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Assimilation of soil moisture on multiple spatial scales into the mesoscale hydrologic model (mHM)

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Soil moisture observations are often not acquired at scales suitable for mesoscale hydrological modelling. While in situ measurements and observational networks provide measurements for the local scale at fine spatio-temporal resolutions, spaceborne sensors deliver global soil moisture observations in coarse spatio-temporal resolutions. None of these available measurements can be used directly for the assimilation into a mesoscale hydrological model. Nevertheless, these measurements provide valuable information, which have been proven to enhance model performance. Therefore, the application of scaling techniques is a common way to deal with the discrepancy between observational and modelling scale before the observations are assimilated into the model. However, this will always introduce uncertainties into the dataset. This ongoing study aims to quantify the potential gain of assimilating soil moisture data on its original scale. It will be analysed how mesoscale modelling can benefit from the assimilation of soil moisture observations without the use of prior scaling techniques. For this purpose, the mesoscale Hydrological Model (mHM) is used. It employs a Multiscale Parameter Regionalization (MPR) technique that allows the estimation of quasi-scale invariant parameters. Thus, the model is able to run on different scales simultaneously while preserving model fluxes like for example soil moisture dynamics, infiltration, surface runoff and discharge generation. (For a more detailed description of the model see: http://www.ufz.de/index.php?en=31389.) This unique feature of mHM is used to conduct a multiscale synthetic experiment to estimate the potential benefits of multiscale data assimilation. A proxy soil moisture dataset at a mesoscale resolution (e.g. 4x4 km^2) is created and averaged to the size of typical coarse remote sensing pixels (e.g. 25x25 km^2). This proxy remote sensing dataset is assimilated into mHM by the ensemble Kalman filter (EnKF) to update the global model parameters that are common for all scales. The updated parameters are then used for modelling different spatial scales, e.g. the scale of the proxy dataset before it was averaged on remote sensing pixel size. In this way, the information gained through the assimilation of large scale data is preserved and used for modelling smaller scales. Thus, it will be possible to assimilate data at the observational scale and transfer the gained information (updated model parameters) to other scales without the necessity of using prior scaling techniques. The study shows first results for the Saale catchment (23 700 km^2) and demonstrates the positive and negative aspects of assimilating large scale data, including how its effect propagates to smaller scales and how the resolution of the assimilated data influences the potential gain for the model.