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Cosmic Rays impact on Space Weather associated to Geomagnetic Activity with Solar Activity

Sarmistha Basu
Department of Electronics, Behala College, Kolkata ,West Bengal -700060

Abstract: *The flux of incoming Cosmic Rays at the upper atmosphere is dependent on the Solar Wind, the Earth's magnetic field, and the energy of the cosmic rays. For cosmic radiation high energy particles originating outside a solar system. Cosmic rays are also responsible for the continuous production of a number of unstable isotopes in Earth's atmosphere. Cosmic rays can be used for validating magnetospheric field models during very severe storms. Cosmic rays are high-energy radiation, mainly originating outside the Solar System. Solar energetic particles and high-energy particles emitted by the sun. Measurements of the energy and arrival directions of the ultra-high-energy primary cosmic rays by the techniques of density sampling and fast timing of extensive air showers. When cosmic rays enter the Earth's atmosphere they collide with atoms and molecules, mainly oxygen and nitrogen. Gamma ray deriving from local supernovae could have affected cancer and mutation rates, and might be linked to decisive alterations in the Earth's climate.Solar Wind effects on the Cosmic-Ray Electrons from Solar Minimum to Solar Maximum.Cosmic Ray effects on a solar wind velocity gradually. Solar Wind consists of Magnetized Plasma flares and is linked to sunspots. Sunspot impact on the Space Weather and Earth's Environment.*

Keywords: *Cosmic Ray, Solar wind, Sun Spot, Geomagnetic Activity*

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I. Introduction:

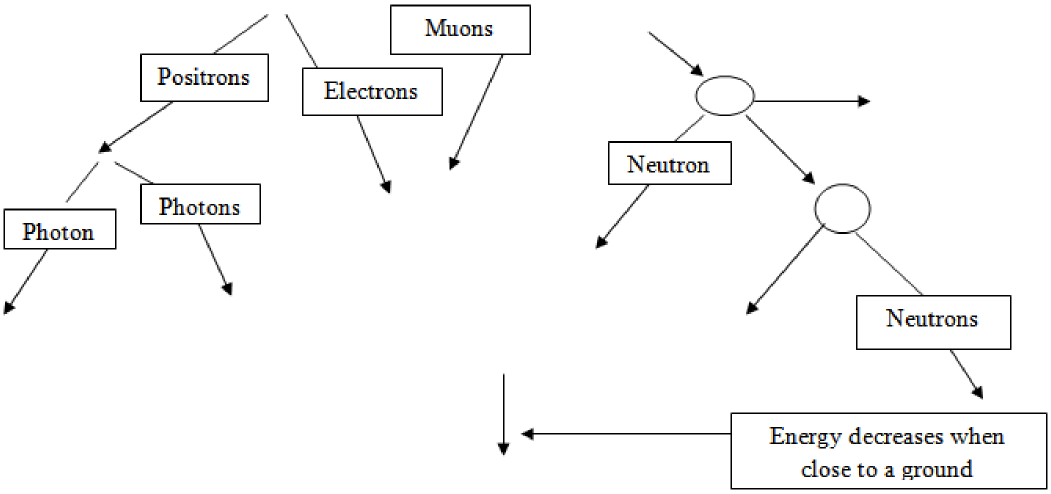
Cosmic rays are high-energy radiation, mainly originating outside the Solar System composed primarily of high-energy protons and atomic nuclei. Magnetic variable stars could be a source of cosmic rays.TheCrab Nebula is also a source of cosmic rays with a wide variety of potential sources for cosmic rays began to surface, including supernovae, active galactic nuclei, quasars, and gamma-ray bursts. Primary cosmic rays primarily originate from outside the Solar system and sometimes even the Milky Way. When they interact with Earth's atmosphere, they are converted to secondary particles. Cosmic rays impacting other planetary bodies in the Solar System are detected indirectly by observing High-energy Gamma ray emissions The flux of incoming cosmic rays at the upper atmosphere is dependent on the solar wind, the Earth's magnetic field, and the energy of the cosmic rays. The magnitude of the energy of cosmic ray flux in interstellar space is very comparable to that of other deep spaceenergies: cosmic ray energy density averages about one electron-volt per cubic centimetre of interstellar space.Cosmic radiation is the main source of air ionization below 40–35 km (only near the ground level, lower than 1 km, are radioactive gases from the soil

The magnetic field of the solar system have scrambled the flight paths of these particles so much that we can no longer point back to their sources in the Galaxy.(1)Cosmic ray is high energy radiation which strikes the earth from space.(2) Cherenkov telescopes can detect lower energy cosmic rays since they are optical instruments they can only operate on clear moonless nights and they can only view a small piece of the sky at a time.(3) The long change in the cosmic ray rate is less than the amplitude of the 22 year variation on the cosmic ray rate. Using the changing cosmic ray for solar activity, this result implies that less than 14% of global warming seen since the 1950s comes from changes in solar activity.(4)Cosmic rays can be described as two Galactic Cosmic Rays (GCR) and Solar Energetic Particles, High Energy Particles (predominantly protons) emitted by the sun, primarily in solar particle events.

Cosmic rays originate a wide range of processes and sources including Supernovae, galactic nuclei, and gamma ray bursts. Galactic Cosmic Rays originates outside the sun and Solar Energetic Particles are emitted by the sun. Electromagnetic radiation consists of mass less and accelerated charged particles. Galactic cosmic rays (CR) are composed mostly of atomic nuclei and solitary electrons, objects that have mass. Primary cosmic rays primarily originate from outside the Solar system and even the Milky Way. When they interact with Earth's atmosphere, they are converted to secondary particles. When cosmic rays enter the Earth's atmosphere they collide with atoms and molecules, mainly oxygen and nitrogen. The interaction produces a cascade of lighter particles, a so-called air shower secondary radiation that rains down, including x-rays, muons, protons, alpha particles, pions, electrons, and neutrons.(5) Data collected by the Fermi Space Telescope provide conclusive evidence that supernovae are the source of the speedy, energetic particles called cosmic rays, an international research team reports. These charged particles, which are mostly protons, continuously assail the planet from outer space. There is general consensus among scientists that supernova remnants (The leftovers of a Supernova Explosion) are the sources of cosmic rays, but the final proof has been elusive because cosmic rays are deflected on their way to Earth.(6)

Cosmic rays are composed predominantly of High-Energy Protons generated by Supernovae in our Galaxy. The energy input from cosmic rays is tiny—about one-billionth of the Solar Irradiance, or roughly the same as that of starlight. However, as the dominant source of penetrating ionizing particle radiation, they have a profound effect on many atmospheric processes.

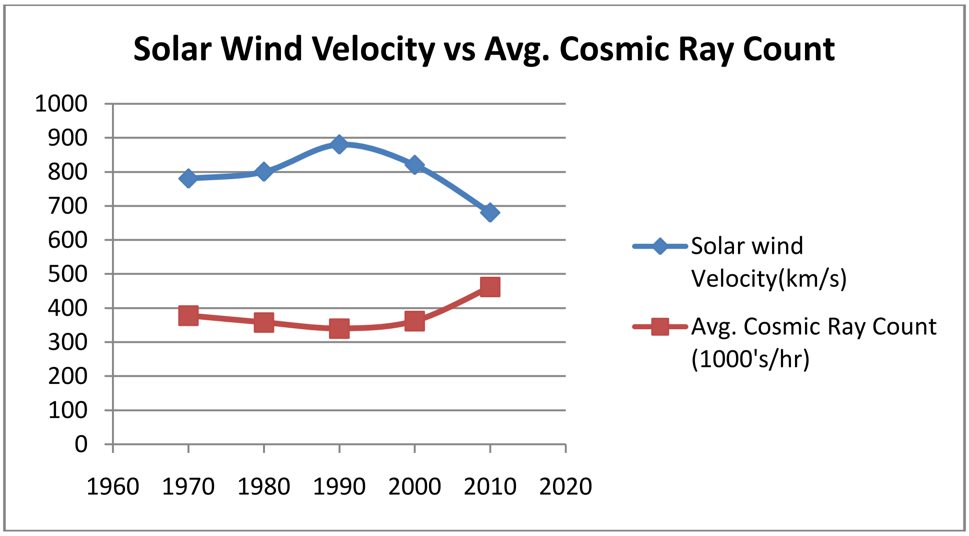
There are also at least two major effects of cosmic rays on the electrical properties of the atmosphere: Cosmic rays provide the sole source of ions away from terrestrial sources of radioisotopes such as radon, and cosmic ray variations directly influence the global atmospheric electric circuit. Cosmic Ray Ionization maintains the atmosphere as very dilute electrically conducting plasma, allowing a continuous electrical current to pass from the ionosphere to Earth's surface.The most Energetic Cosmic Rays are dangerous because they are Ionizing Radiation.



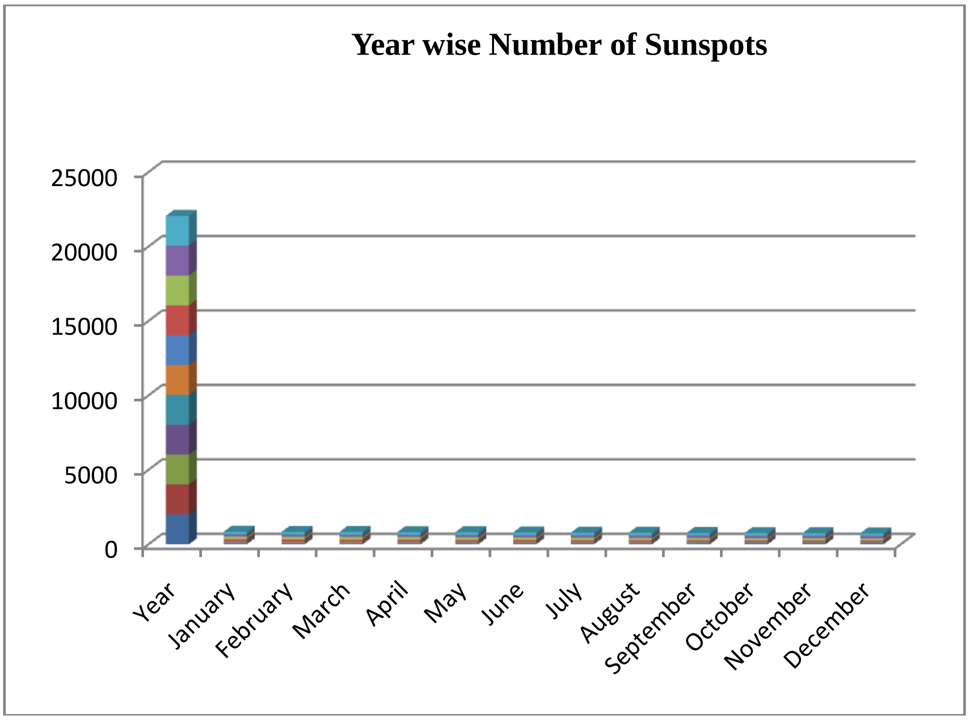
The flux of incoming cosmic rays (Magnetic Flux of Cosmic Ray) at the upper atmosphere is dependent on the Solar Wind. On entering the heliosphere, charged cosmic rays are deflected by the inhomogeneous magnetic fields of the solar wind, and by Earth's dipole field. Over the solar cycle, the variation of cosmic ray intensity at the top of the atmosphere is about 15%, globally averaged, and ranges from about 5% near the geomagnetic equator to 50% at the poles. Showers of secondary particles are produced in the upper troposphere, and muons dominate the cosmic ray intensity below about 6-km altitude. The dominant effect on the motion of cosmic rays in the solar wind is the interplanetary magnetic field, which is irregular and which is therefore best treated statistically, using random functions. The magnetic irregularities scatter the cosmic rays in pitch angle, so that to a good approximation the cosmic rays diffuse through the irregular magnetic field. Using a statistical analysis of the equations of motion, one may relate the diffusion tensor to the power spectrum of the magnetic field, which is in principle measurable. The resulting general transport theory relates the motion of cosmic rays, statistically, to the Solar-Wind Velocity and Magnetic Field. The dynamic processes of magnetic reconnection and turbulence cause magnetic islands/flux-ropes generation.

Further, we propose that cosmic ray (high and/or ultra-high energy) acceleration by Fermi mechanism is valid not only through stochastic reflections of particles from the shock boundaries but also through the boundaries of contracting magnetic islands or/and their merging via magnetic re-connection. This has significant implications on cosmic ray origin and their acceleration process.(7)The pattern in the arrival directions of Extragalactic Cosmic Rays that reach the Earth is different from that of the flux arriving to the halo of the Galaxy for the propagation through the Galactic Magnetic Field. Two different effects are relevant in this process: deflections of trajectories and (de)acceleration by the electric field component due to the galactic rotation. The deflection of the cosmic ray trajectories makes the magnetic flux intensity arriving to the halo from some direction to appear reaching the Earth from the another direction. This applies to any intrinsic anisotropy in the extragalactic distribution or, even in the absence of intrinsic anisotropies, to the dipolar Compton. Getting anisotropy induced when the observer is moving with respect to the cosmic rays rest frame. For an observer moving with the solar system, cosmic rays traveling through far away regions of the Galaxy also experience an electric force coming from the relative motion (due to the rotation of the Galaxy) of the local system in which the field can be considered as being purely magnetic. This produces small changes in the particles momentum that can originate large scale anisotropies even for an isotropic extragalactic flux.The solar wind consists of charged particles which is released from the upper atmosphere of the Sun(corona). The solar-wind plasma is the interplanetary magnetic field.This solar plasma consists of electrons, protons and alpha particles with thermal energy (between 1.5 and 10 keV). The solar wind varies in density, temperature and speed over time and over solar latitude and longitude. We will show how a solar wind velocity varies with a cosmic rays count. The particles of Solar wind can escape the Sun's gravity because of their high energy resulting from the high temperature of the corona.At a distance of more than a few solar radii from the Sun, the solar wind is supersonic .The flow of the solar wind is no longer supersonic at the termination shock. The solar wind is observed to exist in two fundamental states, considered to be the slow solar wind and the fast solar wind, though their differences extend well beyond their speeds. In near-Earth space, the slow solar wind is observed to have a velocity of 300–500 km/s, a temperature of $1.4–1.6×10^6$ K and a composition that is a close match to the corona. By contrast, the fast solar wind has a typical velocity of 750 km/s, a temperature of $8×10^5$ K and it nearly matches the composition of the Sun's photosphere.The slow solar wind is twice as dense and more variable in nature than the fast solar wind. The slow solar wind appears to originate from a region around the Sun's equatorial belt that is known as the "streamer belt", where coronal streamers are produced by magnetic flux open to the heliosphere draping over closed magnetic loops. Observations of the Sun between 1996 and 2001 showed that emission of the slow solar wind occurred at latitudes up to 30–35° during the solar minimum (the period of lowest solar activity), then expanded toward the poles as the solar cycle approached maximum. At solar maximum, the poles were also emitting a slow solar wind.The fast solar wind originates from funnel-like regions of open field lines coronal holes, are in the Sun's magnetic field.Such open lines are particularly prevalent around the Sun's magnetic poles. The plasma source is small magnetic fields created by convection cells in the solar atmosphere. These fields confine the plasma and transport it into the narrow necks of the coronal funnels, are located only 20,000 kilometers above the photosphere. The plasma is released into the funnel when these magnetic field lines reconnect.The amount of solar wind produced continuously by the sun is not constant due to changes in solar activity. This unsteady nature of the solar wind seems to be responsible for galactic cosmic ray flux modulation, hence the flux of incoming galactic cosmic rays observed at the top of the Earth’s atmosphere varies with the solar wind reflecting the solar activity. Sunspots are on the Sun's photosphere that appear as spots darker than the surrounding areas, are marked by intense magnetic activity and play host to solar flares and hot gassy ejections from the sun’s corona. They are regions of reduced surface temperature caused by concentrations of magnetic flux that inhibit convection. Sunspots usually appear in pairs of opposite magnetic polarity.Their sunspot number varies according to the approximately 11-year solar cycle.Itemanates from the sun and influences galactic rays that may in turn affect atmospheric phenomena globally.The material at the solar equator travels significantly faster than the material at the poles. The magnetic field lines become warped. When the magnetic field is strong and twisted— jet streams of flowing currents create ropes of magnetism. Most of the rope, or filament, lies inside the sun, but part of it may break through the visible layer, where it is viewed in the form of two sunspots. The pair are polar opposites, literally as magnetic north and south, with the rope acting as the magnet in between. Sunspots do not appear in random locations. They tend to be concentrated in two mid-latitude bands on either side of the equator. They begin appearing around 25 to 30 degrees north and south of the center. As the solar cycle progresses, new sunspots appear closer to the equator, with the last of them appearing at an average latitude of 5 to 10 degrees. Sunspots are almost never found at latitudes greater than 70 degrees.Sunspots, dark areas on the solar surface, contain strong magnetic fields that are constantly shifting. A moderate-sized sunspot is about as large as the Earth. Sunspots form and dissipate over periods of days or weeks. They occur when strong magnetic fields emerge through the solar surface and allow the area to cool slightly, from a background value of 6000 ° C down to about 4200 ° C; this area appears as a dark spot in contrast with the very bright photosphere of the sun. Groups of sunspots, especially those with complex magnetic field configurations, are often the sites of solar flares. Over the last 300 years, the average number of sunspots has regularly waxed and waned in an 11-year (on average) solar or sunspot cycle.Sun spots show a near-perfect correlation with temperature over the last 400 years – the more sun spots the higher the temperature. This is because sun spots cause solar wind, solar wind prevents cosmic rays from reaching the earth, fewer cosmic rays mean fewer clouds, and fewer clouds mean more heat. This accounts for all climate change.

We are correlating the**Solar Wind Velocity and the Average Cosmic Ray Count**.



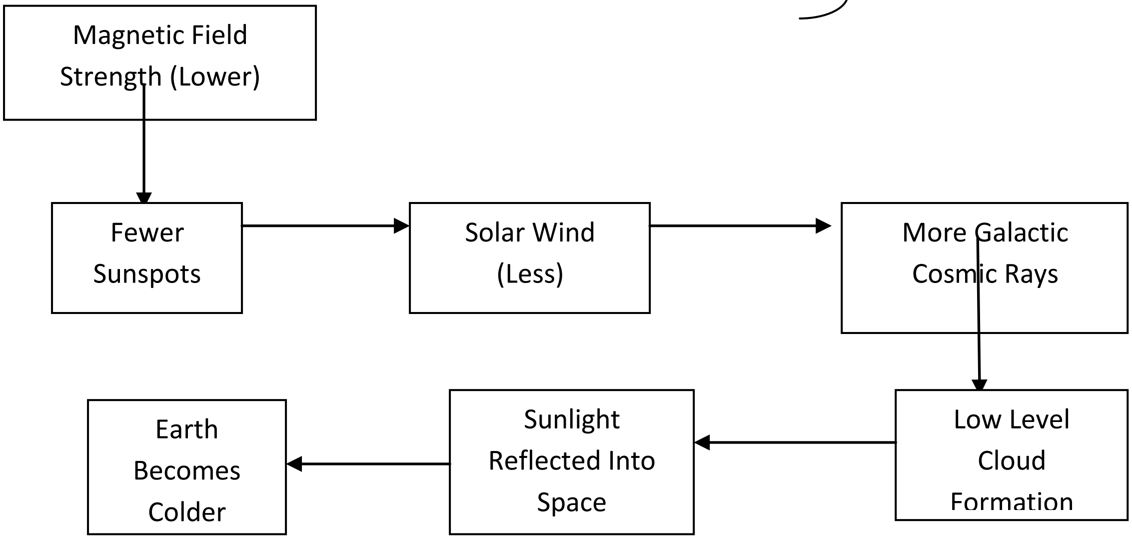
The year wise **Sun spot numbers** varies in a following way: We have collected the data of a sunspot number and plotted in a graph.



The space weather was coined to describe the dynamic conditions in the Earth's outer space environment;same like in the weather and climate refer to conditions in Earth's lower atmosphere. Space weather includes any and all conditions and events on the sun, in the solar wind, in near-Earth space and in our upper atmosphere that can affect space-borne and ground-based technological systems and through these, human life and endeavor. Climate change and global warming as the increasing of a cosmic ray is generally attributed to increases in greenhouse gases in the atmosphere. There is a widely effect of the solar cycle on cosmic rays, it has been speculated for more than 50 years that cosmic ray variations may have an impact on climate. A proposed mechanism would be through the effect of ionization from cosmic rays on the rates of nucleation of cloud condensation nuclei. The result would be an impact of the rate of cosmic rays on cloud formation that would subsequently impact the reflection of incoming short wavelengths and the trapping of outgoing long radiation; more cosmic rays would lead to more clouds and a net cooling of the planet (and vice-versa). This paper concludes that Cosmic Raysimpact on Space Weather associated to Geomagnetic Activity with Solar Wind and Sun Spot.Researchers have speculated for decades on the possible effects of galactic cosmic rays on the immediate environs of Earth's atmosphere, but until recently, a causal relationship between climate and cosmic rays has been difficult to establish.

Lower Magnetic Field= Few Sunspots
Few Sunspots= Less Solar Winds
Less Solar Winds= More Galactic Cosmic Rays
More Galactic Cosmic Rays= Low Level Cloud Formation
Low Level Cloud Formation= More Sunlight reflected back into Space

Relation between Earth's Climate and Solar magnetic field Strength

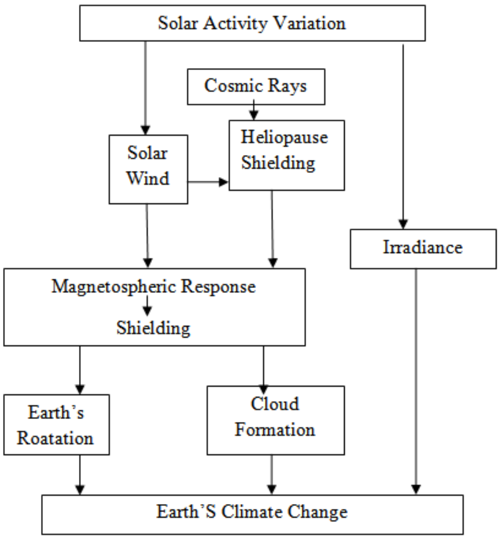


Relation between Climate and Solar

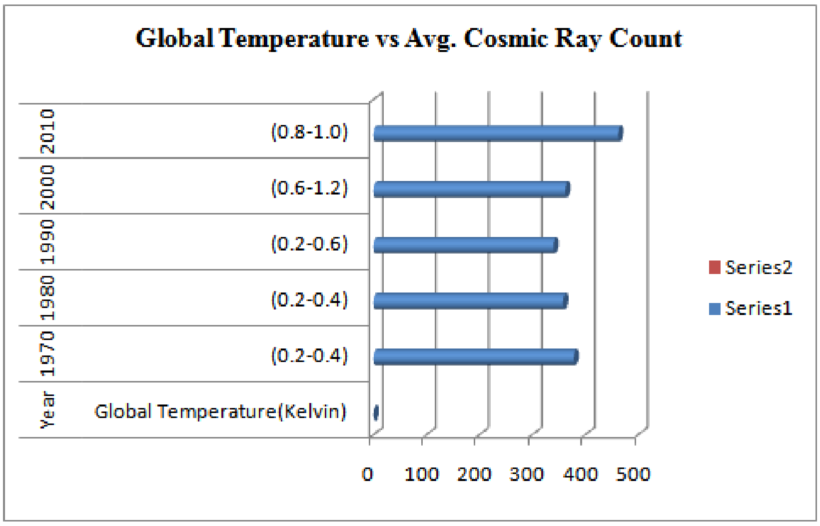
Solar-Climate variability effect on Solar Ultra Violet Ray and total Solar Irradiance directly and on Galactic Cosmic Rays indirectly. It can be resolved in principle since Galactic Cosmic Rays are in addition to 11years Solar Cycle modulated by Galactic Environment, Geomagnetic Field with low latitude effects and Solar Magnetic Disturbance.

The system of internal and external factors formatting the climate is very unstable; decreasing planetary temperature leads to an increase of snow surface, and decrease of the total solar energy input into the system decreases the planetary temperature even more, etc.

Even energetically small factors may have a big influence on climate change. In our opinion, the most important of these factors are cosmic rays and cosmic dust through their influence on clouds, and thus, on climate. (8)



We have plotted a collected data (1970- 2010) in the graph according to the **Cosmic Ray Count depending on the Global Temperature.**



The Sun's energy drives the weather system, scientists naturally wondered whether they might connect climate changes with solar variations.The Sun dominates the skies that the first scientific speculations about different climates asked only how sunlight falls on the Earth in different places. The influence of solar variability on the Earth's climate requires the solar variability, solar-terrestrial interactions, and the mechanisms determining the response of the Earth's climate system, including solar irradiance variations on both decadal and centennial time scales and their relation to galactic cosmic rays.

II. Conclusion:

Looking at the sky with the naked eye, the sun seems static, placid, and constant. But our sun gives us more than just a steady stream of warmth and light. The sun regularly bathes Earth and the rest of our solar system in energy in the forms of light and electrically charged particles and magnetic fields. The resulting impacts are what we call space weather, global temperature and global warming. The sun is a huge thermo-nuclear reactor, fusing hydrogen atoms into helium and producing million degree temperatures and intense magnetic fields. The outer layer of the sun near its surface is like a pot of boiling water, with bubbles of hot, electrified gas—electrons and protons in a fourth state of matter known as plasma—circulating up from the interior and bursting out into space. The steady stream of particles blowing away from the sun as the solar wind. Due to the increasing of Solar Wind with a increment of Cosmic rays and the increment of sunspot has a wide impact on the Space Weather, causes Global Warming.

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[23]. "Space Weather: A Research Perspective | The National Academies Press". www.nap.edu. National Academy of Science. 1997. Retrieved 2015-07-24. Space weather describes the conditions in space that affect Earth and its technological systems. Our space weather is a consequence of the behavior of the Sun, the nature of Earth's magnetic field, and our location in the solar system

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