Modelling precipitation and flood risks up to their probable maxima

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The design of high hazard structures (such as dam spillways and nuclear power plants) require estimates of exceedance probabilities of extreme events up to and including their notional probable maximum limits. This paper describes the developed and application of two largely independent methods to estimate the frequencies of such extreme events. One method is based on a stochastic storm transposition approach and the other combines frequency curves of point rainfalls with regression estimates of local and transposed areal rainfalls. Particular attention is given to separately modelling the epistemic and aleatory sources of uncertainty, and the methods are applied to catchments ranging in size between 6,000 km^2 and 45,000 km^2 in both temperate and tropical regions of Australia. A Monte Carlo simulation scheme is used to accommodate aleatory uncertainty in the factors most relevant to the transformation of rainfalls into floods. This scheme is used to assess how uncertainties in rainfall quantiles propagate through to design flood estimates, and includes consideration of the joint probabilities that control the transformation of flood flows into peak flood levels.