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The Impact of Space Weather on Human Health

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ABSTRACT

This opinion paper discusses the impact of space weather on human health, which problems are caused by space weather anomalies, and how severe they are. My main conclusion is that a significant amount of severe health problems can be attributed towards space weather anomalies and that certain measures could be implemented for prevention against life-threatening, as well as health cost impacts of space weather anomalies.

Keywords: Space Weather; Solar Activity; Geo-Magnetic Anomalies; Cosmic Rays; Human Health; Mortality

Overview

Human health depends on endogenous as well as exogenous factors. Endogenous factors are e.g. the type of nutrition we provide to our body, the time and amount of sleep we get, the degree of stress we expose our body, as well as the degree of psychological well-being, while exogenous factors are external influences on our body, e.g. constant high acoustic levels, exposure to chemical substances, too high or low degrees of sun light exposure, or in general the degree of radiation exposure such as radioactive-, ultraviolet-, or geomagnetic radiation. All these factors are having a long-term effect on our body and should not exceed a certain threshold over an extended period of time, otherwise the human body develops deficiency symptoms or chronical diseases. A mostly unknown or not recognized exogenous factor which has a significant impact on human health is space weather, as changes in magnetic field lead to biological effects [1,2]. 'Space Weather' describes the conditions on the Sun, in the solar wind and the Earth's magnetoionic- and thermosphere. Geomagnetic activity is measured since 1938 on a 3-hours frequency basis via the Kp-index. The Kp-index is scaled from 0 to 9, where 0 indicates low geomagnetic activity while a value of 9 indicates an extreme geomagnetic storm. Like the weather on earth, space weather changes continuously and leads to anomalies in the Earth's geomagnetic field, which leads to radiation on Earth. Space radiation is made up of three kinds of radiation: Particles trapped in the Earth's magnetic field, Particles shot into space during solar flares (solar particle events), and Galactic cosmic rays, which are high-energy protons and heavy ions from outside our solar system. All of these kinds of space radiation represent ionizing radiation.

Studies linking environmental physical activity levels and the human medical data show that geomagnetic field variations, accompanied by the increased level of cosmic ray activity, can have either direct or indirect adverse effects on human health and physiology, even when the magnitude of the geomagnetic field disturbance is extremely small or even is equal to zero. [3,4] found statistical significance of the influence of geomagnetic activity levels in hospital admissions. Other studies have identified the following impacts of space weather on human health:

a) Higher rates of Leukemia and solid cancer [5,6].

b) Higher blood pressure, acute myocardial infarction and more cases of anterior wall myocardial infarction [7-9].

c) More strokes and cerebrovascular insufficiency [7].

d) Severe migraine attacks [7,8].

e) More depressions and suicides [9,10].

f) Cardiovascular fluctuations are related to the level of geo-magnetic activity and the 11-year cycle of solar activity [10].

Yet, [11] analyzed 63 million headache and migraine keyword-bearing messages posted over the three years covering the maximum of Solar Cycle 24 and counter argues that geomagnetic storms don't cause headaches and migraines, by utilizing a vast amount of self-reported symptoms from the online social networking service Twitter in order to investigate a purported link between the level of geomagnetic activity and the onset of

primary headaches and migraines. Anyway, one key take-away of the literature is that extremely high as well as extremely low values of geomagnetic activity seem to have adverse health effects [12].

Conclusion

In my opinion, due to the overwhelming amount and quality of various studies conducted over a period of more than 50 years, showing significant impact of space weather on human health, a positive correlation between space weather anomalies and biological reactions is undeniable. Nevertheless, measures of prevention can hardly be found in the literature. Since space weather anomalies are hard to predict, often just a couple hours ahead of a solar eruption or geomagnetic storm, long-term prevention seems pretty hard. But in case of space weather warnings, acute measures can be taken, e.g. notifications and warnings for high-risk patients, the activation of more medical staff or immediate distribution of medical aid such as drugs and medical devices [13-17].

This would require an establishment of a direct communication channel between space weather monitoring stations and ambulances, hospitals in affected regions of the world. The establishment of such a communication network would entail a certain technological effort but could save lives. From a financial point of perspective, the increased health costs due to space weather anomalies could be hedged using space weather derivatives as proposed [7].

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