Proceedings of the Third International Symposium on Air Quality Management at Urban, Regional and Global Scales. pp. 1453-1465, 26-30 September 2005, Istanbul – Turkey

THE COMBINED NON-LOCAL, BAROCLINIC AND CAPPING INVERSION EFFECTS ON THE TURBULENT AND POLLUTANT CHARACTERISTICS IN THE NEUTRAL AND STABLE PBL

E.Syrakov and E.Cholakov

University of Sofia, Faculty of Physics, Chair Meteorology and Geophysics, J. Baucher str. 5, Sofia 1164, Bulgaria, esyrakov@phys.uni-sofia.bg

ABSTRACT

Practically oriented parameterization schemes: bulk Richardson number (Rb-method), resistance law (Rl-method) and combined (Rb-Rl) method, based on their joint and coordinated use are presented. In this schemes are incorporated not only traditional factors, but and new non-local effects caused by the free- flow stability, baroclinicity and rise of capping inversion at long lived PBL regimes (see Zilitinkevich and Esau, 2005).

Using that it is developed flux- calculating techniques, it is established relationships and coordination between a series of surface, PBL and free atmosphere turbulent and stability parameters. It is also given some estimation for pollutant characteristics.
The approaches can be used (considering traditional and non-local effects) as a practical tool in the environmental and weather/climatic modeling applications.

Key Words: non-local effects, capping inversion, turbulent fluxes, resistance law, dispersion parameters.

1. INTRODUCTION

According to Zilitinkevich and Galanca (2000), it has to differ two types of stably stratified boundary layers (SBL) which exhibit essentially different physical nature. The first type involves nocturnal SBL in the middle latitudes, disconnected from the stably stratified free atmosphere by a thick neutrally stratified residual layer (this is traditional short-lived nocturnal SBL). At high latitudes and coastal zones, another type of boundary layers are often observed (King 1990) namely, long-lived SBL immediately adjusting to the stably stratified free atmosphere. Here the two stably stratified layers are essentially interconnected due to the propagation of internal gravity waves and atmospheric surface layer is essentially affected by the static stability of the free atmosphere. This is a striking demonstration on non-local nature of turbulence (Kitaigorodskii and Joffre 1988), (King and Turner 1997), (Mahrt 1999). The key parameter characterizing this mechanism is the Brundt-Vaisala frequency N in the free atmosphere, and also the baroclinicity and the parameters of rise capping inversion over SBL (Zilitinkevich 2005). Accounting the mentioned above effects in the present work it is realized a parameterization method for determination of the main characteristics of the turbulent regime of neutral and long-lived SBL, based on the joint and coordinated use of the following components: bulk-Richardson number method, resistance and heat transfer laws and its universal functions A, B, C. It is also given some application to the dispersion models.

2. PARAMETERIZATION METHODS, REGIMES AND SOME APPLICATION

It is considered three parameterization schemes and some of their applications, which we consecutively introducing.

2.1. Bulk- Richardson number method with accounting of the non-local effects

A starting point for practical calculation of turbulent fluxes in the surface layer is the Monin-Obukhov similarity theory. Zilitinkevich and Galanca, (2000), Zilitinkevich, (2002), developed a theoretical model of the non-local turbulent transport (accounting the internal- wave interaction between the long-lived SBL and the free atmosphere). In stable stratification its results is dependence of the universal functions in surface layer $\varphi_u = (\aleph z / U_*)(dU / dz)$, $\varphi_\theta = (\aleph_T z / \theta_*)(d\theta / dz)$, on the Brundt-Vaisala frequency $N = (\beta(d\theta / dz)|_{z>h})^{1/2}$ above the top h of the SBL (Zilitinkevich and Esau, 2005):

$$\varphi_u = 1 + C_u \frac{z}{L}(1 + C_{NM}^2 Fi^2)^{1/2}, \quad \varphi_\theta = 1 + C_\theta \frac{z}{L}(1 + C_{NH}^2 Fi^2)^{1/2}$$

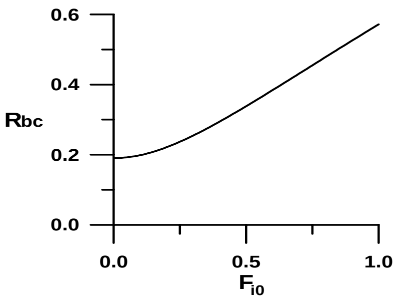

Figure 1.Dependence of Rbc on F_{i0}

where $Fi = NL / U_*$ is the inverse Froude number, $L = \aleph L_{MO}$, $L_{MO} = -U_*^3 / \beta q \aleph$ is the Monin-Obukhov length scale $\theta_* = -q / U_*$ is the von Karman constant, U and θ are wind component and potential temperature, z is the height, U_* and q are the dynamic friction velocity and flux of potential temperature, $C_u = C_\theta = 2$, $C_{NM} = 0.06$, $C_{NH} = 0.6$. With considering the above expressions for $\varphi_u, \varphi_\theta$, (Syrakov, 2004), (Syrakov and Cholakov, 2005) developed practical orientated flux calculation techniques, based on the bulk Richardson number:

$$\frac{\beta \Delta \theta}{U_1^2} z_1 = Rb(\lambda_u, \lambda_\theta, S, F_{i0}) = \frac{\aleph^2}{\aleph_T} S \frac{\lambda_\theta + C_\theta \left[S^2 + C_{NH}^2 \frac{1}{Cd} F_{i0}^2 \right]^{1/2}}{\left[\lambda_u + C_u (S^2 + C_{NM}^2 \frac{1}{Cd} F_{i0}^2)^{1/2} \right]^2}, \quad (1)$$

where $F_{i0} = Nz_1 / U_1$ is non-local parameter, z_1 is a fixed reference height in surface layer (accepted in this study at 10m), $U_1 = U(z = z_1)$, $\Delta\theta = \theta(z_1) - \theta_0$, $\theta_0 = \theta(z = z_{0T})$, z_{0u} and z_{0T} are the roughness lengths, $\lambda_u = \ln(z_1 / z_{0u})$, $\lambda_\theta = \ln(z_1 / z_{0T})$, $S = z_1/L$, β is the buoyancy parameter, $\aleph_T \approx 0.42$. At $S \to \infty$ from (1) we define the critical bulk-Richardson number:

$$Rbc(F_{i0}) = \frac{\aleph^2 C_\theta}{\aleph_T C_u^2} \frac{(1 + C_{NH}^2 F_{i0}^2 A^{-2})^{1/2}}{(1 + C_{NM}^2 F_{i0}^2 A^{-2})}, A = \frac{\aleph}{C_u} \left(1 - \frac{C_{NM}^2}{\aleph^2} F_{i0}^2 C_u^2 \right)^{1/2} \quad (2)$$

At $F_{i0} = 0$ from (2) follows the classical result: $Rbc(0) = \aleph^2 C_\theta / \aleph_T C_u^2$ (see Byun, 1990).

Figure1 present the dependence of Rbc on F_{i0}. It is seen that in the case of non-local effects, the critical number Rbc is significantly greater then the corresponding number in the classical case $Rbc(F_{i0} = 0) = 0.19$. This means that at $Rbc(F_{i0} \neq 0) > 0.19$, it can be generated the non-local exchange effects. The proposed method allows determining the drag coefficient $Cd^{1/2} = U_* / U_1$ and potential temperature transfer coefficient $Ct = \theta_* / \Delta\theta$, from the input conventional $\lambda_u, \lambda_\theta, Rb$ and non-local F_{i0} parameters:

$$Cd^{1/2} = Cd^{1/2}(\lambda_u, \lambda_\theta, Rb, F_{i0}), Ct = Ct(\lambda_u, \lambda_\theta, Rb, F_{i0}) \quad (3)$$

Compared with the traditional case ($F_{i0} = 0$), the non-local effects ($F_{i0} = 0.4, 0.8$) are significant and generate an extended range of the exchange processes of impulse and heat in the surface layer (Figure 2).

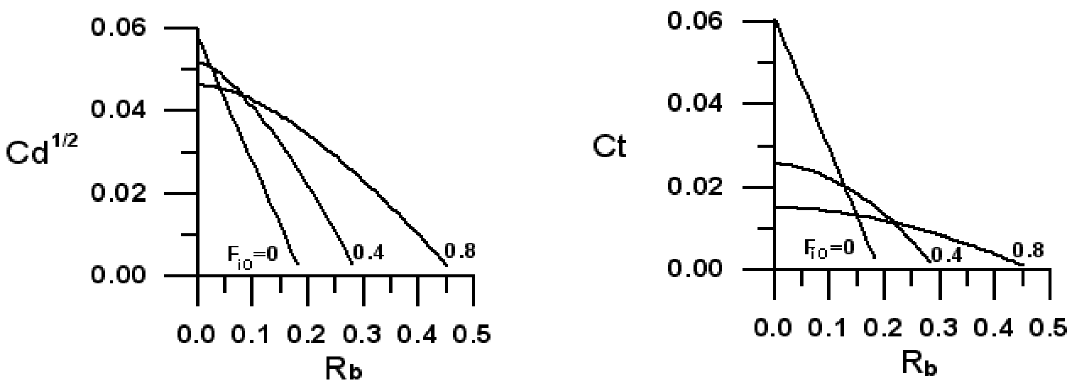

Figure 2. Dependence of drag $Cd^{1/2}$ and heat-transfer coefficient C_t on Rb at different values of non-local parameter F_{i0}.

2.2 Resistance and heat transfer law's functions A, B, C.

On the basis of simple two-layer model of PBL (surface layer (SL) at $z \le h_S$ and the Ekman layer above, where h_S is the height of SL) it is determined the form of the universal functions A, B, C, in neutral and stable SBL considering the mutual effects of stratification, baroclinicity, and non-local factors connected with N and capping inversion (Syrakov, 1990, 2004, 2005):

$$A_k = -\ln(\aleph H_S) + \tilde{C}_U H_S \tilde{\mu}_M - B_k \, ; \tilde{\mu}_M = \left(\mu^2 + \tilde{C}_{NM}^2 \mu_N^2\right)^{1/2} \tag{4}$$

$$B_k = \varepsilon / H_S \tag{5}$$

$$C_k = -\ln(\aleph H_S) + \tilde{C}_\theta H_S \tilde{\mu}_H - 2lB_k \, ; \tilde{\mu}_H = \left(\mu^2 + \tilde{C}_{NH}^2 \mu_N^2\right)^{1/2} \tag{6}$$

for basic barotropic case with non-local N effect and:

$$A = A_k + B_k\left[1 - (F_1 + F_2)\right] + \frac{1}{2B_k}\left[F_1(\eta_y + \eta_x) - F_2(\eta_y - \eta_x)\right] + \eta_x H_S \tag{7}$$

$$B = B_k(F_1 - F_2) + \frac{1}{2B_k}\left[F_1(\eta_y - \eta_x) + F_2(\eta_y + \eta_x)\right] + \eta_y H_S \tag{8}$$

$$\left.\begin{array}{l} C = C_k + \Delta C_{cap}, \Delta C_{cap} = \left[(\Gamma_\theta - \Gamma_I/2)h - \Delta\theta_I + \Gamma_\theta \Delta h\right]\dfrac{\aleph}{\theta_*} \equiv \aleph^5 \dfrac{\tilde{\mu}_{cap}^2}{\mu} H_I, \\ \tilde{\mu}_{cap} = (\mu_N^2 - \mu_{N_I}^2/2 - \mu\Delta\theta_I + \mu_{\Delta h}^2, \end{array}\right] \tag{9}$$

for the general case with baroclinic- capping inversion effects, where F_1 and F_2 are weight functions:

$$F_1 = \frac{sh(2l)}{ch(2l) - \cos(2l)}, F_2 = \frac{-\sin(2l)}{ch(2l) - \cos(2l)}, l = (H_I - H_S)B_k, \tag{10}$$

with asymptotes at $l \to \pi$, $F_1 = 1$, $F_2 = 0$ (very high inversions-practical non-inversion effect in (4)-(6)) and at $l \to 0$ (maximal inversion effects at very low inversions). Here $H_I = h_I / (\aleph U_* / f)$ is dimensionless inversion parameter, h_I is the down limit of inversion coinciding in this case with the upper limit h of SBL, i.e. $h \equiv h_I$, $H_S = h_s / (\aleph U_* / f)$ is the dimensionless height of SL. $\tilde{\mu}_M$ and $\tilde{\mu}_H$ are SBL composite stratification parameters, $\mu_N = N / f$ and $\mu = (\aleph U_* / f) / L_{MO}$ are non-local and conventional internal stratification parameters, $N = (\beta\Gamma_\theta)^{1/2}$, Γ_θ is potential temperature gradient in the free atmosphere above capping inversion, $\tilde{\mu}_{cap}$ is new capping (over SBL) inversion composite stratification parameter characterizing its thermal structure; $\mu_{N_I} = N_I / f$, $\mu_{\Delta\theta_I} = N_{\Delta\theta_I} / f$, $\mu_{\Delta h} = N_{\Delta h} / f$, $N_I = (\beta\Gamma_I)^{1/2}$, $N_{\Delta\theta_I} = (\beta\Gamma_{\Delta\theta_I})^{1/2}$, $N_{\Delta h} = (\beta\Gamma_{\Delta h})^{1/2}$, are corresponding Brundt-Vaisala frequencies, $\Gamma_I = \Delta\theta_I / \Delta h$ is capping inversions temperature gradient, $\Gamma_{\Delta\theta_I} = \Delta\theta_I / h_I$,

$\Gamma_{\Delta h} = \Gamma_\theta \Delta h / h_I$, $\Delta\theta_I = \theta_{h_I + \Delta h} - \theta_{h_I}$ is the potential temperature increment across the capping inversion (see Zilitinkevich, 2005), Δh is capping inversion depth, above h_I, $\eta_x = (\aleph^2 / f) du_g / dz = M \cos\phi$ and $\eta_x = (\aleph^2 / f) dv_g / dz = M \sin\phi$ are non dimensional internal baroclinic parameters (see Yordanov and Wippermann, 1972), $M = \left(\eta_x^2 + \eta_y^2\right)^{1/2}$, ϕ is the angle between surface and thermal wind. We will note that from the relation $H_I \equiv \mu_I / \mu$, instead of H_I it can be introduced the equivalent parameter $\mu_I = h_I / L$ (in present work we will use H_I). The quantity H_S is determined on the basis of analyze of the dynamic equations of SBL, using the limit- method, we force the change of the moment fluxes in SL, with the height to 10% ($\varepsilon = 0.1$). In barotropic case:

$$H_S = \frac{2\varepsilon^2}{1 + \sqrt{1 + 8\varepsilon^2 \widetilde{C}_U \widetilde{\mu}_M}} \tag{11}$$

Substituting (11) in (4)-(6), we determine the explicit form of A_k, B_k, C_k. In the general case for H_S it is received a more complex equation, which together with (7)-(9); (10) is a system of transcendental equations and after its numerical decision we determine the dependence of A, B, C on the parameters (it is listed the different stratification parameters, which includes in the composite parameters $\widetilde{\mu}_M$, $\widetilde{\mu}_H$ and $\widetilde{\mu}_{cap}$):

$$\mu; \mu_N; M, \phi; H_I; \mu_{N_I}, \mu_{\Delta\theta_I}, \mu_{\Delta h}, \tag{12}$$

describing a wide range series conventional and non-local (long-lived PBL) turbulent regimes.

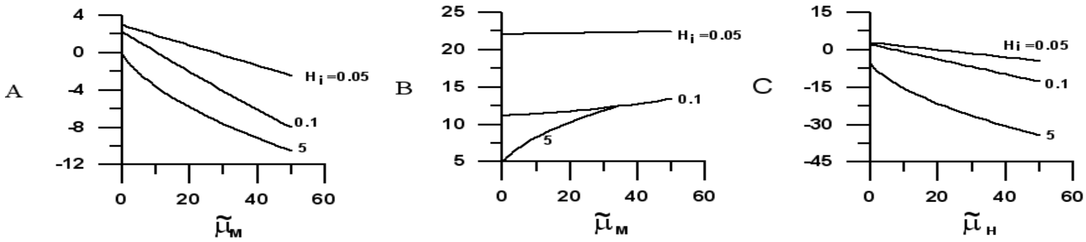

Figure 3. Dependence of A, B, C on composite stratification parameters $\widetilde{\mu}_M$, $\widetilde{\mu}_H$ by different values of inversion parameter H_I

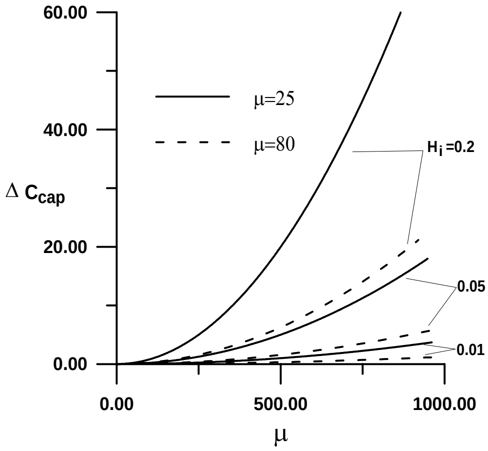

Figure 4. Dependence of ΔC_{cap} from (13) on μ_N at different values of μ and

On the Figure (3) is demonstrated the joint effect of the non-local parameter $\tilde{\mu}_M$ and $\tilde{\mu}_H$, and inversion parameter H_I on A, B, C. With decreasing of H_I, increases this effect. We will notice that this is "clean lid effect" (at $\Delta C_{cap} = 0$). At $H_I = 5$ we have classical non-inversion case. Taking into account also the thermal structure of the capping inversion (in the layer Δh over h_I), at $\Delta C_{cap} \neq 0$, it is considered second additional "capping inversion effect", relatedto the thermal interaction between Δh- capping inversion layer on μ_N by different values of μ and H_I. the correction function ΔC_{cap} from (9). In the capping inversion layer with significantly bigger gradient Γ_I and not very big thickness Δh (i.e. Γ_I significantly exceeds Γ_θ and $\Delta h \leq h$);

$$\Delta C_{cap} = \aleph^5 (\tilde{\mu}_{cap}^2 / \mu) H_I, \; \tilde{\mu}_{cap} = -(\mu_{N_I}^2 / 2 + \mu_{\Delta\theta_I}^2)^{1/2} \qquad (13)$$

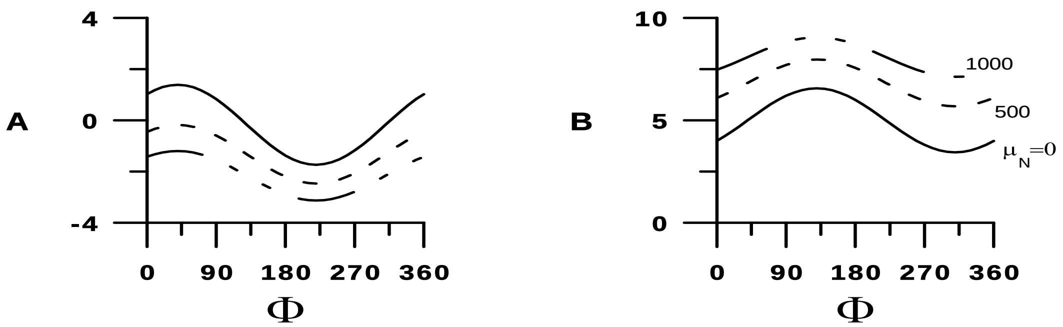

Figure 5. Dependence of A, B functions on baroclinicity parameter ϕ at $M = 10$ and different values of μ_N.

It is seen at Figure 4 that ΔC_{cap} effect can be quite significant and comparable with the basic thermal function C_k from (9). The joint influence of non-local effect at traditionally neutral SBL, (at $\mu = 0$, i.e. $\tilde{\mu} \equiv \mu_N$, (see Zilitinkevich and Esau, 2005) and the baroclinicity on the resistance law's function A and B is demonstrated on Figure 5

2.3 Combined Resistance law's--bulk Richardson method

This method which we will note as (Rb-Rl) method is developed by Syrakov (1990) on the basis of combined parameterization scheme considering the joint and coordinated use of bulk Richardson number method and Resistance laws, for traditional regime of SBL. Here we will generalize the method considering the above studied non-local effects. After some transformation of the resistance and heat transfer laws, considering (1)-(3), we receive the following general relations between the surface (in layer $0-z_1$): $U_1, \Delta\theta, Cd^{1/2}, Ct$ and SBL: $G_0, \delta\theta, \alpha$, parameters (Syrakov (2004), Syrakov, Cholakov (2005)):

$$G_0 / U_1 = F_g\,,\ \ \delta\theta / \Delta\theta = F_t\,,\ \ \alpha = arctg\{B / [\ln(Cd^{1/2}\widetilde{Ro}) - A]\}\,, \qquad (14)$$

where, $f_1 = BC_d^{1/2}$, $f_2 = Cd^{1/2}\left[\ln(Cd^{1/2}\widetilde{Ro}) - A\right]$, $F_t = \frac{C_t}{\aleph}\left[\ln(Cd^{1/2}\widetilde{Ro}) - C\right]$, G_0 is modulus of the surface geostrophic wind, $\delta\theta = \theta_h - \theta_0$ (at inversion $h = h_I$), α is the angle of full turning of the wind in SBL, $\widetilde{Ro} = U_1 / fz_0$ is a local Rossby number in layer $0 - z_1$; A, B, C functions are gived according to (7)-(9).

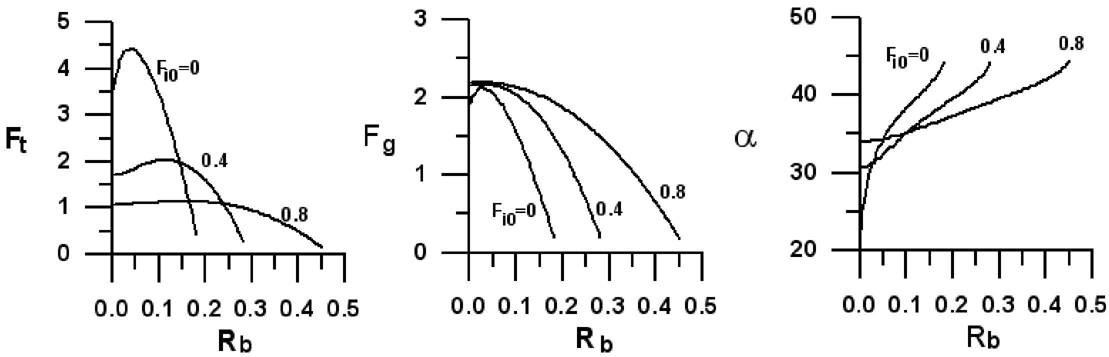

Figure 6. Dependence of F_g, F_t, α from Rb by different values of non-local parameter F_{i0} and $\lambda = 7, \widetilde{Ro} = 3.10^6$.

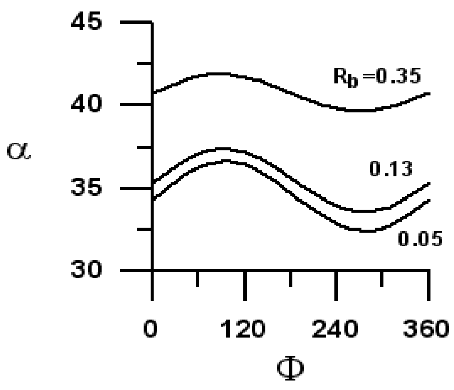

Fig.7. Dependence of α on the baroclinicity parameter ϕ at different Rb and $F_{i0} = 0.8$

Taking into account the relations between the parameters (12) and these in (3):

$$\mu = \aleph^2 \widetilde{Ro} Cd^{1/2} S \exp(-\lambda_u)\,,$$

$$\mu_{N_I} = \widetilde{Ro} F_{i0I} \exp(-\lambda_u)\,,$$

$$\mu_{\Delta\theta} = \widetilde{Ro} F_{i0\Delta\theta_I} \exp(-\lambda_u)\,,$$

$H_I = 1/\aleph C_d^{1/2} Ro_I$, it's easy to see that the right parts of (14) i.e. the explored unknown function F_g, F_t, α depend of the following parameters:

$$\lambda_u, \lambda_\theta, Rb; M, \phi; \widetilde{R}o, F_{i0}; Ro_I; F_{i0I}, F_{i0\Delta\theta_I}, \quad (15)$$

where $Ro_I = U_1 / fh_I$ is mutual (SL-SBL) Rossby inversion number, $F_{i0I} = N_I z_1 / U_1$ and $F_{i0\Delta\theta_I} = N_{\Delta\theta_I} z_1 / U_1$, are parameters describing the thermal structure of the capping inversion layer with thickness Δh over h_I. Obviously parameters (15) are input for the realization of (Rb-Rl) method. For example on Figure 6 it is shown the joint influence of stratification (Rb) and non-local effects ($F_{i0} \neq 0$) on F_g, F_t and α.For comparison it is also given the conventional case ($F_{i0} = 0$). Influence of baroclinicity at $F_{i0} = 0.8$ (strong non-local effect) at different Rb is demonstrated on Figure 7. As it seen in both cases the non-local effects are significant.

2.4. Application to determination of pollutant characteristics

The proposed parameterization schemes allow different procedures for practical application.

For example, using standard surface input data (at z_1=10m), on basis of Rb- method, are calculated turbulent fluxes, Monin-Obukhov length scale and other main turbulent characteristics.

Generalized variant of Rb method with incorporated non-local effects extending the applicability of parameterization also for the cases of surface layer within long- lived SBL.

Using for parameterization, of resistance laws (Rl-method), as input parameters are used external aerologic-synoptic (diagnostic or prognostic) data. On the basis of combined (Rb-Rl)–method and the proposed practically oriented flux-calculation techniques it is calculated relationships and correspondences between a series of main BL, PBL, PBL-free atmosphere turbulent and stability parameters for conventional and non-local turbulent regimes. Here as input parameters it can be used surface, aerologic-synoptic or from mixed format data.

These approaches are connected with accounting the influence of different above commented conventional and non-local effects, on the dynamical turbulent characteristics. As we have seen above, their dynamical influence is significant. It is natural to be expected, that their influence will take effect over the pollution characteristics.

Here we will consider these dynamical effects on the main pollution characteristics, for example: trajectory, dispersion, skewness of an instantly released cloud in SBL, described with pollutant dispersion model (Syrakov and Ganev, 2003, 2004). This model is based on splitting the diffusion to horizontal and vertical components, taking into account turning of wind in PBL and the other discussed above effects, and incorporating the method of moments (Safman, 1962), (Smith, 1965).Differing from the often met procedures, which a' priory give the dispersion, at this approach they are determined in the frames of the solution of the diffusion problem.

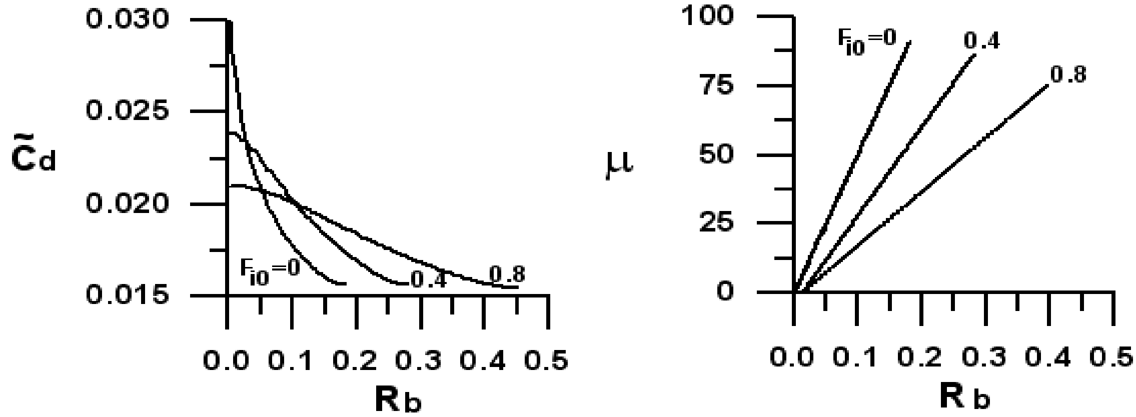

Figure 8. Dependence of geostrophic drag coefficient $\widetilde{C}_d = U_*/G_0$ and internal stratification parameter μ on bulk Richardson number Rb at different values of the non-local parameter F_{i0}.

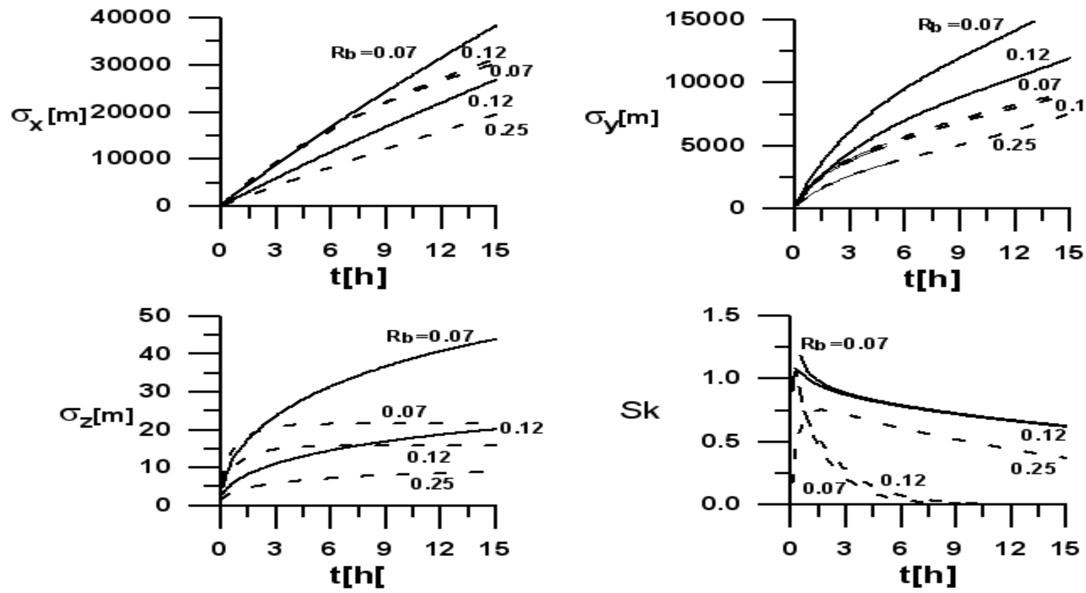

Figure 9. Dependence of dispersion parameters $\sigma_x(t), \sigma_y(t), \sigma_z(t)$ and skewness $Sk(t)$ on non-local parameter F_{i0}: $F_{i0} = 0$ (thick line) (conventional case) and $F_{i0} = 0.4$ (dotted line) by different values of Rb at $\lambda_u = \lambda_\theta = 7$ and $R\widetilde{o} = 3.10^6$.

The necessary for the pollutant model, dynamical parameters: velocity components u, v, vertical turbulent coefficient K_z, are calculated by one dimensional (z,t) - SBL model with formula for mixing length of Blackadar- Delage type. The model has different options for realization. Here we will limit to studying the steady state regime and variance in which as input parameters for the PBL model are used

$C\widetilde{d} = U_*/G_0$, α, μ, G_0 which are calculated by the (Rb-Rl) method. With the PBL model it is determined the dynamical parameters U, V, K_z , after which on the basis of pollutant dispersion model it is calculated different pollutant characteristics, The algorithm of this procedure is shown in table 1. So for example at input parameters (15): $\lambda_u = \lambda_\theta = 7$, $\widetilde{R}_0 = 3.10^6$ and $F_{i0} = 0$, 0.4, 0.8 for barotropic($M = \phi = 0$) and without inversion ($F_{i0I} = F_{i0\Delta\theta_I}$) case. Using (Rb-Rl) it is calculated the quantities: α (see Figure 6); $\widetilde{C}_d$, μ (see Figure 8), and using the function F_g (see Figure 6)it is easy to determine G_0 .

With the same parameters $\lambda_u, \lambda_\theta, \widetilde{R}_0$ and $F_{i0} = 0{,}2$ in an identical way it is calculated and some cases with consideration of the inversion effect: case B (only "clean lid" inversion effect: $R_{0I} = 500$, $F_{i0I} = F_{io\Delta\theta_I} = \Delta C_{cap} = 0$), case C (combined "lid" and ΔC_{cap} effect, $F_{ioI} = 0{,}135$, $F_{io\Delta\theta_I} = 0{,}07$). For comparison with cases B and C it is calculated also and the respective to them non-inversion case A (at $F_{i0} = 0{,}2$). According to the procedure of table 1 it is calculated, for example, the respective pollutant characteristics: dispersion parameters $\sigma_x(t), \sigma_y(t), \sigma_z(t)$ and skewness $Sk(t)$

On Figure 9 is demonstrated the influence of the non-local parameters on the counted parameters. These effects cause folding of the depth of PBL and fast inclining of the skewness $Sk(t)$ to zero. The counted effects increase more in the inversion case, particular in case C when it is counted the joint effects of "lid" and ΔC_{cap} (Figure 10).

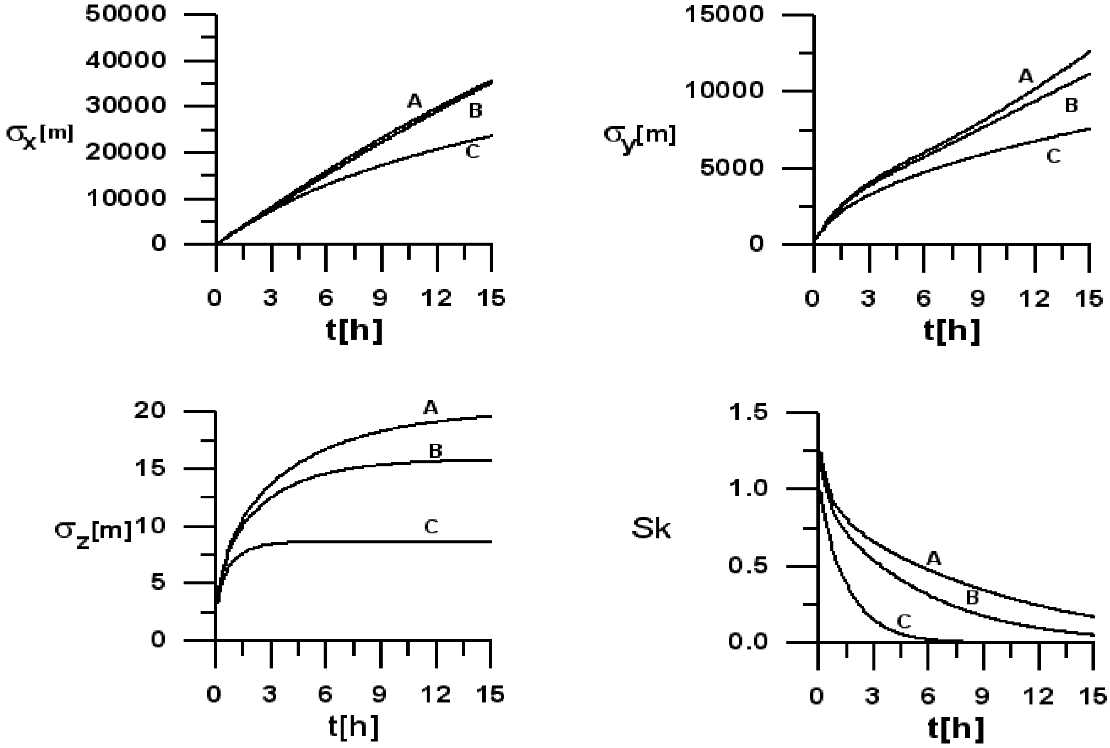

Figure 10. Dependence of dispersion parameters $\sigma_x(t), \sigma_y(t), \sigma_z(t)$, skewness $Sk(t)$ by non-local parameter $F_{i0} = 0.2$, $Rb = 0.12$, on inversion regimes: without inversion (A), only ("clean lid") inversion effect (B) and generalized case with additional ("clean lid") effect" plus thermal structure rise inversion effect (C).

Table1. Procedure for calculation of pollutant characteristics.

Input parameters (15)
(Rb-Rl)-method: determination of Cd, α, μ, G_0
SBL model: determination of $u(z), v(z), K_z(z)$
Pollutant dispersion model and determination of pollutant characteristics

3. CONCLUSION

The most popular (traditional) parameterization schemes from type of Rb-method, Rl-method, etc. are connected with traditional turbulent regimes. The present paper suggests a more general approach including the new non-local and capping inversion effects at long-lived PBL (Zilitinkevich and Esau, 2005), and also suggests combined (Rb-Rl) variant for connection between surface, SBL and free- atmosphere parameters.

In long- lived SBL, the surface layer is strongly affected from free flow stability (parameter N). As difference from the traditional formulation generalized bulk Richardson number Rb and its critical values Rbc are significantly depended on non-local effects. It leads, to incorporating these effects also in turbulent fluxes and other turbulent and stability parameter.

In these conditions the resistance and heat transfer law's functions A, B, C, are advanced accounted with free flow stability, baroclinicity and capping inversion effects. These effects are accounted through corresponding composition stratification parameters ($\widetilde{\mu}_H, \widetilde{\mu}_M, \widetilde{\mu}_{cap}$). It is shown, that capping inversion influence, is formed from two effects: "clean lid" effect and additional connected with thermal structure of capping layer over lower boundary of inversion h_I .

Combined (Rb-Rl) method allows finding coordinated relationships between surface, aerologic-synoptic and free atmosphere entrainment parameter and to use meteorological pre-processors using different input data.

Proposed parameterization schemes and calculated techniques are given in format analogical to conventional, which makes them easy accessible and applicable to determine wide range of dynamical and environmental tasks considering the above mentioned new effects.

4. ACKNOWLEDGEMENTS:

The authors would like to thank to proff. S. Zilitinkevich for the giving us the manuscript of the work (Zilitinkevich, S.and Esau S., 2005.

REFERENCE:

Byun, D. W., 1990. On the analytical solution of flux-profile relationships for the atmospheric surface layer. J. Applied Metorol., 29,652-657.

King J. and Turner J.,1997, Antartic Meteorology and Climatolgy. Cambridge Uni. Press.

King J. C., 1990, Some measurments of turbulence over an Antarctic ice shelf. Quart. J. Roy. Meteorolog. Soc., 116, 379-400.

Safman P., 1962. The effects of wind shear on horizontal spread from instantaneous ground source, Quart. J. Roy. Meteor. Soc., 88, № 378, pp. 382-393.

Smith, F.B., 1965. The role of the wind shear in horizontal difussion of ambient particles. Quart. J. Roy. Meteor. Soc., 91, 318-329.

Syrakov, E., 1990. Processes of thermal convection, dynamics and difussion: parametrization for different atmospheric scales and application for environmental protection. Dr of Sci. Thesis, University of Sofia, p. 274.

Syrakov E., K. Ganev, 2003. Accounting for effects of wind rotation in the PBl on Plume characteristics. Int. J. Environment and Pollution, vol. 20, 154-164.

Syrakov E., 2004. Some relations between surface boundary and PBL parameters considering conventional and non local effects in stable regime. Proc. Fourth ann. Meeting on the Ems, Ann. Meet. Abst., vol. 1, EMS-A-00371, Nice, France, 26-30 Sept.

Syrakov E., Ganev K., 2004. Stratification, baroclinicity and inversion effects on the lagrangian and diffusion characteristics of instanteously released cloud in PBL. Proc., Eight Inter. Conf. of Harm. w Atm. Disp. Modell. for Reg. Purp, vol. 1, 272-276, Germany, 01-04 June.

Syrakov E., 2005. On the explicit form of resistance law's functions A, B, C, considering non-local change effects in barotropic and baroclinic conditions in PBL. Ann.de L'Uni. de Sofia, Faculty of Physics, vol. 98.

Syrakov E., Cholakov E., 2005. Parametrization scheme for determaination of the boundary fluxes and relationships between BL and PBL characteristics considering the non-local

exchange processes at barotropic and baroclinic conditions. Ann.de L'Uni. de Sofia, Faculty of Physics, vol. 98 (in press).
Yordanov D., Wippermann F., 1972, The parametrization on the turbulent fluxes of momentum, heat and moisture at the ground in a baroclinic PBL. Beitr. Phys. Atm. 45, 58-65.
Zilitinkevich, S. and Calanca, P., 2000. An extended similarity-theory for the stably stratified atmospheric surface layer. Quart. J. Roy. Meteorol. Soc., 126, 1913-1923.
Zilitinkevich, S., 2002. Third-order transport due to internal waves and non-local turbulence in the the stably stratified surface layer. Quart. J. Roy. Meteorol. Soc., 128, 913-925.
Zilitinkevich, S.and Esau S., 2005. Resistance and heat transfer law fot stable and neutral PBL: Old Theory advanced and re-evaluated (submitted to Quart. J. Roy. Meteorol. Soc.).