

STOCHASTIC RAINFALL MODELLING

At the University of Newcastle I developed interest in stochastic rainfall modelling as a spin-off research. The first paper published “A hybrid model for point rainfall modelling, **Water Res. Res.**, 33(7), 1699-1706, 1997” made a very significant contribution on the topic. It demonstrated that existing popular Bartlett-Lewis models produced very poor results when applied to rainfall data of Central Queensland. A hybrid point rainfall model, a product of two random processes, was born. The random process models are the nonrandomized Bartlett-Lewis rectangular pulse and an autoregressive model used as a jitter. In the second paper, “Generalisation of a hybrid model for point rainfall, **Journal of Hydrology**, 219(3-4), 218-224, 1999”, the hybrid model was generalised to generate point rainfall for a wide range of aggregation levels. The rainfall process was expressed as a product of a binary chain model, which preserves the dry and wet sequences as well as the mean, and a correlated jitter used to improve the deficiencies in the second-order properties of the binary chain. Two possible binary chain models were analysed, a non-randomised Bartlett-Lewis model and a Markov chain. Although both binary chain models perform equally well, the Bartlett-Lewis model was preferred for reasons of parameter parsimony.

My interest in stochastic rainfall modelling continued after I joined CQU in 1997, also as a spin-off research. The next paper on stochastic rainfall modelling was “Identification of regional parameters of a stochastic model for rainfall disaggregation, **Journal of Hydrology**, 223(3-4), 148-163, 1999.” This paper demonstrated how the generalised hybrid model for point processes could be regionalised for daily rainfall disaggregation using limited high resolution data within a region of interest. The results of using observed daily rainfall statistics to capture sub-daily statistics by the regionalised model were very encouraging. The model is, therefore, a valuable tool for disaggregating daily rainfall data. My passion for stochastic rainfall modelling did not end there. In 2001, the paper “Modelling diurnal cycles in point rainfall properties, **Hydrological Processes Journal**, 15, 595-601, 2001” was published. The improved hybrid model was explored to model the diurnal cycles in rainfall properties.

A new direction of the stochastic rainfall modelling was published in the paper “Stochastic disaggregation of daily rainfall into one-hour time scale, **Journal of Hydrology**, 309, 178-190, 2005.” The Australian SILO Data Drill facility (Queensland Department of Natural Resources and Mines) generates continuous daily rainfall data from 1889 to current date for any set of coordinates on the Australian continent. For the daily rainfall data to have any appeal to users, such as farmers and environmental modellers, a robust disaggregation model that generates sub-daily time series fully consistent with the daily totals while preserving multiple sub-daily time scale stochastic structure is required. The model developed here incorporates repetition techniques and a proportional adjusting procedure into the regionalised hybrid model, and has been demonstrated to have such capability. The model was evaluated with a 5-year time series of hourly rainfall observed at a HEFRAIL Erosion Control experimental site. With this confidence, the 114-year synthetic daily rainfall data set for Rockhampton generated by SILO Data Drill facility was disaggregated to one-hour time scale. The pattern of the results from this data set was identical to that of the observed 5-year data set.

Recently the point process disaggregation model has been extended with the following aims (**Journal of Hydrology**, 347, 358-370, 2007):

- generalisation for any fine timescale at a point;
- a simplified approach to determine the parameters of the regional model for a very large region such as the Australian continent;
- evaluation of the uncertainty of the calibrated parameters;
- enhancement of the capping procedure;
- testing of an Australia-wide parameter set with 9 years continuous rainfall data of 6-min timescale at a point.