Rain rate estimation combining rain gauge, radar and microwave link data

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Accurate and reliable rain rate estimates are crucial for various applications (flood forecasting, road traffic, agriculture to list a few). As a consequence rain sensors of different types have deployed in many regions.

In this work a data assimilation technique has been applied to combine measurements from different sensors, namely rain gauges, radar and microwave links, to estimate with greater accuracy the distribution and intensity of precipitation. The objective is to retrieve the rain rate value that is consistent with all these measurements while incorporating the uncertainty due to the indirect measurements and the different technologies applied. By focusing on static (i.e. time-independent) Gaussian case, assuming our problem is not grossly non-linear, we implement the Gauss-Newton method to solve the cost function of the variational approach. This variational approach is a standard in data assimilation. It is mathematically rigorous and takes full account of errors sources. Furthermore, the method can be flexibly adapted to apply additional data sources.

The proposed approach is tested assimilating data from 14 rain gauges and 14 operational microwave links located in the Zurich area (Switzerland) of about 20x23 km to correct the prior rain rate provided by the operational radar rain product from MeteoSwiss.