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The quasi-biennial variation in the geomagnetic field: a global characteristics analysis

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The periodicity of 1.5-3 years, namely the quasi-biennial oscillation (QBO), has been identified in the solar, geophysical, and atmospheric variability. Sugiura (1976) investigated the observatory annual means over 1900-1970 and confirmed the QBO in the geomagnetic field. At present, studying the quasi-biennial oscillation becomes substantial for separating the internal/external parts in the geomagnetic observations. For the internal field, two typical periodicities, namely the 6-year oscillation in the geomagnetic secular acceleration (SA) and the geomagnetic jerk (occurs in 1-2 years), have close period to the QBO. Recently, a global quasi-biennial fluctuation was identified in the geomagnetic core field model (Silva et al., 2012). Silva et al. speculated this 2.5 years signal to either external source remaining in the core field model or consequence of the methods used to construct the model. As more high-quality data from global observatories are available, it is a good opportunity to characterize the geomagnetic QBO in the global range. In this paper, we investigate the QBO in the observatory monthly geomagnetic field X, Y, and Z components spanning 1985-2010.

We employ the observatory hourly means database from the World Data Center for Geomagnetism (WDC) for the investigation. Wavelet analysis is used to detect and identify the QBO, while Fast Fourier Transform (FFT) analysis to obtain the statistics of the QBO. We apply the spherical harmonic analysis on QBO's amplitude, in order to quantify and separate internal and external sources. Three salient periods respectively at 2.9, 2.2, and 1.7 years, are identified in the amplitude spectrum over 1988-2008. The oscillation with the period of $\sim$2.2 years is most prominent in all field components and further studied. In the X component the QBO is attenuated towards the polar regions, while in the Z component the amplitude of QBO increases with increasing of the geomagnetic latitude. At the high latitudes, the QBO exhibits distinct anisotropic in the local time distribution. The QBO of the X and Z components are both stronger over LT 00:00-06:00. The results of spherical harmonic analysis indicate that the QBO is mainly contributed by the external sources. The QBO is highly correlated with various parameters of solar activity, solar wind at 1AU, and geomagnetic activity.

Reference

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2. Silva, L., Jackson, L., and Mound, J., (2012), Assessing the importance and expression of the 6 year geomagnetic oscillation, J. Geophys. Res.: Solid Earth (1978–2012), 117.