Classifying the Cloudy Boundary Layer for Land Surface-Atmosphere Interactions

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Coupling processes between near surface turbulence and cloud evolution to vegetation properties are essential to understand mixing in the lower atmosphere. The emerging Doppler lidar network of TOPROF (COST Action ES1303) shows a large potential in identifying the strength and origin of the turbulence with a high temporal resolution. For this purpose, a long-term data set from the Jülich Observatory for Cloud Evolution (JOYCE) is available. JOYCE provides constantly growing multi-year observations for detailed insight into patterns related to clouds and surface conditions since 2011.

In addition to the Doppler lidar quantities like turbulent kinetic energy dissipation rate and vertical velocity skewness, the classification into a specific set of boundary layer types is performed including the sensible heat flux from an Eddy-Covariance (EC) station to assess the near surface conditions. The boundary layer classification can also be used for evaluating parameterizations of mixing processes in a ICOsahedral Nonhydrostatic unified modeling system (ICON) that performs as a large eddy simulation.

The JOYCE site is embedded in a rural environment with different crop types. Therefore hemispheric scans of a ground-based microwave and infrared radiometer at JOYCE allow the identification and quantification of land-surface heterogeneity induced spatial and temporal structures in the integrated water vapor (IWV) and liquid water path measurements. Furthermore, IWV gradients derived from azimuth scans at different elevations are connected to near-surface fluxes and the topography depending on the mean wind flow and a weather type classification. The role of surface fluxes and vegetation is monitored by exploiting the time series of the EC station at the ground level. For selected case studies, a comparison to maps of hyperspectral reflectance measurements obtained from a high performance aircraft supported imaging spectrometer can be realized.