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Costs and benefits of adapting to river floods at the global scale

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It is well known that the economic losses associated with flooding are huge; for example in 2012 alone the economic losses from flooding exceeded $19 billion. As a result, different models have been developed to assess global scale flood risk. Recently, these have been used in several studies to assess current flood risk at the global scale, and to project how risk may increase as a result of climate change and/or socioeconomic development. In most regions, these studies show rapid increases in risk into the future, and therefore call for urgent adaptation. However, to date no studies have attempted to assess the costs of carrying out such adaptation, nor the benefits. In this paper, we therefore present the first global scale estimate of the costs and benefits of adapting to increased river flood risk caused by factors such as climate change and socioeconomic development.

For this study, we concentrate on structural adaptation measures, such as dikes, designed to prevent flood hazard up to a certain design standard. We address two questions:
1. What would be the costs and benefits of maintaining current flood protection standards, accounting for future climate and socioeconomic change until 2100?
2. What flood protection standards would be required by 2100 to keep future flood risk constant at today's levels? And what would be the costs and benefits associated with this?

In this paper, we will present our first global estimates of the costs and benefits of adaptation to increased flood risk, as well as maps of these findings per country and river basin. We present the results under 4 emission scenarios (RCPs), 5 socioeconomic scenarios (SSPs), and under several assumptions relating to total potential flood damages, discount rates, construction costs, maintenance costs, and so forth.

The research was carried out using the GLOFRIS modelling cascade. This global flood risk model calculates flood risk in terms of annual expected damage, and has been developed and validated over the past few years. For this study we have extended GLOFRIS by developing a module that calculates the costs and benefits of adaptation by increasing dike flood protection standards. In brief, this is carried out by calculating, per cell, the length of dikes that would be required to provide flood protection, multiplying this with the change in dike height that would be required to offer a certain flood protection standard, and multiplying this with data on the costs of dike construction and maintenance.