Science Update

Washington Ocean Acidification Center

at the

University of Washington

College of the Environment

Dr. Terrie Klinger
Dr. Jan Newton
Co-Directors

MRAC meeting
13 Oct 2015

Photo: Klinger

The Washington Ocean Acidification Center is coordinating BRP actions to:

- ***Assess water conditions, biological response, and what's driving ocean acidification***
  - Monitoring for OA and biological response
  - Spatial coverage and time-series for trends
  - Data input for modeling and analyses
- ***Inform aquaculture practices***
  - Shellfish culture adaptation via monitoring
- ***Assess how species respond***
  - Biological experiments: plankton, crab, shellfish; new focus on fish & forams
- ***Provide forecasts to facilitate adaptation***
  - Forecast modeling

Post-Doctoral Associates are working to:

- *Establish natural variability in pH, CO_2, and associated variables using existing data (A. Fassbender, ongoing; partnership with NOAA and WA Dept of Ecology)*
- *Develop bioindicators of exposure to OA (N. Bednarsek, ongoing; partnership with Educational Fdn of America)*
- *Evaluate response of benthic forams to OA (Burke Museum, ongoing; partnership with Burke Museum)*
- *Estimate future conditions in Washington based on emissions scenarios (E. Howes, new project)*

Science 3 July 2015:
Vol. 349 no. 6243
DOI: 10.1126/science.aac4722

Review

Contrasting futures for ocean and society from different anthropogenic CO_2 emissions scenarios

J.-P. Gattuso[1,2,3,*], A. Magnan[3], R. Billé[4], W. W. L. Cheung[5], E. L. Howes[6], F. Joos[7], D. Allemand[8,9], L. Bopp[10], S. R. Cooley[11], C. M. Eakin[12], O. Hoegh-Guldberg[13], R. P. Kelly[14], H.-O. Pörtner[6], A. D. Rogers[15], J. M. Baxter[16], D. Laffoley[17], D. Osborn[18], A. Rankovic[3,19], J. Rochette[3], U. R. Sumaila[20], S. Treyer[3], C. Turley[21]

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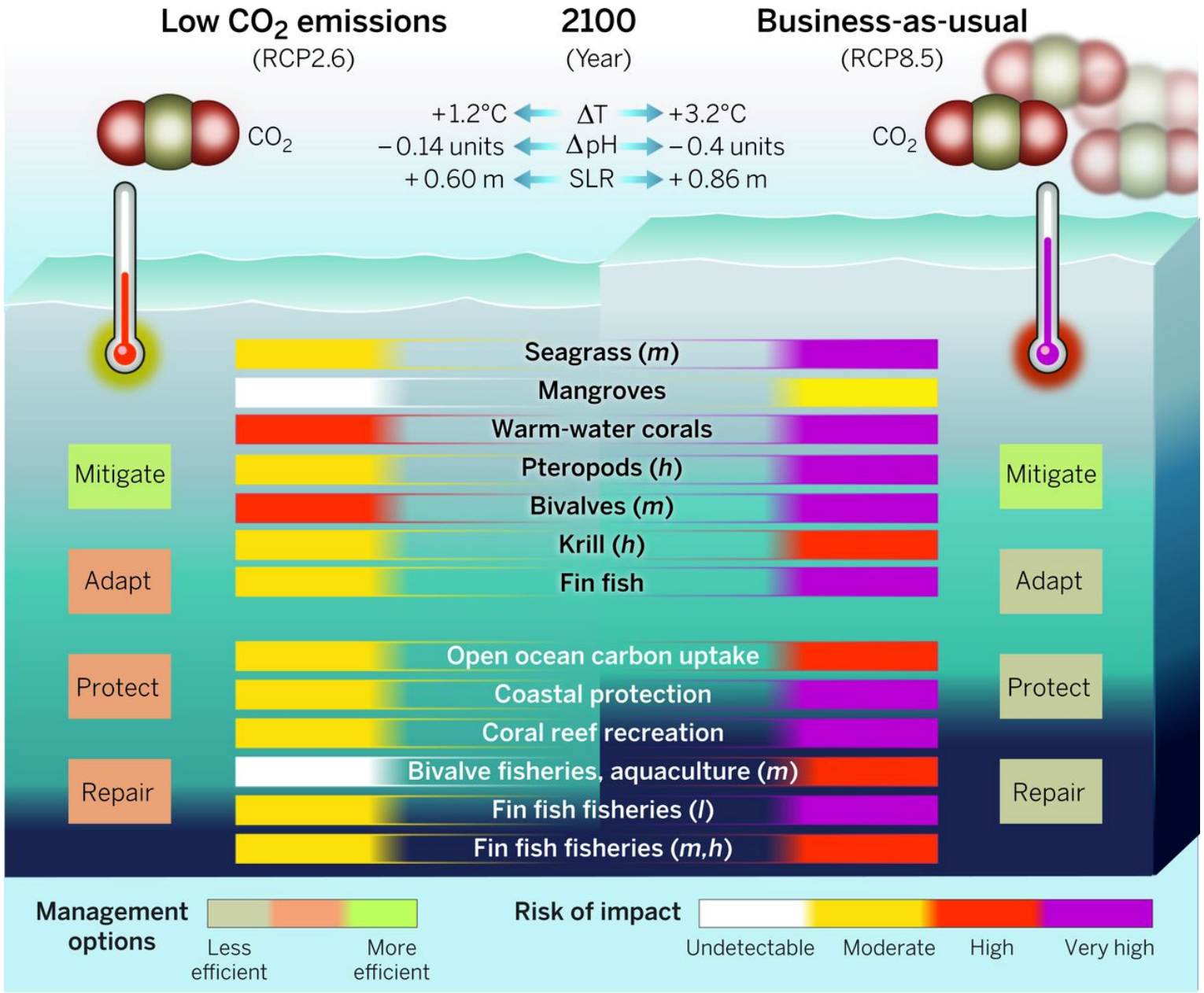
Changes in ocean physics and chemistry and impacts on organisms and ecosystem services according to stringent (RCP2.6) and high business-as-usual (RCP8.5) CO2 emissions scenarios.



Published by AAAS

J.-P. Gattuso et al. Science 2015;349:aac4722

The LiveOcean Daily Forecast Model

Near-term predictions of ocean acidification in Washington waters

- Parker MacCready
- Samantha Siedlecki
- Ryan McCabe
- Neil Banas

University of Washington & Univ. of Strathclyde

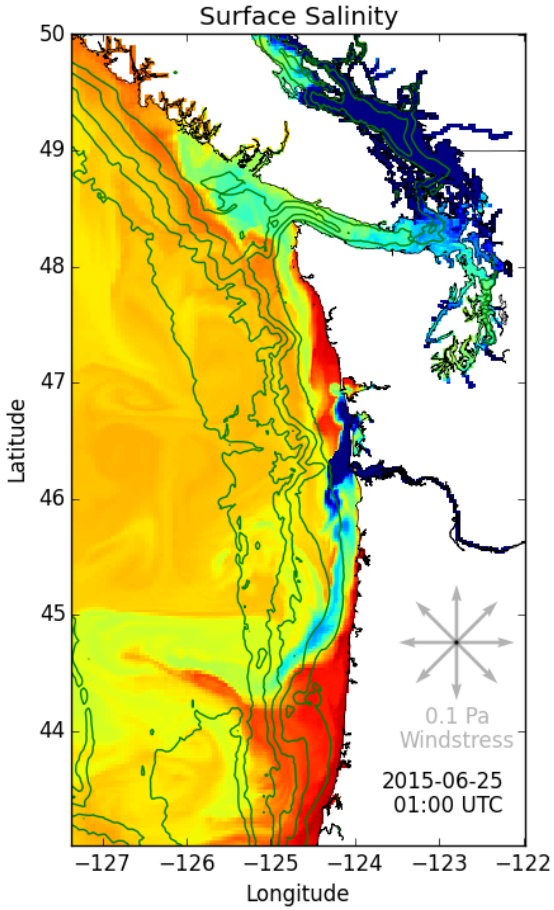
UW Coastal Modeling Group

Overview

- **GOAL**: Provide 3-7 day forecasts of Aragonite saturation state and pH of waters entering shellfish growing areas
- **FUNDING**: Washington Ocean Acidification Center
- **STRATEGY**: Build on existing 3D circulation-biogeochemistry hindcast models of the WA coast and Salish Sea, incorporating carbon chemistry
- **RESULTS SO FAR**:
- Circulation model is currently creating 3-day forecasts of currents, temperature & salinity.
- Model physics and biogeochemistry validation with 2013 hindcast
- Physics forecasts available daily through NANOOS NVS

Model Configuration

- ROMS (Regional Ocean Modeling System)
- Domain: OR-WA-BC Coast and Salish Sea
- Horizontal grid: 1.5 km on coast
- 40 vertical layers
- Run daily on 72 cores, takes 1.5 hours for 3 days of model time
- Full 3D fields stored hourly and sent to cloud storage using Microsoft Azure, simplifying access
- Web front-ends developed by NANOOS and Microsoft



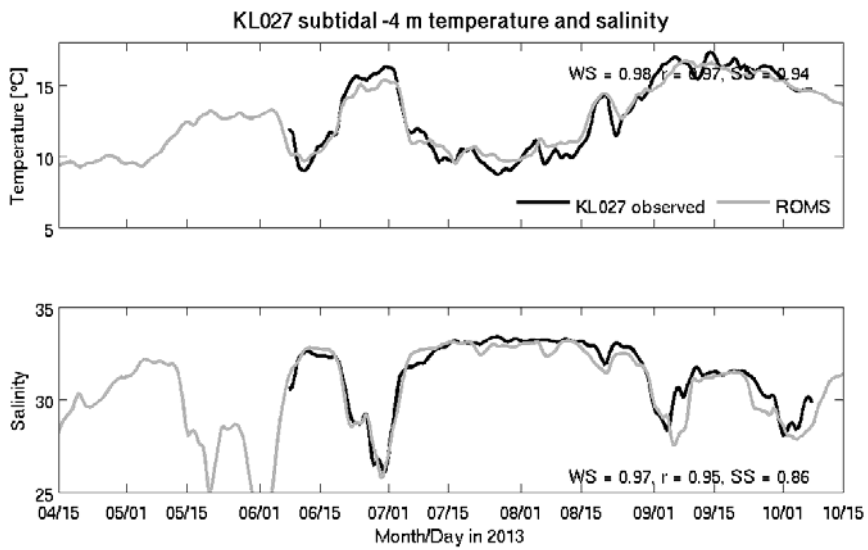
Forcing

- **Atmosphere**: Hourly wind stress and heat fluxes from WRF 12 km Regional Forecast – Cliff Mass UW (4 km and better also available) [+3.5 days]
- **Ocean**: Daily currents, temperature, salinity, sea surface height from HYCOM (Global, Data-assimilative, hycom.org) [+8 days]
- **Rivers**: 15 in Salish Sea + Columbia River, from USGS, Environment Canada and NOAA Northwest River Forecast Center, scaling factors from Ecology [+10 days]
- **Tides**: 8 constituents from TPXO7.2 Inverse Global Tidal Model (Egbert & Erofeeva 2002) [arbitrary time using nodal corrections]

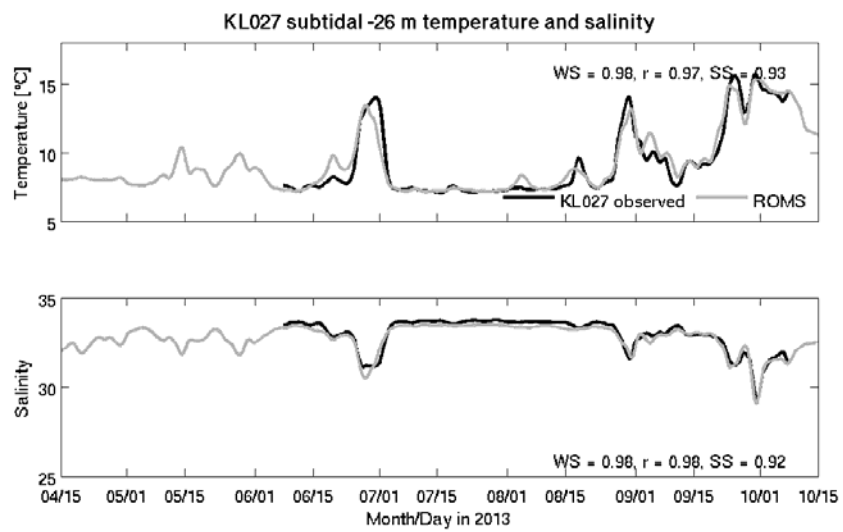
Validation: Mooring T & S

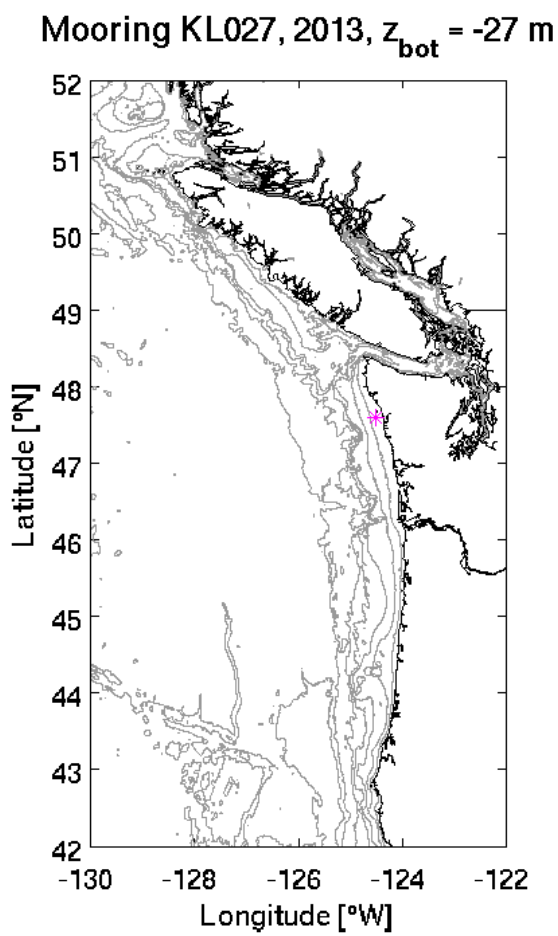
Olympic Coast National Marine Sanctuary

SHALLOW

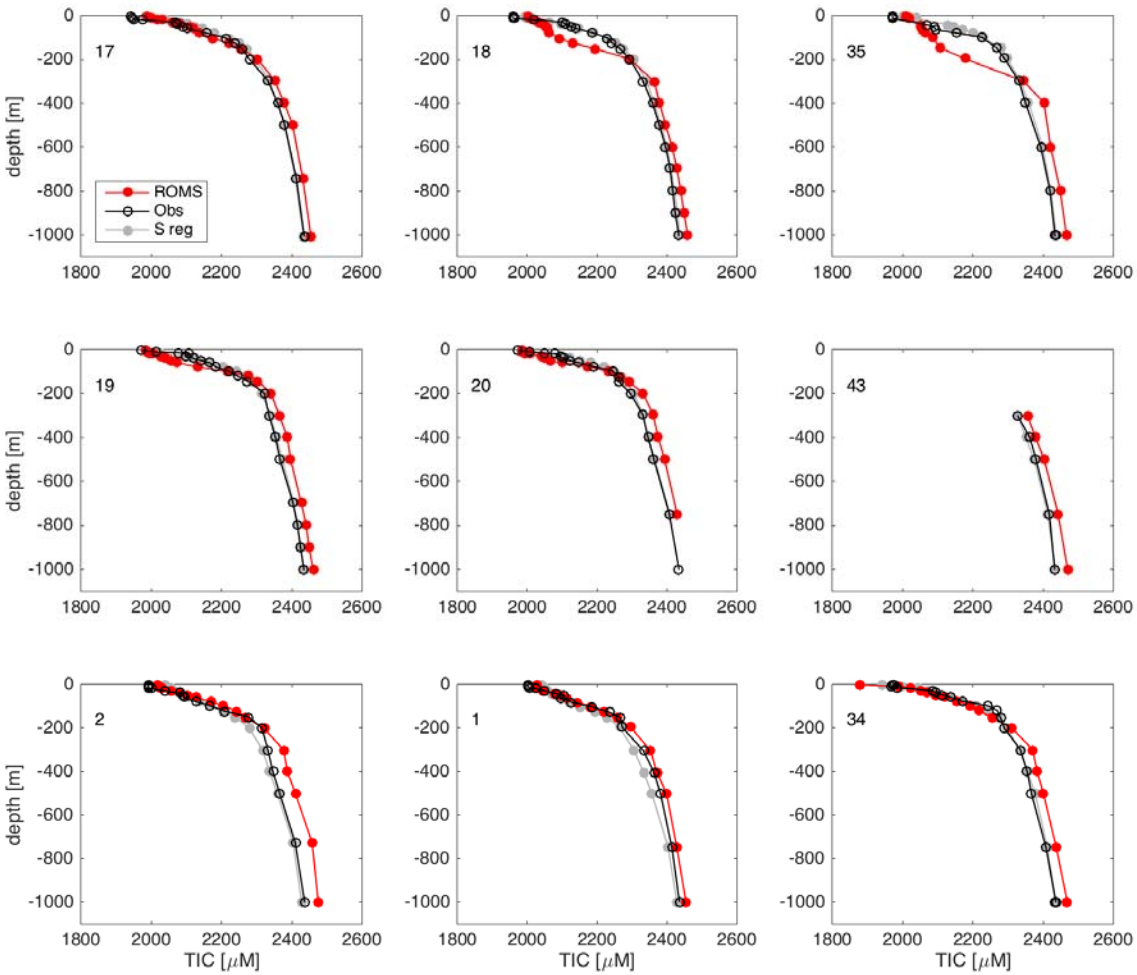


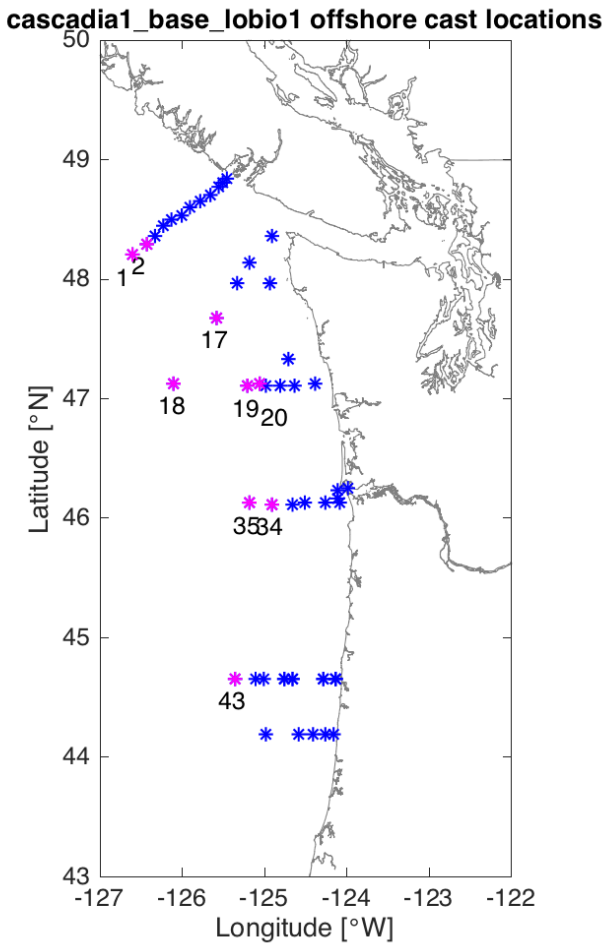
DEEP



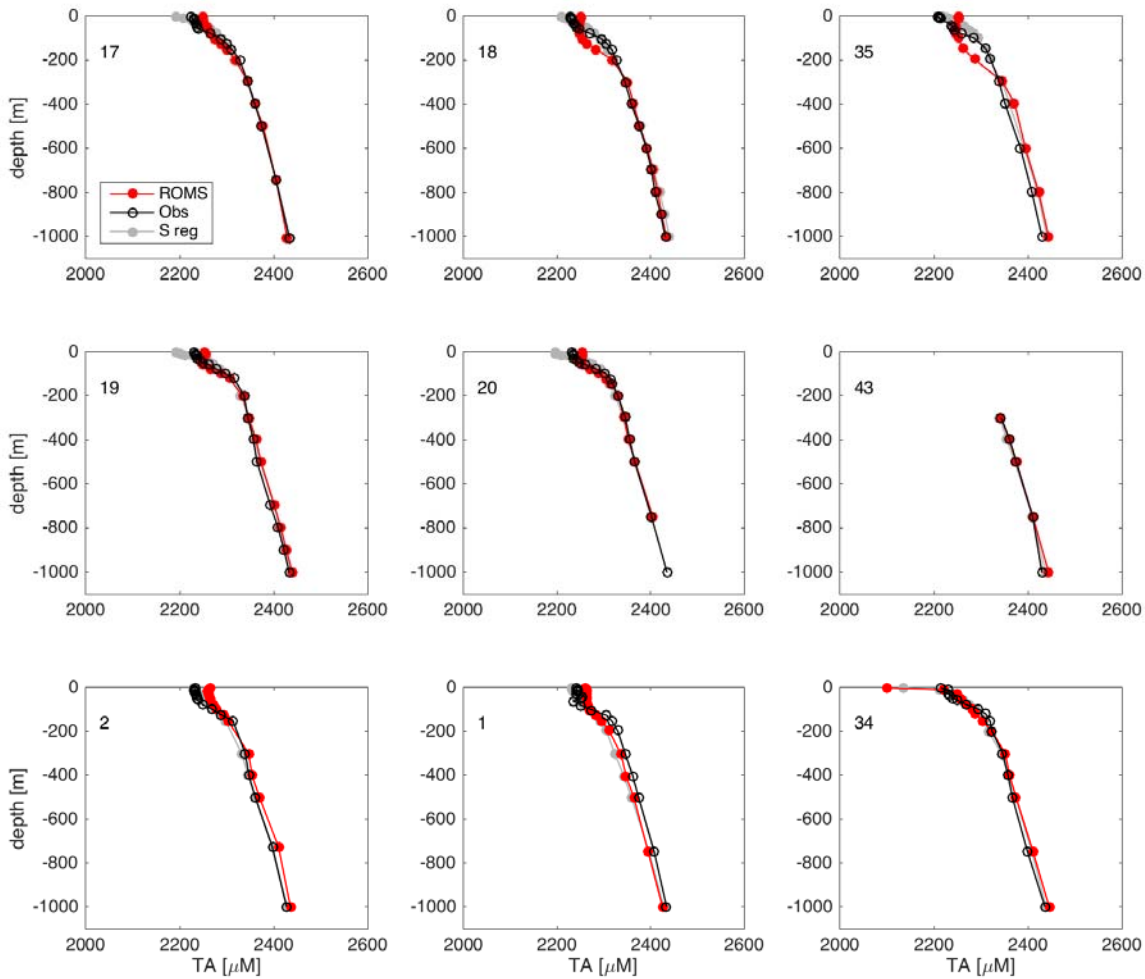


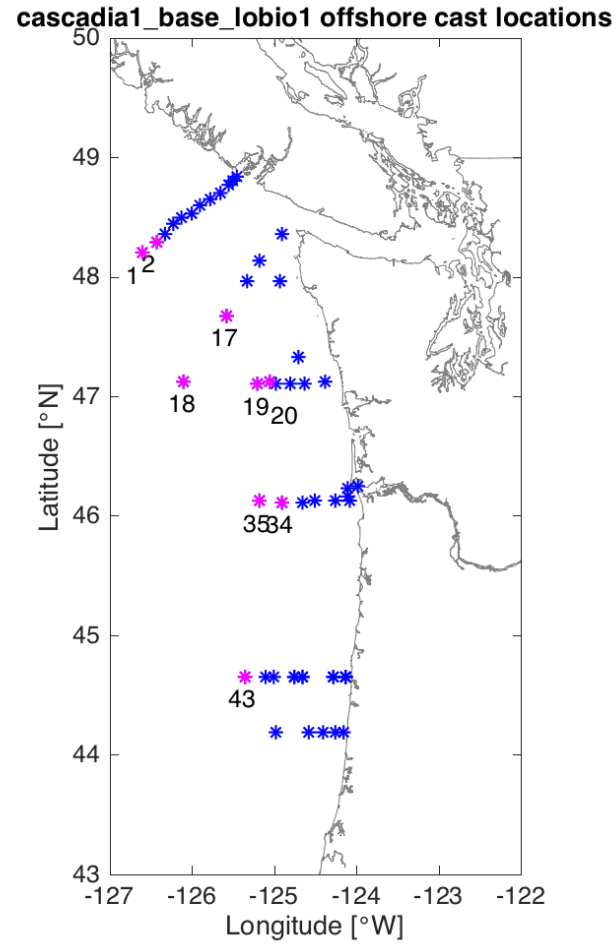
Validation: Total Inorganic Carbon



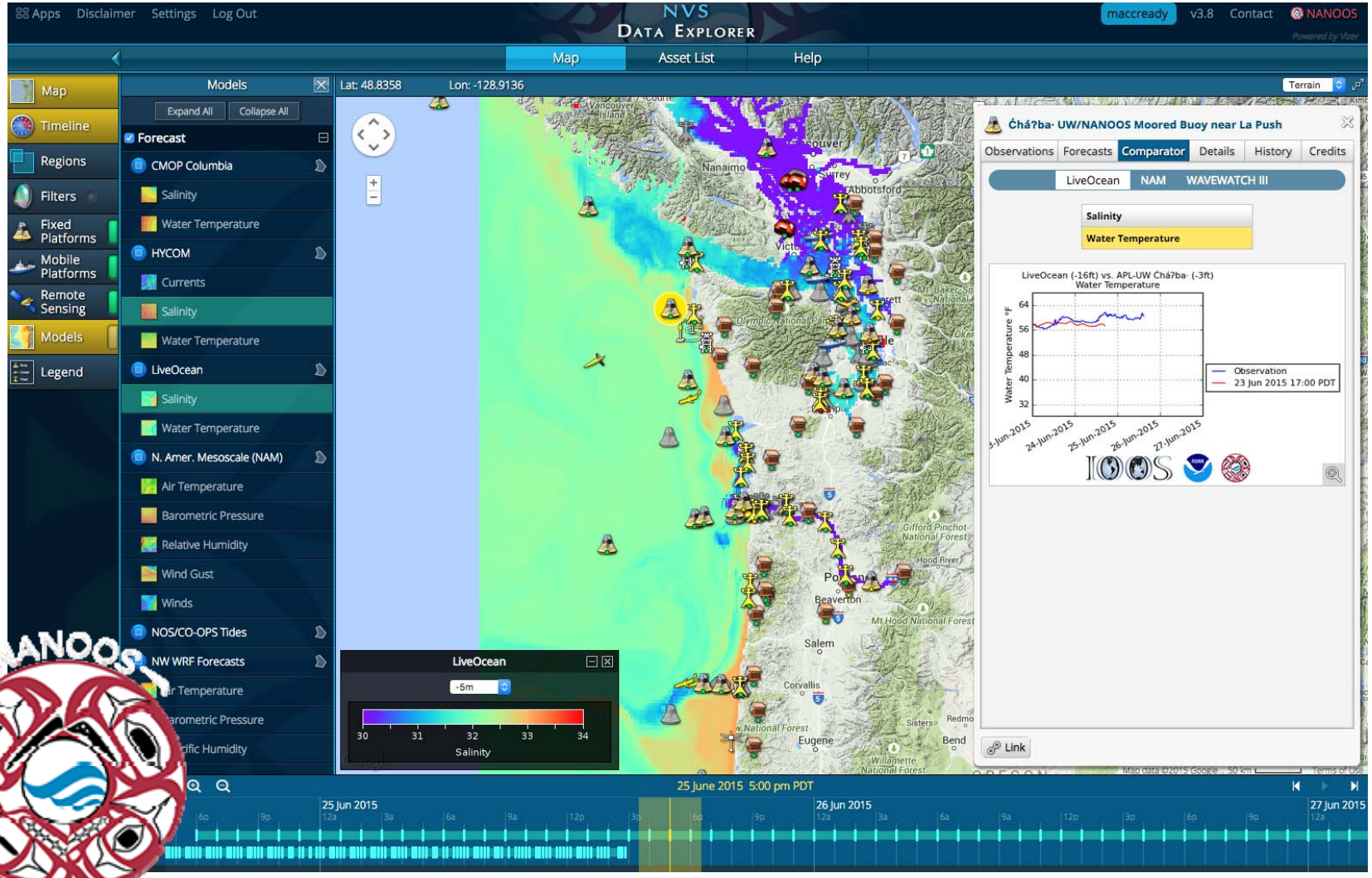
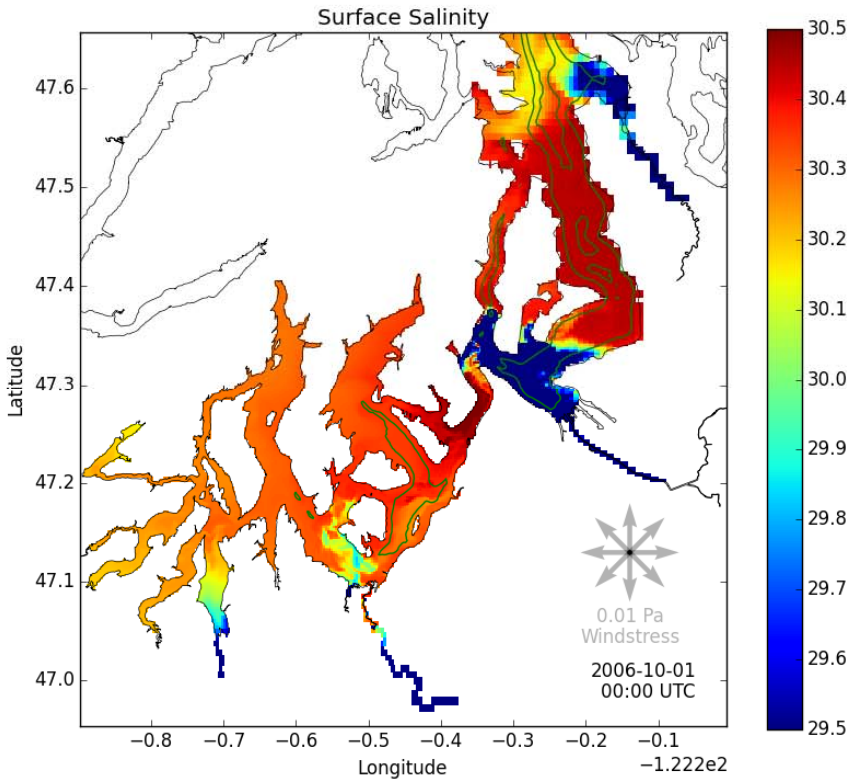
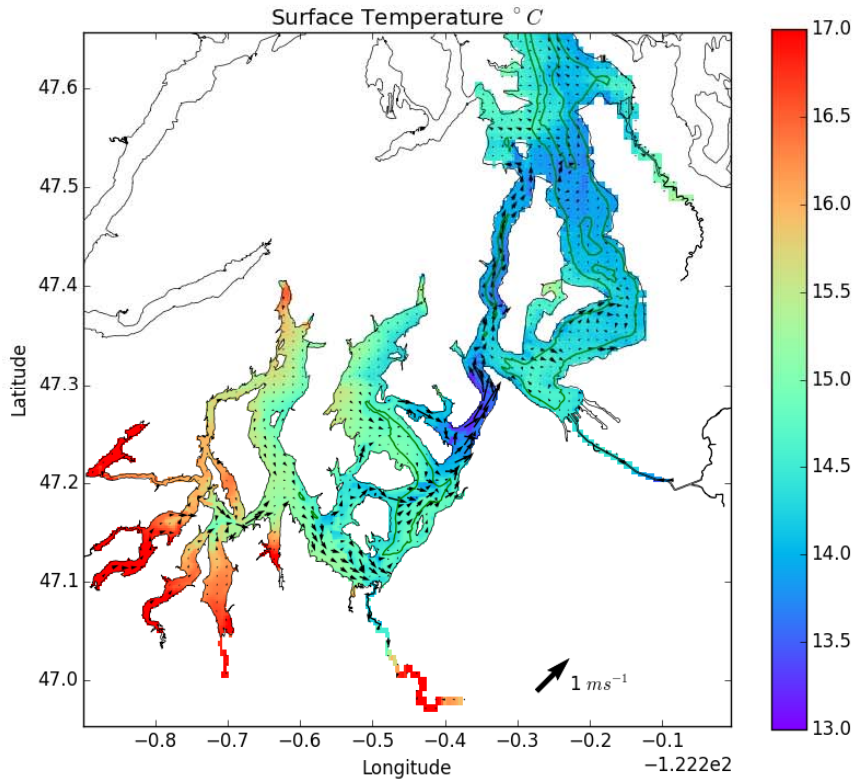


Validation: Alkalinity





3-Day forecast appears daily on NANOOS NVS



Nesting: 200 m resolution