13.57 GEOSTATISTICAL APPROACH TO RAINFALL MAPPING FROM COMMERCIAL MICROWAVE LINKS

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In the last decade, rainfall monitoring by using rain-induced attenuation measurements from commercial microwave links (CML) became an alternative way to estimate rainfall for large areas. For this kind of monitoring, the mean rainfall is measured along a link between two cellular antennas (transmitter and receiver). That topology needs to be considered for rainfall mapping. For instance, in the sections where the links intercept each other oversampled locations are present. Due to the temporal dynamics, both of the CML network topology and of the rainfall itself, each event has a specific spatio-temporal behaviour. Thus, a geostatistical approach based on models allows estimating parameters and capturing the spatial variability for each time interval, in a straightforward way and computationally efficient. The aim of this work is to propose a method for rainfall mapping capable of dealing with crossing links, real-time parameter estimation, and large- area prediction.

Using approximately 2,600 links, the study was carried out in the Netherlands (~35,500 km^2). The R package RAINLINK was used for retrieving rainfall based on attenuation data available from 10-09-2010 18:30 until 11-09-2010 08:00 with a 15 minute temporal resolution. Since it is reasonable to consider that the rainfall spatial variability along the links can be neglected, the path-average rainfall mean can be assumed representative for any link section. Therefore, for the link intersection coordinates, basically, the mean of the links overlaid was sampled. On the other hand, for the non-overlaid links, the centroid coordinates were obtained. Using the method of restricted maximum likelihood (REML), the geostatistical model parameters were estimated. Thus, the ordinary kriging (OK) algorithm was used for rainfall mapping. Here, we call this method REML. For validating REML, a gauge-adjusted radar data set provided by the Royal Netherlands Meteorological Institute (KNMI) was used. Moreover, we compared REML with regular interpolation methods made available in RAINLINK, being OK with fixed parameters for each time interval and inverse distance squared weighted (ID2). The spatial efficiency metric (SPAEF) was employed for measuring the goodness of fit between observed (gauge-adjusted radar) and estimated rainfall maps (REML, OK, and ID2).

The results highlight a few improvements as indicated by a SPAEF value equal to 0.62 compared with 0.60 and -0.02 for OK and ID2, respectively. Moreover, REML is not constrained by crossing links and computationally efficient for large areas. This last characteristic is an advantage of REML with respect to tomography methods, which can deal with crossed links but are computationally impractical for large areas.