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Modifying and evaluating the land surface parameterization of the mesoscale model METRAS for long-term simulations

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Due to increasing computational resources it will soon be possible to run the mesoscale atmosphere model METRAS for simulation periods of several years. This will enable the use of METRAS as a regional climate model not only by applying statistical methods but also by using dynamic downscaling. However, modifications of the land surface parameterization used by METRAS are necessary for this purpose. A multi-layer model that solves the heat conduction equation to predict soil and surface temperature is introduced. It replaces the formerly used force-restore method which is known to produce reliable results on a timescale of a few days but to be inappropriate for longer periods. Concerning soil hydrology the previously used 'single bucket' approach which computes soil water in a single layer is replaced by a multi-layer model that solves the Richards-equation to calculate soil water flows.
The modified parameterizations are compared to the old ones using quality checked measurement data from the Hamburg weather mast. Short and long term simulations of the 1D version of METRAS are conducted and compared to measurement data. This includes offline simulations in which flux measurements are used to force the standalone soil models as well as online simulations in which the soil model is coupled to the atmosphere. The modified soil model produces more realistic values for surface temperature in long term simulations since seasonal influences are reproduced better. For short term simulations the force-restore method delivers satisfactory results at lower computational costs.