be made with in-situ measurements. Similarly, comparisons of in-situ plasma density irregularities will be made with the locations of scintillation predicted by the model. These studies are part of a validation campaign for the forecast models prior to launch of the C/NOFS satellite.

SA31A MCC: 2002-2004 Wednesday 0900h

Van Allen Lecture *(joint with SH, SM)*

Presiding: **D Baker,** Laboratory for Atmospheric and Space Physics, University of Colorado; **R Strangeway,** Institute of Geophysics and Planetary Physics, University of California, Los Angeles

SA31A-01 0910h INVITED

New Insights Into Magnetospheric Physics From Recent Multi-Spacecraft Observations

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Please see abstract paper number SM31D-01 for the complete abstract.

SA31B MCC: 2006 Wednesday 1020h

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

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

SA31B-01 1025h INVITED

Solar Ultraviolet and X-ray Energy Deposition and Partitioning in the MLT

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Solar irradiance in the far-ultraviolet, extreme-ultraviolet, and soft X-ray regions of the spectrum is the primary energy source for the mesosphere and lower thermosphere (MLT). Recent measurements from the solar EUV experiment on the TIMED satellite, from the UARS, SOHO, SNOE, and SORCE satellites, and from various rocket flights, have greatly increased our knowledge of the intensity and variability of the solar spectrum. In this paper, model calculations are combined with measured solar irradiances to produce a description of ionization, dissociation, excitation, and heating rates in the MLT. Key issues and uncertainties are discussed, and a method for efficient computation of these rates in general circulation models is described.

SA31B-02 1045h

Solar Ultraviolet Variability During the TIMED Mission

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The TIMED satellite was launched in December 2001 near solar cycle maximum. The solar activity remained at solar maximum conditions during 2002 and has declined to moderate activity during 2003. As part of the TIMED mission objective to study the energetics of the upper atmosphere, the Solar EUV Experiment (SEE) aboard TIMED measures the solar extreme ultraviolet (EUV) energy input. The SEE instrument is measuring the solar UV irradiance with a spectral resolution of 0.4 nm between 27 and 194 nm and with 7-10 nm resolution shortward of 27 nm. The solar UV irradiance varies on all time scales, seconds to years, and this variation is very dependent on wavelength. During the TIMED mission, the SEE instrument has observed over 90 flares which last from minutes to hours, over 24 solar rotations which have a period of about 27 days, and maximum to moderate conditions during the current 11-year solar cycle. The coronal emissions, such as the Fe XVI 33.5 nm emission and X-rays, vary the most, with variations of a factor of 10 for the larger flares, a factor of 2 for solar rotation, and a factor of 4 during the TIMED mission (2 years). The transition region emissions, such as the H I 121.6 nm and He II 30.4 nm emissions, vary less, with variations of a factor of 1.2 for solar rotation and a factor of 1.4 during the TIMED mission. The chromospheric and photospheric emissions vary even less. The variations of the solar UV irradiance shortward of 194 nm and its effects on the upper atmosphere above 60 km will be discussed in the context of the TIMED mission.

URL: http://lasp.colorado.edu/see/

SA31B-03 1100h

Comparisons of Solar EUV Irradiance Variations from Measurements, Models and GUVI Terrestrial Far Ultraviolet Dayglow Observations

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During mid 2002, solar EUV irradiance changed slowly as the Sun rotated on its axis, and increased episodically in association with multiple solar flares. As the TIMED/SEE and SOHO/SEM instruments monitored the solar EUV irradiance changes directly, TIMED/GUVI observed concurrent fluctuations in the Earth's far UV dayglow. An integrated measure of solar EUV electromagnetic energy shortward of 45 nm, called QEUV, is derived from the GUVI dayglow measurements and compared with the directly measured EUV energy and estimates from four different variability models, each summed shortward of 45 nm. The values derived from the GUVI dayglow observations agree well with both the absolute values and solar rotation modulation of the NRLEUV model, and do not support recent suggestions that the solar EUV irradiances estimated by the model of Hinteregger et al. be increased by a factor of four, nor even a factor of two. High resolution (hourly) temporal structure present in QEUV tracks closely the increase in EUV energy during solar flares, monitored by SOHO/SEM, and documents a highly radiatively coupled solar-terrestrial system.

SA31B-04 1115h INVITED

High-latitude Energy and Momentum Balance in the Lower Thermosphere

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The high-latitude lower thermosphere is significantly influenced by energy and momentum forcing associated with magnetosphere-ionosphere coupling. Electric currents produce a force on the air and dissipate energy through Joule heating. The precipitation of energetic electrons and ions into the auroral regions produces additional direct heating, and also influences the energy balance through production of stored chemical energy, through modification of the concentrations of radiatively active species, and through modification of the electrical conductivity. We examine the resulting energy and momentum balance of the lower thermosphere with the aid of a thermosphere-ionosphere-electrodynamics general circulation model.

SA31B-05 1135h

Observations of High Latitude Magnetospheric Energy Deposition

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At polar latitudes, the highly variable magnetospheric energy sources, which manifest themselves as Joule and particle energy, complicate the energy balance of the lower thermosphere. The deposition rate of magnetospheric energy can, at active times and in specific altitude regimes, rival the deposition rate of solar VUV energy. The local heating produced by magnetospheric sources leads to a divergent wind circulation and the redistribution of composition over extended regions of the globe. The response of the mesosphere and lower thermosphere/ionosphere (MLTI) region depends not only on the magnitude of the magnetospheric energy source, but also on the altitude and type of energy deposited. Here, we investigate the vertical distribution of Joule and particle energy deposition rates as observed simultaneously with the Sondrestrom incoherent scatter radar. These observed rates will be compared with solar deposition rates determined from SEE observations of the solar VUV flux. The concurrent measurements in time and space of the two magnetospheric energy sources will also be used to investigate whether Joule energy and particle energy occur concurrently or illustrate any mutual dependence.

SA31B-06 1150h

Space Weather in the ITM: The May-June 2003 Storm and NASA TIMED/GUVI Observations and TIMEGCM Model Results

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The NASA TIMED mission samples all local solar times every 60 days. As such the coverage of any particular geophysical event could be at any local solar time. The May-June 2003 storm occurred when TIMED was in a near a 10AM LST at the ascending node when the storm began and precessed towards 8AM LST by the end of the storm. The Global Ultraviolet Imager (GUVI) on TIMED obtains images at 5 individual wavelength intervals simultaneously. From the TIMED vantage point at 625 km the instrument must scan from horizon to horizon (about 120 deg) to form an image. The integration period for any pixel is about 68 msec - this gives us an instantaneous picture of the auroral features. The May-June 2003 event was notable for the magnitude of the high latitude energy inputs - we see more than 100 ergs/cm2 at times in the GUVI images. We also report the observations of the southern hemisphere inputs. GUVI is able to track the response of the thermosphere to this energy input. We see large changes in the O/N2 ratio in the dayside images. We also note significant changes in the nightside electron density profiles.

URL: http://guvi.jhuapl.edu

SA31B-07 1205h

Analysis of the Energy Input and Loss in the Thermosphere During the Auroral Events Using SABER Infrared Limb Emission and GUVI Limb Emission

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The SABER instrument on TIMED is continuously measuring limb radiance profiles of CO_2 ν_3 (4.3-μm) and ν_2 (15-μm) and NO (5.3-μm) with unprecedented sensitivity. SABER provides limb radiances up to ∼130km for the 15-μm channel and ∼140-150km (approaching 200km during strong auroral events) for the 4.3-μm channel and over 200km (to 300km during storm conditions) for the 5.3-μm channel. From the SABER infrared channels and the GUVI FUV we have a measure of the auroral energy input at high latitudes into the lower thermosphere and its transport southward and its radiative loss through NO emission. We have previously reported that during the April 2002 geomagnetic storm the 4.3-μm band nighttime emission was enhanced dramatically in the high latitude regions. The NO 5.3-μm band emission also dramatically increased but it was not limited to the auroral zone. We extend this analysis to the October 2002 and May 2003 geomagnetic storms and to more isolated (short time) but strong auroral events. We will compare the morphology and time dependence of the enhancement in the 4.3-μm and 5.3-μm channels. Examining different situations in terms of length and strength of energy input allows us to better determine the lifetime of the enhanced NO emission (and hence a clue to the NO cooling) and the contribution of excited NO from auroral chemistry versus temperature and composition changes.

SA32A MCC: 2006 Wednesday 1340h

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

Presiding: **J Forbes,** University of Colorado

SA32A-01 1340h INVITED

Some Aspects of the Momentum Balance in Thermospheric Dynamics

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In the absence of drag, zonally averaged meridional pressure gradients drive purely zonal winds. However, the ions present in a weakly ionized thermosphere are constrained by electromagnetic forces and introduce a drag on the fluid. Zonal winds are slowed, and a global meridional circulation develops that introduces neutral composition changes and a feedback on the ionosphere. At high latitudes, where the magnetospheric convection electric fields force plasma to high velocities, collisions with the neutral atmosphere imparts a momentum source driving winds of many hundreds of meters per second. In addition, inertial forces introduce large asymmetries in the wind magnitudes expected in the dawn and dusk sector of the auroral oval. Sudden changes in high latitude forcing drive global-scale gravity wave surges. These surges propagate towards the equator, transmit new pressure fields, and impact the global wind field. At low latitudes, the Coriolis force tends to zero, leading to possibility of unforced zonal winds. Equatorial electrodynamics can move plasma and produce regions where ion drag is virtually zero, allowing large zonal winds to emerge.

SA32A-02 1400h

Studies on the Coupling Between the Neutral Winds and the Ionosphere at Low Latitudes

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The Appleton anomaly is caused by the upward E x B drift of the equatorial ionospheric plasma and subsequent diffusion along magnetic field lines to lower altitudes at higher latitudes. The strength and location of the Appleton anomaly has been thought to be controlled mainly by the interaction of the neutral winds with the electric and magnetic fields. Variability can arise from different geophysical processes affecting the neutral dynamics and the background electric/magnetic fields. In addition, ion drag from the differing densities between the two peaks of the anomaly can induce hemispheric differences in the zonal wind circulation. Recent global observations of the low latitude ionospheric structure revealed by TIMED/GUVI, TOPEX, and DMSP allow us to investigate the interplay between the neutral, plasma, and background fields. In this paper we will examine both satellite and groundbased measurements and interpret the findings using a global thermospheric/ionospheric model.

SA32A-03 1415h

Gravity Wave Forcing, Interactions, and Variability in the MLT

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Numerical studies of gravity wave breaking are revealing dramatic impacts on wave amplitudes, with amplitude reductions accompanying instability and turbulence far exceeding previous expectations. Theoretical studies likewise imply significant effects of strong local body forcing, while observational studies suggest occasionally strong forcing and considerable variability in both gravity wave activity and forcing of the large-scale flow. These effects are believed to be due to variable sources and to filtering by variable tidal and planetary wave motions. This talk will examine the likely impacts of these processes for wave forcing, wave interactions, and the parameterization of gravity wave effects throughout the MLT.

SA32A-04 1435h

Lidar Observations of Instabilities and Gravity Wave Dissipation in the Mesopause Region at Maui, Hawaii.

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Gravity wave dissipation in the mesopause region is closely related to stabilities of the atmosphere. The relations between the convective and dynamic instabilities and gravity wave dissipation are investigated using measurements made from a high-resolution Na wind/temperature lidar at Maui, HI (20.7 N, 156.3 W). It is found that the stabilities are modulated by the strong tidal perturbations in this low latitude site. Unstable layers appear as gravity waves pass through low stability regions that are formed by tides. Strong wind shear tends to occur in regions with high convective stability. There is also a clear correlation between the stabilities and gravity wave energy. The implications of these results on gravity wave dissipation and its impact on the mean atmosphere will be discussed.

SA32A-05 1450h INVITED

Elements of the energy budget of the mesosphere as revealed by the SABER experiment

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The energy budget of the terrestrial mesosphere remains a frontier of scientific inquiry. Many processes including direct deposition of solar energy, exothermic chemical reactions, and radiative emission by species such as carbon dioxide and ozone influence the energy balance and hence the thermal structure. The Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) experiment now operating in orbit on the Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics (TIMED) satellite has been designed to provide measurements of virtually the entire set of solar, chemical, and infrared radiative sources and sinks of energy in the mesosphere. In this paper we present the first assessment of these many sources and sinks of energy. We focus on the processes of solar energy deposition and conversion of energy to heat by exothermic chemical reactions, including an accounting of the loss of energy by airglow and chemiluminescence that reduces the amount of energy available for heat.

SA32A-06 1510h

Oxygen-Hydrogen Chemistry and Emissions in the Mesosphere: Modeling and SABER Observations

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Chemical reactions of the oxygen and hydrogen families control trace species such as mesospheric ozone and emissions by the dominant airglow features. In this study we focus particularly on the chemistry that affects the OH Meinel band emission of the upper mesosphere, which is measured by SABER. We compare model simulations with SABER emission data and address the following topics: the processes that maintain the vertical structure of the volume emission rate, the role of atomic oxygen transport in the structure and variability of emissions, and how tides and other dynamical processes affect the mean height and emission rate.

SA