☑ **Fact-Checked Science**

PAPER CHECK · SPACE WEATHER

A 2026 paper ties the stronger solar wind since 2023 to the solar cycle; its numbers hold

Adrian Sabin Popescu's paper computes Akasofu's ε, an estimate of the power the solar wind delivers to Earth's magnetosphere, hour by hour for 1963–2026, and scales it by a small factor for the weakening dipole [1 Abstract]. It finds 2023–2026 elevated, ties that to the solar wind of Solar Cycle 25, and says its analysis "does not establish a causal increase in magnetospheric susceptibility" [1 Abstract]. S0's special report described it as finding "an anomalous amplification of Earth's vulnerability in 2023 up to now" [2 00:01:18–00:01:22]. From the public data we reproduced every result the paper reports from its analysis [3] [4], and ran a test of the kind it calls for: set against the solar-wind input, Earth's geomagnetic response in 2023–2025 sat inside the range of earlier years, a little below the earlier relation month by month and a little above it hour by hour [5] [6].

By Fact-Checked Science · Published November 11, 2026

OUR ANALYSIS marks our own reasoning and calculations, including our reproduction of the paper's numbers from NASA's OMNI2 data and IGRF-14, our ranking of years and windows, and our test of Earth's response with GFZ's and Kyoto's indices; the verdicts are our assessment. Everything else comes from the numbered sources. For the paper [1], § gives a section, Table and Fig. a table or figure, and Supp. 1 § a section of its supplementary revision report; for S0's special report [2], times are positions in the video.

The paper's numbers reproduce exactly; the rise since 2023 is in the solar wind, and Earth's response to it shows no unusual rise

OUR ASSESSMENT

2.75%

the most the paper's dipole factor changes the solar wind's energy input over 1963–2026, by our reproduction; the paper gives about 2.8% [1 Abstract] [4]. The factor lowers the input as the dipole weakens.

4th of 29

Our analysis: where 2023–2025 ranks among three-year windows of that energy input since 1995. It is 3.7% below 2000–2002, the last solar maximum of similar size [3].

−8% to +6%

Our analysis: Earth's geomagnetic response in 2023–2025, against what the 1995–2022 relation predicts for the solar-wind input. Month by month the ap index, a measure of magnetic disturbance, ran 8.2% and 6.5% below it, by two measures of the input; hour by hour its hourly version ran 2.9% and 6.4% above. All four are inside the range of earlier three-year windows [5] [6] [3].

THE CLAIMS

TRUE

Dipole effect is under 3%

The paper: "the normalized first-degree IGRF-14 dipole proxy produces a sensitivity range of approximately 2.8%" [1 Abstract]

Reproduced from the public IGRF-14 coefficients: the factor runs from 1 in 1963 to 0.9725 in 2026, a range of 2.75% (our analysis) [4]. It is below 1 and falling, so it lowers the scaled series as the dipole weakens: by 0.8% between 2000–2002 and 2023–2025. See section 3.

TRUE

Recent rise is solar-wind driven

The paper: "The recent 2023-2026 elevation coincides with enhanced solar-wind forcing during Solar Cycle 25" [1 Abstract]

ε is calculated from the solar wind's speed and field and a fixed length [1 §6.1], and the dipole factor only lowers it (section 3). The paper's averages reproduce: 1.13 × 10^{11} W for 2023–2025 against 1.19 × 10^{11} W for 2000–2002 [1 §7.2] [3]. In 2023–2025 the solar wind's field and speed were close to those of 2000–2002, and the window ranks fourth of 29 since 1995 (our analysis). See sections 2 and 4.

TRUE

No proven rise in susceptibility

The paper: "The analysis does not establish a causal increase in magnetospheric susceptibility" [1 Abstract]

The verdict rates this as a statement of what the paper's own analysis can show, and it is right: neither the energy input nor the dipole factor holds any measurement of how Earth responded [1 §2.1] [1 §8]. Separately, our own test of the measured response, with its rules fixed in advance, found no unusual rise: set against the solar-wind input, the response in 2023–2025 sat inside the range of earlier years, a little below the earlier relation month by month and a little above it hour by hour (our analysis) [5] [6]. See section 5.

MISREAD

Earth's vulnerability amplified

S0's special report: "A paper came out this last month looking at the Akasofu epsilon parameter, our planetary vulnerability to the solar wind. There has been an anomalous amplification of Earth's vulnerability in 2023 up to now." [2 00:01:10–00:01:22]

The parameter measures what the solar wind delivers, not how vulnerable Earth is: the paper calls it "an empirical estimate of the energy-input rate" [1 §2]. The paper says its scaling "does not establish a change in reconnection efficiency or magnetospheric vulnerability" [1 §5], lists "Evidence for anomalous coupling" among the things its incomplete years cannot establish [1 Table 2], and puts 2000–2002 higher than 2023–2025 [1 §7.2]. See section 7.

PARTLY TRUE

Paper blames a random surge

The report: "Now, they are hypothesizing that it was just a random surge in the solar wind." [2 00:01:26–00:01:31]

The paper does put the rise down to the solar wind: it reads it "primarily as a solar-wind-driven feature" [1 §7.2]. But it ties the rise to Solar Cycle 25, not to chance [1 Abstract], and for ε that is arithmetic, not a hypothesis: it is calculated from the solar wind's speed and field and a fixed length [1 §6.1], and the dipole factor only lowers it [1 §5]. The paper keeps the word hypothesis for a rise in susceptibility, which it says it has not established [1 Abstract]. See section 7.

PARTLY TRUE

Bigger solar storms since 2023

S0's label on its link to the paper: "Bigger Solar Storms since 2023" [2]

The paper measures the monthly and yearly average of the energy input, not the size of storms, and no sentence of it is about storm size [1]. What it reports is elevated solar-wind input in 2023–2026, with a lower mean than in 2000–2002 [1 §7.2]. By our own series, 2023–2025 is the highest three-year window since 2001–2003 (section 4). By our count, hours with ε in the top 1% of 1995–2022 came 166 times a year in 2023–2025, against 93 in 2013–2015 and 203 in 2000–2002 [3]. See section 7.

1 · THE PAPER

Six decades of solar-wind energy input, a small factor for the weakening dipole, and a list of what neither can show

Adrian Sabin Popescu asks how a simple measure of sensitivity to Earth's internal field behaves when it is joined to more than sixty years of solar-wind data [1 §1]. The paper is a peer-reviewed article in *Advances in Space Research*, dated November 2026, and it calls its analysis "exploratory and descriptive" [1 §1]. Its supplement holds the processed tables [1 §9] and a report on what peer review changed [1 Supp. 1 §1].

STEP 1

Energy input, hour by hour

For every hour with data in NASA's OMNI2 record, 1963–2026, the paper computes Akasofu's epsilon (ε), first defined by Paul Perreault and Syun-Ichi Akasofu in 1978 [17 p. 547]: the solar wind's speed, times the square of its magnetic field across the Sun–Earth line, weighted so that a southward field counts most, times the square of a fixed length of seven Earth radii [1 §2] [1 §6.1]. The result is a power in watts.

STEP 2

Averages

Monthly and yearly means of the hourly values. Hours without data are left out, never filled in, and the number of valid hours is reported for every month and year [1 §6.1] [1 §6.2].

STEP 3

The dipole factor

Each mean is multiplied by the strength of Earth's dipole in the IGRF-14 model, relative to 1963, raised to the power 2/3. That is how the magnetosphere's cross-section changes with the dipole when the solar wind's pressure is held fixed [1 §2.1].

STEP 4

A ratio and an index

The dipole's strength divided by the solar wind's yearly mean field, with a straight-line fit over 1995–2025 and errors that allow for serial correlation; and the correlation of scaled ε with Kp, the planetary index of magnetic disturbance [1 §6.3] [1 §7.3].

DIPOLE FACTOR, 1963–2026

about 2.8%

its whole range, from about 0.972 to 1.000, which the paper calls "a modest modulation" beside the solar wind's own swings [1 §5]

SCALED EPSILON, 2023–2026

1.13

× 10^{11} W on average, against 1.19 for 2000–2002, a reference window around the maximum of Solar Cycle 23, which the paper says is not a phase-matched comparison [1 §7.2]

TREND IN THE RATIO

p ≈ 0.677

with errors that allow for serial correlation: the fitted coefficient is "not interpreted as statistically significant evidence for a secular trend" [1 §7.1]

In the paper's words Verbatim; © 2026 COSPAR, quoted for review.

> *"The recent elevation is therefore interpreted primarily as a solar-wind-driven feature"*
>
> On 2023–2026 [1 §7.2]

> *"The present diagnostic does not establish that a weaker geomagnetic background made the energy input more effectively transmitted."*
>
> On the dipole factor [1 §2.1]

> *"independent magnetopause or magnetospheric-response observables and pre-specified time-series inference"*
>
> What future work should bring before anyone claims a change in space-weather susceptibility [1 §8]

The paper's own limits

Solar-wind coverage is sparse in the early years, and 2026 is an incomplete year, so the paper treats early peaks as lower-confidence and keeps 2026 out of full-year comparisons [1 §6.1] [1 §6.2]. Its 60- and 132-month running means are for display, not independent observations, and the longer one does not remove the solar cycle [1 §6.3]. The ratio of the dipole to the solar wind's field is "not by itself a measure of magnetospheric resilience or storm susceptibility" [1 §4]. Kp can itself carry a bias over decades, because its stations' magnetic latitudes change, so the paper treats it as a companion measure, not a benchmark [1 §7.3]. The dipole's 2026 value is a model forecast [1 §6.1].

The paper also leaves the larger question open. Its last paragraph calls the analysis "compatible with the possibility" that slow change in Earth's internal field modulates the response to the solar wind, though it "does not establish that relationship causally" [1 §8]. Its abstract offers the work as a "framework for testing that hypothesis" with independent measures of the response [1 Abstract].

ε is one of several "coupling functions", formulas that estimate from the solar wind how strongly it drives the magnetosphere. The paper keeps ε for continuity with earlier work and "does not claim that it is a universal response function" [1 §1]. Section 6 gives its origin and its standing.

2 · THE REPRODUCTION

Every result the paper reports from its analysis comes out of the public files, and its tables match ours to fifteen digits

We downloaded the same public inputs, NASA's hourly OMNI2 files for 1963–2026 [3] and the IGRF-14 coefficients [4], wrote down our rules, and computed the paper's quantities with our own code. Then we compared our monthly and yearly series with the paper's supplementary tables, cell by cell [1 §9].

VALID HOURS OUR ANALYSIS

407,054

of the 561,024 hours in the files, which run to the end of 2026, have the solar wind's speed and field. Our count equals the paper's table in each of the 63 full years and each of 723 months to June 2026 [3] [1 §9]

LARGEST DIFFERENCE OUR ANALYSIS

6 × 10^{-16}

relative, over 7,919 monthly cells and 567 yearly ones: speed, field, ε, scaled ε, the ratio, Kp and the running means. That is the rounding of the arithmetic [3] [4]

THE ONE MOVING PART OUR ANALYSIS

0.03%

July 2026, a partial month in the paper. NASA has since extended and lightly revised the 2026 file; the same number of hours from today's file gives 0.03% less [3]

The paper's stated numbers beside ours

QUANTITY	THE PAPER	OUR COMPUTATION
Dipole factor, 1963–2026	about 0.972 to 1.000, a range of about 2.8% [1 §5]	0.9725 to 1, a range of 2.75%
Mean scaled ε, 2023–2025	about 1.13 × 10^{11} W, from about 8,603 valid hours a year [1 §7.2]	1.135 × 10^{11} W, from 8,603.3
The same with partial 2026	about 1.11 × 10^{11} W, from about 7,648 valid hours a year [1 §7.2]	1.112 × 10^{11} W, from 7,648.0, with 2026 cut at the same number of hours
Mean scaled ε, 2000–2002	about 1.19 × 10^{11} W [1 §7.2]	1.188 × 10^{11} W
Ratio fit, 1995–2025: slope	positive [1 §7.1]; its Fig. 4 is labelled 12.2 a year [1 Fig. 4]	12.24 a year
Durbin–Watson statistic	≈ 0.40 [1 §7.1]	0.398
p-value with HC3 errors	approximately 0.566 [1 §7.1]	0.566
p-value with Newey–West errors, three lags	≈ 0.677 [1 §7.1]	0.677
Correlation with Kp: monthly, 60-month and 132-month means	approximately 0.632, 0.795 and 0.888 [1 §7.3]	0.632, 0.795 and 0.888, over the 701 months where all three exist

Our computation from OMNI2 [3], IGRF-14 [4] and GFZ's Kp [5]. The Durbin–Watson statistic measures serial correlation in a fit's residuals: 2 means none, and values near 0 mean strong correlation. HC3 and Newey–West are two ways of computing a slope's uncertainty, the second allowing for serial correlation. Our p-values use the normal distribution, as common software does by default; with Student's t they are 0.570 and 0.680.

OUR ANALYSIS

The result the paper calls its principal methodological one is that ε has to be computed hour by hour and then averaged, because "Annual values formed from separately averaged inputs can differ substantially" [1 §8]. That holds. If a year's speed and field components are averaged first, ε collapses to a median 0.4% of its true yearly mean over 1995–2025, because the field's components average to nearly zero. If the speed, the strength of the field across the Sun–Earth line and the direction term are each averaged and then combined, the result is 51–82% of the true mean [3]; that second way of averaging is an addition of ours, made after the rules were written. The 2026 file has grown since the paper: NASA's copy now runs to October 15, 2026, with 6,546 valid hours, and with it 2023–2026 averages 1.09 × 10^{11} W [3]. Two things in the paper were not ours to rerun: the particle energies and altitudes of its Table 1, which it takes from an earlier study [1 Table 1], and a test for a break at 1990, which it describes without giving a result [1 §6.3].

The paper's tables follow from the public files by the recipe it states. We found no result of its analysis that fails to reproduce.

3 · THE DIPOLE FACTOR

The paper's factor makes a weaker dipole take in less energy, not more

The factor is the dipole's strength relative to 1963, to the power 2/3. The dipole has weakened, so the factor is below 1 and falling, and the scaled series sits below the unscaled one [1 §5].

What the paper reports

A weaker internal field could act in two ways, and the factor covers one. A smaller magnetosphere offers the solar wind a smaller area: that is the geometric effect, "the only effect represented" by the factor. A weaker field might also change how efficiently the solar wind's field connects with Earth's, but "this effect is not quantified by the present model" [1 §2.1]. The paper calls the scaled series a "counterfactual first-order sensitivity transform", not a measurement of energy input [1 §2.1].

OUR ANALYSIS

From IGRF-14, the dipole's strength by the paper's measure falls from 30,988 nT in 1963 to 29,717 nT in the 2026 forecast, down 4.1% [4]. The factor falls from 1 to 0.9725. It averaged 0.9809 over 2000–2002 and 0.9731 over 2023–2025, so between those two solar maxima it lowered the scaled input by 0.8%. The scaling itself is fifty years old: Siscoe and Chen argued in 1975 that the energy the solar wind delivers goes with the magnetosphere's cross-section, and so with the dipole moment to the power 2/3, as a 2004 study reports them [13 p. 3671] [14].

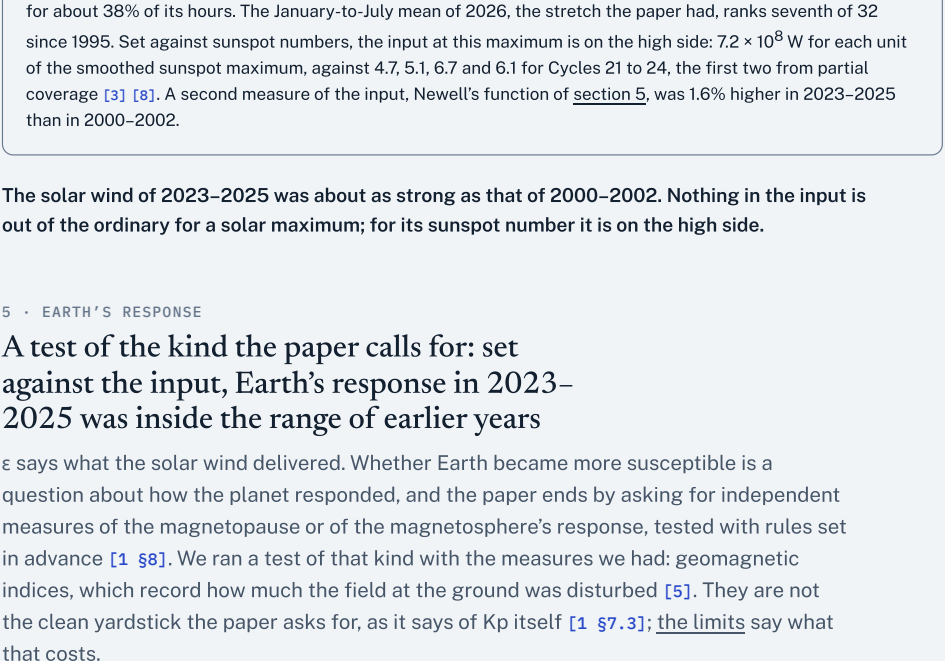
On the one effect the paper models, the dipole's decline since 2001 trims the energy input by under 1%. The effect that could work the other way is the one the paper says it does not quantify.

4 · THE RECENT YEARS

2023–2025 is high beside the weak cycle before it and ordinary beside the three before that

The paper compares 2023–2025 with one earlier window, 2000–2002, and finds the earlier one higher [1 §7.2]. We ranked every year and every three-year window, and set the three years around each sunspot maximum since 1979 side by side.

The solar wind's energy input, year by year, 1963–2026 (our analysis)



Yearly mean of Akasofu's ε, in 10^{11} watts, unscaled

Our analysis of NASA's OMNI2 hourly data [3]: the mean of ε over each year's valid hours, by the paper's recipe [1 §6.1], without the dipole factor. Shaded bands mark the three calendar years centred on the smoothed sunspot maximum of Cycles 21 to 25, from SILSO's sunspot number [8]; the orange lines and the numbers are those windows' means. Hatched bars are years with under 75% of their hours measured, where a few stormy months can carry the mean. This is our own chart, not a redrawing of any figure in the paper. Hover or tap a bar for its value and coverage.

The three years around each sunspot maximum (our analysis)

WINDOW	CYCLE AND ITS SMOOTHED SUNSPOT MAXIMUM	VALID HOURS A YEAR	EPSILON, 10^{11} W	SOLAR WIND'S FIELD, NT	SPEED, KM/S	AP	KP
1978–1980	21: 232.9, December 1979	7,082	1.09	7.26	409	14.2	2.34
1988–1990	22: 212.5, November 1989	3,696	1.08	7.61	442	16.1	2.52
2000–2002	23: 180.3, November 2001	8,761	1.21	7.23	438	13.7	2.23
2013–2015	24: 116.4, April 2014	8,760	0.71	5.98	411	9.2	1.74
2023–2025	25: 160.9, October 2024	8,603	1.17	7.05	440	12.7	2.14

ε, field and speed are means over the valid hours of OMNI2 [3]; ap and Kp are GFZ's indices of geomagnetic disturbance, ap being Kp converted to a linear scale [5 §2.2], averaged over every hour of the window; sunspot maxima are SILSO's 13-month smoothed numbers, version 2.0 [8]. A full year has 8,760 or 8,784 hours, so the two earliest windows rest on 81% and 42% of theirs.

OUR ANALYSIS

Among the 31 full years since 1995, when coverage became nearly continuous, 2024 ranks second for ε, after 2000; 2025 ranks fifth and 2023 ninth. Among the 29 three-year windows, 2023–2025 ranks fourth, after 2000–2002, 1999–2001 and 2001–2003, and fifth once the dipole factor is applied. Against 2000–2002 it had 3.7% less ε, with the solar wind's field at 7.05 nT against 7.23 and its speed at 440 km/s against 438; its sunspot maximum was 11% lower [3] [8]. Against 2013–2015, around the maximum of the weakest sunspot cycle in more than a century [8], it had 63% more. Since 1963 the sparse years count for more: 2024 ranks fifth of 63 years, after 1991, 1982, 2000 and 1992, and 2023–2025 ranks tenth of 61 windows, the highest being 1990–1992, measured for about 38% of its hours. The January-to-July mean of 2026, the stretch the paper had, ranks seventh of 32 since 1995. Set against sunspot numbers, the input at this maximum is on the high side: 7.2 × 10^8 W for each unit of the smoothed sunspot maximum, against 4.7, 5.1, 6.7 and 6.1 for Cycles 21 to 24, the first two from partial coverage [3] [8]. A second measure of the input, Newell's function of section 5, was 1.6% higher in 2023–2025 than in 2000–2002.

The solar wind of 2023–2025 was about as strong as that of 2000–2002. Nothing in the input is out of the ordinary for a solar maximum; for its sunspot number it is on the high side.

5 · EARTH'S RESPONSE

A test of the kind the paper calls for: set against the input, Earth's response in 2023–2025 was inside the range of earlier years

ε says what the solar wind delivered. Whether Earth became more susceptible is a question about how the planet responded, and the paper ends by asking for independent measures of the magnetopause or of the magnetosphere's response, tested with rules set in advance [1 §8]. We ran a test of that kind with the measures we had: geomagnetic indices, which record how much the field at the ground was disturbed [5]. They are not the clean yardstick the paper asks for, as it says of Kp itself [1 §7.3]; the limits say what that costs.

STEP 1

Rules first

We wrote the test down, with its pass mark, before computing anything, though after seeing the paper's tables, which list a yearly Kp beside each yearly ε. From them we already knew, roughly, that 2024's Kp was not high for its ε, so the direction of the result could be guessed. The rules file says so. It is hosted below.

STEP 2

Fit the past

For each month of 1995–2022: the mean ε over its valid hours, and the mean of the ap index over the same hours [3] [5]. A power law fitted to those 336 months says what response goes with what input.

STEP 3

Score the windows

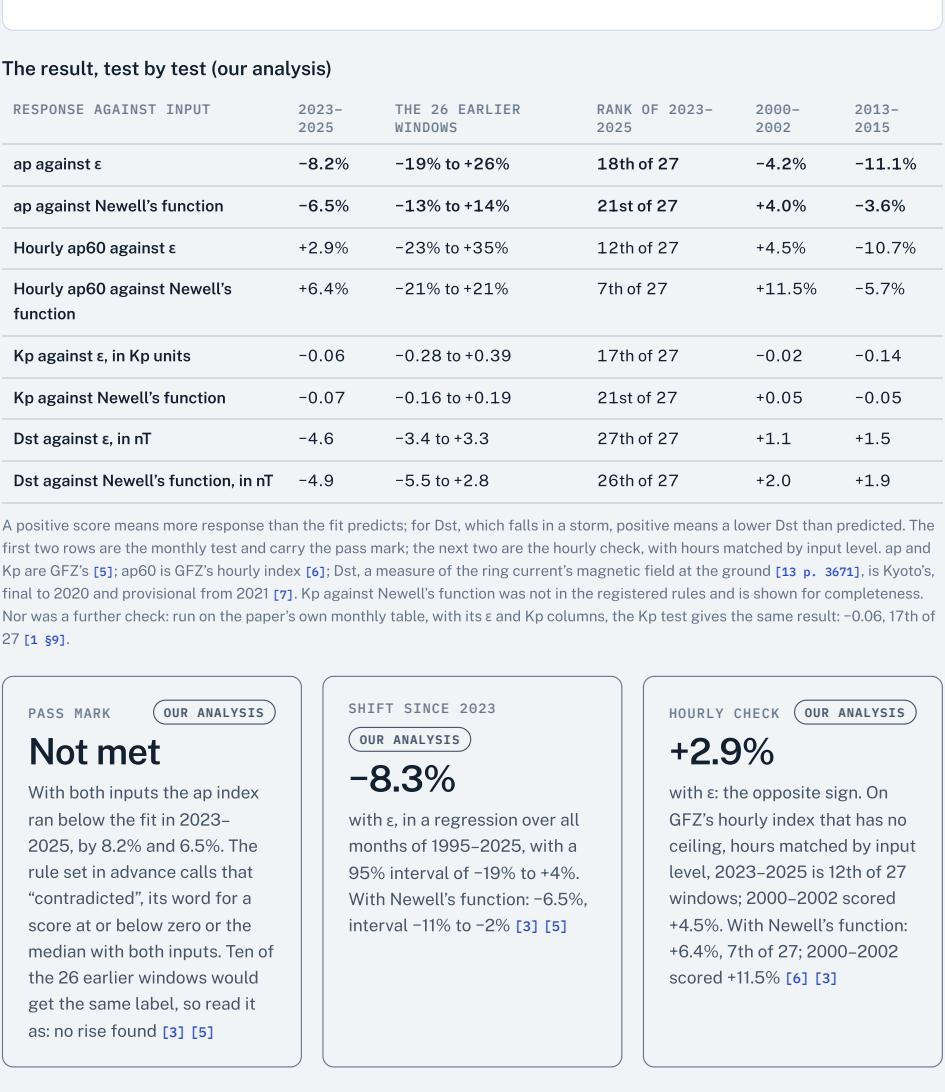
A window's score is how far its months sit above or below the fit, on average. 2023–2025 is scored against the fit to 1995–2022; each of the 26 three-year windows inside 1995–2022 is scored with its own months left out of the fit.

STEP 4

Pass mark

Three outcomes, each judged with ε and again with a second coupling function. A grown response is **supported** only if, with both, 2023–2025 scores above zero, above all 26 earlier windows and above both earlier solar maxima. It is **contradicted** if, with both, the score is zero or negative, or no higher than the median of the 26 earlier scores. Anything in between is **not shown**.

Earth's response above or below the fitted relation, by three-year window (our analysis)



Three-year windows, each starting a year after the last; the score is the ap index's mean departure from the fit, in percent

Our analysis of OMNI2 [3] and GFZ's ap index, CC BY 4.0 [5]. Upper panel: ap against ε. Lower panel: ap against the coupling function of Newell and colleagues [11 Abstract]. A bar above zero means more geomagnetic disturbance than the solar-wind input predicts. With ε the scores swing with the solar cycle, because ε gives little weight to the solar wind's speed and the fast-wind years of 2003–2008 score high; the second function allows for speed and swings less. These are the monthly scores; the hourly check, where 2023–2025 scores above zero, is in the table below. Hover or tap a bar for its window and score.

The result, test by test (our analysis)

RESPONSE AGAINST INPUT	2023–2025	THE 26 EARLIER WINDOWS	RANK OF 2023–2025	2000–2002	2013–2015
ap against ε	−8.2%	−19% to +26%	18th of 27	−4.2%	−11.1%
ap against Newell's function	−6.5%	−13% to +14%	21st of 27	+4.0%	−3.6%
Hourly ap60 against ε	+2.9%	−23% to +35%	12th of 27	+4.5%	−10.7%
Hourly ap60 against Newell's function	+6.4%	−21% to +21%	7th of 27	+11.5%	−5.7%
Kp against ε, in Kp units	−0.06	−0.28 to +0.39	17th of 27	−0.02	−0.14
Kp against Newell's function	−0.07	−0.16 to +0.19	21st of 27	+0.05	−0.05
Dst against ε, in nT	−4.6	−3.4 to +3.3	27th of 27	+1.1	+1.5
Dst against Newell's function, in nT	−4.9	−5.5 to +2.8	26th of 27	+2.0	+1.9

A positive score means more response than the fit predicts; for Dst, which falls in a storm, positive means a lower Dst than predicted. The first two rows are the monthly test and carry the pass mark; the next two are the hourly check, with hours matched by input level. ap and Kp are GFZ's [5]; ap60 is GFZ's hourly index [6]; Dst, a measure of the ring current's magnetic field at the ground [13 p. 3671], is Kyoto's, final to 2020 and provisional from 2021 [7]. Kp against Newell's function was not in the registered rules and is shown for completeness. Nor was a further check: run on the paper's own monthly table, with its ε and Kp columns, the Kp test gives the same result: −0.06, 17th of 27 [1 §9].

PASS MARK OUR ANALYSIS

Not met

With both inputs the ap index ran below the fit in 2023–2025, by 8.2% and 6.5%. The rule set in advance calls that "contradicted", its word for a score at or below zero or the median with both inputs. Ten of the 26 earlier windows would get the same label, so read it as: no rise found [3] [5]

SHIFT SINCE 2023 OUR ANALYSIS

−8.3%

with ε, in a regression over all months of 1995–2025, with a 95% interval of −19% to +4%. With Newell's function: −6.5%, interval −11% to −2% [3] [5]

HOURLY CHECK OUR ANALYSIS

+2.9%

with ε: the opposite sign. On GFZ's hourly index that has no ceiling, hours matched by input level, 2023–2025 is 12th of 27 windows; 2000–2002 scored +4.5%. With Newell's function: +6.4%, 7th of 27; 2000–2002 scored +11.5% [6] [3]

OUR ANALYSIS

The pass mark's label. The registered outcome is "contradicted", and we report it as registered. It is weak evidence. With Newell's function the median of the earlier scores is +1.4%, so even a small positive score would have drawn the label. Put through the same rule, ten of the 26 earlier windows are "contradicted", 16 "not shown" and none "supported"; the window around Cycle 24's maximum is among the ten. To be "supported", a window had to beat +26% with ε and +14% with Newell's function, and with ε both earlier maxima scored below zero. On the monthly test 2023–2025 still scores above nine and six of the 26 earlier windows.

The hourly check points the other way. ap and Kp stop at a ceiling in the greatest storms, so the rules included a second test on ap60, GFZ's hourly, Kp-like index, which is open-ended [5 §1]: in GFZ's files ap60 reaches 705, where ap stops at 400, the top of its scale [6] [5 §2.2]. Each hour's ap60 is compared with the average ap60 of the 1995–2022 hours that had the same input over that hour and the two before it. This is the test that matches hours by input level, and its sign is the opposite of the monthly test's: 2023–2025 comes out above the earlier average, +2.9% with ε and +6.4% with Newell's function, higher than 15 and 20 of the 26 earlier windows. Both are inside the range of earlier windows, and both are below 2000–2002. In the hours of storm-level input, the top 1%, 2023–2025 scores +3.5% and +3.9%, against +8.4% and +9.6% for 2000–2002: ninth of 27 windows and 14th of 26.

Quiet hours, and the solar cycle. The largest departures in the whole analysis are at quiet input, the lower half of hours: there 2023–2025 scores +27.7% with ε and +31.4% with Newell's function, fifth and sixth of 27 windows. More disturbance for the same quiet input is what the report's argument would predict. But the earlier large maximum shows more of it and the weak one shows none: 2000–2002 scores +32.0% and +38.8% at quiet input, and 2013–2015 scores −7.7% and −3.2%. The scores follow the solar cycle. Split into four levels of input, 2023–2025 is inside the range of earlier windows at every level, and below 2000–2002 in seven of the eight comparisons; at moderate input with ε it is a point above, +0.2% against −0.9%. One pattern could be read as amplification: from the window three years before to the window at maximum, the overall hourly score rose 19 and 21 points for Cycle 25, against 11 and 11 for Cycle 23 and 7 and 9 for Cycle 24. With three cycles, and window scores that scatter by 13 to 16 points, that is not a finding.

The windows just before, and the year so far. In both tests and with both inputs, 2023–2025 scores above each of the three windows before it, 2018–2020 to 2020–2022, which span the solar minimum: by 0.1 to 6 points in the monthly test and by 19 to 27 in the hourly one. January to September 2026, which the rules report separately, scores +0.7% with ε, 15th of 32 years for the same months, and −7.0% with Newell's function, 23rd of 32.

The trend. Over 1995–2025 the ap index at a given input drifted down, not up: by 6.0% a decade with ε (95% interval −11.3% to −0.4%) and by 5.4% a decade with Newell's function (−7.9% to −2.9%).

OUR ANALYSIS

Two notes made after the results were in, and not part of the registered test. The first: Kp's stations. GFZ estimates that the slow change of the field moved the Kp stations 1.7° of magnetic latitude farther from the auroral zone between 1932 and 2020, which biases Kp low by about a third of a unit over those 88 years; two-thirds of a unit is its upper limit [5 §3.2]. If the drift was even, that is about 0.06 of a unit between the middle of the fitted years and 2023–2025, the size of the Kp scores in the table; in ap it is about 3.5% a decade, more than half of the downward drift. That the drift was even, that it has gone on since 2020 and that ap60 shares it are our assumptions. After a fresh review of this page we carried the allowance through every month, hour and window and ran the tests again (table). 2023–2025 moves to the middle of the earlier windows in the monthly test and higher in the hourly one, and stays inside the range of earlier windows in all four comparisons. As measured it stood below 2000–2002 in all four; with the allowance it stands above in three. The regression's shift since 2023 becomes −2.6% with ε (95% interval −15% to +11%) and −0.8% with Newell's function (−6% to +4%); at GFZ's upper limit the intervals would reach +19% and +11%.

With an allowance for the drift of Kp's stations (our analysis, not registered)

RESPONSE AGAINST INPUT	2023–2025 AS MEASURED	WITH THE ALLOWANCE	EARLIER WINDOWS, WITH THE ALLOWANCE	2000–2002 AS MEASURED	2000–2002 WITH THE ALLOWANCE
Monthly ap against ε	−8.2%, 18th of 27	−2.4%, 13th	−18% to +24%	−4.2%	−6.2%
Monthly ap against Newell's function	−6.5%, 21st	−0.8%, 16th	−9% to +13%	+4.0%	+1.6%
Hourly ap60 against ε	+2.9%, 12th	+9.1%, 7th	−22% to +34%	+4.5%	+2.1%
Hourly ap60 against Newell's function	+6.4%, 7th	+12.8%, 4th	−20% to +19%	+11.5%	+8.8%

Every monthly ap and hourly ap60 value is raised by 0.34% for each year after 2009 and lowered by as much for each year before it; then the fits, the bins and the scores are made again, each earlier window still scored with its own months or hours left out. The rate is GFZ's best estimate of the bias, a third of a Kp unit in 88 years [5 §3.2], converted to ap with the ratio of our two fitted slopes. Ranks are among the 27 windows.

OUR ANALYSIS

The second note: Dst. All five provisional years, 2021–2025, score below the fit, which suggests an effect of how provisional values are made. In hours of quiet driving, Dst averages −1.5 nT over the final years 1995–2020 and +2.1 nT over 2021–2025, an offset of 3.6 nT that accounts for most of the −4.6 and −4.9 nT in the table [7]. It is not proof: three of the 26 final years also averaged above +1.3 nT, the lowest of the provisional years. With or without that allowance, Dst shows no larger response.

Set against the solar-wind input, Earth's geomagnetic response in 2023–2025 sat inside the range of earlier years, a little below the earlier relation month by month and a little above it hour by hour. That is no unusual rise. The monthly regression excludes a rise beyond roughly 10%, with station drift allowed for at GFZ's best estimate; the hourly check sets no limit of its own; and a rise of a percent or two is below what either test can see.

6 · THE WIDER LITERATURE

A dipole 1% weaker should change the magnetosphere by about 1% or less, and published scalings differ on the direction

Two questions sit behind the paper: how good a yardstick ε is, and what a weaker dipole does to the magnetosphere. Both have a literature, which the paper cites in part [1 §1].

Where ε comes from

ε was first defined in 1978 by Paul Perreault and Syun-Ichi Akasofu, in a study of 15 major storms of 1967–1970 [17 p. 547] [17 Table 1]. They set the energy the solar wind brings to the magnetosphere against the rate at which each storm dissipated energy: the energy injected into the ring current, Joule heating of the ionosphere and the energy of auroral particles [17 p. 547]. For the first they took the part of the solar wind's Poynting flux "which enters the magnetosphere across the front of the magnetosphere", through an "opening" whose size depends on the angle between the interplanetary field and Earth's field there, with a length l_0 of about 7 Earth radii [17 p. 549]. That form was "obtained empirically", as the one that best related the flux to the dissipation; its dependence on the angle came from Perreault's 1974 thesis [17 p. 549] [17 p. 571].

They found the two rates closely related, and over each storm the two totals agreeing "within a factor of 2" [17 p. 547]; in their table the ratio runs from 0.40 to 1.70 [17 Table 1]. They said the dissipation could be accounted for only "semi-quantitatively", and then only while a storm's main phase was developing rapidly; the agreement tended to break down in the recovery phase [17 p. 570]; and some of their measures were, in their words, "admittedly far from perfect" [17 p. 551]. They wrote ε in the cgs units of the time, with the Poynting flux's factor of 1/4π [17 p. 547].

OUR ANALYSIS

The constant differs from the one printed in 1978. The Poynting flux carries 1/4π in cgs units, as in the 1978 formula, and $1/\mu_0$ in SI units [1 §2.2]. The SI form the paper uses for ε, which it calls the standard convention, has $4\pi/\mu_0$ instead [1 §2]: a factor of 4π, about 12.6, above the 1978 constant. The level of ε in watts is therefore partly a convention, as the paper itself notes of the 4π [1 §2]. Every comparison on this page, the paper's and ours, is between values computed the same way, so the constant changes none of them.

ε as a yardstick

Akasofu's 1981 review presents ε as a first approximation that correlates well with the magnetosphere's total rate of energy use [9 Abstract]. A 2002 assessment found it a remarkably good estimate of the energy reaching the inner magnetosphere in storms and substorms, saw no convincing evidence that it beats other coupling functions, and warned against reading it as the solar wind's Poynting flux entering the magnetosphere [10 Abstract], the reading its originators gave it [17 p. 549]. In a 2007 comparison on yearly means, ε correlated with two long-running geomagnetic indices at 0.74 to 0.79, against 0.94 to 0.96 for the best function tested [12 Table 1]; its authors judged ε "an inferior proxy" at every timescale above three hours [12 p. 501]. Newell and colleagues' function, the one we use as a second input, correlated best with nine of ten measures of the magnetosphere's state in their own study [11 Abstract].

A weaker dipole

Siscoe and Chen's 1975 scalings have the energy input falling with the dipole moment, to the power 2/3, and the storm-time disturbance at the ground growing as the moment falls, to the power −1/3, as a 2004 study reports them [13 p. 3671] [14]. That study derives its own scalings and finds that ring-current disturbances "do not increase with decreasing dipole moment" [13 Abstract], and that the dipole's secular change "is of minor importance compared to the overall solar wind induced variability of the magnetosphere" [13 p. 3676]. Simulations of a magnetosphere with a different dipole give exponents that differ from the simple theory and depend on the solar wind's field [15 Abstract]; in a coupled model the magnetopause distance and the potential across the polar cap rise with the dipole moment, while the heating of the upper atmosphere rises and then falls as the moment grows [16 Abstract].

The scale of the effect between the last two comparable solar maxima (our analysis)

QUANTITY	SCALING WITH THE DIPOLE MOMENT M	CHANGE, 2001 TO 2024
The dipole itself, in IGRF-14	—	−1.18%
Distance to the magnetopause	$M^{1/3}$ [1 §2.1]	−0.39%
Cross-section, and energy input	$M^{2/3}$, the paper's factor [1 §2.1]	−0.79%
Storm-time Dst, in Siscoe and Chen's scaling	$M^{-1/3}$ [13 p. 3671]	+0.40%
For comparison: yearly ε since 1995	—	a factor of 5.9 between 2009 and 2000

Our arithmetic from IGRF-14's dipole at the start of 2001 and of 2024 [4], and from our yearly ε [3].

Our guide to the field sets the dipole's century of weakening against what the Sun does in a single storm, and rates "More vulnerable to solar storms" Overstated: the direction is right, the size is not.

7 · WHAT S0'S SPECIAL REPORT SAID

The report credits the paper with a finding the paper expressly declines to make

S0's special report of November 11, 2026, gives the paper forty seconds, and links it in the video's description under the label "Bigger Solar Storms since 2023" [2]. We quote the report from its automatic transcript; we did not see what was on screen.

In the report's words From the automatic transcript [2].

> *"There has been an anomalous amplification of Earth's vulnerability in 2023 up to now."*
>
> S0's special report [2 00:01:18–00:01:22]

> *"Now, they are hypothesizing that it was just a random surge in the solar wind."*
>
> The report [2 00:01:26–00:01:31]

> *"So why the solar wind amplified impact? You at this channel know the answer. Our shields are down."*
>
> The report [2 00:01:38–00:01:46]

The report's words beside the paper's

THE REPORT, OR ITS LABEL	THE PAPER	WHAT WE FOUND
ε is "our planetary vulnerability to the solar wind" [2 00:01:13–00:01:18]	ε is "an empirical estimate of the energy-input rate" [1 §2], built from the solar wind's speed and field and a fixed length [1 §6.1]	ε is the driver: its originators defined it as part of the solar wind's energy flux entering the magnetosphere [17 p. 549]. Of Earth's field, only the direction enters it, through the angle; the field's strength does not [17 p. 549] [1 §6.1]
"an anomalous amplification of Earth's vulnerability in 2023 up to now" [2 00:01:18–00:01:22]	An elevation that "coincides with enhanced solar-wind forcing during Solar Cycle 25" [1 Abstract]; no change in vulnerability established [1 §5]	2000–2002 was higher (section 4); the measured response shows no unusual rise (section 5)
"just a random surge in the solar wind" [2 00:01:29–00:01:31]	Read "primarily as a solar-wind-driven feature", and tied to the solar cycle [1 §7.2]	Right about the solar wind. The paper ties it to the solar cycle, not to chance; and for ε it is arithmetic, not a hypothesis
"Bigger Solar Storms since 2023" [2]	Monthly and yearly means of ε; no statement about the size of storms [1]	More solar-wind input than in any three-year window since 2001–2003, and less than in 2000–2002

OUR ANALYSIS

We searched the paper's text. "Vulnerability" appears twice, both times in a denial [1 §5] [1 §8]. "Anomalous" appears once, in the list of what cannot be established [1 Table 2]. "Amplification", "random" and "surge" do not appear, nor do "pole shift", "excursion" or "reversal" [1]. The label speaks of bigger solar storms, while the report's narration says "the sun isn't doing anything special" [2 00:01:33–00:01:36]. By SILSO's smoothed sunspot number, Cycle 25's maximum of 160.9 is 89% of Cycle 23's 180.3 and 138% of Cycle 24's 116.4 [8], and the solar wind's energy input was close to Cycle 23's and well above Cycle 24's (section 4). The answer the report then gives, that "Our shields are down" [2 00:01:44–00:01:46], is its own: it does not attribute that to the paper. The paper leaves that question open and does not answer it: its analysis is "compatible with the possibility" that the changing field modulates the response, which it leaves to future tests [1 §8].

The report's other sentences in this passage, on the Sun's strength and on Earth's "shields", are taken up in our review of the report. The claim that this is already showing, in more low-latitude aurora from a weaker Sun, is rated False at stop 8 of our video check; the general idea, that a weaker field leaves Earth more exposed to solar storms, is rated Overstated on our guide to the field. Our check of the May 2024 storm and our review of November 1, on low-latitude aurora, test it on single storms.

8 · WHAT PEER REVIEW CHANGED

The paper's own revision report says an earlier manuscript framed the rise as an anomaly, and that the published paper does not

The article's first supplementary file is its "Supplementary Revision Report", on the changes between manuscript versions 3 and 4 [1 Supp. 1 §1]. We have not seen version 3, or any version but the published one, so what follows is only what that report says. The published version is the paper, and these changes are to its credit.

What the revision report says changed, where it bears on S0's wording

SUBJECT	VERSION 3, AS THE REVISION REPORT DESCRIBES IT	THE PUBLISHED VERSION
2023–2026	"Recent increase was framed as an anomaly or risk signal" [1 Supp. 1 §2]	Compared with and without incomplete 2026, and read mainly in the context of Solar Cycle 25 [1 Supp. 1 §2]. The increase "is not presented as evidence of a geomagnetic regime transition, causal internal-field amplification, or a future risk forecast" [1 Supp. 1 §3.11]
Conclusions	"Included weakening, vulnerability, extrapolation, and causal implications" [1 Supp. 1 §2]	Limited to descriptive association and first-order sensitivity [1 Supp. 1 §2]; they "do not extrapolate to the 2050s or 2070s" [1 Supp. 1 §3.13]
The field's weakening	A statement "that Swarm observations imply an 8% global loss of field intensity between 2014 and 2025" [1 Supp. 1 §3.5]	Removed as unsupported; "secular variation" replaces "field decay" or "weakening" where a global fall is not established [1 Supp. 1 §3.5]
The ratio of Earth's field to the solar wind's	"used too literally in statements concerning magnetospheric resilience, shielding, vulnerability, and future shielding strength", and extrapolated to 2055 [1 Supp. 1 §3.17]	The extrapolation and those statements removed or revised; the paper's Table 2 now lists what the ratio cannot establish [1 Supp. 1 §3.17]
Whether 2024–2025 is exceptional	The terms "2024-2025 anomaly", "unprecedented surge" and "non-linear transition regime" [1 Supp. 1 §3.18]	Those terms removed; the revised manuscript "does not claim that the 2024-2025 amplitude is statistically exceptional" [1 Supp. 1 §3.18]

Quoted from the article's revision report, part of its supplementary material [1]. A reviewer had asked for a comparison of the recent maximum with those of earlier solar cycles, or for the anomaly framing to be downgraded; the revision took the second course and left the comparison to future work [1 Supp. 1 §3.18].

OUR ANALYSIS

The comparison that reviewer asked for is of the same kind as what section 4 does with five cycles, and the published paper's own numbers already point the same way: its 2000–2002 mean is higher than its 2023–2025 mean [1 §7.2].

9 · LIMITS

What this check could and couldn't settle

A test that sees only large shifts

To be called supported, 2023–2025 needed a response more than 26% above the fit with ε and 14% with Newell's function. In the monthly test three-year windows differ from one another by about 13% with ε and 7% with Newell's function, and in the hourly check by more, so a change of a percent or two, which is what the dipole's decline predicts, is far below what either can resolve in either direction [3] [5] [6]. The hourly check has no interval of its own, and the limit of roughly 10% rests on the monthly regression and on GFZ's best estimate of the stations' drift.

Averages, not storms or aurora

Monthly means and matched hours say little about any single storm, and nothing about where aurora was seen. Our reviews of single storms and of the aurora record are linked in section 7.

Abstracts only

We read five background papers only in their abstracts: Akasofu's [9], Koskinen and Tanskanen's [10], Newell and colleagues' [11], Zieger and colleagues' [15] and Crossen and colleagues' [16]. Siscoe and Chen's 1975 paper we did not read at all: its scalings are given as a 2004 study reports them [14] [13 p. 3671].

Imperfect yardsticks

The paper asks for independent measures of the magnetopause or of the magnetosphere's response [1 §8]. Ours are indices of the Kp family and Dst, so this is a test of the kind it calls for, not the one it describes. Kp and ap are capped in great storms [5 §1] and their stations drift in magnetic latitude [5 §3.2]; our allowance for that drift assumes that it was even, that it has gone on since 2020 and that ap60, whose reference paper we did not read, shares it [6]. Dst's recent years are provisional [7]; ε and Newell's function are estimates from hourly averages of the solar wind near L1, and NASA revises OMNI2 over time [3]. An index free of these problems would be a better judge; we did not use one.

One version of the paper

We read the published article's text and supplement, supplied by the site's owner, and its six figures as images. We have not seen the earlier manuscript the revision report describes, and we know of it only what that report says [1].

An unfinished year and cycle

2026 is incomplete and Solar Cycle 25 is not over, as the paper also says [1 §6.3]. The windows here end with 2025; the partial-year numbers for 2026 will move.

What would change these verdicts

01 A measure of Earth's response that is free of station drift, such as an index built from more stations or from satellites, showing 2023–2026 above every earlier window at the same solar-wind input.

02 Measurements of the magnetopause or the polar cap, the independent observables the paper asks for, showing the response growing as the dipole weakens.

03 A passage in the published paper that reports an anomalous amplification of vulnerability, or a finding about the size of storms.

These are our own judgments of what would change the verdicts, not forecasts from the sources.

10 · HOW WE WORKED IT OUT

One script, the public files, and every number of ours on this page

Every number tagged "Our analysis" comes from one standard-library Python script that downloads the public files, checks them and writes its results. It reproduces the two analyses we first ran with numpy under rules written in advance; the two agree to eleven decimal places. The readings added after the review are in the same script, marked as not registered.

PY **akasofu_epsilon.py**
The dipole factor; hourly ε and its monthly and yearly means; the ratio and its regression; the correlations with Kp; the ranks and the cycle-maximum windows; the response test, its checks, the two later notes and the readings added after the review · 74 KB

JSON **akasofu-epsilon-numbers.json**
Every number from our analysis on this page, as the script writes it · 69 KB

CSV **epsilon-annual.csv** and **response-window-scores.csv**
Our yearly series for 1963–2026, with each year's valid hours, and the score of every window in every test. Both are our own computation from the public data of NASA, GFZ and Kyoto. The yearly series, here and in the JSON file, equals the paper's supplementary annual table to the rounding of the arithmetic, because it is the same recipe applied to the same data; the paper's tables themselves are not hosted · 14 KB and 17 KB

TXT **RULES_reproduction.txt** and **RULES_response_test.txt**
The rules, written before any computation, with what we had already seen when we wrote them. The response test's pass mark is in the second. In them, "the coordinator" is whoever organized this batch of checks for the site · 8 KB and 8 KB

PY **reproduce.py**, **response_test.py** and **omni_common.py**
The numpy code we ran first under those rules, with the response test's first output, response_test.json. Two things differ from the files as they ran: a folder name in omni_common.py is made general, and one empty value in response_test.json is written as null, not NaN, so that strict readers accept the file. The code expects our folder layout and, for the cell-by-cell comparison, the paper's supplementary tables · 21 KB, 18 KB, 8 KB and 47 KB

TXT **analysis-log.txt**
The SHA-256 of the rules, the inputs, the scripts and the outputs, in the order they were made, what was added after the registered runs and what changed after the review · 14 KB

Run it

It needs only Python 3. Run `python3 -I -B akasofu_epsilon.py` in a folder of its own. The first time, it downloads its inputs, about 223 MB: NASA's 64 yearly OMNI2 files [3], IGRF-14 [4] and GFZ's Kp, ap and ap60 files [5] [6]. It identifies itself as factchecked-research/1.0 and checks each file against the copy we used. Add `--dst` to read Kyoto's final and provisional Dst as well, 381 small pages fetched one a second [7]; the script never requests a real-time page, and it writes no hourly Dst value, only window scores and yearly means of Dst in quiet hours. If you have the article's two supplementary tables, put them beside the script and it reports the largest difference from our series. Once the files are there it takes about ten seconds.

Related checks

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

Sources

Bracketed numbers refer to this list. For the paper [1], § gives a section of the published text, Abstract its abstract, and Table and Fig. a table or figure; "Supp. 1 §" gives a section of its first supplementary file, the article's revision report. The text supplied to us has no page numbers. For S0's special report [2], times are positions in the video (hours:minutes:seconds), from the first to the last line of the transcript that holds the words quoted; a bare [2] is the video's description. For the other sources, p. gives a page as printed, § a section, Table a table and Abstract the abstract; where we read only an abstract or a record, the entry says so. Links checked November 11, 2026.

1 Popescu, A. S. (2026). Akasofu Epsilon and Magnetospheric Energy Coupling under a Weakening Geomagnetic Field. *Advances in Space Research*, dated November 2026; its Crossref record, the source of these details, gives no volume or pages yet. © 2026 COSPAR, published by Elsevier, all rights reserved: quoted for review, and no figure or table is reproduced. Read: the text of the publisher's page, its six figures and its five supplementary files, supplied by the site's owner. The supplementary files are the article's "Supplementary Revision Report" on the changes between manuscript versions 3 and 4 (cited as Supp. 1), a data dictionary, the annual and monthly tables, and a spreadsheet of the same tables.

2 SpaceWeatherNews (S0) (November 11, 2026). SPECIAL REPORT: Pole Shift - Part 2. YouTube video, https://www.youtube.com/watch?v=CwcmU6pc3BA. Quoted from tactiq.io's automatic transcript, supplied by the site's owner; times are positions in the video, and we did not see its graphics. The label "Bigger Solar Storms since 2023" is the report's own, on its link to source 1 in the video's description.

3 King, J. H., and Papitashvili, N. E. (2005). Solar wind spatial scales in and comparisons of hourly Wind and ACE plasma and magnetic field data. *Journal of Geophysical Research: Space Physics* 110(A2), A02104. Cited as the data set's reference paper, not read. With the data: NASA/GSFC's OMNI, the hourly OMNI2 files omni2_1963.dat to omni2_2026.dat from the Space Physics Data Facility, read November 11, 2026, when the 2026 file ran to October 15; analysed by us.

4 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; read November 11, 2026, the same file, by its SHA-256, as on our earlier pages. The dipole's strength by the paper's measure is our computation from it.

5 Matzka, J., Bronkalla, O., Tornow, K., Elger, K., and Stolle, C. (2021). Geomagnetic Kp index, version 1.0. GFZ Data Services. The three-hourly Kp and ap indices from GFZ's file Kp_ap_since_1932.txt, read November 11, 2026, when they were definitive to October 31, 2026. CC BY 4.0, from Geomagnetic Observatory Niemegk, GFZ Helmholtz Centre for Geosciences; averaged and tested by us. The indices are described in 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(5), e2020SW002641, CC BY 4.0, read in the copy in GFZ's repository; § gives a section of that paper.

6 Matzka, J., Bronkalla, O., da Silva, M. V., Kervalishvili, G., Rauberg, J., Korte, M., and Yamazaki, Y. (2024). Geomagnetic Hpo index, version 3.0. GFZ Data Services. The hourly Hp60 and ap60 indices from GFZ's file Hp60_ap60_complete_series.txt, read November 11, 2026. CC BY 4.0; tested by us. The file asks users to cite Yamazaki, Y., and colleagues (2024), Assessment of geomagnetic activity for the Kp=9 "Gannon Storm" in May 2024 based on version 3.0 Hpo indices, ESS Open Archive, which we did not read.

7 World Data Center for Geomagnetism, Kyoto, Nose, M., Iyemori, T., Sugiura, M., and Kamei, T. (2015). Geomagnetic Dst index: hourly values from the WDC's monthly pages, final from January 1995 to December 2020 and provisional from January 2021 to September 2026. Read November 11, 2026, under the WDC's data usage rules: scientific use, no commercial use, with acknowledgement of the WDC and of the observatories that supply the data: Kakioka, Honolulu, San Juan, Hermanus and Alibag, with NiCT, INTERMAGNET and others. The rules ask that the WDC be contacted before its real-time values are published: none is read, used or published here, and no hourly value is hosted, only our derived scores.

8 WDC-SILSO, Royal Observatory of Belgium, Brussels. Sunspot number, version 2.0: the 13-month smoothed monthly total sunspot number, read November 11, 2026. CC BY-NC 4.0; only the sizes and months of the cycles' smoothed maxima are used here. The sunspot number is described in Clette, F., and Lefèvre, L. (2016), The new sunspot number: assembling all corrections, *Solar Physics* 291, 2629–2651, which we did not read.

9 Akasofu, S.-I. (1981). Energy coupling between the solar wind and the magnetosphere. *Space Science Reviews* 28(2), 121–190. Abstract only, on the publisher's page; the article is paywalled.

10 Koskinen, H. E. J., and Tanskanen, E. I. (2002). Magnetospheric energy budget and the epsilon parameter. *Journal of Geophysical Research: Space Physics* 107(A11), 1415. Abstract only, as its publisher deposited it with Crossref, and paraphrased here.

11 Newell, P. T., Sotirelis, T., Liou, K., Meng, C.-I., and Rich, F. J. (2007). A nearly universal solar wind-magnetosphere coupling function inferred from 10 magnetospheric state variables. *Journal of Geophysical Research: Space Physics* 112(A1), A01206. Abstract only, as its publisher deposited it with Crossref, and paraphrased here; the abstract gives the function we use as a second input.

12 Finch, I., and Lockwood, M. (2007). Solar wind-magnetosphere coupling functions on timescales of 1 day to 1 year. *Annales Geophysicae* 25(2), 495–506. CC BY 3.0. Read in its abstract, Table 1 and section 3.

13 Glassmeier, K.-H., Vogt, J., Stadelmann, A., and Buchert, S. (2004). Concerning long-term geomagnetic variations and space climatology. *Annales Geophysicae* 22(10), 3669–3677. CC BY 3.0. Read in its abstract, sections 1 and 2 and conclusions; also cited on our guide to the field.

14 Siscoe, G. L., and Chen, C.-K. (1975). The paleomagnetosphere. *Journal of Geophysical Research* 80(34), 4675–4680. Record only: unread, and described here as source 13 reports it.

15 Zieger, B., Vogt, J., and Glassmeier, K.-H. (2006). Scaling relations in the paleomagnetosphere derived from MHD simulations. *Journal of Geophysical Research: Space Physics* 111(A6), A06203. Abstract only, as its publisher deposited it with Crossref, and paraphrased here.

16 Cnossen, I., Richmond, A. D., and Wiltberger, M. (2012). The dependence of the coupled magnetosphere-ionosphere-thermosphere system on the Earth's magnetic dipole moment. *Journal of Geophysical Research: Space Physics* 117(A5), A05302. Abstract only, as its publisher deposited it with Crossref, and paraphrased here.

17 Perreault, P., and Akasofu, S.-I. (1978). A study of geomagnetic storms. *Geophysical Journal of the Royal Astronomical Society* 54(3), 547–573. The paper that first defined ε. Read in full, in a copy the site's owner downloaded from the publisher, Oxford University Press, whose site had shown our tools a bot check; all rights reserved, quoted for review. Its equations are read from the page images, which our own script decoded as data, since the text layer lacks them.

METHOD

How this was checked

On November 11, 2026, we checked every statement, number, quotation and citation on this page against its source. Of the paper we read the text of the publisher's page, its six figures and its five supplementary files, all supplied by the site's owner, because the publisher's site refuses our tools; we have seen no earlier version of the manuscript. We read S0's special report in tactiq.io's automatic transcript, supplied by the site's owner, and did not see its graphics. Beside them the page rests on five sets of data that we downloaded and analysed (NASA's OMNI2, IGRF-14, GFZ's Kp and ap, GFZ's hourly Hpo indices and Kyoto's Dst), on SILSO's sunspot number, and on ten papers about the indices, coupling functions and the magnetosphere of a weaker dipole: one, Perreault and Akasofu's 1978 paper, read in full (see below); three read in the sections cited; five in their abstracts; and one known only through another paper's account of it. The reference papers of three data sets are cited as their makers ask and were not read. That is 17 sources in all.

The verdicts and the items tagged "Our analysis" are our own assessment, built on the cited sources. They include the reproduction of the paper's numbers; the ranks of years and three-year windows and the comparison of five solar maxima; the response test, with its pass mark, its regressions, its hourly check, the two notes added after the results and the readings added after the review; the scale of the dipole's effect; the comparison of ε's constant with the one printed in 1978; and our search of the paper's text for the report's words.

We wrote the rules for the reproduction and for the response test before computing anything, though after reading the paper's tables, from which the direction of the response test's result could be guessed; both rules files are hosted on this page. We ran both analyses first with numpy and then with the standard-library script this page hosts, which reads the data with separate code and gives the same numbers to eleven decimal places. The paper's 63 full years and 723 months to June 2026 match our series to the rounding of the arithmetic, and every result the paper reports from its analysis reproduces; its partial July 2026 reproduces to 0.03%, because NASA has since revised those hours. The response test found no unusual rise: 2023–2025 sits inside the range of earlier windows, below the earlier relation in the monthly test and above it in the hourly check, which the rules also required. By the pass mark set in advance the monthly result is labelled "contradicted", a label that ten of the 26 earlier windows would also get. Two notes, on the drift of the Kp stations and on provisional Dst, were added after the results and are labelled as such. We could not test for a change of a percent or two, which is what the dipole's decline predicts; we did not use an index free of station drift; and we know the earlier manuscript only from the article's revision report. We redrew no figure of the paper: both charts are our own analysis of public data.

Before publication, a separate fresh review recomputed the paper's tables and every score of the response test with its own code and checked the quotations, locators, sources and verdicts. It confirmed the reproduction and all six verdicts, and found that we had worded the response test's outcome more strongly than the evidence supports: the page had called a grown response contradicted and said Earth's response was no larger than before. After it the page says what the tests show, gives the registered rule with its three outcomes, and says plainly that the hourly check has the opposite sign. We also carried the allowance for station drift through every comparison, added the hourly scores at quiet input, the partial year 2026 and what the paper keeps open, changed the title, and corrected about twenty smaller points of wording and citation; where we worded a correction differently from the review, our records say why.

After publication, on November 11, 2026, the site's owner supplied Perreault and Akasofu's 1978 paper, which first defined ε [17], downloaded from the publisher after its site had shown our tools a bot check. We read it in full; its equations, which the text layer lacks, we read from the page images, decoded by our own script reading the file as data only. Section 6 now gives the paper's account of where ε comes from, what it claimed for it and its own caveats; section 1 credits it; and section 7 no longer says that nothing in ε changes with Earth's field, since the field's direction enters through the angle. We also compared ε's constant with the one printed in 1978. A rough test against the 1978 storm totals, with NASA's hourly data, could not tell which constant those totals carried, so the page gives only the printed one. No verdict changed.

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

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 11, 2026	Updated November 11, 2026: we read in full Perreault and Akasofu's 1978 paper, which first defined ε, from a copy the site's owner supplied after the publisher's bot check had stopped our tools. Section 6 now says where ε comes from: 15 storms of 1967–1970, a form chosen empirically to match the energy they dissipated, and storm totals that the paper found to agree "within a factor of 2", with its own caveats; and it notes that the SI constant the 2026 paper uses is 4π times the one printed in 1978, which changes no comparison on this page. Section 1 credits the 1978 paper, and in section 7 the line saying that nothing in ε changes with Earth's field now says that the field's direction enters it and its strength does not. No verdict changed.
Nov 11, 2026	Published on factchecked.science after a full check against the sources and a fresh review of the built page. Built from our verification of Popescu (2026), read in the text, figures and supplementary files the site's owner supplied, and of S0's special report of November 11, 2026: six claims rated on the site's scale, three the paper's own, two the report's and one its link label. The charts and tables are our own analysis of public data; no figure or table of the paper is reproduced.

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