

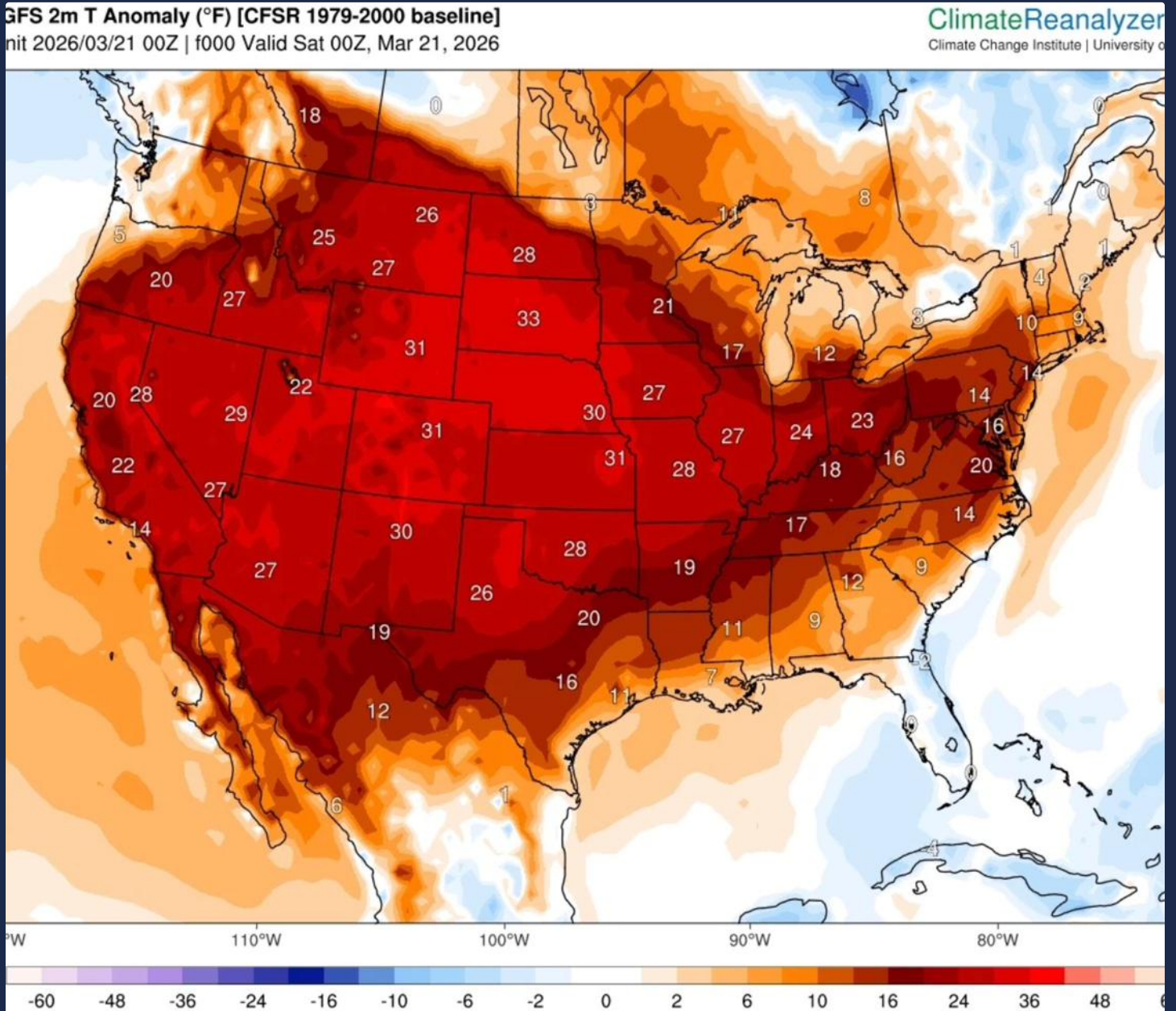
EXTREME EVENT ANALYSIS

The March 2026 Western U.S. Heatwave

Anatomy, Attribution, and Forward-Looking Risks

Prepared using the Berkeley Earth High-Resolution Surface Temperature Dataset (BEST-HR)

Robert A. Rohde, Chief Scientist · Berkeley Earth · April 2026



GFS 2m temperature anomaly (°F) vs. 1979–2000 baseline, March 21, 2026. Anomalies of +20 to +33°F across the continental interior. Source: ClimateReanalyzer.org / University of Maine.

Executive Summary

Key findings from the March 2026 Western U.S. heatwave analysis

March 2026 produced one of the most extraordinary temperature anomalies ever recorded across the Western United States, one that generated not just a localized spike, but a continent-scale thermal event with coherent impacts across hydrology, ecosystems, and human systems simultaneously.

+11.5°F

Western U.S. March Mean Anomaly

Above mid-20th-century baseline. ~3.5°F above the previous March record and ~7.7°F above the long-term warming trend. The largest March anomaly in the 170-year record — also the largest positive deviation from trend in that record.

1,008+

Stations Setting New March Records

Stations with ≥30 years of data. 229 tied or exceeded any prior April day. 10 matched or exceeded their all-time May records — two full months ahead of schedule.

~30%

Active U.S. Stations Setting Monthly Records

Second-highest in the century-long GHCN record — exceeded only by May 1934 at the peak of the Dust Bowl. Unprecedented for any March on record.

Historic low

Colorado River Snowpack by April 7

Rapid melt of an already-thin snowpack drove snow-water equivalent to near-record lows — shifting runoff timing and elevating summer wildfire risk across the basin.

Three Overarching Conclusions

- 1 Anthropogenic warming materially enabled the event.** Attribution analyses indicate it would have been effectively impossible in the pre-warming climate — enabled by approximately 4°F of long-term regional warming since the mid-20th century.
- 2 Even in today's warmed climate, the event sits at the deep tail of the distribution,** raising critical questions about whether standard risk models — which assume stationary variance or only a shifting mean — adequately capture the probability of such extremes.
- 3 The juxtaposition of an anomalously cold March 2023 and a record-shattering warm March 2026 may indicate increasing temperature variability** — not just a shifting mean. If the variance of western U.S. spring temperatures is widening, standard risk models will systematically underestimate the probability of extremes in both directions. This possibility warrants formal investigation.

+4°F

LONG-TERM WARMING

Since the mid-20th century, March mean temperatures across the western U.S. have risen ~4°F (~2.2°C). This warming provided the thermodynamic floor without which the +11.5°F anomaly of March 2026 would have been **effectively impossible** — even accounting for the exceptional blocking dynamics that drove the event.

What Happened: The Observational Record

Magnitude, spatial coherence, and record-breaking breadth

The heatwave was driven by a strong, persistent upper-level blocking ridge — a "heat dome" — producing sustained subsidence, clear skies, and record warmth across the West and central U.S. Pre-existing drought-stressed soils and thin snowpack suppressed evaporative cooling, further amplifying surface temperatures beyond what the atmospheric dynamics could ordinarily have produced.

Magnitude and Spatial Coherence

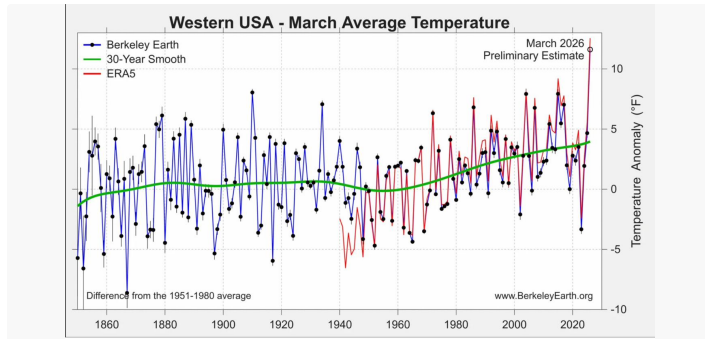


Fig. 1. Western USA March average temperature anomaly (°F), 1850–2026. March 2026 (open circle, far right) is the preliminary estimate — unprecedented in the 170-year instrumental record. Source: Berkeley Earth.

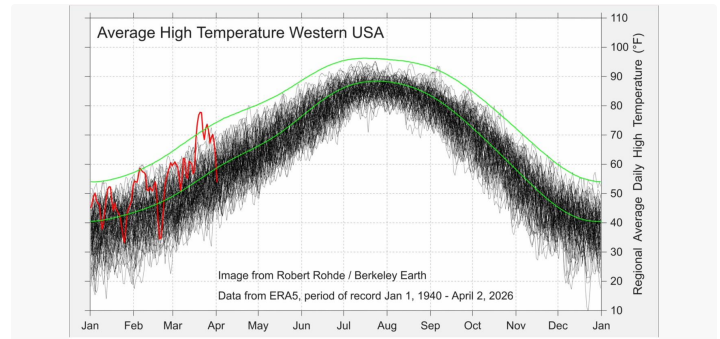


Fig. 2. Average daily high temperature, Western USA, showing the long-term warming trend and the 2026 spike far above the historical envelope. Source: Berkeley Earth / ERA5.

The Berkeley Earth preliminary estimate: **+11.5°F (+6.4°C)** above the mid-20th-century baseline — **~7.7°F** above the long-term warming trend. Largest March anomaly on record; largest deviation from trend in the 170-year record; previous March record beaten by 3.5°F.

Record-Breaking Breadth — Station Records

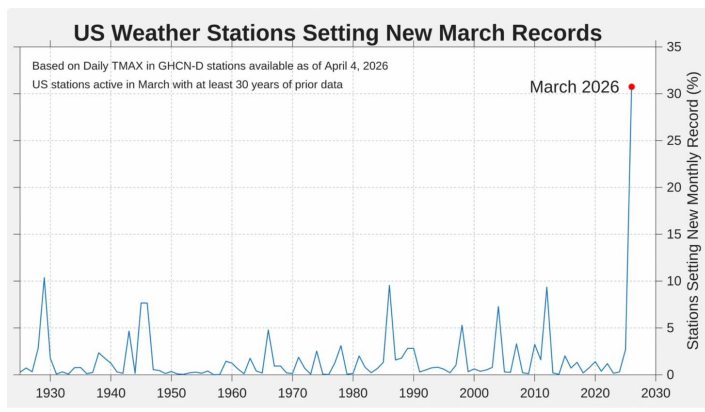


Fig. 3. U.S. weather stations setting new March monthly records, 1926–2026. March 2026 reaches ~30% — unprecedented for March, second only to May 1934 across all months. Source: GHCN-D.

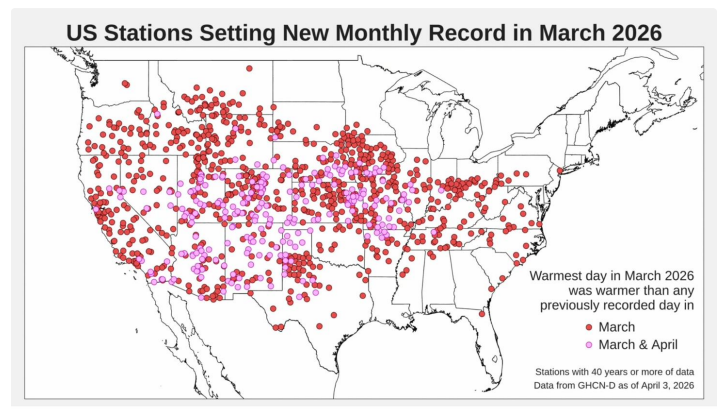


Fig. 4. U.S. stations setting new March 2026 monthly records. Red: exceeded all prior March days. Pink: exceeded all prior March and April days. Stations with ≥40 years of data. Source: GHCN-D, April 3, 2026.

More than 1,008 stations set or tied their warmest March daily maximum on record. **229 tied or exceeded any prior April day; 10 matched or exceeded their all-time May records** — two full months ahead of schedule.

Local Extremes: Station-Level Records

Phoenix, Sedan, and the scale of individual departures from climatology

30% of active stations across the entire U.S. set new monthly records, demonstrating the astonishing breadth of this event, while obscuring how exceptional individual locations were. Within that region, the event produced departures that would be remarkable in any season, let alone March.

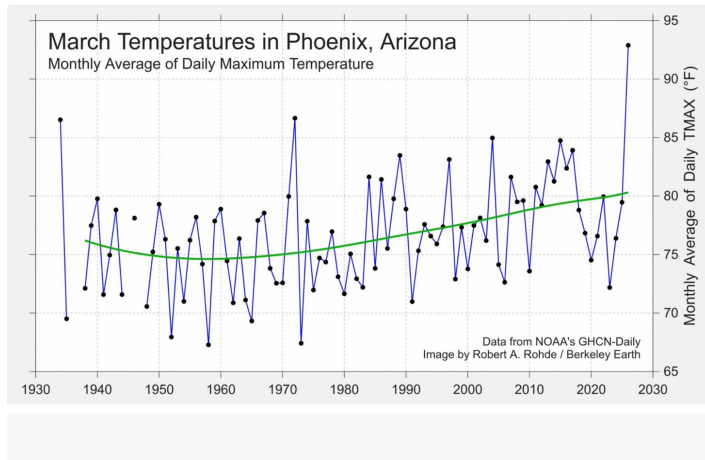


Fig. 5. March temperatures in Phoenix, Arizona (monthly average of daily maximum, °C). The 2026 value soars well above the historical envelope and the long-term trend line. Source: NOAA GHCN-Daily / Berkeley Earth.

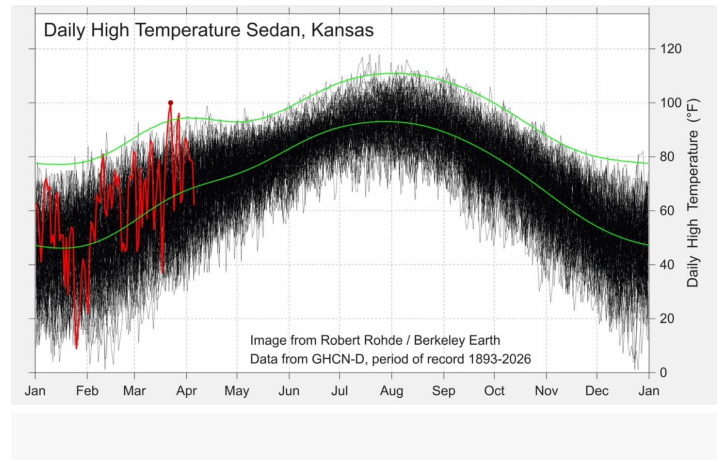


Fig. 6. Daily high temperatures at Sedan, Kansas, 1893–2026. The red spike in March 2026 reached 100°F — equaling the station's May record and occurring more than two months before any prior 100°F reading in the 130-year record. Source: GHCN-D / Berkeley Earth.

229
STATIONS

recorded a March 2026 day that **tied or exceeded any April day** ever observed at that location. Ten stations even matched or surpassed their all-time *May* records — equivalent to summer heat arriving two months ahead of schedule.

+23°F
PEAK DAILY ANOMALY

Phoenix, AZ: Three consecutive days at 105°F (40°C), beating the previous March record by 5°F (~3°C) and tying the all-time April record — the largest positive deviation above normal in Phoenix station history.

Sedan, KS: Reached 100°F on March 22nd — more than two months before the previous earliest 100°F reading in its 130-year history, effectively tying the station's May record. The peak regional daily anomaly of **+23°F (+12.5°C)** in mid-March is the largest positive daily excursion ever recorded for the western U.S.

Meteorological Drivers and Hydrologic Consequences

The blocking ridge, land-surface amplification, and snowpack collapse

The Blocking Ridge

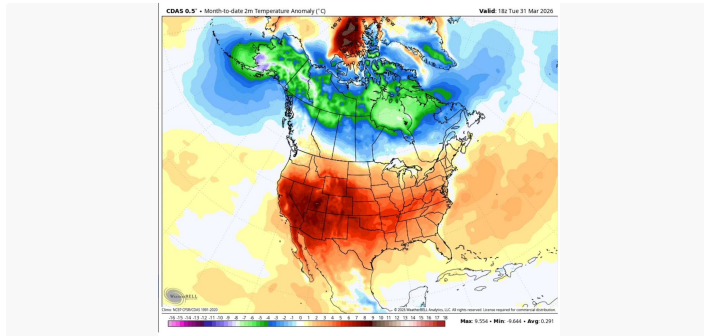


Fig. 7. Month-to-date 2m temperature anomaly (°C) relative to 1979–2000 baseline. The western U.S. interior shows sustained anomalies of +6 to +9°C across the full month of March 2026. Source: ClimateReanalyzer.org.

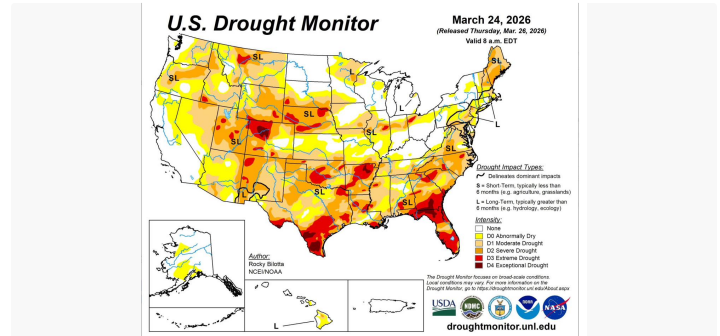


Fig. 8. U.S. Drought Monitor, March 24, 2026. Widespread D1–D3 drought across the West and southern Plains suppressed evaporative cooling, amplifying surface temperatures during the event. Source: USDA/NDMC/NOAA/NASA.

Compound Mechanism

The jet stream deviated north through Canada; a high-pressure system built across the western U.S. with persistent clear skies. Drought-depleted soils disabled evaporative cooling — all incoming solar energy converted directly to sensible heat. Corresponding cold anomalies appeared across Canada, but the area of record cold was only ~5% the size of the area of record warmth.

Hydrologic Consequences

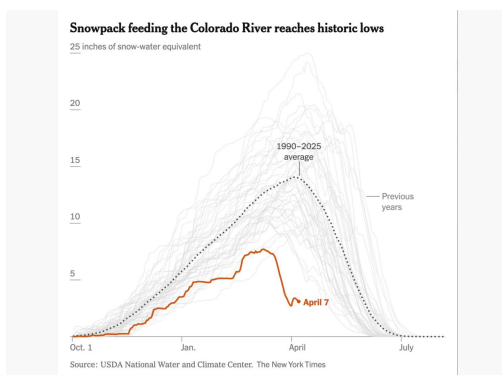


Fig. 9. Snow-water equivalent (inches), Colorado River basin. The 2025–26 line collapsed to a record low for the start of April, far short of the normal seasonal peak. Source: USDA NWCC / NYT.

Low snowfall in the 2025–2026 winter left the snowpack already thin when the heat dome arrived. Rapid melt drove snow-water equivalent to record lows at Colorado River headwaters for early April, when snowpack should be approaching its annual peak.

Early snowmelt means less runoff in late spring and early summer, when cities and agriculture most depend on it. Less runoff in late spring and early summer will also elevate wildfire risk before late summer rains arrive.

Cascade: Blocking ridge → rapid snowmelt → reduced late-season storage → elevated fire weather. Each stage amplifies the next, extending a weeks-long weather event into a multi-sector crisis across the full water year.

Historical Context

The Dust Bowl benchmark and the June 2021 structural analog

Dust Bowl Summers (1930s)

HISTORICAL BENCHMARK

~35%

Peak stations setting monthly records (May 1934)

The canonical U.S. extreme heat precedent, driven by land degradation, severe drought, and natural variability, without significant greenhouse warming. March 2026 (~30%) approaches this benchmark from a cold season month, with anthropogenic warming as an enabling factor.

Pacific Northwest Heat Dome (June 2021)

STRUCTURAL ANALOG

49.6°C

Canada's all-time national record, Lytton, BC

The precedent for compound blocking + land amplification + warming. Attribution: "virtually impossible without climate change." March 2026 shares the same architecture, but its early-season timing carries unique hydrologic consequences that summer heatwaves do not.

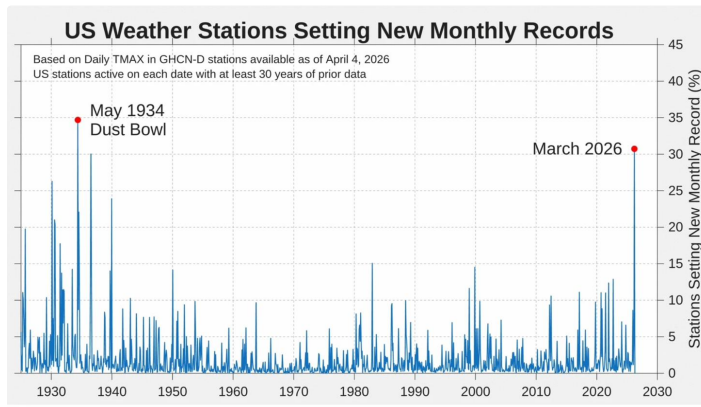


Fig. 10. U.S. weather stations setting new all-time monthly records, all months, 1926–2026. Only May 1934 (Dust Bowl) and March 2026 exceed 30% of active stations. This places March 2026 in the same class as the most extreme heat events in the observational record. Source: GHCN-D.

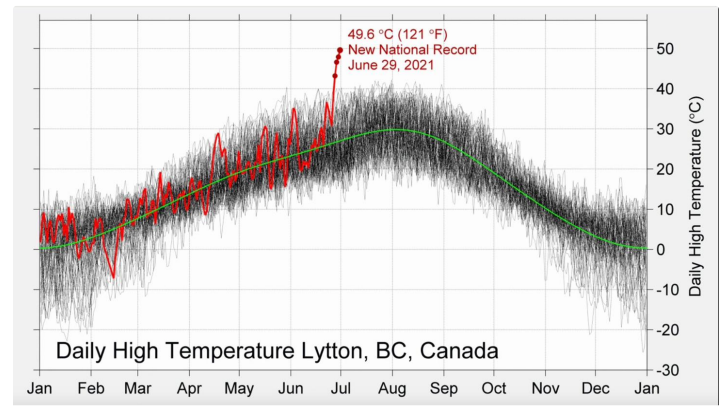


Fig. 11. Daily high temperatures at Lytton, BC, Canada. The red 2021 line reaches 49.6°C on June 29 — Canada's all-time national record, well outside the envelope of any prior year. Shares the compound blocking + land + warming architecture of March 2026. Source: Berkeley Earth / GHCN-D.

What distinguishes March 2026 from the Dust Bowl is the thermodynamic floor: the mid-20th-century baseline has risen ~4°F in March across the western U.S., providing a boost that was absent in the 1930s. What distinguishes it from June 2021 is seasonal timing — cold-season extremes allow physically larger anomalies in absolute terms, and the destruction of snowpack creates cascading water-system consequences that summer heatwaves do not.

Attribution

What enabled this event — and what the observational record shows about the distribution

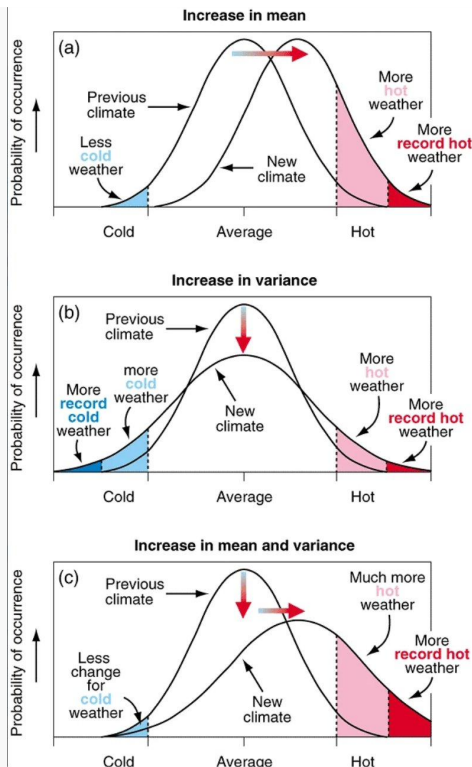


Fig. 12. How climate change shifts extreme heat probability. (a) Mean shift only — the basis for most risk planning. (b) Variance increase only. (c) Combined mean and variance increase — the scenario most consistent with the Berkeley Earth observational record for western U.S. spring temperatures. Source: IPCC AR6.

The $\sim 4^\circ\text{F}$ long-term increase in Western U.S. March mean temperatures since the mid-20th century raised the baseline and made the event possible. GEV methods and large-ensemble modeling indicate the event's probability was **effectively zero in the pre-warming climate**. Most of the temperature deviation was due to weather dynamics — but climate change provided the thermodynamic floor without which that deviation could not have produced a $+11.5^\circ\text{F}$ monthly anomaly.

Scenario (a) in the figure — a shift in the mean alone — is the assumption underlying most infrastructure risk planning, return-period estimates, and extreme-event probabilistic frameworks. Scenario (c) — a combined shift in both the mean *and* the variance — is what the Berkeley Earth observational record appears to be showing for western U.S. March temperatures. The difference between these two scenarios is not academic: scenario (c) produces far more frequent extreme events at both tails of the distribution than scenario (a) predicts, even for identical mean warming.

This has direct implications for how we size water infrastructure, design emergency preparedness systems, and set building codes — all of which are anchored to probabilistic return-period estimates that assume scenario (a). If scenario (c) better describes the real system, those estimates are systematically wrong.

Scenarios (a) vs. (c): A planning-critical distinction

Most infrastructure risk planning is built on scenario (a). Berkeley Earth's observational record for the western U.S. is increasingly consistent with scenario (c). Closing this gap — by testing whether variance in western U.S. spring temperature extremes is stationary or trending — is a first-order priority for climate-risk planners, insurers, and water managers.

The Variance Problem

A key finding unique to Berkeley Earth's long-record observational dataset

Even in today's climate, March 2026 sits at the deep tail of the temperature distribution — and that placement is diagnostic. The question is not simply *whether* the event was extreme, but *what kind* of extreme it represents: a shifted mean, a widened distribution, or both. The answer has first-order consequences for how we estimate the probability of future extremes.

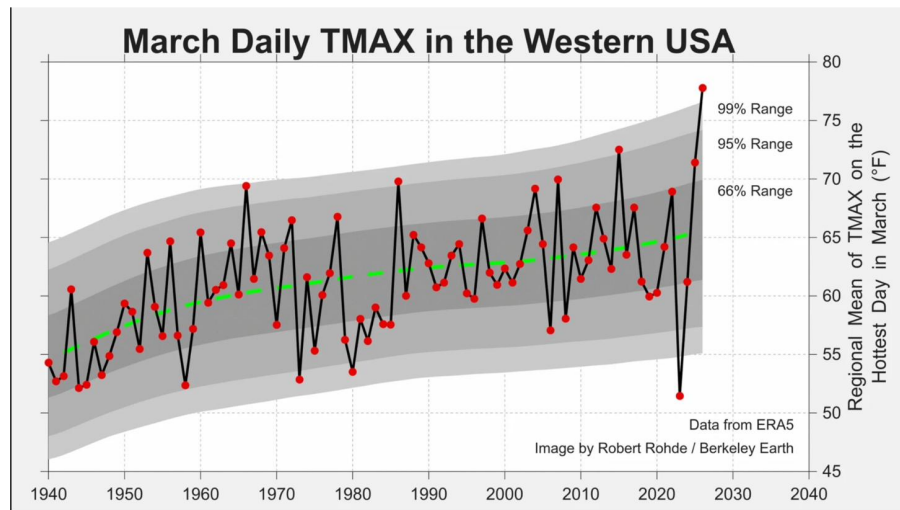


Fig. 13. March daily TMAX on the hottest day of the month, Western USA, 1940–2040. The 99th, 95th, and 60th percentile bands show the historical distribution envelope. March 2026 (red dot, far right) sits above the 99th percentile. Cold outliers in the mid-record reveal the other tail — the signature of a widening distribution, not simply a shifting mean. Source: Berkeley Earth / ERA5.

Berkeley Earth Chief Scientist Robert Rohde flagged a critical observation at the April 2026 press briefing: March 2023 was an anomalously *cold* March in the western U.S. — daily highs markedly suppressed, the mirror image of March 2026. A record-shattering warm March (2026) and an anomalously cold March (2023) within a few years is an empirical signature of **increasing year-to-year variance**, not simply a warming mean.

This matters profoundly for planning. Increased variance means probability mass rises in *both* tails simultaneously — more frequent record-breaking heat *and* more frequent anomalous cold snaps. Standard return-period calculations anchored to a mean-shift assumption miss this signal, producing systematically low estimates of extreme-event probability in both directions.

Topics for Future Research

Variance diagnostics: Formal testing of whether the variance parameter in extreme-value models for western U.S. spring temperatures is stationary or trending upward.

Land–atmosphere coupling: Quantifying the soil–moisture amplification pathway and how winter conditions set the stage for spring extremes.

Blocking frequency: Whether the frequency or persistence of spring blocking ridges over the western U.S. is changing under anthropogenic forcing.

Nonstationary EVT methods: Developing extreme-value models with time-varying scale parameters and dynamical covariates fit for a non-stationary climate.

Research Priorities and Monitoring

What the science still needs — and what to watch going forward

Key Research Needs

- **Variance diagnostics:** Rigorous testing for trends in seasonal temperature variance, not just the mean. Do spring temperatures continue to show increasing variability in the western U.S.?
- **Land-atmosphere coupling:** Quantify the soil-moisture → air-temperature amplification, including how antecedent snowpack and winter precipitation set the stage for spring extremes.
- **Attribution decomposition:** Partition thermodynamic, dynamical, and land-surface contributions via ensemble/AGCM experiments to produce cleaner fractional attributions.
- **Blocking mechanisms:** Better understanding of amplified, persistent ridging — jet-stream dynamics, Arctic–midlatitude linkages — and whether anthropogenic forcing changes their frequency.
- **Nonstationary EVT methods:** Develop extreme-value methods with time-varying scale and dynamical covariates (blocking indices, ENSO phase) — fit for a non-stationary climate.
- **Compound impact modeling:** Integrated hydrologic-ecological-infrastructure models: early snowmelt → reduced inflows → elevated wildfire risk.

Monitoring Indicators

- ENSO indices (Niño 3.4, Niño 4) and ensemble forecasts: NOAA CPC, ECMWF, IRI

- 500-hPa geopotential height anomalies and blocking indices, North Pacific / western N. America

- SNOTEL/NWCC SWE and SMAP/ERA5 soil moisture: Colorado, Sacramento, Columbia basins

- Streamflow anomalies and reservoir storage, Colorado River system

- Arctic polar vortex behavior and sea-ice extent — upstream midlatitude circulation modulator

- NOAA Synoptic Summary of the Day (launched April 2026) — monitor for station gap infill

Key Takeaways and References

For senior decision-makers, planners, and researchers

1 Exceptional event, enabled by warming

The +11.5°F anomaly and ~30% station-record rate are unprecedented outside the Dust Bowl — which had no anthropogenic warming beneath it. This event would have been effectively impossible in the pre-industrial climate.

2 Modeling limits are a practical planning problem

Deep-tail placement reveals that risk assessments must address potential changes in variance and circulation, not just mean shifts. Standard return-period calculations likely understate the frequency of such events.

3 Early-season heat carries unique hydrologic risks

A March extreme destroys snowpack — the West's primary water storage mechanism. Early runoff, reduced late-season inflows, and elevated wildfire risk persist across the full water year.

4 El Niño warrants close monitoring

>90% probability before year-end; ~50% strong or very strong. Primary temperature impact in 2027. Regional effects are basin- and timing-dependent.

5 Invest in nonstationary risk methods

The 2023 cold March / 2026 warm March pairing is exactly the variance signal that mean-shift models miss. Variance diagnostics, dynamical attribution, and nonstationary EVT models are now a planning necessity.

Berkeley Earth High-Resolution Surface Temperature Dataset (BEST-HR)

The analyses throughout this briefing draw on Berkeley Earth's BEST-HR dataset — quarter-degree spatial resolution, bias-corrected and quality-controlled, sourced from 50,000+ global weather stations. BEST-HR powers city-level warming projections, physical risk quantification, and extreme-event attribution. To request access for research or commercial applications:

Request access to BEST-HR: [Berkeley Earth Dataset Access Request Form](#)

REFERENCES

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USDA National Water and Climate Center / NOAA — SNOTEL snow-water equivalent data, Colorado River basin. · NOAA CPC — ENSO forecasts, April 2026.

NOAA / NDMC / NASA — U.S. Drought Monitor, March 24, 2026. · NOAA NCEI — GHCN-Daily station records.

Philip et al. (2021) — Rapid attribution analysis of the June 2021 Pacific coast heat wave. *Earth System Dynamics*.

IPCC AR6, Working Group I, Chapter 11 — Weather and Climate Extreme Events in a Changing Climate.