Observing the marine carbonate system in Alaska's southeast region to detect ocean acidification

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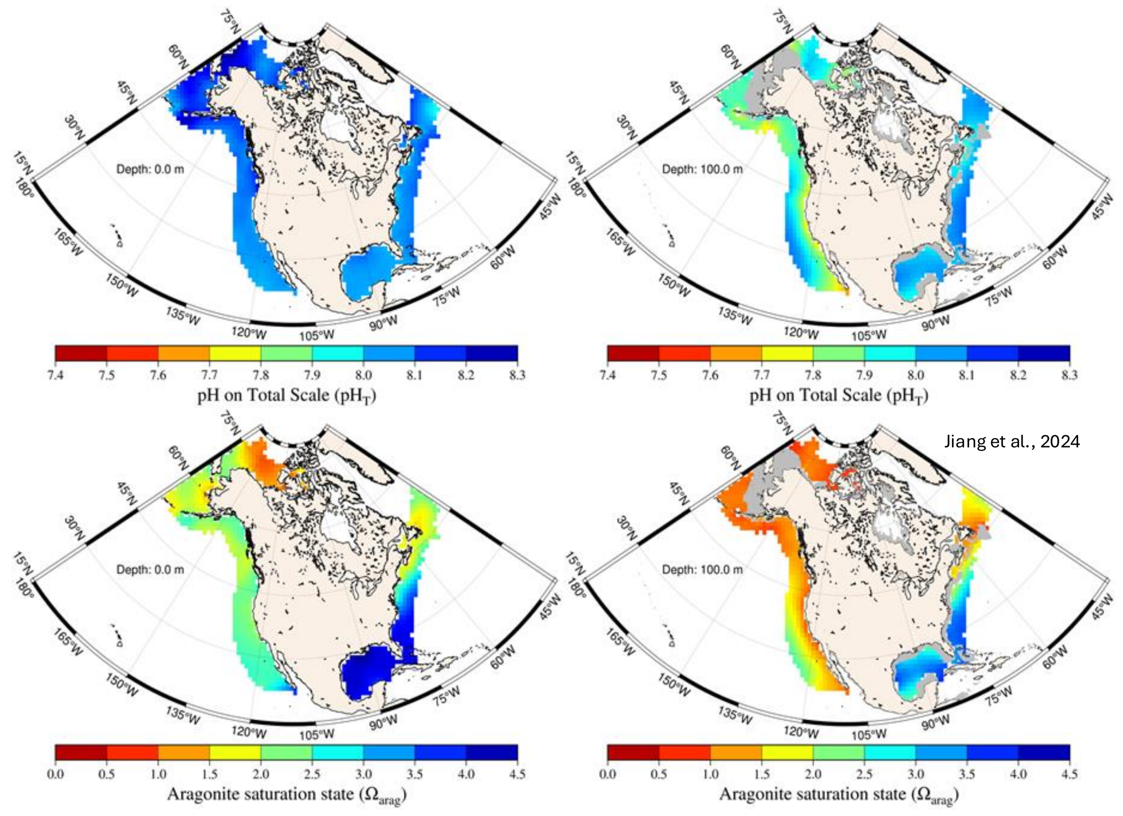
Alaska is vulnerable to ocean acidification

The global oceans are absorbing 30% of excess carbon dioxide from the atmosphere, decreasing seawater pH. The resulting ocean acidification is amplified in Alaskan waters due to natural, physical processes. The current global average surface ocean pH is 8.1 and naturally decreases with depth.



Aragonite saturation state (Ω_{arag}) measures the carbonate ion availability for marine species to build carbonate shells. Ω_{arag} is driven by temperature, with Alaska waters having naturally lower values.

NOAA OCEAN ACIDIFICATION PROGRAM

Alaska Ocean Observing System

NATIONAL PARK SERVICE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

College of Fisheries and Ocean Sciences

UNIVERSITY OF ALASKA FAIRBANKS

OARC
Ocean Acidification Research Center

ALASKA OCEAN ACIDIFICATION NETWORK
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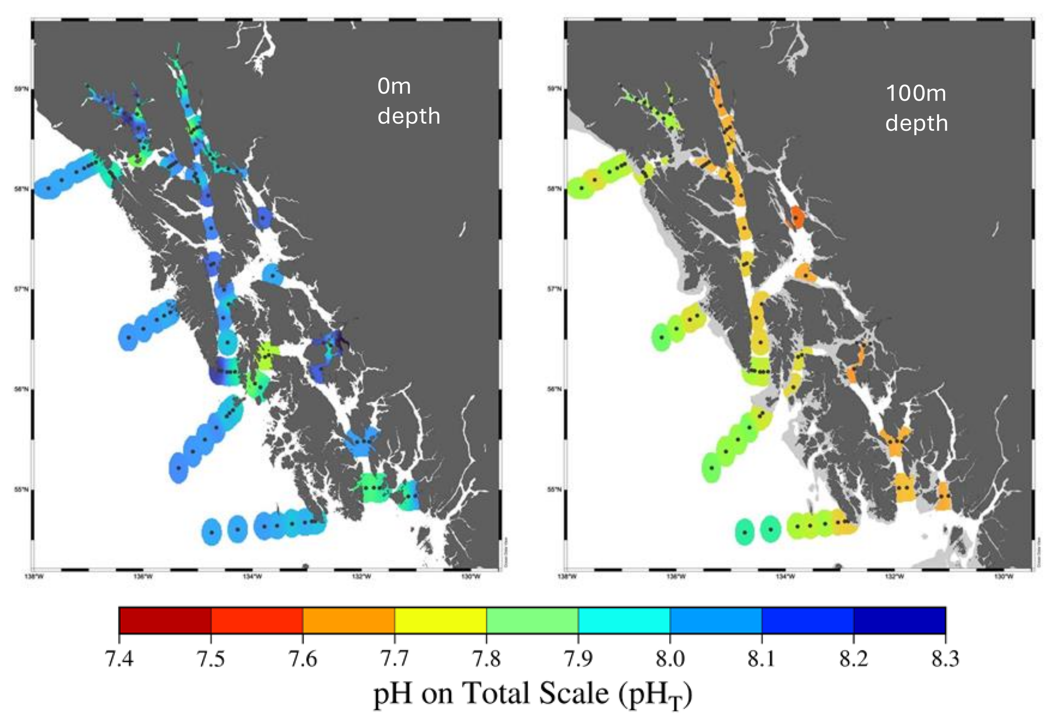
Surveying Lingít Aaní in 2022

NOAA and UAF led a survey in August 2022 on the R/V Rachel Carson. Results show large variability and carbonate conditions harmful to some marine species, particularly at depth and Inside waters.



pH

8.1
global surface pH

7.8
negative growth, juvenile red king crab

7.7
dungeness crab sensitivity

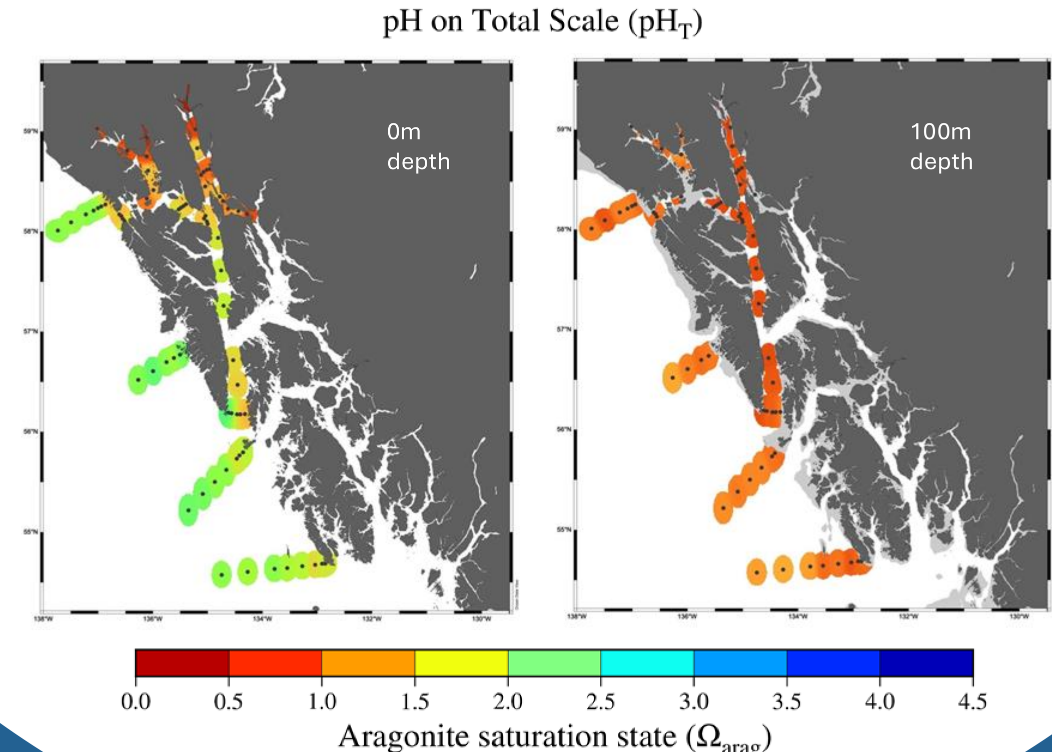
7.5
mortality of juvenile red king crab

Ω_{arag}

< 2
stress on some species

<1
undersaturation

< 0.5
severe dissolution possible



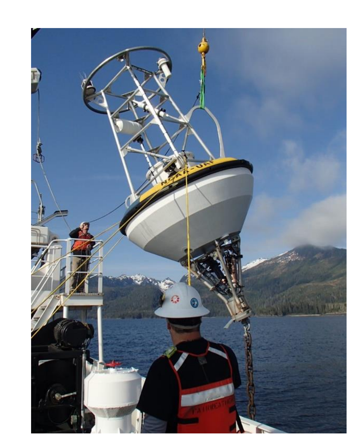
Monitoring for ecosystem and cultural health

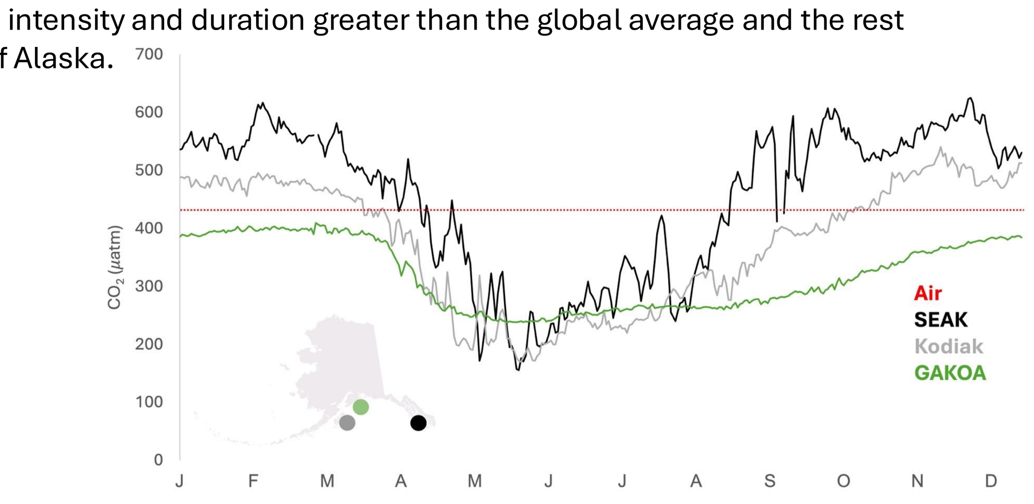
Ocean acidification is one component of ecosystem response to climate change. Community monitoring programs provide information for decision makers assessing risk, preparing adaptation plans, and continuing resiliency.

The goal of Indigenous-led monitoring programs is to provide information for Tribal leaders developing ocean acidification and climate change adaptation plans for their communities. Southeast Alaska Tribal Ocean Research (SEATOR) members recognize the importance of reacting proactively to ocean acidification to reduce impacts to traditional food sources and cultural practices.

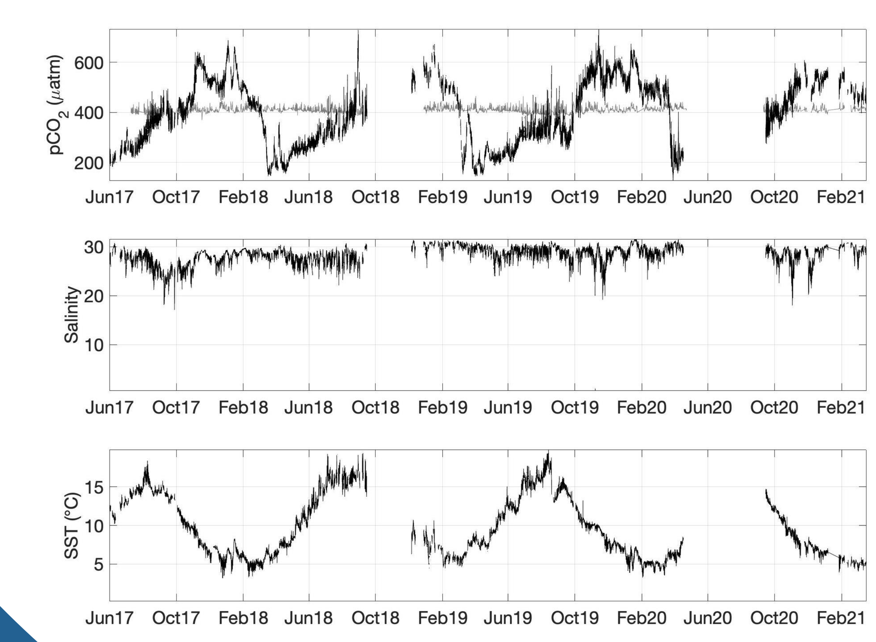
Detecting a long-term trend

Surface seawater carbon dioxide in the coastal regions of the Gulf of Alaska show a clear seasonal signal. Values decrease during high summer productivity and rebound during the winter. On average, Lingít Aaní experiences ocean acidification intensity and duration greater than the global average and the rest of the Gulf of Alaska.





Sitka Tribe of Alaska (STA) currently leads the only continuous observations of surface seawater carbon dioxide in the region. The coastal signal is driven by tidal mixing, net community production, and the magnitude of freshwater input. In general, coastal observations have higher annual and seasonal variability, requiring long records to detect the long-term trend of change.

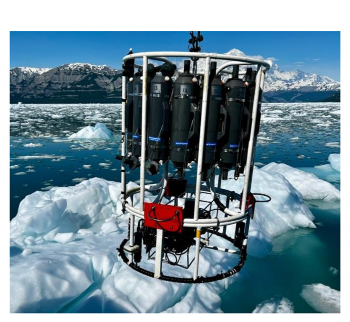


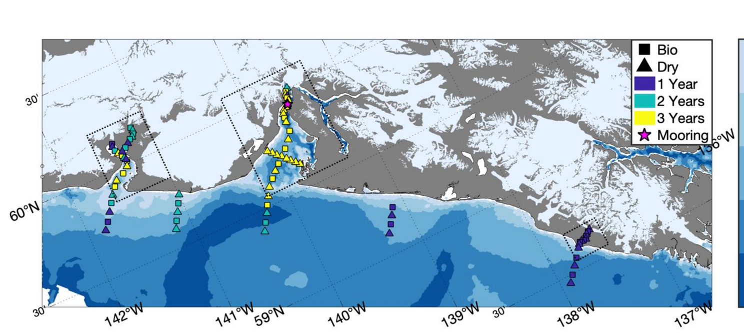
SHEET'KÁ KWÁAN
SITKA TRIBE OF ALASKA

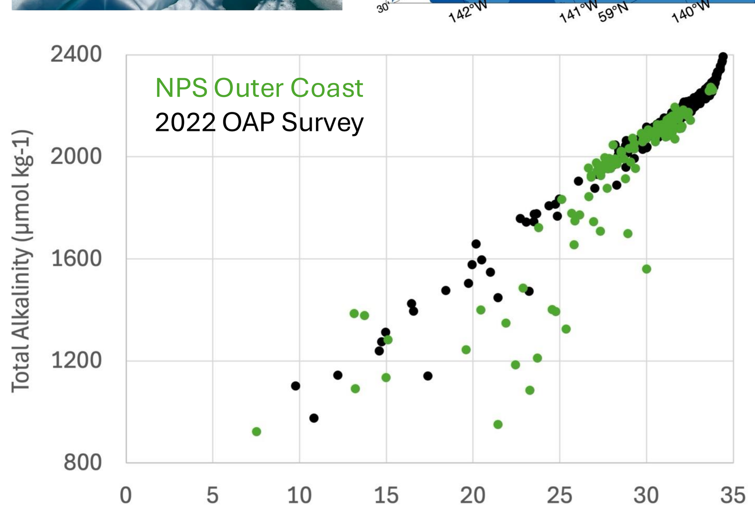
Hakai
Science on the Coastal Margin

Glacial melt and freshwater influences

The NPS Outer Coast program combines marine carbonate observations with key environmental parameters to understand how changing oceanographic conditions may impact lower (zooplankton) and higher (marine mammals and birds) trophic levels in the fjords of the outer coastal region between Wrangell - St. Elias and Glacier Bay National Parks and Preserves.







Biophysical drivers are shown to dominate the marine carbonate system in the region, except in areas highly influenced by glacial melt.

Glacial meltwater is low in total alkalinity and reduces the buffering capacity of seawater to drastic changes in pH.

We are merging the regional data, including the current NPS Outer Coast program monitoring in Lituya Bay, Disenchantment Bay, and Icy Bay (2022 to present), with the NPS Glacier Bay program (2010-2016) and the 2022 NOAA OAP survey.

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1824

Plan for the future

The SEATOR consortium and University of Alaska Southeast (UAS) collaborate to incorporate the community observations with other data sources to produce detailed maps of year-round coastal carbon chemistry. Marine ecosystems are experiencing multiple stressors, including increasing temperatures, acidification, and harmful algal blooms. New maps will enhance existing Tribal wild shellfish management by informing harmful algal bloom and shellfish toxin prediction, while highlighting areas of long-term acidification risk to marine species.

The University of Alaska Fairbanks (UAF) Ocean Acidification Research Center (OARC) continues to work with all partners monitoring ocean chemistry in Lingít Aaní. The primary goals are to observe the intensity, duration, and extent of ocean acidification; inform biogeochemical products such as acidification rates and models; identify ranges for setting species vulnerability experiments researching the response to current and future ocean conditions; and provide analytical and data services.

Contact for information and updates. **oarc@uaf.edu** **uaf.edu/cfos/oarc** **uaf-oarc-alaska.bsky.social**

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