Bahçeşehir University, Istanbul, Turkey
Analysis & PDE Center, Ghent University, Ghent, Belgium
Institute Mathematics & Math. Modeling, Almaty, Kazakhstan

"Analysis and Applied Mathematics"

Weekly Online Seminar

Seminar leaders:
Prof. Allaberen Ashyralyev (BAU, Istanbul),
Prof. Michael Ruzhansky (UGent, Ghent),
Prof. Makhmud Sadybekov (IMMM, Almaty)

Date: **Tuesday, June 13, 2023**

Time: 12.00-13.00 (Istanbul) = 11.00-12.00 (Ghent) = 15.00-16.00 (Almaty)

Place: Meeting room of Faculty of Engineering and Natural Sciences, Bahçeşehir University, D-415

Zoom link: https://us02web.zoom.us/j/6678270445?pwd=SFNmQUIvT0tRaH-lDaVYrN3l5bzJVQT09, **Conference ID:** 667 827 0445, **Access code:** 1

Speaker:

Ms. Dinara Tamabay

al-Farabi Kazakh National University, Almaty, Kazakhstan

Title: **Mathematical Issues of Difference Schemes for Atmospheric Boundary Layer Equations**

Abstract: To assess the influence of human-generated heat sources, harmful substances and changes in surface characteristics on the atmosphere of an urban area with industrial activity, a model of the boundary layer of the atmosphere is considered. Equations of motions and continuity equation are:

$$\frac{\partial u_i}{\partial t} + \frac{\partial u_i u_j}{\partial x_j} = -\frac{\partial p_i}{\partial x_i} + a_i K_i + \frac{\partial}{\partial x_3}\left(\nu \frac{\partial u_i}{\partial x_3}\right) + \Delta u_i, \frac{\partial u_j}{\partial x_j} = 0, i = 1,2,3, \tag{1}$$

where t is time, $p = (p_1, p_2, p_3)$ is pressure, in the second term in the left part and in the continuity equation summation is performed by repeating indices j $(j = 1,2,3)$, $u = (u_1, u_2, u_3)$ is a velocity vector, $x = (x_1, x_2, x_3)$ is Cartesian coordinates, $a = (1, -1, \lambda), K = (u_1, u_2, \theta)$. Heat inflow equation is:

$$\frac{\partial \theta}{\partial t} + \frac{\partial u_i \theta}{\partial x_j} + S u_3 = \frac{\partial}{\partial x_3}\left(\nu \frac{\partial \theta}{\partial x_3}\right) + \Delta\theta, i = 1,2,3, \tag{2}$$

here θ is background potential temperature, ν is vertical coefficient of turbulent exchange, S is stratification parameter. Equation of transfer of harmful substances in the atmosphere is:

$$\frac{\partial \varphi_q}{\partial t} + u_i \frac{\partial \varphi_q}{\partial x_j} = \Delta\varphi_q + \frac{\partial}{\partial x_3}\left(\nu \frac{\partial \varphi_q}{\partial x_3}\right) + \alpha_q \varphi_q + \beta_q + f_q, \sum_q \varphi_q = 1,\ i = 1,2,3, \tag{3}$$

here $\Delta = \frac{\partial}{\partial x}\mu_x \frac{\partial}{\partial x} + \frac{\partial}{\partial y}\mu_y \frac{\partial}{\partial y}$ is the differential operator of horizontal turbulent diffusion.

ϕ_q is the fraction of the concentration of a harmful substance in the impurity, f_q describes the sources of substances at the level of roughness, α_q, β_q are coefficients arising from the equations of transformations of impurities in the atmosphere, the index q means the chemical formula of the substance.

These equations are considered with initial and boundary conditions depending on the climatic and geographical features of the industrial city. Work provides a strict mathematical justification of the model. Application is also considered.

Biography:

Dinara Tamabay is a doctoral student at al-Farabi Kazakh National University (Almaty, Kazakhstan). Her research interests include Numerical methods, Model of the boundary layer of the atmosphere, etc.