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Comparative Study of IDW-based Algorithms for 2-D Rain Mapping Using CMLs

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Accurate retrieval of near-ground rain field is a topic of great importance for many applications (such as hydrology, cities operation and planning, etc.). Conventionally, it utilizes designated network of local sensors – rain gauges or weather stations. In the last decade, the use of Commercial Microwave Links (CMLs) as opportunistic near-ground rain sensors has proven to be an exciting alternative, and retrieval of near-ground rain fields has already been demonstrated. In spite of the link representing a path integrated rainfall, most of the studies as well as operational rain field reconstruction work, represent the estimated rainfall observation by a single Virtual Rain Gauge (VRG) in the middle of the CML path. In this paper we compare the 2-D retrieval performances of Inverse Distance Weighting (IDW) based spatial interpolation methods, where a CML is represented either by one or by multiple VRGs. The performance of an iterative IDW based algorithm, utilizing neighboring samples in order to assess the rain rate distribution along a CML, was compared to the case where the CML path-averaged rain is represented as either a single or multiple points (i.e. VRGs). The simulation study presented has produced synthetic rain field, which was simplified to a single Gaussian-shape rain cell, sampled by a synthetic CML network, built according to the statistics of actual CMLs. The main finding of this study is that if the size of a rain-cell is sufficiently larger than the average length of the CML, representing a CML by more than a single VRG, in addition to iteratively accounting neighboring CMLs, negligibly improves the mapping performance. However, if the rain-cell dimension is of the order of the length of the CMLs, using the iterative algorithm can improve retrieval performance significantly.