The strategy of ocean observing in Alaska

For almost a decade, AOOS has been working with state, federal and private groups to strategically establish and maintain moored weather buoys and ocean sensors, as well as land-based surface current radar and SnoTel stations all over the Sound.

These instruments measure phenomena such as the speed and direction of wind and ocean currents, water temperature, salinity, and precipitation. We use these data to create complex numerical simulations, or models, of the atmosphere and ocean. We are now refining the models to the point where they can more accurately mimic the phenomena indicated by the observed data—and then forecast what will happen if a variable changes. This information will be used in products needed by fishers, boaters, recreationists, resource managers and others to make better decisions about how to use the ocean environment.

AOOS builds and facilitates partnerships

As the Alaska regional node for a national network of observing systems, AOOS is taking a lead role to promote partnerships among groups active in marine research and monitoring in Alaska, including Prince William Sound. Partnerships are important for leveraging funds, sharing information, promoting collaborations and finding solutions to the challenges of meeting the needs of stakeholders and data users and providers.

This project includes California Polytechnic State University, Micro Specialties, Inc., NASA Jet Propulsion Lab, Natural Resources Conservation Service, NOAA National Data Buoy Center, Oil Spill Recovery Institute, Prince William Sound Regional Citizens' Advisory Council, Prince William Sound Science Center, Texas A&M University, University of Alaska Anchorage, University of Alaska Fairbanks School of Fisheries and Ocean Sciences, UC-Santa Barbara, University of Maine, and the U.S. Coast Guard.

The 2009 field experiment

In summer 2009, AOOS will evaluate regional forecast models for their effectiveness in predicting wind, waves, and ocean circulation in Prince William Sound. We will:

- deploy drifting buoys throughout the Sound to measure the speed and direction of surface currents, and measure how well the model predicts ocean conditions
- follow the tracks of buoys that mimic Coast Guard Search and Rescue targets and oil spill trajectories
- deploy autonomous vehicles to fly and swim the Sound, collecting data as they go

Follow the field experiment online at www.aoos.org

Field experiment data will be uploaded in near real-time, thanks to the efforts of the UAF School of Fisheries and Ocean Sciences and the NASA Jet Propulsion Lab.

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The Alaska Ocean Observing System is building a network of observation platforms and forecast models that will provide information products and tools to improve our understanding of Alaska's ocean ecosystem and allow us to make better decisions about our use of the marine environment.

This view of Jack Bay near Valdez, looking southwest into Valdez Arm, is typical of the Sound's intricate coastline. (Prince William Sound Science Center)

About Prince William Sound

The Sound contains approximately 3,500 miles of coastline, including hundreds of islands. Montague Strait and Hinchinbrook Entrance are its two gateways to the Gulf of Alaska.

The Sound is used extensively by transoceanic shippers, oil tankers, state ferries, fishing boats, cruise ships, sailboats, and kayaks, and is relatively protected from severe weather in the adjacent Gulf of Alaska. It takes in large, seasonal additions of fresh water from rivers and melting glaciers that result in rich marine habitat for plankton, fish, marine mammals, and people.

Glaciers provide large seasonal inputs of fresh water to the Sound and influence coastal currents. (EVOS Trustee Council)

PRINCE WILLIAM SOUND OIL SPILL RECOVERY INSTITUTE
pws-osri.org

PRINCE WILLIAM SOUND SCIENCE CENTER CORDOVA, ALASKA
pwssc.org

UAF UNIVERSITY OF ALASKA FAIRBANKS
sfos.uaf.edu

IOOS INTEGRATED OCEAN OBSERVING SYSTEM
ioos.noaa.gov

ALASKA OCEAN OBSERVING SYSTEM

Sound Predictions 2009

Ocean observing and its applications in Prince William Sound, Alaska

AOOS

You're fishing in some nasty weather in the Sound when a crewmember falls overboard. Where will the currents take him? How will rescuers find him?

Even with precautions taken since *Exxon Valdez*, an oil spill could still happen. Where will the oil go? When will it hit the beach?

Accurate ocean observations help keep everyone safe at sea, including fishermen, recreational boaters, and the shipping industry.

Mariners need solid weather forecasts, especially when conditions turn marginal. AOOS weather forecasts can be scaled to the local needs of mariners in the Sound because its weather data come from one of the world's densest networks of observation platforms.

With 20+ weather stations operating within a 40 square-mile area, AOOS weather stations can deliver the real-time measurements of actual weather conditions so important to anyone going out on the water. AOOS ocean current models predict the trajectories of anything drifting in the sea, including disabled vessels, overboard crew, and cargo. **Read More >>**

Above: Rescue at sea: a life raft drops out the back of a Coast Guard C-130 lands next to the wreckage of float plane that crashed with six people on board. All six were located and rescued by air crews from Coast Guard Air Station Kodiak. All passengers from the downed plane were transported to Kodiak where they were treated for hypothermia and minor injuries.

Improving our ability to observe and forecast changes in Alaska's oceans

1 Observe

Deploy instruments and collect data

Instruments

Visit http://ak.aoos.org/fieldexp/tools to learn more about these observation instruments.

SnoTel weather stations

Spring melt and runoff are important drivers of coastal ocean circulation and the spring plankton bloom. Snowpack Telemetry (SnoTel) stations measure precipitation, snow depth, wind speed and direction, air temperature and pressure, and solar radiation. The station on Mt. Eyak, near Cordova, also measures the water content of the snowpack. Additionally, stations at Esther Island, Port San Juan, Tatitlek, and Nuchek send images to the Internet to show actual weather conditions.

SnoTel data allow better forecasting of ocean currents driven by freshwater inputs, as well as the likelihood of wind and rain.

NDBC weather buoys

National Data Buoy Center (NDBC) weather buoys carry instruments that measure wind speed and direction, air temperature, air pressure, and sea surface temperature. Data are used to predict ocean circulation.

Tide gages

Tide gages measure sea level by continuously recording the height of the water level with respect to a height reference surface close to the Earth's mean ocean surface.

High-frequency radar

The 3m mean tidal range in the Sound can create powerful currents. When it's windy, the velocity of these currents can magnify waves to dangerous heights.

High-Frequency (HF) radar uses Doppler frequency shifts to determine the speed of surface currents. HF radar stations are able to transmit and receive radio waves traveling as far as 60km (37 miles) across the Sound.

C-MAN weather stations

Coastal Marine Automated Network (C-MAN) stations measure barometric pressure, wind speed and direction, air and sea temperatures, water level, waves, relative humidity, precipitation, and visibility.

Oceanographic moorings

Water exchange between the Gulf of Alaska and the Sound influences the abundance and distribution of plankton, which form the base of the marine food web.

Anchored to the ocean floor, moorings continuously measure temperature, salinity, and current velocity.

AUVs and gliders

Autonomous underwater vehicles (AUVs) and gliders can be deployed to collect nearly continuous measurements of temperature and salinity. These measurements contribute to a regional scale view of water column structure to 200m depth, and help evaluate and improve the performance of ROMS, the Regional Ocean Modeling System.

Drifters

Surface current information is critical to oil spill response and search and rescue efforts. Drifters (deployed at the surface) and drogues (deployed ten meters underwater) are strongly influenced by wind speed and circulation. Should dispersants be used following an oil spill in the central Sound, results suggest that the trajectory and fate of subsurface oil would likely differ considerably from the trajectory and fate of untreated surface oil.

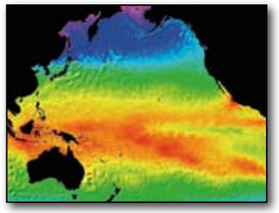
Drifters are important tools for search-and-rescue personnel, who can construct current speed and direction from sequential drifter positions to establish ocean surface motion. This enables them to better predict the trajectories of disabled vessels and people in the water.

Cover photos: Fisherman, kayakers (EVOS Trustee Council); sailboat in storm (Frank Gerry); oil tanker (E. O'Neill); rescue raft deployment (U.S. Coast Guard).

2 Forecast

Feed data into computer models to predict weather and climate

As meteorologists forecast the behavior of the atmosphere, scientists use the information gathered from the Prince William Sound Observing System to predict the behavior of the ocean waters of the Sound and the freshwater that flows through it.

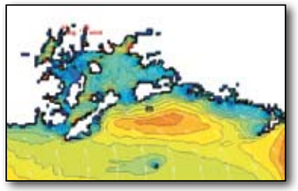


Understanding ocean dynamics

Ocean circulation in the Sound is driven by an intricate mixture of buoyancy, wind, tidal, and other forces. The Regional Ocean Modeling System (ROMS) can simulate the behavior of currents, tides, salinity, and temperatures at any time during the year.

The ROMS modeling team has created three scales of measurement, with the largest measuring the Gulf of Alaska and the smallest focused on the Sound. As the area of measurement decreases, the resolution increases to as little as 1.2 km^2. The different scales enable the team to know what's going on outside the Sound so they can model what's happening inside the Sound.

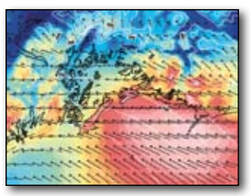
Preliminary results from ROMS clearly show the movement of a warmer current from the south as is passes along the coast in the winter. The model also reveals great spatial and temporal variation of ocean conditions in the Sound.



Predicting waves on a Sound scale

Wave simulations in the Gulf of Alaska currently generate relatively coarse-scale forecasts that are of little value at the fine (small) scale of Prince William Sound.

SWAN (Simulating WAves in the Nearshore) is used in more than 50 countries to predict wave heights in nearshore and inland waters. Placing this modeling system in the Sound allows for higher-resolution forecasts.



Weather forecasting on a Sound scale

The Sound has a dense array of networked observing platforms, with more than 20 weather stations reporting real time data within an area of 100km^2.

The Alaska Experimental Forecast Facility uses the Weather Research and Forecasting (WRF) model and the North American Mesoscale Weather Research and Forecasting (NAM-WRF) model to predict weather. National Weather Service (NWS) models can forecast for areas of about 12 km^2, but these models allow for forecasts for areas as small as 4 km^2. This finer resolution allows capture of topographic effects that are not in the NWS model.

The WRF model predicts air temperature, freezing level, precipitation, air pressure, relative humidity, sea spray icing, and snow depth.

3 Use

Use model predictions to create products tailored to local needs

AOOS directly benefits user groups

AOOS contributes to safety at sea by helping commercial fishermen and transoceanic shippers stay informed about ocean and weather conditions. AOOS also provides customized data products for the oil spill response community and US Coast Guard search and rescue teams.

We link educators from formal and informal settings by creating exemplary educational resources for use in and outside of Alaska. We work with local communities, including Alaska Native groups, that make their living from the sea by providing relevant environmental data for daily decision-making.

Goals of the Alaska Ocean Observing System

- To improve safety and efficiency of marine operations
- To mitigate effects of natural hazards
- To improve predictions of climate change and its effects on coastal populations
- To improve national security
- To reduce public health risks
- To protect and restore healthy coastal marine ecosystems
- To enable sustained use of marine resources

Visit aoos.org and find ...

- Data and information products from remote observation platforms, enhanced for local needs
- Processed satellite data on sea-surface temperature, ocean color (chlorophyll), and wind
- Surface current maps
- Biological data on fish, birds and marine mammals, the environmental effects of human activities, and any other information that can be used with the physical data to predict changes to the ocean ecosystem