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Flood frequency analysis with uncertainty estimation for the Mekong Delta

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Floods in the Mekong Delta which take place annually are often considered as the basis for the livelihoods of the inhabitants in this large and densely populated area. However, extreme events (e.g the flood years 2000 and 2011) can cause major damage and pose a serious threat to millions of people. This hazard has, however, not been studied within the frame of a probabilistic flood hazard analysis. Thus this study focuses on the identification of a suitable statistical model for the estimation of flood frequencies. The nature of the floods in the Mekong Delta calls for a bivariate approach, because the flood severity is determined by both the maximum discharge Q and the volume V of the flood. The testing of several distribution functions for Q and V reveals that the 3-parameter Log-normal distribution fits the marginals best. By goodness-of-fit tests for different copula based-bivariate models used to model the bivariate dependence structure, the Gumbel-Hougaard and the Gaussian copula perform similarly. Although the Gaussian copula performs slightly better than the Gumbel-Hougaard copula in representing the overall dependence structure but the latter is apparently suitable for extreme flood event analysis because of its tail dependence in the upper right quadrant. An uncertainty analysis of the quantile estimates for the bivariate stationary approach which is developed by using resampling-based procedure reveals quite large uncertainties, even for moderate floods. Considering the comparatively long observation series of 88 years, this analysis illustrates the inherent limitations of bivariate statistics in flood hazard analysis. Nevertheless, we advocate the use of bivariate statistics, because it describes two important flood characteristics of the Mekong Delta.