EMS Annual Meeting Abstracts
Vol. 12, EMS2015-575, 2015
15th EMS / 12th ECAM

Comparison of Energy- & flux-budget turbulence closure with Large Eddy Simulation of idealized cases

Evgeny Kadantsev (1) and Sergej Zilitinkevich (1,2,3)

(1) Division of Atmospheric Sciences, University of Helsinki, Finland (evgeny.kadantsev@helsinki.fi), (2) Finnish Meteorological Institute, Helsinki, Finland, (3) Department of Radio Physics, University of Nizhniy Novgorod, Russia

Recently a new theoretical derivation of for a new turbulence closure has been presented by Zilitinkevich et al. (2013). This Energy- & flux-budget (EFB) closure is based on the budget equations for the basic second moments: the two energies, the TKE E_K and the turbulent potential energy (TPE) E_P, and the vertical turbulent fluxes of momentum and potential temperature, τ_i (i = 1, 2) and F_z. Instead of the traditional postulation of the down-gradient turbulent transport, it uses the flux-profile relationships and determines the eddy viscosity and eddy conductivity from the steady-state version of the budget equations for τ_i and F_z. In that closure authors further advance the physical background of the EFB closure, introduce a new prognostic equation for the turbulent dissipation time scale t_T, and extend the theory to non-steady turbulence regimes accounting for non-gradient and non-local turbulent transports (when the traditional concepts of eddy viscosity and eddy conductivity become generally inconsistent).

In the present study we implement a new turbulence closure in one-column RANS model and in HARMONIE/AROME weather prediction system (HIRLAM-B, 2013). We test the closure in various idealized cases, varying stratification from stable (GABLS1 case) to neutral (Truly Neutral and Conventionally Neutral cases) running HARMONIE/AROME model in single-column mode. Results are compared with LES runs and different numerical weather prediction models.

Bougeault P., and P. Lacarrère, 1989: Parameterization of orography-induced turbulence in a meso-beta scale model. Mon. Wea. Rev., 117, 1872-1890.

Cuxart, J., P. Bougeault, and J.-L. Redelsperger, 2000: A turbulence scheme allowing for mesoscale and large-eddy simulations. Quart. J. Roy. Meteor. Soc., 126, 1-30.

HIRLAM-B Project, 2013: General description of the HARMONIE model. http://hirlam.org/index.php?option=com_content&view=article&id=65&Itemid=102

Zilitinkevich S.S., T. Elperin, N. Kleeorin, I. Rogachevskii, and I. Esau, 2013: A Hierarchy of Energy- and Flux-Budget (EFB) Turbulence Closure Models for Stably-Stratified Geophysical Flows. Boundary-Layer Meteorol, 146, 341-373.