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Small-Scale Research Project: Enviro-HIRLAM Application for Studies of Urban and Aerosol Impacts on Metropolitan Areas

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To attract more perspective young scientists (and especially, MSc and PhD students) for advanced research and development of complex and modern modelling systems, a specific approach is required. It should allow within a short period of time to evaluate personal background levels, skills, capabilities, etc. To learn more about new potential science-oriented developers of the models, it is often not enough to look into the personal resume. Thus, a special event such as Young Scientist Summer School (YSSS) can be organized, where young researchers could have an opportunity to attend not only relevant lectures, but also participate in practical exercises allowing to solidify lecture materials. Here, the practical exercises are presented as independent small-scale (having duration of up to a week) research projects or studies oriented on specific topics of YSSS. Developed approach was tested and realized during 2008 and 2011 YSSS events held and organized in Zelenogorsk, Russia (by NetFAM et al.; http://netfam.fmi.fi/YSSS08) and Odessa, Ukraine (by MUSCATEN et al.; http://atmos.physic.ut.ee/∼muscaten/YSSS/1info.html), respectively. The main focus of these YSSSs was on the integrated modelling of meteorological and chemical transport processes and impact of chemical weather on numerical weather prediction and climate modelling.

During YSSSs some of such projects – "URBAN: The Influence of Metropolitan Areas on Meteorology", "AEROSOL: The Impact of Aerosols Effects on Meteorology", and "COASTAL: The Coastal & Cities Effects on Meteorology" – were focused on evaluation of influence of metropolitan areas on formation of meteorological fields above urban areas and surroundings. The Environment – HIgh Resolution Limited Area Model (Enviro-HIRLAM) was used and modifications were made taking into account urban (anthropogenic heat flux, roughness, buildings and their characteristics) and aerosol (feedback mechanisms) effects with further analysis of temporal and spatial variability of diurnal cycle for meteorological variables of key importance.

Main items of listed above YSSS small-scale research projects include the following:
• Introduction with background discussions (with brainstorming to outline research and technical tasks planned including main goal, specific objectives, etc.) in groups;
• Analysis of meteorological situations (selecting specific cases/ dates using surface maps, diagrams of vertical sounding, and surface meteorological measurements);
• Learning practical technical steps (in order to make necessary changes in the model and implementing urban and aerosol effects, compiling executables, making test runs);
• Performing model runs/simulations at different options (dates, control vs. modified urban and aerosol runs, forecast lengths, spatial and temporal resolutions, etc.);
• Visualization/ plotting of results obtained (in a form of graphs, tables, animations);
• Evaluation of possible impact on urban areas (estimating differences between the control and modified runs through temporal and spatial variability of simulated meteorological (air temperature, wind speed, relative humidity, sensible and latent heat fluxes, etc.) and chemical pollutants (concentration and deposition) fields/ patterns;
• Team's oral presentation of the project about results and findings and following guidelines (including aim and specific objectives, methodology and approaches, results and discussions with examples, conclusions, acknowledgements, references).

Outline and detailed description of the developed approach, key items of the research projects and their

schedules, preparatory steps including team of students' familiarization with general information on planned exercises and literature list (composed of required, recommended, and additional readings), requirements for successful completion and defense of the project, team independent work as well as under supervision are presented and discussed.