Modeling tides in Prince William Sound, Alask and their influence on circulation

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Abstract

In the process of developing a real-time data-assimilating coastal ocean forecasting system for Prince William Sound (the Sound), Alaska, tidal signal was added to a three-domain nested model for the region. The model, which is configured from the Regional Ocean Modeling System (ROMS), has 40 levels in the vertical direction and horizontal resolutions of 10km, 3km and 1km for its three nested domains, espectively. In the present research, the model tidal solution is validated using data from coastal tide gauges, satellite altimeters, high-frequency coastal radars, and ADCP current surveys. The accuracy of barotropic tides, as measured by root of summed squares of the RMS discrepancy of the sea surface height amplitudes of eight major tidal constituents, is 11.5 cm in the open ocean and 10.9 cm in the Sound, which is about 10% of the amplitude of the most energetic semidiurnal constituent M2 of the region. Model tidal current agrees reasonably well with the observation. The influence of tides on the circulation around the Sound is also investigated using the model. Besides tides, three other types of forcing (heat flux, wind stress, and freshwater discharge) demonstrated to play a role in the circulation of the region in earlier studies, are also included in the model. Our results indicate that tides play a significant role in shaping the mean circulation of the region. For annual averaged state, the tidal rectification tends to generate a cyclonic gyre in the central Sound and an anticyclonic gyre around Montague Island. Thus, the net transport into the Sound through Hinchinbrook Entrance is reduced. Including tides also increases the mixed layer depth in the Sound.