



A diver looks at the coral reefs of the Society Islands in French Polynesia in May 2019, where major bleaching had occurred.

Alexis Rosenfeld/Getty Images

# Ocean temperatures are off the charts right now, and scientists are alarmed

By Laura Paddison, CNN

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## **CNN —**

Ocean surface heat is at record-breaking levels. Temperatures began climbing in mid-March and skyrocketed over the course of several weeks, leaving scientists scrambling to figure out exactly why.

Temperatures have fallen since their peak in April – as they naturally do in the spring – but they are still higher than they have ever been on record for this time of year.

“It is remarkable,” said Gregory C. Johnson, an oceanographer at the National Oceanic and Atmospheric Administration, which calculates the ocean surface temperature using a network of ships, buoys, satellites and floats.

Although it’s still preliminary data, if it holds up, he said, “this is another milestone.”

The record may not seem huge – it’s nearly two-tenths of a degree higher than the previous record in 2016 – but given how much heat is needed to warm up this huge body of water, “it’s a massive amount of energy,” Matthew England, professor of ocean and climate dynamics at the University of New South Wales, Australia, told CNN.

What’s behind this rapid increase isn’t totally clear yet. “These temperatures just rocketed up, people haven’t had a chance to puzzle it all out,” Johnson said.

Some scientists are concerned the scale of these new records could mark the start of an alarming trend. Others say record-breaking temperatures like these are always concerning but to be expected given the human-caused climate crisis.

All agree the consequences are likely to be significant. Warmer oceans bleach coral, kill marine life, increase sea level rise and make the ocean less efficient at absorbing planet-warming pollution – the warmer oceans get, the more the planet will heat.

The return of El Niño

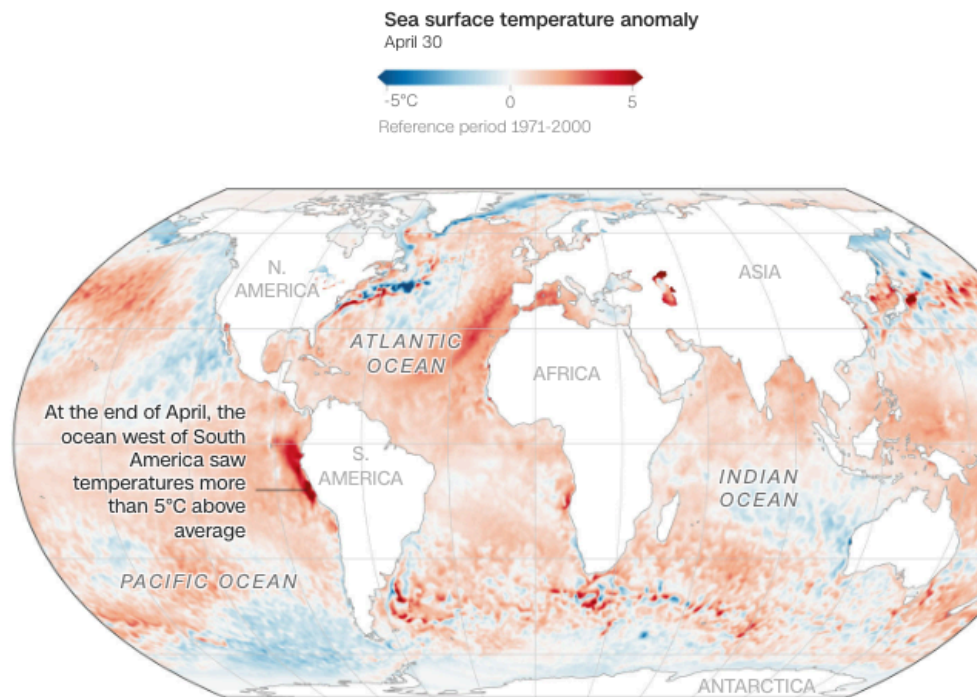
One major driver of the heat is believed to be an approaching – and potentially strong – El Niño, a natural climate fluctuation associated with warming in the central and eastern tropical Pacific Ocean, which has a global heating effect.

The world has just emerged from a 3-year La Niña, El Niño’s cooler counterpart, which has helped mask the full impact of global warming. Since La Niña ended in March, ocean temperatures seem to be on a rebound, scientists say.

“It’s a little bit like we’ve had the freezer door open for a while and it’s helped to cool the planet,” Johnson said. But even while that freezer has been open, background temperatures have continued to rise. Now the freezer is closed, everything is hotter than before.

## **Large swaths of ocean were warmer than average in spring 2023**

Following La Niña, the eastern Pacific off the coast of South America is experiencing particularly prominent warming, along with parts of the North Atlantic and North Pacific to a lesser extent, recent analysis shows.



Note: The most recent La Niña event was from 2020 to 2022.

Source: US National Oceanic and Atmospheric Administration  
Graphic: Amy O’Kruk and Krystina Shveda, CNN

The World Meteorological Organization said on Wednesday there is about an 80% chance El Niño will develop between July and September. But part of what has puzzled scientists is temperatures have risen so much before it has even arrived.

Some are concerned this suggests climate change might be progressing in ways climate models have not predicted.

“An El Niño event is brewing, but it’s probably too early to blame that as the cause,” professor Mike Meredith, science leader at the British Antarctic Survey, told CNN. “It’s vital that we find out what is causing [the peak in ocean surface temperature] though, and understand whether this is an isolated extreme high or the start of an even more worrying trend.”

Deeper ocean heat

Surface temperatures tell one story about what’s happening to the world’s oceans.

But to understand where the world is heading in the long term, it’s important to also look at the deeper ocean temperatures, said Sarah Purkey, an assistant professor at the Scripps Institution of Oceanography.

Thousands of floats in the world's oceans measure its heat content, analyzing temperature from the surface down to the deep waters, feeding back data.

“Ocean heat content has been on a very steady, sometimes accelerating, rise,” Purkey told CNN, because of human-caused global warming. The oceans absorb around 90% of the excess heat the world produces, as well as around 25% of carbon pollution.



The oceans just reached their hottest temperature on record as El Niño looms. Here are 6 things to watch for

In 2022, the oceans were the warmest on record for the fourth year in a row.

A study published in April found the heat in the climate system was accelerating, spelling bad news for the oceans.

It found the rate of change in how much heat the Earth has accumulated has more than doubled over the last two decades – and most of that is going into the ocean.

“There’s a really urgent need to understand this because if it’s part of a long term trend, this is really highly concerning,” said Karina von Schuckmann, an oceanographer at Mercator Ocean International in France and a co-author on the study.

One surprising reason could be the reduction of aerosols in the atmosphere. In 2020, regulations were introduced to limit the amount of sulfur in the fuel ships used – a policy aimed at addressing air pollution.

Though air pollution has a significant impact on human health, it also acts as an artificial sunscreen and reflects sunlight away from the Earth. One theory is the absence of aerosols may have turned up the heat, von Schuckmann said.

Worrying impacts of ocean warming

Whatever the reasons behind the increase in ocean heat, the impacts are potentially catastrophic if temperatures continue to head off the charts.

The oceans shield us from the full impacts of the climate crisis. “We should thank the ocean for taking up most of what we’ve done to the climate system, otherwise we would be seeing effects that are really 100 times what we’re seeing right now,” Purkey said.

But this buffering role comes at a high cost.

Hotter oceans cause coral reef bleaching and are linked to toxic algae blooms, which can suck oxygen from the water and choke marine life, sometimes forcing fisheries to close. Warmer waters are also less effective at absorbing carbon, which means more is left in the atmosphere, which in turn fuels more global warming.



Bleaching on the coral reefs of the Society Islands in Moorea, French Polynesia, in 2019.

Alexis Rosenfeld/Getty Images

Sea level rises as water warms – not only through the melting of ice sheets, but water also expands as it heats up.

Surface warming supercharges cyclones and hurricanes.



Our underwater future: What sea level rise will look like around the globe

Scientists are particularly concerned about the impact of warming on meridional overturning currents, ocean “conveyor belts” that push surface water to the deeper ocean and play a key role in regulating the planet’s energy balance. “It’s probably the most important thing to monitor,” said Purkey.

The strength of the currents will determine how efficient the ocean is at taking up the excess heat humans are producing, she said. And, for example, if the overturning current in the Atlantic Ocean weakens, or even collapses, the consequences could be dire – including very cold winters in Western Europe, rapid sea level rise and disruption to tropical monsoons.

For now, ocean surface temperatures have started to fall, even if they remain high for this time of year.

As scientists continue to analyze the reasons for record ocean warming, they are clear records will continue to be smashed as the climate crisis intensifies.

“This is a bit of a wake-up call, I hope, for everybody globally that this trajectory of warming that we’re on is not going to stop until we bring our emissions right back down to zero,” England said.

## **Oceans have been absorbing the world’s extra heat. But there’s a huge payback**

Record sea surface temperatures suggest the Earth is headed for ‘uncharted territory’ in terms of sea level rise, coastal flooding and extreme weather



As the ocean heats up, it expands, pushing up sea levels around the globe. Photograph: Kerem Yücel/AFP/Getty Images

## **Graham Readfearn**

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By the end of March, the surface temperature of the world's oceans was above anything seen in the 40 years that satellites have been measuring it.

Records were “**headed off the charts**” and, as the heat refused to fade for more than a month, the Earth marched into “**uncharted territory**”, scientists said.

The temperature at the ocean's surface – like on land – is being pushed higher by global heating but can jump around from one year to the next as weather systems come and go.

But in the two kilometres below the surface, that variability is almost nowhere to be seen. The rising heat down there has been on a relentless climb for decades, thanks to burning fossil fuels.



Life in ocean's twilight zone 'could disappear' amid warming seas  
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“The heat holding capacity of the ocean is mammoth,” says Dr Paul Durack, a research scientist specialising in ocean measurements and modelling at the US Department of Energy’s Lawrence Livermore National Laboratory.

“The ocean captures more than 90% of the imbalance of energy that we’re creating because of anthropogenic climate change.”

The ocean is much less reflective than the land and soaks up more of the direct energy from sunlight.

But as greenhouse gases trap more of the energy that’s reflected back – allowing less to escape to space – the ocean tries to balance itself with the heat in the atmosphere above.

A technical chart in a chapter of the latest UN climate assessment **laid out the unfathomable heat gain**. Between 1971 and 2018, the ocean had gained 396 zeta joules of heat.





More heat means more marine heatwaves that devastate marine ecosystems, causing bleaching on coral reefs and killing underwater plants. Photograph: VW Pics/Universal Images Group/Getty Images

How much heat is that? Scientists have calculated it is the equivalent energy of more than 25 billion Hiroshima atomic bombs. And that **heat gain is accelerating**.

A **study in January** found the ocean gained 10 ZJ more in 2022 than the year before – enough heat to boil 700 million kettles every second.

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Compared with the ocean, **according to a study in January** the atmosphere has held on to about 2% of the extra heat caused by global heating since 2006.

To understand what's happening below the ocean surface, out of sight of satellites, scientists look at a **vast network of thousands of thermometers** on buoys, ships, underwater gliders and permanent moorings.

Durack says it wasn't until the early 2000s that a view of the changes in the ocean – long-predicted by climate scientists – started to become clear as more and more data became available.

But scientists have been able to get a longer view going back many more decades by using climate models.

“When **we look at the climate models and compare them with the observations**, we get consistent results across that simulated Earth and the real Earth. They’re all showing consistent warming.”

Dr Bernadette Sloyan researches changes in the ocean at Australia’s CSIRO government science agency and spends her days analysing ocean data.

“This is where the ocean is like a flywheel that drives our climate and that’s all because of the amount of energy it takes to heat it up,” she says.

“We have this constant talking between the ocean and the atmosphere that’s driving our weather and, annually, that’s our climate.”

Sloyan says the ocean has acted like the planet’s air conditioner, relentlessly absorbing extra heat.

“But that air conditioner isn’t just passive. It is not a free service. Adding that heat has come with ocean acidification, rising sea levels and changes in the frequency of extreme weather.”

The affects of the extra heat are almost everywhere. As the ocean heats up, it expands, pushing up sea levels around the globe. Just over one-third of the rise in global sea levels is down to thermal expansion.

More heat means more marine heatwaves that have devastated marine ecosystems, causing bleaching on coral reefs and **killing underwater plants** that act like forests, providing habitats for marine life and acting as nurseries for fisheries.

Ocean heating could also **radically alter marine food webs**, with warmer conditions favouring smaller species and algae at the expense of the larger species that humans tend to eat.

In the deep ocean, where species have adapted to stable temperatures, scientists have said warming there in the coming decades **could devastate marine life**.



Prof Matthew England says 'Remember the world is 70% covered by ocean. It should have been called Ocean, not Earth.' Photograph: Stocktrek Images/Getty Images

Around the tropics, where oceans are warmest, scientists have found species are already migrating towards the poles to find cooler waters. But with no other species able to take their place, this leaves behind waters **stripped of marine life**.

In places like the Mediterranean, where land blocks a route to cooler waters, Prof David Schoeman says many species will run out of ocean.

“Fish can’t just climb out of the water so they may have to go deeper,” says Schoeman, of the University of the Sunshine Coast in Australia and who helped coordinate the latest UN climate assessment’s work on the ocean.



### Record ocean temperatures put Earth in ‘uncharted territory’, say scientists

But if species go deeper to survive the heat, this could present another problem. Schoeman says near the surface waters easily mix with the air above to provide enough oxygen for marine life. But as deeper waters warm they hold less oxygen – potentially cutting off another survival option for some species.

Schoeman says much of the heat that has pushed surface temperatures to new highs in recent weeks is likely coming from below.

“Every year about 134 million atomic bombs of heat is being trapped by the ocean. It has kept global temperatures down and kept the land livable but we have to realise that energy hasn’t gone.”

The latest UN climate report says the warming of the ocean is likely to continue “until at least 2300” even if greenhouse gas emissions are low because of the “slow circulation of the deep ocean”.

Prof Matthew England, an oceanographer and climate scientist at the University of New South Wales, is on a video call and shows an image of the globe taken over the Pacific, where almost no land is visible.

“Remember the world is 70% covered by ocean. It should have been called Ocean, not Earth,” he says.

England says that simple physics means the ocean “has this huge ability to absorb heat and then hold on to it.”

England holds his arms out wide to show the size of one cubic metre of air. To heat that air by 1C, he says it takes about 2,000 joules. But to warm a cubic metre of ocean needs about 4,200,000 joules.

“By absorbing all this heat, the ocean lulls people into a false sense of security that climate change is progressing slowly.

“But there is a huge payback. It’s overwhelming when you start to go through all the negative impacts of a warming ocean.

“There’s sea level rise, coastal inundation, increased floods and drought cycles, bleached corals, intensification of cyclones, ecological impacts, melting of ice at higher latitudes in the coastal margins – that gives us a double whammy on sea level rise.

“The oceans have stored the problem,” says England. “But it’s coming back to bite us.”