Using a High-Resolution Regional Model to Develop a Mechanistic Explanation of Intrusion Events in Halifax Harbour, a Mid-latitude Fjord in Eastern Canada

In light of scaling efforts to mitigate climate change, research on Ocean Alkalinity Enhancement (OAE) is ongoing in Halifax Harbour, a small, midlatitude fjord in Atlantic Canada. The Harbour consists of the 70-m deep Bedford Basin and a 20-m deep, narrow channel connecting the Basin to the adjacent Scotian Shelf. Physical and biogeochemical properties of Bedford Basin are strongly influenced by sporadic intrusion events, during which waters from the adjacent shelf replace bottom waters in the Basin. This project aims to provide a better understanding of the dynamical drivers of these events so we can gain predictive understanding and improve sampling strategies. We use a 20-year hindcast simulation, generated with a 3-level nested Regional Ocean Modelling System (ROMS) of Halifax Harbour, to define and explain the driving mechanisms behind the intrusion events. Wind-driven transport of shelf waters and tidal exchange in the narrow channel are investigated as dynamic mechanisms behind all simulated intrusions in the 20-year hindcast. This first-order mechanistic explanation informed by the regional model improves our understanding of intrusion events while also supporting the optimal placement of observing assets to guide model refinements and model comparisons. Developing a predictive understanding through testing the model-derived mechanistic explanation against observed intrusion events will improve our ability to simulate and predict intrusions and their biogeochemical effects on the Bedford Basin. These results have direct implications for the ongoing OAE research and demonstrate the importance and effectiveness of combining models and observations in regional oceanographic research.

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