the Alfven transit scale, that is $k_\perp \lambda_A \simeq 1$, will provide energy into electron acceleration. This process is expected to be more effective above a conductive ionosphere. These theoretical predictions could be verified with the multi-satellite measurements in the Cluster-2 mission.

SM41B-0573 0830h POSTER

Polar distributions of small-scale magnetic disturbances derived from the Akebono magnetometer data

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In the cusp and its vicinity, burst-like disturbances of magnetic and electric fields are often observed on Freja, FAST, and Akebono spacecraft. Recent studies suggest that these small-scale disturbances are signatures of the dispersive Alfvén waves (DAW) and the ionospheric Alfvén resonator (IAR) excited in the topside ionosphere. These disturbances would play a key role in the energy coupling between the magnetosphere and the ionosphere. The purpose of this study is to obtain the polar distributions of these small-scale disturbances and their contributions to field-aligned currents from the Akebono magnetometer data. We analyzed the magnetometer data of 2596 passes in 1991 during the periods when the Akebono satellite was located above an altitude of 5000 km with the FFT method. The obtained polar maps show that the region of intense magnetic disturbances in the frequency range 0.0156-0.125 Hz covers the local time sector from the dayside cusp to the dawnside. In contrast, no intense disturbances are found on the nightside and duskside region. It is also found that in the altitude region from 5000 to 8000 km intense magnetic disturbances are observed over a wide latitude range from the auroral oval to the polar cap, while in the altitude region above 8000 km, these disturbances are concentrated in the dayside cusp region and its vicinity. We will discuss the origins of such day-night and dawn-dusk asymmetry and altitude dependency.

SM41B-0574 0830h POSTER

Effects of the seasonal asymmetry in magnetospheric thermal density distribution and ionospheric conductance on the rate of energy deposition into auroral ionosphere

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A 2D numerical model of the coupled magnetosphere-ionosphere system has been used to analyze the effects of seasonal variations in thermal plasma density distribution along magnetic flux tube and ionospheric solar-induced Pedersen conductance on the development of ionospheric feedback instability and associated energetic electron precipitation. The numerical model includes a model of the horizontally inhomogeneous auroral ionosphere with conductivity dynamics coupled to a two-fluid MHD model describing dispersive shear Alfvén dynamics in the magnetosphere. Effects of plasma anomalous resistivity and Alfvén wave dispersion in the magnetospheric MHD model lead to the formation of parallel electric fields above the ionosphere as the feedback instability evolves. The energy deposition rate of energetic electrons is estimated from Fridman-Lemaire theoretical model based on adiabatic motion of loss-cone electrons originating in the equatorial magnetosphere. Due to the seasonal asymmetry in thermal electron density distribution along magnetic field lines and ionospheric Pedersen conductance the rate of kinetic electron energy deposition is significantly greater in the dark winter hemisphere where the thermal plasma density at the auroral acceleration region and solar-induced ionospheric conductance are substantially lower. It is also demonstrated that the asymmetry in thermal density distribution leads to seasonal variations in the altitude of acceleration region, while the asymmetry in ionospheric conductance results in hemispherical asymmetry of field-aligned Poynting flux. The higher energy deposition into the dark ionosphere may increase the occurrence of discrete aurora as been demonstrated by satellite measurements of energetic electron precipitation and UV auroral imaging.

SM41B-0575 0830h POSTER

Automated Classification of Auroral Images

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Modern ground-based auroral All-Sky Imager (ASI) networks capture millions of images annually. While case studies still play an important role in auroral research, there are important reasons for developing automated analysis tools for use on large numbers of images, which is required for objective statistical studies. Future programmes such as NASA's THEMIS (Time History of Events and Macroscale Interactions during Substorms), which will produce about 84 million auroral images annually, can not fully utilise the data without automated tools. We have developed computer vision techniques for automatic classification of auroral images in terms of the type of aurora they contain. In this paper, we discuss our approach in formulating a numerical representation of the contents of each image, and the results of the application of these techniques to roughly 500,000 images from CANOPUS and MIRACLE. We also discuss possibilities for incorporating these techniques in multi-instrument statistical studies in which extensive ASI data sets will be combined with other obsevations, like solar wind or ground-based magnetometer data.

SM41B-0576 0830h POSTER

The global patterns of Joule heating in the high-latitude ionosphere

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Joule heating in the high-latitude ionosphere and upper atmosphere, which depends on geomagnetic activities and the solar activities, is an important factor for several critical problem areas in the space weather, among them satellite drag, changing satellite position and lifetime. The statistical global patterns of the hemispheric Joule heating are being studied over a complete solar cycle, based on Weimer electric field model and height-integrated conductance model. These statistical patterns are used to study the dependence of the hemispheric Joule heating on the levels of geomagnetic activity and the phase of solar cycle. This investigation also provides the opportunity to identify periods of variations in the upper atmospheric temperature and neutral density. The preliminary results of this study are presented.

SM41B-0577 0830h POSTER

Correlation between DMSP Particle Data and Polar Image Intensities

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Precipitating particle data from the DMSP F12 and F13 satellites has been merged with image intensities from the Ultraviolet Imager (UVI) and Earth Camera (EC) on the Polar satellite. Particle data were averaged within an image accumulation time and matched with the image intensity along the corresponding segment of the DMSP trajectory in magnetic local time coordinates. The particle data and image intensity data of many hundreds of such matches were then correlated with a simple linear fit. The image intensities have the best correlation with precipitating electron energy, and the intensities correlate less well with other particle data such as the precipitating proton data, at least when considering the overall polar region. Similar correlations can be performed to detail energy input into a specific region of interest, such as the dawn or dusk side of the oval, or the equatorward or poleward side. The good correlation between the precipitating particles and the image intensities suggests that imagers can be directly calibrated to measure energy input without the additional complication of modeling the intensities based on hypothetical particle fluxes. In this way, a map of global energy input into the aurora may be derived based wholly on measurements

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SM41C MCC: Level 1 Thursday 0830h

Radiation Belts and the Inner Magnetosphere I Posters

Presiding: **R H Friedel,** Los Alamos National Laboratory**; S R Elkington,** Laboratory for Atmospheric and Space Physics, University of Colorado

SM41C-0578 0830h POSTER

Exploring the Inner Magnetosphere with the Magnetospheric Multiscale Phase I Orbit

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We discuss the use of the unique space-time separated measurements that will obtained by the Magnetospheric Multiscale (MMS) Solar Terrestrial Probe mission for better understanding the dynamics of the terrestrial inner magnetosphere. The first phase of MMS will involve a low inclination orbit approximately 1.2 X 12 earth radii geocentric. The MMS primary science goals center on measurements made at the outer part of this orbit. However measurements will also be possible during the inner part of the orbit which would allow studies of microscale processes of importance to inner magnetospheric dynamics. We will discuss the applicability of these observations to the objectives of the Living With A Space Geospace program

SM41C-0579 0830h POSTER

The feasibility of measuring electric and magnetic field parameters at geostationary orbit using LANL satellites

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In this paper we investigate the feasibility of deriving large-scale electric and magnetic fields at geostationary orbit by comparing particle flux time series between pairs of LANL geostationary satellites. In the Earth's magnetosphere particle motions can be described by parameterized drift equations. By measuring the particle drift velocities at different energies and pitch-angles, we can in some situations fit for these parameters and thus have a description of the large-scale fields. The drift velocities are derived by measuring the time-offset between time series measured at different satellites. There are several complications: First

and most serious, the mere fact that time series are correlated between satellites does not guarantee that the two satellites are measuring the same population. And second, the actual energy/pitch-angle bins are sufficiently wide that an optimal fit cannot be obtained without modeling the dispersion within the bins. We will present the results of the dispersion calculations, match-up of time series and fit to large-scale parameters.

SM41C-0580 0830h POSTER

Azimuthal Properties of Pc3-5 ULF Waves at Geosynchronous Orbit: GOES Results

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Since late 2001 four and sometimes five NOAA GOES satellites have been operating at geosynchronous orbit. For example, in September 2001 GOES 8 was located at 74.9 degrees West, GOES 12 at 89.9 degrees West, GOES 11 at 108.7 degrees West and GOES 10 at 134.5 degrees West. This range of 60 degrees in longitudinal coverage with adjacent satellite pair spacing of the order of 15-27 degrees provides a unique geosynchronous satellite chain of magnetometers, ideal for the study of the azimuthal properties of Pc3-5 $1-100mHz$ ultra-low frequency ULF waves. At synchronous orbit these waves may be observed as field line resonances, compressional cavity or waveguide mode resonances, or as propagating waves for the higher frequency Pc3 waves. Results will be presented on the spatial extent and azimuthal wave numbers of the various wave types seen in order to identify modes seen at both storm and quiet times.

SM41C-0581 0830h POSTER

Modeling Albedo Particles Distribution at the near Earth Region

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A recent space experiment, Alpha Magnetic Spectrometer (AMS), had measured cosmic rays at altitude 400km. An unexpected result is a secondary spectrum at below cutoff. Their energy ranges from 0.1 to 6 GeV. These particles, called albedo particles, originate from atmosphere and rebound to space. They stay at space in very short time. These albedo particles compose a high energetic part of space radiation but little knowledge of them is known. They have energy near the minimum ionization and have greatest penetrating power. A good model of these high energetic particles is essential to the modeling of radiation dosage in space. To reach this goal, computer simulation code of albedo particle fluxes covering areas outside AMS flight path is developing. The major difficulty is the massive amount of computer simulation. For re-tracing AMS data, the estimate time is approximately 500 days for a Pentium III 500MHz computer. To assess the possibility to reduce computing time, we adopt adiabatic invariants method to trace particles in the IGRF field model. Our previous studies have used this method to simulate energetic particles' equatorial trajectories for VIP4 model of Jupiter at much less computing time. The global distribution of fluxes would be deduced from the available AMS data.

SM41C-0582 0830h POSTER

Multiple Balloon Campaign (MINIS) to Study MeV Electron Precipitation

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A unique new Antarctic multiple balloon campaign MINIS (MINIature Spectrometer) is set for launch in December 04. Using small (7000m^3) hand-launched balloons, four identical payloads will carry a suite of instruments principally designed to study the precipitation of relativistic (MeV) electrons from the radiation belts. The payloads will have the opportunity and the capability to study rare, recently discovered precipitation events that are short-lived and precipitate only the highest-energy electrons, (Foat et al. 1998, GRL 25, no. 22; Millan et al. 2002, GRL 29, no. 24). Understanding the loss mechanisms for the MeV electron radiation belt population is interesting in its own right, but may also help us to understand the origin and acceleration of these particles and better protect satellites from radiation damage. MeV electron precipitation events may even influence ozone depletion at mid to high latitudes, depending on the downward transport of odd nitrogen compounds. Each MINIS payload will include a NaI scintillator for the detection of bremsstrahlung X-rays as well as instruments to detect electromagnetic fields and waves which will help indicate the cause of a given precipitation event. The payloads will be launched successively in December 2004 from the South African National Antarctic Expedition IV (SANAE) base (72S,2E) such that they will be able to simultaneously study temporal and spatial variations in the precipitation of electrons in both the bounce-loss and drift-loss populations at L-values between 4 and 6. Having four balloons at different positions will also allow us to study magnetic local time effects in the precipitation processes and will also provide a new platform for studying substorm evolution in conjunction with existing instruments on the ground and in space. In preparation for the December '04 campaign from SANAE, a single balloon will be launched in December '03 from McMurdo Station, Antarctica in order to test the payload performance and begin to gather data on these unusual precipitation events.

SM41C-0583 0830h POSTER

Mechanisms of the outer radiation belt electron flux variation during magnetic storms

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We have investigated variations of the energetic electron flux (> 0.4 MeV) and the magnetic field in the outer radiation belt obtained from the Standard DOse Monitor (SDOM) and the MAgnetoMeter (MAM) of the Space Environment Data Acquisition equipment (SEDA) onboard Tsubasa (Mission Demonstration Test Satellite (MDS)-1). Since Tsubasa operates in geostationary transfer orbit (GTO) with an orbital period of 10 hours and an inclination of 28.5 degrees, it has provided a rare opportunity for directly observing near-equatorial radiation belt plasma particles and the magnetic field during magnetic storms. The decreases of the energetic electron flux during the main phase of the magnetic storms, and the subsequent recoveries and enhancements during the recovery phase in the outer radiation belt are linked respectively to typical variations of the magnetic field. At the moment that the outer radiation belt flux sharply drops during the main phase of the 17 April 2002 magnetic storm, the butterfly distribution is observed at L=5 and the magnetic equator where the magnitude of magnetic field is much smaller than the IGRF model. Calculating the drift motions of the energetic electrons in the Tyganenko 2001 magnetospheric magnetic field model, shows that the drift-shell splitting mechanism could generate the butterfly distribution due to loss of the near-equatorially mirroring electrons through dayside magnetopause boundary. We evaluate roles and contributions of the other possible mechanisms to explain the flux decreases. We discuss the three-dimensional field configuration in the magnetopause to compare with the low earth orbital observation of the outer radiation belt flux.

SM41C-0584 0830h POSTER

A Long-lived Enhancement of >30 keV Electron Fluxes at Very Low L-values

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Beginning in May, 2003 and continuing through the summer, the NOAA/POES satellites have observed the >30 keV trapped electron fluxes at L-values between 1.18 and 1.22 elevated by about a factor of 100 over their normal intensities. At lower L-values the electron fluxes have displayed dramatic (factors of 1000 and more), but short lived, intensity increases. We hypothesize that solar wind/magnetospheric activity, especially the storm of May 29, greatly enhanced the energetic electron population at L-values above 1.18 where losses to the atmosphere are low. Continued magnetospheric activity during the summer transported electrons from that reservoir inward in L thus producing large intensity enhancements on drift shells that intersect the atmosphere where the electrons are quickly lost. NOAA/POES observations complemented with data from other spacecraft supporting this hypothesis will be presented.

SM41C-0585 0830h POSTER

Low Altitude Distribution of Radiation Belt Electrons

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In radiation belt mapping it is usual to assume that particle data are independent of the phase angles associated with gyration, bounce, and drift motions. Similarly, trapped particle modeling often addresses the bounce and drift averaged distribution of the guiding centers. These are useful approximations for the high altitude radiation belt, where most of the observed particles have mirror points that are well above the dense atmosphere. The reverse is true at low altitudes (below ∼1000 km) where it becomes necessary to account for the role of the atmosphere in creating strong bounce and drift phase dependences of the trapped particle guiding center distributions. Such a computational model of the low altitude electron distribution is described. It applies to geomagnetically quiet periods of decaying electron intensity and to locations inside the plasmasphere where plasma waves are the dominant scattering mechanism that cause diffusion into the atmospheric loss cones. The model parameters are adjusted to fit samples of electron data taken by a low altitude satellite, thereby providing empirical constraints on theories of radiation belt electron losses.

SM41C-0586 0830h POSTER

Quantification of Relativistic Electron Microburst Losses During the GEM Storms

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Bursty precipitation of relativistic electrons has been implicated as a major loss process during magnetic storms. So-called microbursts appear to contain enough electrons to empty the prestorm radiation belts in approximately a day. During storms that result in high fluxes of trapped relativistic electrons, microbursts continue for several days into the recovery phase, when trapped fluxes are dramatically increasing. The present study shows that this apparent inconsistency is resolved by observations that the number of electrons lost to microbursts is many times larger during the main phase than during the recovery phase of several magnetic storms chosen by the Geospace Environment Modeling (GEM) program.

SM41C-0587 0830h POSTER

Observations of Particle Injection and Loss Processes in the Earth's Radiation Belts

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CEPPAD IPS data of positive ion pitch-angle distributions (PADs) with energies of 15-234 keV during the 1997 geomagnetic storms of January 10 and May 15 were analyzed for injection, scattering, and precipitation. These events were chosen for the particular orientation of the POLAR spacecraft orbit, which roughly covers the dusk-dawn and noon-midnight meridians respectively. During the course of the storms, the data showed extensive isotropic PADs over the dusk-to-midnight MLT sectors for L-shells between 5-10, indicating strong pitch-angle diffusion. Filled loss cones were also observed associated with the isotropic distributions, signifying the presence of intense precipitation in these regions. These findings were corroborated with data from Polar's CAMMICE MICS instrument. Tsyganenko's T01 model was used to trace the field line of in situ observations and derive mirror points, equatorial crossing points, and radii of curvature of the field line. Mappings of in situ PADs into the equatorial plane were then compared with magnetospheric model simulations. At lower L-shells the observed strong diffusion and precipitation was found to be in agreement with model simulations, which incorporate wave-particle interaction loss processes. However the radial profiles of trapped and precipitated particles as well as field line curvatures, points to a wide scattering source at higher L. These finding are interpreted as the signature of non-adiabatic pitch-angle scattering in the dusk and night side current-sheet. Unlike pitch-angle scattering induced by wave activity, which is a local effect at low L-shells, current-sheet scattering is associated with a much wider and extensive region.

SM41C-0588 0830h POSTER

Phase Space Distribution of Relativistic Electrons at Geosynchronous Orbit

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Understanding the behavior of relativistic electrons in the Earth's radiation belts is of great significance for both practical and theoretical reasons. Although many models have been developed to describe the acceleration, transportation and loss processes, the differentiation of those competing theories eventually calls for a data-assimilation based global electron phase space density model. As an initial step in this development we present the relativistic electron phase space density distribution in the vicinity of geostationary orbit. Combining data from the LANL geosynchronous SOPA and ESP instruments with data from the GOES satellites provides up to 8 simultaneous measurements distributed in longitude. Because of the tilt of the magnetic equator with respect to the geographic equator and drift shell splitting for different pitch angles each satellite samples a different range of L* throughout its orbit. We use a storm-time magnetic field model and the measured pitch-angle resolved electron spectra to determine the phase space density as a function of fixed adiabatic invariants at each spacecraft. Comparing all satellite measurements provides a determination of the global phase space density gradient over the range L* 6-7 as a function of both universal time and local time. We also describe methods for simultaneously solving the field model and particle distributions as a next step toward a global data-assimilation based radiation belt model.

SM41C-0589 0830h POSTER

A Correlation Study for Substorm Injection Electrons in Relativistic Electron Events

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While it is presumed that substorm injection electrons of a few hundred keV are the seeds for relativistic electrons frequently observed during the recovery phase of storms, correlation between the two events has not been well explored with the observed satellite data. We would like to address this problem in the present paper using the data from the geosynchronous GOES and LANL satellites as well as from the polar orbiting NOAA satellites. Our statistical study shows the two channels of LANL SOPA instrument, 105 - 150 keV and 150 - 225 keV, best correlates with the increase of the flux levels of GOES relativistic electrons. Especially, the relativistic electron events are not observed when the flux levels of these two channels are maintained low in the substorm injections, regardless of the level of the ULF activities. . The conclusion does not change whether the substorm injections occur during the storm recovery phase or during the non-storm time. As the ULF waves are observed quite frequently over the entire range of L=4 to L=7, the reason why REEs are seen mostly during the storm time seems to be related to the fact that storm-time substorms produce more seed electrons than the substorms that occur during the non-storm time.

SM41D MCC: 2008 Thursday 1020h

Sun-to-Earth Elements and Linkages That Drive Geoeffectiveness IV *(joint with SA, SH, NG)*

Presiding: **N J Fox,** Applied Physics Laboratory, Johns Hopkins University; **N Gopalswamy,** NASA Goddard Space Flight Center

SM41D-01 1020h

Numerical Simulation of Solar Wind Structures Upstream of Earth

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Our geospace environment is controlled by the parameters of the solar wind. A significant progress in modeling of the magnetosphere has been achieved recently and simulations of its response to specific interplanetary events becomes possible. An important question of the primary importance to the space weather research and forecasting is whether a spacecraft orbiting around the L1 point samples the same solar wind that hits the Earth. We use a high-resolution numerical magnetohydrodynamic model driven by near-Earth spacecraft observations. Selected events are used to investigate the evolution of small-scale solar wind structures and evaluate limitations of current observational capabilities when combined with available numerical models.

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Discrete time–frequency coupling between the interplanetary magnetic field and the magnetosphere

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Recent work has shown the existence at geosynchronous orbit of wave power at frequencies substantially below that of fundamental field-line resonances. The existence of spectral power below that of fundamental frequencies indicates that the driver must be external to the magnetosphere, i.e, that the source is contained in the solar wind. Other work has shown that frequencies matching field-line resonances can sometimes also be observed in the solar wind. The combined spectrum that includes power at fundamental frequencies and lower overlaps with *p*-mode helioseismic oscillations and the question has been raised whether these helioseismic modes may stimulate the magnetospheric fluctuations. In this study, we compute coherences between the magnetometers on ACE and GOES-10, that is in interplanetary space and inside the magnetosphere. These show several frequencies where all nine coherences are significant. Moreover, many of these frequencies are the same as those reported from Ulysses data in Thomson, Maclennan, and Lanzerotti (1995). Using hourly average data from all 1999, a frequency tolerance of 30 nHz, and retaining only peaks in the coherence above the 95% significance level, about 21 agreements would be expected by chance but 34 are observed. The coherences exhibit seasonal dependence, so the coupling has a complicated time–frequency structure exhibiting both frequency and event dependence.

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On the Geoeffectiveness of Shocks in the Creation of New Radiation Belts

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