European Commission

JRC PESETA III Science for Policy Summary Series

CLIMATE CHANGE AND EUROPE'S WATER RESOURCES

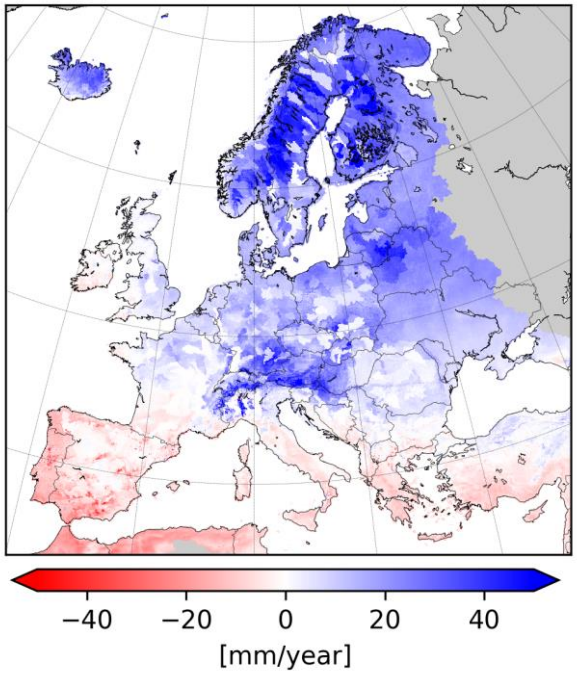
A North-South pattern emerges across Europe for water availability under a 2°C warming scenario. Overall, Southern European countries are projected to face increased water shortages, particularly Spain, Cyprus, Italy and Turkey. The severity of impacts under the 2°C warming scenario suggests that mitigation alone is not enough to avoid adverse climate change impacts; adaptation strategies will be needed too. At the same time, analysis suggests that planned EU Member State measures on water efficiency improve the state of water resources under current climate, but are not sufficient under the 2°C warming scenario.

GROUNDWATER

Under a 2°C warming scenario, a North-South divide is evident for changes from present in groundwater, with a decrease in groundwater resources for Southern Europe, and an increase north of this region (Figure 1). Further over-abstraction of groundwater in Southern Europe, beyond renewable capacity, could lead to critical deep groundwater levels and increased pumping costs to extract the water for use at the surface. The higher altitudes of the Alps show an increase in groundwater.

Seven countries are projected to see declines in groundwater under the 2°C warming scenario when the changes in groundwater are averaged at the country-level: Cyprus, Italy, Turkey, Former Yugoslav Republic of Macedonia, Portugal, Malta and Ireland. The declines are larger than 80% for the first three countries.

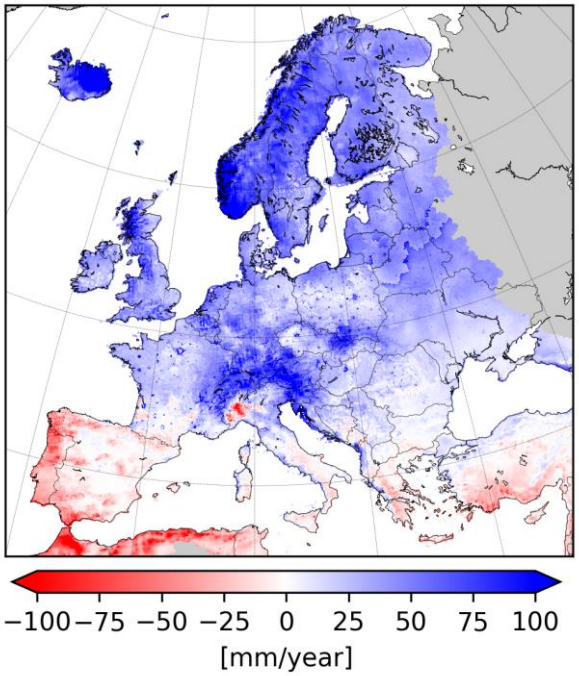
Figure 1. Changes in annual groundwater recharge between a 2°C warming scenario and present (average from 11 climate model-driven simulations).



RUNOFF IN CITIES IS BECOMING A GROWING ISSUE OF CONCERN IN CENTRAL AND NORTHERN EUROPEAN URBAN AREAS

Local runoff production increases under the 2°C warming scenario as a consequence of climate change and urban expansion. This could cause local water excess problems and sewer overflows (Figure 2).

Figure 2. Changes in local runoff between a 2°C warming scenario and present (average from 11 climate model-driven simulations).



CURRENT PRESSURES ON WATER RESOURCES ARE EXACERBATED IN SOUTHERN EUROPE

The Water Exploitation Index (WEI+) is a metric that takes account of net water consumption versus available renewable water resources. Values below 0.2 indicate areas without major water scarcity. Areas with values between 0.2 and 0.4 experience water scarcity in at least a part of the year. Areas with a WEI+ larger than 0.4 are often water scarce during a year. This indicator takes into account inflowing river water from cross-border river basins. According to this index, water scarcity is a regular issue already in some parts of Europe (Figure 3(a)).

The water resources situation becomes more unsustainable under a 2°C warming scenario for countries in the Mediterranean, and especially Spain (Figure 3(b)). Under the high warming scenario at the end of the century, water scarcity is even more widespread (Figure 3(c)), expanding to central Europe. Overall, Southern European countries are projected to face increased water shortages.

THE NEED FOR ADAPTATION

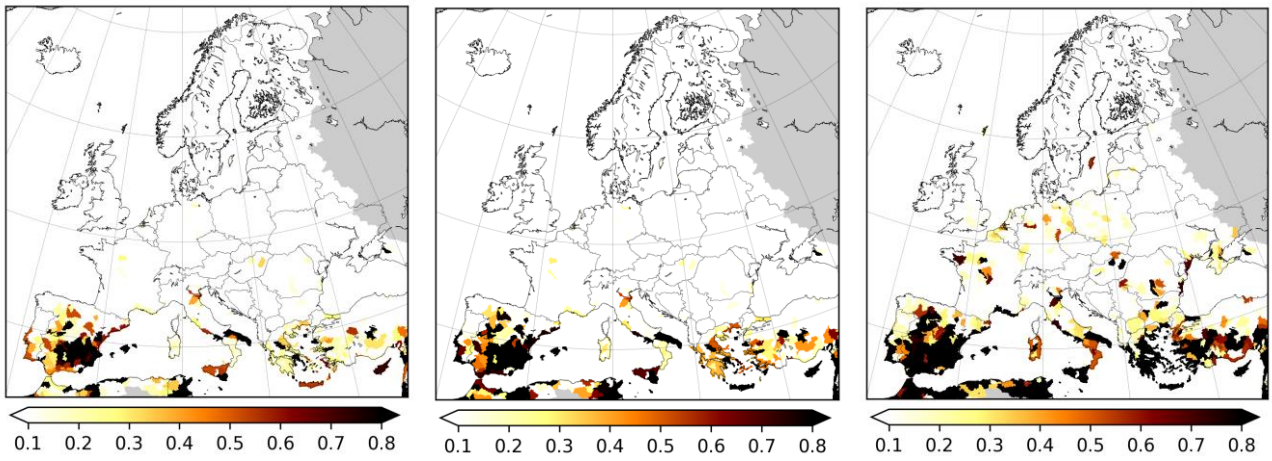
The severity of some of the projected changes in water availability presented here, which are under a global warming scenario in line with the Paris Agreement, suggests that various adaptation mechanisms will be needed to lessen the effects of climate change on European water resources, even under a 2°C warming scenario.

Projected increases in water dependency for some regions calls for sustained water diplomacy between countries as well as international multi-member-state management of river basin water resources. In Europe, this is already foreseen under the Water Framework Directive.

A number of planned adaptation strategies could be targeted at irrigation practices to lower pressures on water resources. Water pricing for irrigation water, as well as for industrial water, and public water, could create an incentive for users to consider water savings. Irrigation efficiency could be increased by changing irrigation methods (e.g from sprinkling to drip irrigation), but this is likely to only be feasible when irrigation water has a price. Furthermore, sub-optimal irrigation strategies may lead to only limited reductions in crop yields, but towards substantial water savings.

Other options might focus on delivering more efficient cooling technologies that lead to a reduction in water use for producing energy. In addition, shifts from conventional energy production (coal) to renewable energy production could reduce cooling water demand and net consumption.

Figure 3. Present values for the annual average Water Exploitation Index (WEI+) (a) and the WEI+ under a 2°C warming scenario (b) and under the high warming scenario at the end of the century (c) (average from 11 climate model-driven simulations). Water Exploitation Index values larger than 0.4 indicate extreme water scarcity during at least parts of the year.



(a) (b) (c)

APPROACH

PESETA III estimated the impact of climate change on water availability using the same hydrological model that was used elsewhere in the project to assess drought and damages from river flooding. The model was run under two climate change scenarios: a 2°C warming scenario and a high warming scenario at the end of the century, using climate inputs from eleven different climate models, while assuming no change in land use and water demand from nowadays. The geographical scope of the study was all of Europe.

Read more

PESETA III Task 12: Projections of changes in Europe's water resources under a 2 degree climate change. Available on our website https://ec.europa.eu/jrc/en/peseta