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RISE IN SEA LEVEL

Climate change could lead to sea level rises that are larger, and happen more rapidly, than previously thought, according to a trio of new studies that reflect mounting concerns about the stability of polar ice. In one case, the research suggests that previous high end projections for sea level rise by the year 2100, a little over three feet, could be too low, substituting numbers as high as six feet at the extreme if the world continues to burn large volumes of fossil fuels throughout the century.

The results comprise both novel scientific observations, based on high resolution seafloor imaging techniques that give a new window on past sea level events, and new modeling techniques based on a better understanding of Antarctic ice.

The observational results, from Texas and Antarctica, examine a similar time period, the close of the last Ice Age a little over 10,000 years ago, when seas are believed to have risen very rapidly at times, as northern hemisphere ice sheets collapsed.

Off the Texas coast, this would have inundated ancient coral reefs. Usually, these reefs can grow upward to keep pace with sea level rise, but there's a limit, one observed by a team of scientists aboard a vessel called the Falcor in 200 foot deep waters off the coast of Corpus Christi.

These so-called drowned reefs showed features that the researchers called "terraces," an indicator of how the corals would have tried to respond to fast rising sea levels. Because the organisms must maintain access to a certain amount of sunlight, they would have tried to grow higher to keep up with fast rising seas, but they wouldn't have been able to do so over a very large area. And so their growth became concentrated in progressively smaller, stepped regions:

The reef under stress often has a tendency to kind of shrink to this higher elevated area, according to a study in Nature Communications and a researcher at Rice University. The youngest drowned corals date to the end of the last ice age, around 11,500 years ago, corresponding to what scientists believe were large warming events in the northern hemisphere and so-called meltwater pulses from now melted ice sheets. And multiple drowned reefs off Texas show a similar pattern, and terminate in similar water depths. Over 120 kilometers, the reefs behaved the same way. It's difficult to find any other reason why they would do this, scientists observed.

Scientists think the reef structures suggest eras when sea level was rising by tens of millimeters annually, far beyond the current, roughly 3 millimeters

per year. (A 50 millimeter annual sea level rise would produce a meter, or over 3 feet, of rise every 20 years.) The new study therefore concludes that during the last ice age, there were multiple bursts of fast sea level rise, and implies that our future could hold something similar.

The steady and gradual sea-level rise, observed over the past two centuries may not be a complete characterization of how sea level would rise in the future, the study concludes. Meanwhile, far away in the Southern hemisphere, a team of scientists used a very similar seafloor mapping technology to detect ancient iceberg “plough marks” etched deep into the seafloor of Pine Island Bay, an ocean body that currently sits in front of one of West Antarctica’s most worrying glaciers, Pine Island. The seafloor grooves, the researchers believe, were made during a similar era to the Texas coral steppes (the close of the last ice age), and signal a very rapid retreat of Pine Island over roughly a thousand years.

What’s critical about the markings, explains lead study at University of Cambridge, is their maximum depth, 848 meters, or around 2,800 feet. Because ice floats with 10 percent of its mass above the surface and the remaining 90 percent below it, this suggests that when the ice broke from the glacier, close to 100 meters (over 300 feet) of it was extending above the water surface.

That’s a key number, because scientists are converging on the belief that ice cliffs of about this height above the water level are no longer sustainable and collapse under their own weight, meaning that when you get a glacier this tall up against the ocean, it tends to crumble and crumble, leading to fast retreat and potentially fast sea level rise.

If a cliff even higher than the ~100 m subaerial/900 m submarine cliffs were to form, as might occur with retreat of Thwaites Glacier in West Antarctica, it might break repeatedly with much shorter pauses than now observed, causing very fast grounding line retreat and sea level rise, explained a glaciologist at Penn State University. The final study, takes a different approach but provides perhaps the most sweeping verdict. The study used five “shared socioeconomic pathways” that analyze possible futures for global society and its energy system, and resulting climate change, over the course of this century. These scenarios will feed into the next report of the United Nations Intergovernmental Panel on Climate Change, the most influential scientific body that assesses climate change, according to the University of Melbourne’s current study. The research combined these scenarios with tools to project future sea level rise in light of recent science suggesting that Antarctic ice in key regions could collapse relatively rapidly. That includes possible fast retreat at Pine Island and Thwaites glaciers due, in part, to the problem of ice cliff instability.

The result was that in one scenario assuming high fossil fuel use and strong economic growth during the century, the study predicted that seas could rise by as much as 4.33 feet on average, with a high end possibility of as much as 6.2 feet, by 2100. That includes possibly rapid sea level rise as high as 19 millimeters per year by the end of the

century. These numbers are considerably higher than high end projections released in 2013 by the Intergovernmental Panel on Climate Change.

It is important to emphasize that the highest sea level numbers presented in the new study would result from human choices to pursue large fossil fuel exploitation and economic growth with little attempt to slow climate change. It is far from clear that this is the path the world will actually take.

On the other hand, if the world limits global warming to the Paris climate agreement emissions target, the study finds that sea level rise might be held as low as 1.7 feet by 2100, on average.

So in sum, new research is affirming that seas have risen quite rapidly in the planet's past, and that major glaciers have retreated quickly because their enormous size makes them potentially unstable. Meanwhile, additional modeling projects these kinds of observations forward and suggests that the century in which we are now living could see similar changes, at least in more severe global warming scenarios in which the world continues to burn high volumes of fossil fuels.