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■ 2019年5月30日(木) 9:00 ~ 10:30 | 会 A03 東京ベイ幕張ホール

[P-EM09] Vertical coupling in the atmosphere and ionosphere

コンビーナ:Liu Huixin(九州大学理学研究院地球惑星科学専攻 九州大学宙空環境研究センター)、Chang Loren(Institute of Space Science, National Central University)、大塚 雄一(名古屋大学宇宙地球環境研究所)、座長:Huixin Liu(Kyushu University, Japan)、Stan Solomon(National Center for Atmospheric Research, US)

Vertical coupling mechanisms throughout the whole atmosphere are critical to understanding the near Earth space environment, as well as its sensitivity to the solar, geomagnetic, and atmospheric drivers. This international session focuses on physical/chemical processes occurring in the mesosphere, thermosphere, and ionosphere (MTI). Both quiet and disturbed states in response to lower atmospheric forcing or solar forcing are important for understanding the MTI system and its coupling to other regions. We invite presentations of observations and observational concepts with ground-based and/or space-borne instruments, theoretical studies, numerical simulations, and development of data analysis systems for various kinds of temporal and spatial variations in atmosphere-ionosphere coupled system.

9:00 ~ 9:20

[PEM09-11] Assimilation products of thermospheric and ionospheric measurements by the NASA Ionospheric Connection Explorer

★Invited Papers

*Thomas J Immel¹、Chihoko Cullens¹、Yen-Jung Wu¹、Gary Bust²、Jeffrey Forbes³、Scott L England⁴ (1.University of California, Berkeley、2.Johns Hopkins University、3.University of Colorado、4.Virginia Tech)

9:20 ~ 9:35

[PEM09-12] petitSat - A 6U CubeSat to examine the link between MSTIDS and ionospheric plasma density enhancements

*Jeffrey Klenzing¹、Ryan L Davidson²、Gregory D Earle³、Alexa J Halford⁴、Sarah L Jones¹、Carlos Martinis⁵、Nikolaos Paschalidis¹、Robert F Pfaff¹、Jonathon M Smith^{1,6} (1.NASA Goddard Space Flight Center, Greenbelt, MD, USA、2.Utah State University, Logan, UT, USA、3.Virginia Tech, Blacksburg, VA, USA、4.The Aerospace Corporation, Chantilly, VA, USA、5.Boston University, Boston, MA, USA、6.Catholic University of America, Washington, DC, USA)

9:35 ~ 9:55

[PEM09-13] A three-dimensional ionospheric electrodynamics model

★Invited Papers

*Astrid I Maute¹、Arthur D Richmond¹ (1.High Altitude Observatory, National Center for Atmospheric Research, Boulder CO, USA.)

9:55 ~ 10:10

[PEM09-14] Spatial Fluctuation of TEC Index: A new index of ionospheric irregularities

*馬冠一¹、丸山隆² (1.中国科学院国家天文台、2.国立研究開発法人情報通信研究機構)

10:10 ~ 10:25

[PEM09-15] Coupling of lower thermosphere planetary wave energy into the ionosphere

*Patrick J Espy^{1,2}、Nora Stray^{1,2,3}、Robert Hibbins^{1,2} (1.Norwegian University of Science and Technology, Trondheim, Norway、2.Birkeland Centre for Space Science, Bergen, Norway、3.Teknova AS, Tordenskjolds Gate 9, 4612 Kristiansand, Norway)

10:25 ~ 10:30

Discussion

Assimilation products of thermospheric and ionospheric measurements by the NASA Ionospheric Connection Explorer

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ICON is an orbiting NASA observatory built to simultaneously observe the characteristics of the ionosphere and thermosphere in order to understand the connection between conditions in space and energy sources in the atmosphere below. Ready for launch in 2019 into a 27 degree inclination, 575 km altitude orbit, it will provide neutral wind, density and temperature products as well as in-situ and remotely-sensed ionospheric densities. These products will inform the conditions of two models that assimilate the data in different ways, and be available on the ICON website. The first is the TIEGCM, where assimilation is accomplished through modification of the winds and temperatures at the lower boundary as prescribed by observations. The second is the IDA4D model, that through a Gauss-Markov scheme modifies a background ionosphere with actual observations that include many different sources including ICON. Given the expected sampling and data uncertainties from ICON, the expected performance of these models is reported. ICON expects a launch in 2019.

Keywords: ionosphere, thermosphere, atmospheric tides



petitSat - A 6U CubeSat to examine the link between MSTIDS and ionospheric plasma density enhancements

*Jeffrey Klenzing¹, Ryan L Davidson², Gregory D Earle³, Alexa J Halford⁴, Sarah L Jones¹, Carlos Martinis⁵, Nikolaos Paschalidis¹, Robert F Pfaff¹, Jonathon M Smith^{1,6}

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The mid- and low-latitude ionosphere is home to a variety of plasma density irregularities, including depletions (bubbles), enhancements (blobs), and small-scale scintillation, which result in the distortion of radio wave propagation. Recent observations from the C/NOFS satellite suggest that multiple mechanisms are responsible for forming plasma density enhancements, with wave action in the thermosphere as a significant driver of the enhanced densities. Indeed, statistical analysis of enhancements observed from satellites resembles the statistics of Medium-Scale Traveling Ionosphere Disturbances (MSTIDs) with respect to seasonal variability and solar activity. In order to investigate the link between these two phenomena, both in-situ data of the plasma enhancement and remote data of the MSTID at the magnetic footpoint are required. petitSat is a CubeSat mission designed to provide in situ measurements of the plasma density, 3D ion drift, as well as ion and neutral composition. The instrument suite includes a combined retarding potential analyzer and cross-track drift meter and an ion neutral mass spectrometer. This instrument suite will provide comprehensive information about the fluctuations in plasma, as well as changes in the neutral profile. petitSat will launch into a 51 deg inclination orbit at 400 km (consistent with an International Space Station deployment), allowing for numerous conjunctions with the Boston University All-Sky Imager network and GPS receivers from the International Global Navigation Satellite Systems (GNSS) Service (IGS) network over the mission lifetime.

Keywords: Ionosphere, CubeSat, MSTIDs

A three-dimensional ionospheric electrodynamics model

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Ionospheric electric fields and currents are driven by collisional interaction between thermospheric winds and ions, by magnetospherically driven convection and field-aligned currents at high latitudes, by gravitational and pressure-gradient forces on the ionospheric plasma, and by weak currents from the lower atmosphere. The electrodynamics of the ionospheric E and F regions are strongly coupled. For time scales longer than a few minutes the electric field is electrostatic. The electric potential is nearly constant along geomagnetic-field lines, and can be represented in two dimensions in a coordinate system aligned with the magnetic field. The current density, however, varies in all three dimensions. Knowing the ionospheric current flow in three dimension is important for determining the magnetic perturbations at Low Earth Orbit (LEO) satellite height.

We are developing a model of ionospheric electrodynamics that takes into account all of the sources and calculates the three-dimensional structure of currents and their associated magnetic perturbation fields. This model will be used to simulate ionospheric drifts, currents, and ground and LEO geomagnetic perturbations. In this presentation we discuss the modeling principles and present results relevant to the electrodynamics of the middle and low latitude ionosphere, including the effects of coupling with F-region electrodynamics and the expected observable effects at low Earth orbit satellites.

Keywords: Ionospheric electrodynamics, ionospheric current, magnetic perturbations

Spatial Fluctuation of TEC Index: A new index of ionospheric irregularities

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This study presents a new spatial fluctuation of total electron content (TEC) index (SFTI) to identify and analyze ionospheric irregularities. SFTI is defined as the dispersion of vertical TEC (VTEC) within a specific area at a given time. With the data from the Global Navigation Satellite System (GNSS) Earth Observation Network of Japan (GEONET), the size of the specific area for SFTI calculation can be chosen as $0.8^\circ \times 0.8^\circ$ in longitude and latitude. An SFTI map generated by sliding window shows the spatial variation of the ionospheric irregularities in two dimensions. It can be used to obtain the size, shape, orientation and intensity distribution of the irregularity structures. With a series of SFTI maps, we analyzed three strong irregularity events on 12 February 2000, 20 March 2001 and 10 November 2004. The irregularities are found to consist of branching structures, which are anisotropic and elongate along longitudinal direction when first seen at low latitudes. The structures can drift and eventually move perpendicular to their orientations. It is concluded that SFTI will provide an unprecedented view of irregularity development and help to understand the process of irregularity generation.

キーワード : ionospheric irregularities, GNSS observation, SFTI

Keywords: ionospheric irregularities, GNSS observation, SFTI

Coupling of lower thermosphere planetary wave energy into the ionosphere

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Neutral atmosphere winds derived from meteor trail drifts observed by a longitudinal chain of Super Dual Auroral Radar Network (SuperDARN) radars have characterized planetary waves with wavenumber 1 and 2 in the lower thermosphere near 95 km. The simultaneous wind observations at stations between 50° and 66° N removes the temporal-spatial aliasing associated with satellite observations and shows the continuous evolution of the planetary waves near the turbopause. A similar technique has been applied to a longitudinal chain of ionosondes in the same latitude band, and the same wavenumber components were observed in f_oF_2 . An analysis of the two signals shows them to be highly correlated, with the ionospheric waves lagging behind those in the lower thermosphere. We will describe the technique to extract the waves and compare it with other observations. We will also show the relationship of the ionospheric waves with magnetic and solar activity, and describe a process, commensurate with our measurements, by which planetary wave signals near the turbopause can be transmitted into the ionospheric electron density.

Keywords: dynamics, turbopause, ionosphere