POLICY BRIEF | WATER SUPPLY AND FLOOD RISK

INTEGRATED SOLUTIONS TO ADDRESS HIGH LEVELS OF CLIMATE CHANGE

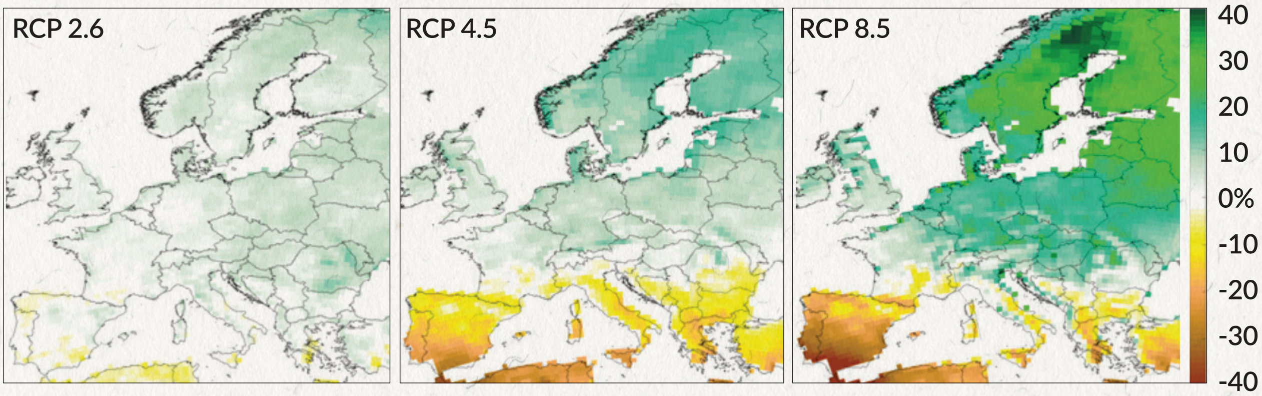
We are not yet on track to meet the Paris Agreement goal to keep global mean temperatures below 2°C (and ideally below 1.5°C) above pre-industrial levels. IMPRESSIONS modelled the impacts of higher levels of climate change (above +2°C) on water supply and flood risk across Europe under different socio-economic scenarios, including interactions with agriculture, forestry, biodiversity and urban development.

Key Messages

- With climate change above 2°C, severe water scarcity is expected in southern Europe and flood damage will increase significantly across Europe, especially in coastal areas. Water scarcity could have severe impacts on agriculture, drinking water supplies, industry, power generation and ecosystems.
- Participatory integrated water and land management that considers the synergies and trade-offs between agriculture, forestry, water, energy and biodiversity can help to identify and implement the most cost-effective and sustainable solutions, including nature-based solutions.
- Urgent investment is needed to reduce water demand and improve water use efficiency in regions vulnerable to water shortages.

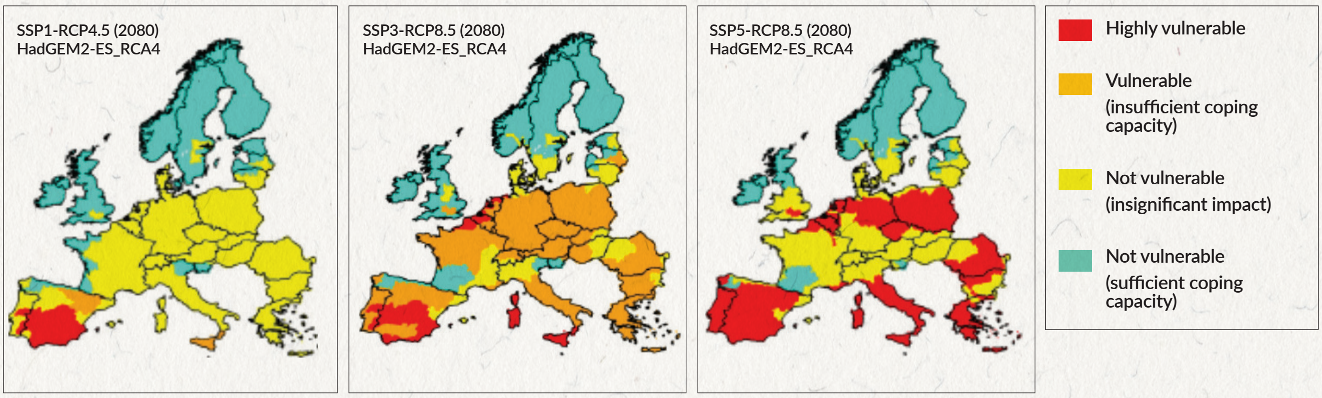
How will climate change affect water supply and flood risk in Europe?

High levels of climate change are expected to dramatically alter rainfall patterns across Europe. In southern Europe, significant decreases in annual rainfall are projected to lead to more frequent and prolonged droughts. At the same time, precipitation is projected to increase in northern Europe and parts of central Europe. Rainfall events could become more intense, flood risk will increase and lake and river levels could oscillate between low and high extremes.



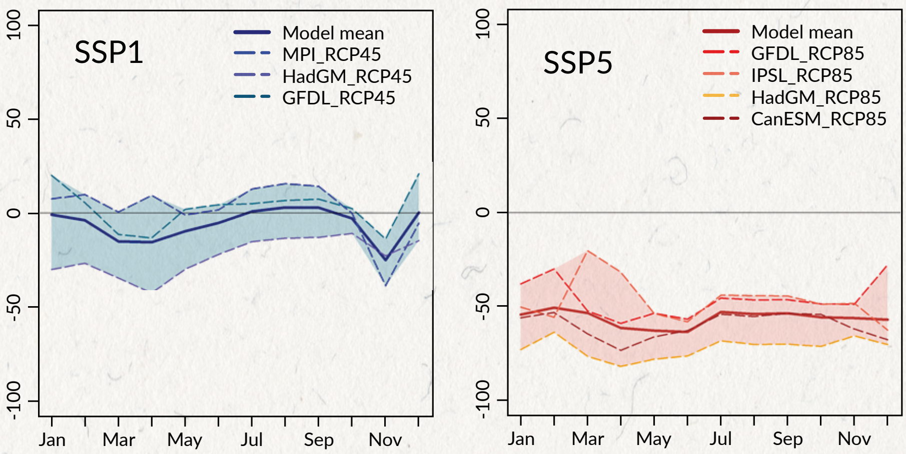
Projections of changes in average annual precipitation from 1961-1990 to 2071-2100 for three climate scenarios: RCP2.6 (+1.3 to +1.4°C in Europe), RCP4.5 (+2 to +3°C) and RCP8.5 (+3.6 to +5.4°C), showing mean outputs from the subset of climate models used in IMPRESSIONS.

Impacts and vulnerability depend strongly on socio-economic factors, which were modelled based on four of the global 'Shared Socio-economic pathways' (SSPs) (see Scenarios policy brief). Under an environmentally-focused scenario (SSP1), efficient water-use technologies and water-saving behaviour reduce pressure on water resources, and high human, social and natural capital increase coping capacity and thus reduce vulnerability to water stress. Under the resource-intensive SSP5 and the politically unstable SSP3, however, adapting to climate change is more challenging and severe vulnerability to water scarcity and flooding extends across much of Europe. If current emission trends continue (taking us close to the RCP8.5 climate scenario), virtually all river basins in southern Europe and many of those in north-western Europe will experience severe water stress (withdrawal to availability ratio >0.4), with adverse impacts on agriculture, forests, ecosystems, domestic supply, power supply and tourism.



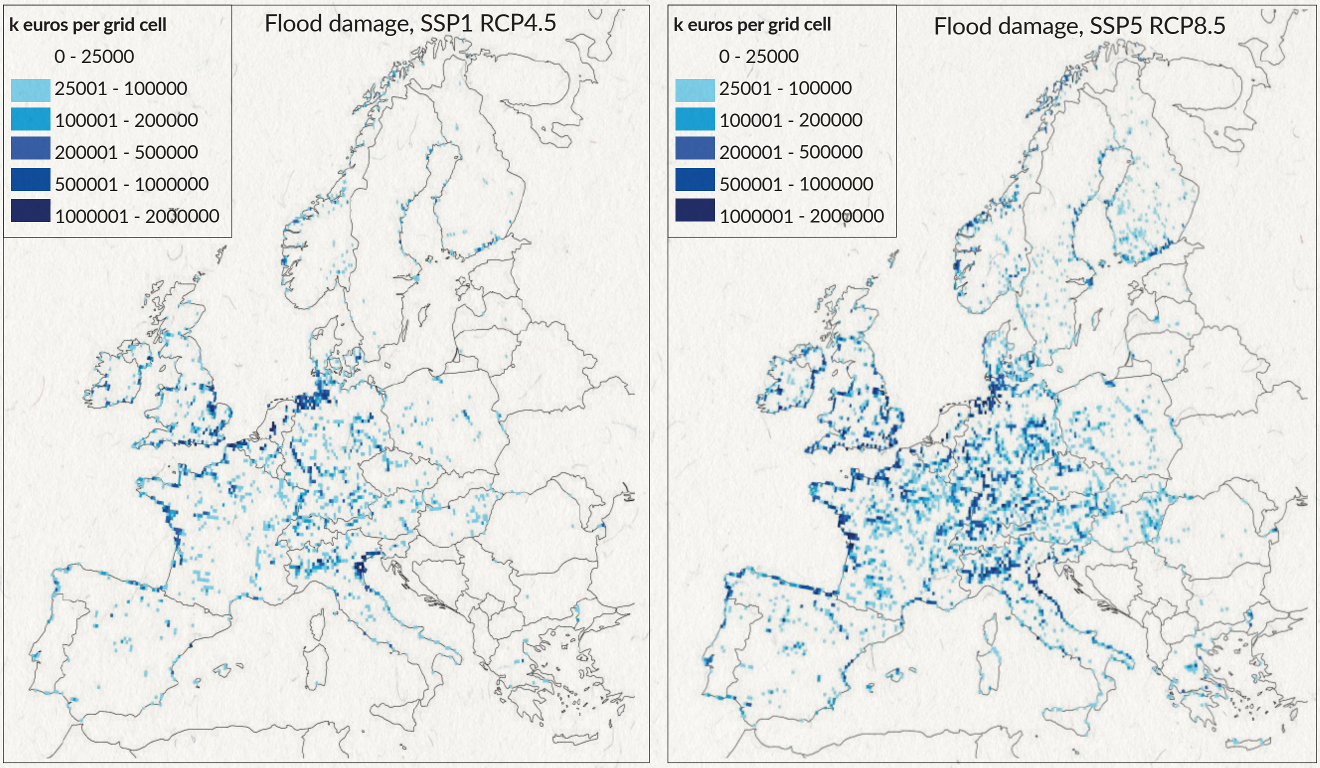
Vulnerability to water scarcity in European river basins for SSP1, SSP3 and SSP5 (left to right) in the 2080s.

Water scarcity will be a particular problem in the Iberian Peninsula, where there are already challenges for the management of transboundary water resources between Portugal and Spain (see Iberian case study brief). In the Tagus River Basin, winter flows are expected to fall by around 25% under RCP4.5 and 50% under RCP8.5, cutting hydropower production by approximately 45% and 50% in 2071-2100. The region will be unable to meet competing demands for water for irrigation, urban use and canal transfers to the intensive horticulture region in south-eastern Spain, and the fulfilment of the Albufeira transboundary treaty between Portugal and Spain will probably become impossible by the end of the century. In the "green" SSP1 scenario with lower climate change and a 40% improvement in water use efficiency, the water shortages can be mitigated but only until mid-century. Droughts pose severe threats to the unique dry oak-grassland agroforestry systems known as "Dehesa" in Spain and "Montado" in Portugal, reducing the amount of forage available for livestock and leading to the end of cork production by the end of the century in RCP8.5.



Change in discharge at the outlet of the Tagus river in 2071-2100 compared to 1981-2010 for a +2 to +3°C temperature rise with efficient water use (SSP1 x RCP4.5, left) and a resource-intensive scenario with higher climate change of +3.6 to +5.4°C (SSP5 x RCP8.5, right).

Similarly, flood damage is also highly dependent on socio-economic factors. Under SSP5, extensive urban sprawl creates large areas vulnerable to flooding. Estimated damage from a 1 in 100 year flood event grows from €78 billion today to €1800 billion in the 2080s, affecting an extra 15 million people. Under the more sustainable SSP1 scenario, compact urban development and lower climate change restricts the damage to around €490 billion.



Total damage ~€490 billion ~22 million people flooded

Total damage ~€1,800 billion ~32 million people flooded

Flood damage from a 1 in 100 year coastal and fluvial flood event in the 2080s (thousand euros per grid cell) for two scenario combinations: a +2 to +3°C temperature rise with compact development (SSP1 x RCP4.5, left) and higher climate change (+3.6 to +5.4°C) with urban sprawl (SSP5 x RCP8.5, right).

What adaptation and mitigation pathways are possible?

Stakeholders in all the IMPRESSIONS case studies identified transformative pathways towards more sustainable water management, though the emphasis varied between regions. In Iberia, the focus was on adapting to water scarcity through integrated and collaborative water management and sustainable water use and infrastructure operation. This pathway sets goals to protect water quality and quantity and ensure equal access to water. It includes participatory transboundary water governance systems; new infrastructure (e.g. for rainwater harvesting, water treatment and re-use, metering, efficient irrigation and appliances); strong regulations, incentives, eco-labels, taxes, quotas and consumer education to cut water use; and real-time monitoring systems to control water quality and river flows. In Hungary, water saving and storage measures were combined with soil improvements and revitalisation of local water management institutions.

Existing flood protection measures in Europe are effective in reducing potential socio-economic impacts under current climate conditions, including for hot-spot areas such as around the North Sea (e.g. the Netherlands and London), and Venice and Ravenna in Italy. However, measures such as raising properties will not be sufficient to adapt to high climate change. Significant interventions such as upgrading existing flood protection by 500%, 1000% or more will be required, especially in the case of extreme sea-level rise. In the face of increasing climate pressures and associated uncertainty, these interventions can become unsustainable and future management policies are likely to include more use of the “managed realignment” option, where people are relocated if necessary to areas that can be protected.

In addition, the concepts of “working with nature” to create space for water in river basins and restricting developments in high flood risk areas can be seen as viable approaches for responding to higher levels of climate change. Many of the adaptation pathways developed by IMPRESSIONS stakeholders included nature-based solutions such as planting woodland in strategic locations, reconnecting rivers with their flood plains and restoring coastal dunes, saltmarshes and beaches, as well as urban green infrastructure such as retention basins and swales. These options can often help to reduce flooding cost-effectively at the same time as contributing to climate mitigation through carbon storage, and delivering multiple cultural and environmental benefits.

Policy Recommendations

- Set up participatory, multi-level and transboundary water governance systems that manage water use, quality and quantity, taking into account the need to maintain environmental flows and navigability, and the projected future changes in demand and water availability.

- Apply integrated solutions to address water management, land use planning and biodiversity conservation together (e.g. conservation agriculture; catchment management; ecosystem-based adaptation), to exploit synergies and reduce trade-offs between these sectors. This includes tackling the tension between agriculture and water use, e.g. so that the CAP supports agricultural water efficiency.

- Make more use of innovative and cost-effective nature-based solutions and grey-green infrastructure for flood protection, water quality and natural cooling of water.

- Avoid building new development in areas vulnerable to flooding and consider the need to move the most vulnerable communities to safer areas.

- Promote behaviour change to cut water demand in all sectors (household, agriculture, business and energy), using the education system, awareness campaigns, regulations and incentives. Abstraction taxes should include all externalities, and abstraction licenses should be time-limited so they can adapt to the changing climate.

- Prioritise investments to increase water use efficiency (and wider resource efficiency to minimise the consumption of ‘embedded water’) in line with the “Blueprint to safeguard Europe’s water”.

- Explore innovative options for distributed (non-reservoir) water storage, e.g. groundwater recharge; storage in soils; small lakes on farms.

- Invest in technologies for re-use of treated wastewater and stormwater, in line with the Urban Wastewater Treatment Directive, and provide clearer guidance on when Member States should implement water re-use (i.e. the definition of “whenever appropriate”).

Contributors: Anastasia Lobanova, Martina Flörke, Florian Wimmer, Marc Mokrech, Alison Smith.

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