# Behind The Forecasts

## Terminology and Forecast Language

The NWS has a unique way of describing expected weather. Some of the terms used to describe time periods and weather conditions may seem arbitrary, but there are rather specific meanings attached to them.

**Forecast Time Periods**

| Time Period | Definition |
|---|---|
| today | sunrise to sunset |
| tonight | sunset to sunrise |
| morning or in the morning | sunrise to noon |
| afternoon or in the afternoon | noon to around 6 pm |
| evening or in the evening | from 6 pm to midnight |

In the forecast the days are divided into both day and night periods. A night period crosses over midnight as outlined above. For example, “Sunday night” means from sunset Sunday evening until sunrise Monday morning. Lows for Sunday night most of the time would technically occur early Monday morning around sunrise, but are mentioned in the Sunday night period.

**Sky Conditions**

Sky conditions are described depending on how many tenths of the sky is covered by opaque clouds (clouds that completely block the sun).

| | |
|---|---|
| clear or sunny | less than 1/10 opaque clouds |
| mostly clear or mostly sunny | 1/10 to 2/10 opaque clouds |
| partly cloudy | 3/10 to 6/10 opaque clouds |
| mostly cloudy | 7/10 to 8/10 opaque clouds |
| cloudy | 9/10 to 10/10 opaque clouds |

High cirrus clouds are often somewhat transparent, so even if the sky is full of them the term mostly clear or partly cloudy may be used. In contrast, a small patch of fog can entirely obscure the sky from an observer’s point of view. It may be cloudy or foggy at that point, but only a mile or two away the skies are completely clear. That patch of fog is so low it is below the horizon from an outside observer’s perspective. This is often the case with varying terrain, a shallow marine layer, and dense fog. Fog may persist at the beaches while only a quarter mile inland it is clear. Forecasters attempt to include language to specify the range of possibilities, but cannot describe every possibility without becoming entirely too wordy. A mostly sunny forecast may be a bad forecast to the few people underneath a tiny isolated patch of fog, but a correct forecast to the other 99% of the population. By contrast, high clouds can be seen hundreds of horizontal miles away.

**Winds**

Wind direction is described as the direction **from** which the wind is blowing (e.g., a northwest wind is a wind coming from the northwest). Wind speeds are given in miles per hour. Terms that may be used to describe wind speeds are defined in the following table.

| | |
|---|---|
| 0-5 mph | light or light and variable |
| 5-15 mph | none used |
| 15-25 mph | breezy (for mild weather)<br>brisk or blustery (for cold weather) |
| 20-30 mph | Windy |
| 30-40 mph | very windy |
| 40 mph or greater | strong, damaging, dangerous |

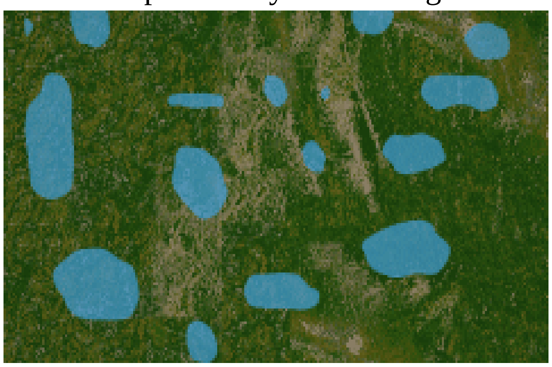
Since winds are highly variable in time and space, usually the strongest winds expected anywhere in the zone are mentioned. For people in areas normally protected from the wind, this understanding is important. “Local” is a term often used to imply that indicated winds will not blow over the entire area, but at some unspecified locations that may differ in time and space. Often, winds are influenced by terrain creating a predictable wind pattern. If there is enough confidence about exactly where and when the winds will take place, a better description is given. For example, phrases such as “mainly below Cajon Pass in the morning” are often included to add beneficial detail.

**Temperatures**

Temperatures are given in simple numerical ranges such as “lows 42 to 50”. In many weather situations temperature ranges can be very large; a forecast of the entire range would not be useful, and a detailed description would be too wordy. In these cases, extreme temperature outliers are simply left out of the range and the forecast is made for the majority of the area. For example, on a clear morning in the San Bernardino Mountains low temperatures may range from 29 degrees in a high mountain valley to 51 degrees on a foothill slope. A forecast covering that entire range (28 to 52 for example) is not very useful, so a judgment is made that most lows within that zone will be 33 to 47. Observers over time will come to know where their local temperatures fit with respect to the standard forecast ranges. The details can still be found using the point-specific digital forecast, however.

**Precipitation**

The idea to use probabilities for whether it was going to rain began with the National Weather Service in 1965. The original concept was to provide a risk-benefit assessment for people to whom the occurrence of rain was critical. For example, a contractor might decide to pour concrete if the chance of rain is only 30 percent, but might decide not to pour if it's 60 percent. **Probability of Precipitation (PoP)** is the likelihood (expressed as a percent) of measurable liquid precipitation (or the water equivalent of frozen precipitation) during a specified period of time for any point in the forecast zone. **Measurable precipitation is defined as 0.01 inch or more.** PoPs accompany **expressions of uncertainty** or **areal qualifiers** within the forecast narrative. For example, a slight chance of rain (20%) is an expression of uncertainty that means at least one location in a zone should receive measurable precipitation 2 out of 10 times (20%) given a similar weather situation. Or, to state the converse, rain is NOT expected 8 out of 10 times. The probability has nothing to do with the amount, duration, or the percentage of the area that will get rain. When showers are mentioned in a forecast, there is a high likelihood of them occurring somewhere in the area, and thus the probability refers to the amount of the area in the forecast that will receive measurable rain, and receive an areal qualifier. "Scattered showers" means that 30 to 50 percent of the zone's area gets hit by at least one shower and receives measurable precipitation. Below is a table of these two descriptive methods and their relationship to PoPs.



| PoP Percent | Expression of Uncertainty | Equivalent Area Qualifiers |
|---|---|---|
| 10-20 percent | slight chance | isolated |
| 30-40-50 percent | chance | scattered |
| 60-70 percent | likely | numerous (or none used) |
| 80-90-100 percent | (none used) | (none used) |

Other qualifying terms may be used with the above non-numerical expressions.
Terms of duration: brief, occasional, intermittent, frequent
Terms of intensity: Very light: less than 0.01 inch per hour
Light: 0.01 to 0.10 inch per hour
Moderate: 0.10 to 0.30 inch per hour
Heavy: greater than 0.30 inch per hour

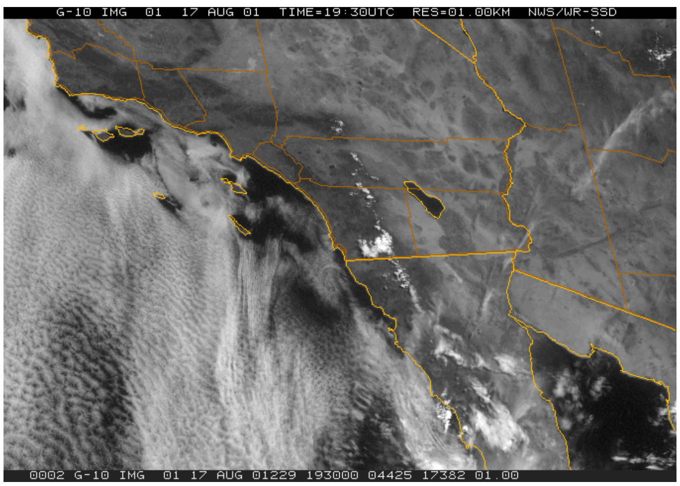
For trace events (precipitation of less than 0.01 inch), the terms "drizzle," "light rain" or "sprinkles" will be used, often with a PoP of 10%. Our marine environment can bring dense fog (which can be very misty), heavy condensation, and drizzle. Most of the time these marine layer precipitation events result in a trace, even when road surfaces become completely wet. For more on the philosophy of probabilities, see the Uncertainty section under Forecast Challenges below.

## Forecast Tools

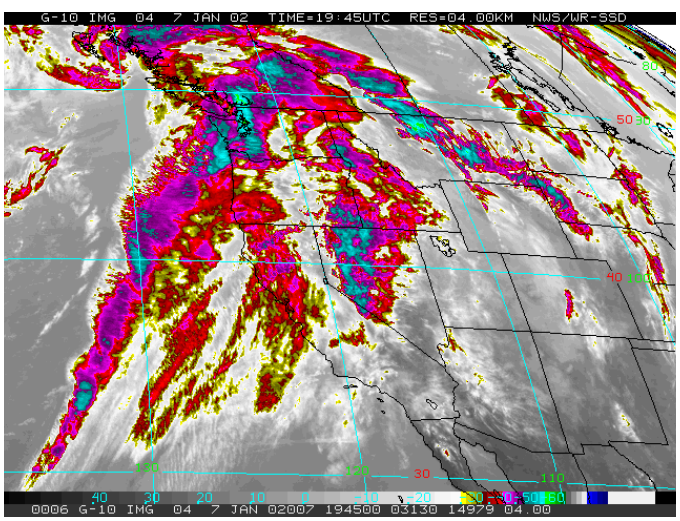
Today's forecaster has a large variety of tools available. Many advances in technology and the understanding of meteorological principles in recent decades have added a great deal to the science. Seven day forecasts today are about as accurate as three day forecasts were 20 years ago. Meteorologists blend their own knowledge and experience with the data provided by these tools to make a forecast.

### Satellite

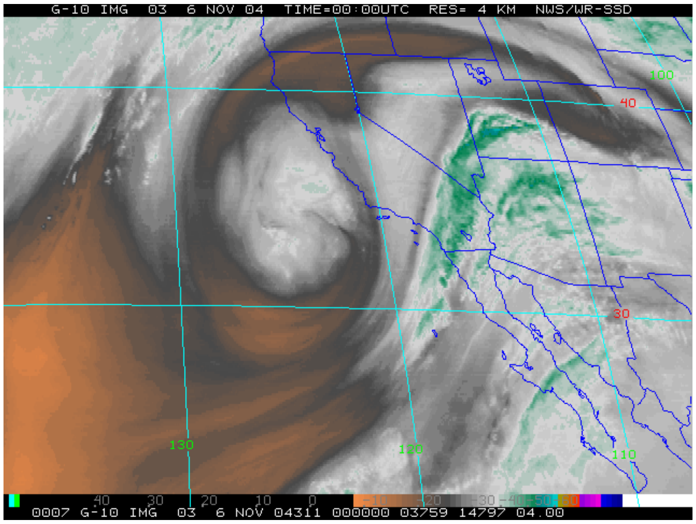
Satellite data is one of the more essential forecasting tools. The satellite in use over the western U.S. is the GOES - West Satellite. This satellite is geostationary, meaning that it rotates along with the earth so that it is always over the same place on the earth. Three basic images are generated from this satellite: visible, infrared and water vapor imagery. Polar-orbiting satellite data are also used. These satellites orbit the earth crossing the poles. Several additional specialized images are also available.




**Visible** imagery is like a camera snapshot from space, recording reflected visible light from the earth's surface. All clouds are white. The image goes black as the sun sets. Since all clouds are white, it is sometimes difficult to tell at what levels these clouds exist.




**Infrared** images are actually measurements of temperature, rather than reflected light as in visible satellite images. Warmer objects appear darker than colder objects. Cloud temperatures are related to cloud height, and relative cloud height can be readily inferred. The color spectrum on the gray scale is converted to colors to more easily discern the temperature differences.




**Water vapor** images are useful for identifying regions of moist and dry air. Dark colors such as black and dark grey indicate dry air while bright colors such as white or light grey indicate moist air. Swirling wind patterns in low pressure systems and jet streams are easily identified. Colors have also been added to these images to more easily discern the moisture differences.

Other derived satellite products have been developed, such as the **fog** product. In San Diego this is commonly used at night to easily detect the low clouds and fog common to our region. For more background on satellite imagery, click on: **www.srh.weather.gov/jetstream/remote/satellite.htm**.

**Radar**

Doppler Weather Radars were installed during the early 1990s and marked the beginning of a new era in detecting and forecasting weather. The official name is **NEXRAD WSR-88D**, meaning NEXt Generation Weather Service RADar-1988 Doppler. Technicians at the San Diego office maintain two Doppler radars: one east of Scripps Ranch in San Diego, and one in the Santa Ana Mountains south of Corona. While some media outlets claim ownership of WSR-88D Doppler Radars, only the National Weather Service owns and maintains weather radars in our area. In addition to detecting areas of precipitation called **echoes**, the Doppler Radar also detects movement and intensity of the precipitation. The radar also detects wind velocity and direction, useful for detecting rapid shifts in wind direction, including tornadoes. These data alert forecasters to the possible need of warnings or advisories.

How does it work? The radar sends out a beam of energy that strikes an object. Some of that energy is reflected back to the radar. The velocity of the object can be derived from the phase change of the beam's wavelength as it returns to the radar. The radar has many limitations. Due to occasional atmospheric conditions, the beam is bent toward the ground and detects ground effects (hills, trees, structures) called "clutter." The beam scans the atmosphere in slices, one angle at a time. As the beam angles upward, the beam may be over 20,000 feet high at a distance beyond 100 miles. Significant weather can occur below the beam completely

undetected. In addition to raindrops and ground effects, the radar can detect birds, insects, dust, etc. Military operations often include spreading **chaff** (tiny, fine metal strips) into the atmosphere. Chaff is a very good reflector for the radar beam and shows up on the radar display as an intense radar echo. Often, a quick look at the satellite image can help verify that this is not precipitation. Echo signatures of chaff look quite different in appearance than actual precipitation and can be easily identified by the trained eye, but it becomes more difficult when echoes of legitimate precipitation are also present. For more information about Doppler Radar, click on: **www.srh.weather.gov/jetstream/remote/doppler.htm**.

## Observations

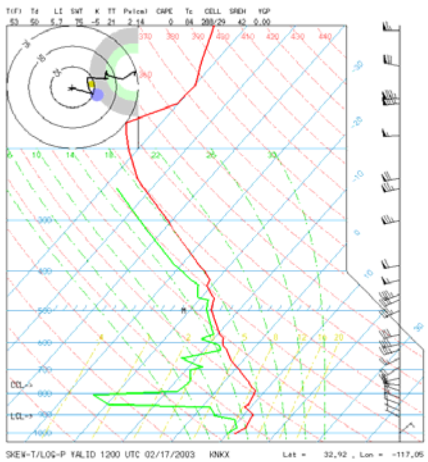
**Surface observations** are current weather conditions measured at a point on the earth's surface. The most reliable and accurate source of hourly weather observations are automated surface observation systems, called **ASOS** stations, a network of standardized equipment funded and maintained by the NWS. This equipment, usually located at airports, transmits at least one hourly observation called a **METAR** (METeorological Aviation Routine weather report). METARs are written in METAR code, an international weather descriptive code.

A network of **ALERT** (Automated Local Evaluation in Real Time) equipment is used primarily for hydrological purposes, measuring rainfall and river levels, but also temperature and wind in some cases. This equipment is maintained by flood control agencies in cooperation with the NWS.

Another network of weather instrumentation is **RAWS** (Remote Automated Weather Station) data, used primarily for fire weather forecasting support. The network is maintained by several other federal and state agencies, such as the California Department of Forestry and the Bureau of Land Management.

The **San Diego Mesonet** is a relatively new network comprising private citizens or external agencies providing real-time data to the NWS in San Diego from their own privately funded equipment. Participants collect their data on a data logger installed on their computer. Using high speed Internet and the ftp process, the data is transmitted automatically to workstations at the NWS in San Diego. The siting, placement, and accuracy of the equipment of these sites have been verified and approved by NWS personnel, so forecasters can trust them. For more information, click on "San Diego Mesonet" on our home page.

A large variety of **other weather data** sources are available, mainly on the Internet. These include school networks, resorts, businesses and private citizens with weather equipment. We use these sources only as a last resort and with caution due to their occasional low levels of accuracy and reliability. On occasion we invite these providers to join the San Diego Mesonet.




**Upper Air Observations** provide valuable data for a lot of reasons. Forecasters need to know the behavior of the atmosphere in three dimensions, not just at the earth's surface. Observations of the upper air are taken by weather balloons with an attached radiosonde, a small packet of weather instruments. As the radiosonde rises, it sends a constant stream of data, which is crucial for understanding the current state of the atmosphere. The data is collected by radio receivers on the ground and plotted as a vertical trace called a **sounding**, on a thermodynamic diagram called a "Skew-T." This snapshot of temperature, dew point and winds in the atmospheric column is a most valuable set of data. A forecaster can identify temperature inversions common to our region, levels of instability and moisture, changes in wind speed and direction, and infer many other atmospheric behaviors. More than 2,000 of these balloons are launched around the world at 00z and 12z universal "zulu" time (locally 4 am/pm PST and 5 am/pm PDT). In this way the world is synchronized with an accurate three dimensional picture of the weather conditions twice a day. These data are among the most important input to computerized numerical weather models. It's only by getting a complete picture of what the weather is doing now that forecasters can hope to say what it will do next. Unfortunately, the sounding network is rather sparse and soundings are taken only twice a day. Locally, soundings are taken at Miramar MCAS (pictured at right, below). Around the region, other soundings are taken at Vandenberg AFB, Oakland, and occasionally at Edwards AFB, Yuma, Arizona, and Guaymas, Mexico.

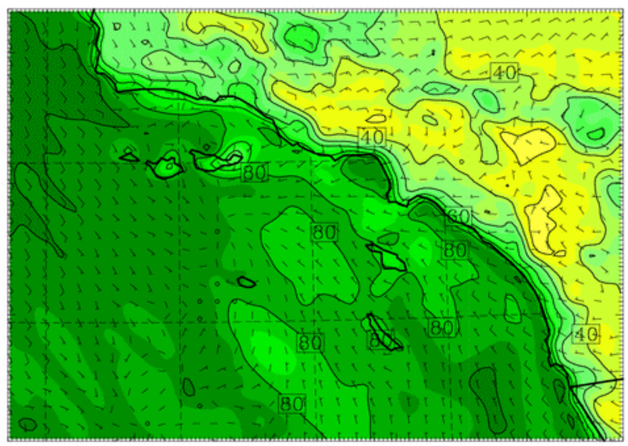
The typical weather balloon is about six feet in diameter (two meters) and is filled with either helium or hydrogen. It carries a one-pound (half a kilogram) package of weather instruments and transmitters. Flights may last over two hours, reaching altitudes of 22 miles (35 kilometers), where the temperature drops to minus 130 degrees F (minus 90 degrees C). At that height the balloon, having swollen to about 20 feet (six meters) in diameter due to the low air pressure, tends to pop, cutting short the flight. The one-pound radiosondes do not hurtle to the ground, however—little parachutes bring them back down safely, complete with mailing instructions. Returned instrument packages can be retooled and reused. But even now, with GPS tracking, the NWS recovers only about 20 percent of the radiosondes.

**Satellite Sounders** are becoming more adept at correctly inferring temperatures and winds at all levels of the atmosphere from GOES Satellites. Satellites have equipment that will acquire profiles of temperature and moisture for clear or partly clear fields of view. In addition, cloud tracking allows for the measurement of wind in the atmosphere. This information is used for input to the weather models which result in improved weather analysis and forecasting.

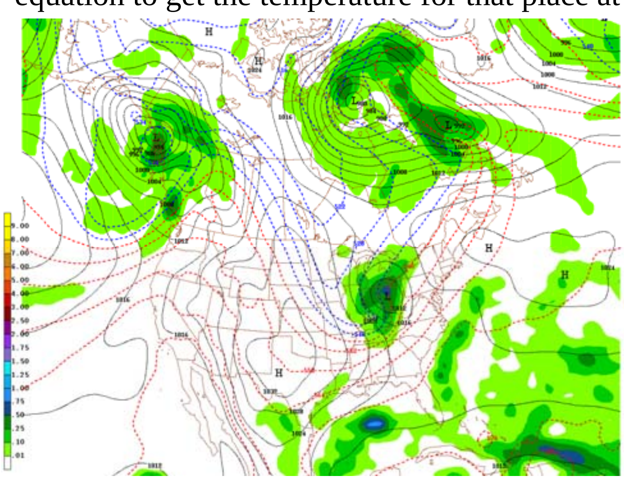
**Wind Profilers** are surface based instrument grids that detect winds and temperatures in the atmospheric column. Most of these are maintained by the military, universities, or other research institutions.

**ACARS** (Aircraft Communication Addressing and Reporting System) data are vertical traces of weather data taken by commercial airliners during ascents out of and descents into major airports. The frequent upper air observations are valuable because they often fill in the gaps of time and space between weather balloon soundings.

## Forecast Models - Numerical Model Guidance




Once meteorologists have an accurate picture of the current atmosphere, the process of forecasting can begin. Scientists through the ages have come to understand some of the movements of the atmosphere through the study of physics, fluid dynamics, and thermodynamics. Mathematical equations called equations of motion have been developed to describe the movement of air in the atmosphere. By modifying these equations, removing the less important components, and inserting the weather data into the equations, a solution can be calculated for a future time. For example, if we know the temperature for a certain place at midnight, we can enter that value into the equation to get the temperature for that place at noon. This can be done for many time steps (i.e. 24, 36, 48 hours) into the future and for numerous points on the map. These equations of motion are non-linear, meaning they cannot be solved by hand in a timely fashion; if we attempted to solve the equation by hand, the weather event would occur before we could produce a forecast for it! This is why powerful computers are essential. The computer can make iterations, a long sequence of approximations which increasingly get closer to the solution. After numerous iterations, an acceptable solution arrives. The process is repeated for every weather parameter and for



every grid point on the map. The plotted values can then be connected by interpolating values between the points, like connecting the dots. The whole process works like baking bread as follows:

| | |
|---|---|
| Data is collected: upper air, satellite, radar, surface observations, buoys, etc. | *Ingredients are gathered.* |
| Data is input into mathematical equations of motion to be solved by powerful computers. | *Ingredients are mixed and put in the oven.* |
| The computer generates a numerical solution in future time steps. | *The bread is baked.* |
| The solutions are checked for quality and plotted graphically on maps. | *The warm bread is sliced and served.* |

In its finished form, the numerical model guidance arrives at each forecast office a few hours after the "run time": 00z, 06z, 12z, and 18z universal time (a few models are run more frequently, but do not extend very far into the future). The main supercomputer in use by the NWS is named Blue and is located at an IBM facility in Gaithersburg, Maryland. Weather data arrives from an array of sources, including observation stations, ocean buoys, and global weather balloons. Some aircraft even carry sampling instruments. But satellites increasingly provide extensive coverage that can penetrate and monitor different layers of the atmosphere. The number of daily weather observations crunched by NOAA's supercomputers is around 200 million. After the guidance is computed and post-processed, it is sent to each forecast office where the data is ingested by AWIPS equipment. The guidance packages are then available to the forecaster to analyze and formulate a forecast. It comes in graphical format or statistically generated text format. Just like bread, the model guidance package becomes stale with time, and obsolete with the arrival of the new model guidance run.

Some guidance is received from national or regional centers regarding rainfall amounts, flooding and flash flooding potential, severe thunderstorms, hurricanes, hazardous fire weather, etc. For example, if a big storm is coming and forecasters need to figure out how much rainfall is coming, the San Diego office will receive guidance from the Hydrometeorological Prediction Center (HPC) in Maryland and the River Forecast Center (RFC) in Sacramento. They will provide valuable input for deciding how much precipitation will fall and what flooding impacts may occur. The Storm Prediction Center (SPC) in Oklahoma provides guidance on the probability of severe thunderstorms. The National Hurricane Center (NHC) in Miami projects tropical cyclone tracks and intensities in the Atlantic and eastern Pacific Oceans. In the end, final decisions regarding local warnings and forecasts rest with the forecasters in the San Diego office.

**Advanced Weather Information Processing System (AWIPS)**

AWIPS is a workstation that provides one-stop shopping for weather data and guidance used by the forecaster. Numerical model guidance, satellite imagery, radar data, and analyses can be viewed graphically. AWIPS offers the capability of viewing the model guidance in a variety of ways to get a four-dimensional understanding of the atmosphere's behavior. NWS alphanumeric guidance, observations, and text products nationwide are also available.

**Interactive Forecast Preparation System (IFPS)**

IFPS is the software that forecasters use for preparing and issuing forecasts. With this system, located in AWIPS, forecasters manipulate a high-resolution digital database that represents the expected weather, rather than writing text. Forecasters edit grids of numerous weather parameters, such as maximum and minimum temperatures, hourly temperatures and dew points, three-hourly winds, chances of precipitation, sky cloud cover, and so on. IFPS then generates a suite of graphical and text forecasts from the digital database. The resulting digital forecasts offer a much higher degree of temporal and spatial detail, with additional weather elements not available previously, such as relative humidity and rainfall amounts. Now you can literally get a forecast specific to your neighborhood and see how the weather will change during the day. Explore the available information by clicking "Digital" on our home page.

The grids generated by each local NWS forecast is collected and merged into one seamless **National Digital Forecast Database (NDFD)**. To ensure consistency and quality along forecast office boundaries, weather elements are coordinated between offices. The NDFD database is made available to all customers and partners (public and private) who can then create a wide range of text, graphic, and image products of their own. Any individual user with a computer and access to the internet can download information from the NDFD to suit his or her needs.

## Forecast Challenges

Regarding Southern California weather, some observers may joke, "What weather?" Our climate and our profession have often been the target of jokes (e.g., "why don't you get a real job?!", "if I were wrong as often as you are, I'd be fired!" or "isn't this where they send the junior meteorologists?"). It is true that our climate does not suffer the extremes of temperature, wind, and precipitation that many other climates do. The challenge of predicting our weather lies in the uncertainties, subtleties, and relatively infrequent extremes, not often in the severity. Our enormous population base is largely unfamiliar with severe life-threatening weather is less prepared for it when it comes, and that presents a new risk. For these reasons Southern California is prone to low-probability yet high-impact weather events. Dense fog, drizzle, or light rainfall can be a killer. Compare traffic accident reports in Southern California when it rains with those reports when it does not rain, then look at the same figures for Seattle. Additionally, expectations differ with professions. A surgeon is expected to be perfect or very near perfect all the time, but baseball players are considered successful when they get a hit in only one third of their attempts. Stock market analysts are much less accurate and far more ambiguous than are weather forecasters.

Despite popular belief, forecasting the weather in our region is not as easy at it seems. "You guys have it easy, it's always nice here" is an often heard comment. A common misconception is that difficulty to forecast corresponds to severity of the weather, and conversely, it is easy to forecast for benign weather. For example, it is very difficult to forecast tornadoes and hurricanes and easy to forecast coastal fog. Understandably, more research has been conducted on severe life-threatening weather (because that's where the funding goes) and better model guidance has come from it. Much less model improvement has been made for coastal fog, Santa Ana winds, and terrain issues common to our region. Therefore, forecasting for weather that is not severe can often be more difficult, but is overlooked because the weather remains benign and low impact. However, when active weather occurs very locally, but in a very sensitive area, it can be catastrophic. For example, only one hour of strong wind on only one hillside can make a wildfire explode. Advances in the science have led to greater forecast accuracy, and that has increased the public's expectations of weather forecasters to get the forecast right. While forecasters may claim and promise greater forecast accuracy, the weather is still the weather: chaotic, complex, and inherently unpredictable.

There are a number of questions to answer and puzzles to solve each day. These puzzles may be as innocuous as determining when the coastal clouds will clear or what the high temperature will be, but most of the time there are more significant issues. These issues are mentioned in the **forecast discussion**. Reasons, opinions, clarifications, and expressions of model performance and preference are included in the discussion. Formerly, discussions were meant only for coordination purposes within the NWS meteorology community and transmitted through equipment that required extreme brevity. For these reasons, many complex meteorological terms, abbreviations, contractions, and jargon were used. In recent years discussions have become much more public (and posted on the Internet) and have become much more readable for non-meteorologists. One who reads the discussions day after day will quickly gain an understanding of the particular challenges the forecasters are facing, even when the weather is benign. A glossary is linked to select terms often used in the discussion, providing explanations of these complex terms. Click on "Discussion" on our home page for the latest update.

**Uncertainty**

***"To the often-heard question, 'Why can't we make better weather forecasts?' I have been tempted to reply, 'Well, why should we be able to make any forecasts at all?' "***
**-** Edward N. Lorenz, MIT researcher, in *The Essence of Chaos*.

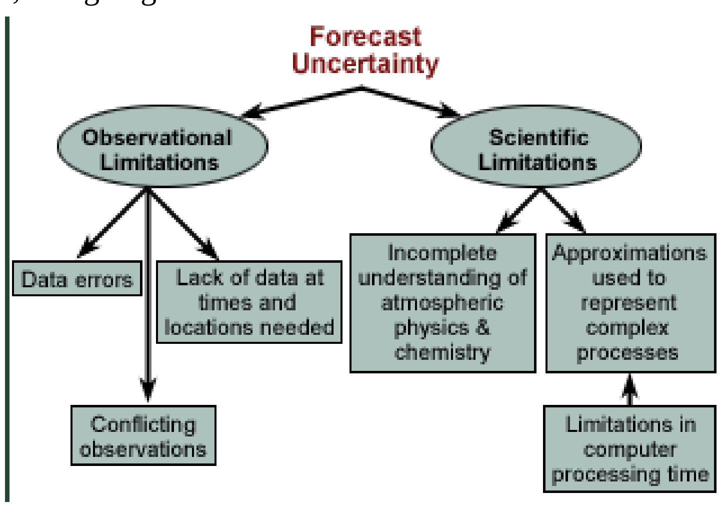
**Chaos Theory** is very real in meteorology. The tiniest errors in the initial conditions become very large errors in the solution. If a computer model does not initialize well, it is like a golf club swinging through the ball at an angle only slightly off perfection. The result, as many golfers know, is a large error in where the ball ends up.

Some uncertainties in our forecasts arise because of the lack of essential information. With our current knowledge and technology, it is impossible to account for all the possible variables that impact the weather. Our data networks may not be dense enough to detect some significant local effect. The leading researchers in the field may not have discovered the meteorological theory behind an event and forecasters may not even understand everything that is actually taking place. The forecaster may not be fully aware of the situation or sufficiently experienced to detect something important. Sometimes the weather simply defies explanation, or at least an explanation that forecasters can come up with. For example, if we look at two identical low pressure systems with the same dynamics, moisture, temperature profile, structure, etc., we often see different results, like rain with one system, but not with the other. We often ask how and why. After the event forecasters can speculate on why it rained or didn't rain, and even come up with an acceptable explanation, but that's after the fact. Forecasters keep that in their records and in their brains for future reference. If the event is rather significant, forecasters may even collect the data surrounding the event, analyze and study it in depth, and write and publish a paper as a case study.

Our climate and global position add to the uncertainty in our forecasts. San Diego is located just far enough south to be on the southern edge of the normal winter storm track. We may be on the edge of the area of expected rain. Promising weather systems may not maintain strength as they approach us. The weather system may bring local showers where some spots measure rain while the rest of the area remains dry.

Comparisons of satellite data to model guidance can be done on AWIPS to determine the quality of the guidance. This is called model initialization. For example, if the model guidance at 00z does not match closely to the observed atmosphere (model data and observations can be overlaid on a satellite image) at 00z, then the initialization was not good. The forecaster may conclude that since this particular model did not initialize well (does not have a good handle on the current weather pattern), there is no way its prognoses will have a good handle on it for future time periods; the forecaster will then discount or ignore its solutions. The model guidance may give us different solutions with each new model run, or the models' solutions differ from one model to another. When the models seem to disagree from run to run and/or with each other, forecaster confidence lowers. At times with a particular feature such as a storm, the models are very tardy to come into agreement, perhaps less than one day before the storm. When the confidence is low, the forecaster relies more on experience and the observed weather data than the guidance, and as a result the forecast may become less specific.

In contrast to our challenges, the Seattle forecaster has it relatively simple: A storm approaches, forecast rain. It is only a question of when and how much. Many local folks demand that forecasters could be so certain: "Just tell us, is it going to rain or not?" The science of meteorology is young. Many discoveries in meteorology theory and improvements in numerical model guidance are taking place, but there are still numerous hidden variables or nuances that can go undetected and change the weather. Our efforts to correctly define atmospheric motion in real time are clumsy at best. The NWS prefers to avoid giving an irresponsible and possibly misleading forecast of certainty when no such certainty exists. This is why forecasters use terms of

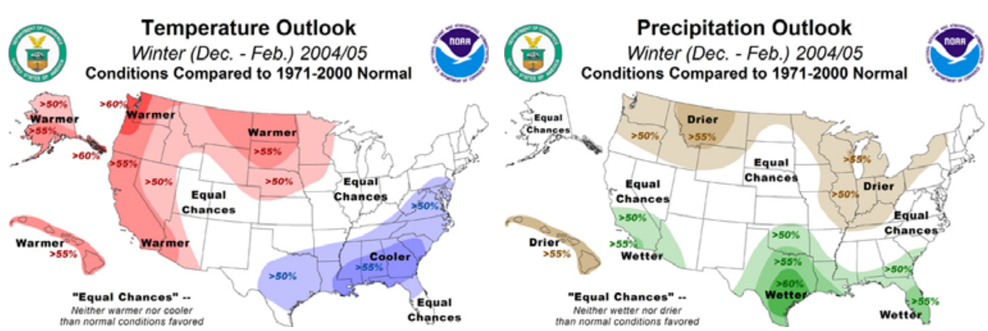


probability. The following true example is illustrative. One day the NWS issued a forecast with a 40% chance of rain for the next day. When the next day arrived, a radio personality reported rain where he was and questioned on the air: “Does this mean that the chance of rain was really 100%?” No. If we were to flip a coin, we know the chance of it coming up heads is 50%. If it comes up heads, it does not mean the chance of coming up heads before the coin flip should have been 100%. The chance is again 50% before the next coin flip. Failure of the broadcast media to grasp the probability concept can unintentionally change the meaning of the forecast that much of the public receives. Broadcasters are often heard to report a chance of rain, or even a slight chance, as “rain in the forecast,” significantly altering the meaning. It is human nature to add certainty where there is little.

Forecasts can be misinterpreted or trusted too much. “A chance of showers” would have been a good forecast if only some areas get measurable rain (in the radio personality example above, the shower he experienced may have been the only one in the area). “Mostly sunny” is a good forecast if most coastal areas are sunny, even if a few beaches experience fog all day. “Locally windy” is a good forecast if a few spots are windy, even if most areas are not. Conditions change in both time and space. “Partly cloudy” may mean mostly cloudy at times or mostly sunny at times during the day, but for brevity’s sake the forecaster chose to simplify the wording. With the common low clouds, it may be completely cloudy in some spots and completely sunny in other spots, then the reverse occurs, all within the same zone; for this, “partly cloudy” might be appropriate forecast wording as well. It should also be remembered that forecasts are refreshed often. A forecast is routinely issued every 12 hours. Often, the forecast is updated between those routine issuances. By the time the morning newspaper reaches your door, there may already be two or three updates made to the forecast you are reading.

Forecasts for future time periods become more and more uncertain with each future forecast day. The NWS issues seven-day forecasts as part of the routine public forecasts. On average, NWS forecasters accurately predict the next day’s weather 90% of the time. Today's four-day forecast is as accurate as the two-day forecast was in 1985. The accuracy deteriorates as the forecast goes further out; the day seven forecast is just over 50% accurate. Beyond seven days, let’s be frank, the forecast is a flip of the coin, but some extended models can indicate which way to lean, warm or cool, wet or dry. Actually, the climatological normals become the best forecast much beyond about ten days. When someone calls requesting a forecast for an outdoor wedding two months away, we give them the climatological normal high, low, and chance of rainfall for the date.

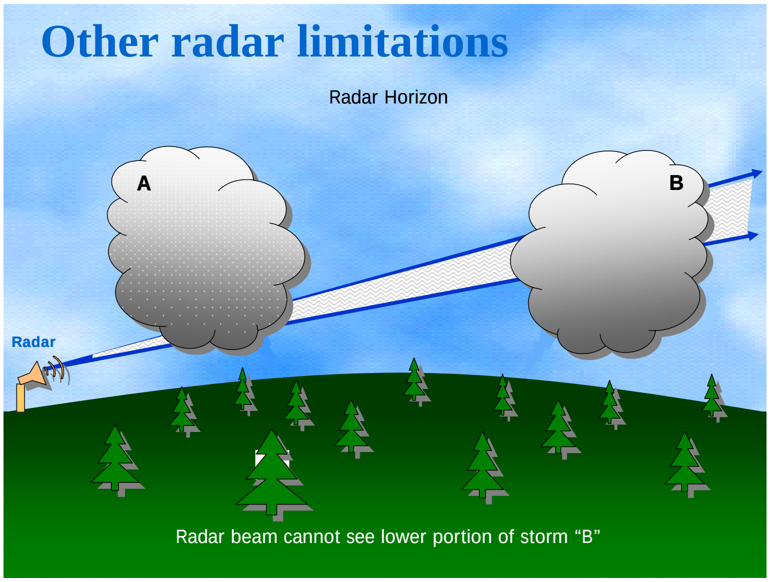
**Long Term Prediction** is fraught with uncertainty, but significant advances have been made in understanding the global climate and today there are more data available for analysis. In recent decades the climate altering mechanism **El Niño** has been a catalyst for these advances (for more on El Niño, see “The Weather of Southwest



California - A Climate Overview"). The **Climate Prediction Center** (CPC) is a national agency and world leader in climate studies and long term predictions. They produce monthly and seasonal outlooks for the entire country. The outlooks are not exactly forecasts, but graphical expectations of whether temperature and precipitation will be above normal, near normal, or below normal. Sophisticated climate models take into account all important effects on global weather such as sea surface temperatures, pressure patterns, upper level winds, and solar radiation. Occasional press releases on outlooks of significance are one way the CPC informs us of the weather trends in the weeks and months ahead. Many of these press releases are headlined on our home page when they occur.

**Scarce Data on the Edge**

To the west and south of California lies the vast, open Pacific Ocean. There are a few buoys and ship reports, but it is largely devoid of data. To the south and east is Mexico with very few reliable data sources. Because much of our weather comes from the west or south, it is difficult to know just what kind of weather is headed our way. By contrast, most of the country has the advantage of looking west (where most of their weather comes from) to learn exactly what kind of weather is headed their way. An old axiom states that if you want to know what weather to expect in New York City tomorrow, just look at the weather in Chicago today. The lack of upstream observations hurt California forecasters in another way. Numerical model guidance depends on initial data to get a correct start on the forecast. With very few data points over the ocean, the model has only a vague idea of the weather conditions before they reach land. Accordingly, the model often has trouble ascertaining the strength, position and/or timing of approaching weather systems. Yet another problem arises. Several model domains (areas covered by the model) have a western boundary not far out to sea. So these models do not "see" a weather system before it enters the domain. Once it sees the system, it may struggle to correctly represent and define it before it reaches land.




Even in our highly populated area with numerous data points, there never seem to be enough data points when they are most needed. That is because many weather phenomena are highly localized and very brief. California tornadoes provide a good example. It is nearly impossible to forecast a Southern California tornado before it touches down. The Doppler Radar scans a slice of the atmosphere every six minutes at each beam angle. A tornado can touch down, do its damage and lift back into the cloud in much less time than the six minutes between radar scans. Additionally, a tornado may be distant from the radar, occur below the beam, and go undetected. Doppler Radars were built and tested for the severe weather of the plain states and are more attuned to detecting those larger scale severe storms. Luckily, California tornadoes are usually not as severe or damaging as those in the Midwest. In an effort to better detect these localized weather phenomena, we have around 1300 volunteer weather spotters across the region that help fill in the gaps in data. We also appreciate it when our partners in the media and public agencies pass along a significant report to us.

**Microclimates**

Microclimates are very small scale climate zones. Southern California's highly complex terrain and proximity to the ocean create a variety of microclimates. The weather can be very different between canyons and mesas, beaches and inland areas, mountain tops, slopes and valleys, urban and rural areas, and a number of other variables. On a clear night, overnight low temperatures may be 15 degrees lower in a canyon compared to a neighboring mesa. High temperatures at a foggy beach may be 15 degrees lower compared to the temperature under the sun only a mile inland. Winds may be strong through certain corridors, while neighboring areas are nearly calm. A mountain area may receive significantly more precipitation from a storm than that received in the valley at its foot.

The digital forecasts generated by the IFPS (Interactive Forecast Preparation System) are our way to provide this kind of microclimate detail to our users. But even with this cutting-edge IFPS technology, more weather instrumentation and weather spotters, these slight nuances continue to be very difficult to pinpoint.