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Kyoto University
1. Introduction

1.1 Geomagnetic solar daily quiet variation

The daily variation of geomagnetic field during solar quiet days has been called Sq (geomagnetic Solar Daily Quiet variation), and is mainly produced by ionospheric currents. The currents are driven by ionospheric dynamo of the E-region altitude via interaction between neutral and ionized particles. Since the amplitude of the Sq field strongly depends on ionospheric conductivity and neutral wind in the lower thermosphere and mesosphere, investigation of the Sq field using the long-term observation data is essential for understanding the long-term variation in the upper atmosphere.

Recently, Elias et al. [2010] reported that the Sq field observed at Apia, Fredericksburg and Hermanus show significant increasing trends for the period 1950-1999. They interpreted the Sq trend as effects on both secular variation in the ambient magnetic field intensity and upper atmospheric currents associated with global warming.

1.2 Problems of the past studies and purpose of this study

However, since Elias et al. [2010] analyzed geomagnetic field data obtained only at three stations for a short period, a global feature of the long-Sq trends has remained unknown. They did not also perform a comparison between the Sq field and neutral wind in the lower thermosphere and mesosphere. Then, the purpose of the present study is to clarify characteristics of the long-term variation in the Sq field (latitudinal and longitudinal dependence) using the long-term observation data of geomagnetic field provided from World Data Center for Geomagnetism, Kyoto University. For data search and analysis of the present study, we took advantage of metadata data search system and data analysis software (UDAS) developed in the IUGONET project.

2. Date sets and analysis

2.1 Observation data used in the present analysis

1. Geomagnetic field (1 hour data since 1900) : WDC, Kyoto Univ.
2. Geomagnetic index (Kp, 1932-2010) : WDC, Kyoto Univ.
3. F10.7 flux (1947-2010) : NGDC/NOAA

2.2 Identification of quiet day and Sq amplitude

1. Definition of quiet day:
   - The maximum of Kp index is less than 4 every day.
2. Sq amplitude:
   - Difference between the maximum and minimum values of the daily variation of the H-component of geomagnetic field during quiet.

2.3 Residual amplitude of Sq fields to filter out the solar activity

In order to clarify a global feature of the long-term Sq trends, we performed the integrated analysis of the observation data of geomagnetic field with 1-hour resolution, solar F10.7 Index during 1950-2011. We showed several new and important results as follows.

1. The amplitude of the field observed in a wide region from the northern to the southern polar regions shows large-scale, strongly on 11-year solar activity. The Sq amplitude is also proportional to the solar F10.7 index according to the second-order curve (not linear one).
2. The long-term variations of the residual field showed significant decreasing, increasing and decreasing trends for 1950-1969, 1970-1989, and 1990-2009, respectively. The inclination of the Sq trends is indicated by color scale between -1.0 and 1.0.

In the future study, we try to derive a contribution of secular variation of the ambient magnetic field intensity to the long-term Sq trends, from comparison with ionospheric conductivity calculated using the RI-07 and MSIS-00 models.