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A new algorithm for the downscaling of 2-dimentional atmospheric near-surface fields that adds both explained and not explained small-scale variability

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Fields from dynamical models often have an insufficient resolution and need to be disaggregated. In our case we have atmospheric fields at 2.8 km (coarse) resolution and would like to couple these with a soil module running at 400 m (high) resolution. To avoid biases in the computation of the fluxes between the surface and the atmosphere we need to add small-scale variability to the atmospheric variables in the lowest atmospheric model level.

For such purposes we have developed a disaggregation algorithm that preserves the original mean values of the coarse resolution fields. As a first step, the method starts by converting the coarse fields to the higher resolution using a spline interpolation algorithm that preserves the coarse means. In this way gradients at the coarse scale can be accounted for and jumps at the coarse edges are reduced.

To reduce biases due to nonlinearities we add small-scale variability according to rules as well as noise for the variability we can not explain. Thus in the second step, disaggregation rules for the atmospheric variables are applied that depend on high-resolution surface properties and the current atmospheric conditions. For example, a linear relation between the temperature anomalies and height anomalies is assumed for unstable atmospheric stratification to correct the small scale temperature field based on the known high-resolution height field.

In a third step, we add the remaining variability that could not be explained as noise to reduce biases in the nonlinear calculation of the surface fluxes. We will present the algorithm and show some first tests.

The model used in this work is the COSMO-model, the weather forecast model (and regional climate model) of the German and other European Weather Services. Training and validation of the scheme is based on a number of high-resolution model runs with the fully coupled model, i.e. runs in which also the atmosphere has a grid spacing of 400 m. This fine-scale information is compared with averaged coarser scale information (2.8 km) to derive the rules needed in step two and the estimate how much noise still needs to be added in step three.