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Multi-decadal effects of tides and Greenland glacial melting runoff on the ice, mixing and cross-shelf exchange in the Arctic Ocean.

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We use a novel pan-Arctic sea ice-ocean coupled model to examine the effects of tides on sea ice and the mixing of water masses. Three 30-year simulations were performed: with explicitly resolved tides and the other without any tidal dynamics, with and without Greenland glacial melting runoff.
We find that the tides are responsible for a ∼15% sea ice volume reduction during the last decade and also for changes in the salinity distribution, with surface salinity in the case with tides being on average ∼ 0.5-1.0 practical salinity units (PSU) higher than without tides. On the multi-decadal time scale tidal effects result in strong deflection of freshwater pathways of Siberian rivers in the Kara and Laptev Seas with surface salinity anomalies reaching 3-5 PSU compared with non-tidal case.
Glacial Greenland melting runoff has a minor role in sea ice reduction. However, it results in fresh water barrier for deep convection in the Labrador Sea and strong reduction of deep water formation. Tides amplify this effect, presumably due to tidal transport of fresh waters from Greenland coastline to Labrador Sea.
We evaluate shelf-deep ocean exchange fluxes: Ekman surface and bottom drains, eddy-induced and tidally induced offshore-onshore mass and buoyancy fluxes. It was found that cascading is a dominant process with a net cross-shelf transport about 1Sv, twice exceeding surface and benthic Ekman drains. Cascading is negatively correlated with surface Ekman drain, driven by wind.