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PEM06-P01 会場:コンベンションホール 時間:5 月 26 日 18:15-19:30

Observation of Ozone concentration relation to meteors echo duration distributions by a forward scattering radar

Observation of Ozone concentration relation to meteors echo duration distributions by a forward scattering radar

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Several studies have concluded the existence of secondary maxima of ozone concentration at the mesospheric level of 85-90 km. At this level in atmosphere, meteor radio observations shows a consistent lack of long overdense echoes with certain durations where the number of meteor echoes drops for what is known as the ‘knee’ position. As the lack of long meteor echoes was significantly greater than being only a result of ambipolar diffusion, some studies linked this drop to ozone concentration in the meteor region. Baggley and Cummack (1974) suggested the drop to be the result of oxidation of meteors ions by the secondary maxima of ozone layer which causes the removal of ionization and consequently unreflected radio signals. Jones et. al (1990) and Cevolani and Pupillo (2003) supported this conclusion by analyzing meteor echoes duration distributions and determining approximately the height of meteor echoes at the knee point based on visual magnitude levels.

At Kochi University of Technology (KUT) we attempted to observe the knee position in selected meteor showers. The 5 channel HRO interferometer radar developed at KUT utilizes forward scattering of 53.75 MHz continuous radio signals emitted from Sabae station, Fukui prefecture, Japan (Fukui National College of Technology: FNCT) at a distance of 340 km from Kochi prefecture. The software HROFFT (Ham-band Radio meteor Observation Fast Fourier Transform) generates spectrogram images for meteor echoes in 10 minute intervals. These images are used by the developed auto counting software Meteor echo counter through image processing to automatically count meteor echoes and their durations. The critical duration T at which the drop occurs in long echoes counts can be indicative about the Ozone concentration by the relation derived by McIntosh and Hajduk (1977): O_3=(αT)ˆ(-1). As currently there is no developed mechanism for meteor height determination at KUT, the scope is focused on the analysis of meteor echoes duration, detection of the knee point and then finally comparing the ozone concentration measurements to the results of similar studies.

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キーワード: Ozone concentration, meteors, forward scattering, radar, mesosphere
Keywords: Ozone concentration, meteors, forward scattering, radar, mesosphere

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PEM06-P02 会場:コンベンションホール 時間:5 月 26 日 18:15-19:30

南極昭和基地大型大気レーダーによる極域中間圏エコーと銀河電波吸収の同時観測
Simultaneous observations of polar mesosphere winter echoes (PMWE) and Cosmic Noise Absorption (CNA) by the PANSY radar

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In the lower thermosphere at the altitude of around 100 km, both neutral turbulence and ionization of atmosphere due to solar radiations cause irregularities of refractive index, and as a result back scatter echoes from that altitude are frequently observed by radars on the ground. In the mesosphere, Polar Mesosphere Summer Echo (PMSE) is reported to be a strong echo associated with ice particles, which are produced around the coldest mesopause region in the polar summer, by a number of past radar observations [Cho and Röttger, 1997; Rapp and Luebken, 2004]. It should be also noted that occurrence rate of PMSE is very high (80-90%) [Bremer et al., 2003]. On the other hand, Polar Mesosphere Winter Echo (PMWE) is also known as back scatter echo from 55 to 85 km in the mesosphere, and it has been observed by MST and IS radar in polar region during winter [e.g., Ecklund and Balsley, 1981; Czechowsky et al., 1989; Luebken et al., 2006; Strelnikova and Rapp, 2013]. Due to the lack of of free electrons and ice particles in the dark and warm mesosphere during winter, it is suggested that PMWE requires strong ionization of neutral atmosphere associated with precipitations of Solar Energetic Particles (SEPs) during geomagnetically disturbed periods [Kirkwood et al., 2002; Zeller et al., 2006]. However, the detailed generation process of PMWE has not been identified yet, partly because the reported PMWE occurrence rate was quite low (2.9%) [Zeller et al., 2006].

We present occurrence characteristics of PMWE from June 2012 to October 2013 and its relation to Solar Energetic Particles. When PMWE was detected by the PANSY (Program of the Antarctic Syowa MST/IS) radar, highly energetic particle precipitations, either protons or electrons, were frequently observed by NOAA satellite particle measurements above Syowa Station. During the SPE that occurred in May 23, 2013 PMWE and a significant Cosmic Noise Absorption (CNA) of about 1 dB were simultaneously detected by the PANSY radar. MF radar also showed Isolated Lower Mesosphere Echo (ILME) at the same time [Morris et al., 2011], suggesting enhancement of electron density in ionospheric D-regions. Moreover, occurrence of PMWE was likely related to the flux of precipitating electrons in the medium energy range (30-300 keV) during recovery phase of geomagnetic storms. We would like to show correlations between PMWE and CNA using dataset for mesospheric observation mode.

キーワード: 冬季極域中間圏エコー, 高エネルギー降下粒子, 電離圏 D 領域, 大気乱流, 銀河電波吸収, 南極昭和基地大型大気レーダー
Keywords: Polar Mesoshpere Winter Echo, Eneregetic Particle Precipitation, Ionospheric D-region, Trubulence, Cosmic Noise Absorption, the PANSY radar

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PEM06-P03 会場:コンベンションホール 時間:5 月 26 日 18:15-19:30

南極昭和基地 (69S) 上空の高度 65-110km における大気重力波活動度
Gravity wave activity in a wide height range of 65-110km over Syowa st. (69S), Antarctica

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There are very small number of ground-based observation techniques in the lower thermosphere, especially above around 100 km, although the region is a pronounced transition region in terms of the thermal structure, chemistry and dynamics. Radio meteor echo measurement in a low radio frequency such as MF is a possibility of atmosphere observation above 100 km. We have applied a meteor wind measurement technique, which is widely used in VHF, to MF radar systems, and have successfully obtained meteor winds up to 120 km altitude [Tsutsumi et al, 1999; Tsutsumi and Aso, 2005]. The technique was applied to the MF radar at Syowa station, Antarctica and meteor winds have been continuously obtained since May 1999, simultaneously with conventional correlation based wind measurements in the mesosphere.

In this study we try to estimate seasonal behavior of gravity wave activity over Syowa in a wide height range from 65 to 110km using the accumulated 16 years of data. Gravity wave activity is estimated in two ways. One is a commonly used wave variance estimation technique based on time series of wind velocities [e.g., Vincent, 1994]. Hourly mean winds are used for the purpose in the present study. The other is a recently developed technique by Mitchel and Beldon [2009], where residuals after the hourly mean wind estimation are used as a proxy of short period wave activity. The former and the latter correspond to wave periods longer and shorter than about two hours, respectively. Obtained wave activities show a broad winter time maximum and summer time minimum in both wave periods, which is consistent with previous results in the mesosphere over Antarctica [Dowdy et al.,2007]. We further found that wave activities above 100 km are enhanced in late summer to early winter in both wave periods, which has not been known so far. Details of these features are discussed in the presentation.

キーワード: 大気重力波, 中間圏・下部熱圏, 南極, MF レーダー, 昭和基地
Keywords: atmospheric gravity waves, mesosphere and lower thermosphere, Antarctica, MF radar, Syowa station

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PEM06-P04 会場:コンベンションホール 時間:5 月 26 日 18:15-19:30

Variability of the Equatorial Ionization Anomaly on seasonal and day to day time scales

Variability of the Equatorial Ionization Anomaly on seasonal and day to day time scales

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The Equatorial Ionization Anomaly (EIA) is a persistent feature of the F layer, around 300 km altitude in the thermosphere, generated by the E-region dynamo driven equatorial fountain. When the EIA is present, electron densities on either side of the magnetic equator will become much higher during the local afternoon times. In our study we want to quantify short term EIA variability due to atmospheric, solar, and geophysical sources. Short-term anomalies in EIA region total electron content (TEC) from GPS-derived global ionosphere maps (GIM) at 105 degree West longitude are compared to anomalies in three different geophysical sources: solar flux (F10.7 solar flux proxy), geomagnetic storms (Kp index), and atmospheric zonal winds near the semidiurnal tidal peak at northern mid-latitudes (GAIA assimilative general circulation model). We present spectral and coherence analysis of EIA TECs and the aforementioned geophysical indices in 2008 and 2012, to illustrate the variability on seasonal and day to day time scales. The variability of the F10.7 solar flux proxy is dominated by 23-27 day periodicities. The Kp index indicates significant 9 day periodicities in 2008 for entire year, though 2012 is dominated by significant variations with 9-13 day periods during equinox and 5-7 day periods during boreal summer. F10.7 and Kp index both demonstrate good coherence with EIA TECs during specific seasons. With regard to the neutral zonal winds, TECs at the equator show good coherence with 100 km mid-latitude zonal winds in the same longitude region at specific planetary wave periods during the certain local times, suggesting modulation of the E-region dynamo.

キーワード: Equatorial Ionization Anomaly, ionosphere, mid-latitude, planetary wave, Kp index, E-region dynamo
Keywords: Equatorial Ionization Anomaly, ionosphere, mid-latitude, planetary wave, Kp index, E-region dynamo

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PEM06-P05 会場:コンベンションホール 時間:5 月 26 日 18:15-19:30

Topside Ionospheric Plasma Temperatures Retrieved From FORMOSAT-3/COSMIC Observations

Topside Ionospheric Plasma Temperatures Retrieved From FORMOSAT-3/COSMIC Observations

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Bottom-side ionospheric electron profiles now can be well-determined thanks to mature development of ground-based instruments, such as ionosonde, or incoherent radar. However, the topside ionosphere, located above the F2 layer peak to the exobase (from 200˜400 km to 600˜1000km, depending on solar activity) is still not well understood. Previously, the electron density distribution and plasma temperatures in the topside ionosphere could only be measured by incoherent scatter radar, in-situ sounding rocket, or certain satellite instruments, making it hard to draw a global map of electron density and plasma temperatures in the topside ionosphere. FORMOSAT-3/ Constellation Observing System for Meteorology, Ionosphere, and Climate (F3/C) using the GPS radio occultation method (GPS-RO) now can give us great opportunities to determine the global electron density profiles above the F2 layer peak. We also present results showing how the plasma temperatures may be estimated from such GPS-RO observations.

This study first examines the structure and variability of electron densities in topside ionosphere. Seasonal F3/C observations will first be assimilated into a gridded model in latitude, longitude, altitude, and local time. The resulting vertical profiles at each gridpoint will then be used to infer the vertical scale height of the topside ionosphere. Next, we retrieved the seasonal and local-time variabilities of topside plasma temperature from the scale height of topside ionospheric electron densities. This is one of the first times that topside plasma temperatures can be globally determined using remote sensing techniques.

キーワード: Ionosphere, Topside ionosphere, Plasma temperature, Formosa-3/COSMIC
Keywords: Ionosphere, Topside ionosphere, Plasma temperature, Formosa-3/COSMIC

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PEM06-P06 会場:コンベンションホール 時間:5 月 26 日 18:15-19:30

リアルタイム GPS-TEC3 次元トモグラフィの開発
Development of real-time three-dimensional GPS-TEC tomography

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Recently, a new three-dimensional GPS ionospheric tomography technique is developed which uses total electron content (TEC) data from the dense GPS receiver network, GPS Earth Observation Network (GEONET) in Japan. It uses the least squares fitting method constrained by the spatial gradient, and does not require an ionospheric model as the initial guess that could bias the reconstruction of electron density. But it refers to the NeQuick model to determine constrained parameters. The purpose of this study is to develop this technique and incorporate into the real-time GPS-TEC monitoring system. First we increase the computation speed by using a sparse matrix algorithm when solving the least squares fitting method. Programmed with Python, it takes less than 5 minutes to calculate a tomography by using 1.7GHz Intel Core i7. We could also improve the stability of the calculation. Furthermore we try to find a new method for determining the constrained parameters by analyzing a large amount data. As the tomography uses absolute TEC, it is necessarily to estimate instrumental delay bias which is originated in the hardware of the GPS satellite and receiver. We develop the bias estimation procedure that uses RINEX-OBS data of the previous day. Organizing these parts, we develop a system to conduct three-dimensional tomography analysis in the real-time basis.

キーワード: ジオネット, 全電子数, トモグラフィ, 疎行列, リアルタイムシステム
Keywords: GEONET, TEC, tomography, sparse matrix, real-time system

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PEM06-P07 会場:コンベンションホール 時間:5 月 26 日 18:15-19:30

中間圏重力波観測用低廉大気光カメラの性能評価
Performance evaluation of low-cost airglow camera for mesospheric gravity wave measurements

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Atmospheric gravity waves significantly contribute to the wind/thermal balances in the mesosphere and lower thermosphere (MLT) through their vertical transport of horizontal momentum. It has been reported that the gravity wave momentum flux preferentially associated with the scale of the waves; the momentum fluxes of the waves with a horizontal scale of 10-100 km are particularly significant. Airglow imaging is a useful technique to observe two-dimensional structure of small-scale (<100 km) gravity waves in the MLT region and has been used to investigate global behavior of the waves. Recent studies with simultaneous/multiple airglow cameras have derived spatial extent of the MLT waves. Such network imaging observations are advantageous to ever better understanding of coupling between the lower and upper atmosphere via gravity waves.

In this study, we newly developed a low-cost airglow camera to enlarge the airglow imaging network (Optical Mesosphere and Thermosphere Imagers: OMTIs) operated by the Solar-Terrestrial Environment Laboratory, Nagoya University. This camera has a fish-eye lens with a 185-deg field-of-view and equipped with a CCD video camera (WATEC WAT-910HX) ; the camera is small (W35.5 x H36.0 x D63.5 mm) and inexpensive, much more than the OMTI cameras, but has a highly sensitive CCD sensor with 768 x 494 pixels. OH airglow emissions are imaged at intervals of 4 sec with 4-sec exposure.

In this presentation, we will report some results of performance evaluation of this camera based on test observations at Shigaraki (35-deg N, 136-deg E), Japan, where is one of the OMTI station. By summing 15-images (i.e., 1-min composition of the images) we recognized clear gravity wave patterns in the images with comparable quality to the OMTI's image.

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PEM06-P08 会場:コンベンションホール 時間:5 月 26 日 18:15-19:30

The FORMOSAT-3/COSMIC Radio Occultation Data Assimilated to NCAR/TIE-GCM to study the horizontal winds in the ionosphere

The FORMOSAT-3/COSMIC Radio Occultation Data Assimilated to NCAR/TIE-GCM to study the horizontal winds in the ionosphere

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The NCAR Thermosphere-Ionosphere Electrodynamics General Circulation Model (TIE-GCM) is a self-consistently electrodynamic-coupled thermosphere and ionosphere model subjected by a few parameters and boundary conditions. The migrating tidal waves are parameterized with the amplitudes and phases of the diurnal and semidiurnal tidal waves (Hough modes) as the forcing sources to modulate the TIE-GCM at the lower boundary. We constructed a data assimilation method to assimilate the FORMOSAT-3/COSMIC (F3/C) occultation total electron content (OTEC) observations to the Model with the optimal parameters of the TIE-GCM. The assimilated OTEC of the F3/C data could modulate the ionospheric electron densities, the neutral winds and the temperatures in the TIE-GCM due to the optimal parameters of the Hough modes. The horizontal wind in the assimilated model will be compared with the observations with ground based and the space-borne instruments (TIDI data).

キーワード: ionosphere, thermosphere, FORMOSAT-3/COSMIC radio occultation data, data assmilation
Keywords: ionosphere, thermosphere, FORMOSAT-3/COSMIC radio occultation data, data assmilation

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PEM06-P09 会場:コンベンションホール 時間:5 月 26 日 18:15-19:30

Periodic variations in the thermospheric density
Periodic variations in the thermospheric density

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We examined the periodic variation of thermosphere in this study using the thermospheric total mass density at 400km altitude derived from more than 5000 flying objects during 1967-2013, and also those measured by the accelerometer aboard the CHAMP satellite during 2001-2010. Among the periodic variations, we found a prominent 2-3 year period. Correlation of this density variation with QBO and ENSO indices are carried out to investigate possible lower atmosphere driver of this thermosphere variability.

キーワード: thermosphere
Keywords: thermosphere

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PEM06-P10 会場:コンベンションホール 時間:5 月 26 日 18:15-19:30

Kyushu-GCM 及び準３次元ダイナモモデルを用いた Ultra Fast Kelvin 波による Equatorial Electro Jet 変動の評価
Evaluation of EEJ variation due to Ultra Fast Kelvin Waves using the Kyushu-GCM and the Quasi-3D dynamo model

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Sq 電流系と Equatorial Electro Jet (EEJ: 赤道ジェット電流) は、Kyushu-GCM(Yoshikawa and Miyahara 2003, 2005) の中性風データと準３次元ダイナモモデルを使用することにより、それらの電流観測値の日々変化とほぼ整合性のある計算値を示すことができた (Kawano-Sasaki and Miyahara 2008,Aramaki 2012:修士論文)。

また Kyushu-GCM データ内のケルビン波解析 (Chen and Miyahara 2012) では対流圏を励起源とする Ultra Fast Kelvin (UFK) 波 (東西波数 1 , 周期 2.5 - 4 日) が、赤道上空 高度 約 100 km の中間圏・下部熱圏（MLT）領域で卓越しており、大気力学場に影響を及ぼしていること、また UFK 波の振幅は、約１０日間周期で変動していることが示された。

そこで、本研究は、Kyushu-GCM (Yoshikawa and Miyahara 2003, 2005) の風速データより抽出し再合成した UFK 波の中性風データと赤道反対称成分も記述できる準３次元ダイナモモデル (Aramaki 2012:修士論文) を使用して、UFK 波変動による EEJ 変動への寄与の程度を定量的に評価した。

結論として、UFK 波変動は EEJ の日々変動に寄与しており、Kyushu-GCM のオリジナル中性風による EEJ 電流値の１ヶ月分標準偏差の比較により、シミュレートされた赤道上空東向きの強い EEJ 電流値の日々変動の２５％は、UFK 波の日々変動によるものと見積もる事ができた。更に統合的な解析結果と詳細な評価等は大会会場にて公表する予定である。

（謝辞）
この研究では，川野-佐々木さん、荒牧さんにより開発された準三次元ダイナモモデルを使用しました。
両名に深く感謝致します。

キーワード: 赤道ジェット電流, Ultrafast Kelvin 波, Kyushu-GCM, 準３次元ダイナモモデル
Keywords: Equatorial Electro Jet, Ultra Fast Kelvin wave, the Kyushu-GCM, the quasi-3D dynamo model

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PEM06-P11 会場:コンベンションホール 時間:5 月 26 日 18:15-19:30

大気電場と地磁気日変化の関連
The relationship between the electric field in the lower atmosphere and Sq variations

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The vertical atmospheric electric field (Ez) variations depend on the state of the global electric circuit. Geomagnetic phenomena can influence Ez through ionospheric disturbances [e.g. Kleimenova, 2008]. The daily quiet geomagnetic field variations (Sq variations) are mainly caused by electric field currents flowing in the E region of the ionosphere. It is likely that Sq variations are relevant to Ez variations. In this study, we aim to investigate the relationship between Ez and Sq variations at a low-latitude station. We analyzed the Ez and ground magnetic field data (H) at KAK (G.G. Lat.: 36.2 N, G.G. Lon.: 140.2 E) station during 2006 - 2014. The data was provided by the Kakioka Magnetic Observatory of the Japan Meteorological Agency. In here, we adopt the same definition for Sq amplitudes as defined by Yamazaki et al. [2010]. The daily amplitude of the Sq variation is derived by subtracting nighttime (22-24 LT and 00-02 LT) H values from daytime H (peak) values. Similarly, we calculated the daily Ez variation. The daytime Ez values were selected at the time when daytime H values show their peaks. The obtained Sq and Ez variations show annual and semi-annual variations. The annual variations are clearly seen every year, becoming the smaller values in winter. The semi-annual variations in Ez are clear in 2011 and 2014. As just described, we found similarities between Sq and Ez variations in several respects and ,therefore, conclude that the Ez variations depend on the condition of the ionosphere.

キーワード: 大気電場, 地上磁場
Keywords: atomospheric electric field, Sq