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A nested configuration of WRF-NOAHMP for process studies and the development of turbulence parameterizations over the SGP site

Hans-Stefan Bauer, Florian Späth, Andreas Behrendt, Volker Wulfmeyer, and Diego Lange
University of Hohenheim, Institute of Physics and Meteorology, Stuttgart, Germany (hsbauer@uni-hohenheim.de)

We apply the WRF-NOAHMP model system in a nested configuration from the mesoscale down to the turbulence-permitting resolution of 100 m over the Southern Great Plains. Driven by the ECMWF operational analysis, this setup allows simulations with realistic lower boundary and meteorological forcing. A consistent set of physical parameterizations is applied through the whole chain of domains.

Using this setup, the evolution of the planetary boundary layer and land-atmosphere (L-A) feedback were investigated for selected days during the Land Atmosphere Feedback Experiment (LAFE) performed in August 2017 at the ARM SGP site. The model performance in representing the boundary layer evolution at different horizontal resolutions is presented. Also, detailed comparisons of turbulence parameters derived from the parameterized and turbulence-permitting simulations with observations are presented. The latter provides insight into the performance of turbulence parameterizations and potential improvements.

First comparisons with observations revealed that only the turbulence-permitting simulations realistically represent the temporal evolution and the internal structure of the daytime convective boundary layer as well as the morning and evening transitions. Statistical comparisons with lidar observations revealed differences in details as in the representation of vertical gradients or the variability in the boundary layer.

The results demonstrate that this model configuration is a valuable tool complementing high-resolution observations for the investigation of turbulent processes as well as the test and development of turbulence parameterizations.