HPC-Europa3 - Transnational Access Programme

Main field: Earth Sciences & Environment

Dr. Igor Esau, Nansen Environmental and Remote Sensing Centre, Bergen, Norway

"High-Resolution Integrated Urban Environmental Modeling"

Joint studies of the urban climate and air quality/ atmospheric pollution using integrated approach to high-resolution numerical modeling and data fusion. Integration of the urban large-eddy simulation (meter-scale; PALM code - Parallelized Atmospheric Large-eddy simulation Model) and meteorological (km-scale; Enviro-HIRLAM code – HIgh Resolution Limited Area Model) simulations into a seamless modeling chain. Integration of the remote-sensing and citizen data with the model results to provide very high-resolution environmental assessment and prediction.

Background Information

Urban climate and air quality affects more than 70% of the EU population. It is however, known to be notoriously difficult to work with. The urban areas, even smaller ones, are characterized by very complex surface geometry, high concentrations of surface-level emission sources and significant urban climate anomalies. These factors make the meteorological/air quality models under-performing, regular observations non-representative and non-covering, and pure statistical interpolation methods misleading.

On the side of observations, there are available much more data than presently in use. Diverse observational networks are complemented by citizen observations, e.g., from hundreds of the NETATMO stations. There are statistical methods of data fusion and interpolation *(Johansson et al., 2015; Schneider et al., 2017),* that can create a final user-oriented product (map) of the environmental quality conditions at very high resolution. The methods are computationally costly and require the HPC-computing to be operationalized.

On the side of modeling, there are well-developed integrated modeling chains that detail the meteorological/air quality conditions down to the spatial scale of a few kilometers *(Baklanov et al., 2017a).* Those chains are however missing the final link in the downscaling chain - street-level detailing of the information - that is required to make it useful for the stakeholders. This final link is in strong demand by the society *(Baklanov et al., 2017b).*

In our previous joint collaborative project funded by the Nordic Council of Ministers, we developed and demonstrated essential elements of the numerical modeling technology to close the knowledge gap and to create this missing link with application of the PALM modeling code and data kriging algorithms *(Wolf et al., 2019; Varentsov et al., 2019).* We demonstrated the feasibility using modeling and data setup from the Bergen environment. However, neither connections to the larger scales through Enviro-HIRLAM model chain nor access to the citizen observations have been implemented.

This project aimed to finalize the work with the HPC-related part of the technology development. It will complete the seamless integration of the meteorological models and urban observational data through incorporation of the turbulence-resolving model PALM.

References:

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