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Stochastic reconstruction of precipitation fields using combined information of Commercial Microwave Links and rain gauges

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The simulation of the hydrological cycle by models is an indispensable tool for a variety of environmental challenges such as climate prediction, water resources management, or flood forecasting. One of the crucial variables within the hydrological system, and accordingly one of the main drivers for terrestrial hydrological processes, is precipitation. A correct reproduction of the spatiotemporal distribution of precipitation is crucial for the quality and performance of hydrological applications. In our approach we stochastically generate precipitation fields conditioned on different precipitation observations, i. e. rain gauge observations and path-averaged rain rates estimated using Commercial Microwave Links (CML). Therefore, we applied the Random Mixing method for this stochastic reconstruction. Following this method precipitation fields are generated as a linear combination of unconditional spatial random fields, where the spatial dependence structure is described by copulas. The weights of the linear combination are optimized in such a way that the observations and the spatial structure of the precipitation observations are reproduced. This strategy enables the simulation of precipitation field ensembles of any size, which is the main innovation of this approach. Each ensemble member is in concordance with the utilized observations. The spread of such an ensemble allows an uncertainty estimation of the generated precipitation fields and in particular it reflects the uncertainty of rainfall variability along the CML paths. The applicability of Random Mixing and its advantages are demonstrated utilizing both, a synthetic data set and a real-world data set. While the synthetic example allows an evaluation against a known reference, the second example demonstrates the applicability for real-world observations. These demonstrations will show that the reconstructed precipitation fields reproduce the observed spatial precipitation patterns in a good quality. Furthermore, the influence of the observation network characteristics on the uncertainties will also be revealed by the ensembles of these examples.