Surface Flux Parameterization for Large Eddy Simulation

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Abstract

Atmospheric large eddy simulation (LES) need a surface flux parameterization of turbulent transports near the ground. Conventional parameterizations used for Reynolds- Averaged Navier–Stokes simulation may not be correct for LES: the grid values of wind speed in LES contain turbulence fluctuation, so that they may be inappropriate to substitute in the surface flux parameterization. A sensitivity experiment with an atmospheric LES shows that the issue in the surface flux parameterization is relatively unimportant to domain-averaged wind speeds but significant for their variations.

The results of direct numerical simulation (DNS) and wind tunnel experiments are examined to how surface momentum flux relates to wind speeds in turbulent boundary layers. The surface flux hardly correlates with wind speed fluctuations due to turbulence. Both DNS and wind tunnel experiments suggest temporal (spatial) filtering over the correlation time (length) is required to rationalize the conventional parameterization.

Considering temporally filtered wind speed in the surface flux parameterization is a plausible modification on numerical weather prediction models. Thus, modified parameterization is implemented in LES. Its result is shown to realize more reasonable vertical profiles of wind speed variations in accord with the wind tunnel experiments: the log-law for the wind speed variations (Marusic et al., 2013) is realized.

References:

Marusic, I., J. P. Monty, M. Hultmark, and A. J. Smits (2013), On the logarithmic region in wall turbulence, J. Fluid Mech., **716**, R3, doi:10.1017/jfm.2012.511.