

2018 hottest year on record for oceans

Scientists say heat trapped by increased emissions is warming Earth's waters faster than was recognized.



THE LONGER oceans continue to warm, the more devastating the effects, scientists say. Marine ecosystems, including coral reefs already stressed by warming, will be unable to recover from heat waves and bleaching. (Tane Sinclair-Taylor James Cook University)

BY TONY BARBOZA

Earth's oceans had their warmest year on record in 2018, a stark indication of the enormous amount of heat being absorbed by the sea as greenhouse gas emissions continue to rise, scientists reported Wednesday.

The [analysis](#) by an international team of scientists confirms that the oceans are heating up much faster than previously recognized and that the pace of warming has accelerated sharply since the 1990s.

Rising ocean temperatures are already having profound consequences across the globe, scientists say, contributing to more intense hurricanes, destroying coral reefs and causing sea levels to rise.

The report in the journal *Advances in Atmospheric Sciences* builds on [a study last week](#) that found oceans are warming 40% more, on average, than was estimated by a United Nations scientific panel just five years ago. In fact, each of the last 10 years is among the 10 warmest on record, according to data from [Lijing Cheng](#) of the Institute of Atmospheric Physics in Beijing, who led the research.

The unrelenting pattern is “incontrovertible proof that the Earth is warming,” and an unmistakable signal of the serious damage humans are already causing through climate change, the authors of the new study wrote.

Earth’s oceans provide a crucial buffer against climate change by swallowing 93% of the excess heat trapped by the greenhouse gases humans are spewing into the atmosphere.

“The oceans are really the Earth’s thermometer,” said [Zeke Hausfather](#), a climate scientist with the academic nonprofit Berkeley Earth who collaborated on the research. “They’re where all the heat ends up. They’re where we’d expect the strongest signs of climate change to be. And that’s exactly what we see.”

In contrast with rising surface temperatures, which can vary from year to year with the influence of weather and cyclical climate patterns such as El Niño, the warming of the ocean has been inexorable, with virtually every year breaking the heat record set just 12 months earlier.

“There’s no sign of any slowdown or pause,” Hausfather said. “The ocean temperature is increasing year over year in lockstep with increases in atmospheric carbon dioxide and other greenhouse gases.”

Indeed, emissions have accelerated as President Trump and some other world leaders have pursued energy policies that promote fossil fuels. Global carbon emissions increased 1.6% between 2016 and 2017, then jumped an additional 2.7% in 2018, according to [estimates](#) published last month in the journal *Environmental Research Letters*. Last week, the research firm [Rhodium Group reported](#) that U.S. carbon emissions rose 3.4% in 2018 after years of declines.

Rather than measure the water’s temperature, the researchers focused on the amount of energy the oceans had taken in. They determined that the heat content has increased by around 370 zettajoules since 1955.

The amount of heat gained in 2018 — about 9 zettajoules — was about 100 million times greater than the heat released by the atomic bomb dropped on Hiroshima, Japan, Hausfather said.

The rate of warming in the ocean's upper 6,500 feet has been up to five times faster since 1991 than it was in the 1970s and '80s, scientists found. The warming is more pronounced in shallower waters, with about two-thirds of the energy accumulating within 2,000 feet of the surface.

The effects will grow more devastating the longer oceans continue to warm, scientists say. Wetter, more powerful hurricanes, such as Harvey in 2017, will become more frequent. Marine ecosystems, including coral reefs already stressed by past warming, will be [unable to recover](#) from marine heat waves and bleaching.

Oceans cover 71% of the Earth's surface, but the heat they contain is distributed unevenly. In 2018, one of the warmest spots was along the East Coast of the United States, where Hurricane Florence caused severe flood damage in the Carolinas last summer.

Warming ocean waters have had a direct influence on storms such as Florence and Harvey, scientists said, feeding them more energy and allowing them to hold more water vapor that rains down on coastal communities.

"It leads to an intensification of the storm, and a bigger storm," said [Kevin Trenberth](#), a climate scientist at the National Center for Atmospheric Research in Boulder, Colo., and a coauthor of both recent studies.

Ocean warming is also the main driver of the rising sea levels that are threatening coastal communities and ecosystems in addition to causing more severe flooding.

Without global action to slash greenhouse gas emissions, the study projects, the planet could see about another foot of sea level rise just from warmer water taking up more space. That so-called thermal expansion doesn't factor in additional increases expected as ice sheets melt in Greenland and Antarctica.

[Lisa Suatoni](#), a marine ecologist at the Natural Resources Defense Council, said that the warming detected to date is already causing rapid transformation of ocean ecosystems, including certain marine species moving toward the poles and economically harmful disruptions to fisheries that provide food and livelihoods to hundreds of millions of people worldwide.

"The ocean is playing this silent but important service to the Earth in absorbing most of the heat that's being trapped by our greenhouse gas emissions, but that service comes at a cost," Suatoni said. "The transformation that global warming is having on the oceans is largely unseen because we're land animals and it's hard to observe."

That's changing. Scientists' observations are improving considerably thanks to new measurement techniques, particularly [Argo](#), a network of drifting, automated floats in operation since the mid-2000s that periodically descend into the ocean to measure temperature and salinity, then transmit the readings to satellites.

The new analysis is based on Argo's measurements of the upper 6,500 feet of the ocean combined with earlier readings that go back to the 1950s. Scientists compared four different estimates of ocean warming completed since the United Nations'

[Intergovernmental Panel on Climate Change report](#) in 2014 and found them converging in agreement: Oceans were warming faster than prior estimates.

The findings of record ocean warming come one day before the National Oceanic and Atmospheric Administration and NASA were scheduled to release data on the average global surface temperature for 2018. The federal agencies are expected to report that 2018 was the fourth-hottest year on record, but their announcements have been delayed indefinitely by the partial government shutdown.

Once full operations are restored, it will take a least three days for scientists to finalize their reports, said Gavin Schmidt, head of the NASA Goddard Institute for Space Studies.

The shutdown has also halted the flow of information to the United Kingdom's [Met Office](#), its national weather service, which has not been able to finish its calculations of last year's average global surface temperature, said spokesman Grahame Madge.

“With the United States accounting for around 3% of the world's land surface, the absence of American data, even for one month, would skew the final figure,” he said. “We're hoping that the data can be released before the end of January.”

[A report](#) last week from the European Union's [Copernicus Climate Change Service](#) said the last four years have been the warmest on record, with 2018 in the No. 4 slot.

With a weak El Niño probably underway in the Pacific Ocean, 2019 air temperatures have a good chance of being hotter than they were last year.