Real-Time Coastal Observing System to Support Safe Navigation and Enhance Environmental Intelligence along U.S. Arctic Coasts

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ABSTRACT

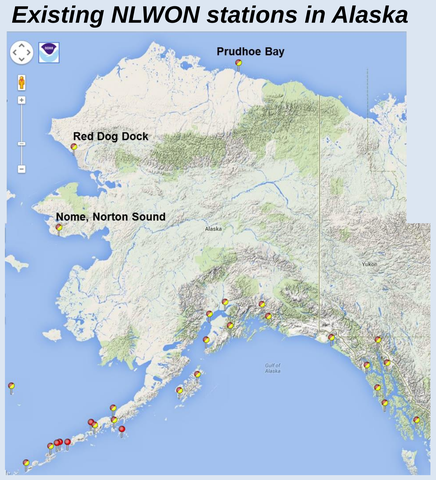
Many recent studies on global climate change have identified an increase in Arctic warming rates along with trends of increased sea ice loss. As Arctic waterways become more accessible during summer seasons, a significant increase in maritime transport throughout the region is anticipated for the future. Presently, Arctic waters within the U.S. Exclusive Economic Zone (EEZ) have very few available oceanographic and meteorological navigational support products and services. In support of long term modernization plans, NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) has been working on the design, development, and testing of a standalone, real-time ocean observing system for use in remote Arctic coastal regions with very limited infrastructure. Two types of system designs have been identified, both for long term deployments (12 months or more), but with short- and long- term real-time telemetry options. Both design types include a bottom mounted platform with oceanographic sensors. The long-term telemetry design involves a cable run from the bottom platform to a small, shore station. The short-term telemetry design includes a surface buoy with an acoustic link to the bottom platform. The buoy based system is intended for real-time communications during ice-free periods only. Details of the short-term version system are presented along with results from recent Atlantic coast field trials.

(1) BACKGROUND

NOAA's CO-OPS is responsible for developing and maintaining the National Water Level Observation Network (NWLON) and Physical Oceanographic Real-Time Systems (PORTS) which combined consist of over 300 long-term, real-time ocean observatories across all U.S. coasts. Real-time oceanographic and meteorological observations from these networks provide critical support to maritime forecasters, emergency managers, vessel operators, port authorities, coastal planners, and many other decision makers. Resulting long-term records support a variety of scientific research and coastal engineering design applications.

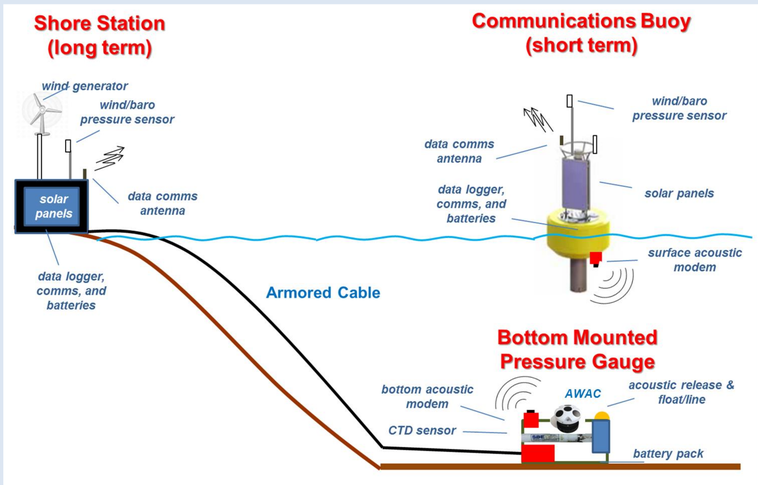
CO-OPS recognizes the changing environmental conditions within the U.S. Arctic EEZ and the potential for significant increase in maritime transport as waterways become more accessible during summer seasons. To date, CO-OPS operates 26 long-term NWLON stations in Alaska, however, significant spatial gaps in observations remain in the western and northern Alaska regions.

Existing NLWON stations in Alaska

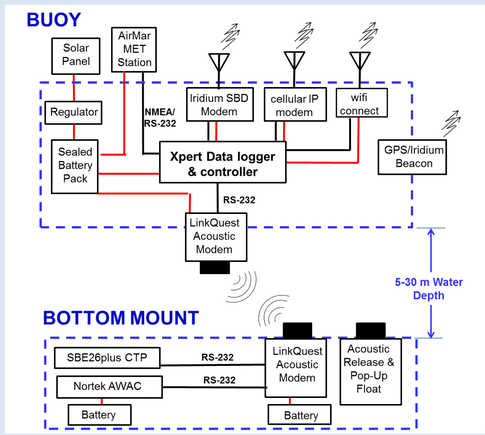


(2) SYSTEM DESIGN

2 Design Concepts, Short- and Long-Term Telemetry Options



Short-Term Telemetry Design

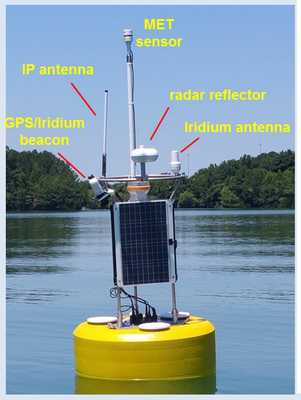


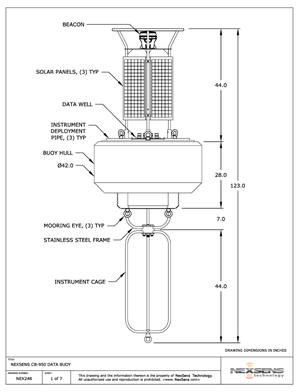
System Requirements

Real-time data telemetry duration: 90 days	Real-time telemetry rate: 6 min	**Parameters and sampling/recording rates**	
Bottom mount deployment duration:12 months	Operating depth: 5-40 m	conductivity, temperature, pressure: 6 min	vertical current profile: 30 min
Water level vertically referenced to land based benchmark s and/or geoid model		wind, air temperature, atm pressure: 6 min	surface waves: 60 min

SURFACE BUOY

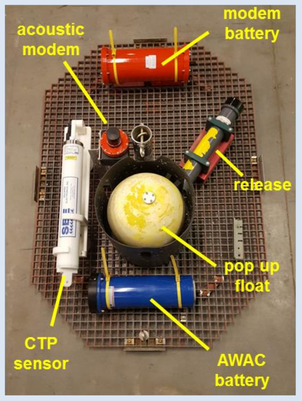
Meteorological Station and Real-Time Communications





BOTTOM MOUNT

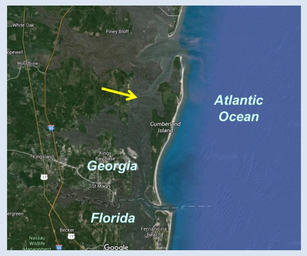
Pressure, Conductivity, Temperature, Currents, Waves

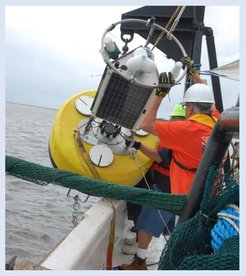


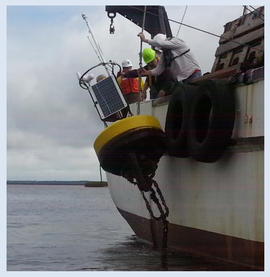
(3) RECENT FIELD TESTING

Chesapeake Bay 2014

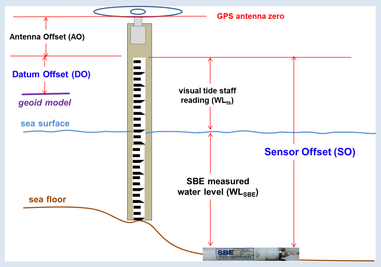
St Andrews Sound 2015

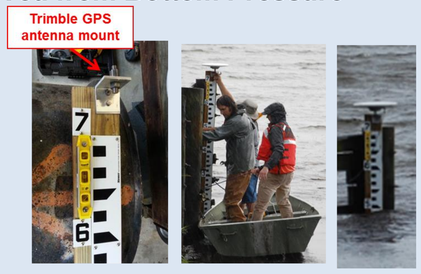






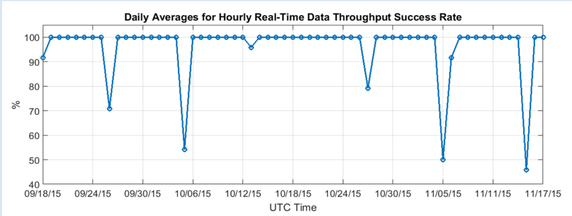
Vertically Referencing Water Levels Derived from Bottom Pressure



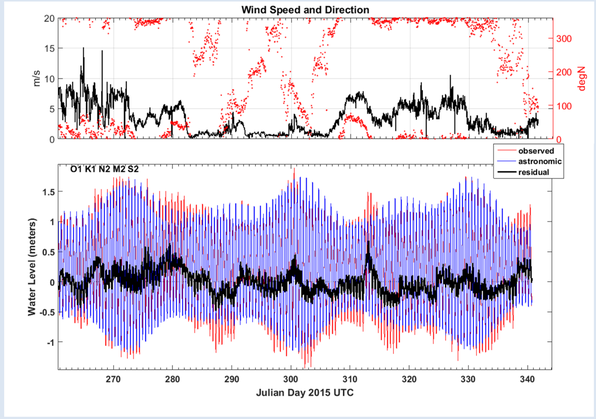


(4) 2015 FIELD TEST RESULTS (St. Andrews Sound, GA)

Real-Time System Performance

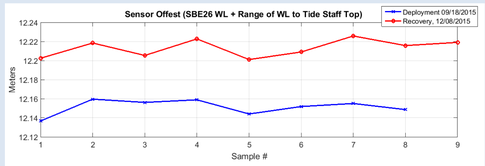


Measured Wind and Water Level

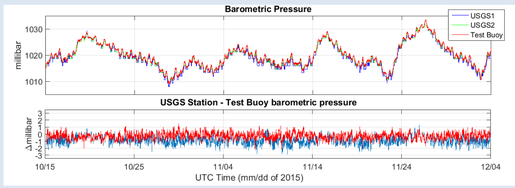


Analyzing Sources of Water Level Measurement Error

Bottom Platform Settling – *sensor offset to tide staff ~ Δ6 cm from deployment to recovery*

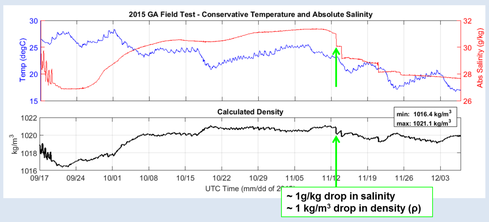


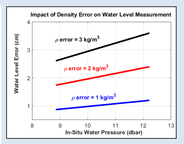
Low Cost Barometric Pressure Sensor – *how good is it?*



average Δ 0.2 mbar

Impacts of Conductivity Sensor Fouling on Derived Density





(5) SUMMARY AND FUTURE PLANS

- CO-OPS recognizes the rapidly changing environmental conditions within the U.S. Artic EEZ and potential for increased maritime traffic; CO-OPS existing observatory network has significant gaps along the western and northern coasts of AK.
- CO-OPS is developing and testing a real-time ocean/met observing system for use along coastlines with very limited infrastructure.
- Initial Atlantic coast field tests of the prototype system have been successful (2014 & 2015); continuing analysis is underway, including evaluating sources of water level measurement error to improve system design.
- A real-time ocean/met system to fill gaps in nearshore ocean/met observations along Alaska's remote coast will provide numerous societal and economic benefits. Resulting observations will address a critical need for reliable information, proving invaluable for maritime forecasters, emergency managers, vessel operators, and many other decision makers.
- A key component to future system work involves field demonstration in a relevant environment, North coast of Alaska. This is planned for FY17 pending available funding; additional work, FY16 onward, includes:

Complete integration of acoustic wave and current sensor Density and water level derivation, in real-time

Replace IP modem with Iridium RUDICS Additional local field demo in open ocean environment

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