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Shelf exchange driven by coastal-trapped waves in an Arctic fjord/trough system

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Ubiquitous and dominant in mid-latitude coastal exchange processes, tides play a relatively minor role in many Arctic fjord and shelf system. Here we show that the class of low frequency (sub-inertial) waves known as coastal-trapped waves (CTWs) play an analogous role to tides in one west Svalbard fjord, and by extension more widely along the west Svalbard and east Greenland margins, where similar conditions prevail. We show that CTWs generated by weather systems passing across the sloping topography of the shelf break propagate into the fjord, steered by the topography of a cross shelf trough. The CTWs have characteristic periods of approximately two days, set by the passage time of weather systems. Phase speeds and wavelengths vary seasonally by a factor of two, according to stratification. Typical winter (summer) values are c = 0.25 ms-1 (0.5 cms-1) and λ = 40 km (84 km). CTW-induced flow velocities in excess of 0.3 ms-1 at 100 m water depth are recorded. Scaled CTW model results indicate that CTW-induced flows may exceed 0.5 ms-1 at the top of the slope. A range of consequences for this dominant mode of sub-inertial variability in Arctic fjord/ocean exchange is discussed, including: generalised geostrophic adjustment, horizontal advection and mixing, resuspension, higher order Stoke's drift effects, and diapycnal mixing via Richardson number instability.