A HIERARCHICAL BAYESIAN APPROACH TO THE NEYMAN-SCOTT RECTANGULAR PULSE MODEL FOR A JOINT ESTIMATION OF MODEL PARAMETERS ACROSS STATIONS

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Abstract

Poisson cluster stochastic rainfall generators such as Modifiend Bartlett-Lewis Rectangualr Pulse model (MBLRP) and Neyman-Scott rectangular Pulse (NSRP) have been widely used to generate sub-daily rainfall sequences using different optimization techniques. However, the existing optimization techniques are typically based on individual parameter estimates that treat each parameter as independent. In this setting, parameter estimates usually compensate for the estimates of other parameters, which can lead to high variability in the results if the covariance structure of the parameters is not formally introduced. Moreover, uncertainty associated with model parameters in the rainfall generator is not addressed properly. Here, we developed a hierarchical Bayesian model (HBM) NSRP model, to jointly estimate parameters across weather stations and explicitly considered the covariance and uncertainty within a Bayesian framework. The model was validated using weather stations in South Korea. The HBM based NSRP model allowed the identification of parameters with better reproduction of rainfall statistics at various temporal scales. Additionally, the spatial variability of the parameters across weather stations was substantially reduced compared to that of other optimization methods. We extended the proposed model to consider spatial coherency across stations so that the simulated rainfall sequences can be used for rainfall-runoff models as an input.

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