



Center for Western Weather and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO



Southern California Storm of 18-20 July 2015

Discussion

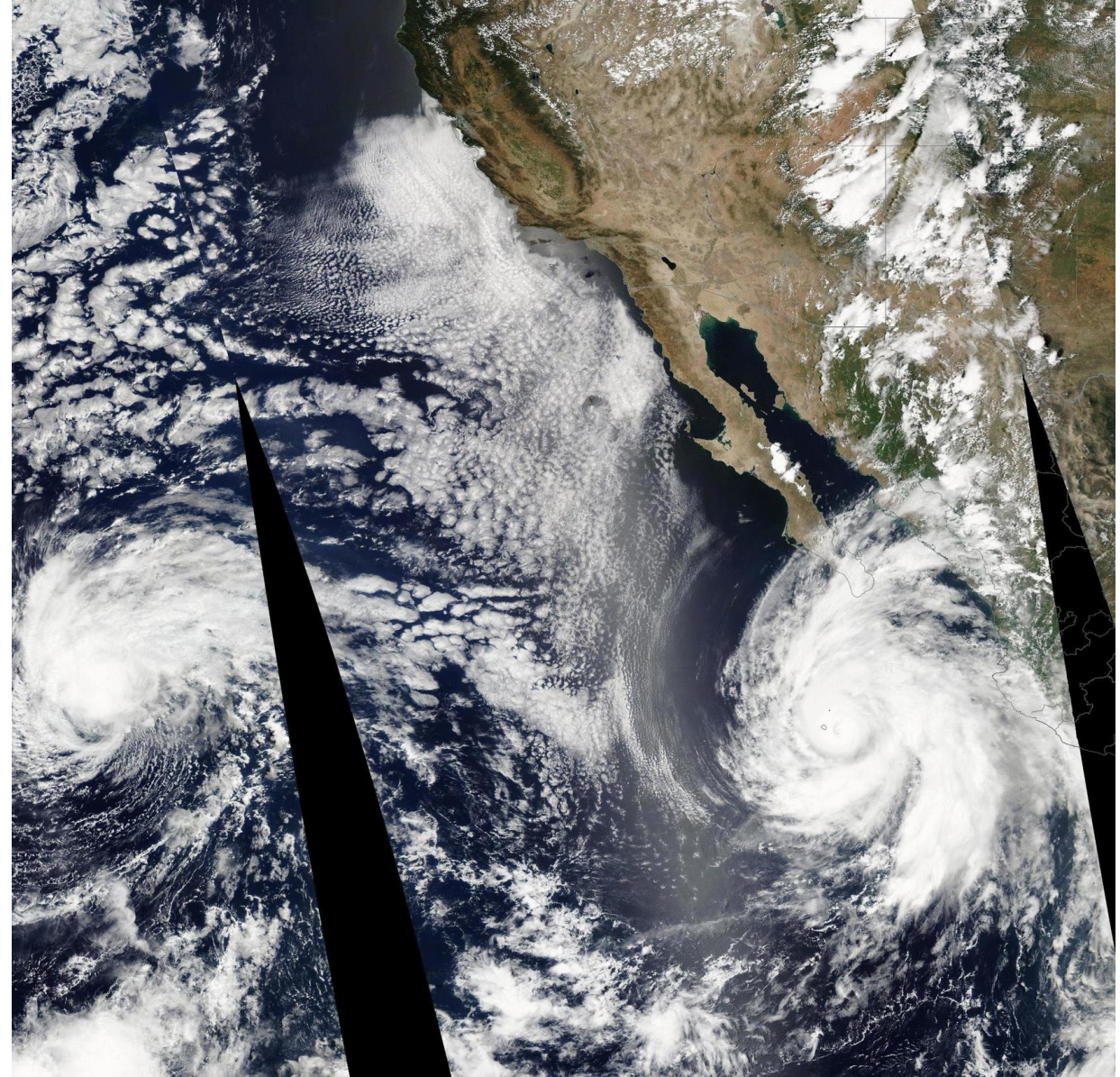
- Former Hurricane Dolores moved north through the northeast Pacific along the Mexican and California coasts
- The tropical air mass associated with Hurricane Dolores provided sufficient moisture and instability for convection to occur
- Multiple showers and thunderstorms developed over the southwestern U.S. on 18 July and 19 July 2015
- Precipitation amounts were record breaking throughout Southern California with multiple monthly records broken in 48 hours
- Multiple landslides and flash floods occurred throughout southern CA and AZ

Hurricane Dolores

- Former Hurricane Dolores moved north along the Mexican and Californian coasts during 15–21 July 2015
- Dolores developed into a hurricane July 13 and intensified into a Category 4 hurricane by July 14
- Dolores weakened into a tropical storm July 17 and a post-tropical low-pressure center July 18
- Despite never making landfall, Dolores provided moisture and heavy precipitation across western Mexico and southwestern U.S.

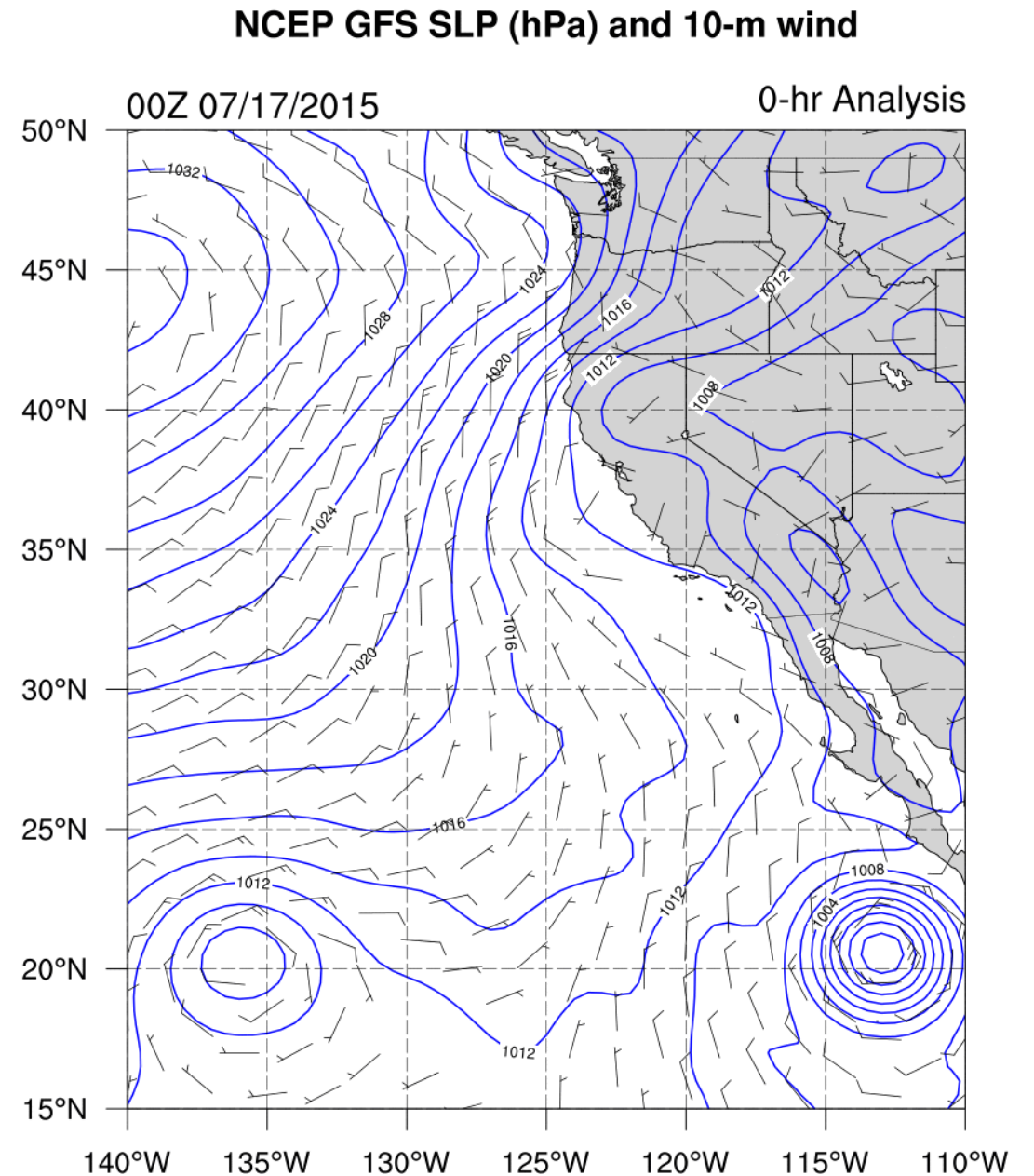
MODIS (Moderate Resolution Imaging Spectroradiometer) true-color

15 – 22 July 2015

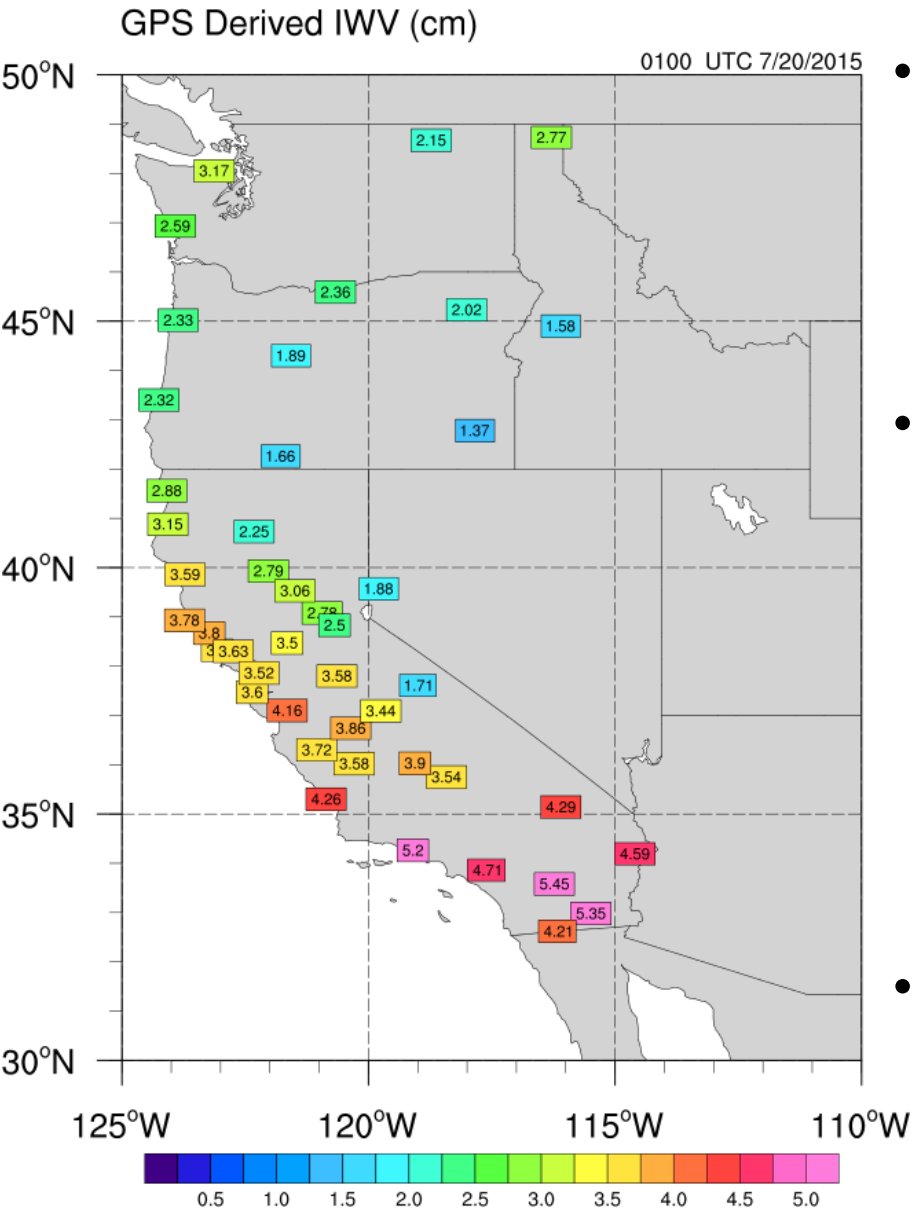


Hurricane Dolores

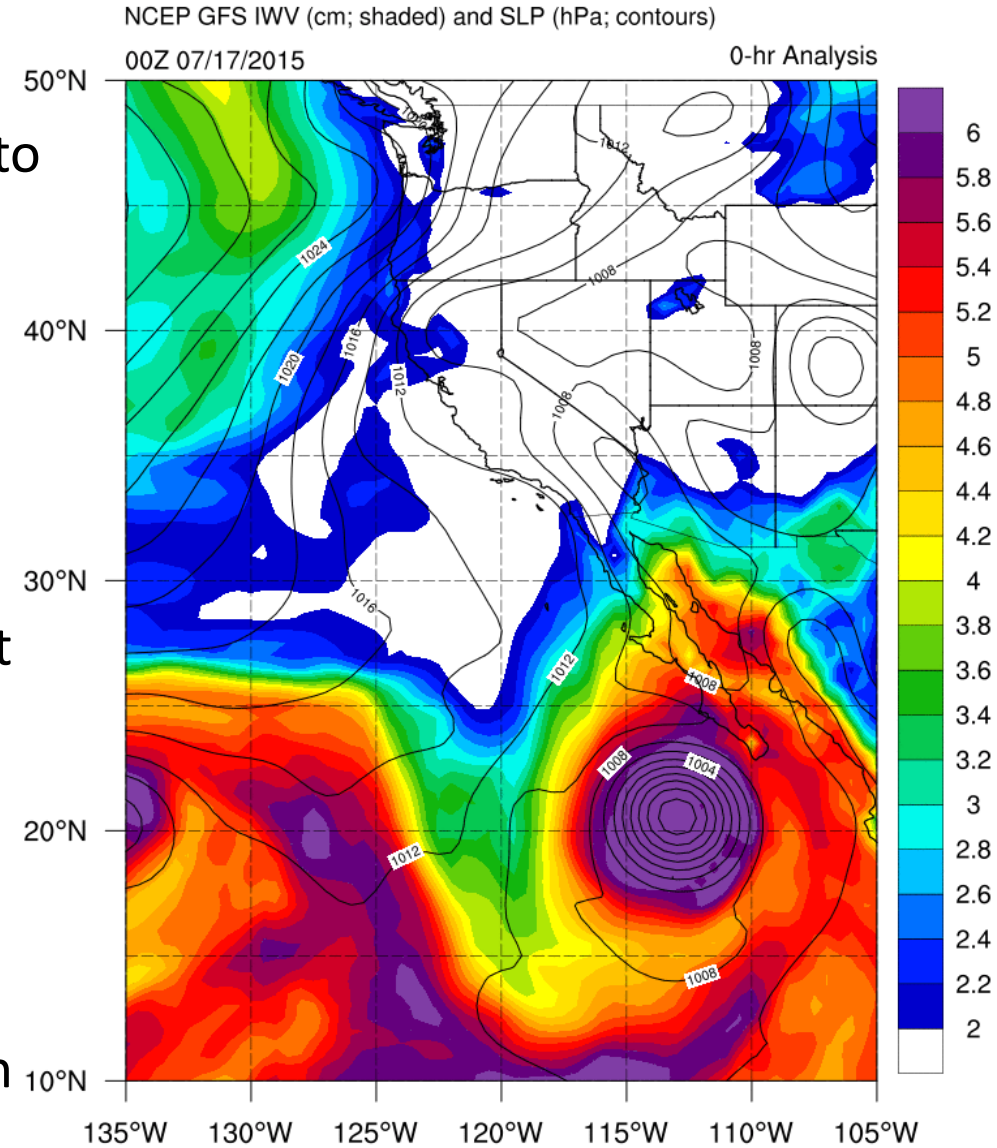
- Low pressure system weakened significantly before reaching southern California
- Center of the low pressure system never made landfall, but the tropical air mass associated with the low pressure system moved over the southwestern U.S.
- Moist, unstable air moved inland over California, Arizona, and Nevada



Tropical Moisture

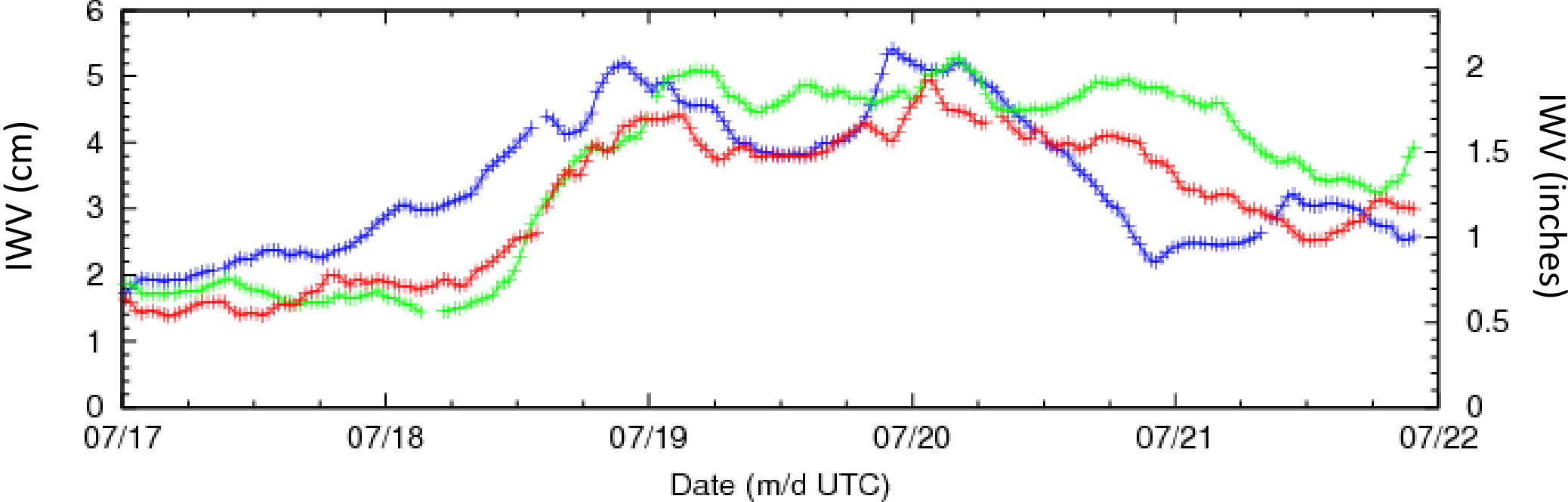


- High amounts of tropical moisture were provided to the region by former Hurricane Delores
- ARO (Atmospheric River Observatory) data recorded > 5 cm of integrated water vapor at multiple locations and times during 18 – 20 July 2015
- NCEP GFS analysis shows IWV > 6 cm over southern CA



GPS-Met IWV

IWV

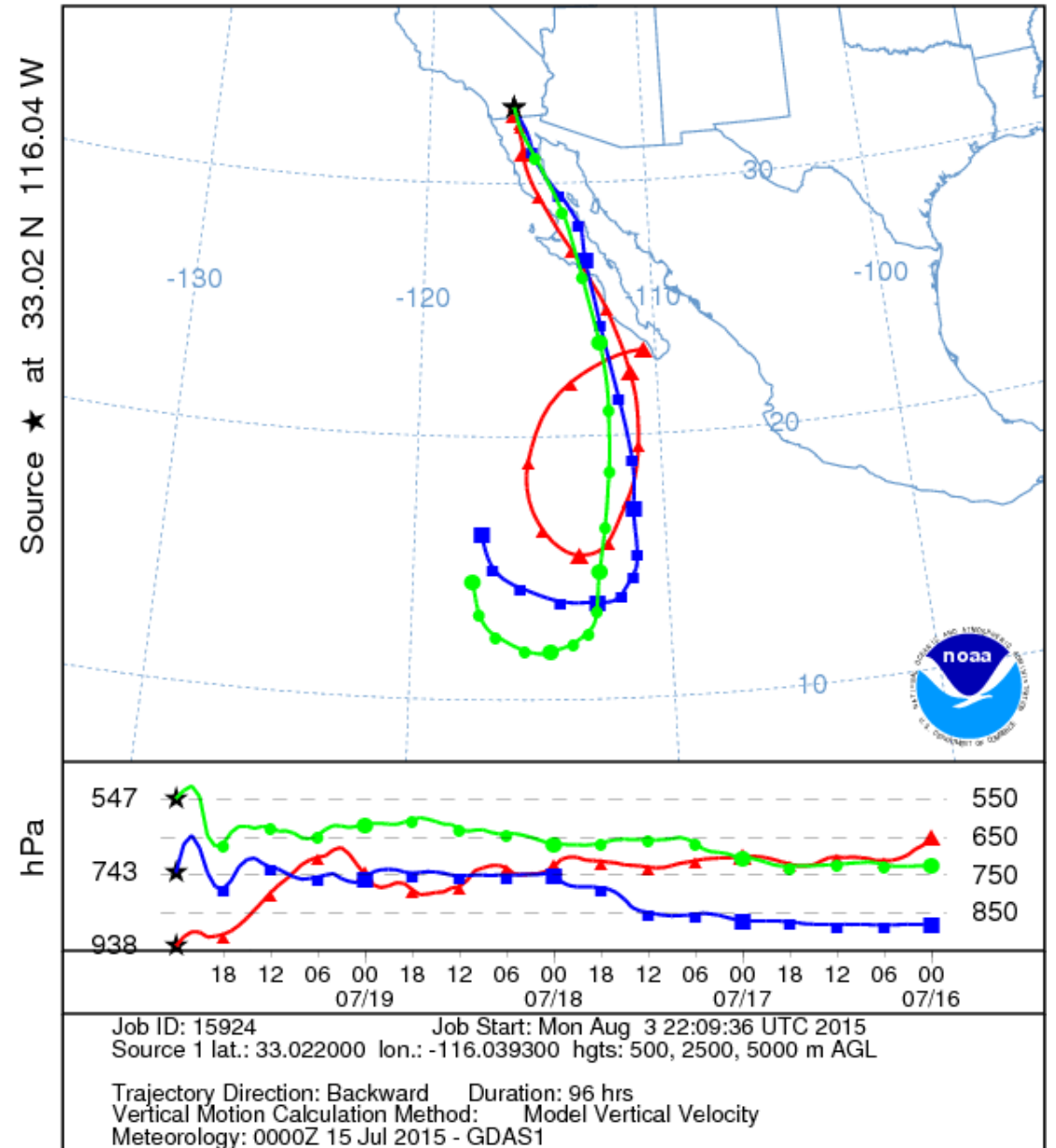


IWV values > 2cm throughout southern California for ~72 hours

Tropical Moisture

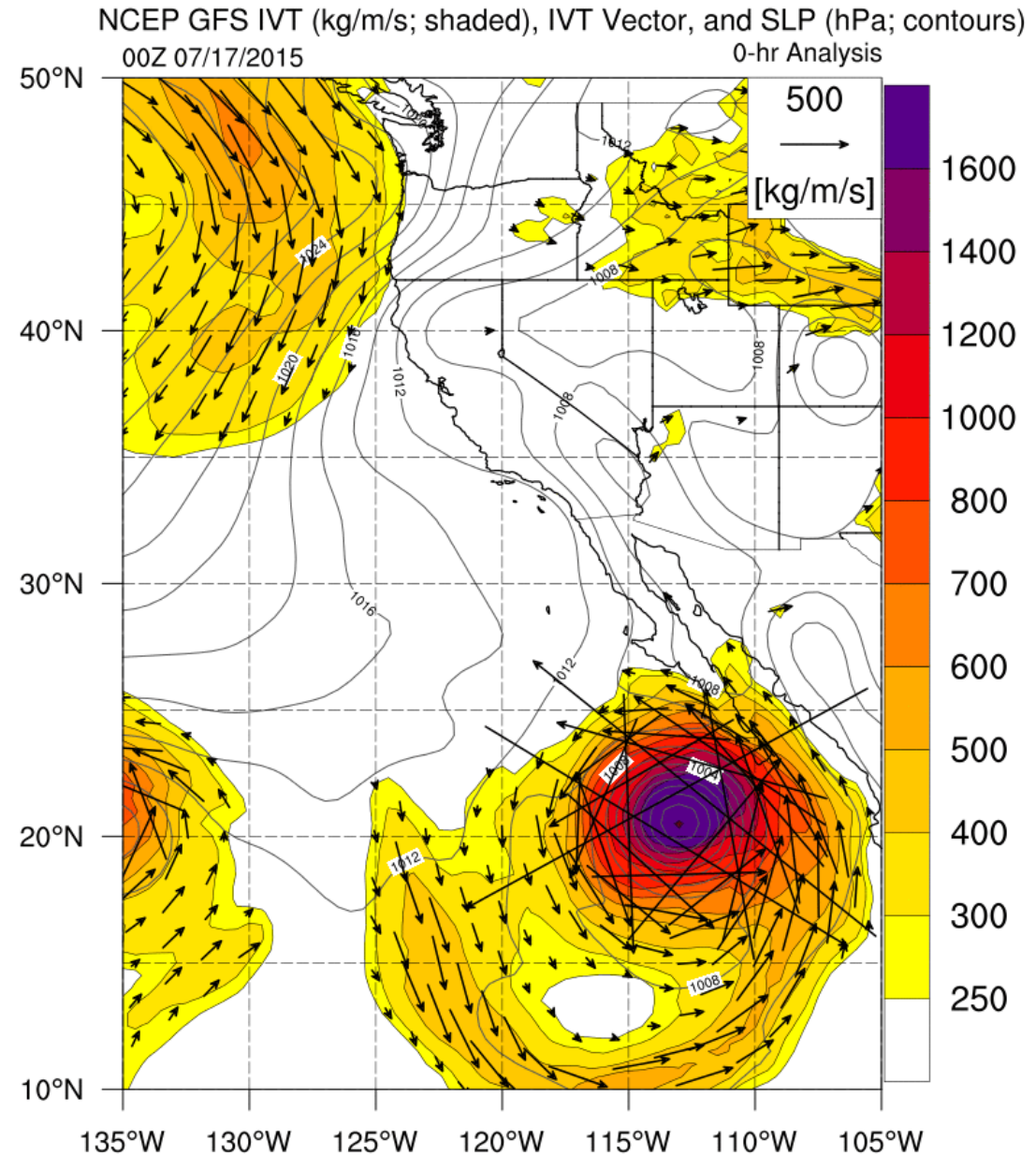
- Backward trajectories using the NOAA Hysplit Model indicate that air parcels in southern California on 20 July 2015 were transported from the tropics
- Mid tropospheric air parcels underwent weak ascent while being transported north

NOAA HYSPLIT MODEL
Backward trajectories ending at 0000 UTC 20 Jul 15
GDAS Meteorological Data



Integrated Vapor Transport

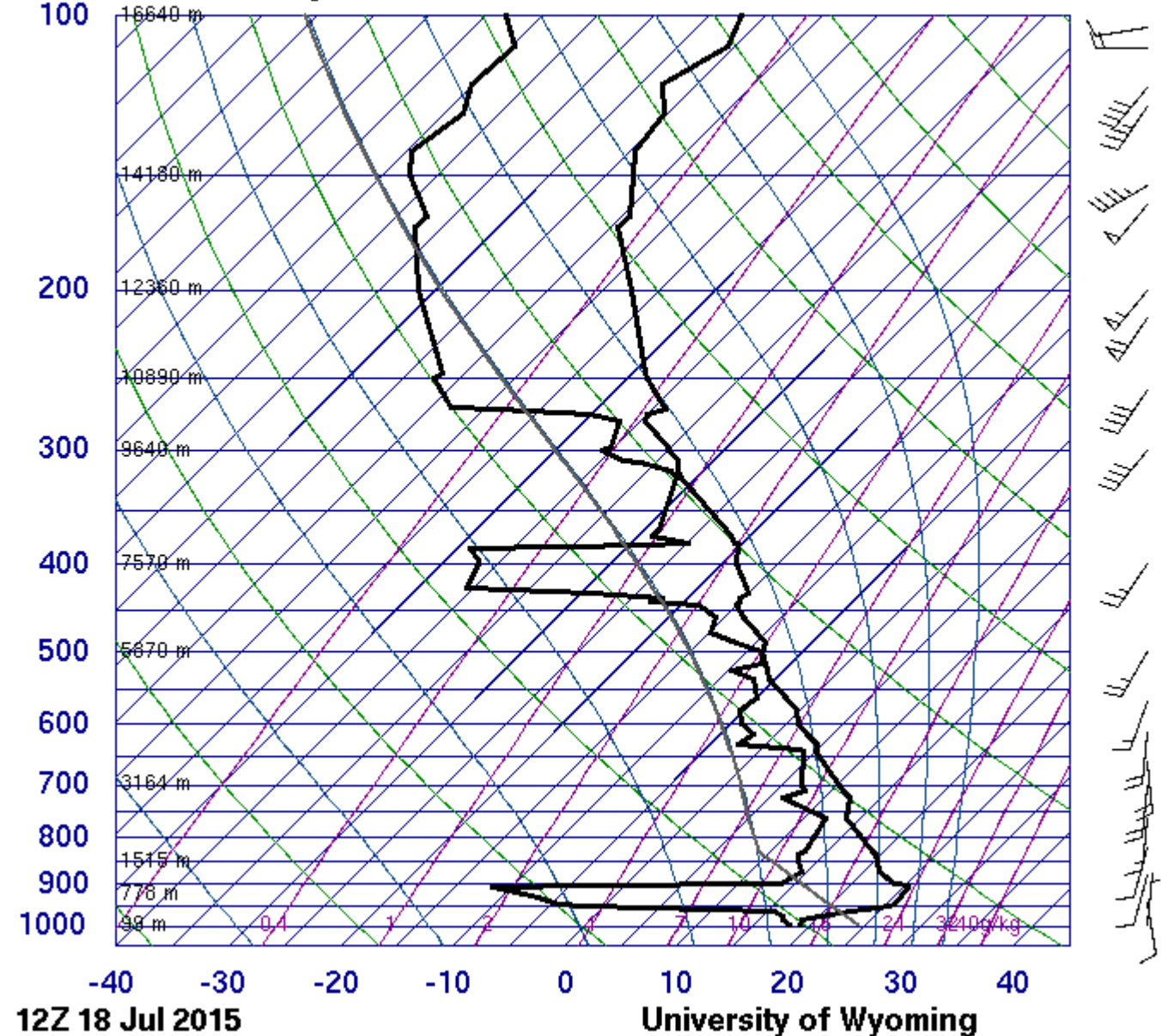
- High amounts of moisture and strong winds associated with former Hurricane Delores resulted in high values of IVT
- IVT values $>1600 \text{ kg m}^{-1} \text{ s}^{-1}$ off the coast of Baja California Sur, and $> 400 \text{ kg m}^{-1} \text{ s}^{-1}$ over southern CA
- Southerly IVT orientation most likely lead to some orographic enhancement over the Transverse Ranges
- Despite high values of IWV and IVT, this event is not classified as an AR due to spatial characteristics



Thermodynamic Profile

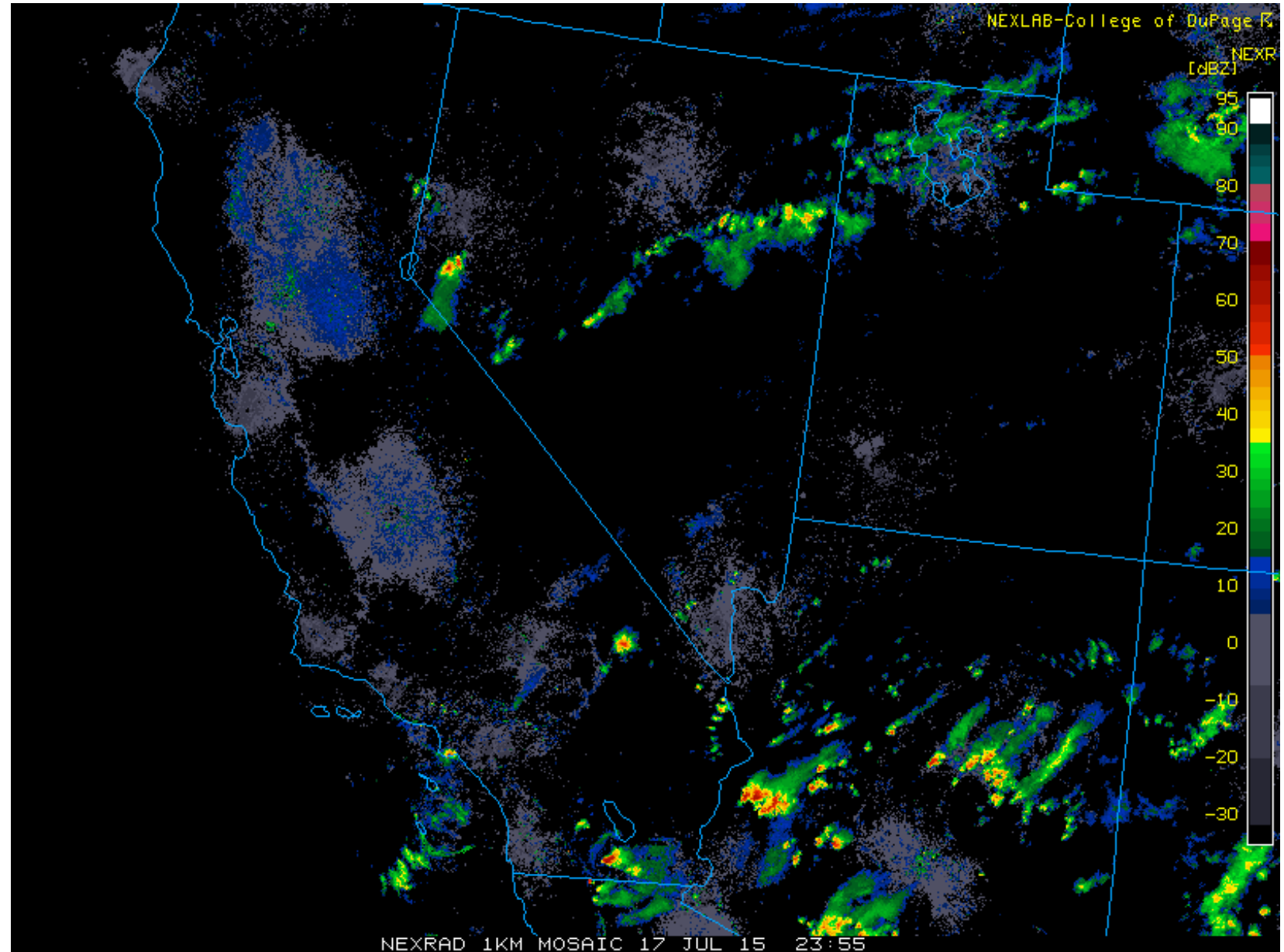
- High amounts of moisture between ~800 hPa and 300 hPa
- Most unstable CAPE of ~1200 J/kg
- Southwesterly winds aloft continue to provide moisture to the region
- Air mass is conditionally unstable between ~900 hPa and 280 hPa

72293 NKX San Diego



NEXRAD Composite (0000 UTC 18 July–0000 UTC 21 July)

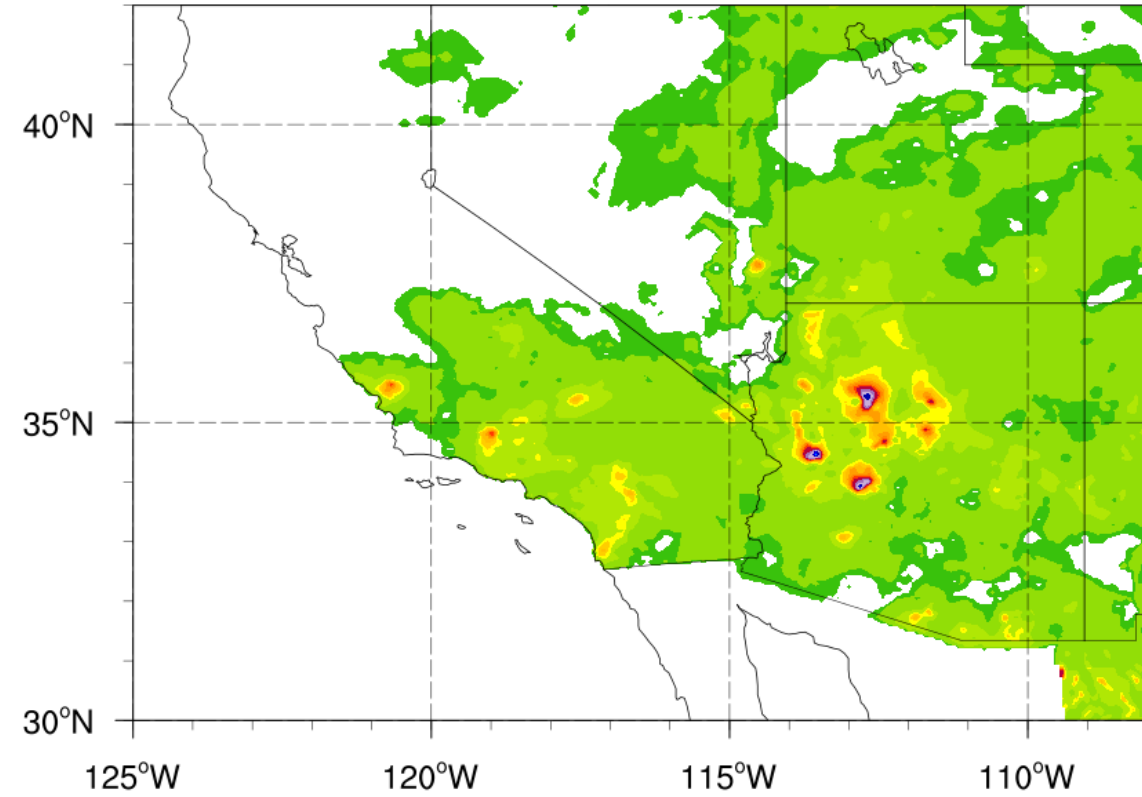
- Scattered thunderstorms developed in the afternoon on 18 July and moved over southern California and Arizona
- Thunderstorms developed again on 19 July throughout the region



Precipitation – 24-hour accumulated

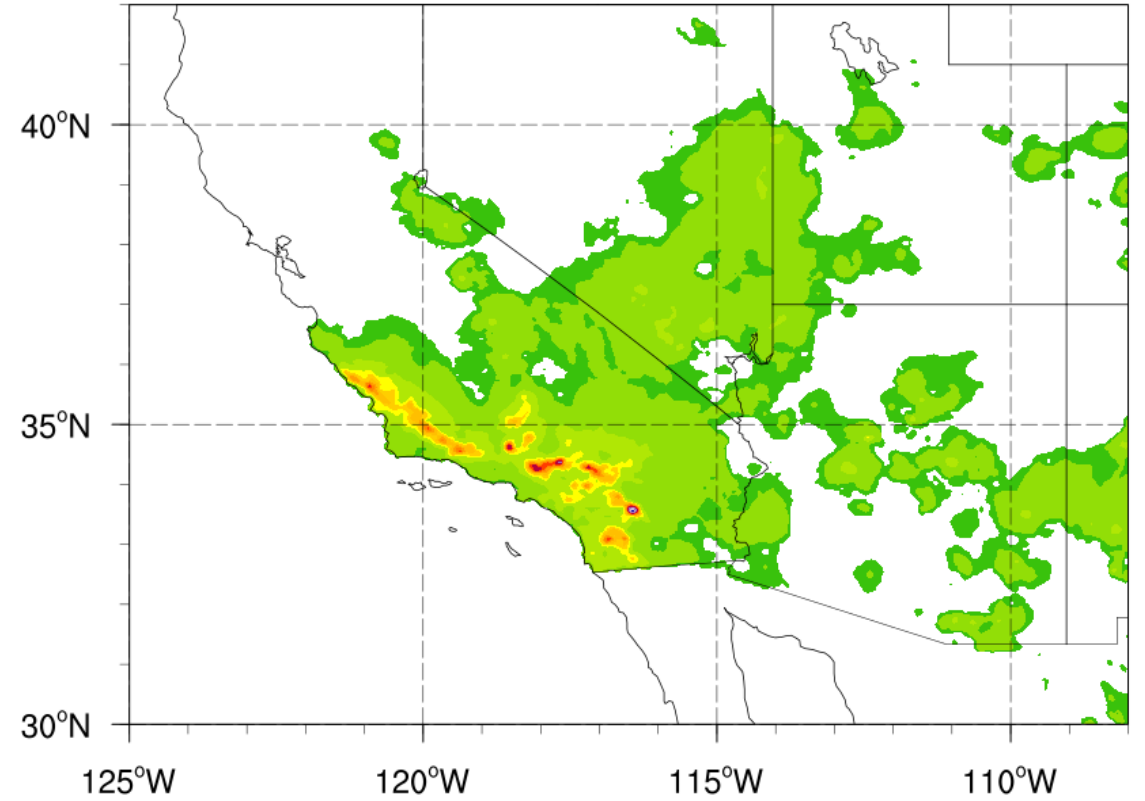
24-hr Accumulated Precipitation (mm)

Ending 1200 UTC 07/19/2015



24-hr Accumulated Precipitation (mm)

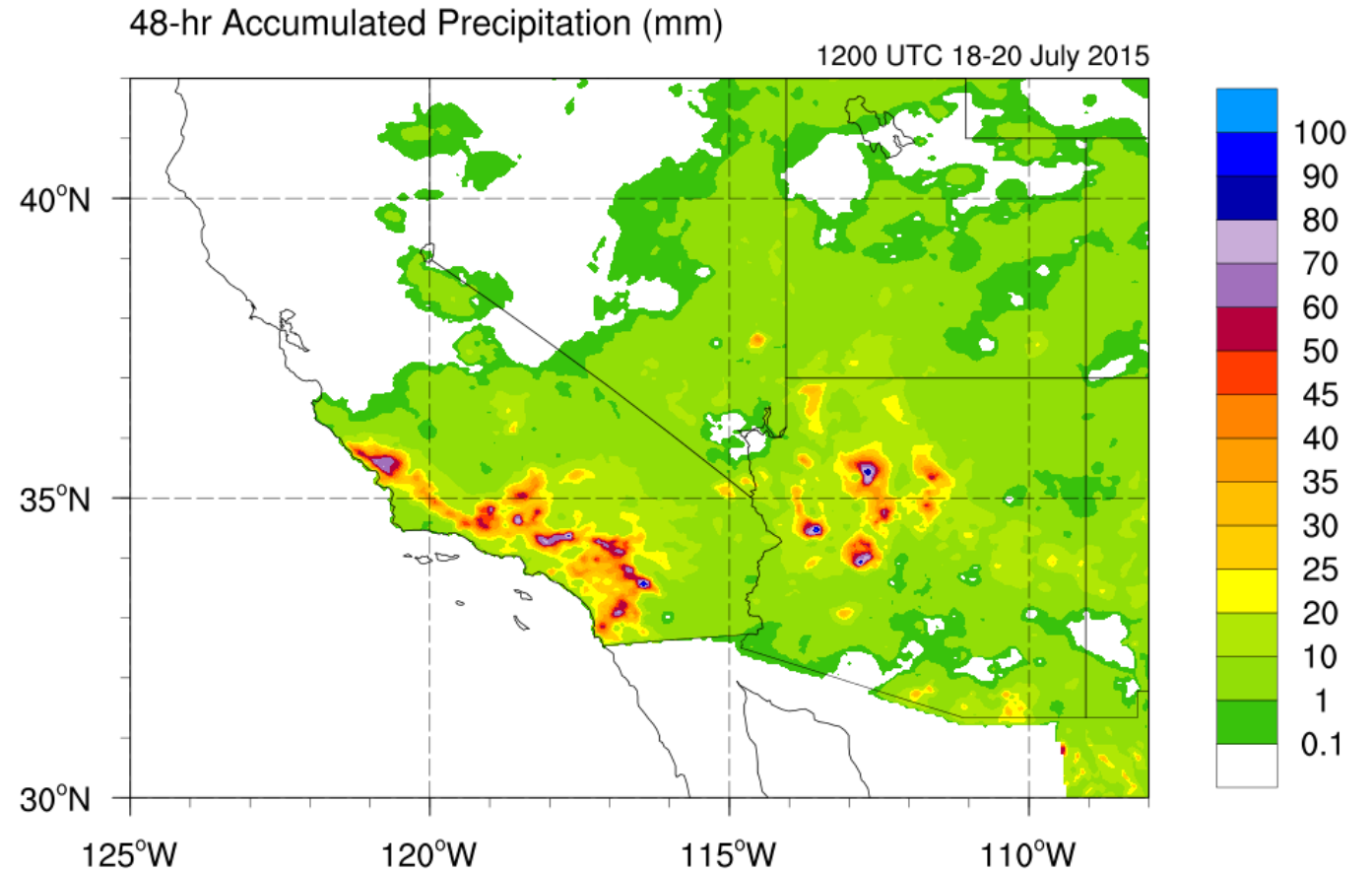
Ending 1200 UTC 07/20/2015



- Maximum 24-h precipitation in California of >80 mm over the Santa Rosa and San Jacinto Mountains
- 24-h Precipitation >80 mm at various locations throughout central Arizona

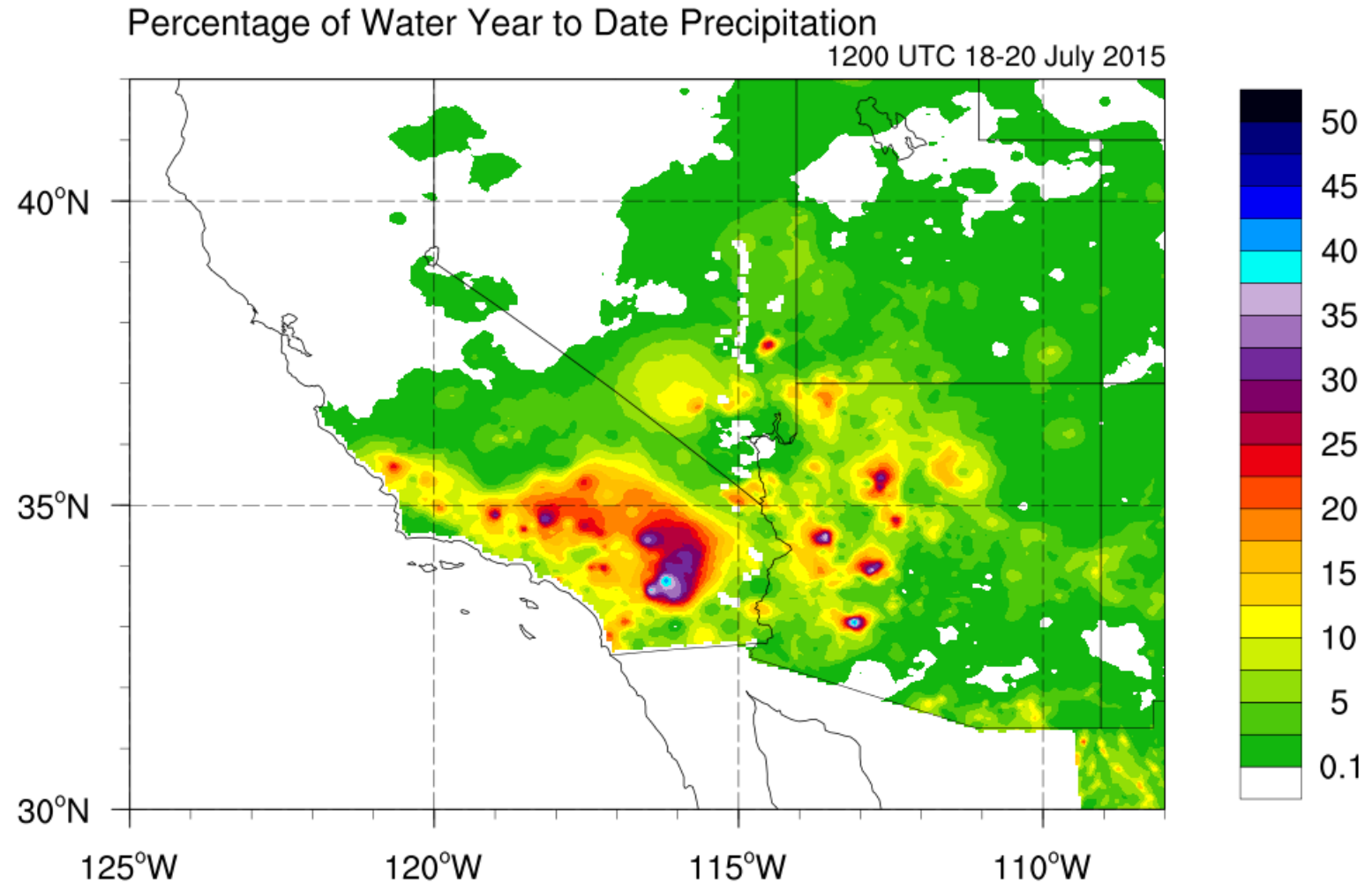
Precipitation – 48-hour accumulated

- Maximum 48-hr precipitation >90 mm at various locations throughout southern California and northwest Arizona
- 48-hr precipitation >40 mm over the Transverse Ranges
- >20 mm of 48-hr precipitation over nearly all of southern coastal California



Precipitation – 48-hr percentage of water year to date (Oct 2014 – July 2015)

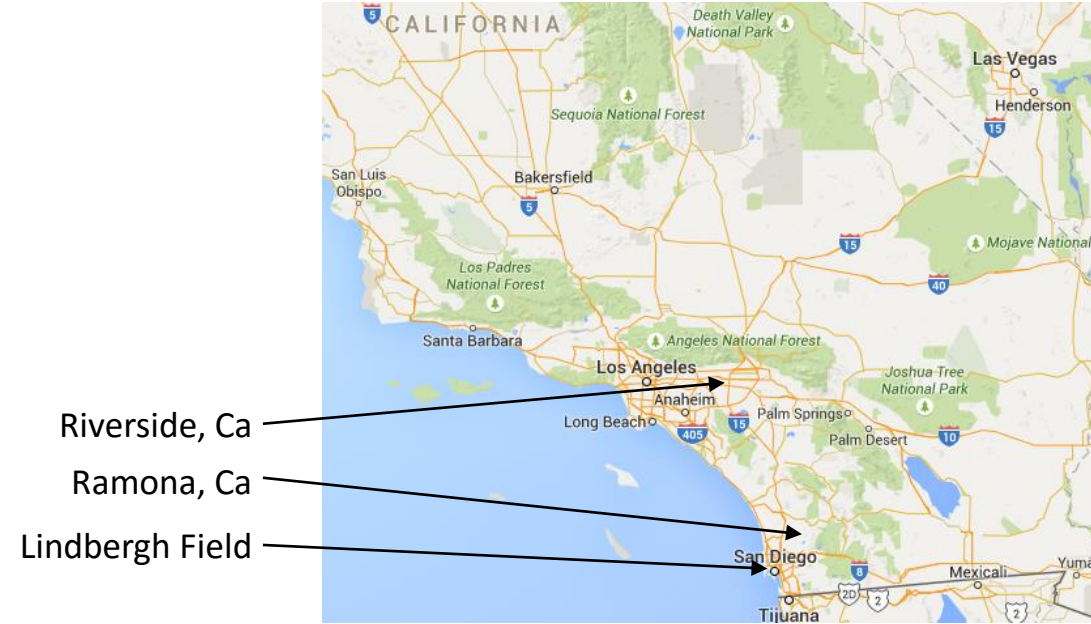
- 48-hr precipitation from this event represented up to 45% of total water year to date (Oct–Jul) precipitation
- A majority of southern Ca and northwest Az received at least 10% of water year to date precipitation



NCEP Stage IV Precipitation data

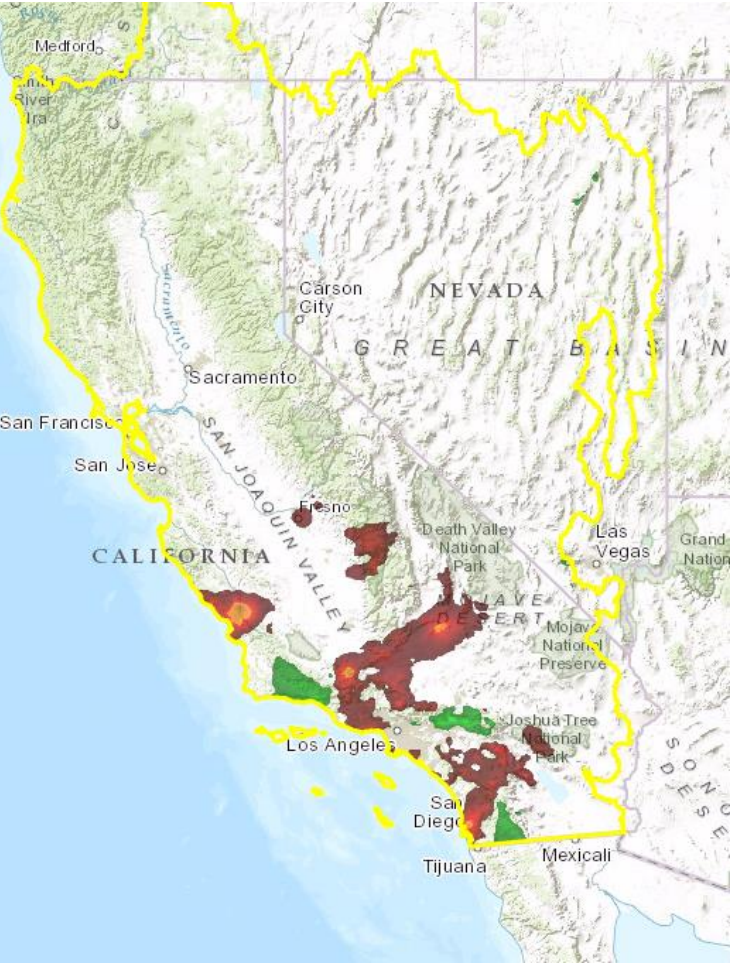
Precipitation – Record observations

Many locations throughout southern California set daily and monthly records for precipitation amounts

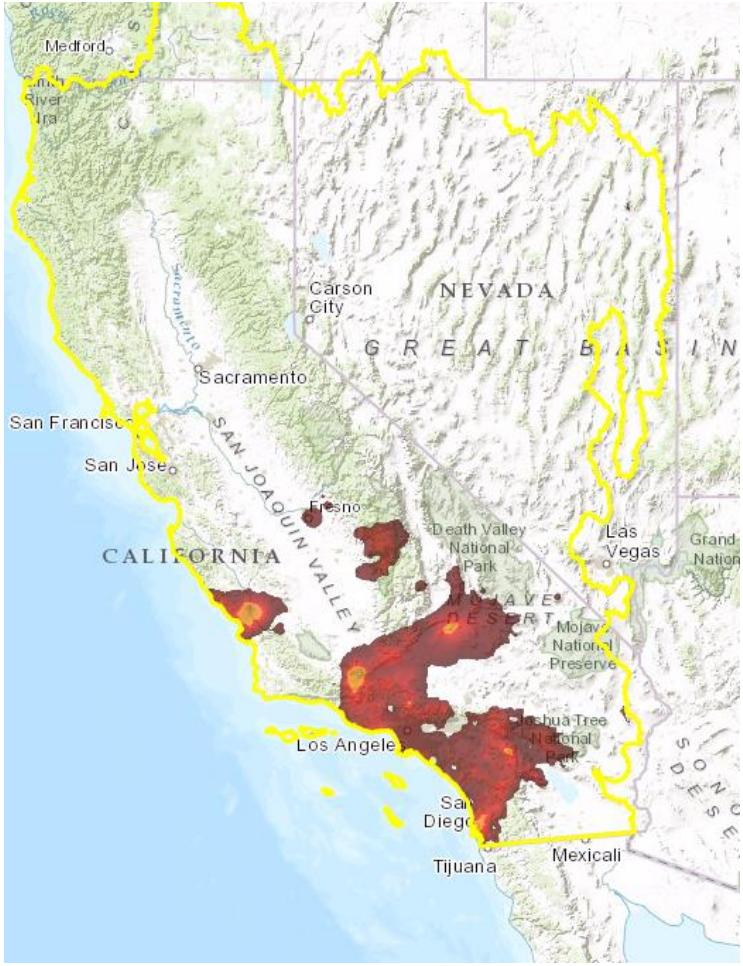


	July 18 2015 Daily Precip (in)	July 18 Previous Record (in)	July 19 2015 Daily Precip (in)	July 19 Previous Record (in)	48-hr Total Precip (in)	July Normal Precip (in)	Previous Monthly Record (in)
Lindbergh Field San Diego, Ca	1.03	0.01	0.66	T	1.69	0.03	1.29
Riverside Municipal Airport	0.55	0.02	1.34	0.05	1.89	0.07	1.26
Ramona Airport	1.25	0.03	1.13	0.04	2.38	0.12	0.80

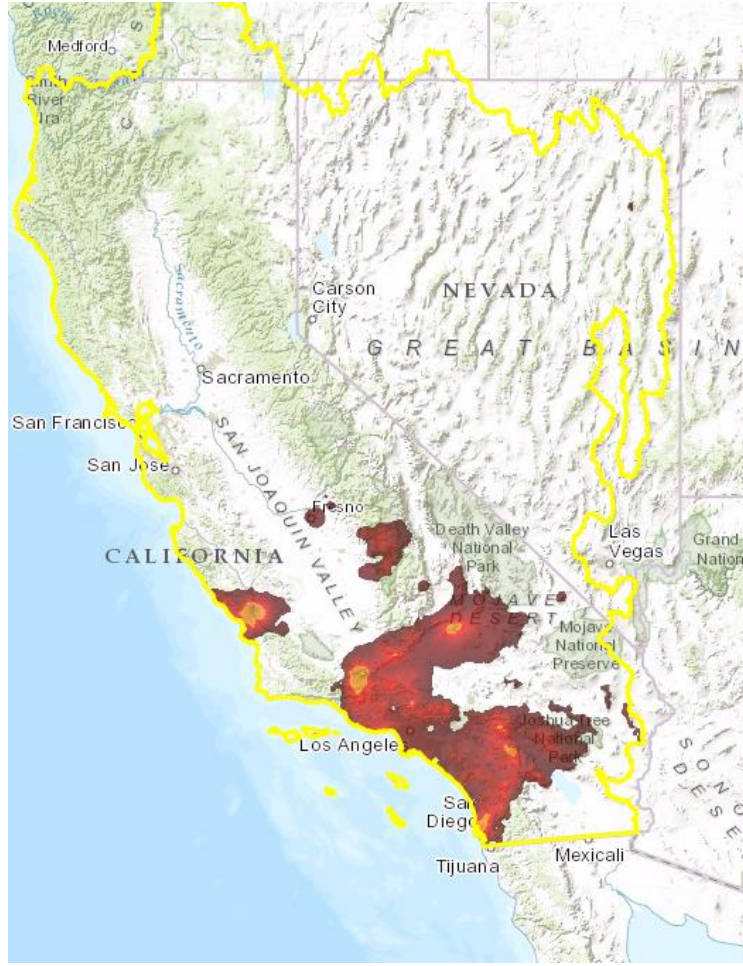
Forecast Verification – CNRFC QPF-QPE 24-h precip ending 1200 UTC 19 July



Day 1- Issued 18 July



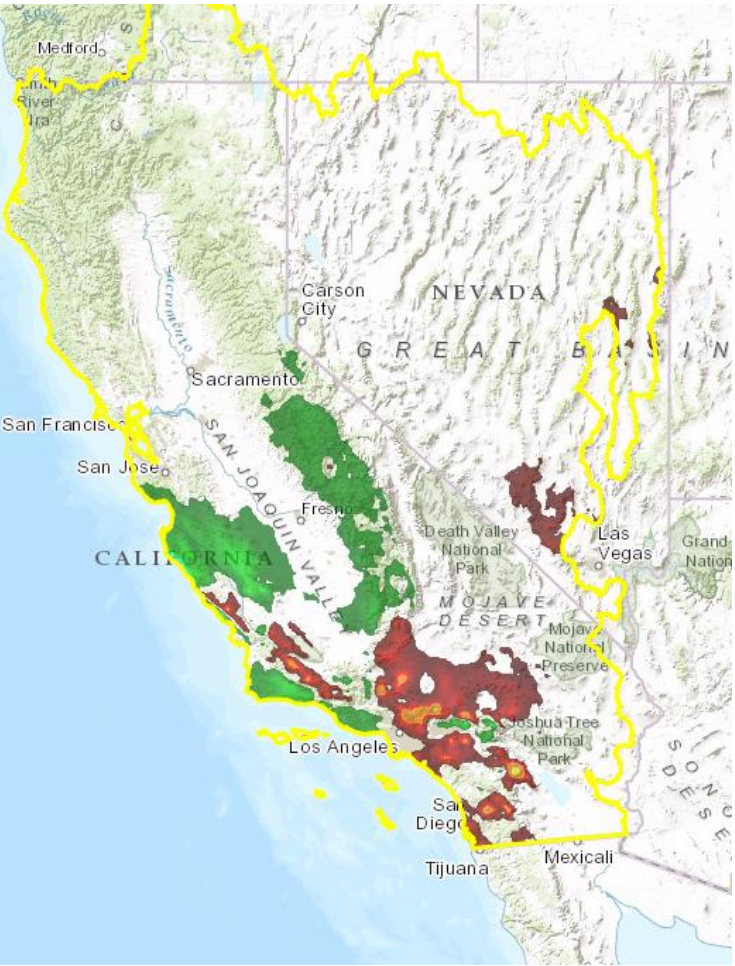
Day 3- Issued 16 July



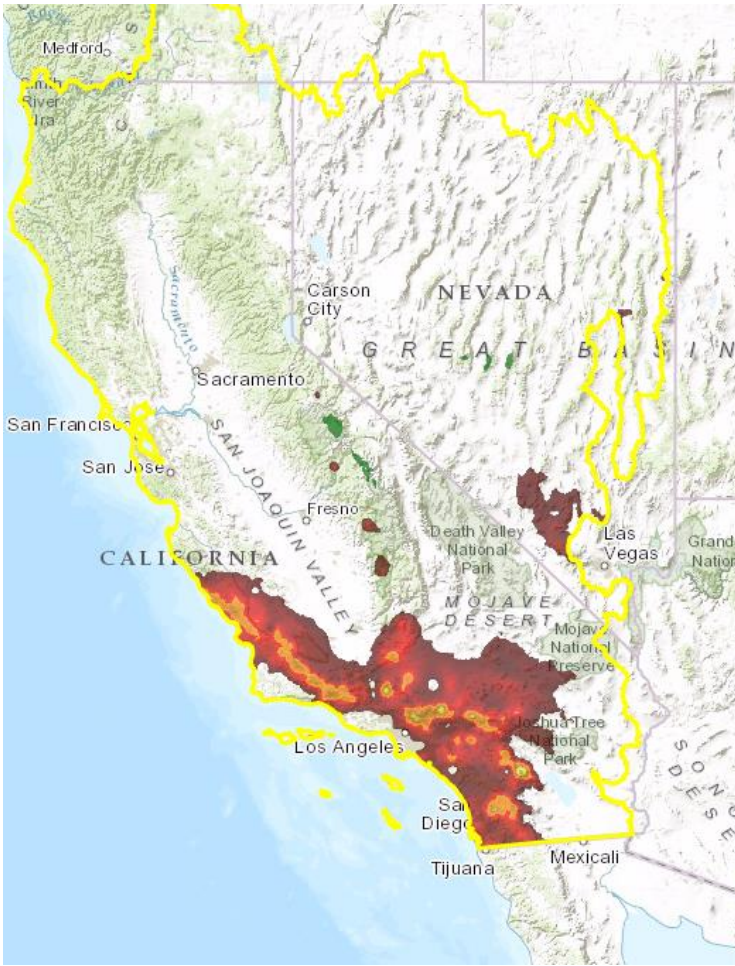
Day 5- Issued 14 July



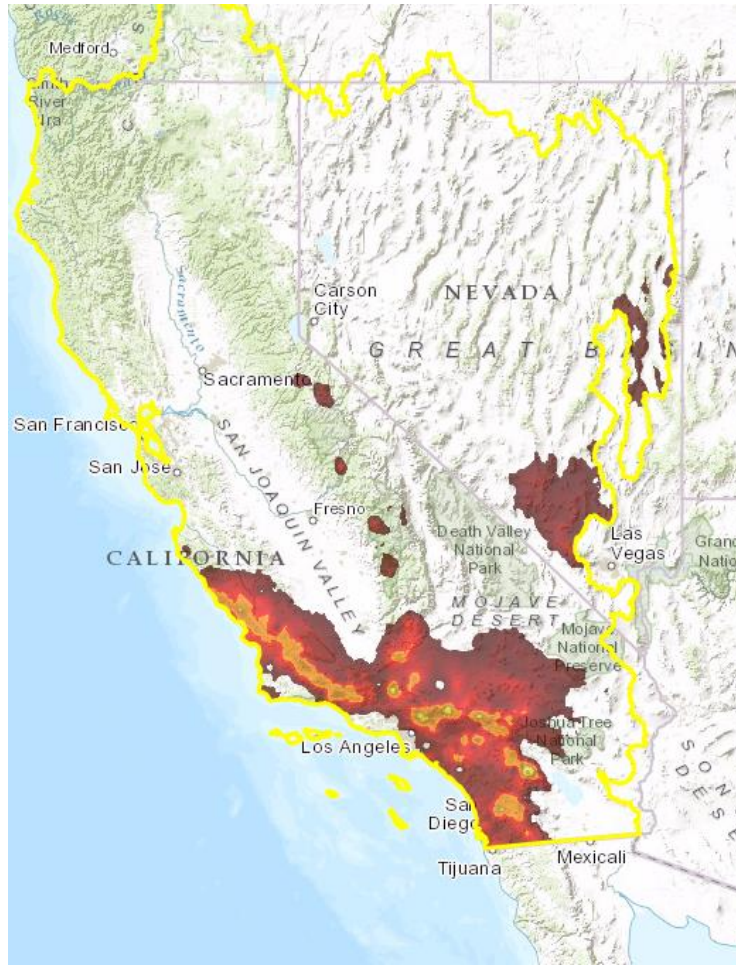
Forecast Verification – CNRFC QPF-QPE 24-h precip ending 1200 UTC 20 July



Day 1- Issued 19 July



Day 3- Issued 17 July



Day 5- Issued 15 July



Impacts

- Multiple flash floods and landslides throughout southern California and Arizona
- Multiple highways closed due to mudslides, flooding, and collapsed roads in CA and AZ
- Collapsed bridge on Interstate 10 near Desert Center, CA
- Power outages throughout southern CA and AZ



Westbound lanes of Interstate 10 near Desert Center CA. Image from ABCNews.

Impacts

- In 48 hours, Lindbergh Field in San Diego received 56 times more precipitation than the July average
- July 2015 monthly precipitation in Los Angeles is greater than all July precipitation combined back to 1987
- July 2015 represents about a third of total July precipitation from 1877 to 2014 in Los Angeles
- First San Diego Padres baseball game to be rained out since 2006 and Los Angeles Angels of Anaheim game to be rained out since 1995