Fact-Checked Science

PAPER CHECK · BIOSPHERE

Tipping-point warning is still research; nothing yet shows the pole shift is the missing piece

Fourteen researchers review what satellites would have to deliver to warn of tipping points in forests, drylands, wetlands and permafrost; they add no new data, and say most such methods "remain in the research phase" [1 p. 23][1 p. 39]. S0 News called it "a great concept and minimal execution" and faulted it for missing "the only earth change that really matters", the "ongoing magnetic pole shift" [2 00:01:32][2 00:01:46–00:01:51]. The omission is real: our word search finds no geomagnetism, pole shift or solar storms in its text, and we found no paper that ties today's field or storms to ecosystem tipping. But what is documented as reshaping nature is land use, exploitation, climate, pollution and invasive species [43 p. 12]; where the review falls short is in firm statements that run ahead of its own sections on limits.

By Fact-Checked Science · Published November 1, 2026

OUR ANALYSIS marks our own reasoning and calculations: the word search of the review and of its sibling reviews, the search of OpenAlex, the field strength we compute from IGRF-14 at the sites in the authors' figure and map script, the arithmetic on the 73%, our reading of why ESA funded the work and of what the paper does and does not say; the verdicts are our assessment. Everything else comes from the numbered sources. For the paper [1], read in full, p. gives a page of the version of record, Fig. a figure and Table a table; its key points, abstract and plain-language summary are on p. 1. For the episode [2], times are positions in the video. Elsewhere p. gives a page, § a section, Fig. a figure and Abstract the part of a source we quote.

A candid review of unfinished science; we found no evidence that the magnetic field belongs in it

OUR ASSESSMENT

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mentions of solar storms, the geomagnetic field, a pole shift, cosmic rays or aurora in the review's text. "Solar" appears once, for sunlight reflected to a sensor, and "magnet-" three times, all in "electromagnetic" (our word search) [1 p. 18][1 p. 35]

73%

of Earth's land where resilience estimates contradict each other, the review says [1 p. 21]; the figure compares three example studies, and three unrelated maps would "disagree" on about 75% by chance (our arithmetic) [18 Fig. 2]

−27%

the largest fall in field strength since 1900 at any of the 37 sites in the authors' figure and map script, in the Patagonian steppe; the Amazon Basin's −18% is fourth. The field rose at 17 of them, and today it differs by a factor of 2.7 across them (our analysis) [49]

THE CLAIMS

CONTEXT

"First up in today's articles is a great concept and minimal execution."

The episode, on the review [2 00:01:29–00:01:32]

An opinion. It is fair if "execution" means a working warning system: the review delivers none, adds "No new data" and says the potential "remains largely unrealized" [1 p. 37][1 p. 39]. It isn't fair as a judgment of the review, which does what a review does: six tipping mechanisms and four spatial categories [1 p. 5][1 p. 10], and eleven systems assessed one by one [1 p. 23], from 315 references [3]. The review isn't the system, and the same team is building one: PREDICT, the ESA project that funds all the authors, lists a prototype as a central outcome [1 p. 39][6]. See section 2.

CONTEXT

"Does anyone disagree with the need for monitoring Earth's tipping points? Of course not."

The episode [2 00:01:35–00:01:38]

A rhetorical aside. On monitoring as such it is roughly right: ESA funds it, an EU science brief urges it [7][8], and none of the papers we read argues against it, though we ran no dedicated search for one. But the concept and the warnings are argued over. Whether the land biosphere has planetary tipping points "remains unconfirmed" [27 Abstract]; 36 meta-analyses found thresholds "rarely detectable" [28 Abstract]; a 2025 perspective says the framing confuses [29 Abstract]; and warning indicators can raise false alarms [30 Abstract], as the review itself says [1 p. 21]. See section 3.

PARTLY TRUE

"Unless they're ignoring solar storms and the magnetic pole shift, magnetic changes altogether or anything other than mainstream climate science."

The episode [2 00:01:38–00:01:46]

The first part holds: the review never mentions solar storms, the geomagnetic field or a pole shift (our word search). Sibling reviews are just as silent, and our searches found no paper tying today's field or storms to ecosystem tipping, which isn't proof that none exists. The last part fails if it means anything but climate: the review treats land use, fire, grazing and insects, mentions El Niño and natural variability, and names large volcanic eruptions and an asteroid among perturbations "of different origin (e.g., subsurface or extra-terrestrial)" [1 p. 7]. It does assume climate and land use as the slow forcing [1 p. 4][1 p. 21], and all it covers is mainstream science. See section 4.

FALSE

"They certainly don't hit the only earth change that really matters right now and that is the ongoing magnetic pole shift"

The episode, where the transcript's words run into the next item [2 00:01:46–00:01:51]

The review doesn't hit it, as said. But "only … that really matters" is contradicted by the record of what is changing nature: "changes in land and sea use; direct exploitation of organisms; climate change; pollution; and invasion of alien species" [43 p. 12]. One counter-example refutes "only", and that says nothing on whether the field matters at all; on that, we found no evidence. The episode offers none here. The premise keeps its earlier ratings: "A pole shift is under way" is Misleading on our reviews of October 20 and October 24, and "An excursion is under way now" False on October 22. See section 5.

TRUE

"Most EO-based early warning approaches remain in the research phase rather than operational implementation."

The paper; EO is Earth observation [1 p. 23]

The authors' own candid assessment: "few approaches have been validated sufficiently for routine operational monitoring", tipping events are too rare in the satellite record to test against, and operational thresholds are "poorly defined" [1 p. 23][1 p. 36]. ESA calls the system its project is building a "prototype" [6]. See section 2.

UNCONFIRMED

"Space-for-time methods using spatial gradients can overcome temporal limitations by identifying systems at different vulnerability stages"

The paper's Key Points [1 p. 1]

Using places along a rainfall or temperature gradient as stand-ins for time is a promising idea, "most tractable where a clear, spatially extensive forcing gradient exists" [1 p. 37]. But its assumptions "do not hold true in general", and it can fail as tipping nears, because correlations grow [1 p. 14]. The same paper says savanna gradients should be read as "informative analogs rather than direct temporal trajectories", and that the method may "potentially overcome" the limit [1 p. 29][1 p. 37]. We saw no test on a real transition reported. See section 6.

1 · THE PAPER

A review of what a warning system would need, not a warning system

Fourteen researchers at the University of Exeter, the UK Centre for Ecology and Hydrology and the University of Leicester ask how satellite data can best warn of tipping points on land: thresholds where "relatively small additional changes could trigger large, persistent shifts" in an ecosystem [1 p. 1]. Its subject is land only, "filtered through consideration of what can be remotely sensed" [1 p. 1]. It reports no monitoring of its own, so the episode's label, "Tipping Point Monitoring", names its topic and not a result [2].

WHAT WE READ

The full text

all 49 pages of the version of record, which the site's owner downloaded from Wiley in a browser; its Supporting Information is not in the PDF and went unread (section 8) [1]

STATUS

Peer reviewed

a review article in *Reviews of Geophysics*, received November 2, 2025, accepted September 21, 2026 and published October 26, 2026 [1 p. 1][3]; a preprint came out in November 2025 [4]

LICENCE

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so its own tables and figures may be adapted, with credit, and the two tables below are, in HTML [1 p. 1][3]. Its Fig. 5 is "From Margazoglou et al. (2021)" [1 p. 13], whose Crossref record shows no CC licence

In the episode's words

Quoted from the automatically generated transcript. It loses a sentence break at 00:01:51, where "magnetic pole shift" runs straight on into "system has tipped enough", the start of the next item, so the words may belong to both; we don't guess beyond that. That item has its own page.

> *"First up in today's articles is a great concept and minimal execution. Does anyone disagree with the need for monitoring Earth's tipping points? Of course not. Unless they're ignoring solar storms and the magnetic pole shift, magnetic changes altogether or anything other than mainstream climate science. They certainly don't hit the only earth change that really matters right now and that is the ongoing magnetic pole shift"*
>
> S0 News, on the review [2 00:01:29–00:01:51]

In the authors' words

> *"Forests could become grasslands, wetlands could flip from storing carbon to releasing it, and frozen ground could thaw, releasing carbon and disrupting ecosystems that people depend on for food, water, and shelter."*
>
> Abrams et al. (2026), Plain Language Summary [1 p. 1]

> *"We focus on the terrestrial biosphere because it provides critical ecosystem services, offers more tractable dynamics for early warning development, and is exceptionally amenable to remote sensing across multiple spatial scales."*
>
> Abrams et al. (2026), abstract [1 p. 1]

> *"In this review, we adopt a criterion consistent with the broader tipping points literature: a process qualifies as tipping behavior when the transition involves positive feedbacks capable of generating bistability and hysteresis."*
>
> Abrams et al. (2026) [1 p. 3]

How the warnings are meant to work

METHOD 1

Slowing down in time

"Critical slowing down" is "the tendency for systems to recover more slowly from perturbations as they approach tipping points" [1 p. 8]. It shows as rising autocorrelation and variance in a sliding window, tested against shuffled copies of the series [1 p. 11]. Satellite records must be long, and forcing slow [1 p. 11].

METHOD 2

Patterns in space

The same slowing should show across a landscape: longer correlation lengths, more spatial variance, changing patch sizes [1 p. 13]. Satellites suit this, but such signals "remain significantly less mature" [1 p. 22].

METHOD 3

Space for time

Where records are short, places along a gradient stand in for one place through time: drier parts of the Amazon as a guide to what wetter parts may face [1 p. 14][1 p. 25].

METHOD 4

The mechanism first

Six kinds of tipping give different warning, so the review says to "identify likely tipping mechanisms before selecting appropriate indicators" [1 p. 17]. A few approaches track the feedbacks themselves, though their practical use "remains limited" [1 p. 11].

Six ways to tip, and how much warning each gives

TYPE	WHAT HAPPENS	EXAMPLES IT GIVES	POTENTIAL FOR EARLY WARNING
Bifurcation (B)	A persistent change in conditions removes the current state, and the system moves to another	Amazon forest, savanna vegetation	Classical theory applies if the forcing changes slowly; in strongly forced systems, specific indicators may be needed and spatial signals are "much more effective"
Noise (N)	Random variation pushes a system with two or more stable states into another, with no lasting change in conditions; reversible	"Ubiquitous in all natural systems"	"Limited potential"; precursors could be identified
Shock (S)	A single large perturbation	"Extreme/rare weather events; bolide collision"	"Low potential — single perturbations, no gradual approach"
Phase (P)	In cyclic systems, tipping is far more likely at certain points of the cycle	Seasonal timing in prey–predator cycles; phytoplankton bloom timing	"Phase-dependent potential — timing matters"; classical theory may apply
Long transient (LT)	A regime that looks stable for a long time ends with no change in conditions	Plankton blooms; savanna–forest transitions	"Unknown potential — sudden transitions without parameter change"
Rate (R)	Conditions change faster than a critical rate, and the system can't keep up	"Compost bomb"; zombie fires	"Emerging potential — deep learning approaches being developed"

Adapted from Table 1 of Abrams et al. (2026) [1 p. 5], CC BY 4.0; shortened and reworded.

Who paid

"All authors acknowledge support from the PREDICT project which has received funding from the European Space Agency (ESA) under ESA Contract No. 4000146344/24/I-LR." Others named: the UK's National Centre for Earth Observation and a UKRI fellowship, an ESA climate-modelling group, the Earth Commission with its foundation funders, the EU's ClimTip and Past2Future projects, and the UK's Advanced Research and Invention Agency. "The authors declare no conflicts of interest relevant to this study." [1 p. 39]

OUR ANALYSIS

Why ESA paid, as we read it

PREDICT is one of six ESA projects on tipping elements [7]. A stated central outcome is "a prototype biosphere resilience sensing system", and work package 3, led by two of these authors, "will perform a comprehensive scientific study demonstrating the value of satellite data in investigating biosphere tipping points" [6]. The paper doesn't say it is that study. That is our reading, from its acknowledgment and its code, named PREDICT_review_map.R [5]. All six work packages are led by authors of this review, and the project's three institutions are the review's three [6]. A funder that flies satellites paid for a study of the value of satellites, and the review closes on "future missions" and "sustained investment" [1 p. 38][1 p. 39]. We offer that as context, not as a charge: its sections on limits are candid, and it declares no conflict.

2 · "MINIMAL EXECUTION"

Fair if it means no warning system; unfair if it means the review

The presenter calls the paper "a great concept and minimal execution" and gives no reason but the omission that follows [2 00:01:32]. That is an opinion, so we mark it Context and add what the paper delivers and what it says is missing.

NEW DATA

None

"No new data was used or created for this article." The figures are illustrations, several from earlier papers [1 p. 39]

A TYPICAL SATELLITE RECORD

10–40 years

too short for systems with decadal or longer timescales, at single locations [1 p. 37]; Landsat, the longest, spans "over 50 years" [1 p. 19]

READINESS

Research

"few approaches have been validated sufficiently for routine operational monitoring" [1 p. 23]

What it delivers

It claims to fill a gap: "no current synthesis explicitly links the full diversity of critical behaviors and tipping mechanisms" to their spatial signatures, warning signals and the satellite data needed, so it offers "a mechanistic framework" [1 p. 3]. That is a way of sorting the problem: six mechanisms and the warning each allows, four spatial categories and the pixel size each needs [1 p. 5][1 p. 10], and eleven systems assessed in the same four parts of evidence, mechanism, scale and what satellites can see [1 p. 23]. It says it marks what it doesn't know: "Where information is missing or genuinely uncertain for any category, we say so explicitly" [1 p. 23]. It points to a real case: autocorrelation in satellite productivity indices warned of boreal tree deaths "before visible symptoms appear" [1 p. 27], in a study that traced the signal "up to 24 years before death" [25 Abstract]. That was found by looking back, not forecast in advance (our reading).

What it says is missing

"Critical gaps include the lack of standardized benchmarking data sets for method comparison across systems", "limited hindcasting validation using historical transitions with known outcomes", and "poorly defined operational thresholds — at what confidence level should warnings trigger management responses?" [1 p. 36] The field "currently lacks robust uncertainty quantification methods for the early warning signals themselves", and needs "enhanced monitoring of subsurface processes, improved integration of multiple sensor types, and development of analysis-ready data sets" [1 p. 38]. Machine-learning applications, it says, "focus primarily on pattern recognition rather than genuine predictive capability" [1 p. 23].

OUR ANALYSIS

In which sense "minimal execution" is fair, and in which it isn't

Fair: there is no warning system here, and the authors say so. The potential "remains largely unrealized" and "only partly realized" [1 p. 37][1 p. 39]. They put the gap down to "the youth of EO-based EWS science rather than fundamental ceilings on what is achievable" [1 p. 36]; that is their judgment, not a result. **Not fair:** a review doesn't build systems. It sorts mechanisms, signals and sensors, rates each system and names the gaps, and this one does that at length. The review isn't the system, and the same team is building one: it comes from PREDICT, the ESA project that lists a prototype as a central outcome and whose work packages its authors lead [1 p. 39][6]. So the execution still to come is their own task, and we haven't seen that prototype. The presenter's stated complaint isn't about any of that; it is the omission, which section 4 takes up.

3 · "OF COURSE NOT"

The need has wide backing; the concept and the warnings are argued over

"Does anyone disagree with the need for monitoring Earth's tipping points? Of course not." [2 00:01:35–00:01:38] That is an aside, so we mark it Context. None of the papers below argues against monitoring as such, though we ran no dedicated search for one and could read several only in abstract. The disputes are over what is being monitored and whether a warning can be trusted.

Who backs the need

ESA funds six projects on tipping elements [7], and reports that a policy brief from the European Commission's Joint Research Centre "emphasises the need for early warning monitoring systems" [8]. The UK's research agency ARIA funds a project on it [1 p. 39]. Armstrong McKay and colleagues ask for "early warning capability" [35 Abstract], and the idea goes back at least to Lenton and colleagues in 2008, who set out "how, in principle, early warning systems could be established" [34 Abstract]. Several of this review's authors argued for a biosphere "resilience sensing system" in 2022 [10 Abstract], and the review calls early warning "not just a scientific challenge but a societal need" [1 p. 38].

The argument, by date

YEAR	WHO	WHAT THEY ARGUE
2010	Hastings and Wysham	Warnings have limits: there is a class of models, and so probably of natural systems, "for which there will be no forewarning of a regime change" [32 Abstract]
2012	Barnosky et al.	The global ecosystem may be nearing a planetary-scale transition, which makes early warning urgent [36]
2012	Boettiger and Hastings	"We show these error rates can be quite severe for common indicators even under favourable assumptions" [30 Abstract]. Picking systems because they tipped gives "an elevated rate of false-positives" [31 Abstract]
2012	Higgins and Scheiter	CO_2 will shift tropical vegetation, but out of step from place to place, which dampens the shock worldwide without removing it [39]
2013	Brook et al.	"Although there is convincing evidence that human drivers can cause regime shifts at local and regional scales, the increasingly invoked concept of planetary scale tipping points in the terrestrial biosphere remains unconfirmed." So "identifying critical points along global continua of drivers might be unfeasible" [27 Abstract]
2013	Lenton and Williams; Hughes et al.	In the same issue, and citing Brook et al. Lenton, this review's last author, places past global tipping in the coupled Earth system, not in its weakly linked ecosystems [37]; Hughes and colleagues hold that planetary-scale regime shifts have happened and can happen again, though how local shifts spread across scales isn't understood [38]
2018	Montoya et al.; Rockström et al.	The idea of a safe operating space for biodiversity is vague and encourages harmful policies [40]; Rockström and colleagues replied [41]
2020	Hillebrand et al.	Across "36 meta-analyses measuring more than 4,600 global change impacts on natural communities", "threshold transgressions were rarely detectable". Yet "minor variances in the response are sufficient to preclude the detection of thresholds from data, even if they are present" [28 Abstract]
2021	Feng et al.	Resilience fell in 64.5% of vegetated land locally, but "there is no evidence for decreased ecological resilience on larger scales" [19 Abstract]
2023	Tao et al.; Boulton et al.	Under the title "Little evidence that Amazonian rainforests are approaching a tipping point", Tao and colleagues say that the Amazon result this review cites, from Boulton et al. (2022), "should be interpreted with caution, because the vegetation optical depth (VOD) they used in their analysis is likely to suffer from soil moisture contamination and sensor discontinuity over Amazonia" [65]. Boulton, Lenton and Boers reply to each concern [66]
2024	Ben-Yami et al.	"the uncertainties are too large to reliably estimate tipping times by extrapolating historical information". This is about predicting dates; they treat declining stability as one way to warn [33 Abstract]
2025	Kopp et al.	"we critique the 'tipping point' framing for oversimplifying the diverse dynamics of complex natural and human systems and for conveying urgency without fostering a meaningful basis for climate action" [29 Abstract]
2026	J. F. Abrams et al.	This review's lead author and others: "concerns have been raised about definitional ambiguity and conceptual overuse that may obscure rather than highlight potential systemic risk", and three properties should define the term [11 Abstract]

Barnosky, Higgins, Lenton and Williams, Hughes and Montoya are paraphrased from their abstracts as indexed; Rockström's reply we know only by its title; Brook et al. is quoted from the accepted manuscript; of Tao et al. and the reply we read only the opening paragraphs, as the rest is paywalled.

What the review does with this

It concedes much of the argument over warnings. "Recent reviews highlight significant concerns about false positive rates" [1 p. 21]; "some studies reporting high false positive and negative rates that undermine operational confidence" [1 p. 35]. It separates real tipping from reversible responses [1 p. 3], and its list includes Feng et al., Higgins and Scheiter, Runge et al. and a permafrost paper titled "No respite from permafrost-thaw impacts in the absence of a global tipping point" [42]. It assesses systems one by one and doesn't argue that the land biosphere tips as a whole.

OUR ANALYSIS

A fair summary

Among the papers we read, nobody argues against monitoring as such; we ran no dedicated search. Critics dispute whether planetary tipping is real, whether thresholds can be found and whether the word helps. So "Of course not" is roughly right about watching ecosystems, and wrong if taken to mean the concept is settled. The review's reference list has Boettiger and Hastings's paper on error rates but not Brook, Hillebrand, Kopp, Montoya, Ben-Yami, Hastings and Wysham or Tao (our check), so it says little of how contested the idea is at the largest scale.

4 · WHAT IS IN IT

S0 News is right about the omission; "anything other than mainstream climate science" holds only in part

We searched the review's whole text. Solar storms, the geomagnetic field and a pole shift are not in it, as the presenter says [2 00:01:38–00:01:46]. But a good deal besides climate is, from land use, grazing and disease to volcanic eruptions and an asteroid. We read the sentence as saying nobody would disagree unless a scheme ignores these things, because the next one says the authors do.

What the word search found

OUR ANALYSIS

TERM	HITS IN THE TEXT	WHAT THE HITS ARE
geomagnet-	0	
pole, poles, pole shift	0	
aurora, space weather, ionosph-	0	
cosmic, galactic	0	
excursion, reversal	0	
sun, sunspot, sunlight, irradiance, insolation	0	
solar	1	Optical sensors "measuring reflected solar radiation to derive indices of vegetation health, productivity, and phenology" [1 p. 18]
magnet-	3	All "electromagnetic", on how sensors work [1 p. 18][1 p. 35]
polar	1	"Polar regions have seasonal gaps", on satellite coverage [1 p. 20]
volcan-, eruption	1, 1	One sentence, on "large volcanic eruptions" [1 p. 7]
asteroid, bolide, extra-terrestrial	1, 1, 1	The asteroid and "extra-terrestrial" [1 p. 7]; the bolide in Table 1 [1 p. 5]
natural variab-	4	The Plain Language Summary [1 p. 1]; Table 4, twice [1 p. 20]; wetlands [1 p. 31]
El Niño, ENSO	3, 1	On fire and mangrove dieback [1 p. 26][1 p. 27], [1 p. 31][1 p. 32]
orbital	3	Satellites' orbits only; no orbital forcing [1 p. 18][1 p. 19], [1 p. 20]
mainstream	0	

Counted case-insensitively over pp. 1–39, before the reference list, with words broken at line ends closed up. Text inside image figures and the unread Supporting Information are not covered. The reference list itself, all 315 entries, has no hit for solar, magnet- or cosmic; one title has "volcano" [1 p. 46], one "ENSO" [1 p. 45] and one, Alvarez et al. (1980), "Extraterrestrial" [1 p. 39]. The script, the other terms we tried and every hit are in section 7.

What it says about forcing from outside the climate

One passage, and a table entry. Very large perturbations "may be generated by processes of different origin (e.g., subsurface or extra-terrestrial). One example of such singular high-magnitude perturbations is given by large volcanic eruptions (Rymer et al., 2005). Those processes are not parts of the climatic system in the strict sense but may lead to a significant climate change and potentially to tipping. It therefore seems reasonable to consider such events separately." "Probably the most remarkable example" is the time "an asteroid collided with Earth about 65 Ma ago" [1 p. 7], and Table 1 lists "bolide collision" [1 p. 5]. So it has a slot for shocks from space, and solar storms aren't in it (our reading). The one reference it gives for eruptions, Rymer et al., is a gravity survey of persistent activity at Poás volcano, not a study of large eruptions [23 Abstract].

What it says about natural variability

It has no section on it, only four mentions. "Key challenges include distinguishing genuine warning signals from natural variability" [1 p. 1]. Table 4 says "natural variability is often poorly characterized", and that a system must "separate anthropogenic from natural signals" [1 p. 20]. In wetlands, "high natural variability obscures resilience signals" [1 p. 31]. Related: noise-induced tipping is treated at length as a mechanism [1 p. 4], weather data would strip short-term noise from the signal [1 p. 21], and boreal monitoring has "challenges distinguishing natural fire cycles from regime shifts" [1 p. 27].

If "anything other than mainstream climate science" means anything but climate, it doesn't describe the review: besides 32 hits for climate change or warming, the body has grazing and herbivory 11 times, land use 8, insects 5, deforestation 3, disease 3, invasive species 2 and aquaculture or coastal development 2, and the passage above (our count). Fire has 54, though the review has it "often serving as the proximate cause of transitions even when underlying drivers are climatic" [1 p. 34], and some hits are about detecting it.

OUR ANALYSIS

Where the presenter has a point

The review does take climate and land use as the slow forcing, without testing other candidates. The change that causes bifurcation tipping "can be linked to the global climate change" [1 p. 4]. Taking out weather noise leaves "the remaining EWS component changes to apply in response to climate change" [1 p. 21]. It opens on "anthropogenic climate forcing and land-use change" [1 p. 2]. That scope goes back to Lenton and colleagues, who "critically evaluate potential policy-relevant tipping elements in the climate system under anthropogenic forcing" [34 Abstract]. The field chose it. It isn't a finding that nothing else matters, and the review doesn't claim it is. And if "mainstream" is the word that counts, the sentence holds: everything the review covers is mainstream science.

OUR ANALYSIS

Is the silence unusual? We found none that breaks it

The same search of five sibling reviews finds no geomagnetism, pole shift, cosmic rays, space weather or aurora, and "solar" only as radiation [9][11], [15][16], [17]. On November 1, 2026, we searched OpenAlex's titles and abstracts for ten pairings, such as "geomagnetic" with "tipping point" and "ecosystem"; the one hit was a literary essay [64]. That is "we found none", not proof that there is none: an index misses papers and wordings. The nearest published arguments concern past field lows far below today's (section 5). Solar radiation does sit behind the review as a model setting: a cited paper by one of its authors perturbs "the intensity of the incoming solar radiation" in a climate model with warm and snowball states [48]. That isn't solar storms, and the review doesn't mention the solar part.

OUR ANALYSIS

Should a review of the terrestrial biosphere cover solar storms and the field?

On present evidence, no, for two reasons, with one exception.

Its question is detection in vegetation, soils and water, through feedbacks with a known mechanism [1 p. 3]. None of its eleven systems has a proposed magnetic feedback that we could find.

The method doesn't need the driver named. Critical-slowing-down signals work "without requiring detailed knowledge of the underlying system dynamics" [1 p. 9]. If a magnetic driver were eroding resilience, these indicators should register it, unnamed. What would suffer is attribution, which the authors already call hard: "EO detects combined effects; challenging to attribute signals to specific drivers" [1 p. 20].

The exception is the sensors, the one place the space environment plainly touches this review. Over the South Atlantic Anomaly, "satellites passing over the region are faced with higher doses of incoming radiation" [63], and TROPOMI, which the review names for methane [1 p. 30], flags "transients, caused by charged particles hitting the detector, relevant all over the world, but in particular over the South Atlantic Anomaly" [47 p. 2040]. Table 4 lists sensor degradation but not this [1 p. 20]. A line there would have been reasonable, as a point about data quality, not about what drives ecosystems.

5 · "THE ONLY EARTH CHANGE"

The documented drivers contradict "only … that really matters"

"They certainly don't hit the only earth change that really matters right now and that is the ongoing magnetic pole shift" [2 00:01:46–00:01:51]. The omission is real. "Only … that really matters" is False: land use, exploitation, climate, pollution and invasive species are documented as reshaping nature, and the episode offers no evidence here for its ranking. The premise, "ongoing magnetic pole shift", is rated separately below.

What two assessments and a key study say is changing nature

> *"The direct drivers of change in nature with the largest global impact have been (starting with those with most impact): changes in land and sea use; direct exploitation of organisms; climate change; pollution; and invasion of alien species."*
>
> IPBES (2019) [43 p. 12]

> *"We show that land/sea use change has been the dominant direct driver of recent biodiversity loss worldwide."*
>
> Jaureguiberry et al. (2022), who rank climate change below exploitation and pollution [44 Abstract]

> *"We find that more than three-quarters of the Amazon rainforest has been losing resilience since the early 2000s, consistent with the approach to a critical transition. Resilience is being lost faster in regions with less rainfall and in parts of the rainforest that are closer to human activity."*
>
> Boulton et al. (2022) [13 Abstract], disputed by Tao et al. [65], with a reply [66]

OUR ANALYSIS

Why False, and what it doesn't say

False rests on "only": one documented counter-example refutes it, so neither assessment needed to test the field, and neither did. The IPBES summary never mentions a magnetic field, and Jaureguiberry and colleagues compare human-caused drivers by design [43][44 Abstract]. "Really matters" can be read as a value judgment, but the sentence ranks things in the world, and these rank high. Whether the field matters at all is a separate question, and there our finding is that we found no evidence, not that it is disproved.

The Amazon, and the climate's natural drivers

For the Amazon, Flores and colleagues list "unprecedented stress from warming temperatures, extreme droughts, deforestation and fires", and estimate that by 2050, "10% to 47% of Amazonian forests will be exposed to compounding disturbances" [20 Abstract]. On the climate itself, the IPCC finds it likely that from 1850–1900 to 2010–2019 "natural drivers changed global surface temperature by −0.1°C to +0.1°C, and internal variability changed it by −0.2°C to +0.2°C" [45 p. 5], its natural drivers being "solar and volcanic activity" [45 p. 6].

The premise, as on our earlier pages

"Ongoing magnetic pole shift" stays where our earlier pages left it, and we reuse those findings without re-checking them. "A pole shift is under way" is Misleading on our reviews of October 20 and October 24: the poles do move and the dipole does weaken, which is the true part. "An excursion is under way now" is False on October 22. The axial dipole is about 9% weaker than in 1840 [51], and past excursions began when it had fallen to about half its usual strength [54 §4.4][53]. Researchers who compared today's field with past excursions conclude it is "probably not reversing" [52]. Our guide to the field has the rest, and our check of the presenter's figures finds the dipole losing 0.46% a decade since 2014 (our analysis on that page).

What a change in the field has been shown to do to life

Extinctions

A 1980 study found no demonstrable link between extinctions and reversals [56], and a 2010 review finds "no clear picture of a geomagnetic link" to the evolution of life [55 Abstract]. The argued cases centre on the Laschamp excursion of 42,000 years ago, when the field fell to 2–5% of today's [54 §4.2]. Cooper and colleagues tie it, with grand solar minima, to climate shifts and extinctions [57]; that drew two formal comments [58][59], and its authors reply that the events "remain only temporally associated" [68]. In this review's own journal, Channell and Vigliotti argue through ultraviolet radiation and ozone that the demise of Neanderthals is "closely tied to the intensity minimum associated with the Laschamp magnetic excursion" [67 Abstract]. Our October 22 review rates "Excursions take out much of life" False.

Radiation at the ground

The air does most of the shielding. With no field at all, our upper bound is about 0.1 mSv a year more at low-latitude sea level (our guide). Asked "Is there any danger to life?", the British Geological Survey answers "Almost certainly not" [60].

Plants

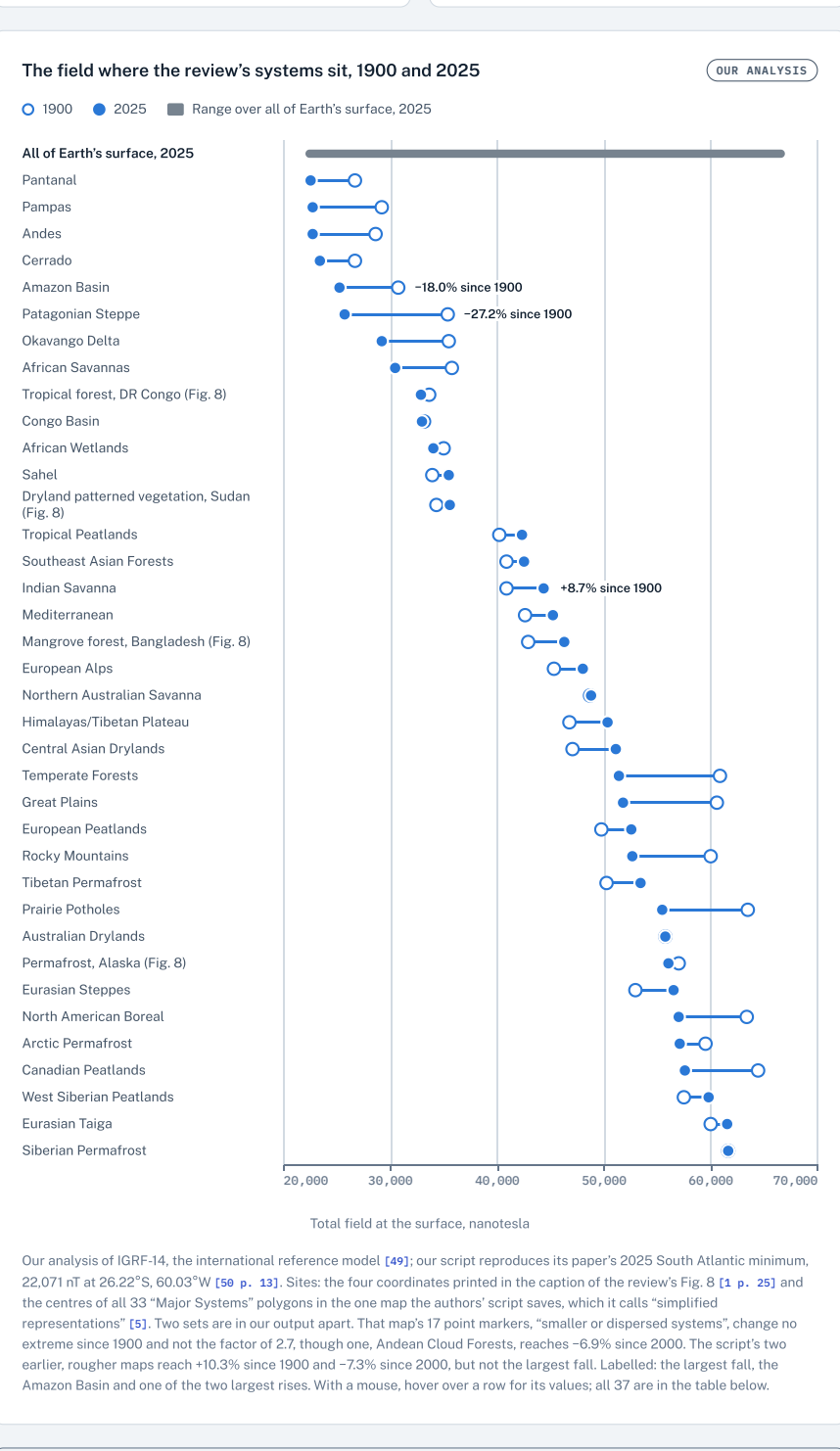
A 2014 review says "the impact of GMF on plant growth and development is not well-understood", GMF being the geomagnetic field. Its experiments are near-null or far above natural fields: "In Arabidopsis seedlings grown in a near-null MF flowering was delayed by ca. 5 days compared with those grown in the GNF" [46], its GNF being the same natural field. That is the field removed, not lowered by the 6% or so of this century, or even the quarter or so at the worst-hit site since 1900.

Animals

Here solar storms have a documented effect: geomagnetic disturbance is linked to less nocturnal bird migration and more birds astray [61][62]. That is behaviour, not a regime shift, and it comes from storms, not from the field's slow decline. The hypomagnetic studies our October 20 review checked used fields 50 to 350 times weaker than their subjects' own. On storms and the air, see our page on ozone and on the weather.

The field where the review's systems sit, 1900 and 2025

OUR ANALYSIS



Our analysis of IGRF-14, the international reference model [49]; our script reproduces its paper's 2025 South Atlantic minimum, 22,071 nT at 26.22°S, 60.03°W [50 p. 13]. Sites: the four coordinates printed in the caption of the review's Fig. 8 [1 p. 25] and the centres of all 33 "Major Systems" polygons in the one map the authors' script saves, which it calls "simplified representations" [5]. Two sets are in our output apart. That map's 17 point markers, "smaller or dispersed systems", change no extreme since 1900 and not the factor of 2.7, though one, Andean Cloud Forests, reaches −6.9% since 2000. The script's two earlier, rougher maps reach +10.3% since 1900 and −7.3% since 2000, but not the largest fall. Labelled: the largest fall, the Amazon Basin and one of the two largest rises. With a mouse, hover over a row for its values; all 37 are in the table below.

OUR ANALYSIS

What this comparison can show, and what it can't

A sense of scale. Rainforest stands at 25,194 nT in the Amazon Basin, 32,907 in the Congo Basin and 42,528 in Southeast Asia, a spread of 69%. The largest change at any of the 37 sites since 1900 is 27%, and since 2000 the changes run from −6.1% to +3.0%. The field rose at 17 of the 37 sites since 1900, and at 15 of the script's 33. This is the review's space-for-time logic turned on the field, and the review warns that such assumptions "do not hold true in general" [1 p. 14], so it gives a sense of scale and isn't a test.

It can't show whether any organism responds. It compares sizes only.

The counterpoint. The Amazon Basin has the fourth-largest fall of the 37, −18.0% since 1900, and the review reports resilience loss there [1 p. 25]. We found nobody who has tested whether the two are connected, and this arithmetic can't rule it out. The three larger falls, in the Patagonian steppe (−27.2%), the Pampas (−22.4%) and the Andes (−20.5%), are on the authors' map but aren't assessed in the review's text, where only "Andean headwater glacier loss" appears, in a caption [1 p. 9]. The fall is shared with the Okavango Delta (−17.6%), the Pantanal (−15.6%), temperate forests (−15.5%) and African savannas (−14.7%). Inside the Amazon, the gradient reported follows rainfall and distance from human activity [13 Abstract].

6 · ITS OWN PAGES

The caveats are all in the review; its headlines and parts of its conclusions run ahead of them

Its sections on limits are careful, and its authors say where evidence is thin. Its Key Points, summary and parts of its conclusions are firmer than that, and one sentence goes further than the paper it cites.

Firm statements against the review's own caveats

THE FIRM STATEMENT	ELSEWHERE	OUR READING
"Satellite data enables global tipping point monitoring, but short records limit detection in slow-changing ecosystems like forests" [1 p. 1]	"well-established monitoring capabilities" for some systems [1 p. 35], but "few approaches have been validated sufficiently for routine operational monitoring" [1 p. 23]; "typically 10–40 years" of record [1 p. 37]	The second half holds; the first is true of watching some systems' state, not yet of warning
"Space-for-time methods using spatial gradients can overcome temporal limitations" [1 p. 1]; "effectively turning space into a proxy for time" [1 p. 39]	"These assumptions do not hold true in general" [1 p. 14]; "though this inference assumes the gradient reflects tipping dynamics rather than reversible climate-envelope tracking" [1 p. 27]	Promising, and we saw no test on a real transition reported: Unconfirmed, in the panel
"Spatial early warning signals remain underexploited despite advantages over temporal methods" [1 p. 1]	"limited empirical validation and inconsistent performance" [1 p. 22]. The one skill comparison it shows comes from "a simple spatially coupled model", and "in the limit of strong spatial coupling, spatial early warning disappears" [12 Abstract]	True of their use; the advantage is conditional
"Climate change is pushing Earth's ecosystems toward critical thresholds called tipping points" [1 p. 1]	"There is a growing concern" [1 p. 2]. For high-altitude systems, evidence for bistability "is currently limited" [1 p. 33]; for permafrost, it is "limited to a subset of thaw processes and environmental settings" [1 p. 32]	The summary is firmer than the review
VOD analysis "has demonstrated approaching tipping behavior through increasing temporal autocorrelation" [1 p. 25]	The sentence before it hedges: "indicating the system may be approaching critical thresholds" [1 p. 25]. The paper it cites says "consistent with the approach to a critical transition", and also "direct empirical evidence that the Amazon rainforest is losing resilience" [13 Abstract]. Smith et al. (2023), who include Boulton et al.'s three authors, find multi-sensor biases "typically more pronounced when resilience metrics are aggregated", "whereas estimates for individual time series remain reliable" [14 p. 173]. They describe the pixel-level analyses behind the Amazon result as ones "which our results indicate are reliable", and say its aggregated series "should be treated with caution" [14 p. 181]. Tao et al. dispute the result, citing soil moisture and sensor changes, and its authors reply [65][66]	"Demonstrated" is stronger than its source on tipping, though Boulton et al. do claim direct evidence of lost resilience, and the point is disputed

VOD is vegetation optical depth, a microwave proxy for biomass and water in plants [1 p. 15][1 p. 18]. The numbers we traced to their sources hold: mangroves at 2°C [1 p. 32][21], and about half of mangrove area at high to severe risk [1 p. 32][22 Abstract]. Two we could not trace are in section 8.

OUR ANALYSIS

What the 73% is

The review says three times that methods give "contradictory resilience estimates across approximately 73% of Earth's land surface" [1 p. 21][1 p. 36], and again at [1 p. 38]. That is faithful to Runge and colleagues' abstract [18 Abstract]. Their text and Fig. 2 show what it rests on: "disagreement on the direction of resilience change for 73% of the land surface across three example studies" [18 §1], three different indicators at 0.3°. "If at least one study showed a different trend, we considered it a disagreement", and "one on one comparisons between the three studies result in a more even proportion of agreement and disagreement" [18 Fig. 2].

Three unrelated maps, each split 50/50, would all agree on 25% of cells (2×0.5^3), so 75% would "disagree" by chance alone. At a 60/40 split it is 72% if all three lean the same way, and 76% if one leans the other. A firmer form needs no assumption about splits: for three yes-or-no maps, the three pairwise agreements sum to 1 + 2A, where A is the share on which all three agree. So 27% agreement means that pairs agree 51.3% of the time on average, which fits Runge and colleagues' "more even proportion". The three maps agree about as rarely as coin flips, or else they differ for other reasons. Runge and colleagues name "different time intervals, EO products" and different indicators, noting that "these indicators capture different 'facets' of resilience" [18 §1]. One map covers 1992 to 2017, another compares 2000–2010 with 2011–2020 [18 §1], and the third is from a preprint with Runge among its authors [18 Fig. 2]. Either way the review's point stands, that the methods don't yet measure one thing. **This is arithmetic only: we don't have the maps,** and their real splits could differ.

7 · REPEAT OUR NUMBERS

The word search, the literature search and the field model, as scripts

The word counts, the field's numbers and the searches come from these files.

PY **word_search.py**
Counts every term in the review's text, with each hit and its page, the drivers it names and whether named papers are in its reference list; also counts terms in sibling reviews · 7 KB

TXT **word-search-results.txt**
Its output, with short passages from the review [1] and, in its last part, from Bathiany et al., Loriani et al. and J. F. Abrams et al. [16][17], [11], each CC BY 4.0 · 18 KB

PY **field_at_sites.py**
The total field at the review's 37 sites from IGRF-14, checked against the 2025 South Atlantic minimum; Python standard library only · 16 KB

JSON **field-at-sites-numbers.json**
Its output: every number in section 5's chart and table, the point markers and earlier maps apart, and the address and SHA-256 of its input · 21 KB

PY **openalex_search.py**
The ten pairings searched in OpenAlex's titles and abstracts, and a wider pass · 2 KB

TXT **openalex-search-results.txt**
Its output on November 1, 2026 [64] · 5 KB

Run them

`python3 field_at_sites.py` downloads IGRF-14's coefficients into its own folder and runs in under a minute. `python3 word_search.py paper.txt` needs the review as text: save its PDF from its DOI in a browser, then `pdftotext -enc UTF-8`; plain-text copies of the five sibling reviews, as further arguments, reproduce the file's last part. `python3 openalex_search.py` needs nothing else, though the index grows, so its counts will change.

The data and their terms

The review is CC BY 4.0 [1 p. 1]. IGRF-14 is published by the International Association of Geomagnetism and Aeronomy, through NOAA [49][50]. The sites come from the review and from the authors' map script, CC BY 4.0, which we read and did not run [5]. We host no data of theirs beyond the short passages named above.

8 · LIMITS

Where this check could be wrong

The Supporting Information is unread

Tables S1–S4 list satellite data sets and summarize the literature [1 p. 23]. They aren't in the PDF and sit behind the publisher's human-verification check, which we don't attempt; we found no other copy. Our word search doesn't cover them, or text inside image figures.

Two of the review's numbers are untraced

We couldn't trace "approximately 28%" of Amazon precipitation from forest evapotranspiration [1 p. 25]: it isn't in Flores et al., Zemp et al. or Staal et al. (2020) by text search [20][24], [69], and Staal et al. (2018) is paywalled. Nor "1,460–1,600 Pg" of permafrost carbon, credited to Schuur et al. (2015), which is paywalled [1 p. 32][26]. We don't say either is wrong.

"Why ESA paid" is our reading

The review doesn't say it is the study ESA's project page describes. We infer that from its acknowledgment and its code's name [1 p. 39][5]. We read ESA's account of the EU brief, not the brief itself [8].

"We found none" isn't proof

OpenAlex misses papers and wordings [64]. Our wider pass turned up work on plants in near-null fields and regional papers listing "solar activity" among vegetation covariates, which we didn't read. The pairings also wouldn't catch work such as Dengel et al. (2009) on cosmic radiation and tree rings, which we know by title [70].

Several sources read only in part

Hillebrand et al. and Kopp et al. are paywalled, and we read their abstracts on the publishers' pages [28][29]. Six papers we paraphrase from abstracts as indexed, and we know two of the debate's papers by title [41][42]. Of Tao et al. and the reply we read the opening paragraphs [65][66]. That no paper argues against monitoring rests on what we read, partly as abstracts; we ran no dedicated search.

Reused findings and a transcript

The field's numbers and the verdicts of October 20, 22 and 24 come from our earlier pages and were not re-checked here. The transcript is automatic, and we couldn't see what the episode showed on screen at this point [2].

What would change these verdicts

01
A study that tests today's change in the field, not near-null laboratory fields, against vegetation state or resilience, controlling for rainfall and land use, and finds an effect. That would change the panel's headline, the title's second half and our answer on whether a review should cover it. It would move claim 4 only if the effect outranked the documented drivers.

02
An out-of-sample test in which space-for-time signals, fixed in advance, anticipate real transitions better than chance. That would move "Space for time overcomes limits" off Unconfirmed.

03
A warning system in routine use, with published thresholds and error rates. ESA's PREDICT prototype and its SIRENE benchmarking are the ones to watch [6][8]. That would date "Still in the research phase".

Sources

Bracketed numbers refer to this list. For the paper [1], read in full, p. gives a page of the version of record, the same as its printed "n of 49", Fig. a figure and Table a table; its key points, abstract and plain-language summary are on p. 1. For the episode [2], times are positions in the video (hours:minutes:seconds), from the first to the last line of its automatically generated transcript that holds the words quoted. For the other sources, p. gives a page, § a section, Fig. a figure and Abstract the abstract of the cited work; where only an abstract was read, the entry says so, and abstracts we read only in an index are paraphrased, not quoted. The field's numbers and the verdicts reused from our earlier pages were not re-checked here. EO is Earth observation, EWS an early warning system or signal, TPs tipping points; nT is the nanotesla. Years are those of the printed issue where there is one, otherwise of online publication. Links checked November 1, 2026.

1 Abrams, J. F., Huntingford, C., Petrovskii, S., Buxton, J. E., Millman, H., Boulton, C. A., Parker, R. J., Ruiz Villena, C., Cunliffe, A. M., Clarke, J., Lucarini, V., Ghent, D., Cox, P. M., and Lenton, T. M. (2026). Science Needs for a Terrestrial Biosphere Tipping Point Early Warning System. *Reviews of Geophysics* 64(4), e2025RG000900. Received November 2, 2025, accepted September 21, 2026, published online October 26, 2026. Peer reviewed; open access, CC BY 4.0. Its acknowledgments (p. 39) list the PREDICT project of the European Space Agency (Contract No. 4000146344/24/I-LR), the UK National Centre for Earth Observation (NE/Y006216/1, NE/W004895/1), a UKRI Future Leaders Fellowship (MR/X033139/1), the ESA-CCI Climate Modelling User Group (4000125156/18/I-NB), the Earth Commission with its foundation funders, Horizon Europe's ClimTip (101137601) and Past2Future (101184070), and the UK's Advanced Research and Invention Agency (SCOP-PR01-P003, AdvanTip). The authors declare no conflicts of interest relevant to this study. © 2026 The Author(s). Read in full: the version of record, 49 pages, which the site's owner downloaded from Wiley in a browser and supplied on November 1, 2026; the publisher's site puts a human-verification check in front of automated readers, which we do not attempt. Its Supporting Information (Tables S1–S4) is not in the PDF and was not read. p. gives a page of the version of record, the same as its printed "n of 49", Fig. a figure and Table a table; its key points, abstract and plain-language summary are on p. 1. Quoted with the publisher's hyphen characters printed as ordinary hyphens; its Tables 1 and 3 are adapted in section 1, with credit.

2 SpaceWeatherNews (S0) (November 1, 2026). Pole Shift Deep Dive Shows Rapid Decay | S0 News Nov.1.2026. YouTube video, https://www.youtube.com/watch?v=w5ryWCaVmII. Quoted from the automatically generated transcript; times are positions in the video. "Tipping Point Monitoring" is the label on the link to the paper. The episode as a whole is reviewed on its own page.

3 Crossref. Record of source 1, read November 1, 2026: its dates, licence, two European Space Agency awards and list of 315 references, of which we resolved 306 to titles through their DOIs.

4 Abrams, J. F., et al. (2025). Science Needs for a Terrestrial Biosphere Tipping Point Early Warning System: Maximizing the Value of Earth Observation Data. Preprint, Authorea, posted November 6, 2025. Not peer reviewed. Crossref record and abstract only: its page shows automated readers a bot check, which we do not attempt.

5 Abrams, J. (2025). Code for figures for: Science needs for a terrestrial biosphere tipping point early warning system. Zenodo, CC BY 4.0. One R script, PREDICT_review_map.R (17.7 KB), which draws a map of the systems from 33 polygons and 17 points; read as data, not run.

6 European Space Agency, Climate Office. PREDICT: Predicting Resilience and Early Detection of Impending Climate Transitions. Project page, undated, read November 1, 2026.

7 European Space Agency, Climate Office. Tipping Elements Projects. List of six projects, undated, read November 1, 2026.

8 European Space Agency, Climate Office. Earth Observation identified as a Key Tool for Tipping Point Preparedness. News item, undated, read November 1, 2026, on a 2025 policy brief by the European Commission's Joint Research Centre (Roman-Cuesta et al.). We read ESA's account, not the brief itself.

9 Lenton, T. M., Abrams, J. F., Bartsch, A., et al. (2024). Remotely sensing potential climate change tipping points across scales. *Nature Communications* 15, 343. CC BY 4.0. Abstract read; full text searched for terms.

10 Lenton, T. M., Buxton, J. E., Armstrong McKay, D. I., et al. (2022). A resilience sensing system for the biosphere. *Philosophical Transactions of the Royal Society B* 377, 20210383. Abstract only, as deposited with Crossref.

11 Abrams, J. F., Pereira, L. M., Spaiser, V., et al. (2026). Integrating tipping point concepts across diverse systems. *Communications Sustainability* 1, 68. CC BY 4.0. Abstract read; full text searched for terms.

12 Clarke, J., Huntingford, C., Ritchie, P. D. L., and Cox, P. (2026). Conditions for skilful spatial and temporal tipping point early warning signals. *Journal of Physics: Complexity* 7, 025007. CC BY 4.0. Abstract only, as deposited with Crossref. The review's Fig. 7 comes from it.

13 Boulton, C. A., Lenton, T. M., and Boers, N. (2022). Pronounced loss of Amazon rainforest resilience since the early 2000s. *Nature Climate Change* 12, 271–278. CC BY 4.0. Abstract read. Disputed by source 65, with a reply in source 66.

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16 Bathiany, S., Bastiaansen, R., Bastos, A., et al. (2025). Ecosystem Resilience Monitoring and Early Warning Using Earth Observation Data: Challenges and Outlook. *Surveys in Geophysics* 46, 265–301, published online 2024. CC BY 4.0. Abstract read; full text searched for terms.

17 Loriani, S., Bartsch, A., Calamita, E., et al. (2025). Monitoring the Multiple Stages of Climate Tipping Systems from Space: Do the GCOS Essential Climate Variables Meet the Needs? *Surveys in Geophysics* 46, 327–374. CC BY 4.0. Abstract read; full text searched for terms.

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21 Saintilan, N., Horton, B., Törnqvist, T. E., et al. (2023). Widespread retreat of coastal habitat is likely at warming levels above 1.5 °C. *Nature* 621, 112–119. CC BY 4.0. The passage on mangroves at 2 °C.

22 Hülsen, S., Dee, L. E., Kropf, C. M., et al. (2025). Mangroves and their services are at risk from tropical cyclones and sea level rise under climate change. *Communications Earth & Environment* 6, 262. CC BY 4.0. Abstract only, as deposited with Crossref.

23 Rymer, H., Locke, C. A., Brenes, J., and Williams-Jones, G. (2005). Magma plumbing processes for persistent activity at Poás volcano, Costa Rica. *Geophysical Research Letters* 32(8). Abstract only, as deposited with Crossref.

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25 Rogers, B. M., Solvik, K., Hogg, E. H., et al. (2018). Detecting early warning signals of tree mortality in boreal North America using multiscale satellite data. *Global Change Biology* 24, 2284–2304. Abstract only, as deposited with Crossref.

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28 Hillebrand, H., Donohue, I., Harpole, W. S., et al. (2020). Thresholds for ecological responses to global change do not emerge from empirical data. *Nature Ecology & Evolution* 4, 1502–1509. Abstract only, on the publisher's page.

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42 Nitzbon, J., Schneider von Deimling, T., Aliyeva, M., et al. (2024). No respite from permafrost-thaw impacts in the absence of a global tipping point. *Nature Climate Change* 14, 573–585. Title only, as the review cites it.

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44 Jaureguiberry, P., Titeux, N., Wiemers, M., et al. (2022). The direct drivers of recent global anthropogenic biodiversity loss. *Science Advances* 8(45), eabm9982. CC BY-NC. Abstract read, as deposited with Crossref.

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METHOD

How this was checked

On November 1, 2026, we checked every statement on this page about the paper against its full text, the version of record, which the site's owner downloaded from Wiley in a browser: its aims, typology of tipping, methods, limits of satellite data, eleven system assessments, tables, figure captions, conclusions, funding, data statement and declaration of interests. Wiley's site puts a human-verification check in front of automated readers, which we do not attempt, and we found no other open copy; its Supporting Information went unread. The page also rests on the paper's Crossref record, with its dates, licence and 315 references [3]; the preprint's record [4]; the authors' map script [5]; ESA's pages on the project behind it [6][7], and its account of an EU brief [8]; the episode's automatically generated transcript [2]; the authors' and others' related reviews and papers [9]–[26]; the debate over tipping points and early warning [27]–[42], and over the Amazon result [65][66]; assessments of what is changing nature and climate [43]–[45]; papers on plants, satellite sensors and a climate model [46]–[48]; the field model IGRF-14 [49]; sources reused from our earlier pages [50]–[63], [67][68]; a search of OpenAlex [64]; and two papers checked for a number or known by title [69][70]: the 70 sources listed. Every quotation from a source we saved was checked word for word by script, and each from the paper against the page cited; quotations reused from our earlier pages were matched to those pages, and the publishers' hyphen characters are printed as ordinary hyphens.

The verdicts and the items tagged "Our analysis" are our own assessment, built on the cited sources. They include the word search and its counts; the same search of five sibling reviews; the search of OpenAlex; the field strength at the 37 sites in the authors' figure and map script, and the comparison of its spread with its change; the arithmetic on what three unrelated maps would do; our reading of why ESA funded the work; and our judgments of where the presenter has a point, of whether such a review should cover the field, and of where its firm statements run ahead of its own sections on limits. The two Context verdicts rate no fact: they mark an opinion and a rhetorical question, and add the facts they leave out.

We ran the word search, the OpenAlex search and the field model ourselves, and the scripts and outputs are hosted in section 7; our script reproduces the IGRF-14 paper's 2025 South Atlantic minimum to within a nanotesla. The field comparison shows sizes only and says nothing on whether any organism responds. There is no analysis of the paper's to re-run: it reports no new data, and its figure code on Zenodo is one map script, which we read and did not run. We could not trace two of its numbers to their sources, could not read Hillebrand et al. and Kopp et al. beyond their abstracts, and read only the opening paragraphs of Tao et al. and the reply; the limits are in section 8. Findings on the field, excursions and extinctions come from our earlier pages and were not re-checked here. Before publication a fresh reviewer read the built page against its sources, searched the paper's full text again and re-ran our three scripts, which reproduced their outputs. That review changed no verdict; it found that we had used 13 of the 33 centres in the authors' script without saying so, and its other corrections are in the change log. We widened the comparison to all 37 sites and re-ran the script, whose output on the page reproduces byte for byte.

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.
UNCONFIRMED	Rests on a preliminary result that hasn't been confirmed.
PARTLY TRUE	Part of the claim holds up and part doesn't.
TRUE	The evidence supports the claim.
CONTEXT	A question or aside rather than a claim. We add the facts it leaves out.

All ten verdicts, and how we check

CORRECTIONS

Corrections and changes

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

Change log

Nov 1, 2026	Published on factchecked.science after a full check against the sources. Built from the paper's full text, which the site's owner supplied because its publisher's site puts a human-verification check in front of automated readers, with the episode's transcript, the literature on tipping points and early warning, and our own word search, OpenAlex search and analysis of IGRF-14, whose scripts are hosted on the page: six claims marked on the site's scale, four the episode's and two the paper's. The paper's Tables 1 and 3 are adapted, with credit. Before publication a fresh review against the sources, which changed no verdict, led us to widen the field comparison from 17 sites to all 37 in the authors' figure and map script, because we had used 13 of the script's 33 centres without saying so, which moves the largest fall from the Amazon Basin's −18% to the Patagonian steppe's −27%; to restore the rest of a sentence from Smith et al. (2023), which calls the pixel-level analyses behind Boulton et al. reliable, and add the published dispute over that paper; to limit "pattern recognition" to machine learning, as the review does; to correct "ESA's separate PREDICT project", since the review comes from the project that is also building the prototype; to change the title's second half from "the pole shift isn't the missing piece", firmer than our finding; and to make smaller corrections of wording, reading and citation.

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