Climate Change - A summary of robust findings and key uncertainties[1]

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1 OBSERVED CHANGES

Robust findings

1. Climate is warming.
2. Many observed physical and biological changes are consistent with this warming.
3. Greenhouse gas (GHG) concentrations far exceed pre-industrial values due to anthropogenic emissions.
4. Most warming over the past 50 years is *very likely* due to anthropogenic GHG increases.
5. Anthropogenic warming over the last three decades has *likely* had a discernible influence at the global scale on observed changes in many physical and biological systems.

Key uncertainties

1. Data limited in some regions (in particular data on changes in natural and managed systems).
2. Analysis and monitoring of changes in extreme events (droughts, tropical cyclones, extreme temperatures, and the frequency and intensity of precipitation).
3. Effects of climate changes on human and some natural systems difficult to detect (due to adaptation and non-climatic drivers).
4. Understanding and attribution of observed temperature changes due to natural or human causes at smaller than continental scales (land- use change, pollution, model deficiency).
5. Magnitude of CO_2 emissions from land-use change; CH_4 emissions from individual sources.

2 FUTURE CHANGES

Robust findings

1. GHG emissions will grow in the next few decades.
2. The next two decades will have a global mean warming trend of about 0.2°C per decade.
3. Warming + induced changes in the 21st century *very likely* larger than those in the 20th century.
4. Stronger warming of land (than adjacent oceans) and northern high latitudes.
5. Positive CO_2 feedback, from land surface and ocean processes.
6. Anthropogenic warming and sea level rise would continue for centuries.
7. Equilibrium climate sensitivity is *very unlikely* to be less than 1.5°C.
8. Some systems, sectors and regions are likely to be especially affected by climate change[2].

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[1] A robust finding for climate change is defined as one that holds under a variety of approaches, methods, models and assumptions, and is expected to be relatively unaffected by uncertainties. Key uncertainties are those that, if reduced, could lead to new robust findings. Note that some findings may be policy relevant even though they are associated with large uncertainties. The present list is not exhaustive.

[2] The systems and sectors are some ecosystems (tundra, boreal forest, mountain, mediterranean-type, mangroves, salt marshes, coral reefs and the sea-ice biome), low-lying coasts, water resources in dry tropics and subtropics and in areas dependent on snow and ice melt, agriculture in low-latitude regions, and human health in areas with low adaptive capacity. The regions are the Arctic, Africa, small islands and Asian and African megadeltas. Within other regions, even those with high incomes, some people, areas and activities can be particularly at risk.

9. Impacts will *very likely* increase due to increased frequencies and intensities of extreme weather events (heat waves, tropical cyclones, flood and drought). Vulnerability stronger than thought.

Key uncertainties

1. Climate sensitivity and emission trajectory required to achieve a particular stabilisation level.
2. Strength of feedbacks (clouds, oceanic heat uptake, carbon cycle); projections of e.g. precipitation at smaller scales.
3. Effect of aerosols.
4. Sea level: Greenland and Antarctic ice sheet dynamics, heating rate of ocean interior.
5. Large scale ocean circulation changes beyond the 21st century (melt water?).
6. Projections of climate change and its impacts beyond 2050 (scenario- and model dependence).
7. Impacts research is hampered by uncertainties in regional projections of climate change, particularly precipitation.
8. Net cost of climate change.

3 RESPONSES TO CLIMATE CHANGE

Robust findings

1. More extensive adaptation is required to reduce vulnerability to climate change.
2. Unmitigated climate change would, in the long term, be *likely* to exceed the capacity of natural, managed and human systems to adapt.
3. Mitigation is possible[3].
4. To reduce risk it is better to start mitigation soon.
5. Making development more sustainable can help achieve mitigation and reduce vulnerability.
6. Decisions about macro-economic and other policies that seem unrelated to climate change can significantly affect emissions.

Key uncertainties

1. Integrated assessment of vulnerability and the use of climate information in planning process.
2. Adaptive and mitigative capacity (socioeconomic development pathways).
3. Costs of adaptation.
4. Estimates of mitigation costs range from net negative up to 100 US$/t$CO_2$-equivalent (innovation speed, lifestyle).
5. The effects of non-climate policies on emissions.

Reference

This summary is based on "Intergovernmental Panel on Climate Change, Fourth Assessment Report: Climate Change 2007: Synthesis Report" [4] . Additional information can be found at www.knmi.nl, www.ipcc.ch and www.klimaatportaal.nl.

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[3] Stabilisation at different GHG concentration levels can be achieved by deployment of a portfolio of technologies. For this to be successful barriers have to be removed and appropriate and effective incentives are necessary. In addition, further R&D would be required to improve the technical performance, reduce the costs, and achieve social acceptability of new technologies.

[4] See in particular topic6 (http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf.)