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Integrated flood risk assessment for the Mekong Delta through the combined assessment of flood hazard change and social vulnerability

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Low lying estuaries as the Mekong Delta in Vietnam are among the most vulnerable areas with respect to climate change impacts. While regular floods are not a threat but an opportunity for livelihoods and income generation, extreme flood events can pose considerable risks to the people living in Deltas. Climate change is expected to increase the frequency of extreme floods globally, which in combination with sea level rise and a likely intensification of cyclone activity creates increased and/or entirely new hazard exposure in the Deltas. Yet, in line with the risk literature and especially the recent IPCC SREX report, flooding risk needs to be understood as deriving from the interaction of physical hazards and the vulnerabilities of exposed elements.

Therefore, the paper aims for an integrated risk assessment through combining the most up to date estimates of flood hazard projections under climate change conditions in the Mekong Delta with the assessment of vulnerability patterns. Projections of flood hazard are estimated based the modulation of the flood frequency distribution by atmospheric circulation patterns. Future projections of these patterns are calculated from an ensemble of climate models. A quasi two-dimensional hydrodynamical model of the Delta is then applied to estimate water levels and flood extend. This model is fed with a set of hydrographs which are based on both the derived climate model uncertainty and the bivariate nature of floods in the Mekong Delta. Flood peak is coupled with flood volume in the probabilistic framework to derive synthetic extreme future floods with associated probabilities of occurrence. This flood hazard analysis is combined with static sea level rise scenarios, which alter the lower boundary of the hydrodynamic model and give estimates of the impact on sea level rise on inundation extend and depths.

The vulnerability assessment is based on a three step approach. Firstly, vulnerability profiles are developed for different agro-ecological zones and socio-economic population profiles. The focus herein is particularly on understanding the causal constellations and trajectories of vulnerability patterns. Secondly, key vulnerability parameters identified in step one are translated into quantitative indicators and aggregated into a vulnerability index, allowing for spatial analysis. Thirdly, ways to assess future vulnerability trajectories in the context of the ongoing socio-economic transformation in the Mekong Delta are explored.

In effect, this analysis generates an integrated risk assessment that is based not only on an advancement of current flood hazard assessments but also on a detailed vulnerability assessment that goes beyond the mapping of exposure. The study thereby contributes knowledge of great relevance for informing disaster risk management and adaptation policies. In addition, the analysis allows for a dynamic perspective and the examination of key trends in the flood risk of the Mekong Delta.