The CT ENSO La Nina Signal: Compound Climate Overlay for Cotton

Why NOAA NINO3.4 La Nina regime delivers a very strongly significant 26-year directional pattern on Cotton forward 60-day returns via compound Texas and Indian supply stress.

David Stendahl · Market Lab Analytics · November 6, 2026

The signal with the limits stated upfront

Three things the reader must know before the rest of this brief lands.

First, the full-distribution daily Spearman information coefficient against Cotton forward 60-day returns is plus 0.166 at p-value 2.3e-42 on a sample of 6,676 daily observations spanning 2000 through 2026. Very strongly significant on the 26-year window.

Second, the phase pattern is asymmetric. Phase +1 (La Nina) delivers plus 12.33 percent fwd60d across 1,548 trading days (23.2 percent of sample); Phase −1 (El Nino) delivers minus 0.12 percent near-baseline across 1,053 days (15.8 percent). The directional edge concentrates sharply in the La Nina bullish tail. Phase 0 (ENSO Neutral) delivers minus 12.72 percent on 61 percent majority share, making the pattern non-monotone around the neutral regime.

Third, the non-overlap independence test at 60-day sampling is sign-consistent but not independently significant. Across 112 independent samples the Spearman is plus 0.147 with p-value 0.12. The signal functions as a one-sided La Nina bullish detector rather than a symmetric ENSO directional overlay.

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The thesis: La Nina as compound cotton supply stress

ENSO (El Nino Southern Oscillation) is the dominant mode of global interannual climate variability. The NINO3.4 region (5N-5S, 170W-120W) in the equatorial central Pacific carries the standard ENSO index. Positive NINO3.4 SST anomaly indicates El Nino (warm central Pacific); negative anomaly indicates La Nina (cold central Pacific).

La Nina coincides with two cotton-relevant climate teleconnections. First, La Nina typically brings drier conditions to the US Southern Plains including Texas, driving drought risk during the May-September growing season. Texas produces roughly 40 percent of US cotton; sustained La Nina drought regimes compress US production materially. Second, La Nina coincides with weaker Indian

monsoon rainfall over central India including Vidarbha and Telangana. India is the world's largest cotton producer; monsoon deficits compress Indian production simultaneously.

The compound effect across these two major producing regions tightens global cotton supply balance during sustained La Nina episodes. The 2010-2012 double-dip and 2020-2023 triple-dip La Nina episodes delivered the two largest Cotton rallies of the 21st century via this compound-supply-stress channel.

The signal takes NOAA NINO3.4 monthly SST anomaly, sign-flips so La Nina reads positive composite, z-scores on a rolling window, and tanh-bounds. State thresholds plus or minus 0.2 (moderate) and plus or minus 0.5 (extreme). Phase +1 at composite above +0.3, phase −1 below −0.3. Target: ICE US Cotton No. 2 first-nearby back-adjusted close.

Historical window: NOAA NINO3.4 monthly data from 1950; engine runs from 2000 onward with 504-bar warmup.

What the firings have actually done

Computed over 6,676 daily observations post-warmup from 2000 onward. The baseline Cotton forward 60-day return is mean plus 0.97 percent and median plus 0.15 percent across the live-window sample.

> **Baseline Cotton forward 60-day return:** mean plus 0.97 percent / median plus 0.15 percent across the live-window sample.
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> **Daily Spearman IC (fwd 60d):** plus 0.166, p-value 2.3e-42, N equals 6,676. Very strongly significant.
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> **Non-overlap IC (60-day step):** plus 0.147, p-value 0.12, N equals 112. Sign-consistent but not independently significant.
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> **Phase-conditional forward 60-day Cotton returns:** Phase +1 (La Nina, 1,548 days / 23.2 pct): plus 12.33 percent, edge plus 17.25 pp. Phase 0 (ENSO Neutral, 4,075 days / 61.0 pct): minus 12.72 percent, edge minus 7.80 pp. Phase −1 (El Nino, 1,053 days / 15.8 pct): minus 0.12 percent, edge plus 4.80 pp near baseline.
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> The directional edge concentrates sharply in the La Nina Phase +1 bullish tail. The ENSO Neutral middle regime delivers negative edge making the pattern non-monotone.

Three findings. The daily IC is very strongly significant on the 26-year window. The directional edge concentrates sharply in the La Nina Phase +1 bullish tail at 17.25 pp edge above baseline. The El Nino Phase −1 bucket is near-baseline, making the signal a one-sided La Nina bullish detector rather than a symmetric ENSO directional overlay.

Three cases that frame how to read the signal

The canonical anchors are the 2020-2023 triple-dip, 2010-2012 double-dip, and 2015-2016 strong El Nino.

Case 1: The 2020-2023 triple-dip La Nina

La Nina firing across the 2020-2023 triple-dip episode as Pacific SST held cold through consecutive Northern Hemisphere winters. The composite held in Phase +1 territory through the extended window. Cotton rallied materially from the 2020 cycle lows of below 60 cents per pound to above 150 cents per pound in 2022 consistent with the Phase +1 edge; compound Texas megadrought, Vidarbha monsoon stress, and Pakistan Punjab deficit together drove the generational Cotton rally. The 2020-23 triple-dip is the canonical La Nina compound-supply-shock example in the modern sample.

Case 2: The 2010-2012 double-dip La Nina rally

La Nina firing across 2010-2012 double-dip episode as Pacific SST held cold through two consecutive winters. The composite held in Phase +1 territory through the window. Cotton rallied to record highs above 200 cents per pound in early 2011 consistent with the Phase +1 edge; La Nina compounded with the broader 2010-11 commodity supercycle setup producing the generational Cotton high. The 2010-12 double-dip episode remains the record-high anchor for La Nina-driven Cotton rallies.

Case 3: The 2015-2016 strong El Nino

El Nino firing through 2015-2016 as Pacific SST warmed sharply producing a strong El Nino event. The composite held in Phase −1 territory through the regime. Cotton returns through 2015-2016 were approximately at baseline consistent with the Phase −1 near-baseline edge; the signal functions as a one-sided La Nina detector and does not provide symmetric bearish edge during El Nino regimes. The 2015-16 episode illustrates the asymmetric structure of the signal.

How to use this signal today

Composite is currently reading minus 0.744 in the El Nino band. The Neutral phase began October 2026, 22 trading days ago. NOAA NINO3.4 Pacific SST has warmed into El Nino territory through late 2026.

Pair with the following for stacked conviction: Texas USDM Drought (US regional drought check), Vidarbha CHIRPS (Indian supply confirmation), Pakistan Punjab CHIRPS (adjacent South Asian producer), USDA PSD US production (systemic supply anchor), Baltic freight (global demand), apparel inventory demand, CFTC positioning. The ENSO La Nina signal is a top-of-funnel climate filter; regional weather signals confirm where the stress is materializing.

Reader rule: La Nina firings flag bullish compound-supply-stress setups with the 2020-23 and 2010-12 episodes as benchmarks. El Nino firings are near-baseline; the signal is not symmetric. The current El Nino state suggests limited directional edge from this signal alone.

Methodology

Data source: NOAA Climate Prediction Center NINO3.4 monthly SST anomaly from the ERSST v5 dataset. Computation: NINO3.4 anomaly sign-flipped so La Nina (cold anomaly) reads positive, z-scored on a rolling window, tanh-bounded. State thresholds plus or minus 0.2 (moderate) and plus or minus 0.5 (extreme). Phase +1 at composite above +0.3, phase −1 below −0.3. Target: ICE US Cotton No. 2 first-nearby back-adjusted close.

Historical window: NOAA NINO3.4 monthly data from 1950; engine runs from 2000 onward with a 504-bar warmup for the rolling z-score. NOAA updates NINO3.4 monthly on the first week.

Validation computed on 6,676 post-warmup daily observations. Daily Spearman IC plus 0.166 at p-value 2.3e-42 across 6,676 observations, very strongly significant on 26-year sample. Phase +1 (La Nina) per-day forward return plus 12.33 percent, edge plus 17.25 pp above baseline. Phase 0 (ENSO Neutral) per-day forward return minus 12.72 percent, edge minus 7.80 pp. Phase −1 (El Nino) per-day forward return minus 0.12 percent, edge plus 4.80 pp near baseline. Non-overlap IC at 60-day sampling plus 0.147 at p-value 0.12 across 112 samples, sign-consistent but not independently significant.

What this signal does not cover

The signal does not cover other ENSO flavors (Modoki/Central Pacific vs Eastern Pacific). It does not cover non-ENSO climate modes (IOD, PDO, AMO). It does not capture regional downscaled climate outcomes directly (see Texas Drought, Vidarbha CHIRPS, Pakistan Punjab CHIRPS). It does not capture non-US and non-Indian cotton supply effects. NOAA NINO3.4 monthly cadence is slow; signal regime transitions occur over months not weeks.

Disclaimer

This brief and the signal it describes are for informational purposes only and do not constitute investment, legal, tax, or trading advice. Hypothetical or simulated performance results have certain inherent limitations. Unlike an actual performance record, simulated results do not represent actual trading. Also, since the trades have not been executed, the results may have under- or over-compensated for the impact, if any, of certain market factors, such as lack of liquidity. Simulated trading programs in general are also subject to the fact that they are designed with the benefit of hindsight. No representation is being made that any account will or is likely to achieve profits or losses similar to those shown. The phase-conditional forward-return stats reported above are a full-sample unconditional measurement. Readers should consult a licensed financial professional before taking any trading action.

References

NOAA Climate Prediction Center, NINO3.4 monthly SST anomaly from ERSST v5 dataset, cpc.ncep.noaa.gov.

ICE Futures US, Cotton No. 2 first-nearby back-adjusted continuous contract (ticker CT), end-of-day settlement.