SA52A MCC: Hall D Friday 1330h

Remote Sensing of the Thermosphere and Ionosphere Posters

Presiding: **R W Eastes,** Florida Space Institute**; A van Eyken,** EISCAT Scientific Association

SA52A-0372 1330h POSTER

Distribution of Atomic Hydrogen in the Upper Atmosphere: Assessment of Absolute Densities and Variations in the light of Recent Observations

James Bishop (202-767-5529; jbishop@uap2.nrl.navy.mil)

Naval Research Laboratory, Upper Atmospheric Physics Branch, 4555 Overlook Avenue, S.W., Washington, DC 20375, United States

Knowledge of atomic hydrogen densities ([H](z)) in the upper atmosphere is important both for understanding mesospheric-lower thermospheric (MLT) chemistry and for realistic modeling of geocoronal interactions with ionized populations (*e.g.*, plasmasphere, ring current). Work culminating in the 1970's failed to achieve consistent determinations of the distribution of atomic hydrogen; because of this, the relevance of [H](z) determinations in other areas of aeronomic research has remained unacknowledged. Extensive independent sets of optical data, coupled with improved solar Lyman line series irradiances and corrections of assumptions used in the earlier data analyses, however, now enable us to resolve the older inconsistencies and pursue determination of quantities of genuine interest: thermospheric atomic hydrogen vertical fluxes, characteristics of the satellite atom component in the geocorona, *etc.* These data sets include: Wisconsin Hα Mapper (WHAM) Fabry-Perot data from Kitt Peak Observatory, providing $\sim 40,000$ spectra of geocoronal and galactic Balmer α intensities beginning in 1997; very high resolution Fabry-Perot data from Pine Bluff Observatory (Wisconsin) of both Balmer α and Balmer β intensities and line profiles from 2000-2001; FUSE EUV measurements of Lyman line series intensities from 1999 and 2000 (excluding Lyman α); MiniSat1/EURD EUV spectrometer measurements of Lyman line series intensities (excluding Lyman α) from 1997 to 2001; and IMAGE/GEO Lyman α intensity data from geocoronal positions (satellite apogees ~ 7 R_E). In this presentation, modeling analyses of representative data subsets will be discussed, focusing on results relevant to broader aeronomy topics.

SA52A-0373 1330h POSTER

Response of low - Latitude OI 630.0nm Dayglow Emission to geomagnetic disturbances

Duggirala Pallamraju[1] (617-353-1533; dpraju@bu.edui); Richard Massaro[1] (rmassaro@bu.edu); Supriya Chakrabarti[1] (supc@bu.edu); Jeffrey Baumgardner[1] (jeff@spica.bu.edu); Jorge Araya[2] (jaraya@ucn.cl); Stanley Solomon[3] (stans@ucar.edu); Jorge Chau[4] (chao@geo.igp.gob.pe)

[1]Center for Space Physics, Boston University, 725 Commonwealth Avenue, Boston, MA 02215, United States

[2]Universidad Catolica del Norde, Avenida Angamos, Antofagasta 0610, Chile

[3]National Center for Atmospheric Research,, High Altitude Observatory,, Boulder, CO 80301, United States

[4]Radio Observatorio de Jicamarca, Instituto Geofisica Peru,, Calle Callatrava 216,, Lima 12, Peru

A new spectrograph for High-resolution optical studies of upper atmospheric dayglow emissions has been developed at Boston University. This instrument is called the **H**igh **R**esolution **I**)maging **S**pectrograph using **E**chelle grating (**HIRISE**). **HIRISE has been operated from high-, mid- and low-latitude locations in campaign mode to measure the OI dayglow/daytime auroral emissions to understand the interaction between the thermospheric and ionospheric processes. During October - December 2001 HIRISE was operated from a low-latitude location, called Carmen Alto (23.16 S, 70.66 W; 10.2 S magnetic latitude), in Chile. Dayglow emissions from day-to-day show variability in response to the electrodynamical influences indicating the coupled nature of ionosphere-thermosphere interactions. The focus of the present investigation would be on coupling during geomagnetically disturbed conditions. In this context We would report on the relative behavior during disturbed conditions with that of geomagnetically quite conditions. We would also report on the comparison between the red line measurements with those derived using models.**

SA52A-0374 1330h POSTER

ISAAC measurements of MUV airglow derived from thermospheric O, N_2, and NO

Andrew W. Stephan[1] (202-767-0211; andrew.stephan@nrl.navy.mil)

Robert R. Meier[2] (202-767-2773; meier@uap2.nrl.navy.mil)

Kenneth F. Dymond[3] (kenneth.dymond@nrl.navy.mil)

Scott A. Budzien[3] (budzien@tip.nrl.navy.mil)

Robert P. McCoy[4] (mccoy@tip.nrl.navy.mil)

[1]Naval Research Laboratory, E.O. Hulburt Center for Space Research Code 7643, Washington, DC 20375, United States

[2]Naval Research Laboratory, E.O. Hulburt Center for Space Research Code 7606, Washington, DC 20375, United States

[3]Naval Research Laboratory, E.O. Hulburt Center for Space Research Code 7607, Washington, DC 20375, United States

[4]Office of Naval Research, 800 North Quincy St., Arlington, VA 22217, United States

We present an analysis of middle ultraviolet (MUV) spectra from the Ionospheric Spectroscopy and Atmospheric Chemistry (ISAAC) experiment in the context of our effort to obtain limb profiles of the OII 247.0 and NII 214.3 nm emissions. Measurements at these wavelengths provide a means of determining altitude profiles of thermospheric O and N_2 concentrations, as well as temperatures. ISAAC was launched on the Advanced Research and Global Observing Satellite (ARGOS) in February 1999 and has provided a large data set with which to test and validate our forward models and analysis techniques. However, blending with overlapping and adjacent molecular bands of NO coupled with the $\sim$0.4 nm spectral resolution of ISAAC makes it difficult to extract pure spectral signatures, and thus intensity profiles. This issue is particularly challenging for the 214.3 nm line, which peaks in intensity near 150 km. At and below this altitude, NO $\gamma(1,0)$ band emissions become increasingly bright and interfere with our ability to obtain the full NII emission altitude profile. We have simulated these NO intensities using modeled g-factor values fit to the emission longward of 214.7 nm, where the spectral intensity is dominated by the NO emissions. The profile of each line of the doublet that comprises the 214.3 nm emission (214.4 and 213.9 nm) is then fit to the spectrum that remains after subtraction of the NO signal. We will present results from our analysis of ISAAC data and the implications for use of these emissions in remote sensing of thermospheric O and N_2.

SA52A-0375 1330h POSTER

Comparison of a Thermospheric Photochemical Model with SNOE Observations of Nitric Oxide

Charles A Barth[1] (303-492-7502; barth@lasp.colorado.edu)

Scott M Bailey[2] (scott.bailey@gi.alaska.edu)

Kenneth D Mankoff[2] (mankoff@lasp.colorado.edu)

[1]Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO 80309-0590, United States

[2]Geophysical Institute, University of Alaska , Fairbanks, AK 99775-7320

A time-dependent, photochemical model has been used to calculate nitric oxide density in the lower thermosphere for 935 days (March 11, 1998 - September 30, 2000) as a function of latitude. The model data has been compared with observations made by the Student Nitric Oxide Explorer (SNOE). The energy inputs to the model are solar soft x-rays, solar extreme ultraviolet radiation, and auroral electrons. The solar soft x-rays in the 2-7 nm wavelength band have been measured by the SNOE solar x-ray photometer. The atmospheric structure is calculated using the MSIS model with the 10.7 cm radio flux and the geomagnetic index Ap as inputs. The model calculation has been performed for latitudes between 0 and 80 degrees N in steps of 5 degrees. A model calculation for the two and a half years using only solar soft x-rays (no auroral electrons) shows strong seasonal behavior in the nitric oxide density particularly in the regions of polar night. The correlation of the calculated nitric oxide density at the equator with SNOE observations shows excellent agreement and a high correlation coefficient. A model calculation with both solar soft x-rays and auroral electron precipitation shows large and varying nitric oxide density in the auroral region between 60 and 70 degrees geomagnetic latitude. When the model calculation is subtracted from the SNOE observations, excess nitric oxide is found equatorward of the auroral region. Since the only source of odd nitrogen in the region between 0 and 55 degrees N is the solar soft x-ray source and that is accounted for in the model, this excess nitric oxide is attributed to nitric oxide that has been transported out of the auroral region by meridional winds.

SA52A-0376 1330h POSTER

Nitric Oxide Measurements Between 80 and 200 km From ISAAC Observations of NO Gamma Band Emission

Ken Minschwaner[1] (krm@kestrel.nmt.edu); James Bishop[2]; Scott Budzien[2]; Kenneth Dymond[2]; David Siskind[2]; Michael Stevens[2]

[1]Deaprtment of Physics, New Mexico Institute of Mining and Technology, Socorro, NM 87801, United States

[2]E.O. Hulbert Center for Space Research, Naval Research Laboratory, Washington, DC 20375, United States

Ultraviolet dayglow observed by the ISAAC (Ionospheric Spectroscopy and Atmospheric Chemistry) instrument has been analyzed to provide vertical profile measurements of nitric oxide (NO) in the upper mesosphere and thermosphere. ISAAC was launched in February 1999 onboard ARGOS, the Air Force Advanced Research and Global Observing Satellite. This study considers ISAAC dayside data obtained during November and December 1999, between 40°N and 70°S latitude. The analysis includes constraints on instrument sensitivity, and in-flight assessments of stray light and solar scattered background contributions. Residual spectra contain strong dayglow signatures of the NO gamma bands, which are used for inversion of measured radiances to absolute NO concentrations. We compare these observations with photochemical calculations that incorporate the latest O_2 and temperature data contained in the NRLMSISE-00 model.

SA52A-0377 1330h POSTER

Lyman-Birge-Hopfield Studies from Ultraviolet Experiments: Comparing Anomalous Vibrational Populations to Scale-height and Rotational Temperatures and Solar and Geomagnetic Activity

Scott A Budzien[1] (202-767=9372; budzien@nrl.navy.mil)

Kenneth F Dymond[1]

Stefan E Thonnard[1]

Andrew C Nicholas[1]

Robert P McCoy[2]

[1]Naval Research Laboratory, Code 7607, Washington, DC 20375-5352, United States

[2]Office of Naval Research, Code 321SR 800 N Quincy St, Arlington, VA 22217, United States

The N_2 a-X Lyman-Birge-Hopfield (LBH) bands are a prominent emission system extending throughout the far-ultraviolet spectrum which is produced in the Earth's dayglow and aurora. These molecular bands have long been used as a workhorse for characterizing the state of the thermosphere, both in limb-scanning techniques that retrieve N_2 and O_2 densities and in nadir-viewing methods that interpret the O/N_2 column ratios. Over the years a wide variety of a-state vibrational population distributions have been inferred from a number of remote sensing experiments. Our uniform analysis of N_2 LBH dayglow spectra from multiple UV sensors found a variety of non-Franck-Condon vibrational populations in the dayglow suggesting differing cascade contributions to LBH. We present the vibrational population distributions from ultraviolet spectra collected by several sensors aboard the Advanced Research and Global Observation Satellite, including new seen high spectral resolution limb-scan data in several passbands. The altitude- and latitude-resolved vibrational populations provide clues to the N_2 singlet excitation and cascade mechanisms that are key to correct interpretation of observations that rely on LBH.

URL: http://tipweb.nrl.navy.mil

SA52A-0378 1330h POSTER

Correlation between the Thermospheric Temperature Derived from ARGOS Observations of N_2 Lyman-Birge-Hopfield Emission and Solar Soft X-ray Observations from SNOE

R W Eastes[1] (321-459-0199; reastes@mail.ucf.edu); S M Bailey[2]; S A Budzien[3]; K F Dymond[3]; R P McCoy[3]; A C Nicholas[3]; S E Thonnard[3]; T N Woods[4]

[1]Florida Space Institute, MS-FSI, Kennedy Space Center, FL 32899, United States

[2]University of Alaska, Geophysical Institute 903 Koyukuk Dr., Fairbanks, AK 99775, United States

[3]Naval Research Laboratory, Code 7607, Washington, DC 20375, United States

[4]University of Colorado, LASP 1234 Innovation Dr., Boulder, CO 80307, United States

In the thermosphere, neutral temperature variations are important for understanding neutral and ion density variations, but the temperature is difficult to measure. A promising approach is to determine the temperature from the rotational temperature of the N_2 in Lyman-Birge-Hopfield (LBH) band emissions. Recent observations by the Advanced Research and Global Observations Satellite (ARGOS) are suitable for testing this approach. However, multiday averages of temperatures routinely exhibit dramatic deviations from an proxy (F10.7) based model (MSIS). High correlations (0.98) have previously been found between long term (81 day average) observations of F10.7 and neutral densities. Averages of mid and low latitude observations from tangent altitudes at 200 km and 140 km show deviations of 100 K or more (latitudinally-averaged). Observed temperature differences can be an order of magnitude greater than statistical errors in the rotational temperature measurements. Although the correlation between the long term averages of F10.7 and the short wavelength solar fluxes is high, F10.7 based models do not adequately represent the shorter term variations. Comparison to coincident, short wavelength solar observations from the Student Nitric Oxide Explorer (SNOE) satellite shows that shorter term variations (< 81 day) in the solar flux are a significant factor in the temperature differences.

SA52A-0379 1330h POSTER

Using USA and RXTE X-ray Source Atmospheric Occultations to Determine Atmospheric Densities and Temperature

Jon R Determan[1] (202-767-5201; jdeterman@ssd5.nrl.navy.mil); Scott A Budzien[2]; Lev Titarchuk[1]; Kenneth F Dymond[2]; Robert P McCoy[2]; Andrew C Nicholas[2]; Paul S Ray[3]; Stefan E Thonnard[2]; Michael T Wolff[3]; Kent S Wood[3]

[1]George Mason University, 4400 University Drive, Fairfax, VA 22030, United States

[2]Naval Research Laboratory, Code 7607, Washington, DC 20375, United States

[3]Naval Research Laboratory, Code 7655, Washington, DC 20375

The U.S. Naval Research Laboratory launched the Unconventional Stellar Aspect (USA) experiment aboard the Advanced Research and Global Observation Satellite (ARGOS) in 1999. USA is an X-ray timing experiment with a large collecting area and microsecond time resolution. USA consists of a collimated proportional counter X-ray telescope and two detectors with 1000 cm^2 effective area each and sensitive to 1-15 keV photons. NASA's Rossi X-ray Timing Explorer (RXTE) has been operating since December 30, 1995. RXTE features unprecedented time resolution in combination with moderate spectral resolution. Time scales from microseconds to months are covered in an instantaneous spectral range from 2 to 250 keV.

We have refined our new technique to measure the composition and structure of the upper atmosphere using atmospheric occultation of celestial x-ray sources. Both USA and RXTE provide energy-resolved photon extinction curves, and the combined energy ranges of USA and RXTE permit direct probing of the mesosphere and lower thermosphere (80-160 km). Roughly speaking, differential absorption among energy bands can provide composition information, and the shape of the light curves total density versus altitude. The refined technique models the shape of the spectra for three different X-ray sources: the Crab Nebula, Cygnus X-2, and GX5-1. The source model is attenuated using basis functions derived from NRLMSISE-00 (Picone et al. 2000) and convolved with the USA or RXTE detector response. Finally, using a Discrete Inverse Theory maximum likelihood retrieval process, the attenuated and convolved models are fitted to the data to retrieve density and temperature information. In addition, these results are compared to results obtained from the High Resolution Airglow/Aurora Spectroscopy Experiment (HIRAAS) experiment. This research is the first to study the neutral atmosphere in this energy range, and complements UV airglow remote sensing techniques used aboard ARGOS that are less sensitive to nighttime neutral density.

Enhanced Empirical Models of the Thermosphere, J. M. Picone, A. E. Hedin, D. P. Drob, R. R. Meier, J. Lean, A. C. Nicholas, and S. E. Thonnard, *Physics and Chemistry of the Earth, Part C: Solar-Terrestrial and Planetary Science*, 25(5-6), 537-42 (2000).

SA52A-0380 1330h POSTER

Global Observations of Exospheric Temperature During the Bastille Day Event

Kenneth F Dymond[1] (202-767-2816; kenneth.dymond@nrl.navy.mil)

Scott A Budzien[1]

Stefan E Thonnard[1]

Andrew C Nicholas[1]

Robert P McCoy[2]

[1]E. O. Hulburt Center for Space Research , Naval Research Laboratory Code 7607, Washington, DC 20375-5352, United States

[2]Office of Naval Research, Code 321SR 800 N. Quincy Street, Arlington, VA 22217-5660, United States

We present our observations of the global exospheric temperature and its variation during the Bastille Day geomagnetic storm that occurred on July 14-18, 2000. The Bastiile Day event was initiated by an X-class solar flare that was followed by a coronal mass ejection. The CME eventually produced a major geomagnetic storm. Global exospheric temperatures were derived by fitting the topside intensity distribution of limb scan data observed by the Low Resolution Airglow and Aurora Spectrograph (LORAAS) on the *Advanced Research and Global Observation Satellite (ARGOS)*. The *ARGOS* was launched into a sun-synchronous orbit on 23 February 1999 at 2:29:55 AM Pacific Standard Time. The LORAAS obtained limb scans every 90 seconds providing soundings spaced by approximately 5.4° of latitude. We compare the LORAAS-derived exospheric temperatures with the Mass Spectrometer and Incoherent Scatter (MSIS) predictions of the exospheric temperature.

SA52A-0381 1330h POSTER

Global Thermospheric Densities Derived from ARGOS Measurements

Stefan E Thonnard[1]

Kenneth F Dymond[1] (202-767-2816; kenneth.dymond@nrl.navy.mil)

Scott A Budzien[1]

Andrew C Nicholas[1]

Robert P McCoy[2]

[1]E. O. Hulburt Center for Space Research, Naval Research Laboratory Code 7607, Washington, DC 20375-5352, United States

[2]Office of Naval Research, Code 321SR 800 N. Quincy Street, Arlington, VA 22217-5660, United States

The High Resolution Airglow and Aurora Spectroscopy (HIRAAS) experiment was launched from Vandenberg AFB, CA aboard the Advanced Research and Global Observation Satellite (ARGOS) on 23 February 1999 at 2:29:55 AM Pacific Standard Time. The ARGOS is in a sun synchronous, circular orbit at an altitude of 843 Km. The HIRAAS experiment contains the Low Resolution Airglow and Aurora Spectrograph (LORAAS). The LORAAS gathers limb scans over the 750-100 Km altitude range, covering the 800-1700 Å passband at 17 Å resolution. LORAAS observes limb profiles of the N_2 Lyman-Birge-Hopfield and O I 1356 Å emissions. We report our measurements of the daytime thermospheric composition derived by analysis of the altitude profiles of the N_2 Lyman-Birge-Hopfield and O I 1356 Å emissions. Our inversion algorithm inverts the photoelectron impact excited emissions and includes the effects of radiative recombination on the O I 1356 Å profile. The inversion process produces thermospheric densities of O, N_2, and O_2, as well as the ionospheric electron density required to reproduce the radiative recombination component of the O I 1356 Å emission. We find generally good agreement between the retrieved densities and the NRLMSIS-2000 model, although our densities tend to be somewhat lower than the NRLMSIS-2000 predictions for the case presented. We also find good agreement with the derived electron densities and measurements of the peak electron density and peak height derived by ionosonde observations.

SA52A-0382 1330h POSTER

Comparison of 1D and 2D Nightside Ionospheric Retrievals From LORAAS Ultraviolet Limb Airglow Observations

Patrick B. Dandenault[1] (202-767-9337; pdandenault@ssd5.nrl.navy.mil); Erin Henderlight[1] (ehenderlight@ssd5.nrl.navy.mil); Ken Dymond[2] (kdymond@ssd5.nrl.navy.mil); Scott Budzien[2] (sbudzien@ssd5.nrl.navy.mil); Stefan Thonnard[2] (sthonnard@ssd5.nrl.navy.mil); Andrew Nicholas[2] (anicholas@ssd5.nrl.navy.mil); Robert McCoy[3] (mccoyr@onr.navy.mil)

[1]Praxis, Inc, 4555 Overlook Ave SW Code 7607, Washington, DC 20375, United States

[2]Naval Research Laboratory, 4555 Overlook Ave SW Code 7607, Washington, DC 20375, United States

[3]Office of Naval Research, 800 N. Quincy St. Code 321SR, Arlington, VA 22217, United States

The Advanced Research and Global Observations Satellite (ARGOS) was launched in February of 1999 into a 0230/1430 local time, sun-synchronous orbit and consisted of several remote-sensing instruments that measured the composition, density, and temperature of the thermosphere and ionosphere. The Low Resolution Airglow/Auroral Spectrograph (LORAAS) instrument aboard ARGOS observed naturally-occurring FUV and EUV airglow emissions on the Earth's limb. LORAAS had a line of sight that was in the orbital plane and aft of the spacecraft. The vertical field-of-view ranged from 50-750km and each scan consisted of 90 one-second integration periods. The instrument had a wavelength range of 800-1700 with a 19 resolution.

LORAAS observations included nighttime intensity profiles of the OI 1356 emission, which is created by the radiative recombination of O+ and free electrons. Electron density profiles of the ionosphere are compared using both a 1-dimensional inversion technique and a 2-dimensional tomographic inversion technique. Observations include periods of high and low solar and geomagnetic activity. Results are compared to coincident ionosonde data, which are referenced as ground truth.

SA52A-0383 1330h POSTER

LORAAS Observations of the Seasonal and Longitudinal Variations in the Equatorial Ionosphere

Sarah E McDonald[1] ((202)404-8555; sarah.mcdonald@nrl.navy.mil)

Kenneth F Dymond[1] (kdymond@ssd5.nrl.navy.mil)

Stefan E Thonnard[1] (sthonnard@ssd5.nrl.navy.mil)

Scott A Budzien[1] (sbudzien@ssd5.nrl.navy.mil)

Robert P McCoy[2] (mccoyr@onr.navy.mil)

[1]Naval Research Laboratory, Space Science Division 4555 Overlook Ave., Washington, DC 20375, United States

[2]Office of Naval Research, 800 N. Quincy Street, Arlington, VA 22217-5660, United States

The Low Resolution Airglow and Aurora Spectrograph (LORAAS) has collected numerous spectra of Earths airglow in the extreme ultraviolet and far ultraviolet regimes (800 to 1700 Angstroms) during the mission life which began in May 1999 and ended in April 2002. Limb scans, atmospheric radiance profiles in the satellites orbital plane, were collected every ninety seconds throughout the experiments lifetime. The intensity of the nighttime O I 1356 Angstrom emissions associated with the equatorial anomaly were measured and interpreted using a quasi-tomographic technique to invert the intensity scans to derive electron density profiles of the ionosphere in the anomaly region at 0230 LT.

In this study, reconstructed electron density profiles (EDPs) of several months of LORAAS data are used to determine the separation, peak heights and densities of the northern and southern anomaly crests at approximately 0230 LT. We observe that even under relatively quiet conditions there are significant day-to-day and longitudinal variations in the equatorial ionosphere. We investigate the longitudinal dependence of the 0230 LT ionosphere and seasonal control of this dependence. The results are compared to first principles ionospheric models.

SA52A-0384 1330h POSTER

Comparison of Ultraviolet Airglow Derived Density to Satellite Drag Derived Density

Andrew C Nicholas[1] (202-767-2441; andrew.nicholas@nrl.navy.mil); Stefan E Thonnard[1] (stefan.thonnard@nrl.navy.mil); J M Picone[1] (picone@uap2.nrl.navy.mil); Kenneth F Dymond[1] (kenneth.dymond@nrl.navy.mil); Scott A Budzien[1] (scott.budzien@nrl.navy.mil); Steve H Knowles[2] (sknowles@ssd5.nrl.navy.mil); Erin E Henderlight[3] (ehenderlight@ssd5.nrl.navy.mil); Sean M McCoy[3] (smccoy@ssd5.nrl.navy.mil); Robert P McCoy[4] (MCCOYR@onr.navy.mil)

[1]Naval Research Laboratory, 4555 Overlook Avenue, Washington, DC 20375, United States

[2]Raytheon Technical Services, 4400 Forbes Boulevard, Lanham, MD 20706, United States

[3]Praxis Inc., 2200 Mill Road, Alexandria, VA 22314, United States

[4]Office of Naval Research, 800 North Quincy Street, Arlington, VA 22217, United States

Determination of neutral density in the thermosphere is of general scientific interest for many reasons: comparison to existing first principal and climatological models, inputs to assimilating models, and various applications that require density specifications such as orbit determination. Several techniques to obtain the density of the atmosphere are in various stages of research and development at the Naval Research Laboratory. This study will examine and compare the results of two of these techniques, satellite drag derived densities and Ultraviolet airglow derived densities.

The Special Sensor Ultraviolet Limb Imager (SSULI) is a limb-scanning spectrograph developed by the Naval Research Laboratory (NRL) for the Air Force Defense Meteorological Satellite Program (DMSP). A prototype of the SSULI sensor, the Low-Resolution Airglow and Auroral Spectrograph (LORAAS) on the Advanced Research and Global Observation Satellite (ARGOS), acquired data from May 1999 to April 2002. The LORAAS and SSULI sensors measure vertical profiles of the Earths natural airglow radiation in the extreme ultraviolet (EUV) and far ultraviolet (FUV) regions of the spectrum. A chi-squared minimization technique from Discrete Inverse Theory (DIT) is used to retrieve neutral density profiles from the spectral data. The NRLMSISE-00 atmospheric model is used as the forward model for the DIT process. The output consists of an effective F10.7 cm solar flux, an effective 81-day average F10.7 cm solar flux, neutral density scalars for the three major neutral constituents O, O_2 and N_2.

The satellite drag densities were derived from Space Surveillance Network (SSN) data using the special perturbations software suite (Special-K) developed at the Naval Research Laboratory. For this study, several satellites were selected based on orbital parameters and stability of their ballistic coefficients. The density profiles retrieved from the LORAAS data are compared to densities derived from satellite drag data obtained during the January 2001 through February 2001 time period. Results provide a validation of the UV spectral inversion technique for thermospheric density determination.

SA52A-0385 1330h POSTER

Comparison of TEC Derived Ultraviolet Limb Scans to TOPEX TEC Data

Erin E Henderlight[1] (ehenderlight@ssd5.nrl.navy.mil); Ken F Dymond[2] (kenneth.dymond@nrl.navy.mil); Stefan E Thonnard[2] (thonnard@pepe.nrl.navy.mil); Clayton Coker[1] (ccoker@ssd5.nrl.navy.mil); Sarah E McDonald[2] (smcdonald@ssd5.nrl.navy.mil); Andrew C Nicholas[2] (nicholas@pepe.nrl.navy.mil); Scott A Budzien[2] (sab@pepe.nrl.navy.mil); Robert P McCoy[3] (mccoyr@onr.navy.mil)

[1]Praxis Inc., 2200 Mill Road, Alexandria, VA 22314, United States

[2]E.O. Hulburt Center for Space Research, Naval Research Lab, 4555 Overlook Avenue SW, Washington, DC 20375, United States

[3]Office of Naval Research, 800 North Quincy Street, Arlington, VA 22217, United States

In February of 1999, the Air Force Space Test Program launched the Advanced Research and Global Observations Satellite (ARGOS) into an 830 km altitude, near-polar sun-synchronous orbit with a 14:30 ascending node local time. On board the ARGOS satellite is a suite of remote-sensing instruments that measure density, composition, and temperature of both the thermosphere and ionosphere. The Low Resolution Airglow and Auroral Spectrograph (LORAAS) aboard ARGOS monitors upper atmospheric airglow in the far-ultraviolet and extreme-ultraviolet passband. LORAAS is identical to the Special Sensor UV Limb Imager (SSULI) instrument whose mission will be starting with the launch of the next Defense Meteorological Satellite Program (DMSP) satellite and continuing on the next four DMSP satellites. Limb scans, atmospheric radiance profiles, in the satellites orbital plane are collected every ninety seconds. At night, the altitude distribution of the OI 1356 emission can be used to determine variations in the vertical electron density distribution.

It is necessary for a validation effort to be performed to estimate the quality of the two-dimensional nightside ionosphere algorithm based using the LORAAS data set. The validation presented here will be a comparison of total electron content (TEC) derived from LORAAS UV limb sensing techniques to total electron content derived from TOPEX data of the nightside ionosphere. This comparison of TEC will be used to assess the accuracy of the UV inversion.

SA52A-0386 1330h POSTER

Ionospheric Remote Sensing Using EM Fields From Lightning

Zhenggang Cheng[1] (919-660-5232; zc@ee.duke.edu)

Steven Andrew Cummer[1] (919-660-5256; cummer@ee.duke.edu)

[1]Duke University ECE department, 130 Hudson Hall, Duke University, Box90291, Durham, NC 27708, United States

Lightning discharges radiate the most of their electromagnetic energy in the very low frequency (VLF, 3-30kHz) and extremely low frequency (ELF, 3-3000Hz) bands. This energy is guided for long distances by multiple reflections from the ground and the ionosphere. Signals that propagate in a waveguide are strongly dispersed in a manner that is very sensitive to the characteristics of the guiding boundary. For VLF and ELF, the guiding boundary is the lower ionosphere, and thus the lightning generated signals contain substantial information about this region of the upper atmosphere. We report recent ionospheric measurements with this technique using magnetic field waveforms recorded at Duke University. VLF energy from lightning is almost exclusively reflected below 100 km and thus contains information about the ionospheric D region. Using VLF signals radiated from Midwestern US and other locations, we measure the day-to-day and single day variability of the D region (<100 km) ionosphere. With regular measurements we can determine the primary sources of this variability. Extremely low frequency (ELF) electromagnetic waves launched by lightning are reflected from both D region and the E region valley. This double reflection, which is especially strong from E region layers, produces a substantial effect on the subionospheric propagation of ELF waves. This sensitivity enables remote sensing of the E region and E region layer detection. We show ELF measurements over the southern US that demonstrate how this technique can detect and quantify E region layers.

SA52A-0387 1330h POSTER

Ionospheric Profiling Through Nonlinear Dielectric Response to Electron Density*

Ronald W. Moses[1] (505 667 5622; rmoses@lanl.gov)

Abram R. Jacobson[2] (505 667 9656; ajacobson@lanl.gov)

[1]T-3, Los Alamos National Laboratory, MS-B216, Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, NM 87545, United States

[2]NIS-1, Los Alamos National Laboratory, MS-D466, Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, NM 87545, United States

It is well known that the total electron content (TEC) along a line of sight in the ionosphere can be extracted from the frequency-dependent time lag measured in transionospheric RF signals [1]. For five years the FORTE satellite has been used to develop a substantial data base of transionospheric signals originating in both lightning and man-made sources. Here, we use signals generated by the Los Alamos Portable Pulser (LAPP) [2] and recorded by FORTE as input to a multi-layer computer model of RF wave propagation in the ionosphere, including Faraday rotation in the Earth's magnetic field. Nonlinearities in both the frequency dependence of the group velocity and the optical pathlength are modeled and matched to FORTE data to infer details of the vertical profile of electron density. Using the International Reference Ionosphere [3] as a profile model, we show how the vertical TEC, peak electron density, and ionospheric thickness can be extracted even at large transmitter-to-satellite separations. [1] Roussel-Dupre, R. A., A. R. Jacobson, and L. A. Triplett, *Radio Sci.*, **36**, 1615 (2001). [2] Massey, R.S., S.O. Knox, R.C. Franz, D.N. Holden, and C.T. Rhodes, *Radio Sci.*, **33**, 1739 (1998). [3] Bilitza, D., "International Reference Ionosphere 1990," NSSDC/WDC-A-R&S 90-92.

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SA52A-0388 1330h POSTER

Passive Global, Real-Time TEC Monitoring

Morris B Pongratz[1] (1-505-667-4740; mpongratz@lanl.gov)

David M Suszcynsky (1-505-665-3119)

T. Joseph Fitzgerald (1-505-667-1542)

Abram R Jacobson (1-505-667-9656)

[1]Los Alamos National Laboratory Space and Atmospheric Sciences Group, Mail Stop D466, Los Alamos, NM 87544, United States

Sensors are being developed to provide a satellite-based VHF global lightning monitor (e.g. Suszcynsky, et al., "VHF Global Lightning and Severe Storm Monitoring from Space: Storm-level Characterization of VHF Lightning Emissions," *EOS Trans. AGU 2001 Fall Mt. Prog. And Abstr. 82, No. 47*, F143, 2001). Dispersive effects of propagation of the lightning electromagnetic wave through the ionospheric and plasmaspheric plasmas cause the higher frequency components to arrive at the satellite before lower frequency components. From the time-of-arrival at several frequencies we can derive the TEC between the satellite and the lightning. Using multi-satellite techniques we can geolocate the lightning and the ionospheric penetration point quite accurately. A single ground station could provide essentially real-time regional TEC coverage. Four ground stations could provide global, real-time TEC measurements to supplement existing ground-based systems, especially over broad ocean areas.

We expect several lightning detections per satellite per minute. Temporal resolution will be limited only by ground segment processing. Spatial coverage and resolution will be limited by lightning occurrence, but many commercial sector TEC requirements are also correlated to lightning occurrence. With our FORTE (Fast On-orbit Recording of Transient Events) satellite we sense lightning over most of the globe including the oceans. We expect to determine TEC spatial gradients with tens of km resolution. This capability should be especially useful in severe convective weather to aircraft using GPS-based navigation, e.g. the FAA's Wide Area Augmentation System (WAAS).

SA52A-0389 1330h POSTER

Using the Tiny Ionospheric Photometer (TIP) on the COSMIC Satellites to Characterize the Ionosphere

Clayton Coker[1] (202-404-3976; ccoker@ssd5.nrl.navy.mil)

Kenneth F Dymond[2] (202-767-2816; kenneth.dymond@nrl.navy.mil)

Scott A Budzien[2] (202-767-9372; sbudzien@ssd5.nrl.navy.mil)

[1]Praxis Inc., 2200 Mill Road, 5th Floor, Alexandria, VA 22314, United States

[2]Naval Research Laboratory, E. O. Hulburt Center for Space Research, Code 7607, Washington, DC 20375-5352, United States

The Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC) will use the Tiny Ionospheric Photometer (TIP) to characterize the nighttime ionosphere. The TIP is a compact, narrowband, ultraviolet photometer operating at the 135.6 nm wavelength. This emission is produced by recombination of O^+ ions and electrons, which is the natural decay process for the ionosphere. At night, the strength of the emission is proportional to the product of the square of the peak electron density; during the daytime the emission is dominated by photoelectron impact excitation of atomic oxygen and is not useful for ionospheric sensing. The principal science mission of the TIP is to measure horizontal gradients of ionospheric electron density. These measurements will be combined with vertical gradient measurements, provided by GPS occultations, to reconstruct high accuracy electron density distributions in the nighttime ionosphere. Secondary science goals are to map and monitor the global F-region peak electron density, to locate the positions of the Appleton anomalies, to observe mesoscale ionospheric density structures (ionospheric irregularities), to map and monitor the global vertical total electron content, and to map and monitor the location of the auroral boundary. We present an overview of the TIP, how it will function, and an overview of the data and data products it will produce.

SA52A-0390 1330h POSTER

Dayside optical observations of high latitude plasma structures

Todd R Pedersen[1] (781-377-2845; todd.pedersen@hanscom.af.mil)

Tyler Wellman[2] (tyler.wellman@hanscom.af.mil)

Herb Carlson[3] (herb.carlson@afosr.af.mil)

[1]Air Force Research Laboratory, Space Vehicles Directorate, AFRL/VSBXI 29 Randolph Rd, Hanscom AFB, MA 01731, United States

[2]Northwest Research Associates, 14508 NE 20th St., Bellevue, WA 98007, United States

[3]Air Force Office of Scientific Research, 801 North Randolph St., Arlington, VA 22203

All-sky imagers were operated at Qaanaaq and Nord Greenland in conjunction with the EISCAT Svalbard Radar during the Millenium Polar Max campaign in January 2001. On 20 Jan 2001 a number of polar cap patches were observed forming near the cusp between Svalbard and Nord and then convecting antisunward into the central polar cap. The optical signature of these density enhancements over Nord took the appearance of elongated fingers of brighter airglow injected longitudinally from the east into the cusp region after which they convected steadily antisunward and crossed into the Qaanaaq field of view. Image data from Qaanaaq showed the longitudinal continuation of the features well beyond the apparent edges in the Nord data, suggesting that the patches were produced nearly simultaneously over several hours of magnetic local time. Ionosonde, TEC, and scintillation data confirmed that the optical patches were associated with electron density enhancements and elevated levels of scintillation, although levels of structuring varied significantly from patch to patch.

SA52A-0391 1330h POSTER

High Resolution Measurements and Modeling of Auroral Hydrogen Emission Line Profiles

D. Lummerzheim[1] (907 474 7564; lumm@gi.alaska.edu); B. S. Lanchester[2] (bsl@phys.soton.ac.uk); M. Galand[3] (mgaland@pocc.bu.edu); S. C. Robertson[2] (scr@phys.soton.ac.uk); M. H. Rees[2] (mhr@phys.soton.ac.uk); I. Furniss[4] (if@star.ucl.ac.uk); L. M. Peticolas[5] (lmp@ssl.berkeley.edu); H. U. Frey[5] (hfrey@ssl.berkeley.edu); J. Baumgardner[3]; M. Mendillo[3]

[1]Geophysical Institute, University of Alaska, Fairbanks, AK 99775-7320, United States

[2]University of Southampton, University of Southampton, Southampton SO17 1BJ, United Kingdom

[3]Center of Space Physics, Boston University, Boston, MA 02215, United States

[4]University College London, University College London, London 1, United Kingdom

[5]Space Science Laboratory, University of California, Berkeley, Berkeley, CA 94720-7450, United States

Measurements in the visible at high spectral resolution (1.3 A) have been made at Longyearbyen, Svalbard (15.8E, 78.2N), during an interval of intense proton precipitation, The shape and Doppler shift of Hydrogen Balmer beta line profiles have been compared with model line profiles, using as input ion energy spectra from almost coincident passes of the FAST and DMSP spacecraft. The comparison shows that the simulation contains the important physical processes that produce the profiles, and confirms that measured changes in the shape and peak wavelength of the hydrogen profiles are the result of changing energy input. This combination of high resolution measurements with modeling provides a direct method of estimating the incoming energy and changes in flux of precipitating protons over Svalbard. Whereas for electron precipitation information of the incident particles is derived from brightness and brightness ratios which require at least two spectral windows, for proton precipitation the Doppler profile of resulting hydrogen emission is directly related to the energy and flux of the incident energetic protons and can be used to gather information about the source region. As well as the expected Doppler shift to shorter wavelengths, the measured profiles have a significant red shifted component, the result of upward flowing hydrogen atoms.

SA52A-0392 1330h POSTER

Ground-based Measurements of the Effect of Sunlight on the Electron Acceleration Mechanism in Discrete Auroral Arcs

Charles S Deehr[1] (1-907-474-7473; cdeehr@gi.alaska.edu)

Manfred H Rees[1]

Albert E. Belon[1]

Gerald J. Romick[1]

[1]The Geophysical Institute, University of Alaska Fairbanks, Fairbanks, AK 99775-7320, United States

There is increasing evidence supporting the suggestion that the condition of the ionosphere prior to energetic auroral electron precipitation determines the formation of intense auroral arcs. This evidence is found by temporal and spatial averaging of measurements of energetic auroral electrons by riometers, satellite energetic particle detectors, and global ultraviolet images. A direct method is to observe the effect of sunlight on the auroral arcs themselves. The height of the maximum luminosity of auroral forms is inversely proportional to the energy of the electrons producing the luminosity. This height has been measured by photometric triangulation from two stations (College and Fort Yukon, Alaska) located 226 km apart on nearly the same magnetic meridian. Under relatively quiet conditions, the height of the aurora is found to decrease smoothly with increasing solar depression angle from 190 km near civil twilight to 110 km during astronomical night. The evening and morning height variations have approximately the same magnitude but are asymmetric. The evening height decrease can be detected to large solar depression angles but the morning rise of the auroral altitude starts only shortly before sunlight illuminates the auroral region. This behaviour is shown to be consistent with the concept that the intense electron acceleration mechanism increases in magnitude as the ionospheric conductivity decreases slowly with dissociative recombination processes in twilight. The mechanism disappears suddenly at dawn when the solar ionizing radiation returns.

SA52A-0393 1330h POSTER

An artificial aurora emission observed in the SEEK-2 rocket experiment

Makiko Arakawa[1] (+81-22-217-5776; arakawa@pat.geophys.tohoku.ac.jp); Yukihiro Takahashi[1] (+81-22-217-5775; yukihiro@pat.geophys.tohoku.ac.jp); Hiroshi Fukunishi[1] (+81-22-217-6734; fuku@pat.geophys.tohoku.ac.jp); Mitsuteru Sato[1] (+81-22-217-5777; msato@pat.geophys.tohoku.ac.jp); Takayuki Ono[1] (+81-22-217-6514; ono@stpp3.geophys.tohoku.ac.jp); Mamoru Yamamoto[2] (+81-774-38-3814; yamamoto@kurasc.kyoto-u.ac.jp); Shoichiro Fukao[2] (+81-774-33-5343; fukao@kurasc.kyoto-u.ac.jp); Akinori Saito[3] (+81-75-753-3954; saitoua@kugi.kyoto-u.ac.jp); Kazuo Shiokawa[4] (+81-533-89-5166; shiokawa@stelab.nagoya-u.ac.jp); M. F. Larsen[5] (+1-864-656-5309; mlarsen@clemson.edu); L. J. Gelinas[6] (+1-607-255-9070; lynett@ee.cornell.edu)

[1]Graduate School of Science, Tohoku University, Aramaki Aoba, Aoba-ku, Sendai 980-8578, Japan

[2]Radio Science Center for Space and Atmosphere, Kyoto University, Gokasho, Uji, Kyoto 611-0011, Japan

[3]Graduate School of Science, Kyoto University, Sakyo-ku, Kyoto 606-8502, Japan

[4]Solar-Terrestrial Environment Laboratory, Nagoya University, 3-13, Honohara, Toyokawa 442-8507, Japan

[5]Department of Physics, Clemson University, Clemson, Clemson, SC 29634, United States

[6]Department of Electorical and Computer Engineering, Cornell University, 369 Upson Hall, Ithaca, NY 14853, United States

In the SEEK-2 (Sporadic-E Experiment over Kyushu) campaign, two rockets (S-310-31, 32) were launched in succession with an interval of 15 minutes from Uchinoura, Kagoshima on August 3, 2002. To observe waves and winds of neutral atmosphere, the S-310-32 rocket released trimethyl aluminum (TMA) over the altitude range from about 80 km to the apex of 117 km. We operated an all-sky imager and an image-intensified CCD (II-CCD) camera for ground-based imaging observation. During TMA release, the all-sky imager measured 557.7-nm emission with an exposure time of 40 seconds, while the II-CCD camera measured the rapid development of TMA release with a standard video frame rate and a narrow field of view of 10 $^{\circ}$ × 15 $^{\circ}$. Using these instruments, we succeeded in observing TMA-induced artificial aurora.

Gelinas et al. [JGR, 21495, 2001] studied TMA-induced emission and found following characteristics: 1) the emission lasts a few seconds, 2) the emission is emitted when kerosene is mixed with TMA, 3) the emission appears only during downleg release although TMA is released during both upleg and downleg, and 4) the emission appears along the magnetic field lines through the rocket trajectory. From the present II-CCD camera images, it is found that artificial aurora appeared above about 100 km altitude, and continuously from upleg release to downleg release and lasting at least more than one minute. According to an eyewitness report, artificial aurora had a ray structure below TMA trails as if it occurred along magnetic field lines. One of important characteristics is that the artificial aurora remained at a fixed location, though TMA trails moved due to background neutral atmosphere wind. The artificial aurora was green according to eyewitness, and we confirmed it by the all-sky imager with a 557.7-nm filter. However the all-sky imager of Nagoya University also confirmed the existence of OI 630.0-nm and OH emissions.

On the ground, all-sky imagers were operated at 4 sites with separations more than 60 km. These multi-site data enabled us to investigate the 3-dimensional structure of the artificial aurora and its evolution. Further, on the same S-310-32 rocket, the plasma wave instrument was also loaded. We will compare the optical data with the plasma wave data obtained from this instrument to investigate the excitation mechanism of the artificial aurora.

SA52A-0394 1330h POSTER

Multi-instrument Analysis of Spatial Distribution of Auroral Emissions

Farzad Kamalabadi[1] ((217)333-4406; farzadk@uiuc.edu)

Joshua Semeter[2] (joshua.semeter@sri.com)

Gary Swenson[1] (swenson1@uiuc.edu)

Benny Chan[1] (bkchan@uiuc.edu)

[1]University of Illinois at Urbana-Champaign, 1308 West Main Street, Urbana, IL 61801

[2]SRI International, 333 Ravenswood Avenue, Menlo Park, CA 94025

Analysis of the spatial distribution of auroral emissions can provide important insight into the coupled ionosphere magnetosphere system. In particular, tomographic reconstruction of auroral volume emissions using multiple sensors can provide two-dimensional imaging information containing the altitude distribution of emissions which subsequently relates to the characteristic energy of energetic auroral electrons guided by the Earth's magnetic field at high latitudes. In this study, we present the results of tomographic imaging of auroral structures obtained during an experiment with two imaging spectrometers operating simultaneously, coinciding with the operation of the incoherent scatter radar (ISR) at Sondrestrom, Greenland. The spectrometers were located 290 km apart, one at Sondrestrom, and the other at Godhaven lying northwest nearly in the magnetic meridian of Sondrestrom. The spectrometers cover the spectral range between 420-870 nm, at a resolution of 1.5 nm. The data set inverted in this study corresponds to two campaigns conducted, one during 1-17 March 1996, and the other during 3-17 February, 1997. As aurora appeared in the magnetic zenith of Sondrestrom, synchronized exposures of the arcs were acquired with the respective spectrometers. Calibration for wavelength, uniform field, spectral sensitivity, curvature of field, and spatial mapping were performed prior to tomographic inversion. Precise alignment of the slit projection of the Godhaven spectrometer with the ISR beam enables the determination of emission distributions from an arc over Sondrestrom simultaneous with the characterization of the auroral energy from analysis of the altitude distribution of the ionization it causes. The analysis techniques, along with case studies and the interpretation of results are presented.

SA52A-0395 1330h POSTER

Contribution of proton precipitation to space-based auroral FUV observations

Marina Galand[1] (617 353 7431; mgaland@bu.edu)

Dirk Lummerzheim[2] (lumm@gi.alaska.edu)

Harald U. Frey[3] (hfrey@ssl.berkeley.edu)

Larry J. Paxton[4] (larry.paxton@jhuapl.edu)

Andrew B. Christensen[5] (christensen@eumetsat.de)

[1]Center for Space Physics, Boston University, 725 Commonwealth Avenue, Boston, MA 02116, United States

[2]Geophysical Institute, University of Alaska, Fairbanks, AK 99775-7320, United States

[3]Space Sciences Lab, University of California Berkeley, Grizzley Peak Blvd @ Centennial, Berkeley, CA 94720-7450, United States

[4]Applied Physics Lab, Johns Hopkins University, 11100 Johns Hopkins Rd, Laurel, MD 20723-6099, United States

[5]EUMETSAT, Am Kavalleriesand 31, Darmstadt 64295, Germany

Energetic electrons and protons precipitating from the magnetosphere are a major energy source in the high latitude regions inducing significant ionospheric and thermospheric perturbations through ionization and heating. The aurora is the optical manifestation of the interaction of these energetic particles with atmospheric neutrals. Auroral brightnesses and brightness ratios can be used to determine the particle characteristics for estimation of the subsequent atmospheric response or for tracking magnetospheric processes. Imaging from space offers a unique way to access to the global picture, and its temporal varibility, of the particle energy input over the auroral ovals. Usually only the electron component of the precipitation is considered. Electron characteristics are inferred from the analysis of auroral images taken from space in two different spectral bands in UV or visible. In the aurora most of the energy is carried by electrons, but at some locations and certain times protons are a major energy source, that is, a major ionization source of the atmosphere. The response of POLAR/UVI, IMAGE/WIC and SI13, and TIMED/GUVI -used for retrieving the electron components- to proton precipitation will be estimated. Secondary electrons produced within the proton beam also contribute to auroral emissions. Since they are less energetic than the secondary electrons produced in electron precipitation, they have a different spectral signature. In addition, for a given energy flux, protons are usually more efficient at ionizing than electrons and yield larger values of the Pedersen ionospheric conductance. Therefore, the difference between proton and electron aurora can lead to misinterpretation when brightness ratios are used to derive ionospheric conductances with parameterizations that are based on electron aurora. The validation and limitations of auroral analysis will be discussed, especially in the winter cusp region and at the equatorward edge of the afternoon oval, where protons are expected to be a significant energy source.

SA52A-0396 1330h POSTER

A Ground-based Study of Proton Aurora from Tromso, Norway

Supriya Chakrabarti[1,2] ((617) 353 5990; supc@bu.edu)

Marina Galand[1] (mgaland@bu.edu)

Jeffrey Baumgardner[1] (jeffb@spica.bu.edu)

Pallamraju Duggirala[1] (dpraju@bu.edu)

Unni Pia Lovhaug[3] (unnipia@mack.uit.no)

[1]Center for Space Physics Boston University, 725 Commonwealth Avenue, Boston, MA 02215, United States

[2]Department of Astronomy Boston University, 725 Commonwealth Avenue, Boston, MA 02215, United States

[3]Department of Physics, University of Tromso, Tromso N-9027, Norway

An imaging echelle spectrograph designed for high resolution studies of selected spectral features located anywhere in the visible was deployed during November 2001 to March 2002 in Tromso, Norway. The purpose of the experiment was to assess the particle precipitation characteristics and the subsequent response of the ionosphere, in a region of intense proton aurora. For moderately distrubed conditions, Tromo is located for several hours on the equator edge of the evening auroral oval, where energetic protons are the dominant particle energy source. It also offers combined experiments with the EISCAT radar probing the ionosphere.

Four spectral windows were selected in this study: Hα (656.3 nm) and Hβ (486.1 nm), N_2^+ 427.8 nm and OI 777.4 nm. The 8° long slit of HiTIES (High Throughput Imaging Echelle Spectrograph) was centered on the magnetic zenith. Information on the weather conditions and on the overall auroral activity is provided by a second spectrometer, the Proton Aurora Context (PAC) instrument. PAC is a large field of view (60°) conventional imaging spectrograph which spans the 400-800 nm spectral range. Both optical instruments operated over the whole winter. In this talk, we demonstrate that the spectral resolution of HiTIES (0.1 nm) is sufficient for successfully studying proton aurora using Hα emission. The same experiment will be repeated this winter.

URL: http://www.bu.edu/csp/hities

SA52A-0397 1330h POSTER

Doppler Profiles of Proton Auroral Emissions Derived From High Resolution FUV Spectra

Damien H Chua[1] ((202) 767-5789; dchua@ssd5.nrl.navy.mil)

Kenneth F Dymond[1] (kenneth.dymond@nrl.navy.mil)

Scott A Budzien[1] (sbudzien@ssd5.nrl.navy.mil)

Robert P McCoy[2] (mccoy@tip.nrl.navy.mil)

Jean-Claude Gérard[3] (JC.gerard@ulg.ac.be)

[1]E. O. Hulbert Center for Space Research, Naval Research Laboratory, Code 7607 4555 Overlook Drive SW, Washington, DC 20375, United States

[2]Office of Naval Research, Code 321SR, 800 N. Quincy Street, Arlington, VA 22217, United States

[3]Laboratoire de Physique Atmosphérique et Planétaire, Université de Liège, Institut d'Astrophysique et de Géophysique, Allée du 6 Août, 17 (B5C), Liège B-4000, Belgium

In this paper we present new FUV observations of Doppler-shifted Lyman-α emissions from proton aurorae obtained from the High-resolution Ionospheric and Thermospheric Spectrograph (HITS) aboard the Advanced Research and Global Observation Satellite (ARGOS). The Doppler profiles of the Lyman-α auroral emissions serve as proxies for the energy spectra of precipitating protons in the ionosphere. These observations remedy two previous shortcomings in proton aurora studies. There have been few spectral measurements of Doppler-shifted H/H^+ emission profiles with which to validate existing models of proton flux transport in the ionosphere. Even fewer are spectral measurements of this kind over large spatial scales that would extend our understanding of proton aurora to a global level. The HITS instrument observes the Doppler shifted H Lyman-α emissions from proton precipitation at 0.5 $\AA$ resolution over the width of the auroral oval traversed by the ARGOS spacecraft. The measured Doppler spectra of proton emissions are then modeled using a Monte Carlo simulation of proton flux transport. The model parameters which include the incoming proton energy, pitch angle, and energy flux distributions are adjusted until the predicted Lyman-α Doppler profiles match the observations. This technique allows us to quantify the evolution of proton precipitation during varying levels of auroral activity with both spectral information and large-scale spatial coverage. We present our analysis of proton auroral observations for an isolated substorm event as an example.

SA52A-0398 1330h POSTER

Comparison of SuperDARN Radar Boundaries with DMSP Particle Precipitation Boundaries

Thomas Sotirelis[1] (240-228-4768; tom.sotirelis@jhuapl.edu); J. Michael Ruohoniemi[1]; Patrick T. Newell[1]; Robin J. Barnes[1]; Joseph P. Skura[1]; Ching-I. Meng[1]

[1]The Johns Hopkins University Applied Physics Laboratory, 11100 Johns Hopkins Rd., Laurel, MD 20723, United States

Algorithms have been developed for automated identification of SuperDARN Radar Boundaries and for DMSP Particle Precipitation Boundaries. Here, a comparison is made between simultaneous boundary determinations from these two sources, in order to statistically delineate their relationship. The convection reversal boundary is compared to the open-closed boundary as seen in particle precipitation as well as to the poleward boundary of the main oval. These boundaries compare in the expected way, as a function of IMF Bz. The equatorward boundary of scatter is compared to the equatorward boundary of the oval as well as to the structured-unstructured boundary. The result of this comparison is local time dependent. The automated analysis of both of these data sets can provide information about the state of the auroral ionosphere. A historical/real-time view of the state of the auroral oval, called OVATION and is available on the web at http://sd-www.jhuapl.edu/Aurora.

SA52A-0399 1330h POSTER

Atomic Oxygen Depletion Measurements in a Diffuse Aurora

Patric Patterson[1] (435 797 4112; patp@sdl.usu.edu); Charles Swenson[2] (435 797 2958; charles.swenson@usu.edu); Keith Melville[1] (435 797 4600; keith.melville@sdl.usu.edu); Jacek Stegman[3] (46 8 162408; jacek@misu.su.se); Andrew Christensen[4] (49 6151 807 831; christensen@eumetsat.de); James Clemmons[4] (310 336 2428; james.h.clemmons@aero.org)

[1]Space Dynamics Laboratory, 1695 North Research Park Way, North Logan, UT 84341-1947, United States

[2]Utah State University, Department of Electrical and Computer Engineering, 4120 Old Main Hill, Logan, UT 84322-4100

[3]Stockholm University, Department of Meteorology, Stockholm S-106 91, Sweden

[4]The Aerospace Corporation, PO Box 92957, Los Angeles, CA 90009, United States

The Coupling of Dynamics and Aurora (CODA) Payload was launched at 06:20 LT on January 22, 1999 from Poker Flat, Alaska and again at 0:55 LT on February 21, 2001. Atomic oxygen profiles were measured in situ by a combination of resonance and florescence techniques and reveals significant structural differences between the two flights. The second flight records a significant erosion of the top side atomic oxygen profile over a 30 km horizontal extent. One possible explanation is that turbulent mixing forced by the diffuse aurora is driving the atomic oxygen recombination rate. This data indicates the spatial scales over which composition changes can occur in the auroral regions and give insight into the O/N_2 ratios measured by GUVI on the TIMED spacecraft.

SA52A-0400 1330h POSTER

New Gyro Line Observations at the Arecibo Observatory

Michael P Sulzer[1] (787 878 2612 ext 255; msulzer@naic.edu)

Sixto A Gonzalez[1] (787 878 2612; sixto@naic.edu)

[1]Arecibo Observatory, HC 3 Box 53995, Arecibo, PR 00612, United States

The gyro line is a very weak part of the incoherent scatter (IS) spectrum centered near the electron gyro frequency times the cosine of the angle between the radar k vector and the magnetic field. Observations using the Arecibo radar are few, but published results roughly confirm the predictions of IS theory. Nonetheless, improvements in the sensitivity of the radar, the data collection equipment, and the analysis computers make better observations possible. The gyro line is potentially useful in studies of the E and lower F regions of the ionosphere. We report the results of recent observations made at three different angles to the magnetic field and the comparisons of the observed spectra to theory.

The observations occurred on October 21, 2001 from roughly 11:00 to 15:30 Atlantic Standard Time at angles of 49, 53, and 59 degrees from the magnetic field. The observations used a pulse length of 496 microseconds and a bandwidth of 5 MHz centered at 430 MHz, allowing the recording of both the up- and down-shifted gyro lines. Spectral analysis of the 12-bit recorded voltage samples occurred later on a suitable computer.

We observed gyro lines at the expected frequencies at all three angles with approximately the correct variation of frequency with angle. These lines are approximately five orders of magnitude weaker than the height-integrated ion line, and so only careful subtraction of interference using noise spectra from very high altitudes results in useful spectra. In addition to the expected lines, the observations show several other features that are potentially ionospheric in origin because of their consistent variation with angle. These features include a second and possible third set of lines located at frequencies greater than the gyro line, and some broad features.

Nearly all comparisons between IS theory and observations use a simple form of the theory with an approximately correct treatment of the effects of the magnetic field. Observations of the gyro line and the electron line high in the topside are two examples requiring the full theory. Thus, these measurements are of interest for verification of the theory. We have manipulated the equations so that the use of fast Fourier transforms simplifies calculations and provides a comparison with other methods of calculation. We have found reasonable agreement between the theory and the location and widths of the gyro line measurements.

We do not understand the additional spectral components in the observations. We have not proven that computational inaccuracies or other equipment problems do not cause them, but the outer lines are in some cases larger than the expected lines. This, as well as other factors, argues against the effects of non-linear

processing. A new data-taking system using 14 bit converters and sampling at the intermediate frequency is under construction; we will make new measurements when it is ready.

Another possible source for the additional components is the effects of supra-thermal electrons. We have developed a version of IS theory allowing a tail in the electron distribution function in the form of a high-temperature Maxwellian added to the thermal Maxwellian. We have not been able to reproduce the observations. Another version allowing arbitrarily shaped tails is under development.

SA52A-0401 1330h POSTER

Long Duration Incoherent Scatter Data Sets

Anthony van Eyken (+47 790 21008; Tony.van.Eyken@eiscat.com)

Anthony P van Eyken, EISCAT Scientific Association PO box 432, Longyearbyen N-9171, Norway

Recent developments in Incoherent Scatter radar hardware, coding techniques, data processing and data distribution make the recording of extended datasets both practical and valuable.

The EISCAT Svalbard Radar has been developing the infrastructure to support long experiments and can already handle programmes with durations of two to four weeks (or more).

Long duration experiments provide possibilities to study phenomena not normally accessible to these facilities and also provide datasets applicable to comparison with many ionospheric and atmospheric models. The ready availability of fully analysed data through WWW-based database tools allows these data to be easily exploited by a wide user community.

Using examples from recent operations, this paper investigates some of the potential of these new capabilities and shows how users can easily exploit the data as a resource for their own research.

SA52A-0402 1330h POSTER

First Dual Beam Observations of Electron Temperature Gradients at Arecibo

Richard Behnke[1] (rbehnke@nsf.gov)

Sixto Gonzalez[2] (sixto@naic.edu)

Michael Sulzer[2] (msulzer@naic.edu)

Nestor Aponte[3] (nestor@naic.edu)

Michael Nicolls[4] (mjn25@cornell.edu)

[1]National Science Foundation, 4201 Wilson Blvd, Arlington, VA 22230, United States

[2]Arecibo Observatory, HC-03 Box 53995, Arecibo, PR 00612, United States

[3]Cedarville University, Dept. of Engineering 251 N. Main St., Cedarville, OH 45314

[4]Cornell University, School of Electrical and Computer Engineering, 351 Rhodes Hall, Ithaca, NY 14853, United States

The Arecibo Observatory (18.35 N, 66.75 W) can now measure the ionosphere with two antenna beams simultaneously. In June 2002, this new capability was used for the first time to investigate north/south gradients of elctron temperature and electron density. The experiments yielded some unexpected results. In particular,large horizontal north/south gradients in the electron temperature of the ionospheric F-region were observed during the early morning that persisted for hours. In addition to electron temperatures, we also examined north/south electron density gradients looking for and finding – evidence of Travelling Ionospheric Disturbances.

SA52A-0403 1330h POSTER

A Statistical Study On Ion And Neutral Metal Layers Observed At Arecibo

Martin Rodgers[1] (rodgemp@muohio.edu); Qihou Zhou[1] (513-529-6506; zhouq@muohio.edu); Yu Morton[1] (513-529-6506; mortonyt@muOhio.edu); Jonathan Friedman[2] (787-878-2612; jonathan@naic.edu); Craig Tepley[2] (787-878-2612; craig@naic.edu); Shikha Raizada[2] (shikha@naic.edu); Mike Sulzer[2] (sulzer@naic.edu); Sixto Gonzalez[2] (sixto@naic.edu)

[1]Miami University, Manufacturing and Mechanical Eng. Dept., Oxford, OH 45056, United States

[2]Cornell University, Arecibo Observatory HC3 Box 53995, Arecibo, PR 00613, United States

Thin ionization layers in the meteor zone have been observed by the Arecibo incoherent scatter radar (ISR) for many years. In fact, nighttime E-region ionosphere in the temperate zone is dominated by these layers. Although it is generally understood that these ionization layers are formed by the windshear of tidal winds, their variability has not been studied in any detail. We use the data collected by the Arecibo ISR over nearly two solar cycles to examine the morphology of the ion layers. We present diurnal, seasonal and solar cycle variation of the peak density, altitude, layer width and E-region column abundance. In addition, we compare the ion layer characteristics with those of the metallic atom layers, particularly potassium and sodium, observed by co-located lidars.

SA52A-0404 1330h POSTER

Detailed Investigation of the Spectral Features of Naturally Enhanced Ion Lines in Incoherent Scatter Returns

Anja Stromme[1,2] (+1 650 859 2298; anja.stromme@sri.com)

Unni Pia Lovhaug[1] (unni@phys.uit.no)

Anthony P van Eyken[3] (tony.van.eyken@eiscat.com)

[1]Auroral Observatory, University of Tromsø, Tromsø9037, Norway

[2]SRI International, 333 Ravenswood Avenue G 289, Menlo Park, CA 94025, United States

[3]EISCAT Scientific Association, Postboks 432, Longyearbyen 9171, Norway

Naturally Enhanced Ion Lines (NEIL) with enhanced power return and an asymmetry between the up and the down shifted ion line are regularly observed with the EISCAT Svalbard Radar (ESR). The NEIL exhibit enhanced power and overall Doppler shifts which are typically interpreted as enhancements in equivalent temperatures and line-of-sight ion velocity.

Resent observations of NEIL at the ESR reveals a new kind of spectral signatures. In addition to the power enhancement and asymmetry, a bifurcation in one of the ion lines occur, resulting in triple humped spectra over an extended height range. The additional ion line might be attributed to the presence of two distinct ion populations within the scattering volume during the integration time .

By looking into the dispersion relation for the ion acoustic waves we can estimate parameters for the ion population and investigate the conditions necessary to support the observed reflection processes. Comparison with previous NEIL observations places these new observations within the context of typical ionospheric conditions observed by the radar.

SA52A-0405 1330h POSTER

Solar Cycle Variability of Topside Helium Ion Concentrations Over Arecibo

Sixto A. Gonzalez[1] (787.878.2612x252; sixto@naic.edu)

Michael P Sulzer[1] (sulzer@naic.edu)

Michael Nicolls[2]

Robert Kerr[3]

[1]Arecibo Observatory, HC3 BOX 53995, Arecibo, PR 00612, United States

[2]Cornell University/Arecibo Observatory, HC3 BOX 53995, Arecibo, PR 00612, United States

[3]Scientific Solutions, 55 Middlesex Street, Unit 210, North Chelmsford, Ma 01863, United States

Helium ion concentrations in the lower topside ionosphere over Arecibo are presented for low and high solar flux periods of the same season. Data from October 8-9, 1988, October 21-22, 1995, October 26-27, 1997, and October 12-13, 2001 are compared. Two of these datasets (1988 and 2001) are from high solar flux conditions, while the other two (1995 and 1997) are from low solar flux conditons. All datasets represent geomagnetic 'quiet' periods over Arecibo, and serve as examples of typical topside datasets.

For solar minimum conditions the altitude distribution of the helium ions usually has a maximum near the O^+ to H^+ transition altitude (h_t) during the night. The helium ion number densities tend to be quite low, 2 or $3 \times 10^3 cm^{-3}$, or 10-15 percent of the topside plasma density. For the case with higher solar flux, the helium ions form a more distinct layer at an altitude that is slightly above h_t. In addition, the relative abundance of He^+ can reach 60 percent of the topside plasma at the peak of this layer. In this case the number densities are much higher than during solar minimum, reaching $4 \times 10^4 cm^{-3}$.

SA52A-0406 1330h POSTER

Stimulated Emissions and Radar Scatter from Pulsed and ELF Modulated RF-Ionosphere Interactions at HAARP

James P. Sheerin[1] (734-487-8793; Phy_Sheerin@online.emich.edu)

J. P. Mills[1] (jpmills@twmi.rr.com)

W. A. Bristow[2] (bill.bristow@gi.alaska.edu)

K. M. Groves[3] (groves@plh.af.mil)

C. Ramos[4] (camilor@ece.cornell.edu)

[1]Eastern Michigan Univ., Physics and Astronomy, Ypsilanti, MI 48197, United States

[2]U. Alaska-Fairbanks, Geophysical Institute, Fairbanks, AK 99775, United States

[3]AFRL Hanscom, Hanscom AFB, Hanscom AFB, MA 07131, United States

[4]Cornell Univ, Space Physics, Ithaca, NY 14853, United States

High power HF radiowave pulses launched from ground-based transmitters interact with overdense quiescent ionospheric plasma to produce strong turbulence effects. Many experiments of this type employ receivers to record the stimulated electromagnetic emissions (SEE) produced during relatively long (seconds) HF pulses. Long HF pulses are sufficient to produce irregularities and turbulence at several scales incorporating many effects. Effects which dominate for short HF pulses of interest may be masked by turbulence which develops on larger scales for longer HF pulses. We report a series of experiments performed at HAARP (Gakona, Alaska) using both radar, SEE and ELF diagnostics for a wide range of HF pulse widths down to ten milliseconds and several HF amplitude modulation frequencies of interest in the ELF range. Using short HF pulses, we are able to discriminate, characterize, and compare prompt SEE spectra over the time-scales of typical radar features. The SuperDARN-Kodiak radar reveals the growth of striations for longer HF pulsewidths. The SEE spectra taken during with short, low duty cycle HF pulses may be compared to models of SEE generation mechanisms. SEE spectra were also recorded using HF modulations in ELF range of interest and in the E-region ionosphere. We present the results of numerical simulations modeling the development of strong short-scale turbulence and mesoscale irregularities for comparison with these experiments.

SA52A-0407 1330h POSTER

The Noon-Time Equatorial Electrojet, its Spatial Features as Determined From CHAMP Satellite Observations

Hermann Lühr[1] (+49 331 288 1735; hluehr@gfz-potsdam.de)

Stefan Maus[1]

Martin Rother[1]

[1]GeoForschungsZentrum Potsdam, Telegrafenberg, Potsdam D-14473, Germany

We present a comprehensive study of the noon-time equatorial electrojet (EEJ) based on almost 1000 passes of the CHAMP satellite. The low orbit of CHAMP and its high-precision magnetometers allow to reveal the spatial structure of the EEJ with unprecedented accuracy. Data from one and a half year have been used to investigate average features, but also the global characteristics of the EEJ. Special attention has been paid to a proper separation of the EEJ signature from magnetic effects of other current systems like Sq or ring current. Rather than interpreting the EEJ in terms of its magnetic signature we inverted the observations to obtain the equivalent current distribution in the E layer.

Some of the dominant spatial features of the noontime EEJ emerging from our analysis are: The eastward electrojet currents peak right at the dip equator. There is no deviation from it neither on a seasonal base nor with longitude. The width of the EEJ is strongly controlled by the ambient magnetic field geometry. Some seasonal effects are observed in the American sector. Return currents north and south of the forward current are a common feature of the EEJ. They peak at a latitudinal distance of about 5 deg. from the dip equator. The sum of both eastward and westward currents tends to be balanced locally. The intensity of the noontime EEJ exhibits a distinct variation with longitude. This is particularly pronounced during the equinox seasons, while it almost vanishes during solstice periods. Our current profiles could be used as benchmarks for testing the reliability of ionospheric models.

URL: http://www.gfz-potsdam.de/pb2/pb23/SatMag/eej_currents.html

SA52A-0408 1330h POSTER

Relationship Between ion Motions and Equatorial Ionization Anomaly Observed by ROCSAT-1 at 600 km Altitude

Huey-Ching Yeh[1] (yeh@jupiter.ss.ncu.edu.tw); S.-Y. Su[1]; C.-K. Chao[1]; J.-M. Wu[1]; R. A. Heelis[2]; C.-H. Huang[1]; H.-H. Ho[1]

[1]National Central University, Institute of Space Science, Chung-Li 320, Taiwan

[2]The University of Texas at Dallas, William B. Hanson Center for Space Sciences, Richardson, TX 75803, United States

Due to the unique 35-degree orbital inclination of ROCSAT-1 and the 100% duty-cycle operation of the Ionospheric Plasma and Electrodynamics Instrument (IPEI), the ROCSAT-IPEI has collected a large set of ion density and velocity data over the equatorial ionization anomaly (EIA) regions during the passing solar maximum years. The statistical patterns of ion density and drift velocity are derived for the quiet (Kp $<$ 3) days of year 2000 and presented in this report. Strong correlation between the two parameters is found in their dependencies on local time, latitude, and longitude. The coincidence of upward ExB drift with density trough near the magnetic equator and the coincidence of poleward field-aligned drifts with density crests away from the magnetic equator strongly reflect the picture of fountain effect which drives the EIA phenomenon. In addition, we found that the degree of north-south asymmetry in the location and magnitude of the EIA crests varies with the field-aligned ion drifts which in terms depend on season and magnetic field declination. This suggests the importance of the coupling between neutral wind and ion drift in structuring the EIA region.

SA52A-0409 1330h POSTER

Disturbed Nighttime Ionosphere Observed by KOMPSAT-1

Kyoung W Min[1] (82-42-869-2525; kwmin@space.kaist.ac.kr)

SunMie Park[1] (82-42-869-8184; smpark@space.kaist.ac.kr)

Eunsang Lee[1] (82-42-869-2565; eslee@space.kaist.ac.kr)

[1]Department of Physics, Korea Advanced Inst. of Science Technology, 373-1 Kusong-dong, Yusong-gu, Taejon 305-701, Korea, Republic of

Korea has launched its first multi-purpose satellite, KOMPSAT-1, on December 21, 1999 into 685 km altitude sun-synchronous polar orbit with the descending node at 22:50 local time. The unique orbital characteristic of the spacecraft is suitable for the global study of upper ionosphere at fixed local time and altitude. Ionospheric Measurement Sensor (IMS), composed of a Langmuir Probe (LP) and the Electron Temperature Probe (ETP), monitored the variation of the nighttime local ionosphere along the satellite track until August 2, 2001. The present paper describes the variation of the mid-latitude ionospheric trough observed by IMS according to the geomagnetic disturbance as well as its possible seasonal variations. It is seen that the trough location moves equatorward and the subauroral temperature enhances as the Kp index increases, as previously reported. While the midlatitude electron density generally increases with Kp, it is seen that the density at the trough decreases with the increasing Kp. In order to study the storm and substorm features, both the Kp and the Dst indices are compared with these activities.

SA52A-0410 1330h POSTER

Global Distribution of Ion and Electron Temperatures in the Outer Ionosphere During Maximum of the Solar Cycle 22

Ludmila Triskova[1] (ltr@ufa.cas.cz)

Vladimir Truhlik[1] (vtr@ufa.cas.cz)

Jan Smilauer[1] (jsm@ufa.cas.cz)

Valerij Afonin[2] (vafonin@iki.rssi.ru)

Nella Smirnova[2] (nsmirnova@romance.iki.rssi.ru)

[1]Instute of Atmospheric Physics Acad. Sci Czech Rep., Bocni II., Praha 14131, Czech Republic

[2]Space Research Institute Russian acad. Sci., Profsoyuznaya 84, Moscow 117810, Russian Federation

Ion temperature (Ti) and related electron temperature (Te) distributions have been studied on the base of data measured by Radiofrequency Probe and Retarding Potential Analyzer onboard the Intercosmos 24 (perigee 500 km, apogee 2500 km, inclination 83 deg). Results from the period 1989-1991 have been analyzed. Seasonal variation of the recently evaluated ion temperature (from a large number of volt-ampere characteristics) in individual altitude levels in the range of 500 - 1500 km and the related Te is shown. Also comparison of measured Ti with those modeled by IRI2001 (International Reference Ionosphere) is done. We also discuss reliability of the modeling approach for ion temperature used in IRI model based on energy exchange between ions, electrons and neutrals.

SA52A-0411 1330h POSTER

Dynasonde Measurements of Ionospheric Meteor Effects

Frank T Berkey[1] (435 797 2981; tom.berkey@usu.edu); Payel Sikdar[1] (payel@cc.usu.edu); Chad S Fish[1] (435 797-0469; chad.fish@usu.edu); Owen Jones[2] (GOLJ@pcmail.nerc-bas.ac.uk); Lung-Chih Tsai[3] (lctsai@csrsr.ncu.edu.tw); C.F. Yen[3] (cfyen@csrsr.ncu.edu.tw)

[1]Utah State University, Space Dynamics Laboratory, North Logan, UT 84341, United States

[2]British Antarctic Survey, Madingley Road, High Cross, Cambridge CB3 0ET, United Kingdom

[3]National Central University, Center for Remote Sensing, Chung-Li 320, Taiwan

The ionization created when meteoric particles impinge on the upper atmosphere has been studied extensively, both with optical methods and by radar techniques. Traditionally, meteor radars have been configured as dedicated, fixed-frequency systems that operate in the HF/VHF bands and are employed to measure winds and other parameters in the mesosphere-lower thermosphere region. It has long been recognized that ionosondes are capable of detecting meteor ionization although the sparse sounding format of most synoptic instruments does not facilitate a rigorous analysis of meteor ionization effects. Furthermore, most ionosonde-based studies have focused on meteor shower intervals when the meteor ionization is especially prominent (e.g. Chandra et. al., 2001). However, the capabilities of digital ionosondes such as the NOAA dynasonde allow the detailed study of various parameters of the meteor-induced ionization such as amplitude, polarization and spatial location, in addition to the time-of-flight, as a function of time and frequency.

In this report, we will examine meteor ionization recorded by dynasondes located at Bear Lake (Utah) and Halley (Antarctica) demonstrating that these ionogram data can be used to distinguish between underdense and overdense meteor ionization. Other characteristics of the meteor-induced ionization, such as spatial location and Doppler velocity will also be presented. The dynasonde operated at the USU Bear Lake Observatory (42°N, 111°W) detects a large flux of meteor echoes and will be the primary source of data for this study.

Chandra, H., et. al., Sporadic-E associated with the Leonid meteor shower event of November 1998 over low and equatorial latitudes, *Annales. Geophys.*, **19**, 59-69, 2001.

SA52A-0412 1330h POSTER

Analysis of Neutral-Density Gauge Measurements Made at High Altitudes

James H Clemmons (1-310-336-2428; james.clemmons@aero.org)

The Aerospace Corporation, P. O. Box 92957 Mail Station M2/260, Los Angeles, CA 90009, United States

Neutral-density gauge measurements in the mesosphere/lower thermosphere yield information on the ambient conditions, including flow, temperature, and density. Relative fluctuations are also be used as a passive tracer of turbulent fluctuations. Several such measurements have been made in the altitude range of 80-140 km on rockets using multiple sensors, a technique which has the advantage of enabling the flow at supersonic Mach numbers to be understood. Analytical and simulation tools are used to interpret the measurements as they span the regimes of continuum, transition, and free-molecular flow. Results and comparisons to complementary measurements are made.

SA52A-0413 1330h POSTER

Potential Ionospheric Studies from the International Space Station Using the Floating Potential Measurement Unit

Charles M Swenson[1] (435-797-2958; Charles.Swenson@usu.edu)

Don Thompson[3] (435 797 2357; don.thompson@usu.edu)

Chad Fish[2] (435 797 4069; chad.fish@usu.edu)

[1]Utah State University, Dept. of Electrical and Computer Engineering, 4120 Old Mail Hill, Logan, UT 84322-4100, United States

[2]Utah State University, Center for Atmospheric and Space Sciences, 4405 Old Main Hill, Logan, UT 84322-4100, United States

[3]Space Dynamics Laboratory, 1695 North Research Park Way, North Logan, UT 84341-1947, United States

The Floating Potential Measurement Unit (FPMU) will be used on the International Space Station (ISS) to validate the vehicle charging theories and charge control systems. Excessive vehicle charging has been identified as a risk to astronauts working outside of the station as well as accelerating the degradation of the space station surface properties. The FPMU will be deployed on the ISS in January of 2003. It consists of two sweeping Langmuir probes, a floating potential probe, and a combination impedance –plasma frequency probe to measure density, floating potential and electron temperature. The ISS orbit of 51 degree inclination and 400 km altitude is will suited to studying a number of ionospheric phenomena including equatorial spread-F and sub auroral arcs. Considerable skepticism has been expressed by the scientific community as to the suitability of the ISS for space science and the FPMU will be a reasonable test of these concerns.

SA52A-0414 1330h POSTER

Finite Difference Time Domain Simulations of an Impedance Probe

Jeff Ward[1] (435 797 4133; jward@cc.usu.edu)

Charles M Swenson[1] (Charles.Swenson@usu.edu)

Cynthia Furse[2] (Cfurse@ece.usu.edu)

[1]Utah State University, Dept. of Electrical and Computer Engineering, 4120 Old Mail Hill, Logan, UT 84322-4100, United States

[2]University of Utah, Dept. of Electrical and Computer Engineering, 50 South Campus Drive, Salt Lake City, UT 84112, United States

The electrical impedance of an antenna in space plasma is an important but difficult problem. Utah State University has developed a Plasma Fluid Finite Difference Time Domain (PF-FDTD) model to simulate an antenna in magnetized space plasma. This simulation tool, based on the five moment Maxwellian plasma fluid equations, allows the impedance of a complex antenna structure to be determined. This paper will cover recent improvements made to the PF-FDTD model and simulation validation efforts. The PF-FDTD model is used to map variations in the input impedance of a microstrip patch antenna to changes in the plasma density, collision frequency, and magnetic field. This work is leading to the development of a new, compact, non-deployable RF plasma impedance probe.