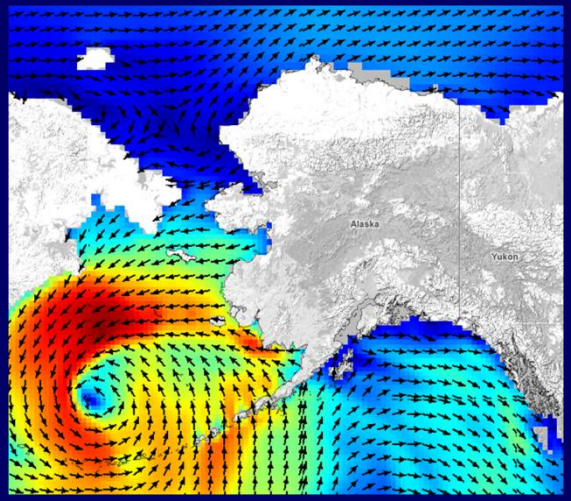
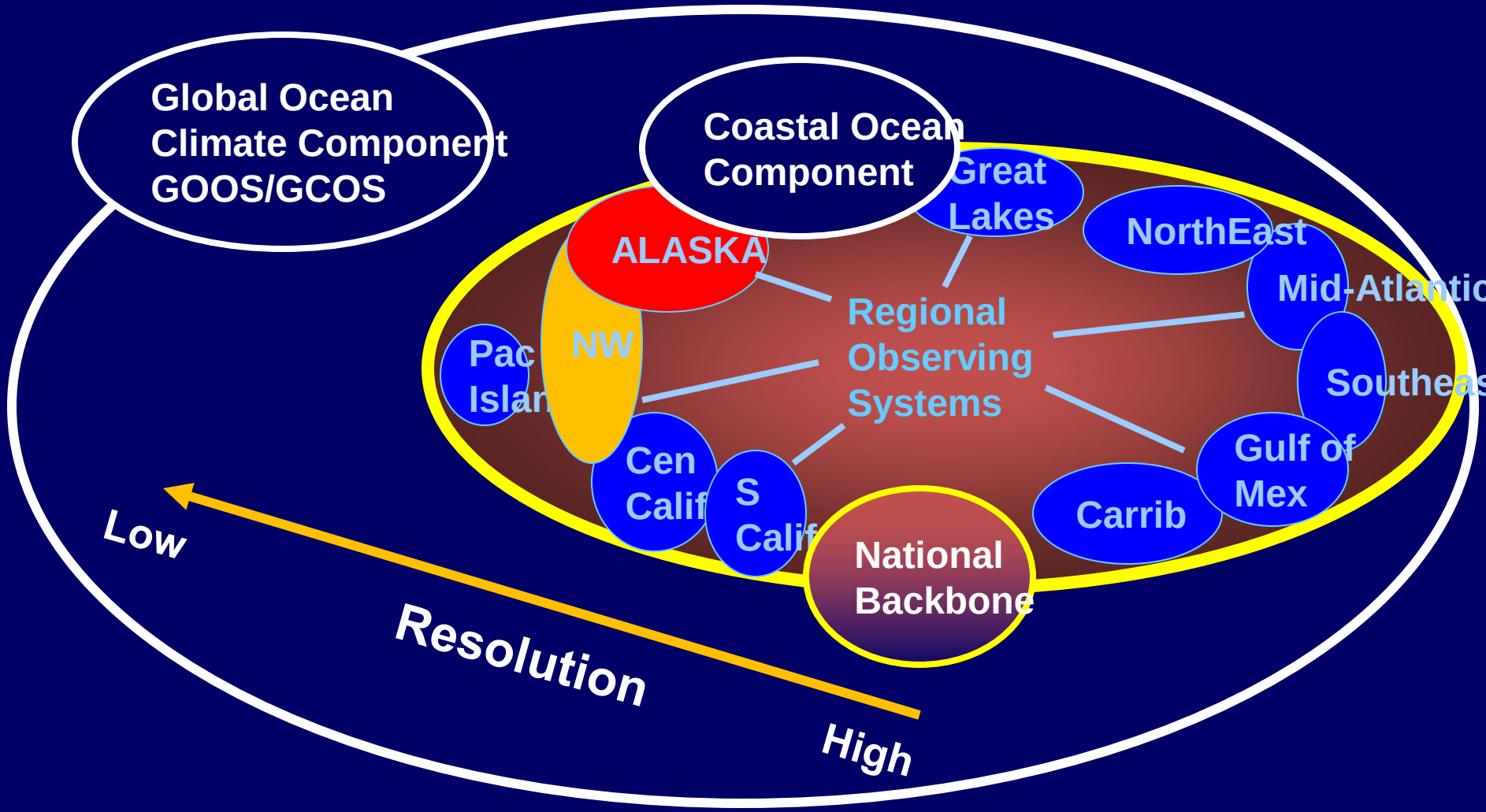
Designing an Ocean Observing System for the Future: an Innovative Approach in Alaska



May 30, 2012

U.S. IOOS
Multi–Scale System




AOOS
NANOOS
CeNCOOS
SCCOOS
GLOS
NERACOOS
MACOORA
SECOORA
GCOOS
CaRA
PacIOOS
Non-U.S. waters of PacIOOS

AOOS Founding Board Members

- **State**
- Fish and Game
- Environ Conservation
- Natural Resources
- **Research**
- Univ of AK
- Sea Grant
- AK SeaLife Center
- Prince William Sound Science Center/Oil Spill Recovery Inst.
- US Arctic Research Commission
- North Pacific Research Board
- Barrow Arctic Science Consortium
- NOAA AK Fisheries Science Center

- **Federal**
- USGS
- NOAA
- Coast Guard
- BOERME (MMS)
- **Other**
- Marine Exchange of Alaska

2011-2012
AOOS Officers

Chair –Ed Page, Marine Exchange

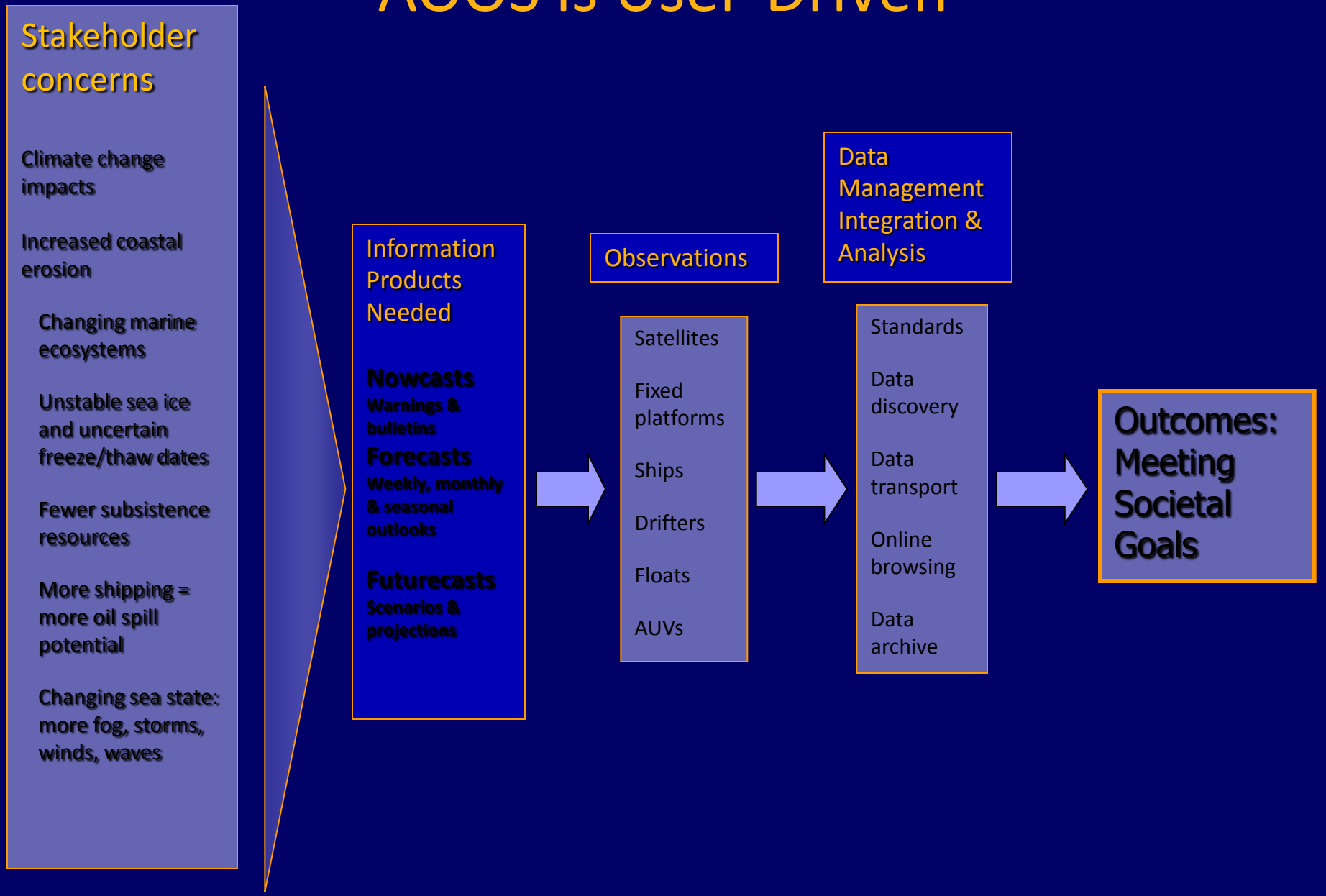
Vice-chair – Ed Fogels, ADNR

Secretary – Glenn Sheehan, BASC

Treasurer – Amy Holman, NOAA

Ex officio EXCOM – ASLC rep

AOOS is User-Driven



PROJECTS & PROGRAMS

What We fund – (*examples)*:

Marine Operations

- •Circulation and wind modeling, providing daily forecasts in Gulf of AK
- •Wave modeling (SWAN)
- •Wave buoy in Cook Inlet
- •Snotel stations in Prince William Sound & CI
- •AIS & weather sites

Coastal Hazards

- •Alaska Harbor Observation Network
- •Sea Ice Atlas

Ecosystems, Fisheries & Climate Trends

- •Seward Line (long-term data series)
- •Glider for Arctic research
- •Ocean Acidification Sensors

National Federation of Regional Associations for Coastal and Ocean Observing

Alaska Ocean Observing System

INTEGRATED OCEAN OBSERVING SYSTEM

Preliminary Build-out Plan

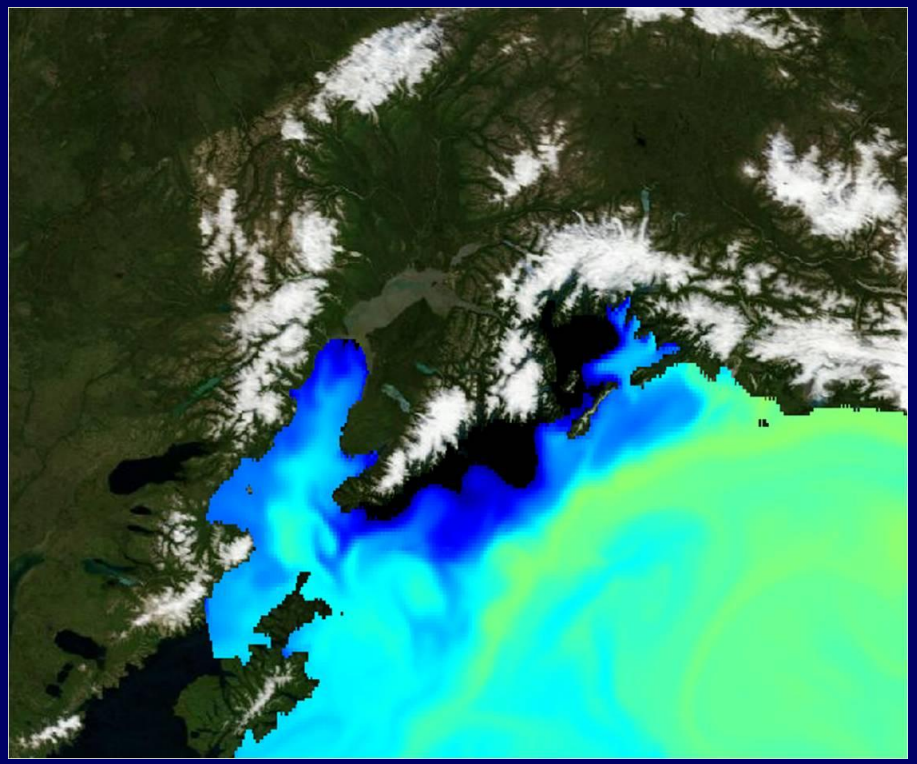
Alaska Ocean Observing System

September 2011

Thematic Issues and Products

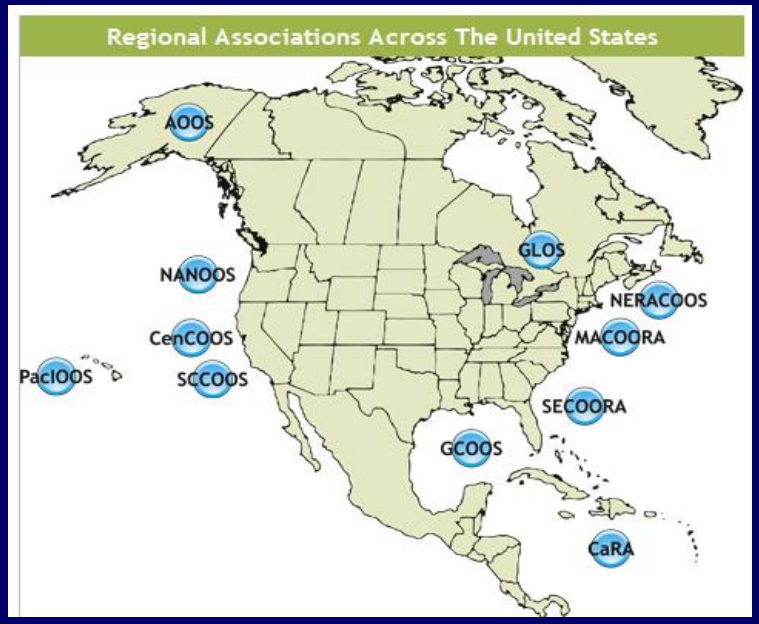
NFRA/IOOS Given:

1. National themes:
    a. marine operations
    b. climate variability and long term change
    c. ecosystem health, water quality & fisheries
    d. coastal hazards



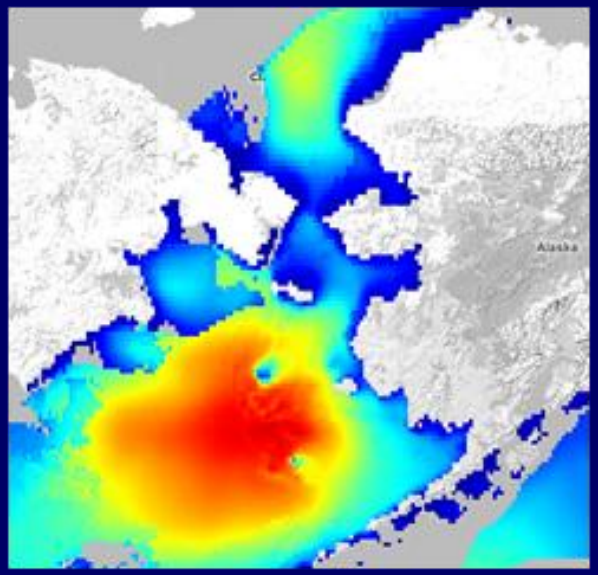
NFRA/IOOS Given:

1. National themes
2. Regional stakeholder needs and issues
3. Common products and services among Regional Associations
4. Information requirements (observations and forecasts)

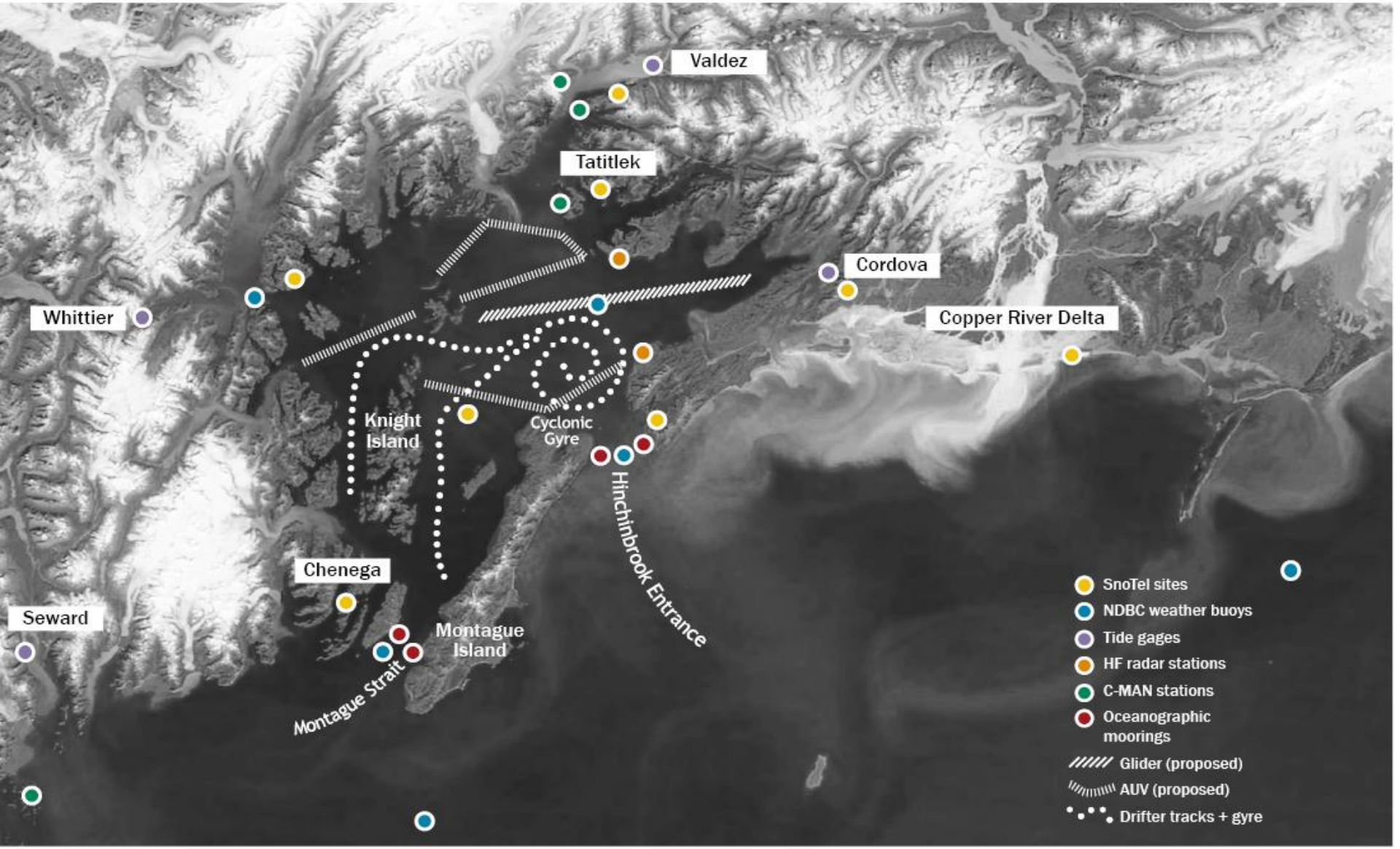


NFRA/IOOS Given:

5. Goal: Gap analysis, cost estimates
6. 10 Year build out plan
7. Bare bones implementation
8. Assume existing federal assets will continue to be funded
9. Include capital as well as operation & maintenance costs



Lessons from the Prince William Sound Demonstration



Approach

1. Build on: 6 years stakeholder outreach, 3 workshops in 2010, FY11-15 proposal

1. Modular and scalable (geographically nested: areas must be about 100km X 100km for logistics, ease of deployment, resolution of models

Approach

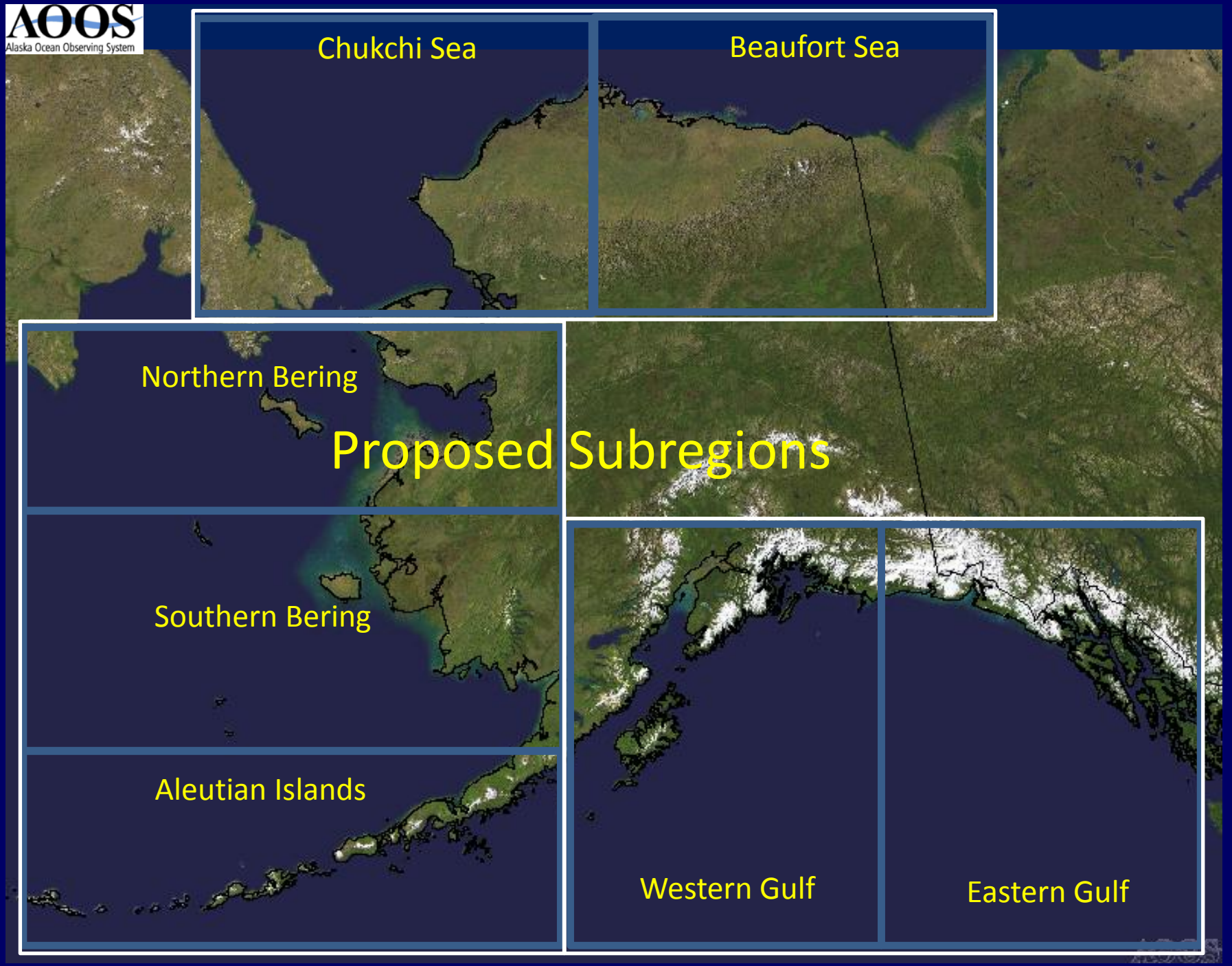
1. Build on stakeholder outreach
2. Modular and scalable (geographically nested)
3. Design can be used to prioritize investments at specific scales of interest: some issues can only be addressed at small spatial scales, others only at larger spatial scales

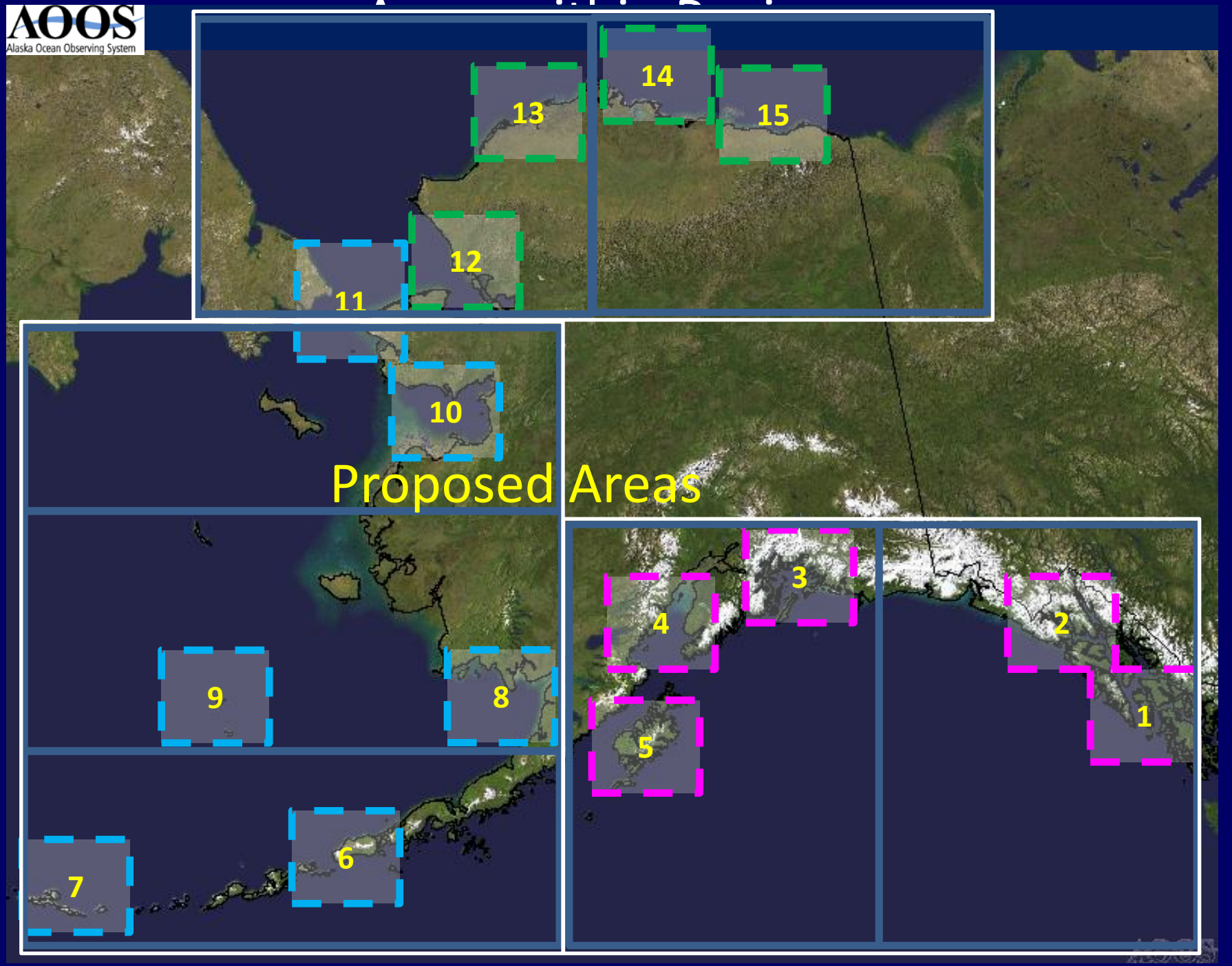
Approach

1. Build on stakeholder outreach
2. Modular and scalable (geographically nested)
3. Design will be used to prioritize investments at specific scales of interest
4. AOOS assets must be combined with existing federal, state, and NGO assets, & those assets must be secure:

   NO ONE CAN DO THIS ALONE;
   IT REQUIRES COLLABORATION & PARTNERSHIPS


AOOS
Alaska Ocean Observing System
Arctic Ocean
Large Marine Ecosystems of Alaska
Bering Sea
and Aleutian Islands
Gulf of Alaska


AOOS
Alaska Ocean Observing System
Chukchi Sea
Beaufort Sea
Northern Bering
Proposed Subregions
Southern Bering
Aleutian Islands
Western Gulf
Eastern Gulf


AOOS
Alaska Ocean Observing System
13
14
15
12
11
10
Proposed Areas
9
8
4
3
2
1
5
6
7

Stakeholder Identified Priority Products (2010)

1. Marine Operations
    a. Weather and sea state communication via improved AIS
    b. Real-time harbor weather and currents
    c. Forecasts of sea ice drift trajectory, floe density, thickness
2. Climate Variability and Change
3. Water quality, Ecosystem Health, and Fisheries

Combined Workshop

    a. Annual state of the oceans synthesis
    b. GOA: GAK1 and glider line, OA, HABs
    c. Bering Sea: PMEL moorings (e.g. M2), OA, climate change
    d. Arctic: ice mapping, drift trajectory forecasts, mooring, DBO
4. Coastal Hazards
    a. Storm forecasts, waves, surges, inundation, erosion, ice
    b. High resolution digital shoreline, bathymetry, DEMs
    c. Real-time harbor weather

IOOS Themes

Marine Operations:

- Vessel Safety
- Search & rescue
- Offshore energy

Long term change & variability

- Status & trends of ocean conditions
- Ocean acidification
- Sea level change (relative)

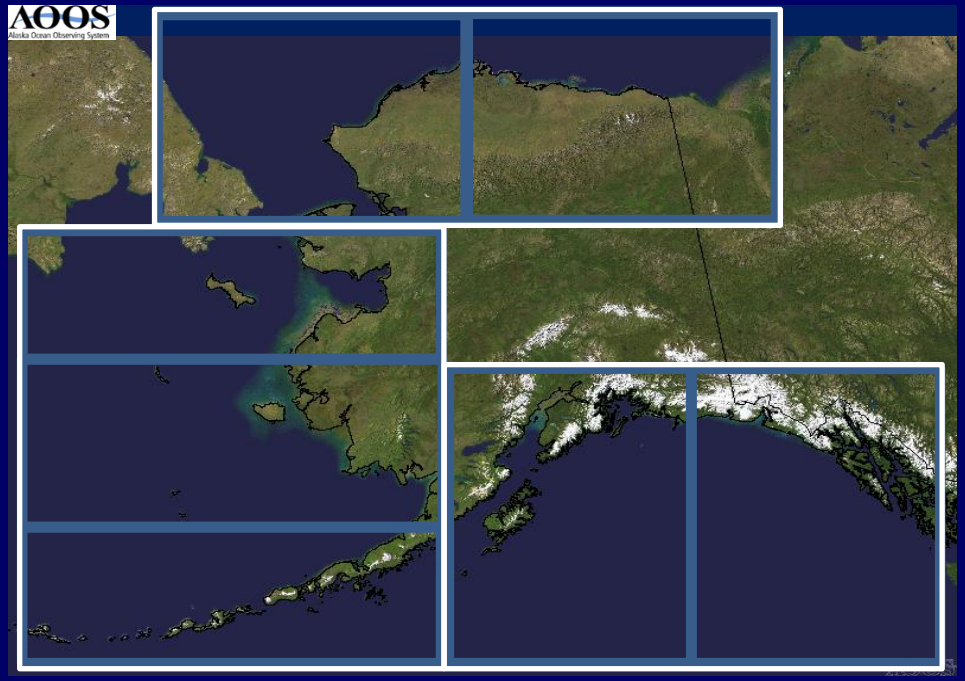
Ecosystems, fisheries & water quality

- Ocean health and productivity
- Sustainable fisheries
- Harmful algal blooms
- Hypoxia
- Water pollution

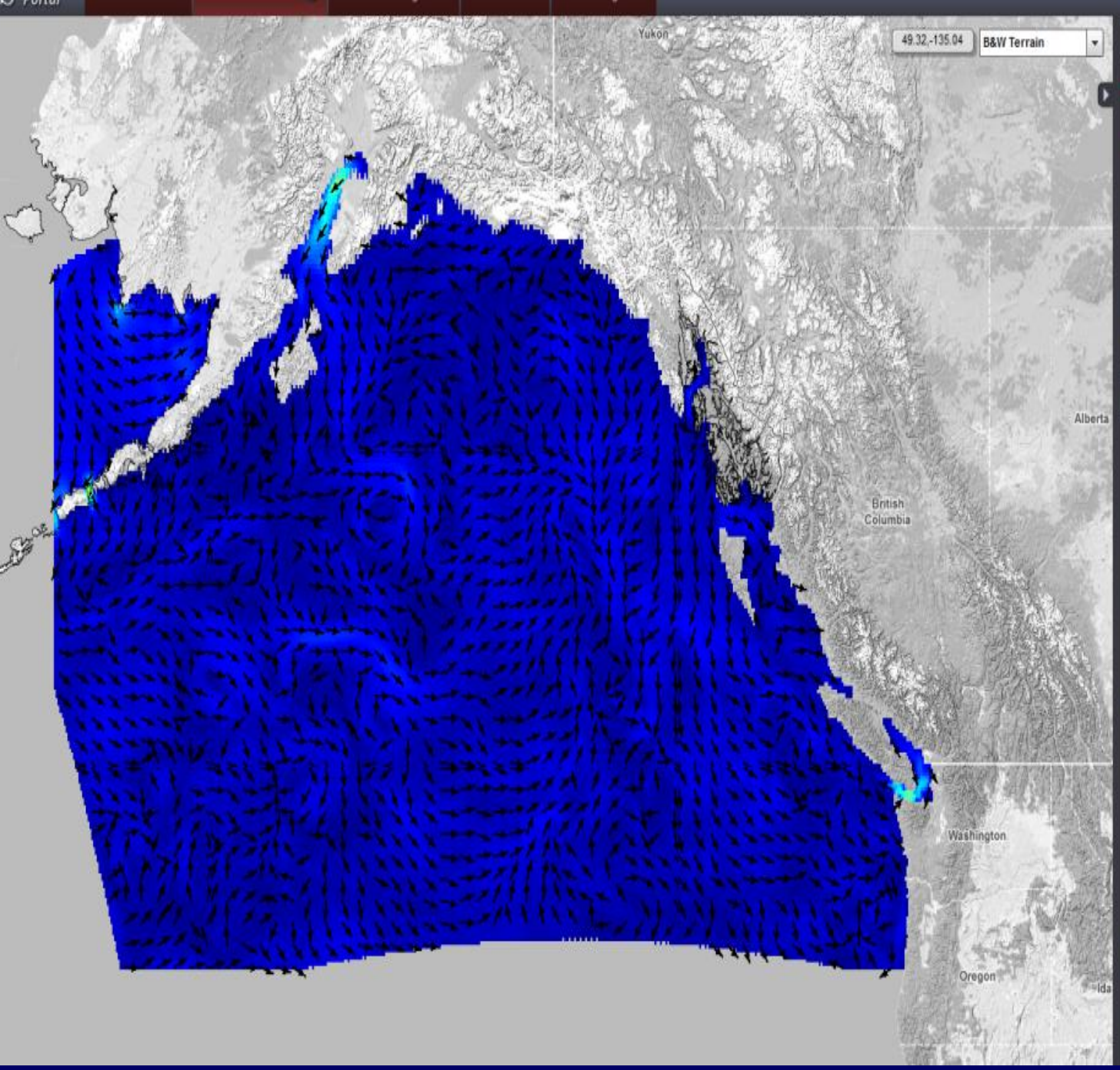
Coastal, beach & nearshore hazards

- Ocean hazards and disasters, extreme weather events
- Coastal inundation, storm surge

Subregional scale



- Coarse resolution everywhere
- Rely more on remote sensing, models & regional syntheses
- Few observations



Legend

Region Ocean Modeling System (ROMS) Forecast 9 km x 9 km (North Pacific) - 9 km x 9 km - North Pacific

Current at Surface and Depth [m/s]

Local time displayed: Wed Feb 15 2012 03:00:00 PM
UTC time displayed: 2012-02-16T00:00:00UTC
Depth displayed: 0 M

Virtual sensor mode

Layer opacity

1.8E-11 1.1 2.3 3.4 4.5
m/s

Layers

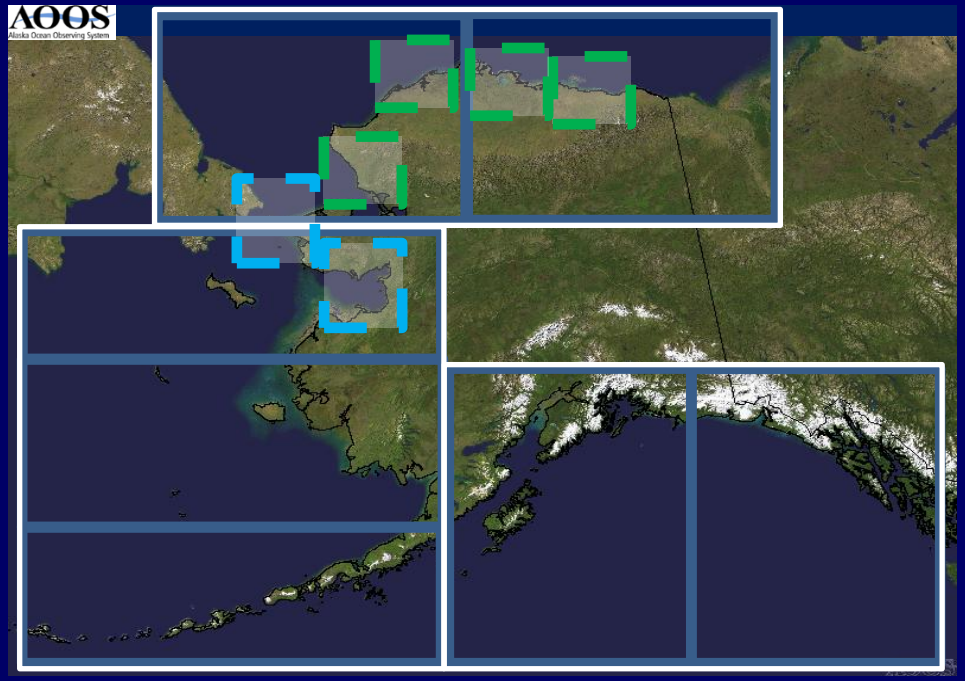
Sensors | All layers

Zoom to extent of layer

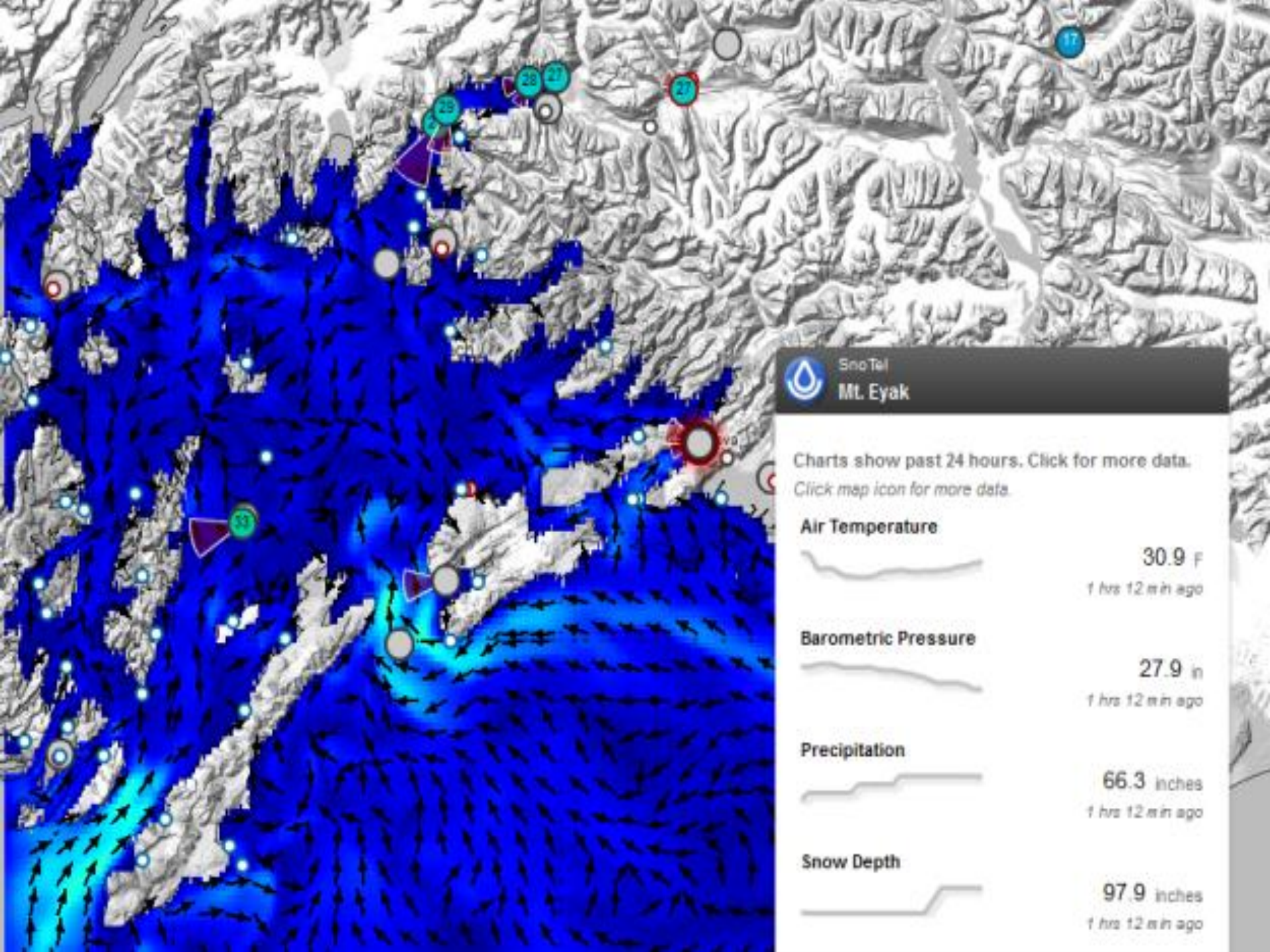
Search

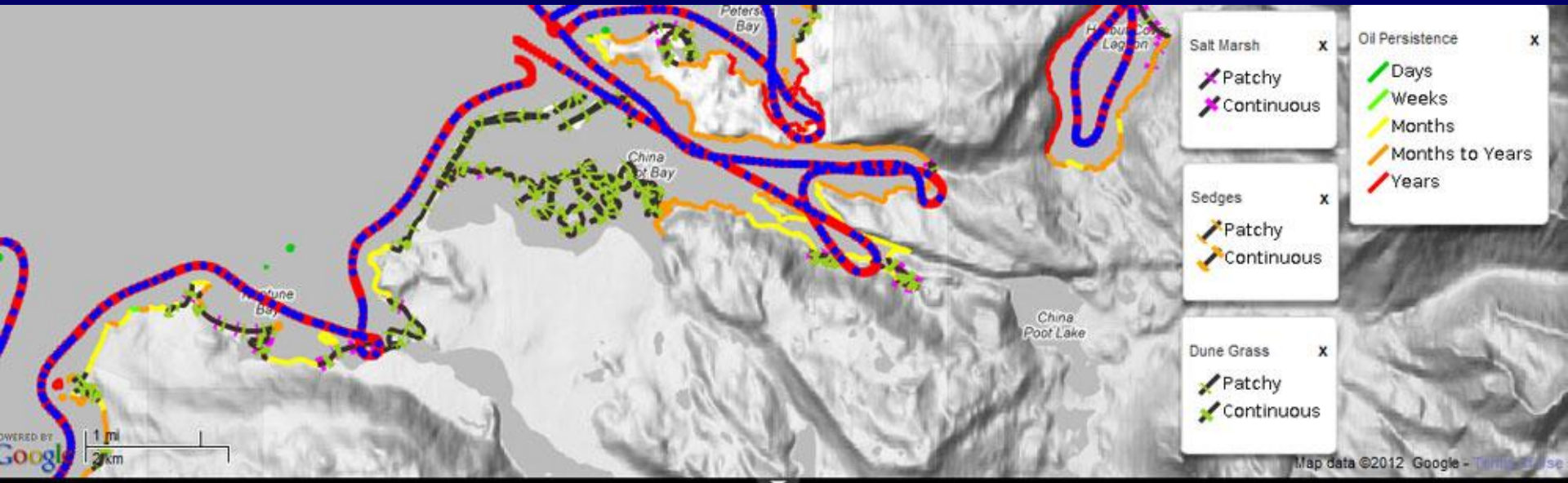
- Air Temperature
- Currents
- Depth to Sea Floor
- Dew Point
- Ground Temperature
- Precipitation
- Relative Humidity
- Salinity
- Sea Ice
- Snow Depth
- Snow Water Equivalent
- Water Level (Tides)
- Water Temperature
- Waves
- Winds

Area scale



- More point observations
- Sentinel monitoring
- Finer scale models & forecasts
- Add Shorezone detail
- GIS data layers


SnoTel
Mt. Eyak
Charts show past 24 hours. Click for more data.
Click map icon for more data.
Air Temperature
30.9 F
1 hrs 12 min ago
Barometric Pressure
27.9 in
1 hrs 12 min ago
Precipitation
66.3 inches
1 hrs 12 min ago
Snow Depth
97.9 inches
1 hrs 12 min ago

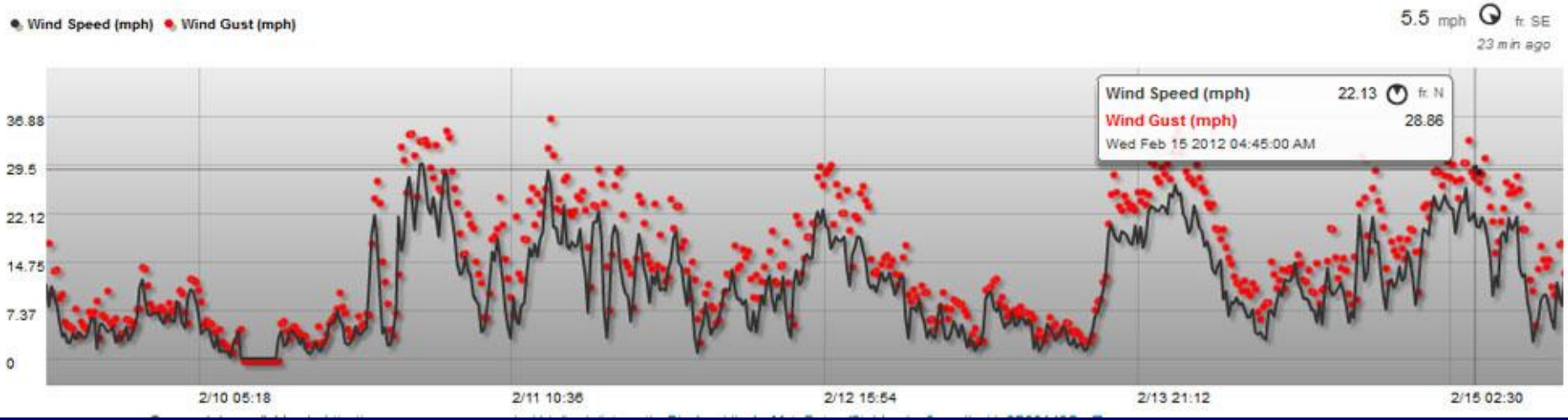


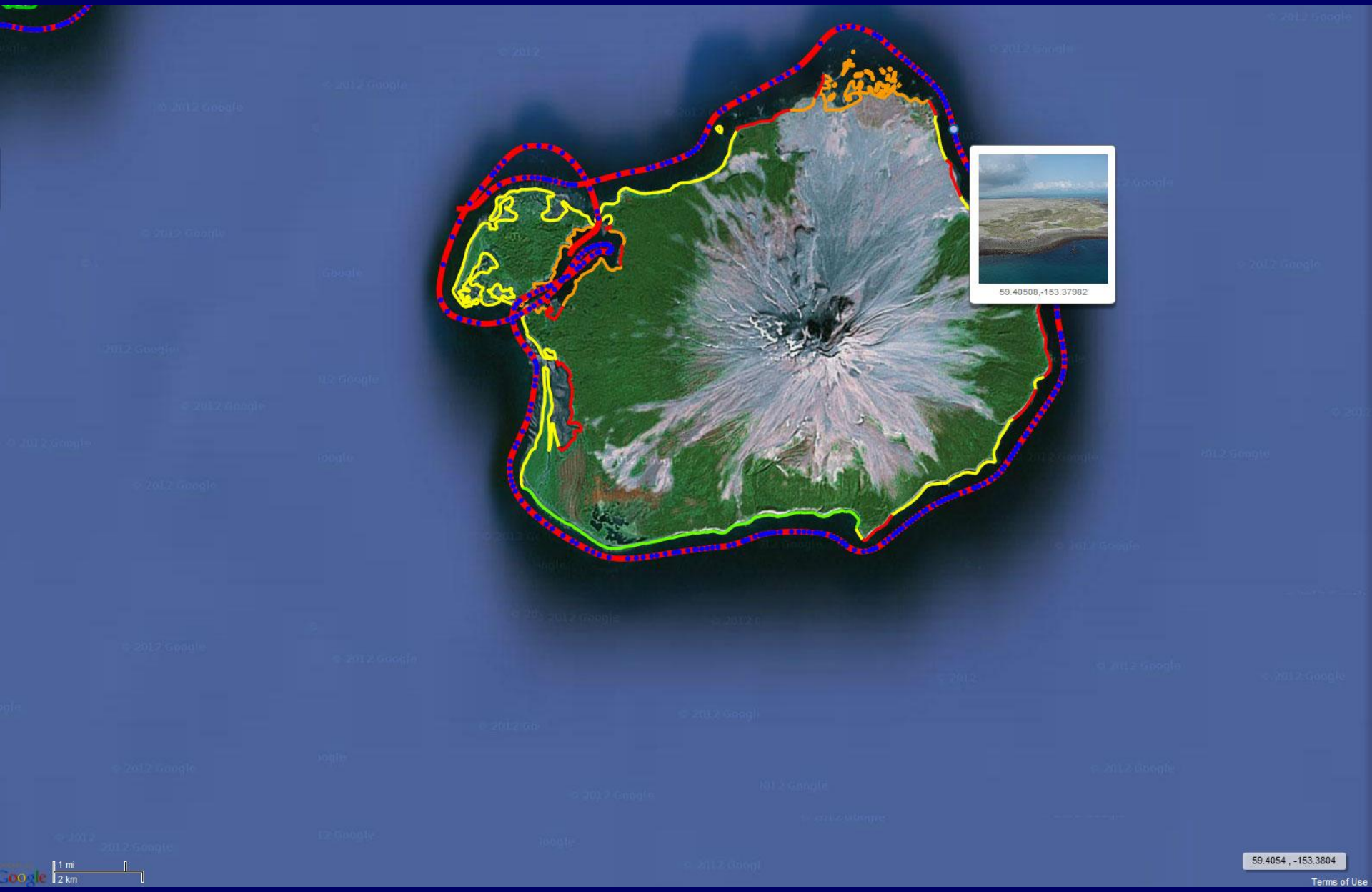
Sensor data

Kachemak Bay National Estuarine Research Reserve

NERRS meteorological site at Kachemak Bay Near Homer, 5SE

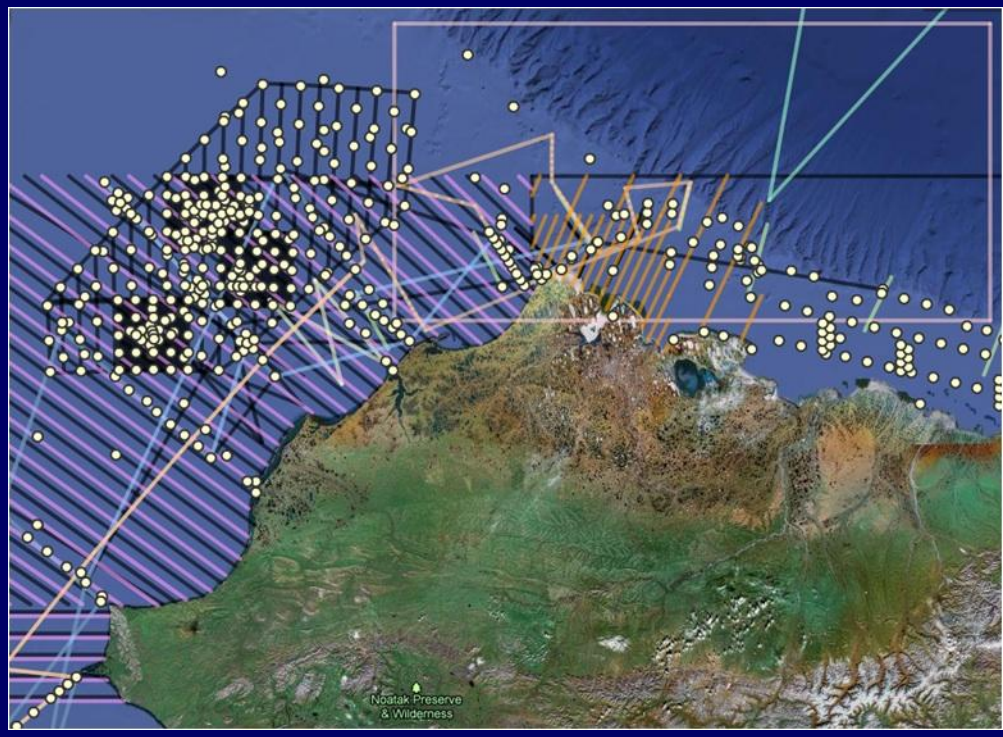
Air Temperature | Barometric Pressure | Battery | Precipitation | Relative Humidity | Solar Radiation | Winds




59.40508,-153.37982
1 mi
2 km
59.4054 , -153.3804
Terms of Use

Applications of build-out plan

1. Planning for other programs
2. Stakeholder dialogue
3. Facilitate coordination, collaboration



2010 Coastal Hazards Workshop

Participants included

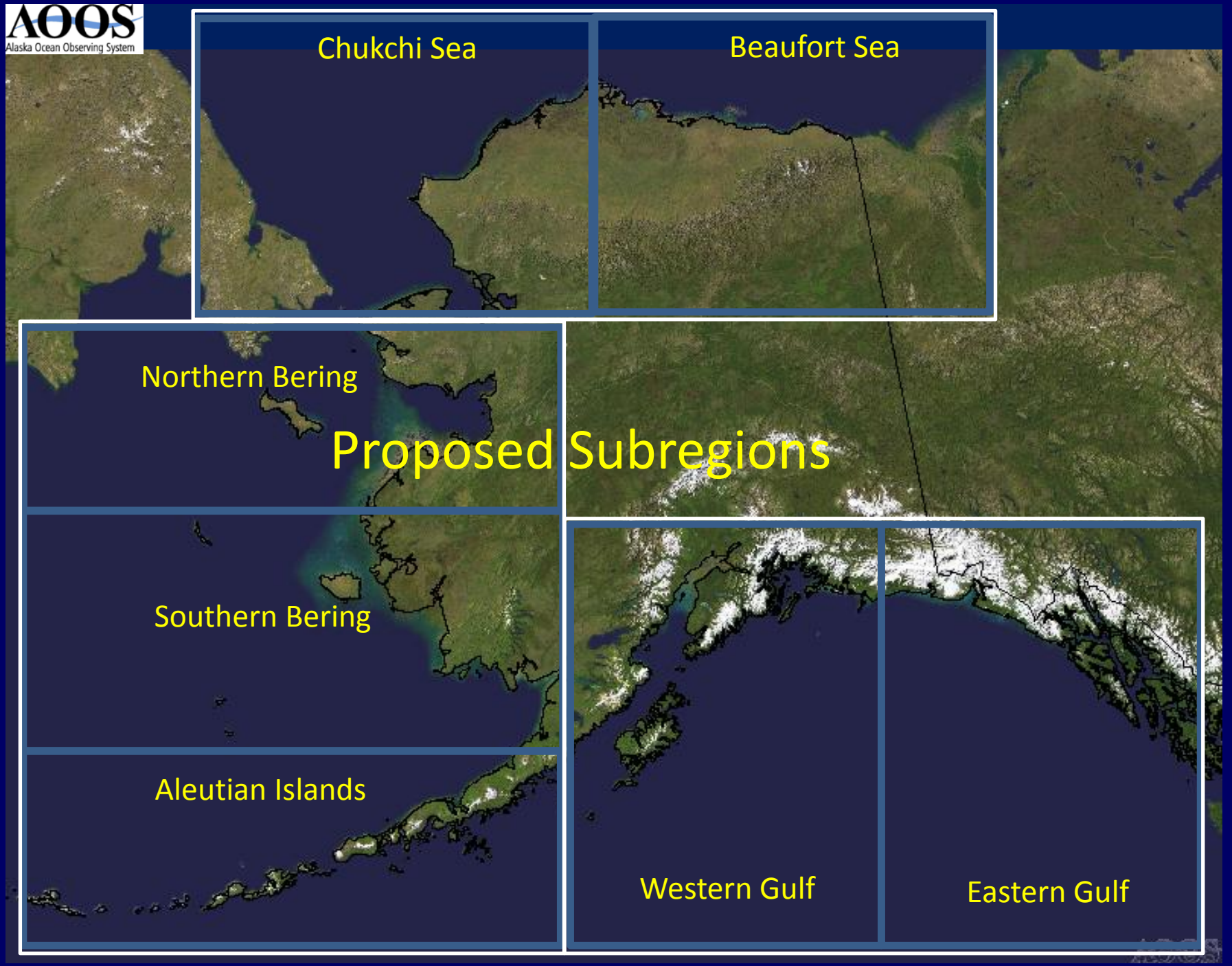
- Agencies
- Stakeholders
- Technical & scientific experts

Needs discussed

- Storm forecasting
- Sea ice: thickness, concentration, trajectory
- Digital coast: stitch together bathymetry & topography
- Erosion & shoreline change
- Shoreline observations
- Inundation
- Evacuation needs
- Data access

Recommendations

- For data: harbor obs, ice extent & thickness, shoreline obs
- For forecasts: storm surge/inundation; ice nowcast/forecast/trajectory; wave forecast/hindcast
- For data access tools: coastal hazards portal; project tracking system


AOOS
Alaska Ocean Observing System
Chukchi Sea
Beaufort Sea
Northern Bering
Proposed Subregions
Southern Bering
Aleutian Islands
Western Gulf
Eastern Gulf

COASTAL HAZARDS: REGION

Issue: Provide hazard & disaster info when & where needed

Products:

1. Improved forecasts for extreme weather events, storm surges & erosion events
2. Increase water obs & coastal inundation forecasts
3. Increase wave obs & forecasts
4. Improved sea ice thickness, extent and trajectory nowcasts/forecasts

Weather (NWS)

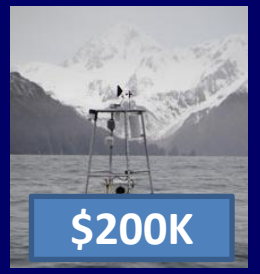
Waves (NDBC)

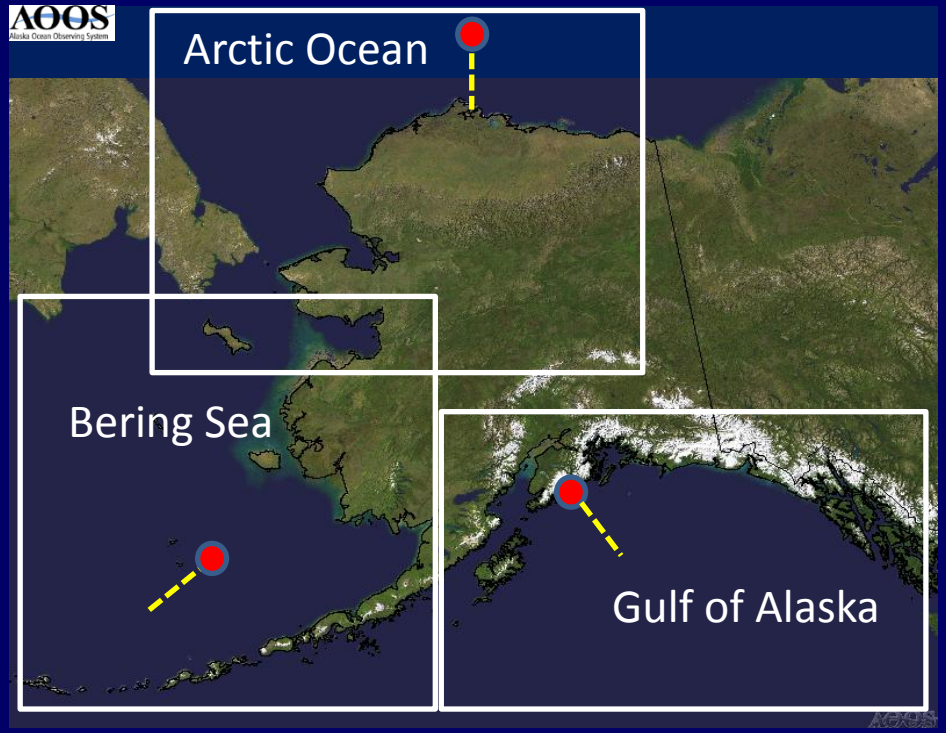
Sea surface (NASA/NOAA)

Aircraft (AOOS)

Glider (AOOS)

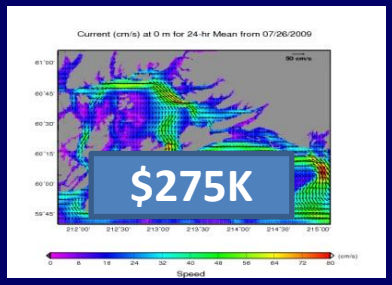
Buoy (AOOS)





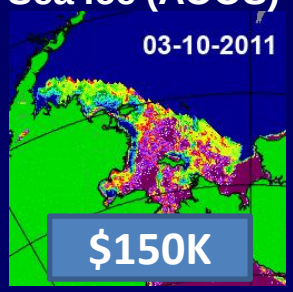
Mooring (AOOS)

Ocean (AOOS)



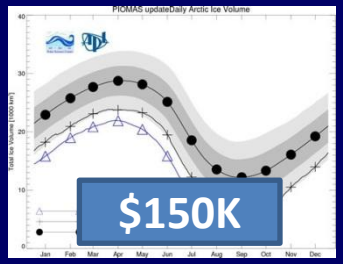
Ship (AOOS/DBO)

Sea Ice (AOOS)



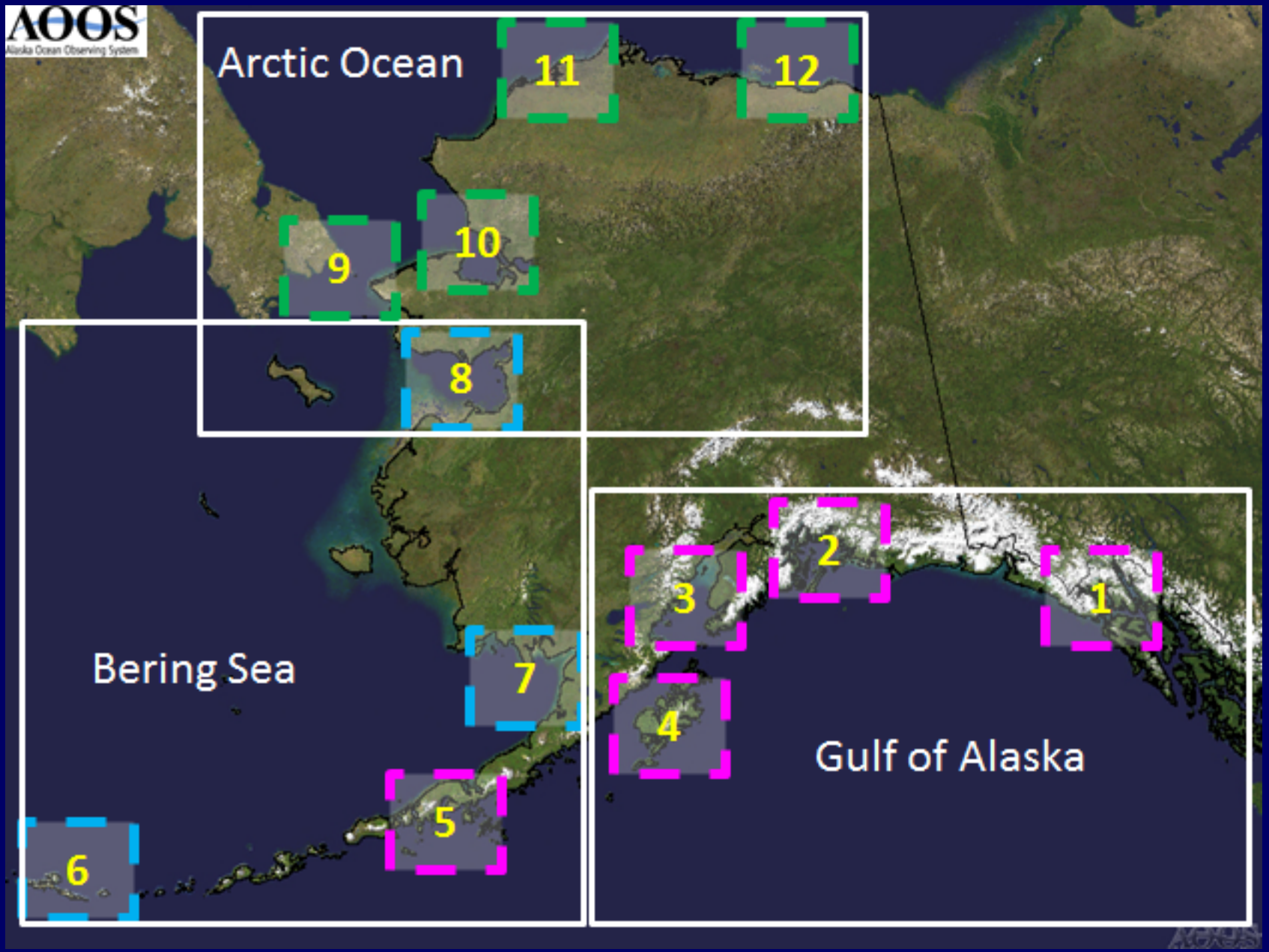
R&D (AOOS)

Annual Synthesis (AOOS)



HABs (AOOS)

Given: Areas within Regions



COASTAL HAZARDS: AREA

Issue: Provide hazard & disaster info when & where needed

Products:

1. Improved forecasts for extreme weather events, storm surges & erosion events
2. Increase water obs & coastal inundation forecasts
3. Increase wave obs & forecasts
4. Improved sea ice thickness, extent and trajectory nowcasts/forecasts

Geographic Focus				Observations and models				
Regions	Subregion	Areas	**	Platform	Parameters	Time step	Resolution	Spatial
Gulf of Alaska	Eastern	Dixon Entrance	1	Land	Wind speed	15 min	Point	Site*
		Cross Sound/Icy Strait	2	Land	Wind direction	15 min	Point	Site*
	Western	**Prince William Sound**	3	Land	Temperature air	15 min	Point	Site*
		Cook Inlet	4	Land	Pressure air	15 min	Point	Site*
		Kodiak	5	Buoy	Wave height	1 hr	Point	Site
Bering Sea	Aleutians	Alaska Peninsula	6	Buoy	Wave period	1 hr	Point	Site
		Adak	7	Buoy	Wave direction	1 hr	Point	Site
	Southern	Bristol Bay	8	Buoy	Water temperature	1 hr	Point	Site
		Pribilof Islands	9					
	Northern	Norton Sound	10					
		Bering Strait	11					
Arctic Ocean	Chukchi	Kotzebue Sound	12					
		Wainwright	13					
	Beaufort	Prudhoe Bay	14					
		Kaktovik	15					

**Areas in bold have some existing AOOS infrastructure

* minimum or 3 sites (TBD)/area

Forecasts for extreme weather events & storm surges: Same requirements as for weather & sea state conditions for mariners

Geographic Focus				Observations and models				
Regions	Subregion	Areas		Platform	Parameters	Time step	Resolution	Spatial
Bering Sea	Southern	Bristol Bay	8	Land	Water level	15 min	Point	Site
	Northern	Norton Sound	10	Model	Coastal inundation	0.5 hr	0.5 km	Area
		Bering Strait	11					
Arctic Ocean	Chukchi	Kotzebue Sound	12					
		Wainwright	13					
	Beaufort	Prudhoe Bay	14					
		Kaktovik	15					

Increase water level obs & coastal inundation forecasts:

- Only 3 NWLON sites north of Aleutians
- Deploy sensors at new sites (bottom mount for modeling & planning; real-time for forecasting)
- Develop coastal inundation models

Geographic Focus			
Regions	Subregion	Areas	
Gulf of Alaska	Eastern	Dixon Entrance	1
		Cross Sound/Icy Strait	2
	Western	Prince William Sound	3
		Cook Inlet	4
		Kodiak	5
Bering Sea	Aleutians	Alaska Peninsula	6
		Adak	7
	Southern	Bristol Bay	8
		Pribilof Islands	9
	Northern	Norton Sound	10
		Bering Strait	11
Arctic Ocean	Chukchi	Kotzebue Sound	12
		Wainwright	13
	Beaufort	Prudhoe Bay	14
		Kaktovik	15

Observations and models				
Platform	Parameters	Time step	Resolution	Spatial
Buoy	Wave height	1 hr	Point	Area
Buoy	Wave period	1 hr	Point	Area
Buoy	Wave direction	1 hr	Point	Area
Buoy	Water temperature	1 hr	Point	Area
Model	Wave Nowcast/Forecast	6hr/48hr	1 km	Area

Increase wave observations & forecasts

Deploy additional wave buoys

Develop & operate wave forecasting models

Geographic Focus				Observations and models				
Regions	Subregion	Areas	**	Platform	Parameters	Time step	Resolution	Spatial
Gulf of Alaska	Western	**Cook Inlet**	**4**	Land	Wind speed	15 min	Point	Site*
Bering Sea	Southern	Bristol Bay	8	Land	Wind direction	15 min	Point	Site*
		Pribilof Islands	9	Land	Temperature air	15 min	Point	Site*
	Northern	Norton Sound	10	Land	Pressure air	15 min	Point	Site*
		Bering Strait	11	Model	Weather Nowcast/Forecast	6hr/48hr	3 km	Area
Arctic Ocean	Chukchi	Kotzebue Sound	12	Mooring	Ice thickness	24 hr	Point	Site
		Wainwright	**13**	Radar	Ice density and trajectory	15 min	1 km	Site
	Beaufort	Prudhoe Bay	14	Webcams	Ice floe density	15 min	Point	Site
		Kaktovik	15	Model	Ice trajectory	6hr/48hr	1 km	Area
				Model	Sea Ice Nowcast/Forecast	6hr/48hr	3 km	Area

** Areas in bold have some existing AOOS infrastructure

*minimum of 3 sites (TBD)/area

Improved sea ice thickness, extent & trajectory nowcasts/forecasts

Requirements are same for marine operations/navigation safety

Weather (AOOS)

$30K

Water Level (AOOS)

$125K

Waves (AOOS)

$200K

Mooring (AOOS)

$350K

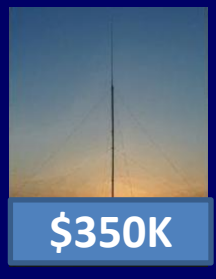
Glider (AOOS)

$150K

Vessel (AOOS)

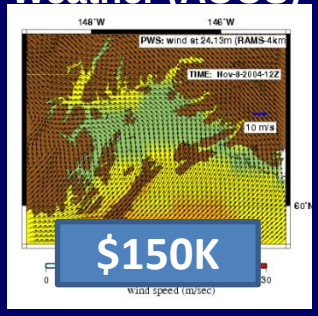
$100K

HR Radar (AOOS)



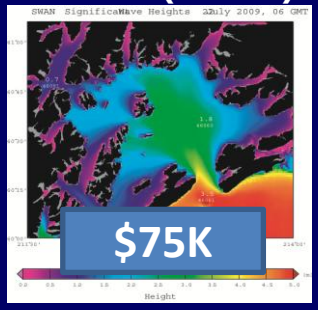
$350K

Weather (AOOS)

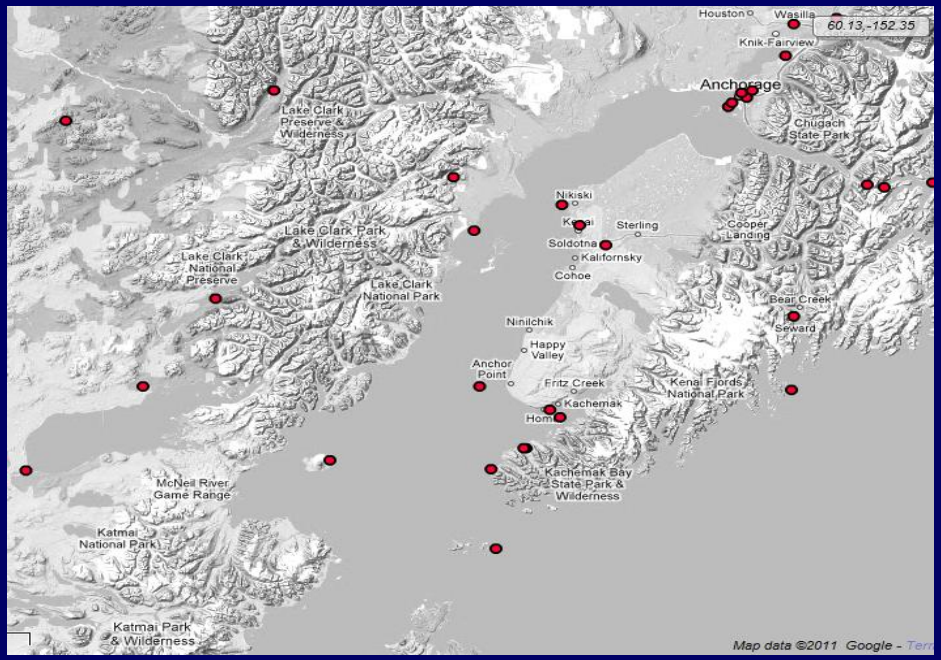


$150K

Waves (AOOS)



$75K



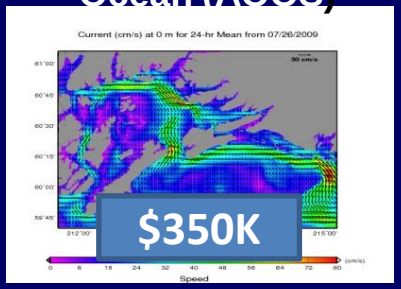
Vessel/Aircraft Surveys (AOOS)

$100K

Sea surface (NASA/NOAA)

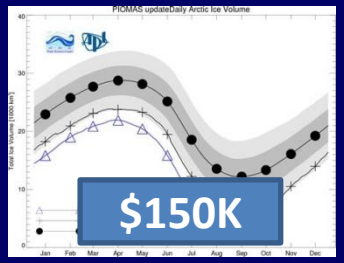
$20K

Ocean (AOOS)



$350K

Annual Synthesis (AOOS)



$150K

R&D (AOOS)

$150K

HABs (AOOS)

$30K

Questions for you

- Are these still the right issues & products?
- What are priorities?
  - for products
  - for platforms
  - for locations to deploy

www.aoos.org

www.aoos.org/aoos-drafts-10-year-build-out-plan

Molly McCammon
mccammon@aoos.org