

Upper ocean temperatures hit record high in 2020

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Fishing boats amidst "Arctic sea smoke" near Qingdao, China on January 7th. Arctic sea smoke is a result of frigid air passing over relatively warm water; the phenomenon is rare, even in the Arctic. Credit: Shaoqing Wang

Even with the small COVID-19-related dip in global carbon emissions due to limited travel and other activities, the ocean temperatures continued a trend of breaking records in 2020. A new study, authored by 20 scientists from 13 institutes around the world, reported the highest ocean temperatures since 1955 from surface level to a depth of 2,000 meters.

The report was published on January 13 in *Advances in Atmospheric Sciences* and concluded with a plea to policymakers and others to consider the lasting damage warmer oceans can cause as they attempt to mitigate the effects of climate change.

"Over 90% of the excess heat due to global warming is absorbed by the oceans, so [ocean warming](#) is a direct indicator of global warming—the warming we have measured paints a picture of long-term global warming," said Lijing Cheng, lead

paper author and associate professor with the International Center for Climate and Environmental Sciences at the Institute of Atmospheric Physics (IAP) of the Chinese Academy of Sciences (CAS). Cheng is also affiliated with CAS's Center for Ocean Mega-Science. "However, due to the [ocean](#)'s delayed response to global warming, the trends of ocean change will persist at least for several decades, so societies need to adapt to the now unavoidable consequences of our unabated warming. But there is still time to take action and reduce our emissions of greenhouse gases."

Using a method developed at IAP/CAS, the researchers calculated the [ocean temperatures](#) and salinity of the oceans down to 2,000 meters, recording data from all available observations from the World Ocean Database, which is overseen by the National Oceanic Atmospheric Administration and the National Center for Environmental Information.

They found that in 2020, the upper 2,000 meters of the world's oceans absorbed 20 more zettajoules than in 2019. That amount of heat could boil 1.3 billion kettles, each containing 1.5 liters of water.

"Why is the ocean not boiling?" Cheng asked. "Because the ocean is vast. We can imagine how much energy the ocean can absorb and contain, and, when it's released slowly, how big the impact is."

The researchers reported other effects, such as ocean salinity pattern amplification and more stratification due to the upper layer warming quicker than the deeper sections. Both changes could cause harm to ocean ecosystems.

"The fresh gets fresher; the salty gets saltier," Cheng said. "The ocean takes a large amount of global warming heat, buffering global warming. However, the associated ocean changes also pose a severe risk to human and natural systems."

Cheng noted the 2020 wildfires that ravaged Australia, parts of the Amazon region, and the west coast of the United States. "Warmer oceans and a warmer atmosphere and also promote more intense rainfall in all storms, and especially hurricanes, increasing the risk of flooding," Cheng said. "Extreme fires like those witnessed in 2020 will become even more common in the future. Warmer oceans also make storms more powerful, particularly typhoons and hurricanes."

The researchers will continue to monitor the ocean temperatures and the impacts [warming](#) has on other oceanic characteristics, such as salinity and stratification.

"As more countries pledge to achieve 'carbon neutrality' or 'zero carbon' in the coming decades, special attention should be paid to the ocean," Cheng said. "Any activities or agreements to address [global warming](#) must be coupled with the understanding that the ocean has already absorbed an immense amount of heat and will continue to absorb excess energy in the Earth's system until atmospheric carbon levels are significantly lowered."

More information: *Advances in Atmospheric Sciences* [DOI: 10.1007/s00376-021-0447-x](https://doi.org/10.1007/s00376-021-0447-x)

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