Head quarters

How soon will the 'ice apocalypse' come?

An emotive article on the 'ice apocalypse' by Eric Holthaus describes a terrifying vision of catastrophic sea level rise this century caused by climate change and the collapse of the Antarctic ice sheet. But how likely is this - and how soon could such a future be here?

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I've been gripped by the story of Antarctic 'ice cliff instability' ever since Rob DeConto and Dave Pollard published their controversial predictions last year. They suggested disintegration of ice shelves caused by global warming could leave behind coastal ice cliffs so tall they would be unstable, crumbling endlessly into the ocean and causing rapid, sustained sea level rise.

I'm glad Eric Holthaus is writing about an impact of climate change that is both certain (seas will rise around the world, no matter what we do) and incredibly important (we must adapt). I'm sympathetic to his concerns about the future. But I think his article is too pessimistic: that it overstates the possibility of disaster. Too soon, too certain.

I'll admit my fascination is personal. In late 2015, Catherine Ritz and I co-led a study about the future of Antarctica, and our predictions – though definitely

bad news – were far less dire. So what evidence do we have that the Antarctic ice sheet could, or would, collapse this century?

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First, it's important to map out what is known. Yes, the Antarctic ice sheet is vulnerable to global warming. Not because it will melt in the warm air like an ice cube, but because the ice shelves around the coastlines act as bracing for the glaciers. When the surface of an ice shelf melts it can disintegrate, and the flow of ice into the oceans can speed up: we saw this for Larsen B in 2002. Our greenhouse gas emissions make this more likely.

Yes, scientists have proposed that disintegration of ice shelves could trigger two types of 'instability' that may have caused the 'marine' parts of the Antarctic ice sheet (lying on bedrock below sea level) to drastically reduce in the past, raising sea levels by several metres. Confusingly, these are named 'marine ice *sheet* instability' and 'marine ice *cliff* instability'. Broadly speaking, both are based around the idea that the thicker the edge of the ice sheet, the faster ice can be lost into the oceans. Both may be 'positive feedbacks': in other words, self-sustaining. The marine parts of the ice sheet are thicker in the middle than at the edges, so once these proposed instabilities started, they would keep going until they ran out of ice. As Eric says, this would be over three metres worth of sea level rise.

Yes, one instability may already be happening. In 2014, new evidence suggested marine ice sheet instability may be underway in the Amundsen Sea area, forty years after it was first predicted. But Eric is wrong to say Antarctica's 'ice budget' has tipped out of balance due to our burning of fossil fuels. Not only has it been out of balance before – such as the ancient West Antarctic collapse that causes concern – but the reason for the Amundsen Sea changes, where most ice is being lost, is that the ring of deep warm water around Antarctica has welled up onto the continental shelf and is melting the ice from underneath. We don't know if human activities made this more likely.

As far as I know, scientists agree the basic theory of marine ice cliff instability by Jeremy Bassis and Catherine Walker is sound (it's a shame Catherine's joint contribution to that key 2011 paper wasn't mentioned). Ice is not strong enough to form a sheer cliff taller than about 100 m above the water line. And indeed, we don't see any ice cliffs taller than this, which gives us indirect evidence their calculations are correct. We also have the recent study led by Matthew Wise of marks left by the keels of ancient icebergs, scraping along the bedrock like heavy ships, which point towards this kind of cliff collapse in the distant past.

But there is little consensus in the scientific community about how this ice cliff instability could behave. That's because there is a big leap from identifying a potential problem and predicting the real world consequences. Iceberg scrape marks, though important, can't tell us how soon, how fast, or for how long. Rob DeConto and Dave Pollard have been the first to put their heads above the parapet, but others may come to different conclusions. Ted Scambos mentioned 'piles of icebergs' acting as new ice shelves. Could cold freshwater from melted icebergs also slow things down? Could cliffs partially, instead of catastrophically, crumble? Would a model with finer detail predict fewer tall cliffs? Eric describes the collapse rate as conservative compared with Jakobshavn in Greenland, but this compares apples with oranges: the rapid ice losses from that great glacier are mostly due to its unusually fast speed, rather than the rate of retreat of the ice edge.

Just as important is the initial trigger: how sensitive are the ice shelves to global warming? In Rob and Dave's study, they disintegrated fast and early: predictions by others are less pessimistic. Eric compounds this by describing their highest scenario as 'business as usual', but it's really business-worse-than-usual. Under current policies we're headed for less warming than this scenario, and if national pledges under the Paris agreement are carried out this would decrease the warming more (though not meeting the two degree target).

Even Rob and Dave had a huge range of predictions for that very high scenario – anything from 30 cm sea level *fall* to nearly two metres *rise* – and they originally described their model as 'speculative'. So it's not justified to use such strong, certain phrases as 'the destruction would be unstoppable'.

I was particularly concerned about some of the implied time scales and impacts. That 'slowly burying every shoreline…creating hundreds of millions of climate refugees…could play out in a mere 20 to 50 years' (it could begin then, but would take far longer). That 'the full 11 feet' could be unlocked by 2100 (Rob and Dave predicted the middle of next century). That cities will be 'wiped off the map' (we will adapt, because the costs of protecting coastlines are predicted to be far less than those of flooding). We absolutely should be concerned about climate risks, and reduce them. But black-and-white thinking and over-simplification don't help with risk management, they hinder.

Is "the entire scientific community [in] emergency mode"? We are cautious, and trying to learn more. Climate prediction is a strange game. It takes decades to test our predictions, so society must make decisions with the best evidence but always under uncertainty. I understand why a US-based climate scientist would feel particularly pessimistic. But we have to take care not to talk about the apocalypse as if it were inevitable.

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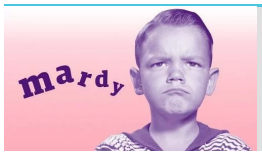

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