

# CW3E Event Summary – Hurricane Hilary: 20 and 21 August 2023

## Hurricane Hilary Brings Heavy Rain, Flooding and High Winds to Southern California

- Hilary made landfall as a Category 1 hurricane in Baja California and weakened into a tropical storm before crossing into California
- The cyclone produced heavy rain and high winds across Southern and Central California on 20 and 21 August
- Much of Southern California and Southwestern Nevada received > 2 inches of precipitation with stations in the Transverse Range measuring > 10 inches
- Several stations set new daily precipitation records for the month of August while Death Valley set its all-time single day precipitation total at 2.20 inches
- Precipitable water observed during this event in San Diego was 2.38 inches, tying for the second highest recorded value per Storm Prediction Center records
- Many streamflow stations throughout Central and Southern California saw streamflows > 90<sup>th</sup> percentile of climatology because of the record-breaking rainfalls
- Heavy rainfall resulted in widespread flash flooding and debris flows that damaged roadways
- High winds caused trees to fall and resulted in power outages for more than 50,000 people across Central and Southern California
- Per the National Oceanic and Atmospheric Administration Hilary was the first tropical storm to pass over California since Nora in 1997

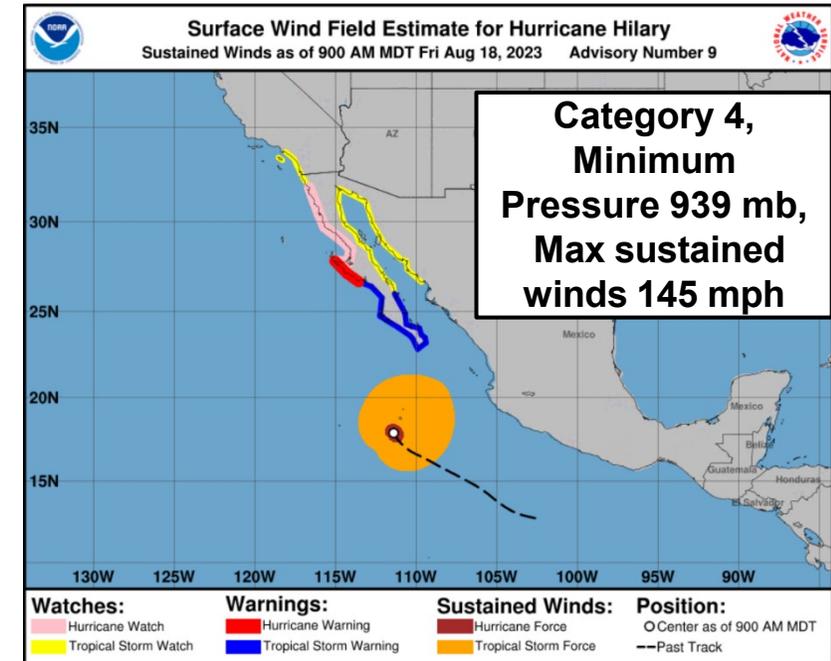
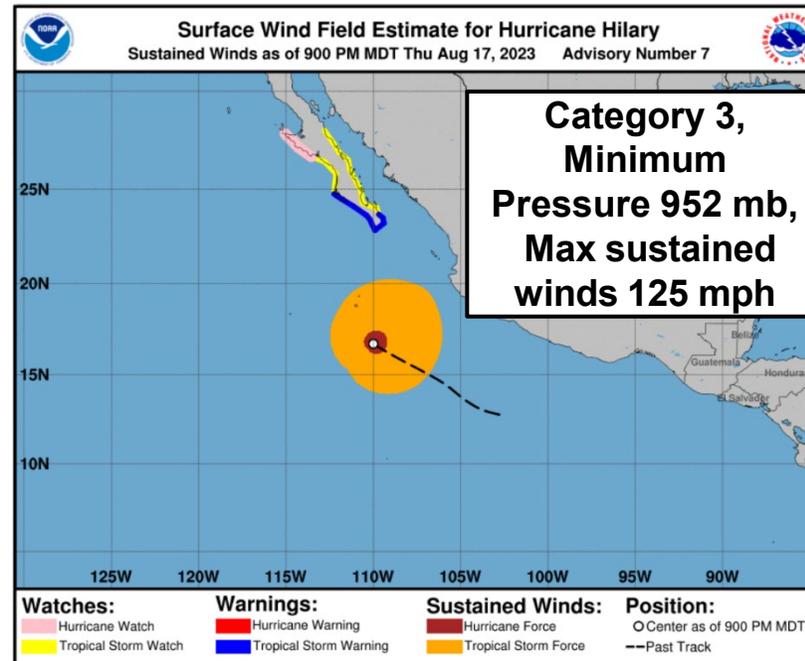
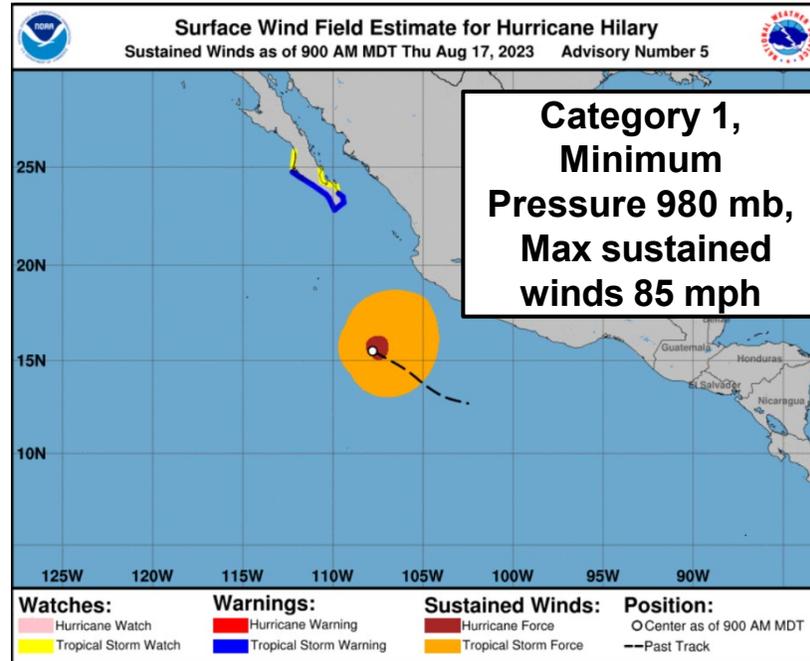
# CW3E Event Summary – Hurricane Hilary: 20 and 21 August 2023

## Surface Wind Field and Watches and Warnings

A) Watches and Warnings as of 8 AM PDT 17 Aug

B) Watches and Warnings as of 8 PM PDT 17 Aug

C) Watches and Warnings as of 8 AM PDT 18 Aug

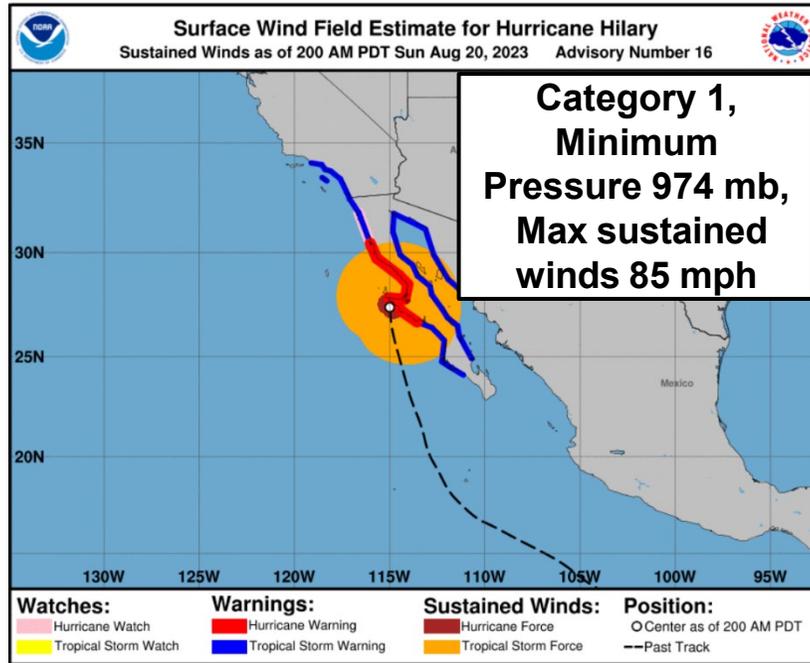


- Advisory 5 showed Hilary maintaining hurricane force winds as the first Tropical Storm Warnings were issued early 17 Aug (Figure A)
- The first Hurricane Watch was issued for coastal Baja Peninsula with Advisory 7 late on 17 Aug as Hilary continued to intensify (Figure B)
- Hilary underwent rapid intensification over the 24-hour period ending 8 am PT Aug 18 as the first Hurricane Warning was issued along the Baja Peninsula and the first ever Tropical Storm watch was issued for Southern California (Figure C)

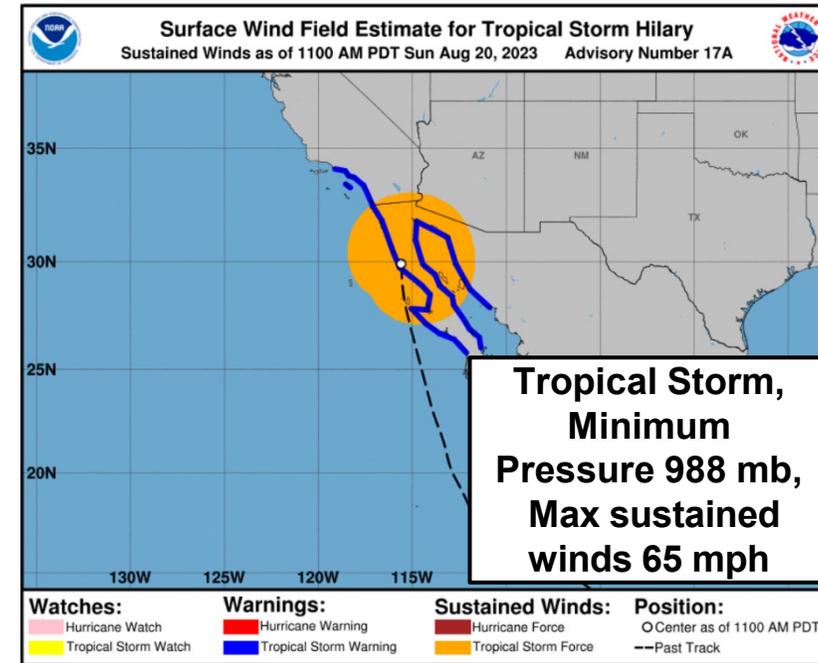
# CW3E Event Summary – Hurricane Hilary: 20 and 21 August 2023

## Surface Wind Field and Watches and Warnings

A) Watches and Warnings as of  
1 AM PDT 20 Aug



B) Watches and Warnings as of  
10 AM PDT 20 Aug

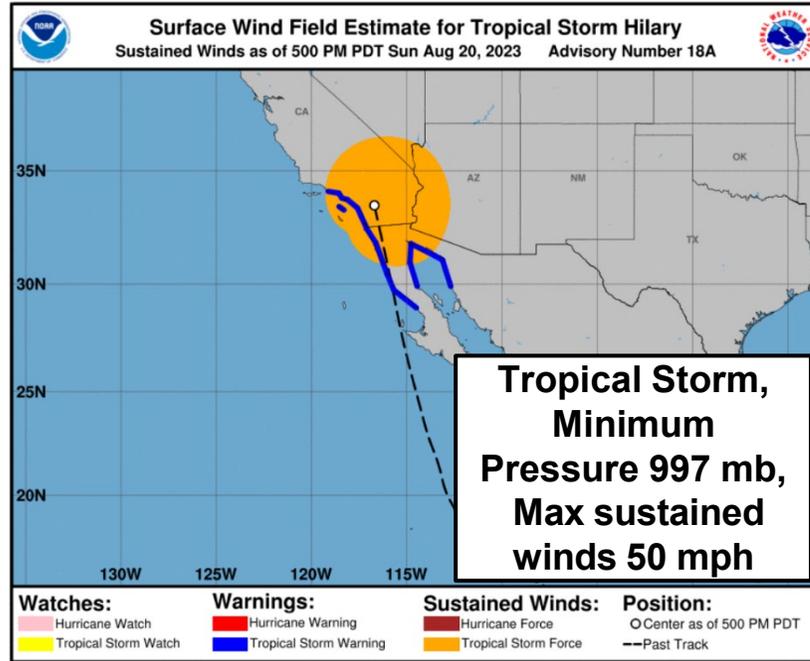


- By early morning 20 Aug, Hilary had weakened to a Category 1 hurricane near Punta Eugenia, Mexico, while the outer rainbands had begun to expand into California (Figure A)
- Hilary made initial landfall on the morning of 20 August along the Baja Peninsula; at this point the heavy precipitation from the outer bands of the storm had begun impacting Southern California (Figure B)

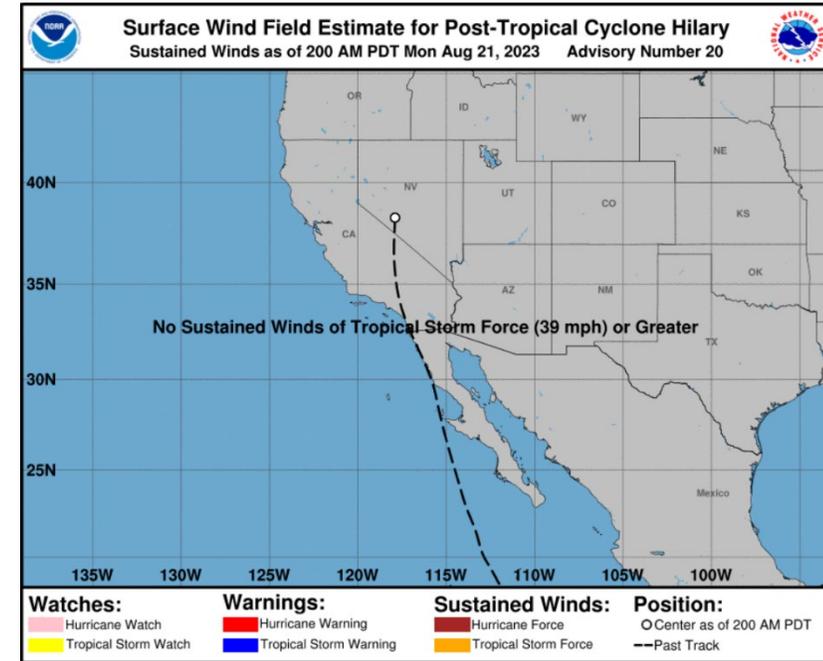
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## Surface Wind Field and Current Watches and Warnings

### A) Watches and Warnings as of 5 PM PDT 20 Aug



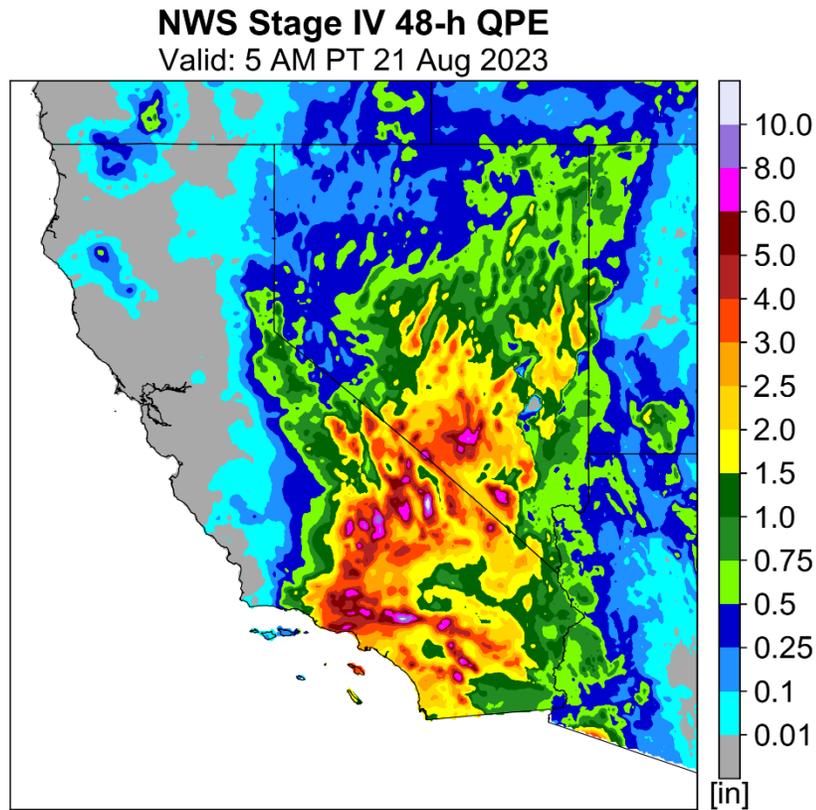
### C) Watches and Warnings as of 2 AM PDT 21 Aug



- The center of Hilary passed into Southern California during the afternoon of 20 Aug, bringing heavy rainfall and tropical storm force winds to much of the region (Figure A)
- By early Monday morning, the storm had progressed into Nevada and there were no longer sustained tropical storm force winds (Figure B)

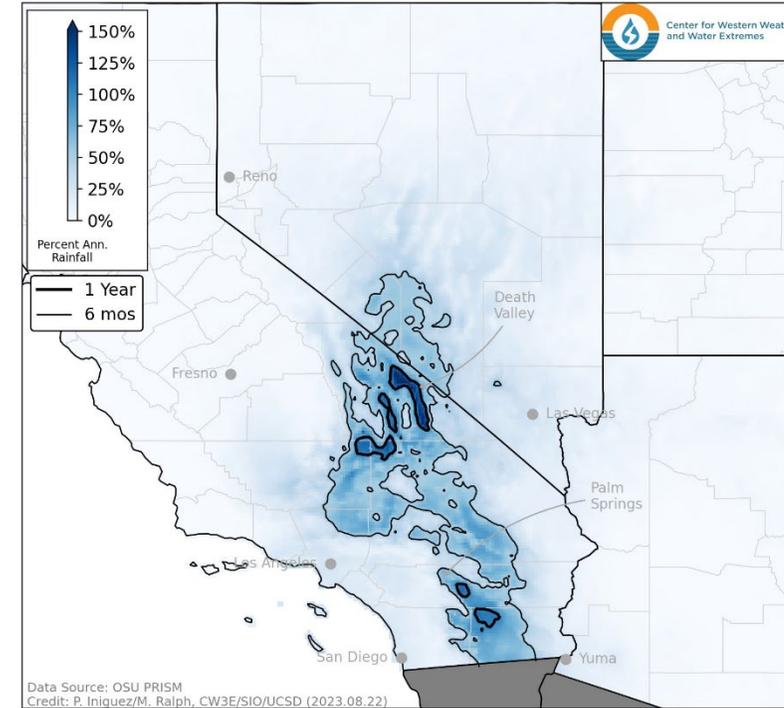
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## 48-h Stage IV Gridded QPE and Percent of Water Year Precipitation



## How much rain?!

The remnants from Hurricane Hilary brought unusually significant summer rains to the Southwest. This map shows the percent of \*annual\* rainfall during the event (Aug 19-22, 2023).

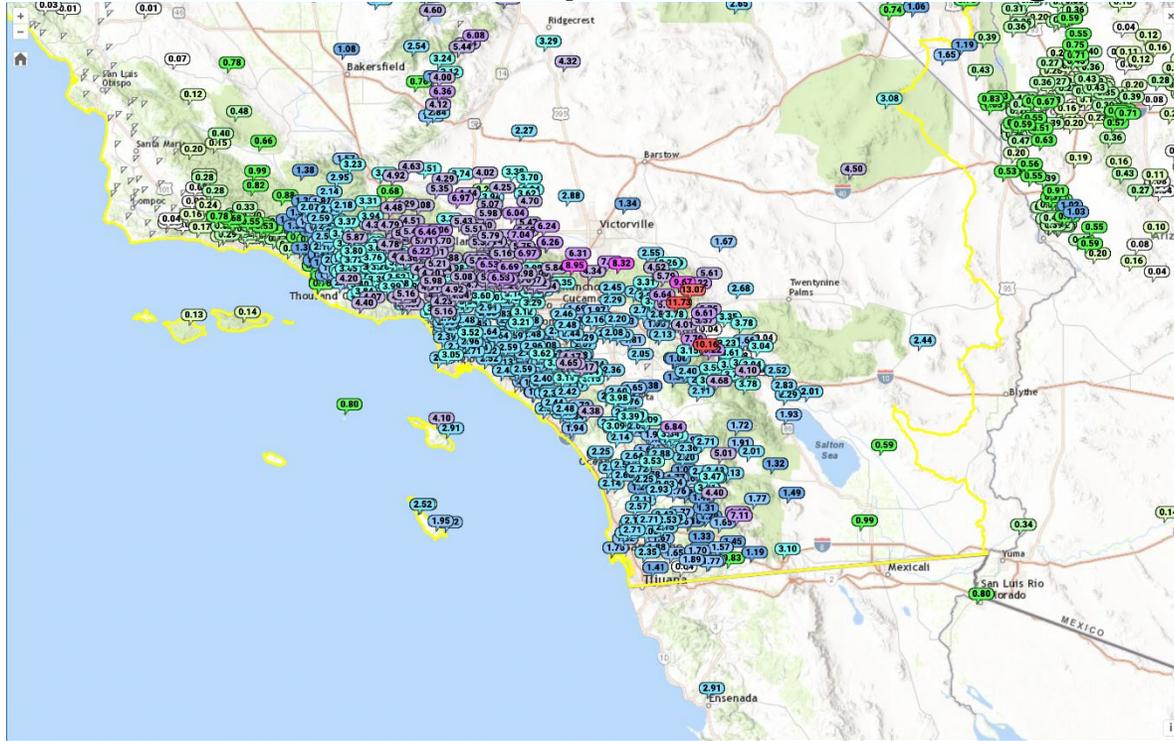


- Hurricane Hilary produced record-breaking rainfall across much of Southern California and Southwestern Nevada, with much of these regions receiving > 2 inches of precipitation
- Several mountainous regions saw precipitation > 6 inches, with areas of the Transverse Ranges recording > 10 inches
- Observed precipitation during the 19-21 Aug period exceeded 50% of the normal total water year precipitation in much of interior Southern California and southwestern Nevada

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## Record Setting Precipitation

### 72-hr Observed Precipitation for 19-21 Aug



Source: CNRFC

### Select Daily Rainfall Amounts for August 20, 2023:

Location	Amount	Notes	Start of POR
Alpine	1.36	New daily record for August 20; 3rd highest summer daily amount	11/1951
Anaheim	1.26	New summer daily record	8/1989
Avalon	4.04	New summer daily record; 2nd highest all-time daily amount	1/1948
Bakersfield	1.08	New daily record for August 20; 2nd highest summer daily amount	1/1893
Bishop	1.72	New summer daily record	9/1943
Burbank	3.28	New summer daily record	12/1939
Chino	2.41	New summer daily record	4/1998
Chula Vista	1.43	New daily record for August 20; 2nd highest summer daily amount	9/1918
El Cajon	1.86	New daily record for August 20; 2nd highest summer daily amount	2/1899
Escondido	2.66	New summer daily record	12/1893
Hawthorne	1.89	New summer daily record	4/1998
Lake Cuyamaca	4.11	New summer daily record	1/1899
Lake Elsinore	1.67	New daily record for August 20; 3rd highest summer daily amount	3/1897
Long Beach	2.27	New summer daily record	4/1958
Los Angeles	2.03	New daily record for August 20; 2nd highest summer daily amount	8/1944
Los Angeles (Downtown)	2.48	New summer daily record	7/1877
Newport Beach	0.76	New daily record for August 20; 3rd highest summer daily amount	1/1921
Oceanside Harbor	2.38	New summer daily record; 8th highest all-time daily amount	10/1909
Palm Springs	3.18	New summer daily record	3/1922
Palmdale	3.93	New all-time daily record	4/1931
Ramona	2.03	New summer daily record	2/1974
Riverside	1.83	New daily record for August 20	1/1893
San Diego	1.82	New summer daily record	10/1850
Santa Ana	1.76	New daily record for August 20; 2nd highest summer daily amount	4/1906
Santa Barbara	0.11	New daily record for August 20	1/1941
Santa Monica	2.59	New summer daily record	4/1998
Torrance	1.63	New daily record for August 20; 3rd highest summer daily amount	1/1932
Van Nuys	3.93	New summer daily record; 4th highest all-time daily amount	1/1949
Vista	2.12	New summer daily record	8/1957

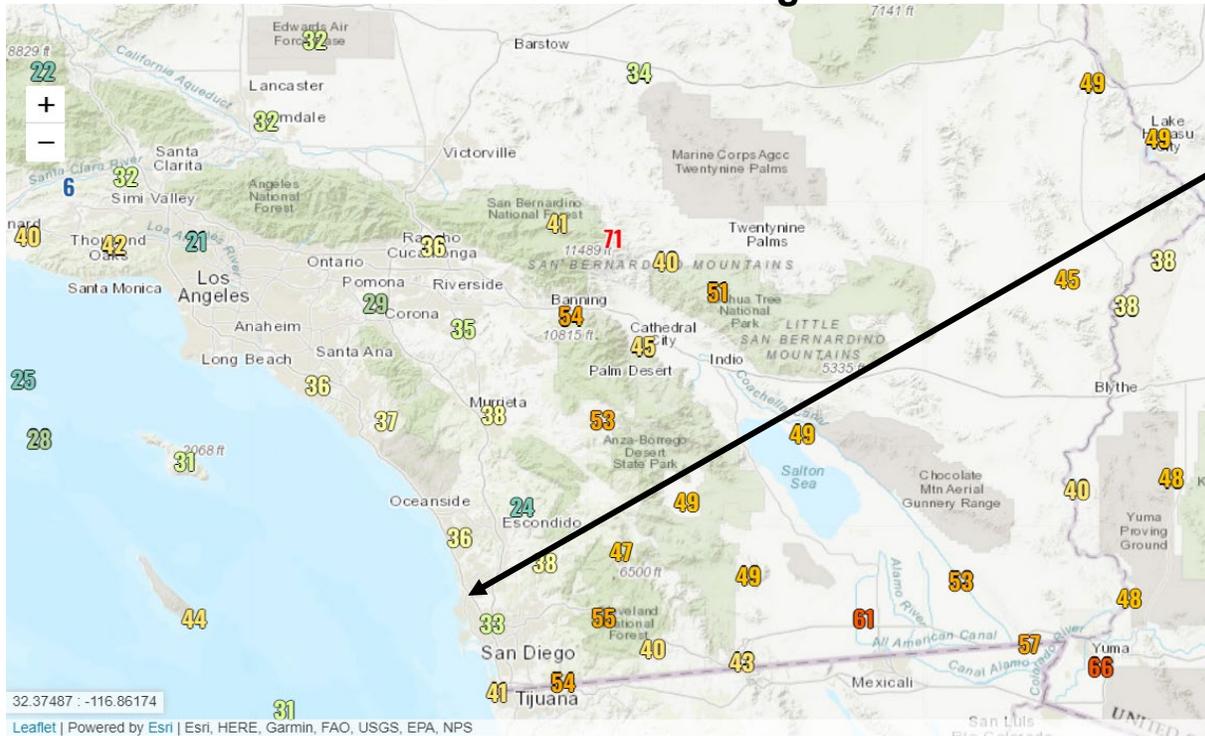
Source: Don Sutherland, Twitter Don Sutherland on X: "A more comprehensive list of #California #rainfall records from August 20, 2023. #cawx #Hilary #rain @Kenwxman <https://t.co/eGvy5Fc5Ow> / X (twitter.com)

- Many stations in Southern California set new August and/or summertime daily precipitation records
- The rainfall received in San Diego on 20 Aug made for the wettest day in the city since 2017
- Death Valley saw its wettest day on record, recording 2.20 inches of precipitation, breaking the previous record of 1.70 inches in August of last year per NWS Las Vegas. This single day of precipitation matches Death Valley's average annual precipitation

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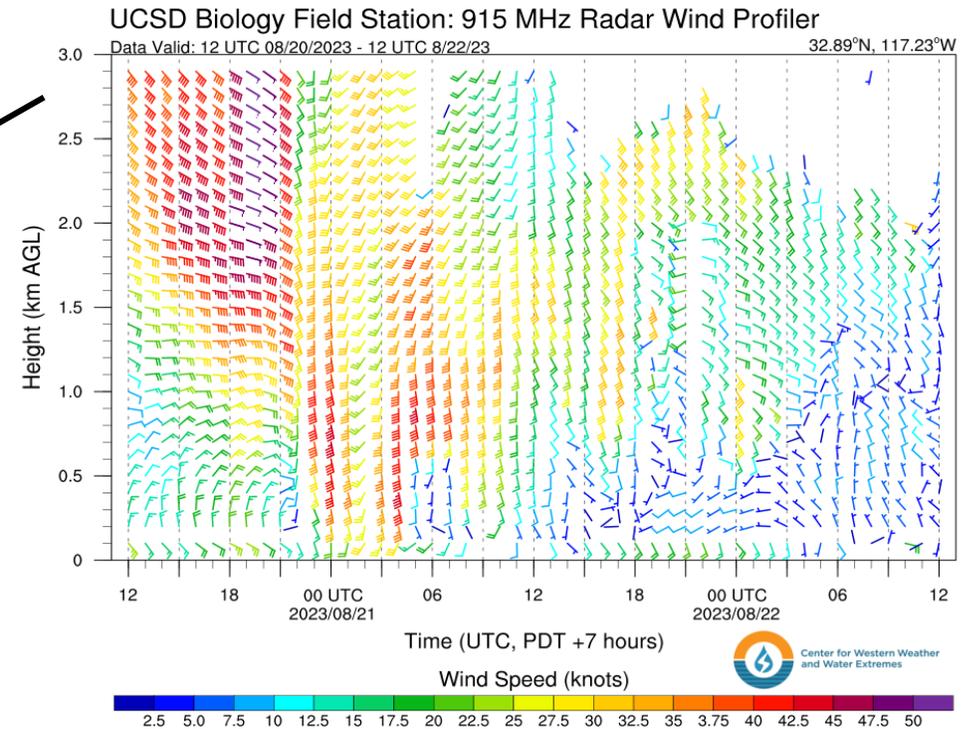
## Observed Wind Gusts

A) 24-Hr Max Wind Gust  
Valid: 1159 PDT 20 Aug



Source: NWS Western Region Headquarters

B) CW3E Wind Profiler  
Valid: 12 UTC 20 Aug- 22 Aug

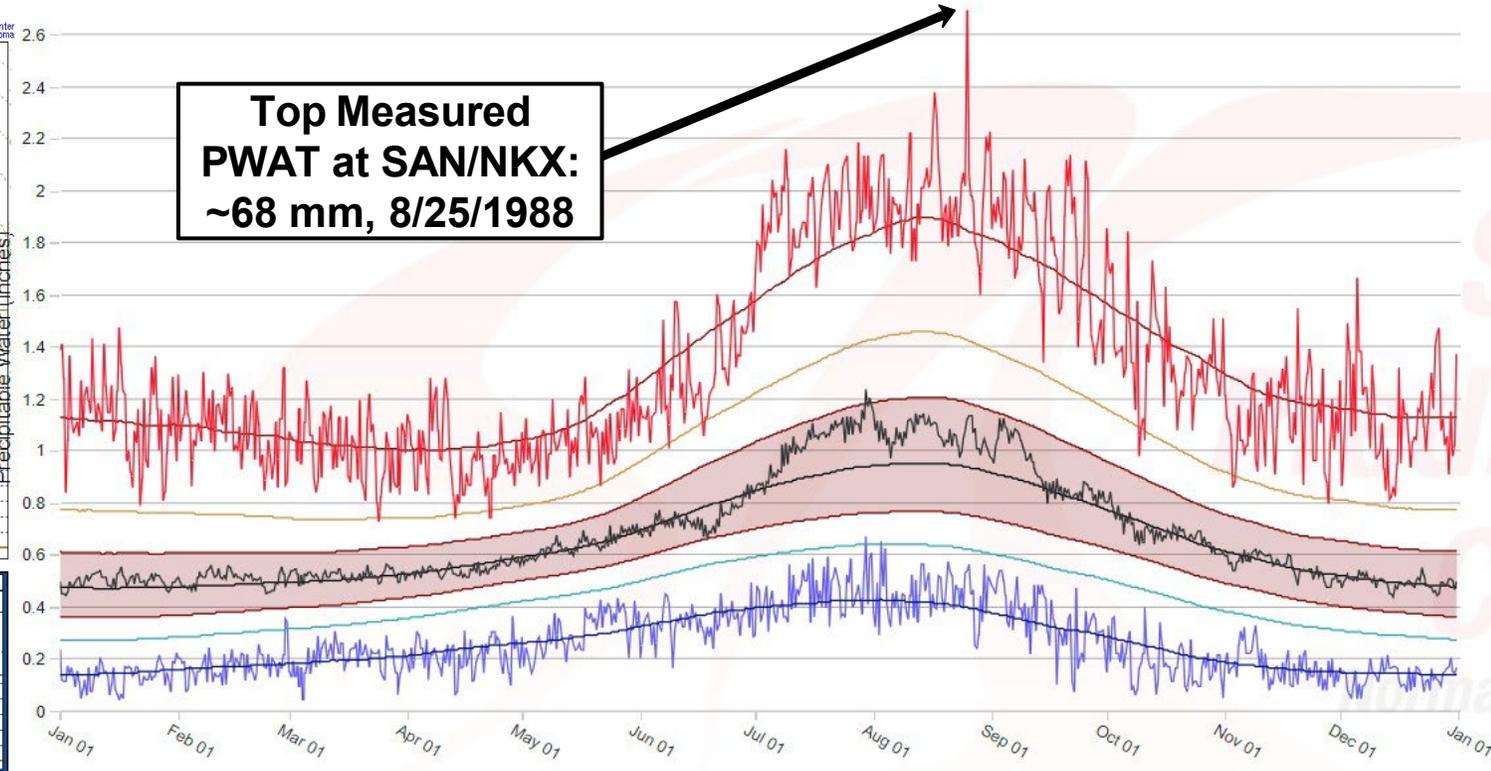
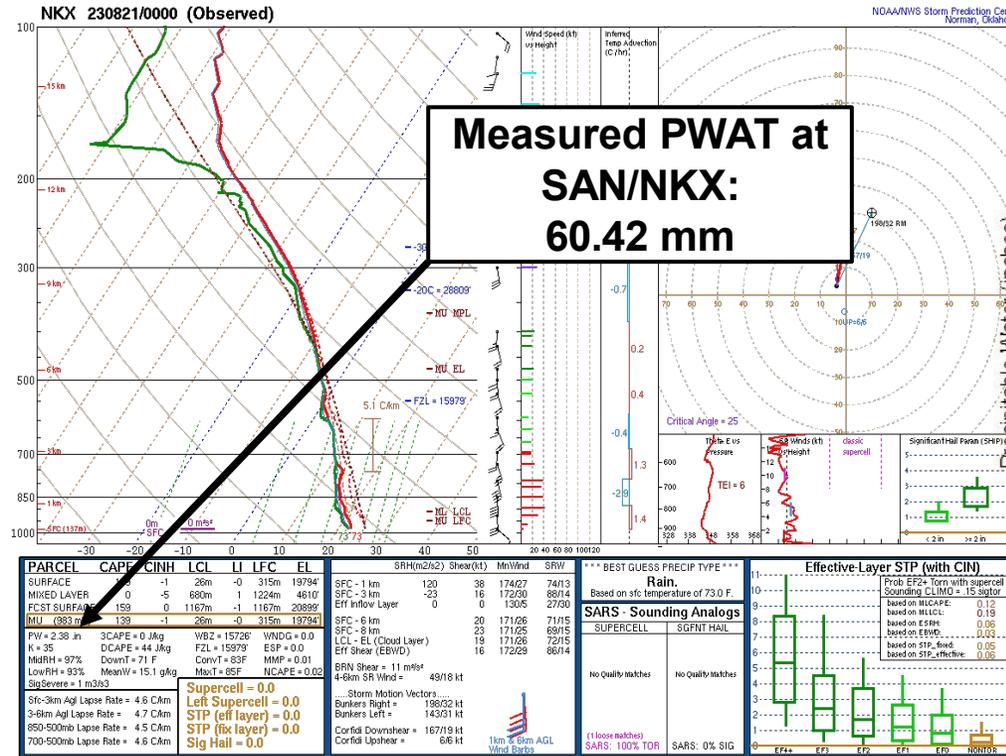


- 24-hour max wind gusts across Southern California were measured as > 30 mph, with many stations closer to the Mexico border peaking over 50 mph
- Notable wind gusts for this time period: Big Black Mountain, 84 mph; Pisgah Peak, 79 mph; Hauser Mountain 78 mph
- A CW3E Radar Wind Profiler located on UCSD campus measured peak wind speeds of 31-34 mph (27.5-30 knots) between 6 and 9 pm on 20 Aug

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## Precipitable Water from Upper Air Sounding

## ALL Soundings for NKX



Source: NOAA NWS Storm Prediction Center

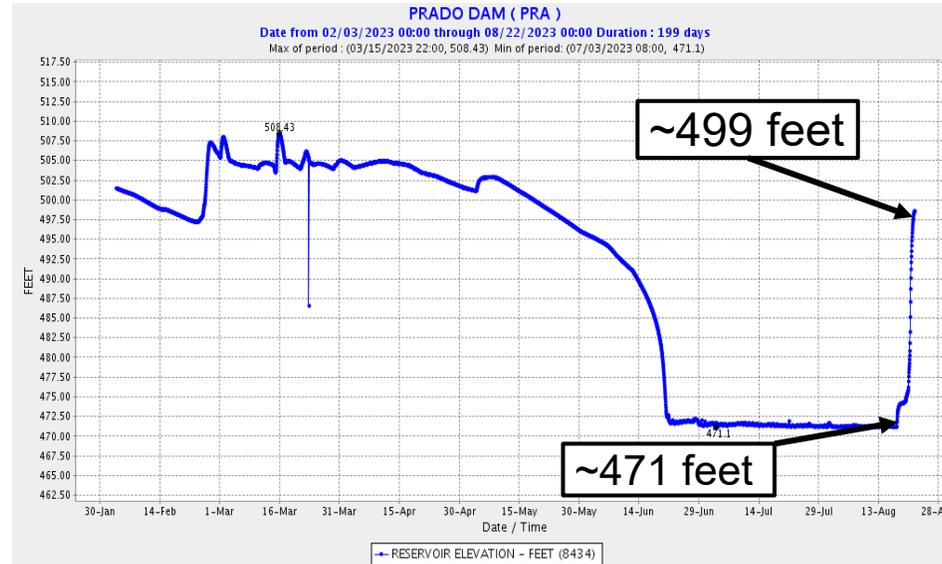
Source: NOAA NWS Storm Prediction Center <https://www.spc.noaa.gov/exper/soundingclimov2/>

- The 00Z 21 Aug upper air sounding from San Diego (NKX) measured a precipitable water value of 60.42 mm (2.38 inches)
- That measurement is tied with an event from 8/17/1977 for the second highest precipitable water value observed at NKX, second only to the ~68 mm recorded on 8/25/1988

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## Streamflow

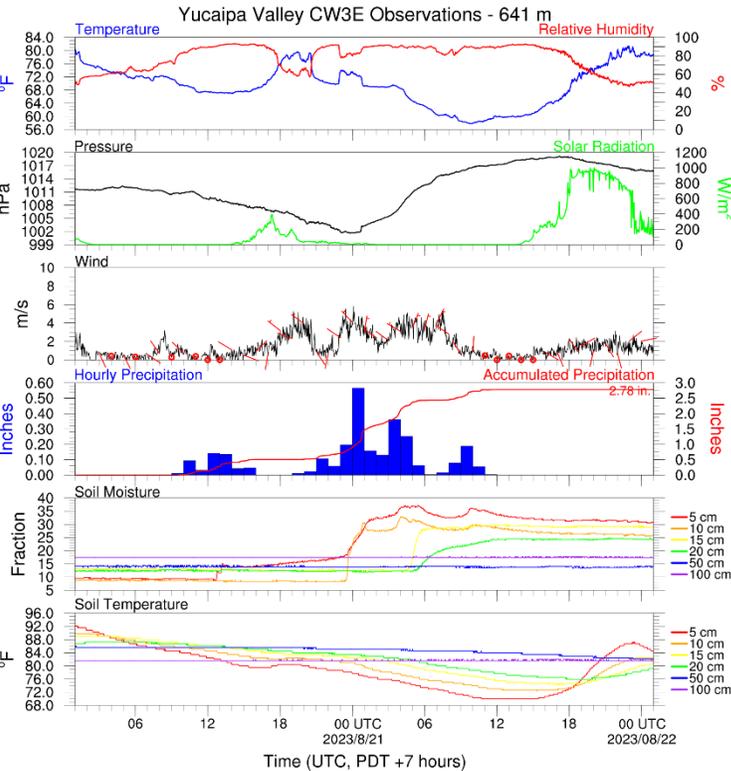
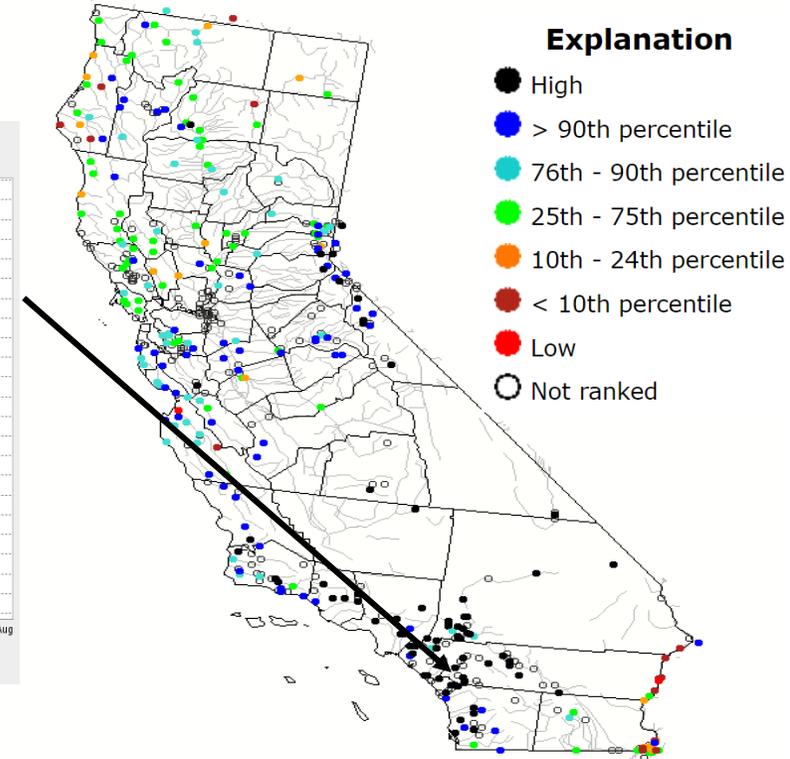
### A) Prado Dam Reservoir Height Valid: 930 AM 21 Aug



Source: California DWR



### B) CA Streamflow Conditions Valid: 930 AM 21 Aug



- Record-breaking rainfall resulted in elevated streamflow across Southern and Central California with many stations reporting streamflow > 90th percentile of climatology (blue and black dots in Figure B) as of the morning of 21 Aug
- Reservoir levels at Prado Dam increased more than 20 feet because of heavy rainfall and elevated streamflow

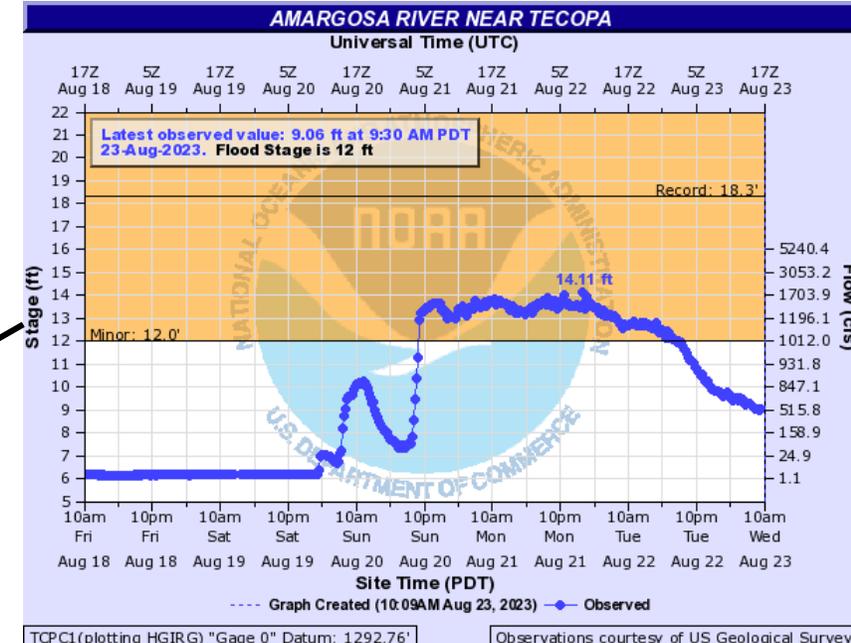
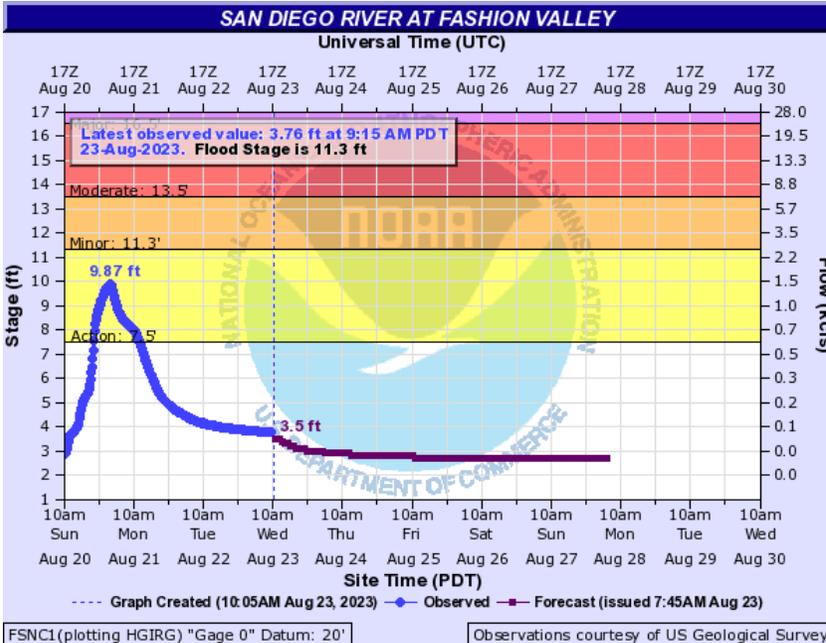
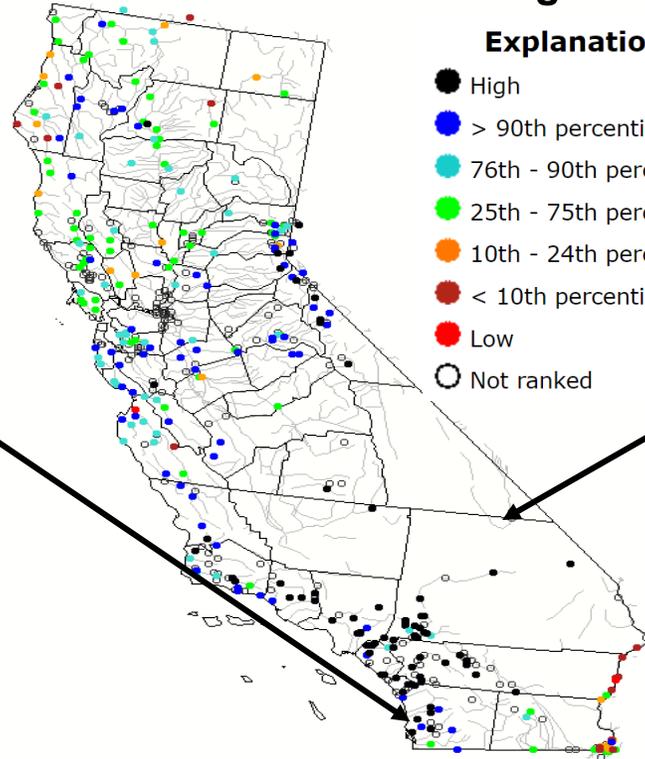
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## Streamflow

### A) CA Streamflow Conditions Valid: 930 AM 21 Aug

#### Explanation

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

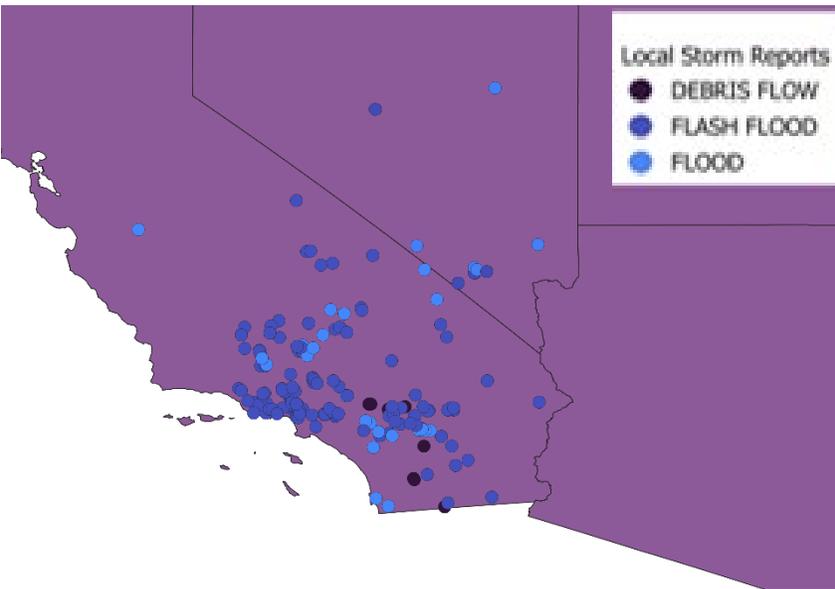


- San Diego River at Fashion Valley showed river stage rising through 20 Aug and peaking above action stage that night and receding through 22 Aug
- The Amargosa River near Tecopa saw a quick rise to minor flood level late on 20 Aug and stayed at that level until the evening of 22 Aug as the river stage began to lower following the passage of the system

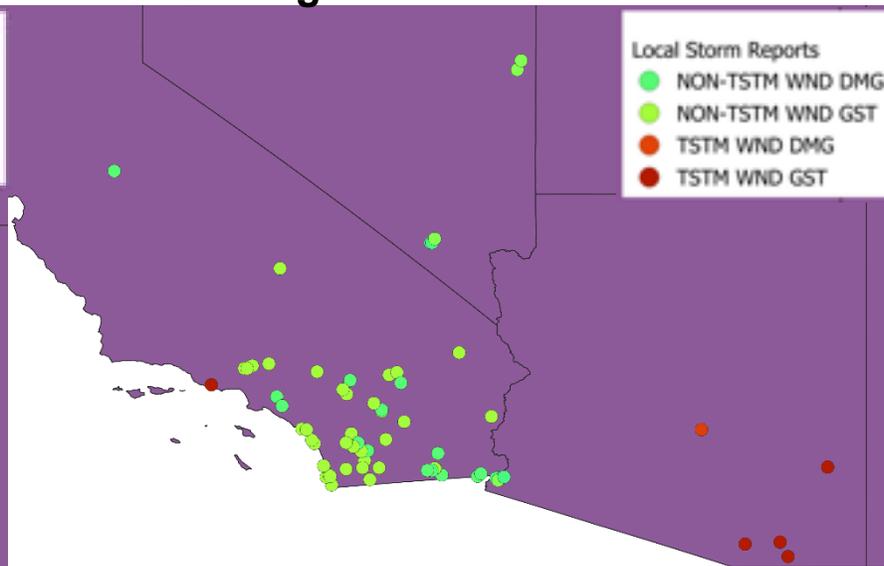
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## Local Storm Reports for 12 AM PDT 20 Aug- 12 AM PDT 22 Aug

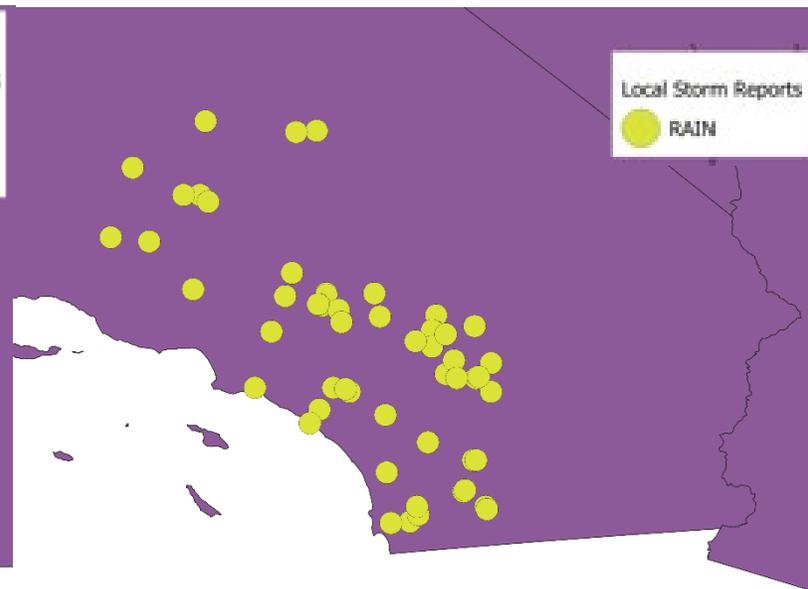
### A) Flooding, Flash Flooding and Debris Flows



### B) Thunderstorm and Non-Thunderstorm Wind Damage and Gusts



### C) Heavy Rain



- Impacts from Hilary included flooding/flash flooding from the heavy rain and thunderstorm and non-thunderstorm wind damage
- Most of the reports came from Southern and Central California, the region hit hardest by Hilary (Figures A-C)
- This is most notable in the wind reports, where all but four non-thunderstorm wind gust and damage reports were in Southern California (Figure B)

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## Impacts

### Flooding on Badwater Road Near CA-190, Furnace Creek CA



Credit: NPS;  
<https://www.nps.gov/media/photo/gallery.htm?pg=7589199&id=0A999AF1-CA8E-4579-918E-722B2EBBD152>

### Mudslide Destroyed Seven Oaks Road, Seven Oaks CA



Credit: Aaron Rigsby;  
<https://twitter.com/AaronRigsbyOSC/status/1693635184011149574?s=20>

### Flood Control Basin Almost Overflowing, Palm Desert CA



Credit: Mark J Terril, AP; <https://www.msn.com/en-us/weather/topstories/hilary-unleashes-historic-flash-floods-photos/ar-AA1fzEYR>

- Flash flooding, mudslides, and debris flows brought on by the extreme precipitation, as well as downed trees and loss of power from the high winds, were seen across Southern California during and following Hilary
- At the peak, more than 50,000 people reported loss of power

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## Impacts

### Rockslide on I-8 near In-Ko-Pah, East San Diego County, CA



Credit: Caltrans San Diego;  
<https://twitter.com/SDCaltrans/status/1693663251719160030/photo/1>

### Mud and debris flow across Highway 58, Kern County, CA



Credit: Caltrans District 9;  
<https://twitter.com/Caltrans9/status/1693740201691185217/photo/1>

### Washed out portion of SR-38 near Onyx Summit



Credit: Caltrans District 8;  
<https://twitter.com/Caltrans8/status/1693628497061613589/photo/1>

- A rockslide onto Interstate-8 in eastern San Diego County caused the eastbound lanes to close for more than a day as crews cleared a school bus sized boulder from the roadway
- A mud and debris flow across SR-58 at the Cameron Road overpass in eastern Kern County buried the roadway under what appears to be feet of mud and debris, trapping a semi truck and trailer
- A portion of SR-38 near Wildhorse Meadows Road was washed out due to a debris flow from the El Dorado burn scar