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How are flood risk estimates affected by the choice of return-periods?

P.J. Ward (1,2), J.C.J.H. Aerts (1,2), H. De Moel (1,2), J.K. Poussin (1,2)

(1) Institute for Environmental Studies (IVM), VU University Amsterdam, Amsterdam, Netherlands (philip.ward@ivm.vu.nl), (2) Amsterdam Global Change Institute (AGCI), VU University Amsterdam, Amsterdam, Netherlands

Flood management is more and more adopting a risk based approach, whereby flood risk is the product of the probability and consequences of flooding. One of the most common approaches in flood risk assessment is to estimate the damage that would occur for floods of several exceedance probabilities (or return periods), to plot these on an exceedance probability-loss curve (risk curve) and to estimate risk as the area under the curve. However, there is little insight into how the selection of the return-periods (which ones and how many) used to calculate risk actually affects the final risk calculation. To gain such insights, we developed and validated an inundation model capable of rapidly simulating inundation extent and depth, and dynamically coupled this to an existing damage model. The method was applied to a section of the River Meuse in the southeast of the Netherlands. Firstly, we estimated risk based on a risk curve using yearly return periods from 2 to 10 000 yr (€ 34 million p.a.). We found that the overall risk is greatly affected by the number of return periods used to construct the risk curve, with over-estimations of annual risk between 33% and 100% when only three return periods are used. Also, the final risk estimate is greatly dependent on the minimum and maximum return periods (and their associated damages) used in the construction of the risk curve. In addition, binary assumptions on dike failure can have a large effect (a factor two difference) on risk estimates. The results suggest that more research is needed to develop relatively simple inundation models that can be used to produce large numbers of inundation maps, complementary to more complex 2D-3D hydrodynamic models. We then used the insights and models described above to assess the relative change in risk between current conditions and several scenarios of land use and climate change. For the case study region, we found that future land use change has a larger impact than future climate change on the overall economic risk.