Human dynamics of climate change – Q & A

Q1. What does the map show?

A1. The poster illustrates some of the impacts of climate and population change in the context of a globalised world. There are two types of information included in the poster — present-day human dynamics, and projected future changes in climate and population between a present-day (1981—2010) baseline and the end of the 21st century (2071—2100).

The present-day dynamics information includes population density, water stress, countries that have appeared in the top ten of the Fund For Peace's Fragile States Index (2005—2013), ports, airports, maritime choke points, shipping routes, fish catch volumes, tropical cyclone regions and the location of major glaciers. In addition, information on the top five importers and exporters of four important agricultural commodities (wheat, maize, soybean and rice) are shown.

The climate impact projections include information on change in the average annual wheat, maize, soybean and rice yield, and are shown for the largest producing regions (regions that produce more than 1% of the present-day (year 2000) global total). Also shown are changes in surface and sub-surface water run-off (water flowing into rivers), changes in the demand for water for irrigation, the increased temperature of the warmest days, changes in the number of days in drought, changes in flood frequency, the number of people flooded in coastal regions due to sea level rise and sea surface temperature change.

Q2. Can you explain the different scenarios that have been used in this project?

A2. This project summarises the results on climate impacts for a number of the latest climate model simulations. It also outlines the geography of present day human activity, to give context to these impacts. All the climate impact projections shown are for the change from the present day climate (1981-2010), to the end of the century (2071-2100), assuming greenhouse gas concentrations in the atmosphere equivalent to a 'business as usual' scenario (RCP 8.5). The population projections shown are for 2085, following a 'middle of the road' socio-economic scenario (SSP2).

Each of the maps of future change look at a different aspect of climate impacts, but are consistent with each other, and a single future climatatology.

Q3. There have been many maps that have been published following the IPCC's latest report. What's special/new/different about these maps?

A3. This project is the first attempt to synthesis a coherent picture of climate impacts from the latest climate model and climate impact model runs. The projections have been produced by combining the results from some of the latest computer models of the global climate with models of climate impacts. The climate models used were a sub-set of five of those used in the most recent IPCC report (IPCC AR5). The climate impacts models have been driven by all, or a selection, of these five climate models and are those included in the Inter-Sectorial Impact Model Intercomparison Project (ISI_MIP) database (corordinated by the Postdam Institute for Climate Impact Research); also used in the IPCC AR5 reports.

The result is a consistent and systematic analysis of the latest climate impacts projections, summarised to form a coherent picture of the affects of future climate change on human activity, if we continue unmitigated emission of greenhouse gases into the atmosphere.

Q4. What is different about these maps from the 4 Degree map, published previously in 2009?

A4. The 4 Degree map also highlighted the potential range of impacts that could result from unmitigated climate change. However, the Human dynamics of climate change map differs from this information in a number of ways.
The 4 Degree map analysed impacts for a pre-defined level of climate change (4ºC of warming over the pre-industrial climate), without looking at a specific time period. All the impacts models used for the 4 Degree map were driven by a single climate model (HadCM3), although more than one run of this model was used, to better understand the range of projections consistent with this model. Each impact shown on the 4 degree map is the projection from an impact model driven by the Global Climate Model.

In this new project, the impacts are analysed at the end of the century, irrespective of the levels of warming in the driving climate models, for a single greenhouse gas concentration pathway (the 'business as usual' concentration pathway known as RCP8.5). The impacts data in the Human dynamics of climate change map come from an ensemble of impacts models, each driven by a sub-set of five Global Climate Models (GCMs) used in the most recent IPCC report (AR5). This means that a range of projections across both climate models and impacts models is accounted for, rather than just the range across a single model.

Finally the Human dynamics of climate change map also includes information about present-day human activity, to allow the viewer to understand the context in which the changes shown will occur.

Q5. How were the maps generated, from what data and are they robust?

A5. The maps were generated from climate projections from some of the latest computer models of the global climate driving a set of the most up-to-date climate impact models. The climate models used were a sub-set of five of those used in the most recent Intergovernmental Panel on Climate Change analysis (IPCC AR5). The climate impacts models have been driven by all, or a selection, of these five climate models and are those included in the Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP) database (coordinated by the Potsdam Institute for Climate Impact Research); also used in the IPCC AR5 reports.

By studying the range of projections generated from several climate models and several impacts models we are able to better understand which features of the future projections are most robust, and can provide an indication of the uncertainty in the results. This is reflected in the ranges in the impacts shown in the supplementary material (where you can find the median values and inter-quartile ranges for the icons on the maps); for some impacts, model projections disagree on even the direction (increase or decrease) of change.

Q6. How did you decide what climate information to use?

A6. The climate information used in this map was chosen for two main reasons. Firstly, it combines the results from some of the latest computer models of the global climate with models of specific impacts, analysed to systematically sample uncertainty across the model projections and subject to rigorous peer review. Secondly, the data represents a coherent picture of future climate. This means that all the impacts shown could plausibly occur together and are consistent with a single future world.

Q7. Why are the impacts averaged over large regions?

A7. The data from the climate and impacts models is extremely complex and so averaging allows us to see the underlying patterns, and to more easily aggregate different impacts across similar regions. In order to make global comparisons it is necessary to look over large areas. It would be possible to look at specific regions in more detail from this data, but that would make it very difficult to include on a single global map. However, the spatial pattern of the impact is shown underneath the averaged values represented by the icons, so it is already possible to discern more detailed local variability.

Q8. How can I tell what this will mean for my area?

A8. To see what these impacts mean for your area, we recommend you start with the central present-day map to get an idea about local factors that may be important to understanding the impact of climate change, such as population density, present-day water stress, important infrastructure and trade links with other regions. Then look at each of the future climate change maps around the edges, to see the projections for future changes in climate and population. For some regions there are example case studies of how the impacts could interact with present-day activity.

Q9. Is there a particular reason why the map is centred on the Pacific?

A9. There is not significance to the fact that the map is centred on the Pacific, although it was beneficial in design terms, as it allowed space on the map itself to include keys, where appropriate.

Q10. What does this map tell us about future climate change?

A10. This map shows us the scale of climate impacts from the latest climate projections that could occur under a 'business as usual' greenhouse gas concentration scenario by the end of the century. This represents the levels of climate change that would occur if mitigation action is not undertaken.

The information on run-off, tells us something about how the water available for use from rainfall may change over time. The change in water demand for irrigation highlights how, in a future, warmer climate, crops will need more water. The change in average crop yields show areas of present day crop production and summarises the average change in yield from change in climate alone, assuming that irrigated crops continue to recieve suffient water. The maps of drought and high temperature show that nearly all areas will see the warmest days becoming warmer, and the incidence of drought increasing. The flooding map indicates how a changing climate will affect the pattern of inland flooding, as well as highlighting the coastal communities where climate change has the potential to have the most effect on coastal flooding. Changes in sea surface temperature are shown alongside informaton about present-day fish catch volumes, as changes in sea temperature, along with acidification of the ocean, could have a large impact on marine ecosystems and therefore fish stocks. All these changes will occur in the context of changing human activity, and the projections of population change linked to this climate change scenario are also shown.

Q11. What does the map tell us about crop yields and food security?

A11. This map shows the change in average annual yield for four of the major traded crops. 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 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.

Q12. Flood risk across Europe is projected to significantly decrease, but yet the UK has experienced, and is expected to experience, more high-impact flooding in future. Why does this map contradict the evidence elsewhere?

A12. The map shows the change in flood frequency, and the icons show the percentage of the area that will experience an increase or decrease in the frequency of, what is in the present climate, a 1 in 30 year flood event. The projections indicate that around 60-76% of Europe will see a decrease in flood frequency. However, if you look at the spatial map in the background that shows which areas will see an increase or decrease, the UK is projected to have an increase in the frequency of flooding in the future.

Q13. The choke points represent the millions of barrels of oil per day, how is this relevant to the other factors on the map?

A13. Maritime choke points are shown on the map as these are fixed locations of high maritime traffic. The measure used is barrels of oil per day, as the most reliable measure of the traffic levels available. This is shown on the map to provide context to the future climate changes. Maritime shipping routes are an important component of global trade, and changes in climate affecting regions where shipping is concentrated could have important consequences globally.

Q14. The map shows present day fish catch and the main fishing regions, but there are no projections for what this looks like in the future. Why?

A14. The response of marine ecosystems and fish stocks to changes in temperature and ocean acidification are extremely complex, and we do not have reliable projections of these changes. However, the consequences for global food security and ecosystem services of these changes could be very large. The map highlights those ocean regions most important for the global fishing industry, and shows the levels of changes in temperature that are projected there. Although we do not have projections of how this will affect fish stocks, it is important to be aware of the potential for severe adverse impacts.

Q15. How are the melting glaciers relevant to human security? They haven't been mentioned on the map in much detail.

A15. The locations of glaciers are marked on the map because for some communities these are an important component of their overall water security. Although the relationship between glaciers and access to water is complex and different in different locations, it is part of the water security system for many regions, and so is included here, to highlight the combined impacts of melting glaciers and changes in run-off, both of which have the potential to impact on local water availability.

Q16. Why are there so many regions with increases in crop yield, when the IPCC says that climate change will threaten food security? Does this mean there isn't a problem?

A16. This map shows the change in average annual yield for four of the major traded crops, in regions that produce 1% or more of the global total yield. 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, in line with the IPCC AR5 report conclusions. The changes in average yield 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-to-year variability as a result of the projected increases in drought, high temperatures, and in many places, flooding.

Q17. Does the map on "change in water demand for irrigation" factor in the change in water run-off.

A17. Each of the impacts shown is independent of the other changes. So the change in water demand is only a result of an increase in the requirement for water from crops growing in a warmer climate. It also does not include changes in cultivation, either from adaptation to climate, or as a result of a larger population. The average crop yield projections assume that if crops are currently irrigated then they obtain sufficient water from irrigation throughout the model run, but in reality, the increase in the amount of water they will need, combined with changes in run-off and greater demand for water from a larger population, may mean that this is not always achieved.

Q18. Does the increase in warmer days influence water demand in the map "Days of drought"?

A18. The impacts shown are all consistent with each other. The warmer climate is part of the reason why the demand for water for irrigation increases. In this same climate the number of days in drought increases by the amounts shown. Although it may not be exactly correct to say the impacts 'influence' each other, they are all driven by the same changes in climate and represent the different aspects of that change.