

The Last Three Years' Climate Anomalies X-Flare Disturbances on Earth

Marilia Hagen¹, Anibal Azevedo²

¹Independent Researcher (Retired), Bloomington, Indiana, USA

²Faculdade de Ciências Aplicadas da Unicamp, Limeira, Brazil

Email: mariliadtavares@gmail.com, atanibal@gmail.com

How to cite this paper: Hagen, M. and Azevedo, A. (2026) The Last Three Years' Climate Anomalies X-Flare Disturbances on Earth. *Atmospheric and Climate Sciences*, **16**, 292-310.

<https://doi.org/10.4236/acs.2026.162016>

Received: February 2, 2026

Accepted: March 10, 2026

Published: March 13, 2026

Copyright © 2026 by author(s) and Scientific Research Publishing Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

This paper investigates the global rise in temperatures and provides a comprehensive analysis of projected temperature trends for 2023-2025. It also examines the heightened frequency of wildfires and floods observed over the preceding three-year period. Notably, these events resemble those recorded between 2003 and 2005, both of which have been linked to G5-Class solar flares and geomagnetic storms. A comparative evaluation indicates that climate anomalies over the past three years have been particularly severe. The rise in temperatures in certain regions, alongside unprecedented climate anomalies such as wildfires, extreme rainfall, and flooding, introduces variables that have not been documented since 1850. Therefore, it is imperative to consider additional factors that may contribute to these developments. Beyond natural phenomena, including X-class solar flares and G5 geomagnetic storms, the rise of green technology is a concurrent trend that warrants examination. Recent advances in technology aimed at replacing highly polluting materials have introduced new challenges. For instance, the widespread adoption of solar panels—currently numbering four million cells—may inadvertently intensify climate change by increasing the incidence of wildfires, heavy rainfall, and flooding across the United States and other regions of the Northern Hemisphere.

Keywords

Solar Flares, Geomagnetic Storms, Wildfires, Floods, Climate Anomalies

1. Introduction

The period from 2023 to 2025 is the recorded three-year span, with 2024 being the hottest year, followed by 2023 and 2025. In 2025, global temperatures ranged approximately 1.34°C to 1.44°C above the pre-industrial average of 1850-1900. 2024

was established as the warmest year in the instrumental record. The temperature surge recorded in 2023 and 2024 has been exceptionally severe, marking a significant departure from the established warming trajectory. Over the previous 50 years, global warming has progressed in an almost linear fashion, consistent with an almost linear increase in total greenhouse gas forcing. In 2024, 24% of Earth's surface had a locally record warm annual average, including 32% of land areas and 21% of ocean areas.

Understanding the underlying drivers of these temperature increases is essential for predicting future climate scenarios and developing effective mitigation strategies. However, these hypotheses do not fully explain the sudden wildfires in California or the floods in other regions of the USA.

Therefore, there is a search for additional sources that may contribute to these climate events. A notable development in 2023 is the apparent installation of 5 million solar panel cells nationwide. The production of electricity and energy by these panels appears to be correlated with increases in wildfires and floods. Over the past two years, temperatures have increased by 1.5 degrees Celsius above the average worldwide.

First, we examine anomalies in the USA to determine whether they are linked to solar variability and Earth's climate over the past few years.

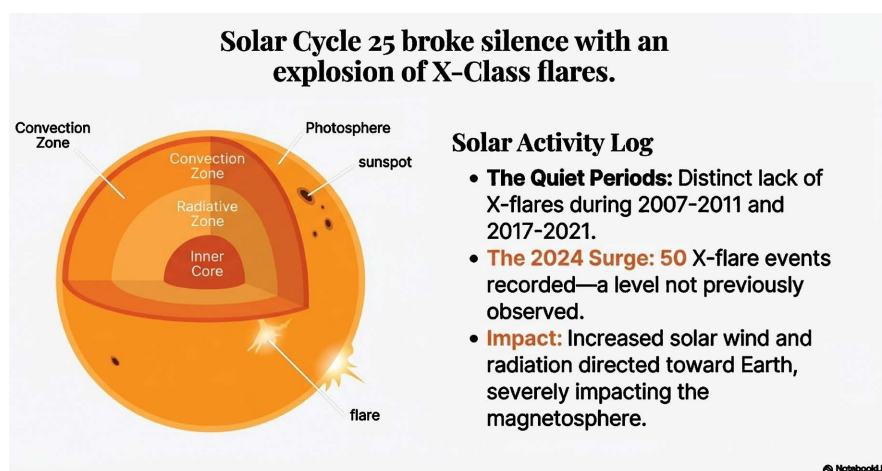


Figure 1. The formation of flares on the Solar surface.

The periods with the most substantial increases in X-flares occurred in 2001, 2014, and 2024, as documented in [1] and [2]. Following this, **Figure 1** illustrates the interrelationships governing the Sun and Earth. Nevertheless, most of our study will focus on years featuring X-flares that instigated the most severe geomagnetic storms in 2003 and 2024.

It is crucial to understand the significance and intensity of geomagnetic storms to interpret not only external effects, such as satellite disruptions, but also climatic anomalies, including auroras observed at lower latitudes in 2024.

Observing **Figure 2**, the number of X-class flares among the 2001-2004 enhancements is comparable to that observed in 2023-2025. The 2002-2004 flares

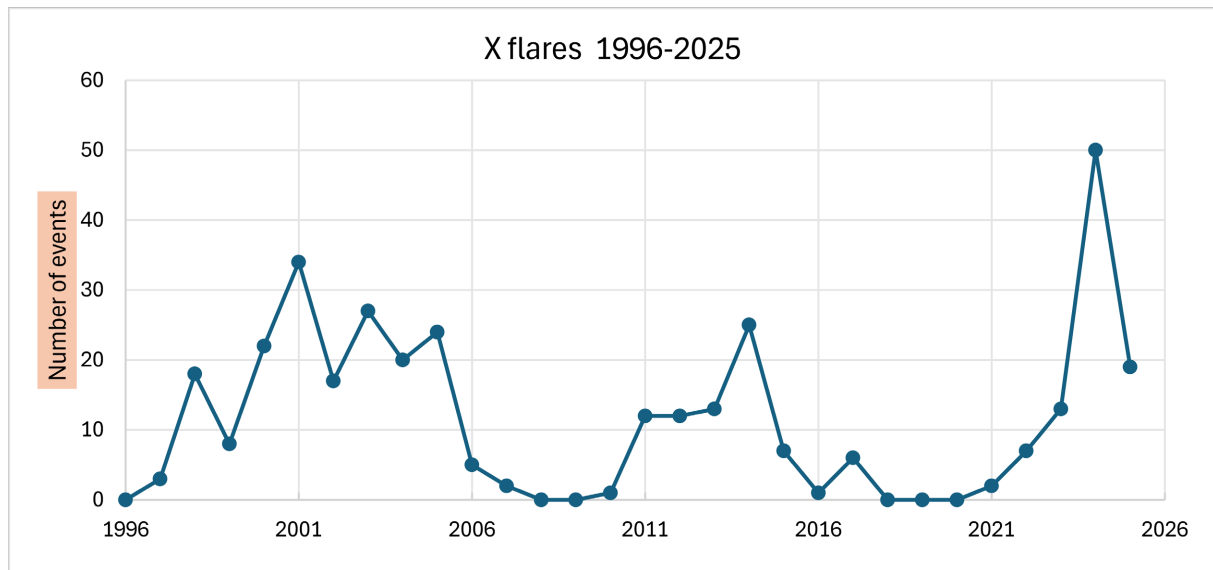


Figure 2. Number of X flares 1996-2025 plot created from NOAA data.

occurred during a solar minimum, and the 2024-2025 flares occurred during a solar maximum.

An analysis of the plot displaying Solar X flares since 1996 reveals distinct gaps between 2007-2011 and 2017-2021, indicating no recorded X flares during these periods. Notably, there were unprecedented numbers of X-flares in 2001 and 2014, with prior years showing a trend toward increasing frequency. In 2024, X-flares increased to 50 events, a level not previously observed. As the year is not considered the maximum of the cycle, an unusual activity is recorded. Although there is an apparent anomaly in 2024 regarding the number of X flares directed towards Earth, which strongly impact the magnetosphere, the mechanisms connecting this radiation to Earth's surface remain unknown. Despite the observed temperature increases since 2023, it remains difficult to establish a definitive correlation between the energy released by X-class flares within Earth's magnetic field and their subsequent impact on ground-level weather patterns. The other evidences that would be rising the atmosphere temperatures as volcanos, ONI, North Atlantic anomalies showed conflicting signs: A record warm first half (Jan. - Jun.) with widespread above average sea surface temperatures(SSTs) with significant cold anomalies developing in the northern parts of North America and Gulf stream region later in the year, creating a colder winter 2025/2026 potentially linked to a weakening Atlantic Meridional Overturning Circulation (AMOC), ENSO variability exhibited strong La Niña in 2021 and 2023, but most of the time the records indicated the phenomenon's neutrality in the region (**Figure 2**).

Observing the ENSO in **Table 1**, which shows the ENSO 1950-2025, La Niña was a significant presence in the interval 2000-2023, weak 12 times, moderate 6 times, and strong 7 times. El Niño was weak 11 times, moderate 7 times, and strong 6 times. Over the years we have been working, the ENSO has produced a strong El Niño, with the ONI index ranging from 1.5 to 1.9.

Table 1 shows the variability of ENSO since 1950. There are three distinct phases: warm, neutral, and cold. The strength of the phenomena is Moderate, Strong, or Very Strong; red denotes El Niño, and blue denotes La Niña. **Figure 3**

Table 1. Events are defined as 5 consecutive overlapping 3-month periods at or above the +0.5° anomaly for warm (El Niño) events and at or below the -0.5° anomaly for cool (La Niña) events. The threshold is further broken down into Weak (with a 0.5 to 0.9 SST anomaly), <https://ggweather.com/enso/oni.htm>.

El NINO				La NINA-25		
Weak-11	Moderate-7	Strong-6	Very strong-3	Weak-12	Moderate-6	Strong-7
1952-53	1951-52	1957-58	1982-58	1954-55	1955-56	1973-74
1953-54	1963-64	1963-64	1997-98	1964-65	1970-71	1975-76
1958-59	1968-87	1968-69	2015-16	1971-72	1995-96	1998-99
1969-70	1994-95	1986-87		1974-75	2011-12	2007-08
1976-77	2002-03	1994-95		1983-84	2020-21	2010-11
1979-80	2009-10	2002-03		1984-85	2021-22	
2004-05		2009-10		2000-01		
2006-07				2005-06		
2014-15				2008-09		
2018-19				2016-17		
				2017-18		
				2022-23		

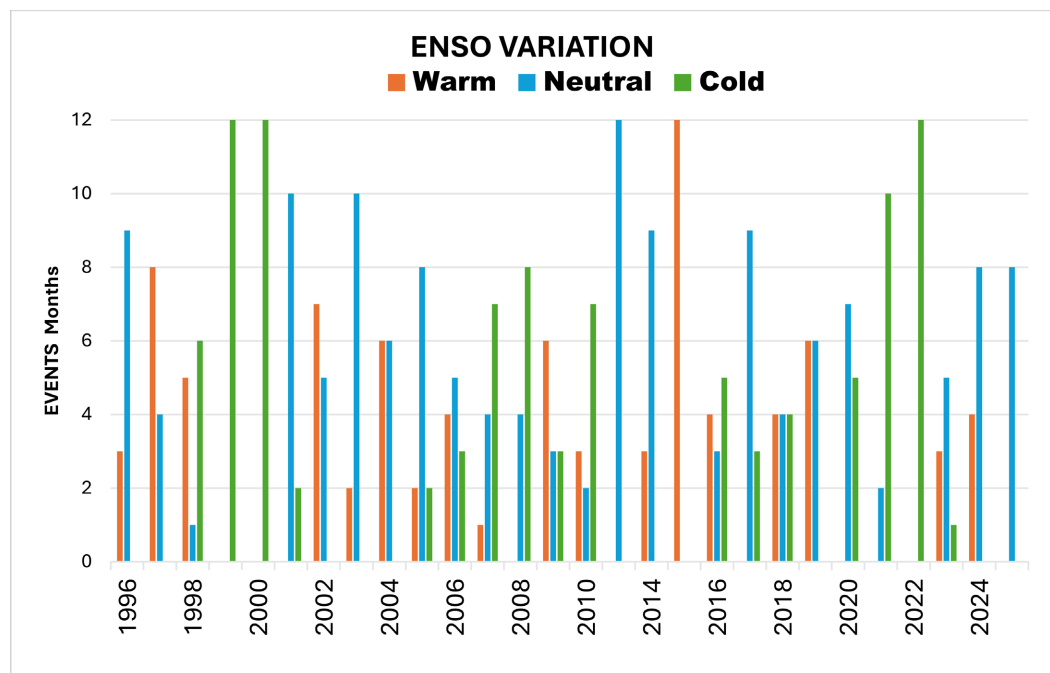


Figure 3. The variations in ENSO from 1996 to 2025.

is the ENSO variation in the duration of each phenomenon since 1996. Given the periods analyzed in **Table 1** and **Figure 3**, it will be necessary to identify the events more precisely in the Pacific region, given their impact on temperature last year.

The temperature anomaly period from 2000 has been above 0.38°C , see the following figure [3]. Recently, between 2022 and 2024, global average temperatures increased by 1.2°C .

Nevertheless, the USA has exhibited additional anomalies in recent years, without the new natural or anthropogenic causes we are accustomed to discussing daily. All unusual weather anomalies may be linked to modern technologies. The one that would be the Solar panels, which are apparently the fastest-growing industrial technology, to save the environment. As shown in **Figure 4**, global temperature has been increasing since the previous solar maximum in 2000.

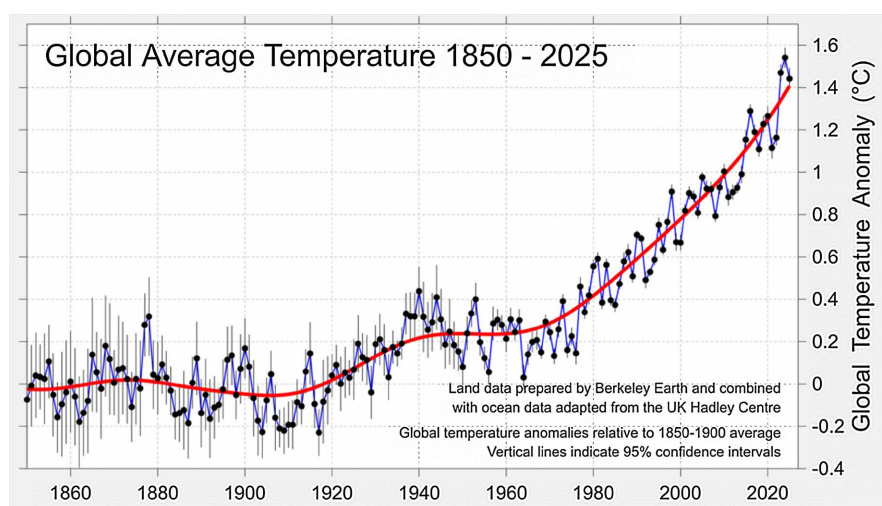


Figure 4. Land stations provide surface data. Satellite measurements cover the lower troposphere, the lowest level of Earth's atmosphere.

In Berkeley Earth's analysis, the global mean temperature in 2025 is estimated to have been $1.44^{\circ}\text{C} \pm 0.09^{\circ}\text{C}$ ($2.60^{\circ}\text{F} \pm 0.17^{\circ}\text{F}$) above the average temperature from 1850-1900, a period often used as a pre-industrial baseline for global temperature targets. This is $\sim 0.08^{\circ}\text{C}$ ($\sim 0.14^{\circ}\text{F}$) cooler than the previous record high observed in 2024, and 0.03°C (0.05°F) cooler than 2023. As a result, 2025 is the 3rd-warmest year directly observed using thermometer measurements. The last 11 years are the warmest years directly observed.

Over the last few years, the USA has brought forth more unusual occurrences that do not seem to align with explanations rooted in nature. Linking with the recently developed technologies is undoubtedly possible. Solar panels, which are part of a fast-growing industry, are the primary cause of environmental disruption. The natural causes of the anomalies are not explained by knowledge of natural fall/winter anomalies across all known records [3].

Through a comparative analysis of natural events on Earth, solar activity-related phenomena, and Earth's surface conditions, we determined that these fac-

tors, taken individually or collectively, were insufficient to explain the observed anomalies and global temperatures fully. Due to the observed discrepancies, there must be an unknown component that scientists have thus far ignored, affecting the weather. Although it most often occurred in the Northern Hemisphere, extreme weather could happen outside the standard conditions expected for the season. The purpose of this document is to initially present a depiction of the irregular weather patterns that occurred around the world during the time through 2025. As we move forward, we will offer suggestions for the potential causes of this occurring during the current period. We are presently attempting to solve the unsolvable questions [4].

In 2025, the USA experienced severe weather events, including devastating floods, severe wildfires, and record-breaking heat. Major flooding occurred in Texas in July and Oregon in March, while early 2025 saw destructive wildfires in Southern California. Extreme heat affected the Northeast in June and July, resulting in high dew points and heat indices, and there was a significant spike in wildfires in Alaska in June (Figure 5).

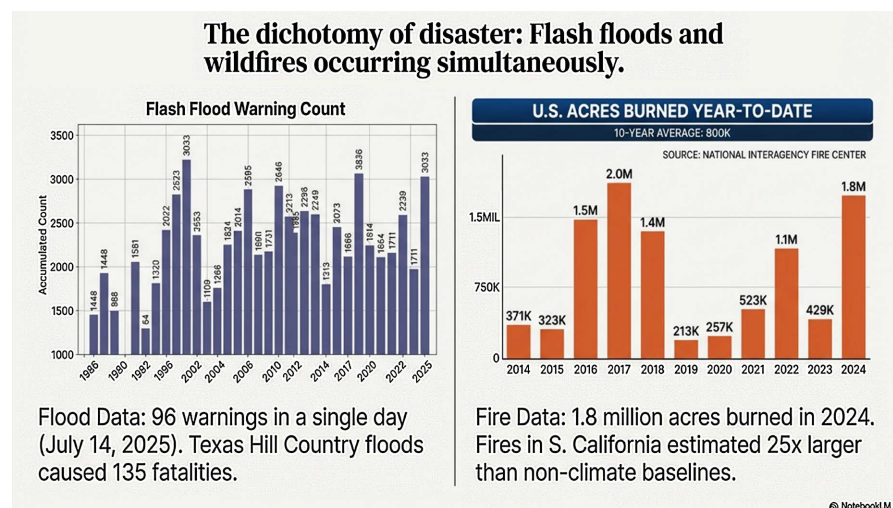


Figure 5. The apparent connections between the enhancement of wildfires and floods in the U.S.

Rainfall and floods in Texas: The July 4th weekend saw catastrophic flooding in the Texas Hill Country, causing at least 135 fatalities after extreme rainfall.

Oregon: Heavy rain and snowmelt in mid-March caused widespread flooding along the coast and inland, forcing evacuations and damaging infrastructure. **Lower Rio Grande Valley:** On March 27-28, an extreme rainfall event caused flash flooding, with Harlingen receiving more than 18 inches of rain in two days, resulting in fatalities and hundreds of rescues. **General precipitation:** April was wetter than average across the contiguous U.S., with Kentucky recording its second-highest average rainfall and Alaska its second-wettest April on record. **Fires in Southern California:** In early January 2025, the Palisades and Eaton wildfires were among the most destructive in the region, with the burned area estimated to be about 25

times larger than it would have been without climate change, according to a BBC article. Alaska: In late June, a sudden increase in wildfires, sparked by lightning, led to evacuation orders for many interior areas and burned over 56,000 acres within a week. Southern Appalachia: By late March, dry conditions and intense winds fueled wildfire across the region, burning over 30,000 acres and prompting states of emergency [5]-[7].

Wildfire potential: The National Interagency Fire Center (NIFC) identified above-normal wildland fire potential for early 2025 across Southern California, the Deep South, and the Southeast. Heat Northeast: The Northeast experienced its hottest June on record in 2025, with record-breaking hot temperatures, heat indices, and minimum temperatures in cities like New York City and Hartford, CT—**Figure 6**.

Alaska: In June, Alaska issued its first official heat advisory, with temperatures reaching the mid-80s °F in some areas. Florida: On July 27, Tampa recorded its all-time elevated temperature of 38°C. In November 2025, climate anomalies in the USA were characterized by a patchwork of contrasting weather patterns, including atmospheric river-fueled flooding on the West Coast, extensive drought in the South and East, and a severe wildfire season earlier in the year.

To understand what is occurring on the continental landmass of the USA, we will examine temperature characteristics observed there since 2018.

2018—the average temperature in the USA was 53.50°F above the 1.5°F average. The precipitation was 4.69 inches above average.

2019—the average temperature, on the continent, was 52.7°F, 0.70°F above average, ranking in the upper third of the 125-year record. The USA precipitation average was 4.84" above average.

2020—the average U.S. temperature was 54.5°F, 2.4°F above average, precipitation average was 30.28in., 034in. Above average, ranking in the middle of the third of the historical record.

2021—ranked 4th warmest year on record; the average US temperature was 54.5°F, 2.5°F above average. The precipitation was 30.48in., 0.54in., above average.

2022—ranked was 53.4°F, 1.4°F above average. Precipitation was 1.59 in. below average.

2023—ranked as the fifth-warmest year on record, the average U.S. temperature was 2.4°F above average. Precipitation averages 0.48 in. below average, placing it in the driest third of the record.

2024 was the warmest year on record, with an average temperature 3.5°F above the long-term average. The 2024 U.S. precipitation average was 1.66 in. above average.

These exclusive observations for the USA, compared with the global average, indicated that factors specific to the USA are increasing climate anomalies in some regions of the continent. Isolating the period from 2018 to 2025 shows how the climate affected the area on average. However, during this period, reports of several severe floods were received, primarily in California and Texas. Those floods and rainfall events are not reported to NOAA for some reason. Data for 2025 has

not yet been released; therefore, we are using data from other years in the same catalog. Below, we recorded the regional extremes.

The next step shows the 2023-2025 range and the anomalies present in the USA, independent of the other observations worldwide.

2023 Contiguous U.S. average temperature: 2.4°F above average, making it the fifth-warmest year on record. This occurred during the warmest year on record globally.

Regional extremes: Widespread above-average temperatures were recorded across most of the U.S. Many states, including Texas, Louisiana, and Massachusetts, had their warmest or second-warmest year on record. Phoenix, Arizona, experienced its hottest month ever in July, with an average temperature of 102.8°F.

Contributing factors: An emerging and strong El Niño event intensified heat, contributing significantly to record warmth, especially later in the year.

2024 Contiguous U.S. average temperature: 3.5°F above average, making it the warmest year in the 130-year record. All but two states in the contiguous U.S. had a top-five warmest year.

Regional extremes: 17 states, from the Upper Midwest to the Northeast, recorded their warmest year on record. Heat advisories and warnings, including an unprecedented one in Caribou, Maine, were common. Phoenix, Arizona, again recorded its hottest year on record and set a record for the longest consecutive stretch of days with temperatures at or above 100°F.

Contributing factors: Continuing the trend from the previous year, the strong El Niño at the beginning of 2024, followed by a transition to La Niña, contributed to the persistent warmth.

2025—Early-year global records: January 2025 was the warmest January on record globally. In the 12 months from February 2024 to January 2025, global temperatures were the second-highest on record. U.S. anomalies: Preliminary U.S. data show significant regional temperature variations. May was the second-warmest spring on record for the contiguous U.S. Alaska, Hawaii, and much of the Gulf and Atlantic coasts also experienced much-above-average warmth. October was the eighth-warmest on record for the contiguous U.S., with above-average temperatures in the central U.S. and Northeast. Alaska also experienced much-above-average warmth in October.

As the years have passed, extreme heat events have intensified, and 2024 has been the warmest year on record for the contiguous United States, also setting a record for billion-dollar weather and climate disasters.

2. China's Recent Climate Anomalies in Rainfalls, Floods, and Wildfires 2023-2025

China experienced a warm and dry climate in 2023. The annual surface air temperature reached a new high of 10.71°C, with the hottest autumn and the second warmest summer since 1961. Meanwhile, the annual precipitation was the second lowest since 2012, totaling 615.0 mm. Precipitation was below normal from winter

to summer but increased in autumn. Consistent with the year's overall conditions, precipitation during the flood season from May to September was also the second-lowest since 2012, 4.3% below normal, with variations across China—higher in central areas and lower in the north and south. Conversely, the West China Autumn Rain brought significantly more rainfall than usual, starting earlier and ending later. Despite lower total annual precipitation in 2023, China experienced severe rainfall events and floods. Notably, from late July to early August, a rare and extreme rainstorm caused by Typhoon Dussuri struck Beijing, Tianjin, and Hebei, abruptly shifting conditions from drought to flood in North China.

On the other hand, Southwest China endured a prolonged drought from the previous autumn into spring. In early summer, North China and the Huanghuai region experienced the strongest heatwave since 1961. However, there were more cold-air incursions than usual, with the most severe occurring mid-January. Unexpectedly, spring brought increased sand and dust storms in northern China.

According to the bulletin, China's average temperature reached 10.9 degrees Celsius in 2024, the highest national average since 1951.

All four seasons in the past year recorded above-normal temperatures, with spring, summer, and autumn temperatures all setting historic highs. The number of high-temperature days nationwide was 6.6 days above average, the second-highest since 1961.

Frequent heavy rainfall and other precipitation events have caused damage to the country in the past year. The bulletin reports that the national average precipitation is the fourth-highest since 1951.

Over the last few years, China has experienced an increase in extreme weather events, such as intense heatwaves, severe droughts, and heavy rainfall, which are driven by global warming, resulting in power outages, poor crop yields, and flooding. The country is experiencing a faster warming trend compared to the worldwide average, which is characterized by record-breaking temperatures, more glacial melting, and an elevation in coastal sea levels, further intensified by occurrences like the El Niño event spanning from 2023 to 2024.

China has experienced increased flooding and drought, according to climate data collected over the past few years. While wildfire frequency has not followed a consistent pattern, it has been significantly influenced by regional factors. Due to climate change, these events are becoming more extreme, as rising temperatures and irregular precipitation patterns worsen both flooding and drought-related fire risks.

Over the past few years, China has experienced numerous significant flood events, characterized by unprecedented rainfall, stronger typhoons, and increasingly complex consequences of urban development.

2024: Heavy rainfall starting in April caused catastrophic floods along the Yangtze and Pearl River deltas. The disaster forced the relocation of hundreds of thousands of people, destroyed roads, and resulted in at least 71 deaths.

2023: Summer saw severe flooding affect over 133,000 people in Hebei province

alone, with billions of dollars in economic damage. Typhoon Haikui also caused heavy rainfall and landslides in southern regions.

2022: Heavy rainfall caused flooding in the Pearl River Basin, and the Song-Liao River Basin in the Northeast also experienced severe flooding.

2021: The city of Zhengzhou in Henan province received nearly a year's worth of rain in just three days, leading to flash floods that killed hundreds and caused almost \$19 billion in losses.

2020: Heavy rains caused record-high water levels in the Yangtze River and its tributaries, resulting in the country's most severe flood season since 1998.

2.1. Wildfire Conditions

Wildfire conditions in China are driven by a complex mix of climate and human factors, with trends varying by region.

2024: According to data from Global Forest Watch, the number of high-confidence fire alerts was in the normal range compared to previous years.

Regional hotspots: The highest rates of fire-related tree cover loss between 2001 and 2024 were in Heilongjiang, Nei Mongol, Yunnan, and Sichuan.

Notable fires: Major incidents include the 2019 Muli forest fire and the 2020 Xichang forest fire, both in Sichuan province, which resulted in the deaths of multiple firefighters.

China's climate conditions are showing trends consistent with global warming, leading to more extreme and frequent weather events.

2.2. Severe Drought and Heat

2022: A record-breaking heatwave and severe drought affected the Yangtze River Basin, causing energy shortages and impacting agriculture.

2023: Southwest China experienced a severe drought in the winter and spring.

“Drought-to-flood” events: A growing concern is the abrupt transition from severe drought to heavy rainfall, a phenomenon that poses significant challenges for water management and agriculture.

2.3. Regional Variability

While some areas of China are experiencing drier conditions overall, others are experiencing more intense downpours. Extreme rainfall days have become more frequent, even as the national average number of rainy days has decreased. Rising temperatures: The national average temperature is increasing faster than the global average, with 2023 and 2024 ranking as the hottest and second-hottest years on record, respectively.

Since 2023, the world has experienced a significant and alarming intensification of climate anomalies, with 2023 and 2024 confirmed as the two warmest years on record and 2025 on track to be the second- or third-warmest. Record-high global temperatures, unprecedented ocean heat content, accelerated sea-level rise, and widespread extreme weather events characterize this period.

2.4. Key Observations of Enhanced Climate Anomalies Worldwide (2023-2025)

Global Temperatures: The global near-surface temperature in 2023 was 1.45°C above the pre-industrial average (1850-1900), a record surpassed in 2024, the first year on record to clearly exceed the 1.5°C threshold. This rapid warming, partly driven by an intense El Niño event that began in mid-2023, has continued into 2025, with every month from June 2023 to December 2024 setting a record for that month.

Ocean Heat: Ocean heat content reached its highest recorded levels in both 2023 and 2024 and continued to rise in 2025. This has led to widespread and persistent marine heatwaves, which degrade marine ecosystems and contribute to sea-level rise through thermal expansion.

Sea Ice and Glaciers: Antarctic sea-ice extent reached record lows in both 2023 and early 2025. Glaciers worldwide also suffered record mass loss over three consecutive years (2022-2024), with some regions, such as the European Alps, losing a substantial portion of their volume in just two years.

2.5. Extreme Events

The period has seen a massive increase in the intensity and frequency of extreme weather events with severe socio-economic impacts. These include record-breaking wildfires in Canada, deadly tropical cyclones that intensified rapidly (e.g., Hurricane Otis in Mexico), and widespread, severe flooding and heatwaves across the globe.

Data from the World Population Review and the Global Carbon Project show that China, the United States, and India had the highest CO₂ emissions in 2021 and remain on top in 2022. It is expected, given their large populations and industrial activity. However, when examining CO₂ emissions per capita, the picture shifts notably. Smaller countries such as Palau and Qatar have high per-capita emissions due to their small populations and heavy reliance on fossil fuels for energy and industry. Analyzing each country's challenges helps us understand global emissions, the primary driver of climate change. Increasing awareness of these issues is crucial for making changes that can reduce our environmental impact.

Countries with the highest carbon emissions predominantly have large populations and extensive industrial activity. China, with a population of over 1.4 billion, tops the list, followed by the United States, India, Russia, and Japan.

However, total emissions alone do not tell the full story. It is also essential to consider per capita emissions, which provide a more accurate measure of a country's carbon footprint relative to its population size (**Figure 6**).

3. Countries with the Highest Carbon Footprint

China Emissions: 12,667.43 million tons of CO₂

It is not surprising that China ranks at the top of this list, given its population of over 1.4 billion. This results in substantial demand for energy-intensive industries.

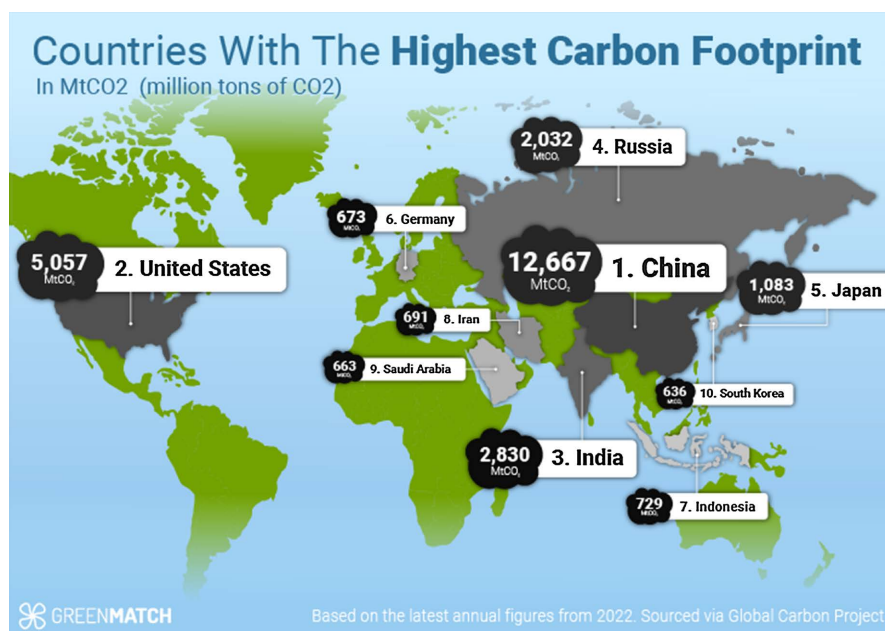


Figure 6. Countries with the highest carbon emissions worldwide (2025) [6].

Despite efforts to expand renewable energy sources, China's industry and exports still rely heavily on coal and other fossil fuels, which are a major source of the nation's high carbon dioxide emissions. This dependence on fossil fuels is a major contributor to the country's high carbon footprint. China's economy and industry have also expanded rapidly in recent years. Major infrastructure projects have increased demand for cement and steel, significantly raising CO₂ emissions. Half of the world's steel is produced in China.

According to a 2021 report on global CO₂ emissions, electricity and heating were the largest sources of emissions. Between 2019 and 2021, China accounted for nearly all of the net global increase in emissions from this sector.

4. United States of America Emissions: 5,0507.00 Million Tons of CO₂

With the third-largest population in the world, the United States is home to approximately 333 million individuals. This demographic factor significantly influences emissions, as a larger population increases energy demand and fuel consumption.

Notably, India, which ranks second globally in population, has a smaller carbon footprint than the United States. Several primary reasons account for this disparity. Although the United States has experienced a marginal increase in emissions attributable to advances in renewable energy and energy efficiency, the transportation and industrial sectors remain major contributors. It is well established that most emissions in most countries originate from the combustion of fossil fuels. In the United States, the predominant sources of emissions include electricity generation and heating, primarily fueled by coal, oil, and natural gas. Additionally, the transportation sector—encompassing automobiles, freight trucks, aviation, and

public transportation—also plays a significant role.

Another aspect to consider is the variability of weather patterns across the United States, which increases demand for heating and cooling systems. While adopting renewable energy technologies such as heat pumps or solar panels could address these needs, approximately 48% of U.S. homes still use natural gas for heating, thereby contributing substantially to the nation's overall emissions. Given the escalation in extreme weather events, including heatwaves and blizzards, the use of household temperature-regulation technologies is expected to continue to rise.

5. India Emissions: 2,709,683,700.00 Tons of CO₂

In the case of our third nation on the list, the predominant sources of emissions exhibit slight variation. In India, the principal contributors to carbon emissions are power plants and agricultural activities.

Power plants in India primarily operate on coal, resulting in substantial carbon dioxide emissions during energy generation. The carbon intensity of coal is among the highest of all fuel sources, resulting in twice the CO₂ emissions per unit of energy output compared with natural gas. Consequently, coal has been classified as a highly unsustainable energy source from an environmental perspective.

Agricultural practices account for India's second-largest source of emissions, primarily from rice paddies and cattle, which emit significant volumes of methane. Methane is recognized as a greenhouse gas (GHG), a group of gases that directly contribute to global warming. Furthermore, increased use of synthetic fertilizers and burning of crop residues have collectively increased the country's emissions.

6. Russia Emissions: 2,0321.04 Million Tons of CO₂

In Russia, the causes of carbon emissions are comparable to those of other countries on the list. Most of its emissions come from burning fossil fuels for energy production and for manufacturing materials such as cement. It is worth noting that Russia has a population of over 146 million. Given that Russia is the largest exporter of oil and gas, it is understandable that the country would have high emissions if fossil fuels powered most homes, businesses, production, and transportation. This is primarily due to the country's vast oil and gas industry, which accounts for most of its emissions.

7. Japan Emissions: 1083.65 Million Tons of CO₂

The energy and production industries are responsible for Japan's largest carbon output. The generation of electricity and the intensive manufacture of materials are the main contributors to the nation's emissions.

Burning fossil fuels to generate energy, as in the other top countries, contributes to their high carbon dioxide emissions. However, within Japanese cities, gasoline, kerosene, and LPG (Liquefied Petroleum Gas) are also used as fuel sources, which contribute to the figures.

The primary cause of these issues is the combustion of coal, oil, and gas for energy generation and industrial activities. Most nations rely heavily on coal for energy, a fuel among the most carbon-intensive. Transportation, agriculture, industrial operations, and manufacturing also contribute significantly to record-high carbon emissions. Furthermore, rapid population growth, along with the widespread use of heating and cooling systems in residential buildings—most of which operate on fossil fuels—exacerbate these emissions. Despite these discouraging findings, there remains a degree of optimism derived from commitments and agreements made by individual states and international bodies.

8. The Natural Hazard Events Worldwide

Europe and Asia's climates are substantially shaped by the North Atlantic's circulation, which operates through two main pathways: the transfer of oceanic heat by the Atlantic Meridional Overturning Circulation (AMOC) and the North Atlantic Current, alongside atmospheric connections such as the North Atlantic Oscillation (NAO) and the Atlantic-Eurasian (AEA) wave train.

The primary connection with Europe is the transport of vast amounts of heat via ocean currents, which substantially moderates the European climate. Atlantic Meridional Overturning Circulation (AMOC): The AMOC is an extensive system of ocean currents that brings warm, shallow water from the tropics northward toward the North Atlantic. In the subpolar region, this water cools, becomes denser, and sinks, forming a deep return current.

North Atlantic Current/Drift: An extension of the Gulf Stream, the North Atlantic Current transports warm water along the coasts of Europe, contributing to the region's mild winters and temperate climate, particularly in countries such as the UK, Ireland, and Norway.

Climate Impacts: Without this heat transport, Europe would experience significantly colder average temperatures and less precipitation. Changes in the strength of the AMOC, which is currently weakening due to climate change, are projected to substantially alter European weather patterns, including longer summer heatwaves and colder winters.

The influence on Asia is primarily driven by atmospheric teleconnection patterns, in which climate anomalies are linked across vast distances.

Atmospheric Wave Trains: The North Atlantic Oscillation (NAO) and other circulation patterns excite large-scale Rossby waves that propagate eastward across Eurasia, affecting Asia's climate, particularly in East Asia.

North Atlantic Oscillation (NAO): The NAO is a significant mode of atmospheric variability in the North Atlantic region. Depending on whether the NAO is in a positive or negative phase, it can alter the jet stream's path and influence winter temperatures and precipitation across Eurasia. A positive winter NAO, for example, can be linked to specific temperature anomalies in East Asia months later through a "cross-seasonal coupled oceanic-atmospheric bridge" mechanism involving sea surface temperature anomalies.

Atlantic-Eurasian (AEA) Teleconnection: This summer teleconnection pattern, originating in the subtropical North Atlantic, has centers of action that extend across Europe, Siberia, and into North China, linking climate variability across these regions. Sea surface temperature (SST) anomalies in the North Atlantic can drive atmospheric responses that modulate the Asian jet stream and alter the frequency of extreme weather events, such as heat waves and freezing air outbreaks, in North-east Asia. In essence, the North Atlantic circulation acts as a critical heat engine and climate modulator, directly shaping Europe's mild climate through oceanic currents and indirectly influencing Asia's climate through complex, large-scale atmospheric linkages.

9. Geomagnetic Storms, G5 Anomalies, Last 20 Years

Geomagnetic storms are intense, solar-induced disturbances in Earth's magnetic field. These storms cause widespread voltage-control problems on power grids, disruptions to satellite navigation, and auroral displays. G4 (severe) geomagnetic storms are the second-highest level, with Kp = 8.

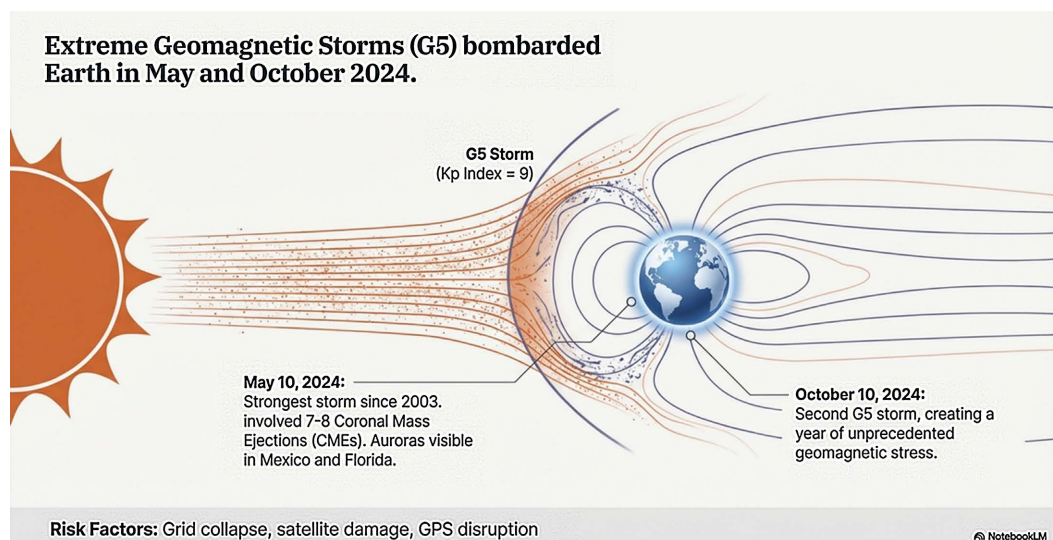


Figure 7. Geomagnetic storms caused by X flares.

They affect pipeline currents, degrade GPS signals, and cause radio interference. They also allow auroral observations at lower latitudes, sometimes as far south as Alabama or Northern California.

G5 (extreme)—the highest level on the scale, Kp = 9. A Kp = 9 value during a solar storm indicates an extreme (G5-level) geomagnetic storm, the highest level on the 0 - 9 planetary K-index scale. It signifies a severe disturbance of Earth's magnetic field, typically caused by a massive Coronal Mass Ejection (CME), which can lead to widespread power grid and satellite disruptions and to auroras visible near the equator (**Figure 7**).

It has the potential for total grid collapse or blackouts, damage to transformers, damage to satellites, GPS/navigation blackouts, and unusable high-frequency ra-

dio for days. Aurora is visible at extremely low latitudes, reaching Florida and southern Texas.

In 2024, there were at least three periods of severe G4- or higher-class geomagnetic storms, primarily driven by intense solar activity in May and August. The most notable event occurred on May 10, involving seven to eight coronal mass ejections (CMEs) and widespread G4 conditions, reaching G5 (extreme), the strongest since 2003. Throughout 2024, the record for the highest number of X-class flares was broken, resulting in multiple, sometimes prolonged, G4-level storms. The G5 storms in 2024 occurred on May 10-11, with several CMEs that produced auroras at exceptionally low latitudes, including Mexico, the Canary Islands, and the southern United States. Another G5 storm was recorded on October 10, 2024. A similar radiation storm took place in 2003.

They were called “Halloween solar storms,” which occurred on October 29 and October 30, causing widespread outages in Sweden, satellite anomalies, and transformer damage in South Africa. Both were G5 storms. They were part of the major solar flares, including an X17.2 flares on October 28 and between October 9 and November 5, 2003. The next step is to compare the 2003 climate anomalies with those observed in the last three years. 2003 was the second-warmest year after 2015. There was significant climate turbulence in 2003, dominated by a catastrophic European heatwave and unusual precipitation patterns globally. Europe experienced a heatwave, with the warmest summer in parts of the continent since 1540.

Antarctic Ozone hole reached a near record extent of 28.2 million km² in September. In May 2003, 546 tornadoes struck the U.S., the highest number in history. In May, Sri Lanka faced its most severe floods in half a century. Meanwhile, Eastern and Southern Africa endured prolonged drought, and the western U.S. continued its multi-year dry spell. Russia experienced unseasonably freezing weather and snow, with June snowfall, a phenomenon not seen in Moscow since 1963.

August brought record-breaking cold to South Africa. India is currently experiencing severe cold in December. In January, a significant arctic front delivered the coldest temperatures to parts of South Florida, with the state setting a record low of -4°C on January 24. The Northeast experienced its coldest spring on record, ranking in the 20th percentile for occurrences since 1895. Ocean temperatures were notably colder, ranging from 5°C to 8°C below average. It is now possible to search for similarities between the two climate boundaries on Earth across both years. Let us continue the analysis in both years.

2003: An unprecedented heatwave killed more than 70,000 people across Europe.

Europe experienced its hottest year on record in 2024, marked by an unprecedentedly prolonged heatwave in the southeastern region. Elevated ocean temperatures played a significant role in shaping weather patterns during both years. 2024 saw exceptionally high sea temperatures, partly due to the lasting impact of

a strong El Niño event.

In 2003, researchers identified at least nine hydrothermal vents in the Arctic region, while observations showed that gradually warming ocean waters had initiated a consistent process of ice melting.

In 2024, a concerning record of glacier mass loss was observed across Scandinavia and Svalbard, while the broader phenomenon of global ice melt has demonstrably influenced the planet's physical form and the length of its days.

The year in question marked a significant milestone, becoming the first calendar year to exceed the critical 1.5°C threshold for pre-industrial warming, with average temperatures ranging from approximately 1.54°C to 1.60°C above the baseline levels established between 1850 and 1900. Although this increase does not officially constitute a breach of the Paris Agreement's established long-term targets, it does undeniably mark a historical spike in a single year.

The upper ocean, specifically the top 2000 meters, has recorded its highest heat content for the fifth consecutive year, setting a record. Sea surface temperatures remained at record highs for 15 consecutive months, fueled by a strong El Niño and accelerating greenhouse gas effects. On July 22, 2024, the world recorded its hottest day ever, with the average global temperature reaching 17.16°C (62.89°F).

All 58 global reference glaciers across five continents lost mass, marking the greatest average ice loss in 55 years of record-keeping. Venezuela officially became the first Andean country to lose all its glaciers. The U.S. alone faced 27 billion-dollar disasters, the second-highest count on record, costing an estimated \$182.7 billion. Globally, climate change has added an average of 41 additional days of dangerous heat per person relative to a world without human-caused warming. Although Earth's climate showed similar patterns, there were some differences between the two years. For example, the number of X flares in 2024 was double that of 2003. The strongest X flare in 2003 was X 40, which occurred on November 4.

In 2024, an X9 flare occurred on October 3, although it was one of many that occurred multiple times during the period.

In 2024, we observed two solar events: the Solar maximum and an exceptional number of X-flares, CMEs, and other events. It appears that those two contributions to the climate increased the evolution of climate anomalies in 2024. The external factors from 2003 to 2024 are largely similar. The occurrence of extreme X-flares and the G5 geomagnetic storm in both years, which are linked to, or at least point to, climate anomalies, is similar. Events in 2003 were half as many as in 2024; however, the energy from the 2003 Halloween event was almost double that of the events in 2024. Nevertheless, the increased frequency of wildfires, rainfall, and flooding indicates that the rise in 2024 temperatures cannot be explained by these factors alone. Although those events occurred in a similar pattern, the claimed anomalies in 2024 were stronger than in any other year on record since 1850.

Global solar panel installations from 2022 to 2026 experienced unprecedented growth, increasing from approximately 239 GW in 2022 to nearly 600 GW in

2024. This surge, driven by rapid advances in TOPCon and HJT technologies, led to plummeting module prices and substantial cost reductions. Global total capacity exceeded 2 TW in 2024, though growth is projected to slow slightly in 2026 due to policy shifts in China and the US.

A careful search for possible links showed that only natural or known anthropogenic causes, such as gas emissions, could not account for such a result. Here, a new proposal emerges. Greenhouse gas emissions and green technologies can affect rainfall locally, increasing evaporation rates in the areas where they are located. Lithium batteries are increasing the number of wildfires by causing rapid ignition when exposed to solar heating. Solar panels are being deployed rapidly across large areas, with China leading globally, followed by the United States. Our paper outlines that these two locations are also the most dangerous and damaging climate anomalies observed in 2024.

10. Conclusions

After carefully examining the data, we collected throughout the past three years. Our research has led us to conclude that the phenomena we observed cannot be sufficiently accounted for by relying exclusively on natural explanations or by attributing them entirely to human interventions. We should also consider another factor that has contributed to these developments over the past three years. The research presented in our paper has demonstrated that most climate anomalies observed over the last three years can be attributed to the Sun's atypical behavior in 2024, a period characterized by elevated levels of charged particles and a robust solar wind directed toward Earth. Nevertheless, the recent adoption of environmentally friendly technologies by humankind indicates that the green mechanism requires further explanation and improvement to enhance its energy-capture capabilities. In the subsequent phase of our work, we will conduct an in-depth investigation into the increasing adoption of solar panels and the integration of advanced technologies, while also thoroughly examining the inherent risks and their potential environmental consequences. The forthcoming publication will delve into an examination of the various anthropogenic influences that are suspected of exacerbating the thermal increases observed in the specific regions under consideration. In our forthcoming research, we intend to concentrate on a comprehensive analysis of the human-driven causes that might be leading to elevated temperatures in the geographical locales that are the focus of this present investigation.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] Hagen, M. (2015) Mechanism of Intraplate Earthquakes and Anthropogenic Causes in USA. *Natural Science*, 7, 459-474. <https://doi.org/10.4236/ns.2015.79047>
- [2] Hagen, M. and Azevedo, A. (2022) Climate Changes Consequences from Sun-Earth

Connections and Anthropogenic Relationships. *Natural Science*, **14**, 24-41.

<https://doi.org/10.4236/ns.2022.142004>

- [3] Hagen, M. (2025) Intelligent Systems for Sun-Earth-Anthropogenic Climate Research: A Program for Causal, Hybrid, and Decision-Relevant Modeling. *Journal of Geoscience and Environment Protection*, **13**, 353-367.
<https://doi.org/10.4236/gep.2025.1312018>
- [4] NOAA-National Ocean Service/National Centers for Environmental Information.
<https://www.ncei.noaa.gov/access/monitoring/monthly-report/>
- [5] ESA: Euclid Q1 Data License and Credits.
<https://www.cosmos.esa.int/web/euclid/q1-data-credits>
- [6] Mckay, B. (2024) Countries with the Highest Carbon Footprint 2026.
<https://www.greenmatch.co.uk/blog/countries-with-the-highest-carbon-footprint>
- [7] Copernicus-E.U. Copernicus Marine Service Information (CMEMS) (2025) Marine Data Store (MDS).