

Press release**GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel****Ilka Thomsen**

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<http://idw-online.de/en/news840936>Research results, Scientific Publications
Biology, Chemistry, Environment / ecology, Nutrition / healthcare / nursing, Oceanology / climate
transregional, national**Heavy Metals in the Ocean Become More Toxic: How Climate Change Impacts Contaminants in the Sea**

09 October 2024/Kiel. Toxic trace elements such as lead, mercury, arsenic, and cadmium naturally occur in small quantities in coastal seas. However, human activities, such as industry and agriculture, contribute significantly larger amounts. A new study has examined how climate change already affects the distribution and accumulation of these elements and how it could impact them in the future. One of the findings: Climate-related natural events are releasing more contaminants, which pose a risk to both human and animal health. However, there is still insufficient knowledge about how these contaminants will behave in the future.

The ocean is warming, becoming more acidic, and losing oxygen – these are well-known effects of climate change. What has been less studied is how these changes are affecting contaminants in the seas. A new study titled “Impacts of Climate Change on the Transport, Fate, and Biogeochemistry of Contaminants in Coastal Marine Ecosystems” has investigated the interaction of trace elements with climate change. The findings have been published in the Nature journal Communications Earth & Environment.

Climate Events are Releasing More Contaminants

“We wanted to understand how trace elements are being affected by climate change – an area that has seen very little research so far,” explains Dr Rebecca Zitoun, marine chemist at GEOMAR Helmholtz Centre for Ocean Research Kiel and co-lead author of the study alongside her Croatian colleague Dr Saša Marcinek from the Ruđer Bošković Institute in Zagreb. “We examined both human-induced and natural sources.” Metals such as lead, mercury, and cadmium enter the oceans not only through human activities such as industry or fossil fuel burning. Natural sources are also changing due to climate change: rising sea levels, rivers overflowing or drying up, melting sea ice and glaciers – all these processes mobilise and increase contaminant flows.

The study summarises the findings of a working group of the UN Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) focusing on metal contaminants in the ocean. The working group was initiated by Dr Sylvia Sander, Professor of Marine Mineral Resources at GEOMAR and former head of the Marine Environmental Studies Laboratories at the International Atomic Energy Agency (IAEA) in Monaco. Christoph Völker from the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI) is also contributing from Germany.

“Our working group has focused on the effects of climate change and greenhouse gases on contaminants in the ocean,” explains Dr Sander. One example of these impacts is rising mercury levels in Arctic waters: melting glaciers, thawing permafrost and coastal erosion are releasing more mercury from natural sources. This poses a particular threat to communities that rely on traditional fishing, as mercury accumulates in the food chain and can end up on our plates through the consumption of contaminated fish.

Human Sources of Toxic Metals

“Human activities have increased the global flow of toxic metals such as lead by tenfold and mercury by three to seven times compared to pre-industrial levels,” says Professor Sander, highlighting another example. “Toxic elements like silver are increasingly detectable in coastal waters, originating from coal combustion and the growing use of silver nanoparticles in antibacterial products.” Additionally, shipping and the use of plastics contribute to the spread of heavy metals. Plastics can bind metals such as copper, zinc, and lead from the water. These bound contaminants can also enter the food chain.

In the future, the human contribution of heavy metals could rise further due to the increasing exploitation of the oceans.

Trace Elements in Seawater are Sensitive to Climate Change

Climate changes, such as rising sea temperatures, ocean acidification, and oxygen depletion, impact trace elements in various ways.

Higher water temperatures increase the bioavailability and uptake of trace elements such as mercury by marine organisms. This happens because higher temperatures boost metabolism, reduce oxygen solubility, and increase gill ventilation, leading to more metals entering organisms and accumulating in their bodies.

As the ocean absorbs most of the carbon dioxide (CO₂) released by humans, it becomes more acidic – the pH level drops. This increases the solubility and bioavailability of metals such as copper, zinc, or iron. The effect is particularly pronounced with copper, which is highly toxic to many marine organisms at higher concentrations.

Furthermore, the growing depletion of oxygen, especially in coastal zones and on the seabed, enhances the toxic effects of trace elements. This stresses organisms that live directly in or on the seabed, such as mussels, crabs, and other crustaceans.

Double Burden: Pollutants and Climate Change

Human activities influence the amount of contaminants in coastal regions in two ways: directly through the release of pollutants into the environment, and indirectly through the impacts of human-induced climate change on natural sources.

However, the study also reveals that there is still insufficient data on how climate change influences contaminants in the ocean. The working group calls for increased research into new and under-studied contaminants. Additionally, better models should be developed, and legislation adjusted to improve control over the impact of contaminants in the seas.

Dr Rebecca Zitoun: “To better understand the impacts on ecosystems and human health, we need to close knowledge gaps on the interactions between pollutants and climate change and develop standardised methods that provide globally comparable data.” This is a crucial step towards strengthening marine protection and developing sustainable solutions for vulnerable coastal areas.

About the GESAMP-Working group

The study is part of the findings of Working Group 45 (WG45: “Climate Change and Greenhouse Gas Related Impacts on Contaminants in the Ocean”) of the UN expert group on marine environmental protection (GESAMP). GESAMP (“Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection”) was established by the United Nations in 1969 to provide scientific advice on protecting the marine environment. The organisation's main goal is to identify new threats to the oceans and propose solutions to address these challenges and protect the seas.

Original publication:

<https://www.nature.com/articles/s43247-024-01679-y>

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