Climate change and global risk: implications of latest climate change science

Dave Frame
Climate Change Research Institute
Victoria University of Wellington
CO₂ concentrations
Radiative Forcing

Radiative forcing of climate between 1750 and 2011

Forcing agent

- Well Mixed Greenhouse Gases
  - CO₂
  - Halocarbons
  - Other WMGHG
  - CH₄
  - N₂O

- Ozone
  - Stratospheric
  - Tropospheric

- Stratospheric water vapour from CH₄

- Surface Albedo
  - Land Use
  - Black carbon on snow

- Contrails
  - Contrail induced cirrus

- Aerosol-Radiation Interac.

- Aerosol-Cloud Interac.

- Total anthropogenic

- Solar irradiance

Radiative Forcing [W m⁻²]

Figure 8.15: Bar chart for RF (hatched) and ERF (solid) for the period 1750–2011, where the total ERF is derived from Figure 8.16. Uncertainties (5–95% confidence range) are given for RF (dotted lines) and ERF (solid lines).
Figure 9.43: a) Strengths of individual feedbacks for CMIP3 and CMIP5 models (left and right columns of symbols) for Planck (P), water vapour (WV), clouds (C), albedo (A), lapse rate (LR), combination of water vapour and lapse rate (WV+LR), and sum of all feedbacks except Planck (ALL), from Soden and Held (2006) and (Vial et al., 2013), following Soden et al (2008). CMIP5 feedbacks are derived from CMIP5 simulations for abrupt four-fold increases in CO$_2$ concentrations (4 × CO$_2$). b) ECS obtained using regression techniques by Andrews et al. (2012) against ECS estimated from the ratio of CO$_2$ ERF to the sum of all feedbacks. The CO$_2$ ERF is one-half the 4 × CO$_2$ forcings from Andrews et al. (2012), and the total feedback (ALL + Planck) is from (Vial et al., 2013).
Global mean surface temperatures
Total emissions determine warming
New ways of looking at the problem: Time of emergence
New ways of looking at the problem:
Time of emergence
New ways of looking at the problem: Time of emergence

Tropics

Storm Tracks
New ways of looking at the problem:
Time of emergence
Climate science summary

• The world has a large problem which has looked the same (pretty much) for 25 years.
• It’s probably the most investigated topic in earth sciences in the last quarter century
• We have a good handle on it
• And we are learning more, and creating new policy-relevant products

• Expected global costs outweigh expected global benefits on virtually all analyses where global temperatures rise a few degrees or more
Climate policy

- To stop the warming we have to get net emissions of CO$_2$ to zero.
- Inevitably, this means a focus, first and foremost, on CO$_2$ emissions.
- “By making it clear how rapidly emissions have to decline to satisfy temperature targets, scientists are reducing the scope for the organised display of cognitive dissonance between short-term actions and long-term goals that has too often characterised climate policy.”
- Climate policy is inevitably about a transition away from CO$_2$-emitting technologies.
Global public goods can be excellent investments

“The eradication of smallpox is very likely the greatest collective investment the world has ever made.”

But they are hard to realise.
International relations is more or less a “self-help” system
Types of public goods (Barrett, after Hirshleifer)

- Easier
  - Best Shot
- Harder
  - Weakest Link
  - Summation
Climate “Risk”

This is amenable to multiple interpretations
- Standard, moderate public policy problem
- Significant and serious problem
- Catastrophic threat
Potential disruptions to the linear picture

<table>
<thead>
<tr>
<th>Change in climate system component</th>
<th>Potentially abrupt (AR5 definition)</th>
<th>Irreversibility if forcing reversed</th>
<th>Projected likelihood of 21st century change in scenarios considered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlantic MOC collapse</td>
<td>Yes</td>
<td>Unknown</td>
<td>Very unlikely that the AMOC will undergo a rapid transition (high confidence)</td>
</tr>
<tr>
<td>Ice sheet collapse</td>
<td>No</td>
<td>Irreversible for millennia</td>
<td>Exceptionally unlikely that either Greenland or West Antarctic ice sheets will suffer near-complete disintegration (high confidence)</td>
</tr>
<tr>
<td>Permafrost carbon release</td>
<td>No</td>
<td>Irreversible for millennia</td>
<td>Possible that permafrost will become a net source of atmospheric greenhouse gases (low confidence)</td>
</tr>
<tr>
<td>Clathrate methane release</td>
<td>Yes</td>
<td>Irreversible for millennia</td>
<td>Very unlikely that methane from clathrates will undergo catastrophic release (high confidence)</td>
</tr>
<tr>
<td>Tropical forests dieback</td>
<td>Yes</td>
<td>Reversible within centuries</td>
<td>Low confidence in projections of the collapse of large areas of tropical forest</td>
</tr>
<tr>
<td>Boreal forests dieback</td>
<td>Yes</td>
<td>Reversible within centuries</td>
<td>Low confidence in projections of the collapse of large areas of boreal forest</td>
</tr>
<tr>
<td>Disappearance of summer Arctic sea ice</td>
<td>Yes</td>
<td>Reversible within years to decades</td>
<td>Likely that the Arctic Ocean becomes nearly ice-free in September before mid-century under high forcing scenarios such as RCP8.5 (medium confidence)</td>
</tr>
<tr>
<td>Long-term droughts</td>
<td>Yes</td>
<td>Reversible within years to decades</td>
<td>Low confidence in projections of changes in the frequency and duration of megadroughts</td>
</tr>
<tr>
<td>Monsoonal circulation</td>
<td>Yes</td>
<td>Reversible within years to decades</td>
<td>Low confidence in projections of a collapse in monsoon circulations</td>
</tr>
</tbody>
</table>
A circle of sorts

Governments

IPCC report

Free-riding framing

Moralist framing

It’s worse than that!