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Sensitivity of global river flood simulations to the choice of climate forcing and hydrological model

Benedikt Mester[1,2], Sven Willner[1], Katja Frieler[1], and Jacob Schewe[1]
[1]Potsdam Institute for Climate Impact Research, Potsdam, Germany
[2]Potsdam University, Potsdam, Germany

Global flood models (GFM) are increasingly being used to estimate societal and economic risks of river flooding. A recent collective validation of several GFMs highlighted substantial differences in performance between models and between validation sites. However, it has not been systematically quantified to what extent the choice of the underlying climate forcing and global hydrological model (GHM) influence flood model performance. Here, we investigate this sensitivity by comparing simulated flood extent with satellite imagery of past flood events, for an ensemble of three climate reanalyses and 11 GHMs. We study eight historical flood events covering four continents and various climate zones. Our results show that model performance varies greatly among the events. For most regions, the simulated inundation extent is relatively insensitive to the choice of GHM. For some events, however, individual GHMs lead to much lower agreement with observations than the others, mostly resulting from an overestimation of inundated areas. Two of the climate forcings show very similar results, while with the third, differences between GHMs become more pronounced. We further show that neither a previously used flood-volume adjustment procedure, nor the application of a global flood protection database, substantially improves model performance. Our study guides future applications of these models, and highlights regions and models where targeted improvements might yield the largest performance gains.