PAPER CHECK · SPACE WEATHER AND THE WEATHER

A 2018 solar-effect index tracks temperature, but the match comes from humidity

S0 News introduced a paper "out of Russia that says solar activity ties extremely well to variations in temperature at ground level" [1 00:01:04-00:01:09]. The paper, from 2018, proposes an index of the "solar activity effect" and reports "a high degree of correlation" between it and the temperature of the 925–700 hPa layer, about 0.8–3 km up [18], at 16 areas during four geomagnetic disturbances [2 p. 59][2 p. 60]. The index multiplies the local humidity anomaly, which follows temperature anyway; in our rebuild from the same public data, humidity alone matches temperature as closely, and the storms' geomagnetic record adds little [5][6].

By Fact-Checked Science · Published October 28, 2026

OUR ANALYSIS marks our own reasoning and calculations, including our rebuild of the paper's index from NCEP/NCAR reanalysis and NASA's OMNI data and the controls we ran on it, and the verdicts are our assessment. Everything else comes from the numbered sources. For the episode [1], times are positions in the video. The paper appeared in two editions with the same table, figures and numbers: [2] is the English edition, quoted in its own words and cited by its printed pages, 59–62, and [3] is the Russian edition the episode linked, cited by its printed pages, 76–81.

A close fit that comes from humidity, not from the storms, and a 2018 paper presented without its date

OUR ASSESSMENT

0.90
the paper's median correlation between its index and temperature, at 16 areas chosen for their large swings, over about eight days each, by our count of its table [2 p. 60]

0.81
the median correlation at the same 16 areas of temperature with the humidity anomaly alone, with no geomagnetic data at all, in our rebuild from the same reanalysis, where our index itself reaches 0.68 with a positive geomagnetic factor [5]

+0.80 / −0.68
the geomagnetic indices alone against temperature, where it rose and where it fell, in the paper's own September 2005 event [2 pp. 61–62]

THE CLAIMS

OVERSTATED
Sun tracks ground temperature
The presenter: "a paper out of Russia that says solar activity ties extremely well to variations in temperature at ground level." [1 00:01:04-00:01:09]

The paper does report a "high degree of correlation" with an index it names after the solar activity effect [2 p. 59], but the temperature is that of the 925–700 hPa layer, about 0.8–3 km up [18], not at ground level; the index multiplies the local humidity anomaly [2 p. 60]; and the evidence is 16 hand-picked areas over about a week of four disturbances in 2002 and 2005 [2 pp. 60–61]. The geomagnetic indices alone correlated with temperature positively where it rose and negatively where it fell [2 pp. 61–62]. In our rebuild, humidity alone matches temperature as closely as the index does. See section 5.

OVERSTATED
Clouds and rain take Sun's cues
The presenter: "Sometimes this is about the UV load and sometimes it's about where the pressure and clouds and precipitation are found. These are also taking their cues from that same solar activity." [1 00:01:09-00:01:18]

Not from this paper: it says nothing about ultraviolet light or ozone and analyses no pressure, cloud or rain data; the route it proposes is electrical, through water vapour [2 p. 60]. Solar ultraviolet does change the stratosphere over the 11-year cycle [13 §1.1.1–1.1.2], but claimed effects of the solar wind and cosmic rays on weather within days are contested and have failed stricter tests [16 Abstract][17 Abstract]. Our check of a 2026 storms-and-weather paper rated "Storms have a profound weather impact" Overstated and "Strong storms suppress precipitation" Unsupported (storms and weather). See section 6.

MISLEADING
A high degree of correlation
The paper: "We identify the presence of a high degree of correlation between the temperature in the 925–700 hPa layer and the proposed index of solar activity effect." [2 p. 59]

The paper's table gives 0.51 to 0.97 [2 p. 60], higher than our rebuild reaches (section 5). But the index multiplies the humidity anomaly of the same air, which rises and falls with its temperature, storm or no storm, and the paper never compares humidity alone or a quiet period. In our rebuild, humidity alone gives a median of 0.81 at the 16 areas, against 0.68 for the index with a geomagnetic factor that stays positive and 0.36 as printed; with the positive factor, other storms' geomagnetic records give 0.60. See section 4.

UNSUPPORTED
Maps show a storm response
The paper: "The similarity in the variation of the spatial distribution of temperature and the proposed index suggests that this index does reflect the spatial structure of the temperature response to geomagnetic disturbance." [2 p. 61]

Nothing in the paper separates a response to the storms from weather that would have happened anyway: there is no comparison with quiet periods or random dates, no significance test, four events, and areas picked for their swings [2 pp. 60–61]. With a positive geomagnetic factor, areas picked the same way in weather 20–60 days from the storms correlate with the storms' index as well as those in the storm windows, a median of 0.79 against 0.78; with the factor as printed both are low, 0.20 against 0.34, by our analysis. That shows the method can't tell; it doesn't show there is no effect. See section 4.

TRUE
Indices alone: opposite signs
The paper: "In regions with lower temperature, temperature variations anticorrelate with PC- and aa-index variations (R=−0.68±0.30)" [2 p. 62]

Where temperature rose, the same indices correlated with it at 0.80 ± 0.24 [2 p. 61]. The authors report this themselves, and it is what to expect when one storm index is set against places warming and cooling at once. Pooled over the four events, our rebuild shows a similar, weaker split, with correlations with PC above zero at 6 of the 8 warming areas and below zero at 6 of the 8 cooling ones, three of them within 0.1 of zero; but not for September 2005 alone, where our averaged warming and cooling curves both correlate negatively with PC (−0.36 and −0.45). The verdict rests on the paper's own report: its evidence that geomagnetic activity alone doesn't say which way temperature will go. See section 3.

CONTEXT
A 2018 paper in today's list
The presenter: "So, let's head over to the article list today." [1 00:00:41-00:00:44]

The paper was received in May 2018 [3 p. 76] and published in December 2018 [2][3], almost eight years before the episode, which gave no date. The episode's other three links are to work from October 2026: see the airline radiation paper, the planetary alignments preprint and our review of the episode, which covers the Lumina simulation.

1 · THE PAPER

Four disturbances, sixteen areas and an index of the "solar activity effect"

A. A. Karakhanyan and S. I. Molodykh, of the Institute of Solar-Terrestrial Physics in Irkutsk, proposed in 2018 an index of how efficiently solar activity acts on the temperature of the lower troposphere, and compared it with temperature in NCEP/NCAR reanalysis during geomagnetic disturbances [2 p. 59][4]. The paper appeared in Russian in *Solnechno-Zemnaya Fizika*, in six pages, the edition the episode linked [3], and in English in *Solar-Terrestrial Physics*, in four [2]. INFRA-M publishes both editions for the authors' institute, which founded the journal; they carry the same table, figures and numbers.

STEP 1
A geomagnetic proxy
The PC index of magnetic activity over the polar cap, from the Arctic and Antarctic Research Institute's site, taken as "a proxy of solar activity" [2 p. 59]. It tracks how strongly the solar wind couples to Earth's magnetic field: the unified index is proportional to the solar wind's merging electric field [7 Abstract].

STEP 2
An index with humidity in it
$A = k \cdot a \cdot \log|PC| \cdot \exp(-(\varphi - \varphi_0)^2/d\varphi^2)$, where a is the anomaly of absolute humidity in the 925–700 hPa layer, φ the latitude, $\varphi_0 = 60°$ and $d\varphi = 20°$ [2 p. 60].

STEP 3
Daily maps
Maps of the index and of temperature anomalies in the same layer, both measured from the mean of the 15 days before the disturbance began, for "some heliogeophysical disturbances with the daily average PC index >1.5" [2 p. 60].

STEP 4
Sixteen areas
Areas of 5° × 5°, one to three warming and one to three cooling in each event, chosen as the "regions with the largest amplitude of variations", each correlated over the days of the disturbance [2 pp. 60–61].

The paper's sixteen correlations

FLARE	WARMING AREA, CENTRE ON DAY 0	R	COOLING AREA, CENTRE ON DAY 0	R
22 March 2002	60° N, 130° W	0.90 ± 0.18	80° N, 135° W	0.93 ± 0.15
	65° N, 40° W	0.94 ± 0.14	50° N, 15° E	0.90 ± 0.18
16 April 2002	50° N, 160° W	0.68 ± 0.26	65° N, 165° E	0.96 ± 0.10
16 June 2005	65° N, 100° W	0.91 ± 0.17	55° N, 120° W	0.64 ± 0.31
	50° N, 15° E	0.88 ± 0.18	65° N, 60° E	0.85 ± 0.20
7 September 2005	70° N, 180°	0.90 ± 0.18	75° N, 90° W	0.97 ± 0.10
	80° N, 105° E	0.51 ± 0.35	65° N, 140° E	0.56 ± 0.34
	55° N, 50° W	0.78 ± 0.26	70° N, 45° E	0.93 ± 0.15

Numbers from the paper's one table, the same in both editions [2 p. 60][3 p. 76]. For the September 2005 event the paper also gives the correlation of curves averaged over its warming areas, R = 0.94 ± 0.14, and over its cooling areas, R = 0.92 ± 0.16 [2 pp. 61–62]; it gives maps and averaged curves only for September 2005.

In the authors' words From the English edition.

> *"It has been found that the direct effect of solar flux on surface temperature is much less than the effect of carbon dioxide"*
>
> Karakhanyan and Molodykh (2018) [2 p. 59]

> *"As a characteristic of the water vapor content in the atmosphere we use the absolute humidity."*
>
> Karakhanyan and Molodykh (2018) [2 p. 60]

> *"For the analysis, we have selected regions with the largest amplitude of variations of the parameters under study."*
>
> Karakhanyan and Molodykh (2018) [2 p. 61]

What we read
Both editions in full. The publisher's site refused connections from our machines, so we read the English edition in the Internet Archive's copy of the publisher's PDF, captured on July 24, 2026 [2], and the Russian edition in a copy supplied by the site's editor [3]. Beyond the language, the editions differ in small ways: the English one names a second funder, a climate programme of the Russian Academy of Sciences [2 p. 62][3 p. 80]; its last abstract sentence says "indices" where the English abstract printed in the Russian edition says "index" [2 p. 59][3 p. 76]; and the Russian edition, the one the episode linked, words the map claim and the second conclusion more firmly than the English edition's "suggests" and "suggest" [3 p. 78][2 pp. 61–62]. The paper is peer reviewed: it thanks its referees, and the journal says it decides only after peer review [2 p. 62][2]. It is open access under CC BY-NC-ND [2 p. 59]. That licence allows no adapted versions, so this page quotes the English edition's own words, adds no translation of ours and redraws none of the paper's four figures, to which we point.

2 · THE INDEX

An index of the "solar activity effect" that is mostly the local humidity

Each day, at each place, the index multiplies four things [2 p. 60]. On a given day only one of them varies with longitude, and the authors chose it to bring in what geomagnetic indices lack: by their account those vary only with latitude, while the weather's response "has a significant longitudinal inhomogeneity" [2 p. 59].

What each part of the index does

PART	WHAT IT IS	WHAT IT DOES TO THE CORRELATIONS THE PAPER REPORTS
a	The anomaly of absolute humidity, the mass of water vapour in each cubic metre of air, in the same 925–700 hPa layer, from the same reanalysis and measured from the same 1.5 days as the temperature anomaly [2 p. 60]	Sets the index's sign and its pattern from place to place. Warmer air can hold more water vapour, about 7% more per °C near 0 °C by the Clausius–Clapeyron equation, so this factor tends to follow temperature in any weather (Our analysis)
log|PC|	The geomagnetic part: the logarithm of the PC index, used because the index varies over a wide range [2 p. 60]	The same at every place on a given day; it scales the humidity anomaly up and down with the storm. Below |PC| = 1 the logarithm is negative and flips the index's sign
exp(−(φ − 60°)²/(20°)²)	A weighting that peaks at 60° latitude, added because PC describes the polar cap as a whole [2 p. 60]	A constant at any one place, so it drops out of each area's correlation in time; it shapes the maps and, through the mix of areas, the averaged curves (Our analysis)
k	A scale factor; its value isn't given [2 p. 60]	A constant: it drops out of every correlation (Our analysis)

OUR ANALYSIS
Was the weighting fitted to the data?
It can't have been tuned to raise the 16 correlations in the paper's table or its map of correlations. Those are correlations in time at fixed places [2 pp. 60–61], where the factor is a constant, and multiplying a series by a positive constant doesn't change its correlation with anything. That holds exactly at a point and almost exactly over a 5° box: applying the weight at each grid point before averaging moves our area correlations by a median of 0.004 and at most 0.07. It does enter the averaged curves of Figs. 3 and 4, by weighting areas at different latitudes differently [2 Fig. 3]: in our rebuild, with a positive factor, the September 2005 warming-area value is 0.62 with the weight and 0.55 without it, and the cooling areas' 0.74 barely moves. The paper doesn't say how it chose 60° and 20°; it motivates the factor by earlier findings that the response is greatest at middle and high latitudes [2 p. 59]. What remains at each area is temperature against humidity anomaly × log|PC|.

OUR ANALYSIS
Where the "sign" comes from
On days when |PC| is above 1, the index has the sign of the humidity anomaly. So when the authors find that it describes "both the value and the sign" of the temperature changes better than the geomagnetic indices do [2 p. 59], they are comparing the local weather with one number a day for the whole polar cap. The comparison that would test a solar effect, the index against humidity alone, is not in the paper.

Two loose ends in the formula
As printed in both editions, the formula reads $(\varphi - \varphi)$ where the text beneath it gives $\varphi - \varphi_0$ [2 p. 60][3 p. 77]. More consequential, the paper doesn't say what it did on days when |PC| is below 1, where log|PC| is negative and the index changes sign. Such days are common: in NASA's OMNI record, the daily mean of PC(N) was below 1 in absolute value on 6 of the 8 days of the March 2002 window, and near zero, −0.01, on 20 June 2005 [6]. In the paper's Figs. 3 and 4 the plotted index has the same sign as the temperature change on days −1 and 0, when the plotted PC is below 1 (read by eye) [2 Fig. 3][2 Fig. 4]. With log|PC| negative, the printed formula would give it the opposite sign unless those areas were warmer and drier, or colder and moister, than before; the factor the authors computed probably stayed positive. We run both forms in section 4.

3 · THE EVIDENCE

Sixteen areas of about eight days each, chosen after the fact and not tested

The paper's evidence is its table of 16 correlations and, for the September 2005 event, maps and curves averaged over its warming and cooling areas [2 pp. 60–62]. It reports no significance test, no comparison with quiet periods or other dates, and no events beyond the four [2].

DAYS PER CORRELATION
OUR ANALYSIS
About 8
Figs. 3 and 4 run from day −1 to day 6 [2 Fig. 3], and 16 of the paper's 20 °.* values imply 7.8–8.3 values per correlation if they are the usual standard errors [2 pp. 60–62]

ABOVE THE NOMINAL BAR
OUR ANALYSIS
12 of 16
correlations above 0.71, the level a single test of 8 independent values would need for p < 0.05; the 0.51, 0.56, 0.64 and 0.68 fall short [2 p. 60]

DAYS THAT QUALIFIED
OUR ANALYSIS
95 and 99
days in 2002 and in 2005 with a daily mean PC(N) above the paper's 1.5, about 24 and 36 separate episodes, in NASA's OMNI record [6]; the paper doesn't say how it chose its four

OUR ANALYSIS
Why a nominal test wouldn't settle it
A textbook significance test assumes independent values and one comparison chosen in advance. Daily anomalies persist from one day to the next, so eight days hold fewer than eight independent values, and each area was picked after the event, for its large swings, from maps covering thousands of grid boxes. With a positive geomagnetic factor, areas chosen that way in ordinary weather reach 0.8 or more 47% of the time (section 4), against roughly a quarter if the days were independent.

The four disturbances in NASA's OMNI record

FLARE (THE PAPER)	DAY 0	DAYS ABOVE 1.5, OF 8	LARGEST DAILY PC(N)	LOWEST DST	LOWEST DST IN THE 15 DAYS BEFORE
22 March 2002	23 March	1	4.15	−100 nT	−37 nT
16 April 2002	17 April	6	5.07	−149 nT	−48 nT
16 June 2005	17 June	2	3.94, on day 6	−85 nT	**−106 nT**, 13 June
7 September 2005	8 September	5	6.16	−139 nT	**−184 nT**, 24 August

OUR ANALYSIS From the hourly PC(N) and Dst in OMNI [6], over days −1 to 6 of each event; "days above 1.5" counts the days whose mean PC(N) exceeds the paper's threshold, and Dst is the standard index of a storm's strength, from WDC Kyoto. The paper states day 0 only for September 2005, the day after the flare (8 September) [2 Fig. 3]; for the other three we take the day after the flare too. OMNI's PC(N) peaks on 11 September 2005, day 3, as in the paper's Fig. 3, but at 6.16 it runs about 25% above the paper's plotted peak (read by eye), so the paper probably used another version of the index; there are several [8 Abstract].

OUR ANALYSIS
Baselines with storms in them
The anomalies are measured from the mean of the 15 days before each disturbance [2 p. 60], but in two of the four events that baseline held a stronger storm than the event itself: −106 nT on 13 June 2005 before a disturbance of −85 nT, and −184 nT on 24 August 2005 before one of −139 nT [6]. The anomalies are not measured from quiet conditions.

The geomagnetic indices on their own
For the September 2005 event the authors set temperature against the PC and aa indices without the humidity term: 0.80 ± 0.24 over the warming areas, and −0.68 ± 0.30 over the cooling ones, an anticorrelation [2 pp. 61–62]. The same storm index goes with warming in some places and cooling in others; the humidity factor is what turns both into a positive match.

4 · OUR TEST

With the same public data, humidity alone does as well, and the storms' timing adds little

We rebuilt the index from the same reanalysis [4][5] and NASA's OMNI record of the PC(N) index [6] at the paper's 16 areas and four events, and ran three controls: humidity alone, the geomagnetic records of other disturbances, and weather from weeks before or after the storms, with the areas chosen the paper's way (Our analysis).

STEP 1
The same data
Daily NCEP/NCAR temperature and humidity at 925, 850 and 700 hPa for 2002 and 2005 [5], and hourly PC(N), turned into daily means [6].

STEP 2
The same index
The layer mean of the three levels, anomalies from the 15 days before day 0, 5° × 5° areas, days −1 to 6, and the factor in two forms: log|PC| as printed, and log(1 + |PC|), which stays positive as the paper's figures imply.

STEP 3
Three controls
Humidity alone; the PC series of the 428–446 other disturbed windows of 2002 and 2005; and the storm's own PC series set against weather from 20–60 days earlier or later, 69–82 windows per event.

STEP 4
Areas and maps
In every window, the two warming and two cooling areas at 45–80° N with the largest temperature swings, as the paper chose its own, and the share of the hemisphere where the index correlates with temperature above 0.5.

OUR ANALYSIS
At the paper's 16 areas, humidity alone matches temperature about as well as the index

Correlation with the temperature anomaly over days −1 to 6, r

OUR ANALYSIS Orange rings: the paper's table [2 p. 60]. The rest is our rebuild from NCEP/NCAR Reanalysis 1 daily means, data provided by the NOAA PSL, Boulder, Colorado, USA, from their website at https://psl.noaa.gov [5], and from the PC(N) index in NASA's OMNI data set, CC0 [6]. Each area is the mean of the 3 × 3 grid points of its 5° × 5° box; the shaded band marks correlations above 0.71, the nominal 5% level for 8 values. The positive form was added after our first run, once the paper's figures showed it probably used one. Our values are a rebuild, not the paper's own computation; see section 8.

HUMIDITY ALONE
OUR ANALYSIS
0.81
the median correlation of temperature with the humidity anomaly alone at the 16 areas, above 0.7 at 9 of them; at least as high as the index at 12 areas with the factor as printed and at 9 with the positive one

THE INDEX · OUR ANALYSIS
0.68 or 0.36
the median correlation of our index with temperature, with the positive factor or as printed, against the paper's 0.90 [2 p. 60]

OTHER STORMS' RECORDS
OUR ANALYSIS
0.60
the median correlation, with the positive factor, when the real PC series is swapped for another disturbance's: at 8 of the 16 areas at least half of the swapped series reach 0.5

OUR ANALYSIS
Choosing areas the paper's way gives high correlations without the storm

Correlation of temperature with the index over days −1 to 6, r

OUR ANALYSIS In every window, among 5° × 5° boxes centred at 45–80° N, the two warming and the two cooling boxes on day 0 with the largest temperature range over days −1 to 6, at least 10° of latitude or 20° of longitude apart, each scored against the index built from the storm's own PC series [9][6]. Bars: the share of the 1,208 boxes chosen in windows 20–60 days from the four storms that fall in each band of 0.1. Dots: the 16 boxes chosen the same way in the storm windows. The paper chose its areas by the swings of both temperature and index [2 p. 61]; we used temperature alone.

Across the hemisphere, the storm windows look like any others

EVENT	INDEX ABOVE 0.5, FACTOR AS PRINTED	INDEX ABOVE 0.5, POSITIVE FACTOR	HUMIDITY ALONE ABOVE 0.5
March 2002	7% (6%; 28%)	42% (46%; 64%)	58% (61%)
April 2002	43% (38%; 41%)	54% (49%; 41%)	59% (52%)
June 2005	7% (9%; 93%)	30% (35%; 77%)	41% (43%)
September 2005	39% (34%; 32%)	47% (44%; 50%)	49% (49%)

OUR ANALYSIS The share of the Northern Hemisphere from 20° N, weighted by area, where the correlation over days −1 to 6 exceeds 0.5, in the storm window; in brackets, the median share over the 69–82 windows 20–60 days away, with the storm's PC series, and the fraction of those windows that reach the storm window's share [9][6]. Humidity alone uses no PC series, so its brackets give only the median over the same windows. The paper maps this correlation for September 2005 only, on a scale from 0 to 1 [2 Fig. 2].

OUR ANALYSIS
What the controls show, and what they don't
Humidity alone tracks temperature at the paper's areas at least as closely as the index, in both forms. The real storm's record doesn't stand out either: in the median area about a third of other storms' records match or beat it, 31% with the factor as printed and 33% with the positive one, and its small edge may partly reflect that those areas were picked from this event's own maps. With the positive factor the index keeps most of its score when the storm's record is swapped for another's or set against other weeks' weather, a median of 0.60 with other storms against 0.68 with the real one; with the factor as printed it scores poorly with all of them, 0.36 with the real storm, 0.05 with others and 0.08 with other weeks' weather. Winds are re-chosen by a fixed rule, the storm windows' areas don't stand out from those of windows weeks away, and over the hemisphere the share above 0.5 in each storm window is typical of the others. Our rebuild does not reach the paper's 0.90, so these numbers are ours, not the paper's; what holds in both forms is that the index does no better than humidity alone and that the storm's own record adds little.

5 · WHAT THE EPISODE SAID

A 2018 paper about air 0.8–3 km up, presented without its date and as the Sun at ground level

S0 News introduced the paper as one "that says solar activity ties extremely well to variations in temperature at ground level" [1 00:01:04-00:01:09], under a link it labelled "Solar Forcing Temperature and Climate" [1].

Not ground level
The paper's temperature are those of the 925–700 hPa layer [2 p. 59]. In the U.S. Standard Atmosphere those pressures lie at 762, 1,457 and 3,012 m [18] (our calculation), so the layer spans about 0.8 to 3 km above sea level. At four of the 16 areas the reanalysis model's own terrain averages 1.05–1.27 km, above the 925 hPa level, which the paper doesn't mention (Our analysis, from NCEP's model terrain [5]).

Not solar activity as such
The geomagnetic part of the index is the PC index, the paper's "proxy of solar activity" [2 p. 59], a measure of the solar wind's grip on Earth's magnetic field [7 Abstract]. The correlations are with an index carrying the local humidity anomaly, and the geomagnetic indices alone gave opposite signs where temperatures rose and fell [2 pp. 61–62].

"Extremely well"
The paper says a "high degree of correlation" [2 p. 59]. Its values run from 0.51 to 0.97 at areas chosen after the fact, over about eight days each, with no test [2 p. 60]; in our rebuild, humidity alone does as well (section 4).

The date, and the climate label
The paper was published in December 2018 [2][3] and was presented in "the article list today" [1 00:00:44] without its date. It studies weather over about a week of four storms and makes no finding about climate: beyond framing remarks in its introduction, its one statement on the subject is that the Sun's direct effect on surface temperature is much smaller than that of carbon dioxide [2 p. 59].

6 · MECHANISMS

The paper's route is electrical; quick weather effects of storms remain contested

The authors adopt a model in which the solar wind changes the electric potential between the ionosphere and the ground, rearranging electric charge in the air, which "affects the water vapor (the main greenhouse gas) and consequently the radiation balance" [2 p. 60]. That is why their index carries humidity. The episode's ultraviolet, pressure, clouds and rain are not in the paper.

What the paper proposes
An electrical route through the global circuit and water vapour, after Zherebtsov and colleagues (2005), a model one of the authors helped build [2 p. 60][2 p. 62]. It mentions, as other researchers' ideas, the effects of cosmic rays on aerosols and minor gases, and non-linear effects through the atmosphere's circulation, citing for these among others the authors' own 2017 study of cyclones during disturbed geomagnetic conditions [2 p. 59][2 p. 62]. It tests none of them and analyses no pressure data itself: its data are temperature, humidity and two geomagnetic indices [2 pp. 60–62].

What it doesn't study
It never mentions ultraviolet light or ozone, and it analyses no pressure, cloud or precipitation data; clouds appear only in the titles of papers it cites [2 p. 59][2 p. 62]. So the episode's "UV load" and its "pressure and clouds and precipitation … taking their cues from that same solar activity" [1 00:01:09-00:01:18] are not findings of this paper.

Well established
The upper atmosphere responds
Over the 11-year cycle, changing solar ultraviolet alters stratospheric ozone by a few percent and temperature by up to about 2 K [13 §3.1.1–3.1.2]. The nearest established effect to the episode's "UV load" is this change over the solar cycle.

Supported, still debated
Surface patterns over seasons, in polar winter
Reanalysis data for 1957–2006 show polar winter surface temperatures differing by up to about ±4.5 K between years of high and low geomagnetic activity, though the authors could not conclusively show a physical link [14 Abstract].

Contested
Effects on weather within days
A close relative of this paper's mechanism is the Mansurov effect, a proposed link through the global electric circuit [16 Abstract]: changes of about 8 nT in the dawn–dusk component of the solar wind's magnetic field go with high-latitude surface pressure changes of about 1–2 hPa, clearest over Antarctica [15 §1]. A 2022 study using ERA5 found that, with tests suited to strongly autocorrelated data, the cyclic response offered as support has "a fairly high probability" of arising by chance [16 Abstract].
Our check of a 2026 paper on storms and weather, on the same kind of data, rated "Storms have a profound weather impact" Overstated, "Strong storms suppress precipitation" Unsupported and "Cosmic ray–cloud hypothesis falsified" Overstated (storms and weather).

The method trap
Why short-term claims keep splitting
> *"…we also demonstrate how a seemingly significant false positive may be obtained from non-significant data by minor alterations to methodological approaches."*
>
> Laken and Calogovic (2013) [17 Abstract]

OUR ANALYSIS
Where this paper sits
Its mechanism belongs to the contested tier, and its evidence could not separate that mechanism from ordinary weather even if it were right: an index that carries the local humidity will track the local temperature in any week. Another Russian paper S0 News presented this month, on bogs and solar minima, had a related problem: matches that chance produces about as often (our check).

7 · LATER WORK

Cited twice in eight years, once by the authors themselves

OpenAlex lists three records that cite the English edition, two distinct papers, and none for the Russian one; Semantic Scholar lists the same two [19]. We found no independent test of the index.

The authors' follow-up, 2020
Molodykh, Zherebtsov and Karakhanyan built the same approach, again with the PC index, into a model of outgoing longwave radiation, and report that including solar activity raises the correlation of the radiation with 925–700 hPa temperature [9 Abstract].

An independent citation, 2026
Yanchukovsky, Kuzmenko and Khisamov, of another Siberian institute, report that pressure rose at seven mid-latitude cosmic-ray stations during Forbush decreases in 1966–2024 and suggest changes in cloud and transparency as a cause [10 Abstract]. The 2018 paper is in their references; we could read only the abstract, so we can't say how they use it.

Where the authors went next
Since 2023 they have also used an "ionospheric electric potential", computed from a semi-empirical model, as their indicator of solar activity [11 Abstract], and studied single supersterms, such as those of July 2000 and November 2003 [12 Abstract]. This later work, by the same group, compares indicators over 1975–2019 and studies single storms; none of it tests the 2018 index.

8 · LIMITS

What this page can and can't settle

A rebuild, not the authors' code
The paper doesn't give k, the logarithm's base or its handling of |PC| below 1, which PC index it used, the exact days of the storms, how it averaged its areas and its layer, or the exact days it correlated [2 p. 60]. Our median correlation is 0.36 with the formula as printed and 0.68 with a positive factor, against the paper's 0.90, and our September 2005 warming-area curve peaks on day 0 where the paper's Fig. 3 peaks on day 3 (read by eye) [2 Fig. 3]. The numbers in section 4 are our rebuild's. What holds in both forms is that humidity alone tracks temperature at least as closely as the index and that the real storm's record does no better than about a third of other storms' records; with the positive factor the index also scores about as well without the right storm. A third form, with the daily mean of hourly PC, gives medians of 0.54 and 0.79, and humidity alone matches or beats it at 11 and 8 of the 16 areas. The positive form was added after our first run; the script lists every rule and every addition.

A different PC index
We used the PC(N) index in NASA's OMNI data [6], which runs about 25% above the paper's plotted peak in early and a daily mean PC(N) above the paper's 1.5, about 24 and 36 separate episodes, in NASA's OMNI record [6]; the paper doesn't say how it chose its four

One way to choose areas
The paper chose areas by the swings of both temperature and index [2 p. 61]; our fixed rule uses temperature alone, and our comparison windows share the season and year with the events, so they are not independent of one another.

Not shown is not absent
Our controls show that this method can't tell a storm's effect from ordinary weather. They don't show that geomagnetic activity has no effect on the lower atmosphere, which other work studies with other methods (section 6).

What would change these verdicts
01 The index tested against humidity alone and against random or quiet-time windows, with areas fixed in advance or the whole map scored.
02 Many disturbances chosen by a stated rule, with significance that allows for day-to-day persistence, beating those controls.
03 The same test, rules frozen first, passed on storms the authors haven't seen, such as those of the current solar cycle.

9 · FILES

Repeat our analysis

One script produces every number of ours on this page, and the charts draw its output. It fetches public data by URL and treats them as data: NCEP/NCAR reanalysis from NOAA PSL [5] and NASA's OMNI files [6].

pc_index_rerun.py
Rebuilds the index at the paper's 16 areas in both forms and runs the controls, with the events in OMNI's record, the days with PC(N) above 1.5, the sample size the paper's "≥" values imply, the standard-atmosphere heights and the model terrain; fetches about 29 MB on its first run · 28 KB

pc-index-numbers.json
Every number the script produces, area by area and window by window, with checksums of the data it read · 46 KB

Run it
`python3 -I pc_index_rerun.py` in an empty folder. It needs Python 3 with NumPy and netCDF4, downloads its inputs into `pc_index_data` on the first run and reuses them after, and writes `pc-index-numbers.json` in under a minute. NOAA PSL rebuilds each data subset on request, so the files differ byte for byte between downloads; the script records checksums of the data values in `pc-index-numbers.json` instead, and a fresh download reproduced ours exactly. We ran it with Python 3.12, NumPy 2.4 and netCDF4 1.7. It is a rebuild, not the authors' code: the choices the paper leaves open are listed at the top of the script.

Related checks

OVERSTATED Particles "left out of climate models" The Disaster Cycle, Fact-Checked

Sources

Bracketed numbers refer to this list. For the episode [1], times are positions in the video, from the first to the last transcript line of each quotation. For the paper, [2] is its English edition and [3] its Russian edition, with the same table, figures and numbers: p. gives a printed page of that edition (59–62 and 76–81), fig. a figure and Abstract the abstract; quotations are the English edition's own words. Values read off the paper's figures are marked "read by eye". For the other sources, § gives a section and Abstract the abstract; where only an abstract was read, the entry says so. The Russian edition was read in a copy supplied by the site's editor. Links checked October 28, 2026.

1 SpaceWeatherNews (S0) (October 28, 2026). They Should Have Warned the Airline | S0 News Oct.28.2026. YouTube video, https://www.youtube.com/watch?v=0PvPJ0WZy6g. Quoted from the automatically generated transcript; times are positions in the video. The label "Solar Forcing Temperature and Climate" is the episode's own, on its link to the paper in the video's description.

2 Karakhanyan, A. A., and Molodykh, S. I. (2018). Пространственное распределение температуры во время геомагнитных возмущений [Spatial distribution of temperature during geomagnetic disturbances]. *Solnechno-Zemnaya Fizika* 4(4), 76–81 (in Russian, with an English abstract). Received May 14, 2018, accepted September 14, 2018, published December 20, 2018, by INFRA-M. The edition the episode linked, at this address; its PDF states no licence, and the journal licenses its papers CC BY-NC-ND. Peer reviewed, as [2]: the article thanks its referees. Read in full in a copy supplied by the site's editor.

3 NOAA Physical Sciences Laboratory. NCEP/NCAR Reanalysis 1 [data set]: daily means of air temperature and specific humidity at 925, 850 and 700 hPa for January–June 2002 and April–November 2005, north of 20° N, and the model's surface height, downloaded October 28, 2026, through PSL's THREDDS server. NCEP-NCAR Reanalysis 1 data provided by the NOAA PSL, Boulder, Colorado, USA, from their website at https://psl.noaa.gov; free to use, with that acknowledgement.

4 Troshichev, O., Janzhura, A., and Stauning, P. (2006). Unified PCN and PCS indices: method of calculation, physical sense, and dependence on the IMF azimuthal and northward components. *Journal of Geophysical Research: Space Physics* 111(A5), A05208. Abstract only.

5 Molodykh, S. I., Zherebtsov, G. A., and Karakhanyan, A. A. (2020). Estimation of solar activity impact on the outgoing infrared-radiation flux. *Geomagnetism and Aeronomy* 60(2), 205–211. Abstract only.

6 Karakhanyan, A. A., and Molodykh, S. I. (2023). Ionospheric electric potential as an alternative indicator of solar effect on the lower atmosphere. *Solar-Terrestrial Physics* 9(2), 103–106. Abstract only.

7 Gray, L. J., Beer, J., Geller, M., Haigh, J. D., Lockwood, M., Matthes, K., Cubasch, U., Fleitmann, D., Harrison, G., Hood, L., Luterbacher, J., Meehl, G. A., Shindell, D., van Geel, B., and White, W. (2010). Solar influences on climate. *Reviews of Geophysics* 48(4), RG4001. Cited as on our storms-and-weather check.

8 Lam, M. M., Chisham, G., and Freeman, M. P. (2014). Solar wind-driven geopotential height anomalies originate in the Antarctic lower troposphere. *Geophysical Research Letters* 41(18), 6509–6514. Cited as on our storms-and-weather check.

9 Laken, B. A., and Calogović, J. (2013). Composite analysis with Monte Carlo methods: an example with cosmic rays and clouds. *Journal of Space Weather and Space Climate* 3, A29. Cited as on our storms-and-weather check.

10 OpenAlex. Works citing the English edition (three records, two papers) and the Russian edition (none), read October 28, 2026; Semantic Scholar's record of the English edition lists the same two papers.

METHOD

How this was checked

On October 28, 2026, we checked every statement, number, quotation and citation on this page against its source: both editions of the paper, read in full, the English one in the Internet Archive's copy of the publisher's PDF, because the publisher's site refused connections from our machines, and the Russian one in a copy supplied by the site's editor; the S0 News episode's transcript [1]; NCEP/NCAR reanalysis, the reanalysis the paper used, and NASA's OMNI record of the PC index, in a version that may differ from the paper's [5][6]; and the 14 further sources listed, read as the list says. DOIs were resolved through Crossref, and OMNI's through DataCite. Eight were read as abstracts only, and three on the wider evidence are cited as our page on a 2026 storms-and-weather paper reads them.

The verdicts and the items tagged "Our analysis" are our own assessment,