Mapping the Wave Climate in the Nearshore Offshore the Pacific Northwest Coast

How NANOOS is working with coastal wave modelers to provide information on wave conditions offshore the coasts of Oregon and Washington

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Understanding how waves vary in place and time — the wave "climate" (i.e. the heights, frequency and direction of wave approach) offshore any coastline is critically important to the operation and safety of ships working out on the ocean, whether they are fishing boats operating close in to the coast or large container ships travelling across the expanse of the ocean. In the Pacific Northwest waters within the domain of the Northwest Association of Networked Ocean Observing Systems (NANOOS), waves impact all aspects of maritime trade and there are indications that the height of extreme waves in the region may be increasing. The impact of this changing wave regime in the particular area of the Columbia River bar, which has claimed over two thousand vessels since the late 1700's, is vitally important to understand as it is generally throughout the region.

Besides the maritime industry, information on ocean wave climates is important to many other marine stakeholders including coastal residents (be it for recreation or in preparation for a major storm), engineers (e.g. for wave energy extraction or jetty rehabilitation) and by coastal scientists for understanding hazards (e.g. risk from wave runup and overtopping and/or erosion). Around the coastline of the United States there are numerous wave buoy stations operated by the National Data Buoy Center (NDBC) of the National Oceanic and Atmospheric Administration (NOAA), providing critical information about both existing and historical ocean conditions. However, in order to understand potential future wave conditions, the wave climate must be modeled using sophisticated computer programs that take into account basin-scale climate processes. These forecasts, spanning several days into the future, are provided at the national level by the National Weather Service (NWS) of NOAA, using their Wavewatch III (version 3.14) model[1].

The simulations, which are run by NOAA four times a day (00Z, 06Z, 12Z, and 18Z) produces forecasts of every 3 hours from the initial time out to 180 hours. The model requires use of wind forecasts from the Global Forecasting System (GFS) utilized by the National Centers for Environmental Prediction (NCEP). Wind forecasts are available at roughly half a degree resolution, while the final wave model forecasts are ultimately provided at quarter degree resolution.

In March 2010, NANOOS began repackaging the NOAA Wavewatch III forecasts (wave height and period), making them available through their NANOOS Visualization System (NVS[2]) mapping portal (Fig. 1). The purpose here was to meet a core objective, which is to make such information more easily accessible to the broader maritime community in order to better assist with their operations, safety, and commerce. In addition to making Wavewatch III data more easily accessible, NANOOS software engineers developed a "compara-

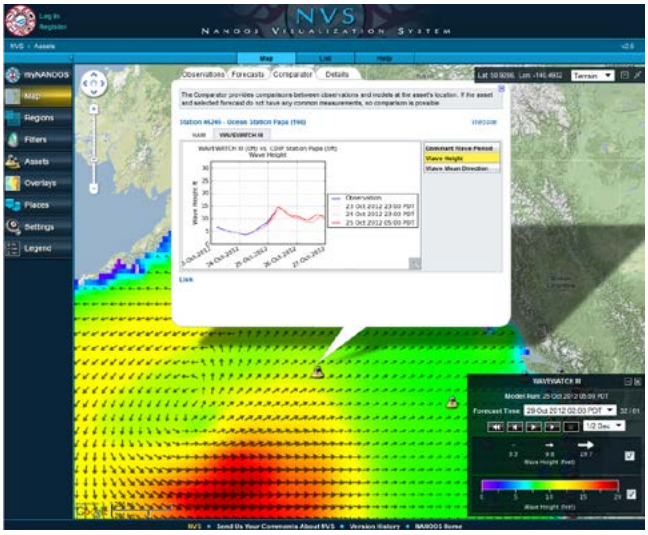

Fig. 1: North Pacific Wavewatch III forecast overlay for October 29, 2012, along with the NVS "comparator" tool showing comparisons between the model predictions and the measured waves at NDBC 46246 (Papa).

tor" tool that provide a direct comparison between the measured waves at individual stations and the forecast waves at the same location (Fig. 1), enabling the user to gain confidence in the model forecast. The model run overlays can be visualized for specific dates and times of interest or looped as a movie showing the progression of storm systems as they track across the North Pacific Ocean.

To further improve the accuracy and applicability of the NWS Wavewatch III model in shallower areas such as across the continental shelf and adjacent to the coast, scientists in the College of Earth, Ocean, Atmospheric Sciences at Oregon State University begin developing an experimental forecast of wave conditions along the Oregon/Southern Washington Coast (Fig. 2). The model is a high-resolution (30 arc-second) nearshore wave forecasting model that spans the region from the Klamath River, in California (41.50°) north to Taholah, Washington (47.35°). The spatial resolution used here is much finer than the quarter degree resolution used by the NWS forecasts. The high spatial resolution allows for the inclusion of shallow water bathymetric features (e.g. banks, canyons, etc) and, therefore, accounts for the wave transformation due to these features. The model is essentially Wavewatch III but with the shallow water physics turned on, and importantly the inclusion of detailed bathymetry.

Hence, these new forecasts cover water depths much shallower than the routine forecasts produced by the National Weather Service, essentially bringing the waves into just outside the surf zone. The forecasts are updated daily at 0200 UTC and provide insights into conditions from the initial time out to 84 hours. To reduce the number of overlays provided through NVS, NANOOS product developers merged the NOAA NCEP low-resolution northeast Pacific domain for regional wave conditions and the OSU high-resolution Oregon domain for localized, nearshore wave conditions, resulting in a single overlay (Fig. 2) that can be easily viewed within the NVS mapping portal.

To further assist mariners operating along our coastline, NANOOS product developers and OSU scientists are exploring a suite of new wave climate products that may be of interest to the maritime industry including the provision of virtual wave buoy stations spaced 1-2 km along the length of the coast. These "virtual" buoys provide information specific to the particular location (i.e. wave height, period, frequency and energy spectra) and are analogous to the existing instruments currently operating along the Oregon coast. Furthermore, NANOOS product developers are also exploring a new situational awareness capability that will enable users to visualize the current conditions for all stations (both virtual and instrumented). ☆

1. http://polar.ncep.noaa.gov/waves/index2.shtml
2. http://www.nanoos.org/nvs/nvs.php?section=NVS-Assets

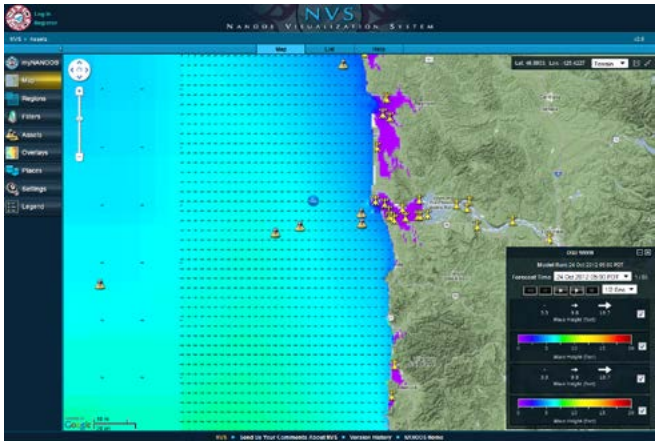

Fig. 2: Merged low/high resolution Wavewatch III product developed by OSU scientists and NANOOS.

The Northwest Association of Networked Ocean Observing Systems (NANOOS) is the Regional Association of the national Integrated Ocean Observing System (IOOS) in the Pacific Northwest, primarily Washington and Oregon. NANOOS is a partnership of over 40 entities, including industry, state agencies, local governments, tribes, non government organizations, and educational institutions. NANOOS has strong ties with the observing programs in Alaska and British Columbia through our common purpose and the occasional overlap of data and products.

NOAA and American Pilots' Association sign Memorandum of Agreement to advance safe navigation

Press release: October 18, 2012 by NOAA Office of Coast Survey

Dr. Kathryn Sullivan, NOAA Assistant Secretary of Commerce for Environmental Observation & Prediction, signed an agreement today that recognizes the long-standing working relationship between marine pilots and NOAA's navigational services. Coast Survey has a long-term working relationship with the American Pilots' Association, whose members include virtually all of the 1,200 state-licensed marine pilots working in the 24 coastal states and the Great Lakes. This agreement updates an earlier collaborative agreement between APA and NOAA.

Dr. Sullivan and Captain Michael Watson, APA president, signed the MOA this morning, during the APA annual meeting.

The MOA lays out specific cooperative activities to promote safe navigation. Among a wide range of provisions, it encourages the 57 APA-member pilot groups to provide information to update NOAA's nautical charts and the U.S. Coast Pilot. The MOA will also facilitate timely investigations of apparent discrepancies between actual and charted features, which could pose dangers to navigation or adversely affect shipping efficiencies. ☆