



Downscaling site rainfall from daily to 11.25-minute resolution: event, diurnal, seasonal and decadal controls on downscaling parameters

Neil McIntyre (1,2), Shirley Shi (1), and Christian Onof (2)

(1) Sustainable Minerals Institute, The University of Queensland, St Lucia, Brisbane, Australia, (2) Department of Civil and Environmental Engineering, Imperial College London, South Kensington, London, UK

Downscaling site rainfall from daily to sub-daily resolution is often approached using the multiplicative discrete random cascade (MDRC) class of models, with mixed success. Questions in any application – for MDRCs or indeed other classes of downscaling model - is to what extent and in what way are model parameters functions of rainfall event type and/or large scale climate controls for example those linked to the El Nino Southern Oscillation (ENSO). These questions underlie the applicability of downscaling models for analysing rainfall and hydrological extremes, in particular for synthesising long-term historical or future sub-daily extremes conditional on historic or projected daily data. Coastal Queensland, Australia, is subject to combinations of multiple weather systems, including tropical cyclones, blocking systems, convective storms, frontal systems and ENSO influences. Using 100 years of fine resolution data from two gauges in central Brisbane, microcanonical MDRC models are fitted to data from 1 day to 11.25 minutes in seven cascade levels, each level dividing the time interval and its rainfall volume into two sub-intervals. Each cascade level involves estimating: the probabilities that all the rainfall observed in a time interval is concentrated in only the first of the two sub-intervals and that all the rainfall observed in a time interval is concentrated in only the second of the two sub-intervals; and also two beta distribution parameters that define the probability of a given division of the rainfall into both sub-intervals. These parameters are found to vary systematically with time of day, rainfall volume, event temporal structure, month of year, and ENSO anomaly. Reasonable downscaling performance is achieved (in terms of replicating extreme values of 11.25 minute rainfall given the observed daily data) by including the parameter dependence on the rainfall volume and event structure, although particular applications may justify development of more complex conditional MDRC models. A further important challenge discussed is the prospect for generalising the MDRC model parameters across sites.