EMS Annual Meeting Abstracts
Vol. 16, EMS2019-521-2, 2019

Multi-scale observation of velocity and temperature structures

Matthias Zeeman

Karlsruhe Institute of Technology, Institute of Meteorology and Climate Research, Atmospheric Environmental Research (IMK-IFU), Garmisch-Partenkirchen, Germany (matthias.zeeman@kit.edu)

The intermittent, mixed and spatially heterogeneous nature of some sub-mesoscale processes pose a challenge for the quantification of surface exchange of matter and energy. Observations at multiple scales are needed to identify patterns and modes of turbulence, understand their impact on motion and transport in the surface layer and, in turn, further the verification of earth-system models.

Spatial measurements of the wind and temperature field were made in order to investigate the interconnection between irregular events at different scales and their contribution to surface exchange observed in the surface layer. Ground-based sensing methods were combined to observe the local velocity field from the ground up, as well as the temperature structures near the surface, both in high resolution and spatial extent. The experimental set-up included a concerted network of Doppler lidar and sonic anemometer systems, in tandem with high-resolution fiber-optic temperature sensing (DTS) and thermal image temperature velocimetry. The experiments were centered around the TERENO/ICOS preAlpine grassland observatory during the ScaleX Campaigns (http://scalex.imk-ifu.kit.edu). The multi-scale observations were analyzed to identify velocity and temperature structures and their lagged translocation within a 0.5 km^3 domain, in both unstable and weak-wind conditions. The spatial observations allowed the investigation of the development of stratification, the properties of shear layers, the regulation by topography as well as processes leading to the rapid destruction of cold pools at night. The analyses rely on signal decomposition and statistical clustering, aimed to characterize (non-)turbulent motions and their feedback on turbulent mixing.

We discuss how multi-scale observations can help improve our understanding of boundary layer processes and the interaction near the surface in real-life, non-idealized situations.