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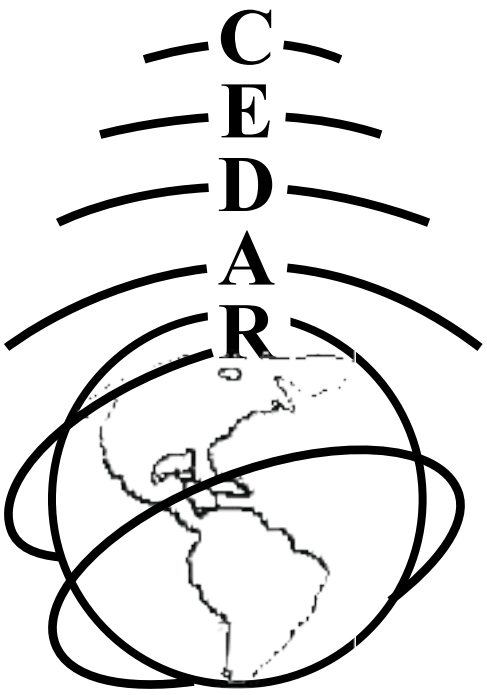

Wednesday CEDAR Poster Session Booklet
June 21

Table of Contents

I. Instruments or Techniques for Ionospheric or Thermospheric Observation

II. Long-Term Variations of the Upper Atmosphere

III. Solar Terrestrial Interactions in the Upper Atmosphere

IV. Data Assimilation

V. Polar Aeronomy

VI. Midlatitude Ionosphere or Thermosphere

VII. Equatorial Ionosphere or Thermosphere

VIII. Irregularities of the Ionosphere or Atmosphere

Instruments or Techniques for Ionospheric or Thermospheric Observation

ITIT-01 Conjugate photoelectron effects on gyro line and plasma line observed at Arecibo - by Asti Bhatt

Status of First Author: Student IN poster competition PhD

Authors: Asti Bhatt, anb22@cornell.edu, Cornell University, M. C. Kelley, Cornell University, M. P. Sulzer, Arecibo Observatory/NAIC

Abstract: The results obtained during the evening time experiments carried out in December 2005 at Arecibo Observatory show the night time gyro line as well as the plasma line. The enhancement in the plasma line after local sunset seems to be due to the conjugate photoelectrons, since the conjugate hemisphere is still sunlit at that time. The gyro line also gets enhanced with the conjugate photoelectrons. We present here some results obtained during this campaign and our interpreations.

ITIT-02 Comparing Measured Altitude Profiles of N2 Lyman-Birge-Hopfield Band Emissions with Model Calculations - by D. Jay Murray

Status of First Author: Student NOT in poster competition PhD

Authors: D. J. Murray1, R. W. Eastes1,2, A. Aksnes2, S. A. Budzien3, K. F. Dymond3, R. Daniell4
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Abstract: The N2 Lyman-Birge-Hopfield (LBH) band constitutes one of the most important ultraviolet emissions for remote sensing of the Earth's atmosphere. Today, several satellite-based instruments depend on LBH measurements in the dayglow and aurora; however, a complete understanding of LBH emissions has not been reached. Model calculations of airglow emissions from the N2 LBH bands usually rely on direct excitation only, while radiative and collisional cascading between singlet states is ignored. In this study we investigate the effect of cascading on the LBH limb profiles by comparing model calculations, (with and without cascading), to observations from the High resolution Ionospheric and Thermospheric Spectrograph (HITS) aboard the Advanced Research and Global Observation Satellite (ARGOS).

ITIT-03 The Digital Receiver based Data-Taking and Display System at the Arecibo Observatory - by Ryan Seal, presented by Michael Suzer

Status of First Author: Student NOT in competition

ITIT-04 CHIRP: Coordinated High-Resolution Ionospheric Receiver Project - by Glynn Germany

Status of First Author: Non-student

Authors: G. A. Germany, C. D. Fry, D. Gallagher, K. Wright

Abstract: Plans to develop an ionospheric sensing network of low-cost HF receivers at regional universities and colleges will be presented. The instrument concept is based on using low-cost (~$1k) computer-controlled receivers to capture scheduled ionosonde transmissions from existing chirp sounder transmitters. The receiver tracks the transmitter's FMCW signal in lock-step to measure the signal group delay resulting from propagation and ionospheric refraction. The received signal is processed to yield an electron density versus height profile, assumed to lie mid-way between the transmitter and receiver locations. Configured as a sensing array, the network would be capable of high spatial resolution sensing of the bottomside ionosphere at regional scales. This project has a strong education component.

ITIT-05 A Digital Receiver for Meteor Radar Applications - by Lloyd Rochester

Status of First Author: Student IN poster competition Masters

Authors: Lloyd Rochester, University of Colorado, Department of Electrical Engineering; Scott Palo, University of Colorado, Department of Aerospace Engineering Sciences

Abstract: High speed analog-to-digital conversion and dedicated digital signal processors offer the potential to revolutionize the radio science community. The increase in sampling speed and computing performance has drastically improved the bandwidth of processing that can be accomplished digitally, thus pushing the analog-to-digital conversion process further up the RF/IF chain from baseband. As such, the advent of software radios and digital receivers has moved much of the RF/IF chain from analog processing to digital processing. Interest has been growing in the CEDAR and broader radio science community to develop new, more capable and flexible digital receivers, to replace aging analog technology and provide new instruments with capabilities never before considered. Evidence of this is the current receiver development work occurring in conjunction with the new AMISR radar system and other upper atmosphere facilities.

The goal of this pro ject is to develop a simple, agile, and inexpensive multi-carrier digital receiver for meteor radar applications that could also be extended to other applications suitable for deployment on unmanned aerial vehicles. This digital receiver design exploits the low complexity and power, small weight and size of analog receivers, and also offers simplicity and low cost over current commerically available digital receivers. It also exploits recent advances in analog-to-digital conversion to greatly reduce analog intermediate frequency processing. All this functionality is contained on a single digital receiver chip that includes both analog-to-digital conversion and multi-channel processing. This chip, the Analog Devices AD6654, supports a wide range of input and output sampling frequencies, and processing of up to 6 passband signals simultaneously with each signal processing stage programmed independently. By adding a Field Programmable Gate Array (FPGA) and a USB integrated circuit, the design supports great versatility for application specific signal processing. The FPGA also provides a FIFO memory structure to ensure valid data, and glue logic for a USB interface to a host computer. Current USB specifications limit the combined output rate of all channels to 480Mbits/second and the receiver has been benchmarked at 40MB/s using the Cypress FX2 USB interface and a host computer running the Linux operating system. This poster will describe the inner workings, design and implementation issues of the digital receiver and will compare our approach of using the USB interface as well as other design decisions with other commercially available digital receiver systems.

ITIT-06 Electron Density Estimates from Absolute ISR Power at Jicamarca: Preliminary Results - by Jorge Chau, presented by Karim Kuyeng

Status of First Author: Student NOT in poster competition

Authors: J. L. Chau, K. Kuyeng, and R. R. Ilma

Abstract: Until recently, ISR measurements at Jicamarca provided either drifts or electron densities, depending on the radar mode selected. Kudeki et al. [2003] showed that absolute density measurements can be also obtained when a drift mode was used if two linear polarizations were received. Such measurements are based on the phase difference between the normal transverse modes of propagation when the radar points perpendicular to B. Although preliminary density estimates are very good, this mode is still under development and not for operational purposes, since manual intervention is still needed, for example, during events of equatorial spread F irregularities. In this work, we present preliminary results of getting absolute densities from absolute power measurements. This procedure is common practice at other ISR facilities, where usually ionosonde values are used for calibration. In our case, we also use the ionosonde values, but just at the beginning of the experiment, the other parameters changing with time are being recorded, e.g., transmitter power and receiver gain. Since the reciving noise is mainly dominated by the skynoise, the receiver gain is obtained by comparing the received noise with know values of skynoise temperature. We present preliminary results of such procedure for the September 2005 and March 2006 World day campaigns. Special discussion will be given to the possibility of using this procedure in on-line runs.

ITIT-07 Investigations of daylit auroral arcs from Sondrestrom - by Duggirala Pallamraju

Status of First Author: Non-student

Authors: D. Pallamraju (Boston University), R. Doe (SRI International)

Abstract: Estimating energetics of particles incident into the ionosphere thermosphere system is an essential step which will eventually enable our understanding of the coupling between Magnetosphere-Ionosphere-Thermosphere (MIT) system. So far, estimates of particle energies and fluxes have been carried out from Space-borne measurements, coupled ISR and modeling techniques, and by nighttime optical emissions at some strategic wavelengths. However, estimating the low-energy spectral information during daytime has remained a challenge as the combined ISR E-region/ inverse techniques estimate particle spectra at energies approximately above 600 eV, satellite measurements do not provide time resolution, and optical measurements have so far been confined to the nighttime. With the advent of HIRISE, it is now possible to make daytime measurements of optical emissions, and thereby investigate MIT coupling round-the-clock. We commissioned HIRISE spectrograph at ISR facility in Sondrestrom for round-the-year optical measurements. The brightness calibrated HIRISE OI 630 nm emissions show excellent agreement with the ISR/GLOW estimates and with those measured by the nighttime all-sky OI 630 nm imager operating at the same location.

We have evolved a methodology to estimate low-energy particle flux by combined use of HIRISE measurements and forward modeling of ISR/GLOW emissions. We compare the GLOW model predictions constrained by the ISR (Ne, Te) measurements with the measured HIRISE emissions. The difference between the HIRISE measured and the ISR/GLOW emissions are due to low-energy particle fluxes. For soft arcs we obtain the hmF information from the ISR-Ne profiles and from the Rees modeled mono-energetic production profiles we obtain Eo. Assuming that the excess HIRISE emissions are due to precipitating electrons with Maxwellian distribution at this characteristic Eo, we now vary the E-flux as a free input to GLOW in order to match with the HIRISE redline emissions. Some of the first results on different days
will be presented and discussed.

ITIT-08 Laboratory Validation of the Ram Wind Sensor for the CINDI Mission of Opportunity - by Jeffrey Klenzing

Status of First Author: Student IN poster competition PhD

Authors: Jeffrey Klenzing (jeffk@utdallas.edu), Gregory Earle (earle@utdallas.edu), Paul Mahaffy, Edward Patrick, Edward.L.Patrick.1@gsfc.nasa.gov),
Roderick Heelis (heelis@utdallas.edu),
Patrick Roddy (roddy@utdallas.edu)

Abstract: In 2008 the US Air Force plans to launch the Communication/Navigation Outage Forecast System (C/NOFS) satellite, which is designed to measure geophysical parameters relevant to the initiation of equatorial spread F (ESF) irregularities in the ionosphere. The satellite will be launched into a low inclination elliptical orbit with a perigee near 375 km. The Coupled Ion Neutral Dynamics Investigation (CINDI) is a NASA-funded mission of opportunity that will fly on the C/NOFS satellite. One component of the CINDI mission is the neutral wind meter instrument, which is designed to measure the three-dimensional bulk flow of the neutral gas encountered along the satellite's orbit track. The component of the neutral flow along the rbit track will be measured by the Ram Wind Sensor (RWS). In this poster we present laboratory test data that highlight the capabilities of the RWS instrument, and validate the instrument concept.

ITIT-09 Variation of twilight low-latitude 732-nm observations with magnetic activity - by Russell Hedden

Status of First Author: Student IN poster competition Undergraduate

Authors: Russell Hedden, J. W. Meriwether, M. Faivre (Department of Physics and Astronomy, Clemson University) and P. Sherwood (Interactive Technology), (rhedden@clemson.edu)

Abstract: High resolution imaging Fabry-Perot observations of the spectral line shape of O+ emissions at 732-nm have been taking place automatically at Arequipa, Peru, since March, 2005, for both evening and morning twilights. Although the 732-nm spectral emission is observed in a spectral blend with OH, it has proven possible in the analysis to remove the OH 731.6-nm and 730.2-nm rotational emissions from the observed spectral blend so that the intensity and line shape of this emission can be

determined. Plots of the variation of the 732-nm intensity with time show a roughly linear variation over the twilight period of ~25 minutes. Examination of the data base as a function of magnetic activity will determine how the 732-nm spectral intensity that is related to the thermospheric oxygen density will vary in magnitude and shape.

ITIT-10 Simulation of the Incoherent Scattering Radar Spectrum in the Auroral Ionosphere - by Marcos Diaz

Status of First Author: Student NOT in poster competition PhD

Authors: M. Diaz, J. Semeter, M. Zettergren, J. Byrnes

Abstract: The most prominent ground-based diagnostic for ionospheric studies is Incoherent Scatter Radar (ISR). ISR's operate above the plasma frequency, collecting a weak backscatter produced by random fluctuations in the dielectric constant of the medium. The power spectrum of the received signal can be analyzed to determine the temperature, composition, and motion of the plasma. To simplify the analysis, strict assumptions are made about the plasma within the radar volume—specifically, it is assumed to be uniform, isotropic, and in thermal equilibrium. At high latitudes, non-thermal, non-equilibrium, conditions arise due to coupling with the solar wind and distant magnetosphere. Currents and gradients created by this coupling result in instabilities that cover a broad range of spatial and temporal scales. These instabilities produce distortions in the ISR spectrum, and make physical interpretation of the spectrum difficult and inaccurate. In order to study those distortions in the ISR's spectrum the ionospheric plasma is simulated by using a 3D particle-in-cell code. In a first stage classical assumptions are used to validate the simulation. In a second stage a more dynamic ionosphere is used to study the distortions in the ISR's spectrum.

ITIT-11 Implementation of novel radar modulations on the SuperDARN - by Mrinal Singh Balaji

Status of First Author: Student NOT in poster competition Masters

Authors: Mrinal Singh Balaji, (ftmsb2@uaf.edu), Dr. William Bristow (bill.bristow@gi.alaska.edu)

Abstract: The Kodiak SuperDARN (Super Dual Auroral Radar Network), located on the Kodiak Island, Alaska, has a 16-antenna phased array transmitting ~9600 W peak power, with ~2.1 MW ERP and operates in a frequency range ~8-20 MHz. It is a coherent-backscatter radar sensitive to Bragg scatter from ionospheric irregularities. SuperDARN transmitters typically send out a 7-pulse sequence with each pulse being of 300 microseconds duration with a fundamental lag spacing of 2.4 milliseconds. The returns are sampled by the receivers, which form the complex Auto Correlation Function and fit a signal model to the power and phase at each range gate along the beam thereby estimating the power, velocity and the spectral widths of the scattering plasma waves. The complex auto-correlation functions are used to sort out the returns from different pulses and from different distances. However, the multipulse sequence being transmitted presently on the radar has some missing and bad lags. In addition, the analysis technique for estimating the properties of the ACF assumes that there is only a single velocity component present at one time. In this study, we use the Aperiodic Radar Technique designed by Dr. John D. Sahr and Dr. Sathyadev. V. Uppala [Uppala and Sahr 1994] to design an optimized transmission sequence that would have no repeated lags, minimum number of inherently missing lags and have no loss of lags due to Tx-on/Rx-off conflicts. Results from simulations run on single and multiple targets would be presented. With an appropriately designed transmission sequence, we hope to obtain data that will not require the single velocity component assumption, and would allow analysis using standard spectral estimators.
Reference: S. V. Uppala and J. D. Sahr, "Spectrum Estimation of moderately overspread radar targets using aperiodic transmitter coding," Radio Sci., vol. 29, pp. 611, 1994.

ITIT-12 Simulations of electron & ion Coulomb collisions under the presence of a DC magnetic field for ISR applications- by Marco Antonio Milla

Status of First Author: Student IN poster competition PhD

Authors: Marco Milla (mmilla@uiuc.edu), Erhan Kudeki (erhan@uiuc.edu), University of Illinois at Urbana-Champaign

Monte Carlo calculations of the trajectories of electrons and ions in a plasma suffering Coulomb collisions under the presence of a DC magnetic field have been carried out. The random motion of these particles is a Markov process in velocity space and can be described by a generalized Langevin equation with friction and diffusion coefficients that are velocity dependent. The statistical analysis of these simulations shows that probability distributions of the ion displacement are approximately Gaussian at all times, therefore a constant collision/diffusion coefficient Brownian motion approach can be used to model this ion motion process, as it was proposed by Woodman (1967). However, the same analysis shows that the electron displacements are not Gaussian, thus a

simple Brownian model is not a good approximation for the motion of electrons, this was previously pointed out by Sulzer & González (1999). Based on our simulated trajectories, we have computed ion and electron Gordeyev integrals and their corresponding incoherent scatter spectra for different radar wavelengths and magnetic aspect angles (including exact magnetic perpendicularity). Comparisons of our results with previous simulations (Sulzer & González, 1999) and the model proposed by Woodman (2004) have been performed and are presented here.

Sulzer, M. P. and González, S. A.: The effect of electron Coulomb collisions on the incoherent scatter spectrum in the F region at Jicamarca, J. Geophys. Res., 104, 22 535–22 551, 1999.
Woodman, R. F.: Incoherent scattering of electromagnetic waves by a plasma, Ph.D. thesis, Harvard University, Cambridge, Massachusetts, 1967.
Woodman, R. F.: On a proper electron collision frequency for a Fokker-Planck collision model with Jicamarca applications, J. Atmos. S.-P., 66, 1521–1541, 2004.

ITIT-13 AO SAS Instrumentation Overview - by Paloma Farias Guiterrez

Status of First Author: Student NOT in poster competition PhD

Authors: P. Farias, A. Cerruti, J. Friedman , R. Garcia, H. Hvo, MC. Lee, J. Mathews, C.R. Martinis, M. Mendillo, J. Meriweather, S. Razida, E. Robles, S.M. Smith, C Tepley, J. Wiig

Abstract: The Arecibo Observatory Space and Atmospheric Science group has hosted atmospheric instrumentation since the mid sixties. Soon after the 430MHz incoherent scatter radar first light, the first photometers were installed for passive optical measurements to study terrestrial airglow emissions. Today the photometers are accompanied by all-sky imagers, spectrometers, radiometers, seismographs as well as active remote sensing instruments in the form of Lidar systems, and the facility continues to grow. Over the last few years the site expanded further with high resolution barometers and GPS receivers and its most recent addition a magnetometer. The growth is a result from extended collaboration by institutions around the U.S. including Boston University, Clemson, Cornell University, MIT, Penn State, UCLA, and University of Puerto Rico among others. The purpose of this work is to provide to our community, especially emerging researchers, an updated and clear overview of the available instruments, their use, as well as data availability and selected publications.

ITIT-14 AO SAS Instrumentation Overview - by Johannes Wiig

Status of First Author: Student NOT in poster competition PhD

Authors: J. Wiig, A. Cerruti, P. Farias, J. Friedman , R. Garcia, H. Hvo, MC. Lee, J. Mathews, C.R. Martinis, M. Mendillo, J. Meriweather, S. Razida, E. Robles, S.M. Smith, C Tepley

Abstract: The Arecibo Observatory Space and Atmospheric Science group has hosted atmospheric instrumentation since the mid sixties. Soon after the 430MHz incoherent scatter radar first light, the first photometers were installed for passive optical measurements to study terrestrial airglow emissions. Today the photometers are accompanied by all-sky imagers, spectrometers, radiometers, seismographs as well as active remote sensing instruments in the form of Lidar systems, and the facility continues to grow. Over the last few years the site expanded further with high resolution barometers and GPS receivers and its most recent addition a magnetometer. The growth is a result from extended collaboration by institutions around the U.S. including Boston University, Clemson, Cornell University, MIT, Penn State, UCLA, and University of Puerto Rico among others. The purpose of this work is to provide to our community, especially emerging researchers, an updated and clear overview of the available instruments, their use, as well as data availability and selected publications.

ITIT-15 A New Amplitude Modulation Technique for F-Region Incoherent Scatter Measurements - by Romina Nikoukar

Status of First Author: Student IN poster competition PhD

Authors: R. Nikoukar - UIUC - nikoukar@uiuc.edu, F. Kamalabadi - UIUC - farzadk@uiuc.edu, M. Sulzer - NAIC - msulzer@naic.edu, E. Kudeki - UIUC - erhan@uiuc.edu, S. Gonzalez - NAIC - sgonzalez@naic.edu

Abstract: In this work we present a new coding scheme for measuring the incoherent scatter autocorrelation function (ACF) that exhibits more accurate extraction of ionospheric parameters in comparison with existing coding schemes. This coding scheme

includes the transmission of two amplitude modulated (AM) pulses, that we call Simplex codes. These code patterns are obtained from the so-called Simplex matrix, and their particular structure can provide a more uniform distribution of the number of contributing altitudes in each lag estimate. This uniformity allows a more accurate recovery of the ionosphere ACF at individual altitudes. Thus, from this point of view the Simplex coding technique behaves similarly to the Alternating coding scheme. However, it differs in that it works equally well under low and high signal-to-noise-ratios (SNR). Moreover, the Simplex codes decrease the correlations between the lag-estimate errors. This reduction in the correlations, which is due to the on-off structure of the codes, justifies using only the error variances in the nonlinear least-squares fitting routines instead of the full error covariance. Although amplitude modulated, the Simplex codes have duty cycles greater than 50% and are, therefore, less sensitive than the multi-pulse technique to the background noise level and the integration time.
In order to verify the superiority of the proposed coding scheme, we conducted a new F-region experiment at the Arecibo Observatory, in which both long pulse modulation and Simplex codes were utilized in transmission. The inversion analysis of the Simplex-code data yields a 50% reduction in the parameter error variances. Moreover, the Simplex inversion reduces oscillatory artifacts in the altitude profiles of the parameters associated with the long-pulse modulation.

ITIT-16 Real-time interaction with Poker AMISR - by Craig Heinselman

Status of First Author: Non-student

Authors: Craig Heinselman and Todd Valentic

Abstract: The AMISR is designed to be operated remotely by the use of internet connectivity. Although still early in development, the Poker AMISR connection will be demonstrated.

ITIT-17 Optical flow studies of the aurora - by John Byrnes

Status of First Author: Student IN poster competition Masters

Authors: John Byrnes, Boston University, Joshua Semeter, Boston University, E. M. Blixt, Univeristy of Tromso, Marcos Diaz, Boston University

Abstract: Auroral arcs are caused by some dynamic interaction of the ionosphere, magnetosphere and solar wind. At around one Earth radii, the electrons that cause the aurora are accelerated by a largely unknown means. The motion of structures in auroral arcs may contain information about this acceleration region. To study this motion, we have used optical flow techniques that are well knownto machine vision researchers. These techniques allow us to solve for the apparent 2D motion of the auroral arcs through the image plane. Through these methods, we can solve for the dense velocity and displacement fields of image sequences. The physical properties of the aurora lead to some interesting problems when applying traditional optical flow techniques, many of which were designed for tracking objects. We use a technique incorporating a physical model for fluid motion and robust statistics that we feel can be useful in resolving some of the difficulties associated with analyzing the aurora.

ITIT-18 Characterization of two new miniaturized ionospheric imaging systems - by Jonathan J Makela

Status of First Author: Non-student

Authors: J. J. Makela (University of Illinois), E. S. Miller (University of Illinois), D. A. Grunschel (University of Illinois)
J. S. Wilczynski (WILC Instruments, LLP)

Abstract: Two new ionospheric imaging systems have been designed that are significantly smaller than the traditional all-sky systems used in nightglow studies. The first is a wide-field system, covering a field-of-view of approximately 150 degrees. The second is a narrow-field system, with a field-of-view of approximately 80 degrees. The systems were designed with portability in mind: they measure approximately 12 inches x 12 inches x 9 inches (30 cm x 30 cm x 23 cm) and weigh about 30 pounds (14 kg). Their small size will make deployment of these imaging systems significantly easier than with previous systems. As we shall show, this reduction in size was accomplished without reducing the utility of the instruments, as resolution and sensitivity remain excellent. We present a characterization of the two systems, including CCD properties, imaging resolution, and sensitivity and compare them to imaging systems currently in use. The two imagers will be deployed this summer in South America to measure the conjugate properties of equatorial plasma bubbles. Additional systems are under construction to be deployed at mid latitudes.

ITIT-19 Implications of O-X mode interference on large HF receive arrays - by Trevor James Harris

Status of First Author: Non-student

Authors: G.J. Frazer, T.J. Harris, ISRD, Defence Science and Technology Organisation, Edinburgh, SA 5111, AUSTRALIA

Abstract: High time resolution radar observations were made of the angle-of-arrival, power, group-delay and Doppler characteristics of oblique HF propagation at fixed frequencies, over a 1850km path in the north of Australia. It was observed that when the ordinary (O) and extra-ordinary (X) propagation modes in the F2 low ray were not separable, the expected amplitude fading occurred. Along with the energy fading, apparent elevation and azimuthal deviations were also observed. By resolving the O and X modes all of these "interference" effects were removed. It is concluded that interaction between unresolved O and X components in a given propagation path will cause received energy and angle-of-arrival to fluctuate on the tens of seconds time scale. The results imply that for the case of a large array, unless the received signal propagation paths are resolved there is likely to be at least one fade located somewhere spatially within the large array. This will distort the spatial signature of the received signal and may render spatial processing algorithms ineffective. We believe that spatial distortion of a skywave propagated signal will occur with increasing likelihood as the size of the receiving aperture increases and may in fact place an upper bound on the effective aperture of large HF arrays. This limitation may be removed using an array containing polarimetric elements.

Long-Term Variations of the Upper Atmosphere

LTRV-01 Characteristics of Mesospheric Sporadic Potassium and Iron Atom Layers Over the Arecibo Observatory - by Ruben Delgado

Status of First Author: Student IN poster competition PhD

Authors: Shikha Raizada (shikha@naic.edu), Craig Tepley (ctepley@naic.edu), Jonathan S. Friedman (jonathan@naic.edu), National Astronomy and Ionosphere Center, Arecibo Observatory, HC03 Box 53995, Arecibo PR 00612, Brad R. Weiner (brad@hpcf.upr.edu), University of Puerto Rico, Chemistry Department P.O. Box 23346 University Station, san Juan, PR 00931

Abstract: Nighttime observations of mesospheric metal atom layers have been performed at the Arecibo Observatory using lidar for nearly a decade. A statistical analysis of parameters related to sporadic potassium and iron atom layers over the Arecibo Observatory was performed. Parameters, such as average peak height, average thickness, rise and fall times, seasonal variation, as well as their correlation with other geophysical parameters, were analyzed for each metal species over the Arecibo Observatory. The goal of this work is to achieve a better understanding of the chemical and dynamical processes that govern the metal layers.

LTRV-02 Seasonal Variations of the Equatorial Ionization Anomaly - GPS Observations and Model Results - by Tzu-Wei Fang

Status of First Author: Student IN poster competition PhD

Authors: Fang, T. W.1, C. H. Chen1, J. Y. Liu1, C. H. Lin2 and H. F. Tsai3
1. Institute of Space Science, National Central University, Jungli City, Taoyuan, Taiwan
2. National Space Organization, HsinChu City, Taiwan
3. Taiwan Analysis Center for Cosmic, Taipei, Taiwan

Abstract: The ionospheric total electron contents (TEC) in both northern and southern equatorial anomaly regions are examined by using the Global Positioning System (GPS) in Asian (120°E) and American (70°W) areas. Observation from GPS stations are used to investigate the large area variation from 1999 to 2005. Meanwhile, we use the International Reference Ionosphere (IRI) model to compare with GPS observation. Results show that in both areas the density of equatorial anomaly crests exist remarkable semi-annual variations. The maximum values are during the vernal and autumnal months and the winter anomalies mostly appear in the northern hemisphere. In Asian area, the position of the crest move significantly poleward in summer of the southern hemisphere. The phenomenon also occurs but inversely in northern hemisphere in American area. The altitude of peak electron density in the equatorial ionization region from IRI is higher in summer especially in the northern(southern) hemisphere in Asian(American) area.

In order to investigate the causal mechanism of seasonal variation in equatorial anomaly crests, Sheffield University Plasmasphere Ionosphere Model (SUPIM) is used. Model simulation shows that the transequatorial neutral wind and plasma velocity parallel to the magnetic field line may play important roles in the poleward movement for summer southern (northern) hemisphere of Asian (American) area.

LTRV-03 Retrieve of topside parameters from ISR spectrum using Genetic Algorithms - by Jose Fernandez

Status of First Author: Non-student PhD

Authors: Arecibo Observatory

Abstract: A new approach to estimate topside parameters from Incoherent Scatter Radar (ISR) spectrum using Genetic Algorithms (GA) is introduced. Current fitting method used to retrieve ISR parameters based on least-squares fitting (LSF) and derivatives is compared to this new approach in noisy topside scenarios. Results from synthetic data with different Signal to Noise Ratios (SNR) proved that GA perform better at topside altitudes where reduction of electrons and transmitted power produce noisy spectra. Both methods are compared in two fitting cases: assuming equal electron and ion temperatures (T=Te=Ti), and ixing the temperature ratio (Tr=Te/Ti) and fitting for the ion temperature. In both cases, the GA approach retrieves better estimations.

LTRV-04 Thermosphere Response to Magnetic Activity: Dependences on Latitude, Season, and Solar Cycle - by Selena Coats

Status of First Author: Student IN poster competition PhD

Authors: Selena Coats, Jeffrey M. Forbes, Frank A. Marcos, Bruce Bowman

Abstract: In this study, atmospheric densities derived from satellite orbital drag were utilized to establish the spatial-temporal dependence of exospheric temperature upon factors that were not previously modeled in the Jacchia (1970) empirical model. Density measurements had daily resolution, and were derived from satellite drag analyses on 26 satellites ranging in altitude from 200 to 600 km. Measurements made from 1966 until 2003 resulted in a database of approximately 200,000 measurements covering virtually all latitudes and local times, a wide range of geomagnetic activity and 3 complete solar cycles. To effectively compare data from all contributing satellites, the Jacchia (1970) model was used to convert density perturbations into variations in exospheric temperature. Perturbations in exospheric temperature were then related to changes in the daily Ap index, and this relationship was studied with respect to dependences upon local time, season, and solar cycle. The effect of high-speed streams and other solar wind characteristics were also studied.

LTRV-05 The Themosphere Ionosphere Doppler Interferometer (TIDI): contributions from the first 4 1/2 years in orbit - by Rick Niciejewski

Status of First Author: Non-student

Authors: Rick Niciejewski, Space Physics Research Laboratory, The University of Michigan, Ann Arbor, MI 48109, contact: niciejew@umich.edu

Abstract: Synoptic measurements of the global horizontal neutral wind field have been performed continuously since early 2002 by the TIDI instrument, orbiting aboard the TIMED satellite. The mesosphere and lower thermosphere (MLT) are sampled at the terrestrial limb by four simultaneous altitude-scanning telescopes, which have generated a wealth of new measurements of the neutral wind and the O2 Atmospheric airglow, the latter providing ozone height profiles during daylit periods. Satellite based wind measurements of the MLT are an attractive accompaniment to CEDAR ground based observations, providing a global context for individual field site efforts.

This poster will describe the data sets that have been archived by the TIDI team at the University of Michigan. Results of wind validation efforts indicate that TIDI winds are similar in quality to both climatological and concurrent HRDI and WINDII measurements. Results from the retrieval of ozone height profiles from TIDI airglow observations will also be described.

LTRV-06 Solar cycle variations of F-layer electron density and ion temperature measured by the Sondrestrom incoherent scatter radar - by Elizabeth Kendall

Status of First Author: Non-student

Authors: Elizabeth Gerken Kendall (SRI International, elizabeth.kendall@sri.com); Craig Heinselman (SRI International, craig.heinselman@sri.com)

Abstract: Long-term studies of ionospheric density and temperature variations show diurnal, seasonal, annual, and solar cycle variations. These variations are highly dependent on the geographic location of the measurements. We add to a growing database of incoherent scatter radar (ISR) solar cycle studies with observations of F-layer electron density and ion temperature from the Sondrestrom Upper Atmospheric Research Facility in Kangerlussuaq, Greenland over the duration of 1990-2003. We find that while the variations do indeed show solar cycle dependence, there is not a simple correlation with the f10.7 or Kp indices. We additionally compare the Sondrestrom-measured densities and temperatures to those predicted by the International Reference Ionosphere model (IRI 2001). We find the bulk long timescale trends to be predicted by the IRI but that the measured daily variations are dramatically different from those generated by the IRI model.

LTRV-07 Solar Cycle Influences Seen in Ground-based Geocoronal Hydrogen Measurements - by Susan Marcelle Nossal

Status of First Author: Non-student

Authors: S.M. Nossal, E.J. Mierkiewicz, F.L. Roesler, J. Bishop, R.J. Reynolds, L.M. Haffner, nossal@wisp.physics.wisc.edu, 608-262-9107

Abstract: Understanding the influence of the solar cycle on the upper atmosphere is required to isolate signatures of natural variability from those due to long term variations. We will discuss geocoronal hydrogen column emission observations taken during differing solar conditions with the Wisconsin H-alpha Mapper Fabry-Perot as well as efforts to connect these observations with those taken during solar cycle 22 with different, though similarly designed Fabry-Perot instruments at mid-latitude observatories. We will also discuss work in progress on parameter definitions in the LYAO_RT forward modeling technique for retrieving column abundance information, tested in terms of sensitivity under differing observing applications (e.g. lone station measurements versus coincident measurements acquired by several independent instruments).

LTRV-08 Study of the meridional neutral winds behavior obtained by the Incoherent Scattering Radar in Arecibo Observatory - by Pedrina Terra Santos

Status of First Author: Non-student PhD

Authors: Pedrina Terra, Arecibo Observatory, pterra @naic.edu; Sixto Gonzalez, Arecibo Observatory, sixto@naic.edu; Nestor Aponte, Arecibo Observatory,naponte@naic.edu; Craig Tepley, Arecibo Observatory, ctepley@naic.edu; Eva Robles, Arecibo Observatoy,erobles@naic.edu;Christiano Garnett Marques Brum, INPE, garnett@dae.inpe.br

Abstract: This work presents the preliminary results of a long-term meridional neutral winds study realized in Arecibo (18.35°N, 66.75°W) from 1986 to 1998. The meridional wind component used here was obtained indirectly from measurements of the ion velocities by the Incoherent Scattering Radar (ISR). The analyses are done to each month, under both low and high solar activity condition. In addition, it is presented a comparison between these results and the meridional neutral winds obtained with Fabry-Perot Interferometer (FPI) measurements under same conditions.

LTRV-09 Quasi-biannual periodicity detected in the cosmic noise absorption registers over sub-auroral region - by Christiano Garnett M Brum

Status of First Author: Student IN poster competition PhD

Authors: Christiano Garnett Marques Brum, Mangalathayil Ali Abdu, Inez Staciarini Batista

Abstract: In this work we present and discuss the ionospheric D region response to the geomagnetic activity and the galactic cosmic ray (GCR) precipitation under sub-auroral region (Brazilian Antarctic Station (BAS) - geographic coordinates: 62,56S; 58,39W). For this propose, it was analyzed the galactic cosmic noise absorption (CNA) registered by riometers operating at 30 MHz over BAS (connected to an antenna pointed to the zenith direction) during almost one complete solar cycle (1989-1996). In order to study the variability of the CNA, we employ a filtering procedure using the continuous wavelet transform analysis that it is consisted by the decomposition of the signals using Morlet "mother" function. From the correlation of the wavelet details among these signals it was detected that the GRC is the main source of the ionization of the lower ionosphere in this region with a correlation coefficient (CR) closest to 1.0 for the detail D11 (with the 3 to 6 years of periodicity). Also, from this same analysis, it was verified an expressive CR of the detail D9 (0.8) for periodicity of the 1 to 2 years denoting a seasonality dependency of the CNA by the GCR precipitation. The seasonality dependence also was verified by the CR in the detail D9 between the CNA and kp index decomposition (CR0.9). From these results we follow that the GCR is the major source of the ionization of the sub-auroral lower ionosphere and its precipitation is modulated by the local geomagnetic cut-off variation with a bi-annual/annual periodicity.

LTRV-10 Neutral wind velocity behavior with the solar cycle over Arecibo - by Christiano Garnett Brum, presented by Eva Robles

Status of First Author: Non-student PhD

Authors: Craig Tepley, ctepley@naic.edu

Abstract: This work represents the behavior of the neutral atmospheric winds at the Arecibo Observatory. Approximately 14 years of Fabry Perot Interferometer data have been analyzed in order to obtain this information. For this purpose, a linear regression method was applied to determine the response of the neutral wind velocity (zonal and meridional wind components) to solar cycle variations. A positive correlation was found between the increase of solar cycle and the increase of the meridional velocity component, mainly from 21LT to 02LT. The zonal wind component showed a strong dependence with season and local time during winter months (December, January and February), and a positive correlation with the solar activity was detected. Relative to the seasonal variation, both the zonal and meridional wind components present a larger value during the winter months and their amplitudes present a small variation with solar cycle. A numerical model was developed with this analysis procedure and the results presented show a good agreement with Fabry Perot Interferometer data.

Solar Terrestrial Interactions in the Upper Atmosphere

SOLA-01 Observed Solar Radio Burst Effects on GPS/WAAS Carrier-to-Noise Ratio - by Alessandro Cerruti

Status of First Author: Student NOT in poster competition PhD

Authors: Paul Kintner, pmk1@cornell.edu, Louis Lanzerotti, ljl@njit.edu, Dale Gary, dgary@njit.edu, Eurico de Paula, eurico@dae.inpe.br, Hien Vo, vo@naic.edu

Abstract: GPS signals, systems, and navigation accuracy are vulnerable to a variety of space weather effects that are caused mostly by the ionosphere. However, the sun, which is sometimes a strong radio source, is the cause of GPS signal interference presented here. The first direct observations of GPS L1 (1.57542 GHz) carrier-to-noise ratio degradation on two different models of GPS receivers due to the solar radio burst associated with the 7 September 2005 solar flare are presented.

Carrier-to-noise ratio data from three identical, collocated receivers at Arecibo Observatory and also from four identical receivers of a different model located in Brazil, were available at the time of the solar radio burst. These receivers were all in the sun-lit hemisphere and all were affected similarly. The maximum solar radio burst power associated with the 7 September 2005 flare had a peak intensity of about 8,700 solar flux units (1 SFU = 10-22 W/m2-Hz) RHCP at 1,600 MHz, which caused a corresponding

decrease in the signal-to-noise ratio of about 2.3 dB-Hz across all visible satellites. Only the right-hand, circularly polarized (RHCP) emissions affected the GPS signals.

To confirm the effect, the solar radio burst associated with the 28 October 2003 flare was investigated. Although polarization data were not available for this event, the maximum degradation at GPS L1 was about 3.0 dB-Hz, and a degradation of 10 dB-Hz was observed on the semi-codeless L2 signal for a solar radio burst of 13,600 SFU.

The event analyzed herein can be used to scale historical solar radio bursts of 80,000 SFU. Decreases of 12 dB-Hz (21 dB-Hz) in the L1 (L2, semi-codeless) signal-to-noise ratio are implied along with loss of tracking for inadequately designed GPS receivers. Since solar radio bursts affect all satellites in view of a receiver, all receivers in the sun-lit hemisphere, the new Galileo navigation system, and all space-based augmentation systems such as WAAS and EGNOS, they are a potential threat to life-critical systems.

SOLA-02 Day-to-day Variability of the E-layer - by Amanda Johnson

Status of First Author: Student IN poster competition Undergraduate

Authors: Amanda Johnson (akj@bu.edu), Luke Moore (moore@bu.edu), Carlos Martinis (martinis@bu.edu), Michael Mendillo (mendillo@bu.edu)

Abstract: Variability in the E-layer of the Ionosphere is caused by four variable sources: solar flux, neutral atmosphere, neutral nitric oxide, and solar declination. A one-dimensional photochemical model of the E-layer developed by Moore et al. (2006)* uses Solar 2000 version 2.27 parameters, NRL-MSIS neutral atmosphere predictions, modeled NO, and solar declination for the time period September 1-30, 2005. The 30 Day Long Duration Run data were obtained from the Madrigal database for MIT's Haystack Observatory Incoherent Scatter Radar. The photochemical model allows any combination of sources of variability to fluctuate or remain constant. The sun is found to dominate sources of day-to-day variability in the E-layer, either from variable solar flux or changing solar declination.

SOLA-03 Study of Sudden Increases in Total Electron Content Induced by Solar Flares Using Observations and Models - by Takuya Tsugawa

Status of First Author: Non-student PhD

Authors: T. Tsugawa (Solar-Terrestrial Environment Laboratory, Nagoya University)
S. Katoh (Solar-Terrestrial Environment Laboratory, Nagoya University)
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K. Shiokawa (Solar-Terrestrial Environment Laboratory, Nagoya University)
A. Saito (Graduate School of Science, Kyoto University)

Abstract: Sudden increases in total electron content (SITEC) induced by intense solar flares were studied using GPS networks and models. SITEC is one of sudden ionospheric disturbances induced by solar flares, which emit extreme ultraviolet and X rays in short time interval. The recently developed imaging technique using TEC data from GPS receiver networks has been applied to study SITEC [e.g., Afraimovich et al., 2001; Zhang and Xiao, 2003, 2005], and have clarified some of global-scale characteristics of SITEC phenomena. However, seasonal and local time dependencies of SITEC are still unknown. In this study, we investigated 197 SITEC events associated with solar flares larger than M5 X-ray class during January 2000 and May 2005 global TEC data from SOPAC GPS networks. The global TEC maps revealed that the SITEC value is linearly dependent on the cosine of solar zenith angle (SZA) with negligible residuals in almost all the flare events. It was found that the residual values of SITEC tend to be larger in the winter hemisphere than in the summer hemisphere. The similar characteristics were also seen in the dayside distribution of the O/N2 density ratio and the photo-ionization rate around the F2-peak calculated using the MSISe90 model and the EUVAC model. This indicate that the SITEC phenomena induced by intense solar flares depend on not only the SZA, but also the background atmospheric composition.

SOLA-04 Quantification of global 30-240 keV proton precipitation pattern change in the 17-18 April 2002 storms - by Xiaohua Fang

Status of First Author: Non-student

Authors: Xiaohua Fang, Michael Liemohn, Janet Kozyra, David Evans, Anna DeJong, and Barbara Emery

Abstract: Global 30-240 keV proton precipitation patterns during the 17-18 April 2002 geomagnetic storm events were generated using newly-developed 3-hour data products of the medium energy proton and electron detector (MEPED) onboard the NOAA-15 and -16 satellites. The change of energetic proton precipitation patterns is quantified in terms of three aspects: hemispheric integrated total particle energy input, midnight proton oval equatorward boundary, and position of proton precipitation peak. In a general sense, as magnetospheric activity intensified, the midnight equatorward boundary trended to move to the lower latitude, while the precipitation peak moved equatorward and westward away from midnight, in agreement with ring current motion. It is well illustrated that 3-hour NOAA/POES >30 keV proton precipitation patterns can serve as a valuable diagnostic tool for investigating the inner magnetospheric activity.

SOLA-05 The short-term relationship between the equatorial peak electron density and the solar irradiance - by Xiaoni Wang

Status of First Author: Student IN poster competition PhD

Authors: Department of Electrical and Computer Engineering, University of Central Florida, Orlando, Florida

Abstract: The short-term relationship of the equatorial peak electron density and the solar short wavelength irradiance is examined using foF2 observations from Jicamarca, Peru and solar irradiance measurements from recent satellites. Solar soft X-ray measurements from both the SNOE (1998-2000) and TIMED (2002-2004) satellites as well as Extreme UltraViolet (EUV) measurements from the TIMED satellite are used. Both the EUV and soft x-rays show similar correlations with foF2 at short time scales (27 days or less); although, the EUV measurements do show a higher correlation for longer periods. For the short term variations, both SNOE and TIMED observations have a higher correlation in the morning (~0.5) than the afternoon (~0.15). In the afternoon SNOE observations have a higher correlation (~0.2) with foF2 than the TIMED observations (~0.1 correlation), which is attributed to differences in the solar cycle (maximum and minimum). At morning times foF2 has a ~27 day variation, consistent with the solar rotation rate. After noon, but not in the morning, a ~14- day variation consistently appears in the foF2. This ~14 day variation is attributed to geomagnetic influences.

SOLA-06 Global model simulations using the TIMED solar EUV experiment - by David John Pawlowski

Status of First Author: Student IN poster competition PhD

Authors: Aaron Ridley, Yue Deng

Abstract: Solar extreme ultraviolet (EUV) radiation is an important source of energy to the ionosphere. Recent measurements of the EUV and soft x-ray spectrum have been taken by the TIMED satellite. This data provides improved resolution over previously used proxy models. In this study, the Global Ionosphere-Thermosphere Model (GITM) is used to compare physical quantities using TIMED data and a F10.7 proxy model (EUVAC and EUV91) during the Halloween storm. Differences in the preliminary results are discussed.

SOLA-07 Looking for Rules in Geomagnetic Storm Occurrence Using the Decision Tree Technique - by Amita Muralikrishna

Status of First Author: Student IN poster competition Masters

Authors: Amita Muralikrishna, Rafael Duarte Coelho dos Santos, Alisson Dal Lago, Jose Demisio Simoes da Silva

Abstract: The Earth suffers a considerable influence from the solar activity through the solar wind, which carries within it counterparts from some solar structures, mainly, solar flares and CME – Coronal Mass Ejections, observed in the solar corona and in the visible photosphere. The arrival of those structures at the Earth, depending on its characteristics, may cause magnetic storms,

which, may lead to diverse damages to technological systems on earth. One of the solutions to diminish the effects caused by intense magnetic storms is the forecasting of their occurrences. Recent works study the use of artificial intelligence techniques, such as Artificial Neural Networks (ANN) to forecast geomagnetic indexes. The present work approaches the use of a Data Mining technique - Decision Tree - to try to extract rules based on plasma and interplanetary magnetic field data during magnetic storm occurrences, which are represented by the Dst geomagnetic index. The aim is to use such technique to provide means of forecasting magnetic storms.

SOLA-08 Study of a X17 solar flare effects observed over Jicamarca on Sep 07 2005 - by Pablo M. Reyes

Status of First Author: Student IN poster competition Masters

Authors: P. Reyes (Univ. of Illinois), A. Akgiray (Univ. of Illinois), E. Kudeki (Univ. of Illinois), G. Lehmacher (Clemson Univ.) R. Woodman (Jicamarca Radio Observatory), J. Chau (Jicamarca Radio Observatory)

Abstract: We present here Jicamarca radar observations conducted during a sudden ionospheric disturbance (SID) caused by a X17 solar flare event. The event took place at ~12:40 LT while the Jicamarca radar was making combined MST and ISR measurements using a four beam configuration. During the event, D-region echoes were enhanced, but equatorial electrojet and F-region incoherent scatter echoes were suppressed. Cosmic noise initially decreased and then increased throughout the main phase of the event which lasted about 45 min. 150 km echoes were observed throughout the event with Doppler velocities which did not show any significant variation due to SID. However, the altitude of the 150 km echo layer was lowered by about 10 km. In this poster we will attempt to explain the observations summarized above in terms of an anomalous increase of D-region electron densities accompanied by a reversal of the vertical gradient of electron density at E-region heights.

SOLA-09 Modeling Sudden Impulse Events in the High Latitude Ionosphere - by Michael J. Holliday, presented by Simon Shepherd

Status of First Author: Non-student Masters

Authors: Michael J. Holliday, Simon G. Shepherd, David L. Murr

Abstract: Sudden changes in dynamic solar wind pressure can lead to dramatic changes in the shape of the magnetosphere. One class of these transient phenomena, known as sudden impulse (SI) events, leads to the formation of large-scale currents (spatial scales on the order of 1000 km.), which couple the ionosphere and magnetosphere in the high-latitude region. By combining SuperDARN and magnetometer data, we have developed a model of the SI-driven current system as a series of field-aligned current sheets. With a computer simulation of the model and a case study SI event, we show that the model can accurately reproduce the ground signature of an actual SI event. Removing background ionospheric convection, and calculating ionospheric velocity shears, we estimate the current density of these structures to within the limitations of radar resolution, and, by comparing radar spectral returns, investigate strong anti-parallel flows within a single range gate. We are also beginning a statistical study of these events, and present the first steps in identifying and classifying these events.

SOLA-10 Community Coordinated Modeling Center Support of the CEDAR Science Campaigns - by Maria M Kuznetsova

Status of First Author: Non-student

Authors: M.Kuznetsova, M.Hesse, L.Rastatter, A.Chulaki, NASA Goddard Space Flight Center, Maria.M.Kuznetsova@nasa.gov

Abstract: One of the ways to address the science needs of the research community and to enable science progress is to provide community access to modern space science models. The Community Coordinated Modeling Center (CCMC) hosts a set of state-of-the-art space science models ranging from the solar atmosphere to the Earth's upper atmosphere. CCMC provides a web-based, no-cost, Run-on-Request system, by which the interested scientist can readily request simulations for time intervals of interest. CCMC also provides a tailored web-based visualization interface for the model output. CCMC is performing simulations for science community campaigns (e.g., CAWSES space weather campaigns, Incoherent Scatter Radar world-month campaigns) involving all available models including CTIP, Utah State University GAIM, AbbyNormal, SAMI2, Weimer-2005. CCMC offers a variety of visualization and output analysis tools to aid scientists in the interpretation of simulation results. Model output has been specifically tailored for easy comparison with observational data, to facilitate data analysis and model validation. Model

output can be customized to focus on specified locations and/or to address specific science questions. CCMC invite CEDAR community comments and suggestions to better address needs of science campaigns.

Data Assimilation

DASS-01 Recent Result from Ionospheric Data Assimilation Three-Dimensonal (IDA3D) - by Gary Bust

Status of First Author: Non-student

Authors: Gary Bust

Abstract: Recent results of Three-dimensional, time evolving electron density are presented from the data assimilation algorithm IDA3D. Results include storm-time dynamics and mid and high latitudes, and regional results on spatial scales of a few hundred kilometers and smaller.

DASS-02 Continual initialization of a coupled thermosphere-ionosphere forecast model by an ionospheric data assimilation model - by Geonhwa Jee

Status of First Author: Non-student PhD

Authors: Alan G. Burns, NCAR/HAO, Wenbin Wang, NCAR/HAO, Stanley C. Solomon, NCAR/HAO, Robert W. Schunk, USU/CASS, Ludger Scherliess, USU/CASS, Donald C. Thompson, USU/CASS, Jan J. Sojka, USU/CASS, Lie Zhu, USU/CASS

Abstract: Data assimilation models have been extensively utilized to specify the system and to provide initial conditions for their numerical forecast models in meteorology and oceanography. As data assimilation models have recently become available for the ionosphere (e.g., Global Assimilation of Ionospheric Measurements (GAIM) model), we have conducted the initialization of the Thermosphere Ionosphere Nested Grid (TING) model using electron densities from the GAIM model for various geophysical conditions. Our study shows that the effects of the initialization generally disappear in few hours for most conditions.
We have also studied the effects of continually replacing the electron densities in the TING model by GAIM outputs. These different electron densities cause some changes in thermospheric and other ionospheric parameters in the TING model, but the overall structure of the thermosphere is still preserved.

Polar Aeronomy

POLA-01 Three-Dimensional High-Resolution Storm-Time Simulation of the Ion and Neutral Polar Winds - by Larry Gardner

Status of First Author: Non-student PhD

Authors: Larry C. Gardner, Utah State University, lgardner@cc.usu.edu, Robert W. Schunk, Utah State University, robert.schunk@usu.edu

Abstract: Magnetic storms impact the flow of mass and momentum between the ionosphere and magnetosphere at high-latitudes along open magnetic field lines and in the auroral oval. A three-dimensional storm-time simulation was conducted using a global ion and neutral polar wind model, developed at Utah State University. The study looked at the one way coupling of the ionosphere to the magnetosphere during the magnetic storm of May 5, 1998, between 2:00 and 12:00 UT. The focus of the simulation was on the effects of small-scale F-region structures of a few hundred kilometers on the ion and neutral polar winds. The simulation indicated that the outflow from the ionosphere is highly dynamic on scales of a few hundred kilometers, with outflow rates varying according to temporal changes in electron precipitation and plasma convection.

POLA-02 The role of vertical ion convection in the high-latitude ionospheric plasma distribution - by Yue Deng

Status of First Author: Student NOT in poster competition PhD

Authors: Yue Deng

Abstract: During storm times, complex disturbances in the ionosphere-thermosphere can cause both increases and decreases in the F2 peak electron density, which are ionospheric positive and negative storm phases, respectively [lu et al. (2001)]. The electron density profile is very important, possibly changing the total electron content (TEC), and also feeding back to the Joule heating. While it is understood that the coexistence of many effects causes the variety of forms of ionosphere, these effects have not been thoroughly quantified. sojka et al. [1981] qualitatively analyzed the effect of vertical electrodynamic drift on the ion density profiles at high latitudes. Besides these studies, little attention has been paid to the effects of the vertical component of the ExB drift in the polar region, while the influence of horizontal ion convection and neutral composition have been well studied. Here Global Ionosphere Thermosphere Model (GITM) is used to investigate the polar region ionosphere reaction to a simple step change of the high latitude forcing terms. The changes of vertical ion drift and its impact on the F2 layer are presented. Then, the relative importance of different mechanisms is examined, including horizontal advection, vertical convection and chemical reactions on both the bottomside and topside of the F2 layer. The correlation between the O/N2 ratio and electron density in a non-equilibrium situation is also investigated.

POLA-03 A Comparison of the Cross Polar Cap Potential Drop During Steady State versus Non-Steady State During Southward IMF Conditions - by Kelly Ann Drake

Status of First Author: Student IN poster competition PhD

Authors: Kelly Ann Drake (dr.kelly@physics.org), R. A. Heelis (heelis@utdallas.edu), and M. R. Hairston (hairston@utdallas.edu); all at the Wm. B. Hanson for Space Sciences at the University of Texas at Dallas

Abstract: The cross polar cap potential difference, Φ_{PC}, is a direct measure of the instantaneous rate of plasma flow through the magnetosphere-ionosphere system and provides a measure of the ionospheric plasma flow which is the low-altitude "footprint" of magnetospheric convection processes. Most empirical models of Φ_{PC} are based on data taken when the interplanetary magnetic field (IMF) is in a quasi-steady state (SS). However, the IMF is usually in a non-steady state (NSS) and we wish to know if the average measure of Φ_{PC} is different during these times compared to SS times. This study uses two years (2000-2001) of ionospheric plasma flow data provided by the DMSP to calculate Φ_{PC}, along with solar wind data from the ACE satellite in order to address this question. We compare Φ_{PC} during both SS state and NSS conditions for various published forms:

1) $\Phi = c_1 + c_2 v B_z$,

2) $\Phi = c_1 + c_2 v B_T \, sin^3(\theta/2)$, and

3) $\Phi = c_1 v^2 + c_2 B \sin^3(\theta/2)$,

where *v* is the solar wind velocity, $B_T = \sqrt{B_y^2 + B_z^2}$ is the projection of **B** on the *y*-*z* plane of the solar magnetosphere coordinates (i.e. the plane perpendicular to the sun-earth line), and θ, the "clock angle," is defined by $cos^{-1}\left(B_z / |B_T|\right)_{GSM}$. Systematic deviations in the fits obtained using SS and NSS data will be discussed in terms of the effects of variable IMF conditions on the magnetosphere solar wind interaction.

POLA-04 Multi-resolution analysis of aurora images - by Tomoko Matsuo

Status of First Author: Non-student

Authors: Tomoko Matsuo, Dirk Lummerzheim, Douglas W. Nychka

Abstract: The Ultraviolet Imager (UVI) on board the POLAR satellite provides an estimate of the auroral electron precipitation, in terms of characteristic energy and total energy flux, with excellent spatial coverage and high temporal resolution. These parameters are being used to determine the enhanced conductivity due to ionization of the neutral atmosphere by auroral particles. We apply a state of the art multi-resolution nonstationary covariance model to this rich data set in order to quantify the temporal scales of the aurora at various length scales. Such characterization is essential for the understanding of the physical mechanisms behind the behavior of the aurora which cannot be fully described by current physical models. It is also needed for modeling of the background error (prior) covariance required in data assimilation procedures for the Earth's polar ionosphere.

POLA-05 Contributions of Spatial and Temporal Ion Drift Variability to the Joule Heating Rate during Southward IMF - by Eric Schoen Johnson

Status of First Author: Student NOT in poster competition PhD

Authors: E. S. Johnson, The University of Texas at Dallas, ejohnson@utdallas.edu, R. A. Heelis, The University of Texas at Dallas, heelis@utdallas.edu

Abstract: Ion drift variability in time and space may contribute significantly to heating of the F region and this information could be used to improve our understanding of the energy budget of the atmosphere. The presence of spatial and temporal variability in the ion drift can increase the Joule heating rate over that expected from only the mean bulk flow. This investigation examines the spatial and temporal variability in the ion drift and its contribution to the total Joule heating rate in the F-region ionosphere in the summer and the winter at all local times during southward interplanetary magnetic field conditions using the Dynamics Explorer 2 satellite. It was found that both spatial and temporal variability in the ion drift influenced the Joule heating rate. The contribution of spatial variability to the Joule heating rate maximized at approximately 40% in the dawn auroral zone during winter while the temporal variability contribution to the Joule heating rate maximized near 80% in the same region.

POLA-06 Development of Resonance Lidar for Studying the Auroral Thermosphere - by Eric M Lundell

Status of First Author: Student IN poster competition PhD

Authors: Eric M. Lundell, Liguo Su, Richard L. Collins, Dirk Lummerzheim, Geophysical Institute, University of Alaska Fairbanks, Fairbanks, Alaska 99775; iamcire@yahoo.com, ftls1@uaf.edu, rlc@gi.alaska.edu, lumm@gi.alaska.edu

Abstract: Many remote sensing techniques have been used in observing the aurora. Traditionally, these include imagers, radars, and photometers. Recently, resonance lidars have been proposed for remote sensing of the aurora. An auroral lidar is currently under development at the Poker Flat Research Range of the Geophysical Institute, University of Alaska Fairbanks. The lidar will employ scattering from molecular nitrogen ions that have been produced by auroral precipitation. This paper will describe the resonance lidar and the expected performance measurements of the lidar system. The performance of the lidar system will be discussed in terms of conventional resonance lidars that measure atomic metals in the mesopause region. Future developments of the system will also be discussed.

POLA-07 Neutral Atmosphere dynamics: A Fabry Perot Interferometer at Concordia - by Qian Wu

Status of First Author: Non-student

Authors: Q. Wu1 and C. Lathuillère2
1High Altitude Observatory, National Center for Atmospheric Reserarch
2Laboratoire de Planétologie de Grenoble

Abstract: We propose to deploy a multi-emission Fabry-Perot interferometer at Concordia station, Antarctica (75S) to measure mesospheric and thermospheric neutral winds. The instrument will be mostly identical to the one currently operational at Resolute (75N), Canada. Here we use the results from Resolute to demonstrate the performance of the instrument and possible scientific

goals that can be achieved by an FPI in Concordia alone and in conjunction with the Resolute measurements. Being at a high altitude location, Concordia is ideally situated for nighttime upper atmospheric optical measurements. The instrument will be fully automatic with low power consumption (for a PC and CCD camera, and a small heater).

POLA-08 Plans for ion-neutral coupling studies utilzing the Alaskan Fabry-Perot Interferometer network and the AMISR radar - by John W. Meriwether

Status of First Author: Non-student

Authors: J. W. Meriwether, R. Hedden, M. Larsen (Clemson University), J. Herron, V. Wickwar (Utah State Univ.), L.L. Cogger (Univ. of Calgary); (john.meriwether@ces.clemson.edu)

Abstract: Ion-neutral coupling studies require accurate determination of the neutral wind vector as well as ion drift measurements. Common volume (CV) measurements by three FPI observatories represent an important tool by which the transfer of momentum by convecting plasma to the neutral atmosphere can be studied. There is no need to assume a symmetric wind field or that the vertical wind speed is small as all three components of the neutral wind vector within the common volume can be precisely determined. The three FPI locations that have been chosen are Poker, Ft. Yukon, and Eagle. A sequence of CV measurements over central Alaska with these observatories would provide measurements of the neutral wind vectors from which the scalar quantities of divergence and vorticity can be calculated. The variation of both of these quantities during a substorm would provide information regarding the relative importance of Joule heating and Lorentz forcing (ion-drag. The evolution of the polar thermosphere during the substorm can be regarded as the equivalence of a geostrophic adjustment in which the response of the thermosphere varies as the Rossby radius is modified by the large-scale structure of Joule heating and particle precipitation. The three FPI observatories are undergoing construction and testing and are expected to be installed and operational by mid-August, 2006.

POLA-09 (displayed with IRIA-06) - **Parametric dependence of electric field variability in the Sondrestrom data base: a linear relation with Kp** by Russell Cosgrove

Status of First Author: Non-student

Authors: Russell Cosgrove and Jeffrey Thayer

Absrtact: Motivated by the question of the auroral region contribution to thermospheric heating, the data base from the Sondrestrom incoherent scatter radar is used to study the variability of the high latitude vector electric field. The ability of various geophysical parameters to describe the variability is evaluated, using a minimum variance criterion, and it is found that the standard deviation $\sqrt{\left\langle \left| \vec{E} - \left\langle \vec{E} \right\rangle \right|^2 \right\rangle}$ scales linearly with Kp. It is also found that magnetic latitude and magnetic local time are important descriptors, and that the specific dependence largely agrees with variability measurements made by the DE 2 satellite, even though the latter measurements probe a much higher frequency range. A number of other parameters are found to be less important as descriptors, including the IMF clock angle and the season. Thermospheric global circulation models currently incorporate an auroral zone heat source in the form of Joule heating associated with the mean electric field $\left\langle \vec{E} \right\rangle$, where the mean is taken over temporal and spatial scales below the models resolution. However, comparison of the modeling outputs with MSIS suggests that the auroral zone heat source is underestimated. Because it is the mean of the squared electric field that determines Joule heating, and not the square of the mean, the electric field variability has been put forward as the missing source. Our results indicate that this heat source may be parameterized by Kp, which carries the further implication that the variability is associated with a global scale phenomenon.

Midlatitude Ionosphere or Thermosphere

MDIT-01 Statistical study of medium-scale traveling ionospheric disturbances observed with GPS networks in Japan and Southern California - by Nobuki Kotake

Status of First Author: Student IN poster competition PhD

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Abstract: Using GPS data obtained from GPS networks in Southern California and in Japan in 2002, we investigated total electron content (TEC) variations caused by Medium-Scale Traveling Ionospheric Disturbances (MSTIDs) to reveal statistical characteristics (occurrence rate, propagation direction, horizontal wavelength, horizontal phase velocity, and amplitude) of MSTIDs. Occurrence rate of MSTIDs has tree peaks in winter daytime, summer dusk, and summer nighttime. During daytime, most of MSTIDs propagate southeastward. Ions in the F region move by the neutral particles along the geomagnetic fields (B) at the same velocity as the neutral particles through neutral-ion collisions. Since the neutral particle oscillation parallel to B is larger for gravity waves propagating southward than for gravity waves propagating to other directions, southward-propagating MSTIDs could cause larger amplitude of TEC perturbations than MSTIDs propagating in other directions. This directivity in the response of the plasma density variations to the gravity waves could be responsible for the southward preference in propagation directions of daytime MSTIDs. During nighttime, most of MSTIDs have wavefronts elongated from northwest to southeast and propagate southwestward. This result is consistent with the previous observations of the nighttime MSTIDs using GPS networks and 630-nm all-sky airglow imagers. Electric currents in the F region could flow northeastward because neutral winds blow southeastward. In the condition that the northeastward electric currents and plasma density perturbations which has wavefronts elongated from northwest to southeast, northeastward (southwestward) polarization electric fields are generated to maintain divergence free of the electric currents. These polarization electric fields move the plasma upward (downward) to cause the plasma density perturbations. Therefore, polarization electric fields are expected to play an important role in generating the nighttime MSTIDs. The dusk MSTIDs have wavefronts which is almost parallel to the sunset terminator and propagate north-northwestward at velocity of 60-120 m/s. From these features, the dusk MSTIDs is expected to be caused by gravity waves originated from the sunset terminator.

MDIT-02 Data and Model Comparison of the Neutral Temperature and Composition Based on Incoherent Scatter Radar - by Tanya Rae Phillips

Status of First Author: Student IN poster competition Undergraduate

Authors: Gregory Earle, earle@utdallas.edu; Shun-rong Zhang, shunrong@haystack.mit.edu; John Holt, jmh@haystack.mit.edu

Abstract: A previously developed ISR model generates values of the local electron temperature, electron density, and ion temperature for Millstone Hill. The ISR generated values are inputs for the ion energy balance equation, while the height profile is extrapolated using a least squares fit to the ion temperature. The case study presented here uses four days in October 2002 that provide a variety of solar and magnetic conditions. There different plots are generated for each parameter during daytime hours and analyzed: the regional Millstone Hill model, the MSIS global model, and the ISR inferred parameters. The focus of the case study is to improve and validate the Millstone Hill model using the ISR data. This poster presents the results of this case study, and speculates on the discrepancies between the local model and the inferred parameters.

MDIT-03 Studies of Neutral Oxygen via Bowen Fluorescence using Spatial Heterodyne Spectroscopy - by Steve Watchorn

Status of First Author: Non-student PhD

Authors: Steven Watchorn (steve@sci-sol.com)

Abstract: This presentation will highlight the development of the Spatial Heterodyne Spectrometer (SHS) to measure neutral oxygen densities in the thermosphere via Bowen fluorescence at 8446 Å. As the dominant neutral species between 250 and 500

km altitude, neutral oxygen plays a vital role in the physics of the thermosphere. Its measured value, combined with a forward model of twilight airglow emissions can be used to constrain theoretical relations between ion and neutral parameters, such as charge exchange equilibrium and ion energy balance. Knowing the density of neutral oxygen, [O], in this layer is a key to describing the generation of O+, thus illuminating the interaction of the thermosphere and the F-region ionosphere. Bowen flourescence -- a process born of an accidental resonance between atomic oxygen and hydrogen -- yields a path to determining the neutral oxygen density. Additional topics and processes important to thermospheric dynamics, such as the existence of non-thermal oxygen atoms above 500 km, can be studied via other airglow emissions near the Bowen fluorescence lines, at 7320 Å and 11290 Å. The physics of these topics will be introduced.

The SHS, and the specific characteristics of the SHS developed for this study, will also be presented. A close relative of the Michelson interferometer, the SHS replaces the mirrors of a Michelson with reflection diffraction gratings, and the Littrow angle of the gratings sets the center of the Fourier transform spectrum computed from the instrument's interference pattern. The center wavelength of the instrument's produced spectrum can thus be altered merely by rotating the gratings. Employing the SHS will allow this same instrument to also investigate Bowen fluorescence, as well as related airglow emissions, including O I 6300 Å, O II 7320 Å, and the little-studied O I 11290 Å group. This versatility in a single, small package makes the SHS an outstanding instrument for applications in atmospheric science.

MDIT-04 Measurements and Modeling of the Daytime Molecular Ion Composition in the F1 Region Over Arecibo - by Michael Nicolls

Status of First Author: Student IN poster competition PhD

Authors: M. J. Nicolls, N. Aponte, M. P. Sulzer, M. N. Vlasov, S. A. Gonzalez

Abstract: Here we present initial results of our attempts to measure the molecular ion composition in the F1 region over Arecibo using the incoherent scatter technique. The method involves using high resolution plasma line measurements in combination with the power in the zero lag of the ion line to estimate the ratio Te/Ti. This estimate is then used to constrain the fitting of the ion line to obtain the molecular ion fraction, along with the temperatures. We present the first successful results of this experiment. We also present a photochemical model of the F1 region designed to investigate these results. We compare the measurements and our model predictions to the IRI and MSIS models. Finally, we present the first attempts of a technique to improve this methodology by measuring the electron temperature using the plasma line asymmetry. If successful, this technique would allow us to measure the electron and ion temperatures with high resolution without having to fit the ion line.

MDIT-05 Midlatitude Spread F - by Preeti Bhaneja

Status of First Author: Student IN poster competition

Authors: P. Bhaneja, G.D.Earle, R. Bishop, R. Conkright

Abstract: This research involves a case study of Midlatitude Spread F (MSF) at Wallops Island (37.8°N, 75.5°W) using ionosonde data. Software has been developed in MATLAB to detect the edges of the O-Mode traces, so that range and frequency spreading can be objectively identified. A separate algorithm is used to identify sporadic E conditions. The intent is to determine the seasonal variation of MSF over a complete solar cycle from 1993-2004. The correlation between MSF and geophysical parameters such as, Kp, Ap, DST, Bz, F10.7 and sunspot number, and between sporadic E and MSF is to be determined. An initial study using only two years of data (2002, 2004) approaching solar minimum indicates that MSF occurs most frequently over Wallops Island in the autumn months. The declination angle is negative at Wallops, implying that mapping of electric fields may be important in creating MSF.

MDIT-06 The Behavior of Ionospheric Zonal Ion Drifts at Middle Latitudes - by Sasmita Mohapatra

Status of First Author: Student IN poster competition PhD

Authors: Sasmita Mohapatra, sxm039100@utdallas.edu; Rod Heelis, heelis@utdallas.edu

Abstract: This research involves examining the zonal (east-west) ion flows in the auroral zone and middle latitudes, and how they evolve as a function of magnetic activity and local time. Data from the DMSP F15 and F13 satellite for the month of November in the year 2001 have been utilized. This year corresponds to a period of high solar activity that not only provides a wide range of

magnetic activity levels, but also delivers the highest available background ionospheric number density in which measurements can be made with the highest accuracy and confidence. The use of two satellites will provide data at four different local times. Passes at a given local time in both the northern and southern hemisphere can be used to examine changes over time scales between 25 minutes and 100 minutes. To augment the DMSP measurements, related measurements of magnetic activity and the interplanetary environment available from the National Space Science Data Center are used. From the DMSP data we have described the changes in the latitude profile of the zonal ion drift and how it is related to magnetic activity. The latitude profile of the zonal ion drifts during both daytime and nighttime is considered and compared to the intensity of the ring current (Dst), the intensity of the convective electric field and the interplanetary conditions that drive these changes.

MDIT-07 Thermospheric Waves Over Arecibo - by Dorey Joseph Livneh

Status of First Author: Student IN poster competition PhD

Authors: Dorey Livneh, PSU, dul121@psu.edu, John D. Mathews, PSU, JDMathews@psu.edu

Abstract: Vertically coherent waves with periods of up to 2 hours have been observed in the F-region using incoherent scatter radar (ISR) techniques at Arecibo Observatory. When properly filtered, results from March 22-23, 2004, and June 5-6, 2005 both provide spectacular views of these waves. The waves are strong throughout the F-region, often spanning 160 km to above 500 km in altitude, and are present day and night in the F2-layer. Interference removal and image processing techniques are discussed. Barometric pressure and imager data, both of which were taken on site at Arecibo, are used to provide insight into the nature of the waves.

MDIT-08 Categorization of the Events Observed by the Penn State Allsky Imager at Arecibo Observatory - by Ilgin Seker

Status of First Author: Student IN poster competition PhD

Authors: Ilgin Seker, (ius102@psu.edu); John D. Mathews (JDMathews@psu.edu)

Abstract: The Penn State Allsky Imager (PSASI), a User-Owned-Public-Access (UOPA) instrument installed at Arecibo Observatory (18.3° N, 66.75° W, elevation 497 m, L1.43 @ 300 km, dip angle 50°, geomagnetic coordinates 32° N, 8° E), is a CCD-based high-resolution allsky optical imager that has been collecting ionospheric airglow data at night since May 2003. The computer controlled 6-position filter wheel is equipped with 3 filters at 630 nm (red), 557.7 nm (green), and 777.4 nm (near-IR) which correspond to ionosphere-related oxygen emissions.

Our goal here is to present some of the significant results for various types of mesospheric (waves, bores etc.) and F-region events (depletions or enhancements) observed by PSASI. Details of each imager event such as duration, size, shape, speed of the structures; and useful information from other instruments such as magnetometers, ISR, Lidar, FPI and GPS will be provided where necessary and available. For each type, the previous studies and the science involved is also discussed.

Equatorial Ionosphere or Thermosphere

EQIT-01 Zonal winds inferred from height varying type I and II echoes at Jicamarca - by Esayas Shume

Status of First Author: Student NOT in poster competition PhD

Authors: Esayas Shume ebs27@cornell.edu, Dave Hysell dlh37@cornell.edu

Abstract: We have utilized a combination of (1) phase velocities of type I radar echoes observed using the main Jicamarca antenna, (2) height varying type I and type II oblique radar echo Doppler velocities, (3) the linear dispersion relation of electrojet irregularities, and (4) measured and modeled electric fields in the equatorial electrojet, to infer zonal wind profiles in the equatorial E region. The inferrred profiles are validated utilizing propagation properties of large-scale electrojet turbulence derived from radar interferometric imaging.

EQIT-02 To establish a Space and Atmospheric Physics facility at North Carolina A&T State University - by Jyoti R Nair

Status of First Author: Student NOT in poster competition PhD

Authors: Jyoti R Nair and Abebe Kebede, North Carolina A&T State University, Greensboro, NC, Email: jrnair@ncat.edu

Abstract: The Study of Space and Atmospheric Physics is planned at Department of Physics, NC A&T State University, NC, to meet the needs of the minority community to build a general capability in atmospheric/space science as a necessary support for academic infrastructure development. The course will be intended for graduate and undergraduate students who wish to pursue research in space/atmospheric physics. In order to fortify this effort, we have initiated a collaborative work with US Air Force and GSFC, NASA. The main rationale of this proposed project work is to investigate the current scientific issues associated with MITS like the TEC variations, scintillations and disturbances, and the morphology/manifestations of Ionospheric Spread F phenomena that vary with locations (longitude and latitude), especially over low and mid-latitudes, which is also an important diagnostic for understanding space weather. In addition to this, we plan to install two ground based instruments, a magnetometer and a coherent beacon receiver, at North Carolina A&T State University (a mid latitude station: Geog. Latitude ~36°N), to provide local measurements for geomagnetic activity and TEC/scintillations effects respectively. Scientists, teachers/ professors and students who are interested in studying the space/atmospheric physics and located at different institutions can also make use of these facilities. This work will be the first of its kind in the sense that it will be first ground-based instruments to be installed in North Carolina in a minority community university (HBCU) as a part of Research and Education outreach in space/atmospheric physics. Some of these aspects are discussed here.

EQIT-03 Coordinated space- and ground-based observation of equatorial spread-F in the central Pacific - by Ethan S Miller

Status of First Author: Student IN poster competition PhD

Authors: E. S. Miller (University of Illinois), J. J. Makela (Unversity of Illinois), Su. Basu (Naval Research Laboratory), R. T. Tsunoda (SRI)

Abstract: Images of the equatorial anomaly at 135.6 nm from the Global Ultraviolet Imager (GUVI) instrument onboard NASA's Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics (TIMED) satellite are employed to explore indicators for suppression of equatorial plasma bubble formation in the central Pacific (150 E--225 E geographic longitude). The period 28 July 2003 through 10 August 2003 is well-supported by GUVI data in the post-sunset hours, as well as the 50-MHz coherent scatter radar at Christmas Island and optical imagers at Haleakala, HI. Three of these 13 nights exhibit minimal backscatter associated with spread-F as observed by the radar. Equatorward collapses of the crests of the equatorial anomaly are observed in the GUVI data on these three nights. The remaining ten nights exhibit varying amounts of activity in the radar and typical latitudinal separation of the equatorial anomaly. We suggest that the separation of the equatorial anomaly crests corresponds to the time-history of the equatorial vertical ExB drift, and thus a collapse of the anomaly corresponds to a reduction in this parameter. Strong ExB drift is required for the development of the equatorial plasma bubbles associated with spread-F. Thus, data collected from satellite-based imaging systems (e.g., GUVI and the SSUSI instruments on the latest DMSP satellites) can be used to understand the occurrence of spread-F events related to scintillation of trans-ionospheric radio navigation and communication signals.

EQIT-04 Simultaneous GPS Measurements of TEC, Scintillation and Ionospheric Irregularities Zonal Drift Velocity at Equatorial and Low-Latitude Regions - by Marcio Muella

Status of First Author: Student NOT in poster competition PhD

Authors: M. T. A. H. Muella(1,2), A. P. Cerruti(2), P. M. Kintner(2), E. R. de Paula(1), and I. J. Kantor(1)
1 - Instituto Nacional de Pesquisas Espaciais, São José dos Campos, SP, Brazil
2 - Cornell University, Ithaca, NY, USA

Abstract: The nighttime scintillation activity, the total electron content (TEC) and the ionospheric irregularities zonal drift velocity were studied simultaneously using the L-band frequencies of the Global Positioning System (GPS) satellites. These three geophysical parameters measured by ground-based GPS receivers during the last solar maximum years (2000/2001) were collected over eleven stations located in the Brazilian equatorial and low-latitude regions. The observations were carried out during the

months of high occurrence in the ionospheric irregularities (August/2000-March/2001). The zonal plasma velocities were inferred using the spaced-receivers scintillation data technique. Simultaneous measurements of scintillation, TEC and zonal plasma flows at different sites are intended to investigate specific relationships between the space physic quantities measured by GPS receivers. Besides to allow a better understanding of the ionospheric irregularities behavior and dynamics for different local hours, latitudes and for different ionospheric conditions, this study is intended to give a contribution to the development of an efficient tool for processing TEC, scintillation, and ionospheric drifts over the Brazilian sector.

EQIT-05 A new approach to the observations of equatorial thermospheric dynamics - by Michael Faivre

Status of First Author: Non-student PhD

Authors: M. Faivre, J.W. Meriwether, P. Sherwood, Department of Physics and Astronomy, Clemson University
Interactive Technology

Abstract: The Arequipa Fabry-Perot interferometer (FPI) (16.5 °S, 71.57 °W) was recently upgraded with a bare CCD camera. This observatory located 4 degrees south of the magnetic equator operated automatically for nights between late March to mid-October 2005. The new results for the O1D 630-nm Doppler shifts and Doppler widths show uncertainties of ~5 ms-1 and ~20 K for 240 s exposures. A new observation mode was started in early June in which 8 azimuthal directions are sampled every 45° with respect to north with a zenith angle of 60° and 120 s exposures. The radius of this circle for the FPI line-of-sight view at the height of ~250 km is about 800 km. This approach was used two decades ago by Burnside to map the effect of the midnight temperature maximum (MTM) dynamics on the horizontal wind field. The wind vector is expanded in a Taylor series relative to the zenith of the observation site. The analysis procedure retrieves the partial derivatives of the zonal and meridional wind components by using a Fourier decomposition of the line-of-sight azimuthal speed. Numerous midnight temperature maximum (MTM) events occurring between May2005 and May2006 with typical temperature enhancements of 50 to 150 K as compared with the NRL MSIS model reference have been studied with this new strategy, and a number of interesting findings have emerged. Determination of the meridional temperature gradients has indicated, in most cases, the thermosphere to be warmer by 20-30 K toward the south at the time of the MTM peak, generally between 4 and 7 UT. An estimate of the vertical wind can be indirectly inferred from the determination of the horizontal wind divergence of the flow. During quiet nights, the vertical wind speed is generally less than 5 ms-1. During MTM activity, the vertical displacement shows greater amplitude, up to 8-10 ms-1, both upward and downward, but there is no indication of a clear phase correlation with the MTM temperature peak. The two features of the abatement of the zonal flow and reversal of the meridional flow reported by Burnside et al.[1981] are observed as the MTM moves from the northwest to the southeast.

EQIT-06 Imaging studies of ionospheric irregularities near the Arecibo conjugate point - by Carlos Martinis

Status of First Author: Non-student PhD

Authors: J. Baumgardner, M. Mendillo, S. Smith

Abstract: All-sky imagers located at Arecibo, Puerto Rico (18.3o N, 66.7o W, 28o N mag lat) and El Leoncito, Argentina (31.8o S, 69.3o W, 18o S mag lat), are used to compare 6300 Å airglow emission features. While not at exactly conjugate points, these two sites allow the evaluation of statistical occurrence patterns and simultaneous case-study events. Typical mid-latitude processes related to Perkins instability are common features observed at Arecibo, but not at El Leoncito, where Rayleigh-Taylor instability processes are the dominant feature. Supporting information is provided by GPS receivers. Thus the coupling from mid to low latitudes and vice versa is explored and the magnetic conjugacy of thermosphere-ionosphere processes is discussed.

EQIT-07 Retrieval of the Plasma Drift Velocity through Image Processing - by Sung Hong Park

Status of First Author: Student IN poster competition Undergraduate

Authors: Sung H. Park, sunghongpark@ssl.berkeley.edu, Thomas J. Immel, immel@ssl.berkeley.edu, University of California, Berkeley

Abstract: From 2000 to 2006, the NASA IMAGE satellite collected thousands of images of the nighttime airglow using the Far-Ultraviolet(FUV) spectrographic imager on board. The FUV imager observes the 135.6 nm line produced by recombination of O+ in the F-layer. Large scale ionospheric irregularities known as plasma bubbles create airglow depletions, which can be tracked using now an automated software algorithm. The raw satellite images are projected into geomagnetic coordinates then the software

searches for shifts of successive 2-minute images that result in high correlation coefficients. The collection of the maximum cross-correlations collected over hours of imaging time reflects the plasma drift velocity and the software produces a plot of the plasma drift velocity versus magnetic longitude and magnetic latitude. The software has been tested using model data with arbitrary shifts on each successive image. With the actual FUV data, it shows a decreased bubble drift velocity with an increasing distance from the magnetic equator and a change in drift velocity with eastward drifting plasma bubbles, reflecting the expected change in the vertical electric field.

EQIT-08 Analysis of the Response of Vertical Drifts to Geomagnetic Activity at Equatorial Latitudes During Storm-time Periods Using DMSP and ROCSAT Data - by Edgardo E. Pacheco

Status of First Author: Student IN poster competition Masters

Authors: Edgardo Pacheco, (edgardo.pacheco@student.utdallas.edu) and R.A. Heelis, (heelis@utdallas.edu)

Abstract: Electric fields and plasma drifts are important parameters for understanding the dynamics of the equatorial ionosphere system and are essential inputs for many models. In this project we analyze the relationship of the response of the vertical drifts at equatorial latitudes with respect to the variation of the geomagentic activity during storm-time periods. This study uses satellite data from DMSP-F13, DMSP-F15 and ROCSAT for the years 2000, 2001 and 2003, and will examine several storm events which occurred during this time period.

Irregularities of the Ionosphere or Atmosphere

IRIA-01 Occurrence frequency of convective rolls in the mesopause and lower thermosphere region - by Caroline Yount

Status of First Author: Student IN poster competition Undergraduate

Authors: C. Yount and M. F. Larsen, Dept. of Physics and Astronomy, Clemson University, Clemson, South Carolina, USA

Abstract: In the past, lidar observations of the sodium densities in the mesopause and lower thermosphere region from locations in the northern hemisphere that included New Mexico, Hawaii, and Puerto Rico have shown the occurrence of overturning features with periods greater than an hour and vertical extents of several kilometers. These overturning, or convective roll, cells were typically found in the altitude region from 95 to 105 km. The convective rolls appear to be the result of an inflection point instability in the transition region from lower stability in the mesosphere to higher stability in the lower thermosphere. Although examples of the instability features have been presented in earlier studies, little is known about the frequency of occurrence of the rolls. This poster will examine the the occurrence frequency based on lidar data from the Arecibo Observatory in Puerto Rico.

IRIA-02 (WITHDRAWN) **F region Ionospheric Density Irregularities from DE-2 Observations at Low and Midlatitudes** - by Anthony Musumba Mwene

Status of First Author: Student IN poster competition PhD

Authors: Mwene Anthony Musumba, Earle G.D., Mcclure J.P., tonymusumba@yahoo.com, University of Texas at Dallas

Abstract: Ion density and drift data from the Dynamics Explorer 2 (DE-2) Duct sensor and Ion Drift meter (IDM) are examined for the period from August 1981 to February 1983 in order to investigate plasma irregularities in the low and midlatitude ionosphere. Events are selected based on fluctuations in the plasma density and are characterized according to season, magnetic activity and local time. The events are further characterized by spectral analysis and interpreted in light of current theories regarding mechanisms that may cause the irregularities.

IRIA-03 A Theory for Polar Cap Patch Formation - by Natalia A Gondarenko, presented by Parvez Guzdar

Status of First Author: Non-student

Authors: IREAP, University of Maryland, College Park, MD 20742

Abstract: We have developed a theory which investigates the formation of patches when the tongue-of-ionization undergoes a Kelvin-Helmholtz instability. The linear theory of the basic instability and its characterteristics will be presented. Also preliminary two-dimensional nonlinear studies of the patch formation will be addressed.

IRIA-04 Statistic discrete charging model for active perturbation of plasma irregularities associated with charged dust in the summer polar mesosphere - by Chen Chen

Status of First Author: Student IN poster competition PhD

Authors: W.A.Scales wscales@vt.edu

Abstract: Polar Mesospheric Summer Echoes (PMSEs) are strong radar echoes from electron irregularities of meter scale or less in the earth's mesosphere. Previous experimental observations have shown that PMSE may be modulated by radio wave heating the irregularity source region with a ground-based ionospheric heating facility. Due to the low electron charging state of dust in the PMSE layer, this work describes a new model that incorporates a statistical discrete charging model as well as finite diffusion effects. The model utilizes fluid ions described by continuity and momentum equations, electrons whose behavior is determined from quasineutrality, and charged dust described by the standard Particle-In-Cell PIC method. The model has been used to investigate temporal behavior of electron irregularities during electron temperature enhancement associated with radio wave heating. Due to the dependence of diffusion time on irregularity scale-size, these results have important implications for observations of PMSE modification at different radar frequencies. The effects of discrete versus continuous dust charging models are discussed. Finally, possible diagnostics for the dust layer implied by the new model are discussed as well.

IRIA-05 Combined radar observations of equatorial electrojet irregularities at Jicamarca - by Josef Drexler

Status of First Author: Non-student

Authors: J. Drexler, D. L. Hysell, E. B. Shume; Earth and Atmospheric Science, Cornell University, Ithaca, New York
J. L. Chau; Jicamarca Radio Observatory, Lima, Peru; M. Vlasov, R. Cuevas; Electrical and Computer Engineering, Cornell University, Ithaca, New York; C. Heinselman; SRI International, Menlo Park, California

Abstract: We have investigated daytime equatorial electrojet plasma irregularities using five distinct radar diagnostics at Jicamarca including range-time-intensity (RTI) mapping, Faraday rotation, radar imaging, oblique scattering, and multiple frequency scattering using the new AMISR prototype UHF radar. Data point to the existence of density striations, separated by 2-3 km and propagating slowly downward. The striations may be caused by neutral atmospheric turbulence, and we discuss a possible scenario for their formation. The Doppler shifts of type 1 echoes observed at VHF and UHF frequencies are compared in light of kinetic theory. Finally, the up-down and east-west asymmetries evident in the radar observations are described and quantified.

IRIA-06 Spontaneous generation of 100-km-scale midlatitude electric fields by a sporadic E layer, and the effect on the F layer - by Russell Cosgrove

Status of First Author: Non-student

Authors: Russell Cosgrove

Abstract: Using the Arecibo radar, Behnke observed line of sight Doppler velocities in the F region exceeding 400 m/s, together with sharp 80 km rises in the F layer altitude. Although this observation was for some time attributed to the Perkins instability, the growth rate of the Perkins instability is discouragingly small. Cosgrove and Tsunoda have since shown that an instability similar to the Perkins instability, but more energetic, operates in Es layers, and have derived a unified formalism for the unstable Es-F layer coupled system. In the present paper we present a numerical simulation of the two-dimensional nonlinear evolution of the unstable coupled system. The results show that the time scale for the development of structure in the F region is significantly reduced when a Es layer is present. The Es layer evolution is highly nonlinear compared to the F layer evolution, and

exhibits a wave breaking phenomenon that is associated with a strong electric field pulse. The result of the electric field pulse is a sharp modulation of the F layer altitude. The most significant effect comes not as a result of resonance between unstable F layer and Es layer waves, but as a result of the unaided Es layer instability imposing electric fields on the F layer. This unanticipated result occurs because the resonant condition happens to correspond to a growth rate minimum for the Es layer instability. The result allows an explanation for the Behnke observation, and for the orientation and propagation direction of MSTIDs in general.

IRIA-07 A study of Frozen-in property of Field-aligned Irregularities in Ionospheric Sporadic E region using Chung-Li VHF Radar - by Kuo-Feng Yang

Status of First Author: Student NOT in poster competition PhD

Authors: Kuo-Feng Yang, comber@ms41.url.com.tw; Yen-Hsyang Chu, yhchu@jupiter.ss.ncu.edu.tw; Chin-Min Tee, 93623006@cc.ncu.edu.tw

Abstract: In this paper, we developed a method to examine the Frozen-in property of field-aligned irregularities in Sporadic E region. We first analyze the effects of along and transverse radar beam drifts of sporadic E field-aligned irregularities localized in the expected echoing region on mean Doppler velocity and spectral width. Detailed analysis shows that the Doppler velocity nearly linearly proportional to the mean angular distance of the irregularities from the radar beam axis decreases with the increase of the horizontal dimension of the plasma structure. This feature strongly suggests that the beam broadening effect caused by the drift of the field-aligned irregularities cross the radar beam in the geomagnetically zonal direction may play a role in broadening the Doppler spectral width. With this property, we then transverse beam drift velocity of the irregularities in the zone direction. The drift velocity component of the irregularities parallel to the radar beam axis can be obtained from the radial velocity of the irregularities located at the radar beam axis. The use of the drift velocity combined with the configuration of expected echoing region and the plasma structure can estimate corresponding trace velocity of the echo pattern. The result show that the estimated trace velocity is in good agreement with the measurement by using radar interferometer method, strongly showing that the 3-meter plasma irregularities observed in this experiment have frozen-in property, which drifting with large scale plasma structure at the same velocity.

IRIA-08 Implications for Ionospheric Electron Densities from Local Time Variation in Lightning Activity as Measured by the World Wide Lightning Location Network - by Erin H Lay

Status of First Author: Student IN poster competition PhD

Authors: Erin H. Lay, Abram R. Jacobson, Robert H. Holzworth, Craig J. Rodger, Richard L. Dowden

Abstract: We study local time variation of lightning count rates for the different continents as detected by the World Wide Lightning Location Network (WWLLN) ground-based global VLF lightning location network. Because the WWLLN measures lightning strokes with large peak currents, the variation in local time of WWLLN-detected strokes suggests a similar variation in local time of severe weather and Transient Luminous Events (e.g., Elves). We find that the time of peak lightning count rate varies for the different continents by up to five hours in local time, with the peaks in North and South America occurring after 1800 local time. More than 60% of strong lightning in North and South America occurs under the nighttime ionosphere, where strong lightning strokes can have a long-lasting effect on electron densities at altitudes <100km.

Index