

What warming oceans mean for our planet

Last year, sea surface temperature and the energy in the upper 2000 metres of the ocean both [hit record highs](#), according to a study in the journal *Advances in Atmospheric Sciences*.

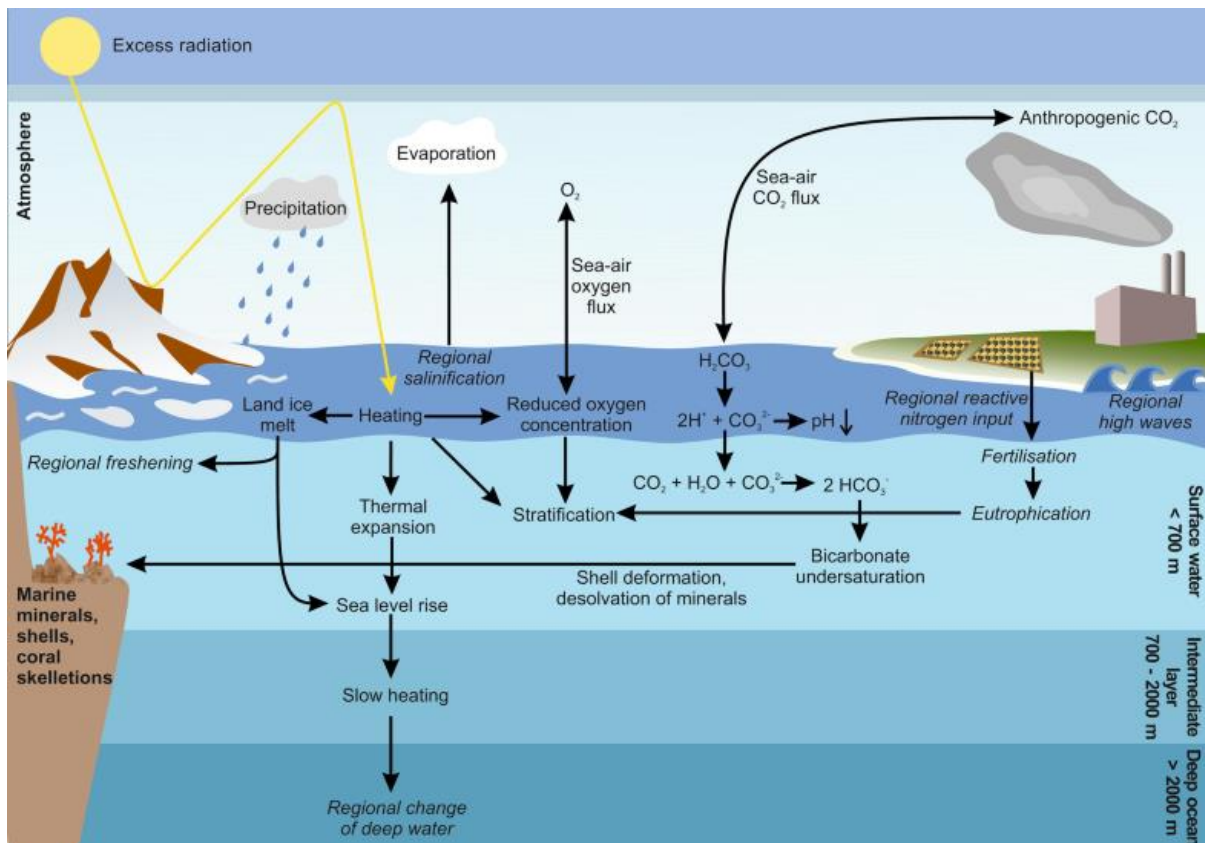
In 2023, the oceans soaked up around 9 to 15 zettajoules more than in 2022, which is enough energy to boil away 2.3 billion Olympic-sized swimming pools, said the US National Oceanic and Atmospheric Administration and the Chinese Institute of Atmospheric Physics.

Analyses show that the amount of heat in the oceans has increased dramatically since the 1950s, according to the United States Environmental Protection Agency (EPA)'s [website](#).

Why are ocean temperatures reaching uncharted levels?

Oceans, which cover 70 percent of Earth's surface, are the largest heat sink on the planet, absorbing more than 90 percent of the warming that has occurred in recent decades, said Dr Tan Koh Siang, Senior Research Fellow at the Tropical Marine Science Institute (TMSI).

Dr Nicholas Yap, Research Fellow at the St John's Island National Marine Laboratory added that ocean surface temperatures are on the uptick due to human-induced climate change.



Overview of climatic changes and their effects on the oceans. Image: [Phytoplankton Responses to Marine Climate Change – An Introduction](#)

Dr Tan said that global warming causes air temperatures to rise by releasing heat-trapping greenhouse gases, such as carbon dioxide, into Earth's atmosphere.

Hot air warms the oceans since water is usually cooler than the air above it, he said.

Dr Patrick Martin, Assistant Professor at Nanyang Technological University's Asian School for the Environment (ASE) said that the ongoing El Niño event that causes the warming of waters in the eastern Pacific Ocean, is also responsible for the rise in ocean temperatures.

Mr Leong Wai, Research Associate at TSMI said that ocean warming is unevenly distributed as there are local effects, such as seasonal oscillation, that moderate general climate trends.

Dr Joyce Ong, Assistant Professor at ASE, said that Singapore sits within the Indo-Pacific Warm Pool (IPWP), an area of the tropics with very warm sea temperatures constantly.

The IPWP has warmed and doubled in size over time because of climate change, she said.

Are rising ocean temperatures a bane or boon?

While some [studies](#) suggest that ocean warming might expand resource-rich marine areas, there is little evidence that indicates the long-term benefits of ocean warming, said Dr Yap.

But evidence relating to the problems caused by ocean warming is plentiful.

Rising ocean temperatures deplete the amount of dissolved oxygen available in the water, increasing the number of fish kills, said Mr Leong.



Bleached white coral on Australia's Great Barrier Reef during a mass bleaching event.

Image: [Getty Images](#)

Ocean warming can cause coral bleaching, said Ms Chen Mengli, Research Fellow at TSML, which occurs when water becomes too warm and corals expel the algae within their tissues.

Mr Leong said that warmer waters have been linked to harmful algal blooms and ecological phase shifts, such as coral reefs becoming algae-dominated due to more frequent bleaching.

In Singapore, a country that is looking to boost aquaculture to improve food security, the increased likelihood of fish kills and algal blooms will have a disruptive effect, he said.

Dr Yap said that societal implications include proliferation of jellyfish blooms that endanger public health and the possibility of dormant viruses being released when the polar ice melts.

Warmer oceans also make hurricanes stronger for longer after reaching land, ramping up damage wrought on impact, according to a 2020 [study](#) in the scientific journal Nature.

Simultaneously, sea levels are set to rise because of two factors related to global warming: added water from melting polar ice and glaciers, and the expansion of seawater as it warms.

Rising sea levels could lead to devastating outcomes, ranging from sand erosion to wetland flooding and agricultural soil contamination, according to the magazine [National Geographic](#).

“Fire-ice”, or methane hydrate, a natural gas frozen deep beneath the ocean floor, could be thawed during ocean warming, releasing more heat-trapping methane and creating a positive feedback loop that amplifies climate change, according to a recent [study](#) in the scientific journal Nature Geoscience.

Marine heatwaves could cause polar species to go extinct, as with the [collapse of the Alaska snow crab fishery in 2022](#). Large numbers of crabs starved to death as a result of their metabolic rates rising with higher water temperatures and an inability to find sufficient food.

“Warmer waters are also not ideal for marine organisms in the tropics, since they are already living very close to their upper temperature limits for them to function normally,” said Dr Tan.

Dr Martin added that warmer oceans directly impact the physiology of marine organisms, for instance, by altering their metabolic mechanisms or interfering with their reproductive cycles.

Some fish, such as herring and whiting, for example, need stable water temperatures to spawn and maintain healthy populations, and sudden warming can decimate these fisheries.



Fish are moving toward higher latitudes to remain within their preferred temperature ranges.

Image: [Yale Environment 360](#)

Other fish, such as black seabream, are leaving coastal areas for deeper ones, exacerbating economic inequalities between big fisheries and under-resourced fishermen while worsening the livelihoods of coastal communities, said Dr Chou Loke Ming, Research Affiliate at TSMI.

Ocean warming in the United Kingdom has also driven fish such as cod to migrate north in search of colder water, disrupting food webs, according to British newspaper [The Guardian](#).

But thanks to fish migration, Portuguese fisheries have reported nearly 20 new species from tropical or subtropical climates, according to a 2016 [study](#) in the journal Fisheries Research.

A raft of opportunity

Experts said that the best solution to prevent rising ocean temperatures is to curb man-made greenhouse emissions that contribute to global warming, and by extension, climate change.

There is also a need to cut down on agricultural land use, which accounts for one-tenth of global greenhouse gas emissions, said Dr Martin.

Mr Leong said that we can do this by reducing meat consumption or exploring plant-based substitutes such as alternative protein.

Dr Ong said that sequestering carbon can also reduce the amount of greenhouse gases. One way is to avoid cutting down carbon-storing forests, she added.

Technologies such as 3D printing offer hope by recreating artificial habitats to help displaced fish find new homes, while Artificial Intelligence could help to automate coral reef restoration.

Word Count: 1000

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