



# OCEAN ACIDIFICATION

CLIMATE THRESHOLDS WEBINAR

NOV 10, 2016

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**Alaska Ocean  
Acidification Network**

# Resources at risk from OA

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- Fish and shellfish species
- Their prey- Zooplankton
- And shelter (corals)



# What are the thresholds for Ocean Acidification?

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–pH (not always a reliable indicator)

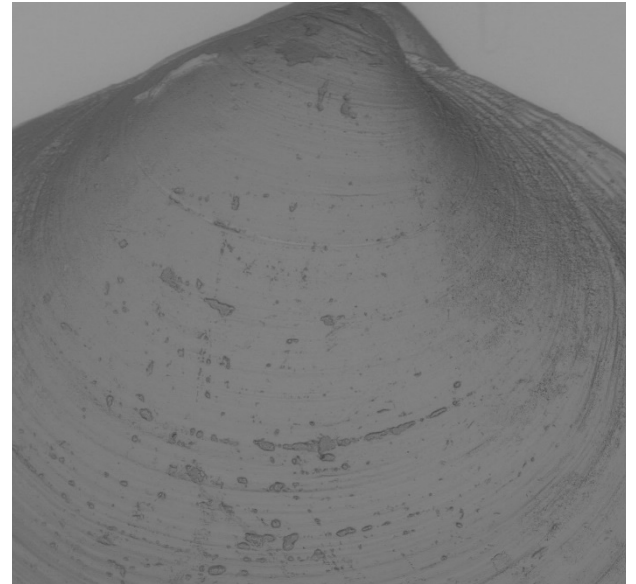
pCO<sub>2</sub>

**Aragonite saturation state:** amount of free

calcium carbonate in the water column

- $\Omega < 1$  or  $\Omega > 1$ ?
- *Researchers learning this does not always hold true*

→ Better metric: Departure from natural range of variability



# Challenges using OA thresholds

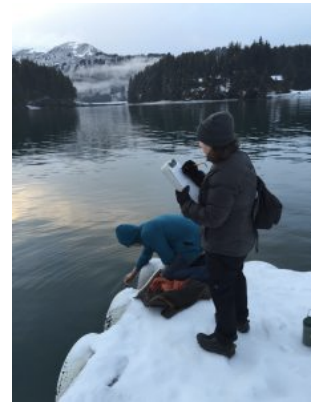
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## **Aragonite saturation has a high range of natural variability**

- Seasonality
- Local drivers (i.e. freshwater run-off, sea ice melt, wind-driven upwelling, primary production)
- Positive or negative feedback cycles

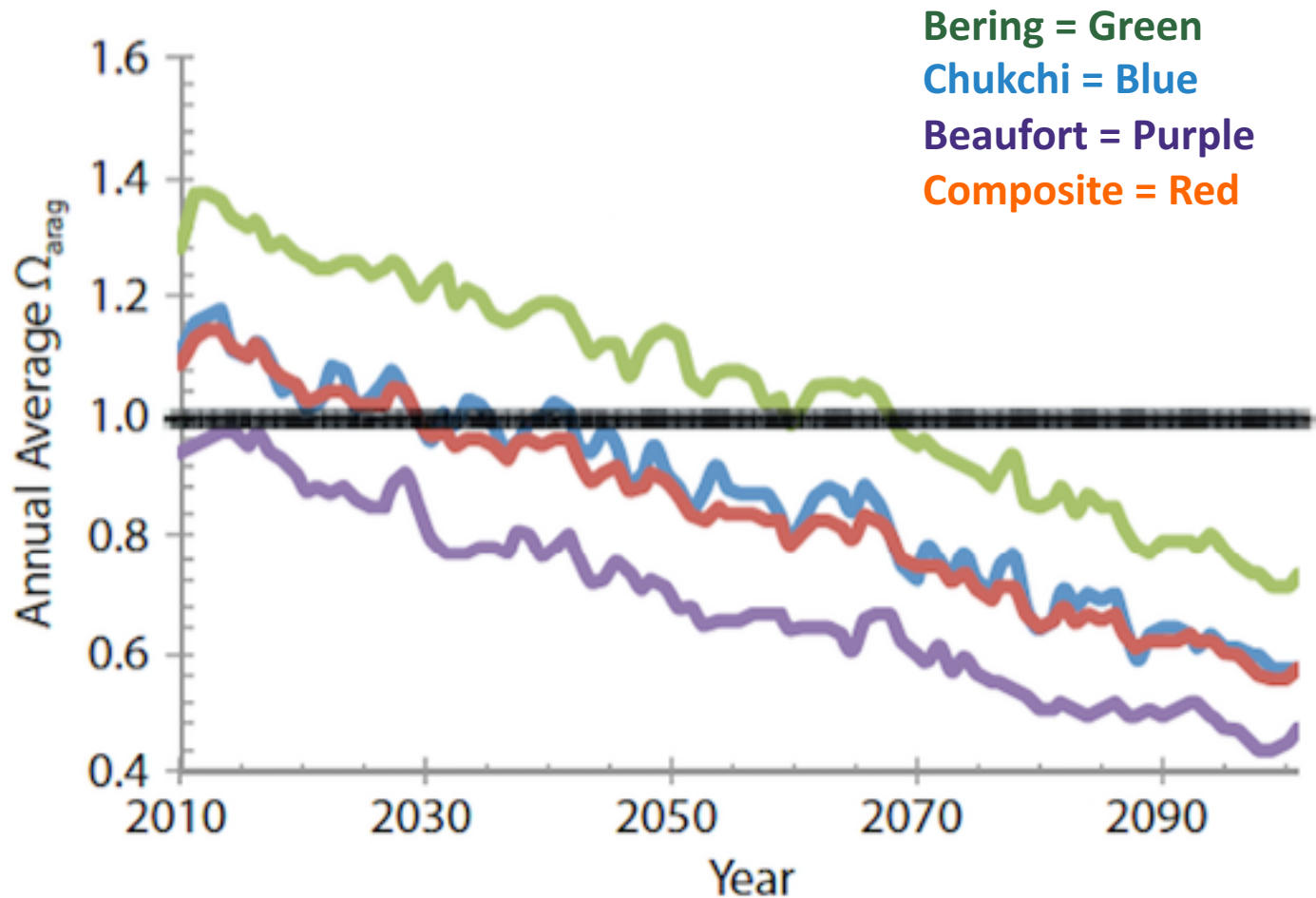
## Species are affected by cumulative impacts

- May still have tough time above OA threshold if also hit by other climate related stressors, like warming ocean



Most forecasts are based on models with limited data, but are a good effort towards this threshold product goal

Sample Product:  
Model projection of aragonite  
saturation temporal trends

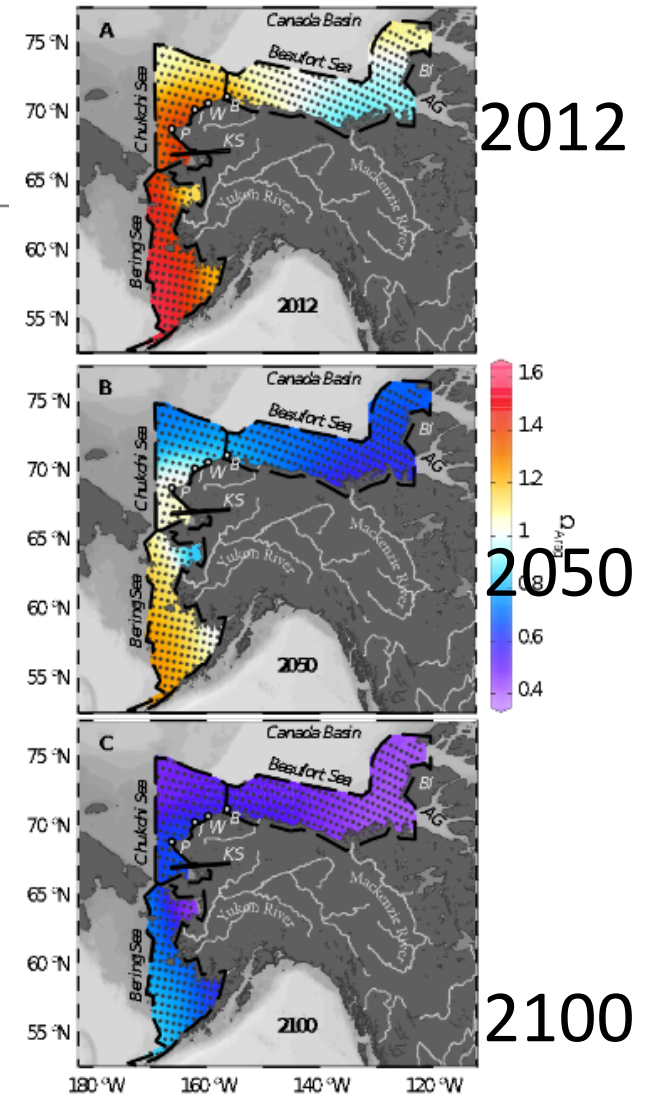


# Sample Product

Model-projections of spatial aragonite saturation state for three periods:

Yellow to Reds > threshold  
(GOOD)

Blues to Purples < threshold  
(BAD)



# Possible Tools

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## **OA Variability assessments by Regions:**

Identify physical, biological and chemical drivers

OA Index for the state by region

- i.e. Aragonite saturation scaled with salinity
- Could be generated for regions with historical data to provide a proxy measure.

Identify indicator species in locations where OA measurements are being made and add these to the sample parameter list (i.e. good example is work done with pteropod shell state conditions relative to aragonite saturation state of resident waters)

# Long-term observing efforts are required for developing reliable tools

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## Long-Term Observing Efforts In Alaska

Burke-O-Lators in near shore: Seward, Ketchikan, soon Sitka

Seward Line transect: 2x/year since 2008 (8 years)

Moorings: 1 each in Bering Sea, Gulf, and Chukchi

Glider transects: Gulf and Chukchi

Quarterly water sampling: Lower Cook Inlet/Kachemak Bay NERRS

Planned 2017:

- Sitka: Mooring and regional water sampling
- Repeat twice weekly OA transect from WA to AK onboard passenger ferry
- *In situ* pH sensors- SeaFETS to track near-shore variability



# Biological impacts of Ocean Acidification

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Use *in situ* measurements to frame OA experiments- include variability

Use data from these laboratory experiments to:

- provide “ecologically relevant” bio data
- identify “biological thresholds”
- inform resource managers

# Alaska OA Network

The screenshot shows the homepage of the Alaska Ocean Acidification Network. At the top left is the logo, a blue crab. To its right is the title "Alaska Ocean Acidification Network". Below the title is a navigation bar with links: "About the Network", "About OA", "Monitoring", "Biological Impacts", "Data", and "Resources & Links". There are also social media icons for YouTube, Facebook, and Twitter.

The main content area is titled "Alaska Ocean Acidification Network" and features a large image of a coastal landscape with mountains and a boat. Below the image is a "Welcome to the network" section with the text: "Alaska joins other regions nationwide in launching an OA network, designed to expand the understanding of ocean acidification processes and consequences in Alaska, as well as potential adaptation and mitigation actions." There are two small numbered icons below the text.

To the right of the main content is a "Subscribe to list serve" section with an "email address" input field and a "Subscribe" button. Below that is a "News feed" section with the date "AUGUST 1, 2016" and a headline: "Alaska Ocean Acidification Network seeks to inform public of ocean acidity". The text below the headline reads: "Alaska Public Media produced a radio piece on ocean acidification, highlighting Alaska's susceptibility to OA, and the role of the network in responding to changing waters." There is a small image of a person on the right side of the news feed.

Below the news feed is a section for "JULY 18, 2016" with the headline "Save the Date - OA 'State of the Science' Workshop". The text reads: "The Alaska OA Network invites a broad audience to a 2-day workshop Nov 30-Dec 1. Presentations will include an OA primer, current monitoring efforts, biological implications, linkages to fisheries & communities, future forecasts, and OA in the national context." There is a small image of a person on the right side of this section.

Below that is a section for "JULY 12, 2016" with the headline "Ocean acidification affects predator-prey response". The text reads: "Ocean acidification makes it harder for sea snails to escape from their sea star predators, according to a study from the University of California, Davis." There is a small image of a sea star on the right side of this section.

Below that is a section for "JULY 2, 2016" with the headline "Modern mussel shells are thinner than 50 years ago due to ocean acidification". The text reads: "Research conducted by researchers from the University of Chicago show that California mussel shells from the 1970's are 32% thicker. This Science World Report article links the study." There is a small image of mussel shells on the right side of this section.

At the bottom of the main content area is an "Upcoming events" section with a list of events:

- July 19: Healthy Oceans Healthy People: OA and invasive species talk (Ketchikan)
- Aug 9: ACCAP Webinar: "Ocean Acidification in Alaska: current status, monitoring efforts, and potential impacts to marine life"
- Aug 16: OA session at the Alaskan Life Forum (Unalaska) [via!](#)
- Nov 30 - Dec 1: Alaska OA "State of the Science" workshop (Anchorage)

On the left side of the main content area is a "Scientist Interview" section. It features a photo of Jessica Cross and the text: "Meet Jessica Cross, a research scientist at NOAA's Pacific Environmental Lab and an expert on ocean acidification. Jessica took some time to answer questions about her research, what drew her to study ocean acidification, and some memorable moments in her career." Below the photo is a "Q: What element of ocean acidification do you work on, and where?" section with the answer: "A: I work with the Ocean Acidification Research Center, which operates along the whole Alaskan coast. My specialty is in working with new technology and autonomous systems that help collect different kinds of data. When different tools are used together, we can better look at complex questions and build a better understanding of how OA works in Alaska." Below that is another "Q: What findings have you been most surprised about?" section with the answer: "A: There are really intense OA hotspots in Alaska, like just south of St. Lawrence Island. Here, the natural carbon system is extremely vulnerable to OA, and even the little bit of new carbon from OA that has already absorbed there has been enough to turn the waters corrosive, and we've seen evidence that carbonate minerals may already be dissolving. That's fast, and intense, and I think it surprised everyone. But, just east of there, south of Nunivak Island, models suggest that the system may be a very resilient, and may not turn corrosive for a long time. We're still investigating that, but it will be surprising too if the model is right!" Below the answer is a link: "Read the rest of the Interview".

At the bottom of the page is a copyright notice: "© Alaska Ocean Observing System 2016".

This screenshot shows a detailed view of the "Upcoming events" section from the website. It features a table with columns for "Date", "Event Name", "Location", and "More Info". The events listed are:

Date	Event Name	Location	More Info
July 19	Healthy Oceans Healthy People: OA and invasive species talk	Ketchikan	<a href="#">More Info</a>
Aug 9	ACCAP Webinar: "Ocean Acidification in Alaska: current status, monitoring efforts, and potential impacts to marine life"	Virtual	<a href="#">More Info</a>
Aug 16	OA session at the Alaskan Life Forum (Unalaska)	Unalaska	<a href="#">via!</a>
Nov 30 - Dec 1	Alaska OA "State of the Science" workshop	Anchorage	<a href="#">More Info</a>