Climate: Observations, projections and impacts

In April 2011, UK Secretary of State for Energy and Climate Change requested information on the observations, projections and impacts of climate change for more than 20 countries.

Reports for each country, provide up-to-date science on how the climate has already changed and the potential consequences of future changes.

Complement to IPCC and national studies.
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Argentina, Australia, Bangladesh, Brazil, Canada, China, Egypt, France, Germany, India, Indonesia, Italy, Japan, Kenya, Mexico, Peru, Russia, Saudi Arabia, South Africa, South Korea, Spain, Turkey, United Kingdom, United States.
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Each report contains:

- An explanation of the key features of national weather and climate, including extreme events.
- An assessment of how the probability of particular seasonal temperatures has altered.
- Projections of future climate conditions.
- The potential impacts of climate change, based on results from a in depth literature review, the UK’s Avoiding Dangerous Climate Change programme (AVOID).
Assessments mostly based on global studies and don’t account for adaptation.

Looked at range of impacts, which included:

- Crop yield
- Food security
- Water stress and drought
- Flooding (pluvial and fluvial)
- Tropical cyclones
- Coastal regions

Some impacts were considered but not included e.g. human health impacts

A limit of 2 °C global average warming substantially reduces many of the impacts
Observations and Attribution Assessments

Peter Stott, 5 December 2011
Develop picture of:

• what weather and climate means in each of the 23 countries
• estimates of trends and extremes
• the contribution of climate change to seasonal temperatures

Extreme weather events such as European heatwave of 2003

New estimates of trends in climate extremes

Estimates of change of seasonal temperatures attributable to human influence
Temperatures are changing globally

Temperature trends from 1960-2010 for the June-July-August seasonal average
Warming is unequivocal
Other signs consistent with a warming world

**INCREASING** – Observations consistent with a warming world

- Tropospheric temperature: 7 datasets
- Sea-level: 6 datasets
- Land-surface air temperature: 4 datasets
- Specific humidity: 3 datasets
- Sea-surface temperature: 6 datasets
Changing extreme temperatures in a warming climate

- Past temperature

(After IPCC 2007 & Karl et al. 2008)

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Example: Australia
Increase in frequency of warm nights
Widespread increases in frequency of warm nights and reductions in frequency of cool nights
Decrease in frequency of cool days

Example 1: European Russia

Example 2: China
Widespread increases in frequency of warm days and reductions in frequency of cool days
Precipitation changes are mixed

“There is medium confidence that anthropogenic influences have contributed to intensification of extreme precipitation on the global scale.”

(IPCC SREX, 2011)
Precipitation changes are mixed even within countries

Example 1: Australia

Example 2: South America
Example 1: South Africa

Increases in length of dry spells at some locations

Example 2: Mexico
• Widespread increases in frequency of warm days and nights
• Widespread decreases in frequency of cool days and nights
• Precipitation changes are mixed
• Increases in length of dry spells at some locations
How much more or less likely has an extreme season become due to the influence of human-driven emissions?

Compare:

- Models of the climate including both natural and human influences
- With models of the climate including only natural influences on climate
Summer heatwaves, France

Heatwaves in 2003 & 2006
• Widespread human induced warming has led to increases in probability of extremely warm regional seasonal temperatures

• Widespread reductions in probability of extremely cold regional seasonal temperatures

• Cold winters still occur but with generally decreased frequency
Key findings

• The world has warmed by almost 0.8°C since pre-industrial times and multiple indicators, not just the surface temperature record, show that it continues to warm.

• There have been widespread increases in frequency of warm days and nights and widespread decreases in frequency of cool days and nights.

• Human induced warming has led to widespread increases in the probability of extremely warm seasonal temperatures and reductions in the probability of extremely cold seasonal temperatures.

• Rainfall changes differ from region to region.
Climate Change Impact Assessment

Richard Jones, 5\textsuperscript{th} December 2011
Our approach

• Assessment of global impact studies combining scientific literature published since the IPCC Fourth Assessment with new climate research.

• Coordinated, consistent, systematic global approach allows a level of comparison between countries, while presenting results on a meaningful scale.

• Sectors include:
  ➢ Fluvial flooding
  ➢ Water stress and drought
  ➢ Crops
  ➢ Coastal regions
  ➢ Food security
  ➢ Tropical cyclones
  ➢ Pluvial flooding and rainfall
Temperature is projected to increase but amount varies with location.

Precipitation is projected to increase at some locations, decrease in others. Range of estimates from different climate models is still large.
Flood risk – rivers and rain

Impact measured as a change in an indicator of flood risk

People exposed to flood damage as a result of changing flood frequency
Many countries may experience large percentage increase in flood risk; small reductions in flood risk can’t be ruled out.

This complex picture of change is expected given the wide spread in rainfall projections.
Example - UK:
future change in flood risk

- Impact in unmitigated scenario increases through 21st century
- Mitigation avoids some of the impacts
Example - UK: future change in flood risk

- Impact in unmitigated scenario increases through 21st century
- Mitigation avoids some of the impacts
Water stress

Population experiencing increases or decreases in water stress

People becoming stressed plus those already stressed that become more stressed or the opposite
Many countries considered had some potential for an increase in water stress. 

However, some countries also see a decrease in water stress in some regions.
Some countries also see a decrease in water stress in some regions.
Example - India: future change in water stress

Because of regional differences it is not appropriate to simply combine the results for increased and decreased water stress.
Crop suitability

Area of cropped land becoming less or more suitable for crops

Measure takes account of temperature, moisture availability, topography and soil properties
The majority of countries may experience a decrease in the area suitable for growing crops. However, some countries also see an improvement in crop suitability.
Some countries also see an improvement in crop suitability
Example - China:
future change in crop suitability

Area Decline in Crop Suitability - China

Area with decline in suitability increases throughout century

Area Improvement in Crop Suitability - China

Improvements level out earlier in the century
Coastal flooding

Additional people at risk of coastal flooding in a given year

People living in coastal regions affected by rising sea levels
Coastal flooding impacts appear to be dominated by those in three countries.
Coastal flooding impacts appear to be dominated by those in three countries

But for many countries coastal flooding will be a potentially important consequence of climate change
Key findings

- Countries across the world are projected to experience detrimental impacts from climate change.
- Some countries may see some beneficial impacts.
- In many sectors impacts are projected to grow through the century for unmitigated emissions.
- In some cases much of the increase may have occurred by 2050.
- In many cases reducing emissions reduces the impact.
- In most sectors there is a wide range of projected impacts.
- Adaptation planning often needs more detailed projections and requires non-climatic information.
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Would now like to explore options for taking forward assessments through international cooperation.

For the latest version of this report and to provide feedback to the project team, please see the website at:

www.metoffice.gov.uk/climate-change/policy-relevant/obs-projections-impacts