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Intercomparisons of turbulence statistics derived from large-eddy simulation and field databases

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Large-eddy simulation (LES) database DATABASE64 has been used to compare turbulent statistics obtained by turbulence-resolving modelling and by field measurements in stably stratified boundary layers. Prime field data were taken from SHEBA and CASES-99 campaigns and Ohya et al. wind tunnel experiments with complementary data extracted from literature. Simulations ware run at 64 x 64 x 64 mesh with a variable resolution so that the turbulent layer comprised from 1/2 to 2/3 of the simulation domain. General agreement between the LES and field data is clearly shown. Moreover, the LES recovered proper surface layer laws like Monin-Obukhov log-linear non-dimensional gradients in spite of inconsistencies in the model boundary conditions and sub-grid scale closure. Although the nature of turbulent statistics in the LES (statistics obtained by horizontal averaging and throughout the entire boundary layer depth with extra weight on capping inversion levels) and in the field data (statistics obtained by time averaging and filtering mostly within the surface layer) is different, they compares fairly well with LES data tending to be located within the field data scatter. Increase of Pr with increasing stability, measured through the gradient Richardson number, is observed both in the field data and the LES data. Present inconsistencies could be explained possibly by momentum loss in radiation of internal gravity waves, which partially offset the general suppression of the turbulent exchange by strong static stability.