7.5 RAIN-RATE ESTIMATION FROM CEILOMETER MEASUREMENTS: A COMPARATIVE CASE STUDY USING S-BAND RADAR AND DISDROMETER RETRIEVALS

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Rain-rate (RR) estimation from ceilometer measurements is becoming a significant area of interest (Lewandowski et al. 2009). Ceilometers are low-cost, low-energy-aperture-product lidar (laser-radar) instruments relying on optical radiation. When compared to microwave radars, key distinctive features are that ceilometers have a much narrower field of view, on the order of fractions of a degree, and that the lidar signal is largely attenuated by rain.

We address RR estimation from vertical-configuration ceilometer measurements (Vaisala CL-31) and its limitations in comparison with co-located S-band Frequency-Modulated Continuous-Wave (FMCW) radar and disdrometer RR measurements. A modified form of the well-known slope-method (Kunz & de Leeuw 1993), (Rocadenbosch et al. 2000) is used to derive the rain optical extinction coefficient from the backscattered lidar signal. A collocated Doppler wind lidar provides complementary observations.

The methodological part addresses the foundations of the RR retrieval procedures from both the ceilometer and the radar as well as the derivation of RR-to-extinction models for both the ceilometer-radar and ceilometer-disdrometer combinations. As a proxy of calibration, RR retrievals from the collocated radar and portable disdrometer are fitted against ceilometer extinction estimates in order to derive the RR-to-extinction correlation models that would allow us to estimate the RR from ceilometer measurements without need to permanently deploy the radar or the disdrometer in similar scenarios.

A 1.5-h-long rain episode is presented in the context of the Verification of the Origins of Rotation in Tornadoes EXperiment-Southeast (VORTEX-SE), which occurred during spring 2016 in Huntsville, AL environs (Tanamachi et al. 2016).

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