Technische Universität Braunschweig

MUSEN

New trends in high resolution large-eddy simulations of the atmospheric boundary layer: from fundamental to applied research

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Abstract:
Originally applied to study convective atmospheric boundary layers (CBL), large-eddy simulation (LES) is meanwhile used in many fields of science. This is mainly the consequence of a massive increase in available computer resources. State-of-the-art massively parallel computers have opened the field for a wide variety of new applications. On these machines, simulations with extremely large numerical grids of up to 40003 grid points and even more are currently carried out in acceptable time. In Meteorology, 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 starts to be used also for more applied topics like air pollution modeling, flow around buildings, or wind energy. Moreover, the interaction of turbulence of different scales can be studied for the first time. Lagrangian particle models coupled to LES allow for further interesting applications, e.g. to calculate footprints of turbulence sensors in heterogeneous terrain, or to simulate the effect of turbulence on the growth of cloud droplets. Respective simulations require both, a large model domain size to capture the large scales and a sufficiently fine grid spacing to resolve the interacting smaller scales, creating a very high demand on computational resources.

The talk will start with a short general introduction to LES and will then give an overview of current studies with very high spatial resolution performed at IMUK, like simulations of coherent structures in the convective boundary layer, simulations of the urban environment, and the effect of turbulence on cloud droplet growth or aircraft during takeoff and landing, as well as LES applications for wind energy systems.