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Close-range radar rainfall estimation and error analysis

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It is well-known that quantitative precipitation estimation (QPE) is affected by many sources of error. The most important of these are 1) radar calibration, 2) wet radome attenuation, 3) rain attenuation, 4) vertical profile of reflectivity, 5) variations in drop size distribution, and 6) sampling effects. The study presented here is an attempt to separate and quantify these sources of error. For this purpose, QPE is performed very close to the radar ($\sim$1-2 km) so that 3), 4), and 6) will only play a minor role. Error source 5) can be corrected for because of the availability of two disdrometers (instruments that measure the drop size distribution). A 3-day rainfall event (25-27 August 2010) that produced more than 50 mm in De Bilt, The Netherlands is analyzed. Radar, rain gauge, and disdrometer data from De Bilt are used for this.

It is clear from the analyses that without any corrections, the radar severely underestimates the total rain amount (only 25 mm). To investigate the effect of wet radome attenuation, stable returns from buildings close to the radar are analyzed. It is shown that this may have caused an underestimation up to $\sim$4 dB. The calibration of the radar is checked by looking at received power from the sun. This turns out to cause another 1 dB of underestimation. The effect of variability of drop size distributions is shown to cause further underestimation. Correcting for all of these effects yields a good match between radar QPE and gauge measurements.