PEM11-01 Room:A01 Time:May 24 16:15-16:30

Overview of the GLIMS Mission

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The Global Lightning and sprIte MeasurementS (GLIMS) on the International Space Station (ISS) is a mission to detect and locate optical transient luminous events (TLEs) and its associated lightning simultaneously from the non-sun synchronous orbit, and was launched successfully in July, 2012 as part of the multi-mission consolidated equipment on Japanese Exposure Module (JEM). Our mission goals are to identify temporal and spatial evolutions of lightning and TLEs and to clarify the occurrence conditions of TLEs and global occurrence locations and rates of TLEs from the nadir observation. To achieve these goals, two CMOS cameras, six Photometers, VLF receiver, and VHF interferometer with two antennas, are installed at the bottom of the module to observe the TLEs as well as parent lighting discharges at nadir direction. Though the luminous events so-called sprite, elves and jets have been investigated by numerous researchers all over the world based mainly on the ground observations, some important problems have not been fully understood yet such as generation mechanisms of columniform fine structure and horizontal offset of some sprites from the parent lightning discharges. So far, more than one thousand events were recorded, and this mission is continuously observing TLEs and lightning events. In this paper, in order to discuss on the TLE and lightning effect to atmosphere, mission overview, and some examples of the observation results are introduced. This is the first time to present on the results of the GLIMS mission from the meteorological aspects.

Keywords: Lightning, Sprite, TLE, ISS

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(May 24th - 28th at Makuhari, Chiba, Japan)

PEM11-02 Room:A01 Time:May 24 16:30-16:50

Lessons learned from SMILES project, and possible SMILES-2

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Superconducting Submillimeter-Wave Limb-emission Sounder (SMILES) was the first instrument to use 4K cooled SIS (Superconductor-Insulator-Superconductor) detection system for the observation of the atmosphere in the frequency regions 625 GHz (Bands A and B) and 650 GHz (Band C) [1]. It has demonstrated its high sensitivity (System Temperature, Tsys ~250K) for measuring stratospheric and mesospheric species, O3, HCl, ClO, HO2, HOCl, BrO, and O3 isotopes from Oct. 12, 2009 to Apr. 21, 2010 [2-5]. So it was very successful scientific program, even though it have been conducted as an engineering demonstration program.

Since SMILES operation has terminated after only 6 months operation due to failure of sub-mm local oscillator (and later 4K cooler system), there exist strong scientific demand to develop successor of SMILES, the SMILES-2, which has optimized and enhanced frequency coverage to observe: (a) BrO and HOCl without interferences of stronger emission lines, (b) N2O, H2O, NO2, and CH3Cl not covered by the SMILES frequency regions, and (c) O2 line to measure temperature.

This paper will describes (a) list of SMILES publications on timeline, (b) lessons learned from SMILES project, and (c) possible SMILES-2 observations based upon those SMILES lessons.

PEM11-03 Room:A01 Time:May 24 16:50-17:10

Observation results and current status of SEDA-AP on the ISS - ”Kibo” Exposed Facility

KOGA, Kiyokazu[1*] ; MATSUMOTO, Haruhisa[1] ; KIMOTO, Yugo[1] ; YAMADA, Noriko[1] ; UENO, Haruka[1] ; MURAKI, Yasushi[2]

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To support future space activities, it is very important to acquire space environmental data related to space radiation degradation of space parts and materials and spacecraft anomalies. Such data are useful for spacecraft design and manned space activity.

On several satellite of the Japan Aerospace Exploration Agency (JAXA) since the Engineering Test Satellite-V (ETS-V), Technical Data Acquisition Equipment (TEDA) and SEDA have been installed for obtaining the data described above.

SEDA-AP measures space environment data on ISS orbit. SEDA-AP comprises common bus equipment supporting launch, RMS handling, the power/communication interface with JEM-EF, an extendible mast that extends the neutron monitor sensor 1 m separate from the bus structure, and equipment that measures space environment data. It has eight environment monitoring sensors, which measure neutrons, heavy ions, plasma, high-energy electrons and protons, atomic oxygen, space debris and dusts.

SEDA-AP was lanced on July 16 in 2009, and attached to Exposed Facility (EF) of ”Kibo” on July 25 using the robot arm of ”Kibo”. Initial checkout was started on August 4 and successfully ended on September 17. The regular operation period ended in 2011. Afterwards, later operation period of three years has started, and operation is being continued now.

We will report the observation results and the current status of SEDA-AP.

Keywords: SEDA-AP, Space Environment

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM11-04 Room:A01 Time:May 24 17:10-17:25

ISS-IMAP observation of the airglow and the ion resonant scattering in the Earth's upper atmosphere

SAITO, Akinori[1*] ; SAKANOI, Takeshi[2] ; YOSHIKAWA, Ichiro[4] ; YAMAZAKI, Atsushi[3] ; OTSUKA, Yuichi[5] ; YAMAMOTO, Mamoru[1] ; AKIYA, Yusuke[1] ; HOZUMI, Yuta[1] ; YUKINO, Hideko[1]

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ISS-IMAP (Ionosphere, Mesosphere, upper Atmosphere, and Plasmasphere mapping) mission have observed the airglow and the ion resonant scattering in the Earth's upper atmosphere since 2012. The scientific goals of ISS-IMAP are to elucidate following two processes: 1) energy transport process by the structures whose horizontal scale is 50-500km in the Earth's upper atmosphere, 2) the effect of the structures and disturbances on the space-borne engineering system. ISS-IMAP was installed on the Exposure Facility of Japanese Experiment Module, Kibo, of the International Space Station in August 2012. It consists of two sets of imagers, VISI and EUVI. Visible-light and infrared spectrum imager (VISI) observes the Mesosphere and the Ionosphere. Extra ultraviolet imager (EUVI) observes the Ionosphere and the Plasmasphere. VISI observes the airglow in the Nadir direction. The airglow emissions were mainly observed by VISI was 730nm (OH, Alt. 85km), 762nm (O2, Alt. 95km), and 630nm (O, Alt. 250km). Additional airglows, such as Sodium, were also observed. The global distributions of the airglow structures whose scale size is 50-500km in the nightside of the Mesosphere and the Ionosphere have been obtained by the VISI observation. EUVI measures the resonant scattering of 30.4nm [He+] and 83.4nm [O+]. Its field- of-view is 15 degrees, and points the limb of the Earth to observe the vertical distribution of the ions. The observational results including its conjugate observation with the ground-based instruments will be introduced in the presentation.

Keywords: Ionosphere, Thermosphere, Mesosphere, Plasmasphere, International Space Station, Airglow

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM11-05 Room:A01 Time:May 24 17:25-17:40

VHF and optical lightning observations by JEM-GLIMS

MORIMOTO, Takeshi[1*] ; OI, Kazumasa[1] ; KIKUCHI, Hiroshi[3] ; SATO, Mitsuteru[2] ; MIHARA, Masahiro[2] ; USHIO, Tomoo[3] ; YAMAZAKI, Atsushi[4] ; SUZUKI, Makoto[4]

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Global Lightning and sprIte Measurements (GLIMS) mission is now ongoing on Exposed Facility of Japanese Experiment Module (JEM-EF) of the International Space Station (ISS). JEM-GLIMS mission is designed to conduct comprehensive observations with both the EM and the optical payloads for lightning activities and related transient luminous events (TLEs) expecting to give us many scientific impacts to the field. The integrated 4 sensors installed into Multi Mission Consolidated Equipment (MCE), which is the bus system, and is mounted at JEM-EF as GLIMS mission. The 4 sensors consist of very high frequency (VHF) broadband digital InTerFerometer (VITF), very low frequency (VLF) receiver, CMOS cameras at two different wavelengths, and photometers at six channels.

VITF consists of two sets of antennas, band-pass filters, amplifiers, and 2-channel-AD-converter. Impulsive EM radiations received by the antennas are digitized by the AD converter synchronizing with another channel through the filters and the amplifiers. A patch type antenna is developed within the size of 200$*$200 mm. It is mounted on the antenna base made of aluminum alloy and Teflon block with the total height of 100 mm to gain its bandwidth and to reduce the interference from other structural objects. The same two units of antennas are installed with the separation of 1.6 m. Their bandwidths with the less return loss than 3 dB are from 70 to 100 MHz. The signals received by the antenna are transmitted along cables with the same lengths to the electronics. The AD converter records 130 waveforms as maximum of one dataset with the duration of 2.5 μs with 200 MS/s. The developments of VITF are based on the heritage of VHF sensor on Maido-1 satellite.

JEM-GIMS mission payload was successfully launched at the end of July 2012, and transported and installed to the ISS. After the initial checkout and maintenance, its nominal operation is continued from December 2012. Through the operation period, VITF corrects numerous VHF EM data synchronized with optical signals. About 2,900 VITF datasets were obtained in 20 months. The timing of data acquisition is controlled by a photometer through this period. Namely, the EM and optical data are recorded being triggered by a photometer. 65 - 80% of optical observations are accompanied with VHF radiations. Though the discrimination is in progress, most optical signals are from lightning.

The estimations of the EM direction-of-arrival (DOA) are attempted using the broadband digital interferometry. Some results agree with the optical observations, even though DOA estimation has difficulties caused by its very short baseline of the antennas and multiple pulses in short time, namely burst-type EM waveforms. VITF is designed expecting to estimate the DOA with about 10 km resolution that is equivalent to the scale of a thundercloud. This paper makes comparative discussion about the observations by VITF and optical payloads, CMOS camera and photometer. It is found that the brighter lightning makes the denser VHF radiations.

Keywords: Lightning discharge, International Space Station, Transient luminous event

PEM11-06 Room:A01 Time:May 24 17:40-17:55

Horizontal Distributions of Sprites and Properties of Parent Lightning Discharges Derived from JEM-GLIMS Observations

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Sprites are lightning-associated transient discharge phenomena occurring in the mesosphere and are mainly excited by positive cloud-to-ground (CG) discharges. Although a large number of studies on sprites have been performed by optical observations from the ground, airplanes and space and numerical simulations, the physical mechanism determining the horizontal distributions of sprites is not clear so far. Recent studies suggested that the in-cloud lightning currents associated with CG discharges would have an important role to determine the horizontal distributions of sprites. In order to clarify this, it is essential to carry out nadir observations of lightning discharges and sprites from the space using optical instruments and radio receivers. JEM-GLIMS is a space mission to conduct nadir observations of lightning discharges and sprites from International Space Station (ISS). In this mission, images of the lightning and sprite emissions can be captured by a wide-band CMOS camera (LSI-1) and a narrow-band CMOS camera (LSI-2). In addition to this, the absolute intensities of N_2 1P, 2P and N_2^+ 1N emissions of lightning discharges and sprites are measured by six-channel spectrophotometers (PH). In order to identify the sprite occurrences, we have developed new identification techniques: (1) a subtraction of the appropriately scaled LSI-1 image from LSI-2 image, (2) a calculation of intensity ratio between different PH channels, and (3) an estimation of the charge moment changes and polarity of the parent CG discharges using 1-100 Hz ELF waveform data. Using these methods, three events observed at (A) 05:08:14 UT on Dec. 21, 2013, (B) 03:48:24 UT on Jun. 10, 2014, and (C) 06:41:15 UT on Jun. 12, 2014 are confirmed that sprites were occurred. In the event (A), sprite emissions were detected at three different locations, and the distances between sprite elements are estimated to be 4.57 km, 6.57 km and 9.92 km. The average distance from the location of the peak lightning emissions is 19.83 km. It is also found that the peak lightning emissions was located by 15 km away from the return stroke position detected by WWLLN. In the events (B) and (C), sprite emissions were widely distributed, and the distances from the peak lightning emissions to the sprite emissions were 8.61 km, 9.66 km respectively. By simulating how sprite and lightning emissions occurring at different altitudes can be measured from the ISS, it is likely that LSI detected the vertical structures of sprite emissions. At the presentation, we will show the detailed characteristics of the horizontal distributions of sprites and the relation to their parent lightning discharges.

Keywords: sprite, JEM-GLIMS, horizontal distribution

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM11-07 Room:A01 Time:May 25 09:00-09:15

Global Occurrence Rates and Distributions of Lightning and TLEs Derived from JEM-GLIMS Nadir Observations

SATO, Mitsuteru[1*] ; SATO, Tsuyoshi[2] ; MIHARA, Masahiro[2] ; SHIMIZU, Chiharu[2] ; ADACHI, Toru[3] ; USHIO, Tomoo[4] ; MORIMOTO, Takeshi[5] ; SUZUKI, Makoto[6] ; YAMAZAKI, Atsushi[6] ; TAKAHASHI, Yukihiro[1]

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JEM-GLIMS is carrying out continuous nadir observations of lightning discharges and TLEs from the ISS since Nov. 20, 2012. For the period between Dec. 2012 and Nov. 2014, JEM-GLIMS succeeded in detecting a total of ˜4,820 lightning events including ˜530 TLEs. It is found that most of these events occurred in continental regions, that is, central Africa, Southeast Asia, North America, and the northern part of South America. It is also found that the lightning activities tend to be enhanced in the local summer hemisphere. These characteristics are comparable to those derived from the MicroLab-1/OTD and TRMM/LIS measurements. Using the JEM-GLIMS optical data, we have estimated the preliminary global occurrence rates of lightning discharges and TLEs. The global occurrence rate of lightning discharges is estimated to be 1.5 events/s, which is smaller than that derived from the previous satellite missions ($\sim$50 events/s). This discrepancy may be caused by the low detection efficiency of JEM-GLIMS due to the high trigger threshold level and the low telemetry speed and by the limited LT area (20-04 LT) where JEM-GLIMS can conduct the optical observations. The global occurrence rate of TLEs, that include both sprites and elves, is also estimated and is calculated to be 9.8 events/min. At the presentation, we will show more detailed global occurrence distributions and rates of lightning discharges and TLEs.

Keywords: lightning, sprites, ISS

PEM11-08 Room:A01 Time:May 25 09:15-09:30

Recent results of airglow and auroral emissions in the lower- and upper-thermosphere obtained with IMAP/VISI on ISS

SAKANOI, Takeshi[1*] ; YAMAZAKI, Atsushi[2] ; SAITO, Akinori[3] ; AKIYA, Yusuke[3] ; HOZUMI, Yuta[3] ; OTSUKA, Yuichi[4] ; PERWITASARI, Septi[1] ; NISHITANI, Nozomu[4] ; HORI, Tomoaki[4]

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We report the recent results on airglow and auroral distribution in the lower- and upper-thermosphere using IMAP/VISI measurement data, and also report the current status of the operation of IMAP/VISI. IMAP/VISI is a visible imaging spectrometer which aims to measures nightglow emissions from ISS (~400 km altitude) covering the wide range from +51 deg. to ? 50 deg. in geographical latitude. VISI adopts 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.

Since the successful launch of IMAP on August 2012, we found that meso-scale (~10 - 50 km) wave pattern is always seen in the airglow emission at O2 762 nm mainly at mid-latitudes. The typical O2 airglow intensity is several hundreds R to several kR. We found the concentric gravity wave (CGW) patterns for more than 170 events out of ~4900 paths, and revealed that these CGW events tend to occur in the southern hemisphere. From the cross-correlation analysis between front FOV data and rear FOV data of which time difference is typically 90 s at the same location, we can determine the direction and phase speed of atmospheric gravity wave.

We compared the CGW pattern obtained with IMAP/VISI and the ionospheric data with Hokkaido HF radar (E-region irregularity) and the GEONET GPS stations (F-region TEC). IMAP/VISI measured westward moving concentric gravity waves in O2 airglow emission with the phase speed up to 160 m/s from 11 to 15 UT on Feb. 5, 2014. Simultaneously the Hokkaido HF radar measured south-westward moving successive echo structures. Phase speeds of CGWs along the E-region echo area and along the radar beams were consistent with those of radar echo structures. During this period, GPS network data showed the south-westward motion of MSTID in the F-region over Japan. This fact suggests that the F-region MSTID was coupled with the E-region gravity waves.

In addition, we changed the VISI operation modes in July 2013, and started the measurment of airglow and auroral measurments at O 557.7nm, Na 589nm and OH 828 nm, in addition to O 630nm, OH 730nm and O2 762nm. After the VISI mode change we routinely obtain the spectra of airglow emissions to estimate OH rotational temperature and faint emissions of sodium and oxygen.

Further, we carried out intensive VISI measurments for 630nm emission during the last winter period to observe MSTID event at mid-latitudes. We will give a talk on the latest results and current status of IMAP/VISI, and would like to point issues for future missions.

Acknowledgements: We thank the IMAP science team and the MCE team for their kind support.

Keywords: ISS, IMAP, airglow, aurora, satellite

PEM11-09 Room:A01 Time:May 25 09:30-09:45

O2 airglow concentric structure observed from International Space Station

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Visible and near-infrared spectral imager (VISI) for ISS-IMAP (the International Space Station - Ionosphere, Mesosphere, upper Atmosphere and Plasmasphere mapping) mission observes nighttime airglow emission from ISS. VISI observes the airglow in the nadir direction by two field-of-views (FOVs) which directs the forward and the backward to the ISS orbit. Some concentric structures which are difficult to observe the entire image by the ground-based imagers were detected from the space by VISI. Concentric structure in the 762-nm O_2 airglow emission observed on June 1, 2013 was analyzed in this study. Spatial scale of this concentric structure was determined to be 1,200 km from the center of the structure to its edge. Propagation velocity of the waves which spread radially from the center was derived as 125 $\pm$ 62 m/s from the difference between the images taken by two FOVs of VISI. Duration time of the concentric structure was estimated to be 2 - 5 hours from the spatial scale and the propagation velocity of the waves. Concentric structure in GPS-TEC which was caused from the tornado was observed before the VISI observation had faster propagation velocity and longer wavelength than those in the airglow concentric structure. It was speculated that the O2 airglow observed by VISI was caused by secondarily waves which propagate in the horizontal direction that were caused from the atmospheric gravity waves generated disturbance in the troposphere.

Keywords: airglow, concentric structure, atmospheric gravity waves, International Space Station, near infrared

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM11-10 Room:A01 Time:May 25 09:45-10:00

Statistical Study of Concentric Gravity Wave in the Mesopause by using the IMAP/VISI Data

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We report the first global study of concentric gravity waves (CGWs) in the mesopause region (~95 km) by using the IMAP/VISI data. CGWs have unique characteristic that shows a direct coupling between lower and upper atmosphere, makes it useful to study the role of gravity waves in atmospheric dynamic by transporting their energy and momentum from their sources in the tropopause to the mesopause region where the waves dissipate. The past studies have revealed the general properties of these CGWs such as: source, propagation mechanism and the effect of the background profile. However, they were mostly a single event studies and gave only limited information locally. Therefore, a statistical study on global distribution of the CGWs is needed to get more comprehensive understanding and the parameterization of gravity waves will also useful for the global circulation model. To address this issue, a space-based observation is more preferable since it covers a wider area. IMAP/VISI is the only space-based instrument that capable of imaging gravity waves in the MLT region in the nadir direction, makes it ideal for such a global study. The Visible and near-Infrared Spectral Imager (VISI) of the IMAP mission was launched successfully on July 21, 2012 with H-IIB/HTV-3 and installed onto the International Space Station (ISS). IMAP/VISI is now operated in the night side hemisphere with a range of +/- 51 deg. GLAT. IMAP/VISI is measuring three airglow emissions: OI (630 nm), OH Meinel (730 nm) and O2 (762 nm) with the typical spatial resolution of 16?50 km. Since the start of nominal operation in October 2012, IMAP/VISI has been operated with approximately 15 paths/day.

In this study, we analyze the CGWs events from IMAP/VISI data of 2013. We found total 172 CGWs events in the O2 (762 nm) airglow emissions out of 4853 data paths. The monthly distribution of the CGWs occurrence shows a clear seasonal dependence with the peak around March-April and August-September. The weak background winds (from GAIA model) in the middle atmosphere during the March and September equinox are likely responsible for the seasonal dependence. We determined the source of CGWs by estimating the center of the circular pattern and applying a ray-tracing method. We found that in the southern hemisphere, the high activity of CGWs can be found in a band-like area between 30-500 S while in the northern hemisphere the latitudinal variation is bigger, means that the activity can be found in the area ranging from 0-500 N. In the southern hemisphere, the high occurrence region is co-located with the jet streams flow region. Therefore, we suspect that the source in the southern hemisphere is likely related with the jet stream activity. In the northern hemisphere, the sources were mostly found to be convective activities (convective plum, tropical storm and typhoon), which were identified from the meteorological satellite data. We have calculated the wave parameters for two months (March and April) and found that the small-scale waves (horizontal wavelength $<$100km) expand from the center up to several hundred km (100-600 km), while the large scale can expand up to 2000 km. We are deriving more data from the other months to investigate any wave parameters distribution tendency globally. We also found that generally the concentric pattern appeared as arc like shape instead of full circle. It indicates that the background wind filter allows the wave to propagate in a particular direction and filter out the other directions. Data from 2014 will also be added and if possible will also be presented in this meeting.

Keywords: Concentric Gravity Waves, IMAP/VISI, Mesopause, Airglow

PEM11-11 Room:A01 Time:May 25 10:00-10:15

Airglow image of mesospheric mesoscale wave captured from the International Space Station

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Mesoscale wave-like structures in the mesospheric airglow were captured by an imaging observation from the International Space Station. Limb imaging observations with a digital single reflex camera provided us the horizontal structure of mesospheric airglow with unprecedentedly wide field-of-view(FOV). The FOV is 3,000 km width at the tangential point. Previous airglow observations captured small scale (10 - 400 km) structures by ground based airglow imagers and large scale (several 1,000s km) structures by satellite limb scanning. Our observation captured mesoscale wave-like structure, whose wavelength is about 1,000 km, and filled the gap of the previous observation. A data on August 26, 2015 shows wavelike oscillation in both peak intensity and layer height for OI, Na and OH airglow. Its wavelength is about 1,000 km and the wave existed region is about 2,500 x 3,000 km size over the Indian ocean and Australia. In the presentation, the cause of this structure will be discussed.

Keywords: airglow, gravity wave

PEM11-12 Room:A01 Time:May 25 10:15-10:30

Estimating ionospheric property by using simultaneous observations of lightning and whistlers from ISS GLIMS mission

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The atmospherics in the VLF frequency range from lightening penetrating through the ionosphere are observed as lightning whistlers. In particular, whistlers observed in the space just after penetrating through the ionosphere are so-called fractional hop whistlers. Since whistlers penetrate through the ionosphere plasma, which is dispersive medium, the group delays of whistler waves with different frequency contain the information of the electron density of ionosphere. In this paper, we estimate the maximum electron density of the ionosphere F2 layer by using the delay time introduced by the optical observation and electromagnetic observation of Global Lightning and SprIte Measurements (GLIMS) mission onboard ISS. And we use another analysis method, the dispersion of whistles. As a result, we found that estimated electron densities from two analysis methods are in good agreement with those from IRI model for whistlers with a small dispersion. We consider that maximum electron density estimation of the ionosphere F2 layer over the ocean or remote area by using whistler dispersion information is useful.

Keywords: Whistler, ionosphere F layer, GLIMS, International Space Station

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM11-13 Room:A01 Time:May 25 10:30-10:45

630-nm airglow imaging observations of plasma bubbles from the International Space Station

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Under the Ionosphere, Mesosphere, upper Atmosphere, and Plasmasphere mapping (IMAP) mission, imaging observations of airglow in the upper atmosphere from International Space Station has been conducted with Visible and Infrared Spectral Imager (VISI) since October 2012. We have analyzed images of the 630.0-nm airglow obtained by the Visual and Infrared Spectral Imager. We have succeeded to detect equatorial anomaly, and plasma bubbles. In the 630-nm airglow image observed by IMAP/VISI on ISS passing over Thailand on October 28, 2012, airglow depletion elongated in the north-south direction was observed. Simultaneously, field-Aligned Irregularity (FAI) echo was observed by the EAR in Indonesia. In order to compare spatial structure of the airglow depletion and FAI, we have mapped the FAI echo region onto the northern hemisphere along the magnetic field lines. We have found that the FAI echo region coincides with the airglow depletion observed by IMAP/VISI, indicating the airglow depletion is caused by a plasma bubble. We have carried out statistical analysis of plasma bubble, and found that plasma bubblef most frequently occurs in spring and autumn equinoxes at African longitudinal sector. We have also measured zonal spacing of plasma bubbles and found that the spacing depends on longitude, suggesting that atmospheric gravity waves may seed plasma bubbles.

Keywords: airglow, ionosphere, international space station, plasma bubble, IMAP, VISI

Japan Geoscience Union Meeting 2015
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PEM11-14 Room:A01 Time:May 25 11:00-11:15

Seasonal-longitudinal dependence of the occurrence of equatorial plasma bubbbles observed by ISS-IMAP

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After sunset in the equatorial region, the small irregularities in the ionosphere grow large-scale depletion of the plasma as Equatorial plasma bubbles (EPBs). Because field-aligned irregularities inside EPBs affect radio waves and degrade the satellite-ground communications, it is very important to examine the dependence of their occurrence on parameters. The global observation of Equatorial plasma bubbles (EPBs) is inevitable. Since the Pacific Ocean spreads widely in the equatorial region, however, the observation of EPBs from the ground cannot be made at any longitude of equatorial region. On the other hand, the observation from the sky is very effective. In this study, the occurrence of EPBs are examined using airglow images obtained by Ionosphere, Mesosphere, upper Atmosphere, and Plasmasphere mapping on board International Space Station (ISS-IMAP). The seasonal-longitudinal dependence of their occurrence is also discussed. To do so, EPBs are chosen from 630-nm airglow images. Since the depletion of electron density is associated with EPBs, EPBs are visualized as dark trajectory. The orbital period of ISS is about 93 minutes and orbit inclination is 52 degrees. Moreover, the observation of airglow has made during the night. The observation is not uniform in longitude. Thus, the occurrence rate of EPBs is calculated by the number of EPBs over the duration of the observation in the latitude between from -30 to 30.

The occurrence rate determined by ISS-IMAP data is high at all longitude in the equinoctial seasons. This result is consistent with the occurrence rate determined by the plasma density data on DMSP satellite [Burke et al., 2004]. The orbital altitude of DMSP is 840 km, which is higher than the observation altitude of ISS-IMAP, which is about 250 km. This result implies that the altitudes of EPBs are not strongly dependent on the solar activity. On the other hand, the occurrence rate by ISS-IMAP is high at the American region as equinoctial seasons, which is not consistent with DMSP observation. As for the events observed during summer in the American sector, most of the events occurred simultaneous with geomagnetic storm. Since it is reported that penetration electric fields near dusk are eastward and enhances in the stormtime occurred in summer, it is considered that penetration electric fields prompt growth of EPBs especially in summer.

Keywords: equatorial plasma bubble, airglow, ISS, IMAP, magnetic storm

PEM11-15 Room:A01 Time:May 25 11:15-11:30

Characteristics of 100-1000 km-scale ionospheric disturbances observed by ISS-IMAP in collaboration with TEC map

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Two-dimensional Total Electron Content (TEC) map has been used for revealing characteristics of meso-scale ionospheric disturbances, such as Medium-Scale Travelling Ionospheric Disturbances (MSTIDs) and Equatorial Plasma Bubble (EPBs). We have developed high-resolution TEC maps as "Dense Regional And Worldwide International Networks of GNSS-TEC observation (DRAWING-TEC)" project (http://seg-web.nict.go.jp/GPS /DRAWING-TEC/). The project provides regional and global maps of absolute value of TEC, de-trended TEC with 60-min window, and Rate of TEC change Index (ROTI). As of 2015, regional maps are produced over North America and Europe in addition to Japan. These regional maps are powerful tools for studying characteristics of MSTIDs and EPBs. However, it is impossible to detect MSTIDs and EPBs over oceans by only TEC data derived from ground-based GPS receivers. In contrast with GPS-TEC data, airglow images observed by ISS-IMAP/VISI cover all areas including continents and oceans. But detecting MSTIDs from the space-borne imager is difficult since the 630 nm-airglow is weak in the mid-latitude ionosphere. In this study, we analysis both GPS-TEC data and ISS-IMAP/VISI 630 nm imager data and succeeded in detecting MSTIDs using ISS-IMAP/VISI 630 nm imager data. The spatial structure and occurrence characteristics of MSTIDs detected from ISS-IMA/VISI 630nm imager will be discussed in this presentation.

Keywords: ionospheric disturbance, ISS-IMAP, VISI 630nm airglow, GPS-TEC map

PEM11-16 Room:A01 Time:May 25 11:30-11:45

Horizontal structures of Helium ion in the upper ionosphere observed by ISS-IMAP/EUVI

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Horizontal structures of ionised Helium in the upper ionosphere of dusk side were obtained from observation of resonant scattering light. The Extreme Ultra Violet Imager (EUVI) of the ISS-IMAP (Ionosphere, Mesosphere, upper Atmosphere and Plasmasphere mapping) mission has taken image of HeII radiation (30.4 nm) from the International Space Station (ISS) since October 2012. North-south asymmetry and longitudinal structure of ionised Helium were found. North-south asymmetry in solstice seasons is well consistent with the previous in-situ measurement and numerical simulation. However, the longitudinal structure is not reported before and cannot be explained by numerical simulation with SAMI2-model. The longitudinal difference of meridional wind is a candidate of the Helium ion structure.

Keywords: topside ionosphere, Helium ion