

Initial results of multi-event analysis of magnetosphere-ionosphere coupling for nighttime medium-scale traveling ionospheric disturbances

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Medium-scale traveling ionospheric disturbances (MSTIDs) are propagating fluctuations of the electron density in the F-region ionosphere and can cause significant influence in the positioning using satellites such as Global Positioning System (GPS). MSTIDs generated by the E-region–F-region coupling and Perkins instabilities show mirrored structures at magnetically conjugate points in the two hemispheres at middle latitudes [e.g., Otsuka et al., GRL, 2004]. In such a case, the electric field variations associated with the MSTIDs probably mapped to the other hemisphere along geomagnetic field lines and they can be observed by magnetospheric satellites. Previously we have reported one such event of the conjugate observation of MSTIDs with the Arase satellite (Kawai et al., JpGU-AGU2020, 2020; Kawai et al., submitted to JGR, 2021). On the other hand, this study reports initial results on the analysis of four events with simultaneous observations of MSTIDs made by the Arase satellite and airglow imagers operated at Athabasca (54.60°N, 246.36°E), Canada on February 25, 2020, at Gakona (62.39°N, 214.78°E), Alaska on February 26, 2019, and at Kapuskasing (49.39°N, 277.81°E), Canada on January 11 and 26, 2019. In the first event at Athabasca, the Arase satellite observed electric field variations associated with airglow intensity deviations, similar to that reported by Kawai et al. [2021]. We projected these electric field variations onto the ionosphere, the direction of the $\mathbf{E} \times \mathbf{B}$ drift derived with the background magnetic field showed the opposite senses between bright and dark structures of the airglow intensity deviation of the MSTIDs taken by the airglow camera. However, electron density fluctuations observed the Arase did not clearly correspond to the airglow intensity deviation of MSTIDs. Similar analyses for the other three events are underway. As preliminary results, we found that the Arase did not necessarily observe the characteristic variations of the magnetospheric electric field variations and electron density fluctuations associated with the MSTID structures. Based on these results, our scientific objective is to reveal the necessary conditions under which variations of the electric field and electron density associated with MSTIDs propagate to the magnetosphere.

Keywords: medium-scale traveling ionospheric disturbances, magnetosphere-ionosphere coupling, the Arase satellite, airglow imager