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Arctic Pathways of the Pacific Water: the Arctic Ocean Model Intercomparison Experiments

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Pacific water represents the principal advective oceanic freshwater source and a large fraction of the Arctic fresh water (Serreze et al, 2006). It brings oceanic nutrients to the Arctic (e.g., Walsh et al, 1989) and is a significant source of near-surface oceanic heat, affecting sea-ice cover (Woodgate et al., 2010). Hydrographic observations show that the total thickness of the Pacific layer in the Canadian Basin reaches approximately 150 m. The Pacific water distribution varies depending on wind stress and ocean circulation modes (Proshutinsky et al., 2009). Winter Ekman convergence accumulates freshwater in the Beaufort Gyre, whereas weak summer winds releases fresh water; ice melt increases the freshwater storage. The pathways of Pacific Water are not fully known due to difficulties of making measurements in the area. We examined results from 6 state-of-the art Ocean General Circulation Models (OGCMs) and available observations. In the models the Pacific water was tracked (using a tracer released in the Bering Strait) to investigate its spread during cyclonic and anti-cyclonic periods of circulation. The results suggest two principal pathways of the Pacific water through the Arctic. The main bulk of the Pacific water follows the near surface circulation, eventually exiting the Arctic Ocean through Fram Strait. The Pacific Water pathways at $\sim$100-200m depth vary from model to model. In the higher resolution models most of this deeper Pacific water moves along the Alaskan and Canadian continental shelves, leaving the Arctic Ocean through the Canadian Archipelago. In the coarser resolution models this deeper outflow is partitioned between Canadian Archipelago and Fram Strait. The models demonstrate that prior to 2007 variations in Pacific Water content contributed $\sim$60-80% of the Arctic fresh water change with Ekman convergence being a primary driver of the seasonal variability of the Pacific water.

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