Estuarine Circulation, Mixing, and Residence Times in the Salish Sea

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Abstract

A realistic numerical model is used to study the circulation and mixing of the Salish Sea, a large, complex estuarine system on the United States and Canadian west coast. The Salish Sea is biologically productive and supports many important fisheries but is threatened by recurrent hypoxia and ocean acidification, so a clear understanding of its circulation patterns and residence times is of value. The estuarine exchange flow is quantified at 39 sections over three years (2017-2019) using the Total Exchange Flow method. Vertical mixing in the 37 segments between sections is quantified as opposing vertical transports: the efflux and reflux. Efflux refers the rate at which deep, landward-flowing water is mixed up to become part of the shallow, seaward-flowing layer. Similarly, reflux refers to the rate at which upper layer water is mixed down to form part of the landward inflow. These horizontal and vertical transports are used to create a box model to explore residence times in a number of different sub-volumes, seasons, and years. Residence times from the box model are generally found to be longer than those based on simpler calculations of flushing time. The longer residence times are partly due to reflux, and partly due to incomplete tracer homogenization in sub-volumes. The methods presented here are broadly applicable to other estuaries.

REFERENCE:

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