



CTA-120- The Ocean Never Forgets

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When It Comes to Climate Change, the Ocean Never Forgets



Even if carbon emissions are reduced, the ocean is still set for centuries or more of warming, acidification, deoxygenation, and sea level rise. Photo by Ethan Daniels/Alamy Stock Photo
Climate scientists are investigating the extent to which warming, acidification, and other effects can be undone.

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If climate change were just a flirtation with disaster—that is, the world acted decisively and cut emissions, and the amount of atmospheric carbon dioxide fell tomorrow to preindustrial levels—the planet would respond quickly.

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Within decades, land temperatures would return to normal. The ocean, however, would bounce back more slowly. Much more slowly.

If greenhouse gas emission plummeted, the surface ocean—the top few hundred meters—would exchange heat with the atmosphere and recover relatively quickly, taking a few decades to improve.* But the deep ocean is like a roast in the oven, remaining hot long after the heat’s been turned off.

“The ocean doesn’t forget,” says Kirsten Zickfeld, a climate scientist at Simon Fraser University in Burnaby, British Columbia. “If we don’t cut emissions now, there’s a huge legacy in the marine environment.”

According to Zickfeld’s research, the deep ocean will hold on to its heat for centuries, if not millennia.

The world’s oceans already face a gauntlet of changes—warming, dwindling oxygen concentrations, and increasing acidification—that affect marine wildlife. Food webs are unraveling and some species, most notably corals and shellfish, are struggling to adapt to new environmental conditions.

The more countries fall short of their goals to mitigate climate change, and the longer it takes to reduce emissions, the more likely these effects are to become irreversible, says Zickfeld, who presented her research at a recent scientific conference in Portland, Oregon.

Aside from the direct effects of warming, secondary effects like sea level rise will also take a long time to undo, says climate model expert Dana Ehlert, who works at the GEOMAR Helmholtz Centre for Ocean Research Kiel in Germany.

Sea level rise is a consequence of retreating glaciers and melting ice caps and ice sheets. [According to a](#) study by Matthias Mengel of the Potsdam Institute for Climate Impact Research in Germany, even if global average warming is limited to less than 2 °C, melting ice will lock us into sea level rise of at least 1.5 meters until 2300.

But there is another cause of sea level rise, one that has an even longer lasting impact: as water warms, it expands. This thermal expansion will force a rise of at least 30 or 40 centimeters by the end of the century, says Ehlert. This effect is not reversible on human timescales. In fact, her research shows that it could take at least hundreds of years for this expansion to subside. The chemical effects of climate change on the ocean—including acidification and deoxygenation—would take a similar time to reverse, according to Zickfeld.

Unfortunately, Zickfeld says, it’s too late to avert part of this fate. She and her team have been studying the possibility of using so-called “[negative emission technologies](#),” such as carbon capture and storage plants or bioenergy plantations, to reduce atmospheric carbon dioxide by sucking it out of the atmosphere or injecting it into the ground.

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But even if these schemes work and quickly reduce carbon dioxide concentrations and surface temperatures to less dangerous levels, it's not enough to undo the damage, Zickfeld says. According to her calculations, sea level rise will still be locked in for several centuries.

*Correction: This sentence originally read "...taking decades or maybe a century."

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