Geophysical Research Abstracts
Vol. 16, EGU2014-11666, 2014
EGU General Assembly 2014

Radar-based rainfall estimation: Improving Z/R relations through comparison of drop size distributions, rainfall rates and radar reflectivity patterns

Malte Neuper and Uwe Ehret

Institute of Water Resources and River Basin Management - Section Hydrology, Karlsruhe Institute of Technology KIT, Karlsruhe, Germany (malte.neuper@kit.edu)

The relation between the measured radar reflectivity factor Z and surface rainfall intensity R – the Z/R relation – is profoundly complex, so that in general one speaks about radar-based quantitative precipitation estimation (QPE) rather than exact measurement. Like in Plato's Allegory of the Cave, what we observe in the end is only the 'shadow' of the true rainfall field through a very small backscatter of an electromagnetic signal emitted by the radar, which we hope has been actually reflected by hydrometeors. The meteorological relevant and valuable Information is gained only indirectly by more or less justified assumptions.

One of these assumptions concerns the drop size distribution, through which the rain intensity is finally associated with the measured radar reflectivity factor Z. The real drop size distribution is however subject to large spatial and temporal variability, and consequently so is the true Z/R relation. Better knowledge of the true spatio-temporal Z/R structure therefore has the potential to improve radar-based QPE compared to the common practice of applying a single or a few standard Z/R relations.

To this end, we use observations from six laser-optic disdrometers, two vertically pointing micro rain radars, 205 rain gauges, one rawindsonde station and two C-band Doppler radars installed or operated in and near the Attert catchment (Luxembourg). The C-band radars and the rawindsonde station are operated by the Belgian and German Weather Services, the rain gauge data was partly provided by the French, Dutch, Belgian, German Weather Services and the Ministry of Agriculture of Luxembourg and the other equipment was installed as part of the interdisciplinary DFG research project CAOS (Catchment as Organized Systems).

With the various data sets correlation analyzes were executed. In order to get a notion on the different appearance of the reflectivity patterns in the radar image, first of all various simple distribution indices (for example the Gini index, Rosenbluth index) were calculated and compared to the synoptic situation in general and the atmospheric stability in special. The indices were then related to the drop size distributions and the rain rate. Special emphasis was laid in an objective distinction between stratiform and convective precipitation and hereby altered droplet size distribution, respectively Z/R relationship.

In our presentation we will show how convective and stratiform precipitation becomes manifest in the different distribution indices, which in turn are thought to represent different patterns in the radar image. We also present and discuss the correlation between these distribution indices and the evolution of the drop size distribution and the rain rate and compare a dynamically adopted Z/R relation to the standard Marshall-Palmer Z/R relation.