PEM08-01 Room:101B Time:May 20 14:15-14:30

Preliminary observational results of the Ionosphere, Mesosphere, upper Atmosphere, and Plasmasphere mapping mission

Akinori Saito[1*], Atsushi Yamazaki[2], Takeshi Sakanoi[3], Ichiro Yoshikawa[4]

[1]Graduate School of Science, Kyoto University, [2]JAXA/ISAS, [3]PPARC, Tohoku University, [4]The University of Tokyo

ISS-IMAP (Ionosphere, Mesosphere, upper Atmosphere, and Plasmasphere mapping) mission is a space-borne imaging mission to elucidate the Earth upper atmosphere, the mesosphere, the ionosphere, the thermosphere and the plasmasphere. It was launched in July 2012, and installed on the Exposed Facility of Japanese Experiment Module on the International Space Station, EF of ISS-JEM, in August 2012. The nominal observation started in the middle of October. It conducts imaging observation of the Earth's upper atmosphere with visible-light and infrared spectrum imager (VISI) and extra ultraviolet imager (EUVI). The objective of this mission is to clarify the physical mechanism of the following three processes: (1) energy transport process by the atmospheric structures whose horizontal scale is 50-500km in the upper atmosphere (2) process of the plasma transport up to 20,000km altitude (3) effect of the upper atmosphere on the space-borne engineering system. ISS-IMAP will measure the following three parameters in the lower latitude region than 50 degrees: (1) distribution of the atmospheric gravity wave in the mesopause (87km), the ionospheric E-region (95km), and the ionospheric F-region (250km) (2) distribution of the ionized atmosphere in the ionospheric F-region (3) distribution of O+ and He+ ions in the ionosphere and plasmasphere. VISI will observe the airglow of 730nm (OH, Alt. 85km), 762nm (O2, Alt 95km), 630nm(O, Alt.250km) in the Nadir direction. EUVI will measure the resonant scattering of 30.4nm [He+] and 83.4nm [O+]. It points the limb of the Earth to observe the vertical distribution of the ions. The outline of the preliminary observation of the ISS-IMAP mission will be introduced in the presentation.

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

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

PEM08-02 Room:101B Time:May 20 14:30-14:45

Characteristics of airglow and aurora with a visible spectrometer ISS-IMAP/VISI

Takeshi Sakanoi[1*], Atsushi Yamazaki[2], Akinori Saito[3], Yuta Hozumi[3], Yusuke Akiya[3], Septi Perwitasari[1], Yuichi Otsuka[4]

[1]Graduate School of Science, Tohoku Univerisity, [2]JAXA/ISAS, [3]Graduate School of Science, Kyoto Univerisity, [4]STEL, Nagoya University

The ISS-IMAP is a science mission which observes the thermosphere, ionosphere and plasmasphere from the international space station (ISS) at an altitude of 400 km. This was launched successfully on July 21, 2012 with HTV3 (Konotori), and installed on the exposed facility (EF) of the Japanese experiment module (JEM) of ISS. The ISS-IMAP/VISI is a visible imaging spectrometer which measures three nightglow emissions; O (630 nm, altitude 250 km), OH Meinel band (730 nm, altitude 87km), and O2 (0-0) atmospheric band (762 nm, altitude 95 km) with the two field-of-views (+/-45 deg. to nadir) to make a stereoscopic measurement of the airglow and aurora to subtract background contaminations from clouds and ground structures. Each field-of-view is faced perpendicular to the orbital plane, and its width is about 550 km mapping to an altitude of 100 km. We will obtain a continuous line-scanning image for all emissions line from + 51 deg to -51 deg. in geographic latitude by the successive exposure cycle with a time interval of 1-several s.

After the successful launch on July 21, we carried out the initial check out of VISI on August 11-14, and confirmed its function working satisfactorily. We started nominal operation from the middle of October. Since then, VISI measures airglow and auroral emissions continuously in the nightside hemisphere on about 10 orbits every day. We found a number of events showing meso-scale (~50 km) wave pattern of airglow emission at O2 762 nm (~95 km alt.). In addition, in the equatorial anomaly region we often measured meso-scale dark filament pattern, i.e., plasma bubble, in the uniform O 630 emission. Further, during geomagnetically disturbed period we measured auroral emissions at O2 762 (~120 km alt.) and O 630 nm (~250 km alt.) at high-latitudes. In this presentation, we report the meso-scale properties and spatial characteristics of gravity waves, plasma bubbles and aurora oained with VISI.

Keywords: IMAP, VISI, ISS, airglow, aurora

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

PEM08-03 Room:101B Time:May 20 14:45-15:00

Latitudinal structures of ion density in the ionosphere and the plasmasphere detected by ISS-IMAP/EUVI

Yuta Hozumi[1*], Akinori Saito[1], Atsushi Yamazaki[2], Go Murakami[2], Ichiro Yoshikawa[3]

[1]Graduate School of Science, Kyoto University, [2]Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, [3]The University of Tokyo

The Extreme Ultra Violet Imager (EUVI) of the ISS-IMAP (Ionosphere, Mesosphere, upper Atmosphere and Plasmasphere mapping) mission has taken images of He II radiation (30.4 nm) and O II radiation (83.4 nm) from the International Space Station (ISS) since October 2012. EUVI has FOV of 13.2 degree x 13.2 degree with the 128 x 128 bins and looks toward the back limb direction of the ISS orbit. The target of this observation is the distribution of He^+ and O^+ in the ionosphere and plasmasphere. Latitudinal structures of He^+ in the plasmasphere and O^+ in the ionosphere were detected by EUVI. In general, plasma density of the plasmasphere increases at low latitudes but decreases at high latitudes. This latitudinal gradient was captured by EUVI at He II radiation. EUVI also captured the latitudinal enhancements of O^+ density associated with Equatorial Ionization Anomalies (EIAs). The longitudinal variability and the geomagnetic activity dependence of these latitudinal structures will be discussed in this presentation.

PEM08-04 Room:101B Time:May 20 15:00-15:15

Ground-based imaging observations of the upper atmosphere

Shin Suzuki[1*]

[1]Solar-Terrestrial Environment Laboratory, Nagoya University

It is now well known that gravity waves contribute significantly to the form of the large-scale atmospheric circulation, especially in the mesosphere and lower thermosphere (MLT), because of wave dissipation and the accompanying momentum flux divergence. Gravity waves are typically generated by meteorological disturbances and orographic structures in the lower atmosphere and propagate into the upper atmosphere while growing in amplitude. In addition, some of these waves directly, or as secondary waves, penetrate into the ionosphere/thermosphere through the MLT region, where they can seed plasma instabilities. It has also been reported that the gravity wave momentum flux preferentially associated with the scale of the waves; the momentum fluxes of the waves with a horizontal scale of 10-100 km are particularly significant.

Airglow imaging is a useful technique to observe two-dimensional structure of small-scale (<100 km) gravity waves in the MLT region and has been used to investigate global behaviour of the waves. Solar-Terrestrial Environment Laboratory, Nagoya University has made long-term airglow imaging observations of the gravity waves in the mesopause region using the Optical Mesosphere and Thermosphere Imager (OMTI) system in the world. Characteristics of the gravity waves in the MLT region seem to reflect the conditions in the lower atmosphere.

In the presentation, I will share several results of the ground-based measurements of the MLT gravity waves and discuss future collaborative works with the ISS-IMAP mission.

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

PEM08-05 Room:101B Time:May 20 15:15-15:30

Possible collaborative study between ISS-IMAP observation and whole atmosphere-ionosphere modeling

Hidekatsu Jin[1*], Yasunobu Miyoshi[2], Hitoshi Fujiwara[3], Hiroyuki Shinagawa[1]

[1]NICT, [2]Kyushu University, [3]Seikei University

There have been an increasing number of studies suggesting the effects of lower atmospheric activities on the upper atmospheric variations on various temporal and spatial scales. The recent discovery of longitudinal wave-4 dependence in the ionospheric density by optical instruments indicates its relation to the longitudinal dependence of tropospheric moist convection, and the subsequent studies suggest that the atmospheric wave propagation plays a key role in the vertical atmospheric coupling. It has been known for long that ionospheric local time variation and its amplitude is observed to differ day-to-day, and the effect of atmospheric waves has been suggested, but its specific origin has not been clarified yet. Recent studies also suggested the significant effects of lower atmosphere in the observed phenomena such as modulated tidal variations in the thermosphere-ionosphere during stratospheric warming periods, thermospheric midnight temperature maximum, and so on.

In order to investigate these vertical atmospheric coupling, we have developed a whole atmosphere-ionosphere coupled model by coupling three independent models self-consistently (GAIA: Ground-to-topside model of Atmosphere and Ionosphere for Aeronomy). In this talk, we will discuss the possibility of collaborative study between the ISS-IMAP observation and GAIA simulation. Models are generally developed over assumptions, simplification and parameterization, and thus it does not necessarily reproduce actual phenomena. On the other hand, observations are not sufficient in their temporal and spatial coverage, resolution, and variable information for analyses. The model-observation collaboration will enable more realistic modeling and reliable analysis with sufficient information by compensating the deficiencies of each other.

Keywords: satellite observation, modeling, simulation, upper atmosphere, middle atmosphere, lower atmosphere

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

PEM08-06 Room:101B Time:May 20 15:30-15:45

Science opportunities from Cluster Swarm synergies

Olaf Amm[1*], Heikki Vanhamaki[1], Kirsti Kauristie[1], Noora Partamies[1], Claudia Stolle[2], Freddy Christiansen[2], Stephan C. Buchert[3], Hermann J. Opgenoorth[3], Malcolm Dunlop[4], Frederic Pitout[5], Patricia Ritter[6], Roger Haagmans[7], Matthew G.G.T. Taylor[7]

[1]Finnish Meteorological Institute, Arctic Research Unit, Helsinki, Finland, [2]Danish Technical University, Copenhagen, Denmark, [3]Swedish Institute of Space Physics, Uppsala division, Uppsala, Sweden, [4]Rutherford Appleton Laboratory, Didcot, United Kingdom, [5]IRAP, Toulouse, France, [6]GFZ German Research Centre for Geosciences, Potsdam, Germany, [7]ESTEC, Noordwijk, Holland

The upcoming ESA Swarm mission, consisting of three spacecraft in the Earth's ionosphere of which two are kept close to each other, together with the four-spacecraft ESA Cluster mission in the magnetosphere, provides a number of exiting new science opportunities for ionospheric physics and magnetosphere-ionosphere coupling studies. The magnetic and electric field measurements from the Swarm mission will allow us to obtain spatial maps of ionospheric currents, convection, and conductances along a strip that envelopes the orbits of the two closeby traveling satellites. The novel technique for calculating these properties from the Swarm data is based on Spherical Elementary Current (Vector) Systems (SECS), and will be presented together with first synthetic application examples. Using these results together with Cluster measurements of field-aligned currents allows us to estimate the ionosphere-magnetosphere coupling factor K, as defined by the Knight relation, solely based on data. Further examples from the multitude of science opportunities from Cluster Swarm synergies, also additionally utilizing ground-based instruments, include amongst others studies of the Poynting flux between the magnetosphere and ionosphere, statistical comparisons between the plasma convection in both domains, and examination of the field-aligned current closure between ionospheric region 2 currents and the magnetospheric ring current.

Keywords: Swarm multi-satellite mission, Cluster multi-satellite mission, magnetosphere-ionosphere coupling, ionospheric electrodynamics

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

PEM08-07 Room:101B Time:May 20 15:45-16:00

Development of neural network based ionospheric tomography and application to actual data under several conditions

Shinji Hirooka[1*], Katsumi Hattori[1], Takashi Ichikawa[1]

[1]Graduate School of Science, Chiba University

Three-dimensional ionospheric tomography is effective for investigation of the dynamics of ionospheric phenomena. Especially, to understand the anomalous and/or irregular ionospheric structure, model-free and robust tomographic technique is important. However, it is an ill posed problem in the context of sparse data, and accurate electron density reconstruction is difficult. The Residual Minimization Training Neural Network (RMTNN) tomographic approach, a multilayer neural network trained by minimizing an objective function, allows reconstruction of sparse data. Moreover, the method is not required the initial ionospheric distributions (in other words, model-free method).

In this study, we validate the reconstruction performance of the developed algorithm using numerical simulation and actual data under various ionospheric conditions. Then we apply it to the practical data observed in March 2011, Japan (before the 2011 off the Pacific coast of Tohoku earthquake, Mw 9.0). As for the Tohoku earthquake, the significant enhancements are found in Total Electron Content (TEC) investigation, 1, 3-4 days prior to the earthquake. Especially, TEC increase of 3 days prior to the earthquake was remarkable. As a result, the reconstructed distribution of electron density was enhanced in sub-ionosphere to over F-region in comparison with 15 days backward median distribution. Moreover the enhanced area is seems to be developed to upper ionosphere from sub-ionosphere with time. The tomographic results suggest the existence of some energy influx from the surface associated with seismic activity. Details will be shown in the presentation.

Keywords: Ionospheric tomography, Neural network, GPS

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

PEM08-08 Room:101B Time:May 20 16:15-16:30

Generation mechanism and ISS-IMAP observation of medium-scale traveling ionospheric disturbances (MSTIDs)

Tatsuhiro Yokoyama[1]*

[1]Research Institute for Sustainable Humanosphere, Kyoto University

Plasma density structures and associated irregularities in the nighttime midlatitude ionosphere are frequently observed as frontal structures elongated from northwest to southeast (NW-SE) in the northern hemisphere, also known as medium-scale traveling ionospheric disturbances (MSTIDs). MSTIDs were often observed simultaneously at magnetic conjugate locations in the Northern and Southern Hemispheres. It has been believed from observational and theoretical studies that MSTIDs are not simple manifestation of atmospheric gravity waves, but generated by electrodynamic processes: Perkins instability in the F region and sporadic-E (Es)-layer instability in the E region. Through the E-F coupling process, the seeding by an Es layer accelerates the growth of MSTIDs, and the neutral wind in the E region controls the propagation of MSTIDs. The most important aspect of MSTIDs which is still unknown from ground-based observations is their boundary at high and low latitudes. There are several reports of MSTID observations at sub-auroral and equatorial ionization anomaly regions, but a systematic study on latitudinal boundary of MSTIDs has yet to be done. Imaging of MSTIDs from ISS-IMAP is expected to reveal the latitudinal boundary and contributes to further understanding of the MSTID generation mechanism.

Keywords: ionosphere, MSTID, Perkins instability, E-F coupling, ISS-IMAP

PEM08-09 Room:101B Time:May 20 16:30-16:45

Calibration and analysis of IMAP/VISI observational data

Yusuke Akiya[1*], Akinori Saito[1], Takeshi Sakanoi[2], Yuta Hozumi[1], Atsushi Yamazaki[3], Yuichi Otsuka[4]

[1]Graduate School of Science, Kyoto Univiersity, [2]PPARC, Tohoku University, [3]ISAS/JAXA, [4]STE Laboratory, Nagoya Univeristy

Visible and near-infrared spectrographic imager (VISI) for the ISS-IMAP (Ionosphere, Mesosphere, upper Atmosphere and Plasmasphere mapping) mission installed on the Exposure Facility on the Japanese Experiment Module on the International Space Station in August 2012. Initial observations were held in August and September and nominal observations started in October. The objective of this study is the quantitative evaluation of some noises which are recorded in the observational data. VISI observes airglow emissions in the night by two field-of-views in nadir direction toward the Earth. VISI observes airglow with three different observational modes which are named ”Calibration”, ”Spectral” and ”Peak.” Airglow observed by this imager is diffracted and imaged on the single CCD. Noise caused by an electrical interference were found in the Calibration mode images. Stripes in the same position which caused by this interference were able to reduce by the evaluation of the noise pattern from 56 calibration data in initial and nominal observations. It is also found that count value of the Peak mode are not uniform in the image. These are thought to be caused by the non-uniformity of the shape of the optical part since these noise were not observed on data in case of the no incoming light to the imager. These noise are also reduced from the analysis of 320 data in Peak mode observations. Sensitivity to the light intensity are different between the two field-of-views. These non-uniformity and difference of sensitivity could be able to be corrected by using patterns earned by the statistical study of the observational data.

Keywords: spectrography, imager, airglow, the International Space Station, nadir, mesosphere

PEM08-10 Room:101B Time:May 20 16:45-17:00

Observation of the O2 (0-0) atmospheric band nightglow by the IMAP/VISI: a case study

Septi Perwitasari[1*], Takeshi Sakanoi[1], Atsushi Yamazaki[2], Yuichi Otsuka[3], Yuta Hozumi[4], Yusuke Akiya[4], Akinori Saito[4]

[1]PPARC Tohoku University, [2]JAXA/ISAS, [3]STEL Nagoya University, [4]Geophysics Dept. Kyoto University

The Visible and near-Infrared Spectral Imager (VISI) of the IMAP mission has been launched onto the International Space Station (ISS) since July 21st 2012. IMAP/VISI begins its nominal operation from the middle of October and will make a continuous observation for the next 3 years. IMAP/VISI is now operated in the nightside hemisphere with a range of +/- 51 deg. GLAT, measuring three different airglow emissions of OI at 630 nm, the OH Meinel band at 730 nm and the O2 (0-0) atmospheric band at 762 nm at an altitude of ˜400 km with the typical spatial resolution of 16 ? 50 km. Since the start of nominal operation in the middle of October 2012, IMAP/VISI has been observing airglow emission in the MLT region and found many interesting features. One of the rare events observed by IMAP/VISI is a concentric pattern of gravity wave on the O2 (0-0) airglow emission. This pattern was observed on October 18, 2012 over northeastern part of Japan around 1200 UT. The similar pattern was also observed by all-sky camera at Rikubetsu in the 557.5 nm and OH airglow emissions. From the MTSAT satellite, we found a strong convective activity over Honshu Island around the same hour, which could be the source of this rare pattern. We will report the case study of this event and a possibility to do the statistic study on this concentric pattern if we could find other events from IMAP/VISI observation.

Keywords: IMAP/VISI, O2 (0-0) atmospheric band, nightglow, concentric gravity wave structu

PEM08-11 Room:101B Time:May 20 17:00-17:15

Preliminary result of the comparison between high-resolution TEC map and airglow images observed by ISS/IMAP-VISI

Michi Nishioka[1*], Takuya Tsugawa[1], Akinori Saito[2], Takeshi Sakanoi[4], Yusuke Akiya[2], Yuichi Otsuka[3], Mamoru Ishii[1]

[1]National Institute of Information and Communications Technology, [2]Graduate school of science, Kyoto University, [3]Graduate school of science, Tohoku University, [4]Solar-Terrestrial Environment Laboratory, Nagoya University

Two-dimensional Total Electron Content (TEC) map has been used for revealing characteristics of meso-scale ionospheric disturbances, such as Equatorial Plasma Bubble (EPB) and Travelling Ionospheric Disturbances (TID). We have developed high-resolution TEC map and started "Dense Regional And Worldwide International Networks of GNSS-TEC observation (DRAWING-TEC) " project (http://seg-web.nict.go.jp/GPS /DRAWING-TEC/). The DRAWING-TEC project aims to expand the high-resolution TEC observation area by sharing TEC data in the newly standardized GTEX format. The project also 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 2013, regional maps are produced over North America and Europe in addition to Japan. The spatial resolution of TEC maps of North America and Europe is 0.15 deg x 0.15 deg with a 5x5 pixel smoothing. The temporal resolution of these maps is 30 seconds. These regional maps are powerful tools for studying characteristics of EPBs and TIDs. We compared the regional TEC map with the 630 nm airglow image obtained by ISS-IMAP/VISI. The preliminary results of the comparison will be shown in the presentation.

Keywords: Total Electron Content map, ISS/IMAP, traveling ionospheric disturbance, equatorial plasma bubble