18th WORLD CLEAN AIR CONGRESS 2019

WCAC'19

EDITORS

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Cansu Düzgün, İlayda Kurşun

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Editors

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PREFACE

The World Clean Air Congress has been held every three years since 1966. Its special contribution is to offer participants the opportunity to update themselves on all dimensions of air quality and related environmental policy - to keep abreast of their own specialised areas and interests while at the same time seeing these in the wider perspective of the overall development of the atmospheric sciences and policy.

The 18th Congress, being held in Istanbul, follows earlier congresses which have been held in all areas of the world. The last, in 2016 was held in Busan, Korea, proceeded by Cape Town, South Africa in 2013, and before that Vancouver, Canada, Brisbane, Australia, and London, in the UK, in 2004. Like its predecessors, the 18th Congress, as one of the premier events in the field, will provide a worldwide platform for scientists, policy makers and industrialists to promote cleaner air through sharing knowledge of the latest scientific, policy and technological developments.

Many key themes have recurred from one World Congress to the next, but each congress has also had its own focus and priorities. In Istanbul in 2019 two in particular stand out.

About 54% of the world population now lives in city centers and this is expected to grow 1.84 per cent per year to 2030. As a result the number of megacities (with populations over 10 million) has now reached 35, with 52% in developing countries. The pressures of this growing population translate into a range of environmental problems such as poor air quality and degradation of habitats and ecosystems. In spite of the significant worldwide progress we have made in improving air quality, 92% of the world's population still lives in places where air quality exceeds WHO guidelines. According to WHO, an estimated 6.5 million deaths were associated with air pollution in 2012, representing 11.6% of all global deaths. For this reason, more serious efforts are now needed to develop and implement policies and investments that support technologies to reduce the sources of air pollution.

At the same time the interaction of climate change and air quality now requires the urgent implementation of the integrated air quality and climate change abatement strategies for which IUAPPA has been pressing since 2005. The interactions between the two dimensions of atmospheric policy are complex, but can only be properly understood and their implications addressed within the broad 'One Atmosphere' vision that has inspired IUAPPA since 2005 and increasingly leads scientific study and public understanding across the world.

The programme of the congress includes over 250 scientific papers, five plenary sessions and six major Side-Events. We would like to convey our thanks and appreciation to the World Bank, European Federation for Clean Air and Environmental Protection Associations, Clean Air Asia, the Malaysian Clean Air Association and the World Resources Institute for their support through contributing these Events. Special thanks go to the International Advisory Committee and Program Committee for their contribution to the Congress. We also thank the Scientific and Technological Research Council of Turkey and Istanbul Technical University for their support. Finally, we thank to all participants and companies. This congress could not be held without them.

Istanbul is one of the most unique and fascinating cities in the world - bridging two continents it is a blend of East and West, the Mediterranean and Asia. Today's mega city exceeding 15 million people has a wonderful historic legacy of religion and culture, along with a rich scientific tradition. This dynamic and modern city was the capital of three ancient empires over the centuries: Roman, Byzantine and Ottoman. It has a remarkable heritage that enriches any visit.

We have a great team working to make this a truly outstanding conference, enhanced by the many interesting sights and delicious food of this beautiful city. We wish you a very pleasant and productive time in İstanbul.

Prof. Selahattin Incecik
President of IUAPPA

Prof. Abdurrahman Bayram
President of TUNCAP

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Emissions from road vehicles play a significant role in the deterioration of air quality in cities. NOx and CO2 emissions from road vehicles accounted for 16% of total emissions in 2016 for Turkey. The total number of vehicles registered in traffic is 22,865,921 and the share of vehicles over the age of 16 is 35%, which is higher than most of the European countries. Older vehicles have higher fuel consumption per km of travel, and also have higher pollutant emission per mass of fuel consumed than the newer ones. In this study, it is aimed to reduce the emissions from road vehicles by replacing older vehicles with new generation technology environmentally friendly vehicles. The vehicle sales between 2019 and 2030 have been estimated by using econometric model based on various economic and demographic parameters. The model results show that the passenger cars and light commercials sales are expected to reach 1,557,567 in 2030. Based on expected number of vehicle sent to scrappage and sales forecast, the total number of passenger cars and light commercials in the fleet is determined annually. Then, COPERT emission model is used to estimate the annual pollutant and greenhouse gas emissions associated with the road transport in Turkey based on five scenarios. Based on the results of the best environmentally scenario which assumes that the hybrid and electric vehicle share will increase drastically by 2030, a significant decrease in CO and NOx emission are estimated. However, CO2 emissions from this scenario are expected to decrease slightly when compared with the results of the business as usual scenario.

SOURCES OF PM2.5 IN SOUTH EASTERN EUROPEAN CITIES

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Levels of PM10 air pollution often exceed the permissible limit values in many zones of South-East Europe. Despite the recent improvements in monitoring networks in non-EU member states of the region, information about air pollution levels is often sketchy due to gaps in time and spatial coverage for PM10 and even more so for PM2.5. To help fill such gaps, a version of the SHERPA tool based on the EMEP air quality model was used in this study to quantitatively assess the major pollution sources and the geographical areas impacting on PM2.5in the main South-East European cities with particular reference to the Danube and Western Balkan regions. The activity sectors influencing most the PM2.5 levels in the study area are energy production (22%), agriculture (19%), residential combustion (16%) and road transport (7%). Energy production in inefficient coal-fuelled power plants was identified as one of main source of PM2.5 in the Western Balkans. As for the geographical origin of PM2.5, transboundary pollution is confirmed as the main source of PM2.5 (44%) in the cities investigated, while emissions from within each city are responsible for on average 22% and national sources outside the city a further 15%. An association was observed between the long-range transport and the impact of agriculture and energy while both local urban emissions and long-range transport were related to the residential sector. Considering that biomass is traditionally used in South-East Europe as fuel for residential heating, special attention is given in this study to the impact of this renewable source on air quality. Combining these model results with estimates of the biomass burning to PM2.5 from receptor models and data on fuel consumption from the literature leads to the conclusion that biomass burning is the dominant source within the residential heating sector in the studied area and that the emissions from this source are likely to be underestimated. More effort is needed to improve the estimations of biomass burning emissions and policies to improve air quality in the cities of South East Europe should involve a wider geographical area than just the city concerned.

USE OF RAIN DATA IN BACKTRAJECTORIES TO ESTIMATE DESERT DUST TRANSPORT TO A CITY LOCATED ON NORTH EAST MEDITERRANEAN SEA

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Determination of distant sources in urban environments is always a difficult task. In general, time dependent sampling is performed in urban areas and then source apportionment tools are applied to identify the sources. However, in urban areas, there are lots of different and continuous sources. Therefore, it is sometimes difficult to identify distant sources.

In this study, PM2.5 and PM2.5-10 data sampled from downtown Antalya, Turkey between June 2014 and July 2015 was used. During this period, one in two day 24 hr continuous sampling was carried out using stack filter unit sampler. Approximately 160 samples were collected and the samples were analyzed with XRF for 15 elements. After the elemental speciation, a source apportionment tool, namely Positive Matrix Factorization (PMF), was used to identify the sources. Four and five factors were identified for PM2.5 and PM2.5-10 data, respectively. Unfortunately, even though, Saharan dust transport was reported in the region, it was not identified.

In order to get a better understanding on dust transport, Dream8assim model outputs for each sampling day were investigated to observe dust transport to the sampling site. In 80 samples dust transport was observed. Then the data was divided into two sub-groups: days with dust transport and days with no dust transport. Five day long HYPLIT backtrajectories of the each sampling day was investigated to get total rain data. The correlations between two sub-groups with total rain amount data was investigated. It was found that crustal elements (Al and Si) concentration in no dust transport group does not show any correlation with rain amount whereas on dust transport days, crustal elements show correlations with rain amount until the precipitation reaches to 10 mm. The maximum concentrations of crustal elements at 10 mm rain is determined. The days with higher concentrations than the determined values were attributed as the dust transporting days. These identified dust transporting days and no dust transport group will be used together to identify desert dust profile in the region using PMF. Then, all data are going to be used in Chemical Mass Balance to identify source contributions of all factors in the urban site including desert dust.

INTRADAY AND INTERDAY VARIATIONS OF 69 VOLATILE ORGANIC COMPOUNDS (BVOCS AND AVOCS) AND THEIR SOURCE PROFILES AT A SEMI URBAN SITE

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Atmosphere includes numerous volatile organic compounds (VOCs) which have biogenic and/or anthropogenic origin. VOCs may have adverse effects on human health and ecosystem. The main objective of this study was to examine concentrations, temporal variations and possible sources of VOCs. VOCs were collected in April, in May, in June, in July, in August 2017 and in January 2018 on Tenax-TA sampling tubes using a Perkin Elmer STS25 sequential tube sampler in the Bolu Abant İzzet Baysal University Campus station. Daily active samplings were performed for a period of eight days for a month whereas hourly samples were collected every six hours for two days a month. Thermal Desorption Gas Chromotography Mass Spectrometry (TD-GC-MS) system was used in analysis of the samples. Totally 69 VOCs having biogenic (i.e., isoprene, monoterpenes and oxygenated VOCs) and anthropogenic origins (i.e., benzene, toluene, ethylbenzenes, xylenes) were investigated. Biogenic VOC levels and detection frequencies were found to be higher in May, June, July and August when temperature and solar intensity increased, compared to those observed in January and April. Decanal, benzaldehyde, benzene, phenol and toluene were the anthropogenic VOCs with higher concentrations while alpha-pinene and hexanal were the dominant biogenic compounds. Intraday variations showed that vehicle traffic during working hours lead to increase in VOC levels. Ozone formation potential of isoprene, benzene, toluene, ethylbenzene, m+p xylene, o-xylene, isopropylbenzene, n-propylbenzene, m-ethyltoluene, p-ethyltoluene, 1,2,4-trimethyl benzene, o-ethyltoluene, 1,3,5-trimethylbenzene, gamma-terpinene, dodecane, camphor and naphthalene were found to be significant. As a result of Positive Matrix Factorization (PMF) analyses; solvent evaporation, gasoline-powered vehicle emissions, fossil fuel (residential heating), biogenic (hornbeam, grass, oak, beech), diesel/domestic activities and forested city atmosphere were determined as the main VOC sources. G-score daily change graphics and G-score pollution roses were also used to support the source apportionment.

THE EFFICIENCY OF ENVIRONMENTAL EXPENDITURE OF LOCAL GOVERNMENTS ON AIR POLLUTION IMPROVEMENT IN CHINA

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China's air pollution problem has been receiving a lot of attention in world since 2013. To mitigate serious air pollution, the State Council of China promulgated the Air Pollution Prevention and Control Action Plan 2013-2017, and the Chinese government has made various regulations and increased the financial budgetary support for improving the air quality. According to the statistics of the National Bureau of Statics of China, the local's government expenditure on environmental protection has dramatically increased from 12.28 billion RMB in 2007 to 363.38 billion RMB in 2016, which means twelve-fold increase. With the rise of public awareness on the air pollution problem, the key issue is not on the amount of governmental environmental expenditure, but more attention tends to be on the efficiency of the environmental expenditure. In other words, the quality of the expenditure would and should be under more scrutiny. This paper aims to use the 1,186 panel data of 31 provinces of China for the period of 2011 to 2016, analyzed the efficiency of local governments' expenditure on air pollution improvement. For dependent variable, we used SO2 and NOx emissions per person as an indicator of air pollution. For independent variables, we used GDP per capita, local government expenditure on environmental protection per person, the percentage of secondary industry in GDP and the number of public transportation per 10,000 people.

The analysis produces the following preliminary results. The efficiency of the percentage of secondary industry has positive impact on air pollutant (SO2 and NOx) emission. In other words, an increase of the percentage of secondary industry makes the air pollutant emission increase. On the other hand, GDP per capita, the percentage of secondary industry in GDP and the number of public transportation per 10,000 people have negative impact on air pollutant emission, which make air pollutant emission decline. Compare the efficiency of GDP per capita to the efficiency of environmental protection expenditure and the number of public transportation per 10,000 people on air pollutant emission, the efficiency of GDP per capita is higher than other variables. Furthermore, the efficiency of the number of public transportation per 10,000 people is much higher than environmental expenditure on environmental protection.

SOURCE APPORTIONMENT OF BIOGENIC AND ANTHROPOGENIC VOCS IN BOLU PLATEAU

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Passive sampling provides a cost-effective way to simultaneous sampling of specific species in rural, regional and global scales. In this study, volatile organic compounds (VOCs) were collected on Tenax-TA tubes during two-week periods in winter (28th January 2017-12nd February 2017) and summer (7th July 2017-23rd July 2017) passive sampling campaigns in Bolu plateau. Samples were analyzed using Thermal Desorption Gas Chromotography Mass Spectrometry (TD-GC-MS). Investigated 69 VOCs were classified as biogenic (isoprene, monoterpenes and oxygenated VOCs) and anthropogenic VOCs (benzene, toluene, ethylbenzenes, xylenes etc.). Benzaldehyde, toluene, phenol, benzene, hexane, decanal, benzothiazole, dodecane and acetophenone were anthropogenic VOCs with higher concentrations. Biogenic VOCs with the higher concentrations were determined as hexanal, alpha-pinene and limonene. Ozone formation potential of VOCs were also determined. Winter and summer seasons were distinguished according to their biogenic VOC percentages. Biogenics had lower concentrations in winter which was characterized with low solar intensity, temperature and amount of leafy tree species. Spatial distribution maps were drawn for each VOC, and the results were supported with Positive Matrix Factorization (PMF) analyses. Anthropogenic VOCs were found at high levels in regions with industrial activities, traffic and population. On the other hand, biogenic VOCs showed higher concentrations related to tree species. PMF analyses and G-score distribution maps of the factors revealed that solvent evaporation, wood-coal combustion, biogenic (pine, grain, grass), city atmosphere, biogenic (hornbeam, pine, juniper) and vehicle emissions were the major VOC sources in Bolu plateau.

INNOVATIVE METHODS FOR CITY SCALE AIR QUALITY MANAGEMENT IN CHINA AND THE UK

Tianlin Niu [1], Mark Broomfield [1], Guy Hitchcock [1]

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Ricardo is at the forefront of developing innovative methods for managing contrasting air quality issues in cities in the UK and China. This paper will describe the challenges of this work program, and how they are being addressed.

The UK is required to achieve European air quality limit values in the shortest possible time. The key challenge in UK cities is dealing with road traffic emissions and roadside NO2 concentrations. As such Clean Air Zones, comprising emission-based charging schemes and related measures targeting transport emissions, are being developed in many UK cities to tackle the problem. To enable these packages of measures for air quality improvement to be rapidly and reliably evaluated, Ricardo has developed and applied innovative methods to integrate city scale traffic and air quality models. This paper will discuss some of the challenges faced in applying these approaches from our work in UK cities such as Cardiff, Derby and Southampton. We will show how these challenges were addressed through the detailed application of Ricardo's RapidAir® modelling tools and the key lessons learnt.

In contrast the urban air quality challenge in China is very different, with urban air pollution often affected most significantly by combustion of solid and liquid fuels in the industrial and electricity generating sectors. Road traffic is also a concern, particularly for communities living close to major roads. There is an extensive policy focus on improving air quality in cities throughout China, but more needs to be done to achieve national standards and international guidelines. Ricardo is working with the Asian Development Bank and local stakeholders to develop enhanced air quality management plans. This work is underpinned by detailed modelling using WRF-Chem to characterise regional-scale contributions to urban air pollution levels, linked with RapidAir® to provide detailed representation of air pollution at a local scale of 1 to 5 metres. This paper will present interim results from this analysis, highlight how data acquisition challenges have been addressed and how this compares with the work in the UK. We will then go on to show how these approaches can be adopted to support the development and implementation of robust air quality strategies and plans for cities worldwide.

REAL WORLD VEHICLE EMISSIONS DATA FOR USE IN AIR QUALITY MANAGEMENT

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Vehicle emissions datasets based on static tests or on-road driving cycles can be inaccurate when applied to vehicle fleets in the real world. This results in discrepancies between modelled levels of air pollutants, and the results of measurement surveys. This in turn reduces confidence in the ability of models to predict the effect of future trends in emissions and the effect of policy interventions to improve air quality, particularly in the many cities where road traffic remains a key source of air pollution.

In order to address this, Ricardo Energy & Environment has invested in a programme of roadside measurements using a remote sensing technique (the OPUS Inspection AccuScan RSD-5000). The remote sensing technology enables individual measurements of air pollutant emissions to be correlated with carbon dioxide emissions, and information on vehicle speed, acceleration/deceleration, and road gradients. Combining the emissions measurements with Automatic Number Plate Recognition enables individual vehicle identities to be logged alongside the emissions measurements. This in turn enables emissions measurements to be classified in terms of vehicle type, engine type, engine capacity, and engine emissions technology.

This paper will describe the use of this remote sensing technology to measure in-service emissions from over 300,000 vehicles, the largest such dataset available for the UK, giving unique insights into the factors affecting emissions from road traffic in the real world.

These real-world emissions measurements in the study area have also been incorporated into emissions calculations for use in regional and city-scale air quality modelling analyses. The use of local emissions, which reflect local topology, fleet and driving conditions, ensure the best representation of emissions in the study area, and results in a more locally tuned representation of air pollution. The method allows the evaluation of potentially subtle mitigation measures, whose impact could otherwise be. For example, we will describe the use of this data to support the assessment of a peak-time HGV ban, which requires information on traffic flows and emissions which is broken down temporally and by vehicle type.

CARCINOGENIC ORGANIC CONTENT OF PARTICULATE MATTER AT URBAN LOCATIONS WITH DIFFERENT POLLUTION SOURCES

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Chemical composition of airborne particulate matter is of considerable importance regarding public health. Polycyclic aromatic hydrocarbons (PAH) are compounds known for their adverse effects on human health. Many of them are proven carcinogens, especially those with 5 and 6 aromatic rings which in ambient air are usually bounded to particulate matter. Benzo(a)pyrene (BaP) is often measured as their representative. Sarajevo (~450 000 inhabitants), the capital of Bosnia and Herzegovina, is one of the European cities with the poorest air quality. As a consequence of topography, meteorological conditions and extensive use of fossil fuels, daily PM10 mass concentrations during winter exceed 400 µg/m3. Measurements of PAH are not part of routine monitoring and only limited data are available from previous studies. The capital of Croatia, Zagreb (~800 000 inhabitants), is located approximately 300 km north-west from Sarajevo. PAH mass concentrations in Zagreb have been measured continuously since 1994 within local and national air quality monitoring networks. During winter 2017/2018, the SAFICA project (Sarajevo Canton Winter Field Campaign 2018) was carried out in order to characterise the organic and inorganic pollutants in the city of Sarajevo and its surroundings. This paper presents results of PAH measurements at one urban location in Sarajevo. 24-hour samples of PM10 particle fraction were collected during heating season, from 10 December 2017 to 26 February 2018. The analysis of PAH was performed using high performance liquid chromatography with a fluorescence detector. PAH mass concentrations in Sarajevo were compared with the results obtained in Zagreb during the same period. Average BaP concentrations in Sarajevo and Zagreb were 6.925 ng/m3 and 3.109 ng/m3, respectively. The contribution of BaP to the sum of PAH mass concentrations was similar at both locations (~ 11 %). However, much higher contributions of fluoranthene and pyrene were obtained in Sarajevo. Contributions of individual PAH and their diagnostic ratios indicated combustion of gasoline and diesel as a potential source of PAH (traffic) at both locations, as well as combustion of other liquid fossil fuels (petroleum, crude oil). Wood burning was occasionally indicated as a source in Zagreb, while in Sarajevo the contribution of coal combustion was evident. The total carcinogenic potency of PAH was estimated by calculating BaP equivalent concentrations using toxic equivalence factors from the literature and it was 10.052 ng/m3 and 4.506 ng/m3 in Sarajevo and Zagreb, respectively. BaP had the highest contribution to the total carcinogenic potency at both locations (69 and 67 %), followed by benzo(b)fluoranthene, dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene.

CHEMICAL CHARACTERIZATION OF ATMOSPHERIC HAZE PARTICLES AT HIGH ALTITUDE MT. HALLA SITE OF JEJU ISLAND KOREA

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The collection of atmospheric aerosol samples has been made at 1100 m altitude site of Mt. Halla (Mt. Halla-1100 Site) of Jeju Island, which is one of the background sites of Korea, in 2017. Their water-soluble ionic and elemental species were analyzed in order to examine the chemical composition characteristics in relation to the air pollutions of meteorological hazes. The average mass concentrations of PM10 and PM2.5 aerosols were 20.9±15.1 μg/m3 and 10.5±7.3 μg/m3 for the normal days, but 38.7±13.5 μg/m3 and 23.9±6.9 μg/m3 for the haze days, respectively. The ionic concentrations of the major secondary air pollutants such as nss-SO42-, NO3-, and NH4+ were 7.5, 6.9, 4.2 μg/m3 for PM10, and 7.2, 3.2, 3.4 μg/m3 for PM2.5, respectively, occupying 90.3% and 96.5% of the total water-soluble ionic species. These concentrations of haze particle components were higher than those of non-event days as 1.7~3.3 times for PM10 and 1.8~5.0 times for PM2.5, respectively, indicating the high increase of anthropogenic species during heavy haze days. The water-soluble components of PM10 were mainly composed of the secondary pollutants (NH4+, nss-SO42-, NO3-), marine (Na+, Cl-, Mg2+) and soil (nss-Ca2+) sources by the ratios of 90.3%, 5.7%, and 2.1%, respectively, during haze days. Meanwhile, the ratios of PM2.5 particles were 96.5%, 1.3%, and 0.4%, respectively, showing the high increase of the secondary pollutants compared to PM10 particles. From the elemental analyses of PM10 particles, the composition ratios of the anthropogenic (S, Zn, Pb, Ni), Soil (Al, Fe, Ca) and Marine (Na, Mg) species were 46.2%, 35.0% and 11.4% respectively for the haze days, whereas those ratios were 41.0%, 41.3% and 10.8% respectively for the normal days. From the observation of acid-base neutralization, the neutralization factors of inorganic and organic acids by ammonia were 0.88 and 0.96 in PM10 and PM2.5 particles, meanwhile those by calcium carbonate were 0.10 and 0.02, respectively. Due to the back trajectory analysis, the concentrations of anthropogenic species of both PM10 and PM2.5 particles were high when the airflows moved from China continent to Jeju Island.

VOLATILITY MEASUREMENTS OF SECONDARY ORGANIC AEROSOL SPECIES USING A THERMAL DENUDER

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Saturation vapor pressure and vaporization enthalpy play important roles in partitioning of organic aerosol between gas and particle phases. Those are critical parameters of secondary organic aerosol (SOA) module in the air quality model. This study aims to develop a thermal denuder (TD) system and to characterize the volatility parameters of SOA species using the TD system. For this study, two types of thermal denuders were developed to evaluate the volatility of individual SOA species. One TD is composed of stainless steel heating section of 1" ID x 50 cm L followed by an activated carbon denuder of 1" ID x 50 cm L. The other is composed of stainless steel heating section of 1" ID x 100 cm L followed by a copper denuding tubing of 1/2" ID x 50 cm L The temperature profile, temperature ramping rate, and particle penetration of the thermal denuder were thoroughly examined. Organic aerosol was generated by nebulizing aqueous solution of organic species using a collision atomizer and subsequently drying using a diffusion dryer of silica gel. Aerosol sizing was performed with a scanning mobility particle sizer. Integrated volume method was used to determine saturation pressure and vaporization enthalpy from the measured volatility profile data. Individual SOA species of different origins were examined including succinic acid, adipic acid, pimelic acid, cis-pinonic acid, (1S)-(+)-ketopinic acid, (1R)-(+)-nopinone, phthalic acid, catechol, benzoic acid, and o-cresol. The volatility of binary mixtures were also estimated using two product model and compared with single component values. For the TD with 100 cm long heating section the volatility of examined organics were comparable with literature data. TD with 50 cm long heating section showed difficulties in reaching an equilibrium state. Estimated volatility using a thermal denuder will be also compared with those determined using a thermal gravimetric analysis.

EVALUATION OF HOURLY BASED PRECIPITATION CHEMISTRY IN SUBURBAN SITE OF BOLU

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Precipitation chemistry is important for understanding atmospheric chemistry and transportation mechanism for a region. Therefore, 6-hour rain samples in rainy days were collected manually in the campus of Bolu Abant İzzet Baysal University between March 2019 and May 2019. Totally, 21 wet deposition samples were collected in 11 rainy days. The collected rain samples were analyzed by ion chromatography for ions including Cl-, NO2-, NO3-, PO43-, SO42-, Na+, Ca2+, Mg2+, K+, NH4+. Volume weighted mean concentrations of ions each sample were also calculated for determination of air pollution levels and transportation of pollutants in the city atmosphere. The highest volume weighted mean concentration for anion and cation belonged to NO3- (5.11 mg. L-1) and NH4+ (21.7 mg. L-1), respectively. The measured concentrations in each rain events were evaluated for local and regional scales to understand the mechanism of precipitation chemistry by using HYSPLIT backward trajectories. Air flow coming from Saharan, Europe, Aegean Sea, Black Sea and Central Anatolia affected precipitation events. Rain out and wash out rain events were also observed.

EVALUATION OF URBAN AIR QUALITY SIMULATIONS USING A WRF CFD COUPLED MODELING SYSTEM AGAINST VERTICAL PROFILE MEASUREMENTS

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Urban air quality prediction is still challenging because of its heterogeneity and complexity within a city. One of the promising approaches to simulate the spatiotemporal variability of urban air quality is a regional-to-local coupled simulation (i.e., WRF (Weather Research and Forecasting) and CFD (Computational Fluid Dynamics) coupled model simulation). The multiscale coupled modeling system enables us to provide realistic inputs into a microscale simulation such as inflow meteorological profiles, building and topographical data, and spatially-allocated emission data. Therefore, atmospheric vertical structures can be realistically reproduced in the lower atmospheric boundary layer using the multiscale coupled modeling system. This study investigates the reproducibility of atmospheric vertical profiles of selected variables using a WRF-CFD coupled model compared with in-situ vertical measurement data for wintertime and summertime cases. For the wintertime case, the area of interest is a densely built-up downtown area of Seoul, Republic of Korea and the simulation period is 17-18th on January, 2017. For the summertime case, the area of interest is a sparsely built-up residential area of Chuncheon, Republic of Korea and the simulation period is 24-25th on July, 2018. To examine the reproducibility of atmospheric vertical profiles, the simulation results are compared with radiosonde measurement (wintertime and summertime cases) and drone measurement (summertime case) up to several hundred meters from the ground. The wintertime case showed mostly stable or neutral atmospheric stability, resulting in aggravation of emitted pollutants near the surface. It is also attributed to the weakened ventilation efficiency due to densely distributed high-rise buildings. The summertime case showed unstable or neutral atmospheric stability depending on a time of day. While the most atmospheric profiles are uniform in the vertical direction due to atmospheric mixing processes, the strong gradients of pollutant concentrations near major roads are still captured both in the simulation and measurement results. Some statistical indices for evaluating the model performance are quantified and compared between the wintertime and summertime cases.

NEAR REAL TIME LOW COST PM SOURCE APPORTIONMENT USING MICROSCOPIC CHEMICAL IMAGING

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Elevated levels of particulate matter (PM) are a major cause of human mortality, with the greatest impacts occurring in the Eastern Mediterranean, South-East Asian, and Western Pacific regions. An important approach to address this issue is the use of PM source apportionment to develop, implement, and assess air quality improvement programs. However, there are a number of barriers limiting the routine application of source apportionment methods. These include: cost, the need for specialized laboratory facilities, and the time delay between sampling and reporting the source contributions. The first two barriers are especially problematic in low and medium income countries (LMICs), where budgets are lower and specialized laboratories with highly trained staff are not as common.

One potential solution for overcoming these barriers is the use of microscopic chemical imaging (MCI) for PM source apportionment. The MCI technology (Green Vision Systems, Ltd.) uses the fluorescence of individual particles collected on a Teflon substrate to identify the PM sources. Since this is a fluorescence-based approach that does not require further laboratory or data analyses, source contributions can be determined in near-real time and at a much lower cost.

To demonstrate the applicability of the MCI technology under a range of conditions and programmatic needs, the results of three studies are presented, along with a description of the method and its validation. Issues addressed included quantifying fugitive emissions from a coal power plant (Hadera, northern Israel), monitoring with high temporal resolution in a polluted megacity (Shanghai), and assessing the contributions from both diesel- and gasoline-fueled motor vehicles (Tel Aviv). Based on the results of these studies, use of MCI could enable the routine application of source apportionment monitoring to aid with air quality management programs and improve our understanding of the health impacts of PM.

CHARACTERISTICS OF HIGH PM2.5 CONCENTRATION EVENTS IN SMALL RESIDENTIAL CITY IN SOUTH KOREA

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It has been proven that fine particles (PM2.5) have raised various problems including adverse health effects, low visibility, and intensified climate change. In South Korea, the atmospheric levels of representative primary pollutants such as carbon monoxide and sulfur dioxide have been efficiently reduced due to the adoption of policies including fuel conversion and tightened emissions standards. However, the concentration of PM2.5 is still two or three times higher than those found in the United States, Japan, and most European countries. PM2.5 concentrations are relatively spatially consistent, which means that the concentration often exceeds the national ambient air quality standard (NAAQS) even in background areas. In this study, we have measured the concentrations of PM2.5 and its chemical constituents including ionic and carbonaceous compounds and metallic elements in small residential city of Korea in order to identify the major sources and/or formation pathways of PM2.5. According to the National Emissions Inventory, the emission rate of PM2.5 in this city is very low compared with rates for other major cities; however, its atmospheric concentrations have been similar to or even higher than those in other major cities including Seoul, the capital of Korea, in recent years. Major findings for the high concentration events are 1) organic carbon was higher in this city than in other cities of Korea, (2) biomass combustion was likely to account for the high polycyclic aromatic hydrocarbons (PAHs) concentration, and (3) meteorological factors were extremely important for PM2.5 concentration. In addition, oxidative potential (OP) of PM2.5 was measured to identify the potential toxicity, and OP was much higher in PM2.5 collected in this city than those in Toronto, Canada.

AMBIENT AIR POLYBROMINATED DIPHENYL ETHER (PBDE) CONCENTRATIONS IN URLA IZMIR AND BACK TRAJECTORY MODELLING

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Polybrominated diphenyl ethers (PBDEs) are a class of halogenated compounds that have emerged as a major group of persistent organic pollutants. They have been used in various industrial and commercial applications due to their high boiling points, non-flammability, chemical stability, insulating properties, and chemical stability. Because of their persistence and long-range transport, PBDEs are measured at places with no local sources. Samples were collected weekly for 24 h with a high-volume sampler between December-2018 and June-2019 in gaseous and particulate phases at Gulbahce Campus of Izmir Institute of Technology (38.318056N, 26.638333E) with 101-mm microfiber quartz filters and polyurethane foam (PUF), respectively. Two 5-cm PUF plugs with a density of 0.222 g/cm3 were placed in series to eliminate breakthrough. Samples were stored at -20 ℃ until extraction. All samples were spiked with surrogate standards (PBDE-77, PBDE-181) prior to extraction. PUF plugs were extracted for 24 h with a 1:1 acetone-hexane. Filters were extracted in the solvent mixture by soaking overnight followed by keeping in an ultrasonic bath for 10 min. All sample extracts were concentrated using a rotary evaporator and analyzed with a GC-MS for PBDE-28, -47, -99, -100, -153, -154, -183, -190, -209. QA/QC measures included blanks, determination of detection limits and recoveries. Lagrangian particle dispersion model FLEXPART was used in backward mode to identify the source regions of air pollutants at the sampling location. Gas phase Σ9PBDE concentrations ranged between 13.2 pg/m3 and 255 pg/m3 while particle phase Σ9PBDEs varied between 46 pg/m3 and 170 pg/m3. PBDE -47,-99, -190 were found to be the dominant congeners in both of the phases, whereas PBDE -28, -154, -153 were the congeners with relatively lower contribution. Results of back-trajectory modeling are due in a short while.

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APPLICATION OF TRAFFIC RELATED NOX EMISSION REDUCTION SCENARIOS IN TRABZON TURKEY

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Short and long-term exposure to air pollution are known to be associated with many health problems such as respiratory diseases, lung cancer, and chronic heart diseases. Traffic related emissions are the main sources of certain air pollutants that affect large number of people in city centers. Due to the unfeasibility of exposure evaluations based on measurements, models are used to estimate human exposures in air pollution and health studies. Quantification of traffic related emissions and their dispersion modelling are the main requirements to determine human exposure. In this study, Trabzon city center was selected as the study area since high traffic intensity in this urbanized region is the dominant air pollution source. Moreover, air quality measurement stations are located very close to the road sections in city center, so that they provide mainly the road traffic related air pollutant concentrations. Traffic emission inventory in Trabzon was prepared to determine the concentrations of main traffic related pollutants (NOx, SO2, CO, PM, and VOC). Among these, NOx concentrations were calculated by using AERMOD dispersion model at the receptor points as the most representative air pollutant of road traffic emissions. Model results were compared to the station measurement data by using different statistical tools. Exposures of the population to traffic-related NOx emissions were examined considering meteorological and topographic effects. Results indicated that 10% of the population in Trabzon city center was exposed to traffic-related NOx concentrations higher than the regulatory limit value. In the scope of the clean air action plan, some scenarios that contain decreasing the number of heavy vehicles in different ratios were modeled to observe the effects on the exposure levels of the population to traffic-related NOx emissions.

DUST AND RADON LEVELS ON THE WEST COAST OF NAMIBIA – WHAT DID WE LEARN

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The study investigated the potential for adverse health exposures from inhalable atmospheric dust and radon concentrations in the main towns along Namibia's central-western coast. An ambient air quality monitoring network was established at the end of 2016 to measure and track the inhalable dust (specifically PM10) and radon concentrations. Data collected between November 2016 and the end of December 2018 were assessed and some of the PM10 samples were analysed for mineral and radionuclide content. In addition, emissions from the man-made sources were quantified and simulated using a regional dispersion model.

Episodic dust storms associated with easterly bergwinds are a common phenomenon during the winter months in the western part of Namibia. During such events, dust is transported over long distances westwards towards and well into the Atlantic Ocean. In view of the natural and man-made nature of atmospheric dust, the study differentiated between sources of natural dust and those arising as a result of man-made processes.

It was found that PM10 concentrations were, on average, higher at the coastal monitoring stations than at the stations located further inland, often exceeding the daily World Health Organisation (WHO) guideline value. Whilst high atmospheric dust concentrations were mostly associated with easterly bergwind conditions, sea salt was found to be a significant PM10 contributor at the coastal stations. Modelled results, which only included emissions from man-made sources, indicated that these sources contribute very little to the total PM10 concentrations measured at the coastal towns.

The radiation exposure doses associated with the inhalation of atmospheric dust and radon concentrations were found to be well-below the world-wide average inhalation doses provided by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR).

MARCH 2018 DUST TRANSPORT CASE FOR TURKEY

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Saharan dust carrying Lodos winds starts dominate Turkey's mainland from West to East mostly in Spring months. Prevailing winds on Eastern Mediterranean Basin like westerlies, Khamsin, Persian throughs, and Asian Moonson, etc. prolongs this phenomenon throughout a year with shifting to the Eastern regions. A Sahara originated case in point has occurred in March, 2018. A low pressure center has developed over North Africa and triggered dust advection to our country. Due to the conventional westerlies affect on Northern Hemisphere, movement of low pressure in the region, firstly dust transport has affected Aegean part on 22 March, and then shifted to the East and became more effective over Eastern Mediterranean and South-Eastern Anatolia on 23 March. These desert dust carrying 20-25 m/s winds gusting at 10 m above ground, also triggered continental dust uplifting from central arid regions of Anatolia and transported to the North. In this study, along with its impacts this prominent dust transport episode has analysed with the help of model outputs, satellite observations and in-situ measurement results of Marmaris and Ankara background stations. With the light of clear sky scenes retrieved from MSG RGB and Aqua-MODIS AOD observations, air parcel movements and associated hot spots are fairly visible. Maximum observed AOD values headed to 0.8 over both Ankara and Marmaris, which reveals an extreme aerosol load. These AOD values are ordinary if the study domain is located in a source region like Sahel or Bodele. MODIS observation and also ground-based measurement results show that there is an increase in particle aerodynamic diameter at 21 March. Values starts to decrease in Marmaris station as of 23 March but coarse particles insist to exist up to 25 March over Ankara. More specifically, measured particle size distribution of Ankara station has substantially modified from Marmaris values. According to concurrent AQM stations measurements, there isn't any significant link between local anthropogenic markers as CO, SO2, NOx and relatively fine mode observed in Ankara. This can be explained as mixing with anthropogenic sources during the desert dust transport. Moreover, CALIPSO derived vertical aerosol classification results shows polluted-dust type over Anatolia along with the significant dust plume for this case.

ESTIMATING PARTICULATE MATTER (PM) CONCENTRATIONS FROM A METEOROLOGICAL INDEX FOR DATA SCARCE REGIONS A PILOT STUDY

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In regions where air quality data are scarce or access thereto is limited, a comprehensive understanding of air pollution is hindered by a lack of emission data and ambient air pollution measurements. Therefore, in this pilot study, we assess the feasibility of estimating particulate matter (PM) mass concentrations from a meteorological index. Measured PM concentrations from air quality monitoring stations (2013–2016) situated in and around South African air pollution priority areas were analysed. Simulated meteorological parameters were used to calculate the newly-developed Air Dispersion Potential (ADP) index, which describes the meteorological potential for pollution dispersion in the atmosphere. For most conditions, there exists weak (r=0.1–0.29) to moderate (r=0.30–0.49) correlations between the ADP index and PM classes. At the three stations with adequate data availability, it was found that the ADP index was relatively successful in predicting conditions of high PM concentrations. An investigation of the effect of meteorological conditions on the diurnal variation of PM concentrations led to both the quantification of this effect, and the realization that at these diverse sites, up to 29% of variation in hourly PM concentrations can be explained by variations in meteorology. The application of the index in this way can play an important role in air quality management by quantifying the impacts of meteorological drivers on PM peaks.

MANAGEMENT OF AIR QUALITY IN SOUTH AFRICA – ANY IMPROVEMENT OVER THE PAST 10 YEARS

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The South African Department of Environmental Affairs published the State of Air Report 2005 for South Africa with the purpose of providing insight into the sources of air emissions and the associated human health, welfare, and broader environmental effects. The report highlighted significant sources, pollutants, and areas of impact in combination with existing air quality management practices; and to pave the way towards integrated air quality management in South Africa. This was followed by the 2014 and again the 2017 state of air reports, each providing a better picture of the of air quality in the country.

Since 2006, three priority air quality management areas were declared which necessitated urgent action for air quality improvements. The first was the Vaal Triangle Airshed Priority Area due mainly to elevated ambient particulate matter (specifically PM10) as a result of industrial activities, domestic fuel burning, waste burning and mining activities. A comprehensive Air Quality Management Plan (AQMP) was published in 2009 for the area and now, 10 years later, this plan is under review to determine improvements in air quality, if any, and the reasons behind these changes. The Highveld Priority Area followed with an AQMP published in 2012. Here, the main concerns were sulfur dioxide and PM10 concentrations due mainly to the number of coal-fired power stations and associated coal mines in the area. A third priority area, located in the north-west of South Africa, was declared in 2012 in line with the precautionary principle of the National Environmental Management Act, where planned economic growth in the region threatens the current state of air quality. An AQMP for this area was published in 2015.

Following 10 years of implementation, this paper provides a critical evaluation of the first Priority Area AQMP and offers motives as to why this plan has not resulted in the anticipated air quality improvements.

SUCCESS OF VOLATILE ORGANIC COMPOUNDS (VOCS) EMISSION REDUCTION AND CHALLENGES FOR OIL AND GAS SECTOR IN THAILAND

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In Thailand, there is a growing concern regarding adverse health effects of Volatile Organic Compounds (VOCs). Majority of VOCs is concentrated in Rayong Province in which it has been announced as pollution controlled area according to Rayong administrative court order. As oil and gas sector is considered as one of major sources of VOCs, PTT Public Company Limited (PTT), the biggest energy company in Thailand and operator of several facilities in Rayong, is obliged to account and mitigate VOCs to environmental impacts. Regulation and guidelines involving VOCs were developed, yet remain challenging for industries to quantify and manage emission. As a result, PTT decides to develop VOCs inventory guideline by itself to identify major sources of VOCs and to determine VOCs reduction potentials.

PTT has integrated guidelines and regulations from USEPA and Thailand, along with PTT's experience in the industry. The inventory comprises of six sources non-methane VOCs emission inventory: flares, fugitives, loading and unloading, combustion, storage tank, and waste water treatment plant as well as categorized into two business activities namely upstream and downstream for effective management. Accordingly, VOCs reduction potentials and management were examined for each source by analyzing API standards, USEPA regulations and guideline, and local guidelines such as Bay Area Air Quality Management District.

PTT successfully established VOCs inventory and expanded to fully cover upstream and downstream that was in compliance with Thailand's regulation. For example, VOCs from flares was calculated by flare volume and emission factors. Fugitives VOCs was calculated from emission factors or from monitoring equipment in accordance with USEPA Method 21. Loading and unloading activities VOCs was calculated from loading loss. Based on the 2018 inventory, majority of emission was from flares in the upstream business, followed by fugitives, and loading and unloading activities in downstream business respectively.Focusing on major sources, VOCs reduction potentials have been determined and implemented such as flare utilization in production process for VOCs from flares, A Smart Leak Detection and Repair for fugitives VOCs.Other mitigations are improving combustion efficiency, modifying liquid fuel transfer equipment, and covering of wastewater treatment plant. In terms of management, PTT recognized impact to surrounding communities and therefore integrated VOCs response program in emergency management plan.

After continuous implementation and management, PTT successfully reduce approximately 15% Upstream VOCs in 2018 compared to 2017. The VOCs response program has been widely utilized in surrounding area to monitor and control environmental problems in collaboration with communities.

DISTRIBUTION OF SVOCS IN FINE AND COARSE PARTICULATE MATTER IN A TRAFFIC SITE IN THE MEGACITY OF ISTANBUL

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Megacities are urban agglomeration with more than 10 million inhabitants. Megacities contain large sources of air pollutants, however, the level of air pollution in highly variable. This may be due to the complexity of geographical locations, particularly their (1) emission sources that determine particle size distribution and chemical composition and (2) meteorology that determines accumulation or dispersion, transport, transformation, and removal. As the population living in Megacities is expected to increase, so is the emission of air pollutants, particularly from combustion of fossil fuel and solid biomass. Carbonaceous aerosol constitutes 20-90% of the PM mass and its sources vary both temporally and geographically. It has been estimated that organic aerosol is composed of 10,000-100,000 different organic compounds. Semi-volatile organic compounds include PAH, n-alkanes, hopanes, steranes, and low-volatility oxygenated n-alkanoic acids, n-alkenoic acids, alkane dicarboxylic acids, aromatic carboxylic acids, resin acids, polyol and sugars, and other multi- and poly-functionalized species. In this work, Fine (Dp<2.5 μm) and coarse (Dp>2.5 μm) ambient air samples were collected with a high-volume sampler on selected days in Jan 2017 to Jan 2018. A total of 15 PAH and 28 n-alkanes were identified and quantified with a newly developed thermal desorption – gas chromatography with mass spectrometry method (TD-GC-MS). A number of variables such as traffic counts and meteorological data is used to investigate their effect on seasonal variation of PAH and n-alkanes. In addition, diagnostic ratios among PAH are used for source analysis. Overall, the highest concentrations of PAH and n-alkanes were observed during the winter, followed by fall, and spring and summer. Comparison of concentrations of PAH and n-alkanes with other megacities, urban areas, and rural areas in the world shows that although the highest concentrations are found in the megacity of Guangzhou, PAH concentrations in Istanbul are slightly lower. In Istanbul, stringent measures for emission control are necessary in order to reduce concentrations of air pollutants, particularly during the fall and winter.

SEASONALITY OF PM2.5 AND ITS ORGANIC FRACTION IN A TRAFFIC SITE IN BEŞIKTAŞ ISTANBUL

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According to the World Health Organization, air pollution is the world's largest environmental health risk, with an estimated value of 5.5 to 7 million of premature deaths. The link between exposure to fine particulate and adverse health effects has been well documented, however, uncertainties still remain regarding health impacts of PM according to size, composition, and number concentration. Organic aerosol (OA) is of special interest due to the fact that it may constitute a large fraction of fine PM. In addition, OA may be of both, primary and secondary origin, therefore it may be composed of thousands of individual organic species. Recently, it has been found that particles emitted by combustion sources are more relevant to human health. For this reason, it has been recommended to decrease the exposure to PM2.5 and related chemical components. Particularly, BC (or EC) has been suggested as an additional health indicator. In order to understand seasonal variation in the abundance of organic aerosol, PM2.5 samples were collected on selected days in Jan 2017 to Jan 2018 with a low volume sampler. PM2.5 concentrations were determined with the gravimetric method and also obtained from the Air Quality Network in Istanbul. Organic carbon (OC) and elemental carbon (EC) concentrations were determined with a thermo-optical carbon analyzer. The 24-h US-EPA air quality standard of 35 µg m-3 was exceeded 54, 13, 51, 33, and 41% in Beşiktaş, Çatladıkapı, Kağıthane, Silivri, and Ümraniye, respectively. These exceedances occur during the fall and winter and are due to a combination of emissions from fuel combustion for residential heating and poor air dispersion due to the absence of vertical atmospheric motion and low mixing heights. Average OC concentrations ranged 6.62-7.32 µg m-3 during spring and summer, respectively and 13.76-14.1 µg m-3 during the fall and winter, respectively. The OC concentrations observed in this work during the summer and winter are 46% and 3.5x higher than concentrations observed in USA and Europe and comparable to China. The EC concentrations on the other hand, do not show considerable diurnal variation with values between 2.16-3.26 µg m-3. These concentrations are 6.5x and 1.6x higher than USA and Europe, respectively. Higher EC concentrations observed in Europe than in USA could reflect the higher use of diesel vehicles. In Beşiktaş, the traffic is mainly light-duty vehicles that could use both gasoline or diesel. These results could be helpful for future implementation of strategies to reduce emissions from combustion sources.

WINTERTIME URBAN AIR POLLUTION IN MACEDONIA – COMPOSITION AND SOURCE CONTRIBUTION OF AIR PARTICULATE MATTER

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High air pollution episodes in most urban areas in Macedonia fill the headlines in recent years, reinforcing public perception that polluted air is by far most important environmental and health problem that urban population face nowadays. Ambient pollutants concentrations often reach dramatic levels triggering warnings and action plans that are mostly based on personal exposure reduction and hopes for changes in weather conditions, thus leaving public disappointed and confused.

Recent studies show that traffic, domestic heating, natural dust and industrial activities are the main sources of PM contributing to urban pollution in European cities. However, there are significant differences between sources and the components of urban AP in different cities. While domestic heating (biomass burning) dominates the contributions to PM in Eastern Europe and in many developing countries, sea salt is the most important (natural) source of PM10 in northwestern Europe. Therefore, detailed characterization (determination of size, form and chemical composition) of suspended air particulates is of crucial importance for definition of possible adverse health effects, sources allocation and applicable control measures.

During the last three years (2016-2019), AMBICON team has collected and analyzed suspended particulate matters from specific urban zones throughout the country. Samples were taken according to standard gravimetric method (EN 12341:2014) using a low volume sampler and 47 mm PTFE filters. Chemical composition was determined using Fluorescent X-ray Spectrometer (Shimadzu EDX-900HS) according to EPA/625/R-96/010a and single particles analysis were performed using Electron Scanning Microscope (TESCAN VEGA3) equipped with Energy Dispersive Spectrometer (Oxford Instruments X-act). Seasonal and diurnal variation were obtained from MOEPP Air Quality Portal, as much as from AMBICON independent monitoring network with in house developed ambient particulate monitors.

The results demonstrate clear domination biomass burning as primary contributor with much smaller contribution of traffic, industrial and crustal matter sources.

ASSESSMENT OF THE LEVELS OF TRACE ELEMENTS AND IONS IN RAINWATER SAMPLES IN PAMUKKALE DENIZLI TURKEY

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Rainwater samples were collected from December 2011 to November 2012 in Pamukkale, Denizli, Turkey to assessment the trace elements and ions in wet deposition. Zn, Al, Fe, Cr, Ni, Mn, Cd, Pb, Cu, Li, Sr, Co, Ba, Ti, Ca+2, Mg+2, K+, NH4+, Na+, Cl-, F-, NO3-, and SO4-2 concentrations were determined using inductively coupled plasma optical emission spectrometry and ion chromatography. Zn, Al and Fe elements contributed to the total element concentration by 50.4%. The contributions of Ca+2, SO4-2 and K+ ions to the total ion concentrations were determined as 31.1%, 17.3% and 15.2%. Total daily concentrations decreased exponentially as daily precipitation amounts increased. Volume weighted mean pH of the rainwater samples was 6.94 ± 0.86. The principal component analysis indicated that ion-containing precipitation was a two-component system. The wet deposition was a three-component system for trace elements. Wet deposition may be very important for local travertine in Pamukkale due to acidic precipitations and high trace element concentrations.

ENVIRONMENTAL AND HEALTH IMPACTS OF BIOMASS BURNING IN SOUTHEAST ASIA

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Biomass burning, the burning of living and dead vegetation for land-clearing and land-use change, is a persistent activity in many tropical countries such as Brazil, Indonesia, Malaysia, Nigeria, and Mexico. Intense forest fires can also ignite subsurface organic soil components (e.g. peat), which can continue to smolder long after the original surface fires are put out. Combustion of vegetation and peat has been recognized as a major source of air pollution on scales ranging from local to global. The immediate effect of burning is the production and release of smoke into the atmosphere in the form of gaseous pollutants such as SO2, NOx, CO, VOCs and airborne particulate matter (PM). Many physical and chemical processes in the atmosphere can influence the characteristics of PM in smoke as it ages. After being emitted, the smoke rises to a few kilometers altitude and disperses rapidly into the atmosphere. Smoke from hundreds of fires mixes with biogenic emissions from forests, suspended soil particles, and anthropogenic pollutants. As the smoke disperses, it undergoes photochemical transformations, gas-to-particle conversion, and particle coagulation. Furthermore, smoke can be entrained into clouds in the boundary layer, thereby increasing the rates of some heterogeneous chemical reactions. Biomass burning emits PM in quantities that in some cases can be significant on a global scale. In recent decades, countries in Southeast Asia (SEA) have been affected repeatedly by periodic episodes of smoke haze from uncontrolled forest and peat fires in Indonesia. The impact of these extensive fires on the regional environment and the health of residents within SEA is thought to be substantial, costly, and possibly long lasting. We have carried out a number of systematic field experiments, laboratory-based investigations and model studies to provide insights into changes in the physical, chemical, microbiological, optical, and radiative characteristics of PM during biomass burning episodes in SEA. The major outcomes of these studies as well as future research directions will be discussed.

ASSESSMENT OF AMBIENT AIR QUALITY IN RESIDENTIAL AREA IN SOUTHERN KUWAIT

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In Kuwait, a sizeable number of local industries, making about 12% of the national industries, are clustered in Shuaiba West Industrial Area (SWIA), which is about 2 km from Ali Sabah Al-Salem (ASAS) residential area. Due to this proximity, there are concerns regarding the effect of emissions from the SWIA's industries on the air quality at ASAS area. Accordingly, this study assessed the air quality at ASAS area utilizing 10 years-worth of ambient air quality data. Monitoring utilized continuous methods to measure five of Kuwait Environment Public Authority (KEPA) criteria pollutants, i.e., NO2, O3, CO, SO2, and PM10. Long-term monitoring of air pollution levels relied on state-of-the-art active sampling techniques which are utilized in KEPA's monitoring station at ASAS Area. Continuous active ambient air quality analyzers provided time series style pollution levels which in turn provided information on short-term changes, like diurnal fluctuations in concentrations.

The variation in O3 ground-level concentrations (G-LCs) per hour of the day shows two local maxima; one at 03:00 h which is followed by a slight decrease in G-LCs to reach a local minimum at 06:00 hrs. Thereafter, the O3 G-LCs were on the increase to reach the maximum concentration at 15:00 h. This maximum value was followed by a continuous decrease until midnight. The time of the maximum G-LCs was just after the time when the solar radiation intensity, as one of the major precursors for ozone production, was highest. Previous studies showed the time of the peak in the hourly O3 G-LCs shifted between seasons, reflecting the increase/decrease in the daytime hours. The NO2, CO, and SO2 G-LCs long-term trend was generally increasing with the increase for SO2 being slower. Despite the cyclic behavior SO2 G-LCs revealed during May-November, the NO2, CO and SO2 G-LCs were highest during November-December and lowest during the summer. The O3 G-LCs were highest during July-August and lowest during December-January, which could also be linked to the higher values of UV solar radiation during summer, an essential component in the process of ozone synthesis. A quick examination of the change in PM10 G-LCs reveals that the peak to be during the summer, especially during the month of August. Generally speaking, this is in agreement with observations made around the State of Kuwait during this season when the northwesterly winds, which travel past the desert region in the Kingdom of Saudi Arabia and Iraq, prevail.

LONG TERM AIR QUALITY ASSESSMENT IN KUWAIT

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Kuwait Institute for Scientific Research (KISR) is developing an emission inventory for the State of Kuwait, which has numerous anthropogenic pollution emission sources, e.g. oil-production and oil-refining activities, power generation which is almost entirely reliant of fossil fuels, and transportation section which is also completely reliant on fossil fuels; in addition to the naturally occurring high levels of particulate matter (PM) due to Kuwait being an arid country. In addition to the typical benefits of the emission inventory, the ultimate goal for this project is to develop an Air Quality Management Information System (AQMIS) to serve as a useful air quality planning tool for the Kuwait Environment Public Authority (KEPA) to improve Kuwait's air quality. Because the existing air quality is assessed through the KEPA's air quality monitoring network, an important consideration of this project was to review and evaluate the ambient air monitoring data. Accordingly, 10 years' worth of 5-min air quality monitoring data were obtained for 13 of KEPA's air monitoring stations. The data was initially assessed relying on the United States Environmental Protection Agency (US EPA) guidelines, i.e. Quality Assurance Handbook for Air Pollution Measurement Systems, EPA Guidance Documents Guidance on Environmental Data Verification and Validation (EPA QA/G8) and Guidance for Data Quality Assessment (EPA QA/G9R), for reducing noise and bias data. The relevant quality control checks were performed on each air pollutant. These included: removing zero/span values, removing readings that are below or above analyzer's limit, removing zero readings if zero was not considered a reading; and removing some potential outliers that are obvious such as spikes in concentrations, repeated values, or a sudden drop in concentration but still in the normal range of observed data. The last stage in the data analysis was to create suitable charts and plots using Microsoft Excel® and Open Air® Software.

The results described above enabled us to conduct long-term analysis of the air quality data in Kuwait with the ability to compare the measured concentrations with the KEPA's national ambient air quality standards (NAAQSs) to identify exceedences, pollutants hot-spots, different temporal cycles, i.e., diurnal, weekly and monthly/seasonal. The paper will present detailed analysis for three criteria pollutants, i.e. SO2, NO2, and PM10.

WINTERTIME AMBIENT NH3 AND ITS POTENTIAL SOURCES MEASURED IN URBAN AND MOUNTAIN SITES IN SEOUL

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[Objective] Ambient NH3 reacts with different species to form the atmospheric aerosols, causing to increase the levels of PM2.5. The ambient NH3 is reported to be from area sources. However, it is also known to be long range transported (hundreds kilometer), since the ammonium sulfates and nitrates reside in the atmosphere for several days to a week though NH3 itself has a residence time of only a day or less (Zhu et al 2015). We assessed the potentials of domestic contribution to the ambient NH3 with comparing PM2.5 and NH3 levels between an urban and a mountain site Cluster analysis of backward trajectories, potential source contribution function (PSCF) analysis, and concentrated trajectories (CWT) were performed to investigate the impact of long-range air transport on NH3, and other air quality parameters.

[Materials and methods] During Dec. 2018-Feb. 2019, the hourly NH3 with other air quality parameters had been measured both at Gwangseo and at Gwanak Mt.(670m) in Seoul. The Wavelength Scanned-Cavity Ring Down Spectroscopy (WS-CRDS) ammonia analyzers (Picarro Inc., USA) were used for ammonia monitoring. The temporal variations of NH3 and PM2.5 levels and their levels between two sites were compared. 72 backward trajectories at the height of 100m for every hour (00:00~23:00 UTC) per day were performed during the sampling period using HYSPIT4. Individual back trajectories were grouped into four clusters after the number of clusters was identified according to the changes in total spatial variance.

[Results] The average ambient NH3 during the winter in Seoul is 12.4 ppb, ranging from 2.4 to 37.5 ppb. The average differences of PM2.5 and NH3 between the urban and the mountain site were 7.2 μg m-3 and 6.3 ppb, respectively.

There are significant different levels of NH3, PM2.5, and air quality parameters ($p<0.001$) among different cluster air parcels. Cluster3(29.7%), representative of the slowest, warmest, and the most humid air parcels coming from Hebei to Seoul corresponds to the most polluted one, with the highest PM2.5(44.5 μg m-3), PM10(80.5 μg m-3), with the highest NH3(18.7 ppb). Cluster4(11.6%) represent the fastest moving and the lowest humid and temperature air parcels from Siberia through North Korea among the four clusters, corresponding lowest PM2.5(16.6 μg m-3), PM10(41.9 μg m-3), NH3(5.6 ppb).

PSCF showed air parcels with high concentration of NH3 from China, especially from Liaoning and Shandong were transported, contributing to the ambient NH3 in Seoul. However CWT analysis demonstrated different tendency that domestic emission of NH3 also contributed considerably to the ambient NH3 in Seoul.

WATERBORNE TRANSPORT IN VENICE LAGOON A COMPROMISE BETWEEN ENVIRONMENTAL AND ECONOMIC SUSTAINABILITY

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Human activities in urban areas strongly affect air quality. In order to characterize the impact of the main air pollutants sources, emission inventories are requested by legislation. Water cities, in particular, must take into account boats and ships apportion. The general concern for the impact of air pollutant emissions on the environment has led to the introduction of numerous regulations targeting land based emission sources. In contrast, marine and inland water emissions from ships and small boats have largely been exempt from this development. Over the past decades, however, the air emissions from shipping have been the subject of increasing attention. Research and development efforts have focused on characterizing the problem at hand and offering suitable abatement solutions recently requested by new regulations. Despite this, some specific scenarios could not easily be considered because of their peculiarity. Venice, as a water town in its historical part, is a very distinctive case where transport is supplied by marine systems. Moreover, it is sited in a protected lagoon that represents a very delicate ecosystem. In relation to waterborne transport, the Venice Public Transport Company (ACTV) has been suggested to adopt electrical engines for the abatement of the main pollutants, however, Venice peculiarity forces another hybrid solution. Moreover, changing completely the ACTV fleet requires high costs not completely justified by the emission quantification. A real estimate of the maintenance costs and disposal must be evaluated for both the traditional vessel and the hybrid one. In order to better investigate on the impact of these vehicles, ACTV in collaboration with Ca' Foscari University, has developed an emission factor model: Water Bus Emission factor Model (WATERBUS). This model permit to better quantify actual and future emission scenarios, helping in decision making. In my talk I will describe the debate between environmental and economic sustainability in this peculiar and protected scenario.

COMPARISON OF BTEX EXPOSURE OF COMMUTERS DUE TO ON ROAD TRAFFIC AROUND CANAKKALE AND KILITBAHIR HARBORS

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A recent report published by World Health Organization indicates the importance of air pollution in terms of its carcinogenic effect on human health. Volatile organic compounds (VOCs) have considerable influence particularly on atmospheric chemistry, compared to other air pollutants. On the other hand, anthropogenic VOCs emissions in urban environments have shown increasing trend. The major source of VOCs is vehicle exhaust emissions both in the rural and urban air. Benzene, Toluene, Xylenes, and Ethylbenzene (BTEX) are the most common VOCs observed in vehicle exhaust air composition. Also, benzene has been classified as human carcinogen. The aims of this study were finding the daily, week/weekend, and spatial variations of BTEX compounds at the study sites. This study was conducted in main roadway routes from downtown of Canakkale city to Canakkale harbor and on the roadways of Kilitbahir Harbors. Both on-road traffic and automobiles that passed Dardanelles strait by ferry boats are thought to be the main potential sources of BTEX at the study site. Two Kilitbahir harbors, alongside to each other, are located at the European side, while Canakkale harbor is located at the Asian side of Canakkale city, Turkey. Composite personal VOCs samples were collected from two routes starting either from Canakkale Harbor or Kilitbahir Harbors to both commuting directions. Air samples were collected and analyzed according to US EPA TO17 Method. Briefly, air samples were collected in stainless steel thermal desorber tubes including selective sorbents and analyzed by Gas Chromatography. VOCs samples were taken in different time periods of the day and also different days of the week. Levels of total VOCs and BTEX compounds were found to be higher around Central Harbor road than Kilitbahir Harbor roads ($p<0.05$). No statistically significant difference was found for BTEX levels between weekdays and weekend days ($p>0.05$). Also, BTEX levels did not vary between the days of the week ($p>0.05$). This study showed that on-road traffic around Canakkale and Kilitbahir harbors have important and constant contributions on organic air pollutant levels, independent from the day, showing the average personal BTEX exposure of people commuting on those roads on a daily basis.

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BIBLIOMETRIC ANALYSIS ON USE OF MOSSES IN AIR POLLUTION STUDIES AND POSSIBITY OF USE OF MOSSES FOR PASSIVE MONITORING OF PM10

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Mosses are living organisms with no roots and use the ambient atmosphere to grow. It is known that there are about 15000 species of mosses. Mosses are resistant organisms and have been frequently used as bio-tracer in air pollution sampling studies in different parts of the world. The use of mosses as bio-tracers is a method used to determine the levels of total atmospheric pollutant deposition. Analysis of pollutant content in mosses is known as technical passive bio-monitoring and was first used in the late 1968s. This method was then developed and standardized using species specific to the areas studied.

This study will be composed of two parts. In the first part, more than 1500 publications on moss use in air pollution studies between 1999 and 2019 were examined. For selection of publications; the “Web of Science” database, “moss” and “air pollution” keywords were used. 852 articles related to the sampling of air pollution by mosses were found. 460 studies, which are fully relevant, were examined. Approximately in 70% of the studies, Hypnum cupressiforme, Pleurozium schreberi and Sphagnum species were used. Most of the studies were conducted in either urban or rural atmospheres (68%). However, one fourth of the studies were conducted in industrial areas. It is shown that mosses were used more common in Europe than other parts of the world. Most of the studies were used to determine heavy metal distribution.

On the second part of the study, possibility of use of laboratory cultivated moss for the long term monitoring (monthly) metals attached on PM10 will be discussed. The preliminary analysis for the conditioning of mosses and preliminary results will be discussed.

AIR QUALITY MANAGEMENT ACHIEVEMENTS CHALLENGES AND THE WAY FORWARD IN CHINA INCLUDING PM2.5 AND OTHER MAJOR AIR POLLUTANTS

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In China, rapid economic development accompanied by complex air pollution issues has resulted in a need for innovative solutions simultaneously addressing these complex pollution issues that lack well developed solutions, since no country has ever faced a similar battle before. To seek innovative solutions, efforts have been made under the Five Sphere Integrated Plan to carry out development under a new concept. In air pollution prevention and control, the Action Plan on Air Pollution Prevention and Control was implemented in 2013–2016. This article provides a brief description of its achievements, with an emphasis on atmospheric quality conditions in 2016. Major air pollutants such as PM2.5 and PM10 have decreased, achieving the Action Plan's target in advance. Furthermore, international cooperation at the global, regional and bilateral levels related to supporting air pollution prevention and control was also been introduced. Air pollution prevention and control has entered a crucial stage, with great challenges from development and new emerging issues such as ozone. At this stage, to improve air quality further, the Three Year Plan on Defending the Blue Sky was published, serving as a guide for the upcoming three years. The major strategy and objectives of this Three Year Plan are introduced. To improve air quality further with substantial effects, technology cooperation is recommended for facilitating progress toward achieving air pollution prevention and control targets among countries under the guidance of air-related SDG goals and targets.

SPATIOTEMPORAL VARIATION OF BRICK KILNS AND ITS RELATION TO GROUND LEVEL PM2.5 THROUGH MODIS IMAGE AT DHAKA DISTRICT BANGLADESH

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The capital Dhaka is one of the polluted cities in Bangladesh. There are many factors influencing this problem where air pollution is one of them. There are many sources are responsible for air pollution in Dhaka city including brick kilns, construction, open burning etc. This study is aimed to identify the spatiotemporal variation of brick kilns in Dhaka City and its relation to the PM2.5 concentrations in three upazilas of Dhaka district. Spatial data have been retrieved from Google earth for assessing the temporal changes of Brick kilns as well as Moderate Resolution Imaging Spectroradiometer (MODIS) data for PM2.5 from NASA online database. Remote sensing technique and ArcGIS 10.2.1 tools were used for analyzing the spatiotemporal and PM2.5 concentrations. The result shows that, the number of brick kilns was 307, 497 and 551 in the years of 2006, 2010 and 2018, respectively which showing the increasing trend of brick kilns in the surrounding Dhaka city. Besides, the annual average PM2.5 concentrations in Dhamrai upazila was found 58.6, 58.9 and 64.8 µg/m3; in Savar upazila it was 58.6, 58.2 and 64.5 µg/m3; in Keraniganj upazila it was 57.7, 56.7 and 63.1 µg/m3 for the year of 2006, 2010 and 2016, respectively. The findings are portraying that concentrations were almost three to four times higher than Bangladesh and WHO Standards. The results also show that, PM2.5 concentrations have been increasing in relation to the number of brick kilns. It is concluded that, brick kilns have considerable contribution to air quality of Dhaka district which may be an important impediment for achieving SDGs no 3,11,13 and 15 for Bangladesh. In addition, this study strongly recommends that, by enforcing existing laws and regulations need to standardized the kiln efficiency through improved combustion techniques. In addition, promoting the sand bricks will be very effective solution to reduce air pollution from brick kilns in Bangladesh.

ASSESSMENT OF ACCURACY AND PRECISION OF SENSOR BASED AIR QUALITY MONITORS AND TIME DEPENDENCE OF FIELD CALIBRATION FUNCTIONS

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Background/Aim
Air quality (AQ) sensors are becoming increasingly important in air pollution management. In the framework of the activities of the Interreg Central Europe AWAIR project a systematic quality assurance (QA) program has been implemented from December 2018 to July 2019 in order to assess accuracy and precision of four AQMESH pods (Environmental Instruments Ltd) equipped with NO2 and O3 electrochemical sensors. The approach used in subsequent project activities related to AQ mapping at urban scale will strictly rely on the findings of the QA analysis.

Methods
The QA program consisted in two measurement periods of three phases each. The measurement periods were Dec-March and April-July. In the first phase of each period all pods were co-located next to a fixed site monitoring station equipped with reference instruments. During this phase a field calibration was carried out. In the second phase the four pods were moved next to four fixed site monitoring stations of different type (urban traffic, urban background, suburban background, rural background). In the third phase the pods were located next to other fixed site monitoring stations of the corresponding type. Linear orthogonal regression was carried out to compare sensor data with reference measurements. Between sampler uncertainty (ubs), determination coefficient and bias were calculated.

Results
Average ubs calculated for NO2 among the pods during the cold period prior to the field calibration was 10.3 ug/m3. Substantial improvement was found after field calibration with mean ubs dropping to 4.1 ug/m3. The sensors displayed excellent linearity compared to reference data ($0.87 < R2 < 0.94$). Very good agreement was found between sensors. Similar findings were found for O3 based on preliminary analysis of the warm season data. Sensors displayed good performance also when moved to stations of different type (ubs< 6.5 ug/m3 for all pods). However a further slight improvement was achieved when a site specific calibration was carried out. Calibration function were quite stable in time at least on a temporal scale of a few months.

Conclusions
The tested sensor-based instruments seem a promising tool in AQ management. Versatility and ease of use are great advantages and proper field calibrations permit to achieve very good performances in terms of accuracy and precision.

INTEGRATING CITIZEN'S BEHAVIOUR AND AIR QUALITY MANAGEMENT TO RAISE PUBLIC AWARENESS IN EUROPEAN CITIES

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Air pollution has now been recognised by the World Health Organisation as a class one carcinogen and the fourth highest risk factor for premature deaths worldwide. However, despite many years of efforts to reduce air pollution to safe ambient concentrations, levels of several pollutants still contravene guidelines across Europe. Air quality management is a concern in many cities where a high density of people and high pollution levels lead to greater risks of exposure. This health impact is further exacerbated as air pollution interacts with other social determinants of health creating a disproportionate risk and burden. Traditional government policy has a very techo-centric view of air pollution sources and solutions focussing on technological solutions but this has resulted in a general apathy among citizens towards the problem of air pollution and subsequently a lack of ownership of the problem and solutions. This paper argues the need for a broader approach to air quality management, one that places a greater emphasis on the social factors that contribute to emissions as it is the daily behaviours, practices and activities of people (e.g. commuting to work), not just technologies (e.g. Euro standards), that produce pollution.

Drawing from evidence collated across six EU cities as part of the ClairCity Project (www.claircity.eu), this paper will illustrate the innovate public engagement activities and quantitative evidence used to create a shift in public understanding towards the causes of poor air quality. The public engagement activities include a Delphi process in which citizens where given a platform to explore the reasons for their entrenched behaviour and possible enabling interventions which would bring about broader societal change and subsequent behaviour change. Additionally, the ClairCity Skylines App utilises game technology to engage citizens and 'crowd-source' public perceptions and acceptability of air pollution policies. These engagement activities where reinforced by quantitative evidence which provided source apportionment of pollution by people's behaviour rather than technology thereby making the data more relevant to people and their daily lives.

Understanding citizens' perceptions, behaviours and activities is a key element in decision-making to reduce air pollution emissions and concentrations. By putting citizens' behaviour and activities at the heart of policy making, citizens are empowered to visualise clean, low carbon, healthy futures for their city.

INTERNATIONAL EPISTEMIC COMMUNITIES AND ENVIRONMENTAL COOPERATION IN REGIONAL SOCIETY THE CASE OF CHINA JAPAN COOPERATION ON AIR POLLUTION

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In January 2013, Beijing air pollution soared to hazard level. The official Beijing city readings suggested air pollution PM 2.5 levels over 400. An unofficial reading from a monitor at the US embassy in Beijing recorded 800, while the WHO guidelines say average concentrations of the PM2.5 should be no more than 25 micrograms per cubic meter. China's air pollution problem rapidly received global attention. Since 2013, the Chinese government has been making great efforts to address this issue as it is closely connected with China's international reputation and domestic governance legitimacy. The government has made various regulations and increased the financial budgetary support for improving the air quality.

As an environmental advanced country and China's immediate neighbor, Japan has been engaged in China's environmental protection for many years. During this process, Japanese air pollution experts and their intellectual interactions with the Chinese experts and officials have formed international environmental epistemic communities (Epicoms) to jointly identify the problems, search for the PM 2.5 formation mechanism, make the agenda-setting, and find scientific solutions.

This paper is aimed to clarify the process of the formation of China-Japan air pollution international epistemic communities and their contribution toward policy-making and regional society in East Asia. This paper firstly would build an analytical framework and then to highlight the formation mechanism through empirical studies of three concrete cases.

EVOLUTION OF ATMOSPHERIC PARTICLE SIZE DISTRIBUTION (10 NM – 32 μM) DURING LIGHT AND HEAVY RAINFALL EVENTS

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As the air quality deteriorates in recent years, not only PM2.5 but also nano-size particles that can easily penetrate into human body are attracting much attention. Atmospheric particles are dramatically removed by raindrops which is known as below-cloud scavenging process. During rainfall events, coarse particles are more effectively removed by raindrops than fine particles. In addition, the removal efficiency of atmospheric particle is also sensitive to size of raindrops and rainfall intensities. In this study, we investigate the removal process of atmospheric coarse and fine particles by measuring the atmospheric particle size distribution for different rainfall intensities. The study area is Chuncheon, Republic of Korea, a medium-size city with a population of approximately 300,000 people. The city is located in an inland basin and near several rivers and lakes, which shows relatively calm and humid climate condition. During the six-month period, we measured the rainfall amount and intensity using a rain gauge (Onset computer, RG3-M) and the atmospheric particle size distribution using a scanning mobility particle sizer (TSI, Model 3910) from 10 to 420 nm and aerosol spectrometer (Grimm Model 1.109) from 0.25 to 32 μm. Without rainfall event, the number concentration of nano-size particles (30—200 nm) increased particularly in the morning and evening rush hour mainly due to traffic emissions, while the mass concentrations such as PM10, PM2.5, and PM1.0 showed typical diurnal variations at a background site. When rainfall events with a rainfall intensity of larger than 1 mm/h occurred, the number and mass concentrations of atmospheric particles immediately decreased within an hour. It is shown that heavy rainfalls clearly remove atmospheric particles regardless of particle size. When rainfall events with a rainfall intensity of smaller than 1 mm/h occurred, removal of fine particles was not effective in comparison with that of coarse particles. It is also found that the removal efficiency of atmospheric particles by raindrops is determined by rainfall amount and intensity mainly at the early-stage of rainfall events. The removal efficiencies for each bin of particle size and consequently PM1, PM2.5, and PM10 were analyzed and presented.

AIR POLLUTION REDUCTION WITH INTELLIGENT TRANSPORTATION SYSTEMS DILOVASI SCENARIO

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Traffic management is one of the main application areas for ITS (Intelligent Transportation Systems). This management begins with the collection of movements and data affecting the route. Ultimately, the data will be used for information access systems. This study is one of the study areas of "Scenario for Reducing the Dilovasi Air Pollution with the ITS Application" which is supported by TUBITAK within the COST (European Cooperation in Scientific and Technology) Program. Within the scope of "Scenario for Reducing Air Pollution with the Intelligent Transport System Application" work package, an alternative route design was made to TEM (Trans European Motorway).

Air pollution from road traffic has the highest share in air pollution caused by transportation. Dilovası, which is designated as a sample region in this study, is a region where high industrialization and the main arteries connecting Istanbul metropolises to other cities pass through the city center, where air pollution is intense and the effects caused by this pollution are seen intensively.

Transfer to north of vehicle traffic will reduce the air pollution caused by transport to the region. The variable values of air pollution make it possible to use the newly designed road as an alternative way. It is planned that the TEM will be closed and the alternative route will be mandatory if air pollution reaches the value that will affect human health.

There are two air pollution measuring stations in the Dilovası region. These stations measure air pollution and produce standardized data. If the data received from the stations are evaluated as part of the ITS designed in the project and the values are not at the desired level, the decision to close the current route is given by the system. This decision must be forwarded to the drivers on the road approaching the area. Among the methods used are many applications such as variable message boards, radios, internet and smart phone systems. The aim is that drivers should turn to an alternative route and should be informed that the current route is closed. In addition, it is important to establish a working system based on meteorological conditions like air pollution in its application. For example, the prevailing wind in the region is known to blow from the north-northeast direction and carry pollution to the region. Therefore, it will be ensured that the emissions from the highway will be transported out of the region by an alternative route.

INTEGRATED AIR QUALITY ASSESSMENT OF KONYA IN TERMS OF METEOROLOGY TOPOGRAPHY AND EMISSION SOURCES

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Considering an integrated approach to assess all of the measured pollutants in a diurnal, monthly, seasonal and annual time scales and understanding the mechanisms hiding under low air quality conditions is essential for tackling the future air pollution issues. Konya, located on central Anatolia, is the largest province of Turkey having a surface area of 40,838 m2 and has different industrial activities including the production of cement, sugar, machinery, chemicals, textile, food, packing material, electronic equipment and paper. Lack of recent detailed studies is limiting our information on underlying air pollution problems of Konya and obscuring policy makers to develop applicable mitigation measures. In this study, we used hourly monitored air quality data of CO, NO, NO2, NOx, PM10, PM2.5, and SO2 from 5 stations of Konya and investigated temporal and spatial variability for the 2008-2018 period via statistical analysis. Air quality data of Konya is subjected to quality control and the periods that have large missing data gaps or no data at all are eliminated from the study. Upon analysis, largest problem is found to be the PM10, together with the highest mean value of PM10 as 70.5 µg/m3 in Karatay Belediye, followed by 67.4 µg/m3 in Meram, 58.7 µg/m3 in Selçuklu, 48.2 µg/m3 in Erenköy Belediye (newly called as Yeni Sille Belediye) and 43.7 µg/m3 in Selçuklu Belediye. In the legislation, 24 hour limit of PM10 is given as 50 µg/m3 for the protection of human health and this limit should not be exceeded more than 35 times in a year. It is found that daily limit value is violated in all of the stations, mainly during winter and autumn. High positive correlations exist among the stations and the highest correlation is the one between Selçuklu Belediye and Karatay Belediye with the Pearson correlation coefficient, r=0.77 and adjusted R2, aR2=0.59 value. Generally, long-term data showed decreasing trends in PM10 levels. Diurnal variability is found to be more pronounced than the weekly variability. For almost all of the pollutants, except for photochemical pollutants like O3, a prominent result is the high nighttime and morning rush hours pollutant levels. This condition is related with the emissions and meteorology. Prevailing stable atmospheric conditions during night generate stagnant and low wind speed conditions, especially during winter, leading to high pollutant values. On the other hand, photochemistry is the leading process in the high O3 values during noon and early afternoon.

DETERMINATION OF PM10 AND DEPOSITED DUST DISPERSION ON THE SETTLEMENT AREAS FROM AKSA GÖYNÜK COAL (LIGNITE) FUELED THERMAL POWER PLANT

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With the growing population and rapidly developing industrialization in Turkey, the energy demand is also increasing. The majority of the energy is produced using imported products, which increase the current account deficit in Turkey. The use of coal from domestic sources are encouraged for economical reasons. One of the coal (lignite) fueled thermal power plants established for this purpose is operating in the province of Bolu Göynük. In order to determine the environmental effect of the plant on the settlement areas in the area, air quality monitoring studies have been conducted. In the study, the periodic PM10 and deposited dust parameters have been monitored monthly at four points between 2013-2018, including before and after installation of the plant. As a result of the study; the mean PM10 measurement were obtained as 37.46 ± 0.74, 36.94 ± 0.74, 37.32 ± 0.75, and 39.81 ± 0.79 μg m-3 for four points. Meanwhile, the mean values of the deposited dust were found as 71.82 ± 2.15, 35.38 ± 10.6, 57.62 ± 1.73, and 29.20 ± 0.88 mg m-2 day-1. Despite the providing current limit values of the dust parameter for the facility where the electrostatic precipitator (ESP) filter and flue gas desulfurization (FGD) systems are applied, it is observed that the dust emissions from activities such as coal extraction, crushing, sieving and ash storage in the area show different cases depending on meteorological conditions.

VEHICLE CATEGORY INFLUENCE ON URBAN AIR POLLUTION IN KUALA LUMPUR MALAYSIA

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Kuala Lumpur is the federal capital and most populous city in Malaysia. Heavy traffic with more than 10,000 volume was reported in the majority of the main roads in urban Kuala Lumpur. The road transportation sector contributes significantly to air pollution particularly in urban area. This study aims to determine the relationship of the urban air pollutants and traffic count based on vehicle categories in Kuala Lumpur urban environment. The statistical analysis used in this study is multivariate analysis include Pearson correlation, Principal Component Analysis (PCA) and Multiple Linear Regression (MLR). Pearson correlation tests was performed to identify the association between the urban air pollutants, PCA is used to determine the influence of meteorological factors on urban air pollutants and Multiple Linear Regression (MLR) to assess the relationship between each vehicle category and different types of urban air pollutant. The PCA analysis showed that the meteorological factors such as ambient temperature, wind speed and humidity influence the concentration of PM10. The MLR analysis demonstrated that vehicle category A (cars and taxis) contributing to CO concentration in the study area. A positive relationship between PM10 concentration and heavy-duty vehicles which is category C and D is also noted from this study. The findings of the study will give valuable insights for transportation planning agencies that can help them to create more health protective and equitable local transportation plans.

INVESTIGATION IN AEROSOL OPTICAL PROPERTIES VARIATIONS DUE TO HAZE EPISODE OVER KUCHING AND THE EFFECT TOWARDS AIR QUALITY FROM 2011 TO 2017

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The characteristics of aerosol optical properties and aerosol types in Kuching, Malaysia and the associations with air pollution from 2011 to 2017 was investigated using ground-based observations which Aerosol Robotic Network (AERONET) Sun-photometer. The purpose of this study is to characterize the aerosol optical properties variation and to identify the possible aerosol types and its sources. Aerosol optical properties help further understanding of the effects of aerosols on the air quality and radiation balance. Different aerosol types come from different sources may affects the global climate change, visibility, and human health. Two patterns of Aerosol Optical Depth (AOD) were reported with low concentration (0.03±0.02) occurred from November to February due to wet seasons and high concentration of AOD (2.33±1.03) observed from June to October due to dry seasons. The Single Scattering Albedo (SSA) were recorded at the ranged from 0.82 and 0.96 shows high value of SSA corresponds to the presence of urban and continental aerosols. The decreasing of Asymmetry Factor (ASY) value suggesting the occurrence of absorbing anthropogenic aerosols. For the aerosol volume size distribution (AVSD), the range of fine mode radius was between 0.14µm to 0.33µm and from 2µm to 4µm was observed for the coarse mode radius. To identify the dominant aerosol types, a related analysis was carried out by analysing threshold analysis between AOD and Angstrom Exponent (α) and new proposed aerosol classification algorithm was performed by using three parameters which are AOD, α and ASY. The results show that significant urban aerosols observed with 34.7%, dust (35.7%), biomass burning (23.8%), and maritime (4%) when using relationship between AOD and α. While, from new proposed algorithm the results indicate that the air pollution was strongly correlated to urban aerosol with appearance at 39% followed by dust aerosols (27%), biomass burning (20%), and maritime aerosols (11%). Back trajectory analysis using HYSPLIT model revealed that air masses from neighbouring countries due to forest fires and open burning activities, along with rapid urbanization in Kuching area resulting in high AOD and appearance of various types of aerosols. The results revealed that during the haze episode the prevailing aerosol types were biomass burning and urban/industrial aerosol.

THE LEVELS AND SOURCES OF OCP AND PBDES IN AGRICULTURAL SOILS OF GREENHOUSES

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Persistent organic pollutants (POPs) have been widely used in commercial and industrial applications worldwide and, as a result of their high chemical stability, resistance to degradation, persistence, lipophilic properties, and tendency to bioaccumulate and be biomagnified in the food chain, are among the most ubiquitous pollutants in the environment. Thus the general population is still exposed to these substance due to their persistent characteristics even if some of the polybrominated diphenyl ethers (PBDEs) and organochlorine pesticides (OCPs) have been banned or restirected by the Stockholm agreement and the regulations. Due to their possible adverse effects of these pollutants on humans, the measurmenets of their levels and the sources estimation have increased attention in recently. With increasing population the consumption of the vegetables grown in greenhouse have increased and these vegetables are affected via the contaminated soil since greenhouse soil is like as a sink for these persistent pollutants. The aim of the study was to evaluate the relationship bwetween OCP and PBDes levels in greenhouse soil and their greenhouse cahracteristics. The greenhouse soil samples were collected from the greenhouses having different characteristics such as cover material (plastic or glass), age of the soil and application of different pesticides. The total concentrations of OCPs (Σ14OCP) ranged from 9.41 ng g-1 to 134.72 ng g-1, with a median of 24.2 ng g-1, while the total soil concentrations of 13 PBDEs (Σ13PBDEs) were between 1.37 ng g-1and 64.74 ng g-1 with a median value of 21.92 ng g-1. The OCP levels were significantly correlated with the number of pesticides application for each greenhouses and age of the soil ($p<0.5$). The OCP and PBDE concentrations levels detected in plastic and glass covered greenhouses were comparable each other. There was no correlation observed between OCP and PBDEs, this result could be indicated emitting of these pollutants from the different sources.

A STUDY OF AIR QUALITY STATUS USING LICHENS ACROSS POLLUTANT GRADIENT IN PENINSULAR MALAYSIA

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The increasing human population over the years had contributed to the increasing human activities such as agriculture, industry, economic and many more. This has to be done to fulfill the human necessities of living and also for the advancement of human technology. However, such acts had taken toll on Mother Nature, both directly and indirectly. An area of high ammonia emissions has been reported that had led to considerable alteration in the composition communities of many plant species that ultimately led to a considerable change in the ecosystems. Thus, this study aimed to help researcher to gain more understandings and information on the effect of poor air quality towards low vegetation such as lichen. Specimens Collection Algal and lichens systematic collection was conducted by scraping off the samples by using cotton buds and/or small knife, from its substratum. Algae will be stored in a 100 ml specimen tube containing 40ml distilled water. Whilst the whole thallus of lichens will be kept in the herbarium sheet. For sample analyzing, the specimens were analyzed morphologically and cross section of samples were made when necessary. Specimens observation were made using digital light microscope. Specimens were collected from two sites at different altitudes namely Templer Park, Rawang (131m) which is the nitrogen rich area and Brinchang, Cameron Highland (1428 m) with nitrogen poor environments. In overall, 19 species of lichens from 12 families and 15 genus were identified and recorded. The morphological and chemical characteristics were observed to help in species identification. Results showed that this study recorded 10 genus of crustose lichens, 4 genus of foliose lichens and 1 genus of fruticose lichens which fall under 12 families. Crustose lichens dominated the distribution at both the sampling sites with 74% while 21% are foliose and fructicose 5%. The number of foliose lichens increases as altitudes increased. The common type lichen obtained was crustose lichen from family Graphidaceae which was collected from the higher altitude, Brinchang. The foliose lichens are mostly from family Parmeliaceae. The only fructicose lichen species found in this study is Usnea ceratina from family Parmeliaceae. Species composition in these study sites did not only being influenced by altitudes but could also be triggered by the abiotic factors such as humidity, temperature, concentration of ammonia and bark pH which also facilitates the growth of the lichens.

OVERVIEW OF AIR POLLUTANT INDEX (API) BASED ON PM2.5 IN MALAYSIA IN YEAR 2018

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The Continuous Air Quality Monitoring Network (CAQM) under Department of Environment (DOE) Malaysia comprises 65 monitoring stations located in Peninsular Malaysia, Sabah and Sarawak. The air quality data from the stations are transmitted to the system located in Environmental Data Centre (EDC) in headquarters of DOE in Putrajaya and went through to QA/QC procedure. This paper review the analysis done on the air quality data in 2018 for Air Pollutant Index (API) based on particulate matter sized 2.5 mikron (PM2.5) for northern, central, southern, eastern and Sabah and Sarawak region. The analysis showed the maximum API values recorded around 53% stations were in the moderate category. Based on the data recorded, PM2.5 and ozone concentrations were the main contributors to maximum API values. The ambient air quality network also recorded incidences of exceedance from the Malaysian Ambient Air Quality Standard (MAAQS). Particulate matter and ozone were the dominant contributor to exceedance episodes. Miri in Sarawak and Klang in Selangor recorded very unhealthy API values due to high PM2.5 concentrations during the regional haze episode in August 2018. Ozone hotspots are located in states within the northern, central and southern regions with Selangor and Kuala Lumpur were recording the highest number of days of ozone exceedance. Overall, stations in Sabah and Sarawak mostly recorded more Good API days than other region.

SPATIAL VARIATIONS OF LINEAR AND VOLATILE METHYL SILOXANES IN A RIVER BASIN AND THEIR AIR WATER EXCHANGE PATTERNS

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Linear and cyclic volatile methylsiloxanes (VMS) are Si and O containing organic compounds that are increasingly subject to scientific studies in recent years. They are used as solvents and coating materials in personal care products, cleaning materials and industrial applications. In this study, it was aimed to investigate the spatial variations of VMS levels in river water and ambient air in Kucuk Menderes Basin and their air-water exchange patterns. Within the scope of the study, grab river water samples and passive ambient air samples collected from 10 sites throughout Kucuk Menderes Basin located in Izmir region in Turkey, and they were analyzed for VMSs. The concentrations of ΣVMS in river water and ambient air ranged from 48.4 to 148.0 ng/L and from 41.7 to 432.7 ng/m3, respectively. Among the VMS compounds, the predominant compounds were found to be D5 and D3 in ambient air and river water, respectively. In general, concentrations of all VMS congeners increased towards downstream of the river for both water and ambient air samples and there were substantial fluctuations between the sampling points. These fluctuations may be due to wastewater discharges at some sites (increase), followed by loss by volatilization along the river (decrease). The direction of the exchange between ambient air and river water was determined by fugacity fractions calculated using the air and water concentrations and Henry's Law constants of siloxanes. The calculated fugacity fractions for all compounds indicated net volatilization from river water to the atmosphere at all sampling sites.

COMPARISON OF MODIS COLLECTION 6.1 AND 6 AEROSOL OPTICAL DEPTH BASED ON FINER RESOLUTION DARK TARGET DATASET OVER TURKEY

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This study aims to compare performance of the Moderate Resolution Imaging Spectroradiometer (MODIS) Collection 6.1 (C6.1) Dark Target 3-km aerosol optical depth (AOD) products with the Collection 6 (C6) products over Turkey during 2008–2017. The AOD retrievals were validated at two Turkish AERONET (V3) sites located in Ankara and Mersin. Since AERONET and MODIS measurements must be matched in space and time, matchups with the average of the AERONET AOD observations (at least two) at the Terra and Aqua overpass time (10:30 and 13:30 local time, ±30 min) and MODIS AOD pixels (at least five) within a radius of 25 km of the AERONET site were adopted in the study. The scientific data set (SDS) named "Optical_Depth_Land_And_Ocean with quality assurance (QA) ≥ 1 over ocean and QA=3 over land was selected. For the statistical analysis, the correlation coefficient (R), root-mean-square error (RMSE), and the mean bias (MB) were calculated. Since aerosol selection with the main focus on single scattering albedo (SSA) is important for data accuracy and seasonal variations affect the data quality, the seasonal differences of correlations and the effects of the accuracy of the SSA parameter on aerosol retrievals and the variability of the assumed surface reflectance were also considered and discussed.

The most recent release of MODIS atmospheric product (Collection 6.1) has been used in the studies from different regions. However, an assessment of the differences and similarities of the last updated and previous MODIS collections (6.1 and 6) for 3-km product is missing in literature. New validation results showed that the new collection DT 3-km AOD product has been greatly improved for Aqua sensor, while there was no significant difference for Terra. Collection 6 DT algorithm Aqua-3km AOD products performed moderately with the correlation coefficients (R=0.51 for Ankara site and R=0.54 for Mersin site) over the region. Higher correlation coefficients for C6.1 DT Aqua-3km product were calculated as 0.65 and 0.85, respectively in Ankara and Mersin sites.

The Mersin site which has moderately vegetated surface indicated the better statistical performance of DT C6 and C6.1 than Ankara site. The reasonable performance of DT suggests that the surface reflectance scheme used in the inversion works well over. These products showed similar seasonal variation to the Aqua C6 and C6.1 products in Mersin, with the values of R (>0.80) being the largest in spring; however, Aqua C6.1 products performs better in autumn in Ankara.

Performance of different MODIS collection data was investigated under different SSA values in Mersin site. SSA values were mainly higher than 0.90 in the site. These results indicated that the Aqua C6.1 DT retrievals were significantly better than Aqua C6 DT retrievals especially when SSA was higher than 0.95 which indicates dominantly fine particles.

INDOOR AIR GAS PARTICULATE PARTITIONING OF SYNTHETIC MUSK COMPOUNDS

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Synthetic Musk Compounds (SMCs) are intensively used in consumer products such as air fresheners, cleaning supplies, and personal care products as fragrance additives. Some of the nitro musks were banned and some were restricted from use, while two of the polycyclic musks were added to hazardous substances lists. However, SMCs have been detected in all environmental media and organisms due to their slow degradation. Indoor air is one of the most human-exposure-relevant environments, where information on their gas-particulate partitioning is limited. In this context, this study aimed to investigate partitioning of SMCs between gas and particulate phases in an indoor environment. Polycyclic (Cashmeran [DPMI], Celestolide [ADBI], Phantolide [AHMI], Traseolide [ATII], Galaxolide [HHCB], Tonalide [AHTN]) and nitro (Musk Ketone [MK], Xylene [MX], Ambrette [MA], Tibetene [MT]) musks were placed in a glass petri dish on top of a hotplate at 60˚C and left for volatilization for 1 h in an unoccupied room (L×W×H, 6.10×2.90×3.80 m). A ventilator was operated during the 1-h period at a low speed for a better mixing in the room of which windows were kept closed and the door was sealed. Then, samples were collected for the 1st 4 h period and for 24 hours at the 6th day using XAD sandwiched between two PUF plugs and glass-fiber filter for gas and PM10 phases, respectively. Collected samples were ultrasonically extracted for 30 min in acetone:hexane mixture (1:1, v/v), and cleaned with a florisil column. A GC-EI-MS, equipped with DB-5MS (30m×0.25mm×0.25µm) capillary column and programmable-temperature-vaporizing injection, was used for separation and quantification of SMCs. Average concentrations of the first 4 h were 8.55, 9.14, 7.88, 4.49, 41.4, 9.30, 2.02, 9.20, 12.1 and 10.3 ng/m3, respectively for DPMI, ADBI, AHMI, ATII, HHCB, AHTN, MK, MX, MA and MT in gas phase, whereas their PM10-bounded concentrations were 1.79, 0.74, 1.28, 4.10, 28.8, 7.55, 6.63 ng/m3, BDL, BDL, and BDL, respectively. logKp values based on these concentrations were calculated to be -0.94, -1.35, -1.05, -0.30, -0.42, -0.35, and 0.25 m3/µg for DPMI, ADBI, AHMI, ATII, HHCB, AHTN, and MK, respectively. Sorption on surfaces (cement-plastered, painted walls and gypsum-board suspended ceiling), which could not be studied, probably resulted in decreasing concentrations with time, and the 6th-day logKp values could be calculated for only ADBI, HHCB, and AHTN to be -1.18, -1.82, -2.10 m3/µg, respectively, because concentrations of the remaining compounds were BDL in one or both of the phases.

SPATIAL AND TEMPORAL INVESTIGATION OF THE CONCENTRATIONS OF OZONE AND ITS PRECURSORS IN MARMARA REGION OF TURKEY

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The first continuous measurements of the hourly surface ozone (O3), nitric oxide (NO) and nitrogen dioxide (NO2) concentrations at 22 sites (7 rural and 15 urban) in Marmara Region of Turkey which is located in the northwest of country are investigated for the period from March 2013 to April 2016. The results indicate that surface O3 is an extensive problem throughout the Marmara Region. O3 levels have similar seasonal pattern in rural and urban sites by following the order of summer, spring, fall, and winter. However, the seasonal results showed an opposite behavior among O3 and NOx (NO + NO2) in both sites, marked by maximums (minimum NOx) of O3 in summer and minimums (maximum NOx) in fall and winter.

The summer concentrations vary between 91.5 and 123.6 μg/m3 and 74.6□112.4 μg/m3 at rural and urban sites, respectively. Furthermore, O3 peak concentration in rural areas in O3 seasons (April–September) occurred at around 17:00–18:00 LST while in urban areas at around 15:00–16:00 LST, respectively. Air quality standards for O3 concentrations in Sile and Yalova rural sites were significantly exceeded during O3 season.

This exceedance made a linkage between back trajectories and air masses with respect to the O3 levels. 72-hr back trajectories at an altitude of 500m agl were computed by Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model to assess the type of air masses which reach the area. Finally, we will present the results from our AOT40 index (accumulated exposure over a threshold of 40 ppb) analyses for both vegetation and forestry standards which show that excessively high AOT40 values seriously threaten forest and vegetation cover and agricultural production in the region.

SOOT OXIDATION IN DIESEL PARTICULATE FILTER UNDER THE ENGINE EMISSION TEMPERATURE

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Diesel particulate filter (DPF) have been used to control the soot by collecting and oxidizing for the Diesel engine emission. Trapping the soot by unitizing wall-flow structure in DPF is an effective control with over 90% removal efficiency. Soot accumulated on DPF would result in fuel consumption, engine burden and pressure drop of filter. Regeneration of DPF need increase high temperature (over 600 ℃) to oxidize soot completely via additional fuel. Emission of engine with high temperature not only enhance the NOx emission but also increase the fuel Consumption. Therefore, removal of soot under the diesel engine emission temperature (300-400 ℃) using catalyst is a cost-effective and commercial-expectation in this study. The synthesis of Pt-DPF was conducted in the proper coating method using H2PtCl6·(H2O)6. dissolved in DI water and coated into the wall-flow cordierite. Then dried under the room temperature for whole night, calcined under the 450 ℃ before. The result of temperature-program-oxidation (TPO) indicated the soot without catalyst could remove above 600 ℃ which mean soot was not oxidized properly under the diesel emission temperature. The TPO peak was shifted to low temperature by impregnating Pt on cordierite indicate Pt-DPF exhibiting high catalytic activity for soot oxidation. Pt-Al2O3-DPF also enhanced the contact efficiency and soot oxidation by doping Al2O3 which provide the more surface area. The addition of CeO2 which supply the active oxygen site further improve the soot oxidation capacity. The result of catalyst performance test suggests that Pt has important role in improving soot oxidation efficiency, while CeO2 assists Pt in increasing soot combustion rate as well.

FACTORS AFFECTING DUST COLLECTION EFFICIENCY OF ELECTROSTATIC PRECIPITATORS PRESSURE LOSSES RELATED TO TURBULENCE

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Dust is a major air pollutant arise from many sources especially from power plants and its control is an important process. Between the dust control processes, electrostatic precipitators (ESPs) have a unique importance due to its high dust collection efficiency. But, its design must be optimized in order to avoid running cost and to increase dust collection efficiency. Optimization of an ESP depends mainly on the optimization of gas flow distribution in it because pressure losses related to turbulence, reduction in dust collection efficiency and increasing of running costs are created mostly by unhomogenized gas distribution in an ESP. In this study, the inlet structure of the ESP, the number of panels inside and the gas flow velocity are optimized by applying the computational fluid dynamics method in order to achieve a minimum pressure loss in the ESP and to homogenize gas flow distribution between the panels. It was found that the factors affecting the pressure loss were inlet angle, inlet flow rate and the number of dust collection panels. As a result of the optimization study, it was found that homogenized velocity distribution between the panels and min turbulence was provided in the case of the inlet angle of 58 degrees, the inlet gas velocity of 6 m / s and the ratio of ESP inlet width to body width of 1 / 1,7.

EXAMINING FACTORS INFLUENCED AND VARIABLE INTERACTIONS OF PARTICULATE MATTER (PM10) CONCENTRATIONS AT AN INDUSTRIAL AND URBAN CITIES USING BOOSTED REGRESSION TREES TECHNIQUE

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This paper investigated the use of boosted regression trees (BRTs) to draw an inference about particulate matter (PM10) concentrations at four selected industrial and cities areas in Malaysia. A total of 122,706 hourly PM10 concentrations, gases and meteorological hourly data were gathered for the year 2000 to 2013 from the Klang in Selangor (CA011), Perai in Penang (CA003), Kota Bahru in Kelantan (CA0022) and Kemaman in Terengganu (CA0002) air quality monitoring stations. Data were used as a response variable and nitric oxide (NO), Nitrogen Dioxide (NO2), Sulphur Dioxide (SO2) and Carbon Monoxide (CO), time systems and meteorological parameters were analysed using R Software and its packages. Five different lr (0.001 - 0.1) were tested with different tree complexities (1 to 20) in the BRT model development process to achieved the lowest root mean squared error (RMSE) with high coefficient of determinant (R2) value (0.90) for the linear relationship between the number of samples and nt were found for all stations with the best number of iterations for Klang, Perai, Kota Bahru and Kemaman were 12,327, 32,987, 16,370 and 57,634, respectively. The R value was over 0.78 for all stations which indicates that the BRT model developed and applied in this study can produce acceptable results.

The performance of the boosting models were assessed, by comparing the fraction of predictions within two factor (FAC2), coefficient of determination (R2) and the index of agreement (IOA) of the model. It were found the R2 values were above 0.71 for CA011 during weekdays and 0.51 CA002 for the weekend. The FAC2 of all stations were found between 0.90 and 0.95 which range are acceptable for model performance. Consistently, it was found that highest factor that influenced PM10 was PM10lag, CO gas and followed by NO2 gases. This can be link to the location of these chosen station is co-inside closed to an arterial road that link this cities to the other, whereby a lot of motor vehicles the source emission strength due to city development were the highest influence to the Perai station. Strong H-Index were found between gases up to 0.83 for CO and SO2 interactions obtained for industrial areas. Results showed that the model developed was within the acceptable range and could be used to understand particles formation and identify important parameters that influence for estimating particle concentrations during weekday and weekend data and this can be applied to other datasets.

FIRST REACTION KINETIC LABORATORY OF TURKEY;THE ATMOSPHERIC AND ENVIRONMENTAL CHEMISTRY LABORATORY (AECL) AT TURKISH ACCELERATOR RADIATION LABORATORY (TARLA) RESOLVING ATMOSPHERIC PROBLEMS ON GLOBAL TO NANO SCALE.

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The hydroxyl radical (OH), hydro/organic peroxy radicals (HO2 and RO2), known as ROx and reactive halogens (e.g. Cl·, BrO·), play a central role in atmospheric chemistry and air pollution (Stone et al., 2012). These species control and dominantly drive the oxidative chemistry of atmosphere, and hence govern the removal of primary trace gas emission and formation of secondary pollutants such as ozone (O3) and secondary organic aerosol (SOA) (Hofzumahaus et al., 2009). In troposphere, they arise from photolysis of molecules such as O3, nitrate radical (NO3·), nitrous acid (HONO), formaldehyde (HCHO) and other carbonyls, as well as ozonolysis of unsaturated volatile organic compounds (VOCs) (Dusanter et al., 2009; Lu et al., 2012; Volkamer et al., 2010). In the presence of nitrogen oxides (NOx) and VOCs, the ROx radicals can undergo recycling which triggered by OH (OH→RO2→RO→HO2→OH) and produce O3 and oxygenated VOCs (OVOCs) (Sheehy et al., 2010). This recycle process terminated by reactions with NOx under high-NOx conditions or radical self-reaction under low-NOx conditions, which results in the formation of nitric acid (HNO3), organic nitrates and peroxides (Liu et al., 2012; Wood et al., 2009). Given the essential significance and complex processes involved, radical reaction chemistry presents one of the core areas in the atmospheric chemistry research.

Parameter ensemble simulations from state of the science models are able to identify the sensitivity to uncertainties in key reactions that drive over all process uncertainty in the atmosphere (Khan et al., 2015 and B. Newsome, M. Evans. 2017). Key tropospheric processes are largely related to secondary pollutants notably O3, oxygenated organic intermediates and SOAs. AECL will address the single largest contributory uncertainty to the tropospheric O3 problem. There for it will improve our prediction capabilities of atmospheric O3 by reducing the uncertainty in the kinetic data base as a result our predictions of secondary pollutant chemistry will largely improve.

Main objective of AECL is to fill the gap of knowledge in fundamentals of oxidation reaction kinetics in the Earth's atmosphere, indicated by model studies and ambient field observations.

Flow Tube Chemical Ionisation Mass Spectrometer (FT-CIMS) is offering a unique opportunity for studying these reactions in wide range of conditions; FT-CIMS technique has already established its superior capability for studying radical reactions. Also an Ultraviolet photoelectron spectrometer (UV-PES) will be employed for the kinetic studies, to detect short lived intermediate species for enriching our understanding of reaction kinetics especially for peroxy radical self-reactions.

EMERGING AIR POLLUTANTS

DETERMINIG THE RELATIONSHIP BETWEEN MODIS AOD AND PM 2.5 A CASE STUDY FROM MARMARA REGION

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Air pollution is a worldwide environmental problem which can lead to many serious environmental effects and threaten human health, especially the atmospheric fine particulate matters (PM 2,5) in many countries. Remotely sensed data derived Aerosol Optical Depth (AOD) data have been used as an efficient tool that supports the air quality studies. Ground based measurements of pollutants includes limited information about spatial distribution of of these pollutants but satellite-drived data provides continues spatial information for large areas. In this study, the statistical relationship between AOD data and the ground based PM 2.5 daily data were analysed for the 13 stations from Marmara Region, Turkey. Marmara Region is located in the northwest part of Turkey. A large part of industrial activities of Turkey is located in the region. Population of the region is 31 % of Turkey's poplulation. PM 2.5 data obtained from Marmara Clean Air Center and MODIS AOD combined Dark Target (DT) and Deep Blue (DB) 550 nm values were extracted for the 13 stations. The study period was chosen between March 2014 and February 2017. Before statistical analysis, MODIS AOD combined DT and DB data sets were validated by using three Aerosol Robotic Network (AERONET) stations located in Turkey, Athens and Cyprus. After validation, MODIS AOD 550 Nm combined DT and DB 10x10 km resolution data were extracted by drawing 3x3 window over each station and mean values were calculated of the extracted pixel. In order to determine the relationship, correlation coefficients were calculated.

POTENTIAL SOURCE REGIONS AFFECTING IONIC COMPOSITION OF RAINWATER AT TEN DIFFERENT RURAL STATIONS IN TURKEY

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Turkish State Meteorological Service (MGM) has been operating 10 rain motoring stations at different parts of Turkey since 2004. The stations are located in İstanbul, Balıkesir, İzmir, Muğla, Antalya, Hatay, Trabzon, Ankara and Bartın. More than 5000 event-based, wet-only rainwater samples have been collected and analyzed with ion chromatography for SO42-, NO3-, Cl-, NH4+, Ca2+, Mg2+, K+ and Na+ at MGM Central Laboratory to date. This study discusses the flow climatology, a trajectory statistics method, of each sampling station to characterize the source areas of measured ions. Three different approaches were used for a better understanding of air-flow patterns at each sampling station. These approaches are residence time analysis, wind sector contribution, and cluster analysis. Back trajectories were calculated for 3 different arrival heights, 100 m, 500 m, and 1500 m. The study domain used in residence time analysis and wind sector contribution calculations extends from west of UK (20ºW) to Center of Asia (60ºE) in North East direction and from Siberia (75ºN) to middle of Africa (15ºN). In residence time analysis, study domain was divided into 1ox1o grids and residence times of air masses in grids were calculated. To calculate the percent contribution of each wind sector, study domain was divided into 8 wind directions and the time of air masses spent in each wind direction was calculated. Clusters were formed in TrajStat software for each sampling station using Ward's hierarchical method. Measured concentrations of ions at each station were assigned clusters and variation of concentrations of ions among the clusters was calculated.

CHARACTERIZATION OF SOLVENT EXTRACTABLE ORGANIC COMPOUNDS AND EC OC IN PM2.5 AEROSOLS IN ANKARA

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The main objective of this study was chemical characterization of solvent extractable organic compounds and EC-OC in PM2.5 aerosols in Ankara, Turkey. Ambient PM2.5 samples were collected from July 2014 to September 2015 in two (urban and suburban) stations to investigate the concentrations, temporal variations, source impacts and spatial correlations. The extracted organic compounds were separated into four major fractions (polycyclic aromatic hydrocarbons (PAHs), n-alkanes, n-alkanoic acids and levoglucosan) and identified with GC-MS (gas chromatography-mass spectrometry). Elemental carbon (EC) and organic carbon (OC) were quantified by means of an EC/OC carbon analyzer (Sunset Laboratory Inc., USA) using the NIOASH 870 protocol. The seasonal average concentrations for these chemical groups ranged from 13.51-65.04 ng m-3, 35.92-149.8 ng m-3, 24.41-47.02 ng m-3, 0.44-3.63 ng m-3, 0.72-2.48 ng m-3, 4.87-14.63 ng m-3, respectively. Diagnostic ratios of selected PAH congeners were used to identify the information about the nature of particulate matter sources. The ratios of ∑LMW/∑HMW were 0.16 in both stations, indicating a predominance of pyrogenic sources (incomplete combustion of fossil fuels and wood). The ratio of BaP/(BaP+BeP) is an indicator of the atmospheric reactivity on particulate organic matters and the ratio was calculated as 0.42 for urban station and 0.53 for suburban station, indicating that there are PAHs decomposition in urban station while fresh particle existence in suburban station. CPI (carbon preference index) values of n-alkanes were indicated that the anthropogenic sources was the characteristic of both stations' aerosols. C18/C16 ratio were determined 0.6 for urban and 1.1 for suburban stations and this suggested that strong contribution of food cooking to the concentrations of n-alkanoic acids. Summer-to-winter concentration ratio was 0.45 at suburban station and 0.3 at urban for levoglucosan. This difference in seasonal ratios indicated anthropogenic contribution to levoglucosan concentrations at urban station. The results of OC/EC ratios (higher than 2.0 for both stations) in the PM2.5 aerosols indicated significant secondary organic aerosol (SOA) formation. Spatial correlation results demonstrated that twenty-six out of forty-five organic compounds showed correlation between urban and suburban stations with statistical significance > 95%.

SPATIAL AND TEMPORAL VARIABILITY OF RAINWATER CHEMISTRY IN TURKEY

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Spatial and temporal variation in concentrations of major ions measured in rainwater samples collected at ten different rural locations in Turkey were investigated. Samples were collected in precipitation monitoring network, which is operated by the General Directorate of Meteorology, Research Division since 2004. Approximately 5000 wet-and-dry rainwater samples were collected in the network. Collected samples were analyzed for major ions using ion chromatography. Concentrations of SO42- and NO3- were higher in Catalca, Yatagan and Amasra stations compared to their concentrations measured in other stations of the network. Higher concentrations of pollution-derived parameters in Catalca station was due to occasional interception of urban plume from Istanbul. Higher SO42- and NO3- concentration at Amasra was related to long range transport of pollutants particularly from heavily industrialized regions in Eastern Ukraine.

An important characteristics of rainwater composition in all stations is the extensive neutralization of rainwater acidity' particularly during summer season. Annual average pH in stations varied between 5.1 and 6.8, indicating neutralization of free acidity. More that 75% of acidity is neutralized in winter season. During summer season, on the other hand, more than 90% of acidity was neutralized. This temporal pattern in neutralization was attributed to easier resuspension of local soil, which is highly enriched in CaCO3, during summer months.

CARBON CONTENT IN PM2.5 AT A COASTAL MEASURING SITE IN CROATIA

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Rijeka is the principal seaport and third largest city in Croatia. It is located in the Primorje-Gorski Kotar County on Kvarner Bay, an inlet of the Adriatic Sea and has a population of about 130000 inhabitants. The city's economy largely depends on shipbuilding and maritime transport. The terrain configuration, with mountains rising steeply just a few kilometres inland from the shores of the Adriatic, provides for some striking climatic and landscape contrasts within a small geographic area. Rijeka has a humid subtropical climate with warm summers and relatively mild winters with frequent rainfall and cold (bura) winds.

This study is the first research on particulate matter with an equivalent aerodynamic diameter of less than 2.5 μm (PM2.5) and the carbon content in it at a coastal urban background station located in Rijeka. Mass concentrations of elemental (EC), organic (OC) and total carbon (TC) in) were investigated from January 1st 2017 to April 30th 2019. Sampling was conducted during 24-hour periods from approximately 55 m3 of ambient air on quartz fibre filters (Pall Tissuequartz 2600QAT-UP, 47 mm) pre-fired at 850°C for 3 hours. Mass concentrations of 850 PM2.5 samples were determined gravimetrically according to the standard EN 12341:2014. Carbon content was measured by the thermal-optical transmittance method (TOT) using a carbon aerosol analyser with a flame ionization detector and EUSAAR_2 temperature program operating according to the standard EN 16909:2017.

The average PM2.5 mass concentration (11.1 μg m-3) did not exceed the limit value of 25 μg m-3 and the maximum was observed in winter (51.3 μg m-3). Carbon mass concentrations revealed strong seasonality having its low in summer and high in winter. The average OC/EC mass ratio values of around 6 pointed to the influence of secondary organic aerosols. Average TC mass contribution to the total PM2.5 mass was 34 %, of which 21 % SOC (secondary OC), 8 % POC (primary OC) and 5 % EC. High mass contribution of SOC to the total OC mass (as much as 73 %), can be explained by the warm climate suitable for photochemical reactions and the formation of SOC from sea spray.

IONIC COMPOSITION OF PM2 5 PARTICLE FRACTION AT A COASTAL URBAN BACKGROUND SITE IN CROATIA

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The aim of this study was to determine the mass concentration and the content of water-soluble anions (Cl-, NO3-, SO42-) and cations (Na+, NH4+, K+, Mg2+, Ca2+) in PM2.5 particle fraction, to investigate their relationship and there contribution to the total PM2.5 mass measured at site located in Rijeka, Croatia. Rijeka is the third-largest city in Croatia at Kvarner Bay on Adriatic Sea with developed petrochemical and metal industry, shipyards, oil refining and transportation especially maritime. Measuring site is a part of Croatian monitoring network for air quality classified as urban background site. Daily samples of PM2.5 particle fraction were collected over a year 2017 on PTFE filters using the low volume sampler Sven Leckel SEQ 47/50. Mass concentration of PM2.5 particle fraction was determined by gravimetric according to the standard HRN EN 12341:2014 (EN 12341:2014). The content of water-soluble inorganic anions and cations were determined using Thermo Scientific ICS-5000 capillary ion chromatograph. Results show that annual average PM2.5 mass concentration was 9.65 µg/m3 and didn't exceed limit value of 25 µg/m3 given by the Regulation on the level of pollutants in air (OG No. 117/12). The annual average mass concentrations of ions in PM2.5 particle fraction was in order SO42- > NH4+ > NO3- > Ca2+ > K+ > Na+ > Cl- > Mg2+. Contribution of total anion mass and cation mass to the total PM2,5 mass were 25.4% and 12.8%, respectively. Contribution of each anion mass to the total anion mass were 84.8% , 14.2% and 0.9% for SO42-, NO3- and Cl- respectively, while contribution of each cation mass to the total cation mass were 6.6% , 72% , 6.2% , 1% and 13.3% for Na+, NH4+, K+, Mg2+ and Ca2+, respectively. The prediction of the pollutant sources we ran the principal component analysis (PCA) which was performed using the statistical packages STATISTICA 13.0. After varimax rotation, the obtained four principal component factors were found to account for 86% of the variance. Factor loadings > 0.7 were considered significant.

CHARACTERIZATION OF AIRBORNE PARTICULATE MATTER COLLECTED IN THE VICINITY OF COAL FIRED POWER PLANT IN JAVA INDONESIA USING ENERGY DISPERSIVE X RAY FLUORESCENCE AND X RAY ABSORPTION NEAR EDGE STRUCTURE SPECTROMETRY

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The 35,000 MW coal power plant crash program in Indonesia has been launched since 2015. Diversification from fossil fuel to coal is considered to improve the reliability of electrical power supply especially in Java Island. The increasing of coal utilization may have some adverse impact on environmental, therefore this energy policy need to be evaluated and monitored to minimize the environmental and human health impact due to the emission from the coal power plant. In this study, airborne particulate matter samples collected from the vicinity of coal power plant in West Java and East Java, Indonesia were characterized by energy dispersive X-ray fluorescence at BATAN Indonesia and synchrotron based technique X-ray absorption near-edge structure (XANES) spectrometry at Elettra, Italy. The airborne particulate matter samples were collected using dichotomous Gent stacked filter unit sampler. Assessment of several trace elements and the speciation of heavy metals for investigation of their toxicity in fine and coarse fractions were presented. Information of As and Cr speciation provides the possible toxic and less toxic oxidation states forms through comparison with standards. The presence of the Cr(VI) oxidation state indicating that the chromium in the APM samples is present as less toxic than Cr(III) form. The speciation of As in the samples indicating the less toxic inorganix form As(V) represented the main arsenic species.

SEASONAL VARIATION OF PARTICULATE MATTERS (PMS) DOWN TO NANOPARTICLE SIZE (PM0.1) IN RURAL SUBURBAN AND URBAN SITES OF SUMATRA ISLAND INDONESIA

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As the initial study of air pollution status, this study shows the seasonal variation of size-segregated particulate matters (PMs) down to PM0.1 or nanoparticles were recorded in the three different characteristic locations (rural, suburban, urban) of Sumatera Island-Indonesia. The particles were collected by using a cascade air sampler with a PM0.1 stage and carbonaceous components were analyzed based on the thermal/optical reflectance (IMPROVE-TOR) method. PMs emitted during the dry season were higher than the rainy season in suburban and urban sites while in the rural there is no significant difference between those seasons. Furthermore, the average concentration in both rainy and dry season, the highest was recorded in urban site following by suburban and rural sites. There is some reason affected the different trend in each location including wet removal mechanism during the rainy season and biomass burning from peatland and forest fire in the dry season. Furthermore, the environment surrounded the sampling sites (e.g. green belt trees) also contributed to preventing the location polluted by some sources, especially in rural and suburban sites. Moreover, the percentage of OC1 and pyrolysis-OC was larger in dry season comparing to rainy season indicated biomass burning has more effect on dry season. It also contributed to the higher ratio OC to EC in rural, suburban, and urban sites which the highest was found in the rural site (up to 12.41). The clearest effect of biomass burning event in dry season recorded on Nanoparticle (PM0.1). OC to EC ratio in this particle size was 1.6 times higher than rainy season. In addition, the ratio of pyrolysis-OC to OC4 was higher in the dry season compared to the rainy season, indicated that peatland fire during the dry season was affected to high PMs level.

NON IGNORABLE POLLUTION SOURCE AIRBORNE MICROPLASTICS

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Plastics have become an indispensable part of our daily lives and their production is increasing day by day due to their widespread use. As a result, global plastic pollution has become a noteworthy issue. Plastics are grouped into macroplastics (> 25 mm), mesoplastics (5-25 mm), microplastics (MPs) (<5 mm) and nanoplastics (<100 nm) according to their size. In the environment, MPs are resulted from primary sources (plastic pellets) and secondary sources through the breakdown of large plastics. MP pollution has been investigated in different environmental media besides atmospheric transport and exposure of MPs has become one of the notable subjects. In this study, literature studies on MP presence and distribution in atmospheric environment were reviewed. Due to their small size, there is an exposure to MPs through inhalation, which raises various potential health effects. It was also determined that MPs could serve as a vector for particulate matter and other pollutants in the air. Natural source fibre particles were mainly detected in the studies that investigated MP pollution in the air. The presence of MPs in air is important not only because of health effects but also being a source to other environmental media in terms of atmospheric deposition. The number of studies investigating MP pollution in the atmosphere is limited. Thus, detailed and comprehensive studies on determining MP concentrations in the air as well as their health effects are required.

SITE SPECIFIC VARIATION OF AMBIENT NANOPARTICLE (PM0.1) IN NORTH SUMATERA PROVINCE INDONESIA

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In this study, size-segregated particulate matter down to nano particle were collected in four different characteristic sites of North Sumatera Province (Medan city and Karo regency) i.e. roadside, school environment, industry, and volcano area, from February 19th to March 12th by using a cascade air sampler with a PM0.1 stage (Nano sampler). The one-week concentration in all location, the result indicated that the industrial area was the highest among the others due to emission from many kinds of industries as well as vehicle combustion from KL. Yos Sudarso St. nearby sampling site. However, the lowest was recorded in the volcano area because of sampling site covered by green area and agricultural used. Furthermore, the concentration of PMs during day time was higher than night time as a result of vehicle combustion emission during day time higher than night time in roadside as well as in the school environment. The concentration of PM0.1 in all size ranges from 5.76 to 20.92 ug/m3. The highest recorded in school environmental day might be due to nearby Sisingamaraja St and emitted from student activities during learning time while the lowest in the volcano site. Then, the fraction of fine particle (PM2.5) was more than half of the total mass in all sites. The percentage of Nanoparticle higher than 10% of the total mass of PMs in all location which day time percentage higher than night time due to the greater number of vehicles during day time than night time.

INVESTIGATION OF GROUND LEVEL PM2.5 WITH DIFFERENT MODE OF TRANSPORTS IN DHAKA BANGLADESH

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The study aimed to determined the correlation existed between increased concentrations of Air pollution and motorization in Dhaka. It reviewed the suspended solid particulates specifically PM2.5 and compared between different categories of roads which are Vehicle Free, Non-motorized, Mixed and Motorized and also with Environment Quality Standards (EQS) for Bangladesh set by the Department of Environment (DoE). Besides measuring the PM2.5, a traffic volume survey also been done in 12 sites across the Dhaka city. PM2.5 concentration in mixed and motorized areas was on average 182% and 272% higher, respectively, than non-motorized. Surprisingly, short term measurements (~8hrs) in predominantly mixed and motorized areas already exceeded the maximum recommended limit for 24hrs (65µg/m3). This suggests a much higher pollution potential over a typical 24hrs period in motorized traffic areas. The study found a significant correlation between the concentration of the particulate matters and increasing of motorization. The study assumed that uncontrolled motorization is major cause of air pollution especially PM2.5 in the Dhaka city and the impact of these particulate matters on public health and environment are beyond the tolerable limits. The study has come up with some recommendations regarding improvement of air quality in respect of particulate matter and emphasized for further comprehensive study on other parameters of air pollution around Dhaka city. The study drew conclusion that the overall air quality regarding the particulate matter already exceeded highest standard limits of Bangladesh. The study recommended several measures to mitigate and prevent the harmful impacts and to improve the air quality of Dhaka city.

LONG TERM ANALYSIS OF THE COLUMNAR SURFACE AEROSOL RELATIONSHIP WITH PLANETARY BOUNDARY HEIGHT AT SOUTHERN COASTAL SITE OF TURKEY

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Planetary Boundary Layer Height (PBLH) has been considered to be a key factor influencing the direct relationship between satellite-derived Aerosol Optical Depth (AOD) and ground-level Particulate Matter (PM). AOD is the column integral of the aerosol extinction coefficient in vertical distribution of the total atmosphere, while PM is the surface measurement. PBLH can account for much of the variability in near-surface air quality. Therefore, the relationship between PBLH and concentrations of surface pollutants, especially particulate matter (PM) should be investigated at different regions. In this study, the relationship between PM and the PBLH was investigated in a coastal site of Turkey. Then, to account for the background pollution level, the PM10 was normalized with MODIS AOD to qualitatively account for background or transported aerosol that is not concentrated in the PBLH. To study the effect of PBLH on the PM vs AOD correlation the PBLH was categorized into three different height intervals, such as low (PBLH < 500 m), moderate (500 m< PBLH < 1000m), and high (PBLH > 1000m). AOD data from both MODIS Terra, and MODIS Aqua satellites were used to investigate correlation between PM10 and AOD. The Collection 6.1 MODIS-Terra and Aqua Level-2 AOD products at 550 nm, were used with a nominal spatial resolution of 3 km ×3 km. Satellite data products were validated using IMS-METU-Erdemli AERONET site located in the southeastern coast of Turkey. Both dataset indicated high correlation as 0.82 for Terra and 0.85 for Aqua. The region is highly effected from dust transport from central-eastern Sahara in summer, and the Middle East-Arabian peninsula in autumn. Hourly PM10 data was obtained from Mersin-Icel station that is the closest station to IMS-METU Erdemli. The PBLH was obtained from the Modern Era-Retrospective Reanalysis for Research and Applications (MERRA) reanalysis dataset to generate a PBLH climatology for 2008-2017. Clearly, after normalizing PM10 by AOD, the spread of the scatter plots are significantly reduced, and the correlations become more significant for both product, especially for Terra (from -0.16 to -0.41). Based on the seasonal differences observed between PM10 and AOD, PBLH was included in the analysis in order to understand its role in the relationship between AOD and PM10. In this way, highest values of PBLH were usually obtained in summer (>2 km), although occasional high values were found in other seasons. For the correlation of PM10-AOD markedly improves with PBLH (from -0.19 to 0.36, and from -0.95 to 0.33) mainly when PBLH higher than 1 km for Terra and Aqua, respectively. The results indicated that the good correlation between ground and columnar values when the mixing layer is thick for both satellite. PBLH higher than 1 km was generally observed in autumn.

INCREASING BURDEN OF AEROSOLS DUE TO RECENT INTENSE HAZE EVENTS OVER PAKISTAN AND ADJOINING REGIONS

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Aerosols released from biomass burning affect the tropospheric chemistry, radiation budget and cloud processes and hence can cause significant climate modifications. Due to rapid increase in industrialization and urbanization, megacities of Pakistan are facing intense haze events causing important effects on the regional environment and climate. In the present work we have analyzed the properties of aerosols during intense haze events over Pakistan. The data from ground based Aerosol Robotic Network (AERONET), satellite based MODIS and CALIPSO remote sensing instruments have been used for the characterization of aerosols during intense haze events of October 2010 and 2013. HYSPLIT model was also used to estimate the transport of air pollutants during high aerosols optical depth (AOD) days. The maximum AOD values were found to be 2.75 and 2.36 on 20 October, 2010 and 9 October, 2013 in the central regions of Pakistan. Cluster analysis was performed by utilizing the scatter plot between AOD and Angstrom exponent, and absorption Angstrom exponent AAE (440-870 nm) and extinction Angstrom exponent (440-870 nm) (EAE) to classify the dominant aerosol types such as biomass burning, dust and urban-industrial aerosols during the heavy aerosol loading periods over Pakistan. Aerosol sub-types were investigated further with the help of CALIPSO data. High values of single scattering albedo were observed during both the events (~0.95). MODIS fire activity image suggests that the areas in the southeast of Lahore across the border with India are dominated by biomass burning activities.

MONITORING AND ANALYSIS OF FORMALDEHYDE COLUMNS OVER RAWALPINDI ISLAMABAD PAKISTAN USING MAX DOAS AND SATELLITE OBSERVATION

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The oxidation pathway of non-methane hydrocarbons, originated from biogenic emissions and anthropogenic sources, culminates in the production of formaldehyde (HCHO) as an intermediate product. HCHO is used to manufacture domestic products and medical preservatives. It is found naturally, and in trace amounts is also produced during metabolic process of many organism. Pakistan is lacking of regular monitoring system on a larger scale to monitor the trace gases present in the atmosphere. For this study, the ground-based data and satellite-based observations of HCHO were gathered during the time period of years 2014-2015. By using car MAX-DOAS instrument several field campaigns were carried out to explore the spatial distribution of HCHO within twin cities of Pakistan. The DOAS technique was used to retrieve level-2 satellite data product from Ozone Monitoring Instrument (OMI) which was then compared with ground-based observations. HCHO column densities distributed spatio-temporally are described in this study. Within twin cities of Islamabad-Rawalpindi, the highest HCHO concentrations of 108 ppbv was found which exceeded the permissible limit of 83 ppbv from World Health Organization (WHO). Furthermore, the maximum VCDs were around $1.0 \times 1\ 0^{16}$ to $8.5 \times 1\ 0^{16}$ molecules/cm^2, higher than those in Pir-Sohawa valley, which were within the WHO limit, due to less population and vehicular emissions. Similarly, higher amounts of HCHO concentrations were found in areas with higher population densities, increased industrial activity, and along the major highways.

ION COMPOSITION OF THE DAILY PM10 SAMPLES COLLECTED AT KIRKLARELI TURKEY

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Ions such as SO42-, NH4+, PO43-, NO2-, NO3- are certain components of the atmospheric particles with abundances that depend upon the particle source. Inorganic constituents such as SO42− and NO3− might have interactive biological effects together with the other constituents. This study, derived from an ongoing project, focuses on composition of water soluble ions in PM10 and their variabilities in Kırklareli, Thrace region of Turkey. Particulate matter samples were taken during a year from March 2018 to March 2019 in two stations; urban (Kırklareli 41.73° N and 27.23° E) and rural (Kırklareli 41.79° N and 27.14° E). SO42-, NH4+, PO43-, NO2-, NO3- ions were measured daily. In terms of seasonal analysis, ion concentrations were found to be higher in winter than any other season. SO42- ion has the highest concentration during winter with average values of 5.44 µg/m3 in urban and 2.26 µg/m3 in rural area, together with the standard deviation levels as 2.69 µg/m3 and 1.28 µg/m3, in order. The main reason for obtaining high sulfate concentration is believed to be anthropogenic. High coal consumption for residential heating during winter associated with meteorologically critical conditions (high pressure systems having low wind speeds and stagnation) cause high PM10 levels, including high sulfate concentrations.

A STUDY OF METAL COMPOSITION IN THE DAILY PM2.5 SAMPLES IN KIRKLARELI TURKEY

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Ambient fine particulate matter, PM2.5, can be highly correlated with anthropogenic sources including agricultural activities, industrial processes, fossil fuel combustion, construction and demolition activities. To study fine particulates and their sources in the atmosphere of Thrace Region of Turkey, daily PM2.5 samples were collected at two stations in Kirklareli; one urban and one rural (background) station. A low-volume sampler equipped with 47-mm Teflon filters was used to obtain samples for a 67 days time period extending from 27th of March 2018 to 1st of June 2018, representing the spring season. Elemental concentrations of Na, K, Ca, V, Mn, Fe, Ni, Zn, Sr, Sn, Si, Mg, Al, Cr, Cu, Pb, Sb, B in the PM2.5 samples belonging to the rural and urban stations were determined by an ICP MS device. Statistical techniques such as normality test (Shapiro – Wilk), correlation, linear regression and trend tests were used to analyse the PM2.5 data. Observed PM2.5 values were investigated together with the PM10 data obtained from the same stations, to get information about the temporal variability of PM2.5 and the violation of the limit values. Urban and rural PM2.5 concentrations were found to range from 4.32 to 86.92 µg/m³ and from 3.55 to 68.856 µg/m³, and mean values were found to be 26.95 and 19.25 µg/m³, in order. EU legislation expresses for PM2.5 that a 24 h mean concentration of 25 µg/m³ must not be exceeded more than 35 times during a calendar year and this condition was found to be violated in urban station (39 days out of 67 days) and in rural station (31 days out of 67 days). Metal concentrations ranged as Na (1.1 – 650.5 ppm), K (4.5 – 155.7 ppm), Fe (1.2 – 175.7 ppm), Si (8.3 – 210.9 ppm) for the rural station and Na (1.5 – 539.5 ppm), K (5.3 – 144.8 ppm), Fe (0.7 – 228.6 ppm), Si (6.9 – 92.9 ppm) for the urban station. Fe, generally used for identifying whether the sources are natural or anthropogenic, was chosen as a reference element in the Enrichment Factor (EF) analysis. Results showed that the EF values of metals are considerably higher in the urban site compared to those of the rural one. According to the EF analysis, only two metals (Al, Mn) out of 15 metals are found to be natural in the urban site, showing the impact of human induced emissions, while about half of the metals are found to be natural in the rural site (Na, K, Ca, Mn, Sr, Si, Al).

BLACK CARBON EVALUATION IN URBAN SIDE OF ISTANBUL ATMOSPHERE DURING SPRING AND SUMMER SEASONS

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This study was carried out at Yildiz Technical University Davutpaşa Campus where is located between crowded districts of Istanbul. Main sources around the campus are Central Coach Station of Istanbul, residential buildings, small scale industrial facilities, and O-1 and O-2 highway connection. The objective of the study is to relate black carbon levels with conventional air pollutant parameters. Furthermore, determine potential sources using meteorological parameters. We monitored black carbon continuously by an aethalometer at rooftop of the Civil Engineering Faculty, typically 10 m above ground-level. Meteorological data are recorded by a Davis Vantage Pro-2 automatic weather station on the same building. Conventional ambient parameters are NO, NO2, SO2, PM2.5, and PM10. These parameters are gathered from monitoring station which is approximately 900 m away from black carbon sampling station. The station is operated by Istanbul Metropolitan Municipality.

The average black carbon concentration was 2216±1809 ng/m3. Spring concentration was 2542±2019 ng/m3, whilst summer concentration was 1693±1240 ng/m3. Less average concentration and variability was observed during summer season. The reason is attributed to decreased anthropogenic activities and increased boundary layer height. Correlation between black carbon concentrations and conventional parameters are investigated. Pearson correlation coefficients suggested that there was weak relation between black carbon and remaining pollutants. The most significant relation was with SO2 and NO. Their correlation coefficient was 0.16. The correlation coefficient was 0.01 and 0.08 for PM10 and PM2.5, respectively. A higher correlation with PM2.5 revealed the dependency of black carbon on finer particles. Association of black carbon with meteorological parameters showed possible source regions and transportation patterns.

Although studies with black carbon measurements are scarce in Istanbul, we discussed the study outcomes with the available data for Istanbul. The black carbon concentrations of this study are considerably lower than in previous studies. Temporal and spatial differences caused such concentration differences. This study fills a gap for a location that is relatively away from traffic sources when compared to relevant studies in Istanbul.

CHEMICAL CHARACTERIZATION OF RAINWATER AT ÇATALCA ISTANBUL

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Approximately 1090 event based rainwater samples were collected at a station operated by General Directorate of Meteorology by using wet-only sampler between 2005 and 2018 in Çatalca, İstanbul. Collected samples were analyzed in terms of major ions (SO42-, NO3-, Cl-, Ca2+, Mg2+, Na+, K+ and NH4+) by means of ion chromatography. Volume weighted average concentrations of the measured species were ranged from 6.4 µeşd/L for K+ to 115 µeşd/L for Cl-. Among the anthropogenic ions, SO42- showed the highest concentration (69.4 µeşd/L). The mean pH value for the collected samples were determined as 5.79 while it ranged from 3.34 to 7.96 throughout the measurement period. About 22 % of the samples had pH value is less than 5.0 implying that neutralization of rainwater acidity by the cations is important at the region. The seasonality of neutralization was also investigated by calculating the molar ratio of [H+] / ([SO42-+NO3-]. The ratio depicted well-defined seasonal variation with higher ratios in winter months and lower ratios in summer months indicating that cations in summer have a strong impact on the neutralization. The long-term variation of SO42- and NO3- showed decreasing trend throughout the measurement period.

PHYSICAL AND CHEMICAL CHARACTERIZATION OF AIRBORNE PARTICULATES IN THE PORT CITY OF RIJEKA CROATIA

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Based on the results from the previous MED project POSEIDON, that dealt with the impact of maritime traffic to urban air quality in Rijeka, one of the aims of the INTERREG IT-HR project ECOMOBILITY is to further characterize physical and chemical properties of the 11 fractions of airborne particulates collected with 10-stage cascade impactor with nominal cut-off sizes of: 10, 5.6, 3.2, 1.8, 1.0, 0.56, 0.32, 0.18, 0.10 i 0.056 μm. The two sampling campaigns were: autumn, in the period 26.10. -10.12.2018. and spring, in the period 26.03.-21.05.2019. Eight 7-day samples were collected in each campaign. The overall average mass /concentration varied between 9 and 37,4 μg/m3, except for the first week of monitoring when the average was 134,6 μg/m3. Distribution of airborne fractions shows a bimodal curve, with two maxima: S4 (particle diameter range d =1,8-3,2 μm) and S8 (d=0,18-0,32 μm) fractions. Size distribution of particulates' mass concentrations differs for the first week: except secondary peak at S4, there is a primary one at S6 (d= 0,56-1,00 μm) and tertiary at S10 (d= 0,56 □1,00 μm). Three peak mass distribution is characteristic for the desert dust. Sample with Saharan sand shows higher content od nanoparticles (d<1um), although the highest contribution of nanoparticles derived from domestic heating started at mid-November. Chemical analyses showed that multiple higher mass/concentrations of secondary inorganic aerosols (SIA) sulphate and ammonijum were found in the fine fractions S6.-S9 (d= 0,10-0,56 μm) of the sample with Saharan sand, thus indicating atmospheric gas chemistry as their sources. The same is valid for the water soluble organic compounds (WSOC), as a proxy of secondary organic aerosols (SOA) in the same fine fractions. Unlike sulphate and ammonium, maximum of nitrate is found in the coarse fraction S4-S6 (d= 0,56-3,2 μm) suggesting a well known intrusion of Nox in marine aerosols.

PHYSICAL PROPERTIES AND CHEMICAL CHARACTERIZATION OF SUBMICRON PARTICLES IN THE REGION OF CAMPINAS SÃO PAULO BRAZIL

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This study presents a detailed characterization and an analysis of the relationship of optical and physical properties with the chemical composition of submicron particles in an urban area at Southern Brazil. The analysis were based on measurements performed during an field experiment carried out from July 2017 to June 2018, in Campinas city, one of the largest urbanized areas of São Paulo state and an important industrial center. Moreover, the site is strongly impacted by regional biomass burning. The instrumentation was operated inside State University of Campinas (UNICAMP), providing 1-year high time resolution data set of aerosol optical properties, particle number size distribution (PNSD) and chemical characterization of submicron particles. The average submicron particle mass concentration for the whole campaign was 10.1 μg m-3, composed mainly of organics (55%), followed by black carbon (BC), sulfate, nitrate, ammonium and chloride, with contribution of 20%, 14%, 6%, 5% and 0.4%, respectively. Positive Matrix Factorization was performed to divide organic fraction into distinct organic aerosols (OA) components (biomass burning OA, hydrocarbon-like OA and two oxygenated OA), in order to characterize evolution and source of pollutants in urban atmosphere. Composition of submicron particles was strongly affected by meteorological conditions, significant enhancement of secondary organic aerosol (SOA) and inorganic aerosol mass was observed under dry conditions (large dry period from August to September 2017). Increase of oxygenated OA fraction at the same period indicates that the photochemical oxidation of organic gaseous precursors is the predominant mechanism of OA formation in dry conditions. Aerosol classification based on intensive optical parameters (absorption angström exponent (AAE), scattering angström exponent (SAE) and single scattering albedo (SSA)), was used to identify different types of particles. Urban pollution was characterized by small particles (SAE>1.5), BC-dominant (SSA<0.85), with AAE within the range 1-2. Larger particles with SAE<1.5, characterized by SSA>0.9 and absorption dominated by Brown Carbon (AAE>2), were associated to high OA concentrations and photochemical processes.

LONG TERM VARIATIONS OF PH AND MAJOR ION LEVELS IN PRECIPITATION (TURKEY)

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There are ten stations (Çamkoru, Amasra, Çatalca, İzmir, Yatağan, Marmaris, Antalya, Balıkesir, Hatay and Trabzon) have been operated by General Directorate of Meteorology to monitor the rainwater chemistry for a long-time period. The samples were collected by automated rainwater sampler and shipped to the central laboratory located in Ankara for analysis. The collected samples were analyzed terms of major ions (SO42-, NO3-, Cl-, Ca2+, Mg2+, Na+, K+ and NH4+) by means of Dionex 120 ion chromatography and pH by using Selecta 2001 model pH meter. The main objective of this study is to compare the levels and long-term trends of the measured parameters in the precipitation samples at these stations. The volume weighted mean pH values were ranged between 4.69 for Amasra and 8.37 for Antalya. The second lowest mean pH value (5.05) was recorded at Marmaris station. Except for sea salt markers (Na+ and Cl-), lowest levels of ions were measured at Marmaris station. The highest mean SO42- levels were measured at Yatağan station, where a thermal power plant is in operation. In contrast to this, the mean pH value obtained for this station is comparable to other stations, which can be attributed to neutralization of rainwater acidity particularly by Ca2+ and NH4+. The highest mean concentrations of Na+ and Cl- were recorded at Çatalca (İstanbul) station as compared to ones observed in the rest of the stations. The lowest levels of sea salt markers were recorded at Çamkoru (Ankara) station, which was expected since the station is away from the sea. The second highest mean pH value was obtained for this station. The seasonal variations in the measured concentrations were also evaluated in this study for all of the stations. In general, observed seasonality in the levels of parameters reflects the temporal variations in the strength of their sources. Moreover, the long-term trends of measured parameters were also assessed in this study by using Seasonal-Kendall or Mann-Kendall test if applicable.

SOURCE OF PARTICE BOUNDED METAL AND PAH POLUTION IN URBAN AREA CASE STUDY BOR AND ZAJECAR

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This study compared particle-bounded PAHs and metal levels and sources in the urban atmosphere of two neighborhood cities in Eastern Serbia, Bor and Zajecar. Bor is located in the vicinity on the of the biggest copper smelter complex in Europe and it is known as "black spot" according to the levels of particles-bounded toxic metals, especially arsenic compounds. Zajecar, far from Bor 35 km, is located in the valley of Tomok river. During winter season particle mass is significantly higher at Zajecar, due to numerous local heating sources. Pollutants like PAHs and trace elements have the potential to cause adverse health effects as some of them are toxic, mutagenic or carcinogenic, etc…The aim of this study is to provide simultaneous information on the mass, organic, inorganic composition and to identify sources of respirable particulate matter pollution in Bor and Zajecar and to compare health risk due to exposure to metals and PAH in both cities.

DOES POULTRY HOUSES IMPACT THE AIR QUALITY IN BOLU CITY CENTER

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Bolu has been providing 8 % of country's poultry need, hence, it is expected to suffer from the agricultural emissions including nitrate, ammonia and bio-aerosols. In contrast to this, there is not enough research showing the impacts of poultry houses on the air quality of the city. The main objective of this study is to explore the levels and seasonality in the chemical and microbiological parameters determined in ambient air of Bolu city center. PM10 samples were collected at a station located at the city center of Bolu (40.73°N–31.60°E and 741 m asl) by means of high volume sampler (Tisch Environmental Inc., U.S.EPA Federal Reference Number REPS-0202-141) on quartz filters. Sampling was performed daily between June 2017-March 2018. After PM mass concentration determination, one quarter of the samples was analyzed in terms of major ions and WSOC. Moreover, the second quarter of the samples were analyzed in term of bio-aerosols mainly bacteria and fungi by using quantitative PCR (qPCR). The average PM10 concentration was found as 54.98±64.82 µgm-3. The highest average concentration (3.52±1.75 µgm-3) was measured for Ca2+ among the cations determined in the samples. In addition, SO42- depicted the highest mean level (5.89±2.80 µg m-3) as compared to other anions. The mean WSOC concentration was found as 3.22±1.41 (µgm-3) during the study. The seasonality of the measured parameters were also investigated in this study. Except for NH4+ and NO3-, all the ions were showed statistically significant difference ($p<0.05$) between the seasons. Similarly, WSOC levels also depicted statistically significant ($p<0.05$) difference between the seasons with higher concentrations in summer. Bio-aerosol levels differed significantly between the summer and winter samples.

CHARACTERIZATION OF PM2.5 IN RELATION TO METEOROLOGICAL CHARACTERISTICS IN DHAKA CITY BANGLADESH

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The main objective of this study is to assess the concentration of PM2.5 and its relation with meteorological parameters. Secondary data has been collected from the AirNow Department of State (AirNow DOS). They provide maps of real-time hourly Air Quality Index (AQI) and daily AQI forecasts. The PM2.5 instrument installed at the U.S. Embassy in Dhaka is a beta attenuation monitor BAM-1020 PM-Coarse System. Study observed that 31.9% of hourly AQI category were Unhealthy while the percentage of Good was very few. The maximum monthly average concentration was found 192.97±89.30 µg/m3 in the month of January while minimum average concentration was found 29.98±19.37 µg/m3 in July. Besides, analysis of seasonal variation found that, winter season in more polluted than other. The annual concentration was found 79.94±75.55 µg/m3in 2017 which exceed the NAAQS and WHO standard. A number of meteorological factors are affecting to this variation in a year. Study shows that, rainfall is negatively strong and significantly correlated with concentration of PM2.5. It is found that, during the rainy season ambient dust are being settle down in the lithosphere which lead to the reduce pollution level in monsoon season. It can be concluded that, the annual concentration of PM2.5 was 5 times higher than standard level. It is necessary to set up more CAMS in the city, so that air quality of the city can be monitored at different location precisely. Particulate matter concentration may be significantly reduced by taking brick field far away from the city and covering uncovered road.

SPATIAL AND TEMPORAL VARIATION OF AERONET AEROSOL OPTICAL DEPTH OVER TURKEY AND ITS SURROUNDING

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The impact of aerosol that stems from natural and anthropogenic sources in air pollution has drawn significant attention. Aerosol Optical Depth (AOD) is defined as the measurement of light extinction by aerosol in the atmospheric column above the surface of earth and utilized to depict aerosol optical properties. The AERONET is a network of ground-based sun photometers, providing globally distributed observations of spectral AOD in the range of 0.34–1.06 μm, with a high temporal resolution (~15 min). This study aims to determine the spatial and temporal distribution of the selected aerosol parameters: the total aerosol optical depth (AODt) provided at a wavelength of 500 nm and Angstrom Exponent (AE) obtained from the AOD measured at 440 and 870 nm since the combined use of the AOD and AE allows to distinguish between different aerosol types. Long-term ground-based measurements from daily average AERONET V3 Level 2.0, cloud-screened and quality assured AOD data at 12 sites in the Eastern Europe: Turkey, Ukranie, Romania, Bulgaria, Greece and Southern Cyprus were used for the analysis.

The seasonal variation of AOD in the region showed that the maximum AOD values occured in spring and summer since hygroscopic growth at high relative humidity increases AOD, while low values were observed in winter which were characterized by precipitation.

Significant monthly fluctuations of AOD and AE found for all stations affirms the contribution of the aerosol of different types and sizes over the region. The large particles (sea spray and dust) are dominant for AE<0.7, while small particles (mainly smoke and urban aerosols) are dominant for AE>1.5. Between these two thresholds, the aerosol is a mixture of fine and coarse modes. The values of AOD (500 nm) higher than 0.3 and AE (440-870 nm) values lower than 0.7 refer to long-range transport of desert dust.

Annual average AOD is ranging from 0.18 to 0.25 over the region. At rural stations located in Turkey (IMS-METU-Erdemli) and Greece (Xanthi), this value was found relatively higher. The low average AE444-870 value (<0.7) and high AOD values (>0.30) at these stations confirms the major influence of large dust particles mainly spring months. It was also found that Forth-Crete (Greece) station was significantly affected by large dust particles. AOD-AE relationship showed that consecutive peaks resulted from the great number of desert dust events for this site. Conversely, the AOD at urban stations are dominated by fine mode particles. The Angstrom Exponent (AE444-870) above mainly 1.5 were detected in Athens-NOA, Thessaloniki, and Sevastapol located in urban areas. Atmospheric situation corresponding to the urban pollution controlled by a mixture of coarse and fine particles are dominant in these sites.

COMMUTER EXPOSURE TO BLACK CARBON FINE PARTICULATE MATTER AND PARTICLE NUMBER CONCENTRATION IN PUBLIC MARINE TRANSPORT IN ISTANBUL

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This paper presents a measurement and analysing of concentrations for black carbon (BC), particle number concentration (PNC), and PM2.5 (≤2.5 µm) whilst commuting along by ferry in Istanbul. In this context, exposure to the mentioned pollutants was estimated for car ferry, fast ferry and at the pier, and for two travel routes, for a total of 89 trips. BC, PNC and PM2.5 measurements were simultaneously performed in a ferry and at the piers, and the correlation between pollutant concentrations, meteorological parameters, and environmental factors were analysed. The mean concentrations for all pollutants in car ferry were lower than the average concentrations in fast ferry. The ratio of fast ferry to car ferry for BC, PNC and PM2.5 was 6.4, 1.2 and 1.3, respectively. The high variability of the concentrations was observed at the piers and in ferry during berthing. The highest mean concentrations (±standard deviation) of BC (14.3 ± 10.1 µg/m3) and PNC (42005 ± 30899 # / cm3) were measured at Yalova pier. The highest mean concentration(±standard deviation) of PM2.5 (26.1 ± 11.5) was measured at Bostancı pier. It was observed that the main external sources of BC, PNC and PM2.5 at the piers were road transport, residential heating, and shipping activity. There has been no significant correlation between BC, PNC and PM2.5 in fast ferry, while BC was positively correlated with PNC ($r = 0.61$, $p < 0.01$) and PM2.5 ($r = 0.76$, $p < 0.01$) in car ferry. At the piers, a significant relation between pollutants and meteorological variables was observed. It was noticed that there was no significant difference between summer and winter in ferry and at the pier concentrations of BC, PNC and PM2.5 except for Yenikapı pier and Bakırköy pier. The highest total exposure to PNC and PM2.5 were in car ferry mode, the highest total exposure to BC was in fast ferry mode.

CASE STUDY OF PM2.5 HIGH CONCENTRATION POLLUTION USING CPF MODEL

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There are various tools used to analyze the cause of high-concentration of particulate matter. One of the most important things in the analysis of high-concentration causes is to estimate the source location. Conditional Probability Function(CPF) model calculates the source contribution coupled with wind direction and wind speed values measured at the station. So, it is possible to estimate the direction in which contaminants are generated. Therefore, the CPF model is suitable for the cause analysis of high-concentrations.

The analysis period was one year from Jan 2018 to Dec 2018, and the target area was where the fine particulate matter(PM2.5) high-concentrations event occur frequently. The area is surrounded by major road and has a large industrial complex. In the area, there were two monitoring sites(A, B). A site was located near the industrial complex, and B site was located near the downtown. And the distance between the two sites was 5km. At first, it was expected that concentrations of A site were higher than B site because A site located near the industrial complex. But the PM2.5 concentrations of B site(annual concentration 32$\mu g/m^3$) were higher than A site(annual concentration 28$\mu g/m^3$).

The CPF model simulation results are as follows. First, 70-100‰ high-concentrations of A site were mainly affected by the North East(NE), North West(NW) direction. According to the map, the industrial complex was located in that direction. Second, 90-100‰ high-concentrations of B site were affected in the SW and 70-90‰ were affected in all directions except in the SE. There was mountain in the SE, the industrial complex in the NW, and the major road surrounded the B site. Also, the high-concentrations were usually occurred at low wind speeds.

For the comprehensive considering of the surrounding terrain, CPF, and measurement data of B site, the results are as follows. The pollutants emitted from the industrial complex and road in the NW blew to the SE direction and trapped. So PM2.5 accumulated without dispersed at B site. As a result of the high-concentration analysis using the CPF model, it was possible to estimate why the PM2.5 concentrations of the B site were higher than those of the A site by estimating the direction of the pollutants inflow at B site.

SOURCE APPORTIONMENT OF FINE PARTICLES SIMULTANEOUSLY SAMPLED AT RURAL AREA VERSUS URBAN AREA USING RECEPTOR MODEL APPLICATION

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Inhalable fine particles cause health problems to population in urban area as well as in rural area that should be considered together to improve the air quality. The aim of this study is to use the data set of the trace organic concentrations for the collected ambient PM together with published fine particle source profiles in order to forecast the influences of major sources to the overall atmospheric fine particle in urban area (Delray Beach) and rural area (Belle Glade) in Palm Beach County, Florida, USA. The Chemical Mass Balance 8.2 (CMB8.2) software program was used to calculate the source apportionment from the particle emission sources by utilizing identified trace organic and metal compound concentrations. The sugarcane burning emissions were detected in both sampling sites in January. The urban site, neighboring the agricultural area, was affected during sugarcane foliage burning, due to the fact that the airborne particles were transported from rural site to the urban site. In May, there was only vegetative burning emission was detected in the agricultural area. The model results represented the fine particles sources as follows: road dust, sugarcane leaf burning, diesel and gasoline-powered vehicle exhaust, leaf surface abrasion particles, and a minor portion of meat cooking particles.

AIR POLLUTION EFFECTS ON HUMAN HEALTH

INVESTIGATION OF THE EFFECT OF AIR CLEANING DEVICES ON AIR QUALITY IN THE INTENSIVE CARE UNIT

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Indoor air pollutants including particulate matter, gases, fumes and biological pollutants might have adverse impact on health. These hazards cause and exacerbate a variety of adverse health effects in humans, ranging from asthma to cancer. Environmental contamination caused by bio-aerosols is thought to play a role in the spread of infections in hospitals and to prevent or decrease this infections interest in new air disinfection systems has increased. Air cleaning devices used in the indoor environment can be helpful to control the range of pollutants such as allergens, particulate matter, bio-aerosols and odor.

In this study the effect of air cleaning devices in changing the concentration of bio-aerosols (bacteria) in the indoor air was determined. Air quality monitoring carried out at the hospital in two different places including Intensive Care Unit and isolated room.

Bacteria collected on %5 sheep blood agar for pathogen determination and plate count agar for total bacteria count. The measurements done in 3 weeks for 3 times per a day (1. In the morning when doctors controlled patients, 2. Patients visit time, 3. Afternoon). On each study day, 24 samples were collected.

In both the working and non-working conditions of the air cleaning devices, bio-aerosols samples were taken with Biomerieux sampler pump and the concentration change of the bacteria in the environment was monitored.

Indoor levels of bio-aerosols were identified with MALDI-TOF MS instruments. The dominant bacteria in the air of examined area are Staphylococcus hominis, Micrococcus luteus, Staphylococcus capitis, Staphylococcus epidermidis, Corynebacterium afermentans and Staphylococcus haemolyticus.

The highest level of bacteria were measured in the mornings. Because the number of people in the morning were more than the other times.

In this study the efficacy of a hydroxyl radical air disinfection system (AD2.0) in reducing the number of airborne bacteria was assessed in the ICU. According to the results, it was determined that air cleaning devices was effective in decreasing the concentration of microorganisms in the ICU.

The number of people, activity and the ICU cleaning protocol daily was recorded. Throughout the study, temperature and relative humidity values were recorded on-line. The study was also provide information on the sources and mitigation measures can be applied for the pollutants that are associated with health problems. Reduction of hospital infections and other diseases due to environmental factors through air cleaning devices in the hospital environment provided extensive impact on the society by reducing expenditures on health.

HEAVY METAL EXPOSURE MONITORING OF RESIDENTS OF SLAVONSKI BROD

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AIM

The objective of this study was to evaluate the exposure of heavy metals of the residents of Slavonski Brod, Croatia, living within close proximity and somewhat further away from an oil refinery.

MATERIALS AND METHODS

In 2018, heavy metals were analyzed in 40 subjects from Slavonski Brod. The study subjects were divided into two gender- and age-matched groups, assigned as "exposed" (N=20; 16 women and 4 men, aged 52.4±13.8 years) and control or "less exposed"(N=20; 16 women and 4 men, aged 54.9±16.1 years), according to the proximity of the oil refinery and meteorological data on wind directions (wind rose plot). The Ni, Cr, V, Mn, Tl and Pb concentrations were analyzed in whole blood or serum, urine and hair using inductively coupled plasma mass spectrometry (ICP-MS). The reference values used for evaluation of metal exposure were from the German Biomonitoring Commission, the Mayo Medical Laboratories and the ARUP Laboratories (USA), London Pathology and Laboratory Medicine (Canada) and Mediziniche Labor Bremen (Germany). The difference between the groups was tested using student t-test, after logarithmic transformation of variables that did not follow normal distribution.

RESULTS

The concentrations of the analyzed elements in blood, serum, urine and hair were generally within the expected reference ranges, except for Pb, which was > 90 µg/L in 4 subjects in the “exposed” group. There were statistically significant differences between the control and “exposed” subjects for Pb in serum (0.047 [0.023-0.113] µg/L vs. 0.056 [0.028-0.267] µg/L; t=-2.07; p=<0.05), Pb in urine (0.68 [0.10-1.92] µg/g krea vs. 1.02 [0.35-8.39] µg/g krea; t=-2.59; p=<0.02), V in hair (20.8±10.2 µg/L vs. 13.8±9.15; t=2.30; p=<0.027), Mn in blood (9.18 [6.12-30.3] µg/L vs.8.31 [4.57-10.9]; t=2.64; p=<0.02). There was no difference in the concentrations of other metals in urine, hair, serum and blood between the groups.

CONCLUSION

Significant differences were found for several metals between the groups of subjects living in Slavonski Brod and at different distance from an oil refinery. However, to evaluate the possible impact of the refinery on metal exposure, a larger number of the city’s residents as well as additional groups of subjects living at greater distances from the refinery should be included.

EMERGENCY INTERVENTIONS AND AIR POLLUTION IN SLAVONSKI BROD CROATIA

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A great risk for global health, recognized by governments, institutions and citizens, is air pollution . Short term and long-term exposure to air pollutants have different health effects. The purpose of this research is to determine whether particulate matter up to 10 μm in size (PM10), particulate matter up to 2.5 μm in size (PM2.5), hydrogene sulfide (H2S) and meteorological parameters have impact on frequency of urgent interventions in ERs (Institute of Emergency Medicine of Brod-Posavina County and Integrated Emergency Hospital Admission). The observed period is between January 1 and August 31, 2018. in the area of Slavonski Brod (Croatia). Data were collected from four sources: Institute of Emergency Medicine of Brod-Posavina County (Croatia), Integrated Emergency Hospital Admission, Meteorological and Hydrological Service data and Croatian Agency for Environment and Nature. All diseases were included in the analysis. Meteorological and air quality data were added to each day.

During the observed period, 40041 interventions in ERs were recorded. Weak but statistically significant positive correlation was established between maximum temperatures (correlation coeffcient 0.202; p 0.002), PM10 (correlation coefficient 0.1293; p 0.048), PM2.5 (correlation coefficient 0.147; p 0.036) and H2S (correlation coeffcient 0.141; p 0.035) with the number of interventions in ERs. The correlation of mean relative humidity was statistically significant but negative (correlation coefficient -0.172; p 0.007). Connection between minimum and mean pressure values was not established. These results point to the importance of reducing air pollution in Slavonski Brod.

QUANTIFYING THE EFFECTS OF AIR POLLUTION ON HUMAN HEALTH AND ECONOMY IN TURKEY USING THE EVA MODELLING SYSTEM

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Turkey is one of the most rapidly developing country with its economy, industry, and population. Therefore, air pollution may exceed the limits, especially in winter. Cardiovascular, respiratory and other air-pollution-related diseases pose a major threat to human health due to the increasing emissions in Turkey. According to the European Environment Agency (EEA), 97.2% of the urban population in Turkey is exposed to unhealthy levels of particulate matter (PM). The indirect impact of air pollution on the economy in terms of health can be billions of dollars. Therefore, it is very important to calculate the contribution of pollution sources to the level of air pollution and the economic loss caused by the resulting adverse health effects. In this study, the effect of air pollution on human health including both morbidity and mortality and their cost to the economy will be calculated for the first time covering all of Turkey. Economic Valuation of Air Pollution (EVA) model, which is coupled with the Danish Eulerian Hemispheric Model (DEHM) will be used. DEHM is an off-line atmospheric chemistry and transport model, developed to investigate the long-range transport of air pollutants in Europe and the northern hemisphere. In this study, DEHM uses the EMEP inventory and the WRF mesoscale weather prediction model outputs. EVA is based on the impact-pathway chain, to assess the health-related economic externalities of air pollution resulting from specific emission sources or sectors. Main emission sources (10 SNAP categories) will be used to estimate the economic loss linked to health problems with using the DEHM/EVA modelling system. The model simulation consists of three nested domains: coarse domain with a resolution of 150 km covers the northern hemisphere, second domain with a resolution of 50 km for Europe and third domain with 16.7 km resolution covers Turkey.

EFFECTS OF LONG TERM EXPOSURE TO PM2.5 AIR POLLUTION ON LIFE EXPECTANCY OF ELDERLY POPULATION IN TAIWAN

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Mortality is the most serious health effect of air pollution. Studies of modeling differences in life expectancy (LE) in time or space against changes in fine particulate matter (PM2.5) concentrations in subnational areas have shown evidence that long-term exposure to PM2.5 reduced LE of the overall population. In this study, we used claims data of national health insurance to create study cohorts of residents aged 60 years and older living in 63 small areas in Taiwan where air quality monitoring stations are situated. The survival status of the elderly people was followed from 2001 to 2013. For each cohort, we created a reference population of subjects whose sex and age matched the study subjects, with the former's survival function generated from standard life tables. We modified an extrapolation algorithm to estimate the lifetime survival function of each cohort. Finally, we regressed the standardized life expectancy deviation of each study cohort, defined by LE difference between the cohort and the matched reference population, against expected lifetime mean exposure to PM2.5 of the cohort with adjustment of socioeconomic variables among the study cohorts to estimate the air pollution effects. The results showed that long-term exposure of the elderly population in Taiwan aged 60+ to a 10 μg/m^3 increase in PM2.5 concentrations was strongly associated with reduction in life expectancy by 0.41 years (SE = 0.08 years, P < .0001). In conclusion, this study delivers strong evidence that elderly people's life expectancy is vulnerable to long-term exposure to PM2.5 air pollution.

A HIGHWAY TUNNEL STUDY FOR CHARACTERIZATION OF GASOLINE AND DIESEL VEHICLE EXHAUSTS AND ROAD DUST

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This study was performed in 2014 in a highway road tunnel atmosphere, in Bolu, Turkey. Samples were collected simultaneously at the entrance and the exit of the Tunnel (3.1 km long), which represents Turkey's vehicle fleet composition due to the importance of its location. Low volume polyurethane foam (PUF) sampler was operated with a constant flow rate of 225 L min-1 and total suspended particulates (TSP) and organic vapors were collected and analyzed for organic-elemental carbon (OC-EC), polycyclic aromatic hydrocarbons (PAH) and elemental composition. The EC-OC analyzer system allows obtaining four OC peaks and six EC peaks according to temperature differences of the used protocol. Particulate PAHs in the road dust samples showed significant correlations with EC1 (r=0.64), EC2 (r=0.81) and EC3 (r=0.63) while aerosol samples were found to be strongly correlated with EC5 (r=0.77) and EC6 (r=0.93). The ratio of organic carbon to elemental carbon (OC/EC) was known to be a good indicator of diesel vehicle emissions and found to be OC/EC < 1. Road dust measurements indicated that Sb could be a good tracer for brake abrasion emissions of road traffic. Since Cu levels were correlated strongly with Fe, Sb and Ba which are the fingerprints of brake abrasion. As a result, four major groups, namely, gasoline emissions (Fe and Mn), diesel emissions (Al, Mg, Na, Cr, Zn, Ba, Pb and K), tyre abrasion (Zn, Cu and Mn), brake abrasion (Sb, Cu and Fe) of airborne TSP metals were categorized based on the results of enrichment factor, correlation matrix analysis and relation with particulate PAHs and EC fractions. Beside, in road dust, elements such as Ba, Sm, V, La, Cr, Nd, Sm, Mg, Na, Al were correlated significantly with EC6. In aerosol samples, major elements (Na, K, Ca) showed a good relation with the fractions of EC1, EC2 and EC3 while Sc, V, Sr, Nb, Cu, Zn, Sb, Mn, Fe with the fractions of EC5 and EC6. This data set in this work is useful for further studies on traffic emission inventory and human health effects of traffic-related PM.

ASSOCIATIONS BETWEEN AIR BORNE HEAVY METALS AND BLOOD PRESSURE AMONG TRAFFIC ENFORCERS OF THE METROPOLITAN MANILA DEVELOPMENT AUTHORITY (MMDA) HEALTH STUDY MODIFICATION BY SEX AND OBESITY

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Introduction: Studies have linked heavy metal exposure to increased blood pressure. We conducted a repeated measures study to examine the associations between air-borne heavy metals and blood pressure, and whether these associations were modified by participant characteristics.

Methods: We assessed blood lead (Pb), mercury (Hg) and cadmium (Cd) and studied measurements of systolic blood pressure (SBP) and diastolic blood pressure (DBP) for 140 traffic enforcers of the Metropolitan Manila Development Authority (MMDA) health study. We fitted linear mixed-effects models with random subject-specific intercepts to estimate the effects of blood Cd, Pb, and Hg exposure on the change in mean SBP and DBP, adjusting for potential confounding factors. In addition, we looked at effect modification by the characteristics of the traffic enforcers.

Results: Blood lead concentration was related to increased SBP and DBP. A unit increase in lead was associated with a 2.6% increase in mean SBP [95% confidence interval (CI): 1.1–4.0]. Similar effect was observed for the effect of blood lead on DBP (2.5% increase in mean DBP, 95% CI: 0.9–4.2). However, no associations between blood mercury and cadmium and both SBP and DBP health outcomes were found. For the effect modification, the associations between lead and both SBP and DBP were stronger among traffic enforcers who were males (SBP: 2.8% increase; 95% CI: 1.3–4.3 and DBP: 2.8% increase; 95% CI: 1.1–4.5) vs. females (SBP: 0.9% decrease; 95% CI: -4.8–6.7 and DBP: 1.5% decrease; 95% CI: -5.0–8.0), or among traffic enforcers who were non-obese (SBP: 2.8% increase; 95% CI: 1.2–4.3 and DBP: 2.9% increase; 95% CI: 1.1–4.7) vs. obese (SBP: 1.5% increase; 95% CI: -1.7–4.6 and DBP: 0.6% increase; 95% CI: -3.1–4.2).

Conclusions: Blood lead is associated with increased SBP and DBP. Blood lead may both increase SBP and DBP among traffic enforcers who are male, or non-obese traffic enforcers.

A REVIEW ON THE ECONOMIC COST OF THE HEALTH IMPACT DUE TO AIR POLLUTION – ESTIMATING THE COSTS OF MORBIDITY

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Objective

Air pollution has enormous negative impact on human health in terms of morbidity. The economic costs to treat ill health due to air pollution can be divided into direct and indirect costs, where the indirect cost is much more than the direct costs. The objectives of this review is to identify studies conducted on the economic costs of health impact due to air pollution in the last ten years.

Materials and Methods

Scoping systematic review was done using three electronic databases, namely PubMed, Scopus, and ScienceDirect for publications from 2009 to 2019. Combination of keywords were used for the article search using terms such as “economic cost”, “air pollution”, “health impact” or “morbidity”, “financial implication of air pollution”. All articles within 10 years of publication were included with the exclusion cost of mortality, duplicated studies, non-full accessible articles and non-English articles. Screening of articles was made in which the final articles were reviewed. The review was carried out using the components used in determining the economic cost estimation of health impact (morbidity) due to air pollution.

Conclusions

Determining the economic costs of health impacts on human due to air pollution proved to be a challenge. So many factors need to be taken into consideration and since there are so many types of air pollutants involved the tasks of determining these cost can only be estimated.

THE RELATIONSHIP BETWEEN BUILT ENVIRONMENT AND CHILDHOOD ASTHMA

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The rise in asthma among children is a matter of worldwide concern. The reasons include not only genetic but also physical environmental factors such as building density, land-use, street layout, building setbacks and traffic volume. According to a report released by World Health Organization (WHO) on 2002, approximately 25.000 annual childhood deaths are due to the asthma. Studies conducted in different parts of the globe show that asthma prevalence increased over the years. Compared to all other age groups, children are more likely to suffer from asthma. The lung and immune system are rapidly developing during the first few years of life, causing young people to be more sensitive to the effects of air pollution. There are a growing number of studies on the relationship between childhood asthma and built environment. However, most of the studies have approached the topic from a public health perspective. This study focuses on the relationship from an urban planning and design perspective. Acknowledging the fact that childhood asthma is linked to complex mechanisms of interactions between various physical environmental and nonphysical environmental factors and other health problems, this study questions the role of different built environmental factors like neighborhood location, urban form and transportation in promoting childhood asthma. Understanding these factors will guide urban planners and designers in the production of places that promote health. This study draws connections between the children's geographies, urban planning and health literature on physical environmental factors that may promote childhood asthma and the theory, research and practice of healthy city development. Literature across urban planning and health disciplines is examined to develop a framework for understanding the factors that may promote childhood asthma. With this knowledge, the intention is to develop a model that integrates multiple environmental domains to assess the impact of different neighborhood environments on childhood asthma.

CYTOTOXICITY ASSESSMENT OF PM2.5 COLLECTED FROM SPECIFIC ANTHROPOGENIC ACTIVITIES IN TAIWAN

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Health impact caused by fine particulate matter (PM2.5) is influenced by its sources and components. In this research in Eastern Asian country, Taiwan, PM2.5 samples from long range transport event (LRT), traffic emission activity, and cooking smoke of Asian night market, were collected and analyzed. Cell viability, reactive oxygen species (ROS) test, and umu test were performed to investigate the potential toxicity of metal, ion, and organic compounds extracted from PM2.5 samples. The PM2.5 mass concentration were found to be 39.0 μg/m3 during LRT event, 42.9 μg/m3 at traffic emission area, and 28.3 μg/m3 at the night market. Highest concentrations of polychlorinated dibenzo-p-dioxins and furans (PCDD/Fs) were found to be 46.9 fg I-TEQ/m3 at traffic station when highest polycyclic aromatic hydrocarbon (PAH) concentrations were found at cooking station at 3.57 BaPeq ng/m3. About one quarter of PM2.5 mass at LRT and night market station was constituted by water-soluble ion (26.02% - 28.93%) mass. Road dust (represented by high concentration of Al and Ca) was the main contributor for metal element at traffic station whereas presence of natural salt (Na and Cl elements) was a marker of LRT and cooking activities. Cell viability reduced up to 9% comparing to negative control samples after exposure to organic extracts at a dose equivalent to 102.5 ng of PM2.5 from LRT and cooking samples. Highest elevation of Reactive Oxygen Species (ROS) production (150%) was also observed at ROS test (at exposure dose of 10 μg PM2.5) using organic compound of cooking samples. Moreover, organic extracts from cooking activity induced highest genotoxicity in umu test (at exposure dose of 5-20 μg PM2.5). Although, the induction ratio of genotoxicity test (1.10-1.50) did not exceed the toxicity threshold (induction ratio 2.0), the elevation of such ratio of cooking-originated organic compounds can suggest a potential toxicity induction at higher dose. Therefore, apart from LRT and traffic, cooking activity in night market could be another highly influential sources of pollution on human health in Asian country in Taiwan.

DARK REPORT 2019 AIR POLLUTION AND HEALTH IMPACTS

Right To Clean Air Platform [1]

Right To Clean Air Platform, Right To Clean Air Platform, Istanbul-Turkey[1]

The recent report of Right to Clean Air Platform examines the air pollution in Turkey among 2016-2018 with a focus on the health impacts of air pollution in 2017. The study is pioneering in terms of its methodology of using the AirQ+ Model Software that is developed by World Health Organization (WHO) Europe in order to calculate the preventable death numbers in 2017 due to the air pollution in Turkey. The data about the air quality measurements for PM10, PM2.5 and death numbers are extracted from the official data sources. PM 2.5 data for the cities where measurements are not available are converted for PM10 levels by using the conversion rate determined by WHO. AirQ+ program adopts the relative risk coefficient for the non-external death risk due to the long range air pollution for the people over 30 years old as 1,062 (%95 confidence interval: 1,041-1,084) and calculated the estimated death number when the PM2.5 related annual air pollution levels exceed 10 μg/m3. The results suggest that on average 51.574 out of 399.025 deaths (nearly 13%) could have been prevented if the air pollution levels in Turkey could have been reduced to the annual guideline levels of PM2.5 proposed by WHO. The study includes a comparison of the preventable death numbers for all of the provinces in Turkey. Istanbul ranks at the top of the list with a number of 5851 preventable death and it is followed by big cities such as Bursa (3098) and Ankara (2139). It is suggested that it is needed to adopt a binding legislation about the measurement of PM2.5 levels and national limit values at the Turkish legislation in line with the CAFE Directive and WHO guidelines.

ASSESSMENT OF PARTICULATE MATTER CONCENTRATION ELEMENTAL COMPOSITION AND SOURCE APPORTIONMENT IN TWIN CITIES OF RAWALPINDI & ISLAMABAD PAKISTAN

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Exposure to heavy metals (HMs) in particulate matters (PMs) poses serious risks to public health, particularly in preview of carcinogenic components. The purpose of this study was to analyze the PM2.5 and PM10 concentrations, elemental constituents, and sources in the ambient air of twin metropolitans of Islamabad & Rawalpindi, Pakistan. The dwelling is occupied by 2.0198 Millions in Rawalpindi city and 1.152 Million residents in Islamabad respectively. The data monitoring was carried out for all four seasons from February 2017 to January 2018 on alternative days. Principal Component analysis was deployed to investigate the sources of particulate matter. The samples of PM2.5 & PM10 were taken using a low volume sampler in 4 monitoring stations located in study area considering the Industrial Zone, Back ground study area, Residential and commercial Zones. The HMs content of the samples were analyzed using Atomic Absorption Spectroscopy. Al, Ca, Fe, concentrations were highest in summer, Cl, Mg, and Na concentrations were highest in the monsoon season, and the other trace metal concentrations in both PM2.5 and PM2.5–10 were highest in winter. The Industrial zone had higher concentration of Fe & Cr than commercial and residential areas respectively. The results showed that the concentrations of As, Cd and Ni were in a range of 11–29, 2–19, and 4-39 ng/m3 at all the study zones which exceeded the US-EPA standards. Seasonal variation was observed in Heavy metals' concentration in PM2.5 & PM10. PCA results revealed that the different potential sources of HMs in the atmosphere illustrating most important sources of HMs originated from fossil fuel combustion considering the energy demand, abrasion of vehicle tires, industrial activities. The major contributing industries were re-rolling mills. Control of air pollution of industrial plants and vehicles is suggested for reduced risk exposure in twin cities.

GENOTOXICITY OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN SIZE SEGREGATED PM SAMPLES COLLECTED FROM A THERMAL POWER PLANT AREA

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Atmospheric particulate matter (PM) is of great concern because of its adverse health effects including cardiovascular and respiratory diseases. Exposure to atmospheric PM is also associated with increased risk of cancer. Size and chemical composition of PM are important parameters in particulate toxicology. Composition of the PM varies greatly and depends on many factors. It has been shown in previous studies that fine particles might be more toxic because of having large surface area, absorbing high concentrations of toxic air pollutants and easily depositing into lungs compared to coarse particles.

Polycyclic aromatic hydrocarbons (PAHs) are a group of persistent organic pollutants with two or more benzene rings. 16 PAHs have been listed as priority pollutants by the United States Environmental Protection Agency (USEPA) due to their persistence, bioaccumulation and toxicities. PAHs can exist both in particle and gas phases.

Kütahya is one of the highly polluted cities in Turkey based on PM concentrations measured at fixed monitoring stations operated by Ministry of Urbanization and Environment (MUE). Three thermal power plants with a total of 1175MW thermal capacity are being operated in the region. A project was initiated in Kütahya to investigate health effects of air pollution in the region including genotoxicity of the particulate matter.

Daily size segregated PM samples were collected by 5 stage high volume slotted cascade impactor from two different (urban and rural) locations in Kütahya during summer and winter seasons. Size distribution and chemical composition of the PM samples including PAHs were determined. In vitro genotoxicity of the samples were evaluated together with concentrations of PAHs measured in different size fractions.

Size-segregated PAH concentrations are summarized in Table 1. Most of the PAHs were accumulated on submicron PM, and the concentrations were shifted in smaller sizes for winter samples for both stations. Percent contribution of PAHs in fine mode is higher than coarse mode due to the combustion particles. Maximum DNA damage was observed in urban station winter PM2.1-1.3 μm size particles. Tail intensity, which is the sign of genotoxic damage is well correlated with the total PAH concentration (r^2=0.88) and also PM mass concentrations.

ASSESSMENT OF PM2.5 CONCENTRATIONS IN INDOOR AND OUTDOOR ENVIRONMENTS OF DIFFERENT WORK PLACES

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This study provides information about indoor-outdoor PM2.5 concentrations, indoor/outdoor ratios (I/O) of PM2.5 for seven different workplaces; photocopier, bakery, restaurant, hairdresser, dry cleaner, market and hotel in Eskişehir, Turkey. Simultaneous measurements of both indoor and outdoor concentrations were performed. Measurement studies were conducted between 13 January-23 February 2019 and both weekday and weekend measurements were carried out for each workplace. One-hour measurements were performed by using DustTrak II 8530 aerosol monitors during the busy and less active hours of each workplace. PM2.5 concentrations were measured in different indoor microenvironments of the workplaces. Indoor measurement results of the busy hours were higher than those obtained during less active hours during both weekdays and weekend periods at all workplaces. According to the weekday results, the maximum PM2.5 concentration (average 1123.92 µg/m3) was measured at the hairdresser while the minimum concentration was measured at the hotel (average 27.20 µg/m3) during busy hours. In addition, indoor PM2.5 concentrations were higher than outdoor concentrations in restaurant, bakery and hairdresser during the weekday busy hours. The minimum concentration was obtained at the hotel (average 3.58 µg/m3) and the maximum concentration was measured at the hairdresser (average 1037.50 µg/m3) during the less active hours of weekday measurements. According to the weekend results, the maximum concentration (average 3076.00 µg/m3) was measured at the hairdresser while the minimum concentration was measured at the hotel (average 77.13 µg/m3) during busy hours similar to weekday results. Indoor PM2.5 concentrations were higher than outdoor concentrations in restaurant, bakery, dry cleaner and hairdresser during the busy hours at the weekend. During less active hours of the weekend, the minimum concentration was obtained in the market (average 59.80 µg/m3) and the maximum concentration was measured at the hairdresser (average 2575.17 µg/m3). Measurement results obtained from restaurant, dry cleaner and hairdresser on both weekdays and weekends during less active hours showed that indoor PM2.5 concentrations were higher than outdoor concentrations. When I/O ratios were evaluated, the ratios obtained from hairdresser (I/O=7.26-72.34) and restaurant (I/O=1.60-17.32) were > 1 at all sampling periods. In the dry cleaner, except weekday busy hour (I/O=0.90), all the I/O ratios were > 1 (I/O=1.09-3.24) while the ratios obtained during weekday and weekend busy hours at the bakery were > 1 (weekday I/O=1.84, weekend I/O=2.19). In general, PM2.5 concentrations varied due to factors such as presence of strong indoor sources, activity density, ventilation effect, building's location, traffic density around the building etc.

PERSONAL EXPOSURE MONITORING OF SHOPKEEPERS TO PM 2.5 AND HEAVY METALS IN MICROENVIRONMENT

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Occupational health is a global concern now a days. Exposure to Particulate Matter and Air pollutant like heavy metals varies according to occupation and geographical location. Almost 60-70% jobs are performed indoor and hence, air quality in indoors also vary according to the type of micro environment. In the reference of estimation, a designed pathway of whole day activity and time spent in micro environment should be monitored. Hence, we monitored and analysed the exposure of shopkeepers to respirable particulate matter and heavy metals.

Total number of shopkeeper monitored were 60 in 3 main commercial areas of Islamabad. PM2.5 monitoring was conducted with aluminium cyclone and for particle no. count, Dylos DC Pro 1100 was used. To track the movement of shopkeeper Dylos was combined with GPS receiver. Gravimetric analysis conducted for PM mass estimation and analysis of heavy metals done with hot acid digestion lead to analysis of heavy metals (Pb, Zn, Cr) with Atomic absorption spectroscopy.

Results revealed the particle mass on an average was 42.2 µg/m3. Level of Pb, Zn and Cr was significantly higher than the limits set by WHO. This study also revealed that the level of PM2.5 according to the WHO standards is above permissible limit.

GENE ENVIRONMENTAL INTERACTION THE EVALUATION OF CHROMOSOMAL DAMAGE AMONG URBAN TRAFFIC POLICEMEN EXPOSED TO BENZENE IN RELATION TO NQO1 GSTT1 AND GSTM1 POLYMORPHISM

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An urban air toxic of benzene at ambient level has ability to cause chronic health effects, particularly among the urban workers. Other than the nature of carcinogenicity of benzene itself, the factors of genetic susceptibility to benzene toxicity in human necessary to be considered when assessing the health risk to benzene exposure. Aim of this study to evaluate the modulation effect of individual exposure level to benzene and genetic polymorphisms of NQO1, GSTT1, and GSTM1 on benzene-induce chromosomal damage. The NQO1, GSTT1, and GSTM1 genes are chosen as their roles in genetic susceptibility for detoxification of benzene toxicity. This study found the mean personal exposure concentration of benzene among 107 urban traffic policemen was 24.78 µg/m3 compared to only 9.00 µg/m3 in a total of 100 office workers. Chromosomal damage measured via micronuclei (MN) assay in traffic policemen was 1.8-fold higher than in the comparative group ($p<0.001$), accentuate the genotoxic effect potentially associated with benzene exposure. No significant association found between all studied genotypes with markers of effect, chromosomal damage. Carcinogenicity of benzene might have a major role in inducing the chromosomal damage rather than genetic polymorphisms factors among the studied groups. Finally, a more comprehensive study necessary to assure the combination role of benzene and other involvement of gene polymorphisms such as DNA-repair genes which may responsible in benzene genotoxicity.

METAL EMISSIONS CHARACTERIZATION OF PISTON ENGINE AIRCRAFT USED IN GENERAL AVIATION

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There are numerous studies regarding air pollution caused by aviation activity. However, since these studies have generally focused on aircraft using jet engines, many research areas of environmental impacts of general aviation aircraft have remained uncovered. However, there is also a need for understanding of the general aviation's emissions. For instance, unlike the fuel of jet aircraft, Jet A1, AVGAS fuel contains a significant amount of lead (Pb). Therefore, to improve the literature on general aviation's emissions, in this study, the metal elements from the emissions of a typical piston-engine aircraft fuelled by AVGAS 100LL was analyzed.

The emissions tests were carried out in 2018, during the operation of the engine under two fuel mixture ratios and six engine speed points. A total of thirty PM filters were sampled. All of the measurements were performed from the exhaust duct of the engine considering on-wing principle. A full automatic isokinetic powder sampling pump (Zambelli Isoplus) was used for PM sampling. The impinger system was also included in the sampling system according to EPA methods 5 and 17. The samples were collected by 47mm Whatman PTFE (politetrafloroetilen) filter papers. The sampling duration at each engine run was set to 5-minutes with a rate of the exhaust gases flow to be 20 L min-1. Following the emission tests, all of the filter papers were analysed by using triple quadrupole ICP-MS (ICP-QQQ-MS) after a microwave acid digestion process.

The results of the analyses indicated strong associations between the key engine parameters and the concentration of the metal elements. Pb was identified as a major element with concentrations ranged between 772µg/m3 and 11139 µg/m3, due to engine speed and mixture type. This is also evident from the fact that there is a significant amount of Pb as tetraethyl lead in AVGAS fuel. The relationship between other elements (e.g., Na, Al, S, Sn, In, Mg) and engine parameters were also investigated and discussed.

INDOOR AIR THM LEVELS IN AN OLYMPIC AND A SEMI OLYMPIC SWIMMING POOL

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Disinfection is essential for prevention the growth of waterborne pathogens in swimming pools (SPs). Chlorination is the most commonly used disinfection method in SPs due to the superior properties e.g., effective pathogen inhibition, low operating cost, and ensured residual disinfectant. Increased temperature in SPs results in higher chlorine decay rates. Thus, higher doses are needed for compensation. Potential toxic disinfection by-products (DBPs) could be formed with the reaction between the disinfectant and precursors in SP source waters. Trihalomethanes are one of the most abundant DBP groups in SPs. CHCl3 (chloroform), CHCl2Br (bromodichloromethane, BDCM), CHClBr2 (dibromochloromethane, DBCM), and CHBr3 (bromoform) are the regulated in drinking water. However, no reguations have been made for swimming pools in Turkey. Increased water temperature increases the volatilization of THMs from the pool, and accumulation in gas phase resulting in higher indoor air levels. Inhalation exposure of THMs in SPs is crucial for swimmers and staff of indoor SPs. Indoor air concentrations of two indoor swimming pools (an Olympic and a Semi-Olympic) in İzmir were investigated in this study. SP indoor air was sampled according to the ASTM D3686. Activated charcoal sorbent tubes (SKC, Anasorb) were used with the flow rate of 30 LPH. Calcium chloride was used as a dehumidifying agent. Activated charcoal in sampling tubes were ultrasonically extracted with 1 mL carbon disulfide, and centrifuged for separation of the solvent and charcoal particles. THMs were analyzed in electron impact mode using gas chromatography – mass spectroscopy (Agilent 6890N GC – 5973 MSD). The average gas phase concentrations of chloroform, BDCM, DBCM, and bromoform were determined to be 3.99, 0.78, 0.37, and 0.24 µg/m3 in the semi-olympic SP. Indoor air concentrations in the Olympic SP were higher with average concentrations of 104, 7.86, 1.57, and 0.56 µg/m3, respectively. Higher THM concentrations might be related to the differences in source water characteristics and the type and operation of HVAC system, and higher swimmer counts. Measured concentrations in this study indicate magnitudes of inhalation exposure might vary, and could be of importance for health of swimmers and staff.

PRENATAL EXPOSURE TO AIR POLLUTION AS A POTENTIAL RISK FACTOR FOR AUTISM AND ADHD

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Genetic and environmental factors both contribute to the development of Autism Spectrum Disorder (ASD) and Attention-Deficit/Hyperactivity Disorder (ADHD). One suggested environmental risk factor is air pollution, but knowledge of its effects in low-exposure areas are limited. Here, we investigate risks for ASD and ADHD associated with prenatal exposure to air pollution, in an area with air pollution levels generally well below World Health Organization (WHO) air quality guidelines.

We used an epidemiological database (MAPSS) consisting of virtually all (99%) children born between 1999 and 2009 (48,571 births) in the study area, in southern Sweden. MAPSS consists of modelled nitrogen oxide (NOx) levels, derived from a Gaussian dispersion model, during pregnancy at maternal residency; perinatal factors collected from a regional birth registry; and socio-economic factors extracted from Statistics Sweden. All ASD and ADHD diagnoses in our data were undertaken at the Malmö and Lund Departments of Child and Adolescent Psychiatry, using standardized diagnostic instruments. We used logistic regression analyses to obtain estimates of the risk of developing ASD and ADHD associated with different air pollution levels, with adjustments for potential perinatal and socio-economic confounders.

In this longitudinal cohort study, we found positive associations between air pollution exposure during the prenatal period and an increased risk of developing ASD. For example, an adjusted Odds Ratio (OR) of 1.50 and its 95% Confidence Interval (CI) (95% CI: 1.06-2.14) were found when comparing the fourth with the first quartile of NOx. We did not find similar associations on the risk of developing ADHD.

This study contributes to the growing evidence of a link between prenatal exposure to air pollution and autism spectrum disorders, suggesting that prenatal exposure even below current WHO air quality guidelines may increase the risk of autism spectrum disorders.

AN ASSESSMENT OF INDOOR AIR QUALITY OF AN OFFICE BUILDING LOCATED IN GURUGRAM CITY INDIA

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Indoor environmental quality is an important aspect of an office building. People are spending most of their time in indoor only which leads them to suffering from various health issues. The health is affected due to the emission of pollutants from various sources such as furniture, building substances, office equipment, cleaning, discrete maintenance products, heating, poor indoor air exchange rates etc. A study has been carried out for real-time monitoring and interpretation of indoor air quality parameters i.e. Particulate Matter (PM2.5), CO2, Volatile Organic Compound (VOCs), temperature and humidity in Ramboll office located in Gurugram city, India using AWAIR, Foobot and Purple Air sensor for monsoon, post-monsoon and winter season. The data obtained from sensors were analyzed by adopting statistical analysis along with time series analysis which shows the variation of air pollutants with time for each season and it was noted the air pollutants are exceeding the standard limit such as one of the sensor recorded highest indoor concentration of CO2 which was observed around 1900 ppm and indoor PM2.5 concentration was 190 µg/m3. The indoor pollutants were found increased due to an increase in air quality parameters levels from different sources which also includes breathe from human being and heat from computer used in office. The concentration of air pollutants was noted high in winter season as compared to monsoon season. The variation in air pollutants also caused due to indoor meteorological parameter (temperature and humidity). Whereas, a strong correlation existed between indoor air quality parameters is also presented in the work.

AIR POLLUTION AND HEALTH RISK ASSESSMENTS

NICKEL ARSENIC CADMIUM AND LEAD IN PM1 FRACTION IN ZAGREB CROATIA

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Particulate matter (PM) is a mixture of organic and inorganic substances that emerge from a wide range of natural and anthropogenic sources. Fine aerosol particles have been found to play a key role in global climate change, pollution problems and health hazards. PM1 particles (particulate matter with an aerodynamic diameter of less than 1 μm) are characterized by a high surface-area-to-volume ratio, having great potential risks for negative effects on human health. However, as air quality standards in most countries refer to PM10 (particulate matter with an aerodynamic diameter of less than 10 μm) and PM2.5 (particulate matter with an aerodynamic diameter of less than 2.5 μm) particle fractions, PM1 particle fraction measurements are not part of routine monitoring. The metals released by anthropogenic activities, bounded to fine particulate matter, are bioaccumulative and can cause severe disturbance of ecosystems because of their influence on biochemical mechanisms, not to mention the potential risks for different health outcomes. In this study, 24-hour samples of PM1 were collected at an urban background location in Zagreb, the capital of Croatia, during 2011 and 2016, using a low-volume reference sampler. The collected samples of particulate matter were prepared in nitric acid using a high pressure microwave digestion system. Nickel, arsenic, cadmium and lead were determined by inductively coupled plasma mass spectrometry (ICP MS). The objective of the study was to determine mass concentrations of nickel, arsenic, cadmium and lead in PM1 fraction in 2011 and 2016 and to compare the obtained data sets. The mean annual values in 2011 were 1.58 ng m-3, 0.45 ng m-3, 0.21 ng m-3 and 5.55 ng m-3 for Ni, As, Cd and Pb, respectively, and 0.14 ng m-3, 0.23 ng m-3, 0.13 ng m-3, and 4.33 ng m-3 in 2016 for Ni, As, Cd and Pb, respectively. Statistically significant differences between the years were found for all metals with higher concentrations determined in 2011 compared to 2016. A statistically significant difference was found between seasons as well, except in winter and autumn for As and Pb (in 2011) and As, Ni and Cd (in 2016), and in spring and summer for Ni (in 2011) and Ni, Cd and Pb (in 2016). The highest values during the colder part of the year were found for all of the determined metals which was expected because of the adverse weather conditions that make it difficult to circulate air.

A PREVALENCE OF THE SICK BUILDING SYNDROME SYMPTOMS AMONG SHOPPING MALL EMPLOYEES FROM THE CITY OF ZAGREB CROATIA

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Objective: Sick building syndrome (SBS) is an indoor air quality-related disease, which affects skin, nervous and respiratory system and includes a headache, dizziness, nausea, sore throat, cough, sneezing, itchy eyes and various levels of skin inflammation. The aim of this study was to investigate the prevalence of SBS symptoms and associated risk factors among shopping mall employees in Zagreb, Croatia.

Subjects and Methods: The cross-sectional study was conducted among employees working in four shopping malls in Zagreb by using a questionnaire related to the SBS and indoor air quality. In this research, 363 employees (55/15.2% males and 308/84.8% females) participated. The questionnaire consisted of information on demographic characteristics (sex, age and education level), job characteristics (professional qualification and length of the work experience) and habits (smoking status). Regarding to their health status, employees could report from 1 to 22 suggested SBS symptoms. Observed differences between groups were analysed using the Mann-Whitney U test with the statistical significance $P<0.05$.
Results: The prevalence of participants who reported 1 or more SBS symptoms was 96.1% (97.7% in women and 83.3% in men). The most common symptoms reported in the questionnaire were: headache (58.5%), fatigue (56.7%), upper respiratory system problems (cough, sneezing) (56.5%), skin problems (dry skin, itching and a rash) (43.5%), lack of concentration (32.5%) and itchy eyes (32.2%). The average number of observed symptoms significantly differed among females (Mdn=6) and males (Mdn=3), $P<0.001$, while the occurrence of symptoms did not differ between males and females through all the seasons of the year. Eighty-one point nine percent of them were 21-40 years old and 78.2% of them reported a length of the work experience shorter than five years. The group of employees having up to 10 years of the work experience had the highest risk of SBS development. They reported 6.9 ± 5.0 SBS symptoms. There was no significant difference in the appearance of these symptoms between smokers and non-smokers.

Conclusion: Symptoms of SBS often occur among shopping mall employees, which compromise their health, reduce productivity and increase an absence from the workplace. By improving working conditions and working environment, such as lowering noise intensity levels, ensuring thermal comfort and adequate light and ventilation of the workplace, it is possible to reduce the frequency of SBS symptoms and improve the health of shopping mall employees ultimately.

CHEMICAL COMPOSITION OF FINE AND COARSE PARTICULATE MATTER IN JAKARTA MEGACITY INDONESIA

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Air pollution in Jakarta as one of the megacities in Asia has drawn the attention by the government and the public. This paper will discuss the ambient air quality assessment that has been conducted at a central Jakarta site for eight years since 2010. The samples were collected using a Gent sampler in two size fractions of < 2.5 μm (fine, PM2.5) and 2.5 to 10 μm (coarse, PM2.5-10). The samples were analyzed for mass, black carbon, and elemental composition. X-ray-based nuclear techniques have been used in the quantification of chemical species such as Na, Mg, Al, Si, K, Ca, Ti, Cr, Mn, Fe, Zn and, Pb. The concentration of PM2.5 for 8 years of monitoring from 2010 to 2017, shows that all annual averages have exceeded Indonesia's ambient air quality standard (15 μg/m3) and there is a tendency for an increase in PM2.5 concentration. While the annual average of PM10 shows that they were still below the standard (150 μg/m3). The annual average of black carbon is in the range of 21-24% of fine particulate mass concentration. Elemental concentrations in fine particulates were dominated by S, Na, K and Zn which are likely from motor vehicle sources, sea salt, biomass burning and Zn source, respectively. Coarse particulates are dominated by Si, Al, Ca, Fe, and S which are key elements for soil sources, road dust and construction. Assessment of several trace elements especially heavy metals in fine and coarse fractions were also presented.

MODIFICATION OF PARTICLE NUMBER SIZE DISTRIBUTION IN SAHARAN DUST EVENTS AS THEY TRAVEL OVER THE ANATOLIAN PLATEAU

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Saharan Dust events are well known natural phenomena in the Mediterranean region. Interference of these events with aviation, solar energy production, energy budget of the earth attracted attention to this natural event. In this study we operated two stations one on the Mediterranean coast of Turkey (at Marmaris Meteorological Radar, which is approximately 10 km from the city of Marmaris, 1 km altitude, on Toros mountains) and the other one at the approximate center of Anatolian Plateau (Ankara, METU campus, altitude 953 m). In both stations particle number size distributions were measured with one minute intervals, using laser spectrometeers. In addition to size distributions, PM10 and PM2.5 aerosol samples were collected and analyzed for trace elements using EDXRF. The objective of the study was to understand how number size distributions of particles are modified as dust plume travels over the Anatolian Plateau. For this, dust events that were intercepted in both Marmaris and Ankara stations were selected and size distribution measured in two stations were compared. It was demonstrated that dust particles are smaller at Marmaris station but its coarse fraction is higher at Ankara. This was attributed to settling of coarse particles during transport of dust plume over the Mediterranean Sea. However, as plume travels from Marmaris to Ankara, it picks up local soil particles, which are coarse. When dust events are intercepted, PM10 concentrations are dramatically increased, PM2.5 concentration increase, but not as much as PM10. PM1 concentration, on the other hand, is not affected from dust. Because of this, PM10/PM1 ratio was used as a dust indicator. The ratio is small in anthropogenic episodes, but very high during dust events.

SPATIAL DISTRIBUTION OF HEALTH RISKS ASSOCIATED WITH PM2.5 IN TURKEY AND IRAN USING SATELLITE AND GROUND OBSERVATIONS

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PM2.5 originated from anthropogenic or natural sources is still a problem for both developing and developed countries worldwide and highly associated with health impacts. The relationship between PM2.5 and inverse health outcomes is vigorously investigated. For the year of 2016, 4.1 million premature deaths is associated with the ambient PM which is reported as the sixth global burden of disease (GBD) risk factor. In this study, exposure, health effects, and mortality associated with PM2.5 have been calculated using satellite retrievals and ground observations for both Turkey and Iran. Anthropogenic sources such as traffic and domestic heating are responsible for higher concentrations in most populated provinces such as Ankara, Istanbul (Turkey), and Tehran, Isfahan, and Mashhad (Iran); while the dust events are responsible in less populated provinces such as Iğdır (Turkey), and Zabol, Khuzestan (Iran). Satellite retrievals and ground observations, population data, concentration-response factors and baseline mortality rates are used as inputs for dose-response and concentration-response estimation functions in this study. High resolution PM2.5 estimations (dust and sea-salt removed) developed from aerosol optical depth (AOD) data from MODIS, MISR, and SeaWIFS instruments was used in this study. A high resolution population dataset from European Commission has been used along with PM2.5 satellite product. Health risk estimations from three different causes have been calculated by applying the cause-specific mortality rates from WHO for Iran and for Turkey for the year of 2016. These are ischemic heart disease, lung cancer and all causes which are attributable with PM2.5. According to satellite-derived PM2.5 calculations, 30240 total deaths in Turkey and 2817 total deaths in Iran have been estimated by ischemic heart diseases. Meanwhile with ground observations, 25525 and 3866 deaths were estimated in Turkey and Iran, respectively. In Turkey, 5591 deaths in total and 669 deaths in Iran estimated using satellite retrievals, caused by lung cancer, while 5883 deaths in Turkey and 776 deaths in Iran were estimated using ground measurements. Finally, 36967 deaths for Turkey, and 34491 deaths for Iran were estimated caused by all causes, in 2016. Ground observation based calculation was higher than satellite-derived based calculations. When compared with global studies higher values are estimated. Province based estimations were obtained with better spatially resolved PM2.5 concentrations. The risk distribution maps prepared indicated central Turkey, and from west Azerbaijan to Tehran and Khuzestan province are being at higher risk with high-risk estimates.

CHARACTERISTICS OF HARMFUL AND POTENTIALLY HARMFUL COMPOUNDS GENERATED FROM HEAT NOT BURN TOBACCO PRODUCTS

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Abstract

Tobacco companies reported that 'Heat-not-burn (HnB)' tobacco products (such as IQOS (made by Philip Morris International), glo (British American Tobacco), lil (KT&G Corporation) and Ploom Tech (Japan Tobacco)) are less harmful than traditional tobaccos. However, it is not enough reported that the effects of HnBs on the human body were not clearly known up to now. Because many papers on HnB products have been made by research institute under the tobacco companies and there are many limitations to prove the effect. In addition, there are many dual users who use HnB product and conventional tobacco together, and non-smokers are likely to use HnB product. Therefore, we systematically reviewed diverse previous studies with related to HnB products in this study. In particular, this study was focused on characteristics of harmful and potentially harmful compounds (HPHCs) generated from heat-not-burn tobacco products. We explored various experimental results on HPHCs generated from mainstream and secondhand smoking (vaporing) of HnBs. As a result, most of the HPHCs produced in HnB were found to be smaller than those of traditional tobacco, but some of them produced more. In particular, for vegetable glycerin (VG), the levels generated from HnBs are higher than those from traditional tobacco. Therefore, further researches on carbonyl compounds and other harmful substances (heavy metals, particulate matter, and volatile organic compounds) in which propylene glycol (PG) components are converted at high temperatures should be conducted. It is also important to learn more about the effects of diverse variables involved in smoking (or vaporing) (e.g., puff time and puff interval) of HnBs.

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SEASONAL VARIATIONS OF ORGANOCHLORINE PESTICIDES (OCPS) IN AIR SAMPLES DURING DAY AND NIGHT PERIODS IN BURSA TURKEY

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The aim of this study was to determine the seasonal variation of OCP concentrations in a semi-rural area in Bursa. The Bursa Uludag University, the sampling region was a campus located nearly 25 km away from the city center and in the semi-rural area of Nilüfer district. Atmospheric concentrations of OCPs in the particulate and gas phase were measured separately during night and day time periods. OCP concentrations were reported for one year period. Air samples were collected using a high volume air sampler (HVAS). After pre-analysis steps (extraction, solvent exchange, fractionation, and volume reduction). OCP measurements for 9 OCP compounds were performed with Gas Chromatography- Electron Capture Detector (GC-μECD).

The average total (gas + particulate) Σ9 OCP concentration was calculated as 598.60 ± 194.20 pg/m3, and 65% of the total concentration was found to be in the gas phase. It was observed that OCPs with low molecular weights tended to stay in the gas phase. When ∑9 OCP concentrations were examined, it was observed that the values were relatively high in the summer months of June, July, and August. In these months, the total concentrations were in the ranged between 63.71-799.06 pg/m3 in the particulate phase and 173.79-798.99 pg/m3 in the gas phase. The high concentrations in summer may be attributed to the intensification of agricultural activities. Furthermore, it was thought that as the temperature increased, atmospheric concentrations of OCPs increased via evaporation from surfaces such as soil, water, and plants. The maximum annual average gas phase OCP concentration was measured for Beta-HCH species as 176.01 pg/m3. In the particulate phase, the maximum value was 66.96 pg/m3 (Endosulfan-beta).

Day and night samples were collected to determine the effect of temperature and possible sources on OCP concentrations. OCP concentrations measured during the day and night time periods were found to be close to each other. There was no significant difference in particulate phase OCP concentrations during day and night times. For some species (Alpha-Beta HVCH, Endrin, Endrin Aldehyde, etc.), night concentrations were high, while some species (Gamma HCH, Methoxychlor) reached higher levels during day time periods. The similar situation was observed for gas phase samples as well. The lack of a significant difference in OCP concentrations indicated that the impact of local resources was limited.

DETERMINATION OF FLUXES AND MASS TRANSFER COEFFICIENTS OF POLYCHLORINATED BIPHENYLS (PCBS)

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This study was about the evaluation of a new generation water surface sampler (NGWSS) for the sampling of the atmospheric PCB fluxes. The main difference from previous WSSs was its cover which prevents atmospheric deposition of particles and wind effects. There were 8 holes in 7 mm diameter and tubes with walking stick shaped on the edge of the cover of the NGWSS. There were also holes with plain tubes at the same number and in the same diameter at the bottom of the sampler. Distilled water, used during the sampling, entered into the sampler from the hole in the middle of the surface and stays in this surface about 2-4 minutes and then it was collected from 4 collecting spillways. The water went through the filter for the particle phase and the column with XAD-2 for the gas (dissolved) phase contaminants. The collected filter and resin samples were extracted for determining the fluxes of particle and gas-exchange, respectively. To calculate extraction efficiency, the surrogate standard was added into each sample at the beginning of extraction. A column was used for fractionation and clean-up. The samples were analyzed using an Agilent Tech. 7890A model gas chromatography. LOD (limit of detection) was calculated for each PCB congener.

Forty-four samples were collected with the NGWSS. A high volume air sampler (HVAS) was also operated simultaneously. The averages of the dissolved phase, particle phase and dissolved + particle phase PCB fluxes obtained from the NGWSS were 11.18±13.44 (n=15), 1.37±0.54 (n=15) and 16.97±14.60 (n=20) ng/m2day, respectively. It was observed that 4-CBs and lower chlorinated PCBs were dominant in the samples. Homolog groups obtained from both the NGWSS and HVAS were correlated and high correlation coefficients were determined. To calculate the mass transfer coefficients (MTCs), PCB fluxes measured from the resin columns were divided by gas phase PCB concentrations, which were collected using an HVAS. Average MTC was determined to be 0,13±0,14 cm/s and this average value was in line previously reported MTCs for semivolatile organic compounds.

DIURNAL AND SEASONAL VARIATIONS OF VOCS AND THEIR CONTRIBUTIONS TO CANCER RISKS AND SECONDARY ORGANIC AEROSOL IN THE ATMOSPHERE OF SEOUL SOUTH KOREA

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Volatile organic compounds (VOCs) have various harmful effects on human health as well as the environment. Especially, benzene is classified as a carcinogenic compound, and toluene and xylenes are one of the compounds that have a larger potential to the formation of ozone (O3) and secondary organic aerosol (SOA) in the atmosphere. However, studies on the monitoring of atmospheric VOCs in Seoul have rarely been conducted. In this study, the sequential tube sampler (STS-25, Perkin Elmer) with adsorbent tubes (Carbotrap 300, Supleco) and a pump (MP-∑30KNⅡ, Sibata) was used to automatically collect 24 samples for a day every month from July 2018–June 2019 at an urban site in Seoul. The collected samples were analyzed using a thermal desorption-gas chromatograph/mass spectrometer (TD-GC/MS, Agilent), and the target compounds are 65 VOCs of US EPA TO-15. Among the target compounds, toluene, ethylbenzene, and m,p-xylenes were dominant, and the mean concentration of total VOCs was higher at rush hour (8:00 and 18:00 h) than the others. The level of seasonal concentrations was the highest in spring followed by those in summer, winter, and fall, however, there is not statistically different. Diagnostic ratios and conditional bivariate probability function (CBPF) were used to investigate the main sources of VOCs in Seoul, which seems to be more influenced by the local effects. In addition, the possibility of the long-range transport effect was identified with the monthly results of the HYSPLIT trajectory model. Then, the contributions of SOA formation and probabilistic distributions of carcinogenic and non-carcinogenic risks were estimated from fractional aerosol coefficient (FAC) and Monte-Carlo simulation, respectively. Finally, the periods having the highest SOA formation and risks to human health were identified.

INDOOR AIR VOC LEVELS ASSOCIATED WITH THE USE OF BLEACH CONTAINING TOILET BOWL CLEANERS AND THE EFFECT OF VENTILATION

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Household cleaning products are sources of volatile organic compounds (VOCs). Bleach (NaOCl) containing products are a special case because reactions occur between chloride and their organic content such as surfactants, perfumes, etc. generating VOCs, mainly chloroform and carbon tetrachloride during shelf life in the product. Moreover, reactions with organic matter in water could result in their generation during use. Ventilation rate in toilets/bathrooms may be the determining factor along with emission rates if the generated VOCs would reach health threatening indoor air concentrations. Some types of drop-in or hanging toilet-bowl cleaners that contain bleach as a disinfectant and deodorant are such products. In this study; we purchased these products from supermarkets to determine potential chloroform and carbon tetrachloride emission. Experiments were conducted in 20-mL head-space vials by placing 1 g of sample. Solid-phase micro extraction with polydimethylsiloxane fiber was used for adsorption of VOCs from the headspace, and analyzed using GC-MS. Concentrations determined for 1 gram of sample (in 2 mL water for water contact samples) in the headspace vials were upscaled to actual product weights in 1.6 m3, 8.9 m3, and 18 m3 room volumes and for ventilation rates of 0.5 h-1, 25.2 m3/h, 54 m3/h, and 72 m3/h for lifetimes specific to each product .Then, modeled their indoor air concentrations with various ventilation rates, during use to determine occupant exposure concentrations in various sized toilet/bathrooms. The estimated bathroom indoor air concentrations reach levels that may result in above acceptable health risks associated with use of some toilet-bowl cleaners. The use of certain products may produce carcinogenic risks above the acceptable risk level exceeding one-in-a-hundred-thousand, with insufficient ventilation.

ECONOMIC AND HEALTH BURDENS OF AIR POLLUTANT EMISSIONS FROM COAL POWER PLANTS IN TURKEY

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Air pollution and health burdens from coal power plants are issues that need further research, especially in Turkey. Unpaid Health Bill report of HEAL-Health and Environmental Alliance evaluates the health burdens due to coal-fired power plants in Turkey for the first time when 'Hidden Price Tags: How ending fossil fuel subsidies would benefit our health' research provided the first-ever comparison of fossil fuel subsidies and the costs to health associated with air pollution from fossil fuels, when both reports carried out the research for Turkey as well.

The Unpaid Health Bill research adopts an international methodology that estimates health burden by PM2.5 emissions where total air pollutant emissions were converted to PM2.5 by referencing ExternE109 project and CAFE110 Directives. The figures published in the report showed that in Turkey impacts amount to 2,876 premature deaths, 3,823 new cases of chronic bronchitis in adults, 4,311 hospital admissions and 637,643 lost working days each year. The economic costs of the health impacts from coal combustion in Turkey are estimated at 2,9 billion up to 3,6 billion Euro per year.

Hidden Price Tags report, which uses IMF calculations and previous studies on subsidies, estimates that G20 member countries paid out 416 billion Euro in subsidies to fossil-fueled energy production, but the use of fossil fuels resulted in estimated health costs of at least six times this amount: 2.6 trillion Euro; for Turkey this rate is as high as ten times.

It is further suggested that public and detailed datasets of air pollutant emission from the energy sector should be defined and health costs should be additional criteria when determining the energy production strategy.

PRESCRIBED FIRE IMPACTS ON AIR QUALITY AND HUMAN HEALTH IMPACT APPLICATION TO SOUTHEASTERN U.S.

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In 2017, approximately 1 million hectares of forested land has been treated with prescribed fire in the Southeastern U.S., especially in the states of Alabama, Florida, and Georgia. Prescribed fire has ecological benefits for these fire-adapted forests and prevents catastrophic wildfires. However, exposure to fire smoke, especially PM2.5, is associated with adverse health effects. Since 2015, we have been forecasting the prescribed fire activity and air quality in Georgia using the HiRes2 system, which is based on the Weather Research and Forecasting (WRF, version 3.6), and the Community Multiscale Air Quality (CMAQ, version 5.0.2) models. Recently, we have expanded HiRes2 to a larger region over the southeastern U.S. and extended it to predict health impacts.

In this study, HiRes2 was used in a hindcasting mode to generate prescribed-fire-caused PM2.5 fields in Georgia, USA during the 2015-2018 burn seasons. To reduce the uncertainties in model simulations, PM2.5 predictions were combined with observations through a data fusion method. Adjusting modeled fire impacts with observations generally improved the PM2.5 exposure fields; however, in some cases, limited observational data reduced the impact of smoke plumes successfully captured in model simulations. The lack of observations can be alleviated by using low-cost sensors. A data withholding evaluation using only sensors data showed that low-cost sensors could be used to provide spatial and temporal information missed by both regulatory monitoring sites and model simulations. A method has been developed to identify the days when and areas where prescribed fires have a major impact on PM2.5 levels.

A general health impact function was used to describe the relationship between prescribed fire PM2.5 and acute health effects. The results showed a strong spatial and temporal variation of prescribed fire impacts on human health. Differences in burned areas and extent of burn seasons resulted in inter-annual variations in the estimates of health impact. About 145 emergency room (ER) visits in Georgia were estimated for asthma due to prescribed fire impacts during the 2015 burn season. This number increased by about 18% in 2018. Although southwestern, central, and east-central Georgia have larger prescribed fire PM2.5, the number of prescribed fire triggered asthma ER visits is small in those regions compared to metropolitan areas where population density is higher. Metropolitan Atlanta has the largest estimated prescribed fire related asthma ER visits in Georgia with an average of 66 during the reporting years.

DYNAMIC SPATIO TEMPORAL HEALTH IMPACT ASSESSMENTS USING GEOLOCATED POPULATION BASED DATA THE PULSE PROJECT

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Despite the silent effects sometimes hidden to the major audience, air pollution is becoming one of the most impactful threat to global health.
Standing to the report of the European Environmental Agencies the number of deaths from cardiovascular disease that can be attributed only in Europe alone,is about 790.000 a year and each of these deaths affects an average reduction in life expectancy of more than two years: air pollution is addressed to be the cause of premature death in 41 European nations
This outcomes are enforced by the estimates of WHO, finding that air pollution is responsible for 120 extra deaths per year per 100,000 of the population.
Cities are the places where these deaths are concentrated most, as the consequences of bad air quality are more severe and localized. In order to correctly address intervention and prevention thus is essential to assest the risk and the impacts of air pollution spatially and temporally inside the urban spaces.
PULSE (Participatory Urban Living for Sustainable Environment) is a pioneer EU-financed project that aims to develop a set of models and technologies to predict and manage public health problems in cities and promote health.It aims to develop and test dynamic spatio-temporal health impact assessments usinggeolocated population-based data.
The project is currently active in eight pilot cities, Barcelona, Birmingham, New York, Paris, Singapore, Pavia, Keelung and Taiwan, following a participatory approach where citizen provide data through personal devices and the PulseAIR app, that are integrated with information from heterogeneous sources: open city data, health systems, urban sensors and satellites.
PULSE aims to design and build a large-scale data management system enabling real time analytics of flows of personal data
The objective is to reduce the environmental and behavioral risk of chronic disease incidence to allow timely and evidence-driven management of epidemiological episodes linked in particular to two pathologies; asthma and type 2 diabetes in adult populations. developing a policy-making across the domains of health, environment, transport, planning in the PULSE test bed cities.
The work will present the main frameworks of the project and the most relevant components of the decision support platform, such as satellite data processing, deployment of sensors, management of acquired spatial data, WebGIS and Dashboard tools to provide visualization of the correlations between epidemiologic and spatiotemporal data and models.

THE USE OF A VIDEO LIBRARY TO DISTRIBUTE EXPERT KNOWLEDGE ON AIR POLLUTION AND HEALTH

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ABSTRACT

Background:
Humanity's impact on the environment has created an enormous burden of disease causing 7 million deaths a year from air pollution. The disease, disability, and death due to air pollution have been increasingly recognized as a serious issue in many cities and countries. Air pollution is the single biggest environmental risk in our lives. Reducing air pollution emissions provides multiple benefits. The World Health Organization (WHO) plays a key role in promoting policies and interventions that will reduce air pollution emissions and improve the public health and economic growth, while simultaneously removing sources of climate change.

One key challenge is communicating collective expert knowledge, core definitions, analysis, and solutions to an evergrowing global audience of policymakers, researchers, scientists, health workers, students, and citizen scientists. WHO identified the need for an open compendium of this information in video format to be easily accessible from the internet. The use of a video library to distribute expert knowledge on air pollution and health is fundamental to offer analysis and solutions to reduce the impacts of air pollution.

Objective:

WHO intends to distribute expert knowledge on air pollution and health in the autumn of 2019 as a browsable online video library. WHO conducted more than fifty brief video interviews (approx. 3-10 minutes each) during the Global Conference on Air Pollution and Health in Geneva (November 2018) and during the "Expert consultation on risk communication and intervention to reduce exposure and to minimize the health effects of air pollution" meeting (February 2019), with various experts on relevant aspects of Health Impact Assessments (HIA) and air pollution.

Key definitions and observations fundamental to understanding air pollution issues and useful for producing comprehensive health impact assessments and general messages have been collected and edited into short engaging videos. Expert knowledge and dialogues based on the work and experience of air pollution experts when distributed as videos can expand discussions, collaborations, and dissemination of information on air pollution, climate, and health.

Conclusion:
This video library on air pollution and health will expand the availability of expert knowledge reaching all sectors (i.e. government, industry, academia, and civil society) and potentially increase collaboration and action to reduce air pollution emissions.

SPATIAL MAPPING OF THE WINTER AND SUMMER PM10 ELEMENT CONCENTRATIONS IN AN URBAN AND INDUSTRIAL HOT SPOT OF CENTRAL ITALY

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Particulate matter (PM) air pollution is a serious threat to human health; various epidemiological studies have spotlighted strong correlations between exposure to PM and the onset of cardiovascular and respiratory diseases. Since in urban and industrial areas, PM air pollution largely depends on the type, number and rate of local emissions; the study of the spatial distribution of PM chemical compounds is essential for a reliable identification of emission sources and the assessment of personal exposure. However, due to the very high cost of a network based on traditional PM samplers, ambient air quality assessment and epidemiological studies are usually based on measurements taken at a few sampling points. For these reasons, in the last few years, a self-powered and very-low volume device for PM sampling on membrane filters has been developed with the purpose of allowing spatially-resolved determination of PM chemical compounds.

The sampler has been employed from 12/2016 to 02/2018 in a dense (23 sampling sites, about 1 km between the sites) and low-cost monitoring network across Terni, an urban and industrial hot-spot of Central Italy. PM10 samples were monthly collected and chemically characterized for the water-soluble and insoluble fraction of 35 elements (Al, As, B, Ba, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Fe, Ga, K, La, Li, Mg, Mn, Mo, Na, Nb, Ni, Pb, Rb, Sb, Sn, Sr, Ti, Tl, U, V, W, Zn, Zr) by using a chemical fractioning procedure. Principal component analysis was performed on the spatially-resolved chemical data to individuate reliable tracers of the main local PM emission sources. Cu, Sb, Sn, Zr, Bi (insoluble fraction) and Ba (water-soluble fraction) were found to be good tracers of rail network and vehicular traffic; K, Tl, Rb, Cs and Cd (water-soluble fraction) were identified as reliable tracers of biomass burning; Co, Ni, Cr, Nb, Mn, Pb (insoluble fraction) and As, W, Mo, Cr, Zn, Li, Mn, Ga (water-soluble fraction) showed the steel plant role in the emission of PM10. Spatial distribution of the elements was mapped by using ordinary kriging interpolation method.

The new experimental approach was found to be effective for the evaluation of the impact of PM10 emission sources and promises to be powerful for the optimization and validation of dispersion models through high spatial resolution chemical data and for a more accurate assessment of the population exposure to PM air pollutants.

CONTINUOUS NATIONWIDE ATMOSPHERIC PCDD F MONITORING NETWORK IN TAIWAN (2006 2016) CONCENTRATION VARIATION EMISSION SOURCE APPORTIONMENT AND CARCINOGENIC RISK ASSESSMENT

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Concentration of atmospheric polychlorinated dibenzo-dioxins/dibenzo-furans (PCDD/Fs) is an indicator of environmental quality. PCDD/Fs could lead to many short term and long term health complications in human. During 2002-2016, the total inventories of atmospheric PCDD/Fs in Taiwan reduced from 320 to 52.1 g I-TEQ/year. We want to examine the spatial distribution, seasonal concentration variation, and possible sources of atmospheric PCDD/Fs in Taiwan, using their ten-year PCDD/F observation data. PCDD/F concentrations in ambient air gradually decreased during study period with eleven-year median concentration of 28.2 fg I-TEQ/m3. The highest PCDD/F concentrations in Taiwan were found in areas with high industrialization level in the west of the island (38.0-43.4 fg I-TEQ/m3). The concentrations in least industrialized areas in eastern side were found to be just over 10 fg I-TEQ/m3. Background station showed lowest concentrations of PCDD/Fs with mean concentration of 1.47 fg I-TEQ/m3. Overall, concentrations of atmospheric PCDD/Fs in Taiwan were higher in winter (13.4-86.7 fg I-TEQ/m3) than in summer (9.65-27.2 fg I-TEQ/m3). The exceeding carcinogenic risk was found in the western areas including Central (1.17x10-6), Southwestern (1.33x10 6), and Southern areas (1.24x10-6) even the estimated exposure doses were all lower than WHO tolerance threshold (1-4 pg TEQ/kg/day).

AN INTEGRATED ANALYSIS OF DUST TRANSPORT OVER TURKEY

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Dust storms are considered as meteorological hazards that occur when strong winds lift large amounts of sand, dust and other fine graded material from bare, dry ground into the atmosphere. Typically, highly concentrated dust originates from desert areas of Africa and Middle East and are transported long distances and influence air quality and human health in many countries in Europe, Asia and Africa. It is assumed that ome 40% of aerosols in the troposphere are dust particles associated with wind erosion. Being situated on the crossroads of Africa, Asia and Europe, Turkey is one of the mostly affected countries from dust emissions originating from sub-Saharan region. Based on this premise, the fate and transport of a dust storm episode influencing Turkey is analyzed based on remotely-sensed observations of a number of satellites and a Lagrangian particle transport model - FLEXPART. First, episodes with high particulate matter concentrations are determined by analyzing ground-based monitoring station datasets. Later, a source term is assigned to the event by analyzing satellite imagery from the exact time period of the episode and a dust mass loading rate is obtained by using reanalysis data. Finally, the atmospheric dispersion of the emitted dust is estimated using the FLEXPART model. The meteorological data required by FLEXPART is supplied from NCEP/NCAR database. The simulation results are then statistically analyzed and validated by comparing with both the AERONET fine/coarse-mode aerosol optical depth (AOD) and PM10 concentrations obtained from ground level monitoring stations in and around Turkey. Spatiotemporal distributions of the dust column density and aerosol optical depth are presented and cumulative dust depositions over Turkey are predicted.

MONITORING AND ANALYSIS OF AMBIENT AIR QUALITY AND VEHICULAR EMISSION ASSESSING THEIR IMPACTS ON HUMAN HEALTH AND ROLE IN ENHANCING CLIMATE CHANGE

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Abstract

Air pollution is one of the most emerging concern in the world. In the expansion of human advancement, transportation has significantly played a major role in destroying Ambient Air Quality in different ways. Various kinds of pollutants released by the burring of fossils fuel in automobiles are Sulphur dioxide, carbon dioxide, nitrogen dioxide, carbon monoxide and particulate matter, which are major contaminants in the ambient air quality of Lahore city, Pakistan. The study exhibits the result of ambient air quality and vehicular emission obtained through Aeroqual AQM-65 and Lancom III over Lahore city during the time period of 2017-2018. The pollutants concentration was detected at 9 different towns of Lahore city. Findings of Ambient Air Quality analysis of Lahore city, demonstrate that the concentration of nitrogen dioxide, Sulphur dioxide and carbon monoxide were found within the Punjab Environmental Quality standards (PEQS) permissible limit with the mean value of (44.296 µg/m3), (69.91 µg/m3) and (4.67 mg/m3) respectively, while the concentration of particulate matter (PM2.5 and PM10) were found significantly higher than the permissible limit with the mean value of 43.42 µg/m3 and 224.64 µg/m3, respectively. As well as the mean concentration of carbon dioxide (1010ppm), was found higher then USEPA standard limit (1000 ppm), which is directly associated with increase in temperature that cause global warming and climate change. The Findings of vehicular emissions exhibit that the mounting concentration value (3.29%) of vehicular carbon monoxide is significantly associated with the elevated concentration of ambient carbon monoxide (4.67 mg/m3), which is very near to PEQS permissible limit (5 mg/m3) and are the major source for releasing carbon monoxide in the city. Vehicular exhausts are the major contributor of particulate matter because commonly the public automobiles are not well maintained. High value of particulate matters are affecting the human health in several ways, different health issues like Asthma, bronchitis and higher mortality rate in children has been recorded in Lahore city due to bad air quality.

HEALTH RISK ASSESSMENT OF FINE INHALABLE PARTICULATE MATTER EXPOSURE IN KUWAIT

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High concentrations of fine inhalable particulate matter (PM2.5) were documented to adversely affect human health, especially respiratory and cardiovascular diseases. Poor air quality has detrimental health effects which lead to mortalities and morbidities. This study assessed the health risk associated with PM2.5 exposure and five cause-specific mortalities ischaemic heart disease, stroke, lung cancer, chronic obstructive pulmonary disease and acute lower respiratory infection) and two morbidities (cardiovascular diseases and respiratory diseases) in Kuwait. AirQ+ model and Openair model were applied to study the health risk, and spatial and temporal variations for the period (2014 - 2017) in Kuwait. Results revealed that PM2.5 levels peak in the early morning and early evening, Saturdays and summer. Ischemic heart diseases have higher baseline incidence rates and excess cases of mortality. Stroke has higher attributable proportions of excess cases per 100,000 population. Although cardiovascular diseases have higher incidence rates, the excess cases and attributable proportions of respiratory diseases are higher because of their higher relative risk. This is the first study that relates fine inhalable particles to health outcomes in Kuwait.

ASSESSMENT OF POTENTIAL HUMAN AND ECO TOXICITIES FROM AIRBORNE CHEMICAL EMISSIONS IN THE PETROCHEMICAL INDUSTRIAL COMPLEX

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The USEtox model developed by the United Nations Environment Programme was used to evaluate the human and eco toxicity from the release of chemicals to the air in the largest industrial town in Thailand. Analyzed data were achieved from the Pollutant Release and Transfer Registration (PRTR) database which consisted of 107 chemical compounds covering point, area and line emission sources. Results indicated that acrylonitrile has the highest potential health impact (1.5E+0 CTUh) followed by paraquat dichloride (1.46E+0 CTUh) and chlorpyrifos (1.17E+0 CTUh). As for environmental toxicity, ametryn was evaluated as the most toxic substance (2.02 E+08 CTUe) followed by chlopyrifos (1.66E+08 CTUe) and paraquat dichloride (2.48E+07 CTUe). Assessment of atmospheric concentrations and spatial distributions was carried out using the AERMOD dispersion model. Emission data of acrylonitrile were used together with the local meteorological and topographical characteristics as input data for model simulation. Modeled results indicated that the highest daily (24-hours) and annual concentrations were 1.77 and 0.5 µg/m3, respectively. These predicted values exceeded the ambient air quality criteria developed by the Ontario Ministry of Environment, Canada (less than 0.6 and 0.12 µg/m3 for daily and annual standards). This study reveals the necessity to develop the emission inventory and further evaluate them for potential health and environmental impacts for future sustainable air pollution management of the area.

AN OVERVIEW OF WRI EXPERIENCES IN IMPACTS ASSESSMENT ON AIR QUALITY AND PERSONAL EXPOSURE TO AIR POLLUTANTS OF MOBILITY INTERVENTIONS

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Air pollution in cities is a major health threat considering the high density of people being exposed to air pollutants. Vehicular emissions are the major source of nitrogen oxides (NO2), in most of the cities and in some cities major contributors of sulfur dioxides (SO2), and particulate matter (PM). The objective of this paper is to present an overview of the work done by the World Resources Institute (WRI) in Brazil, Mexico and Turkey over the last years assessing the impacts on air quality and personal exposure of mobility interventions in Mexico city, Istanbul and Sao Paolo. Between 2004 and 2015, several studies showed that passengers personal exposure to air pollutants was reduced after bus rapid transport (BRT) lines were introduced in Mexico City. Commuter´s personal exposure to carbon monoxide (CO), particulate matter 10 microns (PM10), particulate matter 2.5 microns (PM2.5) and benzene inside BRTs, showed PM2.5 and benzene were reduced up to 30% and 69% respectively, compared to buses and microbuses before BRT was implemented. In Istanbul, an assessment of the air quality impacts of pedestrianization on its historic peninsula was performed in 2015. Impacts on NO2, SO2, ozone (O3) and PM2.5 ambient levels were assessed converting streets to public spaces in up to 300 streets. Air pollutants including criteria pollutants (NO2, SO2, O3) and non-criteria pollutants. were measured using an array of monitoring equipment including passive samplers. As a result of the pedestrianization, ambient monitoring showed a reduction up to 42% and 80% of NO2 and SO2, respectively compared to a former air quality profile study of the Peninsula before pedestrianization in 2009-2010. Finally, preliminary results of a short study in 2018 to determine the impact of “day with no cars” in Sao Paulo central area in ambient air using low cost sensors for ambient air quality. Although no statistically significant reductions in local PM2.5 concentrations were observed, public perception of the citizens were very positive with respect of improvement of air quality. Lessons learned from these studies will be summarized and discussed in view of the opportunities and challenges encountered. Collaboration and synergies between the different stake holders including scientific community, governments and non governmental organizations in designing, performing and applying these studies into policies and programs both to improve air quality and mobility are part of the lessons learned. Opportunities and challenges with current low cost monitors will be discussed.

AIR POLLUTION EXPOSURE ASSESSMENT USING MOBILE POPULATION BIG DATA

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Metropolitan areas have a very high population density, and this population is usually very active and mobile. Thus, in order to properly assess the impact of on-road transport emissions on public health, it is imperative to not only track the real-time traffic volume changes but also the actual movement activity of the receptor public. However, there is a limiting factor in that static population data and vehicle registration data organized by administrative districts do not reflect the temporal and spatial reality of both source and receptor. In order to cope with this problem for the receptor public, population census and mobile phone-based big data were compared in time and space to evaluate the damage due to air pollution. Population movement activity and road traffic origin/destination (O/D) data were used to analyze the correlation for the traffic source. Based on these analyses, the advantage of using big data for the mobile receptor public could be potentially significant.

The correlation(R2, in parentheses) between the static population data and the mobile phone-based big data varied with time of day, from in-residence time-3:00 (0.92), to morning rush hour-9:00 (0.21), and weekly activity time-15:00 (0.09). The correlation was relatively high at 21:00 (0.64). This shows that while the population census reflects reality for in-residence times, it is not able to follow the actual activity of the public. In addition, as a result of analyzing the moving population through comparison with the mobile on-road pollutant sources, which closely portrays human movement and which are the closest source of emissions relative to the public, the correlation between the receptors (mobile population) and the sources (mobile vehicle transport) was 0.87. This indicates that the pollution damage to the human receptors by on-road transport sources may be underestimated when using static information. Therefore, in order to properly estimate the actual air pollution impact, it is suggested that methods using big data such as mobile population information is needed.

AIR POLLUTION CONTROL AND BENEFITS FOR BIODIVERSITY

COMPARING THE PERFORMANCE OF ENTRAINED MIXING REACTOR APPLIED TO THE DRY SCRUBBING OF GASEOUS SO2 AND HCL WITH HYDRATED LIME

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Entrained mixing reaction system, combining a numerical optimized entrained mixing up flow reactor with a rectifier for homogeneous flue gas flow distribution were developed as reaction chambers for the dry scrubbing of gaseous SO2 and HCl with solid hydrated lime particles. The performance of this technology was experimented at business model scale with 0.3m in diameter and 6.0 m in height. Three kind of solid hydrated limes with different surface area and pore volume were injected with carrier compressed air into the reaction chamber for absorption of acid gaseous. The experimental conditions were the following: reaction temperature 180oC, gas flow rate 1,800Nm3/h and SO2 and HCl concentration in inlet gas 300ppm, respectively, giving different values for the ratio the amount of fresh hydrated lime and acid gaseous concentration at the inlet of reaction chamber and that corresponding to the stoichiometric molar ratio(SR). The gaseous SO2 and HCl removal efficiencies ranged from 95 to 99 %, and the best performance were obtained for high surface area and pore volume of the hydrated lime. Increased the surface area and pore volume of hydrated lime improved the performance of the gaseous SO2 and HCl removal as well as the solid reactant conversion.

PLANT BASED NEGATIVE AIR ION GENERATION SYSTEM AND ITS APPLICATION ON PARTICULATE MATTER REMOVAL

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Particulate matter (PM, specially PM2.5 with diameter 2.5 microns) has been regarded as the major air pollutant. Evidence showed that negative air ions (NAIs) could efficiently remove particulate matter with diameter of 2.5 or 10 microns (PM2.5 and PM10) in the air. NAIs have many other benefits to human health. Plants are natural resources to generate NAIs. However, the released NAI concentration is very low and cannot be used to remove PM2.5 and PM10 efficiently. We have developed a bio-generator of NAIs to high efficiently eliminate indoor air pollutants including PM2.5 and PM10. The bio-generator of NAIs helps plants to release NAIs at the concentration of 100 × 106 ions/cm3 under pulsed electrical field (PEF) stimulation. By using the bio-generator of NAIs, PM2.5 and PM10 concentration in the growth chamber could be reduced from around 500 and 900 μg/m3, respectively, to healthy level within 5 minutes. Further investigation showed that power sources of PEF stimulator significantly contributed to NAI release and PM removal. RNA-Seq data showed that PEF treatment regulated the expression of stress-related genes, especially those encoding oxidoreductases, which might contribute to the generation of superoxide anions. We have also explored other mechanisms for the PEF treatment to help plants release huge amount of NAIs. The newly developed bio-generator of NAIs produces bio-based NAIs with more bio-activities and it is also an environmental product. The results provide important information for utilization of plants as a new-type of NAI generator.

ASSESSMENT OF VOLATILE ORGANIC COMPOUNDS CONTENT FOR A GREEN ANTI CORROSION COATING USING NOVEL ADDITIVE OF MORINGA OLEIFERA

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Volatile organic compounds (VOCs) are a large class of air contaminants posing adverse health effects to human. Some consequences of inhaling VOCs are difficulty in breathing, headache and damages of the central nervous system. Till date, few formulated paints with micro or nanoparticle pigments to remove VOCs in the surrounding environment has been introduced. However, these paints were known for a fact to emit harmful VOCs over time such as formaldehyde due to matrix degradation. In the study, a commercialized anticorrosion coating for steels is compared with the newly formulated green coating for the quantification of VOCs content. The comparison was executed using the mass difference method, according to ASTM D2369-03. Additionally, the formulated coating was also subjected to optical, electrochemical and morphological studies, i.e., Fourier Transform Infrared (FTIR) Spectroscopy, Ultraviolet-Visible (UV-Vis) Spectroscopy, Electrochemical Impedance Spectroscopy (EIS) and Scanning Electron Microscope (SEM). The primary goal of the project is to develop an effective anti-corrosion coating for a marine vessel with low-or-no negative impacts on the environment. Based on the results, coating with 3 wt.% of Moringa oleifera leaves extract (MLE) showed the optimum performance in reducing corrosion rate in seawater. The optimized coating was later subjected to VOCs content analysis, and the outcome displayed a significant decrease of VOCs in contrast to the commercialized coating. Hence, it can be concluded that the developed green anticorrosion coating possessed low VOCs content with excellent abilities in protecting the steels exposed to an aggressive environment.

CARBON SEQUESTRATION POTENTIAL OF VEGETATIVE SPECIES (TREES) OF LAHORE PAKISTAN

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Unplanned urbanization is causing disastrous effect in many cities of Pakistan. Increase in number of vehicles and industries are the major sources of air pollution and carbon dioxide emissions. The present study was conducted to calculate and analyze carbon sequestration potential of different tree species along 10 major roads of Lahore. A total 25 number of tree species were identified from the sampling points. Above ground biomass, below ground biomass, total biomass, carbon content and carbon sequestration potential were estimated for each species. Population density (%) of tree species was also calculated for each sampling point. The results showed that urban areas of Lahore have highest population density of Alstonia scholaris (21.54%) and lowest diverse specie was Acacia speciosa (0.06%) and Melia azedarach (0.06%). Average height ranged from Populus alba (14.25±1.65 m) while average diameter at breast height (DBH) ranged from 31.63±1.67 cm (Mangifera indica) to 3.22 ±0.25 cm (Tectona grandis) was having lowest average DBH. Study also revealed above ground biomass which found to be highest for the specie Ficus religious (7.95 t/tree) a2nd lowest for Tectona grandis (0.32 t/tree). Below ground biomass was highest for Ficus religious (2.07 t/tree). Below ground biomass was lowest for Tectona grandis (0.08 t/tree).Total biomass was highest for Ficus religious (10.02 t/tree) and total biomass was lowest for Tectona grandis (0.40 t/tree).Carbon content was highest for Ficus religious (5.01 t/tree). Carbon sequestration ability was also highest for Ficus religious (18.36 t/tree) Carbon content was lowest for Tectona grandis (0.30 t/tree). Carbon sequestration was lowest for Tectona grandis (0.74 t/tree). So, it is recommended that tree species with greater biomass and higher carbon sequestration potential i.e. Mangifera indica, Ficus religious and Syzygium cumini should be preferred over species with less growth and biomass to increase carbon sequestration rate.

DETERMINATION OF GREENHOUSE GAS REDUCTION POTENTIAL FOR SOLID FUEL BASED POWER GENERATION PLANTS IN TURKEY

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Climate change, as one of the most important problems faced by the human race in the present century, is triggered by the increasing use of fossil fuels, land use changes and various human activities generating greenhouse gases (GHG) such as carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O). According to the latest IPCC (The Intergovernmental Panel on Climate Change) Special Report on the impacts of global warming, 1°C of global warming above pre-industrial levels are estimated to be caused by human activities and it is likely to reach 1.5°C between 2030 and 2052 if it continues to increase with the current rate. Under these circumstances, countries need to limit their greenhouse gas emissions in accordance with the provisions of the Paris Agreement. In this context Turkey provided its nationally determined contribution and committed to reduce its GHG emissions up to 21 percent from the business as usual level by 2030. However, as a developing country, Turkey needs to evaluate its domestic energy resources taking into account its energy policies in which lignite and biomass have been mainly targeted as national energy sources for a sustainable and secure energy supply chain. Therefore assessment of new investments to be made for the solid fuel based power generation plants will be important both in terms of environmental aspects and determination of the most suitable technologies that will increase the utilization of domestic energy resources and increase the contributions of Turkey on the mitigation of GHG emissions in global scale. Within the scope of this study, the current situation of the solid fuel based power generation plants operating in Turkey was determined and alternative clean coal technology scenarios for reducing the GHG emissions from these power plants were evaluated. For this purpose, a modelling tool known as TIMES (The Integrated MARKAL-EFOM System) which provides to the users an interface to analyze energy, economy and environment relation on a basis of technological development was used. Results were obtained for the business as usual scenario which assumes that current policies for the energy generation will remain same and for the alternative clean coal technologies scenario for the period of 2010-2050. Energy demand growth was projected based on national statistics on population, gross domestic products and recently licensed power plants.

AIR QUALITY LEVEL EMISSION SOURCES AND CONTROL STRATEGIES IN BURSA

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In parallel with the rapidly increasing population and the number of motor vehicles, irregular urbanization, and unplanned industrialization, air pollution has reached dangerous levels in much cities. In recent years, high-quality fuels used especially in our big cities have removed air pollution from being an important environmental problem. Bursa is a good example in this aspect because air pollution, which is caused by intensive urbanization because of industrialization and excessive migration, has been a problem for Bursa for many years. This study was realized with the cooperation of Bursa Metropolitan Municipality Environmental Protection and Control Department, Bursa Uludağ University Environmental Engineering Department and Bursa Governorship Provincial Directorate of Environment and Urbanization. In this study, in order to improve the air quality of Bursa, the main causes of air pollution were presented and their solutions were discussed in the workshop attended by the related institutions. In the scope of study; the measurement data obtained from air pollution monitoring stations of Marmara Clean Air Center in Gürsu, Kestel, Kükürtlü street, Yıldırım street, Soğanlı and Bursa Uludağ University regions were evaluated. The parameters of sulfur dioxide (SO2), carbon monoxide (CO), nitrogen oxides (NOx = NO + NO2) and particulate matter (PM) measured between 2013-2018 were examined. As a result of the evaluation of annual, seasonal and hourly concentrations, possible resource evaluation was made. In addition, annual pollutant emissions were calculated by using EMEP and Corinair emission factors for fuel consumption in the city. Air pollutant resource groups that are active in the city of Bursa came to the fore as industry, transportation, heating and uncontrolled combustion activities respectively. While the main source groups for PM and SO2 pollution emerged as coal use, natural gas and transportation were found to be effective for NOx. A workshop was organized with the participation of stakeholders on air quality monitoring, measurement, control and evaluation. After presenting the measurement and calculation results previously obtained to the stakeholders, the opinions of the stakeholders were taken in the titles of resources, operational problems and solution suggestions. Opinions were evaluated using statistical methods (Pareto, SPSS) and prioritized. The necessary activities for the control of air pollution in Bursa have been determined in the short, medium and long term in order of priority. Especially the fact that the industry is located in the city and the transportation network of the city is inadequate has emerged as the main source of the air pollution problem. In order to solve this problem, it was emphasized that effective supervision should come to the forefront and new industrial facilities should not be established in the regions close to the city.

EVALUATIONS OF MANGANESE CATALYSTS FOR THE REMOVAL OF VOLATILE ORGANIC COMPOUNDS EMITTED FROM PRINTING PROCESSES

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Printing processes utilizes various inks and solvents, and they commonly emit high concentrations of volatile organic compounds (VOCs) including aromatics, ketones, and alcohols into the air. These VOCs play important roles in ozone formation in the urban air shed, so that appropriate control actions need to be implemented to printing facilities located in urban areas. In this study, a combined system comprised of adsorption and advanced ozone oxidation was developed to abate VOCs emitted from small-scale printing processes. In addition, the advanced oxidation using external ozone was carried out on the surface of manganese catalyst at the room temperature. A continuous column test was conducted to oxidize toluene, a model compound at a gas-phase concentration of 100 ppm in the presence of ozone at 500 ppm at a temperature of 25°C. The column test showed that the toluene removal efficiency was greater than 80%, implying that the catalytic oxidation was active even at the room temperature. Furthermore, the ozone introduced to the column was almost completely removed. Meanwhile, the carbon dioxide produced by the oxidation reaction was approximately 50 ppm, indicating that only 7% of toluene was completely oxidized. An additional investigation is being performed to improve the activity of the catalyst working at the room temperature.

AN IMPROVED HIGH PRESSURE CO2 CAPTURE TECHNOLOGY FOR OXY FUEL COMBUSTION

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The fossil-fuel based power generation sector is facing important challenges to develop energy efficient solutions while reducing the greenhouse gas emissions (mainly CO2). For decreasing greenhouse gas emissions several approaches have been evaluated and reviewed for capturing CO2 in the utilty industry namely Carbon Capture and Storage Technologies (CCS) including pre-combustion, oxy-fuel combustion and post-combustion. As a promising CCS technology oxy-fuel combustion can be used in existing and new power plants.

In oxy-fuel combustion, the fossil fuel, bio-fuel or biomass is combusted with pure oxygen using recycled flue gas stream that is highly enriched in CO2 to control the combustion temperature and to ensure proper heat transfer. In the oxy-fuel combustion system, a high concentration of CO2 (80-90%, dry basis) in the flue gas makes it easy and economical to capture it with the flue gas compression train.

The aim of this work is to develop a novel large-scale experimental set-up for seperation CO2 from flue gas of oxy-fuel combustion by liquefaction method which is based on compression.

Experimental setup installed in the laboratory consists of five main units: Simulating flue gas composition, separation of water from highly enriched CO2 simulated flue gas, CO2 capture and storage, PLC system and gas chromatography system.

Owing to newly developed large scale experimental setup liquefaction of CO2 has been succesfully carried out at the temperatures between -10 and 0 oC and presures between 35 to 80 bar. The results show that as the temperature decrease the operable presure range increases. Meaning, based on desired CO2 specifications operating conditions can be set. As the results of experiments and thermodynamic simulations show while presure increasing at the constant temperature purity of liquid CO2 decrease while the amount of liquid CO2 increase. Thus it is possible to get high yield of CO2 using high presures at the temperatures between -10 and 0 oC.

TECHNOLOGICAL IMPROVEMENT STUDIES IN TURKISH CEMENT SECTOR ACCORDING TO EUROPEAN UNION BEST AVAILABLE TECHNIQUES DIRECTIVES

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By the end of 2018, Turkish cement sector has a production capacity of 90 million tons clinker per year and an installed capacity of 141.8 million tons per year with 55 production facilities spread throughout the country. With 75.8 million tons of cement production in 2018, Turkey is the largest cement producer in Europe and the 5th largest in the world. Due to the use of fossil fuels both for its raw material, i.e. limestone, production and for intensive energy consumption during production processes in the facilities, the cement industry globally has a greenhouse gas emission of 2.2 Gt which is equivalent to 8% of world total greenhouse gas production. As of 2018, cement industry ranks first in the industrial sector with approximately 847 kg CO2 per ton of production and 65 million tons of CO2 equivalent emissions in Turkey. In addition to CO2, the cement sector also plays an important role in the emission of conventional pollutants such as dust (i.e. TSP, PM10 and PM2.5), NOx, CO, VOC and SO2 from. In this respect, its environmental impacts, especially local air pollution, gain importance.

In this study, the existing technological level of the 54 existing cement production facilities in Turkey is presented and the differences between the proposed technological level in EU Best Available Techniques and the current situation are discussed in detail. In this context, the current technological levels, energy efficiency and related environmental impacts were determined through detailed surveys and on-site inspections at each facility. In order to minimize the environmental impacts of the facilities, necessary investment requirements have been determined and compliance costs have been established in order to reach the technological level proposed by BAT from the current technological levels. These costs include conversion to energy efficient pre-drying and pre-calcination process technologies in clinker production, dust control, NOx control, closure of stock areas and control of fugitive dust emissions. In addition, the usage rates of wastes as substitute fuels and energy production from waste heat were examined.

ODOR REMOVAL TECHNOLOGIES IN FERMENTATION INDUSTRY A PAKMAYA EXPERIENCE

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Pakmaya is one of the leading manufacturer of baker's yeast in the world and the production of baker's yeast by fermentation has started more than about 45 years ago. It has four production facilities in Turkey and Romania. Molasses, a by-product of the sugar production process is used as a raw material. Pakmaya has made a large number of investments about the environment during last 30 years. It has began with biological treatment investment in the 1980s and has pioneered the anaerobic treatment technology in Turkey. Then evaporation and membrane technology have been implemented in addition to the biological treatment system to adapt to the changes in "Water Pollution Control Regulation". In recent years, because of increased sensitivity about odor, Pakmaya has taken the issue on its agenda and possible technological options were evaluated and assessed at pilot scale. For this reason, photocatalytic, bioscrubber and ozone options were studied at pilot and industrial scale. In this paper, first the sources of emissions were discussed, then treatment options will be evaluated together with industrial experience over a few years after briefly introducing general overview of environmental activities in Pakmaya over the last thirty five years.

COMPARATIVE STUDY BETWEEN ATTACHED AND SUSPENDED GROWTH SYSTEM IN VOSCS ABATEMENT

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Nowadays odor nuisance has become a topic of significant importance and considered one of the important air pollution parameters due to its adverse effect on human as well as on environment even at trace concentrations. Especially today, within rapid industrialization in developing countries, industrial facilities faced with odor problem that need to be overcome. Among the malodorous pollutants, Ethanethiol (ET) is considered one of the volatile organic sulfur compounds (VOSCs) that frequently present in food industry, papermaking industry, and petrochemical industry emissions. To reduce ET emission release to the atmosphere a comparative study has been conducted for differentiating between attached and suspended growth represented by a anoxic lab-scale bio-trickling filter and bio-scrubber that are considered environmental friendly and cost saving techniques and tide over the drawbacks of physico-chemical treatment alternatives. O2 free conditions offer bio-conversion of (ET) gas into elemental sulfur and/or sulfate using NO3− as electron acceptor under specific S/ NO3− ratio. Bio scrubber operation was examined as a function of inlet concentration (150, 300, 800, and 1500 mg/m3), trickling velocities (0.12, 0.18, 0.24, 0.3, and 0.45 m/h), and empty bed residence times (EBRT) (30, 60, 90, and 120 s). Best operation conditions and operation characteristics of the bio-scrubber was obtained at an inlet concentration of 150 mg/m3, a trickling velocity of 0.24 m/h and an EBRT of 90 s. An average RE of 91% and elimination capacity (EC) of 24.74 g/m3 h was found for all inlet ET concentrations. Variations in trickling velocity higher than 0.24 m/h had no effect on removal efficiency at different concentrations. While in bio-trickling filter operation the effect of trickling velocity on removal efficiency depended on inlet concentrations; 0.24 m/h trickling velocity resulted in efficient ET removal (higher than 90.8% for 150 mg/m3 of inlet concentration) while 0.45 m/h trickling velocity could only achieve a removal of 80.6% for high inlet concentration of 1500 mg/m3 at fixed EBRT 60 s. However, increasing the EBRT up to 60 s was adequate to achieve removal efficiency, i.e. 92 and 80% for ET inlet concentrations 150 and 1500 mg/m3 respectively, and the maximum elimination capacity was 75.18 g/m3/h at 0.45 m/h. Overall, the performance of the bio-trickling filter under anoxic conditions surpassed the bio-scrubber act, and enhanced the low oxidation rates of ET despite mass transfer limitations and poor solubility of ET.

AN EXAMINATION OF THE OZONE EFFECT ON THE MARITIME PINE IN THE RIVA FOREST PLAN UNIT IN THE NORTHEAST OF MARMARA REGION TURKEY A CASE STUDY

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The focus of this study is to investigate the drying and causes of maritime pine trees in the forest areas in the northeast of Marmara region. The examinations on the trees in the region show that drying starts from the lower branches of the trees and proceeds towards the crown, initially resulting in yellowing of the hands, then browning and death of the tree.

It is understood that this drying pattern observed in marine pine trees starting from the lower branches of the tree towards the hill shows the ozone effect as a result of the comparison with the photographs of similar damaged leaves in the literature. For a case study, Kanlica Forest Management Directorate determined the presence of dry plants in coastal pine stands in August 2017 in Riva forest plan unit. Microtome sections of the needle samples were stained with toluidineblue and visualized microscopically. The obtained images were compared with the witness images in the literature. As the closest air quality monitoring station to the research area, the average O3 value in the 2017 vegetation period was calculated as 84 µg / m3 according to Şile Air Quality Monitoring Station data. The forest index value of AOT40 for Şile in 2017 was calculated as 37008 µg / m3-hour. If one year value is considered, the limit value is exceeded to be 85.04%. The higher ozone concentrations in the period defined as the ozone season (April-September) are seen as the effective factors on the bulk dryings seen in the maritime pine divisions of the Riva Forestry Management Directorate. As a result of ozone damage, the stomas are degenerated and the trees cannot receive water from the soil due to inability to breathe. For all these reasons, all the drying of the trees is attributed to the physiological drought based on ozone effect. In this study, Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT) is used to investigate the transport effect on high rural ozone levels in the region.

AN ECOLOGICAL ASSESSMENT ON THE AIR POLLUTION ENVIRONMENT OF AKHISAR

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The height of Akhisar level is 60-110 m. At the vest lies Yund-Berg and prevents the sea effect over Aegean Sea.The Massifs of Mount Görenez and Mount Katırcı in the east prevent the terrestrial climate effect in the east. The valleys, where the Akhisar Kırkağaç-Soma Road and the Akhisar-Sındırgı Road extend to the north, provide the north wind to reach the plain.

The average annual temperatures in Akhisar between 1970-2017 show significant differences. It was 15,7 °C in the years 1970-1981, 15,8 °C in 1982-1993, 16,7 °C in 1994-20016 and 17,0 °C in 2007-2017. The average annual precipitation was calculated 616,3 mm in the period 1970-1981 and decreased to 483,2 mm from 1982-1993, to 586,1 mm from 1994-2006 and to 557,6 mm from 2007-2017. The rise in temperature and the fall in precipitation caused the humidity in the summer to drop between 20 and 30 % at 14 o'clock. The fact that the humidity in the summer at 7 o'clock in the morning between 50-65 %, indicates a serious lack of water. The winds number from the north is much higher in Akhisar than in the other directions. The average annual wind force is 28685, of which 66,8 % is from the north, 18,3 % from the south, 1 % from the west and 0,5 % from the west.

The density of exhaust gases from Soma thermal power plants in and around Akhisar was calculated using a simple model as general values. According to a trapezoidal distribution area with a width of 10 km on Soma, 30 km on Akhisar and a distance of 40 km and a depth of 1 km.

It is assumed that power plants operate 300 days a year.

The total amount of coal incinerated in Soma A and B power plants in the period 1990-2008 is between 4,2 - 8,9 million tons/year and the amount of SO_2 released from the chimneys is 35806,27 to 86892,49 tons year.

According to the model, the daily SO_2 concentration in Akhisar was calculated to be 143,09-362,05 µg/m³/day. In dry and cold regions, the SO_2 limit is 30 µg/m³. This limit is exceeded at daytime increasing weather. Most forest and olive trees are affected by the SO_2 concentration above 100 µg/m³.

The amount of NOx released from the plants in the period 1990-2008 was 9432,06-22628,46 tons/year.

Using the model, the daily NOx concentration in Akhisar was calculated as 39,30-94,37 µg/m³/day. The limit value of the EU for NOx is 30 µg / m³ and is exceeded during daytime rising air.

In addition, ash and dust emissions from thermal power plants and dust from quarries and trucking on roads cause a remarkable air pollution.

ELUCIDATION OF THE PHYTOHORMONE AS PLANT BIOSTIMULANT FROM PALM OIL MILL EFFLUENTS (POME) DIGESTATE

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Presently, the enormous wet process of crude palm oil (CPO) extraction create a huge loads of POME with the ratio of POME to CPO produced is 3.05 and thus create a huge environmental problem especially in term of methane release into the environment. This statistic leads to a positive investment for biogas capture from POME but secretively, it also signifies an underlying problem pertaining to the AD process by-product which is the digestate. Common AD practices would emphasize upon re-circulating a portion the digestate and using the rest as biofertilizer because of the abundant nutrients contents without realizing the potential of POME digestate as high value product namely phytohormone. This research will be focusing on in investigating the presence of phytohormone in the digestate of anaerobic digestion system of palm oil mill effluent (POME) and the potential of the phytohormone in promoting plant growth. The anaerobic digestate will be collected and preserved at temperature less than 4°C. The samples than will be thawed and freeze dried for further extraction of phytohormone form the digestate. After the extraction of phytohormone successfully done, the samples will be analyzed for the presence of different type of phytohormones by using Salkowski method and HPLC. The phytohormone will be tested on model plant, chili pepper to observe the effect of phytohormone from digestate on the growth of plant. New potential of beneficial residues of digestate is a novel finding towards the volarization of waste to wealth concept. Result from the study illustrated that the two different planting of chili pepper showed different growth production between treatment plant and control plant. This study indicated that treatment plant which with the application of foliar amino acid showed significant length of growth, diameter of leaves and plant height of the chili pepper growth. Among two different planting methods, the treatment plant with the application of foliar amino acid showed the highest growth production with the highest length of growth (5.38±0.86cm) and the highest plant height (18.82±5.87) compared to the control plant. Therefore, this phytohormone application increased the growth performance of the chili pepper. Moreover, the application of this biostimulant in organic farming is effective and ecologically sustainable method of supplying additional nutrients to crop plants with an appropriate, low cost level of technology to suit the circumstances of most families and farmer.

AIR POLLUTION MODELING

COMBINED EFFECTS OF BUILDING GEOMETRIES AND ROADSIDE TREES ON NOX DISPERSION IN A DOWNTOWN AREA

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Tree planting is one of the effective ways to alleviate air pollution problems in urban areas. However, in some situations, air pollutants are often present at high concentration due to the combined effects of building geometries and roadside trees. Many previous studies have used computational fluid dynamics (CFD) models to examine various effects of roadside trees on pollutant dispersion, such as aerodynamic and deposition effects. In contrast, field measurement studies have rarely been reported which are necessary to demonstrate the roadside effects of buildings and trees on pollutant dispersion in real urban areas. The aims of study are to identify air pollution hotspots in near-road environments using a mobile monitoring technique and to examine the combined effects of building geometries and roadside trees on pollutant dispersion by comparing them in different near-road environments using mobile monitoring and CFD modelling techniques. We incorporated the aerodynamic and deposition effects of trees into the CFD model. The study area is the downtown area of Seoul (with a population of approximately 10 million people), Republic of Korea. Jong-ro and Eulji-ro are two major roads oriented in the East-West direction in the downtown of Seoul. Jong-ro is typically surrounded by densely-built and low-rise buildings with 3-4 floors, while Eulji-ro is mainly surrounded by sparsely-built and high-rise buildings. The field measurement period is 25-30th on January, 2019. To quantify the traffic volume, we recorded and counted the number of vehicles at each target area. Mobile monitoring results showed that, on average, the NOx concentrations at the Jong-ro and Eulji-ro were 178 and 188 ppb, respectively, with similar traffic volumes to each other. High NOx concentrations frequently appeared at the intersections and in street canyons rather than open spaces. This implies the near-road environment consisting of buildings and trees can affect the on-road and roadside air quality significantly. In the base scenario, we performed the CFD model simulations at the Jong-ro and Eulji-ro, which showed that the distributions of NOx concentration were well reproduced. With the existing effect of building geometries, we have additionally performed several CFD model simulations with different scenarios of roadside tree plantings. The numerical simulation results of the combined effects of building geometries and roadside trees are analyzed and presented.

DETERMINATION OF PM10 AND SO2 SOURCE CONTRIBUTION USING EMISSION INVENTORY DATA IN THE MULTI INDUSTRIAL CITY OF ULSAN SOUTH KOREA

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Ulsan is the largest industrial city of South Korea. Among criteria air pollutants (CAPs), particulate matters (PM) and sulfur dioxide (SO2), directly emitted from industrial activities, are major environmental concerns in Ulsan. The effect of local sources is crucial for these pollutants, and also long-range atmospheric transport (LRAT) from China is also an important source of CAPs, especially the PM10. However, there have been no studies dealing with both the LRAT and local pollution of CAPs in Ulsan. In this study, we collected and interpreted hourly data on CAPs measured at 14 automatic monitoring stations. The conditional bivariate probability function (CBPF) and air dispersion model CALPUFF were used to identify the local pollution sources of PM10 and SO2. For the LRAT of PM10, potential source contribution function (PSCF) and cluster analysis of back-trajectories were performed. Totally, the monitoring data, modeling results, and back-trajectory data were derived at the hourly data set. These parameters were processed c-tree and randomforest analysis to assess the major sources between local and LRAT effects for each month. The hourly PM10 showed the highest level in April and May and the lowest in August and December. Moreover, the highest and the lowest concentrations of SO2 were observed in July and December, respectively. The CBPF results indicated that the petrochemical industry and road traffic were the main local sources for PM10, however, SO2 concentration was greatly influenced by the petrochemical industry. The CALPUFF results revealed that both PM10 and SO2 were dispersed from the industrial areas to the residential areas in summer. Additionally, the effect of PM emitted from neighboring cities was high. The PSCF and cluster analysis results showed the potential LRAT sources of PM10 was China in spring. Lastly, the importance of the local and LRAT impacts in each month was identified by randomforest analysis. The local impacts of PM10 and SO2 were largest in summer and decreased in winter. The LRAT of PM10 was observed in spring when high levels of PM coming from China. This study can contribute to the identification of the local and long-distance sources of CAPs in other cities.

SIMULATION OF ATMOSPHERIC POLLUTANT DISPERSION FROM INDUSTRIAL EMISSIONS OF NOVOKUZNETSK RUSSIA USING WRF CALPUFF MODEL

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Through WRF(Weather Research & Forecasting)-CALPUFF modeling based on weather data provided to the world, this study conducted air quality dispersion simulations for Novokuznetsk, one of the largest industrial cities in Russia. For developing countries with insufficient weather observation facilities and data, this method of study can be utilized to predict air pollutant dispersion impacts. We employed the numerical model WRF to generate meteorological input data and used FNL (Final Analysis Data) global reanalysis data of grid resolution 1.0° × 1.0° at six-hour intervals provided by the National Center for Environmental Prediction (NCEP). The CALPUFF model, an air pollution dispersion model, is used to predict air quality impacts of emissions. This model can represent wind field changes as movements of the puff and also implement abnormal conditions. The modeling period was selected to consider the two extreme seasons, January (2017.01.02~07) and July (2017.07.02~07). Using the result file of the WRF model as input data to the CALWRF, the two models were integrated. In addition, STM3 (Shuttle Radar Topography Mission), topographical data that matches the UTM coordinates of the target region and land-use data in the format of GLCC (Global Land Cover Characterization) provided by USGS was used as input data for the CALPUFF model. In view of urban characteristics developed by the dominant local steel industry, major air pollutants, TSP (Total Suspended Particles), SO2, and CO were selected as the target materials. Using source and emissions data that could be collected in the city, emissions by pollutants were calculated for five representative point sources. The effect of the emission sources can be visually verified through the operation of CALPOST. Because of the short run time, much representation was not shown for each season, but we were able to identify certain characteristics for the conducted periods. In winter (January), because of strong southwest winds and high wind speeds, air pollutants are rapidly diffused, resulting in a sharp decrease in concentration from the source of emissions. Therefore, the overall effect on residential areas to the south of major emission sources is low. But in summer (July), as a result of low wind speeds and northeasterly wind direction, pollutants tend to accumulate thus keeping the concentration of pollutants high, and consequently reaching residential areas.

CHALLENGES OF INDIAN OPERATIONAL AIR QUALITY FORECASTING SYSTEM AND EXTREME POLLUTION EVENT

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Air pollution is a major planetary health risk that contributes substantially to premature mortality and disease burden globally, with a greater impact in developing and underdeveloped countries. India has initiated the "System of Air quality and Weather Forecasting And Research (SAFAR)" in 2010 as pilot project of GURME of WMO for Indian Metro cities. It has now been implemented in 4 metro cities namely Delhi, Pune, Mumbai and Ahmedabad. It provides location specific information on air quality in near real time and its forecast along with weather information. There are 4 basic components of SAFAR, namely, SAFAR Observational Network, Emission Inventory Development, Forecasting Model and Communication to Society. The main objective was to understand the spatial distribution of major criteria pollutants. This paper addresses the most toxic particulate pollutants PM10 and PM2.5. Each city has dense observational network on 10 locations. Scientific evaluation of the data generated from AQMS and WRF-Chem provides a basis to understand the air quality status. However, each city has different challenges. The sources of PM2.5 emissions in Delhi and Pune are dominated by transport sector; Mumbai and Ahmedabad emissions are mainly due to industrial and biofuel sectors. Pune's forecasting system does not provide any surprises; Delhi forecast is posing challenges on each passing day. It has been noticed that Delhi air quality is highly influences by local weather conditions as it is a landlocked geography. The frequency of extreme pollution events is increasing. The air quality of Mumbai region is highly influenced by sea breeze being a costal station and plays a flip-flop. This paper will address issues and challenges in operational services. Comprehending multi-scale nature of such cities will be useful to deal with the challenges of other Mega cities of the world.

MODELING OF PM10 EMISSIONS FROM MOTOR VEHICLES IN ZONGULDAK TURKEY

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Motor vehicles still use fossil fuels in developing countries like Turkey. Motor vehicle emissions are one of the main contributors of air pollution in cities. This pollution can cause a serious threat to human health. Therefore, prevention or reduction of motor vehicle emissions is in the concern of scientist. The aim of this study is the modeling of particulate matter (PM10) emissions from motor vehicles in the city center of Zonguldak, Turkey. As a study area, portion of D010 state road is selected. The numbers of vehicles are counted in three different sections of this road. Automobiles are classified as gasoline, diesel or LPG cars according to the data of Turkish Statistical Institute. The emission factors are selected from the latest version of EMEP/EEA Emission Inventory Guidebook in order to calculate the amount of motor vehicle emissions. After that, air quality modeling is performed by using CALRoads View software which can run CAL3QHCR line model. CAL3QHCR can model traffic emissions by considering signalization of the road. Two different scenarios are applied in air quality modeling: (1) current flow of traffic with queuing at red lights and (2) optimization of traffic by the help of green wave. It is assumed that, applying green wave could prevent queuing at traffic lights and traffic will flow freely which reduce idle emissions. In the former scenario, maximum hourly PM10 concentration is found as 287,7 µg/m3, while in the latter scenario maximum hourly PM10 concentration is calculated as 29,1 µg/m3. So it is proved that with the aid of signal optimization, the motor vehicle related air pollution could be reduced in cities.

DISPERSION MODELING AND AIR QUALITY MEASUREMENTS TO EVALUATE THE ODOR IMPACT OF A WASTEWATER TREATMENT PLANT IN IZMIR

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Municipal wastewater treatment plants (WTP) are potential sources of offensive odors that can create annoyance in the communities. Therefore, odors have been rated as the primary concern of the public relative to implementation of wastewater treatment facilities. In this study, dispersion modeling and air quality measurements were used to quantify the potential odor impact around a Wastewater Treatment Plant in İzmir. AERMOD atmospheric dispersion model was used to predict odor levels in OU/m3 around the treatment plant. Odor measurement results of the wastewater treatment plant units that are considered as area odor sources were used for odor modelling. Air quality measurements of H2S and NH3, which are two main odorous compounds emit from wastewater treatment plants, were also conducted by using passive sampling methodology in the surroundings of the plant to evaluate the odor impact of the plant. Both odor emission and air quality measurements were conducted in the period of June-July 2018 for evaluation of odor impact, and consequent application of dispersion model. The air quality measurements of the pollutants which exceeds the odor threshold values reveal annoying odor impact on residential areas. The dispersion modeling demonstrate that the odor concentrations exceed 10 OU/m3 concentration levels that can be measured olfactometrically creating an odor perception on local residents.

ESTIMATION OF PM2.5 CONCENTRATIONS USING RANDOM FOREST MODELS WITH MAIAC AOD RETRIEVALS MERRA 2 AND LAND USE PARAMETERS

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Elevated levels of fine particulate matter (PM2.5, particles smaller than 2.5 μm in aerodynamic diameter) are a global problem that affects the population health and contributes to climate change. Remote sensing provides useful information to complement air monitoring networks to produce PM2.5 exposure estimates. However, the relationship between the aerosol optical depth (AOD) recovered by satellite and ground concentrations of PM2.5 is mediated by multiple factors. Land-use regression models (LUR) have been able to capture this variation by incorporating auxiliary variables with spatial and temporal behaviour. In this paper, a LUR model was developed using the aerosol product with a spatial resolution of 1 km derived from the Multi-Angle Implementation of Atmospheric Correction (MAIAC) algorithm with parameters from the Modern Era-Retrospective Analysis for Research and Applications, Version 2 (MERRA-2) and land use information, employing a Random Forest algorithm. The study area is the Valencian Community for the period 2008-2018. The verification of the model was carried out using 10 fold cross-validation, and an evaluation of a test set with 20% of the collected information. We obtained a good fit: R2 = 0.90, mean absolute error (MAE) of 0.7 μg/m3 and square root of the mean squared errors (RMSE) of 2.3 μg/m3 in model fitting, and MAE of 0.67 μg/m3, and RMSE of 2.29 μg/m3 for the test set. Also, the stations not included in the model due to their high rate of missing data obtained a satisfactory fit (RMSE of 5.8 μg/m3 and MAE of 4.47 μg/m3). These results show that the proposed methodology can be used to generate maps with estimates of PM2.5 daily concentrations with a resolution of 1 km.

NUMERICAL INVESTIGATION OF MAJOR SPECIES DISTRIBUTION IN TURBULENT LARGE SCALE FLOW

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Turbulence and species dispersion modelling are key parameters in the study of pollutants dispersion in cities. In this paper, Large-Eddy Simulation (LES) model is used to investigate an accidental hazardous gas dispersion from stacks situated in 1:1 scaled city. Two computational domain, with different scenarios, and geometries are investigated. Computer Aided Design (CAD) of two Europeans city are cleaned, then in fine grids meshed. Weather conditions are introduced using logarithmic velocity profiles at inlets under the hypothesis of neutral atmospheric conditions. Computed mean concentration of methane CH4 and carbon dioxide CO2 as well as streamlines and velocity profiles show reasonable results. Effects of the release locations and wind directions are also included in the simulation. The analysis of CO2 and / or CH4 dispersion in downtown Hanover and Frankfurt cities provide a database of both large-scale flammable and toxic gases distributions depending on the boundaries conditions.

FORECASTING OF PM10 CONCENTRATIONS IN ISTANBUL USING BACKPROPAGATION NEURAL NETWORK

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This study aims to predict urban air quality levels in İstanbul by an artificial neural network (ANN). PM10 concentrations were predicted using hourly concentrations of other air pollutants, i.e., PM10, SO2, NO, NO2, NOx, CO and O3 measured in Aksaray station. Additionally, several meteorological parameters such as temperature, relative humidity, pressure, wind speed and wind direction were also used as inputs of ANN. All data was obtained from Ministry of Environment and Urbanization for the period of March 2016 to April 2018. “MATLAB - Neural Network Toolbox” was used for development of the air quality prediction model. Backpropagation Learning Algorithm was used as the learning network model. Levenberg-Marquardt algorithm was preferred since it provides fast convergence and stability in training of the model. The model was established based on 8657x12 data sets. Model data partitioned in to separate subsets; %70 for training set, %10 for validation set and %20 for testing set. The best results were achieved when hidden layer was 23. The model was evaluated using the “R” value for regression analysis of training, validation, test, and all data are 0.86, 0.85, 0.83, and 0.85, respectively. This model produces R2 of 0,72 which indicate good correlation between the targets and predicted outputs.

CHARACTERIZATION SOURCE APPORTIONMENT AND CARCINOGENIC RISK ASSESSMENT OF PM10 AND PM2.5 OVER THE DOON VALLEY LOCATED IN THE WESTERN HIMALAYAS OF INDIA

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The Himalayas are often considered pristine environments; however, they can be influenced by transported aerosols emitted from urbanized and industrialized areas. In this study, PM10 and PM2.5 were measured at a semi-urban site in Doon valley, situated in the western Himalayas between the Shivalik range and lesser Himalayas during summer and winter season. Based on chemical elements associated with particles source apportionment study was performed through positive matrix factorization (PMF) model and results were substantiated through CALIPSO profile. Further, carcinogenic risk due to inhalation of PM was calculated through Excess Cancer Risk (ECR). PM concentration showed strong seasonal cycle with a maximum during winter (PM10:89.79±32.10 µg m-3; PM2.5:63.28±27.07 µg m-3) and minimum during summer season (PM10:87.48±40.25 µg m-3; PM2.5:39.28.28±18.71 µg m-3). PMF results reveal soil/road dust, vehicular activities, industrial activities, mixed aerosols and anthropogenic burning emissions as the major sources for PM. Seasonal variation of sources reveals that during summer, soil/road dust (56%) is the predominant source of PM10, whereas industrial activities (50%) in case of PM2.5. Likewise, during winter, mixed aerosols comprising of emissions from vehicular activities, biomass and anthropogenic burning emissions (62%) is predominant sources of PM10, whereas, industrial emissions (42%) in case of PM2.5. The study of aerosol vertical profile using satellite-derived CALIPSO data reveals the presence of polluted aerosol at high altitude (0.6-2.9 km) over Doon valley, suggesting influence of neighboring polluted Indo-Gangetic Plain (IGP) region during both seasons. ECR analysis suggested that carcinogenic elements can cause a severe health risk to adults and children in the Doon valley.

TEMPORAL AND SPATIAL VARIABILITY OF ATMOSPHERIC AMMONIA IN THE LOMBARDY REGION (NORTHERN ITALY)

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Ammonia in the atmosphere plays a fundamental role in the processes of acidification of ecosystems and of eutrophication of water due to its deposition on sensitive environments. Additionally, because of its alkaline properties ammonia is capable of neutralizing acid gases in the atmosphere, such as sulfuric and nitric acid, and thus is a precursor of secondary inorganic particulate matter, whose harmful effects on human health are well known. Nevertheless, atmospheric ammonia is not considered by air quality standards and the knowledge on its concentration levels is still limited.

This work investigates the spatial and temporal variability of atmospheric ammonia concentrations in the Lombardy region in Northern Italy, where its continuous measurement at hourly resolution began in 2007 at monitoring stations representative of three different land use areas (urban, rural, and mountain areas). Ammonia concentration data have been jointly elaborated with wind direction and speed to highlight the association between the origin of the air masses and the concentration levels observed at the monitoring sites far from the primary sources, essentially consisting of farming activities and cattle and pigs breeding activities located in the Southern part of the region.

The annual average concentrations of ammonia observed at urban (4–13 μg m-3 range) and rural (17–35 μg m-3 range) monitoring sites are in substantial agreement with literature data, which are however limited and strongly influenced by the measurement techniques used. The lowest concentration levels (0.4–5 μg m-3 range) are observed at the monitoring sites in the mountain areas. Both the seasonal and daily time patterns of the concentrations appear strongly related to the features of the measurement sites, namely with regard to the monitoring sites most exposed to emissions of agricultural activities, whose seasonal practices determine emissions responsible for strong variations in the ammonia atmospheric presence. Conversely, in the mountain areas in the North of region, weather conditions of atmospheric circulation seem to play a more important role than local sources, with the highest concentrations occurring when the breezes transport ammonia-rich air masses from the Southern part of the region.

LINKAGE AMONG AMBIENT AIR QUALITY MEASUREMENTS AIR QUALITY MODELS AND RESPIRATORY SYMPTOMS AND DISEASES IN DIFFERENT LOCATIONS OF CANAKKALE TURKEY

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In Turkey, few epidemiological studies are available investigating the association between air pollution and health. Once the mortality rates due to the diseases in Canakkale was considered from 2007, relatively high deaths numbers from the respiratory system disorders were seen in Can town than Lapseki and Central towns of Canakkale city, Turkey. Air quality models are useful tools to estimate potential source contributors of the air pollutants. The aim of this cohort-type study is to examine the relationships between ambient air quality, respiratory diseases, and decreases in pulmonary function over a year in three different towns in Canakkale and also to estimate the of source contributors of ambient air pollution. Three different towns were selected here, which are Canakkale Central town (urban), Lapseki town center (rural), and Can town (industrial and rural; including downtown and 3 villages). In the first stage of the study, a detailed questionnaire was completed by the participants by face-to-face interviews and pulmonary function test (PFT) was performed twice in a year. Ambient levels of particulate matter, SO2, NO2, and ozone were gathered from air quality monitoring stations located in the centers of the three regions. Moreover, air quality modelling studies were carried by AERMOD program. Three air pollution sources, namely, industry, domestic heating, and traffic, were taken into account to find the contribution of the sources on CO, PM10, SO2, and NOX emissions. According to the results, the most polluted area was Can, while Central town and Lapseki were the least polluted areas. Domestic heating was found to be the major source contributor of SO2 emissions (exceeded the national limit), while NOx emissions were originated from traffic and industry in Canakkale city. Although no limit exceedances were calculated for PM10 and CO emissions throughout the city, PM10 measurement levels were above the national limit in Can town. The risk of pulmonary function decline throughout a year was 2.1 times higher in Can and 1.6 times higher for smokers in all regions. In the present study, ambient air quality was worse in Can (industrialized region), which influenced PFT scores and the prognostics for chronic respiratory diseases. Also, the highest frequency of obstructive disorders (24.6%) was occurred in one of the village in Can town. The findings of this study showed that air quality monitoring, modeling, and medical follow-ups should be considered for future investment plans in this region related to human and environmental health needs.

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LOCATION OPTIMIZATION FOR COAL FIRED POWER PLANTS USING GEOGRAPHICAL INFORMATION SYSTEMS AND CALPUFF DISPERSION MODEL

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Determination of existing pollution is not enough by itself to manage air quality of a region. It is also necessary to consider the possible future impacts from sources such as urban growth, energy and industry sector. Energy sector still uses fossil fuels, preferably coal as a national resource and continues to increase the installed capacity of coal-fired power plants in Turkey. In addition to technology, capacity, fuel type and quality, location of the power plant is decisive on its air pollution contribution because meteorology, geography and existing sources also strongly affect the ambient pollution levels and their health and environmental impact. The objective of this study is to determine the most suitable locations for coal-fired power plants using economic, environmental and geographical constraints compared to current practice where this selection is mostly done using economic constraints and environmental and public health concerns are then investigated. In this study, location selection is performed for Thrace region of Turkey. The environmental factors taken into account are urban settlements and population density, proximity to other power plants, protected areas and national parks, historical areas and current air pollution levels. Geographical features of the region such as terrain height and ruggedness, meteorology, land use (urban, agricultural and forest areas) have impacts on both economic and environmental factors. The economic factors include proximity to transportation, coal reserves, large cement and kiln facilities, consumers and available work force. All these factors are evaluated depending on their positive and negative impact. Firstly, the relevant geographic datasets such as high resolution population density, urban settlement, land cover, elevation are combined in ArcGIS along with air pollution levels using ground and satellite observations. The alternative locations for power plants are given according to assessment criteria and spatial processing of the datasets. In the second part, CALPUFF air quality dispersion model is used in estimating the pollutant concentrations resulting from the power plant in the study region for each alternative location. The results are compared with each other according to magnitude and spatial distribution of the pollutants. Maximum concentrations, compliance with the legislation, pollution impact areas are determined. In summary, these runs indicate the alternative with the lowest concentrations, thus minimum impact while considering multi-criteria. This proposed methodology can be used for other regions whereas well.

EVALUATING THE PERFORMANCE OF ANN IN PREDICTING THE CONCENTRATIONS OF AMBIENT AIR POLLUTANTS

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Air pollution is a key concern that has been impacting human health, agricultural harvests, forestry, animals as well as the environment. Indigenous environmental or health organizations regularly make daily air contamination predictions for public awareness and for use in making decisions concerning reduction methods in addition to the management air quality. Predictions are customarily centered on statistical associations between meteorological conditions and ambient air contamination concentrations. Multiple linear regression models have been extensively utilized. The aim of this work is to ascertain the better technique between MLR (linear method) and Artificial Neural Network- ANN (non-linear method) models for forecasting concentrations of PM10, NO2 and O3 in Nicosia. Multiple regression models and neural networks are investigated for Nicosia using the similar input and output parameters, allowing a comparative study of the two methods. Data from 2012-2015 was used in this research. Previous day's pollutant concentration, atmospheric pressure, wind speed, relative humidity and temperature used as an input parameters. The reliability and strength of the models were evaluated via Root Mean Squared Error (RMSE), Mean Absolute Error (MAE) and Correlation Coefficient (R). The results obtained indicate that MLR did better than ANN except in a few cases where ANN had better predictive performances. The results obtained indicate that MLR did better than ANN except in a few cases where ANN had better predictive performances. However upon comparison, the Backpropagation models of all three pollutants developed in this research were found to be in agreement other studies in the literature proving that the BPANN models built in this study can be used for the prediction of NO2, O3 and PM10.

ANALYSIS AND MODELING OF URBAN STORM BIFURCATION EFFECTS OVER BEIJING

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The most frequently cited urban impact on summer convective thunderstorm precipitation has been the downwind urban-edge max, first observed in the extensive 1970s METROMEX observational field program. The current observational and modeling study, however, shows a more complex picture of Beijing's impacts, as follows: (1) during large urban heat island (UHI) periods, cities initiate convective storms and thus produce a precipitation max over the center of the city, but (2) during weak UHI conditions, regional flows (and thus their storms) bifurcate and go around the city, producing min precipitation, both over the city and in a downwind urban rain shadow area, but in conjunction with precipitation max with in the bifurcating flows around the city, producing a precipitation max in each of the two areas on the downwind urban edge. Observations of a "golden case" bifurcating storm are thus analyzed, the storm is simulated with a highly urbanized version of WRF, and the model results are analyzed to understand the dynamical processes producing the bifurcation in a changing climate.

A NUMERICAL INVESTIGATION OF AEROSOL CLOUD RADIATION INTERACTIONS

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International concern has grown about anthropogenic climate change. Because the both Arctic and mid-latitude regions show a greater response to climate change than other regions, these regions should be focus in climate studies. Temperature changes in the Arctic are larger in magnitude than elsewhere on the planet, with sea ice extent and thickness diminishing. Convective storm systems in mid-latitudes (e.g., mesoscale convective complexes, MCC) are now longer lived and commonly contain heavy rainfall, wind, hail, lighting and possibly tornadoes. While greenhouse gases play a large role in determining these changes, aerosols also play a vital role. However, there are still large uncertainties associated with aerosol-cloud-radiation interactions.

With WRF-CHEM, this study will present the aerosol-cloud-radiation interactions. In the Arctic, changes in surface temperature as well as the variables which affect surface temperature due to aerosol effects are investigated, while the effect of the interaction of aerosols with convective storms in mid-latitudes are also investigated in this study. A suite of ensemble runs is used to develop a filtering mechanism to eliminate the effects of meteorological variability. The total aerosol effect is then separated into the changes caused by the aerosol direct effect, the aerosol semi-direct effect, and the aerosol indirect effects through the use of additional WRF-CHEM runs. These studies have shown that aerosols have significant impact on surface temperatures and convective storms.

DEVELOPMENT OF ATMOSPHERIC DISPERSION MODEL ADMER INTERNATIONAL FOR EXPOSURE AND RISK ASSESSMENT

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AIST-ADMER (national institute of Advanced Industrial Science and Technology; Atmospheric Dispersion Model for Exposure and Risk assessment) is an atmospheric dispersion model that has been developed for risk assessment of chemical substances in Japan. If emissions and simple physical properties are prepared as input data, the distribution of chemical concentrations in the atmosphere and deposition on the ground can be estimated with detailed spatial resolution (5 km to 100 m square grid). Now that the need for air pollution control is increasing in other countries with a rapidly developing economy all over the world, we universalized the AIST-ADMER so that it can be applied worldwide. The model has been now completed as ADMER-International. The following main modifications were made from AIST-ADMER.

1) As default meteorological data, it has become possible to use ADMER-dedicated global meteorological data created based on global reanalysis data (JRA-55). In addition, instead of data from Japanese AMeDAS (Automated Meteorological Data Acquisition System) or Japanese Meteorological Office, a file (user-defined meteorological data) in which the user described necessary meteorological data in text format was optionally available.

2) A new map projection (Web Mercator coordinate system) was adopted.

By releasing the ADMER-international (scheduled for summer of 2019), it is considered that the risk assessment of chemical substances will progress dramatically worldwide.

ANALYSIS OF SURFACE OZONE LEVELS IN THE FOREST AND VEGETATION AREAS IN NORTHWEST ANATOLIA WITH USING METEOROLOGICAL AND AIR QUALITY MODELS

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Surface ozone, which is one of the significant critical pollutants in the 21st century, threats to human health, forest and vegetation in rural and urban areas. The primary purposes of this study are to understand the atmospheric conditions that lead to the ozone episodes in the north-western side of the Biga Peninsula, which covers by the mountainous and forested area. Ozone concentrations were measured with passive samplers and monitoring stations for three years to identify and characterise the ozone episodes that occur in the study area. WRF meteorological model was run for these episodes to describe the atmospheric conditions. Meteorological model results were tested with observed meteorological data from four stations by using different statistical techniques. The influences of the meteorological parameters on ozone levels were also examined by wind speed and ambient temperature. In order to analyze the long-range transport sources contributing to the high ozone levels in the region, backward trajectories were computed using the HYSPLIT model for these episodes. The WRF outputs were served as input for HYSPLIT. This analysis was completed with 3-day backward air mass trajectories to assess the contribution of long-range transport of away contributors, resulting in the following main routes: İstanbul, Eastern Europe, and Western Russia. Additionally, an air quality model is used to understand the sources of high ozone concentration in the region for these periods. The results show that mountainous areas have higher cumulative exposure to ozone than suburban locations.

COMPARISON OF SA APPROACHES AND ANALYSIS OF NON LINEARITIES IN A REAL CASE MODEL APPLICATION

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The objectives of the study were to identify the factors leading to non-linear behavior of sources. To that end the contribution of three sources (agriculture, road transport and industry) in a real-world situation were estimated applying the brute force (BF) and the tagged species (TS) approaches using the same CTM (CAMx). The interaction terms of the Stein and Alpert decomposition were used as indicator of the non-linear situations (Stein and Alpert, 1993). When all the interaction terms between a series of sources were zero or close to zero the situation was considered to be linear. On the contrary, when the interaction terms between two or three sources were different than zero the situation was considered non-linear. The results of the study confirm that the interaction terms are useful to detect and quantify the non-linearities. In addition, they were used in association with the gas ratio (Ansari and Pandis, 1998) to analyze the relationships between the chemical regime and the non-linear behavior of the sources. Strong non-linearities were associated with agriculture source and the interaction of this source with NOX and, to a lesser extent, SO2 emitters. This is particularly true for the 100% reduction but less relevant for the 50% reduction. It was also observed there are many situations in which non-linearity is negligible and the TS and the BF approaches provide comparable results. The mass allocation of these two approaches were significantly different for agriculture when the emission reduction was 100%. In the other cases, the mass allocated to the sources were highly comparable in terms of spatial patterns and quantification of the relevance of the sources (contribution or impact), in particular for industry and transport.

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PARTICLE NUMBER CONCENTRATIONS IN THE PO VALLEY (NORTHERN ITALY) IN WINTERTIME COMPARISON BETWEEN URBAN AND RURAL SITES

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The Po valley in Northern Italy is a well-known hot-spot for atmospheric pollution, especially for particulate matter (PM), whose air quality limits are frequently exceeded at monitoring sites. As PM air quality standards are mass based, particle number concentration (PNC) and related size distribution (PNSD) are not routinely measured and their knowledge is still scarce for this area.

The temporal and spatial variability of PNC levels and of the related PNSD over the Po valley was investigated during an intensive multi-site monitoring campaign conducted in February 2014. Measurements were concurrently taken at five sites: three urban background sites, in the cities of Milano), Bologna, and Padova (1350000, 400000, 200000 residents, respectively), and at two rural site, San Pietro Capofiume and Ispra, on the South-Eastern and North-Western side of the valley. PNC data have been collected by means of an Ultrafine Particle Monitor (UPM, TSI 3031), a Fast Mobility Particle Sizer (FMPS, TSI 3091), a Differential Mobility Particle Sizer (DMPS, TSI); investigated particle size ranges were 3-600 nm for both FMPS and DMPS and 20-1000 nm. Total PNC data and PNC for 5 size intervals (20-30 nm, 30-50 nm, 50-70 nm, 70-100 nm, and 100-200 nm), have been processed on hourly time resolution.

Average hourly data for PNC were in the 5·103 -1.1·104 cm-3 range, with the lowest values at the rural sites and the highest in the city of Milan. At the urban sites the PNC daily time pattern showed two main peaks on the morning and evening traffic rush hours; conversely, at the rural sites it was mainly driven by the boundary layer evolution and much less affected by source activity. Ultra fine particles (UFP, 20-100nm size range) accounted for about 75% of PNC at urban sites and for about 63% at the rural sites. On rush hours at the urban sites, concentration levels of the particles in the smallest size range (20-50 nm) greatly increased, thus confirming that motor vehicle emissions were the main source of ultrafine particles, as also suggested by their correlation with NOx and CO concentrations. Inter-site comparison was performed for both the PNCs and for the PNSD hourly time pattern and k-means cluster analysis was performed in order to classify days based on PNC and PNSD, criteria pollutants levels and meteorological conditions. The result of the cluster analysis showed that PNC levels have a stronger association with atmospheric pollution conditions than with weather conditions.

INTEGRATING AIR QUALITY AND CLIMATE CHANGE ABATEMENT STRATEGIES

ALIGNING NATIONAL SELF INTEREST WITH GLOBAL CLIMATE STABILIZATION OVER THE SHORT MEDIUM AND LONGER TERM

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Per the 2015 Paris COP, each nation is "free" to set its own climate commitments, In reality, developing countries remain mired in vastly different stages of economic, social and environmental development. Soaring air pollution is just one symptom of the struggle to grow economically using the most affordable energy at hand. Public outreach on smog mortality statistics (e.g., "Breathe Life") is not sufficient to turn this around. Nor is the dissemination of model rules and/or best practices, many of which come from the wealthiest nations of the world blessed with abundant capacity. Instead, what is required are country-specific, economically-sound, culturally-sensitive measures that meet each nation exactly where it is. Tailor-made strategies that align with the country's immediate political objectives and which emphasize economic and administrative efficiency will gain the most traction. Innovation is key. Western techniques for managing thousands of facilities do not transfer easily to regulated enterprises numbering in the millions. Even the most basic air quality management tools need to be adapted to local conditions. Happily, advances in computing processes and low-cost sensors et al are providing new management techniques. It will take time to build robust integrated air quality and climate mitigation regimes but that patience will be rewarded. Every nation aspires to provide its citizens with the highest quality of life, including freedom from pollution and the ravages that will result from a wildly unpredictable, destabilized climate.

MEASUREMENT OF NIGHTTIME NO3 BY USING PASSIVE DOAS IN YONGIN KOREA

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The nitrate radical (NO3) is one of the most important trace gases in the nighttime atmospheric chemistry, which is a dominant oxidant in nocturnal chemistry. The presence of NO3 contributes not only oxidation of volatile organic compound (VOCS), but conversion of nitrogen oxides (NOX) to nitric acid (HNO3). Thus, NO3 indirectly influences the nocturnal budget of VOCS and NOX. Despite its importance, the impact of NO3 chemistry in Korea is not well understood due to its low concentration in the atmosphere. In order to explain the effect of NO3 on initial conditions of daytime ozone (O3) and NOX, we measured concentration of NO3 and analyzed the concentration characteristics. In this study, NO3 measurement was conducted in Hankuk University of Foreign Studies (HUFS), which is located in Yongin, Korea, from April to May, 2019, using passive Differential Optical Absorption Spectroscopy (DOAS) system. Nighttime NO3 was observed up to 7.03 x 107 molecule/cm3 with optical density of 5.37 x 1012 molecule/cm2. The measured NO3 was highest level at 1:30 am and sharply decreased after sunrise. The detailed behavior of NO3 will be discussed in the conference.

INFLUENCES OF ANTHROPOGENIC EMISSIONS ON STRONGLY LIGHT ABSORBING PRIMARY AND SECONDARY ORGANIC AEROSOL FORMATION IN URBAN ENVIRONMENT

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Light absorbing organic aerosol (OA), commonly referred to as brown carbon (BrC), can have significant impacts on aerosol photochemistry and climate. While biomass burning is one of the major sources of atmospheric BrC, there are limited field studies to investigate other potential sources of BrC in urban environments. The formation and characteristics of BrC due to urban emissions remains poorly understood.

In this study, we aim to first identify the major types of BrC and quantify their light absorption properties in Singapore, a well-developed city in warm and humid tropical region. A unique combination of seven-wavelength Aethalometer (Magee Scientific) and a high-resolution aerosol mass spectrometer (Aerodyne Research) were deployed to determine the light absorption properties of ambient black carbon (BC) and OA. Positive matrix factorization of the HR-AMS measurement identified five types of OA. The mass absorption cross-section (MAC) and absorption Angstrom exponent (AAE) of each type of OA were determined, assuming BC and OA are the major contributors to the total absorption at each wavelength.

This work provides evidence that two types of primary OA (POA) and the fresh secondary OA (SOA) produced through local photochemistry were associated with fuel combustion-related sources and/or industrial emissions. These primary and secondary anthropogenic OA were strongly absorbing at shorter wavelengths (i.e., MAC at 370 nm = 1.1-1.87 m2/g) that are comparable to that of biomass burning OA reported in previous studies. The fresh SOA showed the strongest wavelength dependence (AAE ~ 6) among the five OA factors, and accounted for ~46% of the observed OA absorbance at 370 nm. In contrast, the absorption of aged or background SOA was negligible. The large difference of MAC values between the less- and more-oxidised SOA could be due to different SOA formation conditions (e.g. types of precursors and pollution levels) and degree of aerosol aging (e.g., photochemical processing). Overall, our observations indicate that human activities can significantly affect both primary and secondary BrC formation in urban environment, and highlight the importance of quantifying optical properties of urban OA for improving our understanding of aerosol-climate interactions and developing effective BrC mitigation strategies from urban emissions.

COLLABORATIVE AND COOPERATIVE EFFORTS IN COMBATING LOCAL AND TRANSBOUNDARY HAZE IN SARAWAK MALAYSIA

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The State of Emergency was declared in 1997 for the State of Sarawak, Malaysia when air quality breached hazardous levels API 500(Air Pollutant Index) from widespread open burning throughout Borneo. Since then, concerted efforts by affected ASEAN Countries through the Sub-Ministerial and Technical Working and the SOSEK-MALINDO Cooperation between the Sarawak Government and Central-Southern Provinces of Kalimantan, Indonesia have succeeded in combating perennial transboundary haze pollution. The implementation of Natural Resources and Environment (Fire Danger Rating System) Order 2004 in Sarawak Malaysia helps in regulating open burning activities, while the Centre for Remote Environmental Monitoring (CREM) helps in determining the location of hotspots from illegal open burning which caused localised haze pollution. Following the signing of Memorandum of Understanding (MoU) between the NREB and the land owners in 2016, the implementation of Standard Operating Procedures (SOP) for prevention and suppression of peat fires have succeeded in reducing the incidence of peat fires and preventing of widespread peat burning in Miri, Sarawak. This SOP is ready for state wide implementation for all development sectors in Sarawak.

AIR POLLUTION AND CLIMATE CHANGE IN AMAZONIA

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Amazonia is the largest tropical rain forest in our planet and is undergoing changes from land use as well as urbanization. The GoAmazon experiment was designed to study the interaction of urban emissions from the city of Manaus with the pristine surrounding forest. Manaus is a city with 2 million inhabitants and is isolated by 1500 Km of tropical forest in all directions. This means that NOx, BC, CO and other air pollutants interacts with VOCs and biogenic aerosols from the surrounding forest and change the atmospheric chemistry of trace gases and aerosols. Ozone is produced in large amounts, as well as secondary organic aerosols. These interactions change the hydrological cycle, as well as radiative forcing in Central Amazonia. The production of secondary organic aerosols can enhance aerosol concentrations by 90% in the wet season, and 30% in the dry season. This additional aerosol changes the cloud condensation nuclei (CCN) concentrations, making clouds that have large lifetime, smaller droplet sizes and brighter. The enhanced concentration of aerosol also changes the radiative balance, increasing the diffuse radiation that makes forest photosynthesis more efficient, increasing carbon uptake, enhancing the Net Ecosystem Exchange (NEE). Land use change and the associated biomass burning affects climate over large areas of South America that increase strong the aerosol optical depth measured using a large network of AERONET sun-photometers.

TOWARDS LOW CARBON MOBILITY IN A DEVELOPING COUNTRY

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Malaysia as one of the participants of the United Nations Framework Convention on Climate Change (UNFCCC), ratified its commitment to the Kyoto Protocol in September 2002. Malaysia's Intended Nationally Determined Contribution (INDC) in reducing its GHG emissions intensity (per unit of GDP) by 45% by 2030 relative to the emissions intensity in 2005. This reduction consists of 35% on an unconditional basis and a further 10% conditional upon receipt of climate finance, technology transfer and capacity building from developed countries.

Transport sector in Malaysia contributes 20% of the total GHG emissions and the land transport sector takes up 90% of this emissions. In order to address this issue, a study was conducted to determine the appropriate policies, strategies and action plans to be implemented in order to achieve a low carbon mobility in the land transport sector.

This paper will highlight the approach undertaken in developing the policies, strategies and action plans to reduce GHG emissions as compared with business-as-usual (BAU) scenario. The Avoid-Shift-Improve approach has been employed in the study while the analysis on GHG emissions has focused on three major domains, namely, mode shift and traffic management, vehicle technology, and fuel and energy. Examples of policies and action plans that were developed specifically for a developing country like Malaysia will be discussed. The outcome of the study has indicated that a comprehensive set of strategies that covers the three major domains mentioned earlier would be necessary to achieve the desired goal.

CLIMATE CHANGE MITIGATION VIA AFFORESTATION A CASE STUDY ON ISTANBUL DURUSU COASTAL DUNES PINUS PINASTER AFFORESTATION

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The negative effects of climate change are becoming more severe. It is foreseen that if the greenhouse gas emissions can't be reduced, the temperature increase will reach up to 2° C in 2060. It is stated in the 1.5° C report of IPCC's that global greenhouse gas emissions should be halved by 2030 and net emissions should be reset by mid-century to avoid exceeding 2° C, which is considered a critical threshold. Reduction of fossil fuel consumption and prevention of land use changes are among the most important steps to be taken to reduce greenhouse gas emissions. However, reforestation activities are also very important to remove atmospheric CO2.

In this study, it is aimed to determine the increase in carbon stocks by the afforestation introduced with Maritime pine (Pinus pinaster) 50 years ago in Durusu Sand Dunes in the north of Istanbul. For this purpose, biomass, understory, forest floor, dead wood and soil samples were collected in 60 sample areas of different development stages in afforestation area. In addition, 25 sample areas were selected from the non-afforested dune areas. Single-tree and stand-level biomass equations were developed to predict biomass for Pinus pinaster. In these equations, diameter at breast height and stand volume were used as independent variables. In addition, the C concentrations of the wood components were measured and mean weighted carbon concentrations were found to vary between 49.83% and 50.64%. Soil samples were taken with steel corers from 6 different depth levels (0–5, 5–15, 15–30, 30–50, 50–70, and 70–100 cm). The highest soil organic C at these depth levels was on 0-5 cm depth and varies between 0.03% -0.36%. Carbon concentrations of forest floor were between 30-44% in leaf+fermentation layers and 17-20% in humus layer.

As a result, it has been determined that carbon stock of the area is 1.52 t C/ha, which is 0.07 t C/ha in the afforested and 1.45 t C/ha in bare dunes. In maritime pine, it was found that C stocks increased according to developmental stages and average C stock reached 221,5 t/ha in old stands. 184 t C/ha of this carbon stock is in biomass, 18.72 t C/ha in forest floor, 16.40 t C/ha in soil and 2.33 t C/ha in fine woody debris. The average annual C accumulation was 2.29 t C/ha/year in biomass, 0.32 t C/ha/year in forest floor and 0.28 t C/ha/year in soil. When all C pools were evaluated together, it was determined that on average, 2.89 t C/ha/year (10.60 t CO2 eq/ha/ year) C was deposited in Istanbul-Durusu Coastal Dunes Pinus pinaster afforestation.

ANALYSIS AND MODELING OF URBAN WEATHER AND AIR QUALITY IN A CHANGING CLIMATE

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The talk first summaries the growth of mega-cites around the world, as well as the main environmental challenges facing such areas in a changing climate. It next reviews the data analysis techniques that best illuminate the dynamical and physical processes that produce the unique climate, weather and air quality in cities. It finally reviews the current state of urban-scale numerical weather, air quality, and climate models. These reviews are illustrated by results from a variety of California, US, and international cities. It finishes with a review of the current challenges in this area of research.

FUTURE CHALLENGES IN IMPROVING OF AIR QUALITY

COMPARISON OF ELECTRO CHEMICAL SENSORS FOR AIR QUALITY MONITORING WITH REFERENCE METHODS IN ZAGREB

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Within the project "Eco Map of Zagreb", 8 sensor sets (type AQMeshPod) were obtained for air quality measurement. Throughout 2018, a set of sensors was set up at an automatic measuring station at the Institute for Medical Research and Occupational Medicine (IMROH) for comparison with reference methods for air quality measurement. This automatic station is a city background station within the Zagreb network for air quality monitoring, where measurements of SO2, CO, NO2, O3, PM10 and PM2.5 are performed using standardized methods accredited to EN ISO / IEC 17025.

The paper presents a comparison of mass concentrations of pollutants SO2, CO, NO2, O3, PM10 and PM2.5 determined by sensors and reference methods during 2018. For the gases, the hourly averages were compared and for the particle matter, 24-hour averages of concentrations. The raw data of the sensor and validated data of the reference devices were used. Negative data values from the sensor were replaced by the minimum detection limits of the reference methods. Data were compared using Student's t-test dependent samples and regression analysis. A Grubb test was performed to remove the outliers of data pairs from the database. The Grubb test is not applicable for gaseous pollutants due to high dispersion of results. For PM10 and PM2.5, the Grubb test is satisfactorily applied with a critical factor of 5% confidence level. In order to remove large deviations between the results between the sensor and the reference methods for gaseous pollutants and to reduce the scattering of the results, data filtering was performed. In the filtering process, the results where the deviation between sensors data and reference data over 100% were excluded. The Grubb test was performed over the new set of data.

A comparison of sensor results with the results of reference methods showed a large scattering of all gaseous pollutants but the comparison for PM10 and PM2.5 indicated a satisfactory low dispersion. The results of regression analysis showed a significant seasonal dependence for all pollutants. There was a significant statistical difference between the reference method and sensors for the whole year and in all seasons for all gas pollutants as well as for PM10. For PM2.5 there was not a significant statistical difference for the whole year as well as in summer, while for other periods there was a statistically significant difference.

SYNTHESIS NANOFIBER MEMBRANE COMPOSITE FOR AEROSOL FILTRATION OF AIR POLLUTANTS

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Air pollutants such as particulate matter (PM), volatile organic compound, and toxic gas (NO2 and SO2) and biology substances are main environment problem in the world. Air pollution is a cause of death and disease (such as lung cancer, stroke, heart disease, pulmonary). Nanotechnology can be used to solve this environmental problem. Nanofiber membrane composite is promising tool for purification of air pollution. Focus of our research is to produce nanofiber membrane composite for aerosol filtration of air pollutant by electrospinning process. Electrospinning process parameters (such as polymer concentration, applied voltage, composition of electrospinning solution) were optimized to produce nanofiber. After that, nanofiber membrane composite was characterized by scanning electron microscopy (SEM), FTIR, XRD, TGA, air permeability, and aerosol filtration test. Nanofiber membranes have diameter ranges from 200 nm – 750 nm and air permeability ranges from 15 - 90 cm3/cm2/s, respectively. Nanofiber membrane showed good collection efficiency to particulate matter with size 0.3 μm, 2.5 μm and 10 μm. Nanofiber membrane composites have potential application for filtration of particulate in the contaminated air.

ASSESSMENT OF THE LONG TERM OZONE INCREASE IN KOREA.

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We have confronted perplexing increase of ozone in Korea for last two decades. Many studies confirmed consistent 0.65 ppbv increase of ozone per year in Greater Seoul Metropolitan Area and other part of Korea from 2000 to 2018, while daily maximum 8-hour O3 in summer season had a much higher rate of 1.2 ppbv per year. Our current air quality policy toward ozone reduction has been severely questioned by large uncertainties in precursor emissions, transport paths, chemical mechanisms, and weather/climate factors. Many studies have suggested potential causes and sources of increasing ozone, especially in Northeast Asia. The convincing theories can be listed as plausible aspects of decreasing ozone titration effect by decreasing NO emission, NO2 fraction increase by diesel emission control, background ozone increase, increasing oxidants due to decreasing aerosol scavenging, climate change (temperature and humidity increase), and failure of VOCs control policy. These unresolved causes of increasing ozone will be assessed and discussed in detail in the conference.

ANALYSIS OF MONITORING DATA OF EANET AND POLICY IMPLICATIONS FOR ATMOSPHERIC ENVIRONMENT MANAGEMENT IN EAST ASIA

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In the Asian region, the serious air pollution problem is crucial to be solved. Monitoring of acid deposition including air pollutants is important to identify the necessary actions to be taken step by step. The Acid Deposition Monitoring Network in East Asia (EANET) was established as a regional cooperative initiative to promote efforts for environmental sustainability and protection of human health in the East Asian region. EANET started its regular activities in 2001 and its monitoring data has been disclosed for public to provide the scientific information.

The monitoring data of EANET was analysed for checking with the ambient air quality standards of World Health Organization (WHO), United States Environmental Protection Agency (USEPA) and Japan. Concentration of ozone and PM2.5/PM10 are not met with the air quality standards in many monitoring sites though nitrogen dioxides and sulfur dioxides are met the standards in almost monitoring sites.

The analysis was also implemented for checking the spatial and temporal trend in terms of the relationship of air pollutants with the other socioeconomic factors such as the economic development (Gross Domestic Products) and population growth in this area. The results from the analysis were compared with the emission inventory of air pollutants in this region to identify the characteristics of the emission of air pollutants.

Though there are many initiatives related to the atmospheric environment in Asia, EANET is the only intergovernmental organization of the atmospheric environment in this region in which participating countries of EANET contribute financially to the activities of the network. The monitoring data of EANET is considered compatible internationally with good Quality Assurance/Quality Control (QA/QC) system. In terms of this point, it is expected to utilize the data to improve the air pollution problems in this region in more efficient and effective manner of EANET. The relationships and cooperation among relative initiatives, and possible action plan for the atmospheric environment in Asia are considered in this study.

Based on those analysis, the characteristics of monitoring and future direction of EANET are considered. In order to carry out the effective actions, science based policy should be enhanced including monitoring of PM2.5 and ozone as more significant items. In addition, the appropriate countermeasures and atmospheric environmental policies in East Asia such as the international cooperation for transboundary air pollution problems are suggested.

ENERGY AND AIR POLLUTION

CHARACTERIZATION OF INDIVIDUAL AEROSOL PARTICLES COLLECTED DURING KORUS AQ (KOREA US AIR QUALITY) CAMPAIGN PERIOD AT OLYMPIC PARK SEOUL KOREA

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In this study, aerosol particles of PM2.5-10 and PM1-2.5 samples collected during KORUS-AQ (Korea-US Air Quality) campaign period (May 23-June 5, 2016) were investigated on a single particle basis by low-Z particle EPMA (electron probe X-ray microanalysis) and Raman microspectrometry. Based on their elemental chemical compositions, major species of individual aerosol particles were mineral dust (aluminosilicate, CaCO3, SiO2, TiO2), reacted mineral dust, organics (organic carbons, (NH4)2SO4/NH4HSO4-containing organics, K-containing organics, biogenic organics), and reacted sea salts, which account for the relative number abundances of 94.8% and 96.1% in PM2.5-10 and PM1-2.5 fractions, respectively. Fe-rich, heavy metal-containing (HMs), soot, tarball, and fly ash particles were also frequently observed. Noticeable amounts of HMs were observed in both fractions (3.4% out of overall 8027 particles), among which Zn-containing particles were the most abundant (42.8% of HMs), largely as ZnCl and organic mixtures. Nitrate-containing reacted/aged particles were more abundant than sulfate-containing ones in the PM2.5-10 fraction, whereas it was reverse in the PM1-2.5 fraction. Raman microspectrometry was performed to obtain comprehensive molecular species and mixing state information on the same individual particles investigated by low-Z particle EPMA, showing that mineral dust particles coated with fatty acids were abundantly observed during biomass burning events, while secondary organic aerosols, sulfates, nitrates, and heavy metal-containing particles were significant during haze events. Attenuated total reflectance FTIR investigations for PM1-2, PM0.5-1, and PM0.25-0.5 bulk samples showed that main functional groups are NH4+, SO42-, NO3-, and organics. The average NO3-/SO42- intensity values for the PM1-2, PM0.5-1, and PM0.25-0.5 samples collected during haze events were 17.5, 12.7, and 1.7 times higher than those during non-haze days, respectively. The different characteristics of aerosol particles in biomass burning and haze events were clearly elucidated by the above complementary techniques.

DETERMINATION OF CHEMICAL MARKERS OF WOOD COMBUSTION IN AMBIENT AIR OF A RURAL COMMUNITY IN SOUTH WESTERN NIGERIA

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Particulate matter (PM) from biomass combustion process is one of the leading air pollution problems globally. Whereas information on the profile of the PM levels is replete there is dearth of available data on wood combustion related markers which are required for health risk assessment and climate change modeling. Therefore, this study determined the chemical markers of wood combustion processes in the ambient air of a rural community in South Western Nigeria.

The study randomly recruited and interviewed 138 participants comprising farmers, charcoal producers and food processors involved in wood combustion processes. Information on the quantity of wood combusted per day was obtained. The mean concentration of the PM2.5 was quantified using an environ tech gravimetric sampler with pre-equilibrated filter paper. Heavy metals adsorbed on the filter papers were estimated following standard procedures. The profile of chemical tracers was determined using Gas Chromatography coupled with Mass Spectrometer (GC/MS).

The proportion of wood burnt per day was, 60%, 30% and 10% for food processing, charcoal production and farm practice respectively. Total amount of wood burnt per day was 3000kg. The mean concentration of PM2.5 from biomass burning was 350±250µg/m3 occurring ten times higher than NAAQS guideline limits Mean concentration of heavy metals present were; lead (1.82 ±0.24mg/kg), cadmium (2.52±0.49 mg/kg), arsenic (0.58± 0.38 mg/kg), and manganese (3.2±0.66 mg/kg). Organic compounds identified were: Cyclohexanone, 2-(2-butynyl); (C10H14O), Phenol, 4-bis (1, 1-dimethyiethyl); (C14H22O), Octadecanoic acid,(C18H36O2), Dasycarpidan-1-methanol, acetate (ester); (C20H26N2O2), 1-Monolinoleoylglycerol trimethylsily ether, (C27H54O4Si2) and Thymol; (C10H14O). Thymol was found to be the most dominant of all the six organic compounds observed in the chromatogram of the PM-bound processed and analysed filter paper.

Biomass combustion processes at the household and commercial levels produced hazardous concentrations of respirable PM. The discovery of Thymol as the dominant organic marker would be useful for profiling of secondary organic aerosols in the area.

IMPACT ON URBAN AND REGIONAL AIR QUALITY FROM UNCONVENTIONAL ENERGY PRODUCTION OF SHALE GAS IN NORTH TEXAS

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Over the past two decades, unconventional energy production from shale gas in North Texas has grown rapidly. The Barnett Shale play in North Texas is one of the largest active onshore shale gas regions in the United States. The Dallas-Fort Worth (DFW) metroplex located adjacent to this energy production region, has consistently failed to comply with the U.S. Environmental Protection Agency's (EPA) National Ambient Air Quality Standards (NAAQS) for ozone. Exposure to elevated levels of ozone pollution can cause respiratory and cardio-pulmonary ailments in susceptible populations of very young and the elderly. In this study, we conduct a long-term trend analysis on the measured concentrations of ozone, oxides of nitrogen (NOx) and total non-methane organic compounds (TNMOC) from three ambient air quality monitoring sites in North Texas. The air quality data for Dallas Hinton (DAL), Fort Worth Northwest (FWNW) and Denton (DEN) was acquired from the Texas Commission on Environmental Quality (TCEQ) for a 19 year period spanning from 2000 through 2018. DEN, an exurban site surrounded by high shale gas production, had 582 days when the daily maximum eight-hour concentration of ozone exceeded 70 ppb. DAL and FWNW had lower number of exceedance days of 345 and 416, respectively, despite being located in two of the largest cities in North Texas. At all three sites, the oxides of nitrogen (NOx), a precursor pollutant to ozone, had declined since 2000 (-3.87%/year at DAL, -2.69%/year at FWNW, and -1.21%/year at DEN), primarily due to decreased emissions from mobile and stationary sources in the region. However, since 2000, DEN saw an increase in TNMOC concentrations by about +9.97%/year, while these declined in DAL (-1.62 %/year) and FWNW (-0.63%/year). The dominant TNMOC species measured at all three sites were ethane, propane, and n-butane, typically associated with natural gas emissions. The isopentane/n-pentane ratios calculated for DAL (1.931) and FWNW (1.514) suggested a higher influence from vehicular emissions, while DEN (0.959) was heavily influenced by natural gas production activities. The ozone formation potential (OFP) were calculated for all measured TNMOC species. Species associated with traditional urban sources (1-butene, m/p-xylene, propylene and toluene) affected the calculated OFP in DAL and FWNW, while the species linked to natural gas operations (ethane, isopentane and propane) influenced the OFP in DEN. Policy planners must factor such spatial and temporal variations in measured air quality levels while determining effective emission control strategies to mitigate the urban and regional ozone problem.

CO COMBUSTION OF BIOCOAL WITH SOMA LIGNITE IN A 30 KWTH CIRCULATING FLUIDIZED BED COMBUSTION SYSTEM

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Turkey imports 72% of its total primary energy demand. This demand increases every year because Turkey's development rate is about 5-7 %/year which requires huge amount of energy Therefore, it will be wise to use lignite and biomass sources together in clean energy production with a suitable combustion technology. A suitable technology for burning low calorie, high ash fuels with biomass can be co-firing in fluidized bed or in pulverized combustion. One of the advantages of co-firing is to use an existing plant to burn two fuels together which may be more economical and more environmentally friendly. Biomass co-firing has the potential to reduce emissions from coal-fuelled power plants. Contribution of biomass to emission reduction in co-firing with coal is limited due to its different structure and due to transportation difficulties. It is possible to increase this contribution by torrefaction of biomass and by obtaining biocoal which is similar to lignite coal. Using woody biomass directly as a fuel for combustion/co-combustion system is challenging due to its fuel properties as compared to lignites. Therefore, the use of biomass together with coal in power plants is limited. One way to increase the use of woody biomass in energy systems is to turn biomass into biocoal by torrefaction.

This work covers co-combustion of biocoal obtained from red pine with Soma lignite in a 30 kW-thermal capacity circulating fluidized bed combustor (CFBC) system in air and oxygen-enriched atmosphere. The combustor was of 108 mm inside diameter and 6 m height. The combustion temperature was held at 850+50°C. Oxygen enriched combustion tests were carried out at different ratios of lignite and biocoal mixtures. Biocoal was produced from red pine wood chips under 300oC and 30 min conditions by a screw type torrefaction system. Biocoal share in the fuel mixture was increased up to 50% by wt. It was found that the fuel mixtures up to 50% by wt. of biocoal were combusted effectively in the system. The oxygen concentration in the oxidant was varied between 21 and 28% by vol. for the oxygen-enriched combustion experiments. Flue gas emissions were measured by Gasmet DX-400 flue gas analyser. The results showed that biocoal can be a good additive fuel to lignite coal and oxygen-enriched co-combustion is an option for reducing flue gas emissions of CO and N2O. Particularly high oxygen concentrations reduced CO emissions. In contrast, NOx emissions increased with high oxygen concentrations and high levels of biocoal addition.

SUSTAINABLE CEMENT SECTOR STRATEGIES TO CONTROL EMISSIONS AND COMBAT CLIMATE CHANGE

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The cement sector is a leading industry of Turkey as well as being the first biggest producer in Europe and 4th biggest producer in the World. The sector continues contribution to Turkey's economy by producing approximately 71 million tons of clinker and 75 million tons of cement annually in 2018 with a total of 74 facilities, 55 of which are integrated and 19 are grinding.

Turkish cement sector is a leading industry, growing economically while considering all environmental responsibilities. The sector has great awareness and experience related to local air pollution control and global emissions such as the greenhouse gases.

The sector has been making environmental investments since early 1990's. Up to day, majority of the plants installed baghouse filters at the main stacks those are more efficient than the electrostatic precipitators. Reduction systems for nitrogen oxide were installed in many facilities to achieve the reduced emission limits. As per the on-going European Union acquis period, the sector follows and tries to apply the Best Available Techniques of the EU Regulation. This paper reviews the level of environmental investments to control local air pollutants.

Cement production comprises approximately 5-7% of the global emissions. Greenhouse gas emissions due to cement production can be classified as direct and indirect emissions. Direct emissions are those controlled by the facility (emissions from decarbonization and fuel). Indirect emissions are those, which are the result of the activities at the facility but result from other activities (such as electric power consumption). Cement plants in our country implements greenhouse gas monitoring, reporting and verification process annually as per the legislation.

The strategy of the cement sector in a low carbon economy requires implementation of the following pathways: increasing energy efficiency, increasing the use alternative fuels, reducing the clinker/cement ratio, installing waste heat recovery units and using new and innovative technologies (e.g. Carbon capture, storage and use).

This paper reviews improvements related to the pathways and further potential to reduce greenhouse gas emissions and the major challenges. The paper also reviews the consistency of these pathways with the Sustainable Development Goals of the United Nations.

INVESTIGATION OF THE EFFECTS OF ATMOSPHERIC PARTICULATE MATTER TRANSPORTED FROM DESERTS ON PHOTOVOLTAIC MODULE PERFORMANCE IN ŞANLIURFA TURKEY

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In Turkey with its rich renewable energy resources the GAP(Southeastern Anatolia Project) region is the highest in terms of solar radiation level. However, the provinces in the GAP region are subject to Particulate Matter (PM) coming from atmospheric transport from the Sahara desert, the Syrian desert and even the Arabian desert. Sanliurfa often exceeds the daily limit of PM10 and PM2.5 set by WHO for health. PM10 and PM2.5 pollutants affect air quality and health as well as accumulate on the Photovoltaic(PV) panels and cause loss of PV panel performance.

In this study, the effects of atmospheric dust accumulated on the panel surfaces for monocrystalline and polycrystalline PV technologies on panel performance was determined under Sanliurfa atmospheric conditions. In the experimental study, two panels with the same characteristics were used for each PV panel group from 2 different PV technologies. One of the panels in the PV panel group was cleaned by washing with distilled water while the other was not cleaned. Thus, the effect of the dust accumulation on the PV panel was determined by comparison to the cleaned PV panel. For this purpose, I-V values of all PV panels are measured with I-V meter. Panel surface temperature, solar radiation values and other meteorological values are measured simultaneously. In this study, the panels were washed every Monday. I-V measurements of PVs were taken every Monday, Wednesday and Friday at 12:00 am from 1 May 2019 to 31 July 2019.

According to the measurements, it is observed that the dust accumulation on the PV surface reduces the energy obtained from the panel between 3-5% depending on the amount of radiation.

EMISSION INVENTORY

DEVELOPMENT OF AN EMISSION INVENTORY FOR THE STATE OF KUWAIT

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Kuwait is a relatively small nation covering an area of roughly 17,820 km2, with a population of only approximately 2.8 million. Kuwait has sizable crude oil reserves, i.e almost 10% of the world's total, coupled with oil-production and a large number of oil-refining activities. This oil-driven modernization has its impact on the environment. Electricity generation is based on six power generation and/or desalination plants with a total power generation capacity of 12,579MW which are entirely dependent on fossil fuels with high levels of sulfur, in most cases. Another source of air pollution is vehicular emission, exacerbated by their complete reliance on fossil fuels and the fact that the number of vehicles per thousand people in Kuwait is nearly triple that of the world average and the overall length of the road network is 6,608 km and 1.6 million vehicles ply on the road.

Kuwait Institute for Scientific Research is currently conducting a project to develop the first comprehensive emission inventory for the State of Kuwait. This communication sheds light on the part related to calculating the emissions from the shipping activities. The emissions calculations considered emissions from main and auxiliary engines covering the cruising, hoteling and maneuvering phases. Tier 3 emissions calculations require detailed ship movement data as well as technical information on the ships (e.g. engine size and technology, power installed or fuel use, hours in different activities). Despite being time consuming, it is considered suitable for estimating national emissions. For the 2016 shipping activities, the total NOx, VOCs, TSP, and SO2 emissions were 47,462, 2,020, 4,011, 34,080 tonnes.

DEVELOPMENT OF AIR POLLUTION EMISSION INVENTORY FOR SHIPPING ACTIVITIES IN HA LONG BAY VIETNAM

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Air pollution is a serious issue in Vietnam which is mainly caused by intensive emissions from human activities. None of the studies have produced any comprehensive non-road mobile source emissions such as aviation, locomotive and shipping which may be equally important in Vietnam due to its long coastal line and many large river systems. This study attempts to fill in the gap by conducting an emission inventory (EI) for shipping activities in Ha Long Bay, Vietnam. The annual 2018 emissions with the spatial distribution and monthly variation were prepared and evaluated using the satellite data. EI for 2015 before new diesel quality (lower sulfur fuel) was developed and compared to the emission results of 2018 to see the effects of the intervention.

The shipping activity data were collected using a survey while the emission factors were calculated for main engine and auxiliary engine applying the USEPA method. The total annual emissions in 2018 of NOx, SO2, CO2, CO, PM10, PM2.5, BC, OC, NMHC and CH4 were 1,240; 114; 166; 81,018; 28.4; 26.2; 8.12; 5.21; 57.6 and 1.18 tons/year, respectively. Passenger vessels accounted for 72% of NOx emission, 73% of CO, NMHC and CH4 emission while international vessel group was in charge of 43% SO2 emission. Fishing and local cargo vessels were responsible for 3-14% of emissions of every considered pollutant. Maintenance vessels shared less than 0.2% of the emissions on average. The spatial distribution of pollutants was generated by the ArcMap v.10.5 which showed higher emission intensities along with the passenger and international vessel routes. The monthly variation of emission showed that June, December and November are the busiest months of passenger vessels which also had the highest monthly emissions.

The emission of SO2 and PM reduced significantly by the improvement of fuel quality from DO 0.25%S to DO 0.05%S. The emission results for 2018 showed that the SO2 emissions declined by 44%. Emission of PM10 and PM2.5, and their components (BC and OC) decreased by 20%. The reduction of SO2 and PM emission mainly came from local vessels since the international vessel group was not affected by the intervention.

The EI results serve as the first step toward the development of the emission reduction strategies for the Bay. The results can be used to prepare the input to 3D air quality modeling to further assess the effects of the emissions to ambient air quality and associated effects.

MODELING OF GREENHOUSE GAS EMISSIONS FROM TRANSPORTATION SECTOR IN ISTANBUL

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Climate change is one of the most important problems on a global scale in recent years. Due to the rapid increase in greenhouse gas emissions including carbon dioxide (CO2), methane (CH4) and dinitrogen monoxide (N2O), which are released into atmosphere as a result of human activities such as industrialization, fossil fuel consumption, agricultural activities and energy production, a significant rise in the average temperature of the earth's surface has been observed. According to data of 2016 obtained from NASA (National Aeronautics and Space Administration), the average global temperature on Earth has increased by about 0.8°C since 1880. In this respect, the Paris Agreement, which aims to limit greenhouse gas emissions and hold the increase in the global average temperature below 2°C, entered into force in November 2016. The countries that have ratified the agreement should declare their contribution to reducing greenhouse gas emissions. One of the most important components contributing to global greenhouse gas emissions is the transportation sector within this context. The greenhouse gas emission from the transportation sector is 84.7 Mton CO2e, which accounts for 16% of the total greenhouse gas emissions throughout Turkey in 2017. With a rate of 93%, road transport corresponds to the biggest share of greenhouse gas emissions from the transport sector. This value is followed by domestic aviation (4.5%), domestic water-borne navigation (1.1%) and railways (0.5%) in 2017. In this study, greenhouse gas emissions were modeled for the period of 2016-2050, in order to asses the impacts of the transportation sector on climate change in Istanbul, which is the most crowded city and has the highest number of vehicles in Turkey. (The number of road motor vehicles in Istanbul is approximately 4 million and constitutes 18.3% of the whole country road motor vehicles.) For this purpose, the TIMES Model (The Integrated MARKAL-EFOM System) as a technology-rich and economic model was used. TIMES uses long term energy scenarios to conduct in-depth energy and environmental analyses. The transportation sector was considered in four categories as road transportation, railways, domestic aviation, and water-borne navigation. the results of the study were obtained for the reference scenario, which assumes that the existing plans and policies will continue. It is expected that conducting such a study for Istanbul on the basis of the transportation sector will produce important outputs for in countrywide.

CORRECTION OF CRUSTAL AND ROAD DUST RESUSPENSIONS CONTRIBUTIONS IN EMISSION FACTOR CALCULATIONS

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Metals, particulate organic carbon (OC), elemental carbon (EC) and water soluble major ions emissions from road traffic were studied in Bolu Highway Tunnel located in western Black Sea region of Turkey. Three runs were made in each day, with a sampling time of 2 hours from July 23, 2018 to July 29, 2018. Emission factors (EF) for metals and ions in TSP samples were determined. Road and crustal dust resuspension contributions to metal and ions concentrations were corrected by calculation of crustal and road dust enrichment factors of the metals and ions. Road dust resuspension contributions on the EF results are very important to obtain reliable and representative EF values which directly affect the results of traffic emission inventory studies. A novel EF correction approach in which crustal and road dust resuspension components of the pollutants excluded in EF calculations, will be presented. Crustal (EFcrst) and road dust (EFrd) enrichment factors for metals and water soluble ions were calculated and sum of these two components were subtracted from the measured TSP concentrations to obtain the net vehicle emitted concentrations of the pollutants. This approach clearly differentiated the vehicle and dust resuspension related concentrations of the metals and the ions. Aluminum was used as a reference element for EFcrst and EC was used as a reference element for the EFrd calculations. Uncorrected emission factor values of As, Ba, Cd, Cu, Pb and Sb were 8.95±4.91, 57.3±51, 2.58±1.68, 175±88.0, 14.5±12.0, 6.30±4.30 µg/vehicle.km, respectively. Vanadium showed an unexpectedly high EF value (11000±3500 µg/vehicle.km) and the EF values of chloride, sulfate and ammonium ion were determined as 2000±1000, 15000 ± 4000 and 2600 ± 2000 µg/vehicle.km, respectively.

VEHICLE INSPECTION POLICY AND EMISSION ANALYSIS IN KUWAIT

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Technical vehicle inspection centers are widespread in Kuwait. All vehicles should pass the test every two years if not older than six years or every one-year for other vehicles. This study provided an insight into the data collected from test centers and the emission test utilized in Kuwait. Data were collected from tests' centers in the six governorates. 196 vehicles were tested but only 152 vehicles were utilized for CO emission violation and 157 vehicles for HC emission violation. European standards were selected as limits for emission violation. Independent variables included place of vehicle manufacture, vehicle's age, and odometer reading. A multinomial logit model was used to identify the significant predictors and to determine the correlation between dependent and independent variables. ANN was employed to compare prediction estimates of neural network and multinomial logit. The findings showed that the place of vehicle's manufacture, vehicle's age, and odometer reading were significant regarding violating emission standards of CO. Asian vehicles, vehicles with more than 150,000 km mileage, and vehicles older than 15 years had a higher probability of failing CO test compared to place of manufacture. In contrast, the odometer reading was the only significant indicator for vehicles that have failed HC test especially for vehicles with 150,000 km odometer reading.

A METHODOLOGY FOR CALCULATING RESIDENTIAL HEATING EMISSIONS IN TURKEY AND COMPARISON OF THE RESULTS WITH EDGAR AND EMEP EMISSION DATA BASES

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One of the key steps in local and regional air quality management is the determination of reliable emission inventories. Emission inventories are among the most important inputs that determine the performance of air quality modeling. Emission inventories are mainly the amount of pollutants released into the air from power generation plants, industrial plants, transportation activities and residential heating activities for a given period of time in a region. Among these emission sources, residential heating activities are the most prevalent source group in Turkey for difficulties in data collection for emission inventory calculations. The reliability of inventories for residential heating emissions is therefore controversial.
In this study, an appropriate approach has been developed for the calculation of emissions generated from residential heating activities. Based on "Family Structure Survey in Turkey 2011" report published by Turkish Statistics Institute, by using provincial population distribution at district and village level, family size, housing type and size (single-layer, independent housing, multi-storey apartment buildings, etc.), heat energy depending on the residential insulation conditions, heating systems (stove, boiler, central heating) data, fuel types used for heating were determined. In order to estimate the annual fuel quantities used in the houses, required heat energy was calculated by using daily average temperature of the winter season, the size of the residential area to be heated and the insulation status of the building. The methodology presented in "Turkish Standandard 825 - Thermal Insulation in Buildings with Examples" published by İzocam Company was adopted for calculating the required fuel amount by using current fuel types and heating practices used in each region. Thus, the residential emissions were calculated with the help of appropriate emission factors for each fuel type and combustion system.

Using the Geographical Information System, the calculated were mapped in to 1x1, 0.5x0.5 and 0.1x0.1 degree grids based on the population density of the settlements at each grid area. The grids obtained with this method were compared with the data in similar sized grids in the internationally used Emission Database for Global Atmospheric Research (EDGAR) and European Monitoring and Evaluation Program (EMEP) databases.

POSTER SESSION

PREPARATION OF CALCIUM PHOSPHATE SOLUTION FOR REMOVAL OF HARMFUL GASES

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Generally, air purifier equipped with an air filter is well used for indoor space to remove particulate matter(PM) and harmful gases. An air filter made of non-woven fabric cannot capture harmful gases such as NOx, SOx and NH3. For this purpose, activated carbon is used usually. However, it is well known that activated carbon cannot capture the harmful gases with low molecular weight. Also, activated carbon has the problem of releasing absorbed gases. Previous studies reported that calcium phosphates can capture harmful gases. In this study, we assumed to use of calcium phosphate on air filter to improve removal of harmful gases. We prepared amorphous calcium phosphate following previous study. The prepared calcium phosphate was determined to be hydroxyapatite from XRD pattern. And the calcium phosphate mixed with distilled water containing a binder and additives. The calcium phosphate solution was spray coated on an air filter and then dried. The removal efficiency was tested using toddler bags and detector tubes for 2 h. The removal efficiency of raw air filter was 62.5%, 9.5% and 9.3% for NO2, SO2 and NH3, respectively. After spray coating the calcium phosphate solution on raw air filter, the efficiency of the filter was improved to 95.3%, 96.4% and 94.9% for the gases. Using the calcium phosphate already captured NH3 on efficiency, gas release test was performed. The gas release test results showed that calcium phosphate did not release the already captured NH3 gas comparing to activated carbon which release about 15% of captured NH3 gas. Consequently calcium phosphate is effective to remove harmful gases for air filters.

NECESSITY OF IMPROVED AMMONIA EMISSION INVENTORY IN AGRICULTURE

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In winter and spring seasons, high concentration particulate matter severely affects human health in Korea.. Particulate matter is emitted from various sources and formed from many chemical materials. Increasing use of nitrogen fertilizer during the past 50 years has also increased the agricultural production and induced environmental load in the agricultural environment. In the agricultural sector, non-point source pollutants could be emitted to not only water but also air. Agriculture is a complex system which has a broad border and includes various living organisms. Ammonia emitted from animal feeding operations is an air pollutant contributing to the formation of fine particulate matter. Secondary formation particulate matter is composed of 72% fine particulate matter in 2014. Ammonia is mainly emitted from animal feeding, manure process, fertilizer application, and industrial process. It reacts in the atmosphere with sulfur dioxide(SO2) and nitrogen oxides(NOx) to form particles containing ammonium sulfate and ammonium nitrate. An ammonia emission of 78% was found in agriculture through the Clean Air Policy Support System (CAPSS, Ministry of Environment) in 2015. The EU, the USA, and China ammonia emissions in the agricultural sector were 94 %, 86 %, and 82 %, respectively. The livestock sector needs to develop improved emission factor by animal housing type, animal, manure storage method, manure management, and livestock environments. Crop land sector also needs to enhance emission factors by crop, cultivation method, nutrient input material, application time, and cultivation environments. The nitrogen budget of crop land is not reduced by increasing manure application although nitrogen fertilizer application is reduced in Korea. In order to develop the quality emission inventory of ammonia, the activity data (animal number, amount of manure, amount of fertilizer application, crop land area, etc.) should be renewed every year. When the amount of ammonia emission in the agricultural sector is established, one could apply the practical reduction technology of ammonia emission at the agricultural field and could contribute to preserving the sustainability of agriculture and improving air quality.

HONO SENSITIVITY TO H2O2 AND O3 FORMATION DURING KORUS AQ CAMPAIGN IN SEOUL KOREA

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Nitrous acid (HONO) is a key source of OH radical and hydrogen peroxide (H2O2) play as reservoirs of HOX radicals, and both are important photochemical indicator species. To understand the oxidative mechanisms that lead to urban ozone and aerosol formation, research of budget and behavior of these trace gases is very important. In this study, in order to investigate the major path of HONO production and conduct budget analysis of H2O2, BOX Model eXtension (BOXMOX) using the North Carolina State University (NCSU) version of the CB05TUCL mechanism was utilized. HONO and H2O2 were measured during KORUS-AQ campaign performed in Olympic Park located in Seoul, Korea, from May 19 to June 15, 2016, including high ozone (O3) days (>100 ppbv), using Quantum Cascade-Tunable Infrared Laser Differential Absorption Spectrometer (QC-TILDAS). Atmospheric other components (O3, nitric oxide (NO), nitrogen dioxide (NO2), sulfur dioxide (SO2), formaldehyde (HCHO), nitric acid (HNO3), carbon monoxide (CO), isoprene, toluene and xylene) were simultaneously measured. HONO concentration over the measurement period varied from 0.10 ppbv to 3.46 ppbv, H2O2 concentration varied from 0.10 ppbv to 2.06 ppbv. We analyzed the sensitivity of HONO to H2O2 and O3 formation and its potential sources using a box model.

PAHS IN PM1 PARTICLE FRACTION AN URBAN LOCATION IN CROATIA

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Airborne particles are composed of inorganic species and organic compounds. Particle pollution includes “inhalable coarse particles” with diameters larger than 2.5 μm and smaller than 10 μm and fine particles with diameters of 2.5 μm or smaller. PM1 particles, with an aerodynamic diameter smaller than 1 μm, are considered to be of importance in the context of adverse health effects. The mass concentration of particulate matter (PM) is not the only important parameter for the assessment of health risks of atmospheric pollution. Many compounds bound to particulate matter, such as polycyclic aromatic hydrocarbons (PAH), are suspected to be genotoxic, mutagenic and carcinogenic. PAHs are organic compounds that consist of two or more aromatic rings. More than 500 PAHs have been identified in the air and they were among the first pollutants recognized as potential carcinogens. PAHs are products of the incomplete combustion of fossil fuels and other organic materials and originate from a variety of natural and industrial processes. In this study, PAHs in PM1 particle fraction were measured during one year (1/1/2018–31/12/2018). The measuring station was located in the northern residential part of Zagreb, the Croatian capital, close to a street with modest traffic. 24-hour samples of PM1 particle fraction were collected on quartz filters from about 50 m3 air using a low-volume sampler. The analysis was performed using a high performance liquid chromatograph (HPLC) with a fluorescence detector and time programmed changes in excitation and emission. Samples were analysed for the following PAHs: fluoranthene (Flu), pyrene (Pyr), benzo(a)anthracene (BaA), chrysene (Chry), benzo(j)fluoranthene (BjF), benzo(b)fluoranthene (BbF), benzo(k)fluoranthene (BkF), benzo(a)pyrene (BaP), dibenzo(ah)anthracene (DahA), benzo(ghi)perylene (BghiP), and indeno(1,2,3-cd)pyrene (IP).

Significant differences were found between PAH concentrations during cold (January- March, October-December) and warm (April-September) periods of the year. During the cold period, BbF had the highest mass concentrations (0.215–3.412 ngm-3), while during the warm period the highest mass concentrations was recorded for BghiP (0.067–0.277 ngm-3). During both periods, DahA had the lowest mass concentrations. The average monthly mass concentrations of BaP ranged from 0.038 ngm-3 in June to 2.826 ngm-3 in December (the annual average was 0.765 ngm-3). In general, during the whole year mass concentrations of PAH characteristic for car exhaust (BghiP, IP, BbF) were higher than concentrations of Flu and Pyr, which originate mostly from domestic heating and biomass burning.

ATMOSPHERIC DEPOSITION OF ORGANIC COMPOUNDS

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The atmosphere is a carrier on which some natural and anthropogenic pollutants are transported. Deposition events are the most important mechanisms that remove organic compounds from the atmosphere to terrestrial and aquatic ecosystems. A method based on solid phase extraction (SPE), gas chromatography-mass spectrometry (GC-MS/MS) and gas chromatography with electron capture detector (GC-ECD) was developed for a determination of polycyclic aromatic compounds (PAHs) and polychlorinated biphenyls (PCBs) in atmospheric deposition samples. PAH compounds (fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(j)fluoranthene, benzo(a)pyrene, benzo(e)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene and benzo(g,h,i)perylene) were analysed by GC-MS/MS and six indicator PCB congeners (PCB-28, PCB-52, PCB-101, PCB-138, PCB-153 and PCB-180) were analysed by GC-ECD equipped with two micro electron-capture detectors and two gas chromatographic columns.

The extraction procedure was based on forcing the whole sample through a silica cartridge with a mixture of dichloromethane and hexane (1:1, v/v) as the eluting solvent. Prior to the analysis, the eluate was dried with sodium anhydrous sulphate and evaporated under a stream of nitrogen to 2 mL. The limits of detection for the analysed compounds ranged from 0.005 ng mL-1 for PAHs to 0.05 ng mL-1 for PCBs. For the determination of extraction efficiency, before extraction model samples were spiked with perylen-d12 as surrogate standard and standards of PAHs and PCBs in a range of mass concentrations from 1 ng mL-1 to 10 ng mL-1. The extraction recoveries ranged from 65 % for pyrene to 124 % for chrysene with relative standard deviation (RSD) values between 6 % and 15 %, while for PCBs recoveries from 70 % for PCB-28 to 80 % for PCB-153 with RSD values between 8 % and 10 %.

The method was applied to determine the 12 PAHs and six indicator PCBs in monthly total deposited matters collected by bulk method at an urban background station in Zagreb, Croatia during 2018. The levels and occurrence of PCBs corresponded to global environmental pollution with the highest PCB deposition rate determined in December. During the measurement period, the deposition rates of ∑12PAHs varied between 132.2 ng m-2 d-1 and 698.6 ng m-2 d-1.

TRAFFIC EMISSION FACTORS OF WATER SOLUBLE MAJOR IONS

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In this study, total suspended particles (TSP) were collected with active sampling method at Bolu Mountain Tunnel to determinate the emission factors (EF) of water-soluble ions. The tunnel is 3.1 km long and divided in two separate tubes (Istanbul-Ankara and Ankara-Istanbul) with three driving lanes in each. Two PUF samplers were installed at the entrance and the exit of southern tube (Istanbul to Ankara). Samples were collected simultaneously at the entrance and the exit of the tunnel tube. Types and numbers of vehicles passing through the tunnel were determined from the videos recorded by the tunnel operators. Temperature and wind speed values corresponding to each sample were also gathered from the records of tunnel operators. Manual counting from video records showed that the average number of vehicles using the tube was about 1000 vehicles per hour. The average contribution of heavy duty vehicles and the light duty vehicles on the vehicle fleet were determined as 15% and 85%, respectively. Sampling was carried out in seven consecutive days between July 23 and July 29, 2018. The contribution of major cations to TSP were found as 29% and 6% at the entrance and exit of tunnel, respectively. while the contributions to TSP by the major anions were calculated as 20% and 6% at the entrance and the exit of the tunnel, respectively. The averages of major anion concentrations were found as 11.5±4.36 µg.m-3, 8.05±1.04 µg.m-3 and 3.18±1.43 µg.m-3 at the entrance of the tunnel for SO4-2, Cl-, NO3-, respectively. They were 32.68±7.67, 10.98±1.62 and 3.05±1.11 µg.m-3 at the exit of the tunnel for the same anions. Furthermore, the major cation concentrations were 47.2±35.6, 4.24±2.65 and 2.66±1.24 µg.m-3 at the entrance station for Ca2+, NH4+ and Na+, respectively. The averages of the same cations were determined as 7.37±7.02, 4.44±3.18 and 1.07±0.76 µg.m-3 at the exit station for Ca2+, NH4+ and Na+, respectively. EF values of water-soluble ions were determined as 2.0±1.0 (Cl-), 15.0 ± 4.0 (SO4-2) and 2.6 ± 2.0 (NH4+) mg/vehicle.km-1 in tunnel atmosphere. In EF results, soil borne Na+, K+, Mg+2 and Ca+2 ions showed positive EF values, ie. The exit concentrations were higher than the entrance concentrations, however, they were not evaluated as the result of vehicular emissions, since the aeration of the tunnel tube re-suspend the accumulated dust in the tunnel atmosphere. The calculated EF values for ions were found to be higher than and at comparable levels with the values reported in literature.

FUGITIVE SOURCES CONTRIBUTION TO PETROLEUM REFINERY EMISSIONS

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Fugitive emissions are defined as emissions which could not reasonably pass through a stack, chimney, vent, or other functionally-equivalent opening, generally characterized as low point leaks with minimal exit velocity. Apart from product and financial loss, fugitive emissions also contribute to air pollution and climate change, and present a dangerous threat to human health and safety. Despite this, fugitive emissions are often left unreported in emission inventories or air quality monitoring. The objective of this paper is to quantify fugitive emissions with the purpose to facilitate the prioritization of chemicals potentially emitted from a petroleum refinery based on their health risks.

Emission rates were estimated from point sources i.e flare and stationary combustion equipment, and fugitive sources i.e equipment leaks, loading and unloading activities, storage tanks, wastewater collection and treatment system, and cooling towers based on methodologies recommended by the USEPA for the petroleum refining industries.

Although fugitive emissions are difficult to quantify with a high degree of accuracy, these data are a good start to establish a baseline for input to the consequent health risk assessment.

CHARACTERIZING THE ELEVATED AIR POLLUTION LEVELS NEAR A ROAD INTERSECTION IN A DENSELY POPULATED RESIDENTIAL AREA USING DRONE MONITORING AND CFD MODELING

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Road intersections in urban areas are typically characterized as traffic-related air pollutant emissions due to large traffic volume and frequent stop-and-go driving patterns. To identify the pollutant dispersion near road intersections, ground-based measurements and computational fluid dynamics (CFD) model simulations have been traditionally utilized in relevant fields. The objective of this study is to characterize the air pollutant distribution not only horizontally but also vertically near a road intersection in a densely-populated residential area. We adopt vertical measurements using a drone, which is able to measure vertical profiles of air pollutants within a few hundred meters from the ground. Microscale simulations using a CFD model are also performed to confirm the comparability with the drone measurement. Therefore, the impacts of the traffic-related pollutant emission at a road intersection on the air pollution in surrounding residential areas are examined. The study area is Toegye intersection in Chuncheon, Republic of Korea. The measurement periods were from 11 to 15 on March, 2019, and from 1 to 5 on April, 2019. Air pollutants such as PM2.5, BC, and NOx were measured at a 30-m height of apartment building near the intersection. Vertical PM2.5, BC, and O3 measurements using a drone were carried out at 7 altitudes up to 100 m from the ground at 8-9 LT in the morning on selected 6 days. The PM2.5 and NO2 concentrations measured at the apartment building were higher than those measured at the urban air quality monitoring site, which is located 1 km away from the intersection. It was very clear particularly when the apartment building is located at the downwind side from the intersection. The vertical measurements showed that PM2.5 and BC concentrations decreased with increasing altitude, while the differences in PM2.5 and BC concentrations between the ground and 50-m height were 10 μg m-3 and 1 μg m-3, respectively. This result implies that low-rise apartment buildings can suffer from the elevated air pollution near a road intersection. The CFD model simulations successfully reproduced the elevated air pollution at the apartment building located at the downwind side from the intersection. Based on the measurement and simulation results, air pollution hotspot areas can be identified not only horizontally but also vertically.

THE PREDICTION OF EMISSION FACTORS FOR TRAFFIC POLLUTANTS IN MAJOR REGIONAL ROAD OF KYOTO JAPAN

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In this works, the emission factors (EFs) for traffic air pollutants (TAPs) were predicted on two classification of vehicles (passenger cars and trucks) at the major regional roads of Kyoto, Japan. Depending on the availability of real-time traffic information which recorded via an intelligent transport systems (ITS), the traffic characteristics (compositions, mean speed and volume of vehicles) were gathered. A macroscopic vehicle emission model `Computer Program to Calculate Emission from road Transport` (COPERT) was used to compute the EFs of TAPs. Input variables such as fuel data (specification), activity data (number of vehicles and mileages), driving condition (average speed of vehicles), and miscellaneous (meteorological information, mean trip distance, evaporation distribution data) are required. TAPs include benzene, nitrogen oxide (NOx), carbon monoxide (CO), coarse particulate matter (PM 10) and fine particulate matter (PM 2.5). Results show that the vehicle flow for passenger cars and trucks are 1449 veh/hr and 128 veh/hour, respectively. The speed of vehicles are between 5.3 kmph to 47.3kmph, proves that the road has a high possibility of congestion (mean congestion degree: 1.24). Passenger cars are the prominent source of the CO (mean: 45.52 g/km, S.D: 8.26 g/km). However, the trucks are responsible for the greatest EFs of NOx (mean: 26.13 g/km, S.D: 4.28 g/km) and the dominant generator of particulate matters [PM 10 ; (mean: 1.76 g/km, S.D: 0.31 g/km), and PM 2.5 (mean: 1.61 g/km, S.D: 0.31 g/km). Passenger cars indicate the higher EFs of benzene compared than trucks with the mean 1.16 g/km (S.D: 0.18g/km) and 0.17 g/km (S.D: 0.05 g/km). EFs of TAPs for both classification of vehicles demonstrates the large discrepancies due to the variation of fuel types, volume and speed of vehicles and emission standards.

UNDERSTANDING ON GLOBAL STATUS OF PARTICULATE MATTER WITH RESPECT TO RESEARCH NETWORK

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Particulate matters (PM), one group of carcinogens, causing various sources including vehicles and power plants are one of the major concerns in South Korea. The Korean government has a plan to increase the expenditure of R&D to reduce the PM in the atmosphere. However, the level of Korean PM technology is still low in spite of increase of R&D budget. In this study, network of PM technology are investigated to help policymakers future R&D investment more efficiently. Here, social network analysis is used to understand the research collaboration between difference countries or institutes. The results reveal that China and USA published the largest number of SCI papers in the field of PM research, while South Korea was ranked of top 5 country in the world. The research network is mainly formed between China and USA, while South Korea has a week collaboration between countries or institutes. Thus, more effort is necessary to improve the strategic R&D investment and network range.

CHARACTERISTICS OF ALDEHYDES EMITTED FROM STREET TREES AND URBAN FORESTS BY VARIATIONS OF TEMPERATURE AND LIGHT

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Abstract

This study was conducted to investigate the characteristics of aldehydes (formaldehyde, acetaldehyde, propionaldehyde, crotonaldehyde, butyraldehyde, benzaldehyde, valeraldehyde, m,p-tolualdehyde, o-tolualdehyde, hexaldehyde, isovaleraldehyde) emitted from Prunus sargentii, Ginkgo biloba, Zelkova serrata, Taxus cuspidate and Metasequoia glyptostroboides depending on various temperature and photosynthetically active radiation (PAR) variations. To collect aldehyde samples emitted from each tree, we used an enclosing chamber system, which can be controlled temperature and PAR, and DNPH cartridge (Model: 21014, Supelco, USA) equipped with an ozone scrubber (Model: WAT054420, Sep-pak, USA). The chamber was designed to be economical, efficient, and capable of minimizing the possibility of internal contamination or sample loss. It was constructed with sufficient size (25 L) based on seedlings size. A zero-air generator (Model: 701, Teledyne Instruments, USA) was used to introduce zero air into the chamber to minimize the interference from external contaminants. The temperature was set as 20, 25, and 30°C. The PAR was set as 500, 1,000, and 1,500 μmol m-2 S-1. After the temperature and PAR conditions had reached setting values, the actual temperature and PAR were measured by thermometer (Model: BST131-BABUC/M, LSI LASTEM, Italy) and PAR meter (Model: BSR107-BABUC/M, LSI LASTEM, Italy) during the sampling of aldehydes. The samples collected were analyzed by High performance liquid chromatography (Model: YL9100 Plus HPLC System, Young in Chromass, Korea). As a result, the emission rates of aldehyde emitted from target trees were considerably different by various influencing factors such as species, temperature, PAR, etc. Formaldehyde and acetaldehyde were emitted from all species. However, other aldehydes except for m,p-tolualdehyde which was emitted from only Prunus sargentii, Zelkova serrata and Metasequoia glyptostroboides were not detected. The aldehyde emission rate from Zelkova serrata was the highest among all target species. For some species, the emission rate of aldehyde increased with increasing temperature or PAR. However, we found that the effect on emission rate was not constant for certain temperatures and PARs.

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ANALYSIS OF THE AEROSOL OPTICAL PARAMETERS AND PM10 CONCENTRATIONS TO DETERMINE THE DOMINANT AEROSOL TYPE

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The aim of this work is to determine the dominant aerosol type at Bucharest_INOE, based on the analysis of the optical parameters of aerosol using data from Aerosol Robotic Network (AERONET). Aerosol types are classified on the basis of the dominant size mode and radiation absorptivity determined by the fine mode fraction (FMF) and single scattering albedo (SSA), respectively. Using this classification it can distinguish between dust, mixture, black carbon(BC) and non-absorbing anthropogenic aerosol (NA). Analyzing a two year data set 2014-2015 we found NA dominant aerosol (80%). In order to estimate the air pollution level, a ground measured data set of PM10 concentrations, for samples collected near Bucharest_INOE station from the same time interval, was analysed. The aerosol properties from ground-based AERONET network and the PM mass concentration determinations can make a local diagnostic about the aerosol type and the level of air pollution.We identified the types of aerosols that lead to values of PM10 greater than 50 μg/m3. As many studies have demonstrated the close relationship between PM10 concentrations and human health, it is important to know particulate matter type from the breathing air. A possibility to establish the dominant aerosol type is based on the globally distributed data from the AERONET network.

MODELING THE AIR POLLUTANTS IN ISTANBUL USING AERMOD

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Since the change in the rate of chemical reactions in the planetary boundary layer alters the climate change, the climate change alters the air quality as well. As the air quality worsens, it results in a change in both the environment and human's health. Air pollutants due to their fast dispersion rates has a complex structure. The dispersion of industrial air pollutants has adverse effects on air quality, since dispersal depends on how they are entering the atmosphere, time, location, source type and etc. Thus it is difficult to determine the emissions, directly. In this study it is aimed to simulate the dispersion of atmospheric pollutants PM10, SO2, NO2 originated in Istanbul for the year 2017, using AERMOD. The concentrations resulting from the simulation were determined and evaluated with respect to the current standards defined by the law. The results showed that the the standards allowed by the law were exceeded in many parts of the city and it was observed that these three pollutants affect the health of people, fauna and flora living around these areas directly or by accumulation.

COMPARISON OF TWO AIR POLLUTION MODELS APPLIED TO ASSESS POPULATION EXPOSURE IN LEIPZIG GERMANY

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Objectives: We compared the exposure assignment of two air pollution models to all addresses in the city of Leipzig.
Methods: Predicted concentrations of nitrogen dioxide (NO2) and fine particulate matter (PM2.5) for 2010 were assigned to all addresses in Leipzig (n=69,662) from two air pollution models with different spatial resolutions: fine spatial resolution (100x100 m) hybrid land use regression models developed for West Europe within the ELAPSE project and models with 2x2 km resolution from German Environmental Agency (UBA) developed for all Germany using the optimal interpolation technique.
Results:
Modeled annual mean concentrations of NO2 at all addresses were 26.9 ± 4.9 (11.8-56.2) µg/m3 and 20.7 ± 1.0 (15.8-25.6) µg/m3 for ELAPSE and UBA models, respectively. PM2.5 concentrations were 18.6 ± 0.8 (14.5-21.1) µg/m3 and 17.0 ± 0.5 (15.6-17.7) µg/m3 for ELAPSE and UBA models, respectively. The range of the ELAPSE exposures was much larger than for the UBA for both pollutants. Pearson's correlation coefficients between ELAPSE and UBA exposures were 0.29 and 0.50 for NO2 and PM2.5, respectively. NO2 ELAPSE exposures correlated poorly with NO2 UBA, possibly explained by the fact that NO2 is a locally varying pollutant, strongly associated with traffic, which is better picked up by the ELAPSE model (100x100m) than by the UBA model ((2x2km). On the other side, PM2.5 ELAPSE exposures correlated better with PM2.5 UBA as PM2.5 is a more regional pollutant so less variation at the local scale and hence a better correlation.
Conclusion:
We assigned two different models developed for Western Europe and Germany to a very defined spatial area in Germany. The model with higher spatial resolution fitted better to explain within city variation of pollutants related to local sources to describe exposures of residents of Leipzig and the LIFE (The Leipzig Research Centre for Civilization Diseases) cohort.

EVALUATION OF POLLUTANT BEHAVIOR EFFECTS ON HUMAN HEALTH IN IĞDIR

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Air pollution, that increases with the industrial revolution threaten our planet; which is one of the most serious problems facing living beings. The rate of increase in air pollution is scaling up exponentially due to the activities such as industry, transportation, and heating in metropolitan cities from day to day. The concentration of pollutants in the air in large cities is much higher than in rural areas, and pollutants can be distributed over different distances in the world due to meteorological and topographical effects. At the same time, these pollutants combine with the water vapor in the air and fall down to earth as the acid rain. Pollutants; sulfur dioxide (SO2), particulate matter (PM), nitrogen oxides (NOx), carbon monoxide (CO), carbon dioxide (CO2), halogens and ozone (O3); that play a significant role in air pollution damage both living and non-living beings. According to the World Health Organization (WHO), air pollution is an effective factor in the death of 4 million people annually and damages the health of billions of people. It is indicated in studies; air pollution that is mainly due to the small size of particulate matter causes lung cancer, asthma, bronchitis diseases, eye diseases, respiratory failure problems. In this study, hourly data of PM10 and SO2 values that measured in Iğdır air monitoring station of the Ministry of Environment and Urbanization were examined between 2014-2018. At the same time; the region was examined in terms of meteorological parameters in this period and, its relation with pollutants was revealed. The distribution of the data on years, months and days were examined and it was determined that the pollutant concentration was high at that time. According to the data, PM10 density is higher in winter and evening hours. In light of this information, the effects of pollutants in the region on human health have been tried to be revealed.

ANALYSIS OF NO2 AND SO2 IN MARMARA REGION

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Living creatures must live in a healthy environment in order to lead a healthy life. This situation further increases the importance of air pollution. Air pollution is the amount of pollutants present in the atmosphere to reach the amount that will affect the living and the environment negatively. Air pollution has become a threat to human health and the environment, especially with the industrial revolution.. In addition to industrial activities, increasing urbanization has led to an increase in the amount of pollutants released to the atmosphere. Air pollution has many natural and anthropogenic sources such as industry, heating, motor vehicle use. Besides, meteorological conditions such as temperature, humidity and precipitation can be observed. One of the important factors is also known as temperature reversal. As the result of an increase in temperature with an elevation, the pollutant particles on the earth do not distribute and create unhealthy conditions on the region. Nitrogen dioxide, the primary source of motor vehicles, is an indicator of the importance of vehicle emissions. The main source of sulfur dioxide (SO2) is a gas produced by the combustion of industrial fuels and fuels used for heating purposes. Especially during the winter months, the values increase due to heating. With the increasing population and developing technology, efforts to reduce air pollution have started to increase.

In this research, the relationship between NO2 and SO2 has been analyzed for Marmara Region. Three stations (Başakşehir, Kandilli and Sultanbeyli) from Istanbul, one station from Tekirdag an done station from Sakarya (Ozanlar) were chosen. For this purpose, NO2 and SO2 data measured between December 2012 and December 2018 were analyzed. As a result the healtiest station by means of NO2 and SO2 were found to be Kandilli, Istanbul. Especially during winter months, the highest value was found to be 341 µg/m3 in Tekirdag.

DEVELOPMENT OF EMISSION INVENTORY FOR AIR POLLUTANTS IN HANOI METROPOLITAN REGION 2015 FOR AIR QUALITY MODELLING AND HEALTH EFFECT ASSESSMENT

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High levels of air pollution are one of the most concerning health and environmental hazards in Hanoi Metropolitan Region or HMR (covering Hanoi capital and number of surrounding provinces). In the first three months of 2018, the 24h PM2.5 concentrations exceeded the National Regulation on Ambient Air QCVN 05/2013/BTNMT of 50µg/m3 in 49 days, i.e. 54% of the daily measurements in Hanoi and were above the WHO guidelines of 25µg/m3 in 82 days (91%). Previous studies conducted at Asian Institute of Technology (AIT) Thailand showed that the total 2010 anthropogenic emissions of CO; SO2; NOx; NMVOC; PM10; PM2.5; BC; OC; NH3; CO2; CH4 and N2O in HMR were in Gg/year of 686; 2.2; 85; 173.6; 15.9; 14.5; 2.7; 3.1; 2.5; 11,257; 8 and 143, respectively (Phuc, 2018). However, the large point sources (stacks) emission from the industrial estates were not separated from other sources which prevented from a more elaborate dispersion modeling studies for PM2.5 and other pollutants. This study updates the EI from HMR to the base year 2015 for key sources (on-road mobile, power generation, industry combustion, biomass open-burning and residential combustion). Detail emissions from main large point sources in the domain are collected to improve the emissions input data for WRF/CAMx (Weather Forecast Research Model/Comprehensive Air Quality Model with Extension) modeling system. The simulated PM2.5 concentration in HMR for the base case (2015) and emission reduction scenarios (better traffic management, open burning ban) will be used to estimate health benefits using BenMAP-CE (Benefits Mapping and Analysis Program - Community Edition). The findings of this study provide the science-based information for comprehensive air quality management policies in the domain.

AMBIENT AIR QUALITY IN ARID AREA DUE TO TRAFFIC EMISSIONS

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According to World Health Organization (WHO) global air pollution exposure assessment models, 4.8 million deaths occurs annually as a result of exposure to ambient air pollution as about 91% of the world's cities currently exceeds the WHO's air quality standards. Thus, air pollution exposures have been associated with the incidence of cardiovascular, respiratory, cancer, diabetic and neurodegenerative diseases. This study assesses the current ambient air quality across some selected locations in Muscat city, in the Sultanate of Oman through deployment of mobile and integrated air quality monitoring station for the measurement of several air pollutants emission levels. The measurements were conducted over a period of 12 months. The results showed that most of the toxic air pollutants hereafter called air criteria pollutants (µg/m3) including NO (12.67- 46.83), NO2 (14.42- 50.4) NOx (52.8- 97.63), O3 (33.5 – 52.87), PM10 (13.71 – 74.95), PM2.5 (0.7-20.62) and CO (0.63 – 3.75 mg/m3) were within WHO and MECA standards. Therefore, it is highly recommended that future air pollution assessment study should employ satellite based air quality chemical transport models to help determine the seasonal and diurnal variabilities for several years compared to mobile air quality instrument which measures pollution levels over very short durations (1-3 months). In addition, it is important that future study should focused on conducting human health exposure assessment studies to determine the association of the air pollution concentration levels and incidence of aforementioned non-communicable diseases among Omani population. Such epidemiological study will be helpful in improving the health of the general population from air pollution levels through formulation of relevant public health policies.

SPATIAL AND TEMPORAL VARIATIONS IN PM10 AND PM2.5 CONCENTRATIONS AT URBAN AND RURAL SITES OF MARMARA REGION IN TURKEY

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In this study, to increase the knowledge of the PM10 and PM2.5 in the Marmara region we assessed the spatial and temporal variations of PM10 and PM2.5concentrations measured at urban and rural areas during 2013-2018. The Marmara region is located in the northwest of Turkey.This region provides the main contribution to the national economy with industrial and energy facilities. In this study, a total of 38 air quality stations, 4 of which are in rural and 34 of which are in urban-industrial and traffic regions, are used for PM10; hourly values of PM2.5 concentrations in 13 air quality stations, 4 of which are rural and 9 of which are in city-industry and traffic regions, were analyzed for April 2013 - December 2018 period.

The PM10 and PM2.5 concentrations in rural areas of the Marmara region are lower than those in urban areas. It is found that PM2.5 concentration values are above the 24-hour average (25 µg / m³) limit set by the WHO at all stations between March 2013 and December 2018. The seasonal variations in PM2.5 concentration values vary between 10-20 µg /m³ in the rural sites of the region while PM10 concentration values in all stations vary between 23-47 µg / m³ in rural sites. However, PM10 concentrations in urban sites exceed air quality standards for most of the year. Especially in winter, PM10 levels exceed 100 µg / m3. Moreover, weekdays and weekend (Sunday) PM10 and PM2.5 levels for both urban and rural sites are compared. In the majority of stations, the weekday values of PM10 concentrations are higher than at the weekend. Weekday values are 53.35 µg / m³ on average, while weekend values are 52.79 µg / m³ due to less industrial production and traffic flow. In PM2.5 concentrations, the difference between weekday and weekend levels is lower than PM10. The effect of meteorological factors such as atmospheric pressure and wind speed on the PM10 and PM2.5 levels in the Marmara region were investigated. Besides, the influence of the atmospheric transport on the PM10 levels was examined by means of back-trajectories. HYSPLIT model was used to understand the role of transport of particular matter on the highest PM levels at several receptor sites. Trajectory clustering in the region has been performed to reduce the uncertainties.

EXPLORING OPTICAL PROPERTIES OF ABSORBING AEROSOLS USING SATELLITE BASED OBSERVATIONS OVER PAKISTAN

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Pakistan's urban air is among the worst in the world, with the major sources of air pollutants to be crop-residue burning, vehicular and industrial emissions. Besides the regional sources, aerosols from agriculture fires in India are also moved over to Pakistan. Atmospheric aerosol is of great implication as it plays a key role in the cloud and fog production processes in the atmosphere. Also, it affects the Earth's climate and its radiative budget. The study aims to characterize the absorbing aerosols using optical properties like, size distribution, single scattering albedo and Angstrom exponent extracted from Aerosol Robotic Network station in Lahore. It also provides a database of satellite observations using products from Moderate Resolution Imaging Spectroradiometer (MODIS), which were verified with AERONET observations and higher correlation were found (R^2 = 0.4949 R= 0.70) during the period of 2017-18. HYSPLIT model (Hybrid Single Particle Lagrangian Trajectory) backward trajectories were used during the incidence of winter fog episodes in the regions of Punjab indicate that major staple burning leads to the deterioration of air quality of Pakistan.

GEOSPATIAL MAPPING OF AIR QUALITY PARAMETERS AN ASSESSMENT OF POLLUTION LEVEL IN ELEME NIGERIA'S NIGER DELTA REGION

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Geospatial modeling of air pollutants in Eleme was carried out using ArcGIS 10.2 software, integrated the spatial air pollutant data from the different sampling locations within the area and analyzed as input variables for graphical presentation to produce air pollutant curves. The geospatial analysis of air dispersion was investigated with the aim of establishing the concentration trend of air pollutant in the area during the dry season and rainy seasons. Air quality parameters considered are SO2, NOx, SPM, and O3, while area of interest includes Akpajo, Aleto, Alode, Alesa, Agbonchia, and Onne in Eleme, Nigeria's Niger-Delta Region. Although, small-scale subsistence agriculture is the most common farming system practiced in the area. Cassava, pumpkins, plantains, maize and yams are the dominant crops found on the farmlands. It was observed that concentration of sulphur dioxide (SO2), nitrogen oxides (NOx), ozone (O3) and exceeded the USEPA standards for the protection of crops significantly. While suspended particulate matter (SPM) is slightly high in all sampling locations. However, O3, SO2 and NO2 and SPM are the most significant air pollutants when compared with USEPA and FEPA standards.

LONG TERM ASSESSMENT OF AIR QUALITY FOR THE LOCAL INDUSTRIAL ZONE DILOVASI

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Dilovası region is located between Istanbul and Kocaeli cities and one of the locations where air pollution potential at the highest level in Turkey in terms of sources of air pollution, topography and weather conditions. In this region, industrial facilities, residential areas, and heavy traffic on the D-100 and E-80 highways lead to high air pollution levels by the topography of the region and meteorological conditions. Low air quality observed occasionally in the region causes health problems such as respiratory insufficiency. In order to offer a solution to air pollution problems, the sources of pollutants and the periods during which these sources pose a threat to air quality has to be studied. In this study, the temporal distribution of PM10, NO, NO2, CO, SO2, and O3 concentrations were evaluated on annual, seasonal, monthly, weekly and daily basis and determined the episodes intense air pollution observed. In addition, the relationship between pollutant concentrations and meteorological parameters such as wind speeds, temperature and vertical motion of atmosphere was investigated. The concentrations are hourly measured every day and reported with the old records by an online website of The Ministry of Environment and Urbanization (MoEU). We used five years of data between 01.01.2014 and 01.01.2019 for long term evaluation. It is observed that all pollutant concentrations except O3 are higher in winter and decreased in summer. According to weekly distributions, the concentration levels on Sunday are lower than weekday pollution levels. Also, pollution varies from hour to hour in daily distribution.

LONG TERM (2007 2017) MEASUREMENTS OF AEROSOL CHARACTERISTICS AT URBAN STATIONS DELHI AND LUCKNOW

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In this study, we present the climatology of atmospheric aerosol characteristics using long term measurements of columnar aerosol properties from different satellites during January 2007 to December 2017 (11 years' period) over the highly polluted Indo-Gangetic Basin (IGB) region. The study was carried out at two different urban stations: Delhi (28.7º N, 77.3º E) in the western IGB and Lucknow (26.85º N, 80.95º E) in the central IGB regions to characterize spatial heterogeneity in aerosol characteristics such as Aerosol Optical Depth at 550 nm (AOD550), Ångstrom Exponent at 412/470 nm (ÅE412/470), Aerosol Single Scattering Albedo at 500 nm (SSA500) and UV-Aerosol Index (AI). Our study shows steadily high aerosol loading at both the stations during the period of measurements, with relative dominance at Delhi. Daily variation of AOD, AE, SSA and AI 0.6 to 3.4 (0.05 to 3.5), 0 to 1.8 (0 to 1.8), 0.8 to 1.0 (0.8 to 1.0) and -1.1 to 5.1 (-1.3 to 3.4) at Delhi (Lucknow) stations. Seasonal variation of AOD, AE, SSA and AI show higher values in Post-Monsoon/Winter at Delhi and Lucknow station. AOD dominate higher values in winter/Post-Monsoons show higher dense haze, fog and smog which are largely due to growth of population and increasing urbanization/industrialization. Annul mean variation of AOD, AE, SSA and AI 0.60±0.15 to 0.76±0.30 (0.54±0.25 to 0.76±0.33), 1.00±0.45 to1.28±0.28 (1.05±0.36 to1.45±0.28), 0.91±.01 to 0.93±0.01 (0.92±0.01 to 0.93 to 0.01) and 0.55±0.41 to 0.77±0.48 (0.35±0.35 to 0.55 to 0.44) at Delhi (Lucknow) stations. AODs values higher in Delhi comparison to Lucknow suggests Delhi is highly polluted compared to Lucknow. Study further reveals that the coarse-mode aerosols dominate during summer (Mar-Jun) and monsoon (Jul-Sep) seasons, whereas fine mode particles enhanced during post-monsoon (Oct-Nov) and winter (Dec-Feb) seasons. Potential temperature change artery has been identified and discussed using concentration weighted trajectory analysis of 5-days air mass back trajectories from the Air Resources Laboratory (ARL), National Oceanic and Atmospheric and Administration (NOAA).

AEROSOL BLACK CARBON OVER NORTHWESTERN INDO GANGETIC PLAIN SEASONALITY SOURCES AND RADIATIVE FORCING

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Objective: Characteristics of Aerosol Black Carbon over Northwestern Indo-Gangetic plain.
Material and Methods:
The present study was conducted over Patiala (30.2˚N; 76.3°E; 250m above mean sea level), a semi-urban location (Punjab), northwest region of the IGP, India during October 2013-September 2014. Seven channel (370, 470, 520, 590, 660, 880, and 950nm) Aethalometer (model: AE-31, Magee Scientific, USA) was used for online monitoring of BC over study site. The local or regional sources contributing to BC aerosol at semi urban site over Patiala (Punjab) were investigated using CWT analysis. TrajStat: GIS- based software has been used for CWT and Cluster Analysis and elaborated technique used in this software can be found elsewhere (http://www.meteothinker.com/Documents/Wang TrajStat Manuscript.pdf). Santa Barbara DISORT Atmospheric Radiative Transfer (SBDART) model was used to estimate the direct aerosol radiative forcing (ARF) solely due to BC aerosol under clear-sky conditions in the short wave (SW) wavelength range of 0.25-4.0 μm at the time interval of 15 minutes.
Results:
 The highest mass concentration of BC aerosol was found to be (10.0 μg m-3) during autumn. In contrast, minimum concentration (2.6 μg m-3) was observed in monsoon. During autumn, high concentration of BC aerosols is attributed to large scale paddy residue burning in the open fields. The minimum concentration of BC during monsoon is attributed to the scavenging and washes out by frequent rainfall as well as dilution by deep convection which is prevalent due to high moisture content in the atmosphere.
• Cluster & Concentration weighted trajectory (CWT) analysis suggests that potential sources of BC aerosol over the study region are local as well as transported from distant places mostly situated in the northwest , south-west and south-east side of the observation site depending upon the meteorological conditions and regional anthropogenic activities that varies with season.
• The mass fraction of BC averaged over the study period was only 2.4% of the total mass of the composite aerosol, its contribution to net ATM ARF was found to be significant (> 60%), indicating that BC contributes significantly to warming on a regional scale.

LONG TERM AIRBORNE MONITORING OF LEAD POLLUTION BY LICHEN FLAVOPARMELIA CAPERATA IN RAMSAR REGION NORTH OF IRAN

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Epiphytic lichens have been widely used as biomonitor of metal deposition at a country level. The purpose of this study was to investigate the changes in the amount of Pb contamination in Ramsar city, in north of Iran. The lead content for three consecutive years (2013, 2014 and 2015) is determined with using Epiphyseal lichen flavoparmelia caperata (L.) Hale. In order to analyze of Pb contents we used the ICP-OES device and a total of 28 samples were taken separately each year and analyzed. The results of the tallus analysis of lichens showed that the mean concentrations of Pb for 2013, 2014, and 2015 were 3.18, 2.45 and 1.80 mg / kg (dry weight) respectively. In addition, the review and comparison of GIS maps for lead contamination revealed a gradual decrease from 2013 to 2015 for the contents of this element. This could be due to the reduction of lead access levels in polluting sources such as vehicle fuel, due to the laws in force in the country (reduced leaded petrol consumption). Also, comparison of lead values from the analysis revealed a very low level of contamination of the element for the study area, which indicates the optimal air quality in the studied area relative to this element. This study, which is based on the integration of ArcGIS and thallus analysis data, indicates that epiphytic lichens are valuable biological monitoring in the assessment of air pollution and mapping the environmental pollution levels map to heavy metals.

ANTIOXIDANTS AS BIOMARKERS FOR OZONE STRESS IN WHEAT PLANTS

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Tropospheric ozone (O3) has been identified as the most damaging air pollutant to crop plants in terms of growth and yield reductions. Considering the negative effect of O3 in tropical regions, fourteen commonly grown Indian wheat cultivars with known sensitivity to O3 were tested for their sensitivity/ tolerance with respect to two major antioxidants (ascorbic acid and thiol) and grain yield responses against elevated O3 (ambient + 30 ppb) exposure. The objectives of the study were to assess the usefulness of the biochemical markers in the screening of wheat cultivars having differential sensitivity to O3 and different release time (modern and old cultivar). Ozone exposure led to an upsurge of ascorbic acid, thiol as well as their ratio greatly in the tolerant group followed by the intermediately sensitive group while least in sensitive one. Both ascorbic acid and thiol content offered more resistance to early released cultivars compared to modern ones. Ascorbic acid served to be the most influential parameter for determining varietal response under elevated O3 stress and directly linked with O3 tolerance. Overall, the sensitive group suffered maximum yield loss while the minimum was found in the tolerant group due to the differential enhancement of tolerance offered by antioxidants in different groups. Higher concentrations of antioxidants in early growth stages were highly correlated with final yield responses suggesting the role of antioxidants as a determinant of final yield. Findings of this study will help in identification of O3 tolerant and sensitive wheat cultivars for future screening programs using ascorbic acid and thiol as markers of O3 tolerance.

CHARACTERIZATION OF ATMOSPHERIC FINE PARTICULATE MATTER AT INDOOR ENVIRONMENT OF SEVERAL RESIDENTIAL HOMES IN DHAKA BANGLADESH

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This study surveyed the characteristics of ambient PM2.5 (particulate matter with an aerodynamic diameter of ≤ 2.5 μm) in order to assess the Indoor Air Quality (IAQ) at different residential houses in Dhaka, Bangladesh. Dual Channel Dust Sampler (Model: IPM-FDS 2510) was used to collect indoor PM2.5 samples from living rooms for a duration of over 15 hours for three consecutive days at four different locations- Dholaipar, Khilkhet, Mirpur and Rampura during August to October, 2017. FTIR spectroscopic analysis of the samples revealed the presence of -O-H, -C-H, aromatic C=C, -CH3 and -C-O-H groups in the indoor PM2.5.Using Scanning Electron Microscope (SEM) technique it was found that, the indoor PM2.5 is less aggregated and more distributed in Rampura whereas that in Dholaipar is more aggregated and less distributed. The samples were also analyzed for several inorganic ions (Na+, K+, Ca2+ and SO42-) and total organic carbon (TOC) using Flame photometer, UV-Visible spectrometer and TOC analyzer respectively. Enrichment factor and source contribution showed that both sea salt spray and crustal sources contributed to the presence of sodium and potassium ions in indoor PM2.5 whereas earth's crust was assumed to be the major source of calcium ion. On the contrary, over 99% of sulphate originated from anthropogenic sources at all the sampling locations. Total hazard ratio was found to be the highest (3.69) in Khilkhet and lowest (2.33) in Mirpur. A positive correlation between the concentration of indoor PM2.5 and total hazard ratio was also found. As fine particulate matter can penetrate deeper into the lungs, necessary measures should be adopted to improve the indoor air quality by reducing its emission.

STUDY OF QUALITATIVE COMPOSITION OF THE ATMOSPHERIC AIR MICROPARTICLES AND THE LEVEL OF ALMATY (KAZAKHSTAN) POPULATION MORBIDITY BY PULMONARY DISEASES

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Almaty is the largest city in Kazakhstan and one of the largest in Central Asia with a population about 2 million people, is located in the center of the Eurasian continent at the foot of the mountains of the Zailiysky Alatau. The city of Almaty is characterized by a relatively small number of industrial enterprises, but very intensive traffic.

As is known, vehicles are a major source of air pollution in cities: 80% of harmful emissions into the atmosphere of Almaty city are produced by vehicles.

Vehicle emissions are a significant source of ultrafine particles (ultrafine particles - UFP), defined as particles with an aerodynamic diameter of less than 100 μm. Particularly distinguish ultra-small solid particles with an aerodynamic diameter equal to or less than 2.5 μm (PM2.5) and with a diameter of 2.5 to 10 μm (PM2.5-10). Solid particles are a heterogeneous structure and consist of combustion products of carbonaceous materials, biogenic compounds and metals.

The purpose of the study was to make a qualitative assessment of atmospheric microparticles from various traffic points in the winter in Almaty city and the level of spread of pulmonary diseases.

The qualitative content of ultra-small particles was determined by collecting samples of the dust and snow along the main transport highways in the winter for 10 days in various administrative district of Almaty, where there are no industrial facilities. In all the investigated areas of Almaty, the MPC is exceeded for nitrites, phosphates, lead and cadmium. With the decrease in the size of solid particles, the process of settling of heavy metals on their surface increases, which makes them most hazardous to health.

About half of the cases, according to official statistics, in the structure of morbidity of the population of the Republic of Kazakhstan belongs to the diseases of the respiratory system. Almaty among other subjects of administrative units has a leading position on the morbidity of respiratory diseases. There is a trend of increasing respiratory rate in the past five years by almost 2 % (80,912 cases) and they make up on average 40% of cases. In this case, the incidence of respiratory diseases among children is more than 60 % with an increase of 2 % over the past 5 years.

SATELLITE OBSERVATIONS OF NO2 OVER SOUTH ASIA USING OZONE MONITORING INSTRUMENT DURING THE TIME PERIOD OF 2004 2018

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NO2 is one often criterion air pollutant considered as an indicator for air quality index. More the concentrations, more the toxic environment for living beings. Different sources impart in NO2 atmospheric concentrations, for instance biofuel consumption, soils emissions, aircrafts and fossil fuels burning. Elevated concentrations of NO2 are fallen in serious category for health risk assessment. South Asia is one of the most affected regions as its economic potential is engrossing interests from all over the world. In this study, TEMIS NO2 data sets were used for the time period of 2004-2018. NO2 from Satellite Observations is retrieved using a DOAS-base algorithm. Spatio temporal analysis and multi-year mean maps clearly depicts different concentrations in different seasons and regions. For instance, relatively large column densities have been reported over hyper arid regions during Monsoon time spans due to augmented bacterial activities in their soils. In addition to it, lightening is also prime source for enhanced atmospheric NO2 levels the emissions. Temporal mean map has indicated enhanced column densities in India, Pakistan and Bangladesh region. On the contrary, Bhutan and Nepal are contributing relatively in smaller amounts. This propense pertains in Industrial emissions and transport sector. Additionally, recent economic boom in south Asian countries is major driver behind enhanced atmospheric NO2 levels across the region.

TRADE OPENNESS AND AIR POLLUTION INDICATORS (CASE STUDY CARBON DIOXIDE METHANE AND NITROGEN OXIDE)

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The threat of climate change over the past decades has become more prominent among environmental experts. As a result, economists and environmental researchers are more likely to pursue economic growth friendly with the environment. For this purpose, the present study examines the variables of open trade, population and GDP variables along with its square to study the Kuznets environmental hypothesis on emissions of carbon dioxide, methane and nitrogen oxide in three separate equations. The study period is 1990 to 2012 and it was done for Asian Productivity Organization, which includes 20 countries. The panel ARDL method was used regarding the panel data used for the structure of the research data. According to results, the Kuznets environmental hypothesis was approved as reversed U for carbon dioxide and methane gases in the long run, but not for nitrous oxide. Short-run results also indicate the rejection of the Kuznets environmental hypothesis among the studied countries. The trade variable had a negative correlation with the emission of all three greenhouse gases. Also, with elasticity to the earnings stretch for CO2, N2O and CH4, which were 0.4, 0.38 and 0.04 respectively, results show that the effect of GDP growth on CO2 emissions is higher than that of N2O and CH4 emissions indicating the importance of CO2, which causes more air pollution than other greenhouse gases and will have an important impact on the quality of the environment. Therefore, it is recommended to consider more measures for carbon dioxide than other greenhouse gases in order to prevent its emissions.

MICROBIAL STUDY OF AIRBORNE MICROORGANISMS IN INDOOR AIR OF HOSPITAL IN NORTHERN ALGERIA

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The hospital is a highly sensitive environment; it produces care and causes contamination of different compartments of the environment (air, water and soil). The control of internal pollution in a hospital environment is indispensable, because it's the first contact with patients, so it should not cause further infection or illness for the sick, especially when it comes to suppressed host immunity defenses. It is with this objective that we started this study which deals with the microbiological analysis of bioaerosols (BAs) in the indoor air of the medical emergencies of Blida hospital. We studied four operating theaters, two preoperative rooms and a resuscitation room. Sampling of indoor air was made by passive technique and the bacterial identification was done by two techniques, the Analytical Profile Index (API) system and Matrix Assisted Laser Desorption/Ionization Time of Flight Mass Spectrometry (MALDI-TOF MS). The highest contamination for bacteria is 2645 (CFU / m3) noted in postoperative 2, the lowest is observed in the traumatology block which is 191 (CFU / m3). Fungal contamination is highest in neurosurgery block 103 (CFU / m3); the lowest is in poste-operative 1 which is 6 (CFU / m3). Gram-positive cocci are the most predominant bacteria in the indoor air of medical emergencies. These bacteria can cause infections therefore increase the risk of contracting a nosocomial infection in the hospital. This study shows the importance of daily indoor air control of hospitals mainly operating theaters primarily that the patient's body is in direct contact with air. In order to reduce nosocomial infections and to create an Algerian standard that limits the rate of BAs in hospitals.

MORTALITY AND MORBIDITY ECONOMIC BURDEN DUE TO PM2.5 AND OZONE; AN AIRQ+ MODELLING IN IRAN

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Abstract

Background: Attributable health impacts of air pollution result in economic costs to societies. In this study, the WHO AirQ+ model was used to estimate the health impacts and health-related economic costs of PM2.5 and O3 in Karaj, the fourth largest city in Iran, from March 2015 to March 2016.

Methods: For PM2.5, long-term mortality due to ischemic heart disease (IHD), lung cancer, chronic obstructive pulmonary disease (COPD), and morbidity such as acute lower respiratory infection (ALRI), and short-term cardiovascular and respiratory hospitalizations were calculated. For ozone, short-term mortality and hospitalizations due to cardiovascular and respiratory diseases were estimated. The human capital method (HCM) was used to monetize the mortality impact attributed to selected air pollutants. Direct and indirect costs of morbidity were estimated using available local data on the costs related to cardiovascular and respiratory diseases.

Results: The total number of IHD, COPD, LC and ALRI deaths attributed to PM2.5 in selected age groups was 576. The total number of cardiovascular and respiratory deaths attributed to O3 was 46 cases. For hospitalization, the aggregate cardiovascular and respiratory hospital admissions for both pollutants were 552. The total economic loss due to mortality and morbidity from selected health endpoints was approximately 44 million USD.

Conclusions: Despite the limitations, such methodologies can be useful for policy-makers. Therefore, there is a compelling need to conduct cost of illness's studies in other areas.

EFFECTS OF METEOROLOGICAL VARIABLES AND HOLIDAYS ON THE CONCENTRATIONS OF PM10 PM2.5 O3 NO2 SO2 AND CO IN MEGACITY OF TEHRAN (2014 2019)

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Introduction: The aim of this study was to investigate the concentrations of PM10, PM2.5, O3, NO2, SO2, and CO in Tehran during March 2014-March 2018, and evaluate the effects of holidays and meteorological parameters on the air pollution levels.

Materials and Methods: Hourly concentrations of PM10, PM2.5, O3, NO2, SO2, and CO in different air quality monitors of Tehran were acquired. The data from each air quality monitored were validated, and only high-quality monitors were included in this study.

Results: The 4-year averages of PM10, PM2.5, O3, NO2, SO2, and CO concentrations were 88.74, 31.02, 34.87, 71.01, 20.04, and 3.78 μg/m3, respectively. Higher concentrations of PM10 and O3 were observed during summer. In case of PM2.5 and CO, autumn and winter concentrations were higher than those in springer and summer. Lower concentrations of PM10 and NO2 in Fridays were observed comparing to other days of week. Ozone had high concentrations in Fridays as the weekend in Iran. Except for O3, all of the pollutants had higher concentrations in the working days, comparing to those in any type of vacation days. Concentrations of all pollutants rather that SO2 and O3 in Nowruz holidays were statistically lower than those in the working days. By controlling for the effects of meteorological variables, our results showed that the air pollution control policies and actions have been not effective for particulate matter and NO2. However, the concentrations of SO2, O3, and CO have reduced during the study period.

Conclusion: These results determines the time periods in which the concentrations of criteria air pollutants are high. This can be very useful for announcing alarms for citizens, and designing the air pollution control plans. In addition, more effective actions should be designed and implemented for reducing ambient levels of particulate matter and NO2.

DISTRIBUTION AND NUMBER OF ISCHEMIC HEART DISEASE (IHD) AND STROKE DEATHS DUE TO CHRONIC EXPOSURE TO PM2.5 IN 10 CITIES OF IRAN (2013 2018); AN AIRQ+ MODELLING

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Introductions: Particulate air pollution is known as a major risk factors of ischemic heart disease (IHD) and stroke. The aim of this study was to estimate the premature IHD and stroke deaths attributed to long-term exposure to PM2.5 in 10 cities of Iran during March 2013 to March 2018 using AirQ+ model.

Materials and Methods: Ten cities of Iran including Tehran, Mashhad, Isfahan, Shiraz, Tabriz, Ahvaz, Arak, Sanandaj, Khoram Abad, and Ilam were chosen, and their air quality data were acquired from Department of Environment (DoE) and Tehran Air Quality Control Company (AQCC). Validation of monitoring stations were accomplished according to WHO and APHEKOM criteria for health impact assessment of air pollution. The number of deaths due to IHD and stroke was estimated using AirQ+ 1.3software, which is developed by WHO.

Results: In case of both IHD and stroke mortality, the highest number of IHD and stroke deaths was estimated to be in Tehran, Mashhad and Isfahan, respectively. The highest number of attributable deaths per 100,000 population were estimated to be in Ahvaz and Isfahan. The average of excess IHD and stroke deaths due to exposure to PM2.5 in all cities were 84 and 41 per 100,000 population, respectively.

Conclusion: The results of this study indicated the necessity of urgent actions to improve the outdoor air quality in Iranian cities.

THE USED OF STOCHASTIC BOOSTED REGRESSION TREES TO ANALYSE IN VEHICLE POLLUTANTS AND PHYSICAL PARAMETERS AT DIFFERENT ROAD CATEGORIES

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This study investigated passenger and driver exposures to in-vehicle air pollution in a long-distance coaches operated in Peninsular of Malaysia. To date there are no air quality and physical parameters guidelines or standard has been established in Malaysia applies to operated by long distance buses even though the indoor air pollutant is more dangerous than outdoor air pollution. We applied machine learning modelling technique name Boosted Regression Trees technique to derive the relationships between pollutants which are particulate matter (PM10), carbon monoxide (CO), carbon dioxide (CO2), physical parameters(relative humidity, air flow, temperature) by using a Q-Trak TSI model 7565 IAQ Monitor, MiniRAE 3000 and TSI Dustrak 8530route segments and busses traveled information (bus speeds and number of passenger) were used data to predict particulate matter (PM10) concentrations and identifying factor influenced. A 10-trips traveled for a long distance coaches averaged between 7-8 hour journey mostly used motorways route that lift passenger from Kuala Terengganu Terminal to Terminal Bersepadu Selatan (TBS) in Kuala Lumpur and another route between TBS and Kota Bahru Bus Terminal. The data were analyzed using a comprehensive software an open-air R-Software and its packages for the variability and statistical analysis including graphical profile of the pollutants and using boosted regression trees (BRT) technique. Data were also segregated into three different road categories namely highway, rural road and urban road.

It was found that was the average concentrations of CO, CO2, PM10, PM2.5, NO2, air temperature, relative humidity and air movements were 0.86 ± 0.70 ppm, 2900 ± 538 ppm, 0.0394 ± 0.0248 mg/m3, 0.0509 ± 0.0207 mg/m3, 4.508 ± 0.936 ppm, 23.7 ± 1.11 degree Celcius, 52.89 ± 9.37 % and 0.05 ± 0.062 m/s respectively were obtained. Except for relative humidity, all parameters were still below permissible level according to the Malaysian National Indoor Air Quality Code of Practice 2010 for building. Results demonstrates significant variation in CO2 during night-time trip, largely influenced by NO2 (36.03%), PM 2.5 (15.77%), PM10 (13.15%), followed by temperature (11.68%), CO (9.73%), wind speed (7.38%) and humidity (6.25%), meanwhile during daylight trip Co2 concentration largely influence by CO (77.15%), NO2 (7.85%), PM2.5 (5.71%), humidity (4.3%), temperature (2.04%), PM10 (1.91%) and wind speed (1.03%). The performance of the both model are good and in acceptable range which are coefficient of determination (R2) are 0.31 for night-time and a good relationship of 0.77 for day-time traveled.

MERCURY FLUX EVASION FROM THE MEDITERRANEAN SEA DURING THREE OCEANOGRAPHIC CAMPAIGNS EVALUATION OF SPATIAL VARIABILITY AND UNCERTAINTY OF ESTIMATES

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Mercury (Hg) is a natural occurring element that is considered a priority global pollutant due to its unique properties and adverse effect on human health and environment. Hg raises even more concern in areas that have high background level, as in the case of the Mediterranean Basin, where peculiar climatic, geological, and anthropogenic conditions are in place. Despite the consensus in the scientific community that Mediterranean Basin is a net source of Hg to the atmosphere, the quantification of Hg evasion from the Mediterranean sea surface is yet affected by an overall uncertainty due primarily to the lack of experimental data.

This study presents experimental measurements of gaseous elemental mercury(GEM) in air and dissolved gaseous mercury (DGM) in surface seawater performed during three oceanographic campaigns carried out in the Mediterranean Sea: Med-Oceanor 2004 (26/10/2004-2/11/2004); Fenice 2010 (26/08/2010-13/09/2010); Fenice 2011 (28/10/2011-8/11/2011), on board the Italian National Council's Research Vessel (RV) Urania. We analyse the spatial variability of DGM, GEM and Hg fluxes with a special focus on polluted sites. Moreover, we assess the uncertainty of Hg evasion flux related to the use of different gas exchange models and to the analytical method for DGM measurement.

Results show high emission rates in polluted sites compared to off-shore and unpolluted sites. Moreover, air–sea Hg flux estimations are significantly affected by the choice of parameterization in the gas exchange models. From our outcome, it is possible to infer that improvement in air-sea Hg exchange determination is essential for a better understanding of the global cycle of atmospheric Hg.

WHY DO WE HAVE A FUNDAMENTAL RIGHT TO BREATHE CLEAN AIR

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Clean air quality is fundamental to our survival and well-being. Most of people ignore the importance of air quality while on average a person inhales about 12,000 litres of air every day. The presence of contaminants in this air can adversely affect people's health and poor air quality can also adversely affect the natural environment and can, in turn, have negative ecological and economic impacts.

In recent years, South Korea face serious fine particulate pollution threats that have become a social problem and necessitate effective cooperation in Northeast Asia Countries. The government has tried emergency measures in an effort to reduce potentially lethal levels of fine particulate pollution, as PM2.5 throughout the country. PM primarily originates from the combustion of fossil fuels from coal-fired thermal power plants and diesel vehicle, and long-range transboundary air pollution from China and other areas, although these are very controversial issues. This means that the health effects of air pollution are long-lasting, and have serious implications for community health. It also highlights the difficulties in proving that a given respiratory, cardiovascular, or other health problem was caused by exposure to air pollution.

In an effort to reduce air pollution, we have tried to let the general population recognize the importance of air quality so that we have held events in several Korea cities to celebrate Air Day. Air Day Ceremony on the 22nd October has been held annually since 2010 in Korea with voluntarily cooperation of several organizations. Air Day Events aim to connect people with air and raise awareness on their critical importance in our lives. In connection of this event in Korea, we need to expand this important issue to people in the world. World Air Day purpose an international observance and an opportunity to learn more about air quality related issues and advocating for the sustainable management of clean air resources.

The framework of the "Global Alliance for Clean Air (GACA)" was established to make the formal process of designation of the World Air Day as a global awareness raising platform. One of main vision of GACA is to get an official adoption of the World Air Day Designation by UN within a few years since World Water Day (22nd March) and World Soil Day (5th December) were already designated by UN.

Many discussions are invited about how to propose the the World Air Day to be designated by UN and to make cooperation with several UN organizations such as WHO, UNEP, ESCAP, etc. and sectors of international academia (IUAPPA), industry, government, NGOs, and other organizations.

EXPLORING SEASONAL VARIATION AND TEMPORAL TREND OF TROPOSPHERIC COLUMN OZONE AND ITS PRECURSORS BY EXPLOITING SATELLITE OBSERVATIONS

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Air pollution has become a serious environmental problem in densely populated Asian countries, especially Pakistan, being the sixth largest populous country in the world. Dramatic growth in population along with the significant increases in industry and number of vehicles has contributed to high concentrations of air pollutants, including tropospheric ozone column (TCO) and its precursor gases. The study aimed to develop a database and analyse the spatio-temporal distributions of tropospheric ozone and its precursors (NO2 and HCHO) over Pakistan. The datasets used were; tropospheric ozone columns retrieved from Ozone Monitoring Instrument (OMI) and Microwave Limb Sounder (MLS) onboard Aura satellite based on Tropospheric Ozone Residual Technique (TOR), NO2 and HCHO from TEMIS OMI. TCO showed strong seasonality with monsoon (Jun, Jul, Aug) maximum and winter (Dec, Jan, Feb) minimum levels. The seasonal variation of formaldehyde is similar to that of tropospheric column ozone, while nitrogen dioxide shows slightly different patterns with higher values in post-monsoon and winter compared to lower values in monsoon and pre-monsoon. Tropospheric ozone column presented an overall increase of 2.15±1.5 Dobson Unit, over Pakistan (2005-2017). Furthermore, we investigate the dependence of tropospheric ozone column on meteorology and transport in detail along with Tropical Rainfall Measuring Mission (TRMM) dataset, OMI ultraviolet index (UVB index) dataset, and MODIS Fire Radiative Power (FRP).

COMPUTATIONAL FLUID DYNAMICS MODELLING OF AIR DISTRIBUTIONS AND OPTIMIZATION OF INDOOR AIR QUALITY IN CLASSROOMS

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Indoor air quality (IAQ) has been a global public concern for many years. Most people spend almost 90% of their time indoors, which further signifies the adverse effects of poor air quality. In most buildings, occupants are the main source of indoor Carbon Dioxide (CO2) due to exhalation. Exhaled breath is a vehicle for the release of airborne infectious particles and thus contributes to the risk of airborne transmission of disease. Although CO2 is not considered to pose serious health risks to occupants, elevated levels of CO2 may serve as an indicator of insufficient ventilation. The limited air circulation in an enclosed space may lead to high concentrations of indoor air pollutants. Hence, this will negatively affect occupants who spend long hours indoor especially those in educational establishments. In Malaysia, natural ventilation system is widely applied in government school building design because of its energy saving and economical construction cost. Standard classrooms may have occupant levels anywhere from 1.8 m2 per person to 2.4 m2 square feet per person. Given so many individuals in a confined space, it is no wonder that schools IAQ are a major concern. Therefore, it is important for architects and engineers to accurately predict the performance of natural ventilation and the flow fields that would bring in the outdoor pollutants into the indoor classrooms, especially in the building design stage. This study investigated the airflow and contaminant (CO2 spatial distribution) transport in enclosed spaces using a combination of Computational Fluid Dynamics (CFD) simulations. The conditions and the modelling of the spatial distributions of CO2 in the chamber and some of the classrooms studied would be modelled using the ANSYS CFX to determine the most physically realistic combination of mass and energy transport models, fluid properties and boundary conditions. This would also enable the visualisation of sensitive aspects of the internal environment such as the prediction of airflow and accuracy of the results, which would otherwise not be possible experimentally. This paper considers the possibility of predicting both external and internal flow fields of wind profiles and the air distributions in a classroom. A computational work were carried out using computational fluid dynamics to simulate the flow field around the school domain as well as the indoor air distribution in selected classrooms. The overall findings would be of immense benefit to designers and building authority in enhancing classroom design guidelines for school buildings in the tropics.

EXPOSURE AND HEALTH RISK ASSESSMENT FROM FINE PARTICULATES IN POPULATED URBAN CENTERS OF PUNJAB PAKISTAN

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Since Pakistan is devoid of a ground-based air quality network, monitoring urban air quality by using satellite data can facilitate with updated information about air quality, thus having vast implications for national policy decisions. AOD from MODIS-Terra was used to study the aerosol trend over Lahore (31.5546° N, 74.3572° E) and Multan (30.1984° N, 71.4687° E) districts from the year 2013 to 2017. In addition, continuous 12-hour sampling of Particulate Matter (PM) (10 and 2.5 microns) was carried out for three months from January to March 2017 in the highly polluted urban cities of Lahore and Multan. In order to test the statistical significance of trend in AOD, the Mann-Kendall seasonal trend analysis was performed. The resultant short-term morbidity in the form of hospital admissions attributable to PM2.5 was estimated by using population health data, the concentration response coefficients recommended by the WHO, the actual measured exposure, and baseline exposures (or counter-factual) for the months of January, February, and March 2017. During the last five years (2013 – 2017), a significant positive trend of AOD was found over Lahore, while the trend over Multan was not significant. The level of particulate pollution was extremely high and frequently exceeded the National Environmental Quality Standards and the WHO air quality guidelines. Moreover, hospital admissions (respiratory diseases) attributable to PM2.5 computed using the NEQS as baseline were 1853 and 1073; and WHO as baseline were 1987 and 1174, for the cities of Lahore and Multan respectively. These numbers are substantial and they essentially reveal that the policy makers need to give urgent attention to air pollution abatement.

METHOD FOR THE REMOVAL OF ALKALI METALS FROM HERBACEOUS BIOMASS AND ITS EFFECT ON PM2.5 AND GASEOUS EMISSION AND SLAGGING AND FOULING BEHAVIOR DURING COMBUSTION

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Nowadays, biomass combustion technology is widely considered as an attractive option to remove greenhouse gas emissions, and thus, could become a viable option as an alternative energy source for the power industry. Among various biomasses, the herbaceous biomass (Miscanthus and Kenaf) is relatively inexpensive as a solid fuel. However, it contains high mineral contents (especially high levels of alkali metals), leading to operation troubles such as slagging and fouling inside a heat exchanger and ultrafine particle emissions during combustion. Accordingly, we herein propose a treatment method to extract the inherent minerals in the biomass prior to the combustion test. The method consists of a single stage treatment with acidic (CH3COOH) solution and a dual stage treatment with a basic (NaOH) solution and acidic (CH3COOH) solution at low temperature over a short time. To verify the proposed method, we investigated the variations in mineral contents, the ultrafine particles (PM2.5), and gaseous (NOx and SO2) emissions between raw- and treated herbaceous biomass. The experimental results show that the potassium and sodium elements in the single stage treated herbaceous sample (Kenaf), which are major factors influencing fouling and slagging in a boiler, were removed up to 99.46 and 100%, respectively. Also sodium, potassium and chloride in the dual stage treated herbaceous sample (Miscanthus), which are the major factors generating ultrafine particles, were removed up to 96.3, 99.4 and 98.3%, respectively. Furthermore, after dual stage treating the Miscanthus sample, the heating value and fixed carbon increased while the PM2.5, NOx and SO2 emissions decreased by 60, 25 and 46% respectively. These results will help to reduce the energy and costs for De-NOx and De-SO2 units and can pave the way for the use of herbaceous biomasses, as a clean solid fuel in power plants in the near future.

MONITORING AND MAPPING OF HYDROGEN SULPHIDE EMISSIONS IN A GEOTHERMAL AREA

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Geothermal energy for electricity generation is likely to become increasingly important in Turkey in the future. There are several centres of thermal activity in Turkey, particularly in Aydın and Manisa. Hydrogen Sulphide (H2S) from geothermal fluids need to be monitored with respect to their impacts on plants and animals. In this study, hydrogen sulfide concentrations in two different regions of Turkey were measured in air using passive/diffusive samplers (Radiello® traps). Ten suburban sites in Aydın and seven suburban sites in Manisa characterized by intense degassing of H2S-rich fluids were selected for measurements. Sampling time is 15 days. Two samples were taken between April and May 2019 in Manisa and one in July 2019 in Aydın.It was evaluated whether H2S concentrations measured in the study areas were below 100 µg/m3 (1-14 days) as the limit value recommended by the World Health Organization. The results indicated that hydrogen sulphide levels varied between 12 and 80 µg/m3 around the geothermal power plants. Values below the limit value determined by the World Health Organization were determined. However, it is well above the hydrogen sulfide level detected at the remote point to geothermal sources.Since the unpleasant odor can be detected at concentrations as low as 7 µg/m3 (World Health Organization), it causes uncomfortable air quality for the people living in rural areas where the plants are located.

INVESTIGATION OF THE ATMOSPHERIC PARTICULAR MATTER EFFECT ON SYSTEM PERFORMANCE IN LARGE CAPACITY SOLAR POWER PLANTS UNDER ŞANLIURFA METEOROLOGICAL CONDITION

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Investigation of the Dust Effect on System Performance in Large Capacity Solar Power Plants under Şanlıurfa Meteorological Condition

According to February 2019 data, there are 6089 solar power plants (SPP) in Turkey with an installed capacity of 5,238 MW. In addition to good project design and the use of high quality devices, the meteorological conditions of the region also play an important role for the efficient operation of the SPPs. The high solar energy potential of Sanliurfa region makes solar energy investments attractive, while the high air temperature and the amount of dust in the air adversely affect.

In this study, it is aimed to determine the effects of atmospheric dusts on the performance of SPPs. For this purpose, HARRAN SPP which has 5MW installed power at Harran University Osmanbey campus has been taken into consideration.

HARRAN SPP has started to produce electricity in May 2018. The electrical energy produced at the HARRAN SPP helps supporting the daily electricity needs of HARRAN University Research and Application Hospital. 16100 monocrystalline panels of 325Wp are used in HARRAN SPP. In the power plant, 5 units central inverters (1MW) and 5 units transformers were used. The meteorological data and performance information of the SPP is collected by a monitoring system.

In order to find the energy loss from the dust effect at the power plant,a PV array of the same panels used in HARRAN SPP was constructed in the application site of GAP YENEV center. Some of the panels were cleaned periodically with disstilled water weekly and the other panels were not washed. Then, I-V measurements of all panels were performed. Thus, the performance decrease in dusty (uncleaned) panels was determined with reference to the cleaned PV panel. In the next step, total efficiency loss due to dust accumulation on the panels was calculated for HARRAN SPP.

A CLUSTER ANALYSIS OF FORWARD TRAJECTORY TO IDENTIFY THE TRANSPORT PATHWAY OF SALT DUST PARTICLES FROM DRIED BOTTOM OF ARAL SEA, CENTRAL ASIA

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The Aral Sea basin is the most active dust storm source region in central Asia, and the exposed bottom of the sea has become the “distributer” of salts and chemicals over the adjacent areas. Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT-4) is used to identify the trajectories of air parcels from the dried bottom of Aral Sea region that are potentially containing salt - dust and their probability of influencing on the downwind area in the period of 2011 - 2015. The trajectories were categorized by k-means clustering into four clusters that are named by their direction of movement as follows: cluster 1: E category, cluster 2: NE category, cluster 3: W category and the cluster 4: S category. The 72 h of forward trajectories showed that salt - dust storms starting from the dried bottom of Aral Sea had the highest probability of affecting the northeastern region e.g. Siberian plain, followed by the southern region e.g. Iran Plateau. Total number of trajectories within these two clusters (NE and S) accounts for 90% (or 413 days) of trajectories in examined days.

INDOOR AIR QUALITY IN BARBECUE RESTAURANTS IN ŞANLIURFA (TURKEY)

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Monitoring of indoor air quality has been taking attention in recent years since people spend 60-70 % of their time in indoor environment. Moreover, World Health Organization (WHO) estimated that about 4.3 million people die each year from indoor air pollution. Considerable amount of harmful substances are released from cooking process, fuel burning and cooking oil heating to indoor air. Respiratory infections, pneumonia, cataracts, asthma and cardiovascular disease can be listed as diseases among others, which human suffer from because of exposure to these harmful substances. There are around 130 barbecue restaurants in Şanlıurfa Province but indoor air quality of these places has not been monitored. In this study, 10 barbecue restaurants were visited in March, April and May, 2019. PM2.5 and PM10 mass concentrations were recorded by using pDR-1500 Aerosol Monitor (Thermo ScientificTM). In addition, CO and CO2 levels inside these places were recorded using Testo 440 indoor air quality monitor. The physical characteristics of the restaurants including the presence of air conditioner, age of the building, distance to the main roadway, the furnace type and surface area were all recorded during the study. Background measurements when the furnace is not operated were also performed and reported concentrations were corrected accordingly. It has been found that background PM2.5 and PM10 levels were in all of the restaurants were higher than 15 µg/m3. Except in one of the restaurants, the measured mass concentrations values both for PM2.5 and PM10 were higher than 150 µg/m3, which are higher than the threshold values set by WHO. The measured CO2 levels during barbecue has been operated was compared with the background concentrations and no significant difference was observed, which situation was explained by the presence of workers and visitors. On the other hand, the difference is much more pronounced in case of CO particularly in 5 of the places, in which CO levels were as high as 4 ppm. This is a preliminary study that reported the indoor air quality in the barbecue places in Şanlıurfa province. However, the contribution of such places to outdoor air quality is also expected and should be studied in detail in the province.

SUMMERTIME OZONE POLLUTION IN YANGTZE RIVER DELTA OF EASTERN CHINA DURING 2013 2017 SYNOPTIC IMPACTS AND SOURCE APPORTIONMENT

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Increasingly severe ozone (O¬3) pollution in China has aroused worldwide concerns over the past years. Exploring the synoptic impacts and quantifying the source contributions are important for mitigating regional O3 pollution, especially in megacity clusters. This study focuses on the summer O3 pollution over Yangtze River Delta (YRD) in eastern China. Using the self-organizing map (SOM) clustering approach, we objectively identify six representative synoptic weather patterns (SWPs) over YRD during the summer of 2013-2017. We find that surface O3 is closely linked with the predominant SWPs over YRD. Three directional types (northeasterly, northerly and southwesterly) are the foremost O3-polluted SWPs, while cyclone and the Meiyu front types are two O3-clean SWPs. On the regional average, the concentration and exceedance of maximum daily 8-hour average (MDA8) O3 reach the maximum (118.8 μg/m3 and 19.2%, respectively) under the northerly type. For representative cities, the exceedance of MDA8 O3 peaks in Nanjing (45.6%), Hangzhou (33.3%), and Hefei (10.7%) under the northeasterly type, and in Shanghai (42.4%) under the southwesterly type. Among all meteorological factors, relative humidity and sunshine duration show a robustly negative and positive correlation with MDA8 O¬3 levels under all SWPs, respectively. Further, we estimate the source region and category contributions to O3 during thirteen high episodes based on Ozone Source Apportionment Technology (OSAT) in a regional transport model. The results reveal the different but significant role of local emissions, and regional and super-regional transport in the formation of severe O3 pollution over YRD. Among all SWPs, local emissions account for the largest proportion (21.8-36.0%) of O3 sources under the strong anticyclone type. Regional transport from upwind source regions within and out of YRD are fundamental in high O¬3 levels under the directional types. Under the northerly and northeasterly types, the contributions of upwind source regions (Beijing-Tianjin-Hebei, Shandong and Liaoning) for MDA8 O3 in YRD are within the range of 9.8-16.6% and 7.2-13.5%, respectively. The impact of super-regional transport is most pronounced along the eastern coast when influenced by strong cyclones. Source category analysis shows that transportation and industry emissions are the dominant contributors for MDA8 O3, with the contributions of 22.2-29.7% and 25.1-25.8%, respectively. Large contributions of industry and power plant emissions are usually found in coastal downwind regions. Our study suggests the imperative implementation of joint emission control over eastern China to reduce O3 pollution in future.

ANALYSIS OF RISING OZONE CONCENTRATION IN SEOUL

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Earlier this year, South Korea declared their air pollution problem is a national emergency. The media is spreading news about the polluted air, politicians are busy coming up with environmental pledges and the public is so concerned with air pollution that it has become one of the biggest problems the government is facing. However, the issue is narrowly focused on pollution due to particulate matter whereas other pollutants are being disregarded. What is going relatively unnoticed is the rising ozone concentrations.

The country's annual average ozone concentration has been increasing steadily since 1989. It has increased by 0.001 ppm every year since 2010, reaching an annual average of 0.029 ppm in 2017. According to the Ministry of Environment's annual report on air quality, none of the 261 effective monitoring stations in Korea met the ozone eight-hour environmental standard, while only 64 met the one-hour environmental standard, recording the lowest percentage of environmental standard compliance among air pollutants. This is the lowest environmental criteria attainment rate ever for ozone. Despite the worsening of the ozone problem, the issue has not drawn enough attention compared to the hype surrounding fine dust. On March 5, 2019, when the fine dust emergency reduction measures were issued, there were 1,892 internet articles related to emergency reduction measures, while on May 24, when ozone warnings were issued, only 57 related internet articles were reported.

Due to its photochemical reaction processes and many precursors, the formation of ozone is quite complicated. Therefore, analysis was conducted considering meteorological factors (temperature, cloud cover, precipitation, direction & speed of the wind), traffic volume, and emission amounts. Some preliminary results are presented. We also reviewed the current governmental ozone measures and pointed out some problems. In addition, ozone attainment determination is difficult because even though the environmental standard for ozone is set for 8-hours, the data available are 1-hour data or daily data. Despite the public's indifference due to the lack of visual impact relative to PM, ozone attainment should be treated as a major air pollution concern and efficient measures to reverse the increasing trend need to be implemented as soon as possible.

AN ANALYSIS OF THE STATUS OF FINE DUST MANAGEMENT POLICY IN KOREA AND ITS IMPLICATIONS

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South Korea's air quality policy has so far been carried out to manage each air pollutant individually. Recently, however, Korea's air quality problem characteristics have changed to those of advanced countries such as the U.S. and Europe, where secondary pollutants such as PM2.5 and ozone are cited as more significant problems, rather than primary pollutants such as SO2 and CO. The secondary contaminants are not only complex in the process of generation and extinction, but are closely interrelated with each other, making it imperative to change the existing management paradigm.

Therefore, this study examined the current state of Korea's air quality management policy and drew implications for a potential transition of the existing management paradigm.

In the case of fine dust management policies, which is recently one of the most controversial issues in Korea, government-level efforts have continued based on the "Comprehensive Measures for Fine Dust Reduction and Management (2017)". Key measures such as implementing emergency reduction measures in case of high-concentration fine dust incidents, reducing the proportion of diesel cars and increasing use of renewable energy all have a common goal - reducing the emissions of potential secondary generated fine dust precursors such as VOCs or NOX. The government is also trying to strengthen international cooperation such as bilateral cooperation between South Korea and China in order to reduce fine dust coming from outside of the country.

What's disappointing is that Korea's fine dust-reduction policy does not appear to be strong enough to ensure its effectiveness. The recent enactment and implementation of the “Special Act on Fine Dust Reduction and Management” which went into effect in 2019 and restrictions on the operation of automobiles and operating hours of emission facilities based on that law, prove that the government is aware of these problems and is in the process of improving them. However, given the limited effect of the mandatory force imposed under the special laws, stronger sanctions like economic penalties are essential for the effective implementation of the policy.

In addition, measurement data show that Korea is failing to meet the management standard of ozone which has common precursors with PM and is not directly emitted but is only produced via atmospheric reactions. To solve this problem, it will be necessary to shift the paradigm away from individual air pollutant management to monitoring and integrated management of all the precursors that generate secondary pollutants.

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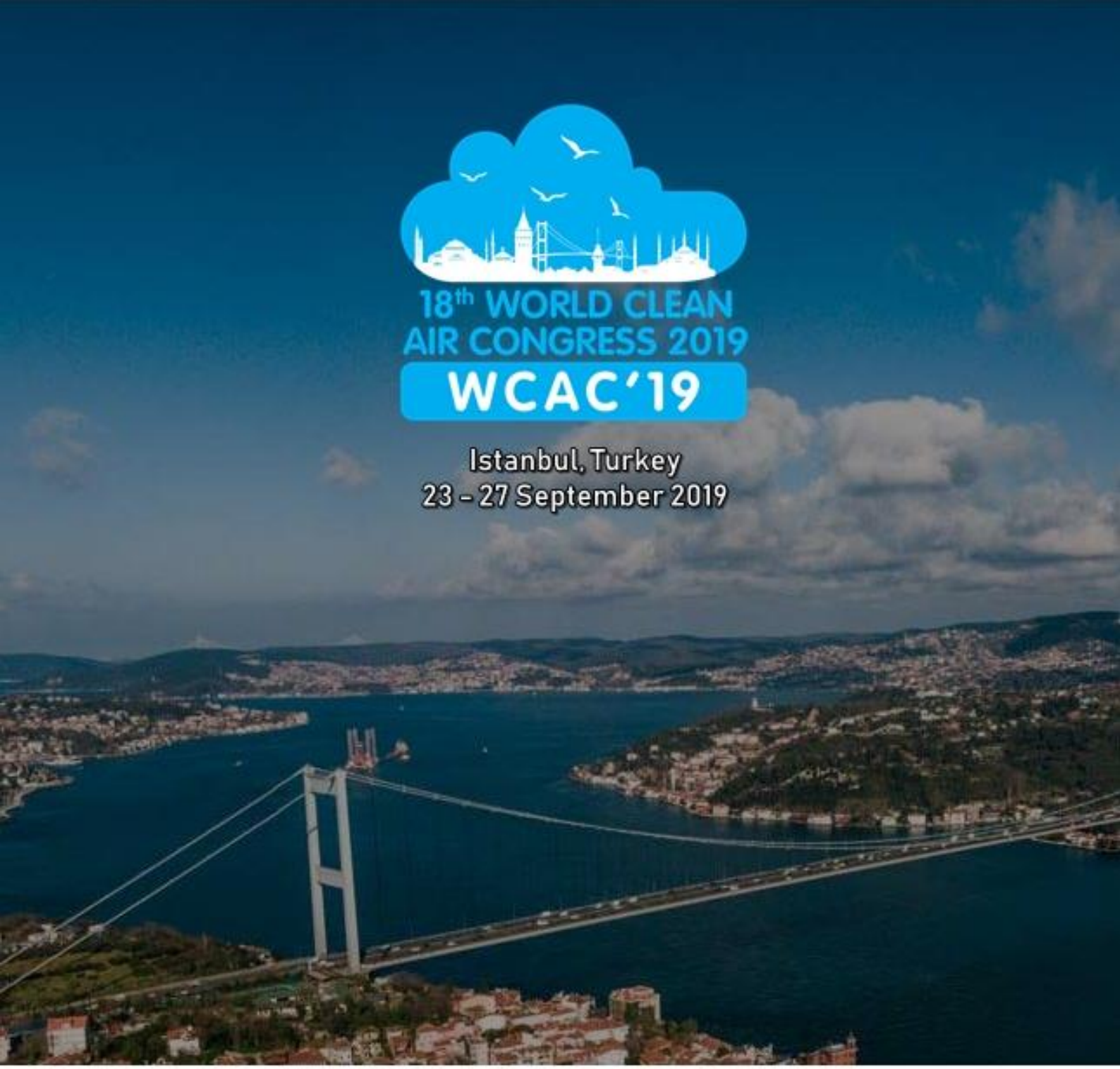

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