



Why 1.5° C Matters

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You'll be hearing a lot about 1.5°C in the next few weeks. Lurid analogies about how it is "in intensive care", "on life support", with "barely a heartbeat" and so on. But what are they talking about? Why is it so important to "Keep 1.5 Alive"? What does that even mean? And how does it even make sense when global temperatures were nudging 1.9°C above pre-industrial levels in September of this year?

These questions dominated my life for a couple of years in 2017-18, when along with Pauline Dube of the University of Botswana, I was one of the Coordinating Lead Authors of the opening "Framing and Context" chapter of the Intergovernmental Panel on Climate Change's Special Report on 1.5°C, and to a large degree they still do. Our job then was to try to answer these questions as best we could, based on the academic literature available at that time: not to say what it would take to succeed, or what it would mean to fail – those were the jobs of other chapters of the Report – but what the goal actually meant.

And the answers still matter, because a lot of people heading for COP28 in Dubai risk being swept up in this 1.5°C deadline narrative, with increasingly dangerous consequences. Only a few weeks ago, James Hansen published a paper arguing that the situation had become so dire there was nothing for it but an immediate programme of solar geo-engineering – artificially cooling the planet by injecting reflective particles into the stratosphere.

We'll be devoting a lecture later in this series to why I think even contemplating solar geoengineering is a very bad idea – spoiler alert, not because I think it wouldn't work, or even that it wouldn't be "cost-effective" on someone's measure of cost-effectiveness, but because it would be so geopolitically destabilizing, pitting countries and communities against each other in a way that almost nothing else could short of a nuclear war. How anyone can even contemplate making the world a less stable place than it is, at this time of all times, I don't know.

Now, I get an email from a member of the public almost once a week telling me it is time for me to get over myself and embrace the inevitability of solar geoengineering. But James Hansen is no member of the public (although, to be fair, he does characterise himself as just a "concerned grandfather" these days). He is one of the godfathers of climate science. He sprang to global attention back in 1988 when he testified before the US Senate that the heatwave America was experiencing that summer was attributable to global warming and has since become something of a grumpy guru of climate activism.

I heard about Hansen's senate testimony when I was working as an intern in the United Nations Environment Programme in Nairobi, editing reports on nuclear safety, a rather depressing job in the aftermath of Chernobyl. My boss was one Janos Pasztor, who went on to become the lead climate advisor to Ban Ki Moon in the run-up to the Paris Agreement (and has since also become something of a proponent of research into solar geoengineering: perhaps it's an occupational hazard of working in this field for a long time).

Janos convinced me that climate change was a more interesting topic than the impact of neutron bombardment on of concrete containment vessels (which wasn't very difficult), and that I should make use of a physics degree that I happened to have and go do a doctorate in atmospheric physics. And here I am.

Another dangerous rabbit-hole this deadline narrative leads people down is "deep adaptation" – the idea that it's too late to stop climate change so there is nothing for it but to focus all our resources on hunkering down to make sure the human race survives – either by heading off to Mars, or dystopian visions of colonising Antarctica and forcibly moving billions of people around the world to avoid the rising heat. Jem Bendell is the leading current proponent of this idea, but James Lovelock, the author of the Gaia Theory and another

scientist who certainly achieved the status of guru in his time, also flirted with it. The argument is always disturbingly close to the line “of course, the real problem is that there are too many people”, and that it would be a lot easier to accommodate everyone in the remaining habitable regions of the planet if there were 2 billion of us rather than 10. I’ve never dared to explore where this line of argument takes people.

But whether you are a devotee of Hansen, Bendell, or Lovelock, or just someone who likes to hurl abuse at Oxford climate researchers over the internet (and I’m not the only one here – I read recently that Hannah Ritchie, of Our World in Data, was also reporting that the balance of climate hate-mail had shifted from “it’s all a Chinese hoax” to “you scientists are lying to people about how completely doomed we all are”), the implication is the same: we’ve missed the boat for trying to stop climate change by just boring old emission reductions, so it’s time to start thinking about more radical options. I do sometimes wonder what the overlap is between the people hurling abuse at me for being reluctant to admit that it’s all too late, and the people who were ranting “show me a single piece of data that proves carbon dioxide causes global warming” only a few years ago.

So, this 1.5°C deadline narrative matters, particularly for young people: remember Zoe, who I met over the 2019 school-strikes carrying a homemade cardboard placard saying, “You’ll die of old age, I’ll die of climate change” and worrying about whether it would ever be right for her to have children.

I do want to reassure Zoe, not least because she and her fellow school-strikers were such an impressive and empowered movement, tragically cut short by Covid (I think they did try and organise some school strikes on Zoom, but it wasn’t really the same thing), and the notion that “we’ve missed the boat” is so utterly disempowering. But, at the same time, I absolutely don’t want to be telling people that 1.5°C is not such a big deal after all – you can just imagine the Daily Mail headline, “one of the main authors of the 2018 IPCC 1.5°C report finally admits...”

The analogy I found myself using with the school strikers was that climate change was a bit like smoking: it’s a good idea to stop it; it’s a good idea to stop it today rather than putting it off until tomorrow; but if you happen to fail to stop it today, it is still a very good idea to stop it tomorrow. And the analogy can be taken even further: there is a large and very profitable industry with a strong vested interest in making sure you fail.

So, the 1.5°C goal was always more like a New Year’s Resolution: there is absolutely no particular more reason for you to stub out your last puff as the New Year countdown begins than on any other day of the year, but humans respond to such things, and they do help us crystallize our decisions.

So, whatever happens in Dubai next month, and to global temperatures over the next few years, the decision of 190 governments in the Paris Agreement in 2015 to “strengthen the global response to climate change ... by holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C” remains the guiding star of climate action.

The inclusion of the 1.5°C goal in the Paris Agreement took the academic community almost completely by surprise. Scientists, much like everyone else, don’t follow the negotiations that closely, and we are largely unaware of the movement, spearheaded by the small island states, to increase the ambition beyond the 2°C that was – kind of – agreed in Durban in 2010 after the debacle of Copenhagen in 2009.

We didn’t have much time to get used to the idea, because as a condition of agreeing to the inclusion of 1.5°C in the final Paris text, some more sceptical governments insisted that the UN commission that Special Report on 1.5°C. Following IPCC rules, this report had to be based on a peer-reviewed academic literature which (thanks to us not really following what was going on) largely didn’t exist at the beginning on 2016, and had to be delivered on an absurdly compressed timescale (given the laborious process of multiple drafts, reviews and revisions that the IPCC insists on as a condition of government buy-in) of just over two years: the normal cycle of IPCC reports is 6-7 years.

There were two headline objectives for that 1.5°C report, first to assess the benefits of limiting warming to 1.5°C, and second whether it was even feasible to do so. I’ll be talking through these in detail in the lecture, but first we had a more mundane task, which was to say what it meant to “limit warming to 1.5°C above pre-industrial levels” in the first place.

And the arguments we had still resonate today and would be helpful for you to bear in mind in all the increasingly desperate rhetoric about “keeping 1.5°C alive” you will hear at COP28.

First of all, we had to agree what the Paris Agreement meant by “the increase in the global average temperature” – what does it mean to talk about the “current” level of global warming in a rapidly warming world. The traditional definition of “average temperature” used by the World Meteorological Organisation”

was the average over 30 years, but if you define the “current level of warming” as the average over the most recent 30 years of a world warming at over 0.2°C per decade, you inevitably end up with number that is, on average, 0.3°C too cold – more than half the remaining warming to 1.5°C, so a not-insignificant discrepancy.

After much discussion, we managed to agree on a definition of the level of global warming in the current year as the estimated average temperature over a 30-year period centred on the current year, assuming recent trends continue into the future and eliminating the impact of external natural fluctuations, like another Krakatoa going off next year. Part of the reason I was so fixated on nailing down this definition of the current level of warming was that, all the way through the IPCC 1.5°C report drafting and approval process, there was a volcano rumbling in Java which lots of people were predicting could be a Krakatoa-style event, and I really wanted to be sure that it would not completely derail our report.

Not all authors and certainly not all countries were happy with this definition, and in the IPCC 6th Assessment Report (which I wasn't involved in) they reverted to defining the current level of warming as the average over the most recent 10 years of the record. So, after the 6th Assessment came out in 2021, you heard plenty of headlines saying warming had reached 1.1°C, and probably didn't realise that that number actually referred to the average of 2010-2019, so a good 0.1°C cooler than what it was in 2021 based on the definition we used in the 1.5°C report.

In my opinion, this was the worst of both worlds – short enough to be potentially strongly affected by natural variability (remember those few years after 2009 when we kept being reminded by the Global Warming Policy Foundation that global warming stopped in 1998? For a long time, the GWPF headed up its home page with a plot of recent global temperature, to show you how flat it was over the period 1998-2013. They have switched to a more neutral logo since warming resumed in the mid-2010s.). And long enough to introduce a 0.1°C cool bias in the headline current level of warming figure.

This is a systemic problem with the IPCC process: every new report brings in a new author team, and since no group of scientists wants to spend years of their lives just redoing exactly what the previous lot did, there is a strong incentive to do “better”, which inevitably means “different”. I'm not suggesting that the decisions we made in the 1.5°C report over things like the definition of the current level of warming were necessarily perfect, but they were what they were, governments eventually signed off on them, and I think we need a very strong argument to change tack. Of course, the 7th Assessment Report will have another set of authors, but I suspect and hope it will revert to our definition, because it really isn't helpful to talk about the current level of warming as meaning the level, we reached over six years ago.

Another topic we spent a remarkable amount of time on was what the Paris Agreement meant by “pre-industrial levels” – inconveniently, different reports in the 2013 IPCC 5th Assessment, which informed the Paris Agreement, used two different reference periods, 1861-1880 and 1850-1900. Because it includes the years following the eruption of Krakatoa, the longer period is slightly cooler and, according to climate impact researchers, more representative of genuinely “pre-industrial” conditions. But because it remains very hard to model the climate impact of Krakatoa (there is only a limit to how much you can infer from traces of ash in ice-cores and Turner's paintings of sunsets), climate modellers like myself preferred to avoid it. Anyway, we lost that argument, because, after all, it is the impacts that matter not the nerdy concerns of physicists worrying about uncertainty in radiative forcing, so 1850-1900 it was.

The clincher, for me, was that the negotiators in Paris were explicitly told that the world was already experiencing a warming of 0.85°C, and it was absolutely true that, based on the records available at the time, the decade 2006-2015, in the immediate run-up to Paris, was almost exactly 0.85°C warmer than 1850-1900. This was enough to settle the argument about reference periods: even if they didn't say so or perhaps even weren't aware of it, Paris negotiators were implicitly considering the Krakatoa years as “pre-industrial”. So, we used that record, and that reference period, to define the warming we had got to (around 1°C ± 0.2°C in 2017) and therefore what it would take to limit warming to 1.5°C.

Now this is all probably sounding incredibly nerdy, but before you doze off completely, an interesting development is that the climate observation community have, since 2018, gone back over the records and dug up more data to conclude that 1850-1900 was around 0.1°C cooler than previously thought. I'm not for a moment suggesting that there is anything wrong with this revision, but it means that in the IPCC 6th Assessment Report, published in 2021 and the basis of all the statements about how close we are to 1.5°C at the moment, 2017 would have been over 1.1°C using the definition of the current level of warming we used in the 1.5°C report. And, crucially, the 2006-2015 period, that the Paris negotiators were told was 0.85°C warmer than pre-industrial, would, if they had had the updated record available, have been placed at around 1°C warming. Would the Paris negotiators have agreed on a target of 1.5°C if they had been told they were

already experiencing the impacts of 1°C of warming, rather than the impacts of 0.85°C of warming? We'll never know.

Why on earth does any of this matter – after all, a revision of estimated temperatures in the 19th century has no impact whatsoever on the climate impacts that will be experienced over the next few decades. The point, of course, is the lawyers are moving in. Many countries consider the date on which global temperatures “breach” (or some such evocative phrase) 1.5°C as the trigger for so-called “loss and damage” payments. Other countries (and you can guess, of course, which are which) strongly disagree. So, the current level of warming has become part of a negotiation process.

When a company goes bankrupt, there is very clear trigger – the company’s business might have been going downhill for years, but there is always a very specific day when they can’t make payroll and the courts move in. Likewise, the rhetoric of “keep 1.5 alive” is equally misleading, because in those dramatic scenes in medical dramas, there is always a moment when the doctor “calls it” and the patient is declared dead. The global temperature just doesn’t work that way. But unfortunately, lawyers do. So, there is a lot of rather bogus precision being thrown around about 1.5°C, and remaining carbon budgets, and the like at the moment.

I’m not for a moment suggesting that the world crossing 1.5°C, on whoever’s definition, isn’t an important milestone. But it is just that: a milestone. An arbitrary sign of how bad things are getting, and an indication of how fast we have to act if we don’t what things to get any worse. Remember the smoking analogy: let’s try and keep that New Year’s Resolution made in Paris in 2015, but if we fail, there is always the 3rd of January to aim for.

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