EMS Annual Meeting Abstracts
Vol. 18, EMS2021-272, 2021
https://doi.org/10.5194/ems2021-272
EMS Annual Meeting 2021

Can Lidars compete with sonic anemometers? - Comparison of wind measurements from different Doppler Lidar scan strategies to sonic anemometer data

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The technological development of ground-based active remote sensing instruments has reached a point where they have the possibility to drastically increase the temporal and spatial data density compared to conventional instruments, which would allow for a better process understanding and is expected to enhance the forecasting skills of numerical weather prediction systems and reduce its uncertainties. To test the measurement uncertainty and feasibility of Doppler Lidar systems we participated in the FESST@MOL 2020 field campaign, organized by the German Meteorological Service (DWD) in Lindenberg, Germany. During this campaign, eight Doppler Lidars were operated at the boundary layer field site (GM) Falkenberg. We evaluated different scanning strategies for the determination of the wind profile in the Atmospheric Boundary Layer (ABL) using multiple different triple Lidar virtual tower (VT) scan patterns including range height indicator (RHI) and step/stare scan modes. We compared these Lidar-based wind measurements with the data from a sonic anemometer on a 99 m tall instrumented tower also located in Falkenberg over a period of four months. The lidar and the sonic anemometer data were processed to 10- and 30- minute averages and compared to each other. The VT measurements underestimated the mean horizontal wind compared to the sonic anemometer by around 0.2 m $s^{\square 1}$. Besides that, we compared the VT data with those from a single fourth nearby Doppler Lidar which was running in a velocity-azimuth display (VAD) mode. The calculated mean horizontal wind values between the two different modes showed a good comparability but differed stronger with increasing height.