Geophysical Research Abstracts
Vol. 17, EGU2015-14928-1, 2015
EGU General Assembly 2015

Improved estimation of heavy rainfall by weather radar after reflectivity correction and accounting for raindrop size distribution variability

Pieter Hazenberg (1,2), Hidde Leijnse (3), and Remko Uijlenhoet (2)

(1) Department of Atmospheric Sciences, University of Arizona, 1118 E. 4th St., 85721 Tucson, AZ, USA, (2) Hydrology and Quantitative Water Management Group, Wageningen University, Droevendaalsesteeg 4, P.O. Box 47, 6700 AA Wageningen, The Netherlands, (3) Royal Netherlands Meteorological Institute, P.O. Box 201, 3730 AE De Bilt, The Netherlands

Between 25 and 27 August 2010 a long-duration mesoscale convective system was observed above the Netherlands, locally giving rise to rainfall accumulations exceeding 150 mm. Correctly measuring the amount of precipitation during such an extreme event is important, both from a hydrological and meteorological perspective. Unfortunately, the operational weather radar measurements were affected by multiple sources of error and only 30% of the precipitation observed by rain gauges was estimated. Such an underestimation of heavy rainfall, albeit generally less strong than in this extreme case, is typical for operational weather radar in The Netherlands.

In general weather radar measurement errors can be subdivided into two groups: (1) errors affecting the volumetric reflectivity measurements (e.g. ground clutter, radar calibration, vertical profile of reflectivity) and (2) errors resulting from variations in the raindrop size distribution that in turn result in incorrect rainfall intensity and attenuation estimates from observed reflectivity measurements. A stepwise procedure to correct for the first group of errors leads to large improvements in the quality of the estimated precipitation, increasing the radar rainfall accumulations to about 65% of those observed by gauges. To correct for the second group of errors, a coherent method is presented linking the parameters of the radar reflectivity-rain rate (Z–R) and radar reflectivity-specific attenuation (Z–k) relationships to the normalized drop size distribution (DSD). Two different procedures were applied. First, normalized DSD parameters for the whole event and for each precipitation type separately (convective, stratiform and undefined) were obtained using local disdrometer observations. Second, 10,000 randomly generated plausible normalized drop size distributions were used for rainfall estimation, to evaluate whether this Monte Carlo method would improve the quality of weather radar rainfall products.

Using the disdrometer information, the best results were obtained in case no differentiation between precipitation type (convective, stratiform and undefined) was made, increasing the event accumulations to more than 80% of those observed by gauges. For the randomly optimized procedure, radar precipitation estimates further improve and closely resemble observations in case one differentiates between precipitation type. However, the optimal parameter sets are very different from those derived from disdrometer observations. It is therefore questionable if single disdrometer observations are suitable for large-scale quantitative precipitation estimation, especially if the disdrometer is located relatively far away from the main rain event, which was the case in this study.

In conclusion, this study shows the benefit of applying detailed error correction methods to improve the quality of the weather radar product, but also confirms the need to be cautious using locally obtained disdrometer measurements.