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Comparison between the 2D wind fields retrieved by a scanning Doppler lidar and anemometric measurements

José Antonio Benavent-Oltra[1], Djordje Romanic[1,2], Milos Lompar[3], and Massimiliano Burlando[1]
[1]Department of Civil, Chemical and Environmental Engineering, University of Genoa, 16100 Genoa, Italy.
[2]Department of Atmospheric and Oceanic Sciences, McGill University, Montréal, QC H3A 0G4, Canada.
[3]Department of Meteorology, Republic Hydrometeorological Service of Serbia, Kneza Višeslava 66,11000 Belgrade, Serbia.

In this work, two-dimensional (2D) wind fields retrieved by SingleDop software using scanning Doppler lidar data are compared with anemometric measurements in Genoa (Italy). SingleDop is a software module based on the theoretical work described in Xu et al. (2006), which is intended to retrieve 2D low-level winds from either real or simulated Doppler radar data. The lidar used in this work is a three-dimensional (3D) scanning WindCube 400S lidar, developed by Leosphere (France), which scans the azimuthal range of 100º –250º, up to a maximum distance of 14 km in the radial direction, for 4 elevations corresponding to 2.5º, 5°, 7.5° and 10º from the horizontal. The anemometer used for comparison is located about 1.3 km (horizontally) from the Doppler lidar and provides the wind velocity with a sampling rate of 1 Hz.

The dataset analyzed is from November 2019 to June 2020. The total number of available lidar scans per day is ~420 for each elevation (2.5º, 5º, 7.5º and 10º). The 2D wind fields are retrieved by SingleDop for different de-correlated lengths (L= 10, 5 and 1 km). The overall number of measurements available for the comparison is therefore approximately 420 scans per day × 180 days × 4 heights × 3 L, which results in nearly 10^6 wind velocity values. The wind direction retrieved by SingleDop properly corresponds to the anemometric data with a BIAS ~13º, RMSE ~40º and a circular correlation of 0.8. Concerning the wind intensity, the results obtained for L = 5 km show the best agreement with the anemometric measurements with a BIAS of 0.8 m/s, RMSE around 1.8 m/s and a correlation coefficient higher than 0.9. Both for wind direction and velocity, the BIAS and RMSE slightly increase with the elevation whereas the circular and linear correlations decrease, as expected due to the increasing distance between lidar and anemometric measurements.

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