Geophysical Research Abstracts
Vol. 14, EGU2012-5937, 2012
EGU General Assembly 2012

Country-wide rainfall maps from a commercial cellular telephone network

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Accurate rainfall observations with high spatial and temporal resolutions are needed for many applications, for instance, as input for hydrological models. Weather radars often provide data with sufficient spatial and temporal resolution, but usually need adjustment. In general, only few rain gauge measurements are available to adjust the radar data in real-time, for example, each hour. Physically based methods, such as a VPR correction, can be valuable and hold a promise. However, they are not always performed in real-time yet and can be difficult to implement.

The estimation of rainfall using microwave links from commercial cellular telephone networks is a new and potentially valuable source of information. Such networks cover large parts of the land surface of the earth and have a high density. The data produced by the microwave links in such networks is essentially a by-product of the communication between mobile telephones. 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. Previous studies have shown that average rainfall intensities over the length of a link can be derived from the path-integrated attenuation. A recent study of us shows that urban rainfall can be estimated from commercial microwave link data for the Rotterdam region, a densely-populated delta city in the Netherlands.

A data set from a commercial microwave link network over the Netherlands is analyzed, containing approximately 1500 links covering the land surface of the Netherlands (35500 km^2). This data set consists of several days with extreme rainfall in June, July and August 2011. A methodology is presented to derive rainfall intensities and daily rainfall depths from the microwave link data, which have a temporal resolution of 15 min. The magnitude and dynamics of these rainfall intensities is compared with those obtained from weather radar. Rainfall maps are derived from the microwave link data and are verified against rainfall maps based on gauge-adjusted weather radar data. Although much more work needs to be done, the first results look promising. Since cellular telephone networks are used worldwide, data from such networks could also become a valuable source of rainfall information in countries which do not have continuously operating weather radars, and no or few rain gauges.

Apart from rainfall maps which are solely based on microwave link data, a preliminary analysis will be presented to assess whether commercial microwave link data can be used to adjust radar rainfall accumulations.