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Doppler Lidar Scanning Strategies for Wind and Turbulence Measurements

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Since the emergence of infrared Doppler lidars on the commercial market these systems have been increasingly used for wind and turbulence measurements for a wide range of research, operational, and engineering applications. Besides various other fields, high-resolution wind and turbulence measurements can give helpful information in operational weather forecasting and numerical weather prediction (data assimilation, parametrization development, model validation). With this application in mind, Doppler-Lidars "Streamline" (manufactured by Halo Photonics, UK) have been tested for quasi-continuous, operational monitoring of wind and turbulence at the Meteorological Observatory Lindenberg – Richard-Aßmann-Observatory (Germany) over the last five years.
First studies were devoted to a long-term comparison of the standard wind retrieval against well-established operational systems (wind profiler radar, tower, radiosonde). Recently, test measurements focused, i.a., on different scanning strategies and different retrieval schemes under different atmospheric conditions (e.g. convective versus stable nocturnal atmospheric boundary layer). A series of experiments has been carried out with two co-located Doppler Lidar Systems measuring either synchronously in an identical mode or with different scanning configurations over periods of several weeks. These experiments particularly aim at finding an optimum scanning strategy that can be used to derive both wind and turbulence parameters simultaneously. A special problem addressed is the possible uncertainty of the retrieved atmospheric variables due to inhomogeneous and non-stationary wind and turbulence conditions over the scanning volume. The contribution will discuss selected aspects and results of the work on these topics. E.g. we tried to study the question whether there is a difference in the derived wind vector and its estimated uncertainty depending on the number of beam directions vs. the number of scans per averaging time interval.