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Simulating monthly and inter-annual precipitation variability with a Neyman Scott space-time rainfall generator

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Stochastic rainfall models are an important tool for assisting hydrologists to assess the impacts of climate and land-use changes and to assess the vulnerability of water resources. One such model is Rainsim, which is able to generate synthetic spatial-temporal rainfall fields, typically with hourly or daily time steps. Storms are comprised of raincells with space-time coordinates generated by means of a Neyman Scott process in time and a Poisson process in space. Each raincell precipitatates over a circular area, with independent exponentially distributed radius, intensity and duration. A typical parameterization reproduces the probability of rainfall occurrence and accumulation moments for simple multiples of hourly and daily periods. Parameterisation is independent for each month of the year to represent seasonality over the whole annual cycle. A consequence of this procedure is that the model is effectively stationary at time scales approaching a month and greater than a year. Consequently, monthly and annual rainfall variances are under-simulated despite their mean values being well reproduced. The successful representation of this variability is paramount for impacts studies sensitive to prolonged periods of relatively high or low rainfall amounts such as drought studies or groundwater impacts. Extensions of the model are therefore developed to allow the stochastic simulations to represent monthly and inter-annual variability for Mediterranean catchments. This is achieved by means of an external generator of annual total rainfall which is used to condition the storm generation process. This work was supported by the projects SUSMAQ (UK-DFID) and AQUATERRA (EU FP6 project number 505428).