Pacific Water Pathways through the Arctic Ocean

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The volume, characteristics and sources of freshwater circulating in the Arctic Ocean vary in time and are expected to change under a declining sea ice cover, influencing the physical environment and Arctic ecosystem. Relatively fresh (S = 32) Pacific Water, which enters the Arctic Ocean via the Bering Strait makes up a significant part of the liquid freshwater exiting the Arctic Ocean through Fram Strait. If transported to the Nordic Seas and North Atlantic via the East- and West Greenland Currents freshwater from the Pacific could have an effect on convection and dense water formation in those regions.

More than 30 repeated sections of nutrient measurements have been collected across Fram Strait between 1980 and 2019. The fraction of Pacific Water along these repeated sections can be estimated from the ratio of nitrate to phosphate. The time-series of repeated Fram Strait sections indicates that the fraction of Pacific Water passing out of the Arctic Ocean has changed significantly over the last 30 years. Pacific water fractions remained high from 1980 to 1998, but in 1999 Pacific water almost disappeared from Fram Strait, reappearing from 2011 to 2012, when there was a peak in freshwater export though Fram Strait.

Several hypotheses suggest how variations in the large-scale atmospheric circulation over the Arctic Ocean may influence the transport and pathways of Pacific Water. We show how anomalies in reanalysis wind fields are associated with the reappearance of Pacific Water in Fram Strait in recent years. Repeated sections across Fram Strait are compared with sea ice back-trajectories in the Polar Pathfinder 4 product and a simulated Pacific Water tracer in the NAOSIM numerical model to investigate likely Pacific water pathways through the Arctic Ocean and upstream drivers of changes observed in Fram Strait.