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Quantifying the propagation of satellite precipitation retrieval error though coupled hydrological models

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This paper describes the development of a generic procedure to quantify the uncertainty in satellite precipitation estimates and to propagate that uncertainty through coupled hydrological models. Precipitation uncertainty is quantified using an ensemble product, each element of which represents an equiprobable realisation of the precipitation field consistent with the input data. Such a product may be used to drive a deterministic hydrological model, yielding an envelope of hydrographs that map out precipitation-related runoff or streamflow uncertainties. A significant advantage of this approach is that it decouples the choice of input data resolution (spatial or temporal) from concerns regarding acceptable levels of precipitation input uncertainty. Very high resolution satellite precipitation estimates, displaying significant and complex error characteristics, may be used to drive spatiotemporally detailed hydrological models constructed with respect to the natural hydrological scaling properties of the basins under study. A second advantage of this approach is that it avoids the inherent loss of information that occurs with spatiotemporal aggregation. High resolution cloud indices may be much better predictors of local precipitation statistics than they are of deterministic rainfall totals. To generate the ensemble product, collateral precipitation data must be available that possess either an independent error model or a level of uncertainty that is negligible with respect to that of the satellite estimates. A comparison of coincident satellite estimates and collateral precipitation measurements is used to create an uncertainty model consisting of two components: conditional distribution functions of observed precipitation with respect to coincident satellite estimates and representations of the spatiotemporal covariance structure of the uncertainty in the satellite estimates. The uncertainty model is used to constrain a stochastic rainfall generator that, in turn, generates the desired ensemble product.