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Modeling wind-induced waves in the Salish Sea

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Modeling Wind-Induced Waves in Salish Sea

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Salish Sea Ecosystem Conference
Seattle, WA
April 4-6, 2018

UNIVERSITY of WASHINGTON

Pacific Northwest NATIONAL LABORATORY

PNNL-SA-126513

Background and Motivation

- Storm surge and extreme waves pose risks to coastal communities
- No adequate data for impact assessment in Salish Sea
  - Limited wave measurements
  - No detailed wave model simulations

Need for conducting high-resolution wave modeling using state-of-the-art models and best practice approaches

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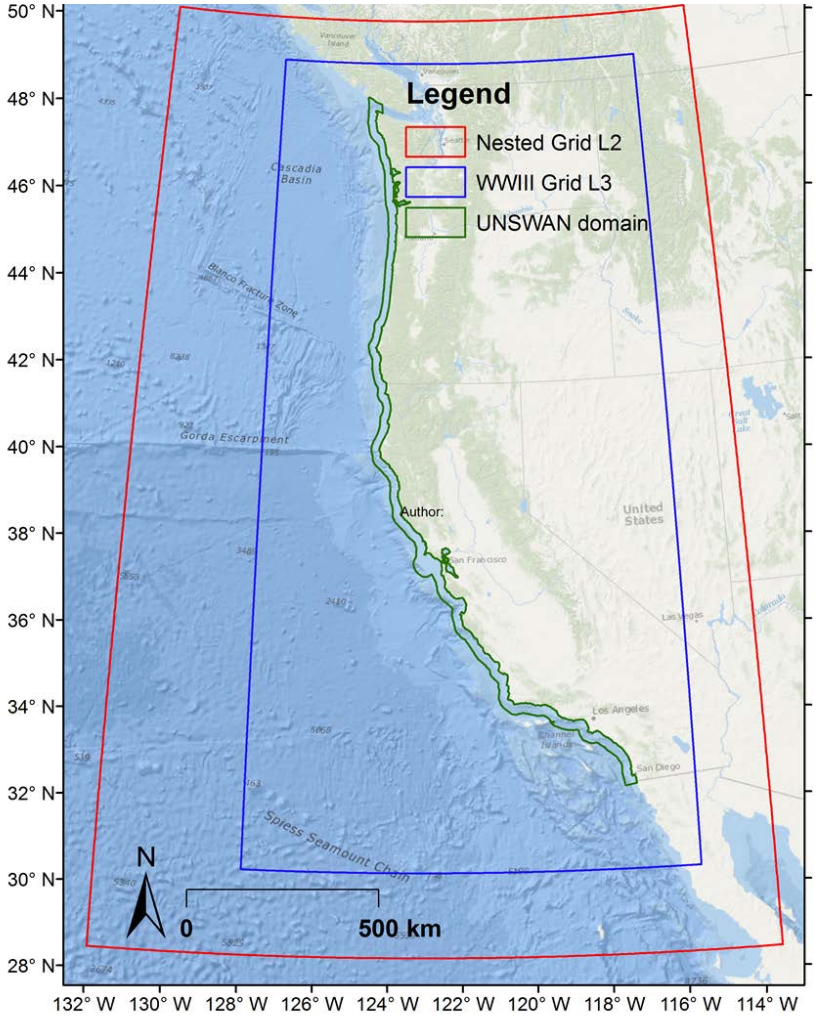
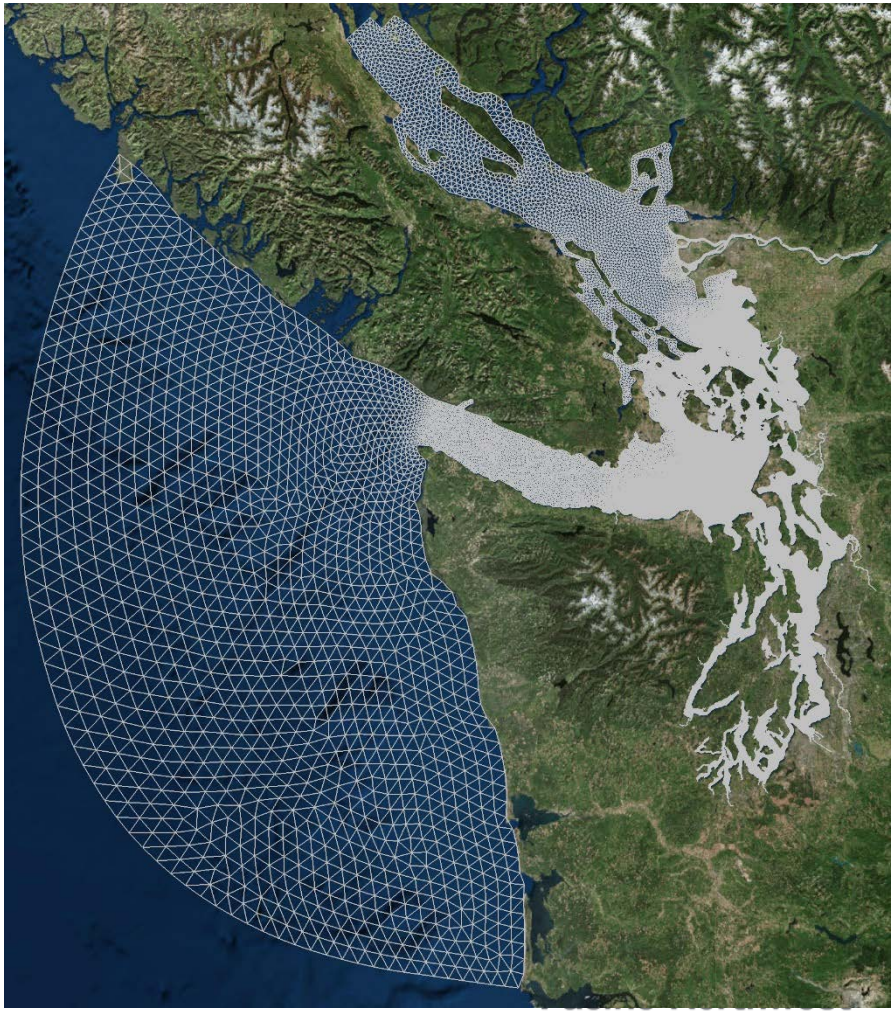
Multi-scale, Nested-grid Modeling Approach

- Global-regional nested WWIII model for US west coast (1-arc minute)

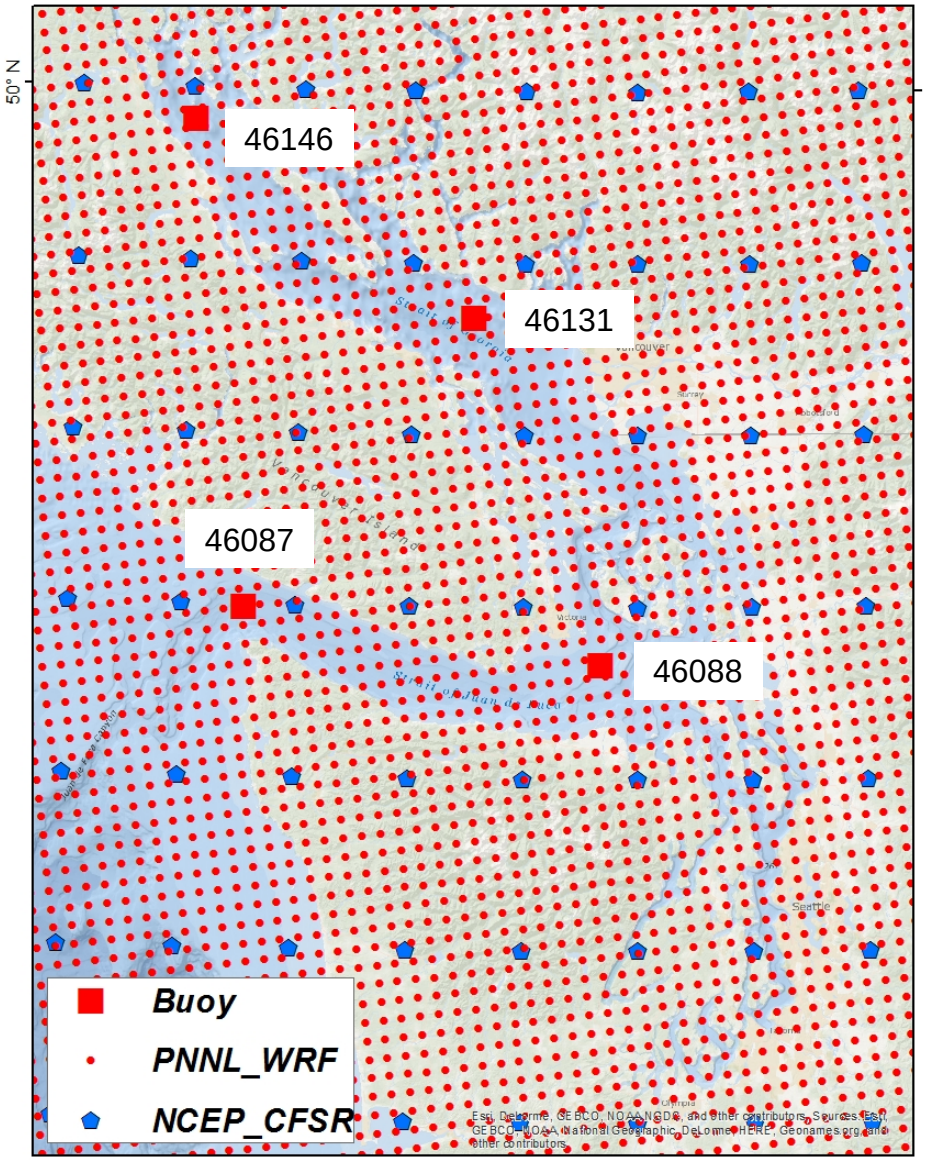


- High resolution UnSWAN model for Salish Sea (~200 m)



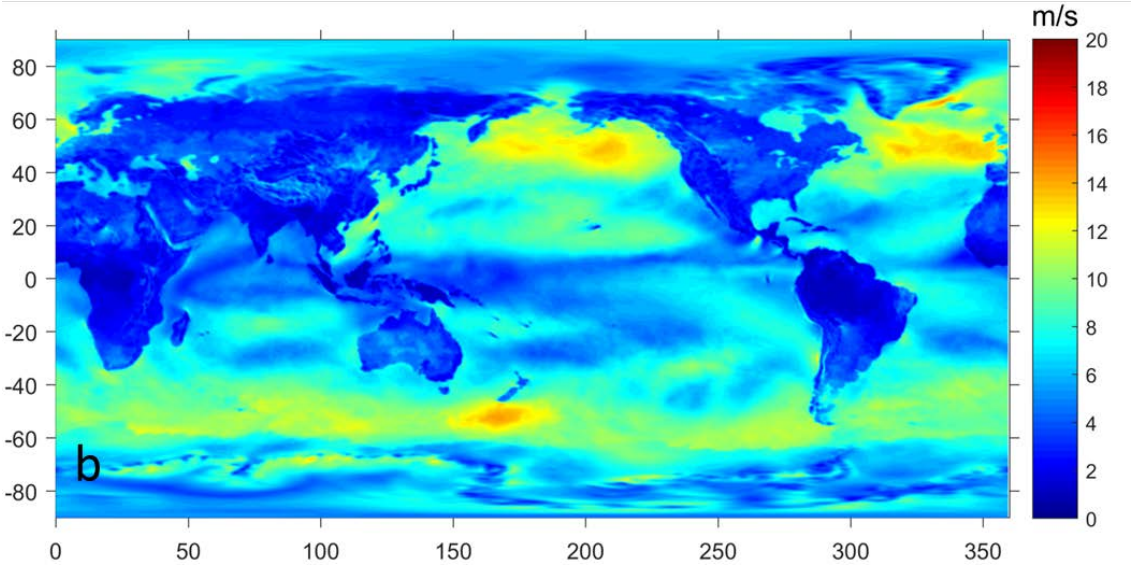
Wind Forcing

- NCEP Climate Forecast Systems Reanalysis (CFSR) to drive global-regional WWIII
  - Hourly, 0.5 deg (global)
  - 1979 - present
- PNNL Weather and Forecasting Research (WRF) model to drive UnSWAN for Salish Sea
  - Hourly, 6-km (west coast)
  - 1975 - 2015

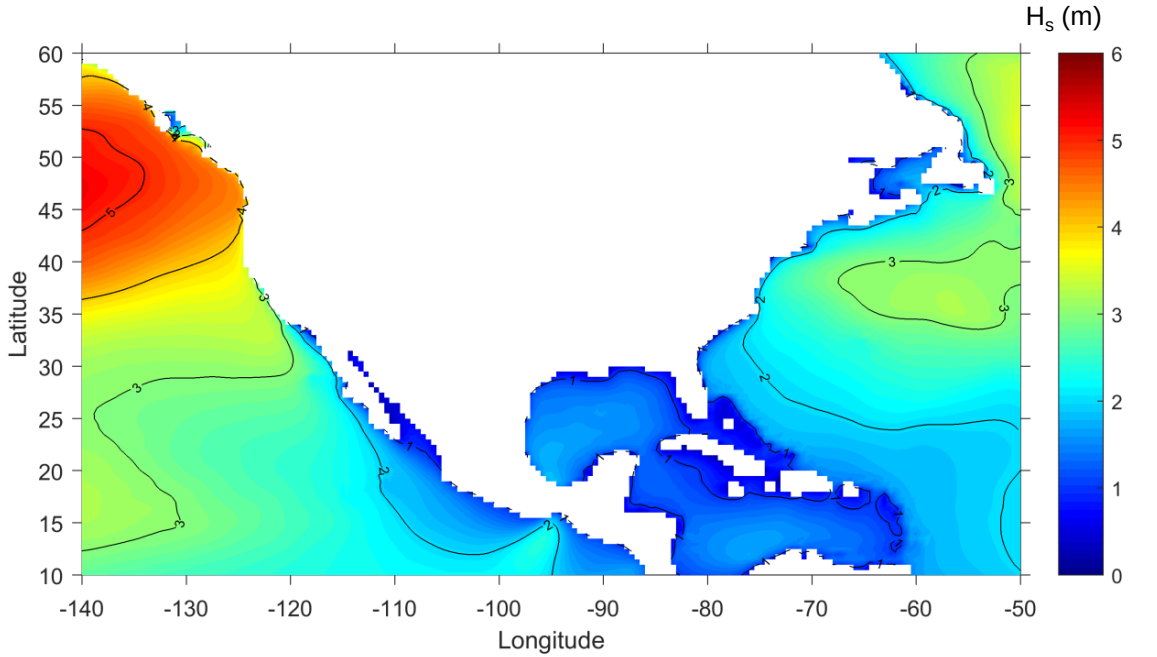


Global and Regional WWIII Simulations

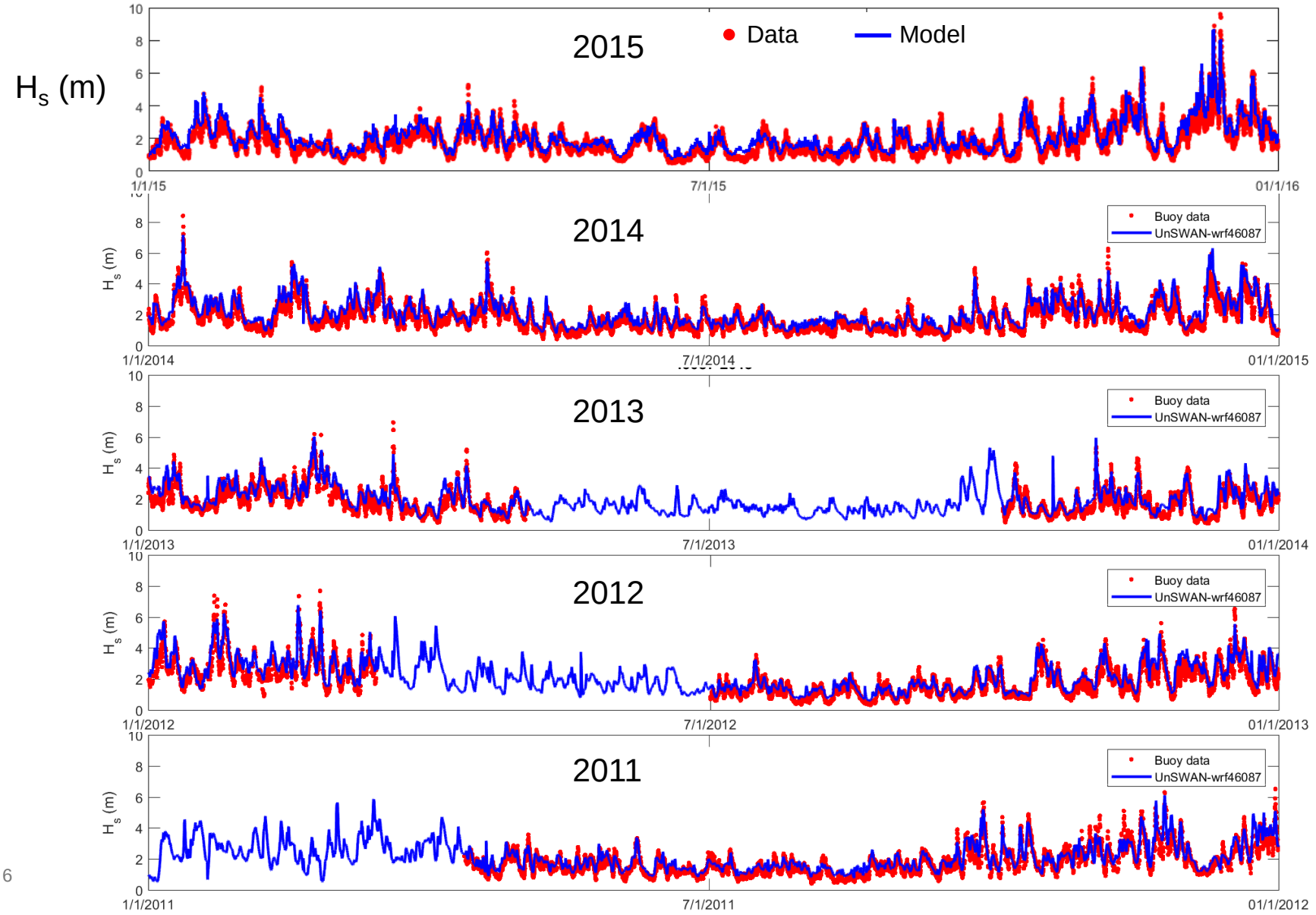
- CFSR monthly wind speed (November)



- Simulated significant wave height in North America with WWIII (November)

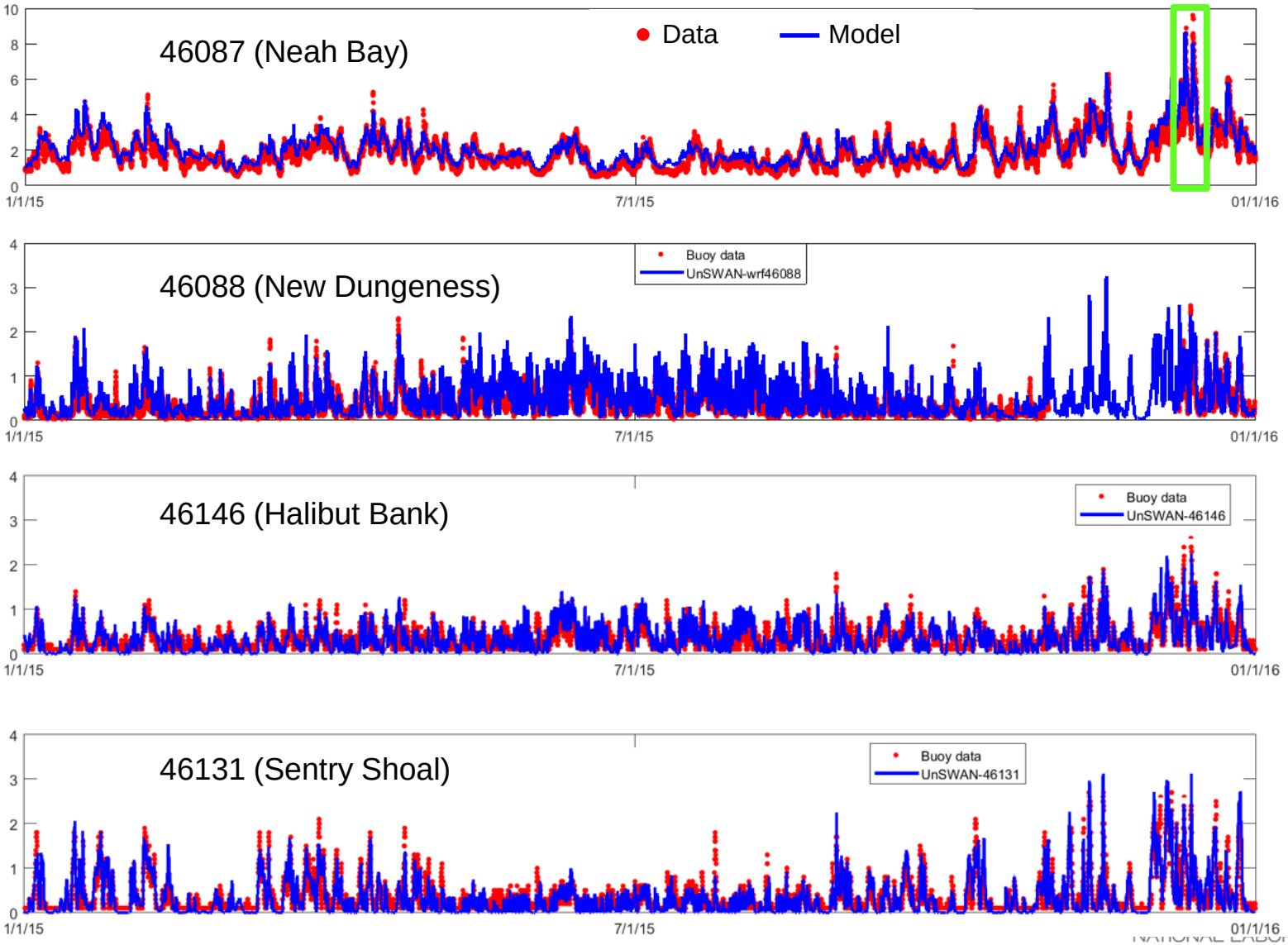


Model Validation – Significant Wave Height at Buoy 46087 (Neah Bay), 2011-2015

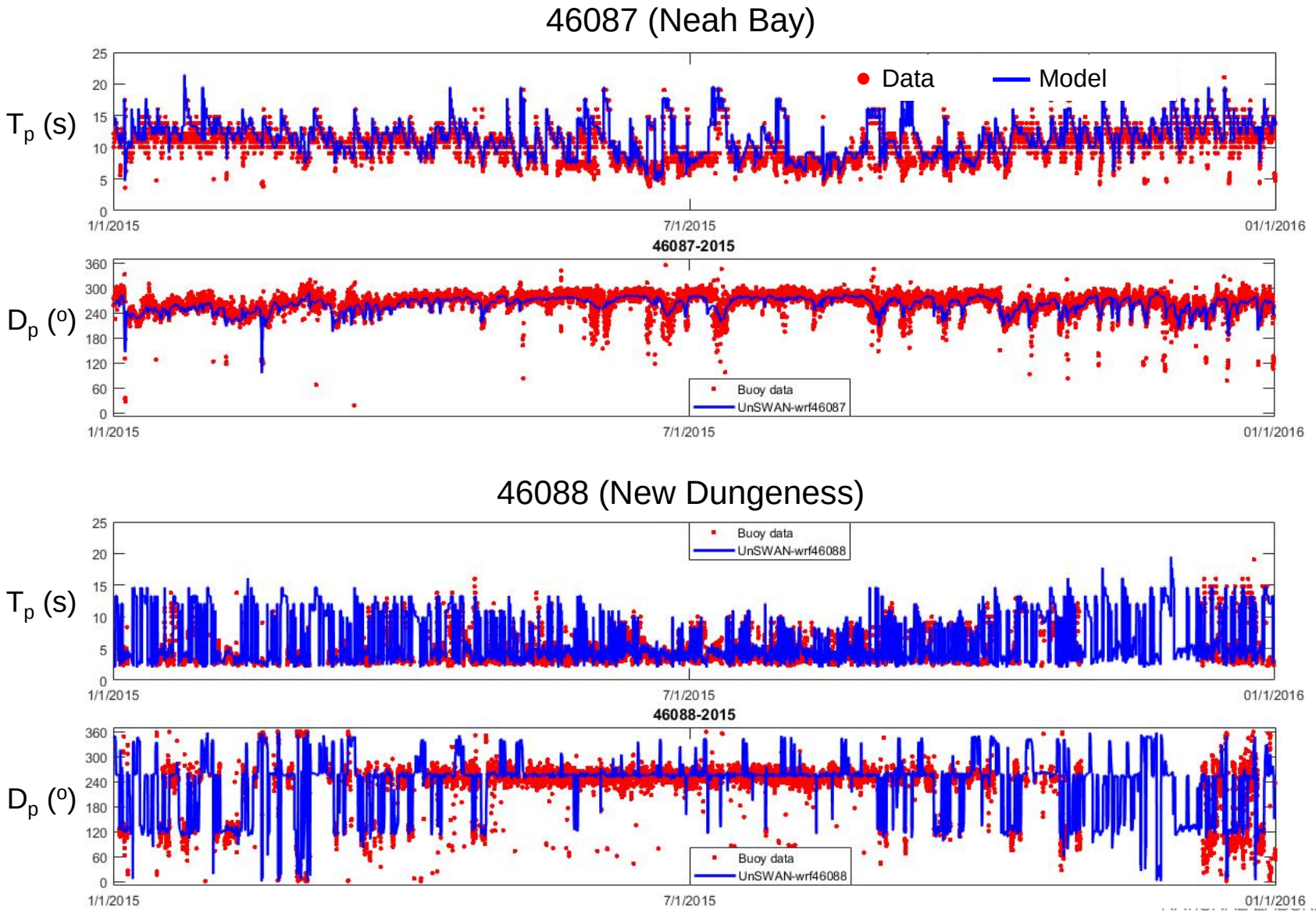


Model Validation – Significant Wave Height (2015) at four buoys

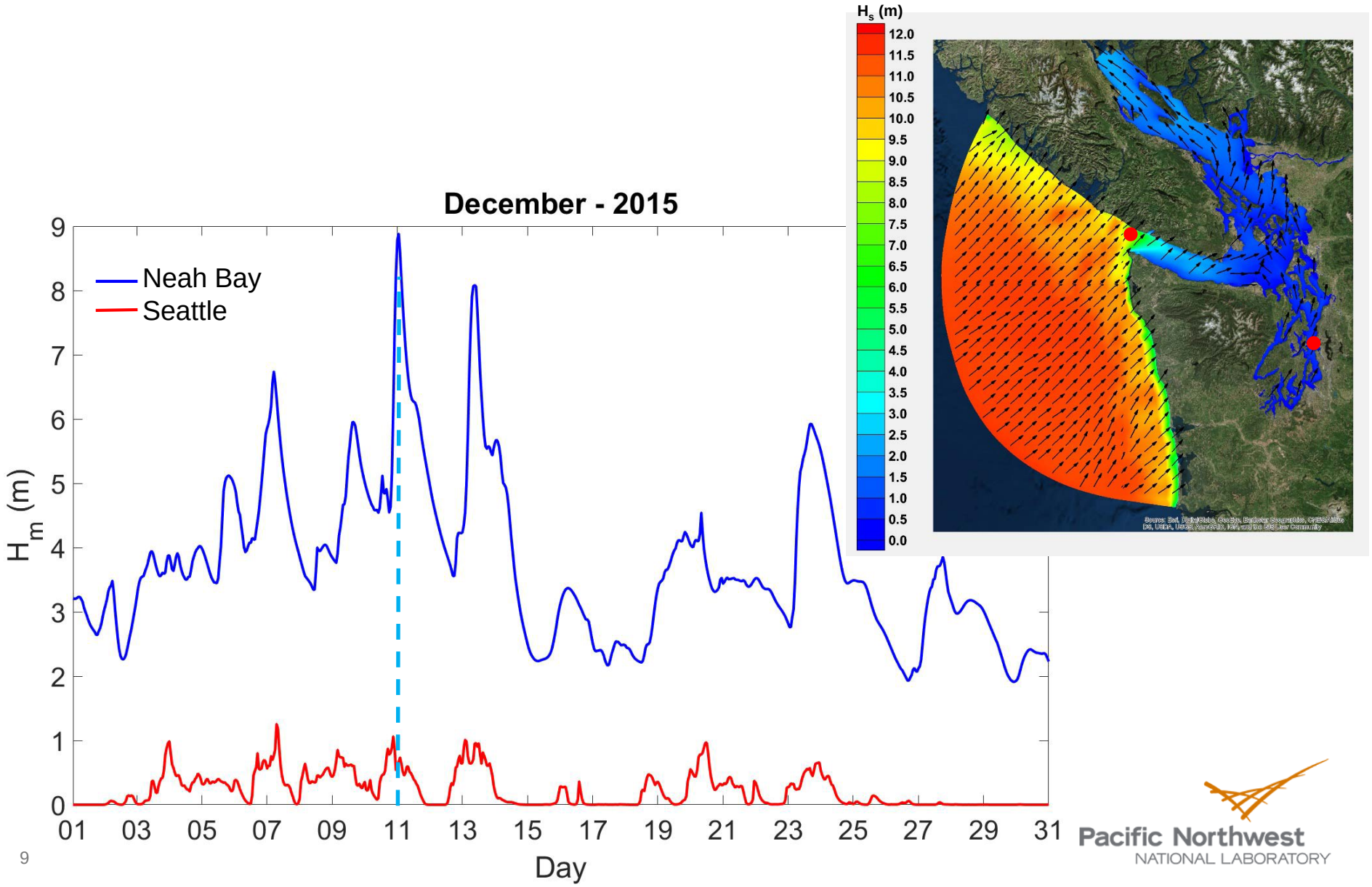
H_s (m)



Model Validation – Peak Period and Direction (2015)



Distribution of Significant Wave Height



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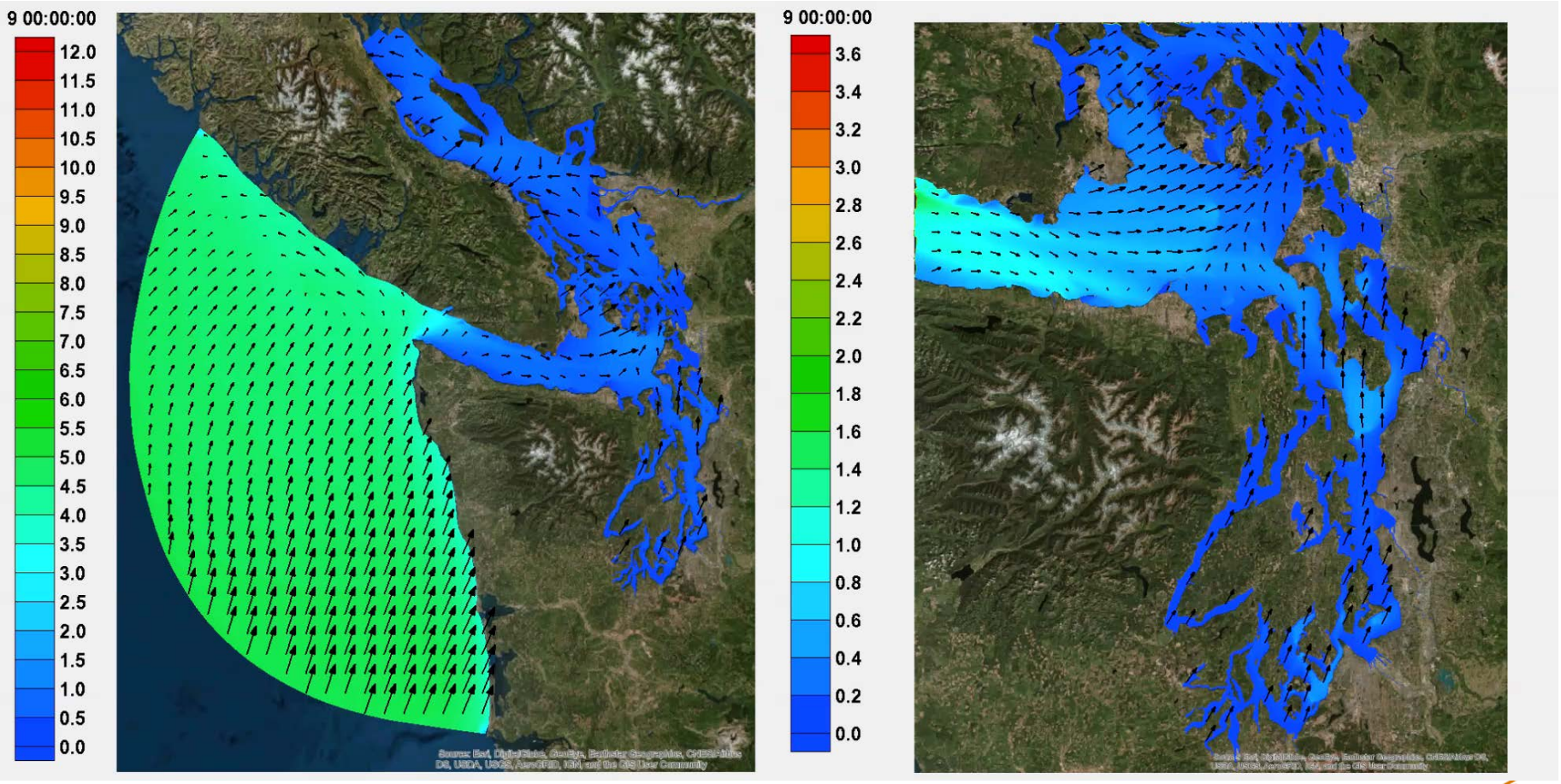
Simulated Significant Wave Height: December 9 – 15, 2015

Wind Speed

20 (m/s)



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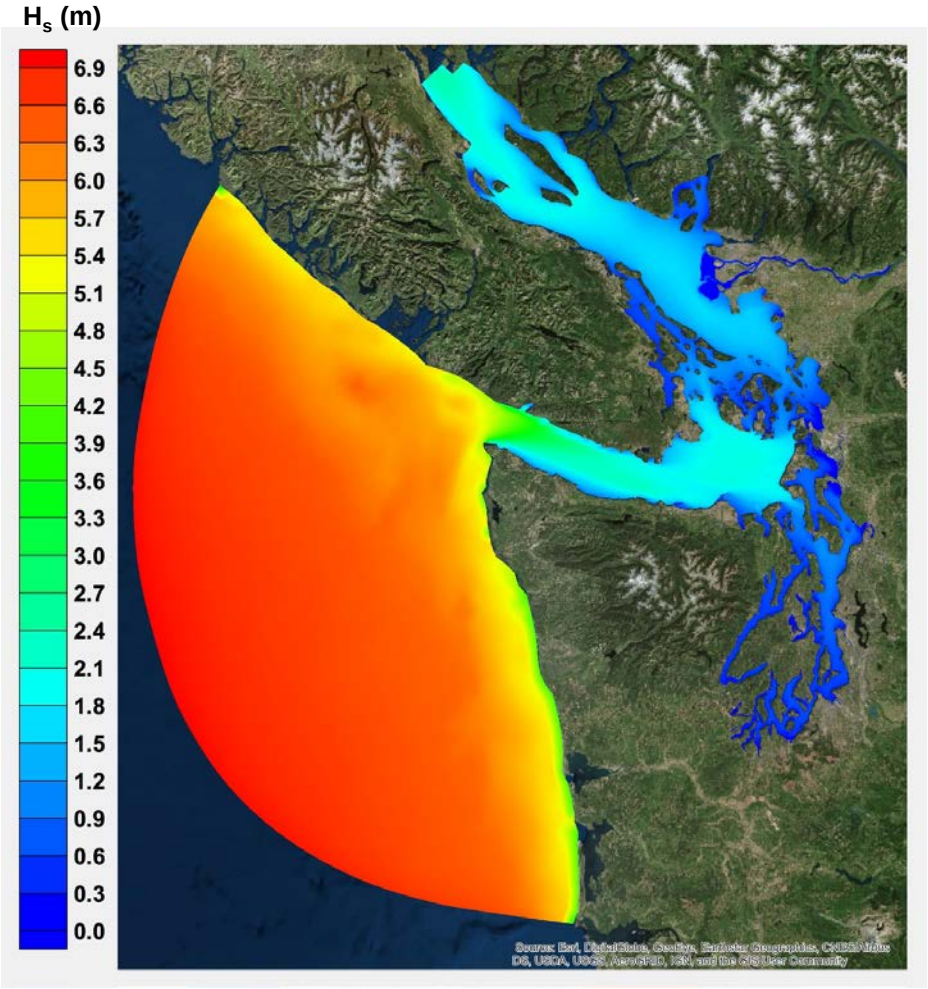
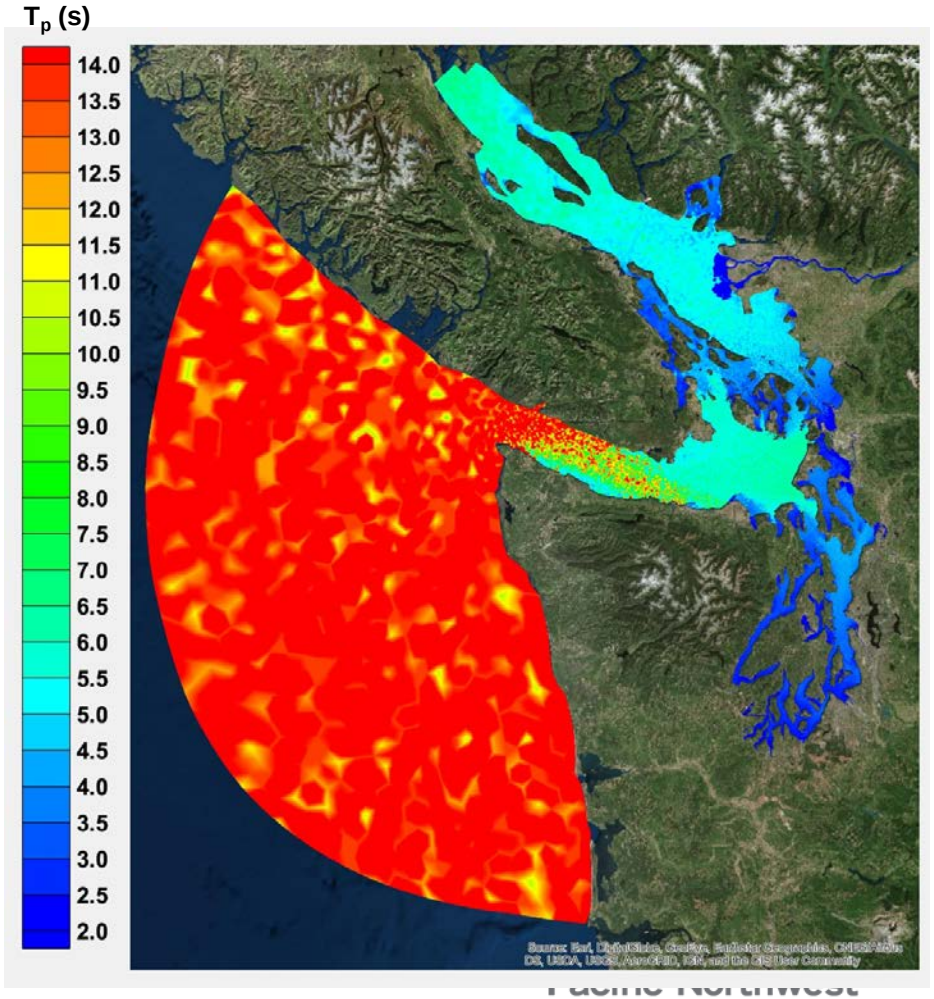
Wave Mapping for Risk Assessment

- Top 1% significant wave height and corresponding peak period in Salish Sea





Conclusions

- A wave model has been developed and validated for Salish Sea using a multi-scale, nested-grid approach
  - High model resolution and accurate wind forcing are important
- Wave climate in Salish Sea is complex
  - Swell dominant on outer coast and western Strait of Juan de Fuca
  - Wind-sea dominant in Georgia Strait and Puget Sound
- The straits are more vulnerable to wave action while Puget Sound is sheltered from large waves

Thank you!

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