Extreme Event During Santa Rosa Workshop on Extreme Events: Informal Case Summary

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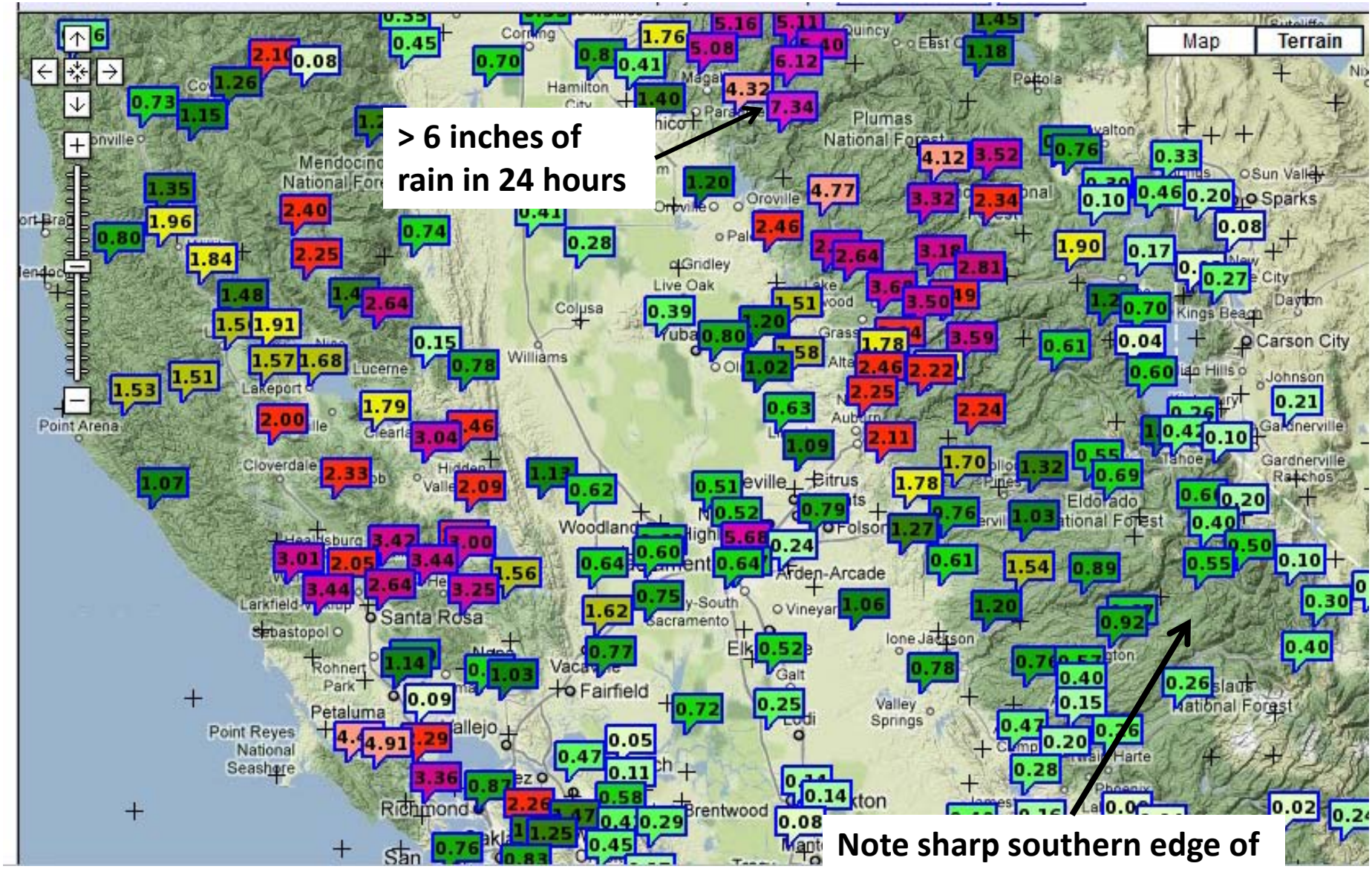
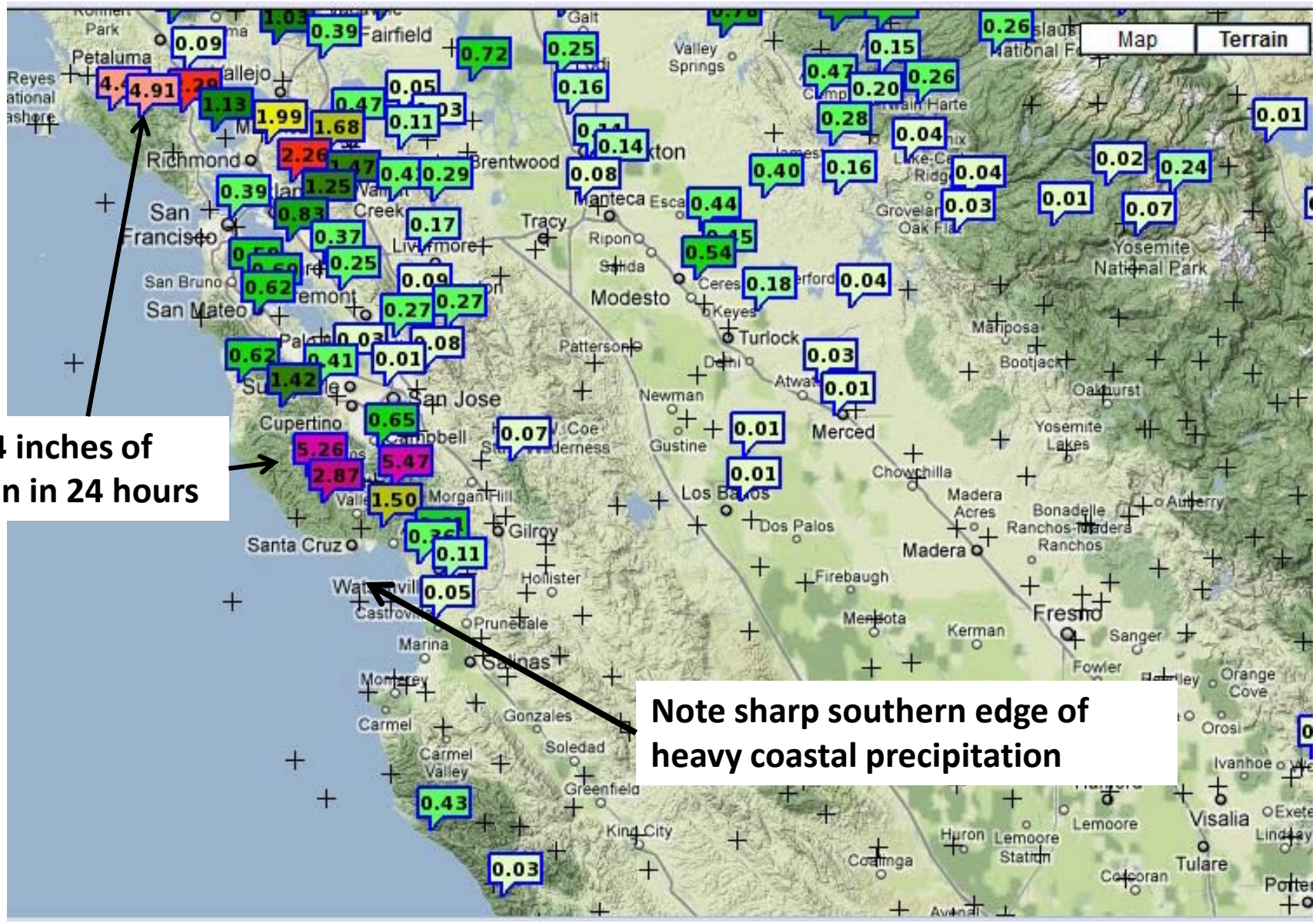
13-14 March 2012

- This informal summary highlights a few key meteorological and hydrological aspects of the storm that hit northern California on 13-14 March
- New data are primarily from NOAA's HMT-West Legacy project sponsored by CA DWR's Enhanced Flood Response and Emergency Preparedness Program are included

24-h accumulated precipitation (inches) ending 7 AM PT 14 March 2012

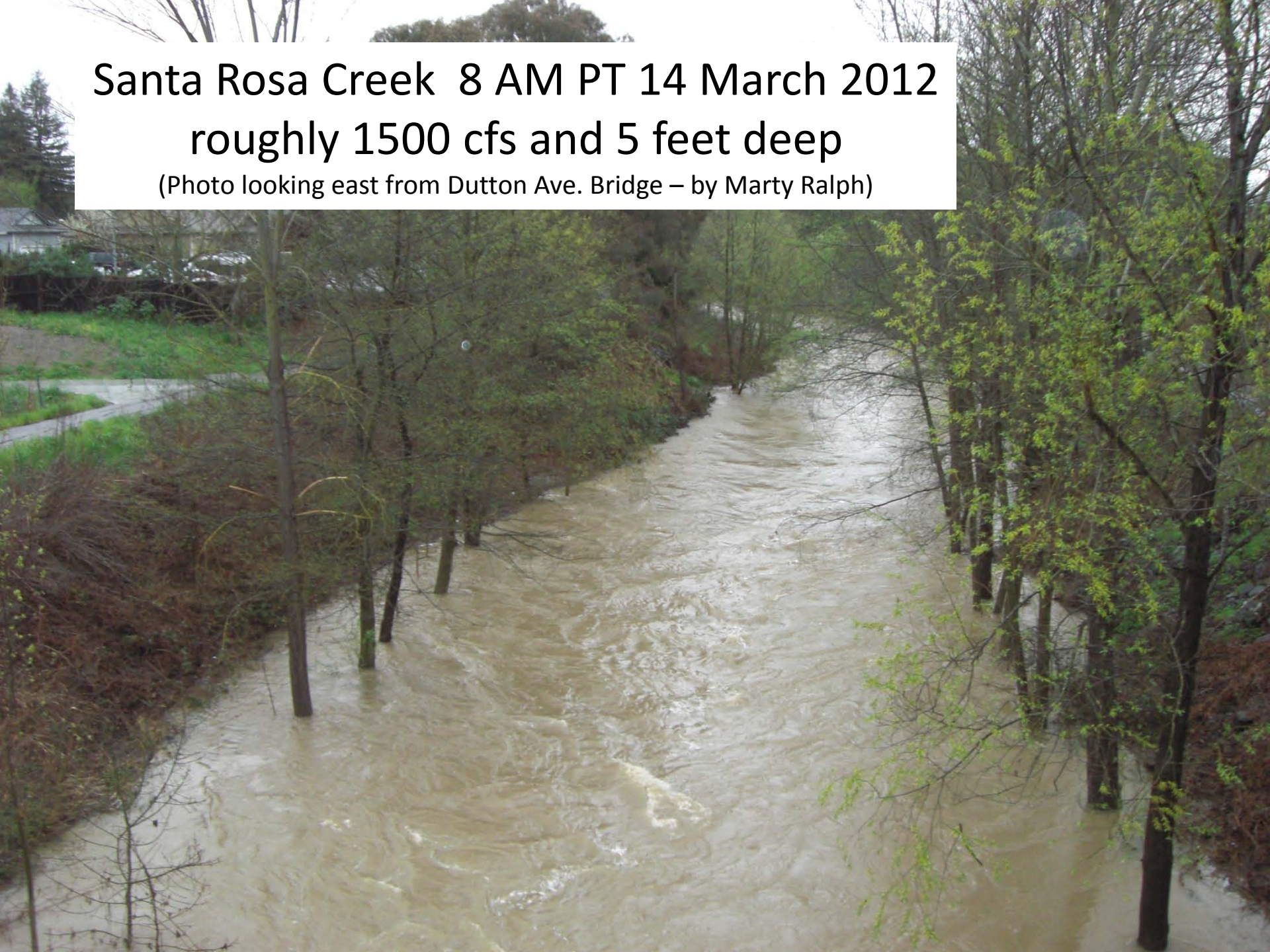


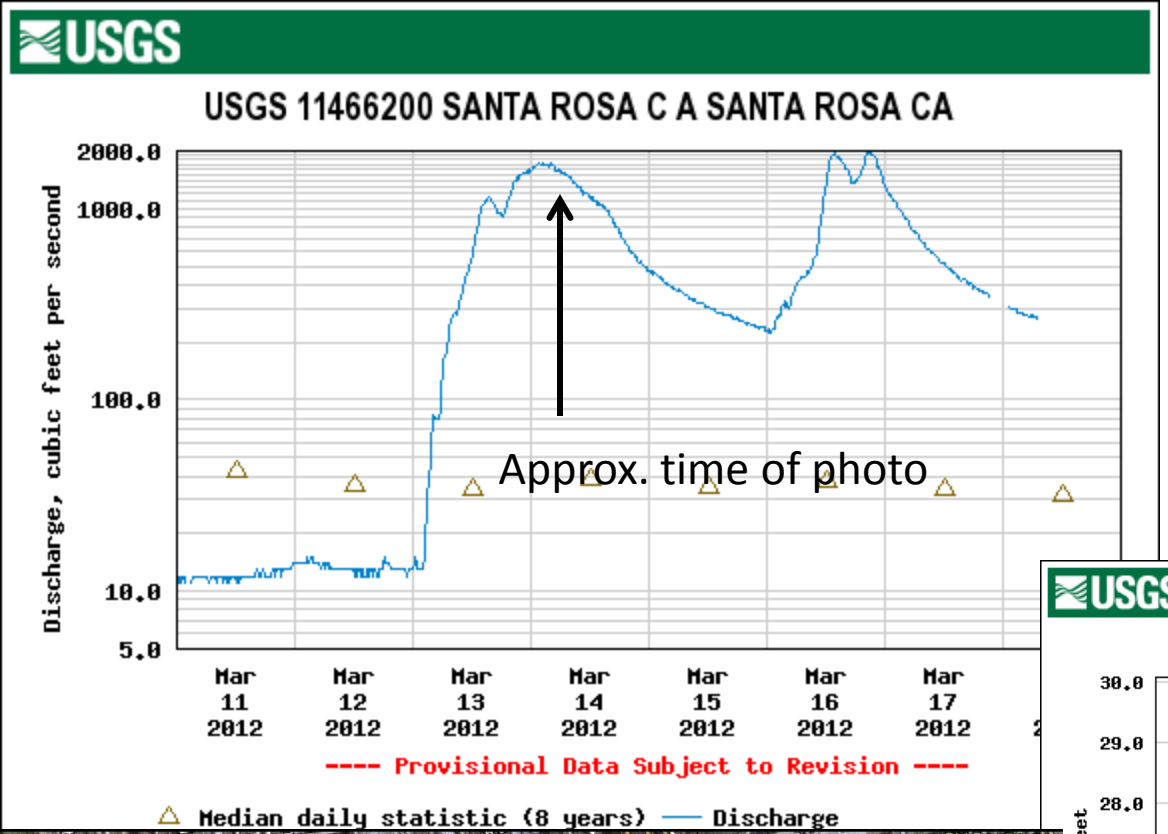
24-h accumulated precipitation (inches) ending 7 AM PT 14 March 2012

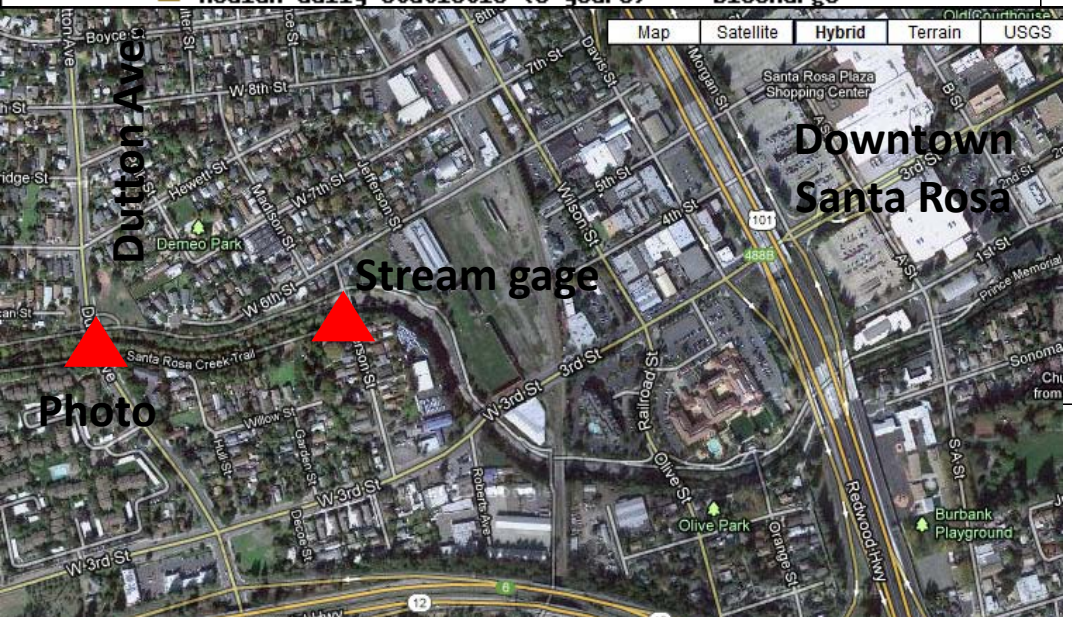


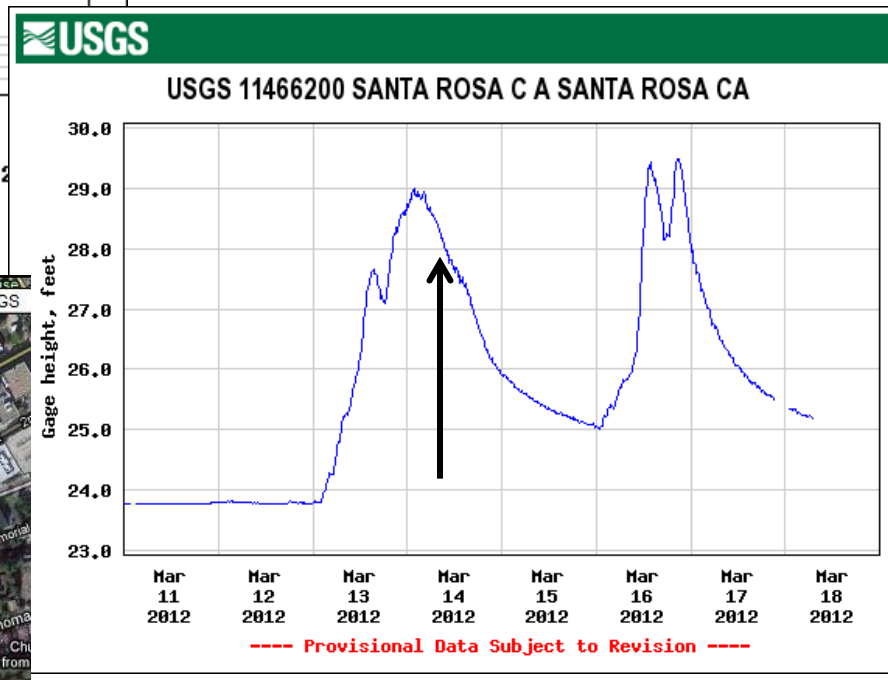
Santa Rosa Creek 8 AM PT 14 March 2012 roughly 1500 cfs and 5 feet deep

(Photo looking east from Dutton Ave. Bridge – by Marty Ralph)



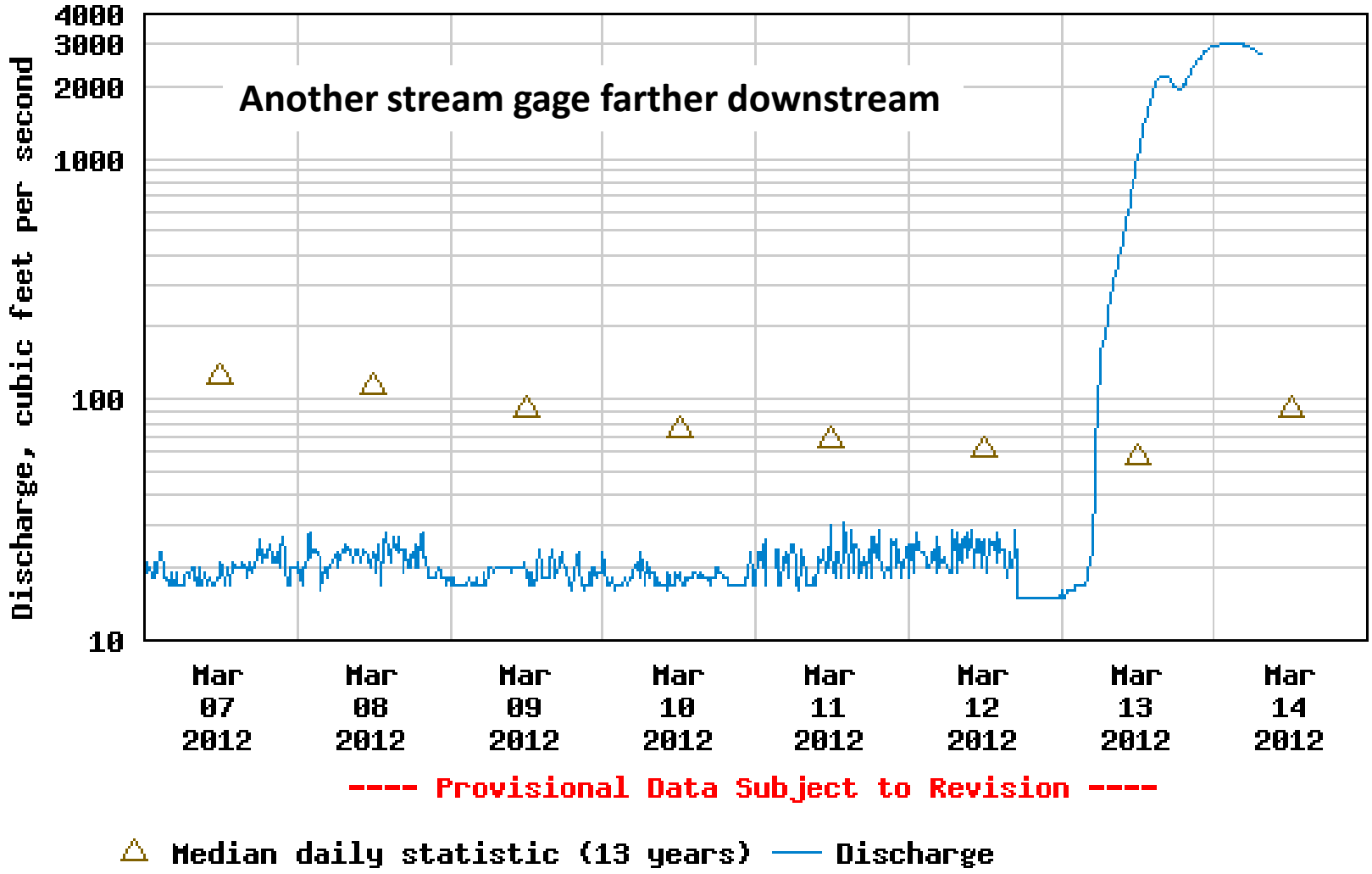

USGS
USGS 11466200 SANTA ROSA C A SANTA ROSA CA
Discharge, cubic feet per second
2000.0
1000.0
100.0
10.0
5.0
Approx. time of photo
Mar 11 2012
Mar 12 2012
Mar 13 2012
Mar 14 2012
Mar 15 2012
Mar 16 2012
Mar 17 2012
---- Provisional Data Subject to Revision ----
Median daily statistic (8 years)
Discharge

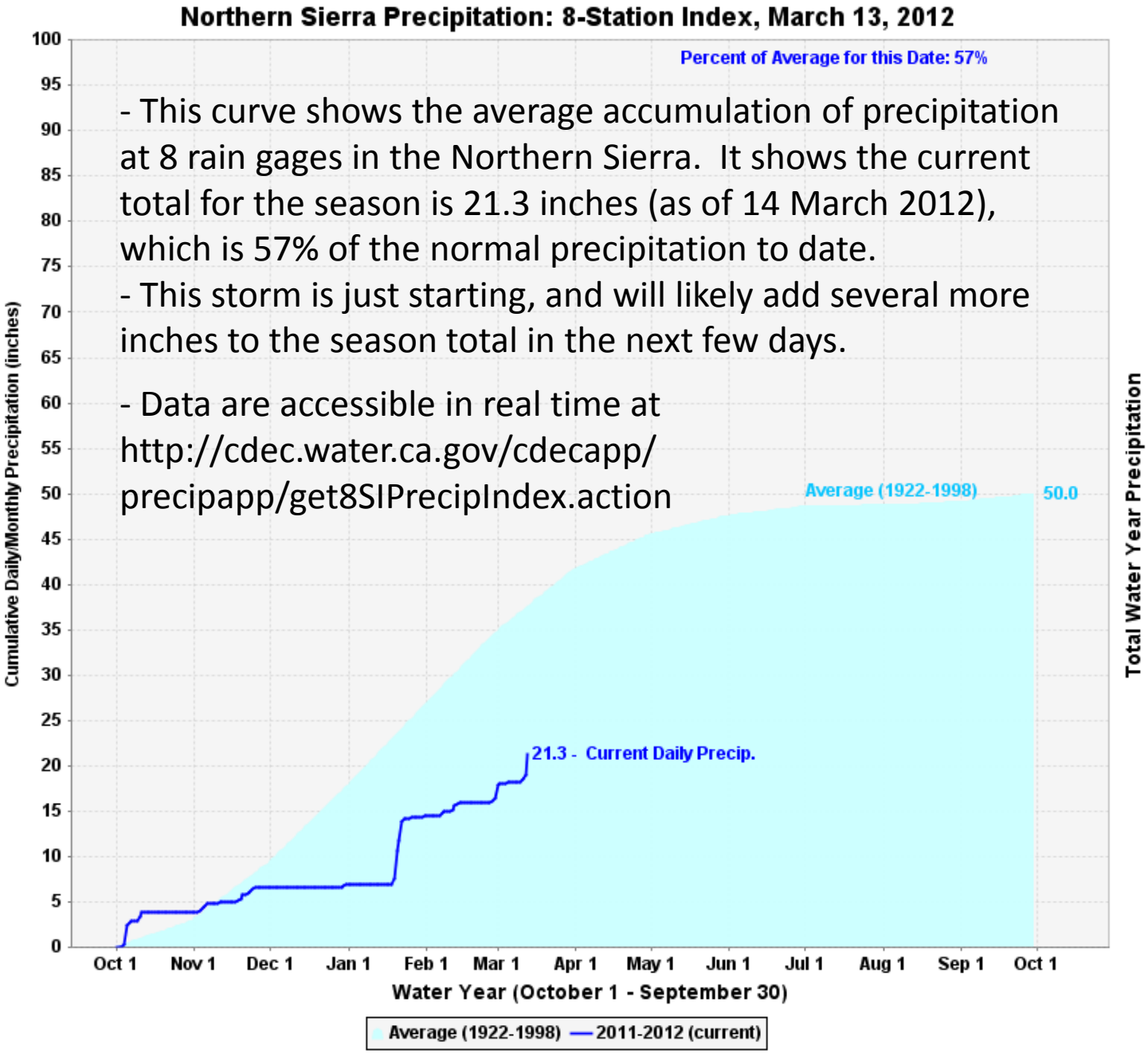

Map
Satellite
Hybrid
Terrain
USGS
Dutton Ave
Downtown Santa Rosa
Stream gage
Photo
Santa Rosa Plaza Shopping Center
Demeo Park
Santa Rosa Creek Trail
Olive Park
Burbank Playground
W 8th St
W 7th St
W 6th St
W 3rd St
Wilson St
Railroad St
Olive St
Redwood Hwy
Morgan St
Davis St
Jefferson St
Madison St
Hewett St
Boyce St
Willow St
Garden St
Roberts Ave
Orange St
Prince Memorial
101
12


USGS
USGS 11466200 SANTA ROSA C A SANTA ROSA CA
Gage height, feet
30.0
29.0
28.0
27.0
26.0
25.0
24.0
23.0
Mar 11 2012
Mar 12 2012
Mar 13 2012
Mar 14 2012
Mar 15 2012
Mar 16 2012
Mar 17 2012
Mar 18 2012
---- Provisional Data Subject to Revision ----

USGS

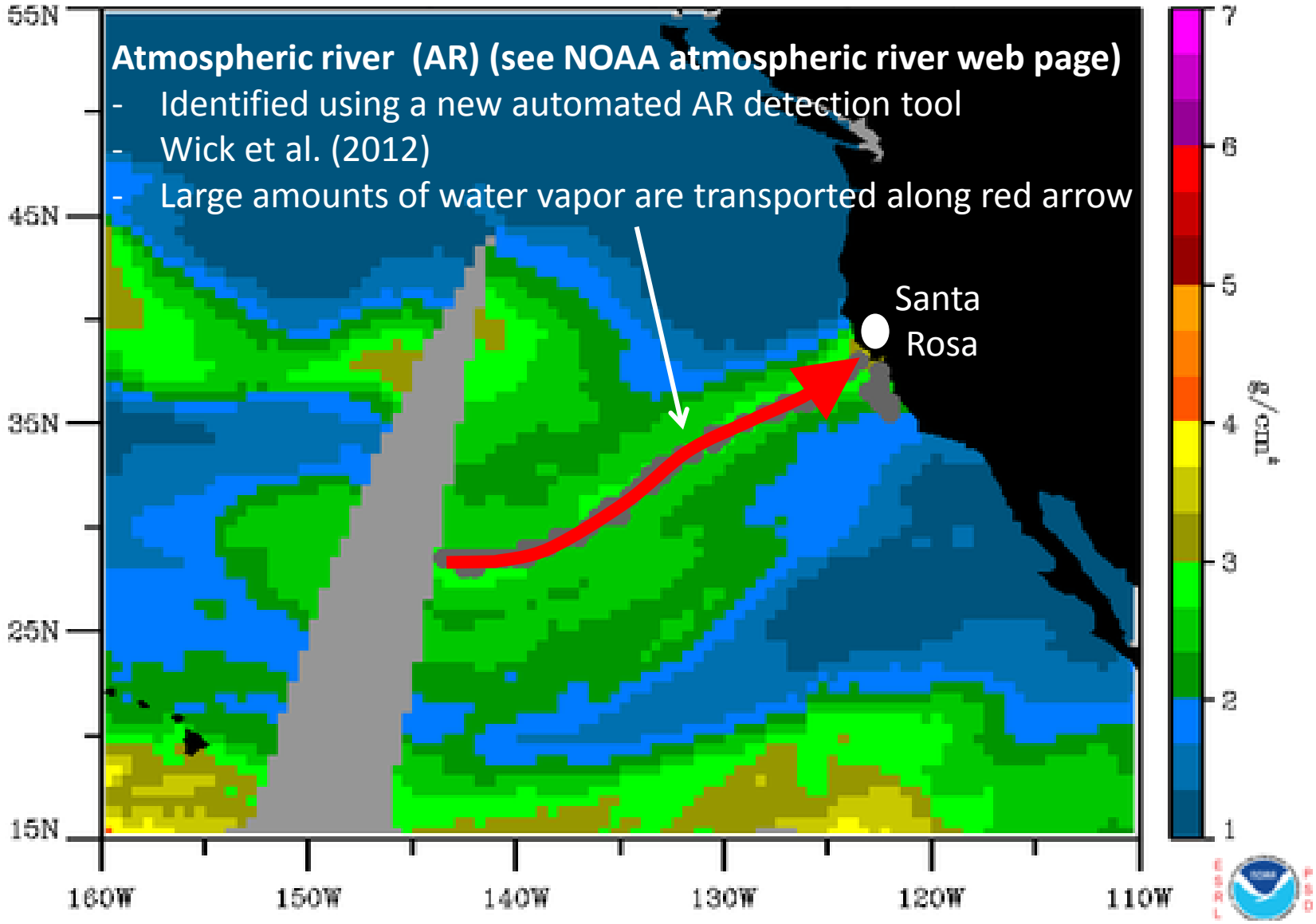
USGS 11466320 SANTA ROSA C A WILLOWSIDE RD NR SANTA ROSA CA




Northern Sierra Precipitation: 8-Station Index, March 13, 2012
Percent of Average for this Date: 57%
- This curve shows the average accumulation of precipitation at 8 rain gages in the Northern Sierra. It shows the current total for the season is 21.3 inches (as of 14 March 2012), which is 57% of the normal precipitation to date.
- This storm is just starting, and will likely add several more inches to the season total in the next few days.
- Data are accessible in real time at http://cdec.water.ca.gov/cdecapp/precipapp/get8SIPrecipIndex.action
Average (1922-1998)
50.0
21.3 - Current Daily Precip.
Cumulative Daily/Monthly Precipitation (inches)
Total Water Year Precipitation
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Oct 1
Nov 1
Dec 1
Jan 1
Feb 1
Mar 1
Apr 1
May 1
Jun 1
Jul 1
Aug 1
Sep 1
Oct 1
Water Year (October 1 - September 30)
Average (1922-1998)
2011-2012 (current)

Satellite image of an atmospheric river on March 13, 2012

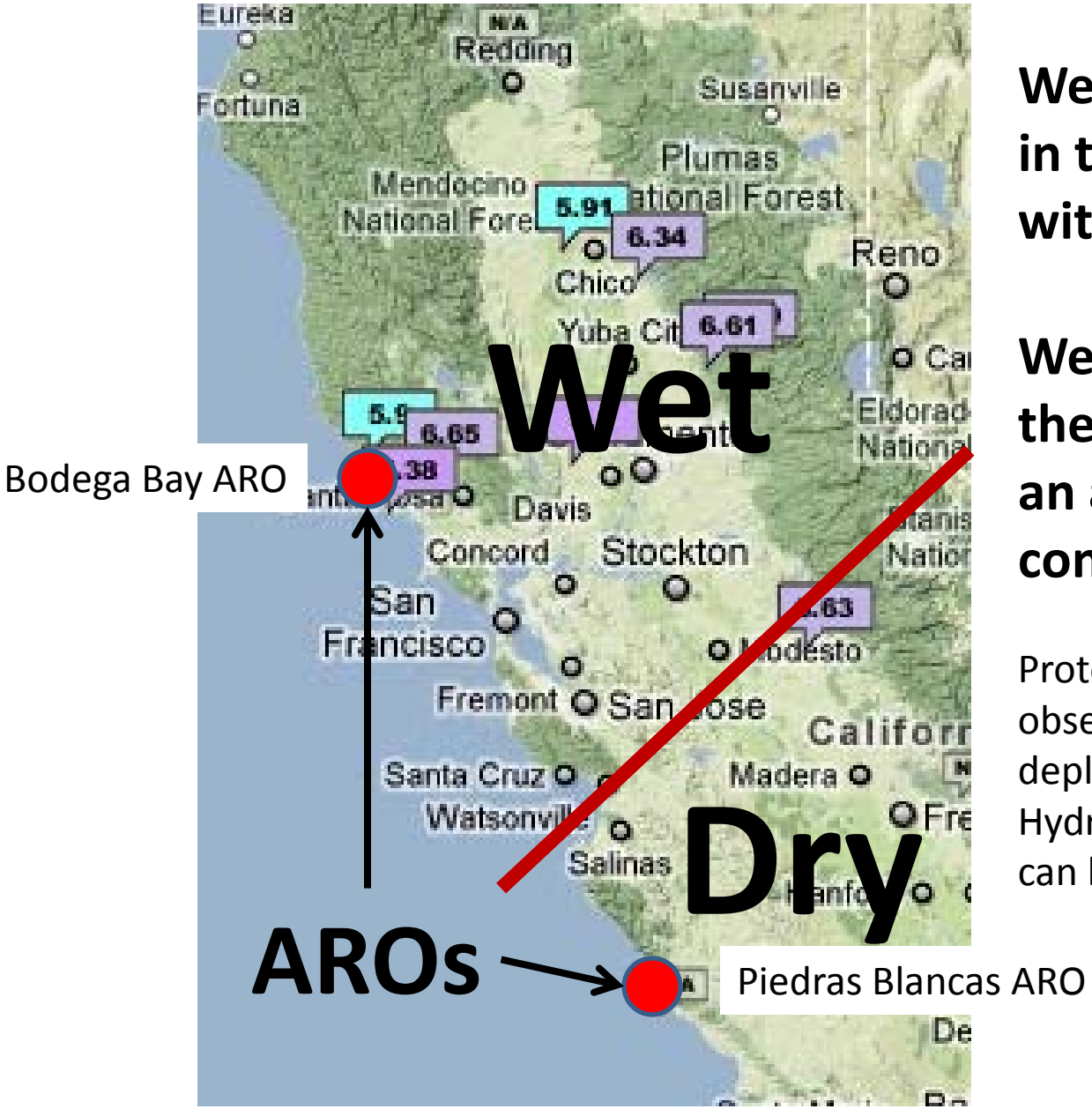
Color scale represents the amount of water vapor in the atmosphere (grey strip is a data gap)



New observations

Vertically integrated water vapor (cm)

Snow level observing network showing the "snow level" in 1000's of feet above sea level. The snow level is the altitude above which precipitation is occurring as snow at that place and time.



Were the wet conditions in the north associated with AR conditions?

Were the dry conditions in the south consistent with an absence of AR conditions there?

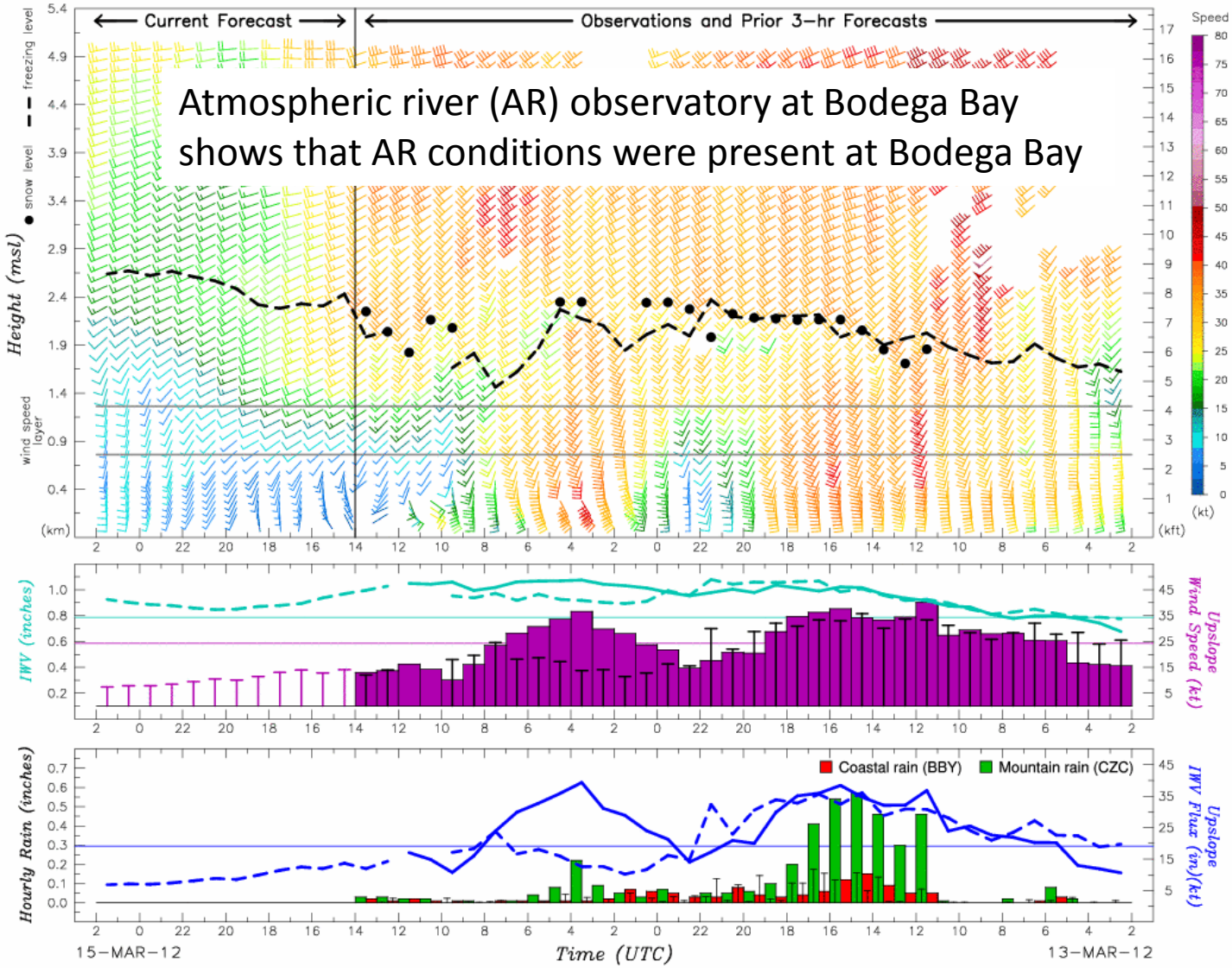
Prototype atmospheric river observatories (AROs) invented and deployed through NOAA's Hydrometeorology Testbed (HMT) can help answer this question.

ESRL Physical Sciences Division

Coastal Atmospheric River Monitoring and Early Warning System

Model forecast provided by the ESRL Global Systems Division

Atmospheric river (AR) observatory at Bodega Bay shows that AR conditions were present at Bodega Bay



Bodega Bay,CA (BBY)
38.32 N, 123.07 W, 12 m

Cazadero,CA (CZC)
38.61 N, 123.22 W, 475 m

Upslope Direction = 230 deg
T and -- = Model Forecast
Obs/Fcst Verification: 3 hours
Fcst Init: 14-MAR-12 13 UTC

BBY 36-hr obs precip: 1.13 in
CZC 36-hr obs precip: 4.03 in
BBY 12-hr fcst precip: 0.00 in
CZC 12-hr fcst precip: 0.00 in

ESRL Physical Sciences Division

Coastal Atmospheric River Monitoring and Early Warning System

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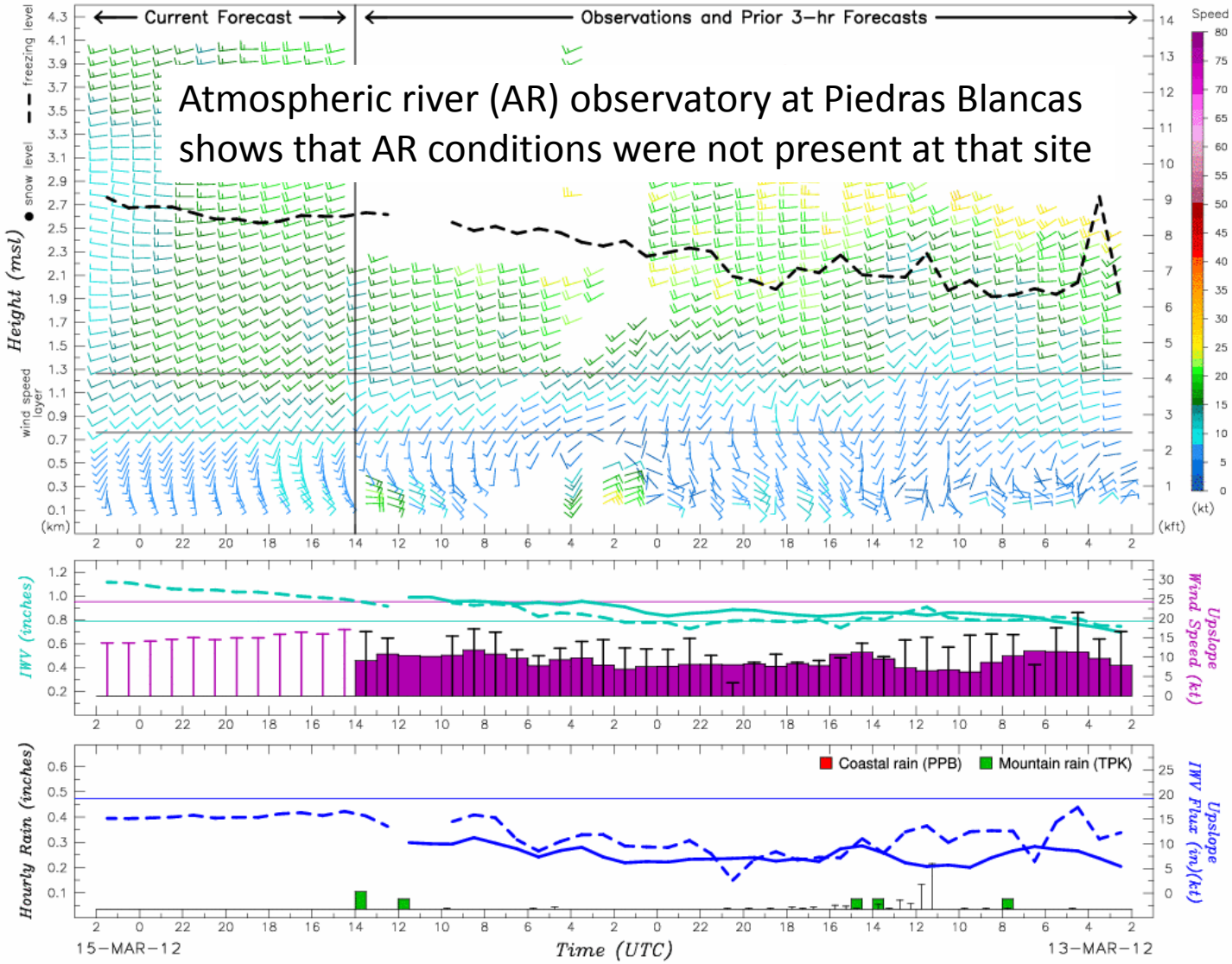


Atmospheric river (AR) observatory at Piedras Blancas shows that AR conditions were not present at that site

Pt. Piedras Blancas,CA (PPB)
35.66 N, 121.29 W, 11 m

Three Peaks,CA (TPK)
35.85 N, 121.31 W, 1021 m

Upslope Direction = 225 deg
T and -- = Model Forecast
Obs/Fcst Verification: 3 hours
Fcst Init: 14-MAR-12 13 UTC

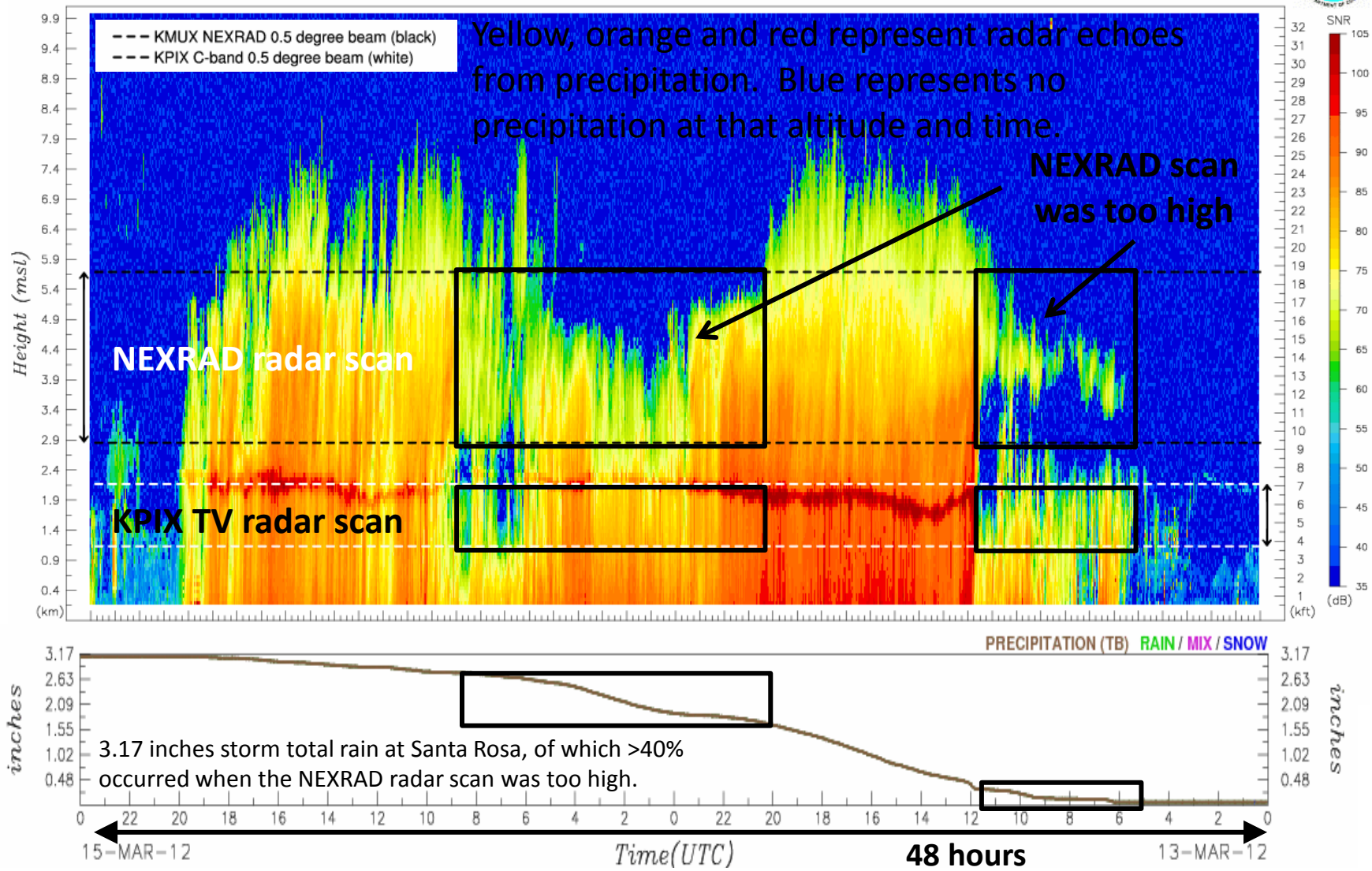
PPB 36-hr obs precip: 0.00 in
TPK 36-hr obs precip: 0.23 in
PPB 12-hr fcst precip: 0.00 in
TPK 12-hr fcst precip: 0.00 in

Atmospheric River evaluation

- AR conditions were clearly present in Sonoma County, i.e., an AR transported large amounts of water vapor into the region during this storm.
- The ARO data document that a moderate strength AR was present to the north where heavy rain occurred and were absent to the south of Monterey where heavy rain did not occur.
- This type of finding is consistent with lessons learned over nearly 10 years of atmospheric river science and tool development in NOAA's HMT.

Santa Rosa

ESRL Physical Sciences Division
S-band Precipitation Profiling Radar

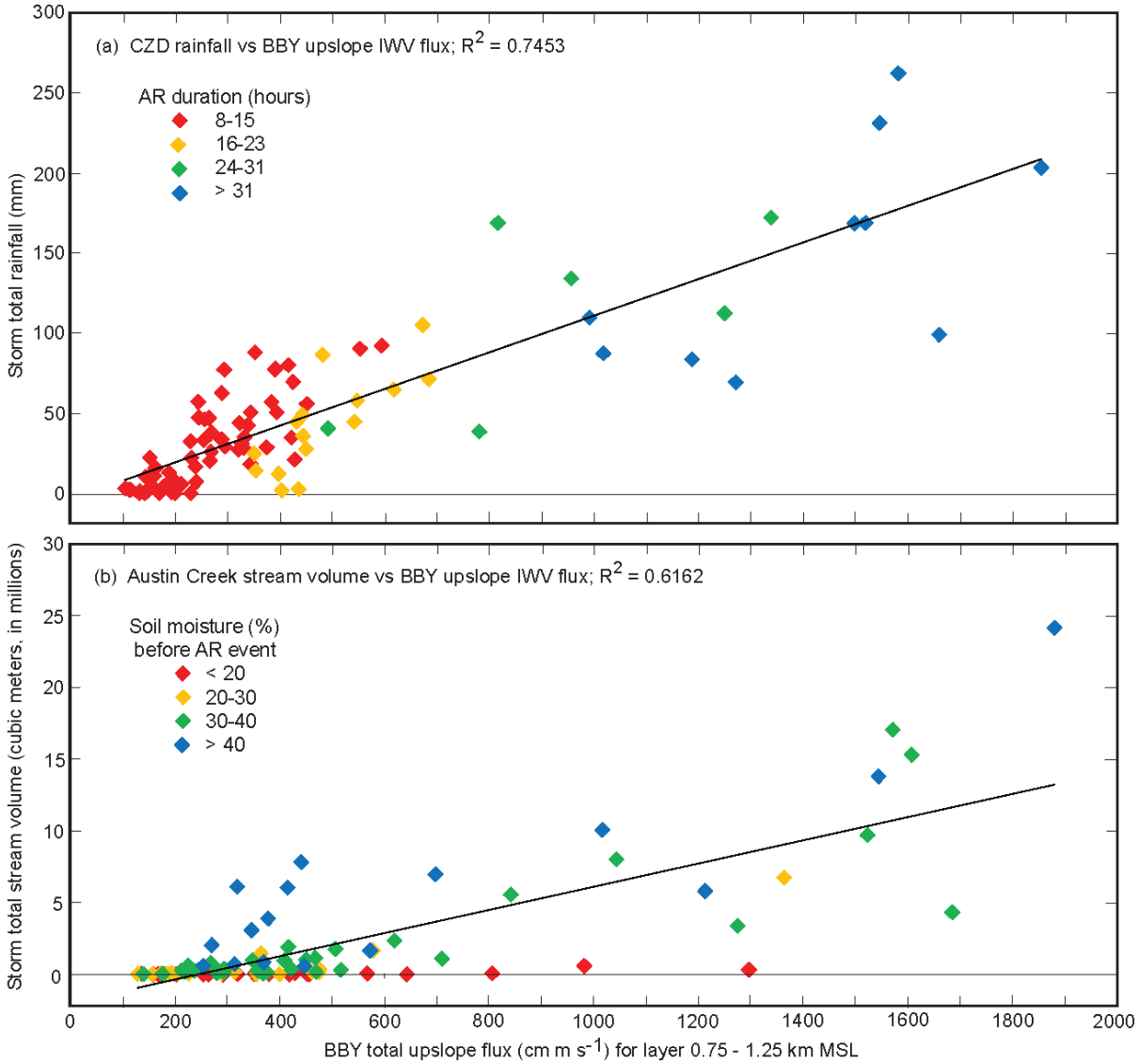


Vertical profile of precipitation observed by HMT radar deployed in Santa Rosa to evaluate performance of NWS operational NEXRAD radar and KPIX TV station radar (sponsored by SCWA). During the middle of this storm, the precipitating clouds were relatively shallow over Santa Rosa –beneath the NEXRAD radar scan, but within KPIX's.

Radar evaluation

- Using the recently deployed HMT S-Prof radar at Santa Rosa, this case illustrates the difficulty of estimating rainfall over Sonoma County using the current operational NWS NEXRAD radar.
- The NEXRAD radar scan was too high to detect the shallow clouds causing about 40% of the rain at Santa Rosa in this storm.
- Conversely, the KPIX TV station radar scan was not too high.

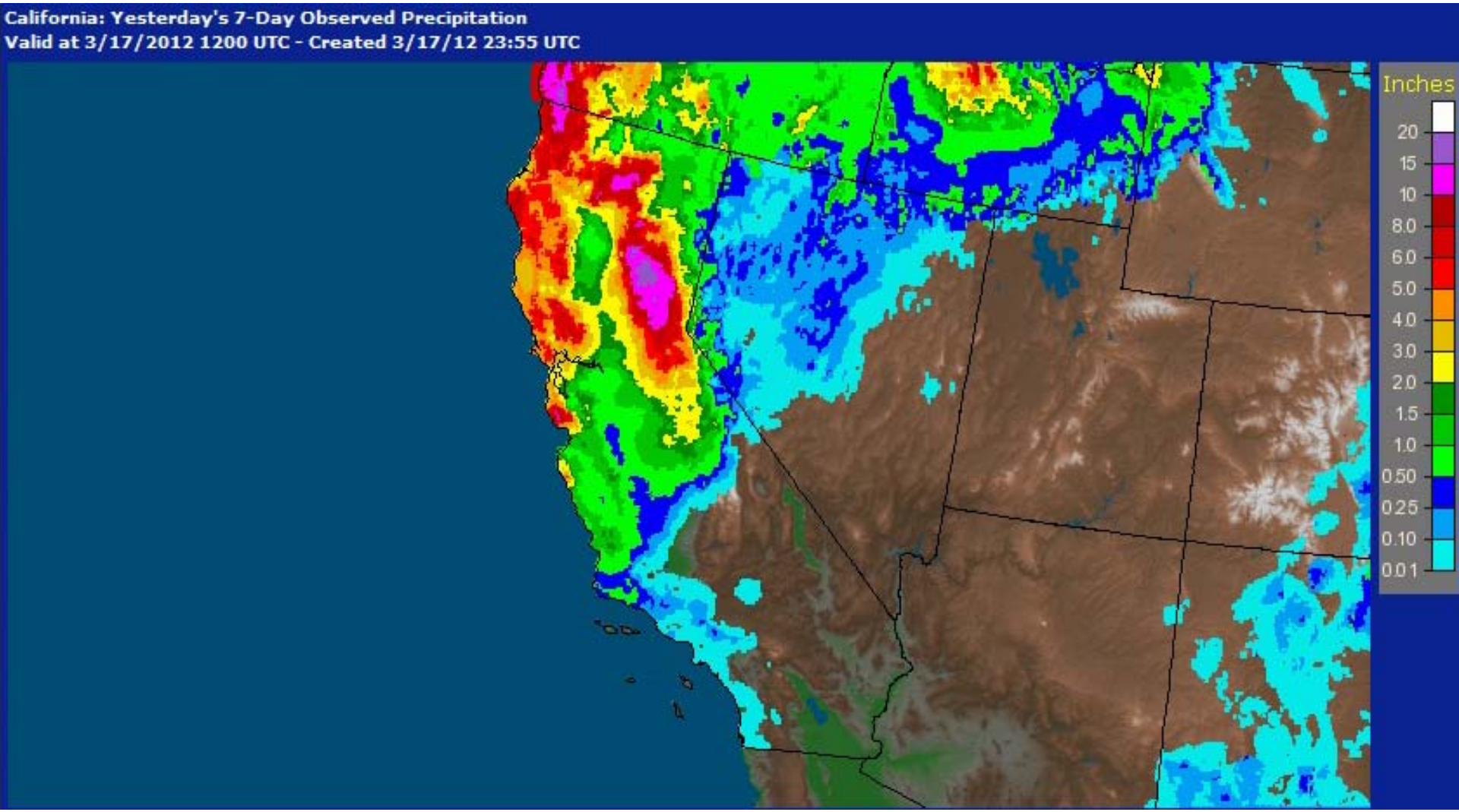
Preliminary results showing the importance of the duration of AR conditions and of soil moisture. The total amount of water vapor transported up the mountain slopes during AR conditions explained 75% of the storm-to-storm variability in rainfall (top panel) and 61% of the variation in streamflow on Austin Creek, a tributary of the Russian River. Also, when soil moisture was <20% at the beginning of the storm, even large rainfall did not cause a rise on Austin Creek (bottom panel).



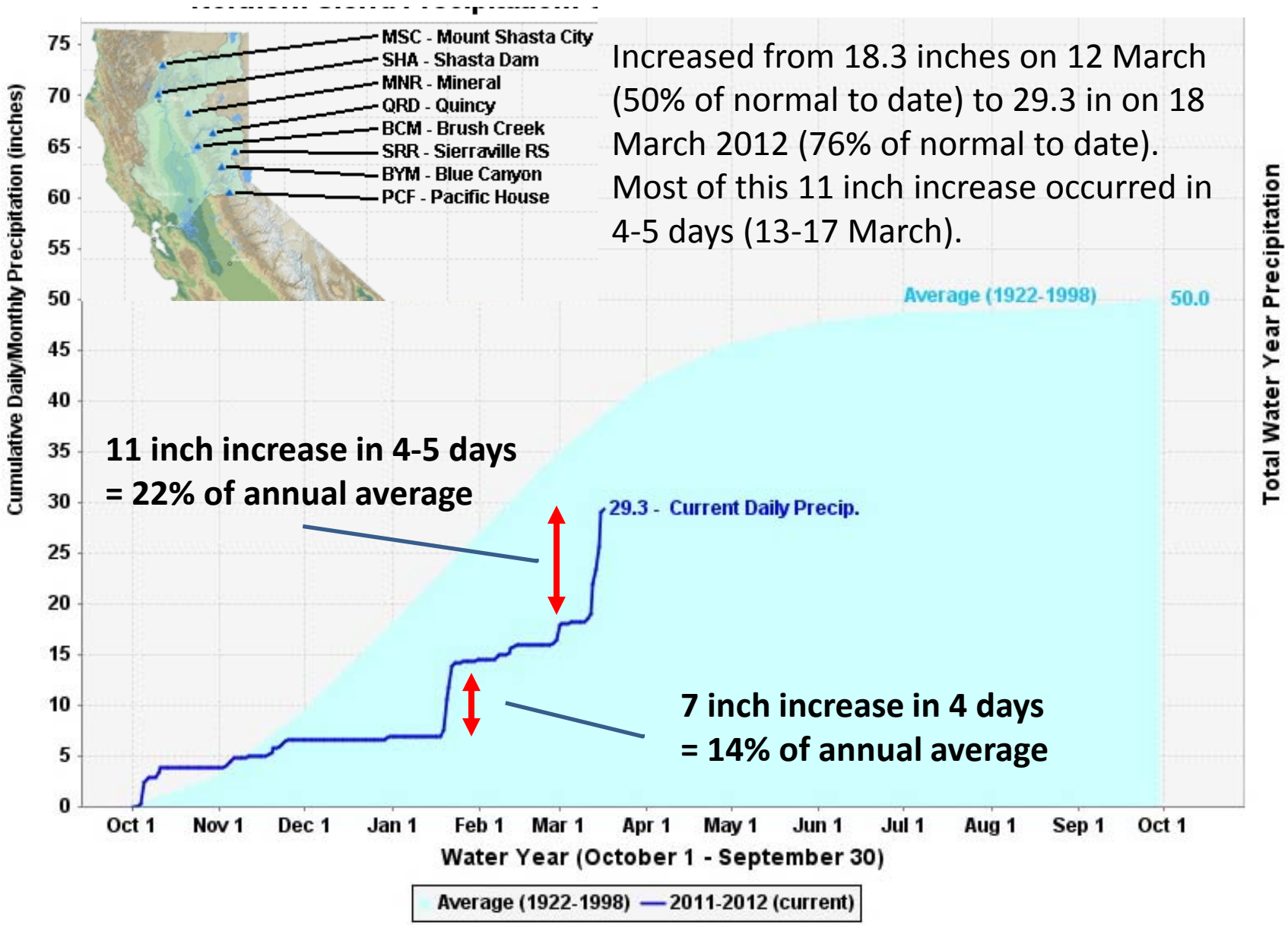
Some post event highlights for 13-18 March 2012

- Several coastal areas received over 6 inches of rain
- Some areas in the Northern Sierra received over 15 inches of rain
- Over the 4-5 days of the event, the northern Sierra received about 22% of their average annual precipitation, boosting water supplies by more than 60% from the before the event.

7-day observed precipitation ending 12 UTC 17 March 2012



Northern Sierra 8-station index as of 18 March 2012



Recent example of use of ARO data by US Army Corps of Engineers (USACE)

NOAA'S RAPID RESPONSE TO THE HOWARD A. HANSON DAM FLOOD RISK MANAGEMENT CRISIS

BY ALLEN B. WHITE, BRAD COLMAN, GARY M. CARTER, F. MARTIN RALPH, ROBERT S. WEBB, DAVID G. BRANDON, CLARK W. KING, PAUL J. NEIMAN, DANIEL J. GOTTAS, ISIDORA JANKOV, KEITH F. BRILL, YUEJIAN ZHU, KIRBY COOK, HENRY E. BUEHNER, HAROLD OPITZ, DAVID W. REYNOLDS, AND LAWRENCE J. SCHICK

NOAA operations and research personnel joined forces to better predict a possible flood and help calm public fears regarding reduced flood protection from a western Washington dam.

After nearly 50 years of service providing flood risk management for areas near Seattle, the U.S. Army Corps of Engineers (USACE) discovered signs of a potential dam failure at Howard A. Hanson Dam (HHD) after a potent winter storm in early January 2009. This dam safety issue increased the risk of catastrophic flooding in the now highly developed Green River Valley (GRV) downstream. As part of a broad set of actions by local, state, and federal agencies, the National Oceanic and Atmospheric Administration (NOAA) implemented a rapid response effort, coordinated between the National Weather Service (NWS) and the Office of Oceanic and Atmospheric Research (OAR), to enhance services to the communities at risk. These enhancements drew from ideas developed at NWS offices with inputs from regional stakeholders and took advantage of innovations in science and technology from NOAA's Hydrometeorology Testbed (HMT; Ralph et al. 2005a), which has focused on extreme precipitation events over the last several years (http://hmt.noaa.gov). This paper briefly describes the HHD and what happened to it,

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The abstract for this article can be found in this issue, following the table of contents.

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- USACE was considering taking over operation of a dam in Washington State during a recent storm, but based partly on an HMT-deployed ARO in the region, USACE decided the storm was about to end, so they did not take over operation from the local water agency in that case.

- See recent peer-reviewed journal article by White et al. (February 2012; Bulletin of the American Meteorological Society).

Some key websites used here

- NOAA's Hydrometeorology Testbed (HMT)
  - Real-time snow-level, water vapor and ARO data: http://www.esrl.noaa.gov/psd/data/obs/sitemap/psdmapdata/
  - Hmt.noaa.gov
- NOAA's atmospheric rivers information web page
  - http://www.esrl.noaa.gov/psd/atmrivers/
- NOAA/NWS' real time precipitation data
  - http://www.wrh.noaa.gov/mesowest/gmap.php?map=pqr
- DWR's real-time 8-station northern Sierra precipitation index
  - http://cdec.water.ca.gov/cdecapp/precipapp/get8SIPrecipIndex.action