

A CLASS OF MULTI-SITE POINT PROCESS MODELS FOR SUB-HOURLY RAINFALL

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Developing stochastic models that can reproduce rainfall properties at fine resolution has been an important area of research in the recent past, amongst environmental scientists, as these models have many hydrological applications. We study a class of stochastic point process models for sub-hourly rainfall time series, collected in the form of raingauge bucket tip-times, from multiple recording stations in a network. Following on from the single-site rainfall models (Ramesh et al, 2012), multi-site doubly stochastic Poisson process models, for which the arrival rates vary according to a finite-state irreducible Markov chain, are considered. The likelihood function of this class of multi-site models, which is not usually available for most point process models, is used to estimate the parameters of the models and to make inferences. This class of models provides a useful alternative to the well known Poisson cluster models based on either Bartlett-Lewis or Neyman-Scott processes.

As the arrival pattern of the rainfall process is thought to be dependent on local atmospheric covariates, the multi-site models under consideration attempt to incorporate local covariate information. In this study we use temperature, sea-level pressure and relative humidity and see how they affect the properties of rainfall time series from multiple sites within a catchment. Previous work suggested that the model which allows the effects of covariates on arrival rates to vary from one station to another provided improved results (Ramesh, et al, 2013). We explore this set of models further to introduce additional dependence among stations using a link model. Models that incorporate the effect of these covariates in different ways are compared. The results of the analysis reveal the potential of this class of models in reproducing temporal and spatial variability of sub-hourly rainfall properties over the catchment area.

In our application, we use rainfall bucket tip-time series data supplied by the British Atmospheric Data Centre (BADC), over a dense raingauge network in south-west England. The properties of accumulated rainfall in discrete time intervals of equal length are used to make inferences about the sub-hourly rainfall accumulations. Various aggregation levels from 5 minutes to 60 minutes intervals are considered.

References:

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