Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM032-P01 Room:Convention Hall Time:May 27 10:30-13:00

Stagnation of a polar cap patch and decay of the accompanying plasma irregularities

Keisuke Hosokawa[1*], Kazuo Shiokawa[2], Yuichi Otsuka[2]

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We report an event in which a polar cap patch, as detected by an all-sky imager (ASI) at Resolute Bay, Canada, stopped its anti-sunward motion and wandered around within the field-of-view of the ASI for more than 1 h. During the wandering motion of the patch, a significant reduction of the cross-polar cap plasma convection was observed by the SuperDARN radars. 10-15 min before the stop of the patch, the IMF observed by the Geotail spacecraft showed a clear northward turning. Such a change in the IMF orientation could lead to the halt of the cross-polar cap convection and resultant stagnation of the patch.

When the patch stagnated, its luminosity decreased gradually, which allows us to investigate how the patch plasma decayed in a quantitative manner. The decay of the patch can be quantitatively explained by the loss through recombinations of O+ with ambient N2 and O2 molecules, if we assume the altitude of the optical patch to be around 295 km. The derived altitude of the patch around 295 km is much higher than the nominal value at 235 km obtained from the MSIS-E90/IRI2007 models. This is probably because the loss process was much faster in the lower-altitude part of the patch; thus, the peak altitude of the patch increased as it traveled across the polar cap due to rapid recombination at the bottomside of the F region.

During the interval of interest, one of the SuperDARN radars at Rankin Inlet, Canada observed a cluster of field-aligned irregularities (FAIs) in the region of enhanced 630.0 nm airglow associated with the patch. These patch-associated FAIs promptly decayed following the weakening of the optical patch, which was obviously due to a convolution effect of the decrease in the patch-associated density gradient and the reduction in the background convection caused by the northward turning of the IMF. However, the decay of the FAIs was much quicker than that of the optical patch. This suggests that the abrupt reduction of the convection probably played a more important role than the gradual decrease of the patch-associated density gradient in causing the prompt decay of the patch-associated FAIs. This indicates that the strength of the background electric field is very crucial in maintaining small-scale density structures in the polar cap.

Keywords: Polar Cap Patches, Polar Cap Ionosphere, Plasma Convection

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Observations of nighttime medium-scale travelling ionospheric disturbances by 630-nm airglow imagers near auroral zone

Kazuo Shiokawa[1*], Masato Mori[1], Shin-ichiro Oyama[1], Yuichi Otsuka[1], Satonori Nozawa[1], Martin Connors[2]

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We study nighttime medium-scale travelling ionospheric disturbances (MSTIDs) observed in the 630-nm airglow imagers at Tromso (69.6N, 19.2E; magnetic latitude: 67.1N), Norway and at Athabasca (54.7N, 246.7E; magnetic latitude: 61.7N), Canada. This is the first study of high-latitude MSTIDs by all-sky imagers in the European and Canadian longitudinal sectors. For Tromso we analyzed airglow images for two winters from 9 January to 2 March 2009 and from 9 October 2009 to 3 March 2010. For Athabasca, we analyzed 2-year data from September 2005 to August 2007. At both stations, the MSTIDs were observed before the midnight with the occurrence rate of more than ˜30 %. The average wavelengths, phase velocities, and periods of the observed MSTIDs were 100-400 km, 50-150m/s, and 30-60 min, respectively. We found that MSTIDs at Tromso tend to show eastward motion in addition to the typical southwestward motion. At Athabasca, we recognized a tendency that southwestward-moving MSTIDs occur frequently in winter. In summer, however we found characteristic northward-moving MSTIDs at Athabasca. At both stations, some MSTIDs showed characteristic change of their directions of propagation and wave front in association with auroral activity. We report an example of sudden motion of MSTIDs at substorm onset observed at 1730 UT on December 8, 2009 at Tromso. On the basis of these results, we discuss possible cause of generation and motion of high-latitude nighttime MSTIDs.

Keywords: medium-scale traveling ionospheric disturbance, airglow, auroral zone, ionosphere, thermosphere, substorm

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An observation plan of ionospheric scintillations by use of GPS signals received in Syowa Station, Antarctica

Hideaki Kitauchi[1*], Minoru Kubota[1], Takuya Tsugawa[1], Hiromitsu Ishibashi[1], Tsutomu Nagatsuma[1], Ken T. Murata[1]

[1]NICT

We begin observation of ionospheric scintillations, by the use of GPS (Global Positioning System) signals, in Syowa Station [69.00'19"S,39.34'52"E], East Ongle Island, Antarctica. In the 52nd Japanese Antarctic Research Expedition started from November 2010, two GPS receivers–one at the Ionospheric Observatory (site name SYO1) and the other the Administration Building (SYO2)–have been implemented (Fig. 1).

Part of the realtime data, not yet calibrated well, is available on the following web site:
http://wdc.nict.go.jp/IONO2/ANTARCTIC/SYOGS/SYO1/TEC/
http://wdc.nict.go.jp/IONO2/ANTARCTIC/SYOGS/SYO2/TEC/

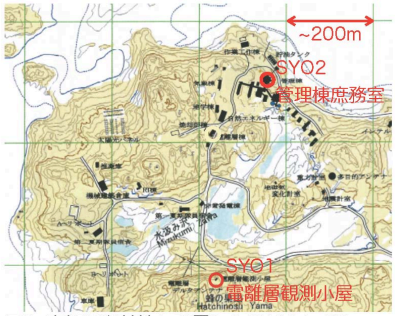

図1. 南極昭和基地に設置したGPSシンチレーション観測システム配置図

Keywords: Syowa Station, Antarctica, ionospheric scintillations, GPS signals, observation plan

Japan Geoscience Union Meeting 2011
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PEM032-P04 Room:Convention Hall Time:May 27 10:30-13:00

Automated estimation of electron density profile in the lower ionosphere by the radio wave propagation characteristics

Toru Sasaki[1*], Taketoshi Miyake[1], Keigo Ishisaka[1], Toshimi Okada[1]

[1]Toyama Prefectural University

SRP-5 sounding rocket was launched from Poker Flat Research Range, Fairbanks, Alaska at 14:17 LT on January 10, 2009. The primary science objective of SRP-5 Project is to measure the plasma density profile of the polar D region ionosphere above Poker Flat Research Range, which was carried out with using a plasma probe, radio receivers, and other sensors. The objective of TPU (Toyama Prefectural University) radio receiver is to investigate the electron density profile in the polar D region at daytime. The electron density profile in the lower ionospheric region is estimated from the absorption of three radio waves observed by SRP-5 sounding rocket.

We observed three different radio waves, CHENA (257 kHz), KFAR (660 kHz) and KCBF (820kHz), transmitted from navigation and broadcast stations near Fairbanks, Alaska. They were successfully observed from the altitude 0 to 98 km during the ascent flight. The receiver observed magnetic field intensities and waveforms down converted to about 100 Hz. During the rocket ascent, up to about 150 seconds, the intensities of these radio waves attenuate gradually with increasing time, until they reach the system noise level of the receiver at about 110 seconds. These attenuations are due to collisions between the electrons and the neutral molecules in the lower ionosphere. On the other hand, the spectra of three radio waves are obtained by FFT (Fast Fourier Transform) from the waveforms. These spectra branch into two after launch, since the frequencies of the polarized waves are affected by the rocket spin.

The approximate electron density profile can be estimated from the comparison between these observation results and propagation characteristics calculated with Full wave method. The estimated electron density profile suddenly increase then decrease at the altitudes between about 80 and 90 km. The magnetic intensity, calculated with Full wave method from this electron density profile, are almost the same as the experimental results. In addition, we are going to distinguish the right- and left-hand polarized waves from the spectra of observed three radio waves, and estimate more detailed electron density profile in the lower ionosphere below 65 km.

This estimation process has some problems. At first, we have no clear standard for comparing observation results and propagation characteristics calculated with Full wave method. In addition, we have to iterate many times correcting the electron density profile by handwork, calculating propagation characteristics with Full wave method and comparing observation results and calculated propagation characteristics. This iteration takes too long to estimate appropriate electron density profile. To reduce these problems, we are going to develop a application to realize automated estimation of electron density profile by the radio wave propagation characteristics analysis.

Keywords: radio wave propagation characteristic, electron density profile, ionosphere, sounding rocket measurement

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PEM032-P05 Room:Convention Hall Time:May 27 10:30-13:00

The Ionospheric Nighttime Electron Density Enhancement by 3D Tomography Method around European Region

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[1]Kyoto University, Japan, [2]National Cheng Kung University, Taiwan, [3]National Central University, Taiwan

The nighttime electron density enhancement of the Earth's ionosphere is characterized by the greater electron density in the nighttime than that in the daytime. Recently, this anomaly feature has intensely been studied by using satellite observations and model simulations. Results show that there are three obvious nighttime electron density enhancement regions around South American, European, and Northeast Asian. The 3D tomography method, employs GPS data observed by an network of dual-frequency GPS receivers, is used in this study to study the three-dimensional structure of the nighttime electron density enhancement around European region, where covers a lot of GPS receivers. Furthermore, we compare with the tomography results and the SAMI2 (Sami2 is Another Model of the Ionosphere) model simulation results. The results will be shown in the poster.

Keywords: 3D tomography, nighttime electron density enhancement, GPS-TEC

Japan Geoscience Union Meeting 2011
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PEM032-P06 Room:Convention Hall Time:May 27 10:30-13:00

Observations of total electron content variations using GPS networks in Europe

Yuichi Otsuka[1*], Shinta Nakagawa[1], Kazuo Shiokawa[1], Takuya Tsugawa[2]

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Using GPS receiver networks in Europe, we have disclosed two-dimensional structure of Total Electron Content (TEC) over Europe and detected ionospheric troughs and Medium-Scale Traveling Ionospheric Disturbances (MSTIDs) on the TEC perturbation maps. In this study, the perturbation component of TEC is obtained by subtracting 1-hour running average from a time series of TEC along the GPS satellite and receiver. From statistical study of the GPS-TEC maps in 2008, we found that the ionospheric troughs were observed frequently between sunset and midnight on equinoxes. This result is consistent with previous studies. We also find that the observed MSTIDs can be categorized into two types. One type is daytime MSTIDs, which frequently occur in winter. Since most of the daytime MSTIDs propagate southeastward, we speculate that the daytime MSTIDs could be caused by atmospheric gravity waves in the thermosphere. Second type is nighttime MSTIDs, which also frequently occur in winter. Nighttime MSTIDs propagate southwestward. This propagation direction is consistent with the idea that polarization electric fields could play an important role in generating nighttime MSTIDs.

Keywords: GPS, TEC, ionosphere, ionospheric trough, TID

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Study of mid-latitude ionosphere convection during super quiet period with the SuperDARN Hokkaido radar

Yun Zou[1*], Nozomu Nishitani[1]

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Characteristics of the ionospheric convection in the mid-latitude and subauroral regions have been studied by various kinds of observation instrument and computer experiments in the last few decades. A presence of westward flow around midnight at mid-latitude has been extensively discussed. This kind of flow can be generated by so-called disturbance dynamo mechanisms working at mid-latitudes (Blanc et al., JGR, 1980). We tested the disturbance dynamo theory by using ionospheric echo data obtained by the SuperDARN Hokkaido radar for 4 years. The SuperDARN Hokkaido radar has been measuring line-of-sight velocities of ionospheric irregularities, which can be regarded as line-of-sight velocities of ionospheric convection. The radar can monitor ionospheric convection at mid-latitude (geomagnetic latitude: 40 to 60 degrees), which could not be monitored by using preexisting SuperDARN radars. In the previous study we found the presence of westward flows around midnight at about 40 to 55 degrees geomagnetic latitude, which intensified with increasing geomagnetic activity. On the other hand, Gonzales et al. (1978, JGR) showed that the ionospheric convection flow just before midnight becomes eastward when the geomagnetic activity level is very quiet (1-day sum of Kp index less than or equal to 14) using the Millstone Hill radar data. This tendency was not found from our previous study using SuperDARN Hokkaido radar.

Kumar et al. (2010, JGR) reported using the data from Digisonde drift measurements made at Bundoora (145.1 degrees E, 37.7 degrees S geographic, 49 degrees S magnetic), Australia, that the effects of major storms (minimum Dst $<$ -60nT) in the nighttime mid-latitude ionosphere were observed to last up to 50 hrs after storm onset. In order to understand the effects of the disturbance dynamo on the mid-latitude nighttime ionosphere, we reanalyzed the SuperDARN Hokkaido radar data using only the data under very quiet geomagnetic condition for preceding 48 hours. However, the tendency reported by Gonzalez et al. (1978) was not found even when geomagnetism index Kp was less than or equal to 0+ and the influence from previous geomagnetic storms has been removed. More detailed analysis result will be presented.

We are studding the of the character of mid-latitude ionosphere convection observed by radar that influenced by the Dst index defined storm, using Superposed Epoch Anaysis (SEA). A more detailed analytical result is scheduled to be reported in the lecture.

Keywords: SuperDARN, SuperDARN Hokkaido radar, mid-latitude ionosphere, disturbance dynamo, westward flow, Geomagnetic kp Indices

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PEM032-P08 Room:Convention Hall Time:May 27 10:30-13:00

Variation of Ne and Ni observed by DEMETER during 2009 total solar eclipse

Kaori Mochizuki[1*], Masashi Kamogawa[1], Yoshihiro Kakinami[2], Wang Xiaoni[3], Jean-Jacques Berthelier[3], Tatsuo Onishi[3]

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We investigate topside ionospheric dynamics of 2009 total solar eclipse in East Asia by using Ne/Te and Ni/Ti data of French satellite DEMETER, of which altitude is around 660 km. On July 22, 2009, one of DEMETER orbits crossed eclipse zone, and the distance closest to the total eclipse area was approximately 200km. Just after the total solar eclipse, Te decreased while Ne did not change. Before the maximum obscuration, Ne decreased and Te increased because production rate of plasma decreased under the F-region. Since strong fountain effect appeared up to +30 degree in latitude, the satellite measured the enhancement of Ne, while Te further decreased due to the eclipse. This feature differs from another eclipse case [Wang et al., JGR, 2010]. In the presentation, we discuss quantitatively ionospheric dynamics during the total solar eclipse.

Keywords: Total solar eclipse, Ion density, Electron density, Gravity wave

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Estimation of spatial structure of sporadic E layer with 2-dimensional FDTD simulations

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[1]Toyama Prefectural University

We developed a 2-dimensional FDTD simulation code which can treat wave propagations in magnetized plasma. FDTD simulations can be performed with much less computer resources than those necessary for full particle simulations, in memories as well as cpu times. In this study, we performed FDTD simulations with different types of electron density profiles in the lower ionophere, uniform ionospheric layer model and oval shape electron cloud model, and then confirmed characteristics of MF wave propagations in the lower ionosphere. We especially study on effects of wave frequecies. According to sounding rocket experiments, we can only obtain altitude profile of wave intensity, especially magnetic field intensity. In this study, therefore, we are going to try to estimate spatial structure in the lower ionosphere by analyzing altitude profile of magnetic field intensities of waves with various frequecies.

Simulation results indicate that spatial structure in the lower ionosphere can be estimated by analyzing altitude profiles of different waves emitted from different wave sources with various frequencies. Effects of spatial structure in the lower ionosphere are shown especially on propagation characteristics of MF waves above the altitude of the spatial structure itself.

Keywords: Sporadic E layer, FDTD simulation, ionosphere, electron density profile, plasma wave propagation

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Study on the estimation of the electron density profile in the lower ionosphere with time domain Full wave analysis

Takahiro Futatsuya[1], Taketoshi Miyake[1*], Keigo Ishisaka[1], Yasuhiro Murayama[2], Seiji Kawamura[2]

[1]Toyama Prefectural University, [2]NICT

MF radar estimates the electron density pro?le in the lower ionospheric D and E regions at the altitude from 60km to 100km by using the partial re?ection information of MF radar transmission wave. Electrons of lower ionosphere are closely related to neutral dynamic meteorology and chemistry including such as hydrated ion and NOx in this region, therefore, it has a possibility to ?nd a new physical knowledge in the mesosphere and lower ionosphere. However, it is dif?cult to observe precise electron density pro?le in the lower ionosphere continuously with the present MF radar system.

In this study, we are going to simulate the observation process of the present MF radar system with using time domain Full wave method, and investigate the observation method to observe the precise electron density pro?le in the lower ionosphere. One of the methods to estimate the electron density profile by the present MF radar system is DAE. DAE is a technique to estimate the electron density pro?le from the differential amount between the left and the right polarized waves re?ected by the lower ionosphere. We have simulated the ovservation process of MF radar and examined the problem and improvement points with time domain Full wave analysis. We found some parameters used in DAE method are not appropriate. We can estimate more accurate electron density profile by using appropriate parameters in DAE method.

Keywords: electron density in the lower ionosphere, Full wave analysis, MF radar, DAE method

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Solar cycle variations of the tweek reflection height

Hiroyo Ohya[1*], Kazuo Shiokawa[2], Yoshizumi Miyoshi[2]

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The purpose of this study is to reveal solar-cycle variations of the tweek reflection height. Tweek atmospherics are reflected at a height where the equivalent electron densities are 20 - 30 cm^{-3}. Descent (rise) of the reflection height corresponds to increase (decrease) in electron density in the ionospheric D- and lower E-regions. It is known that electron density in the sub-ionosphere depends on solar activities, although nighttime lower ionosphere has not been sufficiently investigated yet. An advantage of using tweeks is to be able to monitor variations of electron density less than 10^2 cm^{-3} along long propagation paths (several thousands of kilometers). From cut-off frequency of the first order mode on dynamic spectrum, we can estimate the reflection height. We use tweek data obtained at Kagoshima (31.5N, 130.7E), Japan, on magnetically quiet days in 1976-2010; solar cycles 21,22, 23, and the rising phase of solar cycle 24. The average and standard deviation of the reflection height were 95.9 km and +/-3.1 km, respectively. The years when the tweek reflection height was lower than 93.0 km were 1976 (solar minimum), 1979 (solar maximum), 1985 (solar minimum), 1995-1997 (solar minimum), and 2002 (solar maximum). On the other hand, the years when the tweek reflection height was higher than 99.0 km were 1977-1978 (rising phase), 1987-1991 (rising phase to solar maximum), and 2006-2009 (solar minimum). The significant peaks of the periodgram were seen to be 13.3, 3.2, and 1.3 years. We have considered possible causes of this long-term variation of the reflection height: geocorona emission, galactic cosmic ray (GCR), particle precipitation from the inner radiation belt, and the neutral atmosphere. In the presentation, we discuss possible causes of this long-term variation of the reflection height.

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The dependence of latitude of period of small magnetic variation in the middle and lower latitude over the ionosphere fr

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As the result of the analysis of magnetic field observed by Oersted satellite to measure the Earth's magnetic field accurately at the low altitude(600 km - 900 km) from 1999 to 2002, the existence for nearly all the time of magnetic variation with period shorter than 30 seconds has been reported. We can, as to variation in the region between the middle and lower latitude, see the phenomenon a lot that the period becomes longer with the decrease of latitude. This phenomenon is also shown by magnetic field observed by CHAMP satellite to measure the Earth's magnetic field accurately at the low altitude(300 km - 450 km) from 2000. The calculation of power spectra with respect to period of this variation using the Maximum Entropy Method shows the above characteristic property. This property is reverse to that of geomagnetic pulsation that the period of it, in general, becomes shorter with the decrease of latitude, that is, this can be thought to be beyond description of the magnetic variation. It may, with the assumption that this phenomenon is of Nature, be attributed to the effect of the lower atmosphere. It follows from this theory that the wave arising in the lower atmosphere propagates to the upper to cause dynamo in the ionosphere, accompanied by the magnetic variation that is observed by both the satellites. Following this mechanism, the supposition that the spatial scale in the ionosphere is homogeneous, or, is dependent of the latitude will, because of the increase of the interval of latitude between lines of magnetic force with the increase of latitude, lead to the fact that the spatial scale should become bigger in the upper layer of the ionosphere where the satellite flied, that is, the period should become longer. This time we will, in comparison with Oersted data and CHAMP data, report the result of whether or not the above model is valid, with the dependence of the period of the observational small magnetic variation with respect to the region, the local time, the season respectively.

Keywords: ionosphere, small magnetic variation, CHAMP satellite, Oersted satellite

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Atmosphere-Ionosphere Coupling Studied with a High-Resolution Electrodynamics Model

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

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

Ionospheric electrodynamics plays an important role not only in causing storm-time ionospheric disturbances but in causing day-to-day ionospheric density variation and irregularity. The latter phenomena are known to be related to thermospheric variations, some of which originate from the lower atmosphere. For example, the day-to-day variation of equatorial ionization anomaly (EIA), which affects ionospheric density at low-to-mid latitudes, is driven by low-latitude electric field generated from atmospheric waves via dynamo process. Recently observed 4-wave structure of EIA suggests that some of the variations are of tropospheric origin. The occurrence of equatorial plasma bubble also varies on the day-to-day basis.

We are developing an atmosphere-ionosphere coupled model, which is expected to contribute to the understanding of lower atmospheric effects on the ionospheric day-to-day variation and irregularity. In this presentation, we report some recent upgrades of the electrodynamics model as a component of the atmosphere-ionosphere coupled model.

Keywords: ionosphere, thermosphere, lower atmosphere, electrodynamics, geomagnetic variation, simulation

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Correlation of electron temperature with electron density in the low latitude topside ionosphere

Kenta Hayashi[1*], Shigeto Watanabe[1], Yoshihiro Kakinami[2]

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The correlation between electron temperature (Te) and electron density (Ne) in the low latitude topside ionosphere is investigated from the comparison of the satellite observations and the modeling. The observations show that the negative or the positive correlations between Te and Ne occur in the low latitude topside ionosphere during the daytime. The phenomena are associated with the equatorial ionization anomaly (EIA). To understand the generation process of the electron temperature and density distributions, we compared the observations with the physical modeling and an empirical model such as the International Reference Ionosphere (IRI).

Keywords: Demeter satellite, ionosphere, electron density, electron temperature

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3D MHD simulations of electromagnetic variations in the ionosphere caused by waves from the lower atmospere

Mitsuru Matsumura[1*], Hiroyuki Shinagawa[2], Toshihiko Iyemori[1]

[1]Kyoto University, [2]NICT

It has been shown from a lot of observation that acoustic and internal gravity waves generated in the lower atmosphere can propagate to the ionosphere [e.g., Davies and Jones, 1971; Heki et al., 2006, Otsuka etal., 2006, Choosakul et al., 2009]. A geomagnetic pulsation was observed at Phimai in Thailand, shortly after the origin time of the Sumatra earthquake on December 26, 2004[Iyemori et al., 2005]. The localized nature and the period of oscillations suggest that the magnetic pulsation was generated by dynamo action in the lower ionosphere, set up by an acoustic wave generated by the earthquake. However, geomagnetic pulsations caused by atmospheric waves excited in the lower atmosphere have hardly ever been observed. Accordingly, the objective of this paper is to estimate the physical mechanism of this phenomenon.

Shinagawa et al. [2007] performed a numerical simulation by using a two dimensional atmosphere-ionosphere model, in which atmosphere is non-hydrostatic and compressible, and ionosphere is single-fluid of O+. Results of the simulation agreed with observational results of ionospheric disturbances caused by atmospheric waves generated by a large earthquake. The numerical model used in this simulation does not include the electromagnetic variations. In this work a MHD model is developed which use the plasma velocity calculated with a three dimensional expanded from the model of Shinagawa et al., 2007. Temporal variations of the magnetic field is considered to investigate whether the geomagnetic pulsations caused by atmospheric waves from the lower atmosphere are due to hydromagnetic waves or not.

In this paper, initial results obtained with this model will be reported.

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Study on latitudinal profile of TEC and its relationship with plasma irregularity occurrence over Southeast Asia

Michi Nishioka[1*], Yuichi Otsuka[1], Kazuo Shiokawa[1], Takuya Tsugawa[2], Patrick. A. Roddy[3]

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Latitudinal profile of Total Electron Content (TEC) was investigated with ground-based GPS receiver network Southeast Asia. Development of Equatorial Ionization Anomaly (EIA) was compared with occurrence characteristics of plasma irregularity, which is observed with C/NOFS satellite. EIA, which appears around 10-15 geomagnetic latitude as the high plasma density area, is generated through the plasma fountain effect in the ionosphere caused by eastward electric field around the dip equator and diffusion of plasma along the geomagnetic field line. Since the eastward electric field is related to formation of plasma irregularity, plasma irregularity often appears when EIA is well-developed. During solar minimum period, many plasma irregularities have been observed around midnight in June solstice seasons. The occurrence characteristics of the plasma irregularity is different from that of plasma bubble. It has not been understood whether the midnight irregularity is related to plasma bubble or Traveling Ionospheric Disturbance (TID). In this study, we investigated relationship between EIA development and occurrence of the plasma irregularities. In Southeast Asia, several ground-based GPS receivers were operated by several institutes, such as Solar-Terrestrial Environment Laboratory (STEL), National Institute of Information and Communications Technology (NICT), and International GNSS Service (IGS). In order to clarify the latitudinal profile of Total Electron Content (TEC), data of ground-based GPS receivers around 100E meridian was used in this study; KUNM (IGS: 103E, 24N), CMU (NICT: 99E, 18N), CUSV (IGS: 101E, 13N), KMI (NICT: 101E, 13N), CPN(NICT: 99E, 10N), SAMP (IGS: 99E, 3N), NTUS (IGS: 104E, 1N), KTB2 (STEL: 100E, 0N), XMIS (IGS: 106E, 10S), COCO (IGS: 97E, 12S). It was found that EIA was more developed during equinoxes than during solstice seasons. Relationship between EIA development and plasma irregularity occurrence was studied for two sets of three consecutive days; 26-28 February and 4-6 June, 2010. For detection of the plasma irregularities, data of a Planar Langmuir Probe (PLP) on a low-inclination satellite, the C/NOFS satellite, was used. Plasma bubble was observed on 27 Feb while it was not observed on 26 and 28 Feb. Midnight irregularity was observed on 4 and 6 June while it was not observed on 5 June. EIA was more developed on 27 Feb. when plasma bubble was observed than on 26 and 28 Feb. when plasma bubble was not observed by the C/NOFS satellite. On the other hand, EIA was less developed on 4 and 6 June 2010 when midnight irregularity was observed than on 5 June when the midnight irregularity was not observed. It suggests the relationship between EIA and plasma irregularity occurrence was different between plasma bubble and midnight irregularity.

Keywords: Total Electron Content, latitudinal profile, Equatorial Ionization Anomaly, ionospheric irregularity, plasma bubble

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Comparison between B0 retrieved from FORMOSAT-3 measurements and ground-based observations at equator

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This study presents the results of a comparison of three ionospheric profile parameters, B0, NmF2, and hmF2, derived from measured ionograms and the FORMOSAT-3 radio occultation measurements collected over Jicamarca during the low-solar-activity period from May 2006 to April 2008. The results show that the B0 values are generally in good agreement with those derived from the true electron density profiles. In addition, correlation analysis revealed seasonal and diurnal variation in B0, which is more pronounced during an equinox and daytime (0800-2000), respectively. A comprehensive discussion on the difference between the values of B0, NmF2, and hmF2 derived from two sources is provided in this paper.

Keywords: B0, COSMIC, Ionospheric dynamics

Japan Geoscience Union Meeting 2011
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PEM032-P18 Room:Convention Hall Time:May 27 10:30-13:00

Amplitude of ionospheric disturbance heights estimated by scintillations of geostationary satellite signals

Hiroaki Taniyama[1*], Ichiro Tomizawa[1], Satomi Kudo[1]

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Amplitude scintillations of ionospheric disturbances have been observed at Sugadaira Space Radio Observatory,UEC by using the 1.5GHz band signal of ETS-VIII(146‘E) and MTSAT-2(145‘E). The amplitude scintillation were observed at three separate points to obtain the horizontal velocity of the scintillation pattern on the ground by time lag of waveforms. We independently estimate the heights of of ionospheric irregularities in the following two methods to check the consistency of these estimated heights.

(1)Two satellite method: The irregular heights (h) deduced from time lag (dt) and velocity of irregular structure v. Time lags between two signals by assuming the irregularities moving across the propagation paths. The height h can be calculated by the following equation: d = v ∗ dt , z = (d / sin a) , h = z ∗ sin(El).

(2)Spectral analysis method: As the scintillation spectrum shows the Fresnel filtering characteristics, we can deduce frequency f_n at the n-th minimum value in vibrating part, Fresnel frequency and f_F by the distance z from the observation point to irregular structure, and the velocity v. So the distance z can be estimated as v. f_F{F} = v / sqrt{pi ∗ lambda ∗z} , f_f = f_n / sqrt{n ∗ pi} .

The amplitude scintillation event occurred from 0:00 to 3:00 JST on May 30, 2010 is analyzed by using the horizontal velocity 50 ˜ 250 m/s and direction of 310‘ on the ground obtained by three points observation. The estimated heights from 2:00 to 3:00 of the two methods showed the similar height variation during this period. Therefore, it is concluded that the two height estimation methods can give the actual height distribution of ionospheric irregularities.

Acknowledgment :
The ETS-VIII observations was performed under the JAXA utilization project.

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Keywords: Ionosphere

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM032-P19 Room:Convention Hall Time:May 27 10:30-13:00

CONTINUAL 24-HOUR OBSERVATIONS OF THERMOSPHERIC WINDS MADE WITH THE SOFDI INSTRUMENT FROM HUANCAYO, PERU

Andrew Gerrard[1], John W. Meriwether[2], Kunihiro Keika[1*]

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The Second generation Optimized Fabry-Perot Doppler Imager (SOFDI), a state-of-the-art triple-etalon Fabry-Perot interferometer, has been sucessfully relocated to Huancayo, Peru and is making continual 24-hour observations. The 630-nm data, originating from layer-integrated OI emission with centroid heights of 250 km at night and 220 km during the day, are analyzed so as to obtain measurements of horizontal winds in the thermosphere. In this paper we report the most recent results from continuous 24-hour observations of these thermospheric parameters and show that the zonal wind reversals at equatorial latitudes are very much like the recent CHAMP observations.

Keywords: thermosphere, Doppler Imager, OI emission, horizontal winds, continuous 24-hour observations, low-latitude zonal wind reversals

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM032-P20 Room:Convention Hall Time:May 27 10:30-13:00

Observations of traveling ionospheric disturbances using GPS networks in the Southeast Asia

Takuya Tsugawa[1*], Kornyanat Watthanasangmechai[2], Hiromitsu Ishibashi[1], Kato Hisao[1], Michi Nishioka[3], Yuichi Otsuka[3], Akinori Saito[4], Tsutomu Nagatsuma[1], Ken T. Murata[1]

[1]NICT, [2]KMITL, [3]STEL, Nagoya University, [4]SPEL, Kyoto University

Two-dimensional total electron content (TEC) maps have been derived from ground-based GPS receiver networks and applied to studies of various ionospheric disturbances since mid-1990s. For the purpose of monitoring and researching ionospheric disturbances which can degrade GNSS navigations and cause loss-of-lock on GNSS signals, we have developed TEC maps over Japan using the dense GPS network, GEONET. Using the GPS-TEC maps, we have revealed some severe ionospheric events such as high latitude storm-time plasma bubbles and storm enhanced density events observed over Japan. These events cause loss-of-lock of GPS signals and large GPS positioning errors. The dense GPS receiver networks would be a powerful tool for the nowcast/forecast of ionospheric disturbances.

As a part of Southeast Asia low-latitude ionospheric network (SEALION), four GPS receivers have been operated in Thailand since 2005, collaborated with KMITL, Thailand. We have found that periodic TEC fluctuations (PTF) with the periods of 15-30 minutes are often observed at these GPS stations in the spring (Apr-May) late afternoon. Based on the analysis using multiple GPS receivers in Southeast Asia, we suspect that the PTFs is a manifestation of traveling ionospheric disturbances (TIDs) which propagate at 150-200 m/s away from the equator. However, it has been difficult to reveal the spatial structures and temporal evolutions of such TIDs due to the sparse GPS receiver networks in the Southeast Asia.

We are now developing regional high-resolution TEC maps in the Southeast Asia using GPS receiver networks by installing GPS receivers and/or collecting GPS receiver data, collaborated with KMITL (Thailand), LAPAN (Indonesia), UKM (Malaysia), and HIG (Vietnam). In this presentation, we will show the preliminary results of the two-dimensional TEC observations of TIDs in the Southeast Asia. We also report the current status of future direction of ionospheric monitoring system using GPS receiver networks in the Southeast Asia.

Keywords: ionosphere, southeast asia, GPS, total electron content, ionospheric disturbances

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(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM032-P21 Room:Convention Hall Time:May 27 10:30-13:00

A Preliminary Result of the Ionospheric Observation Using FM/CW Ionosonde on Cebu Island in the Philippines

Hiromitsu Ishibashi[1*], Minoru Kubota[1], Takuya Tsugawa[1], Tsutomu Nagatsuma[1], Ken T. Murata[1], Takashi Maruyama[1]

[1]National Institute of Information and Co

Last September, we reactivated the NICT ionospheric observation at San Carlos University on Cebu Island in the Philippines. A portable FM/CW souder has been in operation. We have already conducted ionospheric observations around western Pacific equatorial region: SEALION Observation Network (SEALION: Southeast Asia Low-latitude Ionospheric Network). Along with these, Cebu ionospheric observation will function as longitudinal network of dense ionospheric observation and contribute a great deal to our understanding physical relationship between the equatorial plasma bubble and large-scale horizontal structure.

In this presentation, we will report a preliminary result after the reactivation.

Keywords: Equatorial Ionosphere, Plasma Bubble, ESF, Space Weather

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM032-P22 Room:Convention Hall Time:May 27 10:30-13:00

Long trend of Sq field and its seasonal variation

Masahiko Takeda[1*]

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The time variation of the amplitude of geomagnetic Sq field was examined for each month in a long period of more than 50 years at a few observatories. It was found that the amplitude is strongly controlled by the solar activity, and the difference between solar cycles including their fine structures reflected in the Sq amplitude. Although most of the effect of solar activity on the amplitude can be explained by the variation of the ionospheric conductivity, the seasonal variation of the amplitude in response to the solar activity cannot be simply explained by the conductivity effect,.

In the presentation, these results will be discussed with those of the spherical harmonics analysis and the ionospheric conductivity estimation.

Keywords: geomagnetism, daily variation, long trend, seasonal variation, solar activity, ionospheric conductivity

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM032-P23 Room:Convention Hall Time:May 27 10:30-13:00

A study of Sq and EEJ based on atmospheric general circulation model

Yui Aramaki[1*], Saburo Miyahara[1]

[1]Kyushu University

It is known that Sq and equatorial electrojet (EEJ) current systems exist in the E-region and they show day-to-day and seasonal variations. These current systems are mainly induced by atmospheric tidal winds.

Kawano-Sasaki and Miyahara (2008) developed a quasi-three-dimensional dynamo model that is symmetric about the equator. They studied three-dimensional structures of the dynamo currents using the September neutral winds in the middle atmosphere general circulation model at Kyushu University, and showed that variations of the neutral winds induce daily variations of Sq and EEJ.

We extend their model to include anti-symmetric components, and simulate asymmetric three-dimensional dynamo currents. Simulations are also conducted using the wind data for June and December when asymmetric components become dominant. We will mainly discuss about relationships between the day-to-day and seasonal variations of the neutral winds and the simulated current system.

Keywords: Sq, EEJ, ionosphere

Japan Geoscience Union Meeting 2011
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PEM032-P24 Room:Convention Hall Time:May 27 10:30-13:00

Visible airglow observation by VISI on ISS-IMAP: Current status of development and simulation of airglow measurement (4)

Takeshi Sakanoi[1*], Atsushi Yamazaki[2], Yusuke Akiya[3], Yuichi Otsuka[4], Takumi Abe[2], Makoto Suzuki[2], Akinori Saito[3]

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The ISS-IMAP mission is one of the Japanese Experiment Module (JEM) 2nd stage plan which will be launched in January 2012 onto the International Space Station (ISS) with HTV (Konotori). The main scientific subject of this mission is to clarify the energy and physical transfer processes in the boundary region between earth's atmosphere and space with the visible spectrometer and extra ultraviolet imagers.

We have been developing a visible imaging spectrometer instrument (VISI) on ISS-IMAP. VISI will measure three nightglow emissions; O (630 nm, altitude 250 km), OH Meinel band (730 nm, altitude 87km), and O2 (0-0) atmospheric band (762 nm, altitude 95 km) with the two field-o-views which enable us to make a stereoscopic measurement of the airglows looking forward (+45 deg.) and backward (-45 deg.) to subtract contaminations from clouds and ground structures. We designed a bright (F/0.9), wide-angle (field-of-view 90 degrees) objective lens. VISI have a two-line-slit on the first focal plane to perform the stereoscopic measurement. Each slit, i.e., field-of-view, is faced perpendicular to the orbital plane, and its width is about 550 km mapping to an altitude of 100 km. The phase velocity of airglow wave structure is also estimated from the difference between forward and backward data. We will obtain a continuous line-scanning image for all emissions line from + 51 deg to -51 deg. in geographic latitude by the successive exposure cycle with a time interval of 1 - several sec.

Over the last year, we manufactured the flight model of optical system and electronics of VISI, carried out the optical test including the adjustment of focus and alignment, intensity calibration, function check, vibration and vacuum thermal tests. We finally evaluated the accomplishment of the VISI instrument. At this moment, VISI and other instruments were installed on the Multi-mission Consolidated Equipment (MCE) to make integration tests. We present the evaluated specifications of VISI, operation plan and the current status of tests.

Keywords: ISS, airglow, thermoshpere, ionosphere, development

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM032-P25 Room:Convention Hall Time:May 27 10:30-13:00

Observation of mesospheric Ca ion by mobile resonance lidar

Makoto Abo[1*], Takuji Nakamura[2], Mitsumu Ejiri[2], Hidehiko Suzuki[2]

[1]Tokyo Metropolitan University, [2]NIPR

Many observations of metal atomic layers such as Na, Fe, K, Ca and Ca ion in the mesopause region have been conducted in many parts of the world. We have also observed several mesospheric metallic layers at Tokyo and Indonesia using resonance scattering lidars consisting of a dye laser and a Ti:Sapphire laser. Especially, in order to solve the formation mechanism of metallic sporadic layers occurred in the mesopause region, the simultaneous observations of Ca ion density, electron density, and wind are necessary. We have developed container based mobile resonance scattering lidar for observations of several mesospheric metallic atoms and an ion. We have started simultaneous observations with the resonance scattering lidar, an ionosonde, and the MU radar at Shigaraki.

Keywords: Ca ion, mesopause, lidar

Japan Geoscience Union Meeting 2011
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PEM032-P26 Room:Convention Hall Time:May 27 10:30-13:00

Automated Rayleigh lidar observation in Syowa station, Antarctica.

Hidehiko Suzuki[1*], Takuji Nakamura[1], Mitsumu Ejiri[1], Makoto Abo[2], Yoshihiro Tomikawa[1], Takuya Kawahara[3], Masaki Tsutsumi[1], Members of Syowa Lidar project in the 8th term Antarctic core research project[1]

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The dynamics of the middle and upper atmosphere is still not fully understood. In particular, a quantitative estimation of dynamical effects related to energetic particle precipitation such as aurora, disturbances propagated from lower atmosphere, and a global circulation in polar middle atmosphere are not satisfactorily conducted mainly due to the lack of observations.

A new Rayleigh lidar system which can measure a vertical profile of the atmospheric temperature between 15km and 80km is developed for the Antarctic observation. This lidar had been transported to the Syowa Station (39E, 69S) in Dec, 2010 by the 52nd Japanese Antarctic Research Expedition (JARE52) and started operation in Feb, 2011. The transmitter of the lidar system consists of a pulsed Nd:YAG laser (355nm) with 300mJ energy and 20Hz repetition frequency, which emits the beam into the vertical direction with a beam divergence of 0.5mrad. The receiver consists of an 82cm diameter telescope with three photo multiplier tubes (PMTs) which are to detect Rayleigh scattered light from low and high atmosphere at 355nm and N2 Raman emission at 387nm. Additionally, a 35cm diameter telescope is also used for reception with a PMT for N2 RAMAN emission at 355nm. By using these channels, the lidar can deduce the wide range of altitude in a temperature profile.

In addition to these PMT channels, an image-intensified CCD camera (ICCD) with a gating is also installed in the receiving system, in order to monitor the image of scattered light from a certain altitude even in a day-time and to align the laser beam to the center of the field of view of the telescope. An etalon with a transmittance width of 10pm in FWHM and a polarizer are inserted to Rayleigh channels in the day time in order to reduce background scattering from the sky. The daytime observation will be carried out not only for profiling the temperature in the stratosphere in summer, but also profiling polar mesospheric clouds (PMCs) around 80-85km which are formed in summer. The system is controlled and operated with two personal computers and manual operations are minimized. Operation will be carried out by operators in Syowa, who are not experts of lidar system. Therefore, control PC and softwares have been prepared in order to continue observation automatically, with assistance from a remote place. We present details about the lidar system and a current status of the first year observation.

Keywords: stratosphere, mesosphere, lidar, Antarctica, gravity wave, PMC

Japan Geoscience Union Meeting 2011
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PEM032-P27 Room:Convention Hall Time:May 27 10:30-13:00

Small scale disturbance in the wind field in the polar mesopause region inferred by successive images of a meteor train.

Hidehiko Suzuki[1*], Takuji Nakamura[1], Sharon L. Vadas[3], Masaki Tsutsumi[1], Makoto Taguchi[2], Yasunori Fujiwara[4]

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A fireball meteor with a visual magnitude of over -6 followed by a persistent trail was observed by two all-sky cameras for detecting the aurora and sodium airglow at Syowa Station (69.0^{o}S, 39.5^{o}E), Antarctica, on 6 June 2008. Orbit and other parameters of the fireball were estimated by an all-sky television camera for detecting the aurora. After the passage of fireball, circular train expanded to a diameter of about 50 km in 9 minutes. This omnidirectional expansion allows us to determine the height of each fraction of the meteor train. The combination of 9 sequential images of the meteor train with 1 minute interval and the meteor orbit information estimated from ATV camera has revealed existence of a large atmospheric wave with a vertical wavelength of ˜16km and an amplitude of ˜30m/s in mesopause region during the event. In addition to the expanding motion due to the wave, the meteor train also showed rapid non-uniform motion with 2˜3 minutes frequency along a background wind direction. The amplitudes of these motions are estimated as 50˜60 m/s at 87km. Since this frequency is shorter than a typical buoyancy frequency (˜5minutes), the oscillation can be an acoustic wave. However, ordinary acoustic waves which can reach mesopause region from an impulsive source such as a thunder storm in the troposphere are likely to have an amplitude of ˜10 m/s [eg. Waltersheid et al., 2003]. According to Vadas et al. [2010], the atmospheric wave generated by an impulsive source such as aurora, and meteor impact is also probable. Alternatively, this rapid motion can likely be due to a kind of non-uniformity of winds in the polar mesopause region.

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Keywords: meteor, mesopause, meteor train, gravity wave, acoustic wave, sodium airglow

Japan Geoscience Union Meeting 2011
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PEM032-P28 Room:Convention Hall Time:May 27 10:30-13:00

Measuring of short-duration meteor trains

Masayuki Toda[1*], Masa-yuki Yamamoto[2], Yoshihiro Higa[3], Jun-ichi Watanabe[4]

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Meteor trains are known as illuminating phenomena appeared along their meteor trajectories, just after appearing of meteors in Earth's atmosphere. Even by our naked-eyes, the illumination can be observed within a few seconds in the shortest, a few minutes in the longest. It can be recorded for about a few tens minutes by professional observation instruments. In order to obtain double-station meteor train images/movies with high spatial/temporal resolution, meteor train observation campaign was conducted by the authors in 1998, during an expected period of Leonids meteor storm, resulting successful archives of train images of numerous values of meteors of train images especially in 2001 .

In double-staion meteor movie data taken by image-intensified (I.I.) video cameras(Shigeno et al., 2003), many video clips of meteors with short-duration meteor trains were found. By using a motion-detection software "UFOCapture" (Sonotaco, 2009), 26 short-duration meteor trains (18 examples of Leonids as well as 8 of sporadic meteors) were picked out, deriving altitude distribution of short-duration meteor trains. As a result, (1) short-duration meteor trains averagely appeared between 120 km and 96 km altitude, (2) altitude distribution of short-duration meteor trains averagely changes in time to be finally centered at around 107 km, with having linear dependence for their upper limit altitudes as well as logarithmic dependence for lower limits, (3) duration time of short-duration meteor trains was in a range between 0.2 s to 4 s, (4) high correlation between absolute magnitudes of parent meteors and duration time of short-duration meteor trains, and (5) the altitude distribution of short-duration meteor trains could be explained with OI557.7 nm luminescence and collision (quenching) process with surrounding upper atmosphere.

Applying the analizing method of Leonids short-duration meteor trains to the other meteor showers, it is expected to obtain altitude distribution of the short-duration meteor trains and its evolution in time for several meteor showers as was studied in Leonids case (Toda et al., 2010), as well as to study comparison in altitude distribution of short-duration meteor trains. Moreover as a suggestion of observing meteor train in near future, we would like to introduce an imaging method with repetition of quick exposure (1s or shorter) with a fixed FOV by high-sensitivity digital cameras, as well as our dating results of meteors and meteor trains.

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Keywords: meteor, meteortrain

Japan Geoscience Union Meeting 2011
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Development of a calibration device for absolute reception power of HRO meteor echoes.

Tadayoshi Yamato[1*], Takashi Usui[2], Tomotaka Yamasaki[1], Masa-yuki Yamamoto[1]

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1.Background and purpose

HRO(Ham-band Radio Observation) is known as an easy meteor observation method using forward-scattering echoes of beacon waves (Maegawa, 1999). In Kochi University of Technology, a 6-channels HRO (North, South, East, West and zenith with 2 polarizations) began in July 2003. A 3-channels radio interferometer was produced and started its observation with direction-findings of meteor echoes in January 2005. (Horiuchi et al., 2005). In January 2009, a 5-channels radio interferometer was developed, resulting more precise calculations of meteor appearance position than the 3-channels radio interferometer as well as quasi-realtime web casting of meteor plasma coordinates in 90 km plane (Noguchi, 2009). However, accurate absolute values of reception power of meteor echoes can not be obtained by these observation tools. Observational data are insufficient for deriving statistical studies of energy estimation of each meteor, mass distribution, and flux. Purpose of the present research is development of absolute reception power by developing a calibration device for HRO echoes.

2.Absolute power calibration device

Reception power of each meteor echo is usually indicated in an intensity graph of the ”HROFFT” (a dedicated software for HRO) corresponding to relative power (dB value) on a noise floor. Intensity of Doppler distribution is indicated on a FFT spectrogram using relative color scale of 13 levels (0 to 12). In HRO, expectation of absolute power of each meteor echo is in a range between -80 dBm and -120 dBm (Usui, 2004). In this study, we develop a signal generator that can output simulated meteor echo signal, creating a descending step-function with 10 dB intervals in 5 seconds per 10 minutes. The developed device will be applied to receiver block of the 5-channels radio interferometer. We can analyze absolute power of each meteor echo by indicating the simulated signal by HRO_IF_View software that can display waveform of each echo.

3.Development

In this study, we produced a circuit using PLL (Phase Lock Loop) technique based on an experiment at Nobeyama observatory (NAOJ) as a reference (Usui et al., 2004). In the PLL circuit, phases are compared between a reference signal of 16 MHz from a crystal oscillator and an output signal from VCO (Voltage Controlled Oscillator). When phases of the both signals are locked by auto-tuning feedback process, the PLL circuit can output a carefully-adjusted 860 MHz signal. Then, the frequency of output signal is down-converted to 1/16 by two frequency dividers. A final output is 53.75 MHz, the observational frequency of HRO. Typical output power of the PLL circuit is about -50 dBm. Therefore, absolute power range of our purpose can be obtained by attenuation and precise calibration process of the output signal by a signal generator (Aglient, 33250A) . In this presentation, we will introduce a preliminary result and detail of the study.

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Keywords: HRO, meteor, forward-scattering, reception power, Phase locked loop, absolute calibration

Japan Geoscience Union Meeting 2011
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Monthly MU radar head echo observation programme for sporadic and shower meteors: 2009 June to 2010 December

Johan Kero[1], Csilla Szasz[1*], Takuji Nakamura[1], David D. Meisel[2], Toshio Terasawa[3], Hideaki Miyamoto[4], Yasunori Fujiwara[5], Masayoshi Ueda[5], Koji Nishimura[1]

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Meteors, or colloquially shooting stars, are caused by particles from space that are heated up and shattered in the atmosphere. Different estimates of how much mass these meteoroids bring to our planet vary by several orders of magnitude. We conducted a systematic set of monthly meteor head echo observations from 2009 June to 2010 December (>500 h), except for 2009 August, by the interferometric Shigaraki Middle and Upper atmosphere (MU) radar in Japan (34.85 degree N, 136.10 degree E). The ultimate purpose of our observation programme is to improve the estimate of the flux of extraterrestrial material into the Earth's atmosphere and to investigate the possible flux of extrasolar meteoroids entering the solar system and crossing Earth's orbit.

Using the interferometric ability of the MU radar we have developed analysis algorithms that give precise geocentric velocities and directions of the observed meteoroids - a few hundreds of metres per seconds and a fraction of a degree, respectively. About 3000 events from a total number of about ten thousand head echoes per 24 h observation have the above mentioned accuracy. The head echoes are detected in the height range of 73-127 km. A total number of more than 100 000 meteor detections allows us to map the seasonal variation of the sporadic meteor influx, as well as its characteristics in form of geocentric velocity and altitude distribution of the deposited material. The initial altitude distribution shows clear velocity dependence, higher velocity meteoroids ablating at higher altitude.

Our data set contains both shower and sporadic meteor detections. Sporadics are those meteoroids that cannot be directly ascribed to a parent body. Sporadics are the most numerous among our observed particles, and the main contributors to the mass influx into the Earth atmosphere.

Head echoes of shower meteors are quite rare in modern high-power large-aperture (HPLA) radar data, primarily because sporadics outnumber shower meteors in the low-mass regime observable with these radar systems. The small collecting area of an HPLA radar system further limits successful observation of shower meteors. Analysis performed on a limited data set may, therefore, contain no or only a few shower meteors due simply to low statistical probability. In this work, we have estimated the MU radar collection area, calculated the flux of Orionid meteors, and show that the Orionid meteoroid stream activity could be accurately tracked with the MU radar when the radiant is at least 10 degrees above the local horizon.

Keywords: meteor, meteoroid, HPLA radar, head echo, meteor shower

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An field test of an improved bistatic observation system with COBRA

Seiji Kawamura[1*], Shigeo Sugitani[1], Hiroshi Hanado[1], Katsuhiro Nakagawa[1]

[1]NICT

The bistatic Doppler velocity measurement is a useful ways to retrieve 2D wind fields with weather radars. We have examined an improved system to get over some problems of the bistatic measurement system. In this study, we will report a result of an actual experiment of this improved bistatic observation system with COBRA.

Usually the bistatic measurement uses a receiving antenna whose beam width is wide. Due to that, the low gain and false echoes by sidelobe contaminations used to be problems. In this improved system, we are planning to use an array antenna for the receiver, it leads to increase the receiving gain. In case of usual array antenna, the spacing between elements is selected short (less than one wavelength) to form only one strong main lobe and to avoid forming grating lobes. But it is difficult to form a narrow beam enough to reduce the sidelobe contamination with limited number of elements. In this study, we dare to select long spacing (e.g. 10 wavelengths) and to form many sharp grating robes (beams) simultaneously. Sidelobe contaminations near around the strong echoes are expected to be reduced with these sharp beams.

We, National Institute of Information and Communications Technology (NICT), have a full polarimetric Doppler weather radar named COBRA in Okinawa. We are planning to perform actual experiments with this radar system. Simulated results, an experimental system, and preliminary observational results will be presented.

Keywords: weather radar, bistatic, Okinawa, COBRA