Measuring the ins and outflows of estuaries
8 November 2022, by Saima May Sidik

In coastal inlets such as bays and fjords, mixing of salt water and fresh water regulates many aspects of the local environment, from nutrient concentrations to oxygen levels and the composition of phytoplankton communities. Studying these areas is critical to our understanding of specialized ecosystems and ocean-land exchanges, but knowing how best to distribute monitoring instruments to capture a full picture of these dynamic environments is challenging.

In 2011, scientists began refining a framework called total exchange flow (TEF) for analyzing how water mixes in estuaries. Until recently, TEF had predominantly been used to model highly defined situations. But in a recent study published in the Journal of Geophysical Research: Oceans, Lemagie et al investigated realistic hydrodynamic models to predict the best way of using moored instruments to measure TEF in three large natural estuaries: San Diego Bay off Southern California, the Salish Sea and Strait of Juan de Fuca between British Columbia and Washington State, and the outlet of the Columbia River off Oregon and Washington.

The three locations represent very different types and shapes of estuaries. San Diego Bay is a shallow estuary that receives little rainfall; the Strait of Juan de Fuca is a relatively deep fjord; and the outlet of the Columbia River is a salt wedge, where fresh water flows outward atop inflowing salt water.

In each model, the researchers varied the lateral and vertical distribution of the instruments to identify the best configurations. Their results suggested that in all three cases, distributing three to four monitoring devices evenly across the estuary channel, with each measuring at one to five depths, could capture more than 90% of water exchange.

The findings are encouraging, the authors say, because they suggest that monitoring with a limited number of instruments is a feasible way to measure TEF in estuaries and better understand the water exchanges that regulate these complex ecosystems.


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