Center for Western Weather and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO

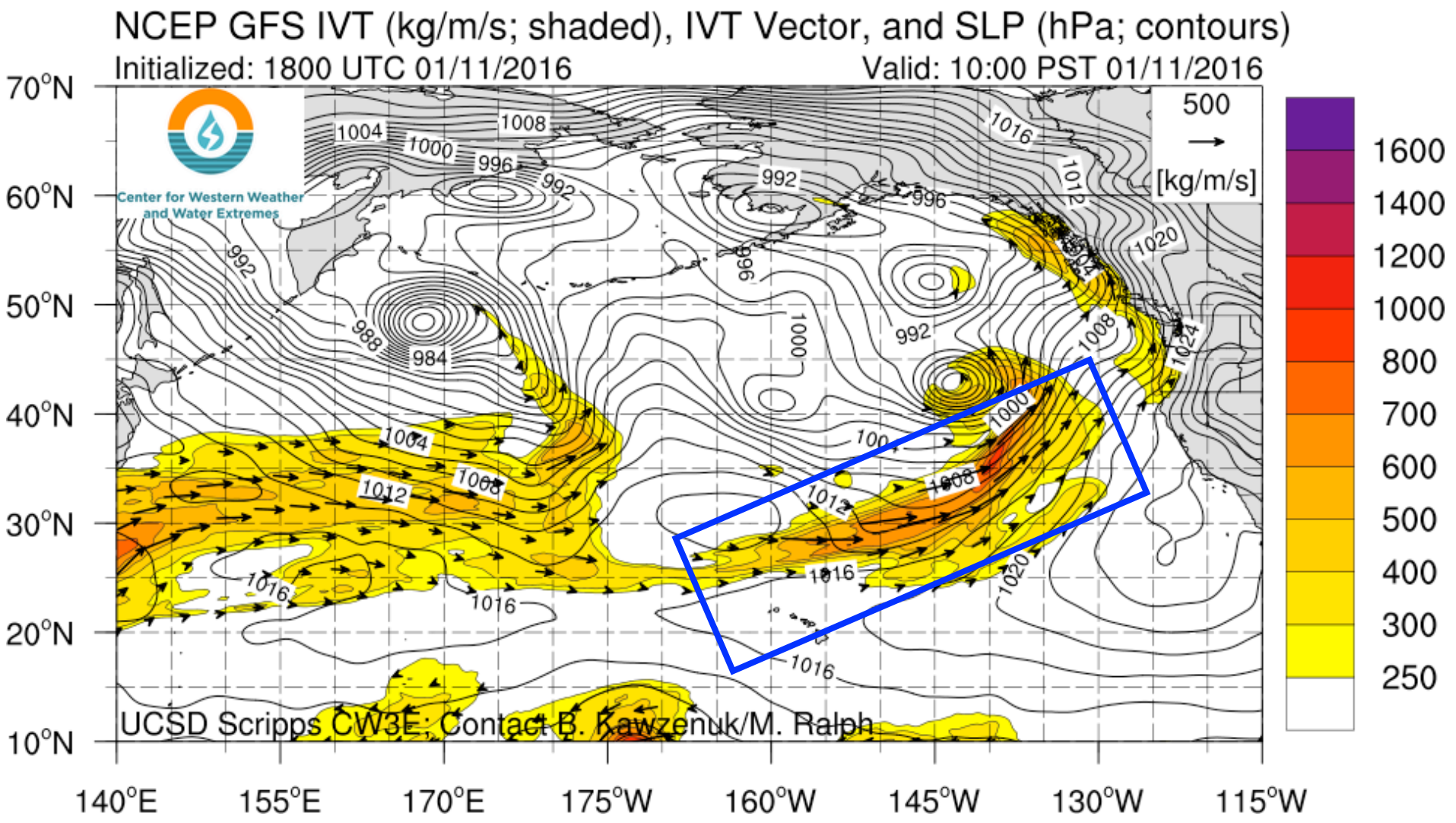
Preliminary synopsis of N. California, Oregon, Washington atmospheric river (AR) events 12-15 January 2016 and Outlook for AR events 15-18 January 2016

Center for Western Weather and Water Extremes (CW3E)

Compiled by Nina Oakley and others…

Summary of 12-14 January AR event:

- Two precipitation events impacted the Pacific Northwest between 12-15 Jan
- The first event was a moderate atmospheric river 12-13 Jan
  - Heaviest precipitation between San Francisco and the Canadian border
  - 1-4+ inches precipitation in northern CA, western OR and western WA over 24 hour period
  - WA Cascades: 3-10+ in snowfall; OR Cascades & Sierra Nevada: 0-3 in snowfall
- The second event was a weak pulse of moisture ahead of a larger scale trans-Pacific atmospheric river-- produced by a small low pressure system spun off the Aleutian Low
  - Heaviest precipitation western OR, northern CA
  - Precipitation totals from storm 2: 1-2 in for Coast Ranges and Sierra, < 0.5 in valleys
  - 6 in to 20+ in snowfall in northern Sierra Nevada



First event:

On Monday, January 11, an atmospheric river developed in central Pacific and propagated eastward, associated with a strong cyclone

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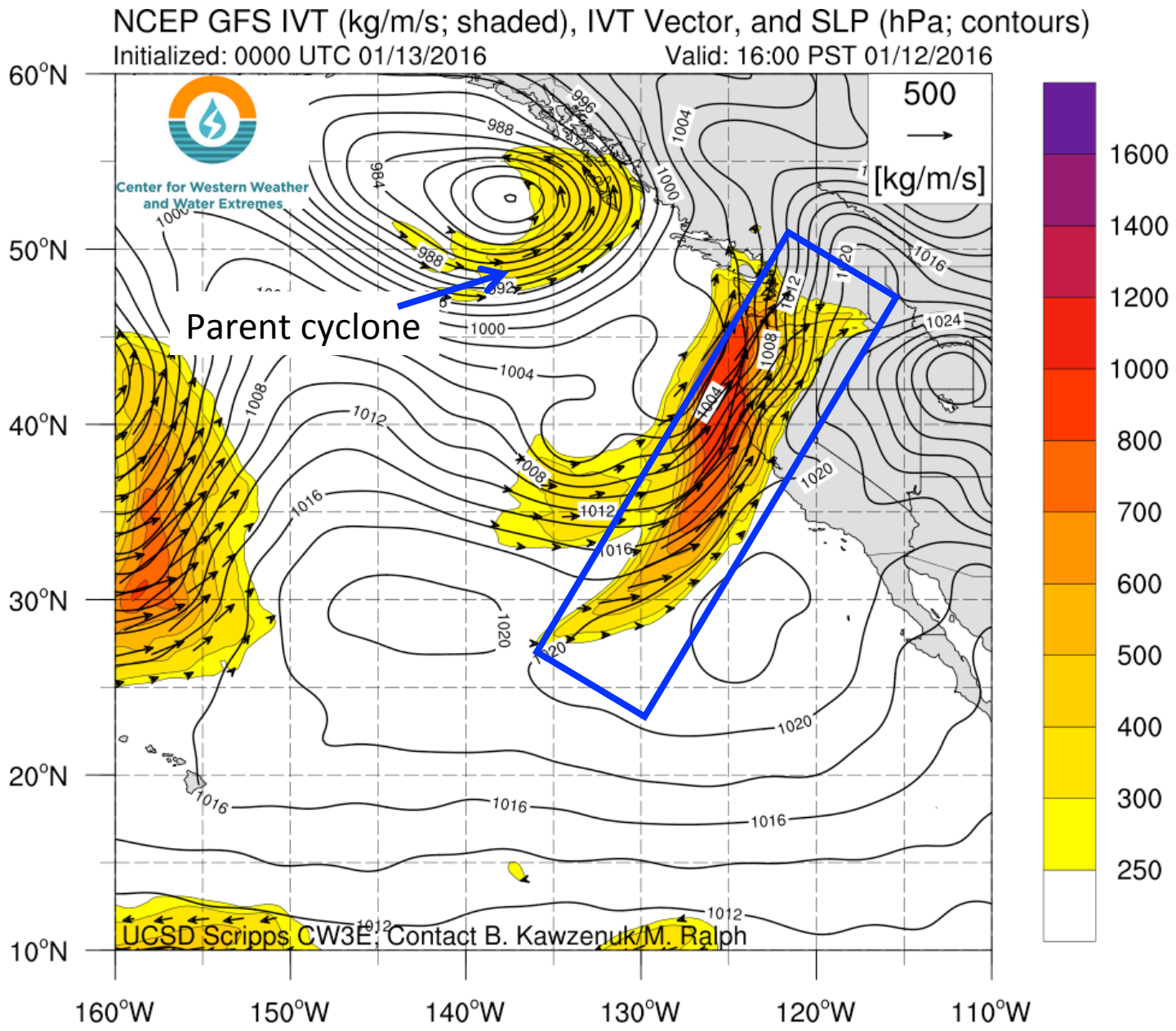

First event:

- The parent cyclone made landfall in Canada
- The AR detached and impacted the Pacific Northwest before ~4 pm PST
- IVT values >500 kg/m/s at landfall
- A secondary broad trough moved onshore immediately following the AR landfall

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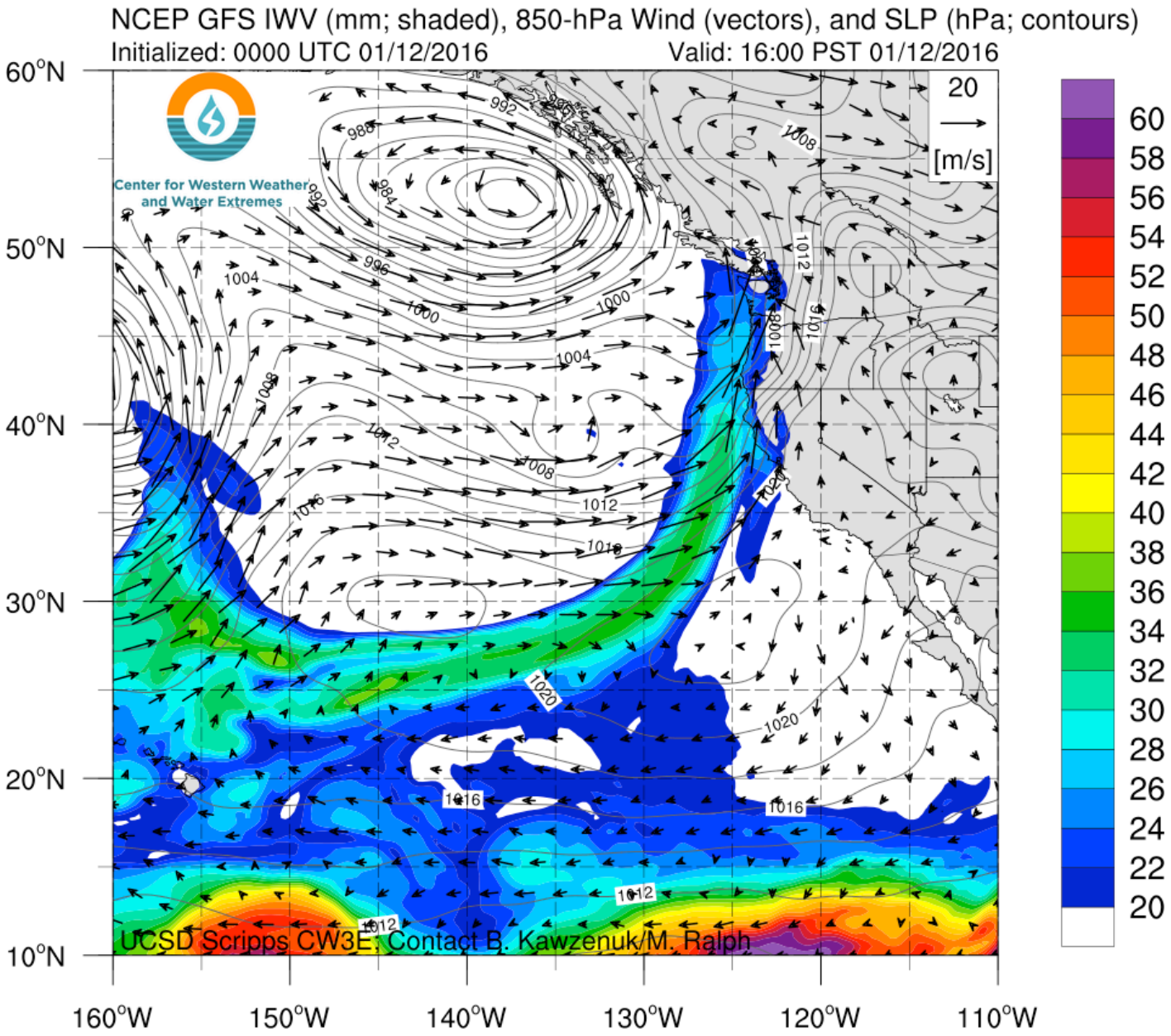
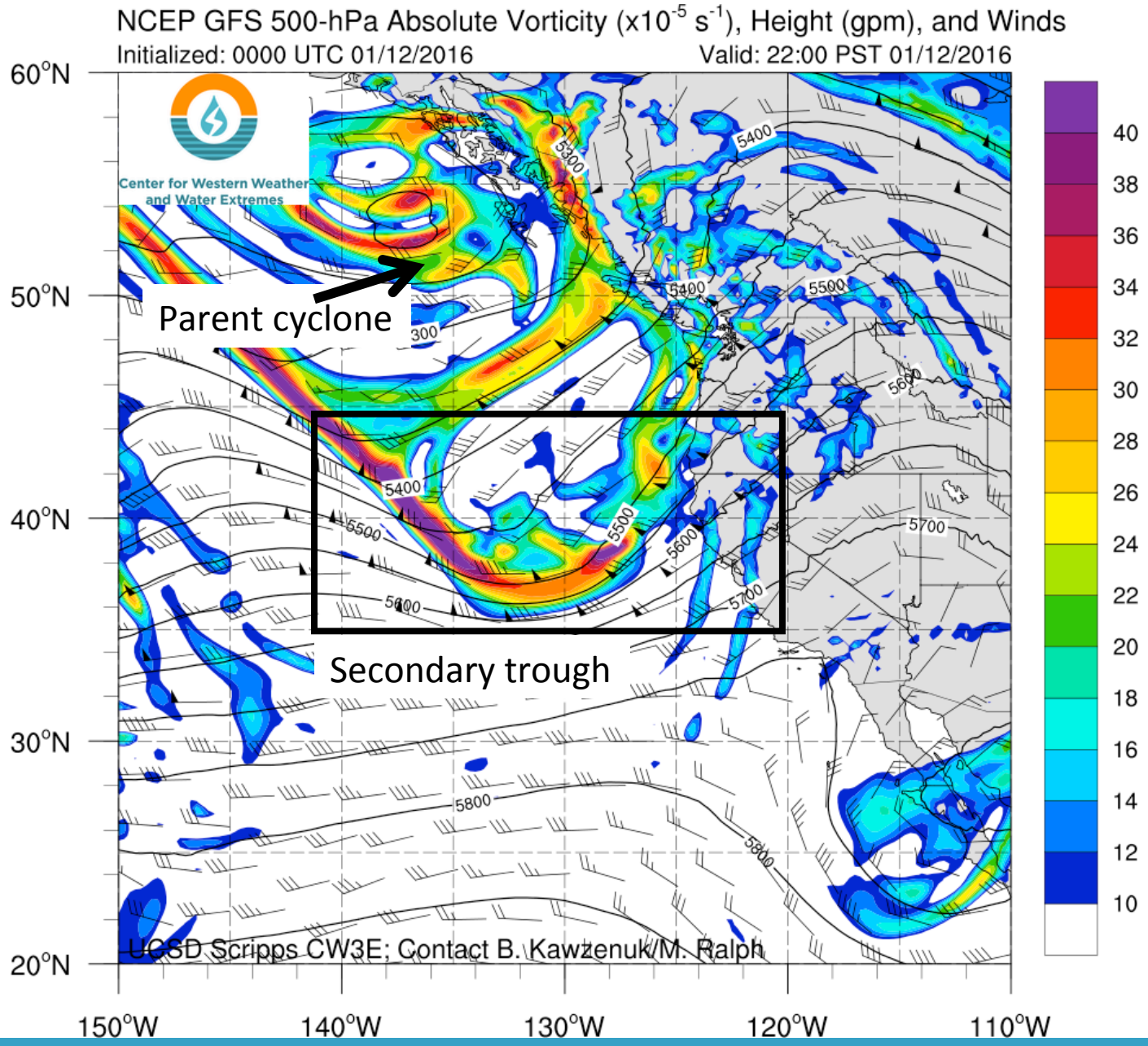


First event:

- AR shown in integrated water vapor 4 pm PST
- Values at time of landfall ~25-30 mm

CW3E



First event:

- Following approximate 4 pm AR landfall, a broad trough impacted the coast at ~10 pm on Tuesday, January 12
- Dynamics associated with the trough may have helped force/support additional precipitation

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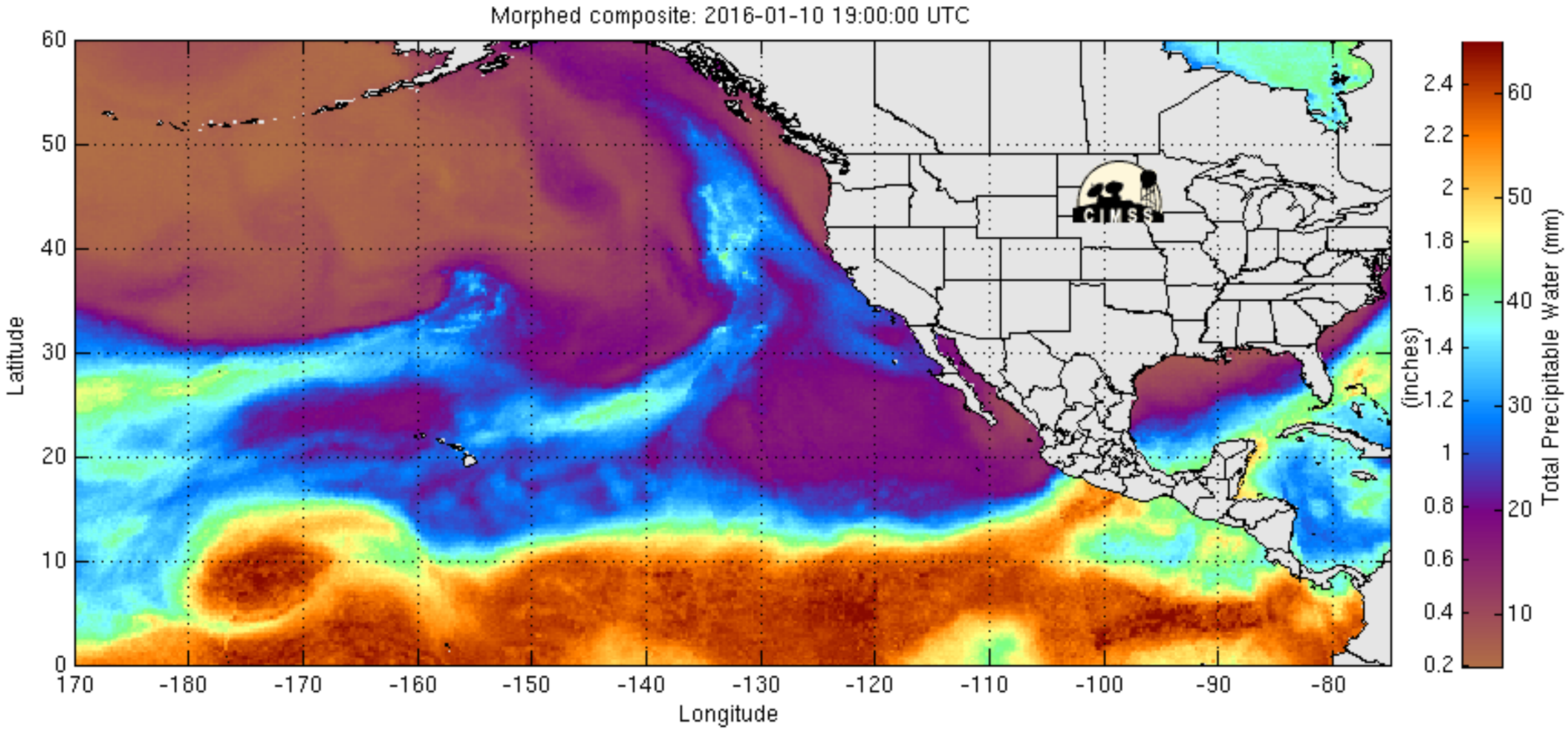

First event:

Loop of SSM/I precipitable water 1/10/16-1/13/16 Source: MIMIC TPW

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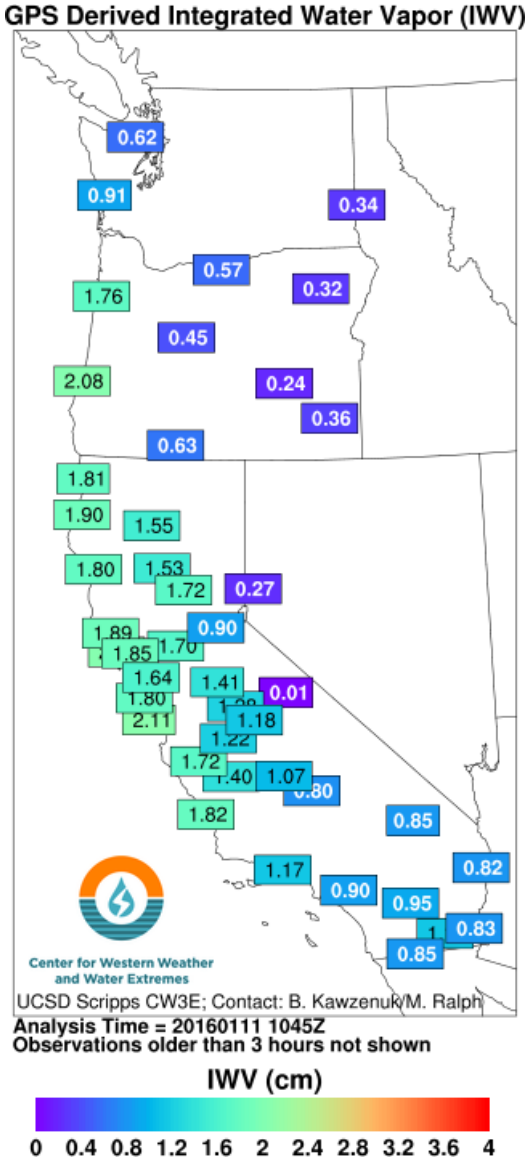
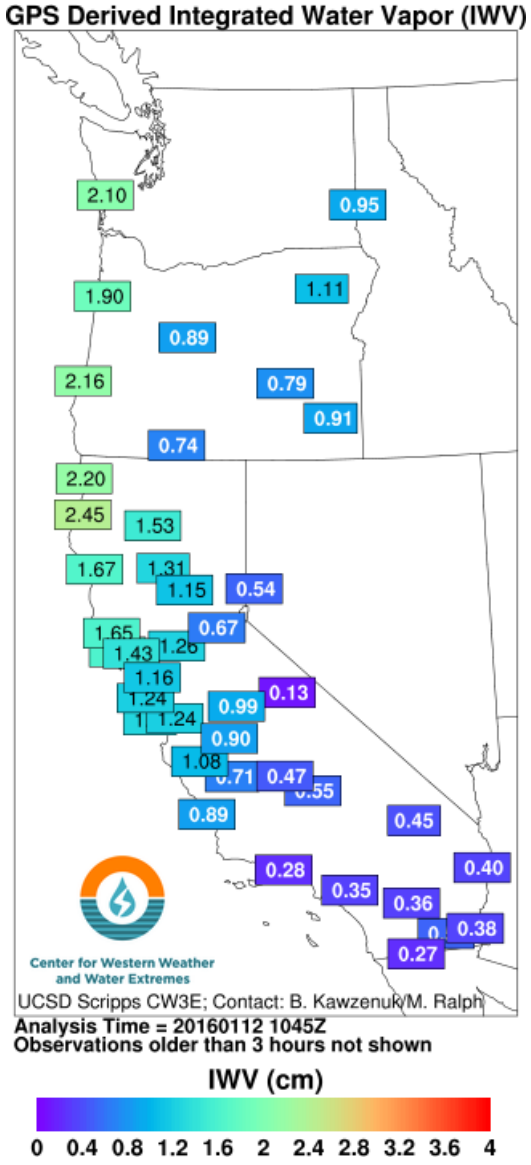
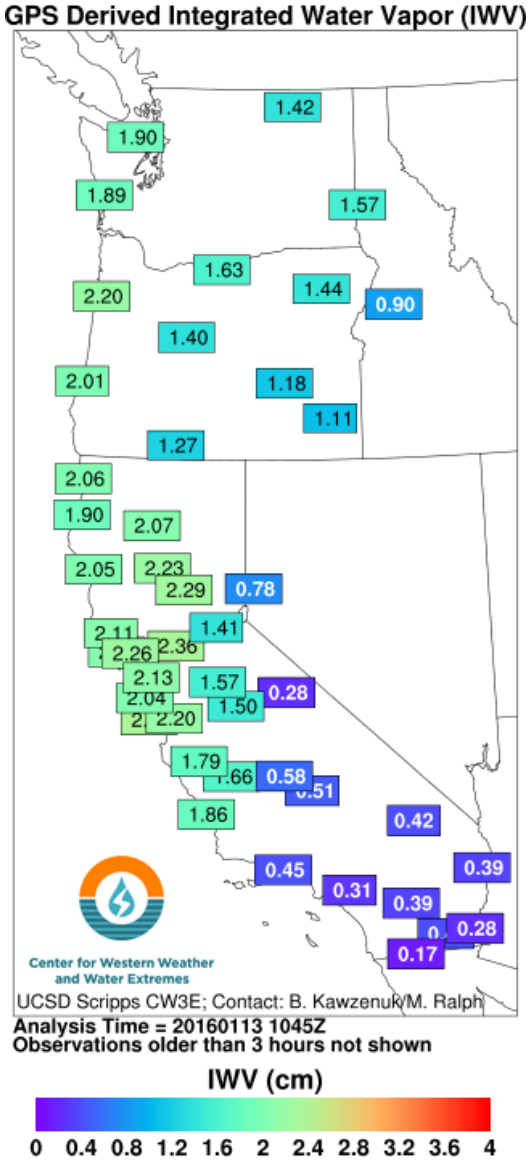
Monday (1/11) 2am



Tuesday (1/12) 2am



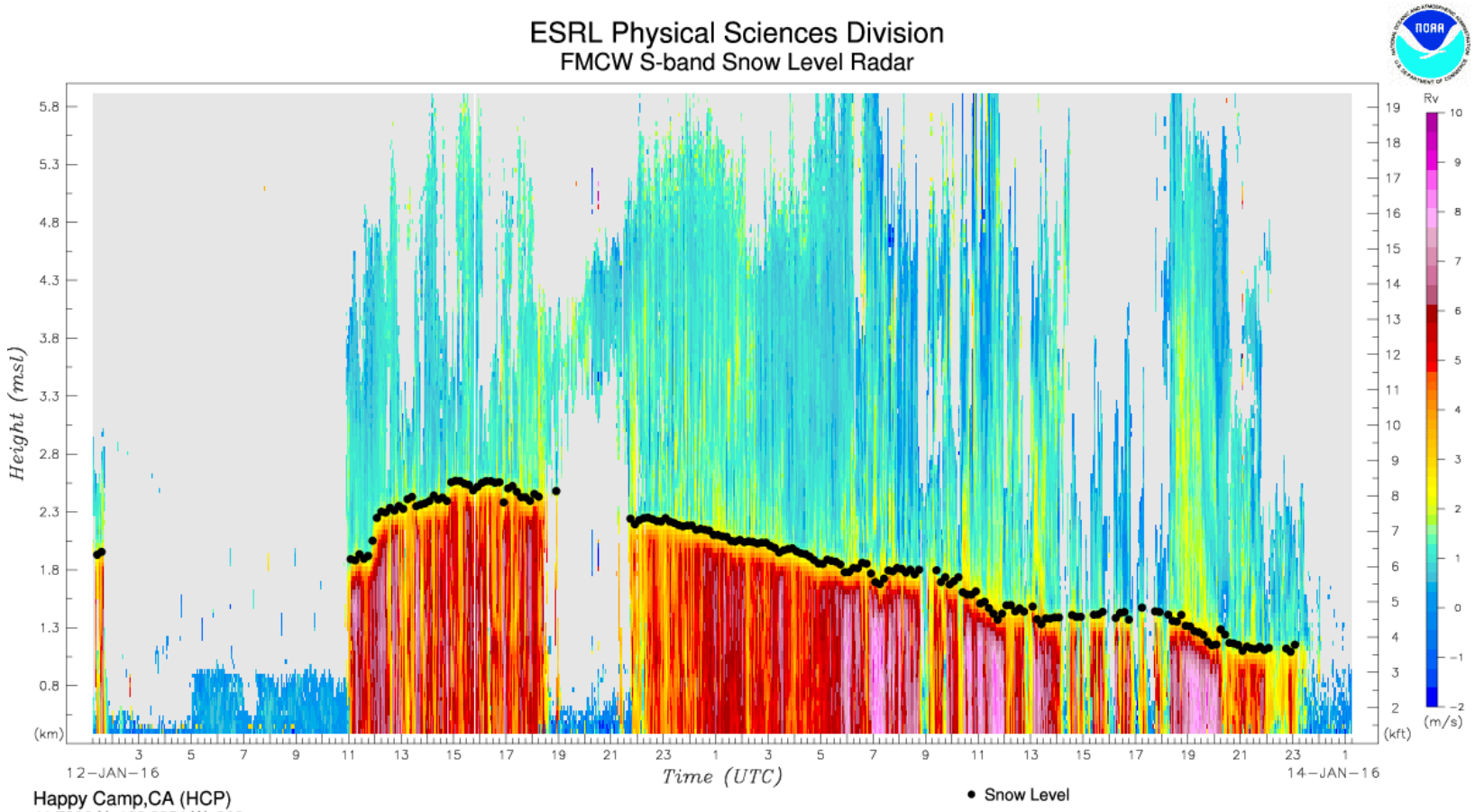
Wednesday (1/13) 2am



GPS-Met IWV

IWV values below 2cm before the AR reaches the coast early Monday morning. By early Tuesday AR values just before AR hits the coast start to surpass 2cm on the northern California and southern Oregon coast. By early Wednesday morning values above 2cm reach northern Oregon and central northern California.

CW3E



Happy Camp,CA (HCP)
41.7906 N, 123.3854 W, 366 m

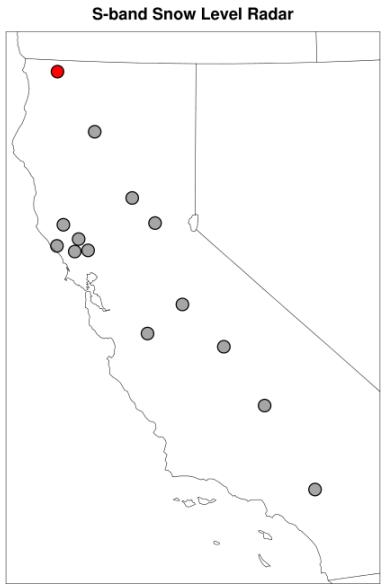
Time (UTC)	0145	0245	0345	0445	0545	0645	0745	0845	0945	1045	1145	1245	1345	1445	1545	1645	1745	1845	1945	2045	2145	2245	2345	0045
Snow Level (m)	1942	none	none	none	none	none	none	none	none	1892	1927	2326	2384	2432	2544	2554	2441	2455	none	none	2235	2241	2185	2138
Snow Level (ft)	6371	none	none	none	none	none	none	none	none	6205	6320	7629	7819	7978	8344	8377	8006	8054	none	none	7330	7352	7166	7012
Sfc Temp (C)	6.10	5.68	5.58	5.37	5.39	5.20	5.00	4.88	4.64	4.55	4.43	4.26	4.17	4.11	3.97	4.15	4.52	5.60	6.57	7.38	7.57	7.30	7.03	6.69

Time (UTC)	0145	0245	0345	0445	0545	0645	0745	0845	0945	1045	1145	1245	1345	1445	1545	1645	1745	1845	1945	2045	2145	2245	2345	0045
Snow Level (m)	2053	2034	1968	1899	1857	1814	1790	1788	1718	1596	1445	1454	1380	1394	1413	1406	1441	1353	1209	1166	1123	1120	none	none
Snow Level (ft)	6735	6671	6455	6228	6092	5949	5871	5866	5636	5234	4741	4769	4526	4572	4634	4611	4726	4437	3965	3826	3685	3673	none	none
Sfc Temp (C)	6.52	6.36	6.25	6.24	6.16	6.18	6.18	6.21	6.21	6.23	6.20	6.26	6.34	6.21	5.94	6.09	7.05	7.07	6.46	5.69	6.06	7.26	7.15	5.41

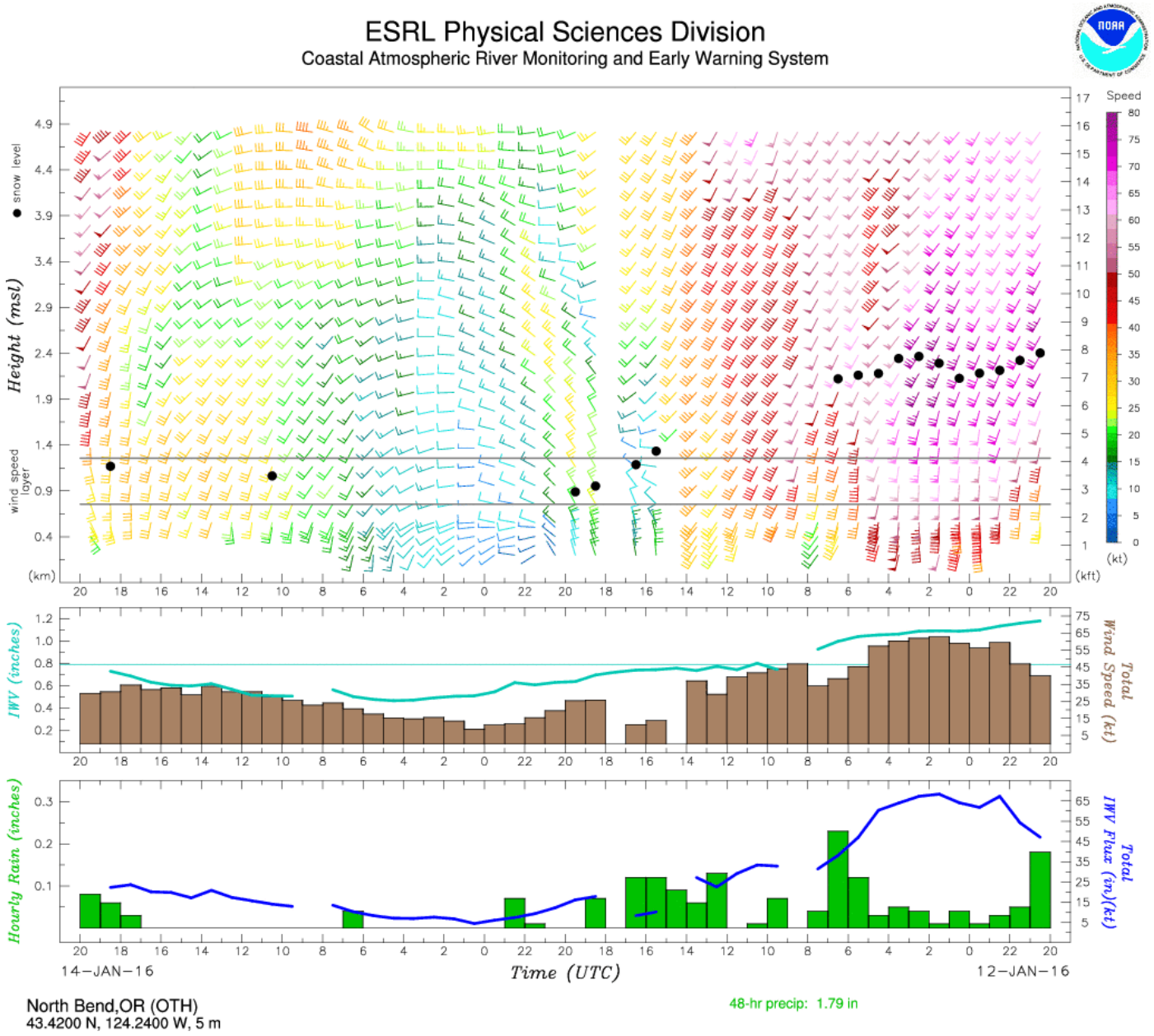
First event:

Snow level radar

Happy Camp, located in California near the Oregon border, recorded a 4704 ft. drop in the snow level from 8377 ft. on Tuesday, January 12, to 3673 ft. on Wednesday, January 13.



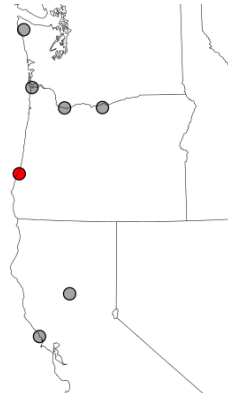
Happy Camp located at red dot on map to the left



First event:

North Bend, Oregon, Atmospheric River (AR) Observatory

The AR observatory at North Bend, Oregon, shows a drop in the snow level from near 8000ft on Tuesday (Jan 12) to near 2500 feet on Wednesday (Jan 13). Rainfall rates from late Tuesday through Wednesday fall in the 0.1 to 0.2 inches per hour range. Strong southerly flow at all levels can be seen as the front approaches with a surface frontal passage indicated around 6am local time on Wednesday (January 13).



Location of the AR observatory at North Bend, Oregon, is shown by the red dot on the map to the left.

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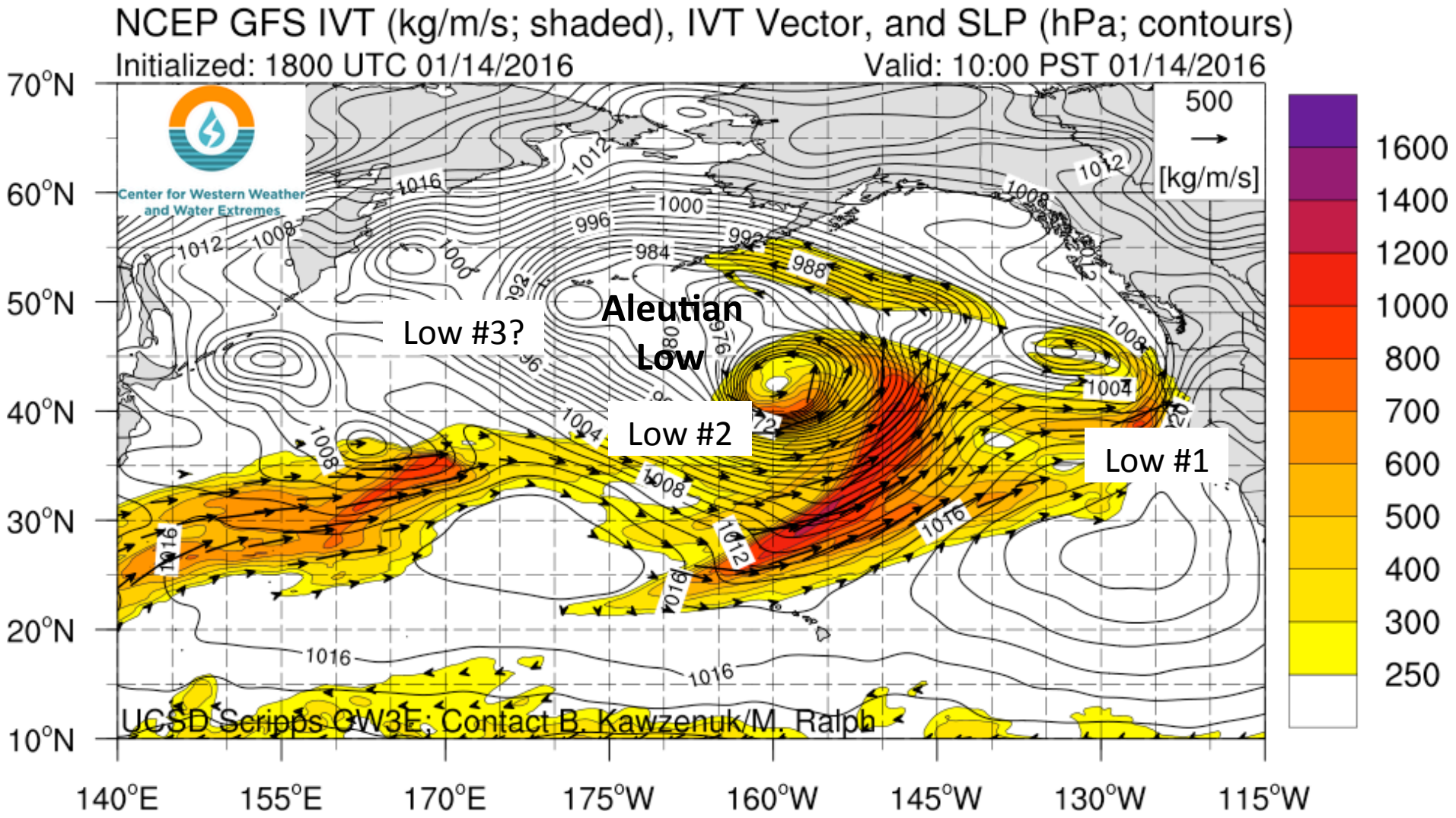
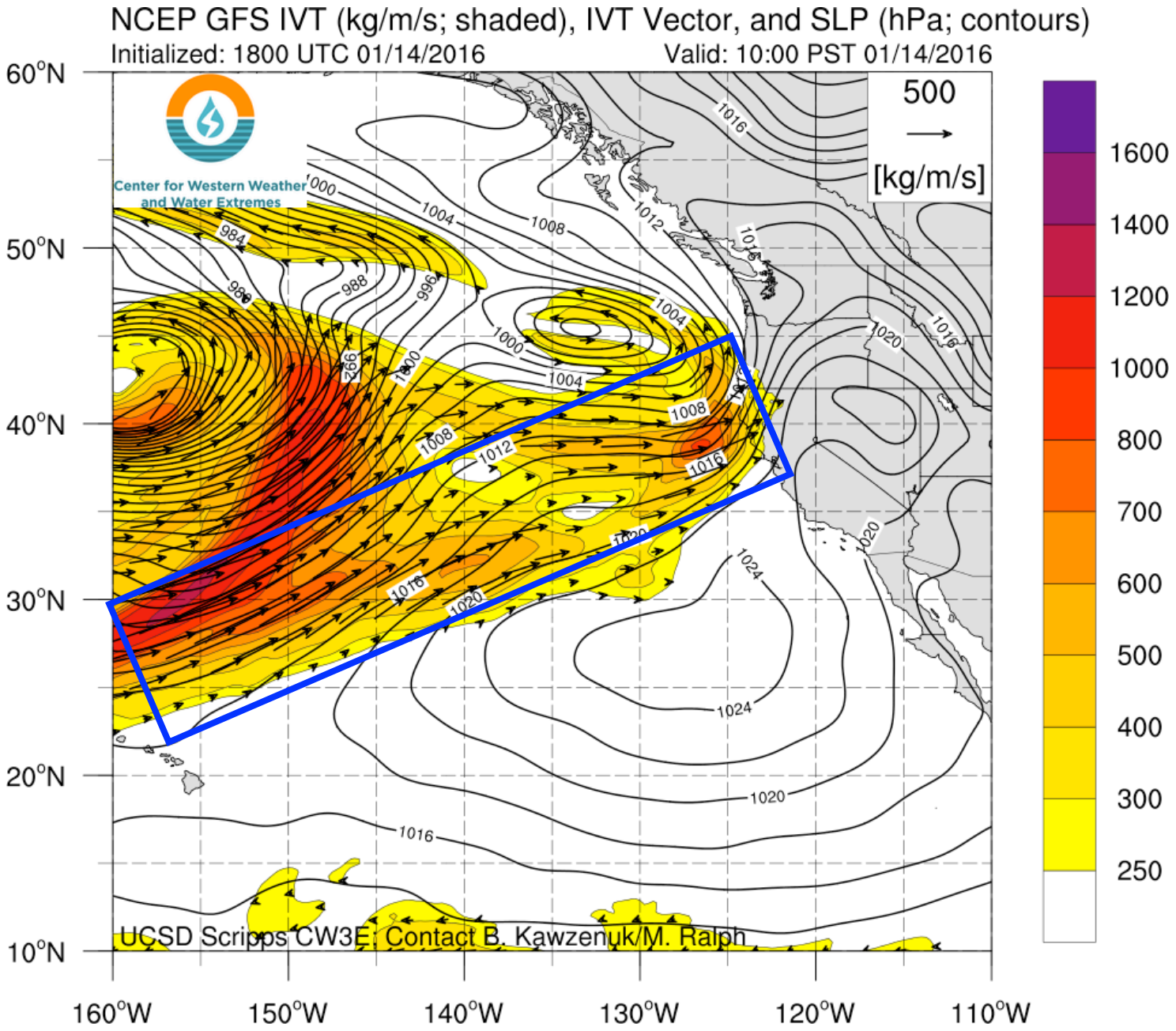


Second event:

Several impulses coming off Aleutian Low are sustaining a fairly cohesive trans-Pacific atmospheric river.

Low #1, relatively weak compared to its follower, began impacting northern CA 14 Jan, 10 AM PST

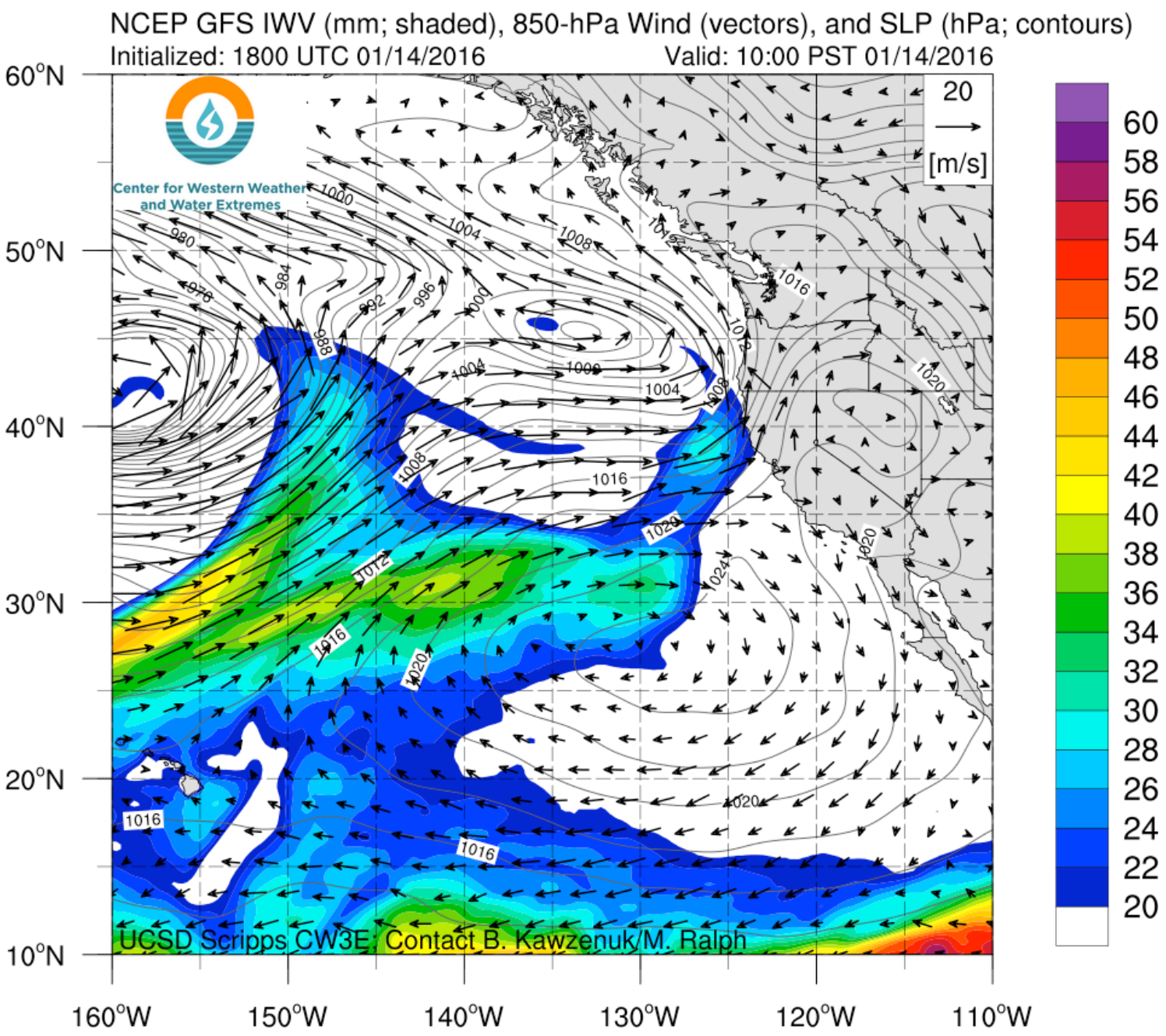
CW3E



Second event:

- Approximate landfall 10 am PST 14th Jan
- >=250 kg/m/s at landfall
- Does not appear to meet AR length/width requirements
- Precipitation observed in relatively narrow area of N. CA, western WA

CW3E



Second event:

- IWV >20 mm at landfall
- Not a cohesive atmospheric-river like structure

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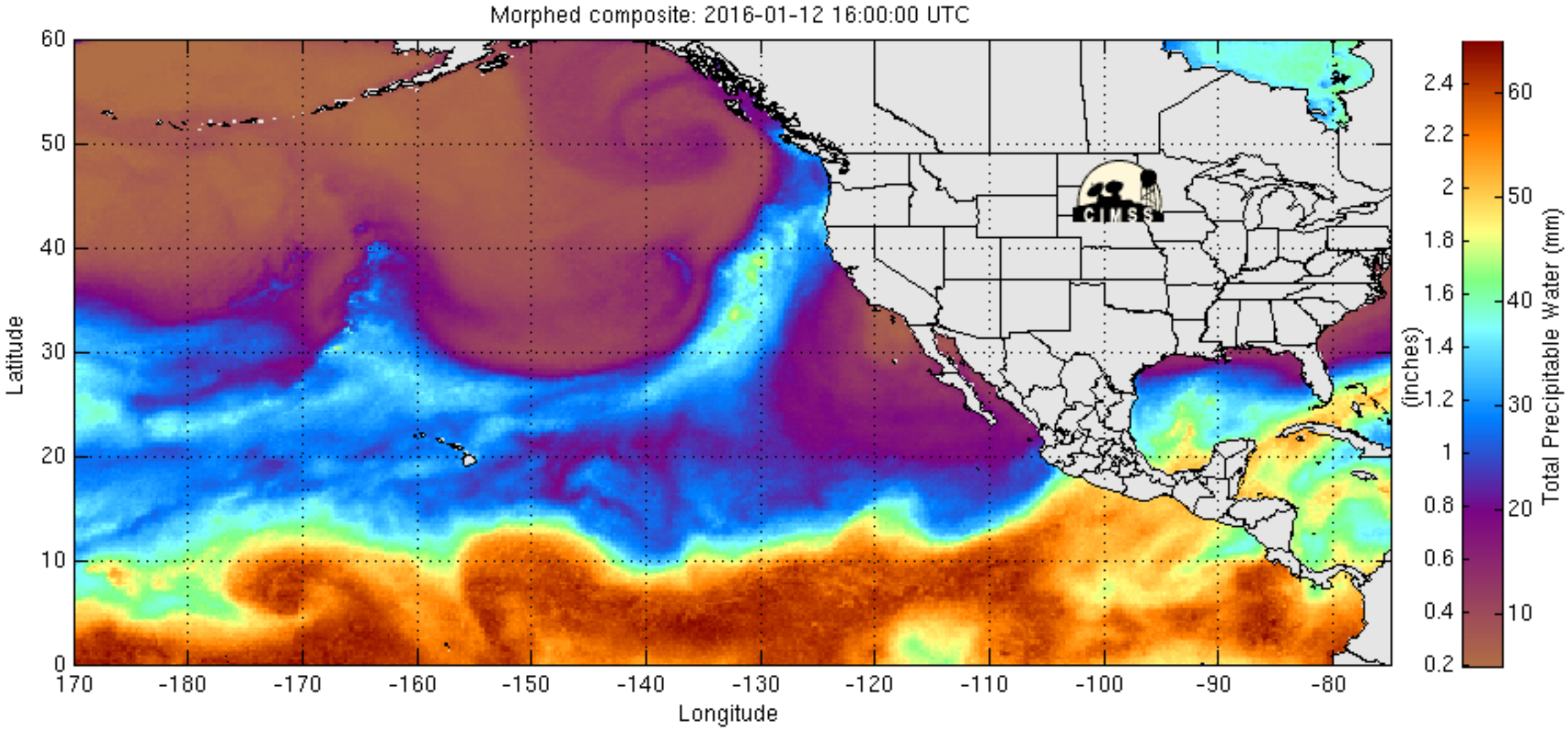

Second event:

Loop of SSM/I precipitable water 1/12/16-1/15/16

Source: MIMIC TPW

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Hydrologic Condition Synopsis

This past week brought an active weather pattern with multiple weather events producing moderate to heavy precipitation across mainly the northern California, Oregon and Washington coasts.

California snow pack conditions (snow water equivalent) show most regions above average for this time of year (Northern Sierra ~117% of normal). Statewide snow pack conditions are running 110% of normal.

Streamflow across Northern California remains elevated with Blue Lake, CA and Ukiah, CA above the median streamflow for this time of year. Precipitation accumulations for the winter season are near average, as seen by the Northern California 8-station index and Tulare Basin 6-station index water year plots.

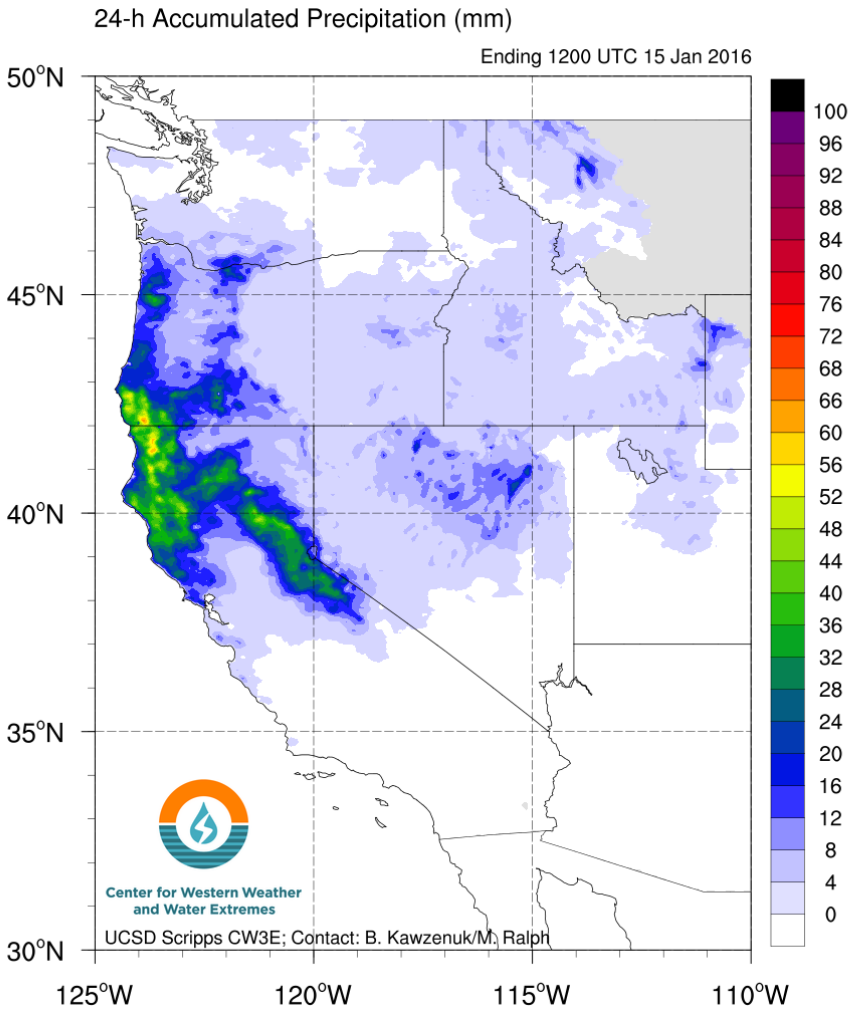
Reservoirs in California continue to receive much needed inflow, allowing for many to reach their highest storage levels of the water year. A clear example of this is Folsom Reservoir in Northern California (northeast of Sacramento) that supplies 200,000+ Californians with drinking water. Folsom dipped below the record low November 1977 level of 140,600 acre-feet and is now on its way back up with levels reaching 275,066 acre-feet after the recent storms, including a series of storms in December (January 14th, midnight). Folsom Reservoir still has a long way to go as normal full-pool storage capacity is 975,000 acre-feet with a minimum seasonally designated flood control storage space of 400,000 acre-feet.

Unsettled weather patterns will continue this weekend according to the National Weather Services and River Forecast Centers as another round of weather systems move into the region Saturday into Sunday. Precipitable water associated with these systems is over an inch with offshore moisture being tapped into it as the systems make landfall. River streamflow predictions for the next 72-96 hours are reflective of the precipitation forecast for the weekend, but also the already saturated soil environment from the storms over the last week.

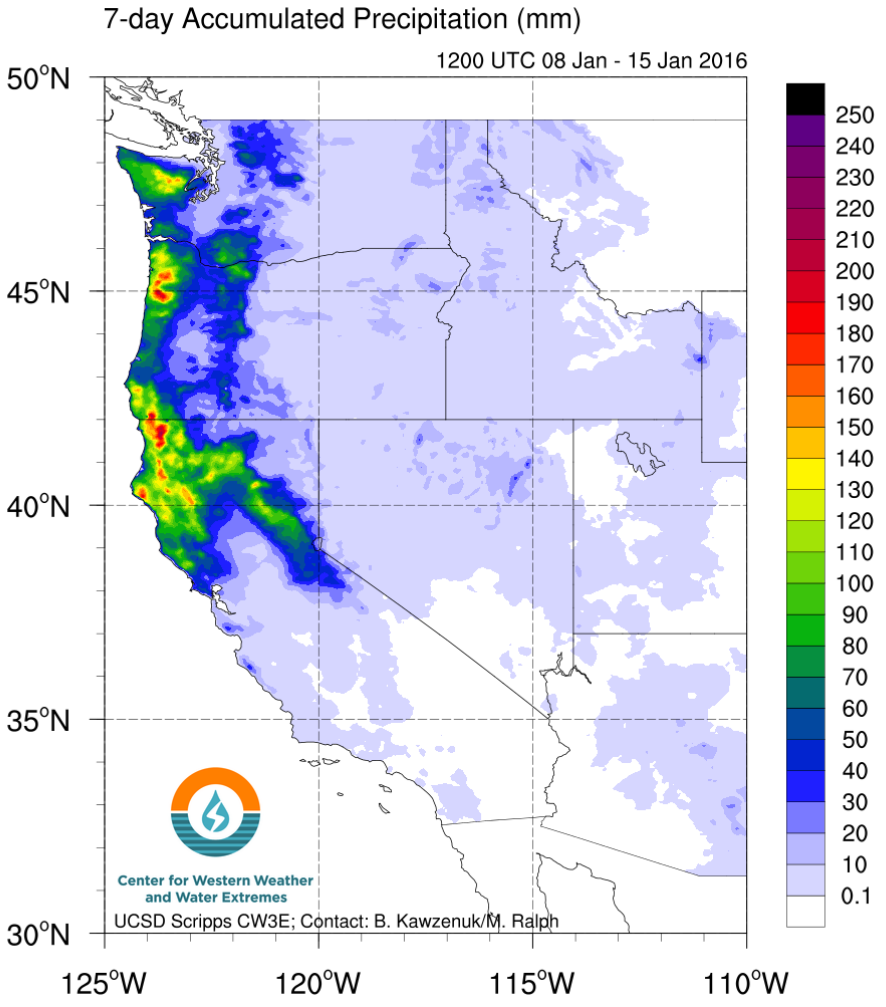
Many Northern California rivers are expected to reach “monitor stage” and/or “flood stage” and include localized flooding. Please stay tuned to your National Weather Services Radio and monitor bulletins for changing river and stream conditions.

Regional Accumulated Precipitation

Precipitation from Jan 14-15 event



Precipitation from both events



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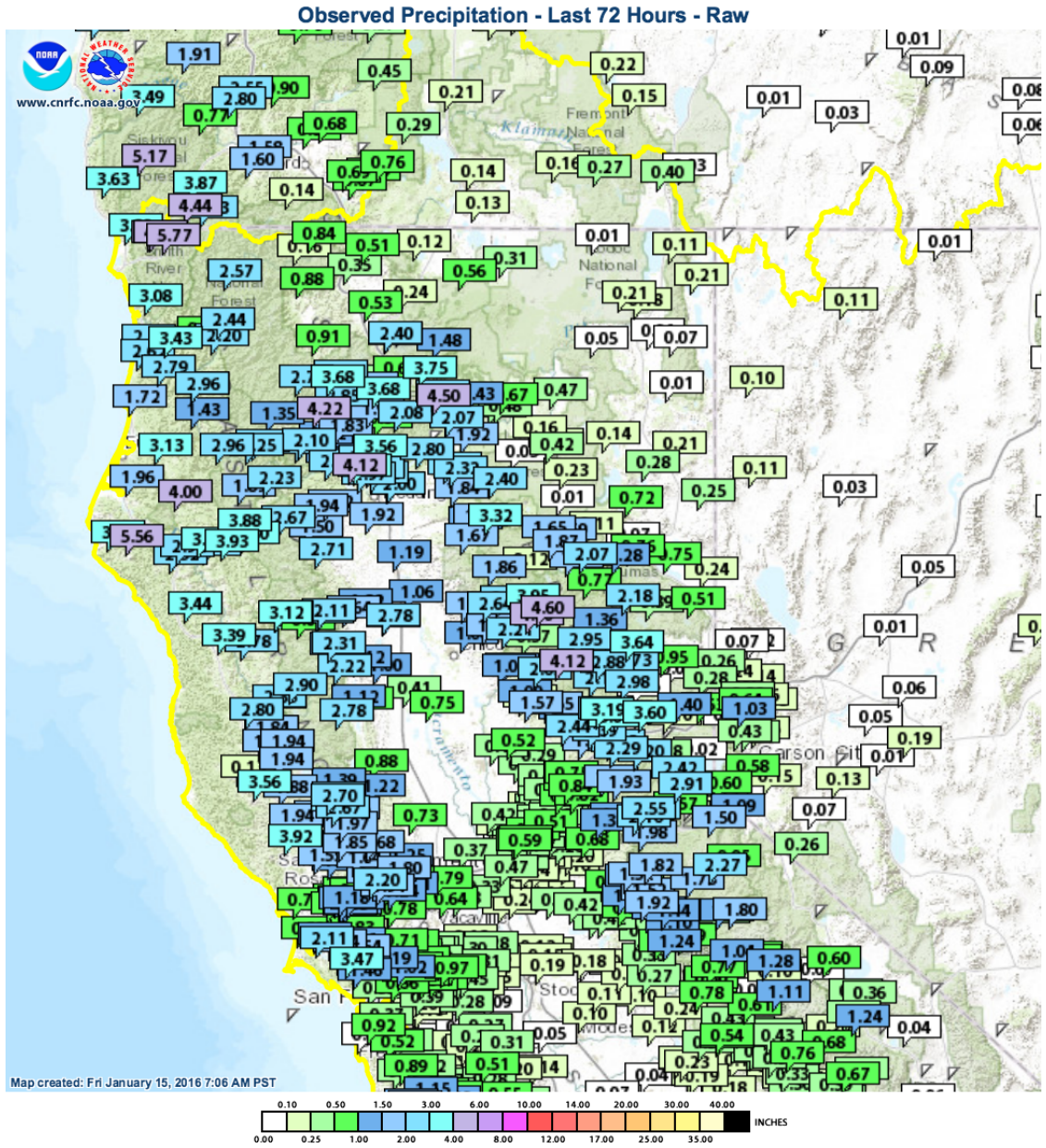

72-hour precipitation ending 6 AM PST 01/15/16 (includes both events)

- 1.5-5+ in for coastal mountains
- 0.5-1 in lower elevations
- 1-4+ in for Sierra Nevada
- Very little spillover into western NV, eastern OR/WA

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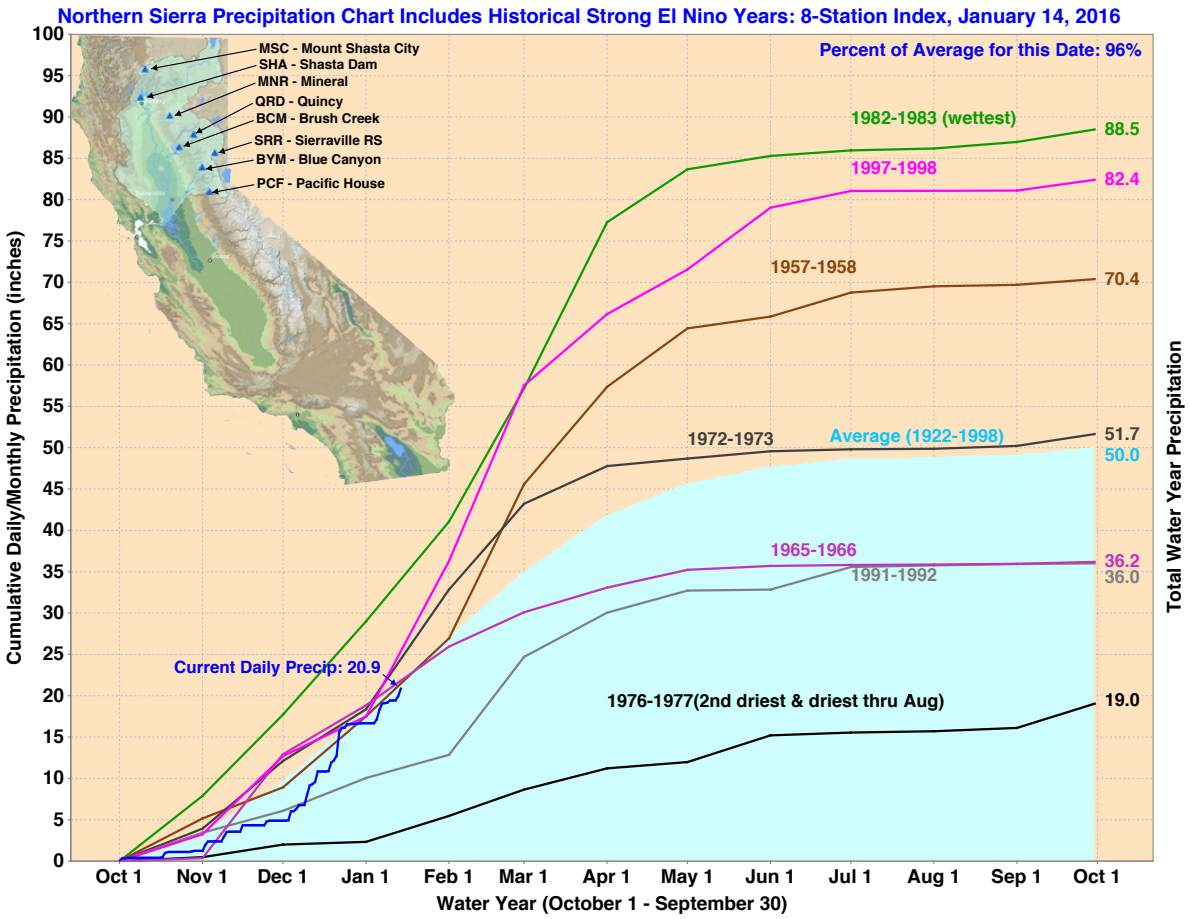
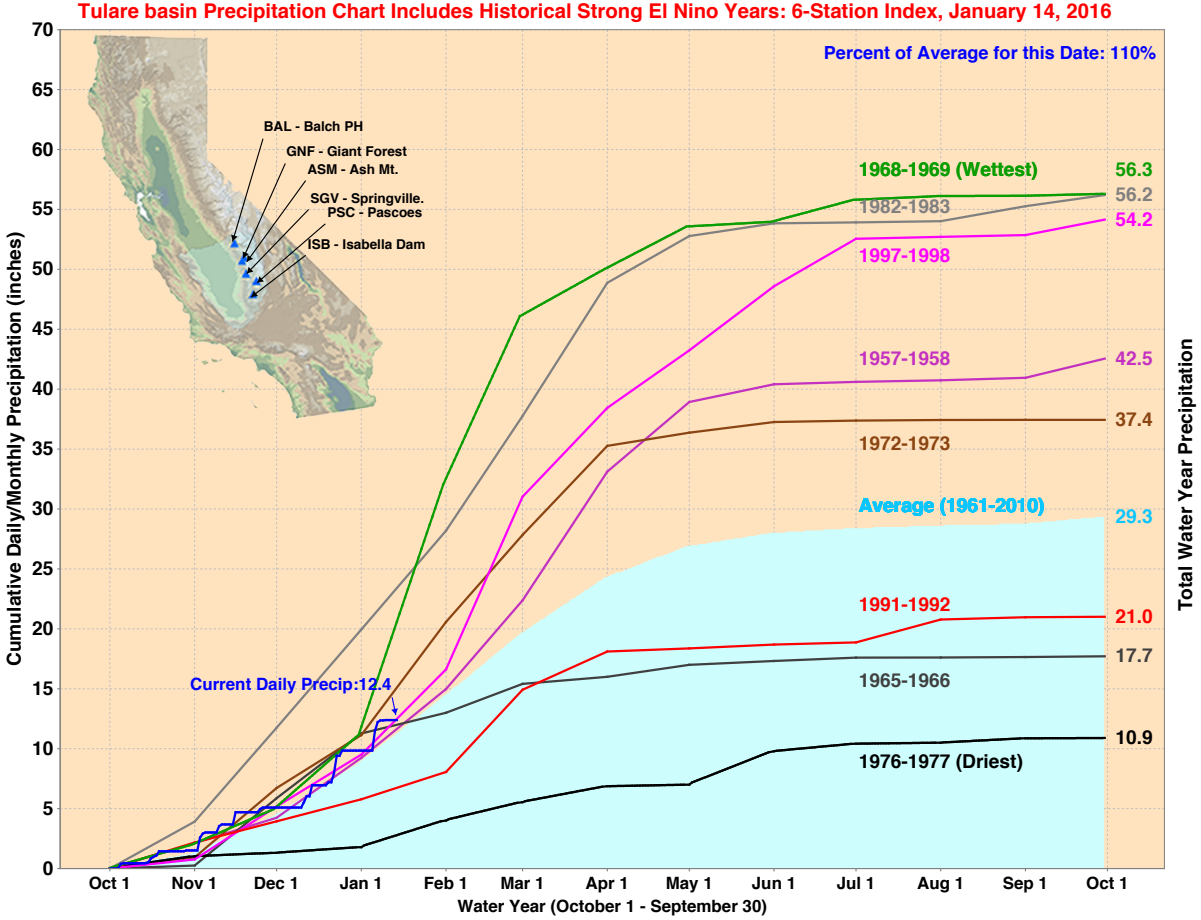
Current California Precipitation Conditions





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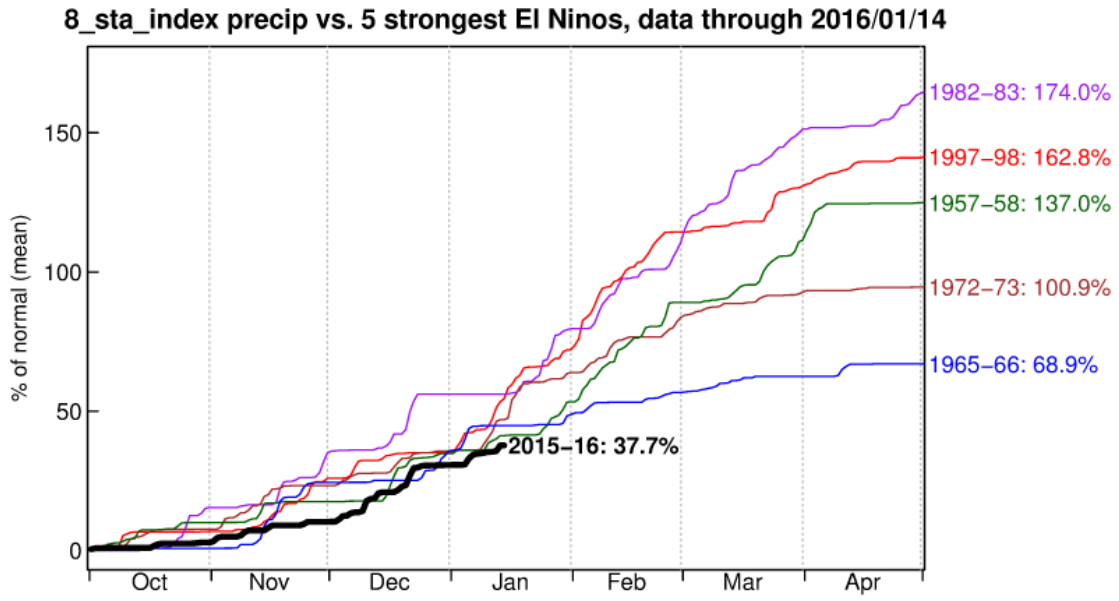

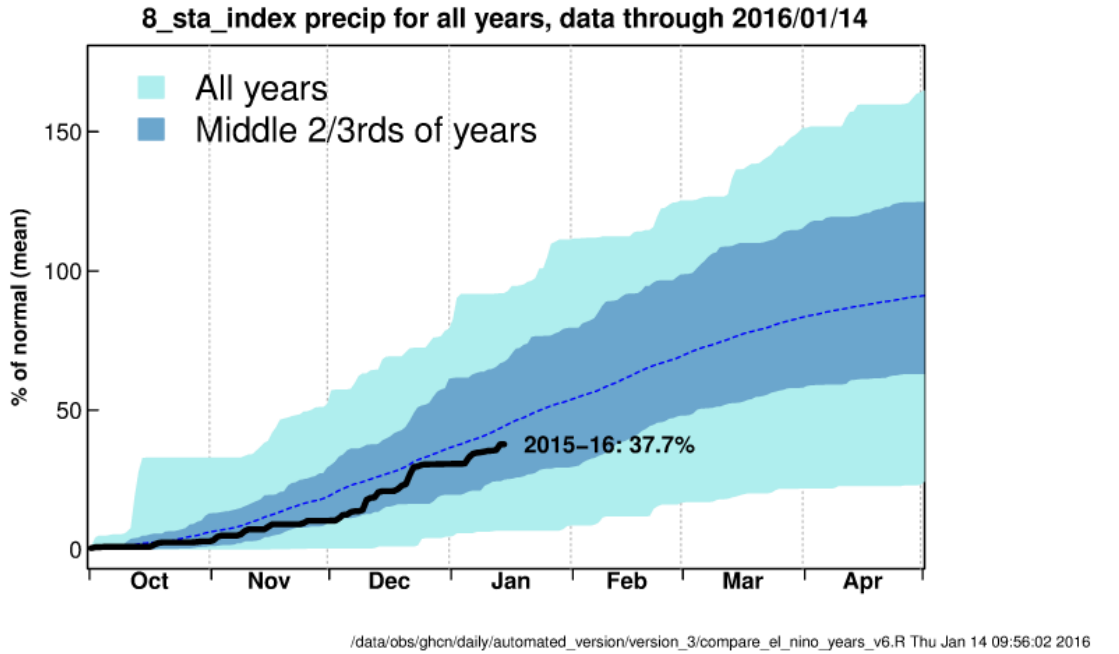

/data/obs/ghcn/daily/automated_version/version_3/compare_el_nino_years_v6.R Thu Jan 14 09:56:02 2016

3-day precipitation accumulation

Through mid-day of Jan 14th, the three day accumulations from the recent Northern California storm activity were modest. The Northern Sierra "eight station index", used to track an important part of the state's water supply outlook, increased by 2.3% of the average water year's total accumulated precipitation. The water-year to date accumulated precipitation for the 8-station index continues to be below the average value seen over the historical record.

Upper: Water-year-to-date accumulated precipitation for the Northern Sierra 8-station index for the current water year (black), compared to the values seen for the 5 strongest El Niños in the observed record (colored lines).

Lower: Water-year-to-date accumulated precipitation for the Northern Sierra 8-station index for the current water year (black), compared to all years. The normal range is shown in dark blue; the extreme range is shown in light blue.

Contributed by David Pierce

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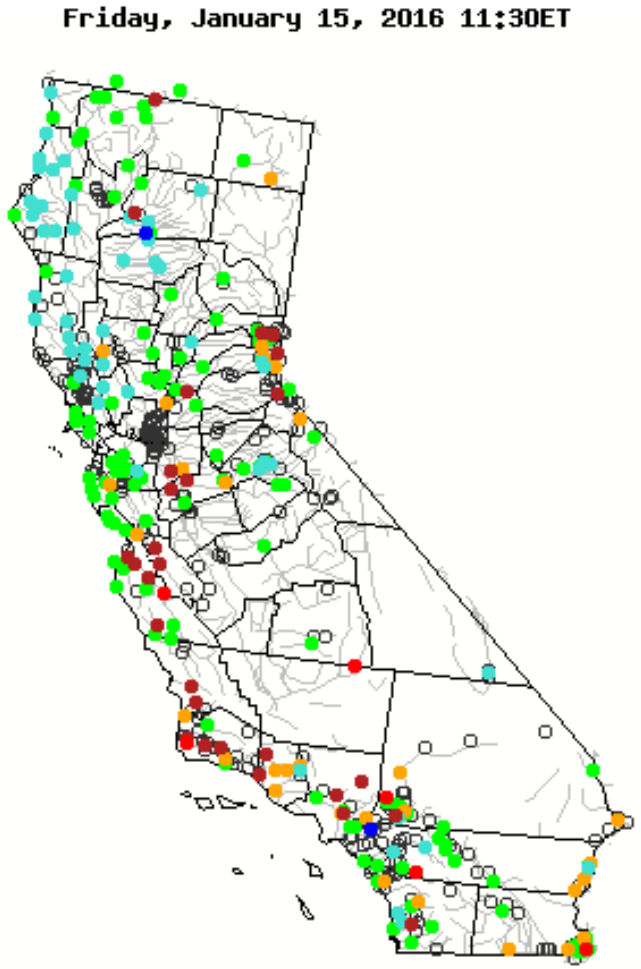
Current California Streamflow Conditions



Explanation

- High
- > 90th percentile
- 76th - 90th percentile
- 25th - 75th percentile
- 10th - 24th percentile
- < 10th percentile
- Low
- Not ranked

The colored dots on this map depict streamflow conditions as a percentile, which is computed from the period of record for the current day of the year. Only stations with at least 30 years of record are used.
The **gray circles** indicate other stations that were not ranked in percentiles either because they have fewer than 30 years of record or because they report parameters other than streamflow. Some stations, for example, measure stage only.

USGS

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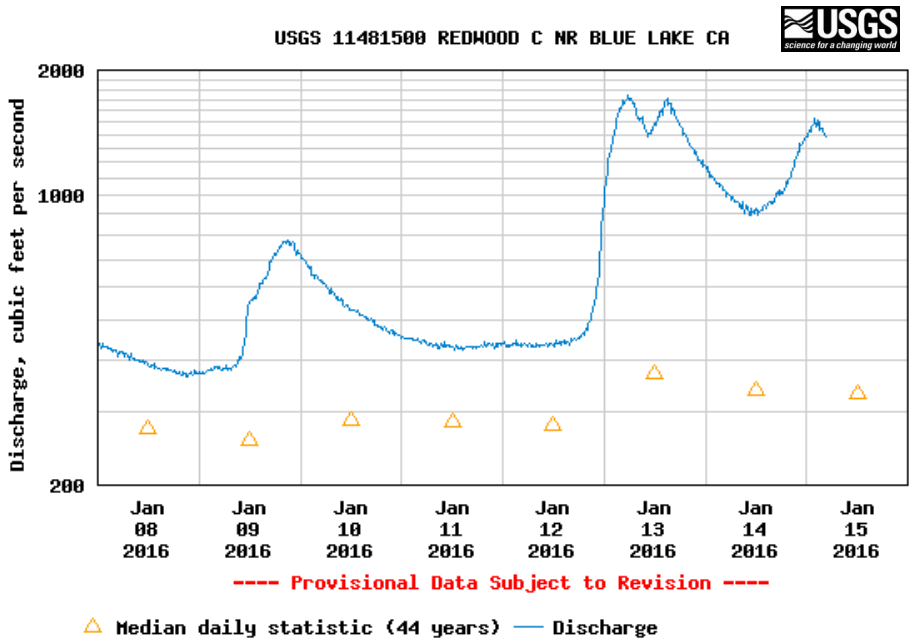
Northern CA Streamflow

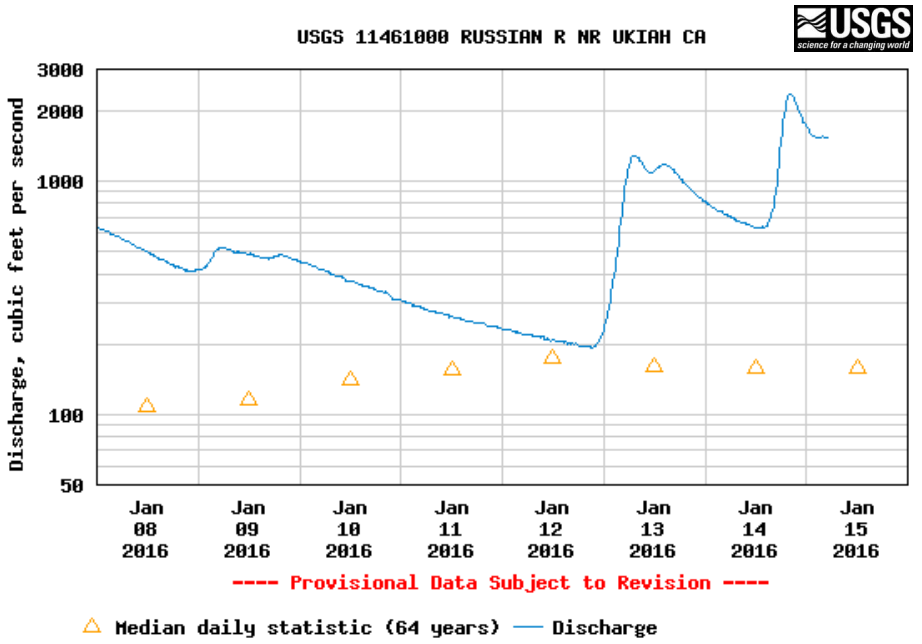
January 15, 2016 @ 4:45am EST

- Coastal Northern California
  - Blue Lake, CA: Peak at ~ 1710cfs
  - Russian River near Ukiah: Peak at ~ 1280cfs

Blue Lake, CA

Ukiah, CA





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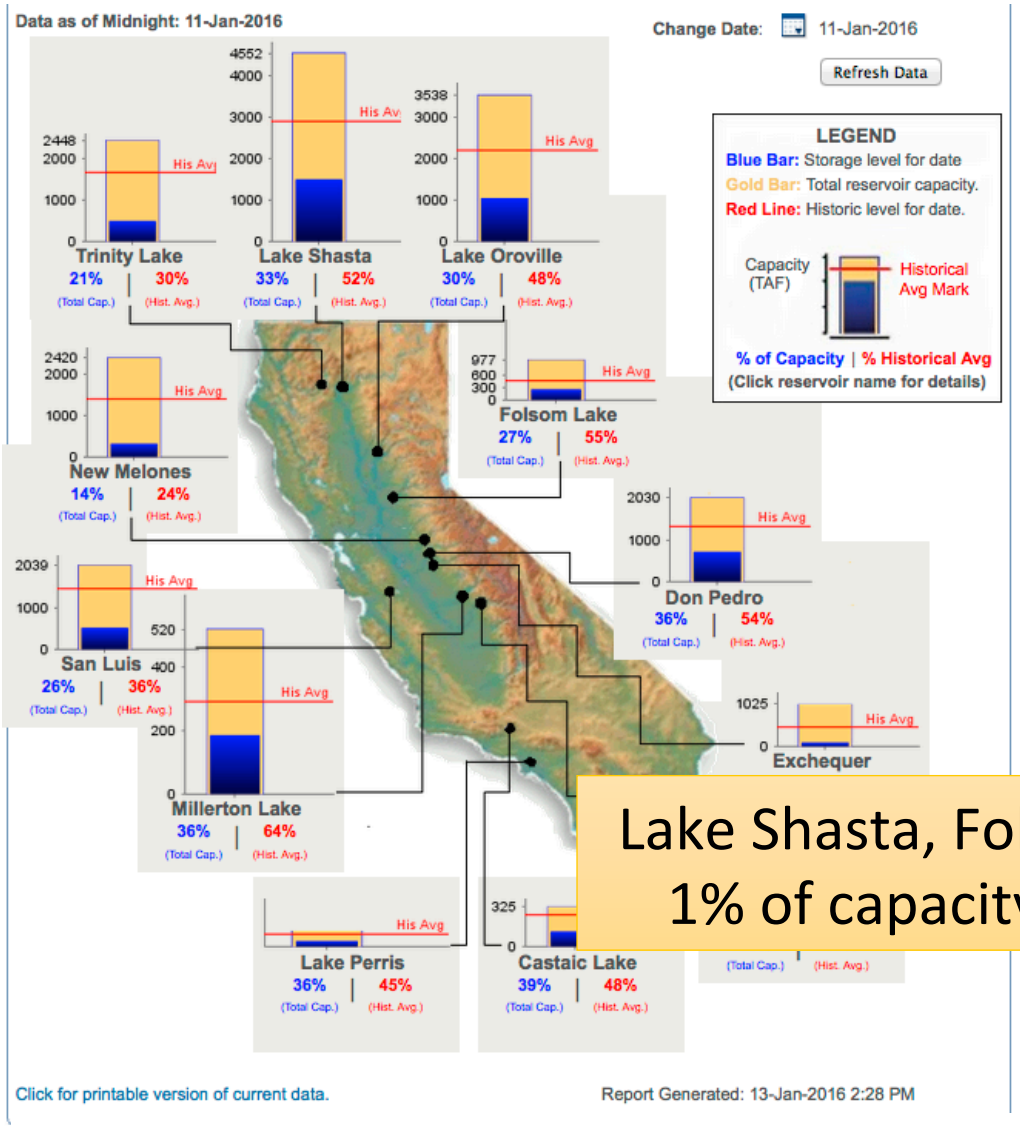
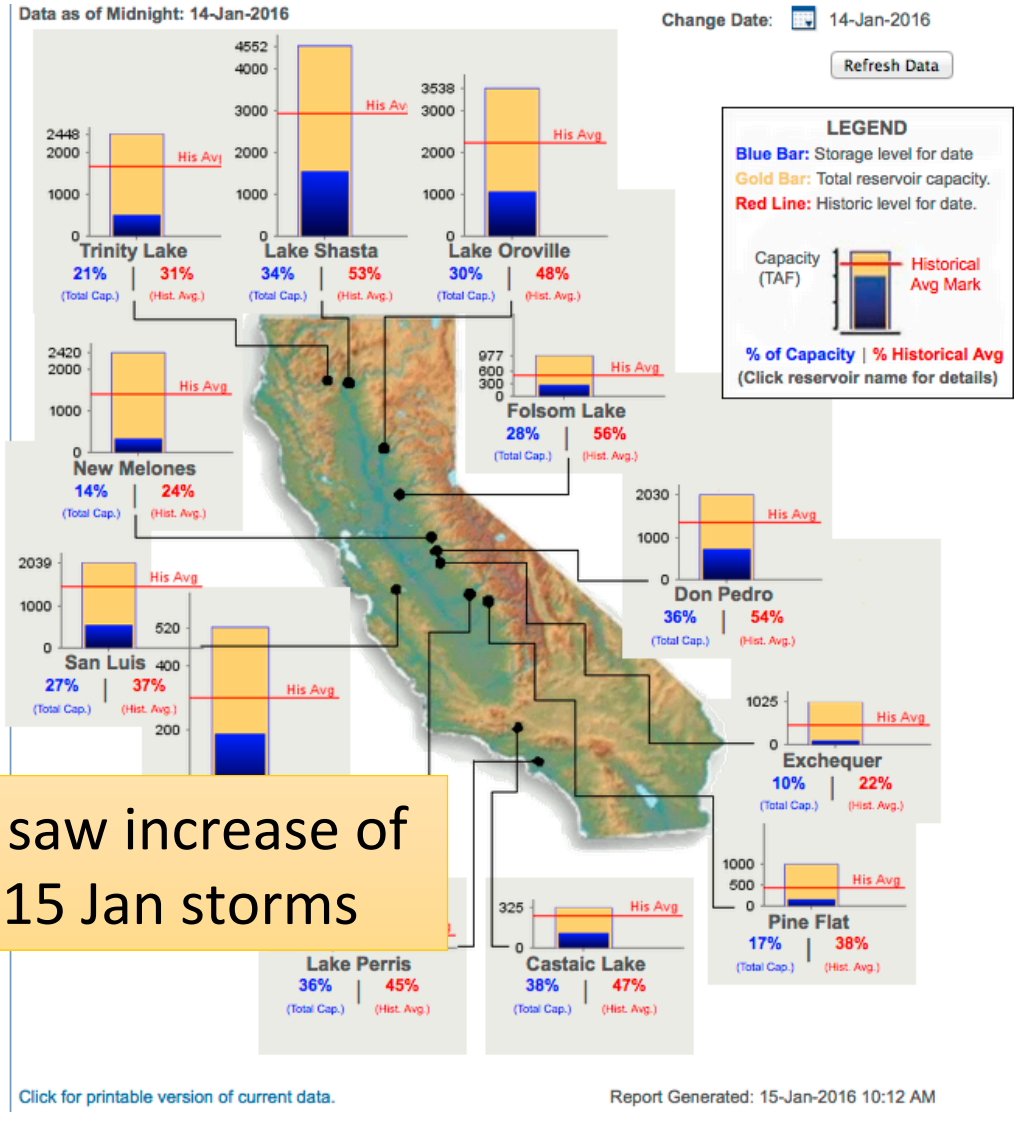
California key reservoir levels only slightly affected by this event



Reservoir Levels Monday Jan 11 (midnight)



Reservoir Levels Thursday Jan 14 (midnight)

Lake Shasta, Folsom Lake saw increase of 1% of capacity from 12-15 Jan storms

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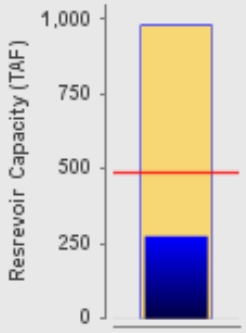
Reservoir Conditions - Folsom Lake

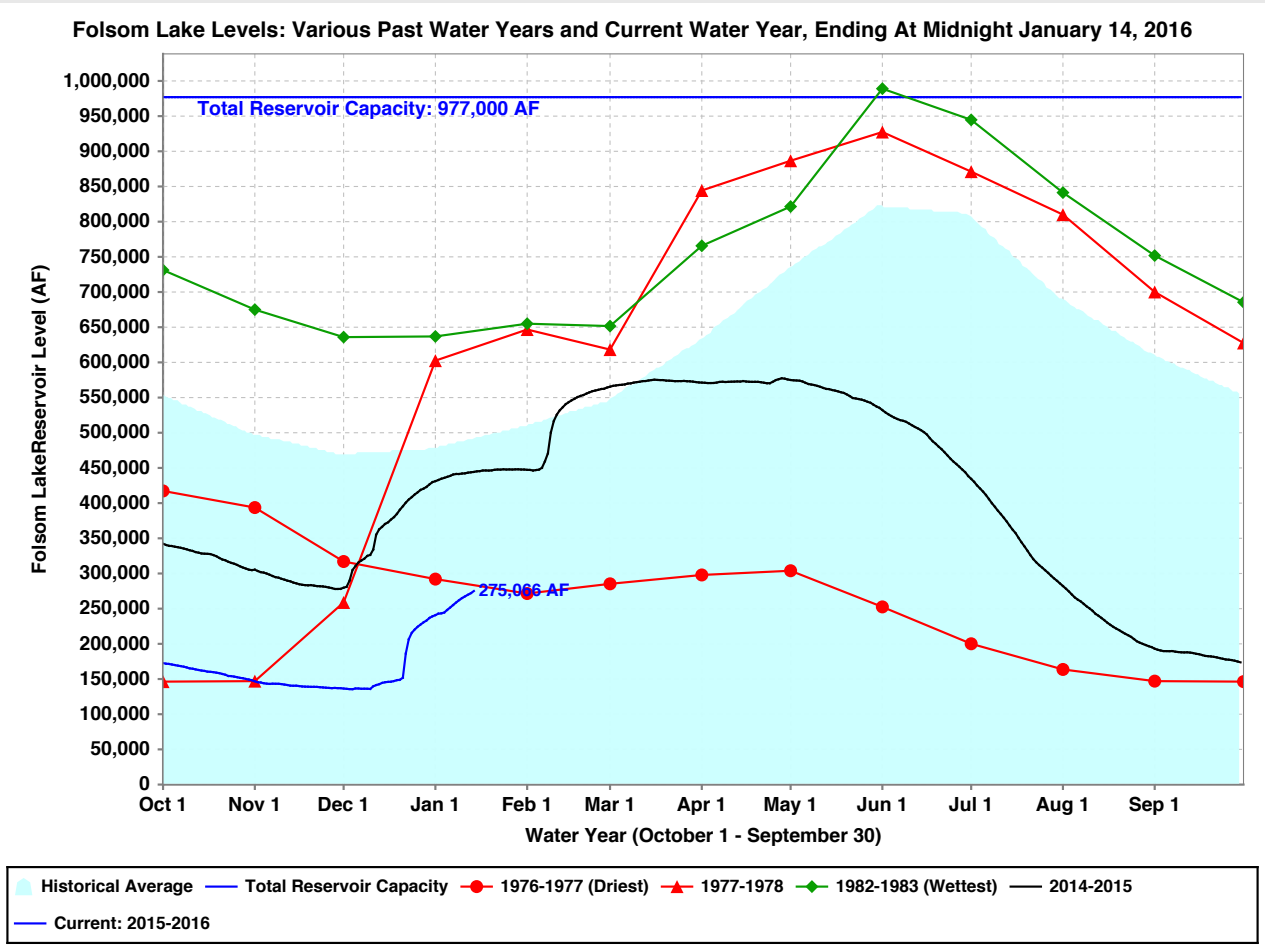
Folsom Lake Conditions

(as of Midnight - January 14, 2016)



Current Level: 275,066 AF

28% (Total Capacity) | 56% (Historical Avg.)



Data Updated 01/15/2016 08:45 AM

California Reservoir Status: Folsom Reservoir

January 15, 2016

Light blue background shows historical average levels. Dark blue line shows current (2015-2016) levels

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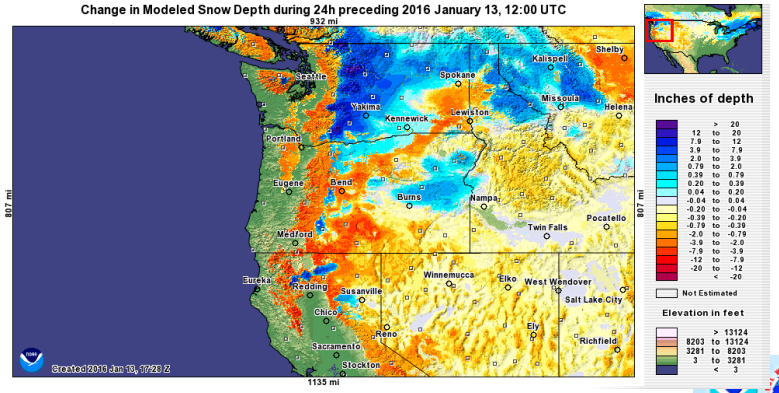
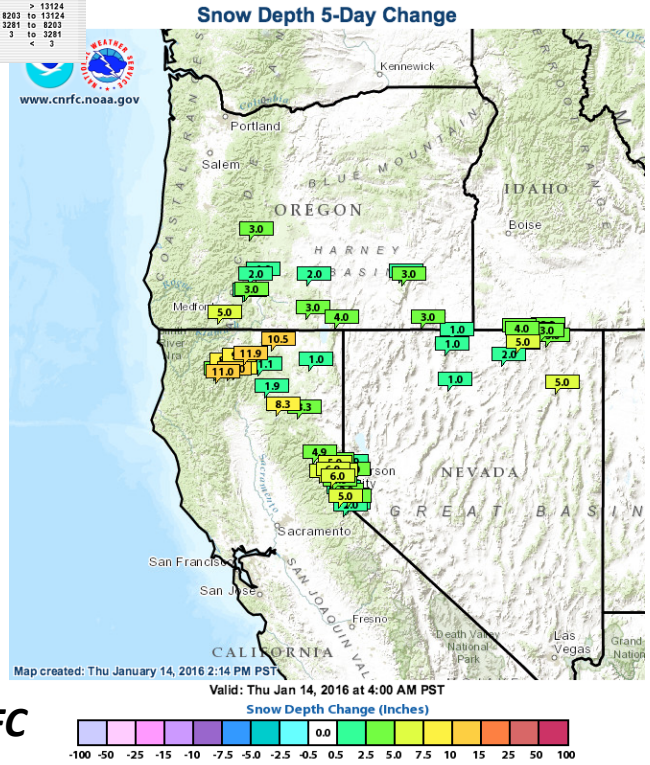
12-14 January 2016:

Snow accumulation in WA Cascades, very little in OR Cascades and Sierra Nevada



Source: NOHRSC



Source: CNRFC

24-hour snowfall ending Friday morning (Jan 15):

Source: NWS Sacramento

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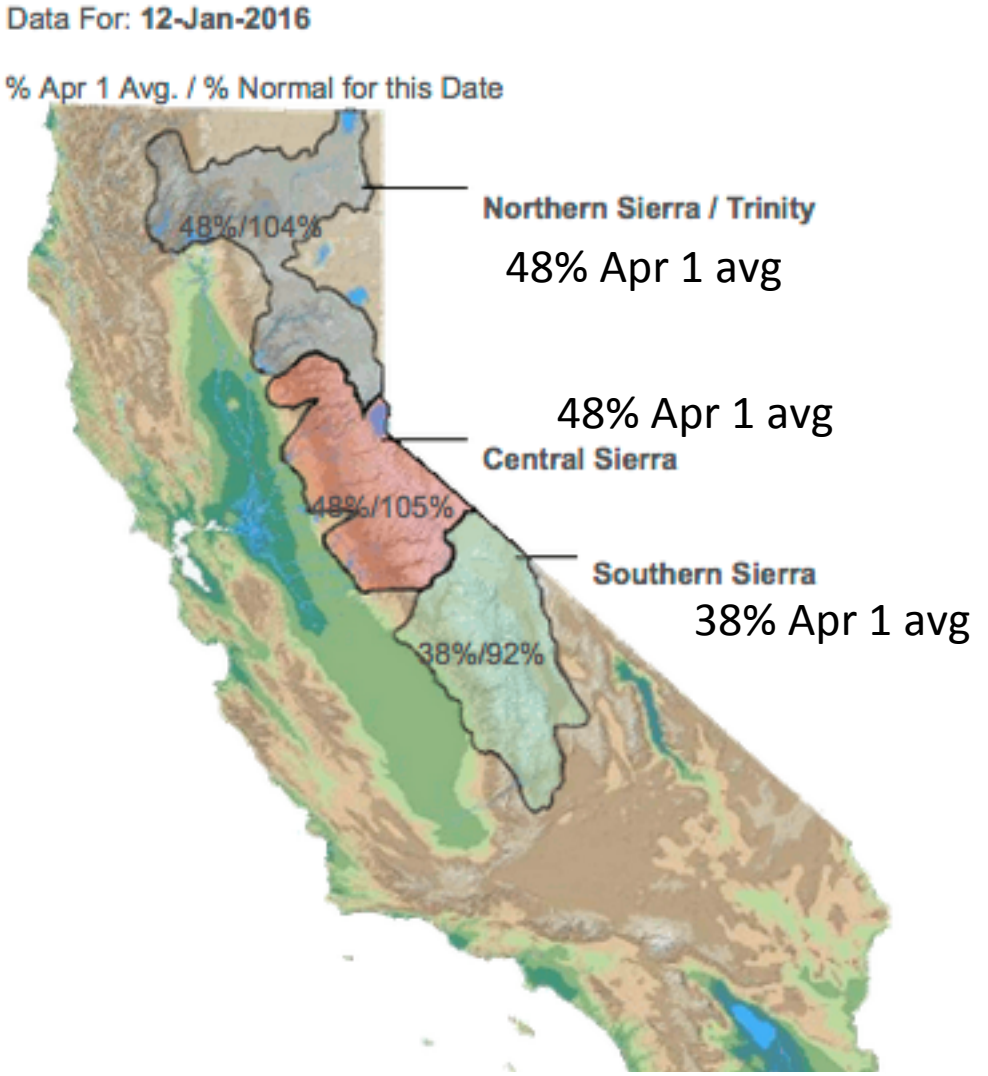
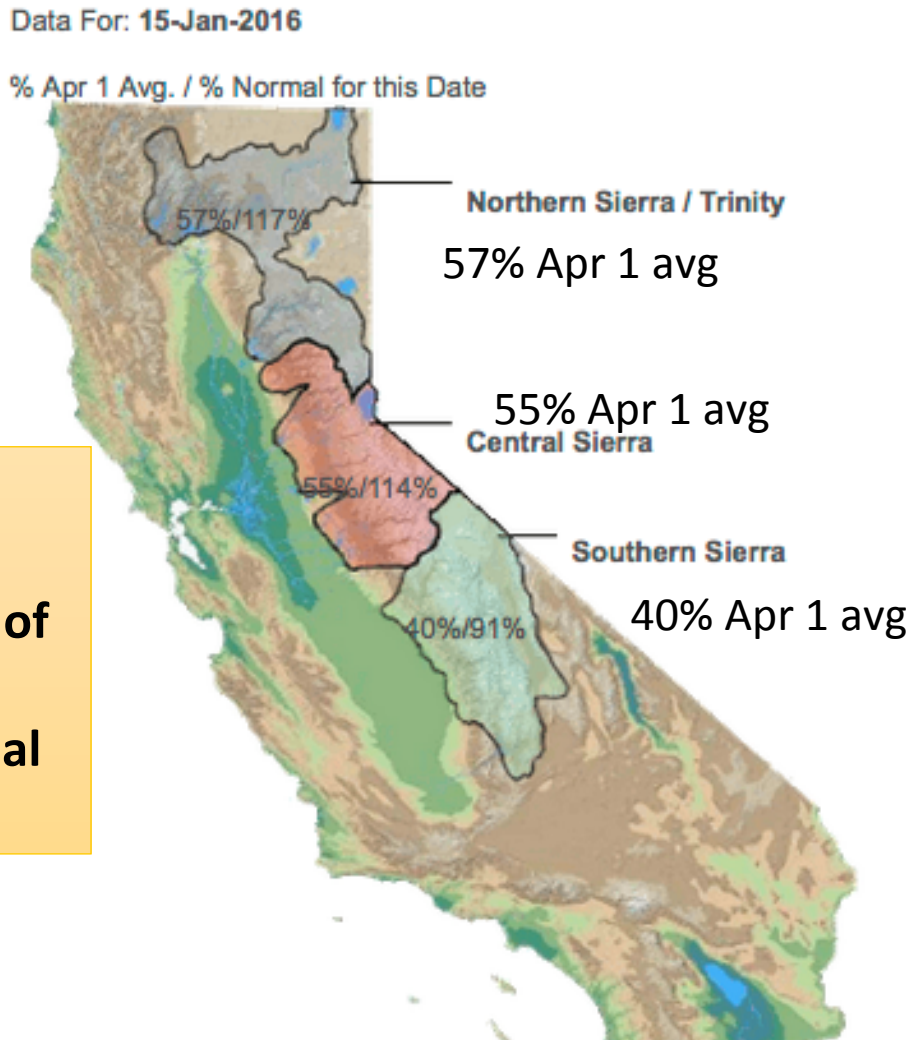
N. CA snowpack increased from 48% to 57% of April 1 average during Jan 12-15



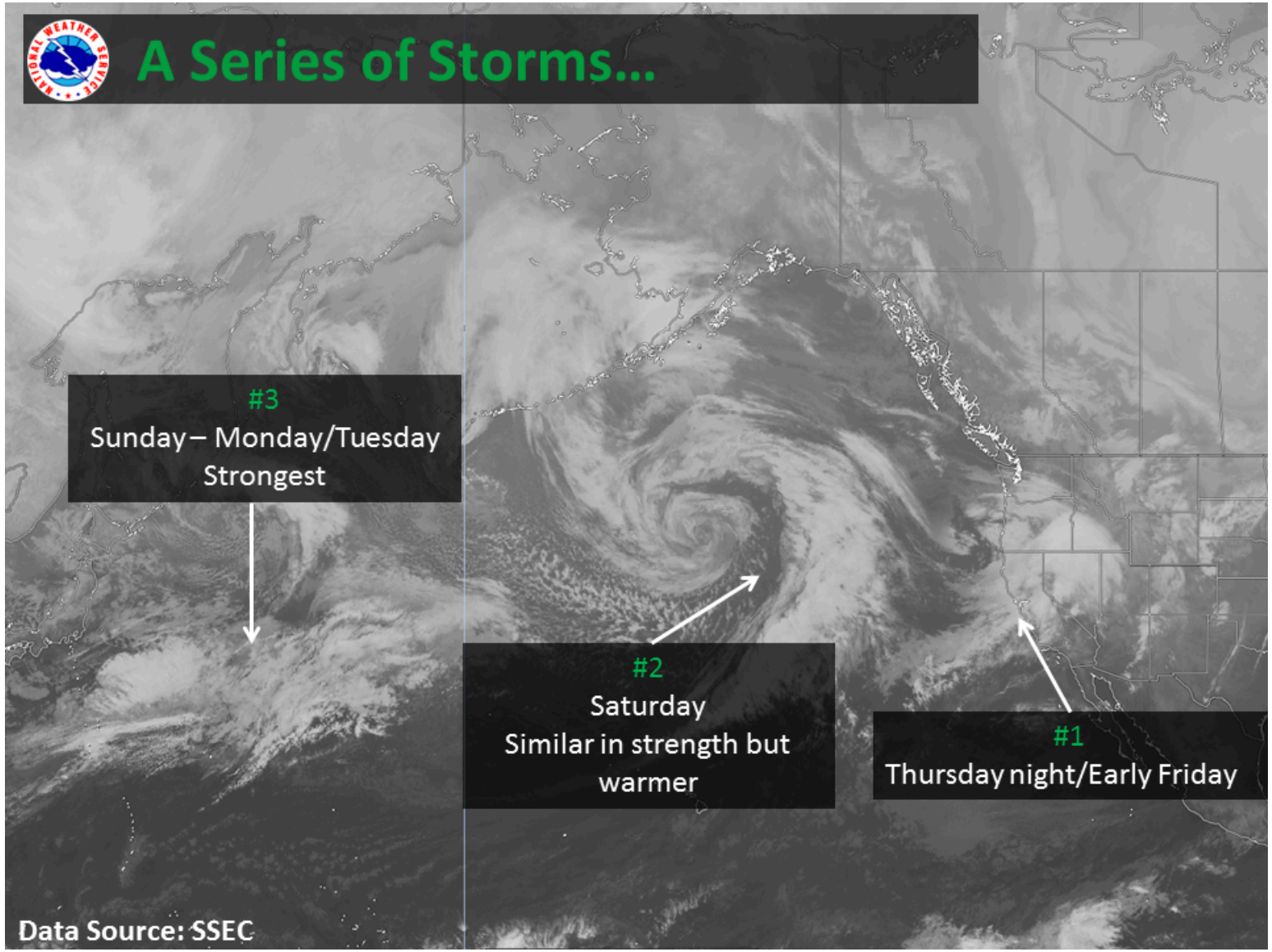
Jan 12 Snowpack Summary

Statewide snowpack currently 52% of Apr 1 avg, 110% of normal for Jan 15



Jan 14 Snowpack Summary

CW3E



Outlook:

Heavy rain and snows are targeted to impact northern California and the Pacific Northwest.

Flooding concerns for northern California early next week.

Portions of the Sierra Nevada may see over a foot of snowfall.

Dappled sun at noon over the Merced River Happy Isles station in Yosemite National Park

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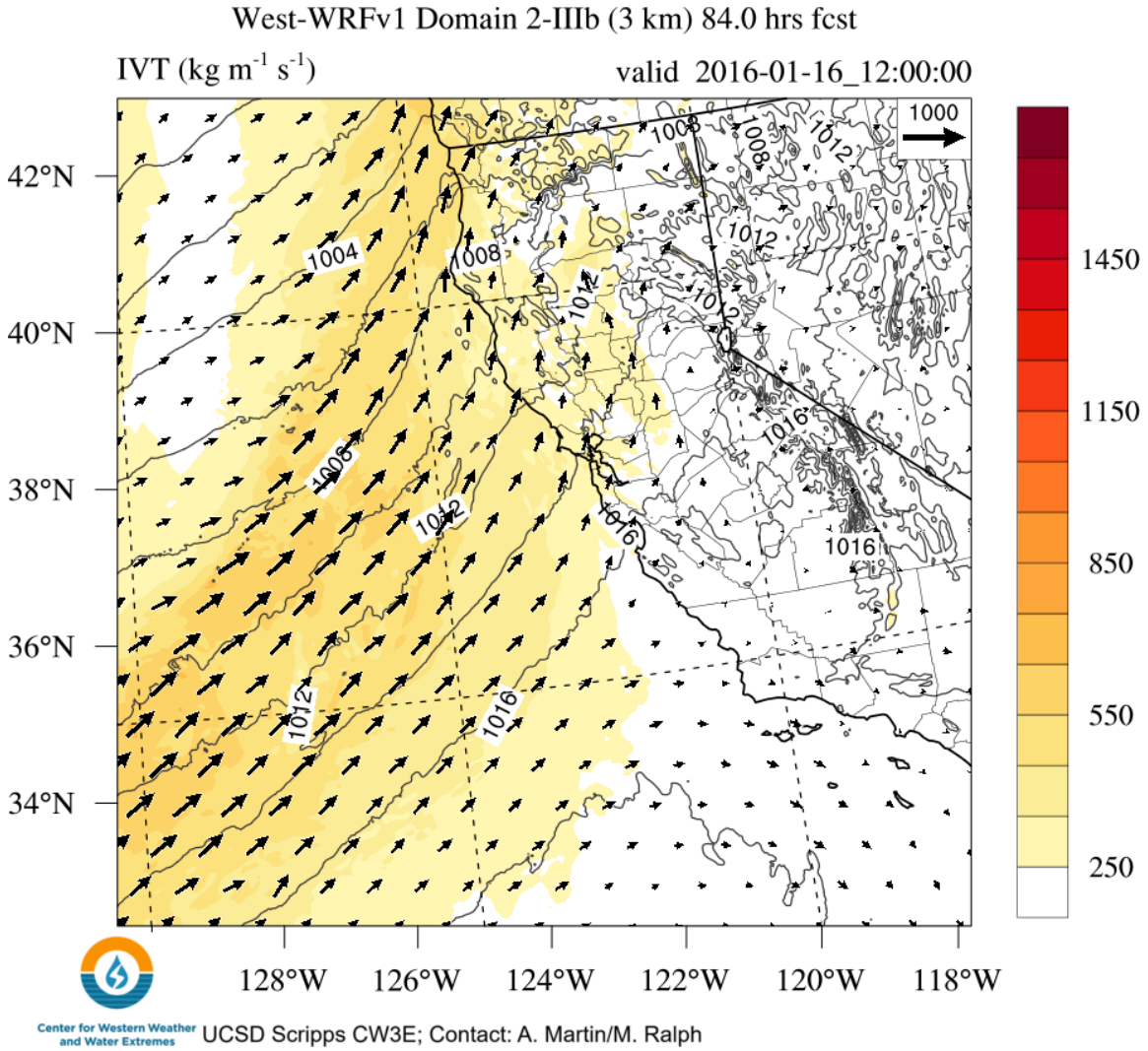
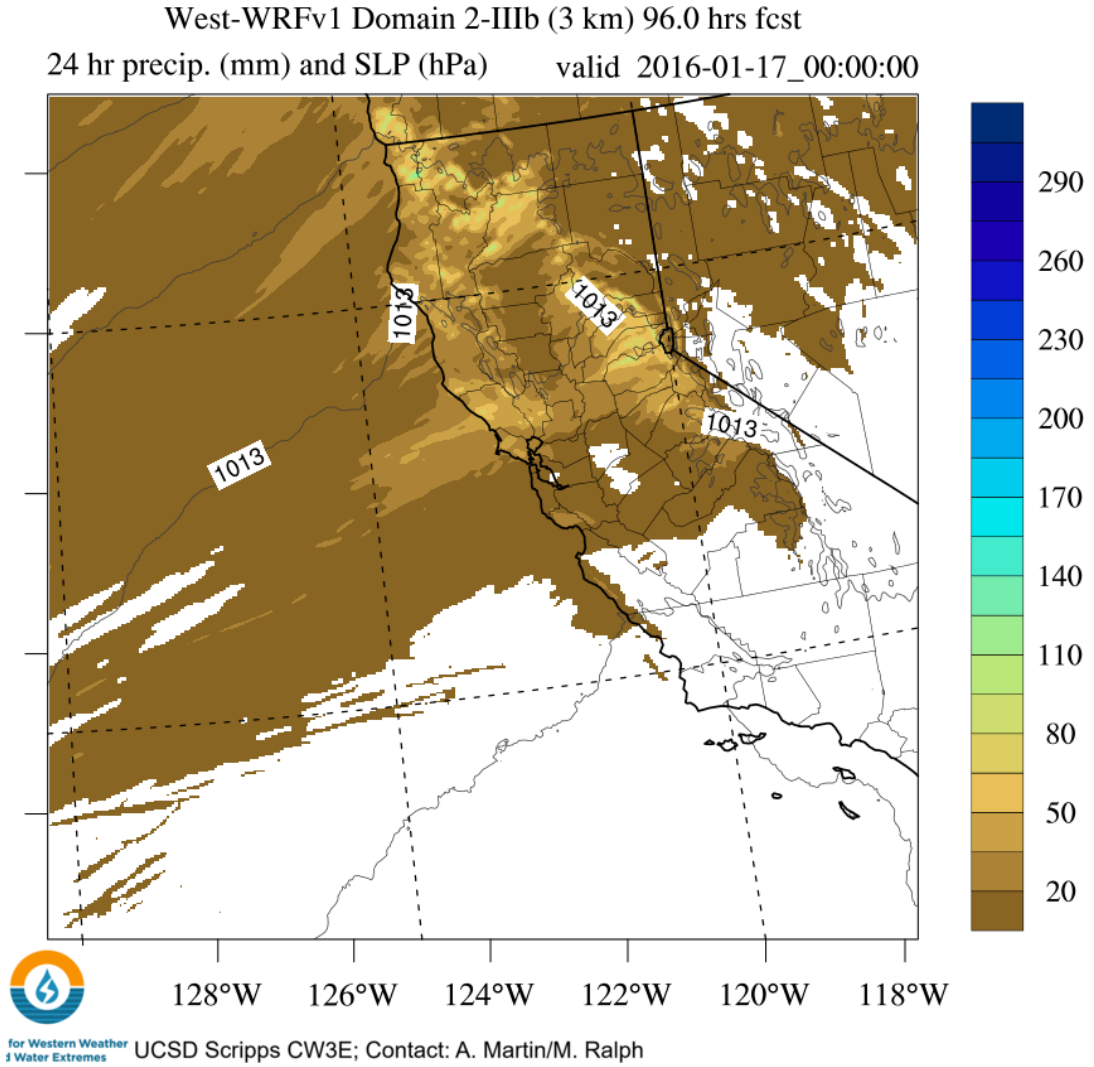
West-WRF forecast

AR arriving northern California coast early Saturday morning (Jan 16)



24-hour precipitation up to 10cm over northern Sierra and northern coastal regions



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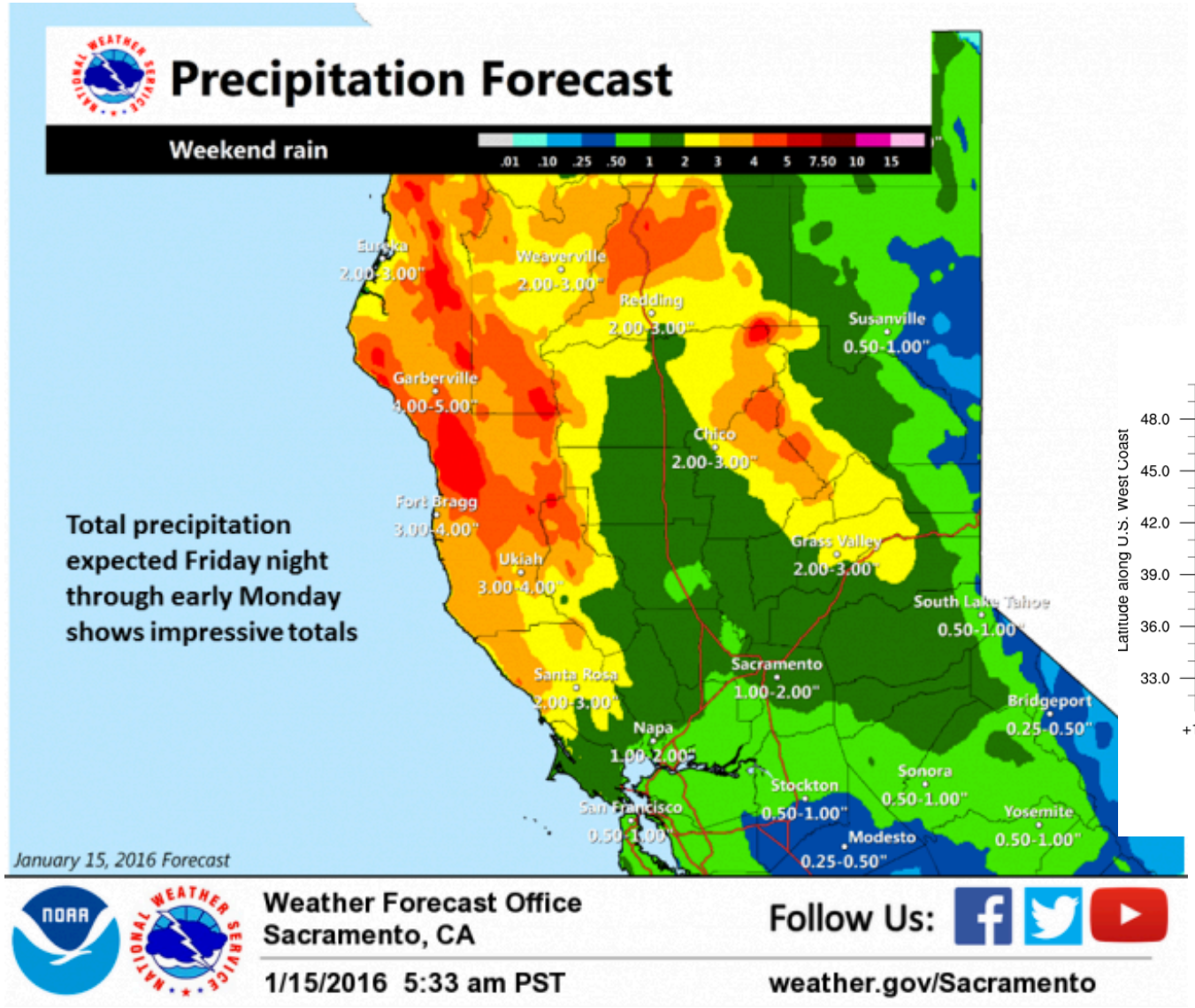

Series of storms:

The series of storms can be seen in the probability of IVT > 250 kg/m/s (below). The dark purple indicates 100% chance of strong IVT from latitudes 34N to 48N in this series of storms. Precipitation totals from Sacramento NWS shown in graphic to the left.