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An attempt to synthesize tower, sodar, lidar and radar wind measurements into a composite wind profile

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The Lindenberg Meteorological Observatory – Richard-Aßmann-Observatory (German Meteorological Service, DWD) has been performing operational wind measurements from the surface layer up to the lower stratosphere using different in-situ and remote sensing techniques over almost two decades. Sensors and systems employed cover cup anemometers mounted on masts up to a height of 99 m, Doppler sodar, Doppler lidar (since 2014), and radar wind profiler. The single records of wind data from these systems at different heights are typically used independently of each other for a variety of applications, including data assimilation, validation and verification in numerical weather prediction and the analyses of wind power conditions.

These systems fundamentally differ in the measurement physics, height range covered, height and time resolution of derived mean wind vector, and data availability. This may result in different wind values at a given height where data from several systems are available.

To further support the use of the wind profile data for model validation a project has been defined aimed at the development of a robust method that provides consistent composite wind profiles across the troposphere (from 50 cm above ground up to a maximum height of 16 km) based on the measurements with different systems. These profiles are finally averaged over 30 minutes and affiliated to a model grid point close to the Lindenberg site (WMO-ID 10393, Germany). An important objective was the estimation of uncertainties for each individual wind vector value representing both the instrumental uncertainty and the uncertainty due to spatial and temporal variations of the wind field. Composite wind profiles have been created over a period of more than 4 years.

The presentation explains the procedure to derive the composite wind profile and uncertainties by weighting the data from the different systems and presents an overview of the time-height availability of wind values. In synthesizing the data, gap filling is performed with application of strict rules concerning the maximum number of time steps and height levels to be filled. In any case gap filling increases the uncertainty of the composite value. Examples will be given to illustrate the different contributions to the uncertainty estimate and some preliminary results from model comparisons will be presented.