Coast to Cactus Weather Examiner

National Weather Service - San Diego

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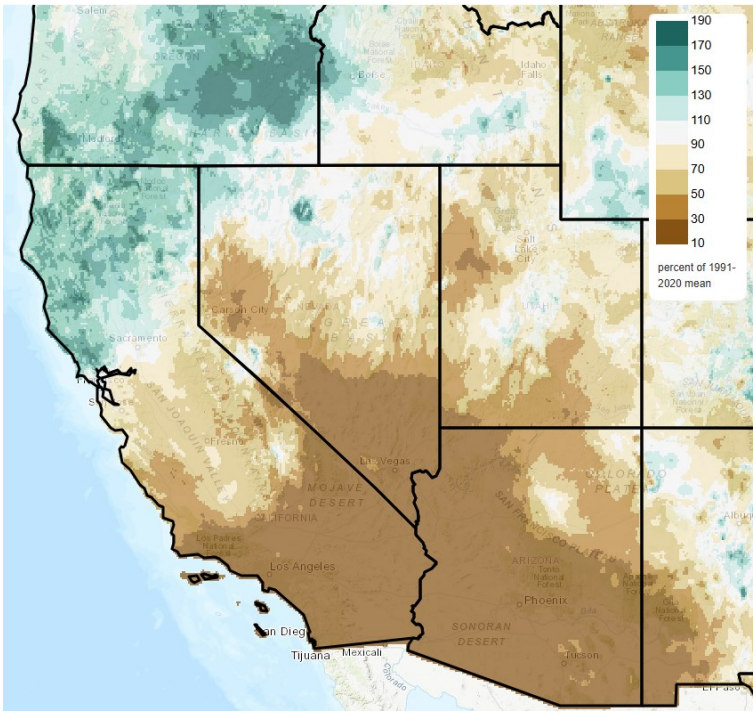
Dry and Offshore by Miguel Miller

This winter so far will go into the record books as the driest first half of the wet season on record in Southern California. Climate stations from the coast to the desert are running record dry for the so-called "wet" season (through mid-January). After a couple of wet seasons, drought has begun to make a return appearance.

Why is it so dry? A stationary ridge of high pressure over the northeast Pacific has been shielding Southern California from any storms this season so far. In Northern California, especially north of San Francisco, atmospheric rivers brought copious, even flooding, rainfall during November, but they didn't wander south. This has created a dipole, a distinct and polarized spectrum of rainfall extremes between the northern and southern ends of the state (see map below). In December and January so far, the ridge has deflected storms away from the entire state, allowing the northern part of the state to begin to dry out and return to normal. The record dryness in the south and the drying trend in the north has become a little concerning, as we reach the climatological peak of storm season in January and February.

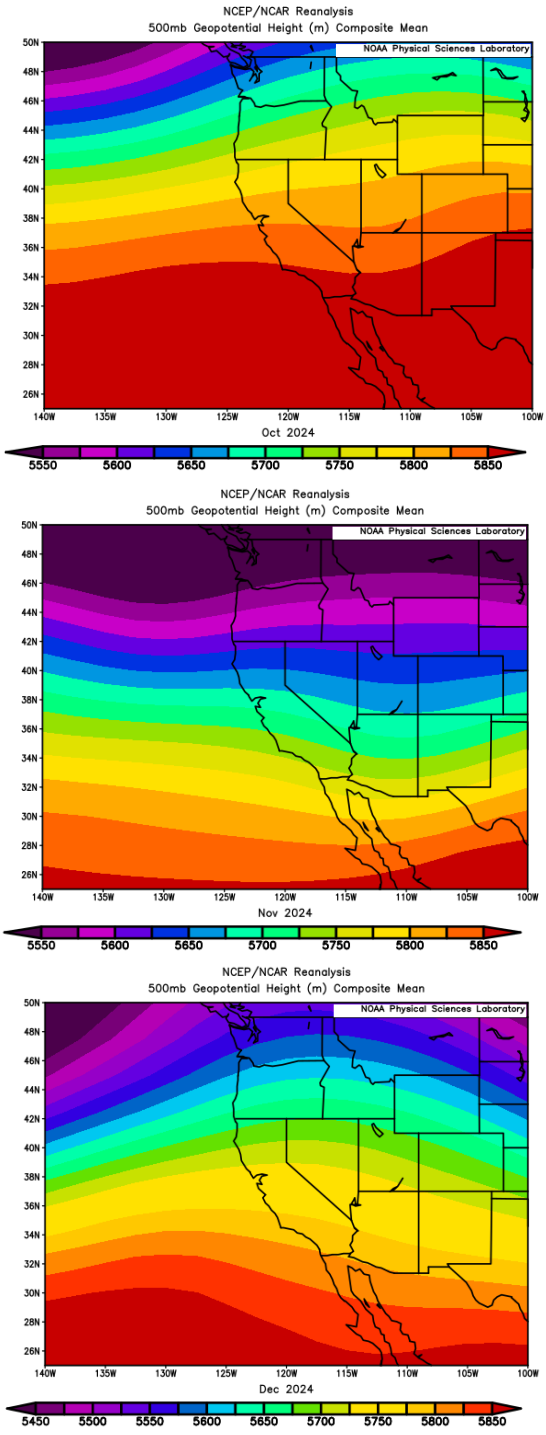
From a purely hydrological perspective, the previous two wet seasons were quite wet, having wiped out any and all drought across the state by the spring of 2024. Reservoirs filled and aquifers recharged. In addition, the Colorado River, the source from which much of Southern California's water comes, was generously fed by its upper basin in Colorado that had received near or above normal precipitation. California water managers know that storing as much water as possible would be key for the

Total Precipitation Anomaly, Since Oct 1st
2024/10/01 - 2025/01/13



The dipole rainfall anomaly across California was very dramatic as of mid-January. Precipitation for some parts of Northern California were near double the seasonal normal, while all of Southern California was near zero, and record dry (climatetoolbox.org).

Dry and Offshore —continued

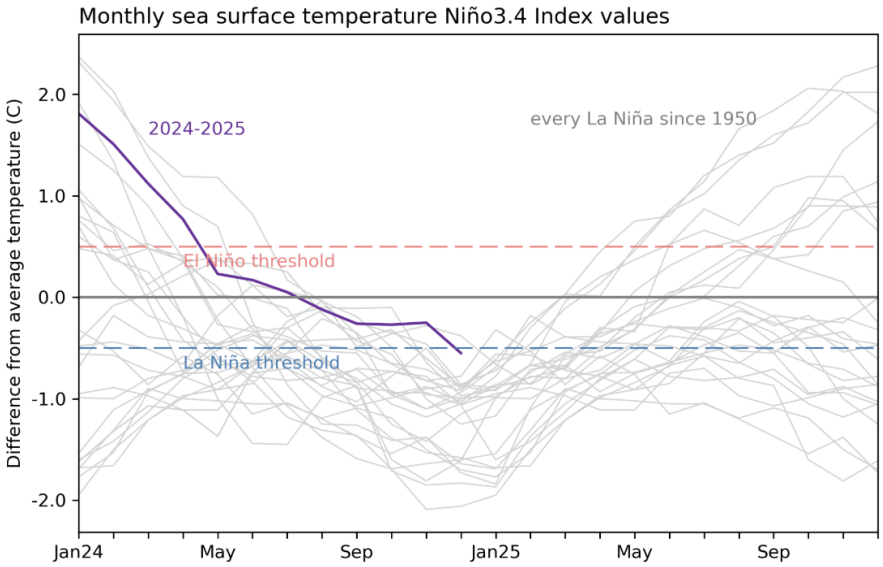


October (top) was seasonally dry as the jet stream and moisture remained mostly north of California. In November (middle), the jet stream dipped south, allowing atmospheric rivers to pummel Northern California. The jet stream retreated north in December (bottom), bringing dry weather to the entire state (NOAA Physical Sciences Laboratory).

Inevitable drought that would come sooner or later (the smart bet is sooner). So while California still has a decent water supply for the moment, there is a legitimate concern that a dry second half of the winter could drain that supply as the long, hot and dry summer generates peak demand.

In addition, all this dry weather during the normally wet season brought fuel (vegetation) moisture down to record, tinder-dry levels.

Is La Niña to blame? While historically, La Niña most likely means drier than average wet seasons for Southern California, this episode didn't really get its act together until December. Emily Becker, NOAA climate scientist, said, "We've been expecting La Niña to show up since last spring. While she's dragged her heels, all the pieces came together this past month [December]." Finally. But does it mean anything? This is a very weak La Niña, expected to remain weak for a couple months before returning back to neutral conditions this spring. In addition, La Niña episodes in recent years have actually brought above normal rainfall. So counting on some predictive value of our weak and temporary La Niña is probably not wise.



Niño 3.4 Index values (the best measure of La Niña) shows the trend barely making it to threshold. Analogs of all La Niñas since 1950 indicate a probable trending back to neutral ENSO conditions this spring.

It has not only been dry in the precipitation department, but in the humidity department as well. Persistent offshore flow and episodes of Santa Ana Winds have plagued the Southland this winter. That ridge over the West Coast has persisted during January, and its corollary has been a persistent trough over the continental interior. That trough brings cold air down from Canada, which settles

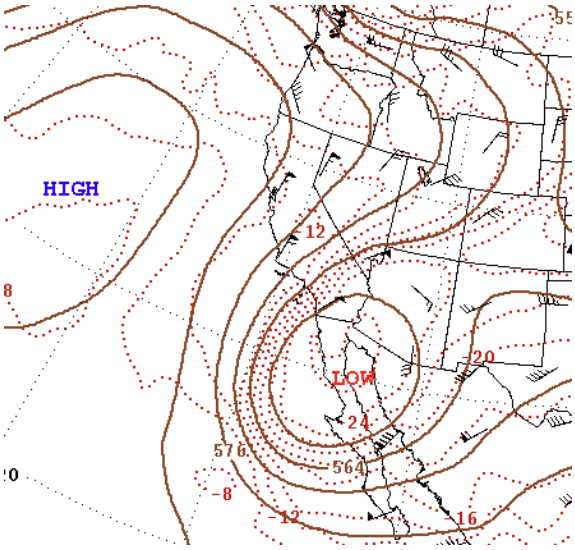
Dry and Offshore —continued

into the western interior (the Great Basin) and produces very strong high pressure at the surface, tightening the surface pressure gradient into Southern California. This was the recipe for the perfect [Santa Ana Wind] storm on 7 January. Two of the largest, deadliest and most destructive fires in Los Angeles recorded history resulted: the Palisades Fire and the Eaton Fire. And they happened in January, which is unprecedented.

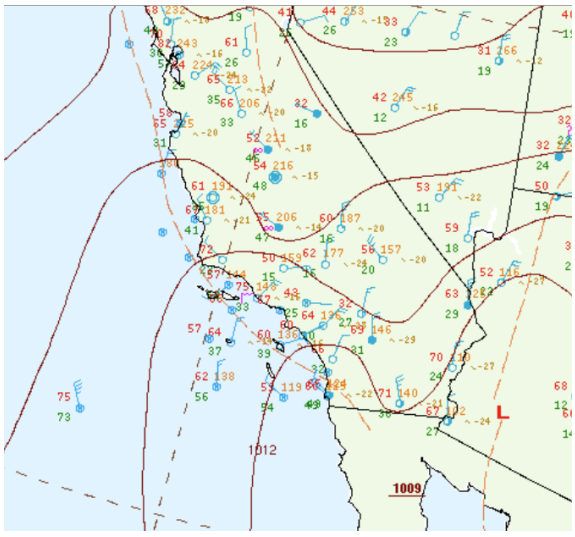
The overall dry pattern in December hasn't changed in January and there's little hope it will change much by month's end according to long term outlooks, although meaningful rainfall does appear on 25-27 January. A stationary wave pattern over the northern mid-latitudes keeps a mean trough over the continental interior while a ridge of high pressure dominates the West Coast. Unless and until we can break out of this entrenched pattern, records for precipitation will continue to be broken even as we move through the climatological peak of the wet season. In addition, Santa Ana Winds love this pattern and will visit more frequently than normal even as we approach the end of the climatological Santa Ana season.

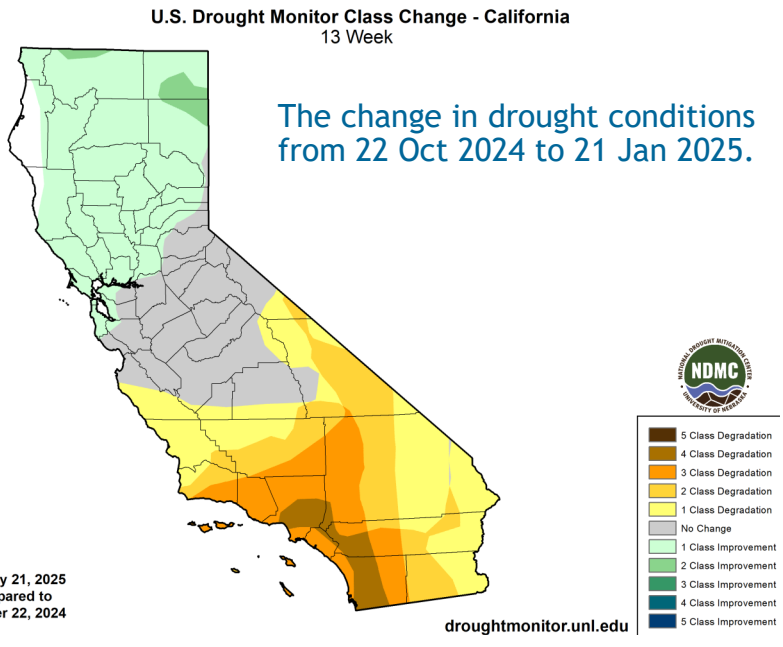
The multi-model (MME) consensus is for this pattern to continue, despite any late January rain. This will push us further into our record dry category and continue to rewrite the dry record books. This seasonal rainfall deficit will be difficult to recover from in February, March and April, adding to the risk that a longer-term drought will develop across SoCal as we head into the climatologically very dry season.

On January 16, federal drought experts released their drought update for California and Nevada, saying in part: "With one to two months remaining in the climatologically wettest part of the year, there is time for wet conditions to return. However, due to the persistent dry conditions since the start of the water year, wet conditions may, at best, slightly reduce drought conditions." To see the report, along with maps and graphics on drought trends, visit **drought.gov/drought-status-updates/drought-status-update-california-nevada-2025-01-16**



The 500 mb (upper level) flow over California was northeast, providing powerful upper support while the surface pressure gradient (below) was very steep, providing strong northeast flow at the surface. The two forces combined to produce very strong Santa Ana Winds on 7 January.

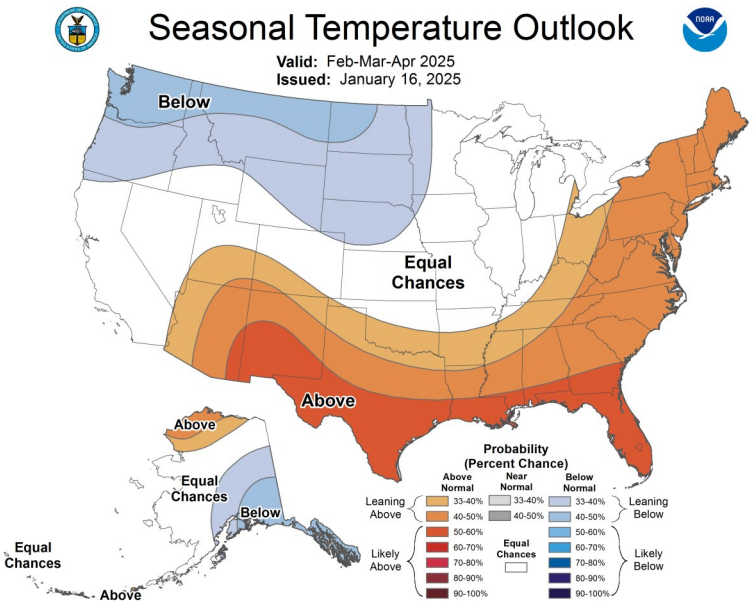




The change in drought conditions from 22 Oct 2024 to 21 Jan 2025.

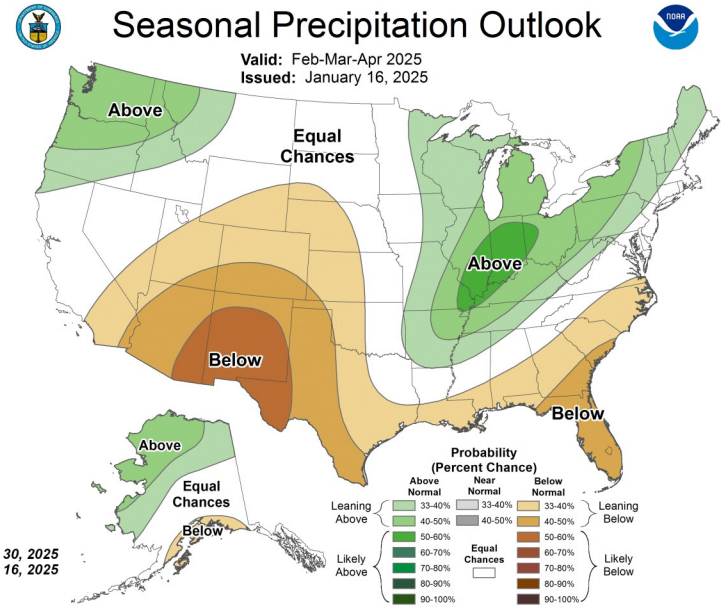
Seasonal Outlook

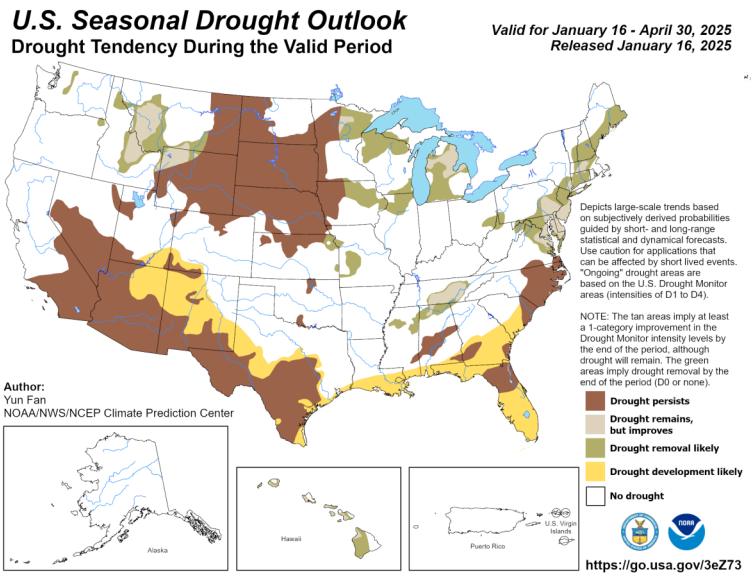
On 16 January, the Climate Prediction Center (CPC) released their three month outlooks for temperature, precipitation and drought.



The Temperature Outlook (left) shows the chances of a warmer-than-average **February-April** (orange and red) are higher than the chances of a cooler-than-average winter across the South and the East. White areas have equal chances for a relatively cool, warm, or average period. Blue areas in the Pacific Northwest and the northern plains indicate a tilt in odds toward cooler than normal conditions.

Out of three possible precipitation outcomes—wetter than average, drier than average, or near average—the outlook for **February-April** (right) says that odds are leaning toward a drier than average period for the Southwest, Florida and coasts of the Southeast. Odds tilt toward a wetter than average period across the Pacific Northwest, the Great Lakes, New England and the Ohio and Mississippi Valleys.





The Drought Outlook (left) **through April** indicates persisting and developing drought in the Southwest, through the Gulf Coast, Florida, the mid-Atlantic region and the northern plains. Scanty drought improvement is expected through parts of the northern Rockies, Great Lakes, southern Appalachia and the northeastern seaboard.

NWS San Diego Fosters Relationships with Partners

UC San Diego Scripps Institution of Oceanography Science Meeting

Scripps Institution of Oceanography hosts the NWS San Diego staff to share recent research. Meaningful discussion about the greatest local weather concerns. (Alex Tardy)

Staff from the NWS San Diego met up with researchers at the University of California San Diego—Scripps Institution of Oceanography. The specific group of scientists is part of the Climate, Atmospheric Science and Physical Oceanography (CASPO). The office has been collaborating and co-authoring with Scripps for over a decade and this was a chance to discuss the latest updates in the scientific community.

The focus of this meeting was to introduce new staff, learn about advancement efforts in long range weather forecasting (sub-seasonal and seasonal predictions) and gain a better understanding of weather patterns and regimes that bring impactful rainfall, drought and wind to southern California.

One of the highlights of the presentations was a demonstration of a tool that uses 16 weather regimes and matches with the European (ECMWF) and National Centers of Environmental Prediction's (NCEP) 71 ensemble systems to demonstrate potential impacts and confidence levels. We also discussed the lack or limited teleconnections with ENSO on California precipitation and patterns as well as the Madden Julian Oscillation (MJO) phases and downstream effects. The plan is to provide feedback to Scripps on the tools that are being developed to help support sub-seasonal outlooks and impactful weather patterns. The ENSO El Niño winters were more often associated with non-atmospheric rivers and three of the four wettest years (three since 2011) were in the cool La Niña phase, which had atmospheric rivers which led to anomalously wet regimes while MJO was more active in ENSO neutral or transitional ocean conditions.

San Diego County Flood Control and San Diego Public Works Meet with NWS San Diego

San Diego County Flood Control employs two full-time meteorologists and technicians that work on rain and stream gauges. They have a network of 120 rain gauges and 15 stream gauges in San Diego County on the Alert system. Each one of the gauges can cost up to $10,000 for installation and communication setup.

In October, their staff visited the NWS office to discuss flood operations and meet NWS meteorologists. The Flood Control agency monitors rainfall events and notifies its partners of potential flooding and issues that may need to be addressed by Public Works. They also monitor stream and river gauges and run a network through the company One Rain.

In the fall of 2024, they will be working with National Weather Service and city of San Diego Public Works on returning a monitoring network in the Tijuana river (with the International Boundary and Water Commission) and also providing some support for flood prone areas in the city of San Diego such as the Mission Valley and the San Diego River.

NWS San Diego Fosters Relationships with Partners—continued

Both agencies participated and presented in the San Diego County Office of Emergency Services hosted Winter Weather Workshop held in late October. Adam Roser and Sebastian Westerink attended and presented for the NWS San Diego.

San Diego County Flood Control personnel visit the NWS San Diego (above left) in October. In November, the NWS San Diego staff returned the favor to discuss flooding issues along with San Diego Public Works (above right).

Later in November, staff from NWS San Diego visited the San Diego County Flood Control along with the city of San Diego Public Works. Sam Zuber provided a presentation to the group on the new Flood Inundation Mapping. There was considerable discussion on lessons learned from the flash flooding on January 22, 2024, a 1000-year flood event, and efforts to improve communication and preparation. More discussions to improve flood preparations and response are forthcoming.

NWS San Diego Visits Mexico Border with U.S. Border Patrol

NWS San Diego staff visited the U.S.-Mexico border with federal partners in the U.S. Border Patrol (USBP) San Diego sector to learn about weather-related challenges at the border.

Sector San Diego has eight field stations that cover 7,000 square miles, including 60 linear miles of international boundary with Mexico and 114 coastal border miles along the Pacific Ocean, including the entire California coast. The area of responsibility includes mountains to 6,000 feet elevation, deserts, complex terrain with canyons and ridges, and the ocean.

For the familiarization tour, we met at the San Diego sector office in Chula Vista, CA, and drove to the Tijuana River fence gate. This portion is a concrete levee on the Tijuana River, where we observed a new bridge crossing for USBP use, connecting the levee on both sides.

NWS San Diego meteorologists visit the U.S. Border Patrol in Chula Vista. They are bookended in this photo by two Border Patrol officers.

We then traveled west and saw the International Boundary Water Commission (IBWC) river gauge and the two U.S. waste water pump stations, Smugglers' Gulch and Goat Canyon, both of which have been impacted by flooding and waste water release as water flow drains from Mexico into the Tijuana River. From there, we traveled through a narrow, windy steep road within two

NWS San Diego Fosters Relationships with Partners—continued

Border Patrol officers guide NWS personnel on a tour of the border fence in Tijuana.

border fences and stopped at the overlook near Border Field State Park Beach.

On the Mexico side, you can see an elevated highway being constructed that will connect to the Tijuana Airport. Along the entire drive was a large new fence, which replaced chain link fencing in 2018. We then exited through a large gate and traveled a dirt road past Goat Canyon, reaching the paved Dairy Mart Roadway and passing a San Diego Flood Control rain gauge and a low water crossing from the Tijuana River where it enters the U.S.

Impacts due to dense fog, rain, heat, and ocean conditions are of significant concern along the border, especially during border patrol interactions with illegal crossings. This visit gave NWS San Diego a better understanding of the variable terrain and weather affecting the safety and operations of border agents and those crossing or working at the border, which will help enhance IDSS provided to core partners at the border.

Lead Meteorologist Paul Steward Joins the NWS San Diego Team

New Lead Meteorologist Paul Steward arrived at NWS San Diego this month and shares some of his background. Welcome, Paul!

I was born in San Diego at the Kaiser Hospital in Mission Valley, and grew up most of my life in Santee. I have always been passionate about weather and knew that I wanted to be a meteorologist since I was very young!

After graduating from Santana High School in 2001, I enlisted in the Navy as an Aerographer's Mate (meteorologist in the Navy). After being honorably discharged from the Navy in 2012, I went to work for Atmospheric Technology Services Company as a contracted Aviation Duty Officer at NAF El Centro until 2016. I completed my Bachelor's Degree in Geosciences, with pertinence in Operational and Broadcasting Meteorology, from Mississippi State University in 2018. I also received an Associates Degree in General Science, Mathematics, and Psychology in 2019.

To get my foot in the door with the National Weather Service, I accepted a job at the NWS Pueblo office in 2020, and moved to Colorado. While being in Pueblo, I was the Aviation Program Manager, where I was able to continue to apply meteorology to the other thing I have a love for, which is aviation! That brings me to recently being selected to be a Lead Meteorologist here at the NWS San Diego and moving back to my home state!

Quarterly Summary

October

San Diego Data - October				
	Max	Min	Avg	Rain
Actual	73.4	60.1	66.7	Trace
Normal	74.6	61.5	68.1	0.50
Anomaly	-0.8	-1.4	-1.4	-0.50
% of normal				0
Max	80	66		Trace
Min	68	51		

October started out hot under a strong high pressure ridge over California. The first ten days of the month featured daily record maximum and record high minimum temperatures. At the same time, a shallow marine layer kept the coast cool with occasional fog. Temperatures in the low desert reached 117 degrees on the 1st and the Inland Empire touched an impressive 110 degrees on the 2nd. That 117-degree reading was at Palm Springs, and became the highest recorded temperature for October in the United States.

The strong ridge persisted overhead, but finally relented as a low pressure trough put a dent in the ridge on the 11th and 12th. This brought down inland temperatures and helped the marine layer rebound.

The weak trough hung around for a few days before a stronger trough brought cooler inland weather and some onshore winds on the 16th and 17th. This system brought light rain, less than 0.10 inch, from the coast to the mountains, heaviest in San Diego County.

This was followed by some locally strong offshore winds on the 18th. Several foothill locations in the San Bernardino and Santa Ana Mountains clocked gusts over 60 mph. A weaker offshore flow continued through the 20th.

High pressure aloft combined with weak offshore flow to bring a full week of spectacular and warm weather to the region through the 27th. The only blemish was some fog that plagued the coast at times.

This view from the upper slopes of a Big Bear area ski resorts confirmed the first measurable snowfall of the season in the mountains, which fell on 28 October (webcam image).

On the 28th and 29th, a deeper low pressure trough brought onshore winds and squeezed out some rain from the coast to the mountains. The foothills of the San Bernardino Mountains harvested one third to 1 inch of rain, largely a result of a convective wave of heavy rain. Valleys received up to one third inch, but Orange County missed out on the rain. The high desert got their first rain of the season, albeit just a few hundredths.

The month finished up cool and dry in the wake of the trough.

Quarterly Summary—continued

November

San Diego Data - November				
	Max	Min	Avg	Rain
Actual	71.1	50.1	60.6	0.13
Normal	70.7	54.8	62.7	0.79
Anomaly	0.4	-4.7	-2.1	-0.66
% of normal				16
Max	79	56		0.08
Min	64	43		

Unlike September and October, November started out cool under a trough pattern over the West.

A shortwave trough on the 2nd and 3rd brought showers to the region, especially to San Diego County's mountains and southwest corner. Pine Hills recorded the greatest amount of 0.40 inch and National City recorded 0.26 inch. One tenth inch or less was measured in Orange County and in other mountain foothills.

The trough pattern migrated east, allowing offshore flow to develop over Southern California on the 4th. Additional interior troughs dropped southward into Arizona over the next several days, reinforcing the offshore flow and occasional Santa Ana Winds through the 9th. Notable wind gusts over 50 mph were reported on 6th and 7th across foothills and into adjacent valleys. The highest gust was 75 mph at Fremont Canyon on the 6th. These winds from the interior dropped humidity into the single digits across much of the region. A few small wildfires erupted in these dry, windy conditions, but were quickly contained.

For the next week, several troughs clipped the region, bringing cool weather and occasional strong westerly winds in the mountains and deserts.

The one on the 15th brought precipitation, too. Foothills of the San Bernardino Mountains managed to wring out over 1 inch, with Panorama Point topping the list with 1.81 inches. All lowlands west of the mountains received from a few hundredths near the coast to 0.40 inch in northern San Diego County. Snow fell, with 1-4 inches reported in the San Bernardino Mountains.

Light snow accumulated on 15 November at Big Bear ski resorts (webcam image).

The trough pattern continued to bring coastal low clouds and fog for several days before weak ridge pattern finally took hold. This brought dry and warmer weather through the 22nd, along with several episodes of offshore breezes.

Several atmospheric rivers pummeled Northern California with rain for the latter half of the month. On the 23rd and 24th, the southern fringes of one of these atmospheric rivers grazed Southern California. This brought rain, particularly to the San Bernardino Mountains and the northern Inland Empire. 0.71 inch was the greatest amount received at Devore. All other areas received less than 0.40 inch (none in deserts).

The next trough on the 27th, also bringing moisture remnants of atmospheric river to the north, brought a very similar rainfall distribution. Only mountains, foothills and the northern Inland Empire received light rain. Glen Helen Park received the most at 0.39 inch.

The month finished out with dry and warmer weather under a weak high pressure ridge.

Quarterly Summary—continued

December

A longwave ridge set up over the western U.S. for the beginning of the month, but with very weak shortwave troughs swirling within it.

Offshore flow developed on the 5th and 6th and strengthened on the 9th through the 11th into moderate to strong Santa Ana Winds. Numerous foothill locations recorded northeast wind gusts over 60 mph. A handful exceeded 70 mph and Sill Hill (just west of Cuyamaca Peak) reached an exceptional 95 mph in the morning on the 10th.

San Diego Data - December				
	Max	Min	Avg	Rain
Actual	66.5	49.0	57.7	0.01
Normal	66.0	49.8	57.9	1.67
Anomaly	0.5	-0.8	-0.2	-1.66
% of normal				1
Max	79	55		
Min	61	42		

Right behind this offshore flow, a rapid and compact low-pressure trough moved through California on the 12th and 13th, with a glancing blow to Southern California. Onshore winds were more impressive than rainfall, as a handful of mountain locations recorded gusts over 50 mph. Light rain fell only in the mountains and in San Diego County; all amounts were less than 0.15 inch.

The onshore/offshore oscillation really got going in the middle of the month. On the 17th and 18th, strong Santa Ana Winds hit the region and were slightly more widespread than in previous episodes. Many stations exceeded 50 mph, even in valleys. The top gust of 76 mph was measured at Arrowhead Springs during the night of the 17th. Several gusts in the valley below the Cajon Pass exceeded 60 mph. High pressure also built on these days, providing unseasonably warm weather that included lots of readings in the 80s from the 17th through the 20th.

Low pressure approached and onshore flow returned to bring a cooling trend from the 21st through the 25th. There was just enough energy and moisture this far south to extract some light rainfall on Christmas Eve. Amounts from the coast to the mountains only amounted to less than 0.10 inch, except for Running Springs, the top spot that reported 0.11 inch. Onshore winds through the San Gorgonio Pass reached 45 mph.

For the last half of the month coastal fog made its presence felt with an unusually healthy marine layer for this time of year. Any time the flow wasn't strongly offshore or onshore, there were many nights and mornings featuring dense fog near the coast. That's how the last few days of the month played out.

Areas of dense fog were rather persistent in coastal areas and western valleys for many nights and mornings during the last half of the month, such as this fog on New Year's Eve in Escondido. Image HPWREN.