

Improving Monitoring and Forecasting of Precipitation and Coastal Flooding in the San Francisco Bay Area

THE CHALLENGE

When big storms hit California, current technology does not always provide forecasters with the level of detail needed to inform reservoir operations, flood protection, combined sewer-stormwater systems, and emergency preparedness. Accurate and timely precipitation information is critical for making decisions regarding public safety, infrastructure operations, and resource allocations. Standard weather radars are often unable to give an accurate picture of what is happening in the complex landscape of California's coastal mountain ranges. Experimental monitoring and prediction of precipitation in the San Francisco Bay region is being developed to enhance public safety through early warning and storm tracking when hazardous weather events come onshore.

THE SOLUTION

The Advanced Quantitative Precipitation Information (AQPI) System is a regional project funded by the California Department of Water Resources. The experimental AQPI System consists of improved weather radar data for precipitation estimation; additional surface measurements of precipitation, streamflow and soil moisture; and a suite of forecast modeling systems to improve lead time on

precipitation and coastal Bay inundation from extreme storms—especially high-moisture laden *atmospheric rivers*. These conveyor belts of water vapor in the sky can bring drought-busting precipitation or hazardous storm conditions to the West Coast.

AQPI observing assets include a coastal Doppler C-band weather radar along the Sonoma County coast which will point offshore to improve tracking of incoming storms and four gap-filling X-band radar units strategically located to provide high-resolution coverage over populated and flood prone urban areas throughout the San Francisco Bay region. The radar data will be assimilated by atmospheric models to improve short-term prediction of precipitation. With these additional observations, the AQPI System will also improve runoff and coastal flooding predictions in and around the Bay. This information will be valuable to wastewater and flood protection managers, and will provide better inputs to urban water models.

To address climate change and sea level rise with possibly more extreme storms the AQPI System will implement the USGS Coastal Storm Modeling System (CoSMoS) to forecast flooding around the San Francisco Bay coastline.

NOAA CONTRIBUTIONS

NOAA is responsible for building the experimental AQPI System, deploying surface meteorological and streamflow instrumentation, developing high resolution quantitative precipitation estimation (QPE), quantitative precipitation forecast (QPF), and tributary streamflow forecast products, as well as prototyping AQPI products for delivery to end users. In particular, the new radar data will be assimilated into an experimental version of the NOAA High Resolution Rapid Refresh (HRRR) model.

NOAA's National Water Model will be coupled to the coastal storm model (CoSMoS) developed by the USGS for coastal flooding forecasts in and around the Bay coastline.

ANTICIPATED BENEFITS

The high resolution surface meteorological data and radar-based precipitation observations in complex terrain will provide a process understanding that can be used to improve operational rainfall estimates, identify forecast challenges and inform the NOAA Unified Forecast System model development.

Real-time access to the experimental data will provide forecasters in the National Weather Service Western Region with

AQPI KEY FEATURES

Five new, state-of-the-art radar systems to improve monitoring of precipitation offshore and within the Bay region.

High-resolution precipitation forecasts.

Coastal flooding, storm surge, and tributary streamflow forecasts.



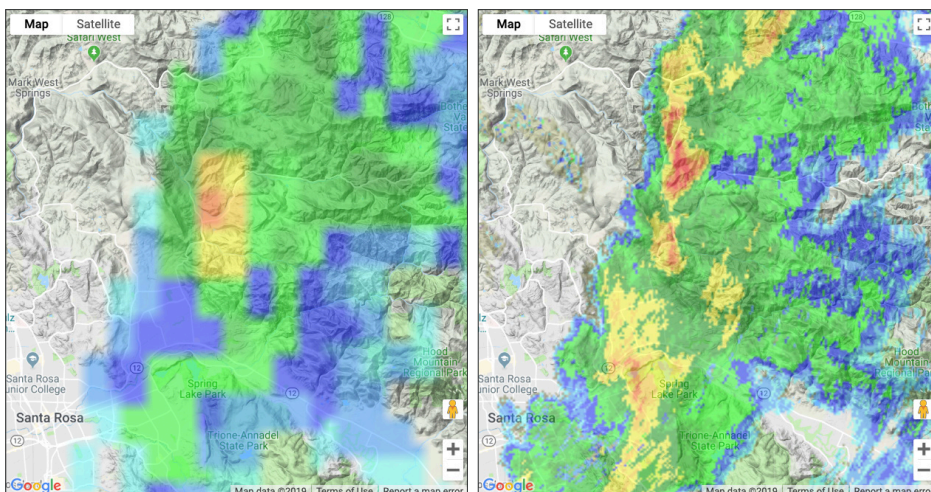
additional data to evaluate operational forecast model performance and to better understand how extreme precipitation events are evolving as storms encounter coastal mountain ranges in the San Francisco Bay area.

The experimental AQPI System can aid water managers in securing water supplies while mitigating flood risk and minimizing potential water quality impacts to the Bay from storm runoff and wastewater infrastructure. The system can be expected to provide benefits exceeding costs by a ratio of at least 4:1. These benefits accrue through:

- Avoided flood damage costs from early warnings.
- Forecast-based operations to maximize reservoir capture for water supply and fisheries flows.
- Minimization of water quality impacts from combined sewer.
- Enhancement of public safety for the various transportation modes (pedestrian, highways, marine and airports).

These benefits will become increasingly important as costs associated with extreme weather events continue to escalate. Since 2015, weather-related disasters across the U.S. caused over 3,800 fatalities and \$480 billion in economic damages. Recent examples in the Bay Area include a flooding event in 2017 which produced over \$70 million in damages in Santa Clara, CA, and a series of northern Bay area rainfall events in 2019, resulting in over \$150 million in flood damages and a presidential disaster declaration.

For more information, visit: <https://psl.noaa.gov/aqpi/> and <https://www.sonomawater.org/aqpi/>.



Radar imagery as seen from (left) NEXRAD and (right) AQPI radar near Santa Rosa, CA. The much higher resolution provided by the AQPI radar more accurately shows areas of heavy rainfall (warm colors) and potential flooding.

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