Building an improved operational coupled wave/current forecast at the Columbia River Mouth

The navigational inlets in the U.S. Pacific Northwest are of significant economic importance to the region's commercial and recreational fishing industries and are critical lifelines for shipping and maritime transportation. In 2021, over 65 million cargo tons traversed the Columbia River mouth amounting to ~$27 billion in goods. We report on a on-going project that will develop, test, and verify a powerful high-resolution wave forecasting system with the critical additional capability of including the effect of currents on the wave forecasts (i.e., wave/current interaction) through one-way coupling with existing estuarine circulation models. In addition, the system will have the capability to adapt to new circulation models that are under current development as they become operational. The project utilizes the WaveWatchIII model and unstructured grids. The significant tidal ranges and freshwater discharges at many estuaries in the Pacific Northwest (PNW) make the inclusion of wave-current interaction critical to the accuracy of wave forecasts in these areas. The first circulation model we consider for coupling is the "Virtual Columbia River" developed at the Center for Coastal Margin Observations and Prediction, which is a 4D (space-time) operational circulation model based on the SELFE computational engine. The model domain is focused on the Columbia River estuary but extends out into the open ocean. The primary focus is on the lower estuary and the river plume, which extends between 20 to 100 miles out into the ocean. Ongoing work with the Virtual Columbia River model is to migrate to a SCHISM based engine. The end target of this effort is integration into NOAA-NOS Surge and Tide Operational Forecast System (STOFS). This model (STOFS-3D-Pacific) is currently in the process of being transferred to NOAA-OCS CSDL for pre-operational testing. At present, this model incorporates tidal, atmospheric, and 3D baroclinic ocean forcings. Last, there is also the Salish Sea and Columbia River Operational Forecast System (SSCOFS), which is a developmental circulation forecasting system that also does not yet include wave forcing. SSCOFS is an unstructured 3D model as well with high-resolution at the mouth of the Columbia and a domain that extends down past Yaquina Bay on the Oregon coast. Our goal is to compare and evaluate the WWIII wave prediction accuracy using each of these circulation models in order to assess the spatial resolution needs and coupling effectiveness. The effort will include additional specialized analyses of both remote sensing and in situ wave data for verification.

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