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Continuous simulation of spatial daily rainfall fields

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The spatial distribution of rainfall has a significant influence on catchment dynamics and the generation of streamflow time series. However, there are few models that can simulate long sequences of rainfall fields continuously in time and space. Most models are limited to being able to reproduce statistics at observed sites, but not able to reproduce spatial fields. To improve the understanding of streamflow, spatially distributed catchment models have been developed, but they often rely on a simplistic representation of rainfall inputs. To address this issue, this paper firstly presents a continuous daily spatial rainfall model that produces spatial rainfall fields across the catchment while also reproducing the statistics at observed sites. The approach uses a latent variable concept which simulates the rainfall amounts as well as occurrences simultaneously. Secondly, the paper presents a comprehensive evaluation of model performance incorporating statistics that cover a range of temporal and spatial scales, from mean values to extreme values on a daily, seasonal and annual basis. A case study using the Onkaparinga catchment in South Australia is presented to demonstrate model performance. The model is able to reproduce key statistics over the region as well as realistic patterns of spatial rain fields, although it shows poorer performance in reproducing inter-annual variability. The model is useful for hydrological applications where spatial rainfall patterns and gradients influence the generation of streamflow and is especially useful as an input to distributed hydrological models.