Geophysical Research Abstracts
Vol. 13, EGU2011-8871, 2011
EGU General Assembly 2011

Bayesian uncertainty analysis of climatological changes in IDF curves

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Intensity-Duration-Frequency (IDF) curves relate the intensity of extreme rainfall events to their duration and period of recurrence. These curves are part of the standard tools used by engineers in the design of dams, culverts, and urban drainage networks; for example, to determine the largest 30 minutes rainfall occurring on average every 20 years. IDF curves are estimated from individual station data, but regional frequency analysis also allows pooling of time series from multiple stations. These time series of annual maxima are described by statistical distributions of extreme values. However, since the sample sizes are small, distribution parameters are quite uncertain, as are intensity estimates derived from those parameters.

Academics and governments are now interested in expected shifts to IDF curves in future climate. This poses an additional challenge since climate models add another layer of uncertainty to IDF curves estimation. This paper describes a straightforward application of Bayesian analysis to IDF curves estimated from climate models. Parameter uncertainty and climate simulation uncertainty are addressed to compute a probabilistic assessment of the expected relative change to extreme rainfalls in the future. This work highlights the magnitude of uncertainties in extreme events, compares Bayesian and classical estimates and identifies some weak spots in regional frequency analysis.