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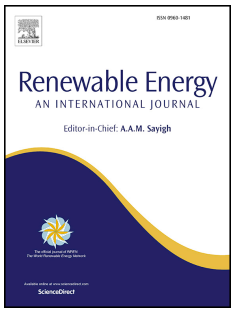

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Geoffrey W. Cowles, Aradea R. Hakim, James H. Churchill

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A Comparison of Numerical and Analytical Predictions of the Tidal Stream Power Resource of Massachusetts, USA

Geoffrey W. Cowles[a], Aradea R. Hakim[a], James H. Churchill[b]

[a]*Dept. of Fisheries Oceanography*
University of Massachusetts Dartmouth
New Bedford, MA 02744, USA

[b]*Dept. of Physical Oceanography*
Woods Hole Oceanographic Institution
Woods Hole, MA 02543, USA

Abstract

The coastal waters of Massachusetts, USA encompass tidal phenomena that generate flows of sufficient magnitude for commercially viable power extraction. We examine the tidal power resource of the Massachusetts coastal region with two high-resolution hydrodynamic tidal models: a regional model encompassing the coastal waters of southeastern New England and a local domain model of Cape Cod Canal. Both models have been subject to comprehensive skill assessment using available surface elevation and ADCP measurements. Based on the model results, we identify five high-energy sites (Cape Cod Canal, Muskeget Channel, Quicks Hole, Robinson Hole and Woods Hole) for evaluation of the maximum extractable tidal power. The power extraction at these sites is modeled using linear momentum actuator disk theory applied to a cross-channel array of turbines. Of the sites evaluated, Muskeget Channel has the greatest resource, with an estimated maximum extractable power of 24 MW. The estimated total power available from all five sites is 44 MW. These estimates agree within 21% with predictions from analytical approaches at all sites. Potential applications for the models include: providing developers with an initial assessment of the resource, guiding observation programs for further study of the resource, and facilitating optimization of turbine array design.

Keywords: tidal power, FVCOM, Cape Cod Canal, Muskeget Channel

Highlights:

- A three dimensional barotropic tidal model for Massachusetts has been validated
- LMADT theory is used to evaluate the theoretical tidal stream power resource
- Results compared with values derived from accepted analytical approaches of Garrett & Cummins
- A maximum extractable power of 44 MW is available from five high energy sites

Email address: gcowles@umassd.edu (Geoffrey W. Cowles)