Geophysical Research Abstracts
Vol. 16, EGU2014-7573, 2014
EGU General Assembly 2014
© Author(s) 2014. CC Attribution 3.0 License.

Turbulence scale interactions in convective boundary-layer flows reproduced with compressible and incompressible large eddy simulation codes

Evgeni Fedorovich and Jeremy Gibbs
School of Meteorology, University of Oklahoma, Norman, United States (fedorovich@ou.edu)

As computing capabilities expand, the use of high-resolution atmospheric numerical models with horizontal grid spacing on the order of 10 m becomes widespread. These models are particularly attractive for users who seek an accurate description of small-scale atmospheric turbulent motions. While the finer-resolution simulations become more desirable, a question remains whether the model-design features originally intended for simulation of larger-scale atmospheric flows will translate to adequate reproduction of small-scale motions.

In this study, turbulent flow in the dry atmospheric convective boundary layer (CBL) is simulated using a conventional incompressible large eddy simulation (LES) code and the compressible Weather Research and Forecasting (WRF) model code applied in an LES mode. The two simulation configurations use almost identical numerical grids and are driven with the same CBL forcings. The effects of the CBL wind shear and of the varying grid spacing on the simulated turbulence fields are analyzed in comparison. Additionally, the effects of varying Courant number on the reproduced CBL turbulence structure are investigated.

Two-dimensional velocity spectra are used to get insights into the planar turbulence structure. Results show that the WRF model tends to attribute slightly more energy to larger-scale flow structures, as compared to the CBL structures reproduced by the incompressible LES, and reproduces relatively less spatially variable velocity fields. Spectra from the WRF model feature narrower inertial spectral subranges and indicate enhanced damping of turbulence on small scales. Possible reasons for the observed discrepancies are discussed.