Geophysical Research Abstracts
Vol. 13, EGU2011-5123, 2011
EGU General Assembly 2011

Impact of climate change on the flood risks in the Mekong River basin: prediction of future flooding extent using a continental-scale hydrodynamics model

Dai Yamazaki (1), Yadu Pokhrel (1), Hyungjun Kim (2), Shinjiro Kanae (3), and Taikan Oki (1)

(1) Institute of Industrial Science, The University of Tokyo, Tokyo, Japan (yamadai@rainbow.iis.u-tokyo.ac.jp), (2) Center for Hydrologic Modeling, University of California Irvine, Irvine CA, U.S.A., (3) Department of Civil and Environmental Engineering, Tokyo Institute of Technology, Tokyo, Japan

Seasonal flooding of the Mekong River has benefits on agriculture and fisheries, while an extreme flooding causes huge damages on the economics and lives of the riparian population. Thus the prediction of flooding extent under the changing climate is helpful for the water resources management of the Mekong River, yet the model-based assessment of future flooding extent is still facing various kinds of difficulties. One of them is the complex hydrodynamics of flooded water in the lower Mekong floodplains including the substantial backflow from the Mekong River to the Tonle-Sap Lake. Regional hydrodynamics models with high-resolution topography information have been used for representing such complex flows on floodplains, but regional models are not suitable for climate change studies because they requires upstream boundary inflows which are not available for future predictions. Instead, we applied a continental-scale distributed hydrodynamics model, CaMa-Flood, for the entire Mekong River in order to simulate the seasonal cycle of flooding extent without using upstream boundary inflows. Even though the spatial resolution of the model is coarse (8 km for this study), CaMa-Flood explicitly predicts the variations of the flooding extent within a single grid-box by allocating a river channel reservoir and a floodplain reservoir with sub-grid topographic parameters. Geometry of the river channel and floodplain reservoirs, which determines the relation between water storage and flooding extent, is objectively parameterized from the flow direction map and the DEM from the 90-m resolution HydroSHEDS. River discharge (i.e. outflow from each grid-box) is calculated along the prescribed river network map using a diffusive wave equation, so that backwater effect is represented in CaMa-Flood. The simulation under the present climate was performed by running the model with observation-based climate forcing, and results were validated against both discharges from in-situ gauge and flooding extents from satellites. It is found that the model well reproduces the daily variations of river discharge in both mountainous regions and downstream regions with floodplains including the seasonal backflow from the Mekong River to the Tonle-Sap Lake. The flooding extents simulated by the model also well agree to the satellite observations. Then the simulation for a future a climate condition was executed using the runoff forcing from a climate change experiment. The flooding extents are predicted to be increased along the Mekong mainstem where the increase in upstream runoff is observed in the climate change experiment. However, the increase in flooding extents is also found around the Tonle-Sap Lake even though the lake basin has no significant increase in upstream runoff. It is found that the enhanced flooding in the mainstem intensifies the seasonal backflow from the mainstem to the Tonle-Sap Lake, which enhances the flooding around the Tonle-Sap Lake without the increase in upstream runoff into the lake basin. Even though there still exist large uncertainties in the climate change experiments, this study suggested a possibility for the explicit prediction of the flooding extent under the climate change using a continental-scale hydrodynamics model.