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Sub-tidal circulation in the Columbia River estuary-plume-shelf system in spring and summer 2009

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Circulation in the Columbia River (CR) estuary-plume-shelf system for spring and summer 2009 is investigated with skill-assessed model simulations. Simulations are hydrostatic, conducted with the unstructured-grid 3D baroclinic circulation model SELFE. Skill assessment is based on observations from SATURN (http://www.stccmop.org/datamart/observation_network) endurance stations (in-situ sensors and coastal surface radar) and pioneer array (AUVs and glider), complemented with shipboard flow-through and cast data. Together, these observations offer substantial insights into the temporal and spatial distributions of salinity, temperature and velocity fields, including important vertical structures. We focus on the period of two integrated field campaigns (May and September). Upwelling-favorable winds are dominant during the spring campaign whereas winds tend to change from upwelling- to downwelling-favorable winds during the summer campaign. The average Columbia River discharges are approximately 10,200 and 3,400 m3/s for the spring and summer campaigns, respectively. Circulation forecasts are used to guide the campaigns. In addition, retrospective simulations are conducted post-campaign, to explore parameter optimization and strategic local refinements. The resulting simulations are usefully realistic, and consistent with expected behavior: a highly (spring) to moderately (summer) stratified estuary, and plume size and location controlled by the combination of prevailing shelf winds and river discharge. By tidally-averaging simulations, we focus on characterizing water and salt fluxes and vertical structure in the plume and lower estuary, including contrasts between the two main channels. Results generally confirm, but add detail and cross-spatial perspective to prior oceanographic studies in the estuary. Interpretations include an analysis of the effects of modeling errors and uncertainties.

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