Lessons for the Arctic: from the Alaska Ocean Observing System

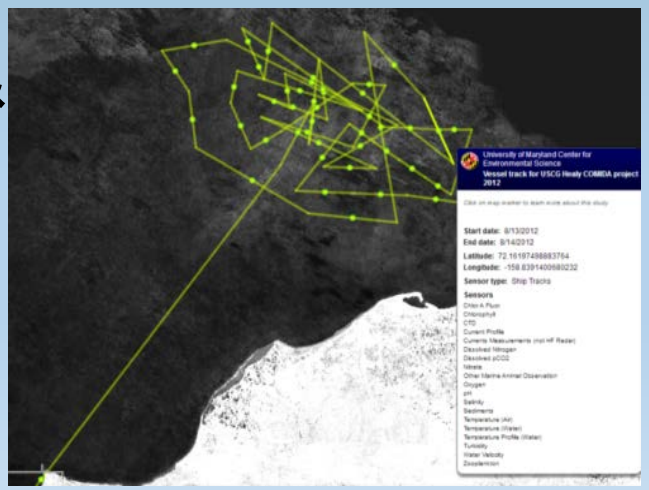
Arctic Observing Summit
Davos, Switzerland
June 25, 2018
Molly McCammon
AOOS Executive Director

AOOS
Alaska Ocean Observing System

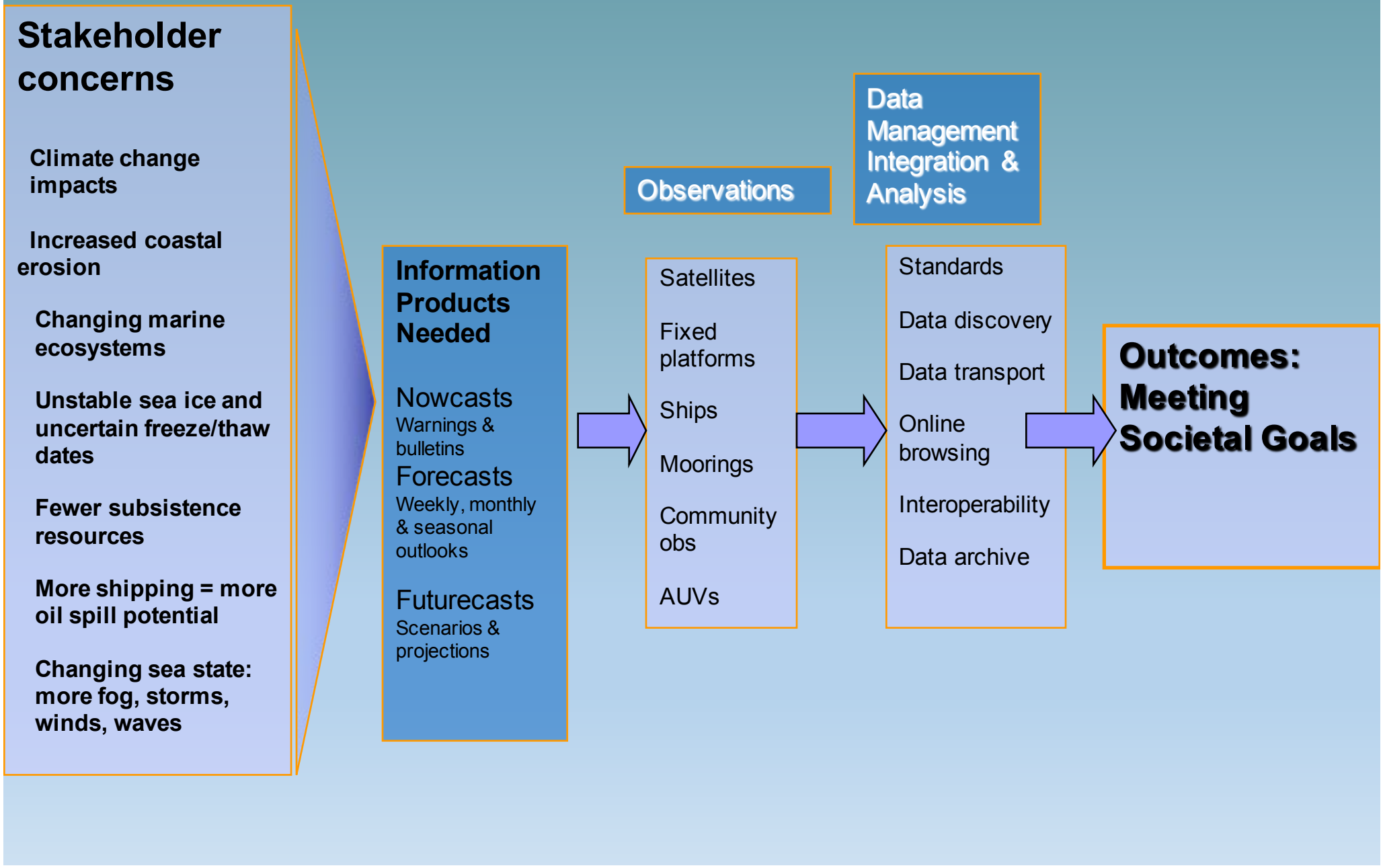
IOOS
Integrated Ocean Observing System

AOOS Mission and Philosophy

- Stakeholder driven, science based
- Identify and fill observing gaps
- Measure once, use many times
- Provide easy access to data
- Develop information products and tools to meet stakeholder needs
- Coordinate private sector, local, state & federal agency efforts



AOOS is User-Driven



Key Stakeholder Needs

Improve Safety of Marine Operations

- Safety at sea
- Search & rescue
- Spill response & prevention
- Offshore energy

Mitigate Coastal Hazards

- Emergency response & coastal erosion
- Sea level rise & flooding

Track Climate & Ecosystem Trends

- Food security: subsistence, recreational & commercial fishing & hunting
- Commercial fishing
- Impacts of climate change

Monitor Water Quality

- Ocean acidification
- Harmful algal blooms & PSP
- Invasive species

Develop Data & Information Products to Support the Above

Making the Business Case for a Pan-Arctic Observing System

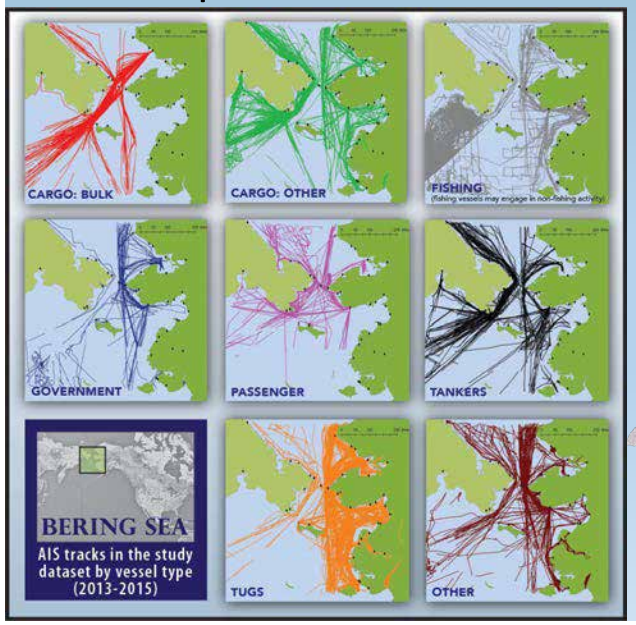
- Starting with stakeholder needs, establish network of sustained platforms with existing & new technologies
- Collaborate with industry & develop partnerships
- Establish prominent role for data management

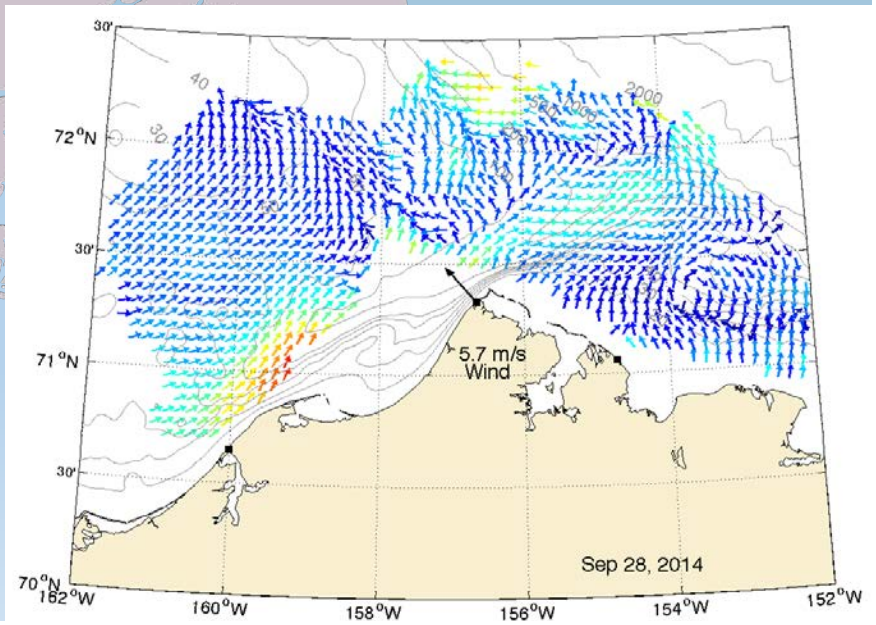
Present & Future Alaska HFR Sites

Chukchi/Beaufort Sites
Wainwright, Point Barrow, Cape Simpson
& Bering Strait in 2019
Funded by AOOS
5 MHz systems

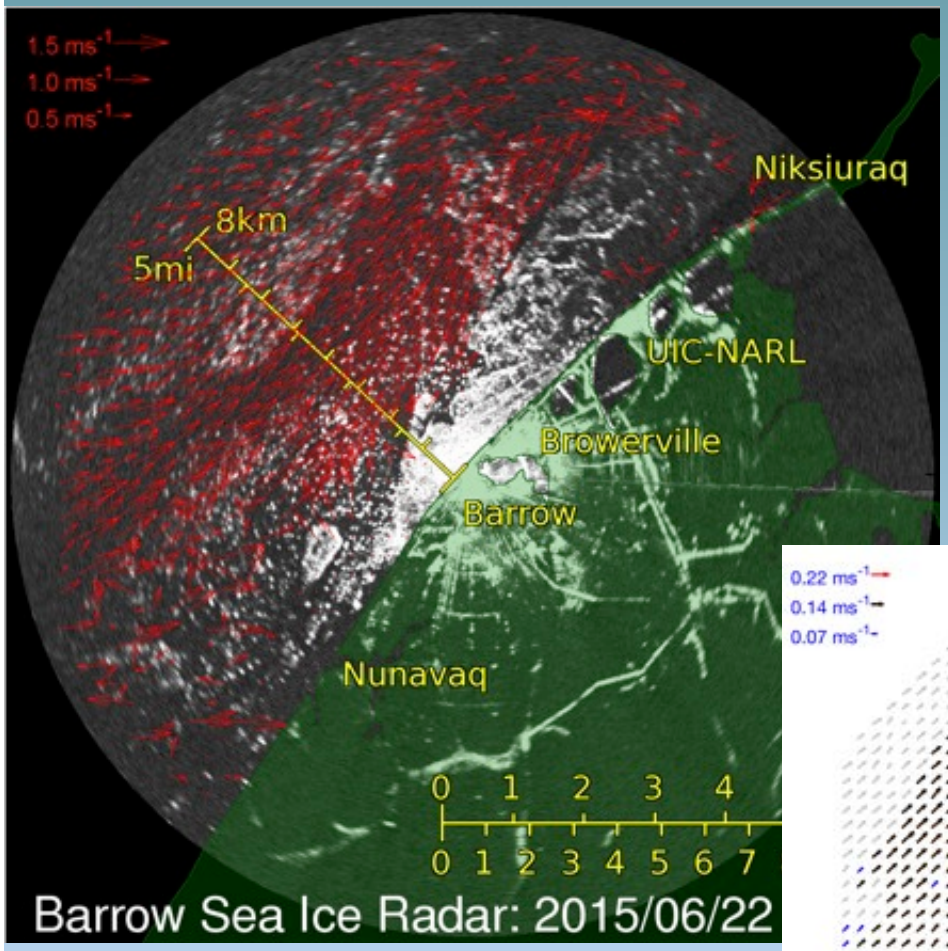
<u>Uses</u>

search & rescue
navigation safety
oil/contaminant spill response
track harmful algal blooms
complement local knowledge

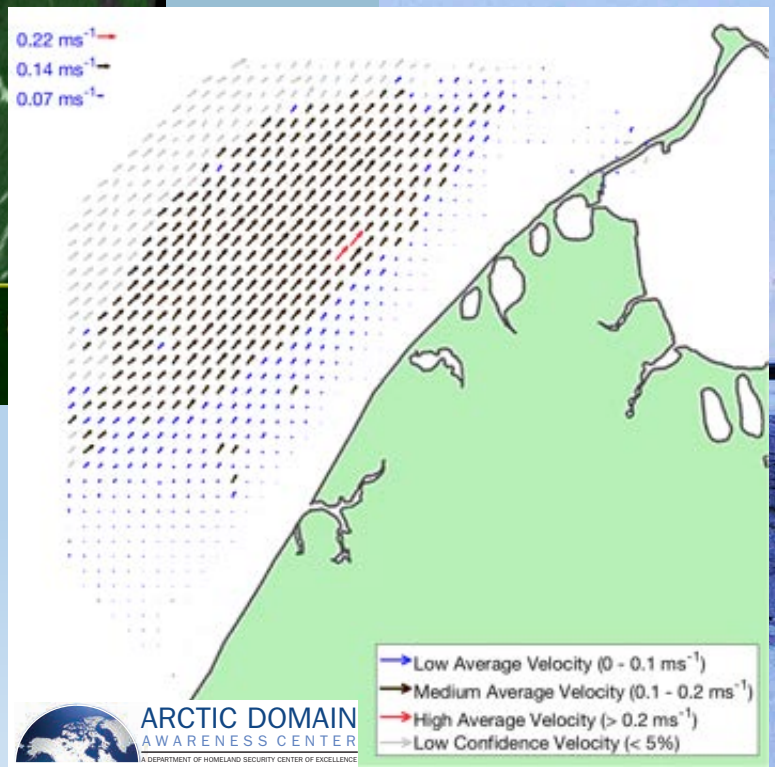




UAF Barrow/Utqiaġvik Sea Ice Radar



Furuno X-band FAR212 25kW, 2.4 m open array 22 m a.s.l.
digital controller,
internet upload



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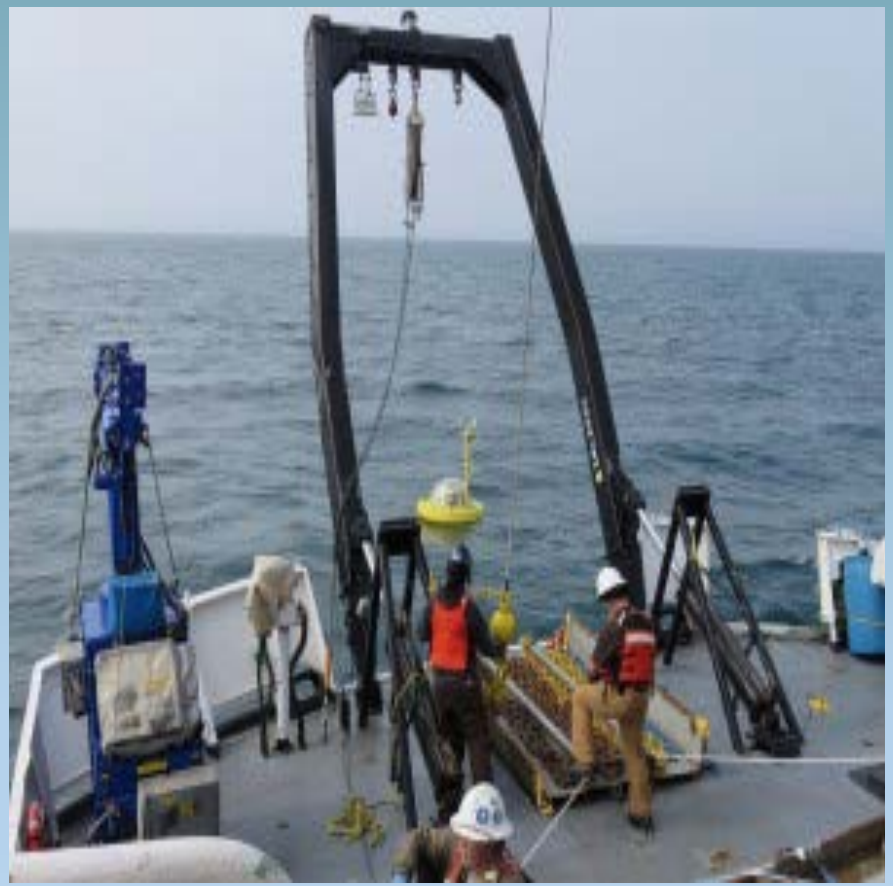
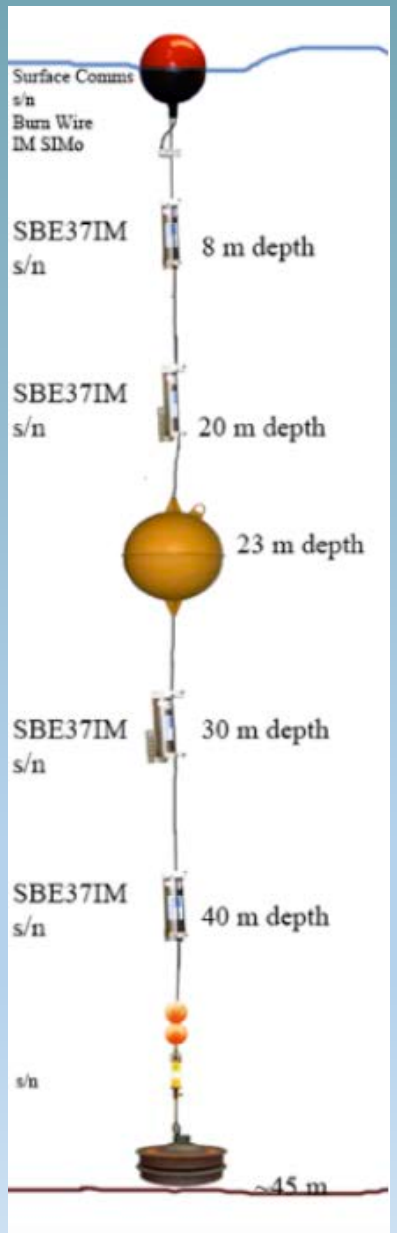
Waves & Weather

- Most real-time data buoys only operate in ice-free regions
- New wave buoy for Port of Nome
- Shore-based weather stations: not necessarily what is happening on water
- Need shore-side logistical support

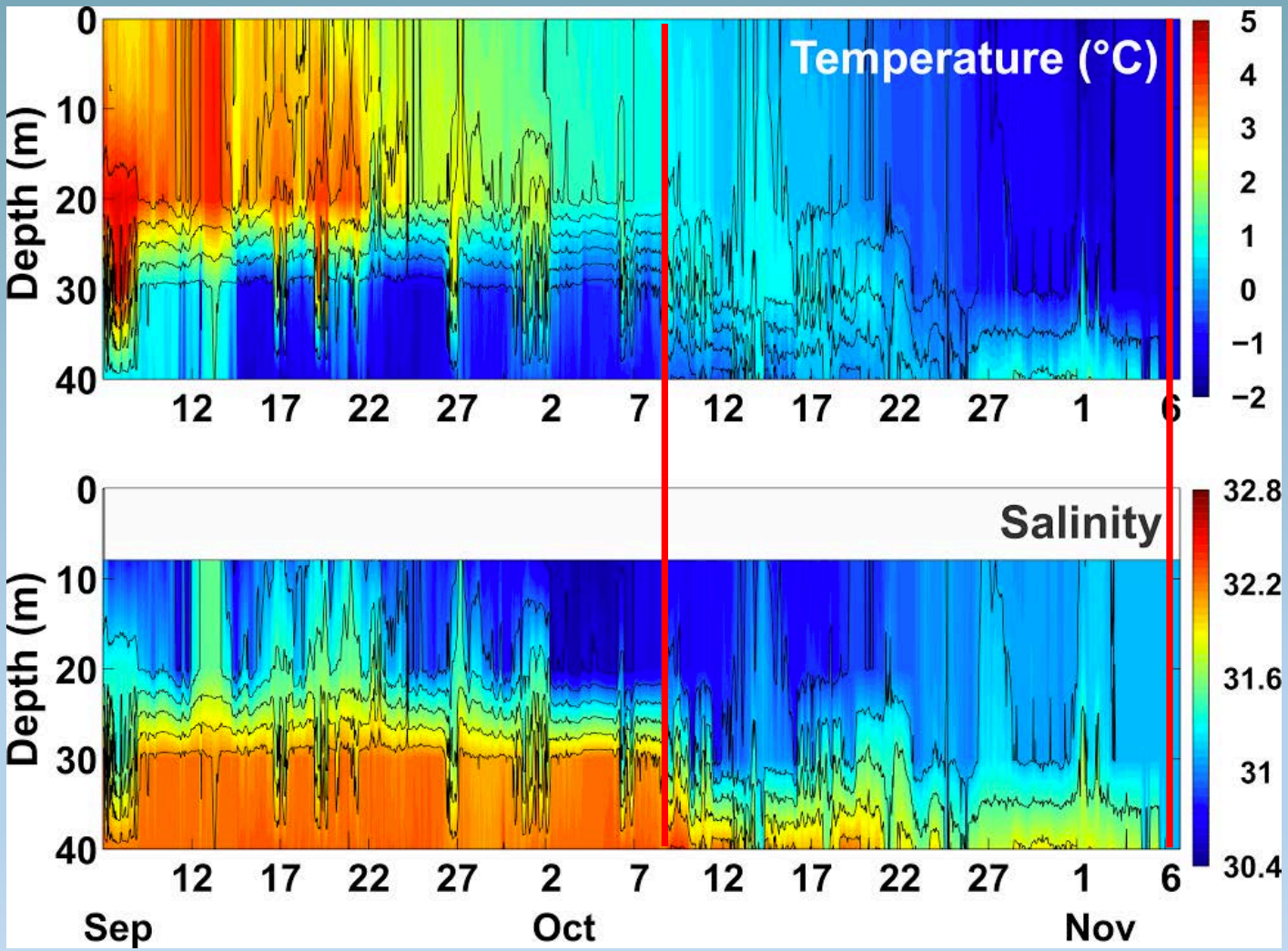


Real-Time Ice Freeze-up Detection Buoy Trials



Typically, would think this overturning was Freeze-up

Time of surface float release & actual time water column well-mixed



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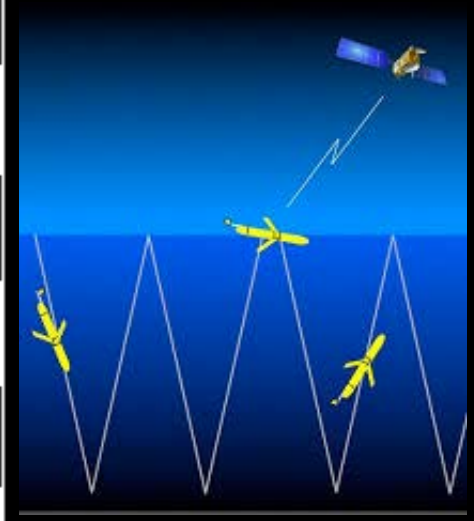
Gliding Through the Bering and Chukchi Seas



Annual Ocean Conditions
Marine Mammal Tracking
Remote Arctic Missions
Since 2013

Scale (km)

25 0 25 50 75 100

Start (07/11/15 20:00)

Last (09/08/15 11:15)

Partners: Baumgartner-WHOI, Stafford UW, Winsor and Statscewich-UAF, NPRB

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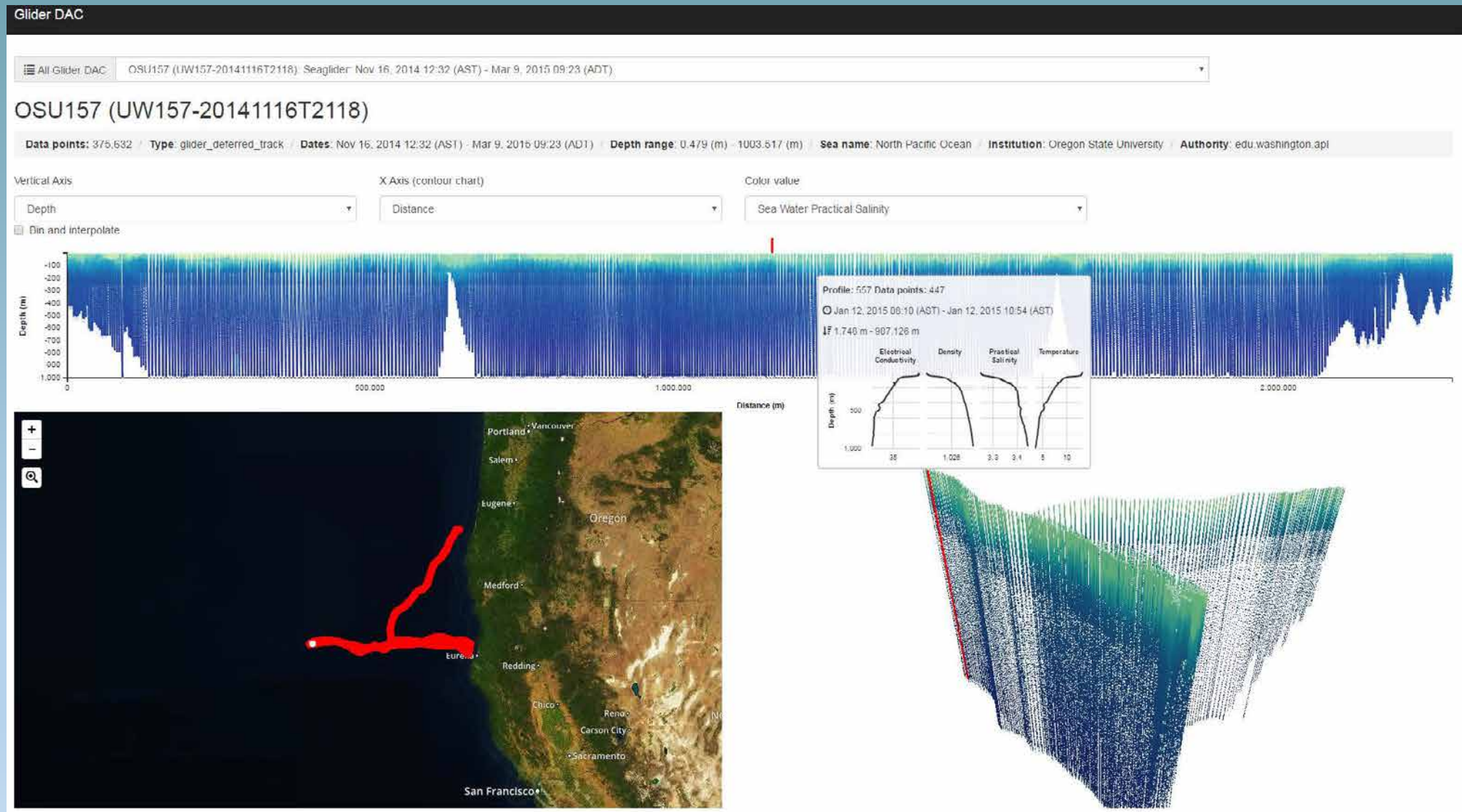
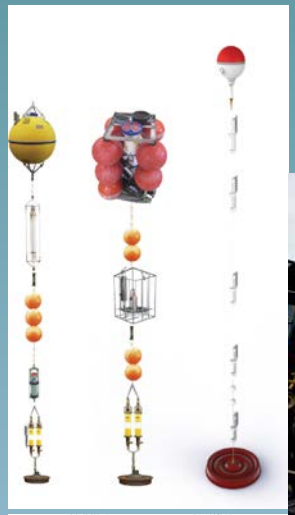
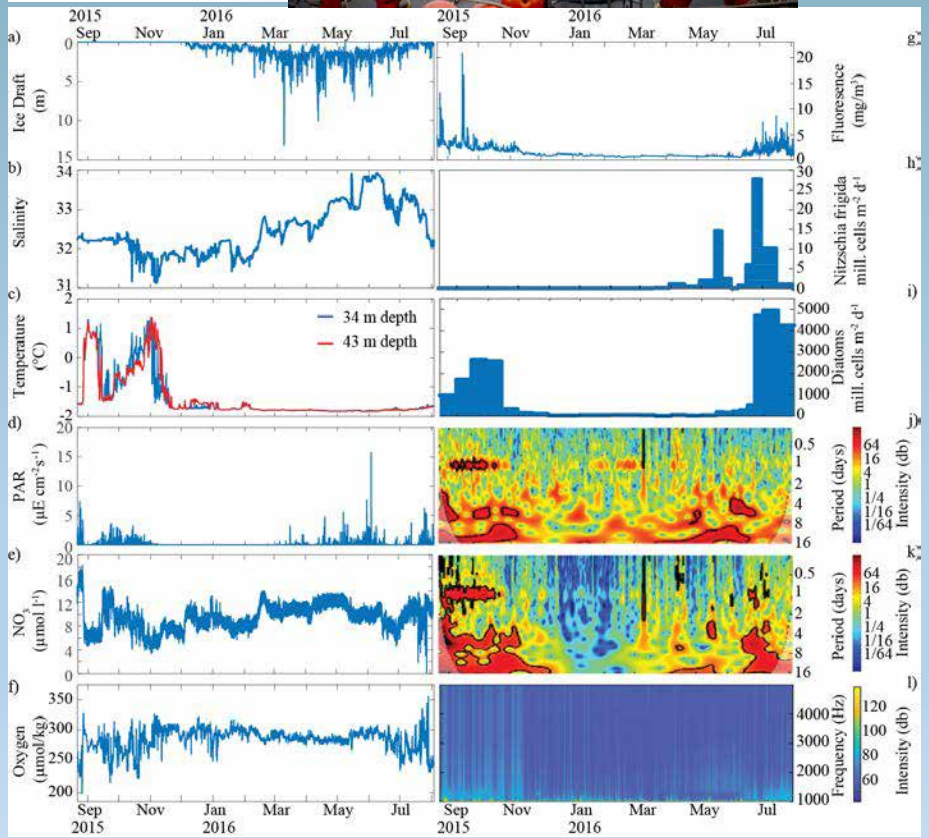
Viewing the Ocean in 4D



Ecosystem Observatories





Partners: Danielson-UAF, NPRB, Murdock-Charitable Trust, and numerous others

- Statewide plan: 1 in each of 4 LMEs (Chukchi, Beaufort, Bering & Gulf of Alaska): Chukchi since 2014, GOA will be deployed in 2019
- Provide year-round coverage – even during ice covered months
- Anchor for ship transect lines (DBO, Seward Line)
- Cutting edge sensor technologies used on a "mooring array" – leading the way for national plan
- Come visit poster "From sea ice to seals: A moored marine ecosystem observatory in the Arctic", ID# T4-6

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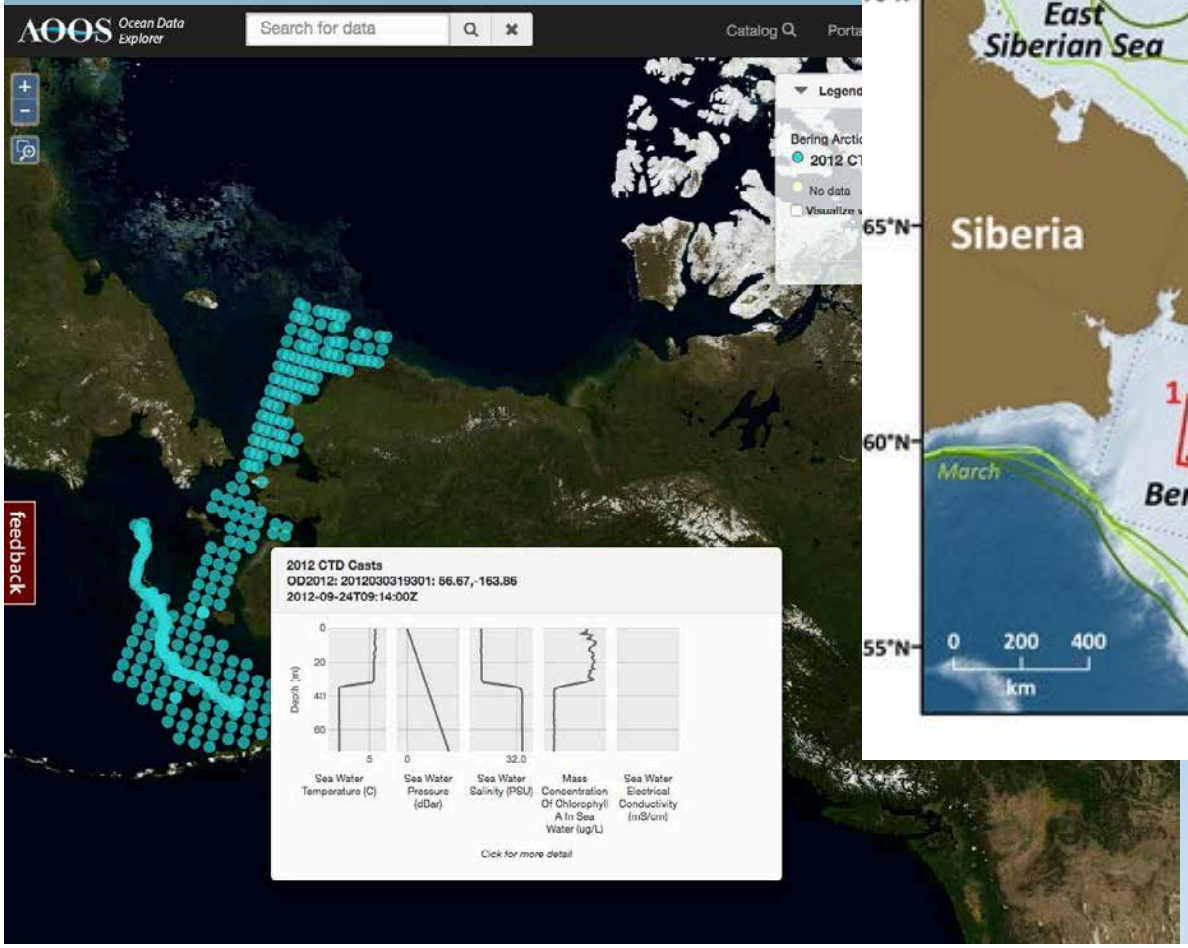
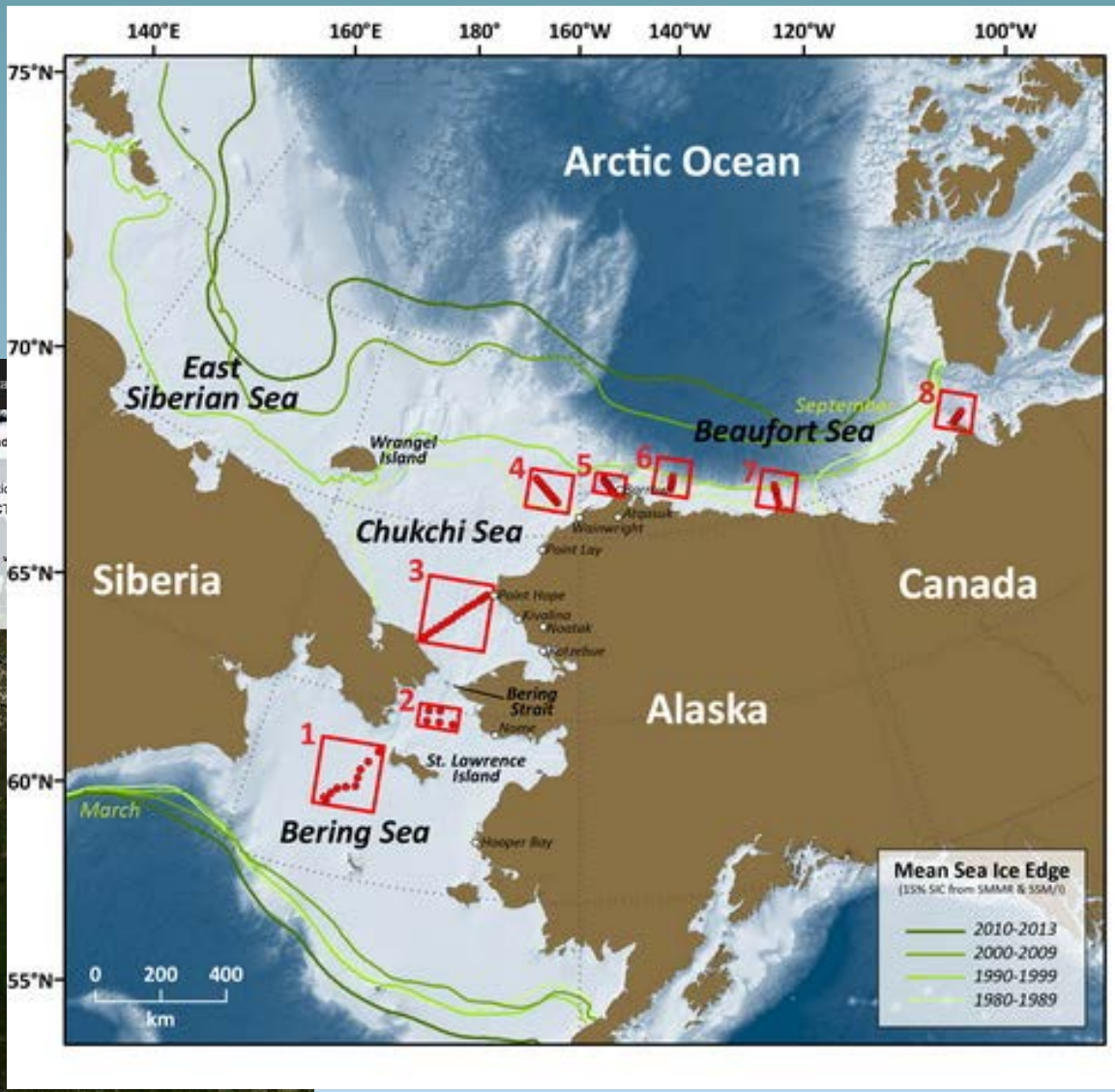
Ship Transects: DBO & Fish Surveys





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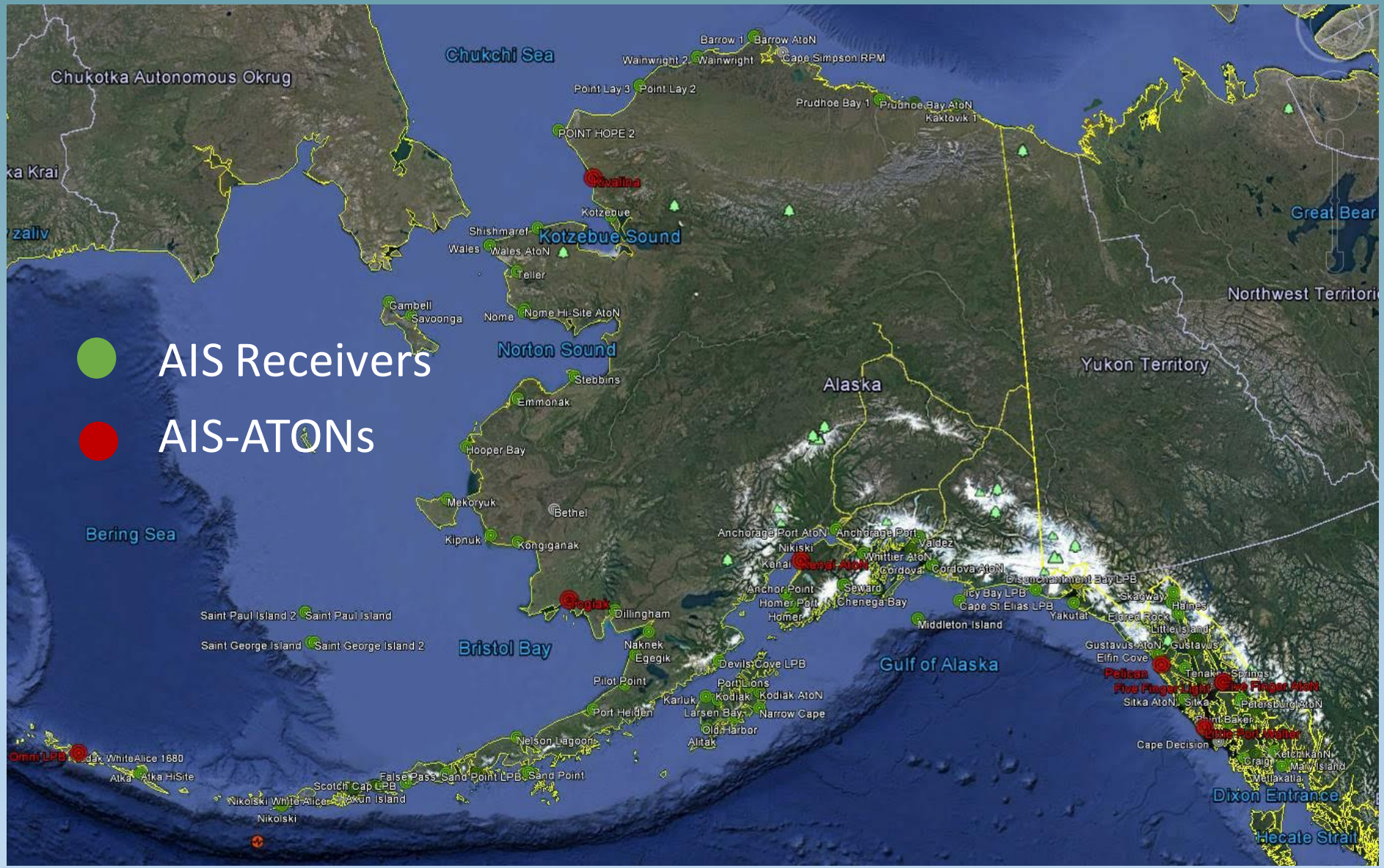
Automated Information System (AIS) stations



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AIS with Weather Stations

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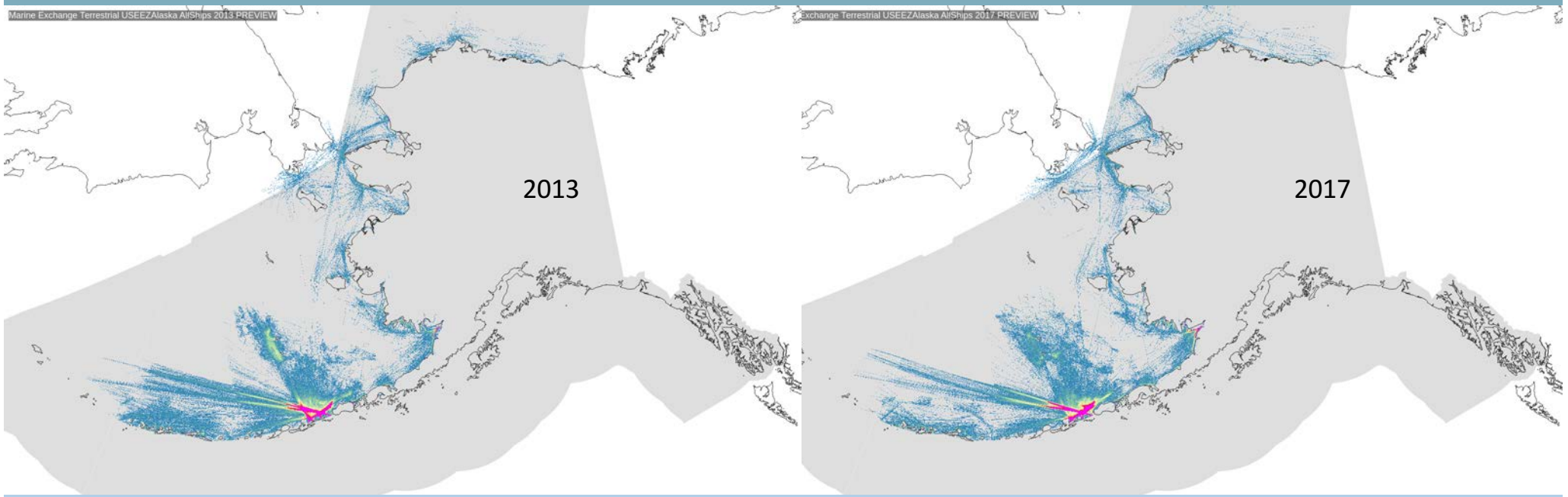
Use of Vessel Tracking data:
Looking for Trends in vessel traffic: 2013 and 2017



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Many Traditions One Alaska

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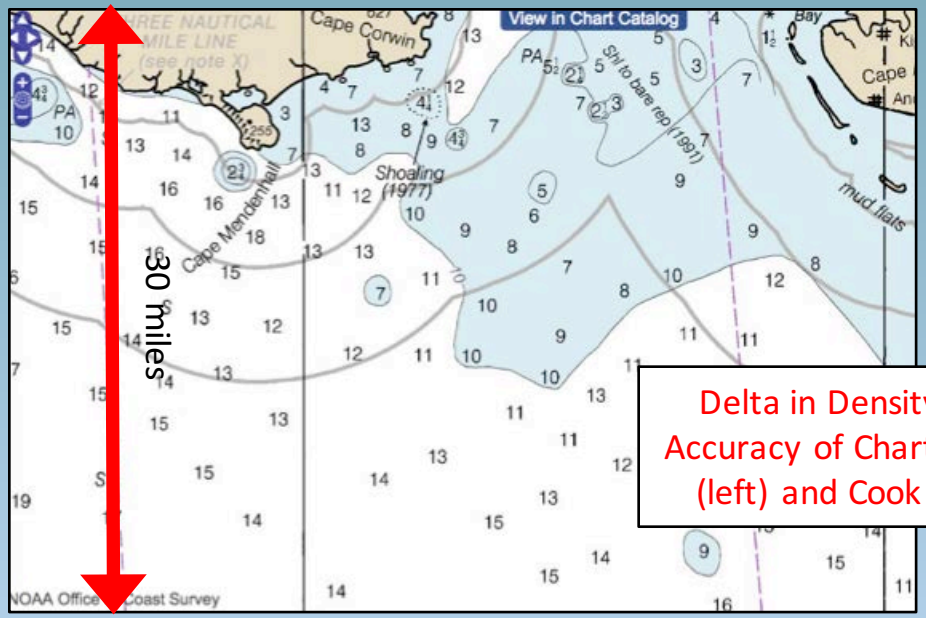
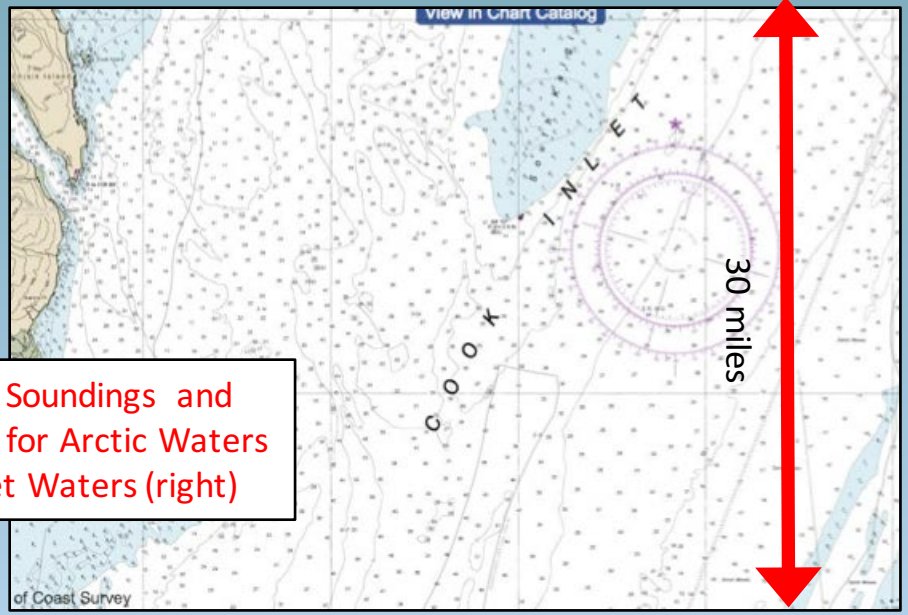
A DEPARTMENT OF HOMELAND SECURITY CENTER OF EXCELLENCE

ADAC: Research for the Arctic Operator...For Today and For the Future

Use of Vessel Tracking Data: Prioritize Bathymetric Surveying in a Rapidly Changing Arctic





Delta in Density of Soundings and Accuracy of Charting for Arctic Waters (left) and Cook Inlet Waters (right)

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ADAC: Research for the Arctic Operator...For Today and For the Future

Developing a Community Impacts Decision Support Tool for Alaska Beaufort

Goals:

- Understand where a spill is most likely to occur based on the frequency of vessels (using AIS data), and
- How could different subsistence activities and their relative timing be impacted in the event of a spill.

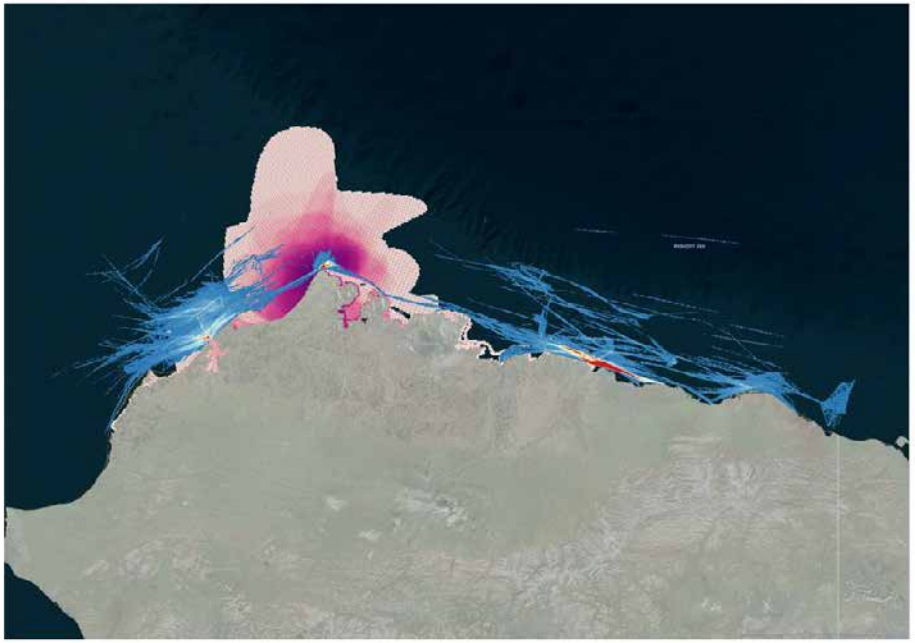

Figure 3. Example image of harvester intensity index for the community of Utqiaġvik (formerly Barrow) relative to marine traffic.

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“Eroding island forces Shishmaref residents to choose: Stay or relocate?”

KTUU, July 24 2016

Reduced ice cover with thawing permafrost sets the stage for rapid coastal erosion along the west and northern Alaska coastline.

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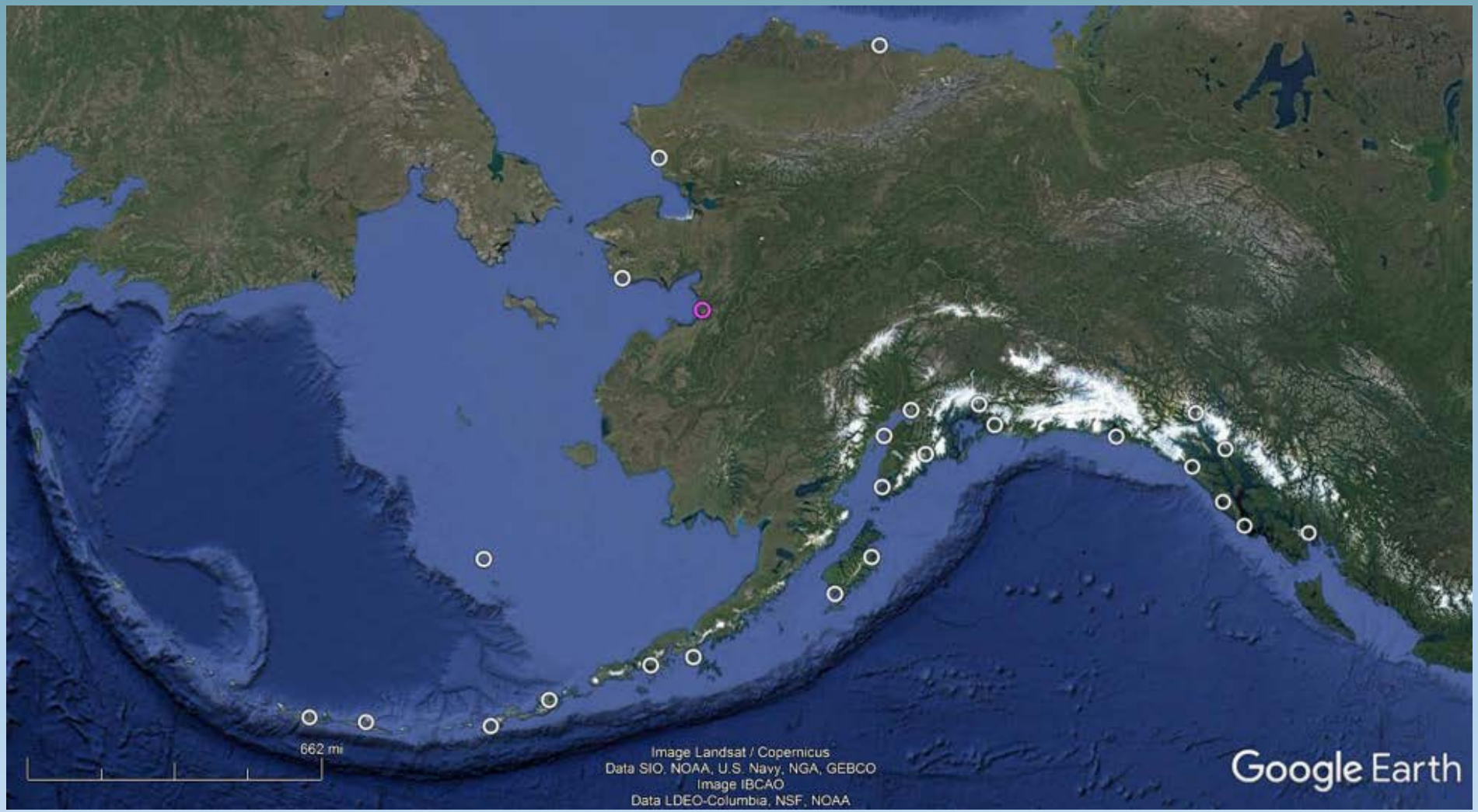
NOAA CO-OPS NWLON Water Level Stations: the nation's backbone & gold standard, but only 5 in Western & Northern Alaska



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Range of options

TEMPORAL RECORD

Timing/Duration:

Tidal Epoch – *5 to 19 years*

LT Subordinate – *>1 year*

open water season

ST Subordinate – *>1 month*

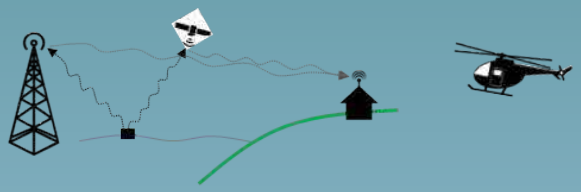
event specific

single measurement

Frequency:
- *wave period*
- *6 minute (std.)*
- *hourly*
- *variable*

DATA RECOVERY

Frequency:
- *real time*
- *batch delivery*
- *post collection*



Tidal Benchmarks
(absolute/fixed)

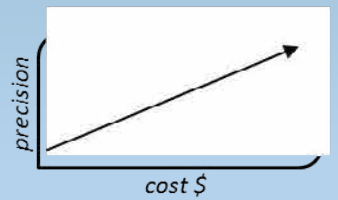
VERTICAL CONTROL

CORS/GPS
(time dependent/active)

Uncontrolled
(relative to series)

SENSOR TYPE

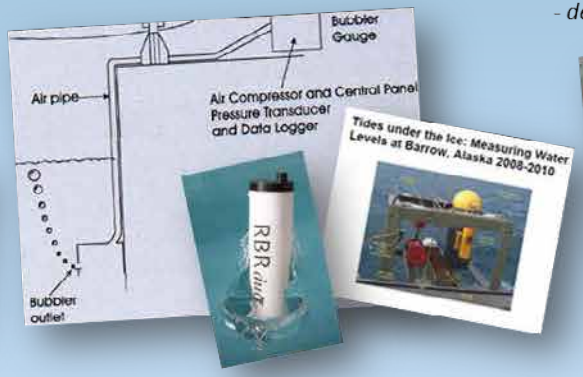
Every category has options:



Range of sensor precision, with similar data standards, best meets AK need.

POSITION-BASED
- *direct (GPS buoy)*
- *rod (visual)*
- *float*

PRESSURE
- *bubbler*
- *direct pressure transducer (vented/unvented)*



RANGE-FINDER
- *signal bounce (acoustic/microwave/radio)*
- *satellite altimetry*
- *depth (sonar/laser)*

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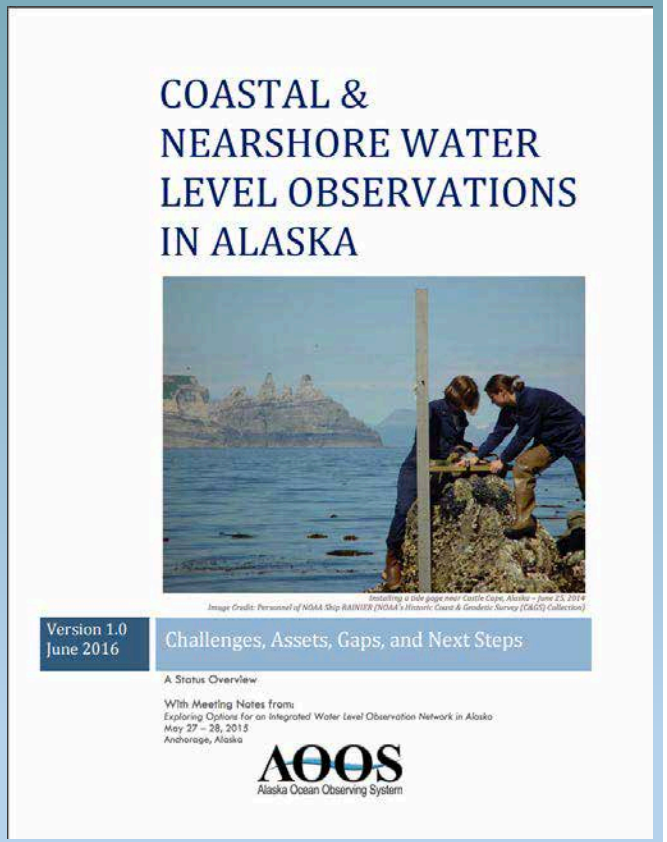
Making Elevation and Water Level Observations Where Conventional Methods Don't Work

- NOAA NWS iGage acoustic sensors: low cost, downward looking on bridges & docks; oblique over tidal rivers
- Rapid deploy water level sensors ahead of storms – not real time
- Bottom mounted pressure sensors – not real time, but help validate models
- Community flooding maps
- Water level observing trials using GPS Reflectometry
- LiDAR imagery of Yukon Delta: spatially expansive, high resolution elevation data



Available on @ www.aoos.org

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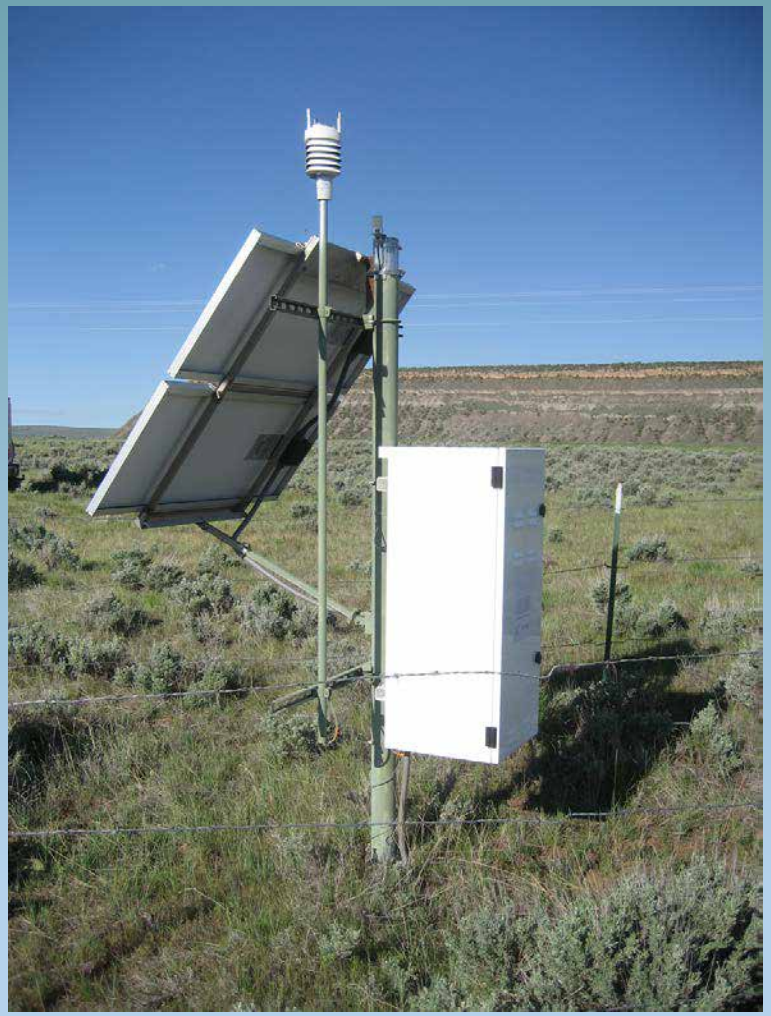
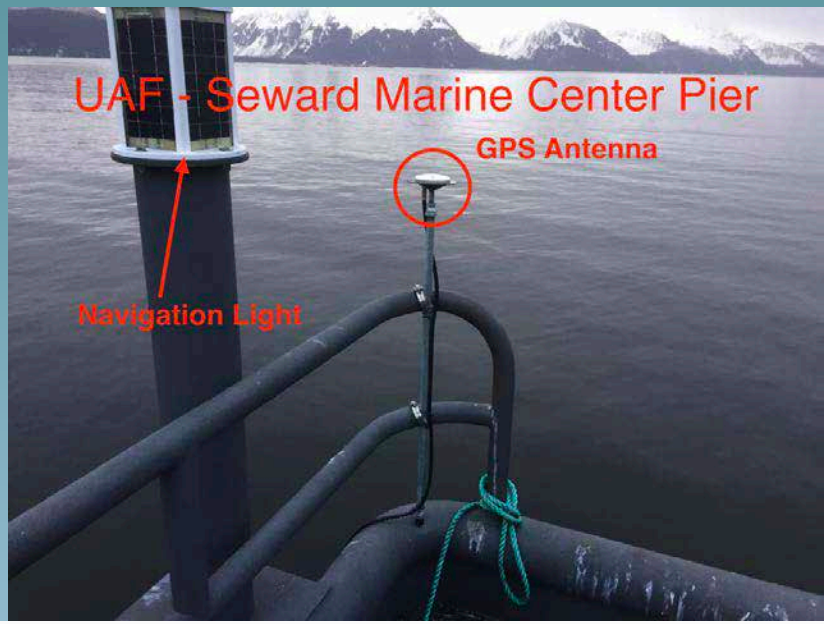
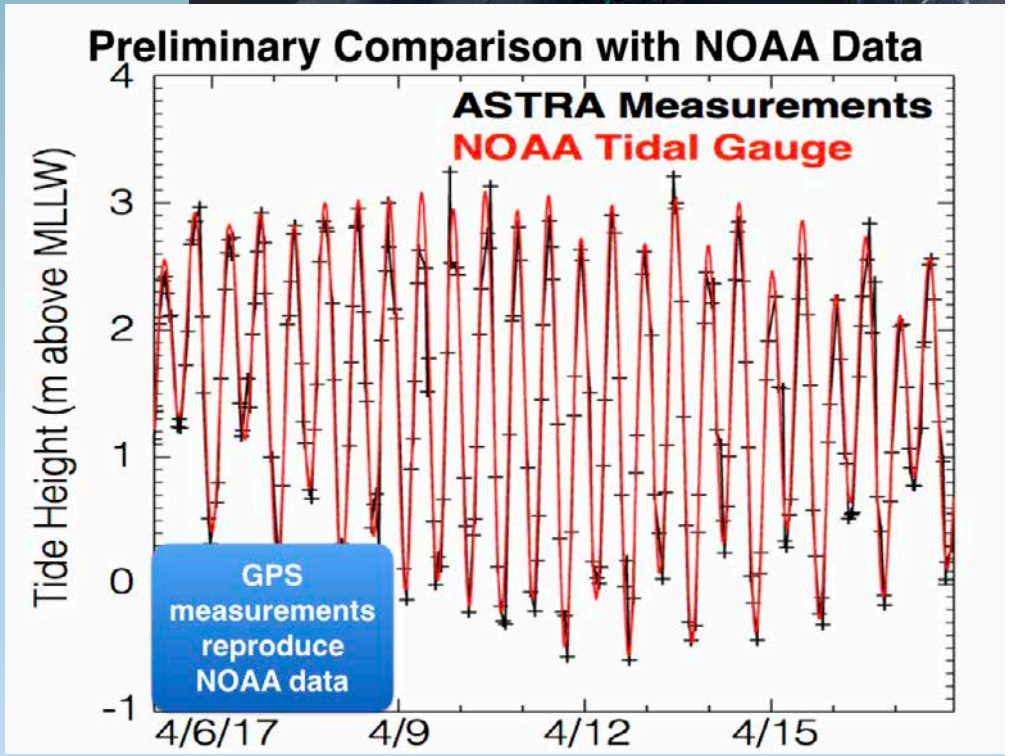
Color Indexed Map Series for Flood Communication

Land-Based, GPS Reflectometry for Measuring Water Level







Private Sector Partners:

UNAVCO - NSF funded Plate Boundary Observatory

ASTRA, LLC

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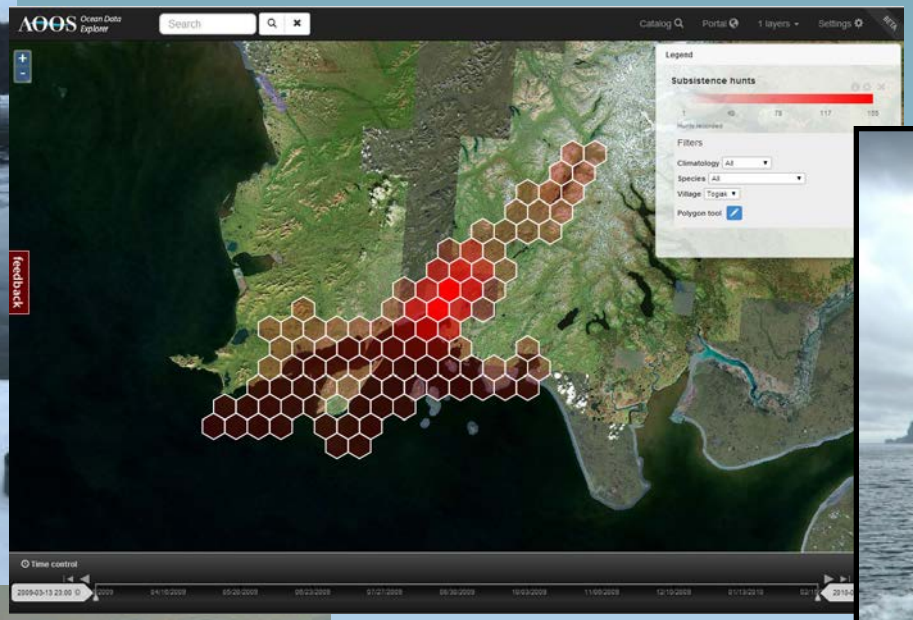
Indigenous knowledge
Community based monitoring
Citizen science



Coordination & facilitation: Convener Role

Ongoing

- **AK Ocean Acidification Network**
- **AK Harmful Algal Bloom Network**
- **AK Water Level Watch**
- **Integrated Coastal Mapping for COTNA (Coastal Onshore, Tidal & Nearshore Areas)**

Short-term

- **The "Blob": blog & AK working group**
- **Bering Strait Response**

Networking activities

- **Local, regional, national and international**

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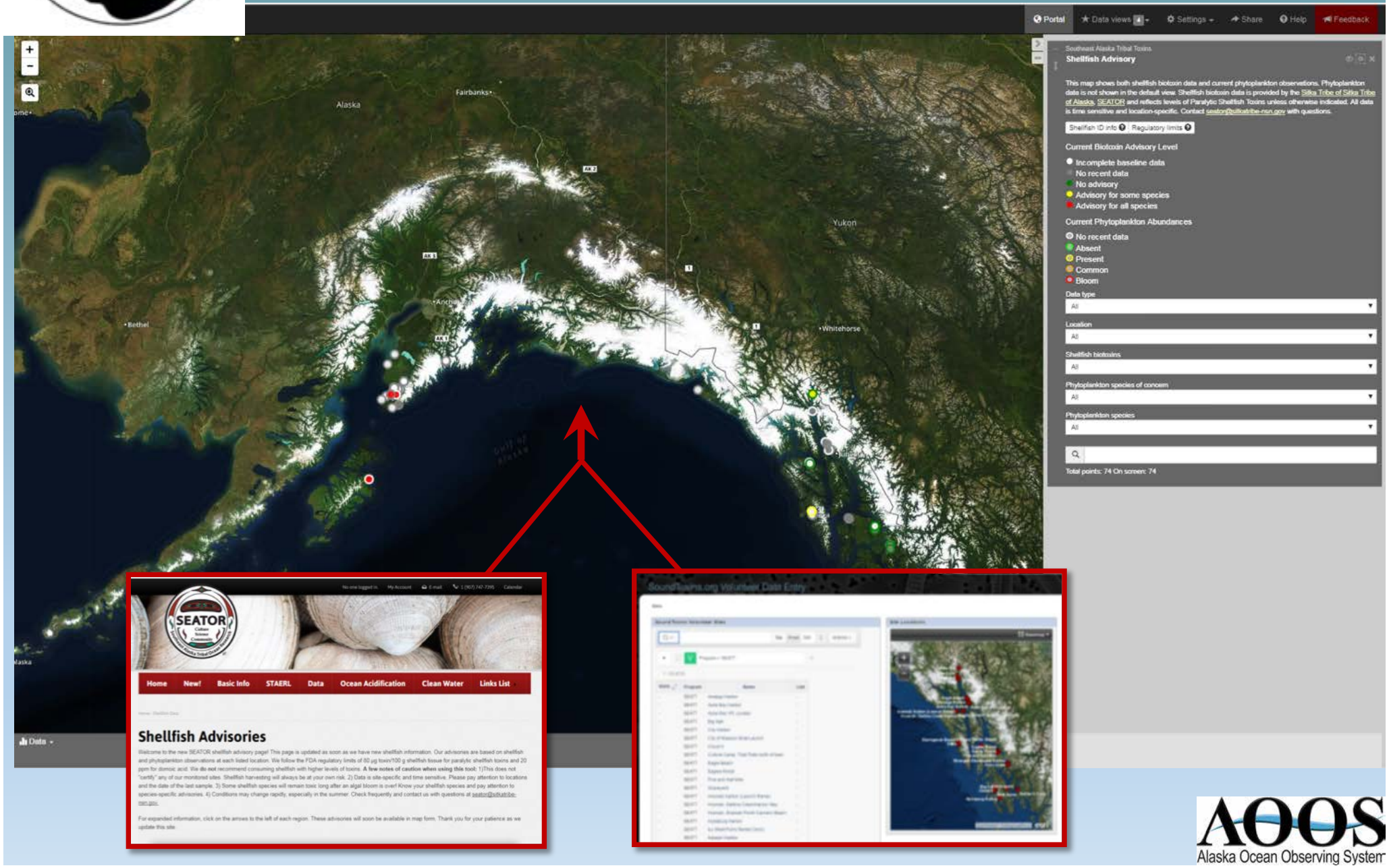
Harmful Algal Bloom Network, Data Portal & Tools



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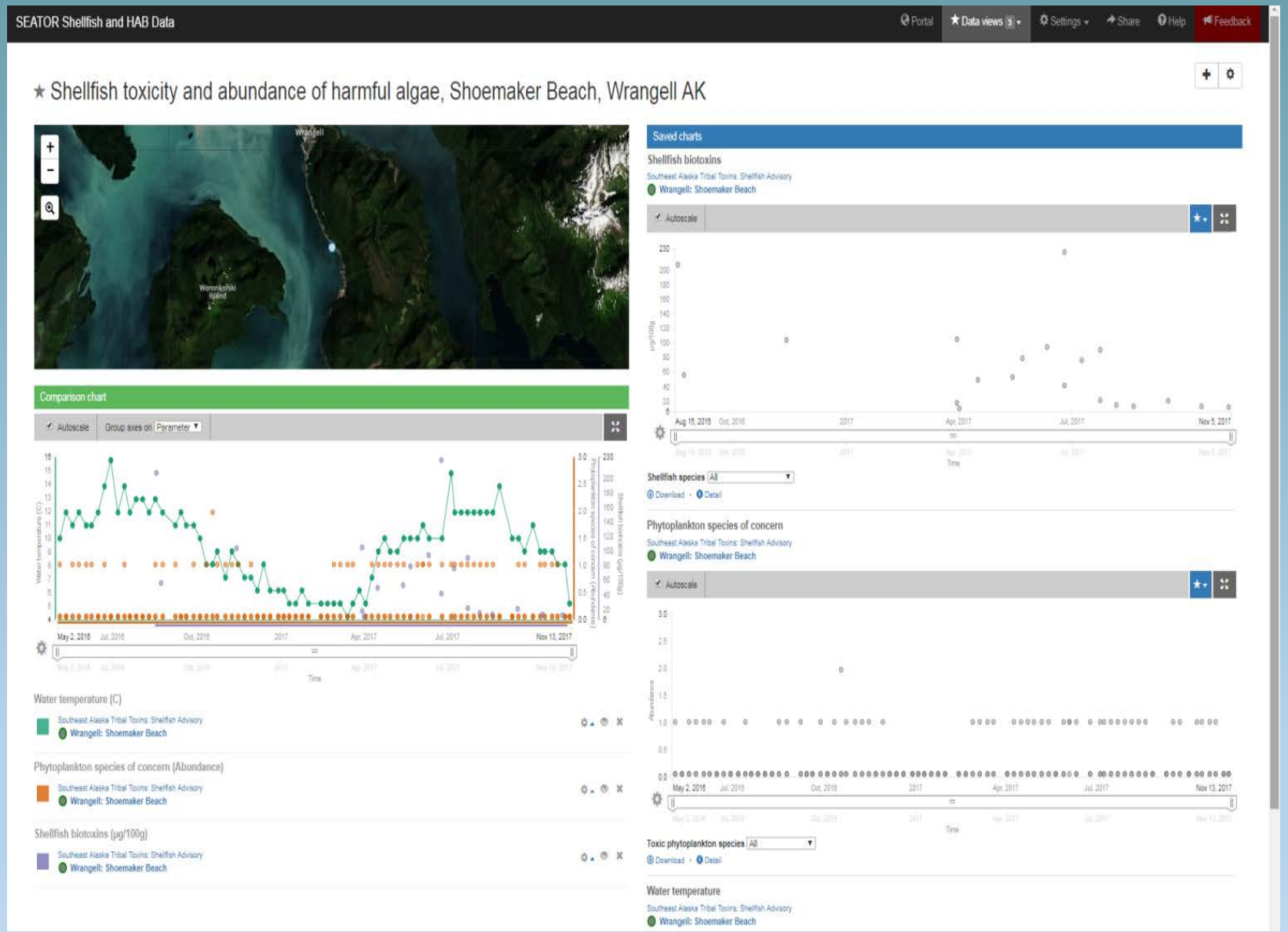
Data View of SEATOR Shellfish and HAB Data Developed by AOOS Data Team (Axiom Data Science)



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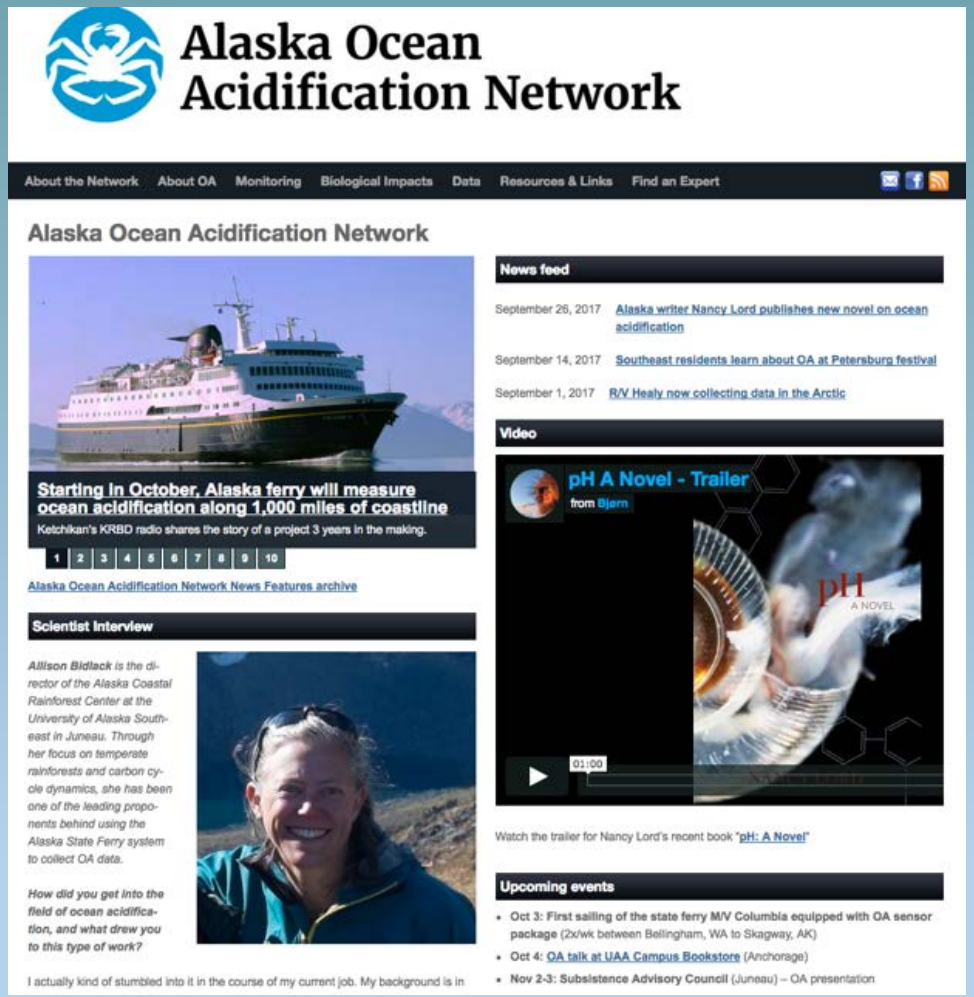
Alaska Ocean Acidification Network



- Engage with communities to expand understanding
- Identify information needs and monitoring priorities
- Share best practices
- Promote data sharing

http://www.aoos.org/alaska-ocean-acidification-network/

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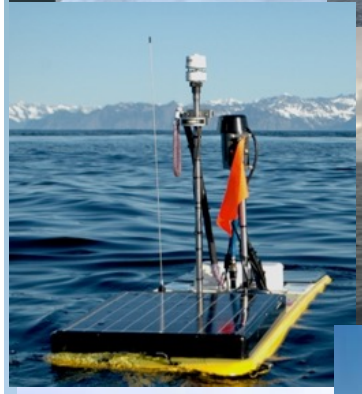
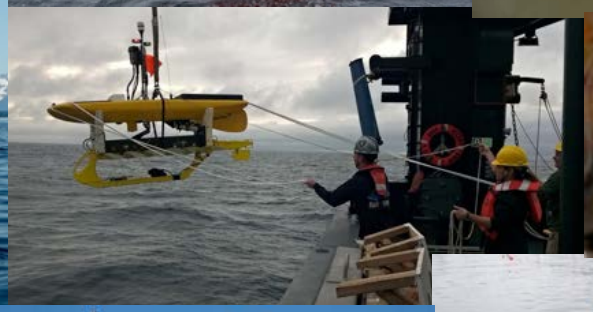
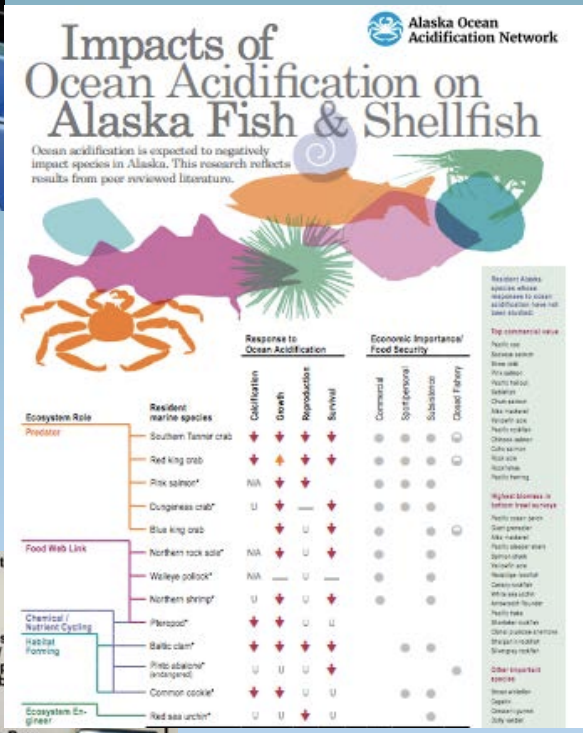
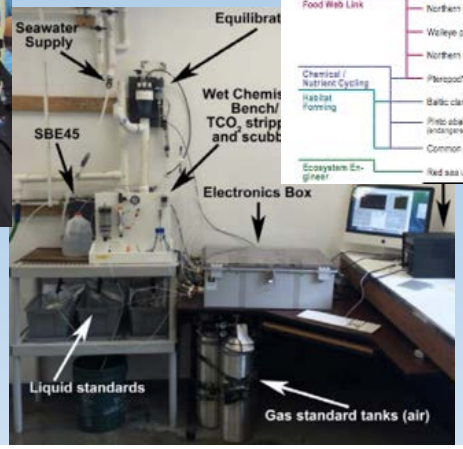
Monitoring: A Multi-Faceted Approach









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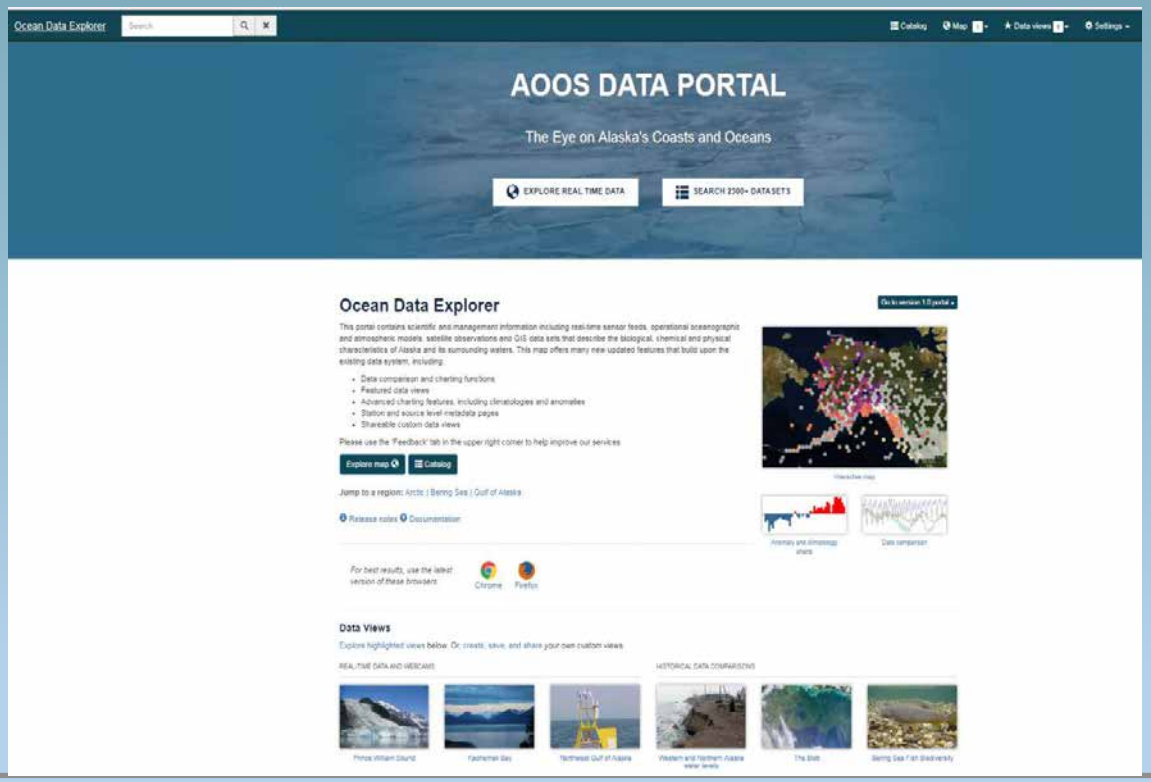
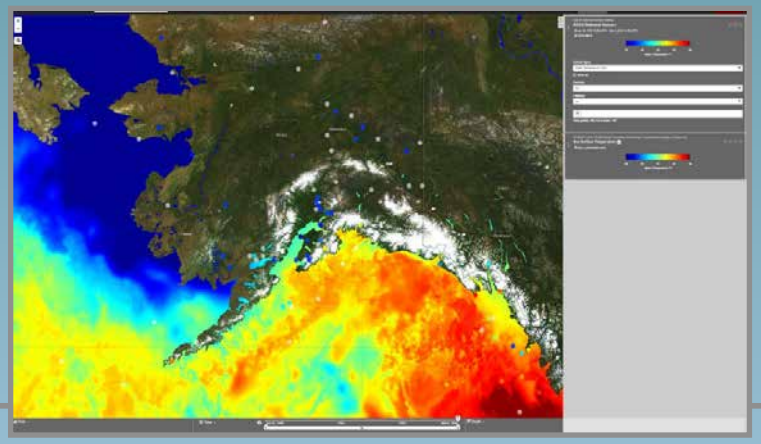
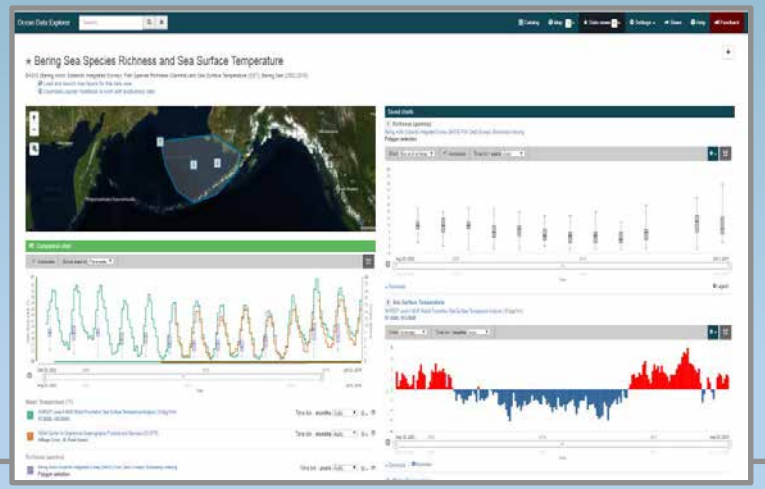
AOOS Data Assembly Center & Ocean Data Explorer







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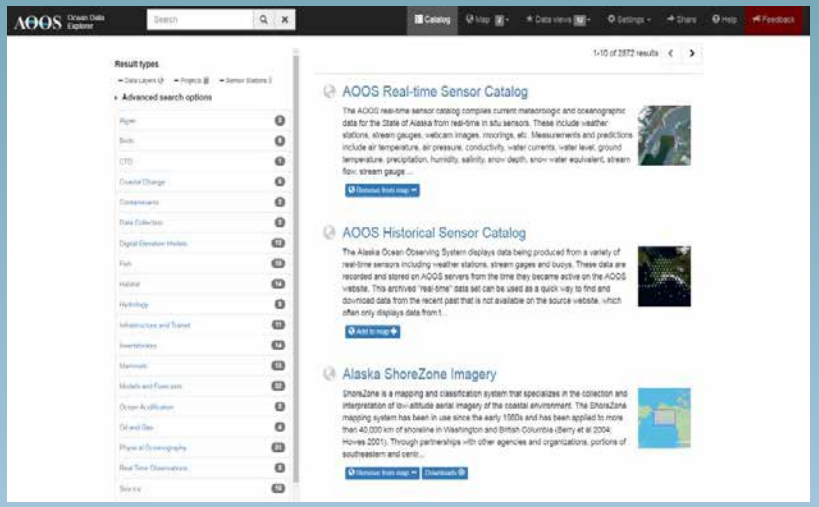
Portal Components

Map

Integrate & visualize data from many sources

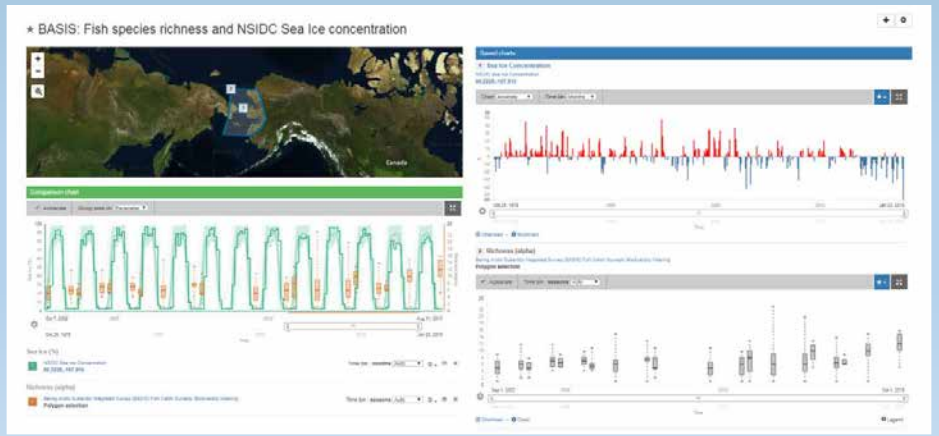
Catalog

Search , metadata, & data download



Data Views

Rapidly assimilate & compare different data streams



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AOOS Ocean Data Explorer

NEED

Remote data exchange to support analysis, integration, & collaboration

CAPABILITY

- Data discovery and access
- Data visualization
- Dynamic interaction
- Custom exploration
- State saving & sharing
- Data publication & archive

AMOUNT

- 2,300 data layers
- 1,500 sensors
- 35 parameters
- 20+ data sources
- 5 million obs/ week

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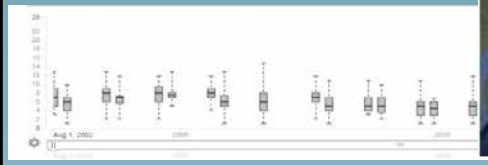
Multiple Data Types

Biodiversity

count, richness, diversity indices

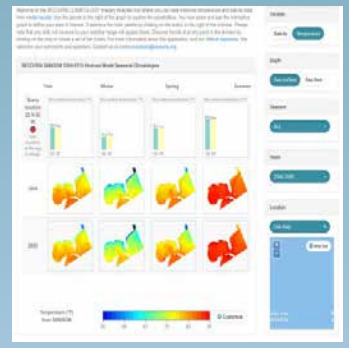


Platforms

moorings, shore stations

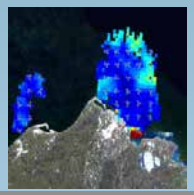
Products

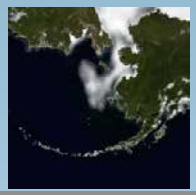
skill assessment, shoreline change, etc.

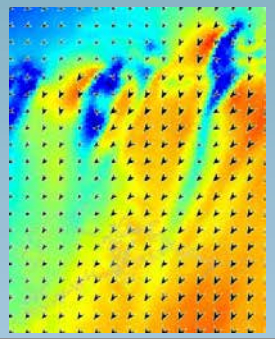


Grids

models, satellite, radar

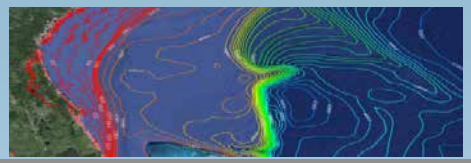






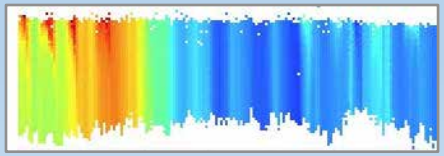
GIS

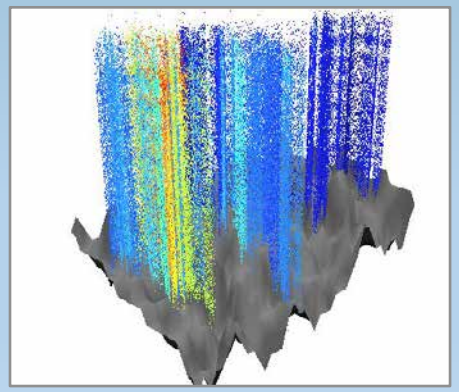
Habitat types, bathymetry, fishing zones, etc.



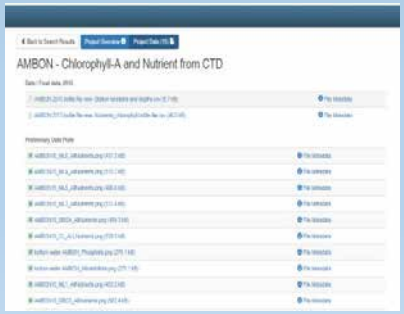
Mobile sensors

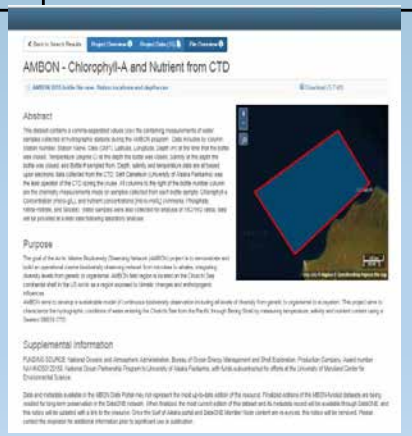
gliders, animal telemetry





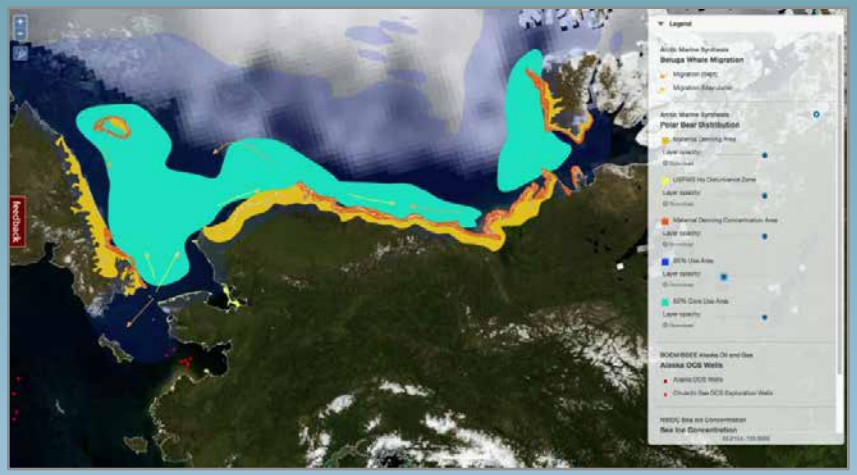
RESEARCH WORKSPACE

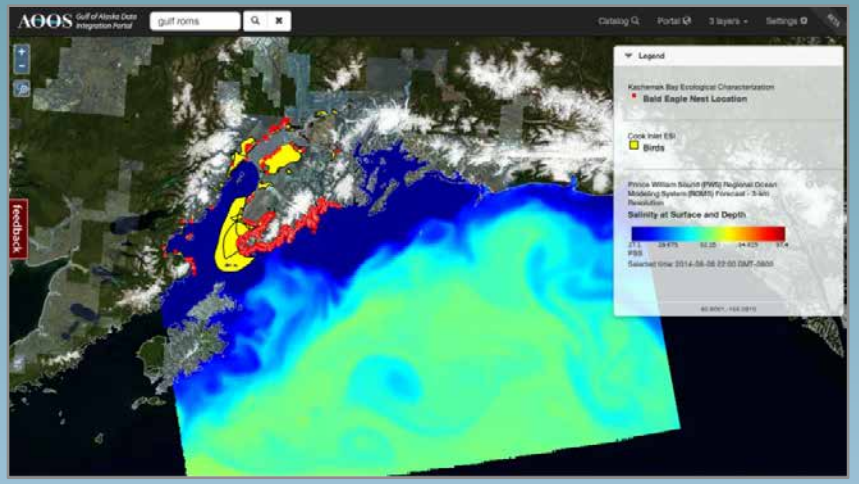




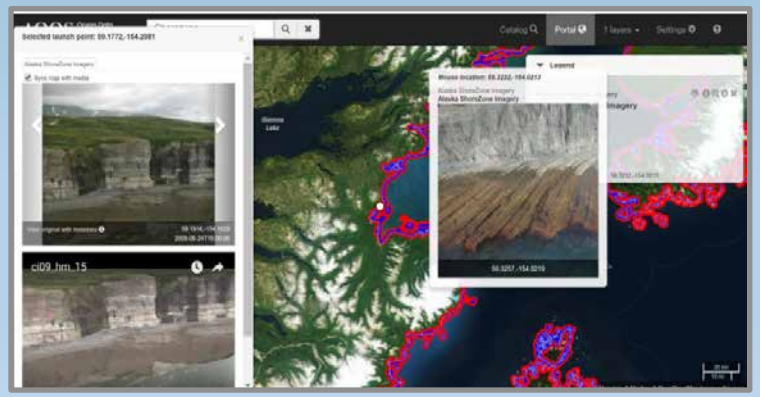
Rapid Deployment of Focused Tools

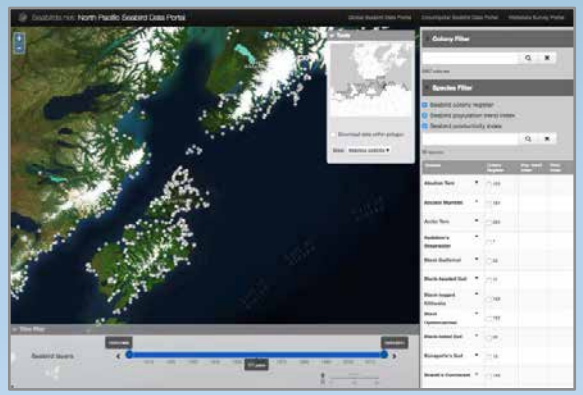
Regional:





Thematic:



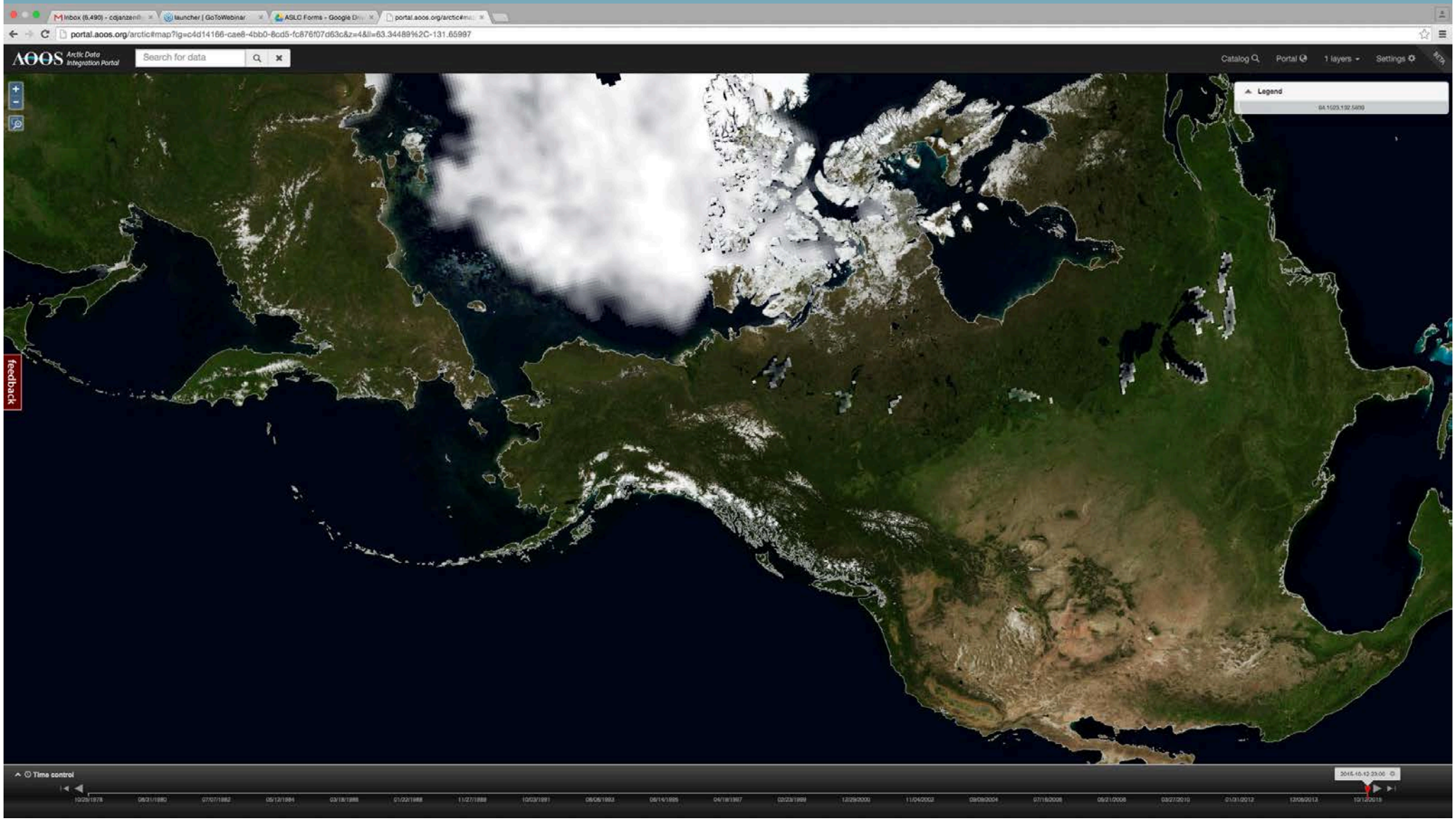


Recommendations

- Have each platform meet many stakeholder needs
- Need local science/technical support to reduce costs
- Industry partners can provide critical logistical support, possible future financial support
- Networking, outreach, communication, coordination, collaboration: all are essential

AOOS
Alaska Ocean Observing System

www.aoos.org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Portal
1 layers
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feedback
Time control