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**Tidally Averaged Circulation in Fjoldal Sub-basins of Puget Sound: Model
Validation Using Historic Records**

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Through extensive field data collection and analysis efforts since the 1950s, researchers have developed a good understanding of the characteristic features of circulation in Puget Sound, Washington, consisting of a two-layered circulation system hydraulically bounded by two sills with net outflow through the mixed surface layer. An attempt at reproducing this behavior by fitting an analytical formulation to past data sets was successful but quickly re-confirmed that the hydrodynamic response is complex, and ranges from the classic fjoldal behavior in some basins, with shallow brackish outflow and compensating inflow immediately below, to the typical two-layer flow observed in many partially mixed estuaries, with saline inflows at much lower depths. A three-dimensional circulation and transport model of Puget Sound (PS-CTM) was therefore developed incorporating multiple connected basins, presence of numerous islands, and site specific strong advective vertical mixing created by shallow sills and includes the effects of inflows, point and non point sources, meteorological forcing. The model developed using unstructured grid finite volume method was calibrated using available recent short term oceanographic time series data sets from different parts of the Puget Sound basin. This paper presents its application over year-long simulations to validate its capability of reproducing long term average circulation in Puget Sound. The results are compared against (i) a recent 1-year record of velocity and current profiles collected in Puget Sound from 2006 and (ii) a well established set of previously analyzed historical records, mostly from the 1970s. The model successfully reproduced velocity and salinity profile characteristics and their variation among Puget Sound sub-basins. Sensitivity of the residual circulation to seasonal variations, and influence of point sources and ungaged flows are also investigated.

Keywords: modeling, fjords, partially mixed estuaries, analytical solution, 3-D hydrodynamic model, unstructured grid, Puget Sound

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