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Characteristics of O630nm emission associated with equatorial ionization anomaly obtained with IMAP/VISI

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The Equatorial Ionization Anomaly (EIA) is occurred by plasma upwelling due to eastward electric field in the dayside magnetic equator, and descends to both northern and southern hemispheres along the field line. Density maximum appears around geomagnetic latitudes of +/-15 degree at both hemispheres. Since most of the past studies carried out with ground experiments, it is difficult to observe a wide area and study the variability of the northern and southern O630nm emission associated with EIA.

IMAP/VISI on the International Space Station(ISS) measures O630 nm airglow emission in the nightside hemisphere at an altitude of 400km. It covers the latitudinal range between +/-52 degrees with a typical spatial resolution of 1x14 km. Because of the wide observation coverage, it is possible to observe the variability of O630nm airglow associated with the EIA.

In this study, we carried out a statistical analysis using IMAP/VISI data from September 2012 to December 2013 to understand the variability of O630nm airglow associated with the EIA, particularly on its local time dependence, seasonal variation and geomagnetic activity. We derived the integrated intensity of O630nm emission along latitude with the four criteria as follows: (1) The O630nm emission in the EIA is greater than the background airglow that was determined by emission intensity in the middle latitude. (2) Latitudinal distribution of O630nm emission in the EIA is fully measured. (3) The northern and southern O630nm emission in the EIA is clearly separated. (4) The moon phase is smaller than 0.5. In case that the moon phase is bigger than 0.5 then we used the data when the moon did not appear.

We find that the time dependence of O630nm emission which is decreased from the evening toward the post mid-night. But there is a large variance in the intensity at the same local time. This fact suggests that other process, such as the longitude and/or seasonal variation, may affect the O630nm emission associated with the EIA in addition to the local time dependence.

On the seasonal dependence, we find that O630nm emission in the EIA in the winter hemisphere is greater than that in the summer hemisphere. This is consistent with the model that the thermospheric tidal wind affects the 630 nm intensity, namely, the tidal wind decreases the altitude of O630 nm emission layer and finally gain the O630 nm intensity.

To examine the longitudinal dependence, we used the data in equinox (September and October, 2013) and find that O630nm emission in the EIA in the northern hemisphere is greater than that in the southern hemisphere where the dip equator is the south of geographic equator (longitude is between 200 degree ? 310 degree). This is also consistent with the model that the thermospheric tidal wind controls the O630 nm intensity by making a vertical motion of emission layer.

Finally, we investigate the magnetic storm dependence on O630 nm intensity and find that significant decrease of O630nm intensity in the EIA happens during the period when the Dst index is larger than 90. From this fact, it is plausible that westward electric field in Region 2 current system penetrates to the low latitude region during the main phase of magnetic storm and reduce the formation of EIA.

Keywords: ISS, airglow, thermosphere, ionosphere, equatorial ionization anomarly, IMAP