Simultaneous Observation of Nighttime Medium-Scale Traveling Ionospheric Disturbance and Field-Aligned Irregularities in Indonesia

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We report simultaneous observation of medium-scale traveling ionospheric disturbances (MSTIDs) and field-aligned irregularities (FAIs) in the nighttime F region using an all-sky airglow imager and the 47-MHz Equatorial Atmosphere Radar (EAR) at Kototabang (0.20^{o}S, 100.32^{o}E; dip latitude 10.36^{o}S), Indonesia. On the night of July 13, 2010, MSTIDs propagating magnetically northwestward were observed in 630-nm airglow images over Kototabang. By making multi-beam measurements with the EAR, F-region FAIs extending from NE to SW were observed. In order to investigate the spatial relationship between the MSTIDs and FAIs, the FAIs were mapped onto the 630-nm airglow layer (altitude, 260 km) along the geomagnetic field lines. We found that FAIs coincided with the airglow depletion caused by the MSTIDs. This result is consistent with that observed at mid-latitudes. From combination of the Doppler velocities on the three radar beams, average velocity of the FAIs is estimated to be magnetically southeastward, indicating existence of northeastward electric field. The direction of this electric field is not consistent with that expected from the previous studies regarding formation of the nighttime MSTIDs. According to the previous studies, polarization electric field in the airglow depletion is southeastward in the southern hemisphere to keep the current continuity, and the plasma move to higher altitudes by ExB drift, decreasing the airglow intensity. This discrepancy could suggest an existence of the electric field parallel to the MSTID wave front. In the current event, MSTID were observed at magnetically low latitudes, and equatorward edge of the MSTID structure were seen in the airglow images. Due to the ionospheric current which could flow magnetically southeastward, negative charge could be accumulated at the equatorward edge of the MSTID structure, and northeastward electric field could be generated to keep the current continuity in the direction parallel to the wavefront of the MSTID elongating in NE-SW direction.