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Numerical Study of Seasonal and Interannual Variability of Freshwater Fluxes over the Eastern Canadian Shelf

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The three-dimensional (3D) currents and hydrography over the eastern Canadian shelf (ECS) are affected significantly by atmospheric forcing and freshwater discharges from rivers and low salinity waters associated with ice/snow melting at high latitudes. A significantly large knowledge gap exists in our understanding of temporal and spatial variability in the 3D circulation and temperature/salinity distributions over the region. A newly developed Coupled Circulation-Ice Modelling System for the northwest Atlantic (CCIMS-NWA) is used in this study to examine the seasonal and interannual variability of freshwater fluxes over the ECS. This coupled modelling system is based on the Regional Ocean Modeling System (ROMS, Haidvogel et al., 2008) and Los Alamos Sea Ice Model (CICE, Hunke et al., 2015). The semi-prognostic method (Sheng et al., 2001; Greatbatch et al., 2004) and the spectral nudging method (Thompson et al., 2007) are used to reduce the systematic errors of the circulation model. The CCIMS is forced by hourly ERA5 atmospheric reanalysis fields produced by ECMWF and boundary forcing based on the daily GLORYS ocean reanalysis data. The performance of the CCIMS-NWA is assessed using the satellite remote sensing data and in-situ oceanographic observations. Analysis of 3D model results for the 5-year period (2014-2018) shows that the freshwater in the top 100 m over the ECS flows equatorward, with significant seasonal variability. Freshwater flux over the northwestern Gulf of St. Lawrence is correlated strongly with the river discharge of St. Lawrence River. Wind forcing plays an important role in affecting interannual variability of cross-slope freshwater flux over the Labrador Shelf, northern Newfoundland Shelf and Scotian Shelf. The cross-slope freshwater transport over Grand Banks is affected significantly by eddies over the continental slope.

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