



The New Normal for Winter and What to Expect

09.22.21

Chris Hyde

MAXAR



Agenda

- What's New at Maxar
- Quick Recap of Summer 2021
- 2021 Atlantic Tropics Update
- Fall 2021 Outlook
- The Winter 2021-22 Outlook

Weather and Impact on Prices

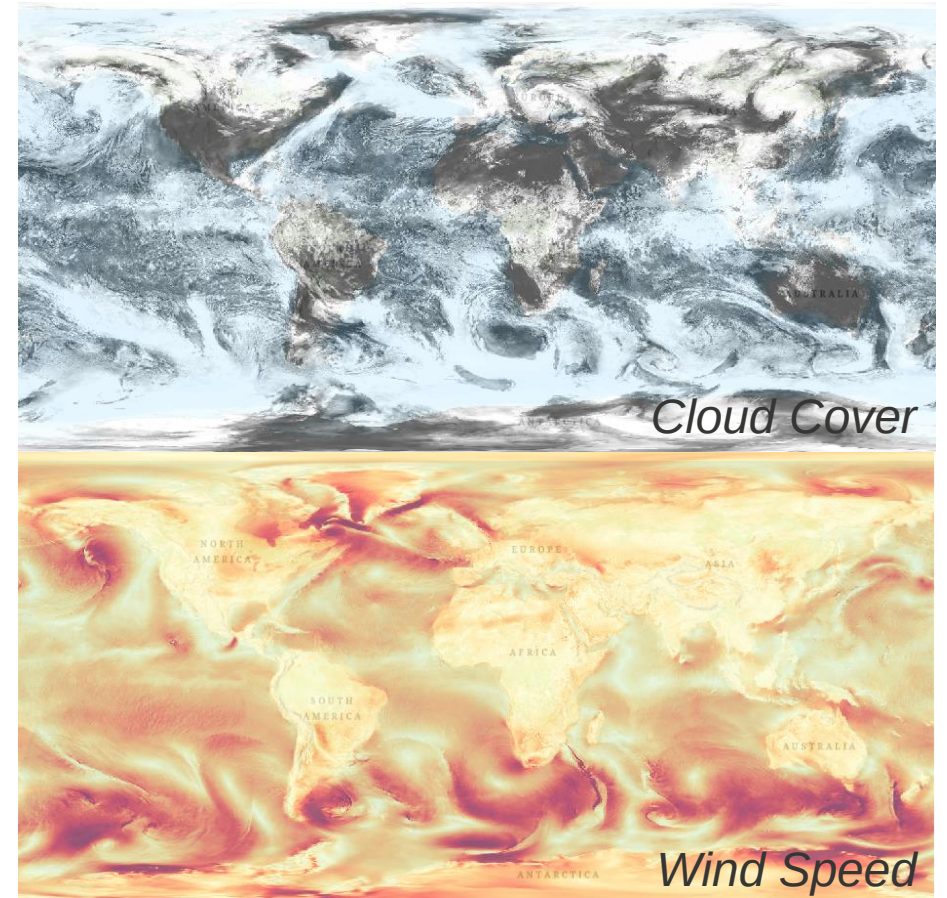


Natural Gas Continuous Contract as of 1 September



Weather Data Layers – an exciting new "big data" offering

- Run your own analytics by ingesting and exploiting gridded weather observations and forecasts
- Spatial resolution:
 - Global forecasts and observations at ~14km²
 - Customer-specific AOIs at ~1km²
- Easy ordering and delivery
 - Choice of AOIs or Global
 - Choice of weather parameters
 - Choice of delivery frequency
 - Choice of forecast length – 1 to 336 hours
- Parameters include: temperature, precipitation, dewpoint temperature, wind speed, wind direction, cloud cover, mean sea level pressure, relative humidity, heat index, and wind chill.





Storm Desk – New Product!

- Risk monitoring and alerting application
 - View at a US-wide level or zoom to your areas of interest
 - Track severe weather in a product that features:
 - Lightning
 - Watches and Warnings
 - Tropical Threats
 - Interactive Meteograms
- Station level Hour-by-hour forecasts/observations API
 - 2030 Stations in US/Canada
 - 902 Forecast Locations
 - 574 with Precip Data





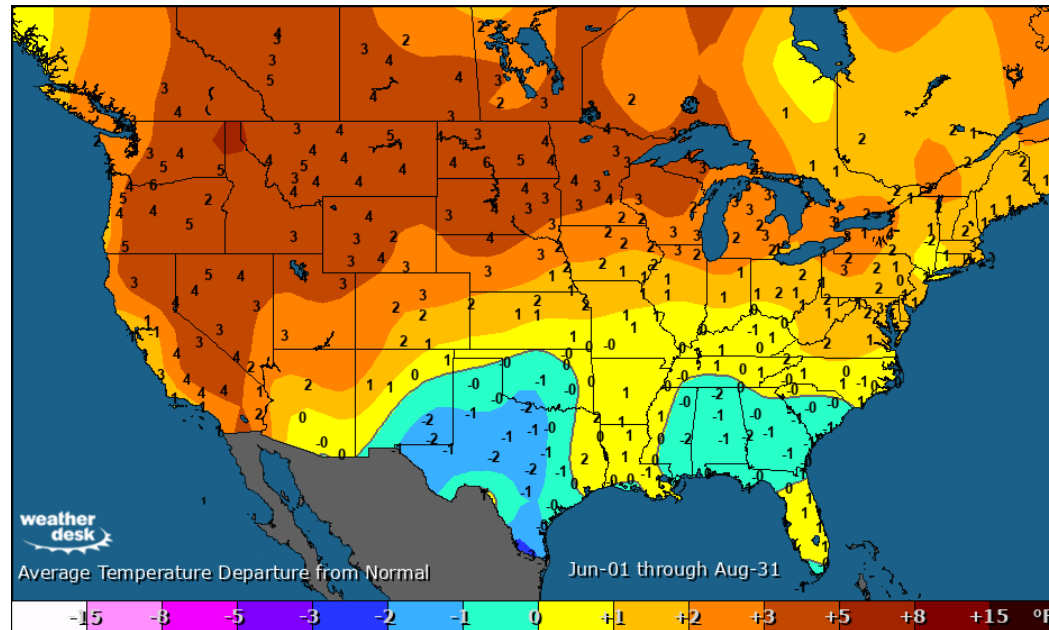
Recapping the 6th Ranked Summer

SUMMER 2021





Maps Compare to NEW 1991-2020 normals



Summer 2021

■ By the Numbers June-August:

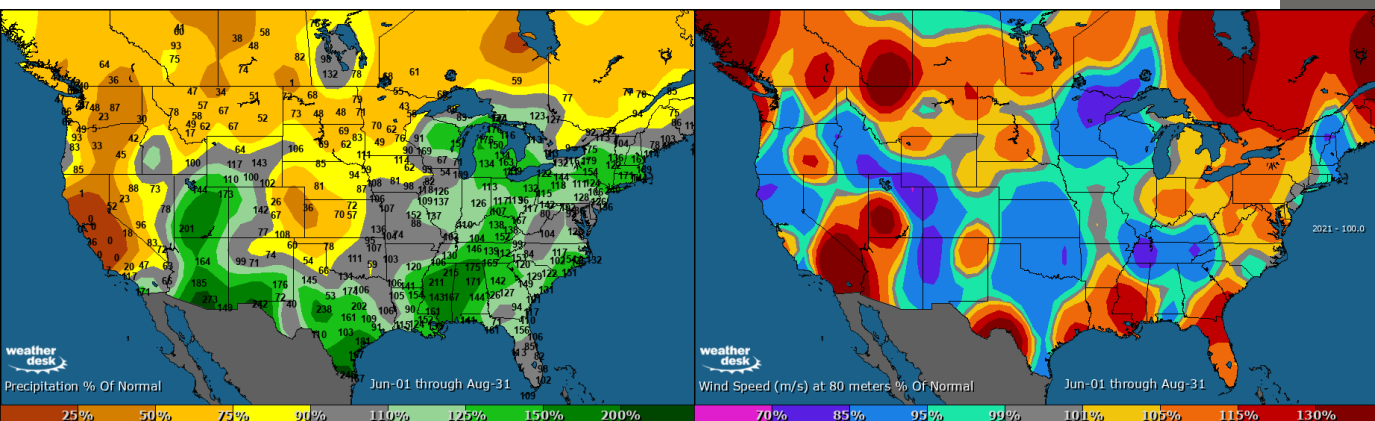
- **1009 PWCDDs**
- 6th Warmest on Record (since 1950)

■ Comparisons:

- 10-year Normal: 977 PWCDDs
- 30-year Normal: 917 PWCDDs
- Last Year (2020): 1033 PWCDDs

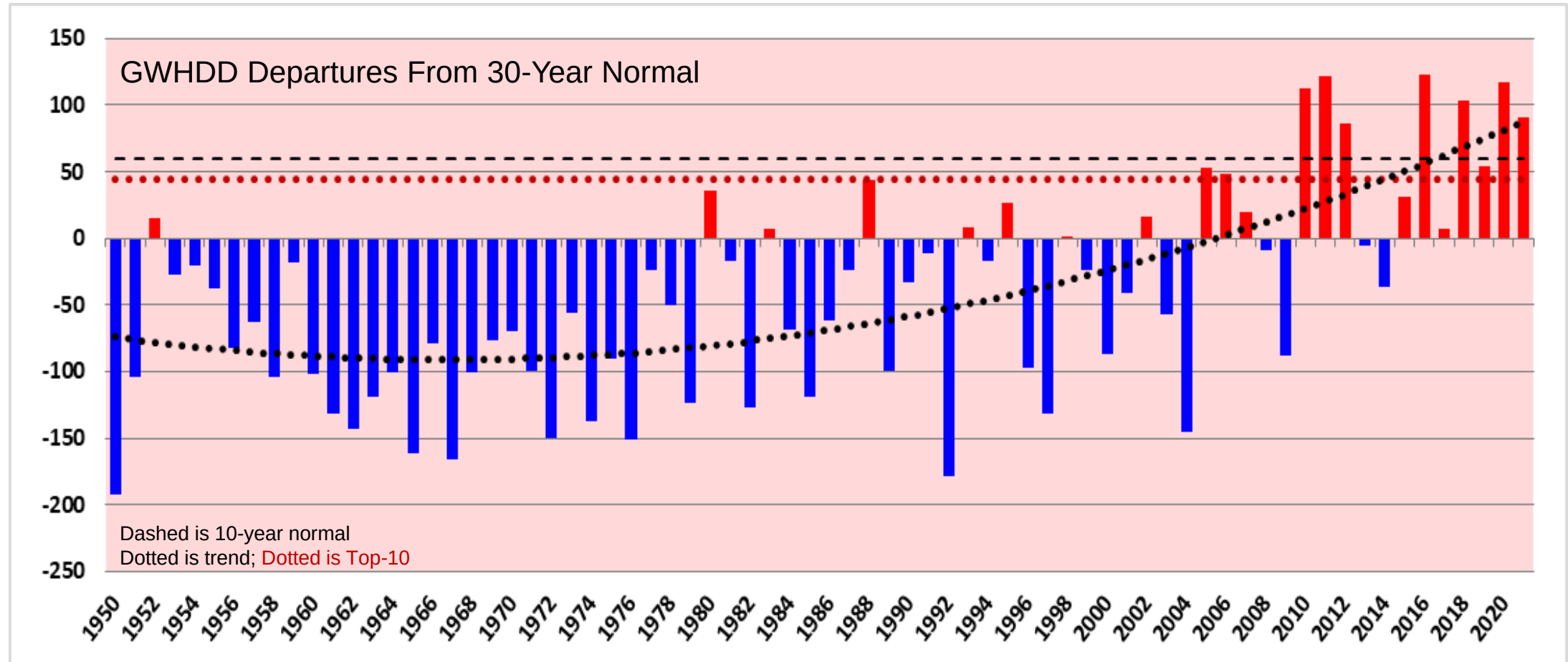
— Records:

- Coldest: 1950 with 725 PWCDDs
- Warmest: 2016 with 1040 PWCDDs





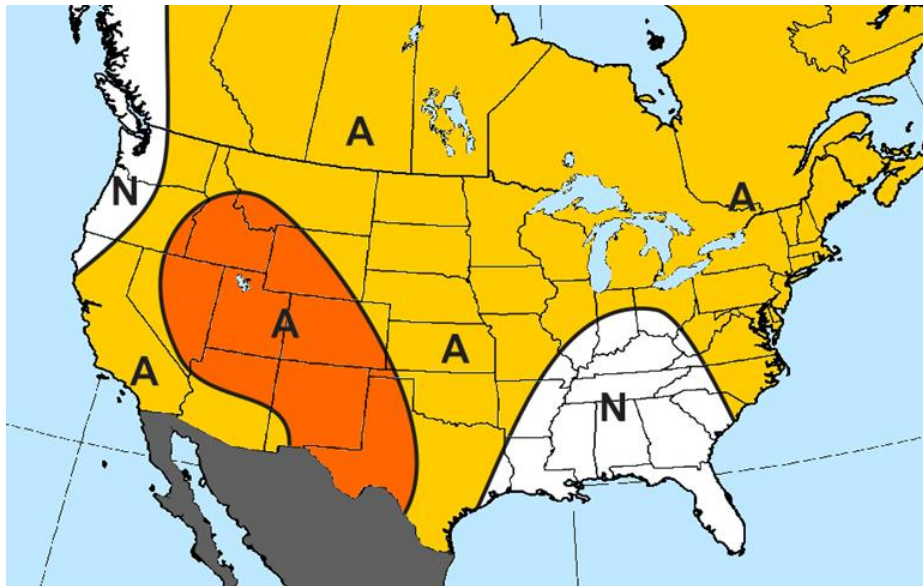
PWCDDs: Historical Context (Jun-Aug)





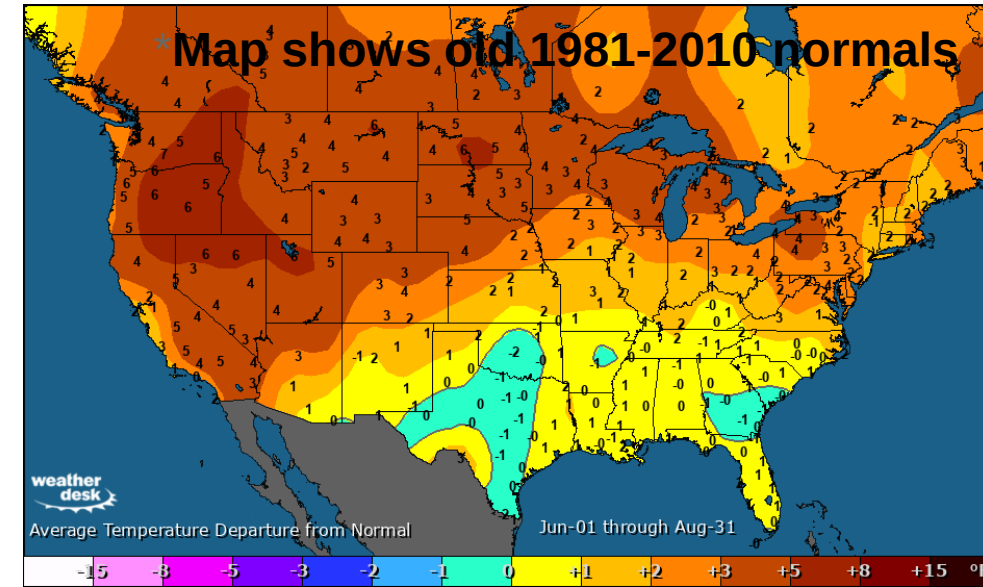
Summer Verification

Summer Forecast (from Feb)

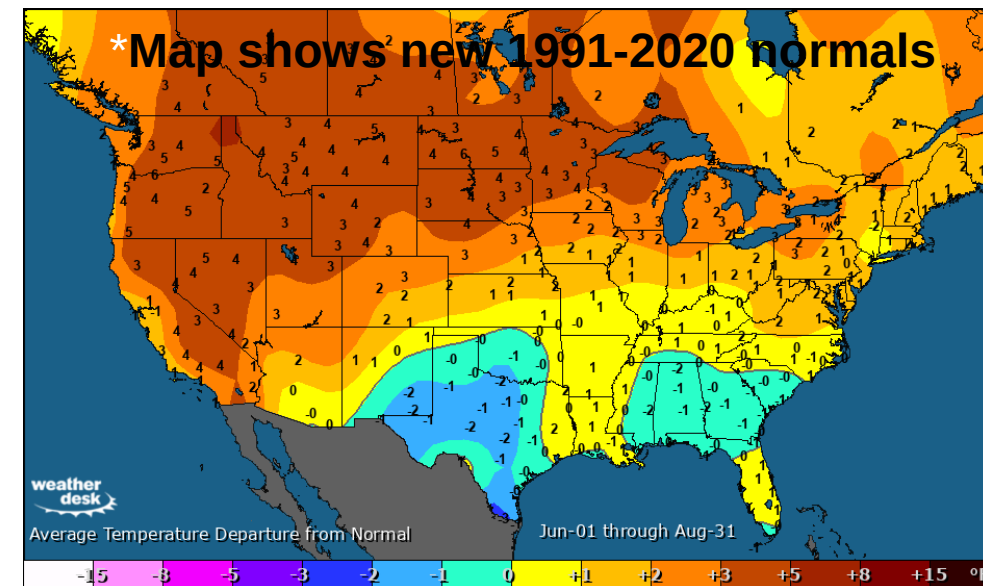


Forecast: 970 PWCCDs

Summer Actual



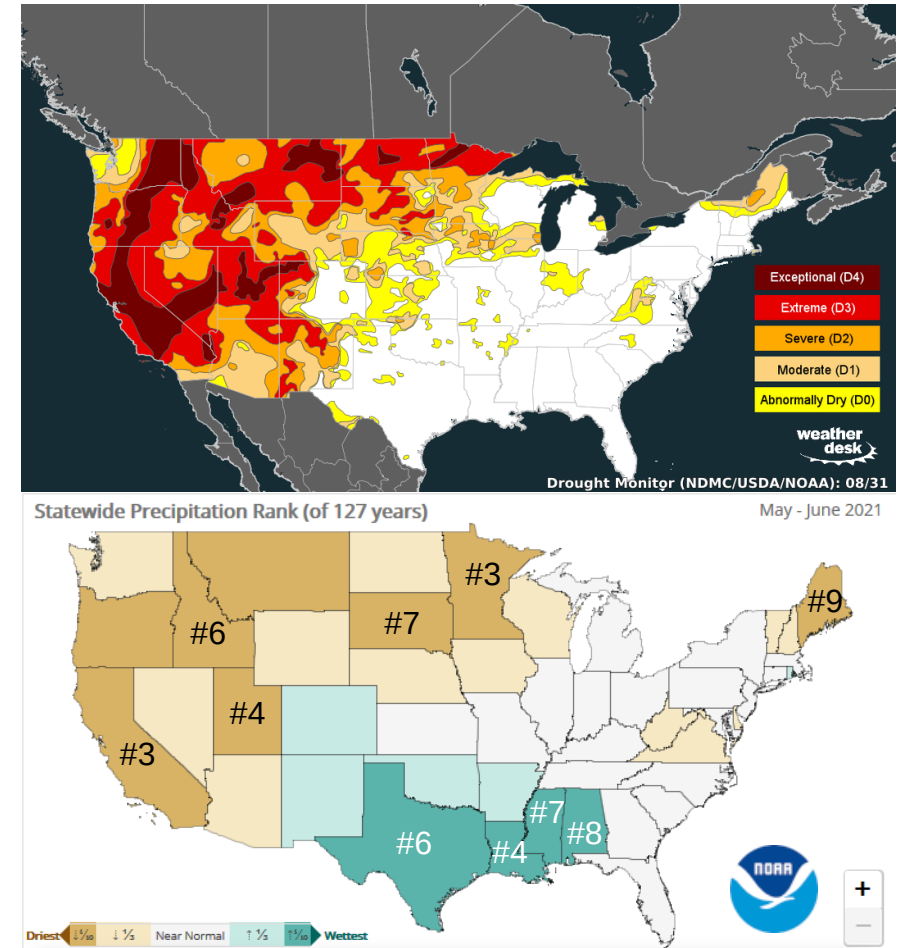
Actual/Forecast: 1010 PWCCDs





Summer Lessons Learned

- The forecast was not hot enough in the West
 - California Exceptional Drought coverage increased from 26% on June 1 to 49% on August 17
 - Only 2014 had greater coverage
 - Washington Exceptional Drought coverage increased by 38% over the course of the season to its highest level among records back to 2000
- Summer verified cooler than preseason forecasts in the South
 - Texas had its 6th ranked wettest May-June period back to 1895.



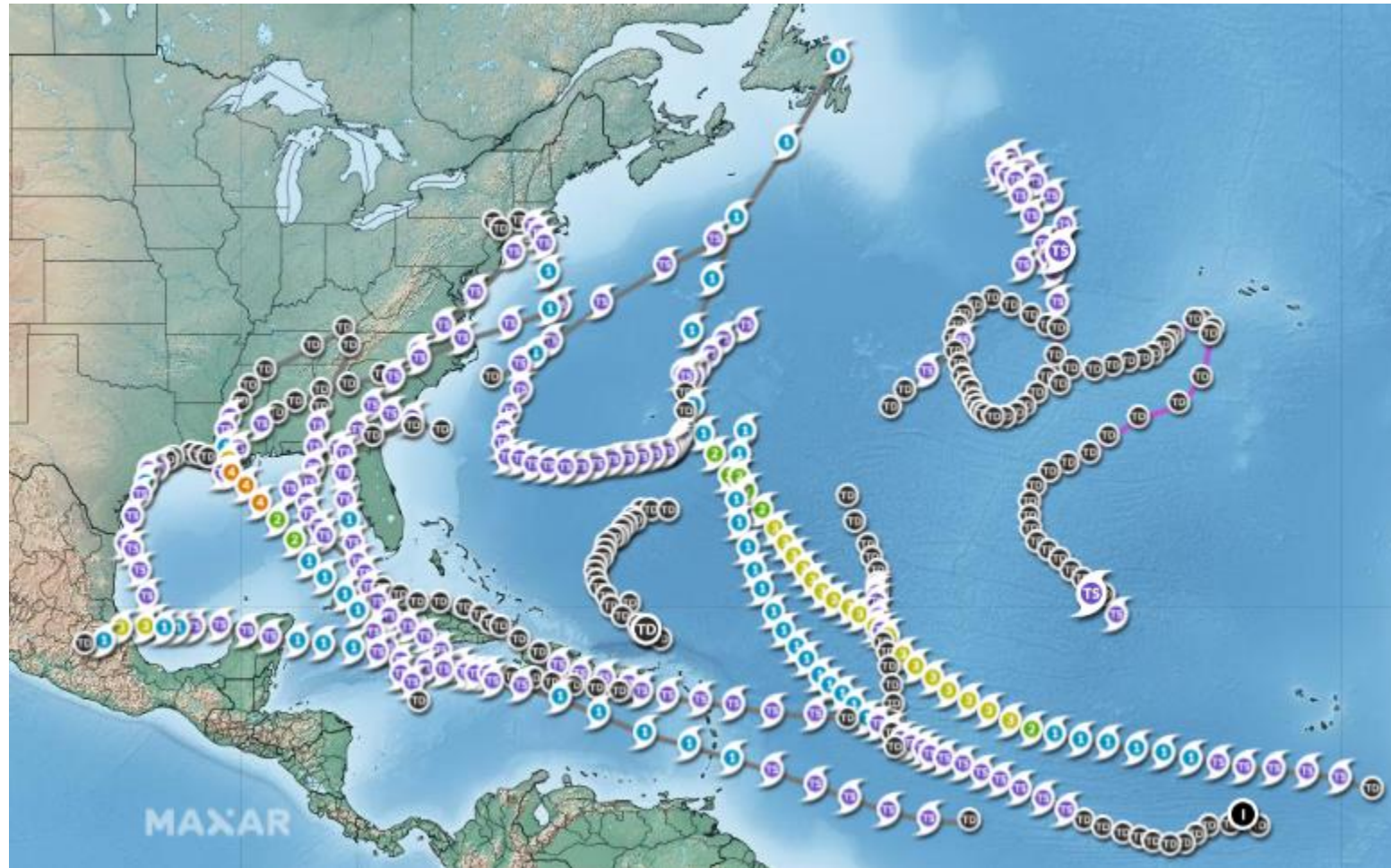


ATLANTIC TROPICS UPDATE



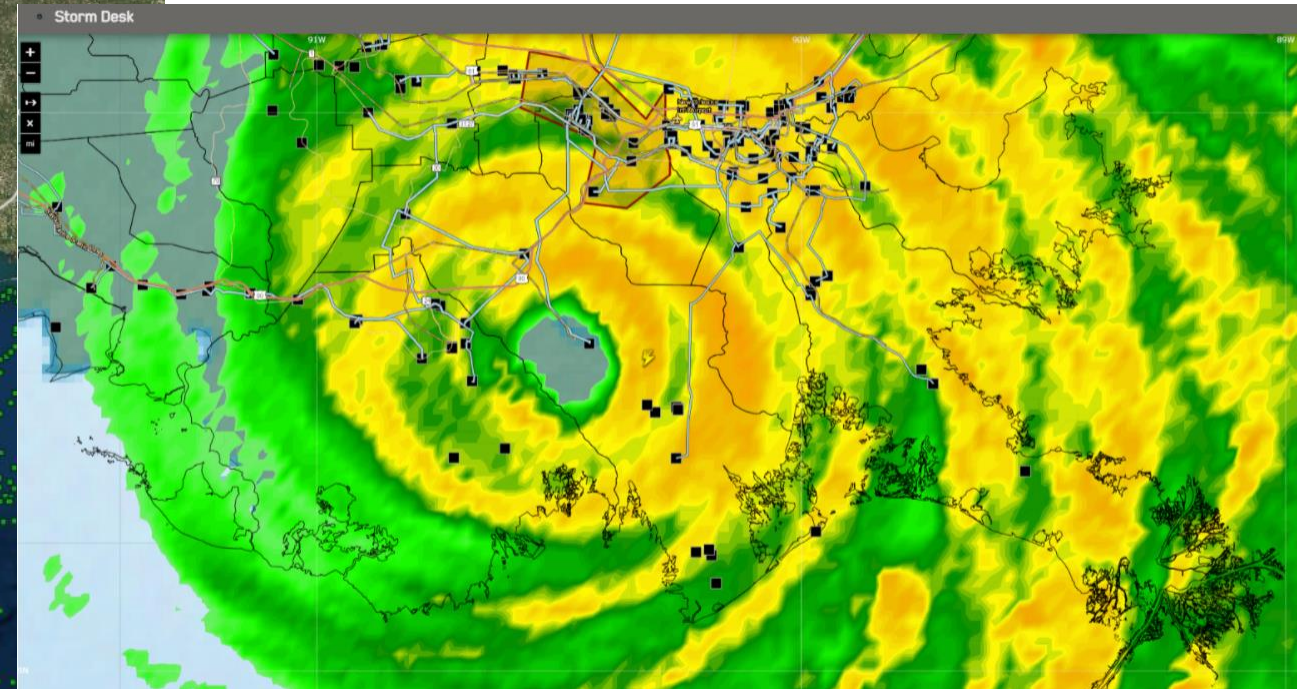
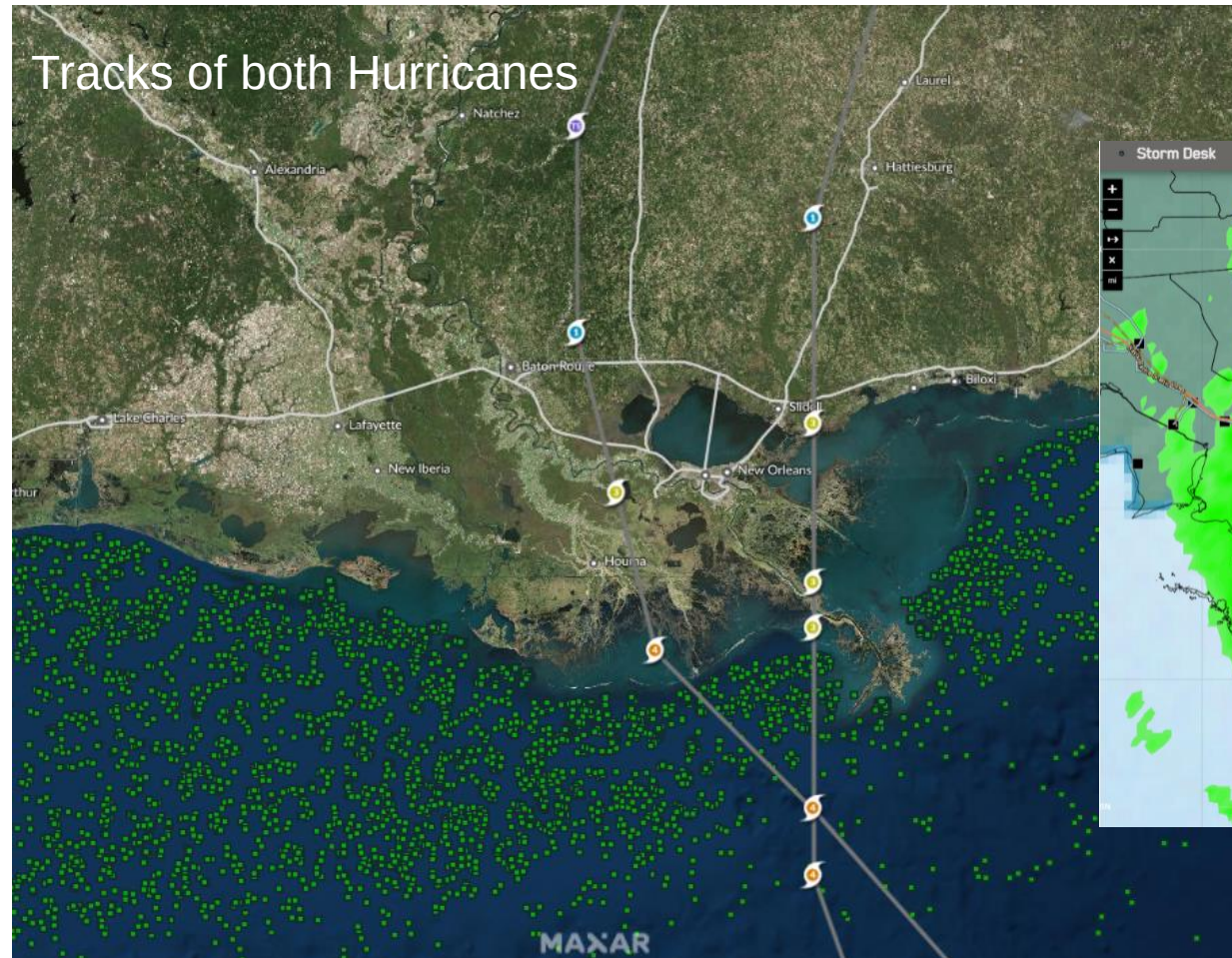


Storm Tracks So Far...





Comparing Ida and Katrina



Ida radar with transmission lines and substations



Atlantic Hurricane Season – Updated Forecast

- To date:
 - 17 Tropical Storms
 - 6 Hurricanes
 - 3 Major Hurricanes
 - **Grace**
 - **Ida** (150 mph – CAT 4)
 - **Larry**

9/22/2021

	Named Storms	Hurricanes	Major Hurricanes
Maxar Outlook			
2020 Actuals			
10Y Average (2011-2020)			
30Y Normal (1991-2020)			
2021 Current Count	17	6	3



THE SHOULDER SEASON

FALL 2021



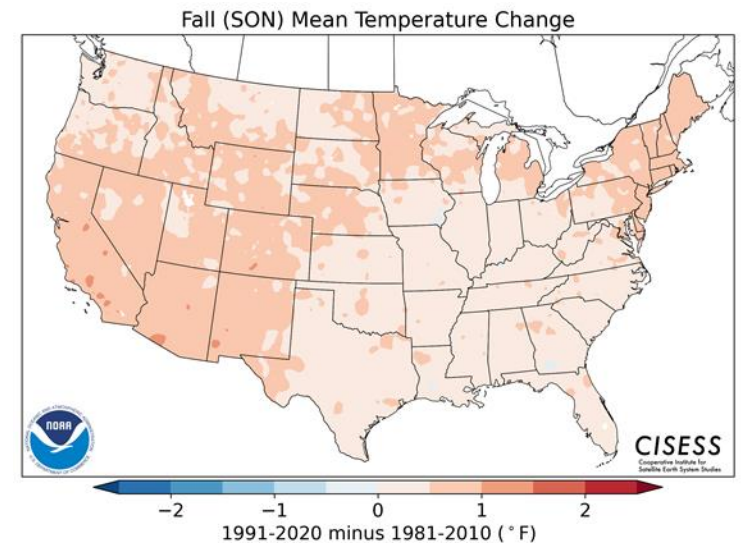
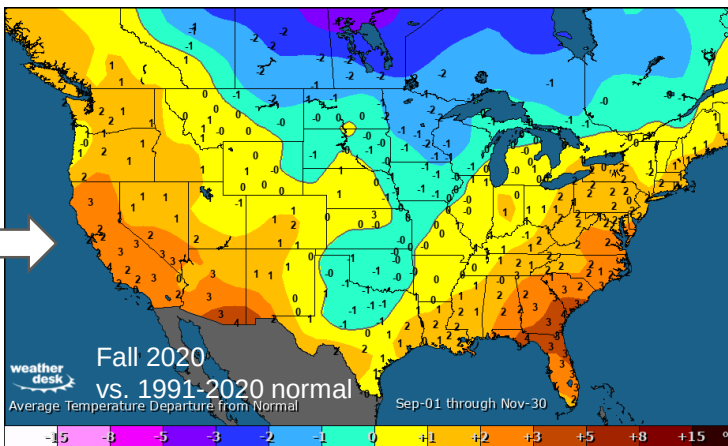
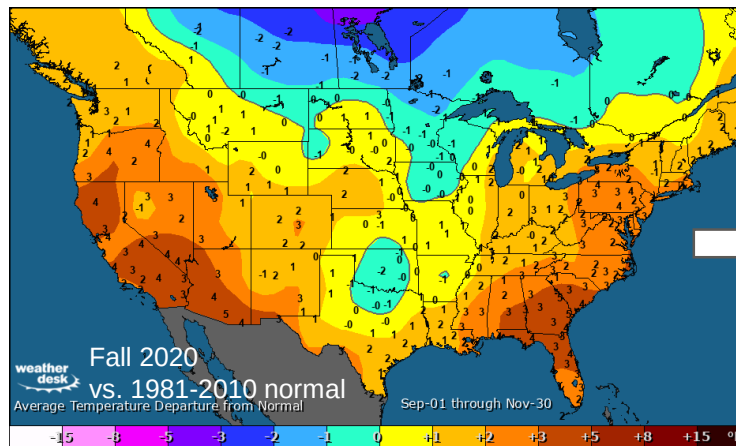


How Has 'Normal' Changed: 1991-2020 vs 1981-2010

Change (°F)	September	October	November
Atlanta	+1.34	+1.23	+0.05
Boston	+0.74	+0.77	-0.04
Chicago	+1.72	+1.42	+0.94
Cincinnati	+0.48	+0.29	-0.69
Dallas	+0.57	+0.11	-0.14
Denver	+1.34	+0.18	+1.14
Houston	+0.75	+0.34	-0.30
Las Vegas	+1.07	+0.82	+0.70
Los Angeles	+0.40	+0.59	+0.53
Memphis	+0.75	+0.43	-0.48

Change (°F)	September	October	November
Minneapolis	+1.47	+0.58	+1.10
New York	+1.65	+1.45	+0.80
Philadelphia	+0.73	+0.63	-0.30
Phoenix	+0.90	+0.69	+0.96
Portland	+0.88	+0.61	+0.35
Sacramento	+1.02	+0.64	+0.50
Salt Lake City	+2.28	+1.50	+1.70
Seattle	+1.27	+0.92	+1.02
St. Louis	+0.52	+0.35	-0.45
Washington DC	+1.35	+1.26	+0.32

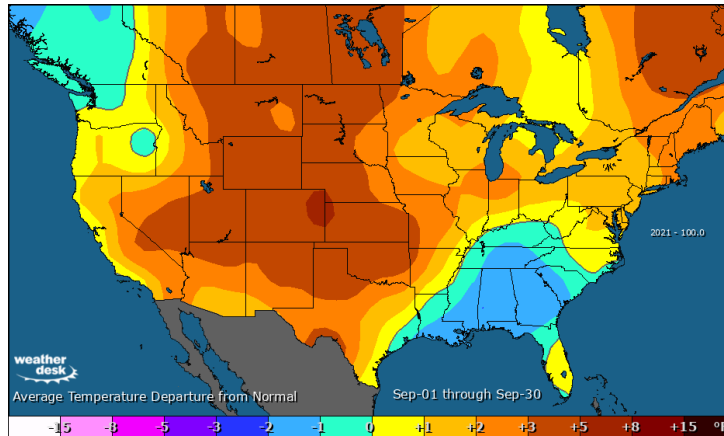
- September
 - + 15 PWCDDs
- October
 - +7 PWCDDs
 - -13 GWHDDs
- November
 - -4 GWHDDs





Fall Month by Month

September

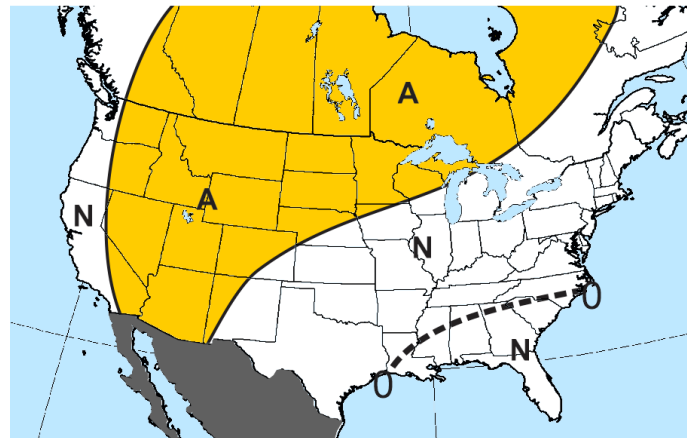


PWCDD Outlook

Forecast	199
10y Normal	211
30y Normal	187
Last Year	185

Forecast Rank: #13 warmest

October

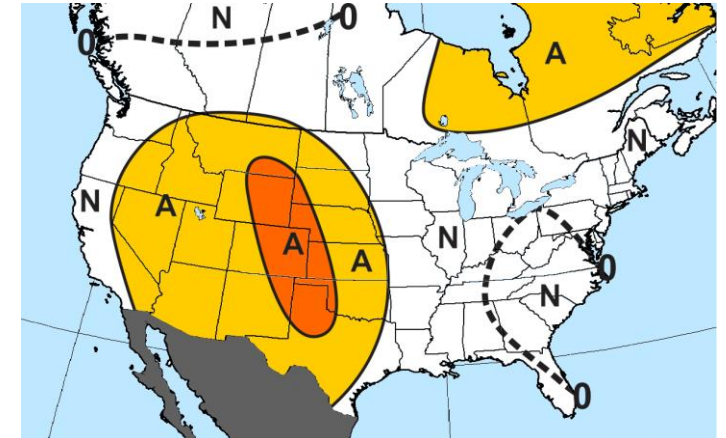


GWHDD Outlook

Forecast	257
10y Normal	257
30y Normal	277
Last Year	283

Forecast Rank: #14 warmest
70 PWCDD

November



GWHDD Outlook

Forecast	550
10y Normal	550
30y Normal	558
Last Year	459

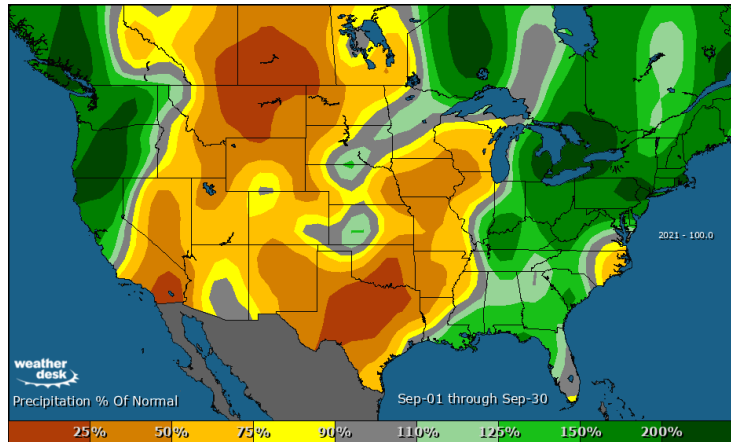
Forecast Rank: #25 warmest



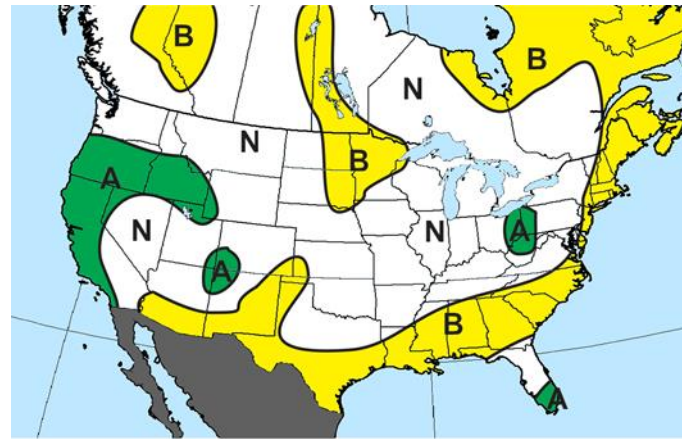


Fall Month by Month

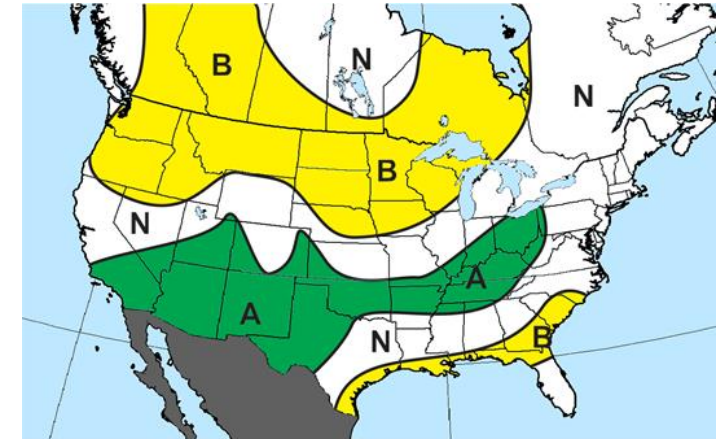
September



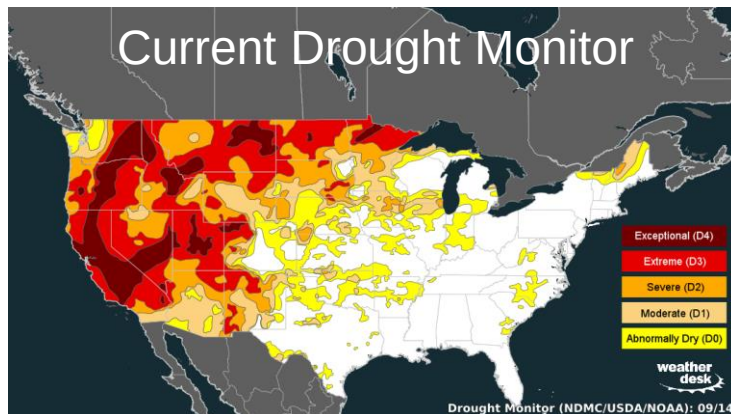
October



November



Current Drought Monitor

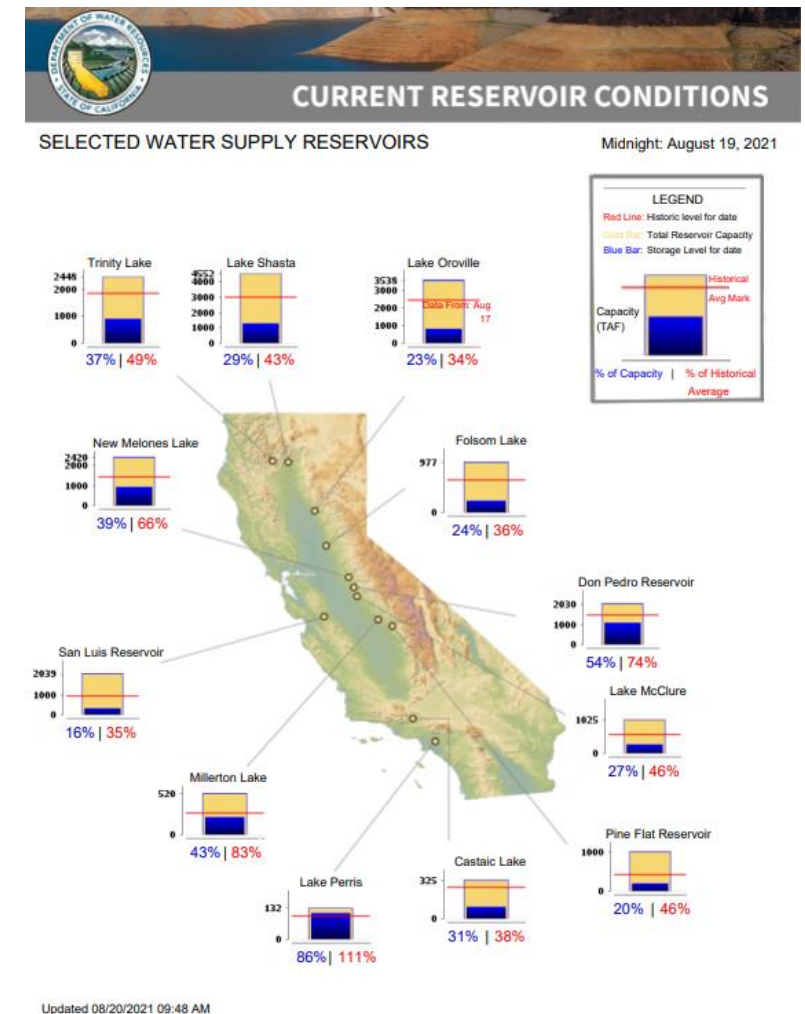
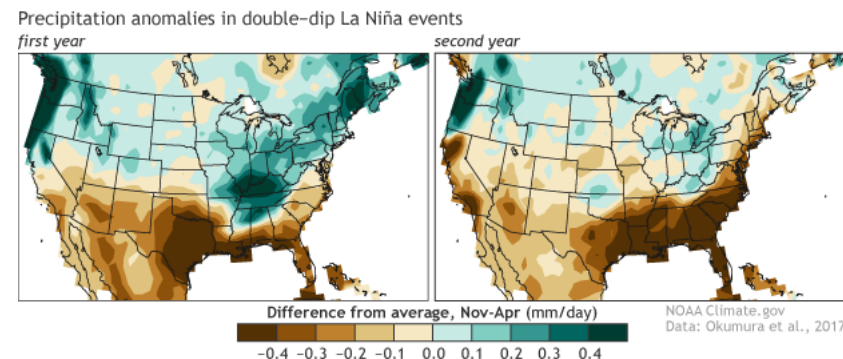


- ~50% drought coverage
- Drought to persist from Southwest to North-Central
- No drought in Eastern U.S.



Fall Highlights: Precipitation & Drought

- Most California reservoirs **well below normal**
- Lake Oroville at its lowest levels on record; **hydroelectric plant shut down** for the first time ever
- Tier 1 water shortage declared on the Colorado River for the first time ever
- Research suggests increased drought in California during the second year of a “double dip” La Niña, but favors wet conditions in the Pacific Northwest





Lake Oroville - California



2019



2021



Lake Oroville Dam - California



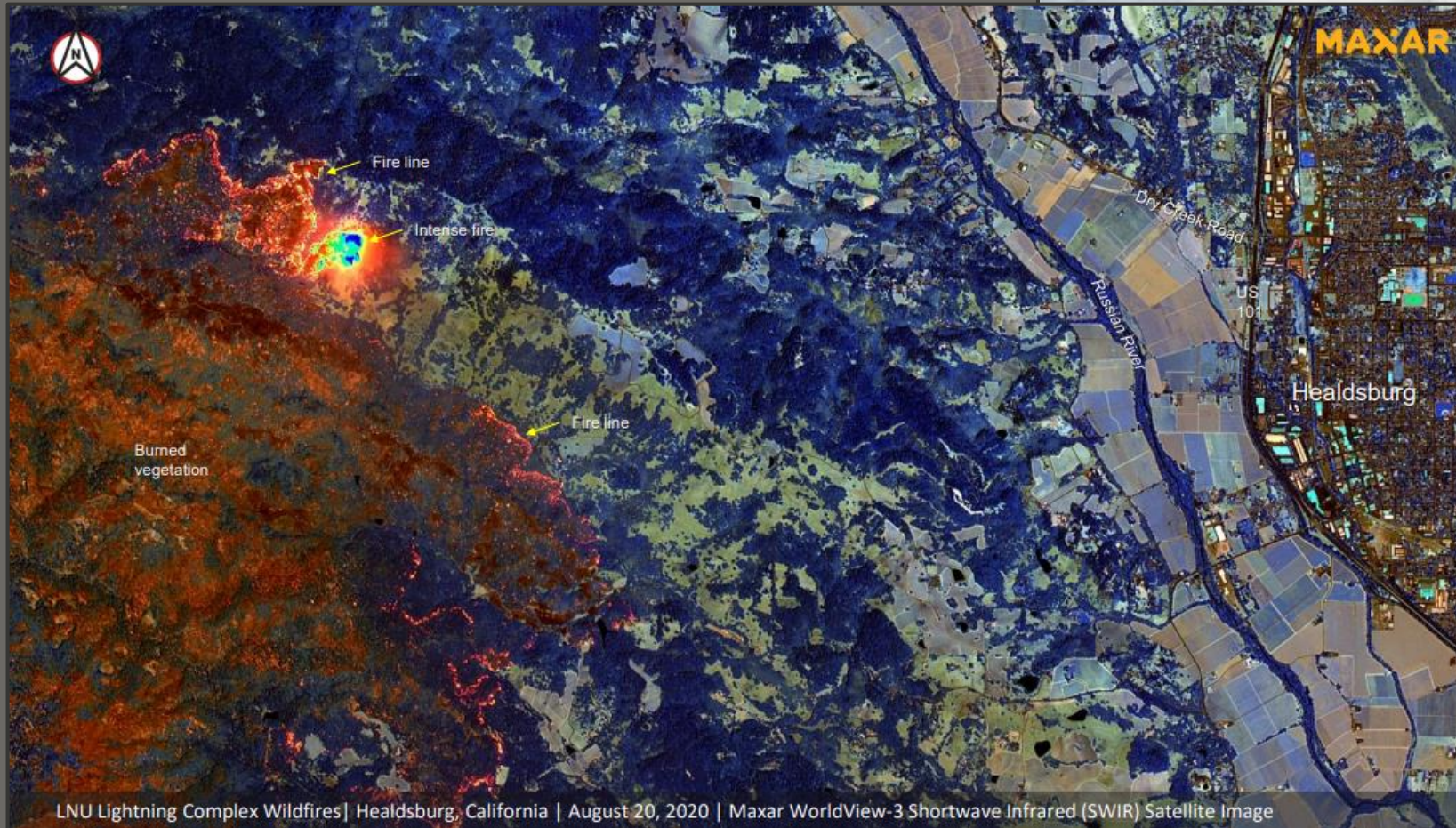
2019



2021

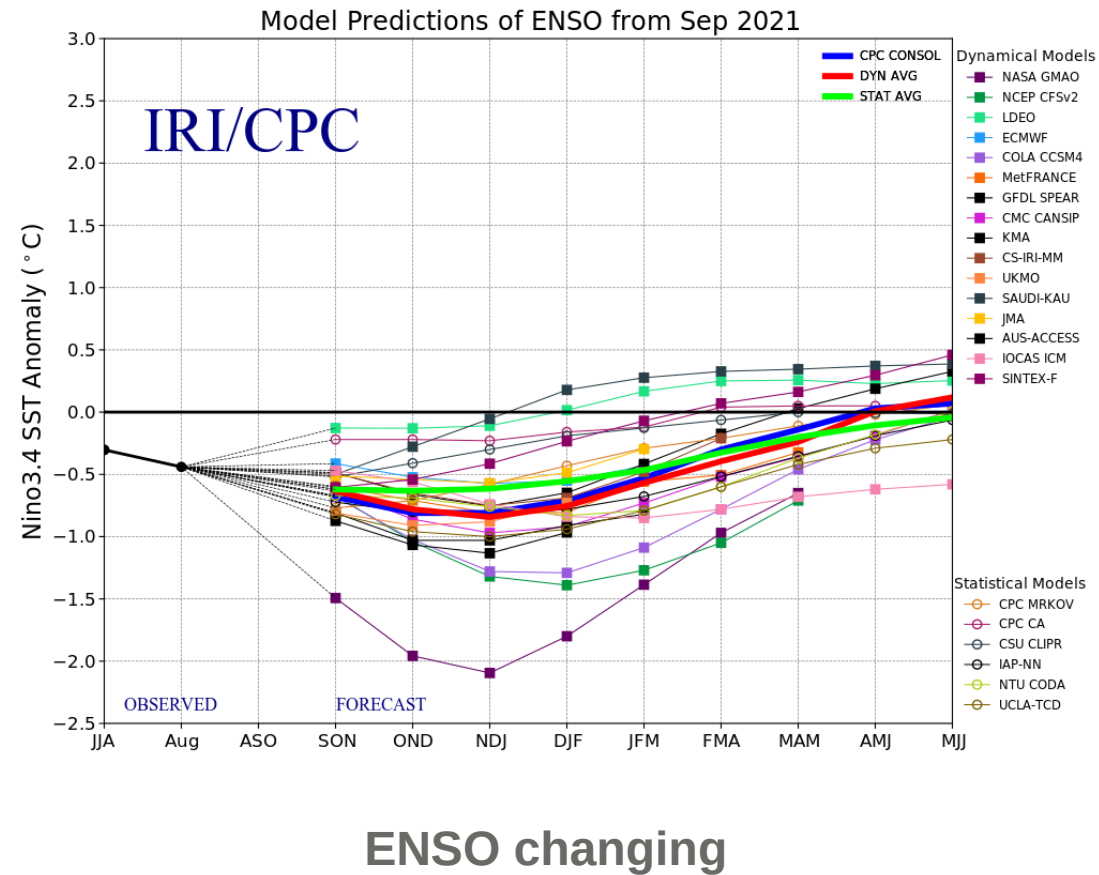


Forest Fire Monitoring Example





Latter part of Fall: Bigger things to watch...

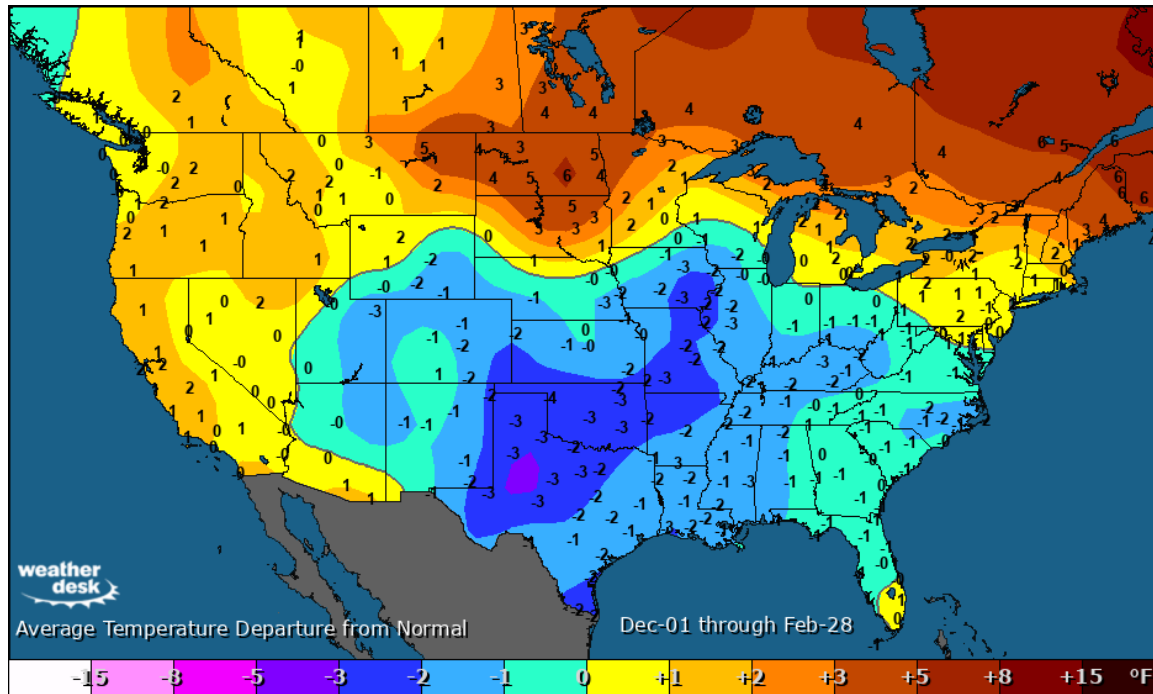




THE WINTER OUTLOOK

WINTER 2021-22





Winter 2020-21

- By the Numbers (Dec-Feb):
 - **2540 GWHDDs**
 - 21st Warmest on Record (since 1950)
- Comparisons:
 - 10-year Normal: 2476 GWHDDs
 - 30-year Normal: 2541 GWHDDs
 - Last Year (2019-20): 2275 GWHDDs
 - Records:
 - Coldest: 1950 with 725 GWHDDs
 - Warmest: 2016 with 1040 GWHDDs



How Has 'Normal' Changed: 1991-2020 vs 1981-2010

Monthly/Seasonal GWHDD 30-Year Normals

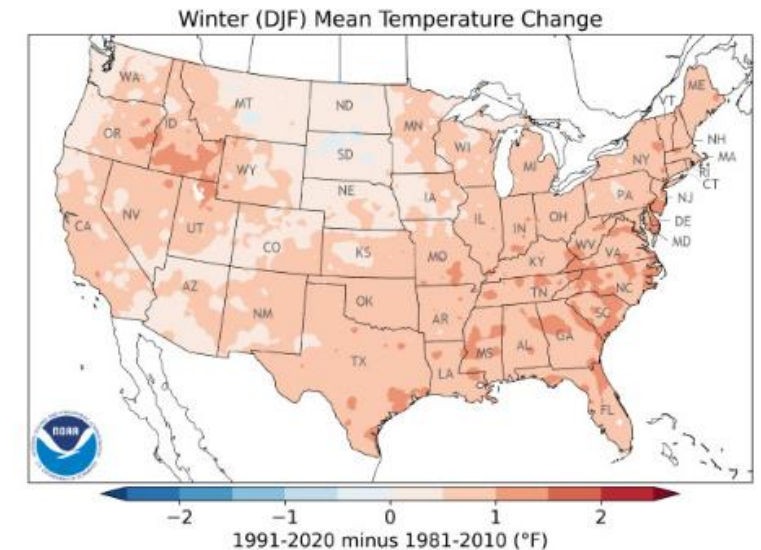
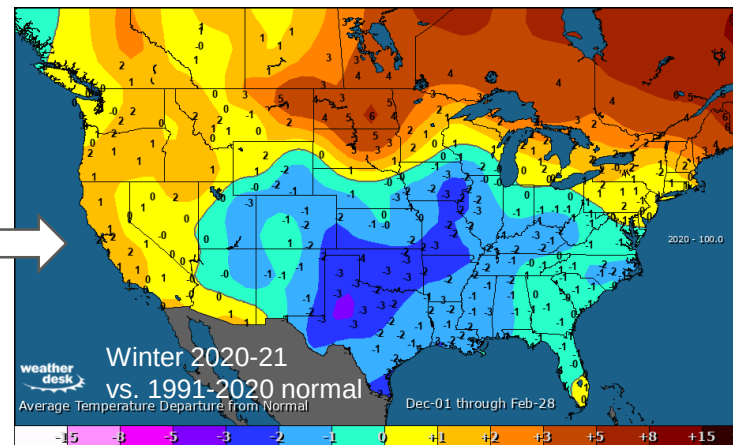
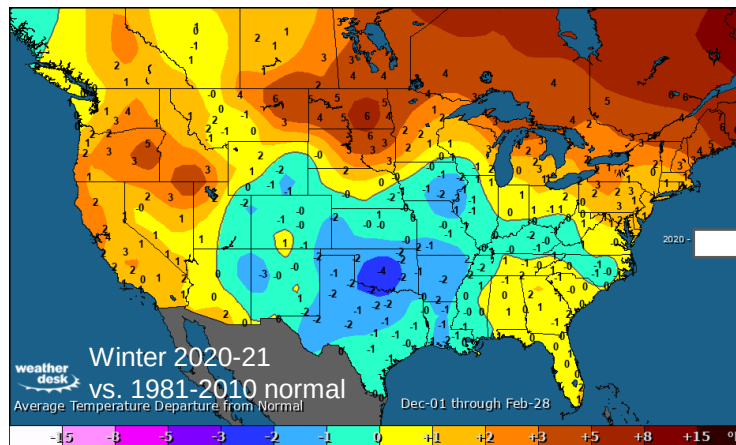
Period	1981-10	1991-20	Change	% Change
November	562	558	-4	-0.71
December	874	838	-36	-4.12
January	952	932	-20	-2.10
February	779	771	-8	-1.03
March	631	620	-11	-1.74
Dec-Feb	2605	2541	-64	-2.46
Nov Mar	3798	3719	-79	-2.08

1981-2010:

- 7 years among **Top 20** Dec 1-Feb 28 GWHDD totals since 1950
- 10 years among **Bottom 20** Dec 1-Feb 28 GWHDD totals since 1950

1991-2020:

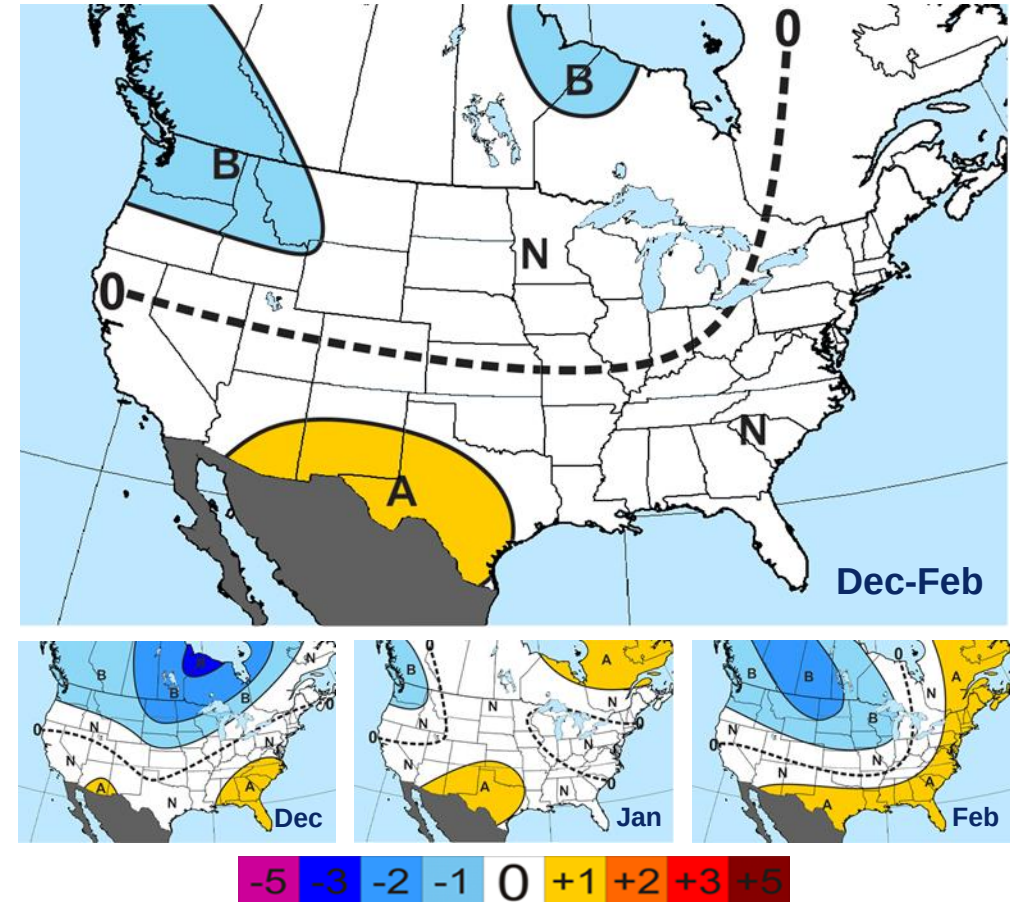
- 5 years among **Top 20** Dec 1-Feb 28 GWHDD totals since 1950
- 14 years among **Bottom 20** Dec 1-Feb 28 GWHDD totals since 1950
- Bottom 4 all occurred after 2010





Winter: The Official Forecast – Dec to Feb

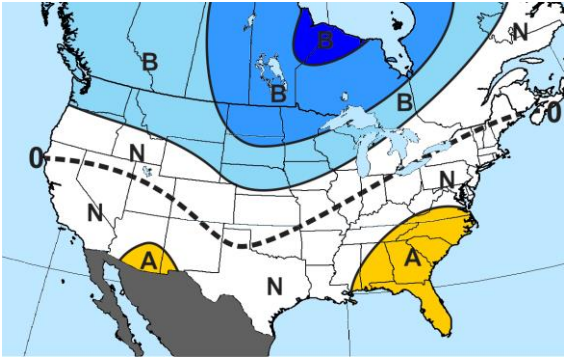
- By the numbers
 - 2520 GWHDDs
 - 19th warmest back to 1950
- Cold support in the Northwest and from west to central Canada
- Warm support in the South
- Near normal overall in East





Winter: Month By Month

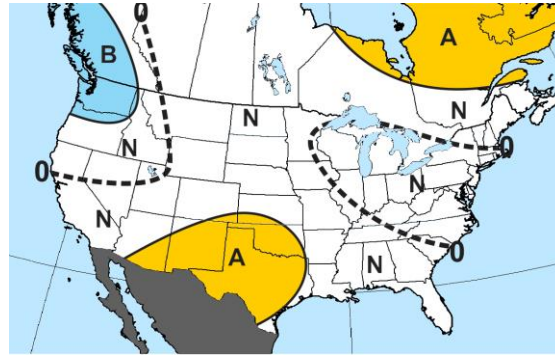
December



GWHDD Outlook	
Forecast	835
10y Normal	793
30y Normal	838
Last Year	802

Warm Forecast Rank: 25/72

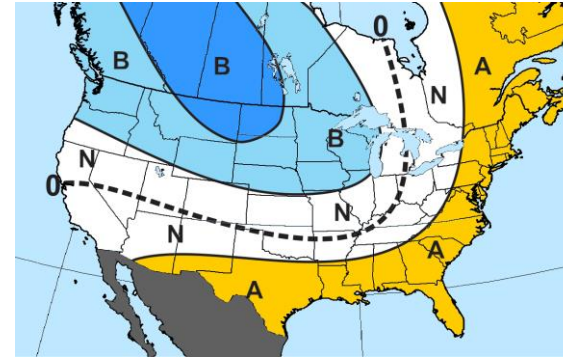
January



GWHDD Outlook	
Forecast	930
10y Normal	918
30y Normal	932
Last Year	864

Warm Forecast Rank: 26/73

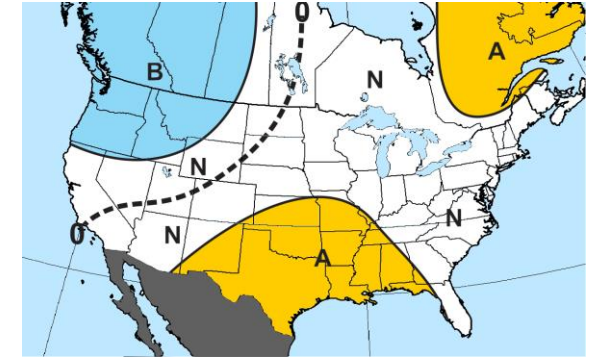
February



GWHDD Outlook	
Forecast	755
10y Normal	765
30y Normal	771
Last Year	874

Forecast Rank: 26/73

March



GWHDD Outlook	
Forecast	605
10y Normal	601
30y Normal	620
Last Year	539

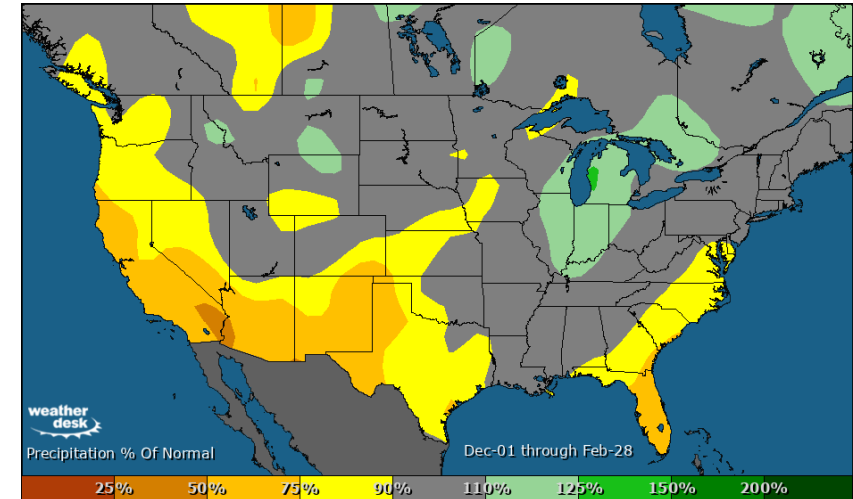
Forecast Rank: 19/73



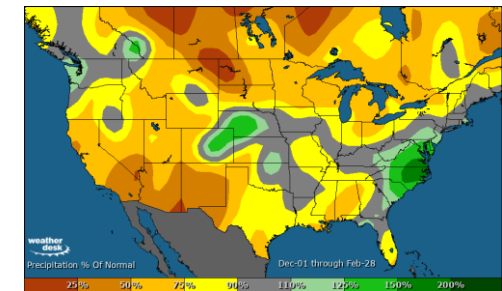


Precipitation Outlook

- Dry winter forecast in California and the Southwest
 - Persists drought in California
 - Drought intensifies again in the Southwest
- Near normal rainfall in Northwest
 - Risk for wetter conditions tied to La Niña
- Slight wetter leans around the Great Lakes
- Near normal precipitation along the East Coast
 - Drier vs last winter in the Mid-Atlantic



Precipitation
Anomalies

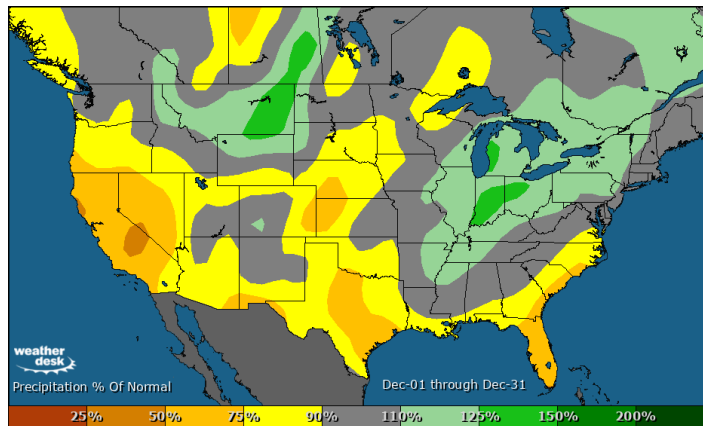


Last Year

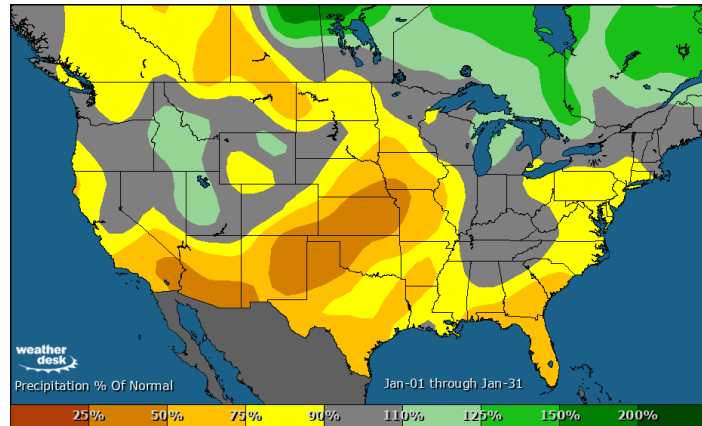


Precipitation – Month By Month

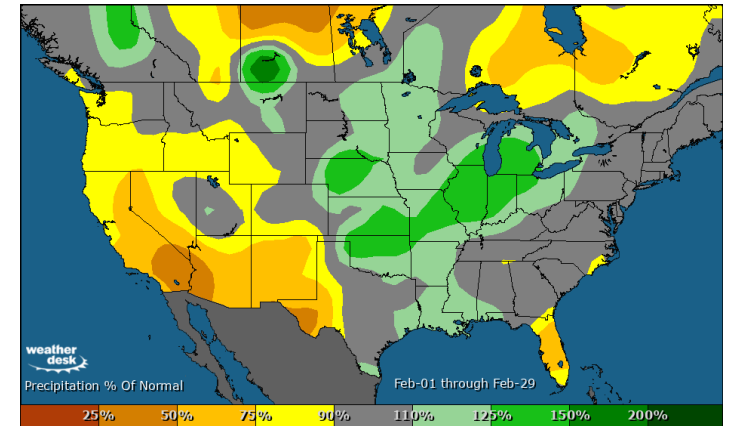
December



January



February





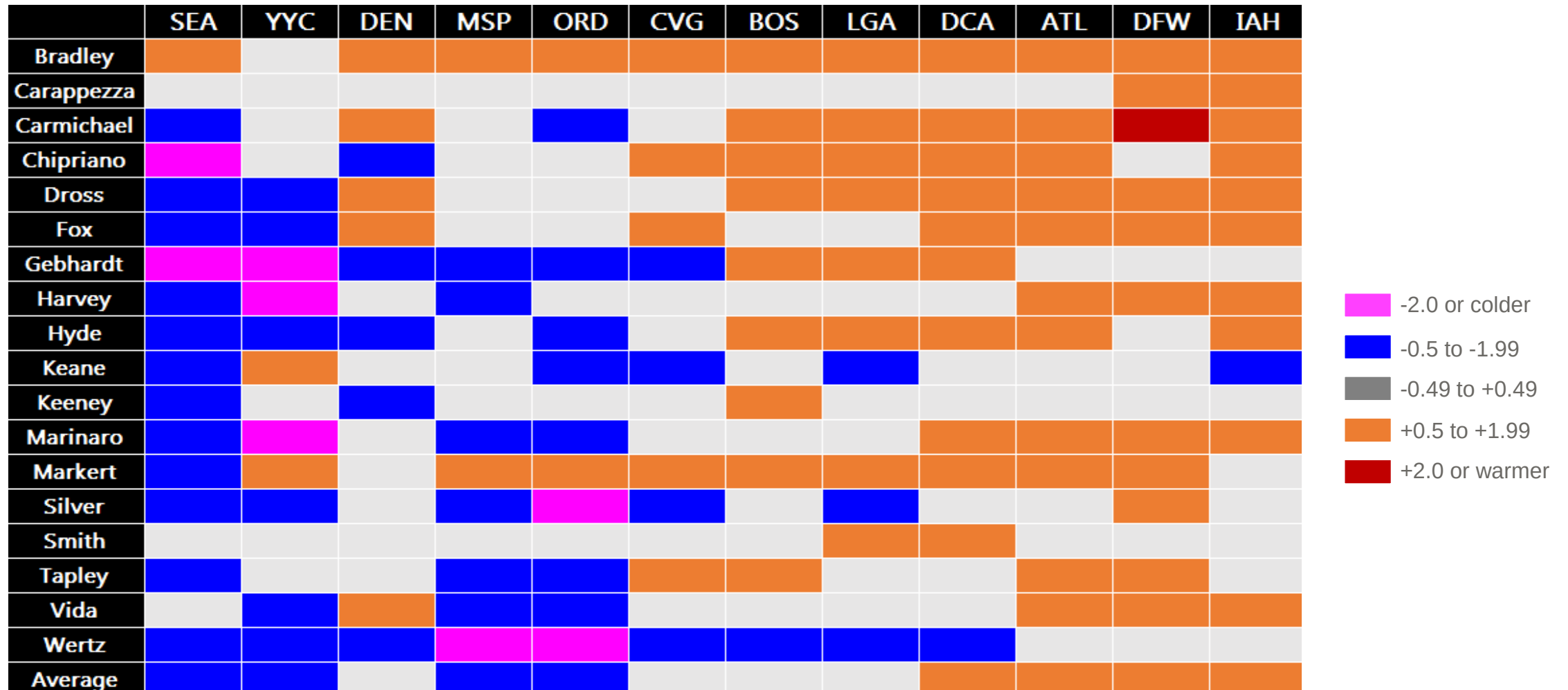
Forecast Influencers

WINTER 2021-22





Winter: Maxar Forecaster Anomalies - Temperatures

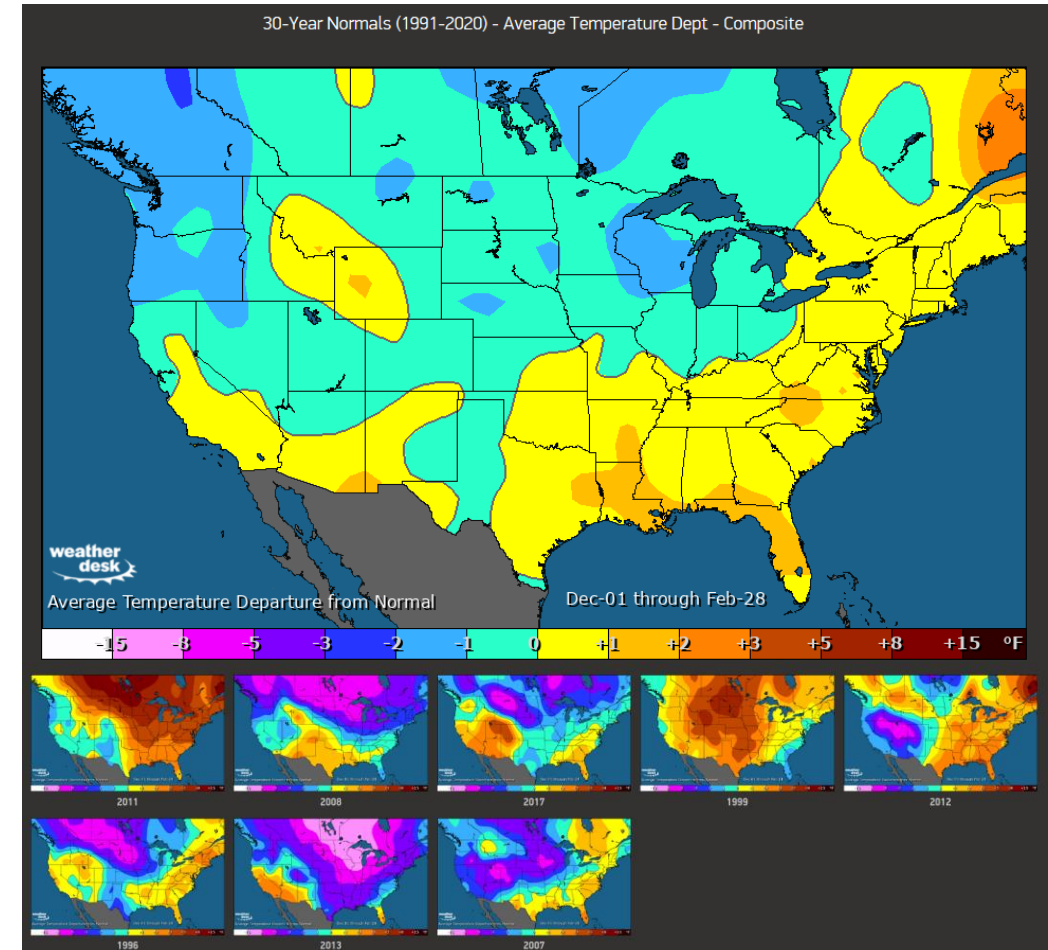




Winter: Forecaster Analogs

Common Analog	# of forecasters	% of forecasters	Dec - Feb GWHDDs	Rank (Since 1950)
2011-12*	15	88.24%	2280	4 th warmest
2008-09	11	64.71%	2680	32 nd coldest
2017-18*	9	52.94%	2525	22 nd warmest
1999-00	8	47.06%	2432	13 th warmest
2012-13	8	47.06%	2446	16 th warmest
1996-97	7	41.18%	2541	49 th coldest
2013-14*	7	41.18%	2842	8 th coldest
2007-08	6	35.29%	2610	40 th coldest

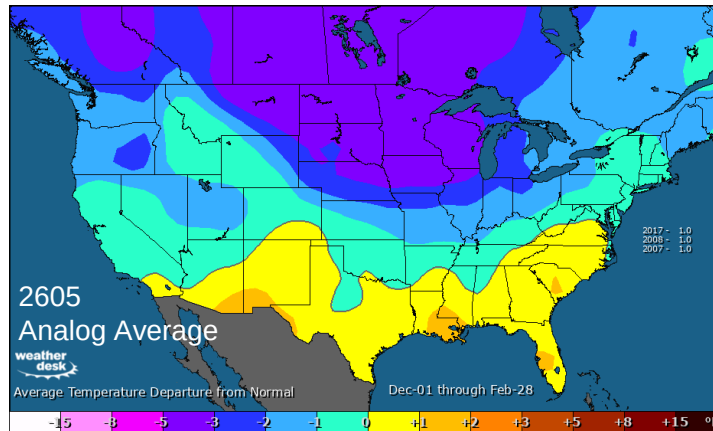
- 3 top-15 warm seasons among the analogs
 - Including 1 in the top-5
- 1 top-15 cold seasons
 - Coldest analog ranks 8th at 2842 GWHDDs
- La Niña represented in 6 of 8 analogs
- Analog set yields 2518 GWHDD average



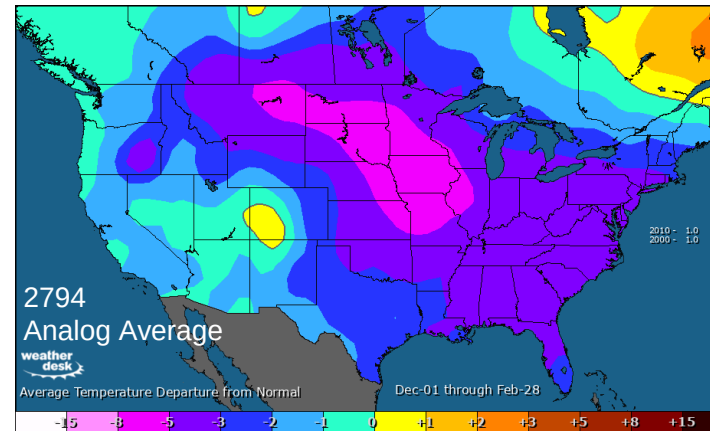


Main Influences: La Niña

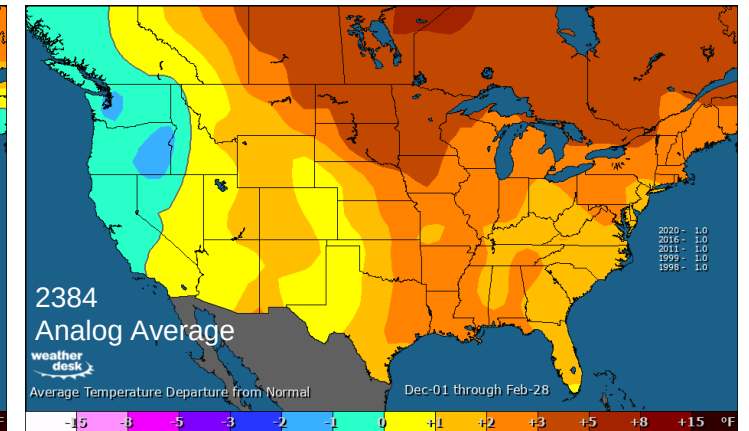
Classic La Niña



La Niña: -AO or -NAO Blocking



La Niña: +AO or +NAO

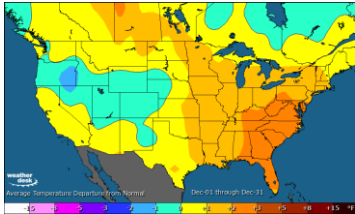


- Wide range of solutions are among the more recent La Niñas, but with most cases falling into three categories
- 2005-06 was the one instance that does not fit into these categories. January 2006 was a record warm month thanks to a strong (i.e. high amplitude) MJO wave out of the Indonesia/western Pacific region.
- Will Arctic blocking play a role this year?

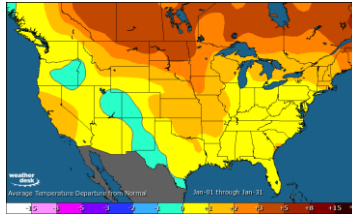


Main Influences: Climate Change

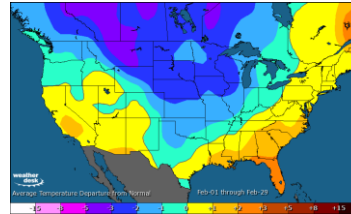
December



January

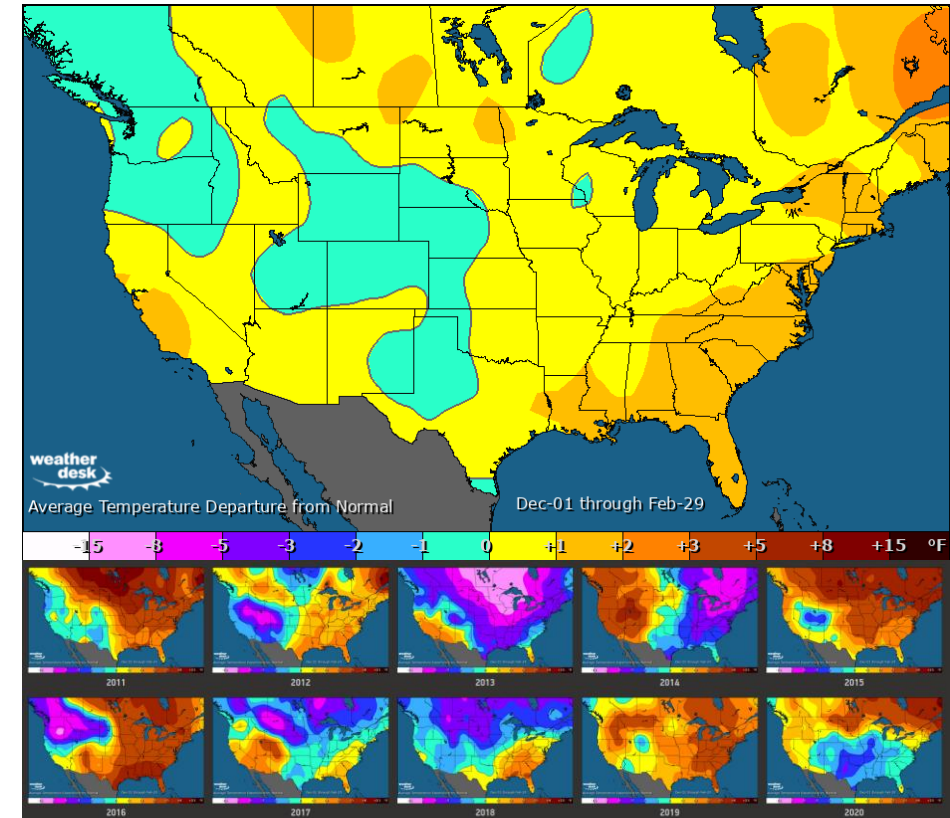


February



- December
 - 793 GWHDD 10-year normal vs 838 GWHDD 30-year normal
- January
 - 918 GWHDD 10-year normal vs 932 GWHDD 30-year normal
- February
 - 765 GWHDD 10-year normal vs 771 GWHDD 30-year normal

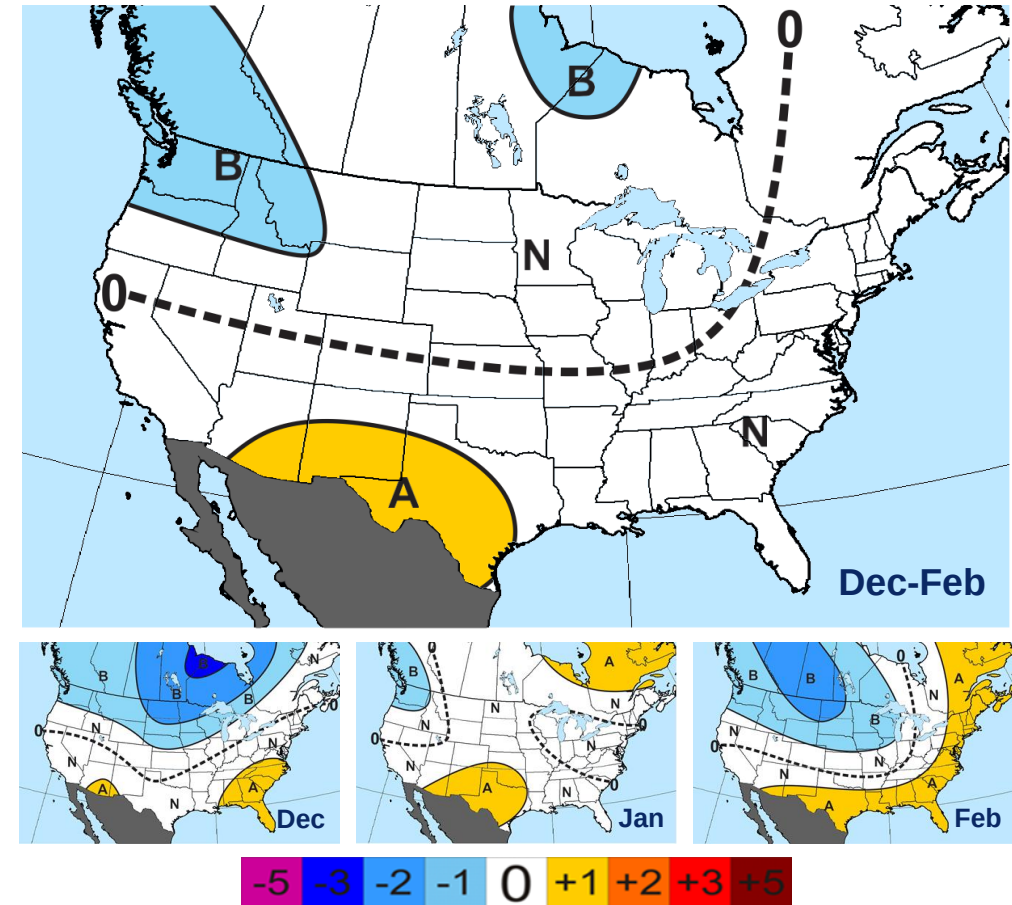
Winter: Past 10 Years





In Summary...

- By the numbers
 - 2520 GWHDDs
 - 19th warmest back to 1950
- **La Niña** influenced pattern
 - Cold support in the Northwest and from western to central Canada
 - Warm support in the South
- **California drought to persist**



MAXAR



wxsales@maxar.com

Christopher.Hyde@maxar.com
+1.301.326.3276