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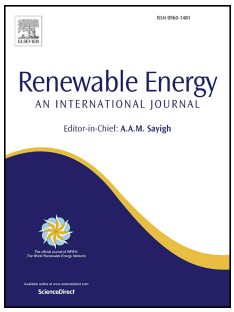

Tidal energy extraction in three-dimensional ocean models

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Tidal energy extraction in three-dimensional ocean models

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Abstract

Access to high performance computing has made 3-D modelling de rigueur for tidal energy resource assessments. Advances in computing resources and numerical model codes have enabled high resolution 3-D ocean models to be applied at basin scales, albeit at a much higher computational cost than the traditional 2-D modelling approach. Here, a comparison between 2-D and 3-D tidal energy extraction modelling techniques is undertaken within a 3-D modelling framework, and differences between the methods are examined from both resource and impact assessment perspectives. Through a series of numerical experiments using the Regional Ocean Modeling System (ROMS), it is shown that 3-D tidal energy extraction can be successfully incorporated in a regional ocean model of the Pentland Firth - one of the top regions in the world for tidal stream energy development. We demonstrate that resolving 3-D flow is important for reducing uncertainty in environmental resource assessments. Further, our results show that 2-D tidal energy extraction methods lead to a misrepresentation of the velocity profile when applied to 3-D models, demonstrating the importance of resolving 3-D flows in the vicinity of tidal arrays.

Keywords: Tidal energy resource, Tidal energy modelling, Tidal power,

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