Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

PEM05-P01 Room:Poster Time:May 2 16:15-17:30

Diurnal tide and QTD wave in the tropical stratosphere and MLT region: Long-term trends and solar cycle influence

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In the present study, long-term trends and solar cycle influence on the diurnal tide (DT) and quasi two day wave (QTDW) in the stratosphere, mesosphere and lower thermosphere (MLT) region over a tropical station Tirununveli (8.7oN, 77.7oE) are investigated using ERA-Interim datasets and MF radar observations available since 1993. As no ground truth is available over Tirununveli, suitability of the ERA-Interim data for the present study is ascertained using simultaneous radiosonde and MST radar observations over Gadanki (13.5oN, 79.2oE) and good consistency is found between the two. Amplitudes of the DT and QTDW over Tirununveli show a long-term linear increasing trend, which becomes prominent in the MLT region. Role of solar cycle on the DT and the QTDW is investigated by separating them with respect to the solar activity (minimum and maximum of solar cycles). Both the DT and QTDW show higher amplitudes during solar minimum and vice versa. Significant higher amplitudes in the recent extended solar minimum are noticed in the MLT region. However, no consistent relation is found between solar activity and DT in the stratosphere although increasing trend is clearly observed. Though increasing trend in the tropical convection is noticed at nearby locations, similar to the DT, it varies from location to location which may be due to large scale circulation effects. This demands data from network of radars located across the globe to see the combined effects of lower atmospheric forcing, circulation and their effects on MLT region.

Keywords: Diurnal Tide, Quasi-two day wave, Long-term trends, Solar cycle, Extended minimum

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PEM05-P02 Room:Poster Time:May 2 16:15-17:30

MQBE and Amplitude Modulation of SAO in the MLT

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Characteristics of various atmospheric waves in the mesosphere and lower thermosphere (MLT) have been investigated by long-term ground-based and satellite-based observation. In the equatorial region, the westward monthly mean wind is enhanced in March in 2 or 3 years in MLT, which is called Mesosphere Quasi-Biennual Enhancement (MQBE) [Rao et al., 2012]. Recently, They showed that MQBE appears once in 2 or 3 years until 2002, based on data analysis of meteor/MF radars in the Asia-Oceania region. However, the occurrence features remained unknown due to no sufficient wind data with high-time resolution from 50 to 80 km.

We analyzed the long-term wind data from 1990 to 2013 obtained from meteor/MF radars in the Asia-Oceania region, such as Kauai, Christmas island, Tirunelveli, Koto Tabang in order to identify the occurrence features and mechanism of MQBE. And also we investigated relationship of the monthly-mean wind between MLT stratosphere using MERRA retrospective-analyses data provided by NASA. We used integrated analysis tool " UDAS " provided by " IUGONET " (Inter-university Upper atmosphere Global Observation NETwork). And We use Stockwell-transform to detect the temporal variation of frequency and amplitude in time series data.

As a result, we found that MQBE occurred in spring of 2005, 2008 and 2011 with amplitude over 32 m/s in an altitude from 80 to 100 km . From an S-transform spectral analysis of zonal wind in MLT, MQBE coincides with the enhancement of the amplitude of 6-months component of zonal wind. Furthermore, comparing the 6-month component in the lower thermosphere at 90 km and stratosphere using retrospective-analyses data of MERRA, 6-months component of lower thermosphere(90 km) and stratopause (1 hPa) are well negative correlated. And also 6-months component of lower thermosphere and lower stratosphere (70 hPa) are well positive correlated. Their correlation coefficients are about 0.6, and lags are under 3 month. the former result is consistent with the fact that the phase of SAO are reversal in the lower thermosphere and in the stratosphere.

Although Rao et al.,[2012] reported that MQBE did not appear after 2002, the present results showed that MQBE takes place after 2002. Next, the SAO amplitude in MLT obtained from the S-transform analysis tends to be enhanced significantly, corresponding to the occurrence of MQBE. This relationship can be a clue of occurrence features of MQBE. Furthermore, the relationship of mean wind between in MLT and stratosphere indicates that MQBE is driven by coupling process of the mesosphere-stratosphere system. We can infer that MQBE is caused by atmospheric gravity waves, which is similar to the generation mechanism of QBO.

In addition, we need to detect and analyze the gravity wave in equatorial region to identify the mechanism of MQBE.

Keywords: meteor radar, MF radar, stratosphere, SAO, MQBE

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PEM05-P03 Room:Poster Time:May 2 16:15-17:30

Meteor Wind Radar Application for the study the dynamics of the neutral winds above at Kototabang and Biak station

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Currently for meteor observations is not only done with the naked eye and optical equipment such as a telescope, the latest development to detect natural phenomena meteor shower rained almost every day the Earth can be detected using radar technology. Meteor Wind Radar (MWR) is a radar system used to detect, analyse and display meteor entrance events to the Earth's atmosphere. By using of radar meteors (SKiYMET Meteor Radar) was used to observe the meteor trail (ionized air columns) that moves with the wind neutral layer of mesosphere. When a meteor enters the atmosphere it rapidly vaporises leaving behind a trail of ionised gas along its path of travel, this trail can form a target for a radar transmission. Generally the frequencies used for the detection of radar, located on the VHF band wave spectrum. The results of the analysis of radar data output consists of 7th meteor parameter can be used to study the behavior of neutral winds in the Mesosphere. In this paper the utilization of SKiYMet shown to detect Wind speed Meridional and Zonal Wind speed, Temperature in the Mesosphere and the number and received Flux meteor in the Earth, as a sources of data to better understand the dynamics of the neutral winds at an altitude of 70-110 km region of observation locations. Simultaneously measurement data will be shown at Kototabang observations that have been operating since year 2006 and in Biak Station since year 2011. All of the radar installation is a collaboration between LAPAN and RISH - Kyoto, NICT Japan.

Keywords: Meteor radar, Indonesia, Equatorial regiona, Koto Tabang, Biak

PEM05-P04 Room:Poster Time:May 2 16:15-17:30

Concentric structures in molecular oxygen emission observed by ISS-IMAP/VISI

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Concentric structures in airglow emissions were often observed from ground based imagers. Some of them were thought to be caused by the active clouds in the troposphere. It was not able to observe the overall structures from the imagers on the ground under the cloudy condition. Field of views of the imagers were not enough to observe whole structure. Space borne imagers are able to observe the structures caused by the disturbances in the lower atmosphere with wider field of view. Concentric structures of the O_2 airglow emission in 762-nm wavelength were found by the Visible and near-infrared imager on the International Space Station on June 1, 2013 over the U. S. This is the first case which took the image from edge to the center of the concentric structure. Spatial scale of this concentric structures were estimated to be 1,200 km. Fine structures with 80 km wavelength and no dumping in the intensity were observed in this VISI observation. Amplitude in these fine structures were about 10 % to the background intensity. Circular structures were also observed in the GPS-TEC observations before the VISI observation. These concentric structures were estimated to be caused from the active clouds after tornado and atmospheric gravity waves had propagated in horizontal direction in the emission layer.

Keywords: Near infrared, Airglow, Concentric structure, the Mesosphere, Atmospheric gravity waves

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Background Lamb waves coupled with thermospheric gravity waves

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Lamb waves of the Earth's atmosphere in the millihertz band have been considered as transient phenomena excited only by large events. Nishida et al. (2014) showed the first evidence of background Lamb waves in the Earth's atmosphere from 0.2 to 10 mHz, based on the array analysis of microbarometer data from the USArray in 2012. The observations suggest that the probable excitation source is atmospheric turbulence in the troposphere. Theoretically, their energy in the troposphere tunnels into the thermosphere at a resonant frequency via thermospheric gravity wave because the Lamb-wave branch intersects that of thermospheric gravity waves at 3.5 mHz and that of acoustic waves trapped near the mesopause at 6.5 mHz [Garrett 1969]. The observed FK spectrum shows a local minimum of Lamb-wave amplitudes at around 3.5 mHz, where the Lamb-wave branch is crossed by the thermospheric gravity-wave branch. Coupled Lamb waves leak a certain amount of energy from the troposphere to the thermosphere, reducing the Lamb-wave amplitudes at the crossover frequency relative to those at neighboring frequencies, when their excitation sources exist in the troposphere. The energy tunnels from the troposphere to the thermosphere at the resonant frequency, although Lamb waves themselves cannot induce an upward flux [Lindzen 1972]. The RMS amplitudes of the coupled modes are estimated to be 0.3 m/s at 150 km and 0.1 m/s at 120 km, respectively. These modes might contribute to the thermosphere energy balance by heating via viscous dissipation [Hickey et al. 2001]. The amplitude suggests that the Lamb waves partly contribute to the excitation of thermospheric wave activity associated with severe convection activity [Hunsucker1982].

Keywords: Atmospheric Lamb wave, Thermospheric gravity wave

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A proposal of simple resonance scattering lidar using an alkali metal vapor laser for monitoring the MLT region

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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 observed several mesospheric metallic layers at Tokyo and Indonesia using resonance scattering lidars consisting of a dye laser and a Ti:Sapphire laser [1]. Especially, in order to solve the formation mechanism of metallic sporadic layers occurred in the mesopause region, the simultaneous observation of Ca ion and the neutral metal atom is necessary. However since the output power of the Ti:Sapphire laser has a low damage threshold of a crystal, it is difficult to improve the output average power. We propose the resonance scattering lidar consisting of the alkali vapor laser for monitoring the MLT region. Optically pumped alkali vapor lasers have attracted increasing attention because of their potential of achieve high power in a high quality beam. The alkali vapor laser can easily realize narrow-linewidth and precise tuning.

Metal atomic layers in the mesosphere are an excellent tracer of the atmospheric wave motion in the region between 80 and 100km. sudden formation of thin metallic layers, superposed in the background mesospheric metallic layers was discovered and these enhanced layers are called the sporadic metallic layers. We have observed frequently the sporadic sodium layers (Nas) at Hachioji, Japan (35.6N, 139.4E) and the sporadic sodium and iron layers (Fes) at Kototabang, Indonesia (0.2S, 100.3E). The ion recombination mechanism invoking wind shear and sporadic E layers appears to be consistent with many observed characteristics, but their cause is still an open question.

Zhdanov et al. presented optically pumped continuous wave potassium vapor laser operating in a single longitudinal and a single transverse mode at 770 nm [2]. Zweiback et al. demonstrated a high efficiency potassium vapor laser using a 0.15nm bandwidth alexandrite laser as the pump source [3]. The alkali vapor laser operates in a three level scheme. The optical pump source excites the D2 line of alkali atom and lasing occurs on the D1 line. To provide a population inversion, fast quenching must be provided by using a buffer gas. We are developing a high peak power pulsed potassium vapor laser using alexandrite laser as the optical pump source. Sealed potassium vapor cell had AR coated windows, and filled with metallic potassium and helium. The cell was assembled inside an oven which had temperature controlled heaters. A pump beam polarized in the horizontal plane was focused through the polarizing beam splitting cube into the potassium vapor cell with a lens. A laser cavity was created for the vertical polarization by two mirrors and the beam splitting cube.

The development of these kinds of lasers is identified as one of the key topics for advancing the application of resonance scattering lidar systems.

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Keywords: mesopause, metal atomic layer, resonance scattering lidar, metal vapor laser