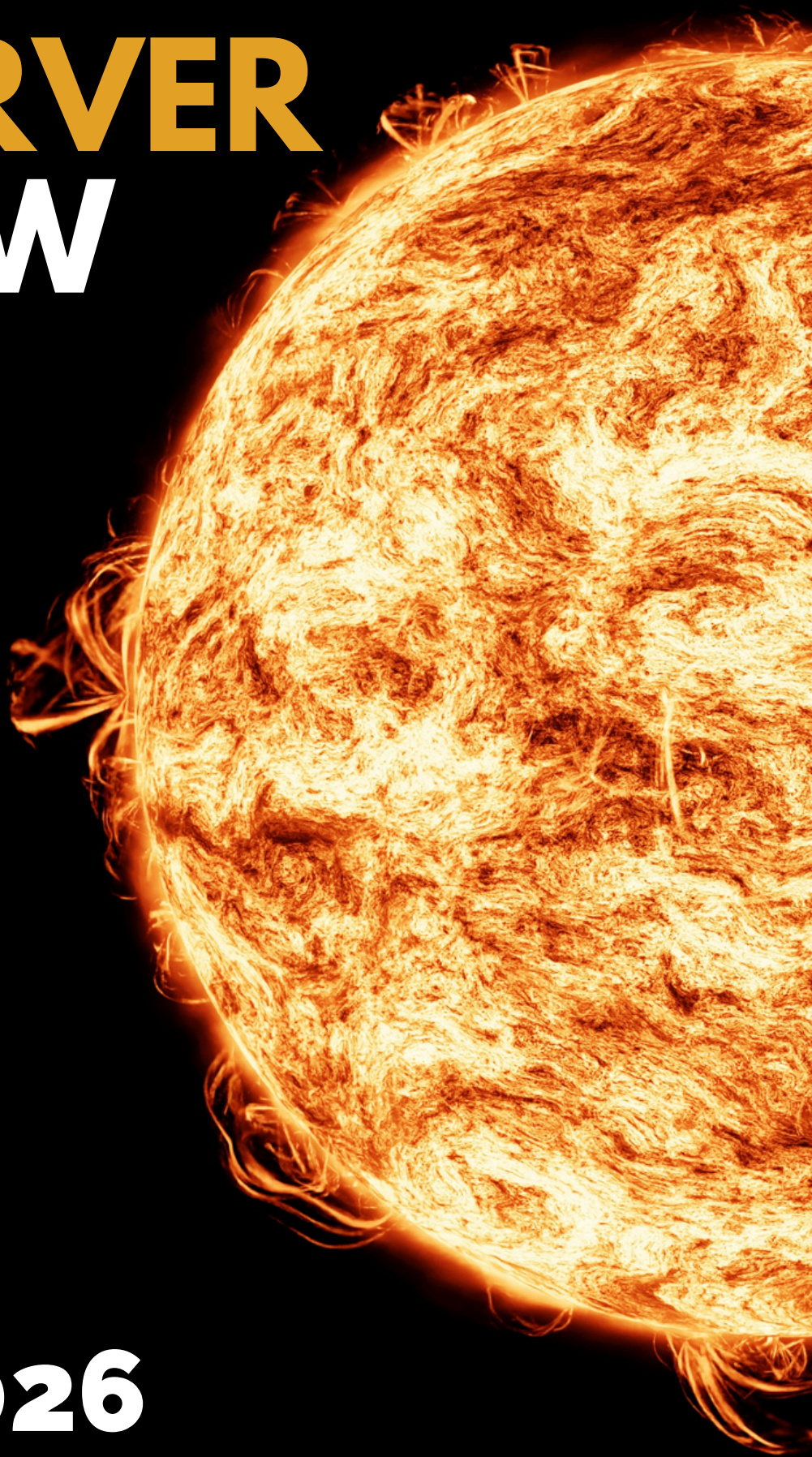


THE OBSERVER REVIEW



JULY 2026

CONTENTS

JULY

WHERE OZONE IS
RISING AND FALLING

03



04

SAN ANDREAS POISED FOR RECORD EARTHQUAKE

We know, southern California is overdue for another major earthquake.



RAPID ELECTROMAGNETIC SOLAR CLIMATE FORCING

A study found that solar proton events are far more effective than geomagnetic electron precipitation at increasing atmospheric ionization and depleting ozone over the polar regions.

FEATURED ARTICLES

08 SOLAR IMPACT ON POLE POSITION

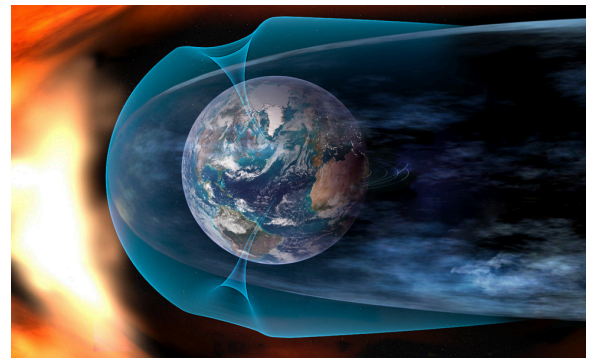
10 PRE-EARTHQUAKE SIGNALS

12 MAGNETIC SENSITIVITY

For years, the biggest question was not whether animals could sense Earth's magnetic field, but how?

14 DEEP CRATON QUAKES REVEAL POLE SHIFT DYNAMICS

15 A 2ND 200% SPACE RADIATION EXCURSION EVENT IN THE RECORD



17 TRUE AXIS TILT EVENT

19 LLSVP TO CORE HEAT FLOW SHOCKS SCIENTISTS

20 NOAH EVENT WEAKNESS REACHED

21 SIGNALS OF ACCELERATION

AND MORE!

WHERE OZONE IS RISING AND FALLING

BY: BAILEY LAURISSA

ARTICLE REFERENCED:

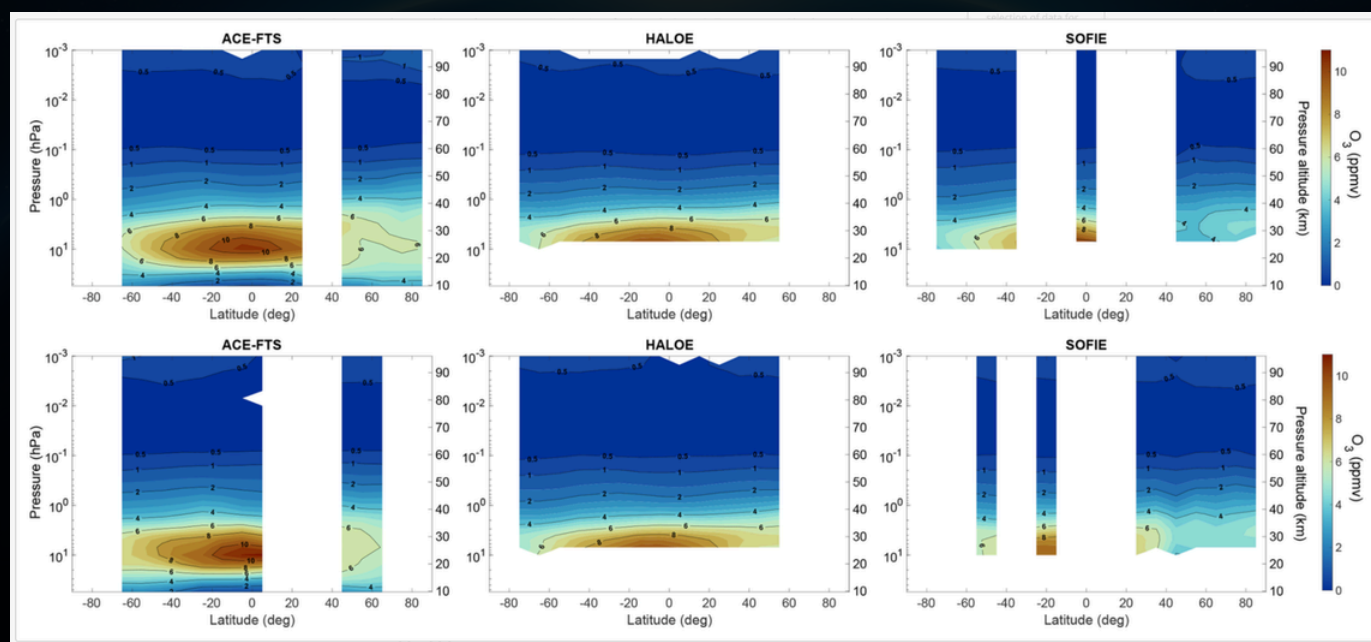
EVALUATION OF OZONE TRENDS IN THE MESOSPHERE/LOWER THERMOSPHERE USING A NEW MERGED DATASET OF OZONE PROFILES

A new study has provided one of the most complete pictures yet of how Earth's ozone layer has changed over the past three decades. Ozone much higher in the atmosphere is steadily declining.

Researchers combined observations from six satellite missions into a new global dataset spanning 1991 to 2023. The record extends from roughly 22 to 100 kilometers above Earth's surface, making it the most comprehensive long-term view yet of ozone changes throughout the middle atmosphere.

The mesosphere shows widespread ozone losses of roughly 1–3% per decade, with the largest declines, between 8% and 12% per decade, occurring between 80 and 90 kilometers altitude.

Ozone in the upper stratosphere is controlled primarily by chlorine chemistry and ozone in the mesosphere and lower thermosphere is far more sensitive to changes in atmospheric circulation, temperature, solar ultraviolet radiation, and energetic particles entering from space.





SAN ANDREAS POISED FOR RECORD EARTHQUAKE

BY: BAILEY LAURISSA

ARTICLE REFERENCED:

[HTTPS://AGUPUBS.ONLINELIBRARY.WILEY.COM/DOI/10.1029/2025JB033213](https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2025JB033213)

[HTTPS://AGUPUBS.ONLINELIBRARY.WILEY.COM/DOI/ABS/10.1029/2025JB032405](https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2025JB032405)

[HTTPS://YOUTU.BE/EPSEUSOKME](https://youtu.be/EPSEUSOKME)

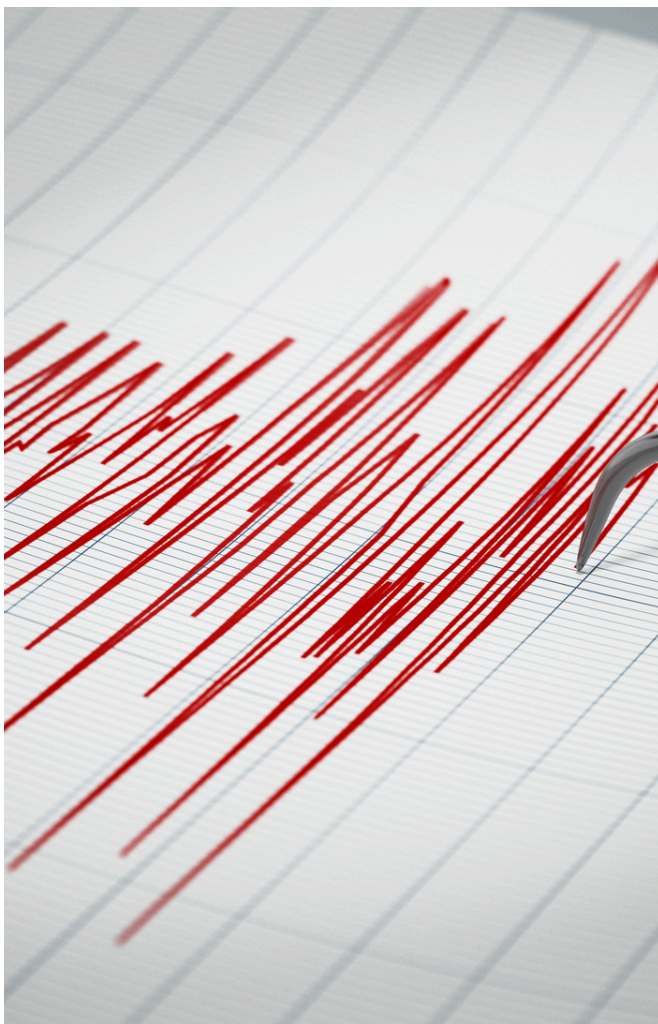
We know, southern California is overdue for another major earthquake. These warnings have largely been based on elapsed time since the last great rupture and measurements of tectonic plate motion. Now, we are looking at two new studies published in 2026 that provide a much more detailed picture of what is happening in that region.

The first study reconstructs more than 1,400,000 years of earthquake behavior on the Puente Hills Blind Thrust Fault, buried directly beneath metropolitan Los Angeles.

The second study simulates 1,000 years of stress accumulation along the southern San Andreas Fault System, including the critical intersection at Cajon Pass.

The last great earthquake on the southern San Andreas Fault occurred in 1857, when the magnitude 7.9 Fort Tejon earthquake ruptured more than 330 kilometers of fault.

Since then, the southern portion of the San Andreas has remained remarkably quiet despite continuously accommodating the motion between the Pacific and North American tectonic plates.



THAT MOTION NEVER STOPS.

Instead, stress accumulates as locked fault segments resist movement until enough strain builds to overcome friction.

The new earthquake-cycle simulations reveal that this accumulation has now reached some of the highest modeled values observed during the past 1,000 years of reconstructed fault history.

One of the most fascinating discoveries involves Cajon Pass, where the San Andreas and San Jacinto faults converge.

Rather than behaving as two independent faults, the models suggest this junction functions like an earthquake gate.

Sometimes ruptures stop there.

Other times they continue through the junction and spread onto adjacent fault systems.

The simulations suggest this behavior depends largely on the relative stress levels present on each fault at the time rupture begins.

When stress becomes similar on both systems, the probability of a through-going rupture appears to increase.

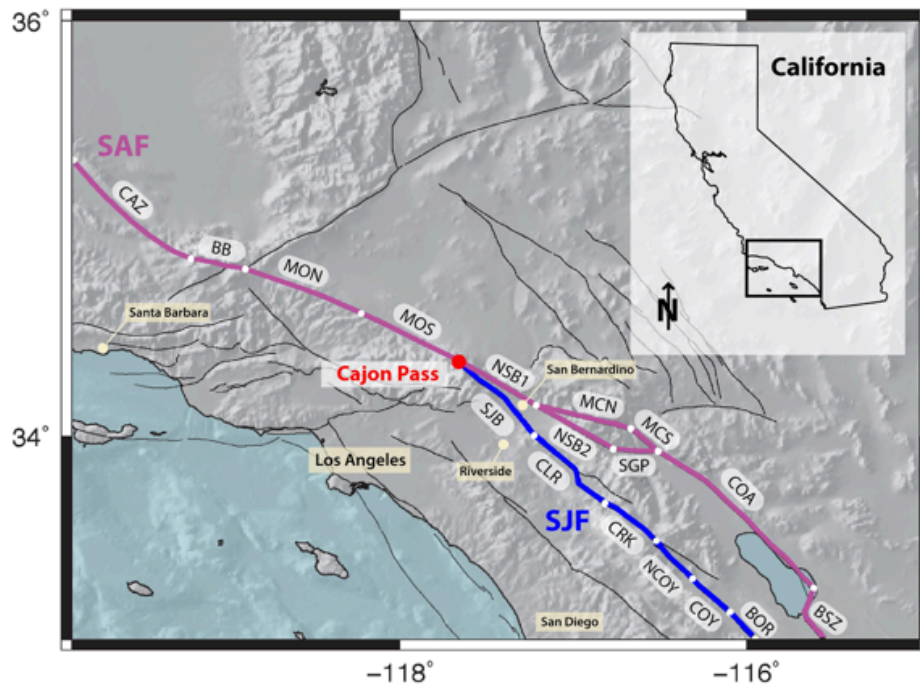
Researchers describe this as a "Gate-Open" configuration. When stress differs substantially between the faults, ruptures tend to terminate at Cajon Pass instead. Historical evidence indicates that an earthquake in 1812 may have propagated through Cajon Pass, rupturing portions of both the San Andreas and San Jacinto systems.

By contrast, the enormous 1857 Fort Tejon earthquake stopped at Cajon Pass despite rupturing more than 330 kilometers of the San Andreas Fault. The simulations reproduced this difference. The model found that before the 1812 event, stress levels on both major fault systems had converged near 2 MPa, allowing rupture to continue across the junction. Before the 1857 event, stress conditions differed sufficiently that the rupture terminated instead.

While the San Andreas dominates public attention, another major fault lies directly beneath downtown Los Angeles.

Unlike the San Andreas, the Puente Hills Blind Thrust Fault has no obvious surface trace. Instead, it remains buried beneath one of the most densely populated metropolitan regions in the United States.

Using seismic reflection imaging, well logs, radiocarbon dating, and luminescence dating, researchers reconstructed approximately 1.4 million years of fault activity. Rather than maintaining a constant rate of deformation, the Puente Hills system has experienced a long-term acceleration beginning roughly 200,000 years ago.



Slip rates increased on multiple segments simultaneously, suggesting a regional reorganization of crustal strain rather than isolated behavior on a single fault.

The study also demonstrated that shallow geologic observations significantly underestimate the total movement occurring on the deeper portions of the fault because much of the displacement is absorbed into folding rather than visible fault offset.

During a morning video, Ben discussed that these two papers should not be viewed independently but rather as two parts of the same tectonic story.

He discussed that the Puente Hills study demonstrates that slip rates beneath Los Angeles have accelerated over the past 200,000 years. Because slip rate reflects how quickly tectonic strain accumulates on a fault, he argues that increasing slip rates indicate pressure is building more rapidly than it did in the past.

BEN THEN CONNECTS THAT FINDING DIRECTLY TO THE NEW CAJON PASS STRESS MODELING STUDY. WHILE THE FIRST PAPER DOCUMENTS INCREASING DEFORMATION BENEATH METROPOLITAN LOS ANGELES, THE SECOND CONCLUDES THAT PORTIONS OF THE SOUTHERN SAN ANDREAS AND SAN JACINTO FAULT SYSTEMS HAVE ACCUMULATED EXCEPTIONALLY HIGH MODELED STRESS AFTER MORE THAN A CENTURY WITHOUT A MAJOR RUPTURE.

He notes that the Cajon Pass study introduces the concept of an "earthquake gate," where rupture may either terminate or continue through the junction depending on evolving stress conditions. In the simulations, periods when stress became similar on multiple fault systems were associated with larger, through-going ruptures that propagated across the junction.

RAPID ELECTROMAGNETIC SOLAR CLIMATE FORCING

BY: BAILEY LAURISSA

ARTICLE REFERENCED:

[HTTPS://WWW.SCIENCEDIRECT.COM/SCIENCE/ARTICLE/ABS/PII/S1364682626001410](https://www.sciencedirect.com/science/article/abs/pii/S1364682626001410)

[HTTPS://AGUPUBS.ONLINELIBRARY.WILEY.COM/DOI/10.1029/2025JA034981](https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2025JA034981)

[HTTPS://EOS.ORG/RESEARCH-SPOTLIGHTS/SOLAR-STORMS-CAN-AFFECT-EARTHS-WEATHER-A-NEW-STUDY-EXAMINES-HOW](https://eos.org/research-spotlights/solar-storms-can-affect-earths-weather-a-new-study-examines-how)

One study found that solar proton events are far more effective than geomagnetic electron precipitation at increasing atmospheric ionization and depleting ozone over the polar regions.

Another showed that enhanced solar proton precipitation over Antarctica immediately strengthened Earth's Global Atmospheric Electric Circuit by increasing atmospheric conductivity, producing measurable changes in the surface electric field with virtually no delay. The second study investigated how a period of enhanced polar-cap proton precipitation affected atmospheric electricity over Antarctica.

During late 2015 and early 2016, elevated solar proton fluxes entered Earth's atmosphere through open polar magnetic field lines.

Measurements at Halley Station showed that atmospheric electric field strength increased almost immediately as proton precipitation intensified.

Researchers attribute this response to Earth's Global Atmospheric Electric Circuit. Normally, electrical currents continuously flow between thunderstorms, the ionosphere, and Earth's surface.

When solar protons dramatically increase ionization in the upper atmosphere. This means the atmospheric electrical resistance decreases, the electrical currents increases, and the near-surface electric field strengthens.

Importantly, the response occurred with almost no measurable delay following the arrival of energetic particles.

This demonstrates that solar activity can rapidly alter Earth's global electrical environment through direct modification of atmospheric conductivity. A third study, which analyzed 67 years of atmospheric and geomagnetic data, found that geomagnetic storms were consistently linked to changes in atmospheric pressure, temperature, and precipitation within hours to days. The researchers concluded that these disturbances begin in the upper atmosphere before propagating downward into the troposphere, where our weather develops.

Together, these findings support the idea behind Rapid Electromagnetic Solar Climate Forcing: that short-lived bursts of solar activity can rapidly influence Earth's atmosphere through electromagnetic, electrical, and chemical processes rather than through changes in solar irradiance alone.

SOLAR IMPACT ON POLE POSITION

BY: BAILEY LAURISSA

ARTICLE REFERENCED:

YAYIN: EXTERNAL MODULATION OF GEOMAGNETIC SECULAR VARIATION: A HYPOTHESIS ON SOLAR WIND COUPLING, THE MAY 2024 STORM, AND THE TESLA CIRCUIT

"FLARES ON THE SUN MAY IMPACT THE ROTATION OF THE EARTH, AND EVEN, AS SOME HAVE SUGGESTED... THE EARTH TURNED OVER." - IMMANUEL VELIKOVSKY

The magnetic field is not an isolated system. It exists within a continuously changing heliophysical environment, where variations in the solar wind, interplanetary magnetic field, and ionospheric conductivity constantly reshape the magnetosphere.

A recently study expands on this notion by suggesting that solar wind dynamic pressure, coupled with the day-night conductivity asymmetry of the ionosphere, functions as an external steering mechanism capable of modulating magnetic pole position and contributing to rapid geomagnetic impulses, or "jerk-like" events.

Rather than attributing every abrupt change in secular variation exclusively to core dynamics, the model argues that solar forcing may periodically amplify or redirect the observable magnetic field through electromagnetic coupling across the magnetosphere-ionosphere system.

This framework gains additional context from a recent atmosphere-ionosphere modeling study examining the response of the high-latitude atmosphere to solar energetic particle events and geomagnetic disturbances.

The simulations demonstrated that solar proton events produce substantially greater ionization in the D-region than energetic electron precipitation associated with geomagnetic storms.

That enhanced ionization led to stronger production of odd nitrogen (NO_x) and odd hydrogen (HO_x), resulting in significantly greater ozone depletion throughout the middle atmosphere.

While the atmospheric chemistry itself is an important result, perhaps the more relevant finding for geomagnetic studies is the accompanying change in ionospheric conductivity.

Conductivity governs how efficiently ionospheric currents respond to magnetospheric forcing. During major solar proton events, increased electron densities strengthen the electrical coupling between the solar wind, magnetosphere, and upper atmosphere.

Because the sunlit ionosphere is considerably more conductive than the nightside, solar wind pressure is distributed unevenly across Earth's electromagnetic system.

Under quiet solar conditions, these asymmetries likely produce only minor adjustments.

During periods of elevated solar activity, however, the combination of increased dynamic pressure and enhanced conductivity may generate larger electromagnetic torques capable of producing measurable changes in magnetic pole motion or rapid reorganizations of the observed field.

THIS PROVIDES AN INTERESTING PERSPECTIVE ON GEOMAGNETIC JERKS.

The May 2024 geomagnetic superstorm illustrates why this hypothesis has attracted attention. The event generated one of the largest geomagnetic disturbances of the satellite era, producing severe magnetospheric compression, global auroral expansion, and exceptionally high ionospheric electron densities.

It represented an ideal natural experiment in which solar wind pressure and ionospheric conductivity were simultaneously enhanced on a planetary scale.

THIS BROADER PERSPECTIVE ALSO INVITES A REEVALUATION OF HISTORICAL IDEAS REGARDING SOLAR INFLUENCES ON EARTH. IMMANUEL VELIKOVSKY FAMOUSLY WROTE, "FLARES ON THE SUN MAY IMPACT THE ROTATION OF THE EARTH, AND EVEN, AS SOME HAVE SUGGESTED... THE EARTH TURNED OVER."

PRE-EARTHQUAKE SIGNALS

BY: BAILEY LAURISSA

ARTICLE REFERENCED:

[HTTPS://DERGIPARK.ORG.TR/EN/PUB/DEUMFFMD/ARTICLE/1723122](https://dergipark.org.tr/en/pub/DEUMFFMD/article/1723122)

[HTTPS://AGUPUBS.ONLINELIBRARY.WILEY.COM/DOI/10.1029/2025SW004787](https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2025SW004787)

Before a major earthquake ruptures a fault, the crust undergoes a prolonged period of stress accumulation and deformation. While these processes originate deep within the lithosphere, an increasing body of evidence suggests their effects may propagate upward through the atmosphere and into the ionosphere, producing measurable disturbances days before failure. One of the most robust parameters being investigated is Total Electron Content (TEC), the integrated number of free electrons along a GPS signal path through the ionosphere. Because TEC is continuously monitored by dense global GNSS networks, it provides an ideal dataset for identifying subtle departures from normal ionospheric behavior.

The primary challenge has never been observing anomalies, but determining whether they originate from lithospheric processes rather than the much larger variability imposed by solar radiation and geomagnetic forcing.

A recent investigation of the February 6, 2023 Kahramanmaraş earthquake sequence provides one of the clearest demonstrations of this problem. Using GPS-derived TEC observations from fifteen stations across Türkiye, researchers analyzed the five days preceding the Mw 7.8 and Mw 7.5 earthquakes with the IONOLAB-FFT algorithm to characterize both the spectral and temporal evolution of ionospheric disturbances.

The results reveal a distinct progression rather than isolated anomalies. Detectable TEC perturbations emerged approximately two to three days before rupture, with the strongest deviations developing during the final 24 to 48 hours.

The most significant changes occurred at stations nearest the epicenters, particularly EKZ1, located only 15.5 km from the Mw 7.5 rupture, where cross-correlation values declined from roughly 0.95 to 0.78 as the event approached. Spectral broadening became increasingly pronounced at near-field stations, suggesting multiple disturbance mechanisms were operating simultaneously rather than a single transient process.

Duration statistics further support this interpretation. Stations closest to the rupture exhibited bimodal distributions, consistent with the coexistence of relatively short-lived acoustic-gravity wave disturbances and longer-duration electromagnetic perturbations. Perhaps most importantly, the study identified a clear distance dependence, with the highest sensitivity occurring within approximately 50–100 km of the eventual rupture zones.

This spatial relationship is difficult to reconcile with random ionospheric variability and instead aligns with expectations from Lithosphere-Atmosphere-Ionosphere (LAI) coupling models.

The second challenge has been separating these signatures from ordinary space weather. Solar flares, coronal mass ejections, high-speed solar wind streams, and geomagnetic storms routinely produce TEC variations that can equal or exceed those associated with earthquakes. Distinguishing endogenous geophysical signals from exogenous solar forcing remains one of the central problems in ionospheric precursor research.

When evaluated against the Jiuzhaigou and Luding earthquakes, the framework detected substantially more pre-seismic TEC anomalies than traditional approaches, increasing detection rates by more than 20 percent in some cases.

EQUALLY SIGNIFICANT WAS ITS ABILITY TO SUPPRESS FALSE DETECTIONS DURING GEOMAGNETICALLY QUIET INTERVALS WHILE SUCCESSFULLY DISCRIMINATING EARTHQUAKE-RELATED ANOMALIES FROM THE STRONG GEOMAGNETIC STORM OF AUGUST 26, 2018.

THIS REPRESENTS A MEANINGFUL ADVANCE BECAUSE IT DEMONSTRATES THAT THE SPATIAL AND TEMPORAL MORPHOLOGY OF TEC DISTURBANCES CONTAINS SUFFICIENT INFORMATION TO DISTINGUISH DIFFERENT PHYSICAL FORCING MECHANISMS.

MAGNETIC SENSITIVITY

BY: BAILEY LAURISSA

ARTICLE REFERENCED:

[HTTPS://WWW.SCIENCE.ORG/DOI/FULL/10.1126/SCIENCE.AEH9507](https://www.science.org/doi/full/10.1126/science.aeh9507)

[HTTPS://EOS.ORG/RESEARCH-AND-DEVELOPMENTS/TURTLES-MAY-MIGRATE-USING-EARTHS-MAGNETIC-FIELD](https://eos.org/research-and-developments/turtles-may-migrate-using-earths-magnetic-field)

Two recent studies, one examining pigeons and another tracking migrating sea turtles, bring researchers closer to understanding how magnetoreception functions and why it has evolved across so many species.

For years, the biggest question was not whether animals could sense Earth's magnetic field, but how. Birds routinely migrate thousands of miles with astonishing precision. Sea turtles return to nesting beaches decades after hatching. Salmon locate their natal rivers, and many species of fish navigate vast stretches of open ocean. All of these behaviors suggest the existence of an internal navigation system that operates independently of vision, smell, or landmarks.

Researchers found evidence that specialized immune cells within the pigeon's liver respond to alignment with Earth's geomagnetic field. These cells appear capable of transmitting magnetic information through afferent nerves to the brain, suggesting that magnetic sensing may begin outside the nervous system before being integrated into neural circuits.

Another recent investigation identified regions of the pigeon brain that become active during magnetic stimulation while also pointing toward the inner ear as a possible location for magnetic sensors.

This makes sense when you think about it. Vision, balance, hearing, and touch all rely on multiple sensory structures that continuously provide overlapping information to the brain. Magnetic perception functions similarly, with several organs contributing different pieces of information that together create an accurate representation of direction and orientation.

Evidence that this system works under real-world conditions comes from an entirely different group of animals: sea turtles.

THE OBSERVER REVIEW

In one of the first studies to directly measure magnetic navigation during migration, researchers attached high-precision satellite tags to six female green sea turtles traveling more than 1,000 miles across the Indian Ocean. The instruments continuously recorded both location and compass heading throughout their month-long journey.

The results revealed that the turtles did not simply drift with ocean currents. Instead, they maintained remarkably straight courses across featureless open water where visual landmarks do not exist. Even more revealing was their behavior during the voyage. Approximately every fifteen hours, the turtles made slow, deliberate directional adjustments before continuing along another straight path.

These periodic corrections resemble the behavior of someone occasionally checking a compass while hiking. Rather than wandering randomly, the turtles appeared to compare their current heading with an internal directional reference before making small course corrections.

Researchers conclude that this behavior is difficult to explain without some form of magnetic navigation. Previous laboratory experiments had already shown that turtles respond to magnetic fields.

This study demonstrates those capabilities operating during an actual ocean migration.

The navigation system, however, is not perfectly precise. Instead, it appears to function much like a GPS used for long-distance travel. Earth's magnetic field provides broad positional information over hundreds or thousands of miles, while local cues such as coastlines, underwater topography, or familiar landmarks likely guide the final stages of navigation near their destination.

OVERALL, WE ARE STILL WORKING TO IDENTIFY THE MOLECULAR MACHINERY RESPONSIBLE. ONE MECHANISM INCLUDES MICROSCOPIC MAGNETIC MINERALS SUCH AS MAGNETITES, WHICH ARE SPECIALIZED PROTEINS THAT RESPOND TO MAGNETIC FIELDS THROUGH QUANTUM PROCESSES, AND NOW POTENTIALLY IMMUNE-RELATED CELLS CONNECTED TO THE NERVOUS SYSTEM.

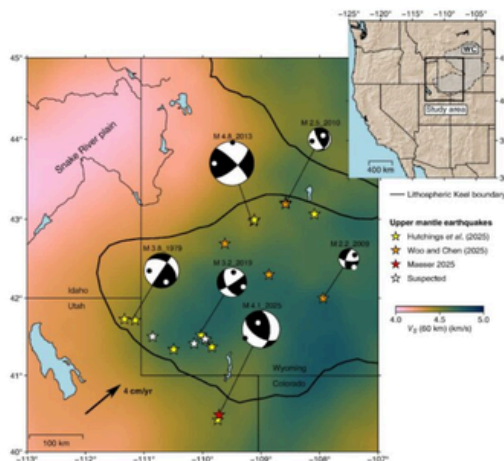
RATHER THAN A SINGLE UNIVERSAL SENSOR, EVOLUTION MAY HAVE PRODUCED SEVERAL DIFFERENT BIOLOGICAL SOLUTIONS FOR DETECTING THE SAME PLANETARY SIGNAL.

DEEP CRATON QUAKES REVEAL POLE SHIFT DYNAMICS

BY: BAILEY LAURISSA

ARTICLE REFERENCED:

THE MYSTERY OF UTAH'S DEEP QUAKES



Map of the Wyoming Craton region. The yellow stars are continental mantle earthquakes (CMEs) from 1979 to 2023. The orange stars are six recently identified CMEs that occurred between 2007 and 2010. The white stars are four suspected CMEs located by the University of Utah Seismograph Stations in 2025, and the red star is the location of the 2025 Maeser earthquake. The black thick line indicates the approximate lithospheric keel boundary of the Wyoming Craton. Graphic credit: U of U Seismograph Stations

A series of unusual earthquakes beneath northeastern Utah and southwestern Wyoming lead to finding are rare continental mantle earthquakes (CMEs), occurring more than 20 kilometers below the Moho, are taking place under conditions once thought incapable of producing earthquakes. Rather than breaking along familiar faults, they appear to result from intense deformation where Earth's mantle flows around the ancient, rigid root of the Wyoming Craton.

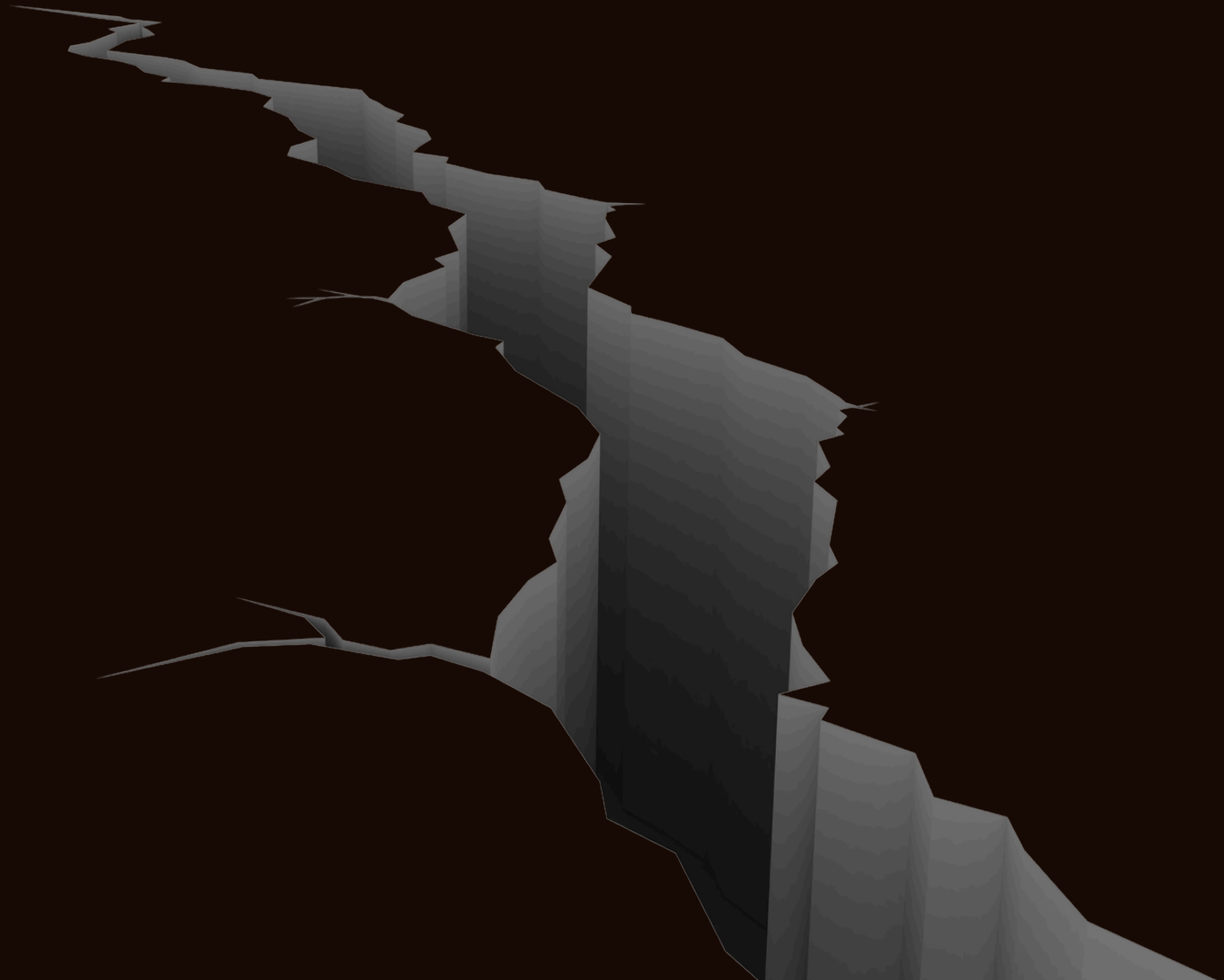
Researchers found these earthquakes cluster along the craton's edge, where the lithosphere transitions from the stable North American interior to the more tectonically active western United States. At depths approaching 70 kilometers and temperatures exceeding 700°C, the surrounding rock behaves more like slowly flowing taffy than brittle stone. Yet despite these ductile conditions, stress still accumulates until it is released in isolated seismic events without the foreshocks and aftershocks typical of shallow earthquakes.

Rather than originating from plate-boundary faults, these earthquakes appear to be driven by mantle flow encountering the craton's thick lithospheric "keel."

As hot mantle circulates around this rigid block, deformation concentrates along its margins, generating localized stresses capable of producing deep earthquakes.

THIS MECHANISM OFFERS AN INTRIGUING PARALLEL TO RESEARCH INVESTIGATING TRUE POLAR WANDER, SOMETIMES REFERRED TO AS EARTH'S FIGURE-AXIS OR POLE-SHIFT DYNAMICS. STUDIES OF EARTH'S FIGURE AXIS HAVE SHOWN THAT THE PLANET'S ROTATION AXIS SLOWLY RESPONDS TO LONG-TERM REDISTRIBUTION OF MASS WITHIN THE MANTLE, OCEANS, ICE SHEETS, AND LITHOSPHERE.

If mantle convection is capable of generating enough stress to fracture rock nearly 70 kilometers beneath the surface, it also demonstrates the immense forces involved in slowly reshaping Earth's internal mass distribution.



A 2ND 200% SPACE RADIATION EXCURSION EVENT IN THE RECORD

BY: BAILEY LAURISSA

ARTICLE REFERENCED:

ATMOSPHERIC ^{10}Be FROM TALOS DOME (EAST ANTARCTIC) ICE CORE RECORDS GEOMAGNETIC DIPOLE INTENSITY FROM 170 TO 270 KA BP

A new analysis of beryllium-10 (^{10}Be) preserved in Antarctica's Talos Dome ice core reveals that the Iceland Basin Excursion, approximately 188,000 years ago, produced atmospheric radiation levels roughly 1.6 to more than 2 times above normal, placing it among the largest known geomagnetic excursions ever identified.

Beryllium-10 is created when high-energy cosmic rays strike Earth's atmosphere. Under normal conditions, Earth's magnetic field deflects much of this incoming radiation. When the magnetic field weakens, significantly more cosmic rays penetrate the atmosphere, dramatically increasing ^{10}Be production.

As snow accumulates over Antarctica, that isotope becomes locked into the ice, preserving a record of past changes in Earth's magnetic shielding. The Talos Dome record captures three separate geomagnetic excursions between 170,000 and 270,000 years ago.

The most striking is the Iceland Basin Excursion, where ^{10}Be flux increased by 159% to 208% above background levels, indicating a major collapse of Earth's dipole field. Researchers also observed that the magnetic field weakened rapidly before recovering in three distinct stages, offering one of the clearest reconstructions yet of how Earth's magnetic field rebounds after a major disruption.

Two smaller events, the Pringle Falls and Mamaku excursions, also appear in the ice core, though they produced more modest increases in cosmic-ray production. The agreement between the Antarctic ice record, marine sediment records, and other Antarctic ice cores demonstrates that these were global geomagnetic events rather than regional anomalies.

TRUE AXIS TILT EVENT

BY: BAILEY LAURISSA

ARTICLE REFERENCED:

OSCILLATIONS IN THE EARTH'S FIGURE AXIS FROM 50-YR SLR DATA AND POLAR MOTION

Our planet constantly shifts and wobbles as mass moves through its atmosphere. A new study analyzing an unprecedented 50 years of satellite observations has uncovered evidence of long-period oscillations in Earth's figure axis.

Most people are familiar with Earth's rotational axis, the imaginary line connecting the North and South Poles around which the planet spins every 24 hours.

The figure axis is something different. It represents the direction in which Earth's mass is distributed. Because Earth is slightly flattened at the poles and bulges around the equator, there is a direction along which the planet's greatest moment of inertia lies. That direction is the figure axis.

To investigate these changes, researchers analyzed five decades of Satellite Laser Ranging (SLR) observations along with 24 years of gravity measurements from the GRACE and GRACE Follow-On satellite missions.

Satellite Laser Ranging works by bouncing laser pulses off satellites equipped with reflective mirrors, allowing scientists to measure their positions with millimeter-level precision. From these measurements, researchers can determine tiny changes in Earth's gravity field and track how the planet's mass distribution changes over time.

The study examined two gravitational parameters known as C21 and S21. Although these coefficients sound technical, they simply describe whether Earth's mass is becoming slightly unbalanced in different directions. Small changes in these values correspond to slight movements of the figure axis.

One of the study's most striking findings is that Earth's figure axis contains clear oscillations with periods of approximately 30 years and 60 years. These are not random fluctuations.

Findings suggest that these decades-long oscillations could be driven by a slight misalignment between Earth's solid inner core and the rest of the planet.

Their model proposes that the inner core's figure axis may be tilted by approximately 0.05 degrees relative to the figure axis of the surrounding core.

Although 0.05 degrees sounds incredibly small, Earth's inner core is about 2,400 kilometers (1,500 miles) across. Even a tiny angular offset represents a significant geometric difference deep inside the planet.

THE STUDY SHOWCASES THAT THIS OFFSET GENERATE SSSLOW OSCILLATIONS THROUGH ELECTROMAGNETIC COUPLING BETWEEN EARTH'S LIQUID OUTER CORE AND THE ROCKY MANTLE. BECAUSE THE OUTER CORE CONSISTS OF ELECTRICALLY CONDUCTIVE MOLTEN IRON, INTERACTIONS BETWEEN FLUID MOTION AND EARTH'S MAGNETIC FIELD CAN TRANSFER FORCES UPWARD INTO THE REST OF THE PLANET.

These findings naturally invite comparisons with the idea of a True Axis Tilt Event, more formally known as True Polar Wander.

Unlike the daily rotation of Earth or the familiar wobble of the rotational poles, True Polar Wander occurs when the entire solid Earth gradually reorients relative to its spin axis.

Imagine spinning a slightly lopsided basketball.

IF ENOUGH WEIGHT SHIFTS INSIDE THE BALL, IT SLOWLY ROTATES UNTIL ITS HEAVIEST PARTS SETTLE INTO A MORE STABLE ORIENTATION WHILE CONTINUING TO SPIN. THE SPIN AXIS IN SPACE REMAINS NEARLY THE SAME, BUT THE PLANET ITSELF SLOWLY CHANGES ITS ORIENTATION BENEATH THAT AXIS.

LLSVP TO CORE HEAT FLOW SHOCKS SCIENTISTS

BY: BAILEY LAURISSA

ARTICLE REFERENCED:

NEGATIVE CORE-MANTLE BOUNDARY HEAT FLUX BENEATH LOW-SHEAR-WAVE-VELOCITY PROVINCES

This study shows that the giant structures deep within Earth's mantle can temporarily reverse the flow of heat at the core/mantle boundary, sending heat back into the core and creating dramatic heat-flow spikes that may influence the behavior of Earth's magnetic field over millions of years.

RESEARCHERS MODELED THE THERMAL INTERACTION BETWEEN EARTH'S CORE AND MANTLE WHILE ACCOUNTING FOR THE ENORMOUS DEEP-MANTLE STRUCTURES THAT WE KNOW AS LARGE LOW-SHEAR-VELOCITY PROVINCES (LLSVPS). THESE CONTINENT-SIZED REGIONS BENEATH AFRICA AND THE PACIFIC ARE THOUGHT TO BE HOTTER AND CHEMICALLY DISTINCT FROM THE SURROUNDING MANTLE.

Their simulations found that directly beneath these structures, core-mantle boundary heat flux can become locally negative. Instead of heat escaping the core, the overlying mantle becomes hot enough to transfer heat back into it.

Then cold, dense tectonic slabs sink through the mantle and eventually reach the core, mantle boundary, they generate intense heat-flow spikes, dramatically increasing the amount of heat extracted from the core in localized regions. Rather than a constant flow of energy, the core appears to experience alternating periods of insulation beneath LLSVPs and sudden bursts of cooling where slabs arrive.

Over geological timescales, these alternating insulating and cooling phases also influence geomagnetic superchrons.

NOAH EVENT WEAKNESS REACHED

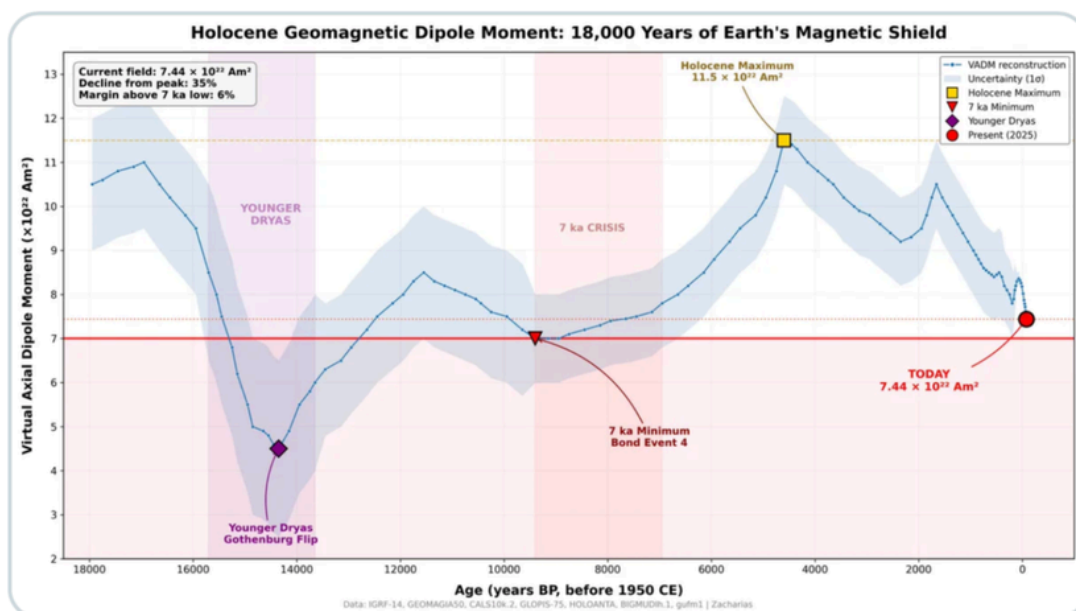
BY: BAILEY LAURISSA

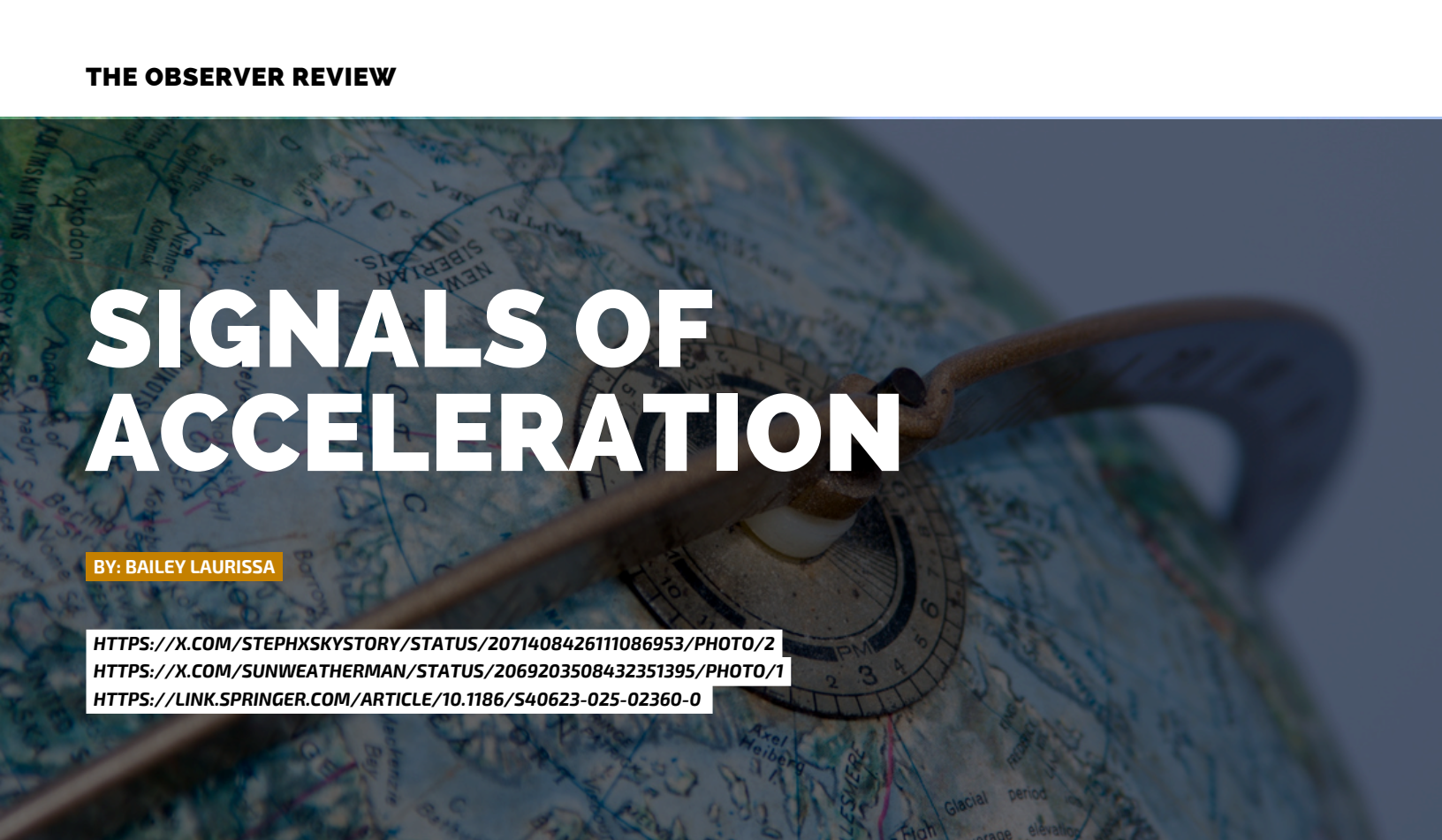
ARTICLE REFERENCED:

NEGATIVE CORE-MANTLE BOUNDARY HEAT FLUX BENEATH LOW-SHEAR-WAVE-VELOCITY PROVINCES

A long-term reconstruction of Earth's geomagnetic dipole suggests the planet's magnetic field has now weakened to levels comparable to one of the lowest points of the Holocene. The reconstruction, which spans the past 18,000 years using multiple paleomagnetic datasets, places the modern virtual axial dipole moment at approximately $7.44 \times 10^{22} \text{ Am}^2$. That is roughly 35% below the Holocene maximum and only about 6% above the minimum reached around 7,000 years ago, often associated with the Bond 4 climate interval.

The reconstruction also highlights another period of exceptionally weak geomagnetic intensity during the Younger Dryas, approximately 14,000 years ago. That interval coincided with the Gothenburg geomagnetic excursion and a period of abrupt climate change.





SIGNALS OF ACCELERATION

BY: BAILEY LAURISSA

[HTTPS://X.COM/STEPHXSKYSTORY/STATUS/2071408426111086953/PHOTO/2](https://x.com/STEPHXSKYSTORY/STATUS/2071408426111086953/PHOTO/2)

[HTTPS://X.COM/SUNWEATHERMAN/STATUS/2069203508432351395/PHOTO/1](https://x.com/SUNWEATHERMAN/STATUS/2069203508432351395/PHOTO/1)

[HTTPS://LINK.SPRINGER.COM/ARTICLE/10.1186/s40623-025-02360-0](https://link.springer.com/article/10.1186/s40623-025-02360-0)

For much of the last 150 years, the North Magnetic Pole drifted at a relatively modest pace, averaging roughly 10 km per year. Then, beginning in the 1990s, that motion accelerated dramatically, briefly exceeding 50 km per year.

Geophysicist Stephanie Buchanan tested this idea by examining whether geomagnetic jerks, abrupt changes in Earth's magnetic field, clustered around proposed Chandler wobble transition periods in 2005, 2015, and 2020. If core-mantle coupling had experienced a major shift, an increase in jerk activity might have been expected during those intervals.

Instead, the analysis found no statistically significant clustering. Although a modest increase appeared during 2024–2026, the rate remained below the threshold the study considered meaningful. In other words, geomagnetic jerk timing alone does not currently provide independent evidence for a major change in core-mantle coupling.

AT THE SAME TIME, EARTH'S MAGNETIC FIELD IS UNQUESTIONABLY CONTINUING TO EVOLVE. THE NEWLY RELEASED FOURTEENTH GENERATION OF THE INTERNATIONAL GEOMAGNETIC REFERENCE FIELD (IGRF-14) PROVIDES UPDATED MODELS OF EARTH'S MAGNETIC FIELD THROUGH 2025 ALONG WITH PREDICTED SECULAR VARIATION THROUGH 2030. THE UPDATED REFERENCE REFLECTS THE ONGOING REDISTRIBUTION OF MAGNETIC FLUX WITHIN EARTH'S LIQUID OUTER CORE AND IDENTIFIES REGIONS WHERE THE MAGNETIC FIELD IS EXPECTED TO CONTINUE CHANGING MOST RAPIDLY OVER THE NEXT SEVERAL YEARS.

THANK YOU!

**WE HOPE YOU ENJOYED OUR JULY ISSUE!
WE APPRECIATE YOUR QUEST AND LOVE FOR KNOWLEDGE
ABOUT SPACE AND OUR GREATER COSMOS.**

HAVE A TOPIC/DISCUSSION YOU WANT FEATURED?
Email observerreview@observerranch.com with a topic
that you'd love to see an article written on!

