

The transpolar drift is faltering—sea ice is now melting before it can leave the nursery

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Credit: Alfred Wegener Institute

The dramatic loss of ice in the Arctic is influencing sea-ice transport across the Arctic Ocean. As experts from the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research report in a new study,

today only 20 percent of the sea ice that forms in the shallow Russian marginal seas of the Arctic Ocean actually reaches the Central Arctic, where it joins the transpolar drift; the remaining 80 percent of the young ice melts before it has a chance to leave its "nursery." Before 2000, that number was only 50 percent.

According to the researchers, this development not only takes the planet one step closer to an ice-free summer in the Arctic; as the sea ice dwindles, the Arctic Ocean stands to lose an important means of transporting nutrients, algae and sediments. The new study will be released as a freely accessible Open Access article in the online journal *Scientific Reports* on 2 April 2019.

The shallow Russian shelf or marginal seas of the Arctic Ocean are broadly considered to be the "nursery" of Arctic sea ice: In winter, the Barents Sea, Kara Sea, Laptev Sea and East Siberian Sea constantly produce new sea ice. This is due to extremely low air temperatures down to minus 40 degrees Celsius, and a strong offshore wind that drives the young ice out to the open sea. In the course of the winter, the sea ice is eventually caught up in the transpolar drift, one of the two main currents in the Arctic Ocean. In two to three years' time, it transports the ice floes from the Siberian part of the Arctic Ocean across the Central Arctic, and into the Fram Strait, where it finally melts. Two decades ago, roughly half the ice from Russia's shelf seas made this transarctic journey. Today, only 20 percent does; the other 80 percent of the young ice melts before it can become a year old and reach the Central Arctic.

Experts from the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI) came to this troubling conclusion after monitoring and analysing the sea ice's movements with the aid of satellite data from 1998 to 2017.

"Our study shows extreme changes in the Arctic: the melting of sea ice

in the Kara Sea, Laptev Sea and East Siberian Sea is now so rapid and widespread that we're seeing a lasting reduction in the amount of new ice for the transpolar drift. Now, most of the ice that still reaches the Fram Strait isn't formed in the marginal seas, but comes from the Central Arctic. What we're witnessing is a major transport current faltering, which is bringing the world one major step closer to a sea-ice-free summer in the Arctic," says first author Dr. Thomas Krumpen, a sea-ice physicist at the Alfred Wegener Institute.

This trend has been confirmed by the outcomes of sea-ice thickness measurements taken in the Fram Strait, which the AWI sea-ice physicists gather on a regular basis. "The ice now leaving the Arctic through the Fram Strait is, on average, 30 percent thinner than it was 15 years ago. The reasons: on the one hand, rising winter temperatures in the Arctic and a melting season that now begins much earlier; on the other, this ice is no longer formed in the shelf seas, but much farther north. As a result, it has far less time to drift through the Arctic and grow into thicker pack ice," Thomas Krumpen explains.

Those ice floes that the transpolar drift still carries to the Fram Strait are for the most part formed in the open sea, i.e., in regions of the Arctic Oceans far from the coasts. Consequently, compared to ice from the shelf seas, they contain significantly fewer particles like algae, sediments and nutrients—because waves, wind and tides stir up far more particles from the seafloor in shallow coastal zones than on the high seas. In addition, rivers like the Lena and the Yenisei carry major quantities of minerals and sediments to coastal areas; when the water freezes, they become trapped in the ice.

Whereas in the past, sea ice from the shelf seas transported this mineral load to the Fram Strait, today the melting floes release it on their way to the Central Arctic; what reaches the Fram Strait is less material, and with a different composition. This finding is a result e.g. of analysis of

samples obtained by means of sediment traps that AWI biologists have been conducting in the Fram Strait for about two decades. "Instead of Siberian minerals, we're now finding more remains of dead algae and microorganisms in our sediment traps," says co-author Eva-Maria Nöthig. In the long term, this altered sea-ice-based particle transport is likely to produce lasting changes in the biogeochemical cycles and ecological processes of the central Arctic Ocean.

The evolution of sea ice and the ecological processes in the Arctic Ocean are also key research questions that will be addressed during the MOSAiC expedition, which will begin this September. The German research icebreaker Polarstern will journey to the Arctic and drift with the transpolar drift through the Arctic Ocean for an entire year, intentionally trapped in the ice. 600 people from 17 countries will take part in the expedition, which will be regularly resupplied by aircraft and other icebreakers; moreover, many times that number of experts will use the resulting data to take climate and ecosystem research to a new level. MOSAiC, the greatest Arctic research expedition in history, will be spearheaded by the Alfred Wegener Institute.

More information: Thomas Krumpfen et al, Arctic warming interrupts the Transpolar Drift and affects long-range transport of sea ice and ice-rafted matter, *Scientific Reports* (2019). [DOI: 10.1038/s41598-019-41456-y](https://doi.org/10.1038/s41598-019-41456-y)

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