Limiting global warming to 1.5°C: Impacts avoided compared to 2°C

Summary

- A warming world brings many potentially damaging impacts for society. How does limiting warming to 1.5°C help us avoid some of the impacts expected in a 2°C warmer world?
- Extremes of heat could be 2-5 times more common in a 2°C warmer world. About half of this impact is avoided by limiting warming to 1.5°C.
- Warming is projected to increase flooding in some areas and drought in others. Both impacts are larger at 2°C global warming than at 1.5°C.
- Vulnerability to food insecurity increases in many countries as our world warms. About three quarters of countries are estimated to be more vulnerable at 2°C warming than at 1.5°C.
- Changes in river flows around the world are uncertain and vary from place to place. Flows in the Ganges are projected to increase, while those in the Amazon mostly decrease. In both cases, the maximum impacts at 1.5°C global warming are about two-thirds of those at 2°C.

Heatwaves

Extremes of heat are projected to increase substantially as our climate warms. Temperatures that are currently only reached occasionally will occur much more often and for longer periods of time.

a). Fraction of time with hot weather at 2°C

b). Difference between fraction of time with hot weather at 2°C and 1.5°C

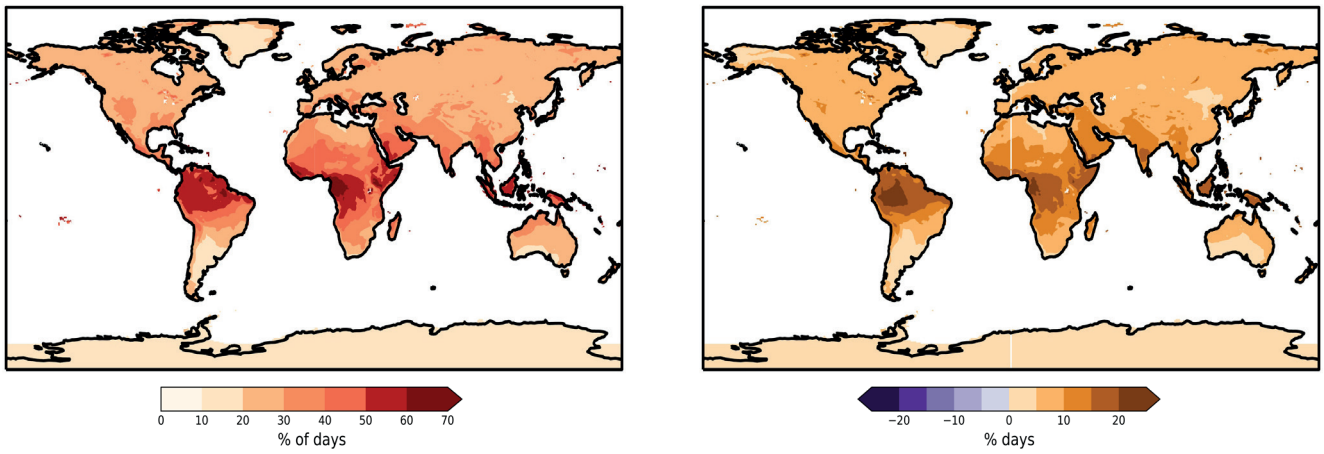

Figure 1. Percentage of time with daily maximum temperatures above the current hottest 10%
a) 2°C global warming b) Difference between 2°C and 1.5°C global warming

Research shows this by finding the daily maximum temperatures of the hottest 10% of days in each region in the current climate. Climate change simulations were then analysed to see how long the temperatures rose above that level in a 2°C warmer world (Figure 1a), and the difference between 2°C and 1.5°C worlds (Figure 1b).

In a warmer 2°C world, the current hottest 10% temperature was exceeded 20% of the time in mid-latitudes and more than 50% in the tropics. About half of these impacts can be avoided by limiting warming to 1.5°C.

New global climate projections

As part of the EU-funded HELIX project, a new model (HadGEM3-GC2) was used to simulate climate change impacts at a higher level of detail (60km resolution) than typically previously used in reports by the Intergovernmental Panel on Climate Change (IPCC). Six simulations were carried out to capture a range of possible patterns of regional climate change at global warming of 1.5°C and 2°C above pre-industrial levels.

River flows and fresh water resources

Declines in river flows could threaten fresh water supplies, while increased flows could raise flooding risks. Projections suggest that at 1.5°C and 2°C global warming, either increased or decreased flows are possible for many of the world's major rivers. Despite this uncertainty, the projected changes and uncertainty are generally smaller at 1.5°C than 2°C. For example, at 2°C, projected changes in flow of the Amazon range from a 5% increase to over a 25% decrease. At 1.5°C, the maximum decrease is about 15%. However, some basins in south and east Asia are projected to see increased flow in all simulations. Flows in the Ganges increase by up to 90% at 1.5°C and by up to 130% at 2°C.

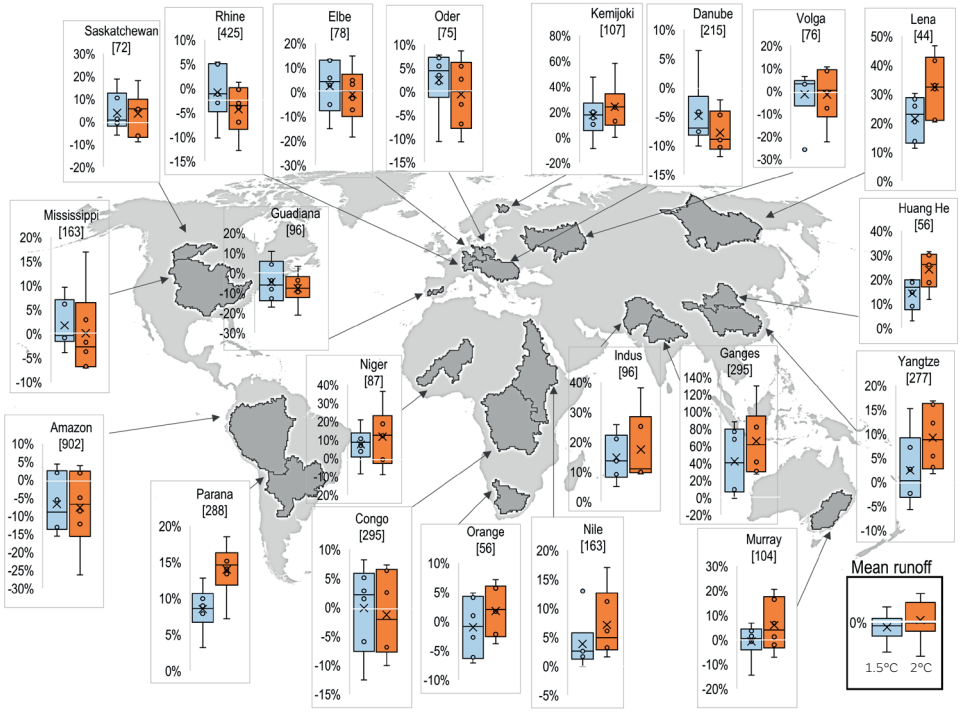

Figure 2. Range of projected changes in flow in major river basins at 2°C and 1.5°C global warming.

Flooding

An increase in global temperature is projected to cause more flooding in some areas, and more drought in others. One reason for this is the change in rainfall due to changes in wind patterns. Both increases and decreases in rainfall are generally larger at 2°C global warming than a 1.5°C. Flooding is projected to increase in more places than it decreases, with the additional economic damage to residential, commercial, industrial, infrastructure, and agricultural sectors being equivalent to billions of Euros more per year at 2°C global warming compared to 1.5°C in many countries.

Vulnerability to food insecurity

For each developing country, HELIX calculated the World Food Programme's Hunger and Climate Vulnerability Index (HCVI). This allows food insecurity in different countries to be compared by combining economic factors such as poverty and transport infrastructure combined with impacts of drought and heavy rain simulated for 1.5°C and 2°C warming (Figure 3). Approximately 75% of countries were calculated as more vulnerable at 2°C than 1.5°C.

a). Food vulnerability at 2°C

b). Difference in food vulnerability between 2°C and 1.5°C

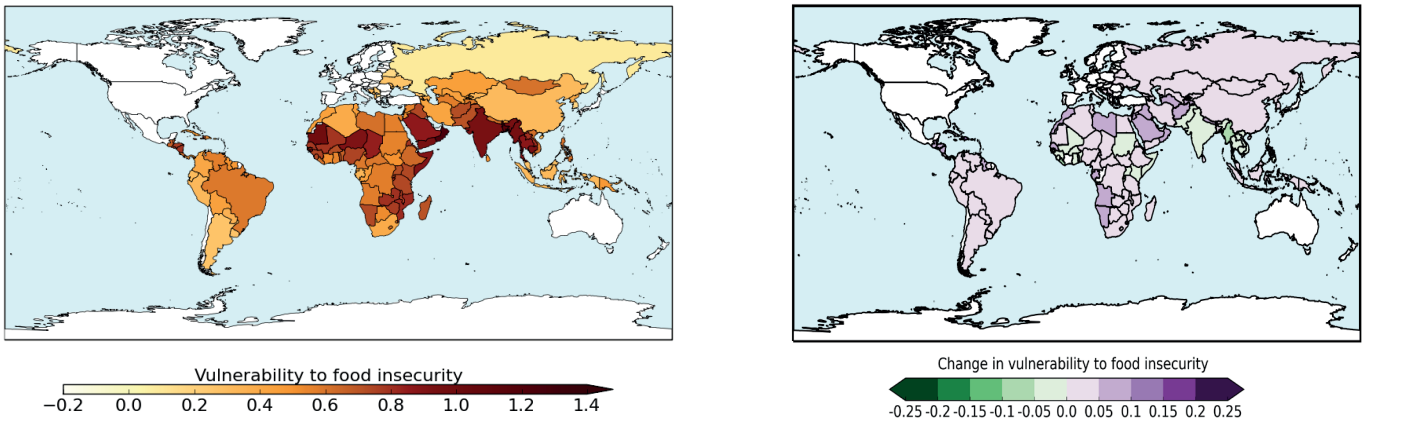

Figure 3. Projected changes in the Hunger and Climate Vulnerability Index a) 2°C b) Difference between 2°C and 1.5°C

Going beyond 1.5°C global warming is also projected to bring other impacts. Some will bring positive benefits, but when all impacts are considered together they are expected to be 'net negative' in their effects on society.

- Increased vegetation cover and biomass due to increased CO_2 driving more plant growth.
- Warmer temperatures giving a longer growing season in many temperate regions.
- Increased risks to biodiversity due to local conditions changing outside of those of current ranges for specific species.