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Turbulence closure problem for stably stratified flows

S.S. Zilitinkevich (1,2,3), T. Elperin (4), N. Kleeorin (4) and I. Rogachevskii (4)

(1) Division of Atmospheric Sciences, Department of Physical Sciences, University of Helsinki, Finland, (2) Finnish Meteorological Institute, Helsinki, Finland, (3) Nansen Environmental and Remote Sensing Centre / Bjerknes Centre for Climate Research, Bergen, Norway, (4) Department of Mechanical Engineering, Ben-Gurion University of the Negev, Beer-Sheva, Israel (Contact Email: sergej.zilitinkevich@fmi.fi)

We propose a new turbulence closure model based on the budget equations for the basic second moments: turbulent kinetic and potential energies: TKE and TPE, which comprise the turbulent total energy: TTE = TKE + TPE; and vertical turbulent fluxes of momentum and buoyancy (potential temperature). Besides the new concept of the TTE, other key points are: non-gradient correction to the traditional formulation for the flux of buoyancy (potential temperature), and advanced analysis of the stability dependence of anisotropy of turbulence. The proposed model affords the existence of turbulence at any gradient Richardson number, Ri. Instead of the critical value of Ri separating the turbulent and the laminar regimes, the model includes its threshold value, between 0.2 and 0.3, which separates two turbulent regimes of essentially different nature: fully developed, chaotic turbulence at low Ri and weak, strongly anisotropic turbulence at large Ri. Predictions from the proposed model are consistent with available data from atmospheric and lab experiments, DNS and LES.