Session: C27 Poster: W101A

Confronting the WRF and RAMS mesoscale models with innovative boundary-layer observations in the Netherlands

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The Weather Research and Forecasting Model (WRF) and the Regional Atmospheric Mesoscale Model System (RAMS) are frequently used for atmospheric physics and chem-istry studies. This paper covers an evaluation of these models for a windy and calm epi-sode against Cabauw tower observations (The Netherlands), with a special focus on the representation of the physical processes in the atmospheric boundary layer (ABL). In ad-dition, area averaged sensible heat flux observations by scintillometry are utilized which enables evaluation of grid scale model fluxes and flux observations of the same horizontal scale. Also, novel ABL height observations by ceilometry and of the near surface longwave radiation divergence are utilized. WRF in its basic set-up shows satisfactory model results for nearly all atmospheric near surface variables. However, both models overestimate friction velocity and near surface wind speed (even after adjustment of mod-el parameters). An important inconsistency was found regarding the ABL daytime heat budget: Both model versions are only able to correctly forecast the ABL thermodynamic structure in case the modeled surface sensible heat flux is much larger than the observa-tions indicate. Sensitivity studies and evaluation of radiative tendencies and entrainment reveal that possible errors in these variables cannot explain the apparent missing sensible heat flux within the current model infrastructure.