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A fresh view on the concept of boundary-layer depth and the Monin-Obukhov similarity theory

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The energy- and flux-budget turbulence closure theory (Zilitinkevich et al, 2007, 2008, 2009, 2012) has disclosed quite sharp transition between the strong-turbulence regimes typical of boundary-layer flows and the newly discovered weak-turbulence regime, typical of the free flows and characterised by dramatic suppression of the heat transfer compared to momentum transfer. This finding suggests a very natural definition of the outer boundary of planetary boundary layers as the strong-to-weak turbulence transition level (obviously applicable to practically all types of atmospheric and hydrosphere boundary layers and suitable all over the globe including equatorial regions). Furthermore, the energy- and flux-budget closure suggests essential revision of the Monin-Obukhov similarity theory for the stably-stratified boundary layers and allows for is modification for the steady-state, stably-stratified geophysical flows in the free atmosphere or deep ocean. These developments call for comprehensive empirical verification and open new prospects for modelling applications.

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