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Future flood hazard under climate change in the Mekong Delta

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The main characteristic of flood hazard estimations is the association of a probability of occurrence to a flood event of a defined magnitude. This is usually performed via frequency analysis assuming stationarity and independence of the analyzed time series. This assumption, however, often does not hold true even for historical records and periods and it will be even more challenged under the expected impact of climate change to the water cycle in general and flood probabilities and magnitudes in particular. Thus strategies and methods have to be developed and evaluated for accounting for climate change impacts on flood hazard. In the presented contribution two options are presented and compared for the Mekong Delta, one of the most endangered areas with respect to climate change world-wide. The first method takes non-stationarity explicitly into account by analyzing the observed time series of peak discharge and flood volume at the upper boundary of the Delta with non-stationary extreme value statistics. The two variables and their dependence are modeled by a copula, coupling their marginal distributions to a joint bivariate distribution. Using this copula in combination with characteristic normalized flood hydrographs, probabilistic flood hazard maps for the Mekong Delta are generated via a large scale hydrodynamic model of the Delta embedded in a Monte Carlo framework for the reference year 2009. In order to account for climate change the observed trend in the non-stationary extreme value distribution was simply extrapolated to two future time horizons 2030 and 2050. However, the extrapolations of the trends are certainly associated with high level of uncertainty, in particular for time horizons in the far future.
Thus we compare the simple extrapolation approach with an approach deriving future flood hazard in the Mekong Delta by establishing direct correlations between monsoon indexes describing the intensity of the flood triggering monsoon activities and the shape parameter of a non-stationary extreme value statistic (Delgado et al., 2011). The future monsoon indexes are derived from 15 Global Circulation Models used in the ENSEMBLES project. The results of this method, both extreme value distributions and hazard maps, are compared to the extrapolation method for the same time horizons and a discussion about the validity and uncertainty of the methods is lead.

References

Delgado, J.M., Merz, B., Apel, H., 2011. A climate-flood link for the lower Mekong River. Hydrol. Earth Syst. Sci. Discuss., 8(6): 10125-10149.