

# Scientists Seek Strategy to Convey Seriousness of Sea-Level Rise

The impact of sea-level rise as a result of global warming will be seen on coastlines around the world over the next several decades and centuries, affecting at least half the world's people

By [Anne C. Mulkern](#) and [ClimateWire](#)

**SEA-LEVEL RISE:** Rising waters as a result of climate change will reshape the world's coastlines.  
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LA JOLLA, Calif. -- Sea-level rise threatens cities around the world, and academic leaders must talk about it differently to help people grasp the potential dangers and costs, climate experts said last week.

Researchers must detail effects at the local and regional levels, members of the Association of Pacific Rim Universities (APRU) Sustainability and Climate Change Program said as they met at the University of California, San Diego. They need to talk shorter time windows, mentioning impacts in 2050 as well as in 2100. And they should drive home to people that actions to limit climate change can help protect their children and grandchildren from huge economic and social impacts.

"Sea-level rise is not a problem that's going away," said Dan Cayan, a climate researcher at the Scripps Institution of [Oceanography](#) at UC San Diego. "In some sense, this is an important investment. This is a multigenerational issue."

Climate researchers from around the world gathered for three days at UC San Diego to share information and formulate strategies. They discussed the importance of talking about sea-level rise and climate change as they brainstormed what advice they should give to university presidents. During that session, some of the APRU members urged more of an activist role, saying too much time already has been lost.

"People who don't believe climate change is real, and sea-level rise is real, are really few and far between," said Bernard Minster, a UC San Diego professor and Scripps researcher.

The conference took place just after sea-level rise and climate change happened to surface on the national stage. At the Republican National Convention, presidential nominee Mitt Romney in his acceptance speech derided President Obama's position on the issues.

"President Obama promised to begin to slow the rise of the oceans," Romney said as some in the audience snickered, "and to heal the planet. My promise is to help you and your family."

Obama in his speech at the Democratic National Convention said that "climate change is not a hoax."

"More droughts and floods and wildfires are not a joke. They are a threat to our children's future. And in this election, you can do something about it."

The scientists who met here asserted that spreading some basic facts about sea-level rise may be helpful. Higher temperatures are causing oceans to swell and glaciers to melt, they said, spawning sea-level rise. Increases now and over the next few decades are the result of greenhouse gas emissions over the past 50 years, making some change inevitable.

By the end of this century, they said, seas will climb 80 centimeters, or roughly 2.6 feet. That number could grow to as much as 2 meters, or 6.6 feet, particularly if the ice sheets in Greenland and Antarctica melt entirely, said Helen Fricker, an associate professor at the Scripps Institution of Oceanography.

By 2300 sea levels could lift 10 feet to 13 feet, she added.

The rising seas will affect the lives of millions of people and cost billions of dollars, the researchers said. Half the world's population lives within 62 miles of a coast.

### **Some areas more threatened than others**

Sea-level rise has the potential to affect some places more than others, even within the same state, the experts said.

For example, in California, the impact will be felt more in the south than it will in the state's north or in Oregon and Washington, Cayan said. Two trends contribute to that phenomenon, he said.

The ocean plate is descending below North America at the Cascadia subduction zone, which runs from northern Vancouver Island, British Columbia, to Northern California. The land there is rising as seismic strain builds, Cayan said, making sea level rise less.

It's likely not permanent, however. An earthquake with a magnitude of 8 or higher would stop the land from rising and also likely would bring about additional sea-level growth of 1 to 2 meters (3.3 to 6.6 feet) in the area, he said.

"This could be a great game changer as far as sea-level rise," Cayan said. It would be "instantaneous sea-level rise of the sort Japan saw a year ago" after its magnitude-9 temblor.

The other factor making sea-level rise higher in Southern California could be winds, Cayan said. There was a study that surmised east-to-west winds are driving storm surges that are pushing waters. If those winds calmed, he said, that likely would stop the comparably higher sea effect in the region.

In California, sea-level rise threatens the coastline's homes and other buildings, including San Francisco International Airport, APRU members said. It also endangers freshwater supplies, which in turn could have a big impact on agriculture. The state exports many of its crops across the country.

The bulk of California's [water](#) passes through the Bay Delta region roughly between San Francisco and Sacramento. Rising seas could cause saltwater intrusion. Additionally, as the state's snowpack melts earlier because of warming, Cayan said, there is more runoff from higher elevation, which increases flooding.

### **Key cities threatened**

Large population centers in the United States already imperiled by sea-level rise include New York, Boston, Miami and Tampa, Fla., said Trevor Davies with the Tyndall Centre at the University of Southampton in England. Elsewhere in the world, rising waters are likely to affect London, Bangkok, Hong Kong, Tokyo and Shanghai.

"Asia has the largest overall exposure," Davies said.

Predicted urban population growth will compound the hazards, he said. London expects to grow to 9 million people within a decade. The U.K. government has a strategy to reduce greenhouse gas emissions 80 percent by 2050, Davies said.

Desalination [plants](#) could help provide water in large population centers, but they also increase carbon pollution, Davies said.

Sea-level rise also could be a major problem in Australia, where 80 percent of people live in coastal cities, said Steffen Lehmann, director of the Centre for Sustainable Design and Behaviour at the University of South Australia. He is urging widespread use of demonstration projects to develop superior green building districts that would cut energy use.

"We are running out of time," Lehmann said. "We need real action on the ground. We need to have real breakthroughs."

Jakarta, Indonesia, faces significant water inundation, said Jatna Supriatna with the University of Indonesia, Jakarta. Gov. Fauzi Bowo wants to build a large sea wall at a cost of \$20 billion.

Some at the conference argued that walls aren't the best solution to manage rising seas, however. They damage sea environments and are prohibitively expensive for most places in the world, said Charles Kennel, director emeritus of the Scripps Institution.

The Netherlands has a 100-year strategy and plans to spend \$2.5 billion per year for the next century, he said, but that country has a short coastline. Venice, Italy, decided to invest €5 billion (\$6.4 billion) on tidal gates to hold back water, because the city sees its buildings as priceless, Kennel said.

"The expense of doing that is an instructive number," he said of the gates.

The gates are supposed to be built to withstand 80 centimeters of sea-level rise, but it is not clear how long that will protect the city, some at the conference said.

Some argue it would make more sense just to retreat from certain areas, Kennel said.

"I cannot imagine that the right solution out is to keep the ocean out via sea wall," Kennel said. "The better solution is to learn how to live with the dynamic ocean."

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# Sea level rise

Background - July 4, 2012

It is not only small island states that need to worry about sea level rise. Sea level rise increases the risk of both temporary and permanent flooding of coastal lands. Around 23% of the world's population lives in the near coastal zone with population densities about three times higher than the global average.

Migration to coastal areas is increasingly common in many countries around the world, developed and developing alike. Settlements and urban centres in coastal regions have expanded more rapidly than elsewhere. Of the 39 big metropolitan areas with a population over 5 million, sixty percent are located within 100km of the coast. These include twelve of the biggest 16 with populations exceeding 10 million although the great majority of people live in smaller settlements in the coastal zone. High densities of people are also found in delta regions, which are particularly vulnerable to flooding.

Over the 20th century as a whole, sea levels rose by an average of around 1.7mm a year with evidence that in recent years the rate of rise has increased. Latest satellite data put the rise at around 3mm a year. **The most recent IPCC assessment based on the most gloomy scenario puts predictions of 21st century sea level rise at between 26 and 59cm (10-23 inches).** There are many variables - including how much the expected increases in precipitation will add to snow packs and, most importantly, our greenhouse gas emissions over the next decades. What we can expect is that even a small amount of sea level rise will have profound and largely negative effects.

Activists make a demand for action from politicians and ministers gathered in Cancun in the second week of the UN climate negotiations. Greenpeace worked with tcktcktck partners 350.org to bring the message that "real people can't live under water" and climate change requires the building blocks to a global climate deal in Cancun.

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## What we can expect

With a fossil fuel intensive future, a global average sea level rise of 26-59cm (10-23 inches) is expected over the next hundred years, thanks to the greenhouse gases we have emitted to date and likely future emissions. This will be around two thirds due to thermal expansion of the oceans (water expands as it heats up) and one third due to melting. Even with more optimistic projections based on greenhouse gas emissions being controlled, sea level could rise by between 10-24cm (4-9 inches). Over several centuries, therefore, sea level could rise by several metres.

Even the comparatively modest projected sea level rise will wreak havoc. **Coastal flooding and storm damage, eroding shorelines, salt water contamination of fresh water supplies, flooding of coastal wetlands and barrier islands, and an increase in the salinity of estuaries are all realities of even a small amount of sea level rise.** Some low lying coastal cities and villages will also be affected. Resources critical to island and coastal populations such as beaches, freshwater, fisheries, coral reefs and atolls, and wildlife habitat are also at risk.

It's worth keeping in mind, however, that changes in sea level do not occur uniformly around the globe. There is actually a fair amount of difference in sea level rise in different parts of the world due to ocean circulation and wind pressure patterns. Accordingly, the effects of storm surges and of spring tides also need to be kept in mind when evaluating sea level rise impacts.

## The disappearing Greenland ice sheet

After stabilizing 2000-3000 years ago following the last ice age 20,000 years ago, sea levels remained stable until the late 19th century when then they began to rise once more. The rate of rise seems to be accelerating.

One area of critical concern are the ice sheets of Greenland and Antarctica which if fully melted would raise sea level by 64m. In the case of Greenland, loss of between 50 and 100 billion tons of ice has taken place annually over the period 1993-2003 with evidence of higher rates more recently. Recent research has suggested that the ice sheet could melt completely over the very long term (millennia) if global temperatures rise by somewhere between 1.9 and 4.6 degrees and they have already risen by an estimated 0.8 degrees. Complete melting would lead to a sea level rise of around 6-7m.

## The Antarctic ice sheets

In 2002, the 500 billion tonne Larsen B ice shelf, which covered an area twice the size of greater London, [disintegrated in less than a month](#). This did not directly add to sea level rise since the ice shelf was already floating, but it was a dramatic reminder of the effects of warming in the area. It's also thought that the ice shelf helped to hold some of the area's land-locked ice in place, and now that it's gone more land ice will fall into the sea over time. The Larsen A ice shelf, two thirds as big as Larsen A, collapsed in 1995

In 2005, the British Antarctic Survey released findings that 87 percent of the glaciers on the Antarctic Peninsula have retreated over the past 50 years in common with many of the glaciers being monitored around the world. Between 2000-2005, the Antarctic Peninsula glaciers lost an average of 50 metres (164 feet) per year.

The most recent IPCC assessment suggests that overall, the Antarctic ice sheets could already be losing many billions of tonnes a year of ice, although the precise figures are highly uncertain due to the quality of the data and methodologies used for the estimates. Potentially, according the IPCC, the West Antarctic ice sheet (WAIS) alone could contribute an additional six metres (20 feet) to sea level rise over several thousand years, although more recent estimates suggest a lower figure of 3.3 metres may be more plausible. The differences in these figures are evidence of the huge uncertainties that exist in the predictions of sea level rise, and the huge gamble being taken if greenhouse gas emissions are not quickly stabilized and reduced.

## Consequences

While melting of the Greenland ice sheet and the Western Antarctic ice sheet could ultimately raise sea levels by anything up to 13 metres or so (43 foot) if we do not drastically curb our greenhouse gas

emissions, even the small fraction of this predicted by 2100 would be an economic and humanitarian disaster. A few possible consequences of rising sea levels:

- **Billions spent on adaptation - if you can afford it.** The US, for example, has roughly 20,000 km (12,400 miles) of coastline and more than 32,000km (19,900 miles) of coastal wetlands. A recent study estimated the costs of adapting to even a one metre sea level rise in the US would amount to US\$156 billion (3 percent of GNP). More recent estimates of the impact of a 66 cm sea level rise by 2100 suggest costs could be in the region of US\$ 236 billion, with nearly 9000 square kilometers of land having to be abandoned and 13,000 km of coastal defences needing to be constructed. Needless to say many poorer countries do not have these resources.
- **With a one metre sea level rise some island nations, such as the Maldives, would be submerged.** Already, two of the islands that make up Kiribati (a Pacific island nation) have gone under the waves, and in early 2005 others were inundated by a high spring tide that washed away farmland, contaminated wells with salt water, and flooded homes and a hospital.
- If current warming trends are allowed to continue, London, Bangkok and New York, Shanghai and Mumbai will be among a number of **cities which will eventually end up below sea level** - displacing millions and causing massive economic damage. There come a point at which, building higher and higher sea defences becomes impractical, and even the wealthiest nations will see cities flood.
- **Rising oceans will contaminate both surface and underground fresh water supplies** - worsening the world's existing fresh water shortage.
- **Rural populations will be displaced and farmland (especially rice) on some coasts will be lost to the seas.** For example, according to the UK Royal Society a one metre sea level rise could flood 17 percent of Bangladesh, one of the world's poorest countries, displacing tens of millions of people and reducing its rice-farming land by 50 percent.

There is some good news, though. If we act rapidly to reduce emissions we can still prevent the worst effects of climate change. [Switching to renewable energy sources](#), if we do it fast enough, is our only hope to avoid disastrous sea level rise.