Implementation of flood diversion canals and retention ponds to the H08 global hydrological model for flood management

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Flood diversion canals play a crucial role in assuaging the flood risk by diverting water from the main channel to the nearby rivers, downstream of the same river, or the ocean. For the impact assessment of such canal systems on river discharge worldwide, their explicit inclusion into the global hydrological models (GHMs) is necessary. Despite this fact, such representation is limited due to their complex operations and lack of data. Therefore, we aim to propose a generalized scheme for the flood water diversion in the H08 GHM that ideally requires the universal parameters only. In this scheme, if the discharge exceeds the channel capacity, an amount equivalent to canal capacity is diverted to the canal, which will then flow to the retention ponds, and finally to the destination once the retention ponds get full. A regionalized scheme with site-specific parameters was also considered to evaluate the validity of the simulations.

The proposed scheme was tested in the upper Chao Phraya River basin, which is characterized by four tributaries of Ping, Wang, Yom, and Nan. The government has implemented Yom-Nan canal system to divert water from Yom to Nan River since 2014 to alleviate flooding in the lower Yom basin. The effect of this canal system was analyzed from 1980-2004 using the H08 model with the generalized scheme as well as the regionalized scheme. The simulations showed that the total flood water diverted from the Yom River was around 1.00 km$^3$/year and 1.64 km$^3$/year under the generalized and regionalized schemes, respectively, over the 25 years. This constitutes about 2.62% and 4.29% of the river discharge in the Yom River at the diversion point. In both simulations, nearly 30% of the water has been diverted to the Nan River and the remaining 70% was stored in the retention ponds. To assess the validity of the simulations, we compared the simulation results of the wet water-year 1994 with the observed canal operation data of the wet water-year 2017. The total flood water diverted was around 0.47 km$^3$/year during the year 2017, whereas the same for 1994 was about 0.17 km$^3$/year and 0.48 km$^3$/year under the generalized and regionalized schemes, respectively. This shows that the regionalized simulations are close to the observations, while the generalized simulations reproduced nearly half of the diverted canal flow. The generalized simulations can be further improved by parameterizations.