

Record highs in the North Sea: Even the German Bight is warmer than ever before

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Karen Wiltshire holds a thermometer. Credit: Esther Horvath, Alfred-Wegener-Institut / Esther Horvath

Researchers around the globe are sounding the alarm: ocean temperatures are the warmest ever recorded. In 2023, the North Sea also

experienced dramatic record highs, as readings taken by the Alfred Wegener Institute's Biological Institute Helgoland indicate. As data from the time series Helgoland Reede also reveal: It's not the first year in which the German Bight experienced marine heat waves. The high temperatures and extreme weather events are a product of climate change and could have substantial impacts on the ecosystem.

Last year, the oceans were warmer than at any time since the beginning of record-keeping. Our own North Sea was no exception, as experts from the Biological Institute Helgoland (BAH), part of the Alfred Wegener Institute, Helmholtz Center for Polar and Marine Research (AWI), determined. And judging by the first months of 2024, this trend shows no signs of stopping: the mean values for January, February, March and April 2024 are among the top 10 warmest months since 1962.

March 2024, with a mean water temperature of 6.9 degrees Celsius, was even the warmest March since 1962. Temperature data from the Helgoland Reede time series shows that the mean water temperature in 2023 was nearly 11.9 degrees Celsius.

The most recent analysis has been [published](#) in *Limnology and Oceanography* with previous research published in *Progress in Oceanography* and *Communications Biology* .

"Accordingly, 2023 was a record-breaking year since the beginning of our time series in 1962," says Dr. Inga Kirstein, a researcher at the BAH. This began in January, which, at ca. 7.2 degrees, was the second-warmest ever recorded. Though it wasn't a record-breaking day in the time series, 12 September was the day with the highest recorded water temperature in 2023; the AWI experts measured a temperature of 19.5 degrees.

Though the year 2023 was shaped by marine heat waves, it wasn't the first year in which the North Sea experienced them. In a recent study,

AWI researchers analyzed sea-surface temperature data from 1962 to 2018, taken from the Helgoland Reede. Marine heat waves aren't limited to the summer; they can also occur in other seasons, even in winter, when [water temperatures](#) are significantly above the normal values.

As the data showed, the frequency of intense heat waves has risen since the 1990s, particularly in the months March to April and July to September. In this regard, the third quarter of the year shows the highest frequency of marine heat waves. Since 1990, AWI researchers on Helgoland and Sylt have observed new temperature patterns: there are far more warmer days in summer and far fewer extremely cold days in winter.

"For example, from 1962 to 1990 we had a total of 24 months with a mean temperature below 3 degrees Celsius; since 1990, there have only been five months. At the same time, up to 1990 there had only been eight months with mean temperatures above 17 degrees, and from 1990 to the end of 2023, there've been no less than 53 months." Further, unusually high temperatures are now occurring earlier in the year.

"The German Bight in particular has seen a major temperature increase since the 1990s," says Prof Karen Wiltshire, Director of the BAH. The data also shows a connection between the monthly temperatures in the German Bight and on the German mainland: marine heat waves occurred more frequently in late summer, during or shortly after atmospheric heat waves, when temperatures were at their highest, which points to a coupling between [ocean temperatures](#) and atmospheric temperatures.

"The North Sea warms so quickly because it's a shelf sea surrounded by landmasses, like a giant puddle. As such, the temperature trends for the mainland are absolutely consistent with those for the water temperature."

The experts consider climate change and the resultant global warming as

a main reason for the high sea-surface temperatures and increased frequency of extreme events like marine heat waves.

Effects on ecosystems

What do these findings mean for the North Sea and its ecosystem? Rising water temperatures in the sea and extreme temperature events like marine heat waves can produce biological responses. Due to the mixing of the water column at the coast, marine heat waves will most likely affect not just the upper water layers, but also habitats on the seafloor

In the North Sea, decadal changes have already been observed, e.g. in the occurrence of species or the composition of biotic communities. In this regard, temperature is one of the most important drivers for biodiversity and species distribution.

"Marine organisms respond to climate change in a number of different ways. We can see these changes in our own research and are currently investigating how marine heat waves are affecting the planktonic food web, for example in the composition or frequency (abundance) of plankton communities and individual species," says Inga Kirstein.

In a mesocosmos study, the AWI researcher has already demonstrated that the combined effects of warming, acidification and changed food availability are impacting plankton dynamics, in favor of smaller plankton species. This can in turn affect food webs, since plankton is a staple for many marine organisms. Rising temperatures and the increasing frequency of marine heat waves in the past few decades, which are connected to the fundamental changes in the German Bight, are a cause of concern for the ecology and society alike.

The ecological time series Helgoland Reede

Since 1962, researchers at the Biological Institute Helgoland have recorded the temperature, salinity and nutrient load in the German Bight, and assessed the plankton composition on a nearly daily basis. Today, the Helgoland Reede is one of the most important and detailed ecological time series available.

It allows researchers at the AWI and from around the world to seamlessly document the impact of [climate change](#) in the North Sea in the past 60 years, and to determine whether specific changes constitute natural, cyclical fluctuations or anthropogenic trends. The data is archived and made available for generations to come in the Alfred Wegener Institutes World Data Bank PANGAEA.

More information: Luis Giménez et al, A multiple baseline approach for marine heatwaves, *Limnology and Oceanography* (2024). [DOI: 10.1002/lno.12521](#)

Felipe de Luca Lopes de Amorim et al, Investigation of marine temperature changes across temporal and spatial Gradients: Providing a fundament for studies on the effects of warming on marine ecosystem function and biodiversity, *Progress in Oceanography* (2023). [DOI: 10.1016/j.pocean.2023.103080](#)

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