地磁気静穏日変化の季節変化と太陽活動依存性

新堀 淳樹 [1]; 小山 幸伸 [2]; 能勢 正仁 [3]; 堀 智昭 [4]; 大塚 雄一 [5]
[1] 名大・宇地研; [2] 大分高専
; [3] 京大・理 地磁気センター; [4] 名大 ISEE; [5] 名大宇地研

Characteristics of seasonal variation and solar activity dependence of the geomagnetic solar quiet daily variation

Atsuki Shinbori[1]; Yukinobu KOYAMA[2]; Masahito Nose[3]; Tomoaki Hori[4]; Yuichi Otsuka[5]
[1] ISEE, Nagoya Univ.; [2] NIT, Oita College; [3] DACGSM, Kyoto Univ.; [4] ISEE, Nagoya Univ.; [5] ISEE, Nagoya Univ.

Geomagnetic solar quiet (Sq) daily variation is observed as a regular waveform at ground magnetometer stations from mid-latitudes to the equator on the dayside. The Sq variation is mainly produced by large-scale ionospheric currents flowing in the E- and lower F1-regions (90-140 km) of the ionosphere. The Sq currents consist of two parts: one is the anti-clockwise current in the northern hemisphere, and the other is the clockwise current in the southern hemisphere. They are driven by the ionospheric electric field caused by the ionospheric dynamo action through interaction between charged and neutral particles in the E- and lower F1-regions of the ionosphere. Since the Sq currents concentrate in a height range of 90 -140 km, we can find several signals of long-term variation in the upper atmosphere from the analysis of long-term variation in the Sq field. In this study, we investigate characteristics of long-term variation in the monthly mean Sq variation in the X and Y components (Sq-X and Sq-Y) using long-term geomagnetic field data obtained at Memanbetsu (MMB) in mid-latitudes and Guam (GUA) near the equator from 1957 to 2016 with an aid of the Inter-university Upper atmosphere Global Observation NETwork tools. Especially, we clarify local time and seasonal dependence of the sensitivity of Sq-X and Sq-Y to the solar activity. In the present analysis, we used long-term geomagnetic field data with 1-h time resolution obtained at MMB and GUA provided by the World Data Center for Geomagnetism, Kyoto University. In order to determine geomagnetic quiet days, we referred the geomagnetic activity index (Kp) with 3-h time resolution provided by the GeoForschungsZentrum (GFZ) Potsdam. In this study, we defined the quiet day when the maximum value of the Kp index is less than 3 for that day. As a good indicator of solar activity, we adopted the 10.7 cm solar radio flux (F10.7) provided by the Natural Resources Canada. In this analysis, we used the monthly average of the adjusted daily F10.7 corresponding to geomagnetically quiet days. For identification of Sq-X and Sq-Y, we first determined the baseline of the X and Y components from the average value from 22 to 2 h (LT: local time) for each quiet day. Next, we calculated a deviation from the baseline of the X- and Y-components of the geomagnetic field for each quiet day, and computed the monthly mean value of the deviation for each local time. As a result, Sq-X and Sq-Y show a clear seasonal variation and solar activity dependence. The amplitude of the seasonal variation in Sq-X and Sq-Y increases significantly during high solar activities, and is proportional to the solar F10.7 index. The pattern of the seasonal variation is quite different between Sq-X and Sq-Y observed in mid-latitudes and equator. The correlation analysis between the solar F10.7 index and Sq-X and Sq-Y shows almost the linear relationship, but the slope and intercept of the linear fitted line depend on both local time and month. This implies that the sensitivity of the Sq variation to the solar activity is different for different local times and seasons. The local time dependence of the offset value of Sq-Y at GUA and its seasonal variation suggest a magnetic field produced by inter-hemispheric FACs. From the sign of the offset value of Sq-Y, it is inferred that the inter-hemispheric FACs flow from the summer to winter hemispheres in the dawn and dusk sectors and from the winter to summer hemispheres in the pre-noon to afternoon sectors. The direction of the inter-hemispheric FAC in the dusk sector is opposite to the prediction by Fukushima's model. From the slope of the linear fitted line, we observe a weak solar activity dependence of the inter-hemispheric FACs, which shows that the intensity of inter-hemispheric FACs has positive and negative correlations in the morning-noon and afternoon sectors, respectively.