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Performance analysis of more than one year of countrywide rainfall derived from commercial microwave link data in Germany

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Precipitation estimation remains a scientific challenge, because of the high variability of precipitation in space and time. Traditional precipitation measurements have well known drawbacks: Gauge measurements are prone to wind induced errors and lack spatial representativeness. Weather radars overcome this spatial constraint, but depend on the non-linear Z-R relation, measure high above ground or suffer from beam blockage and ground clutter effects. The opportunistic use of commercial microwave links (CMLs) is an additional source of precipitation information. Precipitation attenuates the signal along the path of a CML in an almost linear relation which allows the calculation of the rain rate from observed attenuation. Since modern communication networks, which are largely based on CMLs, are becoming ubiquitous in the 21st century, this observation technique has a high potential to improve precipitation estimation.

We present, for the first time, a detailed analysis of more than one year of countrywide CML-derived rainfall in Germany. To the best of our knowledge, this is one of the spatially largest CML data-sets up to date. It covers different precipitation regimes from the North German Plain to the Alps. In cooperation with Ericsson we continuously acquire CML attenuation data in real-time with a temporal resolution of one minute. Since its last extension in August 2017 this data acquisition is running operationally for 4000 CMLs, covering the whole of Germany.

Here we show an analysis of this data set since August 2017. We present more than one year of CML-derived rainfall data and compare it with the gauge adjusted radar product RADOLAN-RW from the German Weather Service. CML data often is perturbed by noise and artifacts which compromise the quality of the estimated rain rate. In order to enhance the quality of our estimates we optimize our existing processing methods to cope with these unwanted effects. The size of our data set allows us to validate our optimization and rainfall estimates with RADOLAN-RW on a large spatiotemporal scale. We show seasonal and diurnal variations of the performance of CML-derived rainfall data. Promising results are achieved year-round except for periods with solid precipitation. Pearson correlations for the comparison of the hourly rainfall sums reach up to 0.7 for summer months. The German-wide distribution of monthly precipitation sum derived from RADOLAN-RW can also be reproduced well by the CML data for the periods with liquid precipitation. Furthermore, we present rainfall maps to show the performance of our CML rainfall estimates from event to seasonal scale.