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Combining in-situ and ground-based remote sensing observation: how to connect the dots?

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Observations that link multi-scale Boundary layer processes to land-atmosphere exchange of matter and energy are needed for the calibration and verification of fluid-dynamics and earth-system models. Of particular interest are methodologies that complement the widely adopted eddy covariance (EC) technique in resolving turbulent and non-turbulent motion at the scale of individual eddies in neutral and stable conditions. The intermittent, mixed and spatially heterogeneous nature of some (sub-)mesoscale processes in the (nocturnal) surface boundary layer makes their identification and characterization very challenging. The challenges lie in the current experimental state-of-the-art as well as the tools to analyze spatially explicit time series.

We tested novel methodologies for the detection and quantification of mode-shifts and events in flow in stable and unstable cases on novel spatially explicit observations of wind vectors and air temperature. The analysis methodologies rely on statistical clustering to characterize (non-)turbulent motions and how these affect turbulent mixing, without prior knowledge of the multi-scale nature of the process that generated such events. The multi-scale observations included wind vector data from a triple Doppler lidar network and air temperature from a fibre-optics based network of distributed temperature sensing. Both systems suit the need for ground-based ‘remote’ sensing up to 1 to 2 km in tandem with ‘in-situ’ EC observations.

We also discuss how such novel observations and analysis tools can help improve our understanding of boundary-layer processes and the interaction near the surface in real-life, non-idealized situations.