Fact-Checked Science

PAPER CHECK · SPACE WEATHER

The South Atlantic Anomaly's stronger ground response is real, but decades old, not new

Eleven researchers, most of them at Brazil's space institute INPE, measured the sudden commencement that opened the great storm of May 10, 2024 at São Martinho da Serra, near the heart of the South Atlantic Anomaly, and found it about 1.85 times as strong as at San Juan, Puerto Rico, at the other end of nearly the same magnetic field line [1 p. 19][1 p. 20]. Our re-run of their public data reproduces that almost to the digit, and the contrast survives other events, local time and season, by our analysis [6][7]. S0 News, in a passage on the magnetic pole shift, said a system has tipped enough for this effect to be starting [2 00:01:51–00:01:59]; but the preprint says nothing of the kind, earlier studies reported an enhanced response by 2005 [17 p. 2] and 2010 [19 Abstract][21], and public records show the same excess in every period back to 1999, highest at the start, by our analysis, added after the results [7]. A large part of the ratio, by most yardsticks more than half in logarithms, is San Juan's low response: it sits at the bottom of 22 comparable stations, also by our analysis, and the split, added after the results, is rough [6][7]. We read the preprint in full; it has not been peer reviewed.

By Fact-Checked Science · Published November 1, 2026

OUR ANALYSIS marks our own reasoning and calculations: the re-run of the preprint's numbers; the tests on other events, local times, seasons and stations; the comparison with quiet days; and what we compute from IGRF-14. The verdicts are our assessment. Everything else comes from the numbered sources. Section 10 says which tests were set down in advance and which we added after seeing the results. For the preprint [1], read in full, p. gives a page of its 26-page PDF, whose manuscript starts on p. 3, and l. the line numbers printed in the manuscript's margin. For the thesis [3], p. gives its printed page. Elsewhere p. gives a page and Abstract the part of a source we rely on.

The stronger response is real and reproducible, and the records don't show it starting

OUR ASSESSMENT

1.88

our re-run of the ratio of amplitudes, São Martinho da Serra over San Juan, on May 10, 2024; the preprint prints 1.85, and its other three ratios match ours to the second decimal [1 p. 20][6]

46 of 46

usable sudden commencements of 2013–2026 with the larger amplitude at São Martinho da Serra; the median ratio is 1.86, by our analysis [6][7]

1.49–2.06

the median excess at Vassouras, also under the anomaly, over San Juan in six periods since 1999: 2.06 in 1999–2002, lowest in 2013–17, 1.79 in 2023–26. Already there when the record starts, by our analysis, added after the results [7]

THE CLAIMS

MISREAD

"starting to become enhanced at ground level beneath the South Atlantic anomaly"

The presenter, on the preprint, saying a system has tipped enough for this to happen [2 00:01:51–00:01:59]. The transcript's words run together at 00:01:51: those on the previous link, which end in the magnetic pole shift, run straight on into that system, so the sentence's opening is lost and the words may belong to both.

The preprint never mentions a pole shift, tipping, an onset of the effect or a trend, and it studies one event [1]. It cites earlier reports of the same enhancement [1 p. 22 l. 425–428] and points to a thesis covering 2013–2024 [1 p. 23 l. 453–458], where the ratios are high across those events [3 p. 70]. Public records show the same excess in every period back to 1999, highest at the start (our analysis, added after the results) [7]. He doesn't say the preprint claims this; we rate it Misread because it is his account of the link, like "A pole-shift signal in the storm" on our check of a May 2024 paper. See section 4.

TRUE

The deepening of the weak spot goes on

The presenter's next sentence, in our paraphrase [2 00:01:59–00:02:02]

Rated on its own. In IGRF-14 the South Atlantic Anomaly's minimum fell from 22,451 nT in 2013 to 22,038 nT in 2026, and the area below 26,000 nT grew from 6.71% to 7.80% of Earth's surface, by our calculation [5]. The pace is steady, about 30 nT a year since 2015. The preprint doesn't address it, and none of this ties the deepening to the ground response. See section 9.

TRUE

On May 10, 2024, São Martinho da Serra responded about 1.85 times as strongly as San Juan

The preprint's Tables 4 and 5 [1 p. 19][1 p. 20]

Its four ratios are 1.85, 1.85, 2.55 and 1.75. From the same public files we get 1.88, 1.85, 2.55 and 1.75 (our analysis) [6][7]. Differences in how the two networks make their one-minute values can move the ratios by about 15%, not to 1. And it holds well beyond that day. See sections 2 and 3.

PARTLY TRUE

These ratios indicate that the anomaly may enhance the ground response

The preprint's abstract and plain-language summary [1 p. 4]; its Table 5 calls the ratios amplification factors [1 p. 20]

Part holds. The contrast with the other pairs survives local time and season: at the same hour and date, 1.91 against 0.85–1.09, and the excess spans South America's weak-field stations, about a quarter above comparable stations near noon, with wide limits (our analysis) [6][7]. Part doesn't: the one-event ratio overstates the size, since a large part of it, by most yardsticks more than half in logarithms, is San Juan's low response, and outside South America amplitude doesn't fall with field strength. The authors themselves say no mechanism is shown [1 p. 23]. See section 6.

MISLEADING

Only this pair has all four ratios above 1, and that reversal sets it apart

The preprint's results [1 p. 19 l. 323–325], and again at [1 p. 19–20 l. 349–351]

True of that May day. But every pair shifts toward its summer hemisphere. The near-noon test we set in advance moves all five the same way, on few events; at all hours, added after the results, three of the four reference pairs lean South in November–February, HBK–PAG with all four ratios above 1 in 15 of 22 events (our analysis) [6][7]. Where all five pairs can be compared, SMS–SJG alone has all four above 1 in 12 of 15 May–August events but in 1 of 11 November–February, so a reversal seen in one northern-summer event doesn't set the pair apart the year round. It does stand apart in level: above 1 in every season, and all four above 1 in 45 of 46 events. See section 5.

MISLEADING

The accumulated perturbation shows an enhanced, persistent response at São Martinho da Serra

The preprint's third key point [1 p. 3 l. 17–19]

It is larger there, but by about the same factor with or without a jolt, so the ratio doesn't single one out. The ratio is 1.74 across events and 1.92 on quiet days with no sudden commencement at all, and two other South American observatories show the same against San Juan, 1.90 and 2.07 (our analysis) [6][7]. The authors rightly warn that it does not measure energy deposition [1 p. 19 l. 334–335]. See section 7.

1 · THE PREPRINT

One great storm, five pairs of stations and four ratios

The authors, led by A. R. Piassi of the Federal Institute of Minas Gerais and mostly at Brazil's space institute INPE, asked whether the anomaly changes the ground magnetic response to the sudden commencement of May 10, 2024, the jolt felt on the ground when a solar-wind shock compresses the magnetosphere [1 p. 5 l. 89–91]. We read the preprint in full [1].

STEP 1

The event

One sudden commencement, at 17:04 UT by the preprint, with a 69.2 nT excursion [1 p. 5 l. 90–91]. Ebre Observatory's list gives 17:05, as does the lead author's thesis [9][3 p. 75], and 69.2 nT is the mean of the five amplitudes that list prints.

STEP 2

The pairs

Five roughly conjugate pairs of stations, at the two ends of nearly the same field line: São Martinho da Serra (SMS) and San Juan (SJG) for the anomaly, and four others as references [1 p. 7]. One-minute horizontal field H, four hours around onset, from EMBRACE and INTERMAGNET [1 p. 5 l. 111][1 p. 6 l. 119–125].

STEP 3

Four measures

A, the peak of H above its level before the event; V, the fastest one-minute change; Pc5, the swing of H in a 1.6–7 mHz band; and PA, the sum of all one-minute changes over the four hours [1 p. 9][1 p. 10].

STEP 4

Four ratios

Each measure at the Southern station over the Northern one: R_A, R_V, R_{Pc5} and R_{PA} [1 p. 11]. Above 1 means the South responded more.

The preprint's ratios, and ours from the public files

Pair	Local time at onset	R_A	R_V	R_{Pc5}	R_{PA}	Ours: R_A	R_V	R_{Pc5}	R_{PA}
SMS–SJG	13:30 / 12:40	1.85	1.85	2.55	1.75	1.88	1.85	2.55	1.75
ASC–GUI	16:07 / 15:59	1.09	0.86	0.76	0.93	1.10	0.86	0.76	0.93
GAN–ABG	21:58 / 21:57	0.87	0.76	0.86	0.84	0.87	0.76	0.86	0.84
KDU–KNY	01:55 / 01:49	0.85	0.68	0.67	0.77	0.84	0.68	0.67	0.76
HBK–PAG	18:56 / 18:42	0.81	0.59	0.61	0.70	0.81	0.71	0.61	0.68

The preprint's Tables 1 and 5, numbers only: all rights reserved, so we redraw none of its figures [1 p. 7][1 p. 20]. "Ours" is our analysis, set out in section 2 [6][7]; HBK–PAG's R_V differs because the definitive file for HBK gives a larger V than the preprint prints. Local times are South / North; KDU–KNY's fall on the next day.

WHAT WE READ

The full text

26 PDF pages, supplied by the site's owner: the archive shows scripts a bot check, which we don't attempt [1]

STATUS

Not peer reviewed

a preprint posted October 30, 2026, headed as a manuscript submitted to *Space Weather* [1 p. 3][4]

LICENCE

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its cover pages say so, so we use numbers from its text and tables and our own analysis of public data [1]

What the authors say of their own limits

They write that this case study doesn't isolate the mechanism, and that establishing one would need simultaneous measurements of conductivity or particle precipitation and an electrodynamic model, which is beyond the study [1 p. 23 l. 449–454]. Their plain-language summary says only that the anomaly may enhance the response [1 p. 4 l. 52–53]. Their data statement points to public archives, and it is accurate: that is what made this check possible [1 p. 24 l. 496–505]. They declare no conflicts of interest and disclose ChatGPT's use for language and organisation, not for data or analysis [1 p. 24 l. 507][1 p. 11 l. 269–273].

OUR ANALYSIS

What the one-event design leaves out

The preprint says local time matters [1 p. 4–5 l. 67–68] and lists it, but its results never use it, though only SMS–SJG was near noon [1 p. 7]. The pair design holds local time about equal within a pair, which is its strength, just not across pairs. Season appears only for the electrojet [1 p. 21 l. 392]; May is southern winter. Conductivity is proposed, not measured [1 p. 23]. Distance from the dip equator isn't tested. Ground conductivity, induction in the ground and San Juan's island setting don't appear at all. For other events it points to the thesis [1 p. 23 l. 454–458].

The label is fair, and it is the same anomaly

S0 News linked the preprint as "SAA Ground Magnetism" [2], and that carries no claim. The preprint's South American Magnetic Anomaly is the South Atlantic Anomaly under another name: the lead author's thesis uses América do Sul while spelling SAMA out as South Atlantic Magnetic Anomaly [3 p. 2], and a 2025 paper by overlapping authors writes South Atlantic Magnetic Anomaly [30 Abstract]. In IGRF-14 in May 2024, SMS has a field of 22,265 nT, 174 nT above the anomaly's minimum of 22,091 nT at 26.25°S 59.90°W, 695 km away (our calculation) [5]. Our guide to the field has the anomaly's size and history.

2 · THE RE-RUN

From the public files, the preprint's numbers come back almost to the digit

The preprint doesn't state its window, its baseline, its wavelet or its filter [1 p. 9][1 p. 10]. We found settings that fit its tables, on raw H, and froze them before computing any other event. That is a credit to the authors: their numbers are real, and anyone can check them.

FASTEST CHANGE, V OUR ANALYSIS

0.04%

median difference from the preprint's 12 stations; Pc5 differs by 0.00% and PA by 0.18% [6][7]

AMPLITUDE, A OUR ANALYSIS

1.0%

median difference; the preprint denoises H with a wavelet whose settings it doesn't give, and we use raw H [1 p. 9]

RATIOS, SMS OVER SJG OUR ANALYSIS

1.88, 1.85, 2.55, 1.75

against its 1.85, 1.85, 2.55 and 1.75 [1 p. 20]

OUR ANALYSIS

Could filtering explain it? No

INTERMAGNET's one-minute values are filtered, and we can't tell from what we read how EMBRACE's are made [31 Abstract]. So we resampled San Juan's one-second file for May 10 five ways, as a filter, as means and as single samples; the rules set three of these, and we added two. R_A stays between 1.64 and 1.90, R_V between 1.69 and 2.07 and R_{PA} between 1.47 and 1.78 [7]. The product can move the ratios by up to about 15%; it can't explain them.

OUR ANALYSIS

EMBRACE's values aren't inflated

Two EMBRACE stations sit near INTERMAGNET's Vassouras observatory. Over every usable event, Cachoeira Paulista over Vassouras is 0.93 in A and 0.93 in PA, and São José dos Campos over Vassouras is 0.98 and 0.99 [6][7]. So the network's records agree with an observatory's to within 1–7%. We added this check after seeing the results.

3 · DOES IT HOLD UP?

Yes: other events, local time and season all leave the contrast standing

The tests in this section were set down in advance in our test rules, before any other event was computed: the same four measures on every sudden commencement of at least 20 nT on Ebre's lists, 2013–2026 [9]. That is 90 events; SMS's record allows 50 of them and the pair 46 [6]. The six-hour local-time bins further down were added after the results.

May 10, 2024 was an ordinary day for this pair

Ratio, SMS over SJG	Median	95% interval	Above 1	May 10, 2024	Its rank	Rank, May–August
R_A, amplitude	1.86	1.61–2.07	100%	1.88	23 of 46	4 of 17
R_V, fastest change	1.79	1.64–2.10	100%	1.85	22 of 46	4 of 17
R_{Pc5}, Pc5 band	2.03	1.81–2.36	98%	2.55	10 of 46	3 of 17
R_{PA}, accumulated	1.74	1.64–1.89	100%	1.73	24 of 46	6 of 17

Our analysis [6][7], at Ebre's onset, 17:05 UT [9]. Ranks count from the largest. The rank among May–August events was added after the results. R_A barely moves with other thresholds: it is 1.75 for 15 nT and up, 1.86 for 30 nT and up, and 1.84 without May 10. R_V moves more: 2.02 for 15 nT and up, against 1.79.

Local time doesn't explain the contrast, and neither does season

Pair	R_A, all events (n)	Near noon, 11–15 h (n)	At its May 10 hour, ±2 h (n)	Fit at 13.1 h, day 131: R_A	R_V	R_{Pc5}	R_{PA}
SMS–SJG	1.86 (46)	2.12 (11)	2.12 (11)	1.91 (1.69–2.21)	2.00	2.21	1.80
ASC–GUI	1.00 (83)	1.24 (12)	1.02 (17)	1.09 (1.00–1.19)	1.13	1.02	1.01
HBK–PAG	1.04 (84)	0.89 (12)	0.81 (18)	0.89 (0.76–1.05)	0.88	0.81	0.84
GAN–ABG	0.88 (80)	0.94 (7)	0.82 (17)	0.85 (0.81–0.89)	0.87	0.87	0.89
KDU–KNY	0.99 (89)	0.91 (18)	0.83 (18)	1.00 (0.91–1.09)	0.90	0.83	0.89

Our analysis, medians with the number of events [6][7]. The last four columns fit each pair's ratio to the hour and the day of the year, then read it at 13.1 h on day 131, SMS–SJG's hour and date on May 10, with a bootstrap 95% interval for R_A.

OUR ANALYSIS

The preprint's main contrast survives both controls it didn't apply.

Only SMS–SJG was near noon on May 10, so one event can't separate place from local time. Many events can: moved to the same hour and date, SMS–SJG stays about twice the others. Its ratio is above 1 at every hour, largest by day and smallest at night. And our medians agree with the lead author's thesis, which used different windows and found means of 1.75, 1.97, 2.15 and 1.82 over 83 events of 2013–2024, with PA above 1 in all of them [3 p. 70][3 p. 64].

4 · IS IT STARTING?

Not on this evidence: the preprint doesn't say so, earlier work found the same, and the excess is there from the first records

The episode, in a passage on the magnetic pole shift, put the enhancement down to a system that has tipped enough, with the effect starting [2 00:01:51–00:01:59]. A single event can't show a change over time, and the preprint doesn't claim one. The test we set in advance over many events leans the way "starting" predicts, so the case rests on more than that test: on the level of the excess from the first records, and on what stations outside South America show.

What the preprint says

Searching its full text, the word pole occurs only inside quasi-dipole, in a figure caption, and reversal only of the direction of the asymmetry [1 p. 8][1 p. 19]. Shift, tipping, trend, secular, decay, weaken and starting don't occur at all. It uses the field model as a fixed map [1 p. 6]. And it says earlier analyses of sudden commencements had already reported larger amplitudes and Pc5 at SMS than at stations farther from the anomaly's core [1 p. 22 l. 425–428].

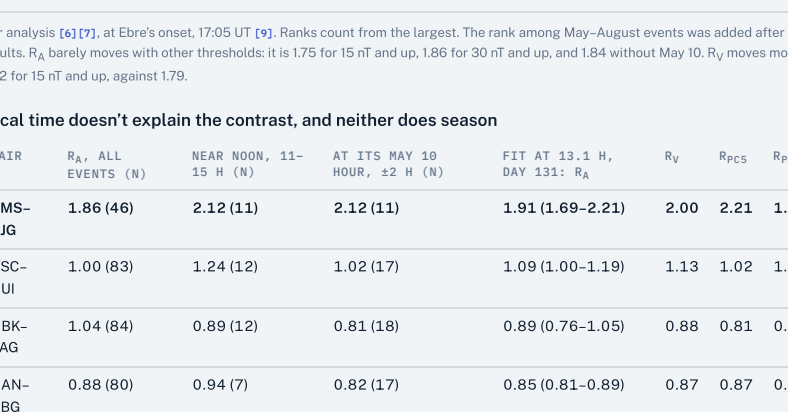
What the authors' own multi-event work shows

The preprint points to the lead author's doctoral thesis for the wider picture [1 p. 23 l. 454–458]. Over 2013–2024, the span of SMS's public record it used, it finds the same four ratios high across events [3 p. 70]. It reports no onset and no trend test, and it leaves seasonal and solar-cycle analysis to future work [3 p. 98].

Earlier work on the anomaly's storm-time and ground effects

Year	What it reported	What we read
1977, 1981	Storm-related ionization in the anomaly's lower ionosphere, from about 110 km down to 70 km, put down to precipitating particles [14][15 Abstract]	The 1977 title; the 1981 abstract
2005	**Sudden-commencement amplitudes in H generally larger at SMS, closer to the anomaly's centre, than at Vassouras [16]; also different storm-time variations at those two stations in November 2004 [18 Abstract]**	**The first reached us only through a later summary, which we paraphrase [17 p. 2]; the second as an abstract**
2010	**At Santa Maria, near the anomaly's centre, the preliminary impulse of sudden commencements appears in up to 80% of events near noon, twice the rate at Okinawa, and about 3 times as large, in 3,163 events of 1996–2008 in the conference version; attributed to conductivity raised by the weak field [19 Abstract][20]**	The abstract and a conference abstract
2010	Sudden-commencement amplitudes at Vassouras generally larger than at comparable observatories outside the anomaly, except between midnight and dawn; amplitude also depends on local time and season, among other things [21]	Full text, in Spanish
2023	Pc5 pulsations in the anomaly, which the preprint cites among its earlier reports [22][1 p. 22 l. 425–428]	Its record only
2025	The ratios at SMS–SJG over 83 events of 2013–2024 [3 p. 70]	Full text, in Portuguese

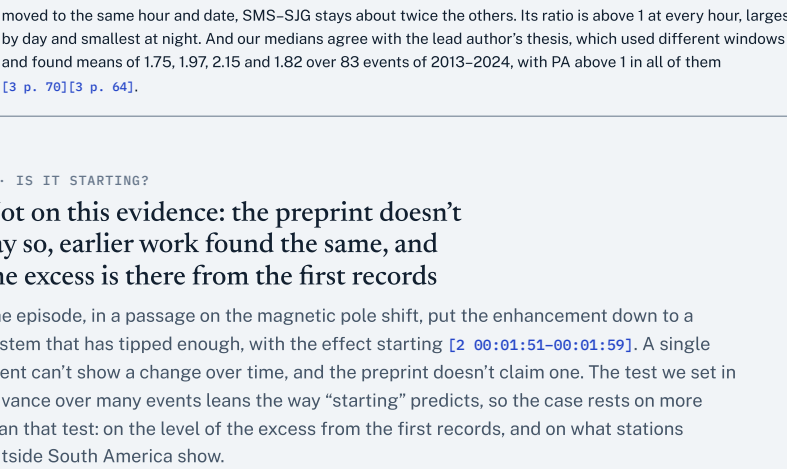
The South American excess over San Juan, by period OUR ANALYSIS



Median ratio of amplitudes with its 95% interval, by period. n counts events; SMS's public record begins in 2013.

Derived numbers from INTERMAGNET's and EMBRACE's files [7][6], with events from Ebre's lists of at least 20 nT [9]. The SMS series is the test set in advance; the Vassouras series was added after the results. Before 2005 the lists print one amplitude rather than five. Vassouras stands in for SMS here: SMS over Vassouras is flat in 2013–2026.

In the fastest change, the excess over San Juan dips and recovers; over the four outside stations it is lower, and its rise since 2013 doesn't clear the scatter OUR ANALYSIS



Median R_V with its 95% interval, by period. n counts events.

Derived numbers from INTERMAGNET's files [7], with events from Ebre's lists of at least 20 nT [9]. Both series were added after the results, the second after a fresh review asked for a comparison that doesn't use San Juan.

The test set in advance, and the long series beside it

Ratio	SMS over SJG, 2013–2026: % a decade	95% interval	VSS over SJG, 1999–2026: % a decade	95% interval
R_A	+15	−4 to +40	−3.3	−8.3 to +2.1
R_V	+27	+6 to +58	−0.1	−5.2 to +5.5
R_{Pc5}	+7	−9 to +27	−1.1	−6.2 to +4.6
R_{PA}	0	−9 to +11	−3.9	−6.8 to −0.7

Our analysis, with local time and season fitted out [6][7]. The SMS–SJG fit was set in advance; the Vassouras one was added after the results. A slope over 27 years averages the dip and the recovery, so it answers a different question from a slope over 2013–2026; the next table sets them side by side.

Span by span: a dip and a recovery against San Juan, and no clear rise since 2013 against the four outside stations

Ratio	Span	R_A: % a decade (95% interval)	R_V	R_{PA}	Events, R_V
Vassouras over San Juan	1999–2026	−3.3 (−8.3 to +2.1)	−0.1 (−5.2 to +5.5)	−3.9 (−6.8 to −0.7)	150
Vassouras over San Juan	**1999–2012**	**−12.4 (−24.2 to +0.5)**	**−21.2 (−31.5 to −9.6)**	**−14.3 (−20.9 to −7.5)**	73
Vassouras over San Juan	2005–2026	+3.9 (−3.3 to +12.4)	+11.6 (+3.5 to +20.8)	+3.7 (−1.3 to +8.5)	112
Vassouras over San Juan	**2013–2026**	**+11.7 (−1.5 to +28.2)**	**+20.6 (+5.9 to +37.8)**	**+1.0 (−5.8 to +8.9)**	77
Vassouras over the four	1999–2026	−3.3 (−7.5 to +0.8)	−5.5 (−9.8 to −1.1)	−3.3 (−6.1 to −0.5)	161
Vassouras over the four	1999–2012	−6.9 (−17.5 to +4.5)	−17.6 (−27.7 to −7.8)	−10.4 (−16.5 to −4.7)	73
Vassouras over the four	2005–2026	0.0 (−5.7 to +6.0)	−1.8 (−9.4 to +5.8)	+3.0 (−1.1 to +7.2)	124
Vassouras over the four	2013–2026	+0.2 (−9.6 to +12.4)	+6.9 (−2.6 to +17.3)	+7.0 (−0.4 to +15.8)	88
San Juan over the four	1999–2026	−1.7 (−7.4 to +4.0)	−6.1 (−11.0 to −1.3)	−0.3 (−3.0 to +2.4)	157
San Juan over the four	1999–2012	−1.1 (−12.6 to +12.0)	+1.3 (−9.3 to +13.7)	+1.9 (−3.8 to +7.6)	83
San Juan over the four	2005–2026	−3.8 (−13.0 to +5.0)	−11.5 (−19.0 to −3.4)	−1.7 (−6.1 to +2.9)	114
San Juan over the four	2013–2026	−12.4 (−26.9 to +3.7)	−11.8 (−23.6 to +0.5)	+1.7 (−5.6 to +10.0)	74
SMS, Vassouras and Pilar over the four	2013–2026	−0.1 (−10.7 to +12.0)	+5.4 (−4.1 to +16.2)	+5.8 (−1.1 to +14.5)	87

Our analysis, added after the results; the same fit, with bootstrap 95% intervals [7]. "The four" are Güimar, Kanoya, Alibag and Honolulu, the outside stations of the table further down, with long public records; an event counts if at least three of them are usable. Station mixes change over time, and four stations at other local times are a rough yardstick.

OUR ANALYSIS

The test we set in advance leans the way "starting" predicts

Our rules say "starting" predicts a positive trend, with recent years above earlier ones. SMS–SJG leans that way: +15, +27, +7 and 0% a decade for the four ratios, with only R_V's interval clear of zero, and R_A's medians go 1.61, 1.73 and 1.91 over 2013–17, 2018–22 and 2023–26. Alone, this test can't rule "starting" out. It is also fragile. R_A's lean rests on one event, on January 19, 2026, when the ratio is 7.91: without 2026's two events it is +5.7 (−6.4 to +18.6). R_V's leans on 2023: without that year it is +14.5 (−1.0 to +34.4). And Vassouras over San Juan rises too since 2013, about 21% a decade in V (+5.9 to +37.8), after falling about as fast before 2013, −21.2 (−31.5 to −9.6), so its 27-year slope of about zero hides a dip and a recovery [6][7].

OUR ANALYSIS

What rules it out: the level, and the stations outside South America

The excess was there from the start: Vassouras over San Juan is well above 1 in every period since 1999 and highest in the first, and earlier work reports it by 2005 and 2010. A ratio that high from the first records isn't starting now. San Juan is doing double duty in that long series, though, as the denominator and as a suspect for the recent rise. So we compared with stations that don't involve it. Over 2013–2026, SMS, Vassouras and Pilar together over Güimar, Kanoya, Alibag and Honolulu move −0.1 (−10.7 to +12.0) in A and +5.4 (−4.1 to +16.2) in V: nothing clearly rises. Over 1999–2026, Vassouras over the four falls, −5.5 (−9.8 to −1.1) in V. San Juan over the same four is low in every period, 0.68, 0.78, 0.73, 0.81, 0.80 and 0.72 in A, and since 2013 it leans down, −12.4 (−26.9 to +3.7) in A and −11.8 (−23.6 to +0.5) in V. So the rise since 2013 points to San Juan's record rather than to a growing South American response, though San Juan's intervals include zero. The fall before 2013 doesn't: then San Juan over the four is flat, −1.1 (−12.6 to +12.0) in A and +1.3 (−9.3 to +13.7) in V, and Vassouras over the four falls, −17.6 (−27.7 to −7.8). Why either moves, we don't know: San Juan's one-minute product changed after 2020, but our filtering test says that alone wouldn't do it [7].

OUR ANALYSIS

What a weakening field would predict

San Juan's field is falling faster than São Martinho da Serra's, about 102 against 26 nT a year in IGRF-14 [5]. So the ratio of their field strengths has narrowed, from 1.660 in 2013 to 1.625 in 2026. If the response simply scaled with a weak field, the ratio would be falling, by about 2%, which these data couldn't detect. Models do find that field changes move daily ground variations in the Atlantic region, but by about 5–10 nT a century [29 Abstract]. A weak spot that deepens by about 0.14% a year gives no reason to expect a ground effect to switch on.

OUR ANALYSIS

Who moves, station by station

Against San Juan, several South American stations rise in 2013–2026: Pilar +14.3 (+1.0 to +29.9) in V, and Cachoeira Paulista +15.7 (+0.3 to +33.7) in A and +16.2 (+1.8 to +34.5) in V. Taken one pair at a time against the four outside stations, SMS, Vassouras and Pilar show no significant trend in A or V. San Juan's ratios to Güimar, Kanoya and Alibag all lean down, by 10–15% a decade, though those intervals include zero. Ratios among the South American stations are mostly flat. These are many comparisons, added after the results, so one interval just clear of zero means little [6][7].

5 · THE REVERSAL

The reference pairs' lean to the North is largely a May result

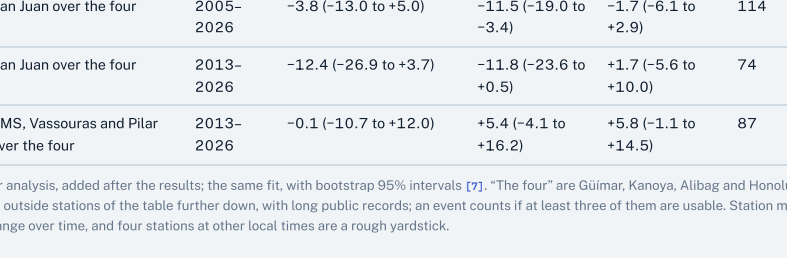
The preprint reports that the other four pairs mostly favour their Northern stations [1 p. 19 l. 322–325], and calls that reversal a mark of the SMS–SJG pair [1 p. 19–20 l. 349–351]. On May 10 that's what the numbers show. But May 10 falls in northern summer, and season was one of the tests we set in advance: R_A near noon, split by season.

The test we set in advance: R_A near noon, by season

Pair	May–August (n)	November–February (n)	The equinox months (n)
SMS–SJG	1.59 (6)	2.39 (3)	2.18 (2)
ASC–GUI	1.02 (3)	1.57 (1)	1.27 (8)
HBK–PAG	0.68 (4)	1.28 (2)	0.94 (6)
GAN–ABG	0.87 (4)	1.09 (2)	0.99 (1)
KDU–KNY	0.85 (8)	1.47 (2)	0.97 (8)

Our analysis, medians with the number of events, at a pair's local time of 11–15 h [6][7]. From May–August to November–February every pair moves the same way, and each reference pair ends above 1, as a seasonal lean predicts. But these cells hold only 1–8 events, some of them one or two, so the figure below shows all local times as well.

Added after the results: at all local times, every pair shifts toward its summer hemisphere OUR ANALYSIS



Median R_A, South over North, at all local times. Above 1, the Southern station responds more.

Derived numbers from EMBRACE's and INTERMAGNET's files [6][7]; 13–35 events a cell. The rules set this test near noon, as in the table above; this view at all local times was added after the results, because those cells are so small. SMS–SJG leans South in May–August too, and GAN–ABG leans North in both seasons: it's the shift that every pair shares. From May–August to November–February, in R_A moves by SMS–SJG +0.41 (+0.24 to +0.65), ASC–GUI +0.20 (−0.02 to +0.33), HBK–PAG +0.44 (+0.19 to +0.69), GAN–ABG +0.14 (+0.07 to +0.27), KDU–KNY +0.37 (+0.22 to +0.44), with bootstrap 95% intervals.

How often all four ratios point the same way

Pair	All four above 1, Nov–Feb	All four above 1, May–Aug	All four below 1, May–Aug	All four above 1, every event
SMS–SJG	13 of 13	16 of 17	0 of 17	45 of 46
HBK–PAG	15 of 22	1 of 27	17 of 27	23 of 83
KDU–KNY	10 of 22	1 of 32	21 of 32	15 of 89
ASC–GUI	9 of 21	3 of 30	15 of 30	21 of 83
GAN–ABG	0 of 21	0 of 30	20 of 30	1 of 79

Our analysis, added after the results [6][7]. Events with all four measures usable at both stations. Where all five pairs can be compared, SMS–SJG is the only pair with all four above 1 in 12 of 15 May–August events, 7 of 12 in the equinox months and 1 of 11 November–February.

OUR ANALYSIS

The others' lean moves with the season, and three of the four change direction; SMS–SJG's doesn't.

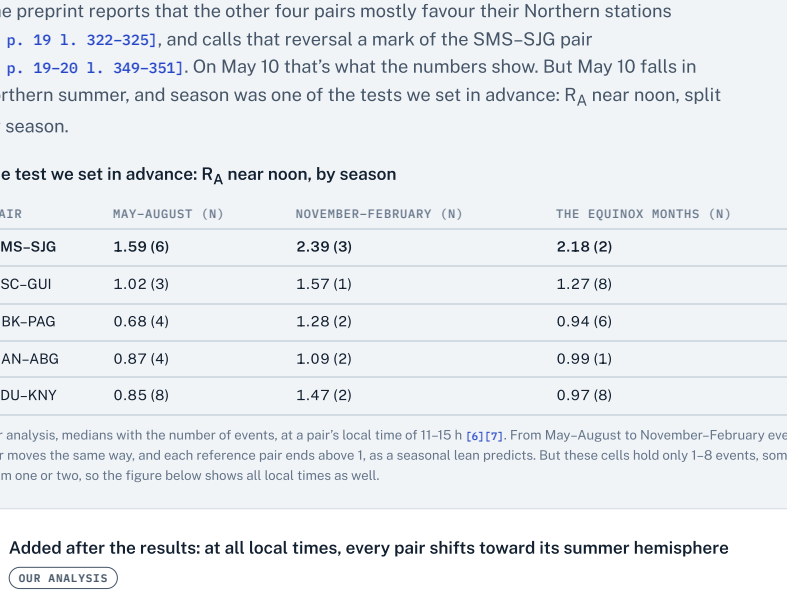
In May–August the reference pairs lean North, though ASC–GUI is about even near noon. In November–February three of the four lean South at all hours, and all four near noon, on very few events. So a single May event makes a contrast of direction that a January event wouldn't show, and the preprint's own mark, all four ratios above 1 at this pair alone, mostly fails in November–February. That fits a stronger response under the sunlit, more conducting summer ionosphere, though we didn't test the cause. Season works against SMS on May 10, since it is then in southern winter: its ratio to SJG is lowest in May–August, 1.59 near noon and 1.46 at all hours, and May 10's 1.88 ranks fourth of 17 in those months. What does set the pair apart is that it stays above 1 in every season.

6 · SAN JUAN AND THE REGION

San Juan sits at the bottom of 22 stations, and any South American station gives about the same ratio

A ratio has two ends. So we set both against every public station with a dip latitude of 12–30°, away from the electrojet and the auroral zones, near its own noon, sizing each event by the mean of the five amplitudes on Ebre's list [9]. This test was set in advance. What we built on it afterward says so where it appears.

Amplitude near local noon, relative to the event's size OUR ANALYSIS



Median amplitude A from 11 to 15 h local time, divided by event size, with each station's field strength in IGRF-14 in May 2024.

Derived numbers from EMBRACE's and INTERMAGNET's files [6][7], field strengths from IGRF-14 [5]; 7–19 events a station. The size comes from the five observatories Ebre lists for each event, at whatever local time they have: San Juan is one of the five in 84 of the 90 events, Honolulu in 86, Kanoya in 90, Alibag in 83 and Güimar in 50. So San Juan's amplitude is in its own denominator. Leaving it out changes little, as a check added after the results: SMS 1.42, San Juan 0.73, SMS's share of the ratio 0.30.

SAN JUAN OUR ANALYSIS

0.79

the lowest of the 22 in amplitude, though Pamatai is not clearly above it: the gap runs −0.10 to +0.19, and San Juan is lowest in 72% of bootstrap draws, added after the results. Lowest in speed too: V relative to event size is 0.28 [7]

SOUTH AMERICA'S WEAK FIELD OUR ANALYSIS

1.49–1.56

six stations in a tight cluster, about 24% above the median of the other stations outside South America, 1.24, with a bootstrap 95% interval of +2 to +51%, added after the results; in V, about 27%. They share events and a region, so they aren't six independent witnesses, and each has its own interval of about ±19–24% [6][7]

THE RATIO'S TWO ENDS OUR ANALYSIS

0.42–0.75

San Juan's share of SMS over SJG, in logarithms, depending on the yardstick; SMS's is the rest, 0.25–0.58. Against all 15 stations outside South America SMS's share is 0.31, with a bootstrap 95% interval of −0.06 to 0.63. Added after the results; rough, on 7–19 events a station

SMS against its neighbours: the excess is regional

Neighbour	SMS over it, near noon (n)	SMS over it, all hours (n)	It over SJG, near noon	It over SJG, all hours
Pilar (PIL)	1.00 (11)	0.99 (46)	2.24	1.72
Jataí (JAT)	1.02 (11)	0.95 (40)	1.81	1.86
Vassouras (VSS)	1.20 (11)	1.08 (50)	1.75	1.74
São José dos Campos (SJC)	1.15 (10)	1.12 (37)	1.74	1.72
Cachoeira Paulista (CXP)	1.18 (11)	1.15 (44)	1.66	1.63

Our analysis of R_A, medians over shared events, with n [6][7]. Pilar and Vassouras are INTERMAGNET observatories. The rules also list Chillán, which has no near-noon events and 7 at all hours. On May 10 itself, the thesis also has JAT and ARA above SMS, which the preprint doesn't report [3 p. 84]. The preprint describes the response at SMS as locally enhanced, compared with the station at the other end of its field line [1 p. 13 l. 309–311], and its Discussion calls the asymmetry regional [1 p. 22 l. 408–409].

OUR ANALYSIS

How much is the weak field? Not all of it, and not simply

The rules set the correlations and the split by season; the p-values, Kakadu, Hartebeesthoek–Panagjurishte and the comparison by hemisphere were added after the results. Near noon the amplitude falls off only weakly with field strength across the 22 stations: Spearman's correlation is −0.31 (p = 0.15), and −0.43 for V (p = 0.05). That comes from South America's six: without them it is +0.49 for A and +0.05 for V, so outside South America amplitude doesn't fall with field strength. Phu Thuy, with twice the field, is the highest of all. Kakadu has SMS's hemisphere and dip latitude and more than twice its field, 46,202 against 22,265 nT, and SMS exceeds it by about 20–25%, though on these numbers the interval includes no excess (A 1.20, 0.94–1.71; V 1.25, 0.85–1.69). Hartebeesthoek and Panagjurishte differ in field strength by even more than SMS and San Juan, 1.70 times against 1.63, yet their fitted ratio is 0.89. And the excess depends on season and on what it is set against. Over all the other stations it is about 10% in May–August and about 74% in November–February, but that sets South America's winter against a group mostly in northern summer, and then its summer against a group mostly in northern winter. Against southern stations only, it is about 32% and 63%. All of this is on few events a station.

OUR ANALYSIS

Why San Juan is low is not established

Small islands as a group sit low: a median of 1.04, against 1.29 for the other stations outside South America. But Easter Island and Ascension don't (1.24, 1.23), and we chose this grouping after seeing the table, so it's exploratory. In a step, San Juan's vertical field moves 0.30 nT per nT of H and SMS's 0.05, a coastal or island signature, yet Vassouras has 0.35 and isn't low. It could be its setting, its place in the morning-to-noon current pattern of the Northern Hemisphere, or something in its record. The data don't separate them.

7 · THE ACCUMULATED PERTURBATION

It is just as lopsided on quiet days, with no sudden commencement at all

The preprint offers PA as a method of its own, and its third key point reads it as an enhanced, persistent response at SMS [1 p. 3 l. 17–19][1 p. 23 l. 468–475]. So we measured it when nothing was happening: the same four hours of the day on the five days of lowest Ap in January, April, July and October [10], with no listed event [9].

WITH AN EVENT OUR ANALYSIS

1.74

median R_{PA} over 46 sudden commencements, with May 10 at 1.73 [6][7]

QUIET DAYS OUR ANALYSIS

1.95 and 1.92

median R_{PA} for 2024 by our rule, 9 usable days of 20, and for 2022–2024, 41 of 60, all above 1, added after the results. The day's H range, also in the rules, gives 1.52 on 7 days and 1.56 on 37 [6][7]

OTHER OBSERVATORIES OUR ANALYSIS

1.90 and 2.07

Vassouras and Pilar over San Juan on the same quiet days; SMS over Vassouras is 1.10, added after the results [7]

OUR ANALYSIS

A factor of about 1.9 is there all the time, so the ratio can't be read as a response to the jolt.

PA adds up every one-minute change, whatever caused it. It does respond to a jolt, at both stations: on May 10 it is about 17 times its quiet level at SMS (1,029 against 61 nT) and about 18 times at San Juan (593 against 32), and across events 3.7 and 3.2 times. The extra over quiet is lopsided too, 1.73 on May 10 and 1.69 across events (added after the results). So the ratio sits near 1.7 in events and 1.9 without them, and it doesn't single a jolt out. The two INTERMAGNET observatories show the same, so it isn't SMS's noise, which the thesis mentions [3 p. 95]: SMS is only 10% above Vassouras. And it says as much about San Juan as about South America: in the same quiet windows Fredericksburg, Stennis and Tucson, at other latitudes and similar hours, are 1.91, 1.50 and 1.42 times San Juan (55, 50 and 54 days), while Güimar and Honolulu, islands at other hours, are 1.09 and 0.76. It's a standing difference between San Juan's record and most of the others we compared, not a mark of South America alone. One correction to our own first pass: SMS's file is frozen or jumping on 11 of those 20 days in 2024, and counting them as zeros gave a meaningless 1.28. Our rules' exclusions, applied properly, give 1.95. The authors' own warning stands: PA is integrated variability, not energy deposition [1 p. 19 l. 334–335].

8 · WHY?

Why South America responds more is still open

Keep three things apart: what was measured (above), what the authors suggest (below, first box), and what the episode said (section 4). None of these explanations needs a pole shift, and the anomaly has been there throughout the record.

What the authors suggest

A plausible contribution, they write, is particle precipitation in the weak field, which adds ionization and conductance [1 p. 22 l. 418–425], so that fields transmitted from high latitudes drive stronger currents [1 p. 22–23 l. 438–449]. That builds on long-standing work on the anomaly's ionization [15 Abstract][32]. They don't measure it.

An older answer the preprint doesn't cite

Shinbori and colleagues in 2010 modelled the height-integrated conductivity and found it raised where the ambient field is weak, directly, and enough to account for a larger preliminary impulse [19 Abstract]. On that reading a weak field matters by day, with or without extra particles.

Local time and latitude

Low-latitude sudden commencements mix the magnetopause's step with ionospheric currents that change with local time and latitude [23][25 Abstract], and the step itself varies through the day [24 Abstract]. The preprint's own numbers rise toward the dip equator, from SMS's 120.66 nT to PVE's 162.16 and HUA's 248.25 [1 p. 21]. Our day-and-night ratios, 2.11 and 1.42, fit a sunlit part and something left over at night (our analysis, added after the results).

The ground

The preprint doesn't consider induction or ground conductivity. A 2009 study of night-time events finds the induction effect at low latitudes quite small [26 Abstract]. In Brazil, two studies find that the ground's conductivity matters for the electric fields behind induced currents [27 Abstract][28 Abstract], the second from an index copy of its abstract. Neither tests sudden-commencement amplitudes at SMS or San Juan.

9 · THE WEAK SPOT AND THE PREMISE

The weak spot is deepening at a steady pace, and that doesn't make a pole shift

The episode's second sentence is right, and the guide's findings carry over: down 13% since 1900, with the low point drifting west, and growing in area [5]. In 2025 the minimum was 22,071 nT, in northeastern Argentina, about 150 nT deeper than in 2020 [12 p. 13].

The anomaly in IGRF-14

Year	Minimum, nT	Where	% of Earth below 26,000 nT	Below 32,000 nT
2000	22,874	26.25°S 54.60°W	5.50	19.03
2013	22,451	26.30°S 57.30°W	6.71	20.18
2020	22,224	26.25°S 59.00°W	7.26	20.82
May 2024	22,091	26.25°S 59.90°W	7.66	21.30
2025	22,071	26.20°S 60.05°W	7.72	21.40
2026	22,038	26.20°S 60.20°W	7.80	21.53
2030 (forecast)	21,907	26.20°S 61.00°W	8.16	22.00

Our analysis, by the method of our guide to the field, whose table these match wherever both exist [5]. The pace: about 38 nT a year in 2013–2015, 30 in 2015–2025 and 33 in the forecast, about 0.14% a year. The area below 26,000 nT grew by 0.9% of Earth's surface from 2014 to 2025, the same as the Swarm team's figure [13 Abstract].

OUR ANALYSIS

The field is changing; this paper doesn't show that the change has tipped anything.

The site has checked the premise before: "An excursion is under way now" is False (October 22), "A pole shift is under way" is Misleading (October 20), and the dipole has lost about half a percent a decade since 2013 (our review of the field-loss figures). The episodes' use of storm papers as pole-shift evidence has fared the same way: "A pole-shift signal in the storm" is Misread (May 2024 aurora), and "Next-level pole-shift data" Unsupported (the inner belt). The use of this preprint joins them. It describes a stronger ground response at a long-standing weak spot, and the records show that response present for at least 27 years.

10 · REPEAT OUR NUMBERS

One script fetches the public records and recomputes everything of ours on this page

It downloads EMBRACE's and INTERMAGNET's one-minute files, Ebre's lists, GFZ's Ap and the field models [6][7], and it checks its field calculation against NOAA's 12 test values for WMM2025, which it reproduces to within 0.05 nT [11]. It writes derived numbers only. This page hosts no magnetometer data.

PY **sama_numbers.py**
The reproduction, the tests set in advance, the checks added afterward, and the anomaly from IGRF-14; Python standard library only · 103 KB

JSON **sama-numbers.json**
Its output: the numbers on this page; derived numbers only, no magnetometer series · 208 KB

CSV **sama-event-metrics.csv**
A, V, Pc5, PA and the step changes in H and Z, per station and event; derived numbers only · 299 KB

MD **test-rules.md**
The rules of the tests, written before any other event was computed, with the one amendment made before any multi-event result was read · 8 KB

Run it

`python3 -I sama_numbers.py <folder>` downloads about 4,800 files, 490 MB, into that folder, reads them as data, and writes its outputs next to the script. Once the files are there a run takes about five minutes on an ordinary computer. Observatories revise their files as data become definitive, so a newer download may differ slightly.

Set in advance, or added after the results

Set in advance, in the rules	Added after the results
The same pair over other events; each pair near noon and at its May 10 hour; each pair near noon by season; each pair fitted to one hour and date; the SMS–SJG trend; the band of 22 stations, its correlation with field strength and its split by season; SMS's neighbours; San Juan against the other Northern stations, which the rules set but we first ran after a fresh review caught the gap; quiet days in 2024, in PA and H range; filtering, three ways; the step in Z over H	Vassouras over San Juan since 1999, and span by span; the four outside stations, 1999–2026; who moves; the trend without 2023 or 2026; the six-hour local-time bins; EMBRACE beside Vassouras; the season at all local times, with its shifts; all four ratios by season, and the only-pair count; May 10's rank in its season; two more filtering ways; the split by yardstick, with its bootstrap; the excess by hemisphere; SMS beside Kakadu; Hartebeesthoek beside Panagjurishte; the groups by setting; the p-values; the correlation without South America; event size without San Juan; quiet days in 2022–2024 with other observatories; PA in events against quiet

One rule changed before any multi-event result was read: the first test for a frozen channel would have thrown out SMS on May 10 itself. The amendment is in the rules.

The data and their terms

EMBRACE: free to download, with a mandatory acknowledgement and no redistribution to third parties [6]. So we host no SMS file and show no SMS series, only numbers derived from it. **INTERMAGNET:** CC BY-NC 4.0 unless noted, with written permission needed for bulk distribution [7]; the site is non-commercial, and we host no data. Definitive data to 2020 carry a DOI [7]. **BCMT** sets its own terms for its observatories, here Easter Island, Pamatai, Phu Thuy, Kourou and Chambon-la-Forêt: its data set is CC BY-NC 4.0 in its DataCite record, but the terms page INTERMAGNET links to did not answer from our network [8]. **ISGI and Ebre:** ISGI's page on these lists gives CC BY-NC 4.0 [9]. We use the lists in two ways: to choose the events, by their times and types and by a threshold on size, and to size each event, because the mean of its five listed amplitudes is the size that divides every near-noon amplitude in section 6. They are credited below. **The Indian Institute of Geomagnetism** doesn't allow its data to be passed on without permission, as an earlier page notes: another reason nothing is hosted.

Acknowledgements

The author(s) thank(s) the Embrace/INPE Program of the MCTI for providing the data for this work.

The results presented on this page rely on the data collected at the observatories below, and, for the May 10 table in our output, at other magnetic observatories. We thank the national institutes that support them and INTERMAGNET for promoting high standards of magnetic observatory practice (www.intermagnet.org): the U.S. Geological Survey (San Juan, Honolulu, Fredericksburg, Stennis, Tucson), the British Geological Survey (Ascension), Instituto Geográfico Nacional (Güimar), the South African National Space Agency (Hartebeesthoek), the Bulgarian Academy of Sciences (Panagjurishte), ETH Zürich and GFZ with their partners (Gan), the Indian Institute of Geomagnetism (Alibag, Jaipur), the CSIR-National Geophysical Research Institute (Hyderabad, Choutuppal), Geoscience Australia (Kakadu, Cocos-Keeling), the Japan Meteorological Agency (Kanoya), Instituto Geofísico del Perú (Huancayo), Observatório Nacional and GFZ (Vassouras, Tatuoca), Servicio Meteorológico Nacional (Pilar), BCMT with IPGP and its partners (Pamatai, Kourou, Easter Island with Dirección Meteorológica de Chile, Phu Thuy with the Vietnam Academy of Science and Technology), CRAAG with IPGP (Tamanrasset), and Samoa's meteorological service with GNS Science (Apia). Definitive data to 2020: INTERMAGNET Reference Data Set 2020; BCMT's observatories: its data set [7][8].

Our event lists rely on sudden commencements listed by the Observatori de l'Ebre, an ISGI Collaborating Institute, from data collected at magnetic observatories. We thank the involved national institutes, the INTERMAGNET network and ISGI (isgi.unistra.fr) [9].

11 · LIMITS

What this check could and couldn't see

Ionosphere or ground

Nothing here separates an ionospheric effect at SMS from a ground-conductivity one, or tests particle precipitation against the direct effect of a weak field.

SMS's record is patchy

It has no usable event in 2018–2019 and 5 of 16 in 2024; across all 142 events we ran it has no file in 32 and a frozen channel in 23 [6]. So its own trend is weak, and Vassouras carries the long test. Vassouras isn't SMS, though SMS over Vassouras is flat in 2013–2026.

EMBRACE's files

What we read doesn't say how the one-minute values are made [31 Abstract]. Stations can differ by a whole minute at onset on May 10: São Luís rises a minute before SMS and Araguatins a minute after it. That is likely a matter of timing, not of the shock arriving first, as the thesis reads SMS's lead [3 p. 82]. EMBRACE's own Vassouras file shows no sudden commencement that day, while the observatory there rises about 87 nT. And Jataí's ratio to San Juan drifts up by about 40% a decade, which looks like a change at that station.

Sources read in part

Trivedi and colleagues (2005) reached us only through a summary [17 p. 2]. Several others are abstracts or records, marked in the list; one abstract comes from an index [28 Abstract]. A 2007 paper the preprint cites for earlier sudden-commencement work could not be found.

The preprint's reference list

Several printed DOIs don't resolve to the cited works. That's ordinary material for peer review, and we draw no conclusion about the cause.

The tests' reach

Local time and season are coarse controls, a pair's stations are never at exactly the same local time, the near-noon cells are small (7–19 events a station, and as few as 1 in a seasonal cell), and several checks came after the results, as marked. The long series rests on six observatories whose instruments and products changed over 27 years, and the fall at Vassouras before 2013 is unexplained. Our A uses raw H, where the preprint denoises it.

What would change these verdicts

01 A record showing the South American excess climbing against stations outside the region as well as against San Juan, beyond the scatter, with instruments and products held constant; that would give "starting" some ground, though not yet a pole shift.

02 Simultaneous conductivity or precipitation measurements with an electrodynamic model, as the authors call for [1 p. 23 l. 449–452], showing how much of the excess the anomaly accounts for; that could move "The anomaly may boost response" toward True.

03 A reason for San Juan's low response, in its setting or its record, and a comparison that doesn't depend on it; that would fix the size of the effect.

04 A clean transcript or on-screen text showing the presenter offered this as his own reading, not the preprint's, would move the premise to Unsupported; starting would still fail on the records.

OUR ANALYSIS

Bottom line: real, reproducible, carefully measured and hedged; decades old; smaller than one ratio suggests; and nothing in it points to a pole shift.

The authors made a careful, checkable measurement and hedged its meaning. Their ratio comes back from public data, and it survives other events, local time and season. It also turns out to be a standing feature of South American records against San Juan, present in every period since 1999, highest at the start, and reported by 2005 and 2010. Against San Juan it has dipped and recovered; against stations outside South America nothing has clearly risen. A large part of the ratio, by most yardsticks more than half in logarithms, is San Juan's low response; the rest is South America above comparable stations, an excess of about a quarter, with wide limits on 7–19 events a station. The weak spot is deepening, as the episode says. But the preprint says nothing of a pole shift or an onset of the effect, and the records don't show one.

Related checks

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

UNSUPPORTED A magnetic pole flip in the 2040s? The Disaster Cycle, Fact-Checked

Sources

Bracketed numbers refer to this list. For the preprint [1], read in full, p. gives a page of its 26-page PDF, whose manuscript starts on p. 3, and l. the line numbers printed in the manuscript's margin; we paraphrase it and take numbers from its text and tables. For the thesis [3], p. gives its printed page. Times in the episode [2] are positions in the video, from the first and last transcript lines cited. For the other sources, p. gives a page and Abstract the abstract of the cited work; where only an abstract or a record was read, the entry says so. H is the horizontal field; nT the nanotesla; UT universal time; local times are solar. Station codes are spelled out where they are used: SMS São Martinho da Serra, SJG San Juan. Links checked November 1, 2026.

1 Piassi, A. R., Denardini, C. M., Resende, L. C. A., Tavares, F. O., Espinosa, K. V., Marchezi, J. P., Picanço, G. A. S., Chen, S. S., da Silva, L. A., Mendes, O. J., and Guizelli, L. M. (2026). Enhanced Ground Magnetic Response Near the South American Magnetic Anomaly During the 10 May 2024 Sudden Commencement. ESS Open Archive preprint, posted October 30, 2026; headed as a manuscript submitted to *Space Weather*; not peer reviewed. Its cover pages state that the copyright holder is the author or funder, all rights reserved, no reuse without permission. We read the full text, 26 PDF pages, supplied by the site's owner, because the archive shows scripts a bot check, which we do not attempt. We use numbers from its text and tables and redraw none of its figures.

2 SpaceWeatherNews (S0) (November 1, 2026). Pole Shift Deep Dive Shows Rapid Decay | S0 News Nov.1.2026. YouTube video, https://www.youtube.com/watch?v=w5ryWCaVmII. Quoted from the automatically generated transcript; times are positions in the video. The transcript loses a sentence break at 00:01:51, where the words on the previous link, which end in the magnetic pole shift, run straight on into a system that has tipped enough, the start of this item, so those words may belong to both; we don't guess beyond that. The label "SAA Ground Magnetism" is the one on the episode's link to the preprint.

3 Piassi, A. R. (2025). Influência da anomalia magnética da América do Sul em sudden commencements. Doctoral thesis, Instituto Nacional de Pesquisas Espaciais (INPE), approved August 1, 2025. In Portuguese. CC BY-NC 3.0 Unported, as printed on its catalogue page; we cite its numbers, with credit, and adapt none of its figures. Full text.

4 Crossref. Metadata record for doi:10.22541/essoar.15011353/v1. Retrieved November 1, 2026: the posting date, the authors' affiliations and the abstract, with no licence.

5 IAGA Working Group V-MOD (2024). International Geomagnetic Reference Field, 14th generation (IGRF-14): Gauss coefficients 1900–2025 and secular variation 2025–2030. Data file, NOAA National Centers for Environmental Information; retrieved November 1, 2026, the same file, by its SHA-256, as on our earlier pages.

6 Embrace Space Weather Program, Instituto Nacional de Pesquisas Espaciais (INPE). Embrace MagNet one-minute magnetometer files, with their readme; retrieved November 1, 2026, for SMS, PVE and neighbouring stations. The programme's conditions are in its announcement of the data release (February 23, 2016): a mandatory acknowledgement, printed in section 10, and no redistribution to third parties. We host none of these files.

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METHOD

How this was checked

On November 1, 2026, we checked every statement on this page about the preprint against its full text, which the site's owner supplied because the archive shows scripts a bot check, which we do not attempt: its stations, method, tables, caveats, data statement, funding and disclosures, and everything it says, and does not say, about pole shifts, trends, local time, season, conductivity, induction and San Juan's setting, by reading it and by searching its text. The page also rests on the lead author's doctoral thesis, read in full; Crossref's record of the preprint [4]; the transcript of the episode [2]; 21 other papers and abstracts on the anomaly and on sudden commencements, read as the entries in the source list say, as full texts, abstracts or records; and our guide to the field. The data are EMBRACE's and INTERMAGNET's one-minute records, about 4,800 day files for 36 stations over up to 142 events and quiet days, with six of them back to 1999, and for every public station below 62° latitude on May 10, 2024, with Ebre Observatory's lists of sudden commencements, GFZ's Ap, IGRF-14 and WMM2025, each with its terms as section 10 states.

The verdicts and the items tagged "Our analysis" are our own assessment, built on the cited sources. They cover our reproduction of the preprint's tables; the same measures over 46 usable events at SMS–SJG and over the other pairs, by local time and season and by fit; the trend; the near-noon amplitudes at 22 stations and the comparison with SMS's neighbours and with the other Northern stations; the quiet-day comparison; the long record at Vassouras and San Juan, and against four stations outside South America; and what we compute from IGRF-14. Section 10 lists which of these were set down in advance, in test rules hosted on the page and written before any event other than May 10, 2024 was computed, and which we added after reading the results. One rule was amended before any multi-event result was read, and the rules record why.

Our script, hosted on this page, fetches every input from its source and recomputes everything of ours here; it checks its field calculation against NOAA's 12 test values for WMM2025, which it reproduces to within 0.05 nT, and its outputs, also hosted, hold derived numbers only. Two end-to-end runs of the hosted script gave outputs identical byte for byte. The page hosts no magnetometer data, because EMBRACE's conditions bar redistribution and INTERMAGNET asks for written permission for bulk distribution. The preprint's wavelet settings are not stated, so its amplitudes could be matched to about 1%, not exactly. We could not read Trivedi et al. (2005) itself, only a summary of it; BCMT's terms page did not answer from our network; and a 2007 paper the preprint cites could not be found.

A fresh reviewer then read the built page against the sources and recomputed our numbers with code of its own. It agreed with the hosted table on 2,250 station-events, apart from two differences that traced to a bug in our script, and its run of the hosted script matched the hosted files byte for byte. It left all six verdicts standing. The changes that followed: the script now keeps a minute with good H when only Z is a fill value, which gives 46 usable events at SMS–SJG rather than 45 and moves some numbers slightly, and every number here comes from the corrected run; "no rise" became the dip and recovery that section 4 now shows, with the test set in advance reported as leaning the way "starting" predicts, and with a comparison against four stations outside South America, added after the results; the split of the ratio became a range across yardsticks, with a bootstrap; section 5 now shows the season test near noon, as the rules set it, and labels the view at all local times as added; the one comparison the rules set that we had not run, San Juan against the other Northern stations, was run; and the wording of several claims moved closer to what the authors and the presenter said.

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.
MISREAD	Cites a real source but gets wrong what it says.
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 1, 2026 Published on factchecked.science after a full check against the sources. Built from the preprint's full text, the lead author's thesis, the earlier literature on the anomaly and on sudden commencements, the episode's transcript, and our own analysis of EMBRACE's and INTERMAGNET's public one-minute records and of IGRF-14, whose script and derived numbers are hosted on the page: six claims rated on the site's scale, two the episode's and four the preprint's. No magnetometer data are hosted, and no figure of the preprint's is redrawn. Before publication a fresh review against the sources, which changed no verdict, found a bug in our script, which dropped good H minutes when only Z was a fill value, and we fixed it and re-ran everything. It also led us to show the dip and recovery behind a flat 27-year trend, to report that the test set in advance leans the way "starting" predicts, to add stations outside South America, to give the split of the ratio as a range across yardsticks, to show the season test as our rules set it, and to run the one comparison the rules set that we had missed.

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

Last updated Nov 1, 2026