Application of an unstructured-grid, finite-volume parallel coastal ocean simulator to the Snohomish River Estuary

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Abstract

A parallel code (Stanford Unstructured Nonhydrostatic Terrain-following Adaptive Navier-Stokes Simulator, SUNTANS) that solves the three-dimensional, nonhydrostatic Navier-Stokes equations with the Boussinesq approximation on an unstructured, staggered, z-level grid has been implemented to simulate the hydrodynamics of the Snohomish River Estuary and resolve coherent structures in the vicinity of an abrupt topographic feature at the north end of Jetty Island near the river mouth. The estuary connects the Snohomish River to Possession Sound in North Puget Sound, WA, and it is well known that this estuarine system is strongly influenced by the tide and there is significant interaction between the saline sound water and fresh river water. Therefore, the simulation domain has been chosen to include Possession Sound to the west and 30-kilometers of the Snohomish River to the east. For computational efficiency, a smoothly stretched unstructured grid with large cells in the sound and smaller cells in the river has been adopted. Moreover, as the coherent structures of interest are on the length scale of several meters, the grid has its finest resolution in the area of interest near Jetty Island. At this initial stage of the study, a test grid has been generated with GAMBIT, and it is sufficiently fine to resolve most of the flow conditions, but not the detail of the finest coherent structures. The main purpose of this grid is to validate boundary conditions and initial conditions. We plan to report on the key aspects and results of implementing the unstructured grid on this complex domain, on the benefits of the unstructured grid configuration for studying the flow physics, and on the code performance. Our next challenge is to generate a highly-resolved grid containing one-meter resolution in the vicinity of the study site.

Acknowledgment: This work is supported under ONR Grant N00014-05-1-0485 (C. Linwood Vincent, Program Officer).