MODELING THE IMPACTS OF TIDAL STREAM ENERGY EXTRACTION

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The ocean tidal currents are a predictable source of renewable energy with the potential to contribute to the supply of energy required to meet increasing global demand. However, many questions remain about the feasibility of utilizing this resource, including the impacts of energy extraction on the environment. Numerical simulations of three sites with diverse geometries have been conducted to examine the impacts of energy extraction on large-scale circulation. The three sites include a large, enclosed bay; a complex set of barrier islands backed by tidal wetlands; and gaps between islands in an archipelago. Each site is modeled with ROMS using eight tidal constituents as forcing. Energy extraction is incorporated as a retarding force imposed at grid cells, representative of a turbine array. For each site, two cases of extraction are modeled: the first case simulates a full tidal fence with a calibrated extraction coefficient to produce the maximum energy extraction for the site; the second case employs a more realistic scenario with a partial fence of energy extraction. In order to assess the relative effects of energy extraction, a case of no energy extraction is also run. The difference in current magnitude will be used to determine the spatial extent of both increases and decreases of current speed and identify locations in which effects are particularly pronounced. The change in total flow in and out of the channel will be determined to shed light upon flushing of the estuary or bay. Similarly, the spatial distribution of changes to the mean water level will be examined to determine changes in tidal amplitude. The total energy flux as well as its potential and kinetic components will be compared between the three cases for each location.

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