

# Climate change: sea level rise could displace millions of people within two generations

May 21 2019, by Jonathan Bamber And Michael Oppenheimer

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A small boat in the Illulissat Icefjord is dwarfed by the icebergs that have calved from the floating tongue of Greenland's largest glacier, Jacobshavn Isbrae.

Credit: Michael Bamber, Author provided

Antarctica is further from civilisation than any other place on Earth. The Greenland ice sheet is closer to home but around one tenth the size of its southern sibling. Together, these two ice masses hold enough frozen water to raise global mean sea level by 65 metres if they were to suddenly melt. But how likely is this to happen?

The Antarctic [ice sheet](#) is around one and half times larger than Australia. What's happening in one part of Antarctica may not be the same as what's happening in another—just like the east and west coasts of the US can experience very different responses to, for example, [a change in the El Niño weather pattern](#). These are periodic climate events that result in [wetter conditions](#) across the southern US, warmer conditions in the north and drier weather on the north-eastern seaboard.

The ice in Antarctica is nearly 5km thick in places and we have very little idea what the conditions are like at the base, even though those conditions play a key role in determining the speed with which the ice can respond to [climate change](#), including how fast it can flow toward and into the ocean. A warm, wet base lubricates the bedrock of land beneath the ice and allows it to slide over it.

These issues have made it particularly difficult to produce [model simulations](#) of how ice sheets will respond to climate change in future. Models have to capture all the processes and uncertainties that we know about and those that we don't—the "known unknowns" and the "unknown unknowns" as [Donald Rumsfeld once put it](#). As a result, several recent studies suggest that previous Intergovernmental Panel on Climate Change reports may have [underestimated how much](#) melting ice sheets will contribute to sea level in future.



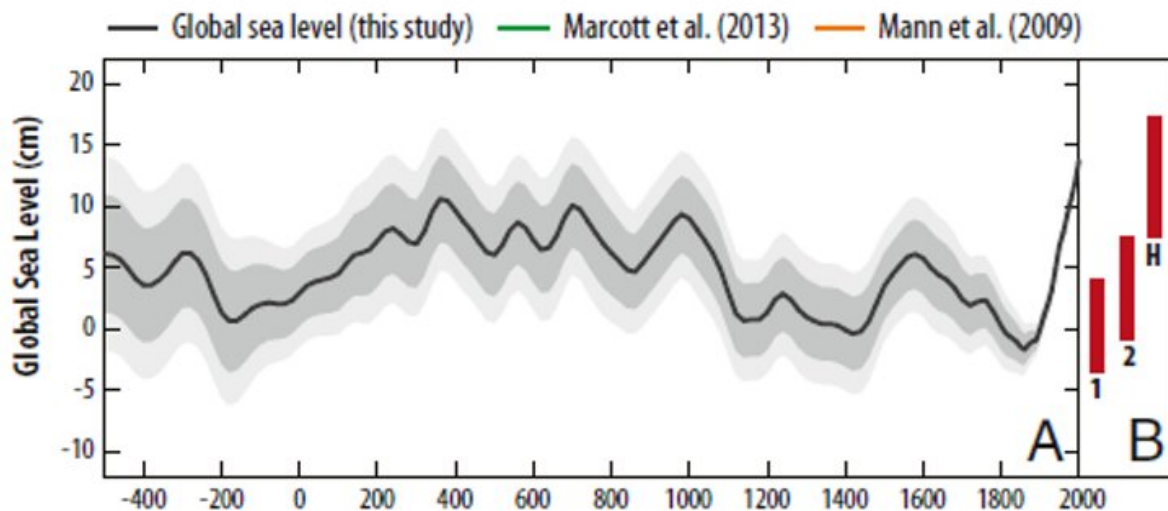
Credit: AI-generated image ([disclaimer](#))

## What the experts say

Fortunately, models are not the only tools for predicting the future. [Structured Expert Judgement](#) is a method from a study one of us published in 2013. Experts give their judgement on a hard-to-model problem and their judgements are combined in a way that takes into account how good they are at [assessing their own uncertainty](#). This provides a rational consensus.

The approach has been used when the consequences of an event are potentially catastrophic, but our ability to model the system is poor. These include volcanic eruptions, earthquakes, the spread of vector-borne diseases such as malaria and even aeroplane crashes.

[Since the study in 2013](#), scientists modelling ice sheets have improved their models by trying to incorporate processes that cause positive and negative feedback. Impurities on the surface of the Greenland ice sheet cause positive feedback as they enhance melting by absorbing more of the sun's heat. The stabilising effect of bedrock rising as the overlying ice thins, lessening the weight on the bed, is an example of negative feedback, as it slows the rate that the ice melts.



Reconstructed sea level for the last 2500 years. Note the marked increase in rate since about 1900 that is unprecedented over the whole time period. Credit: [Robert Kopp/Kopp et al. \(2016\)](#), Author provided

The record of observations of ice sheet change, primarily from satellite data, has also grown in length and quality, helping to [improve knowledge of the recent behaviour of the ice sheets](#).

With colleagues from the UK and US, we undertook [a new Structured Expert Judgement exercise](#). With all the new research, data and

knowledge, you might expect the uncertainties around how much ice sheet melting will contribute to [sea level rise](#) to have got smaller. Unfortunately, that's not what we found. What we did find was a range of future outcomes that go from bad to worse.

## Rising uncertainty

We gathered together 22 experts in the US and UK in 2018 and combined their judgements. The results are sobering. Rather than a shrinking in the uncertainty of future ice [sheet](#) behaviour over the last six years, it has grown.



Credit: AI-generated image ([disclaimer](#))

If the global temperature increase stays below 2°C, the experts' best estimate of the average contribution of the ice sheets to sea level was 26cm. They concluded, however, that there is a 5% chance that the contribution could be as much as 80cm.

If this is combined with the two other main factors that influence sea level—glaciers melting around the world and the expansion of ocean water as it warms—then global mean sea level rise could exceed one metre by 2100. If this were to occur, many small island states would experience their current once-in-a-hundred-year [flood every other day and become effectively uninhabitable](#).

For a climate change scenario closer to business as usual—where our current trajectory for economic growth continues and global temperatures increase by 5°C – the outlook is even more bleak. The experts' best estimate average in this case is 51cm of sea level rise caused by melting ice sheets by 2100, but with a 5% chance that global sea level rise could exceed two metres by 2100. That has the potential to [displace some 200m people](#).

Let's try and put this into context. The Syrian refugee crisis is estimated to have caused [about a million people to migrate to Europe](#). This occurred over years rather than a century, giving much less time for countries to adjust. Still, sea level rise driven by migration of this size might threaten the existence of nation states and result in unimaginable stress on resources and space. There is time to change course, but not much, and the longer we delay the harder it gets, the bigger the mountain we have to climb.

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