Fact-Checked Science

EVIDENCE REVIEW · S0 NEWS RESEARCH NOTE

S0 News's Schumann note: a small after-storm shift on one coil, not days of disruption

S0 News's research note 001, credited to an "internal GrokBot Team", says that after 42 storms the Schumann resonance at a station in Spain stayed outside its quiet-day band for a median 79 hours after Kp had recovered [1]. Its numbers reproduce from its own tables, and its storm list rebuilds from GFZ's Kp [2] [9]. The note lists a placebo test that it didn't run. We ran it on the station team's own data: storm-free days need about 20 hours to pass the same rule, and one in seven doesn't within five days [4]. Storms probably take roughly a day longer, and what remains is a shift of a few hundredths of a hertz on one of the station's two coils.

By Fact-Checked Science · Published November 6, 2026

OUR ANALYSIS marks our own reasoning and calculations. That covers the recomputation of the note's numbers from its tables, the rebuilt storm list, and the re-run of its rule on the station team's data, for its storms and for storm-free starts. It also covers the simulation and the checks on solar flux, Kp and TEC. "Post hoc" marks checks chosen after the first run. The verdicts are our assessment. Everything else comes from the numbered sources. For the note [1], locators are its own section names: Claims 1–7, Methods, What this means, What would falsify this, Scope and Figure 2. For other sources, the list says what we read.

The note's numbers reproduce. The placebo it skipped shows what its rule costs an ordinary day, and leaves a small shift on one coil

OUR ASSESSMENT

14%

of 85 storm-free starts never "recover" within 5 days under the note's own rule, and half of them need 20 hours or more, by our analysis of the station team's own data [4] [9]

49 h

is the median for the note's 41 storms on the station team's own fits, not the note's 79 h. Storm-free starts need 20 h, so storms take roughly a day longer; how sure that is depends on the matching (p = 0.025 to 0.11), by our analysis

+0.07 Hz

is how far the north–south coil's first Schumann frequency sits above quiet days in the first day after storms. After storm-free starts it is +0.01 Hz. The gap narrows to a few hundredths over days 2–4. On the noisier east–west coil we detect no shift, though we can't rule one out, by our analysis

THE NOTE'S CLAIMS

OVERSTATED

Disrupted for days, median 79 h

The title, "Schumann Resonance Stays Disrupted for Days After Solar Storms", and the opening sentence: NS f1 stayed out of band "for a median 79 hours (≈3.3 days) after Kp recovery" [1]

The 79 h reproduces from the note's own table, but its 95% interval runs from 50 hours to beyond 120. On the station team's own fits the median is 49 h. Storm-free starts already need 20 h under the same rule. What remains is a frequency shift of a few hundredths of a hertz, about a fifth of the normal daily swing, on one of the station's two coils. See sections 2 to 4.

TRUE

42 storms, 25 clean

Claims 1: "Every GFZ Kp ≥ 6− episode from March 2013–February 2017: 42 total, 25 clean_5d" [1 Claims 1]

Our own rebuild from GFZ's Kp gives the same 42 storms, 25 of them clean, with every t0 and cut-off identical [9]. One slip in notation: the opening sentence's "Kp6+" would mean Kp 6.33, which only 22 of the 42 reached. The Methods use 6−. See section 2.

TRUE

First-day f1 slightly high

Claims 5: "the first-day median NS f1 deviation from the episode quiet median was about +0.063 Hz" [1 Claims 5]

It reproduces: 40 of 41 storms are positive. On the station team's own fits the shift is +0.07 Hz, positive for 38 of 41, against +0.01 Hz after storm-free starts ($p = 2 \times 10^{-6}$) [4]. Solar radio flux doesn't explain it. It is small, as the note's own word says. On the east–west coil we detect no shift, though its noise can't rule one out. See section 4.

MISLEADING

Early disturbance significant

Claims 6: "Early disturbance is significant. First 24 h after t0: NS f1 Holm-adjusted $p = 3.1 \times 10^{-4}$ (n=41)." [1 Claims 6]

The p-value is computed correctly. But it tests against 0.6745, which holds only if the quiet days' median and spread were known exactly and the day were just like the quiet days. Ordinary storm-free starts pass the same test ($p = 6 \times 10^{-4}$), and storms don't differ from them on it (p = 0.34). So the test leaves the false impression that it shows a storm effect. The signed shift in claim 5 is what does. See section 5.

UNSUPPORTED

TEC recovers a day sooner

Claims 7: "TEC recovers about a day sooner." TEC's median is 58 h against f1's 79 h [1 Claims 7]

On the note's own table TEC's median is shorter. It is shorter still without the 7 storms that have no TEC data: 26 h against 79 h. So that table error helps the claim. But each TEC run needs only six two-hourly samples, against twelve hourly f1 values. Sampled the same way, the station team's f1 recovers in a median 26 h, the same as TEC (post hoc). We didn't test TEC against storm-free days. See section 6.

OVERSTATED

Kp clock off by days

What this means: "A Kp-only clock underestimates how long Earth's electromagnetic environment stays storm-modified, by days." [1 What this means]

The note's clock starts at Kp ≤ 4+, a level at which NOAA still issues alerts [11], and Kp stays raised into day 4. On the north–south coil a small offset does outlast that clock: about 0.03 Hz once Kp is allowed for, lasting into day 4. So "by days" has some basis. What is overstated is "Earth's electromagnetic environment … storm-modified". It rests on a few hundredths of a hertz on one coil, with no shift we can detect on the other, and about 40% of it tracks the Kp still raised after t0. See sections 4 and 8.

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1 · THE NOTE

A research note from S0 News, a strict rule, and a test it said it hadn't run

S0 News's research note 001 is a public Google Doc, a "Space Weather News Research Note from internal GrokBot Team 001". With it comes a public folder of the tables behind its numbers [1] [2]. S0 News linked it from the YouTube page of its November 6, 2026 episode [3]. The note hasn't been peer reviewed, and its code isn't published.

THE STORMS

42 episodes

The note takes every storm from March 2013 to February 2017 in which GFZ's Kp index reached 6− or more [10]. Its clock, t0, starts when Kp has stayed at 4+ or below for six hours after the storm's last peak [1 Methods, Inventory].

THE SIGNAL

One frequency, one coil

The signal is the first Schumann resonance frequency, f1, about 7.8 Hz. It is measured on the north–south coil of the University of Granada's extremely-low-frequency station in the Sierra Nevada, Spain. The note uses hourly medians of 10-minute fits [1 Methods, Signals] [5]. The station's raw recordings, about 107 GB for the four years, are public [8].

THE BAND

About seven quiet days

For each storm, "normal" is the 2.5–97.5 percentile range of up to ten international quiet days within 15 days of t0. The range is taken at the same UT hour. In practice that means 7.4 days on average [1 Methods, Quiet band].

THE CLOCK

Twelve straight hours

A storm counts as "recovered" at the first hour from which f1 stays inside its band for twelve consecutive hours. Each storm is followed for 120 hours, or until a new storm starts. The note summarises the results with a Kaplan–Meier median [1 Methods, Recovery time and survival].

What the note does well

It publishes its derived tables and, under "How to recreate the headline numbers", a step-by-step recipe for each of them [1 Methods] [2]. Every one of them reproduces exactly (section 2). The note names its own limits: one station, one coil, one TEC grid point, the "SC24 declining phase", and an "association with Kp recovery, not mechanism proof" [1 What would falsify this]. It also lists the tests that would falsify it, including the placebo, "not run before this publish" [1 What would falsify this] [1 Scope]. When we ran that placebo, the note passed its own criterion: storm-free starts don't give the same recovery times (section 3).

OUR ANALYSIS

The rule is strict. Seven quiet values give a band close to their minimum and maximum. Twelve hours in a row must then fall inside it. So the question the note leaves open is how often an ordinary day with no storm at all fails the same rule. We answer that with the station team's own published fits in section 3.

2 · IT REPRODUCES

Every number reproduces, and the storm list rebuilds from GFZ's Kp

We recomputed every headline number from the note's own tables with our own code [2]. We also rebuilt its storm list from GFZ's definitive Kp [9]. The list matches: 42 episodes, 25 clean, with every t0 and cut-off identical. The note's storm start is the first bin of Kp 5− or more in each storm.

The headline numbers, recomputed from the note's tables

OUR ANALYSIS

NUMBER	THE NOTE	OUR RECOMPUTATION
Kaplan–Meier median, NS f1, pipeline A	79 h; clean storms 78 h [1 Claims 2]	79 h and 78 h; 95% interval 50 h to beyond 120 h
Recovered within 5 days	22 of 41 [1 Claims 2]	22 of 41
Not recovered: no new storm / new storm	12 / 7; S(106 h) ≈ 0.39 [1 Claims 3]	12 / 7; 0.393
Pipeline B	14 of 39; median not reached [1 Claims 4]	14 of 39; curve flat at 0.637 from 51 h
TEC medians, pipelines A and B	58 h and 61 h [1 Claims 7]	58 h and 61 h
First-day shift	+0.063 Hz, IQR 0.033–0.091, 40 of 41 positive [1 Claims 5]	+0.0633 Hz, 0.033–0.091, 40 of 41
Early-window test	Holm $p = 3.1 \times 10^{-4}$; TEC 0.11 [1 Claims 6]	exact $p = 1.53 \times 10^{-4}$, Holm 3.05×10^{-4}; TEC 0.113

Our code reads the note's tables, fetched by URL [2]; the interval is Brookmeyer and Crowley's. About half the storms never record a recovery, so the median is imprecise: in 10% of bootstrap resamples it is never reached.

The note's other claims about its recovery times

OUR ASSESSMENT

CLAIM	VERDICT	WHY
Claims 2: "Only 22/41 (53.7%) recovered within 5 days" [1 Claims 2]	PARTLY TRUE	The computation is right. But the figure comes from S0 News's own unpublished processing. On the station team's published fits, 26 of the 41 recover and the median is 49 h. S0's quiet-day medians sit 0.09–0.27 Hz above the station team's for all 41 storms (median 0.14 Hz), so the note's f1 values are not the station's [4].
Claims 3: "12 never re-entered the quiet band with no new storm" [1 Claims 3]	PARTLY TRUE	The counts hold. The note defines recovery as to "re-enter the quiet-day band and stay ≥12 h" [1 Claims 2], so "never re-entered" may be its shorthand for that. Read plainly, though, it says more than the table records, which is only that no 12-hour stay occurred [2]. In our re-run, the 8 storms that never qualified spent 25–73 of their 120 hours inside the band.
Claims 4: "Pipeline B corroborates multi-day persistence" [1 Claims 4]	UNSUPPORTED	The note itself warns that pipeline B's data "are effectively thin after ~3 days (~72 h)", and that its median must be read with that limitation [1 Claims 4] [1 Methods, Two pipelines]. The title of its Figure 2 says those data stop at "+71 h" [1 Figure 2]. So no 12-hour run can start after about 60 h, and storms without data stay "out" to 120 h, which builds in the "median not reached". The station's record is 99.7% complete over those hours [4]. Pipelines A and B also disagree on whether a storm recovered for 10 of 39 storms.

3 · THE MISSING CONTROL

Under the note's own rule, ordinary days with no storm often fail too

The note itself lists the test that matters most here: storm-free start times, matched for season and time of day, run through the same rule [1 What would falsify this]. We ran it on the station team's own published fits of f1, which run from 2013 to 2018 [4]. The rules were written and hashed before any f1 value was used.

OUR ANALYSIS

First, the arithmetic

Take seven quiet values. A new hour drawn from the same distribution lands inside their 2.5–97.5 percentile range 72% of the time (75% for their minimum and maximum). If hours were independent, twelve in a row inside would come up only 2% of the time for any given window, and half of all storm-free starts would still be "out" after 120 hours. In reality f1 drifts by day, and its hours move together. A simulation with the station's own scatter (day-to-day 0.081 Hz, hour-to-hour 0.090 Hz, an hour-to-hour correlation of 0.61) gives 13% never recovering and a median of 25 hours [4].

STORM-FREE STARTS THAT NEVER "RECOVER" IN 5 DAYS

OUR ANALYSIS

14%

12 of 85 (95% CI 8–23%). Across 50 random draws of the placebo set it is 7–21%

THEIR MEDIAN TIME TO "RECOVER"

OUR ANALYSIS

20 h

95% CI 15–27 h; 15–30 h across 50 other draws. Intervals are Brookmeyer and Crowley's, as for the storms

THE 41 STORMS, ON THE SAME DATA AND RULE

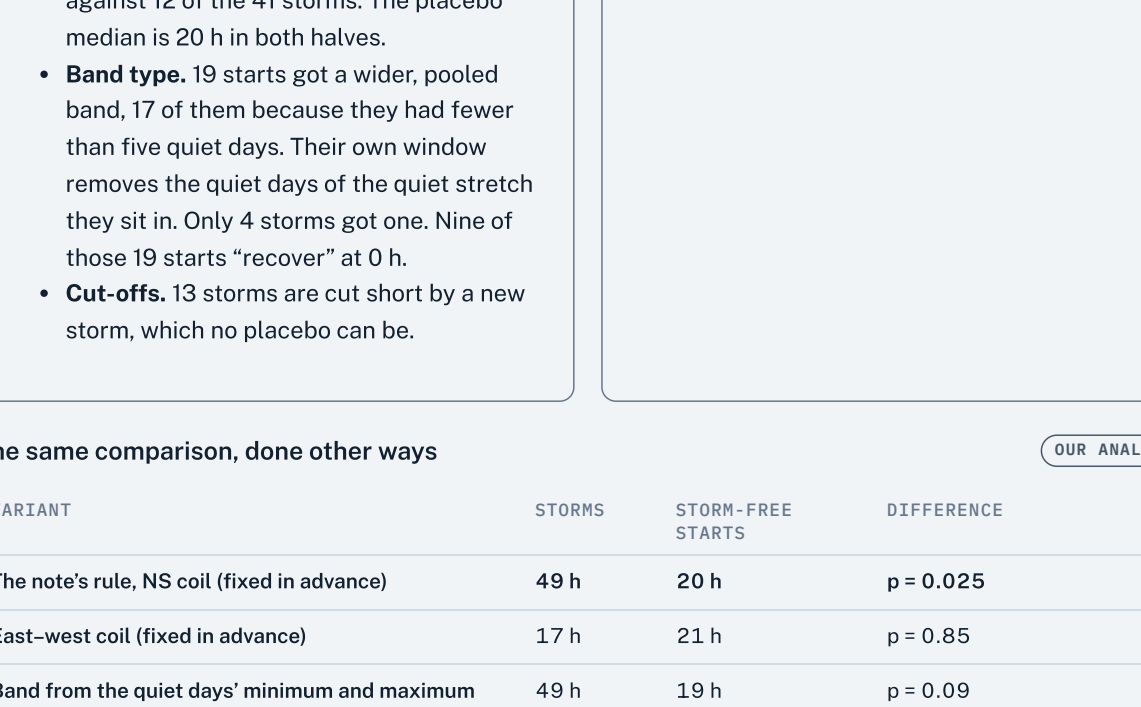
OUR ANALYSIS

49 h

95% CI 26–94 h; 26 of the 41 recover within 5 days

Storms take longer than storm-free days to pass the rule, but storm-free days take time too

OUR ANALYSIS



Hours after Kp returned to 4+ or below (t0). Vertical axis: share of starts not yet back inside the quiet-day band for twelve straight hours

Our own analysis of the station team's f1 series, Rodríguez-Camacho and Salinas (2022), Universidad de Granada, CC BY-NC 4.0, used non-commercially with credit [4]. Storm times are from the note, rebuilt from GFZ's Kp, CC BY 4.0 [9] [2]. The dashed curve is our recomputation from the note's own table, not a redrawing of its figure. Dots mark where each curve crosses half.

OUR ANALYSIS

How the placebo was drawn

Each storm was matched with up to three start times at the same UT hour, within 30 days of its date in the year, from 2013 to 2017. A start needed no Kp of 5− or more from three days before to seven days after it. Starts had to be at least 120 hours apart, and each had to pass the note's coverage and quiet-day rules. That gave 85 starts, fixed by a seeded random draw.

The draw doesn't match three things:

- **Year.** 55 of the 85 starts are from 2013–14, against 12 of the 41 storms. The placebo median is 20 h in both halves.
- **Band type.** 19 starts got a wider, pooled band, 17 of them because they had fewer than five quiet days. Their own window removes the quiet days of the quiet stretch they sit in. Only 4 storms got one. Nine of those 19 starts "recover" at 0 h.
- **Cut-offs.** 13 storms are cut short by a new storm, which no placebo can be.

OUR ANALYSIS

Storms probably take longer

A log-rank test gives p = 0.025. That is the outcome our rules named in advance, "storms recover later than placebos". The direction and the size hold in every variant we tried: storms need roughly 20 hours more within the 120 (restricted mean, 95% CI 2.5–38.5). How sure that is depends on the matching. In 45 of 50 other random draws p stays below 0.05. But matching more strictly, after the first run, leaves p at 0.04–0.11. So the evidence that storms take longer is moderate.

The same comparison, done other ways

OUR ANALYSIS

VARIANT	STORMS	STORM-FREE STARTS	DIFFERENCE
The note's rule, NS coil (fixed in advance)	**49 h**	**20 h**	**p = 0.025**
East–west coil (fixed in advance)	17 h	21 h	p = 0.85
Band from the quiet days' minimum and maximum (fixed in advance)	49 h	19 h	p = 0.09
Run of 6 hours instead of 12 (fixed in advance)	4 h	3 h	p = 0.76
Run of 24 hours (fixed in advance)	17% recover	33% recover; 67% fail	p = 0.10
All 901 storm-free starts at 00 and 12 UT (fixed in advance)	–	17 h, 90% recover	–
Storm-free starts in the station's 2017–18 data (fixed in advance)	–	23 h, 86% recover	–
Like-for-like bands only (post hoc)	65 h	26 h	p = 0.061
Placebos within 400 days of their storm (post hoc)	49 h	24 h	p = 0.057
Band type matched in the draw (post hoc)	49 h	24 h	p = 0.043
Cut-offs allowed for (post hoc)	49 h	20 h	p = 0.043
All three of the above (post hoc)	65 h	26 h	p = 0.11
Three starts for every storm, windows overlapping (post hoc)	49 h	23 h	p = 0.010, too small: 99 pairs overlap

"Post hoc" marks a check chosen after the first run; the "fixed in advance" rows were all named in our rules before it.

- **Like-for-like** keeps only starts whose band is set hour by hour at 20 or more hours of the day.
- **Cut-offs:** starts that never recover are censored 12 hours before their follow-up ends, and each placebo gets its storm's follow-up.
- **All three** also splits the test by year.

On the north–south coil, storms' restricted-mean excess stays at 15–20 h in every row except the 6-hour run.

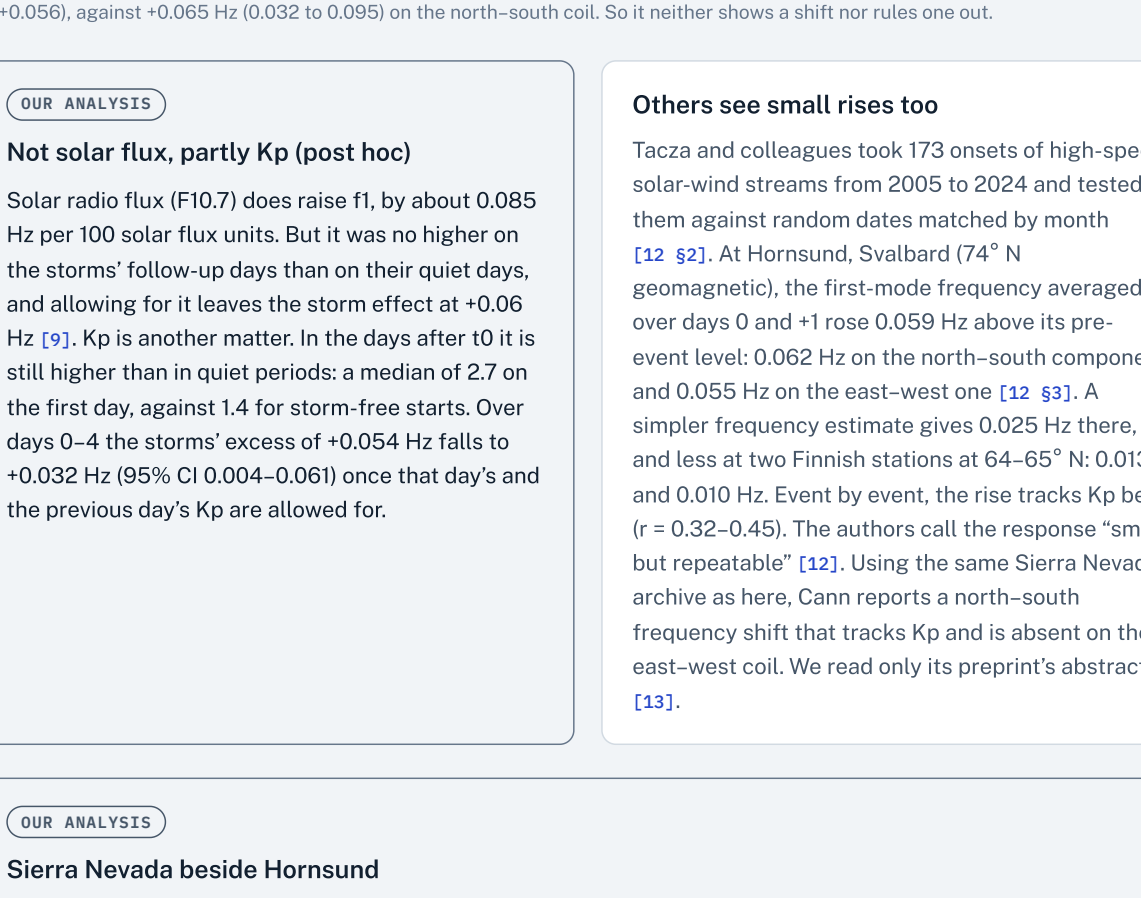
4 · WHAT SURVIVES

A small rise in the north–south frequency after storms, which fades over days

Set the band rule aside and look at f1 itself. After storms, the north–south coil's f1 sits 0.07–0.08 Hz above its quiet-day level over the first two days. After storm-free starts it sits 0.01–0.03 Hz above. The storms' excess is still a few hundredths of a hertz on days 2 to 4 [4].

North–south f1 against its quiet days, hour by hour around t0

OUR ANALYSIS



Hours from t0. Vertical axis: mean of hourly NS f1 minus each start's quiet-day median, hertz. The thin lines are hourly means, which swing with the daily cycle; the thick lines are 24-hour running means of them, which cancel it

Our own analysis of the station team's f1 series, Rodríguez-Camacho and Salinas (2022), Universidad de Granada, CC BY-NC 4.0, used non-commercially with credit [4]. Not a redrawing of the note's Figure 2. Storm hours stop at any new storm.

The daily shift, storms against storm-free starts (post hoc)

OUR ANALYSIS

DAY AFTER T0	NS STORMS	NS STORM-FREE	NS, P	EW STORMS	EW STORM-FREE
The day before	+0.036	+0.021	0.03	+0.008	+0.030
Day 0	**+0.073**	**+0.007**	2×10^{-6}	**+0.027**	**+0.031**
Day 1	+0.083	+0.026	2×10^{-5}	+0.025	+0.043
Day 2	+0.059	+0.026	0.001	+0.017	+0.011
Day 3	+0.075	+0.018	0.003	+0.060	+0.003
Day 4	+0.046	+0.002	0.02	+0.013	+0.014

Medians over the starts of each day's median of hourly f1 minus the quiet-day median, in hertz. The p-values are one-sided Mann–Whitney tests and are not corrected for six days. On the east–west coil only day 3 differs (p = 0.03), and it is one of six tests. That coil's day-to-day scatter, 0.18 Hz against 0.10 Hz on the north–south coil, would hide a small effect [4]. Its first-day difference is −0.004 Hz (95% CI −0.062 to +0.056), against +0.065 Hz (0.032 to 0.095) on the north–south coil. So it neither shows a shift nor rules one out.

OUR ANALYSIS

Not solar flux, partly Kp (post hoc)

Solar radio flux (F10.7) does raise f1, by about 0.085 Hz per 100 solar flux units. But it was no higher on the storms' follow-up days than on their quiet days, and allowing for it leaves the storm effect at +0.06 Hz [9]. Kp is another matter. In the days after t0 it is still higher than in quiet periods: a median of 2.7 on the first day, against 1.4 for storm-free starts. Over days 0–4 the storms' excess of +0.054 Hz falls to +0.032 Hz (95% CI 0.004–0.061) once that day's and the previous day's Kp are allowed for.

Others see small rises too

Tacza and colleagues took 173 onsets of high-speed solar-wind streams from 2005 to 2024 and tested them against random dates matched by month [12 §2]. At Hornsund, Svalbard (74° N geomagnetic), the first-mode frequency averaged over days 0 and +1 rose 0.059 Hz above its pre-event level: 0.062 Hz on the north–south component and 0.055 Hz on the east–west one [12 §3]. A simpler frequency estimate gives 0.025 Hz there, and less at two Finnish stations at 64–65° N: 0.013 and 0.010 Hz. Event by event, the rise tracks Kp best (r = 0.32–0.45). The authors call the response "small but repeatable" [12]. Using the same Sierra Nevada archive as here, Cann reports a north–south frequency shift that tracks Kp and is absent on the east–west coil. We read only its preprint's abstract [13].

OUR ANALYSIS

Sierra Nevada beside Hornsund

At Sierra Nevada the north–south excess over storm-free starts is about 0.06–0.07 Hz on days 0 and 1, the same size as Hornsund's 0.06 Hz on its Lorentzian fits. The two are not measured alike, though. Ours is for bigger storms, with Kp 6− or more, and it is measured from quiet days, counting from t0, after the storm. Theirs is measured from a pre-event baseline, counting from the stream's arrival [12 §2]. Their response appears on both horizontal components [12 §4]. Ours shows on the north–south coil; on the noisier east–west coil we can neither see it nor rule it out. The authors describe a response lasting several days, which they put partly down to daily averaging and to how streams arrive [12 §4]. Our tail, a few hundredths of a hertz to day 4, fits that description. Both are small next to flares: the authors set their response beside the 0.1–0.2 Hz rises reported for flares, and call theirs smaller [12 §4].

5 · THE EARLY-WINDOW TEST

The note's significance test is passed by days with no storm

For each storm the note takes the median of |z| over the first 24 hours after t0, where z measures distance from the quiet median in units of the quiet spread. It then tests those medians against 0.6745 [1 Methods, Headline counts]. That is the value expected only if the quiet median and spread were known exactly and the day itself were just like the quiet days.

THE NOTE'S EXPECTATION

0.6745

The median of |z| for a perfectly known normal distribution

[1 Methods, Headline counts]

STORM-FREE STARTS, REAL DATA

OUR ANALYSIS

0.786

50 of 85 lie above 0.6745. The note's test on them gives p = 6 × 10^{-4}, more "significant" than the storms on the same data (p = 0.007)

STORMS AGAINST STORM-FREE STARTS

OUR ANALYSIS

p = 0.34

No difference in median |z| (Mann–Whitney; storms 0.754 on the station team's fits)

OUR ANALYSIS

Why ordinary days exceed 0.6745 has three parts. The quiet median and spread are estimated from about seven days, which already pushes the expected median of |z| to 0.69–0.71 in our simulation. Quiet days are chosen for being the quietest of their month, and f1 rises about 0.03 Hz per unit of Kp. And days up to 15 days away drift with the season. A fair test compares storms with storm-free starts handled the same way. On that comparison the |z| test shows nothing, while the signed first-day shift of section 4 does.

6 · TEC

Sampled alike, f1 recovers as fast as TEC; TEC's own storm-free baseline is untested

Claim 7 sets the TEC median, 58 h, against f1's 79 h. TEC is the ionosphere's total electron content, taken from CODE's global maps at one point over the station [1 Claims 7] [1 Methods, Signals]. We checked the comparison on the note's own table, and against the station team's f1 sampled as the TEC series is [2] [4].

The table's error helps the claim

Seven storms of 2013–14 have no TEC sample after t0. The table still counts them as "not recovered" for 120 hours, although the note's own rule asks for 70% of samples [1 Methods, Signals]. All seven have t0 at an odd UT hour, while every 2013–14 storm with an even-hour t0 has data. That fits sampling every two hours from t0 when CODE's maps were two-hourly, at even hours (our inference) [2]. Leave the seven out and TEC is faster still: a median of 26 h on the 34 storms with both series, against f1's 79 h. Storm by storm, f1 is later in 14 and TEC in 13, and 7 can't be told apart. The gap vanishes in 5% of resamples (our recomputation) [2].

Like for like, the gap goes

For every storm the TEC series after t0 has one sample every two hours, 60 in a full 120 hours. So a 12-hour run is six TEC samples against twelve f1 values [2]. We sampled the station team's f1 the same way, with the same storms and bands. Its median is then 26 h, the same as TEC's, and f1 recovers later in 10 storms against TEC in 19 (post hoc) [4] [2]. Hourly, the station's f1 gives 37 h on the same 34 storms, still not clearly later than TEC (p = 0.74). The note's 79 h rests on its own f1 processing and its twelve-sample runs.

S0 News's companion note uses band-mean TEC and the same kind of rule. There, storm-free starts "recover" in a median 16 hours against the storms' 24, a difference that can't be told from chance (our check of that note). A single grid point, as here, is noisier than a band mean, so we would expect its storm-free baseline to be longer still. But we didn't run the single-point TEC series used here through a placebo, so we can't say how long it takes to pass the rule on storm-free days.

7 · WHAT IS KNOWN

Solar events do nudge the Schumann frequency, mostly by tenths of a hertz or less and while they last

The Schumann resonances are electromagnetic oscillations of the cavity between the conducting ground and the lower ionosphere, kept ringing by lightning [14]. Their frequencies depend on where the ionosphere's conductivity rises. Ionization added above about 60–70 km raises f1; ionization added below that lowers it [19].

What earlier studies found

- **X-ray flares** raise f1 by about 0.1–0.2 Hz for as long as the burst lasts [15] [19].
- **Solar proton events** lowered it by about 0.15–0.6 Hz at stations in Russia and China while the protons penetrated [16] [17] [19]. At Arrival Heights in Antarctica, one study of particles above 1 MeV found f1 rising instead, and other influences besides [18]. A review traces the opposite signs of X-rays and protons to the depths they reach. It notes that the two magnetic components can respond differently [14].
- **The solar cycle:** f1 is higher when the Sun is more active [6]. At Sierra Nevada, as the Sun quietened from 2015 to 2018, the yearly median fell by 0.19 Hz (our analysis) [4].
- **Geomagnetic activity:** after solar-wind stream onsets, a rise over days 0 and +1. On one estimator it is about 0.06 Hz at a polar station; on another, 0.025 Hz there against 0.010–0.013 Hz at two stations nearer 64° N [12 §3]. And at this station, a north–south shift that tracks Kp [13].

For the March 2013 and 2015 storms, the station team itself found changes in the resonances. It cautioned that lightning and human noise also move them, and that two events can't settle the question [7]. Those two storms are among the note's 42.

How big is 0.06 Hz at Sierra Nevada?

OUR ANALYSIS

NORTH–SOUTH F1, 2013–17	SIZE
Daily swing, peak to peak	0.33–0.39 Hz by season
Spread from day to day at one UT hour	0.10 Hz (SD)
Spread of daily medians within a month	0.07 Hz (SD)
Seasonal range of monthly medians	0.11 Hz
Width of the note's quiet band	0.26 Hz (median)
S0's quiet medians minus the station team's	0.14 Hz (median)
The note's first-day shift	**0.063 Hz**

From the station team's series [4]. The station sits beside a mountain hut whose diesel generator adds interference peaks to the spectra. The team filters them, and its notes log other spectral anomalies that move some fits [5] [4].

8 · DISTURBED FOR DAYS?

Does Earth's environment stay disturbed long after solar storms?

A catastrophist reading would take the note as a sign that the Earth–ionosphere cavity is slow to recover after each storm. This note gives that idea little to stand on.

OUR ANALYSIS

What the data show is modest. The north–south coil sits a few hundredths of a hertz high for a few days after a storm, while geomagnetic activity is itself still raised. That is about a fifth of the daily swing, and it fades. The east–west coil shows nothing we can detect. Under the note's strict rule, the storms' excess over ordinary days is roughly a day, and the offset itself fades over four or five days. Nothing here points to a cavity that fails to recover. This check couldn't see whether changes build up from storm to storm, since each storm is measured against quiet days within 15 days of itself.

What is already known

The ionosphere's response to storms is a long-studied field [20] [21]. The same small, Kp-linked rise in f1 turns up in other studies [12] [13]. And as the Sun quietened from 2015 to 2018, the station's yearly median f1 fell by more than any storm shift here (our analysis) [4].

9 · REPEAT OUR NUMBERS

The rules, the scripts and our derived numbers; S0 News's tables and the station's data stay with their owners

Each rules file was written before the scripts it governs first ran. The hashes and times are our own log, and RULES_reproduce.txt's hash is logged only in its script's output. The checks marked post hoc say so in their own files. One script fetches every input by URL under a plain client name. We ran it into an empty folder and re-ran every script: the outputs matched ours, apart from the lines that give hashes and times.

PY **fetch_inputs.py**
Fetches the note's tables from its Drive folder, GFZ's files whole, and five station series as byte ranges of the University of Granada's zip, checking each against the zip's CRC-32 and our hashes. It holds no data · 9 KB

PY **01_reproduce_s0.py** and **its output**
Every headline number recomputed from the note's tables. The hosted output leaves out lines that reprint the note's own per-storm values · 12 KB and 7 KB

PY **02_placebo_f1.py** and **its output**
The storm re-run, the placebo and the sensitivity checks fixed in advance · 14 KB and 8 KB

PY **03_inventory.py** and **its output**
The storm list rebuilt from GFZ's Kp · 3 KB and 4 KB

PY **04_posthoc.py**, **06_solarflux.py** and **07_kp_adjust.py**
The post hoc checks: like-for-like bands, 50 draws, full matching, restricted means, daily shifts, F10.7 and Kp, with outputs 04, 06 and 07 · 26 KB in all, with outputs

PY **10_fixround.py** and **its output**
The checks made after the fresh review: TEC like for like, the empty TEC storms, the placebo matched more strictly, and the first-day differences with intervals · 18 KB in all

PY **05_descriptive_sim.py** and **08_checks.py**
The station's daily and seasonal swings, the simulation of the band rule, and the checks on TEC and coverage, with outputs 05 and 08 · 21 KB in all, with outputs

PY **sr_core.py**, **ph_lib.py**, **stats_lib.py**, **gfz.py**, **npyread.py** and **09_km_table.py**
The note's rule, the statistics, the readers (no numpy, no pickles) and the curves behind the first chart; standard library only · 20 KB in all

CSV **placebo_starts.csv** and **storm_rerun.csv**
Each storm-free start and each storm: quiet days, band type, coverage, recovery and first-day shift. Our numbers only, without the note's columns · 11 KB and 3 KB

CSV **km_ours.csv** and **epoch_ours.csv**
The data behind the two charts · 3 KB each

TXT **RULES_placebo_f1.txt**
The placebo's rules, hashed before any f1 value was used · 7 KB

TXT **RULES_reproduce.txt**, **RULES_inventory.txt**, **RULES_descriptive_sim.txt** and **RULES_checks.txt**
The other rules fixed before their scripts ran, one with a logged deviation · 8 KB in all

TXT **RULES_posthoc.txt**, **RULES_posthoc2.txt**, **RULES_posthoc3.txt** and **RULES_posthoc4.txt**
The post hoc checks, each written before it ran, and each saying what prompted it · 8 KB in all

TXT **rules_sha256.txt** and **HASHES.txt**
The hash and time of each rules file, and the hash of every file here · 1 KB and 4 KB

Run it

`python3 -I fetch_inputs.py <folder>` fetches about 27 MB in under a minute: 29 requests, six of them byte ranges. Then run each script with the same folder, for example `python3 -I -B 02_placebo_f1.py <folder> <folder>/out/`. Keep the RULES files in the same folder as the scripts, since each script hashes its rules at the start. Scripts 01–08 and 10 each stand alone; 09 needs 02's output. Python 3.10 or later, standard library only.

The data and their terms

The station team's series: Rodríguez-Camacho and Salinas (2022), Universidad de Granada, CC BY-NC 4.0. This site is non-commercial; we host only numbers derived from them, with credit [4]. **GFZ's Kp, quiet days and F10.7:** CC BY 4.0 [9]. **S0 News's note and tables:** no licence is given, so we quote the sentences we rate, link to the rest and host nothing of them [1] [2].

10 · LIMITS

What this check could and couldn't see

Our f1 is not the note's

We used the station team's published fits; the note used its own unpublished processing, whose quiet medians sit 0.14 Hz higher. We can say what the note's rule does on the station's data, not exactly what it did on S0's.

One station

The note's first falsification test names "a second ELF station (or EW coil)" [1 What would falsify this]. We ran only the coil. On the station team's processing it gives a median of 17 h (95% CI 9–49 h), within the note's ~24 h, so by that test the note's result doesn't carry over to the other coil. A second station wasn't tried.

A placebo with some imbalance

The draw matches time of day and season, but not year, band type or cut-offs, and 9 storms got no placebo of their own. Correcting for those after the first run leaves the excess at 15–20 h but p at 0.04–0.11.

TEC untested

We didn't run a placebo on the TEC series, so claim 7 rests on the note's own table.

Abstracts only

Salinas et al. 2016, Matzka et al. 2021, Cann 2026, Sátori et al. 2016, Mendillo 2006, Buonsanto 1999 and the older flare and proton studies were read as abstracts only, and are paraphrased. Tacza et al. 2026 was read in full.

What would change these verdicts

01
S0 News's own f1 series or code. On its processing the storms' median is 79 h, and a placebo run through that same processing could move the headline either way.

02
The same rules on a second ELF station, with the same storm-free starts. A matching north–south shift there would widen "one coil".

03
A TEC placebo at the note's grid point, which would show whether TEC really recovers sooner than f1 once each is set against its own storm-free baseline.

OUR ANALYSIS

Bottom line: the note's arithmetic is right. What it measures is partly its own strict rule, and the storm effect left over is small.

Storm-free days take 20 hours to pass the rule, and one in seven doesn't within five days. Storms probably take roughly a day longer, though how sure that is depends on the matching. The lasting part is a rise of a few hundredths of a hertz on the north–south coil, partly explained by the Kp that is still raised after t0. That is consistent with what earlier studies have reported, and it falls short of "disrupted for days".

Related checks

FALSE More auroras from less solar input? The Disaster Cycle, Fact-Checked

MISREAD A "major magnetic anomaly" in 2023 The Disaster Cycle, Fact-Checked

Sources

Bracketed numbers refer to this list. For the note [1], which has no page numbers, locators are its own section names: Claims 1 to 7, Methods with its sub-heads, What this means, What would falsify this, Scope and Figure 2. For the other sources, the entry says what we read; for papers read in full, § gives a section. Abstracts are paraphrased. Numbers marked "our analysis" are ours, not the sources'. Links checked November 6, 2026.

1 S0 News (Space Weather News), "internal GrokBot Team 001" (2026). Schumann Resonance Stays Disrupted for Days After Solar Storms. A Space Weather News research note, a public Google Doc headed "SPACE WEATHER NEWS & RESEARCH PUBLICATIONS 2026". The note is undated: the files in its Drive folder are dated November 3, 2026, and S0 News linked it from the YouTube page of its November 6, 2026 episode. Retrieved November 6, 2026, as a text export (SHA-256 f3ca788a0a7608b0057d6212c0df666d 8e3d1c830490ac61274dd6c52e3fc99a) and as an HTML export with its two figures. Read in full. No licence is given, so it is quoted, not hosted.

2 S0 News (2026). The derived tables of research note 001, a public Google Drive folder: 11 CSV files and a MANIFEST.md, read November 6, 2026. The SHA256SUMS.txt that the MANIFEST lists isn't in the folder. No licence is given, so our scripts fetch the tables by URL and we host none of them.

3 SpaceWeatherNews (S0) (November 6, 2026). Sky Fall Continues, Solar Storms Linger for Days | S0 News Nov.6.2026. YouTube video. No transcript was available, so it is cited only as the page from which S0 News linked the note.

4 Rodríguez-Camacho, J., and Salinas, A. (2022). Notebooks to study the anomalies detected in the Schumann resonances at the Sierra Nevada ELF station [data set and notebooks]. Universidad de Granada. CC BY-NC 4.0. We used its 10-minute series of first-mode frequencies for both coils, with their masks, from March 2013 to December 2018: five files fetched as byte ranges of the 602 MB archive and checked against its checksums. We read its notebooks as text.

5 Salinas, A., Rodríguez-Camacho, J., Portí, J., Carrión, M. C., Fornieles-Callejón, J., and Toledo-Redondo, S. (2022). Schumann resonance data processing programs and four-year measurements from Sierra Nevada ELF station. Computers & Geosciences 165, 105148. CC BY-NC-ND 4.0. Read in full, in the copy in the University of Granada's repository.

6 Rodríguez-Camacho, J., Salinas, A., Carrión, M. C., Portí, J., Fornieles-Callejón, J., and Toledo-Redondo, S. (2022). Four year study of the Schumann resonance regular variations using the Sierra Nevada station ground-based magnetometers. Journal of Geophysical Research: Atmospheres 127, e2021JD036051. CC BY 4.0. Text read in full; its figures were not rendered.

7 Salinas, A., Toledo-Redondo, S., Navarro, E. A., Fornieles-Callejón, J., and Portí, J. A. (2016). Solar storm effects during Saint Patrick's Days in 2013 and 2015 on the Schumann resonances measured by the ELF station at Sierra Nevada (Spain). Journal of Geophysical Research: Space Physics 121(12). Abstract only, as deposited with Crossref.

8 Salinas, A., Rodríguez-Camacho, J., Portí, J., Carrión, M. C., Fornieles-Callejón, J., and Toledo-Redondo, S. (2022). Four-year measurements from Sierra Nevada ELF station [data sets]. Zenodo records 6348930, 6348691, 6348773 and 6348838. CC BY 4.0. Records only, read through Zenodo's API; the raw recordings, 26.5–27.6 GB a year, were not downloaded.

9 Matzka, J., Bronkalla, O., Tornow, K., Elger, K., and Stolle, C. (2021). Geomagnetic Kp index, version 1.0. GFZ Data Services. CC BY 4.0. Definitive three-hourly Kp, the international quiet and disturbed days, and observed F10.7, 2012–2019, fetched November 6, 2026.

10 Matzka, J., Stolle, C., Yamazaki, Y., Bronkalla, O., and Morschhauser, A. (2021). The geomagnetic Kp index and derived indices of geomagnetic activity. Space Weather 19, e2020SW002641. CC BY 4.0. Abstract only, as deposited with Crossref.

11 NOAA Space Weather Prediction Center. Planetary K-index. Web page, read November 6, 2026. It says that K-index alerts are issued when the estimated Kp reaches 4, 5, 6, 7, 8 or 9, and gives G1 as Kp 5 and G2 as Kp 6. A work of the US government.

12 Tacza, J., Sátori, G., Neska, A., Raita, T., and Bozoki, T. (2026). Schumann resonance frequency increase following recurrent solar wind stream onsets. Earth and Space Science 13(10), e2026EA005271. CC BY 4.0. Read in full, in the publisher's PDF supplied by the site's owner after the publisher's site answered our script with a bot check, which we didn't attempt.

13 Cann, K. (2026). Geomagnetic storm enhancement of Schumann resonance amplitude: a dose-response analysis using the Sierra Nevada ELF archive. Journal of Atmospheric and Solar-Terrestrial Physics 286, 106931. Abstract only, from the record of its preprint (ESS Open Archive, doi:10.22541/essoar.15002103/v1) as deposited with Crossref.

14 Sátori, G., Williams, E., Price, C., Boldi, R., Koloskov, A., Yampolski, Y., Guha, A., and Barta, V. (2016). Effects of energetic solar emissions on the Earth–ionosphere cavity of Schumann resonances. Surveys in Geophysics 37(4), 757–789. Abstract only, on Springer's page.

15 Roldugin, V. C., Maltsev, Y. P., Vasiljev, A. N., Schokotov, A. Y., and Belyajev, G. G. (2004). Schumann resonance frequency increase during solar X-ray bursts. Journal of Geophysical Research: Space Physics 109, A01216. Abstract only, as deposited with Crossref.

16 Roldugin, V. C., Maltsev, Y. P., Petrova, G. A., and Vasiljev, A. N. (2001). Decrease of the first Schumann resonance frequency during solar proton events. Journal of Geophysical Research: Space Physics 106(A9), 18555–18562. Abstract only, as deposited with Crossref.

17 Roldugin, V. C., Maltsev, Y. P., Vasiljev, A. N., Shvets, A. V., and Nikolaenko, A. P. (2003). Changes of Schumann resonance parameters during the solar proton event of 14 July 2000. Journal of Geophysical Research: Space Physics 108(A3). Abstract only, as deposited with Crossref.

18 Schlegel, K., and Füllekrug, M. (1999). Schumann resonance parameter changes during high-energy particle precipitation. Journal of Geophysical Research: Space Physics 104(A5), 10111–10118. Abstract only, as deposited with Crossref.

19 Zhou, H., and Qiao, X. (2015). Studies of the variations of the first Schumann resonance frequency during the solar flare on 7 March 2012. Journal of Geophysical Research: Atmospheres 120(10), 4600–4612. Abstract only, as deposited with Crossref.

20 Buonsanto, M. J. (1999). Ionospheric storms — a review. Space Science Reviews 88(3–4), 563–601. Abstract only, as read for our page on a storm's effects near the ground.

21 Mendillo, M. (2006). Storms in the ionosphere: patterns and processes for total electron content. Reviews of Geophysics 44(4), RG4001. Abstract only, as deposited with Crossref.

METHOD

How this was checked

On November 6, 2026, we checked every claim of S0 News's research note 001 [1] against two kinds of evidence. The first was its own tables, the 11 CSV files in its Drive folder [2]. The second was independent records: GFZ's definitive Kp and international quiet days [9], the Sierra Nevada station team's published 10-minute fits of the resonance frequencies [4], and 14 papers. We read the note in full, with its two figures. We also read in full the station team's two papers [5] [6] and Tacza and colleagues' [12], and the rest as abstracts, as the source list marks. Every quotation from the note was checked word for word against our saved copy.

The verdicts and the items tagged "Our analysis" are our own assessment, built on the cited sources. They cover the recomputation of the note's numbers, the storm list rebuilt from Kp, and the re-run of the note's rule on the station team's data for its 41 storms and for 85 storm-free starts. They also cover the simulation of the rule and the checks on solar flux, Kp and TEC. The rules of each test were written, and their hashes logged, before it ran. The checks marked post hoc were chosen after the first run.

Every headline number in the note reproduced exactly from its tables, and its 42 storms rebuilt exactly from GFZ's Kp. We couldn't check S0 News's own f1 and TEC series or its code, none of which is published. S0's quiet-day medians differ from the station team's by a median of 0.14 Hz, so our re-run uses the station's processing, not the note's. We didn't run a placebo on the TEC series, and we didn't try a second station. One paper's full text was refused to our script by a bot check, which we didn't attempt; the site's owner supplied it. The scripts behind every number are hosted with their rules. Run from an empty folder, they gave the same outputs. A fresh reviewer then recomputed the numbers with independent code. The checks that review prompted are marked post hoc.

This page was researched and written with Claude, an AI assistant made by Anthropic, and then re-checked against its sources in a separate verification pass.

The verdicts on this page

MISLEADING	Contains something true but leaves a false impression, usually by leaving out key context.
OVERSTATED	Has some basis but claims much more than the evidence supports.
UNSUPPORTED	No evidence we could find backs it up, though it hasn't been strictly disproven.
PARTLY TRUE	Part of the claim holds up and part doesn't.
TRUE	The evidence supports the claim.

All ten verdicts, and how we check

CORRECTIONS

Corrections and changes

If we get something wrong, we fix it and record the change below with the date. If a correction changes a verdict, the log says what the old verdict was.

Change log

Nov 6, 2026 Published on factchecked.science after a full check against the sources. The page rates six of the note's claims and three more in its sections. It is built from the note, its tables, GFZ's Kp and the Sierra Nevada station team's published data, with our own pre-registered placebo test of the note's rule. No figure of the note is redrawn. The charts are our own analysis; one also shows our recomputation of the note's pipeline-A curve from its table. A fresh review with independent code confirmed the numbers. It led us to correct the TEC comparison: the table's 7 empty storms help the claim, and, sampled alike, f1 recovers as fast as TEC. It also led us to give the placebo result's full range of p, to reword the reason for the Kp verdict, and to make about twenty smaller fixes.

Fact-Checked Science is independent. It isn't affiliated with the channels, presenters or authors whose claims it checks.

Last updated Nov 6, 2026