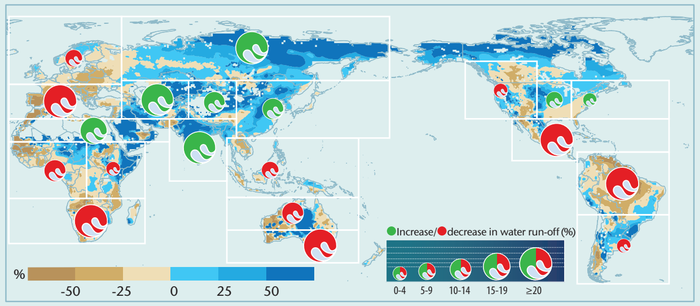
Human dynamics of climate change

HM Government

This poster shows projections of climate change impacts and population change by the end of the 21st century in the context of the way we live today, without adaptation.

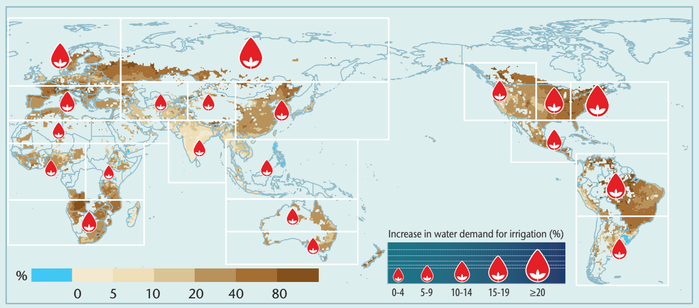
The central map shows information about present-day human dynamics, and the surrounding maps show some of the projections of climate change impacts and population change. The climate projections are taken from the latest generation of climate and impacts models, for the end of the century (2071—2100) relative to a 1981—2010 baseline, under a 'business as usual' greenhouse gas concentration scenario (RCP8.5). The population change follows a 'middle of the road' socio-economic scenario (SSP2). The future change icons show the median change across the model runs in climatologically averaged regions, with the spatial pattern of mean change on the map behind. Each map shows an element of the information and so all the maps should be considered together.

Future change in water run-off



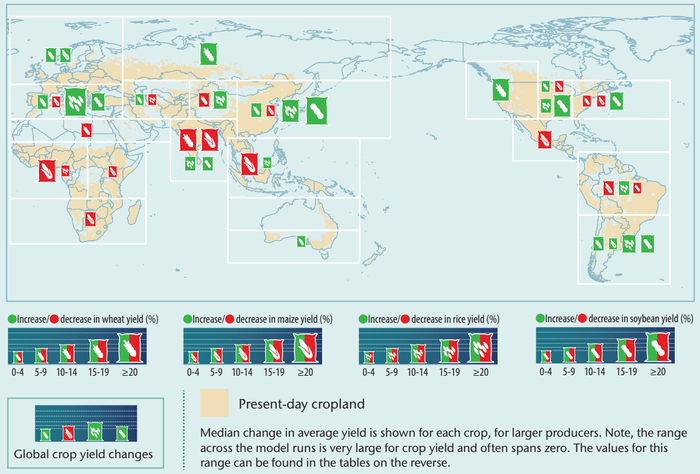
Water run-off is the surface and sub-surface water flowing into rivers. This is the water available for use from precipitation, taking into account losses due to evaporation.

Future change in water demand for irrigation



Water demand for irrigation is a measure of the amount of water crops need to fully meet their water requirements. This map shows the change in demand as a result of the warmer climate. It does not include the effects of population growth and there is a low representation of CO_2 fertilisation (20 of the 25 models used here do not include CO_2 fertilisation). The crop yield changes shown below assume that this water demand is met for irrigated crops, which makes this additional measure important to account for.

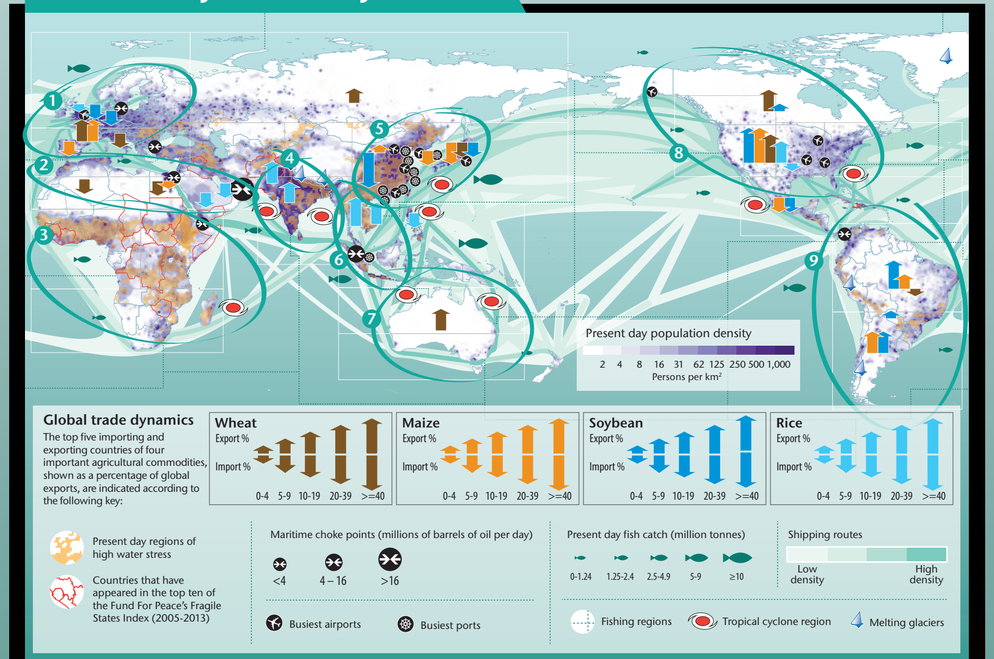
Future change in average crop yield in production regions



Median change in average yield is shown for each crop, for larger producers. Note, the range across the model runs is very large for crop yield and often spans zero. The values for this range can be found in the tables on the reverse.

Crop yield projections show both increases and decreases in different regions for different crops. However, viewed in the context of other changes, it is apparent that the climate projections shown here represent a threat to global food security. The changes in average yield above assume that irrigated crops will continue to be supplied with sufficient water. While demand for water is projected to increase due to the greater water requirements of crops at higher temperatures and also the growing global population; the availability of water will vary, with an increase in run-off in some areas and decreases in others. A larger population also means an increase in demand for food. Finally, average changes in yield mask the increase in year-to-year variability as a result of the projected increases in drought, high temperatures, and in many places, flooding.

Present-day human dynamics



1 Europe

Across Europe the demand for water for irrigation of crops is projected to increase, as are drought and warm day temperatures, while water available through run-off is projected to decrease. Most major crops are projected to see increases in average yields, although projections of crop yield are highly uncertain and this assumes adequate water for irrigation. Europe is an exporter of wheat and maize and an importer of all four major crops; this links climate impacts in the Americas and Asia in particular, to Europe. Some regions are projected to see a decrease in the frequency of river flooding but other areas, such as the UK, show projected increases.

2 Middle East and North Africa

Parts of North Africa are already water stressed and the region around the Mediterranean is projected to see some of the largest increases in the number of drought days and decreases in average annual water run-off. In addition the warmest days are projected to become warmer in this already hot climate. The Middle East and North Africa is a major import region for wheat, maize and rice, linking it to the impacts of climate change in the major production regions of these crops; mainly North America, but also South America, Russia, Australia and northern Europe.

3 Sub-Saharan Africa

Extremely large relative population increases are projected in Sub-Saharan Africa along with decreases in average annual water run-off. This will increase pressure on the demand for food and water, when most of the region already suffers from high levels of food insecurity and water stress. Governance issues across Sub-Saharan Africa are highlighted by the number of countries in the region scoring highly on the Fragile States Index between 2005 and 2013. The temperature of the warmest days, the number of days in drought and the frequency of flood events are all projected to increase across the region.

4 South Asia

South Asia is an area with very high population density, and continued population growth will increase the demand for food and water resources in an already water stressed and food insecure region. Average yields of wheat and maize are both projected to decrease, while for rice, a major export crop for the region, there is a small increase, although the range spans from 16% decrease to 19% increase in average yield. The frequency of inland flood events is projected to increase, and as the region is exposed to tropical cyclones, this along with rising sea levels could mean millions more people flooded per year along the coasts.

5 East Asia

The East Asia region imports a high proportion of wheat, maize and soybeans, with over 40% of the world's soybeans imported by China to meet a growing demand for animal feed. This links the region to climate impacts in the major production and export regions of these crops, primarily the Americas. The frequency of flood events is projected to increase. The region is exposed to tropical cyclones, and the high coastal population means rising sea levels have the potential to affect millions of people. Increasing sea temperatures and ocean acidification may also threaten the important fishing industry in the region.

6 Southeast Asia

Southeast Asia is a densely populated region already exposed to coastal flooding and storms. With projected population increases and rising sea levels, this exposure is projected to increase considerably. The frequency of inland flooding events is also projected to increase. Warmer sea surface temperatures and ocean acidification may threaten fish stocks in this major fishing region. The region is important for rice exports and is a major producer of maize. While there are projections of a slight increase in average rice yield, maize yield is projected to decrease. This also does not account for increasing water demand for irrigation, decreasing water run-off, increases in drought days and the effect of storms.

7 Australasia

Australia has low population density and a high level of self sufficiency for food. However, it is also a major exporter of wheat, with mixed and uncertain projections in the change in average yield, which themselves depend on an adequate supply of water for irrigation. Demand for irrigation is projected to increase and large increases in the number of drought days and temperature of the warmest days are projected, while water available through run-off is projected to decrease.

8 North America

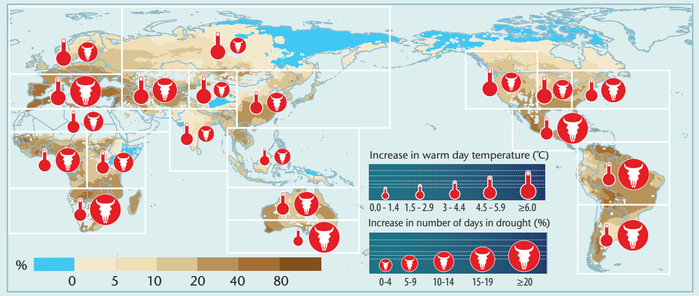
North America is an extremely important region for crop production; it is the primary source of wheat, maize and soybean exports to the world market, and the second largest exporter of rice after Asia. Projections of crop yield changes are highly uncertain, although in this region show some increases in yield for wheat, soybean and rice, but decreases in maize yield. These changes assume a sufficient supply of water for irrigation, as the agricultural demand increases. The number of days in drought is projected to increase, as is the temperature of the warmest days, while projections of changes in flooding are more mixed.

9 South America

South America is an important region for crop production, particularly for maize and soybeans. Brazil and northern South America have projections for decreases in yield of both these crops, as well as wheat, while more southern regions have a slight projected increase. However, the region is projected to experience reductions in water run-off, increases in the number of drought days and higher temperatures, combined with increases in demand for water for irrigation.

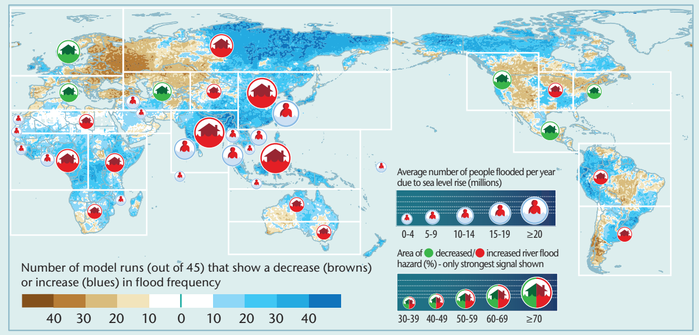
For further information go to: www.metoffice.gov.uk/human-dynamics

Future change in days in drought and change in temperature of warmest days



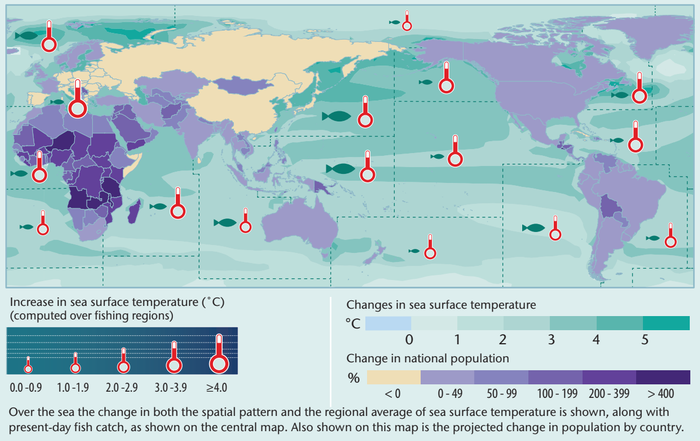
The background spatial pattern and the drought icons show the change in the number of days in drought, where drought means a large shortfall in water run-off compared to the average for the time of year. Also included in this map is the change in the temperature of the warmest days of the year.

Future change in flood frequency and annual number of people affected by coastal flooding



The flood icons show the percentage of the area within a region that is projected to have an increase or decrease in flood frequency, while the background spatial pattern shows the level of confidence across the models in this change (increase or decrease). Also shown are the average numbers of people projected to be affected by coastal flooding, assuming no additional adaptation, for a selection of the worst affected countries.

Future change in sea surface temperature and population change by country



Over the sea the change in both the spatial pattern and the regional average of sea surface temperature is shown, along with present-day fish catch, as shown on the central map. Also shown on this map is the projected change in population by country.

Projections of changes in drought, flooding and high temperatures shown here highlight the importance of considering not just the mean climate, but also variability and extreme events.