The Columbia River Intertribal Fish Commission (CRITFC)'s CMOP program: **Modeling the Columbia River from** watersheds to the Pacific Basin

Charles Seaton^{*1}(cseaton@critfc.org), Antonio Baptista², Aja DeCoteau¹, Laura Gephart¹, Ed Meyers³, Shachak Pe'eri⁴, Mike Swirsky¹, Greg Seroka³, Y. Joseph Zhang⁵

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

- 2: Oregon Health & Science University (OHSU)
- 3: NOAA/NOS/OCS Coast Survey Development Lab (CSDL)
- 4. NOAA/NOS/NGS Geosciences Research Division (GRD)
- 5: Virginia Institute of Marine Science (VIMS)







CMOP's Modeling Program

- Virtual Columbia River Model
- CRITFC's Pacific Ocean to Estuary Model (CPOEM)
- Future plans







Virtual Columbia River

 The CMOP Columbia River estuary model extends to Bonneville dam out to northern California and British Columbia

Models water flow, tides, and the mixing of salt and freshwater from minute to minute over the water column

- Run as a forecast, for historical conditions, and for scenarios
- Used for a wide variety of projects including climatology, salmon survival, storm surge, and search and rescue support







Circulation models support salmon

- A / non the latest of the solution



Heatmaps of migration routes in individual based modeling of juvenile Chinook salmon (SELFE)

K.J. Morrice et al, 2020. Ecological Modeling.



Intercomparison of biological and physical indices and SAR for Chinook salmon. Physical indices include modeled plume area, highlighted above (SELFE).

J. Miller et al, 2014. PLOS ONE



Juvenile Chinook salmon estimated consumption rate as a function of modeled (ROMS/SELFE) out-migration and mean temperature exposure.

B. Burke et al, 2016. Environ Biol Fish.





Plume and Salinity Intrusion







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Salinity Intrusion along channels





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CPOEM

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Basin scale model using unstructured grids allows high resolution in areas of interest



Strait of Georgia, Salish Sea

Fraser River delta



Tides

 Good performance representing harmonic tides

 Model skill at stations is partly dependent on accurate highresolution bathymetry and on grid resolution







Non-tidal elevations

- Median RMS error in non-tidal elevation for full-year simulation is 5 cm at stations throughout the basin. 95% of stations have RMSE ≤ 9 cm
- Seasonal patterns and storm surges are well captured (e.g. Typhoon Trami, in Japan)







Large scale structure

• The model solution describes sea surface currents, salinity and temperature variability qualitatively well at a variety of scales



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Upwelling

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Model captures upwelling and relaxation events along Oregon-Washington coast





Next step for the Virtual Columbia River

National Water Model

Bathymetry

- Lessons learned from CPOEM
- New database and forecast
- High resolution (<5m) wetlands
- Integration of discharge from National Water Model









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Tributary Delta Models

- In planning phase
- Made possible by bathymetry collected by NOAA-NOS and OSU









Columbia River OASIS Model (CROM)

- Hydrosystem model
- CROM will be used at CRITFC to model:

- Ecosystem flow regulation under the CRT
- Flows under climate change scenarios
- Power system scenarios related to the CRITFC Energy Vision
- Provides scenario boundary conditions to estuary and tributary delta models



Map of Columbia River in CROM





Conclusion

- CRITFC's CMOP program continues to develop innovative unstructured grid models, at vast and small scales, to support salmon survival and other regional needs
- The CPOEM basin scale model is being transitioned to a NOAA-NOS operational forecast (STOFS-3D-Pacific)
- New Virtual Columbia River forecasts, hindcasts, and updated climatological atlas scheduled for release this year
- Development of improved flood plain and tidal wetland modeling is ongoing
- Climate change scenario modeling is planned

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- Bathymetry/Topography sources: NOAA, Taiwan Central Weather Bureau, Climate Central for CoastalDEM, DeepReef.org for 3D-GBR and nthaus100

Contact: Charles Seaton, cseaton@critfc.org



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