THE CONVERSATION

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Why I'm sailing to the Arctic in search of missing mercury

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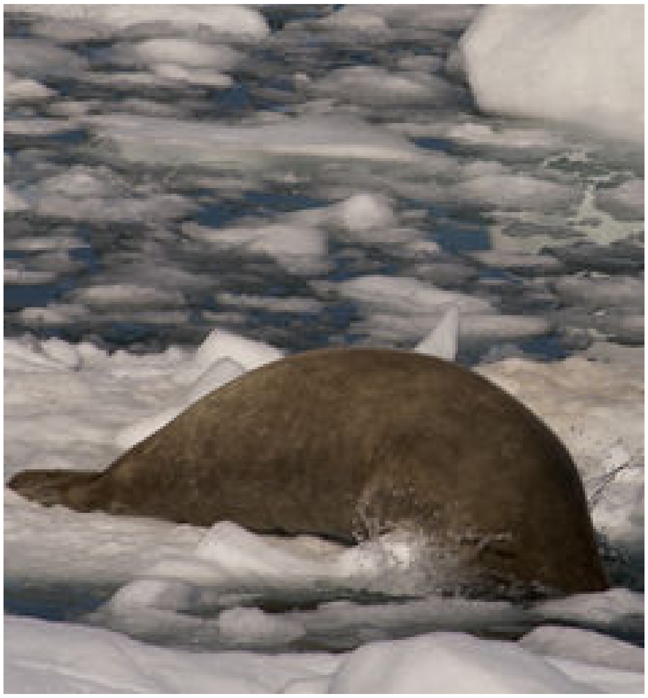
Methylmercury in the fur sounds nasty – but this bear isn't too bothered. HimmelrichPR, CC BY-SA

If you've ever eaten fish from the sea, especially an older or larger fish, you've probably been exposed to the pollutant mercury. It's invisible, odourless, and dangerous. When ingested by humans, mercury is a neurotoxin, attacking the brain and nervous system, and the development of babies and infants can be particularly hampered.

Whereas most of us are at liberty to adapt our diets, people living in the Arctic strictly rely on marine wildlife for food and, unfortunately, mercury levels in animals such as seals, beluga whales and polar bears are among the highest worldwide. It's harming birds too – recent research shows that endangered ivory gulls have 50 times more mercury in their feathers than when records began 130 years ago.

The stuff we're really concerned about is methylmercury, the most toxic form of the element that accumulates in those animals. And there's a mystery here – while emissions from factories and power plants have pumped a lot of mercury into the Arctic, we still know little about exactly how this is converted to methylmercury.

One idea is that methylmercury is produced in the oceans. Inorganic mercury, natural or



You can’t hide from mercury. Andrew Davies, CC BY-NC

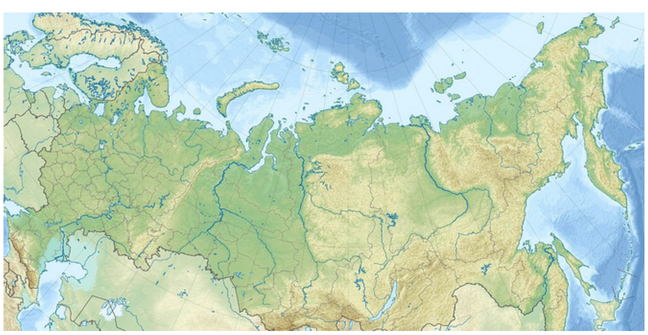
man-made, sticks to algae in the surface waters. When these algae sink to the deep ocean, microbes are already waiting to eat them. We believe some of these microbes can convert the inorganic mercury to methylmercury.

Methylmercury is then passed along the food chain via a process known as bioaccumulation. Algae pick it up from the water, are eaten by zooplankton (krill) which are eaten by smaller fish, which in turn are eaten by bigger fish – at each step, methylmercury gets many times more concentrated, reaching dangerous levels in top predators such as seals, polar bears or even humans.

But where does all this mercury come from? Mercury is unique – it is the only heavy metal that is present as gas in the atmosphere, where it stays on for an average of about a year. As a consequence, it can travel across the globe, including to the remote Arctic. One theory is that the Arctic is a global sink for increased man-made mercury emissions from North America, Europe and now Asia, and possibly causing the high mercury levels in arctic animals. However long-term data on mercury levels in Arctic animals don’t always match up with increasing man-made emissions. Other factors must be at play.

Missing mercury

Though scientists have generally focused on atmospheric mercury sources over the past decade, models suggest that atmospheric emissions can’t account for all the mercury. A large source of mercury to the Arctic Ocean is missing.



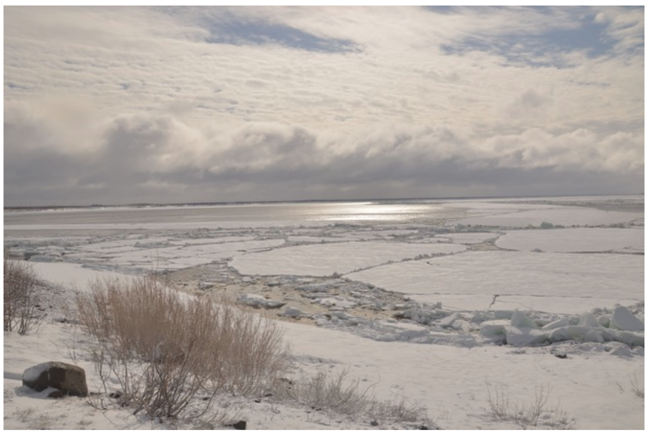
A series of huge rivers cut through Siberia and flow north to the Arctic. Uwe Dedering / Wiki, CC BY-SA

Rivers could provide such a source, especially during spring flood of Siberian rivers. While this finding is exciting, Siberian rivers and the Arctic Ocean itself remain under-sampled. We actually have to go to Siberia during the spring floods and measure mercury to know what is coming out of the rivers, and how far it travels into the sea.

That's why we are now investigating the mercury discharge, especially during the spring flood, of one of the largest Siberian rivers, the Yenisei.

Going toxic

We must find out where, how and what is turning inorganic mercury – natural or man-made, from the atmosphere or from rivers – into its most toxic and bioaccumulating form, methylmercury.



The Yenisei hits its peak in May – but does it come bearing mercury? TOMCAR project, PI Roman Teisserenc, ECOLAB Toulouse, CC BY-NC-SA

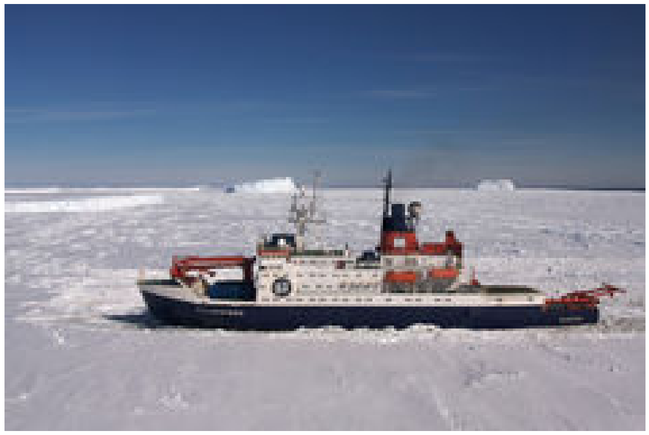
We already know that inorganic mercury in the oceans has increased because of man-made emissions. At the same time a warming climate and melting sea ice is likely to play havoc with Artic algae and methylating microbes. But what will this mean in the future?

A previous Polarstern cruise in 2011 gave us some first insights. In research published in the journal Scientific Reports my colleagues and I presented the first full-depth high resolution profiles (> 5 km-depth) of total mercury and methylmercury in the central Arctic Ocean (79-90°N).

Our findings suggested methylmercury production in the Arctic Ocean is highest in the area of thinner and younger sea ice, probably due to a higher accumulation of algae in these areas. Methylmercury concentrations peak shallower than in the other oceans (150 m in the Arctic versus roughly 1000 m in the Atlantic). The shallow methylmercury production, close to the surface where algae thrive, likely results in enhanced biological uptake at the base of the arctic food chain. While these first few results might hint an alternative explanation for the high methylmercury levels of Arctic wildlife, many questions remain open.

That's why this summer I'll spend two months investigating mercury changes in the Arctic while on board the German icebreaker Polarstern sailing to North Pole. Polarstern will be joined by research ships from the US and Canada – the operation, organised within the international program GEOTRACES, will be the largest exploration of mercury (and other elements) in the Arctic Ocean.

This effort involves many different research teams and will take a whole lot of coordination. At sea we also need to keep each other up to date about what we're doing. To master these efforts the mercury teams on the three research ships connect online and will be keeping each other and the interested public informed on ResearchGate, a professional network for scientists.



Polarstern on a previous mission. Michael Trapp / AWI, CC BY-SA

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The three mercury teams will map mercury and methylmercury distributions throughout the Arctic Ocean, and merge their data. This is critical to understand marine methylmercury production and to predict the impact of ongoing climate changes on the Arctic mercury cycle. After all, global warming is bad enough as it is, without contaminated fish to worry about, too.