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Extreme floods in the Mekong River Delta under climate change: combined impacts of upstream hydrological changes and sea level rise

Long Hoang (1), Dung Nguyen Viet (2), Matti Kummu (3), Hannu Lauri (4), Jorma Koponen (4), Michelle T.H. van Vliet (1), Iwan Supit (1), Rik Leemans (5), Pavel Kabat (1,6), and Fulco Ludwig (1)

(1) Wageningen University, Netherlands (long.hoang@wur.nl), (2) GFZ German Research Centre for Geosciences, Germany, (3) Aalto University, Finland, (4) EIA Finland Ltd., Finland, (5) Wageningen University, The Netherlands, (6) International Institute for Applied System Analysis, Austria

Extreme floods cause huge damages to human lives and infrastructure, and hamper socio-economic development in the Mekong River Delta in Vietnam. Induced by climate change, upstream hydrological changes and sea level rise are expected to further exacerbate future flood hazard and thereby posing critical challenges for securing safety and sustainability. This paper provides a probabilistic quantification of future flood hazard for the Mekong Delta, focusing on extreme events under climate change. We developed a model chain to simulate separate and combined impacts of two drivers, namely upstream hydrological changes and sea level rise on flood magnitude and frequency. Simulation results show that upstream changes and sea level rise substantially increase flood hazard throughout the whole Mekong Delta. Due to differences in their nature, two drivers show different features in their impacts on floods. Impacts of upstream changes are more dominant in floodplains in the upper delta, causing an increase of up to +0.80 m in flood depth. Sea level rise introduces flood hazard to currently safe areas in the middle and coastal delta zones. A 0.6 m rise in relative sea level causes an increase in flood depth between 0.10 and 0.70 m, depending on location by 2050s. Upstream hydrological changes and sea level rise tend to intensify each other's impacts on floods, resulting in stronger combined impacts than linearly summed impacts of each individual driver. Substantial increase of future flood hazard strongly requires better flood protection and more flood resilient development for the Mekong Delta. Findings from this study can be used as quantified physical boundary conditions to develop flood management strategies and strategic delta management plans.