CEDAR-GEM Joint Workshop

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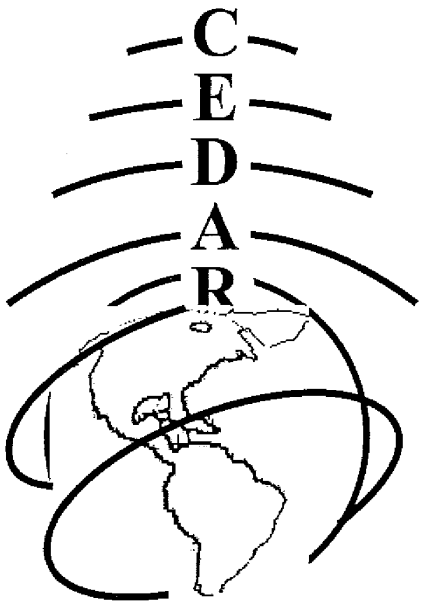

CEDAR IT Poster Session Booklet

Wednesday, June 29, 2011

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CEDAR GEM Joint Workshop – IT Poster Session Abstracts
Day 2 – Wednesday, June 29, 2011

Coupling of the Upper Atmosphere with Lower Altitudes

COUP-01 Ionospheric Response to the Japanese Earthquake and Tsunami of March 11, 2011: GPS TEC Observations - by David Andrew Galvan

Status of First Author: Non-student

Authors: David A. Galvan(1), Attila Komjathy(1), Michael Hickey(2), Philip Stephens(1), and Anthony J. Mannucci(1)
(1)NASA Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA.
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Abstract: Ocean tsunami wavelengths are sufficiently long to produce atmospheric internal gravity waves that propagate to the ionosphere, creating disturbances in ionospheric electron density that travel with the ocean waves below. These traveling ionospheric disturbances (TIDs) can be observed using measurements of integrated ionospheric electron density (also known as total electron content, or TEC) between Global Positioning System (GPS) satellites and GPS receivers on the ground. GPS receivers onboard satellites in low Earth orbit, such as in the COSMIC constellation of radio-occultation measurement satellites, may also be useful in observing these tsunami-driven TIDs. Ground-based GPS TEC observations show variations consistent with tsunami-driven internal gravity waves in several recent events we have investigated, including the Japan tsunami of March 2011. Fluctuations in TEC correlated in time, space, and wave properties of these tsunamis were observed in TEC estimates processed using JPL's Global Ionospheric Mapping Software Suite. The TEC estimates were band-pass filtered to remove variations with wavelengths and periods outside the typical range of internal gravity waves caused by tsunamis. Observed ionospheric TIDs were correlated with the speed, direction, and wavelength of ocean surface tsunami waves as measured by Deep-ocean Assessment and Reporting of Tsunamis (DART) buoys, and simulated by the NOAA's Method of Splitting Tsunami (MOST) model and JPL's Song model. The typical amplitude of ionospheric variation was on the order of 1% of the background TEC measurement for waves far afield from the epicenter, and up to 10% of the background TEC for waves close to the epicenter in the case of the Japan event of March 2011. These observations are compared to estimates of TEC perturbations produced by the Embry Riddle Aeronautical University's Spectral Full Wave Model, an atmosphere-ionosphere coupling model, with reasonable agreement. The potential exists to apply these detection techniques to real-time GPS TEC measurements, providing estimates of tsunami speed and amplitude that may be useful for early warning systems.

COUP-02 Midlatitude ion temperature during sudden stratospheric warming events - by Vicki Hsu

Status of First Author: Student IN poster competition, Undergraduate

Authors: Vicki W Hsu, Larisa P Goncharenko, Jeff P Thayer, Jiuhou Lei

Abstract: Ionospheric variability impacts a variety of communication and navigation systems. Although the primary drivers of ionospheric variability, such as solar ionizing flux and geomagnetic activity, are relatively well understood, the effects of the lower atmosphere onto the ionosphere remain elusive. Due to the current deep solar minimum and the meteorological phenomena known as sudden stratospheric warming (SSW), new studies have shown promising results that shed light on the coupling of the ionosphere to processes from below. This study focuses on the SSW events that occurred in January 2008, 2009, and 2010, and presents the results obtained from the Millstone Hill incoherent scatter radar (42.6°N,

288.5°E). We analyze observed variations in ion temperature in the altitude range 200-400 km. Regions of warming and cooling above 200 km were observed by the radar during the three campaign periods, and we assess to what degree these observations may be attributed to solar flux, geomagnetic activity, or stratospheric warming. After the sunset and during the nighttime, we report a significant increase in ion temperature, which could not be related to the increase in geomagnetic activity. We discuss if it can be associated with tidal phenomena, and how it changes during the stratospheric warming event. We also studied the SSW events that occurred in February 2001 and January 1985. Examining multiple SSW events will provide more insight into the interactions between the lower and upper atmosphere, and recognizing their connection is essential in understanding and forecasting the geospace environment.

COUP-03 Impact of Atmospheric Tides on Ionosphere-Thermosphere System by Tzu-Wei Fang

Status of First Author: Non-student

Authors: T.-W. Fang1, T. J. Fuller-Rowell1, R. A. Akmaev2, and F. Wu1
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Abstract: The Coupled Thermosphere Ionosphere Plasmasphere with self-consistent Electrodynamics (CTIPe) model is a nonlinear, coupled thermosphere-ionosphere-plasmasphere code that includes a self-consistent electrodynamics scheme for the computation of neutral wind induced dynamo electric fields. The model consists of a global thermosphere, a high-latitude ionosphere, a mid- and low-latitude ionosphere/plasmasphere and an electrodynamical calculation of the global dynamo electric field. The diurnal and semidiurnal propagating tidal modes are imposed at 80 km altitude with a prescribed amplitude and phase. Through module the CTIPe and restructure the ionosphere and plasmasphere on the apex coordinates, the Global Ionosphere and Plamsphere model (GIP) has been established. The Whole Atmosphere Model (WAM) is an extension of the operational weather prediction Global Forecast System general circulation model to the top of the atmosphere. The model is being built to study and potentially develop a capability to predict the effects of lower atmosphere dynamics and variability on the upper atmosphere and ionosphere. Since atmospheric waves can be important sources in reproducing ionospheric variability and thermospheric phenomena, we implement WAM parameters at the lower boundary of CTIPe. The geopotential height, neutral temperature, zonal and meridional wind which were prescribed by Hough mode at 80 km in CTIPe are replaced by the WAM outputs between 80 and ~100 km. We compare the tidal modes reproduced in CTIPe and WAM thermosphere to validate the wave propagation scheme in CTIPe and to understand their impact on ionospheric electrodynamics. We also use the WAM wind to drive the GIP in order to study the impacts of ionosphere during sudden stratosphere warming event and the influences from the quasi-two day wave.

COUP-04 Ionospheric Signatures of Stratosphere Sudden Warming Observed by FORMOSAT-3/COSMIC - by Jia-Ting Lin

Status of First Author: Student IN poster competition, Masters

Authors: J. T. Lin1, C. H. Lin2,3, L. C. Chang4, K. I. Oyama5, C. H. Chen6, A. B. Chen1, J. Y. Liu4,7
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6Department of Geophysics, Kyoto University, Kyoto, Japan
7Center for Space and Remote Sensing Research, National Central University, Chung-Li, Taiwan

Abstract: In this study we investigate the ionospheric signatures of Stratosphere Sudden Warming (SSW) during 2009 by using the stratospheric neutral temperature and ionospheric electron density profiles

observed by FORMOSAT-3/COSMIC. The stratospheric temperature measured between 60o~90oN geographic latitude indicates the SSW started at DOY 18, reached to its maximum at DOY 24 and ended at DOY 45. During the SSW the low-latitude ionosphere shows a signature of earlier appearance and subsidence of equatorial ionization anomaly (EIA) in every longitude, but show longitudinal and latitudinal dependences of the effect strength. We further perform the harmonic analysis on the stratospheric temperature and ionospheric electron density, and results reveal that the planetary wave-1, 2 (PW1, PW2) components of the northern stratospheric temperature were enhanced during SSW. Simultaneously, the low-latitude ionospheric tidal signatures vary with the SSW, where the nonmigrating semidiurnal westward propagating tide with zonal wavenumber 1 (SW1) and semidiurnal standing tide (S0) show significant enhancements. Enhancements of SW1 and S0 may result from nonlinear interaction between the tide and planetary wave.

COUP-05 **Using Whole Atmosphere Models to Assess Contributions To Thermospheric Temperature and Winds By Higher Order Migrating Tides** - by Joe McInerney

Status of First Author: Non-student

Authors: Joe McInerney (HAO/NCAR) and Han-Li Liu (HAO/NCAR)

Abstract: Variations in the thermosphere have previously been connected to influences from the lower atmosphere. One method to study these influences is through simulations from a whole atmosphere model which extends from the ground to near the exosphere. Two such models in development are the Whole Atmosphere Community Climate Model - Extended (WACCM-X) and the Whole Atmosphere Model (WAM). Here we present characteristics of higher migrating zonal wavenumbers 4-6 in the thermosphere as simulated by both models. We examined equinox and solstice at the equator and low- to mid-latitudes and propose influences on thermospheric temperature and winds. In particular, contribution by these wavenumbers in the two models to the Midnight Temperature Maximum (MTM) in the thermosphere are assessed and compared.

COUP-06 **Short-Term Variability of Nonmigrating Tidal Structures in the Thermosphere** - by Eric K. Sutton

Status of First Author: Non-student

Authors: Eric K. Sutton, Chin Lin, Frank Marcos, Loren Chang

Abstract: Wave activity plays an important role in the dynamics of the thermosphere due in part to upward-propagating tides generated in the lower atmosphere. Most satellite-based studies of tidal effects in the mesosphere and thermosphere tend to describe tidal amplitudes averaged over a significant time period while discarding any short-term variability. We present empirical findings of nonmigrating tidal activity from the CHAMP and GRACE satellite accelerometers. The high orbit inclination of these two missions allows us to study the latitudinal structure of the thermosphere with high spatial resolution as well as the longitudinal structure of the thermosphere averaged over just several days. Both CHAMP (2001-2010) and GRACE (2002-present) satellites span solar maximum and minimum conditions giving a unique perspective on the evolution of nonmigrating tides throughout the solar cycle.

Data Assimilation

DATA-01 **New space weather products for HF radio, GPS navigation, and aviation** - by David Boyd Hansen

Status of First Author: Student IN poster competition, PhD

Authors: Jennifer Meehan, W. Kent Tobiska, Robert Schunk, Jan Sojka, Herb Carlson, Vince Eccles, Don Rice, Jared Fulgham, Landry Heaton, Larry Gardner, Ludger Scherliess, Lie Zhu, Chris Tschan, Dave Bouwer, and Rian Shelley

Abstract: The Space Weather Center (SWC) at Utah State University is committed to developing and providing real-time, operational products for customers that will help mitigate adverse space weather effects on radio communication and navigation systems. These products are being created by utilizing physics-based models of the ionosphere and data assimilation. New space weather products for HF radio and GPS navigation users are demonstrated via real-time and forecast applications on web browsers and iPhone/iPad apps. Our team shows the wealth of new information available, including global and regional HF signal propagation strength at various frequencies. This information can be obtained in real-time or in a 3-hour forecast. Improvements to GPS uncertainty characterization in real-time are demonstrated, especially capabilities that can improve use of signals affected by scintillation. In addition to the SpaceWx iPhone and iPad app linking together the four major space environment domains (sun, solar wind, magnetosphere, atmosphere) it now includes new information relevant to dose rate radiation exposures to commercial air flight crews and frequent fliers.

DATA-02 **Upgrading La Plata Ionospheric Model in the context of the AIRES Project** - by Juan Federico Conte

Status of First Author: Student IN poster competition, Masters

Authors: Juan Federico Conte (GESA, UNLP & CONICET), Claudio Brunini (GESA, UNLP & CONICET), Francisco Azpilicueta (GESA, UNLP & CONICET), Diego Janches (NASA)

Abstract: In the framework of the AIRES (Argentine Ionospheric Radar Experiment Station) Project, we are currently upgrading the La Plata Ionospheric Model (Brunini et al., 2011). Inspired by the IRI model (Bilitza, 2000) and based on the Jones & Gallet (1965) mapping technique, after a process of data assimilation is applied, this semi-empirical model is capable of reproducing electron densities profiles dependent on the moment of the day, the geographical location and the solar activity level. At the moment, the data assimilation technique only processes the raw data obtained from ground-based dual-frequency GPS measurements. Nevertheless, the model is also capable to incorporate FORMOSAT-3/COSMIC electron densities profiles externally calculated which, combined with the ionospheric information obtained from the ground-based dual-frequency GPS measurements are used to correct the coefficients of the Jones & Gallet formulation. Consequently, we are currently working to adapt our model to process the dual-frequency GPS raw data from the FORMOSAT-3/COSMIC mission in order to obtain our own electron densities profiles, which are especially important because they give ionospheric information dependent on height.

In this poster we present the basis of our ionospheric model, the data assimilation technique, and give an introduction to the works currently carried out to upgrade the model.

Equatorial Ionosphere or Thermosphere

EQIT-01 **Coherent backscatter radar imaging study of equatorial spread F over Brazil** - by Fabiano Rodrigues

Status of First Author: Non-student

Authors: F. S. Rodrigues, ASTRA, Boulder, CO; E. R. de Paula, INPE, Brazil; A. O. Moraes, IAE, Brazil

Abstract: We have been taking advantage of the multiple baseline observations made with a 30 MHz coherent backscatter in the equatorial site of Sao Luis in Brazil to construct in-beam radar images of scattering structures responsible for equatorial spread F (ESF) echoes. The imaging technique employed here is the same developed by Hysell (1996) based on the MaxEnt algorithm. The images show scattering structures with interesting morphological patterns that, at times, resemble features observed in in-situ observations made by rockets and in measurements by the ALTAIR radar in the Kwajalein atoll. The Sao Luis images are presented and discussed in terms of current ESF theories and simulations, and previous observations.

EQIT-02 **C/NOFS observations of the effects of SSW events on equatorial vertical plasma drifts** - by Fabiano Rodrigues

Status of First Author: Non-student

Authors: F. S. Rodrigues, frodrigues@astraspace.net; G. Crowley, gcrowley@astraspace.net; S. M. I. Azeem, iazeem@astraspace.net; Rod Heelis, heelis@utdallas.edu

Abstract: We present new observations made by the Coupled Ion Neutral Dynamics Investigation (CINDI) Ion Velocity Meter (IVM) instrument onboard the Communication/Navigation Outage Forecasting System (C/NOFS) satellite showing the effects of the January 2009 sudden stratospheric warming (SSW) event on equatorial electric fields. We have used IVM observations to construct composite curves of mean equatorial vertical plasma drifts as a function of local time and longitude sector. These curves show large upward vertical drifts during morning hours and downward drifts during afternoon. Our analysis indicates that this pattern is observed over a large range of longitudes. A clear day-to-day, quasi-deterministic variability in the drifts is also observed, with the transition from upward to downward drifts occurring at increasing local times from January 25 to 30, 2009. These in-situ observations are in good agreement with previous ground-based measurements of the response of equatorial electric fields to SSW events. In particular, we found that IVM drift measurements centered around 285 Deg. E depart significantly from climatological values, but agree exceptionally well with ground-based measurements of vertical drifts made by the Jicamarca incoherent scatter radar. To our knowledge, this is the first time that signatures of SSW events on C/NOFS observations are reported. Overall, the results agree well with previous studies using ground-based observations, demonstrate the reliability of the IVM observations and motivate further studies of the variability of the equatorial ionosphere using C/NOFS.

EQIT-03 **Equatorial zonal plasma drift effects during sudden stratospheric warming events** - by Michael Olson

Status of First Author: Student IN poster competition, PhD

Authors: Olson, M. E., Center for Atmospheric and Space Sciences, Utah State University, Logan, Utah, USA; Fejer, B. G., Center for Atmospheric and Space Sciences, Utah State University, Logan, Utah, USA; Chau, J.L., Radio Observatorio de Jicamarca, Instituto Geofisico del Peru, Lima, Peru.

Abstract: We use Jicamarca incoherent scatter and JULIA radar measurements from the Jicamarca Radio Observatory to study, for the first time, the response of equatorial ionospheric E and F region zonal plasma drifts during sudden stratospheric warming events. Our results show significant variations from the climatological drifts throughout the warming. In particular, there are strong variations around the new and full moons. We also examine the corresponding variations of the vertical drifts to determine the response of the velocity vector perpendicular to the Earth's magnetic field.

EQIT-04 **Ionospheric effects of recent stratospheric sudden warmings in the low-latitude ionosphere** - by Larisa Goncharenko

Status of First Author: Non-student

Authors: L. Goncharenko, A. Coster, J. Chau, C. Valladares

Abstract: We use GPS TEC and Jicamarca ISR data to demonstrate effects of recent stratospheric sudden warming (SSW) events on low-latitude ionosphere. Previous studies of SSW events of 2008 and 2009 have revealed strong ionospheric response to such events. The ionospheric vertical drifts increase up to 50-60 m/s in the morning sector and decrease or turn negative in the afternoon sector, resulting in a 50-150% increase in TEC in the morning and ~50-60% decrease in TEC in the afternoon. Our analysis indicates that disturbances in the upper atmosphere during the SSW event of 2010 are consistent with disturbances reported for other SSW cases. In particular, at 70W longitude tidal variation in TEC becomes prominent on January 25-26, 2010, and lasts for several days. The amplitude of this variation is smaller than in 2009, likely due to the weaker SSW event.

We also investigate the characteristics of ionospheric oscillations with periods between 2 and 30 days and in wide range of latitudes. We report strongest oscillations for the 2-3 day and 5-6 day periods, though 8-10 day and 16-day waves are also present. We discuss the temporal development of these oscillations and compare it with temporal development of planetary waves in the stratosphere.

EQIT-05 **Three-dimensional simulation of equatorial spread F: modeling scheme and results** - by Henrique Aveiro

Status of First Author: Student IN poster competition, PhD

Authors: H.C. Aveiro, D.L. Hysell, R. Caton, K. Groves, J. Klenzing, R.F. Pfaff, R. Stoneback, R.A. Heelis

Abstract: A fully three-dimensional numerical scheme for the postsunset equatorial ionosphere dynamics leading to equatorial spread F (ESF) 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 for atomic (O+) and molecular (NO+ and O2+) species. 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. Simulations are performed incorporating realistic background circulation including bottomside shear flow and strong vertical current. To initialize the model runs, we derive plasma number densities from the Parameterized Ionospheric Model (PIM), ionospheric composition estimates from the IRI-2007 model, and the characteristics of the neutral atmosphere from the NRL-MSISE00 model. The results are compared to satellite and radar observations, and reproduce several important characteristics of equatorial spread F.

EQIT-06 Perkins' instability simulations of MSTID Seeding Equatorial Spread F - by Timothy Duly

Status of First Author: Student IN poster competition, PhD

Authors: Timothy Duly

Abstract: Recently, there have been observational evidence of medium scale traveling ionospheric disturbances (MSTIDs) coupling into equatorial regions and seeding equatorial spread F (ESF) there [Miller 2010]. In this poster, we will run a numerical model of the Perkins' instability at a mid-latitude location to investigate the viability of MSTIDs forming, which is a necessary condition for coupling into equatorial regions. The simulation will be compared with radar data collected at the Christmas Island Observatory, an equatorial site in the Pacific. It will be shown that simulations of the Perkins' instability for MSTID formulation correspond with radar data for post-midnight, solar minimum ESF, providing simulation support of this observed data.

EQIT-07 Ionospheric Plasma Depletion Comparison from two Longitudinal Sectors Measured by Airglow Emissions
by Narayan Prasad Chapagain

Status of First Author: Student NOT in poster competition, PhD

Authors: Narayan P. Chapagain, Michael J. Taylor, and J. Vincent Eccles
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Abstract: We analyze the development and dynamics of the equatorial plasma depletions measured by Utah State University all-sky CCD camera using OI (630.0 nm) airglow emissions from two longitudinal sectors: Christmas Island in the Central Pacific Ocean and Ascension Island in South Atlantic Ocean. The results show the large day-to-day variability of the plasma bubbles evolution and development. During the post midnight period, the data from Christmas Island consistently showed nearly constant eastward bubble velocity at a much higher value (~80 m/s) than expected, while data from Ascension Island exhibited a most unusual shear motion of the bubble structure, up to 55 m/s, on one occasion with westward drift at low latitude and eastward at higher latitudes, evident within the field of view of the camera.

EQIT-08 Drift Turbulence from Density-Gradient in the Ionosphere E-Layer
by Ehab Hassan

Status of First Author: Student IN poster competition, PhD

Authors: Ehab Hassan

Abstract: The vertical density gradients in the ionosphere produce low frequency drift wave type instabilities that is important for modulating, scattering and disrupting radio frequency signals propagating through the ionosphere. We look in some detail at the theory and simulations of these waves in the equatorial E-layer region where the horizontal magnetic field is nearly perpendicular to the Earth's magnetic field. Two nonlinear partial differential equations are derived for the large scale convection, vortices and bubbles that arise in from the vertical density gradients. The dynamical equations are solved numerically with pseudo-spectral codes. We find coherent structures on scales of 10 to 100km and small scale turbulence from few meters to 10km. Then we show simulations and theoretical models for various forms of the drift wave turbulence in the ionosphere at altitudes below the peak electron density in the F-layer.

EQIT-09 Recognition of Equatorial Plasma Bubbles and Medium-Scale Traveling Ionospheric Disturbances in Airglow Images
by Thomas Williams Gehrels

Status of First Author: Student IN poster competition, Masters

Authors: Thomas Gehrels; Jonathan Makela, jmakela@illinois.edu; Nicholas Yap, yapjiun1@illinois.edu

Abstract: A large database of night-sky images is being collected in order to study 630.0-nm thermospheric/ionospheric emissions. These images are collected using narrow field imaging systems in Hawaii and Chile. Classification of images containing Equatorial Plasma Bubbles (EPB) and Medium-Scale Traveling Ionospheric Disturbances (MSTID) is useful both for real-time detection for operational systems and for analysis of the properties of these phenomena. A system for analyzing sequences of images and automatically labeling images based on their content has been developed,and algorithms to reduce the computational cost of this analysis have been considered to allow for near real-time detection. We present results compared to human classification, showing excellent accuracy for distinguishing between clear and cloudy images as well as detecting images containing EPBs.

EQIT-10 Equatorial plasma bubbles triggered by non-equatorial traveling ionospheric disturbances or gravity waves - by Jonathan Krall

Status of First Author: Non-student

Authors: J. Krall, J. D. Huba, G. Joyce*, J. J. Makela**, and E. S. Miller+
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** Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois, USA.
+Johns Hopkins University Applied Physics Laboratory, Laurel, Maryland, USA.

Abstract: The Naval Research Laboratory three-dimensional simulation code SAMI3/ESF is used to study the response of the post-sunset ionosphere to electrified mesoscale traveling ionospheric disturbances (MSTIDs). An MSTID is modeled as an externally-imposed traveling-wave E field with wavelength 250 km and period 1 h that drives vertical E × B drifts of up to ±50 m/s. We find that the coupling between the MSTID at low- to mid-latitudes and the equatorial F layer leads to growth of equatorial plasma bubbles (EPBs). This coupling is strongest when the wave vector is perpendicular to the geomagnetic field. Model results reproduce key features of observed nighttime MSTIDs and associated EPBs. We have separately studied the coupling of both circular (local) and plane wave (non-local) gravity waves to the bottomside F layer as a mechanism for triggering EPBs. Results generally support the idea that non-plane gravity waves more strongly couple to the F layer than plane gravity waves. In all cases this coupling occurs through the electric potential, which “maps” disturbances along field lines to the equator and to the conjugate ionosphere.

EQIT-11 Lunar Tidal effects of the equatorial vertical drifts over Jicamarca
by Brian D. Tracy

Status of First Author: Student IN poster competition, Undergraduate

Authors: B.D. Tracy1, B.G. Fejer1, and J.L. Chau2
1.Center for Atmospheric and Space Sciences, Utah State University, Logan, Utah, USA.
2. Radio Observatorio de Jicamarca, Instituto Geofisico del Peru, Lima, Peru.

Abstract: We study lunar tidal perturbations on the equatorial E and F electrodynamic vertical plasma drifts using Jicamarca incoherent scatter and JULIA radar observations. Our data displays strong local time and

seasonal effects which have the largest amplitudes during December solstice. We also examine the altitudinal and solar cycle dependence of these drifts. Our data will be compared with results from earlier studies.

EQIT-12 **SAMI2-PE is Another Model of the Ionosphere Including Photoelectron Transport** - by Roger H. Varney

Status of First Author: Student IN poster competition, PhD

Authors: Roger H. Varney, Wesley E. Swartz, David L. Hysell, Joseph D. Huba, Phillip G. Richards

Abstract: We present an expanded version of the two dimensional SAMI2 ionospheric model which includes photoelectron transport. The new model can use as many pitch angle bins as desired, includes effects associated with curved magnetic field lines, includes the anisotropic pitch angle distribution of newly produced photoelectrons, retains the time dependent terms in the photoelectron transport equations, and uses an energy degradation procedure which will conserve energy on coarse, non-uniformly spaced energy grids. The solutions to the photoelectron transport equations are used to generate secondary electron production rates and thermal electron heating rates which are then passed to the fluid equations in SAMI2. The heating rates produced by the photoelectron model are a drastic improvement over the existing electron heating model in SAMI2. Eight pitch angle bins appear to be sufficient to generate accurate electron heating rates. The modeled electron temperatures show promising agreement with measured profiles from Jicamarca.

EQIT-13 **Validation of the 2007 Horizontal Wind Model at Solar Minimum via Equatorial Field-Aligned Ion Drifts** - by Angeline Gail Burrell

Status of First Author: Student NOT in poster competition, PhD

Authors: Angeline G. Burrell and Roderick A. Heelis

Abstract: The movement of ions along terrestrial magnetic field lines frequently causes the redistribution of ionization between northern and southern hemispheres. One of the primary reasons for this transport is diffusive motion due to the raising and lowering of the ion density peaks by the low-altitude neutral wind. The Horizontal Wind Model (HWM07) is a standard empirical reference model that provides the meridional and zonal components of disturbed and background neutral winds at a range of altitudes and solar conditions. The lack of neutral wind measurements available, however, makes it difficult to predict how the winds will behave under abnormal solar conditions, such as those seen in 2008 and 2009. The Communications/Navigation Outage Forecast System (C/NOFS) satellite and the Coupled Ion Neutral Dynamics Investigation (CINDI) have provided measurements of ion velocities and ion densities in the topside ionosphere beginning in 2008, facilitating a comparison between modeled and measured field-aligned drifts. Using SAMI2 is Another Model of the Ionosphere (SAMI2), the effect of the neutral wind on the field-aligned drifts can be isolated and the strength of the field-aligned component of the low-altitude neutral wind can be evaluated.

EQIT-14 **Longitudinal and Seasonal variation of ion density, temperature and composition during solar minimum** - by Sasmita Mohapatra

Status of First Author: Student NOT in poster competition

Author: Samita Mohapatra, sasmita.mohapatra5@gmail.com

Abstract: Plasma temperature, composition and density observed below 500 km altitude by the ~13 degree inclination C/NOFS satellite are studied. Based on the C/NOFS satellite observations from the year 2008 to 2009, the longitudinal and seasonal distributions of ion temperature (Ti), total ion density (Ni) and ion

composition are studied in terms of local time, season, latitude, magnetic declination and solar flux intensity. The longitudinal variations of both Ti and Ni exhibit obvious seasonal dependence. The electron temperature shows a steep rise in the early morning (well known as "morning overshoot"), a decrease after that, and again an increase at ~18 hours (well known as "evening overshoot"). The evening overshoot becomes more pronounced in the higher latitudes in all seasons. The extended solar minimum prevailing during the C/NOFS mission allows us to establish a baseline model of the quiet-scent seasonal variations of the topside equatorial ionosphere. The IRI measurements at ~500 km altitude of the total ion density and temperature are compared with the C/NOFS measured parameters at the same altitude.

EQIT-15 Effect of IMF Bz orientation on equatorial electrojet plasma waves
by Esayas Shume

Status of First Author: Non-student

Authors: Esayas Shume, Eurico de Paula, M. A. Abdu

Abstract: This study presents day-time 30 MHz coherent scatter radar observations of equatorial electrojet plasma irregularities in Sao Luis (Brazil) during the January 10, 2002, September 4, 2002, and November 6, 2001 geomagnetic storms.

EQIT-16 Effects of convection driven gravity waves on equatorial electrojet plasma waves - by Esayas Shume

Status of First Author: Non-student

Authors: Esayas Shume, Eurico de Paula, Fernanda Sao Sabbas, Jose Valentin Bageston

Abstract: The Sao Luis 30 MHz radar measured quasi-oscillation in the power coherently scattered from equatorial electrojet (EEJ) plasma irregularities (January 9, 2002, quiet day). On the same day, the oscillations were also evident in the horizontal magnetic field perturbation Delta H data observed at equatorial magnetometer station Sao Luis. In this study, we have used (1) spectral analysis of the magnetic field perturbation Delta H signal, (2) GOES 8 IR satellite images, and numerical models to investigate the physical mechanisms for the oscillations of the scattering layer and the equatorial electrojet.

EQIT-17 Analyzing the IAR with IRI During the Recent Solar Minimum
by Stoyan Ivanov

Status of First Author: Student IN poster competition, Undergraduate

Authors: Stoyan Ivanov ,sivanov3@gatech.edu; Jeffrey Klenzing , jeffrey.klenzing@nasa.gov; Fernando Simoes, fernando.a.simoes@nasa.gov; Dieter Bilitza, dieter.bilitza-1@nasa.gov; Phillip Chamberlin, phillip.c.chamberlin@nasa.gov; Douglas Rowland, douglas.e.rowland@nasa.gov

Abstract: The Communications/Navigations Outage Forecast System (C/NOFS) satellite has been able to measure the resonance of Alfven waves inside an ionospheric Alfven resonator (IAR). However, predictions of IAR parameters generated with the International Reference Ionosphere (IRI) have disagreed substantially with C/NOFS measurements. The disagreement was identified to be related to the deep solar minimum between 2008-2009. This was the deepest solar minimum within the last century and as such limited the effectiveness of the empirical IRI model.

EQIT-18 **Stormtime electric field response in the equatorial ionosphere seen from CINDI (C/NOFS) and DMSP data** - by Marc Hairston

Status of First Author: Non-student

Authors: Marc Hairston, University of Texas at Dallas, hairston@utdallas.edu; William Robin Coley, University of Texas at Dallas, coley@utdallas.edu; Russell Stoneback, University of Texas at Dallas, rstoneba@utdallas.edu

Abstract: During times of large geomagnetic storms, the penetration field from the magnetosphere can extend down to the mid-latitude regions and affect the equatorial electric field in the ionosphere. Under these conditions the equatorial east-west electric field becomes more strongly eastward on the dayside and more strongly westward on the nightside. Such an enhancement of the electric field should manifest itself as an increased upward (dayside) or downward (nightside) meridional ion flow in the ionosphere. As the sun's activity has picked up in the past 18 months we have seen an increase in the number of geomagnetic storms which allow us to test for this response. We use the polar ionosphere data from DMSP spacecraft to characterize the onset time and magnitude of the storm, then compare it against the observed meridional ion flows seen by the plasma instrument CINDI on board the equatorial-orbiting C/NOFS spacecraft. An updated analysis of the 2 May 2010 storm will be presented along with some more recent storms.

EQIT-19 **Factors Controlling Prompt Penetration Electric Fields During Superstorms** - by Anthony J. Mannucci

Status of First Author: Non-student

Authors: A. J. Mannucci (1), G. Crowley (2) and B. T. Tsurutani (1)
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Abstract: Prompt penetration electric fields (PPEF) are the primary physical cause of prompt large magnitude ionospheric total electron content (TEC) perturbations on the dayside during the onset phase of superstorms. For the largest superstorms of solar cycle 23, ground networks of GPS receivers measured peak total electron content increases greater than a factor of 2 relative to quiet time TEC averaged over the broad latitude band ±40° for local times 1200-1400. Near 30° latitude, the Halloween storm of 2003 appeared to produce stormtime TEC exceeding quiet time values by a factor of 5 within 2-3 hours of storm onset, at 1300 LT. The physical cause of PPEF is expected to be Region 1 current closure through the ionosphere (Nopper & Carovillano mechanism). An outstanding question is what determines the efficiency of PPEF and why this varies for different superstorms. In some cases, the PPEF measured at the dayside equator appears to be a fixed fraction of the solar wind electric field, approximately 10%, calculated as the product of interplanetary speed and southward magnetic field (Vx * Bs). However, this simple relationship does not always hold. In this poster, we discuss factors that affect the efficiency of PPEF and present data that suggests possible causes for variability of electric field penetration efficiency among different superstorms.

Irregularities of the Ionosphere or Atmosphere

IRRI-01 **Ionospheric disturbances detected by GPS total electron content observation after the 2011 Tohoku earthquake** - by Takuya Tsugawa, presented by Michi Nishioka

Status of First Author: Non-student

Authors: Takuya Tsugawa, Akinori Saito, Yuichi Otsuka, Michi Nishioka, Takashi Maruyama, Hisao Kato, Tsutomu Nagatsuma, and Ken T. Murata

Abstract: All the details of the commencement and evolution of ionospheric disturbances after the 2011 off the Pacific coast of Tohoku Earthquake were firstly revealed by the high-resolution GPS total electron content observation in Japan. The initial ionospheric disturbance appeared as sudden depletions by ~6 TEC unit (20%) following small impulsive TEC enhancements around 05:54UT, about seven minutes after the earthquake onset, near the epicenter. At 06:00UT, zonally extended enhancements of TEC appeared in the west of Japan, and traveled to the southwest direction. From 06:00UT to 06:15UT, large-scale circular waves with two peaks propagated in the radial direction in the propagation velocity of 3,457m/s and 783m/s for the first and second peak, respectively. Following the large-scale waves, medium-scale concentric waves appeared to propagate at the velocity of 138 -423m/s after 06:15 UT. In the vicinity of the epicenter, short period oscillations with period of ~4 minutes were observed after ~06:00 UT for 3 hours or more. The circular or concentric structures of the large- and medium-scale waves indicate that these ionospheric disturbances had a point source. The center of these structures was located around 37.5N of latitude and 144.0E of longitude, 170 km far from the epicenter to the southeast direction.

IRRI-02 **Study on night-time F-region irregularities using a VHF radar, ionosondes, and ground-based GPS stations in Southeast Asia** by Michi Nishioka

Status of First Author: Non-student

Authors: Michi Nishioka,Yuichi Otsuka, Takuya Tsugawa, and Kazuo Shiokawa

Abstract: During solar minimum period, many plasma irregularities have been observed around midnight in June solstice seasons. The occurrence characteristics of the plasma irregularity is different from that of plasma bubble. It has not been understood whether the midnight irregularity is related to plasma bubble or Traveling Ionospheric Disturbance (TID). In this study, we revealed the occurrence characteristics of midnight plasma irregularities from 2006 to 2011 observed by VHF radar installed in Indonesia. The occurrence condition is diagnosed further by a latitudinal ground-based GPS networks and an ionosonde in Southeast Asia.

IRRI-03 **Plasma wave irregularities in the equatorial topside E-region** by Ronald Ilma

Status of First Author: Student IN poster competition, Undergraduate

Authors: R. R. Ilma, D. L. Hysell, M. C. Kelley, H. C. Aveiro and J. L. Chau

Abstract: Large-scale plasma waves have been detected by the low-power JULIA radar in the last decade. These waves, which occur at the topside of the E-region, are a new class of equatorial irregularities and they have not been previously predicted. Although the source of these echoes have not been precisely determined, the current radar database (single-baseline interferometry and aperture synthesis imaging mode) tentatively suggest that they are associated with a gradient drift instability capable of generating

these large-scale primary waves. The statistical result of single-baseline interferometry observations reveal that the probability to detect these echoes is higher during equinox, mainly between 120 and 140 km around twilight. These study is also presenting preliminary efforts on modeling of these irregularities by using a computer simulation code which has been satisfactorily applied to Spread-F previously.

IRRI-04 A Study of the Relation between Mean Doppler Velocity Shear of Es 3-meter field-aligned Irregularities and Neutral Wind Shear by Using Chung-Li VHF Radar - by Ting-Han Lin

Status of First Author: Student IN poster competition, Masters

Author: Ting-Han Lin

Abstract: In February 2008, we observed sporadic E (Es) 3-meter field-aligned irregularities (FAIs) with Chung-Li VHF radar. The 3-dimensional spatial structures of the Es FAIs were reconstructed by using interferometry technique. We estimated the horizontal extents and thicknesses of the Es FAIs structures from the interferometer-resolved echo patterns. An examination shows that the height-time variation of the FAIs structure descending with a downward velocity about 3 km/hr was similar to that of Intermediate Tidal Ion Layer (ITIL) measured by Incoherent scatter radar. We find that the averaged mean Doppler velocity shear in the FAIs structures was about 6 ms-1km-1. The relation between neutral wind shear and generation mechanism of the FAIs was also discussed by comparing the mean Doppler velocity shear, averaged spectral width and averaged echo power of the FAIs structure, respectively. The result shows a positive correlation between mean Doppler velocity shear and averaged spectral width of the FAIs. We speculated that the neutral wind shear was very likely the cause of mean Doppler velocity shear.

IRRI-05 Occurrence of mid-latitude field-aligned irregularities observed with VHF coherent scatter ionospheric radar in South Korea by Tae-yong Yang

Status of First Author: Student IN poster competition, Masters

Authors: Tae-Yong Yang1,2, Young-Sil Kwak1, Jae-Jin Lee1, Junga Hwang1, Seong-Hwan Choi1, Young-Deuk Park1 and Yeon-Han Kim1
1Korea Astronomy and Space Science Institute, Korea
2University of Science and Technology, Korea

Abstract: The 40.8-MHz VHF coherent scatter ionospheric radar, located in South Korea(Gyeryong, 36.18°N, 127.14°E), has been operating since December 2009 to investigate ionosphere E- and F-region field-aligned irregularities(FAIs) of mid-latitude. During the observation, we found E- and F-region FAIs appeared frequently: interesting daytime irregularities, continuous echoes during the post-sunrise period and Quasi-Periodic(QP) echoes at nighttime for E region; strong post-sunset and pre-sunrise FAIs for F region. We present characteristics of mid-latitude E- and F-region plasma irregularities observed using Korea VHF radar. Additionally, we also present seasonal and local time variations of occurrence of mid-latitude E- and F-region FAIs during low solar activity period, December 2009 - May 2011. It is worth to note our occurrence result since long term observation over a year in the mid-latitude has not yet been carried out.

IRRI-06 Heater Beam Angle Effect on Simulated Brillouin Scatter in Magnetized Ionospheric Plasma - by Haiyang Fu

Status of First Author: Student IN poster competition, PhD

Authors: Haiyang Fu1, Wayne Scales1, Paul Bernhardt2, Stan Briczinski2, Geoffrey San Antonio2, Craig. A. Selcher2

1 Bradley Department of Electrical and Computer Engineering, Virginia Tech, Blacksburg, VA 24060
2 Plasma Physics Division, Naval Research Laboratory, Washington, DC 20375

Abstract: The HAARP 3.6MW HF transmitter is used to excite the low frequency electrostatic waves by magnetized stimulated Brillouin scatter (MSBS) near the reflection resonance region or the upper hybrid resonance regions. The pump wave (O mode) may excite either electrostatic ion acoustic wave (IA) or electrostatic ion cyclotron wave (EIC) waves depending on the wave propagation relative to the ambient magnetic field. It had been confirmed that only ion acoustic waves are observed for propagation near magnetic zenith while EIC waves can only be observed with more oblique propagation angles.
The experiment conducted at 2010 HAARP summer school aims to look more thoroughly at a broader range of heater beam angle effects on IA and EIC waves generated by MSBS. The time history of Electromagnetic backscattered waves by the HAARP transmitter is recorded with a 4-channel spectrum analyzer SEE (Simulated Electromagnetic Emission) receiver. The diagnostics data were also collected by the University of Alaska Super DARN radar facility and the MUIR incoherent scatter radar meanwhile. The experimental results show that stronger IA and EIC spectrum emission lines were observed by the O-mode excitation near the reflection resonance region and the upper hybrid resonance region in the F layer of the ionosphere. With tilting angles far away from magnetic zenith, there exists a critical heater power beam angle, where two EIC spectrum lines appear in the lower SEE spectrum. The newly observed EIC line is considered to originate from the upper hybrid resonance region. The amplitude of EIC spectrum line is more sensitively affected by the power beam angle than the IA spectrum lines. The amplitude of IA spectrum line is often observed, which are excited strongly near the magnetic zenith case. These emission lines can be utilized as a tool to provide useful diagnostics of the ionosphere.

IRRI-07 Statistical Investigations of Layer-type and Clump-type Plasma Structures of 3-meterField-Aligned Irregularities in Nighttime Sporadic E Region Made with Chung-Li VHF Radar

by Chien Ya Wang

Status of First Author: Non-student

Authors: C.Y.Wang, K.F.Yang , C.L.Su, Ruey-Ming Kuong, Hsyang-Chan Chen, and Y.H.Chu
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Abstract: With interferometry measurements made with Chung-Li 52 MHz VHF radar, characteristics of layer-type and clump-type plasma structures of 3-m field-aligned irregularities are investigated for the first time. Long-term statistics show that the thickness and the zonal extent of the layer-type plasma structures are in the ranges of approximately 0.2-4 km and 5-28 km, respectively. However, the vertical and zonal extents of the clump-type plasma structure are comparable with each other, ranging from 2 to 12 km. From interferometry-measured echo distributions about the perpendicularity to the local magnetic field line, it is found that the mean aspect angle of the 3-m field-aligned irregularities for the layer-type plasma structures is about 0.05° smaller than that for the clump-type plasma structures. The zonal trace velocities of the layer-type and clump-type plasma structures estimated from their temporal displacements in the horizontal plane are, respectively, in ranges of -150-100 m/s and -180-80 m/s, in which negative (positive) values indicate eastward (westward) drift. The characteristics of the Doppler spectra of the echoes from the layer-type and clump-type plasma structures are also analyzed.

IRRI-08 Irregularity Excitation Associated with Ionospheric Dust Cloud Boundary Layers and Dusty space plasma diagnosis using temporal behavior of polar mesospheric summer echoes during active modification - by Alireza Mahmoudian

Status of First Author: Student IN poster competition, PhD

Authors: Alireza Mahmoudian and Wayne .A Scales

Abstract: Dusty plasmas are rather common in space, being found in planetary rings, interstellar clouds, cometary plasma tails, and the ionosphere of the Earth and other planets. In the Earth's ionosphere the origin of plasma components is from eruptions of volcanoes, meteorite showers as well as anthropogenic factors: rocket and airplane exhausts, large fires, explosions, and so on.

Over 40 metric tons of meteoric dust enters the earth's atmosphere every day. This dust settles and creates natural dust layers in the altitude range between 80 and 100 kilometers which spans the earth's upper mesosphere to lower thermosphere. Since these dust layers are immersed in the earth's upper atmosphere, they become charged due to collection of electrons and ions from earth's ionospheric plasma. Noctilucent Clouds NLCs are a fascinating visual manifestation of these dust layers. So-called Polar Mesospheric Summer Echoes PMSEs are radar echoes that are a direct consequence of the sub-visible charged dust that exists at altitudes above NLC regions. Polar Mesospheric Summer Echoes (PMSE) are strong echoes that have been typically observed in the frequency range from 50MHz to 1.3GHz and in the altitude about 85Km. The PMSE is produced by scattering from electron irregularities due to electron charging on the irregular subvisible mesospheric dust layer. The radar echoes occur at half the radar wavelength therefore the wavelength of the irregularities are roughly in the range of 10cm to 10m. The cause of dust density structures and their persistence over relatively long intervals (10s to 100s of milliseconds) had been an open scientific question and longtime controversial topic.

The first objective of this paper is to consider the temporal behavior of electron irregularities amplitude after turn-on and turn-off of radio wave heating. The variation of plasma parameters and their effect on electron irregularities amplitude is studied. The results described in this paper obtained using mesospheric parameters measured in recent in-situ experiments and are based on the radar facilities and frequencies which are available at EISCAT and HAARP for actual experimental predictions. The results will be compared with the data from recent active modification of PMSE experiments at 56MHz, 224MHz and 930MHz.

In the second part the developed analytical model to validate the computational model will be introduced and possible diagnostic information regarding the charged dust layer and plasma parameters is investigated. In the last part numerical simulation of the generate dust acoustic wave at the boundary layer of charged dust cloud is studied. This can be considered as the first attempt to justify the irregularities existed at the half of radar wavelength at the mesospheric altitude by plasma irregularities generated at the boundary layer of ionospheric dust cloud. The similarity of these excited waves at the boundary with the data from recent in-situ experiments at the PMSE source region is discussed. Other applications of this simulation to the radar echoes observed during the chemical and aerosol release space experiments and laboratory plasma experiments is considered.

IRRI-09 Shear flows in the Mid-latitude E layer - by Eliana Nossa

Status of First Author: Student IN poster competition, PhD

Authors: E. Nossa (1), D. L. Hysell (1), P. Gierasch (1), M. Larsen (2), S. Smith (3), S. Raizada (4), M. P. Sulzer (4), S. Gonzalez (4), J. Munro (5)
(1) Cornell University
(2) Clemsom University
(3) Boston University
(4) Arecibo Observatory
(5) University of Virgin Islands, St. Croix

Abstract: A theoretical analysis under the shear flows theory is presented to explain the irregular sporadic E ionization layers that has been observed at mid-latitudes, giving rise to the irregularities known as quasi-periodic echoes.

IRRI-10 **Observations and theory of ion gyro harmonic structures in the Stimulated Electromagnetic Emission (SEE) spectrum excited near second harmonic of electron gyro-frequency** - by Alireza Samimi

Status of First Author: Student IN poster competition, PhD

Authors: Alireza Samimi, Wayne Scales, Maitrayee Bordikar, and Paul Bernhardt

Abstract: Recent observations of Stimulated Electromagnetic Emission (SEE) for ionospheric heating near the second electron gyro harmonic frequency at the HAARP facility, show structures ordered by harmonics of ion gyro-frequency. An analytical model is provided in which parametric decay of the pump wave into upper hybrid/electron Bernstein and neutralized ion Bernstein waves is considered. It is shown that for the pump wave frequencies near the second electron gyro-harmonic, a band of upper hybrid/electron Bernstein waves separated by harmonics of the ion gyro-frequency is destabilized. The effects of the electron to ion temperature ratio, the pump field strength, and its frequency offset from second harmonic of electron gyro-frequency, and off perpendicular angle of the pump field relative to background magnetic field, on the destabilized structures are presented. It is shown that for certain parameter regimes of the pump field, the destabilized structures are in agreement with characteristics of recent experimental observations.

Furthermore, a new 2D computational model using the Particle-In-Cell (PIC) method is developed to more thoroughly study nonlinear plasma processes involved in producing these spectral features. Initial results are in acceptable agreement with predictions of simplified analytical model.

Instruments or Techniques for Ionospheric or Thermospheric Observation

ITIT-01 **Study of ITM region using ISS as a launch platform** by Padmashri Suresh

Status of First Author: Student IN poster competition, PhD

Authors: Padmashri Suresh and Charles M. Swenson

Abstract: The International Space Station (ISS) serves as a unique and stable platform for deploying multiple small satellites in a responsive or long-term approach. This approach, along with the ISS's convenient location within the heart of the Ionosphere-Thermosphere-Mesosphere (ITM) region, enables the scripted creation of localized and global sensor constellations targeted at key ITM measurement parameters.

The most important highlight of this launch platform would be the ability to perform both in-situ and remote measurements of the 150-400 Km range of ITM region often referred to as "region-of-low-accessibility". We investigate the possible science questions that can be investigated from a mission launched from this platform. An example conceptual study for multi-point measurements of ion and neutral composition using a CubeSat constellation mission launched from the ISS platform is presented.

ITIT-02 **Thermospheric Winds Observed by two All-sky Imaging Fabry-Perot Spectrometers** - by Callum Anderson

Status of First Author: Non-student

Authors: C. Anderson, M. Conde and M. G. McHarg

Abstract: All-sky scanning Doppler imagers (SDI's) are routinely used to infer upper-atmospheric wind fields by measuring the azimuthal variation of the line-of-sight component of the wind. Derivation of these

monostatic (single-station) wind fields requires approximating the spatial wind variation by a first-order Taylor expansion about the zenith, and in addition requires an assumption to be made about one of the four wind gradients. The validity of these assumptions has until now been difficult to assess.
Recently, data from two nearby SDI's located at Poker Flat and Gakona, in Alaska, with overlapping fields-of-view, have been used to infer upper-atmospheric wind vectors through bistatic inversion of line-of-sight winds measured by each instrument in common atmospheric volumes. The horizontal component of these winds can be calculated by assuming a value for the local vertical wind, however the inferred winds are not very sensitive to this choice of vertical wind. The bistatic estimates thus represent a much more direct measurement of the wind than do the monostatic fields.

In this study we compared monostatic wind fields from both instruments with bistatic winds inferred in the regions where their fields-of-view overlapped. This comparison showed that the monostatic technique was often very reliable at modeling the large-scale, first-order wind field for a large range of flow configurations. However, the bistatic technique was essential when accurate knowledge of the small-scale structure of the wind was required.

ITIT-03 **The Ampules Mission: Measurement of Three-Dimensional, Thermospheric Neutral Winds and Gradients with A New Type of Sounding Rocket Payload** - by Carl Andersen

Status of First Author: Student IN poster competition, PhD

Authors: Carl Andersen, Mark Conde, Miguel Larsen

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 and Wallops Island, VA on August 3, 2010. The payload consists of a collection of sub-payloads, or ampules, that are propelled laterally out of the rocket during flight. Each ampule contains around 380 ml of liquid tri-methyl aluminum (TMA) which, after separating from the main rocket, is dispersed by explosive detonation. The result is a luminous "puff" that can be tracked by triangulation using images taken from several ground stations. Twelve puffs were successfully deployed in the February 2010 Ampules mission; tracking their drift produced neutral wind measurements with typical uncertainties of just 2 m/s. The mission thus demonstrated the efficacy of this technique for measuring winds in the upper E-region. Future missions would deploy a constellation of TMA puffs throughout a 3-dimension volume spanning approximately 100x100 km horizontally and vertically from 100 to 180 km altitude. The objective of these deployments is to measure height profiles of all nine first-order spatial gradients of the neutral wind vector in the lower thermosphere.

ITIT-04 **Bistatic Observations of Thermospheric Winds and Temperatures in Peru** - by John W. Meriwether

Status of First Author: Non-student

Author: John W. Meriwether

Abstract: Three Fabry-Perot observatories located at Arequipa, Nazca, and Jicamarca are applied to observe vector winds at four common volume locations between the geomagnetic equator and 8 degrees dip latitude. First results will be presented.

ITIT-05 **CESAR First Light** - by Martin Grill, presented by Tom Slanger

Status of First Author: Non-student

Authors: martin.grill@sri.com, elizabeth.kendall@sri.com, riccardo.melchiorri@sri.com, tom.slanger@sri.com

Abstract: CESAR (Compact Echelle Spectrograph for Aeronomic Research) is an NSF MRI-funded instrument that is nearing completion at SRI International.

This is a high-spectral-resolution large-bandwidth system designed to be re-locatable, with initial measurements planned for the Poker Flat Research Range in Alaska. CESAR autonomously records continuous "patrol mode" spectra. Flexible campaign-mode operation can be commanded remotely in real time. First light was achieved recently, with a laboratory N2 discharge source being used to obtain a spectrum resembling that of an aurora. The N2 First Positive system was recorded at a resolution close to the design figure of 20,000.

ITIT-06 **A high-speed tomographic imaging system for studying dynamic aurora** - by Genevieve Plant

Status of First Author: Student IN poster competition, Undergraduate

Authors: G. Plant(1), J.L. Semeter(1), R. Marshall(1)(2), H. Dahlgren(1), C. Goenka(1), D. Hampton(3)
(1) Boston University, USA
(2) Stanford University, USA
(3) Geophysical Institute University of Alaska Fairbanks, USA

Abstract: Imaging of the rapid variations and dynamic processes of aurora requires advanced high-speed optical systems and sensitive low-light detectors. To improve our current understanding of the physics and formation of aurora, information on the vertical evolution along the geomagnetic field lines of the auroral emissions is crucial. For the full three-dimensional picture of the formation of aurora in the ionosphere, tomographic reconstruction from two or more ground-based stations can be implemented. The additional dimension provides important knowledge on the energy distribution of the precipitating electrons and thus the accelerating mechanisms. A system consisting of two identical imagers with individual controlling systems has been developed for this purpose. Each imager consists of an EMCCD detector, optical system and cut-off interference filter, to suppress the long-lived emissions in the auroral spectrum. The imagers are located 40 km apart, and can obtain images at 30 Hz. Time synchronization is vital for the tomographic reconstruction and each imager has its own gps module for this purpose. High-speed images at unprecedented 50 Hz obtained with the Andor sCMOS detector are presented and demonstrate the need for high temporal resolutions of the aurora. Results from tomographic simulations of the aurora using reconstruction techniques will also be presented.

ITIT-07 **Liquid Crystal Tunable Filters for aeronomy and beyond** by Chhavi Goenka

Status of First Author: Student IN poster competition, PhD

Authors: Chhavi Goenka (Boston University), Joshua Semeter (Boston University), Robert Marshall (Boston University/Stanford University), Jeffrey Baumgardner (Boston University), Hanna Dahlgren (Boston University), John Noto (Scientific Solutions, Inc)

Abstract: An instrument, called the Liquid Crystal Hyperspectral Imager, has been developed to make simultaneous measurements in various wavelength ranges. It has at its center a liquid crystal tunable etalon designed and manufactured by Scientific Solutions Inc (SSI). The refractive index of the liquid crystal is

controlled by applying a voltage across it, thereby enabling it to perform measurements over a pre defined wavelength range. The etalon is segmented into four quadrants, each of them voltage-controlled individually. The optics have been designed to produce four images on a single detector. The combination of the segmented etalon and the optics enable observations in four different wavelength ranges simultaneously, eliminating the need for four completely separate instruments, bringing the cost down significantly. The instrument along with a data acquisition system and a signal processing algorithm can be used in numerous fields to observe transient targets, including aeronomy, biomedical studies, chemical analysis, etc. Optical design of the instrument, results of lab testing of the etalon will be presented and various applications will be discussed.

ITIT-08 Mid-Latitude Thermospheric Wind Observation - by Qian Wu

Status of First Author: Non-student

Author: Qian Wu

Abstract: Recent advances in ground based mid-latitude thermospheric wind observation have provided new insight on the thermospheric dynamics. We will present new results from Millstone Hill and Palmer Station instrument in this poster.

ITIT-09 Simulations of a Satellite-Based Fabry-Perot Interferometer for Measuring Upper-Atmospheric related Temperatures and Winds by Yiyi Huang

Status of First Author: Student IN poster competition, PhD

Authors: Yiyi Huang, Jonathan J. Makela

Abstract: We present a method for retrieving profiles of neutral temperatures and winds in the upper atmosphere, based upon the simulation of a satellite-based Fabry-Perot interferometer (FPI). We focus on two issues: 1) A forward model producing the interference spectrum based on climatological models, and the inverse process used to estimate the weighted averaged temperature and wind along the FPI's LoS. This FPI model is valid for both ground- and satellite-based simulations. 2) Retrieval of profiles of neutral temperatures and winds from a simulated satellite-based FPI. This is achieved by using a Abel-like inversion of the measured spectrum. For each layer, the contributions to the spectrum from higher layers are removed in the spectral domain. Results are presented demonstrating the utility of this analysis technique.

ITIT-10 Lessons from a Lifetime: The Temporal Evolution of O(1D) Emission in Ionospheric Modification - by Konstantinos S. Kalogerakis

Status of First Author: Non-student

Authors: Konstantinos S. Kalogerakis (1), Eleanor B. Byler (1,2), Michael A. Glaros (1, 3)
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Abstract: The atomic oxygen red lines at 630.0 and 636.4 nm, originating from the metastable O(1D) level, are prominent features in the terrestrial airglow and aurora. Despite extensive studies in the past few decades, quantifying the intensity of the O(1D) emission has been a challenge. Significant details regarding the O(1D) production and removal processes are not fully understood; only recently have SRI's experiments on the relaxation of O(1D) by O(3P) confirmed the dominant role of oxygen atoms in controlling the lifetime of O(1D) at altitudes relevant to ionospheric modification (IM) experiments. We

report analyses of observations from representative IM experiments and of laboratory data investigating the relaxation of O(1D) by O(3P), focusing on the interpretation of the O(1D) emission's temporal evolution at high and low altitudes. We discuss the relevance to atmospheric observations and ionospheric heating studies.

This work was supported by the Aeronomy Program of the U.S. National Science Foundation (NSF). The participation of E. B. Byler and M. A. Glaros was supported by the NSF Research Experiences for Undergraduates (REU) Program.

ITIT-11 Continuous Ground-based Multi-wavelength Airglow Measurements using a new Echelle Spectrograph Instrument

by Robert Andrew Marshall

Status of First Author: Non-student

Authors: Robert A. Marshall, Boston University / Stanford University; Steven M. Smith, Boston University; Jeffrey Baumgardner, Boston University; Supriya Chakrabarti, Boston University

Abstract: A new spectrograph instrument, called the Continuous High-resolution Instrument for Multi-wavelength Echelle Spectroscopy (CHIMES), has been developed and built to make simultaneous and spatially overlapping measurements of the green and red airglow emissions (5577 A and 6300 A) continuously, 24 hours-a-day. The spectrograph uses a 50 mm long, 50 um wide slit, and varies the exposure time at different times of day (daytime, twilight, and nighttime), from 2 seconds in daytime to 10 minutes at night. It utilizes an Echelle grating to achieve dispersion of 0.05 A/pixel at 5577 A. Daytime 6300 A and 5577 A airglow from this instrument are extracted by comparing the measured spectra to direct solar spectra and extracting small increases in the Fraunhofer absorption lines at those wavelengths, after compensating for the Ring Effect contribution. We present the instrument design and extraction algorithm, as well as the first ground-based measurements of the daytime 5577 A line. The instrument can detect nighttime airglow with ease down to 10 Rayleighs. In the daytime, the instrument can detect 6300 A airglow of 1 kR or greater, and the same for the green 5577 A line; however, such intense airglow is only common for the red line, and so no such signatures have yet been detected in the 5577 A line.

ITIT-12 The Sondrestrom Research Facility All-Sky Imagers - by Elizabeth Kendall, presented by Anja Stromme

Status of First Author: Non-student

Authors: Elizabeth Kendall, Martin Grill, Eggert Gudmundsson, Anja Strømme
SRI International

Abstract: The Sondrestrom Upper Atmospheric Research Facility is located near Kangerlussuaq, Greenland, just north of the Arctic Circle and 100 km inland from the west coast of Greenland. The facility is operated by SRI International in Menlo Park, California, under the auspices of the U.S. National Science Foundation. Operating in Greenland since 1983, the Sondrestrom facility is host to more than 20 instruments, the majority of which provide unique and complementary information about the arctic upper atmosphere. The Sondrestrom facility has recently acquired two new all-sky imagers. The first new camera replaces the intensified auroral system which has been on site for nearly three decades. This new all-sky imager (ASI), designed and assembled by Keo Scientific Ltd., employs an EM-CCD camera with a medium format 180° fisheye lens coupled to a set of five 3-inch narrowband interference filters. Preview images are posted to the internet in near real-time, with final images posted weeks later. The second new imager installed at the Sondrestrom facility is a color all-sky imager (CASI). The CASI instrument is a low-cost Keo Scientific Ltd. system similar to cameras designed for the THEMIS satellite ground-based imaging network. While it is not possible to resolve fine spectral features as with narrowband filters on the

ASI, this camera provides context on wavelengths not covered by other imagers, and makes it much simpler to distinguish clouds from airglow and aurora.

ITIT-13 Analysis of JPL GAIM Ionospheric Specification Results in a Low-Latitude Region - by Mark Butala

Status of First Author: Non-student

Authors: Philip Stephens, Atilla Komjathy, Brian Wilson, Xiaoqing Pi, Anthony Mannucci

Abstract: The Jet Propulsion Laboratory (JPL) global assimilative ionospheric model (GAIM) combines first-principles physics with empirical measurements to estimate the global electron density structure of the ionosphere. As with other data assimilative models of the ionosphere, JPL GAIM faces numerous challenges, including: sparse data coverage in ocean regions, systematically biased and noisy measurements, and incomplete or simplified physics models. Furthermore, efforts to understand and characterize the ultimate impact of these factors on electron density specification are typically hampered by a lack of a comparative ground-truth.

In this study, we utilize a unique data-set for mid-November 2008 for evaluation and verification of JPL GAIM in an equatorial regime. Provided by the Air Force Research Laboratory (AFRL), this data-set includes calibrated slant TEC measurements from four GPS receivers near Kwajalein Atoll and corresponding ALTAIR-derived F-region TEC estimates that are believed to have an accuracy of 0.1 TECU. We present comparisons using our latest JPL GAIM model which ingests ionospheric radio occultation soundings from the Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC) and ground GPS observations from nearly 200 GNSS receivers. In particular, we evaluate the AFRL calibration of the GPS receivers near Kwajalein Atoll by comparing it to our GPS receiver bias estimates that are obtained from the GPS-based Global Ionospheric Mapping (GIM) process , assess JPL GAIM performance at low latitudes by evaluating the effect of first omitting and then including measurements from the four AFRL calibrated receivers. GAIM modeled vertical electron density profiles and line-of-sight TEC are compered with measurements from the ALTAIR incoherent scatter radar and Jason dual-frequency altimeter for further validation.

ITIT-14 Development and Validation of a Technique for Determining the Background Mid-Latitude TEC from CIDR Measurements by Tim Kelley

Status of First Author: Student IN poster competition, Undergraduate

Authors: Tim Kelley, State University of New York at Oneonta; Anthony DiPietro, State University of New York at Oneonta; Trevor Garner, Applied Research Labs at the University of Texas:Austin; Hugh Gallagher, State University of New York at Oneonta; Allan Weatherwax, Siena College; David Munton, Applied Research Labs at the University of Texas:Austin

Abstract: The North East CIDR (Coherent Ionospheric Doppler Receiver) Array was established to investigate medium scale irregularities in the mid-latitude ionosphere and their location relative to large-scale mid-latitude density variations. The CIDRs measure the Doppler shift on 150 and 400 MHz channels of low earth orbiting satellite beacons. A linear combination of these Doppler shifts determines the ΔSTEC/Δt (rate of change of the slant TEC). The TEC latitude profile, which may be used to characterize large scale density variations, may be constructed by integrating ΔSTEC/Δt along the orbital track from an unknown initial TEC value while applying the obliquity function to correct for the observing geometry. The initial TEC value, which can have a significant impact on the profile, is generally determined from other measurements or models. We have developed a method for inferring the average background TEC from the dependence of ΔSTEC/Δt on the rate of change of the obliquity function. We will describe the method for determining the average background TEC and constructing the

TEC profile. The technique is then applied to observations by the CIDR located at Millstone Hill for a wide range of solar and magnetic conditions. The background TEC obtained in this manner will then be compared to the TEC derived from the density obtained by the Millstone Hill Incoherent Scatter Radar.

ITIT-15 **Data assimilation of FORMOSAT-3/COSMIC using NCAR TIE-GCM** - by I-Te Lee

Status of First Author: Student IN poster competition, PhD

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Abstract: This paper presents our research effort to develop an assimilation model for the FORMOSAT-3/COSMIC (F3/C) GPS Occultation Experiment (GOX) observations by means of ensemble Kalman filtering using the NCAR Thermosphere Ionosphere Electrodynamics General Circulation Model (TIE-GCM) as a forecast model. The GOX antenna receives the dual-band signal of Global Positioning System (GPS) satellites, which are used to estimate the excess phase, derive the calibrated total electron content (TEC) of the signal path, and uses it to retrieve the electron density profiles. More than 2000 electron density profiles are retrieved and uniformly distributed around the globe. They can provide an excellent opportunity to monitor the global ionospheric electron density structure, especially over the ocean, deserts, and the polar region. The NCAR TIE-GCM is a three-dimensional, time-dependent model of the Earth's neutral upper atmosphere and ionosphere that obtains self-consistent solutions for the coupled nonlinear equations of hydrodynamics, thermodynamics, and continuity of the neutral gas and plasma. The Data Assimilation Research Testbed (DART), an open-source community facility for ensemble Kalman filtering, is also involved in our research.

The F3/C GOX observations are combined with the results of TIE-GCM into DART to compute the expected value of electron density, which is considered as 'the best' estimate of the current state of the system corresponding to real observations. An observing system simulation experiment (OSSE) is conducted with synthetic electron density profiles created using the TIE-GCM and the location information from real GOX observations. This paper shows the investigation and impact from the OSSE results, and preliminary results from real observation experiments.

ITIT-16 **A comparison of electric density profiles observed by FORMOSAT-3/COSMIC at 500 km and 800 km altitude** - by Chi-Yen Lin

Status of First Author: Student IN poster competition, PhD

Authors: C. Y. Lin, Institute of Space Science, National Central University, Taiwan, xyz1412@gmail.com; J. Y. Liu, Institute of Space Science, National Central University, Taiwan and National Space Organization, Taiwan, tigerjyliu@gmail.com

Abstract: FORMOSAT-3/COSMIC (F3/C), which consists of 6 micro satellites, was launched at 04/15/2006. The 6 satellites first stay the parking orbits at about 500 km altitude, and eventually reach the mission orbits at 800 km altitude. Numbers of the satellites at 500 and 800 km altitude are about half and half in early 2007. This provides an excellent opportunity to examine the electron density derived by using Abel inversion on data GPS Occultation Experiment (GOX). Since for the FORMOSAT-7/COSMIC-2 (F7/C2) mission, 6 micro satellites with 34-degree inclination angle and 550 km altitude and 6+1 micro satellites with 76-degree and 800 km altitude will be launched in 2014 and 2017, respectively. Based on the F3/C and F7/C2 sounding geometries, observing system simulation experiments (OSSE) will be

conducted. A cross-examination GOX and OSSE results should allow us having a better understand on the accuracy and error of electron density profiles.

ITIT-17 **A Comparison of Different Radio Occultation Algorithms for ionospheric electron density retrievals** - by Jian-Xiang Ruan

Status of First Author: Student IN poster competition, Undergraduate

Author: Jian-Xiang Ruan

Abstract: The excess phase provided by the FORMOSAT3/COSMIC was utilized to retrieve the ionospheric electron density from Global Positioning System (GPS) radio occultation (RO) algorithm that is based on Abel transform under the assumption of the spherical symmetry. In this poster, we compared the different radio occultation techniques for the retrieval of ionospheric electron density, in which the bending angle of the GPS ray and calibrated total electron content (TEC) are used, respectively. The retrieved electron densities from different algorithms are validated by electron density measured by ground base ionosonde for three years from 2008 to 2010. We calculated mean deviation (M0) and root mean square error (RMSE) of the foF2 data for different seasons. The results show the RO-retrieved foF2 from bending angle and calibrated TEC are generally consistent with the COSMIC-retrieved foF2. It appears that the electron densities (with M0 between 0.1 and 0.18%) retrieved from the bending angle are better than those (with M0 between 0.25 and 3.2%) from the calibrated TEC in the daytime. However, for the nighttime data, a comparison shows that the electron densities obtained from piercing methods seem to be better than those retrieved from other methods. Nevertheless, the RMSE values for the different RO algorithms seem to be comparable to each other. The details of the different RO algorithms will be introduced in this poster.

ITIT-18 **Global Comparison of NmF2 and hmF2 between COSMIC and Ionosonde** - by Kang-Hung Wu

Status of First Author: Student IN poster competition, PhD

Author: Kang-Hung Wu

Abstract: Formosat-3/COSMIC (F3/C) satellites were launched successfully in April 2006. The use of F3/C GPS RO (Radio Occultation) technique to retrieve ionospheric electron density profile makes comparisons between F3/C retrieved electron density profiles and other profiles obtained from empirical models, ground-based instruments such as incoherent scatter radar and ionosondes. The preliminary results of COSMIC observations have already been published. However, global comparisons of NmF2 and hmF2 between F3/C and ionosonde instruments in different geomagnetic latitude regions are not well documented in literature. This study compared and analyzed 3-year data (from July 2006 to July 2009) of COSMIC and global ionosonde stations. The COSMIC electron density profiles were first screened in accordance with the data quality control schemes to ensure the good data for further comparisons. The F2 layer parameters, which are NmF2 and hmF2, observed by ionosondes were then collected for the time and locations that are nearly the same as those of the COSMIC. This work primarily focuses on investigations of the latitudinal differences between these two techniques. In the global comparison, four regions were separated, namely 10 (equatorial region); 10 to 30(near EIA crest region); 30 to50 (mid latitude region);50 to90(high latitude region) in geomagnetic latitude. Two parameters NmF2 and hmF2 of electron density profiles of these two techniques were compared. Our results showed that NmF2 retrieved by F3/C and observed by Ionosonde are in good agreement in general, but in the low latitude F3/C tend to overestimate (underestimate) NmF2 for the low (high) electron concentration values. On the other hand, the uncertainty of NmF2 in the southern hemisphere was smaller than that in the conjugate regions in the northern hemisphere. As per as the hmF2 is concerned, the values determined from ionosonde were higher than that retrieved by F3/C, especially in mid and high latitudes. In the low-latitude regions, however, the good agreement between these two techniques in some stations was found.

ITIT-19 **Comparison of different pulse compression techniques in coherent scatter RADAR** - by Ramin Jafari

Status of First Author: Student NOT in poster competition

Author: Ramin Jafari

Abstract: Pulse compression by means of matched filtering is used to improve range resolution and optimal power estimation of the transmitted pulse. Mismatched filtering is applied to mitigate range interference from neighboring ranges (side lobe) produced by matched filter, but suffers from desired range (main lobe) SNR loss. Since matched and mismatched filters are estimated using the transmitted pulse but not the received one, adaptive filtering as a compromise between matched and mismatched filtering, is used to improve the side lobe suppression by estimation of the filter coefficients for each range. Matched, mismatched and adaptive filtering for coherent scatter radar (SuperDARN) in case of point target (meteoroid) and spread target (plasma density irregularities) have been studied and their performance is compared.

ITIT-20 **The new Jicamarca acquisition radar system and its first applications to the study of the equatorial ionosphere** - by Marcos Inoñán Marcos

Status of First Author: Student NOT in poster competition, Undergraduate

Authors: Marcos Inoñán1, Rita Abad1, José Alcántara2, Ramiro Yanque1 and Jorge Chau1
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2 Sección de Ingeniería Mecánica, Pontificia Universidad Católica del Perú, Lima, Perú

Abstract: During the past decade, the engineers at the Jicamarca Radio Observatory (JRO) have been working on the development of radar acquisition systems based on digital receivers. As a result of these efforts, we have recently developed JARS (Jicamarca Acquisiton Radar System), an eight-channel digital reception system that can collect data at a rate of 1 MHz per channel.

Since January 2011, JARS is being used at the observatory in coherent scatter radar (CSR) experiments obtaining excellent results. During the next months, JARS will be tested in incoherent scatter radar (ISR) experiments (Faraday, EW Drift). After these tests, JARS will become the main acquisition system at Jicamarca, increasing the capabilities of our radar.

In this poster, we present a brief description of JARS architecture and functionality. Also, we discuss the advantages of using JARS instead of other systems, as its flexibility to configure different experiments. Finally, we will present some results obtained in some experiments carried out with the Jicamarca radar and some specifications and performance testing of the system as well.

ITIT-21 **Corrections to velocity, temperature, and density measurements from retarding potential analyzers aboard DMSP and C/NOFS** by Ryan Davidson

Status of First Author: Student NOT in poster competition, PhD

Authors: R. L. Davidson, G. D. Earle, and R. A. Heelis

Abstract: A numerical simulation of the grid structure in a retarding potential analyzer (RPA) is used to isolate the effects non-ideal biased grids have on the velocity, temperature, and density measurements made by such an instrument. These errors are shown to be of potentially significant magnitude and effect both absolute and relative measurements. Errors from the simulation are used to construct a correction procedure

that is applied to both DMSP and C/NOFS RPA data. Corrected data from both satellites are presented and compared to uncorrected data.

ITIT-22 **QB50: Multi-point, In-situ, Long-Duration Lower Thermosphere Research** - by Alan Sheng Xi Li

Status of First Author: Student NOT in poster competition

Authors: Sigrid Close, sigridc@stanford.edu; Scott Palo, Scott.Palo@colorado.edu; Ludger Scherliess, ludger.scherliess@usu.edu

Abstract: The lower thermosphere (90-330 km) is the least explored layer of the atmosphere, barred from both stratospheric balloons and remote sensing satellites. QB50 seeks to investigate this region of the atmosphere through a network of 50 double CubeSats, using onboard sensors and instruments (e.g. neutral mass spectrometer, Langmuir probes, accelerometers, etc…) to map the temporal and spatial variations throughout. The project aims to improve collaboration between universities around the world, allowing individual teams per university to build their own CubeSats given their own research interests.

ITIT-23 **Model-Density Anomalies in the Lower Atmosphere as Observed by Aerodynamic Drag on Orbiting Rocket Bodies** - by Marcin Pilinski

Status of First Author: Student IN poster competition, PhD

Authors: Marcin Pilinski, Brian Argrow, Scott Palo

Abstract: We examine the latitude and local solar time dependence on errors in the Jacchia density model. Model errors are estimated by analyzing the fitted ballistic coefficients produced by the Air Force Space Commands High Accuracy Satellite Drag Model. Particularly observations of rocket bodies with very low perigee altitudes allow the examination of density model discrepancies between 120km and 200 km altitudes. The results indicate that Jacchia type models densities below 200 km altitude misestimates density sometimes by as much as 50%.

ITIT-24 **A GPU-based Monte Carlo algorithm for the simulation of particle trajectories in O+, H+ and He+ plasmas** - by Daniel Suarez Munoz

Status of First Author: Student NOT in poster competition, Undergraduate

Author: Daniel Suarez

Abstract: In order to account for the effects of Coulomb collisions on incoherent scatter (IS) radar signals, Milla & Kudeki [2011] developed a Monte Carlo procedure to compute the IS spectra for different plasma configurations. This procedure is based on the simulation of charged-particle trajectories in ionospheric plasmas, a task that requires high computational power. In this poster, we report on the development of a GPU (Graphic Processing Unit) parallel computing algorithm that reduces the computational cost of particle-trajectory simulations. The algorithm takes advantage of the multithreaded processing capability of NVIDIA CUDA-enabled GPUs, such that each thread simulates the trajectory of a particle (either an electron or an ion) for a given set of initial conditions and plasma parameters. The simulation results are time series of particle velocities and displacements in three dimensions, results that are then used in the estimation of IS spectra. The description of our GPU algorithm and some preliminary results are presented.
Milla, M. A., and E. Kudeki (2011), Incoherent scatter spectral theories–Part II: Modeling the spectrum for modes propagating perpendicular to B, IEEE Transactions on Geoscience and Remote Sensing, 49(1), 329–345, doi:10.1109/TGRS.2010.2057253.

ITIT-25 TID Studies with the TIDDBIT HF Doppler Sounder
by Geoff Crowley

Status of First Author: Non-student

Authors: G. Crowley (gcrowley@astraspace.net), A. Reynolds, F. Rodrigues , J. Chau

Abstract: HF Doppler sounders represent a low-cost and low-maintenance solution for monitoring wave activity in the F-region ionosphere. HF Doppler sounders together with modern data analysis techniques provide both horizontal and vertical TID velocities and wavelengths across the entire spectrum from periods of 1 min to over an hour. ASTRA has developed a new system called "TIDDBIT" (TID Detector Built In Texas), and data will be presented from TIDDBIT systems in Texas, Virginia, and Peru. We show how the completeness of the wave information obtained from these systems makes it possible to reconstruct the vertical displacement of iso-ionic contours over the ~200 km horizontal dimension of the sounder array. The TIDDBIT Sounder was recently deployed in Jicamarca, Peru. Early results from the Jicamarca site will be shown and compared with the sounder data from other locations.

ITIT-26 Dynamic Ionosphere Cubesat Experiment (DICE) - by Geoff Crowley

Status of First Author: Non-student

Authors: G. Crowley1 (gcrowley@astraspace.net); C. Swenson2; C. S. Fish2; G. S. Bust1 ;I. Azeem1; A. Barjatya3; M. F. Larsen4; F. Rodrigues1
1. ASTRA, Boulder, CO, United States.
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4. Clemson University, Clemson, SC, United States.

Abstract: The Dynamic Ionosphere Cubesat Experiment (DICE) mission has been selected for flight under the NSF "CubeSat-based Science Mission for Space Weather and Atmospheric Research" program. The mission has three scientific objectives: (1) Investigate the physical processes responsible for formation of the midlatitude ionospheric Storm Enhanced Density (SED) bulge in the noon to post-noon sector during magnetic storms; (2) Investigate the physical processes responsible for the formation of the SED plume at the base of the SED bulge and the transport of the high density SED plume across the magnetic pole; (3) Investigate the relationship between penetration electric fields and the formation and evolution of SED. The mission consists of two identical Cubesats launched simultaneously. Each satellite carries a fixed-bias DC Langmuir Probe (DCP) to measure in-situ ionospheric plasma densities, and an Electric Field Probe (EFP) to measure DC and AC electric fields. These measurements will permit accurate identification of storm-time features such as the SED bulge and plume, together with simultaneous co-located electric field measurements which have previously been missing. The mission team combines expertise from ASTRA, Utah State University/Space Dynamics Laboratory (USU/SDL), Embry-Riddle Aeronautical University and Clemson University.

Launch is scheduled for October 25, 2011 from Vandenburg AFB.

ITIT-27 CASES: A Novel Low-Cost Ground-based Dual-Frequency GPS Software Receiver and Space Weather Monitor - by Geoff Crowley

Status of First Author: Non-student

Authors: G. Crowley (gcrowley@astraspace.net) (ASTRA), G. S. Bust (ASTRA), A. Reynolds (ASTRA), F. Rodrigues (ASTRA), P. M. Kintner (Cornell University), M. Psiaki (Cornell University), S. Powell (Cornell University), B. O'Hanlon (Cornell University), T. E. Humphreys (University of Texas at Austin), J. Bhatti (University of Texas at Austin)

Abstract: GPS receivers can be used for monitoring space weather events such as TEC variations and scintillation. The new CASES GPS sensor developed by ASTRA, Cornell and UTAustin represents a revolutionary advance in dual frequency GPS space-weather monitoring. CASES is a geodetic quality, paperback-novel-sized dual-frequency GPS software receiver with robust dual-frequency tracking performance, stand-alone capability, and complete software upgradability.

In addition to the standard navigation solution, this sensor measures and calculates TEC with a relative accuracy of a few 0.01 TECU at a cadence of up to 100 Hz. It measures amplitude and phase at up to 100 Hz on both L1 and L2, for up to 12 satellites in view. It calculates the scintillation severity indicators S4, $\tau 0$, and $\sigma\varphi$ at a cadence that is user defined. It is able to track through scintillation with {S4, $\tau 0$, amplitude} combinations as severe as {0.8, 0.8 seconds, 43 dB-Hz (nominal)} (i.e., commensurate with vigorous post-sunset equatorial scintillation) with a mean time between cycle slips greater than 240 seconds and with a mean time between frequency-unlock greater than 1 hour.

Other capabilities and options include: Various data interface solutions; In-receiver and network-wide calibration of biases, and detection and mitigation of multipath; Network-wide automated remote configuration of receivers, quality control, re-processing, archiving and redistribution of data in real-time; Software products for data-processing and visualization. The low price of the sensor means that many more instruments can be purchased on a fixed budget, which will lead to new kinds of opportunities for monitoring and scientific study, including networked applications.
Other potential uses for CASES receivers include geodetic and seismic monitoring, measurement of precipitable water vapor in the troposphere at meso-scale resolution, and educational outreach.

ITIT-28 **Passive VHF radar design using software defined radio for the equatorial E and F region** – by Burak Tuysuz

Status of First Author: Student IN poster competition, PhD

Authors: Burak Tuysuz (buraktuysuz@gmail.com) and Julio Urbina (The Pennsylvania State University, Electrical Engineering Department)

Abstract: The Equatorial Ionosphere has now been studied for about half a century, in particular with Jicamarca Radio Observatory. But we still do not understand the variability of ionospheric plasma drifts which is fundamental for the development of realistic ionospheric and thermospheric models. Also, since Jicamarca has a very narrow antenna beamwidth, a wider field of view to the East and West would be very helpful in understanding the dynamics of the E and F regions of the ionosphere. We are motivated to build a flexible yet inexpensive passive radar for low cost and long term observations in the equatorial region.

Long-Term Variations of the Upper Atmosphere

LTRV-01 **Inter-cycle minima differences in thermospheric mass density and ionospheric total electron content** - by John Emmert

Status of First Author: Non-student

Author: John Emmert

Abstract: We investigate differences in thermospheric and ionospheric behavior between two different minima of the 11-year solar cycle, using mass densities derived from orbital drag, and ionospheric total electron content (TEC) derived from Global Positioning System (GPS) signals. At 400 km altitude during the year centered on the cycle 23/24 solar minimum (epoch 2008.8), global thermospheric mass density was 36% lower than during the cycle 22/23 minimum. Ten percent of this difference is attributable to lower

average solar extreme ultraviolet (EUV) irradiance levels, 7% to lower average geomagnetic activity levels, but the remaining 19% is anomalous. An exospheric temperature anomaly of –14 K and a global TEC anomaly of +2% accompanied the anomalous 400 km density difference during the cycle 23/24 minimum, relative to the cycle 22/23 minimum. Following the solar cycle minimum at epoch 2008.8, the mass density began to increase, but the density anomalies continued to decrease to a minimum of 24% at epoch 2009.6. The density abruptly recovered to expected levels at 2010.1, an event apparently independent of solar activity. We explore the sensitivity of the inferred inter-minima anomaly differences to the solar EUV specification used in the analysis.

LTRV-02 **Estimation and Testing for Spatially Ditributed Curves with Application to Ionospheric and Magnetic Field** - by Oleksandr Gromenko

Status of First Author: Student IN poster competition, PhD

Authors: Oleksandr Gromenko , Piotr Kokoszka, Lie Zhu and Jan Sojka

Abstract: We develop methodology for the estimation of the functional mean and the functional principal components when the functions form a spatial process. We propose several methods, and evaluate them by means of a simulation study. All of them significantly improve on the standard approaches available in the R package fda. Next, we develop a significance test for the correlation of two such functional spatial fields. After validating the finite sample performance of this test by means of a simulation study, we apply it to determine if there is correlation between long term trends in the so called critical ionospheric frequency and decadal changes in the direction of the internal magnetic field of the earth. The test provides conclusive evidence for correlation thus solving a long standing space physics conjecture. This conclusion is not apparent if the spatial dependence of the curves is neglected.

Midlatitude Ionosphere or Thermosphere

MDIT-01 **Low-latitude TEC enhancement and associated magnetic signature** by Santiago Marsal

Status of First Author: Student NOT in poster competition, Masters

Authors: Marsal, S., Kutiev, I., Torta, J. M., Curto, J. J.

Abstract: Diverse ground-based data, including magnetic field measurements, EEJ intensity and F region virtual height, are used in conjunction for the study of episodes of TEC enhancement at low latitudes.

MDIT-02 **Investigation of ionospheric plasma irregularities using GPS receivers and mid-latitude SuperDARN HF radars** - by Evan Thomas

Status of First Author: Student IN poster competition, Masters

Authors: E. G. Thomas (1), J. B. H. Baker (1), J. M. Ruohoniemi (1), L. B. N. Clausen (1), A. J. Coster (2), W. Rideout (2)
(1) SuperDARN HF Radar Group, Virginia Tech, Blacksburg, VA, USA.
(2) MIT Haystack Observatory, Westford, MA, USA.

Abstract: Total electron content (TEC) data measured from ground-based GPS receivers is compared to HF backscatter from ionospheric irregularities and ExB drift velocities obtained by SuperDARN radars. A focus is placed on mid-latitudes over North America where expansion of the SuperDARN network allows for unprecedented coverage over areas where the density of GPS receivers is greatest. Of interest is the

relationship between large-scale plasma structures seen in globally gridded TEC measurements and small-scale ionospheric plasma irregularities seen by the SuperDARN radars. In particular, we examine the extent to which the small-scale irregularities form in regions of high electron density gradients located at the edges of large-scale TEC features. Much of the analysis is focused on a Storm Enhanced Density (SED) event that occurred on February 4th, 2009. Several mid-latitude and high-latitude SuperDARN radars observed strong ionospheric backscatter along the tongue of ionization seen in the TEC measurements. We also present preliminary results of a statistical analysis in which spatial maps of the probability for measuring irregularities are compared with average maps of TEC.

MDIT-03 **The source of the steep plasma density gradient in middle latitudes – A case study of the 11–12 April 2001 storm** - by Sarah Park

Status of First Author: Student IN poster competition, PhD

Authors: S. Park, K.-H. Kim, H. Kil, G. Jee, D.-H. Lee, and J. Goldstein

Abstract: A steep plasma density gradient occurs in the middle-latitude F region during large geomagnetic storms. This phenomenon can be understood as a special form of the middle-latitude ionization trough (hereafter trough), but its source has not yet been clarified. We examine the connection between the steep density gradient and trough by using the DMSP and IMAGE satellite data and the total electron content (TEC) maps during the 11–12 April 2001 storm. The trough feature shows an apparent equatorward and poleward motion during the storm, and this behavior is consistent with the motion of the ionospheric footprints of the plasmapause. A steep density gradient is created at dusk by the step-like density change at the equatorward edge of the trough. This phenomenon is associated with the plasma density enhancement in middle latitudes and the plasma density reduction in the high-latitude convection region. Presumably, the middle-latitude plasma density enhancement is produced by the storm-induced electric fields and winds and the plasma density reduction in the high-latitude convection region is produced by the neutral composition change. The plasma depletion associated with the fast plasma flow at sub-auroral region further steepens the density change at the equatorward boundary of the high-latitude convection region. Because the middle-latitude density enhancement in the dayside and its corotation are the primary cause of the steep density gradient at dusk, the steep density gradient is not directly related to the trough which is created primarily by the stagnant plasma flow in darkness.

MDIT-04 **Comparision between Ionospheric and Plasmaspheric TECs measured from JASON satellite:plasmaspheric flux** - by Hanbyul Lee

Status of First Author: Student IN poster competition, Masters

Authors: Hanbyul Lee, Geonhwa Jee, Yong Ha Kim, Jong-Kyun Chung

Abstract: The plasmasphere is filled with the ions and electron transported mostly from the mid-latitude ionosphere. In the topside ionosphere where the O+ ions are still major ions, the O+ ions are in chemical equilibrium with the H+ ions and exchange their charges with each other's parent atoms with similar rates in both reactions. During the day, the newly produced H+ ions flow upward to fill the plasmasphere while they flow downward and contribute to the maintenance of the ionospheric density at night under the geomagnetically quiet condition. The ionosphere and plasmasphere are coupled by these plasma fluxes and therefore strongly affect each other. In order to study these coupling we utilized the plasma density measurements from JASON satellite. This satellite measures vertical total electron content(TEC) from the ground to the satellite orbit(about 1336km) and slant TEC from the satellite orbit to much higher GPS satellites by using the on-board dual frequency altimeter and GPS receiver, respectively. The former measurement can represent the ionospheric TEC while the latter can represent the plasmaspheric TEC in the equatorial region. We compared these data with different seasons solar activities and local times, and the results will be presented.

MDIT-05 An empirical model for the ionospheric parameters (NmF2, hmF2) obtained from Anyang digisonde station - by Eojin Kim

Status of First Author: Student IN poster competition, PhD

Authors: Eojin Kim, Dept. Astronomy and Space Science, Chungnam National University, Korea, jinastro@cnu.ac.kr; Yong Ha Kim, Dept. Astronomy and Space Science, Chungnam National University, Korea; Geonhwa Jee, Korea Polar Research Institute, Korea; Jong-Kyun Chung, Korea Astronomy and Space Science Institute, Korea

Abstract: The variation of the peak electron density (NmF2) and its height (hmF2) in the ionospheric F2 region can affect HF radio communications and accuracies of single channel GPS receivers. As the requirements for the accurate prediction of the ionospheric conditions are gradually rising, we perform a study of the ionospheric prediction model for F-region peak parameters focused on the local region of Northeast Asia, mid-latitude. From the long term (1998 through 2008) NmF2 and hmF2 data measured at Anyang (37.4N, 126.9E) digisonde station, we derived an empirical model formula with 32 coefficients related with diurnal, semi-diurnal, annual, and semi-annual variations depending on the solar activity (F10.7 index) and the geomagnetic activity (Ap index) conditions. To verify this model, we compare the model outputs and fitting coefficients with those of Oliver et al. (2008) in which they utilized Japanese MU radar (34.85N, 136.10E) measurements. We discuss the differences and similarities between these two empirical models for mid-latitude ionospheric F2 regions over the nearby locations and additionally present extraordinary ionospheric variations observed in the digisonde data.

MDIT-06 Optical studies of thermosphere/ionosphere processes at low and midlatitudes - by Carlos Martinis

Status of First Author: Non-student

Authors: C. Martinis, P.Zablowski, J.Baumgardner, J.Wroten, M.Mendillo

Abstract: All-sky imaging systems at Arecibo, Puerto Rico (18.3° N, 66.7° W, + 28° mag lat) and Mercedes, Argentina (34.57° S, 59.41° W, - 24.56° mag lat), close to the Arecibo geomagnetic conjugate point are used to study processes in the low and mid latitude ionosphere. The simultaneous occurrence in both hemispheres of medium-scale traveling ionospheric disturbances (MSTIDs) has been observed for the first time in the American sector. Another all-sky imager located to the west of Mercedes, at the El Leoncito Observatory (31.8° S, 69.3° W, - 18° mag lat), is used to enhance the longitudinal coverage. This configuration provides a unique capability to study low and mid latitude ionospheric processes in the American sector. It also allows the study in the southern hemisphere, in conjunction with GPS and in-situ satellite data, of the formation and evolution of ionospheric structures spanning ~3000 km in longitude. Future plans to incorporate additional optical instruments in the region will also be discussed.

MDIT-07 Observations, modeling and causes of the Weddell Sea Anomaly by Levan Lomidze

Status of First Author: Student IN poster competition, PhD

Authors: Levan Lomidze and Ludger Scherliess
Center for Atmospheric and Space Sciences, Utah State University, 4405 Old Main Hill, Logan, UT 84322

Abstract: One of the intriguing feature of the mid-latitude F region ionosphere is the Weddell Sea Anomaly (WSA), a phenomenon in which the electron densities are larger at night than during the day for periods of southern hemisphere summer months. In order to study the morphology of the WSA, radio occultation measurements from the six FORMOSAT-3/COSMIC satellites were combined with a physics-based data assimilation model of the ionosphere. The model is the Global Assimilation of Ionospheric Measurements

Full-Physics model, which is based on an Ensemble Kalman filter technique and a physics-based model of the ionosphere/plasmasphere. It covers the altitude range from 90 to 20,000 km, includes six ion species, and allows for inter-hemispheric flow. As an output the assimilation model provides the 3-D plasma density throughout the ionosphere and information about the physical drivers such as neutral winds, composition and electric fields. Model runs were performed with and without assimilating the COSMIC data for periods when the WSA is known to be the most prominent. The WSA reproduced by the assimilation model was examined and the resulting electron densities, winds and composition were compared. The results indicate that thermospheric winds and neutral composition play the key role in the formation of the anomaly.

MDIT-08 First observations of the mid-latitude evening anomaly using SuperDARN radars - by Sebastien de Larquier

Status of First Author: Student NOT in poster competition, PhD

Authors: S. de Larquier(1), J. M. Ruohoniemi(1), J. B. H. Baker(1), N. Ravindran Varrier(1), and M. Lester(2)
(1) SuperDARN HF Radar Group, Virginia Tech, Blacksburg, VA, USA.
(2) University of Leicester, Dept. of Physics and Astronomy, Leicester, LE1 7RH, UK

Abstract: Under geomagnetically quiet conditions, the daytime mid-latitude ionosphere is mainly influenced by solar radiation: typically, electron densities in the ionosphere peak around solar noon. Previous observations from the Millstone Hill Incoherent Scatter Radar (ISR) have evidenced the presence of evening electron densities higher than daytime densities during the summer. The recent development of mid-latitude Super Dual Auroral Radar Network (SuperDARN) radars over North America and Japan has revealed an evening enhancement in ground backscatter during the summer. SuperDARN observations are compared to data from the Millstone Hill ISR, confirming a direct relation between the observed evening enhancements in electron densities and ground backscatter. Statistics over a year of data from the Blackstone radar show that the enhancement occurs during sunset for a few hours from April to September. The evening enhancement observed by both SuperDARN and the Millstone Hill ISR is shown to be related to recent satellite observations reporting an enhancement in electron densities over a wide range of longitudes in the Northern hemisphere mid-latitude sector during summer time. Finally, global results from the International Reference Ionosphere (IRI) and the Horizontal Wind Model (HWM07) are presented in relation with previously published experimental results and proposed mechanisms of the evening enhancement, namely thermospheric horizontal winds and geomagnetic field configuration. It is shown that the IRI captures the features of the evening enhancement as observed by SuperDARN radars and satellites.

MDIT-09 Geocoronal Balmer-alpha Derived Effective Temperatures near Solar Maximum - by Edwin J. Mierkiewicz

Status of First Author: Non-student, PhD

Authors: Edwin J. Mierkiewicz, Fred L. Roesler, Susan M. Nossal
University of Wisconsin - Madison , Department of Physics

Abstract: Geocoronal hydrogen Balmer-alpha Doppler widths and effective temperatures retrieved from high spectral resolution line profile observations are presented. These observations were made between 08 January 2000 and 21 November 2001 from Pine Bluff Observatory (WI) with a double etalon Fabry-Perot spectrometer operating at a resolving power of 80,000. This rich data set spans sixty-four nights of observations (1404 spectra in total) over 20 dark-moon periods. A two cluster Gaussian model fitting procedure was used to determine Doppler line widths, accounting for fine structure contributions to the line, including those due to cascade induced emission; cascade contributions at Balmer-alpha emission were found to be 5 +/- 3%. A semiannual exospheric temperature variation is detected with maxima near day number 100 and 300 and minima near day number 1 and 200. Temperatures ranged from ~ 710 to 975 K. Average MSIS model exobase temperatures are approximately 1.5x higher than those observed.

Magnetosphere-Ionosphere Coupling

MIC-01 An Examination of Inter-Hemispheric Conjugacy in Sub Auroral Polarization Streams - by Bharat Kunduri

Status of First Author: Student IN poster competition, PhD

Authors: B.S.R. Kunduri ,J.B.H. Baker, J.M. Ruohoniemi , L.B.N. Clausen , E.B. Thomas
Bradley Department of Electrical and Computer Engineering, Virginia Tech, Blacksburg, Virginia, USA.

Abstract: Magnetic field lines are good conductors and are often treated as electrostatic equipotentials. This assumption implies that electrodynamic events on a magnetic flux tube should be similar in both hemispheres despite differences in the local ionospheric conditions. One class of such events are sub auroral polarization streams (SAPS) which occur when the inner electron and ion boundaries of the ring current separate radially because of increased magnetospheric convection. A SAPS event observed in one hemisphere should be observed in the conjugate ionosphere with similar features. SuperDARN radars have been used to monitor the dynamics of high-latitude ionosphere for almost two decades. Recently new SuperDARN radars have been put in operation at mid-latitudes that offer new views of mid-latitude ionospheric electrodynamics with unprecedented spatial and temporal resolution. During the course of a geomagnetic storm on Aug 4 2010 a SAPS event was observed simultaneously by mid-latitude SuperDARN radars with conjugate fields-of-view. The event exhibited significant variability both in E x B drift and latitudinal position of SAPS activity. The variations exhibited a high degree of correlation in both hemispheres. We analyze the conjugacy exhibited in the event and the influence of solar-wind and inner magnetosphere on its dynamics.

MIC-02 Determination of the True Ionospheric Currents and Conductances from Combined Ground- and Space-Based Observations
by Antti Pulkkinen

Status of First Author: Non-student

Authors: A. Pulkkinen (1) and H. Korth (2)
(1) CUA/IACS at NASA/GSFC
(2) JHU/APL

Abstract: In this paper, a novel ionospheric modeling technique will be applied with ground- and space-based magnetic field observations to determine the spatiotemporal behavior of the true ionospheric currents. Contrary to the earlier modeling techniques, the novel Spherical Elementary Currents System (SECS) method will not require information about ionospheric conductances and will enable a direct solution for full ionospheric electrodynamics if also the electric field is known. Unprecedented Iridium constellation and SuperMAG field-aligned and ground magnetic field data sets, respectively, along with SuperDARN ionospheric electric field observations will be used in the analyses. By combined application of comprehensive data sets the proposed work opens entirely new window to the quasi-instantaneous global ionospheric electrodynamics and general geospace circulation. Initial results of the analyses will be reported.

MIC-03 Comparison of Ionospheric Electric Field Models Effect on Plasmaspheric Dynamics with IMAGE EUV Data - by Aron Dodger

Status of First Author: Student IN poster competition, PhD

Author: Aron Dodger

Abstract: The plasmasphere is a region of low-energy, high-density plasma in the inner magnetosphere. This region controls the mass density of the inner magnetosphere, and is important in considering the wave-particle interactions responsible for energy transfer in the overlapping ring current and radiation belts. The plasmasphere is a very dynamic region that is most significantly controlled by the ionospheric electric fields mapped out along the magnetic field line. This poster compares the use of a number of electric field models to drive a plasmasphere model, specifically the Dynamic Global Core Plasma Model (DGCPM). The results of these field models will be compared against IMAGE EUV plasmapause positions for a selection of storm events. A fitting method is also employed to determine if a better match to EUV plasmapause positions can be obtained.

MIC-04 Possible explanation of the Love-Gannon relationship between Dst and the local-time asymmetry in the low-latitude disturbance field

by George Siscoe

Status of First Author: Non-student

Authors: G. L. Siscoe (1) and J. J. Love (2)
1 Center for Space Physics, Boston University, Boston, MA USA
2 Geomagnetism Program, US Geological Survey, Denver, CO, USA

Abstract: Love and Gannon [2009] have discovered, based on 50 years of data (1958 to 2007), a near-linear relation between geomagnetic storm-time index, Dst, and the local-time asymmetry in the geomagnetic disturbance field at low latitude. The hourly-averaged H-component of the disturbance field is more negative on the dusk meridian than on the dawn meridian by an amount that is close to 40% of the simultaneously measured Dst. This relation holds for all values of Dst. Thus, if Dst registers -100 nT, the disturbance H component at dawn is about -80 nT and at dusk, about -120 nT. For other values of Dst, the dawn and dusk values scale proportionately. A dawn-dusk asymmetry in the low-latitude disturbance field implies a force on the polar thermosphere, which can be significant and possibly measurable when abs(Dst) is large. Cummings [1966] demonstrated that such an asymmetry can be generated by an electrical circuit that flows in a circular segment in the equatorial plane of the magnetosphere (representing a partial ring current) and closes along field lines through the ionosphere. Crooker and Siscoe [1981] developed a formula tying the magnitude of the asymmetry thus generated to the transpolar potential. Here we add a formula that ties Dst to the transpolar potential, thus allowing us to connect the asymmetry quantitatively to Dst. The result reproduces the near-linear relation between the asymmetry and Dst and approximately the observed proportionality.

MIC-05 Role of Ionospheric Physics on the Evolution of Field-aligned Currents - by Tapas Bhattacharya

Status of First Author: Student IN poster competition, PhD

Authors: 1. Tapas Bhattacharya, tbhattacharya@alaska.edu; 2. Antonius Otto, ao@how.gi.alaska.edu; 3. Dirk Lummerzheim, lumm@gi.alaska.edu
1&2. Geophysical Institute & Physics Department, University of Alaska Fairbanks,
3. Geophysical Institute, University of Alaska Fairbanks.

Abstract: Field-aligned current systems play an important role in transferring energy and momentum from the solar wind or from the magnetotail current sheet to the ionosphere. We examine the plasma dynamics in the framework of 3D MHD simulations using the introduction of Alfvenic perturbations in the velocity and magnetic field at the magnetospheric boundary. We examine the generation and modifications of field-aligned currents in response to the Alfven wave interaction with the ionosphere. This presentation will address the influence of ionospheric physics on the evolution of the field aligned currents that is caused by

Alfven wave dynamics with particular emphasis on the filamentation and modification of Alfven waves in the presence of parallel electric fields.

MIC-06 **Diurnal variation of magnetosphere-ionosphere electron heat flux measured with the Poker Flat ISR: seasonal dependence** by Chris Fallen

Status of First Author: Non-student

Authors: C. T. Fallen, University of Alaska Fairbanks, ctfallen@alaska.edu; B. J. Watkins, University of Alaska Fairbanks, ualaska-watkins@usa.net

Abstract: We used long-duration Poker Flat ISR measurements to calculate the diurnal and seasonal variation of vertical electron thermal flux in the high-latitude ionosphere. Electron temperature generally increases with altitude while local energy sources and sinks decrease, indicating a downward thermal energy flux from the magnetosphere. Topside ionosphere electron heat flux is a poorly understood parameter describing magnetosphere-ionosphere coupling and is particularly important in electron temperature calculations in physics-based ionosphere models. The heat flux is presented as a 24-hour periodic function of time for each month.

MIC-07 **A global view of O+ upward flows and outflow rates between DMSP and POLAR** - by Robert Redmon

Status of First Author: Student NOT in poster competition, PhD

Author: Robert Redmon

Abstract: Contemporary magnetosphere modelers are now including species dependent dynamics. Energetic O+ has significant consequences for the ring current stored energy and perhaps the timing of substorm injections. The mechanism by which thermal O+ escapes from the top of the ionosphere and into the magnetosphere is not fully understood. Previous work has indicated there is a MLT dependence on the energization efficiency of thermal ions between DMSP altitudes (~840km) and Polar altitudes (5000-7000km). The study was inconclusive because of uncertainties associated with expansion and contraction of the auroral oval. These results supported the need to project upwelling O+ at DMSP altitudes into dynamic auroral boundary oriented coordinates.

We present a global view of O+ upward flows observed at DMSP (850km) compared to outflow rates observed by POLAR (5000-7000km) during non-storm times.

MIC-08 **Auroral Resources Toolkit (ART)** - by William F. Denig, presented by Rob Redmon

Status of First Author: Student NOT in poster competition

Author: William F. Denig

Abstract: The National Geophysical Data Center (NGDC), Solar Terrestrial Physics (STP) group collects, and disseminates solar and geospace environmental datasets. Building on revolutionary web service and user interface technologies, STP has created a novel and customizable interface for the presentation of original and derived data products. The authors present a new user interface with a specific focus on auroral resources.

MIC-09 **Characteristic energies in an auroral spiral -** by Nathaniel Frissell

Status of First Author: Student IN poster competition, PhD

Authors: Jone P. Reistad - Department of Physics and Technology, University of Bergen, Norway
Dag Lorentzen - Department of Arctic Geophysics, University Centre in Svalbard
Noora Partamies - Space Research Unit, Finnish Meteorological Institute
Peter Stauning - Solar-Terrestrial Physics Division, Danish Meteorological Institute

Abstract: Auroral spirals are dynamical vortex structures with diameters that range from tens to hundreds of kilometers that form from a twisting of the auroral arc. Although previous studies have shown that auroral spirals form as the result of a localized upward field aligned current enhancement, the characteristic energies of precipitating particles within the spiral structure have not been well studied. To address this, meridian scanning photometer observations of an auroral spiral observed on 17 February 2010 at 0020 UT at the Kjell Henriksen Observatory in Longyearbyen, Svalbard are used to derive characteristic energies of the particles causing the spiral. Assuming a Maxwellian distribution of particle energy where α is the distribution maximum, we find an increase in characteristic energy from $\alpha \sim 0.3$ keV prior to spiral formation to approximately $\alpha \sim 2.0$ keV at the peak of the spiral formation at 0020 UT. The energizing rate during the winding and unwinding process is about identical.

MIC-10 **Magnetosphere Sawtooth Oscillations Induced By Ionospheric Outflow -** by Oliver Brambles

Status of First Author: Student NOT in poster competition

Authors: O. Brambles (ojbrambles@dartmouth.edu), W.Lotko, B.Zhang, M.Wiltberger, J.Lyon

Abstract: The sawtooth mode of magnetospheric convection is a quasi-periodic response of the magnetosphere-ionosphere (MI) system to steady solar wind driving. In a sawtooth oscillation, the geomagnetic field in near earth-space undergoes a prolonged period of outward stretching, followed by fast contraction to a dipolar state, with repetition every 2-4 hours. It is not known why the MI system develops sawtooth oscillations. In this study, we provide evidence, based on global magnetohydrodynamic simulations, that O+ ion outflows from the ionosphere generate sawtooth oscillations. Introduction of a novel, empirical model for causally regulated outflow in the global simulations shows that as the outflowing ions fill the inner magnetosphere, their pressure distends the nightside magnetic field from dawn to dusk. When the outflow fluence exceeds a threshold, magnetic field tension no longer confines the accumulating fluid; an O+-rich plasmoid is ejected, with the field subsequently dipolarizing. Repetition of the dynamical process is controlled by the strength of interplanetary driving, which regulates the outflow fluence through electromagnetic energy flows into the ionosphere. Below threshold the sawtooth mode becomes a steady magnetospheric convection mode.

Planetary Atmospheres

PLNT-01 **A framework for establishing the feedback between the M-GITM and the multi-fluid MHD models -** by Chuanfei Dong

Status of First Author: Student IN poster competition, Masters

Authors: Chuanfei Dong (1), Stephen W. Bougher (1), David J. Pawlowski (2), Dalal Najib (1), Michael W. Liemohn (1), Yingjuan Ma (3), Xiaohua Fang (4), Andrew F. Nagy (1)
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(2) Department of Physics and Astronomy, Eastern Michigan University, Ypsilanti, MI 48197, USA
(3) Institute of Geophysics and Planetary Physics, University of California, Los Angeles, CA 90095, USA

(4) Laboratory for Atmospheric and Space Physics, University of Colorado, 392 UCB, Boulder, CO 80309-0392, USA

Abstract: The study of the solar wind interaction with Mars upper atmosphere has triggered great interest in recent years. Among the large number of topics in this research area, the investigation of ion escape fluxes has become increasingly important due to its potential impact on the long-term evolution of Mars atmosphere. In this paper, we first provide a summary of recent calculations of Mars ion escape rates based on several different plasma models, i.e., single-fluid MHD model, test particle model, and multi-fluid MHD model. In addition, we will also give a brief introduction to the recent development and validation of M-GITM (a 3-D whole atmosphere code that captures both the Mars lower atmosphere and its thermosphere ionosphere). Our final goal is to establish the feedback between the M-GITM model and multi-fluid MHD model, in order to better simulate ion escape rates of Mars upper atmosphere. This work has the potential to provide improved predictions of ion escape rates for comparison to future data to be returned by the MAVEN mission (2013-2016).

PLNT-02 Air-density-dependent model for analysis of air heating associated with streamers, leaders, and transient luminous events

by Jeremy A. Riousset

Status of First Author: Non-student

Authors: Jeremy A. Riousset, CSSL Laboratory, Penn State University, University Park, Pennsylvania 16802, USA (riousset@psu.edu); Victor P. Pasko, CSSL Laboratory, Penn State University, University Park, Pennsylvania 16802, USA (pasko@psu.edu); Anne Bourdon, EM2C UPR 288 Ecole Centrale Paris, Grande voie des vignes, 92295 Châtenay-Malabry Cedex, France (anne.bourdon@em2c.ecp.fr)

Abstract: Blue and gigantic jets are transient luminous events in the middle atmosphere that form when conventional lightning leaders escape upward from the thundercloud. The conditions in the Earth's atmosphere (i.e., air density, reduced electric field, etc.) leading to conversion of hot leader channels driven by thermal ionization near cloud tops to nonthermal streamer forms observed at higher altitudes are not understood at present. This work presents a formulation of a streamer-to-spark transition model that allows studies of gas dynamics and chemical kinetics involved in heating of air in streamer channels for a given air density N under assumption of constant applied electric field E. The model accounts for the dynamic expansion of the heated air in the streamer channel and resultant effects of E/N variations on plasma kinetics, the vibrational excitation of nitrogen molecules N2(v), effects of gains in electron energy in collisions with N2(v), and associative ionization processes involving N2(A) and N2(a′) species. The results are in excellent agreement with available experimental data at ground and near-ground air pressures and demonstrate that for the air densities corresponding to 0–70 km altitudes the kinetic effects lead to a significant acceleration of the heating, with effective heating times scaling closer to 1/N than to 1/N2 predicted on the basis of similarity laws for Joule heating. This acceleration is attributed to a strong reduction in electron losses due to three-body attachment and electron-ion recombination processes with reduction of air pressure.

Polar Aeronomy

POLA-01 Energy and flux variations across thin auroral arcs

by Hanna Dahlgren

Status of First Author: Student IN poster competition, PhD

Authors: Hanna Dahlgren - Boston University/Royal Institute of Technology, Sweden; Björn Gustavsson - University of Southampton, UK; Betty S. Lanchester - University of Southampton, UK; Nickolay Ivchenko - Royal Institute of Technology, Sweden; Urban Brändström - Swedish Institute of Space Physics, Sweden Daniel K. Whiter - University of Southampton, UK; Tima Sergienko - Institute of Space Physics, Sweden;

Ingrid Sandahl - Institute of Space Physics, Sweden; Göran Marklund - Royal Institute of Technology, Sweden

Abstract: Two discrete auroral arc filaments, with widths of less than 1 km, have been analyzed using multi-station, multi-monochromatic optical observations from small and medium field-of-view imagers and the EISCAT radar. The energy and flux of the precipitating electrons, volume emission rates and local electric fields in the ionosphere have been determined at high temporal (up to 30 Hz) and spatial (down to tens of meters) resolution. A new time-dependent inversion model is used to derive energy spectra from EISCAT electron density profiles. The energy and flux are also derived independently from optical emissions combined with ion-chemistry modeling, and a good agreement is found. A robust method to obtain detailed 2-D maps of the average energy and number flux of small scale aurora is presented. The different data sets indicate that the arcs appear on the boundaries between regions with different average energy of diffuse precipitation, caused by pitch-angle scattering. The two thin arcs on these boundaries are found to be related to an increase in number flux without an increase in energy.

POLA-02 Direct three-dimensional imaging of polar ionospheric structures with the Resolute Bay Incoherent Scatter Radar - by Joshua Semeter, presented by Hanna Dahlgren

Status of First Author: Non-student

Authors: J. L. Semeter(1), H. Dahlgren(1), K. Hosokawa(2), M. Nicolls(3), M. Johnsen(4), K. Shiokawa(5)
(1) Boston University, USA
(2) University of Electro-Communications, Japan
(3) SRI International, USA
(4) University of Tromso, Norway
(5) Nagoya University, Japan

Abstract: The Resolute Bay Incoherent Scatter Radar (RISR) is used to monitor the spatial and temporal evolution of high density ionospheric plasma at high latitudes (83.55^0N) in the auroral zone and polar cap. Due to the pulse-to-pulse steering of the radar, a three-dimensional image of the ionospheric parameters such as electron density and electron and ion temperatures can be obtained, from a 5 by 5 radar beam grid. By this method it is possible to study the evolution of the internal structure of localized enhancements in the polar cap. We present the first three-dimensional images of these ionospheric parameters obtained with RISR, and compare these with simultaneous all-sky airglow (6300 Å) images. The scale sizes, deformations, altitude variations and drift velocities of the enhanced structures are analyzed. Additionally, data from the Polar Dual Auroral Radar Network (PolarDARN) radars can provide simultaneous measurements of the backscatter echoes of field-aligned irregularities in the region.

POLA-03 Auroral Precipitation Driven Density Structures in the Cusp by Brent Sadler

Status of First Author: Student IN poster competition, PhD

Authors: Brent Sadler, Antonius Otto, Marc Lessard, Eric J Lund, Hermann Luhr

Abstract: Recent observations have confirmed neutral particle density enhancements at high latitudes which are localized to the polar cusp region. The small-scale density structures associated this phenomenon are consistently correlated with strong small-scale field-aligned currents and are often associated with soft electron precipitation similar to that which drives night-side aurora ("auroral precipitation"). We investigate this issue with a numerical model originally developed to study dynamics associated with precipitation in general. It incorporates detailed electron, ion and neutral dynamics to study various processes (e.g., heating, ion outflow, auroral luminosity) in a general sense. Field and particle data from FAST and accelerometer data from CHAMP from a single favorable conjunction alignment event are input to the model. Results are

given which support auroral precipitation as a driver to the density enhancement for this event. Vertical density structures from this model are presented which are consistent with CHAMP / Streak satellite observations and do not depend on upwelling from the E-region.

POLA-04 The interconnection between cross-polar cap convection and the luminosity of polar cap patches - by Gareth William Perry

Status of First Author: Student IN poster competition, PhD

Authors: G.W. Perry (Institute of Space and Atmospheric Studies, University of Saskatchewan)
J.-P. St.-Maurice (Institute of Space and Atmospheric Studies, University of Saskatchewan)
K. Hosokawa (Department of Communication Engineering and Informatics, University of Electro-Communications, Japan)

Abstract: The transport of patches of ionization across the polar cap is carried by the convection electric field, which imposes an E X B drift to the plasma. This drift has an upward component when the plasma is convected towards the pole and a downward component as it moves away from the pole. The vertical motion modulates the rate at which recombination operates, which in turn is directly related to the luminosity of the patches. We show here that if a rapid increase in the electric field produces a downward velocity in excess of 10 m/s, the luminosity of the patches will at first increase before undergoing a marked decrease, in association with an increase in the recombination rates. Both the change in luminosity and the time scale for the temporary increase primarily depend on the vertical velocity, that is, on the strength of the convection electric field and on the magnetic latitude. Increases in luminosity by up to a factor of 2 or more are possible. The time scales for the variations are of the order of 10 to 20 minutes. We present an example of an actual luminosity modulation obtained over Resolute Bay, Canada, that agrees well with the proposed theory.

POLA-05 Observation of a non-thermal scattering from a suggested thin layer in the F region of the ionosphere - by Hassanali Akbari

Status of First Author: Student IN poster competition, PhD

Author: Hassanali Akbari

Abstract: Non-thermal scattering from F region of the ionosphere was observed with Poker Flat Incoherent Scatter Radar on January 23, 2007. Plasma wave enhancement at the time of non-thermal scattering and Ion acoustic wave enhancement after non-thermal scattering were also observed. Optical data of auroral activity during these enhancements is also used to investigate the origin of this phenomena.

POLA-06 A New Auroral Parameterization for the TIEGCM - by Barbara Emery

Status of First Author: Non-student

Authors: Barbara Emery (HAO/NCAR), Xioali Luan (HAO/NCAR) and Rachel Miller (REU at HAO/NCAR in 2010)

Abstract: We use the Global UltraViolet Imager (GUVI) instrument on the TIMED satellite to create a new parameterization of the aurora in the NCAR Thermosphere-Ionosphere-Electrodynamics General Circulation Model (TIEGCM). The aurora is parameterized as a function of Kp, season, hemisphere, and UT/longitude.

POLA-07 **Significance of difference heating mechanisms to the cusp neutral density enhancement** - by Yue Deng

Status of First Author: Non-student

Authors: Yue Deng, Timothy Fuller-Rowell, Delores Knipp and Aaron Ridley

Abstract: CHAMP observations often show thermospheric density enhancements in the cusp region, which require a persistent heating system to maintain them. Due to the limitation of the observations, the heating mechanism has not been confirmed and no conclusive explanation for the neutral density enhancement has been offered. To unveil the mystery of the neutral density enhancement in the cusp, the impact of different heating mechanisms including Poynting flux and soft particle precipitation on the neutral density will be simulated in GCMs. The simulations with different spatial resolutions will be compared.

POLA-08 **Study of Polar Cap Wave Activity in the ULF Frequency Range Using PolarDARN HF Radars** - by Grant Scoular

Status of First Author: Student IN poster competition, Masters

Authors: Grant Scoular, Pasha Ponomarenko, Jean-Pierre St.-Maurice

Abstract: ULF waves exhibit themselves as geomagnetic field variations and have been studied at all latitudes using ground- and space-born magnetometers as well as HF/VHF radars. Daytime Pc3-4 waves (f~10-50 mHz) are generated at the bowshock and in the closed field line geometry they propagate to the ground as field-aligned (Alfen) waves. They have also been detected in the open field line regions (polar cap), but their propagation there remains a mystery.

We ran a pilot study of Doppler shift variations in the HF radar echoes in ~5-60 mHz frequency range over the northern polar cap using the newly commissioned PolarDARN HF radars. We applied a high time resolution operation mode to selected beams from Rankin Inlet and Inuvik radars and analysed coherence lengths of the observed oscillations with the intention of clarifying the propagation mechanism to the polar cap.

From previous studies using ground-based magnetometers it is known that the polar cap ULF waves have relatively long spatial coherence, a distinct band limited spectral component, and occurrence/power maximum near local noon. In contrast, our observations revealed presence of ionospheric waves in the ULF frequency range that do not appear to be characteristic of ULF waves. In particular, the detected waves have a low coherence lengths, a different spectral shape, and pre- and post-noon maxima of activity. Alternate explanations will be discussed.

POLA-09 **Wind-driven transport of thermospheric air parcels in the auroral zone** - by Mark Conde

Status of First Author: Non-student

Authors: Mark Conde, University of Alaska Fairbanks, mark.conde@gi.alaska.edu; James Hecht, Aerospace Corporation, James.H.Hecht@aero.org; Callum Anderson, University of Alaska Fairbanks, callumenator@gmail.com

Abstract: Ground-based all-sky imaging Fabry-Perot spectrometers can map thermospheric wind fields over a spatial region around 1400 km in diameter in the F-region, or 700 km in the E-region, with a cadence of one observation every few minutes. This allows us for the first time to trace the trajectories followed by air parcels moving with the wind, and in particular to predict the past history of air parcels seen above a given site. Examples will be presented showing that these trajectories can often be quite

complicated, indicating that accounting for transport effects may be far more difficult than has often been assumed.

POLA-10 Ground-Based Doppler Mapping of Thermospheric Wind and Temperature Fields with Very High Spatial Resolution
by Mark Conde

Status of First Author: Non-student

Authors: Mark Conde, Geophysical Institute University of Alaska Fairbanks, mark.conde@gi.alaska.edu; Callum Anderson, Geophysical Institute University of Alaska Fairbanks, callumenator@gmail.com; Theo Davies, LaTrobe University, T.Davies@latrobe.edu.au; Peter Dyson, LaTrobe University, P.Dyson@latrobe.edu.au; Mike Kosch, Lancaster University, m.kosch@lancaster.ac.uk

Abstract: All-sky imaging Fabry-Perot spectrometers can provide two dimensional maps of thermospheric wind and temperature fields over a circular region spanning around 1400 km in diameter at F-region heights, or about half this in the E-region. Typical configurations used to date have resolved a few tens of look directions across their field of view. Here we report on an 8-day campaign conducted in March of 2011 in which an instrument at Mawson, Antarctica, was configured to resolve its wind and temperature measurements into 261 independent look directions. This is far higher spatial resolution than has ever been attempted previously. It was made possible by the combination of a new and more sensitive detector coupled with observations taken during a period of higher solar and magnetic activity than has been typical in recent years. Several nights of excellent data were obtained and will be discussed here. While the wind fields did not display much additional high-resolution structure, the 5577A Doppler temperature fields did display a lot of structure associated with individual auroral arcs. While this mode is probably not optimum during periods of weak signal, it does offer the potential to explore very small spatial scales during active times.

POLA-11 Characteristics of spatial variability in high-latitude plasma drifts
by Ellen Cousins

Status of First Author: Student IN poster competition, PhD

Authors: E. D. P. Cousins and S. G. Shepherd

Abstract: Small-scale variability in high-latitude ionospheric plasma drifts can contribute to the total energy deposited through Joule heating but it is often not accounted for in models of high-latitude convection. SuperDARN line-of-sight velocity data from both hemispheres are analyzed to determine the statistical characteristics of velocity fluctuations on scales up to ~500 km. It is found that the overall distributions of fluctuations observed during eight months of the years 2000 and 2001 are the same in both hemispheres. Several interplanetary and geophysical parameters such as Interplanetary Magnetic Field, the Auroral Electrojet Index, and the Earth's dipole tilt angle are found to influence the distribution of fluctuations. These parameters are not seen to have the same influence in both hemispheres.

Solar Terrestrial Interactions in the Upper Atmosphere

SOLA-01 Thermosphere density response to CIR storm in solar minimum observed by coplanar CHAMP and GRACE satellites
by Xianjing Liu

Status of First Author: Student IN poster competition, PhD

Authors: Xianjing Liu, Jeffrey Thayer, Jiuhou Lei

Abstract: Mass density measurements by the CHAMP (Challenging Mini-Satellite Payload) and the GRACE (Gravity Recovery and Climate Experiment) satellites were used to study the density response in thermosphere during the CIR period in Dec, 2008 when the CHAMP and GRACE orbital planes were coplanar (same local time for both satellites). During the CIR period 03-10 December 2008, lower density ratios (active/quite) than expected were observed at the GRACE altitude (476 km mean altitude) in the winter hemisphere. This anomalous behavior is presumed to be due to the substantial presence of helium at the GRACE altitude during this recent solar minimum. The MSISE00 model was employed to study the effect of f10.7, Kp and composition on the density ratio change during CIR period. The change in density at GRACE and CHAMP altitudes from quiet to active conditions is evaluated based on changes in pressure, composition and temperature. The MSIS model illustrates an important transition in response to CIR activity between the GRACE and CHAMP altitudes. The results indicate that a substantial percentage of helium must be present at GRACE altitudes and that the MSIS model underestimates the oxygen to helium transition altitude in solar minimum.

SOLA-02 **Physical Modeling of the Thermosphere-Ionosphere Response to Solar and Geomagnetic Forcing** - by Mariangel Fedrizzi

Status of First Author: Non-student

Authors: Mariangel Fedrizzi, Timothy J. Fuller-Rowell, Mihail Codrescu, and Catalin Negrea

Abstract: Physical models are valuable tools in the task to understand and forecast complex non-linear systems. Their value has been demonstrated in the past by comparing the output of numerical simulations with reliable observations, analyzing the driving terms in the mathematical equations, and so determine the relative importance of the various physical processes. Over the past 40 years, this methodology has enabled great advances in the scientific knowledge of the complex Sun-Earth system. Ground and space-based observations, physics-based and empirical models of the thermosphere and ionosphere have been able to provide a good understanding of many aspects of the physics and dynamics of the upper atmosphere under a wide variety of geophysical conditions. The operational demands on a physical model, however, are much more stringent than that required for scientific enquiry. The model has to perform and meet accuracy requirements in all conditions, has to be numerically stable, robust, and computationally efficient. It is not sufficient to simulate a few isolated storm intervals and show reasonable visual agreement. The model must be tested over a full solar cycle, over all levels of geomagnetic activity and seasons. It must also perform at all latitudes, and this performance must be quantified by appropriate metrics. When this goal is reached and a science code has been rigorously tested for operations, it can then be used to fill gaps in unobserved regions, can be used to help the design of forecast algorithms, or can be the background model in data assimilation schemes. This work presents initial results of a study that aims to quantitatively assess the capabilities and limitations of a self-consistent physics-based coupled model of the thermosphere, ionosphere, plasmasphere and electrodynamics (CTIPe) in specifying and predicting the upper atmosphere neutral and plasma response to changes in external drivers, using a comprehensive observational data set from ground and space and, at the same time, advance the understanding of the T-I system dynamics on different spatial and temporal scales.

SOLA-03 **Observed and Modeled Solar Cyclic Variation in Geocoronal Hydrogen using NRLMSISE-00 Thermospheric Conditions and the Bishop Analytic Exospheric Model** - by Susan M. Nossal

Status of First Author: Non-student

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Abstract: The University of Wisconsin has acquired a long-term data set from mid-latitudes consisting of high precision, consistently calibrated observations of the hydrogen Balmer-alpha column emission. The observations are being used to investigate the impact on hydrogen of the 11-year solar cycle. An outstanding question is how do these observations compare with the solar cycle variation depicted in atmospheric models? To address this question we have compared observations taken with the Wisconsin H-alpha Mapper (WHAM) Fabry-Perot during Solar Cycle 23 with calculations using the thermospheric hydrogen density profile and background conditions from the Mass Spectrometer Incoherent Scatter (NRLMSISE-00) empirical model extended to exospheric altitudes using the Analytic exosphere model of Bishop. We apply the lyao_rt global resonance radiative transfer code of Bishop to calculate expected intensities that would be observed from the ground for the viewing conditions of the observations. Both the observed and calculated WHAM hydrogen column emission intensities are higher for near solar maximum than for solar minimum. In all cases, the observed intensities are higher than those calculated for the corresponding solar geophysical conditions. The slope of the observed-to-calculated ratios versus shadow altitude for near solar maximum conditions is less than the corresponding ratio at minimum, indicating the likelihood that the modeled hydrogen distribution at solar maximum is closer to the actual distribution. Differences in the observed and modeled slope of the intensity versus shadow altitude cannot be reconciled with an adjusted offset due to uncertainties in the absolute intensity calibration or solar excitation flux, and are thus indicative of differences in the underlying hydrogen distributions.

SOLA-04 Ionospheric Total Electron Content and Thermospheric Infrared Emission Dynamics during High-Speed Stream Intervals in 2008

by Olga Verkhoglyadova

Status of First Author: Non-student

Authors: O.P. Verkhoglyadova1,2, B. T. Tsurutani1, A.J. Mannucci1, M.G. Mlynczak3, L.A. Hunt4, A. Komjathy1, and T. Runge1
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Abstract: We analyze a portion of the WHI (Whole Heliospheric Interval) time interval from 25 March to 26 April 2008 to identify the ionospheric and thermospheric responses to high speed solar wind streams. This period during a solar sunspot minimum is of moderate geomagnetic activity (with the minimum Dst ~ -50 nT) with enhanced auroral activity seen in High Intensity Long Duration Continuous Auroral Activity (HILDCAA) events. The solar wind data show several Corotating Interaction Regions (CIRs) and recurrent high-speed streams (HSSs). Using the infrared emission data obtained with SABER on TIMED we identify a distinct relationship between the emitted long wavelength radiation from the thermosphere and CIR/HSS intervals. Specifically, zonal flux of NO infrared radiation correlates well with AE indices. The most pronounced effects are found at high latitudes. We used the GPS total electron content (TEC) database and JPL's Global Ionospheric Maps (GIM) to study vertical TEC (VTEC) dependences on solar wind phenomena. It is shown that VTEC increases during HSS periods. Data analysis shows rapid, global and continuous ionospheric responses to external solar wind forcing. The largest variations are found in low-latitude daytime VTEC. We suggest that CIRs/HSSs are significant external drivers for both thermospheric and ionospheric phenomena during solar minimum. We discuss both prompt penetrating electric fields (PPEFs) and disturbance dynamo as possible mechanisms responsible for the observed effects. It is clear that efficient heliospheric-magnetospheric-ionospheric-thermospheric coupling occurs during CIR/HSS intervals even during solar sunspot minimum.

SOLA-05 **Solar EUV irradiance and geomagnetic energy variation during last solar cycle** - by Yanshi Huang

Status of First Author: Student IN poster competition, PhD

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Abstract: The record-low thermospheric density during last solar minimum has been reported and it has beenmainly explained as the consequence of the anomalously low solar extreme ultraviolet (EUV) irradiance. However, relative little attention has been paid to the variation of geomagnetic energy. The geomagnetic energy is dissipated into upper atmosphere by Joule heating and particle precipitation. In this study, to understand and explain the anomalously low density during the solar minimum 23/24, we examine the energy budget to the Earth's upper atmosphere from solar EUV irradiance, Joule heating and particle precipitation heating from 1995 to 2010. The solar EUV power is derived using the latest version of SOLAR2000 solar irradiance specification model and also from the measurement of SOHO/SEM. The empirical model Weimer05 is used to derive the globally integrated joule heating power. The global hemispheric power data is collected from NOAA to show the variation of particle precipitation heating. The variation of different energy inputs and their significance to the neutral density will be discussed.

SOLA-06 **COSMIC observations of dayside TEC enhancements in response to a moderate disturbance in the solar wind** - by Pei-Chen Lai

Status of First Author: Student IN poster competition, PhD

Authors: Pei-Chen Lai1, 3, Chin S. Lin2, William J. Burke3, C.-M. Huang1, Ming-Quey Chen1, and Yen-Hsyang Chu1
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2. Air Force Research Laboratory, Hanscom Air Force Base, Massachusetts
3. Institute for Scientific Research, Boston College, Chestnut HMassachusetts

Abstract: We have analyzed COSMIC satellite measurements acquired during five days in November 2007 to study Total Electron Content (TEC) responses of dayside ionosphere to the passage of a high-speed stream (HSS) in the solar wind by Earth. The corotating interaction region (CIR) at the leading edge of the HSS reached Earth at approximately the same time as an interplanetary coronal mass ejection (ICME). Near the first Lagrange point the event was marked by a sharp increase in plasma density, followed by an intensification and rotation of the interplanetary magnetic field (IMF), inducing a moderate magnetic storm with minimum Dst = -71 nT. TEC enhancements appeared at mid- to high-magnetic latitudes during the CIR/ICME driven main phase. Some increases exceeded quiet-time values by factors of ~110%. With no auroral electron precipitation to create new plasma in the magnetic-latitude range where COSMIC detected TEC increases the enhancements must reflect transport effects. Neutral winds generated at auroral latitudes should push dayside plasma equatorward, contrary to COSMIC observations. Rather, the required transport implies plasma drifts from low to higher latitudes, due to the dawn-to-dusk penetration electric fields. ACE measurements allow estimates of penetration electric fields which we mapped to the ionosphere and calculated plasma transport velocities. We show that observed TEC dynamics can be understood as reflecting interplay between stormtime transport due to penetration electric fields and production/loss rates experienced by plasma parcels as they rotate around Earth.

Bowshock

GEM-BHSK-01 Model Comparison Study on the Large Dayside GEO Magnetic Field Compression Events - by Sunhak Hong

Status of First Author: Student NOT in poster competition, PhD

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Abstract: Increases in the solar wind dynamic pressure compress the magnetopause and enhance dayside magnetospheric magnetic field strengths but depress nightside magnetospheric magnetic field strengths [Rufenach et al., 1992]. And, most of global magnetosphere models show that the magnetospheric magnetic field strengths can be explained by using the solar wind data.

However, we found some puzzling observations of large-amplitude dayside magnetic fields at geosynchronous orbit that aren't easily explained by the observed solar wind conditions.

In this study, we made comparisons between the observations and the most developed physics-based MHD models, those are BATS-R-US, OpenGGCM and LFM-MIX. They showed a consistence results in the both of the study cases. From this work, we was able to validate the models' performance for these particular conditions.

Ring Currents

GEM-RING-01 Spectral investigation of PC5 oscillations in SWEPAM proton velocities from the ACE spacecraft - by Yajnavalkya Bhattacharya

Status of First Author: Non-student

Authors: Yajnavalkya Bhattacharya [a], Andrew J. Gerrard [a], Kevin Urban [a], Louis J. Lanzerotti [a], Allan Weatherwax [b], New Jersey Institute of Technology, Center for Solar-Terrestrial Research [a], Siena College, NY [b].

Abstract: PC5 geomagnetic pulsations (period: 150–600 s, frequency: 1.67-6.67 mHz) originate in standing Alfven waves in the magnetosphere, commonly seen from ground based observations at high-latitudes, with maximum amplitudes typically between glat ~65◦ and ~75◦. Magnetometers stationed in the Antarctic have been recently used to infer the location of magnetic OCB (Open Closed Boundary) by their ability to detect PC5-type waves on closed magnetic field lines (Urban et al., 2011). PC5 period oscillations are also seen to be quite persistent in proton velocities measured with the SWEPAM (Solar Wind Electron, Proton, and Alpha Monitor), on board the ACE (Advanced Composition Explorer) spacecraft. Time-frequency spectra of solar proton velocities are discussed in the context of simultaneous magnetometer observations of OCB, and their potential impact on the identification of closed field lines.