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*Published in:*
EMS Annual Meeting Abstracts

*Publication date:*
2013

*Document Version*
Publisher's PDF, also known as Version of record

EMS Annual Meeting Abstracts
Vol. 10, EMS2013-465, 2013
13th EMS / 11th ECAM


# The influence of capping inversion strength and surface heat flux on the wind profile in large eddy simulations of near-neutral atmospheric boundary layers

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A range of Large Eddy Simulations has been performed to study the vertical wind profile of the 'conditionally neutral' (Zilitinkevich et al., 2012) and near-neutral atmospheric boundary layer (ABL), developed against a stably stratified free atmosphere. We describe in detail the simulated process of transition from the initially stable flow to a quasi-steady turbulent boundary layer flow. The influence of the surface heat flux and the Brunt Vaisala frequency in the free atmosphere on this equilibration process and on the quasi-steady wind profile is investigated. Applying relatively small heat fluxes at the lower surface of the computational domain causes the simulated near-neutral wind profiles in the upper half of the ABL to differ significantly from those in the conditionally neutral ABL. A distinct feature of the fully developed wind profile in our simulations of the neutral ABL is a super-geostrophic jet just below the ABL top. In the near-neutral simulations a similar jet is to a large extent dissolved when the flow reaches its quasi-steady state. The implied sensitivity of the wind profile to small changes in the surface conditions is potentially significant for accurate assessment of e.g. wind energy resources or wind turbine loads, though the simulated conditions are highly idealized. However, the description of upper-ABL mean wind profiles in the two regimes, including the effect of the free atmosphere, is of academic interest as well as for both modeling and observation-based predictions.