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Transregional Collaborative Research Centre 32: Patterns in Soil-Vegetation-Atmosphere-Systems

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The soil-vegetation-atmosphere (SVA) system is characterized by non-linear multi-scale exchange processes concerning mass, momentum and energy resulting in complex spatial and temporal patterns and structures. Under the TR32 framework, the characterisation of these structures and patterns will lead to a deeper qualitative and quantitative understanding of the SVA system, and ultimately to better predictions of the SVA state.

TR32-research is based on three methodological pillars: Monitoring, Modelling and Data Assimilation. While focusing on the Rur Catchment (Germany), patterns are monitored since 2006 continuously using existing and novel geophysical and remote sensing techniques from the local to the catchment scale like ground penetrating radar, polarimetric precipitation and cloud radar imaging, spectrally induced polarization, radiomagnetotellurics, electrical resistivity tomography, boundary layer scintillometry, lidar techniques, cosmic-ray, and microwave radiometry.

Model development centers around a coupled model platform TerrSysMP, which considers mutual fluxes from the groundwater to the atmosphere from the meter to the kilometer scale by combining the atmospheric model COSMO, the land surface model CLM, and the hydrological model ParFlow in a scale-consistent way using the external OASIS coupler. Another focus is a LES model coupled to a novel landsurface scheme, which has been developed for a better understanding of the propagation of patterns between landsurface and atmosphere and their mutual interactions. A range of projects focus on smaller scales processes e.g. down to individual roots, which are modelled at high resolution in order to develop suitable parametrisations for TerrSysMP.

Other research foci of TR32 are the transfer of results and developed technology related to new soil analysis tools from the laboratory to the field, the quantification of patterns of soil-carbon, evapotranspiration and respiration in the field, and the setup and operation of the atmospheric boundary layer, cloud and precipitation monitoring site JOYCE (Jülich ObservatorY for Cloud Evolution). These modern and predominantly non-invasive measurement techniques are exploited in combination with advanced modelling systems by data assimilation to yield improved predictions of the transfers of water-, energy and CO_2 by accounting for the patterns occurring at various scales.

We will present selected results and remaining challenges for characterizing the intertwined patterns and structure at the catchment scale.