Geophysical Research Abstracts
Vol. 21, EGU2019-11993, 2019
EGU General Assembly 2019

Hydrographical Variations at James Bay Eelgrass Beds in Relation to an Under-Ice River Plume

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Eelgrass beds are globally recognized as important habitats for juvenile fish and birds, and provide important ecosystem services including nutrient recycling, sediment trapping, and carbon sequestration. During the 1990s, eelgrass beds in eastern James Bay underwent a massive decline, a possible contributor to which is the freshwater plume of the La Grande River. Hydroelectric developments of the La Grande River have reportedly more than doubled the average annual discharge and shifted peak discharge from spring to winter. In association with the Cree Nation of Chisasibi and the Arctic Eider Society, a series of CTD profiles were collected at various inshore and offshore locations from the mouth of the La Grande River extending along the northeast coast, with focus on two bays that historically contained eelgrass beds. Data was collected in both the winter and summer of 2016 and 2017 to compare the seasonal variation in the properties of the plume. A series of moorings were deployed during the winter months equipped with sensors measuring conductivity-temperature-depth, current velocity, and turbidity. The more northerly site (Bay of Many Islands) still contains relatively healthy eelgrass beds and the other site (Paul Bay) currently contains very little eelgrass. Towards the river mouth and Paul Bay the winter water column is generally strongly stratified; a relatively thick (5m), low salinity (0psu) surface layer overlies salty water (25psu). In summer, the water column is well mixed and surface salinities are higher (12psu). Both greater river discharge in winter and reduced wind mixing under the landfast ice likely contribute to these differences. Storm events in winter were associated with increases in the salinity of the surface layer and decreases in the salinity of the deeper layer, implying enhanced vertical mixing. At the nearshore eelgrass bed sites surface salinity is consistently lower, and temperatures are higher in Paul Bay compared to Bay of Many Islands. For example, in January 2016 and 2017 temperatures in the Bay of Many Islands were below 0°C and salinities were between 8 and 12.5psu. By contrast, in Paul Bay, the winter water temperatures were between 0°C and 3°C and salinities ranged from 0 to 2psu. The currents are also weaker in Bay of Many Islands, and the estuarine circulation brings in deep saline water into the bay while the fresher surface layer flows out of the bay. Salinity and temperature variations at each site reflect the spring-neap tidal cycle and temporal variability in the vertical properties of the plume. Preliminary interpretation suggests that while very fresh surface waters from the offshore river plume circulate freely into Paul Bay, brackish waters produced by vertical mixing of fresh surface waters and saline deep waters that circulate into Bay of Many Islands. The topography and weaker currents in the sheltered Bay of Many Islands setting likely lead to less entrainment of the freshwater plume and higher salinities, providing more favourable conditions for eelgrass growth.