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The effect of tides and eddies on the hydrophysical fields in the NEMO-shelf Arctic Ocean model.

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We present the results of the coupled ocean-ice NEMO-shelf pan-Arctic model, which is still under development. The model has generalized s-z partial step vertical coordinates and horizontal resolutions of 1/16o and 1/32o in the rotated system of coordinates. The model explicitly resolves tides (8 tidal harmonics), has advanced vertical mixing schemes (generalized length scale turbulence closure model) and monotonic, low diffusive Piecewise Parabolic Method for vertical advection. The model reasonably reproduces tidal dynamics, ice formation. We examine the following effects of tides on the low –frequency components of hydro-physical fields : tidal Reynolds stresses, bottom shear stresses , lateral and vertical salt and heat fluxes. We have found, that the effects of advection (tidal Reynolds stresses) on the slow varying component of currents are relatively small. The additional component of bottom shear stresses, induced by tides, strongly affects the low-frequency component of currents on the shelves and shelf breaks. These effects can be considered as additional "tidal bottom wind shear " stresses, which act as an external forcing, driving the current, rather than damping it. As the typical spatial length-scales of tidal currents variability is much smaller than atmospheric wind length scales , these "tidal wind stresses" create very strong bottom Ekman pumping, reaching magnitudes of 0.1 -1 mm/s for monthly averages.
The important features of the Arctic ocean circulation are narrow jets, following along the bottom topography slopes (topostrophic currents). These currents are assumed to be eddy-driven ("Neptune effect"). Traditionally, topostrophic currents are assumed to be proportional to local topography slope and dependent on one empirical length scale parameter. Idealised theory, developed for the Zapiola Anticyclone in a tropical region predicts that these strong , nearly barotropic currents , following bottom topography contours, are driven by the rotational part of the wind. In our study, using eddy permitting simulations in the Arctic Ocean we examine this hypothesis in the framework of a single dimensional parameter, which is the total eddy energy/or intensity of eddy potential vorticity and four dimensionless parameters.