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


PEM06-01 Room:A01 Time:May 26 16:15-16:45

# Recent advances in the low latitude ionospheric irregularities- a review

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Scientific research on the low latitude ionospheric irregularities continues to be of interest due to their adverse effects on communication and navigation systems. Understanding the physical processes and governing free energy sources leading to develop forecasting capability is the current focus. Low latitude ionospheric E and F regions become unstable both during day and night and irregularities are formed at different height regions. While understanding the F region processes with forcing from below and extra-tropics has been paid attention, research activities are also focused on understanding fascinating details of E- and valley- region plasma processes, such as instabilities linked with tidal ion layer, intermediate layer and daytime 150 km echoes. Recent experiments conducted from low latitudes in the Asian sector have added new observational knowledge on plasma irregularities. This paper will present the recent advancements made in understanding E and F region irregularities including coupling between the two regions and daytime 150 km irregularities based on observations made in the Asian sector.

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PEM06-02 Room:A01 Time:May 26 16:45-17:00

# Three-dimensional plasma bubble simulation driven by whole atmosphere-ionosphere coupled model

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Equatorial plasma bubble (EPB) is a well-known phenomenon in the equatorial ionospheric F region. As it causes severe scintillation in the amplitude and phase of radio signals, it is important to understand and forecast the occurrence of EPB from a space weather point of view. The development of EPB is known as a evolution of the generalized Rayleigh-Taylor instability. Numerical modelings of the instability on the equatorial two-dimensional plane have been conducted since the late 1970's, and the nonlinear evolution of the instability has been clearly presented. Recently, three-dimensional (3D) modelings became popular tools for further understanding of the development of EPB such as 3D structure of EPB, meridional wind effects and gravity wave seeding.

We have developed a new 3D high-resolution bubble (HIRB) model for EPB and presented nonlinear growth of EPB which shows very turbulent internal structures such as bifurcation and pinching. The eastward neutral wind in the evening produced reverse-C shape of EPB as frequently observed by various instruments. We are trying to integrate the high-resolution model for EPB with the whole atmosphere-ionosphere coupled model (GAIA) to study the growth of EPB under the realistic background conditions. The background electric field and neutral wind partially controlled by forcing from the lower atmosphere may cause the day-to-day variability of EPB occurrence.

Keywords: plasma bubble, equatorial ionosphere, simulation, GAIA model, HIRB model

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PEM06-03 Room:A01 Time:May 26 17:00-17:15

# Predawn depletion observed by GRBR and GPS networks in Southeast Asia

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Deep plasma depletion during substorm at predawn (0412-0436 LT) on 6 March 2012 was captured by GRBR network and was confirmed by sparse GPS networks in Southeast Asia. The only available low-Earth-orbit (LEO) satellite during the event is DMSPF15 with NE-to-SW overpass. GRBR network covering both hemispheres is aligned along the ˜100 E meridian. GPS network including 12 GPS receivers sparsely distributes from 25 N to 1 N and from 99 E to 105 E. The supporting information includes in-situ ion density data from DMSPF15 satellite, bottomside ionospheric data from ionosonde at Chumphon (10.72 N, 99.37 E) and data from the EAR at Kototabang (0.20 S, 100.32 E). This event was recognized by GRBR-TEC as having a steep TEC gradient that can trouble in positioning error on the aeronautical augmentation system. This finding was supported by the GPS-TEC. In addition to the depletion, the GPS-TEC revealed the co-locating sub-mesoscale Medium-Scale-Ionospheric-Disturbance-like (MSTID-like) structures. Because the sparseness of the observation points has restricted the resolution of the observations, several assumptions are necessary to interpret the data, such as the neglect of the temporal variations of their structures. As a result, a deep plasma depletion event was understood as having fossil plasma bubbles and sub-mesoscale MSTID-like structures collocating. The wavefront of the plasma bubbles and the MSTID-like structures are found to be the same. This event improves the predawn ionospheric information over Southeast Asia and is significant for being the prior-knowledge for the ionospheric modeling.

Keywords: TEC, GRBR, GPS, predawn depletion, plasma bubble, Southeast Asia

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PEM06-04 Room:A01 Time:May 26 17:15-17:30

# Effects of Pre-reversal Enhancement of E x B drift on the Latitudinal Extension of Plasma Bubble in Southeast Asia

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We investigated the effects of the F region bottomside altitude (h'F), maximum eastward electric field (E), duration of eastward E, and the integral of eastward E on the latitudinal extension of equatorial plasma bubbles in the Southeast Asian sector using the observations recorded by three GPS receivers and two ionosondes. The GPS receivers are installed at Kototabang (0.2 deg S, 100.3 deg E; 10.0 deg N magnetic latitude), Pontianak (0.02 deg S, 109.3 deg E; 8.9 deg S magnetic latitude), and Bandung (6.9 deg S, 107.6 deg E; 17.5 deg S magnetic latitude) in Indonesia. The ionosondes are installed at equatorial stations Chumphon (10.7 deg N, 99.4 deg E; 3.3 deg N magnetic latitude) in Thailand and Bac Lieu (9.3 deg N, 105.7 deg E; 1.7 deg N magnetic latitude) in Vietnam. We analysed those observations acquired in the equinoctial months (March, April, September, and October) in 2010?2012 when the solar activity index F10.7 was in the range from 75 to 150. Assuming that plasma bubbles are the major source of scintillations, the latitudinal extension of the bubbles was determined according to the S4 index. Our results show that the peak of h'F, maximum eastward E within the pre-reversal enhancement period, and the integral of eastward E are positively correlated with the maximum latitude extension of plasma bubbles. Our statistical and observational findings emphasise that plasma bubble extending more than 10?18 deg in latitude from the magnetic equator can be generated when the peak value of h'F is greater than 250?450 km, the maximum vertical upward E x B drift is greater than 10?70 m/s, and the integral of vertical upward E x B drift is greater than 50?250 m/s. In contrast, the duration of eastward E shows only weak correlation with the maximum latitude extension of plasma bubbles. These findings suggest that the latitudinal extension of plasma bubbles is controlled mainly by the magnitude of eastward E and the peak value of h'F at the initial phase of development of plasma bubbles (or equatorial spread F) rather than by the duration of eastward E.

Keywords: equatorial ionosphere, plasma bubble, pre-reversal enhancement, scintillation

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PEM06-05 Room:A01 Time:May 26 17:30-17:45

# Temperature trend of electron and ion with plasma density in middle and low latitude in the topside ionosphere

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It is important to understand energy flow from electron to ion and neutral species because main heat source of ionospheric plasma is photoelectron created by solar EUV. First, electrons are heated by photoelectrons, then heated electrons reduce their energy through the Column collision with ions. Finally, ions are cooled by inelastic collision with neutral species. Temperatures of electron (Te), ion (Ti) and neutral species (Tn) get close to each other during night time due to lack of significant heat source. Heating rate of electron by photoelectron is proportion to ambient plasma density while cooling rate of electron is proportion to square of the plasma density. Therefore, Te decreases with increase of electron density (Ne) in general. However, some satellite results show Te increases with increase of Ne when Ne is high enough (more than about $10^6$ $cm^{-3}$). To understand the unexpected Te, it is also important to know Ti variation because ion plays as a heat sink of electron. In this paper, we summarized correlation of Ne with Te and Ti observed by HINOTORI, CHAMP and ROCSAT-1 in the topside ionosphere. Since these satellites did not observe Te and Ti simultaneously, Te, Ti and Ne measured with the incoherent scatter radars at Jicamaruca and Millstone Hill are also shown. Using these data, we discuss possible cause of unexpected high Te in high Ne region.

Keywords: topside ionsophere, electron temperature, electron density, ion temperature, photoelectron, middle and low latitude

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PEM06-06 Room:A01 Time:May 27 09:00-09:30

# Climatology of gravity waves in the mesosphere observed with the MU radar

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The MU radar at Shigaraki, Japan has been operating periodically since 1986 and the extensive data set provides a unique opportunity to study the seasonal variations of gravity waves. The data has recently been made available publicly to the scientific community through a link in a large meta-database called IUGONET (Inter-university Upper atmosphere Global Observation NETwork). In our study we focus on gravity waves observed during daylight hours between 60 and 97 km. Several days of observations were made during most months during the 29 years of operation. We calculate the vertical fluxes of horizontal momentum and quantify the statistical characteristics and temporal variabilityof the waves. The spatial scales and intrinsic wave properties are determined, as well as their response to seasonal changes in the background conditions. The background conditions considered include changes in the mean horizontal winds and the atmospheric static stability. This study differs from those done previously in that we make extensive use of probablity distribution functions as a complement to spectral analysis.

Keywords: mesosphere, gravity waved, climatology, Mu radar

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PEM06-07 Room:A01 Time:May 27 09:30-09:45

# On the coupling between gravity waves and background field including tides observed with MF radar at Poker Flat & Tromso

KINOSHITA, Takenari[1*] ; MURAYAMA, Yasuhiro[1] ; KAWAMURA, Seiji[1] ; NOZAWA, Satonori[2] ; HALL, Chris[3]

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The neutral wind velocity data from mesosphere to lower thermosphere observed by MF radars at Poker Flat in Alaska and at Tromso in Norway has been observed since the late 1990s. The present study examines the daily and seasonal variations of short-period mesospheric gravity wave activities associated with the background state including tides using these MF radars' data for 10 years of 1999?2008.

Observed wind velocities having the 1˜4 hour period components are analyzed as short-period gravity waves and those having harmonic components with periods of 24, 12, and 8 hours are calculated every 30 minutes. The previous study in AGU2014 showed that the semidiurnal phases of zonal wind and kinetic energy of gravity waves (GW-KE) are locked for more than 10 days. Such phase lock events are found in several years at both observation sites. It is confirmed a phase lock phenomena at both Tromso and Poker Flat continued for about 20 days from November to December in 2000. However, between Tromso and Poker Flat, the phases of 12 hour component of GW-KE differed by 180 degrees. Next, we made climatological 1-day composite plots of semidiurnal components of zonal wind and GW-KE. The result showed that the maximum of GW-KE occurs at Poker Flat when zonal wind is westward from November to December and zonal wind transitions from westward to eastward from January to February and from May to August. The results of Tromso showed that the maximum of GW-KE occurs at local time when zonal wind is eastward from November to February and westward from May to September. Thus, it is suggested that the observed phase lock event is possibly to be occurred fluently. We plan to investigate the relations between other harmonic components of zonal wind and GW-KE and discuss the physical mechanism of the relations.

Keywords: middle atmosphere, gravity waves, tidal waves

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PEM06-08 Room:A01 Time:May 27 09:45-10:00

# Distributions of horizontal phase velocity of gravity waves observed by ANGWIN, using a 3-D spectral analysis technique

MATSUDA, Takashi S.[1*] ; NAKAMURA, Takuji[2] ; EJIRI, Mitsumu K.[2] ; TSUTSUMI, Masaki[2] ; TAYLOR, Michael J.[3] ; ZHAO, Yucheng[3] ; PAUTET, P.-dominique[3] ; MURPHY, Damian[4] ; MOFFAT-GRIFFIN, Tracy[5]

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Atmospheric gravity waves (AGWs), which are generated in the lower atmosphere, transport significant amount of energy and momentum into the mesosphere and lower thermosphere and cause the mean wind accelerations in the mesosphere. This momentum deposit drives the general circulation and affects the temperature structure. Among many parameters to characterize AGWs, horizontal phase velocity is very important to discuss their vertical propagation. Airglow imaging is a useful technique for investigating the horizontal structures of AGWs around mesopause. An international airglow imager (and other instruments) network in the Antarctic, named ANGWIN (Antarctic Gravity Wave Imaging/Instrument Network) was started in 2011. Its purpose is to understand characteristics of mesospheric gravity waves, and to study sources, propagation, breaking of the gravity waves over the Antarctic and the effects on general circulation and upper atmosphere.

In this study, we compared distributions of horizontal phase velocities of gravity waves at around 90 km altitude over different locations using our new statistical analysis method based on 3-D Fourier transform, developed by Matsuda et al. (2014). The comparison has been carried out for the airglow imagers at four stations, that are Syowa (69S, 40E), Halley (76S, 27W), Davis (69S, 78E) and McMurdo (78S, 156E) out of the ANGWIN imagers, for the observation period between April 6 and May 21 in 2013. Not only horizontal propagation characteristics, gravity wave energies can also be quantitatively compared, indicating a smaller GW activity in higher latitudes. The presentation will be focused on showing the performance of the new statistical technique for studying gravity waves.

Keywords: atmospheric gravity wave, airglow imaging

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PEM06-09 Room:A01 Time:May 27 10:00-10:15

# Obervation of mesopause temperature by Kunming meteor radar

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A method to calibrate the initial temperatures derived from the meteor radar at Kunming in low latitudes area using SABER temperatures is presented in this paper. Most of the meteors are observed in the local morning by Kunming meteor radar, therefore, the daily mean temperatures measured by the meteor radar were biased by local morning values. The daily temperatures estimated using temperature gradient model technique are consistent well with the daily SABER temperatures which averaged from 1600 to 0600 UT, but fluctuate greater than SABER temperatures. The correlation coefficient between the meteor and SABER temperatures is 0.58. The Lomb Periodograms of meteor and SABER temperatures both exhibit clear seasonal and interannual periodicities, with annual, semiannual, quasi 90 day and terannual oscillations. The results of harmonic fit analysis show that the mean values are very close and these periodic oscillations have similar phases, however, the oscillation amplitudes of meteor temperatures are larger than SABER temperatures. The larger fluctuations of meteor temperatures were identified as larger amplitude of the temperature oscillation components. Thus, the amplitude calibration was used to adjust the larger fluctuations of meteor temperatures. After temperature calibration was performed, the fluctuations of meteor and SABER temperatures agree well, and the accuracy of the calibrated temperatures has been significantly improved. In addition, the temperatures determined by the temperature gradient model technique could effectively be used to study the waves and oscillations in the mesopause region.

Keywords: meteor radar, mesopause temperature, temperature gradient, temperature oscillation

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PEM06-10 Room:A01 Time:May 27 10:15-10:30

# Characteristics of long-term variation of the geomagnetic solar quiet daily variation

SHINBORI, Atsuki[1*] ; KOYAMA, Yukinobu[2] ; NOSE, Masahito[2] ; HORI, Tomoaki[3] ; OTSUKA, Yuichi[3] ; YATAGAI, Akiyo[3]

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Characteristics of long-term variation in the amplitude of solar quiet (Sq) geomagnetic field daily variation have been investigated using 1-h geomagnetic field data obtained from 69 geomagnetic observation stations within the period of 1947 - 2013. The Sq amplitude observed at these geomagnetic stations showed a clear dependence on the 10 - 12 year solar activity cycle and tended to be enhanced during each solar maximum phase. The Sq amplitude was the smallest around the minimum of solar cycle 23/24 in 2008 - 2009. The relationship between the solar F10.7 index and Sq amplitude was approximately linear but about 53 % of geomagnetic stations showed a weak nonlinear relation to the solar F10.7 index. In order to remove the effect of solar activity seen in the long-term variation of the Sq amplitude, we calculated a linear or second-order fitting curve between the solar F10.7 index and Sq amplitude during 1947 - 2013, and examined the residual Sq amplitude, which is defined as the deviation from the fitting curve. As a result, the majority of trends in the residual Sq amplitude that passed through a trend test showed negative values over a wide region. This tendency was relatively strong in Europe, India, the eastern part of Canada, and New Zealand. The relationship between the magnetic field intensity at 100 km altitude and residual Sq amplitude showed an anti-correlation for about 71 % of the geomagnetic stations. The decreasing trend of the residual Sq amplitude implies that the ionospheric Sq current intensity tends to weaken due to a decrease of the ionospheric conductivity associated with an increase of the ambient magnetic field intensity. Furthermore, the residual Sq amplitude at the equatorial station (Addis Ababa) was anti-correlated with the absolute value of the magnetic field inclination. The decreasing trend of the residual Sq amplitude in the equatorial region indicates movement of the equatorial electrojet due to the secular variation of the ambient magnetic field.

Keywords: Solar activity, Geomagnetic solar quiet daily variation, Ionospheric conductivity, Ionospheric dynamo, Secular variation of geomagnetic field, Thermospheric wind

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PEM06-11 Room:A01 Time:May 27 10:30-10:45

# Equatorial MLT dynamics using long-term radar observation

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In the equatorial region, atmospheric waves cause the S-QBO(Stratospheric Quasi-Biennial Oscillation) in the lower stratosphere, S-SAO(Stratospheric Semi Annual Oscillation) in the upper stratosphere and M-SAO(Mesospheric Semi Annual Oscillation) in the MLT(Mesosphere Lower Thermosphere).S-SAO and M-SAO is opposite phase.

We investigate the periodic oscillation and random variation of wind in the MLT over equatorial region by using long-term meteor radar observation in Indonesia. Especially, we focus on the peculiar phenomenon that enhance westward wind in Feb.-Apr. once in 2 or 3 years, M-QBE(Mqsosphere Quasi-Biennial Enhancement).M-QBE occur only spring but not fall. We think that there must be 1-year oscillation which restrict the M-QBE to spring.

N.V.Rao et al.[2012] reported that gravity wave enhancement coinside with westward wind enhancement. This result suggest that gravity waves drive the M-QBE. However, we have to measure the momentum flux with gravity waves to reveal the relationship between M-QBE and gravity waves.

Hocking[2005] proposed a new method that enables us to measure the momentum flux by using meteor radar. However, this method has several doubtful points, so we checked the validation.

We have two meteor radars which have the same system and which are in the neighborhood in Indonesia(Koto Tabang and Biak) on the equator. We used these meteor radar data ,calculated the momentum flux, and checked the validation in Hocking method.

We compared the data from two meteor radar, and we got the similar momentum flux results during high acquisition rate. From this result, We are succeeded to measure the momentum flux by using the Hocking method.

On the other hand, we did a composit analysis in Koto Tabang which have 12 years long-term data. This composit analysis suggests that the momentum flux has the periodicity of the half year. This result is consistent with M-SAO.

Keywords: Mesosphere and Lower Thermosphere, Quasi-biennual Oscillation, momentum flux, Hocking

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PEM06-12 Room:A01 Time:May 27 11:00-11:30

# Deep ionospheric hole created by sudden stratospheric warming in the post-midnight ionosphere

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Multiple observational studies have demonstrated large ionospheric variations associated with sudden stratospheric warming (SSW) events during the daytime, but only limited evidence of ionospheric disturbances during the night-time was reported up to now. We use observations by GPS TEC receivers and Arecibo and Millstone Hill incoherent scatter radars to investigate large-scale disturbances in the nighttime ionosphere for several SSW events. We report a deep decrease in TEC that reaches ˜70% of the background level and is observed between the local midnight and local sunrise (6-12UT). This decrease is observed for several consecutive days in the range of latitudes from ˜60oS to ˜45oN. It is accompanied by a strong downward plasma motion and significant decrease in ion temperature, as observed by both Arecibo and Millstone Hill radars. We discuss variations in electric field and F-region dynamics as possible drivers of this behavior.

Keywords: sudden stratospheric warming, atmospheric coupling, ionosphere

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PEM06-13 Room:A01 Time:May 27 11:30-11:45

# Spatial and temporal extent of ionospheric anomalies during sudden stratospheric warmings in the daytime ionosphere

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Recent studies have demonstrated large variations in the daytime ionosphere during sudden stratospheric warmings (SSW) and a debate has started about the relative importance of solar and lunar tides in these ionospheric variations. In this study we use GPS TEC data from the MIT Haystack Observatory Madrigal database along 75$^o$W collected in 2000-2014 as well as several digisondes to examine the magnitude and spatio-temporal extent of ionospheric anomalies related to SSW. To separate ionospheric anomalies during SSW from regular ionospheric behavior, we develop empirical models of ionospheric parameters (TEC, NmF2) using available long-term records. The models describe variations in parameters for each lon/lat bin (or digisonde location) as a function of solar activity, geomagnetic activity, day of year, and local time. Ionospheric anomalies are obtained as difference between observations and empirical model. Analysis of anomalies shows that they are observed for both major and minor SSW events, reaching 50-100% variation from expected seasonal behavior for major SSW events and 30-60% variation for minor SSW events. SSW-associated variations are pronounced more strongly in NmF2 than in TEC. The largest variations in TEC in the daytime are observed both in the crests of equatorial ionization anomaly and at 40-60$^o$S (geodetic). Variations in TEC and NmF2 are even discernable up to high latitudes (70$^o$S) in the Southern Hemisphere and mid-latitudes (42$^o$N) in the Northern Hemisphere. We discuss several possible mechanisms contributing to these anomalies, focusing on solar and lunar semidiurnal tides and interhemispheric coupling.

Keywords: sudden stratospheric warming, atmospheric coupling, ionosphere

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PEM06-14 Room:A01 Time:May 27 11:45-12:00

# Longitudinal Variations of Low-Latitude Gravity Waves and Their Impacts on the Ionosphere

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The lower atmospheric forcing has important roles in the ionospheric variability. Previous study suggested that atmospheric tides from the troposphere induce the wavenumber 4 signatures on the ionosphere. However, influences of lower atmospheric gravity waves on the ionospheric variability are still not clear due to the simplified gravity wave parameterizations in general circulation models (GCMs) and the limited knowledge of gravity wave distributions. In this study, we aim to study the longitudinal variations of gravity waves and their impacts on the ionospheric variability.

Variations of lower atmospheric gravity waves are characterized using SABER temperature observations from 2002 to 2012 and also the physically based gravity wave parameterization in the Specified-Dynamics Whole Atmosphere Community Climate Model (SD-WACCM). Longitudinal variations of gravity waves from SABER and WACCM show the largest variability in June-August at low latitudes. We have implemented these low-latitude gravity wave variations into the thermosphere-ionosphere-mesosphere-electrodynamics general circulation model (TIME-GCM) to study the responses of the ionosphere. TIME-GCM shows that wavenumber 3-4 components of TEC variations in June-August are increased by ˜10-15% with the longitudinal variations of gravity waves but there are no significant changes in other months. Potential mechanisms of TEC responses to gravity wave variations will be discussed.

Keywords: Gravity Wave, Ionosphere, Tides

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PEM06-15 Room:A01 Time:May 27 12:00-12:15

# Relationship between phase variation of LF signals and GPS-TEC variations related with MSTIDs at mid-low latitudes

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It is known that phase of LF transmitter signals largely varies in nighttime rather than in daytime, because uniform solar ionization in daytime makes the D-region ionosphere smoother. However, the cause of the nighttime phase variations has not been revealed. In this study, we focus on the periods of the phase variations of the nighttime LF transmitter signals observed in Japan and South-east Asia. As for Japanese data, we investigated the periods of LF signals observed in 16 April, and 6 May, 2007 by wavelet analysis. The propagation path (40 kHz) of the LF signals was located at Fukushima to Kagoshima. Both on 16 April and 6 May, 2007, phase variations with a period of about 50 minute was seen at around 11:00 UT and 15:00 UT, respectively. An occurrence of medium-scale traveling ionospheric disturbances (MSTIDs) was confirmed at 15:00 UT on 6 May, 2007 from GPS Total Electron Content (TEC) data, while the MSTIDs did not occur on 16 April, 2007. In the presentation, we will discuss the periods of LF phase variations and GPS-TEC variations in more detail.

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PEM06-16 Room:A01 Time:May 27 12:15-12:30

# First simultaneous observation of Ca+ densities in the E region and MSTIDs in the F region

EJIRI, Mitsumu K.[1*] ; TSUDA, Takuo[2] ; NISHIYAMA, Takanori[1] ; ABO, Makoto[3] ; NISHIOKA, Michi[4] ; MARUYAMA, Takashi[4] ; SAITO, Akinori[5] ; NAKAMURA, Takuji[1]

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In the mesosphere and lower thermosphere region, there are permanent layers of metal atoms and ions, the source of which is vaporization of cosmic dust and meteoroids during their entry into the Earth's atmosphere. Some metal atom layers e.g. Na, K, Ca, and Fe layers, and only $Ca^+$ (Calcium ion) can be observed by ground-based resonance scattering lidars. The National Institute of Polar Research (NIPR) is developing a new resonance scattering lidar system with a frequency-tunable laser. The lidar transmitter is based on injection-seeded, pulsed alexandrite laser for 768-788 nm and a second-harmonic generation (SHG) unit for 384-394 nm. The new lidar is able to measure density variations of minor constituents including $Ca^+$ (393.477 nm). As a part of the development, observation tests are carried out at NIPR (35.7N, 139.4E) since 2013, and we got the first light from $Ca^+$ layer on 21 August, 2014. The $Ca^+$ density profiles were obtained for $\sim$5 hours (23:13 LT-28:28 LT) with temporal and height resolutions of 1 min and 15 m, respectively. During the night, high density and narrow $Ca^+$ layer was observed. The layer descended from $\sim$107 km to 99 km with quasi-periodic density perturbations until $\sim$17 UT and then stayed at around 99 km until sunrise. At the same night, sporadic E ($E_s$) layer was observed with an ionosonde at Kokubunji by National Institute of Information and Communications Technology (NICT) (35.7N, 139.5E), also medium scale traveling ionospheric disturbances (MSTIDs) were observed with the dense GPS receiver network (GEONET). In this presentation, we compare these data in detail and discuss relationships between observed Ca+ density perturbations, $E_s$ layer and MSTIDs

Keywords: resonance scattering lidar, Ca+, medium scale traveling ionospheric disturbances, GPS-TEC, sporadic E layer

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PEM06-17 Room:A01 Time:May 27 12:30-12:45

# Excitation of large-scale gravity waves in the upper thermosphere by interplanetary fluctuations

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Fluctuations on timescales of minutes to hours are common in the solar wind. When the fluctuations encounter the Earth, they could induce impulsive auroral intensification, which, in turn, excite gravity waves in the auroral regions. These gravity waves, particularly large-scale (>˜1000 km) gravity waves, will give rise to traveling atmospheric disturbances with typical amplitudes of 20˜40% in the upper thermosphere. We report here the detection of full constructive interference between two large-scale gravity waves excited in northern and southern auroral regions by an interplanetary shock, and the detection of extremely efficient multiple excitation of large-scale gravity waves by a long-duration Alfven wave train carried by a high-speed stream.

Keywords: interplanetary fluctuations, gravity wave, traveling atmospheric disturbances, thermosphere

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PEM06-18 Room:A01 Time:May 27 14:15-14:45

# Quasi-two day wave related variability in the background dynamics and composition of the MTI system

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Dissipating planetary waves in the mesosphere and lower thermosphere (MLT) region may cause changes in the background dynamics of that region, subsequently driving variability throughout the broader thermosphere / ionosphere system via mixing due to the induced circulation changes. We report the results of case studies examining the possibility of such coupling during the northern winter in the context of the quasi-two day wave (QTDW) - a planetary wave that recurrently grows to large amplitudes from the summer MLT during the post-solstice period. Six distinct QTDW events between 2003 and 2011 are identified in the MLT using SABER (Sounding of the Atmosphere using Broadband Emission Radiometry) temperature observations. Concurrent changes to the background zonal winds, zonal mean column O/N2 density ratio, and ionospheric total electron content (TEC) are examined using datasets from TIDI (TIMED Doppler Interferometer), GUVI (Global Ultraviolet Imager), and GIMs (Global Ionospheric Maps), respectively. We find that in the 5 - 10 days following a QTDW event, the background zonal winds in the MLT show patterns of eastward and westward anomalies in the low and mid-latitudes consistent with past modeling studies on QTDW-induced mean wind forcing, both below and at turbopause altitudes. This is accompanied by potentially related decreases in zonal mean thermospheric column O/N2, as well as to low latitude TECs. The recurrent nature of the above changes during the six QTDW events examined point to an avenue for vertical coupling via background dynamics and chemistry of the thermosphere / ionosphere not previously observed.

Keywords: quasi-two day wave, ionosphere, thermosphere, mesosphere, composition, dynamics

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PEM06-19 Room:A01 Time:May 27 14:45-15:00

# Simultaneous observation of planetary waves in the mesosphere and ionosphere

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How variations of the neutral atmosphere, in particular planetary wave activity in the mesosphere-lower thermosphere (MLT), drive variations in the ionosphere has been the subject of recent attention. A method has been developed to observe planetary wave activity in the northern hemisphere (50-66 $^{o}$ N) MLT using neutral atmosphere winds derived from meteor trail drifts observed by a longitudinal chain of Super Dual Auroral Radar Network (SuperDARN) radars. The method allows for the removal of tidal effects and provides the temporal variation of the wavenumber 1 and 2 amplitudes without the spatial-temporal aliasing present in satellite observations. The method has been extended to utilize the critical plasma frequency and virtual height of the ionospheric F-layer derived from a longitudinal chain of ionosondes. Details of the method applied to both the meteor radar and ionosonde data will be presented, and the amplitudes and temporal variations of the wavenumber 1 and 2 amplitudes in both the MLT and the F region will be compared.

Keywords: Planetary wave, Mesosphere, Lower Thermosphere, Ionosphere

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PEM06-20 Room:A01 Time:May 27 15:00-15:15

# Ground-based mesopause temperatures at high-latitude over Yakutia:Comparison with SABER measurements

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Ground-based mesopause temperature at high-latitude over Yakutia: Comparison with SABER measurements

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Rotational temperatures obtained from the O2 Atmospheric (0?1) nightglow band, with an infrared spectrograph at the Maimaga station (63 N, 129.5 E) for the period September 2002 to March 2013 are presented. Time series includes the years of maximum and minimum solar activity. The set of spectrograph data has been used to analyze the seasonal behaviour of the mesopause temperatures. Atmospheric temperatures deduced from infrared spectrograph and from satellite observations with the Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) instrument on board the TIMED satellite, have also been compared.

The temperatures measured during the satellite passes at distances not larger than 300 km from the intersection of the spectrograph sighting line with the oxygen emitting layer (˜94 km) have been compared. A seasonal dependence is observed regarding the difference between the ground based and satellite measurements. However, the time variations in the temperature obtained with the ground based device and on the satellite are similar. Based on the performed analysis, it has been concluded that a series of oxygen rotational temperatures can be used to study temperature variations on different time scales, including long-term trends at the temperature emission altitude (˜94 km).

Keywords: mesopause temperature, O2 airglow, SABER measurements

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PEM06-21 Room:A01 Time:May 27 15:15-15:30

# All-sky measurements of short period waves nightglow emissions

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Will present the results of statistical analysis of the parameters of internal gravity waves registered on the variations of emission hydroxyl molecule. Wave patterns registered infrared all-sky camera installed on the optical station Maimaga (Yakutia). Analyzed data received during the winter period 2008-2013. 118 waves were registered, most of which propagated in a westerly direction. For the wave length range from 15 - 70 km (average value is - 29km) observed horizontal phase velocity varies from 17 to 140.8 m / s (average is -57m / s) and the estimated periods are within 7-40 min (the average is - 9min). Statistical characteristics of the waves do not differ from the results of the registration of such waves at middle and low latitudes. The azimuthal distribution of the direction of wave propagation is consistent with the theory of filtering background wind waves in the middle atmosphere. Probable sources of waves are assumed to mountain ranges, located 200 km to the east of the place of observation. There are a few large values of the average wavelength and wave propagation velocity than those registered at lower latitudes. Apparently, this is due to lower energy loss and wave velocity in passing from the source to the mesosphere, although not excluded for other reasons.

It is planned to identify all-sky measurements of short period waves in the green emission recording OI (557,7 nm) in the visible wavelength of the spectrum (the height of the airglow ˜96 km). Will present the results of observations at two different heights (˜87 and 97 km).

Keywords: internal gravity waves, mesosphere, hydroxyl

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PEM06-22 Room:A01 Time:May 27 15:30-15:45

# Thermospheric neutral wind profile in daytime and moonlit midnight by Lithium release experiments

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Neutral wind profiles were observed in lower thermosphere at about between 90 km and 130 km altitude by using resonance scattering light of sunlit and moonlit Lithium (Li) vapor released from sounding rockets in daytime and midnight (almost full moon condition) in 2013. As a target of the Daytime Dynamo campaign, Li release experiment was operated at Wallops Flight Facility (WFF) of NASA, U.S.A. in July, 2013, while the same kind of experiment in midnight was carried out in Uchinoura Space Center (USC) of JAXA, Japan also in July 2013. Since imaging signal-to-noise (S/N) condition of the both experiments was so severe, we conducted to apply airborne observation for Li tracers imaging so as to reduce the illuminating intensity of background skies as an order of magnitude.

Two independent methods for calculating the wind profile were applied to the image sequences obtained by the airborne imaging by special Li imagers aboard the airplanes in order to derive precise information of Li tracers motion under the condition of single observation site moving along the aircraft path in the lower stratosphere. Slight feedback motion of the aircraft 3-axes attitude changes (rolling, yawing and pitching) was considered for obtaining precise coordinates on each snapshot. Another approach is giving a simple mathematic function for wind profile to resolve the shape displacement of the imaged Li tracers. As a result, a wind profile in daytime thermosphere was calculated in a range between 20 and 95 m/s with some fluctuated parts possibly disturbed by wind shears. In this paper, we will introduce the method of wind profile calculation and final result of the profiles.

Keywords: Thermosphere, Neutral wind profile, Lithium release, Airborne observation, Method, Sounding rocket

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PEM06-23 Room:A01 Time:May 27 15:45-16:00

# Atmospheric dynamics InfraStructure in Europe: The ARISE project

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There is currently a lack of observations, data and model parameters, which are needed in weather and climate models. ARISE is an EU-funded infrastructure project (FP7 2012-2014 and H2020 2015-2018) with a long-term objective to fill this gap and solve persistent problems facing the applications which depend on atmospheric dynamics. The atmosphere is a dynamic medium being continuously disturbed by winds and atmospheric waves over a broad range of time and spatial scales. Disturbances include large-scale waves such as gravity and planetary waves which transfer energy and momentum from one region of the atmosphere to another. Atmospheric extreme events such as volcanoes, stratospheric warming events, magnetic storms, tornadoes and tropical thunderstorms also constitute significant disturbances to atmospheric dynamics.

The ARISE project aims at establishing a unique atmospheric research and data platform in Europe and outlying regions, including the polar and equatorial regions. It will combine observations with theoretical and modelling studies to elucidate the dynamics of the middle and upper atmosphere. For the first time, several technologies (infrasound, lidar, airglow, radars, ionospheric observations and satellites) will be used simultaneously and in a complementary way. The measurements will be used to improve the parameterization of gravity waves in the stratosphere to better resolve climate models. Such description is crucial to estimate the impact of stratospheric climate forcing on the troposphere. The collected data are required to improve weather forecasting to monthly or seasonal scales, remote volcano monitoring, climate monitoring and other applications. The ARISE data portal aims to provide high-quality, easy-to-use data and advanced data products to a wide scientific community.

Keywords: atmospheric dynamics, infrasound, gravity waves, planetary waves, weather forecasting, climate monitoring