EXTRATROPICAL STORMS TO TOTAL WATER LEVELS: A US WEST COAST MODEL TESTBED

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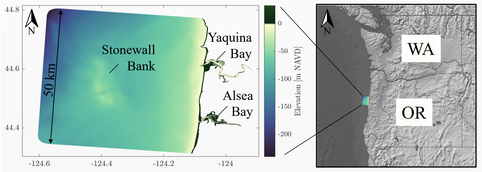
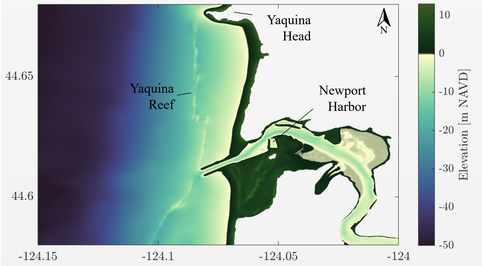
ABSTRACT

As a first step toward the buildout of a United States west coast coastal storm modeling system (WC-CSTORM), we present a numerical model test bed that can support various wave and circulation model configurations and contains a host of available observational datasets for calibration and evaluation. This test bed, located near the city of Newport, Oregon, USA, includes two tidal inlets (one engineered and one with a natural mouth), a headland, and both complex and simple shoreline geometries. A simple hindcast configuration of two-way coupled SWAN and ADCIRC with forcing derived from local observations delivers promising performance during a recent wave-focused field effort with nearshore significant wave heights exceeding 5.5 m.

TESTBED DOMAIN



- Engineered (Yaquina) and natural (Alsea) inlet geometries
- Isolated shelf structure redirects swell
- Headland bounds littoral cell and steers coastal currents
- Submerged rocky reef sharply transforms wave field
- Bluff- and dune-backed dissipative beaches



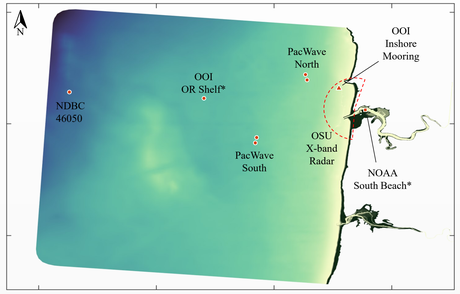
OBSERVATION DATASETS

Monitoring Stations (ongoing)

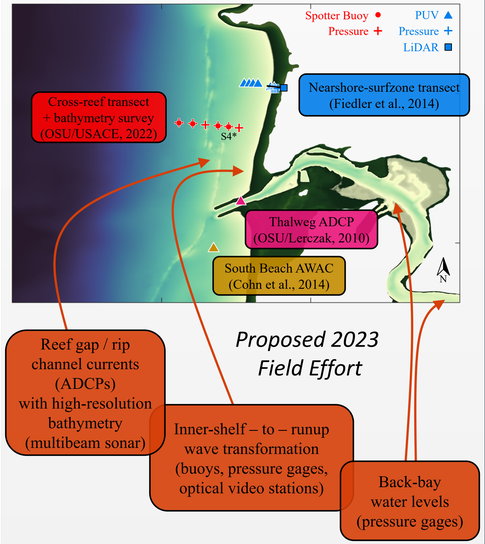
6 mid-shelf wave buoys + inner-shelf ADCP

Multidecadal tide gage

Radar remote sensing



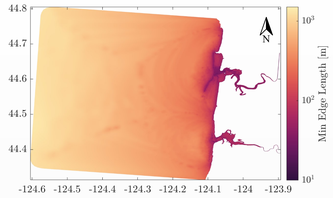
Select Prior Deployments



MODEL UNSTRUCTURED MESH

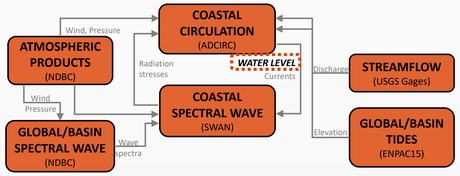
1.5 km to 13 m spatial resolution

250 m depth to MHHW+10 m elevation at coast

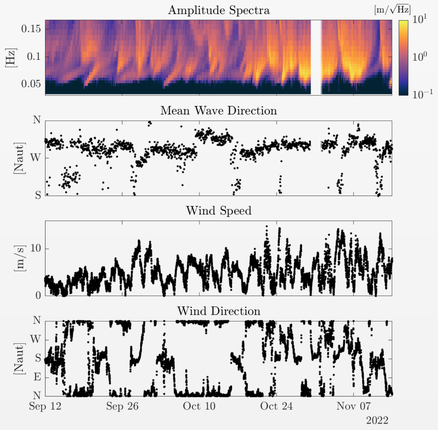


SAMPLE CONFIGURATION

Coupled wave-circulation model
ADCIRC ⇔ SWAN

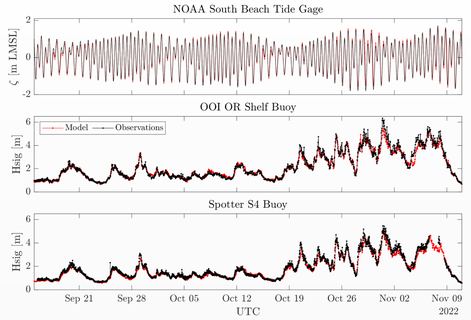


Observation-based forcing
(NDBC 46050 near offshore boundary)

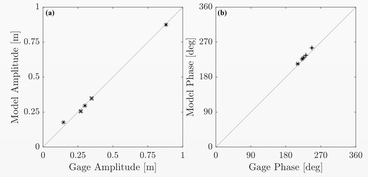


PRELIMINARY EVALUATION

(See starred* observation datasets)

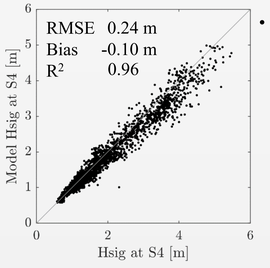


- Water levels are dominantly tidal in Yaquina Bay
- Large amplitude waves persist shoreward of the reef



- Dominant tidal constituent amplitude and phase performance is comparable to ENPAC15 tidal model at similar stations:

Szpilka et al., 2018:
Within 10% amplitude error and within 10 deg phase error



- Shallow water bulk wave metrics are comparable to nested multigrid models:

Garcia-Medina et al., 2014:
RMSE 0.27 m

O'Dea et al., 2018:
RMSE 0.32 m

ONGOING EFFORTS

Ongoing efforts include testing various model configurations, including nearshore wave model performance comparisons between SWAN (41.45) and WaveWatch III (6.07). Upcoming efforts include a comparison between ADCIRC ↔ SWAN and a two-way coupled ADCIRC↔WaveWatch III model that is currently in development. These model configurations will be evaluated during a series of historical and proposed field efforts to build a more complete picture of model performance. In addition, an ensemble of parameterized model forcing will be generated with USACE-supported collaborators. The testbed model results will then enable the buildout of a statistical model of total water levels along the open and sheltered coastline, following the emulator methodologies of Anderson et al., (2019) and Parker et al., (2019).

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