UC San Diego
UC San Diego News Center

By Robert Monroe Feb 11, 2016

El Niño Beach Survey From Air Provides Glimpse of What's to Come for the Coast

Elevated sea level fed by warmer ocean could be the look of the future

Timely funding from the Office of Naval Research and the U.S. Army Corps of Engineers is giving scientists at Scripps Institution of Oceanography a chance to create a detailed survey of the elevations of Southern California beaches and cliffs in the midst of one of the strongest El Niño seasons of the last 60 years.

Physical oceanographers Ken Melville and Luc Lenain are leading aircraft-based measurements using an imaging suite called the Modular Aerial Sensing System (MASS). During flights along the Southern California coast, light detection and ranging, or lidar, equipment measures the elevation of sand and cliffs along California's beaches as they respond to storms and sea levels that are as much as 23 centimeters (9 inches) higher than historical averages. The lidar, coupled to global positioning system (GPS) instrumentation and inertial motion sensors, scans swaths of beach and ocean more than 600 meters (1,970 feet) wide measuring coastal topography on the scale of centimeters.

“The Department of the Navy is keenly interested in understanding the potential effects of climate change and sea-level rise, and this coastal survey is a great example of the strategic partnerships that we contribute to and learn from to that end,” said Deputy Assistant Secretary of the Navy Karnig Ohannessian. “The science informs key stakeholders in a whole-of-community approach to planning and adaptation, which ensures infrastructure resilience and enhances the Navy's mission readiness.”

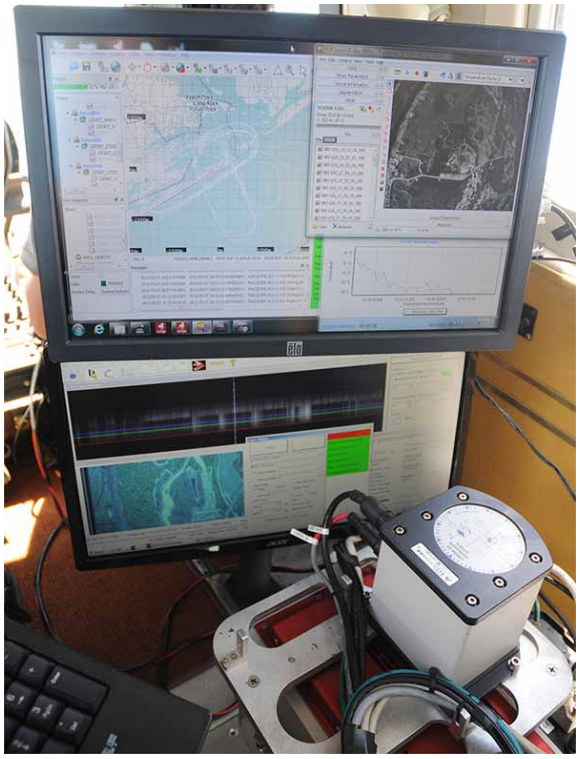
“The Navy has a huge infrastructure at sea level and needs to understand the impact of storms and sea-level change not only in Southern California, but around the globe,” said Tom Drake, the director of Ocean, Atmosphere, and Space Research at Office of Naval Research (ONR). “Scripps is a leader in beach and coastal science and provides an excellent team to gather and interpret a new coastal lidar dataset. The new data will greatly enhance our understanding of El Niño-driven shoreline processes in Southern California and give the Navy valuable insight and ability to predict future coastal change.”

Melville said the data, once processed, could serve as a case study for cities and states to follow as they adapt to higher sea levels that will change how they manage coastal and urban infrastructure in coming decades. Scripps researchers Timu Gallien, Bob Guza, and Adam Young, with support from the U.S. Army Corps of Engineers (USACE), will combine the lidar data with information about rain, waves, and currents. The final product will include a snapshot of how sea level, storms, and tides combined to change beach and cliff topography during the 2015-16 El Niño.

"The critical data collected by Scripps scientists during this large El Niño winter storm season will enable research that helps the Corps of Engineers better understand the coupled effects of elevated water levels and frequent large waves on beach sediment budgets, inundation, and shoreline evolution,” said Jeffrey Waters, Chief of the Coastal Observation & Analysis Branch at the U.S. Army Corp’s Field Research Facility, Coastal and Hydraulics Lab. “This analysis will be integral to developing accurate coastal resilience models for low-lying coastal communities and will enable efficient management of infrastructure and resources during extreme conditions.”

To make the surveys possible, Melville had to apply for funding on an accelerated timetable in order to capture beach changes as they happened. The project uses lidar equipment funded by the National Science Foundation (NSF) through American Reinvestment and Recovery Act funds. A swift response

from ONR, however, made the flights possible, said Melville. USACE supports data analysis.



A typical real-time readout of the lidar, infrared and hyperspectral cameras.

“With the prospect of an unusually large El Niño winter storm season approaching, it was clear that we had to make these airborne lidar measurements so there would be an archived record of coastal erosion in Southern California over the winter,” said Melville. “These data can be used by researchers not just to record the events of this winter but also to test models of the impact of sea-level rise on coastal Southern California.”

Scripps Oceanography researchers were among the first wave of scientists in the 1970s to study El Niño, a phenomenon broadly characterized by warmer waters in the eastern equatorial Pacific Ocean and shifting wind patterns. This year’s event is among the strongest to be seen in the last 60 years in terms of heightened sea surface temperature, rivaling major El Niños in 1982-83 and 1997-98. Melville’s is one of several studies at Scripps designed to observe this year’s event using methods that were less developed or nonexistent during the last major El Niños.

“The MASS was designed to provide fast-response survey capability in response to weather events, which makes it an ideal tool to study the impact of this winter’s El Niño,” said Lenain.

Another NSF-funded study will send Scripps researchers to California’s coastal waters in April to examine El Niño’s effects on California Current marine life during a time of year when nutrients are propelled to the ocean surface from deep waters. Other researchers are enlisting the public’s help to document the evolution of El Niño’s effects on the coastline and estuaries with photos.

The suite of studies not only helps researchers understand a significant climate phenomenon in its own right but to observe it as a proxy for future climate, when El Niño-like conditions become more common. This season’s research could serve as a guide to societal adaptation efforts, a new area of emphasis at Scripps exemplified by the Center for Climate Change Impacts and Adaptation, which was created in August 2015.

El Niño has played a major role in driving sea level to record heights and very active waves and swell this winter, but it is not the only influence. An unusual pool of warm upper-ocean water nicknamed “the blob” has endured off the West Coast since 2014 and has also produced higher sea levels. The

Scripps physical oceanographers Luc Lenain (left) and Ken Melville lead a lidar survey of the Southern California coastline.

influence of the blob and El Niño are superimposed atop a longer-term alternating pattern of rising eastern Pacific temperatures and sea level known as the Pacific Decadal Oscillation (PDO). All those factors add to an even longer trend in global sea-level rise.

In 2015, some monthly mean water temperatures were the highest ever in the 100-year history of temperatures taken at Scripps Pier. March 2015, for instance, set a record with a mean temperature 3.05° C (5.49° F) higher than the historical average. In recent months, the tide in San Diego has on most days been between 15 and 23 centimeters (6 and 9 inches) higher than predicted.

The research team took one pass over the California coast from Ventura to the border of Mexico in October 2015 to create a baseline against which surveys made during the El Niño winter could be compared. Another series of flights took place in mid-January and a third series is planned for early March.

“It is only in the last decade that this combination of lidar and GPS-motion instrumentation has been available to measure beach and coastal topography over such large stretches of coastline with such precision,” Melville said. “The measurements we are making this El Niño winter should be done on a regular basis to monitor the ‘health’ of beaches that are major contributors to the lifestyle and economy of Southern California.”