CALIFORNIA POLICY CENTER

# Statistical Review of United States Drought Monitor

by Edward Ring and Marc Joffe

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## January 27, 2026


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# Statistical Review of United States Drought Monitor
# Executive Summary of Findings

The United States Drought Monitor (USDM), designed as a weekly assessment of drought conditions, is produced by federal and academic partners with its primary contact being the National Drought Mitigation Center at the University of Nebraska-Lincoln. The USDM designates areas in drought by intensity, classified into categories—from "None" (no drought) to "Exceptional Drought" (D4) based on a percentile methodology intended to reflect historical frequencies (e.g., D0-D4 expected 30% of the time).

This report examines the USDM's reports from 2000–2025, focusing on California and Orange County, where USDM drought categorizations are routinely used as part of the justification to trigger water conservation mandates, restrict development of new water supplies, and justify broad regulatory responses.

Given the high stakes of such decisions, we conducted an independent review of USDM reports from 2000 to 2025, with a focus on statewide trends and more localized impacts in Orange County. **Our key findings are as follows:**

### *1. USDM Drought Categorizations Are Statistically Inconsistent With Long-Term Climate Patterns and Not Reproducible*

Our analysis of USDM records for the period 2000–2025 shows that drought categories (D0–D4) were designated to California over 60% of the time—roughly double the frequency implied by the USDM's own percentile-based methodology. This inflation is not isolated to California; national data also reveal significant over-categorization. This discrepancy suggests potential methodological or institutional bias in the USDM's "convergence of evidence" approach.

### *2. Independently Sourced Climate Data Shows Minimal Long-Term Drying*

We conducted an independent analysis using a century of climate records from dozens of California-based monitoring stations. Variables included precipitation, snowpack, temperature, relative humidity, dew point, and vapor pressure deficit (a computed value). The post-2000 climate data show no substantial drying trend compared to prior 25-year periods. This undermines the notion that California has entered a new, dramatically drier era with sharply heightened drought frequency.

### *3. Water Storage Trends Are Mixed and Likely Not Driven Solely by Climate*

Water storage data for major California reservoirs show modest declines in some areas and relative stability in others. Variations appear to be more closely linked to population growth, land-use changes, and water management decisions rather than to changes in natural water availability. This further calls into question the assumption that USDM categories accurately reflect real-world water scarcity.

***4. Empirical Modeling Suggests Drought Frequency Has Only Marginally Increased***

Using a statistical model calibrated against historical climate and drought data, we estimate that the actual increase in drought frequency for California between 2000 and 2025 is approximately 0.83%, far below the observed increase reflected in USDM reports. **This further supports the conclusion that the USDM has consistently overstated drought conditions.**

***5. USDM Only Measures "Dryness", Not Water Availability***

In addition to the other findings that call into question USDM methods, the USDM drought classifications are based on "dryness" and do not account for water availability, based on water storage trends. This critical variable is of equal, if not greater, consequence when assessing water stress and when determining water policy priorities.

To ensure future drought policy in California is based on sound science and objective data, **our key recommendations are as follows:**

***1. Make the USDM Reproducible and Transparent***

The USDM methodology must use transparent inputs and clearly defined calculations to ensure that drought categorizations are independently reproducible and verifiable.

***2. Reframe the Purpose of the USDM***

Rename the USDM to reflect its actual function as a "Dryness Rating" (or similarly named metric), clarifying that it does not directly measure water scarcity.

***3. Reframe the Categorizations of the USDM***

Rename the USDM categories as "Dryness" levels (rather than "Drought" levels)—such as "Moderately," "Severely," "Extremely," or "Exceptionally" Dry—clarifying that the metric does not directly measure water scarcity.

***4. Shift Emphasis to Water Availability Metrics***

Actual drought assessments should prioritize stored water levels and supply-demand balances, rather than relying solely on "dryness" indicators.

***5. Reduce Regulatory Dependence on USDM Categorizations***

Policymakers should avoid using USDM categorizations to trigger regulation unless the methodology becomes fully transparent and automated, and it is shown to correlate meaningfully with actual water shortages.

***6. Invest in Long-Term Water Supply Solutions***

In responding to genuine drought events, the focus should shift from water conservation mandates to expanding supply through, for example, large-scale desalination, wastewater recycling, and runoff harvesting in coastal regions, along with a statewide effort to increase reservoir and aquifer recharge capacity.

Our findings raise serious concerns about the USDM's accuracy and its outsized role in shaping California's water policy. While drought preparedness remains essential, an overreliance on the mislabeled and apparently inflated USDM categorizations may lead to unnecessary water restrictions, economic inefficiencies, and missed opportunities to invest in long-term water resilience. A more balanced, data-driven approach is needed—one that reflects actual water availability and encourages investments in diverse water supply infrastructure instead of reactive rationing.

## Introduction

The United States Drought Monitor (USDM) is a weekly map that depicts drought conditions in the United States and its territories, released every Thursday. Jointly produced by the National Drought Mitigation Center at the University of Nebraska-Lincoln, the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Department of Agriculture (USDA), it serves as a snapshot of current drought intensity based on a blend of scientific data and expert input. The categorizations range from "None" (no drought) to "Abnormally Dry" (D0) and four categories of drought: "Moderate" (D1), "Severe" (D2), "Extreme" (D3), and "Exceptional" (D4) .

These categories inform disaster response, resource allocation, and policy measures. At the federal level, the USDM categorizations primarily trigger eligibility for disaster relief and financial assistance programs rather than mandatory water conservation measures. In California, the USDM plays a significant role in informing drought emergency declarations by the governor, which in turn enable mandatory water conservation measures. The state references USDM maps to assess drought intensity, with categorizations like D3 or D4 often contributing to proclamations that trigger regulatory water conservation actions.

For example, during the 2014–2017 drought, Governor Jerry Brown declared a statewide emergency when much of California reached D4, leading to mandatory 25% water use reductions for urban water suppliers. In 2021, Governor Gavin Newsom expanded a drought emergency to all counties amid persistent D2–D4 conditions, directing the State Water Resources Control Board (SWRCB) to adopt emergency regulations prohibiting allegedly wasteful practices like "overwatering" lawns.

These measures are not automatically triggered by specific USDM thresholds but are enacted through executive orders and SWRCB regulations when USDM designations indicate intense moisture deficits. Local water utilities and city water providers may impose tiered restrictions (e.g., limiting outdoor watering to certain days) based on state directives, with penalties for non-compliance. The California Public Utilities Commission also uses USDM maps to monitor and enforce conservation in regulated water systems.

For the State of California, the USDM's weekly report has designated drought status 61% of the time since its inception in 2000 (this includes the DO "Abnormally Dry" category). For Orange County in Southern California, the USDM has designated drought status in 62% of all weekly reports. The significance of designating a near permanent drought status to the state and many of its most populous counties is reflected in ongoing and escalating imposition of what are turning into permanent restrictions on water consumption and is now reflected in legislation that will restrict residential indoor water use statewide to 42 gallons per person per day by 2030.

These mandatory restrictions on water use, in turn, are reflected in less industry investment in new sources of water supplies. They create a disincentive for water agencies to develop reliable and diverse sources of water because they place arbitrary caps on how much total water an agency can deliver to its customers. Instead, they create an incentive for the state and water agencies to declare water emergencies in order to access disaster relief funds. In short, they flip on its head the natural mission of a water agency, which is to invest in the means to deliver abundant and affordable water to their customers.

With so much at stake, it is fitting to assess the process used by the researchers responsible for producing the USDM's weekly report. This report will therefore investigate and attempt to answer the following questions:

***1. How does the USDM define and designate drought categories, and are the USDM drought categorizations consistent with their own methodology?***

We assess what the discrepancies are between the USDM's theoretical percentile-based methodology and designated drought categorizations from 2000–2025. To do this, we compare the USDM's weekly reports that designate drought status based on historical percentages per category, and measure to what extent those categorizations are consistent with the USDM's stated methodology. We then calculate how that distorts the amount of time the USDM has declared California to be in some stage of a drought categorization.

**2. *Has California's climate changed enough to justify more frequent drought declarations?***

To answer this, we review climate and hydrologic data to see whether the 2000s have been extraordinarily dry, and we estimate what the drought categorization frequencies should be in comparison to 20th century data. This review relies on available source data from California-based stations that have historically reported on key climate variables—rainfall, snowpack, temperature, relative humidity, and dew point—to evaluate what trends can be objectively observed when comparing the quarter-century periods 1925-1949, 1950-1974, 1975-1999, and 2000-2024. We also use this data to determine whether, and to what extent, climate conditions have become drier in the $21^{st}$ century and we estimate the degree to which drier conditions overall might reasonably affect the USDM's drought assessments.

***3. Do water storage and hydrology support USDM drought declarations?***

We suggest a more practical set of criteria for the USDM to assess drought conditions in California. In particular, we review the hydrologic conditions, i.e., the availability of stored water for use by California's urban water agencies. We compare storage data over the past century and observe trends. We then suggest (a) an alternative method to report drought conditions that puts greater emphasis on measuring how much water is banked in reservoir and aquifer storage, and (b) propose a more appropriate name for the USDM report, one that reflects its emphasis on immediate climate conditions and does not imply by its name that water scarcity exists when in fact stored water is available in abundance.

It is important to emphasize that there are inherent difficulties in making these assessments with absolute certainty. USDM personnel, while generous with their time and data, were not themselves aware of precisely how their procedure ascribes weight to the multiple sets of data they incorporate into their weekly drought assessments. At the same time, our own survey of data for the State of California and Orange County took into account every source of raw station reports available, but we had to discard data sets that were missing significant percentages of reports over time because including incomplete reports would not allow us to accurately estimate overall trends.

Moreover, even with a vast pool of data to compile, we contend with the question of which stations are most indicative of overall statewide climate conditions, and which are potentially unrepresentative. We also have to acknowledge that data can vary based not on changes in climate, but on changes in policy. In particular, we recognize that the average amount of water stored in reservoirs does not necessarily indicate the volume of runoff but, rather, can also be affected by new policies that, for example, require releases to maintain higher summertime flows in the Sacramento-San Joaquin Delta.

With these caveats, we nonetheless believe this report will demonstrate that (a) the USDM has overstated the intensity of drought in California and Orange County, and (b) a more valuable tool for reporting drought conditions would be one that emphasizes the amount of stored water available to urban water agencies, and to what degree that signifies water supply security or insecurity for their customers.

The goal of this report is to alter the accepted perception of how accurate the USDM reports "drought" conditions both by revealing the complexity and potential subjectivity of methods, by questioning whether the methods are reliably consistent with the data used by the USDM, and by assessing to what extent objective historical data indicate whether the frequency and intensity of drought conditions in the most recent quarter century are alarmingly different from those same conditions in the previous century.

A final goal of this report is to propose a method of measuring drought to reflect actual water availability, with the hope that this emphasis will restore an incentive to develop more water availability and storage, instead of more water rationing.

## USDM Methodology for Designating Drought Categories

The USDM employs a "convergence of evidence" methodology, integrating multiple quantitative indicators with qualitative inputs from local experts and impact reports to designate drought categories[1]. The methodology cannot be replicated by a computer algorithm and thus could be subject to human bias.

[1] https://droughtmonitor.unl.edu/About/WhatistheUSDM.aspx

The USDM categories are tied to percentile ranges of historical data. As Mark Svoboda and his co-authors explained in a 2002 journal article[2] describing the system:

> "As a guideline, the system uses a percentile approach in determining the thresholds for each severity level, and all data used in drought severity determinations are considered with reference to their historical frequency of occurrence for the location and time of year in question."

Given this statement, we assume that drought categories were created based on a review of climate data from the 20th century, given the lack of availability of United States data from previous centuries.

The theoretical categories and their percentile ranges are as follows:

- **None (No Drought)**: Percentile above 30.01, corresponding to normal or wet conditions, expected about 70% of the time[3].
- **D0 (Abnormally Dry)**: Percentile 20.01–30.00, indicating areas entering or recovering from drought, expected about 10% of the time.
- **D1 (Moderate Drought)**: Percentile 10.01–20.00, with short-term impacts like reduced crop yields, expected about 10% of the time.
- **D2 (Severe Drought)**: Percentile 5.01–10.00, involving crop losses and water shortages, expected about 5% of the time.
- **D3 (Extreme Drought)**: Percentile 2.01–5.00, leading to major agricultural and hydrological impacts, expected about 3% of the time.
- **D4 (Exceptional Drought)**: Percentile 0.00–2.00, the most intense with widespread consequences, expected less than 2% of the time.

It appears that the USDM has been altering its characterization of these percentile values in recent years. In their 2002 journal article, Svoboda, et. al., stated that "Each category is associated with its percentile chance of happening in any given year out of 100 yr."

In the version of the Drought Classification diagram published on the USDM's website in 2019, it labeled these values as "Objective Drought Indicator Blends (Percentiles)".[4] Today, the same web page labels these numbers as "***Example*** Percentile Range for Most Indicators" (emphasis added).

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[2] Mark Svoboda, et. al. (August 2002). The Drought Monitor. Bulletin of the American Meteorological Society. Volume 83, Issue 8, Pages 1181-1190. https://journals.ametsoc.org/view/journals/bams/83/8/1520-0477-83_8_1181.xml

[3] https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx

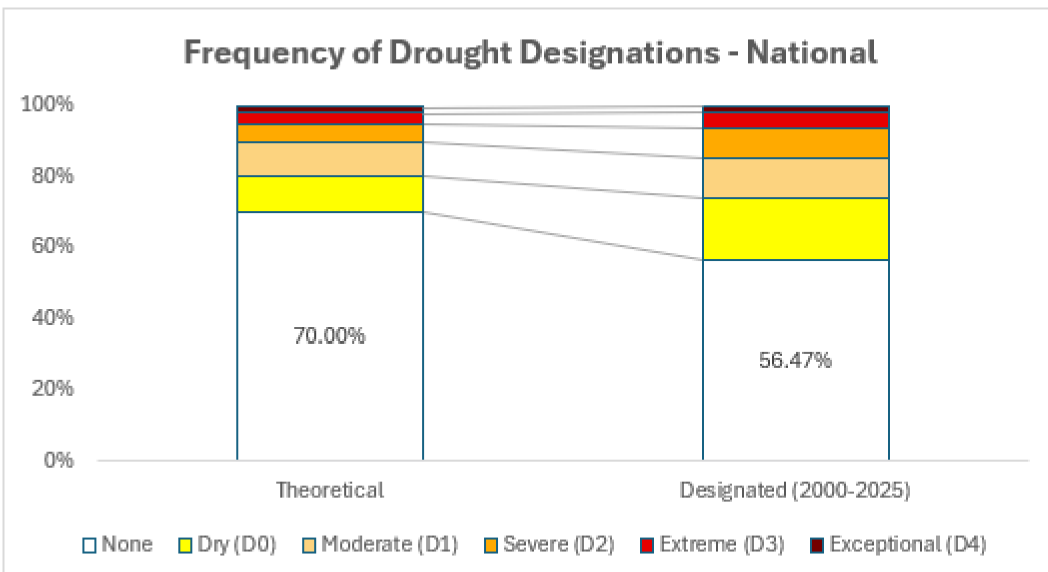
[4] Obtained from the Internet Archive at https://web.archive.org/web/20191001081301/https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx

## Analysis of USDM Data and Inconsistencies with Methodology

Analysis of USDM data from 2000 to 2025 reveals that the actual frequency of drought category designation deviates from the theoretical percentiles – derived as a baseline using climate data from the 20th century – as outlined in the methodology. The following charts, derived from data downloads from the USDM website, illustrate these discrepancies across national, California, Orange County, and Newport Bay regions.[5] In these charts, the left column (labeled "Theoretical") reflects the percentiles stated in the USDM methodology and listed in the previous section. The Designated (2000-2025) column reflects the percentages of D0-D4 categorizations designated by the USDM from its inception through early September 2025.

### National Drought Category Distribution (2000–2025)

The first chart compares theoretical vs. designated drought category frequencies for the United States and Puerto Rico from January 2000 through early September 2025. The table shows that D0-D4 categorizations ("Abnormally Dry" through "Exceptional Drought') are designated much more frequently (43.53%) than suggested by the USDM methodology (30.00%).

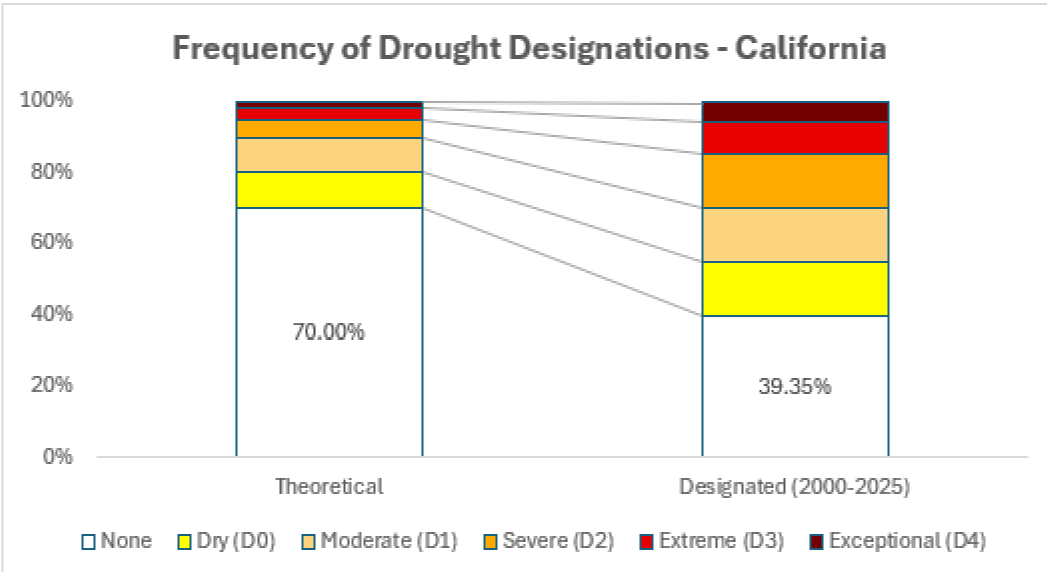



*Comparison of theoretical vs. designated drought category frequencies for US and Puerto Rico (2000–2025). Data source: USDM Data Tables.*

[5] Data were downloaded on September 11, 2025 from https://droughtmonitor.unl.edu/DmData/DataTables.aspx

## California Drought Category Distribution (2000–2025)

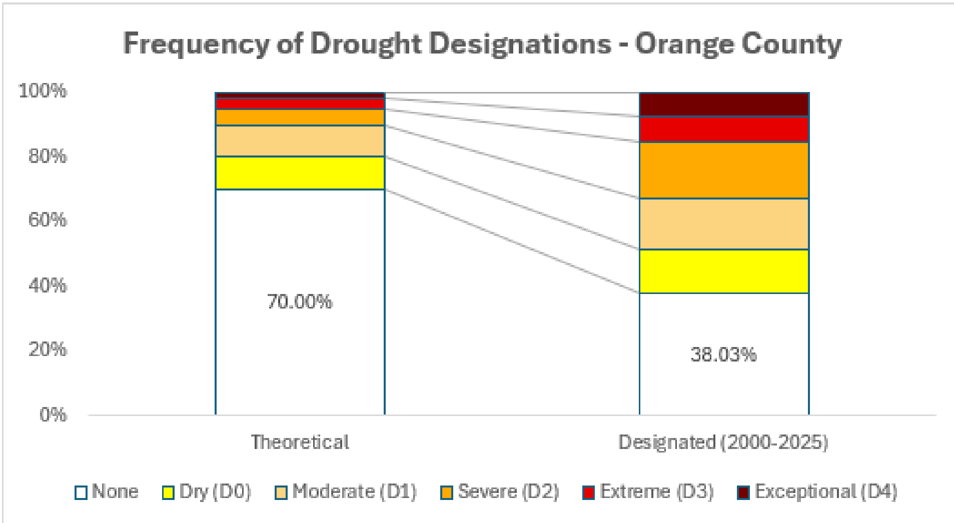
Next, we show the same comparison just for areas within California. The deviation between theoretical and designated drought categorization is even greater than it is for the whole United States, with some dryness/drought categorization (D0-D4) designated more than twice as often (60.65% v. 30.00%) than the methodology would suggest.




*Comparison of theoretical vs. designated drought category frequencies for California (2000–2025). Data source: USDM Data Tables.*

## Orange County Drought Category Distribution (2000–2025)

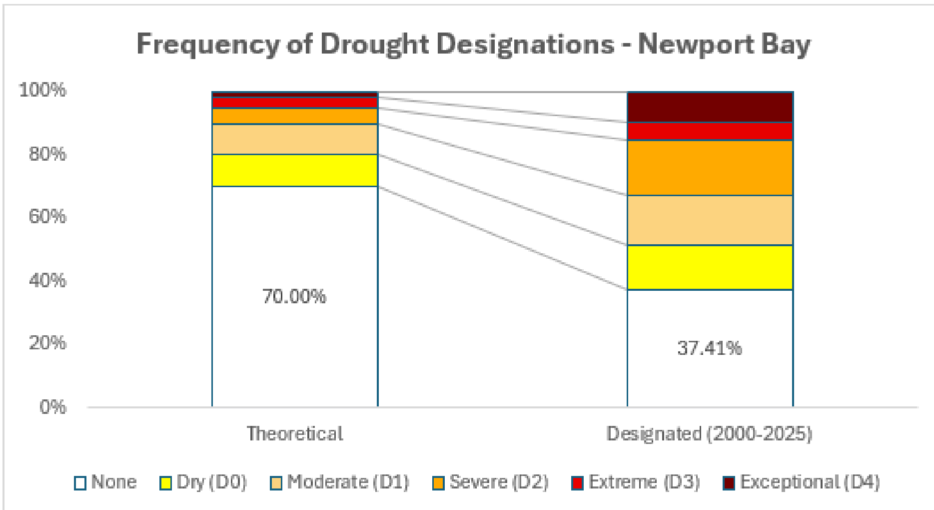
Within Orange County, CA, the deviation is slightly more pronounced than it is statewide (61.97% v. 30.00%).




*Comparison of theoretical vs. designated category frequencies for Orange County, CA (2000–2025). Data source: USDM Data Tables.*

## Newport Bay Drought Category Distribution (2000–2025)

Finally, drought category frequencies within the Mesa Water District (Mesa Water®) service area for the Newport Bay Hydrologic Unit Code (HUC) deviate even more, with 62.59% of observations involving a DO-D4 categorization compared to the 30.00% proportion suggested by the published methodology.




*Comparison of theoretical vs. designated drought category frequencies for Newport Bay HUC (2000–2025). Data source: USDM Data Tables.*

## Summarizing the Drought Category Frequencies

The following table summarizes the relative frequencies graphed in the preceding sections. In all four cases, designated USDM drought categorizations from 2000-2025 indicate more intense drought conditions than the methodology ("Theoretical" column) suggests. The deviation is especially notable in California and its local subdivisions we have analyzed.

| Category | Theoretical | National Designated | California Designated | Orange County Designated | Newport Bay Designated |
|---|---|---|---|---|---|
| None | 70.00% | 56.47% | 39.35% | 38.03% | 37.41% |
| D0 | 10.00% | 17.39% | 15.46% | 13.37%. | 14.19% |
| D1 | 10.00% | 11.35% | 15.32% | 15.64% | 15.54% |
| D2 | 5.00% | 8.41% | 15.42% | 17.96% | 17.80% |
| D3 | 3.00% | 4.83% | 9.02% | 7.72% | 5.36% |
| D4 | 2.00% | 1.55% | 5.43% | 7.26% | 9.69% |

The conclusion indicated by the USDM reports is not subtle. The USDM indicates California as being drought-free ("None") barely half as often in the most recent 25 years compared to the previous century. Similarly, in the categorizations of "Severe Drought" in California, the USDM shows a remarkable increase. For example, the incidence of years when the USDM reports D4 ("Exceptional Drought") shows an increase from 2% in the 20$^{th}$ century baseline to over 5% in the 21$^{st}$ century to-date.

In the next section we will evaluate source data over the past 100 years to determine if such a dramatic shift in climate between this century and the previous one can be independently verified.

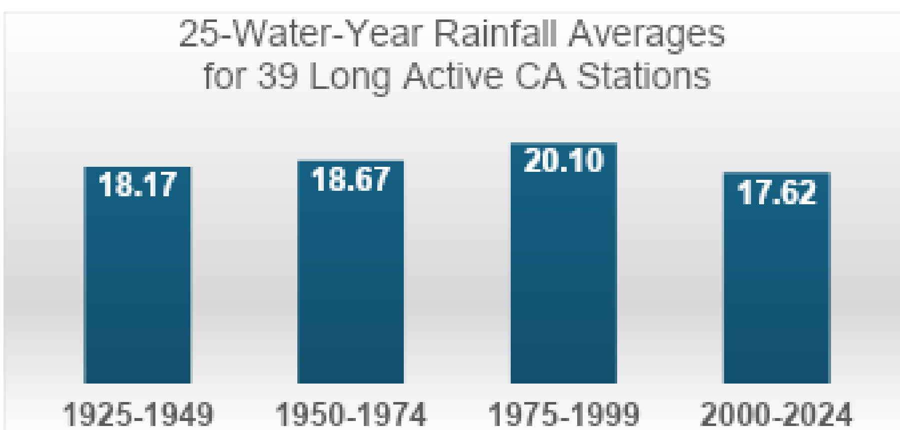
## Comparisons of Pre-2000 and Post-2000 Climate Data

If the climate has, in fact, become drier than in the 21$^{st}$ Century, some deviation from the theoretical percentiles may be justified. So next, we review various long time-series of California climate data to assess whether such a trend can be identified and, if present, how strong it may be. We consider precipitation, snow depth, temperature, relative humidity, dew point, and vapor pressure deficits.

### Precipitation Data

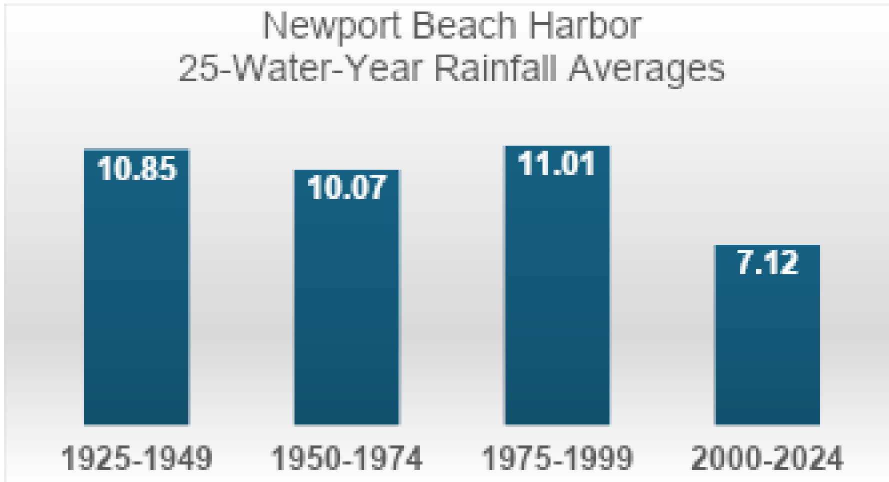
The Applied Climate Information System (ACIS), developed by the NOAA Regional Climate Centers (RCCs), has long histories of daily weather summaries.[6] Unfortunately, many older weather stations have either stopped reporting or have considerable gaps in their data.

We found 39 California weather stations that had "almost complete data" for the 100 years between 1925 and 2024. By "almost complete" we mean having data for at least 90% of the months during the 100-year period. 25-year averages for these 39 stations are as follows:




[6] https://www.rcc-acis.org/

One of these 39 stations is Newport Beach Harbor in Mesa Water's service area, so we report its averages separately.

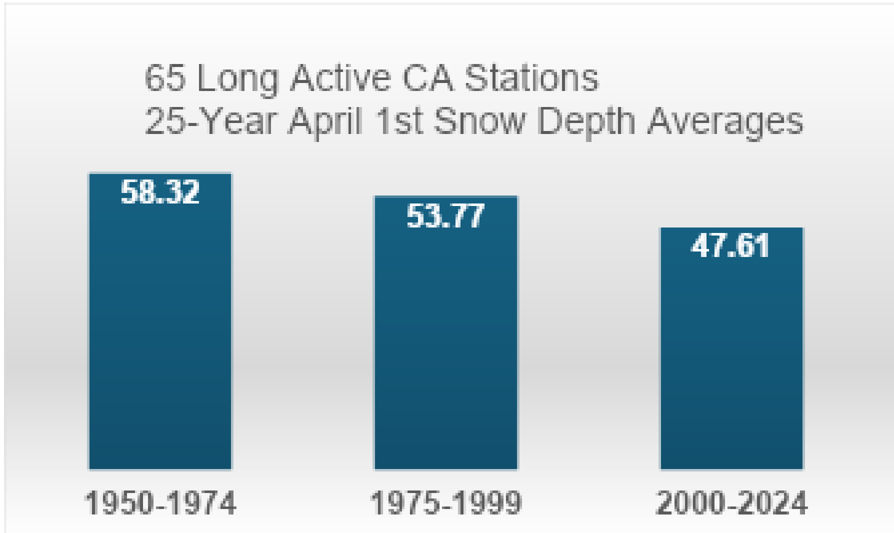



## Snowpack

Some weather stations have a long-time series of snow depths, but unfortunately data prior to World War 2 is relatively sparse. Consequently, we can only provide data for three 25-year periods in this section.

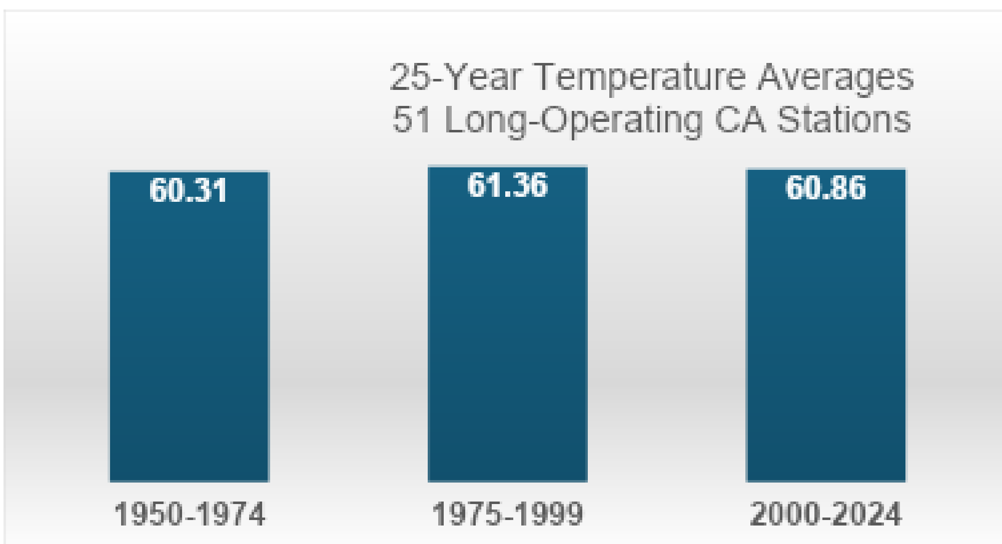
The USDA Natural Resources Conservation Service's National Water and Climate Center collects monthly snowpack data from thousands of weather stations globally.[7] We found 65 California stations in its data set that consistently reported monthly snow depth data since 1950. In the following chart, we report average snow depths for these 65 stations as of April 1st of each year.

[7] https://wcc.sc.egov.usda.gov/reportGenerator/




## Temperature, Relative Humidity, Dew Point, and Vapor Pressure Deficit

The Iowa Environmental Mesonet (IEM) has long time series of temperature, relative humidity, and dew point data for thousands of weather stations around the country.[8] We found 51 California weather stations which frequently reported[9] this data on an hourly basis for the 75 calendar years after January 1, 1950, and present 25-year averages below (data are reported in degrees Fahrenheit).



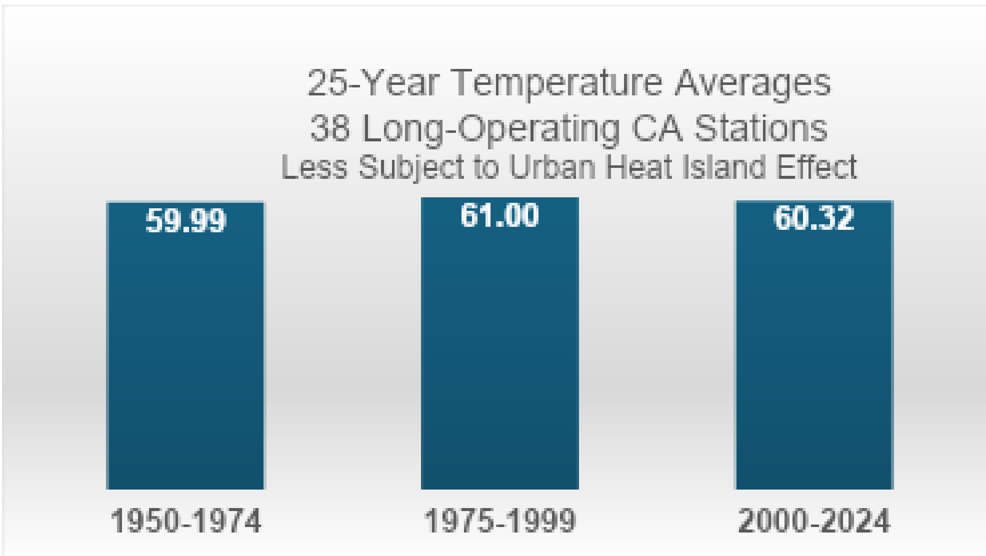

There is relatively little variability in the temperatures across the three periods, with a difference of 0.55° Fahrenheit between the first and last periods. It is also worth noting that

[8] https://mesonet.agron.iastate.edu/

[9] Our criterion for "frequently reported" is at least 80,000 hourly observations per 25-year period.

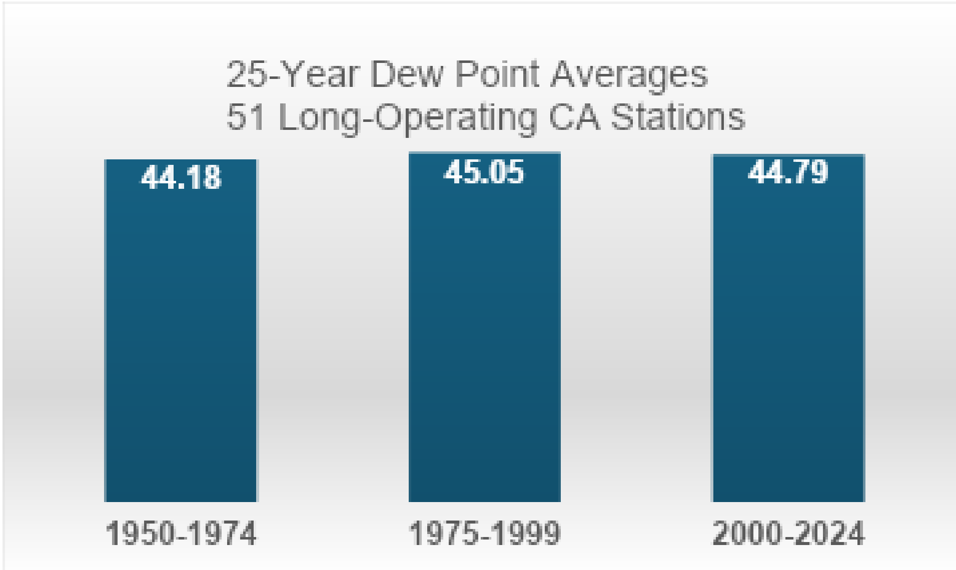
the average of the first two temperature bars (60.83°) is virtually the same as the final bar (60.86°).

Some of the variability may be attributable to the Urban Heat Island (UHI) effect as more land was paved over. We identified 13 stations of the 51 that were especially prone to UHI by interrogating the Grok and Gemini large language models. After removing observations from these 13 stations we obtained averages for the remaining 38 stations in the data set, obtaining the following results.

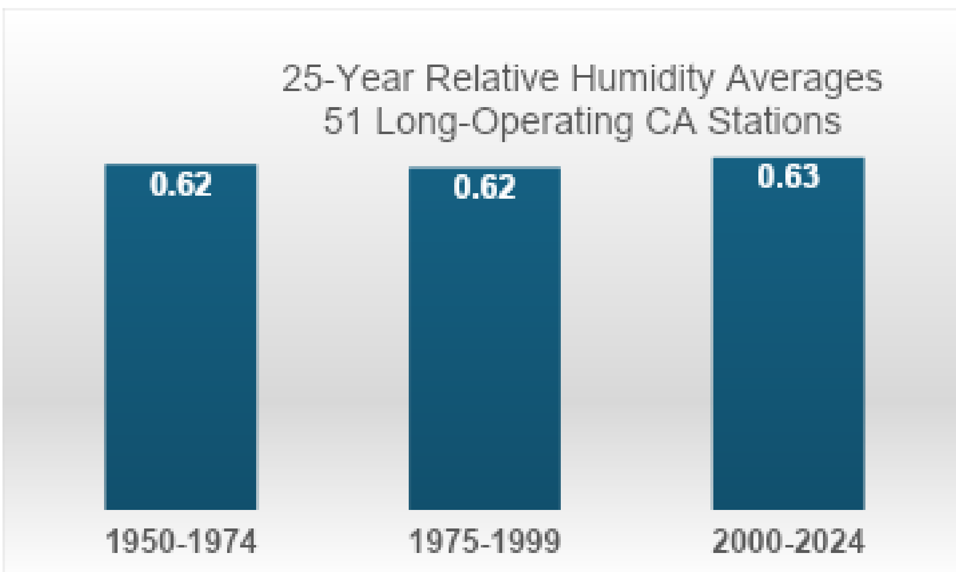



This reduced the gap between the first and last observations to just 0.33° Fahrenheit, and the overall pre-2000 average is higher than the 2000-2024 average. Our findings raise questions about the intensity of anthropogenic global warming over the past half century.

Next, we present dew point averages for the full set of 51 stations, once again using hourly observations. The dew point is the temperature at which the air would be fully saturated under current conditions. In other words, it is the temperature at which the relative humidity would be 100%.



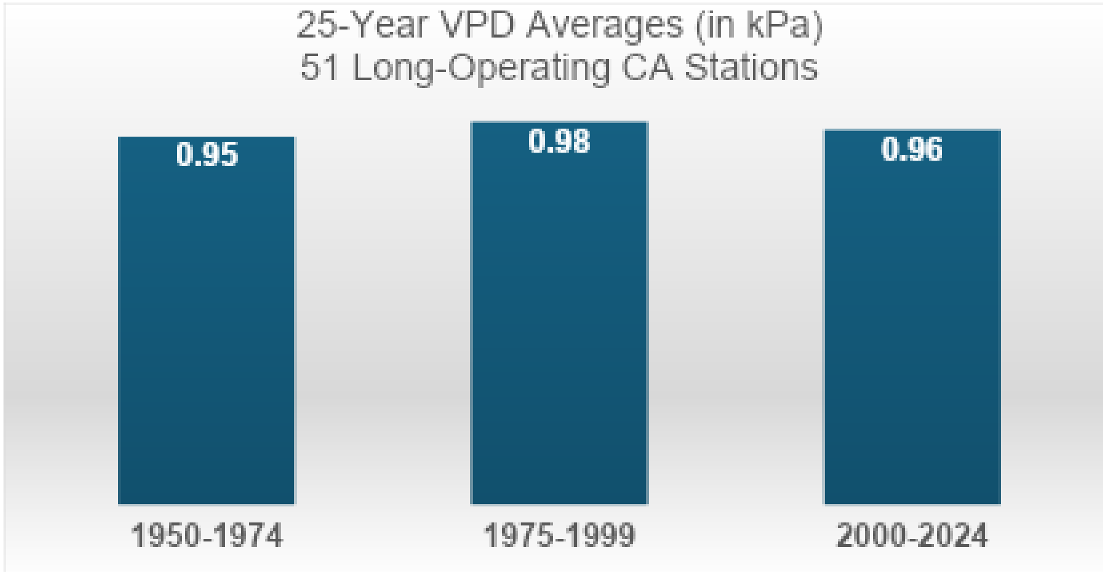

Next we report average relative humidity for the three stations over the same time, once again using hourly observations.




Finally, we show a calculated figure often used in drought analysis. The Vapor Pressure Deficit (VPD) is the difference between the Actual Vapor Pressure and Saturation Vapor Pressure and is normally measured in kiloPascals (kPa).[10]

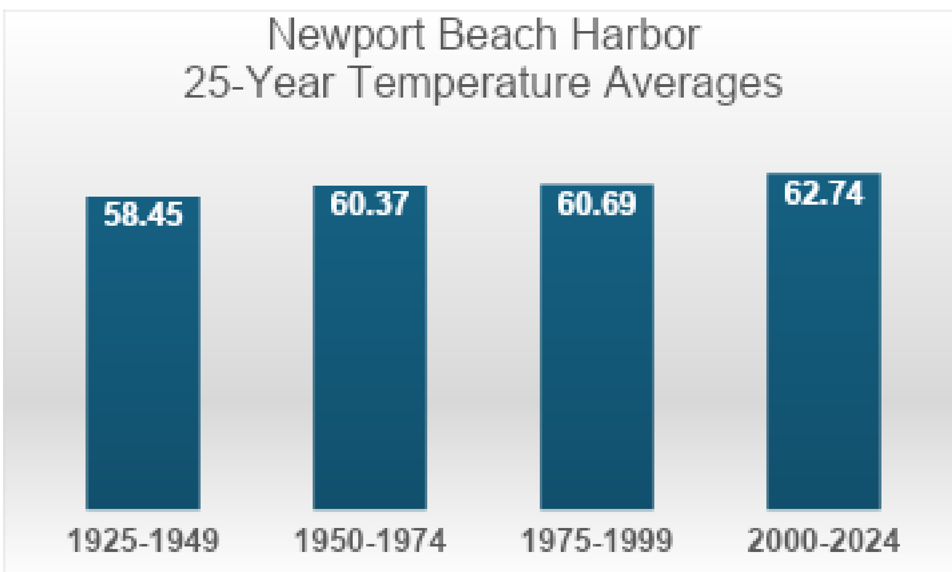
For each hourly weather station observation, we calculated VPD from the observed temperature and relative humidity and then computed averages across the 51 stations.

10 https://pulsegrow.com/blogs/learn/vpd?srsltid=AfmBOopy-XcsP1j5GXmJSi2iV2-YoDyFR-FCpzLWKpNXvBvos31JXgxC




We see little variance over the 75-year time period.

More locally, we found average temperature data on ACIS for the Newport Beach Harbor weather station, and can report 100 years of data from the daily summaries available on that data set.




Although this station shows a steady and pronounced temperature increase, it is worth repeating that the statewide averages did not show significant temperature change.

## Summary of Findings – Actual Climate Data

Based on 75-100 years of source data, there is limited evidence that droughts in California are more intense in this century. The statewide annual rainfall average from 2000-2024 is indeed lower, at 17.6 inches, than the most recent previous quarter century from 1975-1999 of 20.1 inches, but is only marginally lower than the two quarter centuries before that: 18.7 inches from 1950-1974, and 18.2 inches from 1925-1949. This hardly constitutes a precipitous drop in average rainfall.

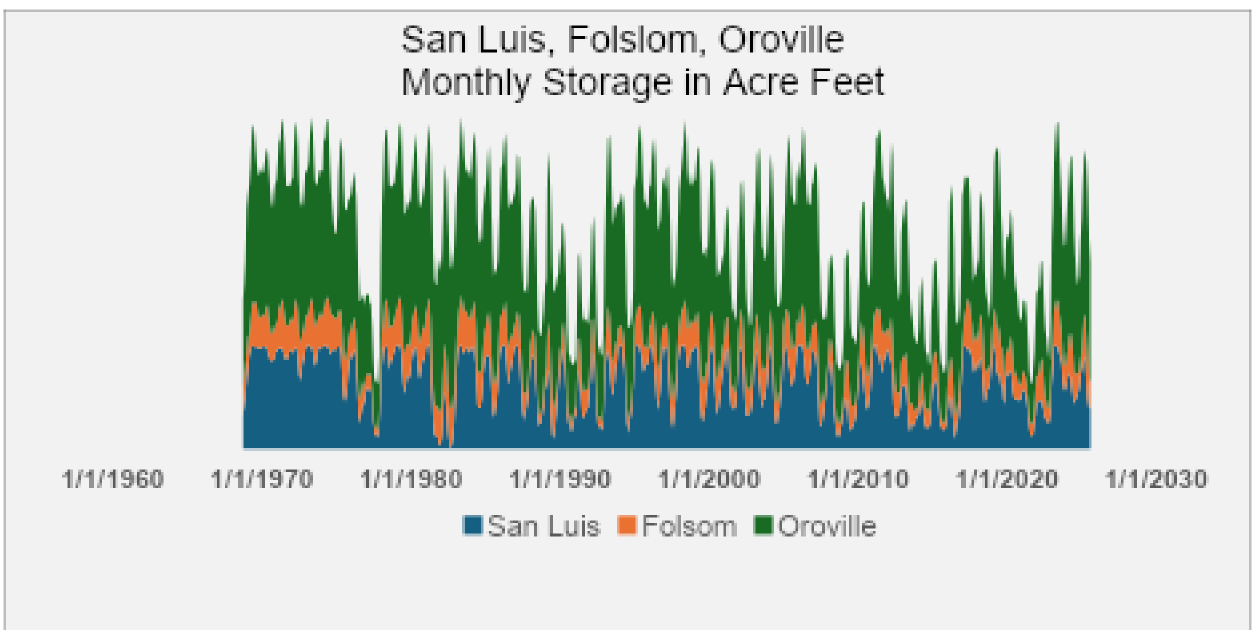
While average snow depth does show a statistically meaningful drop from a high of 58.3 inches in 1950-1974 vs. 47.6 inches in 2000-2024, we lack data for earlier periods, and cannot account for other variables including the impact of greatly increasing forest density in recent decades that causes snow to collect in the canopy and evaporate. Furthermore, additional raw data, in particular temperature, dew point, and vapor pressure deficit, are virtually unchanged in the period for which we have data, 1950 through 2024.

Overall, while source data may indicate a minor drying trend between this century and the last one, as our evaluation will further demonstrate, it is incremental at most, and not at all remarkable or significant.

## Historic Reservoir Conditions

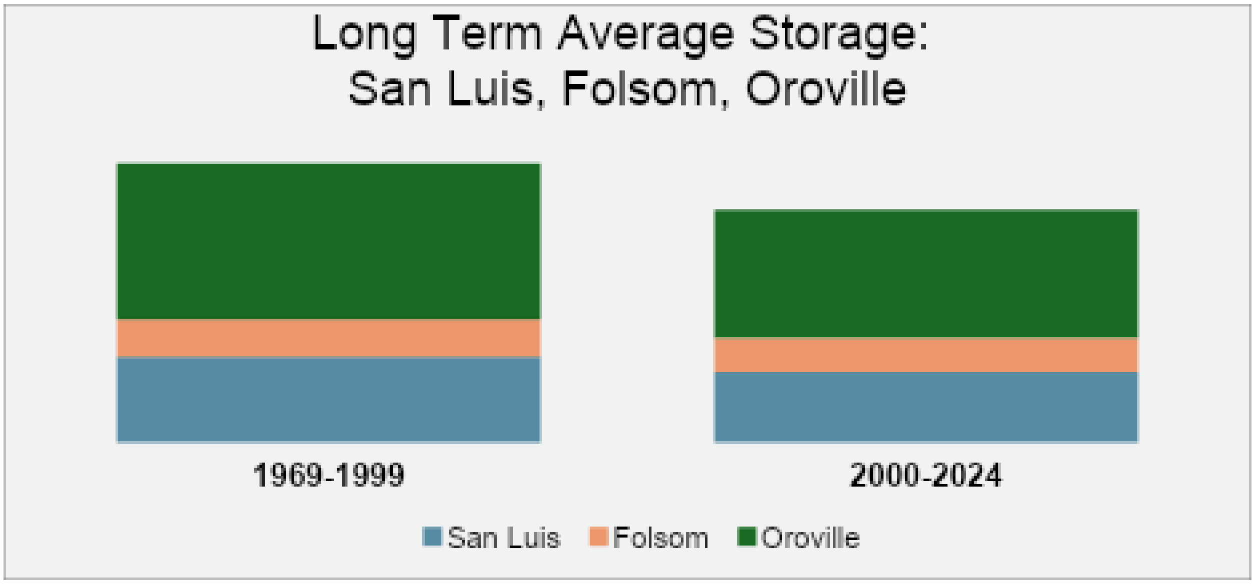
The California Data Exchange Center (CDEC) managed by the California Department of Water Resources (DWR) has long histories of hydrology data.[11] In the following charts, we include storage (in acre feet) for the three major state water project reservoirs. Monthly data for all three are available from October 1968 to present (Folsom Lake goes back to 1955).

The first chart shows the full-time series of storage data for the three facilities.



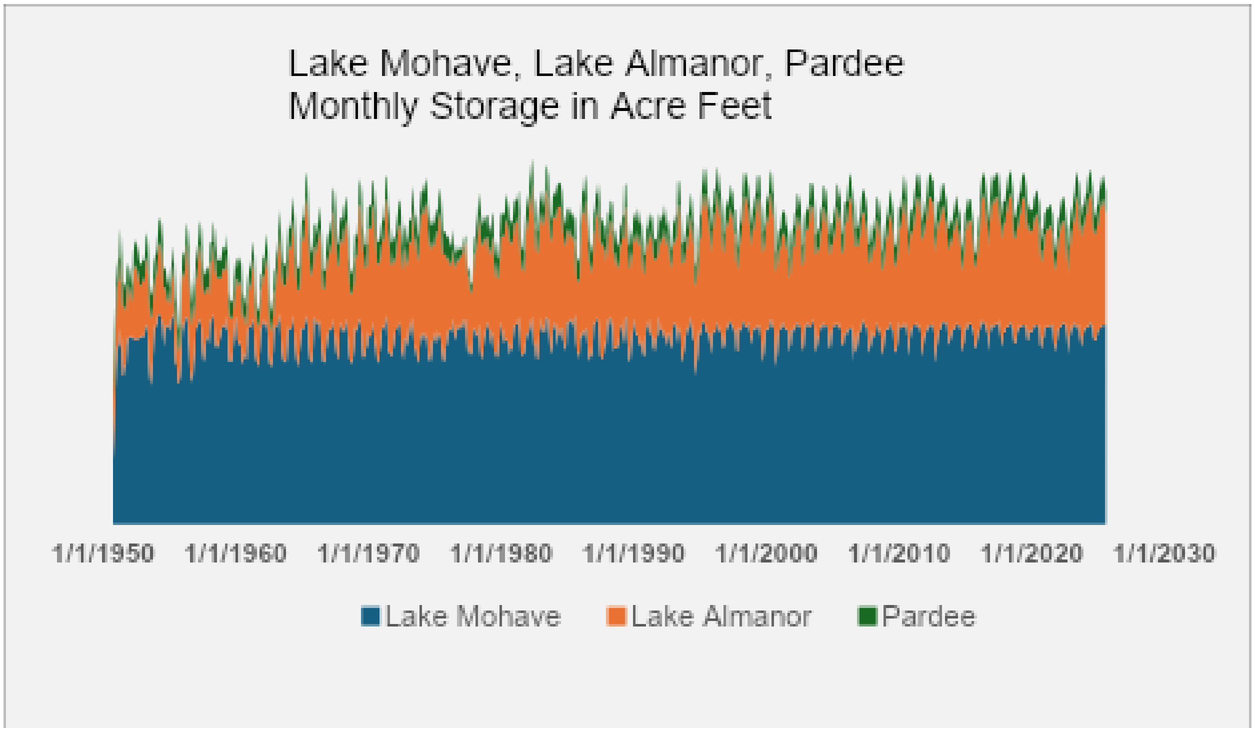

[11] https://cdec.water.ca.gov/

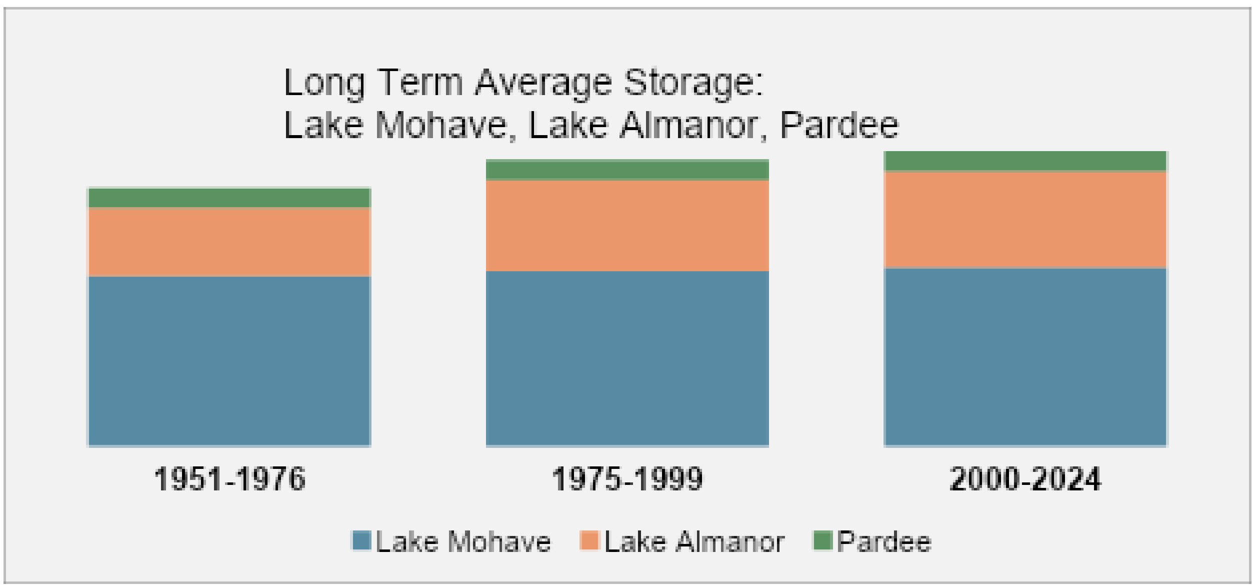
Lacking a full 75 years of data, we compare full year averages of observations from before the USDM was published and thereafter.



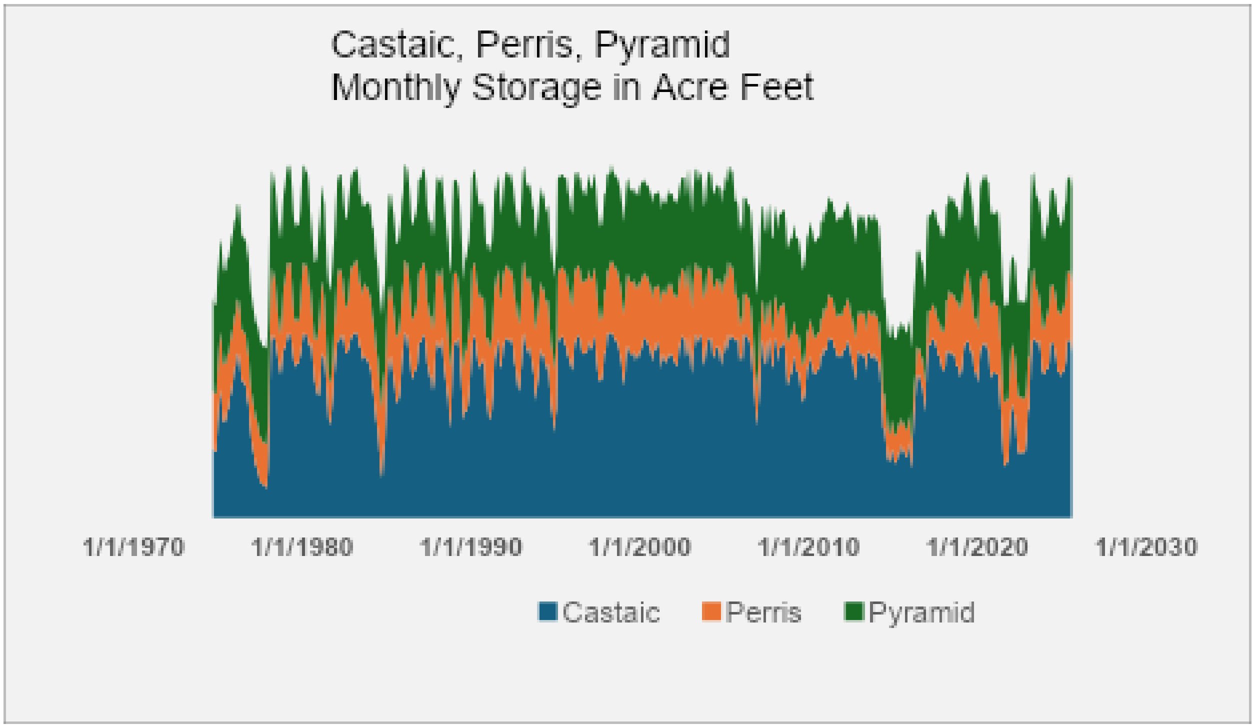

It is possible that the drop in storage could be explained, in part, by increased outflows required by the state's increasing population. But CDEC does not have enough historic inflow and outflow data to confirm or contradict this assumption.

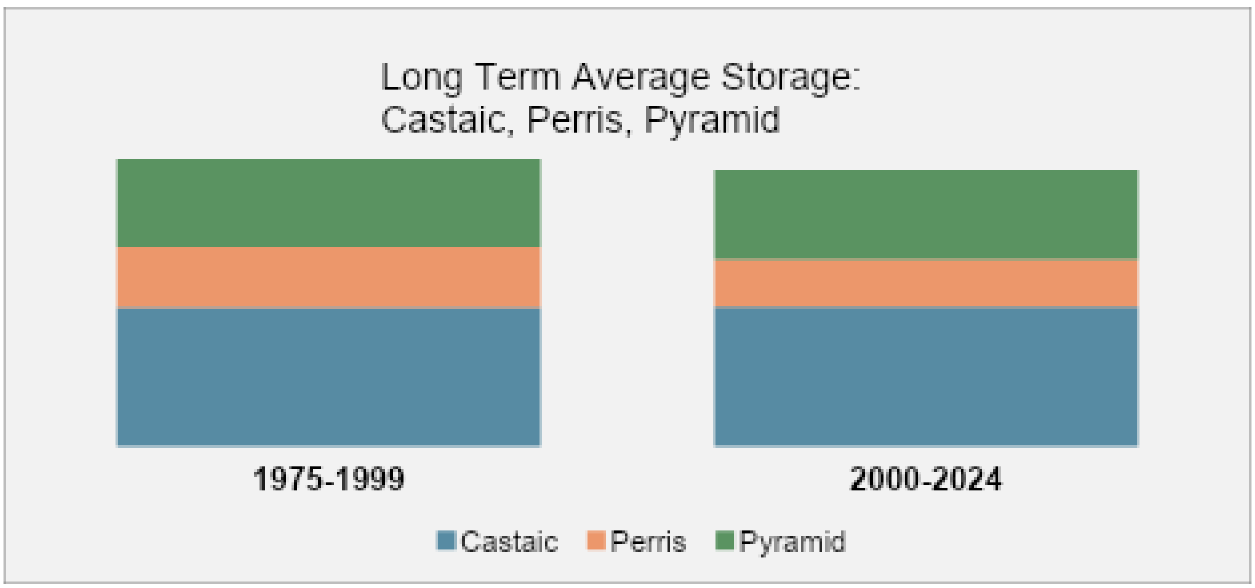
Aside from state water projects dams, there are three sizable water storage facilities that have at least 75 years of data: Lake Mohave, Lake Almanor, and Pardee (although Lake Mohave is not located in California, it is part of the Colorado River system which supplies water to the state). We found a few missing observations and interpolated them from previous and following month data. These three reservoirs show less volatility and no tendency toward reduced storage over an extended time.




The CDEC data does not include historical data for reservoirs in Orange County. The nearest facilities to Orange County in the CDEC database are Castaic Lake and Pyramid Lake in Los Angeles County and Lake Perris in Riverside County. Storage data goes back only to 1974 and is displayed in the graphs below (as with the last charts, a few missing entries were interpolated). Average storage across the three dams fell by less than 4% between the 25 years through 1999 and the most recent 25 years.




## Summary of Findings – Hydrology

What is evident from reservoir data is that three of the biggest dams that are part of the state water project indeed show lower levels this century compared to the 2nd half of the 20th century. But it is impossible to detach these findings from policies. Precipitation has not declined appreciably, but water management at the state level has changed dramatically.

San Luis, for example, is a major off-stream reservoir that is filled up and drained in accordance with regulations set by the California DWR. Over the past two decades, the amount of water that can be stored and moved to the reservoir has been restricted due to new levels of endangered fish protection in the Sacramento-San Joaquin Delta. Additionally, since 2007, San Luis has also been left below capacity for the past several years due to ongoing work to seismically retrofit the dam. Work is not projected to be complete on San Luis until 2027.

Similarly, Lake Oroville, the largest reservoir in the State Water Project system, starting in 2017, was left at barely 40% of its full capacity for over two years in order to complete repairs on its spillway.

Finally, the California DWR has deliberately mandated lower levels in reservoirs in recent decades in order to leave more space available to protect against what the state perceives to be growing flood risk. This is predicated on a perception that the climate is shifting toward more extreme rainfall necessitating more available reservoir capacity, but this decision making is also driven by concern over the condition of the state's dams as exemplified in the 2017 spillway failure at Lake Oroville, as well as the decreasing capacity of the state's reservoirs due to accumulated silt.

We contend that these factors – dramatic shifts in policy with respect to managing flood risk and protecting fish, and storage drawdowns to facilitate maintenance work – are the primary drivers of less water storage in California's major reservoirs. Absent these factors, we find that unremarkable changes in overall precipitation cannot explain somewhat lower average storage. Hydrological drought, such as it is, results from changes in policy, not climate change.

## Estimating an Unbiased Distribution of Drought Categories

Thus far, we have seen that the USDM is designating drought categorizations—including intense drought categories—much more frequently than its stated methodology suggests. This could be explained by greater dryness than expected when the methodology was developed. But given the very large departure, changing climate conditions may not be a sufficient explanation. In this section, we discuss the results of a quantitative model that compared pre-2000 and post-2000 climate observations to determine how much of an increase in USDM drought categorization is empirically justified.

In this section, we focus on the distribution of drought categories for California as a whole, taking advantage of the data presented in this report's "Comparisons of Pre-2000 and Post-2000 Climate Data" section. Aside from averages, we calculated other descriptive statistics for the data sets we collected. We then loaded those statistics into large language models (Grok) and asked it to calculate an empirically justified distribution of post-2000 drought categories.

The indented text below is the explanation Grok generated to explain its approach to calculating this empirically supported distribution of D0-D4 categories:

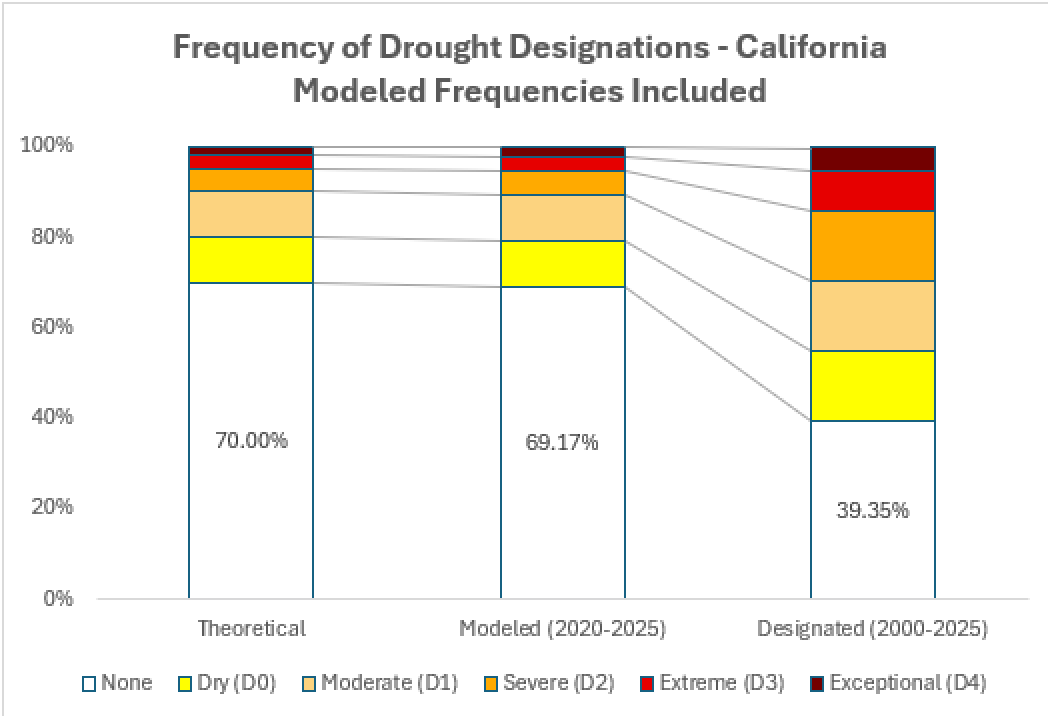
Imagine the USDM as a teacher grading weather conditions on a curve set by pre-2000 data. If today's weather is much drier than that old standard, it gets a "drought" grade more often. Our method updates the expected grades (frequencies) for California by comparing recent weather (2000–2024) to the old curve, using four key variables: rainfall (less rain = drier), snowpack (less snow = drier), temperature (hotter = drier), and vapor pressure deficit (higher = drier air, more evaporation). These are core to how the USDM assesses drought, as it blends precipitation, evaporation, and related factors.

Here's how we do it, step by step, in plain terms:

- **Pick the key weather factors**: We use rainfall, snowpack, temperature, and vapor pressure deficit (VPD) because they drive drought conditions. For example, low rainfall means less water for crops, and high VPD means the air "steals" more moisture from the ground.
- **Draw a picture of past and present weather**: We take the pre-2000 and post-2000 data (like averages and medians) and create a "curve" for each variable—like a graph showing how common different rainfall amounts were. For rainfall and snowpack, which often have many low values and a few high ones, we use a curve that fits this lopsided shape (called lognormal). For temperature and VPD, which are more balanced but still slightly uneven, we use a bell-shaped curve (normal distribution). These curves let us estimate any percentage point, like the driest 2%.
- **Set the grading scale using old data**: Using pre-2000 data, we find cutoff points for each category. For rainfall and snowpack, where low values are bad, we mark the driest 2% as D4, the next 3% as D3, and so on, matching the USDM's targets (e.g., D4 is the bottom 2% of rainfall). For temperature and VPD, where high values are bad, we use the top percentages (e.g., hottest 2% for D4).
- **Grade today's weather on the old scale**: We take the post-2000 weather curve and see how often it falls into each category's range from the pre-2000 scale. For example, if 3% of recent rainfalls are below the old D4 cutoff, then D4 would happen 3% of the time now.
- **Combine the results**: Because the USDM looks at multiple factors, we average the frequencies from rainfall, snowpack, temperature, and VPD to get a balanced set of category frequencies for California.

This method is like checking how often a student would score an A, B, or C on an old test using their new study habits. It keeps the USDM's rules but adjusts for California's new climate reality, such as less rain or hotter days.

The following chart compares the drought frequencies Grok calculated ("modeled") with the frequencies described in USDM documentation ("theoretical") with those designated by the USDM since 2000.




Because conditions have been drier in the 2000s (i.e., less rainfall) the model agrees that there should be some increase in dryness and drought designations. But the increase suggested by the model (0.83%) across all categories is well below the 30.65% departure we have observed.

We performed similar analysis with Google's Gemini, and that model also calculated a far more modest increase in drought categorizations than those published by the USDM since 2000.

## Conclusion

The USDM is designed and recognized as a robust framework for drought assessment through the integration of diverse data sources and expert judgment. We find, however, that it falls short in practice.

Our analysis uncovers significant discrepancies between the high levels of drought intensity reported by the USDM, and the far less alarming levels of drought we infer using the USDM's own stated criteria.

Our analysis demonstrates that drought categories—particularly in California and specifically in Orange County—have been inflated, with D0-D4 designations occurring 60-62% of the time, more than double the expected 30%. If drought conditions over the past 25 years had truly exceeded the levels recorded in the 20th century, then the USDM's assessments might be justified. But our examination of century-long climate data further exposes the USDM's distortions: precipitation, snowpack, temperature, relative humidity, dew point, and vapor pressure deficit reveal only marginal drying trends in the post-2000 era compared to prior quarter-centuries, insufficient to justify their dramatic escalation in drought declarations.

Using statistical modeling grounded in these historical data sets, we estimate an increase in drought frequencies of a mere 0.83% across categories—a small fraction of the USDM's observed 30.65% deviation in California. This suggests that the USDM is not faithfully adhering to its own methodology, and it is instead amplifying perceived dryness, potentially to align with broader narratives or policy agendas that favor emergency declarations over sustainable solutions.

Equally critical and often overlooked in the USDM's climate-centric focus, is the role of stored water availability in defining true drought conditions. Reservoir data from key facilities like San Luis, Folsom, and Oroville show slight declines in average storage this century, but these are largely artifacts of policy shifts—such as heightened environmental releases for endangered species, mandated flood-risk buffers, and maintenance drawdowns—rather than profound climatic changes. In contrast, other reservoirs like Lake Mohave, Lake Almanor, and Pardee exhibit stability over decades, and local Southern California facilities like Castaic, Perris, and Pyramid Lakes have seen only minimal reductions. When population growth and these policy influences are accounted for, the data affirm that water supplies have remained adequate for residents and businesses, particularly in urban areas.

This reality suggests a paradigm shift is warranted: drought declarations must prioritize actual water security—measured by available water storage—over transient weather metrics. In Southern California, where evidence shows consistent access to sufficient supplies throughout the 21st century, routine drought categorizations are not only unjustified but also may be harmful, as they impose unnecessary restrictions that stifle potential investment in innovations that might increase water supplies and boost drought resiliency.

Moreover, coastal regions like Orange County sit adjacent to the vast Pacific Ocean, where large-scale desalination solutions are sidelined by regulatory hurdles and outdated priorities. Adopting an aggressive, Israeli-style desalination strategy—proven effective in transforming arid landscapes into water-secure ones—would render water shortages virtually impossible for these areas, ensuring resilience against any genuine climatic variability. Policymakers must champion such forward-thinking investments in diversified water supplies, including desalination, expanded storage, and advanced recycling, rather than perpetuating a cycle of rationing driven by exaggerated drought alarms.

If the USDM authors are unwilling to incorporate this critical feedback—by automating processes, emphasizing hydrology over meteorology, and recalibrating their reports to accurately reflect empirical realities—then policymakers have no choice but to decisively reject its influence on water policy, rendering the USDM’s designations as nothing more than arbitrary, reminiscent of the discredited, analyst-driven credit ratings that fueled the 2008 financial crisis through unchecked subjectivity and conflicts of interest.

The USDM reports, as are currently compiled and understood, lead to bad policy decisions. The typical response to the USDM's drumbeat of alarming weekly "drought maps," painting the entire western United States in harrowing shades of orange and red, is for water agencies to impose mandatory rationing on their customers. For the last several years, the USDM's reports have depicted an almost perpetual drought. This is misleading and not consistent with observed data over the past century. The USDM's reports disincentivize the very infrastructure investments needed for long-term water abundance. We must redefine drought in terms of actual water scarcity and commit to developing resilient sources of additional fresh water instead of mandatory rationing.

## About the Authors

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## About the District

Founded on January 1, 1960, and governed by a publicly elected, five-member Board of Directors, Mesa Water is an independent special district that provides water service to 110,000 residents in an 18-square-mile service area that includes most of Costa Mesa, a portion of Newport Beach, and John Wayne Airport. Mesa Water provides 100 percent local reliable groundwater to its customers due to the Mesa Water Reliability Facility.