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Towards operational rainfall monitoring employing microwave links from cellular communication networks

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The basic principle of rainfall estimation using microwave links is as follows. Rainfall attenuates the electromagnetic signals transmitted from one telephone tower to another. By measuring the received power at one end of a microwave link as a function of time, the path-integrated attenuation due to rainfall can be calculated, which can be converted to average rainfall intensities over the length of a link. Microwave links from cellular communication networks have been proposed as a promising new rainfall measurement technique since one decade. They are particularly interesting for those countries where few surface rainfall observations are available. Yet too date no operational (real-time) link-based rainfall products are available. To advance the process towards operational application and upscaling of this technique, long time series should be analyzed for different networks and climates.

Here the potential for long-term large-scale operational rainfall monitoring is demonstrated by utilizing a 2.5-year data set from a cellular communication network. The data set consists of roughly 2,000 links covering the land surface of the Netherlands (35,500 km^2). The quality of link rainfall maps is thoroughly quantified by an extensive validation against independent gauge-adjusted radar rainfall maps for, among others, different seasons and extremes. One of the goals is to quantify whether the cellular telecommunication network can yield rainfall maps of comparable quality as those based on automatic rain gauge data (with a density of ~1 gauge per 1000 km^2). Developing countries will usually have rain gauge networks with a lower density (and little or no weather radars). This helps to assess the possibly added value of link-based rainfall estimates with respect to those from existing rain gauge networks. Moreover, this shows the possibly added value of link rainfall estimates for adjustment of radar rainfall images.

The results further confirm the potential of these networks for rainfall monitoring. Performance is less good in the winter, probably caused by dew formation on antennas and melting precipitation at the link path and on antennas. However, the good results found for the summer in a temperate climate, hold a promise for large-scale application in developing countries in (sub)tropical climates.