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2009年７月２２日皆既日食時の赤道ジェット電流強度の増加

Enhancement of Equatorial Electrojet during the July 22, 2009 Solar Eclipse Event

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In the present paper, we report the solar eclipse effect on the equatorial electrojet (EEJ) during the July 22, 2009 solar eclipse event. The solar eclipse effect on the daily magnetic variations (i.e. Sq and EEJ) has been studied by many researchers for a long time since the beginning of the 20th century [e.g. Chapman and Barteles, 1940; Kato, 1961; Campbell, 1989]. They concluded that the solar eclipse effect on magnetic variation was observed in general as the local depression of the Sq or EEJ variations. This morphology was established by magnetic observations, which were done in a local area near the total eclipse path. However, the global effect of the solar eclipse on Sq and EEJ magnetic variation is not yet clarified. It is still unknown how the low-latitude solar eclipse traverses the Sq current vortex, and affects the EEJ variation. The July 22, 2009 total solar eclipse was a good opportunity to study the global effect of the solar eclipse crossing the northern-hemispheric Sq current vortex, by using the meridional magnetometer array of MAGDAS/CPMN. The meridional magnetic observations from Russia (GGLAT=52.9deg) to Australia (-23.2deg) include dense magnetic stations near the total eclipse path (GGLAT around 30deg) and two magnetic equatorial stations (Dip Lat. = -0.7 and 1.7deg).

We found an anomalous enhancement of the EEJ amplitude during the July 22, 2009 solar eclipse event, which is the first observation. During the solar eclipse event, the EEJ amplitude became 2 times larger than that of the averaged EEJ, which is obtained by MAGDAS data during three months before the event. A superposed epoch analysis for EEJ amplitude revealed that the amplitude of EEJ during the solar eclipse event exceeded the 3-sigma (standard deviation) range of the EEJ amplitude estimated from the 3-months data. It means that the anomalous EEJ enhancement is statistically significant. This evidence suggests that the anomalous enhancement of EEJ was caused by the solar eclipse. In the past, a solar eclipse effect on the EEJ was reported

to show the depression of magnetic variation along the trajectory of solar eclipse. The present new finding is the kind which was not possible with previous localized magnetic observations.

In the later half of the solar eclipse event, a moderate magnetic storm (Dst about -80nT) occurred, then the equivalent Sq current pattern could not be described yet. Meanwhile, Sq magnetic variation in the Z component was found to be less affected by the storm disturbance, and the depression of the Sq magnetic variation could be confirmed in the Z component. The latitudinal scale length of the depression area was estimated to be about 1000km. This area roughly corresponded to the area of the eclipse magnitude larger than 0.8. According to a classical theory of the solar eclipse effect by Chapman [Chapman and Barteles, 1940], a twin-vortex current centered at the total eclipse area would be generated, and depress the horizontal Sq magnetic variation. However, the depression pattern in the Z component cannot be explained by using the twin-vortex current system. Large modification of the Sq dynamo system and the electric potential pattern would be required to enhance the EEJ amplitude. More research including global simulation of the ionospheric dynamo is needed to understand the EEJ enhancement during the solar eclipse event.

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