Fact-Checked Science

PAPER CHECK · SPACE WEATHER

Aurora met the equatorial anomaly in May 2024: the storm explains it, not a weakened field

An abstract for the AGU Fall Meeting describes "Preliminary observations" of the southern crest of the equatorial ionization anomaly and the auroral oval over South America during the storm of 10–12 May 2024, "aiming to identify and characterize their apparent merging" [1 Abstract]. S0 News read it as a sign of a weakened field that "should have required a superflare" [2 00:02:54–00:03:02]. We checked what the abstract says, what the peer-reviewed record shows about the merging, and whether the field's strength had anything to do with it.

By Fact-Checked Science · Published October 22, 2026

OUR ANALYSIS marks our own reasoning and calculations, and the verdicts are our assessment. Everything else comes from the numbered sources; for the abstract [1], Abstract names its text and Title its title, and for the episode [2] the times are positions in the video.

A great storm did this, with the field as it is

OUR ASSESSMENT

−412 nT
The storm's real-time Dst at 02:00 UT on 11 May 2024, "the sixth-largest storm since 1957"; Kyoto's provisional index gives −406 nT [4 p. 2][22]

29.8°
Invariant latitude: how far toward the equator the visible auroral oval's edge was reconstructed in the southern hemisphere, with 35.5° in the north [4 p. 35]

0–5°
How far a dipole 9% weaker could move a storm-time edge at 30°, across the three polar-cap scalings the source lists, 1.6° by Siscoe and Chen's; the storm moved it about 30° (our analysis, section 5)

THE CLAIMS

PARTLY TRUE

"During the May 2024 solar supererstorm, the auroral oval expanded so far it merged briefly with the equatorial ionization anomaly"

The presenter, S0 News; "supererstorm" is the transcript's error for "superstorm" [2 00:02:33–00:02:42]

A peer-reviewed GOLD study did see the anomaly's southern crest "merge with the aurora near the southern tip of South America", and the abstract sets out to characterize that "apparent merging" [3 Abstract][1 Abstract]. But both features moved: the crest ran poleward at up to 450 m/s [3 Abstract], to about ±31–35° magnetic latitude [16 Abstract][15 Abstract], as the oval's edge came down to about 30–36° [4 p. 35]. It was seen in one sector, the abstract calls its results preliminary, and "briefly" appears in neither source. See section 3.

MISLEADING

"Needless to say, that's not normal"

The presenter, S0 News [2 00:02:51–00:02:56]

Rare, yes: the sixth storm of its size since 1957, with a statistical return period of about 5.7 years for a storm this deep [4 p. 3][4 p. 25]. But the oval reached about where it did in 1958, 1959 and 1989, and at the Carrington storm's 30.8°; only 1872 and 1921 took it farther, to 24.2° and 27.1° [4 p. 42][5 Table 1], and its extent was "as expected from the empirical correlation" with storm intensity [4 p. 31]. See section 4.

FALSE

"should have required a superflare impact of Earth's magnetic field was at full strength"

The presenter, S0 News; "of" is the transcript's rendering of "if" [2 00:02:54–00:03:02]

The oval's edge moves with the storm's ring current and the solar wind's driving, not with the dipole's strength: the ring current alone enlarges the polar cap inside the oval by about 4° ± 1° for each −100 nT of Dst [10 Abstract], and a dipole 9% weaker moves the edge by a few degrees at most (our analysis from the published polar-cap scalings [14 p. 3669]). Storms under a stronger dipole drove the oval as far or farther without any recorded superflare [5 Table 1][23 p. 11], and this storm's main phase came from ejections launched after flares no larger than X1.0, with nothing in the sequence above X5.8 [4 p. 10][4 Table 1], below the 10^{33} erg at which superflares begin [23 p. 6]. See sections 5 and 6.

MISREAD

"pole shift signals analyzed from the May 2024 solar storm"

The episode's line-up, S0 News [2 00:00:17–00:00:30]

The abstract analyses the ionosphere's equatorial anomaly and the auroral oval with ionosondes, GNSS receivers, satellites and an all-sky camera. It says nothing about the field's strength, the magnetic poles or an excursion [1 Abstract]. See section 7.

UNCONFIRMED

Preliminary observations of an apparent merging of the anomaly's southern crest and the auroral oval over South America

The abstract's title and aim [1 Title][1 Abstract]

A conference abstract of "Preliminary observations", for a poster on 10 December 2026, with no numbers, figures or peer review [1 Abstract]. The phenomenon itself is in the peer-reviewed record [3 Abstract]; the abstract's own analysis is still to come. See section 1.

1 · THE ABSTRACT

An abstract of preliminary observations, due as a poster in December

Eight authors from Argentine universities, CONICET and NASA's Goddard Space Flight Center will present a poster at the AGU Fall Meeting on 10 December 2026. The abstract, all that exists so far, gives the aim, the instruments and four preliminary observations, and no numbers beyond two stations' coordinates [1].

What the authors set out to do

"In this study, we investigate the temporal and spatial evolution of the southern crest of the Equatorial Ionization Anomaly (EIA) and the auroral oval, aiming to identify and characterize their apparent merging during an extreme geomagnetic disturbance. The event analyzed corresponds to the 10–12 May 2024 geomagnetic storm, one of the most intense events of Solar Cycle 25" [1 Abstract].

The equatorial ionization anomaly is the pair of dense bands in the upper atmosphere's ionized layer that sit about 15° either side of the magnetic equator [16 Abstract]; the auroral oval is the ring of aurora around each magnetic pole, whose equatorward edge normally lies at 55–65° magnetic latitude [11 p. 567].

The instruments

"ionosonde measurements of foF2 and hmF2 from Tucumán (low-latitude station; 26.9° S, 65.4° W; −17.6° Mlat) and Bahía Blanca (mid-latitude station; 38.7° S, 62.3° W; −29.4° Mlat), Total Electron Content (TEC) maps derived from the RAMSAC and IGS GNSS networks, electron density profiles from COSMIC-2 radio occultations, maximum ionospheric electron density (NMAX) observations from GOLD, auroral particle precipitation measurements from DMSP/SSUSI, and all-sky optical observations from Río Grande" [1 Abstract].

OUR ANALYSIS Río Grande is in Tierra del Fuego, at about 53.8° S, 67.7° W, which puts the camera near −45° magnetic latitude by a centred-dipole calculation; the same calculation reproduces the abstract's two station values within a quarter of a degree.

The four preliminary observations, in the authors' words

foF2 is the ionosphere's peak plasma frequency, a measure of its peak density; hmF2 is the height of that peak; NMAX the peak electron density; Spread F a spread of ionosonde echoes that marks irregularities.

> *"Preliminary observations reveal a pronounced positive ionospheric storm over South America, characterized by enhanced TEC and a substantial increase in plasma density."*
>
> Melendi et al. (2026) [1 Abstract]

> *"During the storm main phase, an intense optical emission observed by the Río Grande all-sky imager exhibited an equatorward evolution, coincident with the expansion of auroral precipitation detected by DMSP/SSUSI and with a strong regional enhancement of NMAX observed by GOLD."*
>
> Melendi et al. (2026) [1 Abstract]

> *"Concurrently, ionosonde measurements showed an abrupt decrease in foF2 and a marked increase in hmF2, indicating significant uplift of the F-region ionosphere."*
>
> Melendi et al. (2026) [1 Abstract]

> *"Following the peak disturbance interval, Spread F developed at both Tucumán and Bahía Blanca, suggesting the generation of ionospheric irregularities under highly disturbed conditions."*
>
> Melendi et al. (2026) [1 Abstract]

THE AUTHORS' OWN WORDS
Preliminary
"Preliminary observations" in the text; "Apparent" merging in the title [1 Abstract][1 Title]

PRESENTATION
10 Dec 2026
Poster session SA43B at the AGU Fall Meeting. A conference abstract is not peer reviewed [1]

NUMBERS IN THE ABSTRACT
0
beyond the two stations' coordinates: no latitude, time or duration for a merging, no figures [1 Abstract]

OUR ANALYSIS

What the abstract does not say

It never states a merging as a finding. "Merging" appears in the title, as "Apparent", and in the aim, as something to "identify and characterize" [1 Title][1 Abstract]. The one observation that bears on it is an optical emission moving equatorward over Río Grande while the auroral precipitation expanded and GOLD saw a regional density enhancement [1 Abstract]. And it says nothing at all about Earth's magnetic field strength, the dipole, the magnetic poles, excursions, flares or superflares. The episode's framing comes from the presenter, not from this source.

2 · THE STORM

The sixth-largest storm since 1957, from a pile-up of ejections launched after ordinary flares

The data report on the storm by Hayakawa and colleagues: a real-time Dst of −412 nT at 02:00 UT on 11 May, "marking the sixth-largest storm since 1957" [4 p. 2]. Kyoto's provisional index gives −406 nT [22]. Our page on the Sun's two worst cases ranks it among the 34 largest storms since 1957.

MINIMUM DST
−412 nT
in the real-time index, a "great" storm by the usual classification (below −350 nT) and "the ninth greatest in the Dxt index starting from 1932" [4 p. 3]; −406 nT provisional [22]

SINCE 1957
6th
comparable to September 1957 (−427 nT), February 1958 (−426), July 1959 (−429) and November 2003 (−422), and "significantly lower only than" March 1989 [4 p. 40]

RETURN PERIOD
5.7 years
the statistical return period the report calculates for a storm of this minimum Dst, adding that the indices' magnitudes "should not be exaggerated" [4 p. 25][4 p. 39]

The flares behind it

The source region, AR 13664, produced "12 X-class flares up to X8.7 between May 8 and 15", the X8.7 on 14 May having "partially occurred on the western limb" [4 p. 38][4 p. 8]. The data report ties the storm's onset at 17:05 UT on 10 May to the ejection launched at 22:24 UT on 8 May, after an X1.0 and an M9.8 flare in quick succession, which piled onto an earlier X1.0 ejection and two from M-class flares [4 p. 10][4 p. 38]: the storm "is not associated with a single fast ICME but with a complex accumulation of multiple ICMEs and southward interplanetary magnetic fields" [4 p. 11]. The X2.2, X1.1, X3.9 and X5.8 flares of 9–11 May launched further ejections at about 1,000–1,600 km/s; the last two "probably arrived on Earth" around 09:00 UT on 12 May, after the Dst minimum, and prolonged the storm [4 Table 1][4 p. 12]. The region's stored magnetic free energy "surpassed 10^{33} erg on 7 May" [4 p. 2]; that is energy held in the active region, not the output of any flare.

3 · HOW THEY MET

The anomaly's crest ran poleward as the aurora came down to meet it

GOLD, a NASA imager on a geostationary satellite, watched the anomaly's southern crest and the aurora meet "near the southern tip of South America" [3 Abstract]. Both moved: the crest poleward, at up to 450 m/s, and the aurora equatorward.

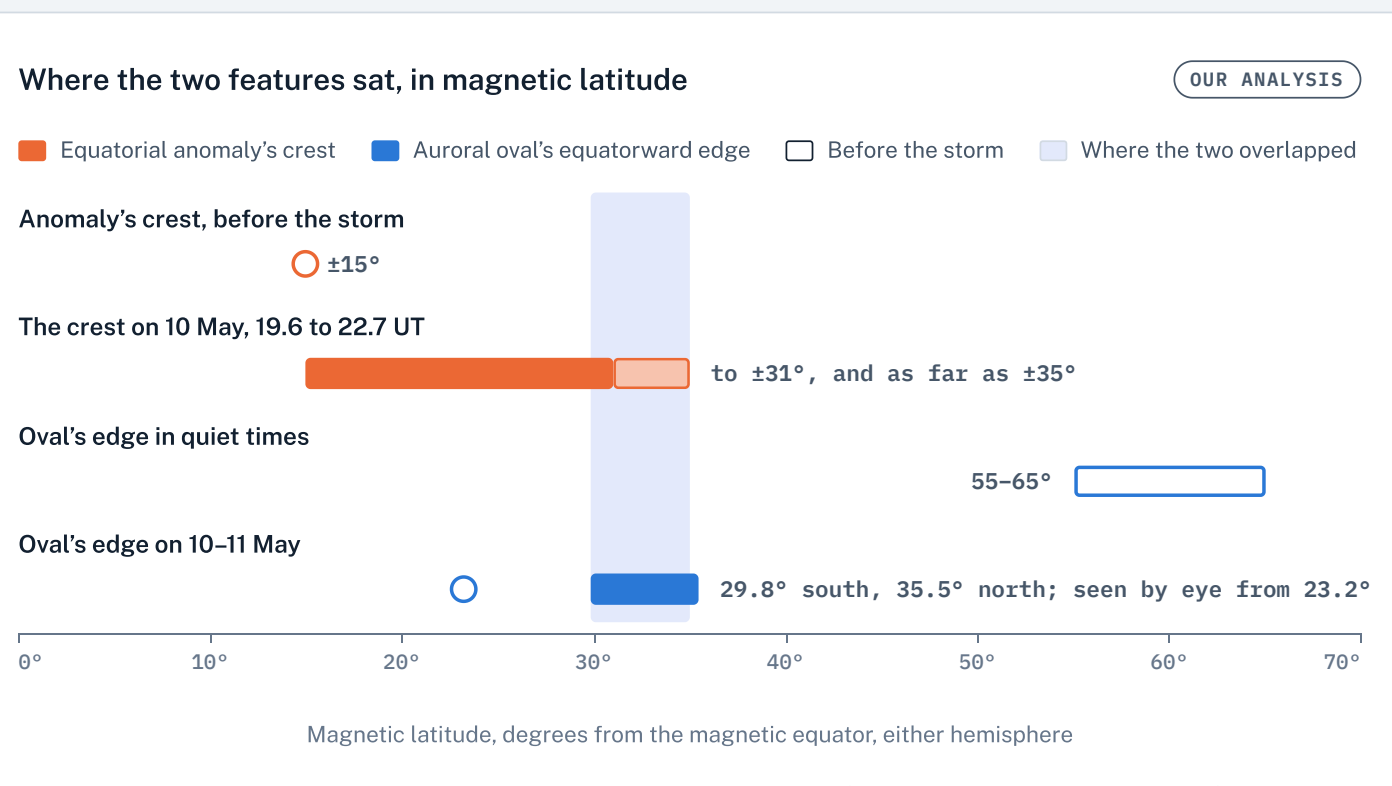
What GOLD saw

"Specifically, the nightside southern crest of the Equatorial Ionization Anomaly (EIA) was observed to merge with the aurora near the southern tip of South America. During the storm, the EIA southern crest was seen moving poleward as fast as 450 m/s. Furthermore, the aurora extended to mid-latitudes reaching the southern tips of Africa and South America. The poleward shift of the equatorial ionospheric structure and equatorward motion of the aurora means there was no mid-latitude ionosphere in this region" [3 Abstract].

OUR ANALYSIS This is the peer-reviewed report of the same phenomenon, by the GOLD team. The abstract does not cite it, but GOLD's peak-density maps are among the abstract's data sets, and the GOLD paper's first author is among the conveners of the abstract's session [1 Abstract][1][3]. The GOLD paper's abstract gives no duration for the merging, and we could read only its abstract [3 Abstract].

Where the two features sat, in magnetic latitude

OUR ANALYSIS



Drawn from numbers in the cited texts, not from any figure. The crest sat at ±15° before the storm and reached ±31° at 22.7 UT on 10 May [16 Abstract], and as far as ±35° [15 Abstract]. In quiet times (Dst above −50 nT) the oval's edge lies at 55–65° corrected geomagnetic latitude [11 p. 567]; on 10–11 May it was reconstructed at 29.8° invariant latitude in the south and 35.5° in the north, and aurora was seen with the naked eye from −23.2° in Namibia [4 p. 34][4 p. 35]. The open ring at 23.2° is that sighting. The GOLD study's figures are CC BY-NC-ND and are not reproduced [3].

The crest ran poleward

GNSS and Swarm data show "the EIA crests moved poleward from ±15° magnetic latitude (MLat) to ±20° MLat at around 19.6 UT, to ±25° MLat at 21.2 UT, and to ±31° MLat at 22.7 UT" on 10 May [16 Abstract]. In the American–Atlantic sector "the EIA crests exhibited a substantial poleward expansion, reaching as high as ±35° MLAT", driven by "the enhanced fountain effect driven by penetration electric fields, along with increased ambipolar diffusion due to transient meridional wind surges", while electron content rose by 50–100% within a few hours [15 Abstract]. Over Jicamarca, Peru, the penetrating electric field raised the ionosphere's vertical drift to about 95 m/s and the equatorial electrojet to about 275 nT [17 Abstract].

The oval came down

From 80 auroral reports, Hayakawa and colleagues "reconstructed the equatorward boundaries of the auroral oval down to 29.8° ILAT based on a Namibian report", and found their reconstructions in both hemispheres "reasonably consistent: 29.8° ILAT in the Southern Hemisphere and 35.5° ILAT in the Northern Hemisphere" [4 p. 35]. Naked-eye aurora was confirmed from New Caledonia (−26.5° MLAT), Australia (−24.2°), Namibia (−23.2°), Mexico (30.7°) and Hanle in India (24.3°) [4 p. 34]. Over Europe "the aurorae extend as far south as 46° N geographic (42° N Quasi-Dipole geomagnetic latitude), a significantly lower position than predicted by some models" [20 Abstract]; over Japan a blue-dominant aurora "was located at approximately 40 degrees magnetic latitude" [21 Abstract].

OUR ANALYSIS

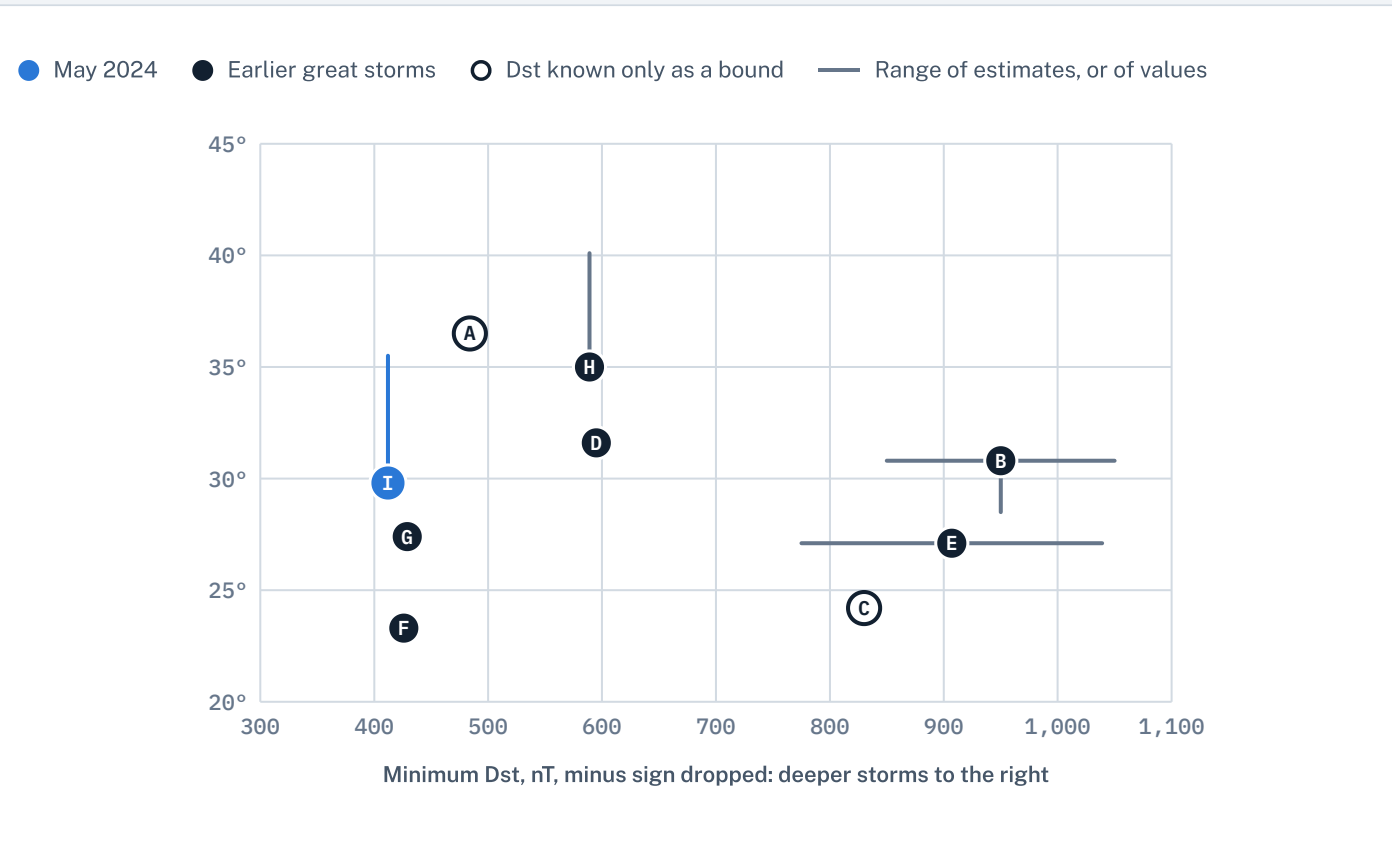
A known response, seen with a new instrument

A storm-time surge of the anomaly toward the poles is a known response of great storms. During the Halloween storms of 2003, "~900% increases in electron content above the CHAMP satellite (~400 km altitude) were observed at mid-latitudes (±30 degrees geomagnetic)", a "daytime super-fountain" [18 Abstract]; in November 2001, at a Dst of −275 nT, "the entire equatorial and midlatitude (up to ±50° magnetic latitude (MLAT)) dayside ionosphere was uplifted" [19 Abstract]. An oval at about 30° is what the record shows for storms of this depth (section 4). What the GOLD study adds is an imager that holds the crest and the aurora in one frame, which is why its authors call the observations "unique insights" [3 Abstract].

4 · IN CONTEXT

The oval went about as far as in 1958, 1959, 1989 and the Carrington storm, and not as far as in 1872 or 1921

The storm "significantly extended the auroral oval equatorward, as expected from the empirical correlation between the extension of the equatorward boundary of the auroral oval and the intensity of the associated geomagnetic storm" [4 p. 31]. The same authors' reconstructions of earlier great storms put May 2024 where its Dst says it belongs.



Vertical: the oval's equatorward edge, degrees of magnetic latitude; lower on the chart means nearer the equator

- Ⓐ **28–29 August 1859:** 36.5° ILAT; Dst at least −484 nT, since the Colaba record missed the main phase [5 Table 1][5 p. 23]
- Ⓑ **Carrington, 1–2 September 1859:** 30.8° ILAT, or 28.5° if a Honolulu report is accepted [6 p. 2][6 p. 13]; Dst estimates of about −850 to −1,050 nT [5 Table 1]
- Ⓒ **4 February 1872:** 24.2° ILAT; Dst "probably < −830 nT", from a single station [5 p. 21]
- Ⓓ **25 September 1909:** 31.6° ILAT; −595 nT [5 p. 21]
- Ⓔ **14–15 May 1921:** 27.1° ILAT, from an aurora seen at Apia, Samoa, at −16.2° MLAT; −907 ± 132 nT [5 p. 22][8 Abstract]
- Ⓕ **11 February 1958:** 23.3°, reported as magnetic latitude; −426 nT [4 p. 42][4 p. 40]
- Ⓖ **July 1959:** 27.4°, as magnetic latitude; −429 nT [4 p. 42][4 p. 40]
- Ⓗ **13–14 March 1989:** 35–40.1° MLAT from satellite precipitation and electric fields, with aurora visible down to 29° [5 p. 22]; −589 nT [5 Table 1]
- Ⓘ **10–11 May 2024:** 29.8° ILAT in the south, 35.5° in the north; −412 nT real time, −406 provisional [4 p. 35][4 p. 2][22]

Drawn by Fact-Checked Science from the numbers in the cited texts and tables; no figure is reproduced. ILAT is invariant latitude, the latitude of the magnetic field line's footprint; the 1958, 1959 and 1989 values are magnetic latitudes as their sources report them. At these latitudes the two differ by about 3°: with the 400 km auroral altitude the authors assume, 30.8° ILAT is 27.7° MLAT [6 p. 12][6 p. 13], and 2024's 29.8° ILAT is about 26.5° MLAT by the same conversion (our analysis), beside 1959's 27.4°. The Carrington storm is plotted at −950 nT, the middle of its range; Hayakawa and colleagues think "≈ −900 (+50, −150) nT" most likely [5 p. 23].

How the specialists rank it

> *"Based on naked-eye observations, this storm was comparable to the great storms of February 1958 and July 1959, for which the equatorward boundary of the auroral oval was reconstructed down to |23.3|° and |27.4|° MLAT, respectively"*
>
> Hayakawa et al. (2025) [4 p. 42]

> *"As far as currently known, the spatial extent of the equatorward boundary of the auroral oval is most extreme in the 1872 February event (24.2° ILAT), immediately followed by that of the 1921 May event (27.1° ILAT) and then the Carrington event (28.5°/30.8° ILAT)"*
>
> Hayakawa et al. (2019) [5 p. 23]

> *"The model indicates that a once-per-century storm would likely induce discrete aurorae at zenith down to a geomagnetic latitude of 34°. ... A Carrington-class storm would induce discrete aurorae down to 24°."*
>
> Love et al. (2025), a statistical model of overhead aurora against storm intensity [7 Abstract]

In 1921, "the lowest geomagnetic latitude of definite overhead aurora (coronal form) was 40° and the lowest geomagnetic latitude from which auroras were observed on the poleward horizon in the northern hemisphere was 30°", with a credible report from Apia, Samoa, "within 13° of the geomagnetic equator" [9 Abstract]. In 1859 the aurora itself was visible down to about 20° magnetic latitude, at Panama [6 p. 12]. Historical records put the oval's edge at "33–40° ILAT during the greatest geomagnetic storms of the space age" and "24–25° during extreme historical storms" [4 p. 42].

OUR ANALYSIS

So "not normal" is half right

A storm this deep comes a handful of times a century: six since 1957, with a statistical return period of about 5.7 years for this minimum Dst [4 p. 2][4 p. 25]. But nothing about the oval's reach was out of line with the storm. At −412 nT it reached about 30–36°, as it did at −426 and −429 nT in 1958 and 1959; the deeper storms of 1859, 1872 and 1921 took it to 24–31°, the Carrington storm's 30.8° overlapping 2024's southern 29.8° [4 p. 42][5 Table 1]. The comparison is rough: the historical boundaries come from reports with elevation angles, the 2024 one from naked-eye reports the authors call "most likely an ultra-conservative estimate" [4 p. 42]. The anomaly's surge toward the poles has precedents too (section 3). Rare, then, but regular: the ordinary behaviour of a great storm.

5 · WHAT SETS THE EDGE

The ring current and the solar wind move the oval; the dipole's 9% barely does

During a storm the oval expands toward the equator because the storm-time ring current inflates the magnetosphere and adds magnetic flux to the polar cap, and the solar wind's driving adds more [11 p. 566][10 Abstract][12 Abstract]. The strength of Earth's own dipole enters only through weak scalings.

THE RING CURRENT'S DIRECT EFFECT
4° ± 1°
growth of the oval's inside diameter, the polar cap's, "for each −100 nT of Dst": about 2° of equatorward shift at the oval's poleward edge, from the ring current's distortion of the field alone [10 Abstract]

WHAT SATELLITES MEASURED
below 50°
where the auroral belt's edge moved "dramatically" once Dst passed −100 nT, from its usual 55–65° at Dst above −50 nT, in the March 1989 storm, the authors' example from their 1983–1991 DMSP data [11 p. 567]

A DIPOLE 9% WEAKER
OUR ANALYSIS
0–5°
how far the polar-cap scalings move a storm-time edge at 30°: 1.6° by Siscoe and Chen's exponent, nothing to 5.2° by the other two the source lists; 0.4–2° at a quiet-time edge of 55–65°

What the measurements say

In 423 storms, "the equatorward boundary of the belt at midnight expands equatorward, reaching its lowest latitude about one hour before Dst peaks", and the ring current's energy grows with the earthward shift of that boundary: "The ring current leads to magnetosphere inflation as a result of an increase in the equivalent dipole moment" [11 p. 566]. Two years of IMAGE spacecraft pictures show that solar-wind coupling and ring-current intensity "both play a role in determining the response of the aurora to geomagnetic storms" [12 Abstract]. Three decades of ground magnetometer data "show how the auroral oval in the Northern hemisphere moves South with larger (more negative Dst) storms"; a simulation with Carrington-like solar wind reached a Dst of −1,142 nT and "a minimum estimated auroral boundary of 35.5° MLAT in places" [13 Abstract].

OUR ANALYSIS

What the dipole's decline could do

The dipole is about 9% weaker than in 1840 [24 p. 1]. For a weaker dipole the magnetopause moves in as the cube root of the dipole moment, and "Siscoe and Chen (1975) argue that the polar cap width scales with $\cos\Lambda \propto M^{-1/6}$, where Λ is the latitude of the polar cap boundary" [14 p. 3669]. That relation is for the polar cap boundary, the oval's poleward edge; we apply it to the equatorward edge as a first approximation. It is also one of three the paper lists: in general $\cos\Lambda \propto M^{\alpha-1/2}$, with $\alpha = 1/3$ from Siscoe and Chen, $\alpha = 0$ from Siebert (1977), and $\alpha = 1/2$ from Vogt and Glassmeier (2001) for periods of strong southward interplanetary field [14 p. 3669][14 Table 1].

With M at 0.91 of its 1840 value, Siscoe and Chen's exponent raises $\cos\Lambda$ by $0.91^{-1/6} = 1.016$: an edge at 55–65° moves 0.4–0.6° toward the equator, and a storm-expanded edge at 30° moves to 28.4°, by 1.6°. Siebert's exponent gives 1.3–2.0° and 5.2°; Vogt and Glassmeier's gives no shift at all. The storm itself moved the edge from the usual 55–65° to about 30–36° [11 p. 567][4 p. 35]: a few degrees at most from the decline since 1840, against about 30° from the storm. The ring current's field changes little either way: by the authors' own scaling it goes as $M^{2/3}$, about 6% less Dst for the same solar-wind driver, while the older Siscoe and Chen scaling gives about 3% more [14 p. 3671][14 Table 1]; the authors conclude that "ring current perturbations do not increase with decreasing dipole moment" [14 Abstract].

6 · A SUPERFLARE?

No superflare was needed, and none happened

A superflare releases about 10^{33} erg or more; Sun-like stars are seen to flare at 10^{33} to 10^{36} erg, while typical large solar flares release 10^{30}–10^{32} erg and the most extreme historical estimates, Carrington's among them, reach a few times 10^{33} erg [23 p. 6][23 p. 11]. Our page on superflares and particle storms has the details.

What May 2024 had

Twelve X-class flares between 8 and 15 May, up to X8.7 [4 p. 38]: large ordinary flares, of the order of 10^{32} erg, an order of magnitude or more below the superflare range [23 p. 11]. The storm's onset came from the ejection launched after an X1.0 and an M9.8 flare on 8 May, piled on three earlier ejections; the X2.2, X1.1, X3.9 and X5.8 flares of 9–11 May launched ejections that followed, the last two arriving around 12 May [4 p. 10][4 p. 12][4 Table 1]. In the report's words, "at least 4 ICMEs erupted from 13664 eventually overcoming each other and combining" [4 p. 2].

What a stronger field saw

Every storm in section 4 happened under a dipole stronger than today's, which has lost about 9% since 1840 [24 p. 1]. The storms of 1958, 1959, 1909, 1921 and 1872 drove the oval to 23–32°, and 1989's to 35–40°, with no superflare on record: the sources record no flare at all for 1872, 1909 or 1921, and the only historical flare estimated in the superflare range is Carrington's, whose oval reached 28.5–30.8° [4 p. 42][5 Table 1][23 p. 11][5 p. 23].

OUR ANALYSIS

No basis for the claim

The claim needs the oval's latitude to depend on the dipole's strength so strongly that restoring 9% would demand a far bigger storm. The published scalings give a shift of a few degrees at most (section 5); the record shows the same reach under a stronger field without any recorded superflare, which is the stronger argument; and the abstract itself says nothing about the field or about flares [1 Abstract]. The evidence contradicts the claim.

7 · A POLE SHIFT?

The abstract says nothing about the field, the poles or an excursion

The episode's line-up promised "pole shift signals analyzed from the May 2024 solar storm" [2 00:00:17–00:00:30], and the segment ends: "Needless to say, that's not normal and should have required a superflare impact of Earth's magnetic field was at full strength. But of course, it isn't." [2 00:02:51–00:03:02].

What the source covers

Ionosonde frequencies and heights, electron content, density profiles, peak densities, auroral precipitation and all-sky images [1 Abstract]. The words "magnetic field strength", "dipole", "pole", "excursion", "reversal" and "flare" do not appear. The merging it sets out to characterize is a feature of the ionosphere during a storm, not a signal from Earth's core.

The presenter then asks viewers to "hold that thought" for the segment on the Permian extinction [2 00:03:00–00:03:04]. That link is the presenter's, not the authors'.

OUR ANALYSIS

The grain of truth

The dipole is about 9% weaker than in 1840 [24 p. 1]; that is as far as "it isn't" at full strength goes, and section 5 shows it could have moved the aurora's edge by a few degrees at most. What the decline does and doesn't mean is on our pages When Earth's magnetic field falters and S0 News, October 20, 2026, which rate "a pole shift is under way" as Misleading.

8 · LIMITS

What this check could and couldn't see

An abstract, not a paper

The source reports no numbers, so none of its four observations can be checked against data; its own analysis arrives with the poster on 10 December 2026 [1].

The GOLD study, read as an abstract

Its publisher's page blocks scripted readers, so the latitude, time and duration of the merging in GOLD's images are not available to us; "briefly" can be neither confirmed nor refuted beyond noting that no source gives a duration [3 Abstract].

Boundaries from different methods

The 1958 and 1959 values are magnetic latitudes as reported, about 3° below the invariant latitudes used for the others at these latitudes, and the 1989 value comes from satellite precipitation rather than visual reports [4 p. 42][5 p. 22][6 p. 12]. The chart compares like with like only approximately.

Numbers from abstracts

Every figure from the Remote Sensing papers [15][16], the Jicamarca study [17], the European camera study [20], the 2001 and 2003 ionosphere papers [18][19], the 1921 study [9], the statistical model [7] and Schulz's, Milan's and Blake's papers [10][12][13] comes from its abstract.

What would change this verdict

01
The poster or a paper from Melendi and colleagues giving the merging's latitude, time and duration, which would let us rate "merged briefly" against the authors' own result.

02
A storm of similar Dst whose oval reached far beyond the 1958–1989 range, or a published dependence of the oval's edge on the dipole moment strong enough to matter at 9%.

03
Any statement by the authors linking the merging to the field's strength, the poles or an excursion; the abstract contains none.

OUR ANALYSIS

Bottom line: a real, rare and well-explained event, misread as a message from Earth's core.

The anomaly's crest and the aurora did meet over southern South America, as a peer-reviewed study reports and this abstract sets out to characterize [3 Abstract][1 Abstract]. A storm of −412 nT took the oval to about 30°, as such storms have before, under a dipole stronger than today's [4 p. 35][5 Table 1]. The dipole's 9% decline moves the edge by a few degrees at most; no superflare was involved, and the abstract never mentions the field.

Related checks

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

Sources

Bracketed numbers refer to this list. For the abstract [1], Abstract names its text and Title its title. For the episode [2], times are positions in the video (hours:minutes:seconds). For the papers, Abstract means the abstract, Table a table and p. a page: for [4], [5], [6] and [23] the page of the arXiv version we read, for [11], [14] and [24] the journal's page. Links checked October 22, 2026.

1. Melendi, Y., Molina, G., Rowland, D. E., Gonzalez, G. de L., Villegas, A., Paz, M., De Pasquale, L., and Arguelles, N. (2026). Observations of the Apparent EIA–Auroral Oval Merging over South America during the 10–12 May 2024 Geomagnetic Storm. Abstract 2093941, AGU Fall Meeting 2026, poster session SA43B, 10 December 2026. Conference abstract, not peer reviewed; no DOI and no licence stated, so it is quoted here and not reproduced. We read the full abstract as the meeting app renders it.
2. SpaceWeatherNews (S0) (October 22, 2026). Magnetic Pole Shift & The Largest Extinction Ever | S0 News Oct.22.2026. YouTube video. Quoted from the automatically generated transcript; times are positions in the video.
3. Karan, D. K., Martinis, C. R., Daniell, R. E., Eastes, R. W., Wang, W., McClintock, W. E., Michell, R. G., and England, S. (2024). GOLD Observations of the Merging of the Southern Crest of the Equatorial Ionization Anomaly and Aurora During the 10 and 11 May 2024 Mother's Day Super Geomagnetic Storm. *Geophysical Research Letters* 51(15), e2024GL110632. CC BY-NC-ND 4.0: no figure is redrawn. We read the abstract.
4. Hayakawa, H., Ebihara, Y., Mishev, A., Koldobskiy, S., Kusano, K., Bechet, S., et al. (2025). The Solar and Geomagnetic Storms in 2024 May: A Flash Data Report. *The Astrophysical Journal* 979(1), 49. CC BY 4.0. We read the accepted version, arXiv:2407.07665; p. gives its page.
5. Hayakawa, H., Ebihara, Y., Willis, D. M., Toriumi, S., Iju, T., Hattori, K., et al. (2019). Temporal and Spatial Evolutions of a Large Sunspot Group and Great Auroral Storms Around the Carrington Event in 1859. *Space Weather* 17(11), 1553–1569. We read the accepted version, arXiv:1908.10326; p. gives its page, and its Table 1 is on pp. 22–23.
6. Hayakawa, H., Ebihara, Y., Hand, D. P., Hayakawa, S., Kumar, S., Mukherjee, S., and Veenadhari, B. (2018). Low-latitude Aurorae during the Extreme Space Weather Events in 1859. *The Astrophysical Journal* 869(1), 57. We read the accepted version, arXiv:1811.02786; p. gives its page.
7. Love, J. J., Mann, I. R., Qvick, T., and Mursula, K. (2025). What Is the Lowest Latitude of Discrete Aurorae During Superstorms? *Space Weather* 23(4), e2024SW004286. CC BY 4.0. We read the abstract.
8. Love, J. J., Hayakawa, H., and Cliver, E. W. (2019). Intensity and Impact of the New York Railroad Superstorm of May 1921. *Space Weather* 17(8), 1281–1292. CC BY 4.0. We read the abstract.
9. Silverman, S. M., and Cliver, E. W. (2001). Low-latitude auroras: the magnetic storm of 14–15 May 1921. *Journal of Atmospheric and Solar-Terrestrial Physics* 63(5), 523–535. We read the abstract.
10. Schulz, M. (1997). Direct influence of ring current on auroral oval diameter. *Journal of Geophysical Research: Space Physics* 102(A7), 14149–14154. We read the abstract.
11. Yokoyama, N., Kamide, Y., and Miyaoka, H. (1998). The size of the auroral belt during magnetic storms. *Annales Geophysicae* 16(5), 566–573.
12. Milan, S. E. (2009). Both solar wind-magnetosphere coupling and ring current intensity control of the size of the auroral oval. *Geophysical Research Letters* 36(18), L18101. We read the abstract.
13. Blake, S. P., Pulkkinen, A., Schuck, P. W., Glocer, A., and Tóth, G. (2021). Estimating Maximum Extent of Auroral Equatorward Boundary Using Historical and Simulated Surface Magnetic Field Data. *Journal of Geophysical Research: Space Physics* 126(2), e2020JA028284. CC BY 4.0. We read the abstract.
14. 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.
15. Aa, E., Chen, Y., and Luo, B. (2024). Dynamic Expansion and Merging of the Equatorial Ionization Anomaly During the 10–11 May 2024 Super Geomagnetic Storm. *Remote Sensing* 16(22), 4290. CC BY 4.0. We read the abstract.
16. Bai, D., Fu, Y., Yang, C., Zhang, K., and Cui, Y. (2025). The Poleward Shift of the Equatorial Ionization Anomaly During the Main Phase of the Superstorm on 10 May 2024. *Remote Sensing* 17(15), 2616. CC BY 4.0. We read the abstract.
17. Rout, D., Kumar, A., Singh, R., Patra, S., Karan, D. K., Chakraborty, S., Scipion, D., Chakrabarty, D., and Riccobono, J. (2025). Evidence of Unusually Strong Equatorial Ionization Anomaly at Three Local Time Sectors During the Mother's Day Geomagnetic Storm On 10–11 May 2024. *Geophysical Research Letters* 52(2), e2024GL111269. CC BY 4.0. We read the abstract.
18. Mannucci, A. J., Tsurutani, B. T., Iijima, B. A., Komjathy, A., Saito, A., Gonzalez, W. D., Guarnieri, F. L., Kozyra, J. U., and Skoug, R. (2005). Dayside global ionospheric response to the major interplanetary events of October 29–30, 2003 "Halloween Storms". *Geophysical Research Letters* 32(12), L12S02. We read the abstract.
19. Tsurutani, B., Mannucci, A., Iijima, B., Abdu, M. A., Sobral, J. H. A., Gonzalez, W., et al. (2004). Global dayside ionospheric uplift and enhancement associated with interplanetary electric fields. *Journal of Geophysical Research: Space Physics* 109(A8), A08302. We read the abstract.
20. Katz, O., Lilensten, J., Doornbos, E., Colas, F., et al. (2026). Equatorward expansion of the auroral oval during the May 2024 geomagnetic storm observed over Europe by FRIPON all-sky cameras and satellites. *Journal of Space Weather and Space Climate* 16, 15. CC BY 4.0. We read the abstract.
21. Nanjo, S., and Shiokawa, K. (2024). Spatial structures of blue low-latitude aurora observed from Japan during the extreme geomagnetic storm of May 2024. *Earth, Planets and Space* 76, 156. CC BY 4.0.
22. Nose, M., Iyemori, T., Sugiura, M., Kamei, T., Matsuoka, A., Imajo, S., and Kotani, T. (2015). Geomagnetic Dst index [data set]. World Data Center for Geomagnetism, Kyoto. Final hourly values to 2020 and provisional values from 2021, as read for our page on the Sun's two worst cases, October 13, 2026.
23. Vasilyev, V., Usoskin, I., and Krivova, N. (2026). Linking solar magnetism, extreme solar particle events and stellar superflares. *Philosophical Transactions of the Royal Society A* 384(2329), 20250261. CC BY 4.0. We read the accepted version, arXiv:2602.10243; p. gives its page.
24. Finlay, C. C., Aubert, J., and Gillet, N. (2016). Gyre-driven decay of the Earth's magnetic dipole. *Nature Communications* 7, 10422. CC BY 4.0.

METHOD

How this was checked

On October 22, 2026, we checked every statement, number and quotation on this page against its source: the abstract as the AGU meeting app renders it, read in full with a browser because the page gives scripted readers only its title [1]; the episode's automatically generated transcript, quoted verbatim with its timestamps [2]; the full texts of the May 2024 data report, the two 1859 studies, the two Annales Geophysicae papers and the Japanese aurora study, read from the publishers or from arXiv [4][5][6][11][14][21]; and the abstracts of the other papers, about 90 items in all. For the GOLD study, the two Remote Sensing papers, the European camera study, the 1921 study and the superstorm-latitude model, the abstract was all that the publishers' pages would give a scripted reader [3][15][16][20][9][7].

After the page was built, a second reviewer who hadn't seen the drafting read it against the sources and the downloaded files, resolving the DOIs again. The changes that followed: the storm's main phase is now tied, as the data report says, to an ejection launched after an X1.0 and an M9.8 flare on 8 May, piled on three earlier ones, rather than to the X3.9 and X5.8 flares, whose ejections arrived around 12 May; the oval's reach is compared with the Carrington storm's 30.8° instead of being put short of 1859; Schulz's 4° ± 1° per −100 nT is credited to the polar cap's diameter, the oval's inside edge; the dipole-shift estimate now gives all three exponents the source lists, nothing to about 5° at a 30° edge, and the ring-current scaling is the authors' M to the two-thirds, about 6% less Dst; the fifth claim is worded as the abstract's preliminary observations; and a dozen smaller wording and citation fixes.

The verdicts and the items tagged "Our analysis" are our own assessment, built on the cited sources: the reading of the abstract beside the peer-reviewed GOLD study, the comparison of the oval's reach with earlier great storms, the dipole-scaling calculation, the magnetic latitude of Río Grande, and the two charts, which are drawn from numbers in the cited texts and tables rather than from any figure.

We recomputed the dipole scaling from the published relation and the magnetic latitudes of the abstract's two stations with a centred-dipole formula, which reproduces the abstract's values within a quarter of a degree. Nothing in the abstract itself could be recomputed, since it reports no numbers, and we did not re-derive the oval boundaries, which are taken from the published reconstructions; the 1958 and 1959 values are magnetic latitudes as reported and the others invariant latitudes.

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

FALSE	The evidence contradicts the claim.
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.
UNCONFIRMED	Rests on a preliminary result that hasn't been confirmed.
PARTLY TRUE	Part of the claim holds up and part doesn't.

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

Oct 22, 2026	Published on factchecked.science after a full check against the sources. Built from the AGU abstract, the peer-reviewed GOLD study of the same merging and the May 2024 data report, with the oval's reach in earlier great storms taken from the published reconstructions. The verdicts are on the site's scale: Partly true, Misleading, False, Misread and Unconfirmed.

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