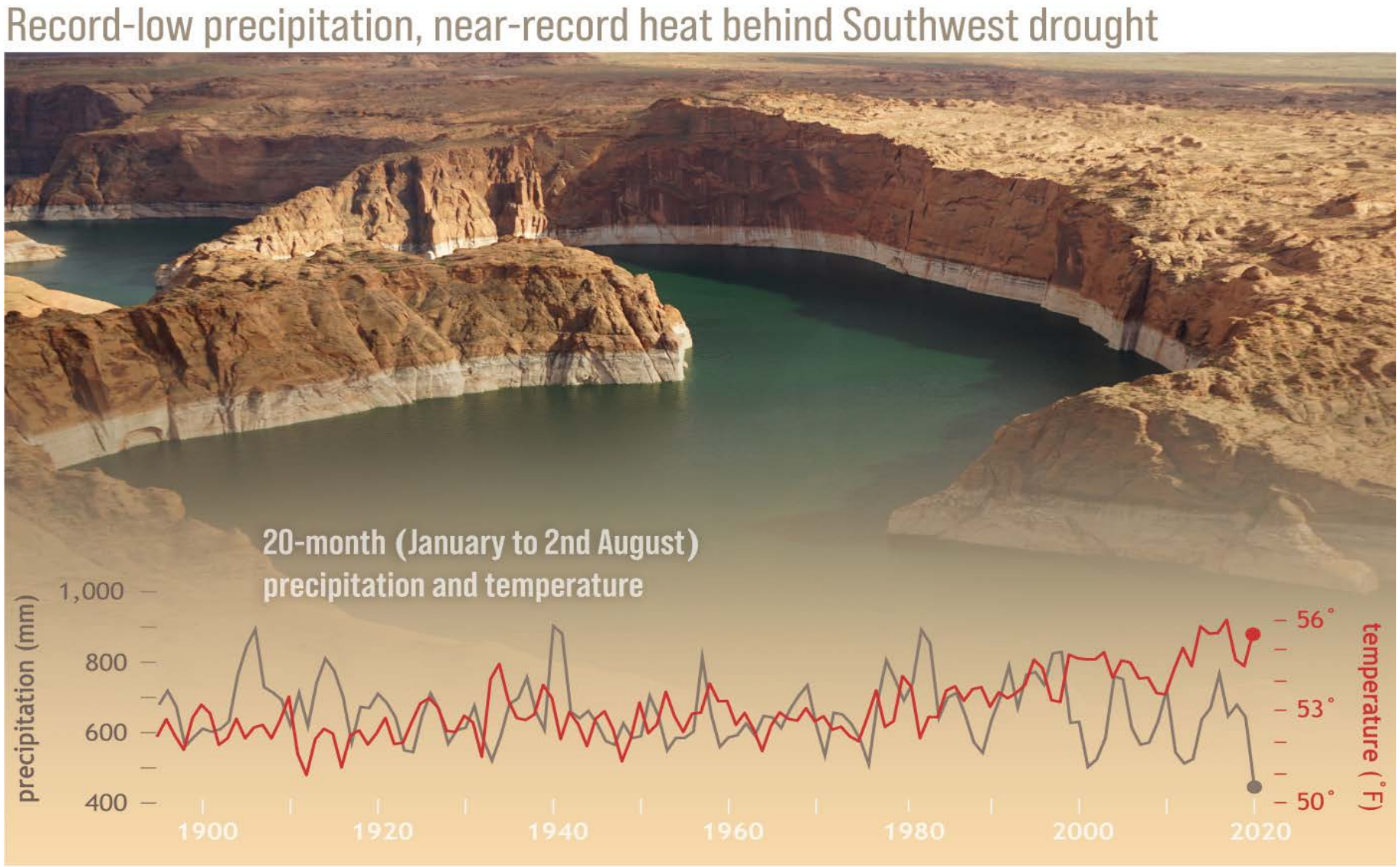
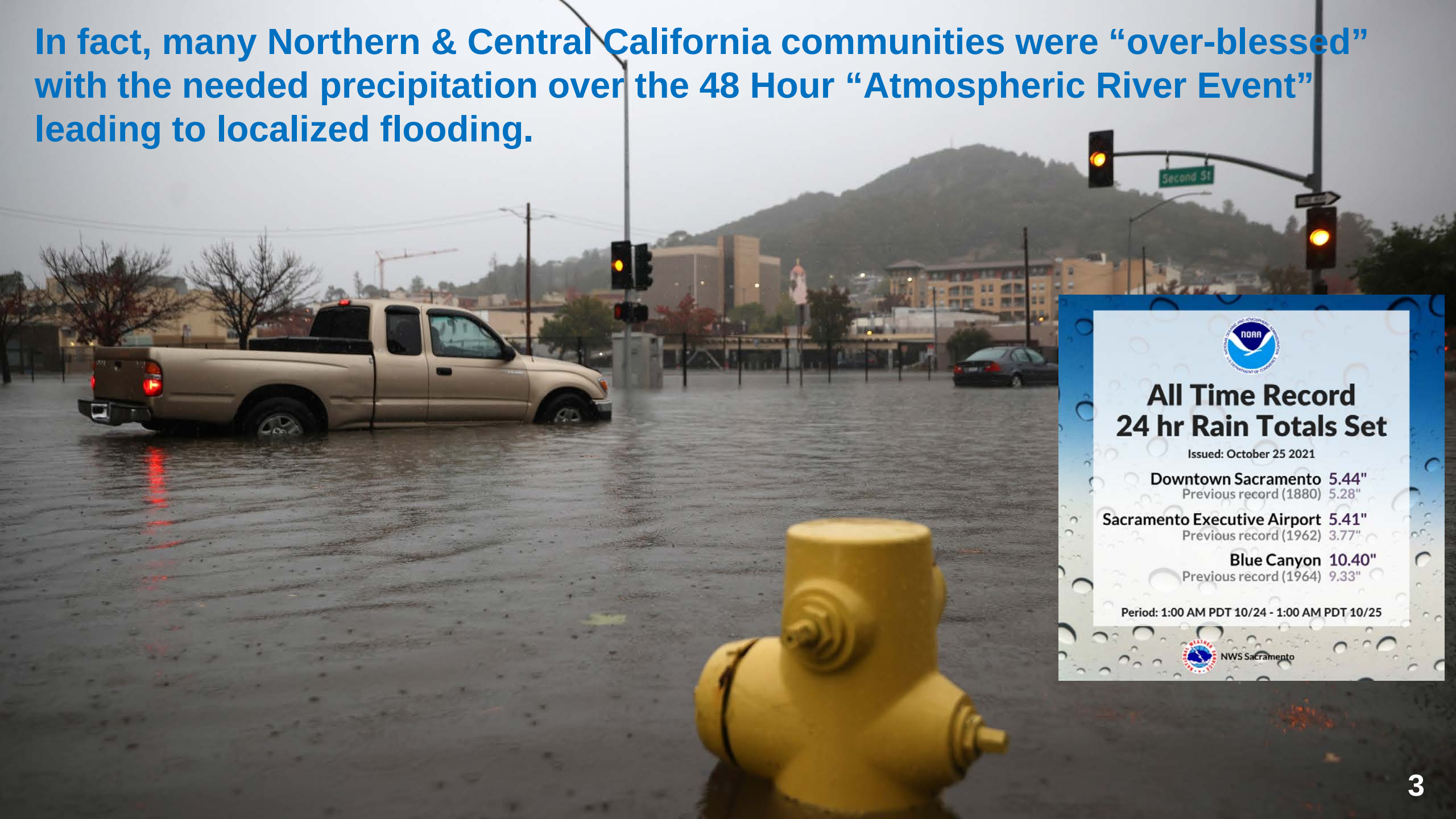
California Drought Update
11/1/2021

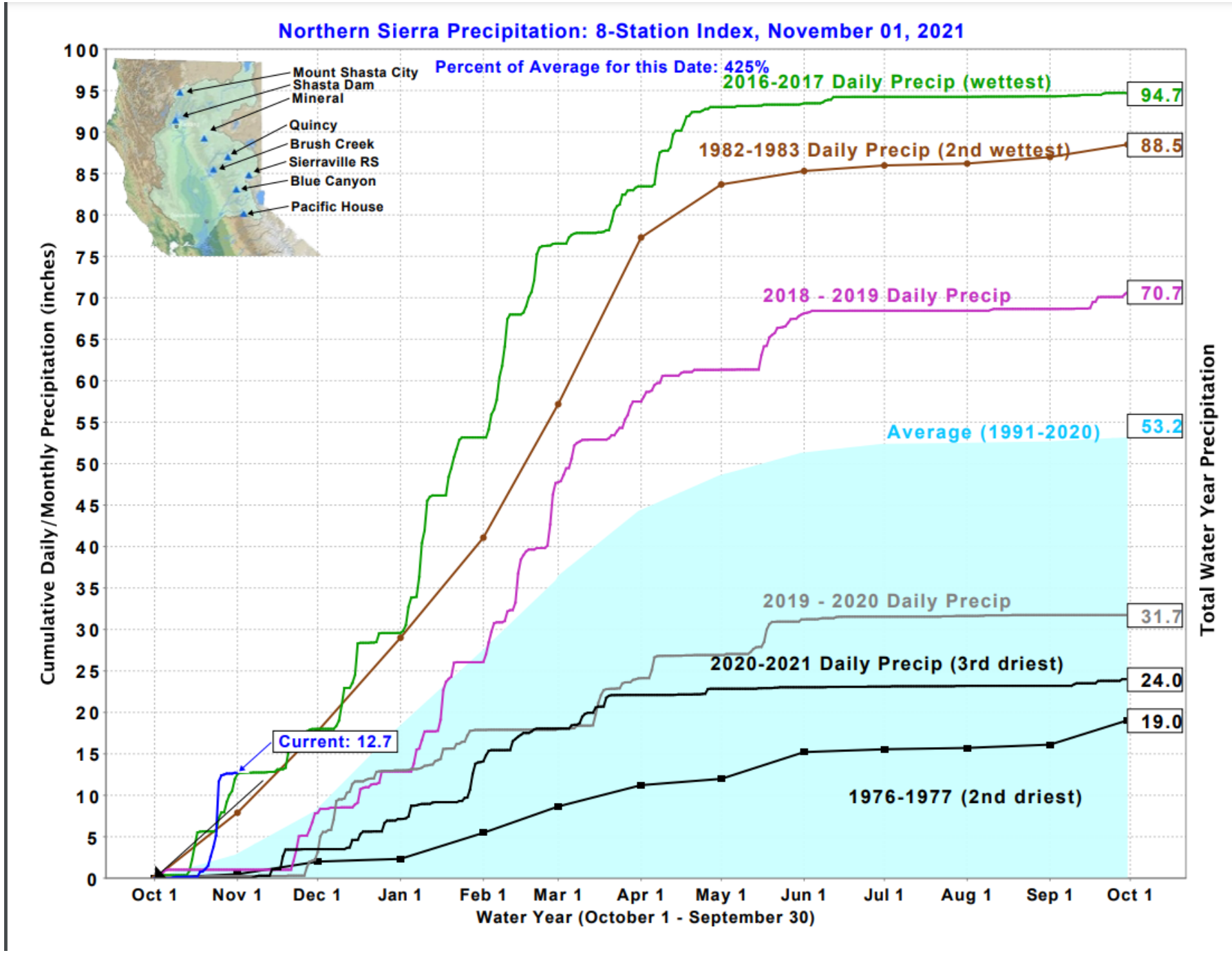
From February through mid-October 2021, we have received nothing but "Bad News" concerning the severity of drought and water supply conditions in the Western U.S. with many citizens in California finding it hard to remember what rain actually looked like!

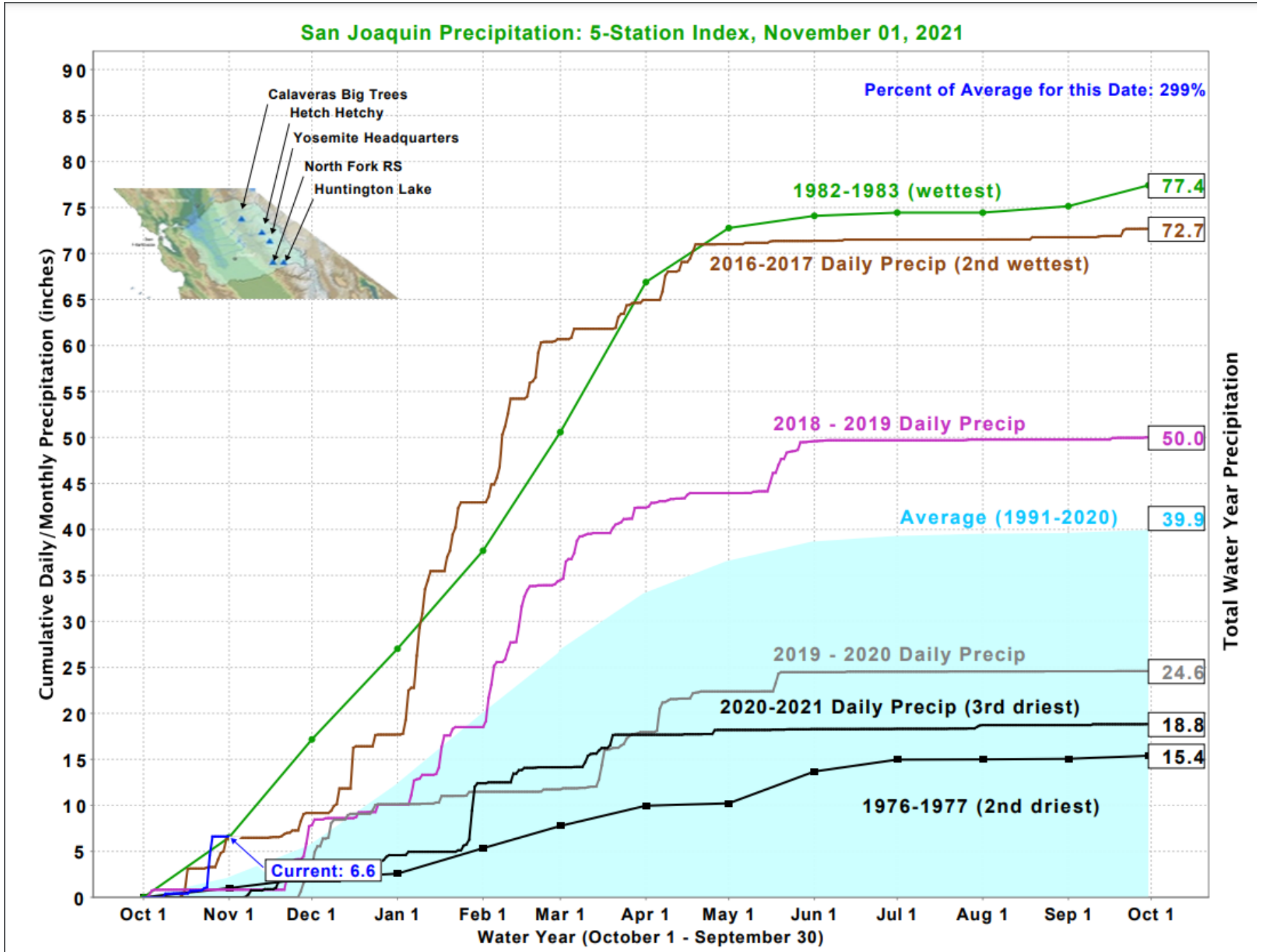


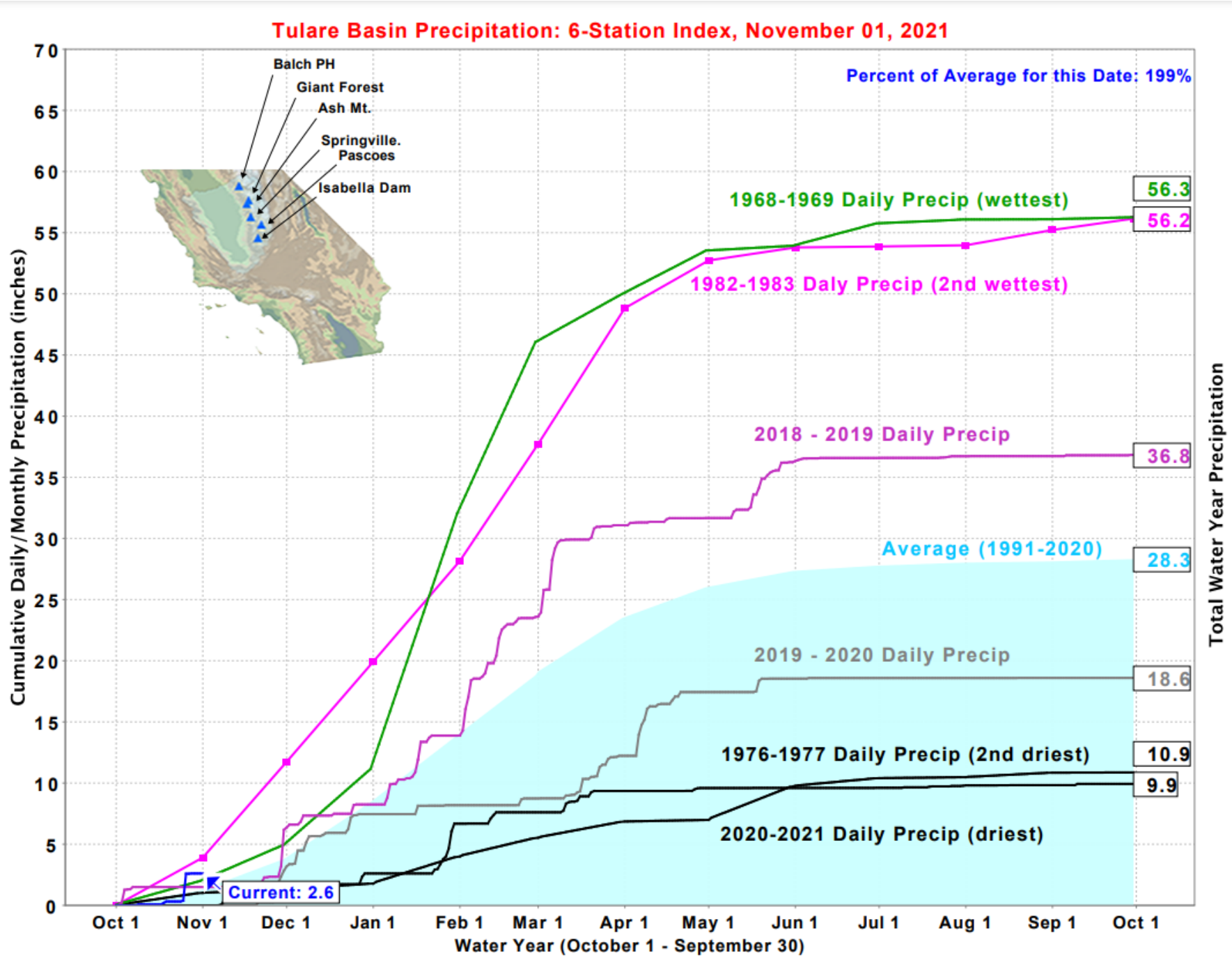
But then…after months of prayer for relief from the hot temperatures, dry soils, prolific forest fires, dirty/unhealthy air quality, and extremely tight water supplies and low reservoir storage levels, God's mercy and grace brought abundant early rain and snowfall to California's landscape from October 23rd – 25th!

In fact, many Northern & Central California communities were “over-blessed” with the needed precipitation over the 48 Hour “Atmospheric River Event” leading to localized flooding.

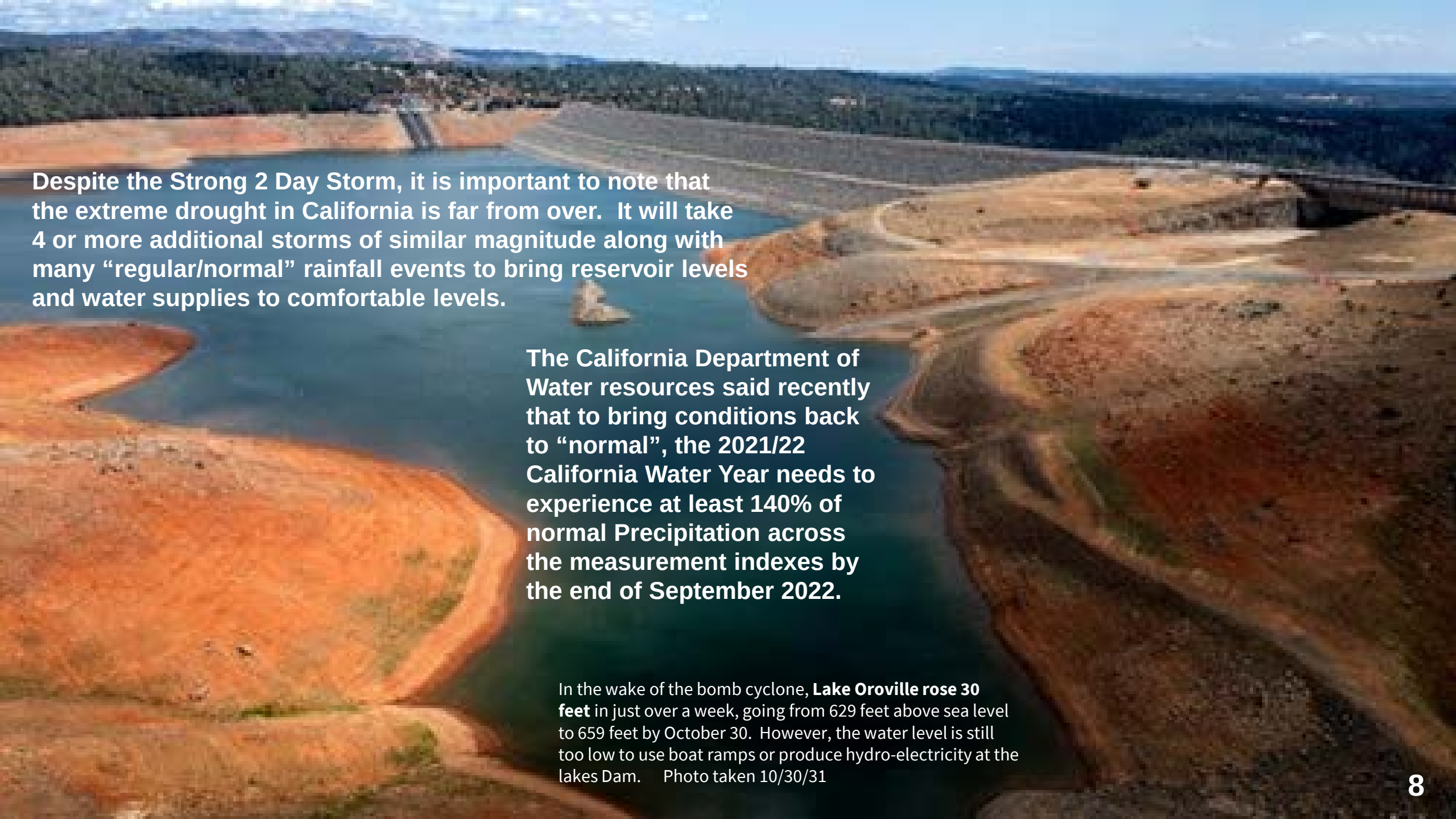



Northern Sierra Precipitation: 8-Station Index, November 01, 2021
Percent of Average for this Date: 425%
Mount Shasta City
Shasta Dam
Mineral
Quincy
Brush Creek
Sierraville RS
Blue Canyon
Pacific House
2016-2017 Daily Precip (wettest)
94.7
1982-1983 Daily Precip (2nd wettest)
88.5
2018 - 2019 Daily Precip
70.7
Average (1991-2020)
53.2
2019 - 2020 Daily Precip
31.7
2020-2021 Daily Precip (3rd driest)
24.0
1976-1977 (2nd driest)
19.0
Current: 12.7
Cumulative Daily/Monthly Precipitation (inches)
Total Water Year Precipitation
Water Year (October 1 - September 30)
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


San Joaquin Precipitation: 5-Station Index, November 01, 2021
Percent of Average for this Date: 299%
Calaveras Big Trees
Hetch Hetchy
Yosemite Headquarters
North Fork RS
Huntington Lake
1982-1983 (wettest)
77.4
72.7
2016-2017 Daily Precip (2nd wettest)
2018 - 2019 Daily Precip
50.0
Average (1991-2020)
39.9
2019 - 2020 Daily Precip
24.6
2020-2021 Daily Precip (3rd driest)
18.8
15.4
1976-1977 (2nd driest)
Current: 6.6
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
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)


Tulare Basin Precipitation: 6-Station Index, November 01, 2021
Balch PH
Giant Forest
Ash Mt.
Springville.
Pascoes
Isabella Dam
Percent of Average for this Date: 199%
1968-1969 Daily Precip (wettest)
56.3
56.2
1982-1983 Daly Precip (2nd wettest)
2018 - 2019 Daily Precip
36.8
Average (1991-2020)
28.3
2019 - 2020 Daily Precip
18.6
1976-1977 Daily Precip (2nd driest)
10.9
9.9
2020-2021 Daily Precip (driest)
Current: 2.6
Cumulative Daily/Monthly Precipitation (inches)
Total Water Year Precipitation
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
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)

Snowfall totals were also Impressive during this 48 Hour period!

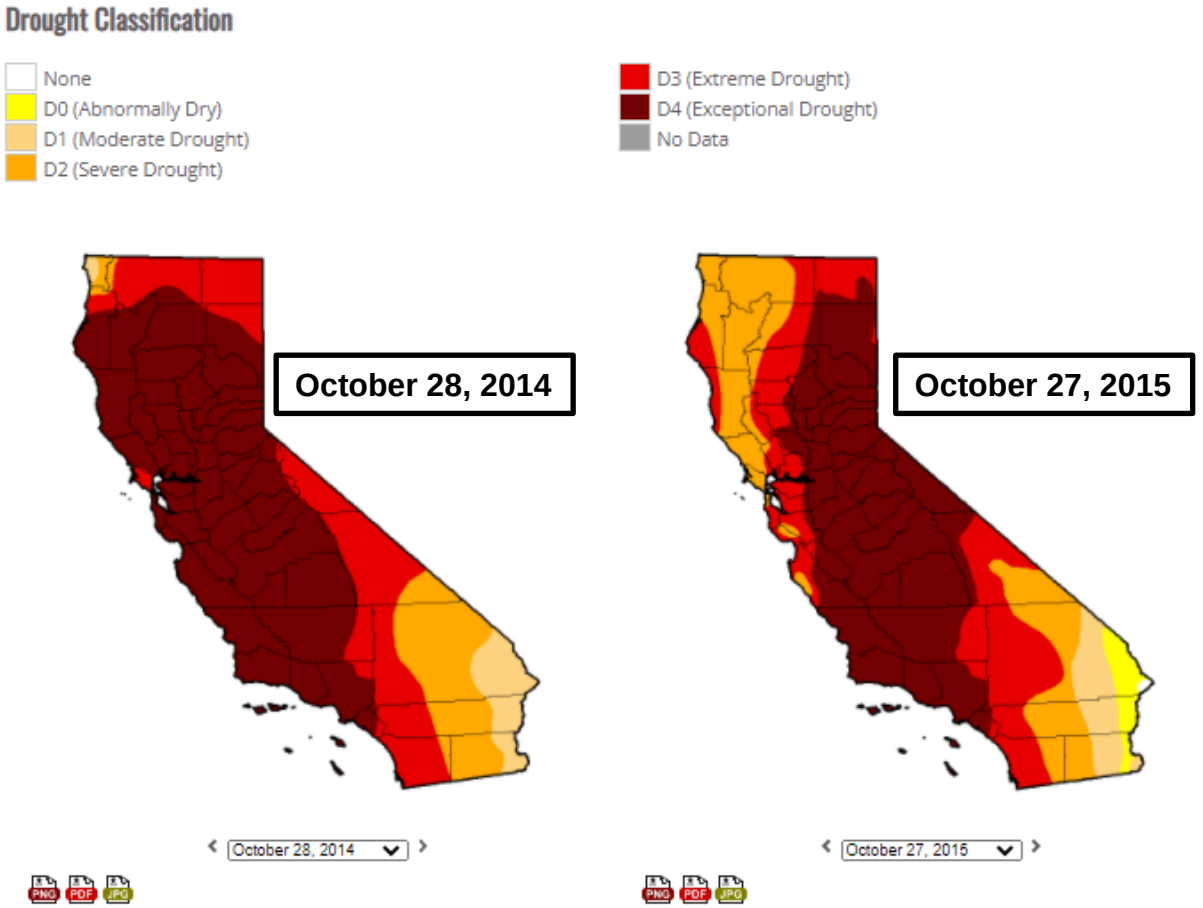


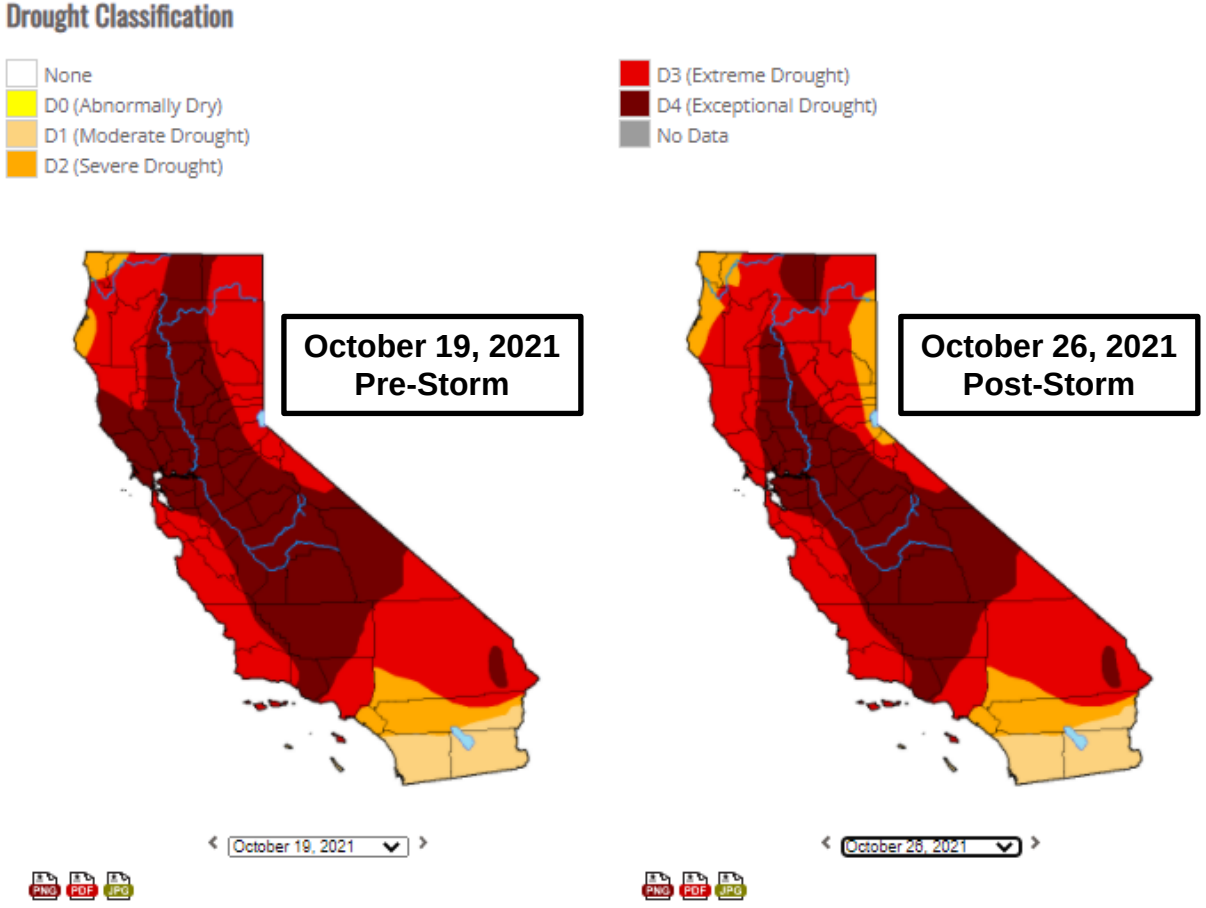
Despite the Strong 2 Day Storm, it is important to note that the extreme drought in California is far from over. It will take 4 or more additional storms of similar magnitude along with many "regular/normal" rainfall events to bring reservoir levels and water supplies to comfortable levels.

The California Department of Water resources said recently that to bring conditions back to "normal", the 2021/22 California Water Year needs to experience at least 140% of normal Precipitation across the measurement indexes by the end of September 2022.

In the wake of the bomb cyclone, **Lake Oroville rose 30 feet** in just over a week, going from 629 feet above sea level to 659 feet by October 30. However, the water level is still too low to use boat ramps or produce hydro-electricity at the lakes Dam. Photo taken 10/30/31

Despite the very good precipitation California received on October 24th & 25th, the Extreme and Exceptional Drought designation remains for the entire Almond growing region of California.





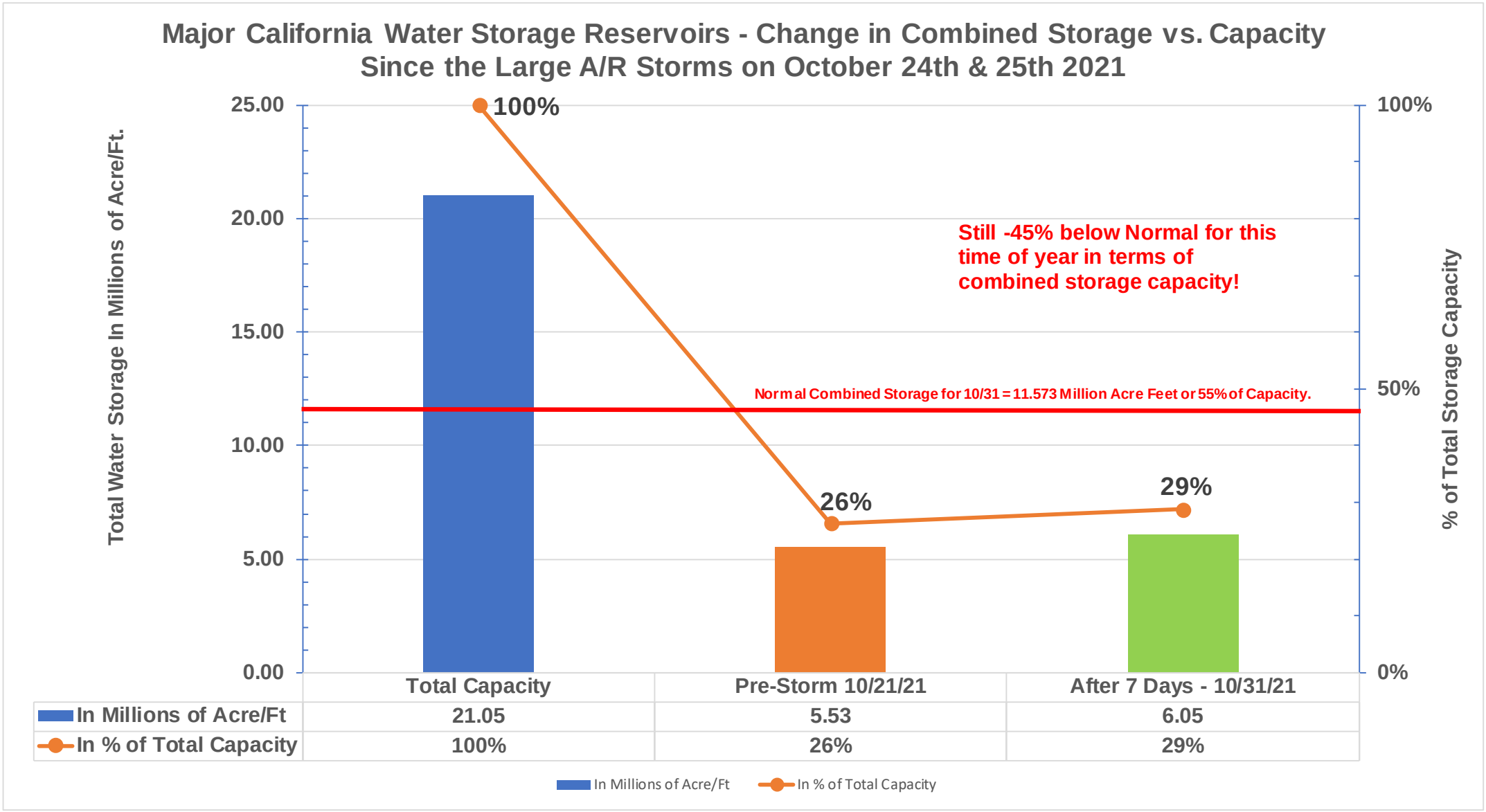
Statistics Comparison

Week	None	D0-D4	D1-D4	D2-D4	D3-D4	D4	DSCI
2014-10-28	0.00	100.00	100.00	95.04	81.92	58.41	435
2015-10-27	0.14	99.86	97.33	92.27	71.08	46.00	407
Change	0.14	-0.14	-2.67	-2.77	-10.84	-12.41	-28

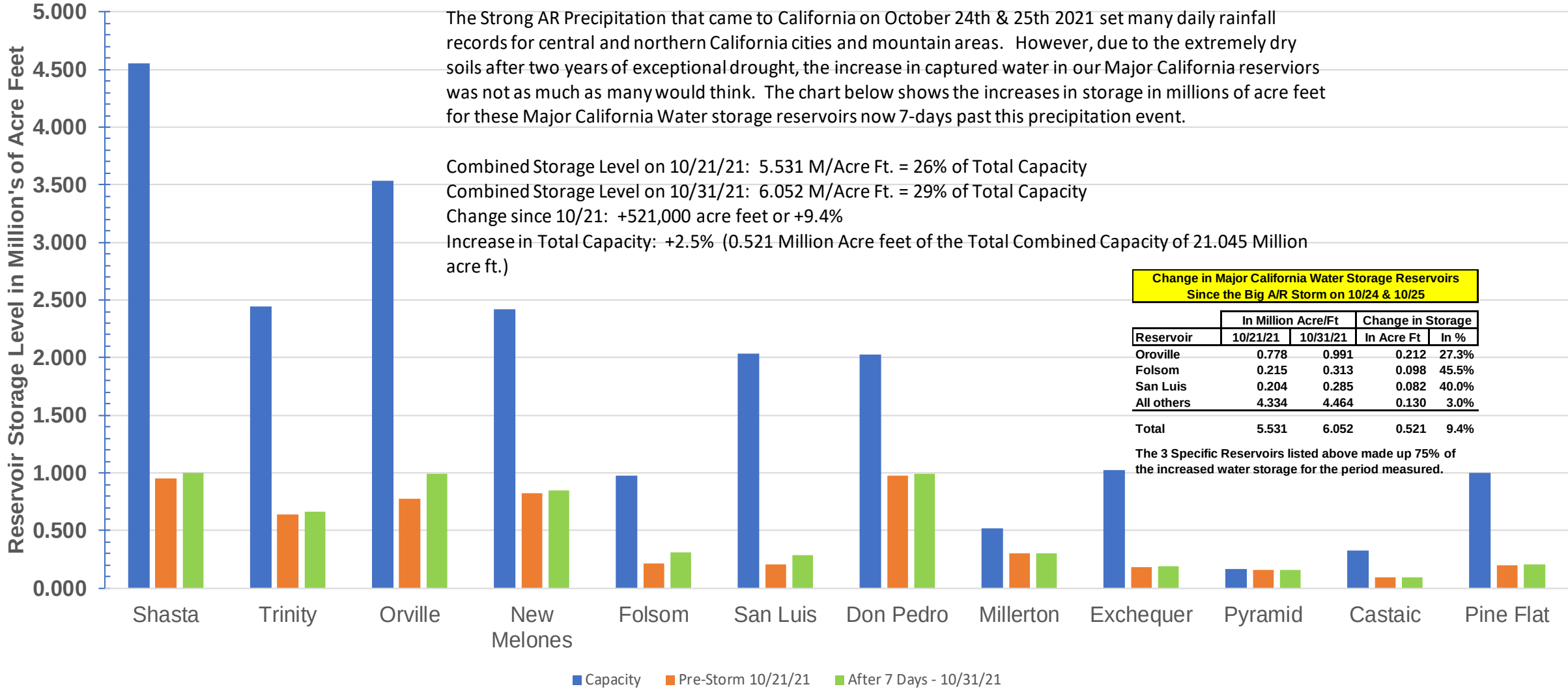
Statistics Comparison

Week	None	D0-D4	D1-D4	D2-D4	D3-D4	D4	DSCI
2021-10-19	0.00	100.00	100.00	93.81	87.18	45.66	427
2021-10-26	0.00	100.00	100.00	93.81	83.33	38.74	416
Change	0.00	0.00	0.00	0.00	-3.85	-6.92	-11

The strong start to the 2021/21 Water Year for California is of course a welcome blessing. However, the water supply for California was not fixed by one good storm. The graph below puts this event in perspective of the overall shortage that still remains.



Change in Major California Reservoir Storage Levels 7-days Past Pre-Storm the October 24th/25th 2021 Storm Event



The Strong AR Precipitation that came to California on October 24th & 25th 2021 set many daily rainfall records for central and northern California cities and mountain areas. However, due to the extremely dry soils after two years of exceptional drought, the increase in captured water in our Major California reserviors was not as much as many would think. The chart below shows the increases in storage in millions of acre feet for these Major California Water storage reservoirs now 7-days past this precipitation event.

Combined Storage Level on 10/21/21: 5.531 M/Acre Ft. = 26% of Total Capacity
Combined Storage Level on 10/31/21: 6.052 M/Acre Ft. = 29% of Total Capacity
Change since 10/21: +521,000 acre feet or +9.4%
Increase in Total Capacity: +2.5% (0.521 Million Acre feet of the Total Combined Capacity of 21.045 Million acre ft.)

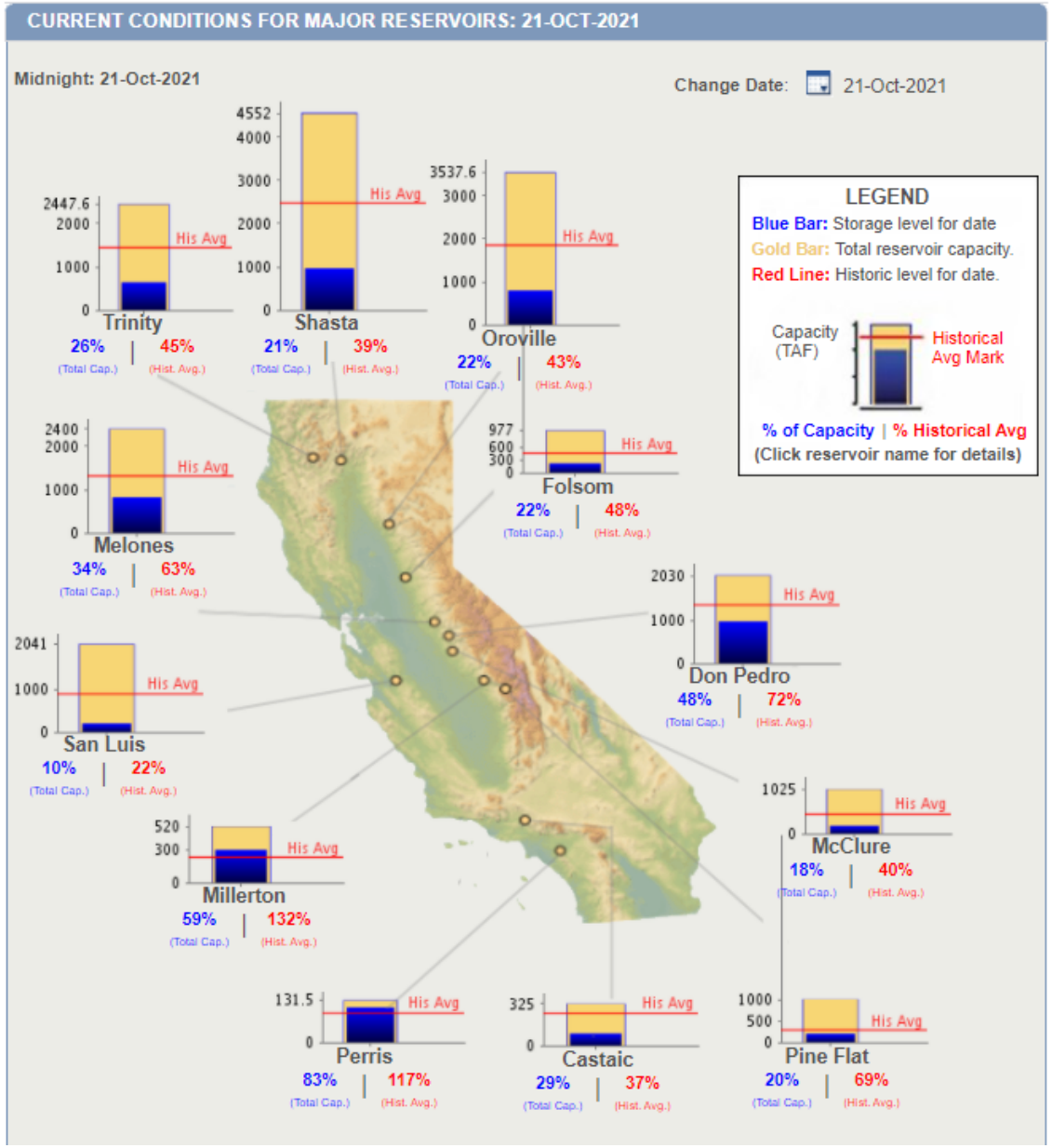
Change in Major California Water Storage Reservoirs Since the Big A/R Storm on 10/24 & 10/25

	In Million Acre/Ft		Change in Storage	
Reservoir	10/21/21	10/31/21	In Acre Ft	In %
Oroville	0.778	0.991	0.212	27.3%
Folsom	0.215	0.313	0.098	45.5%
San Luis	0.204	0.285	0.082	40.0%
All others	4.334	4.464	0.130	3.0%
Total	5.531	6.052	0.521	9.4%

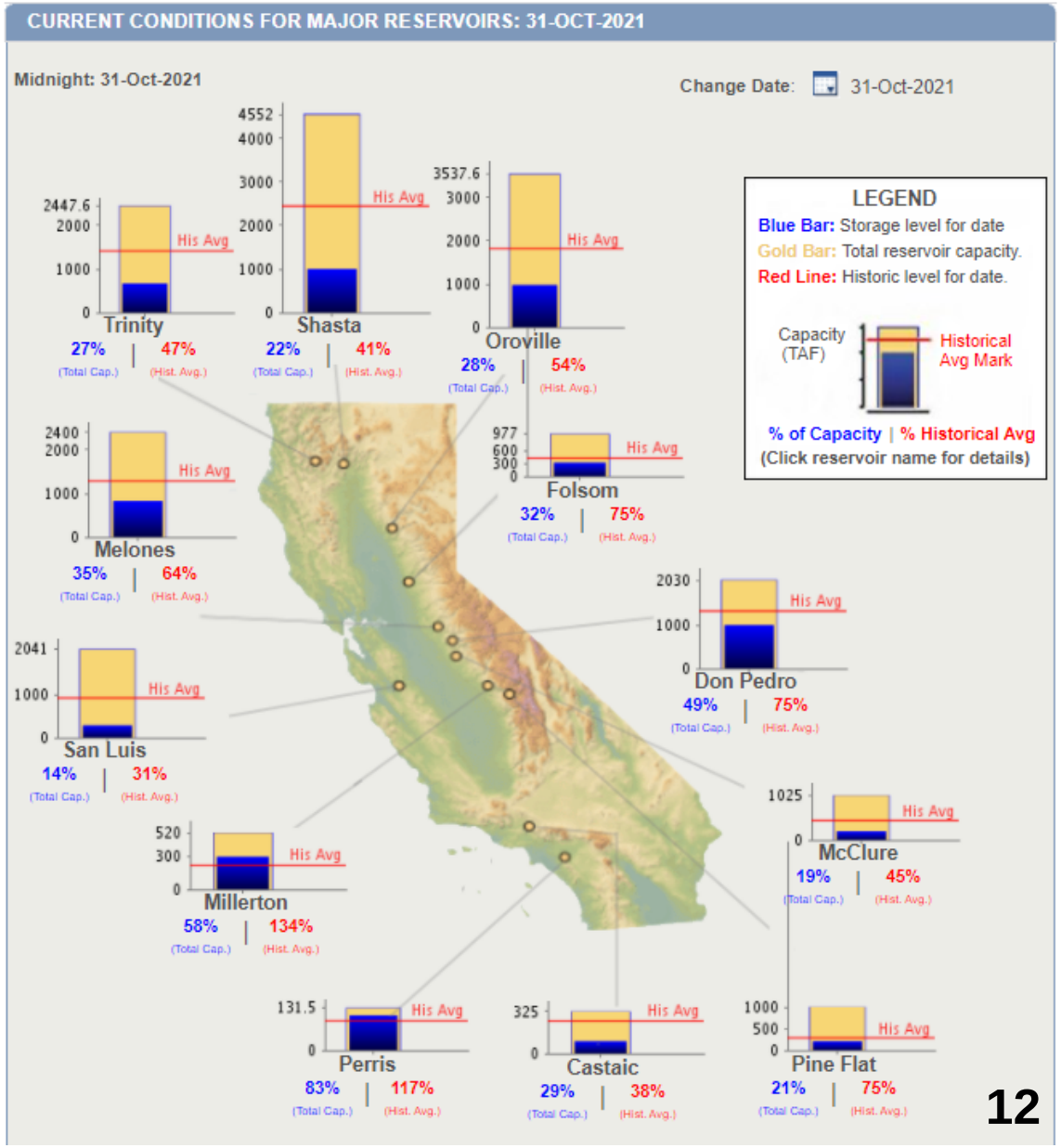
The 3 Specific Reservoirs listed above made up 75% of the increased water storage for the period measured.

Major California Reservoir levels – Before and 7 Days after the October 24th-25th Storms

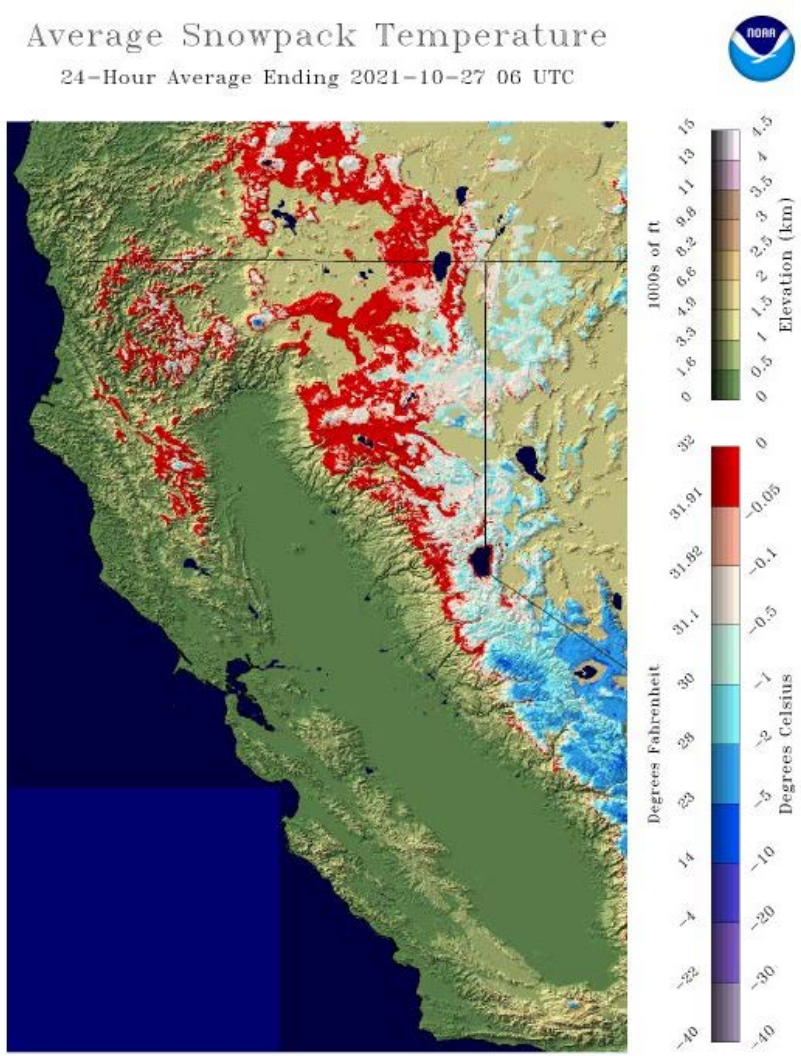
California Data Exchange Center - Reservoirs

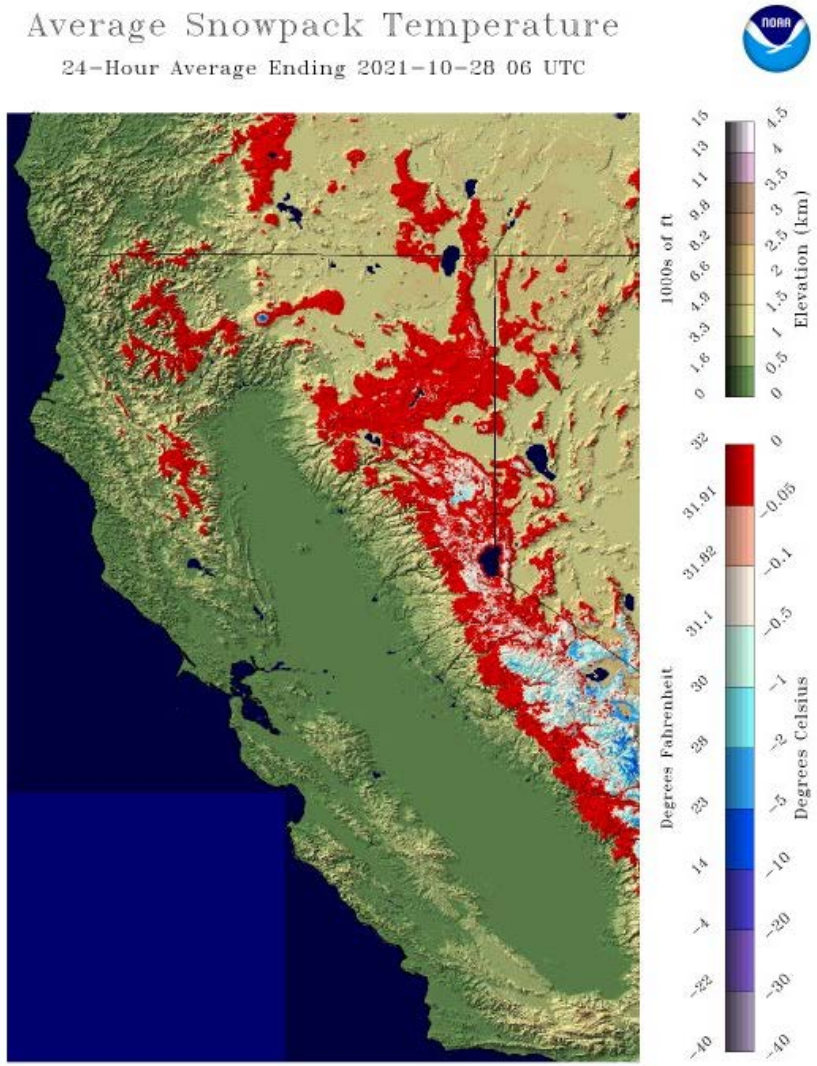


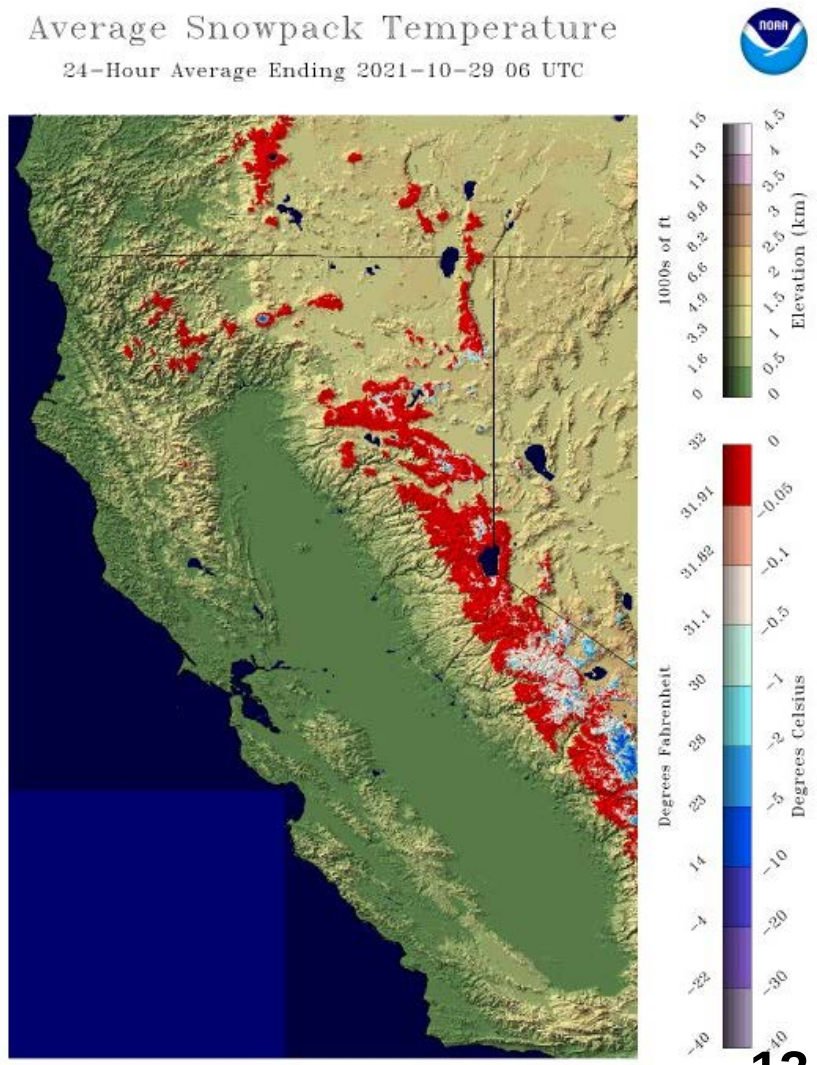
California Data Exchange Center - Reservoirs

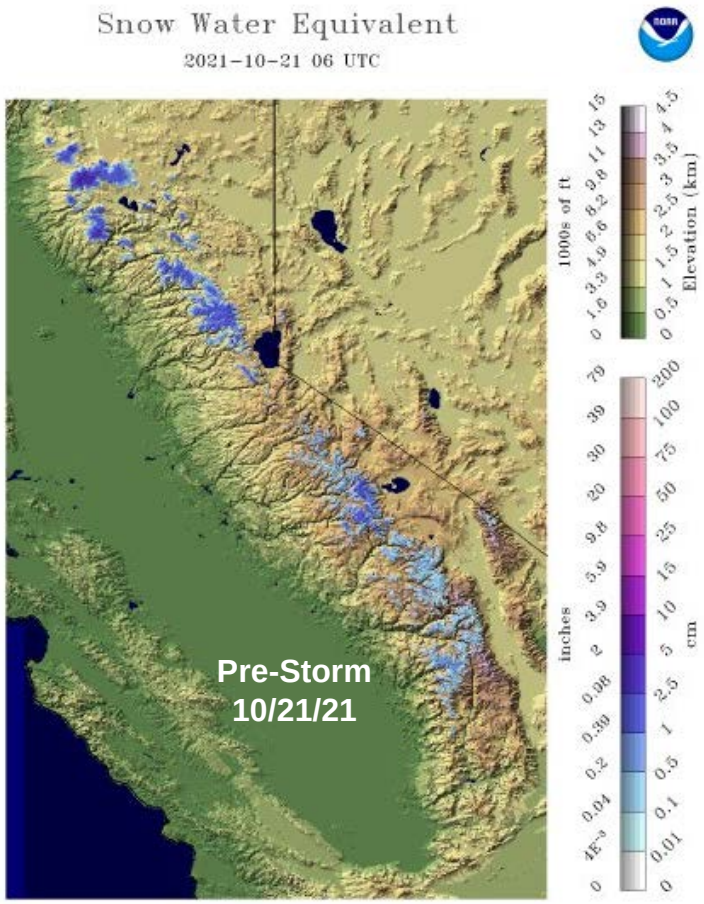


Although the Snowfall from this 2 Day storm was very good for this time of year, post-storm warm temperatures led to a rapid melt-off in many areas of the Sierra as depicted in charts below. The result of this melt-off can be seen on the following page which compares the Sierra snowpack status before this strong storm, the day after the storm, and what the snowpack looks like now on 11/1/21. Only the highest elevations retained the snow we got from this strong early storm event.





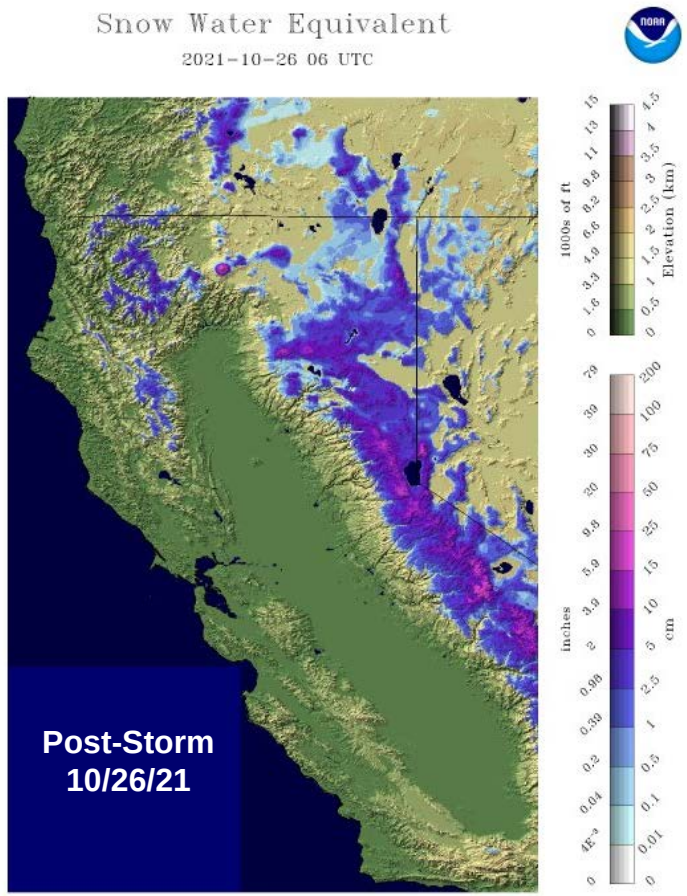




Automated Model Discussion:

21-Oct-21

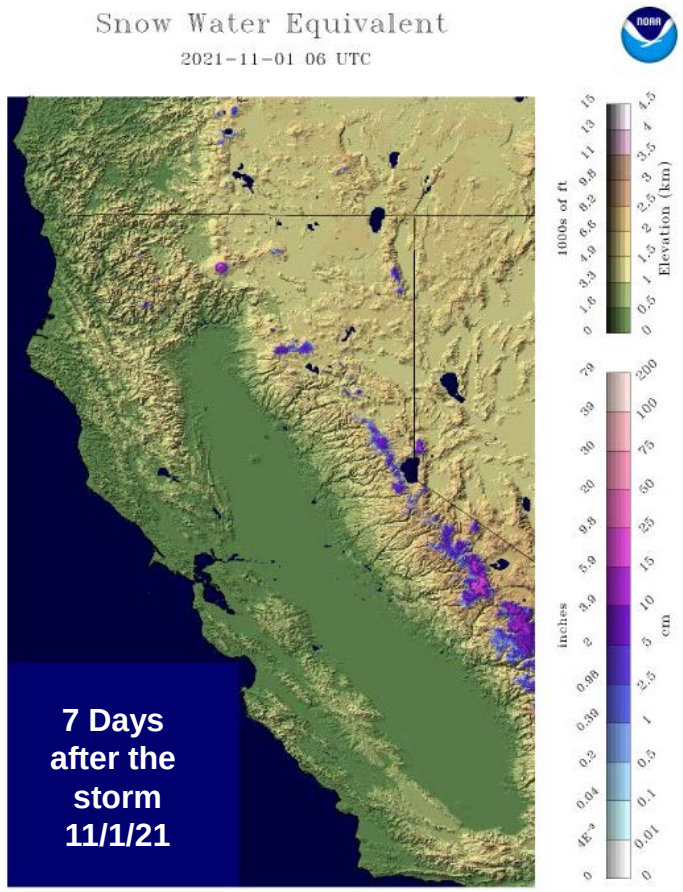
Area Covered By Snow:	1.90%
Area Covered Last Month:	0.00%
Snow Depth	
Average:	0.1 in
Minimum:	0.0 in
Maximum:	13.1 in
Std. Dev.:	0.5 in
Snow Water Equivalent	
Average:	0.0 in
Minimum:	0.0 in
Maximum:	1.9 in
Std. Dev.:	0.1 in



Automated Model Discussion:

26-Oct-21

Area Covered By Snow:	5.40%
Area Covered Last Month:	0.00%
Snow Depth	
Average:	0.2 in
Minimum:	0.0 in
Maximum:	57.7 in
Std. Dev.:	1.5 in
Snow Water Equivalent	
Average:	0.0 in
Minimum:	0.0 in
Maximum:	11.5 in
Std. Dev.:	0.3 in

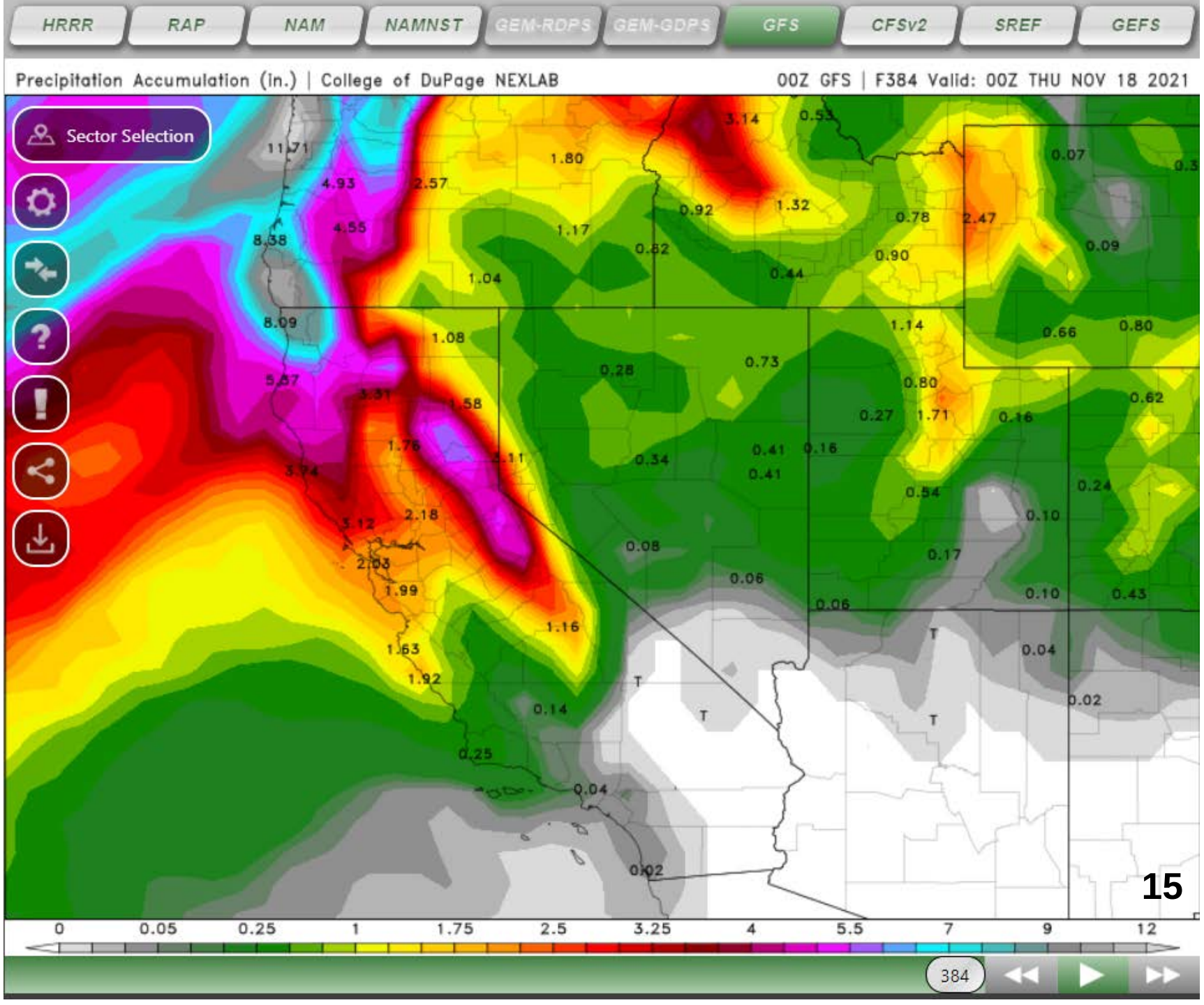


Automated Model Discussion:

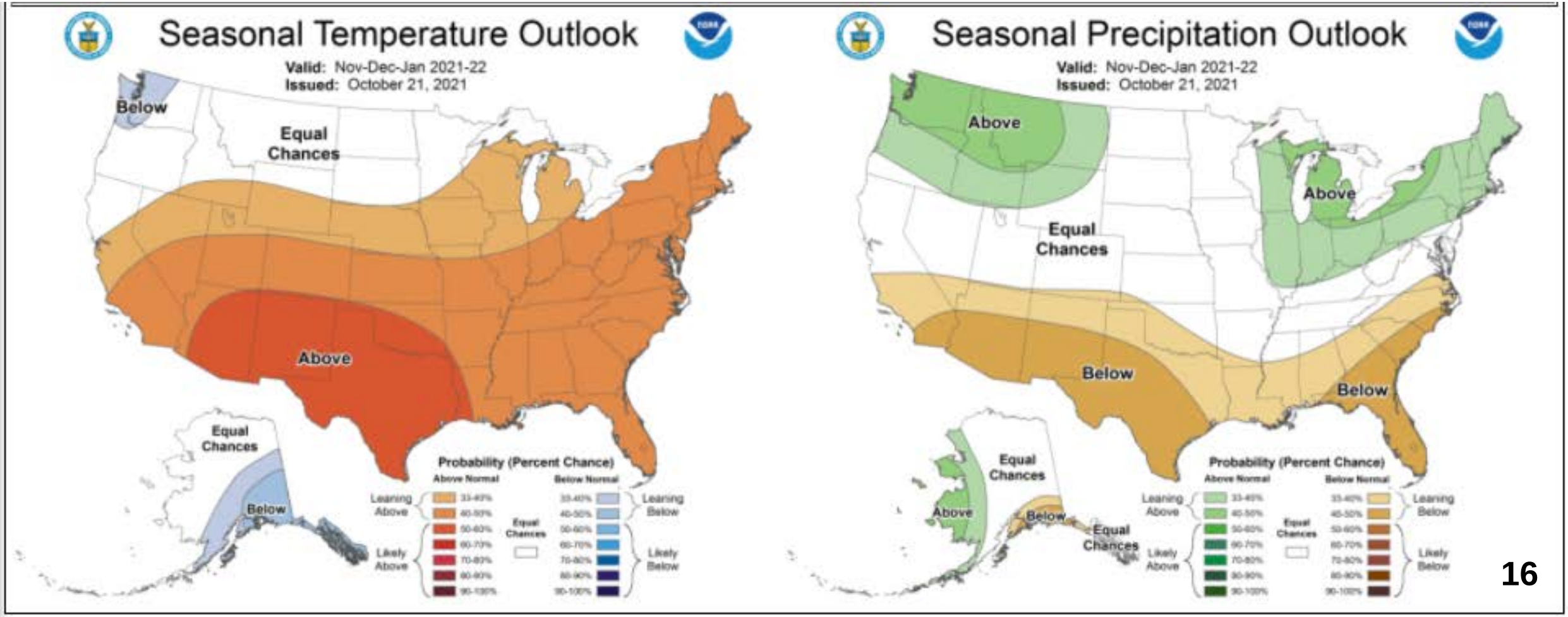
1-Nov-21

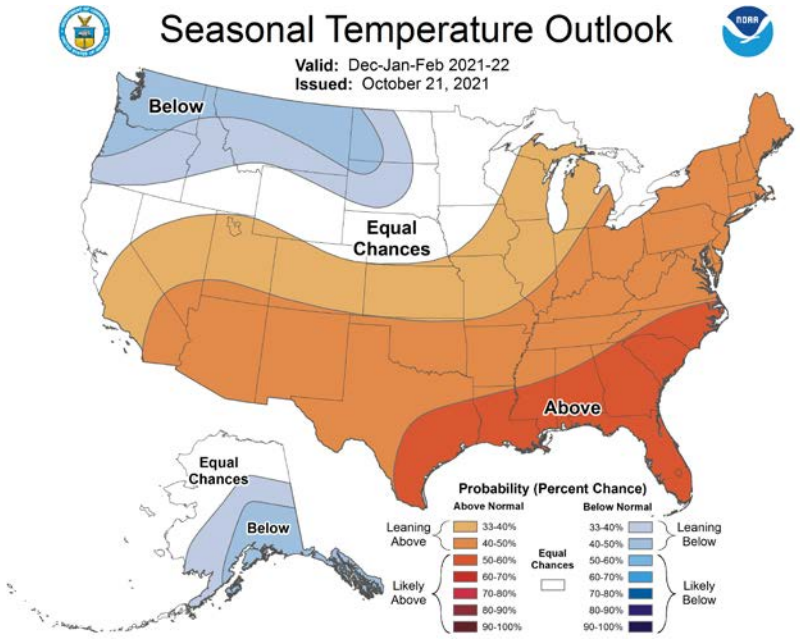
Area Covered By Snow:	0.20%
Area Covered Last Month:	0.00%
Snow Depth	
Average:	0.0 in
Minimum:	0.0 in
Maximum:	39.4 in
Std. Dev.:	0.5 in
Snow Water Equivalent	
Average:	0.0 in
Minimum:	0.0 in
Maximum:	10.2 in
Std. Dev.:	0.1 in

The Current GFS 16-Day Precipitation Accumulation Forecast on 11/1/21 does show that California has the chance for additional rainfall in coming weeks. Most of this forecasted Precipitation arrives on November 9th & 10th which is too far out in time to have good confidence that this rainfall will materialize.

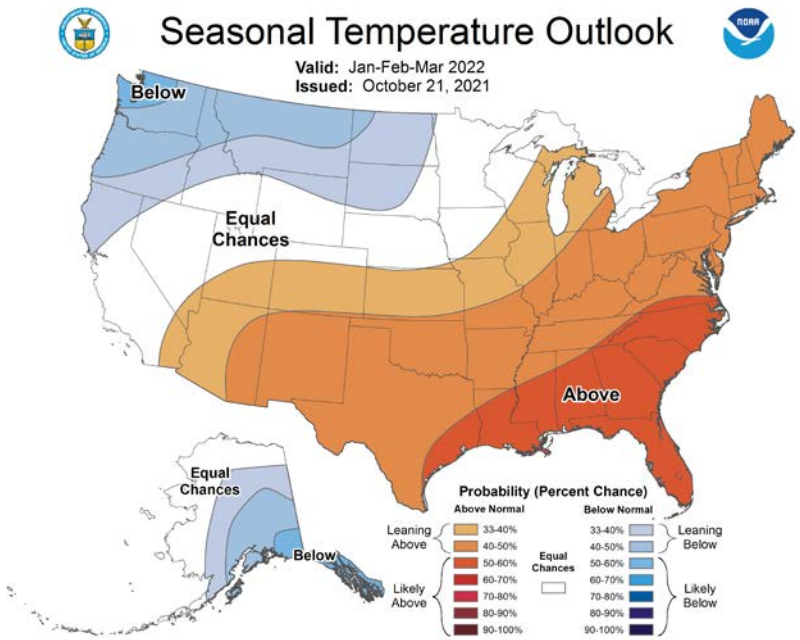


The longer-term 3-month Seasonal Temperature & Precipitation Outlook Maps released by the NOAA on 10/21/21 points to the higher probability of warmer than normal temperatures for most of California. In terms of precipitation, their models predict that there is equal chance for above or below normal rainfall in Central & Northern California and a slight chance of below normal rainfall for Southern California. As you will see on the following page, their rolling 3-month forecasts show a similar pattern out through April 2022. Definitely not the wet winter forecast we really need!

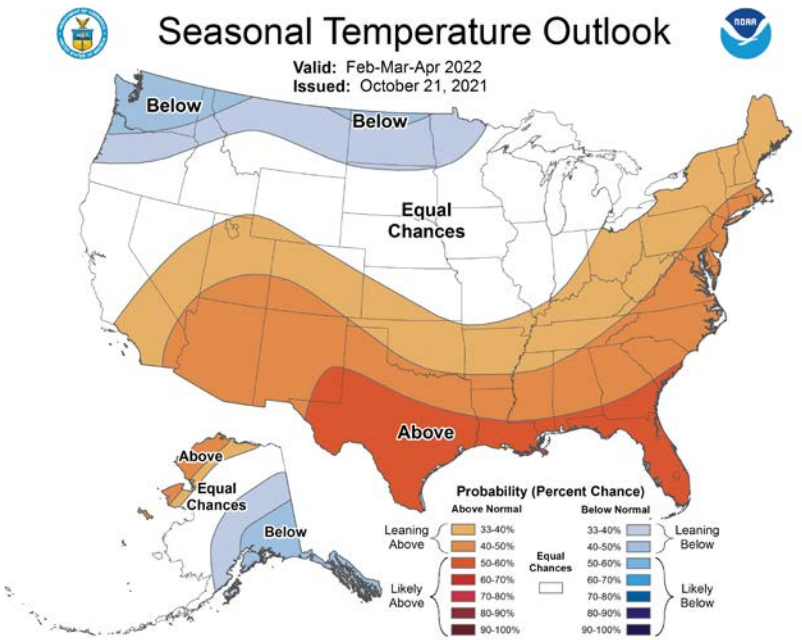




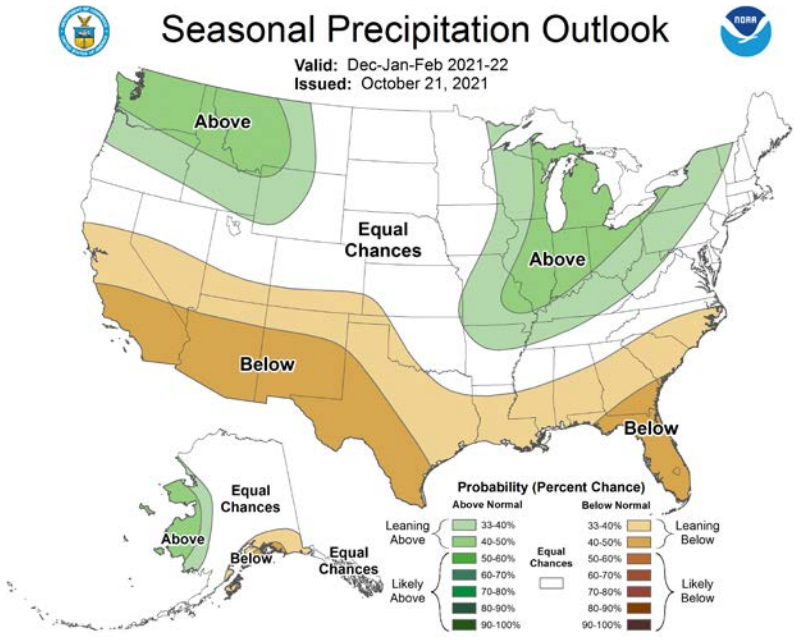
Dec 2021 – Feb 2022

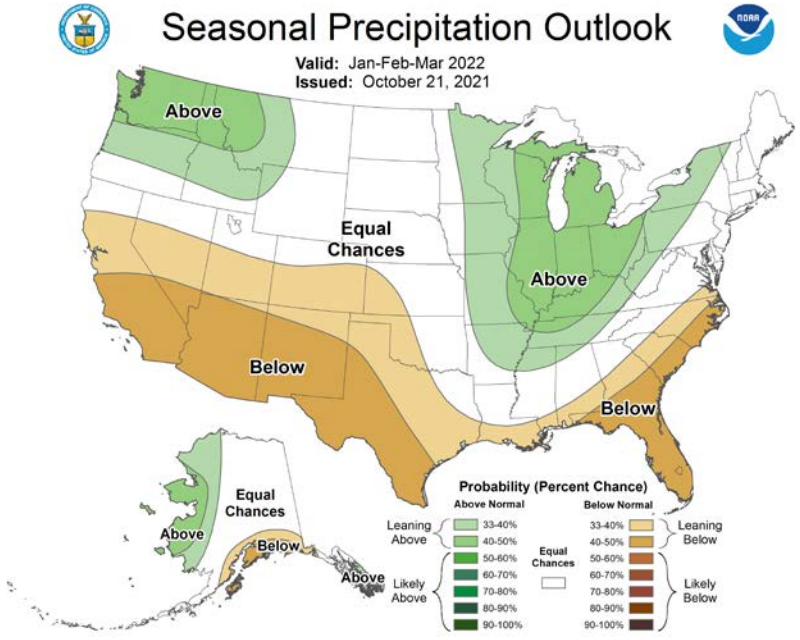


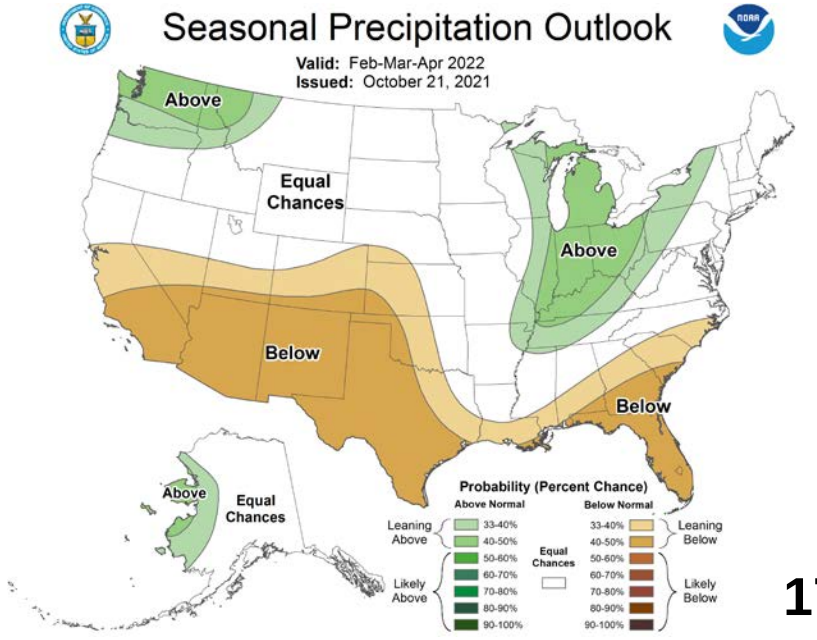
Jan 2022 – Mar 2022



Feb 2022 – Apr 2022

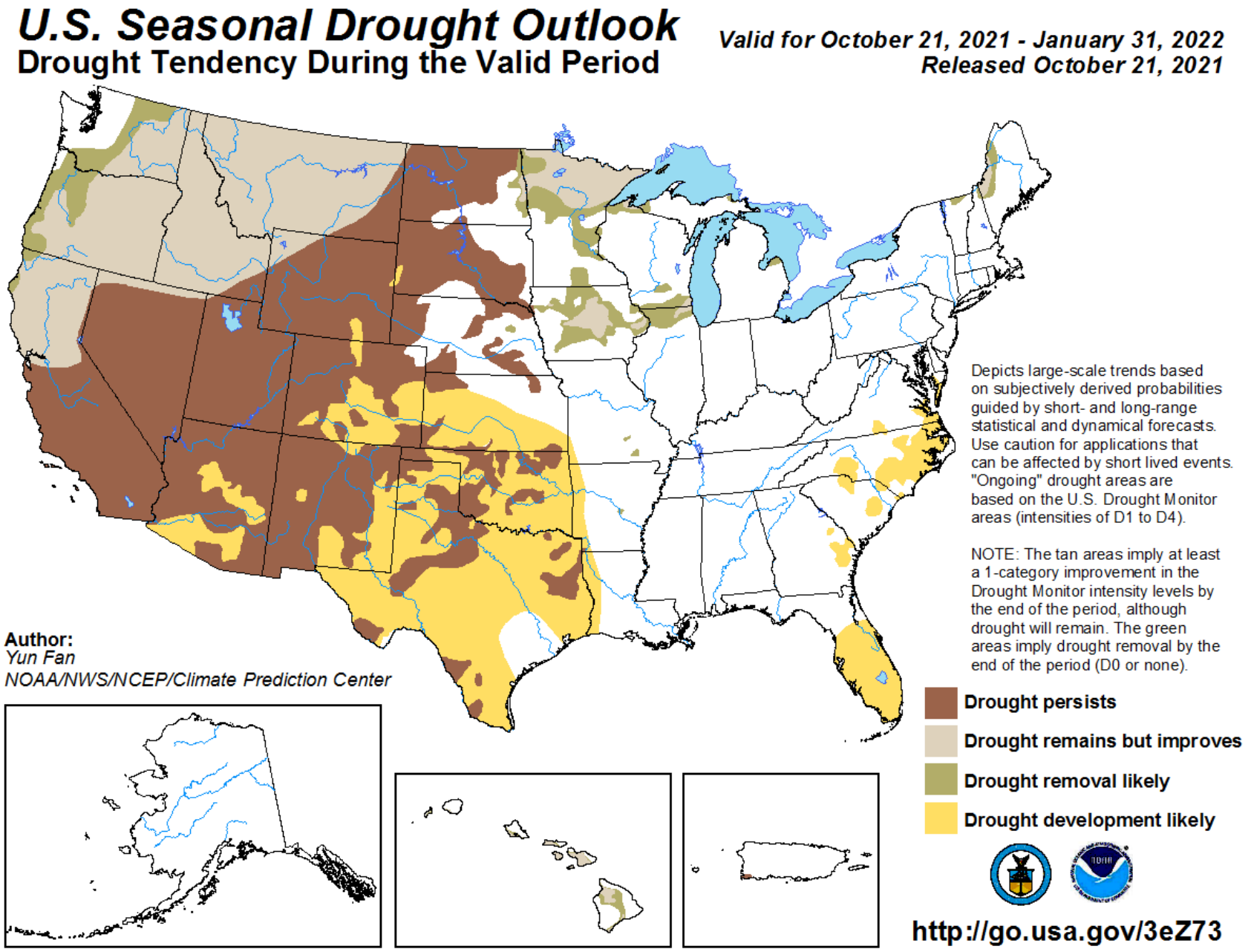






The current NOAA Seasonal Drought Outlook shows that although some drought improvement is expected in Northern California, overall drought conditions will remain in this region.

For Central & Southern California, they are predicting that current Drought conditions will remain in place.



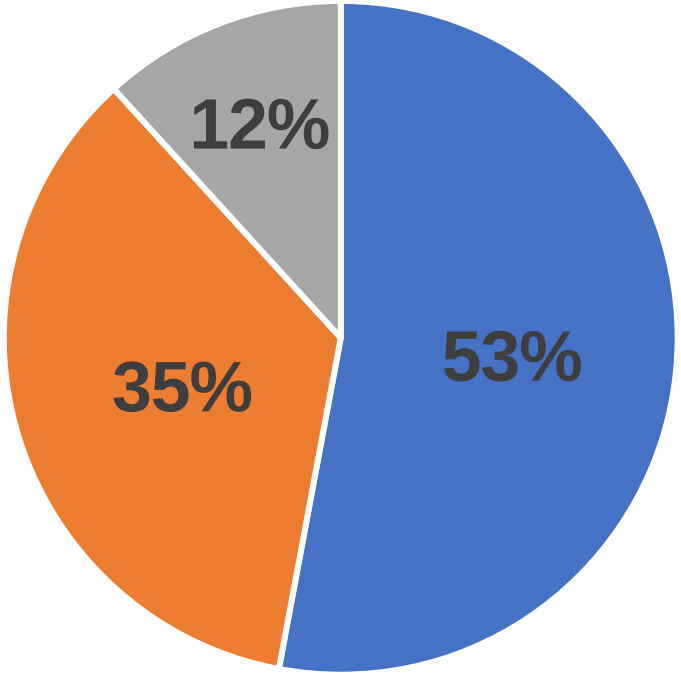
This will be our last California Drought & Water Supply Report for 2021. The next publication will likely be in mid-February of 2022. By that time, we will really know what type of conditions the Winter period brought to our region and if landscape looks good for drought recovery or a more serious water supply situation than we faced this past year.

We will all continue to hope and pray for a wet winter for the Winter/Spring of 2021/22 despite the less than encouraging NOAA Outlook Models and Maps. A large portion of the California Agricultural community will be severely impacted if this coming winter brings anything less than well above average rainfall and snowpack.

Despite the current forecast models, there is always a chance that these current forecast charts are wrong and the influence of the current La Nina ENSO conditions will not bring the historical pattern of dryer-than-normal conditions to California during the Winter and Spring months.

To see what those chances might be, we looked back over the past 70 years of California Precipitation History for the three Precipitation Indexes to see the year-end results for years when precipitation levels got off to a strong start vs. the historical norm (the conditions we have so far this year). As you will see from the Combined Precipitation Index Totals, we found 17 years when October + November rainfall was well ahead of the seasonal average by the end of November. Although the analysis shows a higher probability of ending up with a year that finishes with below normal precipitation (53% of the time), there is a 35% chance of getting precipitation that ends up well above normal.

Final California Water Year Results when October & November Precipitation was well above the Historical Average - Frequency in % Since 1950



Based on established conditions as they occurred in 17 of the past 70 years of record keeping

- Year's When Oct & Nov >100% of Normal but ended up below Normal
- Year's When Oct & Nov >100% of Normal & ended at 120%+ of Normal
- Year' When s Oct & Nov>100% of Normal & ended between 99%-119% of Normal

Year-End Results for Water Years when October & November Precipitation was well above the Historical Normal - as of 10/28/21

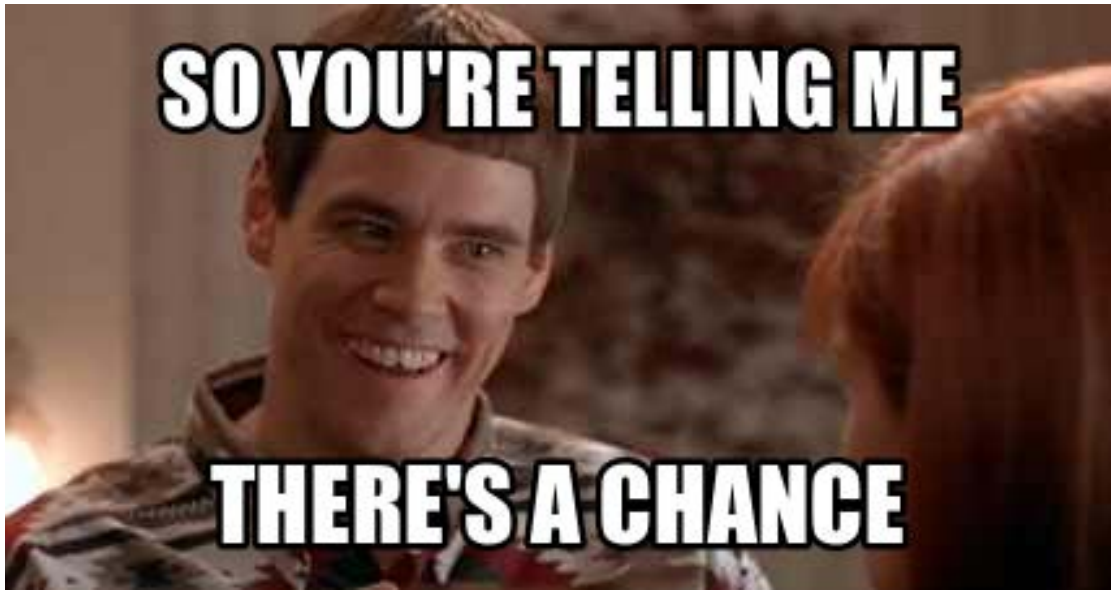
California Water Year

All Regional Indexes Combined

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	% of Normal	Oct - Nov Total	% of Normal	El Nino or La Nina Winter?
Historical Avg:	**6.1**	**11.5**	**21.1**	**22.3**	**20.9**	**18.9**	**10.3**	**6.2**	**2.1**	**0.6**	**0.2**	**0.6**	**120.8**		**17.6**		
Cumulative:	**6.1**	**17.6**	**38.7**	**61.0**	**81.9**	**100.8**	**111.1**	**117.3**	**119.4**	**120.0**	**120.2**	**120.8**					
1950/51	17.9	43.0	29.1	20.7	13.1	8.3	9.5	4.9	0.6	-	0.4	0.1	**147.6**	**122%**	**60.9**	**346%**	Neutral
1962/63	21.2	4.3	7.8	22.4	22.6	19.6	27.6	6.5	3.0	0.0	0.7	2.5	**138.3**	**114%**	**25.5**	**145%**	Neutral
1963/64	7.8	26.2	2.6	15.7	0.7	10.8	5.9	6.0	3.3	0.2	0.4	1.3	**80.9**	**67%**	**34.0**	**193%**	Moderate
1965/66	1.3	31.0	18.3	10.6	9.8	4.6	5.2	1.5	0.6	0.1	0.2	0.5	**83.6**	**69%**	**32.2**	**183%**	Strong
1966/67	0.0	25.0	39.8	31.0	2.8	28.6	32.3	4.3	3.5	0.1	0.4	2.5	**170.2**	**141%**	**25.0**	**142%**	Neutral
1970/71	3.8	30.0	28.4	11.7	3.5	16.2	5.7	9.2	2.2	0.4	0.5	2.4	**113.8**	**94%**	**33.8**	**192%**	Moderate
1973/74	9.5	35.5	22.5	27.4	7.2	33.5	13.3	1.3	0.5	5.7	0.7	0.1	**157.0**	**130%**	**45.0**	**256%**	Strong
1981/82	14.8	31.9	24.6	27.5	18.5	34.1	25.3	1.2	4.3	1.0	0.5	10.9	**194.4**	**161%**	**46.7**	**265%**	Neutral
1982/83	18.3	28.3	29.3	31.0	38.6	47.5	16.2	4.0	1.1	0.3	2.7	4.7	**222.1**	**184%**	**46.6**	**265%**	Very Strong
1983/84	4.8	43.1	40.5	1.0	14.8	10.5	6.6	1.5	2.6	2.4	1.2	0.6	**129.6**	**107%**	**47.9**	**272%**	Weak
1984/85	9.2	31.0	7.3	5.0	11.7	20.1	1.6	0.4	1.0	1.3	0.3	5.3	**94.2**	**78%**	**40.2**	**228%**	Weak
1988/89	0.2	24.0	15.7	5.7	10.1	31.2	4.8	4.4	1.6	0.2	1.0	8.9	**107.9**	**89%**	**24.2**	**137%**	Strong
1998/99	2.9	19.7	9.5	26.7	28.1	11.1	9.8	2.5	2.3	0.4	0.7	0.5	**114.1**	**95%**	**22.6**	**129%**	Strong
2001/02	3.7	23.7	32.1	10.7	7.4	15.7	4.7	5.6	0.3	0.2	0.0	0.3	**104.5**	**86%**	**27.4**	**156%**	Neutral
2012/13	6.1	19.5	29.8	7.7	3.2	11.2	7.9	2.3	2.1	0.1	0.3	1.9	**91.9**	**76%**	**25.6**	**146%**	Neutral
2016/17	20.6	10.1	27.5	68.1	51.8	13.5	18.3	1.1	1.0	-	0.6	1.8	**214.4**	**178%**	**30.7**	**174%**	Weak
2017/18	1.3	17.2	1.1	13.7	3.5	37.7	10.9	2.3	0.3	0.4	-	0.4	**88.8**	**73%**	**18.5**	**105%**	Weak
Average::	**8.4**	**26.1**	**21.5**	**19.8**	**14.5**	**20.8**	**12.1**	**3.5**	**1.8**	**0.8**	**0.6**	**2.6**	**132.5**	**110%**			
% of Normal:	**138%**	**227%**	**102%**	**89%**	**70%**	**110%**	**117%**	**56%**	**84%**	**123%**	**283%**	**478%**	**110%**				
Cumulative:	**8.4**	**34.5**	**56.0**	**75.8**	**90.4**	**111.2**	**123.3**	**126.8**	**128.5**	**129.3**	**129.9**	**132.5**					
% of Normal:	**138%**	**196%**	**145%**	**124%**	**110%**	**110%**	**111%**	**108%**	**108%**	**108%**	**108%**	**110%**					
2021/22 - Current	**21.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**21.8**	**18%**	**21.8**	**124%**	

= Strong Start results in >120%+ Y/E Precip.
= Strong Start results in below normal Y/E Precip.

Regional Precipitation is the sum of total precipitation in the 8-Station Northern, the 5-Station Central, and the 6-Station Southern Indexes.



Yes

And since we all know…

The Wise will Plan for the Worst!