

インドネシア・バンドンの BRIN 滞在中に行った磁気嵐時プラズマバブルの研究

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Characteristics of EPB occurrences over Indonesia during a geomagnetic storm in August 2024 ~Visiting Researcher Program in BRIN~

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Equatorial Plasma bubbles (EPBs) are known as the plasma density depletion regions in the equatorial ionosphere. It is also known that plasma density irregularities exist with multiple spatial scales inside EPBs. EPB generations are sometimes activated and suppressed by geomagnetic storms, depending on the phases of geomagnetic storms. A background eastward electric field is one of the most important factors for generating EPBs through the Rayleigh-Taylor instability. In this study, we found that plasma density irregularities related to EPBs were observed over the east side of Indonesia ($>120^{\circ}$ E) while they did not be generated over the west side of Indonesia ($<120^{\circ}$ E) during a geomagnetic storm that occurred on 12 August 2024. The purpose of this study is to clarify the characteristics of EPB generations over Indonesia during the geomagnetic storm by analyzing global navigation satellite system-rate of total electron content (TEC) index (ROTI) and ionosonde data.

ROTI enhancements appeared over the east side of Indonesia following the sunset terminators until ~12:00 UT on 12 August. On the other hand, ROTI enhancements did not be observed over the west side of Indonesia after ~12:00 UT. The north – south component of interplanetary magnetic field (IMF Bz) suddenly weakened at 12:00 UT although the IMF Bz directed still southward. Furthermore, the ionospheric virtual height (h'F) obtained from the ionosonde at Bac Lieu (9.30° N, 105.71° E: west side) was larger during the geomagnetically quiet day (11 August) than that during the geomagnetic storm after 12:00 UT. The h'F at Cebu (10.35° N, 123.91° E: east side) elevated to the high altitude before 12:00 UT during both the geomagnetic storm and geomagnetically quiet day. The h'F at Cebu declined after 12:00 UT during the geomagnetic storm.

During the main phase of geomagnetic storms under the southward IMF condition, penetration electric field over the equator enhanced due to the developments of convection electric field in the polar region through the magnetosphere – ionosphere coupling. The eastward penetration electric field over the equator is intensified after sunset, superposing the pre-reversal enhancement (PRE). On the other hand, a shielding penetration electric field also enhanced following the development of geomagnetic storms. The polarity of the electric field over the equator is opposite to that of penetration electric field; that is westward after sunset. We suggest that the shielding penetration electric field competed with the penetration electric field over the equator when southward IMF was decreased at 12:00 UT. The PRE at Bac Lieu occurred around 11:00 – 12:00 UT (18:00 – 19:00 LT) while the PRE at Cebu occurred around 10:00 – 11:30 UT (18:00 – 19:30 LT). Our results indicate that the PRE at Bac Lieu was suppressed due to the shielding electric field but the PRE at Cebu was not suppressed. Therefore, ROTI enhancements related to EPBs were generated only over the east side of Indonesia ($>120^{\circ}$ E) in this event. We can conclude that EPB generations during geomagnetic storms are controlled by storm-time electric field variations.

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インドネシアの BRIN が公募する Visiting Researcher Program に参加した。2 か月の間インドネシアのバンドンに滞在し現地の研究者らと磁気嵐時のプラズマバブル発生に関する研究を行った。その解析結果をまとめて発表を行う予定である。