

Introduction from the editors of special issue

“Integration of geospheres in Earth systems: Modern queries to environmental physics, modelling, monitoring and education”

This special issue presents a set of peer-reviewed papers discussed at or inspired by the Workshop “Integration of geospheres in Earth systems: Modern queries to environmental physics, modelling, monitoring and education”. The workshop has been held in Dubrovnik, Croatia, 30 April – 3 May 2011 and hosted by the Andrija Mohorovičić Geophysical Institute, Department of Geophysics, Faculty of Science, University of Zagreb.

The workshop was designed as a joint meeting of the four projects:

- PBL-PMES “Atmospheric Planetary Boundary Layers – Physics, Modelling and role in Earth Systems” (FP7 Specific programme IDEAS, ERC Advanced Grant No. 227915, 2009–2013, coordinator S. S. Zilitinkevich) <http://pbl-pmes.fmi.fi/>;
- MEGAPOLI “Megacities: Emissions, urban, regional and Global Atmospheric POLLution and climate effects, and Integrated tools for assessment and mitigation (FP7-ENV-2007.1.1.2.1 project 212520, 2008–2011, coordinator A. A. Baklanov) <http://megapoli.info>;
- MEGAPOLIS “Integration technologies for evaluation of atmospheric pollution in megacities on regional and global scales based on air, space and ground monitoring for reduction of negative consequences of anthropogenic impacts” (Russian project, customer Ministry of Science and Education of the Russian Federation, 2009–2011, coordinator V. G. Bondur) <http://pro-megapolis.ru>;
- QUALIMET “Development of Qualification Framework in Meteorology” (EU TEMPUS project No. 159352, 2010–2013, coordinator S. S. Zilitinkevich) <http://qualimet.net/>.

In total, 39 members of the projects teams and external collaborators from Croatia, Denmark, Estonia, Finland, Israel, Italy, Russia, Saudi Arabia, Serbia, South Africa, Sweden, Switzerland, Ukraine and USA participated in the following workshop activities:

- Topical presentations of the current state of the above projects: achievements, prospects, dissemination activities and collaboration with other projects and end users;

- Focused discussions on
 - ERC project PBL-PMES: current advancement of the theory of geophysical turbulence, and parameterization of PBLs as modules linking geospheres in weather-prediction, air-quality and climate models;
 - EU and Russian Federation partner projects MEGAPOLI – MEGAPOLIS: observations, monitoring and integrated modelling of urban environment, accounting for dynamic-chemical feedbacks and local-regional scale interactions and using modern satellite remote sensing technologies;
 - TEMPUS project QUALIMET: modern challenges to the environmental (in particular, meteorological) education in view of threatening human impacts on the environment and climate, ultimate demand for sustainable development, and mass-scale higher education;
- General discussions aimed to facilitate networking and exchange of ideas within and beyond the consortia of the above projects.

The following conclusions from the above projects were emphasised:

- The temperature changes given by IPCC are not uniform over the globe. Therefore, true magnitudes of local climate changes require determination of segmented trends on correct scales.
- Urban/megacity effects on climate depend on the scale concerned. Thus, city- and meso-scales are definitely affected by both urban heat island



Workshop Attendees, Dubrovnik, 3 May 2011.

(UHI) and urban emissions, while global-scale climate is affected by urban/megacities emissions, particularly of greenhouse gases and aerosols.

- According to the preliminary calculations using methods developed in the scope of the project MEGAPOLIS and with contributions from the project MEGAPOLI, the concentration levels of PM₁₀ and NO₂ are most significant for comprehensive assessment of air quality in Moscow. The influence of the Moscow megacity on air quality can be detected as far as 100 km.
- Successful testing of technology for remote sensing monitoring of wildfires developed in the scope of the project MEGAPOLIS allowed calculating emissions of carbon monoxide from the summer fires of 2010 and evaluating their impact on air quality in Moscow (the largest metropolis in Europe).
- Extreme natural phenomena can drastically deteriorate environmental conditions in urban areas. For example, interactions between natural and anthropogenic factors in the atmosphere over the Moscow metropolis during the heat wave of summer 2010 have led to the average daily concentrations of gaseous pollutants 20–30 times higher than MPC.
- Regional climate change in the Middle East is closely linked to global circulation processes.
- Life-times and spatial scales of the semi-organized structures (i.e. cloud streets and cloud cells) are much larger than the turbulent scales.
- The direction of the geostrophic wind and the cross-isobaric angle are important parameters controlling the Planetary Boundary Layer (PBL). They should be more carefully treated in the PBL parameterization.
- Mass concentrations of particulate matter with aerodynamic diameter up to 1 μm (PM₁) increase with an increase of relative humidity, except at the highest values of relative humidity.
- Po Valley pollutants emissions impact on the regional air quality at distances up to at least 500 km. Areas affected by these emissions are larger during winters, while the mass of pollutants injected in the free troposphere is larger during summers.

The Workshop highlighted importance of inter-disciplinary educational programs, in particular, those addressing physical and chemical weather and climate change adaptation; and identified scientific problems calling for further investigation:

- How large is the current impact of megacities on regional and global climate?
- How will the growth of megacities affect future climate at global and regional scales?

The partner projects MEGAPOLIS – MEGAPOLI have shown very efficient collaboration between EU and Russian research teams, strong benefits for both projects, and obvious necessity to support further EU-Russia cooperative research activities in environmental sciences. Nowadays, a good example of such collaboration represent two ongoing environmental research projects funded through mega-grants of the Government of the Russian Federation and led by the internationally recognized invited scientists: “Interaction of the Atmosphere, Hydrosphere and Land” at the University of Nizhny Novgorod, lead by Professor Sergej Zilitinkevich, and “Satellite Oceanography Laboratory” at the Russian State Hydrometeorological University in St. Petersburg, lead by Professor Bertrand Chapron.

It is only natural that this issue does not cover all papers presented at the Workshop. Many of them were based on already published, submitted or still uncompleted papers.

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