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Climate change and water resources

The long-term imbalance resulting from water demand exceeding available renewable water resources is an increasingly frequent and widespread issue in the EU. With global warming the duration and intensity of water scarcity will grow in already existing water scarce areas in southern Europe. At higher levels of warming, water availability, especially in summer, will also drop in western parts of Europe and at higher latitudes. As a result, new areas that face periods of water scarcity will emerge. Mitigation alone is not enough to avoid adverse climate change impacts and adaptation strategies will be needed too.

KEY MESSAGES

Water stress increases overall

The number of people in the EU+UK living in areas considered to be under water stress for at least one month per year could rise from 52 million nowadays to 65 million, in a 3°C warming scenario, which is equivalent to 15% of the EU population.

13 million
more people living in water stress than nowadays, in a 3°C scenario

Limiting global warming to 1.5°C would halve this increase.

A north-south pattern

In general, climate projections reveal a north-south pattern across Europe, with decreasing water availability in southern European countries, particularly Spain, Portugal, Greece, and Italy, and increases in northern regions.

Water scarcity is already an issue in the EU

There are currently around 52 million people in the EU+UK living in water scarce regions. This is equivalent to 11% of the population. Most of the people exposed to water stress live in countries in southern Europe. In the Mediterranean, the period of water stress can exceed 5 months (Figure 1).

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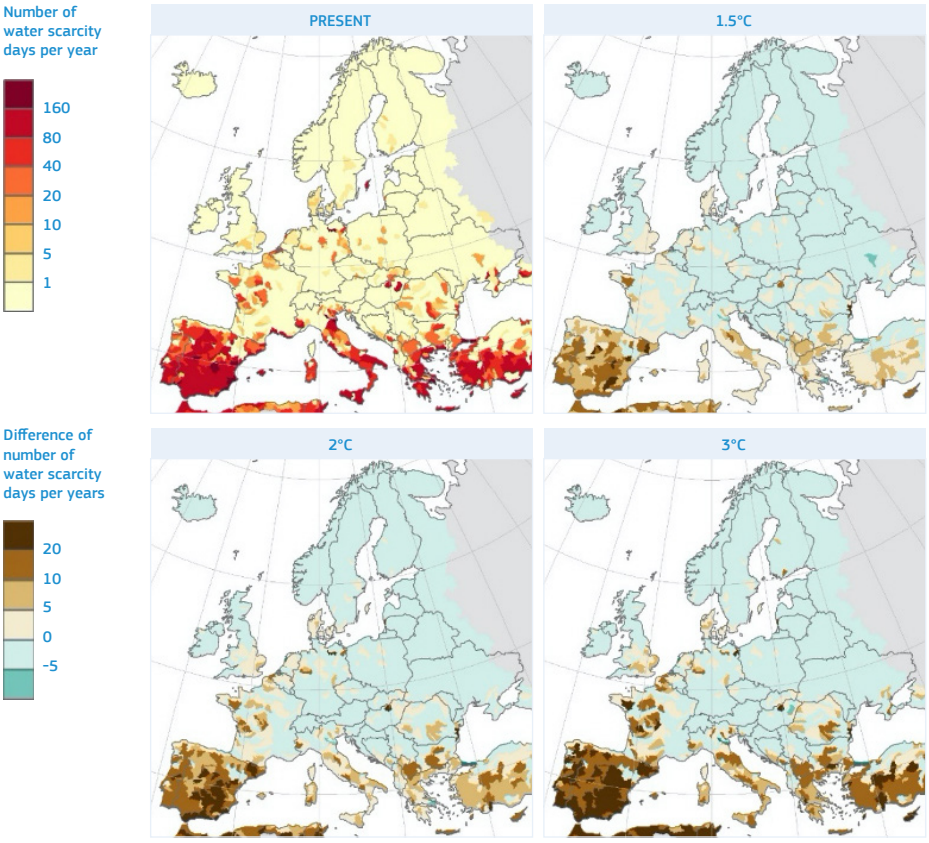

Figure 1. Number of water scarce days (WEI+ greater than 0.2) in present (refer to top clourbar) and projected changes relative to present for three different levels of global warming (refer to bottom colourbar).

About PESETA IV

The JRC PESETA IV project aims to better understand the biophysical and economic consequences of climate change. It does this by using projections of climate change for Europe from several climate models along with a set of climate change impact models. The project covers several sectors that are relevant to society and the natural environment, such as freshwater, agriculture, and coasts.

ec.europa.eu/jrc/en/peseta-iv

Joint Research Centre

Current pressures on water resources are exacerbated by climate change in southern Europe

A clear north-south pattern of change in water stress is projected with global warming. Water scarcity conditions will worsen in regions that already face water stress nowadays. The number of days with conditions that are considered to represent water stress increases sharply around the Mediterranean region with increasing global warming (Figure 1). Areas that will increasingly face water stress also emerge in countries further north like the UK, Belgium, the Netherlands, Germany, Denmark, Bulgaria, Romania and France. Other central and northern European countries show a trend towards increasing water availability with global warming.

Population exposed to water scarcity due to climate change

The number of people living in areas with water stress increases to 65 million with 3°C global warming (Figure 2). This is 13 million (+25%) more than at present. Limiting global warming to 1.5°C would halve the increase in number of people living in water scarce areas.

Spain sees the largest absolute increase in the number of people living in areas with water stress – at 3°C warming, over 7 million more people than present. In Greece, the number of people facing water stress grows by 3.5 million to nearly 9 million with 3°C warming, or about 80% of the present population.

Present	1.5°C	2.0°C	3.0°C
People living in areas with water stress (million)			
52	59	60	65

Figure 2. Population in EU+UK living in areas with water stress (WEI+ > 0.2) for different levels of global warming.

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The need for adaptation

The severity of some of the projected changes in water availability suggests that various adaptation mechanisms will be needed to lessen the effects on population and economic activities exposed to water scarcity, even under lower magnitudes of warming.

In some regions, projected increases in water dependency on upstream water requires further water diplomacy efforts between countries as well as international multi-member-state management of river basin water resources. In the EU, this is already operational under the Water Framework Directive and in various River Basin Commissions, such as for the Danube, Rhine, Elbe, Meuse, Oder, Sava, and others.

Adaptation could be targeted at demand-driven scarcity, rather than increasing supply, as this may further increase water dependency. Supply side measures have known detrimental environmental effects (reservoirs) or increased energy requirements (desalination). Imbalanced water demand can only be alleviated in a sustainable manner by lowering water dependency in water-intensive sectors.

Water pricing could create an incentive for users to consider water savings and develop water-conserving technologies. Among the wide range of possible measures, this includes for example, increasing irrigation efficiency by changing irrigation methods (e.g. from sprinkling to drip irrigation), or shifts to crops with lower water requirements. Furthermore, sub-optimal irrigation strategies may lead to substantial water savings with only limited reductions in crop yield.

Other options include more efficient cooling technologies that lead to a reduction in water use for producing energy. In addition, shifts from conventional energy production (fossil fuel) to renewable energy production (wind and solar) could reduce cooling water demand and net water consumption.

Approach

PESETA IV estimated the impact of climate change on water availability using the same hydrological model that was used elsewhere in the project to assess drought, river flooding, and energy supply impacts. The LISFLOOD hydrological and water use model was forced by climate projections for the present climate and 1.5, 2 and 3°C global warming above preindustrial levels.

The Water Exploitation Index (WEI+) is a metric of water stress that is defined as the percentage of total renewable freshwater resources used in a defined territory in a given period. The WEI+ takes into account inflowing river water from cross-border river basins. It was calculated at monthly scale. WEI+ values have a range between 0 and 1. Values above 0.2 indicate that water resources are under stress, while above 0.4 indicates 'severe' water stress. PESETA IV estimated population exposure to water stress for the present and 1.5, 2 and 3°C global warming, by calculating the number of people living in areas with an average annual WEI+ larger than 0.2 and 0.4 respectively.

Water stress exposure was estimated under two main assumptions of socioeconomic change: 1) a continuation of present conditions into the future (as presented here); and 2) socioeconomic development according to the ECFIN 2015 Ageing Report.

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For all PESETA IV publications - https://ec.europa.eu/jrc/en/peseta-iv