Representation of dams in global flood inundation simulations by coupling the global hydrological model H08 and the global hydrodynamic model CaMa-Flood

*Julien Eric Boulange[1], Naota Hanasaki[1]

1. National Institute for Environmental Studies

Dams and reservoirs regulate the flow of rivers, storing and releasing water to maximize its availability for human and environmental needs[1]. While regulating water flow is beneficial regarding human water security, it was reported to have rather dire consequences for the environment such as aquatic biota[2,3]. Nevertheless, currently about half of the major global river systems are affected by dams[4].
Global hydrodynamic models have greatly improved in terms of accuracy and computational efficiency in reproducing flood inundation extent[5]. However, to this day, still few such models successfully simulated flood inundation considering the influence of dams.
In this research, the global hydrological model H08[6,7] is coupled to the global hydrodynamic model CaMa-Flood[8] for representing dams in global flood inundation simulation. The input meteorological dataset used in this study were provided by the ISIMIP2b project[9] and consisted of 4 GCMs and 4 scenarios.

The coupled model simulates river discharge and inundation globally at a daily interval, at a spatial resolution of 0.5˚ ×0.5˚. Discharge predicted with the original CaMa-Flood model were compared to those obtained with the coupled model. The seasonal discharge in rivers heavily affected by reservoir operation were very different between the two simulations. Generally, annual minimum (maximum) 7-day discharge was significantly higher (lower) for the simulation explicitly representing dams. In addition, timings of the discharge peaks were also different between the 2 simulations. We deeply investigated the results in several selected river basins.

References:

1 Ehsani, N., Vörösmarty, C. J., Fekete, B. M. & Stakhiv, E. Z. *J. Hydrol.* (2017).
2 Pringle, C., Freeman, M. & Freeman, B. *Regional Effects of Hydrologic Alterations on Riverine Macrobiota in the New World: Tropical–Temperate Comparisons*. Vol. 50 (2000).
3 Kingsford, R. T. *Austral Ecology* (2000).
4 Dynesius, M. & Nilsson, C. *Science* (1994).
5 Teng, J. *et al. Environmental Modelling & Software* (2017).
6 Hanasaki, N. *et al. Hydrol. Earth Syst. Sci.* (2008).
7 Hanasaki, N. *et al. Hydrol. Earth Syst. Sci.* (2008).
8 Yamazaki, D., Kanae, S., Kim, H. & Oki, T. *Water Resour. Res.* (2011).
9 Frieler, K. *et al. Geosci. Model Dev. Discuss.* (2016).

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