How to understand 1.5°C climate science

Questions of the IPCC 1.5°C report

Introduction

In October this year, the Intergovernmental Panel on Climate Change (IPCC) will release a special report on the impacts of global warming of 1.5°C and emission pathways to achieve this goal.

The 2015 Paris climate policy-making conference (COP21) set a goal of limiting the global average temperature increase to "well below 2°C above pre-industrial levels and to pursue efforts to limit the increase to 1.5°C". The 1.5°C was included as a COP outcome for the first time to pacify growing anger from the small-island states and least-developed countries about the low ambition of the international policy-making process. COP21 requested the IPCC to report on how to achieve the goal.

The *Paris Agreement* was a political fix in which grand words masked inadequate deeds. The UN Environment Program says that current pledges from governments represent only about half of what would be required to avoid a 2°C temperature rise, and just one third of what's required to limit warming to 1.5°C.

The voluntary emission reduction commitments made by nations since Paris put the world on a path of more than 3°C of warming by 2100, and up to 5°C if high-end risks including carbon-cycle feedbacks are taken into account.

Warming in the zone of 3–5°C is an existential risk to human civilisation.

Key Points

- The current Paris commitments will result in 3–5°C of warming, an existential threat to human civilisation.
- There is no carbon budget for 1.5°C, which may be reached in just a decade. For 1.5°C, all carbon dioxide emissions from now on must be drawn back down out of the atmosphere.
- 1.5°C is far from safe, because significant tipping points have been crossed already
- Emergency-speed action is necessary to end fossil fuel use, reduce short-lived pollutants such as methane, and develop large carbon-drawdown capacity.

What will the 1.5°C report say?

If previous IPCC reports are any guide, the October report will understate the risks and hence also understate the actions required. Leaks of drafts suggest it will include:

- At current emissions rate, human-induced warming will exceed 1.5°C by around 2040.
- Governments can still cap temperatures below the 1.5°C ceiling only with "rapid and far-reaching" transitions in the world economy and deep reductions in all emission sectors.
- How impacts across the climate system and society will be less severe at 1.5°C than at 2°C.

When will Earth hit 1.5°C?

Contrary to the leaked report, there is credible evidence that Earth's warming since the late-19th century will hit 1.5°C about a decade from now. For example, Melbourne-based researchers say the global temperature increase will likely exceed 1.5°C between 2026 and 2031. Other scientists have made similar projections.

Is there a carbon budget remaining for 1.5°C?

No, from a sensible risk-management viewpoint, there is no carbon budget for 1.5°C without including a lot of "negative emissions", that is, drawing carbon dioxide (CO_2) from the atmosphere to reduce the warming. So for a 1.5°C goal, humans need to draw back down every ton of emissions from now on. In other words, what goes up must come down. Yet, extraordinarily, the more recent leaks of the draft IPCC 1.5°C have actually increased the carbon budget for 1.5°C, and dropped references to it being "already out of reach" for a 66% chance of not exceeding the target.

How can there be an emissions path for 1.5°C?

The emission scenarios associated with the 1.5°C goal are based on "overshooting" or exceeding the 1.5°C target by up to half a degree — getting towards 2°C — before cooling back to the target by century's end with carbon drawdown. Because the *Paris Agreement* does not encompass the steep emissions reductions required, many of the emission scenarios rely unduly on an unfeasible amount of drawdown in the second half of the century using a technology — Bio-Energy with Carbon Capture and Storage (BECCS) — which is unproven at scale. This is a dangerous path, and there is growing alarm amongst scientists about BECCS being a political fix in order to avoid stronger action right now.

What are the risks with "overshoot"?

On the present high-emissions path, warming will not only pass 1.5°C but hit the 2°C level by the mid-2040s. Large reductions in CO_2 emissions will not by themselves significantly delay this timing. The dangers in overshooting increase with the duration and the magnitude of the overshoot. In a period of rapid warming, most major tipping points once crossed are irreversible in human timeframes, yet some of those tippings points are likely in the 1.5–2°C range. Thus "overshoot scenarios", which are now becoming the norm in policy making circles, hold much greater risks, specifically that overshoot up to 2°C for up to half a century may trigger events and activate tipping points that cannot be reversed even with significant cooling.

What would hitting 2°C or more mean?

James Hansen, former NASA climate science chief and perhaps the world's best known climate expert, says getting to 2°C or more would be a "recipe for disaster", triggering tens of metres of sea-level rise and passing tipping points which could not be reversed on human timescales**.** In fact, if today's CO_2 level was maintained, it would produce a lot more warming than 1.5°C in the longer term. In the early- to mid-Pliocene 3–4.5 million years ago, CO_2 levels were similar to today but temperatures were 3–4°C warmer than pre-industrial values.

What are the tipping points?

Tipping points have very likely already been passed: for example, summer sea-ice free Arctic conditions, the loss of West Antarctic glaciers and a multi-metre sea-level rise.

Risks increase with temperature. More climate system elements are heading towards tipping points or experiencing qualitative change. These include the slowing of the Atlantic conveyor ocean current, accelerating ice-mass loss from Greenland, and declining efficiency of the Amazon forests and other land-based stores of carbon.

Is 1.5°C safe?

Since 1°C is not safe, warming of 1.5°C would be more dangerous. It would set in train sea-level rises of many metres, sufficient to drown significant components of human civilisation. In past climates, atmospheric CO_2 similar to today's level have been associated with sea levels around 25 metres above the present. Statements such as "Only limiting warming to below 1.5ºC will keep projected sea level rise under one metre in the long run" (Climate Analytics) have no basis in fact and run contrary to clear evidence that West Antarctica is already primed for a multi-metre sea-level rise.

A 1.5ºC global rise in temperature is likely to cause the loss of permafrost area estimated to be four million square kilometres. And 1.5°C would destroy the world's coral ecosystems including the Great Barrier Reef, reducing them to remnant structures. And it's the world's poorest people who will suffer the biggest disruptions to their local climate as temperatures rise. Some tropical regions have already experienced climate warming of 1.5°C.

What would be safe?

What is safe are the climate conditions and the sea level which prevailed during the stable climate of the last 9000 years in which human civilisation developed, known as the Holocene. During that period, the global average temperature was no more than 0.5°C hotter than a late-19th-century baseline. By comparison we are now more than 1°C hotter than that baseline. Prof. James Hansen says 1.5°C "is not an appropriate goal" and "an appropriate goal is to return global temperature to the Holocene range within a century".

If BECCS is not the answer, how can we drawdown carbon?

There are many ways to reduce the amount of carbon in the air, including better farming techniques, regenerative agriculture, soil carbon and biochar, and technologies that can directly capture CO_2 from the air. The most cost-effective, large-scale drawdown action is the restoration of carbon-dense and biologically rich natural forests.

Isn't this academic if in reality we are heading for 3°C or more of warming?

Absolutely not! Sustained political failure means we are heading towards a disaster, but we have the economic and technological capacity to get out of this huge mess. We need to be clear about exactly what would be safe and how we can get there.

What needs to be done?

The big questions are what is necessary to avoid a climate catastrophe and return to a safe climate. And how to achieve emergency-speed national and sub-national actions to make it happen. A campaign in the USA, "Well under 2°C: Fast action policies to protect people and the planet from extreme climate change", led by respected scientists, advocates the "three levers" approach:

1. The **carbon neutral** lever to achieve zero net emissions of CO_2 with renewables and energy efficiency;
2. The **super pollutant** lever to cut short-lived climate pollutants such as methane, black carbon, tropospheric ozone and HFCs to maximum extent possible; and
3. Atmospheric **carbon extraction** lever to thin the atmospheric CO_2 blanket.

They also emphasise sub-national and city-scale climate action plans, the Kigali HFC amendment to the Montreal Protocol, and action on shipping and aircraft emissions which are not included in the Paris Agreement.

Is that enough?

Zero emissions and carbon drawdown cannot be completed fast enough to prevent or reverse the significant tipping points currently crossed, and others close at hand. The other policy option is to use solar radiation management (blocking some incoming energy from the sun by using particles such a sulfates) to reduce the amount of warming until the "three levers" have time to get the climate system heading in the right direction. Solar radiation management only makes sense with very rapid actions towards zero emissions plus drawdown; and if there is a demonstrable, clear, net environmental benefit from it. Much work is needed to see if that is the case, and it should only used if that is so. But we need to be honest about what will be lost and what tipping points will be crossed if it is not considered.

How can we succeed?

We know human society is capable of amazing acts, whether it is building the pyramids, wiping out diseases, or facing down big natural emergencies. We can succeed by transcending the political failure and bring the fossil fuel era to a close. We can build an ethos of common purpose: an emergency, whole-of-society response which draws on our collective community power and skills. We can mobilise to create change at the speed we need to protect ourselves and future generations.

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References: breakthroughonline.org.au/guides


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