'Impossible to adapt': Surprisingly fast ice-melts in past raise fears about sea level rise

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Devising models to predict sea level rise is notoriously difficult, say researchers. Credit: Dan Meyers / Unsplash

Studies of ancient beaches and fossilised coral reefs suggest sea levels have the potential to rise far more quickly than models currently predict, according to geologists who have been studying past periods of warming.

At one point in a comparable period they were rising at three metres per century, or 30mm a year, according to Dr. Fiona Hibbert, a geologist at York University in the UK. The current rate of rise is 3.2mm per year.

Dr. Hibbert is working on a project called ExTaSea, which predicts worst-case scenarios for sea level rise around the globe. The goal is to help policymakers take long-term decisions, for example about the siting of enduring infrastructure such as nuclear power stations.

Devising models that can make such predictions is notoriously difficult, she says.

"We're not entirely sure of all the processes involved. When you melt an ice sheet sometimes it's really long-time scales that they operate over, which is quite difficult to put into a model."

And melting itself alters the system—for example, by lightening the load on the Earth's crust which then undergoes a slow-motion rebound over thousands of years.

A further issue is that data on recent sea levels dates back only 150 years—for tide gauges—and just 20-25 years for satellite measurements.

Because of this, geologists such as Dr. Hibbert, and Professor Alessio Rovere, a geoscientist at the University of Bremen in Germany, are looking back to see what happened during the last interglacial period.

"The geological record is great because it includes all the processes," said Dr. Hibbert.

Interglacial

We live in an interglacial period known as the Holocene. "For the last 6,000 years, humans have enjoyed rather stable climate and sea level conditions, and prospered thanks to this," said Prof. Rovere.

The closest analogue to the Holocene in the geological past is the last interglacial, which occurred between 125,000 and 118,000 years ago. During this time, the global temperature was about one to two degrees higher than the baseline pre-industrial temperatures used to measure climate change today, due to slight differences in the Earth's tilt and orbit.

Geologists can find clues to the sea level at this time from fossilised coral reefs that were stranded as cliff layers when seas subsided, as well as the chemical composition of tiny, marine organisms known as foraminifera, which give an idea of the reach of the sea in the past, says Dr. Hibbert.

And Prof. Rovere, who runs a project called WARMCOASTS, also considers what ancient beaches—which also became layers in the cliffs—can tell us.

"A beach today has sands forming along the shoreline … imagine that all of this … can be frozen in time because it becomes rock. So we can go back, and look at rocks that were former beaches," he said. From their characteristics and the shells preserved inside them, 'we can make connections to the changing sea level," he said.

Teasing out the right message from stranded reefs and beaches is tricky, however. A receding sea might leave remnants of its presence in one place, only for them to be uplifted—or dropped—by subsequent geological activity.

Prof. Rovere experienced these problems when trying to solve the enduring puzzle of mysterious, huge boulders which lie atop 15-metre cliffs on the island of Eleuthera in The Bahamas. While some in the field believe they were flung there by super-storms, others, including him, think a combination of higher sea levels plus lesser storms were responsible.

Ten times higher

Despite these challenges, Dr. Hibbert amalgamated ancient coral reef analyses done by scientists around the globe and concluded that sea levels rose at 'really high' rates—of up to three metres per century, 'which is about ten times higher than current rates."

Prof. Rovere is gathering data on geological features such as ancient corals and beaches to create a database that will help give a nuanced story of how sea levels changed in different places and the strength of the waves during the last interglacial.

It's hard interpreting geological data, so Prof. Rovere is also drawing on models more commonly used by engineers to understand the impact of waves and currents on harbours—they can help him understand how sand was deposited along interglacial shores.

"By combining these two different disciplines … we can say much more about the past than we can do with just the geological interpretation of the rocks," he said.

His work is producing slightly different figures.

"In some rock records—there are some characteristics that make us think that at some point during this warm period the sea level jumped, from three metres to six metres," he said. This equates to about 10 mm a year. The jump occurred in a relatively short time, he says.

"This is really interesting because today we are in a warm period—naturally as well as because of climate change—and in the last interglacial, even without us giving warmth to the system, some data suggest that there was this jump.

"Now this is a very debated idea but what if it is true? It means there is this possibility of rapid melting of ice, on top of what we do as humans."

Prof. Rovere says that a 10mm a year sea level rise would be 'almost impossible' to adapt to with sufficient speed. "It means we just have to abandon our cities," he added.

Acceleration

The prospect of a sudden acceleration in ice melting is further supported by work done by Dr. Yucheng Lin, a student of Dr. Hibbert's as part of the ExTaSea project.

This time the reference period is 24,000 to 11,000 years ago, Earth's most recent deglaciation, which preceded the Holocene.

This period was substantially different from today which makes it 'not so great for looking at the future," said Dr. Hibbert. For example, there were huge ice sheets over North America and Europe.

But they found that, at the peak of the ice-melt, seas rose at 3.6 metres per century.

"Again, these are really high numbers, so ice sheets can lose mass really quite quickly," said Dr. Hibbert.

She is now considering how such a rapid melting would play out this century on different coasts.

Just how are our seas changing and rising with climate change and the melting of Earth's ice caps? In this three-part series, we look at the past, present and future of extreme sea level rise. Coming next, in part two we will look at rise of atmospheric 'meteotsunamis."

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