European Commission

JRC PESETA III Science for Policy Summary Series

RIVER FLOODS AND CLIMATE CHANGE

River floods across Europe are responsible for damage amounting to €5.3 billion each year. Flood risk is likely to increase in the future due to the combined effects of climate change and socio-economic developments. Whilst there is potential for society to adapt to an increase in flood risk through a range of options, it is only through the combination of multiple adaptation strategies that the impacts of river floods will remain close to present-day levels.

IMPACTS WITHOUT ADAPTATION AND NO SOCIO-ECONOMIC CHANGE

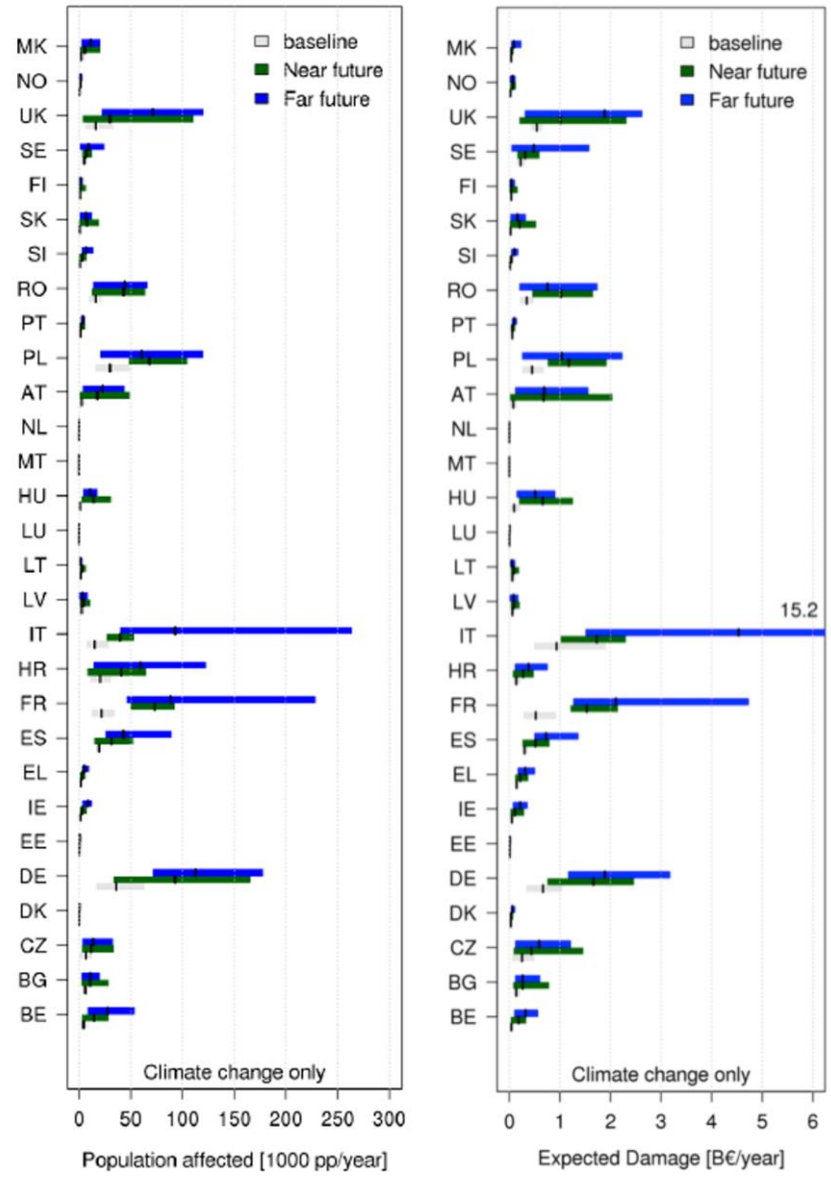
Around 216,000 people across Europe are already exposed to river flooding annually, with flood damage amounting to €5.3 billion each year.

Under a high warming scenario and assuming present socio-economic conditions prevail into the future, and that there is no adaptation, flood risk could more than triple by the end of the century. Around 700,000 people could be exposed to floods each year, amounting to €17.5 billion of annual losses.

Over half of the economic damages would affect the four largest countries in Europe in terms of population: Germany, France, the UK and Italy (Figure 1).

Relative to the high warming scenario, annual damages of around €5 billion could be avoided under a 2°C warming scenario across Europe. Under a 2°C warming scenario, the impacts are reduced to damages around €12.5 billion each year, and around 530,000 people affected.

Figure 1. National averages of population affected (left) and economic damages (right) from flooding, for nowadays ('baseline') as well as the near (2030s) and far (2080s) future under a high warming scenario (indicative of the effects of flooding under a 2°C warming scenario and an above 3°C scenario respectively). The bar denotes the range.



Note: estimates assume present socio-economic conditions prevail into the future and that no adaptation is undertaken. Range is across seven climate model projections with the average shown by a black line. Some countries are not included because the impacts are negligible compared to other countries.

IMPACTS WITH ADAPTATION AND SOCIO-ECONOMIC CHANGE

Climate change mitigation alone cannot avoid the adverse effects of climate change on damages from river flooding. This means adaptation measures will be important in reducing the scale of the impact of flooding in the future. Adaptation options include:

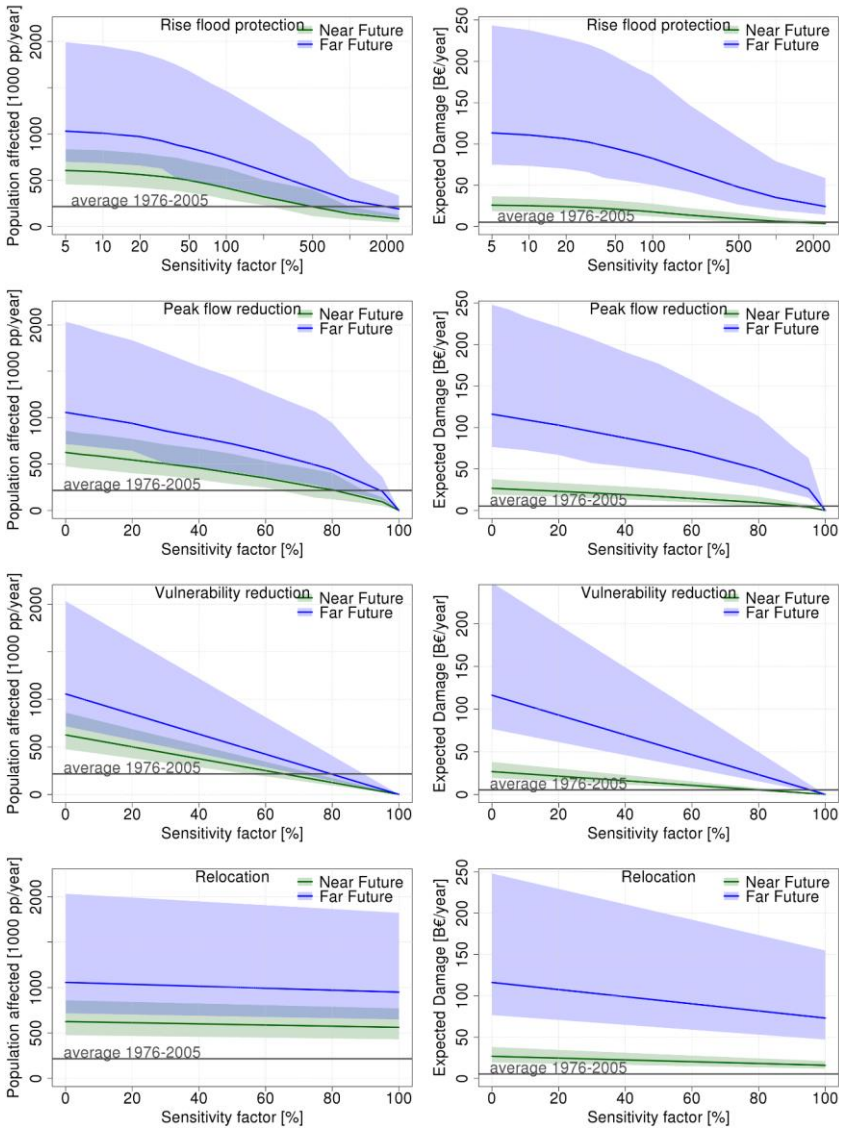
1) a rise of flood protection such as increasing the height of river banks;
2) reducing peak river flows through water retention mechanisms such as sustainable urban drainage systems (SUDS);
3) reduction of vulnerability by implementing early warning systems, dry and wet flood proofing, and floating buildings; and
4) relocation of populations and assets to areas of negligible risk.

Implementing only any one of these options is unlikely to prevent the effects of flooding across Europe from increasing above present levels in the 2030s and 2080s (Figure 2). To keep the effects of flooding close to nowadays with only one adaptation strategy would require it to be implemented at a very high intensity, which, in practice, would likely be unachievable.

The traditional approach to adaptation that only raises flood protection levels is unsustainable in the long-term. It is likely to exacerbate the "levee effect", by reducing the effects of moderate flood events. The levee effect encourages economic development in the floodplain and, as a result, it exposes society to catastrophic floods on the few occasions they occur.

Future adaptation strategies should be based on a combination of different measures that are optimised at the entire river basin scale, rather than through independent actions over selected parts of the river.

Figure 2. Annual affected population and damage across Europe in the near (2030s) and far (2080s) future under a high warming scenario, with four adaptation strategies implemented at different levels of intensity (called "sensitivity" in the charts). Horizontal black lines show the effects of flooding nowadays.



Note: Future socio-economic development is characterised by high mitigation challenges with low adaptation challenges (SSP5). Shading denotes range in impacts from using 7 climate models (average value is the solid line).

APPROACH

To assess the number of people affected and the economic damages from river flooding, PESETA III used maps of present exposure to flooding and information on current flood defences, with simulations of river flows generated by a hydrological model run with projections of climate change. Seven different climate models generated the climate change projections for a high warming scenario. The same hydrological model was used elsewhere in PESETA III to assess soil moisture and water resources. Two main scenarios were considered: impacts without adaptation and no socio-economic change, and impacts with adaptation and socio-economic change. The effects of flooding were considered for the near future (2021-2050) and far future (2071-2100). The former approximates the effects of a 2°C warming scenario and the latter global warming more than 3°C above pre-industrial. The geographical scope of the study was the EU Member States, Norway and Former Yugoslav Republic of Macedonia.

Read more

PESETA III Task 7: River floods. Available on our website https://ec.europa.eu/jrc/en/peseta