Using the operational regional US West Coast model setup for process studies: along-slope anomalies during the 2014-16 heat wave period

+ other stuff

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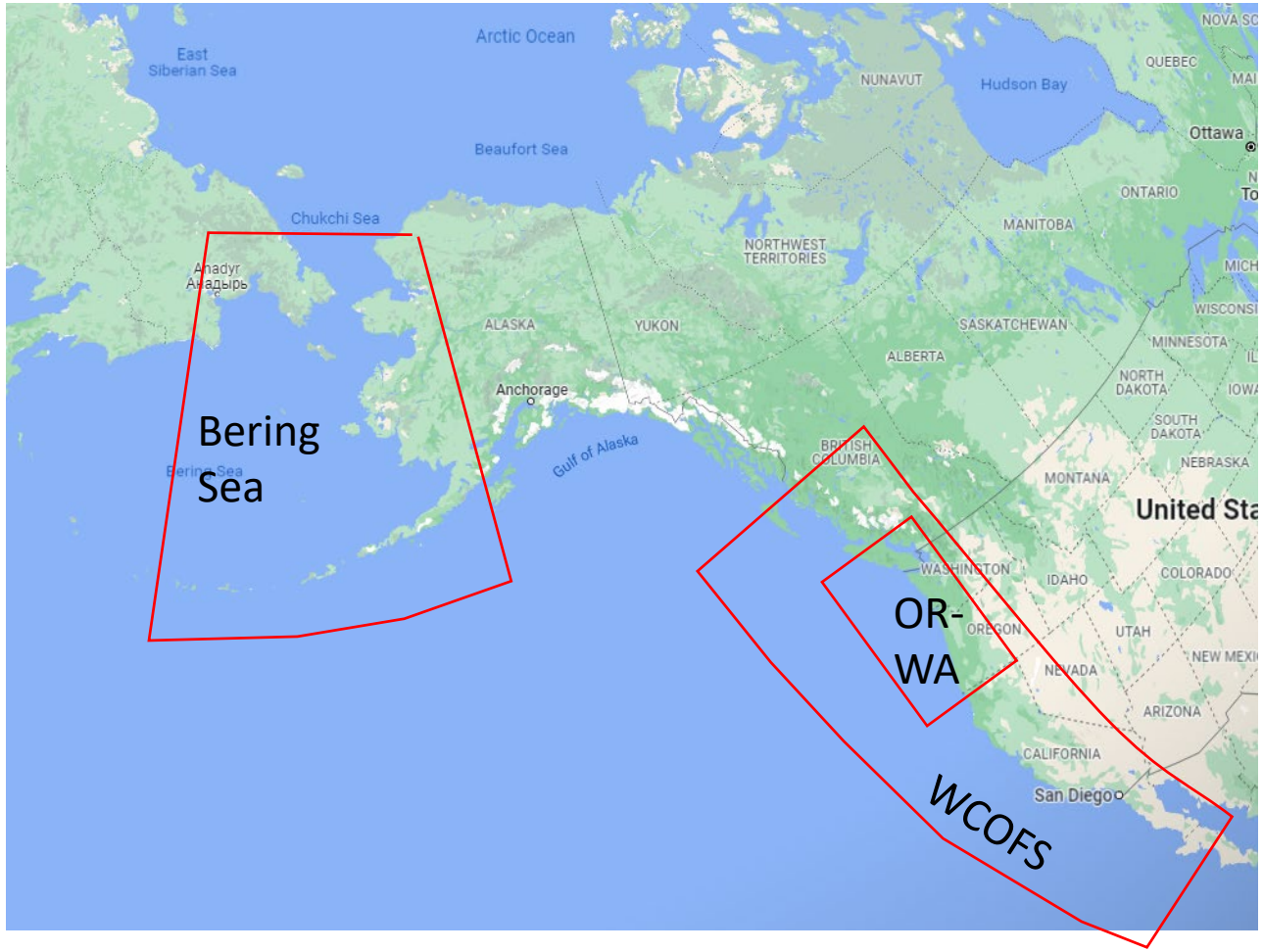
where O=Ocean, C=Coastal

- Activities in the last couple of years along the US West Coast, including Continental US and Bering Sea

- Focus on science in support of coastal ocean forecasting



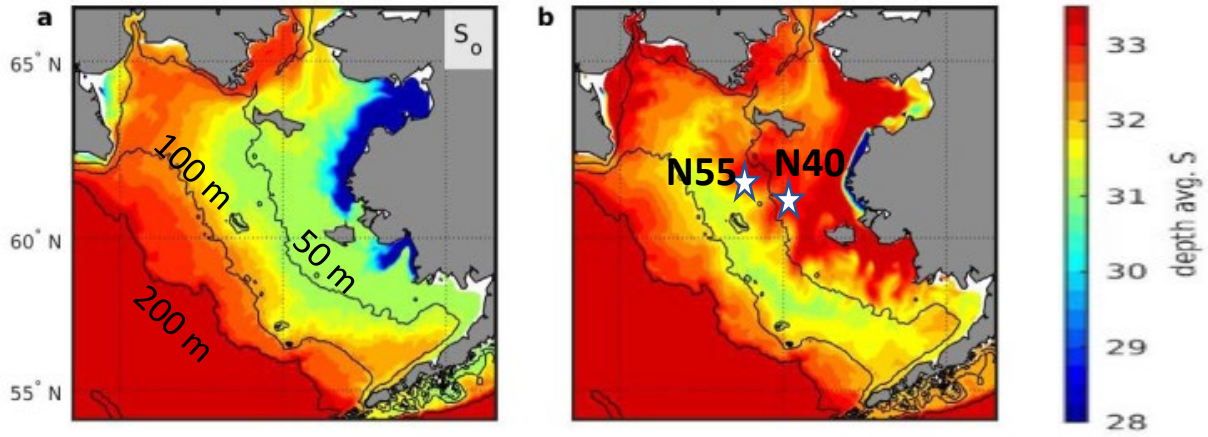
The coupled ice-ocean circulation model of the Eastern Bering Sea

Durski and Kurapov, Oce Mod. 2018, 2020

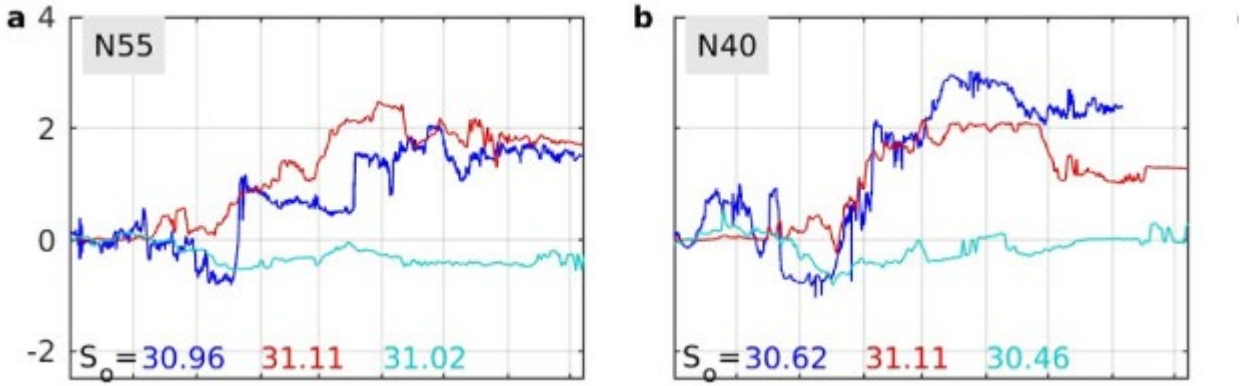
- Based on ROMS (2-km horizontal resolution)
- Improvements to the ice model (a full logic tree for phase transitions: ocean, ice, snow, melt ponds, freezing rain)

  => Improvements in the shelf ice concentration and ice motion

- *Consistent salinity flux between the ice and ocean components*
- Thermodynamic shelf ice budget
- The brine tracer transport



Depth-averaged salinity distribution: (a) Nov 1, 2009, (b) April 10, 2010



Seasonal change in the near-bottom salinity at mid-shelf mooring locations:

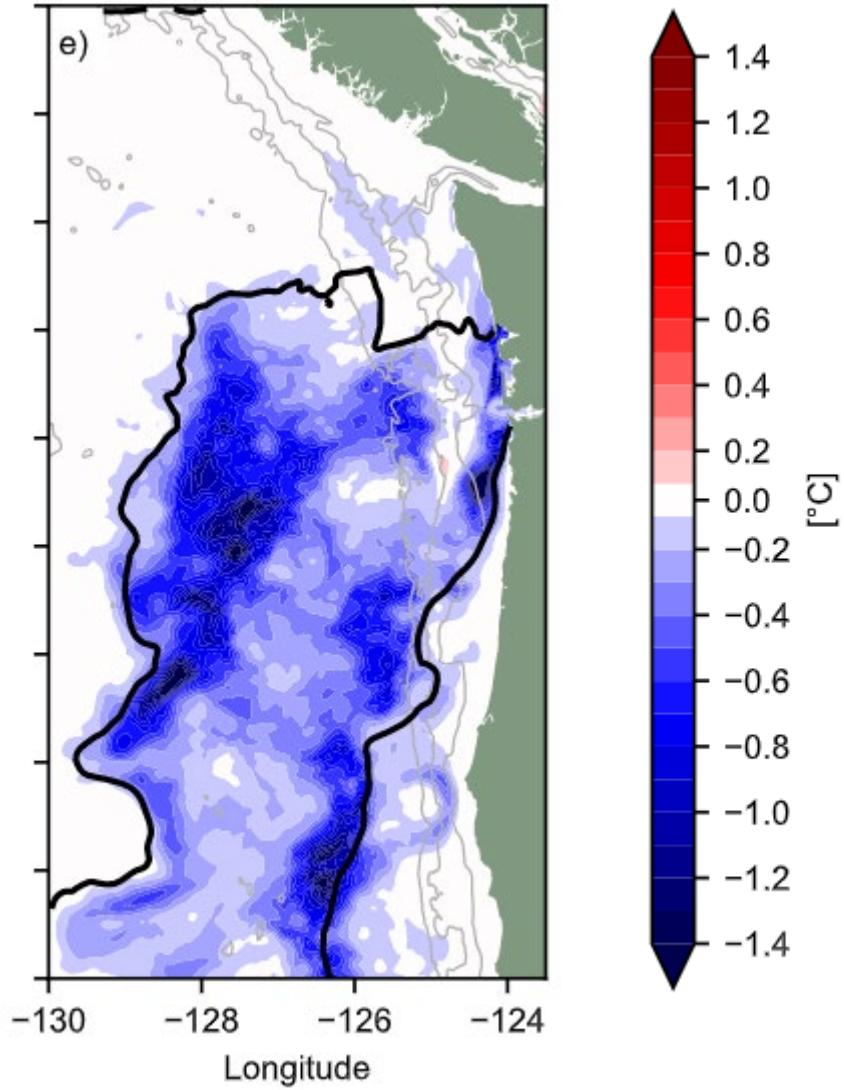
- *Observations,*
- *Global Navy HYCOM,*
- *ROMS Bering Shelf model*

Oregon-Washington Coastal Ocean prediction system

- Continuous operation since 2011 / NANOOS Regional Association
- Forecasts popular among the fishermen

Science: development and testing the hybrid Ensemble-4DVAR DA
Pasmans & Kurapov, Mon Wea Rev. 2017
Pasmans et al., JGR 2019, Oce Mod. 2019, 2020

- Covariance localization
- Ensemble generation (a proper error model for winds)
- Efficient implementation (40 ensemble members, for the price of just 4 4DVARs)
- Realistic tests assimilating altimetry, SST, HF radar surface currents
- Ensemble-based vs balance operator based model error covariance
- Statistical consistency tests
- Surface salinity controls



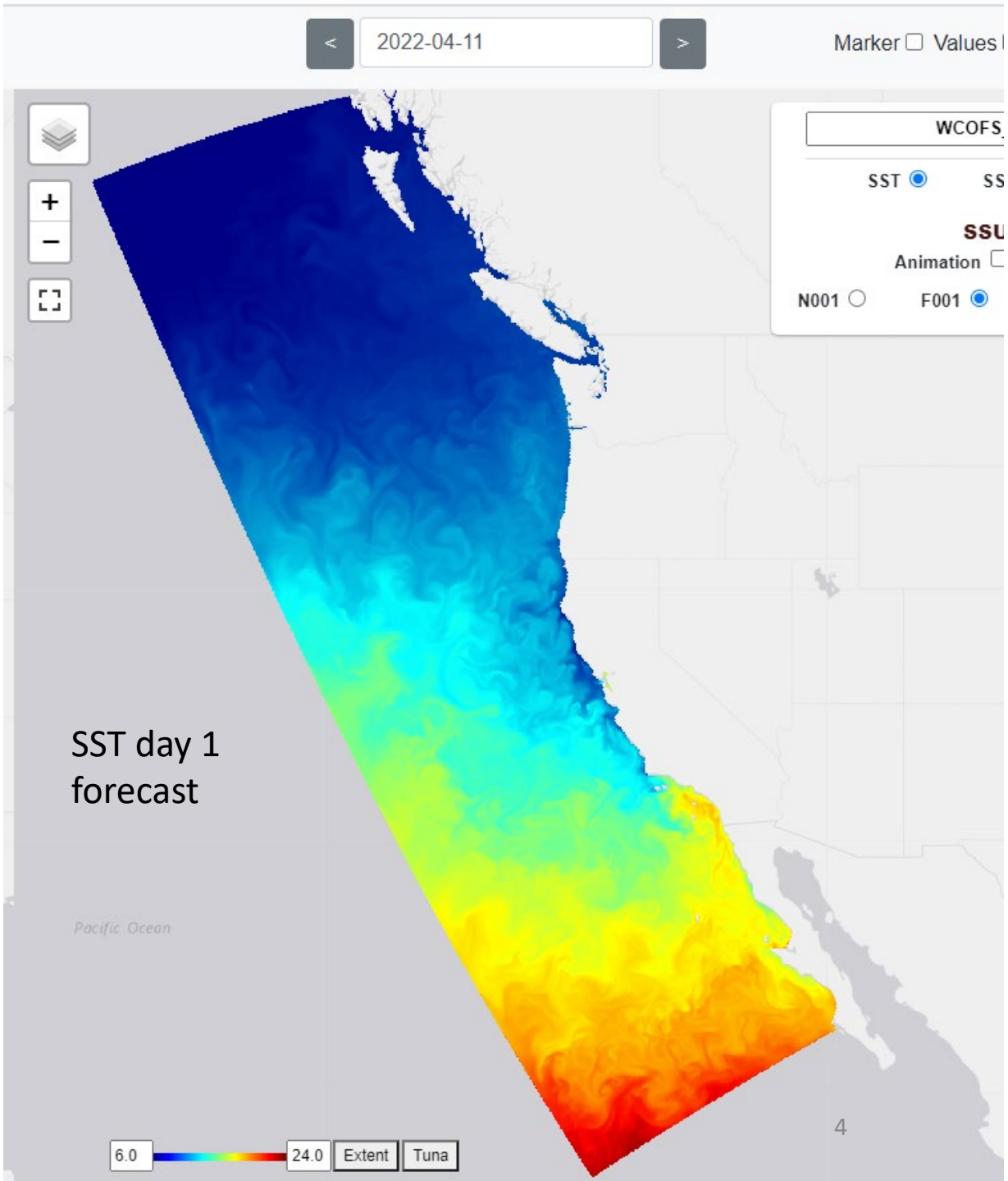
Ensemble-based T-S error covariance in the area of the Columbia River plume (black contour S=31.5), 30 Jul 2011

The West Coast Ocean Forecast System (WCOFS)

- Operational at NOAA
- 4-km ROMS, ROMS 4DVAR
- Assimilates: SST, alongtrack altimetry, HF radar surface currents
- Daily updates of 3 day forecasts

Challenges still to be resolved:

- Faster 4DVAR
- Consistent SSH / subsurface fields correction
- Surface salinity unconstrained
- HF radar hourly surface currents: assimilate low pass filtered velocities in a tide-resolving system (instead of trying to fit instantaneous data)
- Model error covariance (so far, univariate for SSH, u, v, T, S) !!!

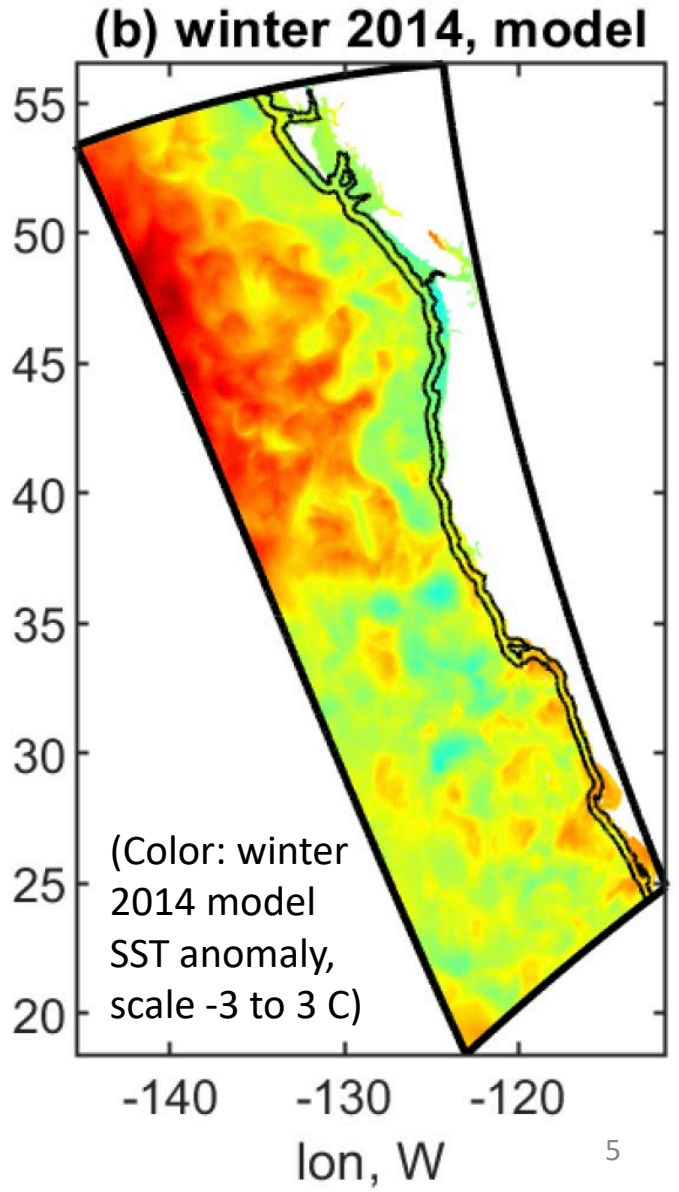


Use the ROMS simulation in the WCOFS domain to learn about the 2014-16 El Niño effects on the shelf and slope flows off Oregon (Kurapov et al., JRG, submitted**)**

- 2-km resolution ROMS
- No Data Assimilation here
- The 10-year simulation: 2009-2018

Present ocean properties as functions of the alongslope coordinate (y) and time (t):

- slope-averaged between h=200 m and 40 km offshore of that isobath (between the black lines in the figure)
- Variables, characteristic of the slope undercurrent, include:
  - $z_{26.5}$: depth of the isopycnal layer σ_θ=26.5 kg/m^3
  - v_s: along-slope subsurface velocity (ave between 300-125 m depths)
  - *q*: potential density between σ_θ=26.25 and 26.5 kg/m^3



Slope anomalies:

Related to the 2014-2016 heat wave events:

- Negative anomaly in σ_θ=26.5 kg/m^3 propagating from the south boundary + local effects (current separation and offshore Rossby wave propagation)

- Positive alongslope subsurface current anomalies in spring-summer 2014 and 2015

- Negative anomalies in potential vorticity (isopycnal levels spreading) in summers 2014 and 2015: *the effect of advection of the seasonal q gradient by the anomalously positive v_s*