

CLIMATE CHANGE: SOONER, HARDER, FASTER AND LESS PREDICTABLE

Summary of the IPCC, AR5, WG1 Released in Stockholm, September 2013

The release of the latest Intergovernmental Panel on Climate Change Report (IPCC AR5) has confirmed that climate change is happening and is driven by human emissions. It warns that already experienced climate impacts are worse than predicted and more destructive changes will be wrought at lower temperatures than first thought. It sounds a warning of a planetary emergency where we are on track for extremely dangerous temperature rise, compounded by the catastrophic risk of passing irreversible tipping points sooner than initially projected. The science is clear that to “limit climate change” the world must embark on “substantial and sustained reductions” of greenhouse gas emissions to fit within an ‘emissions budget’ since 1750. It warns against meeting this budget by risking ‘geoengineering.’

Climate change is happening and is driven by human emissions

The IPCC confirms “it is extremely likely that human influence on climate caused more than half of the observed increase in global average surface temperature from 1951–2010.”

It also confirms that “each of the last three decades has been warmer than all preceding decades since 1850 and the first decade of the 21st century has been the warmest.”

The report continues that “there is high confidence that this has warmed the ocean, melted snow and ice, raised global mean sea level, and changed some climate extremes, in the second half of the 20th century.”

It finds that the 40% increase in CO₂ in the atmosphere since 1750 is a result of human activity “virtually all due to burning of fossil fuels and deforestation, and a small contribution from cement production.”

Already experienced impacts are worsening

The report paints a terrifying picture of the changes already impacting our world with:

- It likely that the frequency of heatwaves has increased;
- It likely that the frequency and severity of heavy storms has increased;
- Very high confidence that glaciers have continued to shrink and lose mass world-wide, with human emissions the likely cause;
- Medium confidence that summer sea ice retreat in the Arctic is unique for at least the last 2000 years with human emissions the very likely cause;
- It virtually certain that sea level rise has accelerated over the last two centuries, with .2m of a rise since 1910 alone, with human emissions a very likely cause;
- It very likely that ocean acidification, leading to the PH of seawater decreasing by 0.1, has been driven by human emissions of CO₂;
- It likely that human emissions have caused the shrinking of the Greenland and Antarctic Ice Sheets in the last two decades, with the rate of loss increasing five-fold over that period.

Probabilities

Note that in the IPCC the following terms mean:

Term	Likelihood of the Outcome
Virtually Certain	99-100%
Extremely Likely	95-100%
Very Likely	90-100%
Likely	66-100%
About as likely as not	33-66%
Unlikely	0-33%
Very unlikely	0-10%

We are on track for extremely dangerous temperature rise

AR5 projects that climate sensitivity, or the temperature rise caused by doubling the amount of CO₂ in the atmosphere, is between 1.5C and 4.5C – but we are currently on track to triple or quadruple the pre-industrial level.

The report finds that human contribution to ‘radiative forcing’, or the extra energy and therefore heat in the climate system, was 44% higher in 2011 than in 2005, illustrating how rapidly we are impacting on the system.

In their official press conference launching the report, the Co-Chair Thomas Stocker said our current emission pathway was ‘above’ those assessed in the report, suggesting temperature rise above 4.8C by the end of the century.

Therefore the IPCC concludes: “Limiting climate change would require substantial and sustained reductions of CO₂ emissions.”

More destructive changes are projected at lower temperatures

The report warns of projected impacts occurring sooner or at lower temperatures than in previous reports, and outlines extremely dangerous impacts connected to continuing temperature rise.

These include:

- There is very high confidence that the maximum global mean sea level was at least 5 m higher than present, and even as high as 10 m above present, when temperatures were not more than 2C higher than today;
- In that period the Greenland icesheet very likely contributed up to 4.3 metres of sea level rise equivalent;
- That the trend of the reduction in the Arctic sea ice extent is large or larger than earlier models, with it a nearly ice-free Arctic ocean likely before 2050 on our current emission pathway;
- There is high confidence that wet and dry seasons will become stronger, and it is likely that the area affected by monsoons will increase, but with weaker circulation and more rain;
- It is very likely that the Atlantic Meridional Overturning Circulation (AMOC) (or the "Gulf Stream") will weaken over the 21st century by as much as 44% on our current emission pathway.
- It is virtually certain that near-surface permafrost will be reduced;
- There is medium confidence that present glacier volume will be eliminated by up to 85% on our current emission pathway;
- It is virtually certain that ocean acidification will increase;
- The area of the Amazon exposed to deforesting fires is estimated to increase by 66%.

Unpredictable events could be catastrophic

The central projections of temperature rise and impacts in the IPCC may in fact be too low, as other parts of the report highlight dangerous 'tipping point' events that could cause climate change to spiral out of control. It warns generally that continued increases in emissions "would induce changes in all components if the climate system, some of which would very likely be unprecedented in hundreds to thousands of years."

Specifically it warns that:

- On our current pathway, additional emissions from the thawing of the permafrost alone could be equivalent to a quarter of all human emissions in all of history (250PgC), and up to 0.6C of warming;
- Larger sea level rise could result from sustained mass loss by ice sheets, and some part of the mass loss might be irreversible. The available evidence indicates that sustained warming greater than a certain 8 threshold (which is less than 4C) above preindustrial would lead to the near-complete loss of the Greenland Ice Sheet over millennium or more, causing a global mean sea level rise of up to 7 m.
- Even further loss of marine-based sectors of the Antarctic Ice sheet could cause sea level rise "substantially above" the projected range;

The dangers of 'geoengineering'

AR5 outlines many of the risks of 'geoengineering'. Geoengineering is the large scale technological interference with natural systems by humans, and its risk include:

- That solar radiation (SRM) methods would modify the global water cycle, and would not compensate for ocean acidification and if terminated there is high confidence that global surface temperatures would rise very rapidly;
- These geoengineering methods carry side effects and long-term consequences on a global scale.

The uncertainties of climate change are not in our favour

The IPCC report details how many uncertainties around climate science have been reduced. However, there remain uncertainties that are deeply concerning, because they imply things could be worse – and maybe much worse – than currently expected.

It outlines a whole range of uncertainties relating to tipping points and feedbacks, where, for example we still don't know exactly how much impact the melting of the permafrost will have and how rapidly it will accelerate with continued warming.

Some are interpreting as a sliver of good news that the “climate sensitivity” may be lower than expected - it may be that higher concentrations of CO₂e (that is more emissions) are required to increase global average temperatures. However, this does not consider the role of feedbacks, nor is it much comfort when impacts such as sea level rise are worsening at lower temperatures and we are on track for catastrophic impacts due to our dangerously high emissions even if the lower sensitivity estimate is correct. A recent scientific paper by former NASA scientist James Hansen, estimates that if tipping-points are included climate sensitivity is likely to be higher than 3-4C.

The one take away message from AR5 is:

- “Limiting climate change would require substantial and sustained reductions of CO₂ emissions.”

An ‘emissions budget’ for humanity

AR5 shows the importance of historical emissions to the planetary emergency. It outlines a total ‘emissions budget’ or emissions over time that humanity can release to limit warming to a target such as 2C. It suggests that:

- Cumulative CO₂ emissions from all anthropogenic sources would need to be limited to about 1000 PgC since the beginning of the industrial era to the end of human history in order to limit warming to less than 2C (with a 66% probability).
- Already 53% of this budget had been emitted by 2011;
- On current annual emissions we would have only 19 years before exceeding the budget;
- The size of the budget will be smaller if a safer temperature target, such as 1.5C is adopted, indicating that an even greater share has been consumed by historical emissions.

The UN climate negotiations must now find a way to share this budget, and the effort to remain within it, fairly across time and going forward.

Figure SPM.1 [FIGURE SUBJECT TO FINAL COPYEDIT]

