

NOAA's Tides & Currents Program

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As the National Oceanic and Atmospheric Administration embarks on a year of celebration honoring "200 years of Science, Service and Stewardship," we begin a series of articles in the ACSM Bulletin about NOAA's vast program areas. NOAA's Tides and Currents Program can trace its roots back to 1807 when President Thomas Jefferson had the foresight and vision to create the Survey of the Coast. This oldest scientific agency in the United States initiated the earliest systematic observations of tides and tidal currents. Today's Tides and Currents Program is managed by NOAA's National Ocean Service Center for Operational Oceanographic Products and Services (CO-OPS). This article takes you on a journey through time. I invite you to reflect on the rich history of CO-OPS and learn about the technological advances and philosophical changes that have shaped the program, and where we aspire to go in the future.

Foundations

CO-OPS has a strong tradition of providing accurate, reliable, and value-added products and services through the operation and maintenance of long-term, sustained observing systems. The Tides and Current Program mission has always focused on promoting safe and efficient marine transportation. It continues to support NOAA's Nautical Charting Program through a variety of activities, such as determining tide and water level reference datums, creating tides and tidal current prediction products, and providing tide and water level reducers for soundings and tide control for shoreline surveys.

In 2004, NOAA celebrated 150 years of continuous tidal observations in San Francisco and since then, the National Water Level Observation Network (NWLON) continued to expand. The 200th NWLON station will be established in Mobile, Alabama, this year.

The surveying and mapping community has traditionally relied upon NOAA for expertise and quality information. Observations and analysis of water levels provide baseline reference elevations such as Mean Lower Low Water (MLLW) and Low Water Datum (Great Lakes) for Chart Datum and Mean High Water for shoreline mapping and maritime boundary delineation.

Tidal current observations continue to be made in critical locations in response to user needs. Tide and tidal current prediction products are available for several thousand locations and continue to be updated by reoccupying historical locations and expanding to new locations. The mariner relies on this tide and current information to safely navigate our coastal waters.

Transformations

Technological advancements truly helped to shape and modernize the program. New sensors and data collection, data base management, and data delivery enabled the development of a more robust and efficient system. Enhanced products are the result of actively reaching out and listening to our customers. We have broadened our constituent base by including customers of core products as well as those seeking non-traditional applications. The Tides and Currents Program is comprised of the following major activities.

The National Water Level Program

Data collection through GOES satellite transmission and 24X7 quality control operations has led to virtually real-time application of data at all NWLON stations. These stations are active components of NOAA's Tsunami Warning System and Storm Surge Warning networks. Their modern data collection platforms can collect other meteorological and oceanographic data as well. A NWLON gap analysis estimates 300 stations would be needed, including at the Great Lakes and U.S. Ocean Island Territories and Possessions, to achieve an optimum size. Currently there are 200 NWLON stations operating.



The hardened NWLON station at Dauphin Island survives Hurricane Katrina



PORTS® data provide under keel and above-ship clearance

The Physical Oceanographic Real-Time System

Using new technology and real-time data delivery, the Physical Oceanographic Real-Time System (PORTS®) facilitates safe and efficient marine transportation. PORTS® measures and disseminates observations and predictions of water levels, currents, air gap for bridges, meteorological parameters, salinity, and water temperature that mariners need for improved navigation.

National Operational Coastal Modeling Program

Traditional tide and tidal current predictions are not adequate to support many applications, especially in areas where the local water level elevations and currents are more strongly influenced by wind and barometric pressure changes than by astronomical tides. NOAA has developed a National Coastal Modeling Program (NOCMP)

to provide 24 x 7 nowcast/forecast model output products to supplement real-time data from PORTS®.

National Current Observation Program

Based on an assessment of the tidal current program in 1999, program activities began focus-



Deployment of an ADCP current meter

ing on priority areas identified by the user community. The major technology upgrade was the use of Acoustic Doppler Current Profiler (ADCP) systems that measure the entire water column and can be used to provide cross-channel profile information as well. Tidal current prediction products are also being significantly improved.

Coastal Oceanographic Applications and Services of Tides And Lakes Program

In order to meet the needs of a broader suite of customers, CO-OPS recently formed the Coastal Oceanographic Applications and Services of Tides And Lakes (COASTAL) Program to focus on non-navigational and non-traditional applications of water levels and datums, such as wetlands restoration, coastal zone management, long-term sea-level assessments, storm-surge monitoring, and emergency preparedness.



Using proper tidal datum elevation control to reconstruct a marsh surface

The COASTAL Program operates through partnerships internally with NOAA and externally with other federal agencies, state and local governments, and nonprofit organizations. The COASTAL Program has expanded to include similar non-traditional applications of geodetic datums within NOAA/NOS National Geodetic Survey.



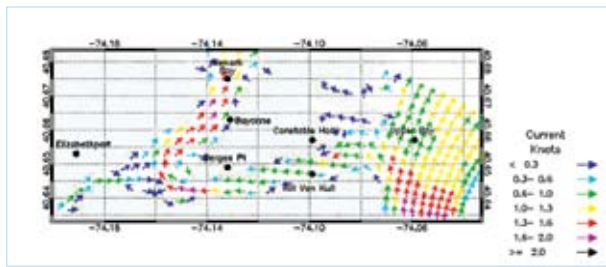
New air gap sensor technology installed into operations on a bridge in Long Beach, California, after OSTEP test and evaluation

Ocean Systems Test and Evaluation Program

OSTEP facilitates the transition of new sensors and systems to an operational status and tests instruments to ensure that they meet CO-OPS requirements. The program develops operational deployment and implementation processes and establishes quality control criteria.

Continuous Operational Real-Time Monitoring System

CORMS is the primary system for real-time quality assurance/quality control (QA/QC) efforts in



New York Harbor channel forecast guidance product for currents



CORMS 24 x 7 operations

CO-OPS. The primary mission of CORMS is to perform thorough and robust QA/QC on all real-time data, systems, and products in the CO-OPS domain. CORMS not only ensures that real-time data are readily available, but stops dissemination of questionable data. All data and products are monitored and reviewed on a 24 x 7 basis, automatically and by experienced CORMS operators working 12-hour shifts. CORMS also utilizes a rules-based artificial intelligence system. When a system and/or data problem is detected, CORMS stops dissemination of data, remedies the situation, or forwards the information to the appropriate field technicians and/or IT personnel to enable corrective action.

Web-based Product Delivery

Web-based delivery of preliminary and verified data, graphical displays and tidal predictions, harmonic constants, and tidal datums and published benchmark elevations provide easy access for the surveying and mapping community. In addition to the home page web access, data are also available through an OPenDAP web portal (compatible with Integrated Ocean Observing System (IOOS)), using structure and metadata standards of the IOOS community.

Visions

The ability of society to make the best decisions possible, whether it is for the safety and efficiency of maritime commerce, the protec-

tion of life and property from hazardous events, the restoration of coastal habitat, or for the management of coastal zones, all require comprehensive understanding of the physical oceanography that drives much of our coastal processes. The modern Tide and Currents Program is one that aspires to this goal.

The Program endeavors to remain rooted in fundamental observational programs and core expertise, and then extend the applications of those products and services into partnership with its customers and with other federal agencies, be they internal or external to NOAA.

The vision of CO-OPS is also to be a leader in integrating oceanographic observations and in the development of innovative tools and solutions; to improve maritime safety; to increase coastal community awareness; to improve the ability to forecast future conditions; and to apply long-term observations to understanding climate change.

CO-OPS has initiated an outreach program to facilitate the delivery of products and services to its customer. For instance, new products being developed based on customer feedback include an electronic tides and tidal current prediction delivery system and training programs focused on specific user needs and applications. The implementation of GIS is just one of the modern tools being planned for use in operations and value-added delivery of tools for data and information.

Summary

Over the last 200 years, technology has improved, and demand for data that are accurate and can be delivered faster has increased

exponentially. Using the strengths of a fundamental program serving the maritime transportation sector needs for tide, water level and current observations and predictions, the tides and currents legacy program has transitioned to a modern operational oceanographic organization that meets a broad spectrum



The CO-OPS home page [<http://tidesandcurrents.noaa.gov/>]

of user needs. The core values of the program and the dedication of the people have not changed. From real-time delivery of data and products, to improved prediction and forecast tools, to improved long-term sea level assessments, CO-OPS has integrated new technology in data collection, quality control, processing, and delivery. The vision is to continue to grow partnerships with users and with other state and federal agencies to maintain the utility and relevance of our products and services. All the products and programs mentioned here will be featured in subsequent issues of the *ACSM Bulletin*. Interested readers can visit the NOAA web-site: <http://tidesandcurrents.noaa.gov> and look under Products, Programs, and Partnerships for more information. Also, check out NOAA's 200th anniversary web site: <http://celebrating200years.noaa.gov/welcome.html>.



The IOOS data portal [<http://tidesandcurrents.noaa.gov/>]