Development of an Equatorial Electro-Jet model based on the dense Peruvian magnetometer array

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論 文 名　：　Development of an Equatorial Electro-Jet model based on the dense Peruvian magnetometer array
(ペルー地磁気稠密観測網に基づく赤道ジェット電流モデルの開発)

区　　分　：　甲

論　文　内　容　の　要　旨

Equatorial Electro-Jet (EEJ) is well known as the origin of abnormal enhancement of daily variation during geomagnetic quiet time at dip equator, which is an eastward electric current flowing in the ionosphere there. It was reported that not only daily variation but also some of geomagnetic disturbance phenomenon such as Dp2 or SSC also has equatorial enhancement (e.g. Kikuchi et al., (1996), Nishida and Jacobs, (1962)). Therefore, development of the model to represent such latitudinal profile is important for space weather study.

Although past researches investigated the latitudinal profile of EEJ using the magnetic data of Low Earth Orbit (LEO) satellite, it was difficult to investigate its time development due to the characteristics of LEO satellite. By contrast, the magnetic data on the ground had important roles for investigating the time development of phenomenon or MLT structure since this data is fixed to certain coordinate system and is continuously derived there. However, it was difficult to identify if increase or decrease of the magnetic field variation caused by the change of current intensity or size of current such as the width.

Thus, the MAGDAS network, which is the largest network of ground magnetometer organized by International Center for the Space Weather Science and Education (ICSWSE) [K. Yumoto et al., (2006, 2007)], was expanded in Peru and developed the dense magnetometer array in Peru. Thereby, we developed the model that derives latitudinal profile of EEJ continuously using that data. The best set of parameters for EEJ model was determined least square method between observed field and calculated field from modeled EEJ current. The estimated EEJ model was evaluated using LEO satellite data, namely the Swarm satellite during the orbital longitude around Peruvian longitude. The dense Peruvian magnetometer array has started its observation since 2016, therefore, the events was selected in 2016. In total, thirty-three of events was selected, and the result shows good correspondence between the modeled field and Swarm observed field during 09 to 11 local time, while some of other local time has discrepancies which is possibly due to different altitude of EEJ was assumed.

Moreover, using derived model, the correlation between estimated current density of EEJ and

amplitude of equatorial enhancement of ground magnetic data was shown. Additionally, it was shown that the width of EEJ and the position of EEJ axis tend to converge a certain value when the amplitude of the equatorial enhancement or the peak current density become larger. This kind of trend has also reported by Luhr et al., (2004), and it is not inconsistent with our results. This result may indicate that the equatorial enhancement is disappeared and more dominant of Sq variation when the amplitude of the field is small. For this reason, it is possible that the correlation between the current density and F10.7, which is a kind of parameter to evaluate the strength of ionization, was not appeared.

However, this study has great impact to the EEJ study since the EEJ structure such as the width or current density become available in quasi-real time, and it is expected that this model will have an important role for space weather study as a tool to monitor the electro-magnetic structure in the ionosphere.