# Long-term Sun-Earth system variations based on MAGDAS/CPMN data

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We will introduce preliminary results obtained by MAGDAS/CPMN data at Space Environment Research Center (SERC) for IUGONET (The Inter-university Upper atmosphere Global Observation NETwork) project. We are one of the members of IUGONET and this project builds a metadata database (MDB) of ground-based observations of the upper atmosphere to any users. Each institution provides some metadata and data, and we will provide MAGDAS/CPMN data about magnetometers, radars, and some geomagnetic parameters.

MAGDAS/CPMN data at SERC allow us to understand long-term geomagnetic variations along the 210 magnetic meridian (210MM). By using MAGDAS/CPMN data, we can know the coupling of Sun-Earth system into the lithosphere from solar surface, that is, solar radiation through the ionospheric solar quiet daily variation (Sq field). The Sq field results principally from currents, flowing in the E layer of the ionosphere. Major part of the electric field which powers the currents, appear to be generated in the manner of a dynamo by tidal winds produced by solar heating of atmosphere. Near the magnetic equator, the large daily variation of horizontal component is caused by eastward ionospheric current known as equatorial electrojet (EEJ). In order to understand the coupling of the Sun-Earth system, we have constructed an empirical Sq model by using MAGDAS/CPMN data during 1996-2007. Our empirical Sq model can be described as a function of the 5 variables (Day of Year, Lunar Age, F10.7 index, Local Time, and Magnetic Latitude) for any given day during 1996-2007, including magnetically disturbed days. We examined the dependence of the Sq model for each station on the 5 variables, and obtained the following results; 1) About 45% of external Sq current intensity is induced in the lithosphere. 2) The total external Sq current intensity shows a clear solar cycle and semi-annual variations, which predominantly appear in the southern hemisphere.

The Pc5 is one of the geomagnetic pulsations, having continuous wave from and the frequency between 1.67 and 6.67 mHz. We are now developing a low-latitude Pc5 index for a space weather study by using MAGDAS/CPMN data. This index provides us the Pc5 activity and estimated solar wind velocity. This index is very important for understanding the Sun-Earth coupling system, because Pc5 is the result of the interaction between the solar wind and the Earth's magnetosphere, and its activity depends on the solar wind velocity and solar wind ram pressure.

Finally, we will introduce one example of new interdisciplinary studies. We are comparing the monthly values of sunspot numbers for a few most recent cycles which are from year 1963 to 2009 and occurrence frequency of earthquake events at different magnitude scales. We also discuss the relationship among the occurrence of geomagnetic storms, the Sq induced currents in the lithosphere, and the solar cycle variation during this observational period. Our statistically analyzed results show a significant possible correlation between the solar and seismic activities.

In the present paper, we will show more details of the above examples by using our providing metadata and MAGDAS/CPMN data.