

## Charting the future: Saltwater intrusion vulnerability along island and continental coastlines

Nicole LeRoux, Bay Berry, Barret Kurylyk  
Dalhousie University, Halifax, Canada

### Abstract

Approximately 40% of the global population lives within 100 km of the marine coast and are vulnerable to converging atmospheric and marine stressors. Along the land-sea interface, a subsurface salt wedge extends inland and underlies fresh groundwater due to the density differences between fresh and saltwater. Dense coastal populations strain fresh groundwater resources, as high pumping rates can draw this salt wedge landward in a process known as saltwater intrusion. Rising sea levels and storm surge can increase coastal aquifer salinization, particularly on islands. Canada has the world's longest coastline and is projected to experience high rates of relative sea-level rise, further increasing the vulnerability of freshwater. Sea-ice reduction and hurricanes tracking higher north will also contribute to more intense waves and storm surges and associated extreme high-water events.

All of Nova Scotia (NS), Canada is within 50 km of the coastline and ~50% of residents, including many on Cape Breton Island, rely on fresh groundwater for drinking water. Given the heavy groundwater reliance and high rates of projected sea-level rise in NS, monitoring and management of these coastal freshwater resources is of paramount importance. This study employs a process-based approach to map saltwater intrusion vulnerability using an analytical solution that models the salt wedge extent based on publicly available data including groundwater levels, aquifer properties, and other (hydro)geological datasets. The vulnerability index considers the impacts of sea-level rise, changing recharge, and reduced seaward groundwater discharge, all of which can drive landward migration of the salt wedge. Preliminary results indicate that this tool can provide a robust first-order assessment of saltwater intrusion, which is inherently difficult to monitor, particularly at a province-wide scale. Identifying coastal regions most vulnerable to saltwater intrusion is the first step towards effective adaptation practices and is of utmost importance in an era of unprecedented change.

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