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Evaluation of the Weather Research and Forecasting model in the Durance Valley complex terrain during the KASCADE field campaign

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In the winter of 2012-2013, the KASCADE observational campaign was carried out in southeast France in order to characterize the wind and thermodynamic structure of the (stable) planetary boundary layer (PBL). Data were collected with two micro-meteorological towers, a SODAR, a tethered balloon and radiosoundings. Here, we use this dataset to evaluate the representation of the boundary layer in the WRF model. Generally, we find that diurnal temperature range (DTR) is largely underestimated, there is a strong negative bias in both longwave radiation components, and evapotranspiration is overestimated. An illustrative case is subjected to a thorough model-physics evaluation. First, five PBL parameterization schemes and two land surface schemes are employed. We find a marginal sensitivity to PBL parameterization, while the sophisticated Noah land-surface model represents the extremes in skin temperature better than a more simple thermal diffusion scheme. In a second stage, we performed sensitivity tests regarding land-surface-atmosphere coupling (through parameterization of z0h/z0m), initial soil moisture content and radiation parameterization. Relatively strong surface coupling and low soil moisture content results in a larger sensible heat flux, deeper PBL and a larger DTR. However, the larger sensible heat flux is not supported by the observations. It turns out that for the selected case, a combination of subsidence and warm air advection is not accurately simulated, but this cannot fully explain the discrepancies found in the WRF simulations. The results of the sensitivity analysis reiterate the important role of initial soil moisture values