Season, Lunar Age, F10.7, LT and Latitude Dependence of Empirical Sq Model Based on CPMN Data During 1996-2007

Kiyohumi Yumoto[1]*, Terada Hiroshi[2], Yosuke Yamazaki[2], Yoshihiro Kakinami[3], Akimasa Yoshikawa[2], Teiji Uozumi[1], Shuji Abe[1], CPMN Group[1]

[1]*Space Environment Research Center, Kyushu University, 6-10- 1 Hakozaki, Higashi-ku, Fukuoka, 812-8581 Japan, yumoto@serc.kyushu-u.ac.jp, +81-92-642-4403*
[2]*Earth & Planetary Sciences Dept. Kyushu University., 6-10- 1 Hakozaki, Higashi-ku, Fukuokay, 812-8581 Japan*
[3]*National Cheng-Kung University, 1 University RD, Tainan City, 70101 Taiwan*

The solar quiet daily variation (the Sq field) results principally from currents flowing in the E layer of the ionosphere. The field variation is observed on the ground as a function of local time because the earth rotates under the currents. 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 examined the dependence of Sq variation on (1) Day of Year (DOY), (2) Lunar Age (LA), (3) Solar Activity (SA), (4) Local Time (LT) and (5) Magnetic Latitude (LAT) of the stations, we have constructed an empirical Sq model by using Circum-pan Pacific Magnetometer Network (CPMN) data during 1996 – 2007.

The CPMN data for constructing of empirical Sq model are selected under the magnetically quiet condition ($Kp \leq 2+$). The geomagnetic Sq daily variations at 17 CPMN stations are estimated with the least squares method as a function of DOY, LA, SA and LT. To improve latitudinal profile (magnetic variation versus latitude (LAT)), we used the polynomial interpolation of Sq variation from 00:00 LT to 23:30 LT in steps of 30 minutes.

For H-component Sq modeling, we used 5 order and 2 order polynomial formula for mid-low latitude region and dip equator region, respectively, because the Sq variation near the dip equator shows an equatorial enhancement, i.e.,EEJ. The latitudinal profile of EEJ was obtained by using 6 CPMN stations near the dip equator. For D-component Sq modeling, only 3 order polynomial formula was used, because there is no equatorial enhancement.

Our empirical Sq model can be described as a function of the 5 variables (DOY, LA, SA, LT and LAT) for any given day between1996 – 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) Hourly averaged horizontal magnetic Sq field increases with increase of solar activity (F10.7 index). Annual and semi annual variations appear at CPMN stations of mid latitude and near the dip equator, respectively.

(2) Hourly averaged horizontal magnetic Sq field increases just after the new moon and full moon.

(3) Seasonal Sq variations are identified in the amplitude of H and D component.