

‘Astounding’ ocean temperatures in 2023 intensified extreme weather, data shows

Record levels of heat were absorbed last year by Earth’s seas, which have been warming year-on-year for the past decade



Cyclone Freddy, the longest-lived cyclone ever recorded, battering Blantyre in Malawi last year. Photograph: Thoko Chikondi/AP

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“Astounding” ocean temperatures in 2023 supercharged “freak” weather around the world as the climate crisis continued to intensify, new data has revealed.

The oceans absorb 90% of the heat trapped by the carbon emissions from the burning of fossil fuels, making it the clearest indicator of global heating. Record levels of heat were taken up by the oceans in 2023, scientists said, and the data showed that for the past decade the oceans have been hotter every year than the year before.

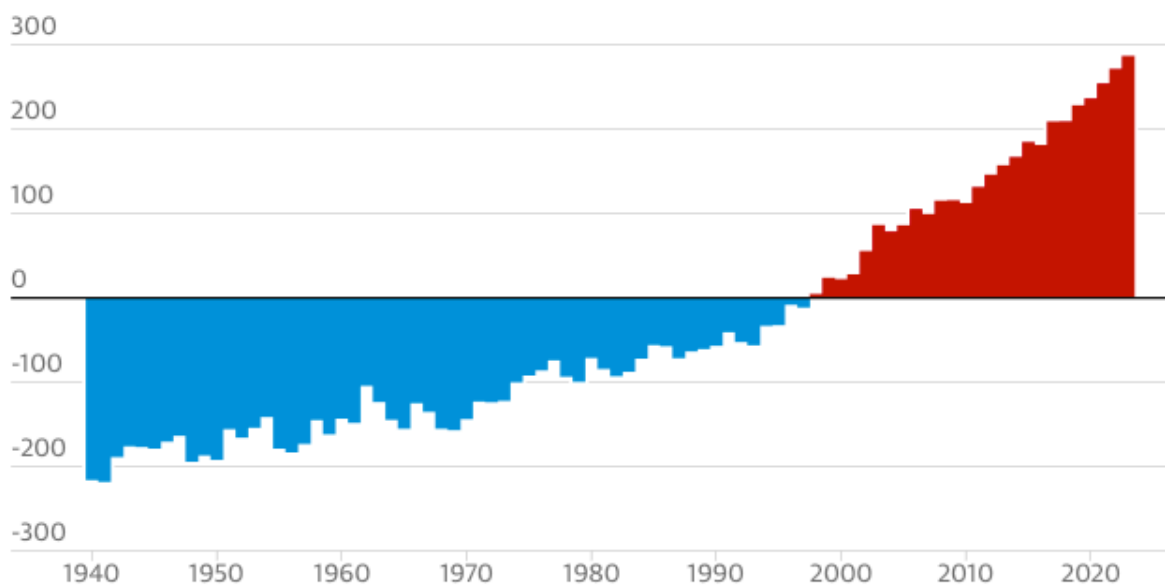
The heat also led to record levels of stratification in the oceans, where warm water ponding on the surface reduces the mixing with deeper waters. This cuts the amount of oxygen in the oceans, threatening marine life, and also reduces the amount of carbon dioxide and heat the seas can take up in the future.

Reliable ocean temperature measurements stretch back to 1940 but it is likely the oceans are now at their hottest for 1,000 years and heating faster than at any time in the past 2,000 years.

The most common measure of the climate crisis – global average air temperature – was also driven up in 2023, by a huge margin. But air temperatures are more affected by natural climate variations, including the return last year of the warming El Niño phenomenon.

The world's oceans were hotter than ever recorded in 2023

Ocean heat content in upper 2,000 metres relative to 1981-2010 average (zettajoules)



Guardian graphic. Source: Institute of Atmospheric Physics, Chinese Academy of Sciences / Cheng et al 2024
Advances in Atmospheric Science

“The ocean is the key to telling us what’s happening to the world and the data is painting a compelling picture of warming year after year after year,” said Prof John Abraham, at the University of St Thomas in Minnesota, part of the team that produced the new data.

“We’re already facing the consequences and they will get far worse if we don’t take action,” he said. “But we can solve this problem today with wind, solar, hydro and energy conservation. Once people realise that, it’s very empowering.

We can usher in the new energy economy of the future, saving money and the environment at the same time.”

The extraordinary temperatures in 2023 raised the question of whether global heating was accelerating. But Abraham said: “We’re watching for this but, currently, we do not detect a statistically significant acceleration. Right now, it’s basically a linear increase from about 1995.”

The new study, published in the journal Advances in Atmospheric Sciences, used temperature data collected by a range of instruments across the oceans to determine the heat content of the top 2,000 metres, where most of the heating is absorbed, as well as sea surface temperatures.

In 2023, an additional 15 zettajoules of heat was taken up by the oceans, compared with 2022. By comparison, humanity uses about half a zettajoule of energy a year to fuel the entire global economy. In total, the oceans absorbed 287 zettajoules in 2023.

These figures are based on data from the Institute of Atmospheric Physics at the Chinese Academy of Sciences. A separate dataset from the US National Oceanic and Atmospheric Administration found a similar increase and identical trend over time.

The ocean surface temperatures in 2023 were “off the charts”, the researchers said. The primary cause was another year of record carbon emissions, assisted by El Niño. Over the whole year, the average temperature was 0.1C above 2022, but in the second half of 2023 the temperature was an “astounding” 0.3C higher.

The scientists said the record level of stratification and reduced oxygen in the ocean would have “severe consequences” for ocean plant and animal life. Marine heatwaves struck across the oceans in 2023.

A separate report, by the consortium Global Water Monitor (GWM), found some of the worst disasters of 2023 were due to unusually strong cyclones bringing extreme rainfall to Mozambique and Malawi, Myanmar, Greece, Libya, New Zealand and Australia.

Prof Albert Van Dijk of GWM said: “We saw cyclones behave in unexpected and deadly ways. The longest-lived cyclone ever recorded battered south-eastern

Africa for weeks. Warmer sea temperatures fuelled those freak behaviours, and we can expect to see more of these extreme events going forward.”

Abraham said a rapid end to the burning of coal, oil and gas was needed: “If we don’t bend the trajectory of climate change downwards, then we are going to experience more extreme weather, more climate disruption, more climate refugees, more loss of agricultural productivity. We’re going to have costs in dollars and lives from a problem that we could have avoided. And, generally, those least responsible are going to suffer the most, which is a tremendous injustice.”