Understanding the Spatiotemporal Structures in Atmosphere-Land Surface Exchange at the Jülich Observatory for Cloud Evolution

This study aims at identifying spatial and temporal patterns of surface-atmosphere exchange parameters from highly-resolved and long-term observations. For this purpose, a combination of continuous ground-based measurements and dedicated aircraft campaigns using state-of-the-art remote sensing instrumentation at the Jülich Observatory for Cloud Evolution (JOYCE) is available. JOYCE provides a constantly growing multi-year data set for detailed insight into boundary layer processes and patterns related to surface conditions since 2011. The JOYCE site is embedded in a rural environment with different crop types.

The availability of a scanning microwave radiometer and cloud radar is a unique component of JOYCE. The hemispheric scans of the ground-based radiometer allow the identification and quantification of horizontal gradients in water vapor and liquid water path measurements. How these gradients are connected to near-surface fluxes and the topography depending on the mean wind flow and surface fluxes is investigated by exploring the long-term data set. Additionally, situations with strong coupling to the surface can be identified by observing the atmospheric turbulence and stability within the boundary layer, using different lidar systems. Furthermore, the influence of thin liquid water clouds, which are typical for the boundary layer development, on the radiation field and the interaction with the vegetation is examined. Applying a synergistic statistical retrieval approach, using passive microwave and infrared observations, shows an improvement in retrieving thin liquid cloud microphysical properties.

The role of vegetation is assessed by exploiting the time series of the sun-induced chlorophyll fluorescence (SIF) signal measured at the ground level using automated measurements. For selected case studies, a comparison to maps of hyperspectral reflectance and SIF obtained from an airborne high-resolution imaging spectrometer is realized.