IOW press release, May 11, 2026

Inland seas around the world are severely affected by climate change

Under the lead of the Leibniz Institute for Baltic Sea Research Warnemünde (IOW), climate simulations were used to investigate how 19 inland seas, including the Baltic Sea, are responding to climate change. The researchers found that they have been warming faster than the global ocean since the 2000s. Projections show that marine heatwaves will affect around 60% of these seas on an annual average basis as early as in the middle of the 21st century. Without adherence to the Paris Agreement targets, up to 90% of these seas would be affected by heatwaves. The study contributes to climate change management practices and was published in the journal Communications Earth & Environment.

The special role of inland seas and their temperature development

Inland seas are important areas for activities such as fishing and tourism. However, because of their limited water exchange with surrounding oceans, they are severely threatened by pollution, nutrients, and rapidly rising water temperatures. This study is the first to assess this warming of inland seas in the context of climate change on a global scale. The researchers examined inland seas with regard to the rate of warming, as marine organisms can adapt better to gradual temperature changes than to sudden, drastic temperature shifts. The researchers also analyzed the occurrence of marine heatwaves. These heatwaves can have sudden and devastating effects, such as fish kills. Extensive climate model simulations were used for the analyses, which made it possible to distinguish long-term trends caused by climate change from natural variability. This is very important when analyzing extreme events such as marine heatwaves.

Study reveals peak in global warming rate in the year 2000

Surprisingly, the study revealed that the rate of warming in the inland seas, which were examined, peaked in 2000. The reason is that during the 20th century, industrial emissions led to the accumulation of aerosols—fine airborne particles—in the atmosphere. “These aerosols reflected sunlight and thus had a cooling effect. As air pollution decreased, these aerosols subsequently declined and the cooling effect was lost,” said IOW scientist and lead author of the study Matthias Gröger.

Future temperature trends and management options

The study shows that, if emissions remain high, many inland seas will warm by several degrees Celsius by the end of the 21st century with 13 out of 19 inland seas warming by more than 1°C. In some regions, the rate of warming could even exceed past temperature trends by a factor of three or four. Many inland seas could also experience prolonged heatwaves. A key finding of the study is that the most severe effects of climate change on inland seas can be prevented if global warming remains below 1.5°C, as stated in the Paris Agreement. In particular, this would significantly reduce the risk of prolonged marine heatwaves. However, even if this temperature limit is adhered to, ocean warming and the occurrence of marine heatwaves will still happen; only their intensity will be reduced. The findings from the study are important for committees developing usage scenarios for inland seas. Future temperature trends must be taken into account both in terms of planting seagrass beds to restore natural habitats and in assessing the introduction of non-native species and the loss of suitable habitats for native species.

Original publication:

Gröger, M., Börgel, F., Dutheil, C., Karsten, S., Meier, H. E. M., Safonova, K., Völker, G. S. (2026). *The world's enclosed seas highlight the need for urgent emission reductions and societal adaptation.* Communications Earth & Environment 7, 312. https://doi.org/10.1038/s43247-026-03412-3

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The Leibniz Institute for Baltic Sea Research Warnemünde (IOW) investigates natural and anthropogenic changes in coastal and marginal seas using a system-wide and interdisciplinary approach, ranging from fundamental to applied research. The Baltic Sea serves as an ideal case study on the institute's doorstep. An important mission of the IOW is to engage in knowledge-based dialogue with policy-makers, stakeholders, and society, thereby contributing to the sustainable development of coastal seas. www.iow.de