

A brief summary of 07-10 April 2016 CA/NV cutoff low event

Nina Oakley; *WRCC*

Marty Ralph and Brian Kawzenuk; *CW3E*



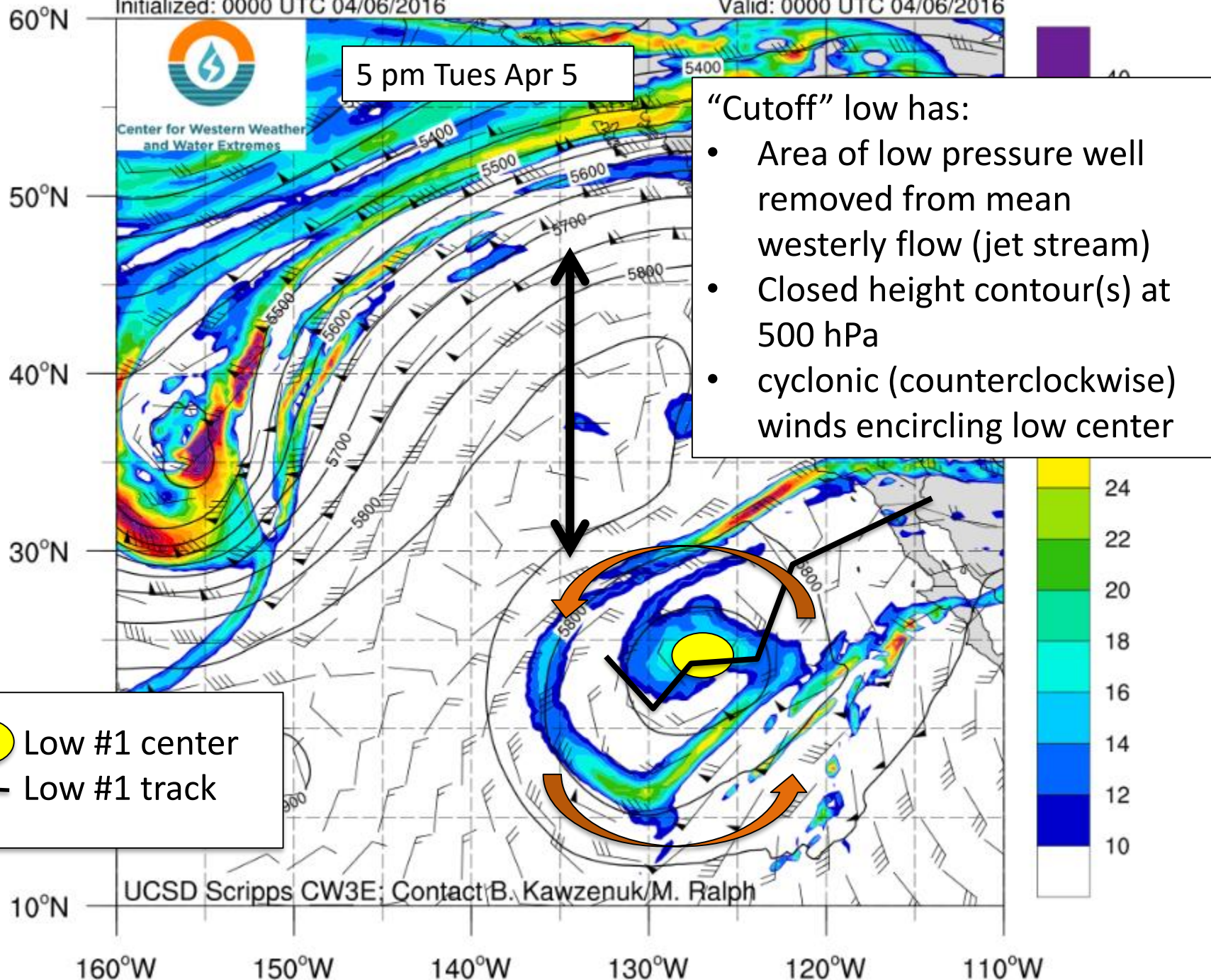
Center for Western Weather
and Water Extremes

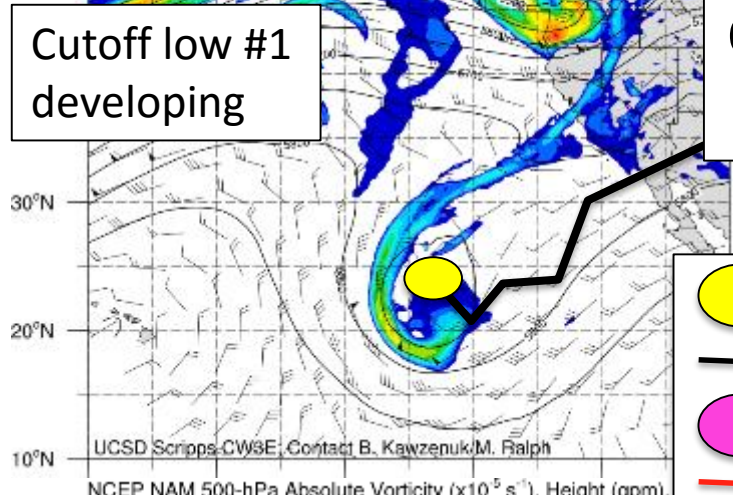
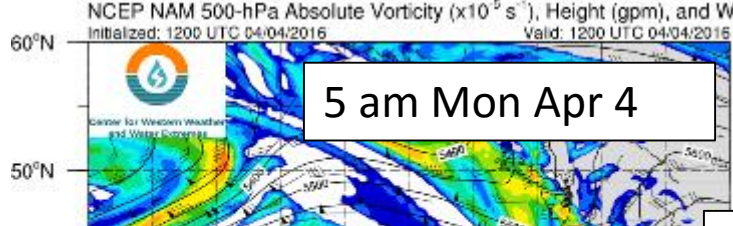


Western Regional
Climate Center

Summary

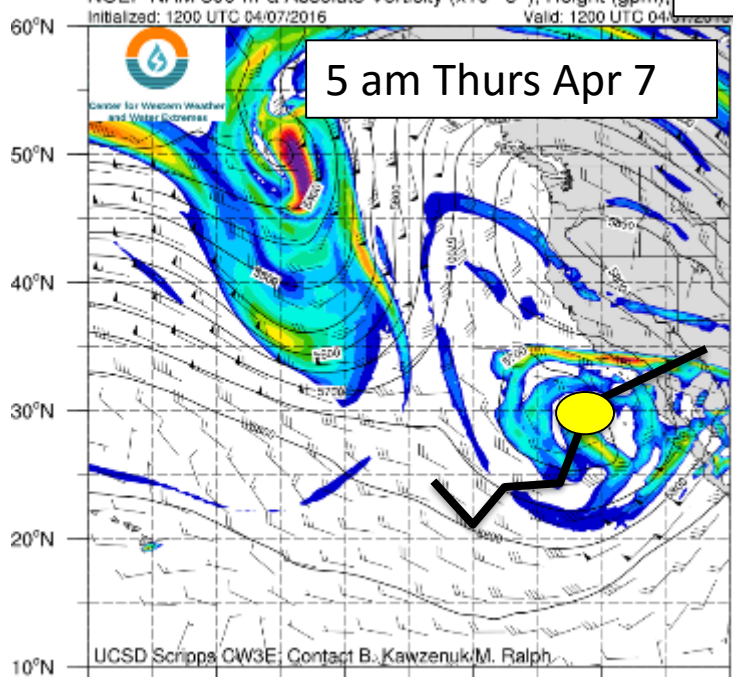
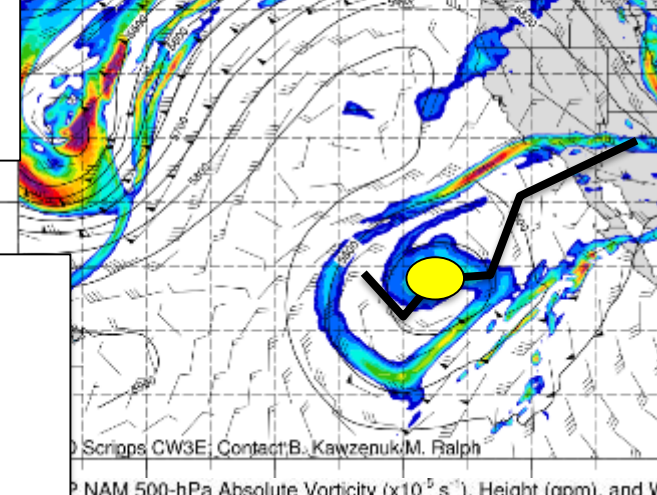
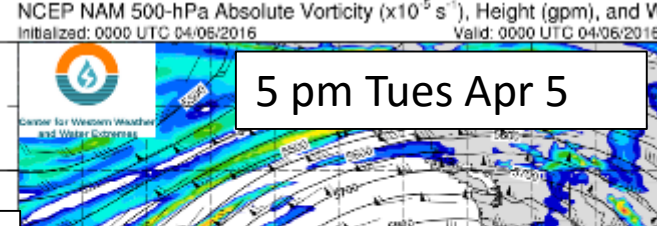
- 2 consecutive cutoff lows brought precipitation to CA, Great Basin, Las Vegas area
 - Low #2 more widespread impact than Low #1
 - 72 hr totals generally <1-3 in
- Periods of heavy precipitation as areas of high vorticity circulated around low
- Subtropical moisture entrainment into low; does not reach atmospheric river criteria



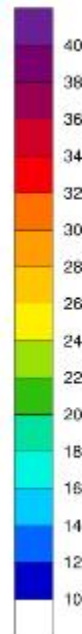
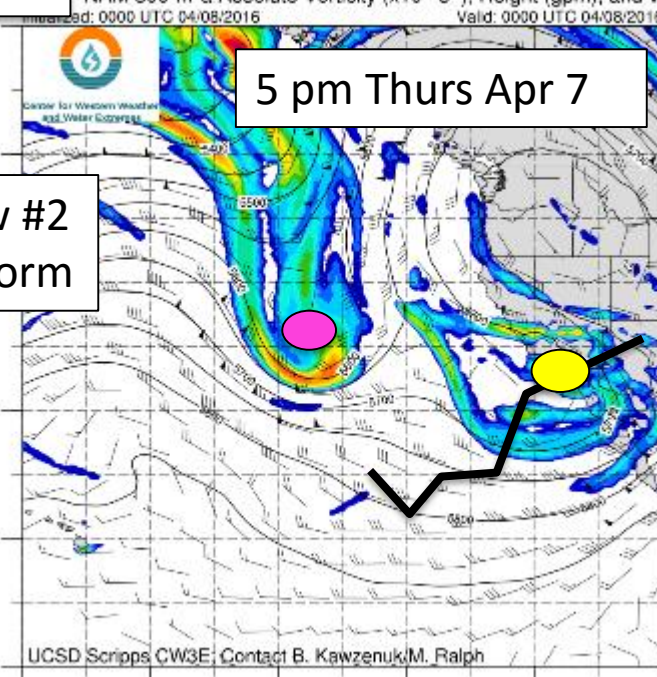


Cutoff low #1
Apr 4-7

-  Low #1 center
-  Low #1 track
-  Low #2 center
-  Low #2 track



Cutoff low #2
starts to form



NCEP NAM 500-hPa Absolute Vorticity ($\times 10^{-5} \text{ s}^{-1}$), Height (gpm), and Winds
Initialized: 0000 UTC 04/08/2016 Valid: 0000 UTC 04/08/2016

5 am Thurs Apr 7

Cutoff low #2 starts to form

Cutoff low #1 Apr 4-7

- Low #1 center
- Low #1 track
- Low #2 center
- Low #2 track

UCSD Scripps CW3E, Contact B. Kawzenuk/M. Ralph

NCEP NAM 500-hPa Absolute Vorticity ($\times 10^{-5} \text{ s}^{-1}$), Height (gpm), and Winds
Initialized: 0000 UTC 04/10/2016 Valid: 0000 UTC 04/10/2016

5 pm Sat Apr 9

UCSD Scripps CW3E, Contact B. Kawzenuk/M. Ralph

NCEP NAM 500-hPa Absolute Vorticity ($\times 10^{-5} \text{ s}^{-1}$), Height (gpm), and Winds
Initialized: 0000 UTC 04/09/2016 Valid: 0000 UTC 04/09/2016

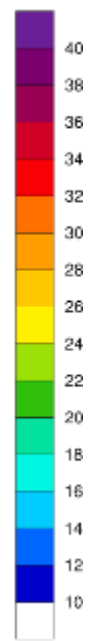
5 pm Fri Apr 8

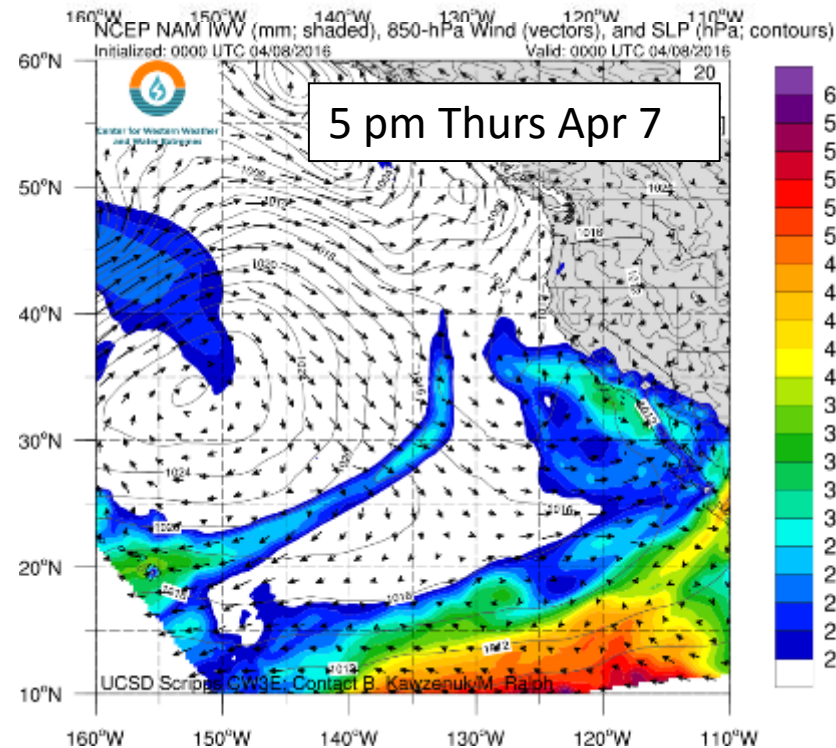
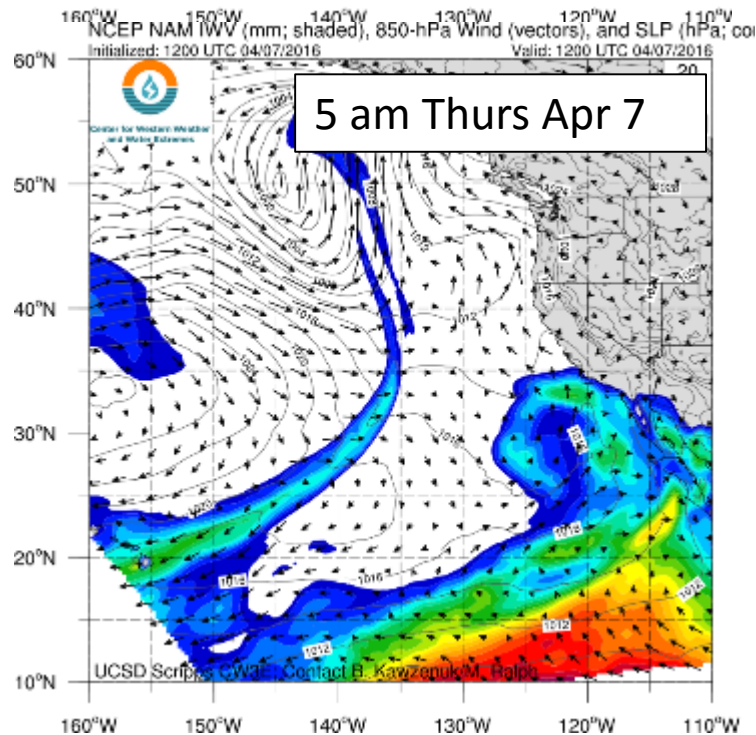
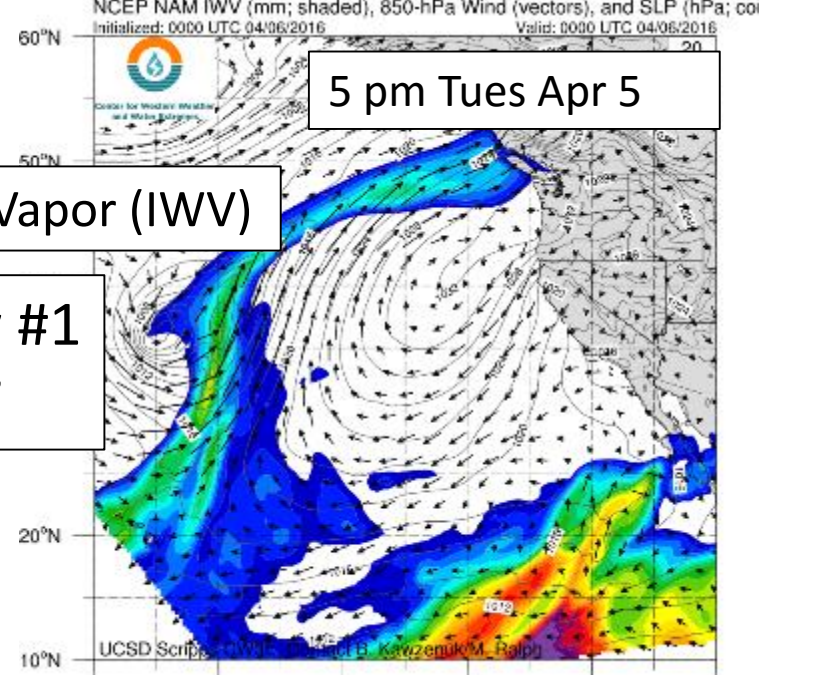
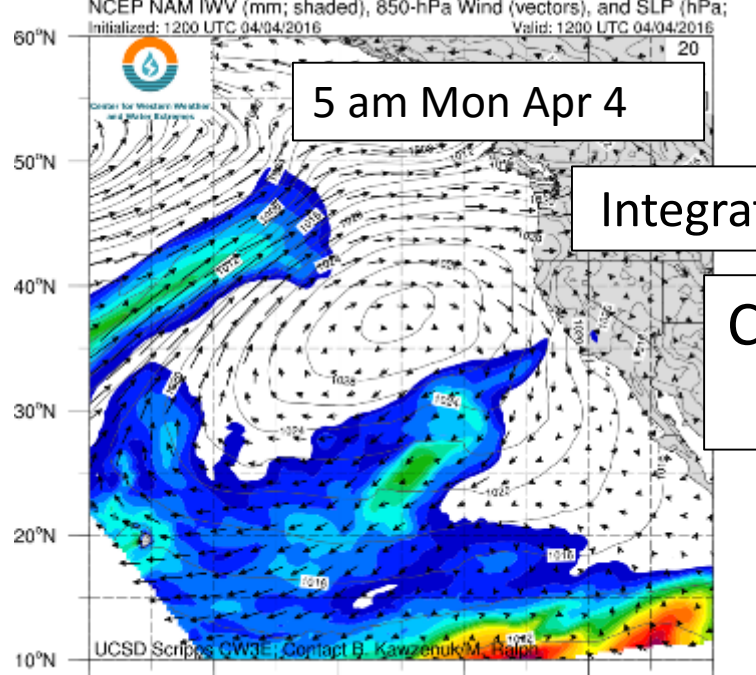
UCSD Scripps CW3E, Contact B. Kawzenuk/M. Ralph

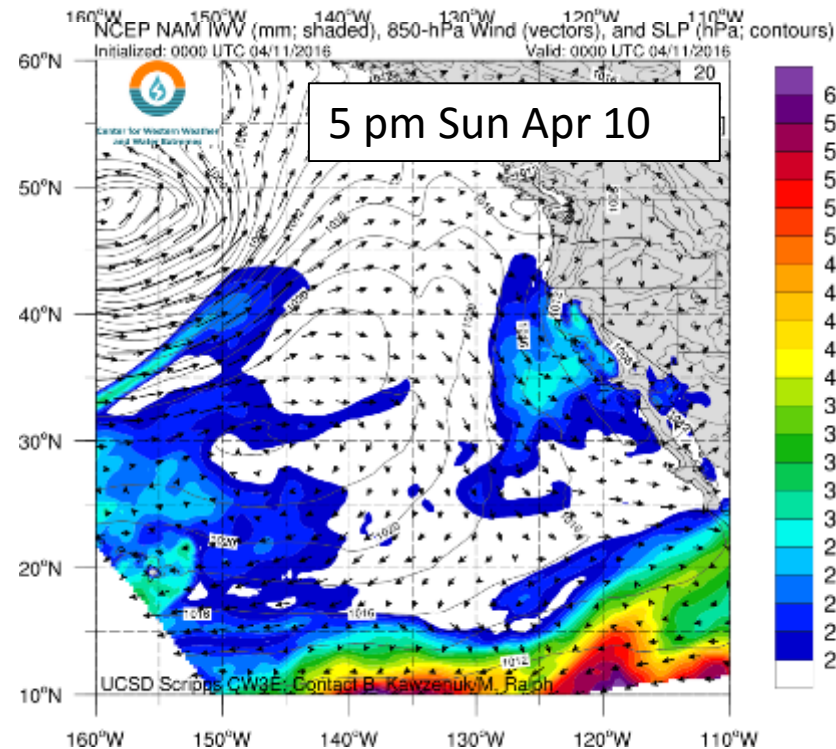
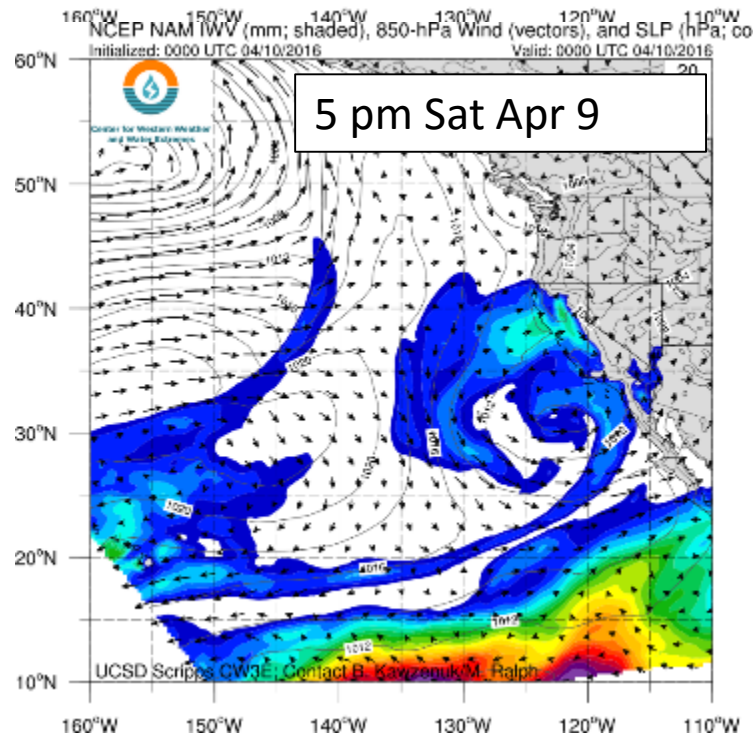
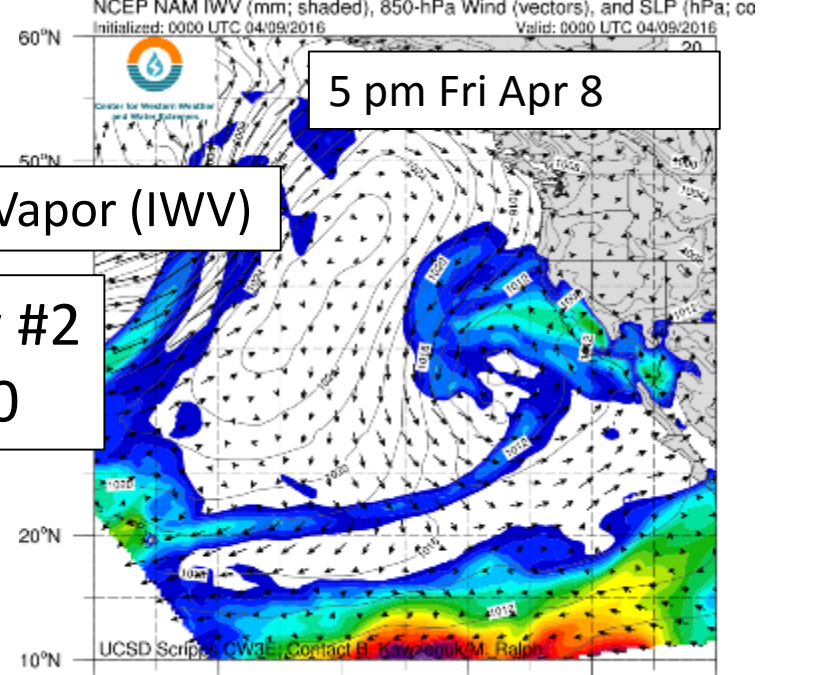
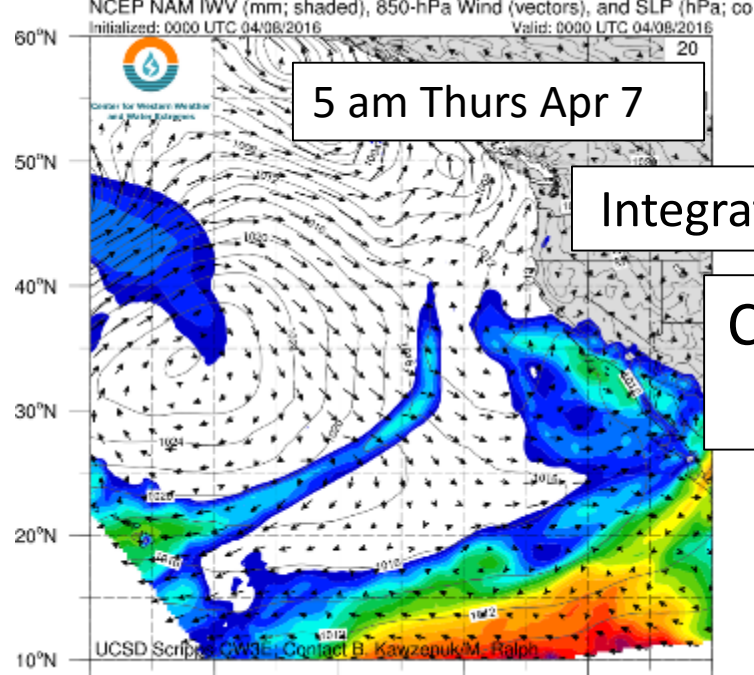
NCEP NAM 500-hPa Absolute Vorticity ($\times 10^{-5} \text{ s}^{-1}$), Height (gpm), and Winds
Initialized: 0000 UTC 04/11/2016 Valid: 0000 UTC 04/11/2016

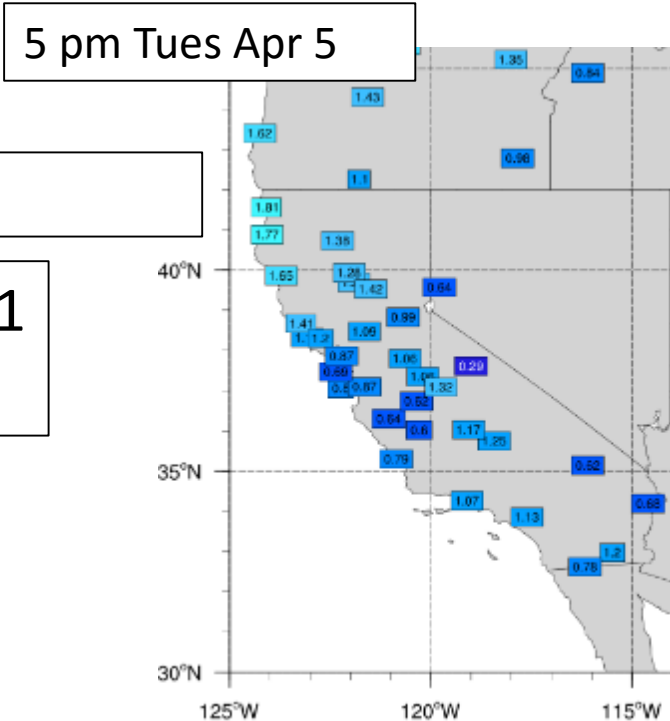
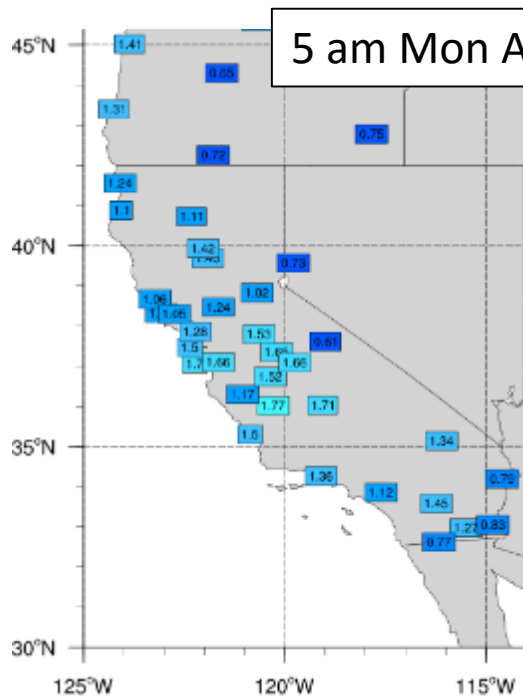
5 pm Sun Apr 10

UCSD Scripps CW3E, Contact B. Kawzenuk/M. Ralph



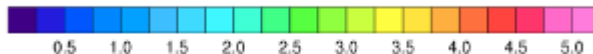
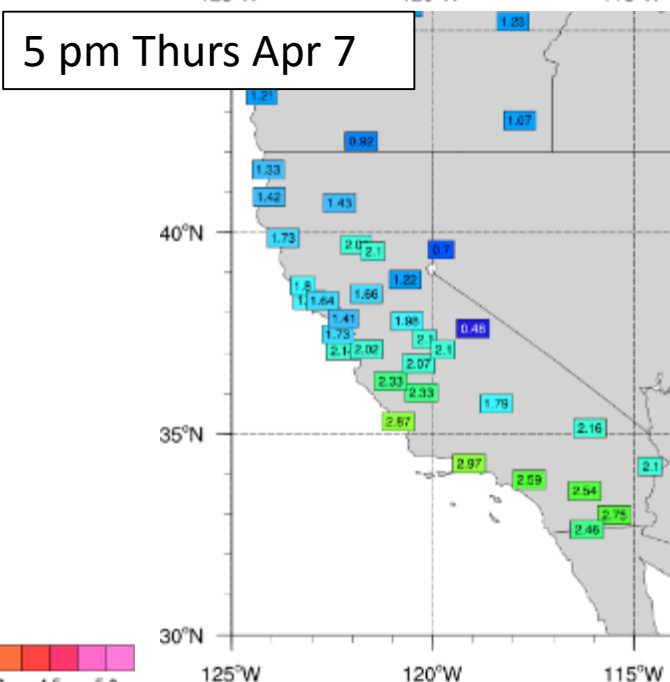
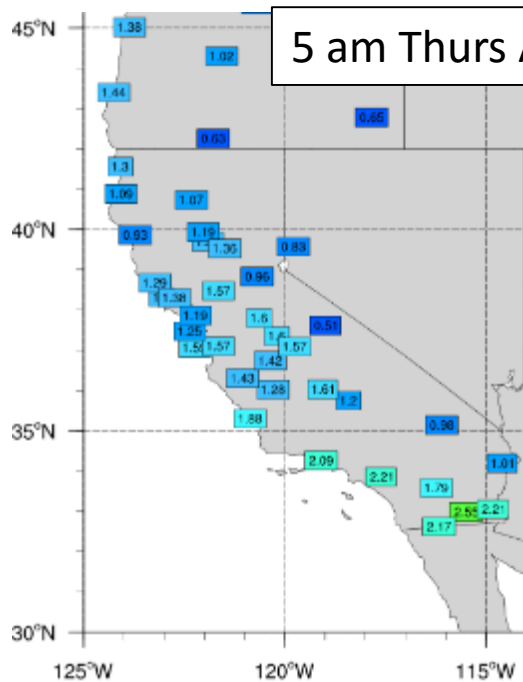


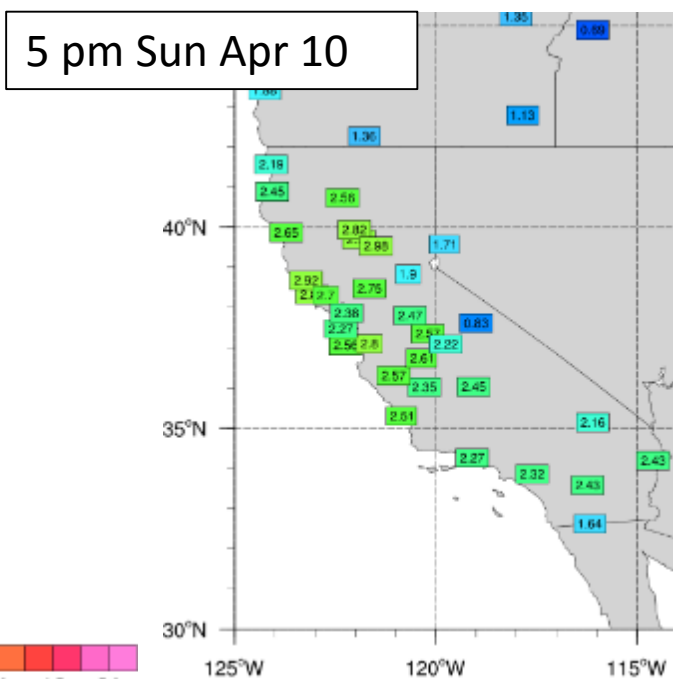
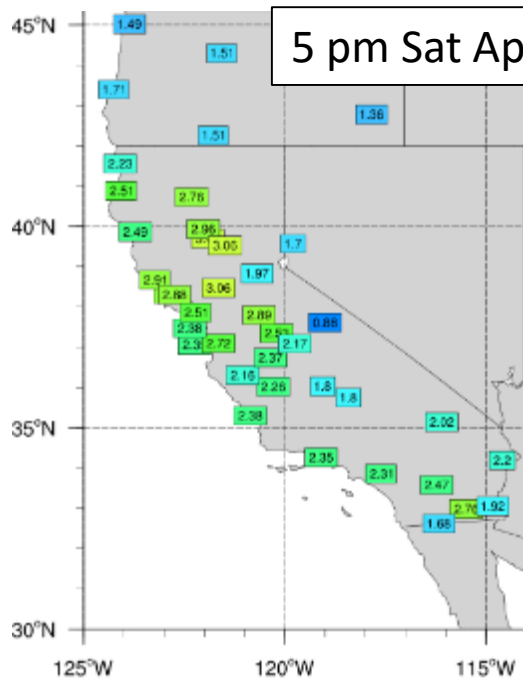
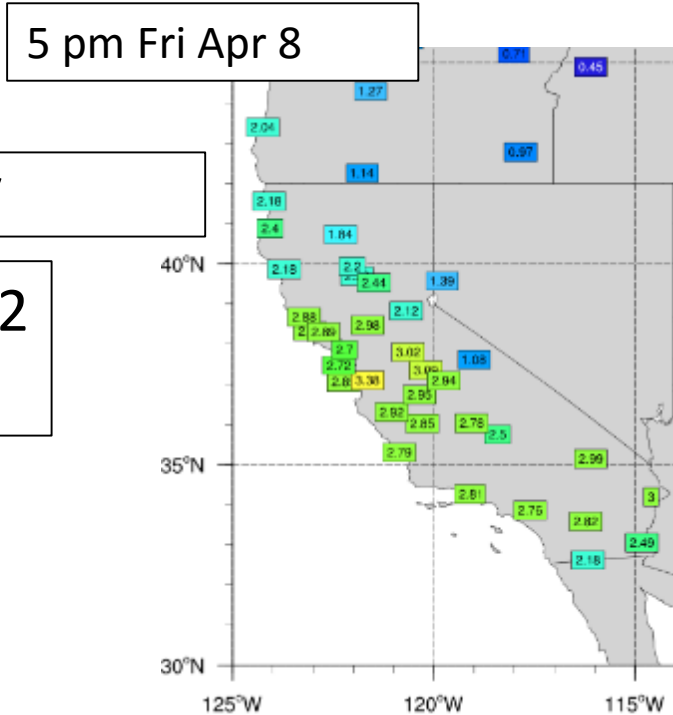
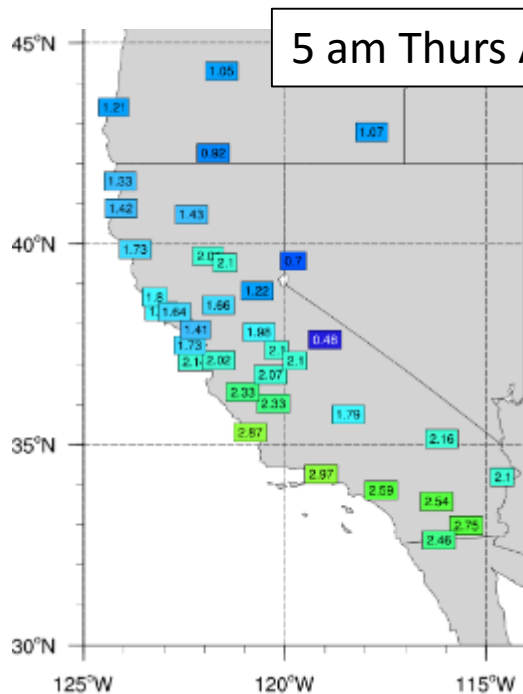




GPS-Met IWV

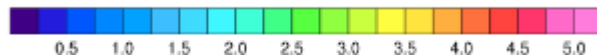
Cutoff low #1
Apr 4-7





GPS-Met IWV

Cutoff low #2
Apr 7-10



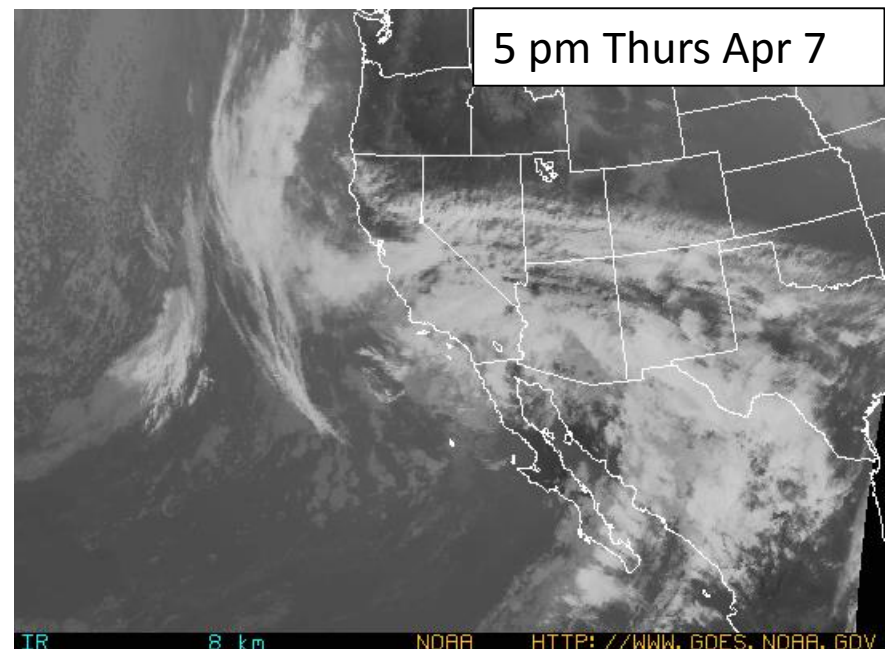
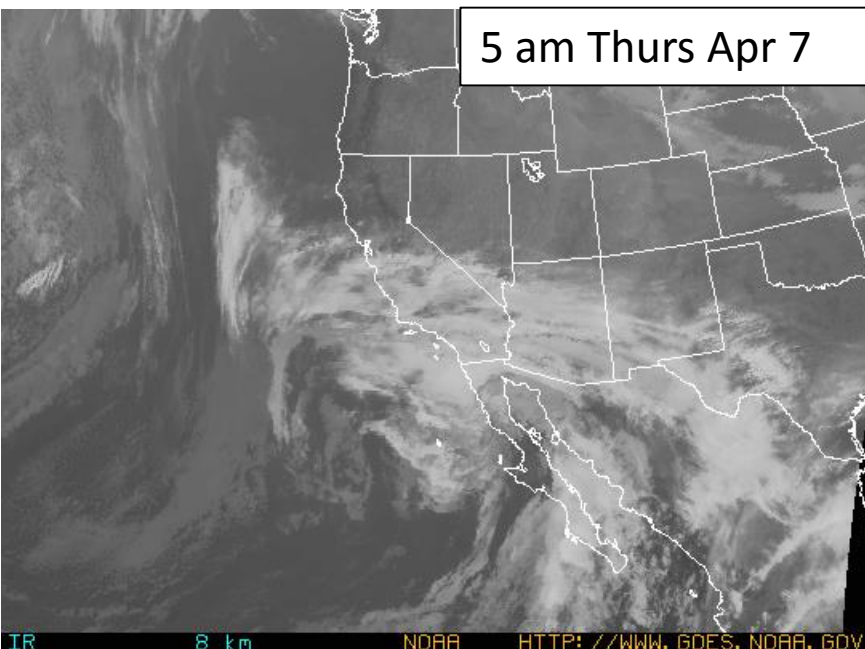
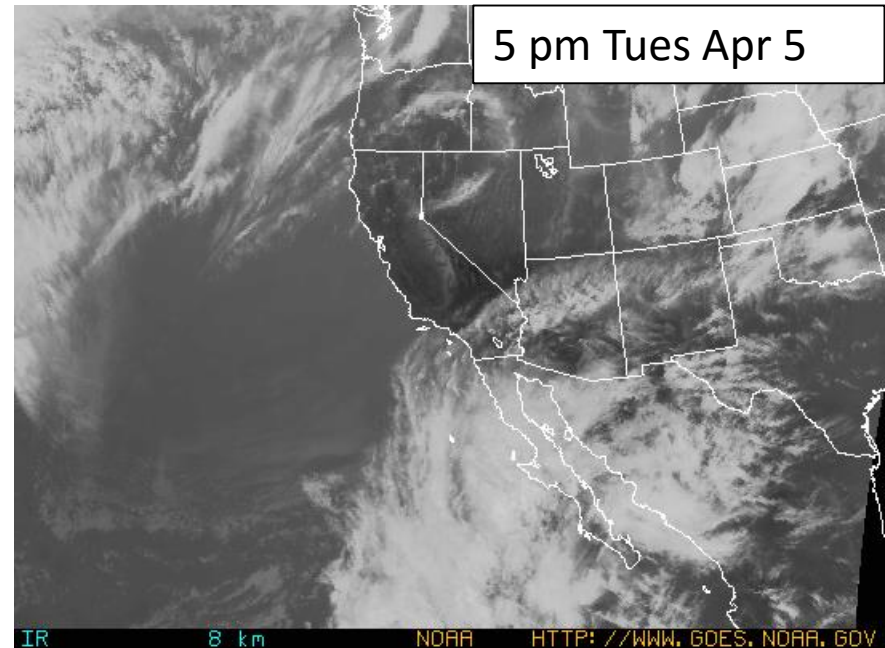
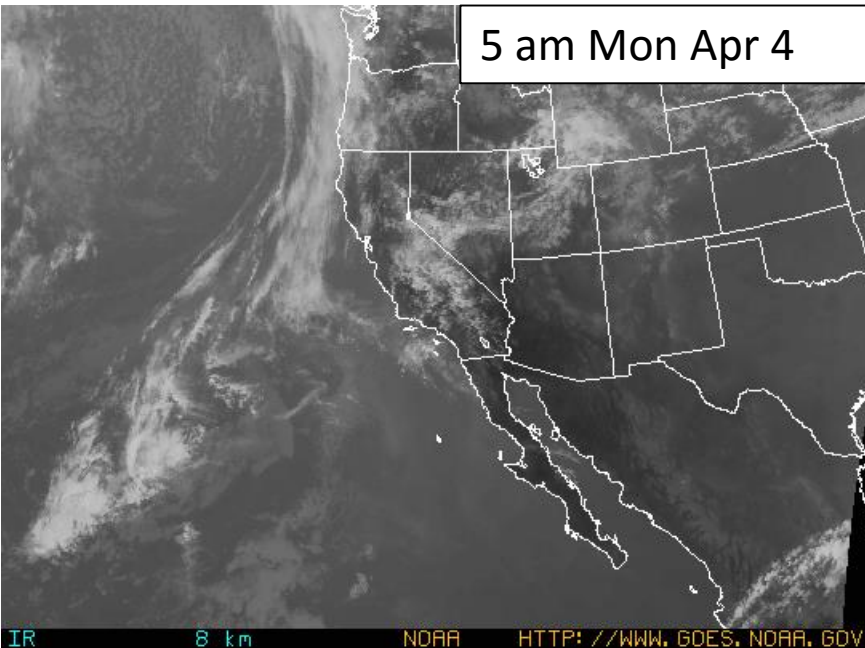
5 am Mon Apr 4

5 pm Tues Apr 5

GOES-West IR: Cutoff low #1 Apr 4-7

5 am Thurs Apr 7

5 pm Thurs Apr 7



5 am Thurs Apr 7

5 pm Fri Apr 8

GOES-West IR: Cutoff low #2 Apr 7-10

5 pm Sat Apr 9

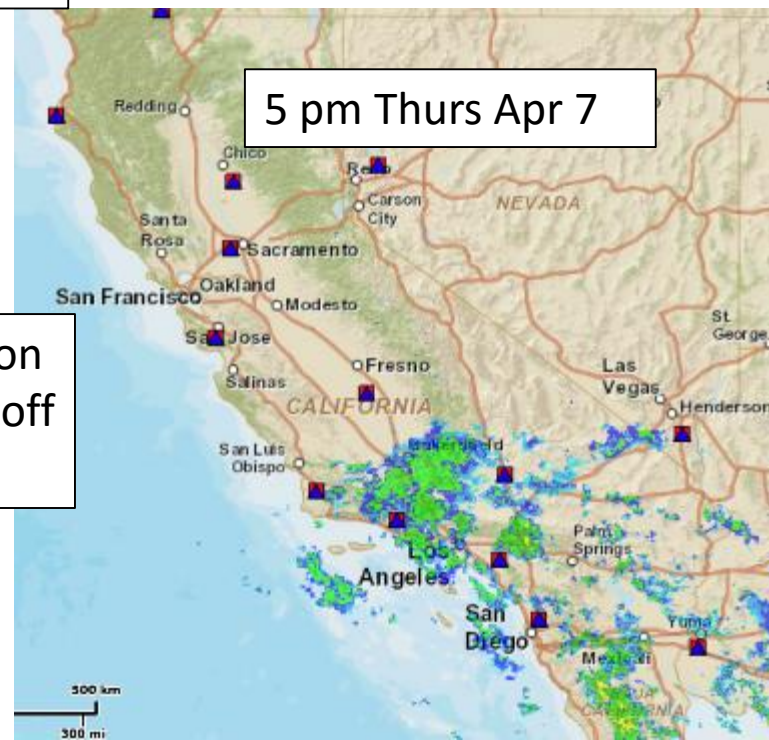
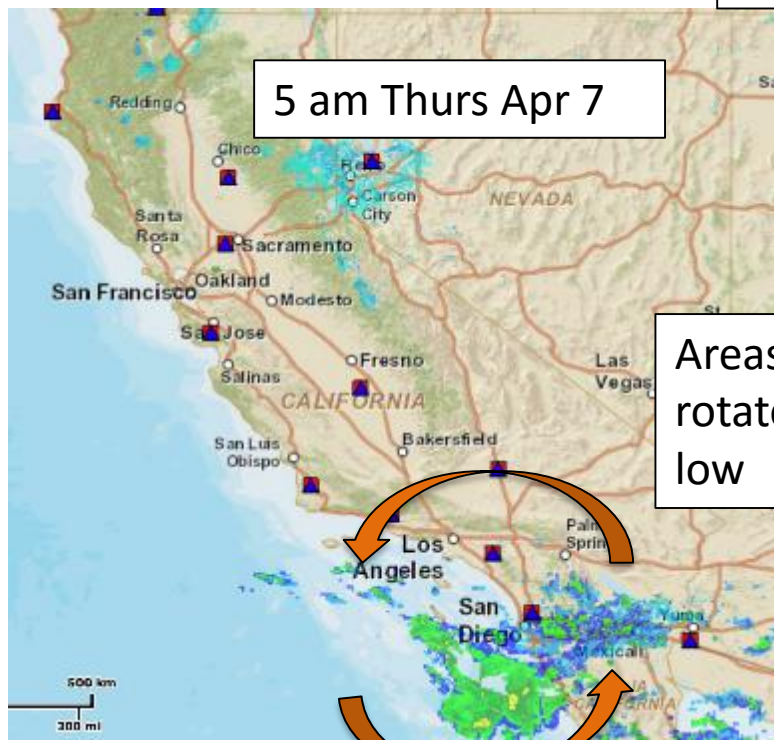
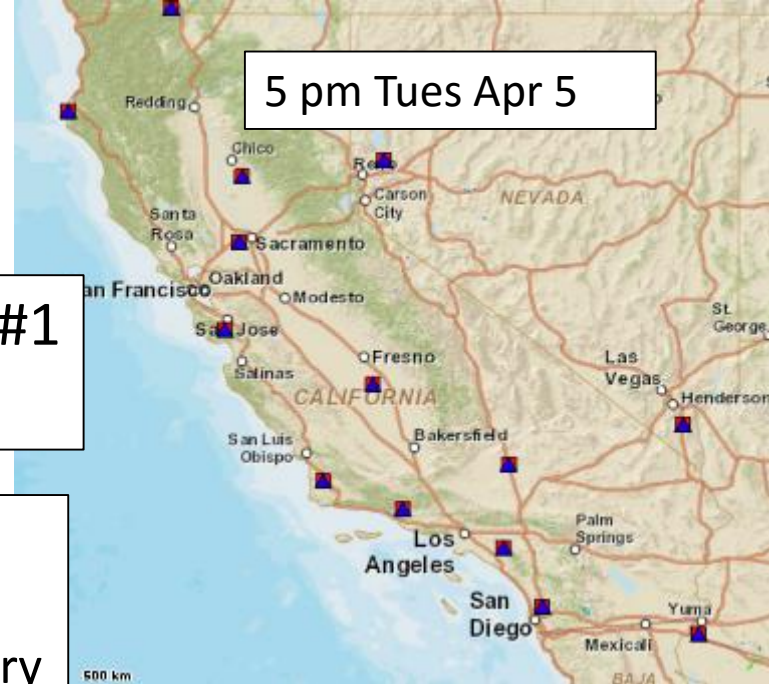
5 pm Sun Apr 10

IR 8 km NOAA [HTTP://WWW.GOES.NOAA.GOV](http://www.goes.noaa.gov)

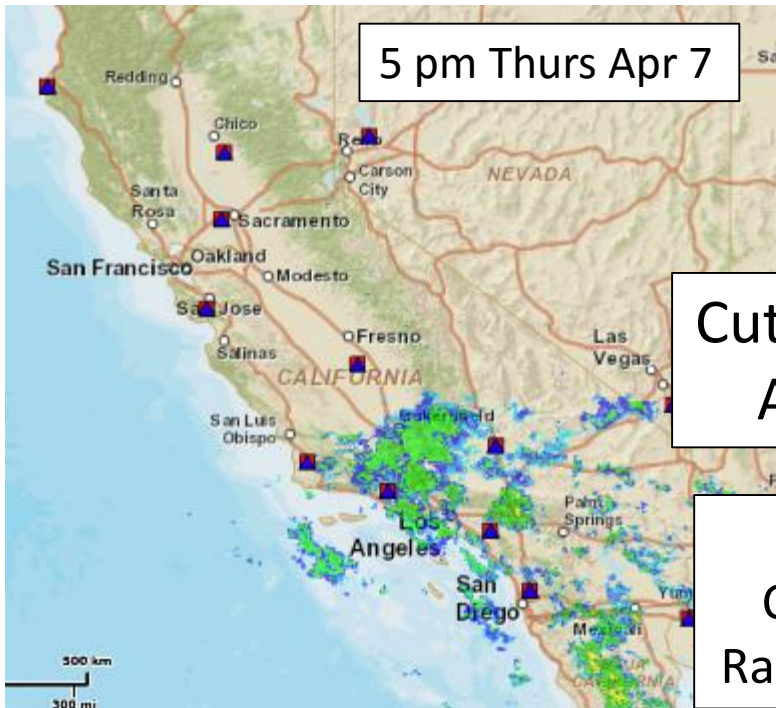
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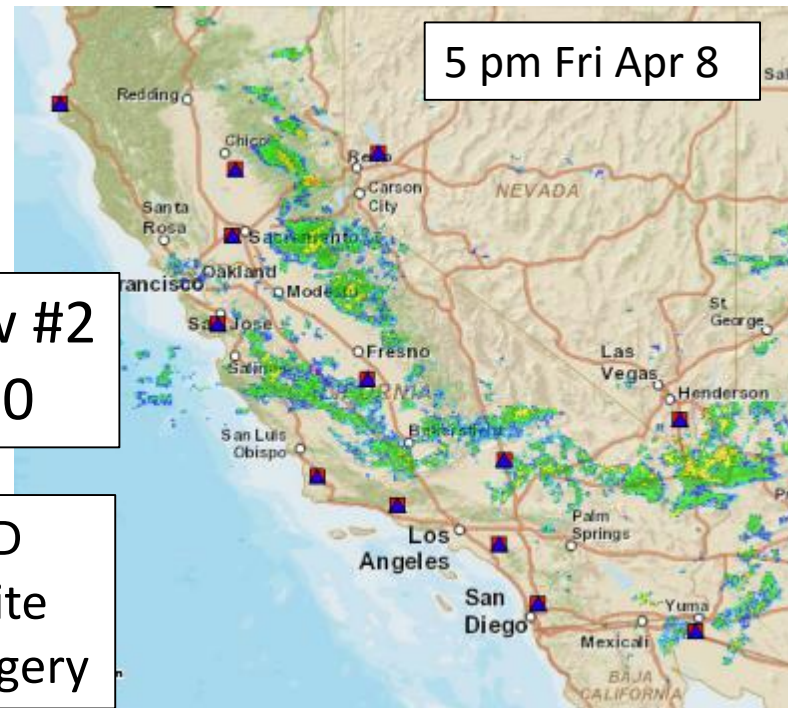
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5 pm Thurs Apr 7



5 pm Fri Apr 8

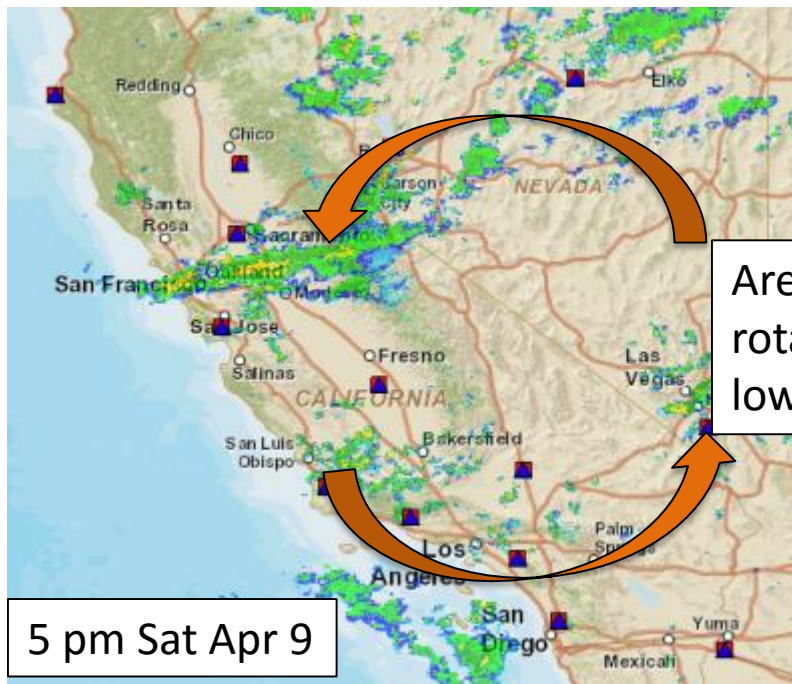


Cutoff low #2
Apr 7-10

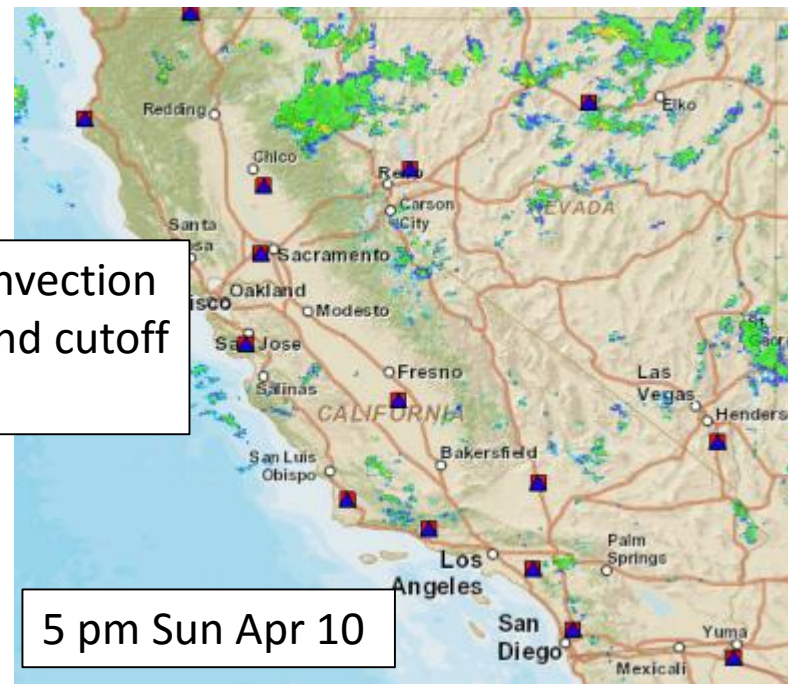
NEXRAD
Composite
Radar Imagery

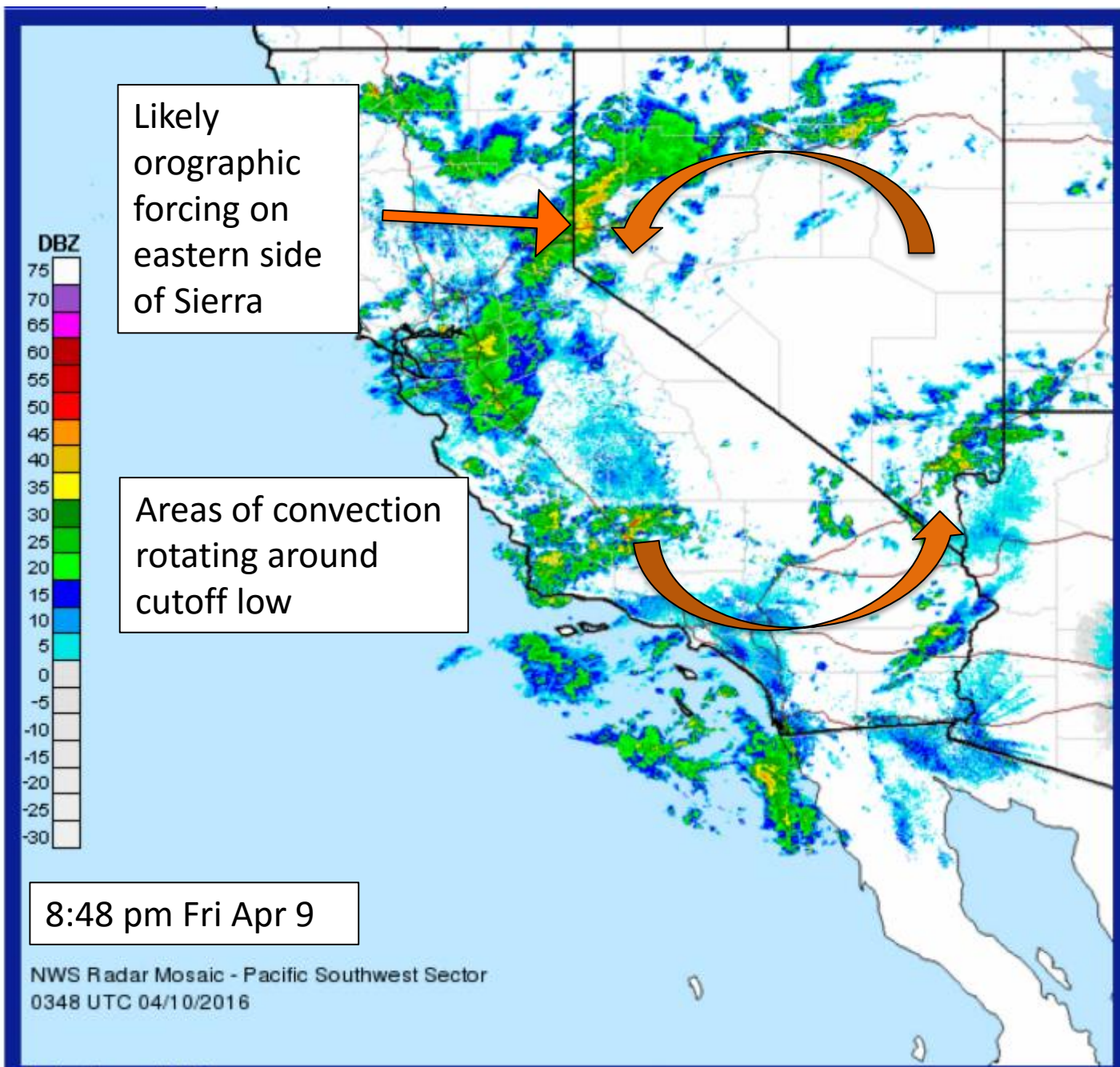
Areas of convection
rotate around cutoff
low

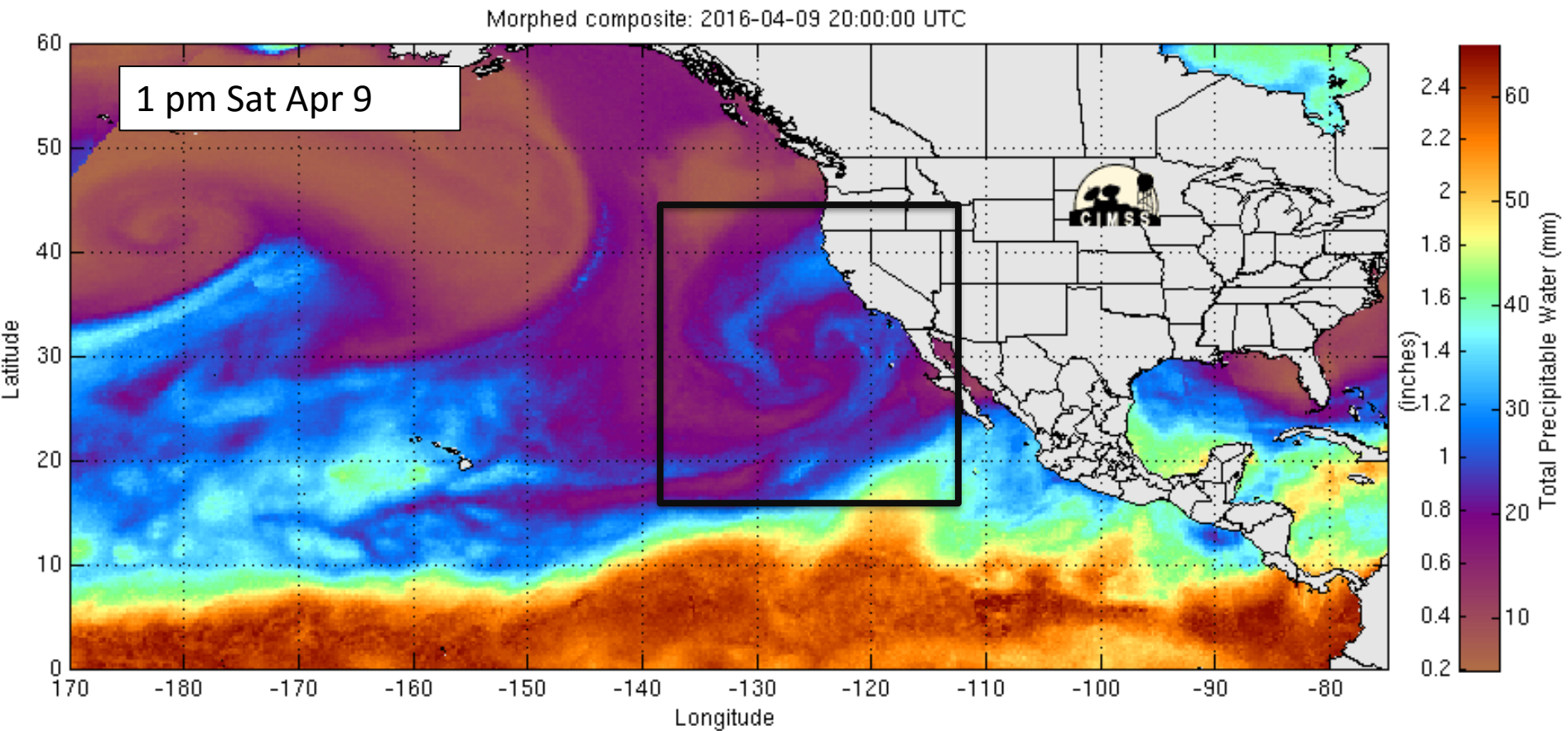
5 pm Sat Apr 9



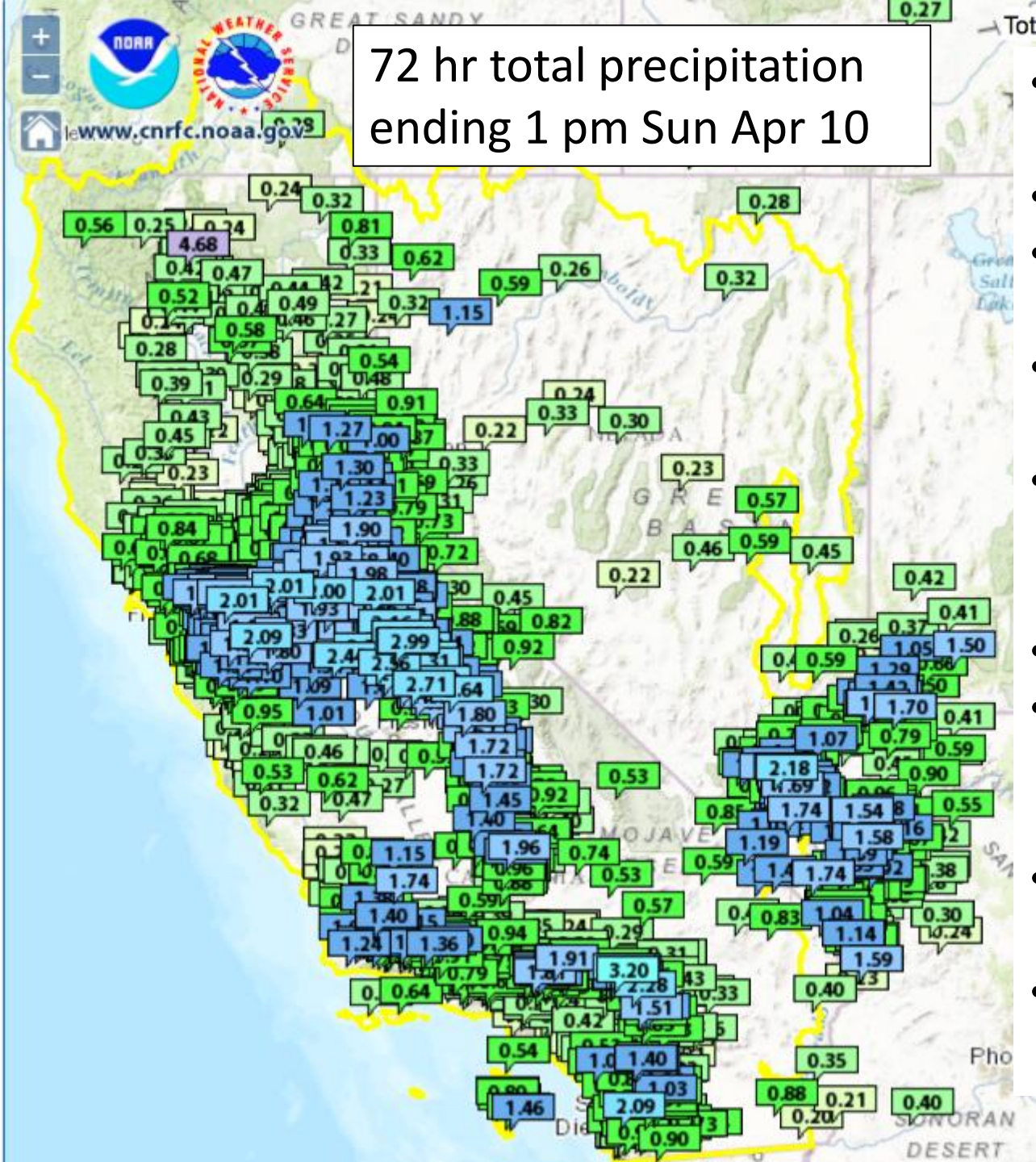
5 pm Sun Apr 10







Well developed cutoff low is entraining moisture plume;
moisture wrapping around low



- Bay Area coast ranges 1-2 in
- Reno area: 0.5-1 in
- Central/southern Sierra Nevada 1-3 in
- Central Valley 1-2+ inches
- 1-2+ in San Gabriel, Santa Ynez, San Bernardino Mtns
- 1-2 in Las Vegas area
- San Diego 0.55 in 6-10th, 71% of Apr normal
- Fresno 0.95 in 8th-9th, 100% of Apr normal
- Reno 0.67 in Apr 9-10, 142% Apr normal

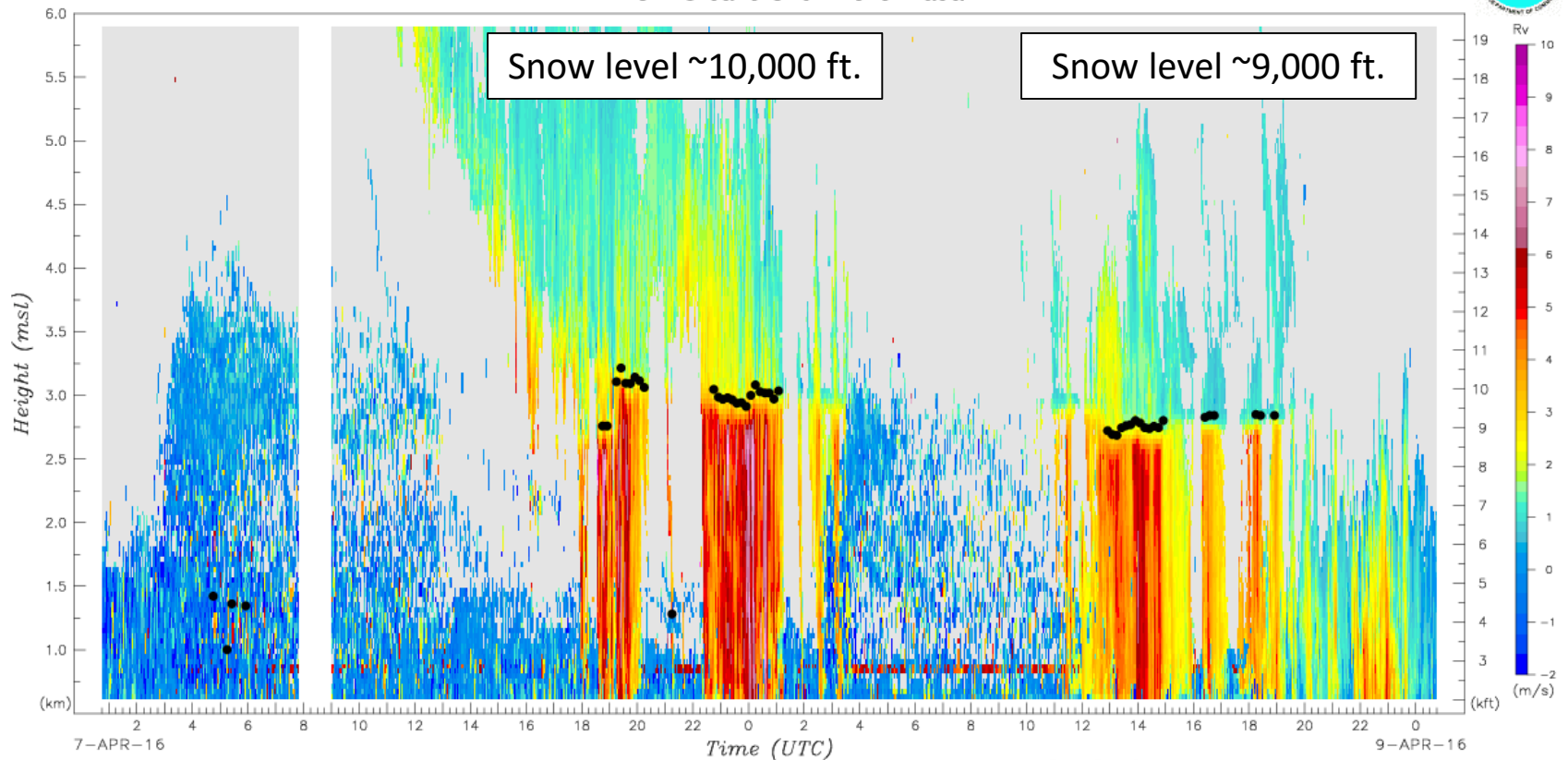
72 hour snowfall totals*

Squaw Ski Area	2 in
Mt Rose Ski Area	2 in
Heavenly Ski Area	4-5 in
Kirkwood Ski Area	12 in
Mammoth Ski Area	13 in

*As reported by each ski resort

Snow Level Radar: San Bernadino, CA

ESRL Physical Sciences Division
FMCW S-band Snow Level Radar



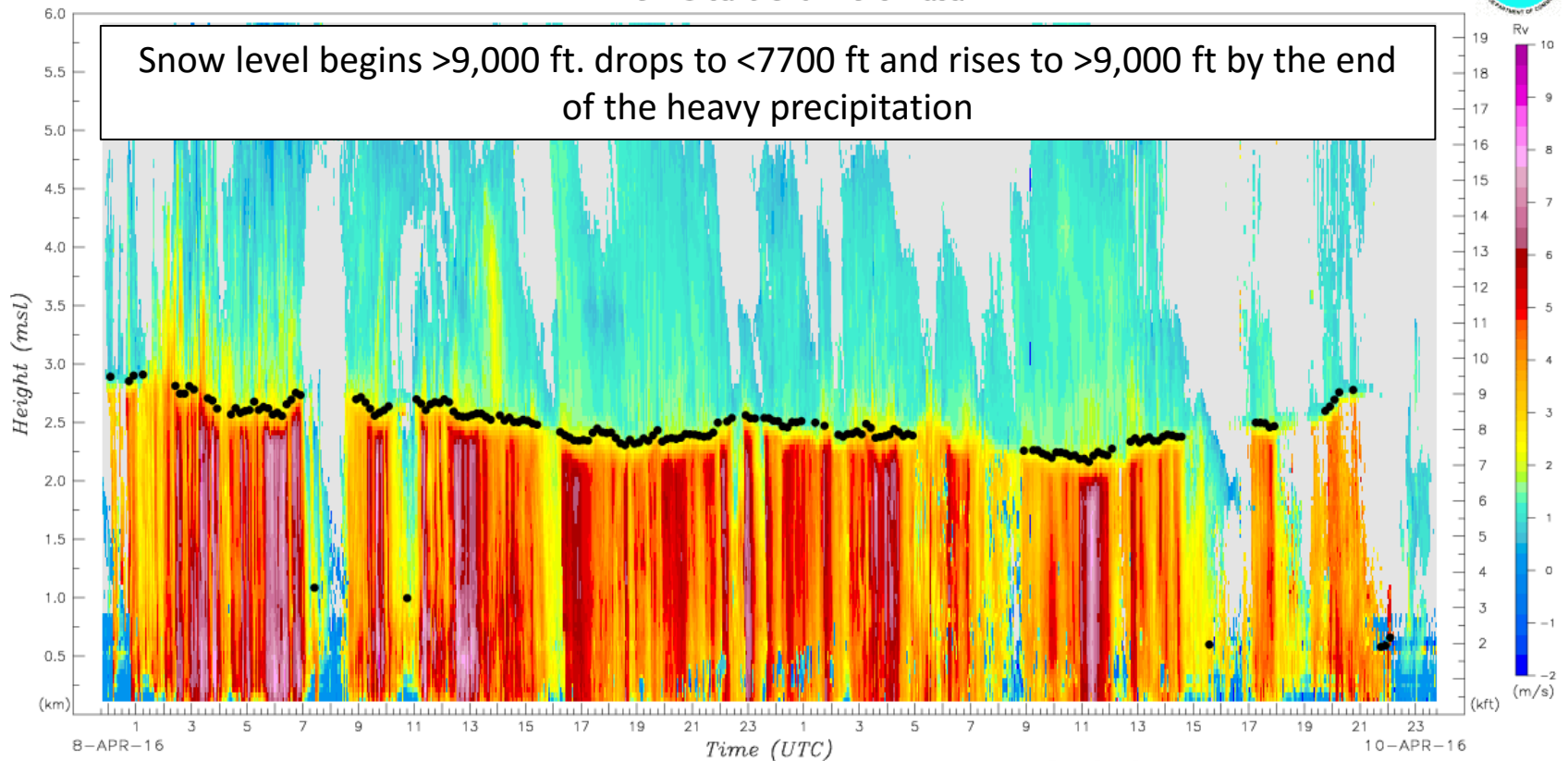
San Bernardino, CA (SBO)
34.2032 N, 117.3353 W, 602 m

Time (UTC)	0115	0215	0315	0415	0515	0615	0715	0815	0915	1015	1115	1215	1315	1415	1515	1615	1715	1815	1915	2015	2115	2215	2315	0015
Snow Level (m)	none	none	none	none	1362	1346	none	none	none	none	none	none	none	none	none	none	none	none	3095	3103	1282	none	2975	3009
Snow Level (ft)	none	none	none	none	4467	4414	none	none	none	none	none	none	none	none	none	none	none	none	10151	10179	4204	none	9758	9871
Sfc Temp (C)	25.88	21.55	18.02	17.36	16.25	16.07	15.51	15.18	15.01	15.05	14.67	15.17	14.98	16.16	17.23	17.17	17.65	17.57	17.56	17.31	16.83	16.56	15.68	14.99

Time (UTC)	0115	0215	0315	0415	0515	0615	0715	0815	0915	1015	1115	1215	1315	1415	1515	1615	1715	1815	1915	2015	2115	2215	2315	0015
Snow Level (m)	3018	none	none	none	none	none	none	none	none	none	none	none	2722	2763	2774	2834	2842	2846	2842	none	none	none	none	none
Snow Level (ft)	9899	none	none	none	none	none	none	none	none	none	none	none	8928	9064	9098	9297	9321	9334	9321	none	none	none	none	none
Sfc Temp (C)	14.63	14.50	14.03	13.34	12.68	12.46	12.46	11.82	11.65	11.82	11.76	12.02	12.14	11.81	12.20	13.13	14.07	14.57	14.24	13.59	13.15	12.83	12.88	13.00

Snow Level Radar: San Luis Reservoir, CA

ESRL Physical Sciences Division
FMCW S-band Snow Level Radar



San Luis Reservoir, CA (SLR)
37.0611 N, 121.0668 W, 81 m

Time (UTC)	0015	0115	0215	0315	0415	0515	0615	0715	0815	0915	1015	1115	1215	1315	1415	1515	1615	1715	1815	1915	2015	2115	2215	2315
Snow Level (m)	2891	2901	2779	2764	2620	2606	2602	2734	none	2671	2604	2655	2670	2555	2523	2503	2391	2348	2387	2346	2362	2391	2503	2536
Snow Level (ft)	9482	9515	9116	9065	8595	8549	8534	8967	none	8760	8541	8708	8757	8382	8275	8209	7842	7703	7831	7694	7747	7842	8209	8319
Sfc Temp (C)	17.97	16.39	15.31	14.69	14.76	14.71	14.46	14.86	14.94	14.78	14.55	14.25	13.99	14.10	14.32	14.32	14.74	15.54	15.49	15.49	15.71	16.44	16.72	15.99

Time (UTC)	0015	0115	0215	0315	0415	0515	0615	0715	0815	0915	1015	1115	1215	1315	1415	1515	1615	1715	1815	1915	2015	2115	2215	2315
Snow Level (m)	2507	2501	2398	2413	2389	2395	none	none	none	2260	2226	2202	2229	2348	2378	598	none	2498	2463	none	2665	2778	591	none
Snow Level (ft)	8222	8203	7865	7914	7837	7855	none	none	none	7412	7301	7224	7311	7703	7799	1961	none	8193	8078	none	8742	9111	1938	none
Sfc Temp (C)	16.40	16.19	15.94	15.53	14.98	14.40	13.89	13.55	13.59	13.52	13.33	13.31	13.19	13.17	13.19	13.90	14.42	14.90	14.81	15.26	15.26	15.04	14.79	14.60

Impacts

- Minor impacts
 - Delayed/impacted outdoor events
 - Giants/Dodgers game in SF delayed
 - Some flooding in Las Vegas area
- Generally beneficial precipitation
- May have impact on fire season in Great Basin, CA)
 - Spring rains increase vegetation that dries out in summer fire months

U.S. Drought Monitor

West

April 5, 2016

(Released Thursday, Apr. 7, 2016)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	38.50	61.50	35.64	15.09	9.53	4.33
Last Week 3/29/2016	32.63	67.37	34.24	14.82	9.53	4.74
3 Months Ago 1/5/2016	33.48	66.52	45.17	25.43	13.09	6.85
Start of Calendar Year 12/29/2015	33.17	66.83	45.07	29.30	15.92	6.85
Start of Water Year 9/29/2015	22.77	77.23	57.81	42.42	26.50	7.62
One Year Ago 4/7/2015	27.70	72.30	59.80	37.72	17.04	7.63

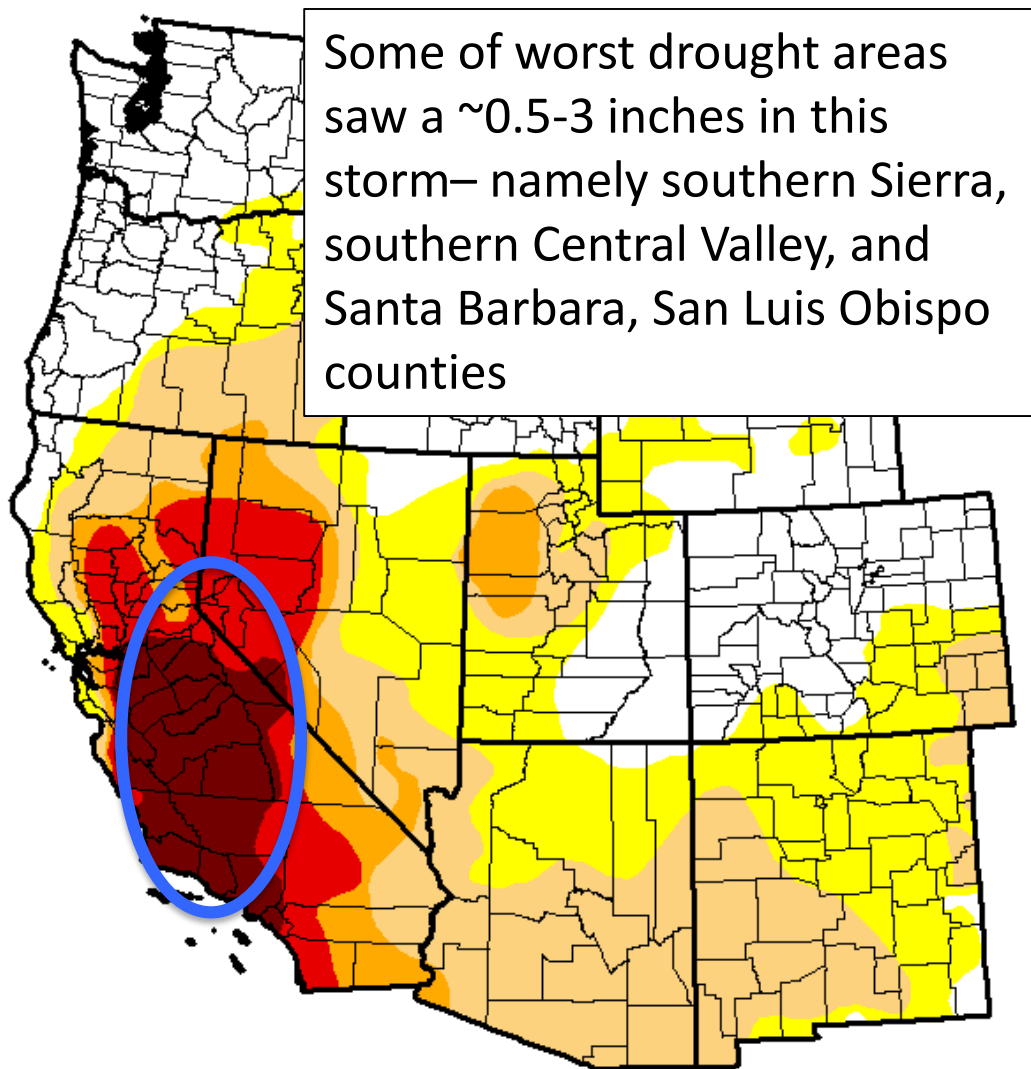
Intensity:

 D0 Abnormally Dry	 D3 Extreme Drought
 D1 Moderate Drought	 D4 Exceptional Drought
 D2 Severe Drought	

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:

Richard Tinker
CPC/NOAA/NWS/NCEP

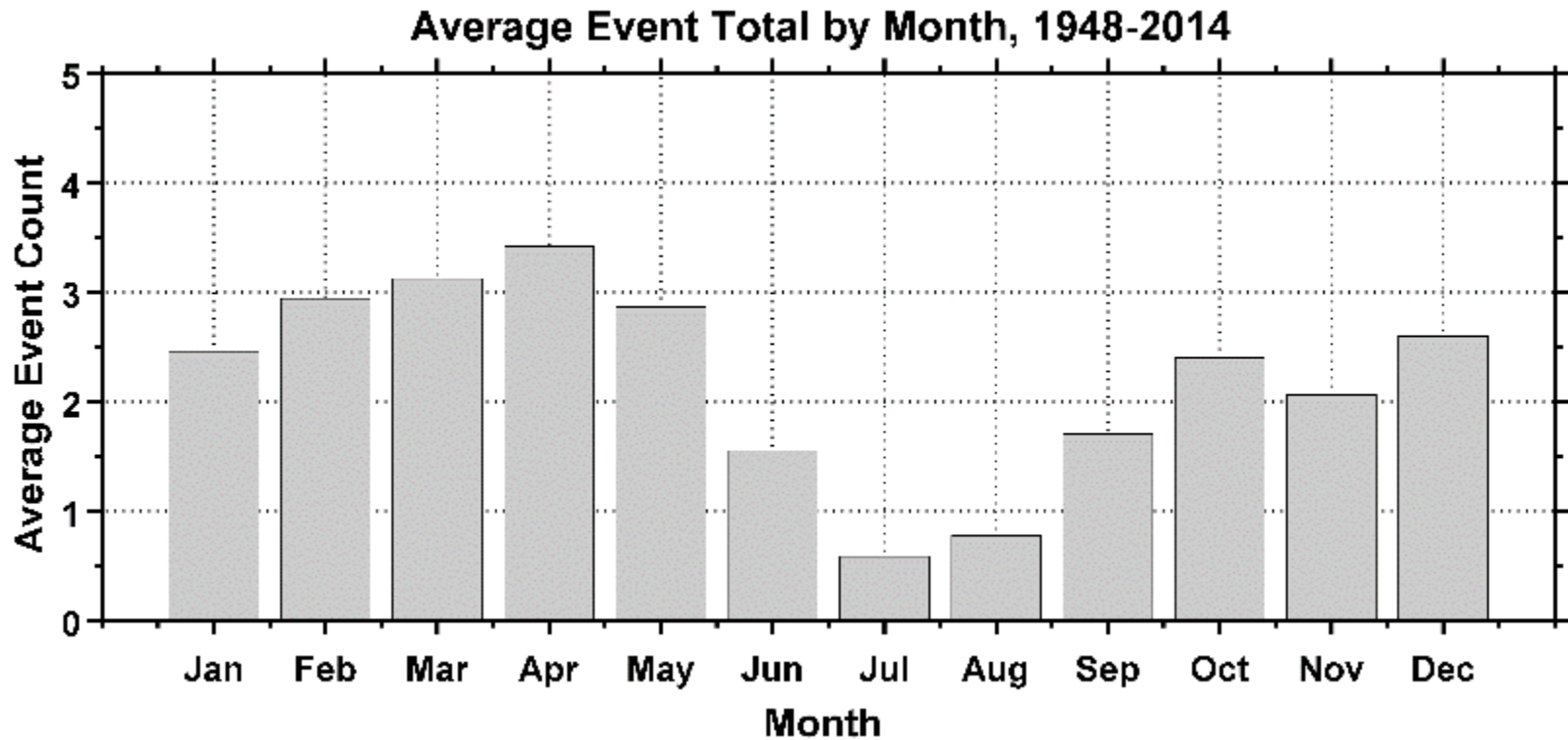


Some of worst drought areas saw a ~0.5-3 inches in this storm— namely southern Sierra, southern Central Valley, and Santa Barbara, San Luis Obispo counties



<http://droughtmonitor.unl.edu/>

April 'tis the season for closed and cutoff lows in the Southwest



Based on Oakley and Redmond (2014)

72393 VBG Vandenberg Afb

100

200

300

400

500

600

700

800

900

00Z 10 Apr 2016

Vandenberg AFB
Saturday afternoon (4/9)
500 J/kg CAPE,
Lifted Index: -2.25
Appreciably unstable for
this area!

SLAT	34.75
SLON	-120.56
SELV	121.0
SHOW	3.83
LIFT	-2.25
LFTV	-2.42
SWET	29.99
KINX	25.90
CTOT	20.50
VTOT	27.50
TOTL	48.00
CAPE	502.5
CAPV	568.1
CINS	-3.22
CINV	-0.05
EQLV	384.8
EQTV	380.8
LFCT	886.8
LFCV	897.9
BRCH	35.67
BRCV	40.32
LCLT	283.2
LCLP	900.4
MLTH	291.8
MLMR	8.72
THCK	5713.
PWAT	21.01



University of Wyoming

KREV 160410/00(Sun) BUFRUA
39.57,-119.8
 293 mb 9437m $\theta=312K$
 -53.8°C 30960ft $\theta_w=286K$
 -64.9°F 0g/Kg $\theta_e=312K$

-64.9°F(-53.8°C) -52.5/-70.5°F(-46.9/-56.9°C)
 71/30kt 293mb 25986ft/7921m agl 31%

Reno (KREV)
 Saturday afternoon (4/9)
 Surface-based parcel
 734 J/kg CAPE,
 Lifted Index: -3
 Appreciably unstable for
 this area!

	Sum1	CAPE	CINH	LCL	LI	LFC	EL	Sum2	SR
SB PARCEL	734	0	0	1000m	-3	1055m	30202'	SFC-1km	-6
FCST PARCEL	314	0	0	1769m	-2	1769m	28430'	SFC-2km	5
MU PARCEL	734	0	0	1000m	-3	1055m	30202'	SFC-3km	46
ML PARCEL	2	-78		1425m	-0	4064m	15026'	Eff Inflow Layer	
USER PARCEL	0	0		M	9982	M	M	SFC-6km	
EFF PARCEL	429	-2		1126m	-2	1227m	28430'	SFC-8km	