to society by creating a Virtual Radiation Belt Observatory (ViRBO). The observatory will be an open access near real time and long term archive of observed and simulated radiation belt model data. It will enable scientists to test theoretical mechanisms proposed to explain how particles are accelerated and removed from the radiation belts and it will provide improved tools for engineers designing satellites and operators assessing satellite malfunctions. The observatory will capitalize on radiation belt modeling efforts currently underway at institutions throughout the country and support the goals of the electronic Geophysical Year (eGY) endorsed by the world wide community.

SM32A CC: 518 C Wednesday 1030h

Relativistic Electrons in the Earth's Inner Magnetosphere: Observations, Models, and Space Weather Implications II

Presiding: **G D Reeves,** Los Alamos National Laboratory**; J F Fennell,** Aerospace Corporation

SM32A-01 1030h

Characteristics of the March 31, 2001 0630 substorm injection front

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The global field reconfiguration associated with a geomagnetic substorm can have a significant impact on the dynamics of energetic particles (> keV) in the near-Earth tail and inner magnetosphere. For example, the Earthward-propagating wavefront associated with substorm onset can energize and inject plasma sheet particles into the stable trapping region of the inner magnetosphere and potentially provide a seed population of radiation belt particles. The physical characteristics of the injection front, including the amplitude of the perturbation fields, the propagation velocity, and the spatial extent of the wave front, determine the degree to which different magnetospheric populations are affected by the substorm onset. In this work, we examine the substorm occurring at 0630 UT during the March 31, 2001 geomagnetic storm. Using 3d MHD simulations of the event, we analyze the characteristics of the global geomagnetic field prior to onset, and discuss the properties and evolution of the subsequent substorm injection front. Test particle simulations are used to track the motion of ions and electrons moving under the influence of the dynamic substorm fields, in an effort to determine the properties and origin of those particles most effectively injected and trapped in the inner magnetosphere.

SM32A-02 1045h

Observations of Outer Zone Relativistic Electrons during the October-November 2003 Geomagnetic Storms

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We report on the measurements of outer zone relativistic electrons during the months of October and November 2003. This period showed high fluxes of relativistic electrons which resulted from the magnetosphere being driven by strong coronal mass ejections with solar wind speeds exceeding 1000 Km/sec. Our previous studies of electron energization events have shown that they exhibit spatial and pitch angle coherence. Such coherent behavior is indicative of energization of preferred pitch-angle electrons followed by rapid scattering and/or pitch-angle independent energization of relativistic electrons. It is of interest to examine these properties during "extreme" events such as the October-November period when the magnetosphere was subject to extremely intense solar drivers. We will investigate the pitch-angle and spatial coherence of relativistic electrons during the October-November event and compare them with the more "usual" events. We will use data collected by sensors onboard SAMPEX and POLAR which provide full coverage of the outer zone over energies ranging from about 0.5 MeV to about 15 MeV.

SM32A-03 1100h

Extreme MeV Electron Fluxes at Geosynchronous Orbit

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Following the work of Koons [2001], we examine the statistical properties of extremely high MeV electron fluxes at geosynchronous orbit. We extend the analysis to include a variety of timescales and energies using observations from Los Alamos and NOAA/GOES spacecraft. We use the statistical formalism of the generalized extreme value distribution, which represents the probability distribution of the maximum value taken out of a sample of fixed size. By taking the maximum flux observed in many non-overlapping intervals of several days, we can determine whether the maximum flux at Geosynchronous is likely to have a finite upper limit or an exponential or power-law tail. Our analysis indicates that MeV electron fluxes over a broad range of energies and timescales have a finite upper limit, a true worst case. However, the statistical estimate of this upper limit is inherently uncertain. We explore the sensitivity of the flux upper limit to changes in the sample interval. In particular, we find that samples from the declining phase (i.e. 1995) dominate the maximum value distribution.

SM32A-04 1115h INVITED

Predicting Radiation Belt Electron Fluxes and Space Weather Implications

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The intimate connection between the variations of radiation belt electrons and the solar wind velocity was identified soon after the solar wind was measured. This connection was demonstrated by the existence of a 27-day periodicity in the intensities of trapped electrons in the outer radiation belt. This correlation provides the base for scientists to develop various models to predict the variations of MeV electrons in the Earth's magnetosphere. In this presentation, the long-term and short-term variations of outer belt electron fluxes will be reviewed, so will the attempts and results of predicting their variations based on solar wind measurements.

SM32A-05 1130h

Electron Flux Prediction in the Radiation Belt Using Autoregressive Models With Optimally-Estimated Coefficients.

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Linear autoregressive (AR) processes have modeled many natural systems successfully. In this study, fourth and sixth order Kalman filters were used to identify the coefficients in time series of relativistic electron flux measurements in the region 1<L<10, available from SAMPEX. The estimation was done recursively, so that the optimal estimated coefficients up to the time of the most recent input measurement were computed. In addition to coefficient identification, AR model electron flux predictions using the optimal coefficients were compared to actual electron flux measured at the predicted time by SAMPEX, and the prediction accuracy was assessed. Results of this estimation and prediction, across all L-shells, demonstrated that the leading term in the autoregressive model was dominant. Further results indicate a nearly linear dependence in the leading coefficient with L-shell in the range from L=3 to L=10. Through these results, dynamical processes present in the outer radiation belt can be inferred. Autoregressive filters of higher order did not demonstrate marked improvement in their electron flux measurement prediction when compared with actual SAMPEX measurements. These results indicate the need for external inputs as can be provided by ARX models that will include solar wind measurements for improved modeled electron flux predictions.

SM32A-06 1145h

Modeling the Radiation Belt Electrons With Radial Diffusion Driven by the Solar Wind

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A radial diffusion model for predicting the relativistic electron flux in the outer radiation belt will be described. The model was developed by expanding the Li et al. [2001] geosynchronous prediction model, which simulates the relativistic electrons with the radial diffusion equation and a loss term. The diffusion equation is solved by making the diffusion coefficient a function of solar wind parameters. The Li et al. model is extended for prediction inside geosynchronous orbit by making some of the model parameters functions of L to represent the changing environment of radiation belt electrons at different L-shells. Using the extended model, prediction efficiencies of 0.54 and 0.56 were achieved for $L = 4$ and $L = 6$, respectively, for the year 1998 when compared with POLAR measurements at $L = 4$ and LANL geosynchronous measurements. These results, and those for individual storms, will be presented.

SM33A CC: 220 C-E Wednesday 1330h

Magnetosphere-Ionosphere Coupling in the Solar System III Posters *(joint with P, SA)*

Presiding: **B H Mauk,** The Johns Hopkins University, Applied Physics Laboratory**; C J Frank,** Southwest Research Institute

SM33A-01 1330h POSTER

Coupled Model of Storm Time Effects on the Low- to Mid-Latitude Ionosphere

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The details of how magnetospherically driven penetration electric fields couple to the mid- and low-latitude ionosphere and generate large scale variations and structure in the plasma density is of paramount importance to the NASA Living with a Star Program. We are developing a computational tool for self-consistent modeling of the coupled inner magnetosphere-ionosphere system. The approach is to combine two existing, but compatible, computer models which treat different parts of the physical system: the Rice Convection Model (RCM), which models the electrodynamics of the inner magnetosphere;

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and SAMI3 (Sami3 is Also a Model of the Ionosphere), which treats the physics of the low- and mid-latitude ionosphere. The fundamental coupling of RCM and SAMI3 is through the electrostatic potential Φ and the ionospheric conductance. The essence of the coupling scheme is as follows: (1) SAMI3 will provide the ionospheric conductance to RCM, (2) RCM will solve the potential equation to determine Φ and the electric field, and (3) RCM will then provide the electric field back to SAMI3. Thus, the coupled model will provide a self-consistent description of the ionosphere/inner-magnetosphere system to investigate the effects of penetration electric fields on the low- to mid-latitude ionosphere. We will present an overview of this program and preliminary results.

Research supported by NASA and ONR.

SM33A-02 1330h POSTER

Steady Magnetospheric Convection During Various Levels of Magnetic Activity

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Periods of enhanced magnetospheric convection without substorm signatures have been called Steady Magnetospheric Convection events (SMC). The working hypothesis to explain these events asserts that when the magnetosphere driving function is enhanced but constant for a sustained interval, it is possible to for the nightside reconnection rate in the magnetosphere to adjust to match the dayside reconnection rate. We test this hypothesis by analysis of the polar cap magnetic flux during SMC events. The poleward auroral boundary obtained from Polar UVI images is utilized to obtain the measure of the polar cap magnetic flux. The temporal changes of this boundary is used to determine the degree of balance between the dayside and nightside reconnection rates. We have investigated several SMC events during various activity levels ranging from moderate to intense magnetic storms. Along with Polar UVI data, the analysis includes: cross polar cap potential difference, mid-latitude magnetic disturbance field, Dst, ionospheric potential pattern, as well as the solar wind drivers.

SM33A-03 1330h POSTER

Multivariate Analysis of Polar Cap Convection

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Ionospheric convection speed in the polar cap is known to be associated with solar wind properties. The solar wind IMF Bz component is usually found to have the major effect on convection speed (see for instance MacDougall and Jayachandran, Radio Sci., v36, p1869-1880, 2001). The present paper reports a detailed reexamination of the dependency of polar cap convection on solar wind properties using multivariate analysis. The main finding of this new analysis is that the main component of the convection is usually the "DC" component which does not depend on any solar wind property.

SM33A-04 1330h POSTER

The Quasi-periodic Occurrence of Solar Radio Bursts, Auroral Kilometric Radiation, and Other Plasma Wave Phenomena Observed by the GEOTAIL Plasma Wave Investigation

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Type III solar radio bursts and auroral kilometric radiation (AKR) are among the most common phenomena observed by the GEOTAIL Plasma Wave Investigation in more than eleven years of operation. The occurrence of Type III bursts, generated in the solar wind by energetic electrons ejected from the sun by solar flares, varies from less than one per day to nearly continuous. When the bursts appear "periodic", the periods typically range from several hours to a few minutes. During solar maximum, some Type III "storms" occurred with bursts every second. Some of the "periodic" Type III bursts had lower cutoff frequencies that progressively dropped in successive bursts. The frequency of occurrence of the bursts is determined by processes at the sun. The change in emission frequencies is determined by the solar wind plasma density distribution. The detection of AKR is affected by the observing location. When GEOTAIL is on the night side of the Earth, the AKR observations are closely related to geomagnetic substorms. The onsets of strong AKR bursts are nearly simultaneous with substorm onsets. Although triggers of substorm onsets such as changes in the magnetic field direction or increases in the ram pressure can often be found in the solar wind, many times we observe AKR bursts with no apparent solar wind trigger for many hours. These bursts may be quasi-periodic with periods of tens of minutes to several hours, or sometimes they appear to occur randomly. Near perigee, GEOTAIL often detects electromagnetic chorus and electrostatic electron cyclotron harmonic waves. At times quasi-periodic episodes of one, the other, or both, are observed indicating periodic movement or structure of the magnetopause. The implications of the various observations to the coupling processes will be examined.

SM33A-05 1330h POSTER

Energy Flow from the Solar Wind Through Magnetosphere and Ionosphere in Global MHD Models

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Due to their different design, global magnetospheric models may at times generate different results for the same solar wind input conditions. In this situation, the average of a quantity obtained from concurrent simulations provides an estimate of the level of geomagnetic activity and the differences between the model results may serve as an estimated error level. We study the shape and location of magnetosphere-solar wind boundaries (bow shock, magnetopause) in simulations with the BATSRUS and Raeder-GGCM (aka UCLA-GGCM) models using prescribed and varying solar wind conditions. The energy fluxes across the magnetospheric boundaries are studied in relation to the energy dissipation in the ionosphere and the mapping of open and closed field lines into the ionosphere. The results are complementary to a similar study performed with the GUMICS-4 model [M. Palmroth et al., JGR **108**, 1048, (2003)] where energy transfers were found to follow solar wind parameters in a power-law relation. Parameters of this functional relation and correlation coefficients are calculated for the two models used in this study.

SM33A-06 1330h POSTER

Energetic Ions in the Solar Wind at 9 AU, Approaching Saturn: Cassini-MIMI/INCA Results

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The Ion And Neutral Camera (INCA) sensor of the Cassini Magnetospheric Imaging Instrument (MIMI) may be configured either as an energetic neutral atom (ENA) camera, or as a sensitive energetic ion sensor. During the distant approach of Cassini to Saturn, the ENA emission from Saturn is too weak to take advantage of the ENA imaging capability of INCA, and so it was configured to measure 10-200 keV/nucleon energetic ions in the solar wind. INCA is easily the most sensitive instrument in this energy range to have measured heliospheric energetic ions in the region between Jupiter and Saturn. The measurements are dominated by ions accelerated at interplanetary shocks, as both coronal mass ejections and corotating interaction regions pass the Cassini spacecraft. The angular distributions of these ions have not been fully charaterized over most of this region, as Cassini remained typically 3-axis oriented and INCA can measure only over a 90° x 120° field of view. From the beginning of 2004 on, as Cassini approached within 0.5 AU upstream and to the dawn side of Saturn, the spacecraft began pointing and rotating to optimize various science activities. In particular, Cassini was rotated about two different axes regularly over a 28 day period early in 2004 in coordination with Hubble Space Telescope observations of the Saturnian southern aurora, and INCA was able to obtain much more complete angular distributions during this interval. Several shocks passed Cassini during the 28 day period, and some of the observed ion anisotropies associated with those passages are consistent with a source in the vicinity of Saturn (possibly Saturn foreshock ions). Features of the energetic particle data will also be interpreted in the context of contemporaneous measurements of the ambient interplanetary magnetic field (allowing consistency with magnetic connection with Saturn's bowshock to be inferred, and shocks to be identified), solar wind plasma (allowing ion anisotropies to be transformed into the plasma rest frame), and HST auroral images (allowing associations between local solar wind structure and magnetospheric responses at Saturn).

URL: http://sd-www.jhuapl.edu/CASSINI/

SM33A-07 1330h POSTER

Saturn's Magnetosphere During the January, 2004 Cassini and HST Observations

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We present results of a 3D global magnetohydrodynamic (MHD) model of the Saturnian system during the month of January, 2004. During this month,

Cassini made measurements of the solar wind conditions upstream of Saturn while at the same time HST measurements were made of the Saturnian aurora and remote sensing measurements of the Saturn Kilometric Radiation(SKR) were made. Using both Cassini data and data propagated from Earth as input to our MHD model, we examine the state of the magnetosphere-ionosphere system for this period. In addition we examine the correlations between remote sensing measurements and the simulations. The model includes all the major factors that influence the Kronian magnetosphere: solar wind IMF, planetary rotation, ionospheric conductivities, plasma mass loading and the magnetospheric interaction with Titan. In addition to the study of events during January, 2004, we will present model results showing the effect of different mass loading models on the Kronian magnetosphere.

SM33A-08 1330h POSTER

The Features of Longitude Distribution of Ionospheric Up-flowing He+ Ion

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A theoretical model is proposed to study ionospheric up-flowing He+ ion distribution along the magnetic field line and to study the He+ ion distribution versus longitude in the magnetosphere. The results show that: (1) Along the field lines, the He+ ions density and flux drop with increasing of the geo-center distance. (2) The higher the Kp index, the quickly the density and the flux drop. (3) The He+ ion distribution changes with the longitude, when Kp = 0 the ions density has maximum at longitude 120 degree and 240 degree respectivelyand has minimum in the magnetotail, when Kp=3-5 the ions density has maximum at the subsolar, and has minimum in the magnetotail. However, the ion flux has maximums at longitude 120 degree and 240 degree respectively,and has minimum in the magnetotail for any Kp. (4) The results of the research for normalized density and flux of the He+ ions show that the geomagnetic configuration takes a key role in the ion distribution in the magnetosphere. Some results are consistent with the observation on the He+ ion distribution by the Extreme Ultraviolet Imager (EUI) on board the IMAGE spacecraft.

SM33A-09 1330h POSTER

Core ions in the dayside cusp: observations from the CUSP sounding rocket

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We investigate the sources and effects of flow pulsations and acceleration of low energy ($E < 1$ eV), or "core", ions in Earth's cusp. The CUSP sounding rocket flew from Ny Alesund, Svalbard, on 14 December 2002, carrying a complement of instrumentation within the cusp to an altitude of 768 km. The Suprathermal Ion Imager (SII), a two-dimensional energy/arrival angle ion spectrograph, observed significant ion outflow within the cusp. Within this upflow, SII observed a region of smaller amplitude pulsations with periods of 20–30 seconds. We will attempt to interpret these observations in the context of the other in-situ and ground-based data.

SM33A-10 1330h POSTER

Charge states of O and He ions injected at substorm onset: Geotail/EPIC observation

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Oxygen and helium ions in the Earth's magnetosphere are supplied from two sources, the ionosphere and the solar wind. The heavy ions from the ionosphere generally have low charge states (1+ or 2+), while those from the solar wind have high charge states. Therefore, we can gain information on the origin of magnetospheric ions by observing their charge states. For example, an increase of O+ ions in the magnetosphere may indicate that they recently flew out of the ionosphere. Determining ion charge state is very useful for the study of the magnetosphere-ionosphere coupling. To date, only a few satellites have carried instruments to measure ion charge states. Furthermore, these instruments did not have temporal resolutions high enough to study ion injection from the near-earth tail into the inner magnetosphere at substorm onset. In this study, we estimated the charge state of injected He and O and injection points of these particles, using the flux data from the EPIC/ICS instrument on Geotail; it can measure the mass of ions in the energy range of 50 keV - 3 MeV with a time resolution of 6 C 48 s. To estimate the charge state, we make use of the energy-time dispersion of ion injections. We assume that all ions are simultaneously injected from a point-like source and that the terrestrial magnetic field is dipole. We also assume that injected ions move with only the gradient drift. This is because the E×B drift is estimated to be much smaller than the gradient drift in the ICS energy range under quiet conditions. In addition, the curvature drift is neglected because we use the flux data with a pitch angle of 90 degrees near the geomagnetic equatorial plane. Therefore, the drift time of particles (T) is proportional to ion's charge state (Q) / energy (W) ratio, since the gradient B drift is proportional to W/Q. We estimated the charge state (q) of ions from observationally determined T. We made a statistical analysis using data in the solar maximum period (October 2000 - September 2001) and the solar minimum period (January 1996 - December 1996). We found that the average charge states of O during the solar maximum period were lower than those during the solar minimum period, implying that the ionospheric ions become more abundant during the solar maximum. The charge states tended to be higher for both O and He ions as the energy range became higher, regardless of solar activity. Almost all injection occurred in the region from dusk to midnight.

SM33A-11 1330h POSTER

The Nonlinear Coupling of Electromagnetic Ion Cyclotron and Lower Hybrid Waves in the Ring Current Region

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The excitation of lower hybrid waves (LHWs) is a widely discussed mechanism of interaction between plasma species in space, and is one of the unresolved questions of magnetospheric multi-ion plasmas. In this paper we present the morphology, dynamics, and level of LHW activity generated by electromagnetic ion cyclotron (EMIC) waves during the May 2-7, 1998 storm period on the global scale. The LHWs were calculated based on a newly developed self-consistent model (Khazanov et. al., 2002, 2003) that couples the system of two kinetic equations: one equation describes the ring current (RC) ion dynamic, and another equation describes the evolution of EMIC waves. It is found that the LHWs are excited by helium ions due to their mass dependent drift in the electric field of EMIC waves. The level of LHW activity is calculated assuming that the induced scattering process is the main saturation mechanism for these waves. The calculated LHWs electric fields are consistent with the observational data.

SM33A-12 1330h POSTER

Global ring current pressure during geomagnetic storms: solar wind and storm phase dependence

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The global ring current proton pressure in the 10-198 keV range can be obtained from Energetic Neutral Atom (ENA) images obtained by the HENA imager on board IMAGE. We present a study of the proton pressure distributions during geomagnetic storms with from 2000-present. HENA is capable of retrieving the O^+ pressure in the 50-250 keV range, but with a coarser angular resolution and spread. Examples of the inferred O^+ pressure distribution are shown. We discuss how the ring current morphology depends on interplanetary magnetic field (IMF) B_z and B_y and solar wind pressure. We also show transitions between a mainphase ring current configuration and a recovery phase ring current configuration. Validations against in-situ Cluster and geosynchronous observations are shown.

SM33A-13 1330h POSTER

Testing the hypothesis that charge exchange can cause a two-phase decay

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We test the hypothesis that a two-phase decay of the ring current energy content can be produced by the differential charge exchange loss rates of hot O^+ and hot H^+. Results are presented from idealized simulations of ring current decay and show that, for realistic plasma boundary conditions, a two-phase decay can only be created by the transition from flow-out to charge exchange dominance of ring current loss. Differential charge exchange between hot ($E>40$ keV) O^+ and hot H^+ cannot produce the observed two-phase decay signature for several reasons. First, there are always significant levels of low-energy ($E<40$ keV) H^+ present in the injected plasma, which charge exchanges rapidly and makes the H^+ loss rate comparable to or greater than the O^+ loss rate. Second, the ring current is spread over a wide range of L values, and the total charge exchange loss rate is an integral value that does not suddenly change. Third, this integral loss rate is too slow (at least in the results presented here) to create a rapid loss of ring current energy content. Other possible causes of two-phase decay signatures in the stormtime Dst index are briefly discussed.

SM33A-14 1330h POSTER

Comparisons between upstream solar wind magnetic field observations and Saturn's aurora

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During January 2004 a campaign to study the influence of changes in the upstream solar wind on Saturn's aurora were carried out using data from the Cassini fields and particles instruments and images from the STIS instrument on the Hubble Space Telescope. Initial

investigation of these images reveals a considerably dynamic auroral oval, with the promise of some clear correspondences with upstream Cassini data that will provide unique insight into Saturn's magnetospheric dynamics. The results will also provide impetus to interpretation of in situ field and plasma data once we arrive in Saturn orbit.

SM33A-15 1330h POSTER

A Self-Consistent Approach to Modeling Ion Outflows Associated with Electromagnetic Ion Cyclotron Waves

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Energetic heavy ion outflows detected by satellites in the auroral region are commonly associated with electromagnetic ion cylotron wave activity (1-100Hz) observed by the same spacecraft. Because the Poynting flux of the waves is into the ionosphere, the waves can provide an energization source for the concomitant ion heating. One difficulty with relating the ion outflows to the wave activity is the nonlocality of the heating process—much of the heating occurs between the ionosphere (where the ions originate) and the spacecraft. A common approach is to obtain a heating rate based on the assumption that the wave spectral density is invariant along the auroral field lines, which provides an estimate of the local ion heating rate. However, wave propagation and dissipation depends strongly on the heavy ion concentrations in the topside ionosphere as well as the collisional ionospheric model, and therefore the wave spectrum—and heating rate—at a given altitude is also strongly dependent on the plasma model. Thus, the plasma background modifies the wave propagation and heating rate. However, the heating rate determines the background plasma profiles. To account for this feedback, we successively iterate (1) a wave propagation code based on background plasma profiles (which solves the full electromagnetic equations including a realistic ionospheric model) and (2) a Monte Carlo simulation code to obtain the ion profiles based on heating rates obtained from the results of the wave propagation code. The method converges rapidly to a stable state, and the results suggest that temporal evolution of the plasma profiles would involve a two-step process where helium is first heated then oxygen. The results also suggest that helium is typically preferentially heated compared with oxygen as is observed.

SM33A-16 1330h POSTER

A One-dimensional Ionosphere Solution with Self-consistent Neutral Motion

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We take a systematic approach to study the coupling from the solar wind and the magnetosphere to the ionosphere and thermosphere, based on three-fluid treatment: electrons, ions, and neutrals, with collisions among the three species. The momentum equations of the three species are converted into the generalized Ohm's law and the plasma momentum and neutral momentum equations. By allowing the collision frequencies and the densities to vary as functions of height, this formulism continuously and smoothly describes the plasma conditions from the collisionless solar wind and magnetospheric plasma to the partially ionized ionosphere/thermosphere gases. We solve this equation set in one-dimension to model the magnetosphere-ionosphere/thermosphere coupling at high latitudes near the poles where Birkeland (field-aligned) currents and precipitating particles are not important. Since the solution is self-consistent, the neutral wind speed is a function of height and time and thus cannot be taken as specifying a single frame of reference. In the ionosphere, the plasma velocity is also a function of height and cannot be treated as a constant. The results show that the F- and E-layers of the ionosphere may behave differently. For example, when the IMF reverses its direction after a long period of steady state, there is a transient enhancement of Pedersen current in the F-layer.

SM33A-17 1330h POSTER

Modeling the Direct Penetration of Electric Fields to the Equatorial Ionosphere

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The interplanetary electric field has been observed to penetrate directly to the equatorial region where it affects the generation of plasma bubbles which, in turn, cause the scintillation of transionospheric electromagnetic signals. We use the approach of Nopper and Caravillano [1978] to model the effect of the Region I and Region II currents on the global electric field. We find, consistent with observations, the well-known shielding of the equatorial region by Region II currents. Numerically, two approaches are taken. The first approach is to solve N-squared simultaneous linear algebraic equations for each of the grid points. The second approach is to use the Multigrid technique, which allows a rapid convergence of the SOR (successive over- relaxation) iterations. The advantage of the algebraic approach is accuracy , while the advantage of the second approach is speed. Further comparisons between these two approaches will be made. Effects of the magnetic dipole tilt relative to the polar cap, the presence of a sub storm current wedge, the saturation of the transpolar potential, and seasonal effects will be discussed . Nopper R.W. and R. L. Carovillano, Geophys. Res. Ltrs., 5, 699, 1978.

SM33A-18 1330h POSTER

Monte Carlo Study of Secondary Electrons and X Rays Produced by Vertical vs. Horizontal Arrival of Precipitating Electrons at the Top of the Atmosphere

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Electron precipitation from the outer belt is an important input of energy and electric charge to the atmosphere. The ionization profile (ionization rate vs. altitude) may be affected by the direction at which electrons enter the top of the atmosphere. Definitive measurements of the angular distribution of precipitating electrons at the top of the atmosphere have not been made; studies of the problem have made a number of assumptions in this regard. Consideration of the mechanism by which electrons in the drift loss cone enter the atmosphere due to eastward drift suggests horizontal entry: an electron in the process of mirroring near the top of the atmosphere encounters a region where its gyro-circumference is equal to its mean-free- path and it collides with an atmospheric molecule. In order to study whether horizontal entry at the top of the atmospere could have a significant effect, we have investigated this question by comparing horizontal to vertical entry with a Monte Carlo study using the FLUKA code. Assuming an energy spectrum typical of outer belt electrons up to 10 MeV at entry, both electrons and X rays were followed down to energies of 100 keV. The Monte Carlo results are compared to measurements in the atmosphere of electrons made below 80 km on rocket-boosted, parachute-deployed payloads, and to measurements of X rays made on balloon payloads at altitudes of about 35 km.

SM33A-19 1330h POSTER

Energy transfer through the LFM MHD model

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We present analyses of energy transfer through the solar wind-magnetosphere-ionosphere system using the Lyon-Fedder-Mobarry global magnetohydrodynamic model. We define magnetospheric regions based on plasma parameters or locations (plasma sheet, magnetic lobes, magnetopause), and calculate the thermal, magnetic, and kinetic energy content of those regions as a function of time during a simulation of an isolated substorm on December 10, 1996. We will compare the model results to previous energy budget analyses based on multipoint spacecraft observations.

SM34A CC: 517 A Wednesday 1530h

Parker Lecture *(joint with SA, SH)*

Presiding: **D N Baker,** Laboratory for Atmospheric and Space Physics

SM34A-01 1540h INVITED

The Sun and Heliosphere as Revealed by Suprathermal Electrons

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Solar wind electron distributions near 1 AU are generally well described as a superposition of two distinct components: a cool core or thermal component and a relatively hot suprathermal component. The breakpoint between these two populations commonly occurs at about 60 eV at 1 AU. The suprathermal component carries the solar wind electron heat flux, is almost always nearly collisionless, behaves largely as a test particle population streaming freely through the solar wind along the heliospheric magnetic field, and is commonly highly anisotropic in the solar wind rest frame. In this lecture I demonstrate some of the remarkable spatial and temporal intensity and pitch angle variability of the suprathermal electron component at energies below about 1.4 keV, relate that variability to different solar and heliospheric processes, and illustrate aspects of the large-scale magnetic topology of the heliosphere revealed by suprathermal electron observations.

SM41A CC: 220 C-E Thursday 0830h

Relativistic Electrons in the Earth's Inner Magnetosphere: Observations, Models, and Space Weather Implications III Posters

Presiding: **S G Kanekal,** Catholic University of America**; X Li,** University of Colorado

SM41A-01 0830h POSTER

Long-Term Prediction of MeV Electrons in Geostationary Orbit

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The flux of MeV electrons at geostationary altitude represents a gauge of the radiation levels associated with severe solar and geomagnetic disturbances. Several techniques have been developed to forecast MeV electron flux, mostly aiming at giving a one to three