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Characterizing Tidal Stream Energy Resource in the Salish Sea
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Introduction

Harvesting tidal stream energy has been gaining strong global interest as an energy resource alternative to fossil fuels for mitigating the impact of climate change and providing energy security. The Salish Sea is one of the top sites for tidal stream energy development in the USA because of its strong tidal currents in many tidal channels. This paper presents a modeling study conducted to characterize the tidal energy resource in the Salish Sea, a critical step towards deployment of tidal turbine farms.

Methods

The Salish Sea tidal hydrodynamic model is based on the Finite Volume Community Ocean Model (FVCOM, Chen et al., 2003). Model resolution varies from 50 m in tidal channels to about 500 m at open boundary (Fig. 2). The model grid consists of 843,000 nodes, 1,632,000 elements and 20 vertical layers. The model is driven by water levels at the open boundaries and stream flows. Model validation was conducted using 10 real-time tide gauges and 132 ADCP stations. Resource assessment was carried out following the International Electrotechnical Commission Technical Specification.

Results

Model performance was evaluated with a set of error metrics and tidal resource parameters. Overall, model results matched the observed data well, which demonstrates that the model is able to simulate the tidal hydrodynamics accurately in the Salish Sea (Fig. 4 and 5) (Yang et al., 2021).

Model outputs were used to identify energy hotspots in the Salish Sea, 16 tidal channels with high current speeds (Fig. 6) and kinetic energy fluxes were identified (Fig. 7) (Yang et al., 2021).

To assess the cross-sectional variability of energy resource, mean power densities at selected tidal channels were calculated (Fig. 8-11).

Conclusions

- A high-resolution tidal hydrodynamic model for the Salish Sea was extensively validated for water levels and tidal currents.
- A total of 16 channels were identified for potential tidal energy development based on the of criteria velocity magnitude, kinetic energy flux, and channel depth.

Literature cited


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