

How Ocean Observations Power Marine Weather Forecasting Along California's North Coast

Voices of the Region | NOAA National Weather Service

When storm systems roll toward California's North Coast, it's not just the sky that tells the story — it's the ocean. Offshore buoys record rising seas, high frequency radars trace the flow of coastal currents, and satellites capture shifting winds. Each of these data points help the National Weather Service (NWS) translate the ocean's motion into something essential: a forecast.

For **Troy Nicolini**, Meteorologist in Charge at the NWS Eureka office, that forecast is more than a product — it's a promise of safety.

"Our goal is to help people be at peace with the natural hazards they live with," he says. "Whether it's sneaker waves, tsunamis, or coastal storms, ocean data gives us the foresight we need to protect lives and livelihoods."

The Backbone of a Forecast

The NWS Eureka office serves five counties along some of northern California's most rugged, weather-exposed coastlines. To build forecasts that mariners can trust, Troy and his team rely on a foundation of **ocean observing infrastructure** — offshore buoys, high-frequency radar, and satellites — many of which are supported through the **Central and Northern California Ocean Observing System (CeNCOOS)**.

"We live and die by the observations," Troy explains. "When a buoy 600 miles offshore goes down, we lose our early warning system. By the time nearshore buoys detect those waves, they're already here."

Buoys capture critical variables — wave height, period, direction, and wind speed — that forecasters use to verify and refine their models in real time. Through the state-wide [CalOOS Data Portal](#), CeNCOOS provides these same high-quality observations in one open, accessible platform, ensuring that coastal managers, scientists, and mariners can all base their decisions on the most up-to-date ocean data available.



When the Forecast Hits Home

Nowhere is that reliance on ocean data clearer than in **California's Dungeness Crab Fishery**. As the season progresses and crabbers move their gear into shallower waters, long-period swells can drag or bury pots, sometimes wiping out **hundreds of thousands of dollars** in a single storm.

"If a 25-second wave comes through and we miss it, people can lose everything in one day," Troy says. "But if we have a day's notice, they can pull their gear and stay safe."

Those warnings depend on comparing offshore buoy readings to model predictions — one of the most direct ways that ocean observing infrastructure supports both safety and the economy.

Similar dynamics guide **tuna and longline fisheries**, where **sea-surface temperature**

maps reveal the warm-water fronts where fish gather. NWS forecasters track those same temperature breaks to focus their forecasts in the regions where boats will be concentrated.

“We literally adjust our forecast coverage based on where the fleet’s heading,” Troy explains. “That’s all driven by observation.”

More Eyes on the Ocean

Despite their critical importance, the North Coast’s observing assets remain sparse. North of Cape Mendocino, there are only **five operational wave buoys**, compared to **24 between Santa Barbara and the U.S.–Mexico border**, and **14 more between San Francisco and Santa Barbara**. In other words, there are nearly **five times more wave buoys in the Southern California Bight** than along Northern California’s coast—**where storms tend to be much larger**. With fewer instruments and harsher conditions, each data gap carries extra weight.

“When we lose a deep-water buoy, we lose lead time, confidence, and accuracy,” Troy says. “It directly affects how people make safety decisions on the water.”

Emerging technologies such as **autonomous buoys and underwater gliders** could help fill those gaps by expanding coverage and capturing subsurface current data that are currently missing from forecasts.

In addition to enhanced observations, data access to the public is more important now than ever. Platforms like the CalOOS Data Portal help visualize and share the very data collected by NOAA’s National Weather Service - these partnerships turn raw observations into information people use every day.

Looking Ahead

As forecasting models grow more advanced — now incorporating wave-current and seafloor interactions — they also demand more observational validation. That means partnerships across agencies and observing systems will only become more important.

“Better models will need better observations,” Troy says. “That’s where groups like CeNCOOS come in — making sure the data is there, and that people can actually use it.”

For Troy, who retires this winter after nearly three decades with the Weather Service, the work remains deeply personal.

“Forecasting,” he reflects, “is about helping people make peace with nature — and that starts with knowing what the ocean is telling us.”

About the Series - “Voices of the Region” highlights the diverse ways that people across central and northern California use and depend on ocean observing data — from forecasting and fisheries to coastal management and community safety.