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SOME FLUID DYNAMICAL ISSUES IN THE SITING OF TURBINES FOR TIDAL ENERGY

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ABSTRACT

Tidal energy has been identified as a potentially important source of renewable energy in several areas of the world, including regions along the eastern and western coasts of the United States and Canada, some coastlines in Asia, and in the British Isles. In the northwestern United States, the Puget Sound, especially Admiralty Inlet in the northern part of the Sound, is a promising source of tidal energy.

In order to explore the potential for tidal energy in the Puget Sound, the Northwest National Marine Renewable Energy Center has been established at the University of Washington, funded by the US Department of Energy. The Center is operated in partnership with Oregon State University, which is addressing the potential of ocean surface wave energy. A local power utility, Snohomish County Public Utility District, is planning to site several water turbines in Admiralty Inlet as part of this exploratory study.

A number of aspects of tidal energy are being addressed by the Center, from field experiments in order to characterize the potential of specific sites, to studies of the potential effects of water turbines on marine mammals, to work on the reliability and survivability of turbine devices through the use of advanced composite materials.

In this presentation one aspect of research at the Center will be discussed, that of using computer simulations to determine the overall flow characteristics in Admiralty Inlet, and hence to determine which regions may be most effective as sites for water turbine operation. The research is a collaborative study between a group in the College of Oceanography at the University of Washington and members of the Center. In particular, using the Regional Ocean Modeling System (ROMS), a community-developed ocean computer model, the oceanography group has performed much larger-scale, but lower resolution, simulations of the Salish Sea region, including the Puget Sound, the Strait of Juan de Fuca, southern portions of the Strait of Georgia, and Washington State and British Columbian portions of the continental shelf. Again employing ROMS, researchers at the Center are performing higher resolution, `nested' simulations of Admiralty Inlet, using the simulations of the Salish Sea as boundary conditions.

Two related aspects of the Center study will be discussed. The first is the detailed dynamics observed in Admiralty Inlet, including the behavior of the tides, but also secondary motions such as vortices generated by the headlands, flow enhancements due to various features in the bathymetry, and the potential for hydraulic control as current speeds approach the local internal interfacial wave speed. The second aspect includes various metrics used to determine, for each region of Admiralty Inlet, the effectiveness of the local flow for tidal energy purposes. These metrics include, for example, the local kinetic power density, asymmetry in flow direction, and various turbulence properties.