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Energy from extraterrestrial sources is driving arctic lightning

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The possible effect of solar activity on lightning has been studied for a long period of time. Specifically, the relationship between sunspot number and lightning activity has been investigated, although the results still remain inconclusive across regions and time. In some regions, a positive correlation is found, in others a negative one. Thus, it is important to explore other solar-geomagnetic variables possibly influencing lightning activity.

In order to examine the possible relationship between solar activity and lightning activity we will study lightning and geomagnetic activity at the latitudes of 50° to 70° together with the solar and solar wind observations (SDO, ACE, OMNI database). Data from the Nordic lightning location system (NORDLIS) was used for lightning strikes and geomagnetic measurements from Sodankylä Geophysical Observatory, INTERMAGNET and IMAGE for geomagnetic disturbances. Our analysis showed a strong correlation between high-speed streams and lightning activity as well as with geomagnetic activity during solar cycle 23. All parameters peaked in 2003 during the early declining phase of solar cycle 23 and showed similar trends over the solar cycle. The correlation was strong and significant between latitudes 62° and 66°. The best coupling was found at 63° and 65°, where solar wind variability explained 86% and 88% of the variability of lightning activity, respectively. We hypothesize that this correlation is because of a much larger number of energetic particles due to an exceptionally high number of HSS during solar cycle 23. Penetration of these highly energetic particles to the atmosphere and production of high energetic secondary electrons can lead to runaway breakdown in thunderclouds and initiation of lightning.