Lessons for the Arctic: from the Alaska Ocean Observing System

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

Stakeholder concerns
- Climate change impacts
- Increased coastal erosion
- Changing marine ecosystems
- Unstable sea ice and uncertain freeze/thaw dates
- Fewer subsistence resources
- More shipping = more oil spill potential
- Changing sea state: more fog, storms, winds, waves

Information Products Needed
- Nowcasts
  - Warnings & bulletins
- Forecasts
  - Weekly, monthly & seasonal outlooks
- Futurecasts
  - Scenarios & projections

Observations
- Satellites
- Fixed platforms
- Ships
- Moorings
- Community obs
- AUVs

Data Management Integration & Analysis
- Standards
- Data discovery
- Data transport
- Online browsing
- Interoperability
- Data archive

Outcomes: Meeting Societal Goals
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

Uses
- search & rescue
- navigation safety
- oil/contaminant spill response
- track harmful algal blooms
- complement local knowledge
UAF Barrow/Utqiagvik Sea Ice Radar

Furuno X-band FAR212 25kW, 2.4 m open array 22 m a.s.l. digital controller, internet upload
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
Typically, would think this overturning was Freeze-up

Time of surface float release & actual time water column well-mixed
Gliding Through the Bering and Chukchi Seas

Annual Ocean Conditions
Marine Mammal Tracking
Remote Arctic Missions Since 2013

Partners: Baumgartner-WHOI, Stafford UW, Winsor and Statscewich-UAF, NPRB
Viewing the Ocean in 4D

Glider DAC

OSU157 (UW157-20141116T2118)

Data points: 375.65 G | Type: glider佃etered_track | Dates: Nov 16, 2014 12:32 (AST) - Mar 5, 2015 09:23 (AST) | Depth range: 0.479 (m) - 1003.817 (m) | Sea name: North Pacific Ocean | Institution: Oregon State University | Authority: edu.washington.edu

Vertical Axis

X Axis (contour chart)

Color value

Depth

Distance

Sea Water Practical Salinity

Profile: 507 Data points: 447

17.740 m - 967.120 m

Temperature

Conductivity

Density
Ecosystem Observatories

- 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

Partners: Danielson-UAF, NPRB, Murdock-Charitable Trust, and numerous others
Ship Transects: DBO & Fish Surveys
Automated Information System (AIS) stations

- **AIS Receivers**
- **AIS-ATONs**

[Map of Alaska showing AIS Receivers and AIS-ATONs]
AIS with Weather Stations

Google Earth

AIS Weather Installations
Use of Vessel Tracking data: Looking for Trends in vessel traffic: 2013 and 2017
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)
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 Utqiagvik (formerly Barrow) relative to marine traffic.
“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.
NOAA CO-OPS NWLON Water Level Stations: the nation’s backbone & gold standard, but only 5 in Western & Northern Alaska
Range of options

TEMPORAL RECORD
Timing/Duration:
- Tidal Epoch – 5 to 19 years
- LT Subordinate – >1 year (open water season)
- LT Subordinate = <1 month (event specific)
  - single measurement

SENSOR TYPE
Every category has options:
- Precision
  - cost $ (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/fusor)

DATA RECOVERY
Frequency:
- Real time
- Batch delivery
- Post collection

VERTICAL CONTROL
- Tidal Benchmarks
  - Absolute/ Fixed
- Uncontrolled
  - Relative to series
- CORS/GPS
  - Time dependent/ Active
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
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
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
Data View of SEATOR Shellfish and HAB Data
Developed by AOOS Data Team (Axiom Data Science)
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/
AOOS Data Assembly Center & Ocean Data Explorer
## Portal Components

### Map
Integrate & visualize data from many sources

![Map Image]

### Catalog
Search, metadata, & data download

![Catalog Image]

### Data Views
Rapidly assimilate & compare different data streams

![Data Views Image]
Remote data exchange to support analysis, integration, & collaboration

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

2,300 data layers
1,500 sensors
35 parameters
20+ data sources
5 million obs/week
## Multiple Data Types

<table>
<thead>
<tr>
<th>Biodiversity</th>
<th>Platforms</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>count, richness, diversity indices</td>
<td>moorings, shore stations</td>
<td>skill assessment, shoreline change, etc.</td>
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<th>GIS</th>
<th>Mobile sensors</th>
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<tr>
<td>models, satellite, radar</td>
<td>Habitat types, bathymetry, fishing zones, etc.</td>
<td>gliders, animal telemetry</td>
</tr>
</tbody>
</table>

[Image of Multiple Data Types]
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