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Model-based analysis of scaling properties of surface soil moisture in an agricultural landscape

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Being one of the fundamental variables in hydrology, meteorology and agriculture, surface soil moisture (SSM) influences the partitioning of solar energy into latent and sensible heat flux as well as the partitioning of precipitation into runoff and percolation. Numerous studies have shown that in addition to natural factors (rainfall, soil, topography etc.) agricultural management is one of the key drivers for spatio-temporal patterns of SSM in agricultural landscapes. However, only very few studies have dealt with downscaling of SSM. The current study is carried out in the intensively agriculturally used northern part of the Rur catchment (1100 km^2). A two year continuous time-series of SSM raster data (resolution 25 x 25 m) was derived applying the process-based eco-hydrological components of the DANUBIA simulation system. The dynamically coupled model components simulate the interactions between plant growth, soil and surface hydrology, and soil nitrogen transformation. In a first step the modeled daily time-series are used to analyze the temporal evolution of spatial SSM patterns and its relation to the influencing factors, namely soil properties, land use properties and rainfall properties. In a second step the gridded data are successively aggregated to coarser resolution grids (up to 5 km) and the spatial statistical variance of SSM on the different resolutions is analyzed. Aggregated 25 m SSM is compared with coarser scale model runs to study the uncertainty introduced by coarser resolutions and the applicability of scaling functions for the downscaling of SSM patterns.