The Generation and Dissipation of a Solitonic Wave that Travels in the Reverse Direction to the Flow in the Saint John River Estuary, New Brunswick, Canada

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ABSTRACT

In the oceans internal waves are known to be generated where stratification, tides, irregular bathymetry and velocity shear are present. This study presents oceanographic results obtained under highly stratified conditions in the Saint John River Estuary, New Brunswick, Canada. In the study area the bathymetry is almost regular with a constant depth of ~23 m the exception being at the centre of the study area where a 15 m shoal exists. To the north and south of the shoal 30 m channel scours exist. These two channel scours converge upstream the shoal. Shipboard acoustic Doppler Current Profiler, Conductivity Temperature Depth sensor and an echosounder were used to map the oceanographic processes that were occurring. Under highly stratified conditions at neap falling tides within the vicinity of the shoal the echosounder images showed the generation of a solitonic wave. At this time of observation the flow was moving predominantly downstream, however it appears that the solitonic wave was travelling upstream. As the solitonic wave travelled upstream it entered the area where two channel scours converge, at this time and at this location an increase in flow velocity was taking place. When this occur the solitonic wave eventually dissipated. A decrease in density was observed to occur in the bottom layer when the solitonic wave dissipated. Calculations of the gradient Richardson number did not predict mixing to be occurring within the vicinity of the solitonic wave and where a decrease in density was observed. At spring tide the solitonic wave was not observed to occur and the decrease in density was also not present. These observations suggest possibly that: (1) mixing is occurring upstream and advected to the region or (2) within the vicinity of the shoal and channel scours mixing is occurring but due to the restrictions that all observations were made along the channel, the observations were not able to verify any secondary circulation mixing that may have taken place.