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.

SM41D-02 1035h

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.

SM41D-03 1050h

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

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The large shock of 24 March 1991 rapidly created a new radiation belt in the slot region consisting of electrons and protons with energies of tens of MeV. Remnants of this injection persisted for years. This event took the community by surprise and led to a search for others. Since that time smaller injections were seen with sensors aboard SAMPEX, Polar, and 1997-068 (HEO orbit) that also were associated with the presence of energetic solar particles and a shock striking the magnetosphere. However a long-lasting ion injection, persisting for over a year, was not observed until 6 and 24 November 2001. Trapped ions as heavy as Fe were seen. It appears that in order for an ion injection to persist for a long time, the injection must be inside of L = 2.5. Outside, loss processes including a breakdown of adiabatic motion seem to prevent long life. A key question is: What are the characteristics of the shock and perhaps the source population that leads to a deep injection? We have examined the records of the 210 Magnetometer Chain, that stretch back to before the March 1991 event, to look for features in the magnetometer records of SSCs, such as amplitude, rise-time, and frequency content, that might determine the geoeffectiveness of a shock for creating a long-lasting, new belt of radiation.

SM41D-04 1105h

The Role of Post-shock Streams and Sheath Regions in Driving Magnetospheric Activity

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Post-shock streams and sheath regions are efficient drivers of magnetic disturbances in the Earth's magnetosphere. Characteristics for these structures are high solar wind dynamic pressure and fluctuations in the solar wind electric field. We present statistics indicating that post-shock streams and sheath regions caused almost the half of intense magnetic storms (Dst < -100 nT) during the six-year interval 1997-2002, covering rising, maximum and early declining phases of solar cycle 23. For example the third largest storm of the present solar cycle (determined by the Dst index), that took place on Apr 6-7, 2000, was caused by a sheath region whereas the magnetic cloud appears to have missed the Earth almost entirely. Apart from causing a substantial fraction of large Dst storms, post-shock streams and sheath regions seem to drive more strongly the high-latitude activity than magnetic clouds. We compare in more detail the evolution of two intense magnetic storm periods: One event, Apr 17-18, 2001, was caused by sheath region fields and the other, Apr 21-22, 2001, was driven by a magnetic cloud. We have investigated the geomagnetic response using various magnetic indices. The different behavior of the indices during these two storms suggests the different response of magnetospheric current systems at low and high-latitudes.

SM41D-05 1120h

Increased geoeffectiveness of high solar wind dynamic pressure fronts under southward IMF orientation

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It is well known that a persistent southward IMF produces increased geomagnetic activity. We have found that southward IMF conditions combined with high solar wind dynamic pressure lead to an even greater coupling between the solar wind and the terrestrial magnetosphere, dramatically increasing the geoeffectiveness of solar wind dynamic pressure events on the Earth. We illustrate this with satellite and ground measurements of various magnetospheric parameters during solar wind pressure front events occurring under steady southward IMF conditions. We show the effect of pressure enhancements on the auroral oval size and precipitation, ionospheric convection, and field-aligned and ionospheric currents. We find an increase in auroral precipitation and a dramatic poleward expansion of the oval and closing of the polar cap at all MLTs following the arrival of a pressure front. A simultaneous enhancement of ionospheric convection all over the polar cap leads to a further increase of an already high cross-polar-cap potential, despite the fact that the magnetosphere is compressed, revealing a substantial increase in the coupling of the solar wind electric field to the Earth's magnetosphere under the high-pressure environment. Finally, an intensification of both field-aligned and ionospheric currents is observed over a wide range of MLTs during the high pressure regime, pointing to increased magnetosphere-ionosphere coupling. This global magnetospheric response to solar wind dynamic pressure enhancements under southward IMF is compared with the weaker response under near-zero IMF B_z prior to the pressure front impact.

SM41D-06 1135h

EFFECTS OF THE SOLAR WIND AND IONOSPHERIC CONDUCTANCE ON THE TRANSPOLAR POTENTIAL AND MAGNETOSHEATH FLOW: GLOBAL MHD MODELING

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The behavior of the magnetosphere-ionosphere system under the influence of a strong solar wind electric field is studied using global MHD simulations. The simulations indicate the saturation of the transpolar potential for high values of IEF. However, the saturation level is strongly affected by the level of ionospheric conductance. A mechanism of the ionospheric conductance feedback on the magnetosheath flow is presented. The mechanism describes a chain of events from the ionosphere to the magnetopause and to the magnetosheath and shows that the dayside reconnection potential, and consequently the transpolar potential, are determined by the interplay between the ionospheric conductance, magnetopause shape, magnetosheath flow and bow shock stand off distance. Effects of the solar wind dynamic pressure are discussed along with the effect of the ionospheric conductance, and the latter is shown to be dominant.

SM41D-07 1150h

Probabilistic Forecasting of Geomagnetic Indices Using Solar Wind "Air Mass" Analysis

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Measurements of the sun's photospheric magnetic field can in principle be used to predict geomagnetic activity one to three days in advance. The accuracy of such predictions is low, however, because they do not include the north-south component of the interplanetary magnetic field (IMF Bz), which is the most geomagnetically relevant parameter. Aside from that carried by large-scale transients, IMF Bz is mainly a product of small-scale, in-transit turbulence and, so, is inherently unpredictable from solar measurements. Routine one-to-three day forecasts of geomagnetic activity based on deterministic algorithms are, therefore, not possible. Probabilistic forecasts offer the next best thing to deterministic forecasts, and air-mass climatology offers a way to develop the advantages inherent in probabilistic forecasts for space weather applications. Here we address the IMF Bz indeterminacy problem (or better, get around it) by applying the concept of air mass climatology to the solar wind. We give criteria and statistics for solar wind air masses, which provide poof of concept for routine, mid-range (one to three day) probabilistic air-mass forecasts of daily levels of geomagnetic activity.

SM41D-08 1205h

Storm-time Energetic O+ Flux Variations in the Ring Current and the Plasmasheet: A Study of the April 2002 Storm Event

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The development of the ring current during intense magnetospheric storms is often discussed in terms of the energization of single-charged oxygen ions. Although it is generally accepted that the ionosphere is the ultimate source of such O+ ions, it still remains to be understood where and how they are accelerated in the magnetosphere. The present study examines global changes of oxygen ENA fluxes measured by the IMAGE/HENA instrument. A focus is placed on a storm event that took place in April 2002. When the IMAGE satellite was at vantage points during this storm event, it occasionally observed the oxygen ENA flux to increase globally within 10 min or less in the ring current region. This timescale is too short for those O+ ions to be transported from the plasmasheet. In situ measurements of magnetic field and energetic particle fluxes at geosynchronous orbit reveal simultaneous occurrence of dipolarization and particle injection. The Geotail satellite, which was located in the post-midnight magnetotail, also observed an increase of the O+/H+ ratio in the energy density in association with substorm activity. The present result indicates that the substorm-associated local acceleration is crucial for the energization of the ring-current O+ ions at storm time.

SM42A MCC: Level 1 Thursday 1330h

Is a New Lexicon Required for High-Latitude Field-Aligned Current Systems? I Posters *(joint with SA, AE)*

Presiding: **N Ostgaard,** Space Sciences Laboratory, University of California, Berkeley**; J W Gjerloev,** NASA Goddard Space Flight Center

SM42A-0590 1330h INVITED POSTER

IMF-Dependent Maps of High-Latitude Field-Aligned Currents Derived From Ørsted and CHAMP High-Precision Magnetic Field Measurements

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