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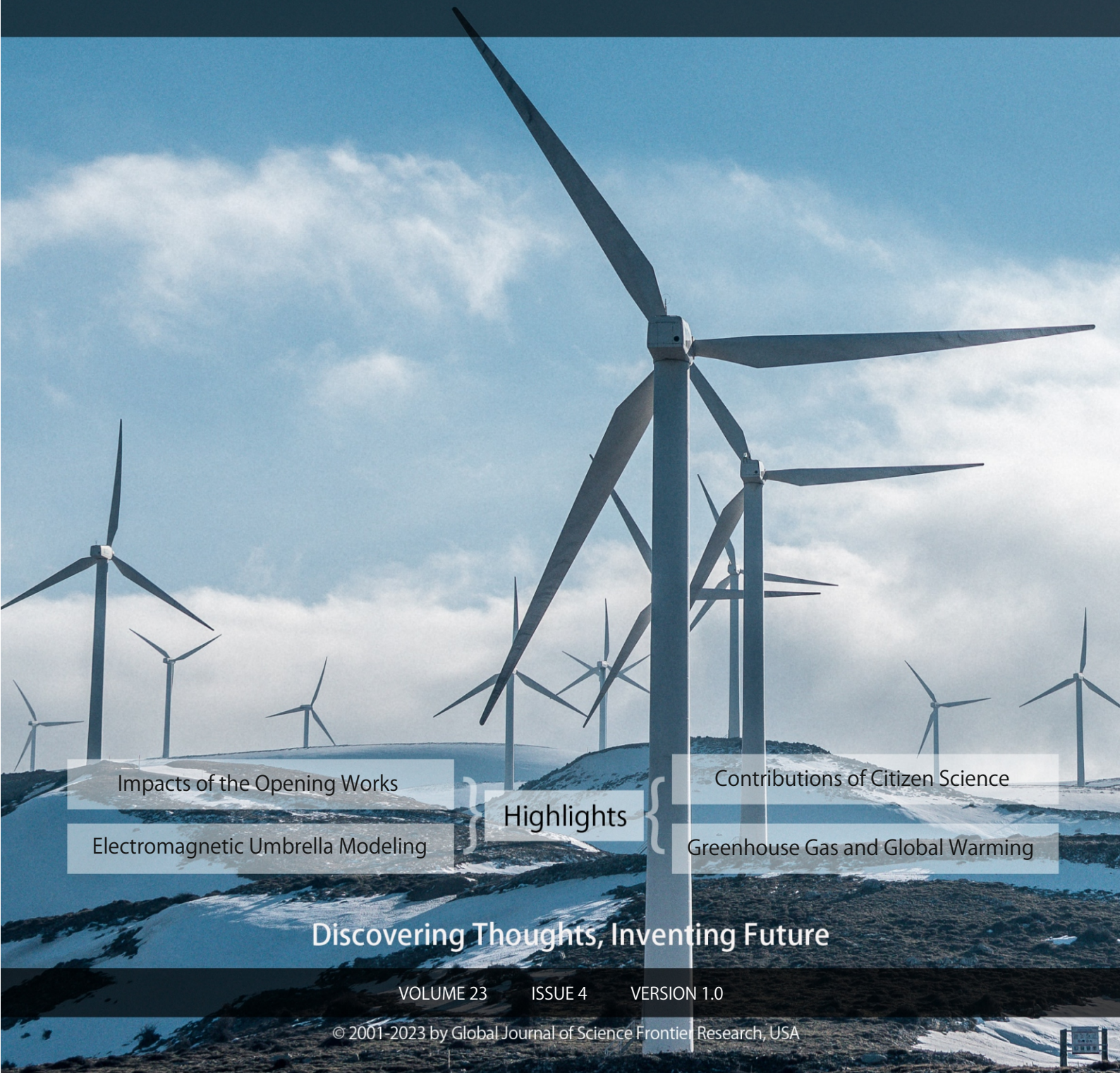

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Highlights

Contributions of Citizen Science

Greenhouse Gas and Global Warming

**Discovering Thoughts, Inventing Future**

VOLUME 23 ISSUE 4 VERSION 1.0

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Enviornment & Earth Science

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# Electromagnetic Umbrella Modeling of Mega Meteorological Anomaly Disasters and Large Earthquake Associations

By CaoDd

*Abstract-* In this paper, we briefly analyze four reasons for the generation of large outbursts of positively charged particle fluxes in the Earth's interior during the gestation period of large earthquakes, and propose a physical mechanism for the formation of an EMB (electromagnetic umbrella) model of the difference between the concentration of positive and negative charged particle fluxes, which can be used to explain the relationship between a mega-meteorological catastrophic event and the generation of excessive charged particle fluxes from the lithosphere prior to the large earthquakes. Causality. We compare some historical records of major earthquakes of magnitude 7.5 around the world, and find that the correlation between mega-meteorological hazard events and large earthquakes has a good fit. Based on this statistic, in this paper, we take three large earthquakes, Wenchuan, May 12, 2008, Fukushima, Japan, March 11, 2011, and Turkey, Feb. 6, 2023, as case studies, to explore the way to assist in locating the epicenter of major earthquakes by reverse tracking method using the major meteorological disaster events

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# Electromagnetic Umbrella Modeling of Mega Meteorological Anomaly Disasters and Large Earthquake Associations

CaoDd

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## I. Introduction

The earliest Chinese scholar to study the relationship between meteorological events and earthquake precursors was Geng Qingguo, a former staff member of the China Earthquake Administration, whose ideas are also known as the drought theory.(1) His analysis of the correlation between droughts and earthquakes was questioned and criticized by many later researchers because he used only crude and simple statistical calculations and did not reveal the deeper geophysical mechanisms.(2) In 2023, Indian scholars like Bikash Sadhukhan and others comprehensively evaluated the results of academics in earthquake precursors, which mentioned that a number of studies have found a close relationship between seismic events and climate anomalies, including drought, precipitation, and so on. (2) We agree with the view that data on climate anomalies can be used as an aid in predicting earthquakes as precursors. Meteorology, as a well-established discipline with well-developed theories, is able to predict climate change quite accurately by using meteorological satellite imagery, such as changes in temperature, barometric pressure, cyclones and atmospheric circulations, and the stresses induced by precipitation, barometric pressure, and snow accumulation. However, it is not easy to come up with convincing data to prove that meteorological anomalies are precursors of major earthquakes, as it is well known that the major factors determining climate variability are very complex, and it is difficult to completely exclude the interplay of astronomical, geophysical, anthropogenic industrialized greenhouse gas emissions and other factors.

In the past decade, the theoretical analysis of electromagnetic signals of earthquake precursors by scholars all over the world has been quite abundant, and the research on the dipole theory of the formation of the Earth's interior, the anomalous changes of geoelectricity and geomagnetism, the signals of low-frequency electromagnetic waves of ULF and VLF, the thermal anomalies of the land and the ocean, and the phenomenon of the Earth's "air-jet" has already provided prospective research results for the correlation study between meteorological hazards and large earthquakes. These studies have provided prospective research results for us to propose the correlation between meteorological hazards and major earthquakes. (3)

One of the main means of studying earthquake precursors in seismic electromagnetism is mainly through NOAA polar-orbiting satellites to monitor data on the time correlation between global electron fluxes and earthquakes, and the study of global electron density (TEC) and low-frequency electromagnetic wave anomalies, which have become the two main research routes for the discovery of earthquake precursors. (4) (5) On the other hand, the latest progress in geophysics of solid geophysical-chemical data from exploration in the depths of the earth, the study of high electrical conductivity of the oceans and lithosphere in localized territories, and the release of heat energy from radioactive elements, etc., have revealed from different sides that during the brewing of earthquakes it is not only the movement of the mechanical mechanics of plates that is traditionally studied by geology, but also the movement of the plates during the brewing of earthquakes, from the thermodynamics, particle physics, and electromagnetism of the Instead, it provides evidence of the existence of various earthquake precursor signals from thermodynamics,

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particle physics, electromagnetism, and other fringe sciences, as well as from the interdisciplinary study of the lithosphere-ionosphere-sun magnetic field. Electromagnetism studies of earthquakes have opened up an original way of thinking in the search for a relationship between global mega-climate anomalies and large earthquakes.

The causes of global anomalous climate disasters can usually be simplified into three factors, 1) the disruption of the self-circulating state of the atmospheric circulation between the Earth and the oceans, 2) cosmic ray factors (e.g., sunspots affecting the Earth's droughts), and 3) factors of human industrialization;

The most talked about topic affecting global climate change in the international community and academia is the excessive greenhouse gas emissions of carbon dioxide and methane resulting from the accelerated industrialization of mankind. It is undeniable that the accelerated industrialization of mankind in the second half of the 19th century contributed to the rise in global atmospheric temperatures, but to attribute greenhouse gas emissions or climatic changes such as high-temperature heat waves and extreme rainstorms and snowstorms to the factors of industrialization of mankind has a large element of wishful thinking and subjectivity.

We propose that the fourth factor influencing the climatic anomaly, the effect of large earthquakes, is the difference in the concentration of fluxes of positively and negatively charged particles formed in the lithosphere and spilled out over the surface during the gestation period of large earthquakes of magnitude 7.5 or greater.(6) This contributes positively to the occurrence of megathrust events. meteorological hazard events with a positive contribution. (Volcanic eruptions and hurricanes have been excluded as influences on mega weather anomalies in order to simplify the research in this paper.)

Based on our long-term experience in actual earthquake prediction and observation of earthquake precursors, we have constructed an EMB (Electromagnetic umbrella) model of the relationship between mega-meteorological catastrophic events and seismic electromagnetism, Note: EMB is the abbreviation for the distribution of charged particle fluxes within the Earth in the atmosphere as an umbrella-shaped state.

*The basic elements of the EMB model are expressed below:*

Prior to a major earthquake, the thin lithosphere beneath the earth's surface produces a much higher than normal flux of positively charged particles within the earth's surface due to stresses and high temperatures, high pressures, and some unknown particle physics, creating a difference in the concentration of positive and negatively charged particle fluxes. (7) Positively charged particle fluxes in excess of "supply" rise from the land and ocean to the sky, which in turn affects dramatic climate change. Thus, a mega-meteorological disaster is not only defined as a climatic upheaval, but is likely to have a fairly significant correlation with the precursor characteristics of a major earthquake.

First of all, we limit the term "extreme meteorological anomalies" to "extreme droughts and extreme rainstorms and snowstorms that have not occurred in a geographical area of the Earth for more than 50 years". The reason for adopting such a quantitative criterion not only comes from the observation of statistical significance, but also because we recognize that it is difficult to exclude all kinds of meteorological factors affecting climate change from the definition of "extreme meteorological anomalies". It is difficult to rule out meteorological factors affecting climate change, and only a mega-meteorological hazard event that has not been encountered for 50 years could have a statistically significant causal relationship with the electromagnetic precursors of earthquakes in the gestation period of earthquakes of magnitude 7.5 or greater.

The accuracy and immediacy of the data in the European Swarm satellites, which currently monitor earthquake precursor characteristics around the globe, depend on the time of day that the satellite observing conditions circle the Earth and the degree of transparency of the atmospheric clouds, and do not always monitor the anomalies of earthquake precursors. In meteorological satellites, there are two particles, electrons to the east and positrons to the west, and if meteorological satellites can measure the positive and negative charge fluxes of different particles in the total number of charged particles, respectively, it will provide a more solid foundation for our EMB model. However, the limited number of meteorological satellites over the Earth does not allow for the observation of electron density variations on the surface and in space every minute, and it also appears that no satellite observation technique has been developed that can instantly distinguish the respective differences in the fluxes of positively and negatively charged particles in the global TEC density anomalies, and thus it is difficult to advance the study of the correlation between atmospheric fluctuations and earthquake precursors. (8) (9)

In view of this, this paper only analyzes the mechanism of EMB formation on a purely physical level and theoretically;

It is assumed that the positively charged particle flux definitely exceeds the negatively charged particle flux during the preparatory phase of a major earthquake, creating an umbrella-shaped state of distribution of charged particle flux in local space. A large flux of charged particles escaping from thin lithospheric

cracks, metaphorically speaking, if these charged particles rise from the subsurface into the atmosphere in a direction similar to the umbrella handle, the positively charged particle flux would normally occupy the center of the umbrella of the EMB, while the negatively charged particle flux would be distributed at the edges of the umbrella.

*There are four main reasons why the positively charged particle flux absolutely exceeds the negatively charged particle flux concentration difference during the preparation phase of a major earthquake:*

Geophysical exploration data and dipole theory have demonstrated that large igneous rocks in plates can produce positrons in large quantities at high temperatures and pressures; (10) (11)

A large number of radon and helium concentrations increase rapidly before a major earthquake, seismologists called the so-called Earth "jet" phenomenon, has been regarded as a more reliable earthquake precursors, the radioactive element uranium 238 is prevalent in granite, melting granite magma state is no exception, the β-decay of uranium 238 produces radioactive isotopes of radium-226, and half-decay produces intermediate radon-222 itself is unstable, it will release positively charged alpha particles. , while half-decay produces the intermediate radon-222, which is inherently unstable and releases positively charged alpha particles; therefore, there is a direct correlation between the increase in radon and helium concentrations prior to major earthquakes and the overproduction of fluxes of positively charged particles; (12)

Cosmic high-energy protons penetrate deep beneath the earth's surface and strike the nuclei of atoms within rocks, causing them to lose their electrons and producing large numbers of positrons;

Plasma waves and Alfven isolated waves formed in melt-hot, highly magnetic material in the soft rheosphere-lithosphere have the potential for small-scale magnetic reconnection locally and accelerated electron clusters, generating clusters of positively charged particles and continuously accelerating electron momentum. (13)

*Self-reinforcing positive feedback mechanisms for positively charged particle fluxes:*

In accordance with the dipole mechanism of the large igneous rupture gap in the lithosphere, the positively charged particle flux generated, penetrating the surface of the thin lithosphere rises to the low altitude, in general, the top of the clouds in the atmosphere for the positively charged particle flux, and the bottom of the clouds for the negatively charged particle flux, when the concentration of positively and negatively charged particle flux is basically the same, the positively charged particles in the upper end of the high-altitude cloud layer will be subjected to the negatively charged particles of the low altitude cloud layer Attraction, the combination of positive and negative charges in the water vapor molecules is a necessary condition for the formation of CNN (cloud condensation nucleation), that is, for the second law of thermodynamics in the reversible space state, the entropy does not increase overall. And the formation of a large number of heavier and colder droplets produces rain clouds. The necessary condition is the overall equilibrium of the flux of positive and negative charged particles in the atmosphere, and if a huge local difference in the concentration of the flux of charged particles occurs, a climatic anomaly with a very unbalanced regional distribution of extraordinarily large droughts and torrential rains and snowfalls is produced. In the soft flow circle - lithosphere can form plasma material containing metal minerals, in a strong magnetic field, high-speed movement by the Lorentz force, resulting in the separation of positive and negative charges, is ionized by a large number of positively charged particles flow, penetrate the surface of the thin lithosphere into the atmosphere. From the properties of the Alvin wave, we can assume that positron or positively charged in the acceleration, if not and negatively charged ions combined annihilation, will certainly produce high heat temperature change.

Here it is necessary to differentiate the process of formation of fluxes of positively and negatively charged particles in different environments on land and in the oceans, and it is also necessary to classify two types of earthquakes, continental and oceanic. It is obvious that large earthquakes on land and large earthquakes on the ocean floor of the ocean have different physicochemical modes of generation of fluxes of positive and negatively charged particles, and different contribution factors to the fluxes of positrons and positively charged particles.

*(1) Positively charged particle flux generation mechanisms before strong continental earthquakes:*

In the thin lithosphere beneath continental plates, large igneous provinces and highly conductive magmas, large clusters of charged particles are generated and enter the atmosphere, and these large clusters of charged particles enter trace gases, which have the greatest proton affinity, and react with aerosols in complex chemical reactions. Clusters of charged particles, originally distributed haphazardly in the atmosphere, collide with water vapor to form water vapor clouds and aerosols, mainly with sulfate. According to the geographical area of the earthquake, earthquakes can be divided into two types: land earthquakes and ocean earthquakes. Since the EMB is the process of a large outburst of charged particle flux in the preparatory stage of a large earthquake, the flux of positively charged particles rises along the direction of the EMB, which is also compare to as the "Along the

vertical upward direction of the umbrella handle", in above the top of the "EMB" , therefore it is reasonable to expect that the Poisson distribution in the center of the "EMB of positively charged particles in the center of the EMB is a natural physical phenomenon.

*Meteorological hazards characterized by large earthquakes on the continent are mainly mega-droughts:*

As a result of the internal changes in the lithosphere during the gestation period of a major earthquake, an excess flux of positively charged particles was generated, the flux of negatively charged particles in the low altitude of the earth's surface was not sufficient to attract positive and negative charges to form a neutralization of the electric elimination, and the excess flux of positively charged particles accelerated with the warm air currents to rise to the high altitude and produce more positively charged particle clusters due to the impact of the high-energy proton streams generated during the solar flares and black-son outbursts, due to the positively charged protons. Solar flares or blackouts produce cosmic proton streams in the atmosphere, which impact and repel each other with clusters of charged particles in the atmosphere, producing a net increase in the atmospheric flux of total positively charged particles due to the constant stripping of electrons from the atomic structure of compounds contained in the water vapor. When the positrons move in the same direction as the atmospheric electric field, the velocity vector of the positrons accelerates and the opposite decelerates. When upward and downward convection of the atmosphere occurs, the warm air stream moves upward, at which point the positively charged particles are driven by the direction of the solar electric field force and move in the same direction as the warm air stream, accelerating upward. Due to the mutual exclusion of positrons and positively charged particles, only the formation of small condensation nodules molecules, it is easy to be dried by solar radiation, becoming a high-pressure hot dry air, preventing the central position of the EMB umbrella low-pressure cold air into the slightly moist air mass down and constantly be dried for the rise of the dry hot air mass when the EMB umbrella type of the formation of the internal pressure is greater than the outside, to prevent the outside of the humid air cloud into the, so called sinking adiabatic. This is the so-called heat dome phenomenon of sinking adiabatic heat. This results in a catastrophic drought in a certain geographic area. This is also in accordance with the second law of thermodynamics, which states that entropy increases monotonically and marginally in an irreversible space.

In plain language, the electromagnetic changes during the brewing period of the great earthquake were extreme and abnormal, forming a huge and incomparable EMB umbrella over the earth's surface, and the positively charged particles generated in the lithosphere were vertically upward along the EMB "umbrella handle", and excessive positively charged particles gathered and distributed around the center of a certain localized space in the atmosphere. The flux of superheated gases in the center of the EMB prevents the formation of heavy rain and snow clouds in the lower part of the atmosphere covered by the EMB, resulting in extreme heat and droughts that do not occur for decades.

Thus, the occurrence of a mega-drought event that has not been encountered in a geographic area for 50 years is a distinctive feature of the production of an excess flux of positively charged particles in the extrusion of the continental plate prior to a major earthquake.

*EMB generation mechanism for the ocean:*

The climate anomaly of oceanic earthquakes is much more complex than the impact of land-based earthquakes on the climate. Meteorologists analyze that the contribution of the ocean to the warm and humid air clouds in the atmospheric circulation is mainly a chain of chemical equilibrium, as follows: abundant planktonic microorganisms in the ocean decompose decaying organisms in the ocean, and the decomposition of the residue produces dimethyl sulfide (DMS) gas, which is the major volatile sulfide emitted by the ocean and accounts for about 95% of the oceanic sulfur emissions. DMS is the main volatile sulfide emitted from the ocean, accounting for about 95% of ocean sulfur emissions, and DMS emitted from the ocean to the atmosphere accounts for about 50% of the natural sulfur emissions to the atmosphere, and is the most important volatile sulfide. The DMS in seawater enters the atmosphere, where it undergoes a series of oxidations to generate methylsulfate and non-sea salt sulfate aerosols. Since sulfate aerosols are an important component in the generation of cloud condensation nuclei, non-sea salt sulfates increase the number of cloud condensation nuclei and increase the density of cloud droplets. A team of researchers led by aerosol physicist Benedet Weisel of the University of Vienna, who revealed data on the formation of global particles covering 40 percent of the Earth's surface through a global circumnavigation of complex airborne meteorological monitoring instruments, found that a new chemical, hydroperoxy methylthiocarbonate (HPMTF), in the DMS is converted to sulfate aerosols, which readily dissolves into the water droplets of existing clouds, thus permanently removing the sulfur.36% of the sulfur in DMS is lost to clouds in the manner described above, and the other 15% is lost through other processes. Thus, less than half of the sulfur released by marine plankton contributes to cloud formation. (14) (15)

Aerosol scientists studying the atmosphere and oceans are further investigating the properties of the new chemical, HPMTF, and there are still many

unknowns. From the chemical equation of HPMTF, the chemical formula of this new chemical substance has a head of hydroperoxy (HOO-), hydroperoxy radical is an important reactive agent in atmospheric chemical reactions, and other compounds combined with other compounds between the main electrostatic and orbital interaction is mainly dominated by the loss of one or a few electrons easily, and the characteristics of positron and positively charged particles are very similar. Experiments have shown that H2O2 is readily soluble in water and can remove sulfur S in DMS, (16) and CO gas from subsurface gas mines can naturally synthesize methyl thiocarbamate, a very stable organic chemical isomer . (17) Upon combination of hydrogen peroxide radical and methyl thiocarbamate, both sulfur and sulfate aerosols are anionic negatively charged particles properties, and mutual attraction of positively and negatively charged charged particles is a necessary physical condition for cloud condensation nucleation (CNN) generation. Based on the chemical reaction process that HPMTF easily dissolves in the water vapor of fine clouds and then removes sulfur, if our hypothetical EMB model can be valid for describing the formation of an absolute excess of total positively charged particle fluxes and densities under the surface during the brewing period of major earthquakes, the so-called difference in the concentration of positively and negatively charged particle fluxes is precisely the culprit behind the abnormal and drastic changes in the global climate. Then, it can be boldly hypothesized that the charged nature of this new chemical substance HPMTF, which is newly produced in the ocean, may be affected by the disturbing factor of the increasing flux of positronic particles before the great earthquake, and formed the cationic property of high electronegativity over the ocean, which ended the physicochemical process of converting most of the DMS into anionic compounds ahead of time, and thus greatly reduced the non-sea-salt sulfate aerosol production rates.

Characteristics of meteorological anomalies of oceanic earthquakes: As a result of large earthquakes under the oceanic crust of the ocean floor in the gestation period, high temperature and high conductivity of the magma and plate extrusion of multiple factors, resulting in the generation of seawater warming to the generation of adverse to the production of plankton dms to the anionic sulfate aerosol direction, the surface of the oceans and seawater generated by the negatively charged particles is not enough to and the positively charged particles flux to the combination of the neutral large droplet cloud, thus The positively charged or cationic compounds and aerosols are carried aloft by the oceanic monsoon to drift along the stratosphere to the northern and southern hemispheres of the Earth, resulting in disruptions in the atmospheric circulation or a country's geographic area of extreme drought and precipitation anomalies in the distribution of the formation of winter blizzards, the formation of summer rainstorms. Unusually hot weather and hot sea water are also formed.

Discounting climate change under normal conditions, as originally estimated by scientists, earthquakes and volcanoes account for only 5 percent of the global geothermal energy in global heat, generating about 46 trillion watts (46 terawatts or TW) of heat energy from the subsurface, with 2 TW of that coming from volcanic eruptions and earthquakes. (18) With the exception of earthquakes and volcanic eruptions, most of the geothermal flux is released as continuous geothermal flow. This is likely to underestimate the thermal energy generated by the accelerated half-life of nuclear decay isotopes such as U-235, U-238, and Thorium and Potassium incorporated into flowing magma during the pre-earthquake gestation period, the subsequent extension of the large mantle column plume into the seismic zone of the thin lithosphere, and the generation of excess positrons in the rock voids, as well as the accelerated half-life of nuclear decay isotopes such as U-235, U-238 and Thorium and Potassium. At the same time, the possibility of plasma wave generation in high conductivity subsurface fluids and localized magnetic reconnection on small scales beneath the surface cannot be ruled out, and it is likely that all four of the above reasons for generating the Earth's heat will multiply the effects of large earthquakes and volcanic eruptions on the release of geothermal energy into the atmosphere.

Making a comparison of the historical data related to mega meteorological disasters and large earthquakes, we find cite Schedule, 1876-1879 North China suffered a great drought, July 1, 1879 A.D. On July 1, 1879, a large earthquake of magnitude 8.0 occurred in Wenxian County, Gansu Province. 1920, the northern provinces of China, such as Shandong, Henan, Shanxi, Shanxi, Shaanxi and Hebei, suffered a great drought not seen for more than 40 years. In 1920, Shandong, Henan, Shanxi, Shaanxi, Hebei and other provinces in northern China suffered a drought that had not been seen for more than 40 years, and on December 16, 1920, an 8.5-magnitude earthquake struck Haiyuan County in Ningxia, China. 1928-1930, Northwest China suffered a century-old drought, centering on Shaanxi, forming a drought-stricken area that accounted for nearly two-thirds of the entire land area of China. The drought lasted for three years, and on December 25, 1932, a 7.6-magnitude earthquake struck Changmabao, Gansu Province, killing and injuring more than 70,000 people, while the 7.8-magnitude earthquake in Tangshan, China, in 1976 was preceded by a major drought in northern China. (19)

In 1998, a magnitude 7.1 earthquake occurred off the northern coast of Chile. Although this year of the Great Drought in Chile was more severe than the years

shown earlier, the fact that only strong earthquakes of less than magnitude 7.5 occurred seems to be a paradox in the continental seismic pattern of the EMB model. However between 1998-2001. Two magnitude 8 and 8.4 occurred off the coast of Peru, which is part of the same South American seismic plate as Chile. It was also demonstrated that there is a good fit between mega-droughts and precursors of large earthquakes. According to the records of the World Meteorological Organization (WMO), the period between 1997 and 1998 was the worst year of El Niño in the 20th century, and the average temperature of the ground and sea level in that year was only 0.4 degrees Celsius higher than the average temperature of 16.5 degrees Celsius of the 30-year period from 1961 to 1990; and for all of the year of 1998, the global temperature of the land and the ocean was 0.7 degrees Celsius higher than the 1997 average temperature of 0.7 degrees Celsius. cite https://www.pmel.noaa.gov/elnino/what-is-el-nino. 而 1997-2001 年 Six major earthquakes of magnitude 8 or greater occurred globally, including two major earthquakes in Peru exceeding magnitude 8, and one each in the southern Indian Ocean and Turkey exceeding magnitude 8, all of which had the potential to greatly affect the countries in the seismic zone of atmospheric and oceanic circulation in the east-central equatorial Pacific. If one assumes that the EMB model of oceanic precursors to large earthquakes that can affect the climate along the Pacific coast of the eastern and western hemispheres can be self-consistent, then the two magnitude 8.4-8.6 mega-earthquakes that occurred in Indonesia on the morning of April 11, 2012, including the strong 6.9 magnitude earthquake that struck the U.S. off the coast of California in 2012, can be reconciled even with the resultant El Niño phenomenon and the 2012 U.S. largest earthquake of magnitude 8 or greater since the the hottest and driest meteorological disaster event since meteorological records began in 1895, (20) Cite earthquake information from the German Seismological Network: http://geofon.gfz-potsdam.de/eqinfo/list.php

We have done rough statistics based on the correspondence between some of the global historical records of large 7.5-magnitude earthquakes and mega droughts and heavy rain and snowfalls, and mega meteorological hazard events are formed on average from half a year to 3.5 years before the occurrence of large earthquakes in advance, and there seems to be a more convincing correlation between mega meteorological hazard events that do not occur once every 50 years and the precursors of large earthquakes with a more persuasive correlation of statistical fit. Yet the reasoning that mega-meteorological catastrophe events are precursors of large earthquakes based solely on such a simple enumeration of juxtapositions is sure to be met with the same criticisms of Geng Qingguo's drought-earthquake modeling that have been made previously by fellow seismologists. It is also and likely to be strongly challenged by meteorologists.

It is known that even if it occurs in the center of the magnetic umbrella, the formation of dense clusters of positron particles causes a mega-drought that corresponds directly to the epicenter of the umbrella in the vertical direction of the umbrella's handle. However, large earthquakes occurring directly below the center of the magnetic umbrella are exceptional. That is, the simplest EMB model. Earthquake forecasters have not always been so lucky as to encounter megadroughts in areas where the epicenters of large earthquakes occur in almost the same geographic location. The atmospheric circulation is influenced by the oceanic monsoon, and the spatial state of the positively charged particle flux forming the EMB is constantly shifted with the atmospheric circulation, as if the magnetic umbrella created in the region of the large earthquakes is drifting through the stratosphere.

Therefore, in reality, just using the occurrence of a large meteorological disaster event as a precursor to a large earthquake, although there are meteorological records that do not occur in 50 years and the occurrence of large earthquakes of magnitude 7.5 or more corresponds to the time and magnitude of the two elements of the three elements of the earthquake prediction, the most difficult is how to predict the epicentral range of the large earthquakes?

In the following, we start from the Wenchuan 7.8 magnitude earthquake in China in 2008, and specifically reveal the idea of the backtracking method in the EMB model applied to the medium-term prediction of large earthquakes.

In May 2008, a 7.8 magnitude earthquake struck the Wenchuan region of Sichuan, China, a strong continental-type earthquake typical of the Eurasian continental plate squeezed by the Indian Ocean plate. In terms of unusual meteorological events prior to the earthquake, in 2007, China experienced a 60-year drought in Gansu, a 100-year drought in Heilongjiang, a severe high-temperature drought in Jiangnan and South China, and a 50-year drought in the fall that lasted until early winter. Special drought occurred in some parts of Sichuan, and in early 2008, Hunan and Jiangxi in southern China were hit by a huge blizzard. (21) (22) According to the magnetic umbrella EMB model, at least these mega-meteorological anomalies in mainland China were precursors to major earthquakes.

However, over a wide area spanning thousands of kilometers, it is critical to determine the extent of the epicenter.

According to the central location of the umbrella state geography of the EMB, the predicted positioning of the epicenter of a large earthquake should first correspond to the region of the eruption of the flux of

positively charged particles of the straight-up type under the c umbrella handle, i.e., Sichuan, Gansu, and Heilongjiang;

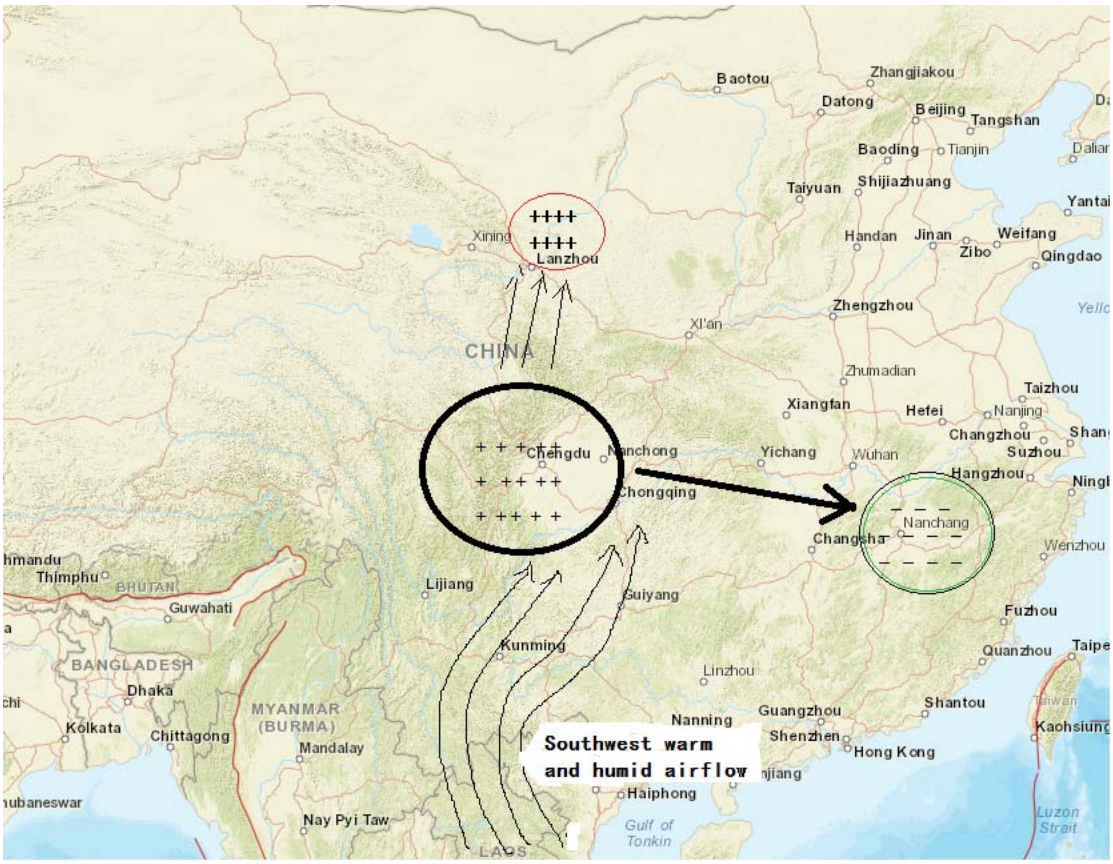
First, the water vapor generated in the Indian Ocean moves northeastward through the southwest monsoon, forming the Southwest Warm and Humid Current (Bay of Bengal Warm and Humid Vapor). As the Himalayan mountain system blocks part of the northern cold air from going directly southward and pushes the cold air along the northern side of the mountain system to extend to the eastern land, the southwestern warm and humid airflow enters into the hinterland of China through the southwestern part of the country, and it is an inevitable route that dominates the significant precipitation in the hinterland of northwestern China and northern China. According to the Chinese hinterland precipitation conditions in a large degree depends on the southwest warm and humid airflow into the route, can not be simply the occurrence of a mega-drought in Gansu has the potential to occur in Gansu, Ningxia, as a simple link to a large earthquake prediction basis. And from Gansu and Heilongjiang have appeared more than 50 years do not meet the mega-drought meteorological disaster event analysis, Heilongjiang to Gansu, the distance of 2697.5 kilometers, in mainland China, the two places so far apart, it is unlikely that two 7.5 magnitude earthquakes at the same time probability of seismic precursors above the large earthquake. Therefore, the possibility of a possible epicenter of a large earthquake must first be ruled out from these two provinces.

Since in 2007 and early 2008 China appeared to be in line with the EMB model of the precursor of large earthquakes in large meteorological disasters, can not simply use the occurrence of large drought in the region of the inevitable existence of large earthquakes in a simple way of thinking, the epicenter of the epicenter is located in Gansu or Heilongjiang, we have to be generated from the EMB model of large meteorological disasters, reverse tracking of large earthquakes in the epicenter of the range. The so-called reverse tracking method is to use the reverse thinking, from the root of the impact of Gansu and Heilongjiang mega-drought, to trace the warm and humid airflow from the southwest to enter the hinterland of China to change the route, and to analyze the cause of the mega-blizzard disaster in Hunan and Jiangxi.

As mentioned in the EMB model above, near the end of a major earthquake's gestation period, the overproduction of positively charged particle fluxes under the surface gradually diminishes, and the kinetic energy of the positively charged particles that rise down the center of the EMB rolls down from the center of the umbrella to the edges of the umbrella, where it combines with the flux of negatively charged particles around the edges of the EMB to create a large meteorological precipitation condition.

From the scope of the EMB umbrella formed before the earthquake, Gansu is about 1,625 kilometers away from Hunan, more than 1,700 kilometers away from Jiangxi, and Sichuan is almost 1,194 kilometers away from Hunan, Sichuan's geographic location and the characteristics of the seismic zone are more likely to be consistent with the large outbursts of positively-charged particles fluxes during the period of earthquake brewing to be concentrated in the central state of the umbrella. The central state of the umbrella. That is to say, the drought in Gansu, which has not been encountered for 60 years, is probably not a precursor of a major earthquake in Gansu, but due to the excessive positively charged particle clusters in the EMB over Wenchuan, Sichuan Province, obstructing the necessary routes for the Bay of Bengal's warm and humid air to enter China's inland hinterland of Northwest China and North China, and altering the uniform distribution of positively and negatively charged particle fluxes in the normal period of the Chinese geospace, due to the fact that the more than normal weather has a greater number of positively charged particles in the water vapor than in the normal weather. More than normal weather caused positively charged particles in water vapor to combine with negatively charged sulfate aerosols, quickly causing CNN and evolving into exceptionally heavy rain and snow clouds sinking to low altitudes, in the winter cold air exchanges, the formation of large hail and frost weather and blizzard disasters in southern China in early 2008. This situation is not uncommon in China's historical records of large seismic events; after a major drought in Gansu Province in 1920, the December 1920 Guyuan A magnitude 8.5 mega-earthquake in Gansu Province in 1920, and an 8.5 magnitude earthquake in Guyuan in December 1920. And before the 1927 Gansu Gulang 8.2-magnitude earthquake, no major drought events occurred in Gansu province between 1924 and 1927; instead, extreme rainstorms occurred continuously in the Jiangnan region of China from 1921 to 1926, with mega-floods lasting more than five years.

And Chinese seismologists' research on the precursors and plates of the pre-2008 Sichuan Longmenshan earthquake also suggests that the Sichuan seismic zone is closer to the territory of high incidence of large earthquakes. Therefore, as can be seen from the figure, Cite Attachment Finally, combining meteorological and seismological analysis, the most probable range of the earthquake epicenter can be located in the area of Longmenshan, Sichuan.




*Notes:*

The multiple thin line arrows show the routes of warm moist moisture from the Bay of Bengal into Yunnan-Sichuan, China;

*The large circle is the Longmenshan seismic zone in Wenchuan, Sichuan, and the + represents a positive charge;*

The green circle represents that due to the opening of the emb on Wenchuan, the warm and humid water vapor in the Bay of Bengal shifted to the south of China, and part of the flux of positively charged particles tumbled down to the edge of the emb and combined with low-altitude negatively charged particles in the eastern part of China, such as Hunan and Jiangxi, to form a mega blizzard and a cold wave.

The red circle indicates that Gansu in the northwestern interior of China suffered a 60-year drought in the second half of 2007 as a result of a flux burst of positively charged particles exposed to the brewing period of the Wenchuan earthquake.

For oceanic earthquakes, Japan's 9.1 magnitude earthquake of March 11, 2011 belongs to the classic example of mega seaquake because of Japan's relatively simple geographic conditions and climate change, and before the 3,11 earthquake, the plate beneath the offshore of Japan's Fukushima region was in a state of intense extrusion and microfracture of the lithosphere, and huge fluxes of positively charged particles were rising from the surface of the ocean in front of Fukushima and ascending to above the dozens of kilometers the stratosphere , drifting toward South Korea. Korea is adjacent to the Changbaishan mountain range in China, which is the "umbrella edge" of the EMB model. When the positively charged particle flux and sulfate aerosol from the Fukushima sea area in Japan are brought to the eastern part of Korea 1000 km away from the stratosphere by the warm and humid air from Japan, the positively charged particle flux in the high altitude is attracted by the negatively charged particle flux in the low altitude, and condenses into low altitude precipitation clouds quickly. condensed into low-altitude precipitation clouds, which descended from the high altitude to the low altitude several kilometers from the surface, forming the 50-year unprecedented blizzard disaster in Gangwon Province, Korea.... Based on the atmospheric circulation in the two neighboring countries of Japan and South Korea, applying the reverse tracking method, it is also important to focus on the fact that Japan's 2011 was one of the hottest years in terms of temperature on record, and according to the Japan Meteorological Agency's records, 2011 was the hottest year for weather in Japan after 1995 (the Kobe Earthquake),, and thus it can be predicted probabilistically and more readily that a large earthquake of magnitude 7.5 or greater will be highly likely to occur in the sea off the southeastern part of

Japan. Cite dacao (2011-2022) Fig Earthquake Prediction History. https://figshare.com/account/home

## II. Discussion and Exploration

Turkey's two major earthquakes of magnitude 7.4-7.7 in February 2023 shook Turkey, killing and injuring more than 40,000 people, making it one of the worst continental plate earthquakes in history in terms of seismic hazard. The analysis of earthquake precursors in Turkey using the emb model is even more complex, the By the standards of a 50-year event of exceptional meteorological disaster, in 2022, Europe and India, Pakistan have suffered from extreme weather, with Europe experiencing the worst drought in at least 500 years,(23) 2022 India's hottest and hottest year in 122 years, and Pakistan suffered the hottest weather in 61 years April to May, daytime temperatures in most areas were 5-8 degrees Celsius warmer than normal for previous years degrees Celsius Pakistan suffered rare extreme heat, in some mountainous areas, the abnormal high temperature accelerated the melting of snow and ice July to August, the State of Pakistan's national rainfall is nearly 190% higher than the average over the past 30 years, while the southeast of Pakistan's Sindh province, which is adjacent to India to the east and bordered by the Arabian Sea to the south, the rainfall is 466% higher than the average, occurring in 30 years have not encountered a mega-flooding. (24)

Using the analysis of the mechanism by which the increasing flux of positively charged particles in the center of the EMB umbrella corresponds to the cause of the formation of megadroughts, both the European continent and the Indian subcontinent can be hypothesized to have the potential for the occurrence of megathrust earthquakes. However, our previous analysis of the cases of great earthquakes in China and Japan has already shown that one cannot simply make a connection between a mega-drought event in a certain geographical area and the possibility of a great earthquake, and that one must apply the principles of the reverse tracking method to strip away the factors interfering with the mega-meteorological event and find clues to the precursors of a great earthquake.

Researchers working under the EU-funded SHARE project have produced a map showing which parts of Europe are most at risk from earthquakes, with Italy, the Balkans, Greece, Bulgaria, Romania and Turkey among the most earthquake-affected parts of the continent, and the continent's Nordic Plain including Poland , and Germany Northern and Denmark and much of western France, like the Central Plateau of the Indian subcontinent, are part of the stable geologically structured Craton continental crust, which is seldom prone to seismic hazards. Therefore, when speculating on the epicentral extent of major earthquakes, one should first focus on those landmasses with high seismic activity.

A 2012 study by geophysicists of global stratigraphic imaging models revealed the presence of a super-mantle column in the lowest mantle beneath Africa. (25)(26) The mega-mantle column beneath East Africa continues to upwell and plume through the dome shaped mantle column into the soft flow ring, forming a 2,500 kilometer long subterranean channel across the African continent, the Mediterranean Sea, to southern Europe and the Balkans. Turkey has no mantle column beneath its geological structure, and the intense extrusion of the lithosphere in the Anatolian region originated from the transportation of highly heated magma from this underground channel of the East African super-mantle column's chondrites, which supplemented the crushing power of the plates. Researchers were surprised to find that, despite passing through 2,500 kilometers of soft flow channels, the hot magma did not cool, but was hotter than average.

Reviewing the positive feedback mechanism of self-reinforcement of positively charged particles of the EMB model expressed in the article above, it seems that a possible answer is found in it.

Assuming that the supply of highly heated mantle material fluid-"highly conductive magma"-supplied by the long-distance lateral transport of supply from the upper mantle of East Africa to the lower Anatolia, Turkey, continues to create excess fluxes of positrons and positively charged particles in melting subterranean channels of igneous rocks in the upper mantle and the soft rheosphere, a new self-consistent conclusion can be drawn for the 2022 European continent and the Indian subcontinent mega-meteorological disasters, a new self-consistent conclusion can be drawn. That is to say this high energy, high heat magma coming from the lower mantle of East Africa, one of the two global super mantle columns, is undoubtedly the culprit for the unprecedented scorching heat and mega not encountered in 500 years in France, Germany, Spain, Italy and 2019-2022. It is also the root cause of the formation of the 50-degree hot climate in India and the mega floods in Pakistan in 2022. (27)(28) It is as if a huge long trench is cracked open in the ground, and the long trench is endlessly burning oil, then this long trench will feel the heat of the blazing moxibustion rising in whatever area and water pool it passes through the perimeter of.

From the above-mentioned analysis of land and sea-based earthquakes, it is clear that the mega-meteorological disasters that occurred at the edge of the embracing umbrella, namely, extremely heavy rainfalls in summer, extremely heavy snowstorms and hailstorms in winter, and the 30-year floods in Pakistan, were meteorological anomalies that occurred around the umbrella, whereas the areas in the central part of the

umbrella were characterized by mega-droughts. Therefore, based on the seismic activity factor of the geological structure and the type of mega-meteorological disaster events, the epicenters were first circled with the driest regions of Europe and the Balkan Peninsula. Then, based on the fact that the plate activity underneath Anatolia in southern Turkey has been recognized by seismologists as the main area of concern for major earthquakes, the possibility of an earthquake of magnitude 7.5 or greater occurring in France, Germany, and the Baltic countries of Eastern Europe was ruled out, and the epicenter was finally located in Turkey.

Certainly, the results of the research on the East African mantle column affecting the thermohydrofluidosphere and plate activity in Anatolia were published on January 19, 2023, and the use of the emb model to study the probable timing of large earthquakes is generally a timescale for medium- to long-term earthquake prediction, and it seems to be an act of hindsight after the horse's back to analyze the use of a mega-meteorological catastrophe event to circle a large earthquake in Turkey on February 6, 2023 in the way that we have done. However, therefore if one goes back to the mega meteorological hazard events that do not occur for more than 50 years in the three years 2019-2022, and applies the principles of the EMB model to exclude geographic areas with the smallest probability of a major earthquake, Turkey and Greece are the most likely options to arrive at a major earthquake. Among them, a strong earthquake of magnitude 7 has already occurred in the Aegean Sea of Greece in October 2020, and the mega meteorological disaster in 2022 is characterized by a mega drought that has not been encountered on the European continent for 500 years, which can also exclude the option of a major earthquake in Greece more easily, while the Arabian plate has been moving northward and colliding with the southern edge of the Eurasian continental plate Turkey is located exactly at the junction of the three major plates, namely the Asia-European plate, the Indian Ocean plate and the African plate, and crosses the northern part of Turkey. The North Anatolian Fault Zone, which crosses the northern part of Turkey, has been recognized by the international seismological community as one of the most seismically active regions in the world, with strong earthquakes of magnitude 7 or higher occurring in 2015, 2017, and 2021. When combined with the combined efforts of meteorologists, seismologists and geophysicists to analyze the factors influencing the various emb patterns on the European and Indian subcontinents, as well as the Mediterranean Balkan Peninsula, there is a high probability that a more accurate judgment about the possibility of a major earthquake in Turkey could have been made three months ago.

## III. Conclusion

The Emb model is a medium-term earthquake prediction method that tracks large earthquakes in reverse with a mega meteorological hazard event, and its mechanism is to take the seismic electromagnetism precursor data during the gestation period of large earthquakes as the intrinsic logic, and to indirectly verify the occurrence of global electron density anomalies and concentration differences in the fluxes of positively and negatively charged particles as precursors of large earthquakes by utilizing a mega meteorological hazard event that does not occur for 50 years against the backdrop of incomplete observations of satellite data. advance warning of the probability of a major earthquake. Of course, the causality of climate variability is highly controversial, and different perspectives on meteorological hazards lead to different conclusions. To make the EMB model a successful model for medium-term prediction of large earthquakes, a comprehensive frontier scientific team involving seismologists, solid-state geophysicists, and meteorologists must be formed to not only collect and pay close attention to mega-hazardous events, but also to carefully differentiate between the influencing factors and the filtering factors that are not precursors of large earthquakes, so that the EMB model can be used to predict large earthquakes in advance. Factors that are not precursors of large earthquakes, and to obtain more adequate and reliable scientific and technological validation results on the observational data of the difference between the flux concentrations of positively and negatively charged particles, in order to move forward the research on seismic precursors of large earthquakes.

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*Commitment*

The author declares that he has no conflict of interest with others.

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# Mapping of the Biophysical Impacts of the Opening Works of a New Pass on the Sandy Coast of Grand-Lahou (Ivory Coast)

By Jacques André Tiemele, Brou Roger Sylvestre Brou & Eric Valère Djagoua

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*Abstract-* The problem of the dynamics of the Grand-Lahou sandy coast has led to the design of an investment and management project for coastal areas in Côte d'Ivoire (West Africa Costal Areas project), with the main objective of carrying out work to stabilize the sandy coast. The objective of this study is to map the biophysical environmental impacts of these protection works. To do this, the Land Cover and Land Use (LCLU) was possible thanks to the processing of data from the USGS Earth Explorer (https://earthexplorer.usgs.gov/) and Earthdata, what are Landsat 8 OLI TIRS, Landsat 7 ETM and ASTER DEM images. An interpolation of the NDVI, NDBI and MNDWI indexes was necessary for the realization of of the environment baseline. Google Pro images from the CNES Airbus sensor were used to map the biophysical impacts of the work. These are a total of 98 potentially destroyed trees, a building with an area of 97.14 m2, surfaces of aquatic plants of 678.82 m2 and 113.54 m2, a surface of shrubs and grasses of 327, 37 m2 and a lake ecosystem of 1646.83 m2.

*Keywords:* *sandy coast, grand-lahou, biophysical impacts, integrated coastal development and management plan.*

*GJSFR-H Classification:* *LCC: Q342*

*Strictly as per the compliance and regulations of:*

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*Keywords: sandy coast, grand-lahou, biophysical impacts, integrated coastal development and management plan.*

## I. Introduction

According to recent observations by the National Aeronautics and Space Administration (NASA), the sea level varies from the 1850s until the 20th century and is rising with increasing speed of 5mm/year (ENGLANDER, 2021). This sea-level rise contributes to coastal erosion and is a major problem for decades to come. Globally, 24% of coastal areas are eroding at rates greater than 0.5 m/year (Luijendijk et al., 2018). These coastal areas are home to valuable wetlands, rich fisheries, oil and gas reserves and high tourism potential (UNIDO, 2011). However, they are under severe pressure, including rapid urbanization and migration to the coast which have increased the demand for land, water and other natural resources (World Bank, 2015a). Artificial infrastructure and sand extraction have contributed to significant coastal retreat, which could reach 10 m/year in highly vulnerable areas (Giardino et al., 2017). In Côte d'Ivoire, research has shown an evolution (erosion/accretion) of sensitive sectors such as the coastal areas of Grand-Lahou, Abidjan and Assinie (HAUHOUOT, 2000, 2008; ABE, 2005; TOURE et al., 2012; N'DOUFFOU, 2012) related to developments (KONAN et al, 2016). In Grand-Lahou for example, the variations observed between 1998 and 2014 made it possible to record an erosion of the coasts of the village of Lahou-Kpanda of -0.84 m/year, a village located in the zone of the mouth of the Bandama river (Djagoua et al. 2016). In addition, studies report that the migration of the mouth is accelerating and shows a migration speed that reaches 170 m/year over a coastal length of 1.1 km, between 2010 and 2017 (Lombardo, 2017). To do this, a resilience project for this coastal zone was initiated by the Ivorian Government and financed by the World Bank, called the WACA project (West Africa Coastal Areas project). One of the main activities of the project is to undertake works for the stabilization of the sandy coast, in particular the opening of a new pass and the filling of the existing pass by dredging of sediments. However, these works are not without harmful consequences on the environmental resources of this coastal zone.

*Presentation of the study area*

The study area includes part of the sandy coast of the city of Grand-Lahou, limited to the north by the Tagba lagoon, to the south by the Atlantic Ocean, to the east by the village of Braffédon and to the west by the village of Lahou-Kpanda (figure 1).

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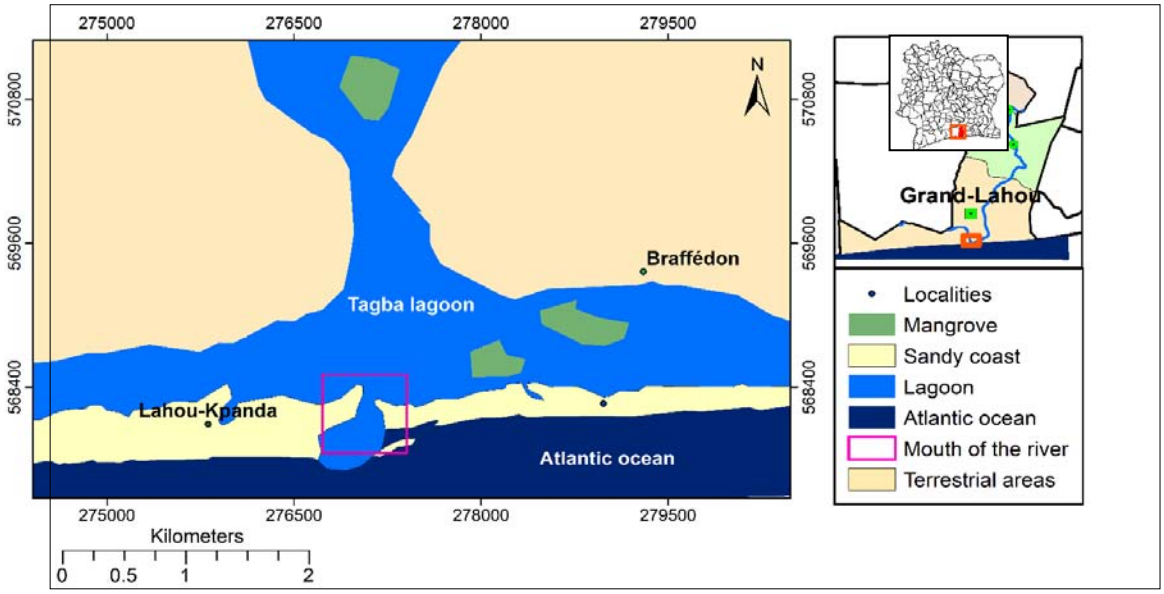


*Figure 1:* Location of the Study Area

## II. Datas and Methodology

*a) Datas*

As part of this study, several data were used, such as the USGS Earth Explorer site (https://earthexplorer. usgs.gov/) and Earthdata, which are Landsat 8 OLI TIRS, Landsat 7 ETM and ASTER DEM images. Indeed, LANDSAT images will make it possible to determine the evolution or change observed in a given area over time. As for the ASTER images (ASTER Global Digital Elevation Model 1 arc second), they are referenced in the geodetic coordinate system (WGS 84) on the 1996 Earth Gravitational Model (EGM 96) geoid and make it possible to observe the relief, the courses of in order to define the surface and depth volumes according to reference points. Theses datas will make it possible to assess the volumes of the right-of-way of the works. Other data comes from the Google Earth Pro application. These are aerial images acquired on January 17, 2020, downloaded from Google Earth Pro, seen at 871 m from the CNES Airbus sensor and constituting data elements recorded in the WGS 84 system. Seven images were recorded with a maximum resolution (4800×2803) marked by twenty-eight (28) points including four (04) per image. The digital processing of the data and the cartographic layout were carried out using the ARCGIS 10 software.

*b) Methodology*

*Techniques for inventorying the environment baseline of the project footprint*

The inventory of the environment baseline consisted in the realization of the Land Cover and Land Use (LCLU) of the zone of study by the treatment and the classification of the spectral signature of satellite images. This classification was made by combining known indices such as Normalized Difference Vegetation Index (NDVI), Normalized different Bare Index or Normalized Difference Built-up Index (NDBI) and Modified Normalized Difference Water Index (MNDWI). These respective indices will make it possible to highlight the three main classes of the OSUS, that is to say, vegetation, buildings, bare soil and water. The superposition of these three (03) classes will make it possible to describe the environment baseline.

*Identification of the impacts of the works on the environment*

The approach to identifying the impacts of the works on the environment was done by creating high-resolution images, taken from Google Earth Pro images of the work site. This approach was based on the pooling of several images recorded with high resolution by creating a single image per mosaic. This technique will highlight the entities or surfaces impacted by spatial interpolation.

## III. Results

*a) Variation of the indices, NDVI, NDBI et MNDWI*

The calculation of NDVI makes it possible to present 3 types of vegetation corresponding to trees, shrubs and grasses. Values from 0 to 9,727 correspond to trees and those greater than 9,727 are shrubs and grasses. As for the NDBI, the value greater than 0.002 makes it possible to highlight the categories of built soils or built surfaces (value 0 to 11, 39) and bare soils (values greater than 11,39). Regarding MNDWI, it highlights 3 main classes of water, namely clear water (0 to 9,398), turbid water (greater than 9,398 to 10,014), visible sandy water (greater than 10,014). Figure 2 presents the variation of the indices.

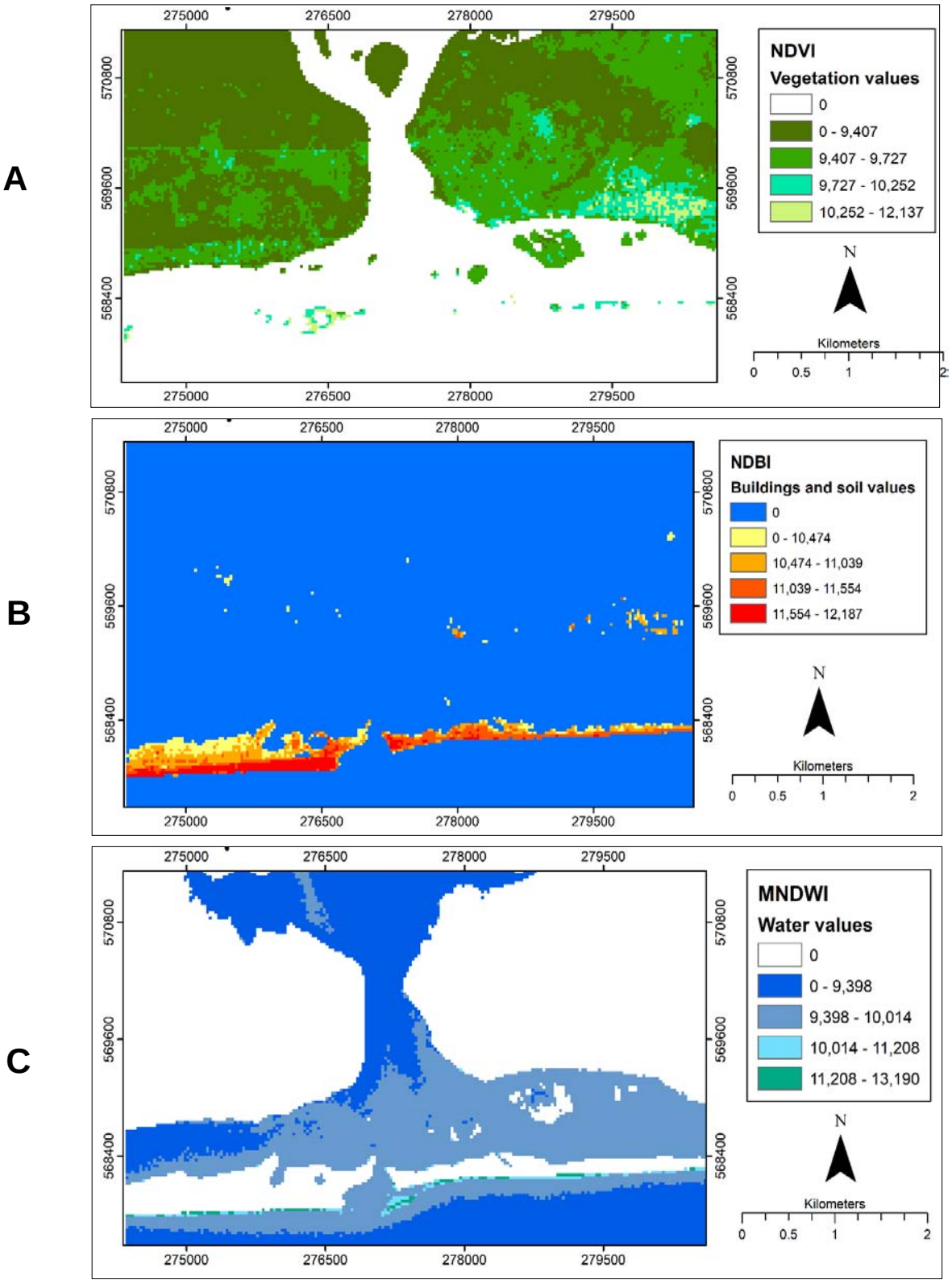


*Figure 2:* Variation of the Indices, NDVI (A), NDBI (B), MNDWI (C)

*b) Baseline of the Environment by Combination of Indices*

The combination of indices made it possible to observe 3 major classes of land use in the project area, including vegetation, sandy coast and water. The vegetation consists mainly of dense forests, gallery forests, forest islands and mangroves. The aquatic environment is made up of the Tagba lagoon, bordered by the Atlantic Ocean. As for the sandy coast that

separates the Atlantic Ocean from the Tagba lagoon, it includes buildings and bare soil (Figure 3).

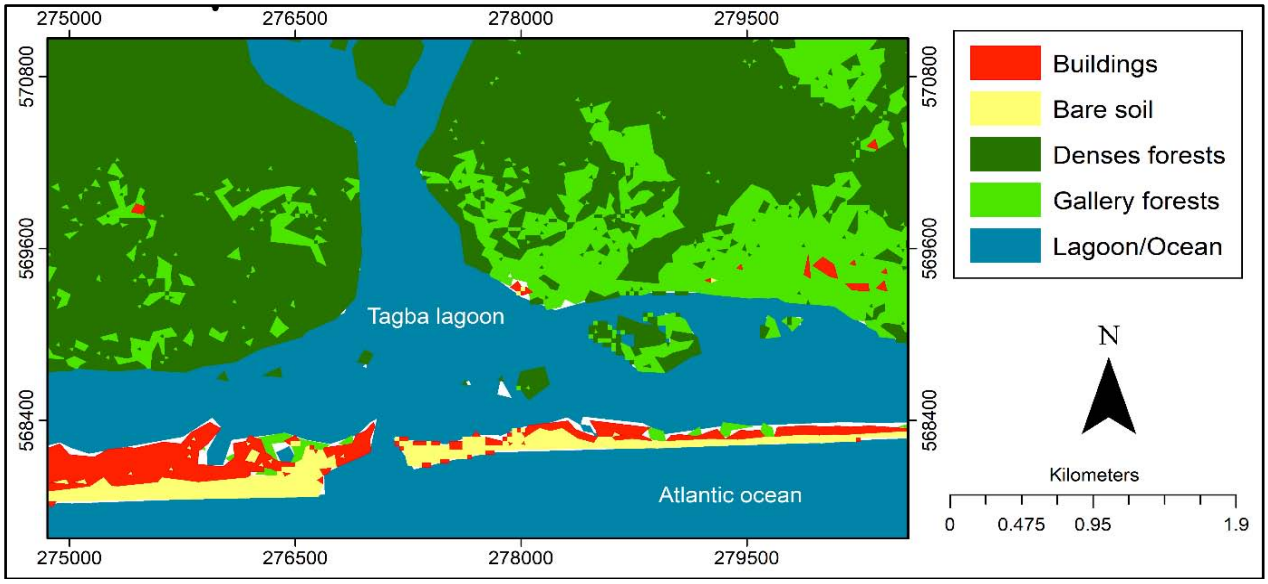


*Figure 3:* Baseline of the Environment by Combination of Indices

c) *Impacts of the Work to Open a New Pass on the Sandy Coast*

i. *Right-of-way*

Work to open a new pass to the east of the sandy coast will be undertaken to facilitate natural exchanges between the Tagba lagoon and the Atlantic Ocean. A site base with a total area of 45,502.18 $m^2$ could be built, consisting of a site fence, parking areas for machinery, storage of materials, site offices, etc. Figure 4 shows the location and surface of the right-of-way for the opening of the new pass on the sandy coast.

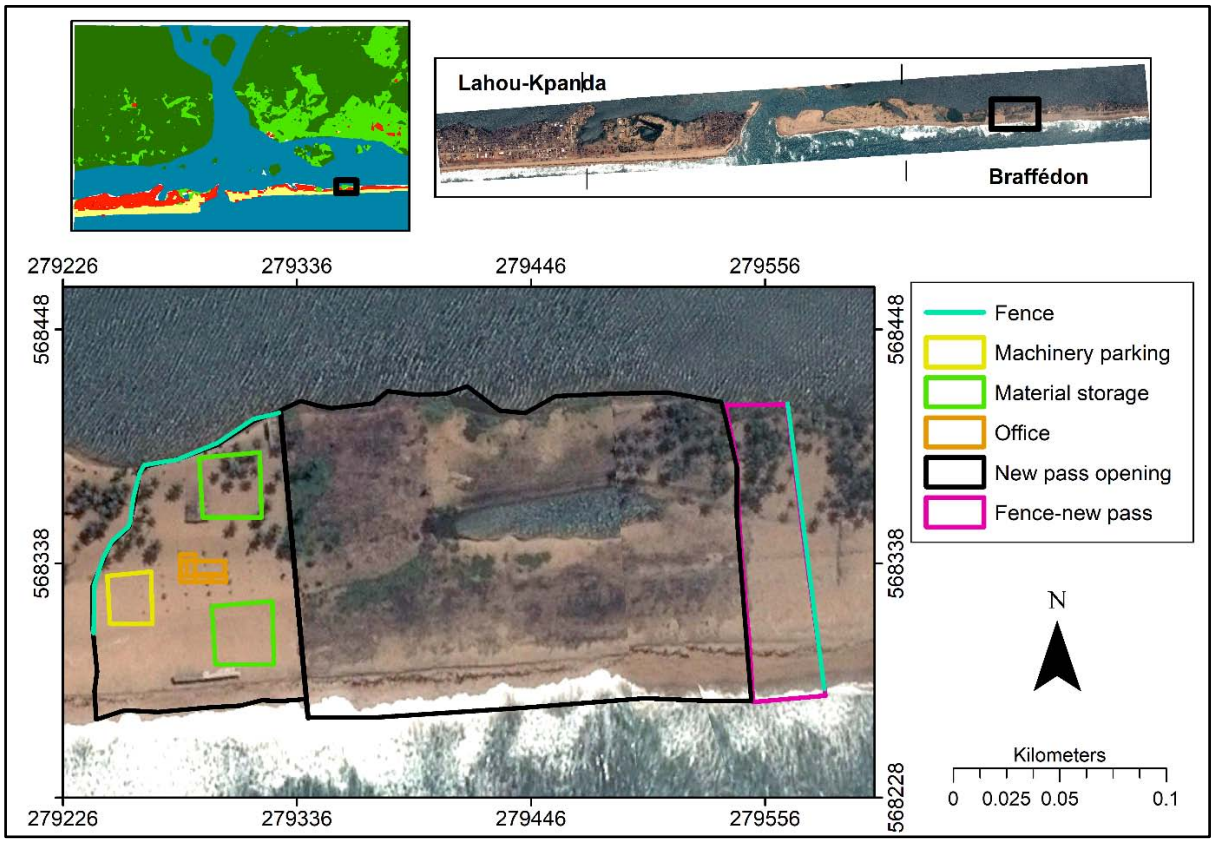


*Figure 4:* A *Right-of-Way of the Opening of a New Pass*

ii. *Impacts of works*

The opening of the new pass on the sandy coast is not without consequence on the biophysical environment, it will cause negative impacts there, in particular the destruction of 98 trees which could belong to the Palmaceae family, a building of a area of 97.14 $m^2$, two surfaces of aquatic plants (one of 678.82 $m^2$ and the other of 113.54 $m^2$), a surface of shrubs and grasses of 327.37 $m^2$ and a lake ecosystem of 1646 .83 $m^2$. Figure 5 shows the significance of the impacts of the work to open this new pass on the Grand-Lahou sandy coast.

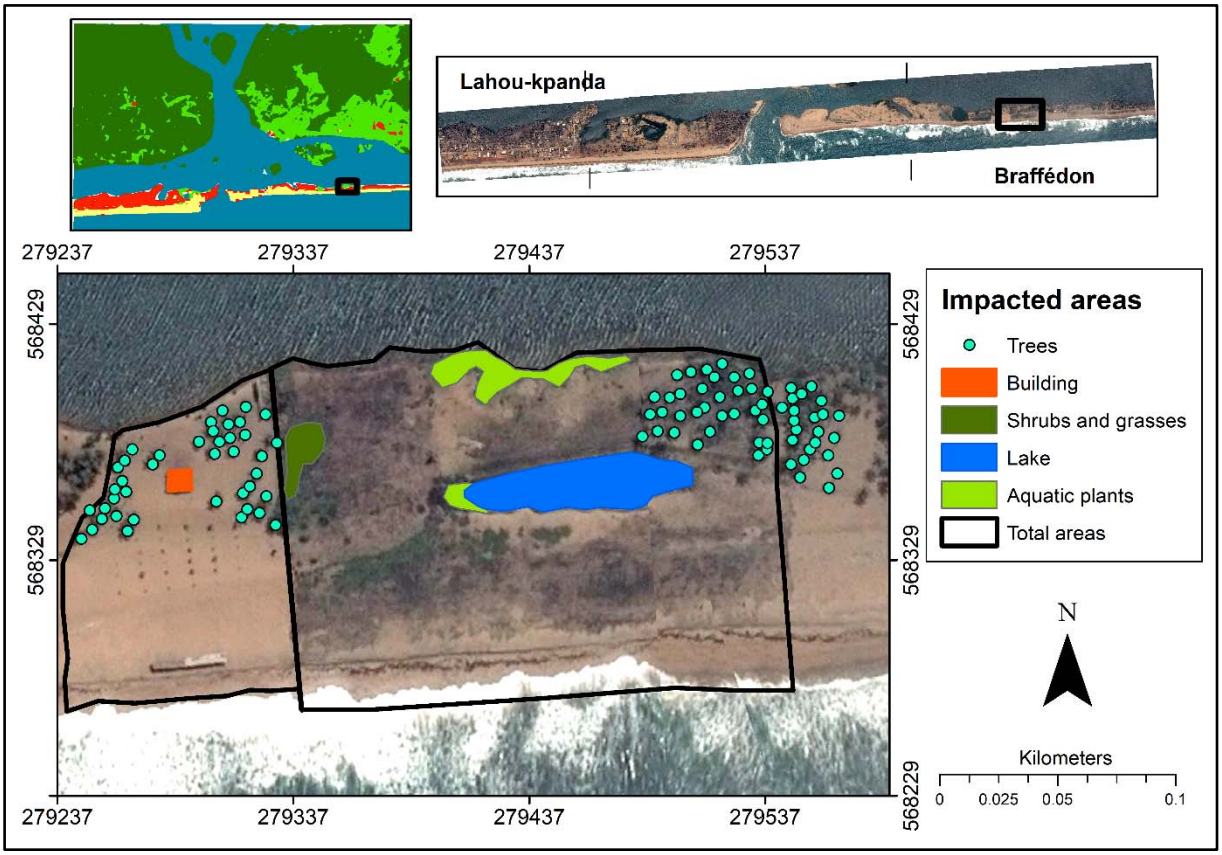


*Figure 5:* Map of the Impacts of the Opening of the New Pass on the Sandy Coast of Grand-Lahou

## IV. Discussion

The realization of the Land Cover and Land Use by the interpolation of the indices NDVI, NDBI and MNDWI is a method which makes it possible to bring out the three main elements of the surface of the ground which are the vegetation, the materials (the buildings and the bare ground) and water. Indeed, NDVI is known for vegetation, NDBI for bare soil and infrastructure and MNDWI for water. These indices are used in mapping studies of urban areas and bare soils (KHALLEF et al, 2020). They can be used to study the evolution of Land Cover and Land Use (EL GAROUANI et al, 2021). The importance of the realization of the Land Cover and Land Use is part of the complexity of the study area, characterized by the mouth of the Bandama river, the lagoon complex, the sandy coast and the Atlantic Ocean, subject of several scientific works and publications for more than 50 years (BEDEVELOPMENT, 2017 ; DHI, 2015). On the basis of the existing data in the literature and collected, it appears that the stability of the mouth of the Bandama river is conditioned by the conjunction of the concomitant actions of the tidal currents (filling and emptying of the lagoon) and the flow of the river on the one hand, which keep the existing mouth open, and from the littoral drift generated by the swell on the other hand, which tends to close it. To do this, numerical and physical modeling studies were carried out to understand this complex dynamics, which made it possible to highlight the role of helical currents in the updrift migration (direction opposite to the coastal transit), from the ebb delta in the natural bypass of the transit on either side of the outlet and the influence of the position of the mouth of the Bandama river, along the sandy coast in the mechanism of its migration (LE DISSEZ et al., 2022). This therefore made it possible to carry out a phasing study of the opening of the new pass and the closing of the current one, a crucial point for the success of the work based on the numerical model studied.

## v. Conclusion

This study is initiated to understand the approach to the environmental impact of coastal protection and preservation works carried out in complex estuarine areas. This approach made it possible to calculate, map the Land Cover and Land Use Indices in order to combine and interpolate them, with a view to identifying the biophysical impacts of coastal zone protection works. The use of high-resolution images from Google Pro's image mosaic helped to better appreciate the value of these impacts. Knowledge of these impacts should therefore enable the Contracting Authority to put in place compensation or adaptation measures for the populations affected by the works and to insert into the the contracts of the works companies, measures to reduce the impacts, in particular the planting of plant species to effectively combat coastal erosion and which plays an important role in carbon sequestration. Further studies could also bring out the mapping of the economic and social aspects of the project. These results could then constitute effective tools for the technical and environmental feasibility of resilience projects against the effects of climate change.

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# Fossil Fuel, Greenhouse Gas and Global Warming

By Chunji Liu & Tao Liu

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*Abstract-* Since the Industrial Revolution, fossil fuel consumption and greenhouse gas emission have increased substantially, causing the rise of greenhouse gas concentration (GHGC) and in turn the rise of global mean surface temperature (GMST). We analyze the years of the rises and the falls of global temperature fluctuation, and find that the natural time interval between the rise and the fall of the temperature fluctuation has decreased from 31.5 years to 23 years, the impact from human activities has increased from 2.5 years to 9 years. We analyze the shares of total solar irradiance (TSI), greenhouse gas concentration (GHGC), and water vapor for the rise of GMST, we find that: TSI accounts for 23.4% for greenhouse effect from 1880 to 1964, and 12.4% from 1965 to 2022; GHGC accounts for 80.9% for greenhouse effect from 1880 to 1964,and 86.6% from 1965 to 2022; water vapor is negatively related with GMST from 1880 to 1964, accounting for -4.3% for greenhouse effect, and positively related with GMST from 1965 to 2022, accounting for 1% for greenhouse effect. Global warming hiatus from 1998 to 2012 is a shortened fall of global temperature fluctuation.

*Keywords:* *fossil fuel, greenhouse gas, total solar irradiance, global warming.*

*GJSFR-H Classification:* *FoR Code: 0502*


*Strictly as per the compliance and regulations of:*

# Fossil Fuel, Greenhouse Gas and Global Warming

Chunji Liu [α] & Tao Liu [σ]

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*Keywords: fossil fuel, greenhouse gas, total solar irradiance, global warming.*

## I. Introduction

Since the 1950s, there are observed changes that global mean surface temperature (GMST) of the Earth is rising, such as rising atmospheric temperatures, rising sea levels and shrinking glaciers in the polar regions (US EPA, 2017). Researches indicated that ice depth in all regions of the Arctic Ocean decreased by approximately 40% over the late 40 years in the 20th century (Leggett, 2005). Global mean land-ocean surface temperature (GMST) was -0.16°C in 1880, and it was 0.89°C in 2022, thus an increase of 1.05°C (NASA, 2023a). The growth rate of the Earth's surface temperature was 0.08°C per decade from 1880 to 1980, and it was 0.18°C per decade from 1981 to 2020, an increase of 0.1°C (Lindsey and Dahlman, 2021). The hottest year was 2020 with an average surface temperature of 1.02°C, followed by 2016 at 1.01°C (NASA, 2023a). The average surface temperature in 2021 and 2022 was a little lower than that in 2020.

Since the 1960s, the surface air temperature in Northern China has significantly increased in winter, which leads to a drop in wind speed of the East Asia Monsoon. For example, the average annual wind speed decreased by 28%, and days with wind speeds exceeding 5m/s decreased by 58% (Xu et al, 2006). The Arctic is covered by millions of square miles of sea ice most of the year. But the extent of sea ice in the Arctic has been declining since 1970s, and the amount of sea ice has decreased by two-thirds. The growth rate of the Arctic temperatures is 3 times of that in the other places on Earth (Berardelli, 2020).

But at the beginning of the 21st century, there is no record of continued significant temperature rise, challenging the viewpoint of global warming. The growth rate of GMST was 0.09 ± 0.01°C per decade from 1900 to 1950, 0.1 ± 0.01°C per decade from 1950 to 2000. But the growth rate dropped to 0.04 ± 0.05°C per decade at the beginning of the 21st century (Lean, 2018). From 1998 to 2012, there was a slowdown or hiatus in global surface temperatures (Medhaug et al., 2017; Fyfe et al, 2013 and 2016). Ma et al. (2022) indicated that there was a winter warming slowdown in northwest cold regions and north cold regions across China from 1998 to 2018. Researches of both global and regional surface temperature indicated that there was not significant temperature rises from 1998 to 2012 (Johnson et al., 2018; Winslow et al., 2018; Garfinkel et al., 2017; Shen et al., 2018 ).

Different meteorological data sets and models can lead to different and even contradictory conclusions, it is apparent that the slowdown in surface temperature has led to doubt about the anthropogenic global warming in the public. We want to know the share of the greenhouse gas, total solar irradiance (TSI), and water vapor for the rise of GMST, and conduct empirical research to examine their impact. The following part of this article is arranged in this way: Part 2 is total solar irradiance, greenhouse gas and water vapor, we analyze their effect on GMST; Part 3 is fossil fuel and increased greenhouse gas emissions, we present the data of the use of fossil fuel and greenhouse emissions; Part 4 is global warming hiatus, a period of shortened fall in temperature fluctuation, the causes that lead to global

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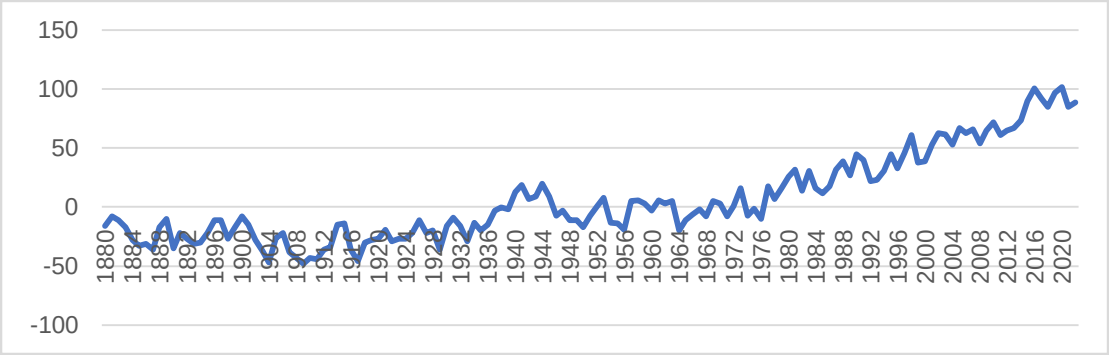
warming hiatus are reported; Part 5 is discussion; and Part 6 is conclusion

## II. Total Solar Irradiance (TSI), Greenhouse Gas and Water Vapor

Before 1.2 million years, global temperature was warmer than today, and it gradually cooled down, the cooling came to a halt at 1.2 million years ago, and the situation continued to the present (Snyder, 2016). Research of Milutin Milankovitch indicated that global temperature warms and cools on roughly 41,000-year cycles. Since the last ice age, about 24,000 years ago, the rise of atmospheric concentration of greenhouse gases has been causing the rise of global surface temperature. But global surface temperature has risen much faster over the past 150 years than it did 24,000 years ago (Kelley, 2021).

Figure 1 is the annual data of GMST from 1880 to 2022 (NASA, 2023a). We divide GMST into 4 periods: (1) from 1880 to1909, 29 years, GMST slowed down gradually; (2) from 1910 to1944, 34 years, GMST rose gradually; (3) from 1945 to1964, 19 years, GMST slowed down gradually; and (4) from 1965 to 2022, 57 years, GMST rose gradually. During the first 3 periods of 1880-1964, GMST alternated in rise and fall at an average time interval of 27 years. After 1965, the pattern of temperature fluctuations changed, the temperature was on the rise with little decline.




*Credit: NASA (2023a), GISS Surface Temperature Analysis (GISTEMP v4)*

*Figure 1:* Annual Data of GMST from 1880 to 2022 (in 0.01 Degrees Celsius)

According to the 27-year time interval during the first 3 periods of 1880-1964, there should have been one year in 1990s when the temperature entered the period of decline. However, there was a global warming hiatus from 1998 to 2012, and global warming continued in 2013.

Suppose the natural time interval between the rise and the fall of the temperature fluctuation is "*x*", and the human impact on the temperature is "*y*". Human activities have caused the rise of global surface temperature, therefore, we suppose the real time interval of the rise of surface temperature is "x+y", and the fall "x-y", from period (1) and period (2), we have equation system (1):

$$\begin{cases} x - y = 29 \\ x + y = 34 \end{cases} \quad (1)$$

*We get:* x=31.5, y=2.5, which means the natural time interval between the rise and the fall of temperature fluctuation is 31.5 years from 1880 to 1944, and the impact from human activities is 2.5 years.

We can divide the period of 1965-2022 into three small periods: (1) from 1965 to 1997, 32 years, the temperature rose gradually; (2) from 1998 to 2012, 14 years, global temperature slowed down; and (3) from 2013 to 2022, 9 years, the temperature rose again, this period is not over yet. During the first 2 small periods of 1965-2012, we can see that the average time interval is 23 years. The small period of 1998-2012 is most likely a shortened period of the fall of temperature fluctuation, which has been disturbed and shortened by human activities. From small period (1) and small period (2), we have equation system (2):

$$\begin{cases} x + y = 32 \\ x - y = 14 \end{cases} \quad (2)$$

*We get:* x=23, y=9, which means the natural time interval between the rise and the fall of temperature fluctuation is 23 years from 1965 to 2012, and the impact of human activities is 9 years. From equation system (1) and equation system (2), we know that the natural time interval between the rise and the fall of the temperature fluctuation has decreased from 31.5 years to 23 years, and the impact from human activities has increased from 2.5 years to 9 years.

We want to examine the relationship between GMST and TSI, greenhouse gas concentration (GHGC) and water vapor, calculate the share of TSI, GHGC and water vapor for global warming, and figure out the order of these factors in which they have contributed to global warming.

There are many factors that affect greenhouse effect, here we only focus on TSI, GHGC, and water vapor. Here, GHGC consists of carbon dioxide ($CO_2$), methane

(CH4) and nitrous oxide (N2O), we list water vapor as an independent factor that affects GMST. The reasons are as follows: although water vapor is a greenhouse gas, its behavior is different from other greenhouse gases. First, increased concentration of carbon dioxide leads to the rise of surface temperature, which is mainly brought about by the use of fossil fuel. Second, higher surface temperature causes surface water to evaporate and more water to enter the atmosphere. Third, the increasing concentration of water vapor in the air leads to a further increase in surface temperature. The concentration of water vapor varies according to temperature. At 30°C, a volume of air contains up to 4% water vapor. At -40°C, it can hold 0.2% water vapor (Britannica, 2023a). Atmospheric water vapor reflects and absorbs solar radiation, it transports heat from the tropics to the cold regions and plays a leading role in the hydrological cycle (Jacob, 2001). Water vapor is a regulator of the atmospheric temperature. The overall concentration of water vapor in the air is stable, and its change in the air is small. Therefore, we list water vapor as the third factor after TSI and GHGC.

We conduct regressions with GMST as dependent variable, and TSI, GHGC and water vapor as independent variables respectively. The data set of GMST is from NASA (2023a), the time is from 1880 to 2022, the base period is 1951-1980. Outliers have been eliminated from the data set and adjusted for homogeneity, the unit of the datais 0.01 degrees Celsius. The data set of TSI is from Kopp (2023), the data consist of two parts, one part is "Historical TSI Reconstruction", it is from 1610 to 2018, we only take the data from 1880 to 2018. The other part is from the data set of "community-consensus TSI composite" (Kopp, 2023), we only take the data of 2019, 2020, 2021, and 2022. The units of the data are watts per square meter (w/m$^2$). The data set of greenhouse gas concentration (GHGC) is from Ritchie and Roser (2023a). The time of the data is from1880 to 2022. The data of annual GHGC are the sum of annual carbon dioxide concentration, methane concentration, and nitrous oxide concentration, the units are ppm. We can't find the data of atmospheric concentration of water vapor, but we have the data of global mean precipitation (GMP). Water vapor concentration is closely related with GMP, so we use GMP as the proxy variable for water vapor concentration. The data set of GMP is from the website of the Environmental Protection Agency of the United States (EPA, 2022a), the time is from 1901 to 2021, the units are inches.

*Table 1:* Regression Output between GMST and TSI from 1880 to 1964

| Independent Variables | coefficient | t-Statistic | R-Squared: 0.11 |
|---|---|---|---|
| *C* | -18628.32 | -3.13 | F-statistic: 9.79 |
| *TSI* | 13.67 | 3.13 | D-W statistic: 0.53 |

*Note: here C is the intercept*

*Table 2:* Regression Output between GMST and GHGC from 1880 to 1964

| Independent Variables | Coefficient | t-Statistic | R-Squared: 0.38 |
|---|---|---|---|
| *C* | -128.4 | -8.21 | F-statistic: 51.0 |
| *GHGC* | 0.07 | 7.14 | D-W statistic: 0.72 |

*Note: here C is the intercept*

*Table 3:* Regression Output between GMST and GMP from 1901 to 1964

| Independent Variables | Coefficient | t-Statistic | R-Squared: 0.02 |
|---|---|---|---|
| *C* | -16.04 | -7.39 | F-statistic: 0.99 |
| *GMP* | -5.51 | -0.99 | D-W statistic: 0.37 |

*Note: here C is the intercept*

Due to the obvious changes in patterns and trends after 1965, we divided the data of GMST into two periods for empirical analysis, the first period is 1880-1964, and the second period is 1965-2022. Table 1 presents the regression output between GMST and TSI from 1880 to 1964, the output indicates that there is a positive relationship between GMST and TSI, t-statistics and F-statistic are significant at 5% confidence level. The R-squared is 0.11, which means that the rise in TSI accounts for 11% of the rise in GMST. Table 2 presents the regression output between GMST and GHGC from 1880 to 1964, the output indicates that there is also a positive relationship between GMST and GHGC, t-statistics and F-statistic are significant. The R-squared is 0.38, which means the rise in GHGC accounts for 38% of the rise in GMST.

Table 3 presents the regression output between GMST and GMP from 1901 to 1964. The output indicates that there is a negative relationship between GMST and GMP, the R-squared is 0.02, which means that the rise in GMP accounts for 2% of the decline in GMST. However, the t-Statistic of GMP is not significant at 5% confidence level, the F-statistic is a little smaller than the critical value, which means that there is no significant correlation between GMST and GMP. We also conduct Granger causality test between GMST and GMP, the output indicates that there is not a statistically significant Granger causality between them.

We get the quantified effect of TSI, GHGC and GMP on GMST, they are 0.11, 0.38 and 0.02 respectively. So we have the sum of the effects of them, which is 0.47 (0.11+0.38-0.02). We get the share of 23.4 % of TSI for the rise of GMST as shown in equation (1). Similarly, we get the share of 80.9% of GHGC for the rise of GMST, and -4.3% of GMP (water vapor).

*Share of TSI for the greenhouse effect 1880-1964:*

$$\frac{the\ effect\ of\ TSI}{sum\ of\ the\ effects\ of\ TSI,GHGC\ and\ water\ vapor}=\frac{0.11}{0.11+0.38-0.02}=0.234 \quad (1)$$

We continue to conduct regressions between GMST and TSI, GHGC and GMP with data from 1965 to 2022. The output in table 4 indicates that there is a positive relationship between GMST and TSI from 1965 to 2022, t-statistics and F-statistic are significant at 5% confidence level. The increase in TSI account for 12% of the rise in GMST. The output in table 5 indicates that there is also a positive relationship between GMST and GHGC, the t-statistics and F-statistic are significant, the rise in GHGC account for 84% of the rise in GMST. We also conduct regression with GMST as dependent variable, with TSI and GHGC as independent variables in the same equation from 1965 to 2022, the output indicates that GHGC is statistically significant at 5% confidence level, however, TSI is not statistically significant.

We conduct regression between GMST and GMP from 1965 to 2021 as shown in table 6. The output in table 6 indicates that there is a positive relationship between GMST and GMP from 1965 to 2021, the rise in GMP accounts for 1% of the rise in GMST. However, t-Statistic of GMP is not significant at 5% confidence level, F-statistic is not significant too. Granger Causality test between them indicates that: "GMST does not Granger Cause GMP"; "GMP does Granger Cause GMST".

*Table 4:* Regression Output between GMST and TSI from 1965 to 2022

| Independent Variables | Coefficient | t-Statistic | R-Squared: 0.12 |
|---|---|---|---|
| *C* | -45325.03 | -2.72 | F-statistic: 7.42 |
| *TSI* | 33.32 | 2.72 | D-W statistic: 0.19 |

*Note: here C is the intercept*

*Table 5:* Regression Output between GMST and GHGC from 1965 to 2022

| Independent Variables | Coefficient | t-Statistic | R-Squared: 0.84 |
|---|---|---|---|
| *C* | -288.17 | -15.14 | F-statistic: 299.30 |
| *GHGC* | 0.14 | 17.30 | D-W statistic: 0.85 |

*Note: here C is the intercept*

*Table 6:* Regression Output between GMST and GMP from 1965 to 2021

| Independent Variables | Coefficient | t-Statistic | R-Squared: 0.01 |
|---|---|---|---|
| *C* | 38.17 | 8.75 | F-statistic: 0.54 |
| *GMP* | 5.09 | 0.73 | D-W statistic: 0.16 |

*Note: here C is the intercept*

We get the quantified effects of TSI, GHGC and GMP on GMST from 1965 to 2022, they are 0.12, 0.84and 0.01 respectively. We get the sum of the effects of TSI, GHGC and water vapor on GMST, which is 0.97 (0.12+0.84+0.01). We get the share of 12.4% of TSI for the rise of GMST as shown in equation (2). Similarly, we get the share of 86.6% of GHGC for the rise of GMST, and 1% of GMP (water vapor).

*Share of TSI for the greenhouse effect 1965-2022:*

$$\frac{the\ effect\ of\ TSI}{sum\ of\ the\ effects\ of\ TSI,GHGC\ and\ water\ vapor}=\frac{0.12}{0.12+0.84+0.01}=0.124 \quad (2)$$

The share of TSI for the greenhouse effect was 23.4 % from 1880 to 1964, and it was 12.4% from 1965 to 2022, thus, an decrease of 11%. The share of GHGC for the greenhouse effect was 80.9% from 1880 to 1964, and it was 86.6% from 1965 to 2022, thus an increase of 5.7%. The share of GMP (water vapor) for the greenhouse effect was -4.3% from 1880 to 1964, and it was 1% from 1965 to 2022, thus an increase of 5.3%.

## III. Fossil Fuel and Increased Greenhouse Gas Emission

In the Northern Hemisphere, temperature differences between July (summer) and January (winter) have been decreasing, the average surface temperature in July has been lower than that in January since 2013 (NASA, 2023a). In the Southern Hemisphere, temperature differences between January (summer) and July (winter) have been also decreasing, the average temperature in January has been lower than that in July since 2017 except 2020 (NASA, 2023a). The increase in average surface temperature in the Northern Hemisphere is higher than in the Southern Hemisphere, this is brought about by more greenhouse gas emissions and more fossil fuel use in the Northern Hemisphere.

Increased use of fossil fuels have led to rapid rise in atmospheric GHGC since 1750. Atmospheric GHGC was 1,413.45 ppm in 1880, and it was 2,663.61 ppm in 2022, thus an increase of 88.45%(Ritchie and Roser, 2023a). Changes in the Earth's energy budget demonstrated that greenhouse gas emission was the main cause for global climate change (Xie et al., 2015).Anthropogenic greenhouse gas emissions have increased greatly and caused the rise of global surface temperature since the mid of the 20$^{th}$ century (IPCC, 2013; Fleming, 2007).

In 2019, fossil fuels accounted for 84% of global primary energy consumption, renewable energy accounted for only 11%, and nuclear energy accounted for 4% (Ritchie and Roser, 2021). Fossil fuels accounted for more than 80% of primary energy consumption in China, the United States and India, this pattern of energy consumption is also common in most developing countries (BP data, 2020).

Atmospheric CO2 concentration in 2009 increased by 38% compared with that in 1750, and the methane concentration increased by 1.48 times (Riebeek, 2010). Global CO2 emission was 3,954.43 million metric tons (including land use change) in 1880, 41,062.90 million metric tons in 2021, thus an increase of 9.38 times (Ritchie and Roser, 2020a). Global CO2 emission has been increasing since the Industrial Revolution. The use of global fossil fuels were 2,575TWh in 1880, and it were 136,761TWh in 2019, thus an increase of 52.11 times (Ritchie and Roser, 2020b). Approximately 337 billion metric tons of carbon have been emitted into the atmosphere due to the use of fossil fuels and cement production since 1751, half of which was after the mid-1970s (Boden et al., 2017).

In 2004, CO2 emissions from OECD counties were 13,450.8 million tons, and it were 13,626.7 million tons from Non-OECD countries (BP data, 2021). For the first time in history, Non-OECD countries are emitting more CO2 than OECD countries. In 2020, CO2 emissions in OECD countries were 10,778.1 million tons, and it were 21,540.5 million tons in Non-OECD (BP data, 2021). Thus, CO2 emissions from Non-OECD countries have been 2 times of that from OECD countries. From 2000 to 2019, developed countries experienced a decline in CO2 emission. On the contrary, CO2 emissions in most developing countries are gradually increasing including China and India (BP data, 2021).

The average growth rate of CO2 emissions in OECD countries was -0.4% per year from 2009 to 2019, and it was 2.5% per year in Non-OECD countries (BP data, 2021). The total increase of CO2 emissions from developing countries are farmore than the total reduction from developed countries, and the total reduction from developed countries offsets only 15.7% of the total increase from developing countries (Zhou, 2021). Therefore, reducing CO2 emissions in developing countries have been the key to mitigating global warming.

## IV. Global Warming Hiatus, a Period of Shortened Fall in Temperature Fluctuation

Atmospheric circulation between ocean basins affects global surface temperatures, research of Kosaka and Xie (2013) indicated that the cooling in the eastern equatorial Pacific led to the slowdown in surface temperature from 1998 to 2012. In 2014, the abnormal warming of the sea surface temperature in the tropics of the west Pacific Ocean drove the atmospheric circulation, leading to the cold winter in central North America (Hartmann, 2015). The cooling in sea surface temperature in the tropical eastern Pacific caused the global warming hiatus from 1998 to 2013, such as La Niña, and it is connected with the warming in both Indian Ocean and Atlantic Ocean (Zhao, 2018).

The slowdown of global surface temperature is part of natural climate variability, it is known as La-Niña decadal cooling. The cooling surface temperature of the tropical Pacific and sea-ice loss of the Arctic brought about an atmospheric teleconenction between the two regions during the phase of La Niña-decay years, and

brought about the cold winter over Eurasian continent during the past two decades (Matsumura and Kosaka, 2019). The decline in global surface temperature was connected to the natural decadal cycle in the Pacific Ocean and is exacerbated by the warming of the Atlantic Ocean (Ma et al., 2020).

The synchronized tropical eastern Pacific variability led to the slowdown of the global surface temperature in early 2000s, the atmospheric pattern of cold ocean-warm land also led to the hiatus of global warming in the early 2000s and the acceleration in the 2010s (Yang et al., 2020). Owing to the phase variations in the Atlantic Multi Decadal Oscillation and the Arctic Oscillation, there was a significant slowdown in the surface temperature in the cold regions over China, and the Tibetan Plateau determines the characteristics of extreme temperatures across these cold regions (Ma et al., 2022).

The multidecadal variability in the Southern Ocean is linked to the internal variability in the tropical oceans through atmospheric teleconnection, especially to the internal variability in the Pacific Ocean (Chung et al., 2022). There are atmospheric interactions between the regime of the Atlantic Ocean and the regime of the Pacific Ocean. Before 1980s, the El Niño-Southern Oscillation in the tropical Pacific in winter caused the anomaly in the tropical Atlantic in the next spring. But the impact declined after 1980s. The impact from the North Tropical Atlantic on the El Niño-Southern Oscillation has become significant since mid-1980s (Park et al., 2023).

Trade wind drives the warm surface water in tropical oceans to flow from east to west, which causes warm water pools along the west coast of continents. Thus the surface temperature in the west Pacific is 8°C warmer than in the east Pacific, which contributes to the precipitation in Indonesia, Australia, and parts of Africa (Stevens, 2011).93.4% of the energy that led to global warming was absorbed by the ocean, 2.3% by the atmosphere, 2.1% by continents, 0.9% by glaciers/ice caps, 0.8% by the Arctic Sea ice, 0.2% by the Greenland ice sheet, 0.2% by the Antarctic ice sheet (Mooney, 2013). Therefore, oceans absorb heat and balance the heat of Earth surface, playing a key role in regulating the surface temperature.

Earth's obliquity is the angle between the plane of Earth's orbit and that of Earth's equator, it varies between 24.5° and 22.1°. It causes the change of the incident angle of solar radiation and affects the amount of sunlight, leading to the change of seasons. It is currently 23.4° and falling, halfway between 24.5° and 22.1°. This change has brought about milder seasons, making winter a little warmer and summer a little cooler. As Earth changes its position relative to the Sun, the climate is coming into an ice age (Buis, 2020). Therefore, changes in the Earth's obliquity have been leading to the change of the climate, it is one of the factors that brought the the slowdown in global surface temperature from 1998 to 2012.

In fact, the above mentioned factors that contribute to global warming hiatus are also factors that contribute to the cyclical patterns and the characteristic of global surface temperature fluctuation. Therefore, global warming hiatus of 1998-2012 is also a period of shortened fall in temperature fluctuation.

## V. Discussion

TSI was 1362.31w/m$^2$ in 2022, and 1360.76w/m$^2$ in 1880, an increase of 1.55w/m$^2$. Although TSI has increased, its share for the greenhouse effect has declined, which was mainly caused by the rise in GHGC. Water vapor was negatively related with global surface temperature from 1880 to 1964, however, it became positively related with global surface temperature from 1965 to2022, which means water vapor prevented the rise of global surface temperature from 1880 to 1964, and the evaporation of water vapor increased with the rise of surface temperature from 1965 to 2022.

The Earth's rotation around the sun, especially the axial tilt dominates the glacial cycle in Milankovitch cycles. The axial tilt affect the incoming solar energy to the Earth, which affects the climate of Earth. According to the theory of Milankovitch cycles, the surface climate should be more cooling than it is now (Buis, 2020). Changes in Earth's obliquity can influence long-term climate trends, they are factors to operate on much longer timescales, such as tens of thousands of years, which play a role in the broader climate context. The impact from the use of fossil fuels on global surface temperature is of short-term, it may be decades of years. If we reduce the use of fossil fuels significantly, the growth rate of global warming will slow down in decades.

Human activities have made global surface temperature rise by 0.7°C in the 20$^{th}$century by the use of fossil fuel and greenhouse gas emission. According to predictions, average surface temperature will rise 2-6°C by the end of the 21$^{st}$century (Riebeek, 2010). The increased use of fossil fuel in cities has altered hydro-meteorological fluxes. During the phase of El Niño, the cities in the western parts of Pacific Ocean show a strong urban heat island effect, while during the phase of La Niña, the cities in the eastern parts of Pacific Ocean show a strong urban heat island effect (Fitria et al., 2019). The urban heat island effect has driven the temperature rise over the capital cities in east Africa, it raises the temperature of Dodoma by 1°C, Kampala by 4°C, and Khartoum by 8°C. It raised the regional temperature by 0.64°C during the daytime from 2000 to 2020, and 0.34°C during the nighttime (Garuma, 2023).

Humans are also raising the surface temperature by deforestation. Trees convert CO2 in the air into oxygen through photosynthesis, they are natural regulators of CO2. An increase in tree cover leads to more oxygen in

the atmosphere. Trees also raise atmospheric humidity by transpiration and in turn make precipitation to increase in the region. Therefore, trees can buffer the surface temperature from over-heating or cooling, making the surface temperature suitable for human life (Derouin, 2022).Carbon dioxides are released into the air when trees are cut or burned, deforestation is preventing trees from converting CO2 into oxygen. Deforestation has led to the rise of atmospheric GHGC and in turn intensified the greenhouse effect.

According to research of Food and Agriculture Organization of the United Nations, the first cause for climate change is the use of fossil fuels, the second is deforestation, which accounts for 20% of greenhouse gas emissions (Derouin, 2022). Most of the farmland around the world were once forests, agriculture has been the primary driver for deforestation. Beef, soybean, palm oil and wood products are responsible for the most tropical deforestation. Deforestation, agriculture, and other land-use changes are the second sources contributing to the rise of GHGC after the use of fossil fuels (EPA, 2022b).

4,000 years ago, most of China was covered in forests, but by the end of the 20$^{th}$century, only 20% of the forests were left. From 1600s to 1870s, half of the forests in the eastern part of North America were cut down. 2,000 years ago, 80% of West Europe were covered by forests, but only 34% of forests were left by the early 2000s (National Geographic, 2022). 10 million square kilometers of forests have disappeared since the beginning of the 20$^{th}$ century, 10% tropical trees have been cut down since 2000, and in 2019 alone, 121,000 square kilometers of tropical trees were destroyed (Derouin, 2022). From 2000 to 2010, land use for cattle ranches, soybeans and oil palms accounted for 40% of tropical deforestation, local agriculture accounted for 33% of the subsistence deforestation (FAO, 2020).

## VI. Conclusion

Over the 11-year solar cycle, the difference in TSI between the most active and least active states is 0.1%, about 2 watts per square meter (NASA, 2023b). According to the data from Kopp (2023), the mean value of TSI was 1360.19 w/m$^2$ in 1610, and 1361.26 w/m$^2$ in 2018, thus an increase of 1.07 w/m$^2$. The variation in TSI is minimal and negligible. The researches of Finsterle et al (2021) also indicated that there were no significant change in TSI during recent solar minima in 2008/09 and 2019/20. The impact from changes of TSI on global surface temperature is much smaller than that from the use of fossil fuel from 1885 to 2013 (Solanki et al., 2013).

Human activities are causing the natural time interval of the rise and fall of temperature fluctuation to shorten. Both the share of GHGC and water vapor for the greenhouse effect have increased, but the share of TSI for the greenhouse effect has decreased. The average solar radiation that strikes each square metre of Earth's surface is 342 watts, the net radiative forcing from humans has been 1.6 watts per square meter since the Industrial Revolution (Britannica, 2023b). Although anthropogenic activities are the main cause for global warming and climate change, the impact itself is much smaller compared to TSI. TSI is still the primary factor that makes the climate of Earth.

In the first half of the 21st century, low growth rate in the world's population can reduce greenhouse gas emissions to a level equivalent to eliminating all deforestation. Voluntary family planning can help women actively participate in economic activities, help to preserve local environment and contribute to the establishment of sustainable ecological environment (World watch Institute, 2016). In low-income countries, rapid population growth has reduced the average resources devoted to improving their health and education. Therefore, slowing down the high levels of fertility in low-income countries is essential for their sustainable development (UN DESA, 2022). Developing countries have exceeded developed countries in the use of fossil fuels and greenhouse gas emissions, they should reduce the use of fossil fuel and replace fossil fuel with clean energy just like the developed countries.

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# Theme: A Brief Study and One Step Ahead of Plastic Sustainability

By Azizul Haque

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*Abstract-* Plastic recycling is the reprocessing of plastic waste into new and useful products. When this job is performed correctly, can reduce dependence on landfill, conserve resources and protect the environment from plastic pollution and greenhouse gas emissions. Recycling is essential because almost all plastics are non-biodegradable and thus build-up in the environment, where it can cause harm. Presently, almost all recycling is performed by re-melting and reforming used plastic into new items; so-called mechanical recycling. In an alternative approach known as feedstock recycling, waste plastic is converted back into its starting chemicals, which can then be reprocessed back into fresh plastic. This whole work demonstrates the Turning Residual / Old plastics into eco-friendly alternatives, Synthetic oil, Gas or Fuel & Nanomaterials and chemical recycling as an environmental win-win situation and reinventing Recycling from rubbish to resources including live experiments/examples.

*Keywords:* *sustainability, microplastics, recycling, recovery, algae, microalgae, biodegradation, byfusion, landfill, nanomaterials, carbon footprint, environmental, fuel, reusable, chemical industry, polymer, monomer, depolymerization, petase, real time, waste, pandemic.*

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# Theme: A Brief Study and One Step Ahead of Plastic Sustainability

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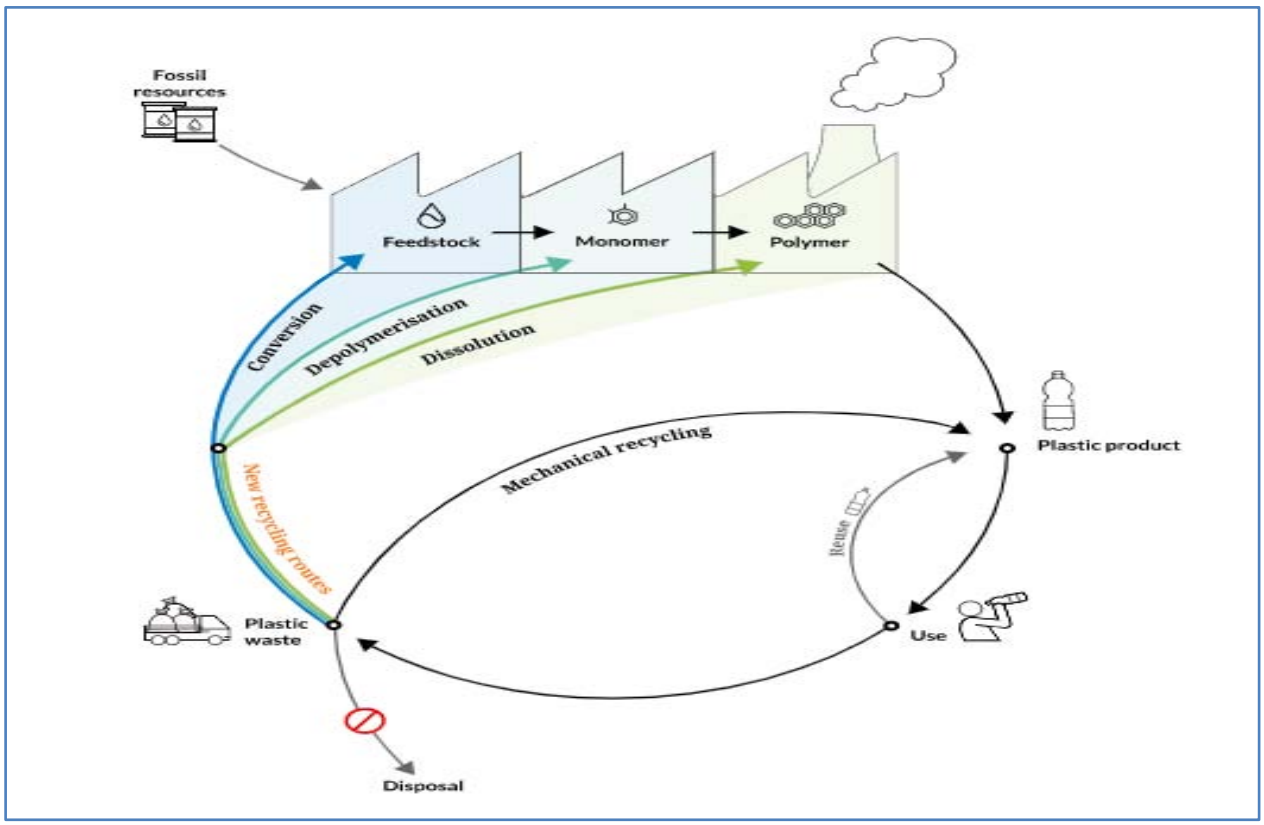
*Abstract-* Plastic recycling is the reprocessing of plastic waste into new and useful products. When this job is performed correctly, can reduce dependence on landfill, conserve resources and protect the environment from plastic pollution and greenhouse gas emissions. Recycling is essential because almost all plastics are non-biodegradable and thus build-up in the environment, where it can cause harm. Presently, almost all recycling is performed by re-melting and reforming used plastic into new items; so-called mechanical recycling. In an alternative approach known as feedstock recycling, waste plastic is converted back into its starting chemicals, which can then be reprocessed back into fresh plastic. This whole work demonstrates the Turning Residual / Old plastics into eco-friendly alternatives, Synthetic oil, Gas or Fuel & Nanomaterials and chemical recycling as an environmental win-win situation and reinventing Recycling from rubbish to resources including live experiments/examples.

*Keywords:* *sustainability, microplastics, recycling, recovery, algae, microalgae, biodegradation, byfusion, landfill, nanomaterials, carbon footprint, environmental, fuel, reusable, chemical industry, polymer, monomer, depolymerization, petase, real time, waste, pandemic.*

A brief study and one step ahead of plastic sustainability vs. genuine plastic recycling and upcycling including Advantages and/or benefits as well as future opportunities across the Globe.




*Definition*

In a nutshell, sustainability describes whether something (a product, an action or a resource etc.) can hold up over a long period. Solar energy, for example, is more sustainable than fossil fuel energy sources because the sun is not going anywhere anytime very soon. Fossil fuel sources, however, are quickly being exhausted. The Plastics manufacturing industry sustains the best sustainability, maintaining a guideline / principle at all levels of operations, and conducts business in such a way that seeks to drive value creation for society, the environment, and the industry. It also strives for improvements to reduce impacts on natural resources, minimizing waste generation, and shifting toward

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renewable energy options - all of which ultimately reduces greenhouse gas impacts. Meanwhile, manufacturers should be guided by scientific data that measures the impacts of many lifecycle stages of plastic products, consistent with the value of Sustainable Materials Management, and strive to keep materials in circularity for remanufacturing when it yields the greatest environmental benefit. All these activities should be measured and reported with integrity. To achieve their sustainability goal, steps to be followed:

a. *Promoting:* Sustainable manufacturing practices including the use of recycled plastics in new products.
b. *Educating:* Companies about the aspects of sustainable manufacturing, for instance, how to reduce water and energy use and make their products easier for consumers to recycle.
c. *Demonstrating:* Viable business models for collecting and recycling different types of plastic materials from different locations.
d. *Motivating:* Companies to eliminate waste and increase recycling and
e. *Measuring:* The amount of wasted recyclable plastic material.

*Highlights*

Plastics - It's cheap! It's light! It's safe! It's hygienic! Imagine the COVID-19 pandemic without plastic! More than 8 billion tons of plastic have been produced since it was invented in the 1950s. And that only 14% of plastics are recycled, with 79% of plastic waste ending up in the landfill, clogging up the oceans and being shipped from wealthy nations to poorer countries to dispose of. Microplastics have been found in both animal and human organs. It's an environmental disaster and a global health crisis. Currently, waste plastic can only be exported if it is sorted into a single resin or polymer type, or processed with other materials into processed engineered fuel.

Every year, more than 350 million tons of plastics have been produced worldwide. These plastics contain a large variety of chemicals that may be released during their lifecycle, including substances that pose a significant risk to people and the environment. There have been identified around 10,500 and out of 10,500, 2,480 substances (24%) are of potential concern. Reality is that almost quarters of all chemicals used in plastic are highly stable, accumulate in organisms, or are toxic and can cause cancer, or damage specific organs. Currently, it was finalized that waste plastic can only be exported if it is sorted into a single resin or polymer type, or processed with other materials into processed engineered fuel.

## I. Introduction

Plastic waste is a problem! A big problem that the chemical industry can help to address. One of the most promising solutions provided by the chemical industry is chemical recycling. Using the chemical recycling technology kills two birds on one stone. First, we reduce the amount of plastic waste, and secondly, we improve our resource efficiency and reduce our dependence on non-renewable resources such as oil when making new chemicals. With chemical recycling technologies, the industry has developed complementary solutions to existing mechanical recycling to recycle mixed or contaminated plastic waste that otherwise would be incinerated or sent to landfill. These technologies can break down plastics and transform them into valuable secondary raw materials to produce new chemicals and plastics of similar quality to those made from fossil resources as well.

## II. Background

Polyethylene usually has between 2,000 and 10,000 carbons in a chain. This is one reason that it does not stick to metals, which are polar or charged. Importantly, the environmental impacts of many consumer products, including soft drinks, are tied to the products inside but not the packaging and consumers usually tend to focus on the impact of the packaging rather than the impact of the product itself. Common misperceptions are:

a. The environmental impacts of plastics are greater than any other packaging material.
b. Reusable products, having lower environmental impacts are always better than single-use plastics.
c. Recycling and composting, environmental benefits should be the highest priority.

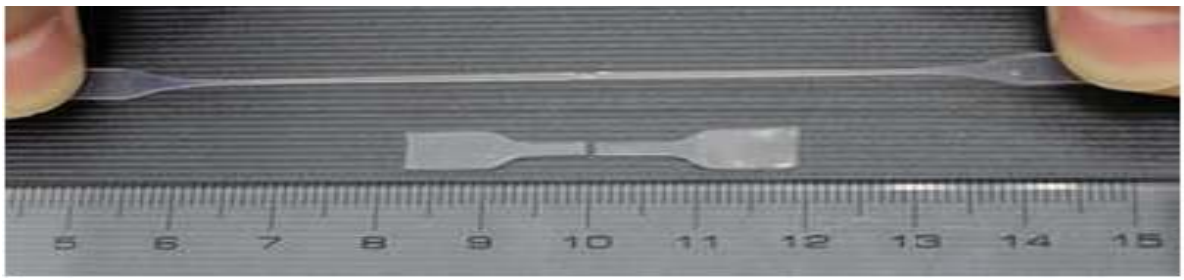
Therefore, to place the plasticwaste problem in a proper context, it's critical to verify the environmental impacts that occur at every stage of a product's lifetime. Life-cycle assessment (LCA) is a tool that used to quantify lifetime environmental impacts in multiple categories, including climate change and energy use, water and resource exhaustion, biodiversity loss, solid waste generation, and human and ecological toxicity etc.

*a) Initiation of the Work/Coincidence*

To cut down on plastic waste, packaging is taking on different forms that can be more easily recycled or that do away with plastic altogether. For instance, Soda and Beer Companies Are Ditching Plastic Six-Pack Rings. The changes are taking different forms from cardboard to six-pack rings made with leftover barley straw. While the transition can be a step toward sustainability, simply switching to different packaging materials could be the wrong solution or not enough and that more plastic needs to be recycled and remade. For example, the Lafarge cement factory gets 80% of its fuel from waste.

*b) Methods and Methodology/Mechanistic Interpretation*

Experiment shows that we can even recycle the material into monomers several times, without loss of quality. Although 87% of the monomers can already be recovered, the scientists want to get as close to a hundred percent as possible. Hard and soft elastic polymers can be fully depolymerized but still remains challenging and their elastomeric polymer could be stretched to almost 14 times of its original length before breaking. And when cut in two, the polymer restored itself within five minutes to recover 99% of its toughness and 97% of its tensile strength.




*Some Examples of Experiments of Plastic Recovery by Different Diversities Across The Globe:*

i. *Critical advances and future opportunities in cycling commodity polymers*

The vast majority of commodity plastics do not degrade and therefore they permanently pollute the environment. At present, less than 20% of postconsumer plastic waste in developed countries is recycled predominately for energy recovery or repurposing as lower-valued materials by mechanical recycling. Chemical recycling offers an opportunity to revert plastics back to monomers without altering the properties of the material or the economic value of the polymer. For plastic waste that is either cost prohibitive or infeasible to mechanically or chemically recycle, the growing field of chemical cycling promises to use chemical or engineering approaches to place plastic waste at the beginning of a new value chain. Here state-of-the-art methods are highlighted for cycling plastic waste into value-added performance materials, fine chemicals, and specialty polymers, realizing a sustainable plastic economy.

ii. *Reuse Plastic Bottle to make a Solar Bottle Lamp*

Solar Bottle Lamp is a solar-powered light that is constructed from waste plastic bottles. The design idea is to reuse waste plastic bottles by attaching a 3D printed solar lamp in place of their old plastic cap. It can be fitted into almost all soft drink bottles. Solar Bottle Lamps can be used to provide lighting in rural areas as well. These lights are surprisingly bright, illuminating campsite, backyard, pathways, or even at home in the case of a power outage. Some benefits are:

a. Reusing plastic bottles can significantly reduce pollution, greenhouse gas emissions, and energy usage.
b. The use of the solar lamp will decrease the amount of local air pollution and save energy.
c. It can provide access to solar lamps at an affordable price to a wide range of people living in remote areas.
d. Also as an alternative business model with the potential to strengthen the overall rural economy by generating technology-based livelihood opportunities.

iii. *Turning off the Plastic Tap*

The figures for plastic waste are shocking. Seventy years ago, production was relatively low, within 2 million tons by 1950. Today production is pushing towards 350 million tons and much of it is going into packaging, textiles and consumer goods. Yet, despite recycling rates increasing to a little over 20%, the majority of plastics (55%) is discarded with the remainder incinerated. There are clear opportunities for conventional recycling technologies to reform graded plastics into new items. However, this leads to a lower quality product than with virgin petrochemicals.

iv. *Tiny Pieces of Plastic*

Microplastics are tiny plastic particles formed when larger pieces of plastic degrade over time and they are ubiquitous, found everywhere from Mount Everest to the Mariana Trench. They can act as magnets for environmental pollution, transforming them into potentially toxic particles.

We know that we ingest about 2000 tiny pieces of plastic every week. These minute specks of plastic are everywhere. The microplastics included polyethylene terephthalate (PET) – commonly used in clothing and drink bottles – and polymers of styrene, often used in vehicle parts, carpets, and food containers. On average, 1.6 micrograms of plastic material were measured for every milliliter of blood, with the highest concentration being just over 7 micrograms. However, more research will be needed on larger, more diverse groups to map just how and where microplastics spread and accumulate in humans, and how our body eventually discards them.

v. *Plastic-eating bacteria*

Plastic-eating bacteria could help to one day tackle some of the 14 million tons of plastic that is offloaded into our oceans every year. Plastic pollution leads to a severe impacts on marine ecosystems and can affect human health. After analyzing the bacteria, it has been found that it produced two digestive enzymes called hydrolyzed PET or PET ase. When these enzymes interact with PET plastic, it breaks down the long molecular chains into shorter chains (monomers) called terephthalic acid and ethylene glycol. These monomers are then broken down further to release energy for the growth of the bacteria. PETase only decomposes PET plastic.

vi. *Turning residual plastic into fuel and nanomaterials*

No matter how many times we try and recycle the plastic, one day, it will reach ends of life. As a waste stream it is problematic – landfills don't want it, while environmentalists believe burning it when it is in its residual state, no matter how 'clean' the technology is unacceptable. Those who champion zero waste work on ways of making it more biodegradable or give it properties that greatly reduce its end-of-life impact on the environment. However, turning such a useful product – and it is useful in many ways – into something that is more environmentally friendly is not as easy as it sounds. There is a great potential that problematic plastics, if processed through this approach, can have much reduced environmental impact, indeed. Ultimately, we have to look at what we can do the best to damage the environment the least."

vii. *Synthetic Gas & Oil from Old Plastics*

The term "chemical recycling" should only be used for plastic wastes and reconverted into new plastics. If those plastics are transformed into fuels or petrochemical products, the process should be called "recovery" instead. Shakespeare wrote that changing what a rose is called does not change what it is in essence. The same logic goes for the term 'chemical recycling' - the conversion of used plastics, mainly to produce synthetic gas (syngas) and oils where plastics need to go through highly polluting processes. Some might try to call this 'recycling' — but it's not. It's 'recovery'.

Only 30% of all generated plastic waste is collected for recycling and chemical recovery of plastics to produce new materials could be a welcome complement to mechanical recycling and a useful way to reduce waste.

Instead of proper recycling, industry in Europe is promoting technologies that process plastic waste through highly polluting processes such as pyrolysis and gasification to mainly produce outputs like syngas and oils. In some cases, these outputs are used as fuels, releasing the carbon previously locked inside the plastic into the atmosphere.

viii. *SDGs*

The global community is at a critical moment in its pursuit of the Sustainable Development Goals (SDGs). More than a year into the global pandemic, millions of lives have been lost, the human and economic toll has been unprecedented and recovery efforts so far have been uneven, inequitable, and insufficiently geared towards achieving sustainable development. The current crisis is threatening decades of development gains, further delaying the urgent transition to greener, more inclusive economies and throwing progress on the SDGs even further off track, which outlines some significant impacts in many areas that are already apparent. The global extreme poverty rate rose for the first time in over 20 years and 119 to 124 million people were pushed back into extreme poverty in 2020 while an additional 101 million children have fallen below the minimum reading proficiency level. Women have faced increased domestic violence; child marriage is projected to rise after a decline in recent years and unpaid & underpaid repair work is increasing excessively, impacting educational and income opportunities and health.

A recommitment by governments, cities, businesses and industries to be developed to ensure that recovery reduces carbon emissions, conserves natural resources, creates better jobs, advances gender equality and tackles growing poverty and inequalities.

ix. *Chemical Recycling of Plastics- an Environmental Wing*

On a life cycle basis, is the overall environmental impact positive or negative in regard to using advanced recycling technologies (also called chemical recycling through PRU-Pyrolysis Reactor

Units) to convert plastic waste that would otherwise end up in a landfill? The answer in the net impact is positive.


Chemical recycling usually refers to technologies that break down plastic with some combination of heat, pressure, depleted oxygen, catalysts, and/or solvents into either fuel or building blocks for new plastic. The oil and gas outputs of most of these technologies can either be burned as a dirty fuel or further processed to be made into new plastic. Although some companies do aim to produce polymers, the outputs are usually burned on site as turning them into plastic requires extensive decontamination and enrichment. Turning plastic into fuel ("plastic-to-fuel") does not displace virgin plastic, and therefore cannot be considered a recycling solution; it does not contribute to a circular economy. If combusted, the products result in similar environmental impacts to other fossil fuels.

While typical chemical recycling doesn't work for polymer wastes with low fixed carbon content, generate CO2 sorbents including polypropylene and high& low-density polyethylene, the main constituents in municipal waste especially well for capturing CO2 when treated with potassium acetate. Waste plastic is now turned into powder, mixed with potassium acetate and heated at 600 C (1,112 F) for 45 minutes to optimize the pores, most of which are about 0.7 nanometers wide. Higher temperatures led to wider pores. The process also produces a wax byproduct that can be recycled into detergents or lubricants. Another option to pull CO2 out of the air is the interchange between permeability and selectivity. In general, the more selective the membrane, the more slow gases can flow through it. Then joined with an intermittent layer of polyamine, which selectively attracts carbon dioxide.

Therefore, we need to consider all options to safely and sustainably manage the enormous amount of waste that we generate, nearly four pounds per person per day. The decisions we make about which options to use should be backed by reliable scientific data. Ultimately, the common objective must be to divert as much waste as possible from landfills, recover as much material and energy as possible from the waste stream, and recirculate it through the economy.

x. *Reinventing recycling: Taking plastics from rubbish on resources*

The contamination of our oceans and rivers is one direct consequence of the lack of alternatives for managing plastic waste. Perhaps the most studied case of chemical recycling is that of polyethylene phthalate, or PET, a type of plastic used in soda bottles and medical blister packs. This type of polyester can be reacted with other small molecules in the presence of adequate catalysts during a process called "depolymerization". Recently, a chemistry team at the University of Oxford, led by Professor Charlotte Williams, has discovered a different depolymerization method for plastics derived from carbon dioxide (CO2), limonene oxide and decalactone, a series of bio-sourced and renewable monomers. These new polyester-polycarbonate thermoplastic materials are very elastic and show superior mechanical properties than some commercial polymers derived from other renewable sources. The researchers demonstrated that the polycarbonate units could be partially depolymerized back to CO2 and limonene oxide, the original building block molecules. Closed-loop recycling could create a revolution in the perception of discarded plastics. What is now, rubbish would become a resource.

On the Global Recycling Day, we can all make a difference. The power is in all of us consumers, producers, and policy makers, to contribute to a more sustainable and less wasteful future, for us and for the planet.

*Some Live examples of Experiments/projects of plastic sustainability, initiated by different organizations across the globe:*

i. *P & G India becomes "Plastic waste neutral" Company*

The company, which has a portfolio of powder brands including Ariel, Tide, Whisper, Gillette, Oral B, Head &Shoulders and Vicks, joined the club of a few FMCG companies in India that have achieved plastic waste neutrality in FY 2021-22, after having recycled 100 per cent of post-consumer plastic packaging waste. The company is also taking a deliberate approach towards reducing the impact of its operations and setting up in-

house solar plants. They are fully committed to making a positive impact in the world and creating a sustainable future for generations to come. Several FMCG makers such as Dabur and Nestle, India, have already achieved the tag of being plastic waste neutral companies.

ii. *Making shampoo more sustainable by eliminating the most useless ingredient, water in it*

80 per cent of our regular shampoo is made of water. This water, however, does not enhance the formula. On the contrary, it dilutes the product only. As a result, consumers need a larger quantity for a single wash. Also, when we do shampoo, we still need to wet our hair to lather the product. Therefore why do we need to add water to the shampoo formula! Therefore, to reduce single-use plastic and the carbon footprint of transporting products, simply remove water from the formula. However, don't confuse these for dry shampoo and consumers need to be applied directly to wet hair for the full lathering shampoo experience.

iii. *HSBC*

The Hong Kong and Shanghai Banking Corporation (HSBC) has set a goal to provide between $750 billion and $1 trillion investment globally in the next decade to support its clients to lower carbon emissions and achieve sustainable growth to encourage them to turn their production facilities green and guide them towards net zero emissions. This is the first-ever sustainability-linked loan, which is connected to environmental, social, and governance performance targets.

iv. *Boxed water, an eco-friendly alternative to plastic bottles*

Recently, a North West family has introduced an eco-friendly and 100% recyclable carton boxes called Boxy Water. Boxy Water is made of cartons sleeves which are thick boxes with a thin layer of plastic that are strong enough to package liquids. These plastic bottles have a very hardy plastic, meaning they are not biodegradable and are incapable of being decomposed, which then increases the chances of pollution. Once the sleeves were delivered, the real work began with Boxy Water. Once the water is pumped, it gets filtered and purified. Even with filtration and purification processes, the family chose a more environmentally friendly way instead of using industrial chemicals; they use ozone treatment, which is similar to chlorine, to purify the water.

v. *Avery Dennison*

Avery Dennison recently launched atma.io, a groundbreaking sustainability feature to minimize carbon footprint and eliminate waste across the supply chain. The new 'Real-time Waste Elimination Tool' uses artificial intelligence and machine learning to analyze and alert on anomalies and inefficiencies across the supply chain. It flags up products that are close to expiry or potentially compromised, allowing minimizing spoilage, reduce losses, cut waste and greenhouse gas emissions. This new feature provides brands with data-driven insights regarding the carbon footprint of products, including Scope 3 emissions and beyond. This is a powerful new tool that captures data from every stage of a product's journey from raw material to consumer and can help to comply with the forthcoming EU 'Digital Product Passports regulations as well as the existing US Food Safety Modernization Act.


vi. *Heat Storage: Development of New Material that is Stable, Efficient, and Eco-Friendly*

A new heat storage material could help to significantly improve the energy efficiency of buildings. It can be used to store surplus heat and release it back into the environment, if required. Unlike existing materials, the new one can absorb significantly more heat, is more stable and is made of harmless substances. This is a so-called shape-stabilized phase change material. It can absorb large amounts of heat by changing its physical state from solid to liquid. The stored heat is then rereleased when the material hardens. However, it could be used by the construction industry as large panels that could be integrated into walls. These would then absorb heat during the sunny hours of the day and release it again later when the temperature goes down. This could save a lot of energy. It has been calculated that when the new material heats up, it can store under the right

conditionsup to 24 times per 10 degrees Celsius more heat than conventional concrete or wallboard.

Unlike hand warmers, the panels made of this material mixture do not melt when they absorb heat. The heat storage material is enclosed in a framework of solid silicate and cannot escape due to high capillary forces; the substances used in its production are environmentally friendly, harmless fatty acids like those found in soaps and creams. Even the additives that lend the material its strength and increased thermal conductivity can be obtained from rice shells. Therefore, in the future, this will help to make buildings significantly more energy efficient.

vii. *Majority responsibility of ecological damage caused by excess use of raw materials*

Not all nations are equally responsible for this trend; some nations use substantially more resources per capita than others through material extraction, production, consumption, and waste. The study shows that high-income countries (with 16% of the world's population) are responsible for 74% of the global excess resources over the years1970-2017 period, driven mainly by the United States (27%) and high-income countries in the European Union (25%), Spain ranks 11th in the list of 15 countries, exceeding the planetary sustainable limit of raw material usage. Spain is responsible for 2% of the excess, behind countries such as Japan, Germany, France, the United Kingdom, Canada and Italy, among others.

viii. *By Fusion*

By fusion has found a new way to reuse plastic that would never get recycled. Therefore a broad range of clients, from waste management companies to municipalities, can utilize them to fit their needs and then produce the blocks themselves instead of transporting worthless plastics and dealing with associated compliance issues, cities and companies (and even universities) could create these blocks. *By Fusion* will buy back any surplus and sell to the market on their behalf.

## III. Conclusion

Algae can be our next secret weapon to combat plastic pollution. Plastic pollution has become an alarming problem worldwide. It has been projected that by 2025, around 100–250 million metric tons of plastic waste could enter our oceans every year. However, even if all drastic measures were put in place to stop plastic production tomorrow, we would still have around 5 billion tons of plastic waste in landfills and the environment. Research has shown that plastics can disintegrate into microplastics. Microalgae, for instance, are the most promising nature-based candidate capable of destroying micro plastics. It is aunicellular species that exists individually or in chains or groups, depending on the species, their size can range from a few millimeters to hundreds of micrometers. Cultivating microalgae is simple because it does not require fertile land, large quantities of freshwater and pesticides compared to other aquaculture crops. Microalgae are also capable of growing rapidly. Open pond cultivation has been one of the oldest and simplest ways to cultivate microalgae on a large scale. Some people also use photo-bioreactors in an enclosed system to increase microalgae cultivation.

Microalgae can significantly change the properties of plastic, including its biodegradation, the alteration of plastic density, and sinking behavior. Moreover, microalgae may take control, gather, and stick to microplastics on their surface, regardless of their size. There are four stages of plastic biodegradation.

a. First is the attachment of microalgae to plastic surfaces. This starts the biodegradation process and alters the surface properties.
b. The second is bio-deterioration; microalgae will excrete specific enzymes, which are pivotal for plastic biodegradation.
c. The third is the bio-fragmentation process. In this stage, the plastic material loses its mechanical stability and becomes fragile.
d. The last stage is the assimilation process, where microbial filaments and water start to penetrate plastics, which results in the decomposition and utilization of plastic by microorganisms.

To prevent plastic disasters, we also need improvements in plastic recycling and reusing strategies as well as waste management, reduction or substitution of plastic usage, redesign of plastic products and packaging, doubling plastic waste collection rates, and expansion of waste disposal facilities etc. The goal is to boost plastic packaging recycling from 16 percent to 70 per cent by 2025.It comes after 176 countries endorsing a United Nations resolution to establish a legally binding treaty by 2024 to end plastic pollution.

*Survey:*

People are being encouraged to count how much plastic packaging they throw away in a week. The data will contribute to a national picture of how much plastic packaging is being thrown away and how much is recycled. Hope, the results of the Big Plastic Count will push the government to bring in stricter policies to reduce plastic waste, including setting a target to reduce single-use plastic. They are also calling for a ban on all plastic waste exports and the implementation of a deposit return scheme (DPS) for recycling and reusing all drink containers. Moreover, a collaborative project like NEMO, New End Market Opportunity can be formed based on objectives:

a. Focuses on improving reuse through recycling of a plastic product

b. Works across the supply chain, partnering trade associations and their members, academics and other contributing experts
c. Addresses technical or logistical challenges via data generation/collection as well as proof-of-concept demonstration projects
d. Results of publication of reports, case studies, best practices, etc. for use by the industry

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*List of Declaration (s):*

I declare that this abstract/Article was composed by me and that the work contained herein is my own except where explicitly stated otherwise in the text and that this work has not been submitted for any other professional qualification except as specified.

*List of abbreviations:*

*DPS:* Deposit returns scheme,
*NEMO:* New End Market Opportunity,
*PET:* Polyethylene Terephthalate,
*LCA:* Life Cycle Assessment,
*PRU:* Pyrolysis Reactor Units,
*FMCG:* Fast Moving Consumer Goods.
*SDG:* Sustainable Development Goal.

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Fellows are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

Career | Credibility | Financial

## Early Invitations

### Early invitations to all the symposiums, seminars, conferences

All fellows receive the early invitations to all the symposiums, seminars, conferences and webinars hosted by Global Journals in their subject.

Exclusive


## Publishing Articles & Books

### Earn 60% of sales proceeds

Fellows can publish articles (limited) without any fees. Also, they can earn up to 60% of sales proceeds from the sale of reference/review books/literature/ publishing of research paper. The FSFRC member can decide its price and we can help in making the right decision.

Exclusive | Financial

## Reviewers

### Get a remuneration of 15% of author fees

Fellow members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

## Access to Editorial Board

### Become a member of the Editorial Board

Fellows may join as a member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. Additionally, Fellows get a chance to nominate other members for Editorial Board.

Career | Credibility | Exclusive | Reputation

## And Much More

### Get access to scientific museums and observatories across the globe

All members get access to 5 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 10 GB free secure cloud access for storing research files.

## ASSOCIATE OF SCIENCE FRONTIER RESEARCH COUNCIL

ASSOCIATE OF SCIENCE FRONTIER RESEARCH COUNCIL is the membership of Global Journals awarded to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Associate membership can later be promoted to Fellow Membership. Associates are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Associate Members.

## To the institution

### Get letter of appreciation

Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

## Exclusive Network

### Get access to a closed network

A ASFRC member gets access to a closed network of Tier 1 researchers and scientists with direct communication channel through our website. Associates can reach out to other members or researchers directly. They should also be open to reaching out by other.

Career | Credibility | Exclusive | Reputation


## Certificate

### Receive a print ed copy of a certificate

Associates receive a printed copy of a certificate signed by our Chief Author that may be used for academic purposes and a personal recommendation letter to the dean of member's university.

Career | Credibility | Exclusive | Reputation


## Designation

### Get honored title of membership

Associates can use the honored title of membership. The “ASFRC” is an honored title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., ASFRC or William Walldroff, M.S., ASFRC.

Career | Credibility | Exclusive | Reputation

## Recognition on the Platform

### Better visibility and citation

All the Associate members of ASFRC get a badge of "Leading Member of Global Journals" on the Research Community that distinguishes them from others. Additionally, the profile is also partially maintained by our team for better visibility and citation. All associates get a dedicated page on the website with their biography.

Career | Credibility | Reputation

## Future Work

### Get discounts on the future publications

Associates receive discounts on the future publications with Global Journals up to 60%. Through our recommendation programs, members also receive discounts on publications made with OARS affiliated organizations.

Career | Financial

## GJ Internal Account

### Unlimited forward of Emails

Associates get secure and fast GJ work emails with unlimited forward of emails that they may use them as their primary email. For example,
john [AT] globaljournals [DOT] org.

Career | Credibility | Reputation

## Premium Tools

### Access to all the premium tools

To take future researches to the zenith, fellows receive access to almost all the premium tools that Global Journals have to offer along with the partnership with some of the best marketing leading tools out there.

Financial

## Conferences & Events

### Organize seminar/conference

Associates are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

Career | Credibility | Financial

## Early Invitations

### Early invitations to all the symposiums, seminars, conferences

All associates receive the early invitations to all the symposiums, seminars, conferences and webinars hosted by Global Journals in their subject.

Exclusive


## Publishing Articles & Books

### Earn 30-40% of sales proceeds

Associates can publish articles (limited) without any fees. Also, they can earn up to 30-40% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.

Exclusive | Financial

## Reviewers

### Get a remuneration of 15% of author fees

Associate members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

## And Much More

### Get access to scientific museums and observatories across the globe

All members get access to 2 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 5 GB free secure cloud access for storing research files.

| Associate | Fellow | Research Group | Basic |
|---|---|---|---|
| $4800<br>**lifetime designation** | $6800<br>**lifetime designation** | $12500.00<br>**organizational** | APC<br>**per article** |
| **Certificate,** LoR and Momento<br>**2** discounted publishing/year<br>**Gradation** of Research<br>**10** research contacts/day<br>**1 GB** Cloud Storage<br>**GJ** Community Access | **Certificate,** LoR and Momento<br>**Unlimited** discounted publishing/year<br>**Gradation** of Research<br>**Unlimited** research contacts/day<br>**5 GB** Cloud Storage<br>**Online Presense** Assistance<br>**GJ** Community Access | **Certificates,** LoRs and Momentos<br>**Unlimited** free publishing/year<br>**Gradation** of Research<br>**Unlimited** research contacts/day<br>**Unlimited** Cloud Storage<br>**Online Presense** Assistance<br>**GJ** Community Access | **GJ** Community Access |

# Preferred Author Guidelines

**We accept the manuscript submissions in any standard (generic) format.**

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

Alternatively, you can download our basic template from https://globaljournals.org/Template.zip

Authors should submit their complete paper/article, including text illustrations, graphics, conclusions, artwork, and tables. Authors who are not able to submit manuscript using the form above can email the manuscript department at submit@globaljournals.org or get in touch with chiefeditor@globaljournals.org if they wish to send the abstract before submission.

## Before and during Submission

Authors must ensure the information provided during the submission of a paper is authentic. Please go through the following checklist before submitting:

1. Authors must go through the complete author guideline and understand and *agree to Global Journals' ethics and code of conduct,* along with author responsibilities.
2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s') names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted *must not have been submitted or published elsewhere* and all authors must be aware of the submission.

**Declaration of Conflicts of Interest**

It is required for authors to declare all financial, institutional, and personal relationships with other individuals and organizations that could influence (bias) their research.

## Policy on Plagiarism

Plagiarism is not acceptable in Global Journals submissions at all.

Plagiarized content will not be considered for publication. We reserve the right to inform authors' institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures

- Printed material
- Graphic representations
- Computer programs
- Electronic material
- Any other original work

## Authorship Policies

Global Journals follows the definition of authorship set up by the Open Association of Research Society, USA. According to its guidelines, authorship criteria must be based on:

1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

**Changes in Authorship**

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

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**Appealing Decisions**

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

**Acknowledgments**

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

**Declaration of funding sources**

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

## Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

***Manuscript Style Instruction (Optional)***

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

***Structure and Format of Manuscript***

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

## Format Structure

***It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.***

All manuscripts submitted to Global Journals should include:

**Title**

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

**Author details**

The full postal address of any related author(s) must be specified.

**Abstract**

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

**Keywords**

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

**Numerical Methods**

Numerical methods used should be transparent and, where appropriate, supported by references.

**Abbreviations**

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

**Formulas and equations**

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

**Tables, Figures, and Figure Legends**

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

**Figures**

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

## Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

## Tips for Writing a Good Quality Science Frontier Research Paper

Techniques for writing a good quality Science Frontier Research paper:

***1. Choosing the topic:*** In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

***2. Think like evaluators:*** If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

***3. Ask your guides:*** If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

***4. Use of computer is recommended:*** As you are doing research in the field of science frontier then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

***5. Use the internet for help:*** An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

***6. Bookmarks are useful:*** When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

***7. Revise what you wrote:*** When you write anything, always read it, summarize it, and then finalize it.

***8. Make every effort:*** Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

***9. Produce good diagrams of your own:*** Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

***10. Use proper verb tense:*** Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

***11. Pick a good study spot:*** Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

***12. Know what you know:*** Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

***13. Use good grammar:*** Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

***14. Arrangement of information:*** Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

***15. Never start at the last minute:*** Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

***16. Multitasking in research is not good:*** Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

***17. Never copy others' work:*** Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

***18. Go to seminars:*** Attend seminars if the topic is relevant to your research area. Utilize all your resources.

***19. Refresh your mind after intervals:*** Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

***20. Think technically:*** Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

***21. Adding unnecessary information:*** Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

***22. Report concluded results:*** Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

***23. Upon conclusion:*** Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

## Informal Guidelines of Research Paper Writing

***Key points to remember:***

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

**Final points:**

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

*The introduction:* This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

**The discussion section:**

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

**General style:**

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

**To make a paper clear:** Adhere to recommended page limits.

*Mistakes to avoid:*

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

**Title page:**

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

**Abstract:** This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

*Reason for writing the article—theory, overall issue, purpose.*

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

**Approach:**

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

**Introduction:**

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

*The following approach can create a valuable beginning:*

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

**Approach:**

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

**Procedures (methods and materials):**

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

**Materials:**

*Materials may be reported in part of a section or else they may be recognized along with your measures.*

**Methods:**

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

**Approach:**

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

**What to keep away from:**

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

**Results:**

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

**Content:**

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

**What to stay away from:**

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

**Approach:**

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

**Figures and tables:**

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

**Discussion:**

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

**Approach:**

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

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| Topics | Grades | | |
|---|---|---|---|
| | **A-B** | **C-D** | **E-F** |
| ***Abstract*** | Clear and concise with appropriate content, Correct format. 200 words or below | Unclear summary and no specific data, Incorrect form<br><br>Above 200 words | No specific data with ambiguous information<br><br>Above 250 words |
| ***Introduction*** | Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited | Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter | Out of place depth and content, hazy format |
| ***Methods and Procedures*** | Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads | Difficult to comprehend with embarrassed text, too much explanation but completed | Incorrect and unorganized structure with hazy meaning |
| ***Result*** | Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake | Complete and embarrassed text, difficult to comprehend | Irregular format with wrong facts and figures |
| ***Discussion*** | Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited | Wordy, unclear conclusion, spurious | Conclusion is not cited, unorganized, difficult to comprehend |
| ***References*** | Complete and correct format, well organized | Beside the point, Incomplete | Wrong format and structuring |

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