antennas are immersed in a water tank with an applied uniform ac electric field. By actually receiving the ac field with the wire antenna attached to the GEOTAIL model, we evaluate various characteristics of the antenna, such as effective lengths, directivity patterns, and frequency responses. We will report the results of the experiment, and discuss the characteristics of the dipole antennas onboard GEOTAIL.

SM51C MC: 300 Friday 0830h

Paradigms of Ring Current Decay II

(joint with SA, SH, AE)

Presiding: **I Y Daglis,** National Observatory of Athens**; R M Thorne,** UCLA

SM51C-01 0830h INVITED

Stormtime Access of Ring Current Ions Under AMIE Electric Field: Implications for Ring Current Formation and Decay

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In the past we have traced particles in simplified models of the magnetospheric convection electric field to explain injection of particles to the stormtime ring current. We have begun to trace the guiding-center motion of ions and electrons having a constant first adiabatic invariant in the more realistic AMIE electric field. The magnetic field we use is a dipole field plus a uniform southward IMF, a simple field model that allows for an analytical mapping of ionospheric AMIE potentials to anywhere within the model. We compare drift trajectories and required drift times for representative ring current particles in the AMIE electric field with those for our previous simplified electric field model for several large storms. During the 19 October 1998 storm we find that large AMIE electric fields in the evening sector leads to much faster (∼ 20 minutes) inward transport from the plasma sheet to where the partial ring current is formed than in the simplified electric field model. This result is consistent with recent observations of the time scale for partial ring current formation. For the extremely large 15 July 2000 (Bastille Day), storm in which large stormtime penetration electric fields were observed by the DMSP satellite, we find deep penetration of ring current ions to as low as $L \sim 2$. We discuss the implication of the rapid and azimuthally asymmetric stormtime access under this more realistic electric field for ring current formation and decay.

SM51C-02 0850h INVITED

Effects of EMIC Waves Scattering on Ring Current Dynamics

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During storm conditions the ring current ion distributions are often unstable and can generate electromagnetic ion cyclotron (EMIC) waves with amplitudes above 1 nT. The subsequent interaction of energetic particles with these waves results in pitch angle scattering on short timescales and intense precipitation to the atmosphere. We simulate the dynamical evolution of the ring current during several large and great geomagnetic storms and investigate the effect of resonant interactions of ring current ions with EMIC waves on the early ring current decay. The initial and boundary conditions of our kinetic drift-loss model are inferred from measurements from the hot plasma instruments on the POLAR spacecraft and the geosynchronous LANL satellites. We calculate the growth rate of EMIC waves considering for the first time wave excitation not only in the frequency range between the He^+ and O^+ gyrofrequencies, but also at frequencies below O^+ gyrofrequency. A time-dependent global wave model is constructed and the spatial and temporal evolution of precipitating ion fluxes is determined. We find that the most unstable regions form after intensification of the ring current, i.e., near Dst minimum, and occur in the duskside local time sector. The wave gain of O^+ band waves exceeds the magnitude and is located at larger L shells than that of the He^+ band waves during the great storms. The global EMIC wave activity predicted by our model compares reasonably well to storm time satellite observations. The relative contribution of losses due to charge exchange, Coulomb collisions, atmospheric collisions at low altitudes, and wave-particle interactions along adiabatic drift paths is calculated during different storm phases and intercompared.

SM51C-03 0910h

Stormtime Pc5 Hydromagnetic Waves in the Middle Magnetosphere: Modulation of Pc1 Ion Cyclotron Waves and the Role of Medium Energy Ions

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The influence of compressional Pc5 ULF waves on the Pc1-2 electromagnetic ion cyclotron wave generation process involving medium energy ions in the middle magnetosphere is studied using CRRES observations. The two types of waves are seen simultaneously in association with magnetic storms. In the waves studied here, EMIC waves have a short duration in comparison with the Pc5 wave cycle and appear to be modulated by the Pc5 waves. There is also a tendency for the EMIC waves to increase in amplitude during the decrease in Pc5 wave magnetic field, with maximum EMIC wave power shifting to lower frequencies. From consideration of instability theory it is shown that the modulation of the EMIC waves by the Pc5 waves may not be controlled only through the variation of energetic ion temperature anisotropy in an adiabatic process which shows in-phase modulation, but also through the variation in the magnetic field on the ion cyclotron instability, and the variation of the number and energy density of the energetic ions in a non-adiabatic interaction with the Pc5 waves. These latter modulations will be discussed with respect to the CRRES magnetic field, wave and particle data analysed.

SM51C-04 0925h

Ring Current Ion Losses by Pitch Angle Scattering

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The Source/Loss Cone Energetic Particle Spectrometer (SEPS) on the Polar Satellite observes ions above 155 keV with an angular resolution of about 1.5 degrees. When the axis of SEPS is pointing within 10 degrees of the magnetic field direction, the detector measures particles in both the downward and upward loss cones. Measurements of the loss cone fluxes during the magnetic storms of August 6, 1998, August 27, 1998, September 25, 1998, October 19, 1998, and November 13, 1998 often show large fluxes of ring current ions moving downward inside the loss cone. At times these fluxes are comparable to the trapped ion population, indicating that strong pitch angle scattering is taking place at least locally. Although Polar encounters the ring current region at only two magnetic local times during any given storm, the frequent observation of precipitation suggests that pitch angle scattering is an important loss mechanism for ring current ions.

SM51C-05 0940h

Ring Current Development and Decay During a Geomagnetic Storm

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The time evolution of H+ flux equatorial 90° pitch angle distributions, as observed during a geomagnetic storm occurred on June 4 - 7 1991, is discussed. Proton spectra hourly data from CRRES MICS experiment, obtained along the spacecraft orbit in the midnight-dusk quadrant between L ∼ 4 and ∼ 7, are analyzed. The potentiality of a ring current empirical model [Milillo et al., JGR, in press, 2001] is tested by attempting to reconstruct the trend of the ion distributions on a global scale during the whole storm development. The global storm major effects, like L-shell compression, partial ring current generation, and cross-tail potential drop increase are reconstructed by modifying some of the model parameters in order to best-fit the experimental data at each space and time location. During the recovery phase, when the cross-tail potential decreases, the energetic proton fast decay by diffusion across the dayside magnetopause is discussed with respect to charge exchange decay.

SM51C-06 1020h INVITED

The Roles of Charge Exchange and Flow-Out Losses in Ring Current Decay

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It is becoming clear that flow-out losses are an important ring current decay mechanism in addition to charge-exchange losses. Flow out losses result from an imbalance between the energy flux entering the inner magnetosphere from the nightside plasma sheet and that leaving through the dayside magnetopause before the ring current becomes trapped on closed drift paths. The Michigan ring current drift-loss model (RAM) which calculates ring current losses due to Coulomb drag, charge-exchange and flow-out using realistic geocoronal and dynamical plasmasphere models, has been used to model 8 magnetic storms ranging from moderate to superstorm status. In each case, plasma sheet ion distributions measured by the LANL geosynchronous satellites are used to specify the ring current source population and its dynamical variation. The McIlwain (1986) model is used to specify the inner magnetosphere electric potential pattern which is scaled by the observed polar cap potential values (derived from DMSP passes directly or from the AMIE model) and shielded based on the DMSP auroral boundary index (MBI). Model results indicate that flow-out losses can be driven by an abrupt decrease in plasma sheet density, change in plasma sheet temperature and/or weakening of magnetotail convection prior to northward turning of the IMF. When the IMF abruptly turns northward at the end of the main phase, the entire recovery phase can result from charge-exchange loss. Examples of each of these types of decay are given. RAM decay time scales for all modeled storms are plotted against the simultaneous value of solar wind Ey and compared to the results of statistical studies of this relationship in the literature.

SM51C-07 1040h INVITED

Local Time Asymmetries in the Main Phase of Two Geomagnetic Storms as a Function of Ion Energy

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Since the launch of the IMAGE spacecraft in March 2000, the High Energy Neutral Atom imager (HENA) has imaged several large magnetic storms in energetic neutral atom (ENA) emission. The largest of these were the Bastille day storm (July 15-16, Dst -300nT), the August 12 storm (Dst -240 nT), and the March 31, 2001 storm (Dst = -360). We review these three, as well as several weaker storms, to investigate the global scale symmetry of the storm time ring current. We find that the degree of symmetry of the ring current depends more on the interplanetary magnetic field (IMF), than on the phase of the storm. In particular, the ring current may remain quite asymmetric well into the recovery phase, if the IMF stays southward, whereas it may become quite symmetric even at the end of the main phase if the IMF turns northward. The March 31 storm demonstrates the first effect quite dramatically, remaining very asymmetric to the main phase, then quickly filling all local times when the IMF abruptly switches polarity at the beginning of recovery. Much later, the ring current in this storm becomes markedly asymmetric again when the IMF returns to a southward orientation.

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

SM51C-08 1100h

The prime killer of the ring current at storm maximum

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Charge-exchange decay of the ring current is among the rather successful paradigms in space storm physics. It is generally accepted that charge exchange is the major loss process of the storm-time ring current. Moreover, charge exchange has been considered as the driving mechanism of the two-stage recovery - a particular feature of intense storms reported by S.-I. Akasofu as early as 1963. However, recent observations and modeling studies indicate that convective drift loss through the dayside magnetopause rivals charge exchange in producing the two-stage ring current decay. A comparative study of two intense space storms in June 1991 and September 1998 partly confirmed this scenario, introducing however a solar cycle dependence through the abundance of O^+ ions in the inner magnetosphere. We present and discuss these results.

SM51C-09 1115h

Anticorrelation between the ring current intensity and the Dst index

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Ohtani et al. [2001] previously found that geosynchronous magnetic field dipolarizes at the start of the storm recovery phase as measured by the Dst (Sym-H) index, suggesting that energetic particles are injected into the ring current even though Dst is being recovering. They inferred that this apparent contradiction can be resolved if the recovery of Dst is actually caused by the reduction of the tail current rather than the ring current. From the magnitude of the Dst recovery during the interval of geosynchronous dipolarization, the contribution of the tail current to Dst was estimated to be at least 20-25%. The result suggests that the Dst minimum is misidentified as the start of the ring current (storm) decay at a time when the ring current may actually be intensifying due to substorm-associated injection. The present study seeks to test this idea by referring to the flux of energetic neutral atoms (ENAs) measured by the IMAGE/HENA instrument. The instrument measures ENA fluxes in the energy range of 10 to 200 keV, which covers the core part of the ring current energy density. By cross-examining ENA fluxes, geosynchronous dipolarization, and Dst variations, the present study will discuss the Dst decay in terms of the two current systems, that is, the ring current and the tail current.

Reference:

Ohtani, S., M. Nose', G. Rostoker, H. Singer, A. T. Y. Lui, and M. Nakamura, Storm-substorm relationship: Contribution of the tail current to Dst, J. Geophys. Res., 2001 (in press).

SM51C-10 1130h

The Relation of Ring Current Asymmetry to the Dst Index in Different Phases of a Magnetic Storm

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In one popular paradigm for the development of a magnetic storm, substorm expansions inject ions onto closed drift paths near midnight. These ions drift westward around the earth causing a ground magnetic perturbation that is initially asymmetric with a maximum near dusk. After the ions drift completely around the earth, the current and its perturbation should be symmetric. Thus asymmetry should vanish early in the recovery phase after substorm injection ceases. This paradigm is not supported by observations. The ring current is nearly always asymmetric with the asymmetry index proportional to Dst. We demonstrate this relation with time series plots of Dst and asymmetry, and scatter plots of asymmetry versus Dst in different storm phases. Another paradigm suggests that most of the ground magnetic perturbations are caused by ions convecting through the magnetosphere on open drift paths that pass through the dusk terminator. If this is true, asymmetry should be related to the strength of the convection electric field as parameterized by VBs. We investigate this hypothesis by calculating linear prediction filters that relate both Dst and asymmetry to VBs in the solar wind. We will show that most of the variance in these indices is predictable by the solar wind electric field alone. Because of this it is possible to calculate filters that relate asymmetry to Dst.

SM51C-11 1145h

A Self-consistent Model of the Interacting Ring Current Ions with Electromagnetic ICWs

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Initial results from a newly developed model of the interacting ring current ions and ion cyclotron waves are presented. The model is based on the system of two bound kinetic equations: one equation describes the ring current ion dynamics, and another equation describes wave evolution. The system gives a self-consistent description of ring current ions and ion cyclotron waves in a quasilinear approach. These two equations were solved on a global scale under non steady-state conditions during the May 2–5, 1998 storm. The structure and dynamics of the ring current proton precipitating flux regions and the wave active zones are presented and discussed in detail. Comparisons of the model wave-ion data with the Polar/HYDRA and Polar/MFE instruments results are presented.

SM51D MC: 301 Friday 0830h

Solar Wind - Magnetosphere - Ionosphere Coupling

Presiding: **V O Papitashvili,** SPRL, University of Michigan**; D R Weimer,** Mission Research Corp.

SM51D-01 0830h

Efficiency of Energy Transfer from the Solar Wind to the Magnetosphere

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The interaction of the solar wind with Earth's magnetosphere can result in the storage of large amounts of energy in the magnetospheric system. The rate of energy storage in the magnetosphere is related to the rate of merging of magnetic flux on the dayside of Earth. It has been known for several decades that the addition of energy to the magnetospheric system is controlled by the north/south orientation of the magnetic field in the solar wind impinging on Earth's dayside magnetosphere. However, the efficiency of energy transfer from the solar wind to the magnetosphere is not well understood as a function of magnetic field strength, orientation, solar wind plasma density, and velocity. Global auroral images acquired with the Earth Camera of the Visible Imaging System (VIS) on the Polar spacecraft are used to determine the instantaneous open polar cap magnetic flux. The poleward boundary of the auroral oval observed with the Polar/VIS Earth Camera is the location of the separatrix between the open magnetic field of the polar cap that connects to the lobes of the magnetosphere and of the closed magnetic field of the auroral zone that connects to the plasma sheet. The time rate of change of the observed open polar cap magnetic flux is the net result of magnetic merging in the solar wind-magnetosphere interaction region and reconnection in the distant magnetotail. During periods of low activity in the nightside auroral oval, the reconnection rate in the magnetotail is small and the change in the total open magnetic flux of the polar cap is a direct measure of the global rate of merging on the dayside. The results of a study to determine the dependence of the global rate of dayside magnetic merging on the magnetic field and plasma parameters in the solar wind will be presented.

SM51D-02 0845h

The Effect of Solar Wind Structures on Earth's Magnetosphere

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In recent years, global magnetohydrodynamic (MHD) simulations have been driven by input from solar wind monitoring spacecraft and have produced results that are in good agreement with observations within the magnetosphere. Discrepancies between MHD results and satellite observations in the magnetosphere are a result of MHD limitations and the uncertainty in the three-dimensional structure of the solar wind. For example, the manner in which the solar wind propagates from the monitor spacecraft (often at