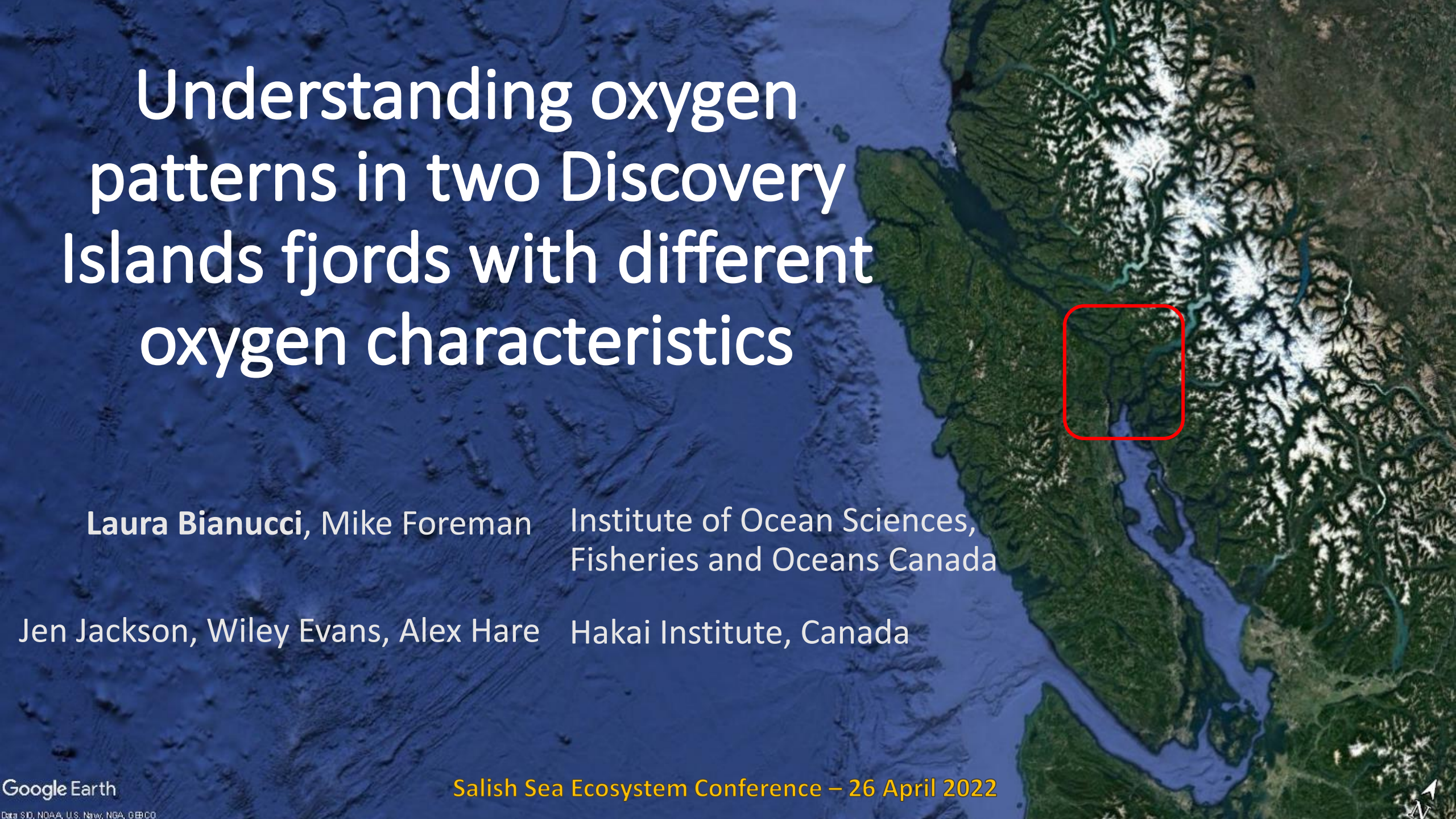
Apr 26th, 1:30 PM - 3:00 PM

# Understanding oxygen dynamics in two Discovery Islands fjords with different oxygen characteristics (oxic vs. hypoxic subsurface waters)

Dr. Laura Bianucci

# Understanding oxygen patterns in two Discovery Islands fjords with different oxygen characteristics



**Laura Bianucci**, Mike Foreman — Institute of Ocean Sciences, Fisheries and Oceans Canada

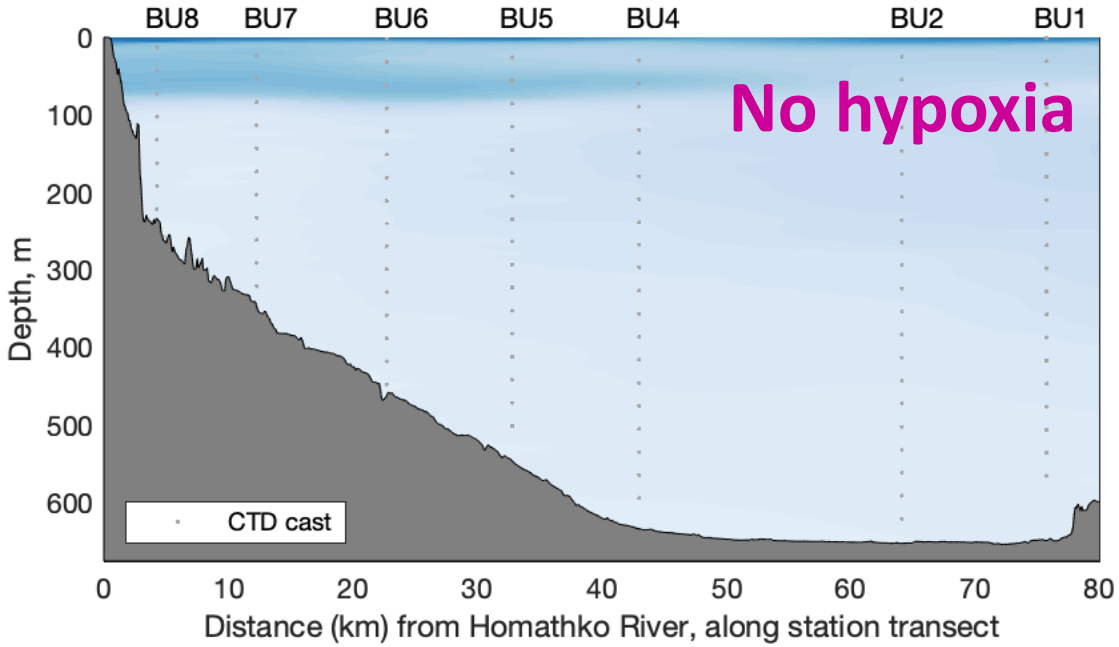
Jen Jackson, Wiley Evans, Alex Hare — Hakai Institute, Canada

Salish Sea Ecosystem Conference – 26 April 2022

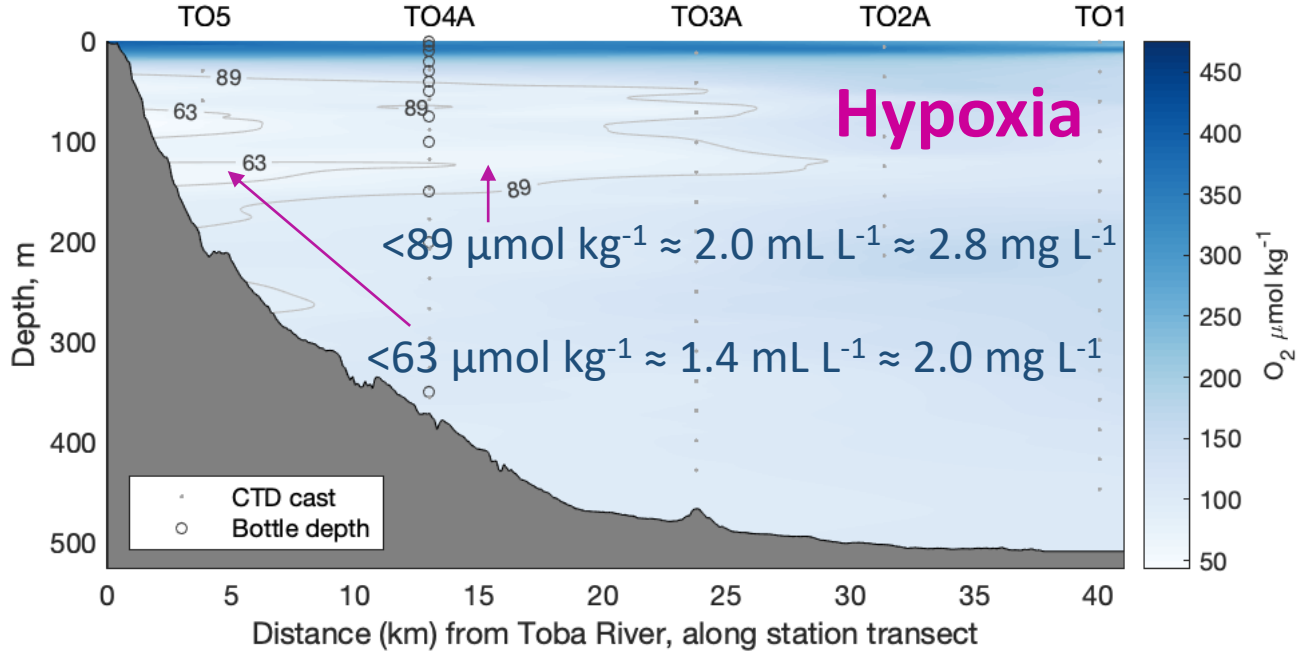
# Why study $O_2$ in Discovery Islands?

- In 2019, Bute and Toba Inlets showed different oxygen characteristics


**Bute Inlet - 26 Jun 2019**



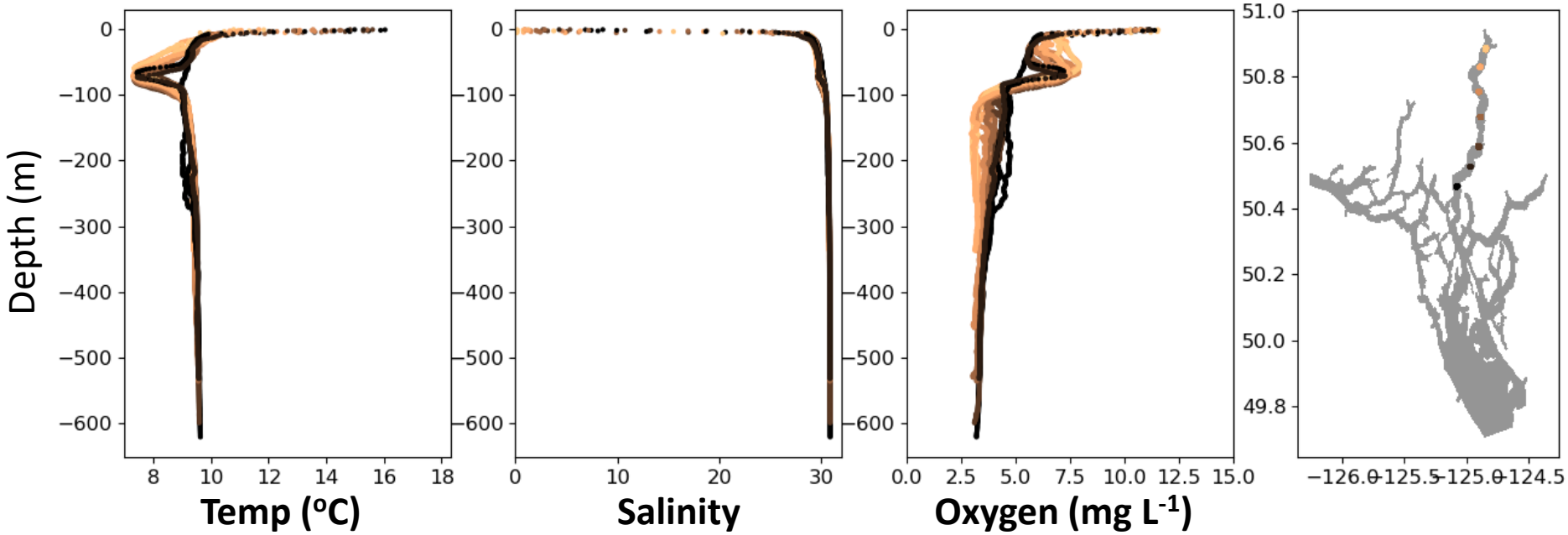

**Toba Inlet - 24 Jun 2019**



# Observed oxygen and temperature patterns

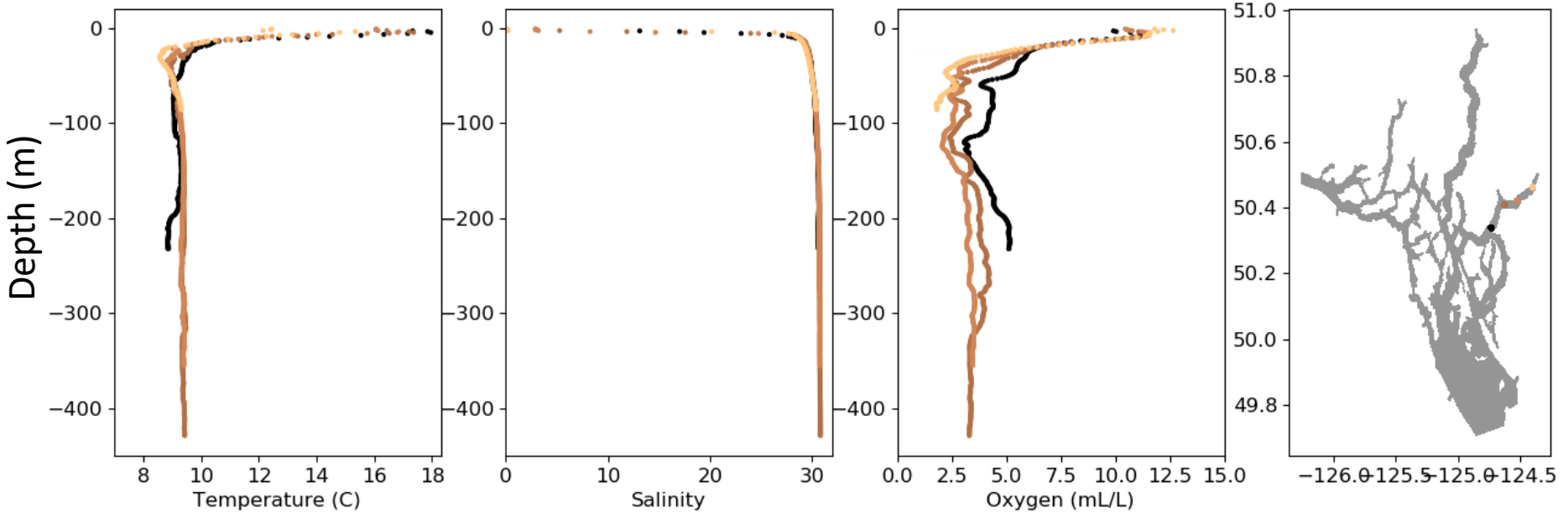
## Bute

12 Jun 2019
26 Jun 2019




## Toba

24 Jun 2019



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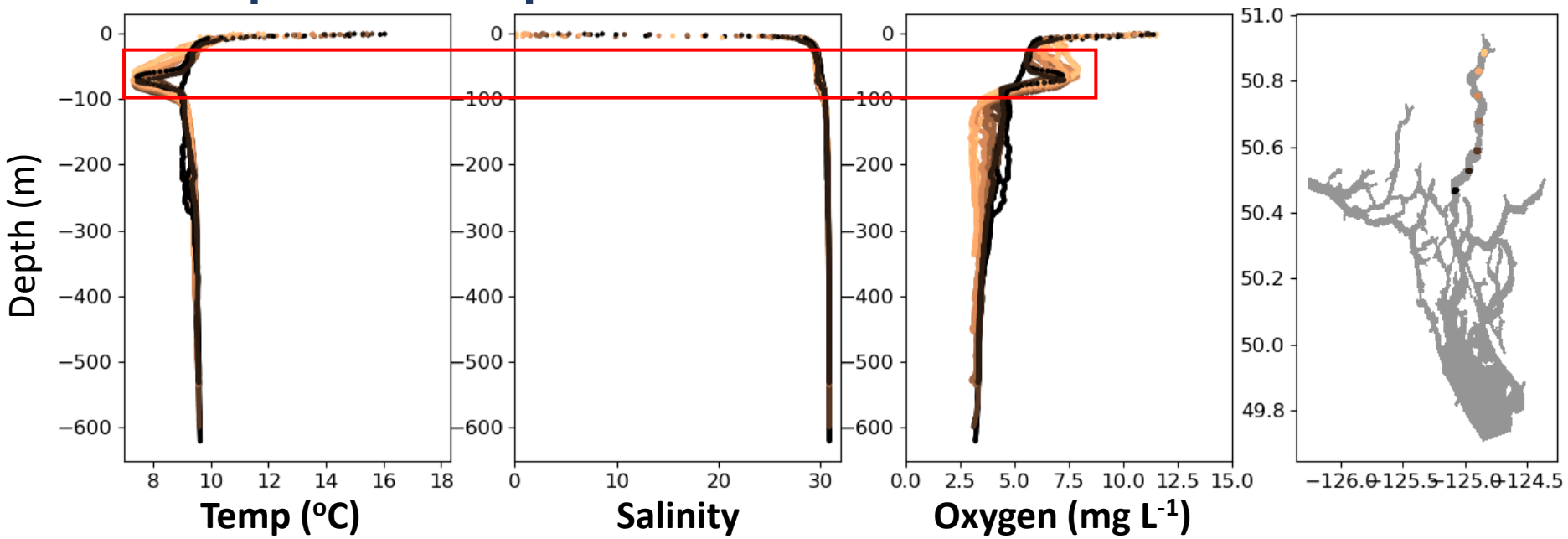
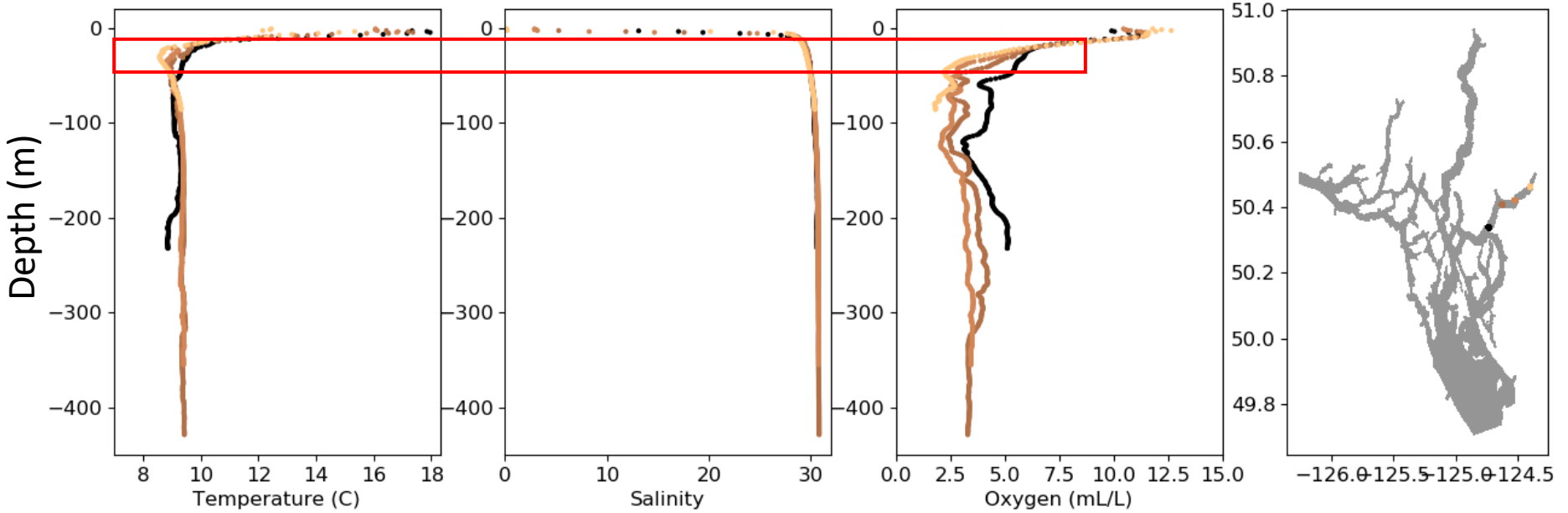


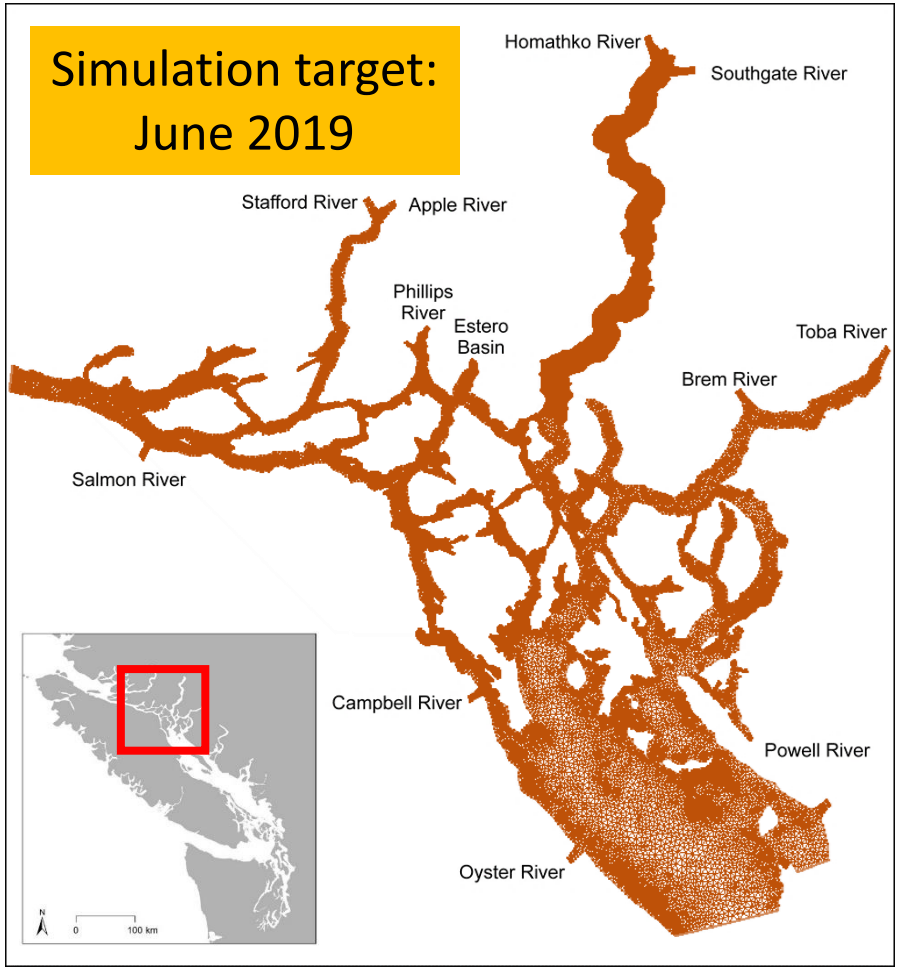

## Toba

24 Jun 2019



# Physical Model: FVCOM

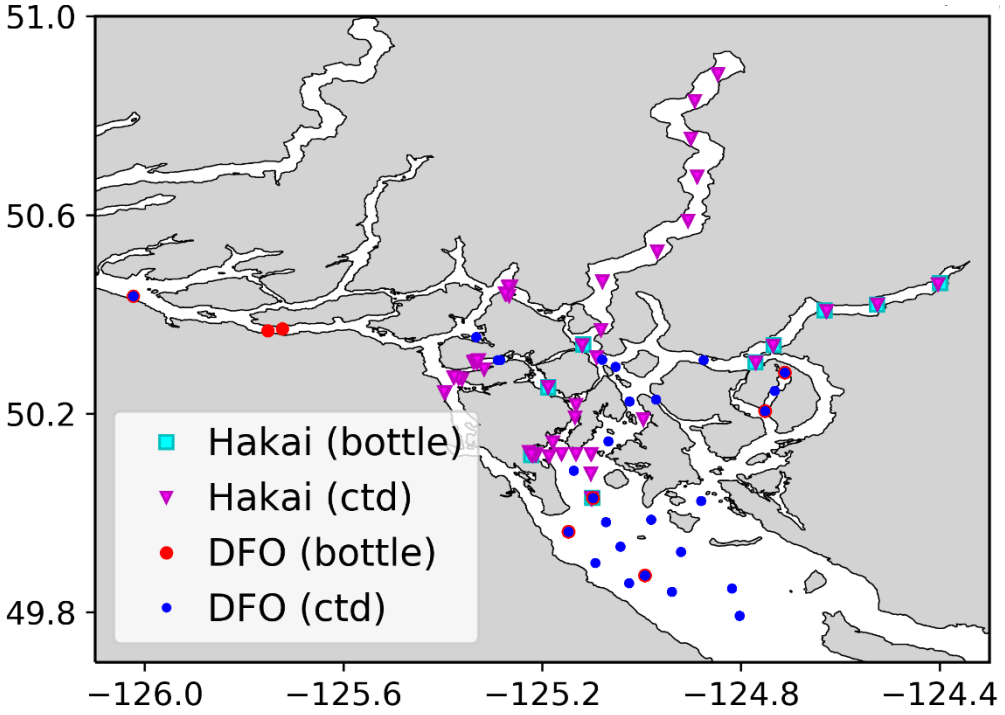
- **F**inite **V**olume **C**ommunity **O**cean **M**odel, v4.1 *(Chen et al. 2006)*
- Unstructured triangular grid (~41K nodes)
  Horizontal resolution: 20 m to 1 km
- 20 terrain-following sigma levels
  Vertical resolution: 1 cm to 100 m
- Winds and surface fluxes: **H**igh **R**esolution (1 km) **D**eterministic **P**rediction **S**ystem
- Initial, open boundary conditions:
  Observations + SalishSeaCast (Soontiens et al. 2016)
- Rivers: 12 (discharge available in 4; no temperature observations)



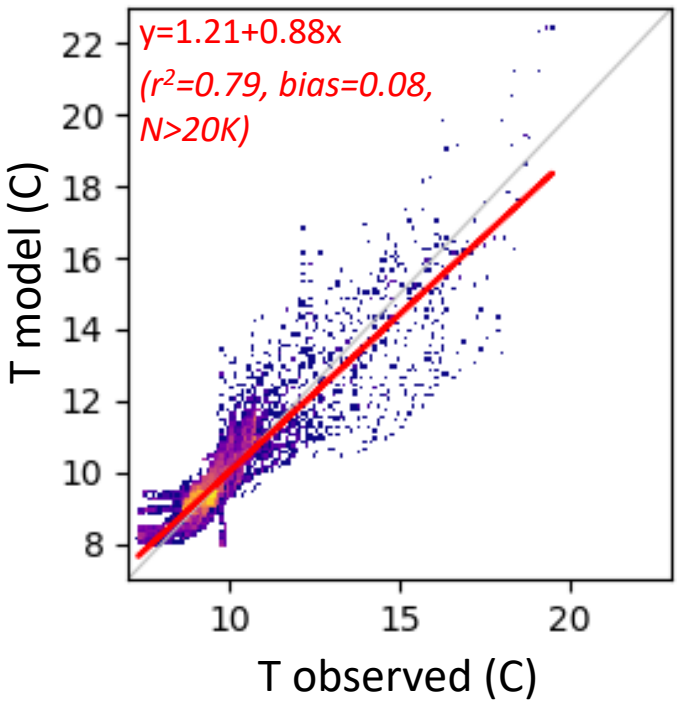
# Model Evaluation: Physics

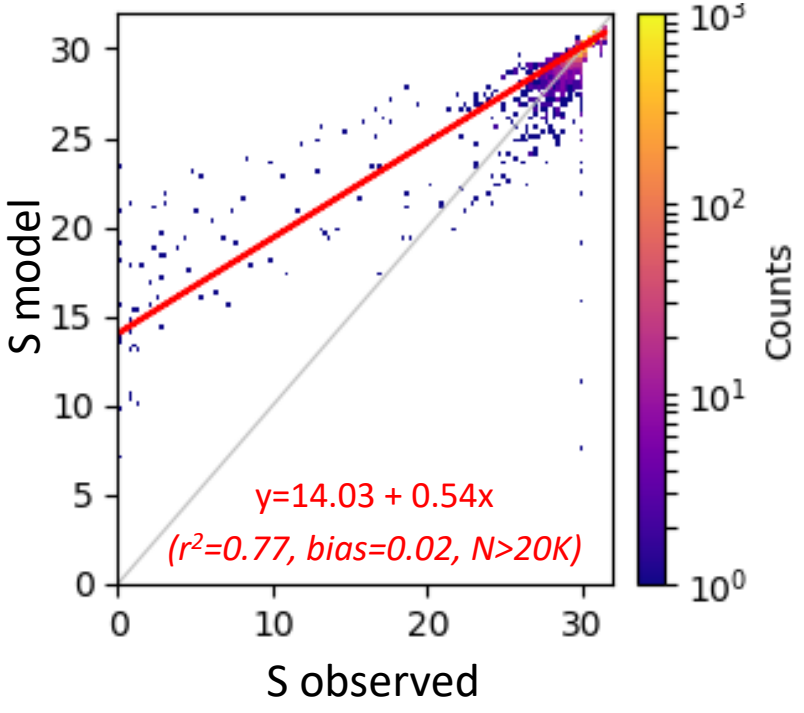
## Simulation: 24 May to 27 June 2019

### Location observations




### Model vs Observations in whole domain



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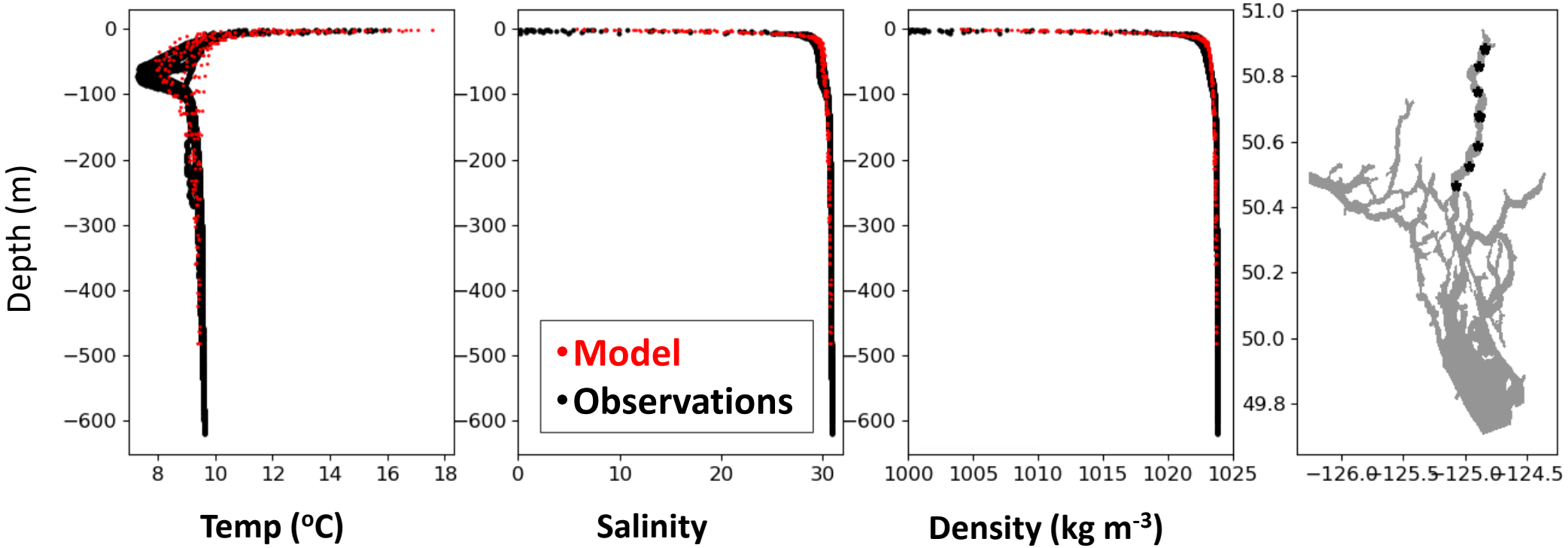


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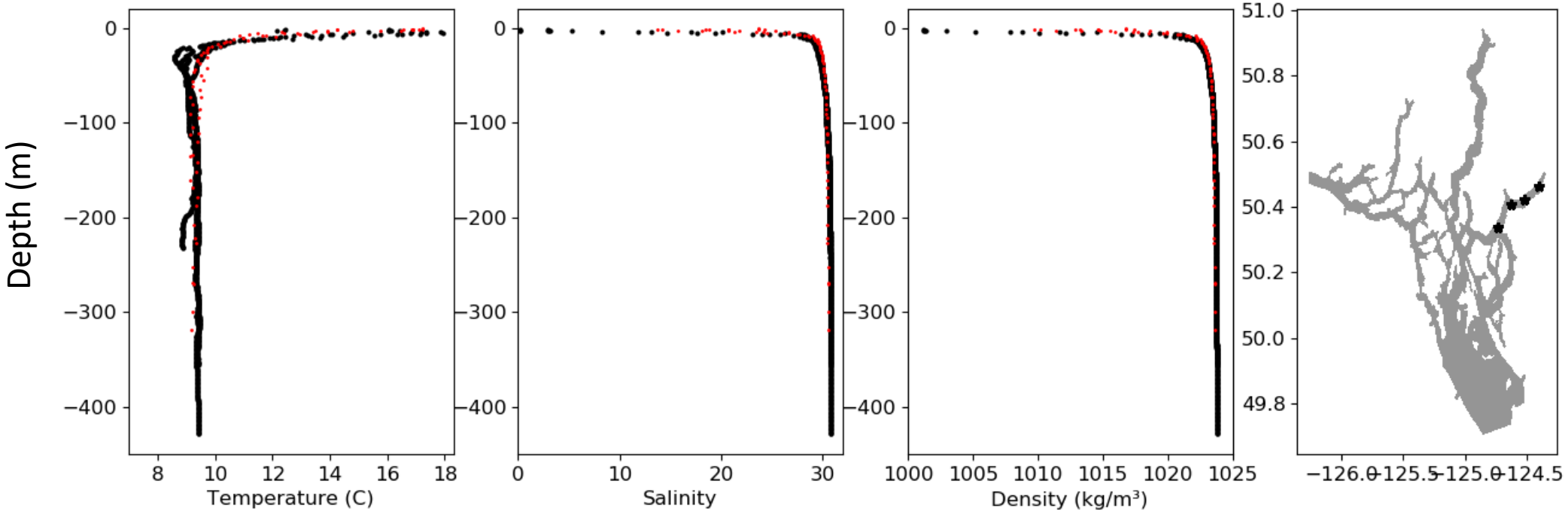
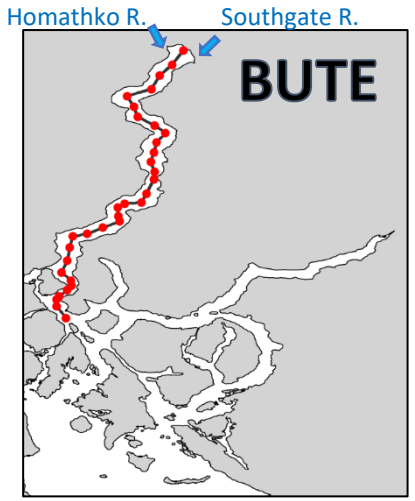
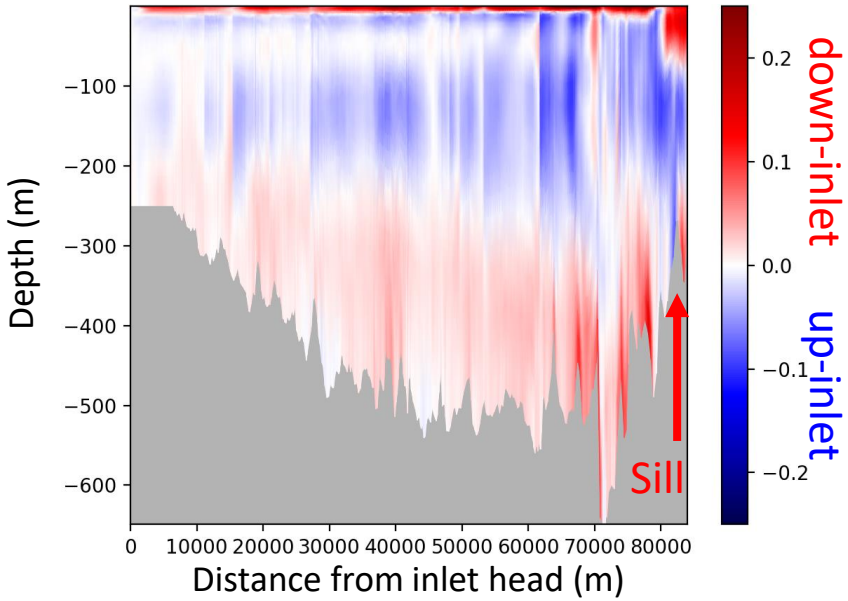
24 Jun 2019





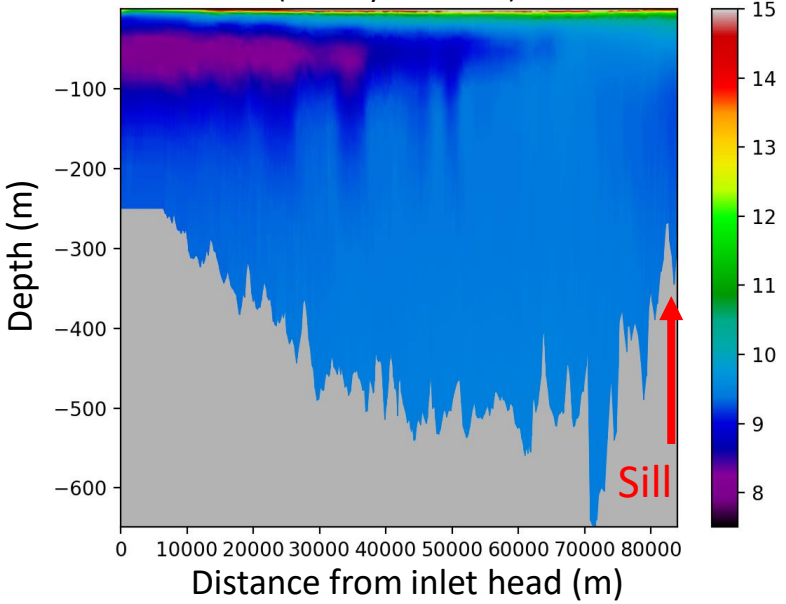

## Mean Along-Inlet Velocity (m/s)

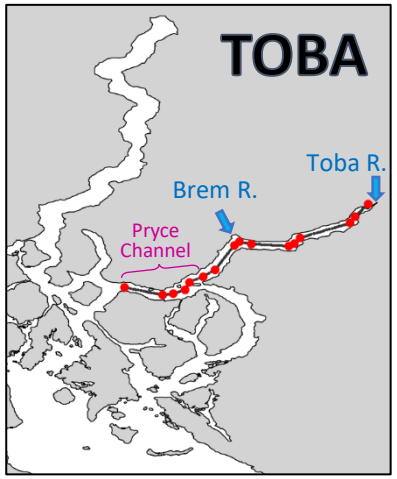
(29 May to 27 Jun)

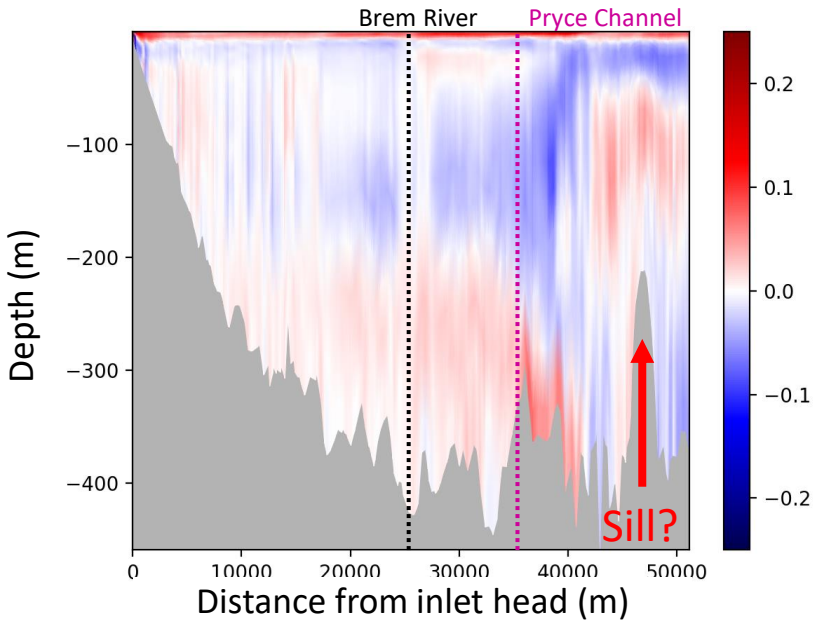


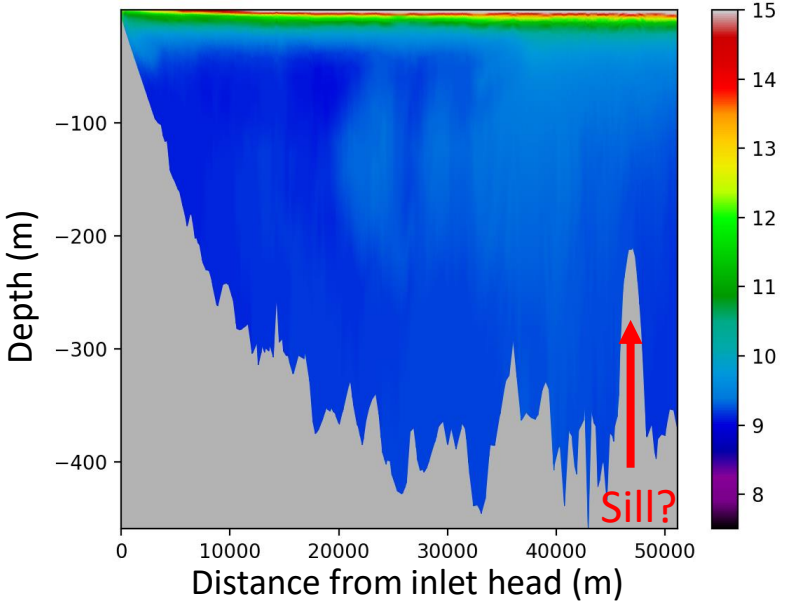

## Mean Temperature (°C)

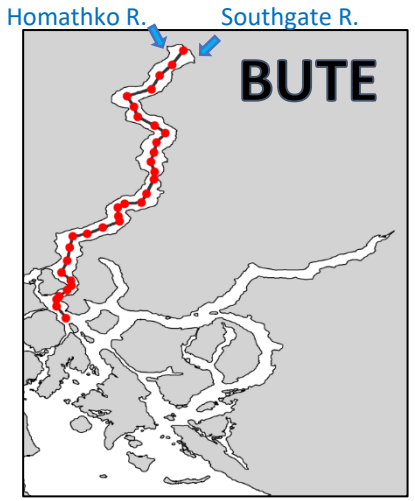
(29 May to 27 Jun)



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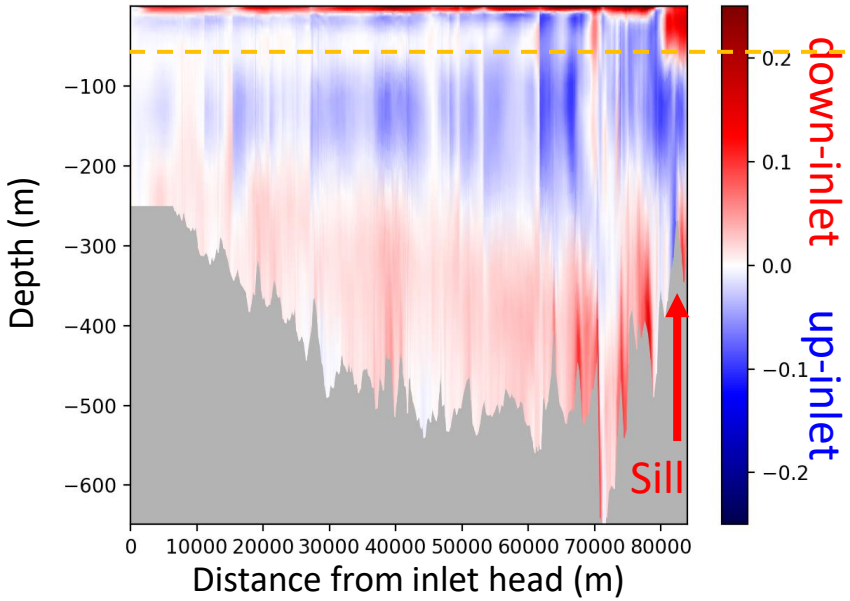


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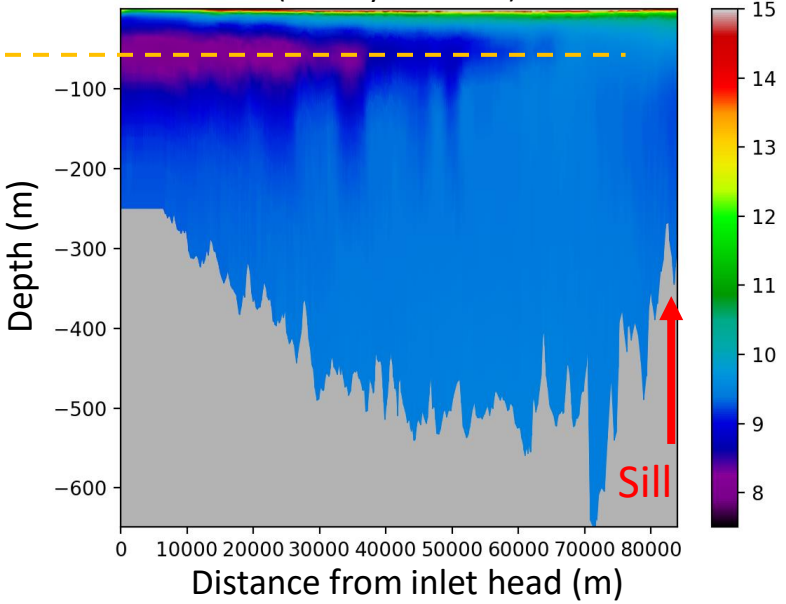


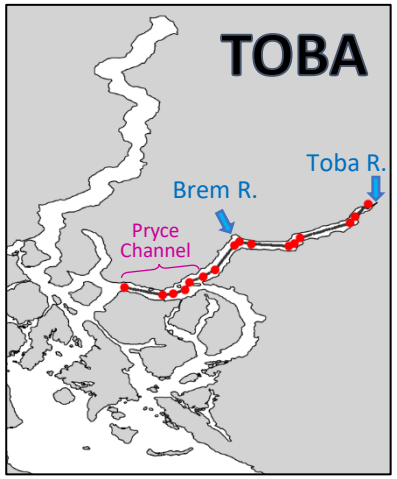


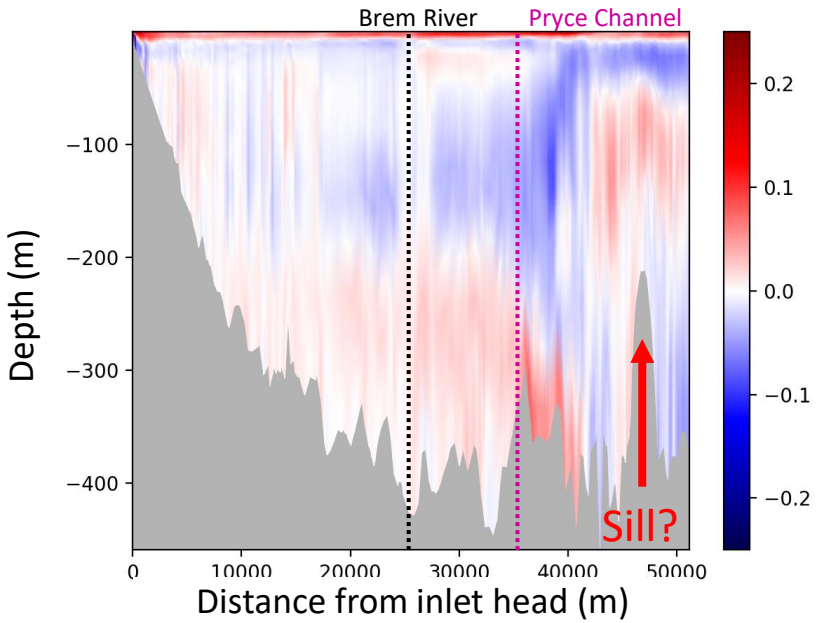


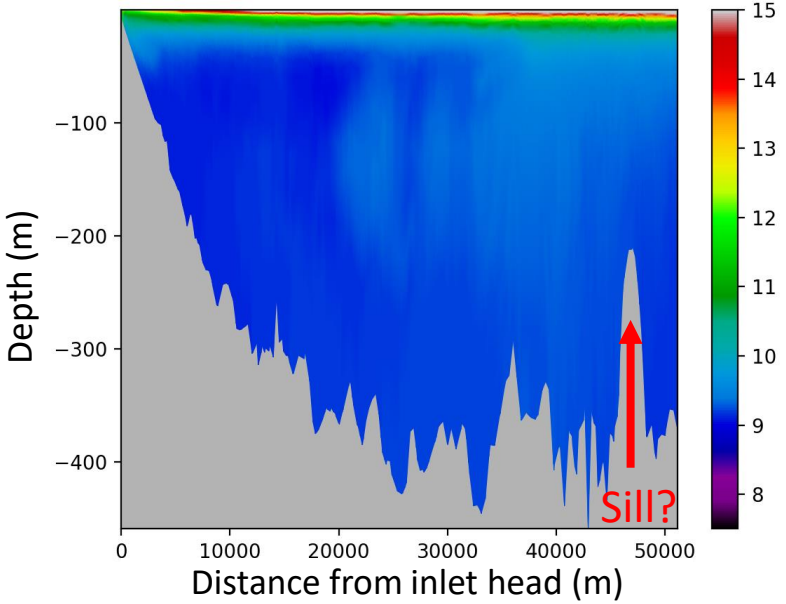

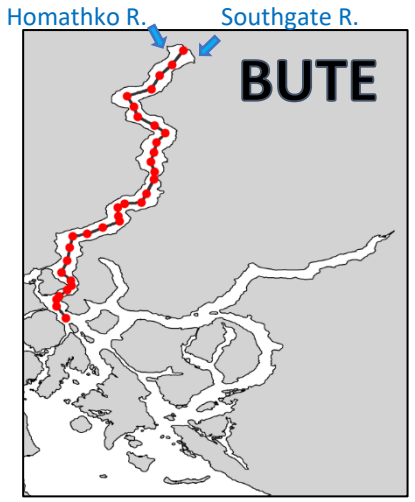


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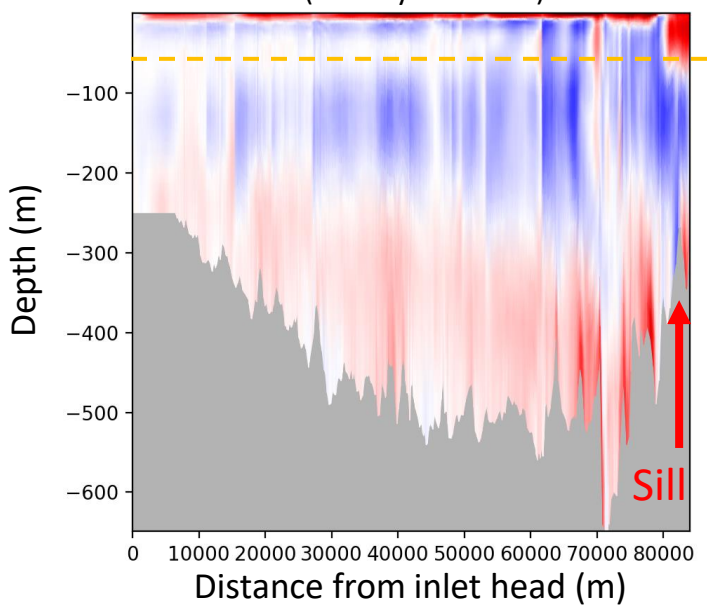


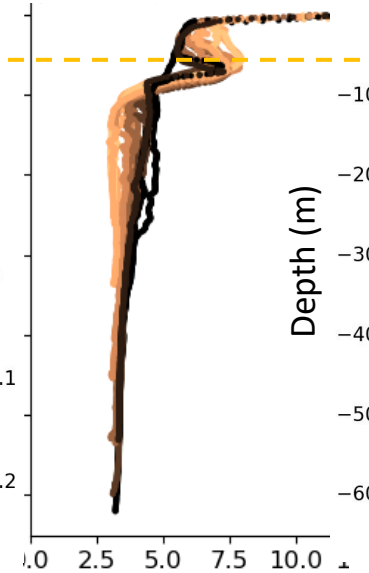


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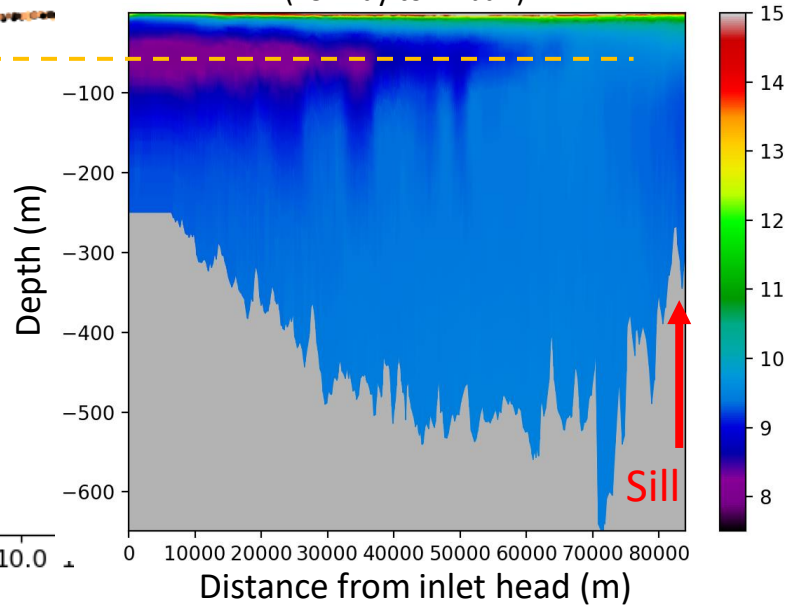
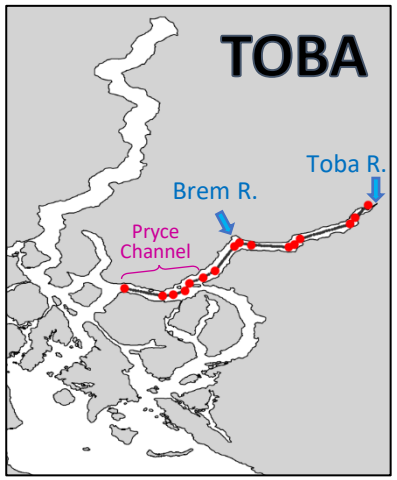
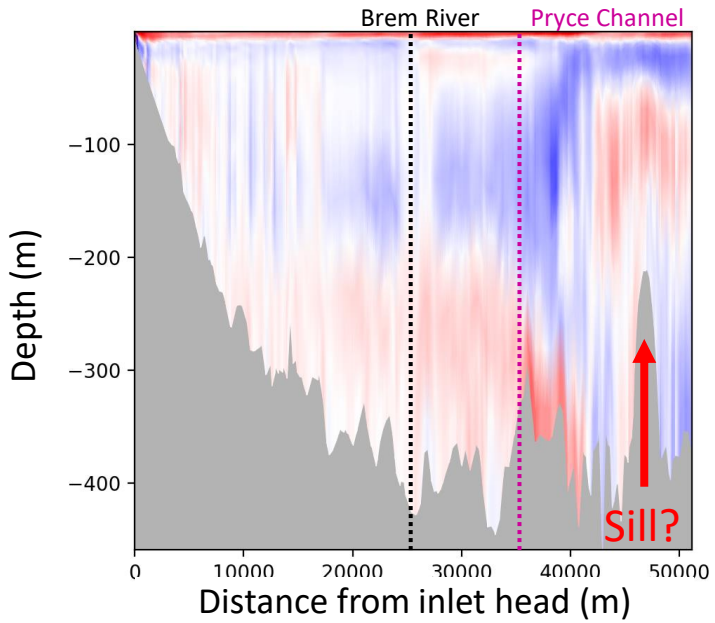
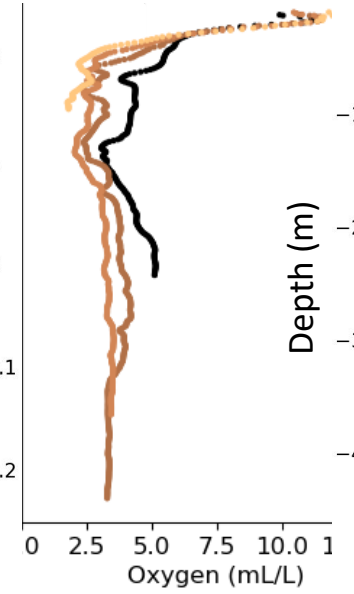
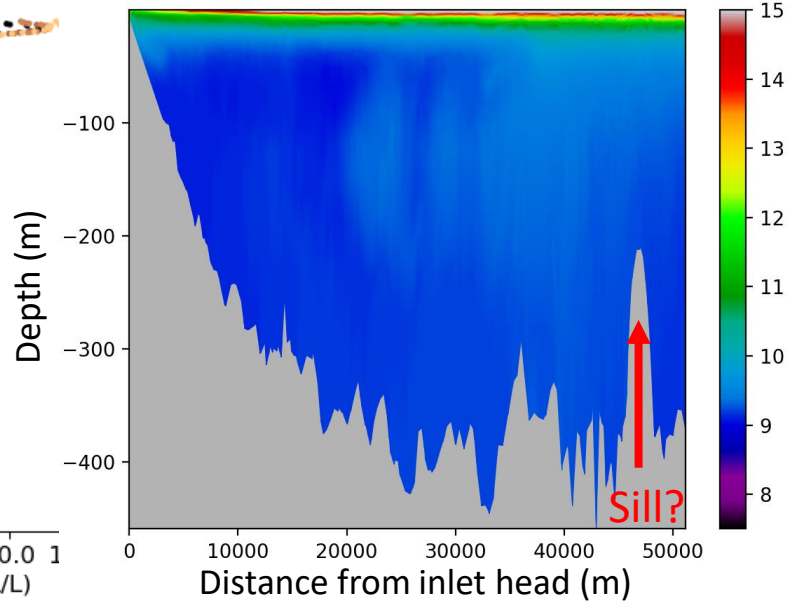


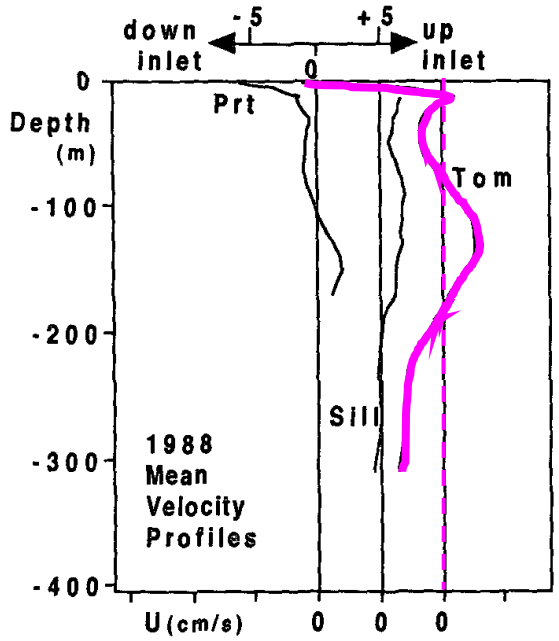



# Previous studies show 4-layer flow in summer

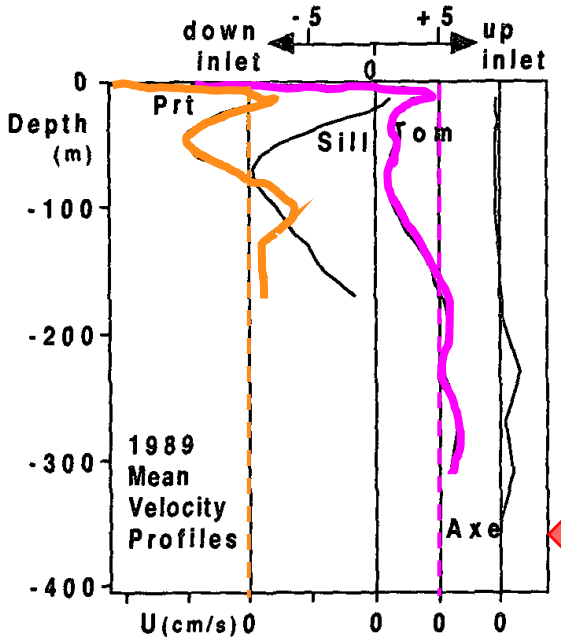
## Knight Inlet

**Baker and Pond, J. Phys. Oc. (1995)**




**Mean Along-Inlet Velocities (cm/s)**

1-month dataset in spring 1988

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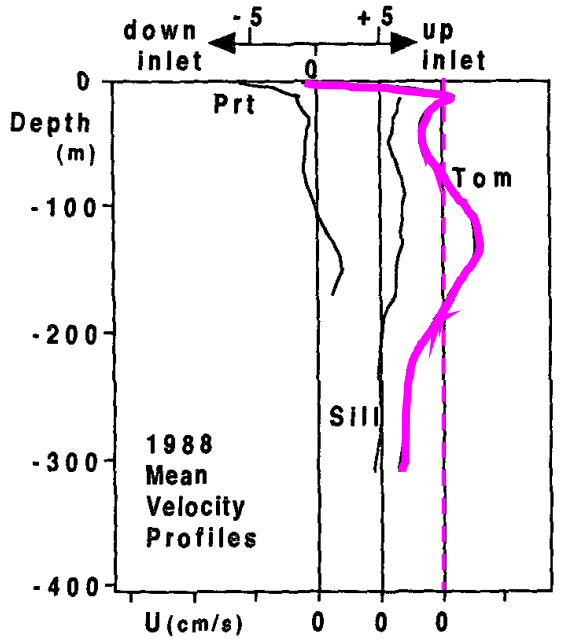


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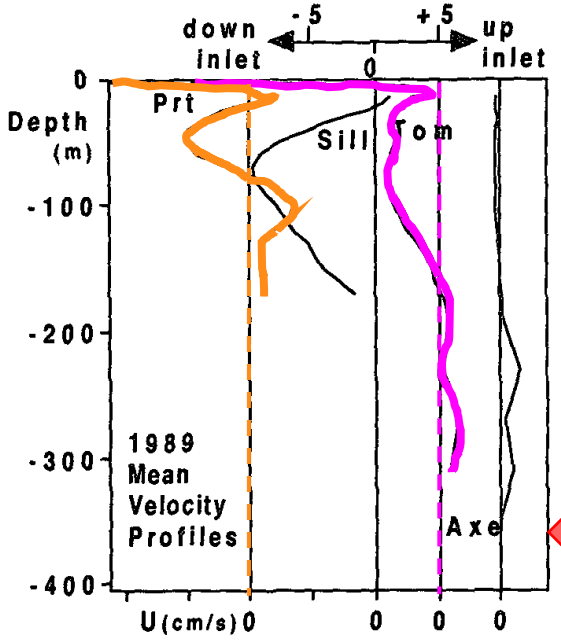


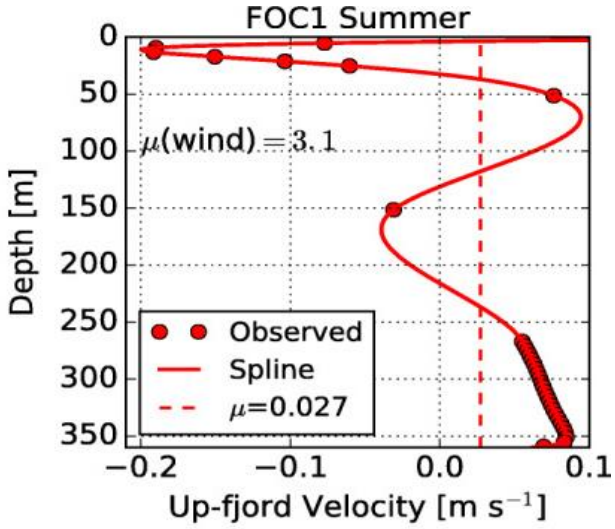

**Mean Along-Inlet Velocities (cm/s)**

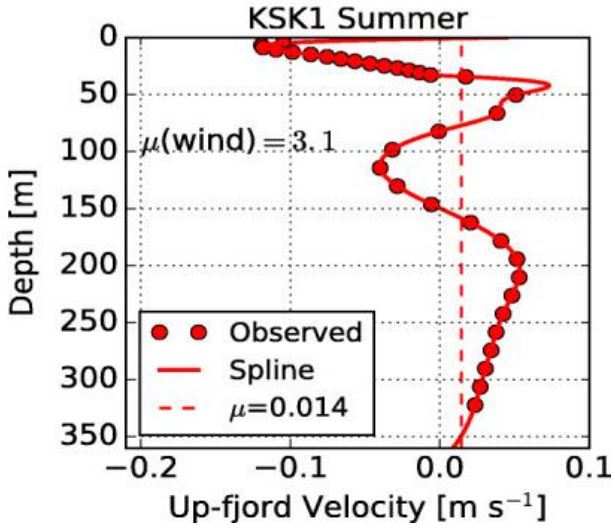
1-month dataset in summer 1989

## Douglas Channel

Wan et al., JGR:Oceans (2017)


**Mean Summer 2015 Along-Fjord Velocity (m/s)**



# Thank you!

Laura.Bianucci@dfo-mpo.gc.ca

# Summary and Future Work

- **In the model, Bute Inlet shows a 4-layered flow in summer, consistent with studies in other BC fjords**
  - The transition between layers (mean along-inlet velocity ≈ 0) is stable, which allows previously entrained waters (low T, high $O_2$) to remain at the entrainment depth
- **In contrast, Toba Inlet does not show the same clear layering underneath the surface estuarine circulation**
  - This is consistent with the low $O_2$ feature being more spread out in the water column
- **Lots of work to do!**
  - Topography and initial conditions need to be improved. Also, river temperature/discharge.
  - Run biogeochemical model once hydrodynamic model is improved. Run longer simulations.
  - Can we explain the observed $O_2$ differences between Toba and Bute?