Investigation of Extreme Flood Changes in the Mekong River Basin Using +4K Climate Simulation

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The future changes in frequency and intensity of precipitation will definitely affect the flooding due to climate change leading to the future direction for the development of social infrastructure. The study of flood was done by using the precipitation output from the climate model as input data to the hydrologic model. The uncertainty of climate simulation due to an insufficient number of ensemble members was inadequate to capture the change of the edge of the phenomenon. For this reason, the application of large ensemble data would reduce the uncertainty of climate simulation. This study aims to (1) define the effective duration of precipitation which has the highest correlation to the annual maximum flood in the Lower Mekong Basin (LMB); (2) assess the change of flood severity under climate change impacts using large ensemble dataset from Database for Policy Decision-Making for Future Climate Change (d4PDF). The data is available for 60-year (1950-2010) with 100 ensemble members for historical climate; the future climate simulation (2050-2110) consists of 90 ensemble members which were simulated under 4 K warmer experiment by 6 patterns of sea surface temperature (SST) from CMIP5 models. The flood inundation in the LMB was simulated using a coupling rainfall-runoff and inundation (RRI) model with 2-D diffusive wave approximation. The statistical Kolmogorov-Smirnov (K-S) test of two samples was used to determine the significant difference between the two cumulative distribution function (CDF) for each future SST pattern. The Generalized Extreme Value (GEV) was used for fitting the extreme flood. The results indicated that 90-day precipitation counting backward from the day of peak flooding has a high correlation to peak inundation volume and discharge (both R-sqr = 0.81). The historical simulation of d4PDF was able to catch up the past observed flood events in the LMB in 78 years of the data record (1934-2011) which had good agreement with the ensemble mean. The K-S test revealed the majority of significant difference of discharge simulation from each SST (i.e. 14 out of 15 cases) while the null hypothesis from only one case was accepted at a significant level of 5%. The relative changes of future and past experiments of 1:50, 1:100, and 1:1000 year flood events showed an increase by +25%, +33%, and +40% for peak discharge at Kratie and +19%, +29%, and +36% for inundation extent, respectively. In conclusion, the magnitude of extreme flood in the LMB in the future will definitely be severer than the historical experiment. To reduce its impacts and damages, we need to implement effective water resource management as well as flood mitigation and adaption countermeasures.

Keywords: flood frequency, climate change, d4PDF, Mekong River Basin

