

## **Adjustment of radar rainfall images employing rainfall estimates from a cellular communication network**

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Microwave links from operational cellular telecommunication networks may be used for rainfall monitoring, potentially over large parts of the land surface of the earth. Along such links, radio signals propagate from a transmitting antenna at one base station to a receiving antenna at another base station. Rain-induced attenuation and, subsequently, path-averaged rainfall intensity can be retrieved from the signal's attenuation between transmitter and receiver.

Recently, it has been shown that country-wide rainfall maps can be obtained from microwave link data for the Netherlands (35,000 square kilometers). For countries operating weather radars a potential benefit of link rainfall data lies in merging with radar rainfall data. Often radar rainfall images are adjusted employing rain gauge data to improve the quality of rainfall maps. However, the number of automatic rain gauges suitable for adjustment is generally low, thus limiting the improvement of real-time radar rainfall images of, e.g., 1-hour rainfall depths. Microwave links are not expected to be as accurate as rain gauges, but their larger number may partially compensate for this.

The potential of microwave link data to improve real-time radar rainfall products is investigated. A data set from a commercial microwave link network over the Netherlands is analyzed, containing two years of data from an unprecedented number of links (~ 1500) covering the land surface of the Netherlands (35500 square kilometers). Hourly rainfall data are derived from the microwave link data and employed to adjust hourly country-wide radar rainfall maps, which are accumulated to 3-h and daily rainfall maps. The performance of a mean-field bias adjustment method and a spatial adjustment method is investigated. The resulting 3-h and daily rainfall maps are validated against a high-quality, climatological, gauge-adjusted radar rainfall data set and the existing real-time radar rainfall product of 3-h accumulations, which has been adjusted using data from 32 automatic rain gauges.

Adjustment of radar data utilizing microwave link data could substantially improve the quality of real-time radar rainfall products and thus increase their applicability for hydrological purposes, validation of precipitation forecasts of numerical weather prediction models, as well as validation of satellite-based rainfall retrievals.