Modelling Multi-site Rainfall Time Series using Stochastic Point Process Models

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We consider stochastic point process models, based on doubly stochastic Poisson process, to analyse rainfall data collected in the form of raingauge bucket tip-times over a network of stations in a catchment. Multi-site doubly stochastic point process models are constructed whereby the arrival rate of the process varies according to a finite-state Markov chain thought to be representing the underlying environmental weather conditions. The tip-time series at a station is viewed as a univarite stochastic point process evolving in time and its multi-variate generalisation is studied to analyse data from multiple sites across the network. The likelihood function of this class of multi-site models, which is not usually available for most point process models, is derived by conditioning on the underlying Markov chain of the process. This allows us to make use of the likelihood approach for parameter estimation and inference.

The application of the proposed class of multi-site models, a useful alternative to the well known Poisson cluster models based on either Bartlett-Lewis or Neyman-Scott processes, in rainfall modelling is explored. We use data from the Hydrological Radar Experiment (HYREX) project, supplied by the British Atmospheric Data Centre (BADC), over a dense raingauge network in Brue experimental catchment in Somerset, South-West England. The models are used to make inferences about the properties of accumulated rainfall in discrete time intervals of equal length with the focus on fine time-scale. The proposed models and their variant that incorporate local covariate information such as elevation, temperature, sea-level pressure and relative humidity are utilised to study properties of rainfall time series from multiple sites. Results of the models that incorporate covariates are compared with the results of the model that does not take account of any covariates. The analysis shows the potential of this class of models in reproducing temporal and spatial variability of rainfall characteristics over the catchment area.

References

[Ramesh, N.I. et al. (2013)] Ramesh, N.I., Thayakaran, R. and Onof, C. 2013: Multi-site doubly stochastic Poisson process models for fine-scale rainfall, *Stochastic Environmental Research and Risk Assessment*, 1-14. DOI: 10.1007/s00477-012-0674-x