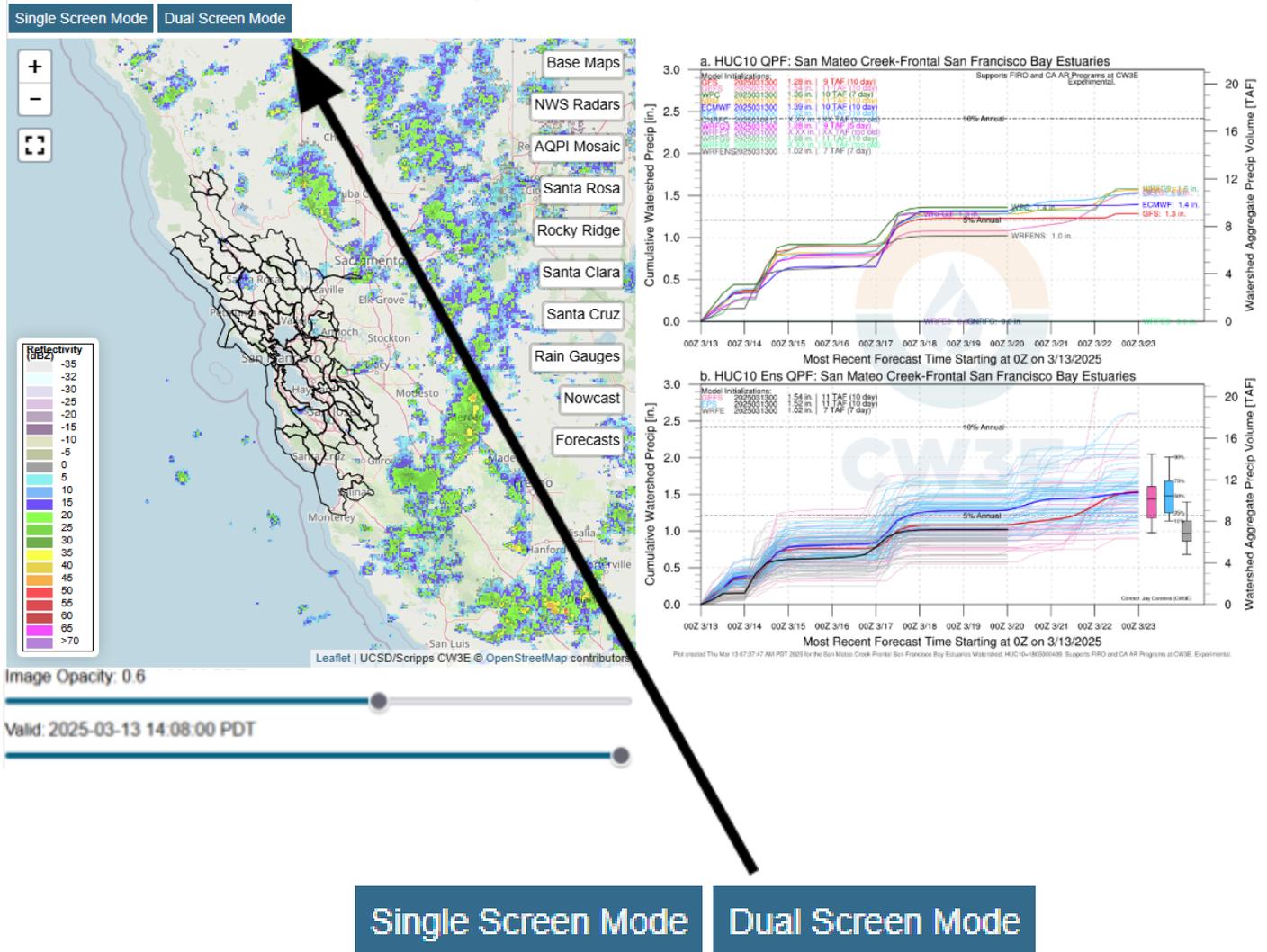


CW3E - Center for Western Weather and Water Extremes AQPI User Documentation

Last Updated: 20 Jun 2025

AQPI User Interface: <https://cw3e.ucsd.edu/Projects/AQPI/main.html>

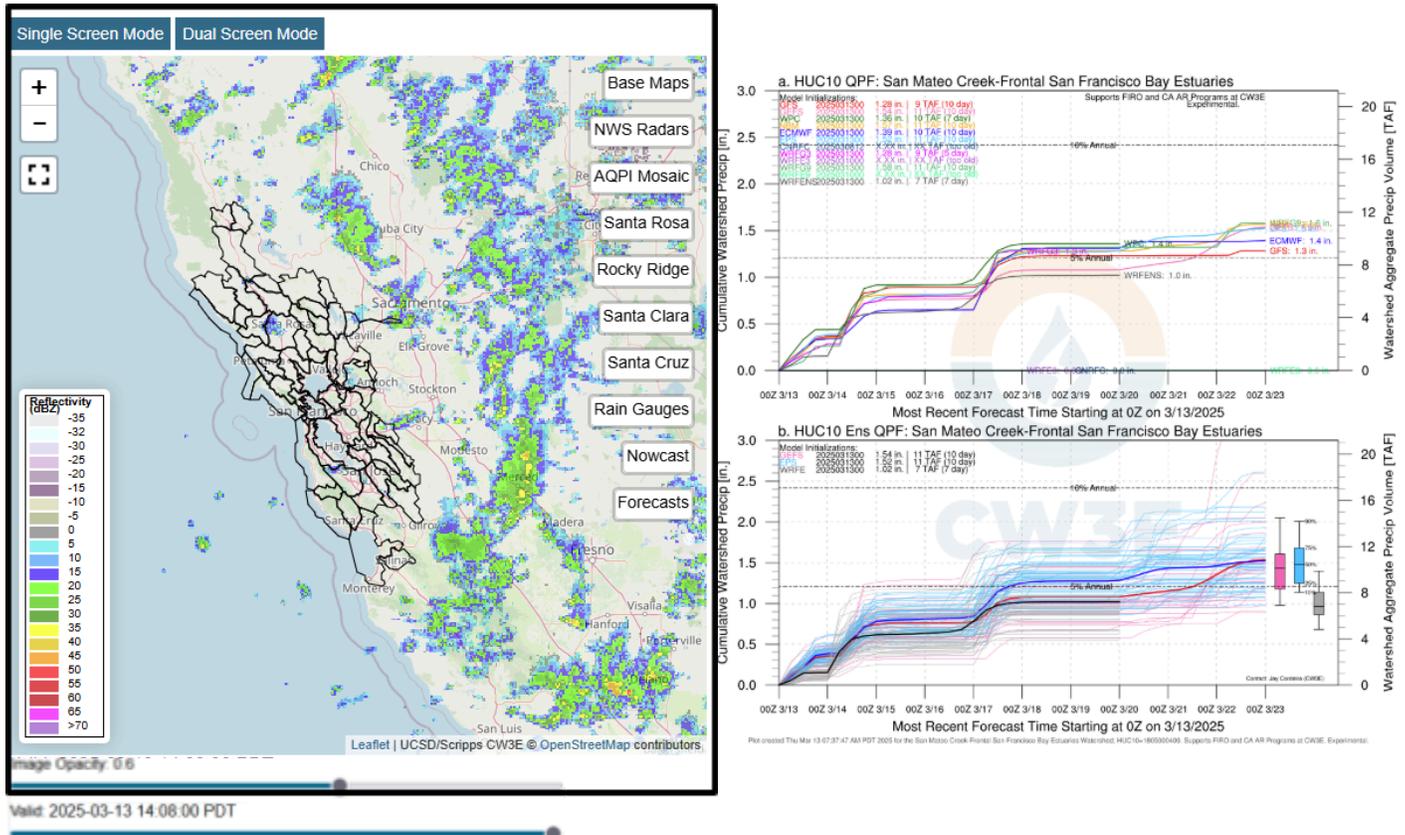


The AQPI User interface has two different viewing modes, Single Screen Mode and Dual Screen Mode. We will walk through each mode separately.

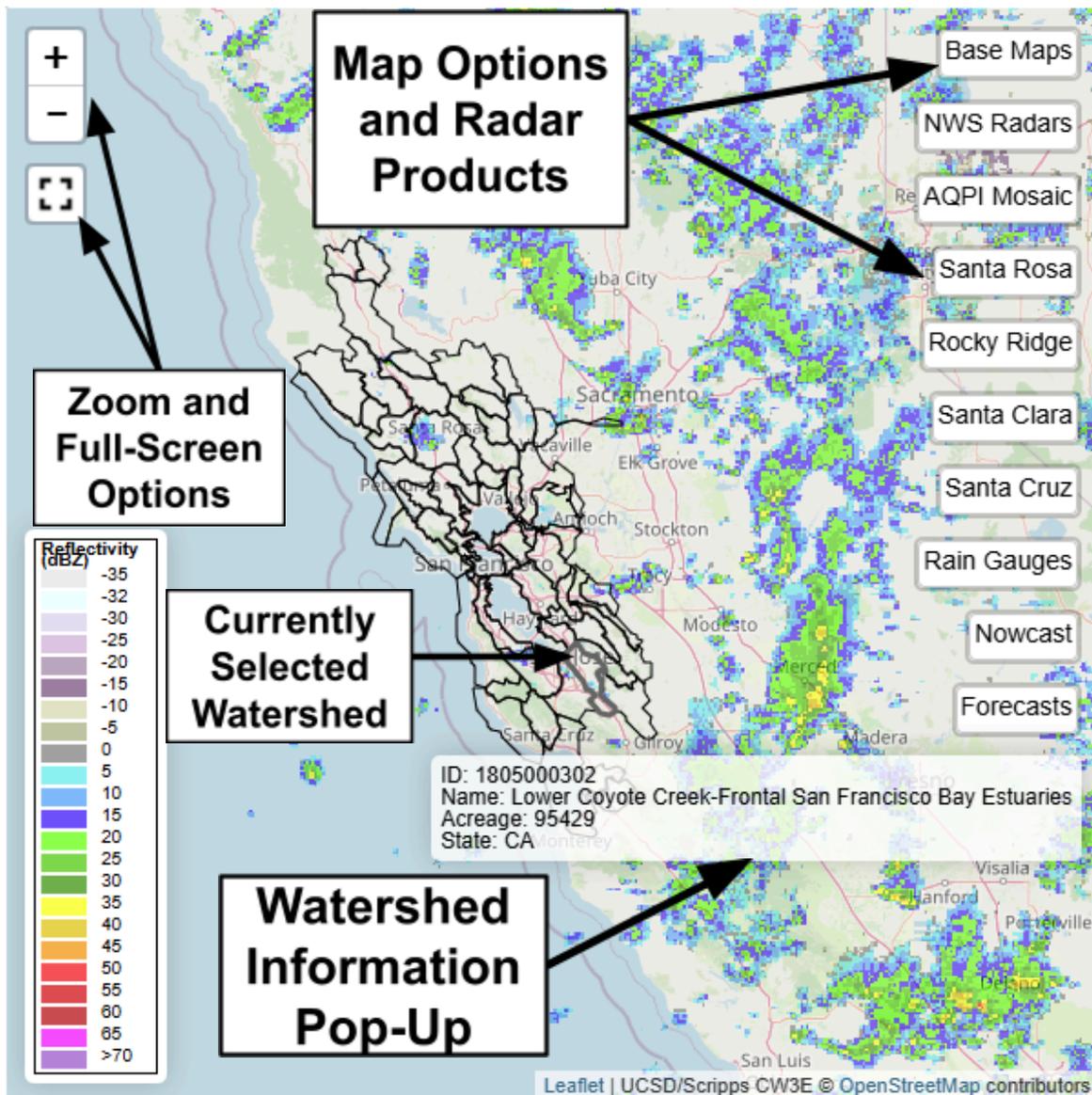
1. Single Screen Mode

Single screen mode is the default view when loading into the AQPI User Interface.

a. Left Side of Single Screen Mode



The left half of the page is a street map view of major highways and city locations centered on the San Francisco Bay Area. The background map can be changed with the buttons on the upper right portion of the map. The other option is a topographic base map which still features major city locations but further emphasizes the local terrain. The left screen will be where radar images are viewed. Directly below the map are two slider bars. The top slider bar adjusts the opacity of the selected radar or forecast imagery. The bottom slider bar allows you to cycle through the last hour of images for the selected product. The black outlines over and around the Bay Area are HUC-10 watersheds for the region.

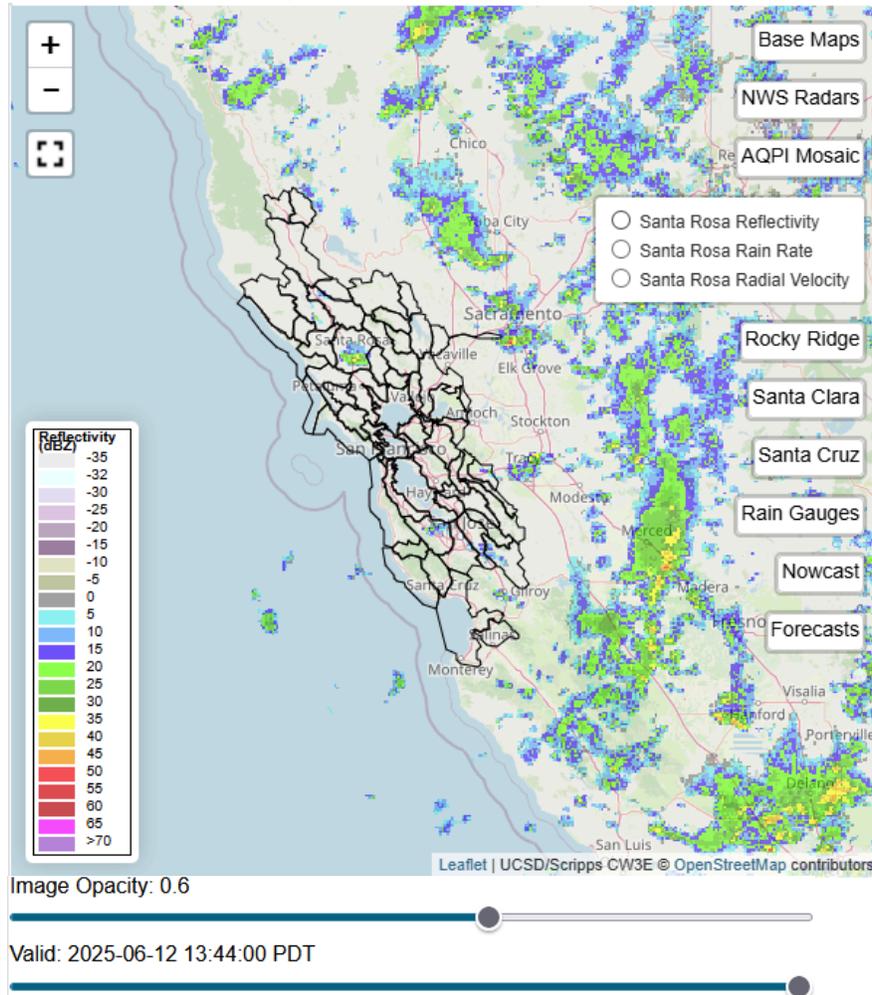


A HUC-10 watershed can be selected by clicking on it. You can tell which watershed has been selected by the gray outline placed over the watershed boundary. The ID, Name, Acreage and State of the currently selected watershed will also appear in a pop-up window from the right side of the radar screen. The radar screen can be zoomed in or out with the scroll wheel on the mouse or the touchpad on a laptop or via the plus and minus buttons in the upper left of the screen. The button directly below the zoom options allows you to make the image full screen.

By default, the latest Multi-Radar Multi-Sensor (MRMS) reflectivity data is loaded into the viewer. The MRMS aggregates radar data from all National Weather Service's (NWS) S-Band radars to provide a larger scale picture of the current conditions across the US to improve forecasting and warnings. This data can be incredibly useful in locations with terrain as some radar may have limited viewing range in certain directions given the height of local peaks. The

lower left portion of the radar screen shows the legend for the reflectivity. Higher values of reflectivity (35+, yellows) typically indicate higher rainfall intensities.

The product shown in the image can be changed by hovering over the menus on the right and selecting a product from there.



There are many options available for data viewing within the AQPI domain. They are as follows:

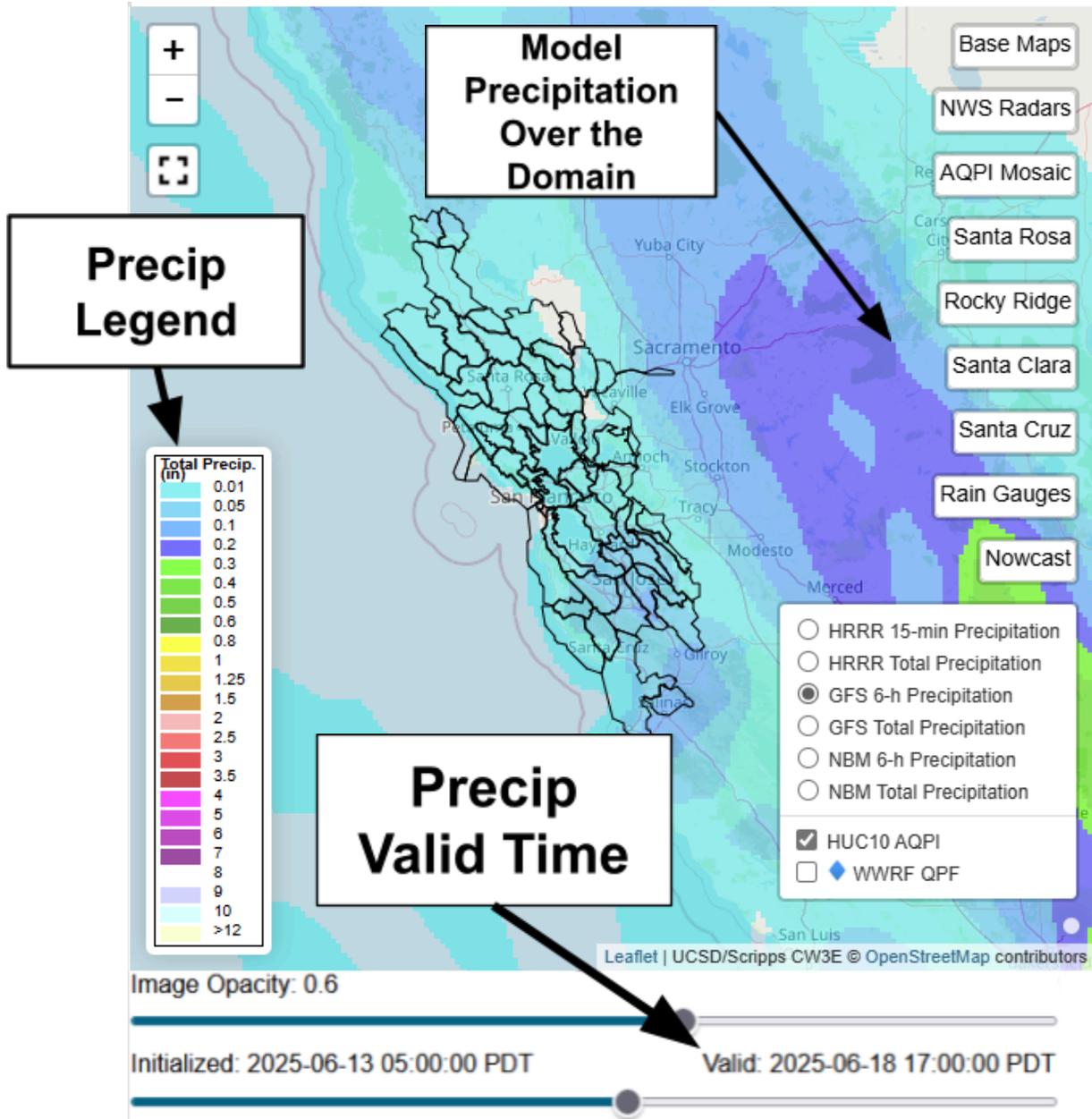
- **Reflectivity** is the standard data shown when viewing radar data. Reflectivity helps detect precipitation. The options for reflectivity are NWS Radars, which will cover the full domain using MRMS data, the AQPI Mosaic (a composite of all the X-band radars) and the individual X-bands at Santa Rosa (XSCW), Rocky Ridge (XEBY), Santa Clara (XSTC) and Santa Cruz (XSCZ) covering the AQPI domain.
- **Rain Rate** is the radar's estimation of how much precipitation is occurring at that location. The options for rain rate are NWS Radars/MRMS, the AQPI Mosaic and the individual X-bands at Santa Rosa (XSCW), Rocky Ridge (XEBY), Santa Clara (XSTC) and Santa Cruz (XSCZ) covering the AQPI domain
- **Radial Velocity** is the measure of how fast an object (ex/ storm cell) is approaching or traveling away from the radar. The options for radial velocity the individual X-bands at

Santa Rosa (XSCW), Rocky Ridge (XEBY), Santa Clara (XSTC) and Santa Cruz (XSCZ) covering the AQPI domain

- **Precipitation** totals are available for the AQPI Mosaic in 15-minute and 1 hour increments

The **Rain Gauges** tab allows for the option to toggle selectable California-Nevada River Forecast Center rain gauge locations across the domain. These gauges will present unQC'd 24-hour precipitation observations. The **Nowcast** tab provides a forecast of the next hour of reflectivity in **two-minute intervals** shown on the same domain as the AQPI mosaic. The **Forecasts** tab contains model precipitation forecasts viewable across the domain as either **accumulations** for the forecast period or in **15-minute intervals** for the HRRR and **6-hour intervals** for the GFS and NBM. Also selectable are precipitation forecasts from CW3E's West-WRF for select locations over the domain. The HUC10 watersheds are also able to be toggled on/off from this menu. An explanation of the models that can be selected:

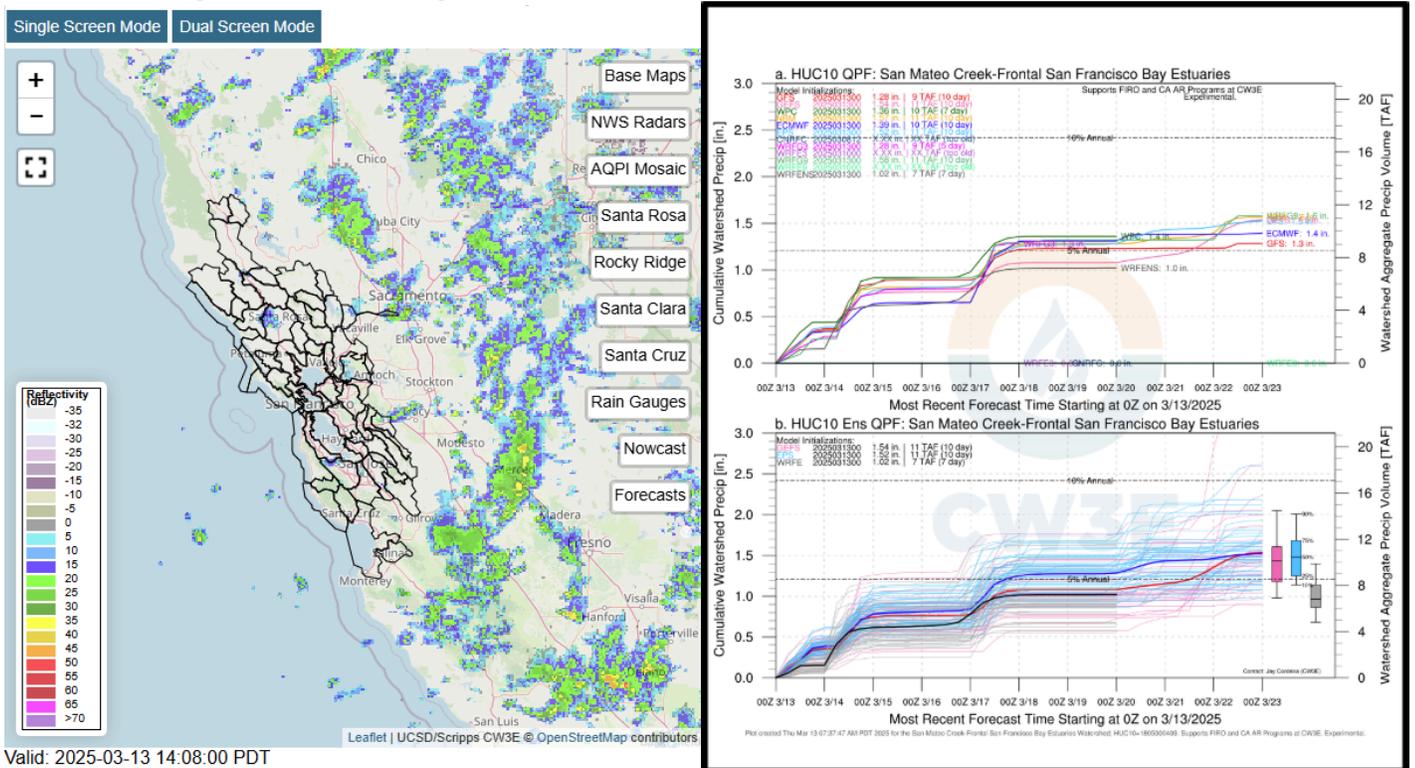
- High Resolution Rapid Refresh (**HRRR**) provides high resolution, short-range forecasts that are highly useful for convective forecasting. Provided are both 15-minute precipitation estimates and total precipitation accumulating from the latest initialization time.
- Global Forecast System (**GFS**) is the American worldwide weather forecast model developed by the National Center for Environmental Prediction (NCEP). Provided are 6-hour precipitation estimates and total precipitation accumulating from the latest initialization time.
- The National Blend of Models (**NBM**) combines NWS and non-NWS weather model data and post-processed model guidance to produce a forecast across the United States. Provided are 6-hour precipitation estimates and total precipitation accumulating from the latest initialization time.
- The **West-WRF** is developed by CW3E to be a "regional weather prediction system tailored to western U.S. weather and hydrological extremes, including heavy rainfall and extended dry period". Choosing the West-WRF will show select locations that forecast precipitation graphics are produced for. Clicking on one of these points will show the graphic on the right side of the screen, which is covered in the next section.



When viewing radar data you can view the last hour of scans by toggling through images using the buttons below the left side of the screen. The blue bar can be grabbed to freely move back/forward in time. Using the time slider button, you can also toggle through images. They are (left to right): move to first scan, move back on scan, play/pause the loop, move forward one scan, and move to latest scan.



b. Right Side of Single Screen Mode



The right side of single-screen mode will show graphs of precipitation data. By default, shown is model and ensemble precipitation forecasts (image a, top) and ensemble member forecasts (image b, bottom) for the San Mateo Creek-Frontal San Francisco Bay Estuaries HUC10 watershed. As long as the HUC10 watersheds are toggled on, the maps on the right can be changed to any HUC10 watershed by clicking on the watershed.

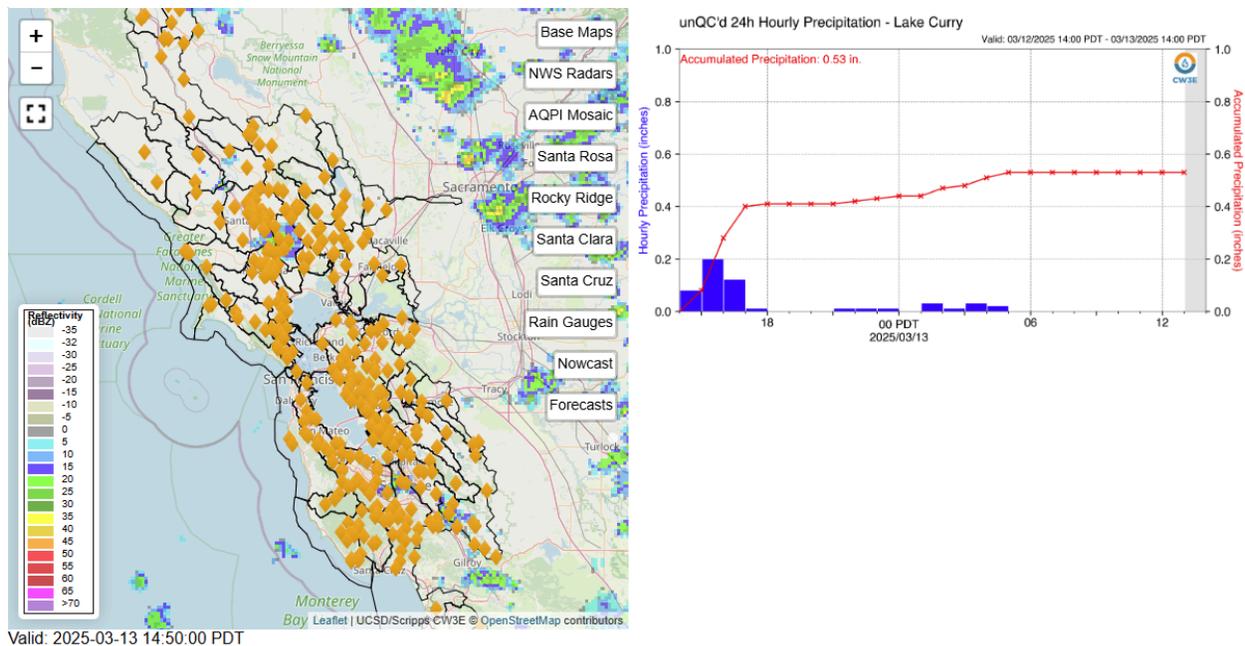
Image a shows 10-day mean areal precipitation accumulation over the given watershed. Shown are a mix of model forecasts (GFS, ECMWF, CNRFC, WRFG3, WRFE3, WRFG9, WRFE9), ensemble forecasts (GEFS, EPS, NBM, WRFENS) and human forecasts (WPC). These acronyms above represent different weather forecast models with a range of strengths and weaknesses; seeing them all in one place allows for seeing the range of possible outcomes. The Mean areal precipitation is derived by (1) identifying grid points (lat/lon pairs)

that are within each of the watersheds, (2) finding the precipitation at those points using bilinear interpolation from the model grids, and (3) averaging the values across those lat/lon pairs.

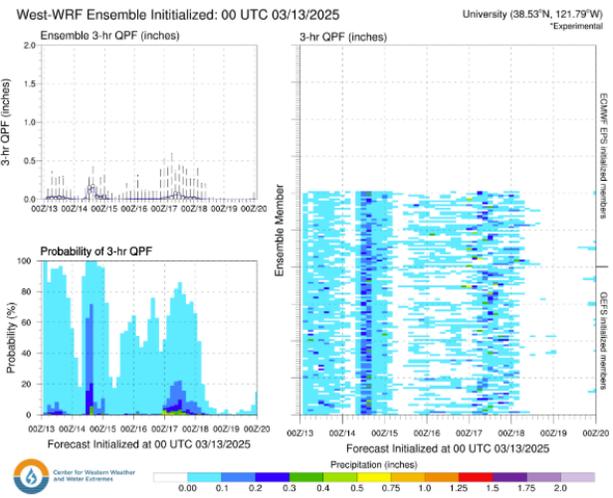
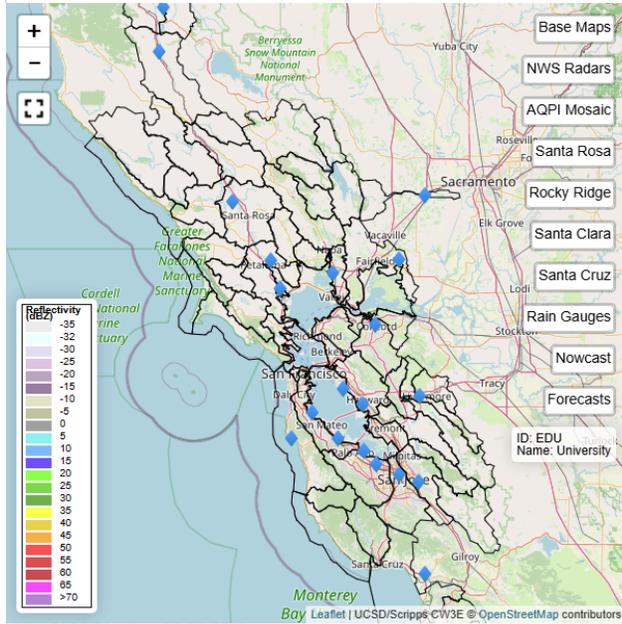
The dashed lines across the graph indicate the given level of normal annual precipitation over the watershed. For example, shown above, 1.2 in. of mean areal precipitation is 5% of normal annual precipitation for the San Mateo Creek-Frontal San Francisco Bay Estuaries HUC10 watershed. In the upper left of the graph, each of these forecasts are listed with their initialization time and 10-day accumulations in inches and thousand acre feet.

Image b shows 10-day mean areal precipitation accumulations for individual ensemble members of the **GEFS**, **EPS** and West-WRF as well as the ensemble mean for each model. The benefit of this graph is being able to see the ensemble spread which shows the range of likely solutions within the various models. In the upper left of the graph, each of these ensemble forecasts are listed with their initialization time and ensemble mean 10-day accumulations in inches and thousand acre feet.

For both graphs, the left y-axis represents the cumulative watershed precipitation in inches and the right y-axis represents the watershed aggregate precipitation volume in thousands of acre feet. The x-axis is in 24-hour increments based on the time of the most recent forecast, which can be seen below the x-axis of both graphs.

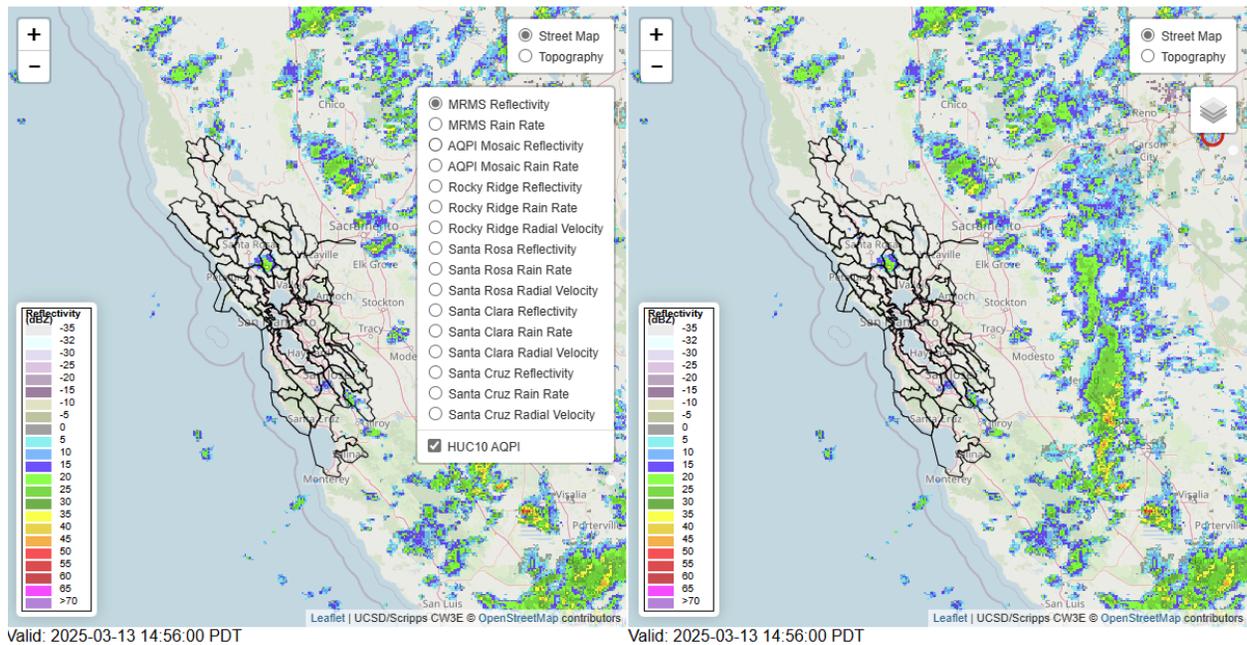


If you toggle on the rain gauges, clicking on a gauge marker will pull up the last 24 hours of observed precipitation by that station. The time that the data is valid for can be found just above the graph on the right side. Each hour's precipitation is represented by the blue bars in inches and is tied to the left y-axis. The 24-hour accumulation is represented by the red line and is tied to the right y-axis. Grey bars represent missing data.



There is one final option that shows an image on the right side of the screen. Under the **Forecasts** tab, the **West-WRF QPF** option shows select locations in the AQPI domain where West-WRF ensemble precipitation matrices are produced. Selecting one will display the matrix on the right side of the screen. The initialization of the West-WRF ensemble is in the top left and the name of the location and coordinates are in the upper right. The upper left image in the matrix will show a box plot of the 3-hour accumulations from the ensemble. The lower left image shows the probability of 3-hour QPF totals above a given threshold (based on the colorbar at the bottom) and based on the individual ensemble member forecasts on the right. The right image shows each individual ensemble member's forecast over the next 3-days shaded based on the colorbar at the bottom, where gray bars indicate missing data.

2. Dual Screen Mode

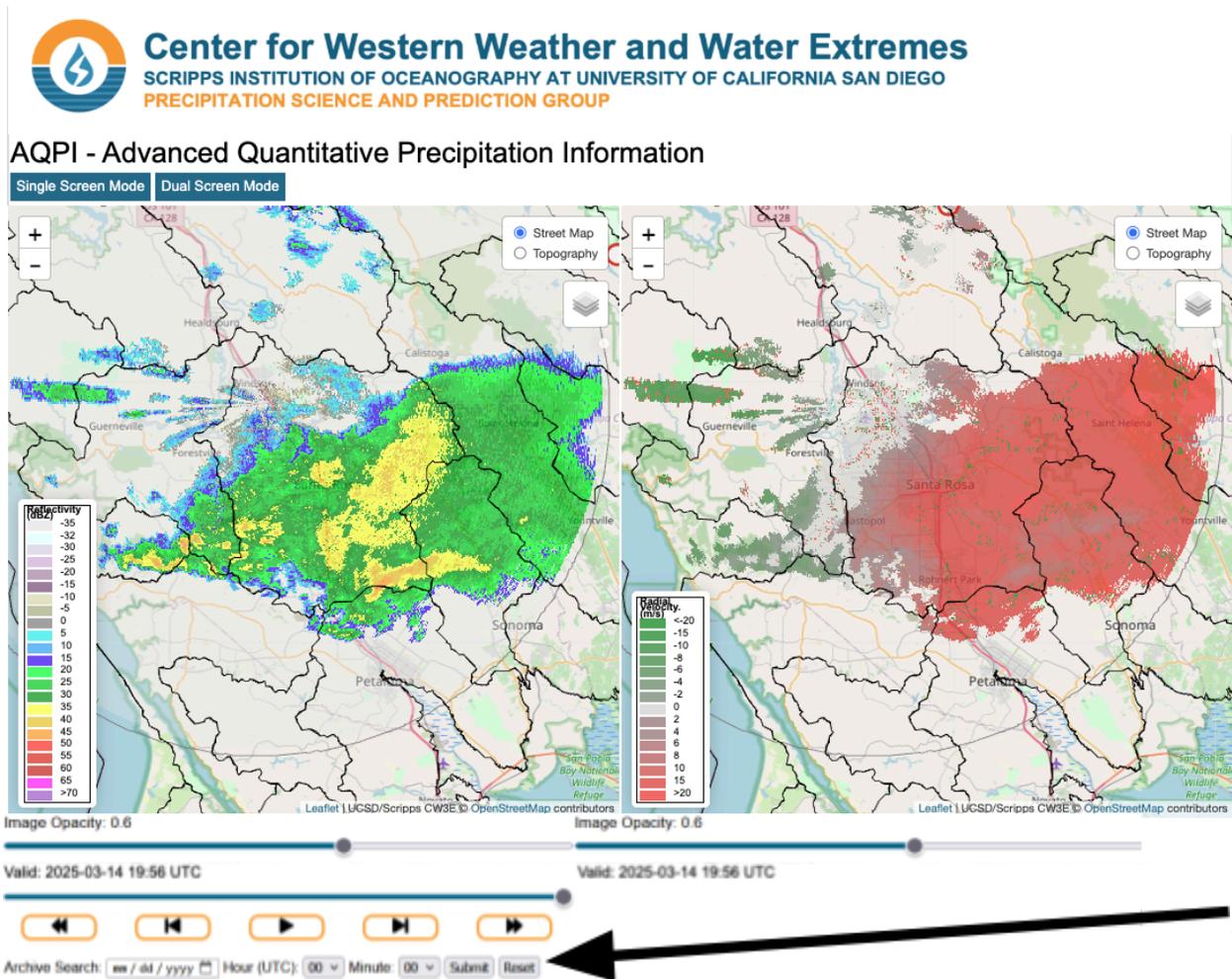


The **Dual-Screen Mode** puts a radar viewer on each side of the screen. This screen is very valuable for comparing product views to obtain a better picture of the current conditions. Each product may not have the time span that products are generated at, so products most recent scan may not be valid at the same time.

Both screens contain the zoom buttons on the upper left (which will zoom in/out both screens at the same level), the legend for the chosen product in the lower left, the background map toggle in the upper right (which only changes the background map of the given side), and a product menu below the background map toggle.

The product menu for each screen is the same. You can show **Reflectivity** (MRMS, AQPI Mosaic and each AQPI X-Band), **Rain Rate** (MRMS, AQPI Mosaic and each AQPI X-Band) and **Radial Velocity** (each AQPI X-Band). Different products can be viewed on each screen by selecting one within the menu. The HUC10 basins can be toggled off independently on each screen as well from the menu.

3. Archive Search



Below the time slider in the **dual screen** mode you can see the archive search option. This allows you to go back and view radar scans at the selected time for scans going back to 11/01/2024 for all products except the AQIP Mosaic, whose data begins on 2/12/2025. You can customize the data being shown by clicking on the calendar button or typing in your date of choice as well as choosing your time on the "Hour" and "Minute" dropdown menus. Once clicking submit, the images will be loaded into the viewer. Layers can be switched using the layer menu on the upper right corner of each map.

Data Sources

These are official data sources of the data used to create all the graphics and the data shown within the AQPI User page. All combined there are over 289 model forecasts!

- National Centers for Environmental Prediction (NCEP) Global Forecast System (GFS) Model obtained from NOAA/NCEP at 0.25-degree resolution out to 10 days via [NOMADS](#).
- NCEP Global Ensemble Forecast System (GEFS) obtained from NOAA/NCEP at 0.25-degree resolution out to 10 days via [NOMADS](#).
- NOAA/NWS National Blend of Models (NBM) obtained from NOAA/NCEP at 2.5-km resolution out to 10 days via [NOMADS](#).
- NOAA/NWS Weather Prediction Center (WPC) obtained from their [website](#) at 2.5-km resolution out to 7 days.
- ECMWF and the ECMWF Ensemble Prediction System (EPS) data are obtained from ECMWF at 0.25-degrees out to 10 days.
- The California-Nevada River Forecast Center (CNRFC) precipitation grids are obtained at 4-km resolution from their [website](#) out to 6 days.
- The Sub-Basin analysis also illustrate precipitation forecasts by five additional CW3E in-house model forecasts by its Western Weather Research and Forecast (West-WRF) model: (1,2) A WRF model run at 9-km out to 10 days forced by the GFS and ECMWF deterministic models, (3,4) A WRF model run at 3-km out to 5 days forced by the GFS and ECMWF deterministic models, and (5) A 200-member WRF model ensemble run at 9-km out to 7 days forced by a combination of GEFS and EPS models. More on the Deterministic West-WRF model can be found [here](#), and more on the West-WRF ensemble model can be found [here](#).

Note that the interactive map is created using [Leaflet Javascript](#).

Potential Limitations

The mean areal precipitation (MAP) may not be representative of the distribution of precipitation within the watershed and may be skewed; however, it is derived from global and regional NWP models that have relatively coarse resolutions of ~2.5-25 km that are not able to resolve some of the finer resolution variability due to topography within the watersheds anyways.

Contact

For questions regarding content on the webpage, issues with the webpage or questions about this documentation, contact Ricardo Vilela (rbatistavilela@ucsd.edu) or Matthew Steen (msteen@ucsd.edu)

Acknowledgement

We would like to acknowledge support from the CA Department of Water Resources AR Program and NOAA in development of the AQPI User Interface.

APPENDIX

X-Band radars description:

Radars Name	Latitude	Longitude
Santa Rosa	38.5216	-122.8022
Santa Cruz	36.98471	-121.97864
Rocky Ridge	37.81558	-122.06199
Santa Clara	37.39888	-121.83336

Rain Rate (in/h) and Reflectivity (dBZ) fields are provided for each radar.

MRMS (Multi Radar Multi Sensor) merge products (NEXRAD S-Bands):

Variable	Product Name	Product Source
Reflectivity (dBZ)	MergedReflectivityQCComposite	https://mrms.ncep.noaa.gov/data/2D/MergedReflectivityQCComposite
Rain Rate (in/h)	PrecipRate	https://mrms.ncep.noaa.gov/data/2D/PrecipRate

Quantitative Precipitation Forecast products

	GFS	HRRR	NBM
Source	https://nomads.ncep.noaa.gov/pub/data/nccf/com/gfs/prod/gfs.YYYYmmddHH/atmos/gfs.tHz.pgrb2.0p25.fLT	https://nomads.ncep.noaa.gov/pub/data/nccf/com/hrrr/prod/hrrr.YYYYmmdd/conus/hrrr.tHz.wrfsubhfLT.grib2	https://nomads.ncep.noaa.gov/pub/data/nccf/com/blend/v4.2/blend.YYYYmmddHH/core/blend.tHz.core.fLT.co.grib2
Variable	6-h precipitation accumulation (in)	15-min precipitation accumulation (in)	6-h precipitation accumulation (in)
Lead Times	6-h to 240-h every 6-h	15-min to 18-h every 15-min	6-h to 240-h every 6-h
Run Times	00z,06z, 12z, 18z	Hourly	01z,07z, 13z, 19z
Latency	5h10min	1h40min	2h20min
Spatial Resolution	~25km	~3km	~2.5km