Session: **HS7.1**
Precipitation modelling: uncertainty, variability, assimilation, ensemble simulation and downscaling

Combining commercial microwave link and rain gauge observations to estimate countrywide precipitation: a stochastic reconstruction and pattern analysis approach

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Precipitation is characterized by large spatial variability. For hydrological applications it is crucial to estimate precipitation such that spatial correlation lengths and precipitation patterns are represented accurately.

We derive countrywide precipitation estimates using approx. 4000 commercial microwave links (CMLs) obtained from Ericsson and approx. 1000 rain gauges operated by the German Weather Service. CML and gauge observations are regarded as non-linear and linear constraints on the spatial estimate, respectively.

We apply the *Random-Mixing-Whittaker-Shannon* method in a Python based environment (RMWSPy) to reconstruct ensembles of precipitation fields. With *RMWSPy,* linear combinations of unconditional random spatial fields are conditioned to the observational data. This involves the exact local representation of rain gauge observations as well as the consideration of the path-averaged precipitation along the CMLs. Additionally, the method ensures that resulting estimates are similar to the data with respect to spatial correlations and marginal distributions. The stochastic process allows for variability at unobserved locations and thereby the calculation of ensembles.

We evaluate the spatial pattern of our results by performance characteristics such as *ensemble Structure-, Amplitude-, and Location-error* (*eSAL*). This approach considers precipitation objects as connected areas that exceed a certain precipitation value, and involves the analysis of the objects' shapes and locations. Thereby, it is possible to quantify aspects of precipitation patterns in a way that is not possible with standard performance metrics which are based on pixel-by-pixel comparisons.

We find that our precipitation estimates are in good agreement with the gauge-adjusted weather radar product RADOLAN-RW of the German Weather Service which we use as a reference. In particular, we see advantages in reproducing the pattern of precipitation objects, in terms of

smaller structure- and location-errors, when comparing our ensemble-based Random-Mixing approach to an Ordinary Kriging interpolation.