SM72B-0625 1330h POSTER

Simulation on the solar cycle variation of the radiation belts - Evaluation on time variation of radial diffusion -

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So far, we have performed the analysis to investigate solar cycle variations of the energetic electros in the radiation belts using the data set from the TIROS/NOAA satellites (1979-) and the EXOS-D satellite (1989-). It is confirmed that there exists the synchronized variation with the solar cycle in both the inner and outer radiation belts. It is also revealed that the spatial structure of the outer radiation belt changes during the solar cycle. As the result, there are phase differences in flux variation among the location of the outer belt.

In order to investigate the control parameters for the long-term variation of the radiation belts, we have developed numerical code on the radial diffusion expressed by the Fokker-Planck equation. The model can cover the dynamics of whole radiation belts, and includes loss processes due to both Coulomb collisions with thermal plasma and wave-particle interaction with plasmasheric hiss. To examine the effect of the variation of the particle transport efficiency, we fix parameters such as wave amplitude, outer boundary condition and plasmapause location, except for the radial diffusion coefficients that are parameterized by Kp index. The model reproduces not only the solar cycle variation but also the semi-annual and recurrent variations of the flux in the inner portion of the outer belt. The evolution of the slot region is also reproduced despite constant plasma wave amplitude. The model, however, cannot reproduce the long-term variation of the flux around outer portion of the outer belt. This result means that the variations of the other parameters on source and losses are important for long-term variation of the outer belt besides the variation of the transport efficiency. Especially, it is important to examine the effect of internal acceleration process on the long-term variation.

SM72B-0626 1330h POSTER

Dynamics of the Inner Magnetosphere Eestimated From Geosynchronous Observation

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We have examined the characteristics of magnetic field variations at geosynchronous orbit using magnetic field data from GOES satellites located at different geomagnetic latitudes and solar wind data from Wind and ACE satellites for the period from 1996 to 1999. We binned the data on the magnetic field data for every 5 degrees range of the dipole tilt angle, since the trend of magnetic field variations at geosynchronous orbit changes depending on the dipole tilt angle.

The results of our data analysis suggests that the magnetic field variations at geosynchronous orbit strongly depend on the variations of dynamic presure of solar wind and those of pressure corrected Dst index (Dst*). The dependence of solar wind electric field is not significant rather than the dependence of Dst*. And magnetic field variations at dayside has a weak dependence of dipole tilt angle on VDH coordinate system but those at nightside has a strong dependence. This difference corresponds to the origin and location of the current system in the inner magnetosphere. However, the Dst* dependences of magnetic field variations derived from two different magnetic latidudes suggest that these magnetic field variations can be explained by the existence of equivalent westward current beyond the geosynchronous orbit. This suggests that westward current grobally dominates in the inner magnetosphere during storm time.

SM72B-0627 1330h POSTER

Magnetopause erosion: A global view from MHD simulation

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In this paper we use a global magnetohydrodynamic simulation of the magnetosphere to examine the behavior of the magnetopause position when the interplanetary magnetic field suddenly changes from northward to southward. The inward motion of the magnetopause under the influence of a southward IMF is generally referred to as magnetopause "erosion." Physical models to explain erosion have been proposed, notably the "onion" peeling model, a model based on the effects of fringe fields from the Region 1 Birkeland currents and the nightside cross-tail current. The simulation shows behavior consistent with aspects of these models, but it also shows behavior that is most consistent with the major driver of erosion being the growth of the nightside cross-tail current. In particular, the simulation exhibits a marked delay between the arrival of the southward IMF at the magnetopause and the inward motion of the magnetopause. We attribute this delay to the delay in the growth of the nightside current system in response to the southward turning of the IMF.

SM72B-0628 1330h POSTER

Correlations between AKR with Auroral Dynamics and Dipole Tilt Angle

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The Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) spacecraft is well suited to make unique observations of the aurora and auroral kilometric radiation (AKR) during substorms. Simultaneous data from the Radio Plasma Imager (RPI) instrument and the Far Ultraviolet (FUV) instrument on the IMAGE satellite will be used to correlate features in the AKR spectrum with substorm onset and dipole tilt angle. The RPI observations used in this study are primarily from passive wave measurements. The AKR spectrum typically shows a single peak in intensity around 180 kHz, however, recent measurements by RPI show that a second peak at higher frequencies (near 300 kHz) in the emission spectrum can occur simultaneously with the primary peak AKR at lower frequency. This higher frequency portion of the AKR emission spectrum does not appear be a harmonic of the primary component. Surprisingly, from a year's worth of IMAGE/RPI data it is found that most of the double-peaked spectra of AKR are observed under positive dipole tilt angle conditions. FUV observations of the aurora are used during the times when IMAGE is at apogee and well situated in the AKR emission cone. At these locations FUV can observe the location and intensity of the aurora over the entire auroral oval. Specific substorms will be examined for onset timing and location and related to the occurrences of the single- and double-peaked AKR emissions in an effort to understand the source location of the emissions and the implications of the double-peaked emission in substorm dynamics.

SM72B-0629 1330h POSTER

Asymmetries produced in the mass loading of the magnetosphere during high dipole tilt and southward IMF

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High dipole tilt events present important opportunities to investigate acceleration processes associated with magnetospheric/ionospheric coupling. One such event occurred on January 8, 1998 where the dipole tilt was large and significant O^+ ions where observed downtail by Geotail. Multi-fluid simulations are used to examine this event, so that solar wind entry relative to ionospheric outflow can by distinctly identified. It is shown that the high dipole tilt leads to clear asymmetries in the solar wind entry occurring preferentially into the summer hemisphere and this preferential entry is seen through the inner and middle tail but not in the deep tail. The light ionospheric ions show a similar asymmetry with preferential mass loading of the summer hemisphere even into the deep tail. The story is very much more complicated for the heavy ions. While there may be preferential outflow from the summer hemisphere, they experience very much stronger dayside convection (due to their slower field-aligned velocity), and are then convected into the nightside winter hemisphere. This leads to strong O^+ loading of the winter hemisphere with O^+ becoming the dominant species in the nightside portion of the winter magnetotail.

SM72B-0630 1330h POSTER

The Influence of Dipole Tilt and Corotation in the Near-Earth Magnetotail

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The rotation of the Earth's tilted magnetic dipole produces a corotation electric field that dominates the electrodynamics of the inner magnetosphere. In particular, it is responsible for the eastward drift of cold plasma in the plasmasphere. However, the extent to which the stretched (but closed) magnetic field lines of the near-earth magnetotail are influenced by the corotation of their ionospheric footpoints is unclear. To what extent might there be decoupling of corotation on stretched magnetic field lines and what effect does dipole tilt have on this decoupling? In this paper we use conjugate ionospheric and magnetospheric measurements to investigate this question. We map SuperDARN measurements of ionospheric convection to the magnetosphere using Tsyganenko magnetic field models and compare with conjugate measurements of magnetospheric drift obtained from the Cluster spacecraft.

SM72C MCC: 105 Sunday 1330h

Magnetosphere-Ionosphere Coupling II *(joint with SA)*

Presiding: **J Sojka,** Utah State University**; B L Giles,** NASA Goddard Space Flight Center

SM72C-01 1330h

Comparison of Iridium Determined Field-Aligned Current Patterns With High-Resolution MHD Simulations

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The engineering magnetometers aboard the 70+ Iridium satellites arranged in six equally spaced polar orbital planes provide a unique database for determination of global field-aligned currents [Waters et al., 2001]. A previous study compared these field-aligned currents with MHD simulation results to quantitatively evaluate the MHD results in a global way [Korth et al., 2002]. The analysis of three events of prolonged steady interplanetary magnetic field orientation, stable to within 25 degrees of the average direction, revealed considerable differences between observed field-aligned current densities and the MHD simulations. The field-aligned current densities in the Lyon-Fedder MHD simulations were evaluated at an inner simulation boundary of 3 Re and mapped on dipole field lines to

ionospheric altitudes. In the present study we expand on the previous work by moving the inner simulation boundary inward to 2 Re. The achieved increase in spatial resolution of the simulation grid results in a dramatically improved agreement of the simulated Region-1 currents with the observations. Moreover, the high-resolution MHD simulations lead to a better representation of the observed dayside Region-2 current system. However, the Region-2 currents show expectedly larger differences since ring current drift physics necessary to drive these currents in the magnetosphere is not implemented in the MHD evaluations. DMSP particle source identifications are used to compare source regions in the observed FAC maps with those in the MHD simulations.

SM72C-02 1345h

Observed relationship between rayed aurora and intense ion upflows near the polar cap boundary

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Ion outflow is truly a cross-scale phenomenon, where localized energy conversion in the ionosphere can have a fundamental impact the global magnetosphere. The morphology of outflowing ion distributions has been well characterized by satellites, but the physical coupling to the ionospheric source remains speculative. We have amassed a 12 year database of measurements made by the Sondrestrom incoherent scatter radar (ISR) from which we will characterized the morphology of ion outflows in detail from an ionospheric perspective. Because of its high latitude, Sondrestrom is primarily within the cusp, within the polar cap, or near the polar cap boundary - regions where the most significant ion outflows occur. The radar database is enhanced by the comprehensive set of permanent optical diagnostics at Sondrestrom, thus providing a window into the relationship between magnetospheric forcing and ionospheric response that is singular among ISR facilities.

The initial focus of this study has been on intense upflow events (Vi>500 m/s, flux>5e7/cm^{2}s at 700km) occurring when all-sky spectral imaging was available. Initial results suggest that ion upflows at the polar cap boundary are associated with soft (<100 eV) auroral rays. Prior analysis of such aurora has revealed an anomalously high altitude of the forbidden O^+(732nm) emission line (>500km) [Semeter, GRL 2002, in press]. This feature may be produced by the vertical transport of aurorally produced $O^+(^2P)$. If confirmed, this could lead to an optical diagnostic for ion outflow.

URL: http://isr.sri.com

SM72C-03 1400h

April 2000 storm: Energy transfer and dissipation in MHD

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We investigate both energy transfer and dissipation in a global MHD simulation. We have simulated a major magnetospheric storm that occurred on April 6, 2000, during which the Dst index reached almost -300 nT. For the energy transfer calculation, we first identify the magnetopause surface from the simulation results, after which we calculate the total energy flux incident to the surface. With this method we identify the locations on the magnetopause surface, where the energy transfer takes place and investigate the energy transfer location dependence on the solar wind parameters as well as the dependence of the total transferred energy on the empirical epsilon parameter. Furthermore, we calculate the Joule heating power and the precipitation power in the ionosphere, and determine the locations where the most significant ionospheric dissipation takes place. We find that during the main phase the energy is transferred in the plane of the IMF clock angle, and is dissipated mainly in the dayside ionosphere. Furthermore, we develop a relationship between the ionospheric dissipation power and solar wind parameters using similarity scaling laws. We discuss the implications of the found high correlation results both on magnetospheric dynamics and MHD simulation representation of the dynamics.

SM72C-04 1415h

Akebono satellite observations of Dispersive Alfven waves and the ionospheric Alfven resonator in the cusp region

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In the cusp region at altitudes of a few thousands of km, burst-like fluctuations of electric and magnetic fields are often observed in the ULF range of 0.2-5 Hz on the Akebono satellite. We have found that these bursts occasionally have clear harmonic structures in small-scale upward field-aligned current regions. The Alfven resonator between the bottom of the Auroral acceleration region and the ionospheric E layer is one of the candidates of these harmonic structures. The model of Lysak et al. [1991] calculated the phase shifts of electric and magnetic field as a function of frequency using the ionospheric Alfven resonator model. Grzesiak. [2001] succeeded in demonstrating that satellite measurements coincide with the model given by Lysak. Pilipenko et al. [2001] investigated the resonance condition of dispersive Alfven wave between the bottom of the auroral acceleration and the E layer.

Based on these previous results, we compared electric and magnetic field data obtained by the Akebono satellite with the Lysak model, using the cross-wavelet analysis method. Further, considering that small-scale upward and downward field-aligned currents would be produced by dispersive Alfven waves, we compared the measured ratios of electric and magnetic field with the resonance condition of dispersive Alfven waves.

SM72C-05 1430h

Ion Acceleration in Alfven Waves Above the Aurora From FAST

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In this presentation we examine the ion heating process that occurs in Alfven waves above the auroral oval from FAST. Observations show that outflowing fluxes of energized ionospheric ions as large as 10^{10} cm^{-2} s^{-1} are observed in conjunction with intervals of Alfvenic fluctuations in fields quantities at frequencies in the spacecraft frame up to the ion gyrofrequency. These ions may represent a significant portion of the density of ionospheric ions in the plasma sheet. Through the use of simulations and observations we show that this heating/acceleration process may be closely related to the process of electron acceleration in the observed Alfven waves and the subsequent feedback response of the ionosphere.

SM72C-06 1445h

Observations from the Polar and Cluster Spacecraft of the Structure and Dynamics of Strong Poynting Flux in the Plasma Sheet During Periods of Strong Magnetic Activity

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This paper presents observations from the Polar and Cluster spacecraft of wave and steady state Poynting flux in the plasma sheet at radial distances of about 9 and 18 Re when both spacecraft were with in several hours of the same magnetic local time position on the night side during magnetically disturbed intervals. The data indicates that strong Poynting flux is associated with passage of the outer boundary of the plasma sheet over the spacecraft, the the Poynting flux is directed predominately Earthward along the magnetic field line, and that Poynting flux magnitudes at Polar locations (9 Re) are larger than at Cluster (18 Re) but scale with the magnitude of the magnetic field strength. The last observation suggests that parallel Poynting flux maps along magnetic field lines inversely as the cross section area of the flux tube. Cluster inter-spacecraft timing indicates that layers of strong wave Poynting flux exist over typical scale sizes 1-2 Re (with plasma sheet normal velocities of 10-100 km/s and durations of Poynting Flux of 2 minutes). This spatial scale implies the region of strong wave Poynting flux observed by Cluster, when mapped along magnetic field lines to altitudes of 100 km in the auroral ionosphere, has typical scale sizes of 1-3 degrees in latitude with amplitudes of 10-50 mW/m . Instances of strong steady state parallel Poynting flux at distances of 9 Re will also be presented. These observatons strongly suggest that Poynting flux can be a major mechanism for transferring energy along plasma sheet field lines and powering low altitude acceleration processes. Comparisons to the kinetic energy flux in ion beams will also be presented. A survey of auroral images from the Polar UVI and VIS instruments and the WIC imager on the IMAGE spacecraft indicates the existence of strong Poynting flux in the tail near radial distances of 9 Re in the PSBL is often associated with the formation and dynamics of intense auroral structures at the pole ward boundary of the auroral oval.

SM72D MCC: 105 Sunday 1530h

Aurora and Auroral Processes I *(joint with SA)*

Presiding: **P T Newell,** Applied Physics Laboratory**; K A Lynch,** Dartmouth College

SM72D-01 1530h

The Distribution of Auroral Power Increases and Decreases

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The auroral substorm was originally identified as a large increase in auroral power. There does not seem to be any investigation of just how large a power increase is needed to identify a substorm. It is not clear