Strategies to measure vertical profiles of wind gusts with a doppler lidar within FESSTVaL

Julian Steinheuer (1,2), Ulrich Löhnert (1), Sabrina Wahl (2,3)

(1) Institute for Geophysics and Meteorology, University of Cologne, Germany (Julian.Steinheuer@uni-koeln.de), (2) Hans-Ertel Centre for Weather Research, (3) Institute of Geoscience and Meteorology, University of Bonn, Germany

In the measurement campaign FESSTVaL (Field Experiment on Sub-Mesoscale Spatio-Temporal Variability in Lindenberg) different aspects of sub-mesoscale phenomena in the atmospheric boundary layer will be investigated in summer 2020. Our focus lays in the precise detection of wind gusts. Doppler lidars empower the determination of the wind in different heights and give an alternative to classical weather tower observations. In addition doppler lidars can receive signals from higher altitudes than towers and are flexible in positioning. However, a wind gust retrieval is challenging as the space-time fluctuations of gusts are difficult to capture. Therefore, we test different doppler lidar configurations in autumn 2019 and evaluate the retrievals of wind vector and gusts. The configurations consist of velocity–azimuth display (VAD) strategies with differing period of time and amount of beams, and a six beam method that includes a vertical stare. The reference is a sonic anemometer from the 99 m Falkenberg weather tower. We investigate the trade-off between scanning configuration, time resolution, and uncertainty. Different scan strategies can be be compared directly, as multiple lidars are at one location. The temporal synchronisation and spatial colocation of three lidar beams (virtual tower) enables a direct determination of the wind vector in an air parcel. This does not require the assumption of spatial homogeneity as in the case of the single lidar scanning approaches. This technique is extended to different heights and can be used to directly retrieve the wind vector up to the boundary layer height.