# Mesoscale Meteorology and Air Pollution: Introduction into the Problem and Conference Aims

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This special issue presents a set of scientific papers following the International Conference “Mesoscale Meteorology and Air Pollution”. It has been held at the Odessa State Environmental University (OSEU), city of Odessa, Ukraine, 15–17 September 2008. More than 50 researchers from 16 countries of the Europe, North America, Africa and the NIS states attended the events. Unfortunately, not all the conference papers are presented in this journal issue (some of them already published in other journals or are waiting to be improved for further publication), so the reader can find the conference program, list of participants and all the PowerPoint presentations on the conference web-site: http://www.conf.osenu.org.ua/. Due to the geographical location of the meeting many papers of the issue are representing the current stage of mesometeorological research and applications in former SU countries, which are less represented in international journals.

An important reason to arrange this event in September 2008 was the commemoration of the late Professor Lev N. Gutman (85th Anniversary) and his outstanding contribution to theoretical mesometeorology. Note with his scientific biography and achievements in mesometeorology written by his former PhD student Dr. Alexander Kazakov (OSEU) is included in this issue.

Mesometeorology is an important and growing part of the atmospheric science. For a definition of the ‘Mesometeorology’ we can refer to a brilliant paper of Prof. Gutman[1], where he described it and specified the role of mesometeorology in the field of dynamic meteorology. He suggested a cell-diagram representing the various processes of dynamic meteorology as a function of linear scale, with emphasis on mesometeorological processes. “The processes listed in the cell-diagram include precipitation, thermal processes, convection and circulation (cell one) and free-atmospheric mesometeorological processes (cell two). Major emphasis is placed on the definition of the mesometeorological boundary layer (cell four). On the basis of the cell-diagram, mesometeorology is defined as the meteorology of

[1] Gutman, L. N. (1975) View of theoretical mesometeorology. In: Some problems of computational and applied mathematics. (A76-28676 12-59) Novosibirsk, Izdatel'stvo Nauka, p. 51-61. In Russian.

those atmospheric processes with a horizontal scale from several hundred meters to several hundred kilometers.”

Mesometeorological processes (atmospheric phenomena of relatively small size, as local winds, urban heat islands, thunderstorms or tornadoes, and of the detailed structure of larger disturbances) are playing an important role in different areas of meteorology, numerical weather prediction (NWP), climate and climate change modelling, air quality forecasting, emergency preparedness modelling, wind energy research, etc.

In the last two decades major advances have been made in quantifying the mesometeorological processes and planetary boundary layer (PBL) physics through theoretical studies, field and wind tunnel experiments, and numerical large-eddy and direct numerical simulations. The importance of turbulent processes in maintaining the mesoscale phenomena and inhomogeneities has become widely recognized. However, our knowledge of interactions between turbulence, local phenomena and large-scale geophysical processes remains insufficient.

Due to the fast growing supercomputer capabilities, modern meteorological models (even for the global scale) are reaching the mesoscale resolution already or in the nearest future. All mesoscale models have to account for the effects of a variety of atmospheric processes and parameterize the sub-grid scale processes. Typically, parameterization schemes have to simulate the effects of:

- Surface as well as subsurface layer fluxes of heat, moisture, chemical species and momentum transport;
- Subgrid flows such as turbulence within and outside the boundary layer, shallow and deep convection and gravity waves;
- Atmospheric radiation transport and redistribution on the surface and in the atmosphere;
- Cloud processes including cloud, aerosol and precipitation microphysics.

A gap has thus emerged between modern knowledge of the PBL physics and limited applicability of the theoretical schemes used in operational mesoscale models. It responds to demands from meteorological, environmental and climate modelling and emergency preparedness, this conference has addressed essential mesoscale features of PBLs insufficiently investigated or overlooked in practical applications and educational programs.

So, the conference program covered the following key topics with corresponding sections and subsections:

1) Nature, Theory and Modelling of Mesoscale Meteorological Processes:

- *Aspects of Modelling the Processes of the Atmospheric Boundary Layer,*
- *Numerical Simulation of Mesoscale Processes in the Atmosphere,*
- *The Problem of Tropical Vortice Simulation,*
- *Application of Regional and Mesoscale Models at Diagnosing and Forecasting;*

2) Role of the Mesoscale Processes in Climate Systems, and
3) Mesoscale Meteorology and Air Pollution.

The sections were focused on different aspects of modelling the processes of the atmospheric boundary layer, numerical simulations of mesoscale processes in the atmosphere, problems of vortices simulations, applications of regional and mesoscale models at diagnosing and forecasting, and use of mesoscale models in studies of air pollutant and aerosol distribution in the atmosphere. During the last day of the Conference the COST-728 research workshop "Use of Mesoscale Models in Studies of Air Pollutant and Aerosol Distribution in the Atmosphere" was also organized.

The COST Action 728 "Enhancing mesoscale meteorological modelling capabilities for air pollution and dispersion applications" (see web-site: http://cost728.org/) was launched in December 2004 for 5 years duration. It includes 23 European and 4 countries outside Europe. The Action addresses key issues concerning the development of mesoscale modelling capability for air pollution and dispersion applications. The Action encourages the advancement of science in terms of parameterization schemes, integration methodologies/strategies, air pollution and other dispersion applications, development of model evaluation methods and the investigation of meteorological influences on atmospheric chemistry and emissions. Where appropriate, this Action welcomes interaction and coordination with other scientific groups, therefore COST728 is acting as one of the co-organizers of the conference.

Additionally to the Cost 728 the Conference was sponsored by the Tempus Tacis Joint European Project COMBAT–METEO: "Development of a Competency-Based Two-Level Curricula in Meteorology" (JEP 26005), OSEU and the Administration of the city of Odessa and the Odessa region. The International Programme Committee of the conference included: Profs. Alexander Baklanov (Denmark/COST), George Djolov (South Africa), Sergey A. Dobrolubov (Russia), Joseph Egger (Germany), Branko Grisogono (Croatia), Lev N. Karlin (Russia), Alexander Khain (Israel), Arakel Petrosyan (Russia, co-chair), Ranjeet Sokhi (United Kingdom, COST), Sergej N. Stepanenko (Ukraine, co-chair), Sergej S. Zilitinkevich (Finland/TEMPUS, chair). The working languages of the conference were English and Russian (with simultaneous translation to both languages), so the papers in this issue are partly in English and partly in Russian.

Beside the presentations, the programme included the Round table discussion on "Mesometeorological modelling and environmental applications", convened by S-E. Gryning. The round table conclusions and recommendations were reported by E. Batchvarova (see this volume, enclosed). Based on that the most important issues for further research include: (i) Integrated online coupling modeling of mesometeorological and chemical transport processes with two-way feedbacks; (ii) Turbulence closures and flux aggregation for heterogeneous and complex surfaces; (iii) Flows within urban and forest canopies; (iv) Very stable stratification phenomena; (v) Observations and estimation of PBL height.

Great thanks to the Local Organizing Committee from OSEU, including Rector Prof. S.N. Stepanenko, Vice-rector Dr. Yu.S. Tuchkovenko, Dr. A.L. Kazakov, Vice-rector M.A. Krachkovs'kaya, Dr. V.N. Bondarenko, Dr. A.M. Luzhbin, O.V. Shabliy, I.A. Khomenko, etc. for making this meeting possible, productive and well organized.