

Analysis of 630-nm airglow three-dimensional structure based on satellite and ground observations

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630-nm airglow is used to study ionospheric structures in the F-region. Main instruments for the observations are CCD imagers on the ground. ISUAL (Imager of the Sprites: Upper Atmosphere Lightning) is an instrument on board of the FORMOSAT-3 satellite. Although the main target of the ISUAL is the tangent luminous events (TLEs), it can measure limb image of the 630-nm airglow by slightly changing the attitude of the satellite.

We conducted total 14 days of 630-nm airglow observations with the FORMOSAT-2/ISUAL in December 2006, May-June 2007, and April-May 2008. The observations are limited to around local midnight, and provided us with meridional distribution of the airglow at the Australia-to-Japan region. We estimated altitude profile of the airglow layer to be 220-280 km. There were bright emissions near the equator and around 30 S. Simultaneous observations between ISUAL and a ground-based imager were successful over Darwin at 0 LT on 16 May 2007. We studied structures of MSTID (Medium-Scale Traveling Ionospheric Disturbance). By using height information from ISUAL and horizontal distribution of airglow from the imager, we modeled three-dimensional structure of the airglow. Reconstructed ISUAL image from the model agreed well with the real data. We further tried to estimate three-dimensional structures of the ionosphere based on the ISUAL data only. From clear images of airglow on 21 December 2006 and 16 May 2007, we successfully estimated reasonable structures of MSTID and equatorial anomaly, respectively. From these studies we showed that the limb imaging of 630-nm airglow from space is a useful tool to study the ionosphere structures.