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Interaction between the tidal and seasonal variability of the Gulf of Maine and Scotian Shelf region

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In the Gulf of Maine and Scotian Shelf (off the northeastern coast of North America) tides are large and can alter the local hydrographic properties, circulation, and sea surface height through processes such as tidal rectification, mixing, and horizontal advection. Furthermore, the stratification of the water column can influence tidal elevation and currents over the shelves (e.g., baroclinic tides). To investigate this interaction, a newly developed high resolution (1/36 degree) regional circulation model is used (GoMSS model). First, numerical experiments with and without density stratification are used to demonstrate the influence of stratification on the tides. GoMSS model is then used to interpret the physical mechanisms responsible for the largest seasonal variations in the M2 surface current which occur over, and to the north of, Georges Bank. An alternating pattern of highs and lows in the summer maximum M2 surface speed in the Gulf of Maine is identified, for the first time, in both the model output and observations by a high frequency coastal radar system. This pattern consists of extended striations in tidal speed aligned with the northern flank of Georges Bank that separates the Gulf of Maine from the North Atlantic. The striations are explained in terms of a linear superposition of the barotropic tide flowing across the northern flank of Georges Bank and the reflected, phase-locked baroclinic tide. The striations have amplitudes of about 0.1 m/s and longitudinal length scales of order 100 km, and are thus of practical significance.