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Using precipitation data ensemble and Bayesian Model Averaging for uncertainty analysis in hydrologic modeling.

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Precipitation pattern in the tropics are characterized by extremely high spatial and temporal variability that are difficult to cover by rain gauge networks. Since precipitation represents the most important input to hydrological models, this amplifies model uncertainties especially in areas with sparse rain gauge networks. In order to investigate the influence of precipitation uncertainty on model parameter and prediction uncertainty in a data sparse region, the integrated river basin model SWAT was calibrated against measured streamflow of the Pipiripau River in Central Brazil. This was done based on an ensemble of different reasonable precipitation data, i.e. (1) measured data of the only available rain gauge within the watershed, (2) a smoothed version of these data derived by the sliding mean, (3) Thiessen Polygons including rain gauges outside the watershed, and (4) Tropical Rainfall Measuring Mission (TRMM) radar data. For each precipitation input model, we determined the best parameter setting and respective uncertainty ranges using the Sequential Uncertainty Fitting Procedure (SUFI-2). With each rainfall input model, it was possible to achieve good or at least satisfactory streamflow simulations. However, the results of our study clearly illustrate that parameter uncertainty increases strongly by using different methods for precipitation dataset generation. Moreover, we obtained improved deterministic streamflow predictions and more reliable probabilistic forecasts by means of simple ensemble-based methods, such as the arithmetic ensemble mean, and more advanced Bayesian Model Averaging (BMA) schemes. The study shows that ensemble modeling with multiple precipitation inputs can significantly increase the level of confidence in the simulation results especially in data-poor regions but also for hydrologic modeling in general.