SH41D-02 1040h

Large-Scale Magnetic Field Inversions at Sector Boundaries and Their Relation to Coronal Mass Ejections

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During the declining phase of the last solar cycle, the Wind spacecraft observed a quasi-recurrent pattern of mismatches between sector boundaries identified in suprathermal electron pitch angle spectrograms and in magnetic field data alone. Intervals of mismatch imply the presence of magnetic fields that are locally inverted or turned back on themselves in a way that is intrinsic to the sector boundary. We analyze 8 cases of inversion during 9 successive solar rotations in 1994-1995. These range in duration from 15 to 53 hours. In most the inversions are incomplete in a systematic way: Rather than pointing opposite to its true polarity along the Parker spiral, the magnetic field hovers at an orientation more nearly orthogonal to it, always in the sense of decreasing azimuth angle. The inversion pattern is consistent with passage through coronal streamer belt loops in which the polarity of the two legs of each loop matches the sector structure and where one leg has been released from the Sun through interchange reconnection. There are four possible variations of this pattern, depending upon the sense of polarity change across the sector boundary and whether the leading or trailing leg has been released. The latter determines whether the sector boundary or the local field reversal passes first. Three of the 4 variations are represented in the 8 cases. Plasma parameters in the inversions are typical of the slow wind. While a some cases display signatures of interplanetary coronal mass ejections, many do not. Thus the inversions may represent the quiet, quasi-steady end of a spectrum of large-scale transient outflows.

SH41D-03 1055h

Nature of the Plasma Sheet Between Same-Polarity Solar Wind Streams

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Heliospheric spacecraft occasionally encounter consecutive high-speed streams that map to two different solar source regions with the same magnetic polarity. The low-speed wind between the two streams has many similarities to the plasma sheets commonly observed between high-speed streams, except that there is no current sheet. We have studied several such plasma sheets observed with the Ulysses spacecraft during the fast, pole-to-pole latitude scans in 1995 and 2001 and with ACE. Common features are large amplitude tangential discontinuities, regions of low entropy, some very low helium abundances, and magnetic holes.

SH41D-04 1110h

The Coronal Magnetic Field, Signatures of Coronal Holes and Silicon Nanometer Dust Grains

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The near-infrared part of the solar spectrum is where some of the strongest coronal forbidden lines are formed. Polarized emission in these lines offers the only tool currently known for the inference of the direction of the coronal magnetic field. The first successful observations of the polarized emission from the 1074.7 nm Fe XIII line were made by Eddy, Lee and Emerson during the eclipse of 1966 in a limited region of the corona. The only subsequent polarimetric observations in this line were carried out with the coronagraph at Sac Peak from 1977-1980. We report on the first successful polarimetric measurements of the 1074.7 nm line in a field of view extending out to 3.5 solar radii which were made during the total solar eclipse of 21 June 2001. In addition to confirming earlier results of the predominance of a radial direction of the coronal magnetic field, these measurements yielded the first polarimetric signature of coronal holes, and the signature of nanometer size dust grains in the corona. These observations suggest the existence of a rich coronal spectrum of narrow lines in the near-infared produced by the fluorescence of silicon nanometer dust grains in the inner corona. This work was funded by NSF grant ATM-0003661 and NASA grant NAG5-10873 to the Smithsonian Astrophysical Observatory.

SH41D-05 1125h

Successful Measurement of the Full Magnetic Vector Near the Base of the Solar Corona

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The measurement of coronal fields has in the past generally been restricted to the field strength or to only some of the components of the magnetic vector. We present here a technique for measuring the full magnetic vector near the base of the solar corona. As an application we report on observations of a developing active region with ongoing magnetic flux emergence. The data allow the first measurement of the 3-D structure of magnetic loops. They also provide the first detection of an electric current sheet located near the base of the solar corona. Such current sheets or tangential discontinuities of the coronal magnetic field have long been thought to be a major source of coronal heating.

SH41D-06 1140h

Thermal IR Prospects for Coronal Magnetic Field Measurement

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The SOLARC Haleakala reflecting coronagraph was designed and built for studying the IR solar corona. High dynamic range imaging and spectroscopy in the thermal IR offers unique prospects for coronal field measurements. Here we summarize the interesting opportunities, our progress and results toward this goal.

SH41D-07 1155h

Stereoscopic Spectrosopy for Magnetic Field Measurements

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We present a novel, photon-efficient technique for measuring the Zeeman splitting of a spectral line everywhere in an image plane. The technique, *differential stereoscopy*, allows extraction of spectral line profiles from multiple dispersed, slitless "smearogram" images of the Sun such as are formed by a slitless, multi-order ("stereoscopic") spectrograph. Because stereoscopic spectrographs admit all photons of interest, they can be over an order of magnitude more photon-efficient than traditional techniques. We will discuss the technique in the context of chromospheric and coronal magnetic fields, and present results from an initial proof-of-concept photospheric test using the ASP at the National Solar Observatory.

SH42A MCC: Level 1 Thursday 1330h

Space Science Research With Societal Consequences I Posters *(joint with SA, SM, AE)*

Presiding: **W D Gonzalez,** National Institute for Space Research**; N Gopalswamy,** NASA Goddard Space Flight Center

SH42A-0472 1330h POSTER

Modeling Services at the Community Coordinated Modeling Center

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The Community Coordinated Modeling Center (CCMC) has as one of its functions the provision of research community access to modern space science models. For this purpose, CCMC hosts a set of state-of-the-art space science models, provided by model developers in all domains, ranging from the solar atmosphere to the Earth's upper atmosphere. CCMC provides, for the benefit of the researcher, a web-based run-on-request system, by which the interested scientist can readily request simulations of science problems. CCMC also provides a tailored web-based visualization interface for the model output, as well as the capability to download to the user simulation output directly. In this poster, we will provide an overview of CCMC services, as well as illustrations of the scientific benefit of open access to modern space science models.

URL: http://ccmc.gsfc.nasa.gov

SH42A-0473 1330h POSTER

Real Time Movies From the GOES Solar X-ray Imager Provide an Unprecedented View of Ongoing Solar Activity

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Data from NOAA's Solar X-ray Imager (SXI) are collected onboard GOES-12, down-linked and processed by NOAA's Space Environment Center, then immediately sent to NOAA's National Geophysical Data Center (NGDC) for archiving and public access. NGDC makes these data available via its public interface (http://sxi.ngdc.noaa.gov)the moment that they are received. In addition to providing browse imagery (PNG) and scientific imagery (FITS), NGDC also generates a series of movies (MPEG), which include sliding 12-hour movies that are updated every five minutes – an ideal means of observing ongoing solar activity. Also, 54-day movies are updated at UT midnight, and daily and monthly movies of all historical imagery are generated and maintained online for retrospective use.

URL: http://sxi.ngdc.noaa.gov

SH42A-0474 1330h POSTER

Evolution of interplanetary magnetic clouds from 0.3 AU to 1 AU: A joint Helios-Wind Study

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A class of interplanetary configurations which interact strongly with the Earth's magnetosphere are interplanetary magnetic clouds. A desideratum of space weather predictions is that they be made from data acquired by distant probes so as to guarantee as long a lead time as possible. For this to be viable, one must have accurate knowledge of how parameters evolve. To this end, we use observations of magnetic cloud made by the spacecraft Wind at 1 AU, and Helios 1 & 2 between 0.3 and 1 AU. A model is constructed, regarding the magnetic cloud as a cylindrically symmetric, force-free constant-alpha magnetic field configuration, i.e. the cylindrically symmetric solution of $\nabla \mathbf{B} = \alpha \mathbf{B}$. We least–squares fit the model to the data and obtain model parameters, e.g. the magnetic field strength on the axis of the tube, the helicity, the orientation, the diameter, and its orientation. We adopt two approaches: In the first we obtain statistically the way these parameters evolve with distance from the Sun. In the second approach we focus on line-ups of the spacecraft and determine directly how parameters scale with distance. The two approaches are compared. This work is supported by NASA Living with a Star under grant NAG 5-10883.

SH42A-0475 1330h POSTER

Interplanetary Magnetic Clouds Observed by Wind and Helios 1 & 2: Influence of the Magnetic Field Strength on the Stand-off Distance

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We study the extent of the sheath region of interplanetary magnetic clouds over the heliospheric distance range 0.3 - 1.0 AU and, in particular, the effect of the magnetic field on the stand-off distance of the shock which fast magnetic clouds drive. For this study we use data on these ejecta acquired by Wind at 1 AU and the Helios 1 and 2 probes at 0.3 - 1 AU. Modelling the ejecta as straight-cylindrical objects, we first apply a hydrodynamic approximation to obtain the stand-off distance of 50 magnetic clouds as a function of sonic Mach number. In a second step we follow Burlaga (1988) and model magnetic clouds as cylindrical-symmetric, force-free magnetic structures of constant alpha , i.e. a 2-component field, satisfying $\nabla \mathbf{B} = \alpha \mathbf{B}$. Least-squares fit of this model to the data then determines several parameters of the model magnetic cloud, such as the total field strength on the axis and the distance the spacecraft passes from the axis of the cylinder. Using this information and comparing the measurements with the hydrodynamic limit of zero $\mathbf{B}$, we derive the effect of the magnetic field on the stand-off distance of the shock. Burlaga, L.F., Magnetic clouds and force-free fields with constant alpha, J. Geophys. Res., 93, 7217, 1988. This work is supported by NASA Living with a Star under grant NAG 5-10883.

SH42A-0476 1330h POSTER

The Dense Sheath Region of Magnetic Clouds as an Interplanetary Trigger of Geomagnetic Storms

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Interplanetary coronal mass ejections and, in particular, their subset magnetic clouds, are known to cause the strongest geomagnetic disturbances, as measured by storm intensity, substorm recurrence rate, etc. Past work has shown that, through compression of pre-existing pre-shock $B_z < 0$ fields, the sheath region ahead of the ejecta may elicit geomagnetic activity in its own right. We present here a case where a combination of these two triggers are present. The interval of negative B_z in the sheath is separated from that in the ejecta by a strong northward turning. The example leads to an extreme manifestation of the above: the storm main phase occurs exclusively during Earth passage of the sheath region and the recovery phase has already set in when the magnetic cloud, the initial part of which had an even more strongly negative B_z than the sheath, arrives. We find that the popular "energy coupling" functions ϵ and VB_s give an erroneous prediction of the geoeffects. The data suggest the need of including the solar wind momentum flux in so-called energy coupling functions. A link between substorms and storms is suggested by the data: The density of the plasma sheet is enhanced episodically at each substrom onset. In sum, the dense sheath region of ejecta is a further interplanetary source of goeffects at times exceeding those of the ejecta itself. This work is a contribution to the study of interplanetary sources of geomagnetic dusturbances. This work is supported in part by NASA grant NAG5-13512.

SH42A-0477 1330h POSTER

Interplanetary Shocks in the Earth's Magnetosheath

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Gas dynamic work of Stahara and Spreiter in the late 80's has suggested that interplanetary (IP) shocks once entering into the magnetosheath, turning into pressure pulses, maintain their original surface geometry to a very good approximation. This work presents WIND, ACE, IMP 8, Geotail and Cluster data observing the same IP shocks in the interplanetary medium and in the Earth's magnetosheath. Multiple solar wind observations are necessary to approximate the interplanetary geometry of these shocks because they often significantly deviate from simple planarity. A number of cases will be presented where 4-spacecraft time/position and single spacecraft MHD jump condition fit results will be compared. Pressure pulses in the magnetosheath, clearly associated with the IP shocks, could be identified for most shocks analyzed for the time period 1998-2002. However, the magnetosheath signatures of very weak and reverse shocks were often completely washed out. For those shocks that have clearly identifiable signatures in the magnetosheath it is demonstrated that they do not deviate significantly from their interplanetary geometry, unlike directional discontinuities hence it becomes possible to extrapolate more accurately their arrival times and locations at the magnetopause.

SH42A-0478 1330h POSTER

A Statistical Study on the Geoeffectiveness of Magnetic Clouds During High Solar Activity Years

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Using the Dst* index and solar wind IMF & plasma data from 1998.001 to 2002.127 in which solar activities are high, we have statistically examined the relationship of 270 storms (Dst*-30nT) to 104 magnetic clouds. It is found that most of the magnetic clouds can result in geomagnetic storms, but only about 30% of storms are due to magnetic clouds. A storm can be induced by the sheath, the leading, the axial, the trailing field, both the leading and trailing fields, or both the sheath and leading or trailing fields of a cloud with 9.6%, 22.1%, 8.7%, 12.5%, 1.0%, 16.4%, 5.8% occurrence percentages, respectively. However, different levels of geomagnetic activity have different occurrence percentages due to different cloud fields. The occurrence percentage of intense storms caused by clouds is 72%, which is much higher than the around 20% occurrence percentage of smaller storms caused by clouds. It is also shown that Unipolar Bz and Bipolar Bz clouds have different geoeffectiveness percentages and the long-known hypothesis of southward Bz control of magnetic activity is supported by the results of this study. Because multiple-step development storms can result not only from both sheath and cloud fields but also from different fields within a cloud, the geoeffectiveness of the fields within the clouds are statistically studied in more detail than before.

URL: http://www-personal.engin.umich.edu/~jichunz/

SH42A-0479 1330h POSTER

Real-time Upstream Monitoring System: Using ACE Data to Predict the Arrival of Interplanetary Shocks

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We have developed an algorithm to predict Earth arrival times for interplanetary (IP) shock events originating at the Sun. Our predictions are generated from real-time data collected by the Electron, Proton, and Alpha Monitor (EPAM) instrument on NASA's Advanced Composition Explorer (ACE) spacecraft. The high intensities of energetic ions that occur prior to and during an IP shock pose a radiation hazard to astronauts as well as to electronics in Earth orbit. The potential to predict such events is based on characteristic signatures in the Energetic Storm Particle (ESP) event ion intensities which are often associated with IP shocks. We have previously reported on the development and implementation of an algorithm to forecast the arrival of ESP events. Historical ion data from ACE/EPAM was used to train an artificial neural network which uses the signature of an approaching event to predict the time remaining until the shock arrives. Tests on the trained network have been encouraging, with an average error of 9.4 hours for predictions made 24 hours in advance, and an reduced average error of 4.9 hours when the shock is 12 hours away. The prediction engine has been integrated into a web-based system that uses real-time ACE/EPAM data provided by the NOAA Space Environment Center (http://sd-www.jhuapl.edu/UPOS/RISP/ index.html.) This system continually processes the latest ACE data, reports whether or not there is an impending shock, and predicts the time remaining until the shock arrival. Our predictions are updated every five minutes and provide significant lead-time, thereby supplying critical information that can be used by mission planners, satellite operations controllers, and scientists. We have continued to refine the prediction capabilities of this system; in addition to forecasting arrival times for shocks, we now provide confidence estimates for those predictions.

URL: http://sd-www.jhuapl.edu/UPOS/RISP/index.html

S
H

SH42A-0480 1330h POSTER

Multispacecraft Observations of Few-MeV SEP Ion Event Onsets Near Earth

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Few-MeV-energy SEP proton flux onsets observed in interplanetary space near Earth are used to investigate the effectiveness of a single spacecraft stationed at the sunward L1 libration point (∼230 Re) to provide complete early warning information about Solar Energetic Particle (SEP) events. Knowledge of the behavior and distribution of few-MeV-energy protons at onset aids development of asset protection, predictive capabilities, and understanding of magnetospheric disturbances related to SEP appearance at Earth. Widely separated spacecraft, ACE near L1 and GOES-8, Geotail, and IMP-8 nearer to Earth (∼6.6-44 Re), provided simultaneous SEP observations from late 1997 to the present. A number of cases of spatial-temporal intensity variations between L1 and nearer-Earth observations are presented. Cases presented demonstrate large-scale transport characteristics both consistent and inconsistent with simple outward radial propagation (i.e., convection with the solar wind) of a locally planar feature over the ∼230 Re (∼0.01 AU) maximum separation distance.

SH42A-0481 1330h POSTER

Living with a Star: Opportunities for Geospace Science

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In a report released in September of 2002, a NASA appointed panel presented recommendations for the science and implementation goals for the Geospace Project of the Living with a Star (LWS) Program. The primary objective of the project is to: Understand and characterize the effect of solar variability on those geospace phenomena that most affect life and society. The purpose of this presentation is to present to the Sun-Earth Connections science community the framework of the Geospace Missions as NASA plans to implement them, to solicit comments and suggestions from the community, and to provide information on the plans for, and opportunities for participation in, the Geospace element of Living With a Star. NASA plans to deploy a focused set of small spacecraft, instruments on missions of opportunity, collaborations with other programs, and related theory, modeling and data mining activities. The spacecraft would be launched in 2008 and 2010 and would perform sets of inner magnetospheric and ionospheric observations over the next solar maximum when the Earth's near space environment will be most disturbed. Discussion emphasis will be placed upon the measurement requirements and mission characteristics.

URL: http://lws.gsfc.nasa.gov

SH42A-0482 1330h POSTER

Cosmic Ray Cutoff Predictions Using Magnetic Fields From Global Magnetosphere MHD Simulations

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The cutoff rigidity of relativistic particles (cosmic rays, solar energetic particles, etc.) that enter the magnetosphere and atmosphere have traditionally been determined with numerical particle orbit integration calculated backwards in time utilizing a suitable magnetic field model. Such models were usually of empirical nature, such as the IGRF and Tsyganenko models. At mid-latitudes and near the polar cap boundary, however, such magnetic field models may not be very accurate during geomagnetic storm times. In this study we therefore employ a magnetospheric magnetic field from a global MHD simulation of the Earth's magnetosphere. We compare our results with those from simpler models, like IGRF and Tsyganenko 1996, for quiet times as well as for magnetically disturbed times.

URL: http://www.igpp.ucla.edu/jweygand

SH42A-0483 1330h POSTER

Dynamic Modeling of Solar Energetic Particle Cutoffs During Geomagnetic Storms

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We investigate numerically the relationship between time variations in the geomagnetic cutoff and prompt trapping of Solar Energetic Particles inside the prestorm cutoff, which form new radiation belt populations distinct from the CRAND-produced inner zone. This is done for several CME-shock initiated geomagnetic storms including the 14 July 2000, 24 Nov 2001, and 21-23 April 2002 storms. Following Smart and Shea [2000], Solar Energetic Particle (SEP) access is determined by computing the reverse particle trajectories. Magnetospheric fields are obtained from the Lyon-Feder-Mobarry (LFM) global MHD model, which is driven by measured solar wind parameters at the sunward boundary. We find well-defined surfaces of constant cutoff that exhibit dynamic behavior in response to solar wind conditions. The results suggest that an enhanced solar wind dynamic pressure plays a direct role in the observed ion injections. Additional mechanisms for SEP access and trapping are considered, including the the role of ULF waves.

SH42A-0484 1330h POSTER

Entry and Acceleration of Solar Wind Electrons in the Earth's Outer Magnetosphere

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It is well known that during the recovery of magnetic storms, relativistic electron fluxes are usually enhanced over pre-storm values in the inner magnetosphere near geosynchronous orbit. Although the final acceleration of electrons to MeV energies most likely occurs in the inner magnetosphere, observations indicate that an enhanced flux of energized electrons (> 10 keV) forms in the so-called seed region located at about 10 RE radially from the Earth in the equatorial plane. To examine the acceleration of electrons from the solar wind to the seed region, a study is being undertaken whereby electron trajectories are followed starting upstream of the bow shock, through the magnetopause and throughout the outer magnetosphere. The entry locations of electrons will be examined along with acceleration mechanisms that occur between the solar wind and seed region. The electron particle trajectories are followed based on the guiding center approximation in a global MHD model of the solar wind interaction with the Earth's magnetosphere for various interplanetary magnetic field (IMF) conditions.

SH42A-0485 1330h POSTER

Solar Energetic Ion Entry into the Magnetosphere during a Magnetic Storm

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The magnetic storm of November 24, 2001 was characterized by an increase in the energetic ion flux in the solar wind by more than an order of magnitude over a wide energy range. Following the increase in energetic ions in the solar wind, large increases in ion flux were observed by geosynchronous spacecraft, which was followed later by a substantial drop in DST. In addition, the dynamic pressure increased and the interplanetary magnetic field (IMF), particularly the y component, also increased in magnitude at about the same time as the geosynchronous spacecraft ion flux increased. The question we will address is how the upstream energetic ions contribute to the magnetic storm process and how their transport into the magnetosphere is determined by the magnetospheric configuration. The approach we use is to perform particle tracing calculations in the electric and magnetic fields from a global magnetohydrodynamic (MHD) simulation. We first performed an MHD simulation of this storm interval by using solar wind and IMF time series measured by upstream spacecraft which determine the upstream boundary conditions for the MHD simulation. Then we launched large number of test ions in the time-dependent electric and magnetic fields from the MHD simulation. The accessibility of magnetospheric regions to these ions as well as precipitation and trapping in the model will then be assessed. The flux of energetic particles from the calculations will be compared to the geosynchronous observations.

SH42A-0486 1330h POSTER

Inner Magnetospheric Current Systems During moderate Magnetic Storm Events

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The interaction of the solar wind with the Earth's geomagnetic field leads to a complex current system within the magnetosphere. Understanding this current system requires a global treatment of the solar wind-magnetosphere- ionosphere system. Global magnetohydrodynamic (MHD) simulations provide a reasonable description of the large-scale structure of the Earth's magnetosphere as it responds to changes in the interplanetary magnetic field. Modeling the inner magnetosphere, however, is limited by the lack of a proper representation of ring current formation. We will consider moderate storm events and compare the plasma pressure distribution in the inner magnetosphere from the MHD result to observed storm intervals. This will allow us to quantify the contributions of ring current particles in the ring current region. We will discuss the inclusion of the physical effects of the ring current in the MHD solutions.

SH42A-0487 1330h POSTER

Diffusion of Radiation Belt Electrons in Three Dimensions

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The three dimensional dynamics of relativistic electrons are simulated using guiding center approximation equations to track the bounce and drift motion of particles. The effects of energy, latitude, L value and magnetic field configuration on diffusion rates are examined. Three different dynamic field configurations will be compared. One field model is an analytic model based on a compressed dipole magnetosphere with modeled poloidal mode ULF wave oscillations, including time-varying magnetic and electric field components. The second model developed by Proehl et al. [2002] employs a self-consistent MHD code in dipole geometry driven by a single frequency sinusoidal perturbation at the magnetopause. We have added a solar wind compression of the dipole magnetic field. The third model employs the Lyon-Fedder-Mobary (LFM) 3D MHD code which uses solar wind data at the upstream boundary as input. Comparisons between models and observations of the effects of Ultra Low Frequency (below 10 mHz) wave fields on radial transport and energization of radiation belt electrons will be presented. Proehl, J. A., W. Lotko, I. Kouznetsov and S. D. Geimer, Ultralow-frequency magnetohydrodynamcis in boundary-constrained geomagnetic flux coordinates, J. Geophys. Res., 107, 1225, 2002.

SH42A-0488 1330h POSTER

Relativistic Electron Equatorial Phase Space Densities Gradients from 4 to 20 Re

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A critical parameter for understanding radiation belt electron dynamics is the gradient in phase space density as a function of radius. Typically one wants to calculate phase space densities as a function of the adiabatic invariants of particle motion. The inaccuracies in calculation of the adiabatic invariants caused by inaccuracies in our global magnetic field models can be reduced if only 90 degree equatorial pitch angles are used (and the second invariant is zero). In this study we use the near-equatorial measurements from geosynchronous satellites along with the equatorial crossings of the GPS, POLAR, and Cluster spacecraft. GPS crosses the magnetic equator around L=4.5, Geosynchronous near L=6.6 and Cluster in the mid-tail, L=18-20. Previous studies that we have presented showed a strong PSD radial gradient inside geosynchronous orbit and a very weak radial gradient outside geosynchronous orbit. The inflection point in the gradient appears near the expected location of the trapping boundary and suggests that the gradients in the plasma sheet are quite weak. Our studies confirm the results of Green et al. suggesting the presence of a peak in phase space density in at least some events. In this study we extend previous work by examining a large number of equatorial measurements by all 4 sets of satellites over the years 1997 to 2002. In particular we concentrate on equatorial PSD measurements by POLAR. Because of the precession of the orbit, POLAR equatorial crossings range from L=4 to L=9 depending on the year of measurement. Therefore, in a statistical sense POLAR fills in the region of primary interest with an unprecedented density of equatorial PSD measurements. This statistical analysis shows the broad range of radiation belt dynamics and average profiles of radial gradients as a function of solar wind driving and geomagnetic conditions.

SH42A-0489 1330h POSTER

Modeling the Transport, Acceleration, and Loss of Energetic Particles During the October 2001 Storm

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The development of a predictive geomagnetic storm model is of central interest to the NASA Sun-Earth Connection program. This study addresses processes that need to be understood to achieve this goal. We simulate the ring current-atmosphere interactions during the October 21-25, 2001, storm using our global physics-based model. The storm had a rapid main phase reaching minimum Dst=-166 nT and maximum Kp=8$^-$ at ∼22 UT, followed by a period of strong geomagnetic activity lasting for more than a day, and a slow storm recovery. We extend our kinetic model which calculates time-dependent transport and loss to relativistic energies and include radial diffusion. Losses due to charge exchange, Coulomb collisions, wave-particle interactions, and convective drift through the dayside magnetopause are considered. The plasma inflow from the magnetotail as the storm evolves is modeled after measurements from the MPA and SOPA instruments on the LANL spacecraft. The initial conditions are inferred from the HYDRA and MICS instruments on Polar. We investigate the relative effect of magnetospheric convection and radial diffusion on the stormtime injection and trapping of energetic particles. We calculate the excitation of EMIC waves and the resulting precipitating flux of resonant particles. Model results are compared with NOAA and Polar observations. We present global patterns of ring current energy density and study the transition from an asymmetric to a symmetric ring current population as the storm evolves.

SH42A-0490 1330h POSTER

Demonstration of a Prototype Magnetospheric State-Based Trapped Radiation Data Base for the LWS Program

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A prototype magnetospheric state-based trapped radiation data base has been constructed as part of a proof-of-concept implementation of a new-generation trapped radiation model. Trapped radiation data from the data base, itself consisting of a data base of magnetospheric state (Psi) parameters and a data base of particle measurements (Phi), can be queried by specifying a set of magnetospheric-state (MS) parameters or a MS vector, as proposed by Fung [1996]. Trapped particle data having the same MS can then be retrieved from the data base and used to construct a trapped radiation model for the given MS condition. In this presentation, we demonstrate the capabilities of the prototype data base and discuss their implications for the LWS program. Fung, S. F., Recent development in the NASA trapped radiation models, Radiation belts Models and Standards, Geophysical Monogr., 97, AGU, Washington, D. C., 79-91, 1996.

SH42A-0491 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; 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.

SH42A-0492 1330h POSTER

Midlatitude D-Region Absorption Studies in the Space Weather Context - Observational Results

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Simultaneous continuous measurements of NOAA/GOES 8/10/12 solar x-ray flux and calibrated HF signal strength were initiated in December 2002 to provide validation data for a "Data Driven D-region (DDDR)" ionospheric model. One-minute signal strength averages of standard time-frequency stations WWV and WWVH over the range of 2.5 to 20.0 MHz and 5-minute averages of 1.0 to 8.0 nm solar x-ray flux have been studied for 35 solar flares ranging from Class C to Class X from March through August 2003 during the descending phase of solar cycle 23. Digital filtering of the received signals allows the individual transmissions to be positively identified, providing quantitative calibration of received signal and noise parameters. The monitoring stations are located at Providence, Utah and Klamath Falls, Oregon. An ionosonde and magnetometer at Bear Lake Observatory in Utah provide data about ionospheric conditions near the WWV to Klamath Falls path midpoint.Continuous monitoring at these stations is planned through August 2005. Not surprisingly, there appears to be a close association between the magnitude of the solar x-ray flares and HF signal attenuation on the midlatitude path from Fort Collins, Colorado (WWV) to both Providence and to Klamath Falls. On the 1400 km WWV to Klamath Falls path, effects are most closely related to daytime 10 and 15 MHz signal absorption. Relationships between x-ray flux, signal absorption, time of day and geomagnetic activity levels for the cases studied is presented.It is proposed that this type of HF signal monitoring can provide an inexpensive, passive, near-real-time data stream for assimilation into the DDDR model and possibly for HF propagation forecasting/nowcasting programs as well. Potential extensions to the monitoring program which could extend its usefulness beyond the American sector wil also be discussed.

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SH42A-0493 1330h POSTER

Combining optical and radio techniques for high-resolution ionospheric specification

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With the proliferation of satellite-based ionospheric measurement systems, opportunities exist for high-resolution ionospheric specification. These systems utilize optical and radio-based techniques. The optical techniques include, UV limb scanning, UV disk scanning, and UV disk imaging. The radio techniques include, radio occultations, radio beacon tomography, and radar altimetry. While assimilative models seek to routinely ingest these data and produce a global or regional specification of the ionosphere, coincident measurements from more than one technique provide frequent opportunities to directly reconstruct the ionospheric densities with a high spatial resolution. The concept is demonstrated by using coincident UV limb scan data from LORAAS with radar altimetry data from TOPEX. The limb scans provide vertical information and the altimetry data provides horizontal information. When combined a 2D reconstruction of the ionosphere is obtained over a large geographic region with high spatial resolution. Additional combination of existing satellites can be used to produce high-resolution ionospheric specifications. In the future, multiple sensors on the same satellite will routinely provide such opportunities. Examples of these satellites include COSMIC and NPOES.

SH42A-0494 1330h POSTER

STARSHINE Studies of Thermospheric Response to Solar Forcing

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A new, fast, accurate methodology is now available for extracting the thermospheric total mass density from NORAD two-line element sets (TLEs) with quality comparable to state-of-the-art, precision orbit determination calculations for routine objects. This result is both unprecedented and unforeseen. Using the new technique, we have derived time series of thermospheric density for the Starshine 1, 2, and 3 spacecraft, which flew at altitudes between 200 and 470 km during 1999-2003, covering a significant portion of the solar cycle 23 maximum. The Starshine spacecraft are especially suitable for measuring thermospheric density, since they are approximately spherical, so that their ballistic coefficients are essentially independent of spacecraft attitude. Analysis of these data using the NRLMSISE-00 empirical atmospheric model and realistic measures of the solar extreme ultraviolet (EUV) flux have quantified the thermospheric response to solar forcing on a range of time scales. Spectral analysis of the solar and thermospheric time series suggest shortcomings in the F10.7 solar radio flux as an index for the solar EUV flux. Based on these findings we outline new physics-based approaches to develop improved atmospheric models for daily nowcasting and prediction of the thermospheric state.

SH42A-0495 1330h POSTER

Climatology of nighttime mid and low latitude upper thermospheric disturbance winds measured by WINDII

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Neutral dynamics directly impact the structure of the thermosphere and ionosphere, but the global characteristics of neutral winds under disturbed conditions are poorly understood. We use measurements from the Wind Imaging Interferometer (WINDII) on board the Upper Atmosphere Research Satellite (UARS) to study the climatology of nighttime mid and low latitude upper thermospheric disturbance winds induced by geospace storms. Previous analyses of WINDII disturbance winds have focused on the daytime sector. Our climatology represents a disturbed condition of Kp $\sim$ 4. At geomagnetic latitudes of 65°, strong westward perturbation winds are observed in the dusk sector, peaking near 1700 LT with values of 160 m/s. At lower latitudes, these westward disturbances are weaker and develop later; at 35°, they peak near midnight with values of 30 m/s. Near the geomagnetic equator, westward perturbations of 20 m/s are observed at 2200 LT; these shift to eastward at 0100 LT. A west-to-east reversal is also observed at this local time at latitudes above 50°, whereas the post-midnight westward disturbance winds at midlatitudes merely diminish with increasing local time. Equatorward perturbation winds are observed after 2000 LT at geomagnetic latitudes from 40° to 65°. These peak around 0300 LT with values of 50 m/s. At lower latitudes, smaller equatorward disturbances appear after 0200 LT, with magnitudes less than 20 m/s. We also investigate the seasonal and solar cycle dependence, and we compare our results with midlatitude disturbance winds derived from Millstone Hill Fabry-Perot interferometer measurements.

SH42A-0496 1330h POSTER

An Analysis on the TEC Variability and Ionospheric Scintillation at Los Alamos, New Mexico Derived from FORTE-Received LAPP Signals

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The total electron content (TEC) of ionosphere and its electron density irregularities (scintillation) have effects of degradation and disruption on radio signals passed between ground stations and orbiting man-made satellites. With the rapid increase in operational reliance on UHF/VHF satellite communication, it is desirable to obtain understandings of ionosphere TEC variability and scintillation characteristics to improve our ability of predicting satellite communication outages. In this work, data collected from FORTE satellite received LAPP (Los Alamos Portable Pulser) signals during 1998-2002 are used to derive TEC and ionospheric scintillation index at Los Alamos, New Mexico. To characterize in-situ TEC variability at Los Alamos, the FORTE-LAPP derived TECs are analyzed against diurnal, seasonal, solar activity, magnetic storm, and stratospheric warming. The results are also compared with the TEC estimates from the Los Alamos ionospheric transfer function (ITF) implemented with the global ionospheric models (IRI, PIM), and GPS -derived TEC maps. The FORTE-LAPP signals are also analyzed against two important measures of the effect of scintillation on broadband signals, the mean time delay and the time delay jitter. The results are used to examine coherence frequency bandwidth and compared with the predictions from a global scintillation model (WBMOD). The FORTE-LAPP analyzed and WBMOD predicted scintillation characteristics are used to investigate temporal and seasonal behavior of scintillation at Los Alamos.

SH42A-0497 1330h POSTER

Forecasting of Ionospheric Scintillation Based on Satellite In-situ Measurements

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Prediction of scintillation occurrence at high latitudes is a complex problem involving irregularity generation and decay rates, time-dependent coupling between the interplanetary magnetic field and ionospheric electric field, and long-range transport of ionospheric plasma by the varying convection electric field. In this paper, we investigate the feasibility and effectiveness of tracing measurements of large-scale density structures and irregularities detected by satellite instrumentation forward in time along convection trajectories for the purpose of providing specification and short-term forecasts of high-latitude scintillation. Given the few number of satellite observations, our specification or forecast for the entire polar region will combine observations with observed climatology. We also need a benchmark capability to use climatology as a nowcast and forecast if trajectory analysis is unavailable. Such a benchmark will provide the means to assess whether the trajectory analysis provides an increase level of performance. We will present examples of convection tracing using variable E x B drift pattern, discuss practical limits on position extrapolation and scintillation specification posed by uncertainty in the convection pattern and temporal evolution of scintillation-producing features, and discuss the combining of climatology with trajectory tracing. We will present examples of scintillation-related irregularities as observed in situ and discuss techniques for estimating radio wave scintillation on the ground from the in situ observations.

SH42A-0498 1330h POSTER

Study of the Pre-Reversal Enhancement at the Jicamarca Radio Observatory using the ASPEN-TIMEGCM

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The Advanced Space Environment Thermosphere Ionosphere Mesosphere Electrodynamics General Circulation Model (ASPEN-TIMEGCM) has been run to simulate the global ionosphere for three days in April 2002 and five days in June 2002. The April period was a time of quiet geomagnetic activity preceding an intense storm while the June period was a time of quiet to moderate activity. These periods were chosen as data from the Jicamarca Radio Observatory were available. Here, we concentrate on the eastward electric field (vertical ion drift) at the location of Jicamarca, as this is one of the most important parameters in setting up the low-latitude ionosphere. We find that the model properly captures the variations of the eastward equatorial electric field. In particular, it correctly models the timing and magnitude of the pre-reversal enhancement, both on nights when it is present and those when it is not.

SH42A-0499 1330h POSTER

ISS Plasma Contactor Units Operations During Strong Geomagnetic Activity

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The large structure and high voltage arrays of the ISS represent a complex system that interacts with the Earth's ionosphere. To mitigate spacecraft charging problems on the ISS, two Plasma Contactor Units discharge ionized xenon gas to "clamp" the potential of the ISS with respect to the low Earth orbit plasma. The Plasma Interaction Model, a model of ISS plasma interaction developed from the basic physics of the interaction phenomena, includes magnetic induction effects, plasma temperature and density effects, interaction of the high voltage solar arrays with ionospheric plasma, and accounts for other conductive areas on the ISS. To augment this model, the PCU discharge current has been monitored for the ISS in a variety of flight attitudes as well as during the annual seasons. A review of the PCU discharge currents shows a correlation to the geomagnetic activity. The variation in the PCU discharge current during strong geomagnetic activity will be presented. Also, the PCU discharge currents during periods of low geomagnetic activity will be discussed. The presentation will conclude with a comparison of satellite plasma measurements during different stages of geomagnetic activity.

SH42A-0500 1330h POSTER

Assessment and Control of International Space Station Spacecraft Charging Risks

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Electrical interactions between the F2 region ionospheric plasma and the 160V photovoltaic (PV) electrical power system on the International Space Station (ISS) can produce floating potentials (FP) on ISS conducting structure of greater magnitude than are usually observed on spacecraft in low-Earth orbit. Flight through the geomagnetic field also causes magnetic induction charging of ISS conducting structure. Charging processes resulting from interaction of ISS with auroral electrons may also contribute to charging, albeit rarely. The magnitude and frequency of occurrence of possibly hazardous charging events depends on the ISS assembly stage (six more 160V PV arrays will be added to ISS), ISS flight configuration, ISS position (latitude and longitude), and the natural variability in the ionospheric flight environment. At present, ISS is equipped with two plasma contactors designed to control ISS FP to within 40 volts of the ambient F2 plasma. The negative-polarity grounding scheme utilized in the ISS 160V power system leads, naturally, to negative values of ISS FP. A negative ISS structural FP leads to application of electrostatic fields across the dielectrics that separate conducting structure from the ambient F2 plasma, thereby enabling dielectric breakdown and arcing. Degradation of some thermal control coatings and noise in electrical systems can result. Continued review and evaluation of the putative charging hazards, as required by the ISS Program Office, revealed that ISS charging could produce a risk of electric shock to the ISS crew during extra vehicular activity. ISS charging risks are being evaluated in ongoing ISS charging measurements and analysis campaigns. The results of ISS charging measurements are combined with a recently developed detailed model of the ISS charging process and an extensive analysis of historical ionospheric variability data, to assess ISS charging risks using Probabilistic Risk Assessment (PRA) methods. The PRA analysis (estimated frequency of occurrence and severity of the charging hazards) are then used to select the hazard control strategy that provides the best overall safety and mission success environment for ISS and the ISS crew. This paper presents: 1) a summary of ISS spacecraft charging analysis, measurements, observations made to date, 2) plans for future ISS spacecraft charging measurement campaigns, and 3) a detailed discussion of the PRA strategy used to assess ISS spacecraft charging risks and select charging hazard control strategies.

SH42A-0501 1330h POSTER

Specifying the ISS Plasma Environment

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Quantifying the spacecraft charging risks and corresponding hazards for the International Space Station (ISS) requires a plasma environment specification describing the natural variability of ionospheric temperature (Te) and density (Ne). Empirical ionospheric specification and forecast models such as the International Reference Ionosphere (IRI) model typically only provide estimates of long term (seasonal) mean Te and Ne values for the low Earth orbit environment. Knowledge of the Te and Ne variability as well as the likelihood of extreme deviations from the mean values are required to estimate both the magnitude and frequency of occurrence of potentially hazardous spacecraft charging environments for a given ISS construction stage and flight configuration. This paper describes a statistical analysis of historical ionospheric low Earth orbit plasma measurements used to estimate Ne, Te variability in the ISS flight environment. The statistical variability analysis of Ne and Te enables calculation of the expected frequency of occurrence of any particular values of Ne and Te, especially those that correspond to possibly hazardous spacecraft charging environments. The database used in the original analysis included measurements from the AE-C, AE-D, and DE-2 satellites and recent work on the database has added additional satellites to the database and ground based incoherent scatter radar observations as well. Deviations of the data values from the IRI estimated Ne, Te parameters for each data point provide a statistical basis for modeling the deviations of the plasma environment from the IRI model output.

SH42A-0502 1330h POSTER

Evolving the Living With a Star Data System Definition

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NASA's Living With a Star (LWS) Program is a space weather-focused and applications-driven research program. The LWS Program is soliciting input from the solar, space physics, space weather, and climate science communities to develop a system that enables access to science data associated with these disciplines, and advances the development of discipline and interdisciplinary findings. The LWS Program will implement a data system that builds upon the existing and planned data capture, processing, and storage components put in place by individual spacecraft missions and also inter-project data management systems, including active and deep archives, and multi-mission data repositories. It is technically feasible for the LWS Program to integrate data from a broad set of resources, assuming they are either publicly accessible or allow access by permission. The LWS Program data system will work in coordination with spacecraft mission data systems and science data repositories, integrating their holdings using a common metadata representation. This common representation relies on a robust metadata definition that provides journalistic and technical data descriptions, plus linkages to supporting data products and tools. The LWS Program intends to become an enabling resource to PIs, interdisciplinary scientists, researchers, and students facilitating both access to a broad collection of science data, as well as the necessary supporting components to understand and make productive use of these data. For the LWS Program to represent science data that are physically distributed across various ground system elements, information will be collected about these distributed data products through a series of LWS Program-created agents. These agents will be customized to interface or interact with each one of these data systems, collect information, and forward any new metadata records to a LWS Program-developed metadata library. A populated LWS metadata library will function as a single point-of-contact that serves the entire science community as a first stop for data availability, whether or not science data are physically stored in an LWS-operated repository. Further, this metadata library will provide the user access to information for understanding these data including descriptions of the associated spacecraft and instrument, data format, calibration and operations issues, links to ancillary and correlative data products, links to processing tools and models associated with these data, and any corresponding findings produced using these data. The LWS may also support an active archive for solar, space physics, space weather, and climate data when these data would otherwise be discarded or archived off-line. This archive could potentially serve also as a data storage backup facility for LWS missions. The plan for the LWS Program metadata library is developed based upon input received from the solar and geospace science communities; the library's architecture is based on existing systems developed for serving science metadata. The LWS Program continues to seek constructive input from the science community, examples of both successes and failures in dealing with science data systems, and insights regarding the obstacles between the current state-of-the-practice and this vision for the LWS Program metadata library.

SH42A-0503 1330h POSTER

Data Integration in the Virtual Solar Observatory

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The aim of the Virtual Solar Observatory (VSO) is the integration of diverse data archives relevant to the study of Solar Physics into a virtual collection providing common search and delivery services. The back-end query services are implemented as Web Services and accessible via the Simple Object Access Protocol (SOAP). SOAP defines a remote procedure call mechanism that employs HTTP as its transport and encodes the client-server interactions in XML documents. In addition to its core function in identifying relevant datasets locally, a SOAP server at each data provider acts as a wrapper that maps descriptions in an abstract data model to those in the provider's specific model, and vice versa. Heterogeneous data search services can thereby be integrated with a common interface. This allows scientists to access multiple archives with differing data organizations at once, enhancing their ability to discover and and analyze correlative data from multiple sources. We have chosen two SOAP implementations for the VSO: SOAP::Lite and OpenSOAP. The former, written in Perl, is suitable for fast and flexible prototyping in data search applications. SOAP::Lite servers have been set up at each of the VSO archives, and can be readily installed at other servers. OpenSOAP, written in C with built-in support for service description and dispatch, may prove useful in transforming current computing utilities into Web Services. We report on initial experiments using OpenSOAP to provide additional services to the basic query functionality of VSO.

URL: http://vso.stanford.edu/papers/agu03.html

SH42B MCC: Level 1 Thursday 1330h

Coronal Magnetic Fields: Models to Measurements IV Posters

Presiding: **C E DeForest,** Southwest Research Institute**; P Riley,** Science Applications International Corp.

SH42B-0504 1330h POSTER

CONDITIONS LEADING TO ERUPTIONS OF CMEs ASSOCIATED WITH ERUPTIVE FILAMENTS

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We report on a few recent and interesting observations of coronal mass ejections associated with eruptive filaments recorded in multiwavelengths using various data sets obtained from ground- and space-based observatories. These include chromospheric observations in H-alpha and the inner coronal data recorded from Mauna Loa Solar observatory (MLSO). The CME recorded in white light observations from the LASCO/SoHO is included in the analysis. In this paper, we attempt to investigate the pre-eruptive scenario of these events leading up to the eventual eruption. The role of the restructuring of the magnetic field and changes in the magnetic field due to the emergence and cancellation of magnetic flux in the source region of the CME will be discussed.

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