Lessons Learned in Developing an Alaska Ocean Observing System

PICES Annual Meeting

October 26, 2010

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Co-authors: Dr. Carl Schoch and Ms. Darcy Dugan

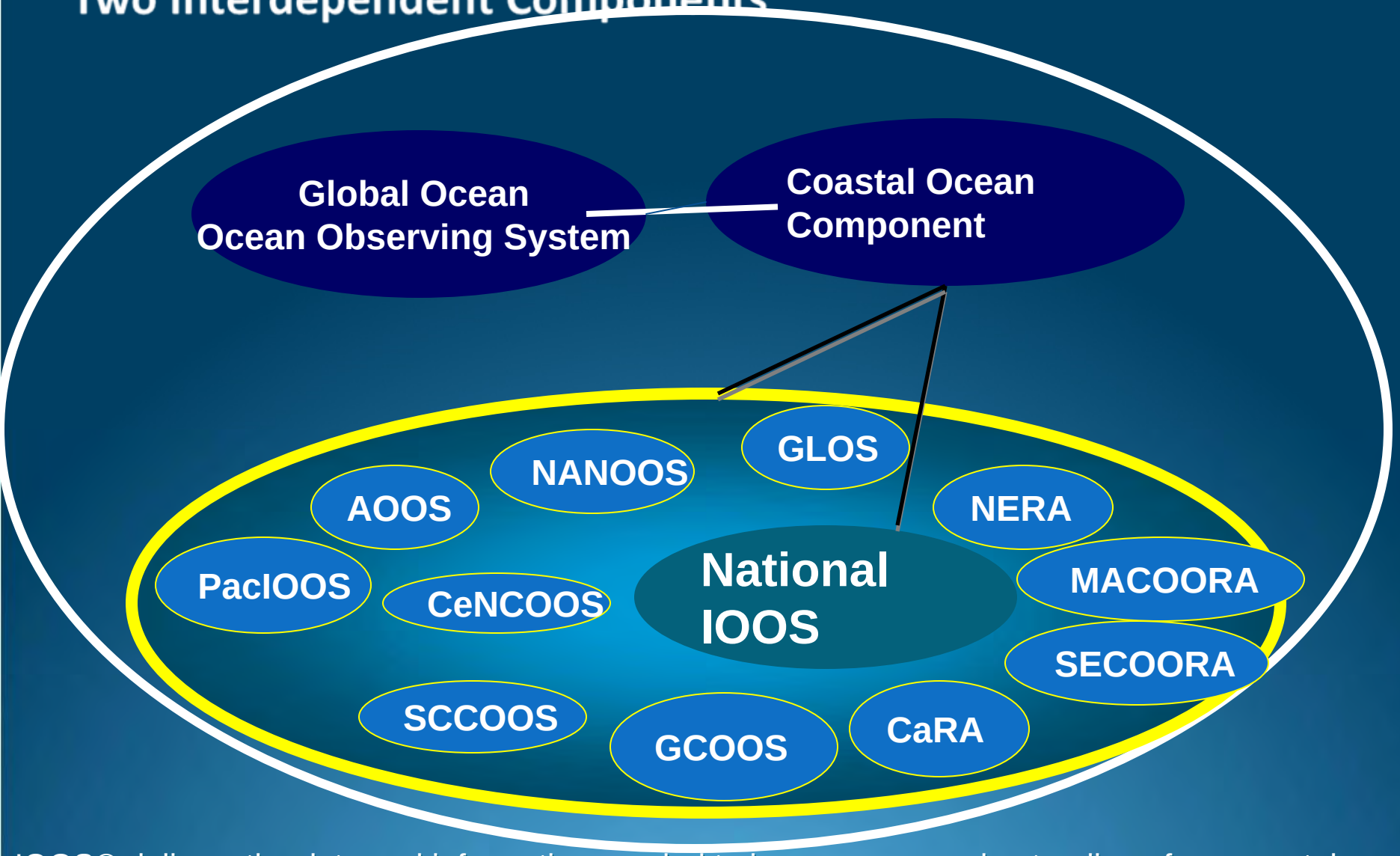
- Alaska Ocean Observing System

www.aoos.org

AOOS

Alaska Ocean Observing System

U.S. IOOS
Two Interdependent Components

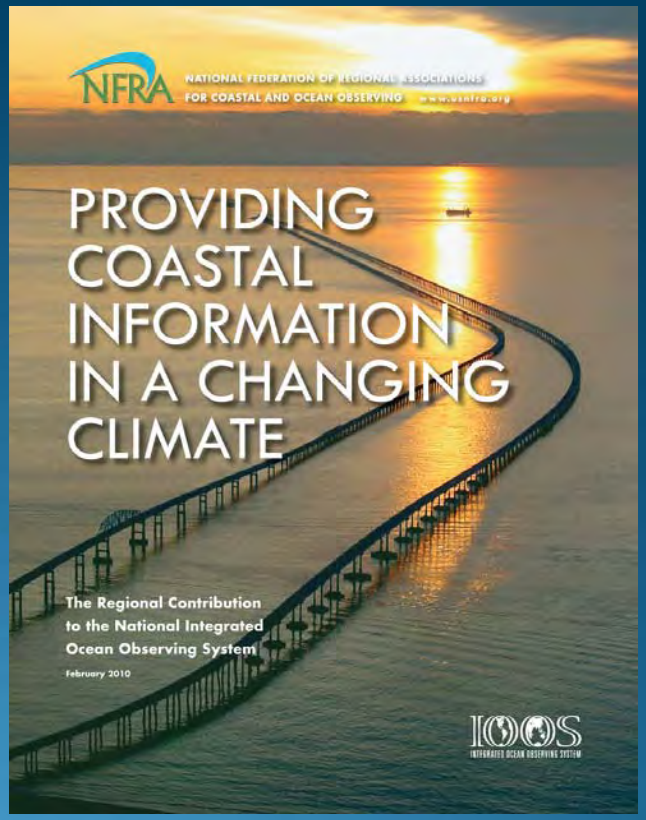


IOOS® delivers the data and information needed to increase our understanding of our coastal waters so decision makers can take action to improve safety, enhance our economy, and protect our environment.

Regional IOOS meets societal needs: a national program

- Climate variability & change
- Ecosystems, fisheries & water quality
- Coastal Hazards
- Marine Operations
- Coastal & Marine Spatial Planning

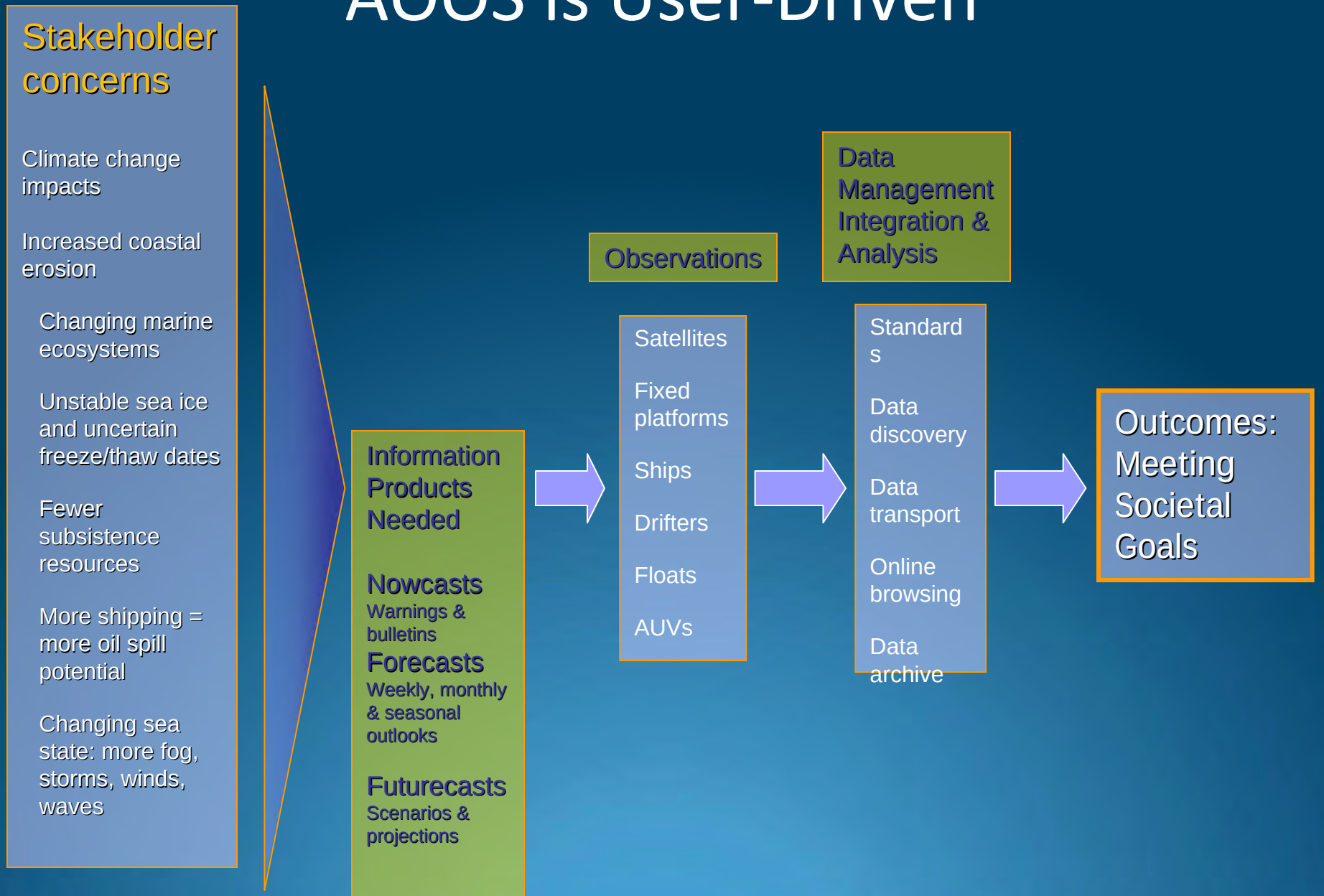
POLICY NEUTRAL



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

AOOS is User-Driven

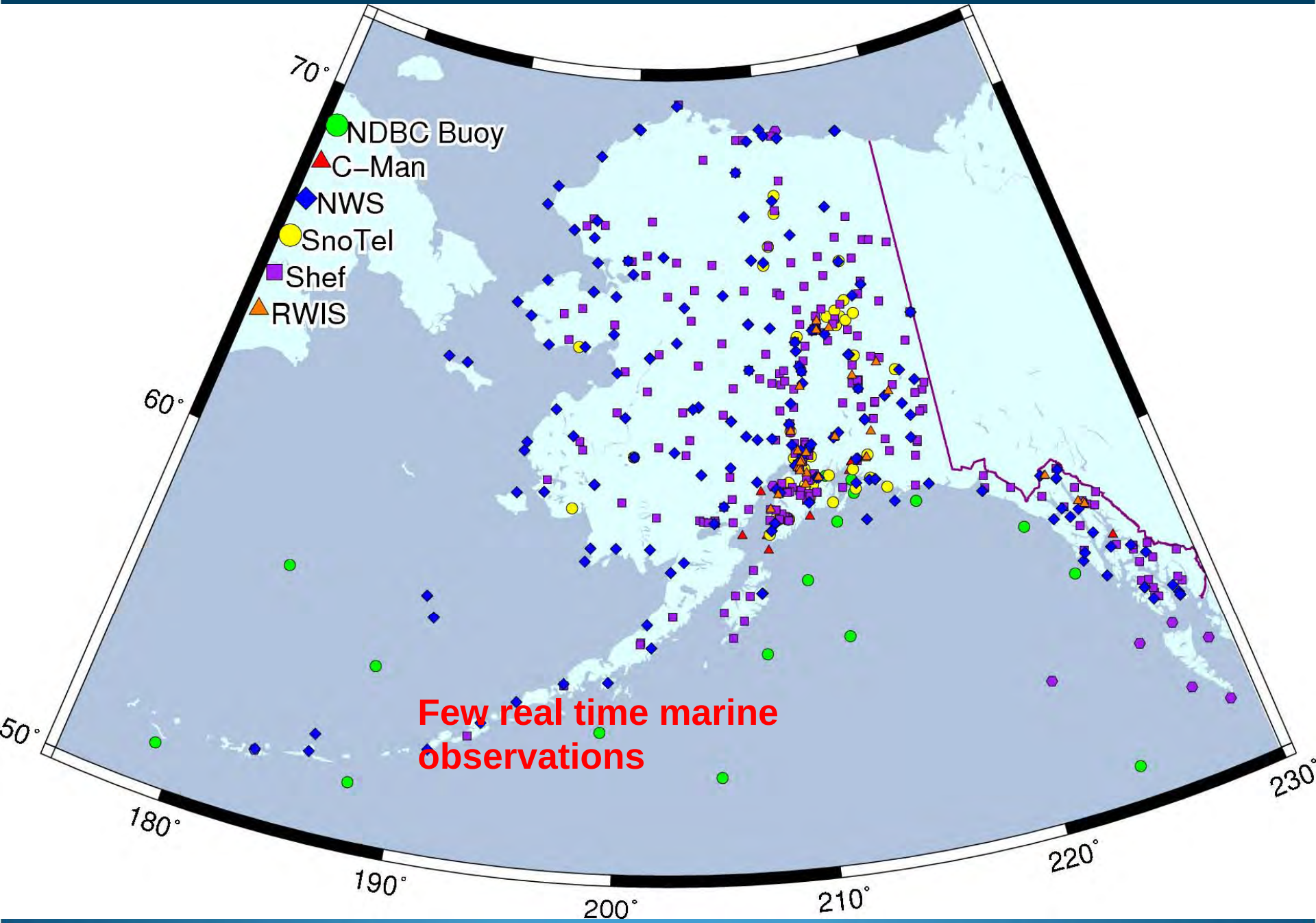


Original thinking in 2003

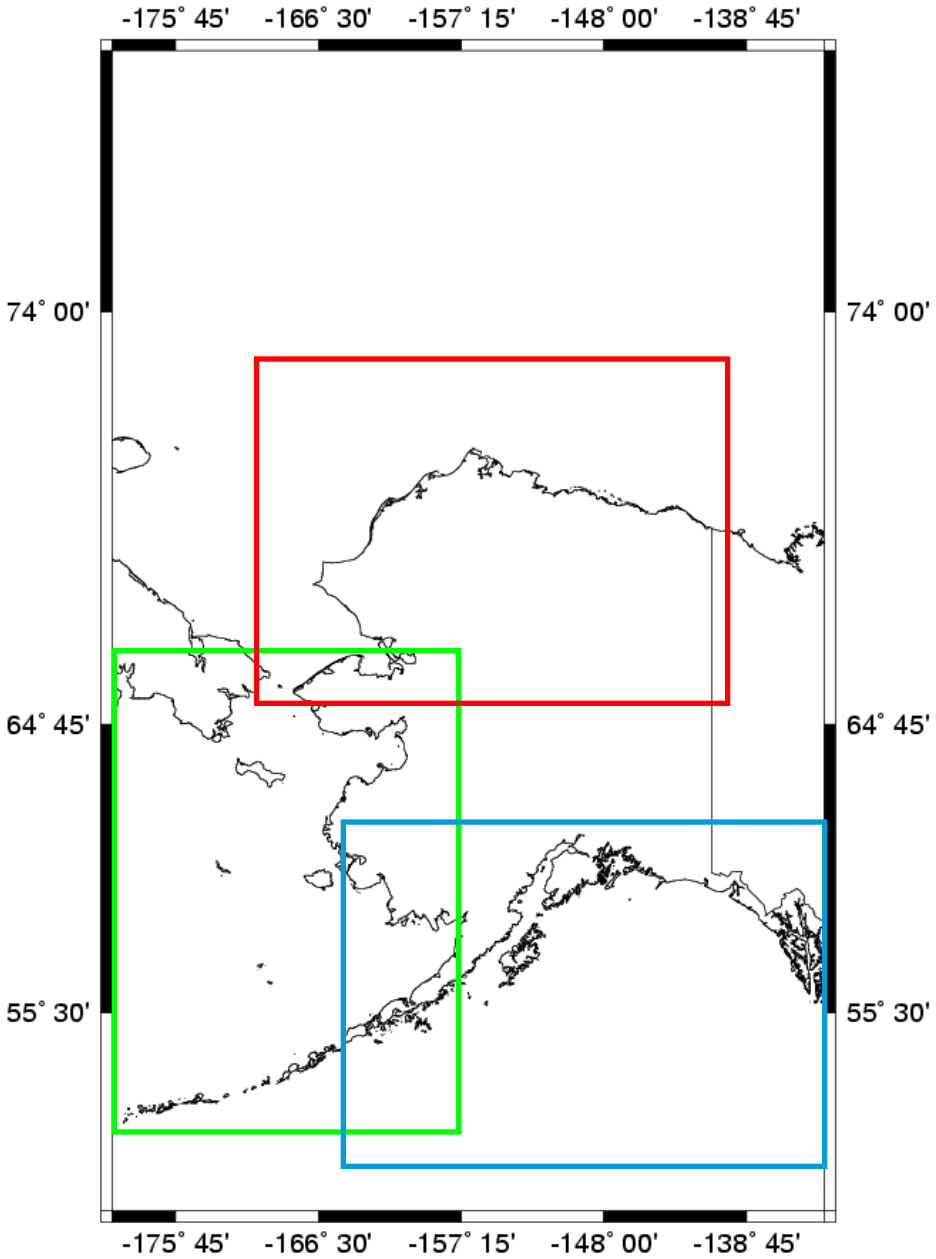
- IOOS program would be well funded - $30 million per region
- Centralized data portal for state was critical need
- Start with PWS as demonstration project – then expand to statewide
- Non-NOAA agencies would step up
-

AOOS VISION: Statewide Strategy

- Increase observation capacity in state:
  - Identify gaps in national backbone to meet larger, more statewide and national needs
  - Develop strategy to fill in gaps – influence federal agency budgets
  - Integrate obs that cross agency missions & disciplines
- Integrate data and provide information products for stakeholders
- Provide coordination/collaboration focal point


NDBC Buoy
C–Man
NWS
SnoTel
Shef
RWIS
70°
60°
50°
180°
190°
200°
210°
220°
230°
Few real time marine observations


But many surveys and
temporary deployments

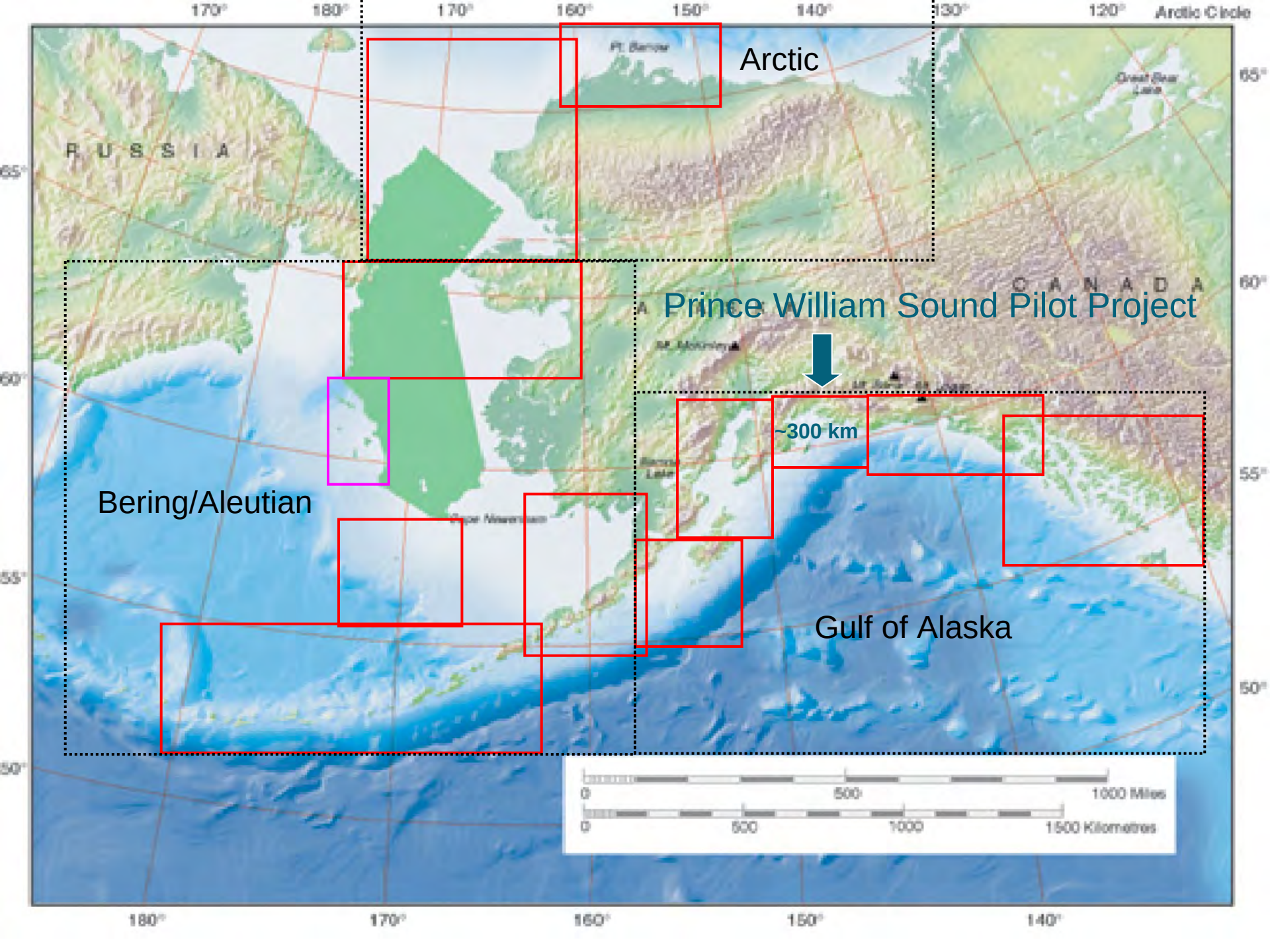


Statewide Sub-regions

Arctic

Bering

Gulf of Alaska


Arctic
Prince William Sound Pilot Project
~300 km
Bering/Aleutian
Gulf of Alaska
RUSSIA
CANADA
Arctic Circle
0 500 1000 Miles
0 500 1000 1500 Kilometres

AOOS Stakeholder needs: inform key regional themes

based upon 100+ meetings & interviews

Safe marine operations

- Improved, real-time ocean conditions and forecasts
- Real-time sea ice conditions (thickness, extent, movement) and forecasts
- Improved search and rescue
- Oil spill response

Fisheries, changing marine ecosystems

- Climate change impacts
- Ocean temperature, salinity, chemistry – including acidification
- Changes to food webs
- Impacts to commercial & subsistence uses

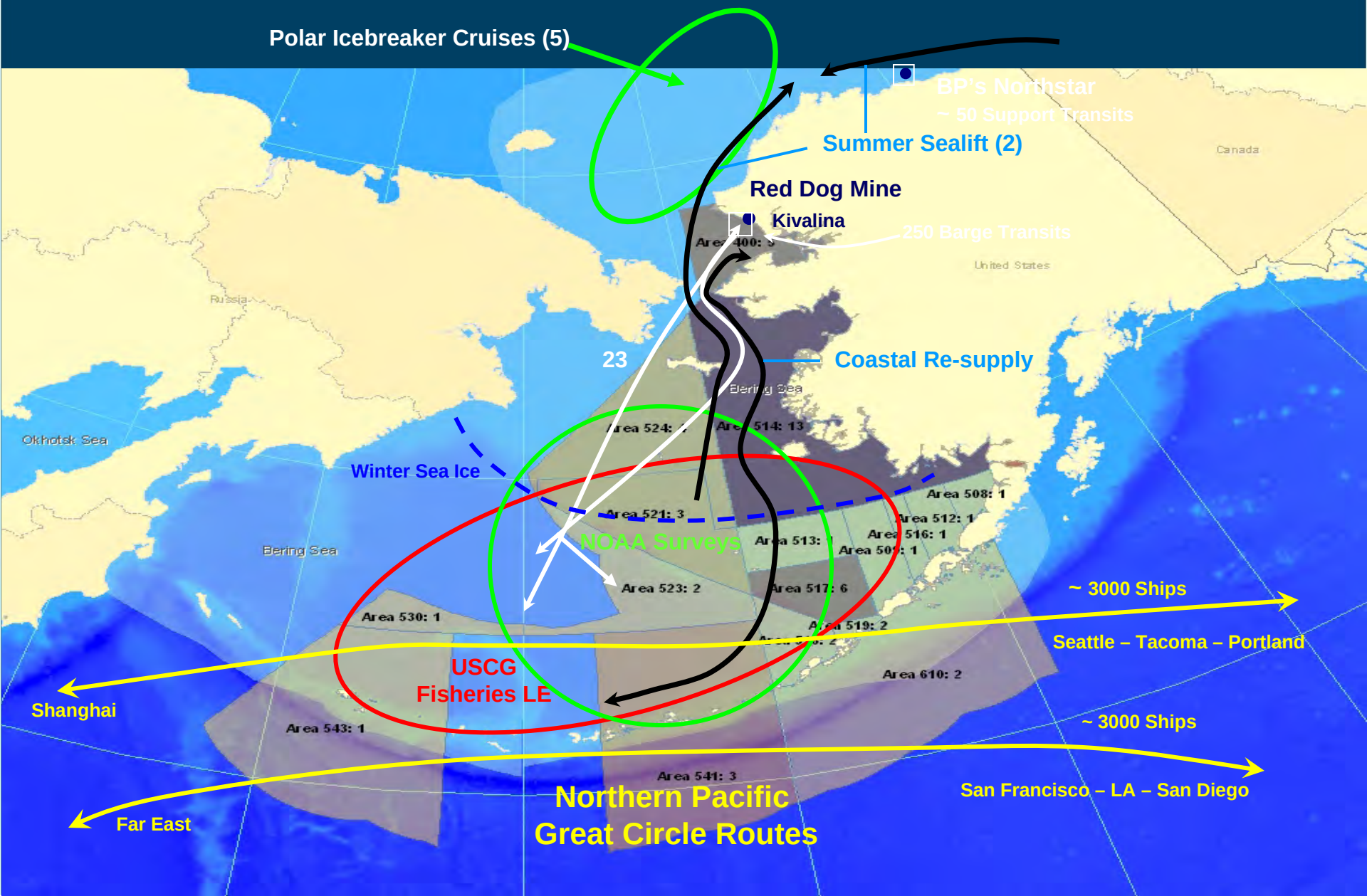
Natural hazard mitigation

- Coastal erosion impacts
- Wave height & direction and storm surge modeling
- Landfast and sea ice conditions

Climate change trends and impacts

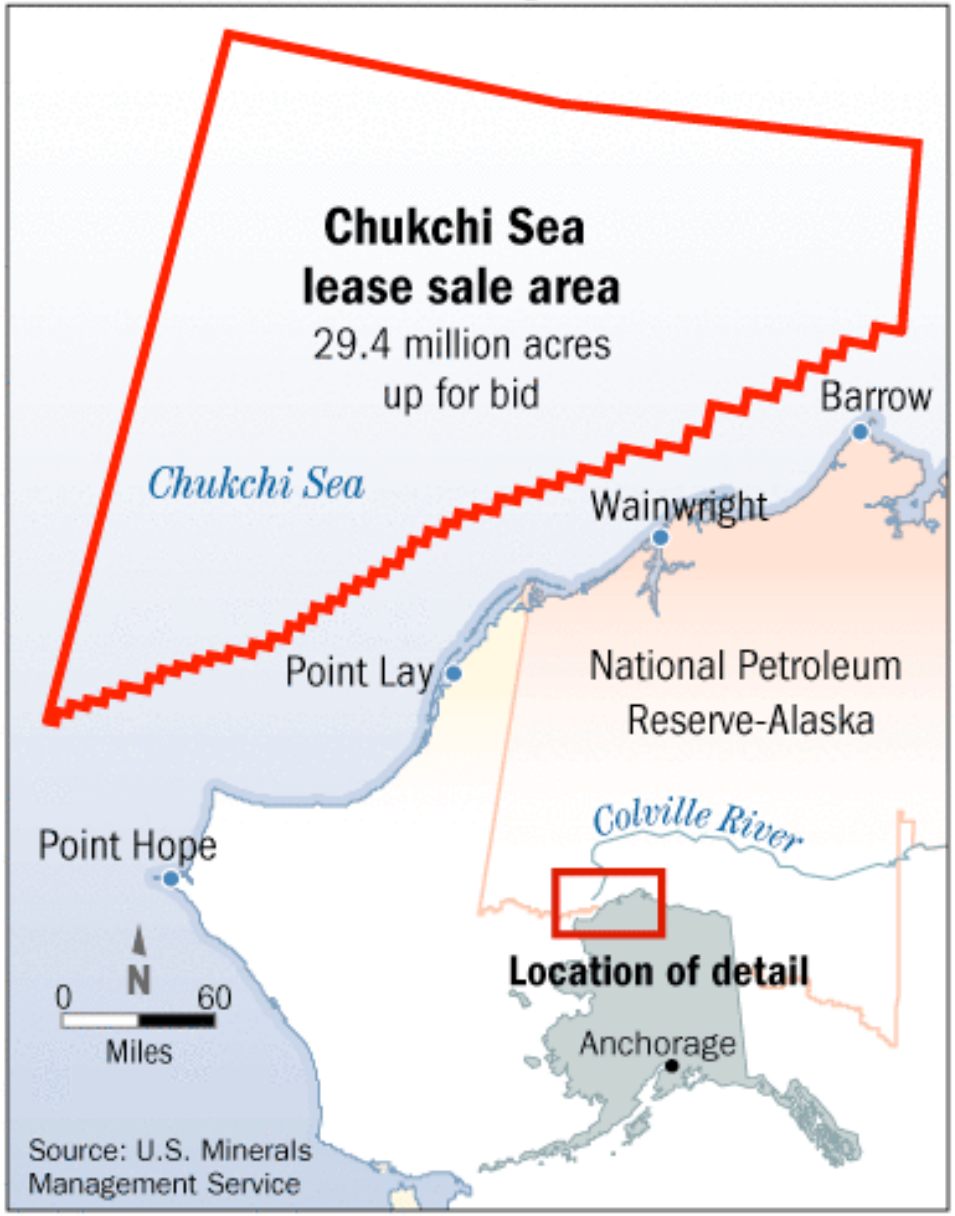
- Changing ocean conditions – nowcasts and forcasts
- Changing sea ice
- Changes to freshwater input
- Changes to sea ice thickness, extent, freeze-up and break-up

U.S. AMSA 2004 Data Survey

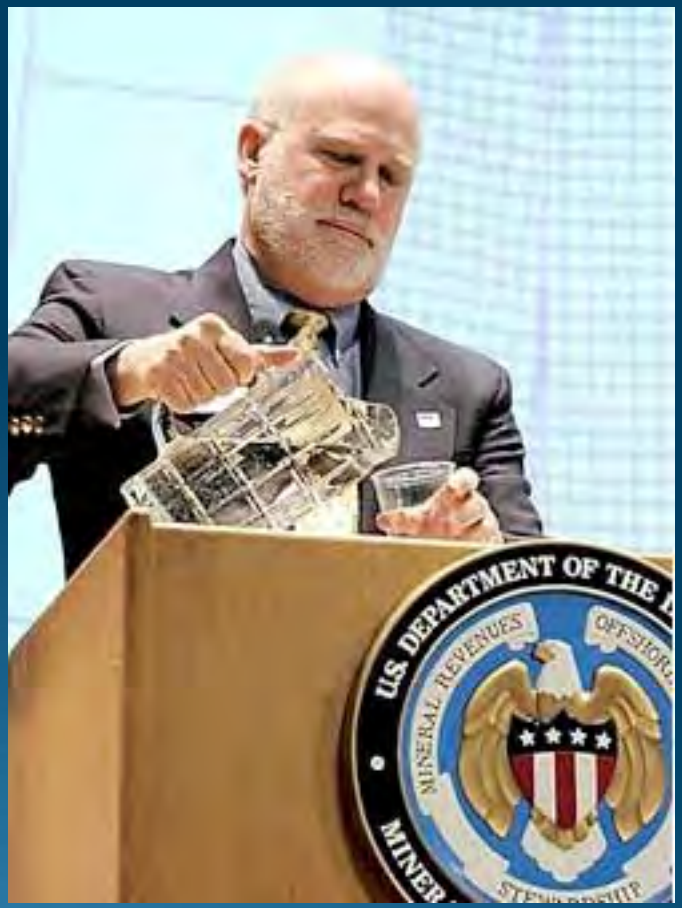


Potential Arctic Shipping Routes

Record $2.7 billion bid for Alaska oil and gas leases



RON ENGSTROM / Anchorage Daily News



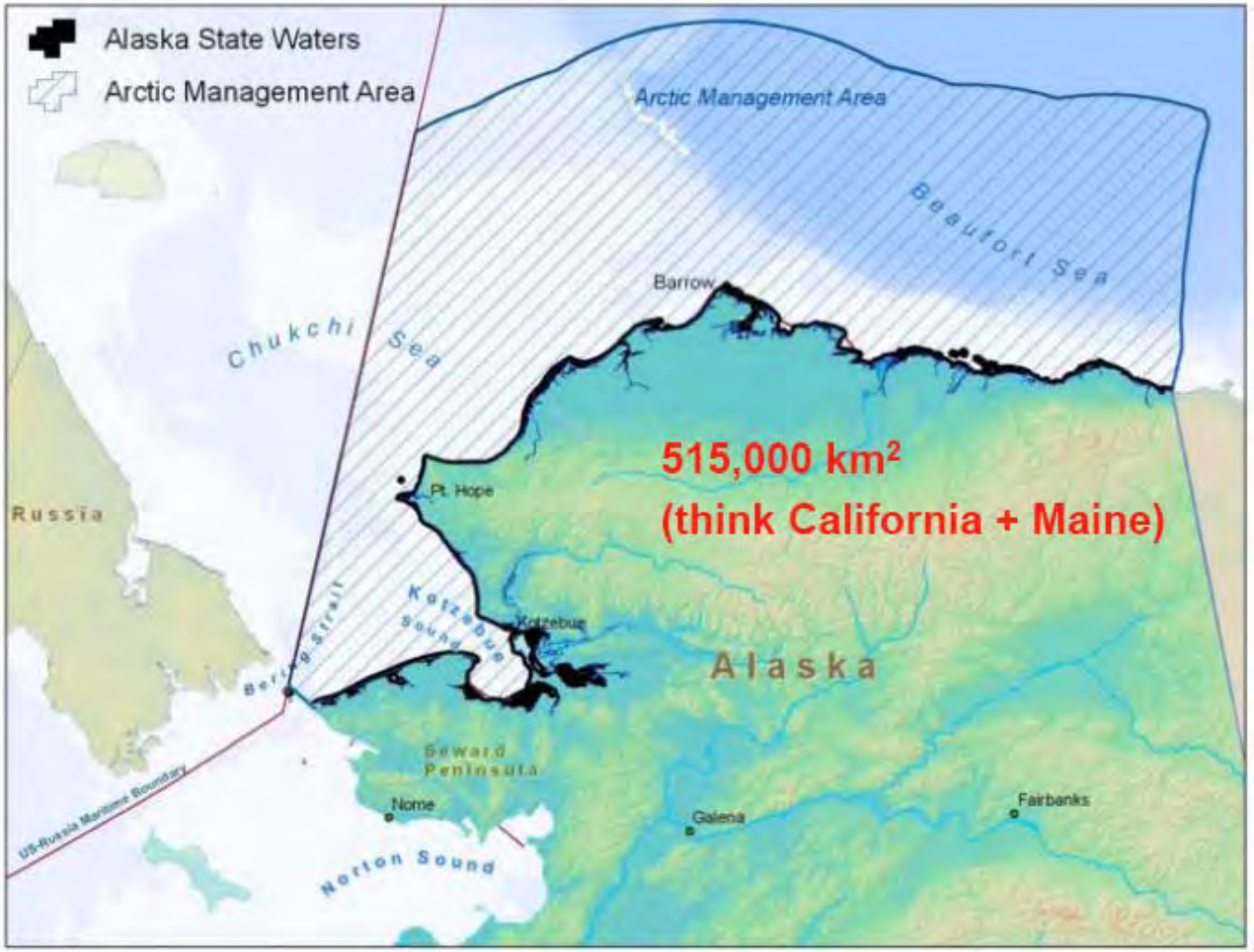
Minerals Management Service's John Goll announces the 667 lease sale bids for the Chukchi Sea totaling $2.7B, the largest in Alaska's history.

Photo/Rob Stapleton/AJOC 2/7/08

NOAA
FISHERIES
SERVICE

Arctic Fishery Management Plan

- Closes Arctic Management Area to commercial fishing
- Public comment period and Secretarial review



Per NPFMC final action in February 2009

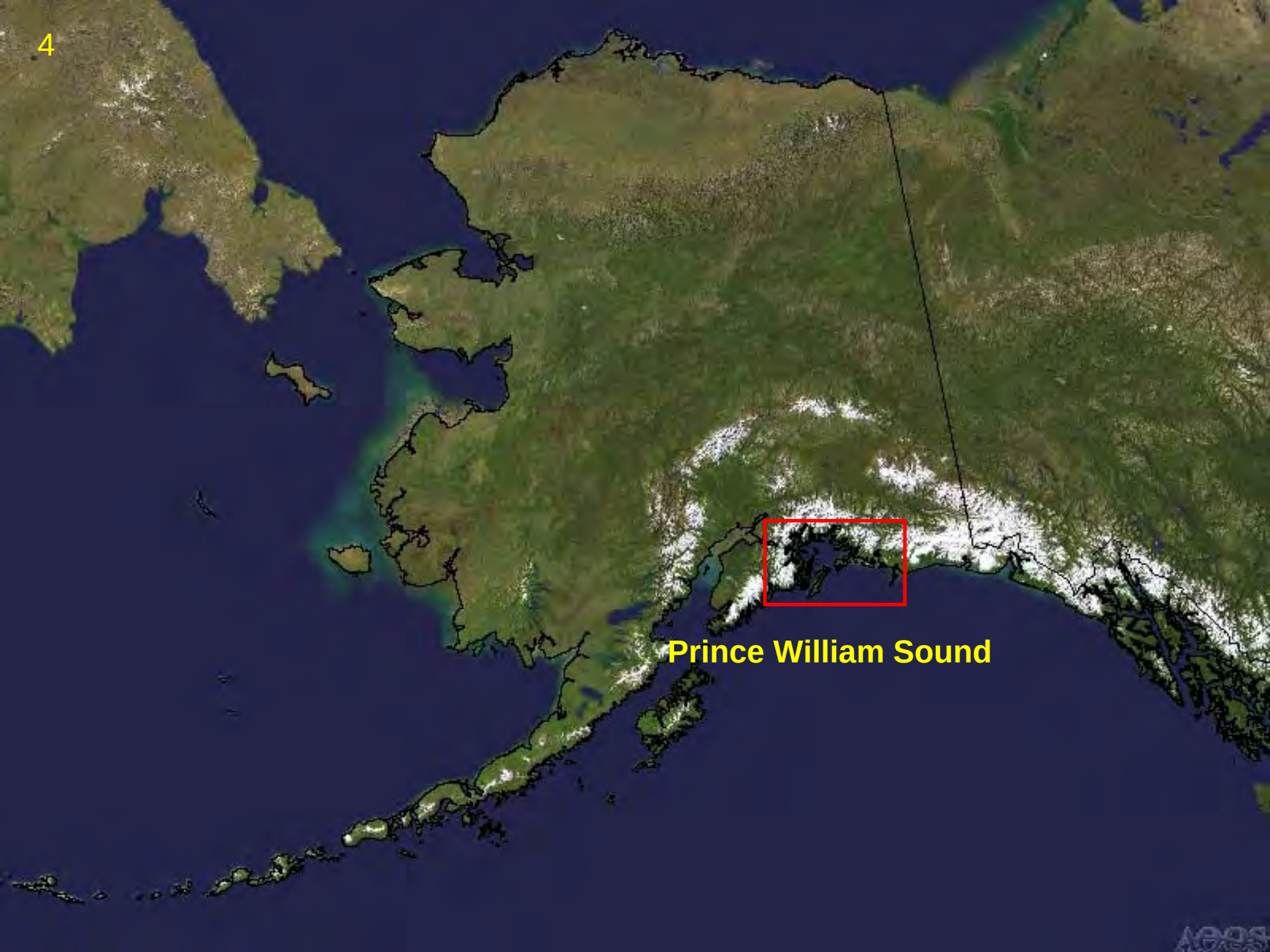
Dr. Mike F. Sigler, NMFS


CAT
D7H LGP

Gulf of Alaska Data Users and Products

- Users
  - navigation services
  - aviation
  - commercial fishing
  - recreational boaters
  - oil & gas development
  - search & rescue
  - tourism
  - aquaculture/mariculture

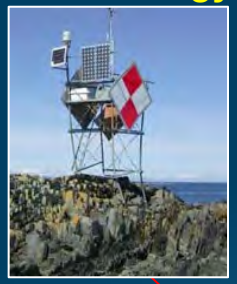
- Information products
  - sea conditions
  - ocean circulation patterns
  - coastal erosion predictions
  - nowcast/forecasts for search & rescue & oil spill response
  - fisheries/ecosystem productivity
  - toxic plankton bloom forecasts


Prince William Sound

Data Assimilation and Modeling Products

Sea Surface Conditions

Meteorology



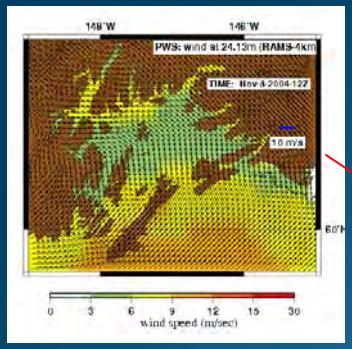
Oceanography

Water Quality

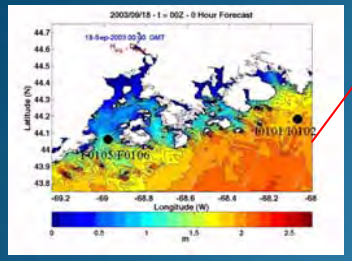
Currents

Precipitation

PWS Weather



PWS Waves



Data Assimilation

Data Assimilation

PWS ROMS

Model Data

Real time data Retrieval & Processing

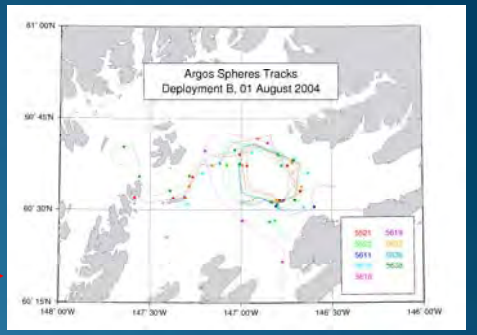
3D Model Assimilation

Application Server

Research Server

Feedback

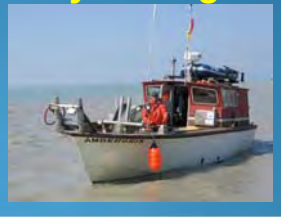
Field Validation Experiments



Education

Economic models

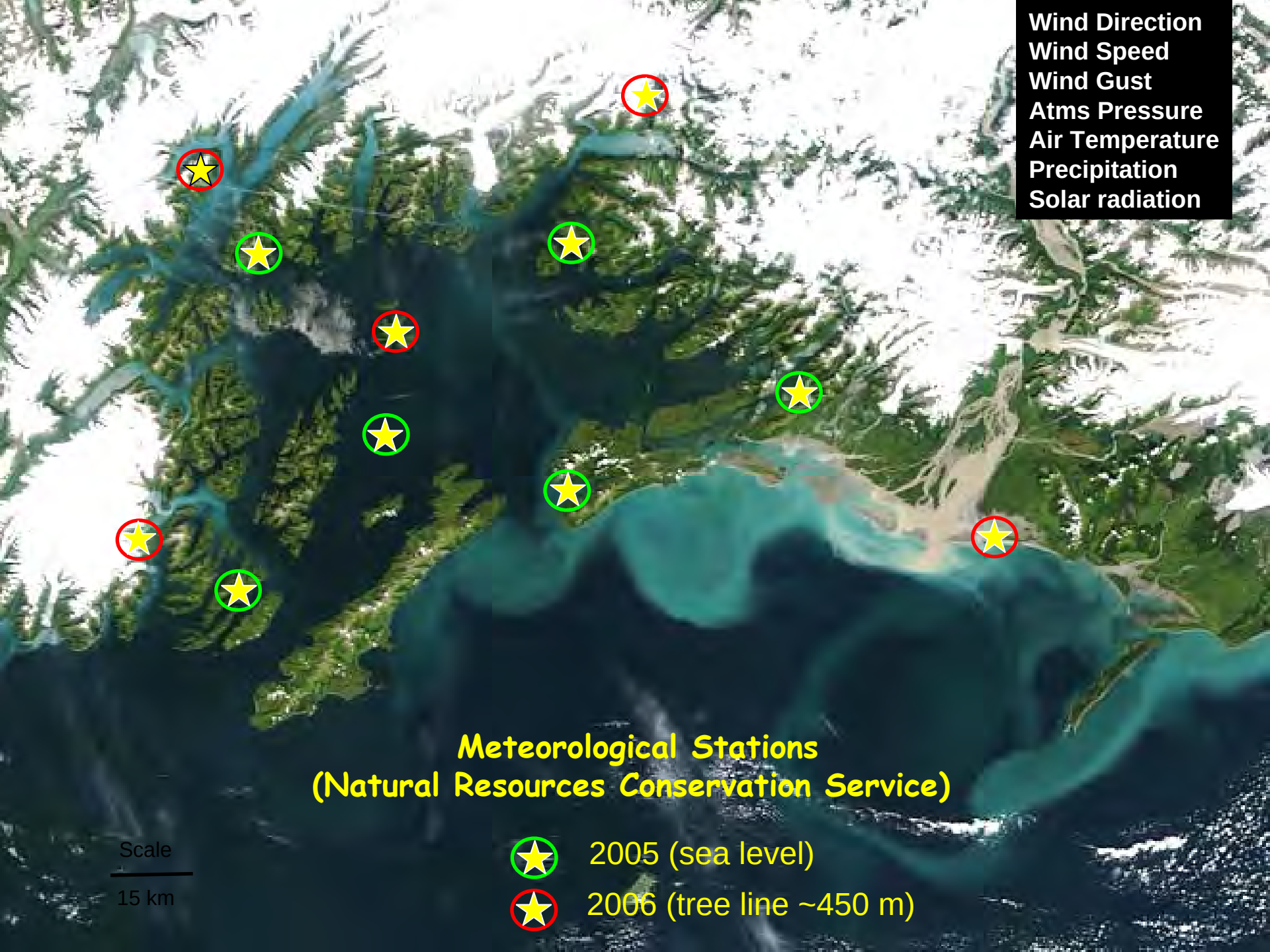
Fishery management



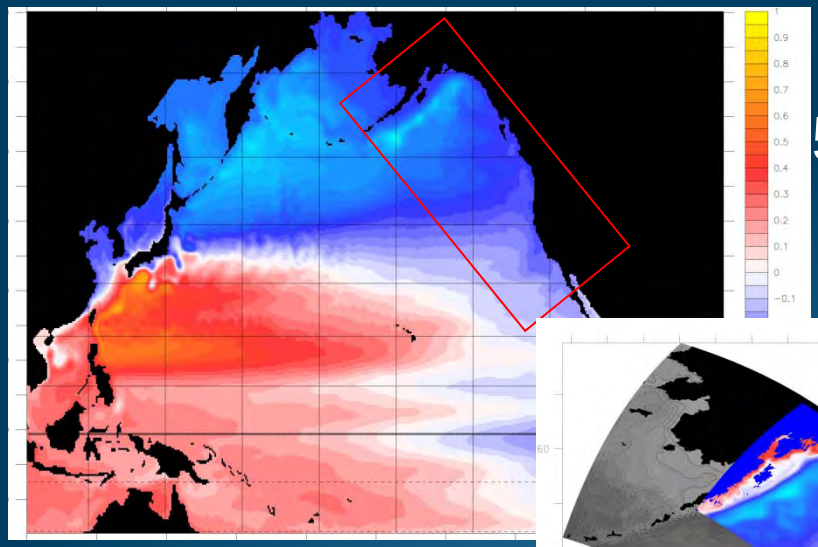
Communities


Five-year Oceanographic Moorings
and seasonal Hydrographic Surveys
Scale
15 km

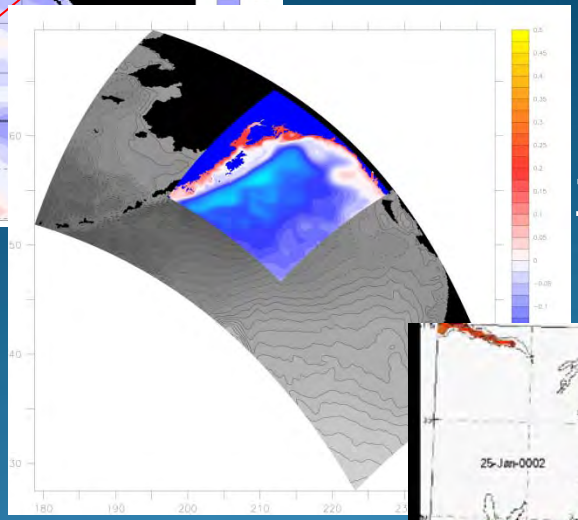

Web Cameras (12)
Scale
15 km


Wind Direction
Wind Speed
Wind Gust
Atms Pressure
Air Temperature
Precipitation
Solar radiation
Meteorological Stations
(Natural Resources Conservation Service)
Scale
15 km
2005 (sea level)
2006 (tree line ~450 m)

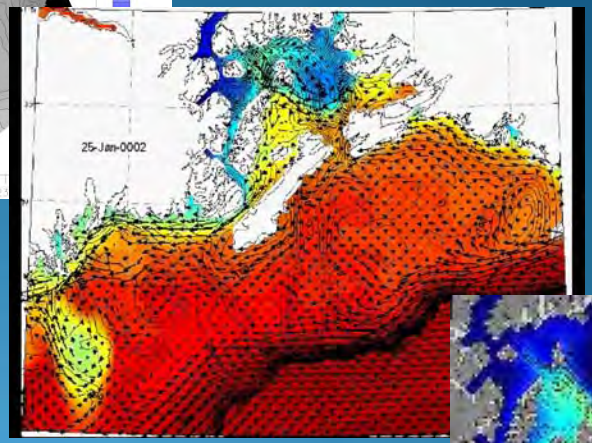
Regional Ocean Modeling System (ROMS)



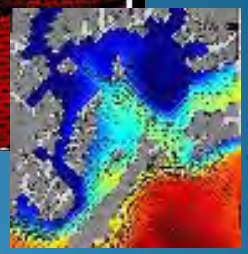
50 km grid



12 km grid



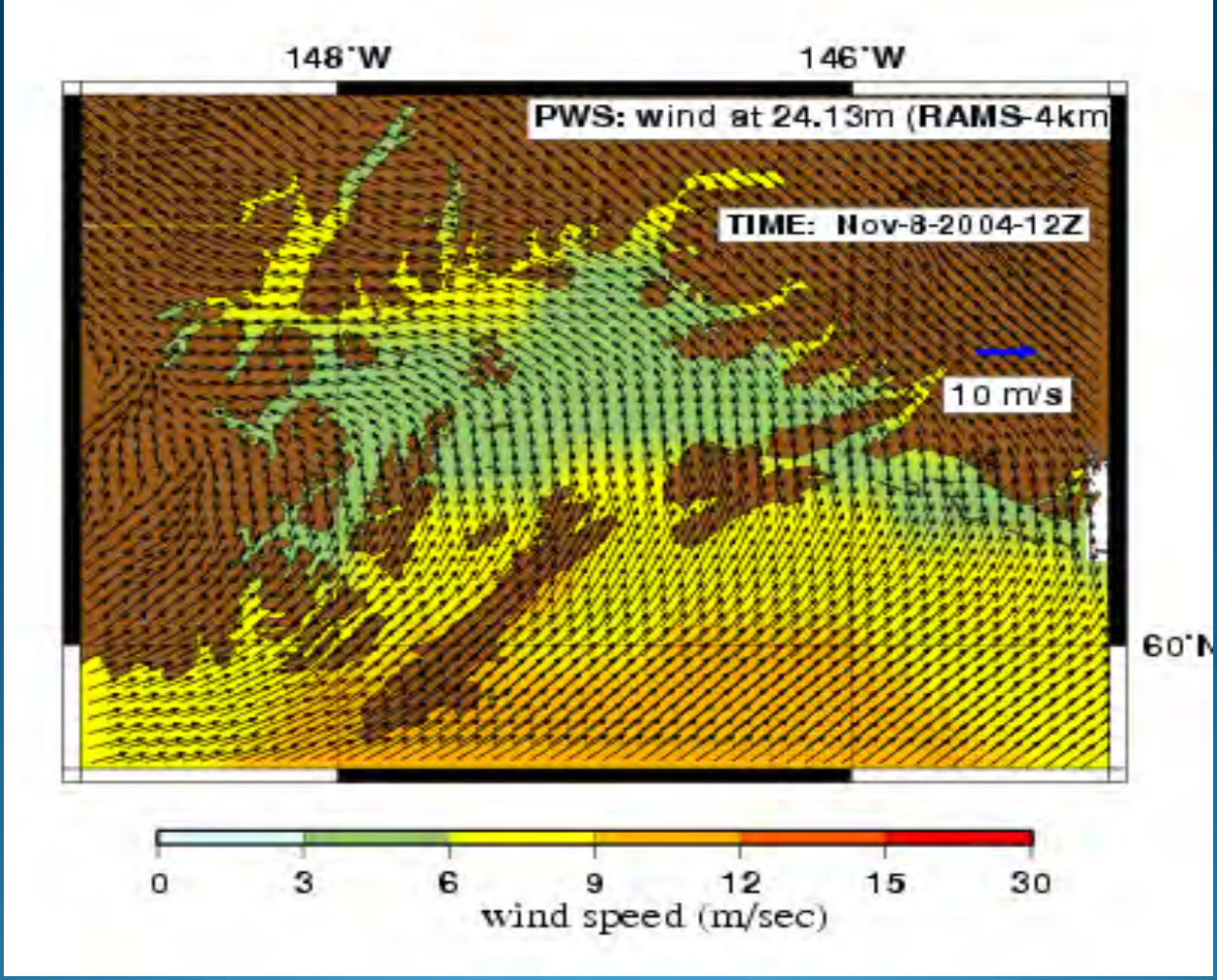
3 km grid



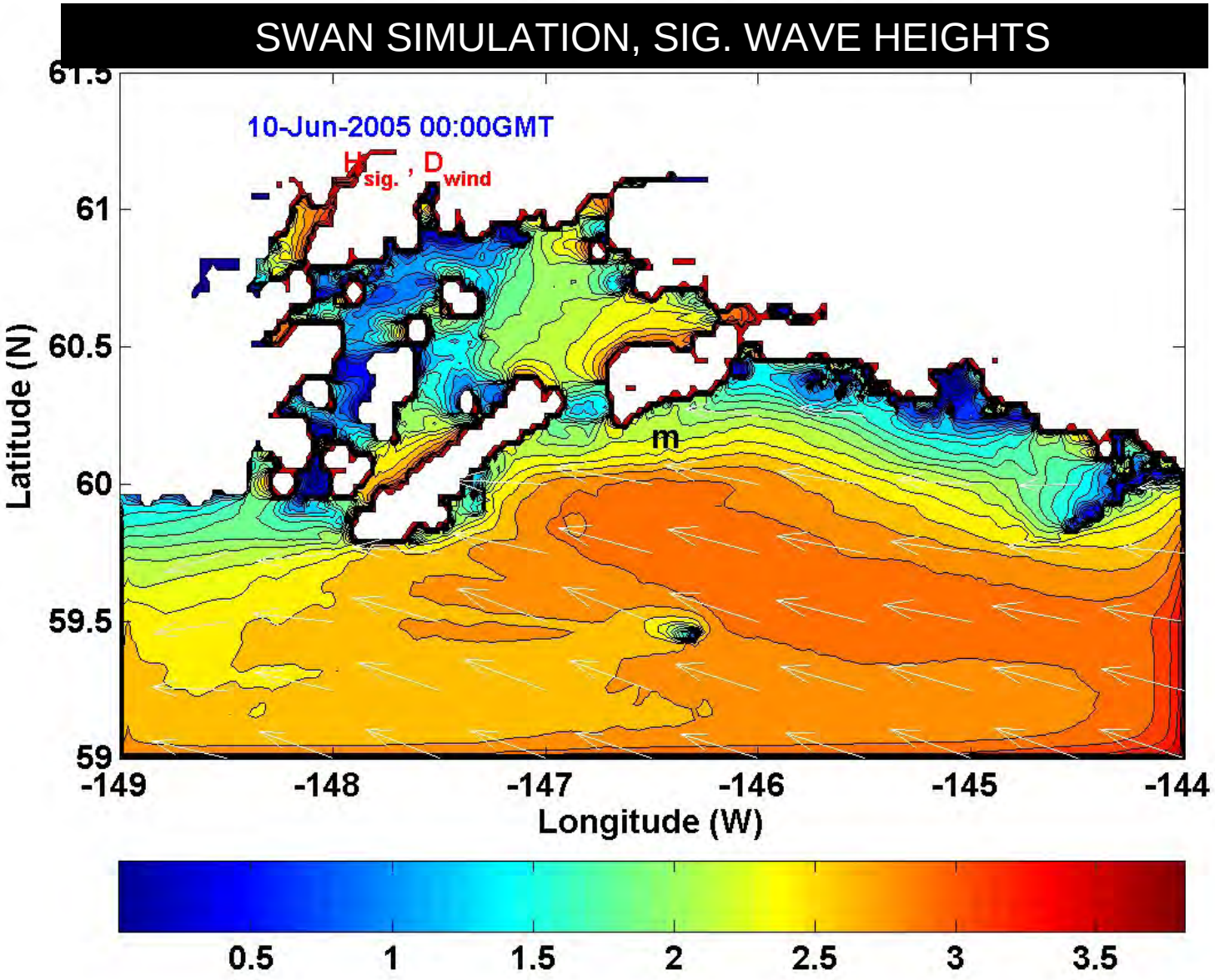
1 km grid

Nested domains

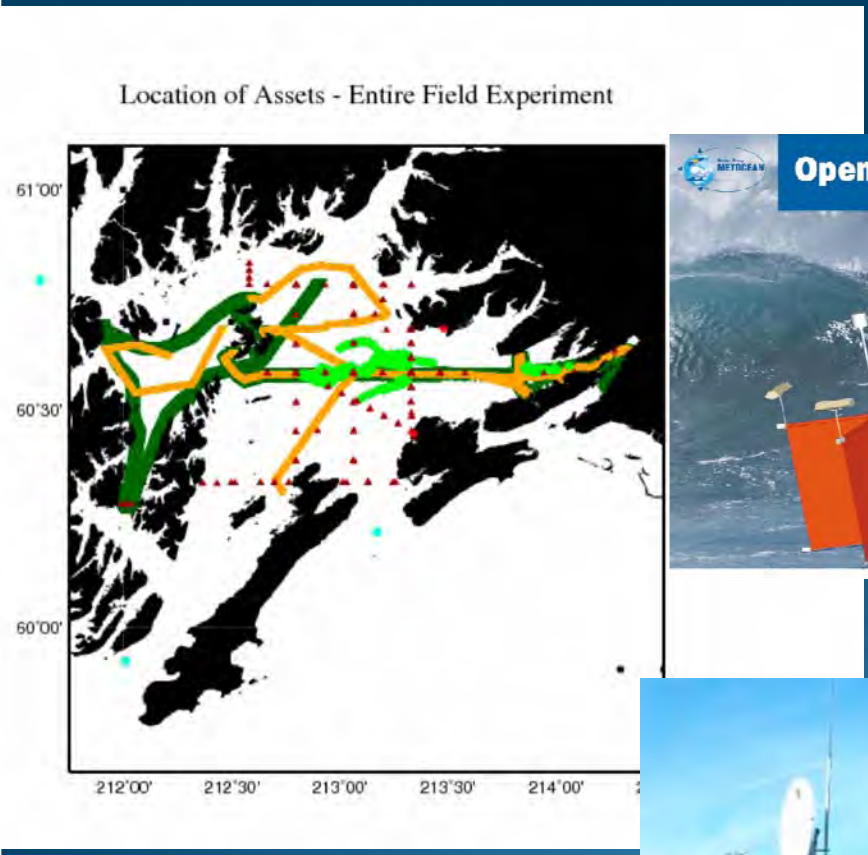
Weather Forecasts

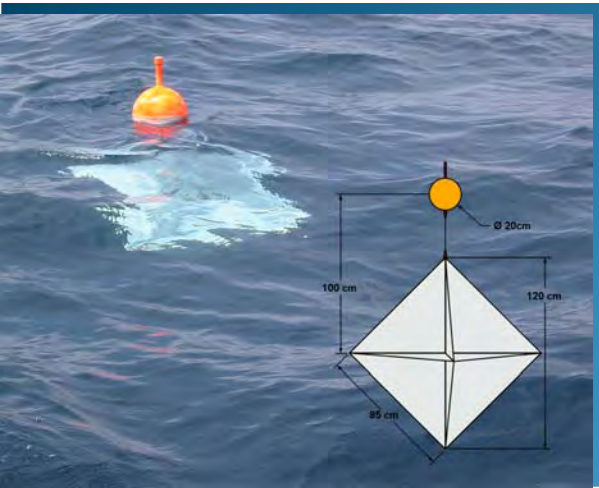


Wave Forecasts

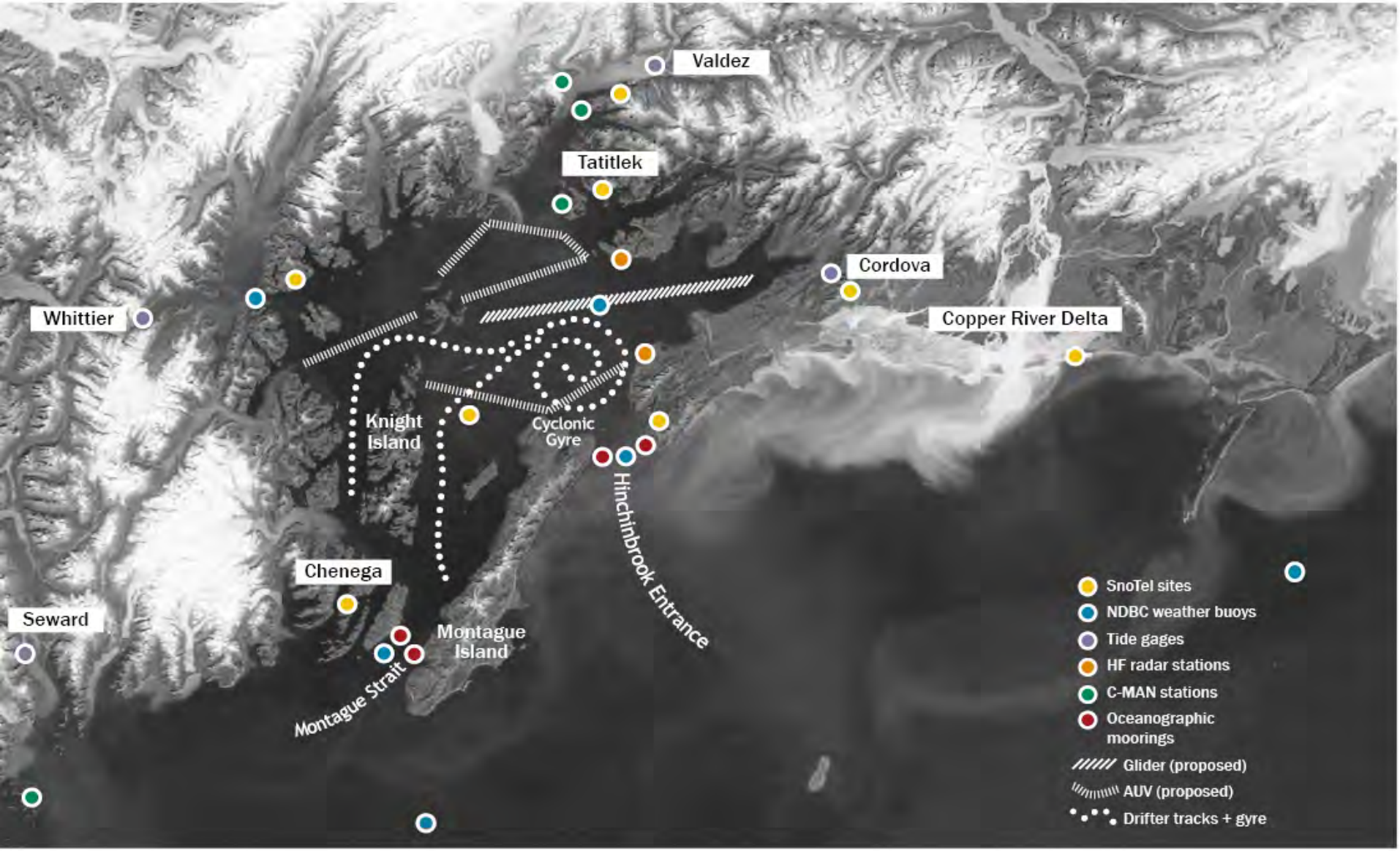


2009 Prince William Sound Field Experiment

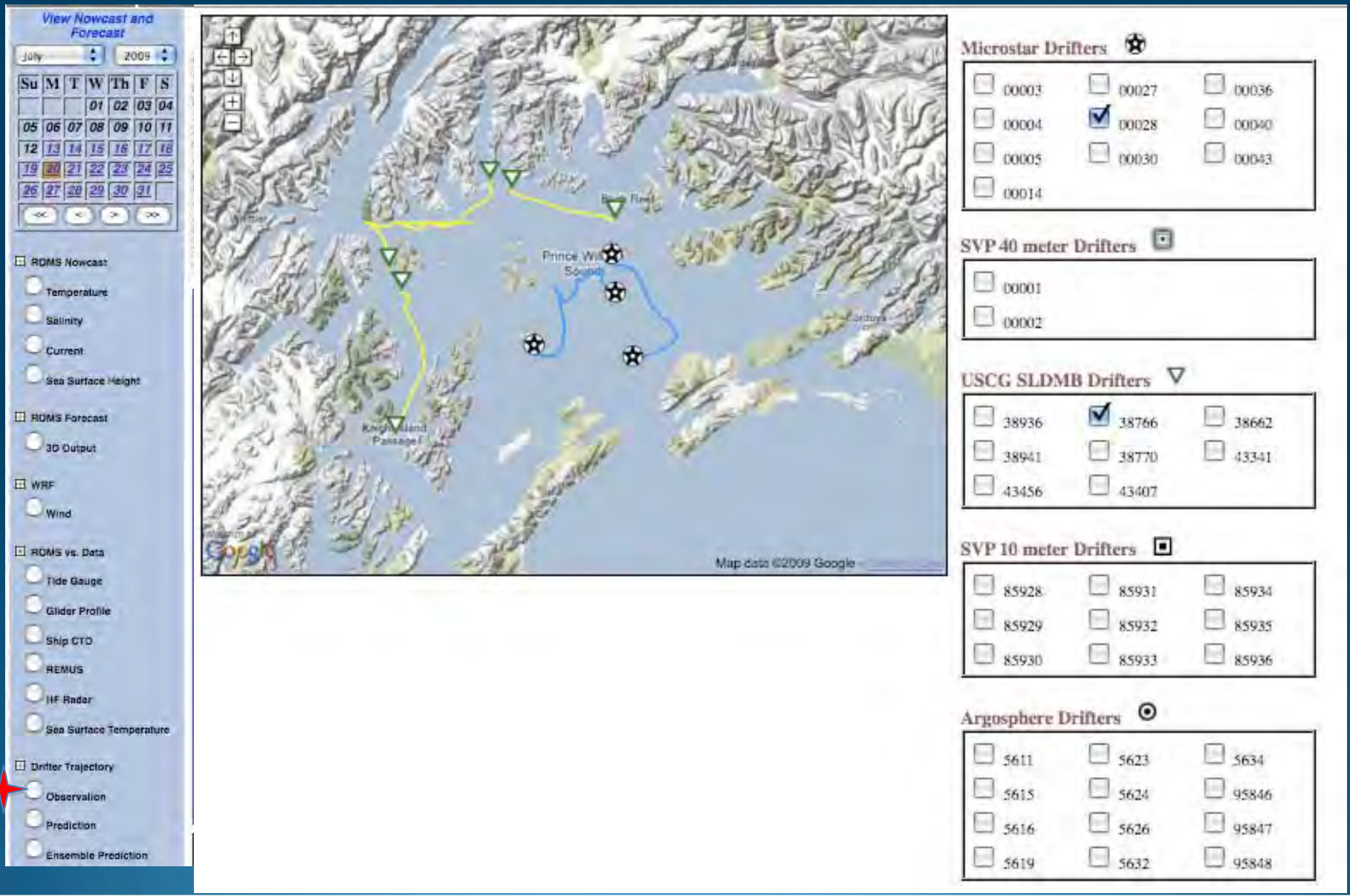




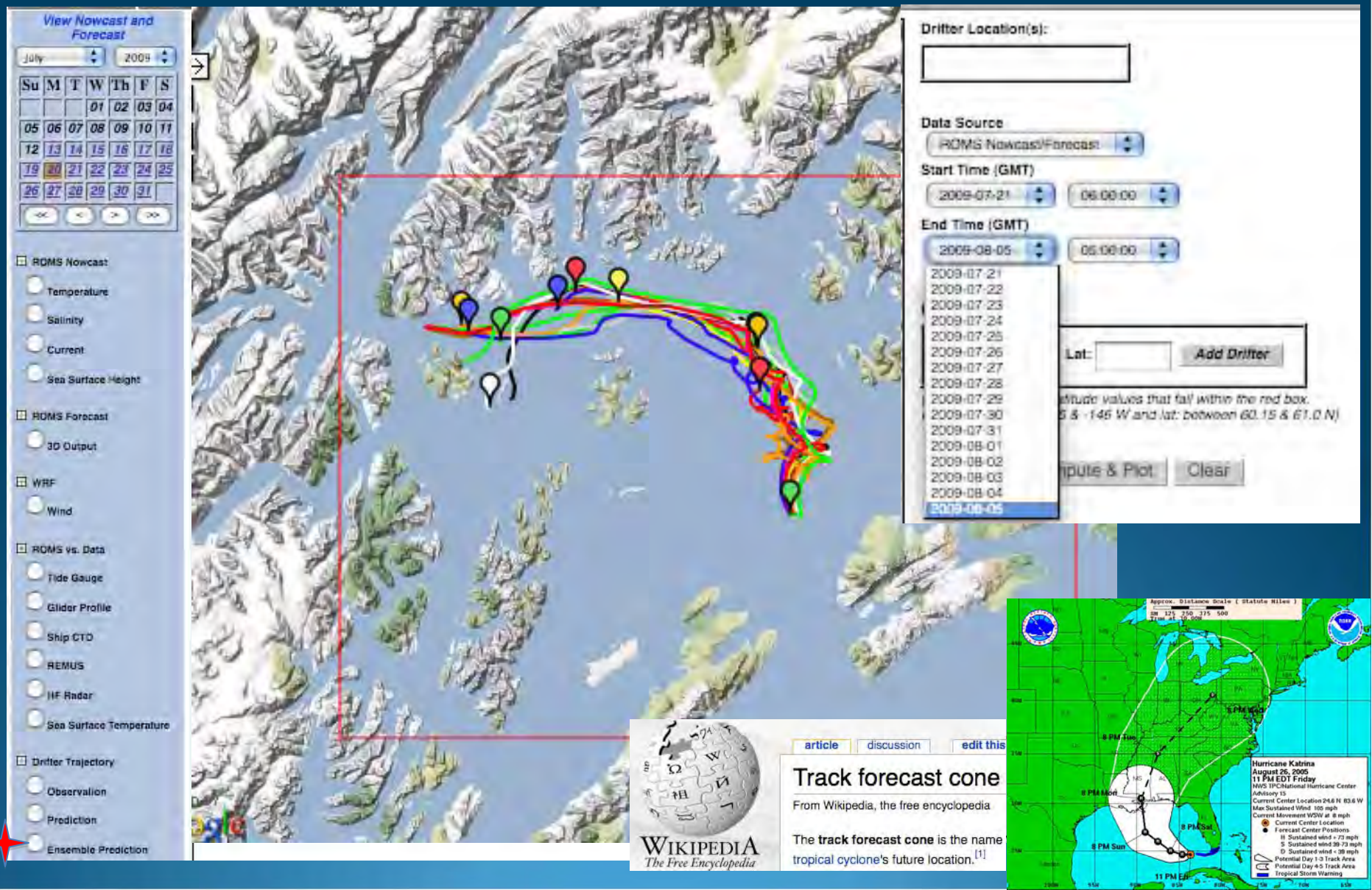
Prince William Sound Field Experiment 2009



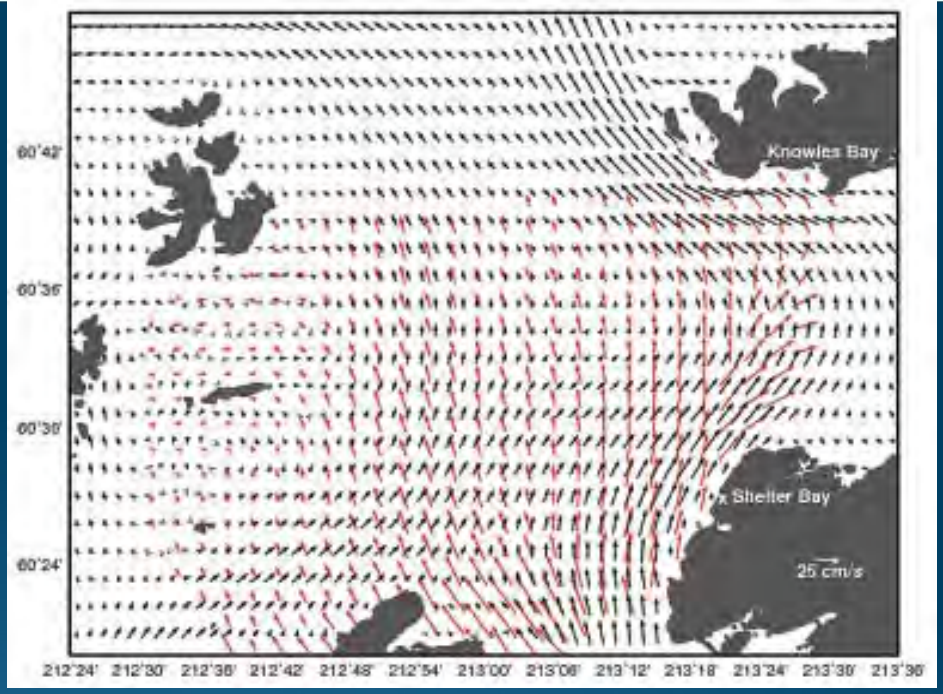
Drifter Observations
http://ourocean.jpl.nasa.gov/PWS09

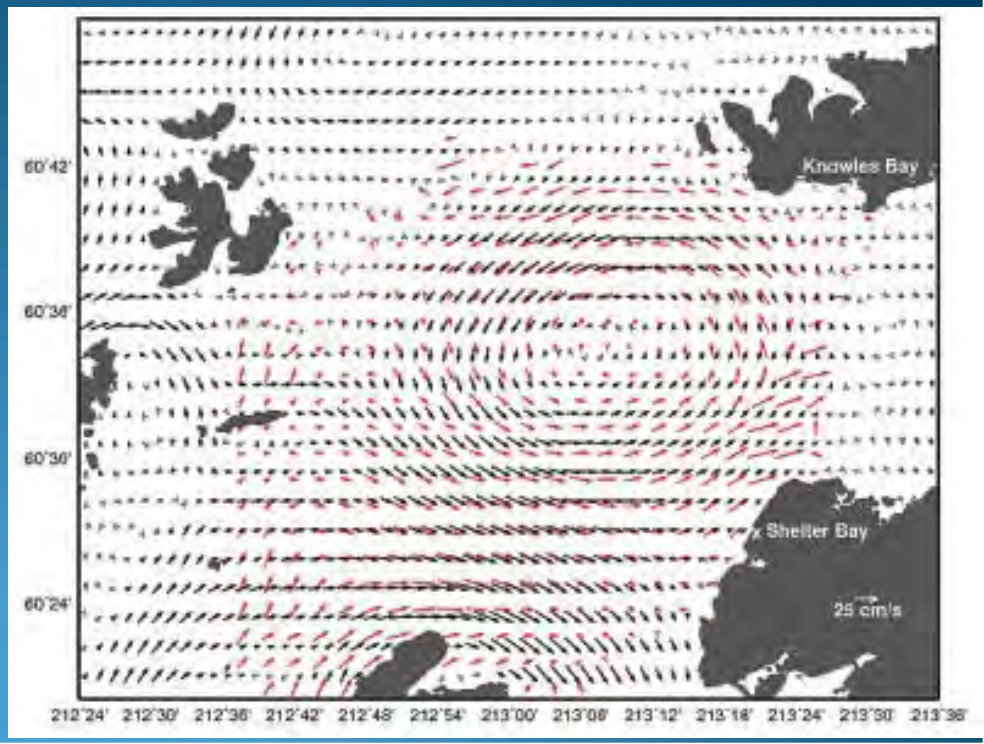


Virtual Drifter Tracker
http://ourocean.jpl.nasa.gov/PWS09

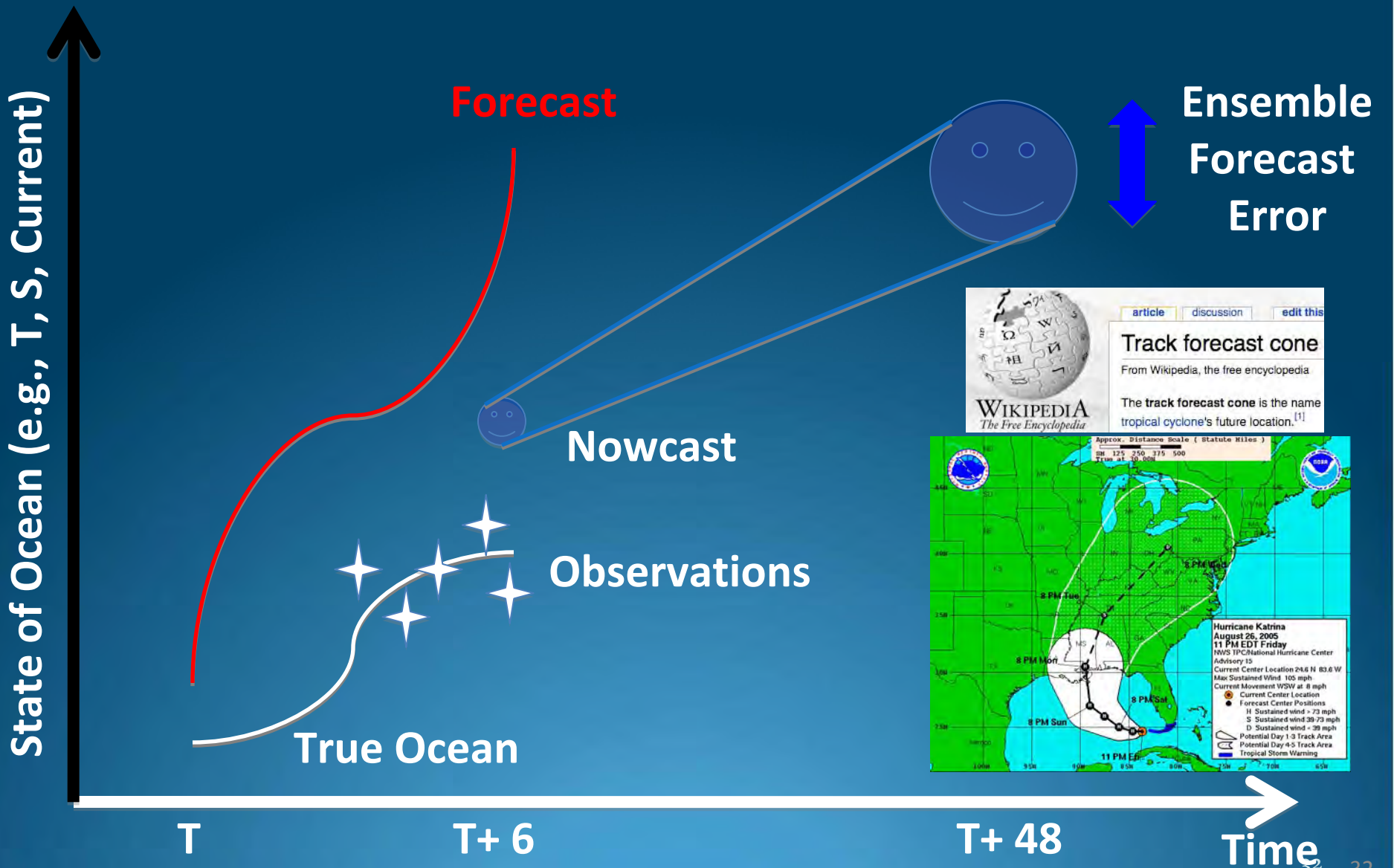


Surface currents were measured using High Frequency radar (red arrows) and compared to the ROMS model predictions (black arrows).





ROMS Data Assimilation to enable forecasting



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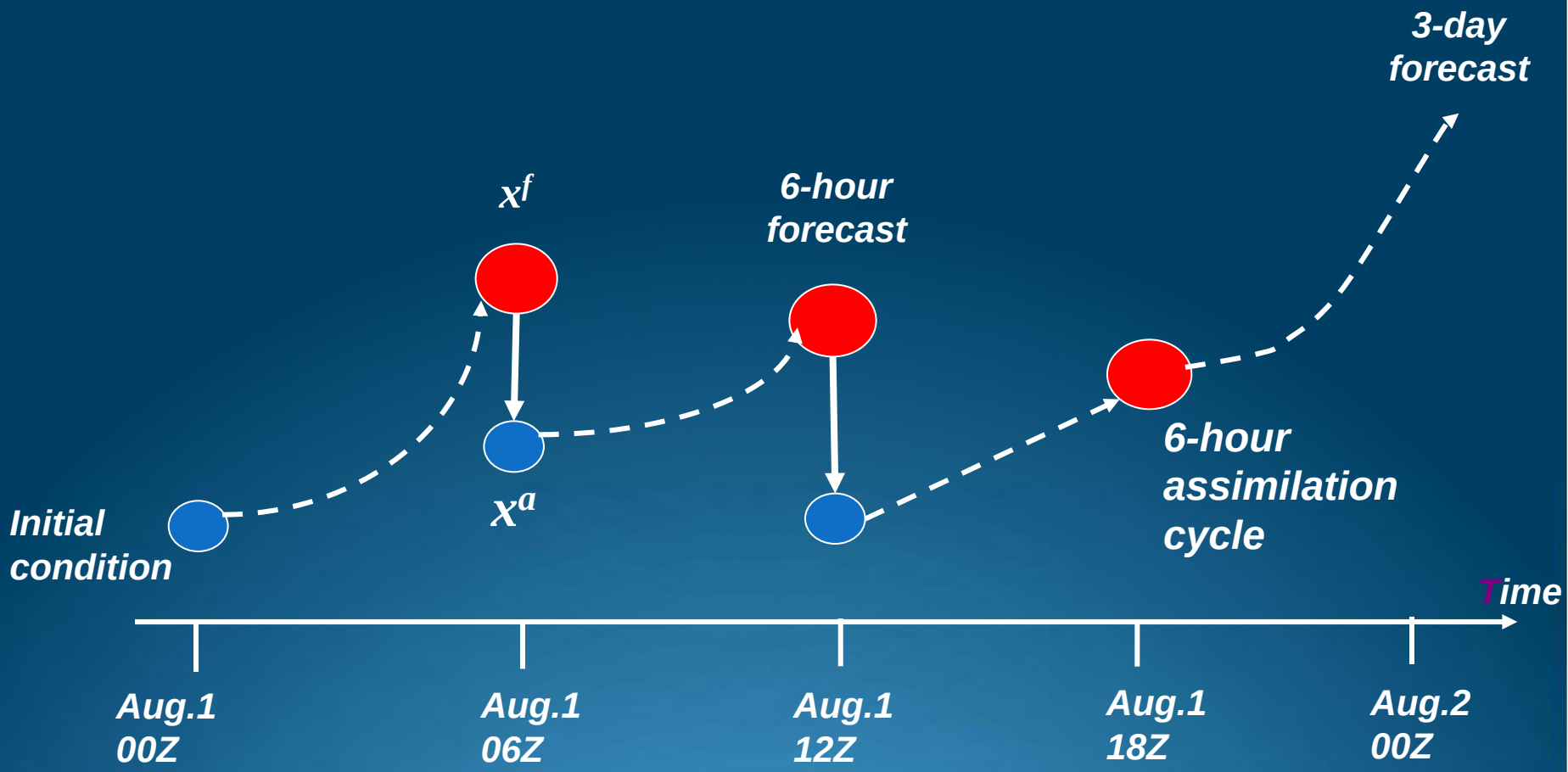
ROMS 6-hour nowcast & daily 3-day forecast



Ability to assimilate:
Satellite: SST, SSH
In-Situ: T/S(z), U/V(z)
HF radar: SSU/SSV

Results

- Successfully developed 3-domain nested ROMS model with data assimilation capabilities to enable real-time forecasting in PWS
- Successfully evaluated performance of ROMS forecasting system, qualitatively during 2009 field experiment and quantitatively during reanalysis phase
- Preliminary results from the Observing System Experiments (OSEs) show HF radar data, when assimilated into ROMS, can significantly improve the surface current and drifter trajectory forecast from 36 to 72 hours
- LESSONS: do we need the expense of the HF radar to get that extra 36 hours of forecast?

Original thinking in 2003

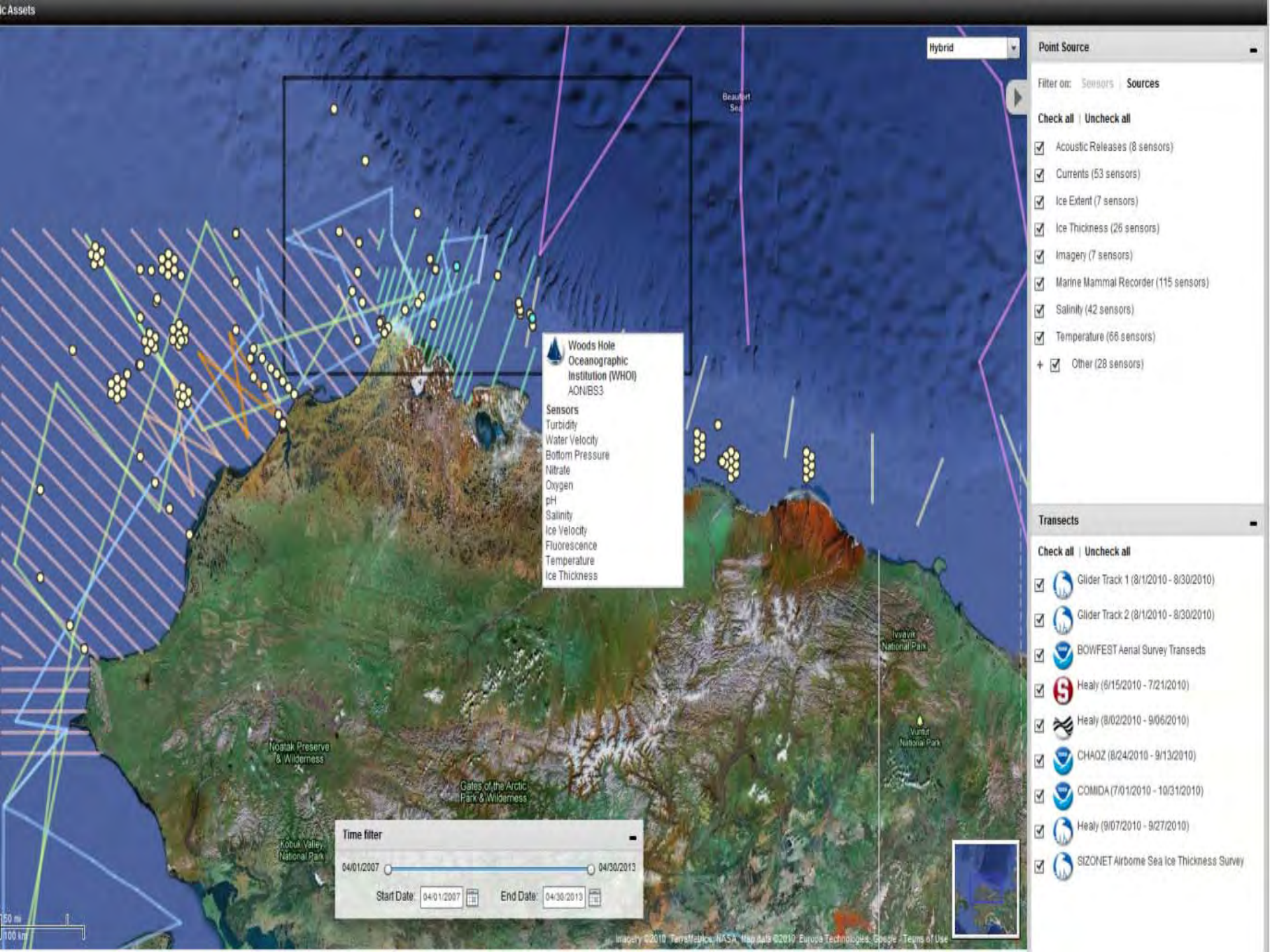
- IOOS program would be well funded - $30 million per region
- Centralized data portal for state was critical need
- Start with PWS as demonstration project – then expand to statewide
- Non-NOAA agencies would step up

Thinking now in 2010

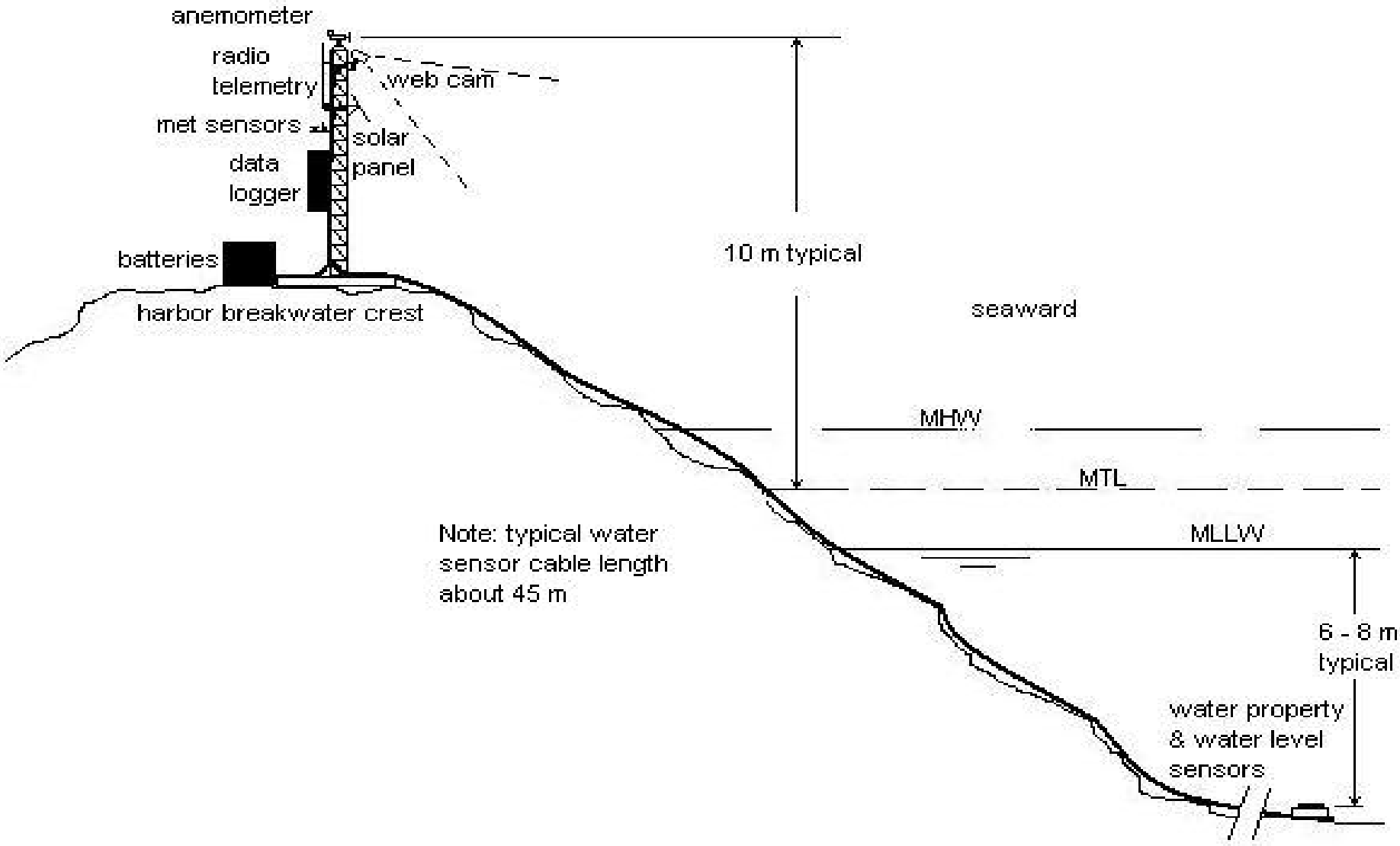
- IOOS program not well funded – less than $2 million per region although in president budget – not earmarks
- Centralized data portal for state was critical need – focus now on improving agency access & capacity, making all real-time available, plus special products
- Started with PWS as demonstration project, now expanding to Cook Inlet. Much interest in Arctic and smaller projects in western AK.
- Some Non-NOAA agencies have stepped up, but only at a small level

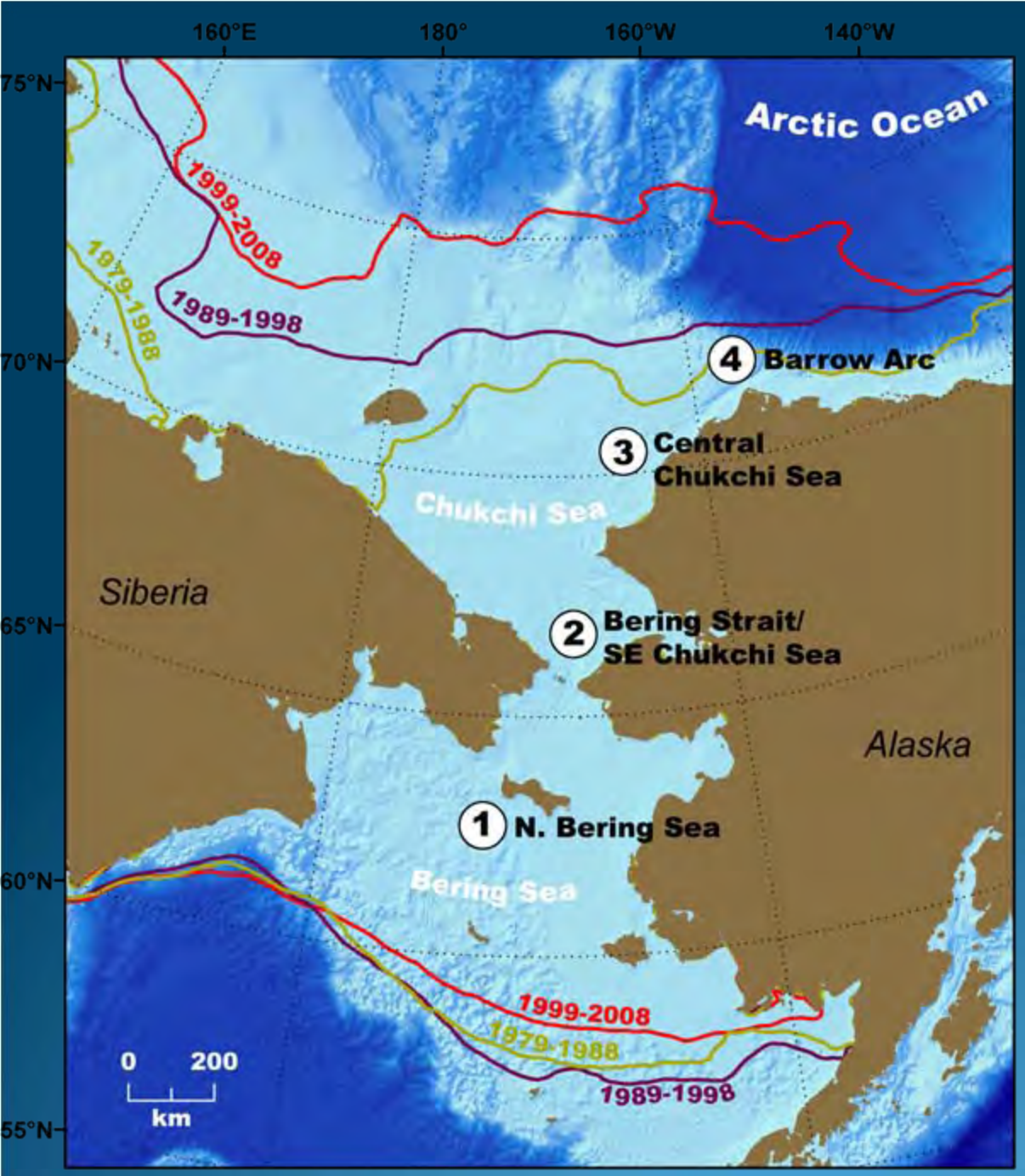
Data dissemination and archiving

Data system and team have changed: more focus on products, tools for stakeholders, model visualization, real-time data


Hybrid
Point Source
Filter on: Sensors | Sources
Check all | Uncheck all
Acoustic Releases (8 sensors)
Currents (53 sensors)
Ice Extent (7 sensors)
Ice Thickness (26 sensors)
Imagery (7 sensors)
Marine Mammal Recorder (115 sensors)
Salinity (42 sensors)
Temperature (66 sensors)
+ Other (28 sensors)
Woods Hole Oceanographic Institution (WHOI)
AON/BS3
Sensors
Turbidity
Water Velocity
Bottom Pressure
Nitrate
Oxygen
pH
Salinity
Ice Velocity
Fluorescence
Temperature
Ice Thickness
Transects
Check all | Uncheck all
Glider Track 1 (8/1/2010 - 8/30/2010)
Glider Track 2 (8/1/2010 - 8/30/2010)
BOWFEST Aerial Survey Transects
Healy (6/15/2010 - 7/21/2010)
Healy (8/02/2010 - 9/06/2010)
CHAOZ (8/24/2010 - 9/13/2010)
COMIDA (7/01/2010 - 10/31/2010)
Healy (9/07/2010 - 9/27/2010)
SIZONET Airborne Sea Ice Thickness Survey
Time filter
04/01/2007
04/30/2013
Start Date: 04/01/2007
End Date: 04/30/2013
Noatak Preserve & Wilderness
Gates of the Arctic Park & Wilderness
Kobuk Valley National Park
Ivvavik National Park
Vuntut National Park
Imagery ©2010 TerraMetrics, NASA Map data ©2010 Europa Technologies, Google Terms of Use

Harbor Observation Network Installation





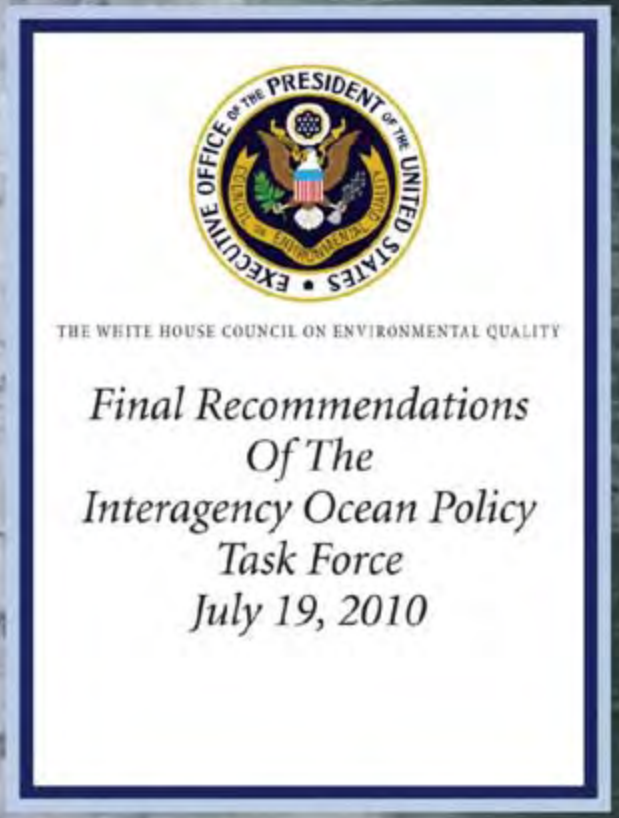
Linking Physics-Biology: the Distributed Biological Observatory (DBO)

- **The DBO will focus on four regional "hotspot" locations along a latitudinal gradient**
- **DBO regions exhibit high productivity, biodiversity, and overall rates of change**
- **The DBO will serve as a *change detection array* for the identification and consistent monitoring of biophysical responses**

[courtesy Karen Frey]

The President's National Ocean Policy

Building Blocks



National Ocean Council

National Priority Objectives

Framework for Coastal and Marine Spatial Planning

Regional Planning Bodies

NOP Priority Objectives

- Ecosystem-based management
- Coastal and marine spatial planning
- Inform decisions and Improve Understanding
- Coordinate and Support
- Resiliency and Adaptation to Climate Change and Ocean Acidification
- Regional Ecosystem Protection and Restoration
- Water Quality and Sustainable Practices on Land
- **Address environmental stewardship needs in the Arctic Ocean and adjacent coastal areas in the face of climate-induced and other environmental changes**
- Ocean, Coastal and Great Lakes Observations, Mapping and Infrastructure

Summary

- Landscape constantly changing: new issues, priorities, partners
- Technology changing
- Given resources, not possible to do comprehensive, end-to-end observing system throughout Alaska
- What is possible: numerous highly leveraged, collaborations:
- Need to pick and choose: are the obs most important, the models, or products with existing data; rarely can we do an excellent job with all three