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spricht

Prof. Dr. Siegfried Raasch
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über

"High resolution large-eddy simulations of the atmospheric boundary layer using massively parallel computer architectures"

Large eddy simulation (LES) has been for many years a tool for fundamental research of turbulent flows. Compared with Reynolds-averaged (RANS) models LES models are based on the volume-averaged Navier Stokes equations which allows them to explicitly resolve all scales of turbulent motions larger than the applied filter width. It is a compromise between RANS and the direct numerical simulation (DNS), where all scales of turbulence are resolved. For practical reasons, the filter width is normally related to the grid spacing of the numerical grid. The effects of turbulent eddies smaller than the grid size on the resolved-scale flow have to be parameterized by a so called subgrid-scale (SGS) model. While the LES technique has first been developed and applied in the field of meteorology, SGS models have been significantly improved in the engineering sciences. However, if the main energy containing eddies are well resolved by the grid, the turbulent transport by the SGS eddies is small compared with the total transport and the quality of the SGS model becomes less important.

Initially applied to study convective atmospheric boundary layers, LES is meanwhile used in many fields of science. This is mainly the consequence of the increase in available computer resources because LES requires both large amounts of memory and CPU time. State-of-the-art massively parallel computers now offer a wide variety of new applications. Currently available computer resources allow for numerical grids with up to 2000^3 grid points and even larger grids in the near future. Beside for the fundamental research of neutral and stable stratified flows, where the typical eddy size is much smaller than for pure convectively driven flows, LES is now used in Meteorology also for more applied topics like air pollution modelling, flow around buildings, and wind energy. Another frequently used method is to use LES generated turbulence data as pseudo observations e.g. in order to improve turbulence parameterizations in RANS models.

The presentation will give a short introduction to LES and the PArallelized LES-Model PALM, including numerical methods and parallelization techniques and will then focus on studies with very high spatial resolution currently done at IMUK, e.g. simulations of dust devils in the convective boundary layer and of cloud street development during cold air outbreaks.

Einladender: Gerald Steinfeld, ForWind