The KC FIRMS Brazil Sul de Minas Fire Signal: Real-Time Satellite Supply-Destruction Lens for Arabica

Why NASA FIRMS satellite fire-detection over the first-tier Brazilian Arabica belt delivers one of the few KC signals with INDEPENDENTLY SIGNIFICANT non-overlap test at the 5 pct threshold.

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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 Arabica forward 60-day returns is plus 0.164 at p-value 5.95e-37 on a sample of 5,955 daily observations. Extremely significant. Phase +1 (Fire Intensity) delivers plus 4.14 percentage points above baseline across 1,346 trading days (22.4 percent of sample); Phase –1 (Quiet Fires) delivers minus 1.73 percentage points across 3,710 days (61.7 percent). 5.87 pp directional spread.

Second, the non-overlapping independence test at 60-day sampling is INDEPENDENTLY SIGNIFICANT at the 5 percent threshold. Across 100 independent samples the Spearman is plus 0.210 with p-value 0.037. This is one of the few KC signals clearing the non-overlap independence threshold, confirming the daily IC is not an artifact of overlapping windows.

Third, this signal has polarity CONFIRMED empirically (higher fire activity in Sul de Minas leads Arabica returns positively), distinct from sibling FIRMS signals in other geographies where the empirical polarity may run opposite to intuition. The confirmation comes from the historical association of Sul de Minas dry-season fires with crop destruction events, as opposed to post-harvest clearing that dominates in other producing regions.

The thesis: FIRMS captures real-time crop destruction

Sul de Minas is the first-tier Arabica growing belt of Brazil, producing roughly 50 percent of Brazil Arabica from the Mogiana plateau south through Carmo de Minas and Tres Pontas. It is the single largest coffee growing region in the world. When fire activity in this belt runs significantly above its 252-day baseline, the signal is reading real-time crop destruction events: wildfire sweeps, drought-driven burn-off, and in compound-shock regimes, direct damage to coffee trees.

NASA FIRMS (Fire Information for Resource Management System) uses VIIRS satellite data to detect thermal anomalies at approximately 375-meter resolution with daily revisit cadence. VIIRS coverage begins 2018; the engine extends via MODIS backfill to 2002-11. The signal takes daily total fire radiative power (FRP, in megawatts) aggregated over the Sul de Minas belt, computes a 30-day trailing average to smooth daily noise, z-scores against a 252-day rolling baseline to isolate regime anomalies, and tanh-bounds to plus or minus one.

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 Coffee C first-nearby close.

What the firings have actually done

The phase pattern is strongly monotone. Computed over 6,015 daily observations post-warmup from November 2002 through November 2026.

> **Baseline Arabica forward 60-day return:** mean plus 2.71 percent / median plus 0.57 percent across the live-window sample.
>
> **Daily Spearman IC (fwd 60d):** plus 0.164, p-value 5.95e-37, N equals 5,955. Extremely significant.
>
> **Daily Pearson IC (fwd 60d):** plus 0.183, p-value 7.2e-46.
>
> **Non-overlap IC (60-day step):** plus 0.210, p-value 0.037, N equals 100. INDEPENDENTLY SIGNIFICANT at 5 pct.
>
> **Phase-conditional forward 60-day Arabica returns:** Phase +1 (Fire Intensity, 1,346 days / 22.4 pct): plus 6.85 percent, edge plus 4.14 pp. Phase 0 (Baseline Fire, 959 days / 15.9 pct): plus 3.63 percent, edge plus 0.93 pp. Phase −1 (Quiet Fires, 3,710 days / 61.7 pct): plus 0.98 percent, edge minus 1.73 pp.
>
> 5.87 pp directional spread.

Three findings. The pattern is strongly monotone across phases consistent with the stated crop-destruction mechanism. The 5.87 pp spread is wide for a short-lead satellite signal. The non-overlap test independently significant at 5 pct is unusual among KC signals and provides strong validation that the signal is not an artifact of temporal correlation.

Three cases that frame how to read the signal

The canonical anchors are the 2021 compound drought-plus-fires, the 2024 drought fire season, and the 2015 La Nina wet regime.

Case 1: The 2021 Brazilian dry-season fires

Fire Intensity firing anchored the 2021 Brazilian dry-season fire event, which coincided with the broader drought regime that led up to the late-June 2021 Minas Gerais frost. NASA FIRMS captured elevated fire activity across Sul de Minas through the dry season as drought-stressed vegetation ignited more easily. The composite held in Phase +1 territory, anticipating the 2021-2022 Arabica rally. Signature anchor for how satellite fire-detection captures compound-shock regimes in real time.

Case 2: The 2024 drought fire season

Fire Intensity firing anchored the 2024 Brazilian dry-season fires during the broader 2024 drought. NASA FIRMS captured sustained elevated fire activity across Sul de Minas through August-September 2024. The composite held in Phase +1 territory, confirming the supply-tightening regime that drove the 2024-2025 Arabica rally. Modern replication of the fire-driven supply-shock pattern.

Case 3: The 2015 La Nina wet regime

Quiet Fires firing anchored the 2015 La Nina wet regime as Sul de Minas ran below-baseline fire activity during the wet-season transition. The composite held in Phase −1 territory consistent with the loose-supply regime. Canonical Phase −1 anchor showing how the signal reads wet-regime quiet-fire context as bearish Arabica.

How to use this signal today

Composite is currently reading minus 0.135 in the Baseline Fire band. The NEUTRAL phase began August 2026, 58 trading days ago. NASA FIRMS fire intensity over Sul de Minas is running near its 252-day baseline.

Pair with the following for stacked drought-plus-fire conviction: the TERRACLIMATE water-deficit signal (medium-lead PET-AET drought lens), the CHIRPS Cerrado signal (satellite precipitation on second-tier belt), the CONAB Minas signal (official supply forecast), the Cecafe realized-price signal (short-lead transaction confirmation), and the ENSO signal (long-lead ocean forcing). The FIRMS signal is short-lead real-time; it confirms the drought-plus-fire compound-shock regime that other signals set up in advance.

Reader rule: Phase +1 firings during the June-October dry-season window are the operative supply-destruction setups. Phase −1 firings coincide with wet-regime loose supply. Phase 0 readings are informational without directional conviction.

Methodology

Data source: NASA FIRMS VIIRS satellite fire detection (total_frp_mw aggregated) over the Brazil Sul de Minas commodity belt. Computation: 30-day trailing average of daily FRP, z-scored against a 252-day rolling baseline, tanh-bounded to plus or minus one. 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 Coffee C first-nearby close.

Historical window: VIIRS from 2018 onward; MODIS backfill extends to 2002-11.

Validation computed on 6,015 post-warmup daily observations. Daily Spearman IC plus 0.164 at p-value 5.95e-37 across 5,955 observations, extremely significant. Phase +1 per-day forward return plus 6.85 percent (plus 4.14 pp above plus 2.71 pct baseline). Phase −1 per-day forward return plus 0.98 percent (minus 1.73 pp below baseline). 5.87 pp directional spread. Non-overlap IC at 60-day sampling plus 0.210 at p-value 0.037 across 100 samples, INDEPENDENTLY SIGNIFICANT at 5 pct.

What this signal does not cover

The signal does not distinguish crop-destruction fires from post-harvest clearing fires; context from other signals (drought, CONAB, realized price) is needed. It does not cover the Cerrado second-tier

belt (see sibling CHIRPS signal for that geography). It does not cover ICE futures positioning. It does not resolve sub-30-day moves due to the trailing smoothing window. Fire activity concentrates June-October; off-window readings carry less information.

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

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