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Tidal and Inertial Variability in Arctic sea ice drift and Deformation

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A dominant aspect of sea ice deformation, and hence air-sea heat and salt fluxes, in the high latitudes is the presence of significant semi-diurnal tidal and inertial variability. Recent observations using synthetic aperature imagery (Kwok et. al., 2003) have shown Winter semi-diurnal variability near the North Pole to be almost continuous with peak to peak variations in divergence of about 0.2 % common. Whether or not such variability is tidal or inertial in origin is a matter of considerable debate. To elucidate this problem a barotropic ice-ocean tidal model with an oceanic boundary layer including imbedded sea ice is constructed for the Arctic Ocean. The tidal model utilizes an implicit B grid solver and is driven with M2 forcing at the southern boundary. While still retaining inertial variability in the oceanic boundary layer, the imbedding procedure of Heil and Hibler (2002) is modified so that in the absence of any ice interaction or surface stress there is no turning angle between the ice and the oceanic boundary layer. To elucidate the relative role of tides, ice mechanics and boundary layer inertial fluctuations on semi-diurnal variability in the ice deformation, a hiearchy of numerical experiments over a several month long period are carried out. Experiments include cases with and without an imbedded boundary layer and with and without ice mechanics. The results are analyzed in conjunction with observed hourly buoy drift and qualitatively compared to fluctuating deformation near the North pole.