Any good business that manufactures and sells a product needs to produce both high quality products and effective sales. If a business produces widgets and they are sub-par, no amount of skillful sales will turn a profit. On the other hand, if the widgets are high quality, but sales are stumbling, a great widget will not get into the hands of consumers and the business’ bottom line suffers. The National Weather Service in recent years has begun to incorporate some of these principles of good business into its operating model.

Except the NWS is not manufacturing and selling widgets. The NWS is producing useful, actionable information and effectively communicating it.

It’s that communication part of the process that has improved in recent years. A great deal of effort has been made to develop and improve relationships with key partners by talking with them and understanding their needs. Outreach has increased to the public and to partners through attending and participating in a variety of public events, meetings, exercises and training done together. Relationships of trust have deepened. This is not to say that outreach, relationships and communication weren’t important before, but that there has been a concerted effort to extend the reach and effectiveness of the NWS message. In addition, there are several new ways of spreading the message via emails to partners, social media and NWS websites. More graphics are skillfully prepared to convey messages that can be understood quickly and easily. NWS communication has improved and the reach of our information has spread dramatically.

Effective and far-reaching communication can only go so far. It is essential that the product and information is of high quality. If a partner makes an important and costly decision based on certain weather information, it must be accurate, useful and actionable. Without it, no amount of effective and far-reaching
communication can compensate. The production of useful and accurate weather information is not as visible as the presentation and communication of it, but it is the foundation of our service.

Producing useful and accurate weather information is not a trivial task. Forecasters work round the clock, every day of the year monitoring the weather to ensure nothing dangerous comes up unannounced. This weather watch is designed to capture any hazard and initiate an appropriate response. For example, if a major earthquake strikes the Pacific Rim, tsunami warnings could go into effect for Southern California. The NWS plays an important role in disseminating that lifesaving information. Other examples include thunderstorms that pop up, fire starts, strong winds, dense fog and many other types of weather that could prove dangerous without the proper response. The NWS is the weather police, patrolling the skies and the landscape for anything dangerous, and protecting you from it, 24/7/365. For the price of a fast food value meal, every taxpayer in the nation has paid for a year of this protection and service. I think you’ll agree that’s a phenomenal value from your federal government. Moneyball author Michael Lewis in his 2018 book The Fifth Risk complimented the NWS for being a shining example of genuine government value.

Watching and responding to weather hazards that pop up cover the non-routine service. Forecasts cover the routine. News media, public safety officials, aviators, mariners, fire fighters and public (you and I) need a fresh, accurate forecast when we wake up each morning. NWS forecasters set the tone for all forecast communication that comes to you via your phone app, the Weather Channel, local news on TV and radio, or your favorite weather web site. These channels of communication adapt, massage or even change the forecast, often with cosmetic improvements for broadcast or web/app display.

How does the forecast materialize? Several workstations within the office make up a national network called Advanced Weather Interactive Processing System (AWIPS). AWIPS is a network of computers that transfers and processes data for display in graphic and alphanumeric formats for use by forecasters.

Forecasters review and analyze the atmosphere using satellite imagery, plotted weather balloon sounding data, radar imagery, surface observations, and so on. They also look at computer model guidance from many numerical weather models, updated several times a day (one does it every hour!). AWIPS allows forecasters to view model guidance’s depiction of the atmosphere sliced and diced in many ways: the map (bird’s-eye) view, cross-sections, and time-height perspectives. There are thousands of different options for displaying atmospheric data and model guidance on AWIPS.

Understandably, that’s a tall task to ask from any workstation or network. It requires constant maintenance and loving care. Meeting that task is forecaster Phil Gonsalves, the AWIPS program leader for the San Diego office. When he’s not focused on making accurate forecasts, he’s the resident AWIPS care-giver. “The biggest challenges are keeping the software updated (it evolves rapidly) and fixing the problems created by the updates, including updates to the LINUX
Operating System," he says.

Phil gets some help. The San Diego office combines technical expertise and meteorological experience to maintain the system functioning and performing as it should. Stefanie Sullivan is a forecaster who helps maintain the system. Michael Khuat is not a meteorologist, but a highly skilled and experienced Information Technology Officer. Stefanie and Michael support Phil to make sure upgrades are made properly and on time, and troubleshoot any problems that come up.

Once a forecaster develops a conceptual forecast in his/her mind, it’s time to edit the grid-ded database found within AWIPS using the graphical forecast editor (GFE). The GFE contains a collection of maps overlaid by color-coded pixels, or grid boxes (2.5 km square), that represent a discrete value of the weather element at its location on the map. For example, if we pull up the maximum temperature map for Monday, we can see hundreds of color-coded grid boxes that cover our forecast region. Each grid box represents the forecast high temperature for Monday in that 2.5 km square neighborhood. That map belongs with the other max temp grid maps for each day out to one week. Combine that with minimum temperature maps for the same time period. Now consider grid maps that depict sky cover, precipitation chance, precipitation amount, snowfall, snow levels, weather, winds, dew point, humidity, heat index, and dozens more. Some of these variables are broken down in chunks of six hours, three hours, or even one hour! With winds, we forecast them hour by hour for the next three days.

The dozens of weather elements in GFE are input directly or derived using numerous tools called smart tools. Putting values into the grid boxes for each variable is called “populating the grids.” If I want a particular blend of the best performing models to input into winds, for example, I would pull up a smart tool for winds and choose my preferred blend of models that will give me the best fit for what I believe is the best forecast. This process can be tedious, but improved smart tools over the years have streamlined the process and have produced excellent grids and subsequent forecasts. The San Diego NWS office prides itself for having some of the finest grids in
all the land because of our fine high-resolution models, intelligent smart tools, and of course forecaster experience.

One of those tools is a bias correction applied to temperatures. Many computer models generate a graphical representation of maximum temperature for a day across the region. If we overlay reality, the observed max temps for the day, we can calculate the difference for each grid box (forecast temp - observed temp). Because of dense, high-quality observation network across our region, the NWS San Diego can input detailed, real-time data to calculate the bias; either the model was too warm or too cool, and by how much. A 30-day running average bias is calculated and a bias correction is applied for each day and for each grid box on the map. Applied to the model, the bias corrected model becomes a “smart model” that understands its biases for each neighborhood. “You have to have a decent analysis in order to get a decent bias correction,” says Greg Martin, Lead Forecaster and GFE specialist.

What that means to you is when you click on the website to get your neighborhood forecast, you’ll get a high quality, accurate forecast that represents that exact location, and not just a scaled-down, interpolated approximation.

Authorized users from federal, state, county, city or tribal agencies may request a spot forecast for an exact location to support their operations. Most of these requests come from firefighting agencies for prescribed burns or actual wildfires. But some of the requests are to support drills and exercises, incidents involving hazardous materials, or other outdoor activities. Most of these spot forecasts are done on the night shift after the latest forecast update of the gridded database, so they are fresh and ready for use early in the morning when the agencies need it.

Without an accurate, detailed gridded database, the GFE’s text formatter cannot generate an accurate, detailed forecast. Requesters often need to know how the weather changes from hour to hour, and the NWS San Diego can deliver on its promise.

The grids for the San Diego forecast area are combined with the grids across all 123 forecast areas across the nation to create the National Digital Forecast Database (NDFD). This database allows users to access the detailed data for weather elements such as temperature, wind, humidity, sky cover and so on. The needs and uses for this digital database are numerous and varied. Utilities want to know how much solar or wind power can be generated ahead of time. Firefighters need to know where to stage equipment and resources before a fire gets started. Airlines and private pilots need to know cloud levels and visibilities, as well as wind speed and direction. You and I need to know whether or not to bring a jacket, an umbrella or plenty of sunscreen and water to the soccer match or to the beach.

Helping partners and public make well-informed decisions is what the NWS is all about. The production of accurate, useful and actionable forecast information is the foundation of our service. The NWS continues to develop its skills to present and communicate effectively, but without compromising the quality of the forecast information.

NWS forecast web pages feature an hourly breakdown in forecast weather elements, among many formats.
**Technology Upgrades**

**Radar Upgrades**

The national network of weather radars were installed in the 1990s and were designed to last 25 years. The KNX radar in San Diego received an important upgrade in March that will add years to its lifespan. The same upgrade will take place in May at our KSOX radar in the Santa Ana Mountains.

What was done? Technicians refurbished and replaced the pedestal, one of the most critical components of the radar, which is necessary for antenna rotation and positioning to capture data in all directions. The components are extremely heavy, so the radome (the radar covering resembling a soccer ball) had to be removed by crane and replaced when the work was completed.

The radar and pedestal were designed to last 25 years, and this radar has exceeded its lifespan. This activity is necessary to keep the radar functioning for another 20 years or more.

The pedestal refurbishment is the third major project of the NEXRAD Service Life Extension program, a series of upgrades that will keep our nation’s radars viable into the 2030s. NOAA’s National Weather Service, the United States Air Force, and the Federal Aviation Administration are investing $150 million into the eight-year program. The first project was the installation of the new signal processor and the second project was the refurbishment of the transmitter. The fourth project will be the refurbishment of the equipment shelters. The Service Life Extension Program will be complete in 2023.

Although it was inconvenient for the San Diego radar to be down during this maintenance period while a couple storms passed through the region, the upgrades will ensure smooth operations for years to come. Hopefully, May will bring less radar demand during the KSOX upgrade.

For more complete understanding of how it all works, check out this two-minute video:

https://youtu.be/H8lYTP342gc

**GOES-17 “Goes” Operational as GOES West** adapted from a NOAA story

It’s official: GOES-17 is now operational as NOAA’s GOES West satellite.

In its new role, GOES-17 will serve as NOAA’s primary geostationary satellite for detecting and monitoring Pacific storm systems, fog, wildfires, and other weather phenomena that affect the western United States, Alaska, and Hawaii.

The latest milestone for GOES-17 comes exactly eleven months after the satellite first reached its geostationary orbit 22,000 above Earth. Launched March 1, 2018, GOES-17 is NOAA’s second advanced geostationary weather satellite and the sister satellite to GOES-16 (also known as GOES East). Together the two satellites provide high-resolution visible and infrared imagery as...
well as lightning observations of more than half the globe— from the west coast of Africa to New Zealand, and from near the Arctic Circle to the Antarctic Circle.

GOES-17 has already been helping forecasters track the weather and other environmental hazards in places like California, Alaska and Hawaii. The satellite began transmitting its first images from its new orbital position in November 2018. Since then, forecasters have been using GOES-17 data to see weather forming over the northeastern Pacific Ocean, where many weather systems that affect the continental U.S. first form.

Until recently, high-quality data coverage of the Pacific Ocean was sparse. Now that GOES-17 data is available, however, forecasters have access to more detailed views of high-impact weather systems and other environmental hazards like wildfire smoke and volcanic ash.

For example, GOES-17 helps forecasters predict the intensity and impact of Pacific storms that hit the West Coast. These include atmospheric river events that bring heavy rain and high-elevation snow to California and the Pacific Northwest, especially during the winter months.

GOES-17’s high-resolution visible and infrared imagery will improve hurricane forecasts and allow meteorologists to better predict areas of intense rainfall.

Forecasters are also now able to track thunderstorms in real-time. The Geostationary Lightning Mapper (GLM) on-board GOES-17 helps forecasters determine when thunderstorms and convective weather events are intensifying or becoming more dangerous. In 2018, the National Weather Service began using GLM data to issue severe thunderstorm warnings and keep the public out of harm’s way.

Among the benefits of GOES-17’s high-resolution and rapid-scan capability is its ability to detect wildfires and monitor smoke coverage in near real-time. In 2018, California faced one of its deadliest and most destructive wildfire seasons.

Providing high-definition images as often as every minute, GOES-17 helps forecasters distribute critical information to firefighters and emergency managers that saves lives. Real-time imagery of smoke plumes from fires also improves the ability to predict a fire’s motion better than before. This information helps firefighters on the ground combat fires more effectively and emergency managers plan life-saving evacuations sooner.

GOES-17 is providing both increased and improved data over the Pacific Ocean, where observations were previously limited, and where many weather systems that affect the continental U.S. originate. The increase in data coupled with sharper and more precise views of hazardous weather systems over the ocean is leading to better marine and aviation forecasts for those traveling across the Pacific Ocean.

“Extraordinary observations from GOES-17 are being infused into the forecast process, enabling us to offer new and improved forecasts, products, and services that save lives and property,” said Louis W. Uccellini, Ph.D., director, NOAA’s National Weather Service.

Fog and icy conditions often cause flight delays and impact airport operations. GOES-17 allows forecasters to predict, with greater accuracy than before, the timing of fog and cloud formation and when it will clear, helping to mitigate ground delays.
Winter Review and The Spring Outlook by Miguel Miller

Before we look ahead at the spring outlook, let’s look back at the winter precipitation outlook and how well it fared.

The chart at far left shows the forecast precipitation for Dec 2018 through Feb 2019 as projected in November 2018. The chart at near left shows the observed precipitation anomaly for that time frame. Overall, the winter precipitation outlook did quite well across the southern third of the nation, including Southern California. Not as good in parts of the Southwest and in the Great Lakes region.

Spring Outlook

The Climate Prediction Center (CPC) released their Spring Outlook in mid-March. April through June 2019 are most likely to be warm and dry across the expanded northwest part of the country, as well as the East. Cooler in the nation’s mid-section.

Odds favor a wetter than average spring across much of the nation, including the central Rockies and the Southeast, but no tilt in odds for the far West, including California.

Research on Local Weather Issues

Researchers at Scripps Institution of Oceanography (SIO) have been busy conducting research on a variety of Southern California weather issues. The NWS San Diego hosted several of them on 12 April to learn about and discuss their findings. Here’s what we learned.

The Role of Atmospheric Rivers in our Future Climate

Atmospheric rivers (ARs) have always played an important role in contributing to California’s winter season. Dr. Sasha Gershunov has found that in our future warmer climate, strong and extreme atmospheric river events will continue to play an important role. But while the ARs during winter might become more extreme, leading to flooding between December and February, the fall and spring months are expected to show a decrease in frequency and intensity of ARs. A winter increase is most likely in central California between Monterey and Los Angeles.

Water and Air Quality

Rosana Aguilera talked briefly about her research on ocean water quality following AR storms. With weather prediction and quantitative precipitation forecasts getting better, an effort to provide advance warning for bacteria in ocean could be undertaken.

Rosana later shared her research on air quality and Santa Ana Wind events (SAWs). The effect of SAWs on air quality seem to be for more cleaning effects for air quality than dirtying effects from blowing particulates. PM2.5 particulates, such as those found in smoke from fuels on fire, increase because SAWs push smoke into broad areas.

Trends of Santa Ana Wind Events

Janin Guzman-Morales developed the Santa Ana Wind Regional Index (SAWRI) which determines the regional mean wind speed of Santa Ana Wind events. All SAW days and extreme SAW days are on a gradual decrease as we head to 2100. She found a greater decrease in October, February and March, but not as much decrease in November, December and January. These trends are related to synoptic shifts and less cold air driving offshore pressure gradients from the interior West. Heat waves caused by SAWs in the future will have the largest effect in the L.A. Basin. Overall, we expect fewer SAW events, slightly weaker winds, and more focused on December and January, and less so in October and February.

Health Effects of Santa Ana Heat

Lara Shwarz discussed the heat burden caused by SAWs. She pointed out heat is number one killer in the U.S. and not only from heat stress, but also cardio-respiratory problems. These can happen during non-summer season in Southern California because of SAWs, but the SAWs do not necessarily make the heat impacts worse.

Some of the above publications can be found at the California Nevada Applications Program (CNAP) website: https://scripps.ucsd.edu/programs/cnap/publications/

CNAP is partially funded by NOAA.

Dwindling Sierra Snowpack and Shrinking Winters

On a separate occasion, researcher Amato Evan came to the NWS in San Diego and shared his findings. Looking at snowpack data from 1982 through 2017, he found that winters are becoming shorter in mountainous regions. While he found no trend in declining snowfall, his research shows that the snow is disappearing earlier in the year, which could have implications for state water management and wildfire activity.

Quarterly Summary

January

The month and year began under dry and cool offshore flow that turned warmer with a fleeting high pressure ridge.

By the 5th and 6th, a vigorous low pressure trough brought rain, mountain snow along with strong winds to the mountains and deserts. It was powerful but quick. Precipitation ranged from about a quarter inch to one inch west of the mountains, and over an inch in some of the mountains. Snowfall was 5-10 inches at ski resorts and higher mountains and 2-5 inches elsewhere. The snow level was about 5,500 feet. Heavy convective cells and a few thunderstorms formed along the front and rolled through coastal areas around midnight.

Dry weather followed for several days before a persistent wet pattern developed on the 11th with a storm that rotated through the region on the 11th and 12th. This negative tilt trough generated rain, mountain snow and thunderstorms. Orange County harvested the greatest rainfall from this storm, with many gauges receiving over one inch. Elsewhere, lower elevations received less than a half inch. Mountains received up to six inches of snow.

There wasn’t much break from the rain before the next series of storms arrived for the 14th and 15th. This latest storm gave the coast the greater share of rain. The rain kept coming as greater moisture pointed at Southern California on the 16th and 17th. Amounts ranged from a half to one inch in coastal areas, including some of the mountains. The Inland Empire and northern San Diego County managed less than a half inch. The snow level was at 5,000 feet, but the greatest snowfall amounted to a few inches. Flows in usually dry streambeds and low water crossings and localized flooding in Orange County were noted on the 15th and 16th. A more zonal flow pattern set up with a plume of moisture directed at Southern California on the 17th. This brought an additional 1 to 3 inches of rain, but with local mountain locations receiving 5 inches. Less than a half inch fell in southern San Diego County. High snow levels dropped rain on snow to add to the runoff in the higher mountains. Debris flows came down the eastern flanks of the Holy burn scar.

High surf and high tides combined to create some coastal damage, particularly to the Ocean Beach pier on the 18th.

High pressure brough fair and warmer weather through the 20th before the next trough moved through the West on the 21st. This one was more of an inside slider, bringing only light rain to San Diego County. But it brought very strong wind. A 97 mph gust was measured at Burns Canyon, with numerous mountain and desert locations clocking gusts over 60 mph. A few gusts over 40 mph hit the coast. A large tree fell on a house in Pt. Loma and killed two. Other trees fell in Yorba Linda. The onshore winds were immediately followed by strong offshore winds on the 22nd. Top wind gusts in the foothills exceeded 60 mph.

High pressure prevailed with cool northerly flow along the West Coast through the 30th. Several warm days with cool nights resulted.

<table>
<thead>
<tr>
<th>San Diego - Lindbergh Field Data</th>
<th>January 2019</th>
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<tr>
<td>Actual</td>
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</tr>
<tr>
<td>Min</td>
<td>61</td>
</tr>
</tbody>
</table>

Heavy rain and the denuded land at the Holy Burn Scar once again produced debris flows and flash floods below the scar. This one in Glen Eden made quite a mess on 17 January. Photo CalFire.
Quarterly Summary—continued

On the 31st, a compact yet potent low pressure system made a direct hit on Southern California. Rainfall amounts were a third to a half inch, but a few spots in Orange County reached one inch. This system was the start of a prolonged wet period through early February.

Season-to-date rainfall at the end of January ranged from 80 to 160% of average.

February

February started very wet with many consecutive days of precipitation. The jet stream continued to send storm after storm into the West Coast giving the region rain and snow for the entire first week.

An atmospheric river (AR) brought copious rainfall to the region on the 2nd. Precipitation ranged from about 1 to 2 inches in the coastal basin, up to 5 inches in the mountains, and 0.25 to 1 inch in the deserts. Snowfall was heavy above 6,000 feet totaling for the five previous days two to four feet. Bands of heavy rainfall in northern Orange County and northern San Diego County led to some urban flooding. Winds toppled a few trees in Laguna Beach and San Diego.

Widespread heavy showers followed the AR from the 4th to the 6th, totaling 1 to 2 inches, with locally 4 inches at Palomar Mountain and Mt. Laguna. The San Diego River reached 8.5 feet. A flash flood developed in Trabuco Canyon under high rainfall rates on the Holy Fire burn scar. Snow levels plummeted as low as 2,500 feet elevation. Snowfall on the I-8 in eastern San Diego County led to two fatalities on the icy roads.

After a couple of dry but cold days (frost was observed at the coast a few mornings), another weak system on the 9th and 10th brought light precipitation. Fleeting high pressure brought dry weather on the 11th and 12th.

A plume of very moist air, an atmospheric river, tapped into subtropical moisture to an extent rarely seen this time of year. The copious moisture and warmer type origin brought enormous rainfall on the 13th and 14th. Showers continued for several days thereafter, totaling six consecutive days of measurable rainfall in San Diego. Very high snow levels allowed for incredible rainfall in the mountains. Storm totals reached over 10 inches at Palomar Mountain and around 9 inches in the San Bernardino and San Jacinto Mountains, and over 8 inches in the Santa Ana Mountains atop the Holy Fire burn scar. Palm Springs incredibly got 3.7 inches. 2 to 4 inches were observed in the lowlands, except about one half inch in the high desert. Severe flooding and washout damage was sustained along many mountain and desert highways, including highway 243, which was completely washed out near Idyllwild. Highest river flows since 2017 were observed on the Santa Margarita, Whitewater and San Luis Rey rivers. The Whitewater flowed fast and

| San Diego - Lindbergh Field Data - February 2019 |
|-------------------------------------------------|--------|--------|--------|--------|
|                                                 | Max    | Min    | Avg    | Rain   |
| Actual                                          | 62.5   | 48.9   | 55.7   | 3.42   |
| Normal                                          | 65.0   | 50.7   | 57.9   | 2.27   |
| Anomaly                                         | -2.5   | -1.8   | -2.2   | 1.15   |
| % of normal                                     |        |        |        | 151    |
| Max                                             | 71     | 55     |        | 0.98   |
| Min                                             | 57     | 41     |        |        |

No way around it, highway 243 north of Idyllwild was completely taken out on 14 February. Photo Caltrans.
Quarterly Summary—continued

deep through the Coachella Valley. Flow through Chino Canyon washed out the Palm Springs Tram road and closed that facility for an extended period. The Mojave River through Hesperia and Victorville exceeded flood stage. Heavy rain on top of snow led to rain plus snowmelt flooding at Big Bear Lake. Flooding and debris flows hit a Lake Elsinore neighborhood below the Holy Fire burn scar. Dozens of high water rescues were made in each county. The rain on snow also destabilized the snowpack on San Gorgonio Peak,

which produced several avalanches. Some trees came down in the strong winds along the coast. Snow levels dropped while snowfall went up on the 18th.

Only a couple days of relatively dry weather followed through the 20th before the next storm system arrived on the 21st. This storm was particularly cold and remarkable for the heavy snowfall at higher elevations and the low snow levels. The San Bernardino Mountains got 1 to 2 feet of snow, and an inch fell as low as 2,000 feet, reported in Rancho Cucamonga, Yucaipa and Alpine. Snow was observed falling as low as 1,000 feet. Snow of 3 to 10 inches fell in Lucerne Valley, Yucca Valley and Landers. Thunderstorms brought numerous lightning strikes and graupel and hail were also in the mix across much of the lowlands. A low temperature of -3 degrees Fahrenheit at Big Bear Lake helped the lake freeze over.

Finally, several days of dry weather rounded out the month under weak high pressure aloft.

Average temperatures at stations across the region averaged from two to six degrees below normal for the month.
Quarterly Summary—continued

March

March featured a lot of days of rain, but fell short of average in overall rainfall.

The month began with an active jet stream sending weather systems into Southern California in rapid succession. Each of these produced rain for most days of the first third of the month.

An atmospheric river weakened and stumbled into Southern California. Even so, the orographic effect (mountains inducing atmospheric lift and greater precipitation) was able to harvest one to nearly four inches of rainfall in the mountains. The lowlands received less than one inch, and less than one quarter inch in southwest San Diego County.

A deep low pressure trough tapped into tropical moisture on the 11th and 12th, and while it dropped south through Baja California, it brought more rain to the desert than it did at many coastal areas. It focused most of its energy on the L.A. Basin, and also produced thunderstorms. Rainfall exceeded 1.5 inches in northern Orange County and northern Inland Empire. Over two inches fell in parts of the San Bernardino Mountains. In general, everywhere else came in with less than 0.75 inch. Amounts were much lower going south where one quarter inch or less fell in the San Diego Metro area. Localized flooding impacted the northern Inland Empire.

A weak, featureless jet stream put the precipitation on pause for the next several days. Offshore flow developed on the 15th, which boosted winds and temperatures on that day through the 17th. The top gust was 75 mph at Sill Hill near Cuyamaca, and several gusts over 45 mph were observed in the far inland valleys. Temperatures on the 17th reached the 80s and even reached 90 in a few coastal-inland areas. That was the first legitimate heat in many months.

A new trough moved into California on the 20th, spreading rain and some thunderstorms across the region through the 21st. The thunderstorms hit on March 20th, including some hail the size of dimes reported in Yorba Linda. Overall, the storm dropped up to 0.75 inch across the region, especially where thunderstorms trained across the same path. That led to local street flooding in Orange County and below the Holy burn scar in Lake Elsinore. Some places only got less than a tenth inch. Snowfall of one to four inches was reported between the mountain elevations of 5,500 to 8,400 feet.

The last week of the month featured an active and wet pattern across northern and central California, but little to no rain in Southern California.

March precipitation was above average in the mountains, thanks to that storm of the 2nd and 3rd, but below average in all the lowlands.

Temperatures overall ended up very close to average. Slightly above average near the coast and slightly below average inland. San Diego’s average monthly temperature was 1.1 degrees above normal. Riverside’s average was 0.7 degrees below normal. Palomar Mountain fell 2.0 degrees below, and Palm Springs ended up 0.1 degree below average for the month.

Copious winter rains led to a prolific poppy bloom, especially in the Lake Elsinore area. Photos Alex Tardy.
Decision Support at Coachella by Matt Moreland, Meteorologist-in-Charge

The Coachella Music and Arts Festival and the Stagecoach Festival, both in Indio, are two back to back large outdoor events that take place in southern California each April. Coachella is billed as one of the largest outdoor music festivals in the world. Coachella, which takes place the first two weekends, sees an average of 125,000 daily attendance including around 12,000 that camp each night. The festival includes six to 10 large stages and many large tents.

Both strong winds and excessive heat can be weather risks in April, along with a less frequent occurrence of thunderstorms. The event is a public-private partnership between Golden-voice, Inc. and a number of federal, state, and local government agencies which provide support for this event, including the FAA, FBI, CalFire, Riverside County Emergency Management, City of Indio Emergency Management, and at least 14 other law enforcement agencies. A daily Incident Action Plan (IAP) is developed which coordinates how public safety agencies work together to ensure safety for event attendees. Forecasters at NWS San Diego provide daily weather email briefings for the event throughout the month of April which are included in the IAP. Meanwhile, a meteorologist from NWS San Diego deploys on site each day of the three weekends of the festival alongside City of Indio Emergency Management. This meteorologist participates in daily public safety briefings held at the Coachella Incident Command Post, and tracks conditions from the City of Indio Emergency Operations Center, providing critical updates as needed.

A daily public safety briefing with emergency management and public safety agencies (above right), on-site meteorologist deployment (left) and a sample Incident Action Plan (right). Photos Matt Moreland

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