Data from the precipitating particle spectrometers on the spacecraft of the Defense Meteorological Satellite Program (DMSP) are provided by AFRL and widely used. The calibrations are done as carefully as possible in a vacuum chamber before flight. However, until now, there has been minimal accounting for changes that take place between calibration and launch, which is often several years, and changes that take place after launch. In the past, the only checking we have done is to compare in-flight auroral particle data from newly launched spacecraft with data from similar instruments on older spacecraft in the same orbit plane. Since two spacecraft almost never cross the auroral zones simultaneously, this has left us with levels of uncertainty of as much as a factor of 2 on newly launched spacecraft. Older spacecraft may have had larger uncertainties because we have not accounted for degradation of the channeltron detectors. We have recently used the flux of MeV particles in the South Atlantic Anomaly region as a standard for determining the degradation of the detectors. In addition, we have used the particle flux on the low-latitude side of the dayside cusp as a standard for changes in the calibration constant between the times of vacuum chamber testing and launch. Both of these sources have variations, especially with respect to the 11-year solar cycle, but if carefully used, they are much steadier sources of particles than any other location available. The result is a new set of time-dependent calibrations, which will be released at the meeting.

SM11C-1189 0830h POSTER

Diurnal Variations of Quasi-Periodic and Periodic VLF emissions in the Outer Magnetosphere

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ELF-VLF receiver and search coil magnetometer data from four Antarctic stations during 1998 have been analyzed to study quasi-periodic emissions (QPs) and periodic emissions (PEs), which occur as ULF-range modulations of ELF-VLF signals between 0.5 kHz and ~4 kHz. QPs are modulated at frequencies of 15-50 mHz, and PEs are modulated at frequencies of 100-500 mHz. The stations used covered a range of magnetic latitudes from -62° (Halley) to -74° (South Pole Station); two automated geophysical observatories (AGOs) were located at intermediate latitudes. Consistent with earlier studies, most QPs were observed with magnetic pulsations of identical period in the Pc 3-4 range (type I QPs). Of those QPs not observed with simultaneous magnetic pulsations (type II QPs), nearly all were accompanied by PEs. It is also notable that no PE events simultaneous with Pc 3-4 magnetic pulsations but without QPs were observed during the entire year at any station. Diurnal patterns of all categories of QP events show occurrence maxima in the noon or post-noon sectors. The total absence of type I QP occurrences without PEs on the nightside is consistent with the expected absence of Pc 3-4 pulsations there, because of their origin at the upstream bow shock. PEs, on the other hand, could be seen at all local times. Diurnal profiles showed no latitudinal or seasonal differences for most categories, except for a clear reversal of the profile of PE occurrence with latitude. In every multistation event studied, we have found QP and/or PE modulations to be simultaneous at all stations to within the 1-s sampling time of the data. This suggests that all such events originate a single, localized region, most probably near the plasmapause. In contrast, the magnetic pulsations showed little or no detailed correlation between stations. Both statistical and single event studies support the hypothesis that highly localized field-aligned currents stimulated by echoing whistlers (PEs) may be responsible for producing type II QPs on the same flux tubes, typically in the sub-auroral or auroral regions. In addition, we have noted that the small number of type II QP events we have observed without accompanying PEs is tightly clustered near local noon. The existence of a set of equatorially-localized, near-noon, compressional Pc 3-4 waves that evidently do not appear in ground records suggests that this category as well might be generated by ULF wave modulation of equatorial ELF/VLF wave growth.

SM11D MCC: 2006 Monday 1020h

Sun-Earth Connections: Linked Models II *(joint with SA, SH, NG)*

Presiding: **R Clauer,** University of Michigan**; J W Freeman,** Rice University

SM11D-01 1020h INVITED

Modeling the May 1, 1998 CME propagation from the Sun to the Earth

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We present a three-dimensional numerical ideal magnetohydrodynamics model describing the halo coronal mass ejection (CME) of May 1, 1998 propagating from the solar corona to 1 A.U. We begin by developing a realistic global steady-state model of the corona and solar wind in which the magnetic field is derived from synoptic magnetograms. The Archimedian spiral topology of the interplanetary magnetic field is reproduced along with fast and slow speed solar wind. Within this model system, we drive the CME eruption by placing a Gibson-Low magnetic flux rope in the helmet streamer of the pre-event active region. The flux rope is in an initial state of force imbalance and expands at such a rate as to approximate the observed speed of the May 1, 1998 CME. Physics based AMR of the BATS-R-US (Block Adaptive Tree Solarwind Roe Upwind Scheme) code allows us to capture the structure of the CME on a particular Sun-Earth line with high spatial resolution. In particular, we highly resolve the the bow shock ahead of the flux rope as well as to the current sheet behind. We compare our model CME plasma parameters at 1 AU to observed values. In a companion paper, we use the model CME-perturbed solar wind as input for an Earth-Magnetospheric/Ionosphere/Thermosphere simulation and compare the geoffectiveness of the Earth-system model to observations.

SM11D-02 1040h INVITED

Magnetospheric, Ionospheric, and Thermospheric Results for the May 1-4, 1998 CME Using a Coupled Sun to Earth Model

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We present results from the Comprehensive Space Environment Model for the May 1-4, 1998 coronal mass ejection (CME). This CME is launched from the Sun and driven through a realistic magnetogram driven heliosphere. We present results of the CME encounter with the near-Earth space environment, including the magnetosphere, ionosphere, and thermosphere (MIT). We have run the simulation in two ways: (1) using measured solar wind and interplanetary magnetic field values; and (2) using the coupled Sun - Earth model. We will present comparisons of the two runs. In addition, we will present comparisons of the coupled code with cross polar cap potential, Joule heating, and hemispheric power index from the assimilative mapping of ionospheric electrodynamics. We will further examine the role of the dipole orientation and tilt of the CME on the magnetospheric and ionospheric results.

SM11D-03 1100h

Hazards of Coupling Models of Different Physical and Regional Properties: Sun-Earth EUV Link

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Physical models have an evolutionary heritage that includes hidden approximations, numerical limitations, as well as forgotten calibration dependencies. As new data sets become available and computer speed increases, the models evolve further and become more ambitious, often leaving their limitations even more deeply hidden. Recent progress in describing the solar extreme ultraviolet EUV spectrum has led to an increase in the number of solar EUV models available. Each has unique strengths but, unfortunately, they are significantly different. Both the ionosphere and thermosphere heavily depend on the solar EUV input for ionization and heating in the former case and heating in the latter case. Hence, the non-expert desire to test the various coupling schemes between solar EUV and ionosphere/thermosphere leads to a series of difficulties lying outside the models' calibration range. The USU Time Dependent Ionospheric Model (TDIM) was used to simulate E and F region responses to the variety of solar EUV representations. These simulations are augmented by a series of TDIM sensitivity studies of the chemical and physical processes. By understanding how sensitive the TDIM is to various drivers, it is then possible to evaluate if indeed the TDIM can uniquely determine which solar EUV representation is appropriate. This will be shown to be impossible because of the large uncertainties that are associated with the other ionospheric drivers; chemical reaction rates, neutral densities and composition, neutral winds and profile shapes, topside fluxes of both density and energy, etc. The surprising result is that by adding newer solar EUV representations, the TDIM becomes less accurate and "recalibration" is necessary.

SM11D-04 1115h INVITED

A Coupled Model Using Solar Observations to Make Probabilistic Forecasts of Magnetospheric Activity

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It is well established that the driver of magnetospheric activity is the rectified dawn-dusk component of the interplanetary electric field, VBz. Accurate forecasts of the temporal development of magnetospheric activity require prediction of the Bz waveform that will arrive at the Earth. This can be accomplished relatively well using observations from L1, but only with about 30-60 minutes lead time. Longer term forecasts are unlikely to be successful because Bz is a turbulent variable produced by a superposition of evolving structures and waves in the solar wind. For forecasts with 1-4 days lead time we advocate the use of probabilistic forecasting, e.g the probability that Dst < -50 nT is 10%. In this report we describe a technique we call probabilistic forecasting by air mass climatology. The basic premise underlying this method is that structures in the solar wind such as CIRs and CMEs organize the statistical properties of the solar wind and hence magnetospheric activity (climatology). We have found that the stream interface between high and low speed solar wind is extremely effective in organizing the statistical properties of geomagnetic indices during the declining phase of a solar cycle. We have used the time of many interfaces in 1994-1996 to determine the cumulative probability distributions (cdfs) for 3-hr ap and 1-minute Dst indices. We couple these statistical results to the Wang-Sheeley (W-S) model. The W-S model utilizes telescopic observations of the Sun's photospheric magnetic field to predict the speed of the solar wind, the polarity of the IMF, and the magnitude of the IMF

at the Earth 3-4 days in advance. By detecting stream interfaces in the predicted velocity we obtain 2-3 days advance warning of a stream interface. We then use the climatology of an index relative to the predicted interface (the cdfs) to forecast the probability of enhanced activity. We will evaluate the quality of the predictions for the years 1995-1996 and apply it to current observations as we progress into the declining phase of the current cycle.

SM11D-05 1135h

Sun-to-Magnetosphere Modeling of Radiation Belt Electrons: Forecasting Using Linked Empirical Methods

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An important space weather threat is associated with very high energy electrons trapped in Earth's outer Van Allen zone. Past work has shown that radiation belt electron fluxes are highly dependent on the solar wind speed (V_{SW}). Generally, when V_{SW}. goes above 500km/s, the radiation belt electron fluxes increase substantially. We have used the Wang-Sheeley-Arge (WSA) method to predict the solar wind speed near Earth's orbit based upon solar surface measurements. This approach gives a predicted solar wind time series with a lead-time of two to three days. This forecasted solar wind speed is then convolved with linear and nonlinear filters in order to provide a predicted flux of electrons at various spatial locations throughout the outer radiation belt. We compare predicted and measured electron fluxes in order to assess the prediction efficiency and available lead times for this forecasting tool. We also compare forecasts based on the WSA method with results obtained by convolving filters with solar wind speeds measured by ACE sensors at the L1 point just upstream of the Earth.

SM11D-06 1150h

"Nudging" the Salammbo Code: First results of seeding a diffusive radiation belt code with in situ data: GPS, GEO, HEO and POLAR

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The Salammbo coded is a diffusive radiation belt code aimed at representing the dynamics of relativistic electrons in the inner magnetosphere. The code currently incorporates physics capturing the majority of the observed dynamics, but does not include all proposed mechanisms that could be responsible for some of the detailed dynamics observed - in particular, it does not include chorus acceleration. However, we do have at our disposal a range of data taken in situ. Traditionally diffusive models use data as boundary conditions only. We here use properly inter-calibrated data from a range of LANL geosynchronous and GPS particle instruments whenever they are available to seed or "nudge" the code, allowing the code in effect to act as a physics based interpolater of the data. This process yields a data/model global synthesis representation of the state of the relativistic electron belts that is better than any representation that can currently be achieved from models or data alone, in spite of some "missing physics". We present here the data ingestion methods used and first runs of this new synthesis model. We test this model against in-situ measurements of spacecraft not part of the assimilation process: In general the synthesis model is able to reproduce measured in-situ fluxes to within a factor of two, irrespective of activity level. This is of the same order as the fidelity of our spacecraft inter-calibration and thus as good as one can be expected to do. We are thus able to produce a high fidelity state of the global magnetosphere against which this and other physics based models may be compared.

SM11D-07 1205h

Role of Ion-drag Processes in the Nighttime, Low-latitude Thermospheric Wind and Temperature Structure

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The purpose of this study is to understand the role of the plasmasphere in equatorial electrodynamics, with a focus on the role of ion-drag processes in the nighttime low-latitude thermospheric structure. This study utilizes the Coupled Thermosphere-Ionosphere-Plasmasphere-Electrodynamics (CTIPe) model where the equatorial plasmasphere is self-consistently coupled to the electrodynamics and the global ionosphere and thermosphere system. Ion-drag processes play a significant role in the momentum and energy interactions between the ionized and neutral species. Comprehensive elucidation of the spatial and temporal variations of the 3-dimensional ion-drag, especially in the evening prereversal enhancement of the zonal electric field, requires a self-consistent plasmaspheric distribution together with the electrodynamics and polarization fields associated with the E- and F-layer dynamo. Furthermore, the impact of ion-drag parallel to the field-lines must be considered, since the parallel ion drag in the vicinity of a pronounced Equatorial Ionization Anomaly has a significant impact on the latitudinal structure of the equatorial thermospheric structure. In this study, the mechanism responsible for the latitudinal structure of neutral wind and temperature, such as Equatorial Temperature and Wind Anomaly, Midnight Temperature Maximum and superrotation of the Earth's upper atmosphere, is addressed. The model results indicate that the ion-drag variations derived from the interacting plasmasphere and electrodynamics is an important consideration in these phenomena.

SM12A MCC: Level 2 Monday 1330h

The Electrodynamics of the Cusp and the Open/Closed Field Line Boundary Region I Posters *(joint with SA)*

***Presiding:* H U Frey,** Space Sciences Laboratory, University of California, Berkeley**; E Lund,** University of New Hampshire

SM12A-1190 1330h POSTER

Slow, Fast and Mixed Compressible Modes near the Magnetopause

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We motivate and illustrate a new technique to certify time variations, observed in spacecraft frame of reference, as compressible slow or fast magnetosonic waves. Like the Walén test for Alfvén waves, our method for identifying compressible modes requires no Galilean transformation. Unlike the Walén test, we use covariance techniques with magnetic field time series to select three special projections of $\mathbf{B}(t)$. The projections of magnetic fluctuations are associated with three, usually non-orthogonal, wavevectors that, in principle, contribute to the locally sampled density fluctuations. Wavevector directions ($\hat{\mathbf{k}}(CoV)$) are derived from eigenvectors of covariance matrices and mean field directions, $\mathbf{B}_o$. Linear theory for compressible modes indicates that these projections are proportional to the density fluctuations. Regression techniques are then applied to observed density and magnetic field profiles to specify coefficients of proportionality. Signs of proportionality constants, connecting the three projections of $\delta\mathbf{B}$ and $\delta\rho$, determine whether the compressional modes are of the fast (+) or slow (-) type. Within a polytropic-closure framework, the proportionality between magnetic and density fluctuations can be computed by relating $\hat{\mathbf{k}}$, the polytropic index, γ, and the plasma β. Our certification program validates the direct interpretation of proportionality constants comparing their best-fit and error values with the directions of wavevectors required by the dispersion relation, $\hat{\mathbf{k}}(Disp)$ inferred from experimental measurements of β and γ. Final certification requires that for each mode retained in the correlation, the scalar product of wavevectors determined through covariance and dispersion-relation analyses are approximately unity $\hat{\mathbf{k}}(CoV) \cdot \hat{\mathbf{k}}(\mathrm{Disp}) \approx 1$. This quality check is the compressible-mode analogue to slope-one tests in the Walén test expressed in Elsässer [1950] variables. By products of completed certification include the assignment of various portions of time-domain data streams to the compression or rarefaction phases of fast/slow modes structures, the directions of wave-power propagation in the plasma frame and relative to the magnetic field direction as well as their phase speeds with respect to the background plasma. These certifications also imply temporal trains of electric fields of the ambipolar type, including spatially varying $E_{\|}(t)$, that may be the cause of some of the structured observations of $E_{\|}$ that have recently been detected near the diffusion region. Along with Walén tests the new procedures enable surveys for the presence and roles of non-dispersive fast, intermediate, and slow MHD waves in geospace. Geophysical examples from the Polar satellite illustrate fast, slow and even admixtures of fast and slow magnetosonic waves retrieved through our analysis. On this experimental basis, we discuss the roles of compressible-mode structures in boundary layers associated with the magnetopause.

SM12A-1191 1330h POSTER

Dayside Auroral Morphology During Southeast IMF Orientation:Spatial Structure and its Implications for Magnetopause Reconnection

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In a case study we elaborate on the spatial structure of the dayside aurora within 0800-1600 MLT and discuss its implications for magnetopause reconnection topology. The detailed 2D auroral morphology is obtained from continuous ground observations at Ny Ålesund (76° MLAT), Svalbard during days when the interplanetary magnetic field (IMF) was oriented in the southeast direction ($B_y > 0$; $B_z < 0$). The major auroral features consist of sequential activations of latitudinally separated, sunward moving, arcs/bands (dayside BPS precipitation) in the prenoon (0800-1100 MLT) and postnoon (1200-1600 MLT) sectors which are separated by a deep minimum in activity/intensity within the 1100-1200 MLT sector. The latter "midday gap" aurora is attributed to the presence of component, steady state reconnection at the subsolar magnetopause where the stagnant magnetosheath flows lead to field-aligned currents (FAC) which are of only moderate intensity. The much more active and intense aurorae in the prenoon (0800-1100 MLT) and postnoon (1200-1600 MLT) sectors originate in magnetopause reconnection events that are initiated well away from the subsolar point, presumably in the form of antiparallel merging taking place near-simultaneously at high magnetopause latitudes in the southern/prenoon and northern/postnoon hemispheres, respectively, where the stronger boundary layer flow shears give rise to more intense FACs and aurorae.