

## Space Weather & Heart Health: Geomagnetic Storms vs. 'Zero' Level GMA

5/12/2014

Solar Flares that become 'Geeffective,' and lead to changes in Geomagnetic Activity here on Earth, are typically doing so through the production of Earth-directed Coronal Mass Ejections (CMEs), which can cause Geomagnetic Disturbances in Earth's Magnetic Field and also result in what's known as a 'Forbush decrease' in Cosmic Ray Activity.

In the 2005 NASA article, 'Who's Afraid of a Solar Flare?' Dr. Tony Phillips explains that:

"Scientists have long known about this phenomenon. It's called a 'Forbush decrease,' after physicist Scott E. Forbush, who studied cosmic rays in the 1930s and 40s. When cosmic rays hit Earth's upper atmosphere, they produce a shower of secondary particles that can reach the ground. By monitoring these showers he noticed, contrary to intuition, that cosmic ray doses dropped when solar activity was high...Wherever CMEs go, cosmic rays are deflected" (Phillips 2005).

Geomagnetic Storms have been making headlines across several Main Stream Media outlets recently. This blog post will focus on the article 'Solar flares might protect against arrhythmias,' which appeared on the site Health24.com today.

The article is about a new analysis, which has yet to be peer-reviewed, that focuses on how Solar Flares "seem to offer some measure of protection against the risk of arrhythmias and correlated with decreased implantable cardioverter-defibrillator activity." Basically, implantable cardioverter-defibrillators (ICDs) protect patients who are at risk for 'sudden death' due to irregular heartbeats, known as arrhythmias, during which the ICDs release a 'corrective measure.'

The study was carried out using ICD data from 60,000 patients spanning from 2009 to 2012, and it's interesting to note that this is during the Maximum of Solar Cycle 24, which is marked by a cyclical increase in the observable Sunspot Number; sunspots are a source region for Solar Storms and Solar Flares. So, when there are more Sunspots there is the potential for more Solar Flaring events to take place.

Dr. Elisa Ebrille, a cardiology research fellow in the division of cardiovascular disease with the Mayo Clinic, was a part of the new analysis that "tackled one such environmental phenomenon - solar flares, or storms - and found that they seemed to offer some measure of protection against the risk of arrhythmias and correlated with decreased ICD activity."

"To be honest, I have no idea why, we don't know because until now there has been nothing in the literature that has suggested that solar flares are protective,' she said. 'So, we can't yet say if this is happening because the device is simply working more efficiently or because the patients are actually experiencing fewer arrhythmias'" (Health24.com).

Dr. Ebrille notes that cardio devices (ICDs) are electronic devices, "And they can certainly be influenced by electrical activity in the environment, including abnormal electrical signals. And a major source of that comes from high-level solar radiation. Or flares," or the potential for Ground Induced Currents (GICs)...not to mention, "Cosmic ray activity (CRA) is related with highest level of known radiation space proton flux" (Stoupelet et al. 2013).

These pull-quotes from Stoupelet et al., 'Days of 'Zero' level geomagnetic activity accompanied by the high neutron activity and dynamics of some medical events-Antipodes to geomagnetic

storms,' should illustrate the inverse correlation between Solar-Geomagnetic Activity (S-GMA) and Cosmic Ray Activity (CRA):

"...when a CME sweeps past Earth, it also sweeps away many of the electrically-charged Cosmic Rays that would otherwise strike our planet. This is the 'Forbush decrease.'

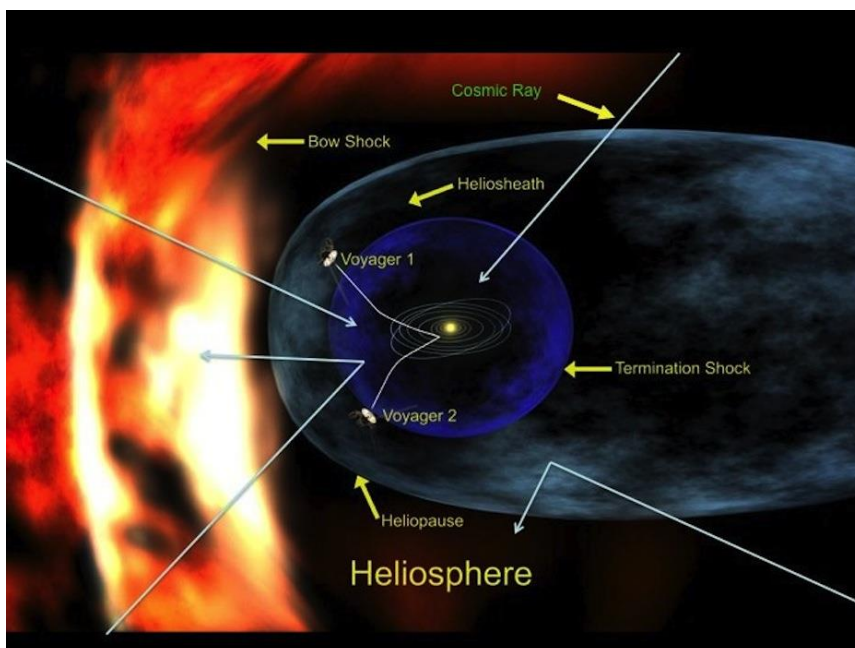
Wherever CMEs go, Cosmic Rays are deflected. Forbush decreases have been observed on Earth and in Earth orbit onboard Mir and the ISS. The Pioneer 10 and 11 and Voyager 1 and 2 spacecraft have experienced them, too, beyond the orbit of Neptune. A single CME can suppress Cosmic Rays for a few weeks. Sustained solar activity can suppress them for a much longer time..." (Health24.com).

Why is Cosmic Ray Activity (Neutron Activity) monitored here on Earth?

"Studies on Cosmic Ray Activity (neutron activity) were helpful in explaining last decade's data about medical events concentrated on low (Quiet I) GMA levels [21, 24-27]. Such studies appeared in the fields of sudden cardiac death (SCD), life threatening cardiac arrhythmias, myocardial infarction occurrence and many other medical events."

"Inverse correlation of GMA with CRA (neutron activity) ( $r=-0.66$ ,  $p<0.0001$ ) and CRA (neutron activity) with solar activity are similar ( $r = -0.85$ ) [49-51]. The last relationship explains the much higher frequency of zero GMA on the lower part of the 11-year solar activity cycle" (Stoupelet et al. 2013).

"It is presumed that high neutron activity, accompanying the lowest GMA level can affect electrical heart instability, a basis for cardiac arrhythmia, and also, is an additional risk factor for unstable (result of disturbed lipid metabolism in the artery wall) atheroma ruptures and fissuring-a basis for the latest stage of the intravascular catastrophic-complete occlusion by thrombus in the region of atheroma plaque disruption and developing infarction in the blockage of oxygen and other life support supply in the zone of 'culprit' artery location (heart muscle, brain)" (Stoupelet et al. 2013).



What this means is that at times of high Solar, Geomagnetic Activity (S-GMA) there is lower Cosmic Ray Activity (CRA), and inversely, at times of low Geomagnetic Activity caused by low Solar Activity (SA) there is an elevated CRA (Neutron Activity) at Earth. It's during these periods of low Solar, Geomagnetic Activity that the Neutron Activity (CRA) is elevated, and this is what leads to a heightened Space Weather risk factor for cardiac arrhythmia:

The Magnetosphere protects Earth from Cosmic Rays that would otherwise strip away our planet's upper atmosphere, including the ozone layer that protects us from harmful ultraviolet radiation:

"Cosmic Ray Activity on the Earth's surface is usually measured by neutron activity (imp/min); these neutrons are remains of atoms crushed by cosmic rays...In general, conditions on the Sun and in the solar wind, interplanetary space, the magnetosphere, ionosphere and thermosphere constitute the so called 'Space Weather;' they can influence not only the performance and reliability of space-borne and ground-based technological systems, but can also endanger many kinds of human activities, particularly in connection to human life itself and human health. Behavioural extremes were related with daily levels of GMA and geomagnetic storms" (Stoupel et al. 2013).

This passage is contextualized by comparing it to the findings from the research of Stoupel et al.:

"...sifted through information gathered between 2009 and 2012 on ICD function among a daily grouping of an average 60,000 patients. ICD function was then stacked up against daily geomagnetic activity as reported by the US Space Weather Prediction Centre, which ranked solar activity as being at either 'quiet,' 'unsettled,' 'active' or 'storm' levels.

The result: during the study, 'storms' occurred about 2 percent of the time, and when they occurred the frequency with which the patients experienced ICD corrective measures dropped" (Health24.com).

It's always worth noting that current estimates from the European Space Agency show that Earth's magnetosphere has weakened by as much as 15% over the last 150 years, and this is in addition to Earth's shrinking upper atmosphere. Which brings us back to the team of researchers who:

"The role of high CRA (neutron activity) and low GMA is worthy of special attention, because most studied links with increased GMA and medical phenomena are gestured at days of geomagnetic storms (IV level of GMA)-relatively rare geophysical phenomena in the middle latitudes. For a term we found geomagnetic storms in average at 3% - 4% of days yearly, only sometimes achieving the 6.0% margin. In a recent couple of years (2007-2008) such level of GMA was not registered in the middle latitudes at all. Low (Quiet-I) GMA level days in

most years in this part of the globe are accounting more that 35% (49.5% for 1995-2006) of yearly days" (Stoupel et al. 2013).

Since Geomagnetic Storms took place on only 2% of the days from 2009 to 2012, it would make sense to check the data for days of low (Quiet-I) GMA, since they occur more frequently and are an indicator of high Neutron Activity (CRA), which results in the elevation of the Space Weather risk factor for cardiac arrhythmia. If this is true, then patients with ICDs would experience an increase in 'corrective measures' on days of 'Zero' Geomagnetic Activity and high Neutron Activity (CRA).

The Health24.com article ends with a few token phrases that are tacked on to the end of any piece of research worth it's weight in funding:

"Dr Michael Gold, chief of cardiology at the Medical University of South Carolina in Charleston, described the findings as both "novel and intriguing." Noting, 'However, this is not a randomised study,' Gold cautioned. 'So this needs to be put into context. And there will need to be further confirmation of this finding.'

"While the study showed an association between solar flares and ICD function, it could not prove a cause-and-effect relationship" (Health24.com).

This is undeniably true: these findings really need to be put into context, as it's possibly more proof of the inverse relationship between S-GMA and CRA (Neutron Activity) observed on Earth and throughout the Heliosphere. I'll let these two quotes from Stoupel et al. respond accordingly:

'Results of our present study revealed evidence that at days with high neutron activity (CRA) there were more medical emergencies and more deaths. Death in most cases is a result of fatal cardiac arrhythmia or heart-standstill-asystolia. A strong trend of SCD (mostly result of fatal cardiac arrhythmia-ventricular tachycardia, fibrillation) occurred more often on days of high CRA (neutron activity) [25, 26, 34, 35, 40]."

"One of the presumed ways of neutron activity action on the mentioned organ on cellular-molecular levels can be their addiction to H+ ions, especially high distributed in lipid concentration places (unstable atheroma and similar locations), conversion neutrons (after joining the H+ ion) to protons, that aggressively attacks cell nuclei and other cells parts and can act as one of the factors for fatal consequences (SCD, myocardial ruptures in AMI, fatal arrhythmias in ischemic cardiomyopathies and repeated AMI) [25, 35, 42-44]" (Stoupel et al. 2013).

It would be interesting to see what the data collected in this new analysis says, if anything, about the days of 'Zero' Geomagnetic Activity in order to find out if ICDs are more active on days of high Neutron Activity (CRA) and low Solar, Geomagnetic Activity.

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