

Enhancing NOS Cook Inlet Alaska ocean models for resource management

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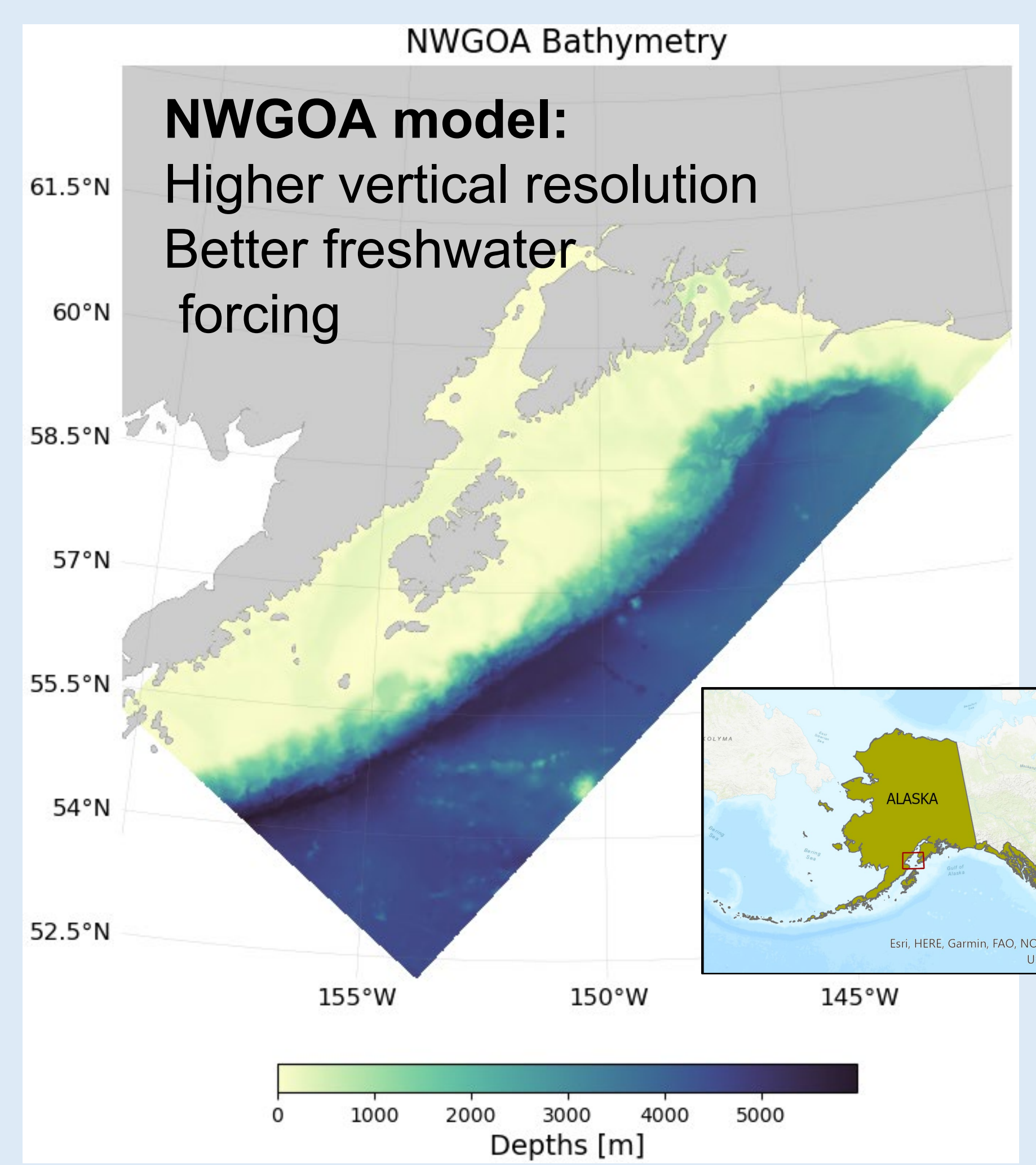
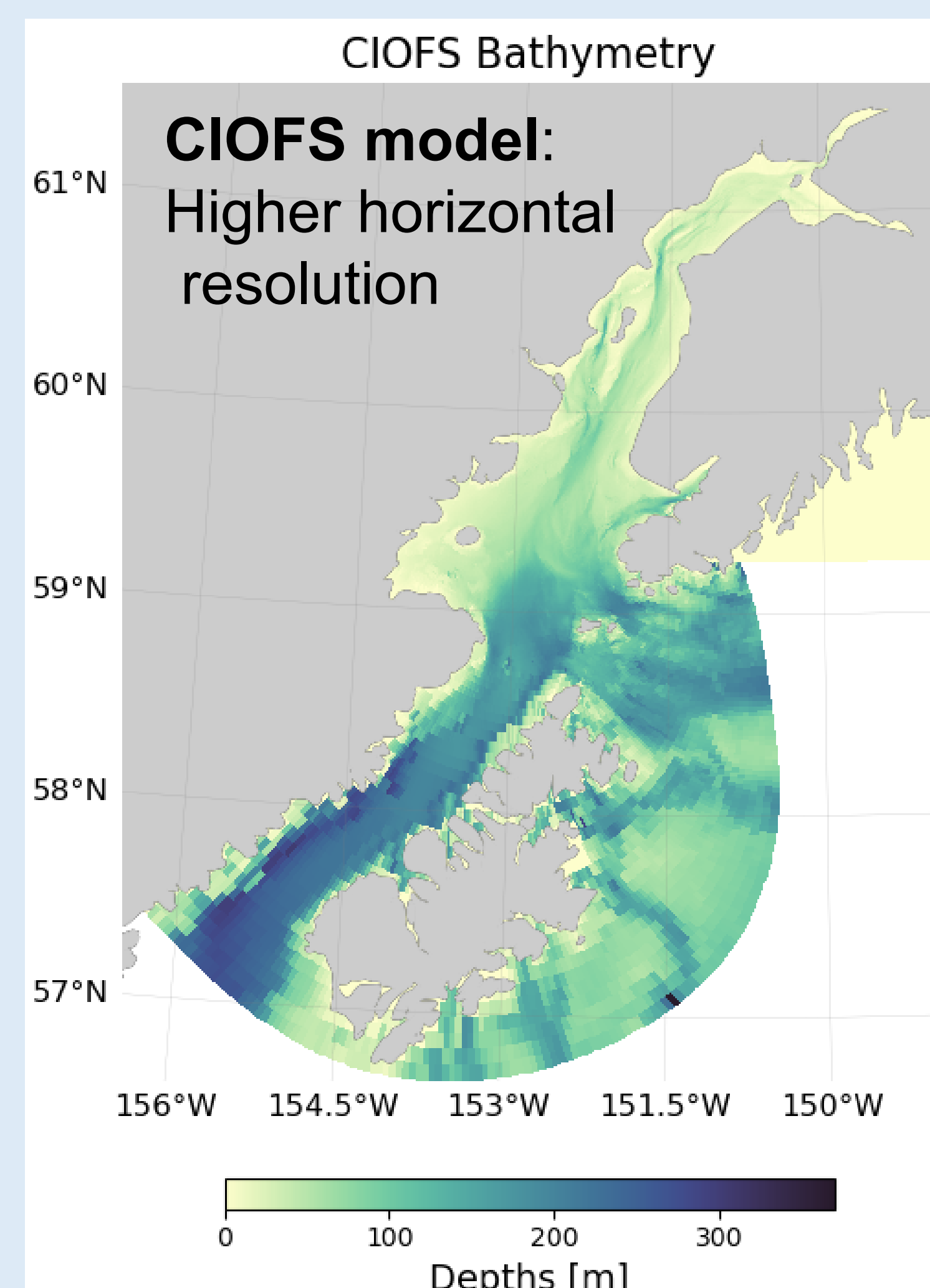


Coastal ocean conditions and water currents affect the distributions, reproduction and survival of marine species, and better ocean habitat information is needed on multiple time scales for climate informed marine resource management in the Gulf of Alaska. Cook Inlet Alaska waters are strongly influenced by changing freshwater input, estuary-shelf water exchanges and extreme tides. High-spatial resolution ocean information is needed to assess marine condition response to sub-seasonal, seasonal and longer-term climate variations, including marine heat waves. To evaluate use of the operational NOS Cook Inlet ocean model for resource management applications, a 24-year model hindcast product was developed, compared to a second Cook Inlet model and evaluated with ocean observing data. The results showed some limited accuracy in model representation of water column structure, especially in surface layers. Next steps are to investigate whether more realistic freshwater forcing improves model performance.

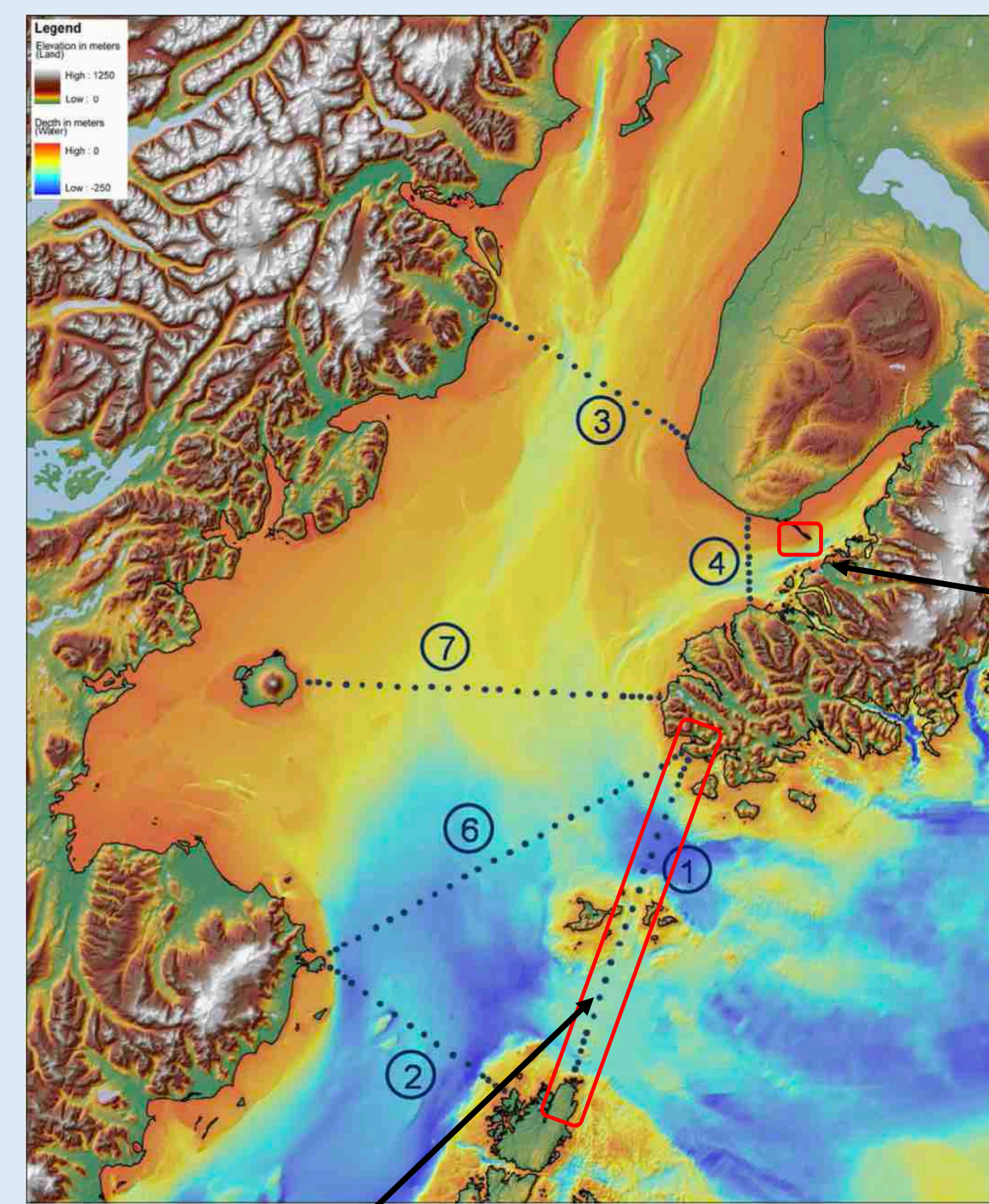
Methods

Developed 24-year hourly 3-D Cook Inlet model hindcast, using NOS ROMS model configuration and forcing. Compared results to hindcast from second regional ROMS model and ocean observing data

- NOAA Cook Inlet Operational Forecast System (CIOFS) model hindcast (1999-2022). 10m to 3.5km horizontal grid. 30 vertical levels.
- Univ. of Alaska Fairbanks NW Gulf of Alaska (NWGOA) model 10 yr hindcast (1999-2008). ~1.5km horizontal grid. 50 vertical levels.



Data



Model-to-model and model-to-data comparisons were made with ocean observing datasets and long-term time-series from:

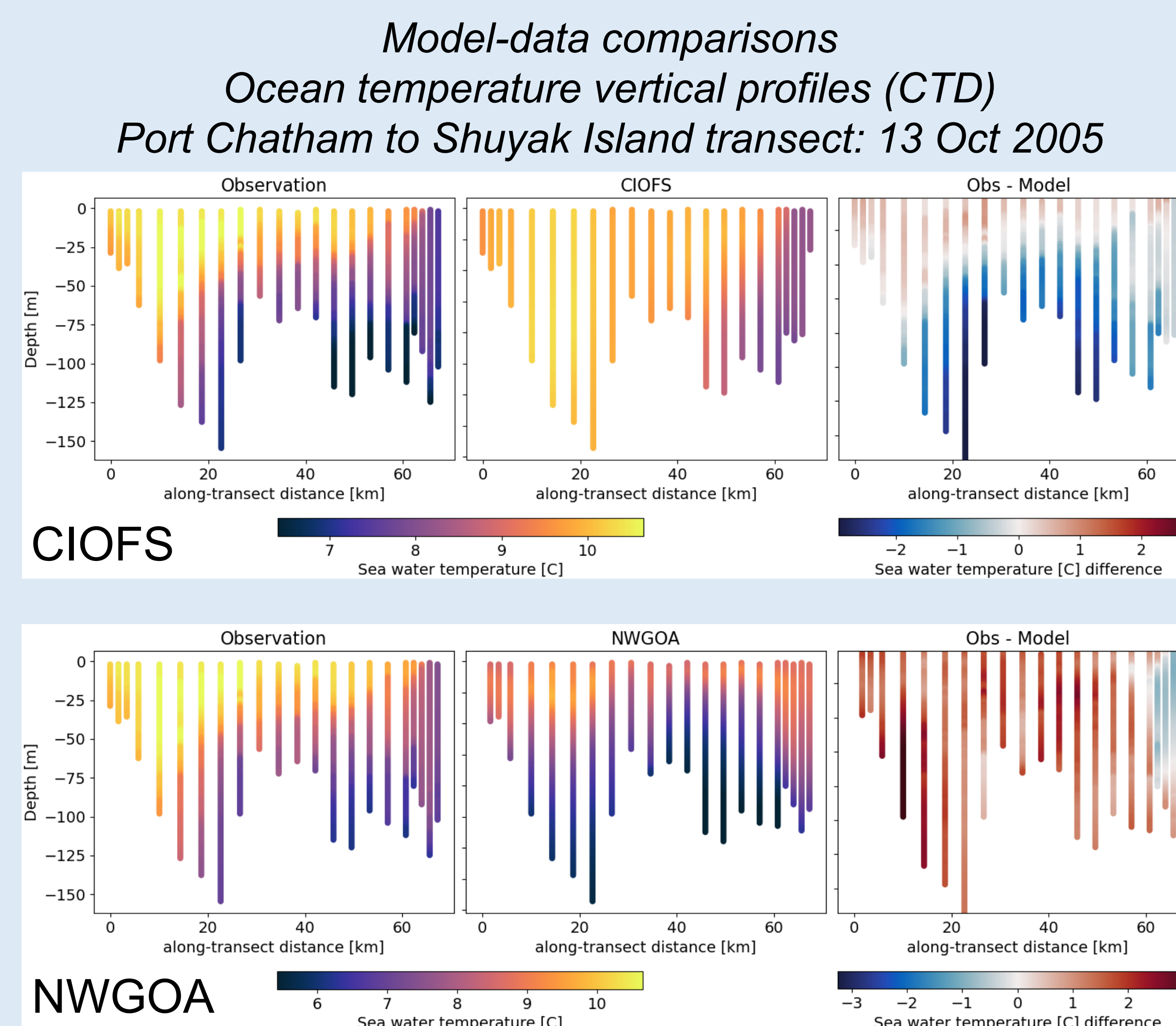
- conductivity-temperature vs depth (CTD) profiler, current meter mooring, HF radar, water quality station, ADCP current meter transect

Dataset locations are marked by red boxes on the Cook Inlet map, for the results shown below from CTD boat surveys and Kachemak Bay water quality station data. Bathymetry is colored with deeper areas in blue.

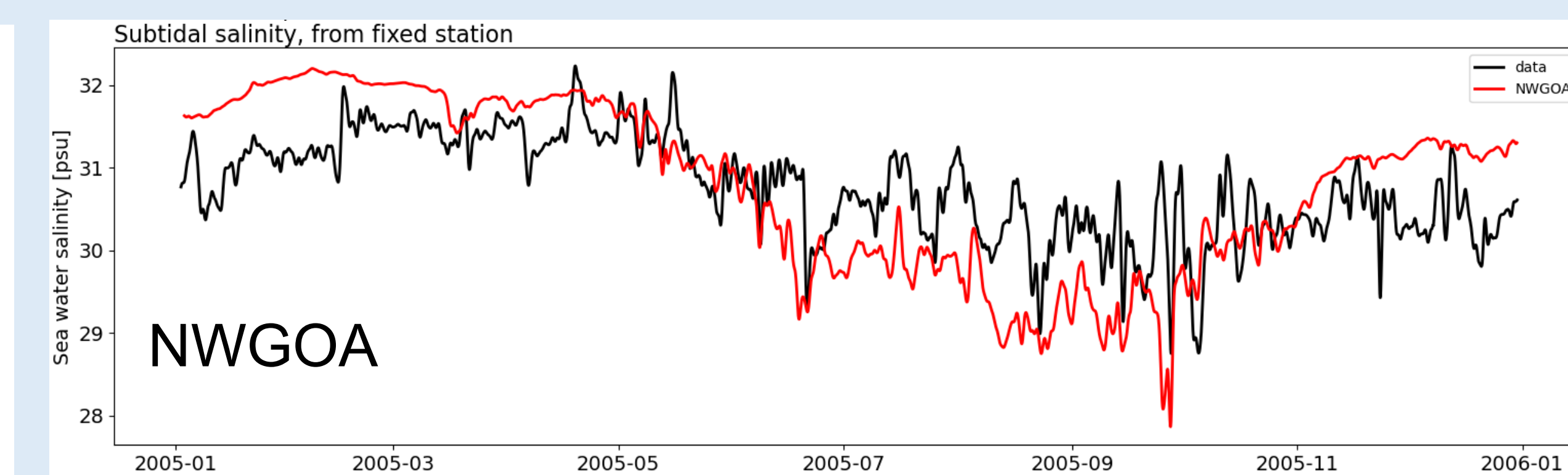
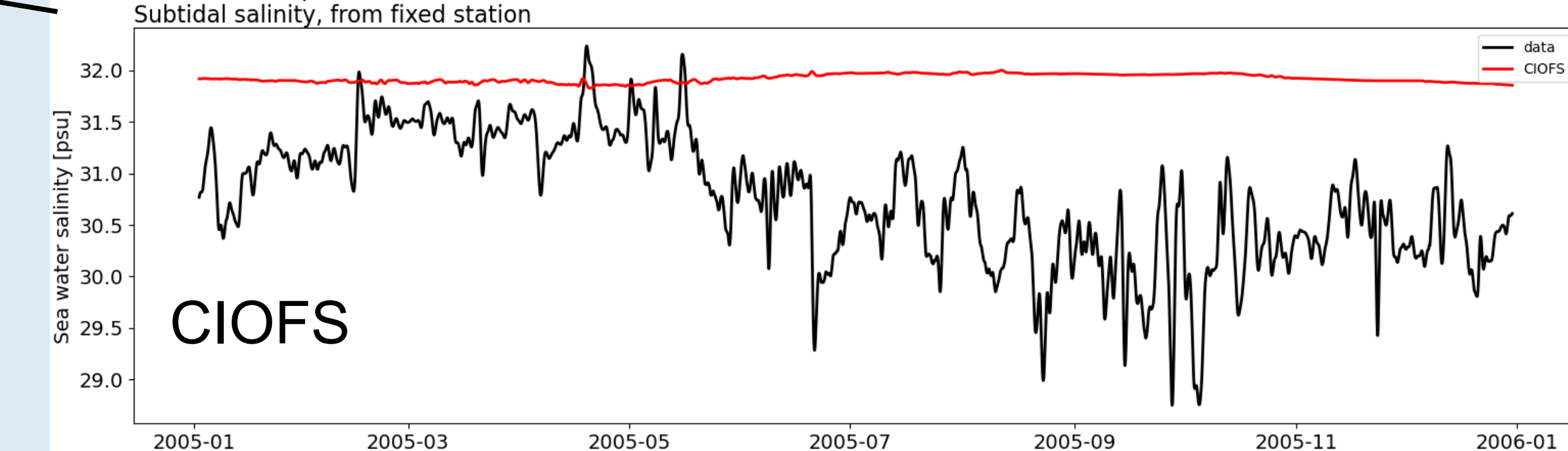
Results

Also see model evaluation report (Thyng et al, 2023).

Temperature: Both models have reasonable seasonal temperature patterns, with spatial differences in accuracy. CIOFS model captured cross-estuary horizontal variation better; NWGOA model better represented vertical variations, consistent with respective model grid resolutions. Example below from Cook Inlet entrance transect.

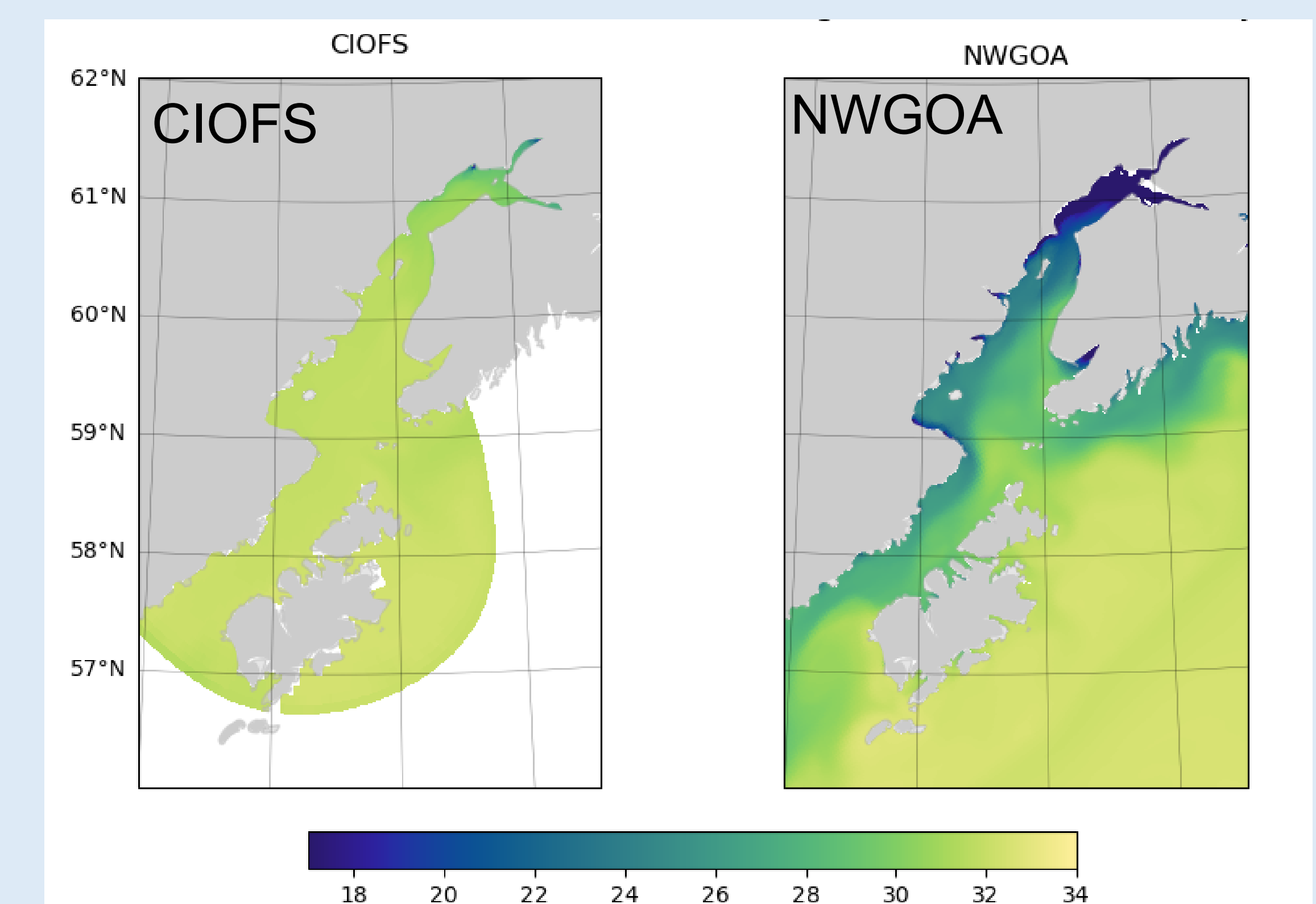


Near-bottom salinity at Homer harbor water quality station: 2005
Model values in red, observations in black



Salinity: CIOFS model is saltier in surface layers and less variable in time than both observations and the NWGOA model, reflecting more limited freshwater forcing inputs in the CIOFS model parameterization.

Modeled surface salinity: August 2006



Next Steps

Test an alternate, watershed runoff-based, freshwater forcing for CIOFS, with initial hindcast product and evaluation report expected in fall 2024. We have ongoing collaborations to develop Cook Inlet ocean model tools for resource management and oil spill response planning with regional partners (Alaska Ocean Observing System, Oil Spill Recovery Institute, Cook Inlet Regional Citizens Advisory Council) and with other NOAA offices (CO-OPS, IOOS, ORR, NWS) under the NOAA Climate, Ecosystem & Fisheries Initiative (CEFI). For more information: Kris.Holderied@noaa.gov

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Thyng, K. M., C. Liu, M. Feen, E. L. Dobbins, 2023. Cook Inlet Circulation Modeling, Final Report to Oil Spill Recovery Institute, Axiom Data Science, Anchorage, AK.



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