

EFREP and AQPI – NOAA Involvement



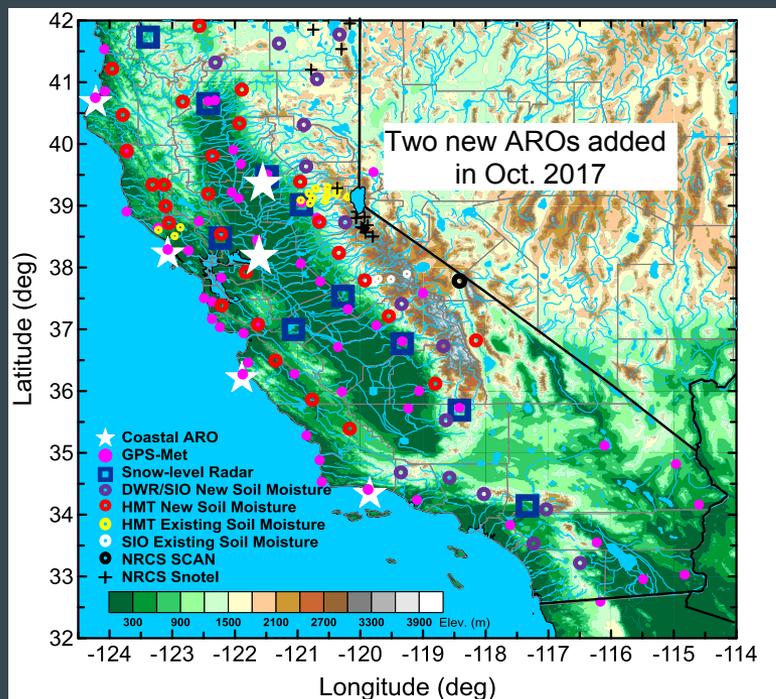
Twitchell Island
Mobile Atmospheric River Observatory
Photo: Clark King

Dr. Allen B. White
NOAA Research Meteorologist
SWRR panel, 3 May 2018

Introduction

- NOAA has been working with CA-DWR since 2007 on CA-DWR's Enhanced Flood Response and Emergency Preparedness (EFREP) program.
- Major outcome of EFREP is a 21-st century observing system that has led to improved process understanding and better forecaster situational awareness for atmospheric rivers and their impacts.
- CA-DWR awarded NOAA and collaborative partners with funding for the Advanced Quantitative Precipitation Information (AQPI) project in 2015.

In 2007, CA-DWR began working with NOAA's Hydrometeorology Testbed (HMT) to develop a 21-st century observing system to help deal with the impacts of ARs



hmt.noaa.gov

Coastal AR Observatory (4)



GPS-Met (35+)



Soil Temp. & Moisture and Surface Met. (27)

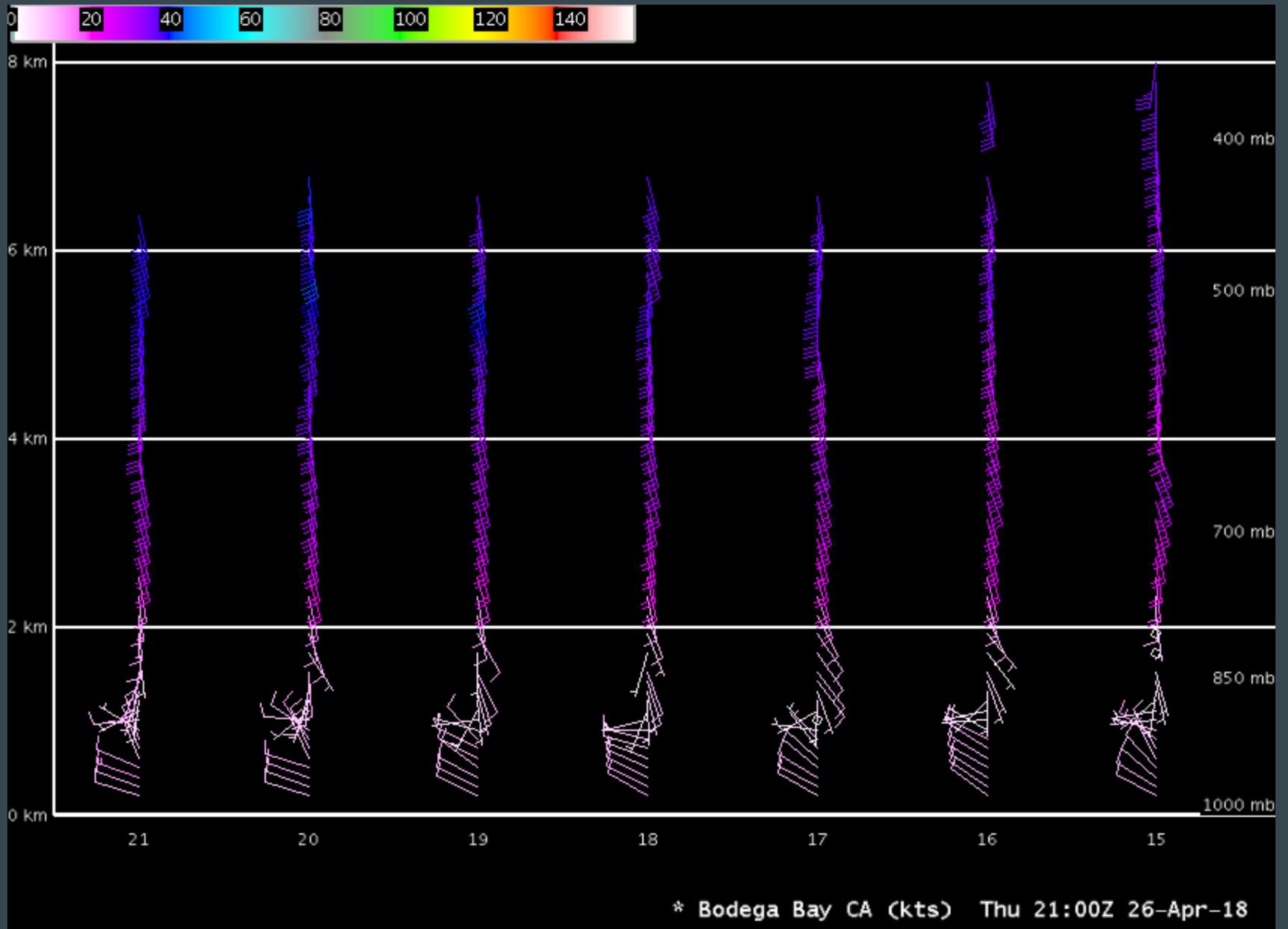
FM-CW Snow-level Radar (10)



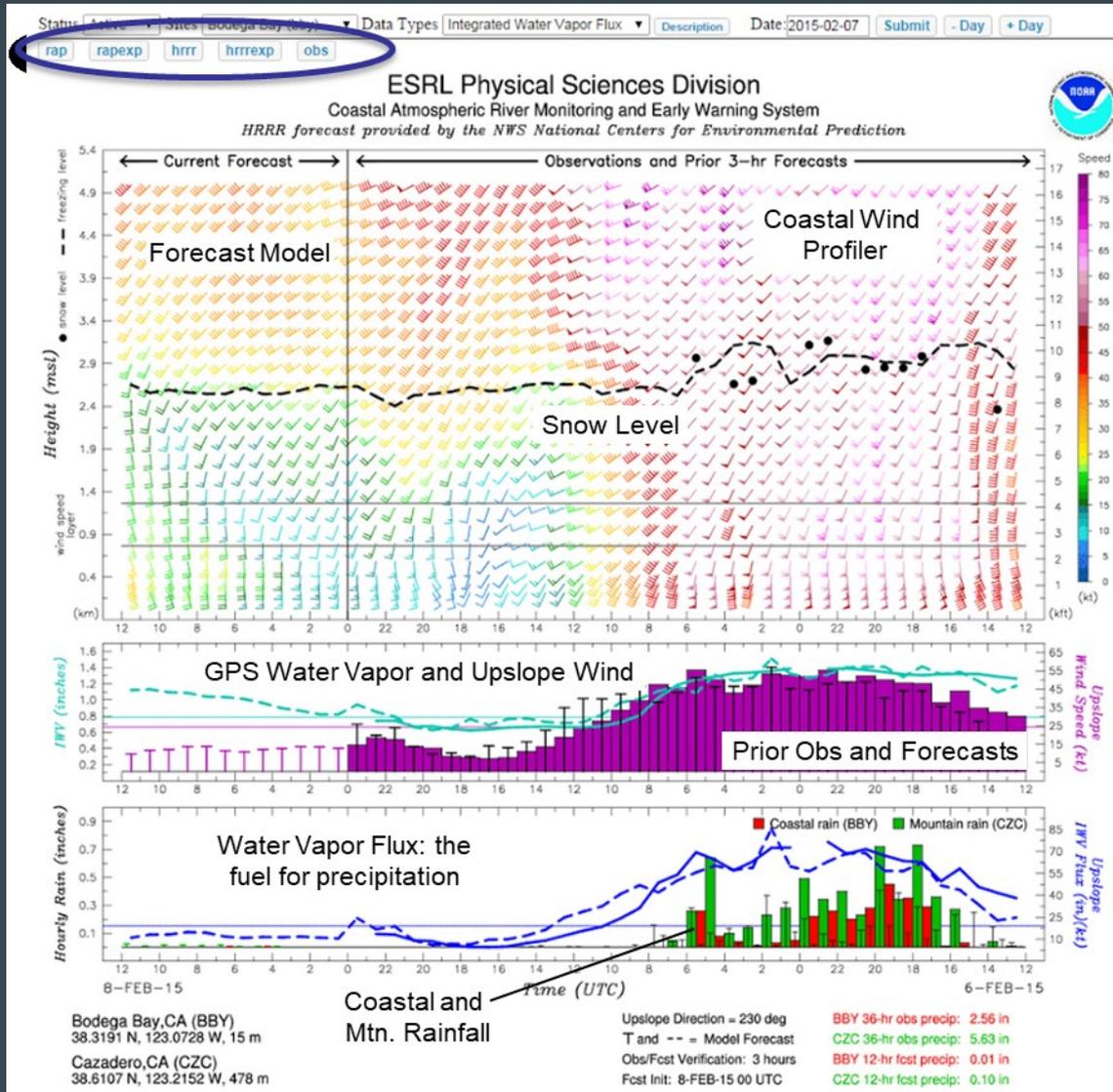
For further details, see White et al., *JTech*, 2013

Data Dissemination

- Real-time and archived data and images from the statewide observing network are available to NWS forecasters and the general public in several locations:
- <https://www.esrl.noaa.gov/psd/data/obs/datadisplay/>
- <https://madis.noaa.gov/>
- <https://cdec.water.ca.gov/>
- Data are also sent to NWS Western Region in NWS specialized formats and some datasets are displayable in the AWIPS2 forecaster toolbox.

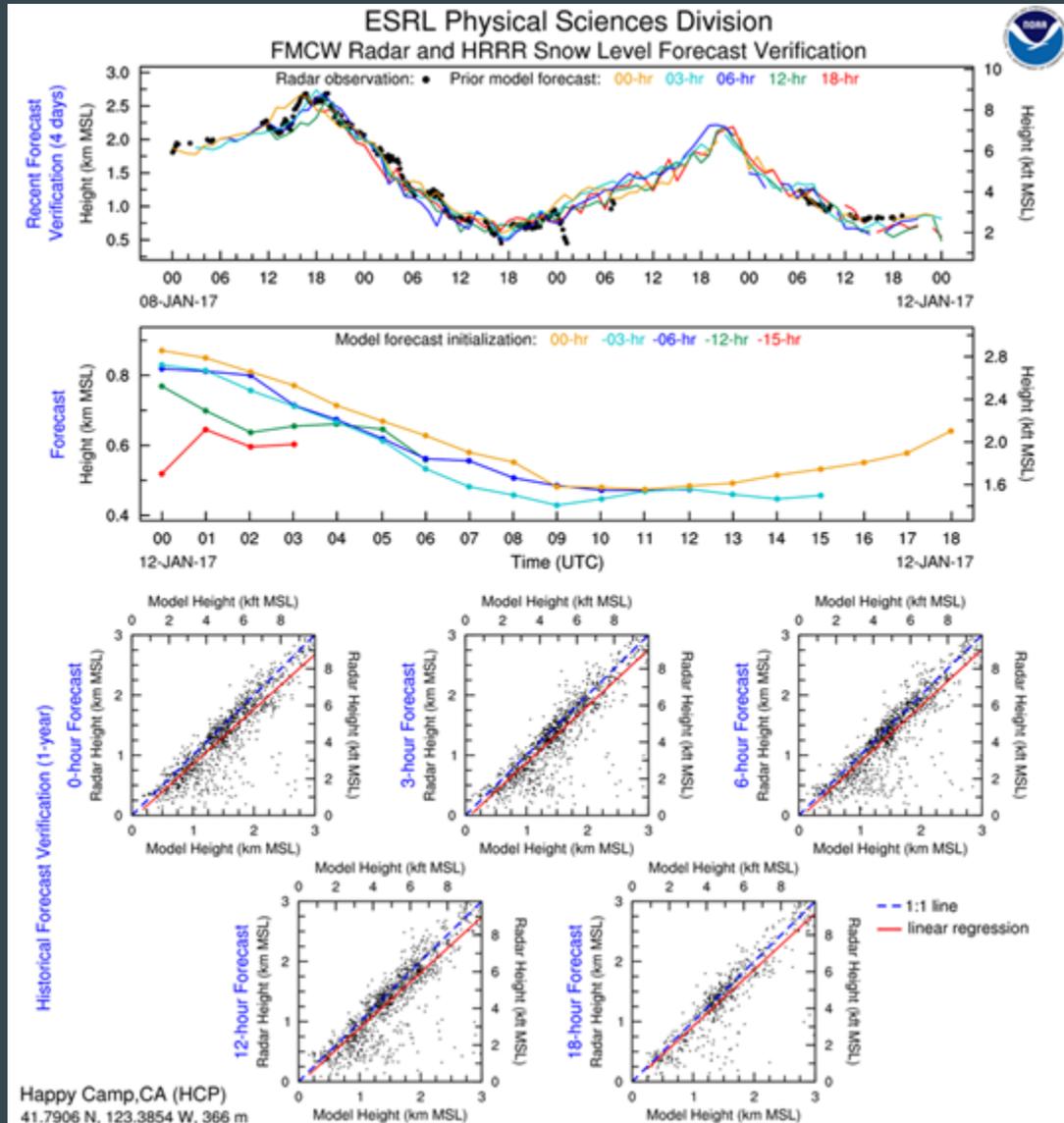


Observation/Forecast Model Tools Atmospheric River Water Vapor Flux Tool



Observation/Forecast Model Tools

Snow-level Forecast Verification Tool



AQPI Overview

- Ultimate goal is to improve NOAA's ability to provide early warning through research, monitoring, and prediction of precipitation, streamflow, and storm surge
 - Integration of capabilities for many users
 - Benefits for waste water management, water supply, water quality, emergency management, transportation
- Grant awarded by California Dept. Water Resources (Prop 84)
 - 4-year project, Sonoma County Water Agency is local sponsor
- Project components
 - Radar and surface met deployments
 - Assimilation and analysis of observations
 - Precipitation, streamflow, and coastal storm surge predictions
 - Integrate and disseminate observations and model forecasts (the AQPI System)
- System to be owned and operated by consortium of CA Bay area water agencies

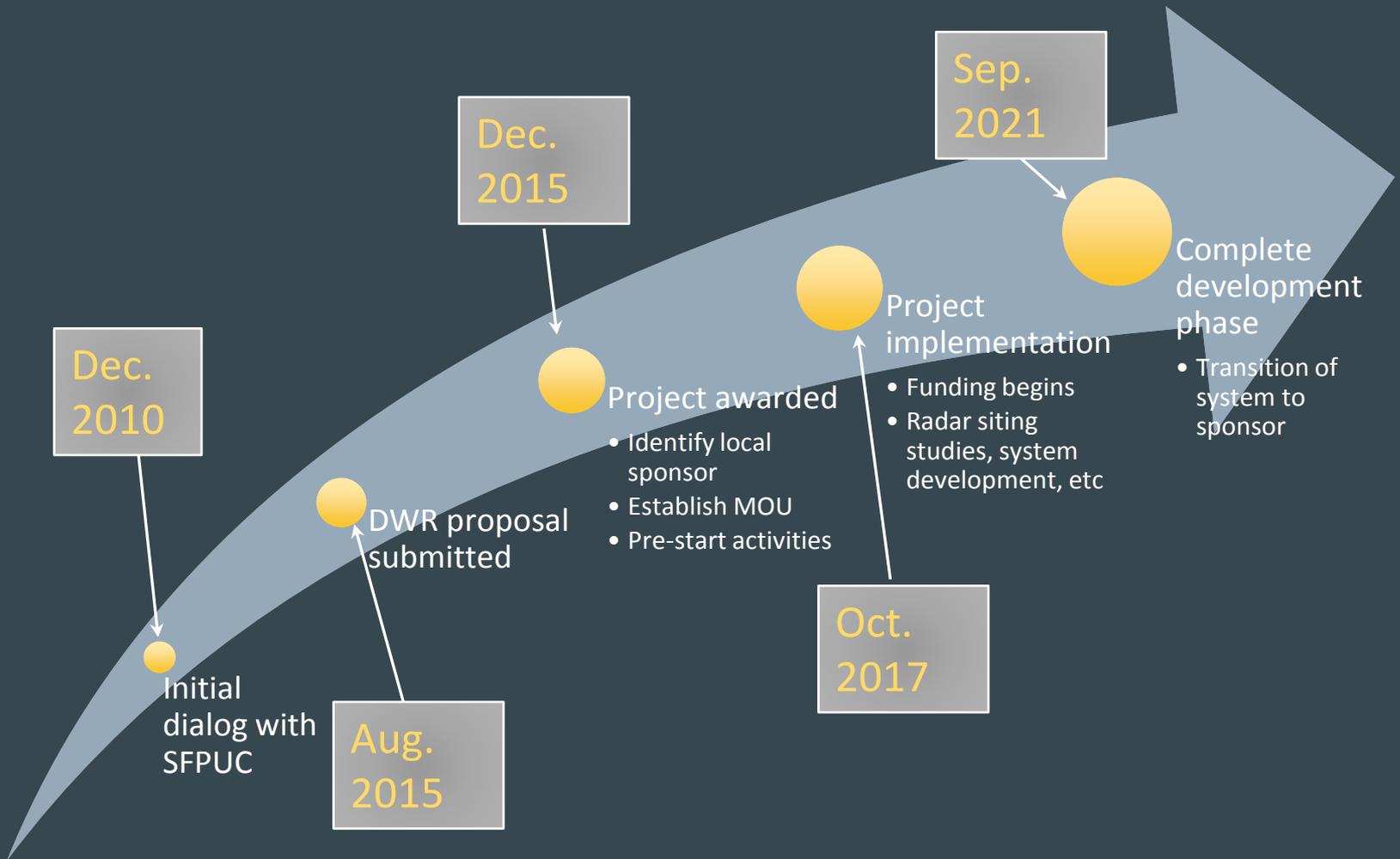
AQPI Project Team

- NOAA
 - Physical Sciences Division
 - Global Systems Division
- Cooperative Institute for Research in the Atmosphere (CIRA)
 - Colorado State University
- USGS
 - Pacific Coastal and Marine Science Center
- Scripps Institution of Oceanography
 - Center for Western Weather and Water Extremes
- Sonoma County Water Agency

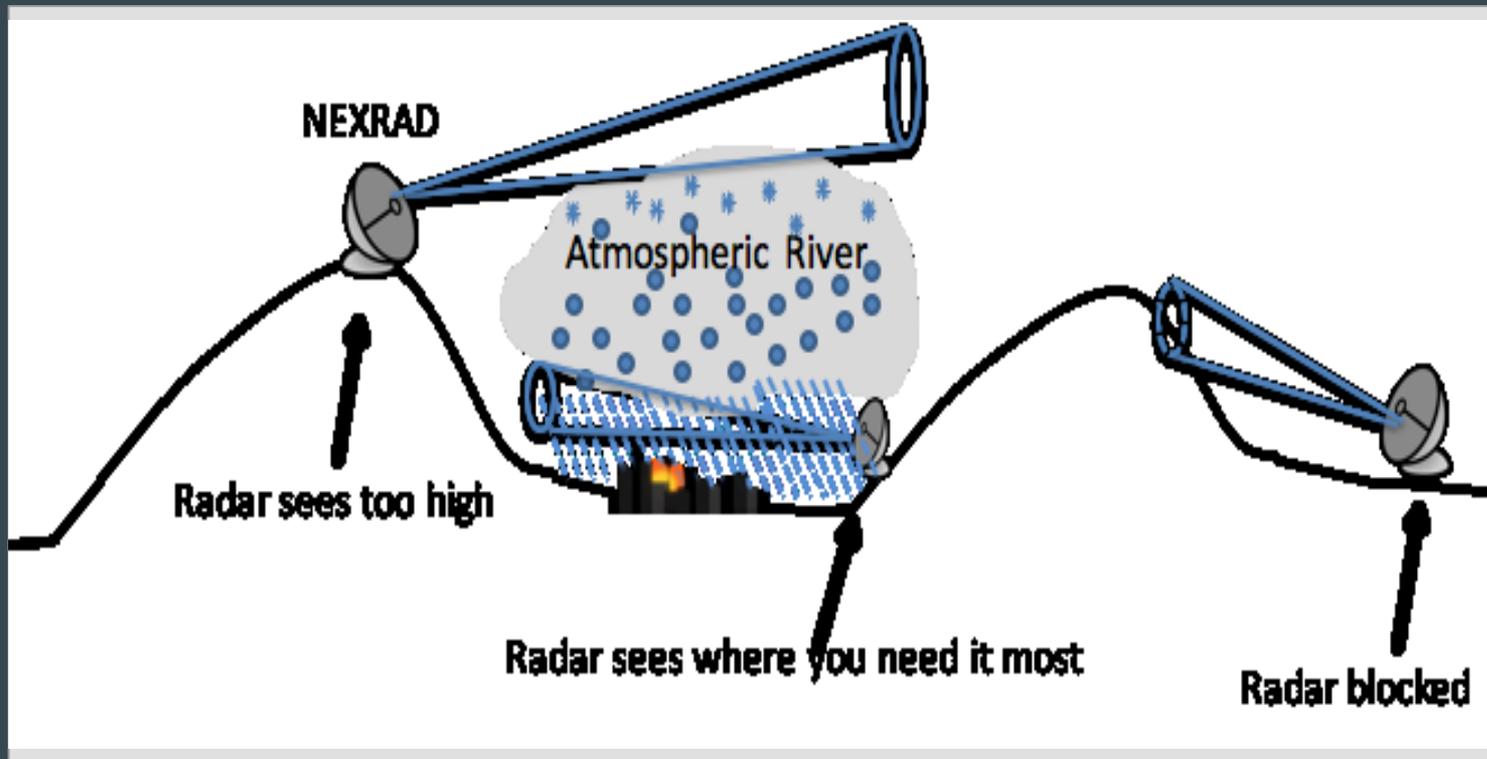
AQPI Components

- **Storm detection and tracking**
 - Satellite-based AR detection + C-band radar
- **Hi-res precipitation forecasting**
 - Radar “nowcasts” + hi-res weather prediction models
- **Watershed and coastal flood forecasting**
 - SF Bay Integrated Flood Forecast Model
- **Flood impacts**
 - Critical infrastructure

Project Timeline



Challenges of Estimating Precipitation in the Bay Area Urban Environment



AQPI Observations

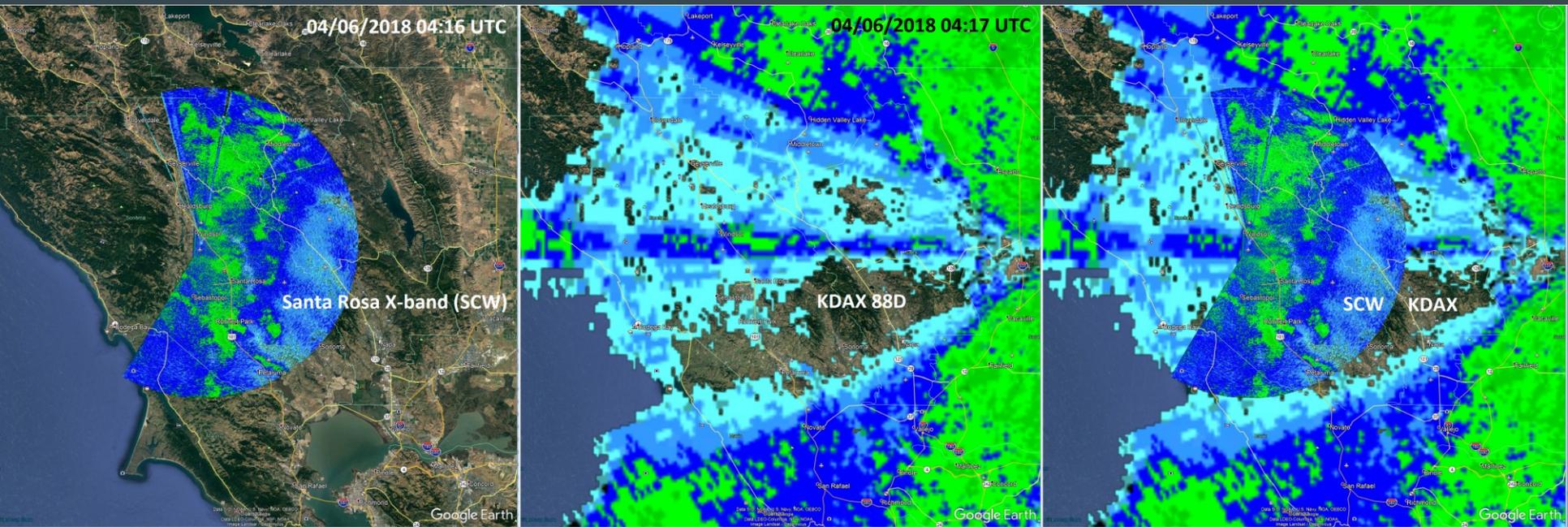
- Observations

- Existing
 - NWS, NOS, USGS, local agency...
- To be added
 - Agency (known+unknown)
 - Gap filling radars and other new equipment

- Integrative Database



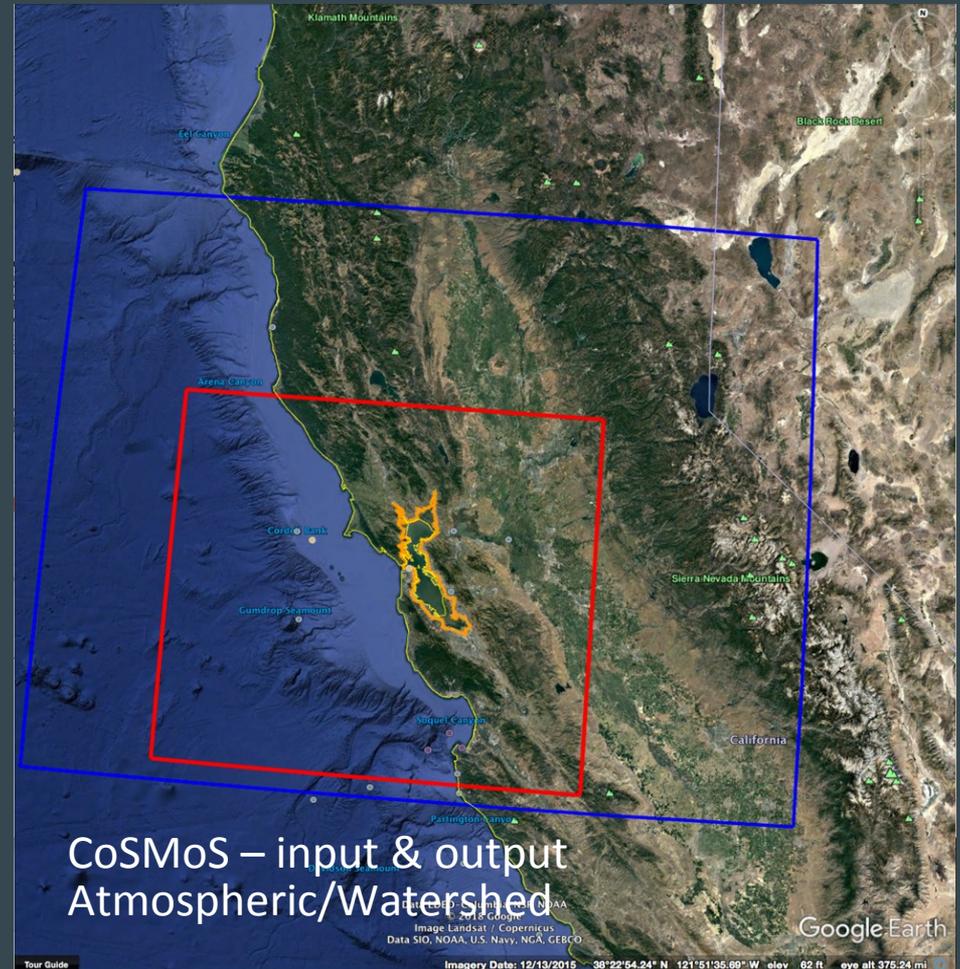
Gap-filling Radar



New AQPI X-band radar in Santa Rosa fills a gap caused by terrain blockage with NWS operational radar at Davis.

AQPI Modeling

- Atmospheric
 - HRRR
- Watershed
 - National Water Model
 - Local models
- Coastal
 - CoSMoS



AQPI Benefits

•By Category

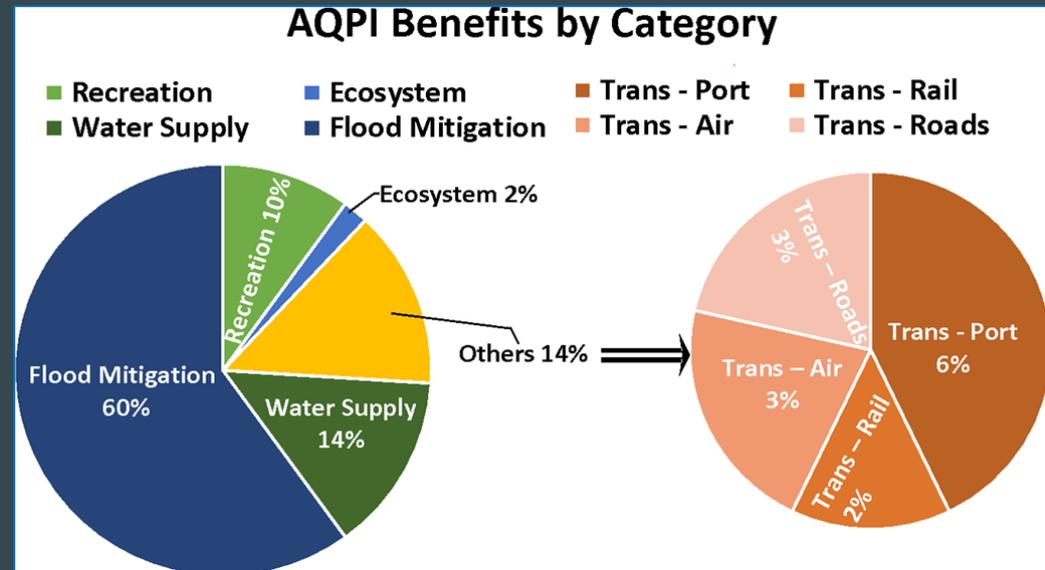
- Flood Mitigation (60%)
- Water Supply (14%)
- Recreation (10%)
- Transportation (14%)
- Ecosystem Services (2%)

•Present Value

- PV(6%, 10yr)
- Benefits - \$460M
- Costs - \$90M

•Benefit/Cost Estimates

- Best Estimate – 5:1
- Optimistic Estimate – 13:1
- Pessimistic Estimate - 2:1



From Johnson et al. 2015: "Benefits Of An Advanced Quantitative Precipitation Information System: San Francisco Bay Area Case Study"

Summary

- CA-DWR has a longstanding, successful collaboration with NOAA Research that has brought observations and new knowledge to bear on the state's water resource and flood protection issues.
- AQPI is a 4-year project started in Oct. 2017 that aims to improve monitoring and forecasting of precipitation and flooding in the SF Bay area.
- The benefits derived from AQPI significantly outweigh the costs.
- The success of AQPI depends in large part on participation from state and local agencies.

Backup slides

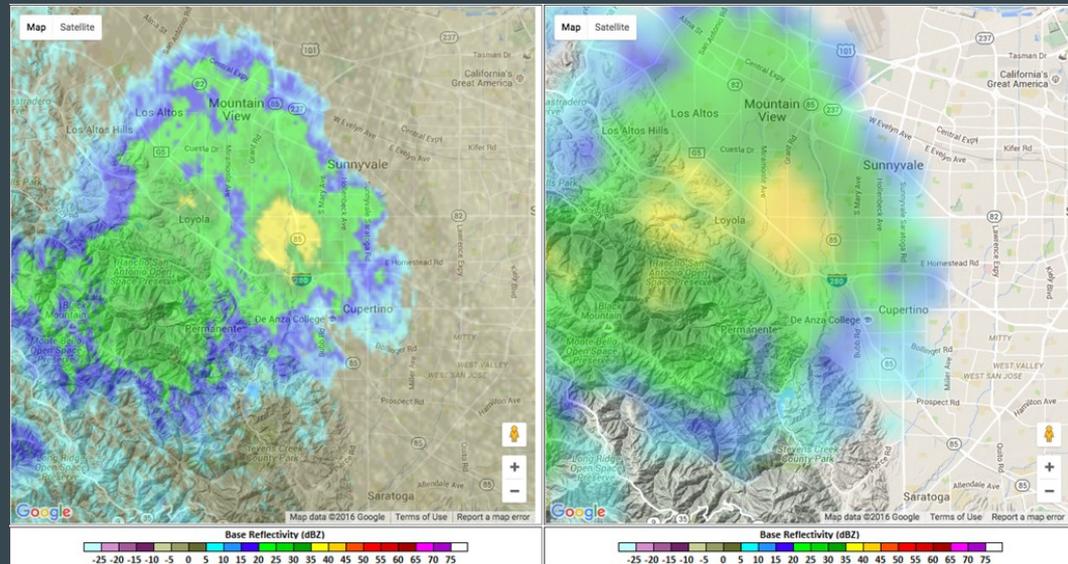
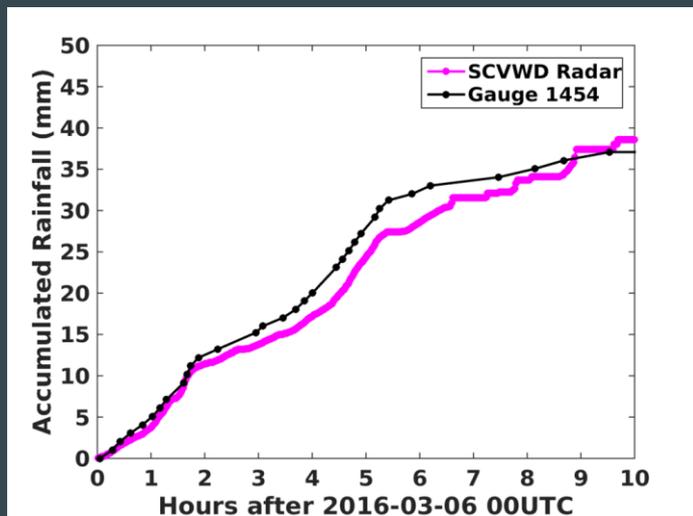
AQPI Prototype

- X-band radar in Santa Clara
 - Feb-May 2016
 - Support Super bowl during El Niño
 - Prototype for AQPI

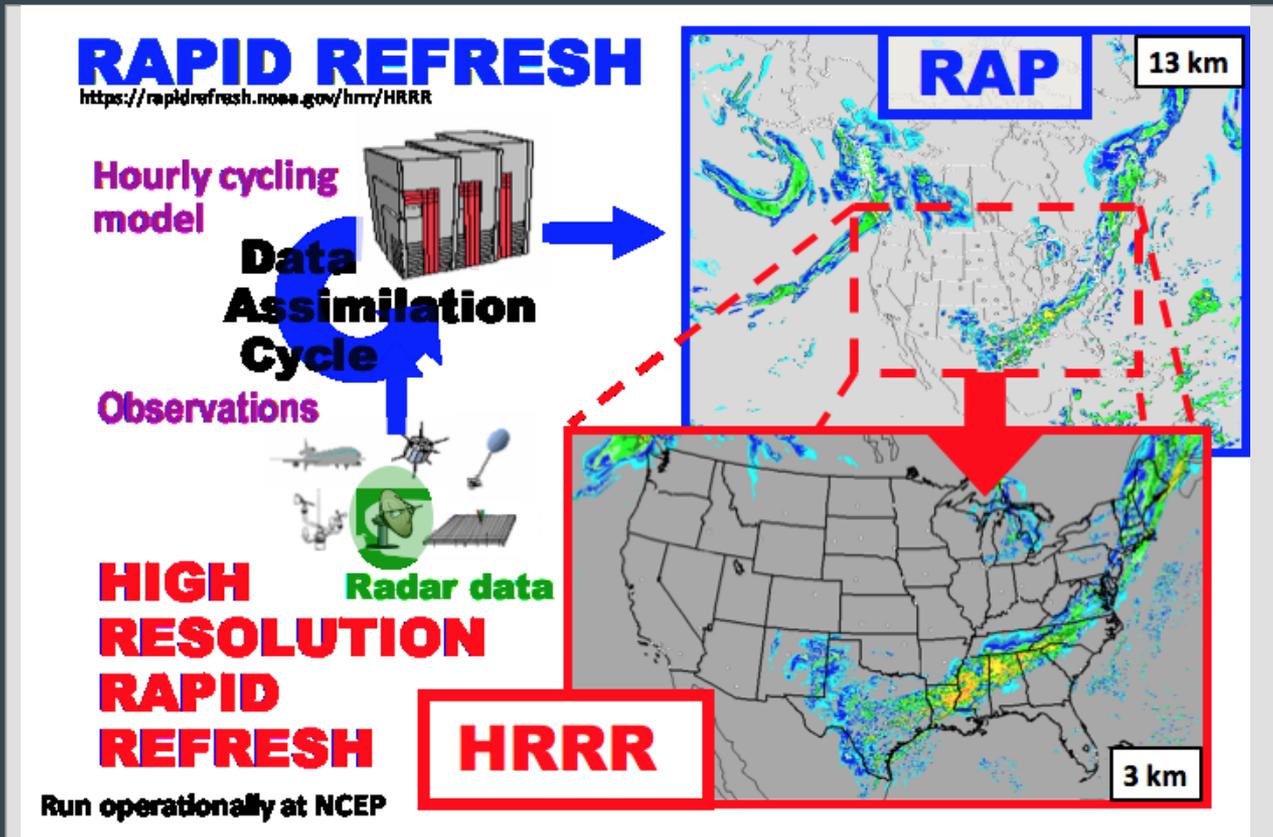


Santa Clara X-band

NEXRAD



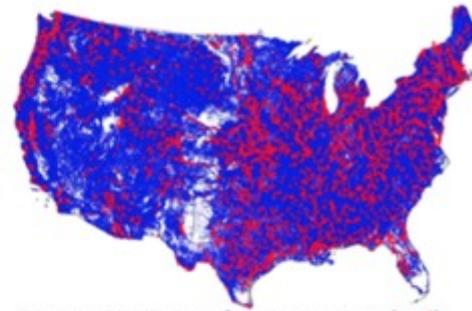
NOAA Hi-Resolution Atmospheric Forecast Modeling



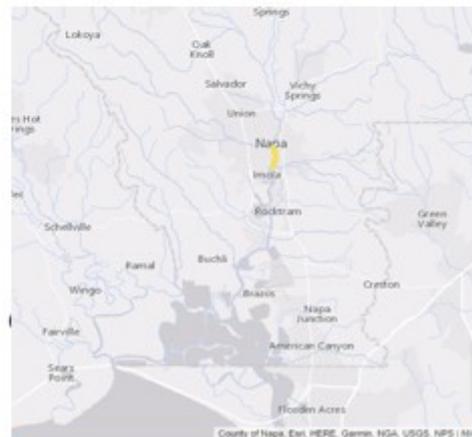
Watershed Component: National Water Model

Overview

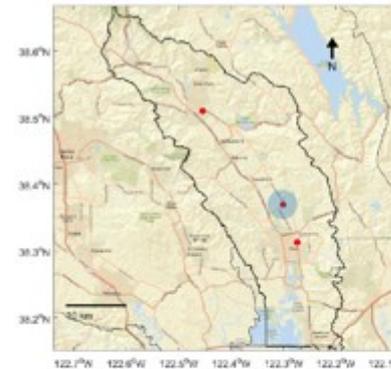
- Hydrologic Output
 - River channel discharge and velocity at 2.6 million river reaches
 - Surface water depth and subsurface flow (250 m CONUS+ grid)
- Land Surface Output
 - 1km CONUS+ grid
 - Soil and snow pack states
 - Energy and water fluxes
- Direct-output and value-added geointelligence products



Current NWS river forecast points (red)
NWM forecast points (blue)



County of Napa, Esri, HERE, Garmin, NGA, USGS, NPS | NWS



Station ID: Napa O

USGS 11458000

Napa R NR Napa CA

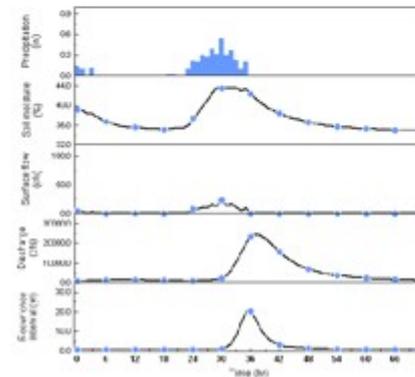
DESCRIPTION:

Latitude 38°22'06"

Longitude 122°18'08"

Drainage area

: 218 square miles



Total Precipitation (in)

: 4.1

Mean/Max. soil moisture (%)

: 35.6/43.5

Maximum surface flow (cfs)

: 24.1

Peak flow of discharge (cfs)

: 24,676

Time to peak (hr)

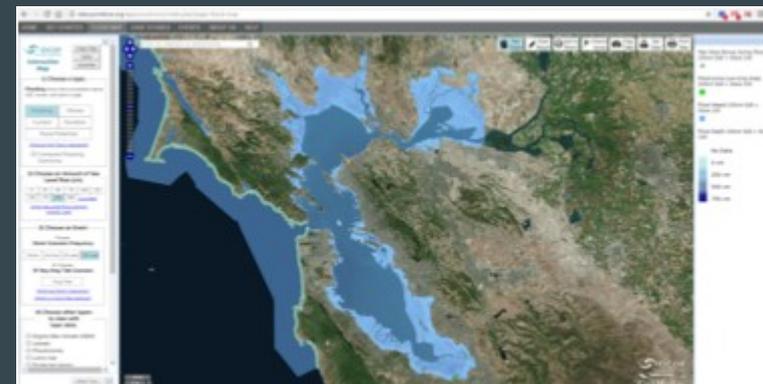
: 36

Maximum recurrence interval (year)

: 20.4

Coastal Storm Modeling System (CoSMoS)

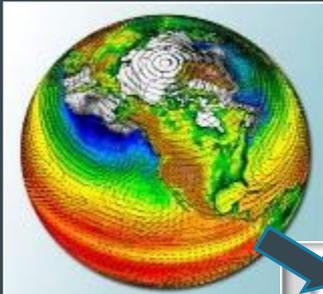
- Physics-based numerical modeling system for assessing coastal hazards due to climate change
- Predicts coastal hazards for the full range of sea level rise (0-2, 5 m) and storm possibilities (up to 100 yr storm)
- Emphasis on directly supporting federal and state-supported climate change guidance
- New operational application for San Francisco Bay



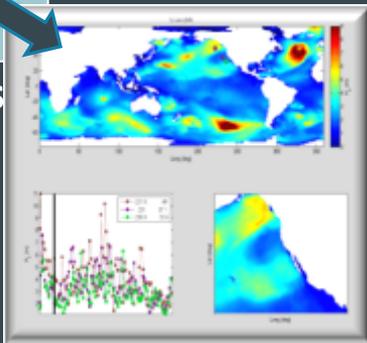
Coastal Prediction: Coastal Storm Modeling System (CoSMoS)

Global

Global conditions of future climate scenarios



GCM winds

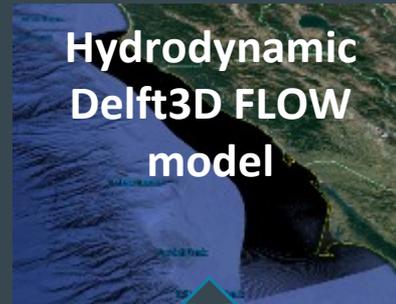


WW3 wave model



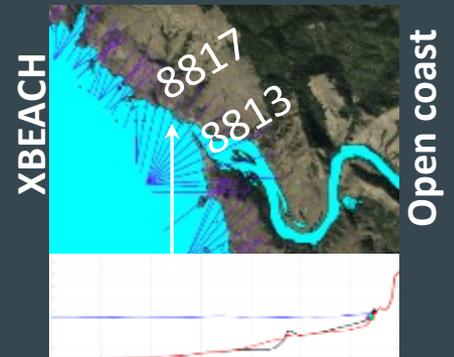
Regional

Tides, water level and regional forcing



Local

High resolution hydrodynamics and waves



Results projected onto high-res DEM

https://walrus.wr.usgs.gov/coastal_processes/cosmos/index.html

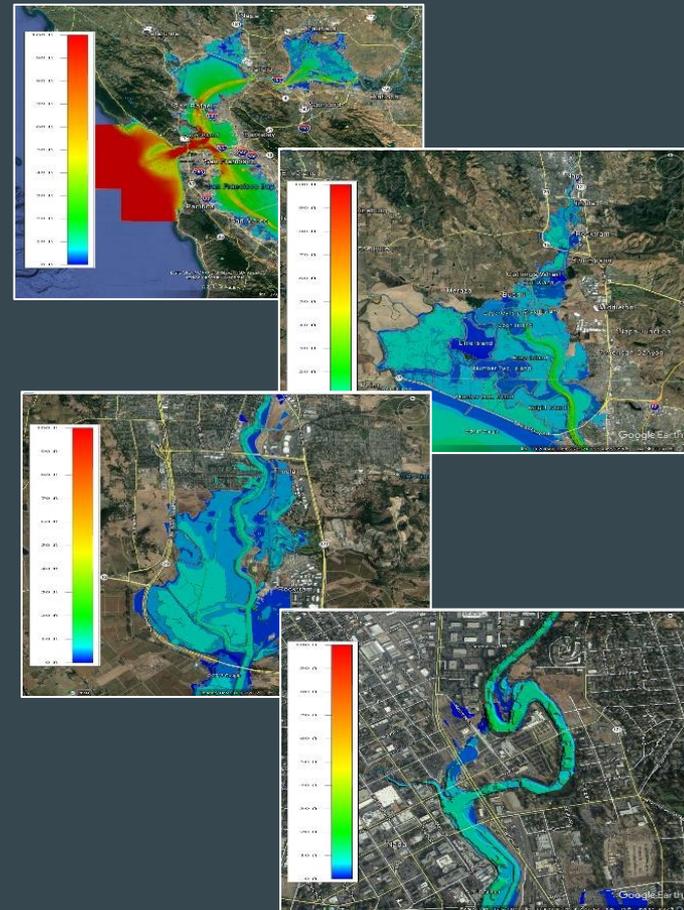
Coastal Products

- CoSMoS Outputs

- Waves
- Currents
- Water Levels
- Time Series

- Flood Indices

- Start of Flooding
- Duration of Flooding
- Time of Max Depth
- Max Water Depth
- Hazard Index



AQPI System Development: 2021

