Ocean Observing Systems: a tool for coastal communities

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Alaska Ocean Observing System
www.aoos.org
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.
11 Regional Associations
Serving user needs along the entire US coastline, the Great Lakes and the territories
Pan-Regional Backbone (PRB)
ASSET MAP FOR SOUTHERN CALIFORNIA
Exercise - cont'd


SCCOOS has been requested by US Coast Guard, Sector San Diego, to provide training by June 2008 to all its ship personnel on full data capabilities and products for outgoing preparation.
Case Study: Tropical Storm Ernesto
Sept 1-3 2006

RU-WRF provided the most accurate real-time forecast of Tropical Storm Ernesto after landfall.

Used by Researchers, by Regional, State & Local Managers, by Power Companies, by Agriculture Extension.

The most significant difference with operational models was improved physics.

This is a common storm track for the Mid-Atlantic States.
GCOOS: Standardization of Local Data Nodes

- 3-yr NOAA funding, Began work 1-Jan-08, ~$300k/yr
- Supports programmers in residence at 10 nodes. (TCOON,TABS,WAVCIS,LSU/ESL,LUMCON,CenGCOOS,DISL,COMPS,IMaRS,Mote)
- Goals
  - Participate in IOOS Regional Observation Registry
  - Adopt common vocabulary for region, to enable machine accessible catalogs and interoperability
  - Serve near real-time and archived data via Open Geospatial Consortium Service interfaces (OGS WFS-WCS).

This support model establishes a de facto ocean data partnership for the region and funds and trains local IT staff to make changes to their data systems leading to interoperability.
AOOS VISION: Arctic

- Users
  - offshore oil & gas
  - SHIPPING & NAVIGATION
  - subsistence hunting
  - resource managers
  - Native communities/planners
  - climate change researchers

- Information products
  - sea ice & fog forecasts
  - real time sea ice movement
  - ocean circulation patterns
  - climate change indicators
  - improved weather forecasts
  - coastal erosion prediction
  - marine mammal tracking
AOOS VISION: Bering Sea/Aleutians

- Users
  - commercial fishing
  - subsistence; communities
  - climate change research
  - SAFE NAVIGATION: search & rescue & oil spill response
  - resource managers

- Information products
  - sea ice & vessel icing forecasts
  - coastal erosion predictions
  - fisheries/ecosystem productivity
  - climate change
  - wind and wave forecasts
AOOS VISION: Gulf of Alaska

- Users
  - NAVIGATION SERVICES
  - commercial fishing
  - recreational boaters
  - oil & gas development
  - search & rescue
  - tourism
  - managers
  - aquaculture/mariculture

- Information products
  - marine sea state & icing conditions
  - ocean circulation patterns
  - coastal erosion predictions
  - nowcast/forecasts for search & rescue & oil spill response
  - fisheries/ecosystem productivity
  - HAB forecasts
Few real time marine observations
Data Catalog Explorer:
AK Marine Information System (AMIS)

Moorings: PWS
Mooring: HE3

Agency: PWSOOS
Lat: 146.75

Start: 2005-06-12 22:30:00
End: 2005-10-26 20:15:00

HE3 CTD

1d cb speed dir u v depth pressure lat lon gecm ars agency
HE3 2005-09-12 00:00:00 107.2 322.9 -64.6663562563 65.500091701 5.7 60.2353333 -146.74575
HE3 2005-09-12 00:00:00 29.7 327.2 -16.2085733949 24.9666281238 7.7 60.2353333 -146.74575
HE3 2005-09-12 00:00:00 17.1 354.3 -14.0599257254 9.65354665141 11.7 60.2353333 -146.74575
HE3 2005-09-12 00:00:00 9.305.5 -7.3270396521 5.226366154 15.7 60.2353333 -166.74575 0.0
HE3 2005-09-12 00:00:00 13.321.5 -8.0262957629 10.1798065591 19.7 60.2353333 -146.74575 0.0
HE3 2005-09-12 00:00:00 13.6 327.1 -7.32685007433 11.334661712 25.7 60.2353333 -146.74575
HE3 2005-09-12 00:00:00 13.8 343.2 -3.80129235975 12.923813267 27.7 60.2353333 -146.74575
HE3 2005-09-12 00:00:00 19.3 339.7 -6.69585357556 16.101266488 31.7 60.2353333 -146.74575
HE3 2005-09-12 00:00:00 27.8 335.6 -11.483031492 24.317027770 35.7 60.2353333 -146.74575
Harbor Facilities on the Alaska Coast
Ocean Observing in Northwest Alaska: A Conceptual Design

Existing Observation Platforms
- NWS stations: real-time met obs (wind, temp, humidity) used by National Weather Service forecasters.
- Bering Sea moorings: Four moorings along the 70-m isobaths measuring temp, salinity, fluorescence, nutrients, currents. Spring and fall hydrographic transects measure temp, salinity, oxygen, fluorescence, nutrients, chlorophyll, zooplankton. Data recovered twice annually.
- Bering Strait moorings: temp, salinity, currents & flow through strait, ice draft, plus some fluorescence and nutrients on Russian and U.S. sides.
- Diomede environmental observatory: shore-based biological and water sampling; marine mammal tissue samples from subsistence use.
- Sea ice observatory: Real-time radar measures ice motion and break-out events; local sea ice observers; web cam.
- Hotspot sampling: benthic high-production zone sampled near annually since 1984.
- Bering Strait ship sampling: samples water column across strait.
- Fish surveys (NOAA-BASIS): sample for groundfish and salmon; take ocean property measurements. Every 2-3 years depending on funding.
- Volunteer ship observing: ships voluntarily report met and ocean wave conditions to NWS. (usually barge traffic transiting strait)
- Bering Sea Sub-Network: indigenous community-based observations of environmental changes by Russian and U.S. villages, including Gambell.
- Ocean Tracking Network: sea-floor based acoustic sensors track migration of marine mammals and fish, and include sensors to monitor ocean conditions.
- Tide gauges: real-time measurements of water levels, winds, air temp.
- AIS System: provide ship Maritime Mobile Service Identify numbers to identify and track ships transiting Bering Strait. (Diomede and/or Wales).
- Satellites: measure ocean color, sea surface temp, sea surface height.
- Wave buoys: used during ice-free season to measure waves and model coastal inundation.

Proposed Observation Platforms
- Harbore: met obs, web cam, plus soil temp profiler and wave, tide and water property sensors.
- HF radar: real-time surface current mapper.

AOOS: Alaska Ocean Observing System.
End-to-End PWS Ocean Forecasting System: a demonstration of a comprehensive ocean observing system

Deploy & Verify

Sensor & Platform

Questions

Hypotheses

Observatory data

Models

Data Assimilation

PWS Ocean Forecasting Control Center

Forecast

Nowcast

$J = 0.5 (x - x_f)^T B^{-1} (x - x_f) + 0.5 (y - x)^T R^{-1} (y - x)$

$X_a = x + \delta x$
PWS Observing System Products (3-5 years)

**Weather Forecasts**
1. Wind velocity
2. Wind direction
3. Precipitation

**Wave Forecasts**
1. Wave heights
2. Nearshore currents
3. Turbulent mixed depth

**Circulation Forecasts**
1. Current velocity
2. Current direction
3. Stratification
4. Upwelling centers
5. Fronts
Multi-scale (or “nested”) ROMS modeling approach is developed in order to simulate the 3D ocean at the spatial scale (e.g., 1-km) measured by in situ and remote sensors.