IT Poster Session

Stadium Club
University of Colorado
Boulder, Colorado, USA

Wednesday June 23, 2010

Poster Abstract Booklet

Table of Contents

IT - Data Management and Visualization

Coupling of the Upper Atmosphere with Lower Altitudes

Equatorial Ionosphere or Thermosphere

Irregularities of the Ionosphere or Atmosphere

Instruments or Techniques for Ionospheric or Thermospheric Observation

Long-Term Variations of the Upper Atmosphere

Midlatitude Ionosphere or Thermosphere

Polar Aeronomy

Solar Terrestrial Interactions in the Upper Atmosphere

IT - Data Management and Visualization

IT-DATA-01 Powering Space Physics Investigations with the new Space Physics Interactive Data Resource - ReST Web Services - by Robert J. Redmon

Status of First Author: Student NOT in poster competition PhD

Authors: Robert J. Redmon, Eric A. Kihn, Mikhail Zhizhin, Peter Elespuru

Abstract: The Solar Terrestrial Physics division of the NOAA National Geophysical Data Center (NGDC) in Boulder, CO is focused on the dissemination of high quality space climate and space weather data sets and services. The Space Physics Interactive Data Resource (SPIDR) system is the primary web distribution method for NGDC's STP data and metadata holdings. Data sets available include global indices (e.g. F10.7, SSN, Kp), ionosonde, GOES, POES, DMSP, and other data sets collected through the World Data Center. It has been recognized that the existing SPIDR website style of data retrieval does not meet the entire communities' preferences for data access. Thus, we have developed a ReST style interface and sample client applications which provide programmatic access to all of the SPIDR's data and metadata holdings. This poster presents the details, capabilities and sample use cases for these new services. In addition we wish to present a new IDL client and API built on the ReST interface for rapid access to all of NGDC's SPIDR accessible data sets.

IT-DATA-02 LISN Network: Tools for GPS data processing and managing - by Juan Carlos Espinoza

Status of First Author: Non-student

Authors: J. C. Espinoza, J. L. Chau, C. Valladares, C. De La Jara

Abstract: The Low-Latitude Ionospheric Sensor Network (LISN) is an array of multi-instruments installed in South America as an distributed observatory, for the purpose of studying the ionospheric phenomena. All instruments sends data to a central server where is saved and processed for near real-time results. LISN involves several GPS receivers of different brands and models with its own binary format. To read this binary files is necessary a set of utilities for pre-processing (concatenation, decimation and RINEX conversion) and processing (TEC estimation) data. Besides real-time results, daily files are created and published in a web-based database available for users.

All programs and applications used for this purpose has been developed using the programming language Python and will be described in the present work. Besides the data managing tools, we present GPS TEC results related to special events, for example the sudden stratospheric warming campaigns for 2008-2010.

Coupling of the Upper Atmosphere with Lower Altitudes

IT-COUP-01 Observations of Ionospheric Features over the Anatolian Plateau - by Kanish Mehta

Status of First Author: Student IN poster competition Undergraduate

Authors: K Mehta, T W Garner, C L Slack, A Scholze and Mahrous

Abstract: A UHF/VHF beacon receiver located in Helwan, Egypt has frequently observes a peak in the dTEC/Dt measurements where the F-region intercept of the radio rays crosses the southern edge of the Anatolian Plateau. This feature was observed repeatedly in passes over Anatolia during the summer of 2008. The □TEC/□t peaks occur where the 300 km intercept passes over the edge. These correlations suggest that the local ionosphere is affected by the ground topography, most likely through the lower atmospheric response to the local topography.

IT-COUP-02 Equatorial Electric Fields during the 2002 Southern Hemisphere Sudden Stratospheric Warming Event - by Michael E. Olson

Status of First Author: Student IN poster competition PhD

Authors: Michael E. Olson, USU; Bela G. Fejer, USU; Jorge Chau, Radio Observatorio de Jicamarca

Abstract: We use equatorial plasma drifts over Jicamarca to study the equatorial electrodynamic responses to the September-October 2002 Southern Hemisphere Sudden Stratospheric Warming (SSW) event. The data show largely enhanced morning and early afternoon upward drifts (eastward electric fields) following the onset of the warming. The perturbation drift pattern systematically shifts to later local times. The onset of these drift patterns occurs near a new moon, suggesting strong semi-diurnal lunar wave effects. Two-day wave patterns also appear in the data. These responses to the 2002 Southern Hemisphere SSW are consistent with those observed during December solstice arctic SSW events reported previously. However, in contrast to responses to arctic events, there are no afternoon drift reversals during the September-October 2002 period. Our results indicate that equatorial electrodynamic responses to the September 2002 warmings over Jicamarca are, in general, similar to those of arctic events, but with weaker enhancements and the absence of afternoon reversals.

Equatorial Ionosphere or Thermosphere

IT-EQIT-01 Why do equatorial ionospheric bubbles stop rising? - by Jonathan Krall

Status of First Author: Non-student

Authors: J. Krall, J. D. Huba, S. L. Ossakow* and G. Joyce**
Plasma Physics Division, Naval Research Laboratory, Code 6700, Washington, DC 20375-5000
*Berkeley Research Associates
**Icarus Research

Abstract: The Naval Research Laboratory (NRL) three-dimensional simulation code SAMI3/ESF is used to study the long time evolution of equatorial spread F (ESF) bubbles. The ESF bubbles are modeled until they stop rising and become "fossils," with results analyzed to address previously-untested hypotheses. Specifically, it has been suggested that bubbles stop rising when either the local electron density inside the bubble is equal to that of the nearby background or the flux-tube-integrated electron density inside the bubble is equal to that of the nearby background. It is shown that equatorial bubbles stop rising when the magnetic flux-tube-integrated ion mass density inside the bubble equals that of the surrounding background ionosphere. In the case of a single-ion ionosphere this reduces to the condition that the flux-tube-integrated electron densities are in balance, consistent with the hypothesis of Mendillo et al. (2005) [1]. Further simulations show that fossil bubbles persist as high-altitude equatorial depletions even while being "blown" by zonal winds. Corresponding airglow-proxy images of fossil plumes, plots of electron density versus longitude and latitude 5 at a constant altitude of 288 km, are shown to partially "fill in" in most cases, beginning with the highest altitude field lines within the plume. In particular, field lines that fill in are those upon which the E field has fallen to zero [2].
Supported by the Office of Naval Research and NASA.
[1] Krall, J., J. D. Huba, S. L. Ossakow, and G. Joyce, "Why do equatorial ionospheric bubbles stop rising?", Geophys. Res. Lett., 37, L09105, doi:10.1029/2010GL043128, 2010
[2] Krall, J., J. D. Huba, S. L. Ossakow, and G. Joyce, "Equatorial spread F fossil plumes," Ann. Geophys., submitted, 2010

IT-EQIT-02 Equatorial spread F "plasma blobs" explained - by Jonathan Krall

Status of First Author: Non-student

Authors: J. Krall, J. D. Huba, and G. Joyce*
Plasma Physics Division, Naval Research Laboratory, Code 6700, Washington, DC 20375-5000
*Icarus Research

Abstract: Forces governing the three-dimensional structure of equatorial spread-F (ESF) plumes are examined using the NRL SAMI3/ESF three-dimensional simulation code. As is the case with the equatorial ionization anomaly (IA), density crests within the plume occur where gravitational and diffusive forces are in balance. Large E×B drifts within the ESF plume place these crests on field lines with apex heights higher than those of the background IA crests. Large poleward field-aligned ion velocities within the plume result in large ion-neutral diffusive forces that support these ionization crests at altitudes higher than background IA crest altitudes. We show examples in which density enhancements associated with ESF, also called "plasma blobs," can occur within an ESF plume on density-crest field lines, at or above the density crests. Simulated ESF density enhancements reproduce all key features of those that have been observed in situ[1].

Supported by the Office of Naval Research and NASA.
[1] J. Krall, J. D. Huba, G. Joyce, and T. Yokoyama, “Density enhancements associated with equatorial spread F,” Ann. Geophys., 28, 327–337, 2010

IT-EQIT-03 C/NOFS observations of large scale-size equatorial spread F irregularities - by Eugene Dao

Status of First Author: Student NOT in poster competition PhD

Authors: Eugene V Dao, Michael C Kelley, F.S. Rodrigues, Robert F Pfaff,P. A. Roddy

Abstract: We will examine large scale waves (greater than 10km) and the possible evidence of the coupling of gravity waves as seen by C/NOFS' Vector Electric Field Instrument (VEFI) and Planar Langmuir Probe (PLP).

IT-EQIT-04 Study of the linear RTI and the possible impact of MSTID electric fields on the growth of post-midnight EPBs during solar minimum - by Timothy M. Duly

Status of First Author: Student IN poster competition

Authors: Jonathan J. Makela - jmakela@illinois.edu

Abstract: A recent study by Miller et al. (2009) provides observational evidence of a relationship between medium-scale traveling ionospheric disturbances (MSTIDs) and the generation of post-midnight, quiet-time equatorial plasma bubbles (EPBs) during solar minimum conditions. They hypothesized that polarization electric fields from the passing MSTID couple into the equatorial ionosphere and generate post-midnight equatorial plasma bubbles (EPBs). Here we investigate this possible triggering mechanism through a numerical simulation of the linear Rayleigh-Taylor instability (RTI). This simulation, based upon background conditions provided by climatological models, allows us to determine the cause-and-effect relationship between changes in various parameters (electric fields, neutral winds, density gradients, etc) and the linear growth rate. In this poster, we concentrate on studying the effect on the RTI associated with an increase in the vertical drift term of the RTI, caused by the polarization electric field of an MSTID. The model is run for several nights at equatorial locations during solar minimum, with perturbation vertical drifts of varying magnitudes informed by measurements of the typical electric field associated with MSTIDs. In this way, we investigate whether the polarization electric field associated with MSTIDs can increase the linear RTI growth rate in the post-midnight hours during solar minimum conditions.

IT-EQIT-05 Equatorial vertical plasma drifts during solar minimum - by Edgardo Pacheco

Status of First Author: Non-student PhD

Authors: Pacheco, E. (edgardo.pacheco@usu.edu), Fejer, B. (bela.fejer@usu.edu), Chau, J. (jorge.chau@jro.igp.gob.pe) Heelis, R.A. (heelis@utdallas.edu)

Abstract: We use equatorial radar measurements from Jicamarca and in-situ data from C/NOFS and ROCSAT-1 to study the height dependent equatorial vertical plasma drifts during the current solar minimum. Our results show very large variability at all local times. The Jicamarca drifts do not change much with height. The C/NOFS low altitude vertical drifts (below about 470 km) are generally in good agreement with the Jicamarca and ROCSAT -1 data.

IT-EQIT-06 On the determination of the peak height of the equatorial electrojet - by Ronald Ilma

Status of First Author: Student IN poster competition

Authors: Ronald R. Ilma and Michael Kelley, School of Electrical and Computer Engineering, Cornell University, Ithaca, NY 14850

Abstract: In this study, we analyze the equatorial electrojet by using a simple physical assumption. With the aid of data in conjunction with model reference results,we provide a new possible explanation for a long-standing (more than 35 years) discrepancy between theory and (rocket) experiments concerning the peak height of the electrojet and the magnetic field

perturbation. Correction by a factor of four of the electron-neutral collision frequency thought to explain this problem is not necessary if the field-line-integrated conductivities are used. Furthermore, we argue that, since the correction factor is independent of the driving electric field, it is unlikely that a nonlinear plasma instability (gradient drift) is involved. The field-aligned conductivity argument is independent of the driving electric field. More observations during counter-electrojet conditions would help to resolve these competing ideas since the gradient drift process is stable.

IT-EQIT-07 Examination of the longitudinal variations of upward ExB drift assimulated by TIME-GCM - by Astrid Maute

Status of First Author: Non-student

Authors: A. Maute, A.D. Richmond, M.E. Hagan, R.G. Roble

Abstract: Space-borne observations of ionospheric densities and derived ExB/B2drift at low and mid latitude show longitudinal variations even duringgeomagnetic quiet times. Studies have confirmed that many of these variations can be connected to the propagation of non-migrating tides which are excited in the troposphere. It is also known that some contribution to the longitudinal variation will be due to gravity-driven current, and to the geomagnetic field configuration. In this study we will use results from the National Center for Atmospheric Research (NCAR) Thermosphere-Ionosphere-Mesosphere-Electrodynamics General Circulation model (TIME-GCM) forced by the Global Scale Wave Model (GSWM02) at the lower boundary (ca. 30 km). The model can reproduce part of the longitudinal variation. We will focus on geomagnetic quiescent conditions. We will examine and compare the contributions to the longitudinal variation of the upward ExB drift due to the neutral wind, the gravity-driven current and the geomagnetic field configuration.

IT-EQIT-08 Global structure of the lunar tide in ionospheric total electron content by Nicholas Pedatella

Status of First Author: Student IN poster competition PhD

Authors: Nicholas Pedatella and Jeffrey Forbes, University of Colorado

Abstract: The global structure of the lunar tide in the ionosphere is studied based on observations of the global positioning system (GPS) total electron content (TEC). The unprecedented spatial and temporal resolution afforded by the GPS TEC observations enables illustration of the latitude, longitude, solar local time, and seasonal variability of the lunar tide in the ionosphere. Based on analysis of the multi-year mean from 1999–2008, the dominant component is generally the semidiurnal lunar tide. However, a significant diurnal variation is also observed in some instances. The semidiurnal component achieves a maximum amplitude of ~6% in the equatorial ionization anomaly crest regions and a slight hemispheric asymmetry is present with larger amplitudes in the Northern Hemisphere. Furthermore, the maximum amplitudes in the semidiurnal lunar tide are found to occur during Northern Hemisphere winter and during 9–15 solar local time. During certain years, a secondary maxima in solar local time is also observed demonstrating the influence of the lunar tide on the prereversal enhancement. Lastly, the observations reveal significant longitudinal variability in the semidiurnal lunar tide that is most prominent between November and February. The presence of a longitudinal variation reveals the existence of nonmigrating components in addition to the dominant migrating semidiurnal lunar tide.

IT-EQIT-09 Comparison between equatorial ionospheric irregularities observed with C/NOFS satellite and occurrence of VHF scintillation over Peruvian sector - by Michi Nishioka

Status of First Author: Non-student

Authors: M. Nishioka, Solar-Terristrial Environmental Laboratory, Nagoya University, Aichi, Japan
Su. Basu, S. Basu, C. E. Valladares, R. E. Sheehan, Institute for Scientific Research, Boston College, Chestnut Hill, MA
P. A. Roddy, K. M. Groves, Air Force Research Laboratory, Hanscom Air Force Base, MA, USA

Abstract: Communication Navigation Outage Forecasting System (C/NOFS) was launched in order to monitor and forecast ionospheric scintillation. The satellite orbits near the magnetic equator at its perigee altitude of ~500km at dusk in the Peruvian sector for ~8 days in every ~50 days. This orbit provides an ideal opportunity of a comparison between plasma density disturbances measured by the Planar Langmuir Probe (PLP) instrument on the C/NOFS satellite at perigee and VHF

scintillation activity at Ancon on the magnetic equator. In this presentation, we show results of an event study and a statistical study. In the case study, we show two extreme cases in early October, 2008: one in which severe in-situ disturbances was accompanied by mild scintillation on a particular day, namely, 10 October; while there was little in-situ disturbance with strong scintillation on 5 October. This apparent contradiction was diagnosed further by a latitudinal ground-based GPS network at Peruvian longitudes, a digisonde, and the incoherent scatter radar (ISR) at Jicamarca. The crucial distinction was provided by the behavior of the equatorial ionization anomaly (EIA), which was well-developed on the day (Oct 10) having severe in-situ disturbance. However, this led to lower equatorial plasma density and total electron content (TEC) at the equator and consequently reduced scintillation at Ancon. In the statistical study, we compare VHF scintillation at Ancon with in-situ plasma density fluctuations observed with C/NOFS PLP instrument from September 2008 to December 2009 when the satellites orbited near the magnetic equator at its perigee altitude of ~500km at dusk in the Peruvian sector. It was found that significant PLP fluctuations were not always accompanied by the VHF scintillations. This suggests that during the sustained solar minimum period, strong VHF scintillation could be accompanied by bottomside irregularities below the perigee of C/NOFS, thus making them difficult to predict.

IT-EQIT-10 **Ionospheric bow wave signatures of the 22 July 2009 total solar eclipse detected by ground-based GPS TEC** - by Yang-Yi Sun

Status of First Author: Student IN poster competition PhD

Author: Yang-Yi Sun

Abstract: It has been suggested that the Moon's shadow sweeping over the Earth's atmosphere with a supersonic speed could trigger bow waves. The longest total solar eclipse within next hundreds year occurring on 22 July 2009 sweeps over the Eastern Asia region during the daytime period. The ionospheric TECs (total electron content) derived from ground-based GPS receivers of two dense networks in Taiwan and Japan are employed to monitor the bow wave signature. The HHT (Hilbert-Huang transform) is further applied to analyze the TEC data deriving the instantaneous wave amplitude and period. It is found that on the equator side of the eclipse path, a wave with the amplitude of 0.2 TECu and wavelength 60 km travels mainly equator ward with phase speed up to 100s m/s. However, there is no obvious bow wave signature appearing in the poleward side of the path.

IT-EQIT-11 **Topside Magnetic Field Aligned Ion Flows Near Equatorial Latitudes at Solar Minimum** by Angeline Gail Burrell

Status of First Author: Student IN poster competition PhD

Authors: Angeline G. Burrell, Roderick A. Heelis

Abstract: The movement of ions along terrestrial magnetic field lines frequently causes the redistribution of ionization between northern and southern hemispheres. This behavior is known as interhemispheric transport and is an important source of coupling between the ion and neutral gases in the upper atmosphere. The Communications/Navigation Outage Forecast System (C/NOFS) satellite and the Coupled Ion Neutral Dynamics Investigation (CINDI) provide an opportunity to directly measure ion velocities and ion densities in the topside ionosphere, facilitating the study of the field-aligned components near the equator. Using data from 2008 and 2009, seasonal differences in the field-aligned ion velocities will show interhemispheric transport taking place at all seasons during this extreme solar minimum. Local time variations in interhemispheric transport at equinox and solstice will be presented and their latitude dependence explored.

IT-EQIT-12 **Measurements of thermospheric winds and temperatures at Jicamarca, Peru** - by Luis Alejandro Navarro Dominguez

Status of First Author: Student NOT in poster competition Undergraduate

Authors: L. Navarro D., O. Veliz, J. Chau (Jicamarca Radio Observatory) and J. W. Meriwether (Clemson University)

Abstract: Over the past year, a new Fabry-Perot interferometer was installed on a hill overlooking the Jicamarca Radio Observatory (11.95 S, 76.87 W) to make nightglow measurements of thermospheric winds and temperatures from the Doppler center and the Doppler broadening of the OI 630-nm spectral profile, respectively. Its location is unique because

simultaneous comparisons of ion drifts and neutral winds can be obtained for a single geographic location. These results can be applied to determine the speed ratio of the neutral wind to the ion drift. These results relate to the question of the superrotation of the thermosphere over 24 hours local time. These results also are connected to the question of how completely engaged the F-region dynamo is. The results obtained thus far are presented.

Irregularities of the Ionosphere or Atmosphere

IT-IRRI-01 A three-dimensional simulation of equatorial F region plasma irregularities
by Henrique Carlotto Aveiro

Status of First Author: Student IN poster competition PhD

Authors: Aveiro, H.C., Hysell, D.L.

Abstract: A fully three-dimensional numerical simulation of F region plasma dynamics in the postsunset equatorial F region ionosphere is described. First, the electrostatic ionospheric potential is self-consistently solved using the BiConjugate Gradient Stabilized (BiCGSTAB) method by enforcing the constraints of quasineutrality and momentum conservation. Second, the simulation advances the plasma number density based on a discretized version of the continuity equation using a flux assignment scheme based on the total variation diminishing (TVD) condition. To initialize the model runs, we derive plasma number densities from the Air Force Research Laboratory PIM model, ionospheric composition estimates from the IRI2003 model, and the characteristics of the neutral atmosphere from the MSISE90 model. To seed the simulation run, we add independent Gaussian white noise to the initial number density. Atomic (O+) and molecular (NO+ and O2+) ions are included, but light ions are not. The initial results reproduce several important characteristics of equatorial F region plasma irregularities and no convergence problems is experienced with this algorithm even when irregularities become fully developed.

IT-IRRI-02 Night-time F-region Plasma Irregularities Observed with the C/NOFS satellite and an All-sky Imager at Arecibo Observatory - by Jeff Klenzing

Status of First Author: Non-student

Authors: JH Klenzing (1), I Seker (2), RF Pfaff (1), DE Rowland (1), SF Fung (2), PA Roddy (3)
1: Space Weather Lab / Code 674, NASA Goddard Space Flight Center, Greenbelt, Maryland
2: Geospace Physics Lab / Code 673, NASA Goddard Space Flight Center, Greenbelt, Maryland
3: Space Vehicles Directorate, Air Force Research Laboratory, Hanscom AFB, Massachusetts

Abstract: The Communication/Navigation Outage Forecast System (C/NOFS) satellite was launched in April 2008 into a low-inclination (13.1 degree) orbit. The satellite is equipped with several instruments for simultaneous in-situ measurements of ionospheric disturbances, including the Vector Electric Field Instrument (VEFI), the Ion Velocity Meter (IVM), and the Planar Langmuir Probe (PLP). The Penn State All-sky Imager (PSASI) at Arecibo Observatory (AO, 18.3° N, 66.75° W, 29° N geomagnetic) has been recording night-time airglow since its installation in 2003. The imager provides the 2D horizontal context to the vertical ionospheric profiles obtained by the Arecibo Incoherent Scatter Radar (ISR). Although AO is geomagnetically at mid-latitudes, the coverage of the 630 nm all-sky images, which represent approximately 300 km altitude, can extend to 10° N geographic, well within the coverage of the C/NOFS satellite. Furthermore, the bottom-side F-layer footprint of the geomagnetic field lines at the altitude of the C/NOFS satellite can easily reach the latitude of AO, allowing multi-instrument studies of field-aligned irregularities with radar, imager, and satellite. We will discuss several observations of F-region irregularities since the recent upgrade of PSASI in late 2009.

IT-IRRI-03 Numerical study of nighttime MSTIDs and possible link to post-midnight irregularities observed by C/NOFS and VHF radars - by Tatsuhiro Yokoyama

Status of First Author: Non-student

Authors: Tatsuhiro Yokoyama(1), Robert Pfaff(1), David Hysell(2), and Mamoru Yamamoto(3)
(1) NASA Goddard Space Flight Center, (2) Cornell University, (3) Kyoto University, Japan

Abstract: Nighttime medium-scale traveling ionospheric disturbances (MSTIDs) often have an intriguing plasma density structure elongated from northwest to southeast (from northeast to southwest) and propagate southwestward (northwestward) in the northern (southern) hemisphere. As a generation mechanism of MSTID, the importance of the coupling between the Perkins instability in the F region and sporadic-E (Es)-layer instability in the E region has been presented with a three-dimensional numerical simulation [Yokoyama et al., 2009]. As an advanced study of Yokoyama et al. [2009], a new simulation model has been developed in which a non-orthogonal and non-uniform coordinate system is used [Yokoyama and Hysell 2010]. One coordinate axis is aligned with dipole magnetic field lines so that we can simulate the generation of MSTID in any latitude regions. Using the new model, MSTID structure is reproduced from random perturbation on an Es layer by the coupled instability mechanism in a wide latitudinal range. Post-midnight irregularities observed by the C/NOFS satellite and VHF radars in Indonesia during the low solar activity period could be attributed to the MSTID-type instability mechanism because their characteristics such as westward propagation and anti-correlation with solar activity are consistent with those of MSTIDs and midlatitude irregularities.

IT-IRRI-04 **Correlative Study of Ionospheric Low Latitude Velocity and Density Irregularities During Solar Minimum** - by Robert Anthony Haaser

Status of First Author: Student IN poster competition

Authors: R. A. Haaser, G. D. Earle, R. A. Heelis, W. R. Coley, J. H. Klenzing, R. Stoneback, A. Burrell

Abstract: After nearly two years of operation the C/NOFS satellite measured ionospheric plasma density irregularities at low latitudes on scales larger than 10 km over a full set of seasons. The focus of this study is on Ion Velocity Meter (IVM) data from Jan-Dec 2009 for afternoon to early morning times, when the data are most reliable. Correlations between the density and velocity fluctuations at scales from ten to a few hundred kilometers are analyzed and compared to expectations established from previous irregularity studies in more active solar conditions. The correlations discovered and their relationship to the unusually quiescent background conditions in this epoch challenge our understanding and add significantly to our knowledge of ionospheric irregularity distributions at low latitudes.

IT-IRRI-05 **On the spectrum of equatorial spread F irregularities at transitional and intermediate scale-size ranges measured by C/NOFS** - by Fabiano Rodrigues

Status of First Author: Non-student

Authors: F. S. Rodrigues, ASTRA, San Antonio, TX; G. S. Bust, ASTRA, San Antonio, TX; M. C. Kelley, Cornell University, Ithaca, NY; E. Dao, Cornell University, Ithaca, NY; P. A. Roddy, AFRL, Hanscom AFB, MA, USA; D. E. Hunton, AFRL, Hanscom AFB, MA, USA

Abstract: The Communication/Navigation Outage Forecasting System (C/NOFS) satellite was launched in April 2008 and, since then, has been making measurements of various ionospheric parameters in the low-latitude ionosphere. Initial results of high rate (512 Hz) observations of ion density fluctuations made by the Planar Langmuir Probe (PLP) during a large equatorial spread F (ESF) event were presented by Rodrigues et al. (2009). The high rate observations allow the study of ESF irregularities with intermediate (0.1 – 10 km) and transitional (10 – 100 m) horizontal scale sizes. Here, we will be presenting a somewhat more extensive analysis of the spectra of density irregularities measured by C/NOFS during various ESF events. Focus again is given to irregularities with scale sizes in the intermediate and transitional domains. Measurements made during two multi-day campaigns of observations in October 2008 and January 2009 were used in this study. The altitudinal and temporal variability of ESF spectra are investigated. The spectra measured by C/NOFS are compared with similar observations made by other satellite missions. Differences and similarities are pointed out. The implications for scintillation estimation are discussed.

IT-IRRI-06 **Nonlinear Evolution of Ion-Cyclotron Turbulence Generated by Artificial Plasma Cloud Release** - by Wayne Scales, presented by Alireza Samimi

Status of First Author: Non-student

Authors: 1- W.A. Scales, ECE department, Virginia Tech, email: wscales@vt.edu; 2- A. Samimi, ECE department, Virginia Tech, email: arsamimi@vt.edu; 3- and O. Chang

Abstract: It has recently been proposed that the release of an artificial plasma cloud in the near earth space environment may induce plasma turbulence with unique properties. Of particular interest is the possibility of such turbulence providing control of space weather processes which adversely effect reliability of space assets. To this end, nonlinear evolution of plasma turbulence generated by a plasma cloud released into a magnetized background plasma is studied using electromagnetic hybrid (fluid electrons and particle ions) plasma simulations incorporating electron inertia. The turbulence considered is generated from free energy in an assumed ring velocity distribution in the released plasma cloud heavy ions. The turbulence initially lies near harmonics of the ring plasma ion cyclotron frequency and propagates nearly perpendicular to the background magnetic field as predicted by linear theory. If the amplitude of the turbulence is sufficiently large, the relatively short wavelength ion cyclotron waves evolve nonlinearly into much longer wavelength obliquely propagating shear Alfven waves. The results indicate that ring densities above a few percent of the background plasma density may produce wave amplitudes large enough for such an evolution to occur. The extraction of energy from the ring plasma may be in the range of 10-20\% with a slight decrease in the magnitude as the ring density is increased from a few percent to several 10's of percent of the background plasma density. Suitability of the nonlinearly generated shear Alfven waves for applications to scattering radiation belt particles is discussed.

IT-IRRI-07 Measurement and Analysis of the Effect of Artificially Generated Ionosphere Scintillations on GNSS L-band signals - by Pelgrum Wouter, presented by Jade Morton

Status of First Author: Non-student PhD

Authors: Wouter Pelgrum, Jade Morton, Frank van Graas,Sanjeev Gunawardena, Dan Chemey, Chen Chen, Lei Zhang

Abstract: Ionosphere scintillations can cause significant amplitude and/or phase fluctuations of GNSS signals, which degrades GNSS signal tracking in terms of accuracy and reliability. Improvements in receiver tracking algorithms can potentially mitigate these degradations. However, a thorough understanding of the scintillations and their impact on GNSS signal propagation are prerequisite to a successful design of the required algorithms.

This poster presents a high-end GNSS measurement setup, deployed at the High-Frequency Active Auroral Research Program (HAARP) in Alaska. This facility can locally heat-up specific layers of the ionosphere with 3.6 MW of HF radiation controlled by a 180-element phased array antenna.

The measurement setup consists of multiple commercial dual-frequency GPS receivers, as well as multi-channel narrow-band (2.2 MHz) and wide-band (20 MHz) GNSS RF data collection. The RF measurement data allows for extensive post-processing, enabling 1 kHz independent measurement update rates using open loop tracking. This, in combination with a multiple GNSS antenna array, will help our understanding of the temporal, spectral, and spatial behavior of GNSS signal fluctuations caused by ionosphere scintillations, and support the development of robust GNSS receivers that are capable of tracking GNSS signals under scintillation conditions.

Two coordinated campaigns were conducted in August and October of 2009. Measurements from both campaigns show a consistent relationship between the HAARP heating of the ionospheric regions and a change in measured Total Electron Count (TEC). Based on our preliminary analysis, measurements from the August campaign do not indicate any detectable scintillation. During the October campaign, significant GNSS signal amplitude fluctuations characteristic of ionosphere scintillation have been observed during at least two periods. The scintillations are well coordinated with the heating intervals. A detailed look at the scintillation data will be presented, using post-processed RF data as well as commercial GPS receiver measurements.

Finally, the paper analyzes the relationship between the effectiveness of the HAARP ionosphere heating to create artificial scintillations and the background ionospheric conditions at that time using measurements provided by an array of diagnostic instruments at HAARP and its vicinity. This knowledge will facilitate a more effective generation of artificial scintillations for future experiments.

IT-IRRI-08 Analysis of QP Echoes under the theory of Neutral winds - by Eliana Nossa

Status of First Author: Student IN poster competition

Authors: -Eliana Nossa (en45@cornell.edu) (Earth and Atmospheric Sciences and Electrical and Computer Engineering, Cornell University, Ithaca, NY, USA), David Hysell (dlh37@cornell.edu)(Earth and Atmospheric Sciences, Cornell University, Ithaca, NY, USA)

Abstract: During the summer nights at midlatitudes, intense irregularities called quasi periodic (QP) echoes are observed at E layer heights. Larsen (2002) suggested that the irregularities are generated by the presence of strong neutral winds, producing Kevin Helmholtz (KH) or dynamic instability. The presence of Richardson number less than 0.25 (condition to generate KH irregularities) was detected by Hysell et al. (2009). Analysis of the general eigenvalue problem of dynamical stability in stratified neutral shear flow is presented. This problem combines the continuity and momentum equations, assuming incompressibility on neutral fluids. For specific wind profiles obtained by Hysell et al. (2009), using the Arecibo 430 MHz Incoherent Scatter Radar (ISR), for the evening of September 27 of 2008, a numerical method to solve the eigenfunction is used. This methodology generates a dispersion relation that allow to search for the natural conditions of the background neutral wave, the direction of propagation, the wavelength and the growth rate when the instabilities are present. A comparison of the theoretical results with the observations of the 30 MHz coherent scatter radar located on St. Croix is presented.

IT-IRRI-09 Multi-instrument studies of F-region equatorial and mid latitude processes
by Carlos Martinis

Status of First Author: Non-student PhD

Authors: C.Martinis, P. Zablowski, C. Miller, J.Baumgardner, W. Oliver, M. Mendillo

Abstract: All-sky imagers at Arecibo (18.3 N, 66.7 W, 28 N mag), El Leoncito (31.8 S, 69.3 W, 18 S mag lat) and Mercedes (34.6° S, 59.4° W, 25° S mag lat) are used to study equatorial Spread-F (ESF), midnight temperature maximum (MTM), and medium scale traveling ionospheric disturbances (MSTIDs) during low solar activity conditions. We complement the optical data with in-situ data from C/NOFS satellite, incoherent scatter radar data from Arecibo, and GPS data from ground-based receivers in the American region. Salient results observed are the simultaneous and conjugate occurrence in both hemispheres of MSTIDs, distinct seasonal patterns for the three processes and the occurrence of ESF-related airglow depletions with very high apex heights.

IT-IRRI-10 Decameter structure in heater-induced airglow at the HAARP facility
by Elizabeth Kendall

Status of First Author: Non-student

Authors: Elizabeth Kendall(1), Robert Marshall(2), Richard Todd Parris(3), Asti Bhatt(4), Anthea Coster(4), Todd Pedersen(5), Paul Bernhardt(6), and Craig Selcher(6)
(1) SRI International, Menlo Park CA, USA
(2) Stanford University, Stanford CA, USA
(3) University of Alaska, Fairbanks AK, USA
(4) MIT Haystack Observatory, Westford MA, USA
(5) Air Force Research Laboratory, Hanscom AFB, MA, USA
(6) Naval Research Laboratory, Washington DC, USA

Abstract: On October 28, 2008, small-scale rayed artificial airglow was observed at the High Frequency Active Auroral Research Program (HAARP) heating facility by the HAARP telescopic imager. This airglow occurred during an experiment at twilight from 2:55-4:00 UT (18:55-20:00 LT) and with estimated scale sizes of 100 m (at assumed 225 km altitude), constitutes the smallest structure observed in artificial airglow to date. The rays appeared to be oriented along the geomagnetic field lines. During this period other instruments – SuperDARN, GPS receivers, SEE receivers - also recorded unusual data sets with the general characteristic of time scales longer than anticipated for features to form. The experiment took place at the commencement of a small geomagnetic disturbance (Kp of 4.3). This unique observation is as yet

unexplained. The airglow features start as large scale structures and then become smaller as heating continues in apparent contradiction to current theories on irregularity development. A thermal gradient instability (TGI) at boundary of the ionospheric footprint of the plasmapause may be responsible for causing the small-scale structuring. Observations of 427.8 nm N2+ (1NG) emissions indicate the presence of ionization.

Instruments or Techniques for Ionospheric or Thermospheric Observation

IT-ITIT-01 CESAR: Compact Echelle Spectrograph for Aeronomy Research - by Martin Grill, presented by Elizabeth Kendall

Status of First Author: Non-student

Authors: Martin Grill, Elizabeth Kendall, Jean Lacoursiere, Riccardo Melchiorri, Matt Radovan, Tom Slanger

Abstract: CESAR is a state-of-the-art instrument being constructed at SRI International under an NSF Major Research Instrumentation (MRI) program grant. Conceptually, CESAR is an outgrowth of nightglow studies carried out over the last 10 years utilizing the sky spectra of the 8 10 m class optical telescopes – Keck I and Keck II on Mauna Kea, and the VLT (Very Large Telescope) in Chile. Our goal is to significantly expand the range of upper atmospheric science investigations (nightglow, aurora, and dayglow emissions) by providing aeronomers with a high-throughput, high-dispersion, large-passband spectrograph of a caliber heretofore only available to astronomers at a handful of large observatories. We have scaled an astronomical grade echelle spectrograph into a portable version which can be sited at multiple geophysically significant stations. CESAR will cover the wavelength range from 300 to 1000nm with a spectral resolution of 20,000 and observe the sky in any direction with a FOV ranging from 7º to 20º and with a spatial resolution ranging from 0.06º to 0.5º. We report on the current state of CESAR. Design of the core CESAR system is complete. All major optical components have been purchased, and mechanical integration is ongoing. Upon completion and testing of the instrument, it will initially be sited at the Poker Flat Research Range (PFRR) in Alaska. We estimate that by the end of the year (2010) the instrument will be fully functional and ready for its first observational survey. Preliminary tests will be conducted locally before the instrument will be shipped to PFRR for remote operations.

IT-ITIT-02 A Numerical and Empirical Study of Geometry Dependent Grid Effects in Planar Retarding Potential Analyzers - by Ryan Davidson

Status of First Author: Student IN poster competition PhD

Authors: R. L. Davidson, G. D. Earle, J. H. Klenzing, R. A. Heelis

Abstract: Retarding potential analyzers have long been the de-facto standard for in-situ measurement of ionospheric plasma parameters. These instruments depend on fine woven mesh grids (or more recently flat electroformed grids) that introduce non-uniformities in the potential map within the instrument. These perturbations are related to the specific geometry of the grid and lead to errors in the inferred plasma parameters. A numerical simulation of these effects has been conducted. Empirical tests have also been preformed to corroborate the numerical results.

IT-ITIT-03 The Effects of BGK, Brownian, and Hard-Sphere Ion-Neutral Collisions on E-region Spectra - by Jonathan Fentzke

Status of First Author: Non-student

Authors: J.T. Fentzke(1,2), M.P. Sulzer(2), and S.A. González(2)
(1) NWRA Inc., CoRA Division, Boulder, CO.
(2) Arecibo Observatory, SAS Dept., Arecibo, PR.

Abstract: In this work, we revisit the collisional ISR theory presented in Hagfors and Brockelman, 1971 (A Theory of Collision Dominated Electron Density Fluctuations in a Plasma with Applications to Incoherent Scattering) for the purpose of comparing derived ISR spectra using different ion-neutral collision approximations. Specifically, we address the variation of the ISR spectra in the lower E-region of the ionosphere between approximately 85 -150 km under the assumption of Brownian, BGK, and Hard-Sphere ion-neutral collisions in the absence of an external magnetic field.

The goal of this work is to examine the variability of the ISR spectra that results from using these ion neutral collision approximations and determine at what altitudes the greatest potential disparity in derived ISR parameters would likely occur based on the choice of collision operator. To this end, we explore the transition region of the ionosphere where the plasma goes from highly collisional below 90 km to near collisionless in the upper E-region and show that the resulting differences in the ISR spectra are maximal near 100 km.

We do not yet have a definitive answer on the effect of ion-neutral collision approximation on the radar derived parameters at Arecibo or other sites. However, it appears that further study is warranted for observations near 100 km where spectral variation based on the choice of collision operator is distinct in the presence of noise.

IT-ITIT-04 Dynamically Adaptive Autonomous Antarctic Low-Power Geophysical Instrument Array by Kshitija Deshpande

Status of First Author: Student IN poster competition PhD

Authors: Kshitija Deshpande, Robert Clauer, Joseph Macon, Randall Nealy, Aaron Ridley, Stephen Musko, Marc Lessard, Gary Bust, Todd Humphreys, Brent Ledvina, Geoff Crowley, Joseph Baker, Tamal Bose, Majeid Manteghi

Abstract: Accurate predictions of space weather require a good understanding of the complicated solar wind - magnetosphere - ionosphere electrodynamic system. Development of global models for this system is restricted by the lack of sufficient data from unexplored Earth regions such as the deep ocean and southern polar cap. In this NSF funded project, we propose to develop an autonomous network of dynamically adaptive, low power geophysical measurement stations along the 40 degree meridian in the Antarctic. The chain of seven stations to be designed, manufactured, and deployed on the East Antarctic plateau over a four-year period will all be equipped with magnetometers and will include several new features: (1) innovative custom designed dual frequency GPS receivers for ionospheric measurements, (2) inter-station communication, (3) dynamically adaptive data collection strategies, (4) a flexible interface to connect other low-power geophysical instruments, and (5) alternative satellite data retrieval and system control options. This chain will provide us with ionospheric GPS data of high temporal and spatial resolution, which will be utilized for characterization, modeling, and imaging of ionospheric dynamics in the southern hemisphere. We will also obtain magnetometer measurements conjugate to the measurements from the existing magnetic observatories operated by the Danish National Space Institute at the Danish Technical University, along the west coast of Greenland, to enable the investigation of coupled interhemispheric electrodynamic system.

In this poster, we describe the design and instrumentation of the proposed system along with our science goals. We present an example of GPS data represented in terms of the total electron content, scintillation index, and signal-to-noise ratio variation with respect to time. Data expected from our network will be modeled along the lines of data represented in this example.

IT-ITIT-05 The NorthEast CIDR Array: A chain of ionospheric tomography receivers for studying the equatorward edge of the auroral oval and the mid-latitude trough - by Hugh Gallagher

Status of First Author: Non-student

Authors: Hugh Gallagher, Peter Anderson, Luke D'Imperio, Timoth Kelly, James Benway (SUNY Oneonta), Trevor Garner (Applied Research Laboratory, University of Texas, Austin), Allan Weatherwax, James Akey, (Siena College)

Abstract: An array of five Coherent Ionospheric Doppler Receivers (CIDRs) has been established in the North Eastern United States. Four of the receivers are distributed over approximately 400 km of longitude at about 54° geomagnetic latitude. A fifth receiver has been deployed south of the primary chain at Wallops Island. This summer a sixth receiver will be positioned north of the primary array in the Adirondack Mountains. The North East CIDR Array makes observations of total electron content (TEC) and the rate of TEC (ROT) fluctuations obtained from VHF and UHF beacons on low-earth orbiting satellites. In this poster, we will present examples of TEC, ROT and the ROT power spectra observed by the array. These observations will be compared large scale features in the TEC determined by the GPS network.

IT-ITIT-06 A Study of Deployment Scenarios for Observing Thermospheric Wave Structures Using Multiple Fabry-Perot Interferometers - by Yiyi Huang

Status of First Author: Student IN poster competition PhD

Authors: Yiyi Huang, Jonathan J. Makela

Abstract: Gravity waves are of great importance in the atmosphere as they transport momentum from one region to another and have been suggested as a plausible seeding mechanism for ionospheric irregulaties. Gravity waves generally originate from the troposphere, and then expand into higher altitudes with exponentially increasing amplitudes. Many studies have been focused on gravity waves in the lower atmosphere, but recent work has begun to shed light on their propagation into the thermosphere. To study properties of gravity waves in the thermosphere, we employ multiple Fabry-Perot Interferometers (FPIs) observing the 630.0-nm redline emission, which generally has a maximum intensity at around 250 km. In this poster, we develop and use a forward model of an FPI based upon several climatological models of the upper atmosphere. Using this model, we study several deployment and analysis scenarios to examine how to best extract gravity wave parameters from FPI observations. We firstly discuss a two-FPI deployment scenario in which the two FPIs observe the same volume of the thermosphere. Next, we explore the idea of the tomographic inversion of observations from multiple FPIs. These inversions reconstruct the airglow emission intensity profiles in the 2D plane above the baseline. We find that the reconstruction results are highly dependent on the geometry and number of the FPIs used, in addition to the orientation of the gravity wave.

IT-ITIT-07 Thermospheric wind observations obtained from 630-nm OI airglow made with SOFDI from Huancayo, Peru - by Andrew Gerrard

Status of First Author: Non-student

Authors: A. J. Gerrard, Center for Solar-Terrestrial Research, New Jersey Institute of Technology, 323 Martin Luther King Jr. Boulevard, 101 Tiernan Hall, Newark, NJ 07102-1982, USA. (andrew.j.gerrard@njit.edu)
J. W. Meriwether, Department of Physics and Astronomy, Clemson University, Kinard Laboratory, Clemson, SC 29634-1911 (meriwej@ces.clemson.edu)

Abstract: The Second generation Optimized Fabry-Perot Doppler Imager (SOFDI), a state-of-the-art triple-etalon Fabry-Perot interferometer, is currently in operation under the magnetic equator in Huancayo, Peru. The system is currently taking both nighttime and daytime measurements of the OI 630-nm airglow emission, used to infer nighttime thermospheric winds and temperatures and daytime thermospheric winds, in a campaign-based data collection scheme. In this paper we report on recent results from such observations and present the current status of the SOFDI instrument in Peru.

IT-ITIT-08 Space-Space Tomography - by Chi-Yen Lin

Status of First Author: Student IN poster competition PhD

Authors: C. Y. Lin, National Central University,Taiwan, 986403005@cc.ncu.edu.tw; J. Y. Liu, National Central University,Taiwan, jyliu@jupiter.ss.ncu.edu.tw;

Abstract: This study develops a space-space tomography by means of data recorded by tiny ionospheric photometer (TIP) and GPS occultation experiment (GOX) onboard FORMOSAT-3/COSMIC. TIP and GOX record the OI 135.6 nm airglow intensities and the occultation total electron content (TEC) for the nighttime ionosphere, respectively. Due to its very high sensitivity ~600 counts/Rayleigh and rather narrow nadir pointing 3.8° circular field-of-view, the TIP provides accurate characteristics of ionospheric electron density gradients in the horizontal direction. Meanwhile, the GOX data gives the information in the vertical direction.

2-D space-space tomography simulated result shows using two kinds of data could obtain ionospheric electron density distribution including horizontal and vertical information. For 3-D space-space tomography, simulation used large amount occultation cases and nadir sounding, the result shows that it's a probably way to reconstruct the ionosphere all over the world in the future.

IT-ITIT-09 Radio phase modes as a potential new tool for atmospheric research - by Brett Isham

Status of First Author: Non-student

Authors: Brett Isham 1, Siavoush M. Mohammadi 2, Jorge Chau 3, David L. Hysell 4, Lars K. S. Daldorff 5, Thomas Leyser 6, Bo Thide 6, Jan Bergman 6, Paul Gallop 7.
1 Department of Electrical and Computer Engineering, Interamerican University, Bayamon, Puerto Rico, USA
2 Uppsala Student Union, Uppsala University, Sweden,
3 Jicamarca Radio Observatory, Peruvian Institute of Geophysics, Lima, Peru,
4 Earth and Atmospheric Sciences, Cornell University, Ithaca, NY, USA,
5 Finnish Meteorological Institute, Helsinki, Finland,
6 Swedish Institute of Space Physics, Uppsala, Sweden,
7 Soffari Ltd., Reading, UK.

Abstract: Radio phase modes are a low-frequency electromagnetic manifestation of photon orbital angular momentum (OAM) modes. At optical (laser) wavelengths OAM is an active area of theoretical and experimental research. Theory and modeling of radio phase modes show they may also easily be generated and, under certain conditions, detected with modern radio antenna arrays. Transmission of radio phase modes has been attempted using the HAARP HF transmitter in Alaska and the Jicamarca VHF radar in Peru. The HAARP experiment is designed to search for possible artificial plasma modification effects of high-power radio phase modes transmitted into the auroral ionosphere, while the Jicamarca experiment is exploring the possibility of using radio phase modes for radar remote sensing of the equatorial electrojet, both of which are turbulent space plasma environments. Future work will be aimed at verifying phase mode transmission and detection capabilities. Other potential applications of phase modes include the detection of radio OAM generated by astrophysical sources, and the use of radio OAM "polarization" channels in communications as a way of transmitting multiple signals at a single frequency.

IT-ITIT-10 Polar E region neutral and ion motion in the current density reference frame
by Xianjing Liu

Status of First Author: Student IN poster competition PhD

Authors: Xianjing Liu, University of Colorado at Boulder, xjliu.pku@gmail.com

Abstract: A new technique is develop to derive neutral wind estimates in the E-region from incoherent scatter radar measurements. Ion motion in the E-region is controlled by electric fields, neutral collisions and neutral winds. It is demonstrated that the neutral wind solution from the ion momentum equation is constrained to lie along line of possible neutral wind values. A relative minimum neutral wind can be directly calculated from the observations with no dependency on collision frequency. Further analysis shows that the minimum wind lies in the direction of the local current and the the uncertainty of collision frequency only affects the neutral wind in the JxB direction. This indicates that adapting a current density coordinate frame can improve the accuracy in neutral wind analysis. A real practice of this technique is dealing with the Sondrestrom incoherent scatter radar measurements of the polar E region. Real radar data analyses shows that ion velocity magnitude in the E region can exceed that in the F region at times due to the neutral wind effect. The accompanied ion temperature response to the enhanced ion speed in E region is also discussed in the poster.

IT-ITIT-11 Ionosphere-Thermosphere Models at Community Coordinated Modeling Center
by Ja Soon Shim

Status of First Author: Non-student PhD

Authors: J. Shim, M. M. Kuznetsova, M. Hesse, A. Chulaki, L. Rastaetter, Community-Coordinated Modeling Center, NASA GSFC

Abstract: The Community Coordinated Modeling Center (CCMC) is a multi-agency partnership that hosts a set of state-of-the-art space science models ranging from the solar atmosphere to the Earth's upper atmosphere. The CCMC provides access the models to the scientific community through a web-based and Runs on Request system by which searchers can readily request simulations to conduct scientific studies for time interval of interest and a broad range of conditions. The

CCMC also provides a variety of modern, visualization and analysis tools to enable users to work with the output of requested model runs. Model output can be specifically tailored for easy comparison with observational data to facilitate data analysis and model validation. This presentation will provide an overview of CCMC activities with an emphasis on the ionosphere-thermosphere models at CCMC which include CTIPe, USU-GAIM, TIE-GCM, AbbyNormal, SAMI2, Weimer, IRI, and MSISE.

IT-ITIT-12 **Fabry-Perot Doppler Spectroscopy Evaluation and Optimization Based on Analytical Measurement Error Bounds** - by Serge Minin

Status of First Author: Student IN poster competition

Authors: Serge Minin, Farzad Kamalabadi, Robert Kerr, Scientific Solutions, Inc.

Abstract: Newly derived analytical formulas are used to closely approximate the bounds on errors in the airglow emission line parameters. General implications on instrument design and specific examples are presented.

IT-ITIT-13 **A topside ionospheric electron density model based on topside sounder data using Artificial Neural Networks (ANNs)** - by Patrick Sibanda

Status of First Author: Non-student

Authors: P. Sibanda (University of Michigan, USA), L.A. McKinnell (Hermanus Magnetic Observatory, Hermanus, South Africa)

Abstract: Due to the complexity of ionospheric structure, successful modeling involves complex procedures requiring proper representation of all the factors that influence its behavior. Observing the topside ionosphere is difficult. Due to the lack of measurements, many external and irregular factors that influence the behavior of the topside ionosphere are not fully known. The vertical structure of the topside ionospheric Ne depends on many variables and the relationships between these multiple variables and the Ne distribution are highly non-linear or chaotic in nature, making it difficult to capture them mathematically. Determining these relationships is a type of function approximation problem that Artificial Neural Networks (ANNs) could be used to solve, typically using the method of multi-layer perception. This paper investigates the possibility of using ANN techniques for empirical modeling of the topside ionosphere based on the available, however irregularly sampled, topside sounder measurements from the Alouette 1 & 2 and ISIS 1 & 2 satellite missions. While this technique is promising, the method did not show significant improvement over the International Reference Ionosphere (IRI) model results when compared with the actual measurements.

IT-ITIT-14 **Observations with the Kodiak Island Imaging HF radar** - by Richard Todd Parris

Status of First Author: Student IN poster competition

Authors: R. Todd Parris, Geophysical Institute, University of Alaska Fairbanks, W. A. Bristow, Geophysical Institute, University of Alaska Fairbanks

Abstract: A new radar imaging system was implemented on the Kodiak Island SuperDARN HF radar in 2008. The details of this system along with initial observations were presented to the CEDAR community in 2009. This poster will focus on new observations afforded by this imaging system.

IT-ITIT-15 **Highlights of Initial Operation of a new High Latitude SuperDARN Radar at McMurdo Station, Antarctica** - by Jef Spaleta, presented by R. T. Parris

Status of First Author: Non-student

Authors: Jef Spaleta (UAF-Geophysical Institute), William Bristow (UAF-Geophysical Institute), Richard T. Parris (UAF-Geophysical Institute)

Abstract: A new SuperDARN Radar installation was completed in February of 2010 at McMurdo Station, Antarctica. The radar is located at 77.8506 deg. S 166.665 E and is oriented such that the geomagnetic south pole is inside its field of view. This poster provides highlights of the first 3 months of the McMurdo radar operation including a data comparison to existing SuperDARN radars with a view of the geomagnetic north pole.

IT-ITIT-16 **A Fuzzy Logic Approach to the Extraction of Plasma Line Frequency for Incoherent Scatter Radar** - by Julio Santana

Status of First Author: Student IN poster competition

Authors: Julio Santana, James Morton, Qihou Zhou, Mike Sulzer, Nestor Aponte, Sixto Gonzalez
zhouq@muohio.edu

Abstract: By measuring the plasma line frequency (PLF), the Arecibo incoherent scatter radar can accurately determine the electron concentration. When the signal-to-noise ratio is large, as at the peak of the F-region, extraction of the PLF is relatively easy. However, in the region where signal to nose ratio is not much larger than 1, extraction of PLF becomes difficult by using simple search of maximum signal. In this poster, we present a method combining several factors, including temporal and altitudinal projection, to obtain more accurate estimate of PLF.

IT-ITIT-17 **MAISR (Movable Antarctic Incoherent Scatter Radar): A Remotely Operated Antarctic Space Science Facility** - by Anja Stroemme

Status of First Author: Non-student

Authors: John Kelly, Anthony van Eyken, Ennio Sanchez, Craig Heinselman

Abstract: By moving toward a more global approach to upper atmosphere and space research, it is becoming obvious that a better distributed network of sophisticated observational platforms is needed in order to gain transformational new knowledge of the short and long term variability of Earth's upper atmosphere, and its connection to the solar wind and space, on a global level.

SRI has recently proposed to establish multiple space science observing facilities in the Antarctic, first at McMurdo, Antarctica, and later at an auroral or sub-auroral location. The facilities will be built around the well-proven, next-generation, Advanced Modular Incoherent Scatter Radar (AMISR) concept, and will each provide unprecedented temporal and spatial coverage of the Antarctic atmosphere. These will be the first ever ISRs in the high south, and a very important addition to the global network of observational platforms needed to address the global state and development of Earth's upper atmosphere and its connection to interplanetary space.

IT-ITIT-18 **Simulated HF heating in the ionosphere** - by Richard John Stevens

Status of First Author: Student IN poster competition

Authors: A. Otto, T. Bhattacharya

Abstract: The coupling between the ionosphere and magnetosphere provides a challenge for numerical simulations. A modified three fluid (electrons, ions, and neutrals) model has been developed to address this interaction. The ionosphere is characterized by a highly collisional plasma and the magnetosphere by a largely collisionless plasma. In order to solve the modified magnetohydrodynamic equations self consistently the collisions in the plasma must be resolved. In the lower ionosphere where the collision frequency becomes very high the time step to resolve these collisions must become very small. The neutral density in this highly collisional region is large enough to dampen some of the plasma dynamics (wave propagation for example). For this region an equilibrium solution is now used. The transition height between the two simulation regions can be modified to accommodate differing neutral densities and collision frequencies. The goal of this model is to study the aurora and high frequency radio wave heating experiments (HAARP, EISCAT). The results of simple heating events from this model are presented here.

IT-ITIT-19 A Constellation of CubeSats to Specify the Orbital Drag Environment - by Eric Sutton

Status of First Author: Non-student

Authors: Eric K. Sutton, Chin S. Lin, Odile H. Clavier, David Voss, Frank A. Marcos

Abstract: The value of CubeSats to the scientific community depends on the availability and quality of suitable miniaturized scientific instruments. We introduce one such instrument capable of measuring total atmospheric density within the envelope of a 3U CubeSat. The Atmospheric Drag Environment Sensor (ADES), to be flown on a constellation of CubeSats, is a miniaturized version of accelerometer technologies that have been used to study the upper atmosphere since the dawn of the space age. ADES is designed to measure at the 10 nano-g level, while occupying a space of less than 10x10x10cm. The remainder of the 3U CubeSat will be dedicated to the attitude determination and control, power production and storage, telemetry, data processing and storage subsystems. The mission goals are as follows: (1) Provide global coverage of atmospheric density measurements, (2) Investigate storm-time features of the Thermosphere over a large range of spatial and temporal scales, and (3) Provide the means for data assimilation into a first-principles model of the upper atmosphere. The benefit of this technology is not only its small size, but also the significant reduction in the cost of the accelerometer. This technological breakthrough will facilitate the addition of a space weather sensor as a secondary payload to many existing LEO satellite missions with minimal impact on the main payloads and overall budget.

IT-ITIT-20 Can we make reliable density measurements from a Langmuir Probe on a CubeSat? by Padmashri Suresh

Status of First Author: Student IN poster competition

Authors: Padmashri Suresh, Charles M. Swenson

Abstract: Langmuir Probes have been successfully flown on various sounding rocket and satellite missions for studying space plasmas. The accuracy of the probe measurements is contingent upon the engineering features of the spacecraft and the sensor. Small surface area ratio of the spacecraft to the Langmuir probe sensor, encountered on some of the sounding rocket missions, has been known to cause anomalous temperature and density measurements. CubeSats with their small surface; pose limitations on the effective area available for return currents. Such non-linear dynamics of current collection are bound to disturb the sensor measurement of the plasma properties. A PSPICE based simulation of current collection process for a 10x10x15 cm CubeSat form factor has been formulated to investigate the dynamics of plasma computations. We present the simulation findings of the suitability of making consistent density measurements from probes subjected to CubeSat regime design constraints.

An empirical dataset from the Langmuir probe onboard the 'STORMS' sounding rocket mission which was subjected to analogous surface area constraints is used to correlate and verify the simulation observations from the CubeSat current collection model.

IT-ITIT-21 Operating Network of Phase-Based Ionosondes (Dynasondes) - by Michael Rietveld

Status of First Author: Non-student

Authors: M. Rietveld (EISCAT Scientific Association), N. Zabotin (University of Colorado at Boulder), T. Bullett (NOAA/NGDC), R. Livingston (Scion Associates Inc.), S. Kolesnik (Tomsk State University)

Abstract: Dynasonde is an ideology of precision ionospheric radio sounding based on rigorously taking into account phase characteristics of a radio echo. Unique products of phase ionosondes intended for various Space Weather-related applications include: echo recognition and noise discrimination, echo classification into traces, scaling of standard ionospheric parameters, 3-D plasma density inversion (NeXtYZ) including true vertical profile with error bars, small-scale irregularity diagnostics, and vector velocities, all obtained directly and autonomously from ionogram data. At present there are three systems in the world which operate continuously and are fully based on the precision phase principles. These reside at EISCAT Tromsø observatory, at EISCAT Svalbard observatory, and at Tomsk State University (Russia). The latter system uses the newest HF Radar ("VIPIR") built by Scion Associates. Data and analysis results from all three stations are stored in a distributed relational SQL database network. These are accessible to a broad research community

either directly or, in abridged version, through the NOAA/NGDC-based SPIDR system. We report details of the network operation and describe its web portal Dynasonde Navigator (http://dynserv.eiscat.uit.no) hosted by EISCAT.

IT-ITIT-22 Effects of HF multiple scattering in the ionosphere: Experimental observations by Nikolay Zabotin

Status of First Author: Non-student

Authors: N. Zabotin (University of Colorado at Boulder), T. Bullett (University of Colorado at Boulder, NOAA/NGDC)

Abstract: The theory of multiple scattering of MF/HF radio waves by intermediate-scale (0.1-2 km) ionospheric irregularities predicts a very distinctive ground-level spatial distribution of the integral intensity of a signal reflected from the ionosphere with a significant reduction in the vicinity of a ground-based transmitter and an increase at greater distances. While there are experimental confirmations of the "anomalous attenuation" effect near the transmitter location, no attempt had been made to track the intensity features at the larger distances. An experiment of this kind, critical for confirmation of the theory, is described in this paper. It has been conducted with Boulder VIPIR installation and a mobile setup of the Radio Vector Field Sensor.

IT-ITIT-23 Ampules: A New Type of Sounding Rocket Payload for the Measurement of Three-Dimensional, Thermospheric Neutral Wind Gradients - by Carl Andersen

Status of First Author: Student IN poster competition PhD

Authors: Carl Andersen, Mark Conde, Miguel Larsen, Dirk Lummerzheim, Hans Stenbaek-Nielsen

Abstract: A new type of sounding rocket payload for measuring neutral wind gradients in the lower thermosphere was launched from Poker Flat, Alaska on February 9, 2010. The new payload design is collection of sub-payloads, or ampules, that are propelled out of the side of the rocket during flight. Each ampule contains an amount of tri-methyl aluminum (TMA) which is detonated after separating from the main rocket to produce a luminous "puff" which is tracked by triangulation using images taken from several ground stations. Twelve ampules were successfully deployed in the 2010 Ampules mission, showing the feasibility of this technique for neutral wind measurements at altitudes of 100-200km. Future missions would be capable of deploying a three-dimensional constellation of TMA puffs with a height and with of ~100km, which would allow for the measurement of all nine spatial gradients of the neutral wind vector in the lower thermosphere.

IT-ITIT-24 Passive VHF Radar Interferometry Feasibility Studies at Equatorial Ionospheric Latitudes - by Burak Tuysuz

Status of First Author: Student IN poster competition

Authors:

Abstract: Third-party radio transmitters routinely broadcasting our surrounding environment providing services such as music, speech, etc. can also be used for other purposes. Most of commercial FM radio stations have high RF power and around 100 MHz they emit radio signals that has very good Doppler and time resolution. These features of FM signals make them excellent illuminators of the ionosphere at a useful wavelength and subsequently enable the remote sensing of a variety of phenomena at this region of the Earth's atmosphere. Combining this resource with utilizing software radio algorithms and digital signal processing techniques, it is possible to implement a passive radar system with two radio receivers and therefore detect high quality Doppler and range maps of the ionosphere. Additional radio receivers can be included to perform interferometry to achieve higher resolutions. In this paper, we present the feasibility of this technique to study plasma instabilities from around 100 km of altitude (E-region of the ionosphere) to 300 km (F-region of the ionosphere) near Lima, Peru.

IT-ITIT-25 Deployment of JARS Jicamarca Acquisition Radar System: 08 reception channels
by Rita Jakelyn Abad

Status of First Author: Student NOT in poster competition Undergraduate

Authors: R. Abad, J.Chau, M. Inoñán, A. Aguilar, R. Yanque

Abstract: The need for high-precision radar measurements of the upper atmosphere has motivated the development of new acquisition systems at the Jicamarca Radio Observatory (JRO). Digital receivers have replaced the old analog receivers, providing higher dynamic range, faster sampling rates, and more flexibility in configuration. The first result of these efforts was the development of a two-channel data acquisition system (REX-2X). The system was finished in 2008 and it has been used to modernize the SOUSY radar at Jicamarca.

In 2009, after the experience gained from REX-2X, a new project was started. An eight-channel acquisition system named JARS (Jicamarca Acquisition Radar System) was designed and it is currently under development. We hope it will be ready for its use by December 2010. The system has the following characteristics:
- Eight complex reception channels (expandable up to 12 channels).
- Analog to digital converters (ADCs) of 14 bits.
- Dynamic range of 84 dB and sensitivity of -90dBm.
- Selects and Handles the power of the channels.
- Control of the system implemented in 03 CPLDs (Complex Programmable Logic Devices).
- Programmable filter and perfect match filter.
- Filter parameters can be reprogrammed online.
- PC communication via a PCI NIDAQ card.

All these characteristics make JARS a very flexible system that can be easily reconfigured for any radar application at the Jicamarca Radio Observatory.

IT-ITIT-26 Global vTEC maps and instrumental DCB estimation based on combined GPS and TOPEX/Jason measurements - by Isabel Bibbó

Status of First Author: Student NOT in poster competition

Authors: Brunini, Claudio; Azpilicueta, Francisco; Janches, Diego

Abstract: Free electrons existing in the terrestrial ionosphere severely affect the transmission of radio waves coming from satellites orbiting around the Earth. That effect, unwanted in most cases, is the main source of information for ionospheric research. Several models developed during the last decades use the data obtained from Global Navigation Satellite Systems (GNSS), to represent and study the global variability of the total electron content (TEC) in the terrestrial ionosphere. These models can represent in a reliable manner the temporal variations of TEC, thanks to the continuous record of data that GNSS offer. However, there are limitations in the spatial resolution of the global TEC, mainly due to the non uniform distribution of the observing stations on the surface of the Earth.

Another source of information for TEC studies are the satellite altimetry missions. TEC observations carried out by TOPEX/Poseidon (and its follow-on missions, Jason I y Jason II) provide an accurate and direct measure of this parameter. An advantage of altimetry missions is the uniform coverage over open oceans (exactly where GNSS data are scarce), although a set of three months of TOPEX observations is needed to obtain a 24-h local time (LT) coverage for every point sampled by the satellite.

This work focuses on the updating of the La Plata Ionospheric Model (LPIM) in order to assimilate long (three months) GNSS and TOPEX data series, and computing high temporal/spatial resolution maps of the global TEC. LPIM gives a two-dimensional representation of the global TEC based on a spherical harmonic expansion with time-varying coefficients. The coordinates used for the expansion are the modip latitude and LT. The GPS ionospheric observable is the geometry-free linear combination from carrier-phase observations leveled to code-delay observations. LPIM algorithms simultaneously estimate the time-varying coefficients of the TEC expansion and the instrumental delays (also called Differential Code Bias, DCBs) for the GPS satellites and receivers. This study takes advantage of the complementary potentialities of both,

GNSS and TOPEX/Poseidon information sources. Combining them in a common model allows GNSS observations provide high temporal resolution of the TEC variability, while TOPEX observations enhance TEC interpolation in open ocean regions and improve DCB calibration.

IT-ITIT-27 Comparison of Phaselock Loop Cycle Slip Predictors in Ionospheric Scintillation
by Robert Miceli

Status of First Author: Student IN poster competition

Author: Robert Miceli

Abstract: Phase error variance (sigmaPhi) and channel decorrelation time (tau0) are evaluated as predictors of phase lock loop cycle slips during periods of severe equatorial ionospheric scintillation. The two parameters are tested under realistic equatorial scintillation conditions generated from a complex baseband signal simulator for common PLLs used in Global Positioning System receivers. While the phase error variance predicts cycle slips well for certain ranges of variances, channel decorrelation time better models cycle slips by relating them to differentially-detected data bit errors.

Long-Term Variations of the Upper Atmosphere

IT-LTRV-01 Variations in the Electron and Ion Auroral Inputs During the Long SC23/24 Solar Minimum and Previous Minima - by Barbara Emery

Status of First Author: Non-student

Authors: Barbara A Emery (HAO/NCAR, emery@ucar.edu), David S Evans (SWPC/NOAA, davysevans@comcast.net), Frederick J Rich (LL/MIT, Frederick.rich@ll.mit.edu), and Gordon Wilson (AFRL, Gordon.wilson@afrl.af.mil)

Abstract: Solar cycle minimum 23/24 is quite long compared to other solar minima, with relatively low values of the IMF B field (Bt) and Kp. The Whole Heliospheric Interval (WHI, 08080-08107) is before the absolute minimum which occurred in late 2008 and early or later 2009, depending on what parameters are examined for their minima over what time duration. Most minima of 81-day solar wind velocity (Vsw), Bt, ap, Kp, and global auroral electron (Pe) and ion power (Pi) occurred in late 2009, while 27-day minimum could be earlier in 2009. Periodicities are found for three solar rotations (81 days) using the Lomb-Scargle technique, similar to FFTs but capable of dealing with data gaps. There were very strong 9-day periodicities in many variables in 2008, triggered by the recurring high-speed streams. This periodicity disappeared in early 2009, when 13.5-day emerged as the strongest periodicity. These periodicities which are related to the solar rotation period of 27 days are compared with periodicities found in previous solar minima periods going back to 1975.

IT-LTRV-02 Climatology of the thermospheric neutral winds over Arecibo - by Eva Robles

Status of First Author: Non-student

Authors: Eva Robles, Craig Tepley, Pedrina Dos Santos, Christiano Brum, and Sixto Gonzalez (all of Arecibo Observatory)

Abstract: We are presenting the climatology of the thermospheric neutral wind (NW) components obtained by 630.0NM airglow emission for the Fabry-Perot Interferometer measurements over Arecibo Observatory from 1980 to 2010. In addition we are presenting and discussing the long trend-term variation of the NW components along the years and comparing these results with the NW computed through the incoherent scatter radar (ISR).

IT-LTRV-03 Analysis of Fabry-Perot measurements for Solar Cycle #22
by Alexandra McLennan Brown

Status of First Author: Student IN poster competition

Authors: A. McLennan Brown (Mt. Allison University, Sackville, New Brunswick, Canada) and J. W. Meriwether (Department of Physics and Astronomy, Clemson University, Clemson, SC)

Abstract: Fabry-Perot interferometer (FPI) measurements of the 630-nm oxygen spectral line shape at Arequipa, Peru (16.5 S, 71.5W) between solar minimum (1996) and solar maximum (2001) were analyzed to produce estimates of the thermospheric zonal and meridional wind speeds, temperature, and 630-nm intensity. The FPI instrument function and stability were calibrated each night with hourly observations of the HeNe emission at the 632.8 nm wavelength. Examination of the thermospheric winds and temperature in four directions (east, west, south, and north) and the zenith found significant increases in wind speed and temperature corresponding to the increase in solar flux from ~70 sfu to ~250 sfu. There was little variation in the wind or temperature measurements in 1997. As the solar maximum approached, the variations and magnitude of the zonal and meridional wind components and temperature increased ~30% for the wind speed and ~a factor of 2 for the temperature. Also notable were the short-lived changes seen for strong changes in the geomagnetic index, ap. Plots of temperature versus solar flux found the temperature increases proportionally with solar flux activity. Monthly-averaged variations in the wind and temperature measurements were calculated removing daily variability. These results were then examined to study the behavior of the midnight temperature maximum winds and temperature increase.

IT-LTRV-04 Comparison between the Observed and Modeled Solar Cyclic Variation in Geocoronal Hydrogen - by Susan M Nossal

Status of First Author: Non-student

Authors: S. M. Nossal, University of Wisconsin-Madison Dept. of Physics, nossal@physics.wisc.edu; E. J. Mierkiewicz, University of Wisconsin-Dept. of Physics; F.L. Roesler, University of Wisconsin, Dept. of Physics; L.M. Haffner, University of Wisconsin, Dept. of Astronomy; G. Crowley, Atmospheric and Space Technology Research Associates

Abstract: Analysis of observations from the Wisconsin H-alpha Mapper (WHAM) during Solar Cycle 23 indicates a statistically significant solar cycle dependence. The WHAM Balmer-alpha column emission intensity is a factor of ~1.5 higher during solar maximum than solar minimum conditions, a difference greater than the ~9.6% uncertainty in the relative intensity of the measurements. This solar cycle variation is consistent with that observed in observations taken during Solar Cycle 22 with the similarly designed "pre-WHAM" Fabry-Perot (Nossal et al., 2008). An outstanding question has been how does the observed solar cycle trend compare with that predicted by models. The observed trend of higher intensities during solar maximum is consistent with forward modeling using thermospheric output from the Mass Spectrometer Incoherent Scatter model and the Thermosphere Ionosphere Mesosphere Electrodynamics General Circulation Model. However, there are differences in magnitude and shape between the predicted and observed intensities, indicating underlying differences in the thermospheric hydrogen distributions.

Midlatitude Ionosphere or Thermosphere

IT-MDIT-01 NECA Observations of Medium Scale Structures in the Ionosphere Over New England by James Akey

Status of First Author: Student IN poster competition

Authors: J. Akey, T. Kelley, P. Anderson, J. Benway, H. Gallagher, T W Garner, A T Weatherwax and A Costner

Abstract: This poster presents rate of TEC (ROT) measurements and power spectrum from ARL:UT Coherent Ionospheric Doppler Receivers (CIDRs) in the NorthEast CIDR Array (NECA). CIDRs measure Doppler shifts of 150 and 400 MHz signals from low-Earth orbiting satellites caused by the ionosphere, which are easily converted into an ROT measurement. Power spectra from these measurements can be used to examine the underlying wave structures within the ionosphere. Here, we examine CIDR observations from four receivers located along constant magnetic latitude and distributed in longitude across upstate New York and Massachusetts. On day 95 of 2008, a significant medium scale structure was observed at 15:51 UT (approximately 50° geographic latitude) by the Millstone Hill receiver. This structure was either not observed by the receivers to the west or was significantly weaker indicating a notable longitudinal variation in the process driving the structure. When projected to the F-region altitudes, the structure is located east of the Appalachian Mountains suggesting some connection with topographic features.

IT-MDIT-02 Pre-storm enhancements of F2-region maximum electron density - by Lastovicka Jan

Status of First Author: Non-student

Authors: J. Lastovicka, D. Buresova, Institute of Atmospheric Physics ASCR, Bocni II, 14131 Prague 4, Czech Republic, jla@ufa.cas.cz

Abstract: Several authors reported pre-storm enhancements of foF2/NmF2 (maximum electron density in the F2 region) a couple of hours before the onset of a geomagnetic/ionospheric storm. However, such enhancements were reported only for some storms and their reality and/or relation to the following storm have been questioned. Here we re-analyze data set of 65 strong-to-severe geomagnetic storms from the period 1995-2005 and confirm previous funding that about 25% of all storms are accompanied by sufficiently strong pre-storm enhancements ($\Delta foF2 > 25\%$ with respect to monthly median and the 27-day running mean), confined to the F2 region only. It is difficult to say if the remaining 75% of storms are or are not accompanied by a pre-storm enhancement, because when the pre-storm enhancement amplitude is smaller than a certain limit, it cannot be distinguished from effects caused by other factors and for still weaker magnitude even from noise. Some statistical results about latitudinal dependence, seasonal, diurnal and solar cycle variation etc. will be presented together with a brief discussion of possible origin of the pre-storm enhancements. Only enhancements, not depletions of such magnitude have been observed during the last 24 hours before storm onset.

IT-MDIT-03 The mid-latitude nighttime ionospheric electron density enhancement in the Weddell Sea region - by Chia-Hung Chen

Status of First Author: Student IN poster competition PhD

Authors: C. H. Chen, Kyoto University, Japan, koichi@kugi.kyoto-u.ac.jp; J. D. Huba, Naval Research Laboratory, Washington, huba@ppd.nrl.navy.mil; A. Saito, Kyoto University, Japan, saitoua@kugi.kyoto-u.ac.jp; C. H. Lin, Nation Cheng Kung University, Taiwan, charles@mail.ncku.edu.tw

Abstract: The physical mechanisms for the formation of the mid-latitude nighttime electron density enhancement in the Weddell Sea region are investigated and simulated by performing the SAMI2 (Sami2 is Another Model of the Ionosphere) model in this study. This feature is called as Weddell Sea Anomaly (WSA). Model Simulation results show that the SAMI2 model can reproduce the nighttime ionospheric electron density enhancement structure successfully. The time series of the altitude-latitudinal maps reveal that the longer time of the photoionization rate can provide more ion ionization during the southern hemisphere summer. Moreover, the equatorward (northward) neutral wind can drive the electron density up to a higher altitude along the magnetic field lines and sustain the electron density for a longer life time. The ion velocity, the motion of the plasma, is also an important factor to form the WSA structure. The altitude-latitudinal maps of the field aligned ion velocity show that the highly downward ion velocities in the winter hemisphere will decrease the electron density and the upward ion velocities in the summer hemisphere will preserve the electron density for a long time. The NO neutral wind condition and the NO E×B drift condition are also applied to drive the SMAI2 model in this study comparing with the normal condition. Result shows that the meridional neutral winds can produce the asymmetric ion velocity between the both hemispheres and cause the appearance of the WSA structure in the summer hemisphere, which tell us that the neutral wind may be the key driver of the WSA formation.

IT-MDIT-04 A new model for ionospheric molecular ion concentrations - by Phil G. Richards

Status of First Author: Non-student

Authors: Phil G. Richards

Abstract: There has long been a need for improved specification of ionospheric molecular ion concentrations. The IRI molecular ion concentrations are based on limited data sets that do not accord well with theoretical calculations. Incoherent scatter radars need to specify the relative ion concentrations in order to accurately determine plasma temperatures. We present a new computationally efficient model of molecular ion concentrations for use with the IRI model and radar data analysis. The basis of the model is the photochemistry of the ionosphere. Below ~150 km, relative ion concentrations can be determined from chemical equilibrium calculations. However, at higher altitudes, the O+ density cannot be derived from chemical equilibrium due to the increasing importance of diffusion. The new model overcomes this problem by using the

electron density that is provided by the IRI model or the radar. The solution is to use an iterative technique to solve for the O+ density given that the total ion concentration must sum to the electron density. This pseudo chemical model produces very good agreement with the Field Line Interhemispheric Plasma (FLIP) ionosphere model, which solves the continuity, momentum, and thermal equations. It also provides good agreement with AE-C ion densities and significantly improves electron and ion temperatures from incoherent scatter radars.

IT-MDIT-05 Study of characteristic appearance of TEC enhancement at mid-latitude using TEC data of LEO satellite - by Yukari GOI

Status of First Author: Student NOT in poster competition

Authors: Yukari Goi, yukari@kugi.kyoto-u.ac.jp; A.Saito, saitoua@kugi.kyoto-u.ac.jp; M.Nishioka, nishioka@stelab.nagoya-u.ac.jp

Abstract: The characteristic appearance of Total Electron Content(TEC) enhancement at mid-latitude was clarified by TEC data. Enhancement of TEC in topside ionosphere was detected with TEC data. TEC data between GRACE and GPS satellites is the integration value of the electron density in the plasmasphere and the topside ionosphere. GRACE satellites observed the enhancement of TEC between 50 degree and 70 degree latitude in the geomagnetic latitude. It tends to appear during geomagnetic storm period and to appear dawn side and dayside. It clarified that the enhancement of TEC in dayside caused by the storm enhanced density (SED) and other phenomena and that occurred above the topside ionosphere. The characteristic appearance of TEC enhancement was studied statistically. The north-south asymmetry of TEC enhancement at mid-latitude was observed. The longitudinal dependence of TEC enhancement in dayside was observed. In the north hemisphere, it tends to appear from 230 degrees longitude to 310 degrees longitude, and in the south hemisphere, it tends to appear from 100 degrees longitude to 220 degrees longitude. On the other hand, the seasonal variation of TEC enhancement at mid-latitudes was observed in dawn side. The night of the midnight sun cause the seasonal variation of TEC enhancement at mid-latitudes. These results indicate it was different that the characteristic appearance of TEC enhancement between in dayside and in dawn side. This difference suggests the physical process of enhancement is not same between in dayside and in dawn side. The ionospheric plasma in low-latitude could make the TEC enhancement in dayside as the phenomena with equatorial ionospheric anomaly. The ionopheric plasma in high-latitude could make the TEC enhancement in morning side by solar irradiation in polar region near midnight.

IT-MDIT-06 Estimates of Temperatures and Wind Velocities in the RENOIR Experiment by Uday Kanwar

Status of First Author: Student IN poster competition

Authors: Uday Kanwar, Yiyi Huang, Jonathan J. Makela, John W. Meriwether

Abstract: The Remote Equatorial Nightime Observatory of Ionospheric Regions (RENOIR) experiment is currently being conducted in northeastern Brazil to study ionospheric irregularities. Two Fabry-Perot Interferometers (FPIs) are part of the instrumentation deployed and are used to observe the 630.0-nm redline emission in the upper atmosphere. From these instruments, estimates of the neutral temperature and wind can be made. The accuracy of these estimates is highly dependent on the weather (e.g., clear, cloudy) conditions in the sky when the observations are made. Data from a collocated allsky imaging system can be used to determine the sky conditions. An average estimate of winds and temperatures from Sept to Dec 2009 in the RENOIR experiment are provided in our poster, for both cloudy and clear weather conditions which are hand-labeled from the images taken by the imaging system. However, the imaging system is limited to taking data during moon down conditions; a constraint not imposed on the FPI systems. Thus, using only the imaging system to determine sky conditions limits the amount of useable data from the FPI. Therefore, we put forward the idea of cloud detection by using only the FPI observations based upon measurements of the continuum background also made by the FPI. We find that large oscillations in the continuum typically indicate the passage of clouds. The month-by-month average temperature and wind estimates based upon this cloud detection method are compared with the results from the imager-only method, and good agreement is found.

IT-MDIT-07 H-alpha response to geomagnetic disturbed activity at Arecibo - by Pedrina Terra Santos

Status of First Author: Non-student

Authors: Pedrina Terra dos Santos (pterra@naic.edu), Christiano Garnett M. Brum (cbrum @naic.edu),R. Kerr (rkerr@sci-sol.com), John Noto (noto@sci-sol.com), Sixto Gonzalez(sixto@naic.edu), Raul Garcia (rgarcia@naic.edu)

Abstract: Configured with a spectral resolution of 0.0086 nm at 656.3 nm, the low resolution Fabry-Perot Interferometer (FPI) sampled the geocoronal Balmer-alpha emission for sixty nights during new moon periods from September 2006 to September 2007. This work shows the H-alpha variability with geomagnetic activity for December 2006 and March 2007. The idea of these analyzes is to take off the effect of the shadow height, local time and solar flux dependencies to be sure that the possible variations were only due to the geomagnetic activity.

IT-MDIT-08 Improvement of the accuracy for the TIE-GCM by incorporating Helium data from the NRLMSISE-00 model - by Jung Soo Kim

Status of First Author: Student IN poster competition PhD

Authors: Jung Soo Kim, juk211@psu.edu; Julio Urbina, JUrbina@engr.psu.edu; David B. Spencer, dbs9@engr.psu.edu Timothy J. Kane, tjk7@psu.edu

Abstract: The total atmospheric neutral densities derived from the CHAMP (CHAllenging Minisatellite Payload) accelerometer data were used to investigate the accuracy of the empirical as well as numerical thermospheric neutral density models during near solar maximum (year 2002) through near solar minimum (year 2007); JB2006, JB2008, NRLMSISE-00, and the TIE-GCM. The thermospheric neutral density models show good morphology to the variations of neutral densities from the CHAMP, but still have uncertainties which should be taken into account for better prediction of satellites' position in orbit. The TIE-GCM shows relatively larger uncertainties at the height of 400 km than the empirical models especially during the solar minimum period. That should be due to the lack of the increased partial pressure of Helium during solar minimum. By incorporating daily averaged Helium data calculated from the NRLMSISE-00 model, the accuracy of the TIE-GCM during the solar minimum period was surprisingly improved.

IT-MDIT-09 Storm time signatures of zonal ion drifts at low and middle latitude ionosphere by Sasmita Mohapatra

Status of First Author: Student IN poster competition PhD

Authors: Sasmita Mohapatra, R.A.Heelis

Abstract: We use measurements from the DMSP-F13 and F15 satellite for the storm periods during 2001 November to investigate the relationships between the zonal ion drift and the particle precipitation boundaries at local times in the evening and relate these findings to our expectations based on the dynamics of the magnetosphere and the ionospheric conductivity. During times of extreme storm activity the expansion and penetration of the high latitude zonal ion drift to middle and low latitudes of the ionosphere is studied using a quantitative identification of the convection and particle boundaries at high latitudes. Our study shows that during the main phase of the storm ion drifts driven by the magnetosphere penetrate to latitudes as low as dip equator on the dusk side. Evidence for ion drifts driven by disturbance dynamo may be found during storm recovery phase. The so-called sub-auroral polarization stream (SAPS), sub-auroral ion drifts (SAID) features are also apparent during the storm main phase. The TDIM model results shows that storm time density change during this period at 1400 and 1600 local time is about 100 TEC.

IT-MDIT-10 CEDAR Post-Doc Interim Report: Coordinated Optical and Radar Observations of the Ionosphere and Thermosphere - by Ethan S. Miller

Status of First Author: Non-student

Authors: E. S. Miller (JHU/APL) and E. R. Talaat (JHU/APL)

Abstract: We report on our efforts in coordinated optical imaging and HF radar backscatter observations of Mesoscale Traveling Ionospheric Disturbances (MSTIDs). The APL-DARC (APL Direct Airglow-Radar Coincidence) all-sky instrument has been operating in rural Westminster, MD, since April 2010. This location provides an overlapping field-of-view with the Wallops Island and Blackstone middle-latitude SuperDARN HF radars, as well as the Boston University all-sky imager at Millstone Hill. Concident observations and MSTID forward models for both instruments are presented.

IT-MDIT-11 Observations of subcorotation in mid-latitude DMSP plasma drift measurements
by Ellen Pettigrew

Status of First Author: Student IN poster competition PhD

Authors: J. M. Ruohoniemi, miker@vt.edu, S. G. Shepherd, simon.shepherd@dartmouth.edu

Abstract: Evidence for subcoration of the plasmasphere has been observed by the IMAGE spacecraft and in ground-based radar and satellite measurements of the drifting plasma in the ionosphere at midlatitudes. Analyzing a year (2001) of velocity measurements from the plasma instruments on the F13 and F15 Defense Meteorological Satellite Program (DMSP) spacecraft, we see strong trends pointing to a seasonally dependent subcorotation of the local plasma. The observed subcorotation is more evident during summer than winter and appears more pronounced on the dawn-side than on the dusk-side. Subcorotation manifests as westward velocities in a corotating frame and contributes an electric field which, when integrated along the satellite track, can contribute a potential difference between the low-latitude limits of integration. This potential difference, referred to as the potential offset, was calculated for all available F13 and F15 passes in 2001 and was found to exhibit a UT dependence consistent with subcorotation effects. Although the drivers of the observed westward drifts are not well understood, previous studies have found that the subcorotation observed in the ionosphere is a good predictor of subcorotation in the plasmasphere. We therefore expect that the corotation electric field in the plasmasphere also has seasonal and local time dependent variations.

IT-MDIT-12 Arecibo-La Plata geomagnetically conjugate ionospheric model - by Emilio Camilion

Status of First Author: Student NOT in poster competition

Authors: Claudio Brunini, Diego Janches, Rodolfo Rodríguez, Francisco Azpilicueta

Abstract: The AIRES (Argentine Ionospheric Research Station) project aims to install an Advanced Modular Incoherent Scatter Radar (AMISR) in Argentina. The idea behind this project is to install an Incoherent Scatter Radar (ISR) magnetically conjugate to the Arecibo Observatory radar in the Southern Hemisphere. The Arecibo geomagnetic conjugate point is located on the ocean near La Plata, Argentina. AMISR is an ideal ISR for this task, because together with the Arecibo ISR, it will enable simultaneous studies in the Northern and Southern Hemisphere of a wide range of geophysical phenomena, particularly those related to electrodynamics process along the geomagnetic field lines. In this context, a theoretical model to simulate Arecibo-La Plata geomagnetically conjugated ionospheric processes is being developed at the Facultad de Ciencias Astronómicas y Geofísicas of the Universidad Nacional de La Plata. This model couples the local ionosphere to the overlying plasmasphere and conjugate ionosphere by solving the coupled equations of continuity, momentum and energy balance along close flux tubes to yield ionospheric parameters in a-self consistent way. It is a numerical model that describes the time-dependent evolution of the ionosphere and calculates density distributions for the electron and ion species as a function of latitude, longitude, and altitude on a pre-specified spatial grid. The model also calculates the field-aligned ion velocity and electron and ion temperatures on the same spatial grid. To resolve this coupled system of equations is necessary to take into account a numerous of chemical and physical processes, including field-aligned diffusion, plasma advection due to E x B drift, thermospheric winds, neutral composition changes, ion production due to EUV radiation, thermal conduction, diffusion-thermal heat flow, and a host of local heating and cooling mechanisms. This work summarizes the current status of the development and discusses the further steps that will be needed to implement and validate the Arecibo-La Plata geomagnetically conjugate ionospheric model.

IT-MDIT-13 The relation between magnetospheric state parameters and the occurrence of plasma depletion events in the night-time mid-latitude F-region - by Ilgin Seker

Status of First Author: Non-student

Authors: Ilgin Seker, (ilgin.seker@nasa.gov); Shing F. Fung, (shing.f.fung@nasa.gov); John D. Mathews, (JDMathews@psu.edu)

Abstract: Studies using all-sky imagers have revealed the presence of various ionospheric irregularities in the night-time mid-latitude F-region. The most prevalent and well known of these are the Medium Scale Traveling Ionospheric Disturbances (MSTIDs) that usually occur when the geomagnetic activity is low, and mid-latitude spread-F plumes that are often observed when the geomagnetic activity is high. The inverse and direct relations between geomagnetic activity (particularly Kp) and the occurrence rate of MSTIDs and mid-latitude plumes, respectively, have been observed by several studies using different instruments. In order to understand the underlying causes of these two relations, it is illuminating to better characterize the occurrence of MSTIDs and plumes using multiple magnetospheric state parameters. Here we statistically compare multiple geomagnetic driver and response parameters (such as Kp, AE, Dst, and solar wind parameters) with the occurrence rates of night-time MSTIDs and plumes observed using an all-sky imager at Arecibo Observatory (AO) between 2003 and 2008. The results not only allow us to better distinguish MSTIDs and plumes, but also shed further light on the generation mechanism and electrodynamics of these two different phenomena occurring at night-time in the mid-latitude F-region.

IT-MDIT-14 Ingesting GPS TEC from the LISN Project into the Low Latitude Ionosphere Sector Model (LLIONS) - by Jonathan V. Thompson

Status of First Author: Student IN poster competition

Authors: Jonathan Thompson, jonthompson3@gmail.com; Vince Eccles, vince.eccles@spacenv.com; Jan Sojka; Cesar Valladares

Abstract: Theoretical models of the ionosphere provide for climatological estimation of the total electron content (TEC) in the ionosphere for given geophysical circumstances. This estimation is important for the Global Positioning System (GPS) because accurate estimation of TEC values allow for more accurate positioning technology. However, there are daily variations in ionosphere structure that models do not capture. To improve the ability of ionospheric models to correctly model day-to-day weather of the ionosphere, TEC data from approximately 100 GPS stations in South America are compared with model TEC. Important model inputs determining ionospheric structure, namely electric field and neutral wind magnitudes, are optimized through this comparison. This comparison is done for each time step of the UT day at a resolution of fifteen minute intervals. The model TEC for the next time step is calculated using the optimum input parameter determined by the comparison. This process is repeated for a large number of time steps and overall optimum values for the input parameters are found. This allows for investigation of the ionospheric drivers as a function of time of the day, as well as for better overall calculation of TEC by the model.

IT-MDIT-15 Estimation of periods and occurrence rate of TIDs and their correlation with geomagnetic activity using riometer time series recorded in sub-auroral and medium latitude stations by Fabio Vargas

Status of First Author: Non-student PhD

Authors: Fábio Vargas (fabio.vargas.br@gmail.com); Christiano Garnett Marques Brum; Mangalathayil Ali Abdu; Inez Staciarine Batista

Abstract: This work presents a TID study carried out using riometer cosmic noise absorption data recorded from 1989 to 1996 in two sites: the first at a sub-suroral region-SAR (at Brazilian Antarctic Station – 62.56oS; 58.39oW) and the other at a south atlantic magnetic anomaly-SAMA region (Cachoeira Paulista – 22.5oS; 45.0oW). It was found that medium temporal scale TIDs (periods from 15 min to 2 hours) were dominant at the SAR station while at the SAMA station were dominant large temporal scale TIDs (periods from 2 to 12 hours). The analysis also suggested that SAR is more prone to TID occurrence than the SAMA region independently of the period of the oscillation. The results showed a close

relationship between medium scale TID occurrence increase as with the geomagnetic activity as with the Dst index decrease (periods of the magnetic storms and magnetic substorms) in the sub-auroral region and in the interplanetary shock periods (positive phase of the magnetic storms). Large temporal scale TIDs observed in SAMA region were found to be well associated with periods of magnetic storms and/or magnetic substorms.

Polar Aeronomy

IT-POLA-01 Physics-motivated regularization of F-region convection pattern reconstruction
by Thomas Butler

Status of First Author: Student IN poster competition

Authors: T. W. Butler, Boston University, butler@bu.edu

Abstract: Incoherent scatter radars (ISRs) provide a measure of plasma flow in the ionosphere derived from the bulk Doppler shift of the received spectrum. The correspoding velocity estimate constitutes a projection onto the radar line-of-sight of an underlying ion flow pattern. The electronic steering capability of phased-array radars --- such as the Poker Flat ISR (PFISR) --- allows many such projections to be gathered in multiple directions almost simultaneously. This effectively increases the observability of the full three-dimensional velocity vector, while also improving the time resolution compared to mechanically-steered dish antennas. These benefits come at the cost of raw signal precision since the effective dwell time per scanning cycle decreases as more beam positions are added. An optimal method of reconstructing the underlying velocity field must take into account the statistical uncertainty of the data as well as deterministic limitations of the observing mode. It should also include a priori information about the underlying field. To satisfy these requirements, we formulate the problem within the framework of statistical inverse theory and use a Bayesian method to constrain the solution. We present some results from PFISR experiments.

IT-POLA-02 Investigating Height-Resolved Joule Heating Rates Using Incoherent Scatter Radars
by Vicki Hsu

Status of First Author: Student NOT in poster competition Undergraduate

Authors: Vicki Hsu, Jeffrey Thayer, Xian-jing Liu

Abstract: The energy transfer processes that occur in the Earth's polar E region, located 100 to 150 km in altitude, directly affect the properties of the thermosphere. Of particular importance is the energy transfer due to electrical currents flowing through the region, i.e. Joule heating. The transfer of electrical energy heats the neutral gas causing expansion throughout the thermosphere. This expansion increases the neutral density at satellite altitudes causing enhanced drag. Improvements in estimating the Joule heating rate and its altitude distribution will help better predict satellite drag issues. Incoherent Scatter Radar technique enables the local determination of height-resolved Joule heating rates. This investigation explores the consequences of Joule heating on the thermosphere.

IT-POLA-03 Detection and measurements of thermospheric gravity wave activity in Alaska with a bi-static Fabry-Perot observatory - by John W. Meriwether

Status of First Author: Non-student PhD

Authors: J. Meriwether (Clemson University); M. Larsen (Clemson University); D. Hampton (Geophysical Institute U. of Alaska); M. Nicolls (SRI, International)

Abstract: Measurements of thermospheric neutral winds and temperatures are reported for common volume observations of four directions from Poker Flat and Fort Yukon. The data from these observations are used to detect gravity wave propagation within the thermospheric flow for a polygon 120 km and 75 km widths in the zonal and meridional directions. Observations of gravity wave activity are particularly striking for the zenith measurements of vertical wind activity. Additional information regarding the gravity wave behavior is provided by the PKISR observations of ion temperature and ion velocity fluctuations along the geomagnetic field line in the geomagnetic zenith direction.

IT-POLA-04 Measurements of thermospheric vorticity and divergence in the auroral oval - by John W. Meriwether

Status of First Author: Non-student

Authors: J. W. Meriwether and M. F. Larsen (john.meriwether@ces.clemson.edu, Department of Physics and Astronomy, Clemson University); D. Hampton (Geophysical Institute, University of Alaska)

Abstract: Measurements of vorticity and divergence have been carried out for a polygon with four common volume (CV) positions located between the three Fabry-Perot interferometer (FPI) stations of Poker, Fort Yukon, and Eagle over the past three northern winters from 2006 to 2010. The area of the polygon is 4435 km, and the meridional and zonal extents of the polygon are 124 and 147 km, respectively. Also obtained were high temporal resolution zenith measurements of vertical winds observed from the Poker Flat Davis Science Center. The line-of-sight thermospheric winds observed for each CV position are corrected to yield a horizontal wind component, and a neutral wind vector for each CV position is calculated. The vorticity and divergence quantities are then determined using line-integral formulas derived from the application of Stokes theorem to the thermospheric flow within the CV polygon. Variation of the relative vorticity is found to exhibit a characteristic sinusoidal variation with a minimum coinciding with the time of westward geomagnetic plasma convection. The initial value of the relative vorticity tends to be positive as a result of eastward flow south of the auroral oval and westward flow within the auroral oval. The divergence varies sporadically during the night with fluctuations depending upon the propagation of thermospheric gravity waves through the polygon region or the development of Joule heating within auroral arcs. The sensitivity of each of the three FPIs is such to allow accurate estimates of the gradients of the zonal and meridional wind components be determined for the meridional and zonal directions, respectively. These quantities cannot be determined by a single station FPI. The results show systematic variations for each gradient during active periods. The characteristic nighttime variation of the relative vorticity appears to be sensitive to the strength of the development of the auroral substorm and may prove to be a useful diagnostic of the level of convective forcing caused by the ion-neutral coupling of the ionosphere to the thermosphere.

IT-POLA-05 Ground and Satellite Conjunction Study of Small-scale Neutral Upwelling in the Cusp by Brent Sadler

Status of First Author: Student IN poster competition PhD

Authors: Brent Sadler, Marc R. Lessard, Eric Lund, H. Luhr, S. Marker, G. Crowley, A. Otto

Abstract: Recent observations have confirmed neutral particle upwelling at high latitudes which are localized to the polar cusp region and seem to be correlated to high auroral activity. For decades, thermospheric upwelling has been recognized as an important topic and has been studied observationally and theoretically, with efforts largely focused on Joule heating being the basic driver. As data and models have improved over the years, Joule heating has indeed proven to be fundamental to upwelling, at least at lower altitudes. At higher latitudes, however, the situation appears to be more complex and recent results indicate that Joule heating alone is not adequate. We investigate this issue with numerical models using data acquired by FAST and CHAMP satellites in combination with ground-based observations. Field and particle data from FAST and accelerometer data from CHAMP are used from favorable conjunction alignment events. These conjunction data are further supplemented with ground-based radar, magnetometers, and other fortuitous satellite passes. Two events are presented and described. One is typical of the events our research is focused on (a cusp density enhancement) and the other, although not occurring in the cusp, does invoke a number of interesting comparison points. The Joule heating model results are compared for these two events.

IT-POLA-06 UV Emissions Observed By the SCIFER2 Sounding Rocket - by Allison Jaynes, presented by Brent Sadler

Status of First Author: Student NOT in poster competition

Authors: A. Jaynes, M. Lessard, P. Kintner, K. Lynch and F. Sigernes

Abstract: The SCIFER2 sounding rocket was launched into a Poleward Moving Auroral Form (PMAF) event on January 18, 2008. As is typical, the event was characterized by the presence of soft electron precipitation, driving discrete auroal arcs at 630 nm. The rocket payload, which included a UV photometer as well as several other instruments, flew in the vicinity of the dayside cusp and reached an apogee of approximately 1500 km. The photometer was included on the payload in order to explore the possibility that sunlight might scatter from upwelling neutral gases as a result of the electron precipitation (and associated microphysical processes). Near these altitudes, the photometer was pointed approximately perpendicular to local zenith. In this configuration, highly structured UV emissions were measured emanating from sources located several hundred km, perhaps 1000 km or more, above the ground. In this study, we examine rocket and ground data to determine the source of these emissions, including the possibilities that the structures are associated with auroral phenomena, flourescence or, as suggested above, from sunlight scattered from high-altitude (upwelling) neutral gases.

Solar Terrestrial Interactions in the Upper Atmosphere

IT-SOLA-01 Energy input into the upper atmosphere associated with high speed solar wind
by Yanshi Huang

Status of First Author: Student IN poster competition PhD

Authors: Yue Deng, Yanshi Huang

Abstract: The importance of solar wind condition to the magnetosphere and its energy input into thermosphere-ionosphere system has been realized. However, the energy transfer process through the solar wind, magnetosphere and ionosphere is still not clear. In this study, we investigated energy deposition methods like Joule heating and particle precipitation. Specifically, yearly AMIE data in 2005 have been analyzed to show the existence of 9-day periodic oscillation in Joule heating and particle precipitation, which is associated with the 9-day oscillation in solar wind velocity. The correlations and phase shifts between Joule heating, particle precipitation and neutral density have been studied. We also examined the sensitivity of Joule heating to the solar wind velocity in different models (AMIE, Weimer [2005]). In addition, WHI (Whole Heliosphere Interval, 08080-08107) solar minimum was studied in detail to examine the variation of the magnetospheric energy inputs caused by the well-structured solar wind.

IT-SOLA-02 Comparison of Wave Propagation Observed from CHAMP with a Coupled Thermosphere Ionosphere Physical Model - by Mariangel Fedrizzi

Status of First Author: Non-student PhD

Authors: Fedrizzi, M., T. Fuller-Rowell, M. Codrescu, S. Bruinsma, J. Forbes

Abstract: Impulsive energy injection at high latitudes during a geomagnetic storm can launch gravity waves that propagate equatorward and into the opposite hemisphere. The large-scale gravity waves appear in the thermosphere as traveling atmospheric disturbances (TADs) and, because of their impact on the ionosphere, can also appear as traveling ionospheric disturbances (TIDs). Comparison of TADs observed by the CHAMP satellite can be used to validate the accuracy and realism with which a physical model can reproduce these traveling disturbances. For this research we use the global, three-dimensional, time-dependent, non-linear coupled model of the thermosphere, ionosphere, plasmasphere and electrodynamics (CTIPe), a self-consistent physics-based model that solves the momentum, energy, and composition equations for the neutral and ionized atmosphere. The F10.7 index is used to define solar EUV heating, ionization, and dissociation. Propagating tidal modes are imposed at 80 km altitude with a prescribed amplitude and phase. The magnetospheric energy input into the system is characterized by the time variations of the solar wind velocity and the interplanetary magnetic field (IMF) magnitude and direction, which drives the Weimer empirical electric field model, whereas the auroral precipitation is derived either from the TIROS/NOAA satellite observations or from ACE solar wind and IMF data. During geomagnetic storms, the temperature of the Earth's upper atmosphere can be substantially increased mainly due to high-latitude Joule heating induced by magnetospheric convection and auroral particle precipitation. This heating drives rapid increases in temperature, inducing upwelling of the neutral atmosphere, and changes in global circulation, neutral composition, plasma density, and electrodynamics. In addition to these longer-term consequences the energy injection also drives large-scale gravity waves. The waves produced by CTIPe during a geomagnetic storm in May 2005 have been compared with CHAMP observations. Agreement with density observations on the dayside is particularly good, whereas the model tends to overestimate the amplitude of the traveling disturbance on the nightside. Some of the

differences are likely due to the empirical high latitude electric field not matching the exact locations of the Joule heating source region. Sampling the density along other hypothetical CHAMP orbits can help to separate the accuracy of the model propagation characteristics and the inadequacies in the model drivers.

IT-SOLA-03 SAMI3 validation during the Whole Heliospheric Interval - by Katherine Roach

Status of First Author: Student NOT in poster competition PhD

Authors: S.E. McDonald, Space Science Division, US Naval Research Laboratory, 4555 Overlook Ave. SW, Washington, DC 20375

Abstract: The Whole Heliospheric Interval (WHI) is a time period in 2008 (March 20 – April 16) that has been defined as part of an international effort to observe and model the Sun and the heliosphere around solar minimum. This period is particularly useful because there is generally low activity, but during the first half of the interval there are some active regions and two, low-latitude coronal holes which make it more interesting. As part of an effort to better understand how well space weather models can simulate the ionosphere's response to the sun, we validate the SAMI3 model during a time period encompassing the WHI (March 1 – April 16) against multiple data sources. The SAMI3 model is an ionospheric model that solves the continuity and momentum equations for seven ion species individually on a nonorthogonal, nonuniform single mesh fixed grid. The data sources used to validate SAMI3 are the Jason-1 TEC data and GPS derived TEC data from IGS (International GNSS Service). These comparisons give us a baseline understanding of how well SAMI3 can model the ionosphere when it is driven with the best possible solar data (the TIMED/SEE data).

IT-SOLA-04 Total Electron Content and High Speed Streams: A Search For Solar Wind Coupling by Anthony J. Mannucci

Status of First Author: Non-student

Authors: A. J. Mannucci, B. T. Tsurutani, O. Verkhoglyadova, A. Komjathy

Abstract: The ionospheric electron density response during geomagnetic storms is varied and complex, changing dramatically as a function of latitude and local time. Spatial extent of the response ranges from planetary scale to the order of a few hundred kilometers. It is clear from the study of geomagnetic storms during solar maximum that electrodynamics is a major driver of planetary scale response. We present results from our search for planetary scale response during periods when high-speed streams (HSS) are dominating the interaction between the solar wind and geospace. HSS rise in importance during the declining phase of the solar cycle, when storms caused by coronal mass ejections (CMEs) are becoming less dominant drivers of geomagnetic response. CMEs cause planetary scale response via prompt penetration electric fields (PPEFs). Are there analogs to prompt penetration electric fields (PPEFs) during high-speed streams? Are the ionospheric effects of PPEFs modified during HSS when the thermosphere/ionospheric system is energized by long-duration auroral activity? We describe our observational approach and results as we attempt to answer these questions.

IT-SOLA-05 Study of Geomagnetic Disturbances and Ring Current Variability During Storm and Quiet Times Using Wavelet Analysis and Ground-based Magnetic Data from Multiple Stations - by Zhonghua Xu

Status of First Author: Student IN poster competition

Authors: Z. Xu1, L. Zhu1, J. Sojka1, P. Kokoszka2, and A. Jach3
1 Department of Physics and Center for Atmospheric and Space Science, Utah State University, Logan, Utah, USA
2 Department of Mathematics and Statistics, Utah State University, Logan, Utah, USA
3 Department of Statistics, Universidad Carlos III de Madrid, Madrid, Spain

Abstract: The magnetosphere-ionosphere contains a number of current systems, such as the ring current, tail current, field-aligned current, and various electrojets in the ionosphere. These currents vary on a wide range of spatial and temporal scales and physically couple with each other. To study the complicated behaviors of these coupled current systems, the ground-based magnetometer has been a useful tool, but the magnetometer data are always multiple scaled and intermittent due to the nature of these current systems. To distinguish these geomagnetic effects with multiple temporal and frequency

scales, the wavelet analysis technique is especially suitable because of its special abilities of presenting information in both temporal and frequency domains. In this presentation, the geomagnetic disturbances and the ring current variability during storm and quiet times are studied by using wavelet analysis and ground-based magnetic data from multiple stations. First, the strengths of the wavelet technique for geomagnetic data analysis are investigated by an assessment study of a newly developed wavelet-based index of storm activity (WISA). Second, the geomagnetic effects related to the symmetric and asymmetric ring currents are characterized by applying wavelet analysis to geomagnetic data from multiple stations. Third, the temporal and spatial variability of the symmetric ring current is studied by applying the wavelet analysis technique to multiple components of magnetic data from multiple stations. The results show that the wavelet analysis of magnetic data from multiple stations provides a powerful tool for geomagnetic disturbance and storm studies. The unique strengths of the wavelet method allow us to quantitatively distinguish the geomagnetic effects of ring current variations from other M-I current systems. It also allows us to separate the magnetic effects of the symmetric ring current from those caused by the asymmetric ring current and to study the spatial and temporal variability of the ring currents, which are essential for understanding the dynamics of the ring currents as well as the magnetic storm processes. Quantitative information of the spatial and temporal variability of the ring currents is also crucial and invaluable for the national space weather programs. The techniques developed here can be used as a real-time monitoring tool for space weather applications.

IT-SOLA-06 Photoelectrons as a tool to monitor solar EUV variability over solar rotation and solar cycle time scales - by WK (Bill) Peterson

Status of First Author: Non-student

Authors: W.K. Peterson, P.G. Richards, S.C. Solomon, T.N. Woods

Abstract: Variability of the photoelectron flux observed escaping the top side ionosphere is driven primarily by variations in the solar EUV irradiance. We present photoelectron energy spectra from NASA's FAST satellite and predictions of the photoelectron spectrum derived from standard photoelectron production codes and various models of solar irradiance. The results show that we really do need hiqher resolution irradiance measurments from 1 to 27 nm now available from SDO to capture the variability in solar energy input to the thermosphere.

IT-SOLA-07 Global Distributions of the Characteristics of Auroral Particles - by Robert McIntosh

Status of First Author: Student NOT in poster competition PhD

Authors: Robert McIntosh, W. B. Center for Space Sciences, The University of Texas at Dallas, rcm033000@utdallas.edu; Phillip Anderson, W.B. Center for Space Sciences, The University of Texas at Dallas, phillip.anderson1@utdallas.edu

Abstract: Particle distributions inferred from auroral images can be used to construct maps which describe the global distribution of characteristics of energetic particles precipitating within the auroral oval. These characteristics, usually described in terms of average energy and integral energy flux, can be greatly
affected by the functional shape of these particle distributions. This functional shape can thus in turn affect properties derived from geospatial models that use these global distributions as inputs. This poster presents an analysis of these characteristics using particle spectrometer data from the DMSP
spacecraft and examines the dependence of these properties on geographic location and geomagnetic indices.

IT-SOLA-08 Determining solar wind and magnetospherically imposed forces on the thermosphere by George Siscoe

Status of First Author: Non-student

Authors: G. Siscoe, J. Semeter, J. J. Love, and K. D. Siebert

Abstract: Modeling and theory predict that the solar wind can drive winds in the high-latitude thermosphere, and observations show the two-cell circulation pattern diagnostic of such winds. The force on the thermosphere is predicted to be an order of magnitude bigger than the force that the solar wind exerts on the terrestrial system, the difference being made up by a force between the thermosphere and Earth's dipole mediated by the region 1 current system. This rather surprising result can be tested by measuring separately the force exerted by the solar wind, the force on the thermosphere and the force

on the dipole during a time when solar wind conditions are steady and the IMF is southward. The force exerted by the solar wind can be determined with global numerical simulation using measured solar wind parameters as input and integrating the computed total momentum stress tensor over a surface containing the terrestrial system. The force on the thermosphere requires measuring the acceleration of thermospheric winds over the area where the force is applied. The force on the dipole can be measured by integrating the magnetic stress tensor over the Earth using globally distributed ground magnetometer data, being sure to include high-latitude stations. To solicit community interest in carrying out such a test, this presentation describes its three components and illustrates them with examples.

IT-SOLA-09 Numerical simulations of the system of ionosphere-magnetosphere coupling - by Tapas Bhattacharya

Status of First Author: Student IN poster competition

Authors: A Otto, R J Stevens

Abstract: The coupling between the magnetosphere and the ionosphere plays an important role in the physics of the Earth's magnetosphere. My current research on magnetospheric plasma dynamics involves numerical simulations of the system of ionosphere-magnetosphere coupling. I am currently working with a sophisticated two-dimensional three fluid model (involving electrons, ions and neutrals) for this system with the goal to incorporate the advanced physics in an already existing three dimensional simulation. These models consider ionization and recombination, ion-neutral collision (friction), the Hall term in Ohm's law, and various sources of heat in the energy equations to investigate the change in composition or density in the system under consideration. The research will focus on processes that lead to ion-upwelling and composition changes, particularly during periods of auroral activity which are important and poorly understood issues of the ionosphere/thermosphere system. The models are written in FORTRAN and IDL is utilized for visualization purposes. The result of the simulations will be compared with the corresponding data obtained from auroral observations and active experiments (like ionospheric heating experiment, HAARP).