Abstract View

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Dynamical Aspects of the Flow Through the Strait of Belle Isle

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ABSTRACT

We present an analysis of 50 days of current meter and sea Revel data collected in a long narrow strait connecting the Gulf of St. Lawrence to the Atlantic Ocean. The dynamical balances implied by a scale analysis of the equation of motion are compared with the data for semidiurnal and diurnal tides and for low-frequency flows, the main result being that the near-surface currents along the strait are, as expected, in geostrophic balance with the sea level slope across the strait. The flow appears to be driven by the sea level difference between opposite ends of the strait produced by large-scale meteorological forcing, and a regression model involving acceleration and friction suggests a spindown time of 1.1 days. The near-bottom currents are significantly less than those new the surface. At both levels the currants are reasonably uniform across the channel, apart from the possibility of nearshore intensification at the lower level. The vertical and horizontal structure of the low-frequency current fluctuations, and the spindown time, are reasonably consistent with the predictions of a dynamical model in which a stratified fluid in a strait of rectangular cross section is driven by an oscillatory pressure gradient along the strait.

Sea level data from an island at the eastern end of the strait of Belle Isle suggest that the flow fluctuations are confined to the south side of the Strait for both incoming and outgoing flows. The moan baroclinic flow appears to be close to critical and so may be hydraulically controlled. Cross-channel geostrophy permits the surface flow through the Strait to be monitored by sea level gages located on opposite sides of the channel, and eight years of data on the monthly mean sea level difference across the Strait suggest substantial winter inflow into the Gulf of St. Lawrence. There is considerable interannual variability for all seasons.

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