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A framework for global river flood risk assessment

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There is an increasing need for strategic global assessments of flood risks. Such assessments may be required by: (a) International Financing Institutes and Disaster Management Agencies to evaluate where, when, and which investments in flood risk mitigation are most required; (b) (re-)insurers, who need to determine their required coverage capital; and (c) large companies to account for risks of regional investments.

In this contribution, we propose a framework for global river flood risk assessment. The framework combines coarse scale resolution hazard probability distributions, derived from global hydrological model runs (typical scale about 0.5 degree resolution) with high resolution estimates of exposure indicators. The high resolution is required because floods typically occur at a much smaller scale than the typical resolution of global hydrological models, and exposure indicators such as population, land use and economic value generally are strongly variable in space and time. The framework therefore estimates hazard at a high resolution (1 km2) by using a) global forcing data sets of the current (or in scenario mode, future) climate; b) a global hydrological model; c) a global flood routing model, and d) importantly, a flood spatial downscaling routine. This results in probability distributions of annual flood extremes as an indicator of flood hazard, at the appropriate resolution. A second component of the framework combines the hazard probability distribution with classical flood impact models (e.g. damage, affected GDP, affected population) to establish indicators for flood risk. The framework can be applied with a large number of datasets and models and sensitivities of such choices can be evaluated by the user.

The framework is applied using the global hydrological model PCR-GLOBWB, combined with a global flood routing model. Downscaling of the hazard probability distributions to 1 km2 resolution is performed with a new downscaling algorithm, applied on a number of target regions. We demonstrate the use of impact models in these regions based on global GDP, population, and land use maps. In this application, we show sensitivities of the estimated risks with regard to the use of different climate input datasets, decisions made in the downscaling algorithm, and different approaches to establish distributed estimates of GDP and asset exposure to flooding.