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From runoff to precipitation: Predicting catchment precipitation by inverting a conceptual rainfall-runoff model

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This contribution presents a method to model catchment precipitation using observed runoff as input into a rainfall-runoff model. Results are shown for the Krems catchment located at the foothills of the Northern Austrian Alps.

Catchment precipitation is a significant input variable in water-management related applications. As a direct measurement is not possible, this input variable is derived by regionalizing of point measurements, sometimes considering remote sensing data. Measurement errors and uncertainties in the regionalization method lead to high total uncertainties of catchment precipitation values. In contrary, although also afflicted by some degree of uncertainty, runoff observation errors are comparatively lower. Observed runoff from a closed catchment is the integral of precipitation over a certain period, considering evapotranspiration losses and water storage differences. Rainfall-runoff models represent the catchment responses to rainfall, considering the interplay between the temporal variability of precipitation, the physical catchment characteristics and antecedent hydrological conditions. An inversion of the rainfall-runoff model therefore returns the temporal disintegrated rainfall input. A conceptual rainfall-runoff model is embedded in an iteration algorithm, in which for every time step a catchment precipitation is determined, which results in a simulated runoff value that corresponds to the observed value.

Results show a strong dependency of simulated precipitation from model parameters. Different model parameters leading to similar runoff simulations show diverging precipitation realizations. At short time steps the correlation between observed and simulated precipitation is low, temporal aggregation leads to higher correlation values. Compared to observations the modeled rainfall intensities are significantly higher.