

## [Scientists to Issue Stark Warning Over Dramatic New Sea Level Figures](#)

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Off Ammassalik Island, Greenland, an iceberg melts. (Photo: John Mcconnico / AP)

***Rising sea levels pose a far bigger eco threat than previously thought. This week's climate change conference in Copenhagen will sound an alarm over new floodings - enough to swamp Bangladesh, Florida, the Norfolk Broads and the Thames estuary.***

Scientists will warn this week that rising sea levels, triggered by global warming, pose a far greater danger to the planet than previously estimated. There is now a major risk that many coastal areas around the world will be inundated by the end of the century because Antarctic and Greenland ice sheets are melting faster than previously estimated.

Low-lying areas including Bangladesh, Florida, the Maldives and the Netherlands face catastrophic flooding, while, in Britain, large areas of the Norfolk Broads and the Thames estuary are likely to disappear by 2100. In addition, cities including London, Hull and Portsmouth will need new flood defences.

"It is now clear that there are going to be massive flooding disasters around the globe," said Dr David Vaughan, of the British Antarctic Survey. "Populations are shifting to the coast, which means that more and more people are going to be threatened by sea-level rises."

The issue is set to dominate the opening sessions of the international climate change conference in Copenhagen this week, when scientists will outline their latest findings on a host of issues concerning global warming. The meeting has been organised to set the agenda for this December's international climate talks (also to be held in Copenhagen), which will draw up a treaty to replace the current Kyoto protocol for limiting carbon dioxide emissions.

And key to these deliberations will be the issue of ice-sheet melting. The International Panel on Climate Change (IPCC) - when it presented its most up-to-date report on the likely impact of global warming in 2007 - concluded that sea-level rises of between 20 and 60 centimetres would occur by 2100. These figures were derived from estimates of how much the sea will increase in volume as it heats up, a process called thermal expansion, and from projected increases in run-off water from melting glaciers in the Himalayas and other mountain ranges.

But the report contained an important caveat: that its sea-level rise estimate contained very little input from melting ice sheets in Antarctica and Greenland. The IPCC forecast therefore tended to underestimate forthcoming changes.

"The IPCC felt the whole dynamics of polar ice-sheet melting were too poorly understood," added Vaughan. "However, we are now getting a much better idea of what is going on in Greenland and Antarctica and can make much more accurate forecasts about ice-sheet melting and its contribution to sea-level rises."

From studying satellite images, scientists have watched the sea ice that hugs the Greenland and Antarctic shores dwindle and disappear. Sea-ice melting on its own does not cause ocean levels to rise, but its disappearance has a major impact on land ice sheets. Without sea ice to prop them up, the land sheets tip into the water and disintegrate at increasing rates, a phenomenon that is now being studied in detail by researchers.

"It is becoming increasingly apparent from our studies of Greenland and Antarctica that changes to sea ice are being transmitted into the hearts of the land-ice sheets in a remarkably short time," added Vaughan. As a result, those land sheets are breaking up faster and far more melt water is being added to the oceans than was previously expected.

These revisions suggest sea-level rises could easily top a metre by 2100 - a figure that is backed by the US Geological Survey, which this year warned that they could reach as much as 1.5 metres.

In addition, in September, a team led by Tad Pfeffer at the University of Colorado at Boulder published calculations using conservative, medium and extreme glaciological assumptions for sea-level rise expected from Greenland, Antarctica and the world's smaller glaciers and ice caps. They concluded that the most plausible scenario, when factoring in thermal expansion due to warming waters, will lead to a total sea level rise of one to two metres by 2100.

Similarly, a commission of 20 international experts, called on by the Dutch government to help plan its coastal defences, recently gave a range of 55cm to 1.1 metres for sea-level rises by 2100. "Equally important, this commission has highlighted the fact that sea-level rise will not stop in the year 2100," said Professor Stefan Rahmstorf of Potsdam Institute for Climate Impact Research. "By 2200, they estimate a rise of 1.5 to 3.5m unless we stop the warming. This would spell the end of many of our coastal cities."

This point was backed by Dr Jason Lowe of the Hadley Centre, the UK's foremost climate change research centre. "It is still not clear exactly how much the sea will rise by the end of this

century, but it is certain that rises will continue for hundreds of years beyond that - even if we do manage to stabilise carbon dioxide emissions and halt the rise in atmospheric temperature. The sea will continue to heat up and expand. In addition, the Greenland ice sheets will continue to melt," he said.

This latter effect could, ultimately, have a particularly destructive impact. Scientists have calculated that if industrial emissions of carbon dioxide and other greenhouse gases eventually produce a global temperature increase of around 4C, there is a risk that Greenland's ice covering could melt completely. This could take several hundred years or it might require a couple of thousand. The end result is not in doubt, however. It would add around seven metres to the planet's sea levels. The consequence would be utter devastation.

Such a scenario is distant, but real, scientists insist. However, at present, the most important issue, they argue, is that of short-term sea-level rises: probably around one metre by 2100. When that occurs, the Maldives will be submerged, along with islands like the Sunderbans in the Bay of Bengal, and Kiribati and Tuvalu in the Pacific. The US - which has roughly 12,400 miles of coastline and more than 19,900 square miles of coastal wetlands - would face a bill of around \$156bn to protect this land. Cities such as London would require massive investments to provide defences against the rising waters. Others, such as Alexandria, in Egypt, would simply be inundated.

Rising oceans will also contaminate both surface and underground fresh water supplies, worsening the world's existing fresh-water shortage. Underground water sources in Thailand, Israel, China and Vietnam are already experiencing salt-water contamination.

Coastal farmland will be wiped out, triggering massive displacements of men, women and children. It is estimated that a one-metre sea-level rise could flood 17% of Bangladesh, one of the world's poorest countries, reducing its rice-farming land by 50% and leaving tens of millions without homes.

Such destruction would not be caused merely by rising sea levels, however. Other effects of global warming will also worsen the mayhem that lies ahead: in particular, the increase in major storms. "When we talk about the dangers of future sea-level rises, we are not talking about a problem akin to pouring water into a bath," added Dr Colin Brown, director of engineering at the Institution of Mechanical Engineering. "Climate-change research shows there will be significant increases in storms as global temperatures rise. These will produce more intense gales and hurricanes and these, in turn, will produce massive storm surges as they pass over the sea."

The result will be the appearance of the super-surge, a climatic double whammy that will savage low-lying regions that include Britain's south-eastern coastline, in particular East Anglia and the Thames Estuary, along with cities such as London, Portsmouth and Hull, which are rated as being particularly vulnerable to sea-level rise.

In addition to these hotspots, the country will also face massive disruption to its transport and energy systems unless it acts swiftly, according to a report - *Climate Change, Adapting to the Inevitable* - published last month by the Institution of Mechanical Engineers. Many rail lines run

along river valleys that will be flooded with increased regularity while bridges carrying trains and lorries often cross shipping lanes and may have to be redesigned to accommodate rising water levels.

"Power supplies will also be affected," added Brown. "The Sizewell B nuclear plant has been built on the Suffolk coast, a site that has been earmarked for the construction of several more nuclear plants. However, Sizewell will certainly be affected by rising sea levels. Engineers say they can build concrete walls that will keep out the water throughout the working lives of these new plants. But that is not enough. Nuclear plants may operate for 50 years, but it could take hundreds of years to decommission them. By that time, who knows what sea-level rises and what kinds of inundations the country will be experiencing?"

Most scientists believe Britain remains relatively well placed to combat sea-level rises. "The government has been fairly far-sighted over this issue, with projects such as Thames Estuary 2100 being set up to prepare flooding defence projects," said Professor Robert Nicholls, of Southampton University.

This does not stop the controversy, however. In its report, the Institution of Mechanical Engineers warned that many areas would have to be abandoned because they are simply too expensive to protect. In particular, large areas of the Norfolk coastline would be left to be inundated, a massive loss of human habitat.

But this approach represents an abrogation of national duty to many people - particularly those whose homes will be destroyed, individuals such as Martin George, former chairman of the Broads Society. "A country that has the technological know-how to extract oil and coal from below the North Sea should surely be capable of finding a way to protect a concrete sea wall against the effects of climate change. We should do our damndest to safeguard our heritage," he said.

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*Additional research by Lisa Kjellsson.*

### **Why the sea is rising.**

- Thermal expansion. All bodies expand when they are heated, and that is true for the water that covers 70 per cent of the planet. The oceans are expanding - upwards. It is estimated this increase in volume will raise levels by 10-40 cms.
- Melting glaciers and mountain ice caps - outside Greenland and Antarctica - are also adding water to rivers that flow to the oceans. However, these remain a modest source of sea-level rise. Possibly around 10 cms.
- The Greenland and Antarctic ice sheets represent vast reserves of frozen fresh water. The former would add 7m to sea levels if melted completely; the latter would bring a further 60m rise to the levels of the world's oceans.

