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Numerical simulation of atmospheric boundary layer turbulence on HPC systems

Wednesday, 6 December 2023 12:00 (15 minutes)

We discuss the development of the unified framework for the numerical simulation of the atmospheric boundary layer turbulence. The model developed at the Lomonosov Moscow State University combines DNS (Direct Numerical Simulation), LES (Large-Eddy Simulation) and RANS (Reynolds-Averaged Navier-Stokes) approaches for turbulence modelling and allows high-resolution simulations on HPC systems by using MPI, OpenMP and CUDA. The code is structured in a such way as to separate the solution of high-level "numerical" and "physical" problems from the code related to parallelization or low-level algorithm optimization highly dependent on the computational architecture. The principal advantage of such separation is the ability to tune the code for different architectures without modifying the high-level and problem specific part of the code. The efficiency of the model implementation and the challenges of using heterogeneous architecture of modern HPC are discussed. A particular emphasis is placed on the code optimizations relevant for problems of aerosol and chemistry transport in urban environment. We show how the DNS- and LES- simulations may be used to improve current boundary-layer processes parameterizations used in Earth system models.

Student or Postdoc?

Post-Doctoral

Primary authors: Dr MORTIKOV, Evgeny (Lomonosov Moscow State University); Mr DEBOLSKIY, Andrey (Lomonosov Moscow State University); Mrs GASCHUK, Elizabeth (Lomonosov Moscow State University); Dr GLAZUNOV, Andrey (Marchuk Institute of Numerical Mathematics)

Presenter: Dr MORTIKOV, Evgeny (Lomonosov Moscow State University)

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