An assessment of a three-beam Doppler lidar wind profiling method for use in urban areas

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Abstract

Currently there are few observations of the urban wind field at heights other than rooftop level. Remote sensing instruments – such as Doppler lidars – provide wind speed data at many heights, which would be useful in determining wind loadings of tall buildings, and predicting local air quality. Studies comparing remote sensing with traditional anemometers carried out in flat, homogeneous terrain often use scan patterns which take several minutes. In an urban context the flow changes quickly in space and time, so faster scans are required to ensure little change in the flow over the scan period. We compare 3993 hours of wind speed data collected using a three-beam Doppler lidar wind profiling method with data from a sonic anemometer (190 m). Both instruments are located in central London, UK; a highly built-up area. Based on lidar wind profile measurements every two minutes, the uncertainty in the hourly mean wind speed due to the sampling frequency is 0.05 - 0.11 m s^{-1}. The lidar tends to overestimate the wind speed by ≈ 0.5 m s^{-1} for wind speeds below 20 m s^{-1}. Accuracy could be improved by increasing the scanning frequency of the lidar. This method is considered suitable for use in urban areas.

Keywords: Doppler lidar, wind profiling, Doppler beam swinging, urban boundary layer