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Tidally-induced dispersion of the Storfjorden overflow plume onto the West Svalbard Shelf

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We investigate the flow of brine-enriched shelf water from the Storfjorden (Svalbard) into Fram Strait and onto the Western Svalbard Shelf using NEMO, a 3D numerical ocean circulation model, in a regional setup with realistic bathymetry, full meteorology, open boundary conditions and tides. The model has 3 km horizontal resolution and 50 vertical levels in the s_h-coordinate system which is specially designed to resolve bottom boundary layer processes.

In a series of experiments varying initial plume density and wind strength we focus on the influence of the tides on the propagation of the dense water plume by turning on and off the tidal forcing at the model boundaries.

Simulations including tides consistently reveal increased horizontal diffusivity around the Sørkapp, the southernmost headland of Spitsbergen, which is in close proximity to the plume path. Due to the tides and largely independent of wind effects the plume widens and laterally disperses as it spreads into Storfjordrenna, the trough steering the plume's path from the fjord towards the continental slope. On the shallow shelf the tides also increase the vertical diffusivity and thus plume height, with wind-driven turbulence contributing to this effect.

We find that a tidally augmented exchange between the Svalbard Coastal Current and lighter fractions of overflow water leads to their propagation onto the Western Svalbard Shelf where water of Storfjorden origin may enter several large fjords. Based on our results from the Storfjorden we conclude that tidal modulation during the shallow phase of the overflow could also be important for other dense water cascades originating in shallow shelf regions.