Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-01 Room:301B Time:May 21 13:45-14:05

Seasonal variations of thermospheric nonmigrating tides observed by CHAMP and GRACE

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In this paper, we present a new method of extracting nonmigrating tides from thermospheric density using CHAMP and GRACE data. The seasonal variations of the global structures of nonmigrating tides of the thermospheric densities near the altitudes of CHAMP and GRACE are obtained using multi-year observations of these two satellites. The results show that the strongest nonmigrating diurnal tides are eastward with zonal wavenumber 3 (DE3), westward with zonal wavenumber 2 (DW2), eastward with zonal wavenumber 2 (DE2) and eastward with zonal wavenumber 1 (DE1). The primary nonmigrating semidiurnal tides are eastward with zonal wavenumber 2 (SE2), westward with zonal wavenumber 3 (SW3), westward with zonal wavenumber 1 (SW1) and eastward with zonal wavenumber 1 (SE1). The seasonal variations for each tidal mode are investigated in this work. We also study the wave-4 structure of the neutral density in the upper thermosphere in detail, which is mainly by the eastward semidiurnal tide with zonal wavenumber 2 (SE2) and the eastward diurnal tide with zonal wavenumber 3 (DE3). SE2 is the main cause of the wave-4 structure at middle latitudes and is asymmetry in phases in the two hemispheres. On the other hand, DE3 is the major driver of the wave-4 structure in the tropical region. The superposition of these two tides results in strong hemispheric asymmetries in the 4-peak structure as well as asymmetries between midday and midnight.

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PEM08-02 Room:301B Time:May 21 14:05-14:20

Long-term variability of mean winds and its oscillations in the mesosphere and lower thermosphere within +/- 22ˆo

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Long-term variability of mean zonal and meridional winds in the Mesosphere and Lower Thermosphere (MLT) are studied at seven locations using MF radar observations from Kauai (22ˆo N, 154ˆo W), Tirunelveli (8.7ˆoN, 77.8ˆo E), Christmas Island (2ˆo N, 157ˆo W), and Pameungpeuk (7.4ˆo S, 107.4ˆo E) and meteor radar observations from Koto Tabang (0.2ˆo S, 100.3ˆo E), Jakarta (6ˆo S, 107ˆo E), and Rarotonga (21.2ˆo S, 159.7ˆo W). Locations with nearly similar latitudes such as Christmas Island and Koto Tabang, and Jakarta and Pameungpeuk are treated as single location (Ignoring longitudinal difference) and the data are appended at each latitude to get long-term data. Thus, we have five distinct latitudes. The length of the data is different at different latitudes and spans a maximum of two decades between 1990 and 2010.

The zonal wind shows a distinct semiannual oscillation (Mesospheric SAO) at all locations. The annual mean zonal winds within +/- 9ˆo are westward biased and are eastward biased outside. The quasi-biennial variability of MLT winds (called MQBO) is observed at all locations. The amplitude of MQBO is maximum over the equator (6-8 m/s) and decreases with increasing latitude. Long-term variability of MQBO is studied which shows that the MQBO strength is more during 1991-1997 than during 2004-2010 period. The MSAO basically shows a biannual modulation. The mean meridional winds show a distinct annual oscillation at all locations. But, the time at which winds change direction (from north to south or south to north) is different at different latitudes. Furthermore, the meridional winds show similar long-term variability at conjugate locations of Tirunelveli and Jakarta-Pameungpeuk.

Keywords: Mesosphere, MLT dynamics, Long-term studies, MF radar, Metero radar, MQBO

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PEM08-03 Room:301B Time:May 21 14:20-14:40

Longitudinal and Geomagnetic Activity Modulation of the Equatorial Thermosphere Anomaly

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Recent observations of thermosphere mass density from satellites have revealed new features of the Equatorial Thermosphere Anomaly (ETA) which enable much more in-depth investigation of its characteristics and its coupling to the more research-established Equatorial Ionosphere Anomaly (EIA). Our recent study (Lei et al., J. Geophys. Res., 2012) has revealed that the field-aligned ion drag mainly contributes to the ETA trough, but has little effect on the ETA crests. However, the formation of the ETA crests is attributed to plasma-neutral heating which has two peaks in the topside ionosphere aside the magnetic equator. This invited talk will highlight the simulated results from the thermosphere-ionosphere-mesosphere-electrodynamics general circulation model (NCAR-TIMEGCM) to demonstrate the relative contributions of the non-migrating tides and geomagnetic field configuration on the longitudinal variations between the ETA and the EIA. Meanwhile, the different longitude/UT dependence between the ETA and the EIA associated with geomagnetic activity is also presented.

Keywords: Equatorial Thermosphere Anomaly, Longitudinal Variation, Geomagnetic Activity Modulation, Lower Atmosphere Tides

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PEM08-04 Room:301B Time:May 21 14:40-14:55

Geomagnetic conjugate observations of airglow images and neutral winds in the low and middle latitude thermosphere

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In 2010-2011, we have installed four Fabry-Perot interferometers and four all-sky cooled-CCD airglow imagers at two pairs of geomagnetic conjugate stations at low and middle latitudes. The pairs are Kototabang, Indonesia (0.2S, 100.3E, magnetic latitude (MLAT): 10.6S) and Chiang Mai, Thailand (18.8N, 98.9E, MLAT: 8.9N) at low latitudes, and Darwin, Australia (12.4S, 131.0E, MLAT:22.1S), and Sata/Shigaraki, Japan (Sata: 31.0N, 130.7E, MLAT: 21.2N, and Shigaraki: 34.8N, 136.1E, MLAT: 25.4N) at middle latitudes. These pairs are suitable for investigation of hemispheric coupling of ionospheric structures. In this presentation, we show some initial results of conjugate observations of plasma bubbles and medium-scale traveling ionospheric disturbances and associated neutral winds at these two pairs of conjugate stations.

Keywords: magnetic conjugate points, plasma bubble, MSTID, airglow imaging, Fabry-Perot interferometer, thermospheric wind

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PEM08-05 Room:301B Time:May 21 14:55-15:10

Simulated longitudinal variations in the E-region plasma density induced by non-migrating tides

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Based on the GCITEM-IGGCAS model and tides from TIMED/SABER observations, the longitudinal variations of the E-region plasma densities, which is induced by non-migrating tides, are investigated. We simulated the intra-annual variation of the E-region plasma density, and found that equinoctial E-region plasma density shows an obvious wavenumber-4 longitudinal structure both in Equinox and in June Solstice, and a wavenumber-3 longitudinal structure in December Solstice. Our simulations suggest that DE3 tide can drive the wavenumber-4 structure in E-region plasma density, and DE2 tide can drive the wavenumber-3 structure. $O2^+$ controls the longitudinal variations of total ions density at lower E-region, and NO^+ mainly controls that at higher E-region. We also noticed that the longitudinal variations of $O2^+$ and of NO^+ show obvious phase differences.

Keywords: Longitudinal variation, E-region plasma density, non-migrating tides

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PEM08-06 Room:301B Time:May 21 15:30-15:50

Acoustic Gravity Waves Triggered by the 22 July 2009 Total Solar Eclipse

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It has been predicted that the Moon shadow, the cooling region, sweeping over the atmosphere with a supersonic speed could trigger bow waves since 1970. The longest total solar eclipse within next hundred years occurring on 22 July 2009 sweeps over the Eastern Asia region during the noontime period. Frequency-amplitude analyses are applied to study ionospheric TEC (total electron content) derived from ground-based GPS receivers in Taiwan and Japan. We not only find the feature of the predicted bow wave but also the stern wave on the equator side of the eclipse path, as well as the stern wake right behind the Moon shadow boat. The bow and stern waves are formed by acoustic gravity waves of periods about 3 and/or 5 minutes traveling equatorward with a phase speed of about 100s m/s in the ionosphere.

Keywords: Acoustic Gravity Waves, Total Solar Eclipse, GPS TEC

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PEM08-07 Room:301B Time:May 21 15:50-16:05

English Variation of Ne and Ni observed by DEMETER during the solar eclipses

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We investigate ionospheric dynamics of solar eclipses during French satellite DEMETER operation by using Ne/Te and Ni/Ti data of French satellite DEMETER, of which altitude is around 660 km. In particular, on July 22, 2009, one of DEMETER orbits crossed eclipse zone, and the distance closest to the total eclipse area was approximately 200km. Just before the total solar eclipse, middle-scale traveling ionospheric disturbance (MSTID) over Japan occurred from GPS-TEC data. At the same time, DEMETER also recorded decrease of Ne and Ni associated with MSTID. After MSTID, however, Te and Ti decreased due to a shadow of the moon when the satellite entered eclipse zone. After that, Ne and Ni enhanced possibly associated with eclipse-origin gravity waves traveling along the magnetic field line. In addition, we compare the results in East-Asia and with other eclipses.

Keywords: Total solar eclipse, Ion density, Electron density

Japan Geoscience Union Meeting 2012
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PEM08-08 Room:301B Time:May 21 16:05-16:20

Statistical analysis of the ionospheric responses to solar flares in solar cycle 23

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In this study, we studied the ionospheric responses to solar flares during 1999-2006 by using the GOES 0.1-0.8nm Xray, 26-34nm EUV, and GPS/TEC in the worldwide. The statistical results show the TEC enhancements are highly related to the solar zenith angle (SZA). The smaller SZA would result in the greater TEC responses. The TEC response is not highly related with the X-ray flux (the correlation coefficient 0.6), which is due to that the ionospheric response is not only related to the X-ray flux level, but also related to the flare location on solar disc. The limb flare has less effect on the ionosphere than the central flare. The reason for this is that the main ionization source EUV flux has such flare location dependence. The statistical results show that the flare location effect decreases with decreasing flare X-ray class. The results also show that the TEC enhancement does not linearly increase with X-ray flux. Its uprising amplitude increases with X-ray flux. The TEC response also has slight latitude dependence: it decrease with latitude. And the TEC response has significant seasonal dependence. The maximum response occurred at equinox and the minimum response at summer.

Keywords: solar flare, Ionospheric response, EUV flux, limb effect

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PEM08-09 Room:301B Time:May 21 16:20-16:35

Discrepant EUV-Proxy Correlations on Solar Cycle and Solar Rotation Timescales and the Manifestation in the Ionosphere

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The variations of solar EUV irradiance significantly affect the ionosphere. Solar proxies are used to indicate EUV variations when direct EUV observation is unavailable. SOHO/SEM 26-34 nm EUV observations, the F10.7 and Mg II proxies, and ionospheric data were collected to investigate the variability of solar EUV and proxies and its manifestation in the ionosphere. Both EUV and proxies show significant variations on solar cycle (long-term) and solar rotation (short-term) timescales, but the correlations of EUV and proxies on the two timescales are discrepant. Short-term EUV-proxy correlations are poorer than the long-term correlations and variable during the solar cycle; the slopes of short-term EUV against proxies vary from solar rotation to solar rotation, and they are generally lower than those of long-term EUV against proxies. EUV and proxies show discrepant evolutions during the episode of major active regions, which is primarily responsible for the poorer short-term EUV-proxy correlation and the variable short-term EUV-proxy slope. Mg II is a better proxy than F10.7 for 26-34 nm EUV owing to its better indications for short-term EUV. Global electron content (GEC) significantly responds to the long and short-term variations of EUV. Accordingly, the correlations between short-term GEC and proxies are poorer and obviously lower than those between short-term EUV and proxies, and short-term GEC-proxy slopes are lower than the long-term slopes. F10.7 and Mg II are improved by combining the daily and 81-day averaged components of them with weighted factors which are designed to decrease the difference between long and short-term EUV-proxy slopes. The improved proxies can effectively upgrade the indications of proxies for solar EUV.

Keywords: Solar EUV Irradiance, Solar Proxy, Ionosphere

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PEM08-10 Room:301B Time:May 21 16:35-16:50

The changes in the ionosphere during the recent deep solar minimum

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The solar activity is low and extremely extended in 2007-2009, with a highest record of spotless days in 2008 since the finding of the ionosphere. It is a critical issue that whether or not this deep solar minimum brought serious influences on the Earth's space environment.

To explore what happened in the ionosphere during the deep minimum, we analyzed the historical records of ionospheric parameters (the F2 layer critical frequency foF2, E-layer critical frequency foE and F-layer virtual height h'F) observed by global ionosondes. A comparative study is performed to evaluate the difference in the ionosphere between recent deep minimum (2008-2009) and past solar minima. The analysis indicates that the moving 1-year mean foF2 at most ionosonde stations went to the lowest during cycle 23/24 minimum. The solar cycle differences in foF2 minima display local time dependence, being more negative during the daytime than at night. In contrast, a complex picture presents in global h'F and foE. Evident reduction exists prevailingly in moving 1-year mean h'F at most stations, while no huge differences are detected at several stations. A compelling feature is the increase in foE at some stations, which requires independent data for further validation.

In addition, the ionograms recorded by a DPS ionosonde at Jicamarca (12.0o S, 283.2o E) are also collected and manually scaled these data to retrieve F-layer parameters and electron density profiles. Compared to 1996-1997, the seasonal median values of foF2 were identified to be remarkably reduced during the deep solar minimum. It is the first time to find that lower values prevail at most times in 2008-2009 in the F2-layer peak height (hmF2) and Chapman scale height (Hm). In contrast, the bottomside profile thickness (B0) in 2008-2009 shows higher values than that in 1996-1997 at some daytime intervals, although it is also smaller during the rest times. Furthermore, the ionogram-retrieved electron density profiles demonstrate that the ionosphere in 2008-2009 is contracted strongly at altitudes above hmF2 and more perceptible in the afternoon hours. The decrease in Ne is strongest in September equinox and weakest in June solstice.

Quantitative analysis indicates that record-low foF2 can be explained principally in terms of the decline in solar extreme ultraviolet (EUV) irradiance recorded by SOHO/SEM, which suggests low solar EUV being the prevailing contributor to the unusual low electron density in the ionosphere during cycle 23/24 minimum. It also verifies that a quadratic fitting still reasonably captures the solar variability of foF2 at such low solar activity levels. The reduction in solar EUV input from solar minimum to minimum mainly contributes to the ionospheric responses, but the involved ionospheric processes are competed and variable in different time scales and played roles in the complicated variations in different seasons and altitudes.

Acknowledgments. The authors would like to thank B. W. Reinisch of the Center for Atmospheric Research, University of Massachusetts Lowell for the ionogram data of DIDBase. Ionosonde data are provided from National Institute of Information and Communications Technology, Institute of Solar-Terrestrial Physics of Russia, and from SPIDR. The F10.7 index is also downloaded from the SPIDR website. The SEM/SOHO EUV data is downloaded from the web site: http://www.usc.edu/dept/space_science/. The CELIAS/SEM experiment on the Solar Heliospheric Observatory (SOHO) spacecraft (SOHO is a joint European Space Agency and US NASA mission). This research was supported by National Natural Science Foundation of China (41074112, 41174137) and National Key Basic Research Program of China (2012CB825604).

Keywords: ionosphere, solar activity, solar cycle, critical frequency, deep solar minimum

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PEM08-11 Room:301B Time:May 22 09:00-09:20

Study of the Atmosphere-Ionosphere Coupling Using Observations of FORMOSAT-3/COSMIC

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Recent studies have shown that the ionospheric plasma structure is modulated by modification of theionospheric dynamo due to upward propagating atmospheric tides of troposphere origins as well as planetary waves generated during the stratospheric sudden warming (SSW) period. These effects of lower atmospheric origins modify the ionospheric electrodynamic and result in longitudinal, latitudinal, and altitudinal variations of the low-latitude equatorial ionization anomaly (EIA). In this study, three-dimensional electron density observations derived from GPS radio occultation sounding of FORMOSAT-3/COSMIC during 2007-2010 are utilized to study the annual and monthly variations of the ionospheric tidal signatures for comparison with existing tidal modes derived from neutral atmospheric parameters observed in the mesosphere lower thermosphere (MLT) region. Meanwhile, this study also investigates the SSW effects to low-latitude ionosphere based on the constructed three-dimensional electron density maps. According to the stratospheric temperature observation of FORMOSAT-3/COSMIC, the SSW occurs every year during 2007-2010 but the occurring months and durations are different. The ionosphere response to the SSW effect is expected to vary due to these year-to-year differences in the stratosphere.

Keywords: Atmosphere-Ionosphere Coupling, FORMOSAT-3/COSMIC

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PEM08-12 Room:301B Time:May 22 09:20-09:35

Effects of Sudden Stratosphere Warming on the ionosphere

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Effect of the large sudden stratospheric warming which occurred in January 2009 on the ionosphere is studied by using COSMIC ionosphere data. The SSW2009 is unique because stratosphere warming occurs in two longitude regions ; 1. Longitude zone ranging from 30E to 30W(30EW,and 2. Longitude zone ranging from 150 E to 150W(150EW), and the highest increase of the temperature among the recent winters.

The temperature increased steeply from 215 K on the 19 January, 2009, peaked on 23 rd January, and then gradually reduced. While the temperature increase at 10 hpa shows the maximum in the longitude zone of 30EW during the period 19-30 January, very similar pattern of SSW feature is seen in 150EW which is opposite side of 30 EW. The effect of SSW on the NmF2 (maximum electron density) is recognized even before the temperature steep increase at 10 hpa. During SSW, reduction of temperature in low latitude appears, and , NmF2 reduces shows the minimum when temperature shows the minimum except midlatitude. Minimum of electron density shifts to late local time after 09-12 Local time. In midlatitude variation of temperature is not recognized, and reduction of NmF2 is not recognized or small. Similar latitudinal and local time feature of the ionosphere is recognized in all latitude zone, not only in 30 EW as well as 150E band.

The largest effect is found in low latitude in the afternoon. Variation of ionosphere (GIM TEC, COSMIC TEC, nmF2 by COSMIC) changes in phase in all latitude zone s well as in local time. GIM TEC is less sensitive to SSW, which suggests the more interaction in lower part of the ionosphere. A big jump of NmF2 in the local time zone 06-09 is found in 14 and 36 DOY both in 30 EW, and in 150 EW, but not in another longitude zones, which seem to be produced by SSW effect.The study is also extended to southern hemisphere.

Keywords: F region, Ionosphere, Stratosphere, Sudden warming

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PEM08-13 Room:301B Time:May 22 09:35-09:50

Response of the global ionospheric current system to stratospheric sudden warmings

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Recent studies have shown the possible impact of the stratospheric sudden warming (SSW) on the ionospheric weather, and have attracted much attention as new evidence of the vertical atmospheric coupling. During SSWs, the counter-electrojet, a reversal of the equatorial electrojet from eastward to westward, is often observed, indicating the amplification of the semidiurnal tide. In the past studies, however, the observations were limited to the equatorial region, and thus it was not clear wether the tidal amplification is a local or global effect. In the present study, the response of the global ionospheric current system to SSWs is examined. The global ionospheric current systems during winter-time SSWs of 2001-2002 and 2002-2003 are derived from ground magnetometer data of the Circum-pan Pacific Magnetometer Network (CPMN). Our results show that the occurrence of the counter-electrojet during these SSWs is due to an addition of the enhanced lunar current system that extends over both the Northern and Southern Hemispheres.

Keywords: Ionospheric dynamics, Stratospheric sudden warming, Vertical coupling of the Earth's atmosphere, Tides and planetary waves, Geomagnetic field, Global observation

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PEM08-14 Room:301B Time:May 22 09:50-10:05

Comparison between GAIA model and COSMIC-TIMED/SABER observations: stratospheric warming event in 2009

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We compare results from a whole atmosphere-ionosphere coupled model, GAIA, and from the COSMIC and TIMED/SABER observations during 2008/2009 northern winter season. The GAIA model has assimilated meteorological reanalysis data by a nudging method. The comparison shows excellent agreements in the major features from the stratosphere to the ionosphere including the growth and decay of the major stratospheric sudden warming (SSW) event in 2009. During the major SSW period, a pronounced semidiurnal variation in TEC and its local-time phase shift similar to the previous observations are reproduced by the model and COSMIC observation. The model suggests that the TEC variation is caused by an enhanced semidiurnal variation in the EXB drift, which is probably related to an amplified semidiurnal migrating tide (SW2) in the lower thermosphere. The model and TIMED/SABER observation show that the SW2 tide amplifies at low latitudes from the stratosphere to the thermosphere as well as the phase variation. Possible mechanisms are discussed.

Keywords: simulation, ionosphere, atmosphere, stratospheric sudden warming, atmospheric wave, satellite observation

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PEM08-15 Room:301B Time:May 22 10:05-10:20

3D-Cowling Channel Model in the Sq Current System

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Cowling channel formation mechanism in the 3D-Sq current system using two-current layer model of Hall and Pedersen current is proposed.

In the earth's ionosphere, formation of Cowling channel is quite universal phenomena in which a continuity of Hall current generated by the magnetospheric or atmospheric dynamo is broken. In the high-latitudinal regions, horizontal gradient of Hall conductance becomes a necessary condition for Cowling channel formation and vertical gradient of Hall conductance also becomes important in the low and mid-latitudinal regions. Although generation mechanism of Cowling channel is different between the high latitudinal region and the low-mid latitudinal regions, their primary structure and energy circulation role has following universality:

(1) The Cowling channel is essentially formed by the upper Pedersen current layer and lower Hall current layer, which are connected through a field-aligned current. The channel is composed of a pair of two current systems; one is 3D-Cowling current directly coupled to the dynamo region and the other is 3D-meridional current, which encircles Cowling current system.

(2) For preserving the Cowling channel, the Cowling current system absorbs electromagnetic energy from generator and supplies holding energy of meridional current system. In each current system, Pedersen current layer becomes an energy sink, while Hall current layer acts as an energy sink in the Cowling current system and as an energy source in the meridional current system.

(3) Connection between Pedersen current layer and Hall current layer through the field-aligned current is indispensable condition for describing Poynting vector between energy sources and energy sinks.

In this paper, we will show that in addition to the well-known substorm-auroral electrojet and equatorial elector jet, Sq-current system in the low and mid latitudinal ionosphere is also a result of formation of Cowling system.

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PEM08-16 Room:301B Time:May 22 10:45-11:05

Zonal Drift Velocities of 3-m Field-aligned Irregularities of Layer-type and Clump-type Plasma Structures in Es Region

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The use of interferometer technique implemented in a VHF coherent scatter radar with relatively broad antenna beam pattern in the azimuth direction makes it possible to reveal zonal drift velocity of 3-meter field-aligned irregularities (FAIs) inside a moving plasma structure at kilometer scale. In this article, we find for the first time the systematic difference in the zonal drift velocities of the 3-m FAIs between layer-type and clump-type plasma structures in sporadic E (Es) region. There is an evident tendency for the 3-m FAIs in the layer-type plasma structure to drift in the same zonal direction as the moving plasma structure. However, the correlation between the drift velocity of the 3-m FAIs and the moving direction of the large scale plasma structure is indistinct for the clump-type plasma structure. The meridioal electric field estimated from the 3-m FAI zonal drift velocity is pointed in the northward/upward (southward/downward) direction for the layer-type plasma structure moving in the west (east) direction. Statistical results show that the mean value of the meridional electric field inside the layer-type plasma structure is approximately 2.7-2.8 mV/m, about 3 times larger than that for the clump-type plasma structure. Physical processes responsible for the formations of the layer-type and clump-type plasma structures are discussed in this article. It is believed that neutral wind shear is very likely the main cause of the layer-type plasma structure formation, while the clump-type plasma structure may be associated with the propagating gravity wave.

Keywords: 3-m field-aligned irregularities, Es plasma structure, zonal drift velocity, neutral wind shear, gravity wave, interferometer method

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PEM08-17 Room:301B Time:May 22 11:05-11:20

Small-scale irregularities in the ionosphere studied by precise ionospheric TEC difference measurement

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In the ionosphere there are various kinds of ionospheric irregularities associated with different ionospheric phenomena. They have been studiend by in-situ meassuements, radar measurements, or radio scintillation techniques. However, it was not easy to study the structures of small-scale ionospheric irregularities with a scale size of a few hundred meters which known to cause scintillation of GNSS signals at the L-band effectively.

We have developed a method to estimate the difference in the ionospheric total electron contents (TECs) between two GNSS receivers even at very short baselines of a few hundred meters. Since this method is based on single-frequency measurements, it can be applied in disturbed conditions where the L2 signal is not available. With this method, difference in TECs between two stations can be estimated with an accuarcy of 0.02 TECU or 3mm in ionospheric delay at GPS L1 frequency (1.57542 GHz).

We applied this method to data obtained at Ishigaki Island (24.3N, 124.2E), Japan. We have installed five GNSS receivers in Ishigaki with mutual distances from 0.08 m to 1.57 km. We have detected very dinamic variations of small-scale irregularities associated with plasma bubbles. Furthermore, we have succeeded in detecting spatical TEC fluctuations in non-disturbed conditions.

This method appear to be promissing in studying various kinds of small-scale irregularities in everywhere in the ionosphere.

Keywords: ionosphere, small-scale irregularities, TEC gradient, advanced GNSS technique, plasma bubble, Es layer

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-18 Room:301B Time:May 22 11:20-11:35

Conjugate observations of mid-latitude travelling ionospheric disturbances by HF radars

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We present a survey of travelling ionospheric disturbances (TIDs) observed at mid-latitudes in the northern and southern hemispheres by the Wallops Island and Falkland Islands SuperDARN HF radars. Observations were made during the 18 month operational interval of the Falkland Islands radar between March 2010 and September 2011. Statistics of the radar ground backscatter, in which the signatures of TIDs are manifest, will be presented along with an analysis of the TID spectral and propagation characteristics. Observed periods were in the range 30 - 60 minutes, corresponding to frequencies of 0.3 - 0.6 mHz. Wavelengths were generally in the range 250 - 400 km with phase speeds in the range 50 - 200 m s^{-1}. These values are within the ranges typically associated with medium-scale gravity waves. We discuss these results in terms of hemispheric, seasonal and diurnal variations, as well as in terms of their relationship to the local topography and large-scale geomagnetic activity.

Keywords: Travelling Ionospheric Disturbance, HF radar, Conjugate observations

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-19 Room:301B Time:May 22 11:35-11:50

Study of tri-band beacon signal scintillation for new LITN

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Beginning from 2006, seven ground stations located at Chung-Li (25.136N, 121.539E), Chiayi (23.5661N, 120.466E), CheCheng (22.725N, 120.544E), Kinmen (24.411N, 118.292E), Manila (14.262N, 121.043E), Pontianak (-0.003N, 109.366E) and Itu Aba Island (10.06N, 114.350E) within the tropical regions were set up to receive beacon signals from six FORMOSAT-3/COSMIC (P. A. Bernhardt et. al, 2000), C/NOFS and other NNSS-like satellites. By applying the differential Doppler technique on three quadrature components of the three-band beacon signals, we were able to obtain total electric contents (TEC) values and scintillation along the radio path through the ionosphere. In this study, we explore the low latitude scintillation near midnight, and approach the correct location of the F region step by step using a simple optical model when the radio signals traveled through them. The data shows scintillations at low-latitude have high correlation with months when Kp less than 3. They are usually happened at May-June and December-February less than the other months. On the contrary, scintillations are normally more frequent during the equinoctial months of August?October and March?April. Finally, we compare seasonal and solar activity dependence using a statistical analysis of the collected data between all stations.

Keywords: Ionosphere, Scintillation, Ionospheric irregularity

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-20 Room:301B Time:May 22 11:50-12:05

Monitoring of seasonal variability of the ionosphere over Japan region on the base of GPS and COSMIC RO measurements

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Knowledge of the state of the upper atmosphere, especially its ionospheric part and its diurnal and seasonal variations, is a very important. Different radio methods and techniques are applied in order to study the ionosphere variability and structure. Nowadays the majority of the ionospheric research activities are base on the measurements of GPS radio signals. Data provided by ground-based GPS receivers allows to estimate values of vertical total electron content (TEC) up to the 20,200 km. GPS measurements onboard Low Earth Orbiting satellites provide possibility to study ionospheric electron density distribution on a global scale. This paper presents results of the joint analysis of GPS/GLONASS observations and FORMOSAT-3/COSMIC radio occultation (RO) measurements at the extended solar minimum of cycle 23/24 over Japan region. COSMIC RO data for different seasons corresponded to equinoxes and solstices of 2007-2009 (March, June, September and December) were analyzed. All selected RO electron density profiles were integrated up to the height of 700 km (altitude of COSMIC satellites), the monthly median estimates of ionospheric electron content (IEC) were retrieved with use of spherical harmonics expansion. Also there was selected several GPS stations located in north-south direction at Japan region. Monthly medians of TEC values were calculated from diurnal variations of GPS TEC estimates during considered month. Joint analysis of GPS TEC and COSMIC data allows us to extract and estimate electron content corresponded to the ionosphere (IEC) and to analyse redistribution of electron content between bottom and topside parts of IEC as well as PEC (plasmaspheric electron content) for different seasons of 2007-2009. Percentage contribution of PEC to GPS TEC indicates the clear dependence from the time and varies from a minimum of about 25-30% during day-time to the value of 50-60% at night-time of winter season. Contribution of bottomside IEC has minimal values during winter season in compare with summer season (for both day and night time). The obtained results were compared with TEC, PEC and IEC estimates retrieved by Standard Plasmasphere-Ionosphere Model (SPIM, http://ftp.izmiran.ru/pub/izmiran/SPIM/) that has the plasmasphere extension up to 20,000 km (GPS orbit altitude). A fair agreement was found between SPIM-derived TEC and GPS TEC for Japan region for solar minimum period.

We acknowledge the University Corporation for Atmospheric Research (UCAR) for providing the COSMIC Data and IGS community for GPS permanent data. This work was supported by Russian Federation President grant MK-2058.2011.5.

Keywords: Ionosphere, GPS, FORMOSAT-3/COSMIC, Radio occultation

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-21 Room:301B Time:May 22 13:45-14:05

VHF coherent scatter radar observations of mid-latitude E- and F-region field-aligned irregularities over South Korea

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We examine the mid-latitude F-region field-aligned irregularity (FAI) activity during 2010 - 2012 by using the VHF coherent scatter radar data in Daejeon (36.2N, 127.1E; dip latitude 26.7N), South Korea. The VHF radar has been operated since December 2009 and provides a unique opportunity to investigate the variability of the FAI activity with local time, season, solar flux, and magnetic activity. Our preliminary results show that E- and F-region FAIs appear frequently: interesting daytime irregularities, continuous echoes during the post-sunrise period and Quasi-Periodic (QP) echoes at nighttime for E region; strong post-sunset and pre-sunrise FAIs for F region. For one event, we observed the association of the F-region FAIs with a medium-scale traveling ionospheric disturbance (MSTID). Additionally, we also present seasonal and local time variations of occurrence of mid-latitude E- and F-region FAIs during low solar activity period, January 2010 - April 2012. It is worth to note our occurrence result since long term observation over a year in the mid-latitude has not yet been carried out. Our study extends to the investigation of the correlations between the irregularities in the equatorial region and middle latitudes and between the conjugate F regions, and the causal linkage of the FAIs with the E-region perturbations. For this purpose, we analyze the VHF radar and C/NOFS data during 2010 - 2011.

Keywords: VHF ionospheric radar, FAIs, mid-latitude

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-22 Room:301B Time:May 22 14:05-14:20

Study of ionosphere-thermosphere coupling using the SuperDARN Hokkaido radar and Asian sector ground-based network

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The SuperDARN Hokkaido radar, one of the mid-latitude SuperDARN radars and the only one in the Asian sector, is a powerful tool for studying ionosphere-thermosphere coupling ranging from 40 to 80 geomagnetic latitudes. Several topics of ionosphere-thermosphere coupling using the SuperDARN Hokkaido radar together with other Asian ground-based instrument, such as traveling ionospheric disturbances and coseismic ionospheric disturbances, will be presented.

Keywords: thermosphere, ionosphere, SuperDARN, Hokkaido radar, large-scale traveling ionospheric disturbance, coseismic ionospheric disturbance

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-23 Room:301B Time:May 22 14:20-14:40

WINDs Campaign -Lithium Releases from Sounding Rockets in the Thermosphere-

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Though the ionization rate is less than 1% in the region of thermosphere, the dynamics of neutral atmosphere is strongly controlled by the plasma. However, the direct observation on the coupling process between neutral atmosphere and plasma is not yet performed in detail. JAXA/ISAS launched successfully S-520-23 and S-520-26 sounding rockets from Kagoshima Space Center (KSC) on September 2, 2007 and January 12, 2012, respectively. The rocket experiments are called WINDs (Wind measurement for Ionized and Neutral atmospheric Dynamics study) Campaign. The purpose is to investigate the neutral atmosphere - plasma coupling process in the thermosphere and ionospheric E and F-regions. The rocket installed Lithium Ejection System (LES) as well as instruments for plasma drift velocity, plasma density and temperature and electric and magnetic fields. The atomic Lithium gases were released at altitudes between 150km and 300km in the evening for S-520-23 and at altitude of ˜100km in the morning for S-520-26. The Lithium atoms scattered sunlight by resonance scattering with wavelength of 670nm. The neutral winds and atmospheric gravity waves in the thermosphere were estimated from the movements of Lithium clouds observed by CCD imagers on ground. From the diffusion of Lithium clouds, we estimated neutral density and temperature in the thermosphere.

Keywords: IT coupling

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-24 Room:301B Time:May 22 14:40-14:55

Lithium release rocket experiments in evening, dawn, and daytime thermosphere.

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Several kinds of chemical release experiments were successfully carried out and established before 1970's by onboard chemical release canisters of many kinds of gaseous metals and Tri-Methyl- Aluminum (TMA). The TMA release technique has been used in many nighttime rocket campaigns in 4 decades mainly in U.S., however, the Lithium canister technique was not maintained afterwards. Recently, Lithium release experiments in midlatitude thermosphere in evening, dawn, and daytime were carried out in 2007, 2011, and 2012, respectively. In 2007, we rebuilt a Lithium Ejection System (LES) for Japanese sounding rocket program, WIND campaign. The experiment was successful by newly developed LES in Japan, resulting neutral wind profile in evening thermosphere in wide altitude range between 115 km and 400 km. The WIND campaign opened a new 3-D view of thermospheic atmosphere, suggesting interesting boundary at about 180 km as is changing main composition of neutral atmosphere from nitrogen molecule to atomic oxygen. By the resonant scattering mechanism, atomic Lithium can emit red light (670.8 nm wavelength) based on its specific characteristics in the case of sunlit condition. So, evening and dawn sky was reasonable condition for thermospheric imaging and wind measurement by Lithium release, moreover, it has been considered the technique could be applied on daytime experiments because of strong efficiency of the resonant scatter by Lithium.

After the WIND campaign, we started U.S.-Japan collaborative rocket program, Daytime Dynamo campaign with NASA/GDSC and Clemson University for obtaining daytime thermospheric wind, WIND-2 campaign for dawn thermospheric wind, as well. The Daytime Dynamo campaign was carried out at Wallops Flight Facility (WFF), NASA (VA, U.S.A.) on July 10, 2011 and the WIND-2 campaign was at Uchinoura Space Center (USC), JAXA (Kagoshima, Japan) on Jan. 12, 2012. Two rocket launches were successful, however, daytime Lithium imaging was failed, whereas the dawn imaging was halfway in success. One of the reason of losing Lithium images in Daytime Dynamo would be strict S/N condition due to the small separation angle between the Sun and the center of the FOV (Field of View) of Lithium imagers in the morning condition (10:00 LT). Whereas, in the WIND-2 campaign, two of three onboard LES were failed to release the Lithium gas, resulting in imaging of only one Lithium trail in lower thermosphere between 76 km and 127 km.

Here, we will present a review talk about previous and recent Lithium release experiments with showing currently facing problems and some considerable solutions for daytime wind measurement to be held in near future.

Keywords: Lithium release experiment, sounding rocket, thermospheric neutral wind, WIND-2 campaign, Daytime Dynamo campaign

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-25 Room:301B Time:May 22 14:55-15:10

Sounding rocket/ground-based observation campaign to study Medium-Scale Traveling Ionospheric Disturbances (MSTID)

YAMAMOTO, Mamoru[1*], SAITO, Akinori[2], YOKOYAMA, Tatsuhiro[1], OTSUKA, Yuichi[3], YAMAMOTO, Masa-yuki[4], ABE, Takumi[5], WATANABE, Shigeto[6], ISHISAKA, Keigo[7], Miguel Larsen[8], Rob Pfaff[9], Paul Bernhardt[10]

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An observation campaign is under preparation. It is to launch sounding rockets S-520-27 and S-310-42 from Uchinoura Space Center of JAXA, while ground-based instruments measure waves in the ionosphere. The main purpose of the study is to reveal seeding mechanism of Medium-Scale Traveling Ionospheric Disturbances (MSTID). The MSTID is enhanced in the summer nighttime of the mid-latitude ionosphere. The MSTID is not only a simple reflection of atmospheric waves to the ionosphere, but includes complicated processes including the electromagnetic coupling of the F- and E-regions, and inter-hemisphere coupling of the ionosphere. We will measure ionospheric parameters such as electron density and electric fields together with neutral winds in the E- and F-regions. TMA and Lithium release experiment will be conducted with S-310-42 and S-520-27 rockets, respectively. The observation campaign is planned in summer 2012 or 2013. In the presentation we will overview characteristics of MSTID, and show plan and current status of the project. We also touch results from the sounding rocket S-520-26 that was launched on January 12, 2012. We will show results of the rocket-ground dual-band beacon experiment.

Keywords: sounding rocket, ground-based experiment, Medium-Scale Traveling Ionospheric Disturbances, observation campaign

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-26 Room:301B Time:May 22 15:30-15:45

Positive correlation between electron density and temperature in high density region of the topside ionosphere

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Electron temperature (Te) in the ionosphere is determined by the heat balance between the heating by photoelectrons, cooling through Coulomb collisions with ions and heat conduction along the magnetic field lines. Many studies have shown a negative correlation between the electron density (Ne) and Te during daytime because cooking through Coulomb collision increases with increase of Ne. In this study, the correlation between Te and Ne observed by the Hinotori satellite and other satellites. Although the results show the well-known negative correlation between daytime Ne and Te when Ne is low, when the daytime Ne is significantly high ($>10^6$ cm^{-3}), the correlation turns positive irrespective of latitude, longitude, season, solar flux levels and magnetic activity levels. The results suggest that an additional heat source(s) is involved for the positive correlation between Ne and Te. Since Te also increases with increasing magnetic dip latitude in the same Ne range, Te does not correlate with in-situ Ne, which suggests the integrated Ne along the magnetic field lines from the ground to 600 km altitude in one hemisphere are important for Te in the topside ionosphere. Therefore, the additional heat source seems to be related the integrated Ne. Although the mechanism for the positive correlation is not well understood, the results imply that the Te in the topside ionosphere is controlled more by the integrated Ne than by in-situ Ne or F2-peak Ne.

Keywords: mid-low latitude ionosphere, electron temperature, electron density, topside ionosphere, heat budget of ionospheric plasma

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-27 Room:301B Time:May 22 15:45-16:00

Imaging observation of the Ionosphere, mesosphere, and plasmasphere from ISS

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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 is a scientific mission that uses two imaging instruments on the Exposed Facility of Japanese Experiment Module on the International Space Station, EF of ISS-JEM. The development of the scientific instruments have been completed in 2011. The observation is planed to be started in 2012. It will make 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+]. Its field-of-view is 15 degrees, and points the limb of the Earth to observe the vertical distribution of the ions. The scientific objectives and current status of the ISS-IMAP mission will be introduced in the presentation.

Keywords: ISS, Ionosphere, Mesosphere, Plasmasphere, JEM, MCE

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-28 Room:301B Time:May 22 16:00-16:15

Simulation of Airglow Observations with IMAP/ VISI on the International Space Station

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The Visible and near-Infrared Spectral Imager (VISI) of the IMAP mission has been developed and ready to be launched onto the International Space Station (ISS) in summer 2012. VISI will be operated in the night-side hemisphere in the range of +/- 51 deg. GLAT, and measure the airglow emissions of OI at 630 nm, the OH Meinel band at 650 nm and the O2 atmospheric band (0-0) at 762 nm at an altitude of ˜400 km with typical spatial resolution of 16-50 km. Since the influence of cloud reflections of moon light is overlapped with the airglow pattern in the visible wavelength range, the precise subtraction of the cloud influence is a key issue of this mission. Therefore, a simulation work to study on how much the surface albedo on the cloud top will affect the data is critically important. We carried out the simulation of O2 airglow pattern including cloud albedo under realistic conditions of VISI measurement since the O2 airglow is the primary candidate for measurement of gravity wave modulated airglow emission that is only visible from space. The height profile of volume emission rate of O2 airglow was estimated with the MSIS model, and then the airglow intensity was integrated along the line-of-sight direction. The cloud pattern was based on the realistic data measured with a geostationary climate satellite. We will report the quantitative effect of cloud albedo on the airglow pattern, and discuss the physical parameters those expected to be derived from the VISI data.

Keywords: ISS-IMAP, VISI, airglow simulation, O2 atmospheric band (0-0)

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-29 Room:301B Time:May 22 16:15-16:30

Mesosphere-Thermosphere-Ionosphere coupling research by using MAGDAS network

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MAGnetic Data Acquisition System/Circum-pan Pacific Magnetometer Network (MAGDAS/CPMN: Yumoto et al, 1996, 2001, 2006, 2007) is a ground magnetometer network all over the world. It conducted by the Space Environment Research Center (SERC), Kyushu University. It mainly consists of three magnetometer chains, and a part of 210 degrees Magnetic Meridian chain and Magnetic Equator chain are locate in Asia region. In addition, we have three Frequency Modulated-Continuous Wave (FM-CW) radar along the 210 magnetic meridian includes Asia region. Long-term observational data can be used to clarify the Sun-Earth coupling system, including Mesosphere-Thermosphere-Ionosphere.

We calculate the equatorial electrojet index (EE-index) every day, and open it to public. The equatorial electrojet is caused by the ionospheric current flowing along the narrow channel (˜3 degrees in latitudinal range) of the enhanced ionospheric conductivity, called Cowling conductivity. We developed the EE-index to quantify the scale of magnetic disturbances in the equatorial region using MAGDAS/CPMN data. The ionospheric equivalent current pattern using the MAGDAS data is also useful for the study MTI coupling. At high latitudes the ionospheric currents are joined with field-aligned currents from the solar wind region into the magnetosphere, and the electro-dynamics is dominated by the influences of solar wind-magnetosphere interaction processes. On the other hand, the ionospheric current at middle and low latitudes is generated by the ionospheric wind dynamo, which produces global current vortices on the dayside ionosphere. By using the MAGDAS ionospheric current pattern and empirical model, the global electromagnetic coupling processes at all latitudes can be clarified.

In this paper, we will introduce of the overview of MAGDAS project, and how data from MAGDAS can be used to research of Mesosphere-Thermosphere-Ionosphere coupling.

Keywords: magnetometer, FM-CW radar, network observation, equatorial electrojet, geomagnetic index

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-30 Room:301B Time:May 22 16:30-16:45

Upper atmospheric researches using metadata database and data analysis software developed by the IUGONET project

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The Earth's upper atmosphere consists of the mesosphere, thermosphere, ionosphere, plasmasphere and magnetosphere. The different atmospheric regions are closely coupled by the exchange of materials and transport of momenta and energies through complicated physical processes. Especially, the chemical reaction and dynamics in the ionosphere-thermosphere-mesosphere (MTI) region are caused by both external and internal factors (e.g., ultraviolet radiation and solar wind from the sun, cosmic ray, atmospheric gravity and tidal waves). Therefore, in order to investigate the mechanism of the long-term variations in the upper atmosphere, multidisciplinary researches are required with the integrated analysis of various types of ground-based observation data obtained at different locations and altitudes. However, since the observation data or databases generally have been maintained and made available to the community by each organization that conducted the observations, most of the researchers in different disciplines could not easily access and analysis their data or databases due to the lack of information on the data description. To solve this problem, the Inter-university Upper atmosphere Global Observation NETwork (IUGONET) project is started in 2009 as an inter-university program by the National Institute of Polar Research (NIPR), Tohoku University, Nagoya University, Kyoto University, and Kyushu University. The main task of this project is to build a database of metadata (data of data such as observation period, type of instrument, location of data, and so on) for the long-term ground-based observations of the upper atmosphere and to develop the integrated data analysis software called UDAS on the basis of the THEMIS Data Analysis Software (TDAS) written in IDL. With the progress of the IUGONET project, we can freely access and download the long-term observation data of the neutral wind in the lower thermosphere and mesosphere (MLT) region obtained from the MF and meteor wind radars over Indonesia using the IUGONET metadata database and UDAS. These observation data for the period from October 28, 1992 to present are available in the RISH database, Kyoto University (http://database.rish.kyoto-u.ac.jp/arch/iugonet/index-idr.html) now. The data format is text or netCDF and png or gif for numerical data and height-time plots of the neutral wind, respectively. The IUGONET project also performs scientific researches on the long-term variation of the upper atmosphere using our metadata database and UDAS in order to evaluate the performance of our products since this year. In this talk, we introduce an overview of the IUGONET project and scientific researches on the long-term trends in geomagnetic solar quiet daily (Sq) variation and the neutral wind in the MLT region over the Asian sector.

Keywords: Solar radiation, Geomagnetic solar quiet daily variation, Ionospheric cunductivity, Thermosphere-mesosphere, IUGONET, Analysis software

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-31 Room:301B Time:May 22 16:45-17:00

Asia-Oceania Space Weather Alliance: AOSWA

MURATA, Ken T.[1*], NAGATSUMA, Tsutomu[1], WATARI, Shinichi[1], TSUGAWA, Takuya[1], NISHIOKA, Michi[1], MARUYAMA, Takashi[1]

[1]NICT

For our studies of the ionosphere, GPS-TEC data analysis is one of the effective methodologies. More than 6000 GPS data files are independently provided every day from several organizations over the world through the Internet. To create GPS-TEC maps from these GPS data, data file crawling is inevitable. It is not easy, however, since the data publication policies are independently regulated at each organization, and we need to catch up with the change of the policies.

In NICT we have developed a new system to collect such GSP data files automatically. Based on the collected data files, we are successfully creating both global and regional GSP-TEC maps. It should be noted that the system can detect a change of the data publication policy, and we can adjust the data crawling settings and/or parameters.

For more dense and precise GPS-TEC maps, we need to involve more data from new GPS receivers. Since there is no standard and public GSP data format, we have implemented an application to make data suitable for our GPS-TEC maps. We have begun to provide this application, which would help our global and regional GPS-TEC maps with higher spatial resolutions or for the new regions where there have no GPS-TEC maps.

To promote such an application and data exchange, a regional collaboration is important. The Asia-Oceania Space Weather Alliance (AOSWA) was established in 2010 with 13 associated organizations from 7 countries (http://aoswa.nict.go.jp) including NICT (National Institute of Information and Communications Technology). The AOSWA has two major objectives; to make progress in collaborative research and practical operations of space weather forecasting.

The AOSWA workshop was held in Chiang Mai, Thailand from February 22nd to 24th as a first regional/international workshop for researchers and operators of space weather forecast in Asia-Oceania countries. The subjects of the workshop are both operational and scientific, including research in ionospheric and magnetospheric science, solar wind and other space weather related phenomena.

Regional workshop in the Asia-Oceania area plays an important role for improvement of space weather forecasting services. The research efforts, operational collaboration, data exchanges, and some competitions will lead to further development of space weather activities; a primary goal of the workshop.

Keywords: Asia-Oceania Space Weather Alliance, AOSWA, GPS-TEC, ionosphere

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-P01 Room:Convention Hall Time:May 22 17:30-18:00

Long-term variation relationship between the strength of EEJ and atmospheric disturbance in the MTI region

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The equatorial electrojet (EEJ) is a huge eastward current which flows at the dayside equatorial region of the Earth's ionosphere, in a narrow channel (+-3˜5 degrees in latitudinal range). The EEJ current is observed as an enhanced magnetic variation of horizontal component of geomagnetic field at the dayside magnetic dip equator. In the past studies, many researchers showed that the main mechanism of EEJ is an effect of polarization electric field in the E region of the ionosphere at the dip equator caused by the horizontal magnetic field at the magnetic equator [e.g., Forbes, 1981]. In a recent study, the observation of atmospheric radars located at the equatorial region showed the existence of neutral wind in the E region of the ionosphere and vertical polarization electric field derived from ionospheric dynamo generated by the gravity wave originating from the lower atmosphere [Aveiro et al., 2009]. In addition, Fang et al. (2008) shows the relationship between wind dynamo effect and EEJ by using their simulation model. However, lack of the long-term comparison analysis of geomagnetic field and wind data obtained from ground magnetometer and atmospheric radars, the detailed relationship between the EEJ and neutral wind fluctuation at the mesosphere and lower thermosphere (MLT) regions has not yet been revealed.

To clarify the relationship between the variations of the EEJ strength and neutral wind at the MLT regions, we perform the long-term comparison analysis of geomagnetic field and neutral wind data obtained from ground magnetometer and medium frequency (MF) radar located at the equatorial region. We use the neutral wind data estimated from the MF radar at Pamuenpauk, which has been operated by Research Institute for Sustainable Humanosphere, Kyoto University. We also used many magnetometer data observed at CEB (geomagnetic latitude=2.53, geomagnetic longitude=195.06), DAV (-1.02, 196.54), YAP (1.49, 209.06), ANC (0.77, 354.33), and EUS (-3.64, 34.21). CEB, DAV, and YAP are located in the Asia and Pacific region, close to the MF radar. ANC and EUS are located at the South America region, far from the radar site. All the magnetometers belong to MAGDAS managed by Space Environment Research Center, Kyushu University. We can observe global and local effect by using these magnetometers and radar data. The analysis period is from 1996 to 2011, over one solar cycle.

As a result, the relationship between the variations of zonal wind and the residual-EEJ showed a clear inverse correlation. Here, the residual-EEJ is defined as the deviation from the second order fitting curve between the F10.7 solar flux and the EEJ amplitude. This trend is observed in not only the Asia Pacific region (close to the radar) but also the South Africa region (far from the radar site). In addition, we performed the frequency analysis to quantitatively define the relationship of zonal wind and residual-EEJ. These results suggest that the vertical current (Jz), which is generated by the dynamo action due to the zonal wind perpendicularly across to the background magnetic field, changes the Cowling conductivity derived under the condition of Jz=0. On the other hand, there was no correlation between the variations of the meridional wind and the residual-EEJ amplitude. This implies that the meridional wind parallel to the background magnetic field does not contribute to the dynamo action. These results allow us to solve the Cowling conductivity including the neutral wind effect, and offer new insight into the study of ionosphere-aerosphere coupling at the equatorial region.

Keywords: equatorial electrojet, MF radar, magnetometer, IUGONET, neutral wind

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-P02 Room:Convention Hall Time:May 22 17:30-18:00

Observation of atmospheric gravity waves with lithium release from sounding rocket

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As WIND-2 Campaign, S-520-26 sounding rocket was launched from ISAS/Kagoshima Space Center (131.08E, 31.25N) at 05:51 on January 12, 2012. The rocket installed Lithium Ejection System (LES), which releases the lithium atom in the thermosphere. The Lithium cloud was observed from Uchinoura, Sukumo and Muroto to estimate the wind and gravity wave in the thermosphere.

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM08-P03 Room:Convention Hall Time:May 22 17:30-18:00

Toward estimating plasmaspheric density along 210MM by using MAGDAS/CPMN stations

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The ultimate goal of this study is to monitor the plasma density distribution in geospace by using ground magnetometers. A method for it is to use the field-line resonance (FLR) frequency, but it is often difficult to identify. Frequently-used methods to identify it, called ”two-station methods” below, need data from two closely neighboring stations. However, many ground stations are not close enough to each other to enable the two-station methods. Therefore, in this paper we focus on the H/D method (also called ”one-station method” below); it is a method which uses the data from a single station. However, it is known that this method can also detect events different from FLR events (called ”Type-B” events below). In this study, we improve the H/D method to decrease Type-B events, by using MAGDAS/CPMN data.

Among the CPMN stations, we have at least two pairs of stations close enough to each other, enabling the two-station method. We applied the two-station methods and the one-station method to those stations’ data during 2001/8-2002/6, and by comparing the results, we improved the one-station method: That is, we set thresholds for the H/D value and for the H-component power spectral density (PSD). The optimum values for the two thresholds were found by numerical search so that as many Type-B events as possible were removed while as many ”Type-A” events as possible were kept (”Type-A” refers to the events identified by all of the two-station methods and the one-station method).

As a result, we found the following:
(1) We could remove 95% of the Type-B events.
(2) The thresholds for the H/D value and the H-component PSD depend on the L-value.
(3) The threshold for the H/D value depends on season.

By using the improved H/D method, we have estimated the plasma mass density as a function of the L-value using the CPMN stations along 210MM (210 degrees magnetic meridian). The result shows the same trend as the plasma mass density observed by past satellites (Gallagher et al., 2000).