

Is Catastrophic Climate Change Inevitable?

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<http://ccdatacenter.org/documents/IsCatastrophicClimateChangeInevitable.pdf>

There have been many articles over the last five years that have attempted to answer the question “Have we passed the point of no return on climate change?” (see Appendix A for some examples). Many refer to the IPCC’s limit of a 2° C temperature increase, others point to possible limits on atmospheric CO₂ (e.g., 450 PPM), and others assume that we really need to make drastic cuts to fossil fuel emission very quickly. And an underlying assumption is that we are in control, i.e., if we can reduce anthropogenic emissions so that the “limit” will not be exceeded (or exceeded only for a short time), then we might be OK.

The problem is that not all contributions to global warming are anthropogenic: the Arctic region has warmed almost four times as fast as the global average since 1980 due primarily to the albedo changes from declines in the extent of both the spring-time snow cover and the summer-time Arctic Ocean sea ice. The albedo changes are currently a part of self-reinforcing feedback loop – the lower albedo causes more warming, which causes more ice and snow to melt, which lowers the albedo, etc. If it hasn’t already, the thawing permafrost will soon become part of the feedback loop as the carbon dioxide and methane released by the thawing cause additional warming. So the answer to the above question is almost certainly “Yes”: we have already exceeded the temperature at which the natural feedbacks become significant when compared to anthropogenic emissions and cannot be realistically compensated for by either reductions in anthropogenic emissions or by the sequestration of carbon dioxide. Global warming will stop only after the feedbacks have “run their course” (e.g., most of the summer-time Arctic Ocean ice is melted, most of the carbon dioxide and methane in the permafrost has been released, etc.).

The following table estimates the temperature increase expected in the next 40-50 years if we take serious action to reduce fossil fuel emissions:

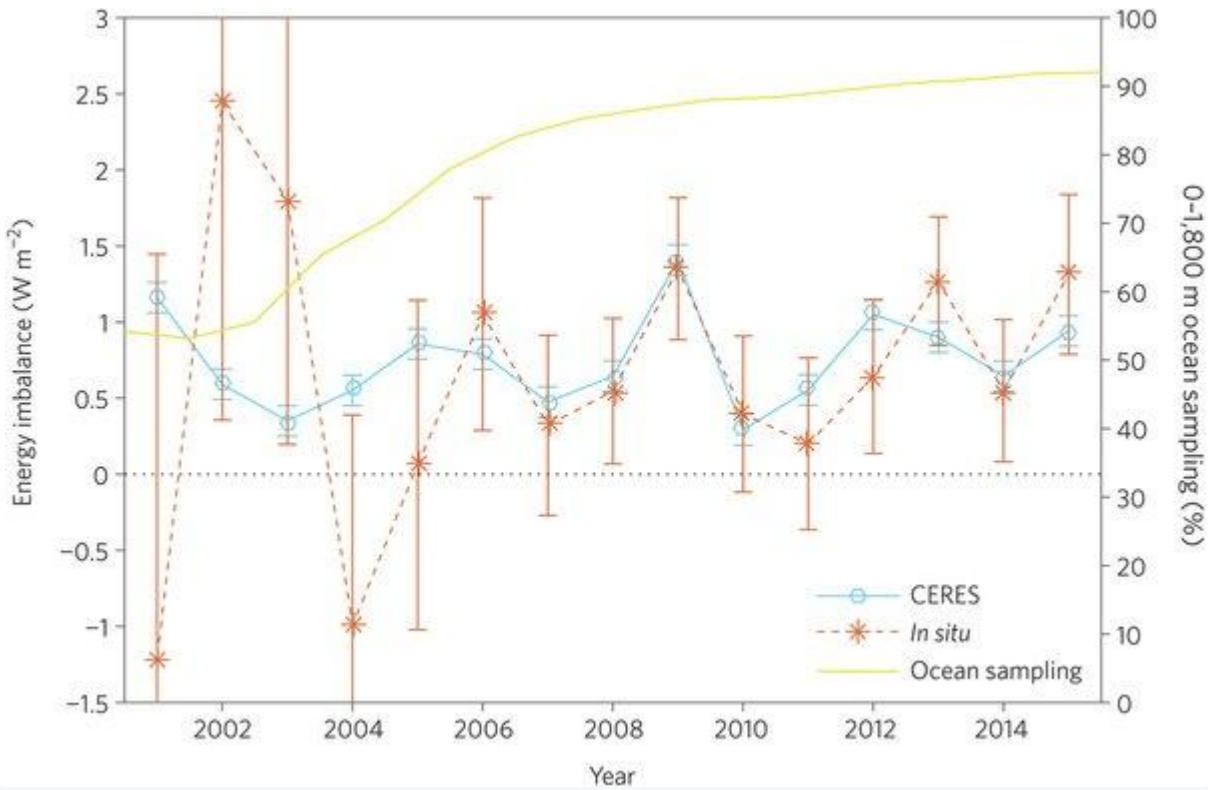
#	° C	Description
1	1.1	Increase from preindustrial times to 2015
2	0.6	From the removal of atmospheric aerosols when emissions from the burning of fossil fuels are reduced significantly ¹
3	0.4	From the current energy imbalance ² (0.7 W/m ²)
4	0.3	From fossil fuel emissions from an aggressive emissions reduction scenario (2010 emissions were about 34 GTCO ₂ ; if they increase annually by 2% until 2025 and then decline by 1.5 GTCO ₂ annually, there will be net zero emissions after 2055 and the total emissions will be about 1240 GTCO ₂ ;) ³ (also assumes an emissions reduction of short-lived greenhouse gases)
	2.4	Expected temperature increase in the next 50 years <i>without considering natural feedbacks</i>
5	0.4	From natural feedbacks (Arctic sea ice melt, Northern Hemisphere snow line retreat, permafrost thaw, and peat drying) ⁴
	2.8	Expected temperature increase in the next 50 years

Climate scientists believe that a 1.5° C rise in global temperature is enough to start permafrost thaw in Siberia⁵. Since by mid century the global temperature will almost certainly be over 2° C, significant amounts of the permafrost will be thawing annually, releasing even more greenhouse gases in a “feedback loop”. If 50% (3,000 GTCO₂) of the carbon in the permafrost is released, the expected temperature increase will be about 1.3°³. Thus the feedbacks from Arctic sea ice melt, Northern Hemisphere snow line retreat, permafrost thaw, and peat drying will be enough to eventually raise the Earth’s temperature to well over 4.0° C. And it is possible that the release of methane from the destabilization of sea-floor methane hydrates could greatly exacerbate global warming⁶. Because of the unacceptable costs associated with removing CO₂ from atmosphere in the quantities needed to offset both the feedbacks and future emissions (trillions of dollars per year⁷), nothing besides albedo modification can possibly stop catastrophic climate change.

Footnotes:

1 <http://ccdatacenter.org/documents/BurningCoalCoolsPlanet.pdf>

2 The current energy imbalance is about 0.7 W/m^2 , equivalent to about 0.42° C of warming.



Gavin Schmidt @ClimateOfGavin Jun 23

New estimate of Earth's energy imbalance $\sim 0.7 \text{ W/m}^2$ (2005-15)

<http://www.nature.com/nclimate/journal/v6/n7/full/nclimate3043.html> ... NB predicted before observed

<https://twitter.com/ClimateOfGavin/status/765237770839269378> 8/15/16

<http://www.nature.com/nclimate/journal/v6/n7/full/nclimate3043.html>

3

Total Emissions	CO2 PPM (GTCO2)	Temp Increase (°C)
1105	63.71	0.47
1190	68.62	0.51
1275	73.52	0.55
1360	78.42	0.58
2984	172.03	1.28
3069	176.93	1.31
3154	181.83	1.35

From <http://ccdatacenter.org/documents/AlbedoCO2TempCalcs.pdf>

4 <http://ccdatacenter.org/documents/GlobalWarmingFeedbacks.pdf>

"This implies that the albedo forcing due solely to changes in Arctic sea ice has been 25% as large globally as the direct radiative forcing from increased carbon dioxide concentrations, which is estimated to be 0.8 W/m^2 between 1979 and 2011". <http://www.pnas.org/content/111/9/3322.full.pdf>

	<i>(This is equivalent to annual fossil fuel emissions of about 3 GCTCO2 per year for about 80- years – about 10% of the current emissions, adding about 0.1° C to the global temperature. Since the Arctic sea ice will continue to decline and since there are other feedbacks of similar magnitude, the expected temperature increase by mid century due to all global warming feedbacks should be well in excess of 0.4° C)</i>
5	https://www.theguardian.com/environment/2013/feb/21/temperature-rise-permafrost-melt
6	http://worldoceanreview.com/en/wor-1/ocean-chemistry/climate-change-and-methane-hydrates/
7	The effective radiative forcings from the natural feedbacks will be at least 0.5 W/m-2 in 2060, which is equivalent to annual emissions about 8 GTCO2. If the cost of sequestration is \$200/ton CO2 (a very low estimate), the annual cost to sequester CO2 to offset the natural feedbacks will be about \$1.6 Trillion. http://ccdatacenter.org/documents/AlbedoCO2TempCalcs.pdf http://ccdatacenter.org/documents/ExpectedGlobalTemperatureIncrease.pdf

Appendix A – Articles relating to “Have we passed the point of no return on climate change?”

Have We Passed the Point of No Return on Climate Change?

Greenhouse gas cuts must begin soon or it could be too late to halt global warming
By EarthTalk on April 13, 2015

While we may not yet have reached the “point of no return”—when no amount of cutbacks on greenhouse gas emissions will save us from potentially catastrophic global warming—climate scientists warn we may be getting awfully close. Since the dawn of the Industrial Revolution a century ago, the average global temperature has risen some 1.6 degrees Fahrenheit. Most climatologists agree that, while the warming to date is already causing environmental problems, another 0.4 degree Fahrenheit rise in temperature, representing a global average atmospheric concentration of carbon dioxide (CO2) of 450 parts per million (ppm), could set in motion unprecedented changes in global climate and a significant increase in the severity of natural disasters—and as such could represent the dreaded point of no return.

<http://www.scientificamerican.com/article/have-we-passed-the-point-of-no-return-on-climate-change/>

World headed for irreversible climate change in five years, IEA warns

If fossil fuel infrastructure is not rapidly changed, the world will 'lose for ever' the chance to avoid dangerous climate change

Fiona Harvey, environment correspondent
Wednesday 9 November 2011 05.01 EST

The world is likely to build so many fossil-fuelled power stations, energy-guzzling factories and inefficient buildings in the next five years that it will become impossible to hold global warming to safe levels, and the last chance of combating dangerous climate change will be "lost for ever", according to the most thorough analysis yet of world energy infrastructure.

If the world is to stay below 2C of warming, which scientists regard as the limit of safety, then emissions must be held to no more than 450 parts per million (ppm) of carbon dioxide in the atmosphere; the level is currently around 390ppm. But the world's existing infrastructure is already producing 80% of that "carbon budget", according to the IEA's analysis, published on Wednesday. This gives an ever-narrowing gap in which to reform the global economy

on to a low-carbon footing.

If current trends continue, and we go on building high-carbon energy generation, then by 2015 at least 90% of the available "carbon budget" will be swallowed up by our energy and industrial infrastructure. By 2017, there will be no room for manoeuvre at all – the whole of the carbon budget will be spoken for, according to the IEA's calculations.

<https://www.theguardian.com/environment/2011/nov/09/fossil-fuel-infrastructure-climate-change>

The Point of No Return: Climate Change Nightmares Are Already Here

The worst predicted impacts of climate change are starting to happen — and much faster than climate scientists expected

In particular, says Rignot, the new research shows a two-degree Celsius rise in global temperature — the previously agreed upon "safe" level of climate change — "would be a catastrophe for sea-level rise."

Even if these novel challenges succeed, it will take years before a bend in the curve is noticeable. But maybe that's enough. When all feels lost, saving a few species will feel like a triumph.

<http://www.rollingstone.com/politics/news/the-point-of-no-return-climate-change-nightmares-are-already-here-20150805>

The awful truth about climate change no one wants to admit

Updated by David Roberts on May 15, 2015, 12:50 p.m. ET @drvox david@vox.com

The obvious truth about global warming is this: barring miracles, humanity is in for some awful shit.

But that's where we're headed. It will take enormous effort just to avoid that fate. Holding temperature down under 2°C — the widely agreed upon target — would require an utterly unprecedented level of global mobilization and coordination, sustained over decades. There's no sign of that happening, or reason to think it's plausible anytime soon. And so, awful shit it is.

Yet here we are. The fact is, on our current trajectory, in the absence of substantial new climate policy, we are heading for up to 4°C and maybe higher by the end of the century. That will be, on any clear reading of the available evidence, catastrophic. We are headed for disaster — slowly, yes, but surely.

Even as many climate experts are now arguing that 2°C is an inadequate target, that it already represents unacceptable harms, we are facing a situation in which limiting temperature even to 3°C requires heroic policy and technology changes.

And yet ... the world doesn't appear to be ending; there's no big, visible threat. Climate change moves so slowly that its pace is evident primarily through graphs and statistics. It rarely rises above the background noise.

So people want to hear that there's hope of 2°C. Politicians want to say that there's hope of 2°C. When asked, modelers are still able to produce scenarios that show 2°C. And nobody wants to be the one to pee in the punch bowl.

<http://www.vox.com/2015/5/15/8612113/truth-climate-change>

World's carbon dioxide concentration teetering on the point of no return

Future in which global concentration of CO₂ is permanently above 400 parts per million looms

Michael Slezak

Wednesday 11 May 2016 04.11 EDT

The world is hurtling towards an era when global concentrations of carbon dioxide never again dip below the 400 parts per million (ppm) milestone, as two important measuring stations sit on the point of no return.

Butler also emphasised that this CO₂ is locking in future warming. "It's like lying in bed with your electric blanket set to three. You jack it up to seven – you don't get hot right away but you do get hot. And that's what we're doing."

The CO₂ concentrations are driving what appears to be runaway climate change around the world.

<https://www.theguardian.com/environment/2016/may/11/worlds-carbon-dioxide-concentration-teetering-on-the-point-of-no-return>

When It Comes to Climate Change, It's Too Late Now to Say Sorry

February's record-breaking temperatures pushed us past the point of no return.

Yasmin Tayag March 7, 2016

Any discussion of climate change inevitably boils down to a single phrase: two degrees Celsius.

But a new report from meteorologist Eric Holthaus in Slate makes it clear that the northern hemisphere has breached that two-degree mark over normal, pre-Industrial temperatures. We have, it seems, already failed.

If Holthaus is right — that it's too late to turn back — it signals a need to switch the focus of our climate change plans from prevention to contingency. Scientists like Stanford University's Rob Jackson, Ph.D., already skeptical of the efficacy of the two-degree limit, have suggested chasing options such as "negative-emission energy," which will allow us to retract the emissions we've already dumped into the atmosphere. That technology doesn't exist yet, but it's clear that it's going to have to happen much sooner rather than later.

"This is a milestone moment for our species," Holthaus writes. "Climate change deserves our greatest possible attention."

<https://www.inverse.com/article/12516-when-it-comes-to-climate-change-it-s-too-late-now-to-say-sorry>

Unavoidable Climate Change — Past the Point of No Return

11/19/2010 03:14 pm ET | Updated May 25, 2011

Peter H. Gleick

It's too late. The world has missed the opportunity to avoid serious, damaging human-induced climate change. For a variety of reasons ranging from ignorance to political ideology to commercial self-interest to inertia to intentional misrepresentations and misdirections on the part of a small number of committed climate deniers, the United States and the rest of the world have waited too long to act to cut the emissions of damaging greenhouse gas pollutants. We are now committed to irreversible long-term and inevitably damaging consequences ranging from rapidly rising sea levels, far greater heat stress and damages, disappearing glaciers and snowpack, more flooding and droughts, and far, far more.

As a result, in twenty more years, the Earth will be even hotter, sea levels will be higher and rising faster, water and

food resources will be increasingly stressed, extinction rates will accelerate, and our forced expenditures for climate adaptation will be far, far greater than they would otherwise have been.

http://www.huffingtonpost.com/peter-h-gleick/unavoidable-climate-chang_b_786158.html

The Fast-Approaching 'Point of No Return' for Climate Change

September 27, 2013

by Karin Kamp and John Light

"There is a small window of opportunity in terms of time. I would say no more than five to ten years," Naidoo told Bill. "And, based on current practices of governments, if we continue like that over the next coming years, then sadly, I think it will be too late," Naidoo said.

<http://billmoyers.com/2013/09/27/action-urgently-needed-on-climate-change/>

Climate Transitions, Tipping Points, and the Point of No Return

As the planet continues to warm, it may be approaching a critical climate threshold beyond which rapid (decadal-scale) and potentially catastrophic changes may occur that are not anticipated—because of complex feedback dynamics and existing computational limitations—by climate models that are tuned to modern conditions.

Hansen et al. (2008) introduced the term "tipping element" to describe subcontinental-scale subsystems of the Earth system that are susceptible to being forced into a new state by small perturbations. Tipping level—the magnitude of climate forcing beyond which, if sustained, abrupt climate change will eventually occur—is differentiated from "point of no return." If the tipping level is exceeded for only a brief period of time, the original state of the system can be restored. More persistent forcing can push the system to the "point of no return," where a reduction of the forcing below the tipping level is ineffective in halting the climate shift (Figure 3.1). This irreversibility of the system response is referred to as hysteresis (NRC, 2002).

<https://www.nap.edu/read/13111/chapter/6>

The amount of warming that occurs because of increased greenhouse gas emissions depends in part on feedback loops. Positive (amplifying) feedback loops increase the net temperature change from a given forcing, while negative (damping) feedbacks offset some of the temperature change associated with a climate forcing. The melting of Arctic sea ice is an example of a positive feedback loop. As the ice melts, less sunlight is reflected back to space and more is absorbed into the dark ocean, causing further warming and further melting of ice.

<https://nas-sites.org/americasclimatechoices/more-resources-on-climate-change/climate-change-lines-of-evidence-booklet/evidence-impacts-and-choices-figure-gallery/figure-9/>

Collapse of Industrial Civilization ~ Finding the Truth behind the American Hologram

The Exact Timing of Near-Term Human Extinction Is Academic

29 May 2014

Posted by xraymike79 in Climate Change, Environmental Degradation, Pollution

If all industrial activity stopped right now, we would already be committed to 2.65°C, a global average temperature rise of three times what we are currently experiencing

<https://collapseofindustrialcivilization.com/tag/climate-change-feedback-loops/>