Geophysical Research Abstracts
Vol. 20, EGU2018-15740, 2018
EGU General Assembly 2018

GPU computing for high-performance large-eddy simulations

Chiel van Heerwaarden (1), Bart van Stratum (2), and Thijs Heus (3)

(1) Wageningen University, Meteorology and Air Quality, Wageningen, Netherlands (chiel.vanheerwaarden@wur.nl), (2) Royal Netherlands Meteorological Institute, De Bilt, Netherlands, (3) Cleveland State University, Cleveland, USA

While the rise and importance of convection permitting weather forecasting and climate models is evident, there remains also an important role for the turbulence-resolving simulations (dx < 50 m). These are the resolutions at which shallow clouds and turbulent mixing processes in the atmospheric boundary layer can be resolved.

It can be beneficial, for instance, to nest cloud resolving models into global models in regions where parameterizations fail in producing the correct turbulent transport rates or cloud properties. For such purposes, it is crucial to have a fast and flexible turbulence-resolving model. With this aim in mind, we have developed MicroHH (van Heerwaarden et al., 2017, GMD; www.microhh.org).

MicroHH is an open-source GPU-enabled computational fluid dynamics code for the simulation of turbulent flows in the atmosphere. MicroHH is designed for minimal memory usage in order to maximize the simulation domain that fits on a single GPU, as in this configuration maximal speedup compared to conventional CPU methods can be achieved. With the current version, $\sim$140-150 Intel Xeon cores are required to match the performance of a single NVIDIA Tesla P100 GPU.

While the presented speedup is promising with the prospect of application in forecasting or climate modelling, several barriers need to be overcome. While the development of the dynamical core for the GPU has been straightforward, we are encountering challenges in the implementation of parameterizations of physical processes as radiation and microphysics is complex. Here, having collaborations with GPU-experts from the fields of computer science is crucial.