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Ameriflux data used for verification of surface layer parameterizations

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The atmospheric surface-layer parameterization is an important component in a coupled model, as its output, the surface exchange coefficients for momentum, heat and humidity, are used to determine the fluxes of these quantities between the land-surface and the atmosphere. An accurate prediction of these fluxes is therefore required in order to provide a correct forecast of the surface temperature, humidity and ultimately also the precipitation in a model.

At the NOAA/NCEP Environmental Modeling Center, a one-dimensional Surface Layer Simulator (SLS) has been developed for simulating the surface layer and its interface. Two different configurations of the SLS exist, replicating in essence the way in which the surface layer is simulated in the GFS and the NAM, respectively. Input data for the SLS are the basic atmospheric quantities of winds, temperature, humidity and pressure evaluated at a specific height above the ground, surface values of temperature and humidity, and the momentum roughness length z0. The output values of the SLS are the surface exchange coefficients for heat and momentum. The exchange coefficients computed by the SLS are then compared with independent estimates derived from measured surface heat fluxes. The SLS is driven by a set of Ameriflux data acquired at 22 stations over a period of several years. This provides a large number of different vegetation characteristics and helps ensure statistical significance.

Even though there are differences in the respective surface layer formulations between the GFS and the NAM, they are both based on similarity theory, and therefore lower boundary conditions, i.e. roughness lengths for momentum and heat, and profile functions are among the main components of the surface layer that need to be evaluated. The SLS is a very powerful tool for this type of evaluation. We present the results of the Ameriflux comparison and discuss the implications of our results for the surface layer parameterizations of the NAM and the GFS.