Scientists for Global Responsibility
Scientists · Architects · Engineers · Technologists

SGR
Promoting ethical science, design and technology

Climate change – why it could be worse than the IPCC projections

Dr Stuart Parkinson, Scientists for Global Responsibility (SGR)
Presentation at the Climate Forum, London, 14/06/08

Main topics

- Sea-level rising faster?
    - Sea-level rise projections from the 2007 reports of the Intergovernmental Panel on Climate Change (IPCC) do not include all the important feedbacks, especially concerning polar ice-sheet dynamics
    - New research shows sea-level rise could be much higher during the 21st century
- Conservatism within science and the IPCC
- Global warming slower in near future?
    - New research argues that global warming could be slower over next decade and then speed up afterwards
- Implications for climate campaigners

- Sea-level rise
    - Sea-level rise (at the global level) has three main components:
        - Thermal expansion due to warming of oceans
        - Meltwater from glaciers (and other ice at low latitudes)
        - Meltwater from polar ice-sheets, especially Greenland and West Antarctica
    - Observed sea-level rise to date (IPCC WGI, 2007):
        - 20th century: ~17cm
        - 1961-2003: average 1.8mm/y
        - 1993-2003: average 3.1mm/y
    - Projected sea-level rise (IPCC WGI, 2007):
        - range: 18-59cm this century
        - upper estimate is significantly less than 88cm in IPCC WGI (2001)
    - Many non-linear effects excluded from this estimate because of uncertainty in ice-sheet dynamics – so it is very likely that the range will be revised back upwards
    - Paleoclimate record contains numerous examples of ice-sheets yielding a sea level rise of **several meters per century**, with heat input smaller than that of the business-as-usual scenarios for 21st century (Hansen, 2007)
    - Examples of sea level changes in the past (Houghton, 2004):
        - About 120,000 years ago – during the last warm (inter-glacial) period when global temperature was a couple of degrees higher – sea level was 5-6m higher than today due to melting of polar ice-sheets

        - About 18,000 years ago – during the coldest part of the last ice-age – sea level was over 100m lower than today due to expansion of polar ice-sheets
    - Paleoclimate ice sheet models used in IPCC assessment did not generally include important factors (Hansen, 2007), e.g.:
        - effects of surface melt descending through crevasses and lubricating flow at the base of the ice-sheet;
        - the physics of ice streams;
        - realistic interactions with the ocean.
    - Rahmstorf (2007) estimates that a linear projection based on observed sea-level rise during the last century gives a further **0.5m to 1.4m rise** by 2100 – but this does not include significant disintegration of ice-sheets.
    - Moore et al (2008) constructed a new ocean model, including updated understanding of ice-sheet dynamics, which accurately reproduces sea-level changes over the past 300 years. Forward projections give estimate of **0.8m to 1.5m** during this century.
    - Contribution to sea-level rise of ice-sheet disintegration has doubled in the past decade to 1 mm/y (Hansen, 2007)
    - Hansen (2007) argues rapid increases in ice-sheet disintegration are much more likely than linear changes and hence a **multi-metre rise** in sea-level this century is more likely
    - Important to remember that due to inertia in the climate system, sea-level rise continues for **centuries to millennia** even after forcings stop
- Potential impacts of sea-level rise (Houghton, 2004: 150-155)
    - Currently, about half the world's population lives in coastal areas
    - China: sea level rise of 0.5m would inundate 40,000km2 on eastern coast where 30 million people currently live
    - Bangladesh: sea level rise of 1m would flood area where 15 million people currently live – land subsidence is projected to add an extra 1.2m by 2100 – so total rise could be ~2.5m
    - Egypt: sea level rise of 1m would flood area where 7 million people currently live – land subsidence is similar to Bangladesh
    - Small island states: whole land area almost entirely below 3m – but inundation of land, increased flood risk and groundwater salination likely to make them uninhabitable well before reaching that level

- Conservatism within science and the IPCC
    - Hansen (2007) argues there can be significant negative consequences for scientists who give early warnings that threaten a powerful interest group, e.g. loss of research funding. However, with many aspects of the climate problem early warnings (while science still has high uncertainties) are essential to give enough time to act.
    - IPCC process is inherently conservative. For example, the executive summaries have to be approved by scientific representatives of all its over 100 member nations – including the sceptical USA and Saudi Arabia. Evidence has to be uncontroversial to make it through that stage.

- Global warming could be slower over next decade

    - Natural variation in ocean currents (Keenlyside et al, 2008)
        - Atlantic Multidecadal Oscillation (AMO) – 60-70y cycle
        - Weakening of ocean current likely to lead to cooler North Atlantic, leading to less surface warming overall
        - Problem is that in the decade following, the warming could be faster
    - Sun entering a quieter period of activity

- Implications for campaigners
    - Need to continue to point out key uncertainties mean impacts could be a lot worse than implied by current IPCC projections
    - Need to be prepared for greater resistance from policy-makers and public in the short-term to action on climate due to perceptions that it might not be so bad

References

Hansen J (2007). Scientific reticence and sea level rise. Environmental Research Letters, Vol. 2, No. 2, April-June. (024002) http://www.iop.org/EJ/article/1748-9326/2/2/024002/erl7_2_024002.html

Houghton J (2004). Global Warming: the complete briefing. Cambridge University Press.

IPCC WGI (2001). Climate Change 2001: the scientific basis. (Summary for policy-markers.) Working Group I of the Intergovernmental Panel on Climate Change. http://www.ipcc.ch/pub/spm22-01.pdf

IPCC WGI (2007). Climate Change 2007: The physical science basis. (Summary for policy-markers.) Working Group I of the Intergovernmental Panel on Climate Change. http://www.ipcc.ch/WG1_SPM_17Apr07.pdf

Keenlyside N et al (2008). Advancing decadal-scale climate prediction in the North Atlantic sector. Nature, vol. 453, pp.84-88.

Moore JC, Grinsted A, Jevrejeva S (2008). Reconstructing sea level from paleo and projected temperatures 100 to 2100AD. Paper no. EGU2008-A-02559. Presented at the General Assembly of the European Geosciences Union, Vienna, April 13-18. http://meetings.copernicus.org/egu2008/

Rahmstorf S (2007). A semi-empirical approach to projecting future sea-level rise. Science, vol. 315, p368-370.