Geophysical Research Abstracts
Vol. 19, EGU2017-18272, 2017
EGU General Assembly 2017

High-resolution modeling assessment of tidal stream resource in Western Passage of Maine, USA

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Although significant efforts have been taken to assess the maximum potential of tidal stream energy at system-wide scale, accurate assessment of tidal stream energy resource at project design scale requires detailed hydrodynamic simulations using high-resolution three-dimensional (3-D) numerical models. Extended model validation against high quality measured data is essential to minimize the uncertainties of the resource assessment. Western Passage in the State of Maine in U.S. has been identified as one of the top ranking sites for tidal stream energy development in U.S. coastal waters, based on a number of criteria including tidal power density, market value and transmission distance. This study presents an on-going modeling effort for simulating the tidal hydrodynamics in Western Passage using the 3-D unstructured-grid Finite Volume Community Ocean Model (FVCOM). The model domain covers a large region including the entire the Bay of Fundy with grid resolution varies from 20 m in the Western Passage to approximately 1000 m along the open boundary near the mouth of Bay of Fundy. Preliminary model validation was conducted using existing NOAA measurements within the model domain. Spatial distributions of tidal power density were calculated and extractable tidal energy was estimated using a tidal turbine module embedded in FVCOM under different tidal farm scenarios. Additional field measurements to characterize resource and support model validation were discussed. This study provides an example of high resolution resource assessment based on the guidance recommended by the International Electrotechnical Commission Technical Specification.