gives us the opportunity to study this interesting situation in situ. In order to understand what Cassini is going to meassure we have to develop numerical models. Our recently developed 3D MHD model includes the following features that have crucial impacts on the interaction: (1) The model neutral atmosphere includes the two species CH4 and N2 which are known to be the major constituants of Titan's atmosphere. (2) Together with the solar euv spectrum and the two free parameters Saturnian local time (SLT) and sub solar latitude (SSL) we are able to calculate realistic 3D distributions of the photoionization rates for distinct condions (e.g. Cassini fly-by times). Although photoionization is the main source of ionospheric plasma production, ionization due to magnetospheric electrons plays also an important role at least on the nightside of Titan. (3) Our 3D time dependent flux tube model includes the effect of the magnetospheric electrons, calculates ionization rates by electron impact, and takes into account heat conduction along the magnetic field lines. All these features are embedded in the MHD model in order to come close to the conditions during the Cassini fly-bys.

SM11B-07 0930h

Pickup ions, plasma anisotropy and instability at Saturn: Predictions for Cassini

Frank J Crary[1] (210-522-6043; fcrary@swri.edu)

David T Young[1] (dyoung@swri.edu)

[1]Southwest Research Institute, 6220 Culebra Road, San Antonio, TX 78228, United States

Pickup ions are a primary source of plasma within Saturn's magnetosphere. These ions are initially in a strongly anisotropic ring distribution, but instabilities can rapidly cause them to evolve into a more isotropic distribution. Similar processes have been studied at length in the case of comets and Jupiter's moon, Io. Here, we apply these theories to Saturn's magnetosphere and predict that the Cassini spacecraft will frequently observe strongly anisotropic distributions. The important processes are the suppression of the ion cyclotron instability by a thermal background of a similar species, the limits to which ion cyclotron waves may reduce anisotropy (especially in a plasma where the pickup velocity is lower than the wave velocity) and the stability criteria for mirror mode instabilities.

SM11B-08 0945h

Modeling the electron and proton radiation belts of Saturn

Michel Blanc[1]; Scott J Bolton[2]; Daniel Santos-Costa[1]; Sylvestre Maurice[1]; Norbert Krupp[3]; I. Dandouras[4]

[1]Observatoire Midi-Pyrénées, Toulouse, Toulouse, F 7, France

[2]Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109, United States

[3]Max Planck Institut fur Max Planck Institut fur Aeronomy, Lindau, Lindau, G 7, Germany

[4]CESR, Toulouse, Toulouse, F 7, France

Results of a physical model for energetic electrons and protons trapped in the inner magnetosphere of Saturn are presented. This radiation-belt model is built in order to improve our understanding of the radiation-belt population as observed during the Pioneer and Voyager flybys, before being used to predict radiation-belt fluxes and emissions for the Cassini Mission. The radiation-belt particle spatial distribution has been determined by modeling the trapped particle interactions with different components of the Saturn system: moons, dust rings, neutral clouds, plasma and magnetic field. Our results suggest some explanations on the dynamics of the radiation belts of Saturn. Absorption by ring particles is dominant in the [1; 2.3] Rs region (inducing low trapped electron and proton populations) while moons. local losses act as the prominent physical process in the outer part of the inner magnetosphere ([2.3; 6] Rs). Concerning the proton radiation belts model, beyond 2.3 Rs, interactions with neutrals also cause significant losses in the outer part of the inner magnetosphere. Our simulations predict a strong production of energetic neutral hydrogen atoms, but it predicts also a very weak synchrotron emission confirming the weakness of this radiation for Saturn. Comparisons between Voyager data and model results are displayed, and trapped particle fluxes along Cassini spacecraft are discussed.

SM11C MCC: Level 2 Monday 0830h

Polar Cap and Auroral Phenomena Posters *(joint with SA, AE)*

Presiding: **T Moretto,** NASA Goddard Space Flight Center**; E Zesta,** University of California, Los Angeles

SM11C-1164 0830h POSTER

Comparison of Dayside Reconnection Rate Measurements by HF and Incoherent Scatter Radar

Gerard T Blanchard[1] (gblanchard@selu.edu)

Kile B Baker[2] (kbaker@nsf.gov)

[1]Southeastern Louisiana University, Department of Chemistry and Physics SLU 10878, Hammond, LA 70402-0878, United States

[2]National Science Foundation, Division of Atmospheric Sciences 4201 Wilson Boulevard, Arlington, VA 22230, United States

There are currently two techniques used to remotely sense magnetospheric reconnection using ground based radar. One technique uses High Frequency (HF) radar. The other uses incoherent scatter (IS) radar. In both cases, the reconnection rate is determined from the F-region plasma velocity in the rest frame of the separatrix. However, the identification of the separatrix and the measurement of the plasma velocity are based on physically different phenomena. Thus the two techniques produce independent measurements of the reconnection rate. In this study, we compare reconnection rate measurements made by the Super Dual Auroral Radar Network and the Sondrestrom IS Radar on four separate dates to determine the accuracy of the reconnection rate measurements. The previously reported finding that the position of the separatrix is poorly correlated between the two instruments when the reconnection rate is high is borne out by this study. However, we will also show that the reconnection rate is well correlated between the two instruments due to the high correlation in the plasma velocity measurements.

SM11C-1165 0830h POSTER

Evolution and Characteristics of Global Pc5 observations of ULF waves During a High Solar Wind Speed Event.

Iain Jonathan Rae[1] (jrae@space.ualberta.ca); Eric F Donovan[2] (eric@phys.ucalgary.ca); Frances R Fenrich[1] (frances@space.ualberta.ca); Ian R Mann[1] (imann@space.ualberta.ca); Clare E. J. Watt[1] (cwatt@space.ualberta.ca); Stuart D Bale[3] (bale@ssl.berkeley.edu); Matthew G. G. T. Taylor[4] (mggtt@lanl.gov); Stanley W. H. Cowley[5] (swhc1@ion.le.ac.uk); Henri Reme[6] (Henri.Reme@cesr.fr); Benoit Lavraud[6] (Benoit.Lavraud@cesr.fr); James A. Wild[5] (jaw11@ion.le.ac.uk)

[1]University of Alberta, Dept. of Physics, University of Alberta,, Edmonton., AB T6G 2J1., Canada

[2]University of Calgary, Dept of Physics and Astronomy, Calgary, AB T2N 1N4, Canada

[3]Space Sciences Laboratory, University of California, Berkeley, CA 94720, United States

[4]Los Alamos National Laboratory, P.O. Box 1663, Mail stop D466, Los Alamos, NM 87545, United States

[5]University of Leicester, Dept. of Physics, University of Leicester, University Road, Leicester LE1 7RH, United Kingdom

[6]Centre d'Étude Spatiale des Rayonnements, Département système solaire 9 avenue du colonel Roche, Tolouse 31028, France

We present an interval of long-lasting Global Pc5 oscillations during a high solar wind speed event, during which there is an excellent conjunction between the Cluster and Polar spacecraft on the dusk flank, and ground-based instrumentation. Virtually monochromatic large amplitude highly-polarised pulsations were observed by the CANOPUS magnetometer chain at dusk for many hours, which we identify as being a field line resonance. Many radars of the SuperDARN HF network observed clear pulsations of similar frequencies as these radars rotated into the dusk sector ionosphere. The pulsations are observed in geosynchronous data at all local times. We analyse the solar wind data to verify the source of these oscillations. Cluster field and plasma instruments indicate Kelvin-Helmholtz type activity on the magnetopause and Polar observed oscillations in both electric- and magnetic fields. We analyse these fluctuations in local field-aligned coordinates and calculate the poynting fluxes along and perpendicular to the field to fully understand the nature of these oscillations. We present these results in terms of previous studies and discuss possible source mechanisms.

SM11C-1166 0830h POSTER

Dependence of the electric field in the inner magnetosphere on the IMF B_Y component

Hiroshi Matsui[1] (hiroshi.matsui@unh.edu)

Jack M Quinn[1] (jack.quinn@unh.edu)

Roy B Torbert[1] (Roy.Torbert@unh.edu)

Vania K Jordanova[1] (vania.jordanova@unh.edu)

Goetz Paschmann[2] (gep@mpe.mpg.de)

[1]Space Science Center, University of New Hampshire, Morse Hall, Durham, NH 03824, United States

[2]Max-Planck-Institut fuer extraterrestrische Physik, P.O.Box 1603, Garching D-85740, Germany

It is known that the electric field pattern at high-latitudes depends on the polarity of IMF B_Y. The potential cell at the duskside (dawnside) is larger than that at the other side for IMF $B_Y > 0$ ($B_Y < 0$) in the northern hemisphere. This asymmetry of the potential cell appears oppositely in the southern hemisphere. In this study we investigate the above problem by using the perigee data from Cluster passing through the magnetic equator. The data consist of both components of the electric field perpendicular to the magnetic field obtained by the electron drift instrument (EDI). These data are sorted by IMF B_Y and discussed in terms of the seasonal variation of the orbits and the possible locations of the reconnection at the dayside magnetopause.

SM11C-1167 0830h POSTER

The dynamic Behaviors of the Magnetosphere Based on A Laboratory Simulation

Rizwan Rana[1] (81-6-6605-2760; rana@em.elec.eng.osaka-cu.ac.jp)

Shigeyuki Minami[1] (81-6-6605-2760; minami@elec.eng.osaka-cu.ac.jp)

Yutaka Suzuki[1] (suzuki@elec.eng.osaka-cu.ac.jp)

[1]Department of Electrical Engineering, Osaska City Jniversity, Sugimoto 3, Sumiyoshi, Osaka 558-8585, Japan

We have performed a laboratory simulation of the magnetosphere. The main aim of this experiment is to understand the acceleration mechanism of the aurora. Our laboratory simulations are examined to satisfy the MHD scaling law. Electric field is measured on the sun-earth line in the nightside of the magnetosphere. The result has shown that the earthward electric field exists on the tail current sheet stably. The value is consistent with the predicted electric field in the magnetospheric current sheet. In this experiment, the dynamic pressure of the simulated solar wind is changed to investigate the dynamic behavior of the magnetosphere and the mechanism of the substorm. The measured electric field in the tail current sheet is modulated due to the change of the solarwind dynamic pressure. The experimental results also show that the magnetospheric current in the plasmapause exists rather longer time after the disappearance of the solar wind. It is found that the confinement time is consistent with the Bohm's magnetic field diffusion time.

SM11C-1168 0830h POSTER

The Relationship Between Proton Aurora and Trapped Ion Flux as Seen by IMAGE

J. D. Perez[1] (334-844-4264; perez@physics.auburn.edu); X.-X. Zhang[2] (256-824-6158; zhangx@cspar.uah.edu); P. C:son Brandt[3] (240-228-3837; brandpc1@jhuapl.edu); D. G. Mitchell[3] (443-778-5981; Donald.G.Mitchell@jhuapl.edu); J.-M. Jahn[4] (210-522-2491; jjahn@swri.edu); C. J. Pollock[4] (210-522-39878; Cpollock@swri.edu); S. B. Mende[5] (510-642-0876; mende@ssl.berkeley.edu)

[1]Physics Department, 206 Allison Lab, Auburn University, AL 36849, United States

[2]Physics Department, Alabama A&M, Normal, AL 35762, United States

[3]Applied Physics Laboratory, The Johns Hopkins University, Laurel, MD 20733, United States

[4]Space Science Department, Southwest Research Institute 6220 Culebra Road, San Antonio, TX 78238-5166, United States

[5]Space Science Laboratory, University of California, Berkeley Centennial Dr. at Grizzly Peak Blvd., Berkeley, CA 94720-7450, United States

The FUV/SI12 instrument on board the IMAGE satellite provides global observations of proton produced aurora. The MENA and HENA instruments on IMAGE provide global energetic neutral atom images that can be inverted to obtain equatorial flux distributions of trapped ring current protons. Mapping the equatorial distributions of trapped protons along magnetic field lines to the polar cap where the proton auroras are observed allows direct comparison of the location of the two populations. Such comparisons for 10:00-13:45 UT on August 12, 2000, 00:00-5:45 UT on June 2, 2001, and 13:00-16:45 on June 18, 2001 show a strong correlation between the location of the 8.5 keV trapped proton flux observed by MENA and the precipitating protons observed by FUV/SI12 but an anti-correlation between the 33 keV trapped protons observed by HENA and the FUV/SI12 observations. Possible explanations of these observations will also be presented.

SM11C-1169 0830h POSTER

Transpolar Aurora: Time Evolution, Associated Convection Patterns, and a Possible Cause

Lars Blomberg[1] (Lars.Blomberg@alfvenlab.kth.se); Judy Cumnock[1,2] (cumnock@utdallas.edu); Igor Alexeev[3] (alexeev@dec1.sinp.msu.ru); Elena Belenkaya[3] (elena@dec1.sinp.msu.ru); Sergei Bobrovnikov[3] (sergo@dec1.sinp.msu.ru); Vladimir Kalegaev[3] (klg@dec1.sinp.msu.ru)

[1]Alfvén Laboratory, Royal Institute of Technology, Stockholm SE-10044, Sweden

[2]University of Texas at Dallas, Center for Space Sciences, PO box 830688 MS/FO 22, Richardson, TX 75083-0688, United States

[3]Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Vorob'evy Gory, Moscow 119992, Russian Federation

We present event studies illustrating the detailed relationships between plasma convection, field-aligned current, polar auroral emissions, and particle precipitation boundaries, as well as illustrating the influence of the Interplanetary Magnetic Field's y-component on theta aurora development. The transpolar arc of the thetas move across the entire polar region and become part of the opposite side of the auroral oval. Electric and magnetic field and precipitating particle data are provided by DMSP, while the Polar UVI instrument provides measurements of auroral emissions. Ionospheric electrostatic potential patterns are calculated at different times during the evolution of the theta aurora using the Royal Institute of Technology model. These model patterns are compared to the convection predicted by mapping the magnetopause electric field to the ionosphere using the Moscow State University's Paraboloid Model of the magnetosphere. A possible cause of the theta aurora in terms of the large-scale convection drivers is discussed.

SM11C-1170 0830h POSTER

Simultaneous Polar Aurorae and Convection Patterns in Both Hemispheres

Judy A Cumnock[1,2] (cumnock@utdallas.edu)

Lars G Blomberg[2] (lars.blomberg@alfvenlab.kth.se)

[1]University of Texas at Dallas, Center for Space Sciences PO Box 830688 MS/FO22, Richardson, TX 75083-0688, United States

[2]Alfven Laboratory, Royal Institute of Technology, Stockholm SE-10044, Sweden

Transpolar arcs are often observed during northward IMF with dawnside (duskside) formation of the TPA and duskward (dawnward) motion occurring when By changes from negative to positive (positive to negative). Whereas simultaneous theta aurorae have been observed in both hemispheres utilizing satellite UV imagers, it is unknown how often theta aurorae occur in both hemispheres and the influence of the IMF. We investigate occurrence of TPAs in both hemispheres. Polar UVI provides images in the northern hemisphere while DMSP provides ionospheric plasma flow and precipitating particle data in both hemispheres. Concurrent solar wind plasma and interplanetary magnetic field measurements are provided by the ACE satellite. Observations indicate that TPAs and theta aurorae depend not only on the orientation of IMF Bz, but on the direction of IMF Bx and By as well. Utilizing the satellite data as inputs, the Royal Institute of Technology model provides the high-latitude ionospheric electrostatic potential patterns in both hemispheres calculated at different times during the evolution of the theta aurora resulting from a variety of field-aligned current configurations associated with the changing global aurora.

SM11C-1171 0830h POSTER

Global Images of a Traveling Convection Vortex Event

D. L. Murr[1] (david.murr@dartmouth.edu)

H. U. Frey[2]

J. Semeter[3]

[1]Thayer School of Engineering, Dartmouth College, Hanover, NH 03755, United States

[2]Space Sciences Laboratory, University of California, Berkeley, CA 94704, United States

[3]SRI International, 333 Ravenswood Avenue, Menlo Park, CA 94025, United States

The large-scale properties of Traveling Convection Vortex (TCV) events in the dayside high-latitude ionosphere have typically been characterized by arrays of ground-based magnetometers. One of these properties is the amplitude of the magnetic perturbation, which peaks two or three hours pre- or post-noon as the events propagate from local noon toward the dawn or dusk flank. Ideally, this amplitude peak in the observed magnetic perturbation could be related to the strength of the field-aligned current associated with the TCV. However, precipitation associated with the event may enhance the local ionospheric conductivity which would also contribute to an enhancement in the observed magnetic perturbation. In this study we use global images from the IMAGE satellite for one TCV event to remove this ambiguity and definitively show the amplitude profile of the TCV field-aligned current as it forms near local noon and propagates dawnward. These space-based images, with global extent but limited spatial resolution, are augmented with ground-based, higher spatial resolution, all-sky images.

SM11C-1172 0830h POSTER

Transmission of Electromagnetic Energy into the Surface-Ionosphere Waveguide

Robert J Strangeway (+1-310-206-6247; strange@igpp.ucla.edu)

Institute of Geophysics and Planetary Physics, University of California, Los Angeles, 405 Hilgard Ave., Los Angeles, CA 90095, United States

The waveguide formed by the Earth's surface and the ionosphere has been postulated as a means for transmitting information rapidly across field lines. If the waveguide can be excited, then this may explain the "prompt" response of the ionosphere to changes in solar wind drivers, where the nightside ionosphere appears to react more quickly than would be expected for a purely magnetospheric driver of convection. Previous analysis of wave propagation into the waveguide suggests that for vertical propagation very little electromagnetic energy, as measured by the Poynting vector, passes through the highly dissipative ionosphere. The simplifying assumption of vertical propagation neglects the fact that the fast mode wave becomes evanescent along the field line for sufficiently short perpendicular wavelength. Because of the very high Alfvén speed this wavelength need only be of the order 1000 km (longer for lower frequencies) for the fast mode to be evanescent. We have therefore explored the transmission of electromagnetic energy for oblique propagation. The degree to which electromagnetic energy flows into the surface-ionosphere waveguide depends on the assumed incident wave mode, and whether or not the wave is assumed to be evanescent across the field. The perpendicularly evanescent mode corresponds to a Laplace transform of the incident signal, which might better represent an impulse than the harmonic (or Fourier mode) assumption. Preliminary analysis suggests that the perpendicularly evanescent fast mode carries the greatest amount of electromagnetic energy into the waveguide, but further analysis is required to determine if this is sufficient to act as a generator for magnetospheric convection.

SM11C-1173 0830h POSTER

A muti-instrument study of polar cap outflowing plasma

Jean-Andre Sauvaud[1] (33 5 61 55 66 76; sauvaud@cesr.fr); Dominique Fontaine[2] (33 1 39 25 49 17; dominique.fontaine@cetp.ipsl.fr); Goetz Paschmann[3] (goetz.paschmann@issi.unibe.ch); Andre Balogh[4] (a.balogh@ic.ac.uk); Andrew Neil Fazakerley[5] (anf@mssl.ucl.ac.uk); Henri Reme[1] (33 5 61 55 66 62; reme@cesr.fr)

[1]CESR, 9, ave du colonel Roche, Toulouse 31028, France

[2]CETP, 10 ave de l'Europe, Velizy 78140, France

[3]MPE, Giessenbachstrasse, Garching D 85740, Germany

[4]Imperail College, Prince Consort Rd., London SW7 2BW, United Kingdom

[5]MSSL, Holmbury St Mary, Dorking RH5 6NT, United Kingdom

We present a Cluster multi-experiment study of outflowing ion beams inside the auroral zone and inside the polar cap. Data are taken at altitudes of the order of 4 RE. At such high altitudes, discrete auroral events of ion outflows can still show the typical particle and field structures reported at lower altitudes; field aligned upgoing ion beams, downgoing electrons, and a converging electric field structure. Inside the polar cap,the same kind of events are also seen. However, many cases of low energy outflowing ion beams display a quite different particle and field topology indicating that the paralell electric field is not strong enough to cause the loss of the precipitating electrons. Both donwngoing and upgoing electrons display a peaked spectra at the same energy, in the 100 eV range. These observations tend to show that the paralell electric field is here weak and widely distributed in altitude. We discuss these events in terms of magnetosphere-ionosphere coupling.

SM11C-1174 0830h POSTER

Feedback Between Ion Cyclotron Waves And Ionospheric Outflows

Jay R Johnson[1] (609 243-2603; jrj@pppl.gov)

C Z Cheng[1] ((609) 243-2648; fcheng@pppl.gov)

[1]Princeton University, Princeton Plasma Physics Laboratory PO Box 451, Princeton, NJ 08543, United States

Electromagnetic ion cyclotron waves with frequencies in the range 1-100 Hz are commonly observed in concert with upwelling ionospheric ions in the auroral acceleration region. Observations typically show that the waves have Poynting flux directed into the ionosphere. Moreover, waves with similar frequencies have also been detected by rockets and ground based magnetometers, which suggests that they transport energy to ionospheric altitudes where they can heat the ions. We model wave propagation between a magnetospheric source and the ground by solving the full electromagnetic wave equations including a realistic ionospheric model that includes multiple ion species and collisional effects. Ions are heated via ion cyclotron heating and collisional Joule dissipation. Wave heating significantly modifies the heavy ion profiles, thus altering wave propagation, dissipation, and selective heating of ions. We present wave solutions and ion distributions that illustrate this feedback process.

SM11C-1175 0830h POSTER

Spectral and Instability Analysis of Plasma Turbulence

Christian T. Dum (49-89-30000-3510; ctd@mpe.mpg.de)

Max Planck Institut f. Extraterr. Physik, P.O.Box 1312, Garching D-85741, Germany

Despite an abundance of data on plasma turbulence, obtained either by direct space observations or from computer simulation, most of the data are interpreted only in a qualitative way, rather than by a detailed analysis that would allow a quantitative comparison with theory. For such a comparison one needs to obtain, as a key ingredient, reliable wave spectra as a function of wave number and frequency. The free energy sources, linear instability mechanisms and nonlinear coupling mechanisms that generate these wave spectra should also be identified. In the case of micro turbulence these mechanisms depend on details of the particle distribution functions. Even the nature of wave modes, not only wave growth rates, may change as the plasma evolves. A particle simulation in which an electron beam excites a variety of wave modes is used as an example for such an analysis. The model corresponds to proposed mechanisms for ion conic generation on auroral field lines. The rather rapid evolution of plasma and turbulence requires that the spectral analysis is carried out over time intervals that are sufficiently short compared to time scales for spectral changes, whereas for statistical reasons and good frequency resolution long sampling intervals would be desirable. Straightforward periodograms are unsatisfactory under these conditions, even when applying windows (tapers) to the wave trains, in order to reduce spectral leakage. Modern spectral analysis methods which were mostly developed in the geophysics context, such as the maximum entropy method and the multiple taper method, can yield far better results. They are adopted for the analysis of plasma turbulence, in particular in connection with particle simulation codes, although, with other data limitations, the considerations mostly apply also to observations. Particular attention is paid to statistical tests for spectral lines which may correspond to eigenmodes (instabilities) of the plasma. For reliable results it is usually advisable to try several ways of spectral analysis. This requires post processing in the case of simulation and special methods to keep the data output manageable, which we discuss.

SM11C-1176 0830h POSTER

Conversion Of Ordinary And Extraordinary Waves To Upper Hbrid Electrostatic Waves In Inhomogeneous Plasmas

Kyung-Sub Kim (+82-31-201-2691; kskim@spacelab.khu.ac.kr)

Eun-Hwa Kim (+82-31-201-2691; ehkim@khu.ac.kr)

Dong-Hun Lee (+82-31-201-2449; dhlee@khu.ac.kr)

It is well known that inhomogeneity becomes important in wave coupling and mode conversion. There have been a few previous studies that ordinary(O) and extraordinary(X) electromagnetic(EM) waves are coupled to upper hybrid(UH) electrostatic(ES) waves in inhomogeneous plasmas. In this paper, we both numerically and analytically examine this issue in a three-dimensional multi-fluid model. First, we derive a set of coupled linear wave equations when a one-dimensional inhomogeneous density profile is assumed in a cold and collisionless plasma. The density gradient is assumed perpendicular to the magnetic field. When we consider the propagation of O and X waves in a magnetized plasma, we analytically show that both O and X modes are coupled and damped to the upper hybrid waves. These EM modes are found to have the logarithmic singular behavior at the upper hybrid resonance(UHR). Second, we numerically test the same case in a 3-D multi-fluid model. An impulsive input is assumed to excite the O and X waves in the inhomogeneous box model. In order to solve an initial-valued problem, the finite difference method is used in both time and space. The wave spectra of each electric and magnetic field are presented and compared with the analytical result. Our results suggest that the EM wave energy of both O and X modes is irreversibly converted into the upper hybrid ES energy wherever the resonant condition is satisfied. We discuss how the mode conversion appears in both electric and magnetic fields by analyzing time histories of each component. We also compare our results with the possibility of excitation and heating of the UH waves from the O and X waves in the UHR region of the ionosphere.

SM11C-1177 0830h POSTER

Alfven Solitons Created by the Interaction with Lower-Hybrid Waves

Defne Ucer[1] (858 8221370; ducer@physics.ucsd.edu)

Vitali D. Shapiro[1] (858 534 8266; ducer@physics.ucsd.edu)

[1]University of California San Diego, Physics Dept., 9500 Gilman Dr., La Jolla, CA 92093-0354

There is evidence in the satellite observations that intensive lower hybrid wave activity is correlated with the deflection of the geomagnetic field at very low frequencies. We propose that this correlation is due to modulational interaction between the lower hybrid waves and short wavelength kinetic or inertial Alfven waves since only this type of Alfven waves are compressional, and can lead to modulational interaction. The driving force for interaction is the ponderomotive force of the lower hybrid waves which leads to the formation of quasineutral density modulations at very low frequency. The density holes associated with modulation act as the potential wells effective in trapping of lower hybrid waves, the trapped waves are enhanced in their amplitude leading to the deepening of the density holes. It is shown that above described modulational coupling of the lower hybrid and inertial Alfven waves lead to the formation of Alfven solitons moving along magnetic field with Alfven velocity and having a localized structure across the field.

SM11C-1178 0830h POSTER

Electron Solitons in a Strong Magnetic Fields

Sergei Galkin[1] (vshapiro@physics.ucsd.edu)

Vitali D. Shapiro[2] (858 5348266; vshapiro@physics.ucsd.edu)

[1]Keldysh Institute for Applied Mathematics, Miuskaya Sq., Moscow 125047, Russian Federation

[2]University of California San Diego, Physics Department, 9500 Gilman Dr., La Jolla, CA 92093-0319

Numerical methods are used to analyze the structure of 2D Langmuir solitons propagating along strong magnetic field in which electrons are magnetized. Soliton structure appears to be that of positive charge (electron hole) travelling along field with the velocity exceeding significantly velocity of ion acoustic solitary structures. The relevance of the constructed soliton solutions to electron holes observed in auroral ionosphere is discussed, as well as their role in supporting parallel electric fields in auroral zone. It is also noteworthy that electrons trapped inside solitary structures can be accelerated by the motional (convective) electric field of plasma flow and to produce surfing electron acceleration to the relativistic energies.

SM11C-1179 0830h POSTER

Electrostatic Fields in Ionospheric Density Cavities and Their Effect on Ion Dynamics

Abhay K Ram[1] (1-617-253-2595; abhay@mit.edu)

Brian C Ross[1] (bcross@mit.edu)

David J Strozzi[1] (dstrozzi@mit.edu)

Abraham Bers[1] (bers@mit.edu)

[1]Plasma Science and Fusion Center, Massachusetts Institute of Technology, Room 38-256, 77 Massachusetts Avenue, Cambridge, MA 02139-4301, United States

In auroral ionospheric plasmas, intense electrostatic fields in density depleted regions and associated transverse energization of ions are observed. We have been studying, theoretically and computationally, the generation of fields in density cavities and the energization of ions by electrostatic fields. Intense localized electric fields can be generated in regions where plasma resonances (e.g., the lower hybrid or the upper hybrid resonances) exist. An appropriate description of the fields is obtained from Maxwell's equations for a cold plasma with a spatial profile. We will discuss the characteristic features of the fields obtained from such a description. We are further studying the interaction of ionospheric ions with electrostatic fields to understand the observed transverse energization of ions. The electrostatic fields are assumed to be represented either by a set of plane waves propagating obliquely to the geomagnetic field or localized field structures whose spatial dimensions are small compared to the thermal Larmor radii of the ionospheric ions. The ion dynamics are compared and contrasted in the two cases. For obliquely propagating waves, nonlinear, coherent, transverse energization of low energy ions can take place for certain conditions that depend on the frequency spectrum, wavenumbers, and amplitudes of the waves [1,2]. The interaction of low energy ions with localized field structures is significantly different from that with an obliquely propagating spectrum of electrostatic waves. We find that the phase space of the energized ions is chaotic, and, for long-time interactions, the ions can undergo large energy gains akin to Levy flights. Detailed analytical and numerical results describing the ion dynamics, and a comparison between the interaction of ions with localized field structures and with plane waves will be discussed. This work is supported by NSF Grant No. ATM-98-06328. [1] A.K. Ram, A. Bers, and D. Benisti, *J. Geophys. Res.* **103**, 9431 (1998). [2] D.J. Strozzi, A.K. Ram, and A. Bers, *Physics of Plasmas* **10**, 2722 (2003).

SM11C-1180 0830h POSTER

Investigations of Plasma Turbulence Using the Cluster Electron Drift Instrument

Scott R Bounds[1] (319-335-0694; scott-bounds@uiowa.edu); Craig A Kletzing[1]; Goetz Paschmann[2]; Pamela A Puhl-Quinn[2]; Jack M Quinn[3]; Roy B Torbert[3]

[1]University of Iowa, University of Iowa, Iowa City, IA 52242, United States

[2]Max-Plank Institut fur extraterrestrishce Physik, Giessenbachstrasse, Garching 85748, Germany

[3]University of New Hampshire, 39 College Road, Durham, NH 03824-3525, United States

Defining the nature of any turbulent flow of plasma within the Earth's magnetosphere is of fundamental importance to understanding the distribution and transport of energy within the system. Of greatest interest is determining the coefficient of the power law governing the cascade of energy from one scale size to another. In previous analysis by single spacecraft, measurements with respect to a spatial scale were calculated by converting temporal sampled data to spatial samples utilizing a known relative velocity. This is achieved in select regions of space where either the plasma flow is much greater than the motion of the spacecraft or the opposite, the spacecraft is moving across the plasma with greater velocity than the relative bulk motion of the plasma. Both cases require knowledge of the relative phase velocity of the observer with respect to the medium. While this technique is extremely useful, it excludes analysis in many regions of the magnetosphere. However, with multi-spacecraft measurements such as Cluster, we are able to investigate regions that were previously excluded. For this analysis, we use the Electron Drift Instrument on board each Cluster satellite because it directly measures the electron gyro-orbit drift step vector, from which is then derived the exact electron flow velocity vector perpendicular to the ambient magnetic field. The average covariances of velocities between two spacecraft are calculated as a function of payload separations. From this technique we can derive approximate spatial structure functions for high latitude regions (auroral zone and polar cap). These results are compared with weak Magnetohydrodynamic fluid turbulence theory.

SM11C-1181 0830h POSTER

CLUSTER observations of lower hybrid waves excited at high altitudes by electromagnetic whistler mode signals from HAARP

Timothy F. Bell[1] ((650) 723-3587; bell@nova.stanford.edu); Umran S. Inan[1] ((650) 723-4994; inan@nova.stanford.edu); Manuel Platino[1]; Jolene Pickett[2]; Paul A. Kossey[3]; Edward J. Kennedy[4]

[1]Star Laboratory, Stanford Univ,, Packard Buikding, Stanford, CA 94305, United States

[2]University of Iowa, Department of Physics and Astronomy, Van Allen Hall, Iowa City, IA 52242, United States

[3]Air Force Research Laboratory, 29 Randolph Rd Hanscom Air Force Base, Hanscom AFB, MA 01731, United States

[4]Naval Research Laboratory, 4555 Overlook Ave, SW, Washington, DC, DC 20375, United States

We report new observations from the CLUSTER spacecraft of strong excitation of lower hybrid waves by electromagnetic whistler mode waves at altitudes of roughly 20,000 km outside the plasmasphere. Previous observations of this phenomenon have been limited to altitudes less than 7000 km. The excitation mechanism appears to be linear mode coupling in the presence of small scale plasma density irregularities. The wavelengths of the excited lower hybrid waves, as deduced from their doppler shifts, appear to lie in the 15 - 1500 m range. These observations provide strong evidence that electromagnetic whistler mode waves are continuously transformed into lower hybrid waves as the whistler mode waves propagate at high altitudes beyond L = 4. This finding may explain the lack of lightning generated whistlers observed in this same region of space.

SM11C-1182 0830h POSTER

Preliminary Results of the VLFE Quadrupole Instrumentation From The PARX Sounding Rocket

Lee A Reinleitner[1] (reinleit@ess.washington.edu)

Robert H Holzworth[1]

Andrew L Meadows[2]

[1]Dept. of Earth and Space Sciences, University of Washington P.O.Box 351310, Seattle, WA 98195, United States

[2]Linden Lab, 577 Second Street, Suite 200, San Francisco, CA 94107, United States

The NASA Pulsating Auroral Rocket eXperiment (PARX - March '97 from Poker Flat, AK) was equipped with 4 electric field probes oriented (X and Y) perpendicular to the ambient magnetic field, and one probe (along the Z axis) to obtain the parallel electric field. The rocket also included a three-axis VLF search coil magnetometer. The VLF measurements for both instruments were from 100 Hz - 8 KHz. Additionally, the electric field information was used onboard the rocket to obtain the "quadrupole" electric field, defined to be (V1+V2) - (V3+V4)/2d, which shows significant response only to short wavelength waves. This instrumentation clearly shows the long wavelength nature of features tentatively described as auroral hiss, and the shorter wavelength nature of the electrostatic and/or quasi-electrostatic waves.

SM11C-1183 0830h POSTER

Intense Structured Upper Hybrid Waves Observed in Situ where $f_{uh} = 2f_{ce}$

Marilia Samara[1] (603-646-1394; marilia@aristotle.dartmouth.edu)

James LaBelle[1] (jlabelle@einstein.dartmouth.edu)

Craig A Kletzing[2] (cak@delta.physics.uiowa.edu)

Scott R Bounds[2] (srb@gamma.physics.uiowa.edu)

[1]Dartmouth College, 6127 Wilder Laboratory, Hanover, NH 03755, United States

[2]University of Iowa, Van Allen Hall, Iowa City, IA 52242, United States

On January 28th, 2003 at 7:50 UT the High Bandwidth Auroral Rocket (HIBAR) was launhed into active aurora from Poker Flat, Alaska. The rocket had its spin axis parallel to the background magnetic field and it reached an apogee of approximately 382 km. Instruments on board included particle and electric field detectors which detected waveforms continuously with a 5 MHz bandwidth. The wave receiver detected two bursts of intense waves at 2.65 MHz, at and just below the upper hybrid frequency, at the approximate altitudes of 377 and 379 km respectively. The wave frequency is about one percent below the local 2fce. The amplitude of these upper hybrid wave bursts ranges from 10 to 140 mV/m, and the ratio of the electric field perpendicular to the background magnetic field to that parallel to the magnetic field is on average about $E_\perp/E_\parallel = 20$. The wave bursts consist of several parallel narrowband features with apparent frequency spacings of about 10 kHz. We speculate that these upper hybrid wave bursts are the sources for electromagnetic auroral roar emissions observed at ground-level. If so, the HIBAR rocket observations provide the first opportunity to estimate the efficiency of the electrostatic to electromagnetic wave conversion, and to test theories of the origin of the fine structure of the auroral roar signals.

SM11C-1184 0830h POSTER

Structured LF-MF Whistler Mode Emissions at Rocket Altitudes

James LaBelle[1] (603-646-2973; jlabelle@einstein.dartmouth.edu); Marilia Samara[1] (marilia.samara@dartmouth.edu,); Kristina A Lynch[1] (kristina.lynch@dartmouth.edu); Paul M Kintner[2] (paul@ece.cornell.edu); Eric Klatt[2] (klatt@memphis.ece.cornell.edu); Elizabeth A MacDonald[3] (elizabeth.macdonald@UNH.edu)

[1]Dartmouth College, Department of Physics, Hanover, NH 03755, United States

[2]Cornell University, School of Electrical Engineering, Ithaca, NY 14853, United States

[3]University of New Hampshire, Institute for the study of Earth, Oceans, and Space, Durham, NH 03824, United States

The SIERRA sounding rocket was launched into an active substorm aurora north of Poker Flat, Alaska, on Jan 14, 2002, achieving an apogee of 735 km. Instrumentation included continuous waveform measurements of 100 kHz–5 MHz electric fields detected with a single 6-m double probe antenna which rotated in a plane containing the ambient magnetic field at the rocket spin rate of 0.33 Hz. For about 200 seconds on the downleg of the flight, corresponding to a range of about 200 km along the ground and vertically, this instrument detected whistler waves in the LF-MF range (up to about 1 MHz) which exhibit complex structure resembling AKR fine structure observed with satellite-borne instruments at higher altitudes. The most intense structured whistler mode waves occur at 250–500 kHz, the same frequency range as AKR. One type of structured whistler mode signal which is common in this data set consists of packets of descending tones separated by tens of kHz in frequency and 10–50 ms in time, with typical downward frequency slopes of 1 MHz/s. Ignoring wave dispersion and assuming excitation at the electron gyrofrequency would imply a height of 2800 km and upward velocity of 5000 km/s for the sources of these structures, though consideration of whistler wave dispersion could significantly affect the latter estimate. The occurrence and intensity of this type of structured whistler mode signal appear not to depend on the antenna orientation with respect to the background magnetic field. Another type of structured whistler mode which is common in this data set consists of signals whose frequency increases rapidly until just below the gyro- or plasma-frequency at which point the rate of change of frequency decreases. These structures may be a form of hissler observed at higher frequencies near the top of the whistler range rather than near the bottom of the whistler frequency range as in the original hisslers reported by Siren [1975]. In addition to these structured whistler mode signals, structured Langmuir/Upper Hybrid waves occurred at frequencies above 1 MHz during most of the flight. Structured LF-MF whistler mode signals have been detected on one other recent rocket flight [LaBelle et al., 1999] restricted to a few short time intervals, rather than dominating the LF-MF spectrum for over 200 seconds as observed during the SIERRA experiment. References: LaBelle, J., K.L. McAdams, and M.L. Trimpi, Structured low and medium frequency whistler mode emissions in the auroral ionosphere, *J. Geophys. Res., 104*, 28101, 1999. Siren, J., Fast Hisslers in substorms, *J. Geophys. Res., 80*, 93, 1975.

SM11C-1185 0830h POSTER

Measurement of Thermal Electrons at Rocket Altitudes in Nightside Active Aurora

E A MacDonald[1] (eamd2@cisunix.unh.edu); K A Lynch[1,2] (kristina.lynch@dartmouth.edu); R Arnoldy[1] (roger.arnoldy@unh.edu); P Kintner[3] (paul@ece.cornell.edu); E Klatt[3] (klatt@ece.cornell.edu); J LaBelle[2] (James.W.LaBelle@dartmouth.edu); M Samara[2] (marilia@dartmouth.edu)

[1]Space Science Center, University of New Hampshire, Durham, NH 03820

[2]Dept. of Physics and Astronomy, Dartmouth College, Hanover, NH 03755

[3]Dept. of Electrical and Computer Engineering, Cornell University, Ithaca, NY 14850

On January 14, 2002 the SIERRA sounding rocket was launched from Alaska into active substorm expansion aurora and reached 735 km altitude. For the first time, measurements of the cold ionospheric population in darkness were made by the UNH thermal electron detector (TED). At these middle altitudes, understanding this population is important because the thermal electrons can carry currents coupling the collisional atmosphere and the magnetospheric auroral source. The considerable instrumental difficulties with this measurement will be thoroughly discussed including the effects of spacecraft potential, Debye length, applied skin bias, and surface charging. Recent efforts to verify instrument response through laboratory testing will be highlighted. During flight, the TED instrument yielded thermal temperatures between 0.1 - 0.4 eV. We will examine how the measured population agrees with a Maxwellian-shaped distribution through independent comparisons of density as derived by the TED and also an HF wave receiver plasma frequency measurement. The physics of the ambient cold population and its interaction with auroral mechanisms will be emphasized throughout.

SM11C-1186 0830h POSTER

Characteristics of crossed wire antennas onboard Akebono

Ryoichi Higashi[1] (+81-76-234-4858; higashi@reg.is.t.kanazawa-u.ac.jp)

Tomohiko Imachi[1] (imachi@reg.is.t.kanazawa-u.ac.jp)

Satoshi Yagitani[1] (yagitani@is.t.kanazawa-u.ac.jp)

Isamu Nagano[1] (nagano@is.t.kanazawa-u.ac.jp)

Iwane Kimura[2] (ikimura@is.oit.ac.jp)

[1]Graduate School of Natural Science & Technology, Kanazawa University, 2-40-20, Kodatsuno, Kanazawa 920-8667, Japan

[2]Faculty of Information Science and Technology, Osaka Institute of Technology, 1-79-1, Kitayama, Hirakata 573-0196, Japan

The characteristics of a wire antenna used for electric field observation in plasma could be different from the case of that in free space because of plasma sheath surrounding the antenna. We need the characteristics of the antennas (antenna impedance and effective length) in plasma to calibrate the observed data and know the absolute intensity of the electric field. We can measure the antenna impedance with the instruments onboard a spacecraft, but it is difficult to measure the effective length of the wire antenna. So far, we have used the assumed effective length which is a half of the antenna physical length for calibration in the case of observing VLF electric field with the antennas of several tens of meters. A few investigations about the effective lengths have been made, and the results have been the same as the assumed length. In this study, we estimate the effective length and/or the impedance of two wire antennas onboard Akebono satellite. We estimate the effective length by comparing the theoretical electric field and the open voltage induced on the terminal of the wire antenna. The theoretical electric field is calculated from the magnetic field of an OMEGA signal, the geomagnetic field and electron density with the dispersion equation and Maxwell's equations of cold plasma. The results by this estimation method are nearly equal to 30m which is a half of the physical length of the wire antenna with a little fluctuation. The open voltage induced on the terminal of the wire antenna is calibrated by using the antenna impedance assumed to be constant for any spin angles of Akebono. If the angle between the direction of the geomagnetic field and the direction of the wire antennas change with the spin, the antenna impedance would fluctuate with the angle. The impedance measured by an instrument onboard Akebono has been reported to be affected by the spin. Here we estimate dependence of the antenna impedance on the angle between the direction of the geomagnetic field and the direction of the antennas, with assuming the effective length be a half of the physical length.

SM11C-1187 0830h POSTER

Rheometry experiment for a wire antenna aboard spacecraft at low frequencies

Tomohiko Imachi[1] (+81-76-234-4858; imachi@reg.is.t.kanazawa-u.ac.jp); Satoshi Yagitani[2]; Isam Nagano[2]; Ryoichi Higashi[2]; Satoshi Esaki[2]; Minoru Tsutsui[3]; Hiroshi Matsumoto[4]

[1]Department of Information and System Engineering, Kanazawa University, 2-40-20 Kodatsuno, Kanazawa 920-8667, Japan

[2]Graduate School of Natural Science and Technology, Kanazawa University, 2-40-20 Kodatsuno, Kanazawa 920-8667, Japan

[3]Information Communication Engineering Department, Kyoto Sangyo University, Motoyama, Kamigamo, Kyoto 603-8555, Japan

[4]Radio Science Center for Space & Atmosphere, Kyoto University, Gokasho, Uji 610-0011, Japan

Observation of plasma waves in the space is an important subject of scientific spacecraft missions. The sensor frequently used to measure the low frequency AC electric field of plasma waves is a wire antenna. It is necessary for an accurate measurement to estimate the effective length of each wire antenna accurately, because it is closely related to the gain of the sensor, and the inaccuracy of it affects greatly to the quantitative studies of plasma waves. In most researches related to plasma waves, the effective length of a wire antenna has been assumed to be a half of its physical length. However, on the other hand, when we measure electrostatic or quasi-static field, the intensity is calculated from a voltage between probes, placed at both tips of the antenna, divided by the distance between them. In this case the antenna effective length is treated as the same as the physical length of the wire. What makes difference between them? To investigate this problem, we estimated frequency dependency of the effective length in quasi-static frequency range, by using "Rheometry experiment"[1], and analyzed the result of the experiment by theoretical calculation of equivalent circuits. The result of the experiment shows that the effective length is a half of their physical length in higher frequencies (more than several kHz), however, in very low frequencies(less than several hundred Hz), it depends on the structure of the antenna. And according to the theoretical calculation, we found that this phenomina can be explained by the static potential along the wire of the antenna, not by electric current distribution. We will show the detailed result. [1] H.O.Rucker et al., Radio Science, Vol.31, No.6, pp.1299, 1996

SM11C-1188 0830h POSTER

Reassessment of Calibrations of Precipitating Particle Sensors on DMSP Spacecraft

Katharine Kadinsky-Cade[1] (Katharine.Kadinsky-Cade@hanscom.af.mil)

Ernest Holeman[2]

Frederick Rich[1]

David Hardy[3]

[1]Air Force Research Laboratory, AFRL/VSBX, Hanscom AFB, MA 01731, United States

[2]Boston College, Institute for Scientific Research, 140 Commonwealth Ave., Chestnut Hill, MA 02467, United States

[3]Air Force Research Laboratory, AFRL/VS, Kirtland AFB, NM 87117, United States

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

M. J. Engebretson[1] (612-330-1067; engebret@augsburg.edu); J. L. Posch[1]; G. A. Shelburne[1]; A. J. Halford[1,2]; A. J. Smith[3]; M. Spasojevich[4]; U. S. Inan[4]; R. L. Arnoldy[5]

[1]Department of Physics, Augsburg College, Minneapolis, MN 55454, United States

[2]LASP, University of Colorado, Boulder, CO 80309, United States

[3]British Antarctic Survey, Madingley Road, Cambridge CB3 0ET, United Kingdom

[4]Star Laboratory, Stanford University, Stanford, CA 94305, United States

[5]Space Science Center, University of New Hampshire, Durham, NH 03824, United States

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

Ward B Manchester[1] (734-647-3475; chipm@umich.edu); Ilia Roussev[1] (iroussev@umich.edu); Igor Sokolov[1] (igorsok@umich.edu); Aaron Ridley[1] (ridley@umich.edu); Tamas Gombosi[1] (tamas@umich.edu); Darren De Zeeuw[1] (darrens@umich.edu); Kenneth Hansen[1] (kenhan@umich.edu); Gabor Toth[2] (gtoth@hermes.elte.hu)

[1]University of Michigan, 2455 Hayward St., Ann Arbor, MI 48109, United States

[2]Eotvos University, Pazmany setany 1/A,, Budapest 1117, Hungary

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

Aaron J Ridley[1] ((734) 764-5727; ridley@umich.edu)

Ward Manchester[1] (chipm@umich.edu)

Ilia Roussev[1] (iroussev@umich.edu)

Tamas Gombosi[1] (tamas@umich.edu)

[1]Center for Space Environment Modelling, 1411B Space Research Building University of Michigan, Ann Arbor, MI 48109-2143, United States

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

Jan J Sojka[1] (435-797-2964; fasojka@sojka.cass.usu.edu)

Michael David[1] (435-797-3573; michael@sim.cass.usu.edu)

Chris Smithtro[1] (435-797-2937; smithtro@cc.usu.edu)

Robert W Schunk[1] (435-797-2978; schunk@cc.usu.edu)

[1]Utah State University, Center for Atmospheric and Space Sciences, 4405 Old Main Hill, Logan, UT 84322-4405, United States

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

Robert L McPherron[1] (310-825-1882; rmcpherron@igpp.ucla.edu)

George Siscoe[2] ((978)443-8559; siscoe@bu.edu)

Nancy N Crooker[2] ((978)443-8559; crooker@bu.edu)

Charles N Arge[3] (Nick.Arge@noaa.gov)

[1]Institute of Geophysics and Planetary Physics, University of California, Los Angeles, CA 90095-1567, United States

[2]Center for Space Physics, Boston University 725 Commonwealth Ave., Boston, MA 02215, United States

[3]Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309

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

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