PAPER CHECK · CLIMATE AND VEGETATION

Not global greening: a model study finds Arctic warming now outpaces natural swings

SO News introduced a 2026 paper in Environmental Research Letters as "the continuation of global greening" [2]. The paper is a climate-model study of growing degree days, the warmth that drives Arctic plant growth, in ecoregions north of 50°N; it measures no vegetation and says nothing about global vegetation, oxygen or food [1 Abstract][1 §2]. Its finding is that human-caused warming already dominates natural swings in most of the Arctic [1 §3.1]. We checked the episode's five statements and the paper's headline result.

By Fact-Checked Science · Published October 22, 2026

OUR ANALYSIS marks our own reasoning and calculations, and the verdicts are our assessment. Everything else comes from the numbered sources; for the paper [1], § gives a numbered section of the published text and Fig. a figure.

A careful Arctic model study, mislabelled as global greening

OUR ASSESSMENT

0
vegetation measurements in the paper. It models growing degree days, the annual sum of daily temperatures above 5 °C, as the warmth that drives Arctic plant growth [1 Abstract][1 §1].

2022
the year the warming trend overtakes natural swings at a Brooks Range grid point in the model's average; eight in ten single runs cross between 2011 and 2037 [1 §3.2].

−19 per meg
a year: the measured change in the atmosphere's oxygen, a loss of 0.0019% of its O_2 content each year, from fossil-fuel burning [14].

THE CLAIMS

MISREAD
"we're covering the continuation of global greening"
The episode, 00:01:33 [2]
The paper is a climate-model study of growing degree days, the warmth that limits plant growth in the Arctic, for ecoregions north of 50°N, checked against weather stations [1 Abstract][1 §2]. It measures no vegetation, by satellite or on the ground, and never uses the phrase "global greening" in its text; it appears once, in the title of a review the paper cites [5]. See section 1.

PARTLY TRUE
"the study is actually going the step further of attempting to make attribution claims between natural cycles and human forcing"
The episode, 00:01:34 [2]
Separating natural variability from the forced response is the whole study, not a further step, and its answer is that the forced trend already dominates in most Arctic ecoregions [1 §3.1]. The natural part is the ocean and atmosphere's own swings, such as El Niño and Pacific decadal variability, not cycles of the Sun or of Earth's field [1 §1][1 §3.2]. See section 3.

PARTLY TRUE
"the observation that stands unquestioned, unchallenged is that the planet is producing more green plant matter"
The episode, 00:01:41 [2]
Satellites do show more leaf area over 25–50% of vegetated land since the 1980s, with under 4% browning [3], and the paper itself says the browning literature "still consistently finds" a biome-scale greening trend [1 §4]. But its causes, evenness and persistence are openly debated [4][6][8][9], and this paper measured none of it. See section 4.

MISLEADING
"more oxygen thereafter"
The episode, 00:01:48 [2]
Plants release oxygen, and net plant growth has made the atmosphere's oxygen loss "slightly smaller than expected from fossil-fuel burning alone" [14]. But the atmosphere is losing oxygen, about 19 molecules in a million each year, because burning fossil fuels consumes roughly four times what the land takes up, and 21% oxygen barely moves either way [14][17]. See section 5.

OVERSTATED
"overall more food"
The episode, 00:01:51 [2]
The paper says nothing about crops. Where croplands have greened, farming drove it: India's greening is 82% cropland, from irrigation, fertilizer and multiple cropping [4]. Extra CO_2 raises the yields of some crops but lowers their zinc, iron and protein, and each degree of warming cuts global yields of wheat, rice, maize and soybean [18][19][20]. See section 6.

TRUE
The warming trend already dominates natural variability in most Arctic ecoregions
The paper's abstract and discussion [1 Abstract][1 §4]
In the 100-member ensemble the average has passed the paper's "forced crossover" threshold in almost all ecoregions, most of the boreal zone before 2030, and station trends over 30 years have been positive since the late 20th century [1 §3.1][1 Fig. 1][1 §3.4]. It is a single-model result with an admitted threshold choice and an aerosol-forcing caveat [1 §2.4][1 §4]. See section 2.

1 · THE STUDY

A climate model, growing degree days and a 2,000-year baseline

Five authors from Colorado College, Colorado State University and Boston University asked when the Arctic's warming trend comes to dominate the natural ups and downs of its growing seasons, and did it in a climate model, with weather stations as a check [1]. The episode called it "global greening" [2]; the paper's own subject is the Arctic's thermal growing season.

What was measured: warmth, not plants

The variable is growing degree days, "the annual sum of daily temperatures above 5 °C", a standard measure of growing-season warmth that field studies tie to Arctic greening [1 Abstract][1 §1]. The 5 °C base follows the protocols of the International Tundra Experiment [1 §2.3].

The authors chose it because models still struggle to simulate vegetation directly: "While directly simulating land surface change in Earth system models remains challenging, models effectively represent regional-scale patterns of many climate variables" [1 §1]. No satellite greenness, leaf area or biomass enters the analysis.

The simulations

The Community Earth System Model 2 Large Ensemble: "an initial condition ensemble with 100 realizations of the historical period (1850–2014) and 21st century (2015–2100)", following the high-emissions SSP3-70 scenario after 2014 [1 §2.1]. Half the members use smoothed biomass-burning aerosol emissions and half the variable CMIP6 emissions, a known source of spurious late-20th-century high-latitude warming in this model [1 §2.1].

The baseline is the model's preindustrial control, "a 2000-year free-running simulation with boundary conditions fixed at 1850 estimates": natural variability with no change in external forcing [1 §2.1].

How "crossover" is counted

STEP 1
Count the baseline years beaten
For each place and year, count how many of the 2,000 preindustrial years had fewer growing degree days than the simulated year, then smooth over a 10-year window [1 §2.4].

STEP 2
No forcing means 50%
Without external forcing a run would beat the preindustrial years half the time: "they would be equally likely to be higher or lower than the Preindustrial values" [1 §2.4].

STEP 3
Set the thresholds
"Forced crossover": the 100-member average beats 80% of baseline years. "Member crossover": a single run beats 90%. "No-analog crossover": a run beats all 2,000. The authors say the choice "involves subjectivity" and test small and large changes to it [1 §2.4].

STEP 4
Check against stations
Growing degree days from weather stations north of 50°N with long records put the model's trends and variability "in context … rather than a comprehensive evaluation of the model or the station dataset" [1 §2.2].

ENSEMBLE MEMBERS
100
plausible climate histories, 1850–2100, started from different atmospheric and ocean states; the two halves also differ in their biomass-burning aerosol forcing [1 §2.1]

PREINDUSTRIAL BASELINE
2,000 years
of simulated climate with 1850 forcing held fixed [1 §2.1]

REGION
> 50°N
ecoregions poleward of 50°N for the maps; stations poleward of 50°N for the check [1 §2.2][1 Fig. 1]

Peer reviewed (double anonymous, one revision), received May 19 and published October 12, 2026; funded by a National Science Foundation graduate fellowship, a grant from the Quadrature Climate Foundation and an NSF grant [1]. The paper uses "Arctic greening" for the increase in productivity and the poleward advance of plants that field studies, satellites, tree rings and Indigenous knowledge have documented since the late 20th century [1 §1].

2 · WHAT IT FOUND

The warming trend already dominates in most Arctic ecoregions

"Growing season temperature conditions in most Arctic ecoregions have already experienced 'forced crossover' … This illustrates how the warming trend already dominates over internal variability for much of the Arctic" [1 §3.1]. Where it has not happened, the tundra is still too cold for many days above 5 °C [1 §3.1].

When the model's average crosses over, by ecoregion

2000–05 · 2005–10 · 2010–15 · 2015–20 · 2020–30 · 2030–35 · 2035–40 · 2040–45 · 2045–50 · No ecoregion value

Greens: crossed over before 2020. Blues: 2020 or later.

Adapted from Fig. 1 of Hueholt et al. (2026), CC BY 4.0 [1 Fig. 1]: the year in which the 100-member average first exceeds 80% of preindustrial years, traced by us from the published image at four-pixel resolution and recoloured. The nine steps are the paper's, with its single 2020–2030 step kept as one; region names are ours. The view is the paper's polar projection, so areas are not to scale. "Central and eastern Canada experience uniform crossover times in the early 21st century": crossover comes earlier on average in the members with variable aerosol emissions, most of all in southern Eurasia and central Canada [1 §3.1].

One place, a hundred histories

BROOKS RANGE, ALASKA: FORCED CROSSOVER
2022
the year the ensemble average passes 80% of preindustrial years at 67.38°N, 202.50°E [1 §3.2][1 Fig. 2]

MEMBER CROSSOVER, 10TH–90TH PERCENTILE
2011–2037
the middle 80% of single runs pass 90% within this range; the earliest in 2007 [1 §3.2]

NO-ANALOG CONDITIONS
mid-century
on average, ecoregions begin to exceed every one of the 2,000 preindustrial years in the mid-21st century, under the high-emissions scenario [1 §3.3][1 Fig. 4]

Brooks Range: share of preindustrial years beaten, 1850–2100

Ensemble average (100 members) · Early storyline, member 24 · Late storyline, member 52 · 2011–2037: 10th–90th percentile of member crossovers

Percent of the 2,000 preindustrial years with fewer growing degree days, 10-year running mean

Adapted from Fig. 2(a) of Hueholt et al. (2026), CC BY 4.0 [1 Fig. 2]: the ensemble average and the early (member 24) and late (member 52) storylines, traced by us from the published image; the hundred individual runs are omitted, and short stretches where lines overlap in the image are bridged with straight segments. Our tracing crosses the paper's thresholds within a year of the 2022, 2011 and 2037 it reports [1 §3.2].

What makes a run early or late

In the decade before an early crossover, the model's North Pacific and Beaufort Sea are unusually warm; before a late one they are cold. These patterns are "consistent with Pacific decadal variability", and the warm pattern is the stronger: "positive PDV patterns may contribute more to advancing the time of crossover than negative phases contribute to delaying it" [1 §3.2][1 Fig. 3]. Sea-level pressure shows no clear pattern, and the result holds in both aerosol subsets [1 §3.2].

The place was chosen because its treeline is moving: a white spruce population in the Brooks Range is advancing at rates last seen after the ice age, doubling each decade [1 §3.2][21].

The station check

At stations north of 50°N, 30-year trends in growing degree days "are broadly positive beginning in the late 20th century", while 10-year trends "remain much more variable" [1 §3.4]. "More than 90% of observed trends in 13 out of 14 10 year periods since 1883 and all 30 year periods since 1903 fall within the LENS2 distribution" [1 §3.4]. The model shows fewer extremes than single stations, as a grid-cell average should [1 §3.4].

The six example stations run from Rothamsted in England to Pond Inlet in Nunavut, two Swedish sites, Wrangel Island and Oymyakon in Russia [1 Fig. 5].

The authors' own caveats

One model, one scenario
"Our analysis does not consider scenario choice or structural model uncertainty." The SSP3-7.0 pathway "is not consistent with recent emissions estimates" but is kept to probe a possible, if less likely, future; for ecoregions that crossed over in the past, the timing does not depend on the scenario [1 §4].

A known aerosol artefact
Variable biomass-burning emissions induce "an unphysical decadal-scale high-latitude warming" in this model, and crossover comes earlier in those members; the authors use both subsets and say the artefact "is systematic across climate models" [1 §2.1][1 §3.1].

Thresholds are a judgement
The year of crossover is "robust to small (0.1% and 1%) perturbations to the threshold value"; large changes of 5% and 10% "affect timing" [1 §2.4].

Model to real ecosystems is a step
"It is difficult to directly connect the simulated timing of forced crossover to observed ecosystem changes." Soil moisture, precipitation, wildfire, recruitment, species interactions and grazing also set the pace: "grazing by reindeer and caribou can halt local greening processes" [1 §3.1][1 §4].

3 · NATURAL SWINGS VS FORCING

What the paper means by natural variability, and what the episode left out

The episode said the study was "attempting to make attribution claims between natural cycles and human forcing" [2]. The paper does separate the two. It just isn't a side step, the "natural" part isn't the Sun or the magnetic field, and the answer went unmentioned.

What the paper separates

"The climate state at any given location and time consists of the response to external forcings, such as anthropogenic greenhouse gas and aerosol emissions, combined with fluctuations from internal climate variability, such as those from the El Niño–Southern Oscillation" [1 §1]. Internal variability "may amplify or oppose long-term forced trends" [1 §1].

The forced side is everything the model is driven with, which over the historical period is "boundary conditions derived from observations"; the natural side is the ocean and atmosphere's own fluctuations, which the paper ties to Pacific decadal variability [1 §2.1][1 §3.2]. The preindustrial baseline, by design, has no natural external forcings "such as volcanic eruptions" [1 §2.1].

OUR ANALYSIS

What the episode left out

"Attempting" and "a step further" make the attribution sound tentative and secondary. It is the paper's question, and its answer: forced crossover "has already occurred in almost all ecoregions" [1 §3.1]. The episode never said which way the attribution came out.

"Natural cycles" is the episode's phrase. Nothing in the paper concerns the Sun, cosmic rays, Earth's magnetic field, a pole shift or the May 2024 storm; the one "solar" in its text is the title of a cited study of solar climate intervention, a form of geoengineering, used to explain the North Atlantic warming hole in the model [1 §3.3].

In the authors' words

CESM2 is the Community Earth System Model 2; LENS2 its large ensemble.

"The finding that forced crossover has already occurred in almost all ecoregions demonstrates how anthropogenic climate change has greatly impacted the coupled Arctic climate-ecological system in these CESM2 simulations."
Hueholt et al. (2026) [1 §3.1]

"Most Arctic ecoregions have already experienced forced crossover and entered a regime where growing season environmental conditions are dominated by the warming trend."
Hueholt et al. (2026) [1 §4]

"On the decadal time horizons relevant for the near-term climate risks we explore, internal variability in the Arctic is greater than either structural or scenario uncertainty."
Hueholt et al. (2026) [1 §4]

4 · IS GREENING UNQUESTIONED?

Greening is real; "unquestioned, unchallenged" it is not

A net increase in leaf area since satellites began watching in the early 1980s is well established [3][5]. What the literature argues about is why, where, and whether it will last. The paper under review observed none of it: its only remark on the subject is that the browning literature "still consistently finds a biome-scale greening trend driven by summertime temperatures" [1 §4].

What the greening literature says

STUDY	WHAT IT FOUND	WHAT IT QUESTIONS
Zhu et al. 2016, 1982–2009 [3]	Greening over "25% to 50% of the global vegetated area, whereas less than 4% of the globe shows decreasing LAI (browning)", from three satellite leaf-area records.	Ten ecosystem models attribute 70% of the greening to CO_2 fertilization, 9% to nitrogen deposition, 8% to climate change and 4% to land-cover change; the drivers differ by region and the models leave a residual unexplained.
Chen et al. 2019, 2000–2017 [4]	A greening pattern "strikingly prominent in China and India and overlaps with croplands world-wide"; China alone gives 25% of the net gain in leaf area from 6.6% of the vegetated area.	Direct human land use is "a key driver", "accounting for over a third, and probably more, of the observed net increase in green leaf area"; Earth system models need "a realistic representation of human land-use practices".
Piao et al. 2020, review [5]	Greenness "has been increasing globally since at least 1981", "highly credible evidence of anthropogenic climate change", pronounced in farmed and afforested areas and in low-footprint biomes such as the Arctic.	Its causes beyond the global scale, its feedbacks on climate, and the need for finer observations and better sampling in the tropics and the Arctic.
Winkler et al. 2021, 1981–2017 [8]	Human-managed regions are mostly greening; natural vegetation shows "patterns of both greening and browning in all continents".	CO_2 fertilization is the dominant driver in only two biomes, "challenging the view of a dominant global-scale effect"; the analysis finds "a slowing down of greening and strengthening of browning trends, particularly in the last 2 decades".
Myers-Smith et al. 2020, Arctic review [6]	Satellite measures indicate "widespread greening at high latitudes", among the most important large-scale ecological responses to climate change.	"A consensus is emerging that the underlying causes and future dynamics of so-called Arctic greening and browning trends are more complex, variable and inherently scale-dependent than previously thought."
Berner et al. 2020, tundra 1985–2016 [7]	At 30-metre resolution, tundra greenness rose at about 37.3% of sites and fell at about 4.7%; greening went with warmer, wetter summers.	Browning at cold sites that cooled and dried: summer warming stimulated productivity "across much, but not all, of the Arctic tundra biome".
Wang et al. 2020 and the dispute [9][10][11][12][13]	Reported that the CO_2 fertilization effect on photosynthesis "has declined across most terrestrial regions of the globe from 1982 to 2015", tracking nutrients and soil water.	Three comments in *Science* called the decline an artefact of satellite-data biases and method; the authors replied that it is robust. The size and trend of the effect remain contested.

Findings quoted from each paper's abstract; LAI is leaf area index, the leaf area per unit of ground.

OUR ANALYSIS

The episode's core observation, more leaf area on the planet than in the 1980s, is supported: every study above finds net greening, and the paper under review agrees that browning papers still find a greening trend at the scale of the Arctic biome [1 §4]. "Unquestioned, unchallenged" is where it goes wrong. Whether the main driver is CO_2, climate or farming is argued over [3][4][8]; the Arctic literature's own word is "complexity" [6]; one group reports the greening slowing and browning strengthening [8]; and whether CO_2 fertilization is weakening is a live dispute [9][10][11][12][13]. None of this comes from the paper the episode was presenting, which measured temperature, not plants.

5 · MORE OXYGEN?

The atmosphere is losing oxygen, slowly

The Scripps O_2 Program has measured atmospheric oxygen since 1989. From January 1992 to January 2009 it fell by 320 per meg, "a loss of 320 O_2 molecules out of each one million O_2 molecules in the atmosphere", an average of "19 per meg or 0.0019 % per year", and "the decrease measured at other stations in our network is very similar, showing that the trend is global" [14].

MEASURED, 1992–2009
−19 per meg
a year, at La Jolla and across the network; "the main cause of the O_2 decrease is fossil-fuel burning" [14]

RELEASED BY NET PLANT GROWTH
OUR ANALYSIS
≈ 8 per meg
a year, from the land's net carbon uptake of 3.2 GtC a year in 2014–2023, at 1.1 molecules of O_2 per carbon atom [17][15]

CONSUMED BY FOSSIL FUELS
OUR ANALYSIS
≈ 32 per meg
a year, from 10.1 GtC of fossil emissions in 2023 at about 1.4 molecules of O_2 per carbon atom [17][14]

OUR ANALYSIS

The arithmetic

The atmosphere holds about 3.7×10^{19} moles of O_2 [14]. The land took up 3.2 ± 0.9 billion tonnes of carbon a year in 2014–2023, the whole net effect of CO_2 fertilization, nitrogen deposition and climate together [17]. That is 2.7×10^{14} moles of carbon, and at the 1.1 molecules of O_2 per carbon atom that Scripps uses for land plants, 2.9×10^{14} moles of O_2 released: 7.9 per meg, or 0.0008% of the atmosphere's oxygen, each year [15].

Fossil fuels released 10.1 ± 0.5 billion tonnes of carbon in 2023 [17]. At Scripps's consumption factors, 1.95 molecules of O_2 per CO_2 for gas, 1.44 for liquids and 1.17 for solids, about 1.4 for the mix, that consumes about 1.2×10^{15} moles: 32 per meg a year [14]. Scripps's own figure for 2005 was 917 trillion moles, 24.8 per meg [14].

Net, for 2023, those two terms leave the air losing about 24 per meg a year. Scripps's measurement, 19 per meg a year over 1992–2009, comes from years with about a quarter less fossil-fuel burning (Scripps's own 2005 figure is 24.8 per meg), so the budget and the measurement are of the same order rather than identical. Greening's contribution is a smaller loss, not a gain, and at most the 8 per meg above: the land sink has other causes too, and land-use emissions of 1.0 ± 0.7 GtC a year take part of it back [17].

How much is that?

Air is 20.95% oxygen. A loss of 19 per meg a year is about 4 parts per million of air, or 0.19% of the oxygen content over a century. Scripps's answer to whether the decline should worry us: the most fossil-fuel burning could ever remove, when the reserves are exhausted, "is only a few percent of the atmospheric burden", over many centuries, and "it's hard to see this as high on the list of possible environmental concerns" [14].

A 2018 oxygen budget reached the same scale: under the highest-emissions pathway, "the O_2 concentration will decrease from its current level of 20.946% to 20.825%" by 2100 [16].

Scripps notes that the measured loss has been "slightly smaller than expected from fossil-fuel burning alone", which shows that "photosynthesis has outpaced respiration globally, leading to biomass production overall" [14]. That is the grain of truth in "more oxygen thereafter": plants are slowing the decline. They are not reversing it.

6 · MORE FOOD?

The paper says nothing about food, and the literature is mixed

Nothing in the paper concerns crops, yields or food; its ecoregions, as far as its map shows, are tundra and boreal forest [1 Fig. 1]. In the greening literature, the link between greening and food runs the other way in croplands, and the effect of more CO_2 on crops comes with costs.

Cropland greening follows farming
India's greening "is mostly from croplands (82%)". "Food production in China and India has increased by over 35% since 2000 mostly owing to an increase in harvested area through multiple cropping facilitated by fertilizer use and surface- and/or groundwater irrigation" [4]. The farming caused the greening; the greening did not cause the food.

More CO_2: more yield, less nutrition
In 30 years of open-air CO_2 enrichment, raising CO_2 by about 200 ppm gave C_3 crops "a ca. 18% increase in yield under non-stress conditions"; nitrogen shortage cut that to 10%, "as did warming by ca. 2 °C", and maize and sorghum gained nothing except in drought [18]. Grown at mid-century CO_2, grains and legumes had "lower concentrations of zinc and iron", and non-legume C_3 crops less protein [20].

Warming cuts yields
Four independent methods agree that "without CO_2 fertilization, effective adaptation, and genetic improvement, each degree-Celsius increase in global mean temperature would, on average, reduce global yields of wheat by 6.0%, rice by 3.2%, maize by 7.4%, and soybean by 3.1%" [19]. These four crops provide two-thirds of human calories [19].

OUR ANALYSIS

World food output has grown, and extra CO_2 does raise some yields, so the claim has a basis. But "overall more food" as a consequence of the greening the episode was describing is not what the evidence shows: cropland greening is a product of farming, the CO_2 gain is partial and dilutes nutrients, warming pushes the other way, and the paper on screen is about tundra temperatures. Overstated.

7 · BOTTOM LINE

A careful model study, and an episode that heard what it wanted

The authors conclude

Most Arctic ecoregions have already entered a regime in which growing-season conditions are dominated by the warming trend: Pacific and Arctic sea-surface variability can bring a place's crossover forward or hold it back by more than a decade at the Brooks Range point; no-analog conditions are projected from the mid-to-late 21st century; and the model's growing degree days agree with the station record [1 §4][1 §3.2]. They offer the method as a way to include natural variability in projections of ecosystem change [1 Abstract].

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Our conclusion

The paper is a well-caveated single-model study of Arctic growing-season warmth, and its headline holds within its own data. The episode presented it as an observation of global greening, treated its central question as a side issue, never reported its answer, and attached two consequences, more oxygen and more food, that the paper does not touch and the evidence does not support as stated.

Limits of this check

The supplement was out of reach
We read the paper's full text and figures, but its supplementary file could not be downloaded, so the threshold-sensitivity tests and station-coverage tables are known only from the main text's description [1 §2.4][1 §3.4].

Abstracts for the wider literature
For the greening, oxygen-budget and crop studies we read abstracts and, for the Global Carbon Budget and the Scripps pages, the relevant passages; the numbers quoted are from those.

Traced figures
Both charts are our tracings of the published images, not replots of the authors' data; the map's colour steps were matched to the paper's colour bar, and small polygons may be merged or lost.

"Unquestioned" is a judgement
Whether a trend counts as questioned is our reading of seven studies, not a measurement.

What would change this verdict

01
A multi-model, multi-scenario version of this analysis that moved the crossover years by decades, or an observational attribution of Arctic vegetation change that contradicted the model, would change how firmly the paper's result can be stated.

02
A measured rise in atmospheric oxygen, or an oxygen budget in which the land biosphere outweighed fossil-fuel consumption, would overturn the oxygen verdict.

03
Evidence that the satellite greening signal is an artefact, or that it has reversed into net browning, would move the greening claim from Partly true to False; a settled driver and a steady trend would move it toward True.

Prepared by Fact-Checked Science from the open-access text and figures of Hueholt et al. (2026), *Environmental Research Letters* 21, 194022, doi:10.1088/1748-9326/ae6e2b, CC BY 4.0 [1], and the episode's transcript [2]. The charts are adapted from the paper's Figures 1 and 2(a) under that licence; the assessment is our own and has not been reviewed by the authors.

Sources

Bracketed numbers refer to this list. For the paper [1], Abstract names that part of the text, § a numbered section of the published article (it has no journal page numbers; §4 is its discussion and conclusion) and Fig. a figure. For the other papers we read the abstracts, except where a source says otherwise. Links checked October 22, 2026.

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METHOD

How this was checked

On October 22, 2026, we checked every statement, number, quotation and citation on this page against its source: the paper's full text, read from the publisher's HTML and PDF, its five figures read from the published images, the episode's transcript at the times quoted, and the 20 other sources listed here, about 70 items in all. The paper's supplementary file could not be downloaded, so its supplementary figures are known only from what the main text says about them. The two charts were traced from the paper's Figures 1 and 2(a); the traced curve reproduces the paper's own marks, forced crossover in 2022 and member crossovers in 2011 and 2037, to within a year.

The verdicts and the items tagged "Our analysis" are our own assessment, built on the cited sources: our reading of what the paper did and did not measure, the oxygen arithmetic, the comparison of the episode's words with the greening literature, and our reading of the paper's map.

We recomputed the oxygen budget from the sources' numbers, the land sink and fossil emissions from the Global Carbon Budget and the oxygen inventory and combustion factors from the Scripps O_2 Program, and re-derived the crossover years from the traced curve, which match the paper. We could not re-run the paper's analysis, which rests on a 100-member climate-model ensemble; its code and derived data are archived at the Open Science Framework, which we did not download.

This page was researched and written with Claude, an AI assistant made by Anthropic, and then re-checked against its sources in a separate verification pass.

The verdicts on this page

MISLEADING — Contains something true but leaves a false impression, usually by leaving out key context.
OVERSTATED — Has some basis but claims much more than the evidence supports.
MISREAD — Cites a real source but gets wrong what it says.
PARTLY TRUE — Part of the claim holds up and part doesn't.
TRUE — The evidence supports the claim.

All ten verdicts, and how we check

CORRECTIONS

Corrections and changes

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

Change log

Oct 22, 2026 — Published on factchecked.science after a full check against the sources. The page is built from the paper's open-access text and figures, the episode's automatically generated transcript, and the greening, oxygen and crop-yield literature listed in the sources; the six verdicts are on the site's scale.