
OBSERVER
REVIEW
APRIL 2025

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When we talk about Earth's climate, few natural patterns hold as much sway as the El Niño-Southern Oscillation, or ENSO.

SOLAR FORCING MONSOON

For over a billion people across South and Southeast Asia, the summer monsoon is a lifeline, delivering water for agriculture, drinking, and daily life. But what causes the monsoon's strength to vary over the centuries?

FEATURED ARTICLES

ARTICLE REFERENCED:
HTTPS://AGUPUBS.ONLINELIBRARY.WILEY.COM/DOI/10.1029/2024GL114532
HTTPS://WWW.NATURE.COM/ARTICLES/S43247-025-02170-Y
HTTPS://EARTHARXIV.ORG/REPOSITORY/VIEW/8810/
HTTPS://ARXIV.ORG/PDF/2503.22111

OCEAN COLLAPSE UPDATE

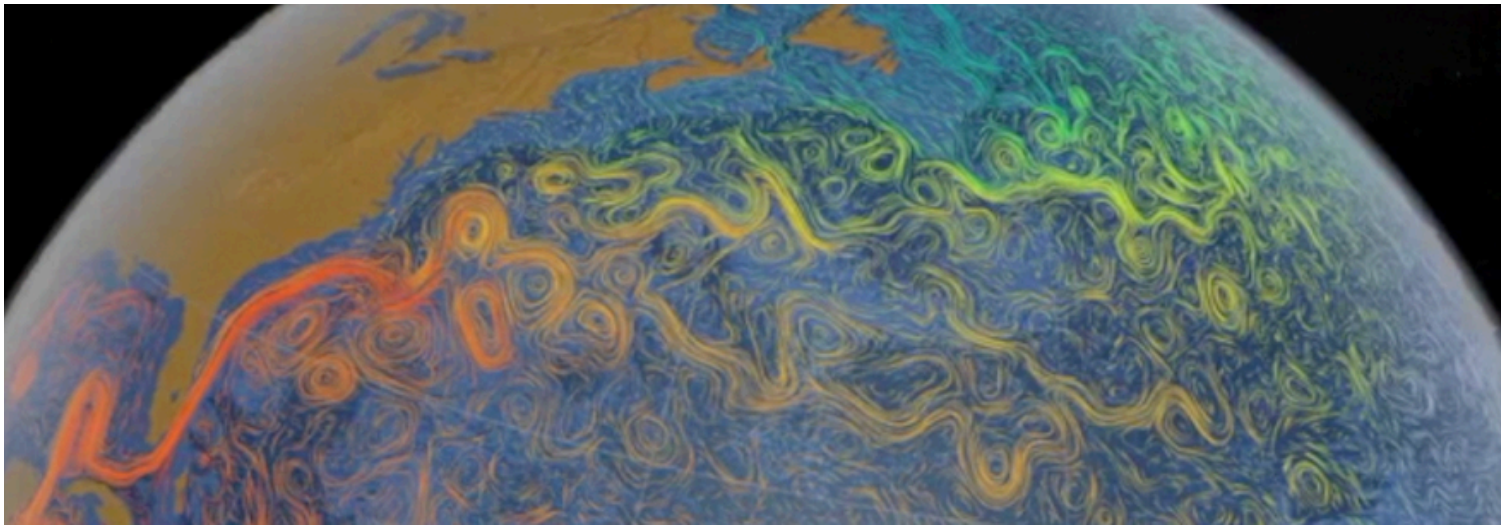
BY: BEN DAVIDSON

FOUR RECENT STUDIES OFFER INSIGHT INTO THE ONGOING COLLAPSE OF THE OCEAN HEAT TRANSPORT AND CIRCULATION.

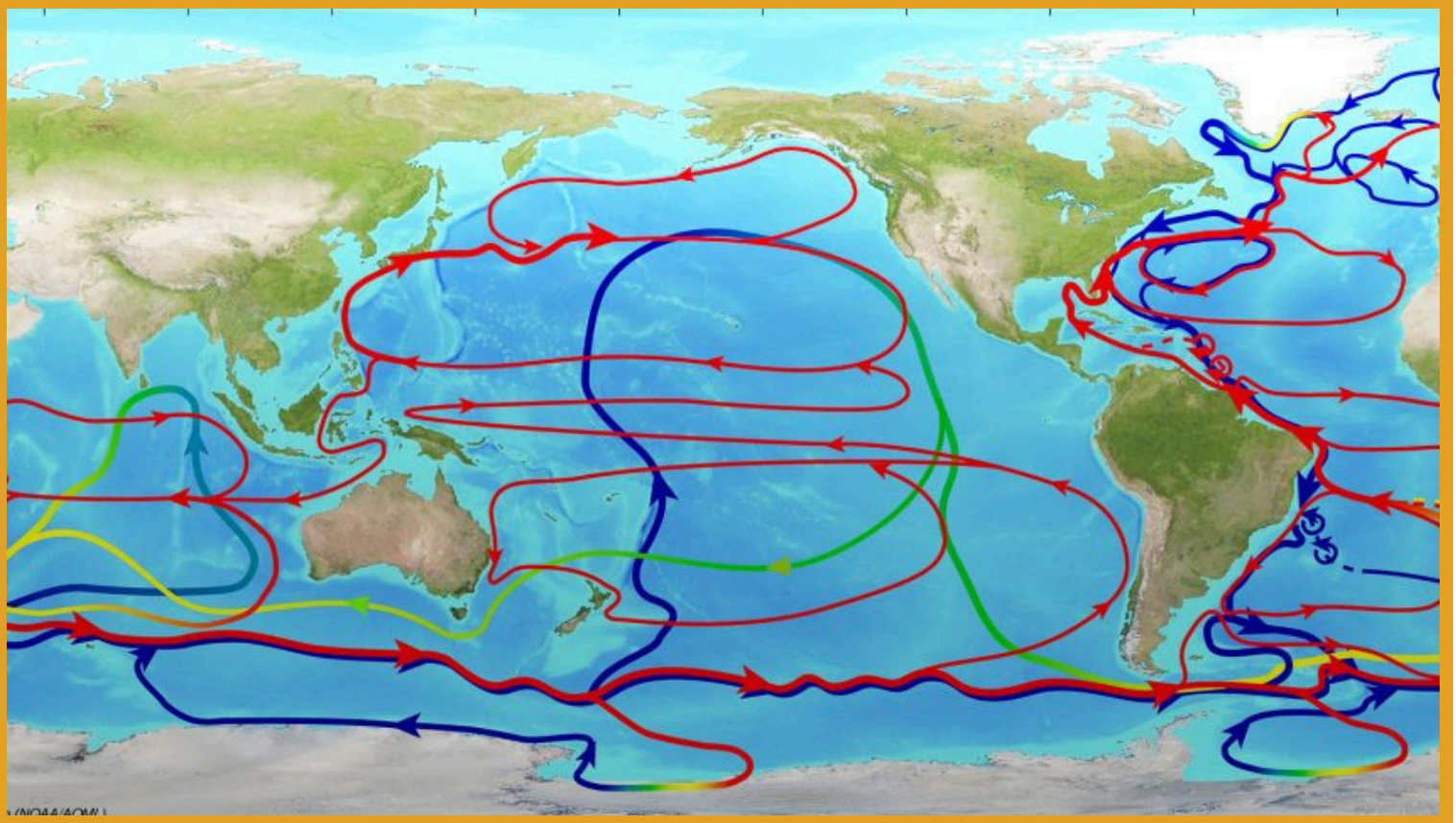
The first investigates the potential collapse of the Atlantic Meridional Overturning Circulation (AMOC) using a high-resolution ocean-only model that explicitly resolves ocean eddies. It identified the AMOC-induced freshwater transport at 34°S as a reliable early warning indicator for such a collapse.

The second study analyzes long-term hydrographic data from the Subtropical North Atlantic at 26.5°N, revealing significant cooling and freshening of deep waters (>2000 m) over the past four decades. The researchers link these changes to similar trends observed in the Subpolar North Atlantic two decades prior, suggesting a propagation of anomalies southward via the AMOC, getting closer to the tipping point.

The third, a theoretical study, explores the dynamics behind the AMOC collapse observed in the Community Earth System Model (CESM). The authors argue that the collapse results from a saddle-node bifurcation—a mathematical concept where a system experiences a sudden shift to a new state when a critical threshold is crossed. By comparing CESM simulations with a conceptual model, they demonstrate that the AMOC's stability is governed by a few dominant feedback processes, emphasizing the importance of understanding these mechanisms for accurate climate predictions.



ATLANTIC MERIDIONAL OVERTURNING CIRCULATION (AMOC)



The fourth paper was narrowly focused but highly detailed, looking at the ice loss from the north polar region, and tying it to AMOC destabilization and a drop in temperatures of up to 7 degrees C. These studies, combined with previous works and the ongoing slow-down of the ocean circulation, paint a grim picture of our future.

THE ONLY PIECE OF GOOD NEWS IS THAT THE CRITICAL SIGNATURES OF THE COLLAPSE ARE STILL AT-LEAST A FEW YEARS AWAY FROM CAUSING THE MAJOR COOLING SHIFT. RIGHT NOW THE IMPACTS HAVE BEEN SEEN DOWN TO THE 26TH LATITUDE N, BUT IT WONT BE UNTIL THESE SPILL ACROSS THE EQUATOR THAT WE ARE IN IMMINENT RISK OF COLLAPSE.

Beyond this empirical datapoint, it is confirmed that the ocean balance is very delicate, and can easily be thrown out of whack, especially by polar heat, ice melt, and spillage into the larger ocean system, which messes with salinity and temperature differentials.

THE LEVEL OF ICE LOSS WE SEE NOW HAS ALREADY MATCHED PREVIOUS COLLAPSE-TRIGGERING EVENTS, AND SO THE LONG-DISCUSSED AMOC TROUBLE MAY BE A COUPLE YEARS AWAY, BUT ITS INEVITABILITY HAS RISEN TO NEAR-CERTAIN LEVELS.

SOLAR FORCING OF ENSO

BY: BAILEY

ARTICLE REFERENCED:
IS THE VARIABILITY OF ENSO DUE TO FREQUENCY MODULATION BY THE LONG TERM VARIATION IN SOLAR ACTIVITY?

When we talk about Earth's climate, few natural patterns hold as much sway as the El Niño-Southern Oscillation, or ENSO. This powerful ocean-atmosphere phenomenon can dramatically influence global temperatures, rainfall, droughts, and even wildfire activity across continents. But one of science's lingering mysteries is why ENSO is so unpredictable — why its strength and frequency seem to change from decade to decade. A new study published in the Journal of Atmospheric and Solar-Terrestrial Physics by Ian Edmonds and Peter Killen proposes an intriguing answer: the variability of ENSO might be frequency modulated by the Sun's long-term activity cycles — a concept borrowed from the world of radio engineering.

WHAT IS ENSO?

ENSO is a natural oscillation between warm (El Niño) and cool (La Niña) phases in the central Pacific Ocean that occurs every 2–7 years. It plays a leading role in shaping seasonal weather patterns around the world.

But when scientists look at the historical record of ENSO — based on both direct observations and proxies like tree rings and coral growth — the picture gets messier. ENSO doesn't hum along at a fixed pace like a metronome. Instead, its timing and intensity shift in a seemingly erratic way, sometimes dominated by 3-year cycles, other times by 11-year or even longer swings.

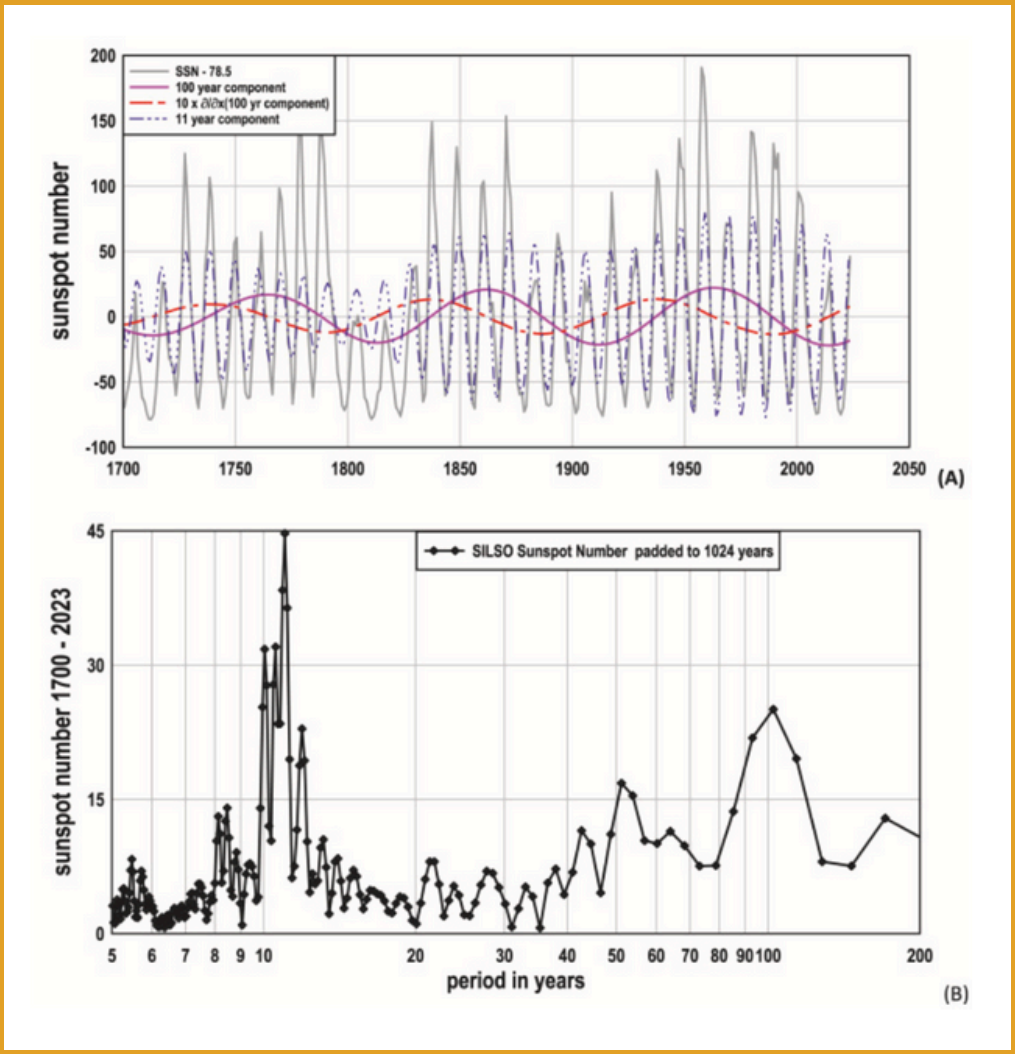
HERE'S WHERE THE CONCEPT FROM COMMUNICATION ENGINEERING COMES IN. IN RADIO BROADCASTING, FREQUENCY MODULATION (FM) IS USED TO ENCODE A SIGNAL BY VARYING THE FREQUENCY OF A WAVE. THIS IS HOW FM RADIO WORKS — IT ALLOWS A STABLE SIGNAL TO CARRY A COMPLEX MESSAGE ACROSS A WIDE RANGE.

WHAT DOES THE STUDY SUGGEST?

Edmonds and Killen suggest that something similar might be happening in the Earth system: the Sun's long-term activity — especially its roughly 100-year Gleissberg cycle — may be subtly "modulating" the frequency of ENSO.This wouldn't change the amplitude of ENSO events (i.e., how strong El Niños and La Niñas are), but rather the spacing between them — just like an FM signal varies the pitch over time.

Past attempts to directly link ENSO to solar amplitude (the amount of solar energy) haven't been very successful. But this study flips the question: What if the Sun isn't turning ENSO up or down, but instead adjusting the tempo at which it plays out?

By modeling ENSO as a kind of climate "oscillator" and applying a frequency modulation using the long-term solar cycle, Edmonds and Killen created a simulation that closely matches real ENSO data over the past 150+ years — especially the decadal components.



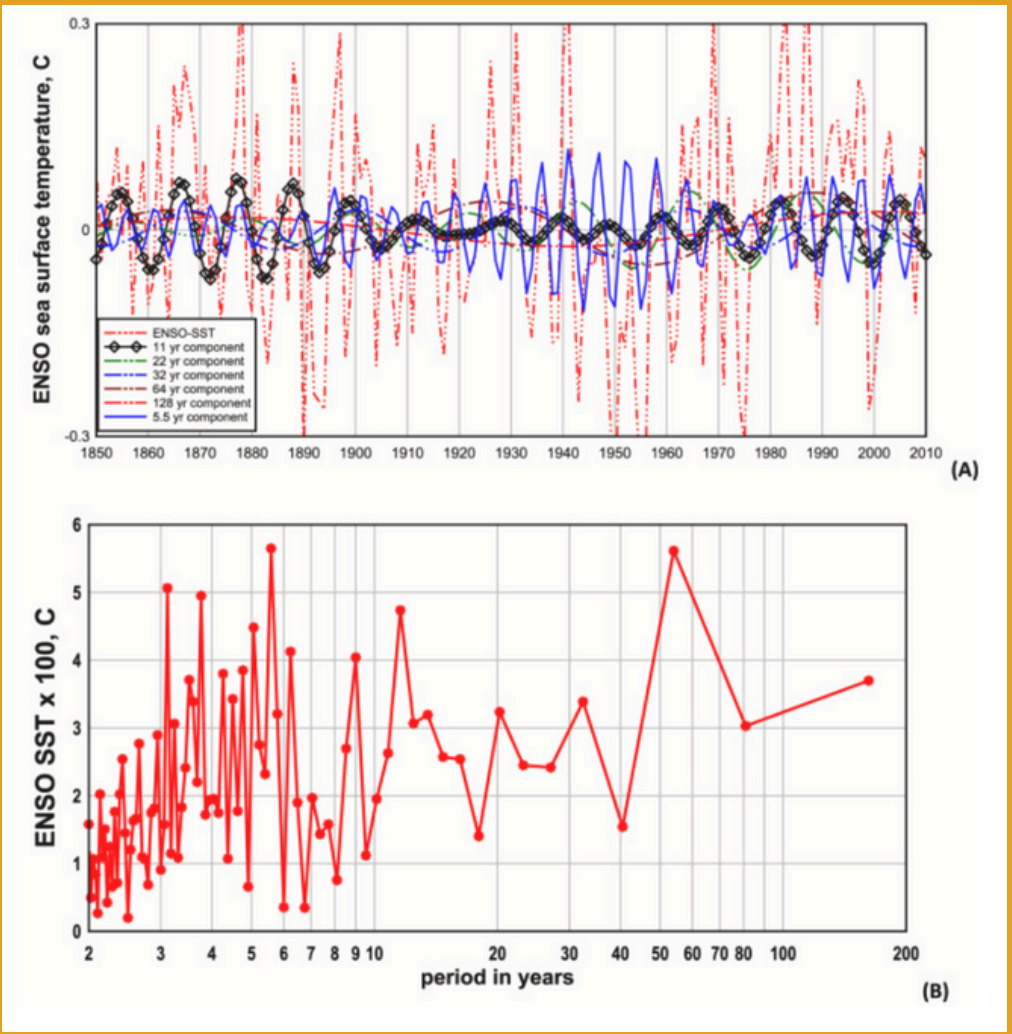
"The ENSO sea surface temperature record 1848 to 2010 and various components obtained by band pass filtering using the INF method. The periodogram of ENSO, obtained by Fourier analysis of the entire 1848–2010 record shows the presence of sub-decadal, decadal and multi-decadal components of roughly equal amplitude in an essentially flat spectrum indicative of either a random noise or frequency modulation characterization of ENSO."

The researchers compared their model not only to sea surface temperature data (a direct proxy for ENSO) but also to global temperature and rainfall records. The results?

- A high correlation between the decadal patterns in the model and ENSO data.
- A moderate match between the model and global temperature variations — which makes sense, since temperature is affected by many other factors too.
- Better fits during time periods (like 1700–present) when long-term solar cycles were more stable, as confirmed by wavelet analysis.

They also used innovative techniques — like applying a double Fourier transform — to extract hidden long-period cycles in climate records, uncovering not just the ~100-year Gleissberg cycle, but also potential ~170-year patterns linked to earlier centuries of solar behavior.

Importantly, it underscores a subtle but powerful idea: climate forcing — like that from the Sun — influences Earth's climate not just by adding heat, but by changing the timing of internal systems like ENSO.



"The average amplitudes of the various components shown are roughly equal and this is also indicated in the periodogram of ENSO, taken over the entire record. The 11 year period component of ENSO dominates in the early part of the record while the 5.5 year period component of ENSO is dominant in the middle of the record suggesting the likelihood of ENSO being frequency modulated.

SOLAR FORCING MONSOON

BY: BAILEY

ARTICLE REFERENCED: HTTPS://WWW.NATURE.COM/ARTICLES/S41612-025-00971-8 HTTPS://WWW.FRONTIERSIN.ORG/JOURNALS/MARINE-SCIENCE/ARTICLES/10.3389/FMARS.2025.1556480/FULL

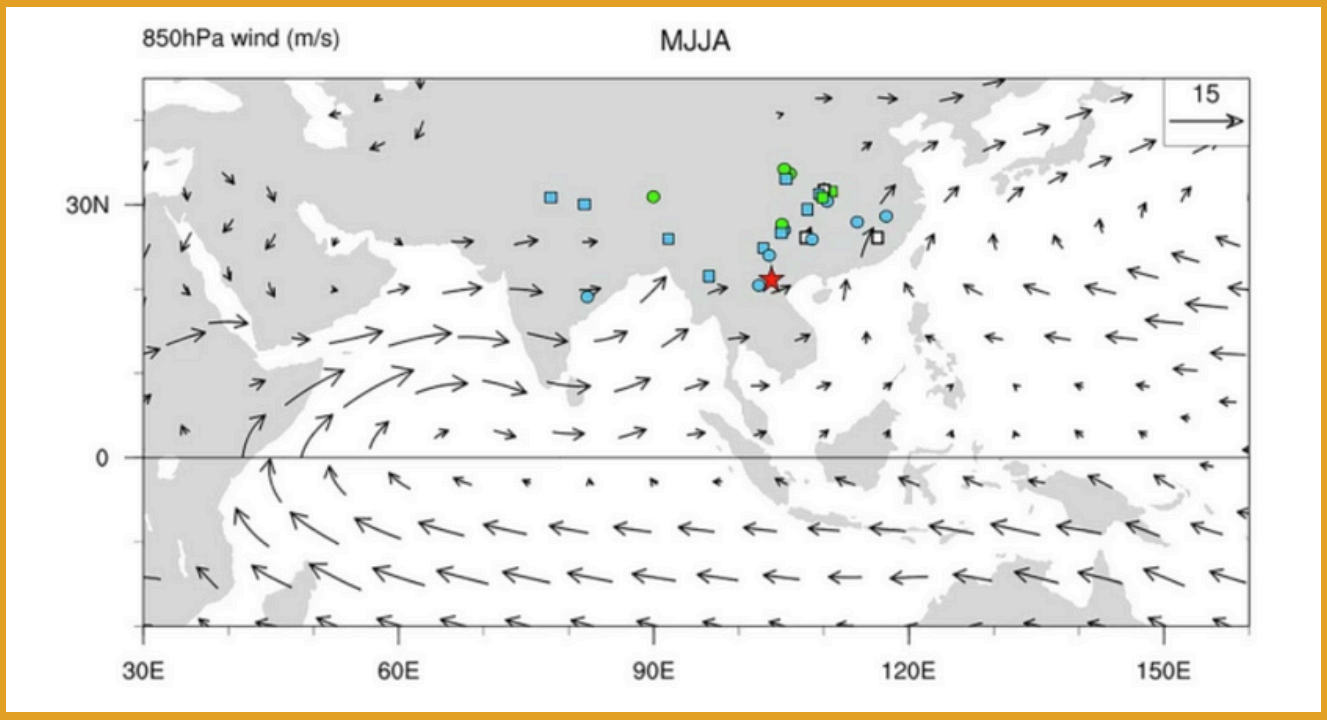
For over a billion people across South and Southeast Asia, the summer monsoon is a lifeline, delivering water for agriculture, drinking, and daily life. But what causes the monsoon's strength to vary over the centuries? While major climatic shifts—like those from Earth's orbit or ocean currents—are well-known influencers, new research shines a light on a subtler but fascinating force that we are familiar with: the Sun.

A team of scientists led by Hong-Wei Chiang and colleagues recently published findings in npj Climate and Atmospheric Science that uncover compelling evidence of the Sun's role in modulating the South Asian Monsoon during the last ice age. And the evidence comes from a rather unassuming source: stalagmites in a Vietnamese cave.

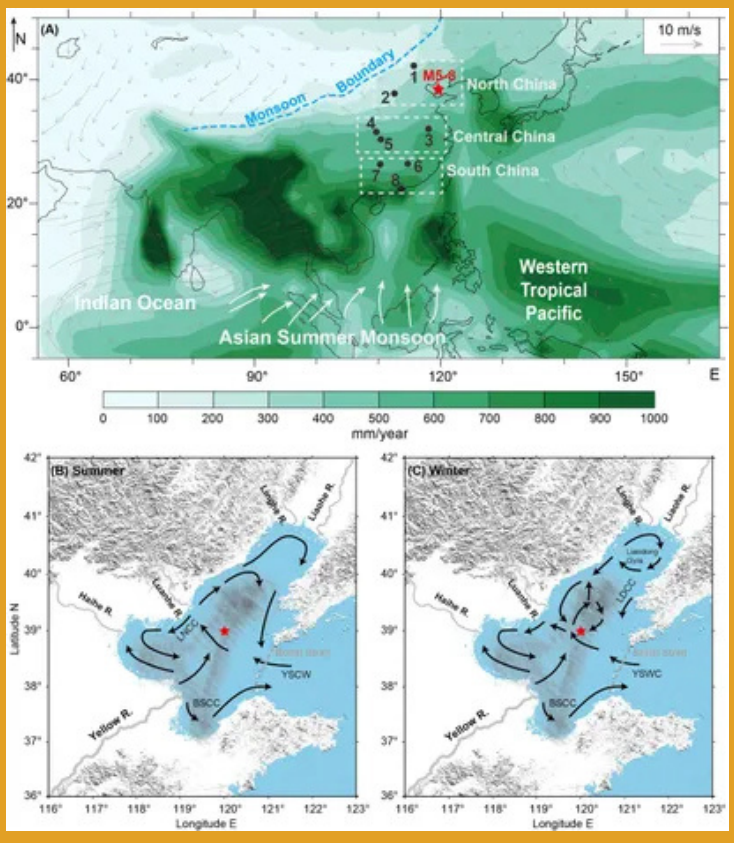
Caves are more than just dark and mysterious places—they can act as natural archives of ancient climate. When rainwater seeps into a cave, it carries minerals that build up over time into stalagmites. The oxygen isotopes (specifically δ18O) preserved in these formations provide a record of past rainfall: lower δ18O values typically mean wetter conditions, and higher values indicate drier times.

In this study, researchers analyzed two stalagmites from Thuong Thien Cave in northwestern Vietnam, dating from around 32,500 to 27,500 years ago—a time deep in the last glacial period. With high-resolution uranium-thorium dating, they were able to reconstruct monsoon strength down to scales of just a few decades.

MAP SHOWING COMPILED SPELEOTHEM RECORDS AND CLIMATOLOGICAL WIND FIELDS.



"TT cave is marked as the red star. Circles and rectangles indicate speleothem §180 records covering Holocene and last glacial periods, respectively. Color codes are the same as in Fig. 4. Arrows represent average early monsoon season (May-August) wind fields at the 850-hPa level from 1980 to 2020 based on the NCEP/NCAR reanalysis."



"The background shading represents the climatological summer (June-July-August) precipitation (unit: mm/year) from the GPCP data (Adler et al., 2003), while the black vectors depict the 850 hPa wind pattern (unit: m/s) from the NCEP Reanalysis II data over the Asia Summer Monsoon region (Kanamitsu et al., 2002). The data for both variables cover the period of 1979-2014 on a 2.5°×2.5° global grid. The monsoon boundary is modified from Zhou et al. (2016). The Ocean circulations in the Bohai Sea in summer (B, C) winter season (modified after Li et al., 2020). YSWC, Yellow Sea Warm Current; YSCW, Yellow Sea Cold Water; "

WHAT IS THE KEY FINDING?

These ancient rainfall records lined up with changes in solar activity. Specifically, when the Sun's energy output (measured as Total Solar Irradiance, or TSI) increased, monsoon rainfall also intensified. When solar activity dipped, the rains weakened.

The researchers even detected a ~180–200 year pattern in the stalagmite data—a cycle known as the de Vries cycle, a well-established rhythm in solar variability.

DURING PERIODS OF HIGHER SOLAR ACTIVITY, INCREASED SUNLIGHT WARMS THE LAND MORE THAN THE OCEANS, BOOSTING THE CONTRAST BETWEEN THEM. THIS ENHANCES MONSOON WINDS, DRAWING MOIST AIR INLAND AND FUELING HEAVIER RAINS. CLIMATE MODELS USED IN THE STUDY CONFIRMED THIS MECHANISM, SHOWING MORE RAINFALL OVER SOUTH AND EAST ASIA DURING SOLAR MAXIMA—ESPECIALLY AT THE START OF THE MONSOON SEASON.

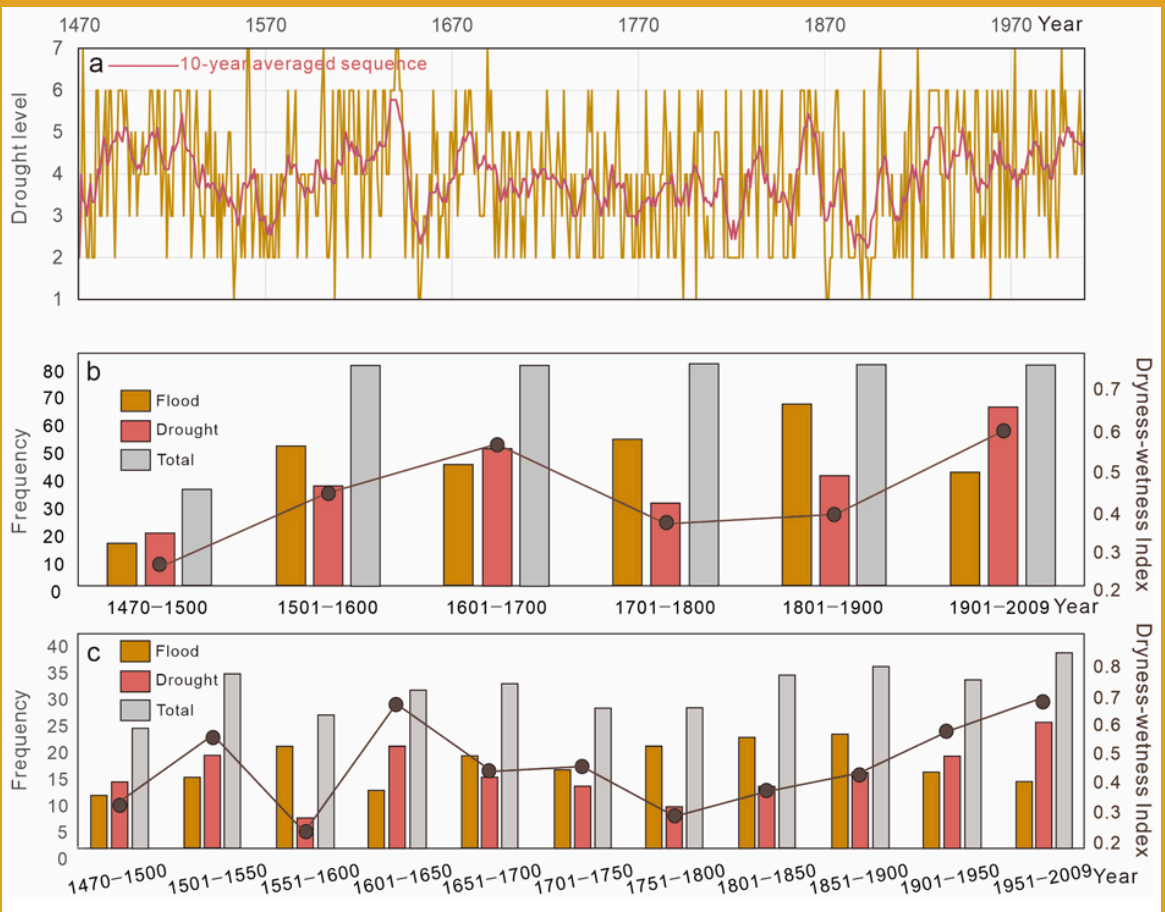
SOLAR FORCING OF DROUGHT AND FLOOD

BY: BAILEY

ARTICLE REFERENCED:
HTTPS://WWW.MDPI.COM/2073-4441/17/6/865
HTTPS://KIRJ.EE/WP-CONTENT/PLUGINS/KIRJ/PUB/EARTH-2-2025-83-95_20250308133907.PDF
HTTPS://PUBS.GEOSCIENCEWORLD.ORG/GSA/GSABULLETIN/ARTICLE-ABSTRACT/DOI/10.1130/B37981.1/652593/FINGERPRINTS-OF-EL-NINO-SOUTHERN-OSCILLATION-AND

At the heart of these oscillations lies a global climate engine modulated by two powerful drivers: solar activity and the El Niño–Southern Oscillation (ENSO). Recent studies, from tree rings in Finland to historical flood records in northern China and ancient lake sediments in East Asia, provide compelling evidence that solar forcing and ENSO cycles are deeply intertwined with long-term patterns of drought and flood.

In this article, we synthesize three pivotal studies: A 500-year reconstruction of drought and flood variability in the northern Haihe River Basin in China; A late-Holocene temperature reconstruction from southern Finland based on tree-ring density and phenology; A middle Eocene sediment record from the Bohai Bay Basin identifying ENSO and solar cycles in annual varves.



"Time sequences of drought–flood occurrences in the northern Haihe River 1470–2009, with 10-year average sequences derived from our study dataset ((a), modified from [23]), in relation to reconstructed frequency and dryness–wetness index occurrences every century (b) and half a century (c)."

Together, these datasets reveal a multi-layered story: solar activity modulates ENSO, ENSO regulates monsoons, and monsoons dictate the rainfall distribution across vast regions—including those most prone to floods and droughts.

The ENSO phenomenon, driven by sea surface temperature anomalies in the equatorial Pacific, is widely recognized as the strongest interannual climate signal influencing the global hydrological cycle. It affects monsoons, jet streams, atmospheric circulation, and precipitation on nearly every continent.

A detailed 540-year study of the northern Haihe River Basin (1470–2009) reveals an 81% correlation between ENSO phases and hydroclimatic extremes. Drought years strongly aligned with El Niño events, while La Niña phases were associated with floods. This spatial and temporal pattern underscores ENSO's dominant role in modulating East Asian summer monsoon strength—a climate lever for much of China's flood/drought variability.

Additionally, wavelet analysis of the Haihe drought–flood record revealed periodicities of 4–6, 12, and 50 years, matching ENSO's known timescales and solar cycles. The shifting dominance of ENSO modes across centuries suggests an external pacing mechanism—solar variability.

Solar variability is imprinted on Earth's climate through cycles like the Schwabe (~11-year), de Vries (~200-year), and Gleissberg (~80–100-year). These cycles influence Earth's atmosphere and ocean systems via total solar irradiance (TSI), ultraviolet radiation, and modulation of cosmic rays.

IN THE HAIHE STUDY, DROUGHT AND FLOOD PEAKS CLOSELY FOLLOWED SUNSPOT CYCLE EXTREMES. PEAKS IN SOLAR ACTIVITY WERE OFTEN FOLLOWED 2–3 YEARS LATER BY HYDROCLIMATIC EXTREMES—SUGGESTING A LAGGED BUT ROBUST CONNECTION.

Remarkably, even during the middle Eocene (~40 million years ago)—a period of extreme warmth and no polar ice caps—sedimentary records in the Bohai Bay Basin reveal solar and ENSO cycles embedded in varved lacustrine sediments.

VARVE THICKNESS, ISOTOPE DATA, AND GRAYSCALE FLUCTUATIONS SHOW:

200–240 AND ~350-YEAR CYCLES LINKED TO SOLAR OUTPUT;

2.1–8.7-YEAR CYCLES CONSISTENT WITH ENSO VARIABILITY.

This finding is profound. It suggests that even in radically different climate regimes, the Sun–ENSO–monsoon connection persisted, with solar forcing driving interannual and multi-century variability.

ENSO doesn't operate in isolation—its effects on rainfall depend heavily on how it interacts with regional monsoons.The East Asian summer monsoon (EASM), in particular, acts as the atmospheric conveyor belt that delivers or withholds rainfall across China and other regions. ENSO can weaken or strengthen monsoonal flows, often depending on whether the anomalous Pacific heating shifts the subtropical jet, suppresses convection, or alters moisture transport.

IN THE HAIHE RIVER BASIN, MONSOON ANOMALIES WERE DIRECTLY LINKED TO ENSO PHASES:

EL NIÑO → WEAKENED MONSOON → SUPPRESSED RAINFALL → DROUGHT

LA NIÑA → INTENSIFIED MONSOON → EXCESSIVE RAINFALL → FLOODING

Moreover, the study identified a 40-year monsoon cycle consistent with solar activity periodicity, aligning with results from latewood density and phenology reconstructions in Finland, which also detected de Vries (~200-year) and Gleissberg (~80–100-year) cycles.

While ENSO and monsoons dominate climate variability in the tropics and subtropics, solar forcing plays a significant role in shaping climate in the mid- and high latitudes as well. A study conducted in southern Finland reconstructed summer temperatures over the past 1,200 years using a multi-proxy approach that combined maximum latewood density (MXD) from Scots pine tree rings and phenological data from plant observations dating back to 1750. The reconstruction revealed a warming of approximately 2.1 to 2.8 °C since the Little Ice Age, with a clear cooling trend during the Medieval Warm Period. These temperature shifts closely align with periods of known solar minima: the Maunder Minimum (1645–1715) corresponds to the coldest 30-year span, and a two-stage Little Ice Age—also mirrored in Chinese climatic records—coincides with prolonged episodes of solar quiescence. This correlation highlights that solar variability not only influences precipitation regimes but also affects thermal growing conditions, with direct implications for agriculture and ecosystem resilience.

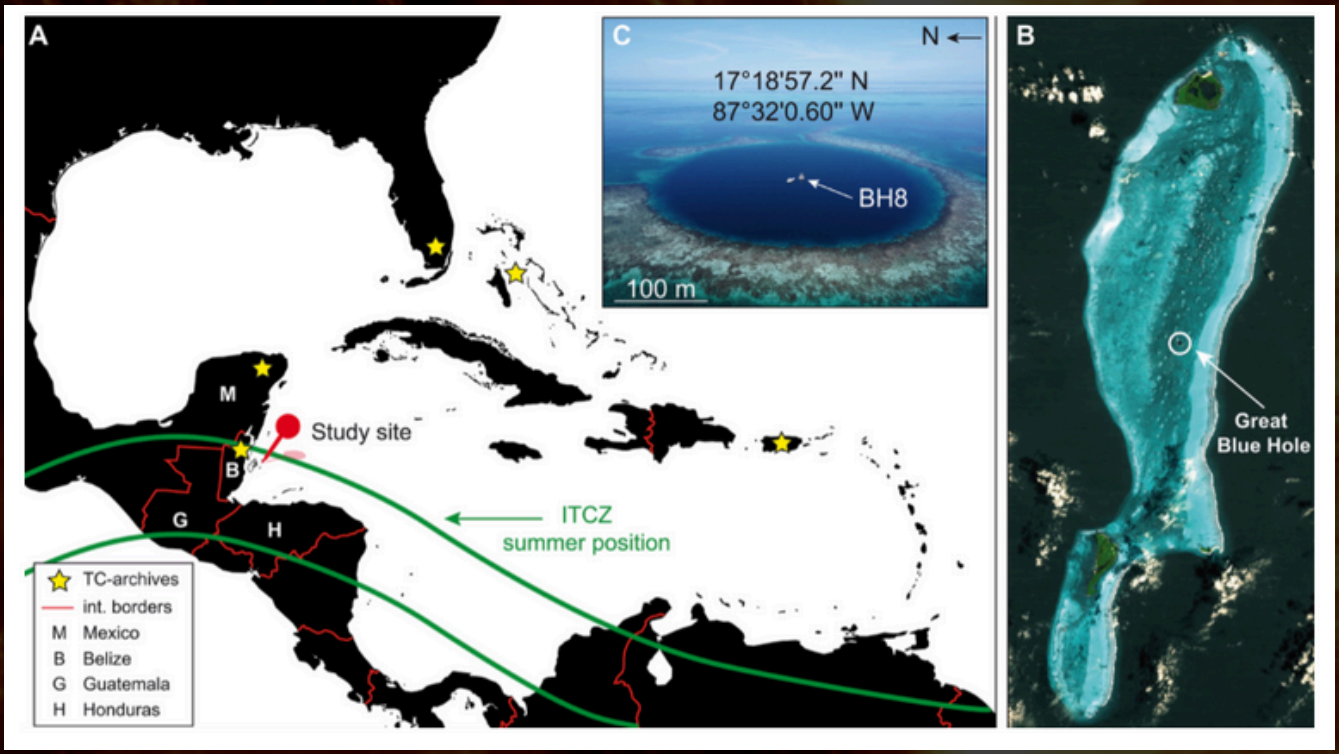
Across the Northern Hemisphere, multiple independent reconstructions—from subfossil pines in Fennoscandia to flood chronologies in China—show synchronous climatic oscillations paced by solar variability. Whether through warming in boreal regions or drying in East Asia, solar activity is a global synchronizer of hydroclimate behavior.

Moreover, the recurrence of ENSO-like signals in the middle Eocene, far before human influence or the current continental configuration, suggests that ENSO may be a permanent feature of Earth's ocean–atmosphere system, modulated by orbital and solar cycles rather than being a product of the modern world alone. These studies—spanning 40 million years and 9,000 kilometers—unite under one common thread: solar activity is a dominant modulator of Earth's hydroclimate. Through its influence on ENSO and monsoons, it drives the cycles of drought and flood that define regional climates and water availability.

SOLAR FORCING OF CYCLONE FREQUENCY

BY; BEN DAVIDSON

ARTICLE REFERENCED:
SOLAR FORCING OF CYCLONE FREQUENCY



A new study presents compelling evidence that solar variability has played a significant role in influencing tropical cyclone activity in the Caribbean over the past several millennia. By analyzing a high-resolution sediment record from the Caribbean, the researchers reconstructed a 5700-year history of storm events, revealing patterns that correlate strongly with known periods of solar activity fluctuations. Notably, the study identifies periods of increased storm frequency aligning with grand solar minima, such as the Maunder Minimum, suggesting that reduced solar output may be linked to heightened cyclone activity. This correlation implies that solar forcing mechanisms, perhaps through modulation of atmospheric circulation patterns or sea surface temperatures, have had a more pronounced impact on regional climate and weather extremes than traditionally acknowledged. These findings challenge the prevailing emphasis on anthropogenic factors as the primary drivers of recent climate variability and extreme weather events. The historical perspective offered by this research underscores the importance of natural solar variability in shaping long-term climate patterns. Basically, it's cooler temperatures that cause more destructive cyclones, not heat. Recognizing the substantial influence of solar forcing on climate systems invites a more nuanced approach to climate science, one that includes more factors, even if they are harder to model and integrate, in the name of “better science”.

PRE-EARTHQUAKE PROCESSES

BY: BAILEY

ARTICLE REFERENCED:
HTTPS://WWW.SCIENCEDIRECT.COM/SCIENCE/ARTICLE/PII/S0273117725002005
HTTPS://ESSOPENARCHIVE.ORG/DOI/FULL/10.22541/ESSOAR.174139353.37607599

A groundbreaking study analyzing data from ESA's Swarm satellite constellation between 2014 and 2024 has uncovered a strong global correlation between electromagnetic anomalies in Earth's upper atmosphere and the occurrence of M4+ earthquakes. The findings, rooted in data science, geophysics, and space weather research, suggest that the planet is be whispering warnings—as we have known.

That's the premise behind a growing field of study exploring the Lithosphere-Atmosphere-Ionosphere Coupling (LAIC)—a chain of interactions where stress deep in the Earth creates electric and magnetic changes that ripple through the atmosphere and into the ionosphere. It's in this outer atmospheric shell that satellites, like ESA's Swarm trio, can detect subtle variations invisible to us on the ground.

TWO KEY METRICS STAND OUT IN THIS NEW RESEARCH:

MFV-Y (MAGNETIC FIELD VECTOR IN THE Y-AXIS)

TEC (TOTAL ELECTRON CONTENT IN THE IONOSPHERE)

Positive anomalies in both have now been repeatedly observed 1 to 7 days before large earthquakes.

In this study, scientists analyzed over 200,000 earthquakes from 2014 to 2024—essentially the entire Swarm mission period—cross-referencing seismic events with satellite-recorded fluctuations in MFV-Y and TEC. The comparison was no small feat. To separate real earthquake precursors from background "noise" caused by solar storms or atmospheric interference, researchers filtered out periods of high solar activity and compared Swarm readings against physical models like the International Geomagnetic Reference Field (IGRF) and International Reference Ionosphere (IRI2020).

What emerged was a consistent pattern: both magnetic and ionospheric anomalies appeared prior to many M4+ earthquakes.

USING ADVANCED STATISTICAL TOOLS LIKE CONFUSION MATRICES AND ROC CURVES, THE TEAM IDENTIFIED THE IDEAL ANOMALY THRESHOLDS:

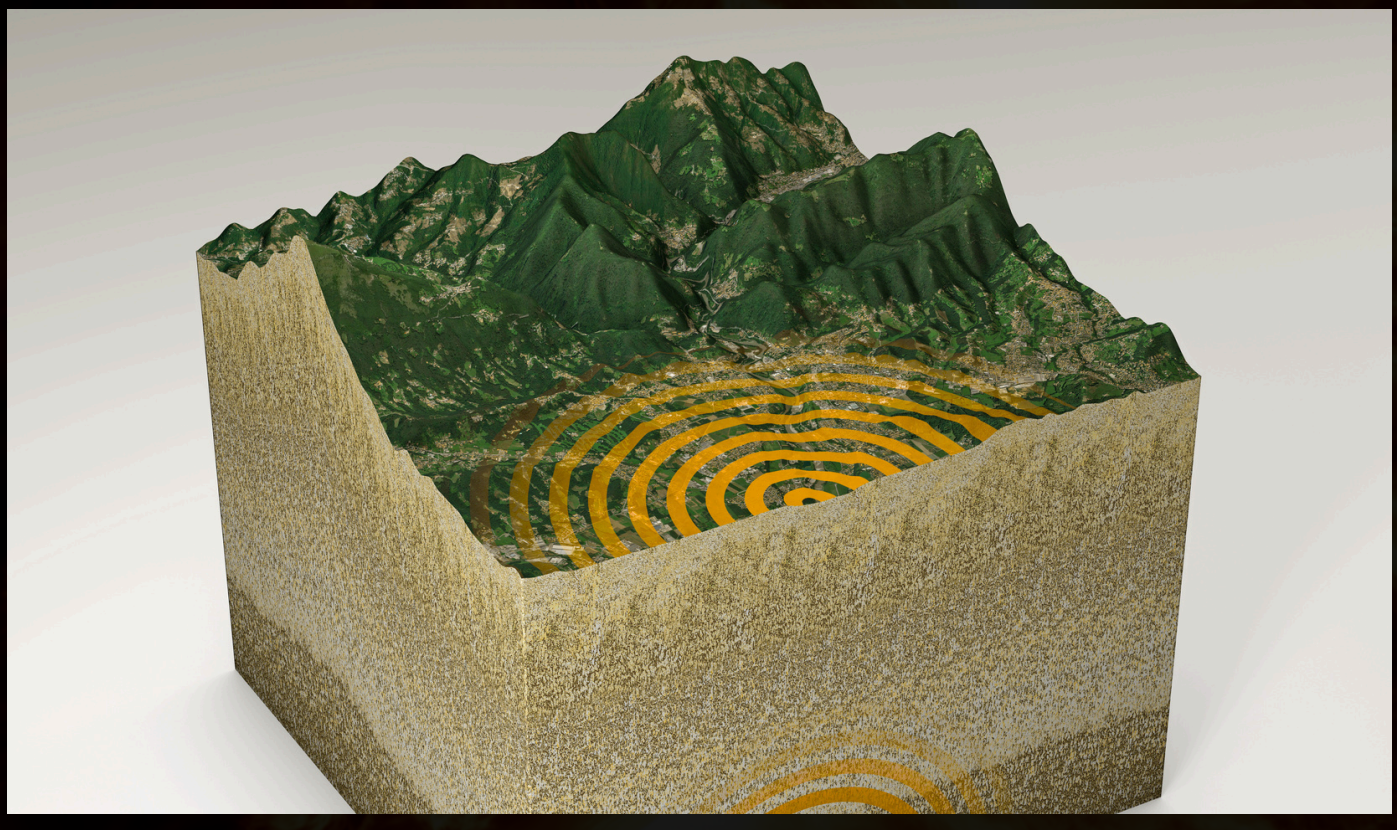
5 NT FOR MFV-Y

0.5 TECU FOR TEC

These thresholds showed the best balance between true detections and minimizing false alarms.

When rocks like granite are squeezed, they release electric charges—called "p-holes"—that migrate toward the surface. This charge movement can alter the atmospheric electric field (AEF) and eventually influence ionospheric electron content (TEC). In seismically active zones, this sequence—PSRC > AEF > TEC/IMF anomalies—could act as a detectable chain reaction before the mainshock.

A JAPANESE STUDY BETWEEN 2021 AND 2023 CONFIRMED THAT MAGNETIC FIELD CHANGES (IMF), AEF, AND TEC ANOMALIES OFTEN FOLLOWED A CLEAR TEMPORAL SEQUENCE IN THE DAYS BEFORE EARTHQUAKES. THESE FINDINGS SUPPORT THE IDEA THAT WHAT BEGINS UNDERGROUND DOESN'T STAY THERE—IT ECHOES UPWARD THROUGH EARTH'S ATMOSPHERIC LAYERS.



COSMIC RAY LIGHTNING

ARTICLE REFERENCED:
3D RADIO FREQUENCY MAPPING AND POLARIZATION OBSERVATIONS SHOW LIGHTNING FLASHES WERE IGNITED BY COSMIC-RAY SHOWERS

BY: BEN DAVIDSON

A new study did something very simple, in description, but it took a wild amount of detailed data analysis with very sophisticated equipment. There have been dozens of studies on either the statistical correlation between cosmic rays and lightning, or the theorized mechanistic action by which the lightning is triggered by these cosmic rays. Now, we have witnessed it in real time.

In this new studying, they were able to trace the secondary particle breakout cascade from the penetrating cosmic rays, which created extra atmospheric ionization, and a conductive pathway for current to flow. This pathway is what lit-up as the flash of lightning occurred, proving the impact of the cosmic ray electromagnetic impact.

This is the same ionization that helps the clouds form in the first place, and which aggregates raindrops to grow to falling size.

THIS PARTICLE CONNECTION IS COMPLETELY ABSENT FROM CLIMATE MODELS, AND THE IMPACT OF THESE COSMIC RAYS ON CLOUDS, PRECIPITATION AND LIGHTNING, AS EVERY BIT AS IMPORTANT AS SOLAR PROTONS ARE FOR THE OZONE, JET STREAMS, AND JOULE HEATING OF THE ATMOSPHERE.

GEOMAGNETIC HEALTH

BY: BAILEY

ARTICLE REFERENCED:
REACTIVATION OF LATENT HUMAN INTRACELLULAR INFECTIONS DURING A MONTHS-LONG EXPEDITION AT THE ANTARCTIC VOSTOK STATION

When we think of Antarctica, we imagine frozen tundras. A new study from Russia's Vostok Station reveals how the extreme isolation, environmental stress, and fluctuating geomagnetic conditions of Antarctica can suppress the immune system and reactivate latent viruses in the human body. The research, published in Scientific Reports, is the most comprehensive of its kind to investigate how these dormant pathogens behave during a nearly year-long polar expedition.

More than 90% of people worldwide carry at least one latent virus—microorganisms that live silently inside our cells, often for life, without causing symptoms. These viruses can remain dormant for years but can reactivate under stress or immune suppression.

Conditions at Vostok Station are brutal: it sits 3,488 meters above sea level on the East Antarctic Ice Sheet, with temperatures plunging below -80°C and atmospheric pressures around 460 mm Hg. Researchers there endure long periods without sunlight, extreme cold, physical isolation, sensory monotony, and limited social stimulation—much like astronauts on a deep space mission.

These stressors are known to impact the immune system. For the 11 male participants of the 64th Russian Antarctic Expedition, scientists monitored immune activity through saliva, plasma, and urine samples, looking for evidence of viral reactivation over the 11-month stay.

THE RESULTS

The results were striking: every single participant showed reactivation of EBV and/or HHV-6 at some point during the expedition. Two also reactivated HSV-1/2. These reactivations weren't always symptomatic, but they clearly showed that the body's control over these viruses weakened under the cumulative stress of polar living.

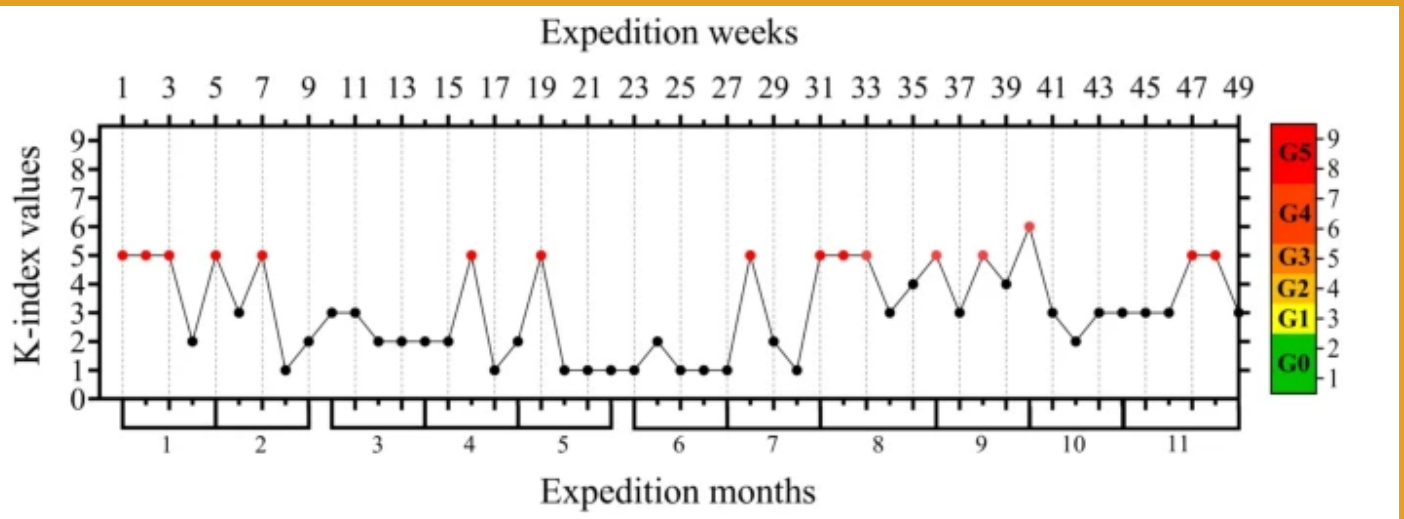
The study found that these viral reactivations were often synchronized with two key patterns: dips in the psychological well-being of the crew and spikes in geomagnetic activity. Using both subjective emotional surveys and environmental magnetic measurements (K-index), the researchers tracked when participants experienced heightened stress or fatigue.

Peaks in viral DNA levels were most commonly found in the 4th and 10th months of the expedition—periods that coincided with reported emotional fatigue and geomagnetic disturbances.

While a clear cause-and-effect relationship wasn't statistically confirmed, the correlations were suggestive. The researchers propose that stress and disturbed circadian rhythms may trigger hormonal and inflammatory changes that weaken immune surveillance, allowing these viruses to slip past cellular defenses.

Perhaps the most fascinating part of this study is its exploration of geomagnetic health—the idea that fluctuations in Earth's magnetic field can impact human physiology. While we don't yet fully understand how, previous research shows that geomagnetic storms can affect the cardiovascular system, brain function, sleep quality, and now, perhaps even immune response.

DURING THE 10TH AND 11TH MONTHS OF THE EXPEDITION—FOLLOWING A PERIOD OF HEIGHTENED GEOMAGNETIC ACTIVITY—RESEARCHERS OBSERVED A SURGE IN EBV, HHV-6, AND HSV SHEDDING. WHILE NOT DEFINITIVE, THIS TIMING SUPPORTS THE HYPOTHESIS THAT SPACE WEATHER SUBTLIES WEAKEN IMMUNE DEFENSES, ESPECIALLY IN PEOPLE ALREADY UNDER ENVIRONMENTAL STRESS.



"Geomagnetic activity variation during the expedition. G0 - quiet geomagnetic background. G1 - intensified geomagnetic activity. G2 - active geomagnetic activity. G3 - weak geomagnetic activity. G4 - medium geomagnetic activity. G5 - strong geomagnetic storm."

SOLAR FORCING OF EARTHQUAKES

BY: BAILEY

ARTICLE REFERENCED:
HTTPS://WWW.PREPRINTS.ORG/MANUSCRIPT/202503.2031
HTTPS://PUBS.AIP.ORG/AIP/CHA/ARTICLE-ABSTRACT/35/3/033107/3338203/THE-ROLE-OF-SOLAR-HEAT-IN-EARTHQUAKE-ACTIVITY?REDIRECTEDFROM=FULLTEXT
HTTPS://AGUPUBS.ONLINELIBRARY.WILEY.COM/DOI/FULL/10.1029/2024GL108590

From solar wind and geomagnetic storms to proton flux and even solar heat, new studies are presenting strong correlations between solar-terrestrial phenomena and seismic events, particularly large earthquakes (M6.5+). While causation remains elusive, the correlations are becoming too consistent to ignore.

This article examines three landmark studies—each using different methodologies and solar-related phenomena—to explore the possibility that the Sun may be triggering or modulating earthquakes here on Earth.

In one of the most statistically sophisticated analyses to date, researchers evaluated a 24-year dataset of 5-minute interval proton flux data (from SOHO) and its relationship to 1,136 earthquakes of M6.5 or greater. Using wavelet entropy, spectral slope, kurtosis, and multifractal analyses, they calculated a "trigger intensity"—essentially, how much a solar proton event may statistically precede or "advance" seismic events.

The study found that proton flux anomalies statistically preceded large earthquakes, with the most significant advance correlation identified in the multifractal singularity spectrum support width ($\Delta\alpha$). Notably, a consistent 89-day periodicity in proton flux fluctuations was observed, which may be linked to Mercury's orbital period or a resonance with the SOHO satellite. The trigger effect was also quantified, revealing that up to 28% of large seismic events may be preceded by specific anomalies in the proton flux signal.

Rather than focus on high-energy particles or electromagnetic storms, this study examined a more subtle candidate: solar-derived heat and its potential to modulate earthquake likelihood through atmospheric and lithospheric feedback loops.

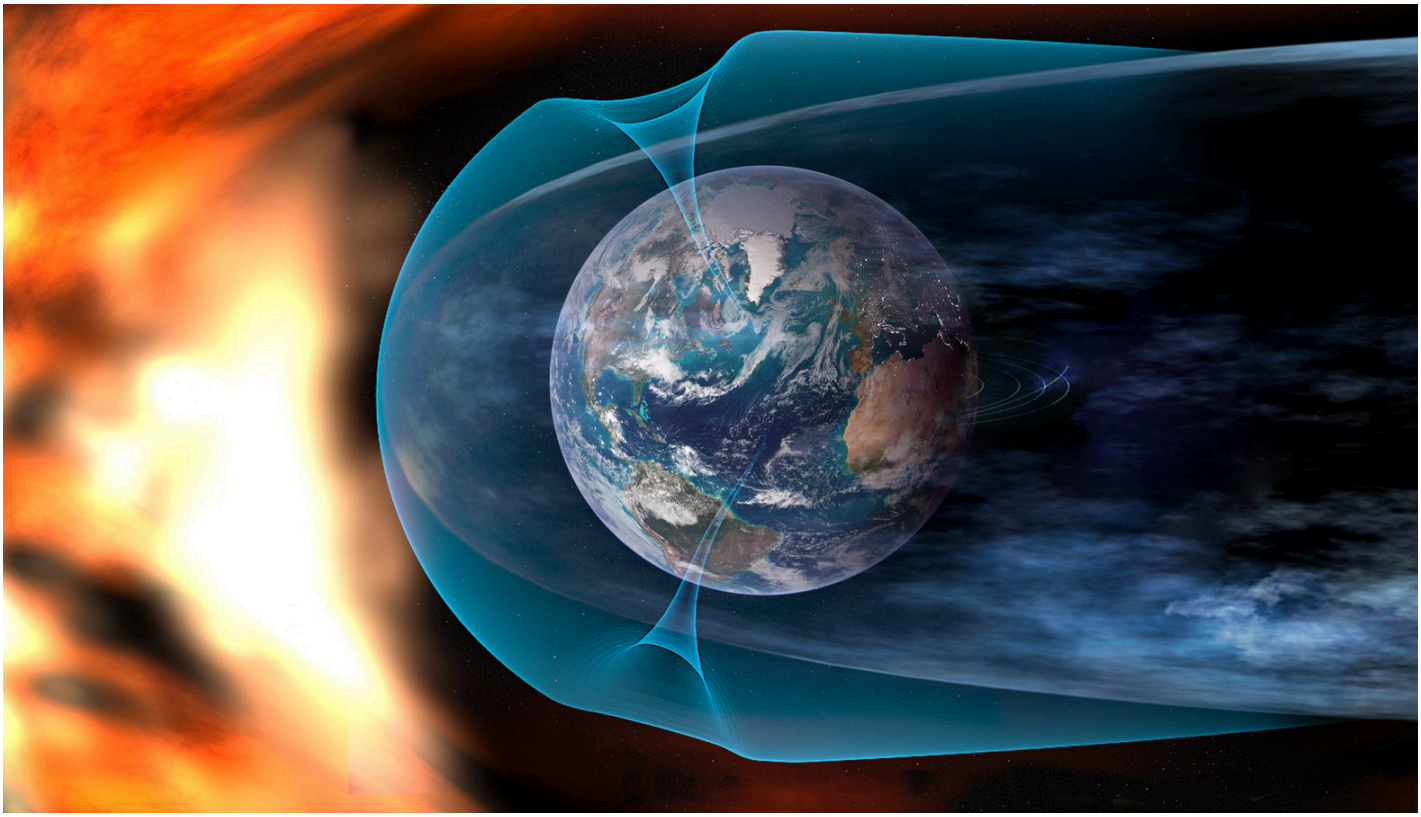
Seasonal variations in seismicity suggest a thermal component in earthquake triggering, with solar heating cycles possibly influencing crustal stress levels. Delayed sunspot correlations and improved predictive power when incorporating surface atmospheric temperaturesuggest nonlinear, thermally modulated geophysical behavior.

Solar and seismic data both exhibit high non-determinism and shared dynamical structures, which may point to an underlying energetic coupling.

In the last study, using nearly a century of data, this study introduced a new method—Shift Neighborhood Matching Correlation (SNMC)—to evaluate whether geomagnetic storms lead to an increased rate of large earthquakes. A significant increase in earthquake activity has been observed 27 to 28 days following intense geomagnetic storms, particularly those marked by a disturbance storm time (Dst) index of ≤ −100 nT or a planetary K-index (Kp) of ≥ 7. Statistical analyses, including chi-square tests and binomial probability models, confirm this temporal delay as highly significant ($p < 0.001$). One proposed mechanism involves electrokinetic stress generated by geomagnetically induced electric fields, which can reach approximately 0.01 MPa—sufficient to trigger fault movement. Conversely, the inverse piezoelectric effect has been dismissed as a likely cause due to its inability to produce the necessary strain energy.

Despite their distinct approaches, these three studies converge on a central theme: Solar-terrestrial interactions—whether electromagnetic, thermal, or particulate—appear capable of influencing seismic processes on Earth.

PROTON FLUX AND PARTICLE STORMS DIRECTLY INFLUENCE TECTONIC FAULT STRESS THROUGH MECHANISMS SUCH AS ELECTROMAGNETIC INDUCTION AND THE GENERATION OF IONOSPHERIC CURRENTS. SEASONAL VARIATIONS IN SOLAR HEATING CAN MODULATE THE READINESS OF FAULT SYSTEMS, SUBTLY ALTERING STRESS DISTRIBUTIONS OVER TIME. MEANWHILE, GEOMAGNETIC STORMS MAY INTENSIFY ELECTROKINETIC PRESSURES WITHIN THE EARTH'S CRUST, POTENTIALLY PUSHING ALREADY UNSTABLE FAULT ZONES BEYOND THEIR TIPPING POINT AND TRIGGERING SEISMIC EVENTS.



NEPTUNIAN AURORA

ARTICLE REFERENCED:
NASA'S WEBB CAPTURES NEPTUNE'S AURORAS FOR FIRST TIME

BY: BEN DAVIDSON

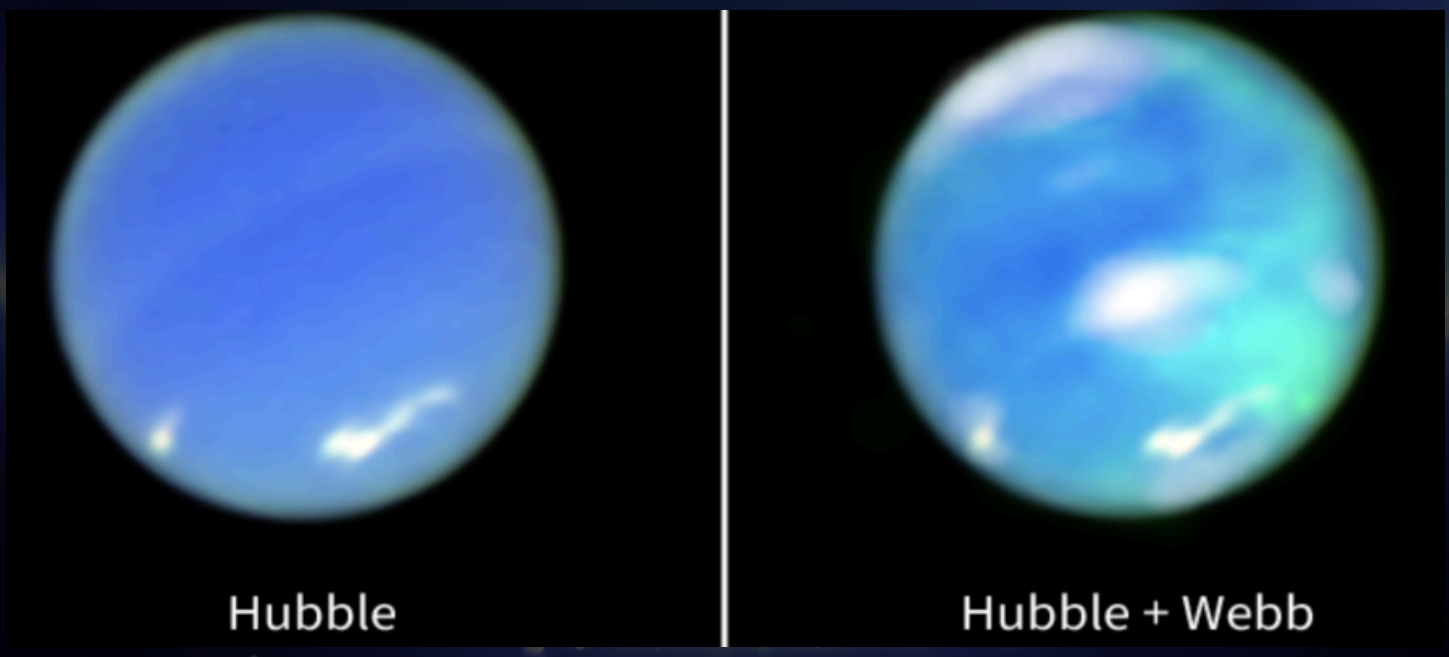
James Webb Space Telescope - the gift that keeps on giving. While there are some who tout its ability to one day discover the nature of dark matter, and others who think its a conspiracy project on an airplane somewhere, the truth, as usual, is found somewhere in the middle.

So far its done more to debunk dark matter cosmologies than it has helped them, and in terms of the planets of our solar system, its now delivering diamonds. This one, which shows neptunian aurora for the first time, does a bit more than show the UV shine of that solar impact. Look at it... does it appear confined to the poles or is it connecting the polar regions across the Neptunian equator?

It's the 2nd one. That's not supposed to happen until a planet's magnetic field is officially in reversal mode (something we don't expect here at Earth until the 2040s). When Neptune had its major storm pattern reversal, combined with the major temperature drop (2021) we suggested it was having its collapse right now.

THIS IMAGE, FROM JUST AFTERWARDS, SEEMS TO INDICATE THAT YES, NEPTUNE HAS FALLEN.

PLUTO HAD ITS COLLAPSE AROUND 2019, AND SO WE ARE NOT LOOKING TO URANUS AND SATURN TO HAVE THEIR MAJOR FIELD SHIFTS.



GOTHENBURG WAS GLOBAL

BY: BEN DAVIDSON

ARTICLE REFERENCED:
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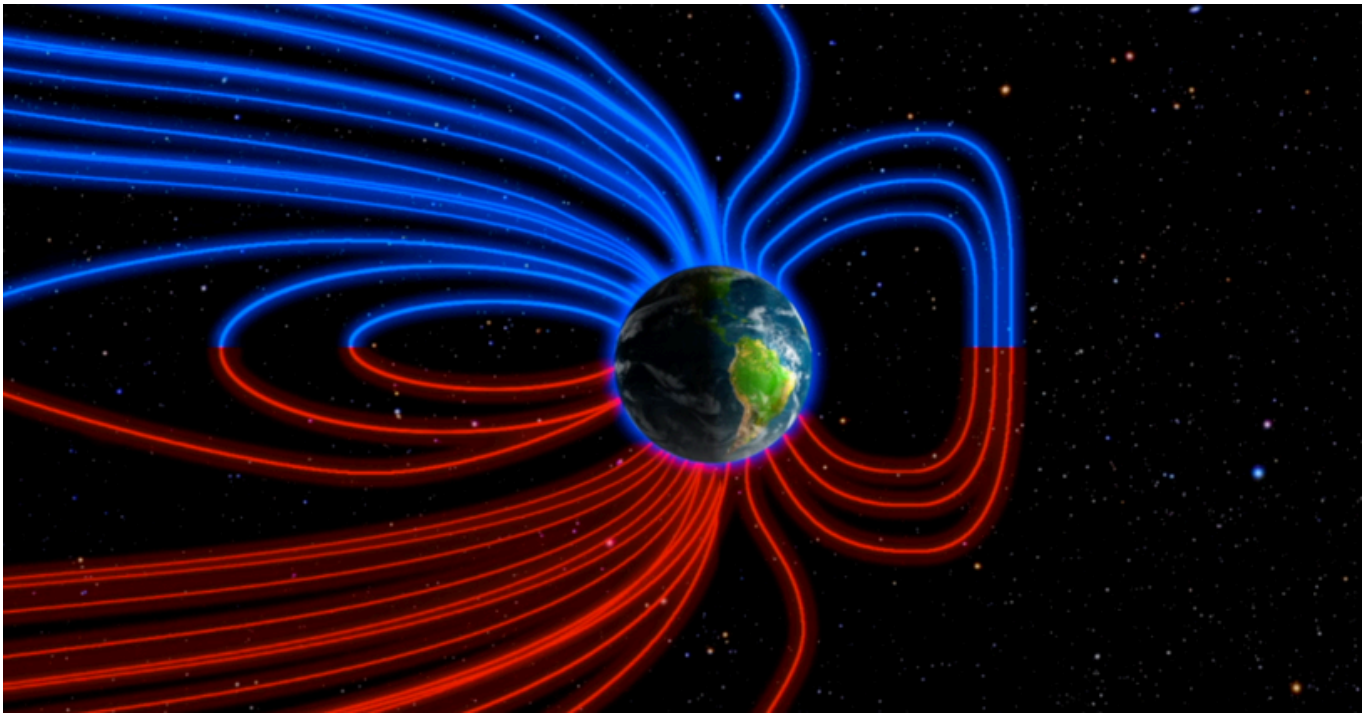
HTTPS://AGUPUBS.ONLINELIBRARY.WILEY.COM/DOI/FULL/10.1029/2024EA003992

Two new studies are taking the Gothenburg geomagnetic excursion and officially declaring it to be a global event. Most of the cyclic (6000 and 12,000 years) excursions of earth's field are not globally recognized, which is most-likely a function of lacking data, but now we can cross the last great event off the list. The Gothenburg excursion ~12,000 years ago was the last major cycle event (last half-cycle mini-event was 6000 years ago) and it's officially: global.

These new detections of the magnetic shift were found in Tahiti and China, which is now added to evidence in Europe and the Americas, to make the event 12,000 years ago officially recognized as a more global event.

FOR OBSERVERS, THIS IS NOT TERRIBLY SIGNIFICANT, WE'VE KNOWN THIS FOR YEARS AND HAVE BEEN DISCUSSING GOTHENBURG AS SUCH, BUT NOW THE MAINSTREAM SCIENTISTS WILL TOO, AND THAT MAY BE A TRIGGER FOR MANY TO BEGIN TO LOOK AT THESE CYCLIC EVENTS, AND COME TO SIMILAR CONCLUSIONS AS THE REST OF US.



SOLAR IMPACT TO ATMOSPHERIC ELECTRICITY

BY: BEN DAVIDSON

ARTICLE REFERENCED:
IMAGE SATELLITE AND GROUND-BASED MAGNETOMETER OBSERVATIONS OF LARGE GEOMAGNETIC DISTURBANCES AND RAPID VARIATIONS IN IONOSPHERIC AND VERTICAL CURRENTS

A new investigates how solar activity drives geomagnetic disturbances and subsequently impacts the global electric circuit (GEC), with a particular focus on vertical currents. The GEC is a continuous electrical system linking the ionosphere to the Earth's surface, sustained by vertical currents flowing downward in fair-weather regions, upwards in high pressure.

Solar storms increase ionospheric conductivity and alter the potential gradient between the ionosphere and the ground, leading to measurable fluctuations in the GEC's vertical currents. During intense geomagnetic events, these currents can intensify or weaken.

The impact of these solar-driven changes extends to atmospheric electricity, notably influencing the fair-weather electric field and thunderstorm dynamics.

By integrating data and theoretical analysis, the study concludes that solar activity acts as a significant external modulator of the GEC and atmospheric electricity, with vertical currents serving as a key conduit for these effects.

This is how the sun directly impact clouds, wind, storms, and temperatures, and its impact will continue to grow as the weakening magnetic field allows more energy into the earth system.

NEW NOVA SCIENCE, AGAIN

BY: BEN DAVIDSON

ARTICLE REFERENCED:
V1047 CEN: THE FIRST Z AND-TYPE OUTBURST OBSERVED IN THE CLASSICAL NOVA BINARY

It's possible that our 2018 claim that "they don't know nova" may end up the truest statement we've ever made. While declaring our solar micronova hypothesis to be "nonsense", they claimed such events were imaginary and did not exist at all, and that nova science was well understood. The problem is that they have discovered 4 new types of novae since then (including micronovae) and stars performing nova event they were not supposed to be able to do... so how much do they really know?

A new study takes that last concept a bit further. The 2019 outburst of the classical nova V1047 Cen has challenged conventional astrophysical classifications by exhibiting characteristics typical of Z And-type outbursts, which were previously observed only in symbiotic binaries.This similarity suggests that, contrary to prior understanding, such outbursts can occur in classical novae, indicating a broader range of systems capable of exhibiting this behavior.

This finding not only expands the understanding of outburst phenomena in binary systems but also suggests a potential pathway for the evolution of such systems toward Type Ia supernovae, highlighting the dynamic and evolving nature of astrophysical knowledge. What this means for Observers is that they are still learning nova science, and the evidence we've put forth for the solar version would be very unwise to ignore.

A FELLOW OBSERVER HAS CREATED
THE SOLAR KILLSHOT NETWORK

The Solar Killshot Network is the only worldwide, member-led, collaborative organization on a mission to connect members locally so they can find or form micronova survival groups.

The Network is nurtured by Sol Survivors for Sol Survivors, so you'll get resources, training, and support from people who understand your unique survival goals, and in a format that makes it easy for you to stay focused and take action

SOLAR KILLSHOT

ACTION NETWORK

Learn the secrets of successful survival groups; ones you can trust to care for you and your family if—for whatever reason—you can't.

Discover the essential survival skills to focus on first, rather than waste time, money, and energy researching rabbit holes on your own. Coming Soon

Customize our community-built micronova action planner to fit your unique needs, budget, lifestyle, and location.

CLICK TO LEARN MORE

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Email observerreview@observerranch.com with a topic that you'd love to see an article written on!