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Evaluation and improvement of the WRF mesoscale model for the stable boundary layer and the representation of the low level jet
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Recorded Presentation

Correct forecasting of the diurnal cycle of the atmospheric boundary layer (ABL) is of key importance for many applications like for wind energy, weather forecasting and climate, agriculture and air quality. Previous research has shown models are very sensitive to the selected boundary-layer parameterization. In this contribution we extend the GABLS3 single-column model intercomparison (Bosveld et al., 2012; http://www.knmi.nl/samenw/gabls/), by evaluating the WRF three dimensional model (version 3.2.1) for the same case and the 7 analogue cases of Baas et al (2010). Results show satisfactory model behaviour for net radiation with comparison to Cabauw observations (Netherlands), although a negative bias in long wave downward radiation of about 20 W/m^2 as in the single-column model studies is seen. Typically, two meter temperatures are slightly underestimated during daytime, and substantially underestimated at night. Concerning the vertical profiles, the YSU ABL scheme in WRF overestimates the ABL depth and low level jet (LLJ) altitude substantially. Also, the modelled LLJ speed is too low with respect to Cabauw tower observations and the nearby radio-sounding measurements of de Bilt . To improve the performance of the YSU scheme for the LLJ, the YSU scheme has been modified by implementing the stable boundary layer height definition in Vogelezang and Holtslag (1996). The latter uses a modified definition of the bulk Richardson number based on a layer between the ABL height and a level several tens of meters above the ground, rather than the ground surface itself. In that way, near surface shear production does not directly affect the ABL height, which make physically sense under relatively high wind geostrophic speed conditions (as in GABLS3) . The revised scheme results in a more accurate forecast of the stable boundary layer. In particular, the LLJ, the boundary-layer height and the near surface stability improves compared to observations. In more detail, we find significant increase in the LLJ speed by ~$1.5 ms^{-1}$ and decrease in LLJ altitude by ~100m which is in closer agreement to the observations than with the original YSU formulation.

Supplementary URL:

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