Geophysical Research Abstracts, Vol. 8, 03176, 2006
SRef-ID: 1607-7962/gra/EGU06-A-03176

Towards quantified uncertainty in flood risk analysis: Statistics and History

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One scientific challenge in hydrology is that with global climate change also the risk of extreme floods is expected to change. Flood risk is an example for a climate risk. Estimating time-dependent flood risk is also of strong societal relevance. Because extreme events are rare and data not free of errors (measurement, proxy, dating), risk estimates have uncertainties. It is imperative to quantify and report these error bars as an input from science to policy makers. This paper evaluates the role of two science branches in quantifying, and potentially reducing, uncertainties in climate risk trends: statistics and history.

Statistics. The nonstationarity makes standard approaches from extreme value analysis (return periods, etc.) inapplicable. We present kernel occurrence rate estimation as a tool that overcomes this problem. Bootstrap resampling allows the construction of confidence bands around the estimated trends in flood risk. Because the kernel method is not parametrically restricted, also nonlinear and non-monotonic trends can be evaluated. This offers the option to relate highs or lows in flood risk to forcing climatic mechanisms. The bootstrap approach to kernel risk estimation has been introduced into flood risk estimation using floods of rivers Elbe and Oder during the past millennium (Mudelsee et al. 2003 Nature 425:166). Here we present new results from the river Werra and show a comparison with previous results (Elbe, Oder).

History. Documentary data can be used to extend the instrumental period from circa 1850 back several centuries. Because more data are then available, risk estimates potentially have reduced uncertainties. On the other hand, however, such data are

vulnerable to inhomogeneities in form of document loss. They have therefore to be historically-critically checked using the method of source interpretation. In this regard, we assess the data quality of the Werra flood record using several, partly independent sources.

Because rainfall has a high spatial variability and hydrological regimes change during the year, we emphasize that any flood risk analysis has to be performed in a highly differentiated manner: winter versus summer floods, analysis of single basins. It is further imperative not to corrupt estimates of climate risk by falsely incorporating data of economic damages of an extreme event.