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Improvement of method of estimating the position of the focus of the Sq current system from geomagnetic observation

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On magnetic quiet a current system consisting of each vorticity in the northern and southern hemispheres, daily variation in the geomagnetic data from the worldwide distribution of observatories has often been used to assess the position of the focus of the Sq current system. The position of the focus of the Sq current system is one of fundamental parameters which have been used to understand a whole current system. However, recent research reports have less discussed about the relationship between the seasonal variation of the position of the focus of the Sq current system and quasi 27-day variation of solar activity. A standard method of estimating the Sq focus position is used to find out the latitude where diurnal H (or X) deviation determined by least squares fit from data of stations at a chain of geomagnetic observation along longitude line goes to zero (Hmax method). Hmax method works well for ideal quiet days but often fails in estimations for disturbance days, especially in automatic computation systems. A statistical analysis method has been discussed getting out the Sq variation by eliminating disturbance components from observed data (Xu and Kamide, 2004).
The authors have developed a wavelet multiresolution signal decomposition method which retrieves the Sq variation from the data contaminated with the other variations of origin such as external geomagnetic field and observation noise and have discussed the seasonal variability of daily geomagnetic variations related to quasi 27-day/11-year period of solar activity (JpGU meeting 2009). Wavelet transform has been used in various geoelectromagnetic surveys such as magnetic noise reduction (Trad and Travassos, 2000) and real-time detection system of Pi2 (Nose, 2001) to obtain really useful profits. Our goals are to improve Hmax method and to reveal the correlation between the seasonal variability of the position of the focus of the Sq current system and the period of solar activity. Data from 4 observatories (Memambetsu, Kakioka, Kanoya, Chichijima) at the Magnetic Observatory, Japan Meteorological Agency (JMA) are used to automatically compute the Sq focus position in the northern hemisphere on Hmax method in conjunction with wavelet multiresolution analysis. Following results were obtained from all the cases of the analysis.
1. It is suggested that the method has a credit with the estimation of the Sq focus position, while significant errors such as showed in JMA technical report (1986) in which corrected Dst is adopted for disturbance reduction could not be detected for our analysis.
2. There are a lot of discrepancies between 3 observatory-based result and 4 observatory-based result. Discrepancies found at around Chichijima station latitude are more remarkable and more significant during periods of low solar activity.
3. It is found that the focus position of the Sq current system has swung between Memambetsu and Chichijima station latitude during spring and summer; the phase synchronization is found in two seasonal variations of the Sq focus position and the geomagnetic Sq field; and the Sq focus position has swung in periods of more than 27 days during winter.
In conclusion, it is achieved that Hmax method in conjunction with a wavelet multiresolution signal decomposition method has been improved in automatic computation; and the correlation of the seasonal variation of the Sq focus position and the seasonal variation of the geomagnetic Sq field

related to the solar activity of quasi 27-day period is revealed.

Keywords: geomagnetic observation, Sq current system, seasonal variation, wavelet multiresolution