Summary of Salish Sea Model Status and Evaluation

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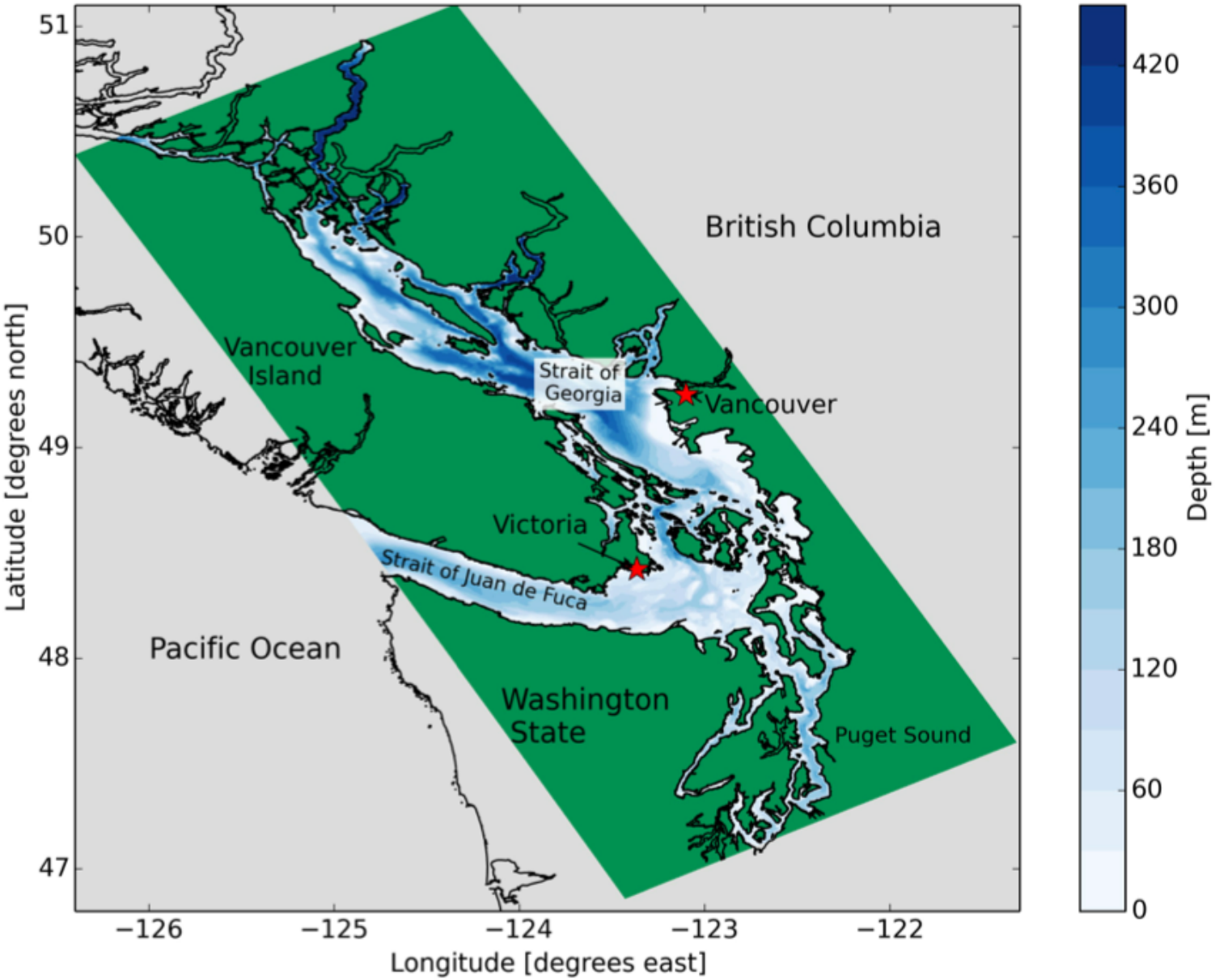
Outline

SalishSea Model: Domain



Model: V1.0: Current Nowcast/Forecast Version

- Based on NEMO 3.4 (Nucleus for European Modelling of the Ocean)
- Prognostic, three-dimensional, hydrostatic, stratified
- Horizontal grid spacing about 500 m
- Vertical grid spacing 1 m near surface, 27 m at bottom (430 m)
- Total grid cells 898 x 398 x 40
- Split time step (2 s barotropic, 10 s baroclinic)
- k-ϵ vertical turbulence model
- Horizontal viscosity and diffusivity are constants
- Partial slip in horizontal
- No restoring, no data assimiliation

Forcing

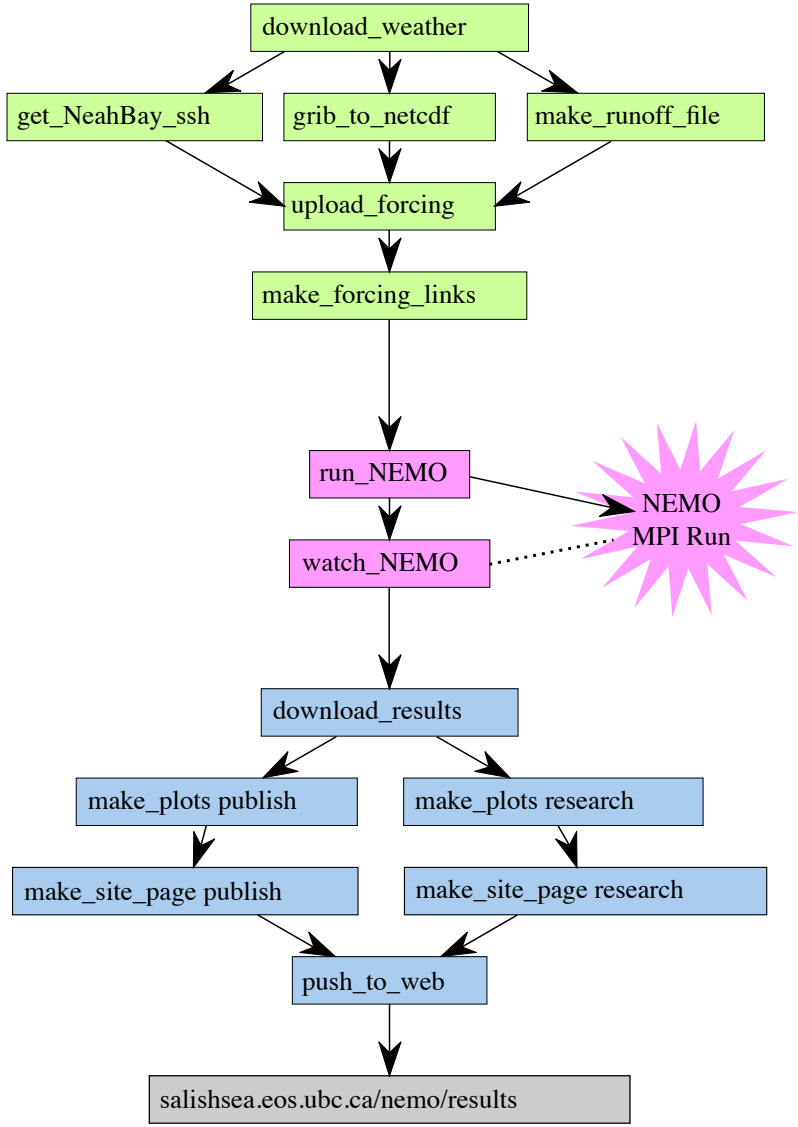
- Winds: from Environment Canada semi-operational : HRDPS 2.5 km resolution
- Rivers: 149: Climatology (John Morrison), Fraser River: daily data from Environment Canada
- Tides: 8 tidal constituents : WebTide + tuning
- Sea surface height anomaly at western boundary: NOAA forecast model
- Temperature and Salinity Climatology, western boundary (from Masson and Fine), northern boundary (from Thomson and Foreman)

Running Real-Time

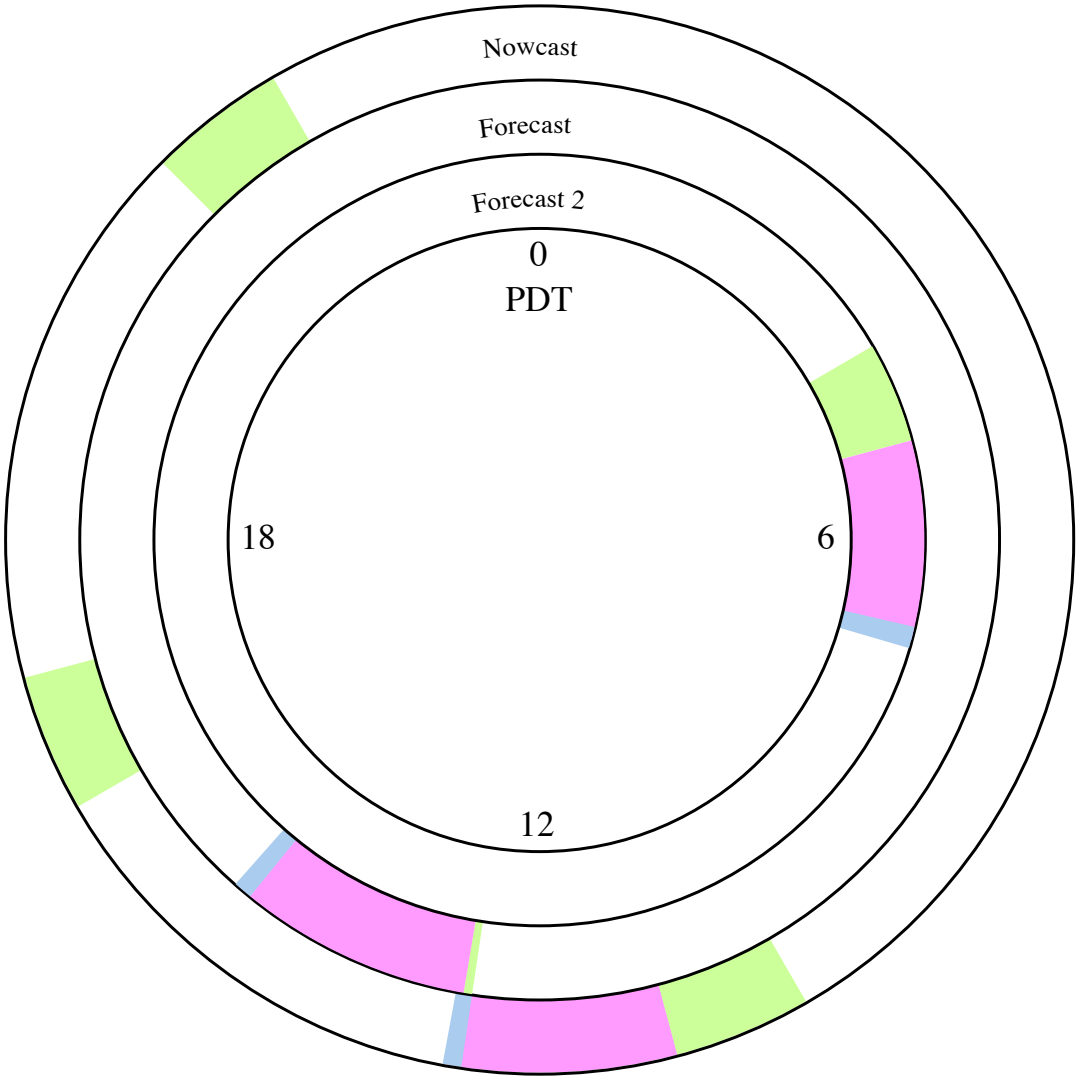
- 4 model runs each day:
  - 24h of model time for today
  - 30h of model time for tomorrow 30h of model time for the next day
  - 24h of model time for today using candidate V2.0 (results not yet on web)
- Use the most up to date available forcing
  - atmospheric: EC HRDPS
  - Fraser River at Hope observations
  - NOAA ssh at Neah Bay

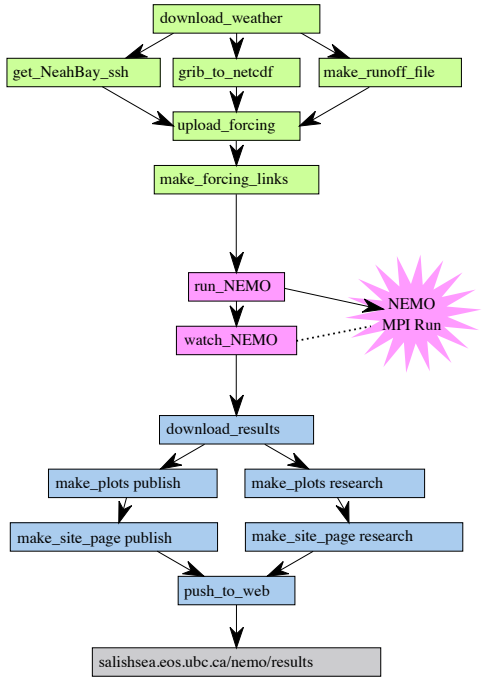
Nowcast System

- Prepare forcing Fields
- Run Code
- Prepare Output



Nowcast Around the Clock

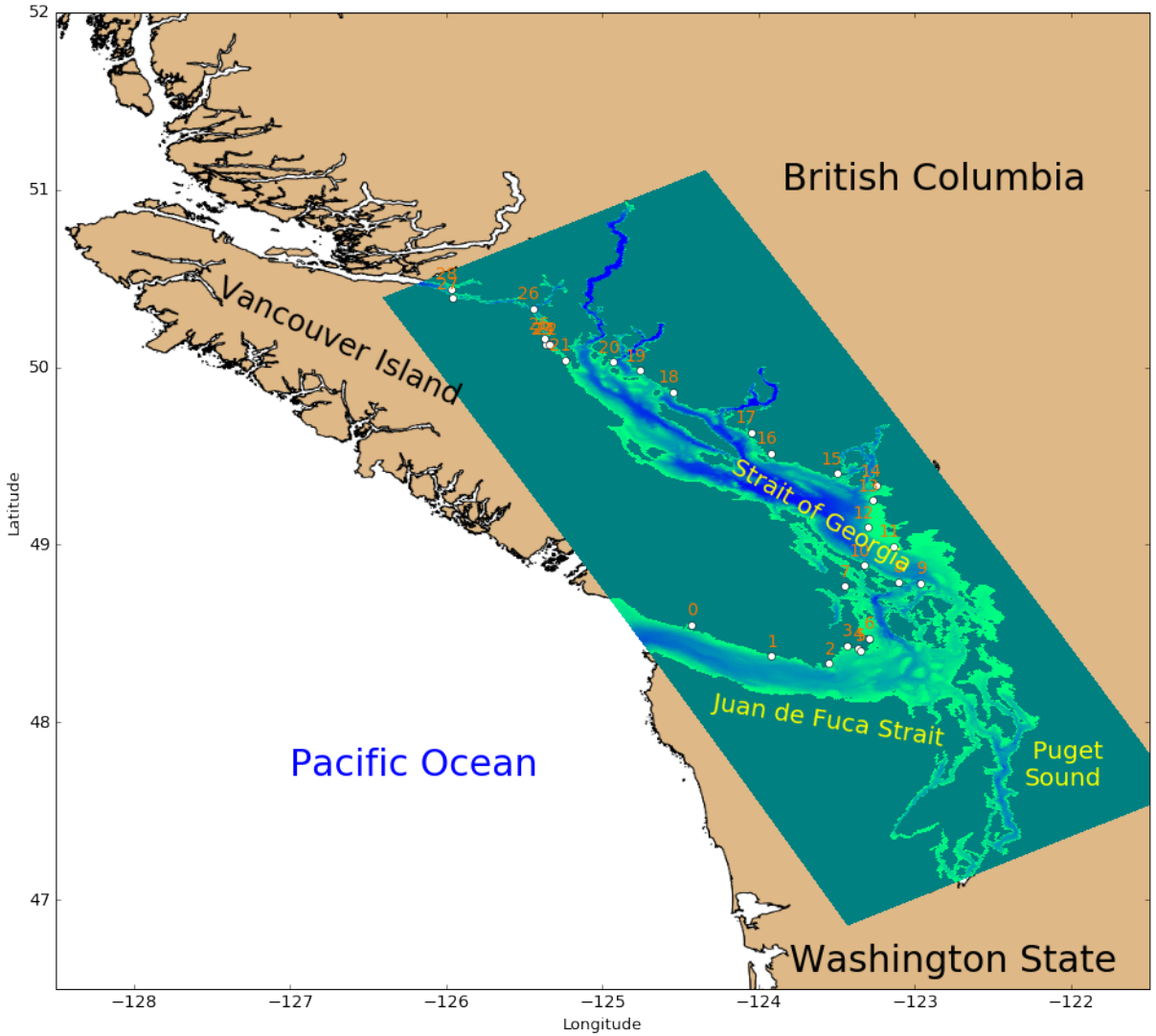




Changes to Code/Parameters during Nowcast Period

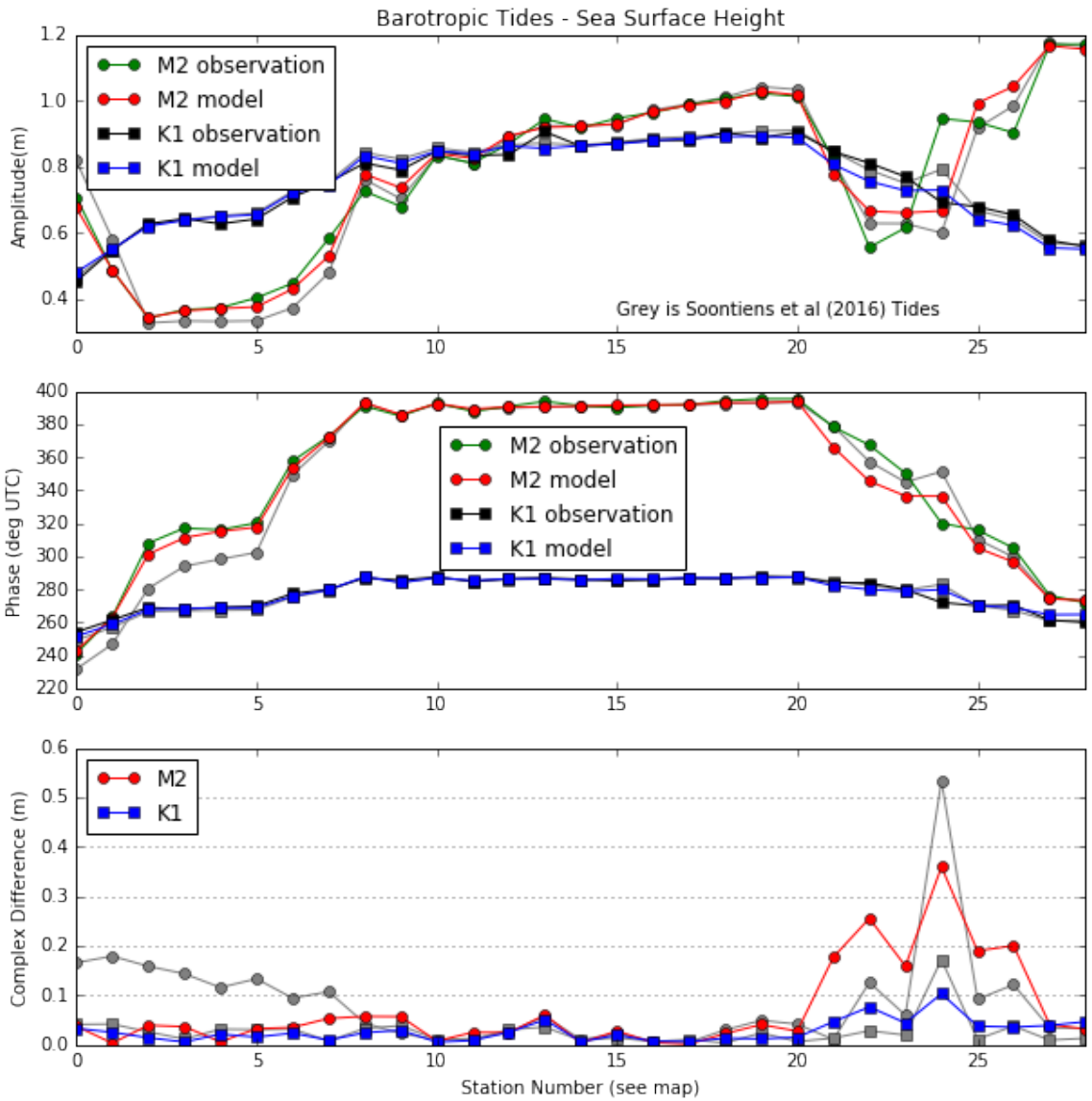
The nowcast started in October 2014. Changes to parameters as we have run are available here:
`http://salishsea-meopar-docs.readthedocs.io/en/latest/results_server/nowcast.html`

Sea Surface Height: Tides



Compare to data from Foreman et al (1995, 2000 and personal communication)

Grey Curves are Version 1.0 Tides



Sea Surface Height: Storm Surge

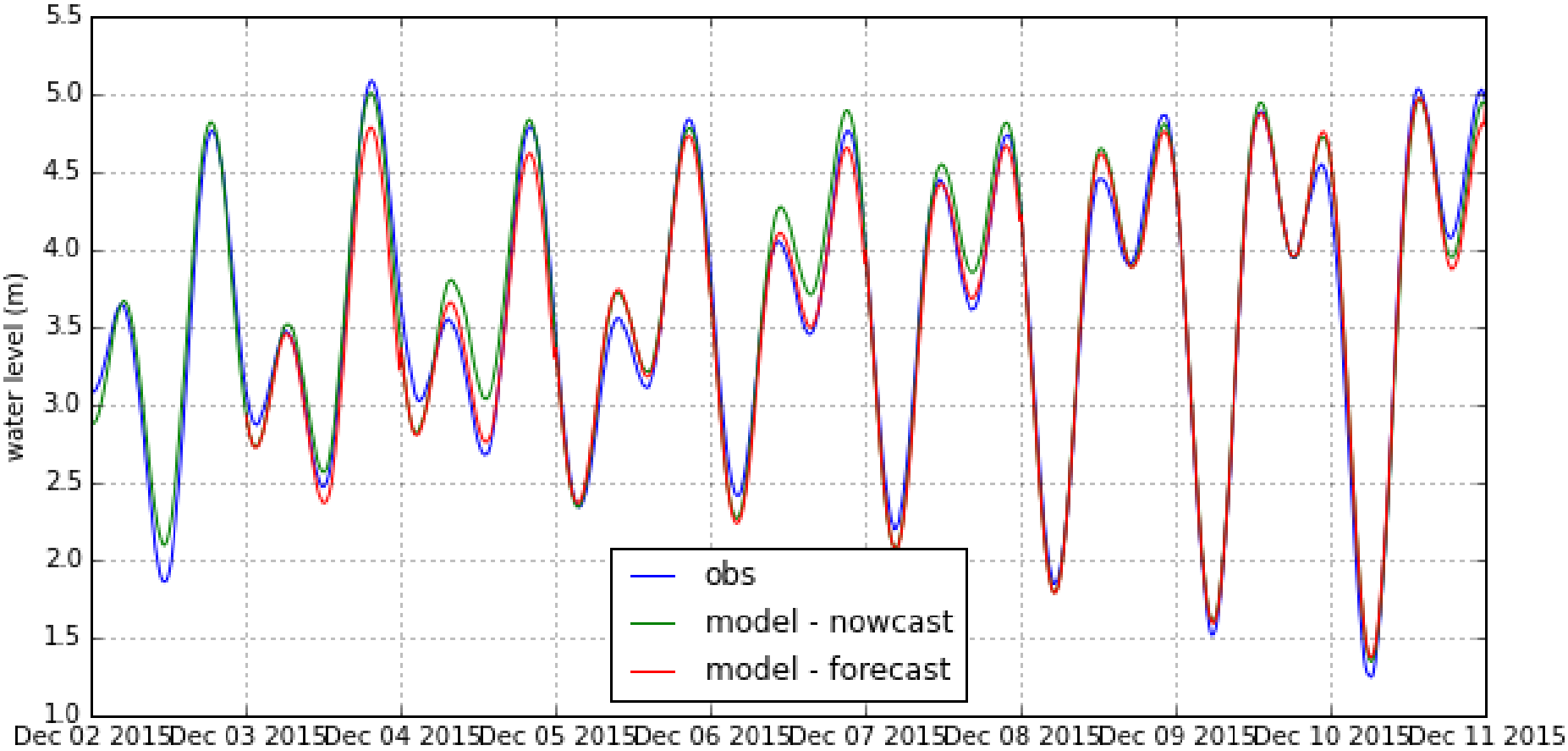
High sea-level in the Strait of Georgia is the sum of:

- High tide
- High sea-surface height on the West Coast of Vancouver Island due to
  - water level set-up (shelf waves, seasonal winds)
  - storm surge due to Pacific Storm
- Local storm surge

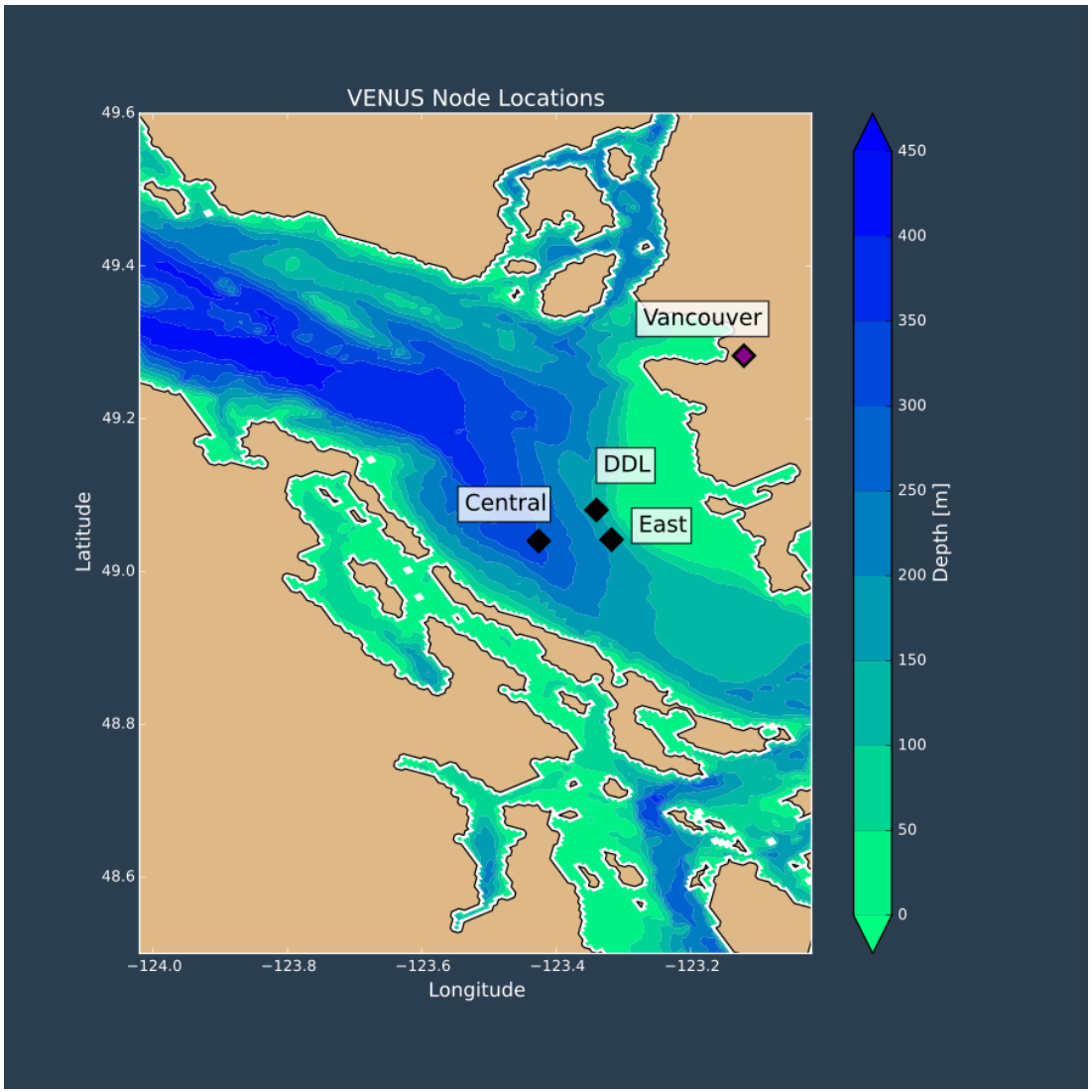
Soontiens et al (2016): Storm Surges in the Strait of Georgia Simulated with a Regional Model. *Atmosphere-Ocean*: 54: 1-21.

Our storm surge forecast error is about 10 cm.

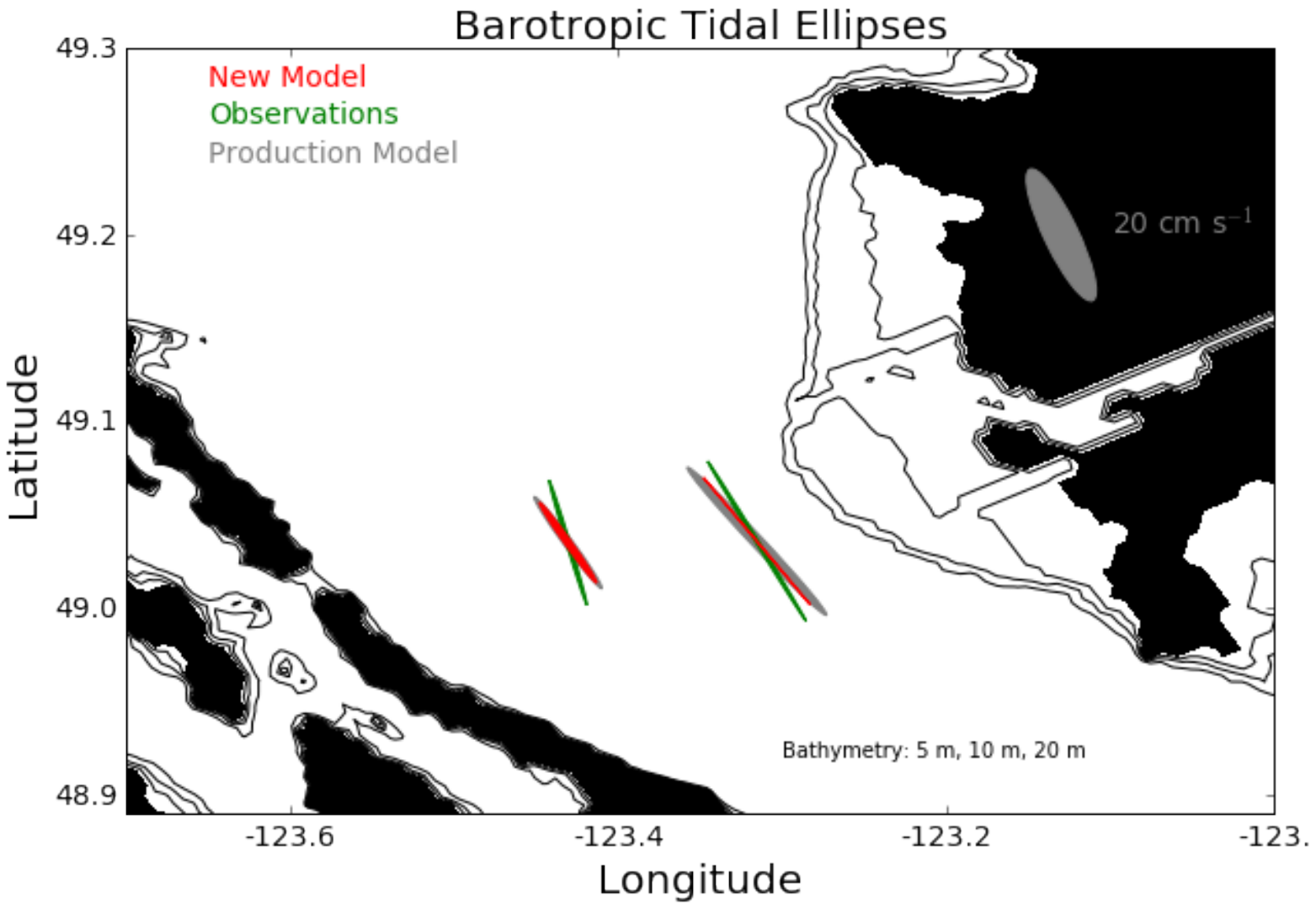
Forecast Success: December 2015



Barotropic Tidal Currents



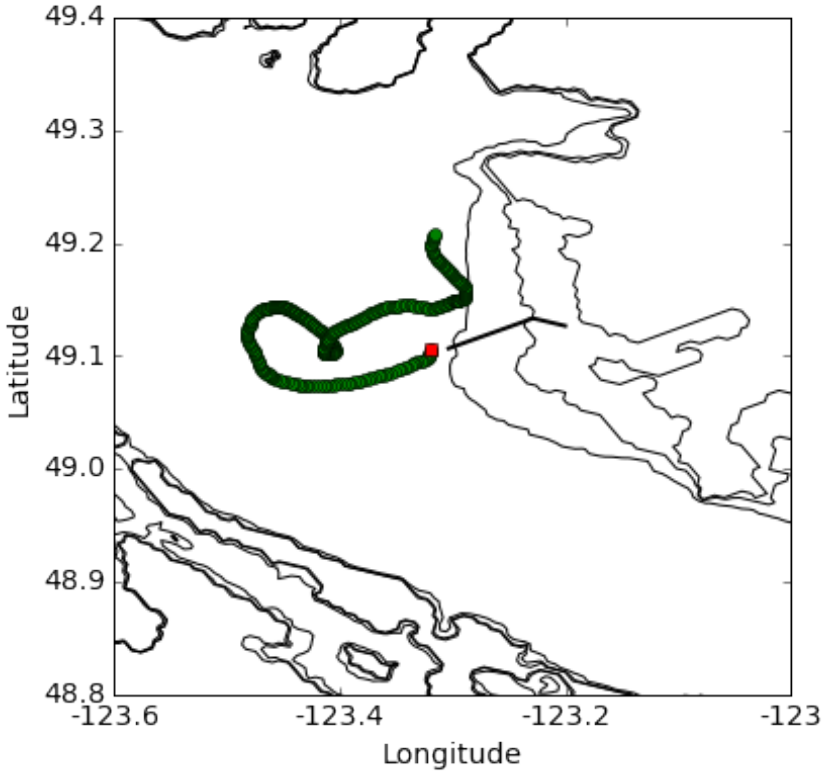
Compare to data from ONC analyzed by R. Pawlowicz and M. Halverson



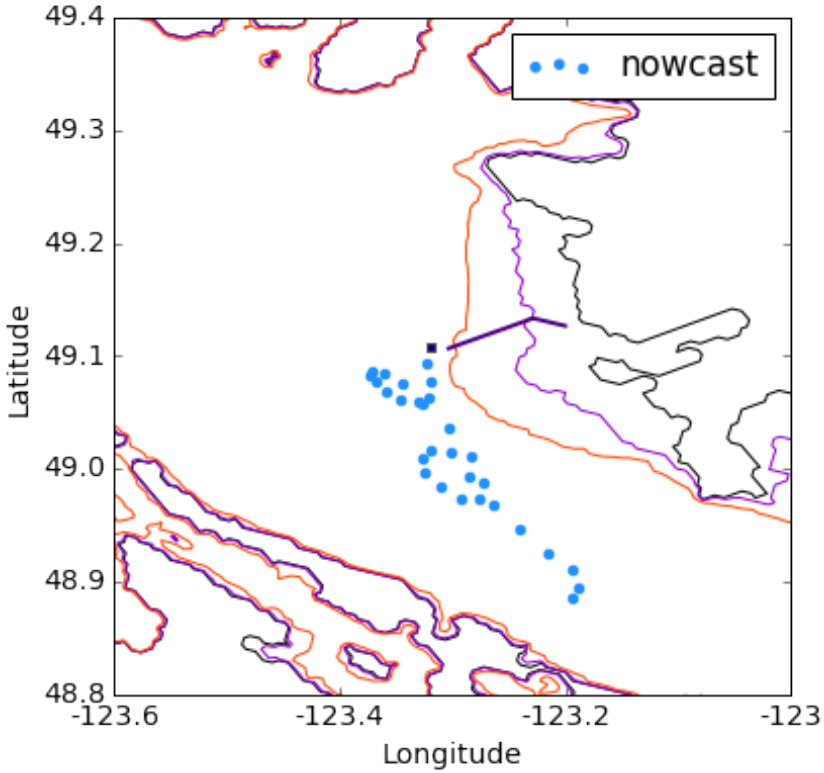
Our barotropic tidal currents are correct within measurement error.

Surface near Plume Currents

Observations



Model V1.0



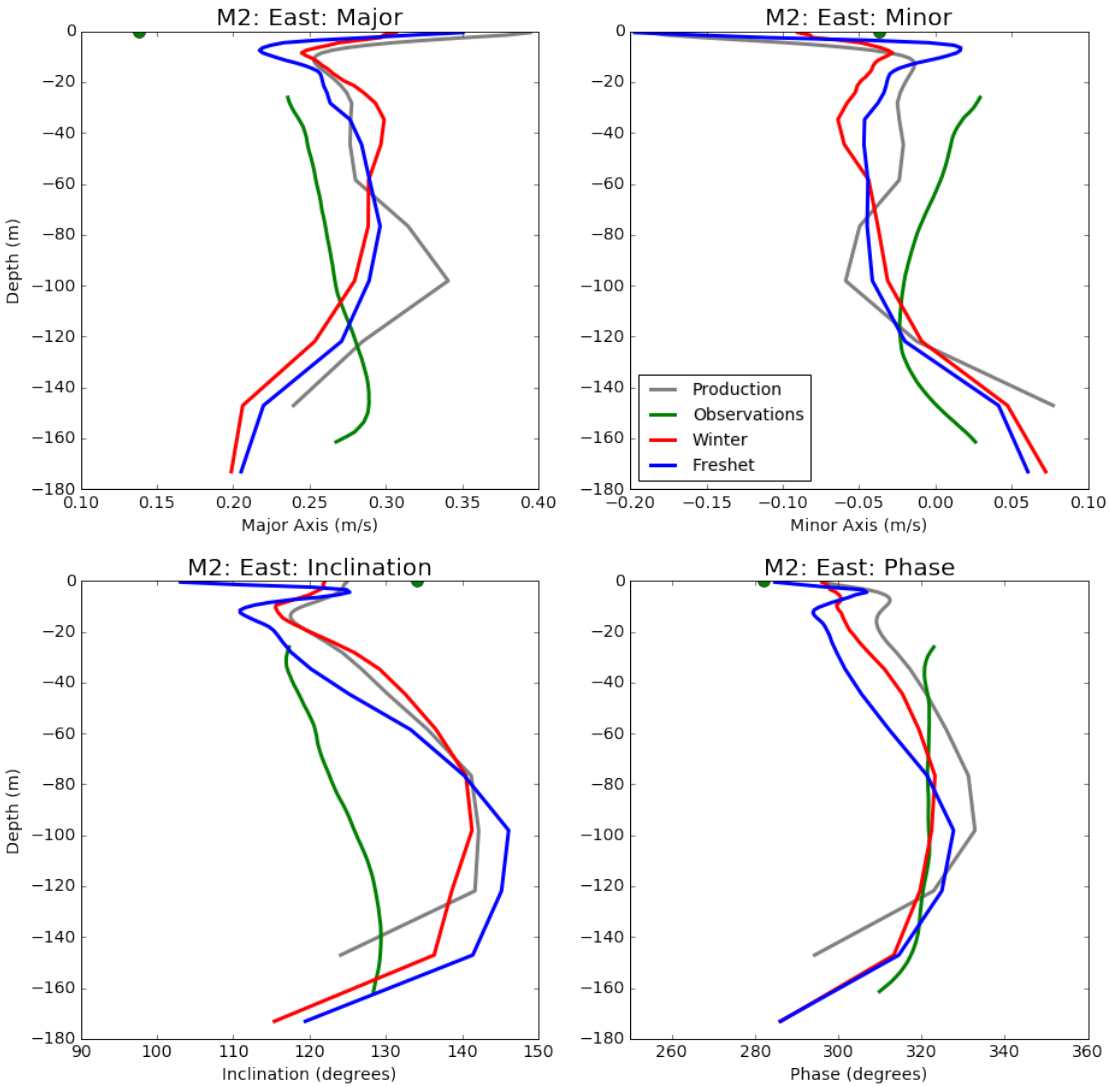
Data from R. Pawlowicz

Surface Currents

Surface currents are not well represented in V1.0. A longer Fraser River (V2.0) improves the currents. A weaker vertical background viscosity (as implemented on 29-Sep-2015) slightly improves surface currents.

Surface currents are not very accurate in V1.0

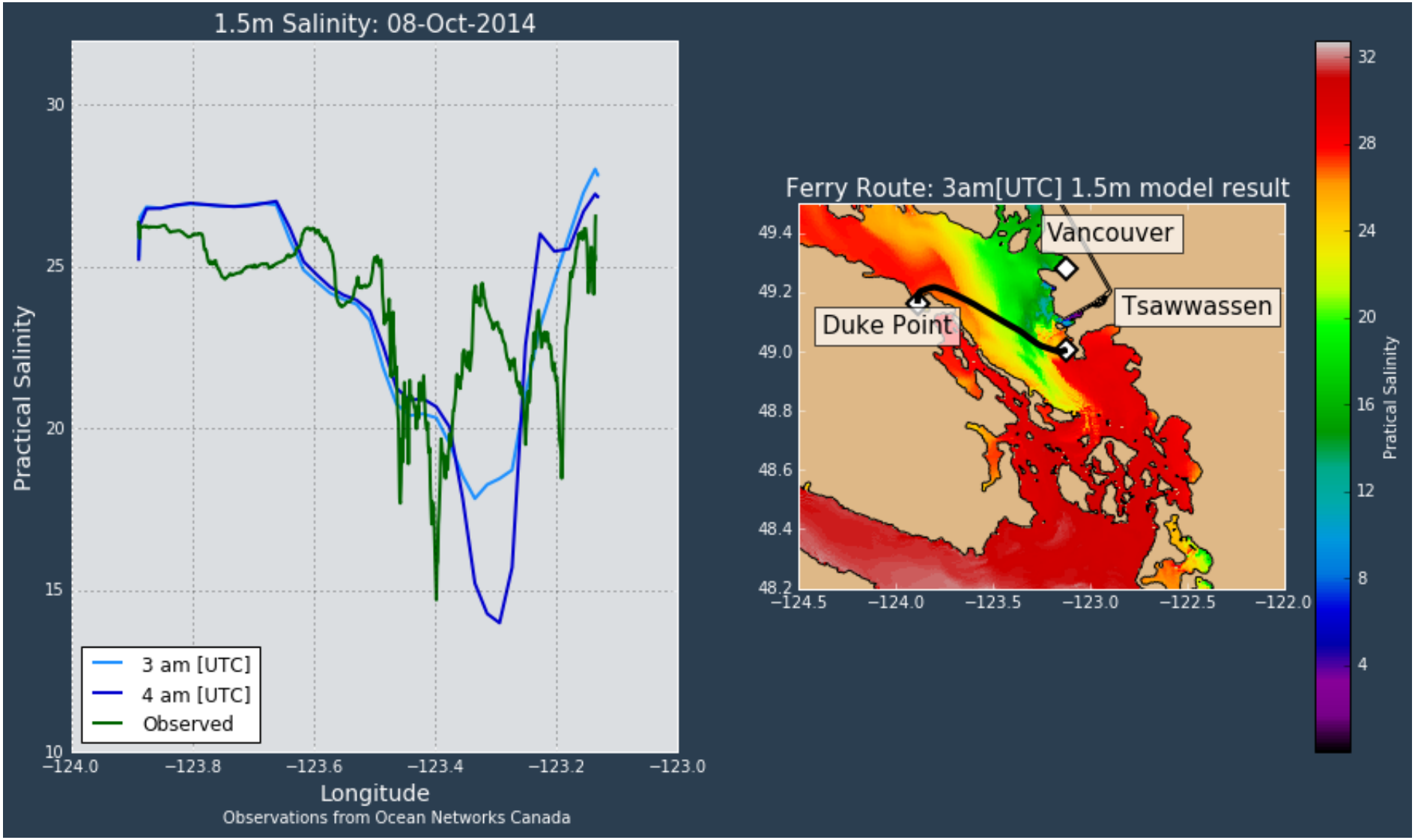
Baroclinic Tides: grey is V1.0



Compare to data from ONC analyzed by R. Pawlowicz and M. Halverson

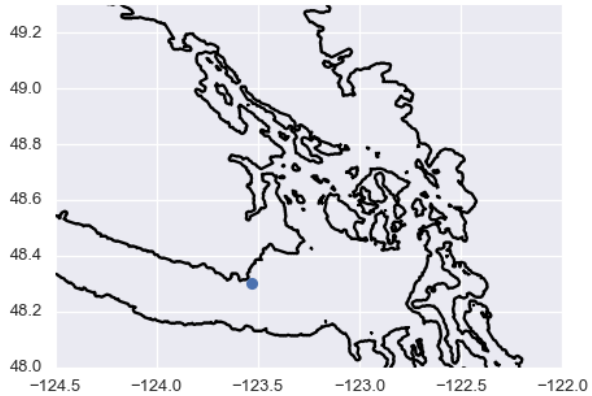
Baroclinic tides are variable in time. Model is reasonable.

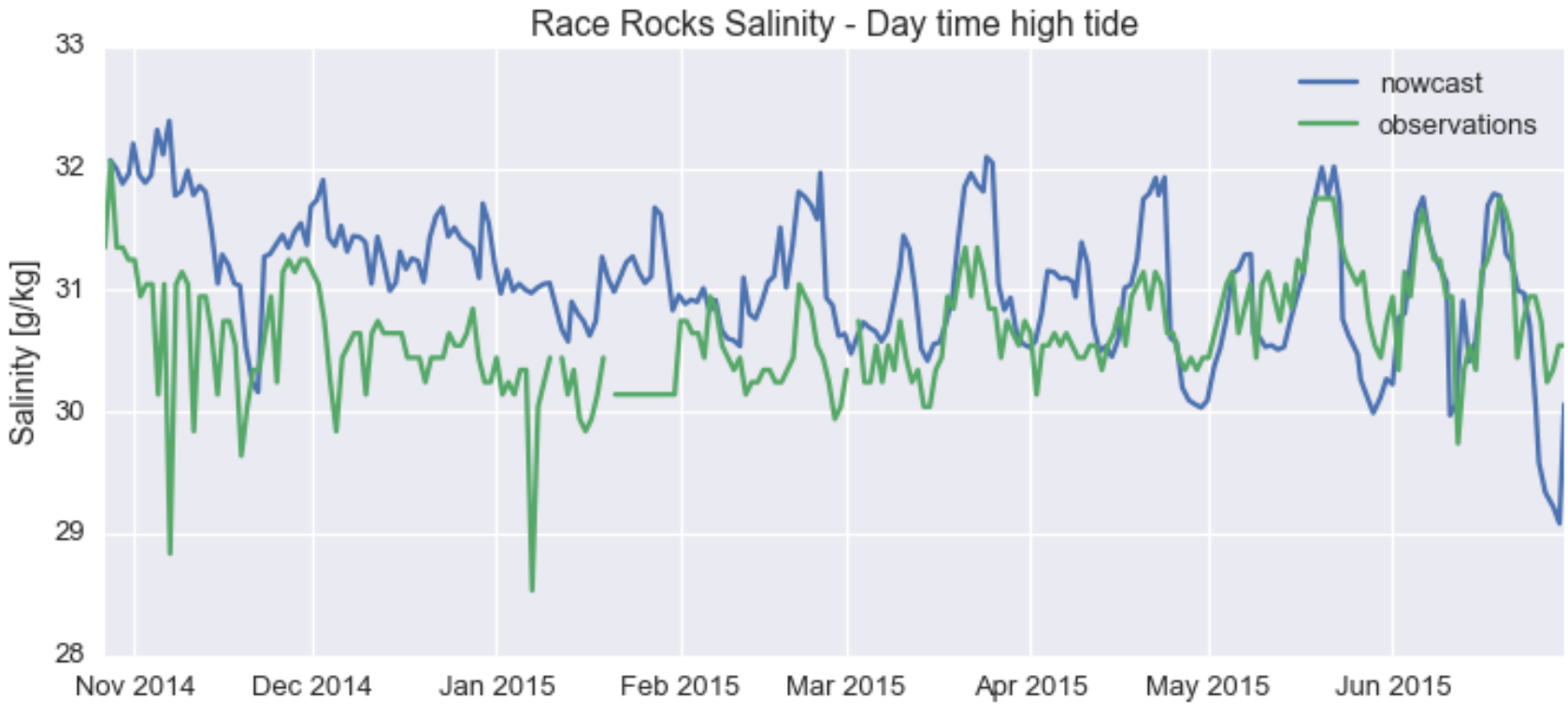
Plume Salinity



Data from ONC

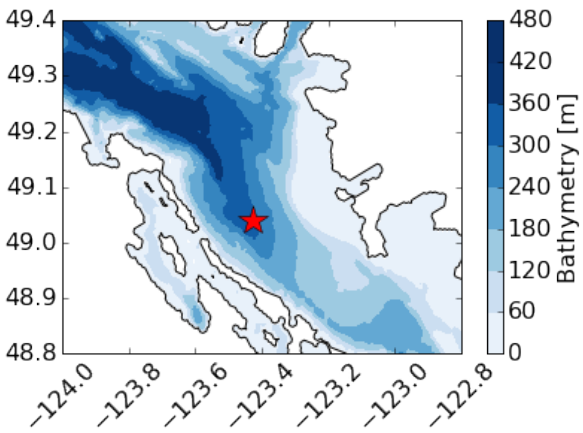
Salinity at Race Rocks

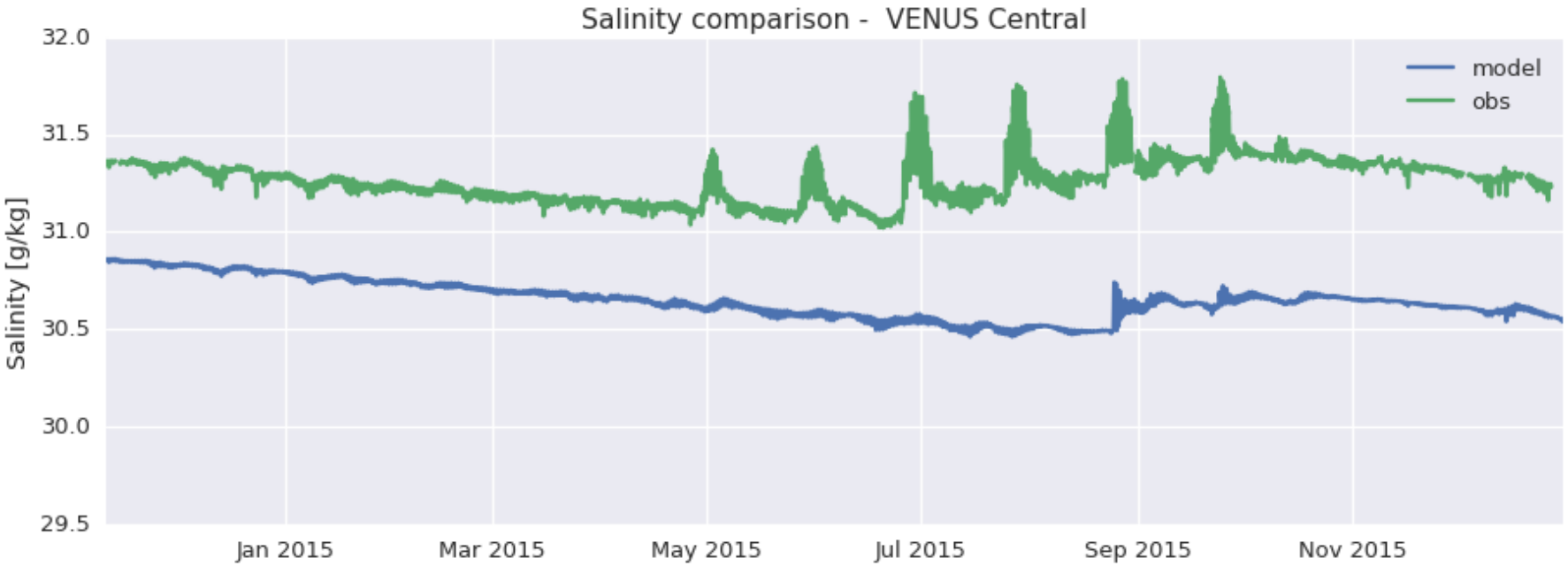




Data from IOS Lighthouse program

Deep Strait of Georgia Salinity





Data from ONC

Salinity and Temperature

Surface Salinity

Salinity values are good; though plume location is not (see currents).

Deep Salinity

Deep salinity is too low.

Temperature

Evaluation of temperature : TBD

Summary of Improvements for Version 2.0

- Move to Version NEMO 3.6
- Split vertical time advection
- Partially resolved bottom boundary layers
- Hollingsworth Instability removed
- Use lower horizontal diffusivity and viscosity (2 $m^2 s^{-1}$)
- Use lower background vertical diffusivity and viscosity (1 $\times 10^{-6}$ $m^2 s^{-1}$)
- Use deeper grid to improve tides
- Use longer Fraser River
- Add a biological model: SMELT