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A brief overview of solar cycle variability effects on climate

Abstract

Among interesting areas of scientific research is the study of the relationship between solar cycle variability and climate change. For centuries now, speculations on the influence of variations in the sunlight intensity on climate have been on going. It is without exaggeration to state that generally the earth has gotten warmer over the past centuries. Over the years, studies have shown that there is a very strong correlation between earth's surface temperature and sunlight intensity variability. Some scholars argue that the main effect on the weather is not a change in the luminosity of the Sun during the period of maximum activity, but an increase in the flow of charged particles (solar wind). These act on the Earth's magnetosphere and ionosphere. This action plays a role of the trigger that starts the processes, the energy of which is contained in the Earth's atmosphere. The periodicity of these processes (hurricanes, floods, epidemics) often correlates with the period of solar activity. Nevertheless, it is quite possible that there may be the processes with a much longer period (hundreds and thousands of years). Some researchers suggest, that the observed increase in the Earth's temperature is part of this long-term process. Thus, this piece of work compares these two views in an attempt to check the effects of solar cycle variability on climate.

Keywords: Solar cycle variability, climate, sunspots

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Introduction

Research has shown that the past two centuries have been the warmest and have recorded the highest average global temperatures in history.[1] This Has resulted in the reduction of the area covered by snow on the globe.[2] Many global forces and events have been correlated to the rise in temperatures. Such events include volcano eruptions as well as radiation variation in many places on the planet.[3] This has made researchers to conclude that there should be a relationship between variations of solar radiation from the sun and global climate change.[4] These phenomena, including unsafe human activities, could be the reason we are facing a relatively sharp global temperature rise.[5] The past years have shown that the sun has contributed significantly in the changes that our climate is facing today.[6] Studies in the area of climate have reviewed that the sunspot cycle of very small percentage, say one percent, has significant contributions to climate change.[7]

In addition, some researchers have argued that despite having had significant changes in temperature rise in the first half of the 20th century, the second half has not shown much of these differences.[8] In this vain, scholars have different views on whether solar radiation variability has an impact on the changes our climate is facing today.[9]

Climate change

In simple terminologies, climate change can be viewed at as the interaction between atmosphere, land and water and all their dynamic.[10] Thus, there are so many factors that contribute to the mean radiation intensity of the planet.[11] This makes the study of global climate change a very important topic of discussion today.[12]

Solar variability

In simple terms, the change in levels of solar radiation intensity is what is referred to as solar variability.[13] This entails that the variation can either be slow or fast. There is a strong belief that climate change can only be affected by slow variation but with time even faster ones can have a significant impact on climate.[14] Therefore, in order to attain accurate results and make informed decisions on climate adaptation, it is vital to consider a much longer period of time.[15] Under the study of solar variability in relation to climate change, there are terms that we need to familiarize ourselves with.[16] These are; sunspot number and total solar irradiation. On one hand, sunspot number refers to an old method of measuring solar activity.[17] On the other hand, total solar irradiation is the measure of the atmospheric total radiated power.

Correlation between solar variability and climate change

A good number of researchers have argued that solar variations have an impact on the change in our climate. From as way back as 1600s, astronauts have been trying to count the number of sunspots via experiments.[18] The experiments have shown a significant correlation between solar variability and global climate change.[19] In addition, Eddy hypothesized that as a result of solar irradiation changes, there has been a high correlation between solar variations and average global temperature rise (Figure 1,2).[20]

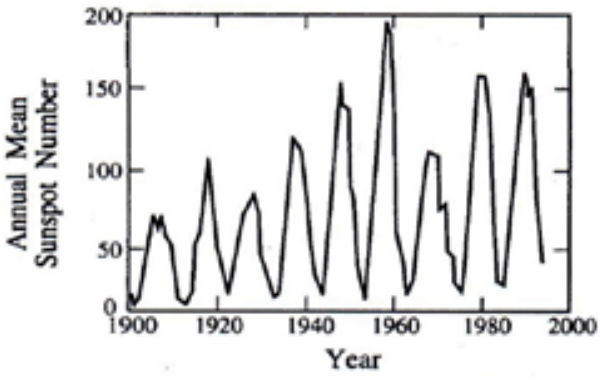

Figure 1 Annual averages of sunspots.[17]

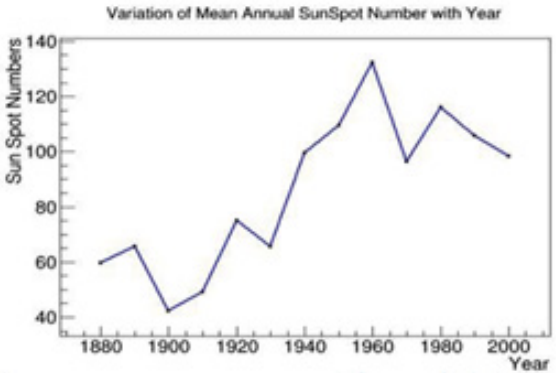

Figure 2 Sunspots against time.[20]

Furthermore, studies have shown that sunspots have a greater influence on the measurement of the total solar activity.[21] This is because these are regions on the sun with lower temperatures as compared to others.[22] This temperature variation is caused by the orientation of the magnetic field lines surrounding the sun while coupling with those from our planet. With the coming of satellites on board, it is now easier to compute for average solar intensities in different regions of the planet.[23] Higher solar activity results into global temperature rise as a result of more sunspots. Thus, climate change comes about as a result of atmospheric heat transfers via air and fluid dynamics (Figure 3).[24]

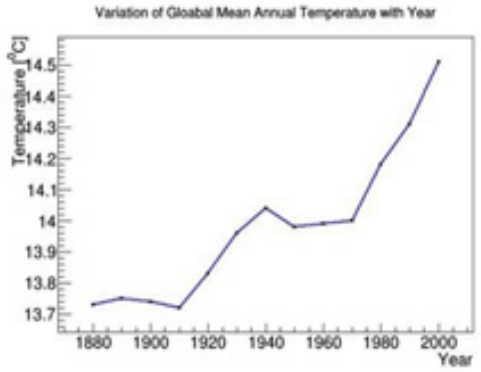

Figure 3 Global Temperature time series.[20]

Conclusion

From our discussion, we can deduce that the aspect of global warming has if not already overtaken the role that solar energy plays. Despite this postulation, more research is critical to ascertain these facts. In addition, to vividly state that sunspots variations affect climate would be a bit unfair with limited data available at the moment due to constrained technology and the vastness of the universe. Thus, this study together with others need further review in the future. This is because human activities as well have a higher contribution to climate change as a result of environmental and air pollution.

Finally, in the quest to find the cause of the rise in global temperature. Some scholars suggest that this may be due to periodic changes of the Sun's luminosity. However, this assumption is not supported by estimates. At the moment, no hypothesis has been proposed to illustrate how this weak force can lead to a permanent increase in the Earth temperature.

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None.

Conflicts of Interest

None.

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