Geophysical Research Abstracts
Vol. 20, EGU2018-1797, 2018
EGU General Assembly 2018

Towards revision of conventional theory of turbulence in atmospheric surface layer

Sergej Zilitinkevich (1,2,3)

(1) Finnish Meteorological Institute, Helsinki, Finland (sergej.zilitinkevich@fmi.fi), (2) University of Helsinki, Finland, (3) University of Nizhny Novgorod, Russia

Since its publication in 1954, Monin-Obukhov Similarity Theory (MOST) of the surface-layer turbulence is universally recognised and widely used in weather and climate models. MOST underlies modelling of the air-land/water turbulent fluxes at the Earth surface, mean and turbulent structure of the surface layer, turbulent diffusion, wind load on constructions, etc. In spite of well-documented inconsistencies in unstable and strongly stable stratifications, MOST has not been seriously questioned. General reluctance to revise MOST is understandable. Its drawbacks root in restrictions inherent to common vision of turbulence based on the universally recognised paradigm attributed to Kolmogorov (1941, 1942). Hence, revision of MOST factually implies revision of the entire vision of stratified turbulence. Notably, Kolmogorov himself considered the shear-generated turbulence in neutrally stratified flows. Subsequent conversion of his vision of turbulence into an ultimate paradigm relevant to any stratified flow was done without proof by Kolmogorov's followers. In this paper, major drawbacks of MOST are demonstrated; conventional paradigm is revised; and first steps towards advanced theory of turbulence in stratified boundary-layer flows are made with due regard to the self-control and maintenance of turbulence in supercritically stable stratification, and to inverse energy cascade in unstable stratification where chaotic plumes merge to build lager plums, thus performing inverse energy cascade towards self-organised motions: cells or rolls in the shear-free or sheared convection, respectively.