ISS 搭載 IMAP/VISI の大気光ならびにオーロラの一年間の観測成果

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One year observation of global airglow and auroral distribution with IMAP/VISI on ISS

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IMAP/VISI is a visible imaging spectrometer which measures three nightglow emissions from ISS (~400 km altitude); O (630 nm, 250 km alt.), OH Meinel band (730 nm, 87km alt.), and O2 (0-0) atmospheric band (762 nm, 95 km alt.) with the two field-of-views (+/-45 deg. to nadir) to make a stereoscopic measurement of the airglow and aurora emission to subtract background contaminations from clouds and ground structures. Each field-of-view has 90 deg width faced perpendicular to the orbital plane, which is mapped to ~600 km width at 100 km altitude and ~300 km width at 250 km altitude. A continuous line-scanning for all emissions lines in the latitudinal range from + 51 deg to -51 deg is carried out by VISI with the successive exposure cycle with a time interval of 1 - several sec, which corresponds to a spatial resolution of 10 km - a few tens km.

We started nominal operation from the middle of October in 2012. Since then, VISI have measured airglow and auroral emissions continuously in the night side hemisphere on about 10 orbits every day. We found a number of events showing meso-scale (~10 - 50 km) wave pattern of airglow emission at O2 762 nm. The O2 airglow emission is characterized by the dark background since there is strong absorption in this wavelength range mainly due to stratospheric ozone. The typical O2 airglow intensity is several hundreds R to several kR. Most of O2 airglow shows straight-shaped pattern, which indicates plane atmospheric gravity waves. However, we found 30 concentric pattern in O2 airglow emission, which suggests that the local generation source in the lower-atmosphere. Septi et al. examined one event on concentric O2 airglow pattern on October 2012, and found the causal relationship to the strong convection in the troposphere. It is remarkable that 26 concentric airglow events out of total 30 events happened in March and April in 2013, which shows its seasonal effect. Further, we found that there are both of airglow strictures in the medium (50 km -a few hundreds km) scale and the large scale overlapped with each other. It is interesting to investigate the cross-scale coupling between medium-scale airglow and large-scale airglow. From one-year continuous data, we plotted the global map of O2 airglow and compared with the past data obtained with UARS.

Although the maximum latitude of ISS orbit is +/- 51 deg, during geomagnetically disturbed period we sometimes measured auroral emissions at O2 762 (~120 km alt.) and O 630 nm (~250 km alt.) at high-latitudes. One of major purposes of auroral measurement with VISI is SAR arc in the sub-auroral region. Even though the solar activity is expected to be maximum in 2012 - 2013, we could not obtain the SAR arc data so far. However, we still expect to measure the SAR arc event caused with a major storm during a solar declining phase. Another target of high-latitude VISI measurement is to obtain the gravity wave caused by auroral activity. VISI has a capability to measure airglow and aurora simultaneously since the dynamic range of VISI is sufficiently large. However, we could not obtain the gravity wave event caused by aurora so far.

In addition, around the magnetic equator, we frequently measured meso-scale dark filament pattern, i.e., plasma bubble, overlapped with the uniform background of O 630 emission. We also try to obtain the MSTID event in O 630 nm emission at middle-latitudes by comparing the O 630 nm emission and TEC map. Further we install an all-sky imager at the summit of Haleakala, Maui, Hawaii (20.71 deg. N. lat., 203.74 deg. W. lon. 3040m alt.)

In this presentation, we give the summary of one-year observation of airglow structure with IMAP/VISI, focusing on the spatial characteristics of gravity waves. We also report the current status of the operation and state of the VISI instrument.

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