Potsdam Institute for Climate Impact Research **PIK**
Member of the Leibnitz Association

Flood Risk: Assessment and Trend Detection

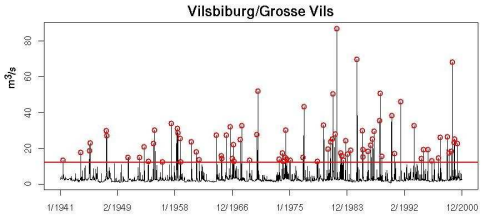
Case Study Danube River Basin, Southern Germany

In Europe floods have been a known natural hazard for centuries. Recently occurred extreme river floods have had severe effects in central Europe and the occurrence of extreme flood events seems to have grown considerably over recent decades. An appropriate assessment of extreme events is an important tool for water management authorities to develop mitigation and adaptation strategies for severe effects of floods on society. Here a data analysis framework to assess trends in extreme discharge is presented and exemplarily applied to discharge data of the Danube River basin in Southern Germany.

Aims

- Is the anticipated influence of global warming on the hydrological cycle already traceable?
- Do river discharge peaks reveal trends?
- Is a refinement of water management assessment measures necessary?
- Design of extreme value framework, which is capable to track changes in extremes.

Threshold Excesses as Extrema



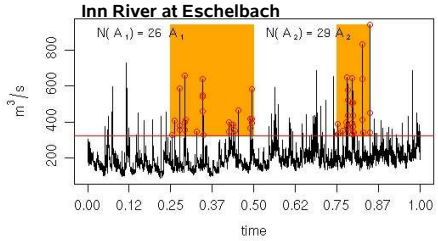
Data preprocessing:

- consideration of the annual cycle (choice of winter season, i.e. Dec. to Feb.),
- choice of threshold (mean residual life plot, fit over range of thresholds),
- consideration of the auto-correlation structure (declustering).

Point Processes

Point process (PP) to model excesses.

Fisher-Tippett theorem: Asymptotic accuracy of model assured for independent and identically distributed random variables X_1, X_2, ...



$$PP\{\Lambda(A)\} = Poi\{\Lambda_1([t_1, t_2])\}\, x\, Poi\{\Lambda_2([z, \infty])\}$$

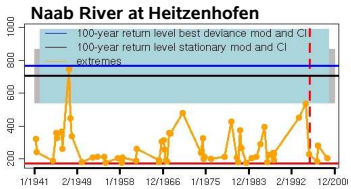
$\Lambda(A)$ Intensity with rate λ as derivative.

Non-stationary model: Allow model parameters to vary with time.

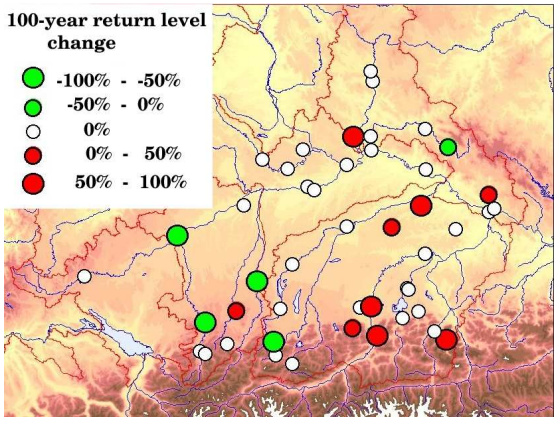
Test for Trend

- Use likelihood-based deviance statistic to select between stationary and all combinations of non-stationary point processes.
- Trend detection is transferred to model selection.

Case Study: Danube River Basin



100-year return level of stationary model is expected to be exceeded every 54 years when applying best model.



Results

- River discharge extremes often possess trends and persistence. The consideration of these characteristics ameliorates extreme value assessment.
- The approaches proposed allow for the assessment of uncertainty.
- No universal spatial trend pattern of river discharge is detectable in the Danube River basin.
- Common practice of management authorities can be improved by the technique presented and thus, flood protection consts may be reduced.

Kallache, M., H.W. Rust, H. Lange and J. P. Kropp (in press). Extreme value analysis for non-stationary data. In J. P. Kropp (Ed.) *In Extremis*, Berlin: Springer.

Kallache, M. (2007). *Trends and Extreme Values of River Discharge Time Series*. Ph. D. thesis, University of Bayreuth, Bayreuth.

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