

## **Geophysical Turbulent Boundary Layers: the Nature, the Theory and the Role in the Atmosphere-ocean System**

**Sergej S. Zilitinkevich**

*Department of Earth Sciences, Uppsala University, Sweden*

Turbulent boundary layers control the exchange processes between the atmosphere and the ocean/ice/land. The key problem of boundary-layer physics is to determine the momentum, energy and matter fluxes in a wide range of boundary-layer regimes from stable and neutral to convective. This paper presents the state of the art and modern developments in boundary-layer physics with focus on the recently recognised non-local mechanisms overlooked in the traditional theories, namely, the effect of internal gravity waves on vertical transports in stably stratified flows and the role the buoyancy-driven large-scale semi-organised eddies in convective flows. New developments are compared with experimental and large-eddy simulation (LES) data. They are motivated by urgent necessity to improve boundary-layer parameterisations in very high resolution environmental models, particularly, in the coupled atmosphere-ocean models.

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