AQPI Users Group #1

January 24, 2020 9:45 to 2:45
East Bay Municipal Utilities District
375 11th Street Oakland, CA 94607, 2nd Floor Large Conference Room

TIME	TOPIC	SPEAKERS
9:45	Welcome	Jennifer Krebs, Jake Spaulding, Michael Anderson, Brian Garcia
9:55	Introductions	All
10:10	Meeting Purpose, Goals, Project Status	Rob Cifelli
10:30	Overview of Program, layout for rest of day	Jennifer Krebs
10:35	AQPI System Archtecture / User Interface	Greg Pratt, Michael Leon, Hilary Peddicord
11:45	Lunch	
12:45	Observations	*Surface:* Allen White *Radar:* V. Chandrasekar, Haonan Chen
1:30	Modeling	*Atmospheric Model:* Melinda Marquis *Water:* Lynn Johnson *CoSMoS:* Babak Tehranirad, Liv Herdman
2:15	Final Thoughts • Interagency Coordination • Other Needs for this Rainy Season? • Topics for Next Meeting • Scheduling Next Meeting	Discussion
2:45	Adjourn	

AQPI User Group Meeting

- Purpose and Goals
  - Re-engage users and engage new users
  - Feedback on the AQPI System
  - Establish a group to share information and improve the AQPI system over time
- Project Status for start of 2019-2020 wet season

Current Status of AQPI Project

- Radar deployment status
- AQPI System Status
- Observations
  - Surface
  - Radar Processing
- Modeling
  - Precipitation Forecast - High Resolution Rapid Refresh (HRRR)
  - River Flow Forecast – National Water Model
  - Costal Inundation Forecast – Costal Storm Modeling System (CoSMoS)

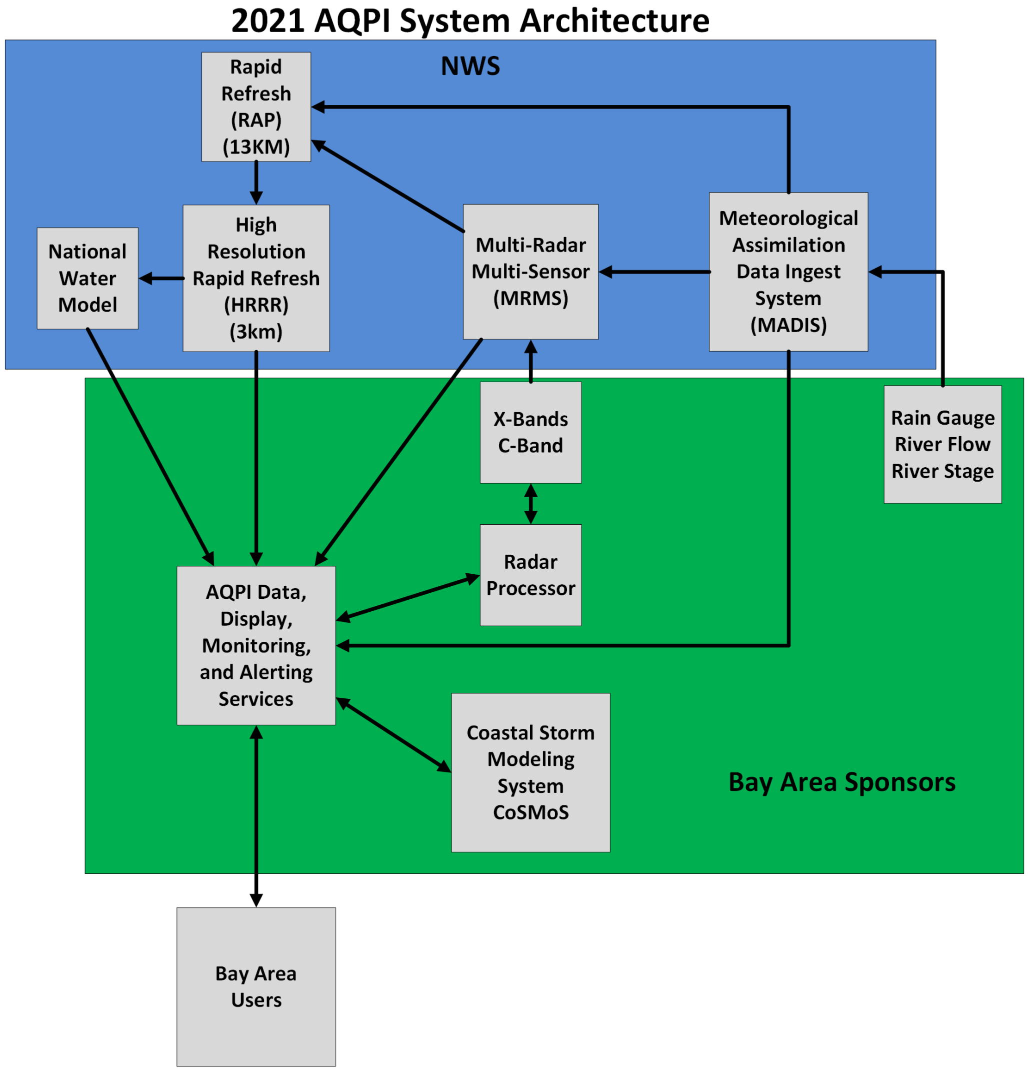
What Are We Trying to Accomplish

- Inform users on current AQPI system capabilities
  - Content
  - Science
- Get feed back on current products and AQPI User Interface
  - Usability
  - Format
  - Notifications
  - Refine requirements
- Foster collaboration between water agencies
- Foster collaboration with NWS
- Continued improvement of the AQPI system through user engagement.

AQPI System Architecture and User Interface

Greg Pratt, Michael Leon, and Hilary Peddicord
NOAA Earth Systems Research Laboratory
Boulder, CO

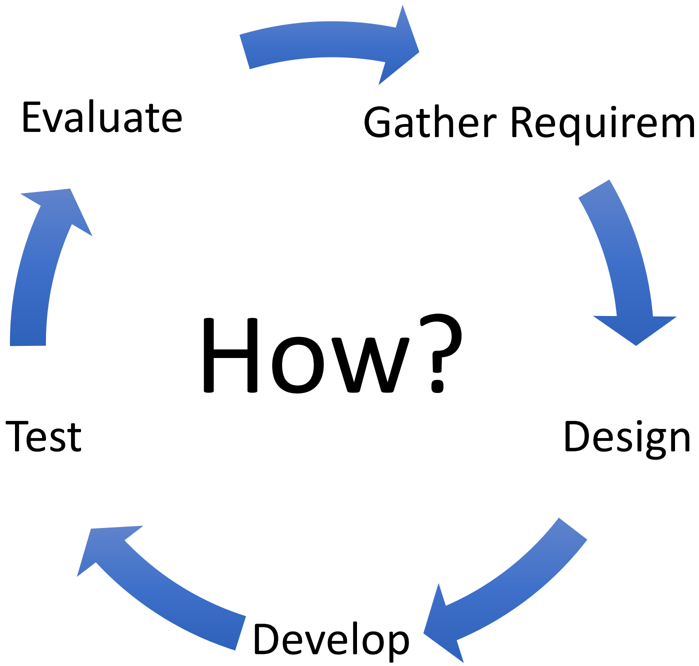
2021 AQPI System Architecture



How best to inform your operations using the AQPI System.

- **Machine-to-Machine?**
- **Graphical Displays?**
- **Monitor and Alerting?**
- **Other?**

Building the AQPI System

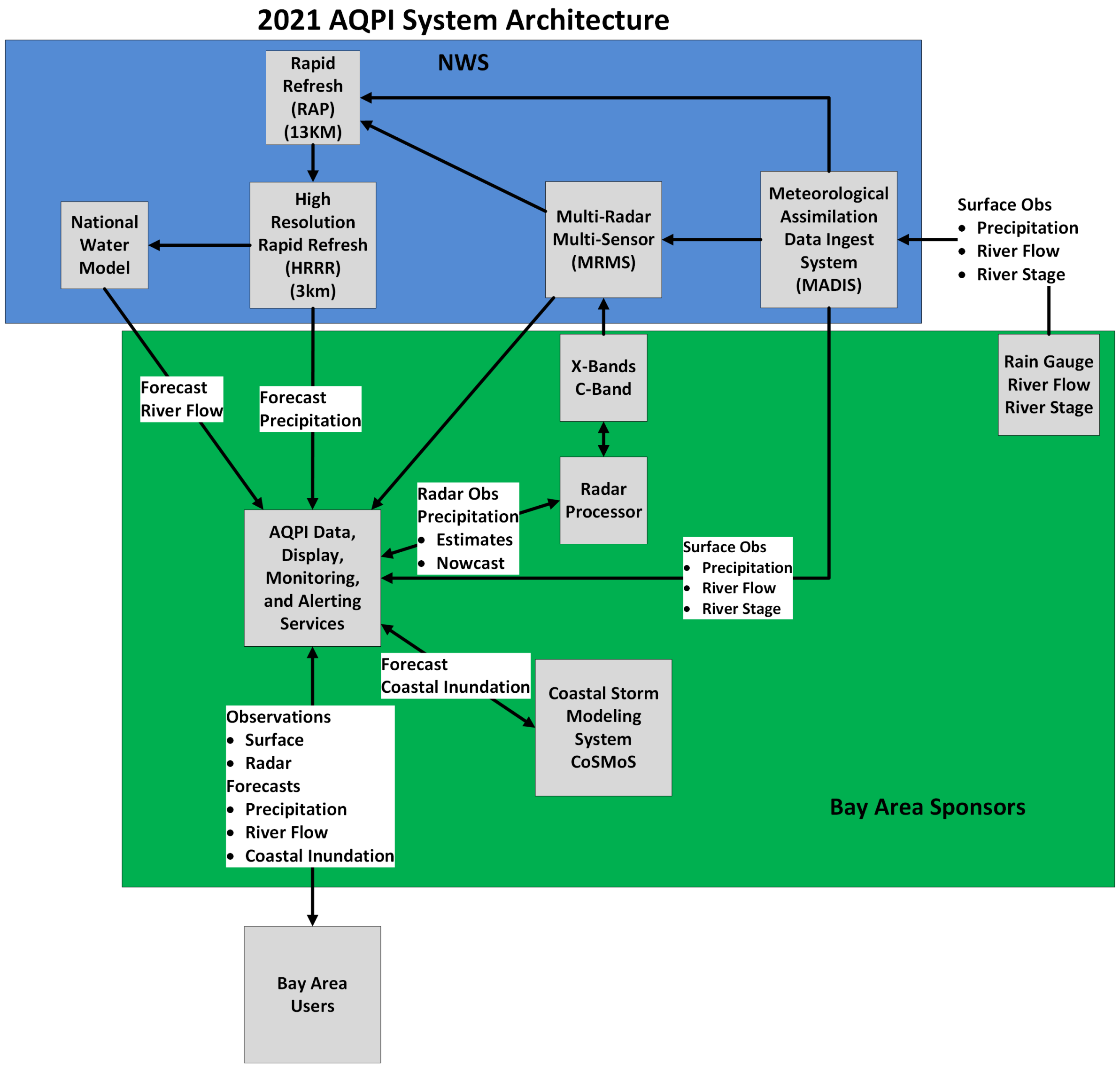


Requirements Meetings
- In Person
- GoToMeetings

Who Has Met With the AQPI Development Team
- Alameda County Public Works
- Alameda County Zone 7
- Alameda County Water District
- Contra Costa County Public Works
- East Bay Discharge Authority
    - Oro Loma
- East Bay Municipal Utilities District
- East Bay Parks
- Marin County Flood Control
- Marin County Municipal Water District
- Napa County
- San Mateo County
- Santa Clara County Valley Water District
- Sonoma County Water Agency
- San Francisco Public Utilities Commission
- Solano County

Who Has Provided Feedback
- Contra Costa County Public Works
- Marin County Flood Control
- Santa Clara County Valley Water District
- San Francisco Public Utilities Commission

2021 AQPI System Architecture



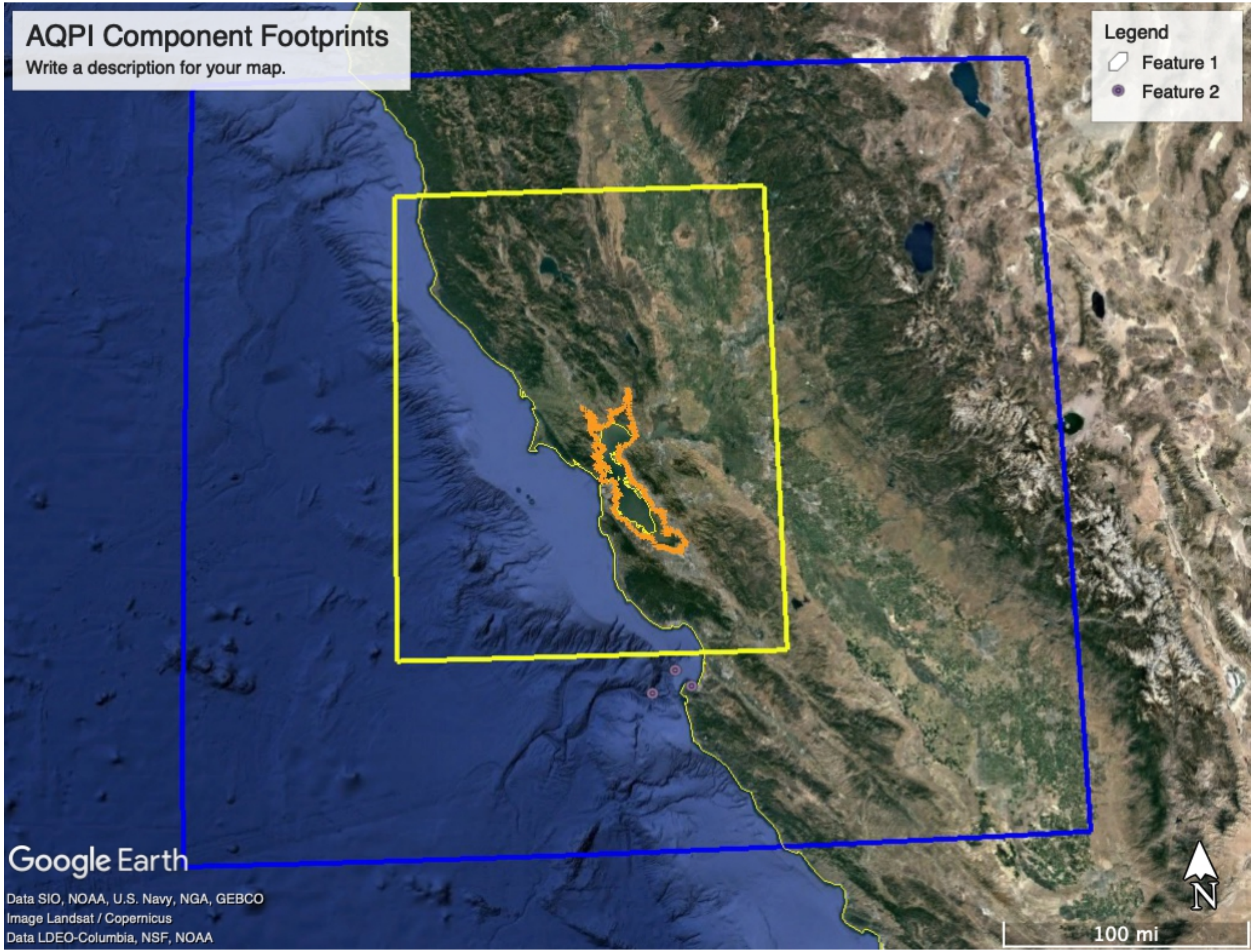
AQPI System Data Sets

- Observed Precipitation
- Observed Stream Flow
- Observed Stream Stage
- Precipitation Estimates
- Precipitation Nowcast
- Precipitation Forecast
- River Flow forecast
- Coastal Inundation Forecast

AQPI End-User Capabilities

- **Machine-to-Machine Data Transfers**
- Graphical Displays
- Monitor
  - System State
  - User Threshold
- Alert
  - System Status
  - User Threshold Met

AQPI Component Footprints



Area and Point Outputs/Inputs

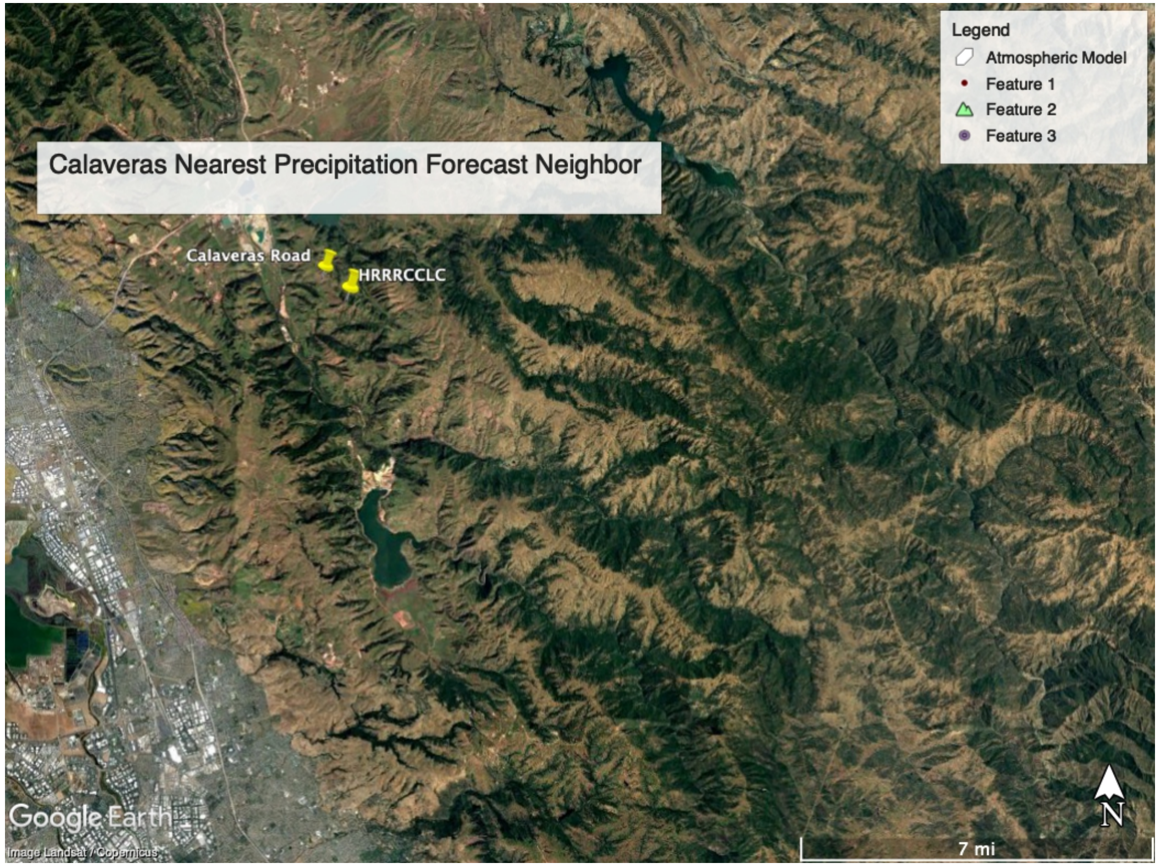
- Blue Rectangle
  - Surface Observations
  - Precipitation Forecast
  - Stream Flow Forecast
- Yellow Rectangle
  - Precipitation Estimates
  - Nowcast
- Orange Area
  - Coastal Inundation Forecasts

AQPI Area Selection

Area Example

- Blue Rectangle
  - Precipitation Forecast
- White Area
  - SCVWD desired Area
- Orange Rectangle
  - HRRR clipped area

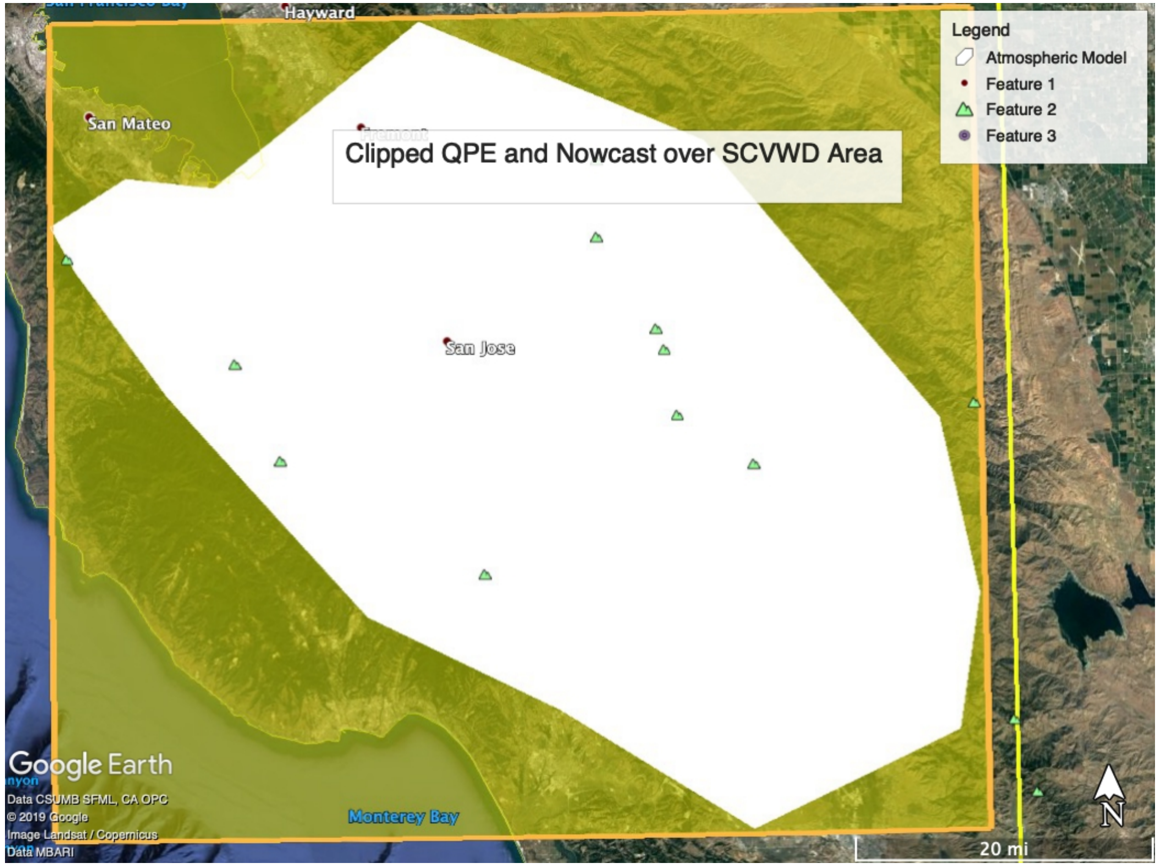
AQPI Point Selection



Point Example

- Calaveras Road
  - SFPUC point
- HRRRCCLC
  - HRRR point

AQPI Area Selection

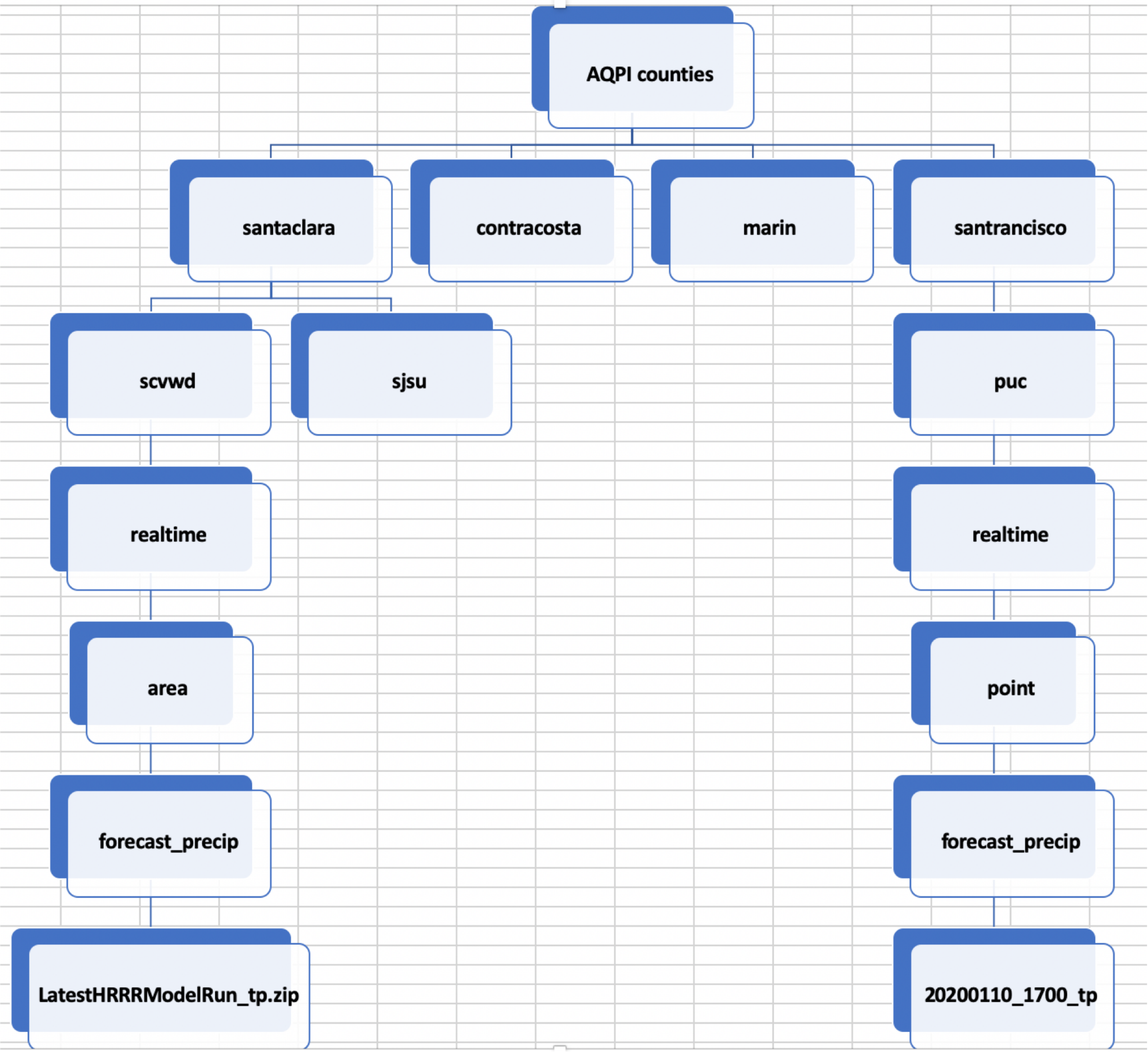


Area Example

- White Area
  - SCVWD desired area
- Yellow Area
  - QPE/Nowcast grid
- Orange Rectangle
  - Radar QPE clipped area

AQPI User Interface Demonstration

AQPI FTP User Landing Area



Area Example:

- **Santa Clara Valley Water District**

Point Example:

- **San Francisco Public Utilities Commission**

Engaging in the Next Steps

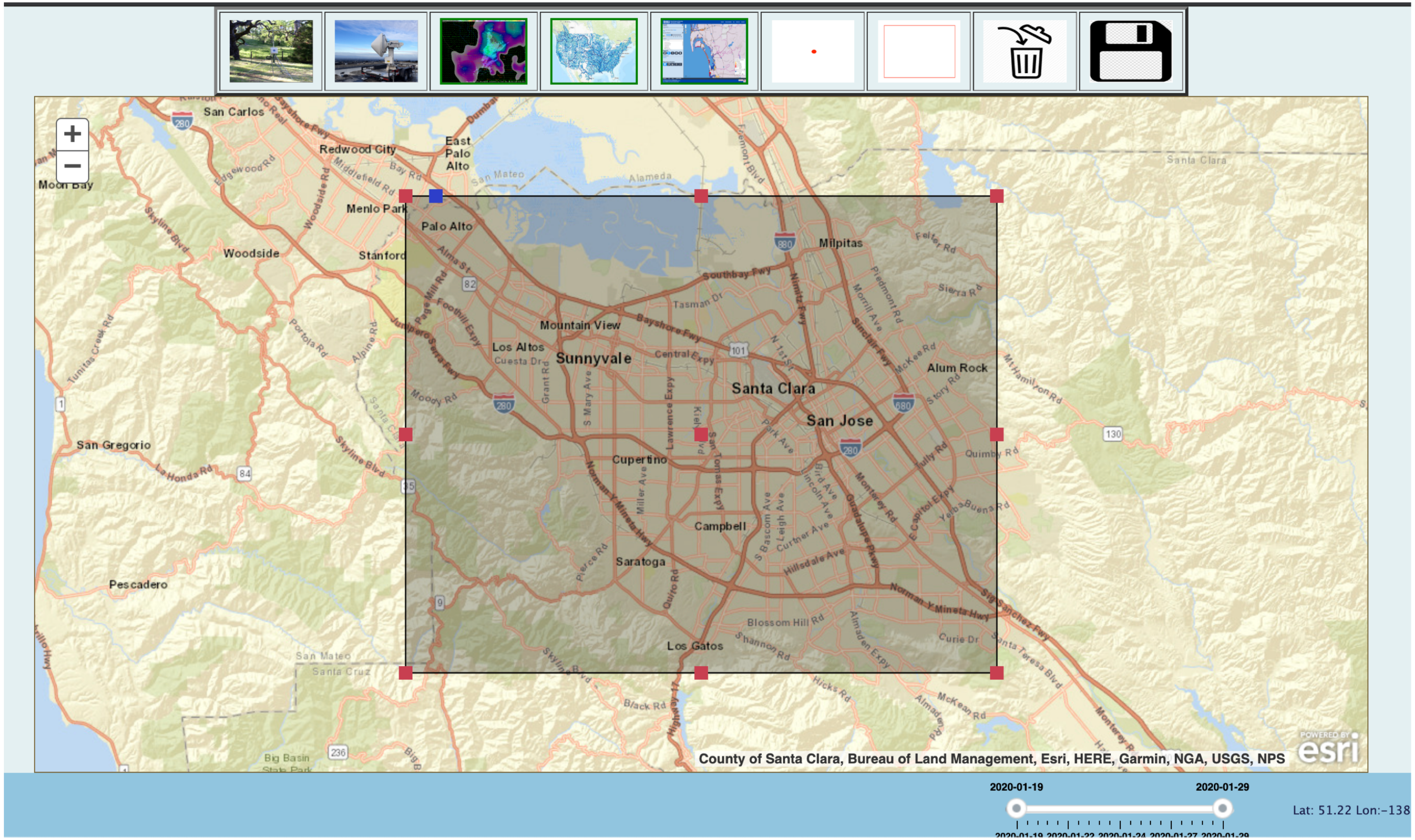
Machine to Machine

Graphics

Alerting and monitoring

Other?

Machine-to-Machine UI

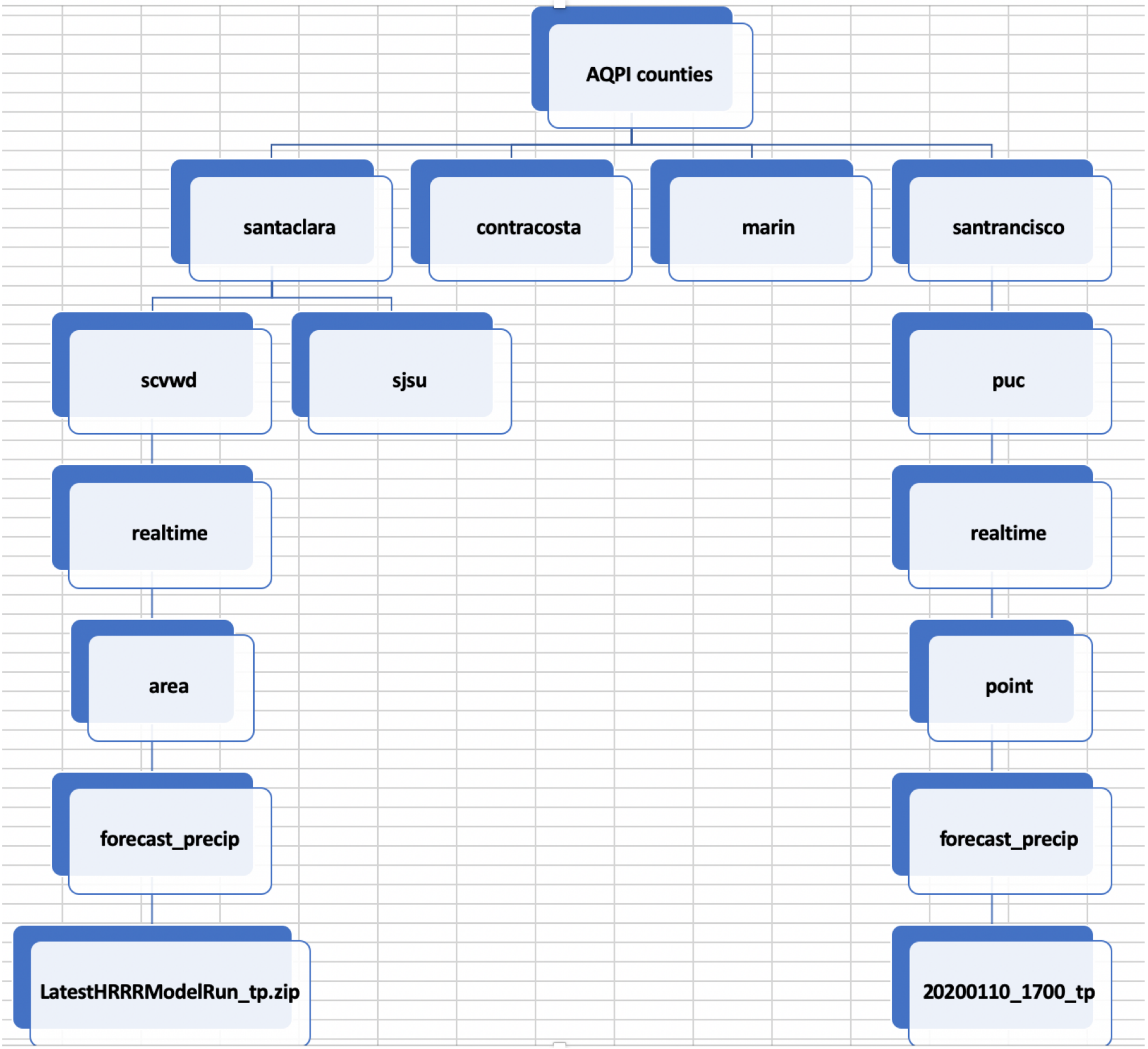


How can we improve this for your use?

GIS Selectable points?

Selectable counties?

FTP - Site Layout



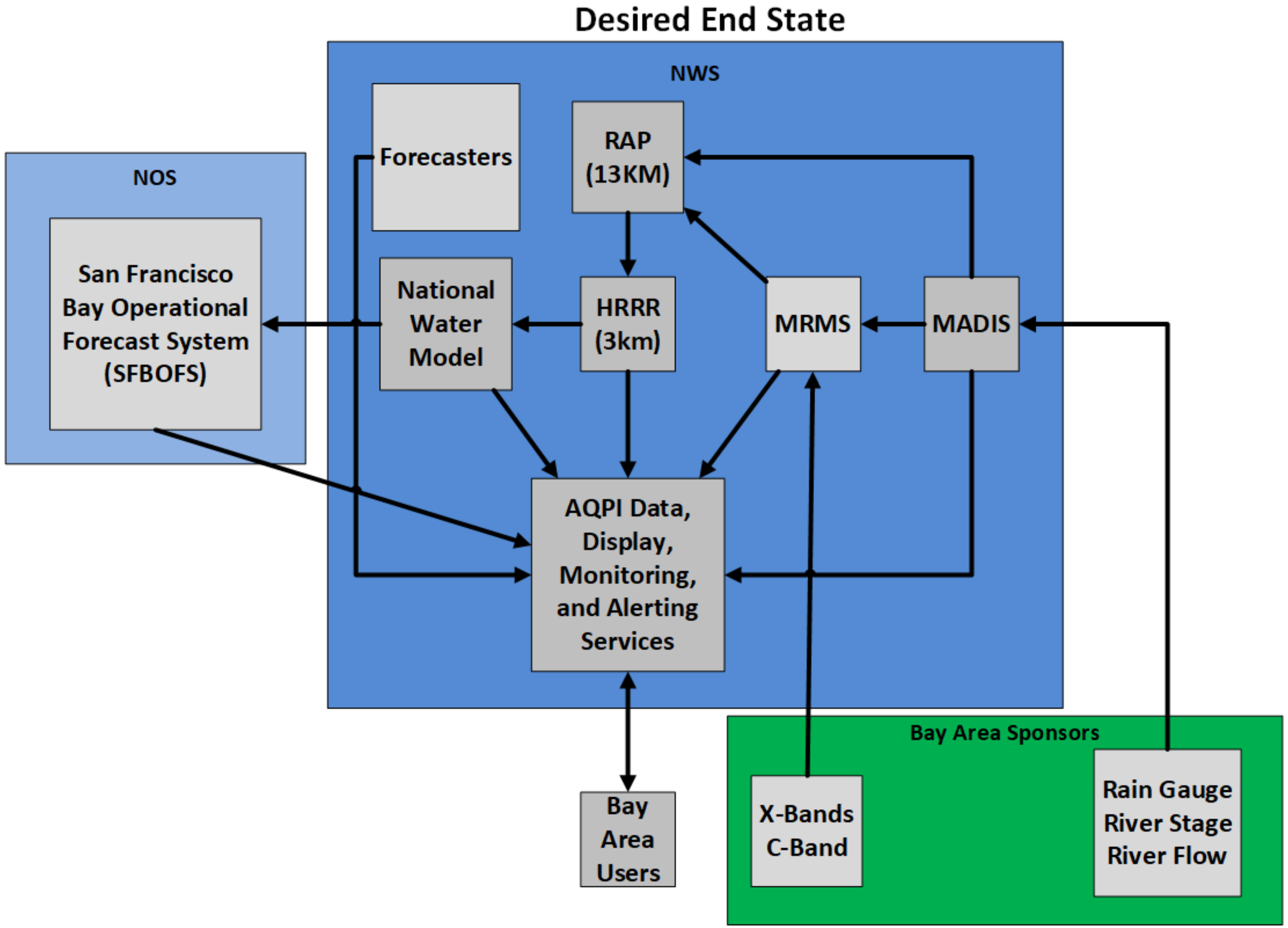
Once a user makes selections from the UI new data will arrive in this structure. Old data will age off as new data arrives.

We envision the archive structure looking like the realtime structure. Archive data will age off after a day.

Should FTP site be structured or flat?

Would a consolidated file containing all data or multiple files work best?

AQPI System Desired End State



AQPI Users Group Meeting

Radar & Surface Met Observations

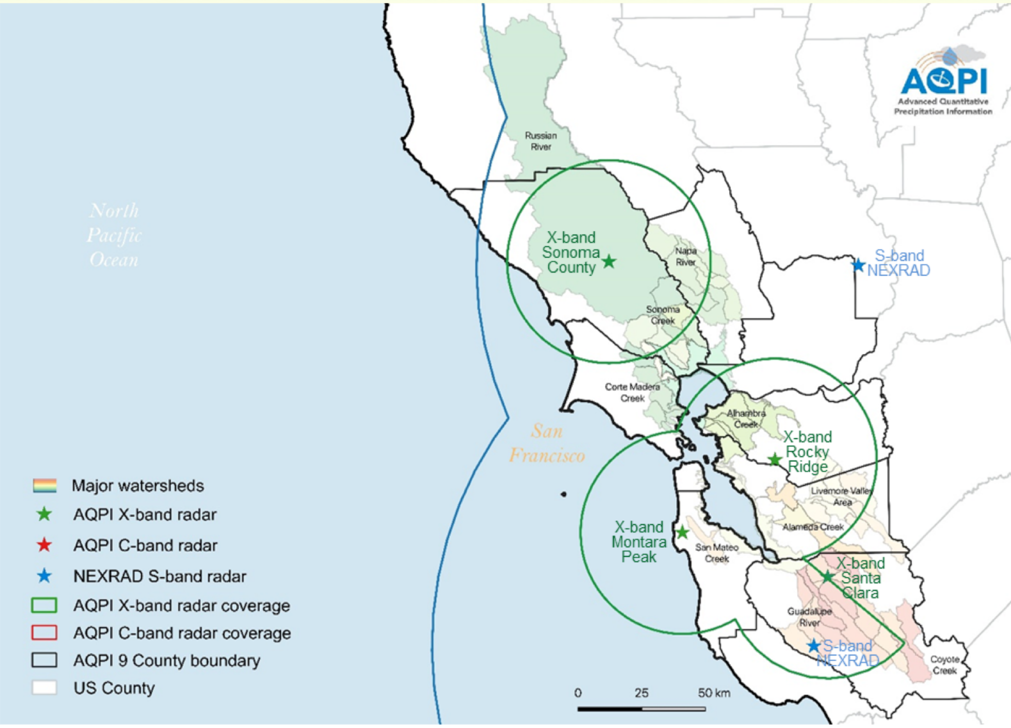
AQPI Radars: V. Chandrasekar, Haonan Chen, Rob Cifelli

Surface Met Stations: Allen White

Oakland, CA

24 January 2020

AQPI Radar Status for the 2019/2020 Storm Season



- Small (large) circles are 40 (150) km coverage rings.
- **A permanent radar has been deployed at Santa Clara Penitencia Water Treatment Plant (37.3989N, 121.8334W).**
- **A temporary radar has been deployed near Sonoma County Airport (38.5216N, 122.8023W).**
- **A temporary radar is being deployed near Montara Peak for the 2019/2020 storm season.**
- **Another radar is planned for deployment near Rocky Ridge for the 2019/2020 storm season.**

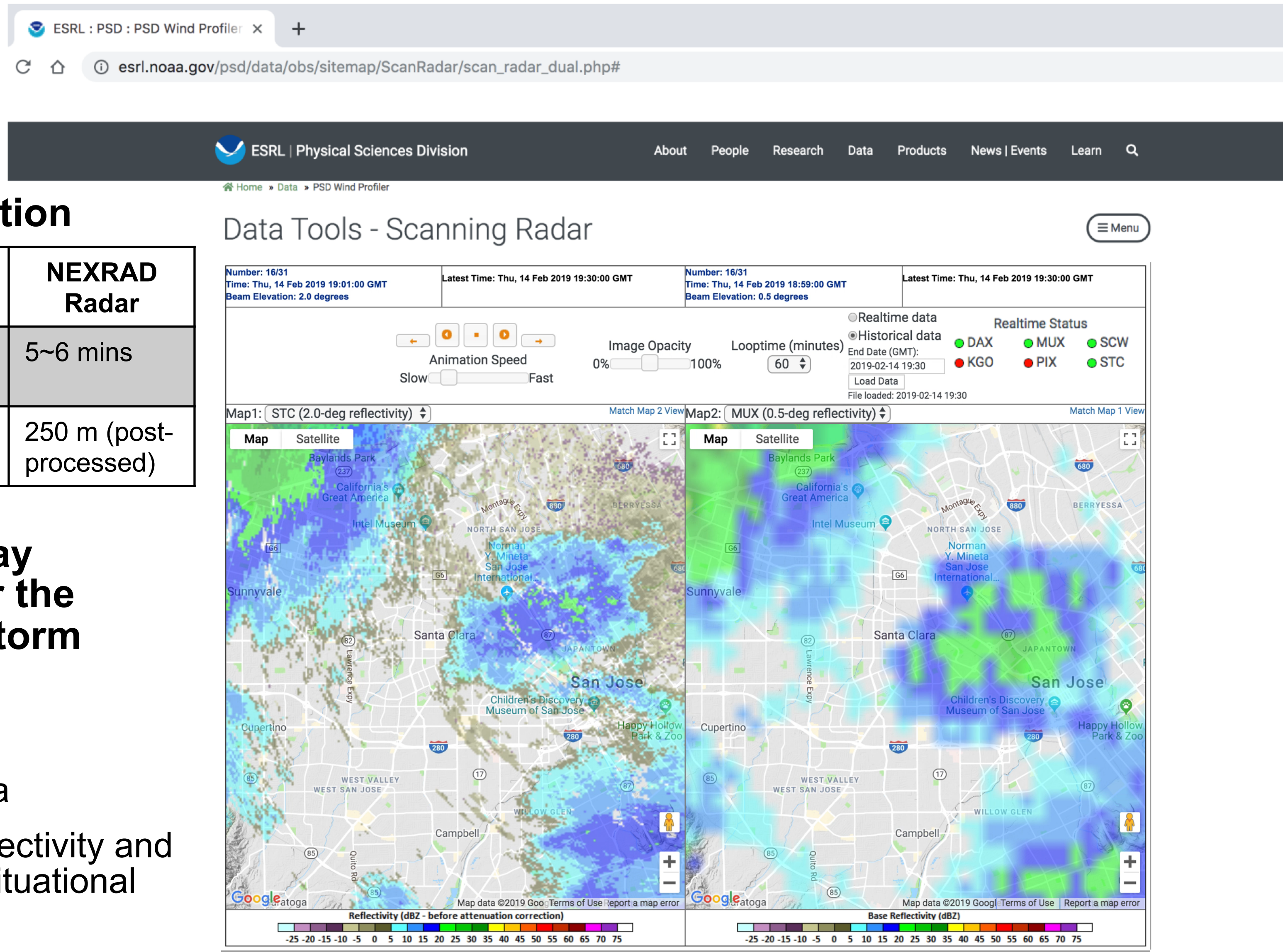
Sonoma County

Santa Clara Valley Water

Santa Clara Valley Water

AQPI Radar Observations and Real-Time Display

https://www.esrl.noaa.gov/psd/data/obs/sitemap/ScanRadar/scan_radar_dual.php#



➢ Radar resolution

Resolution	AQPI Radar	NEXRAD Radar
Temporal Resolution	<2 mins	5~6 mins
Range Gate Width	60 m	250 m (post-processed)

➢ Radar display available for the 2019/2020 storm season

- Radar status
- Historical data
- Real-time reflectivity and rain rate for situational awareness

AQPI Radar Rainfall Product

AQPI product domain:

Lat: [36.795:0.0025:39.505]
Long: [-124.005:0.0025:-121.195]

1085X1125 lat/lon grids

Current product:

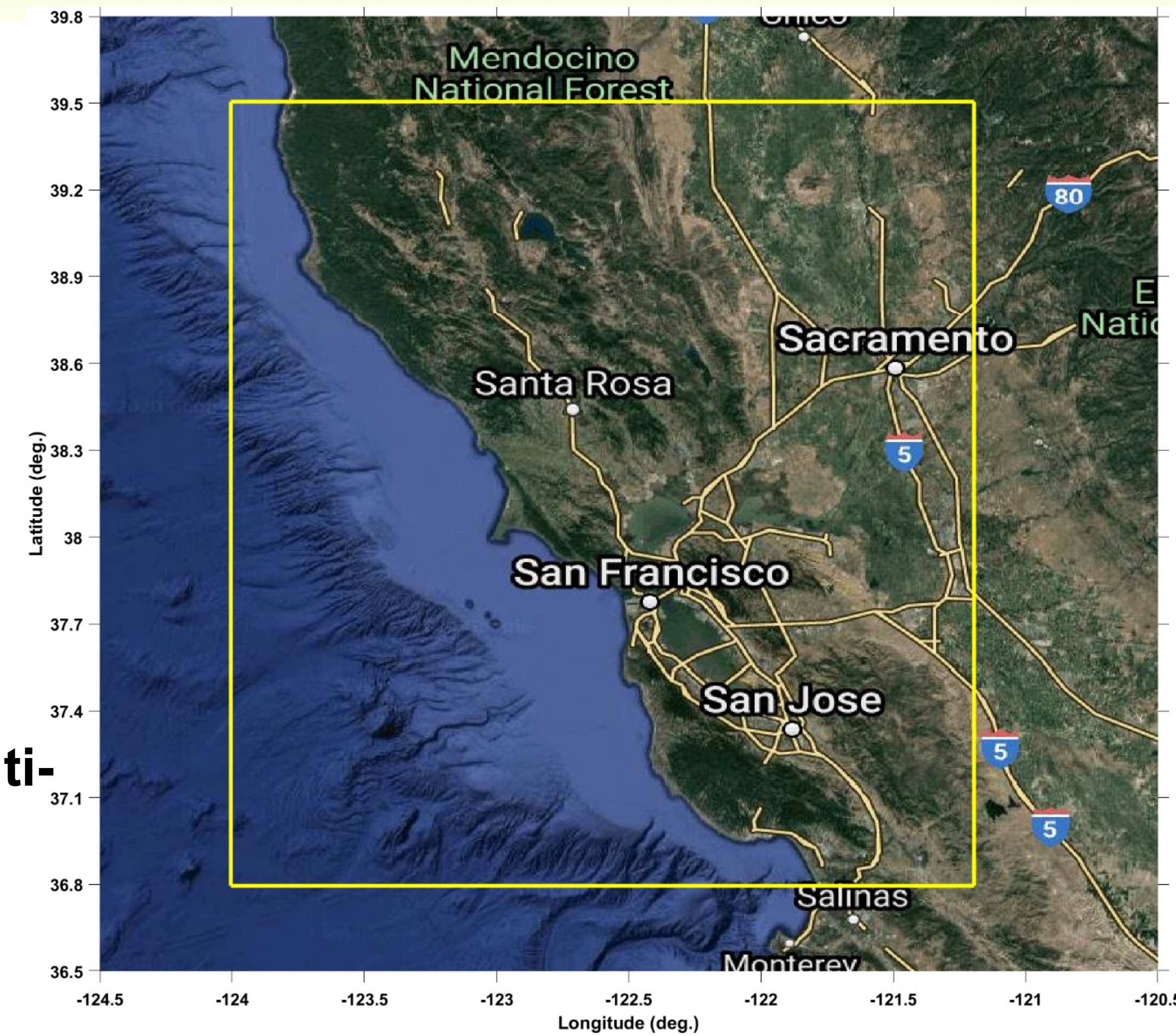
- **Instantaneous rainfall rate**
- **Hourly rainfall accumulation**

AQPI product resolution:

- 250 m X 250 m X 2 min

Operational Multi-Radar Multi-Sensor (MRMS) product resolution:

- 1000 m X 1000 m X 60 min



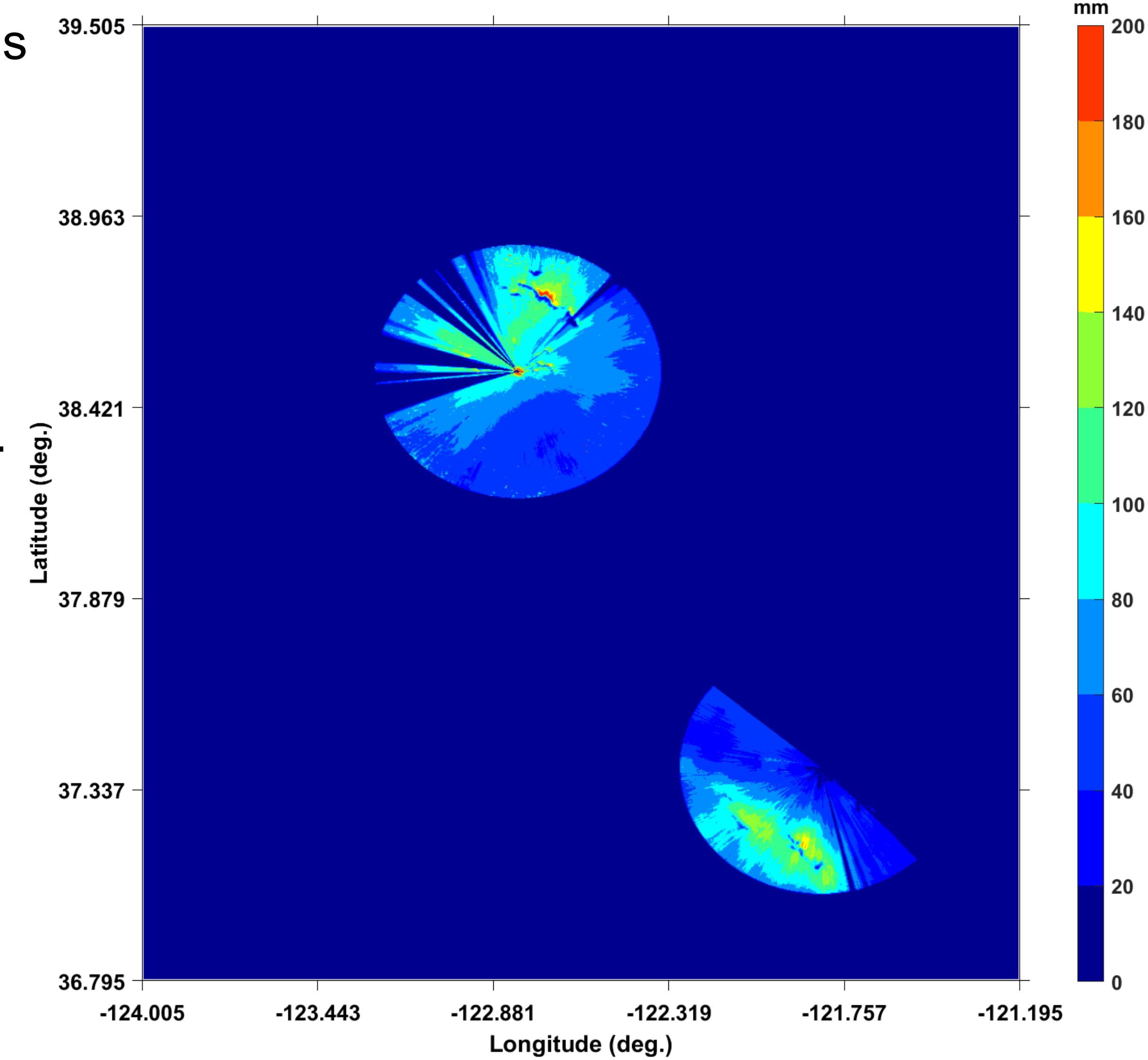
AQPI radar rainfall domain: yellow rectangle

Composite rainfall products (250 m X 250 m X 2 min) are available for the 2019/2020 storm season!

AQPI Radar Rainfall Product for the 2019/2020 Storm Season

Part 1: AQPI radar-only rainfall product (high confidence region)

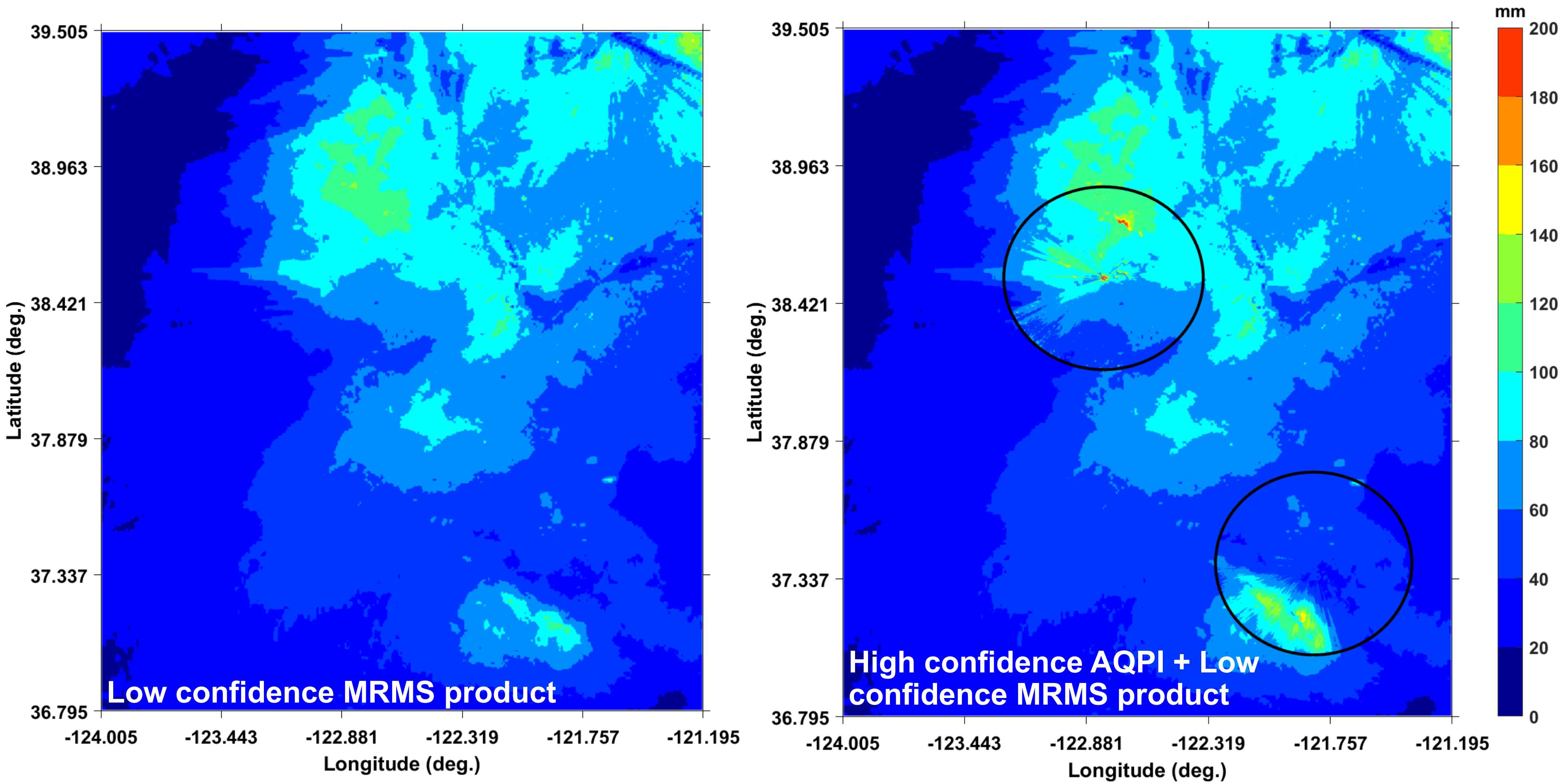
- 48-hr rainfall accumulations during 13-14 Feb 2019.
- Still optimizing the scan strategy to enhance the product completeness;
- Gaps will be filled as more AQPI radars are deployed.
- System is currently operating, producing rain rate and accumulated hourly rainfall at 250mX250m resolution every 2 minutes.
- Can be used for cross quality check with rain gauge data.



AQPI Radar Rainfall Product for the 2019/2020 Storm Season

Part 2: Filling gaps with lower-confidence MRMS rainfall product

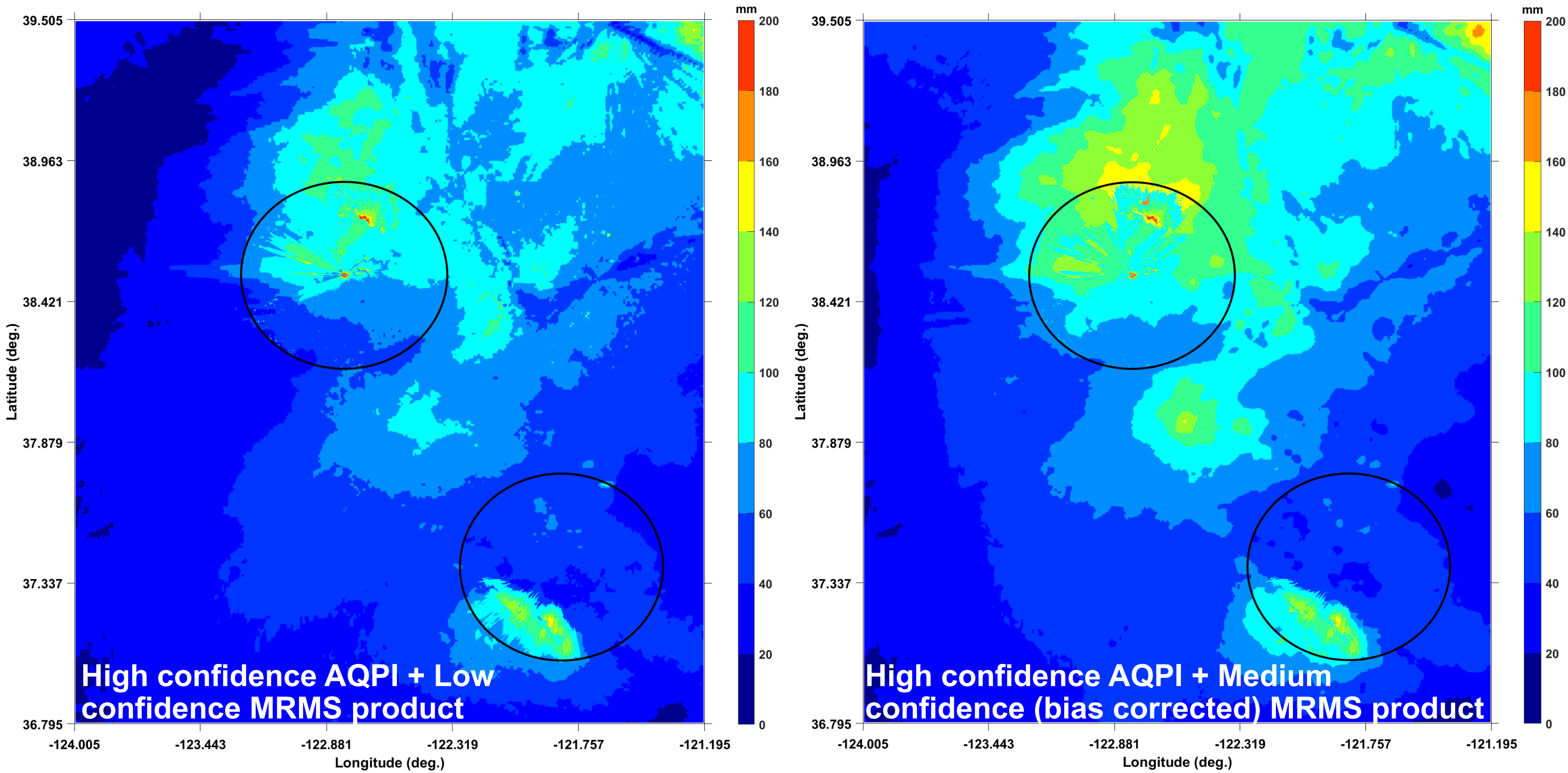
- System ready for the 2019/2020 storm season
- **Lower confidence region**: beyond the AQPI radar coverage



AQPI Radar Rainfall Product for the 2019/2020 Storm Season

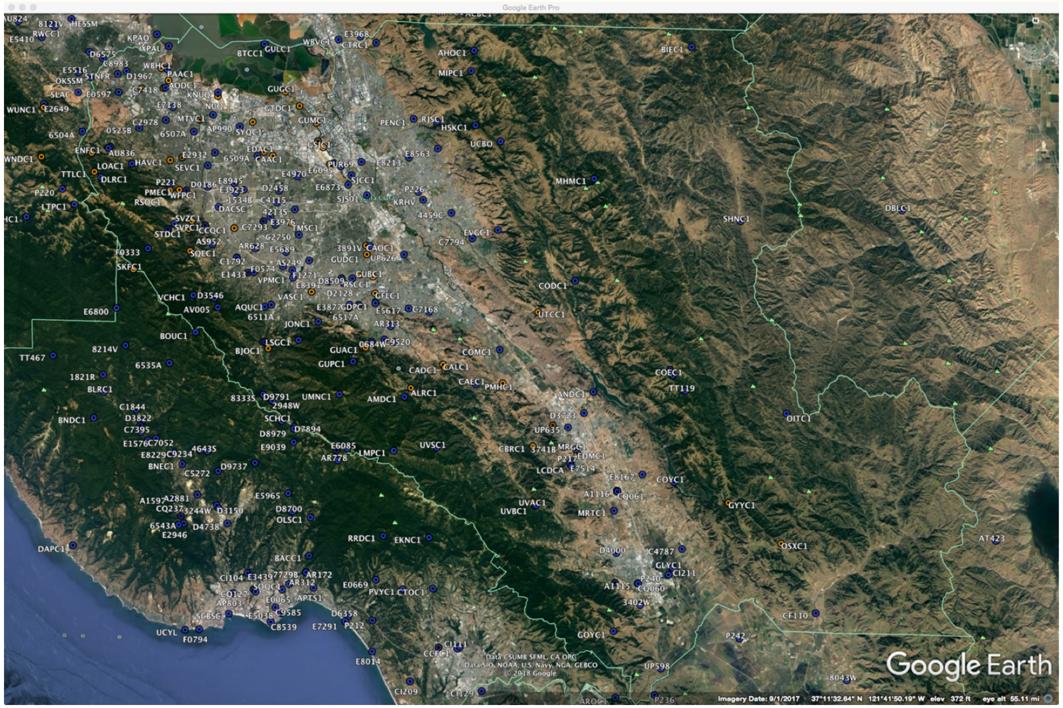
Part 3: Filling gaps with bias corrected MRMS product

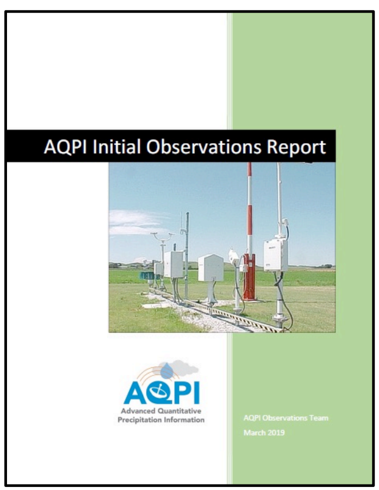
- A gauge-based bias correction scheme is developed for MRMS rainfall product.
- Real-time application system is still in testing phase; will be ready by April 2020.

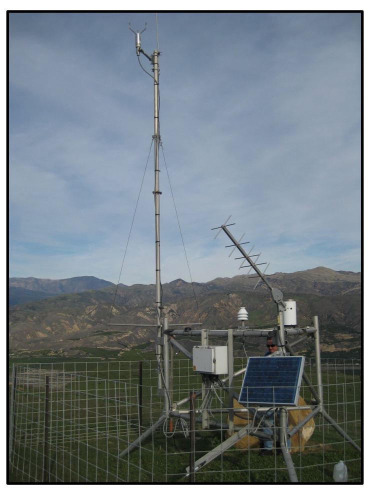


48-hr rainfall accumulations during 13-14 Feb 2019

Surface Observations







Stations marked in blue are already in the AQPI system.

Stations marked in orange need to be added to the AQPI system.

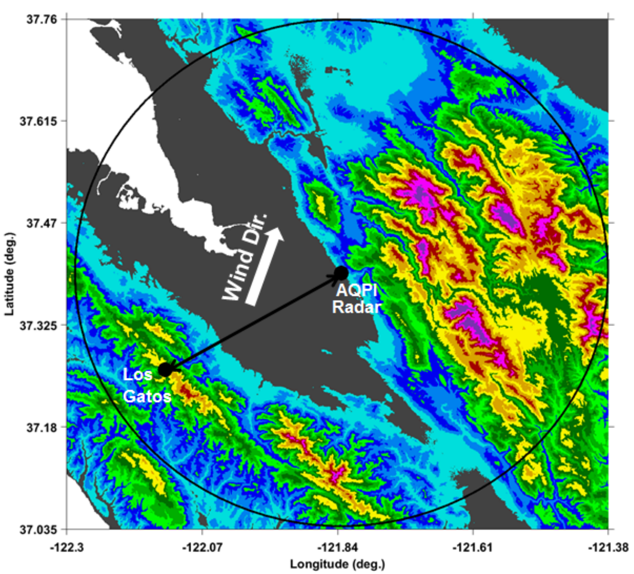
Agencies that use *One Rain* or *Datawise*: Have your data manager contact *One Rain* or *Datawise* and indicate that you would like them to share your data with MADIS.

Agencies that collect their own data or use a different data provider:
Contact the AQPI team (Greg Pratt [greg.pratt@noaa.gov] or Allen White [allen.b.white@noaa.gov]) to establish communication method and to apply for NWS station id's.

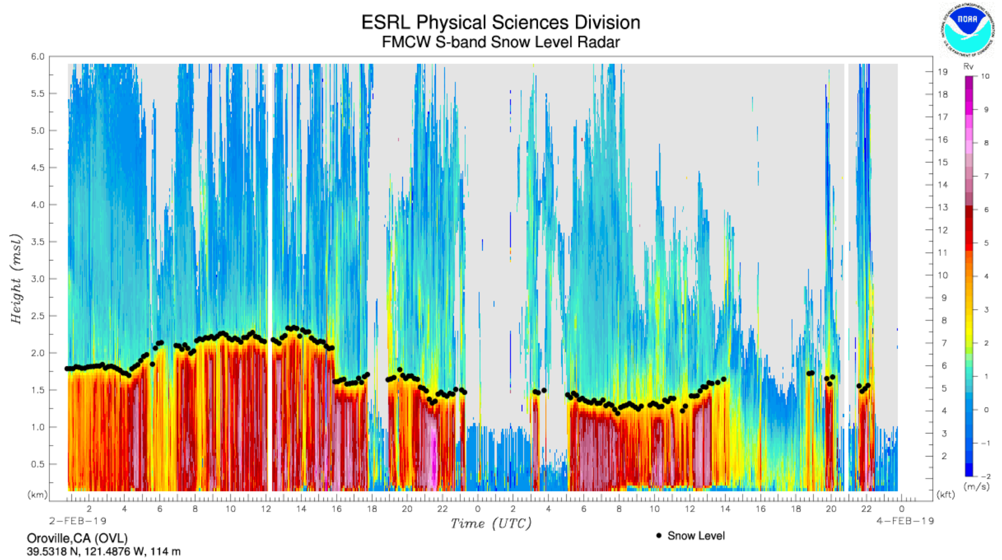
Surface Observations

A new vertically pointing snow-level radar and optical disdrometer have been installed at the Hydrometeorology Testbed (HMT) Los Gatos soil moisture site to help improve precipitation estimation with the Santa Clara AQPI X-band precipitation scanning radar.

Los Gatos site (Lat: 37.261590N; Long: -122.132870W; Elv: 777 m)

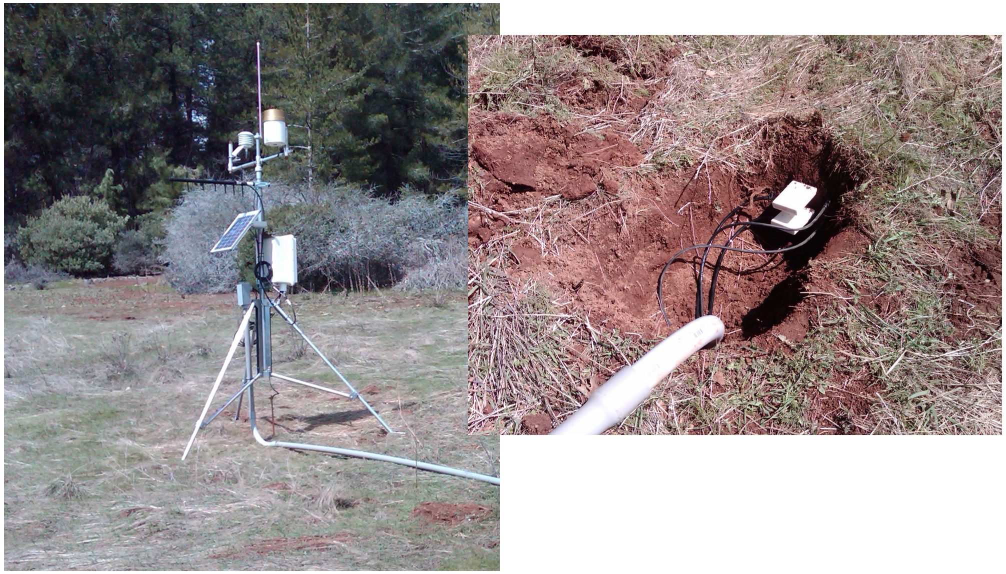


- 30.56 km from the AQPI Santa Clara radar
- 300.06-deg azimuth angle from the AQPI Santa Clara radar



Surface Observations

To tell us if your surface-based observational needs are being met. Do you have observing gaps that AQPI could help address?



A typical setup for one of HMT's surface sites with a tripod and solar panel/battery for instrument power. The site measures temperature, relative humidity, rainfall, soil temperature, and soil moisture at two levels (10 and 15 cm). Data are transferred to our data processing hub by internet cel modems and shared with the AQPI system.

Are there other types of observations that would help meet your needs?

Discussion Points

1. What are your agencies primary areas of concern? What meteorological/hydrological (e.g., rainfall) data are being used?
2. What is the format of the meteorological/hydrological data that is being used? Where do you get these data?
3. What is the spatial resolution of the data? Is it sufficient?
4. How can we help to improve upon what you are currently receiving and what would help to make this project a success in your mind?
5. Do we really need to fill the gaps using lower-quality NEXRAD product? Or should we leave it blank for now?
6. What additional data would you like to have? What format and spatiotemporal resolution would you prefer?
7. What communication protocols (for data sharing) do you prefer?
8. Are you able to access surface data easily and effectively through the AQPI system?
9. Are we able to ingest your observational data into the AQPI system?
10. Are there observing gaps that AQPI can help fill?

AQPI
Advanced Quantitative Precipitation Information

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

CIRA

DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA

Sonoma Water

San Francisco
Water Power Sewer
Services of the San Francisco Public Utilities Commission

JENNIFER KREBS

Bay Area FLOOD PROTECTION AGENCIES Association

USGS
science for a changing world

Valley Water

EBMUD

Center for Western Weather and Water Extremes

BACWA
BAY AREA CLEAN WATER AGENCIES

NOAA’s Atmospheric Modeling for AQPI

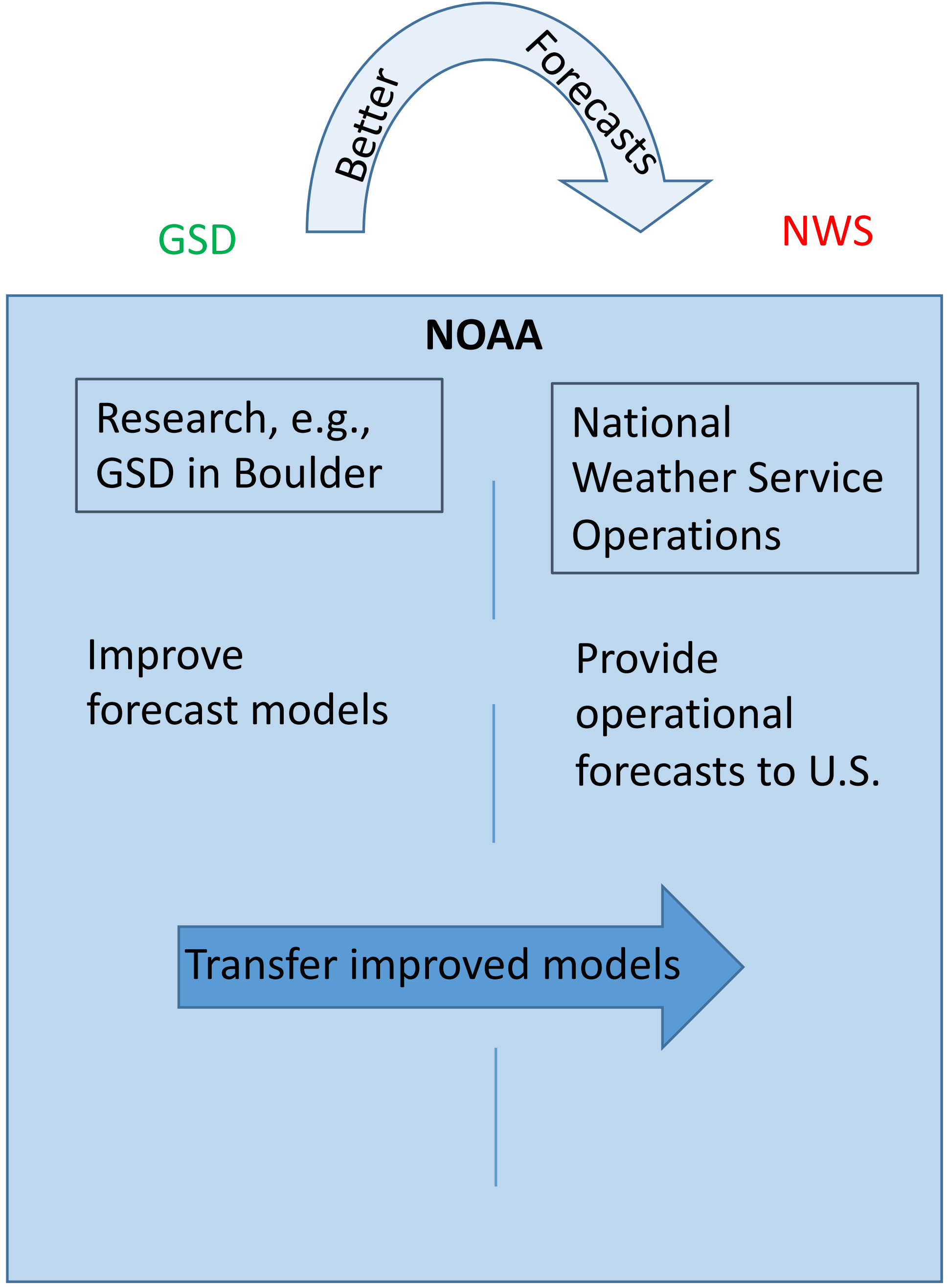
Melinda Marquis
Deputy Chief, Assimilation Development Branch
NOAA Global Systems Division (GSD)
January 24, 2020

Outline

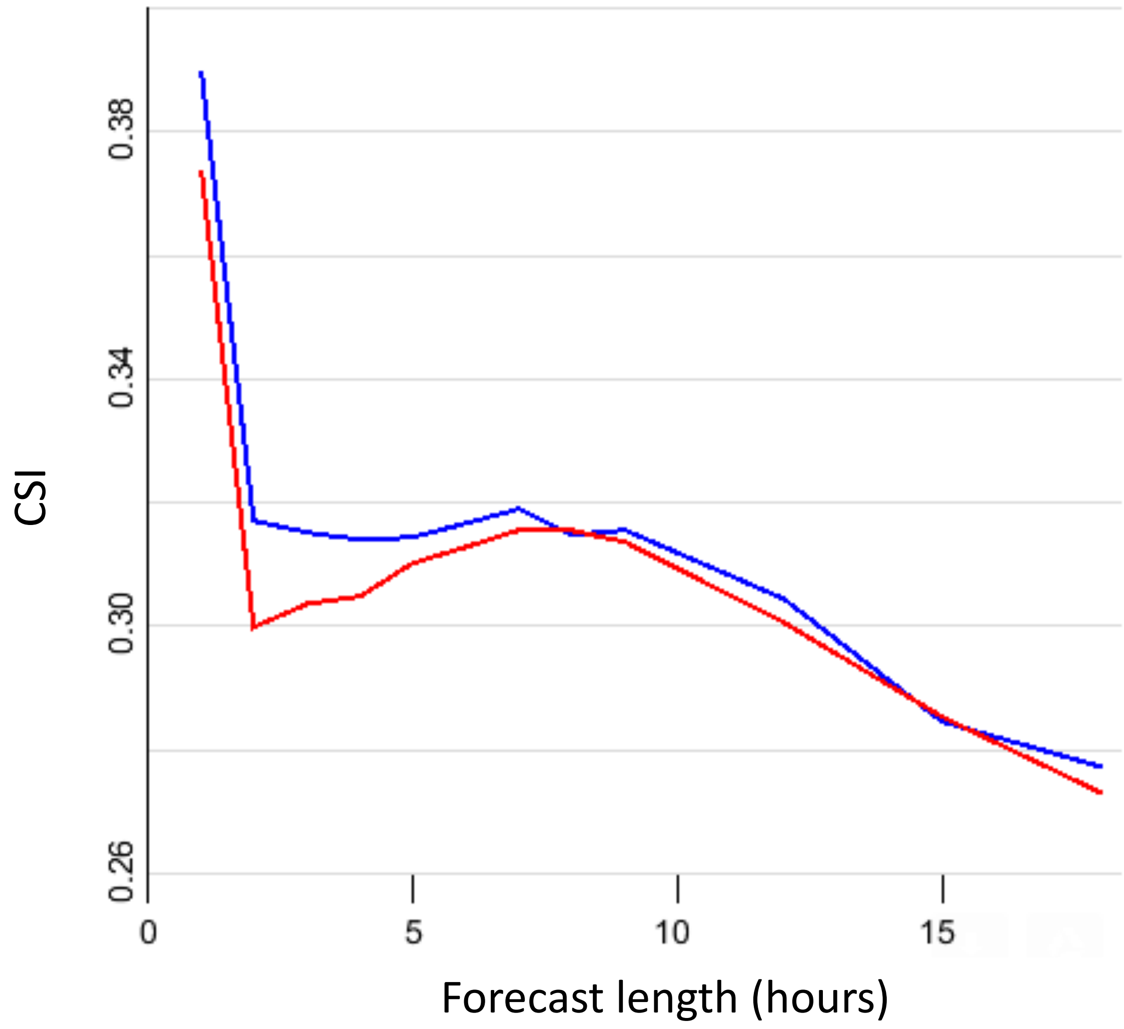
- 3 Aspects of our work
  - Improved use of **observations** in HRRR
  - Improved **physics** in HRRR
  - **Verification** of forecast skill
  - **Blending** regional and global models to **provide 5-day forecast**
- Verification Work
  - HRRR-GSD, which is the newest version of HRRR, has higher skill than the older HRRR-Operational at NWS
  - Observation datasets are "truth" against which we compare our forecasts, but different observation datasets show very different "truths"

Acknowledgment and thanks colleagues:

Trevor Alcott, Curtis Alexander, Janice Bytheway,
Jason English, Bill Moninger, Dave Turner and Hongli Wang



Newest version of HRRR (HRRR_GSD) performs better than the operational HRRR in forecasting precipitation in the AQPI Region:



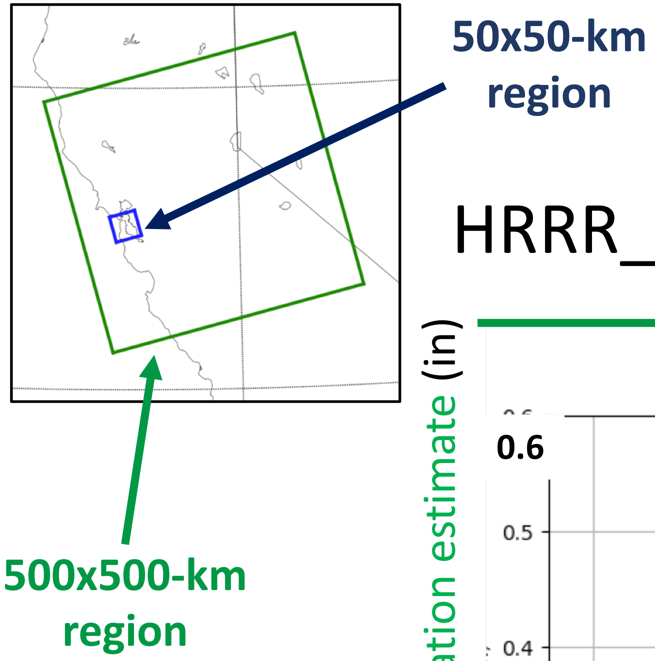
HRRR-GSD in blue, HRRR-Operational in red
Critical Success Index (CSI) for precip >= 0.01”
For a 7-month period starting 8 February 2019
Higher is better.

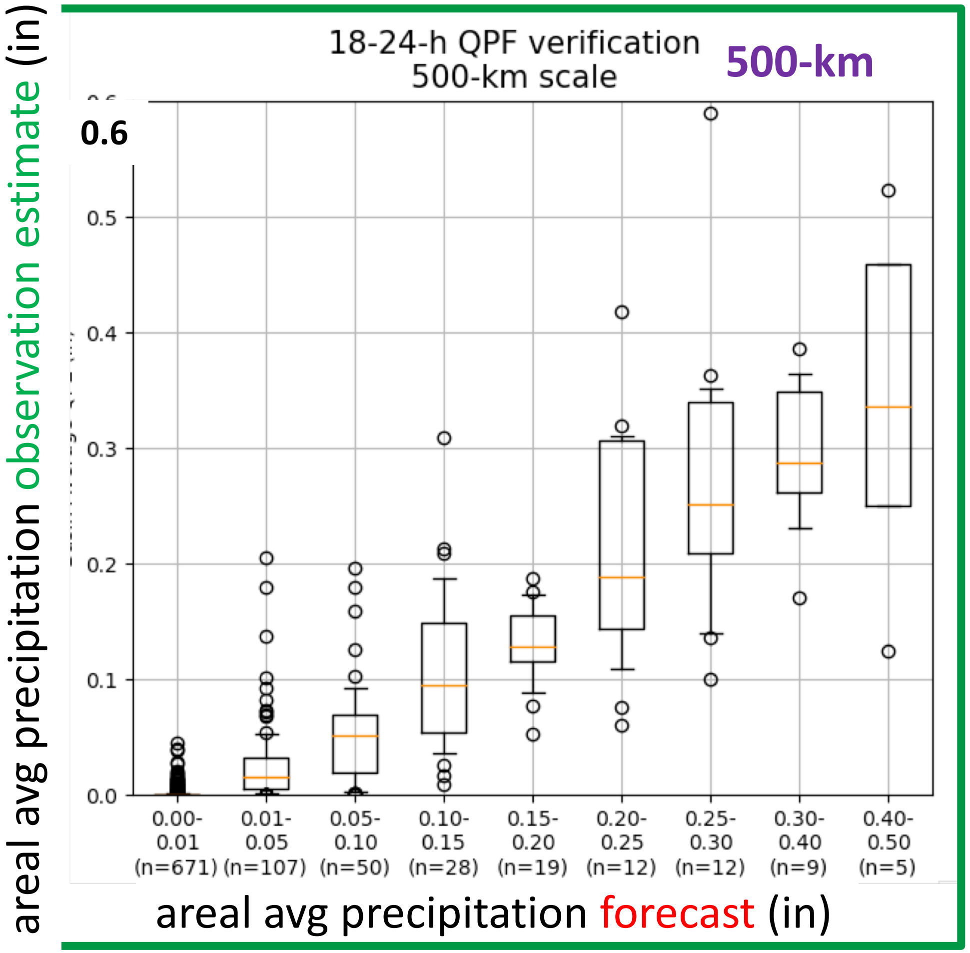
What is CSI?
The Critical Success Index, also called the Threat Score, is given by:
CSI = (hits) / (hits + false alarms + misses)
Its range is 0 to 1, with a value of 1 indicating a perfect forecast.

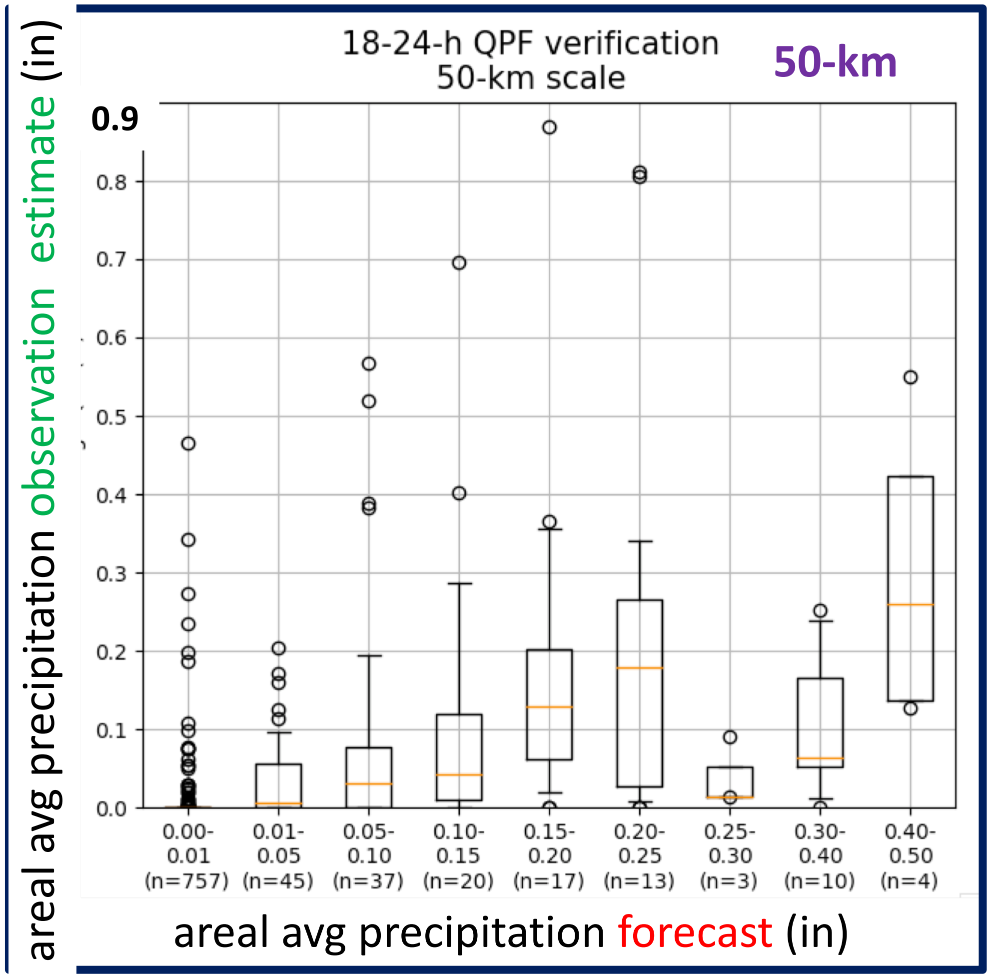
Work of Bill Moninger

Forecast Uncertainty vs Spatial Scale

HRRR_GSD vs Stage-IV Observations (2017-8 & 2018-9 cold seasons)







Work of
Trevor Alcott

Question: Is this verification by spatial scale useful to you?

Longer Time-horizon Forecasts from Blending Regional and Global Models

	Research (GSD)	Operations (NWS)
Short-term regional	Experimental HRRR 0-48 hours, 15-min QPF to 18 hours (hourly update), 1-hour QPF to 48 hours (6-hourly update); 3-km CONUS, 1-km nest over AQPI region	Operational HRRR system 0-36 hrs, 15-min QPF to 18 hrs (hourly update), 1-hour QPF to 36 hrs (six hourly update) -- will go to 48 hrs in June 2020
	AQPI x-band radars, GOES-17 satellite	
Medium-range global	Experimental GFS 2-7 days, 3-hour QPF to 7 days (12-hourly update)	
	GFS will use physics developed at GSD for RAP and HRRR models; including smoke; data assimilation including lightning, cloud analysis, surface observations, AQPI radars, GOES-17 satellite data. No guarantee that this will get into operations at NWS.	Operational GFS system 0-360 hours, 3-hr QPF? -- next update in Q2FY21

Release #1: No blending
- HRRR (regional)
- GFS (global)

Release #2: Autumn 2020
Blended forecast with certainty information, using weighted models:
- HRRR
- GFS
- National Blend of Models

↓

- Rapid Refresh Forecast System (RRFS)

Deterministic forecast with certainty information (e.g., time –lagged ensemble +/or perturbations of initial conditions)

Summary

- The HRRR skill is reasonably good for forecasting precipitation in AQPI domain.
- Experimental HRRR-GSD has higher skill than HRRR-Operational at NWS for precipitation in AQPI domain. The HRRR-GSD is expected to become operational at NWS in June 2020.
- By next autumn, we will develop a blended forecast out to 5 days that is a deterministic forecast with certainty information.

AQPI TRIBUTARY HYDROLOGY

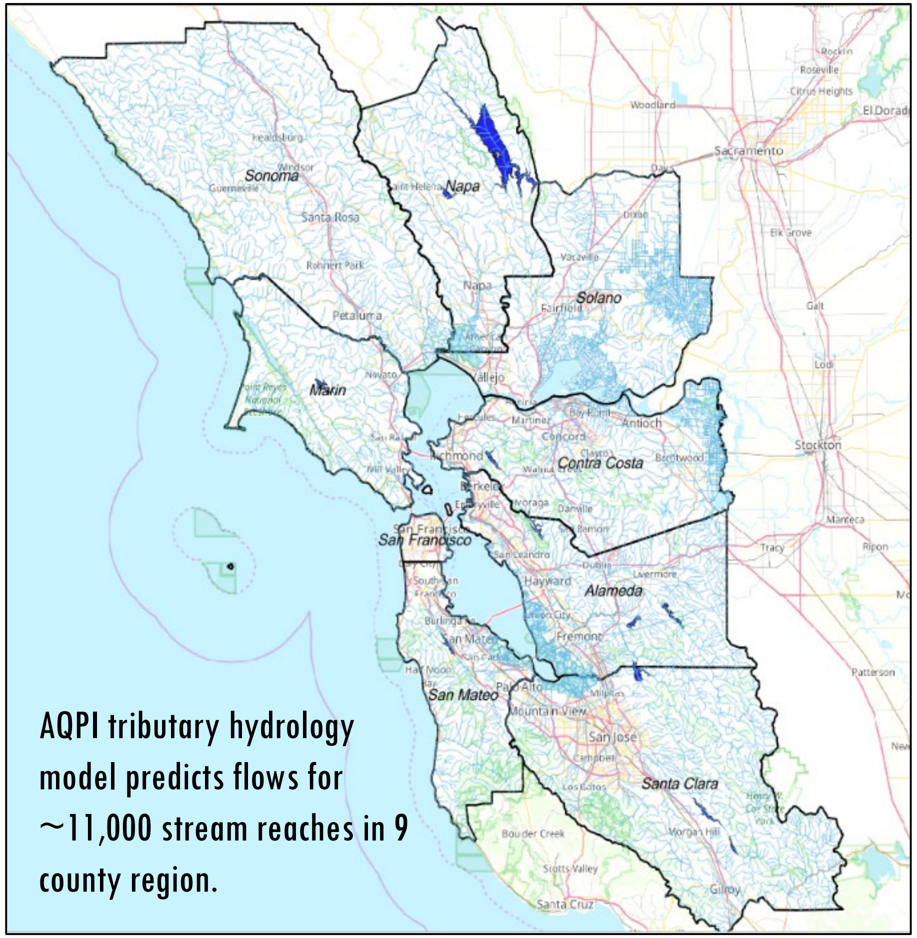
Review of Hydrologic Products and Model Performance

Lynn Johnson, Jungho Kim

January 2020

AQPI Tributary Hydrology Update

- Hydromet Observations
- Quantitative Precipitation Estimation (QPE)
- Quantitative Precipitation Forecast (QPF)
- Support for Local Models
- Watershed Hydrology – National Water Model
    - Stream Discharge
        - Network and Hydrographs
    - Flood Frequency
    - Soil Moisture
    - Impact Features
    - Model Performance
- Coastal Hydrodynamic Model (CoSMoS)



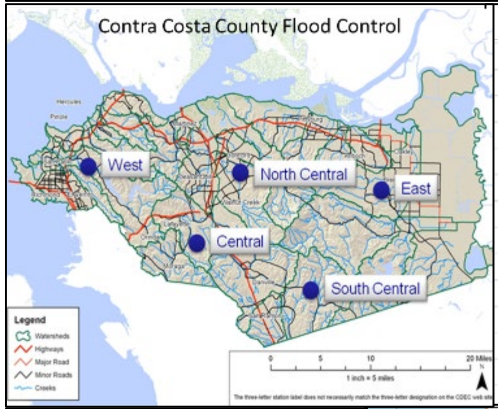
AQPI tributary hydrology model predicts flows for ~11,000 stream reaches in 9 county region.

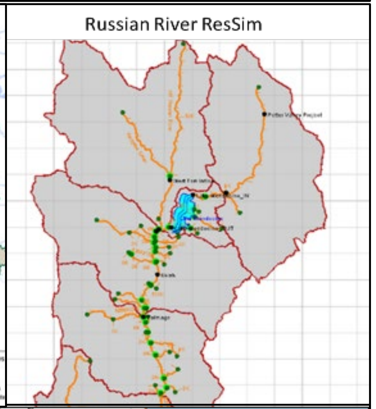
AQPI Local Applications

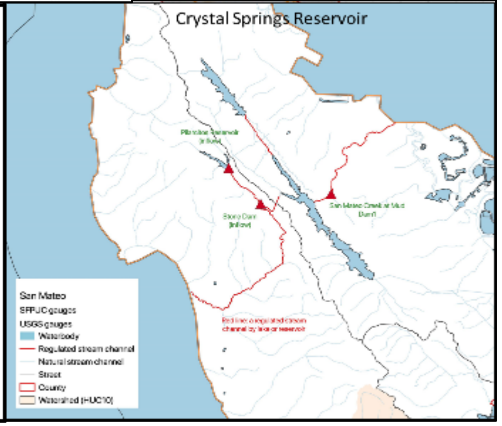
- AQPI system to provide precipitation and streamflow forecasts for points, zones and watersheds as desired.
- County Flood Forecast Tools
  - QPE & QPF precipitation amounts are accumulated to provide tabulations for the 7-5-3-2 application, and 6-hour Flash Flood Trigger.
    - Contra Costa (M. Boucher) and Marin (R. Leventhal)
  - Precipitation forecasts to be provided for HEC-RAS model.
    - Santa Clara Water (J. Xu and L. Xu)
- Reservoir Operations
  - NWM inflows to reservoirs can be provided.
    - SFPUC - Crystal Springs Reservoir (A. Dufour, R. Pluche)
  - Demonstration conducted for upper Russian River basin Lake Mendocino ResSim model linked with NWM .
    - Sonoma County Water (C. Delaney)

Information for the "Thresholds" plot	Year to Date+ (inches)	Avg 30 Days+ (inches)	Avg 7 Days+ (inches)	Avg or Max 24-hr Rainfall Forecast+ + (inches)	6-hour Flash Flood Trigger
Thresholds	7.00	5.00	3.00	2.00	3.00
Current Max/Future Average Conditions	7.38	7.23	4.64	0.254	0.104

Based on Average of Maximum Gauge Readings

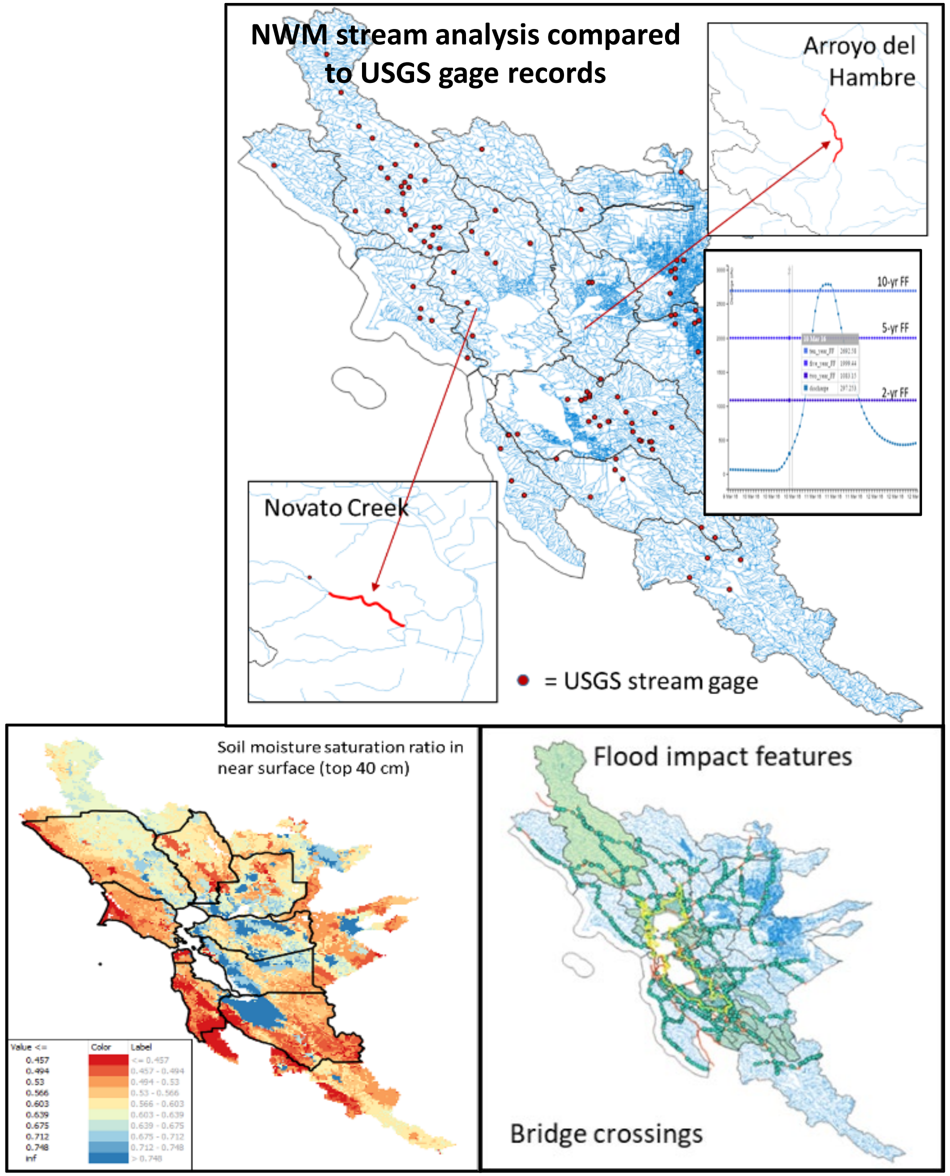






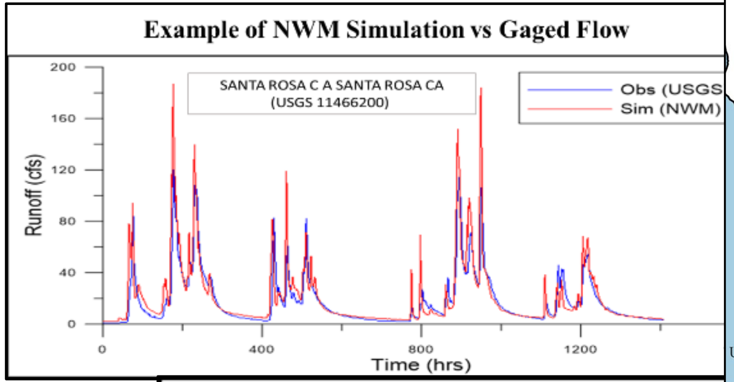
National Water Model Forecasts

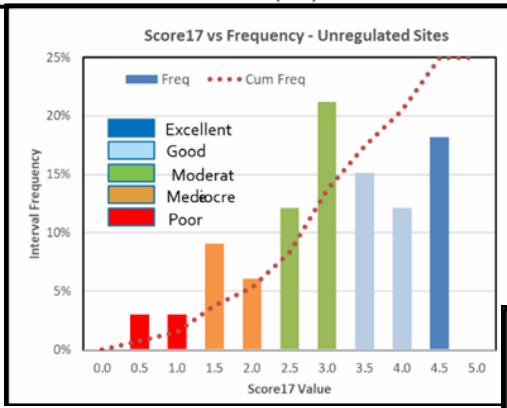
- NWM prototype deployed nationwide
  - http://water.noaa.gov/
  - 1-km grid for water balance
  - ~11,000 reaches for AQPI area
- NWM simulations are issued for four time frames:
  - Analysis (-3 to 0 hrs),
  - Short-range (1 to 18 hrs),
  - Medium range (out to 10 days),
  - Long-range (out to 30 days).
- Variety of products are generated by the NWM, including:
  - Hydrographs of streamflow for any user-selected stream segment; flow frequency overlay.
  - Network portrayal of stream flow and flood frequency
  - Grid images of surface runoff, soil moisture, ponded depth
- Impact features
  - Bridge crossings
  - Critical facilities
  - Site specific alerts

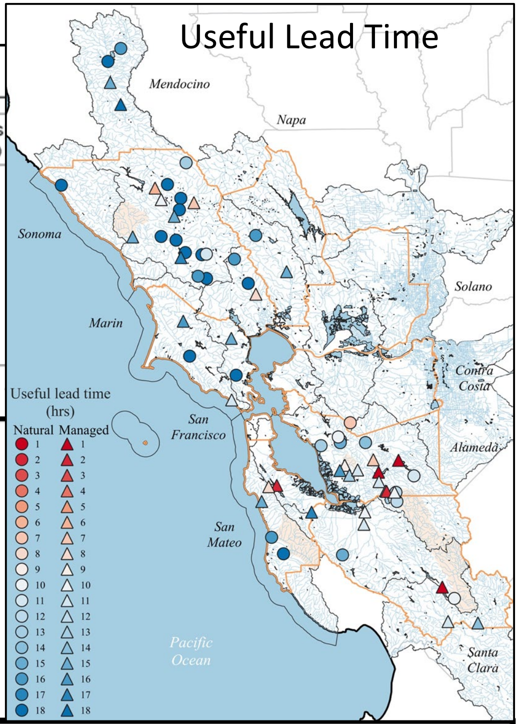


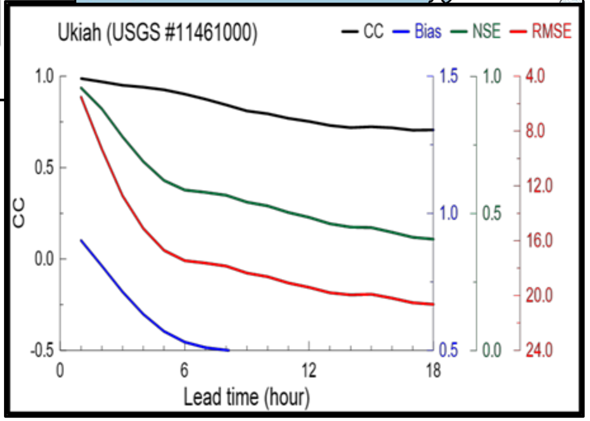
NWM Accuracy

- Retrospective Simulation
  - 2013 – 2017 simulated at 1-hr.
  - Compared to USGS gage observations for ~50 stations.
  - Visual inspection is one way most people can appreciate.
  - Comparative statistics for 32 unregulated basins for Jan. – Feb. 2017.
    - 78% were rated Moderate or better,
    - 50% were rated Good or better, and
    - 16% were rated Excellent
    - Remaining 22% was rated poor or mediocre
    - Regulated sites did not do as well but some still showed useful performance.
- Forecast Assessment
  - Jan. - Feb. 2019 period at 65 USGS gage sites
  - Performance statistics improve, especially at less than 6 hours.
  - Useful lead time mapped.



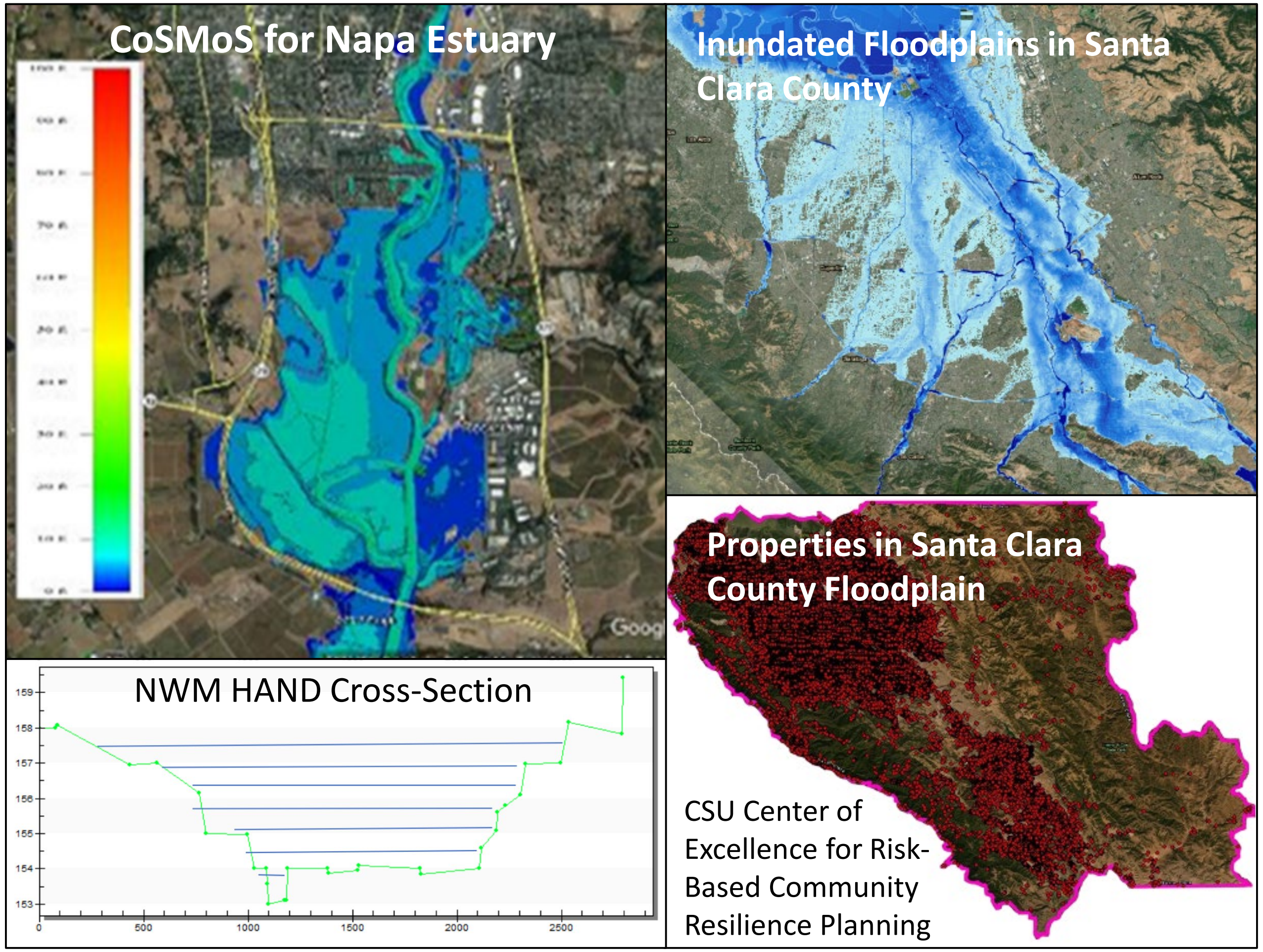


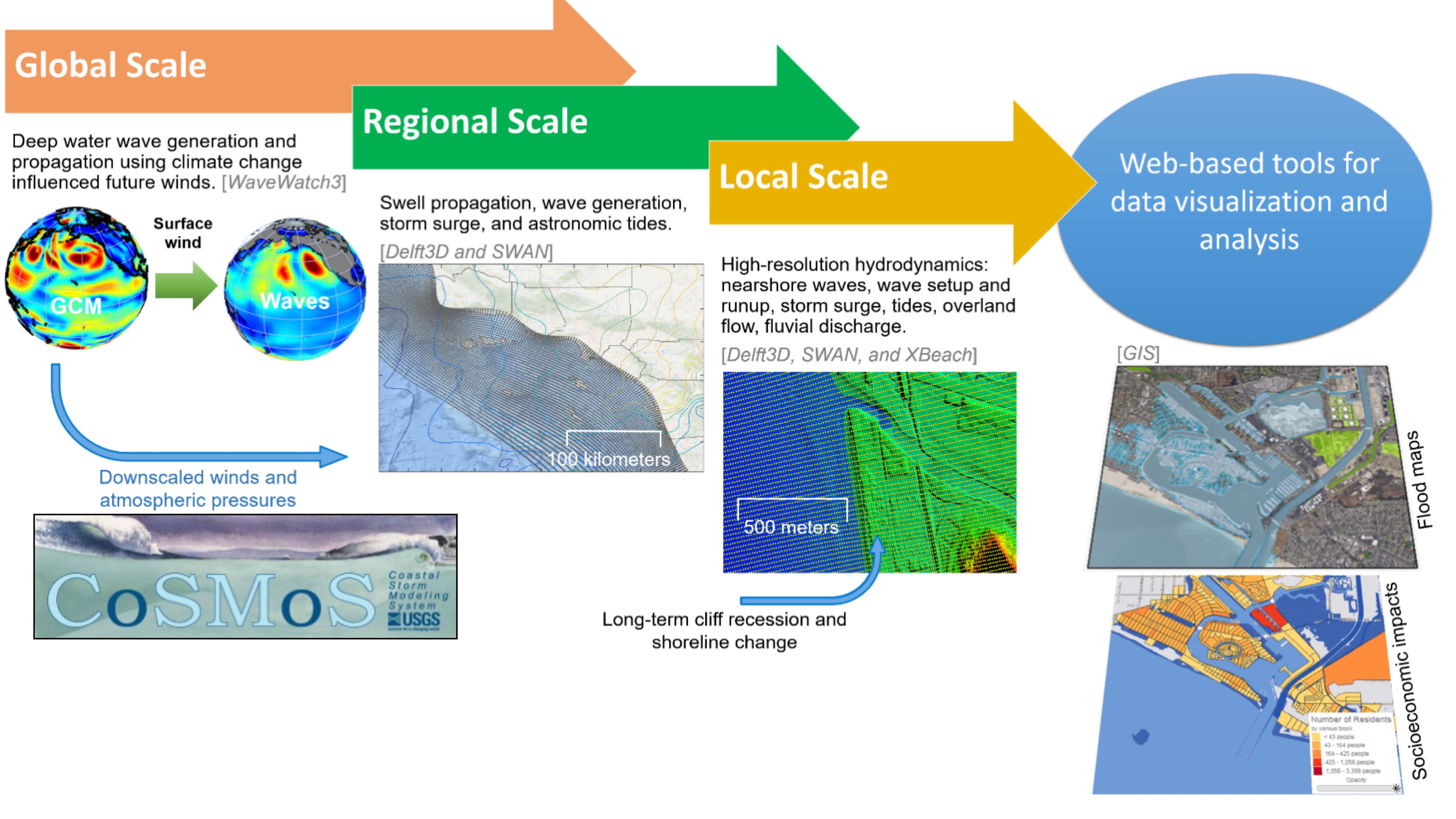




Flood Inundation Modeling

- CoSMoS to portray SF Bay coastal inundations.
- Several agencies may apply their local HEC-RAS model for real-time forecasting of flood inundation.
- NWM will portray tributary inundated floodplains at some point.
- Prototype developed by CSU hydrologists.
  - Identify properties subject to flooding.
  - Basis for estimation of AQPI benefits given increased lead time for flood mitigation actions.





Global Scale
Deep water wave generation and propagation using climate change influenced future winds. [WaveWatch3]
Surface wind
GCM
Waves
Downscaled winds and atmospheric pressures
CoSMoS
Coastal Storm Modeling System
USGS
Regional Scale
Swell propagation, wave generation, storm surge, and astronomic tides.
[Delft3D and SWAN]
100 kilometers
Local Scale
High-resolution hydrodynamics: nearshore waves, wave setup and runup, storm surge, tides, overland flow, fluvial discharge.
[Delft3D, SWAN, and XBeach]
500 meters
Long-term cliff recession and shoreline change
Web-based tools for data visualization and analysis
[GIS]
Flood maps
Socioeconomic impacts
Number of Residents
by census block
< 43 people
43 - 164 people
164 - 425 people
425 - 1,056 people
1,056 - 3,399 people
Opacity

CoSMoS Setup

Coupled Water Level (Delft3D-FM) and Wave Model (SWAN)

Offshore Boundary

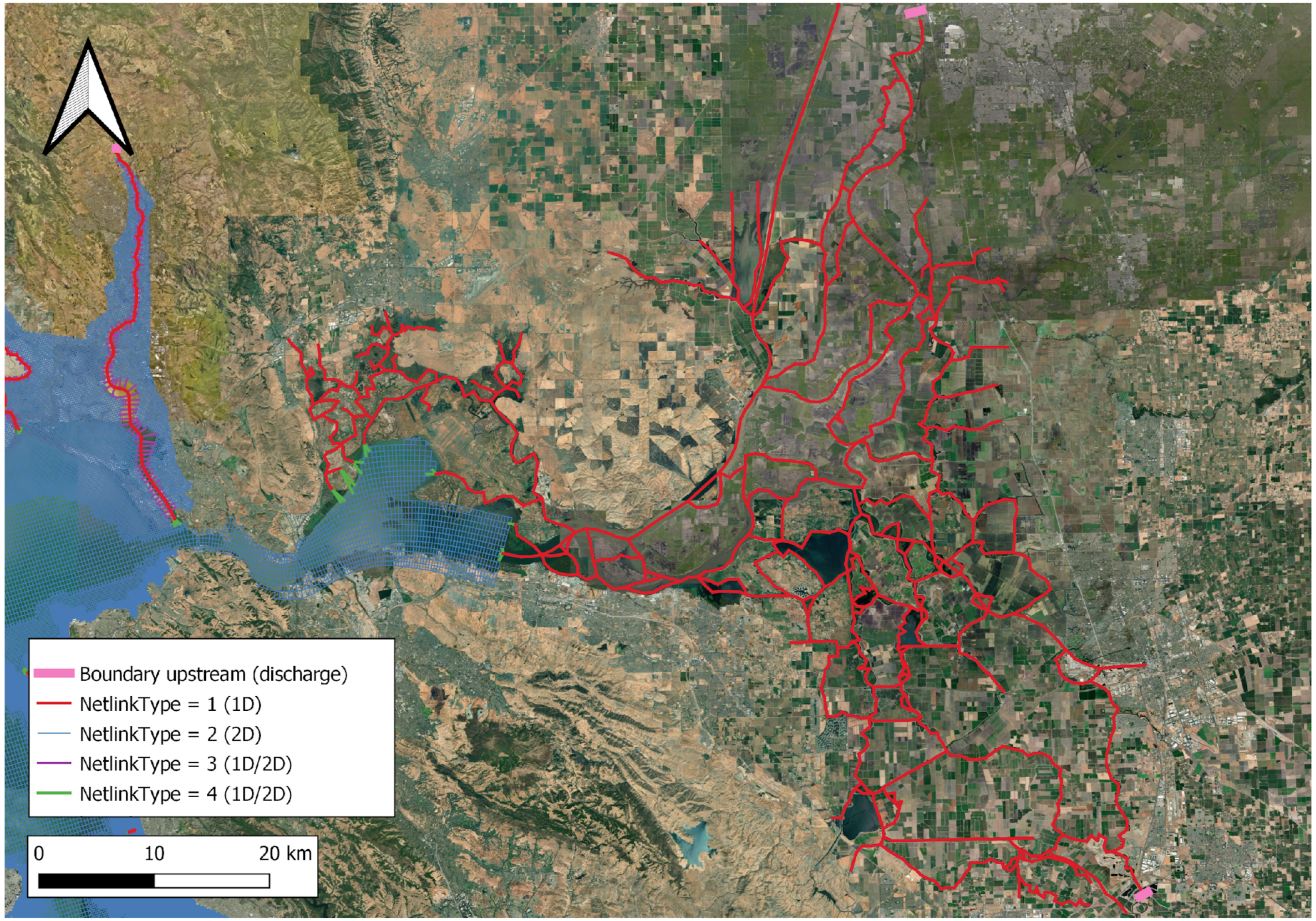
- Astronomical Tides
- Sea Surface Anomalies from Global Water Level Forecast System (HYCOM)
- Offshore Wave Parameters from Global Wave Model (WaveWatchIII)

Tributaries Inputs

- Discharge Predictions (NWM)

Atmospheric Inputs

- Surface Mean Sea-Level Pressure (HRRR)
- Surface Wind Velocities (HRRR)
- Precipitation (HRRR)



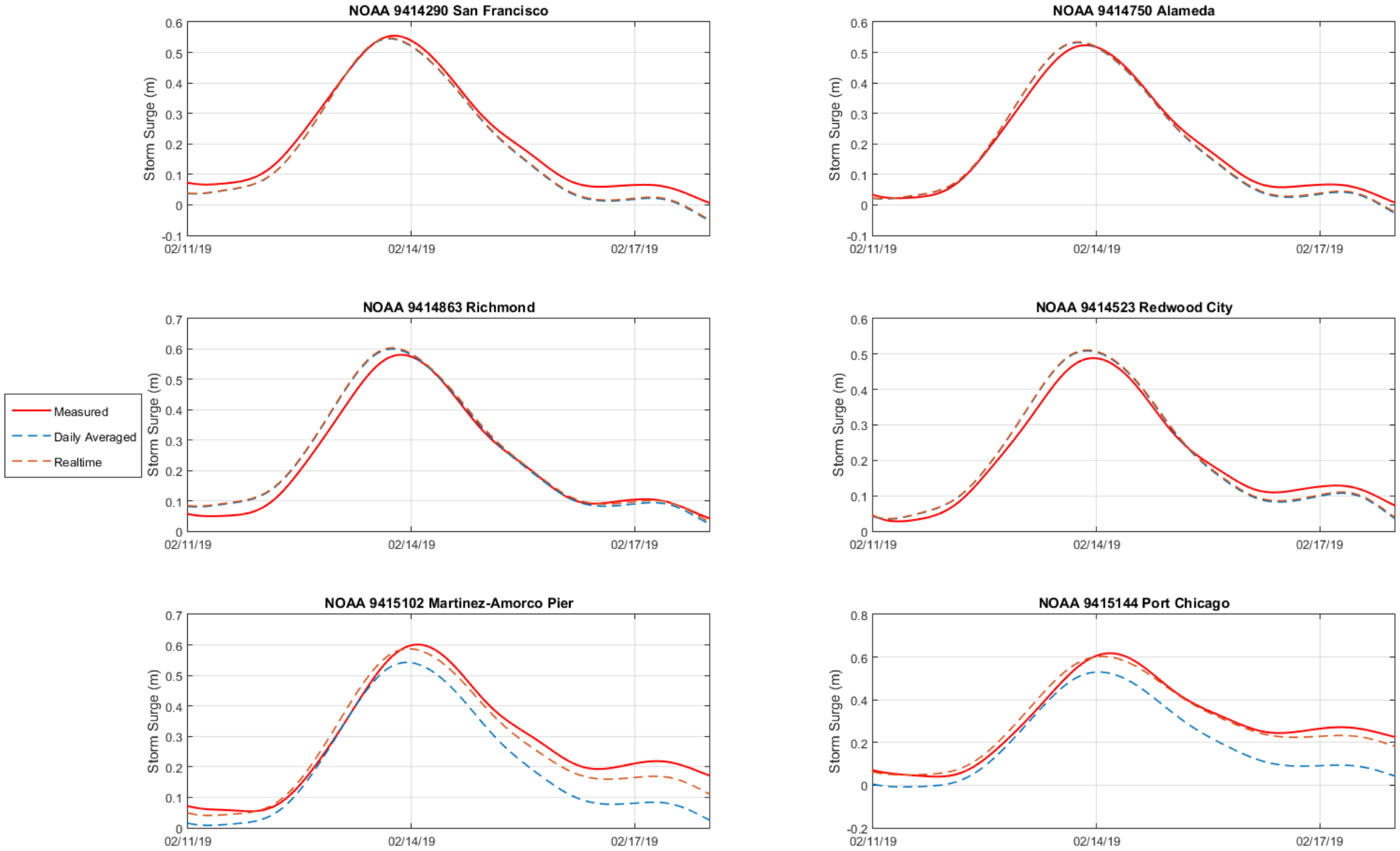
CoSMoS Performance

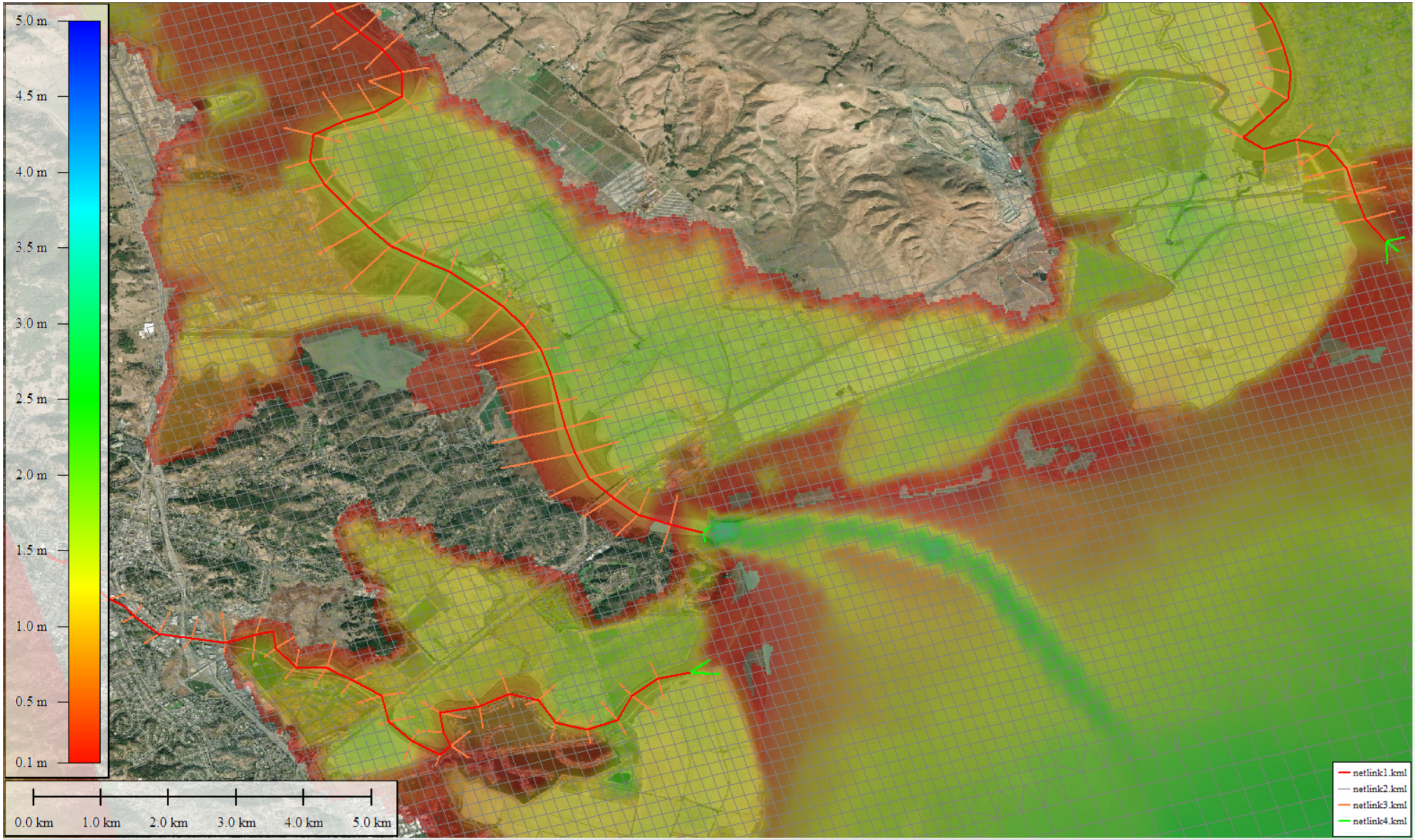
- Running operationally every 6 hours with inputs from,
  - Weather model (HRRR)
  - Global Water Level Forecast (HYCOM)
  - Global Wave Model (WaveWatchIII)

- Working on automating the connection with the National Water Model, and incorporating precipitation inputs from HRRR.

- The model captures the storm surge very well in the areas far from the delta, while the results in regions near the delta are expected to improve once the CoSMoS is operationally coupled with NWM.

- We are continuously in the process of improving the model performance for faster computation and increase the forecast time from 16 to 72 hours.

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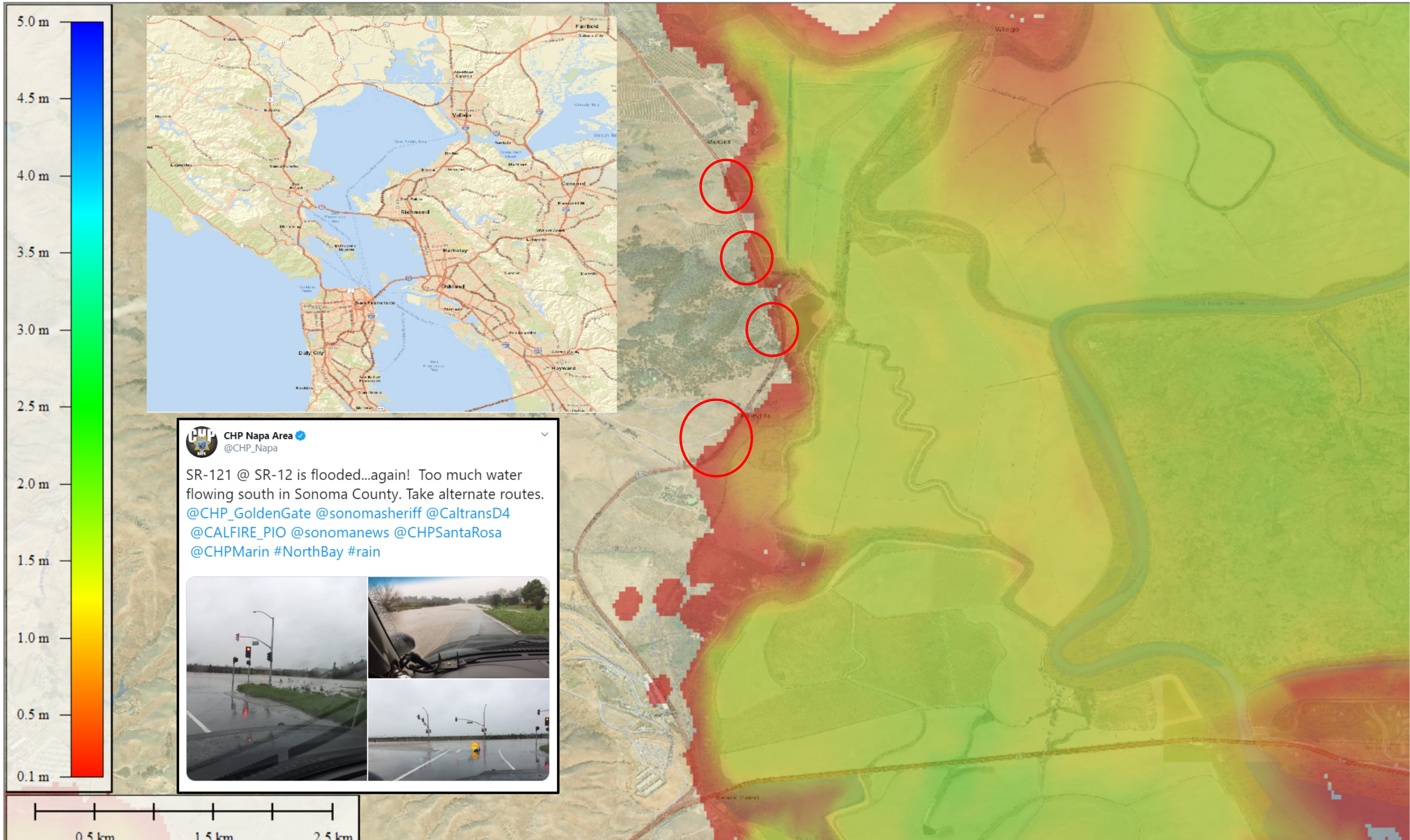
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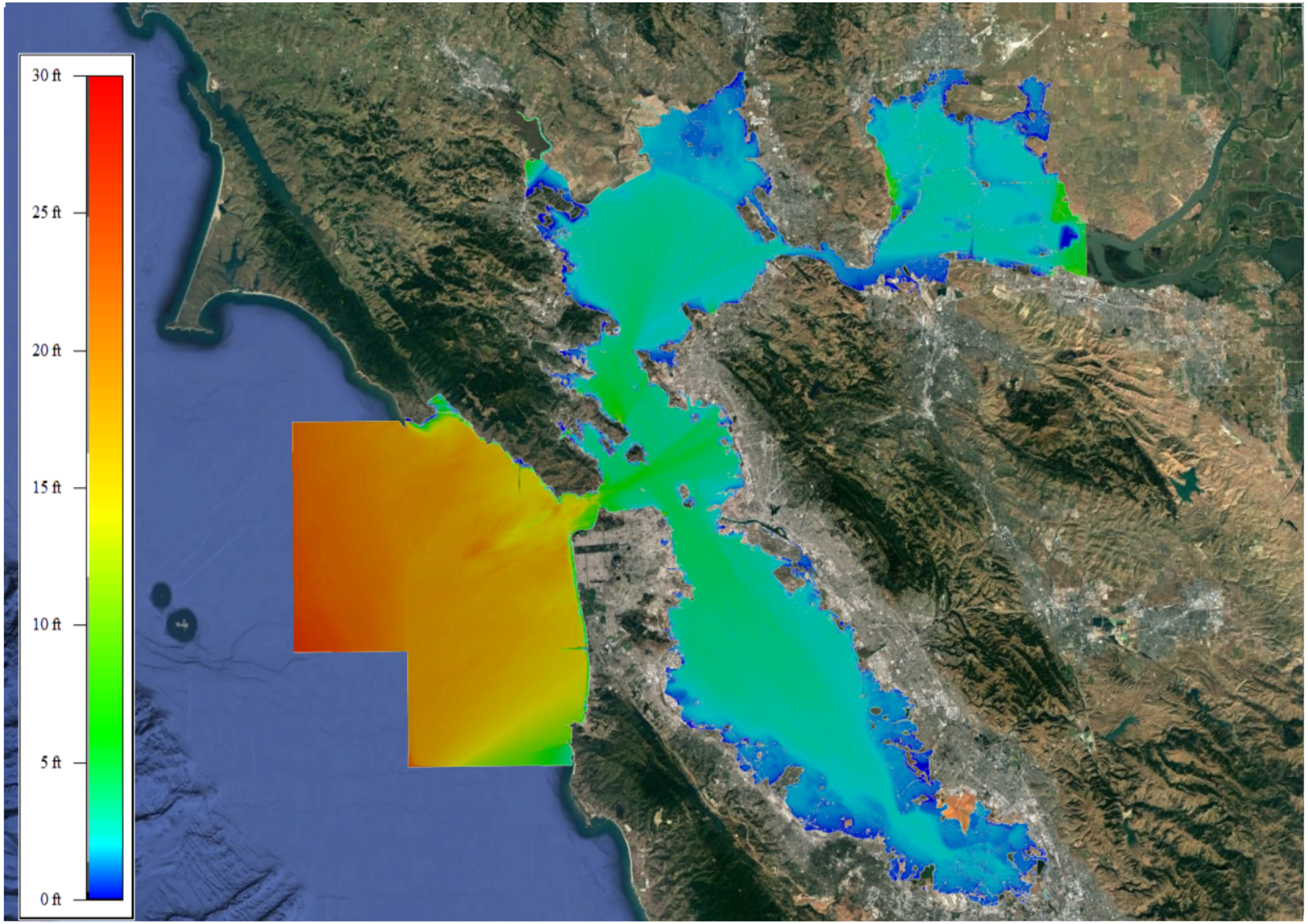
2.5 km
CHP Napa Area
@CHP_Napa
SR-121 @ SR-12 is flooded...again! Too much water flowing south in Sonoma County. Take alternate routes. @CHP_GoldenGate @sonomasheriff @CaltransD4 @CALFIRE_PIO @sonomanews @CHPSantaRosa @CHPMarin #NorthBay #rain

CoSMoS Products

- Time of First Flood
- Flood Duration
- Time of Peak Flood
- Flood Potential From Wave Runup
- Many other potential products including, wave heights, levee overtopping potential, etc



Thank You

How would you want to use this information today?

- Machine to Machine
- Through graphics
- Alert\Monitor specific locations of potential flood impact
- Other methods?

AQPI
Advanced Quantitative Precipitation Information

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CoSMoS
Coastal Storm Modeling System
USGS