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On the new solar-terrestrial institute

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Without the Sun, it is impossible for the Earth to harbor present life-friendly environment. A highly-developed civilization occasionally suffers from large solar flares. With Kepler data, Shibata et al. indicated that Sun-like stars are prone to produce super flares, significantly affecting our life and civilization on Earth, and estimated the non-negligible probability of such events. For the purpose of flare forecast, multiple countries including Japan are committed to space weather forecast. Indeed, Japan has launched 3 excellent solar observation satellites Hinotori, Yohkoh and Hinode, and contributed to develop a forecast algorithm as represented in the research by Kusano et al.

On another front, in a longer time scale, recent studies show that solar variation, typified by increase and decrease of sunspots, can impact the Earth's climate in significant ways. There is a record of global cooling during the Maunder Minimum occurred between 1645 and 1715 when very few sunspots were observed. Furthermore, measuring the captured isotopes in tree rings and ice cores from the polar zone can presume the number of sunspots in pre-telescopic era. This shows that Maunder Minimum-like episodes have occurred more than several times in past 10,000 years, and it is certain that there was decrease in the ocean temperature during the period. Today, it is established that solar variation has a significant effect on terrestrial climate.

It was as early as 1970's when solar observations in space revealed the surprising fact that the solar constant (the total radiation energy received from the Sun per unit of time per unit of area), which was considered to be unchanging, is actually changing by 0.15%. The Sun is slightly brighter at the time of solar maximum where large number of sunspots appears, and it is slightly darker at solar minimum where sunspots diminish. This variance in irradiance is caused by subtle balance between dark sunspots and accompanying bright faculae which consist of flux tube. Overall, the faculae brighten the Sun more than sunspots darken it, therefore the Sun is brighter when large number of sunspots appear. Variance in solar constant significantly correlate with terrestrial average temperature, and 0.1 % variance in irradiance induce approximately 0.12 degrees Celsius of change in temperature. Was the Sun darker during Maunder Minimum? If that is not the case, another mechanism is necessary to link solar variation and terrestrial climate.

Solar magnetic field is filled into interplanetary space, and it shields the Earth from cosmic radiation. When such shield is significant, the amount of cosmic radiation reaching the Earth decreases, and when the Sun is inactive the cosmic radiation increases. Some researches argue that the amount of cosmic radiation give impact on global environment.

It is has been discussed that the cause of the global warming accelerated in past 50 years is to be ascribed to the greenhouse effect, while the Sun is secondary element. Timely, the observation by the Japanese solar physics satellite Hinode shows that both polar regions are in homo-polarity, and there is a sign of significant and rapid decrease in magnetic flux of the Sun.

These facts clearly show that the comprehensive multidisciplinary research institute focusing on solar dynamo to geo-space and terrestrial environment is urgently required. Integrating the Solar-Terrestrial Environment Laboratory, Hydrospheric Atmospheric Research Center, and Center for Chronological Research of Nagoya University into one research institute, and making systematic and comprehensive approach to solar-earth-planetary science that is becoming more and more important is very timely also from the international perspective. I would like to express high degree of respect for the decision made by those who are concerned.

Keywords: solar terrestrial environment