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A HIERARCHY OF ENERGY-AND FLUX-BUDGET (EFB) TURBULENCE CLOSURE MODELS FOR STABLY STRATIFIED GEOPHYSICAL FLOWS

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en salle Joël Noilhan

Abstract :

In this talk we advance physical background of the EFB turbulence closure and present its comprehensive description. It is based on four budget equations for the second moments : turbulent kinetic and potential energies (TKE and TPE) and vertical turbulent fluxes of momentum and buoyancy; a new relaxation equation for the turbulent dissipation timescale ; and advanced concept of the inter-component exchange of TKE.
The EFB closure is designed for stratified, rotating geophysical flows from neutral to very stable. In accordance to modern experimental evidence, it grants maintaining turbulence by the velocity shear at any gradient Richardson number Ri, and distinguishes between the two principally different regimes : "strong turbulence" at Ri << 1 typical of boundary-layer flows and characterised by practically invariable turbulent Prandtl number PrT ; and "weak turbulence" at Ri > 1 typical of the free atmosphere or deep ocean, where T Pr asymptotically linearly increases with increasing Ri that implies strong suppression of the heat transfer as compared to the momentum transfer. For use in different applications, the EFB turbulence closure is formulated at different levels of complexity, from the local algebraic model applicable to the steady-state regime of turbulence to a hierarchy of non-local models including simpler down-gradient models, consistent with the traditional concept of eddy viscosity and conductivity, and general non-gradient.

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