Surface currents for navigation and the environment

Depth-resolving computer models support a wide variety of economic and environmental goals

Charles Seaton, David Graves, Denise Kelsey, Dr. Joseph Zhang, Dr. Antonio Baptista

Coastal Margin Observation and Prediction (CMOP)
Columbia River Inter-Tribal Fish Commission (CRITFC)

NOAA Hydrographic Services Review Panel – Spring 2021
March 3-4, 2021
Columbia River (CR) depth-resolving models

Coastal Margin Observation and Prediction program (CMOP) has a 20+ year history of modeling in the Columbia River estuary

- Component of the IOOS PNW region NANOOS
- Produce forecasts and long-term retrospective simulations
- Depth-resolving models show salinity intrusion, fresh-water plumes, and velocities throughout the water column
- Models use spatially-responsive mesh to allow resolution of complex features

Selected previous projects:
- Salmon habitat opportunity in the CR estuary (NOAA-NMFS)
- Particle tracking, search and rescue and equipment recovery
- Columbia River channel deepening salinity intrusion (USACE)
- River discharge scenarios for Columbia River treaty review
- Storm surge evaluation (FEMA)
SCHISM modeling community

- **Semi-implicit Cross-scale Hydroscience Integrated System Model**
- Academic, NGO, state and Tribal government research community provides a test-bed for model and application development
- International participation in SCHISM development
- Feed-in to NOAA operationalization
- Variety of NOAA projects:
  - NOAA NOS Coastal and Ocean Modeling Testbed (COMT) program,
  - Storm surge modeling on the US East Coast,
  - VDatum development
- NOAA-NOS-OCS led, COOPS, NGS, IOOS collaborations

ccrm.vims.edu/schismweb/
Columbia River: currents and salinity

- Timing of tidal currents, water levels and density
- Potential to support navigation
- Transit timing between ports (currents)
- Underkeel clearance (elevation and water density)

Salinity profiles
- Feb 22, 2021 strong ebb tide

Salinity maps
- Vertical profiles along three transect lines

Current profiles
- Salinity
- Currents
Pacific Basin-scale surface currents

Potential for producing NOAA S-111 surface water currents:

• SCHISM depth-resolving and spatially-responsive model can produce surface currents

• Global ESTOFS produces water level forecast guidance but not surface currents

• Existing NOAA depth-resolving modeling is either regional or structured grids (9.5 km grid spacing)
Pacific model development

• Spatially-responsive model of Pacific combines basin-scale extent with detailed resolution of ports
Pacific surface currents: details (Aug 19, 2018)

Tropical Storm Cimaron near Guam

Currents around Hawai‘i

↑ 1.5 m/s surface current
24 hours later...

Typhoon Cimaron near Guam

Currents around Hawai’i

↑ 1.5 m/s surface current
Conclusions

• Support for modeling community feeds back into NOAA operational modeling
• Spatially-responsive modeling allows basin-scale and high-resolution features to be handled by a single continuous model
• Depth-resolving modeling resolves surface currents, water levels, and density
• This combination provides potential for real-time port-to-port navigation support
• Models will also support understanding of basin-scale ecological processes