arc that was the primary subject of the HEX experiment and finally through a dim, fading arc before reentering the atmosphere. The HEX payload included a trimethyl aluminum (TMA) chemical tracer, photometer and plasma instrument to investigate vertical winds that may exist in the E-region of the ionosphere poleward of a stable auroral arc. The plasma probe measured the ambient relative plasma density to determine if plasma depletions might be associated with vertical winds observed by the TMA tracers. The plasma probe successfully returned in-situ measurements from the vicinity of the auroral arcs, but did not detect plasma depletion signatures linked to vertical winds. Analysis of the response of the plasma instrument in the context of the experiment will be presented. Primary emphasis will be placed on interpreting the response of the plasma instrument's segmented fixed DC collector to resolve ambient positive ion density and secondary auroral electron energy and density estimates as the probe passed through these three auroral regions.

SA22A-0102 1330h POSTER

Hemispheric asymmetries in the location and intensity of the auroral ovals and their association with ionospheric convection and IMF

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As the orbit of the Polar spacecraft has precessed over time, the VIS Earth camera has been able to capture simultaneous images of the aurora in both the northern and southern hemispheres. The angular resolution of these images is sufficient to be able to determine the accurate location and intensity of the two ovals. Preliminary studies have revealed that while the auroras seem to be mirror images of one another on a broad scale, there are a number of fine scale features which are not conjugate in both hemispheres. The mapping of the auroras has revealed that there are longitudinal differences in the onset locations. In this paper, we use the radars of the northern and southern SuperDARN network to investigate whether the convection patterns match the longitudinal differences in the onset locations of the auroral features in the two hemispheres. Differences in the auroral intensity detected in the two hemispheres were found and we determined their association with the electric field strength and convection speeds. The IMF data were studied to determine if these hemispheric asymmetries were due to variations in the IMF direction.

SA22A-0103 1330h POSTER

Electric Field Estimates of the Auroral Electrojet from Imaging Radar Observations

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A 30 Mhz imaging radar located in Anchorage, Alaska provided ground support for the JOULE campaign in March 2003. During the campaign, we observed type 1 and type 2 echoes with Doppler shifts that showed rapid variations in space and time. We will present velocity field variations using spectral decomposition of the radar echo types and provide electric field estimates as a function of range and azimuth. Instrumented rocket flights took place in the region illuminated by the radar which would allow us to compare the electric field estimates from the radar with the in-situ rocket measurements.

SA22A-0104 1330h POSTER

Simple Diffusion Theory Models for Joule Heating in the Thermosphere

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The precipitation of accelerated charged particles and strong increases in ionospheric currents during geomagnetic disturbances take place mainly in the auroral oval. This energy is transmitted to the thermosphere, raising exospheric temperatures there. The thermal energy is transmitted equatorward by gravity waves and neutral winds which can be described by a diffusion equation with some suitable diffusion coefficient. The observed dependence of the enhancement of the exospheric temperature on geomagnetic latitude and the Kp index is determined. Simple diffusion theory models for the latitudinal variation of Tinf are obtained by solving the heat equation in a two-dimensional plane and transforming the solution on to the curved spherical surface of the thermosphere. Analytical solutions for three simple models are obtained: (1) An instantaneous line source at the geomagnetic pole; (2) An instantaneous cylindrical source covering the auroral oval and the polar cap; and (3) An instantaneous annular cylindrical source coinciding with the auroral oval. Models 1 and 2 yield good agreements with the observed latitudinal variation of Tinf with suitable choices of the standard deviations. Model 3 gives only fair agreement with observation.

SA22A-0105 1330h POSTER

Transonic Heating Effects in the Auroral Thermosphere

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We review substantial recent developments to the CTIP coupled thermosphere-ionosphere-plasmasphere model, using observations from the Aberystwyth ionospheric tomographic imaging chain and the IMAGE satellite to benchmark and validate the model results. Thermospheric heating in auroral regions has classically been viewed as a combination of Joule Heating (macroscopic frictional heating from the ionosphere), Lorentz forcing (microscopic momentum transfer from ions) and particle precipitation. Of these, it has been shown that above about 110 km, Joule Heating is the dominant energy transfer mechanism. However, ion velocities during disturbed times often approach or exceed the neutral sound speed. We investigate shock front heating through modelling using the improved CTIP model and compare these with in-situ satellite observation. We conclude that shock heating may be a significant contribution to the auroral thermosphere-ionosphere energy balance.

SA22B MCC: 2006 Tuesday 1340h

Ionosphere Measurements and Models II

Presiding: **A G Burns,** National Center for Atmospheric Research**; J M Ruohoniemi,** Applied Physics Laboratory, Johns Hopkins University

SA22B-01 1340h

Direct Comparison of DMSP and SuperDARN Measurements of Ion Flows in the Polar Ionosphere

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The horizontal convective ion flow in the polar ionosphere plays a key role in characterizing the conditions connecting the Earth's ionosphere with the magnetosphere and the solar wind. Currently there are two methods of directly measuring the horizontal ion flow in the F-layer: the ion flow detectors onboard the polar-orbiting DMSP satellites and using the radar signals detected by the SuperDARN radar arrays. Each method has its own strengths and limitations, but in the regions where they overlap the question arises over whether their measurements match or not. To date some informal studies have shown a fair amount of agreement, but no systematic comparison has ever been done before this. We have identified a set of over 50 events during 2001 when there were good data from SuperDARN corresponding to periods when the DMSP satellites passed through their fields of view. These events occur under all IMF conditions and during various Kp levels. We present the results of the first look at four of these events that contain six or more DMSP passes. We compare the measured horizontal ion flows observed by both sets of instruments to determine how closely they match. In addition we compare the polar cap potential drop measured by the DMSP-F13 satellite with the potential calculated by SuperDARN using a combination of radar observations and model predictions

SA22B-02 1355h

Comparison of 30 Day Continuous EISCAT Svalbard ISR Data with an Ionospheric Model Driven by SuperDARN Convection Patterns

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During October and November 2002 the EISCAT incoherent scatter radar at Svalbard, Norway, operated continuously over a 30 day period. Altitude profiles of electron density are available at high time resolution throughout the study period. The observations collected during this campaign present an unprecedented opportunity for model/data comparisons, of both a space weather and a climatological nature. The Utah State University Time Dependent Ionospheric Model (TDIM) has been used to simulate the ionosphere above Svalbard throughout the month-long study period. In the first stage of this study, in which statistical-empirical representations of the convection electric field and auroral precipitation patterns were used, the model/data comparison brought us insight

into the previously underestimated importance of the thermospheric wind, and pointed to the insufficiency of the model commonly used to represent the wind. However, this study failed to address the issue of day to day variability, the space weather. Now, a new series of simulations has been carried out, incorporating SuperDARN convection patterns based on the northern hemisphere distribution of SuperDARN radars operating during the EISCAT month-long run. These SuperDARN observations provide a high time resolution weather variability in the high latitude convection patterns. As plasma transport is known to have a dominant influence upon plasma structuring in the polar cap, this allows us to appreciate the importance of having detailed information about the prevailing electric field conditions when attempting to model the ionosphere at the level of space weather, rather than being limited to the use of empirical models suitable for climatological studies. Results of these new studies emphasizing the F-layer day to day variability will be presented.

SA22B-03 1410h

Calculation of Magnetic Perturbations at the Ground and Above the Ionosphere due to Ionospheric Currents From the TIEGCM

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We use the National Center for Atmospheric Research Thermosphere-Ionosphere-Electrodynamics General-Circulation Model (TIEGCM) to calculate the electric currents and their associated geomagnetic perturbations generated by the ionospheric wind dynamo, including the effects of magnetospheric field-aligned currents. Calculating the geomagnetic perturbations predicted by the numerical model enables us to compare with world-wide geomagnetic data sets that are available both at ground level and at low-Earth orbit, from satellites like Magsat, Oersted and CHAMP. Comparison between model predictions and observations of magnetic perturbations can help not only to get a better understanding of the physical processes that generate the geomagnetic perturbations but also to improve the numerical models. We will present a method to determine the magnetic perturbations at the ground by spherical-harmonic analysis of the three-dimensional current system. Using spherical harmonics of higher degree and order improves the latitudinal and longitudinal representation which might be necessary in regions with highly variable magnetic perturbations. We consider not only the interhemispheric field-aligned current at middle and low latitudes but also a high-latitude contribution representing the magnetospheric source. In the calculation of the magnetic perturbation we include the diamagnetic effect of the local ionospheric plasma pressure, which can make a difference of a few nanoteslas at low latitudes, and we examine the influence of gravity-driven currents. We will show examples from TIEGCM model runs to illustrate the importance of the different contributions to the calculation of the magnetic perturbations and show how the geomagnetic perturbations can be used to help analyze model results.

SA22B-04 1425h

An Empirical Ionospheric Model for the High Latitude Lower Ionosphere Based on Neural Networks

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This paper discusses the development of a new empirical model for the lower ionosphere in the auroral zone. Available ionospheric data have been used to train neural networks (NNs) to predict the high latitude electron density profile. Data from the European Incoherent Scatter Radar (EISCAT), based in Tromso (69.58°N, 19.23°E), combined with rocket borne measurements make up the database of reliable D- and E-region data. NNs were trained with different combinations of the following input parameters: day number, time of day, total absorption, local magnetic K index, 10.7 cm solar radio flux, solar zenith angle and pressure surface. Initially the database was split into night and daytime data and optimum combinations of these inputs were determined for each dataset. The output that the NNs were trained to predict was the electron density for a given set of input parameters. The criteria for determining the optimum NN are a) the root mean square (RMS) error between the measured and predicted output values, and b) the ability to reproduce the absorption they are representative for. Results from the separate night and daytime models show this method to be successful. Comparisons were made between a conventional analytical approach and this new NN approach. However, a discontinuity showed up at the night-day boundaries when the models were combined to produce the electron densities over an entire 24-hour period. This was not surprising as information pertaining to this boundary was not implicitly included in the dataset with which the NN was trained. Therefore, as another approach NNs were also trained with the entire dataset, night and day time combined. Results from this approach will also be shown as well as comparisons with the conventional analytical method and with measured data. An essential requirement for the employment of the NN technique is a large reliable database that describes the history of the relationship between the input parameters and the output. NNs can still be designed and trained with a limited database as long as the end user is made aware of the limitations of the input space. It is well known that NNs interpolate well but do not extrapolate well. The advantages of the NN method include the ability to re-train a NN relatively easily should more data become available. This paper will show that a NN based model for the high latitude lower ionosphere has been developed and is successful within the limitations of the input space.

SA22B-05 1440h

Vertical Structure of Negative Ionospheric Storms Studied Using DE-1 Images and ISIS Topside Ionograms

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Using an algorithm developed by Strickland et al. [*J. Geophys. Res.*, vol. 104, no. 3, pp. 4251-4266, 1999] and DE-1 FUV images taken during the period of October 19-23, 1981, we have produced images of O/N_2 column density ratios. As a result of a large geomagnetic storm that began on October 20, a large region of greatly reduced O/N_2 was produced over North America and is evident in several of the O/N_2 images for October 22. During the same period there were several overflights of North America by the ISIS-1 satellite with its topside ionograms recorded at the Ottawa receiving station. We have obtained digital copies of these ionograms from the National Space Science Data Center and, with the kind assistance of R. F. Benson at NASA/Goddard Space Flight Center, we have reduced a number of them to topside electron density profiles (EDPs). We have also attempted to model the storm by modifying the neutral density profiles in the Naval Research Laboratory (NRL) MSIS2000 model and using these in conjunction with the SAMI2 ionospheric model, also obtained from NRL. By adjusting the neutral density profiles until the modeled topside EDPs approximately match the ISIS-1 derived topside EDPs we are able to obtain an approximation to the disturbed thermospheric vertical structure associated with a negative ionospheric storm.

SA22B-06 1455h

Observing the Storm Time Ring Current from Low Earth Orbit

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Recent spacecraft of the Defense Meteorological Satellite Program (DMSP) have carried vector magnetometers. We have developed a technique for analyzing magnetic field data obtained at 840 km altitude to determine the disturbance magnetic fields due to the ring current. This disturbance field signature is similar to the DST index. We show the technique for the computation and the results of the computations for a few recent storm periods. Typically, in the early hours of a storm, the disturbance field stronger on the evening side than on the morning side, and it becomes equally strong on the morning and evening sides late in the storm. This behavior has been reported from ground-based magnetometers and is consistent with the ring current development observed from the Image spacecraft. We demonstrate that the space-based magnetometer is a useful supplement to the ground-based sensors in studying the progress of a geomagnetic storm. It is free of signatures due to ionospheric and ground currents and can provide data over areas of the world with few ground-based observatories.

SA22B-07 1510h

Observation and Modeling of Ionospheric Dynamics During Major Solar Flares

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Ionograms from the Bear Lake Observatory dynasonde show a characteristic enhancement to the E and F1-regions during major solar x-ray flares. The virtual height of the bottom-side F-layer often increases 50-100 km within minutes while fof2 remains relatively unchanged. This effect is believed to result from a sudden increase in solar XUV flux (1-30 nm), causing rapid ionization in the E and F1 regions. By contrast, the F2 region is slower to respond. We attempt to model these dynamics and create synthetic ionograms for comparison with observations using the Time-Dependent Ionospheric Model (TDIM). For solar input to the TDIM, we build a representative flare spectrum using measurements from the Solar EUV Experiment (SEE) instrument on the TIMED spacecraft.

SA22B-08 1525h

3-D Dynamic Behavior of Generalized Polar Wind

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The dynamic behavior of the high-latitude plasma during a representative geomagnetic storm is investigated using a 3-D macroscopic particle-in-cell (macPIC) model. In this study, we simulate the behavior of a large number (∼100 to 1000) of plasma-filled geomagnetic flux tubes. Each flux tube extends from 1200 km to several Earth radii, includes $\sim 10^6$ simulation particles, and is followed for ∼12 hours. The lower boundary conditions of the model are provided by a 3-D fluid-like model that extends down to 100 km. Several physical mechanisms are included such as wave-particle interactions, ion-ion collisions, low-altitude ion energization, and magnetospheric particles. The computing-intensive nature of the model requires the utilization of parallel programming techniques. We use a cluster of five nodes, with two (1.6 GHz) processors each, that is available at Utah State University, with the intention of transferring the code to a bigger facility in the future. A 3-D picture is assembled from the temporal evolution of the individual flux tubes by keeping track of their locations. This 3-D picture facilitates comparison with observations, such as radar and satellite measurements. The model and its preliminary results are presented.