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A point process characterisation of river discharge extreme events incorporating non-stationarity

M. Kallache[(1)], H.W. Rust[(1)], H. Lange[(2)] and J. Kropp[(1)]

(1) Potsdam Institute for Climate Impact Research, Germany
(2) Norwegian Forest and Landscape Institute, Ås, Norway

River floods may cause considerable damage. Water management strategies intend to moderate or mitigate the severe effects of extreme discharge events. In this context, techniques for the detection and attribution of changes is of crucial importance. Extreme flood events seem to occur more frequently in recent decades in central Europe. It is anticipated that climate change and weather regime shifts may contribute to this.

Therefore, the methods to assess extreme events should allow to deal with non-stationary data. We use the point process approach to track changes in magnitude and occurrence rate of floods. The Generalized Pareto Distribution is fitted via maximum likelihood to exceedances over a threshold of river discharge. Potential non-stationarity is included by letting the model parameters vary with time. Then the deviance statistics is used to choose the best model out of a range of possible models, including the stationary model. In this way, the test on non-stationarity is transferred to a model selection problem. Finally common assessment measures, like return levels, are obtained from the best model and can be used as indicators for water management strategies. The methodology is demonstrated for daily discharge data in the river Danube catchment in Southern Germany. It is easily transferable to other fields of application.