SA32B-06 1715h

Effects of Geomagnetic Storms and Sudden Stratospheric Warmings on Mesosphere and Lower Thermosphere Winds

Q. Wu[1] (qwu@ucar.edu); R. D. Gablehouse[1] (rdg@ucar.edu); D. A. Gell[2] (gellda@umich.edu); R. M. Johnson[1] (rmjohnsn@ucar.edu); J. F. Kafkalidis[2] (juliek@umich.edu); T. L. Killeen[1] (killeen@ucar.edu); R. J. Niciejewski[2] (niciejew@umich.edu); D. A. Ortland[3] (ortland@nwra.com); W. R. Skinner[2] (wskinner@umich.edu); S. C. Solomon[1] (stans@ucar.edu)

[1]National Center for Atmospheric Research, 3450 Mitchell La., Boulder, CO 80301, United States

[2]The University of Michigan, 2455 Hayward, Ann Arbor, MI 48109, United States

[3]Northwest Research Associates, P.O. Box 3027, Bellevue, WA 98009, United States

Neutral winds in the MLT region are affected by dynamical influences from above and below. This is particular true at high latitudes, where solar forcing of the migrating tide may be smaller but other forcings play a big role. During geomagnetic storms, MLT neutral winds can be driven by magnetospheric convection through ion-neutral interactions. This is imparted onto the ionosphere as a cross polar cap potential forming an anti-sunward two-cell ion convection pattern which in turn drives the neutral winds in the polar MLT region. The question has always been how deep into the atmosphere the ion drift can affect the neutral wind. Scarcity of high-latitude data has hampered further understanding of the problem. Also, in the winter polar regions, the stratosphere from time to time experiences sudden warming events. While it is generally understood that these warmings are caused by troposphere planetary wave activity, there are still many unknown aspects to their excitation and propagation. There are also changes in the MLT region associated with these warming events. Moreover, this phenomena, although usually confined to the northern hemisphere, occurred in the southern hemisphere in 2002. We will use TIDI data to examine MLT neutral winds during the recent geomagnetic storm events in 2002 and 2003, and present data during the recent 2002 southern hemisphere warming event.

SA32B-07 1730h

Search for Thermospheric Composition Changes in the Morning Sector near Local Midnight in Association with Intense Substorm Activity

John D Craven[1] (907-474-5888; craven@gi.alaska.edu); Douglas J Strickland[2] (703-764-7501; dstrick@cpi.com); Robert R Meier[3] (210-522-3475; meier@uap2.nrl.navy.mil); Geoffrey Crowley[4] (210-522-3475; gcrowley@swri.edu); Andrew B Christensen[5] (Andrew.B.Christensen@aero.org); Larry J Paxton[6] (240-228-6871; larry.paxton@jhuapl.edu); Danny Morrison[6] (danny.morrison@jhuapl.edu); Susan K Avery[7] (303-492-1143; savery@cires.colorado.edu); Ching -I Meng[6] (240-228-5409; ching.meng@jhuapl.edu); Paul R Straus[5] (310-336-5328; paul.straus@aero.org); Charles M Swenson[8] (435-797-2958; charles.swenson@usu.edu); Richard L Walterscheid[5] (walterscheid@eumetsat.de)

[1]Geophysical Institute and Dept. of Physics, University of Alaska Fairbanks, Fairbanks, AK 99775, United States

[2]Computational Physics, Inc., 8001 Braddock Rd., Suite 210, Springfield, VA 22151, United States

[3]E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, D.C 20375, United States

[4]Southwest Research Institute, Space Physics Dept., 6220 Culebra Rd., San Antonio, TX 78238, United States

[5]The Aerospace Corporation, PO Box 92957, Los Angeles, CA 90009, United States

[6]JHU/Applied Physics Laboratory, 11100 John Hopkins Road, Laurel, MD 20723, United States

[7]CIRES, 216 University of Colorado, Boulder, CO 80309, United States

[8]Utah State University, Dept. of Electrical and Computer Engineering, 4120 Old Mail Hill, Logan, UT 84322, United States

Repeated DE-1 and other spacecraft observations have established that transient decreases in the far-ultraviolet (FUV) terrestrial OI emissions at subauroral latitudes in the morning sector are associated with decreases in the O/N2 ratio at thermospheric altitudes. The largest decrease is at 130.4 nm. These decreases are observed following onset of intense auroral activity, and at northern latitudes the greater spatial extent and depth of decrease are associated with a positive IMF By component. The DE-1 viewing geometry generally precluded clear observations in the morning sector at local solar times earlier than about 0600 hours. However, it is believed that the altered composition is driven by aurorally related heating and the antisunward polar jet that transports heated air to subauroral latitudes in the very early hours of local time and then into the morning sector. FUV observations of altered composition closer to local midnight are lacking, but are necessary to support this general expectation. The GUVI observations at FUV wavelengths are providing an extensive new set of unambiguous thermospheric composition and temperature measurements over a wide range of local times and latitudes in both auroral hemispheres as the orbit of the near-polar-orbiting TIMED spacecraft processes rapidly in local time. These data are being scanned in a search for the requisite combination of sampling at the right local times in periods of auroral substorms to address the question of composition changes near local midnight. A report on this search and its findings are presented in this paper.

SA32B-08 1745h

F-Region Plasma Distribution seen from TIMED/GUVI and its Effect on the Equatorial Spread F Activity

Hyosub Kil[1] (hyosub.kil@jhuapl.edu); Robert DeMajistre[1] (bob.demajiste@jhuapl.edu); Larry Paxton[1] (larry.paxton@jhuapl.edu); Yongliang Zhang[1] (yongliang.zhang@jhuapl.edu); Brian Wolven[1] (brian.wolven@jhuapl.edu); Danny Morrison[1] (daniel.morrison@jhuapl.edu); Ching Meng[1] (ching.meng@jhuapl.edu)

[1]Johns Hopkins University Applied Physics Laboratory, 11100 Johns Hopkins Road, Laurel, md 20723, United States

The nighttime plasma distribution in the low-latitude F region was investigated using the measurements of O I 135.6-nm intensity from the Global Ultraviolet Imager (GUVI) on board TIMED satellite. The 135.6-nm disk scan images of the Earth showed the equatorial ionization anomaly (EIA) features around $\pm 12^{\circ}$-15° magnetic latitudes. The EIA strength was maximum during equinox periods and minimum during northern summer at most of longitude regions. The most distinguishing feature was a suppression in 135.6-nm intensity in the southern American-Atlantic sector during northern summer. Those observations indicate an existence of season-longitudinal variations in the F-region plasma density that may affect the equatorial spread F (ESF) activity. That is, it is suggested that an occurrence of low plasma density is responsible for the suppressed ESF activity during northern summer in the American-Atlantic sector, whereas an occurrence of high plasma density is responsible for the strong ESF activity during equinox periods in most of longitude regions. We will further investigate the growth condition of ESF by calculating the growth rate of Rayleigh-Taylor instability using the GUVI limb data.

SA41A MCC: 2006 Thursday 0800h

Meteors and the Mesopause I

Presiding: **J Friedman,** National Astronomy and Ionosphere Center, Arecibo Observatory**; D Janches,** National Astronomy and Ionosphere Center, Arecibo Observatory

SA41A-01 0800h INVITED

The Mesopause as a Physical Boundary

Douglas O. ReVelle (505-667-1256; revelle@lanl.gov)

Los Alamos National Laboratory, P.O. Box 1663, MS D401, Los Alamos, NM 87545, United States

Large quantities of meteoric material impact the Mesopause region on a global scale. In this highly elevated region of the atmosphere where, large man-made vehicles first encounter the near-continuum flow regime (the so-called entry interface), there is a complex interplay of air chemistry, charged meteoric aerosol debris in the presence of water vapor, the presence of the Sodium and other metallic layers, solar electromagnetic radiation absorption, terrestrial infrared radiation cooling in the presence of a rapidly changing dynamic circulation pattern, height variable mean molecular weight, etc. In addition, there are also individual wake ionization effects and coupling with the lower ionosphere aloft as well as the presence of strong vertical shear of the horizontal wind and subsequent atmospheric turbulence and propagating neutral gravity and tidal waves, etc. This region of relatively small pressure (density) scale height acts as a physical boundary (for a range of sizes, entry velocities, entry angles, bulk densities or volume porosities, etc.) to the penetration of meteoric material through the atmosphere. We will illustrate this process using recently developed and interconnected highly detailed hydrodynamic and non-hydrodynamic models (including detailed fragmentation processes and panchromatic luminosity generation as well as infrasound generation, etc.) that are applicable to all sizes and type of meteors and meteor-fireballs. Expected effects of this meteoric population on the Mesopause region will be examined.

SA41A-02 0820h INVITED

Meteors and their impact on the atmosphere

John M Plane (44-1603-593108; j.plane@uea.ac.uk)

University of East Anglia, School of Environmental Sciences, Norwich NR4 7TJ, United Kingdom

This paper will begin with an overview of the mesosphere/lower thermosphere (MLT), and the historical role that meteors and the metal layers produced by meteoric ablation have played in understanding the region. The MLT is characterised by enormous seasonal variations in temperature, very low pressures, and is subject to solar radiation extending into the extreme ultra-violet. In addition, more than 50 tonnes of interplanetary dust enters the atmosphere each day, mostly ablating in the MLT region. All of these features contribute to a very unusual chemistry that is quite distinct from the lower atmosphere. Phenomena that will be discussed include: aspects of meteoric ablation; the global layers of metal atoms such as Na and Fe; the Na airglow; sporadic layers of metal ions and neutral atoms; and the role of meteor smoke. I will emphasise the contribution that laboratory studies can make to advancing MLT science, because the region is so difficult to explore directly.

SA41A-03 0840h

The EEA method of chemical lifetime calculation and its application to the sodium layer

Jiyao Xu[1] (xurrjy@center.cssar.ac.cn)

Anne K Smith[2] (3034971876; aksmith@ucar.edu)

[1]Center for Space Science and Applied Research, Chinese Academy of Sciences, Beijing 100080, China

[2]Atmospheric Chemistry Division, NCAR PO Box 3000, Boulder, CO 80307, United States

The method of the eigenvalue and eigenvector analysis (EEA) to determine the response of a chemical system to perturbations is introduced. We apply the EEA method to analysis of the mesospheric sodium layer. The results show that the lifetime determined using EEA is more than a day in the vicinity of the peak of sodium layer while the traditionally defined chemical lifetime for sodium is only a few minutes. In the region near the peak of the sodium layer, the timescale for gravity wave transport is substantially shorter than the chemical lifetime, indicating that the Na layer acts as a tracer of dynamical perturbations on short time scales (a day or less). At the bottom side of the sodium layer, photochemistry is rapid compared to transport or diffusion. Tests of the sensitivity of the EEA chemical lifetime of Na show that it is sensitivity to changes in the densities of background chemical species such as O3, H, and O, but that the transport timescale is shorter than the chemical timescale for realistic values. These results provide a theoretical basis for using Lidar observations of sodium to infer gravity wave vertical velocities.

SA41A-04 0855h

Non-specular meteor trail diagnostics

Lars Dyrud[1] (857-919-4808; ldyrud@bu.edu)

Meers Oppenheim[1]

Sigrid Close[1]

Licia Ray[1]

Kelley McMillion[1]

[1]Center for Space Physics, Boston University, 725 Commonwealth Ave., Boston, MA 02215, United States

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Plasma simulations demonstrate that meteor trails are unstable to growth of gradient-drift Farley-Buneman (GDFB) waves that become turbulent and generate large B-field aligned irregularities (FAI). These simulations and our analysis indicate that the non-specular echos, that can extend between 5-10 km in altitude range, are reflections from plasma instability generated FAI. We present models showing that the specific altitude range of trail instability depends on meteor and atmospheric properties. This variability will allow researchers to infer neutral temperature, neutral wind velocity, and meteoric velocity and composition in completely new ways. We demonstrate some of these non-specular trail diagnostic techniques using radar observations from the ALTAIR and Piura radar facilities. Finally, we present examples of a low altitude variety of non-specular echos that may be related to PMSE.

SA41A-05 0910h

Micrometeroid Flight in the Upper Atmosphere: Electron Emission and Charging

Asoka Mendis[1] (858/534-2719; mendis@ece.ucsd.edu)

Marlene Rosenberg[1] (858/534-4509; rosenber@ece.ucsd.edu)

Wai-Ho Wong[1]

Gianfranco Sorasio[2]

[1](UCSD) Department of Electrical and Computer Engineering, University of California, San Diego 9500 Gilman Drive (0407), La Jolla, CA 92093, United States

[2]Centro de Fisica de Plasmas Instituto Superior Tecnico, Av. Rovisco Pais 1049-001, Lisboa Portugal

Solving the simultaneous equations for the continuity of charge, mass, momentum and energy of a micrometeoroid entering the earth's atmosphere, we study its charging, ablation, deceleration and heating along its path. This analysis, which considers different initial entry speeds and angles, builds on an earlier study (G. Sorasio, D. A. Mendis and M. Rosenberg, 2001, Planet. Space Sci., 49, 1257) where only normal entry at a single speed was considered, while emphasizing the important role of thermionic emission of electrons from the frictionally heated micrometeoroid. While the main conclusions are qualitatively similar, the quantitative differences are significant. As before the micrometeoroid can change its charge polarity during flight and the altitude range of meteoric ionization is larger than in the case when ionization is due only to collisions between sublimating molecules and background atmospheric molecules. However, the present study shows that this range becomes larger, with earlier onset of ionization, as the initial entry speed becomes larger and the initial entry angle becomes smaller. Interestingly we also find that the residual mass of the ablated micrometeoroid is a minimum at a certain critical angle of entry, for a given initial speed. The implications of this study for atmospheric ionization by different meteor streams, as well as for radar observations of meteors (e.g., the head and trail echoes) will be discussed. The implications of this study for atmospheric ionization by different meteor streams, as well as for radar observations of meteors (e.g., the head and trail echoes) will be discussed.

SA41A-06 0925h

Charging of meteoroids: effect of thermionic emission

Gian Luca Delzanno[1] (gianluca.delzanno@polito.it)

Giovanni Lapenta[2] (lapenta@lanl.gov)

Marlene Rosenberg[3] (rosenber@fleece.ucsd.edu)

[1]INFM Sezione di Torino, Corso Duca, Torino 10137, Italy

[2]Los Alamos National Laboratory, MS: K717, Los Alamos, nm 87545, United States

[3]University of San Diego, 5998 Alcala Park San Diego, san diego, ca 92110, United States

In the present work we focus on the role of thermionic emission in the charging of a meteoroid. It has been shown [1] that the higher mobility of the plasma electrons (that would lead to negatively charged meteoroids) can be overcome by electron emission, thus reversing the meteoroid polarity. Moreover, recent work [2] has shown how electron emission can fundamentally affect the shielding potential around the dust. In particular, depending on the physical parameters of the system the shielding potential can develop an attractive potential well. The aim of the present work is two-fold. First, we will present a parametric study in order to understand the conditions for the formation, as well as the stability of the well. Furthermore, simulations will be presented with physical parameters corresponding to the ionosphere, thus extending our study to the case of meteoroids. [1] G. Sorasio, D. A. Mendis, and M. Rosenberg, "The role of thermionic emission in meteor physics," Planet. Space Sci. 49, 1257, 2001. [2] G.L. Delzanno, G. Lapenta, M. Rosenberg, "Attractive Potential among Thermionically Emitting Microparticles", submitted.

SA41A-07 0940h

Meteor Observations Near the Arctic Circle

Werner Singer[1] (+49-38293-680; singer@iap-kborn.de)

Ulf von Zahn[1] (vonzahn@iap-kborn.de)

[1]Leibniz-Institue of Atmospheric Physics, Schloss-Str. 6, Kuehlungsborn 18225, Germany

Since October 2001, we operate a Skiymet meteor radar at the ALOMAR site (69°N latitude) close to the Arctic circle. The gain pattern of the antenna covers a broad range in elevation angles and is almost independent of the azimuth. Due to its location, the axis of the radar antenna sweeps through the ecliptic North pole once a day throughout the year. In this geometry, it thus records meteor entry trajectories from a very large portion of the ecliptic Northern hemisphere. We report on the annual variation and altitude dependence of the observed meteor rate while the radar field-of-view is centered on the North ecliptic pole. The maximum meteor rate is reached in June, while the minimum (in January) is almost a factor three less. Independent of this special look direction, we have also report on the observed diurnal variation of the meteor rate throughout all seasons.

SA41B MCC: Level 1 Thursday 0830h

Energy and Momentum Balance in the Mesosphere and Lower Thermosphere: Results From the TIMED Mission IV Posters *(joint with A)*

Presiding: **J Yee,** Applied Physics Laboratory, Johns Hopkins University

SA41B-0426 0830h POSTER

Measurements of Solar FUV Spectral Irradiance: TIMED-SEE Results Compared with UARS and SORCE

Francis G. Eparvier[1] (303-492-4546; eparvier@colorado.edu); Thomas N. Woods[1] (tom.woods@lasp.colorado.edu); Gary J. Rottman[1] (gary.rottman@lasp.colorado.edu); Linton E. Floyd[2] (linton.floyd@nrl.navy.mil); William E. McClintock[1] (bill.mcclintock@lasp.colorado.edu); Martin Snow[1] (marty.snow@lasp.colorado.edu)

[1]University of Colorado - LASP, 1234 Innovation Dr., Boulder, CO 80303, United States

[2]Interferometrics, Inc. / Naval Research Laboratory, 4555 Overlook Ave., SW, Washington, DC 20375, United States

The solar radiative output in the far ultraviolet (FUV, from 120 to 200 nm in wavelength) deposits its energy in the Earth's mesosphere and lower thermosphere (MLT). Solar variability causes variability in atmospheric temperature, dynamics, and composition, making an understanding of the solar FUV vital to understanding the MLT region of the atmosphere. Currently there are three satellites with sets of instruments measuring the solar FUV spectral irradiance. The Solar EUV Experiment (SEE) on board the TIMED satellite has been measuring both the solar EUV and FUV daily since early 2002. The Upper Atmosphere Research Satellite (UARS), launched in 1991, continues to measure the FUV with two instruments: the Solar Stellar Irradiance Comparison Experiment (SOLSTICE) and the Solar Ultraviolet Spectral Irradiance Monitor (SUSIM). The Solar Radiation Climate Experiment (SORCE) mission was recently launched in early 2003 carrying two SOLSTICE instruments which measure the solar FUV. This paper will present the TIMED-SEE FUV measurements from early 2002 to the present and compare them with historical and simultaneous measurements from the UARS and SORCE FUV instruments, providing an overview of solar FUV variability on time scales from days to a full solar cycle.

SA41B-0427 0830h POSTER

Solar EUV Energy Deposition Rate Calculations for General Circulation Models

Stanley C. Solomon[1] (303-497-2179; stans@ucar.edu)

Liying Qian[1] (303-497-1529; lqian@ucar.edu)

[1]High Altitude Observatory, National Center for Atmospheric Research, 3450 Mitchell La., Boulder, CO 80301, United States

With new measurements of solar irradiance, such as by the TIMED solar extreme-ultraviolet experiment, now available in the extreme ultraviolet (EUV) and soft X-ray (XUV) regions of the spectrum from 1 to 103 nm, it is important to re-examine our quantitative representations of their effect on the Earth's atmosphere. EUV and XUV radiation photoionizes the upper atmosphere and creates the ionosphere, and also causes a variety of ancillary processes, including dissociation, excitation, and generation of photoelectrons. The solar spectrum is highly structured in parts of this region, so precise calculations of these effects should be made using high spectral resolution. This may be appropriate for detailed models of thermosphere/ionosphere processes, but global models require greater computational efficiency. Representation of photoelectron ionization is a particular problem for global models, because the ratio of photoelectron to photon ionization is so variable with altitude. We have developed a new method for parameterizing solar energy deposition and partitioning in the thermosphere that can be employed at fairly low spectral resolution with accurate results. This method is described, and its application to modeled and measured solar spectra demonstrated.

SA41B-0428 0830h POSTER

Detection of Long-Term Variations in Neutral Thermospheric Density

Frank A. Marcos[1] (781-377-3037; frank.marcos@hanscom.af.mil)

Neil J. Grossbard[2] (781-377-3752; neil.grossbard@hanscom.af.mil)

[1]Air Force Research Laboratory VSBXT , 29 Randolph Road, Hanscom AFB, MA 01731-3010, United States

[2]Boston College, 140 Commonwealth Avenue, Chestnut Hill, MA 02467-3862, United States

A new database of thermospheric densities has been derived for the period 1970 - 2000 from satellite orbital decay analysis. The data are generated from actual radar tracking observations, rather than from the less accurate historical element sets, to form precise orbit and drag/density data with improved accuracy and one-day resolution. Satellites with relatively high eccentricities were used to achieve long lifetimes and relatively localized latitude and local time resolution. We analyze data from six satellites with an average altitude of about 350 km. Data are compared to three empirical models (Jacchia, NRLMSIS and NASA MET). The data are normalized to remove systematic model errors vs solar activity detected in all three models. A linear regression fit through these normalized data is obtained for each satellite. The weighted average of these fits show a downward trend of 5.2 percent over 30 years with a 95 percent confidence interval of 1.1 percent. The results are analyzed as a function of solar flux and compared to theoretical predictions. Possible dependencies on local time, latitude and geomagnetic activity are also examined. These results tend to confirm global cooling at satellite altitudes, possibly associated with increased carbon dioxide in the thermosphere.

SA41B-0429 0830h POSTER

Long-term change in mesopause region temperatures over Fort Collins, CO (41N, 105W): Solar cycle effect and trends

Chiao-Yao She[1] (1-970-491-6261; joeshe@lamar.colostate,edu)

David A Krueger[1] (1-970-491-7381; krueger@lamar.colostate,edu)

[1]Colorado State University, 200 West Lake Street, Fort Collins, CO 80523-1875, United States

The Colorado State University Sodium Lidar has measured temperatures in the mesopause region (80-105km) for over 12 years. Based on 7 years' observation, an episodic change with a warming of 11.8K in 1993 at the mean mesopause altitude of 98km, attributable to Mt. Pinatubo eruptions, was reported. In this paper, we focus on the solar cycle effects. With 11 years of data to the end of 2001, we observed a maximum solar response of 0.06K/SFU at 99km, which decreases at lower and higher altitudes to nearly zero and appears to change sign at 82km and 104km. The phase changes are consistent with earlier midlatitude