13TH INTERNATIONAL SYMPOSIUM ON EQUATORIAL AERONOMY

BOOK OF ABSTRACTS

March 12-16, 2012

Paracas, Peru

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ABOUT ISEA

The International Symposium on Equatorial Aeronomy (ISEA) is an event organized approximately every three to four years and is a major event in the field of upper atmospheric and ionospheric science, gathering around 150 scientists from all over the world interested in studying the low latitude atmosphere and ionosphere and the coupling with other latitudinal and altitudinal regions. The ISEA represents an opportunity for scientists to share their most recent research results and progress as well as discuss possibilities for future campaigns and experiments. Its objective is to bring together the leaders in the field of equatorial, low-, and mid-latitude aeronomy to advance our knowledge about these regions of the Earth's atmosphere. The 13th International Symposium on Equatorial Aeronomy will be held from March 12 to 16, 2012 at the La Hacienda Bahia Paracas Hotel, in Peru (near Ica). In addition to the ISEA 13 meeting, in 2012, the international scientific community will celebrate two important events:

- The 50 years from the first ISEA meeting which took place in Huaychulo, Peru (1962);
- The 50th Anniversary of the Jicamarca Radio Observatory, Peru (1962); the main event of this celebration will be held right after ISEA13 on March 17, 2012 at the Jicamarca Radio Observatory. Celebration activities can be find at `http://jro.igp.gob.pe/jro50`.

PREVIOUS ISEA VENUES

- ISEA-12 2008 Creete, Greece - AG, 27, 2009. 33 papers.
- ISEA-11 2005 Taipei, Taiwan - AG, 24(6), 2006. 18 papers.
- ISEA-10 2000 Antalya Turkey - JASTP, 64(12-14), 2002. 30 papers.
- ISEA-9 1995 Bali, Indonesia - JASTP, 59(13), 1997. 20 papers.
- ISEA-8 1990 Tucuman, Argentina - JATP, 53(8), 1991. 10 papers.
- ISEA-7 1984 Hong Kong - JATP, 47(10), 1985. 34 papers.
- ISEA-6 1980 Aguadilla, Puerto Rico - JATP, 43(5/6 & 8), 1981. 40 papers.
- ISEA-5 1976 Townsville, Australia - JATP, 39(9/10), 1977. 35 papers.
- ISEA-4 1972 Ibadan, Nigeria - JATP, 35(6), 1973. 26 papers.
- ISEA-3 1969 Ahmedabad, India.
- ISEA-2 1965 Rio de Janeiro, Brazil.
- ISEA-1 1962 Huaychulo, Peru.

AG = Annales Geophysicae
JASTP = Journal of Atmospheric and Solar-Terrestrial Physics
JATP = Journal of Atmospheric and Terrestrial Physics

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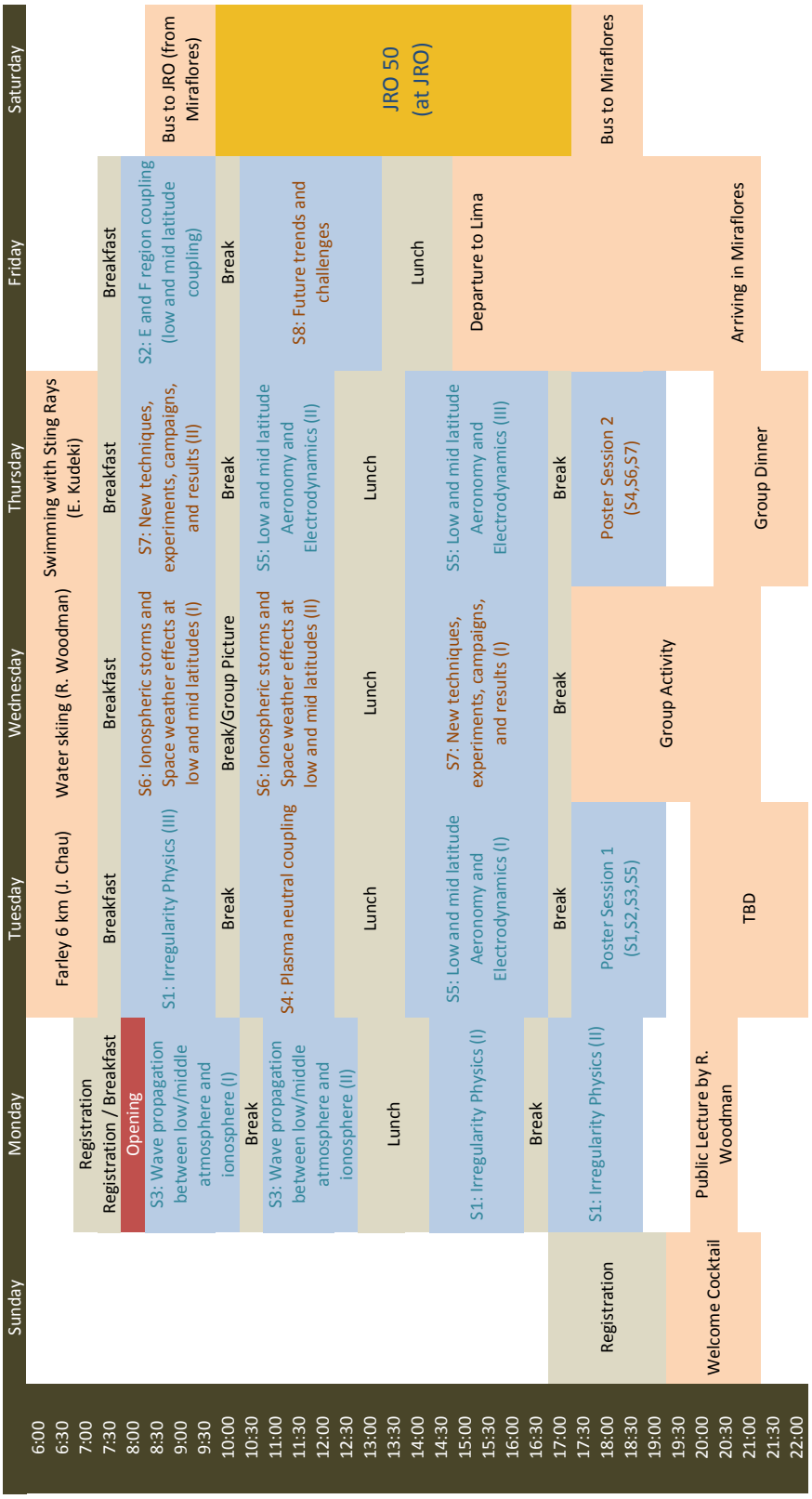

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Session 1

IRREGULARITY PHYSICS

In the past few years, equatorial aeronomers have made significant progress toward understanding the evolution of ionospheric plasma structures and irregularities encompassing scales ranging from meters to hundreds of kilometers. Through observations, simulations, and theory researchers are making steady progress toward understanding and modeling F-region equatorial plasma bubbles, mid-latitude E- and F-region irregularities, meteor trail physics, and the old problem of the non-linear behavior of the Farley-Buneman and Gradient-Drift instabilities. New studies of 150-km echoes have given us a number of clues which should help scientists understand the origin of this enigmatic radar phenomenon. This session welcomes the submission of papers addressing recent experimental, computational and theoretical studies of E- and F-region plasma irregularities. This includes the formation, evolution, and nonlinear properties of km- to m- scales. Research addressing the day-to-day variability of spread F irregularities, including those detected by C/NOFS instruments, are appropriate for this session.

Conveners: Amit Patra, Meers Oppenheim, and Marco Milla

INVITED - HIERARCHY OF PROCESSES BEHIND F-REGION PLASMA DENSITY IRREGULARITIES

David Hysell

Cornell University, Ithaca, NY, USA

Free energy in the F-region ionosphere can express itself in the form of plasma density irregularities which are key components of space weather. The irregularities owe their existence to inhomogeneities in configuration space. Configuration space inhomogeneity includes gradients in ionospheric conductivity and drift velocity, which contribute together to instability and irregularity formation. Conductivity gradients along the magnetic field are overlooked but can also factor in irregularity production. While F-region irregularities are typically driven directly at scale sizes of kilometers or larger, nonlinear mode coupling can excite irregularities at scale sizes shorter than the ion gyroradius. Mode coupling mainly takes the form of steepening rather than a turbulent cascade and is typically highly intermittent. The salient features of mode coupling are consequently more apparent in physical space than in spectral representations. Magnetic aspect sensitivity measurements suggest that small-scale field-aligned plasma density irregularities are initially isotropic, becoming more field aligned as they dissipate.

TYPE: ORAL
DATE: 2012-03-12 – 14:35

3D ELECTROMAGNETIC PLASMA MODEL: ELECTRIC AND MAGNETIC SIGNATURES OF PLASMA IRREGULARITIES

Eugene Dao, Charlie Seyler, and Mike Kelley

Cornell University, Ithaca, NY, USA

Presented are three dimensional electromagnetic model simulations of low-latitude plasma irregularities. Traditionally, simulations of ionospheric plasma instabilities assume electrostatic physics and/or simplify the problem in two dimensions where dynamics along Earth's magnetic field lines are neglected. Explored are the electric and magnetic field signatures of plasma irregularities resulting from current divergence, current flows, and Alfven waves associated with plasma irregularity dynamics.

TYPE: ORAL
DATE: 2012-03-12 – 14:55

ON THE EQUIPOTENTIAL FIELD LINE APPROXIMATION IN THE LOW-LATITUDE IONOSPHERE AND ITS IMPLICATION ON SPREAD F SIMULATIONS

Henrique Aveiro and David Hysell

Cornell University, Ithaca, NY, USA

An initial boundary value simulation of equatorial spread F (ESF) is taken using three different approaches for the computation of the electrostatic potential: equipotential geomagnetic field line assumption (EFL), EFL with a correction due to the ambipolar electric field (EFL-Amb), and the full three-dimensional solution (3-D). The main issue we address is the degree to which it is possible to simulate the background ionospheric current system and its effects on ESF simulations given an appropriate specification of the initial conditions and the forcing. The simulation results are compared to CHAMP magnetometer and ALTAIR radar observations.

TYPE: ORAL
DATE: 2012-03-12 – 15:10

DAY-TO-DAY VARIABILITY OF EQUATORIAL SPREAD-F OBSERVED WITH GNU RADIO BEACON RECEIVER (GRBR) IN ASIA AND AFRICA

Mamoru Yamamoto[1], Kensuke Hangyo[1], S. Tulasi Ram[2], and Roland Tsunoda[3]

[1] Research Institute for Sustainable Humanosphere, Kyoto University, Japan
[2] Equatorial Geophysical Research Laboratory, Indian Institute of Geomagnetism, India
[3] SRI International, Menlo Park, CA, USA

Equatorial spread F (ESF) is intense ionospheric irregularity that occurs around the geomagnetic equator. It can cause intense scintillation to satellite-ground communications, and serious error in the GPS measurements. The ESF has been a hot research topic of the equatorial/low-latitude ionosphere for long time. However, its day-to-day variability is not well understood. Now we deploy a very wide network of GNU Radio beacon receivers (GRBR) at low latitudinal regions over east Africa, southeast Asia, and Pacific region, and observe 150MHz/400MHz beacon signal from C/NOFS and other polar-orbiting satellites. In this paper, we use data from Bac Lieu, Vietnam (9.29N, 105.71E, Dip Lat. 1.67N, observations started in January 2009) and Bahirdar, Ethiopia (11.56N, 37.38E, Dip Lat. 3.93N, observations started in March 2011). We discuss relationships between day-to-day variability of ESF with ionospheric structures, i.e., large-scale wave structure (LSWS), meridional symmetry of the ionosphere density distribution, and VHF/UHF scintillation intensity. Occurrence of ESF is well correlated with enhanced LSWS events in the evening time. At Bahirdar, scintillation level is high, and very intense LSWS events are found. Comparison of statistical results between two locations provides useful information to attack longitudinal variability of the ESF.

TYPE: ORAL
DATE: 2012-03-12 – 15:25

ELECTRIC FIELD AND PLASMA DENSITY OBSERVATIONS OF IRREGULARITIES AND PLASMA INSTABILITIES IN THE LOW LATITUDE IONOSPHERE GATHERED BY THE C/NOFS SATELLITE

Robert Pfaff, Henry Freudenreich, Doug Rowland, Jeff Klenzing, and Carmen Liebrecht
NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Vector Electric Field Investigation (VEFI) on the C/NOFS equatorial satellite provides a unique data set which includes detailed measurements of irregularities associated with the equatorial ionosphere and in particular with spread-F depletions. We present vector AC electric field observations gathered on C/NOFS that address a variety of key questions regarding how plasma irregularities, from meter to kilometer scales, are created and evolve. The talk focuses on occasions where the ionosphere F-peak has been elevated above the C/NOFS satellite perigee of 400 km as solar activity has increased. In particular, during the equinox periods of 2011, the satellite consistently journeyed below the F-peak whenever the orbit was in the region of the South Atlantic anomaly after sunset. During these passes, data from the electric field and plasma density probes on the satellite have revealed two types of instabilities which had not previously been observed in the C/NOFS data set: The first is evidence for 400-500km-scale bottomside "undulations" that appear in the density and electric field data. In one case, these large scale waves are associated with a strong shear in the zonal E x B flow, as evidenced by variations in the meridional (outward) electric fields observed above and below the F-peak. These undulations are devoid of smaller scale structures in the early evening, yet appear at later local times along the same orbit associated with fully-developed spread-F with smaller scale structures. This suggests that they may be precursor waves for spread-F, driven by a collisional shear instability, following ideas advanced previously by researchers using data from the Jicamarca radar. A second result is the appearance of km-scale irregularities that are a common feature in the electric field and plasma density data that also appear when the satellite is near or below the F-peak at night. The vector electric field instrument on C/NOFS clearly shows that the electric field component of these waves is strongest in the zonal direction. These waves are strongly correlated with simultaneous observations of plasma density oscillations and appear both with, and

without, evidence of larger-scale spread-F depletions. These km-scale, quasi-coherent waves strongly resemble the bottomside, sinusoidal irregularities reported in the Atmosphere Explorer satellite data set by Valladares et al. [JGR, 88, 8025, 1983] and are believed to cause scintillations of VHF radiowaves. We interpret these new observations in terms of fundamental plasma instabilities associated with the unstable, nighttime equatorial ionosphere.

TYPE: ORAL
DATE: 2012-03-12 – 15:40

INVITED - IONOSPHERIC IRREGULARITIES AT LOW LATITUDES AND THEIR MAGNETIC SIGNATURES

Hermann Lühr and Jaeheung Park

Helmholtz Centre Potsdam, German Research Centre for Geosciences, Germany

Ionospheric irregularities at low latitudes have received a lot of attention because they can badly degrade GPS navigational signals or even disrupt them. The occurrence distribution of these so-called equatorial plasma bubbles (EPB) has been studied based on ionospheric radar measurements, scintillation of GPS signals or in-situ satellite observations. Here we are reporting about 10 years of CHAMP measurements.

The high-resolution magnetic field measurements performed by CHAMP make it possible to study in detail the magnetic signatures associated with plasma bubbles. Most obvious is the increase of field strength inside the depleted region of the EPB. The deficit of plasma pressure is locally compensated by an increase in magnetic pressure. This relation has been used successfully for deriving the spatial and temporal variations of the EPB occurrence frequencies from magnetic field recordings. CHAMP is sampling the magnetic field at a rate of 50 Hz. These high-resolution data have been used to resolve the smallest scales of the irregularity. It is found that highly structured EPBs only appear on fluxtubes that reach to large apex heights.

Besides the pressure gradient currents there are also field-aligned currents (FAC) associated with EPBs. Such currents have been predicted by numerical models that take into account the electrodynamic nature of the EPB evolution. The existence of FACs has been confirmed by CHAMP magnetic field measurements. The FACs are flowing primarily on the east and west flanks of the depleted fluxtubes. Up to 21:00 local time the FAC topology is well organized confirming the "shell-like" shape of depleted regions. After 22:00 LT the hemispheric symmetry disappears.

We will present instructive examples of magnetic signatures and try to make inferences on the EPB evolution considering their electrodynamic features.

TYPE: ORAL
DATE: 2012-03-12 – 15:55

STUDY OF EQUINOCTIAL ASYMMETRY IN THE EQUATORIAL SPREAD F (ESF) IRREGULARITIES OVER INDIAN REGION USING MULTI-INSTRUMENT OBSERVATIONS IN THE DESCENDING PHASE OF SOLAR CYCLE-23

Samireddipalle Sripathi, Bharati Kakad, and Archana Bhattacharyya

Indian Institute of Geomagnetism, Navi Mumbai, India

In this paper, we present the results of a morphological study of Equatorial Spread F (ESF) irregularities over Indian region based mainly on observations of (a) amplitude scintillations on GPS L-band signal and Rate of TEC Index (ROTI) obtained using a network of GPS receivers and (b) amplitude scintillations on a VHF signal using spaced receivers at Tirunelveli, an equatorial station. Occurrence of both amplitude scintillations on the GPS L1 signal and occurrence of significant ROTI

recorded at several stations has been investigated. The latitudinal extent of L-band scintillations shows that their strength is weak over the dip equator but stronger over Equatorial Ionization Anomaly (EIA) region, preferentially during vernal equinox. We find an equinoctial asymmetry in both the occurrence of scintillations and ROTI wherein their occurrence is greater in the vernal equinox than in the autumn equinox. Attempts have been made to understand the asymmetry in latitudinal extent using maximum cross-correlation (CI) of intensity fluctuations obtained from the VHF spaced receivers observations. The observations suggest that occurrence of CI less than 0.5 is more in the vernal equinox than in the autumn equinox suggesting that the maximum height of the Equatorial Plasma Bubbles (EPBs) during vernal equinox may be higher than that during autumn equinox. TIMED/GUVI retrieved peak electron density during the same period also indicates that background electron density is higher and more symmetric during vernal equinox than autumn equinox. Hence, our results suggest that background electron density may be playing a vital role in creating the equinoctial asymmetry.

TYPE: ORAL
DATE: 2012-03-12 – 16:15

A TUTORIAL: SOLUTIONS TO THE LAST OUTSTANDING EQUATORIAL ELECTROJET PROBLEMS

Michael Kelley

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There are six fundamental problems with equatorial electrojet (EEJ) theory that have been very difficult to solve, even 50 years after they were posed. In summary, they are:

1. Why is the phase velocity of plasma waves responsible for radar scatter independent of zenith angle in defiance of linear plasma theory for acoustic waves (first reported in 1964 (Farley et al., 1963)?

2. Why do rocket-borne magnetic field measurements of the EEJ height disagree with theory (Gagnepain et al., 1977)?

3. Why does the wave phase velocity saturate at Cs and does not equal the electron drift velocity?

4. For large zonal electric fields (>1 mV/m), why is the magnetic field of the EEJ smaller than that extrapolated linearly from smaller electric fields? That is, what is the origin of the anomalously low conductivity for large driving fields?

5. Why is the measured magnetic field lower than predicted by classical theory?

6. Why are the phase velocities of the longest wavelength plasma waves square-wave in nature (Kudeki et al., 1984) while associated horizontal-wave electric fields that are highly nonlinear also appear as square-waves (Pfaff et al., 1987)?

We will examine why these issues are so difficult to answer, and therefore why they are so interesting, and then consider the solutions.

TYPE: ORAL
DATE: 2012-03-12 – 17:00

ON NONLINEAR FARLEY-BUNEMAN IRREGULARITIES

Abdelhaq M. Hamza

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One of the most fundamental challenges of ionospheric physics is to explain why the largest amplitude structures tend to move at phase speeds that do not exceed on average the linear theory threshold? To provide a solution one has to rely on nonlinear theory in order to study the development and evolution of nonlinear ionospheric structures. We propose to study the

development and evolution of nonlinear, large-amplitude, intermittent E-region plasma structures. The results of a model based on the nonlinear coupling between three and four Farley-Buneman (FB) waves in three dimensions (3D) will be presented. We are able to recover the 2D results reported in the literature as a limit case in our study, and we are able to show that both the three-wave and the four-wave interactions play a significant role as far as nonlinear saturation mechanisms are concerned. We will also attempt to describe the impact of nonlinear FB structures on the electron anomalous resistivity and consequently on transport in general and heating in particular.

TYPE: ORAL
DATE: 2012-03-12 – 17:20

E-REGION PLASMA WAVES OVER THUMBA, INDIA: RECENT RESULTS

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It is well known that streaming plasma waves and gradient drift plasma waves are excited in the E-region of the ionosphere over the dip equator location. These plasma waves over Thumba, India, a location closer to the dip equator, have been investigated over the years by rocket borne in situ probes (Prakash et al., 1972; Sastry, 1970) and ground based VHF (Reddy et al., 1987; Krishnamurthy et al., 1998) and HF radars (Janardhanan et al., 2001; Tiwari et al., 2003). Recently, two RH-300 MKII rockets containing Langmuir probes were flown from Thumba on 15 and 16 January 2010 to investigate the equatorial E-region of the ionosphere. The results obtained from this rocket flight campaign are compared with the previous results obtained from the same location using various techniques. The amplitudes of gradient drift waves were found to be less on an annular solar eclipse day (15 January 2010) compared to the control day (16 January 2010) in a region where the electron density gradient is same for both the days. This indicates the reduction in the vertical electric field on annular solar eclipse day. Further, an evidence for the polarity variation in the E-region vertical electric field during an earlier total solar eclipse event (16 February 1980) is obtained. In addition, an investigation is carried out using available rocket, radar and ground based magnetometer measurements to comprehensively understand the generation of plasma waves in the E-region. This investigation revealed that the generation of the streaming waves is sensitive to drift of the dip equator from Thumba obtained using systematic magnetometer measurements. The importance of these scientific results will be highlighted in this paper.

TYPE: ORAL
DATE: 2012-03-12 – 17:35

METEORIC DUST EFFECT ON THE E-REGION PLASMA INSTABILITY MECHANISMS

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It is known that the meteoric dust particles play an important role in the electrodynamics of the E-region plasma. Large amounts of dust particles with average sizes of about 0.1m with number densities of up to several thousands per cubic centimeter and charge densities of the same order have been experimentally detected in the lower E-region altitudes. In some parts of the dust layers it was found that the negative charge density on dusts was so large that the number of free electrons was significantly reduced there, since the dust acted as a sink for electrons, thus causing electron bite outs. Recent studies show the possible role of neutral as well as charged dust particles of submicron size in altering the conductivity parameters in the equatorial E-region through the collision frequencies. In the upper E-region the dust particles are not very effective in capturing the ambient electrons and so do not affect

the quase neutrality of the plasma. But they can alter the effective collision frequencies of the ambient electrons in this region by a factor as high as 4. They can also reduce significantly the growth rate and amplitude of plasma irregularities in this region. In the lower E-region the dust particles can affect significantly the electrical conductivities. When exist in sufficient numbers, charged dust particles can even reverse the ambient vertical polarization electric field in the lower E-region altitudes. This can affect the plasma instability mechanisms like Cross-Field Instability and Two-Stream Instability that operate in the E-region. Assuming a simple exponential model for the dust layer, the role of these dust particles in altering the E-region electrodynamics by affecting the collision and conductivity parameters is investigated here.

TYPE: ORAL
DATE: 2012-03-12 – 17:50

METEOROID FRAGMENTATION AND HIGH-ALTITUDE METEORS OBSERVED AT JICAMARCA

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One of the most exciting, and even controversial, developments in the meteor physics community in the past few years has been the confirmation of fragmentation in perhaps the majority of meteoroids observed by many of the High Power Large Aperture (HPLA) radars. That meteoroid fragmentation can be quantitatively observed using HPLA radar assumes vital significance as it provides additional insight into the mass-loss mechanisms of the billions of meteoroids that strike the Earth's atmosphere annually. The thorough understanding of his aspect of space weather also has the potential to help us understand the aeronomy of MLT region and might also help in interpretation of a variety of upper atmospheric phenomenon including Polar Mesospheric Summer Echoes (PMSE) and NLC (Noctilucent Clouds). Though there have been numerous reports of fragmentation in meteoroids from most of the HPLA radars (Arecibo, EISCAT, PFISR, RISR, ALTAIR), the apparent lack of fragmentation in meteor observations from the Jicamarca Radio Observatory (JRO) presents a mystery although electrojet contamination and the ready formation of range-spread trail-echoes (RSTE) cloud interpretation. We report results from two sets of April 2010 observations at JRO during which an uncoded 20 ?sec pulse was used for meteor observations. This observing mode parallels that used with the Arecibo 46.8 MHz radar that has similar sensitivity to JRO in interferometry mode thus allowing direct comparisons. Our findings include meteoroid fragmentation results that are similar to those from the Arecibo VHF radar and lead to the conclusion that fragmentation is observed at Jicamarca. We additionally report on high-altitude meteor events that are surprisingly common, offer insight into sputtering as a source of the meteor ionization, and perhaps indicate the unique importance of the magnetic field geometry in these head-echo observations. Finally, we also offer interesting new results on meteor events "painting" low-altitude ionization layers.

TYPE: ORAL
DATE: 2012-03-12 – 18:05

THE ROLE OF TURBULENCE ON THE EVOLUTION OF SPECULAR METEOR ECHOES

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We report initial results of a numerical model developed to study the effect of turbulences on the evolution of underdense specular meteor trails. Understanding meteor trail plasma turbulence is important because turbulent meteor trails are visible as non-specular trails to coherent radars, and turbulence influences the growth of specular meteor radar trails, particularly regarding the inference of mesospheric temperatures from trail diffusion rates, and their usage for meteor scatter communication systems. The architecture of the numerical model traces meteor trail evolution from ablation and ionization processes through the creation of the actual specular meteor echo. Thus, this meteor model represents a valuable tool for the analysis of specular meteor physics. We describe and compare our simulation results with the general characteristics of meteor echoes detected with two different data radar systems. The first radar operated at 50 MHz with moderate peak power of about 30 kW and was oriented perpendicular to the Earth's magnetic field while the second radar also operated at 50 MHz but with relatively low peak power of about 5 kW. The latter radar was configured in classical all-sky mode observation. By comparing data from the different meteor systems, our preliminary studies illustrate the significant effect that neutral atmospheric winds and density, and ionospheric plasma density have on the variability of meteor trail evolution and the observation of non- specular meteor trails, and demonstrate that trails are far less likely to become and remain turbulent in daylight, explaining several observational trends using non-specular and specular meteor trails.

TYPE: ORAL
DATE: 2012-03-12 – 18:20

INFLUENCE OF IONOSPHERIC ELECTROJETS ON METEOR TRAIL EVOLUTION

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We present the first global simulations on the occurrence of meteor trail plasma irregularities to incorporate the electrodynamics of the auroral zone and the equatorial electro-jet. The electojet regions of the earth are peculiar locations for meteor trail evolution because strong electric fields dominate the meteor trail evolution by generating mini-electrojets with even stronger polarization fields. As the results show, electrojet meteors, such as those near the magnetic equator are far more likely to be turbulent than other geographic locations where neutral winds dominate polarization fields. Understanding meteor trail plasma turbulence is important in part because turbulent meteor trails are visible as non-specular trails to coherent radars. Turbulence also influences the evolution of specular radar meteor trails; this fact is important for the inference of mesospheric temperatures from the trail diffusion rates, and their usage for meteor burst communication. We provide evidence of the significant effect that neutral atmospheric winds and ionospheric plasma density, and ionospheric electric fields have on the variability of meteor trail evolution and on the observation of non-specular meteor trails, and discuss in particular how meteor trails can be used to remote sense the equatorial electojet.

TYPE: ORAL
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POST-SUNSET IRREGULARITIES IN THE EQUATORIAL UPPER E-REGION

Ronald Ilma, David Hysell, and Henrique Aveiro

Cornell University, Ithaca, NY, USA

Large-scale plasma waves have been detected by the low-power JULIA radar at Jicamarca in the last decade. These waves, which occur in the upper E-region at twilight, are a new class of equatorial irregularities and they have not been previously predicted. Although

the source of these echoes have not been precisely determined, the current radar database, obtained under both single-line interferometric and aperture synthesis imaging modes, tentatively suggest that they are associated with a gradient drift instability capable of generating these large-scale primary waves. The statistical analysis of the single-baseline interferometry observations reveals that the probability to detect these echoes is relatively higher during equinox than solstice, in the height range from 120 to 140 km during and after sunset. Preliminary results from computer simulations code, which has been previously applied to Spread-F studies satisfactorily, show the emergence of waves in similar spatial and temporal conditions to those observed echoes. The numerical model produces nice gradient drift waves in the topside of the electrojet. The simulation results also present a relative density fluctuations of 10 percent or so. From the same results, waves in the E-F valley propagate westward and downward and look like the ones we see from time to time in this physical regime. What's most interesting about them is that they exhibit finite parallel wavenumber vector. This, and the existence of a parallel density gradient, are the keys to their growth.

TYPE: ORAL
DATE: 2012-03-13 – 08:00

ON THE EAST-WEST STRUCTURE OF 150-KM PERPENDICULAR AND OFF-PERPENDICULAR TO B ECHOES OVER JICAMARCA

Jorge Chau[1], David Hysell[2], Erhan Kudeki[3], Marco Milla[1], and Miguel Urco[1]

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For many years 150-km echoes appeared to come from field-aligned irregularities, i.e., when the radar pointed perpendicular to the magnetic field (B). Recent studies at Jicamarca indicate that most of 150-km echoes come from waves that have been enhanced above waves in thermal equilibrium, i.e., they are also observed when the radar points off-perpendicular to B (Oblique). The physical mechanisms generating these echoes are still elusive. In this work we present results of the East-West (EW) structure of both echoes: Perpendicular and Oblique, using observations were dual beams and aperture synthesis imaging techniques were employed. By the time of the conference, we expect that the new observations that involve concurrent measurements of the oblique and perpendicular echoes as well as their EW structure, will reveal new insights on the complexity of these echoes.

TYPE: ORAL
DATE: 2012-03-13 – 08:15

INCOHERENT SCATTER AND SOUNDING MEASUREMENTS IN THE 150 KM REGION OF THE EQUATORIAL IONOSPHERE

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[2] Radio Observatorio de Jicamarca, Instituto Geofísico del Perú, Lima, Perú

Recent VIPIR measurements at Jicarmaca show indications of electron density structures and fluctuations in the upper E-region. These structures can be associated with and possibly cause the generation of the 150 km irregularities observed in the equatorial ionosphere. In this talk we will present incoherent scatter radar data collected using the Jicamarca Faraday rotation mode concurrently with VIPIR observations. The ISR data also support the conjecture that the 150 km altitude region may have structured electron densities at intermediate scales related to the generation of the meter scale 150 km irregularities. Also, recent multi-beam and multi-static measurement results from the region will be presented.

TYPE: ORAL
DATE: 2012-03-13 – 08:30

CHARACTERISTICS OF EQUATORIAL PLASMA BUBBLES OBSERVED FROM INDIAN SECTOR DURING WINTER MONTHS OF DEEP SOLAR MINIMUM

Viswanathan Lakshmi Narayanan and Subramanian Gurubaran

Indian Institute of Geomagnetism, Navi Mumbai, India

All-sky airglow imaging observations of OI 630 nm emissions from low latitude Indian sector during January to March 2008 revealed presence of plasma bubbles on 17 nights. The bubbles observed on 8 of the nights correspond to geomagnetically quiet period and those observed on remaining 9 nights correspond to disturbed period. Herein, we discuss the characteristics of the observed bubbles based on the following parameters: drift speed, interdepletion distances, tilts, bifurcations and merging. We have utilized simultaneous ionosonde measurements made from dip equatorial site Tirunelveli. The variations of base height of F layer (h'F) observed over dip equator clearly showed that PRE has no significant role in the formation of the observed bubbles, at least during this solar epoch. Plasma bubbles were even observed on those nights with no post sunset rise of F region ionosphere. In addition to the eastward drifts, westward drifts are also observed during disturbed geomagnetic conditions. Moreover, the tilts of the observed bubbles were higher during geomagnetically disturbed conditions. No significant variations were found in the range of interdepletion distances observed during quiet and disturbed periods. These observations are expected to augment our understanding of the equatorial plasma bubble phenomenon.

TYPE: ORAL
DATE: 2012-03-13 – 08:45

GLOBAL S4 INDEX OBSERVED BY FORMOSAT-3/COSMIC

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The FORMOSAT-3/COSMIC (F3/C) constellation lunched on 15 April 2006, which consists of six micro-satellites in the low-earth orbit, is capable of monitoring the troposphere and ionosphere by using the powerful technique of radio occultation. With more than 2000 observations per day, it provides an excellent opportunity to monitor three-dimensional structures and dynamics of the ionospheric scintillations during 2006-2011. The global F3/C S4 index are subdivided and examined in various latitudes, longitudes, altitudes, and seasons. The F-region scintillations in the equatorial and low-latitude ionosphere start around post-sunset period and often persist till post-midnight hours (0300 MLT, magnetic local time) during the March and September equinox as well as December Solstice seasons. The E-region scintillations reveal a clear solar zenith effect and yield pronounced intensities in mid-latitudes during the Summer Solstice seasons, which are well correlated with occurrences of the sporadic E-layer. There is no obvious scintillation activity observed in the high-latitude ionosphere.

TYPE: ORAL
DATE: 2012-03-13 – 09:00

FORECASTING L BAND SCINTILLATIONS 'WHEN' AND FOR 'HOW LONG': A REALITY?

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An operational forecasting of L band scintillation is very vital for real time satellite based communication and navigation. Two of the many fundamental questions viz., 'when' and for 'how long' the scintillation patches are likely to be present have been answered conclusively. A novel method based on GPS-TEC (GTEC) data several hours before the actual event has been worked out. The close linkage between the perturbation features and the evolutionary pattern of the scintillation enables us to forecast 'when' and for 'how long' the L band scintillations could occur, in addition to their occurrence pattern. The 'first' of its kind of results take us one step closer towards the operational forecasting of L band scintillations.

TYPE: ORAL
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HE+ DENSITY DEPLETIONS AS INDICATOR OF THE TOPSIDE IONOSPHERE PLASMA BUBBLES

Sergey Filippov

IZMIRAN, Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation RAS, Troitsk, Russia

He+ density depletions, considered as originating from equatorial plasma bubbles, were involved in this study. They are usually detected in the topside ionosphere (1000 km) deeply inside the plasmasphere (L 1.3-3) [Sidorova, ASR, 2004, 2007]. a) Since there are some questions about survival possibilities of the topside plasma bubbles, the characteristic times of the main processes, in which plasma bubbles are involved, were compared. It was suggested that plasma bubbles are produced by Rayleigh-Taylor instability at the bottomside of ionosphere and transported up to the topside ionosphere. It was found that it takes about 3-4 hours for plasma bubbles to reach the topside ionosphere altitudes. It was revealed that ambipolar diffusion transport is the most fast (some minutes). The estimation of the Bohm (cross-field) diffusion time shows that topside plasma bubbles can exist up to 100 hours. It was concluded that there is enough time for the plasma bubbles to survive and to be detected (e.g., in minor species of ion composition inside the bubble like He+) at the topside ionosphere altitudes. (b) It was revealed that the topside plasma bubbles can be easily detected as He+ density depletions during high/ maximal solar activity. The convenient conditions for observations appear because the strong depleted in He+ density bubbles, reaching the topside ionosphere, most well contrast with the He+ density background layer very well developed in topside ionosphere during high solar activity [Wilford et al., JGR, 2003]. (c) He+ density depletions were considered in connection with equatorial F-region irregularities (EFI), equatorial F-spread (ESF) and equatorial plasma bubbles (EPB). Their longitudinal statistics, calculated for all seasons and both hemispheres (20?50?INVLAT), were compared with EFI statistics taken from AE-E [McClure et al., JGR, 1998], OGO-6 [Basu et al. RS, 1976], ROCSAT [Su et al., JGR, 2006] observations. ESF(RSF), EPB statistics taken from [Maruyama, Matuura, JGR, 1984; Watanabe, Oya, JGG, 1986] based on ISS-b and Hinotori data were also used for comparison. It was revealed that the main statistical maxima of the equatorial F-region irregularities are well enough reflected in the statistical plots of the He+ density depletions of the both hemispheres. The best conformity was obtained for equinoxes, the worst one - for solstices, when the most dramatic insolation differences take place in the different hemispheres. Hence, it was validated once again that He+ density depletions may be considered as an indicator of topside plasma bubble presence or as fossil bubble signatures.

TYPE: ORAL
DATE: 2012-03-13 – 09:30

P1.01 CASE STUDIES OF SOME SPECTACULAR JET STREAMS IN THE TROPOSPHERE AND LOWER STRATOSPHERE OVER TWO MAJOR STATIONS IN NIGERIA

M.A. Ayoola and G.O. Akinlade

Obafemi Awolowo University, Ile-Ife, Nigeria

Distinct variations in levels of jet streams from troposphere into the lower stratosphere have been clearly revealed over two major Nigerian stations; Lagos (Lat. 06o 32? N, Long. 03o 21?E) and Kano (lat.12o 03? N, Long.08o 32? E) by an analysis of over 360 radiosonde/rawinsonde observations made over the station. These jets cases range from low-level jet, (LLJ) near the planetary boundary layer, to prominent ones at 650-700hpa, 500hpa and 300hpa pressure levels. The heights of the jet cores range between 3km to18km in most of the period of occurrence.. The troposphere is seen to be a significant layer in this study because 80% of the atmosphere's mass is located within it and almost all of what we call "weather" occurs in the troposphere. The average position of jet stream and intensity varies with the seasons.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P1.03 CHARACTERISTICS OF THE IONOSPHERIC F-REGION IRREGULARITIES OVER SANYA

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Data from the continuous observations of ionospheric F region irregularities by a VHF coherent radar, an ionosonde and a GPS scintillation/TEC receiver over Sanya (18°N, 109°E, dip 13ºN) are analyzed. It is found that the F region 3-m scale field aligned irregularities (FAIs) appeared frequently at post-sunset hours during equinox but initiated mostly at midnight/post-midnight in June solstice at solar minimum. Comparison of FAIs with GPS scintillations, TEC fluctuations and spread-F shows that the equinoctial FAIs coincided well with GPS scintillations and TEC fast depletions, which are associated with the development of equatorial plasma bubbles (EPBs). However, for the June solstitial FAIs, some post-midnight FAI structures over Sanya may originate from equatorial F region and then extend to Sanya latitude along magnetic field lines, but the others could resemble the irregularities of localized origin, not associated with the equatorial process. Both types of post-midnight FAIs during June solstice are not accompanied by GPS scintillations and TEC depletions, but are associated with the occurrence of spread-F. On the other hand, we present some measures of EIA asymmetry and pre-reversal vertical drifts around sunset in the Chinese longitude sector, and investigate their correspondence with the day-to-day variability of ionospheric plasma bubbles during equinox over Sanya. On the ten nights studied in the present investigation, it has been observed that the geomagnetic disturbances have a strong inhibition effect on the F region irregularities.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P1.04 ON THE RELATIONSHIP OF MULTI-REFLECTED ECHOES TO LARGE-SCALE WAVE STRUCTURE AND EQUATORIAL SPREAD F

Thu Trang Nguyen[1], Roland Tsunoda[2], and Mamoru Yamamoto[3]

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There is considerable interest in understanding the day-to-day variability in occurrence of plasma structure in the nighttime equatorial F layer, often referred to as equatorial spread F (ESF). While there is wide acceptance of the notion that the vigor of the post-sunset rise (PSSR) of equatorial F layer is largely responsible for whether ESF occurs

or not, there is mounting evidence that large-scale wave structure (LSWS), which develops in the bottomside F layer prior to onset of ESF, may also be playing a role. The role of LSWS involvement in ESF development has not received much attention because virtually all sensors in use (until recently) are not being used to detect or describe LSWS. In an effort to develop new methods for doing so, we have begun to search for features in equatorial ionograms that could be related to the presence of LSWS. Early indication is that the so-called multi-reflected echoes (MREs) are an ionogram signature for LSWS [Tsunoda, 2009]. The cause of MREs is believed to be an enhancement of the ionospheric reflection coefficient, which occurs when concave isodensity contours associated with LSWS are situated over the ionosonde. The results in this presentation come from an ongoing study, whose objective is to determine the properties of MREs and their relationship to LSWS and ESF. The results to be presented include: (1) a description of how MREs are manifested in ionograms, (2) examples that show the relationship of MREs to upwellings in LSWS, and (3) the occurrence frequency of MREs as a function of time of day, season, solar and magnetic activity. The results show that MREs are related to vertical transport of local F-region plasma; the results are consistent with the notion that plasma seeding could be a consequence of atmospheric gravity waves and neutral-ion coupling in the bottomside F layer. Data used for this study include ionograms from the Kwajalein Atoll, Marshall Islands, and total electron content (TEC) variations derived from the reception (also at Kwajalein) of radio beacon transmissions from the equatorial-orbiting, Communication/Navigation Outage Forecasting System (C/NOFS) satellite. The results are important because MREs can provide a continuous monitor of LSWS presence, which complements the beacon satellite measurements that are made only once every 90 minutes or so.

TYPE: POSTER
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P1.05 IONOSONDE OBSERVATIONS OF SPREAD F IRREGULARITIES AT LOW LATITUDE PAMEUNGPEUK (INDONESIA) DURING LOW SOLAR ACTIVITY

Prayitno Abadi and Buldan Muslim

Space Science Center, Indonesian National Institute of Aeronautics and Space, Indonesia

Spread F (SF) signatures on ionograms are manifestation of ionospheric irregularities in the F layer ionosphere. The basic mechanism of SF is associated with pre-reversal enhancement (PRE) of the eastward electric field after sunset. PRE indicates upward E $\times$ B plasma drifts elevate the F layer sufficiently for spread F initiation. Nevertheless, PRE is not a more-direct precursor of spread F. Although PRE is associated with SF climatologically, our observational evidence which indicate that SF is not always associated with PRE. By using ionosonde that installed in Pameungpeuk, we investigated virtual height (h'f) variations of F layer to indicate correlation between PRE and spread F occurrences during 2009 (low solar activity). We found that spread F occurrences is highest rate occurrences on March, and we found asymmetry occurrences of spread F on equinox, spread F occurrences on February-March is higher than September-October. The primary results, most of spread F occurrences on Jan, Nov, and Dec are well-correlated with PRE. On the other hand, most of spread F occurrences on Apr, May, Jul and equinox months are negative correlated with PRE.

TYPE: POSTER
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P1.07 IONOSPHERIC STRONG RANGE SPREAD-F OBSERVED IN THE LOW LATITUDE STATION HAINAN

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Center for Space Science and Applied Research, Chinese Academy of Sciences, China

The spread-F is an important plasma irregularity in the ionosphere. Since a DPS-4

digisonde was installed in the low latitude station Hainan, China (19.4°N, 109.0°E geogr., dip lat. 9°N) in March 2002, ionograms were recorded at 15-min intervals. The observed ionograms often show Strong range Spread-F (SSF) in the ionosphere over Hainan station. The SSF is similar to the range spread-F but the spread extends in frequency well beyond FoF2, making the critical frequency of the F2 layer difficult to be determined. Here, we statistically study the SSF properties using the data from 2002 to 2007. The results show that the SSF mainly occurred in equinox months and was more actively in high solar activity years. Occurrence of the SSF showed a small increase with sunspot number (SSN) during equinoxes and summer, and seemed insensitive to the SSN during winter. The peak occurrence of the SSF were at 2100-2300 LT during high solar activity years and at 2300-0100 LT during low solar activity years. The occurrence of the SSF was higher in the geomagnetic quiet periods than that in the geomagnetic disturbed periods. The SSF had a good correlation with GPS L-band scintillations and we conclude that the SSF is associated with equatorial plasma bubbles.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P1.08 NEW NETWORK OF SPACED RECEIVER VHF SCINTILLATION EXPERIMENTS OVER INDIAN REGION: RESULTS ON ESF IRREGULARITIES.

Diwakar Tiwari[1], G. Surve[1], C. K. Nayak[1], B. Kakad[1], S. Sripathi[1], Amit K. Patra[2], K. Jeeva[1], K. U. Nair[1], C. Selvaraj[1], R. N. Maurya[1], P. Tiwari[1], P T Patil[1], R. Ghodpage[1], and Archana Bhattacharyya[1]

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Network of spaced receivers recording VHF scintillations have been established over equatorial and low latitude Indian stations at Gadanki (13.45°N, 79.17°E, dip latitude 6.4°N), Kolhapur(16.8°N, 74.2°E, dip latitude 10.6°N) and Allahabad (25.3°N, 81.5°E, 16.24°N) along with existing similar setup at Tirunelveli (8.7oN, 77.8oE, dip latitude 0.60 N). Amplitude scintillations on 251 MHz signal transmitted from geostationary satellite UFO2 (71.20 E) and recorded at every 50 ms at all these stations are utilized in the present work. Here we present, first results on the simultaneous scintillation observations recorded by this network of VHF spaced receivers during January-October 2011 to understand the latitudinal variability in the evolution of Equatorial Spread F (ESF) irregularities. Zonal plasma drift Vo, characteristic velocity Vc, which is a measure of random changes in the irregularity characteristics and maximum cross-correlation CI(x0,tm) between intensity variations of two receivers are estimated for every 3 minute at each station. Quiet time monthly average pattern of zonal drift Vo and characteristic random velocity Vc are studied to get information about latitudinal variability of ESF irregularities.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P1.09 IMPORTANCE OF IONOSPHERIC EQUATORIAL VHF SCINTILLATION IN THE INDIAN REGION TO STUDY SUN-EARTH INTERACTIONS

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Plasma density irregularities in the ionosphere (associated with ESF, plasma bubbles and Sporadic E layers) cause scintillations in various frequency ranges. VHF radio wave scintillation technique is extensively used to study plasma density irregularities of sub-kilometre size . Effects of magnetic and solar activity on ionospheric irregularities are studied so as to ascertain their role in the space weather of the

near earth environment in space. Indian Institute of Geomagnetism operated a ground network of 13 stations monitoring amplitude scintillations on 244/251 MHz (FLEETSAT 73°E) signals in India for more than a decade under AICPITS. At present VHF scintillation is being recorded at Mumbai by monitoring 251 MHz signal transmitted by geostationary satellite UFO2(71.2? E), sampling at 20 Hz. VHF scintillation was monitored at Mumbai during CAWSES Campaigns 2006 and 2008 During campaign 2006 (low sunspot period) occurrence of daytime scintillations was higher than the nighttime scintillations. This could be due to the fact that during low sunspot years occurrence of spread-F is limited to a narrow latitude region near the dip equator. To study solar cycle association of scintillations, long series of simultaneous amplitude scintillation data for period Jan 1989 to Dec 2000 at different locations are utilized. Nighttime scintillation occurrence is solar activity dependent Though equatorial scintillations are inhibited due to the magnetic activity in general, there are cases when strong scintillations result during magnetic storms especially in the post midnight period.

TYPE: POSTER
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P1.10 ELECTRON TEMPERATURE ENHANCEMENTS IN NIGHTTIME EQUATORIAL IONOSPHERE UNDER THE OCCURRENCE OF PLASMA BUBBLES

Francisco Carlos De Meneses[1], Maxim Klimenko[2], Vladimir Klimenko[2], Esfhan Alam Kherani[3], Polinaya Muralikrishna[4], Alina Marie Hasbi[5], and Jiyao Xu[1]

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Rocket borne measurements of electron temperature involve much more than a mere complement to the overwhelming amount of data provided by ground-based instruments and satellites. They are the most suitable technique to perform direct measurements of phenomena that evolve vertically, as well as to provide vertical profiles of parameters in the atmosphere/ionosphere system over a range of altitude currently inaccessible to both balloons and satellites. A rocket experiment carried out on December 18th, 1995 at 21:17 h (LT) over the equatorial station Alcântara (2.31oS; 44.4oW), Brazil, measured both electron density and temperature. These measurements revealed, just before the development of plasma bubbles, a region of large electron temperature below the base of the F-layer. Once the bubbles are developed these large values of temperature drop significantly while relatively large temperatures can now be preferentially observed at the top inside of the bubbles. This phenomenon is examined in the light of results provided by the Global Self-Consistent Model of the Thermosphere, Ionosphere and Protonosphere (GSM TIP) developed by WD IZMIRAN, as well as an alternative 2D numerical simulation that reproduces the growth of an instability and the evolution of energy inside a bubble. The previous results of this analysis suggest that the enhancements observed below the base of the F-region and at the top side of bubbles seem to be a geophysical phenomena. Furthermore, it also suggest that the intra-bubble temperature enhancements are formed due to the convection of hot fluid from bottomside to higher altitude and due to the large divergence in the ion velocity near the upper boundary of bubble.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P1.11 VARIABILITIES OF IONOSPHERIC SCINTILLATIONS AROUND EQUATORIAL IONIZATION ANOMALY CREST OF THE INDIAN ZONE

Shyamal Kumar Chakraborty, Satarupa Chatterjee, Sourav Mazumdar, and Rajkumar Hajra

Raja Peary Mohan College, India

Results of scintillation observations at VHF (250 MHz) from three locations (Bokkhali/BOK (21.58°N, 88.24°E), Raja Peary Mohan College/RPMC (22.66°N, 88.39°E), Krishnath College/KNC (24.1°N, 88.32°E)) around the equatorial ionization anomaly (EIA) crest will be presented. The study will be augmented by observations at GPS, GLONASS and SBAS frequencies in the context of studying temporal and spatial variability pattern of amplitude scintillation around the most vulnerable zone of the globe. In the equinoctial months distinct temporal and spatial variability features are reflected in the occurrence characteristics of VHF scintillation. The postsunset scintillations are found to initiate first at BOK followed by RPMC and KNC. The highest fading rate, depth, duration, spectral slope are recorded at BOK with the gradual decrease of the same at RPMC and KNC respectively. Scintillations are also recorded in three SBAS satellites, GLONASS and GPS tracks and they are found to be associated with TEC depletions/bite-outs. The plasma bubble associated irregularities generated near the magnetic equator and mapping down along the field line may trigger the scintillation activities around the three locations with associated temporal and spatial variability features. It is ascertained by the ionosonde data from the equatorial location. Scintillation along the tracks of various GPS, GLONASS satellites may give an approximate idea of extent of irregularity belt along with its temporal evolution feature. Compared to the equinoctial months, scintillation in summer solstitial months exhibits certain distinctive features which are reflected in occurrence time, fade rate, depth, and duration of scintillation. Nature of summer daytime scintillation exhibits remarkable features at KNC and RPMC. The summer solstitial scintillations in the premidnight period are also observed to exhibit reverse spatial feature compared to equinoctial months. Scintillations occur earlier at KNC with higher fade rate, strength, duration, greater spectral slope of power spectra than those at RPMC. No Fresnel oscillations are observed in spectral features. Mid-latitude type possibly of E-layer irregularity may be the origin of scintillation. Cases are observed when scintillations are detected at RPMC in the postsunset hours baring at KNC with distinct signatures of Fresnel oscillation implying that thin F-layer irregularity may be the possible sources. Sometimes scintillation starts at late premidnight hours continued up to predawn hours with comparatively higher fade rate, duration, depth of scintillation at RPMC than at KNC. Power spectral analysis reveals BSS type irregularities. The results accrued form a useful database for modeling studies of scintillation around the equatorial anomaly crest.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P1.12 ON THE EVOLUTION OF MEDIUM (HUNDRED'S OF M) AND SMALL (FEW M) SCALE ESF IRREGULARITIES: A NEW LOOK THROUGH GPS WINDOW

Mala S. Bagiya and R. Sridharan

Physical Research Laboratory, Ahmedabad, India

The evolutionary pattern of different scale sizes of plasma density irregularities associated with Equatorial Spread-F (ESF) have been studied using GPS-TEC (GTEC) data along with the basic data on the F region heights in the post sunset hours. It has been seen that the evolutionary pattern is very closely related to the fluctuations in the GTEC and also to the ion-neutral collision frequency. The background thermospheric conditions that affect the growth of the plasma instability through

ion-neutral collision frequency (?in) are estimated using the F region base height (h'F) and the representative scale height of the neutral atmosphere and are presented by a growth factor (G). The variations in GTEC with respect to GTEC is derived and considered to represent the seed perturbations for the generation of ESF irregularities. This perturbation factor (P) along with the growth factor has been shown to reproduce the complete evolutionary pattern. The investigation demonstrates that if one gets a handle on above two factors, one could foresee the evolutionary pattern of the medium and small scale irregularities associated with the ESF which requires immediate attention from the point of view of satellite based communication and navigation.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P1.14 PLANE WAVES FORCING ON EQUATORIAL "F-SPREAD", EARTH-SUN, UNIVERSE PHENOMENA . . . AND ON "UPCASTING"

G. Tisnado

TECNOFIL S.A., Lima, Perú

Tracking satellites at Minitrack Station, Ancon Lima-Peru on the 60s, conspicuous East-West-Only trajectory distortions occurred, mostly during past-equinox evenings. These were associated with geomagnetic aligned electron density irregularities at F-region Equatorial Ionosphere. Taking advantage of a unique configuration given by: (i) Polar Satellite passes (ii) precise Minitrack radio interferometry at 136MHz, (iii) local Geomagnetic Field: zero dip due N-S, and (iv) the near-equinox Equatorial Ionosphere dynamics, the author had collected pertinent data sets, study irregularities dominant scale morphology and characterize those as: "Sharply N-S oriented quasi-periodic vertical gradient crests of electron distribution near F max". Physically it was assumed, vertical plane structures could result from seeded parcels grown along high conductivity magnetic field channels. Which is nowadays confirmed: plane Internal Gravity Waves (IGW), from the lower atmosphere traveling to upper thermosphere, with a dominant forcing role, could be the seeding for such dense electron anisotropies. Then fully developed as regional extent patches and propelled by the ion-drift travel resembling forced westerly propagating Plane Waves. After kindly invitation from the ISEA-13 Organizing Committee the author has learned from the web, that this favorite scientific topic is still as enigmatic, as half century ago!!! Therefore gladly moved to dig for and fortunately got some that time data relics (1965-1966, Polar satellite passes). These re-analyzed, will be presented. Due to elements separation, ?=10.5Km and the radio wavelength ?=2.2m at 136MHz, the scenario was found amenable for a simple ray-tracing analysis Anecdotically: late on the 90s, after years using IGW on Solarterrestrial and magnetosphere substorm phenomena, as visitor scientist at GSFC NASA, the author moved back Lima-Peru, working at a copper smelter, has learned about most salient kind of "quantum effects at macro-scale": The way to cast bar feedstock's to fabricate wire, is by wavy pulling-up of the bar from the melt (continuously will never work!!!) Within this "up-casting" technology, the sharper wave front pull, the plenty and better the produce! Obviously the physical model chosen was: "forced plane IGW's propagate into the critical solid-liquidus zone. Finally substantiating above views: "severe geomagnetic anisotropic undulations, near the F max layer", ROJ Spread-F vs Ancon Satellite Scintillations, data sets from concurrent experiments done, along with resent MODIS satellite observations of IGW over Northern Peru, will also be presented. Pertinent Physical-Mathematics explaining the IGW salient role in the addressed henomena will be sketched.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P1.15 MORPHOLOGY OF PLASMA TEC DEPLETIONS OVER SOUTH AMERICA

Cesar Valladares

Boston College, MA, USA

This paper presents regional plots of TEC depletions derived from GPS observations over the South American continent with a coverage of over 45° longitude (i.e., 35? to 80° W). A new numerical algorithm has been developed to automatically detect TEC bite-outs that are produced by the transit of equatorial plasma bubbles. This algorithm was applied to TEC values measured by the Low Latitude Ionospheric Sensor Network (LISN) and by receivers that belong to 4 other networks that exist in South America. The general characteristics of the TEC depletions are provided along with their temporal length, local time distribution and depletion depth. The regional day-to-day and seasonal variability of the TEC depletions are also presented for three years of low solar activity: 2008, 2009 and 2010. The regional day-to-day variability of TEC depletions is highly dynamic, but their seasonal distributions follow the longitudinal characteristics of plasma bubbles presented by other authors. During the equinoxes, TEC depletions are mainly observed on the west coast of South America, and during the December solstice they mostly occur on the east side of the continent. However, in all seasons we observe days when depletions extend all over the continent. These new results are placed in the context of theories of plasma bubble seeding.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P1.16 EXTENDED OBSERVATIONS OF DECAMETER SCATTER ASSOCIATED WITH THE MID-LATITUDE IONOSPHERIC TROUGH

Elsayed Talaat[1], Ethan Miller[1], J. Michael Ruohoniemi[2], William Bristow[3], Raymond Greenwald[2], and Simon Shepherd[4]

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We present extended scatter observations that are associated with the nighttime ionospheric mid-latitude trough. Using data from five mid-latitude SuperDARN HF radar sites, including two radars with greater than 4 years of observations, we are able to compare with trough observations derived from electron density occultation measurements obtained from the COSMIC suite of satellite. We examine the scatter characteristics with respect to trough depth and location. Additionally, we examine longitudinal differences between sites and climatology as a function of seasons and local time.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P1.18 REFINING MEASUREMENTS OF THE SPREAD IN ASPECT ANGLES OF RADAR SCATTER FROM EQUATORIAL ELECTROJET IRREGULARITIES

Wesley E. Swartz[1], Donald T. Farley[1], Jorge Chau[2], Henry Pinedo[3], and Karim Kuyeng[2]

[1] School of Electrical and Computer Engineering, Cornell University, Ithaca, NY, USA
[2] Radio Observatorio de Jicamarca, Instituto Geofísico del Perú, Lima, Perú
[3] University of Tromsø, Norway

We report new measurements of the spread in aspect angles within the equatorial electrojet above the Jicamarca Observatory. This updates the work of Lu et al. [2008] with more and longer baselines so that the shape of the distribution can be better defined. The work of Kudeki and Farley [1989] used just one base line, while Lu et al. [2008] used 6. We have now used 10 baselines with the longest being a factor of 1.9 longer than used previously. We find that the coherence as a function of $\mathbf{k} \cdot \mathbf{D} \approx kD\theta_{RMS}$ (where $\mathbf{D}$ is a vector baseline, $\mathbf{k}$ is the incoming wave vector, and θ_{RMS}

is the complement of the averaged angles between $\mathbf{k}$ and $\mathbf{D}$) nicely follows Gaussian shapes down to small coherence values at the longest baselines for typical values of θ_{RMS} for many of the heights and Doppler shifts of data from within the electrojet. This confirms our previous assumptions for single baseline analysis that the shape is indeed Gaussian.

Kudeki, E., and D. T. Farley, Aspect sensitivity of equatorial electrojet irregularities and theoretical implications, J. Geophys. Res., 94, 426-434, 1989.
Lu, Fei, D. T. Farley, and W. E. Swartz, Spread in aspect angles of equatorial E region irregularities, J. Geophys. Res., 113, A11309, doi:10.1029/2008JA013018.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P1.19 STATISTICAL ANALYSIS OF VHF RADAR PLUME PARAMETERS AT THREE LONGITUDINAL SECTORS (SãO LUíS, JICAMARCA AND CHRISTMAS ISLAND).

Ricardo Cueva[1], Eurico De Paula[1], and Esfhan Alam Kherani[2]

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[2] Institut de Physique du Globe de Paris, CNRS, Paris, France

ESF are manifestation of ionospheric interchange instabilities in the nighttime equatorial F region. These instabilities generate plasma density irregularities with scale sizes ranging from centimeters to thousands of kilometers. The irregularities can be detected by coherent and incoherent scatter radars, in situ space probes, radio propagation and scintillation experiments, and airglow detectors in addition to ionosondes. The plume parameters here presented are onset altitude and time of bottom-type and plume, as well as the peak altitude of the topside plumes. Plume parameters processed from VHF Radars collected from equatorial stations located at São Luís (2.59S, 315.8E, 20.44W dip) -Brazilian region, Jicamarca (12S, 283.1E, 0.3E dip) - Peruvian region and Christmas Island (2N, 202.6E, 8.55E dip) - Central Pacific region, are important for space weather program/forecasting/nowcasting and improving scintillation warning models. These parameters show linear correlation with solar flux index (F10.7cm), as well seasonal and magnetic declination angle variation. In this talk we show the statistical analysis of the plume parameters, collected from three different longitudinal sectors, the fit correlation with F10.7cm and Kp indexes in order to develop an spread-F formation empirical model based on small scale irregularities. Onset altitude/time of bottom-type spread F present a linear regression with the solar flux index (F10.7cm), in agreement with Chapagain et al.(2009), with differences in time/altitude from seasonal and longitudinal basis.Peak altitude of topside plumes show high saturation when going from low to high solar flux activity.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P1.21 CLIMATOLOGICAL STUDY OF THE DAYTIME OCCURRENCE OF THE 3-METER EEJ PLASMA IRREGULARITIES OBSERVED OVER THE JICAMARCA CLOSE TO THE SOLAR MINIMUM (2007 AND 2008)

Lais Maria Guizelli, Clezio Marcos De Nardin, Juliano Moro, and Laysa Cristina Araújo Resende

Instituto Nacional de Pesquisas Espaciais - INPE, Sao Jose dos Campos, SP, Brazil

We have developed algorithms for conducting a seasonal statistical study of the occurrence of plasma irregularities type 1 (due to modified two-stream instability) and type 2 (gradient-drift instability) as function of height and local time, in the Peruvian sector covering two years of data (2007 and 2008), close to the solar minimum. This study is performed based on radar measurements carried out at the

Jicamarca Radio Observatory (JRO), located in Lima - Peru (11.57°S, 76.52°W, dip: 2°N), under the magnetic equator. The statistical analysis runs over daily Range Time Intensity (RTI) maps obtained with the radar operating in the Jicamarca Unattended Long-term Investigations of the Ionosphere and Atmosphere (JULIA) mode. Our results revealed relevant features of the diurnal variation of the plasma irregularities embedded in the equatorial electrojet, such as a more often presence of the 3-m irregularities during equinox and a descent of the scattering profile in the morning hours, followed by its rising in the afternoon.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P1.23 SEASONAL AND SOLAR FLUX VARIATION OF IONOSPHERIC F-REGION ION DENSITY AND DRIFTS AS OBSERVED BY ROCSAT-1 AND THEIR COMPARISON WITH GROUND BASED EEJ STRENGTH AND VHF SCINTILLATIONS OVER INDIAN REGION

Samireddipalle Sripathi[1], S. Tulasi Ram[2], Amit K. Patra[3], and Bharati Kakad[1]

[1] Indian Institute of Geomagnetism, Navi Mumbai, India
[2] Equatorial Geophysical Research Laboratory, Indian Institute of Geomagnetism, India
[3] National Atmospheric Research Laboratory, Gadanki, India

In this paper, we present the quite-time variation of solar flux, seasonal variation of vertical drift velocity and ion density at an altitude of 600 km as obtained by ROCSAT-1 over Indian region during the years 1999-2004, and their comparison with ground based (a) Equatorial Electrojet (EEJ) as obtained by ground-based geomagnetic field variations, (b) spaced receivers VHF scintillations and (c) small scale irregularities obtained using VHF radar to study the background conditions under which the ionospheric irregularities/scintillations are observed. These observations suggest that there exists a definite seasonal and solar flux variation as seen in the vertical drift velocity as well as ion density at ROCSAT-1 altitude over Indian region which in turn reflected in the occurrence of scintillations. In addition, these observations also suggest that vertical drift velocity rapidly enhanced in the evening hours during equinox followed by winter and summer seasons, respectively. The seasonal and latitudinal variations of ion density show the development of Equatorial Ionization Anomaly (EIA) which is found to vary with solar flux and season. The EIA development is visible clearly during equinox followed by winter and show signature of solar flux variations. However, latitudinal extent of EIA has been found to be suppressed during summer seasons. In addition, as solar flux decreases, strength of EIA also decreases, but rather slowly. The seasonal variations of EIA development and vertical drift velocity are highly correlated with EEJ strength during equinox followed by winter and summer seasons, respectively. As solar flux decreases, vertical drift velocity as well as EIA development also decrease over Indian region and hence occurrence of ground scintillations is reduced. While these observations are in accordance with earlier ionosonde observations over Indian region, we present new results showing seasonal and solar flux variations of drift velocity using ROCSAT-1 and compare these variations to the EEJ strength and their influence on the occurrence of scintillations/Equatorial Spread F (ESF) irregularities over Indian region.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P1.26 INTERMEDIATE SCALE LENGTH ESF IRREGULARITY SPECTRUM AND ASSOCIATED ELECTRIC FIELD FLUCTUATIONS

Archana Bhattacharyya, Diwakar Tiwari, and S. Sripathi

Indian Institute of Geomagnetism, Navi Mumbai, India

Ionospheric scintillation measurements and ionosonde observations at an equatorial station are used to study the influence of ambient conditions on the simultaneous evolution of the intermediate scale length (100m – 1 km) ESF irregularity spectrum as well as the perturbation electric field associated with the Generalized Rayleigh – Taylor (GRT) instability. Amplitude scintillations on a 251 MHz signal transmitted from a geostationary satellite and recorded by two receivers spaced along a magnetic east-west baseline at an equatorial station are used to estimate the zonal drift of the ground scintillation pattern, and the 'random velocity', which may be considered to be a proxy for the perturbation electric field associated with the GRT instability. For weak amplitude scintillations with S4 index ? 0.5 , where S4 index is the standard deviation of normalized intensity fluctuations, the spectral index of a power-law type of spectrum of amplitude scintillations for frequencies higher than the Fresnel frequency yields an estimate of the spectral index of a power-law irregularity spectrum. In general it is found that for a scintillation event, the 'random velocity' tends to decrease as the irregularity spectrum steepens. This would indicate that as the electric field fluctuations associated with the irregularities decrease, the shorter scale length irregularities also decay, which results in a steeper spectrum. Presumably the spectrum of electric field fluctuations also steepens, although no such information is available in this study. However, since the development of the GRT instability takes place in a dynamic background the manner in which the two physical processes are interlinked varies from one scintillation event to another. Here the influence of the dynamics of the post-sunset background equatorial F layer on the behavior of the irregularity spectrum and electric field fluctuations is explored.

TYPE: POSTER

DATE: 2012-03-13 – 17:35

P1.27 MERIDIONAL ELECTRIC FIELD MEASUREMENTS OF LAYER-TYPE AND BLOB-TYPE PLASMA STRUCTURES IN MID-LATITUDE SPORADIC E REGION: PLAUSIBLE GENERATION MECHANISMS

Yen Hsyang Chu

Institute of Space Science, National Central University, Taiwan

It has long been known from interferometer measurement that spatial structures of echoing regions of 3-m field-aligned irregularities (FAIs) in Es region can be categorized into layer- and blob-types. The layer-type structure is characterized by wide extent in horizontal and narrow thickness in vertical directions, and the blob-type structure is in quasi-isotropic shape. A method is proposed to measure meridional electric fields inside these two type echo structures observed by the Chung-Li VHF radar. On the basis of the radar data collected more than one year, we find that the meridional electric field of the layer-type structure is very different from that of the blob-type structure. Statistical results indicate that the former is in average about 1-2 mV/m that points in the direction in compliance with that predicted by neutral wind shear theory. However, the electric field inside the blob-type structure is very weak with irregular pointing direction. It is believed that the plausible mechanisms responsible for the formations of the layer-type and clump-type plasma structures are, respectively, very likely the convergence of neutral wind shear and the propagating gravity wave.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

Session 2

E AND F REGION COUPLING (LOW AND MID LATITUDE COUPLING)

Understanding the coupling between the E and F region at low and midlatitudes is important to elucidate the physics behind several processes occurring there. This coupling involves electromagnetic forcing effects between the regions connected by the geomagnetic field. In addition to local coupling, effects from the conjugate hemisphere seem to play an important role in the overall behavior of the processes observed.

This session solicits contributions related to coupling studies between the E and F region. Contributions focusing on multi-instrument observations, computer simulation and theoretical studies, ionospheric irregularities, wave phenomena, and effects of neutral atmosphere processes are encouraged.

Conveners: M. Yamamoto, J. Urbina, and C. Martinis

INVITED - GPS OBSERVATIONS OF MEDIUM-SCALE TRAVELING IONOSPHERIC DISTURBANCES OVER EUROPE

Yuichi Otsuka[1], Shinta Nakagawa[2], Michi Nishioka[3], and Kazuo Shiokawa[1]

[1] Solar-Terrestrial Environment Laboratory, Nagoya University, Japan
[2] Graduate School of Engineering, Nagoya University, Japan
[3] National Institute of Information and Communications Technology, Japan

Two-dimensional structures of medium-scale traveling ionospheric disturbances (MSTIDs) over Europe have been revealed by using maps of the total electron content (TEC) obtained from more than 800 GPS receivers of the European GPS receiver networks. From statistical analysis of the TEC maps, we have found that the observed MSTIDs can be categorized into two groups: daytime MSTID and nighttime MSTID. The daytime MSTID frequently occurs in winter. Its maximum occurrence rate in monthly and hourly bin exceeds 70% at lower latitudes in Europe whereas it is approximately 45% at higher latitudes.?Since most of the daytime MSTIDs propagate southward, we speculate that they could be caused by atmospheric gravity waves in the thermosphere. The nighttime MSTIDs also frequently occur in winter but most of them propagate southwestward, in a direction consistent with the theory that polarization electric fields play an important role in the generation of nighttime MSTIDs. The nighttime MSTID occurrence rate shows distinct latitudinal dependence:?The maximum of the occurrence rate in monthly and hourly bin is approximately 50% at lower latitudes in Europe, whereas the nighttime MSTID was rarely observed at higher latitudes. We have also compared the MSTID occurrence rate over Europe with that in other regions and discussed the longitudinal dependence of the nighttime MSTID occurrence rate along with the E- and F-region coupling processes. Previous studies suggest that the longitudinal and seasonal dependencies of the nighttime MSTID occurrence could be attributed to those of the Es layer occurrence rate. However, the seasonal variation of the nighttime MSTID occurrence over Europe is not consistent with this scenario. We speculate that the nighttime MSTID occurrence is not controlled by the Es layer occurrence alone and that inhomogeneity of Es layer may be needed for the MSTID occurrence.

TYPE: ORAL
DATE: 2012-03-16 – 08:00

INVITED - NUMERICAL MODELING OF MEDIUM-SCALE TRAVELING IONOSPHERIC DISTURBANCES (MSTIDS) SEEDED BY SPORADIC-E LAYERS

Tatsuhiro Yokoyama

Research Institute for Sustainable Humanosphere, Kyoto University, Japan

Plasma density structures and associated irregularities in the nighttime midlatitude ionosphere are frequently observed as frontal structures elongated from northwest to southeast (NW-SE) in the northern hemisphere, also known as medium-scale traveling ionospheric disturbances (MSTIDs). The MSTIDs and the coupling process between the E and F regions are studied with a three-dimensional numerical model which can simulate two instability mechanisms: Perkins instability in the F region and sporadic-E (Es)-layer instability in the E region. The fastest growth of the coupled instability occurs when the unstable conditions on NW-SE perturbation are satisfied in both regions. The meridional component of a rotational wind shear blows an existing Es layer southward, and the F-region structure follows the E-region drift velocity. It has been concluded that (1) the Es-layer instability plays a major role in seeding NW-SE structure in the F region, and the Perkins instability is required to amplify its perturbation, (2) the rotational wind shear in the E region produces southwestward phase propagation of the NW-SE structure in both the E and F regions, and (3) the

coupling process has a significant effect on the scale of the Es-layer perturbation rather than the growth rate of the Es-layer instability. Recently, a new midlatitude ionosphere electrodynamics coupling model (MIECO) has been developed which can model the coupling process between the E and F regions with dipole magnetic field lines. Using the new model, MSTID structure is reproduced from random perturbation on an Es layer in a wide latitudinal range. A typical wavelength of 150 km, larger amplitude, and smaller MSTID's tilt angles at lower latitudes are consistent with observations. It is shown that the polarization process in the E region driven by neutral winds is essentially important for the full development of MSTIDs as well as the seeding of NW-SE perturbation in the F region. With a little modification of the coordinate system, the model is being expanded to the equatorial region, which could be applied to the coupling between the equatorial and low-latitude ionospheres in terms of the seeding of equatorial plasma bubbles.

TYPE: ORAL
DATE: 2012-03-16 – 08:20

MECHANISMS FOR E-F COUPLING AND THEIR MANIFESTATION

Russell Cosgrove

SRI International, Menlo Park, CA, USA

In this talk I will broadly review the main physical mechanisms and constraints thought to be involved in midlatitude E-F coupled phenomena, and discuss some measurements and criteria that might allow identification of the salient mechanisms in a particular case. The discussion will involve mechanisms for polarizing sporadic E layers, effectiveness of F region polarization, scale sizes for gravity waves in the E and F regions, mechanisms for modulating the F layer altitude, typical conductance ratios and the E-F coupled electric circuit. As an example to organize the discussion, the rocket and radar study of Earle et al. [2010] will be reviewed with respect to the evidence for E-F coupling that it provides.

TYPE: ORAL
DATE: 2012-03-16 – 08:40

MSTIDS FROM HIGH TO LOW LATITUDES

Ethan Miller[1], Elsayed Talaat[1], Hyosub Kil[1], Jonathan J. Makela[2], and Larry Paxton[1]

[1] Applied Physics Laboratory, John Hopkins University, MD, USA
[2] University of Illinois at Urbana-Champaign, Urbana, IL USA

Nighttime medium-scale traveling ionospheric disturbances (MSTIDs) are a common feature of the middle and lower latitude ionosphere. These raised band structures propagate oblique to the magnetic meridian toward the equator and appear at magnetically conjugate locations. Several theories exist to explain the development and evolution of MSTIDs including the often-cited Perkins instability, as well as ion-neutral coupling, and coupled E-F region instabilities. We test these theories by fusing observations from radar and optical data sets to highlight relevant aspects of each.

TYPE: ORAL
DATE: 2012-03-16 – 08:55

VARIATIONS OF THE ES LAYER PARAMETERS OVER EUROPE AND ASIAN REGION

Iurii Cherniak[1], Jurij Nina Korenkov[2], Vladimir Leschenko[1], and Irina Zakharenkova[1]

[1] West Department of IZMIRAN, Kaliningrad, Russia
[2] West Department of Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation RAS, Kaliningrad, Russia

The information about statistical characteristics of sporadic Es layer is necessary for the ionospheric dynamics study and for radio applications. In this study we analyzed seasonal variations of foEs and probability of the layer's appearance during period of low solar

activity years 2008-2009 over midlatitudes of central Europe and Japan. This study is based on the data of Kaliningrad ionosonde (54,6N; 20E) and Wakkanai and Kokobunji ionosondes in Japan. For each stations there was calculated the monthly median and seasonal median diurnal variations. Additionally it was calculated the average probability of Es layer appearance. The Es layer with probability more than 30% was appeared from 08 to 17 LT in winter. This time limit was practically coincided with sunrise and sunset in winter. At night time Es layer practically did not appear. For summer season the Es probability is rather high at night time and can reach about 40% for Kaliningrad ionospheric station. At day-time the probability of Es layer appearance was about 80%. It was carried out the comparison average values of foEs with Migulin's Es layer empirical model. It was revealed rather good agreement with model for daytime in winter season and significant scattering of experimental data for other periods. Additionally we calculated the correlation dependences between Es probability and foEs and stratosphere temperature changes and have find the increasing of Es probability and diurnal values of foEs. We acknowledge the National Institute of Information and Communications Technology (NICT) in Japan for providing ionosonde data.

TYPE: ORAL
DATE: 2012-03-16 – 09:10

OCCURRENCE OF IONOSPHERIC F3 LAYER OVER EQUATORIAL STATION TIRUNELVELI UNDER EXTREMELY PROLONGED LOW SOLAR ACTIVITY DURING 2007-2009.

C. K. Nayak, Diwakar Tiwari, K. Emperumal, B. Kakad, S. Sripathi, and Archana Bhattacharyya

Indian Institute of Geomagnetism, Navi Mumbai, India

In the paper we present the observation of Ionospheric F3 layer Occurrence over equatorial station Tirunelveli (77.8° E, 8.7° N, dip lat. 0.7° N) under extremely prolonged low solar activity period during 2007-2009. In this study statistical analysis of the occurrence of the F3 layer observed over the equatorial station Tirunelveli is also presented. It is noticed that Occurrence of F3 layer is maximum in the morning-noon period (09–11 hours IST) and also in the afternoon hours with longer duration during summer solstice months of the year 2008 and 2009. Percentage occurrence of F3 layer has increasing trend from the year 2007 to 2009 and solar activity was minimum during 2009, confirming the model predictions of Balan et al. (1998) that the layer occurrence increases as the solar activity decreases.foF3 varied from 3.5 to 9.5 MHz and highest foF3 was observed during equinoctial month of March 2007 and minimum in the winter month of February during 2009. Height of the F3 –layer corresponding to maximum foF3 for a given day varied from 300 to 900 km and monthly maximum and minimum mean were observed during winter month of October 2008 and November 2009 respectively. Duration of the F3 layer appearance varies from few minutes (15 minutes) to 4 hours and higher duration is observed during summer months. Few cases of F3 layer occurrence and its association with Electrojet strength (?H Peak) are also presented.

TYPE: ORAL
DATE: 2012-03-16 – 09:25

Session 3

WAVE PROPAGATION BETWEEN LOW/MIDDLE ATMOSPHERE AND IONOSPHERE

This session will focus on the main atmospheric waves such as acoustic-gravity waves, solar tides, planetary waves, Kelvin waves, etc. that primarily originate in the lower atmosphere, and on their transmission into the upper atmosphere.

The session will address both theoretical and empirical recent results concerning the transfer of momentum and energy by internal atmospheric waves, breaking and dissipation in the MLT region, wave-wave and wave-mean flow interaction, chemical and dynamical coupling processes, and the MLT response to equatorial oscillations such as QBO and SAO. Contributions are particularly sought that focus on MLT wave seeding (wave penetration and secondary wave generation) of ionospheric disturbances and longitudinal structures and the dependence of wave coupling processes on the solar and geomagnetic activity. As it is widely recognized that numerical simulations driven by integrated ground-based and satellite observations are a powerful tool for quantitatively understanding the complex atmosphere-ionosphere system, and that they are a vital means for predicting the wave coupling processes, such results are most welcome. The main objective of this session is to provide the next opportunity for the international research community to review the progress made so far and suggest some future directions, particularly in studying the role of waves in atmosphere-ionosphere coupling.

Conveners: L. Goncharenko, D. Pancheva, and D. Scipion

SOLAR CYCLE EFFECTS IN THE IONOSPHERE: THE RELATIVE CONTRIBUTION OF SOLAR VARIABILITY AND LOWER ATMOSPHERE DRIVING

Elsayed Talaat, Xun Zhu, Syau-Yun Hsieh, Daniel Smith, Sam Yee, and Larry Paxton

Applied Physics Laboratory, John Hopkins University, MD, USA

Energetic particles and solar X-ray and ultraviolet (XUV) irradiance have important influences on the chemistry, energetics, and dynamics of the ionosphere and thermosphere (IT) via direct energy deposition, effects on chemically active minor constituents, and modulation of ion-neutral frictional heating.

In addition, waves that originate in the troposphere grow in amplitude as they travel upwards into decreasing density at higher altitudes where they become the most prominent dynamical features of the ITM. At low latitudes, the wind-driven E-region dynamo generates large-scale electric fields, causing upward plasma drifts that combine with pressure forces and gravity to form the equatorial ionization anomaly in electron density. As aresult, variability in E-region winds could translate upwards into the low-latitude ionosphere. The dominant dynamical feature in the E-region is the diurnal tide, and its longitudinal, seasonal, interannual, and daily variability are important factors in understanding the behavior of the ionosphere.

Measurements of the XUV spectrum have recently become available over various phases of the solar cycle and in unprecedented wavelength and temporal resolution. At the same time, numerous spaceborne and groundbased platforms have observed electron density, and neutral and ion composition and temperature. Recent long-term global observations of the low latitude neutral atmospheric and ionospheric structure revealed by TIMED/SABER, TIMED/GUVI, COSMIC/FORMOSAT, TOPEX, JASON, and groundbased total electron content (TEC) allow us to investigate the interplay between the neutral, plasma, and background fields.

We investigate analyses using empirical orthogonal function (EOF) decomposition and the corresponding principal component analysis (PCA) technique to capture the modes of spatial and temporal variability observed in the ionosphere. The spectral analysis of the different time series of reveals how different mechanisms such as solar flux variation, change of the orbital declination, nonlinear mode coupling, lower atmosphere forcing, and geomagnetic activity are separated and expressed in different modes.

We also examine similar analysis performed on output from the Thermosphere- Ionosphere-Electrodynamics General Circulation Model (TIE-GCM) to provide insight for the interpretation of the observed phenomena. In this talk we examine the relationship between the variability observed in mesospheric and lower thermospheric dynamical fields to variations observed in the low latitude ionosphere using these long-term global observations and through simulations using the TIE-GCM.

TYPE: ORAL
DATE: 2012-03-12 – 08:45

INVITED - LARGE-SCALE IONOSPHERIC PERTURBATIONS CAUSED BY ATMOSPHERIC WAVES

Hanli Liu

High Altitude Observatory, National Center for Atmospheric Research, Boulder, CO, USA

This study will examine two possible mechansims through which the lower atmosphere can affect the ionospheric variability at low latitudes: namely tidal variability due to its interation with quasi-stationary planetary waves, and secondary generation of gravity waves excited by the body forcing from dissipation of primary gravity waves from the lower atmosphere. The former may be most

significant during stratospheric sudden warming events when the quasi-stationary planetary waves become large, as evidenced by recent observations. Because the amplitudes of the propagating tides and the tidal variability are usually strongest in the ionospheric E-region, we will focus on the modification of E-region dynamo. We will also examine the contribution of various tidal components to the wind dynamo change, as well as the dependence of the ionospheric responses to solar activities. The secondary gravity waves, on the other hand, can introduce large wind perturbations in both E and F regions. Depending on the local time, the wind dynamo in the E or/and F regions are affected. The impacts on the ionospheric plasma drifts and plasma transport can extend after local-midnight.

TYPE: ORAL
DATE: 2012-03-12 – 09:00

INVITED - GRAVITY WAVE COUPLING, INTERACTIONS, AND INSTABILITIES IN THE MLTI

Dave Fritts

NorthWest Research Associates, Colorado Research Associates Division, Boulder, CO, USA

This talk will review recent advances in modeling of gravity wave (GW) propagation, wave-wave and wave-mean flow interactions, and instability dynamics expected to be important in the MLTI. Specific topics will include: 1. momentum transport by maintained and localized GWs and implications for GW structure and propagation, 2. GW instability and turbulence generation at large spatial scales in the MLTI, 3. multi-scale GW interactions and instabilities 4. implications of GW instabilities and turbulence for measurements

Modeling of GW propagation in deep domains has revealed important consequences of momentum flux gradients in time and/or altitude. These include strong induced mean wind shears, self-acceleration of GWs yielding strong modulation of GW character, and instability dynamics that may either extend to high altitudes or be confined to narrow layers. Modeling of multi-scale interactions has revealed that large-scale interactions, GW spectral evolution, and instability intensities may depend critically on orientations of small- and large-scale motions. Modeling of the various instability dynamics has likewise shed light on measurement accuracies and highlighted the potential for measurement biases in radar and in situ measurements.

TYPE: ORAL
DATE: 2012-03-12 – 09:20

GRAVITY WAVE GENERATION BY CONVECTION AND MIDDLE ATMOSPHERE RESPONSE

Robert Vincent[1], Joan Alexander[2], Iain Reid[1], Sujata Kovalam[1], Andrew MacKinnon[1], and Bronwyn Dolman[3]

[1] University of Adelaide, Australia
[2] Colorado Research Associates, Boulder, CO, USA
[3] ATRAD, Australia

The TWPICE campaign centred on Darwin (12°S, 131°E) in northern Australia in January-February 2006 provided an opportunity to study gravity wave generation by convection and the associated wave propagation and momentum transport. The project used a variety of radars to study the spatial and temporal variability of rainfall and the associated latent heat release during large thunderstorms. A high-resolution numerical model utilized the latent heat release to compute the spatial and geographic variation of gravity wave generation and propagation into the lower stratosphere. Gravity wave ray-tracing techniques were then used to estimate the wave flux penetrating to heights near 90 km, where the results were compared with direct measurements made using a meteor radar. An analysis of meteor radar (MR) detection techniques is used to assess the reliability of wave fluxes derived from MR observations. It is shown that, provided the meteor

rates are high enough, wave energies can be reliably measured. This result is used to 'calibrate' the indirect fluxes from the model, including momentum fluxes and the associated wave drag. It is shown that wave fluxes have a high degree of temporal variability, with consequent variability in momentum flux deposition and wave drag. A number of events are studied in detail. Outcomes can be used to help constrain gravity wave parameterization schemes.

TYPE: ORAL
DATE: 2012-03-12 – 09:40

GROUND BASED OBSERVATIONS IN THE MLT, DAMPED GWS; AND NEW LIDAR FOR THE E-REGION (110-200 KM).

Gary Swenson, Fabio Vargas, Chester Gardner, John Westerhoff, and Tony Mangognia

University of Illinois at Urbana-Champaign, Urbana, IL USA

Observations of the mesopause region dynamics has been accomplished with correlative instrumentation including lidar, meteor radar, and airglow imagers. Gravity waves (GWs) have been observed at low and mid latitude over the past 15 years at SOR (Albuquerque, NM), Maui Hawaii, and now at Cerro Pachon, Chile at the Andes Lidar Observatory (ALO). Our observations of HF GWs have been studied to understand the dominant effect of damped GWs and their effect on the mesopause region. A second topic will involve considerations to move observational capabilities to higher altitudes than is currently done. The 110-200 km altitude region is virtually void of measurements, but new methods will be described which can be used to probe the density and temperature structure of this region. Simulations using large power aperture Rayleigh lidars (10,000 Wm^2) will be shown to illustrate the future potential for measurements of this largely unexplored region, as well as large aperture resonance with metals and He.

TYPE: ORAL
DATE: 2012-03-12 – 09:55

STUDY ON VERTICAL PROPAGATION OF MEDIUM-SCALE GRAVITY WAVES OBSERVED DURING THE COPEX CAMPAIGN

Igo Paulino[1], Hisao Takahashi[1], Sharon Vadas[2], Cristiano Max Wrasse[3], Jose Sobral[1], Amauri F. Medeiros[4], Ricardo Arlen Buriti[5], and Delano Gobbi[1]

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[3] Vale Soluções em Energia, Brazil
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[5] Universidade Federal de Campina Grande - UFCG, Brazil

We have ray-traced 15 medium-scale gravity waves (MSGWs) observed at Boa Vista (2.8°N; 60.7°S, dip angle 21.7°) during the Conjugate Point Experiment (COPEX). Ray-tracing database have been composed by wind from the TIE-CGM and HWM-93 models, and temperature profiles from the TIMED/SABER measurements, NRLMSISE-00 and TIE-GCM models. Doppler up-shifted MSGWs in the MLT region reached higher altitudes and larger amplitude than un-shifted waves in the thermosphere-ionosphere. Most MSGWs propagated upwards up to 140 km of altitude and seem to be unlikely candidate to trigger equatorial plasma bubbles (EPBs) at the F layer bottom side. However, five of them propagated up to the altitude close to the F layer bottom side, where they could seed EPBs directly.

TYPE: ORAL
DATE: 2012-03-12 – 10:10

IONOSPHERIC DISTURBANCES AFTER THE 2011 OFF THE PACIFIC COAST OF TOHOKU EARTHQUAKE

OBSERVED BY THE GPS RECEIVER ARRAY IN JAPAN

A. Saito[1], T. Tsugawa[2], Yuichi Otsuka[3], Michi Nishioka[2], T. Iyemori[1], M. Matsumura[1], S. Saito[4], Chia-Hung Chen[1], Y. Goi[1], and N. Choosakul[5]

[1] Kyoto University, Kyoto, Japan
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[3] Solar-Terrestrial Environment Laboratory, Nagoya University, Japan
[4] Electronic Navigation Research Institute, Japan
[5] Rajamangala University of Technology Thanyaburi, Thailand

Ionospheric disturbances were observed after the M9.0 off the Pacific coast of Tohoku Earthquake by the GPS receiver array in Japan on March 11, 2011. The two-dimensional structures of the disturbances generated by earthquakes were detected for the first time in high temporal and spatial resolution. There were four types of the disturbances: 1) fast propagating structures appeared at first, 2) circular wave fronts propagating from the epicenter, 3) periodic oscillation in four minutes, and 4) plasma depletion in the vicinity of the epicenter. The first structures were attributed to the Rayleigh wave on the surface. The atmospheric gravity waves generated in the lower thermosphere would generate second co-centric structures. The center of the circular wave fronts is southeast of the epicenter that was the source region of tsunami. It is interpreted that the uplift of the sea surface generated the tsunami and atmospheric wave, and the atmospheric wave in the acoustic mode propagated upward and reached the thermosphere and the ionosphere. The acoustic wave resonance between the lower thermosphere and the sea surface would cause the periodic oscillation of total electron content in four minutes. This period is consistent with the model prediction of the acoustic resonance. The plasma depletion above the epicenter could be generated by the increase of the recombination rate of plasma. The ionospheric variation after the earthquake is the rare events in number, but is a good example to study the wave propagation from the lower atmosphere to the thermosphere and the ionosphere because the source is specified in time and space. In the presentation, the relationship of the ionospheric disturbances with tsunami and the geomagnetic field variations will be discussed also.

TYPE: ORAL
DATE: 2012-03-12 – 10:25

INFLUENCE OF 2-DAY PLANETARY WAVE IN THE EQUATORIAL IONOSPHERE

Hisao Takahashi[1], Mangalathayil Ali Abdu[1], Inez Staciarini Batista[1], Lourivaldo Mota Lima[2], Cristiano Max Wrasse [3], Amelia Onohara [1], M. Goreti S. Aquino [1], and Paulo Prado Batista[1]

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[2] Universidade Estadual da Paraíba - UEPB, Brazil
[3] Vale Soluções em Energia, Brazil

In the South American equatorial region over Brazil at Fortaleza (3.8?S, 38.6?W), we observed 2-day oscillation in the day to day variability of the ionospheric F layer maximum critical frequency (foF2) during the period of January to February. During the same period, the MLT winds observed at Cariri(7.4?S, 36.5?W) demonstrated the presence of Planetary 2-day wave. Therefore we studied possible coupling structure of the 2-day wave into the ionosphere. Plasma transport by thermospheric meridional wind arising from modulation of tidal field by the 2-day wave might have important roles on the 2-day oscillation of foF2 in the ionosphere. Influence of the planetary waves in generation of plasma bubbles are also discussed.

TYPE: ORAL
DATE: 2012-03-12 – 11:10

SIMULATED EQUINOCTIAL ASYMMETRY OF THE IONOSPHERIC VERTICAL PLASMA DRIFTS

Zhipeng Ren[1], Weixing Wan[1], Jiangang Xiong[2], and Libo Liu[2]

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[2] Beijing National Observatory of Space Environment, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China

Using TIDM-IGGCAS-II model and tidal winds below 105 km from TIMED/TIDI observations, we study the influence of the lower thermospheric tidal winds below 105 km on the equinoctial asymmetry of the equatorial vertical E×B plasma drifts. Although a series of other non-migrating tides also affect the vertical drift asymmetry, the simulated equinoctial asymmetry in vertical drift are mainly driven by the migrating diurnal tide (DW1), migrating semidiurnal tide (SW2), DE3, and DW2 non-migrating tides. The asymmetry in daytime vertical drift varies with local time and longitude, and mainly shows three features. First, the simulated daytime vertical drift during March Equinox is larger than that during September Equinox in most of longitudinal sectors. This asymmetry is mainly driven by the semiannual oscillation (SAO) of the migrating diurnal tide in the tropical MLT region, and the equinoctial asymmetry of the migrating semidiurnal tide also play an important role in the generation of this asymmetry. Second, the daytime vertical drift asymmetry in Eastern Hemisphere is more significant than that in Western Hemisphere. Our simulation suggests that the longitudinal variation of the geomagnetic fields and DW2 tides play important roles in the generation of this hemisphere difference. Thirdly, there is an obvious wavenumber-4 longitudinal structure in the vertical drift asymmetry. Our simulation suggests that this wavenumber-4 structure is mainly driven by the equinoctial asymmetry of the DE3 tide.

TYPE: ORAL
DATE: 2012-03-12 – 11:25

INVITED - IMPACT OF PLANETARY WAVES ON THE IONOSPHERE DURING JANUARY 2009

Tzu-Wei Fang[1], Tim Fuller-Rowell[1], Rashid Akmaev[2], Fei Wu[1], and Houjun Wang[1]

[1] CIRES, University of Colorado Boulder, CO, USA
[2] NOAA Space Weather Prediction Center, Boulder, CO, USA

Studies have demonstrated higher planetary wave activity during a major stratospheric warming (SSW) event in northern hemisphere winter. It is also known that the quasi two-day planetary wave tends to occur near the end of January in the southern hemisphere. Significant two-day and five-day planetary wave activities at equatorial regions in January 2009 are also observed using the GPS-TEC. This work conducts model simulation to study the effects of various planetary waves on the ionosphere-thermosphere system. The Whole Atmospheric Model (WAM) is capable of simulating real sudden stratospheric warming (SSW) events. Driving the Global Ionosphere Plasmasphere model (GIP) with the thermospheric winds from WAM, the responses of ionospheric parameters including NmF2, TEC, and electrodynamics are estimated and compared with observations. The thermospheric winds show a strong two-day perturbation at low- and mid-latitudes at mesosphere and lower thermosphere (MLT) region in January 2009 before the peak SSW occurs. The NmF2 at certain locations also demonstrate the corresponding two-day fluctuations. The possibility of the enhanced planetary wave activities in modulating the day-to-day variability of electrodynamics is also examined. In this presentation, we will focus on the planetary wave signatures in the ionospheric parameters and discuss the role of these planetary waves in day-to-day variability of the ionospheric responses during the January 2009.

TYPE: ORAL
DATE: 2012-03-12 – 11:40

ATMOSPHERE-IONOSPHERE COUPLING EFFECTS AT LOW LATITUDE OBSERVED BY FORMOSAT-3/COSMIC

Charles Lin[1], Jia-Ting Lin [1], and Loren C. Chang[2]

[1] National Cheng Kung University, Taiwan
[2] National Central University, Taiwan

Recent studies have shown that the ionospheric plasma structure is modulated by upward propagating atmospheric tides of troposphere origins and planetary waves generated during the stratospheric sudden warming (SSW) period. These effects of lower atmospheric origins modify the ionospheric electrodynamic and result in longitudinal, latitudinal, and altitudinal variations of the low-latitude equatorial ionization anomaly (EIA). In this study, three-dimensional electron density observations derived from GPS radio occultation sounding of FORMOSAT-3/COSMICduring 2007-2010 are utilized to study the annual and monthly variations of the atmospheric tidal signatures in the ionosphere. This study also investigates SSW effects to the low-latitude ionosphere from the constructed three-dimensional electron density maps. According to the stratospheric temperature observation of FORMOSAT-3/COSMIC, the SSW occurs every year during 2007-2010 but the occurring months and durations are different. The ionosphere response to the SSW effect is expected to vary due to these annual differences.

TYPE: ORAL
DATE: 2012-03-12 – 12:00

IMPACTS OF POLAR STRATOSPHERIC SUDDEN WARMING ON THE EQUATORIAL ATMOSPHERE-IONOSPHERE REGION

C. Vineeth and T. K. Pant

Space Physics Laboratory, Vikram Sarabhai Space Centre, Trivandrum, India

This study discusses the impact of polar Stratospheric Sudden Warmings (SSW) on various parts of the equatorial atmosphere, right from stratosphere to the thermosphere-ionosphere regions. Analysis based on the measurements using a variety of instruments over Trivandrum (8.5o N, 77 o E, 0.5o N diplat.), a geomagnetic dip equatorial station in India, revealed that the equatorial atmosphere-ionosphere as a whole respond significantly to the abrupt changes in energetics and dynamics over polar stratosphere. As far as the equatorial stratosphere is concerned, the important observations are (i) the temperature at 30 km (10 hPa) over Trivandrum shows a sudden cooling 10 days prior to the SSWs (ii) appearance and progression of a zero-wind line in the zonal-mean zonal wind at 30 km from tropics to the pole 60 days prior to the SSWs and (iii) an enhanced PW activity of quasi 16-day periodicity and its propagation from equator to the Pole. At mesospheric altitudes, an overall enhancement in mesopause temperature and amplified planetary wave activity is observed prior to the SSW. When it comes to the lower thermosphere-ionosphere region, the SSW is found to be modulating the electrodynamics in the form of favored occurrences of Equatorial Counter Electrojets (CEJs) with a quasi periodicity of 16-days. It is interesting to note that intense SSW events were associated with stronger CEJs. These aspects are discussed in terms of the prevailing changes in the dynamics and electrodynamics over the equatorial region.

TYPE: ORAL
DATE: 2012-03-12 – 12:15

GRAVITATIONAL TIDES AND THEIR INFLUENCE ON THE THERMOSPHERE

Jeffrey Forbes[1], Xiaoli Zhang[1], and Sean Bruinsma[2]

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Renewed interest in lunar tidal influences on the ionosphere-thermosphere (IT) system has emerged in connection with Fejer's discovery of a possible connection between stratospheric warmings and lunar tidal perturbations of the

equatorial ionosphere. By virtue of its gravitational force on the solid earth, oceans and atmosphere, the moon produces perturbations in the temperature, density, pressure and wind fields of earth's atmosphere. Lunar tidal winds in the dynamo region (ca. 100-150 km) can furthermore generate electric fields that map into the F-region and redistribute ionospheric plasma. Direct penetration (propagation) of lunar tides to F-region heights can also transport ionospheric plasma. The most important lunar tidal components in terms of forcing are M2 (period = 12.42 h), N2 (period = 12.66 h) and K2 (period = 11.97 h). There is also a solar gravitational tide S2 (period = 12.00 h). In this paper, the atmospheric response up to 400 km to solar and lunar gravitational forcing is explored using the Global-Scale Wave Model (GSWM), with particular emphasis on sensitivity of the response to zonal-mean winds derived from observational data in the lower and middle atmosphere (i.e., TIMED-SABER thermal gradient winds, MERRA Reanalysis products). Comparisons are performed between monthly-mean lunar tidal determinations from GSWM, and the corresponding lunar tides in SABER temperatures between 90 and 110 km and CHAMP densities at 400 km. The GSWM is also used to explore atmospheric resonance behavior at periods between 10 and 14 hours. In preliminary results we find the aggregate effects of the M2, N2, K2 and S2 monthly-mean gravitational tides to be as large as 20-30 m/sec in dynamo-region winds and 3-6% in density near 400 km, large enough to impose non-negligible day-to-day variability on the IT system. The sensitivity of gravitational tides to stratwarm-induced zonal mean wind and temperature changes is also explored.

TYPE: ORAL
DATE: 2012-03-12 – 12:30

EFFECTS OF SUDDEN STRATOSPHERIC WARMING SIMULATED BY THE THERMOSPHERE-IONOSPHERE-MESOSPHERE-ELECTRODYNAMICS-GCM

Astrid Maute, Maura E Hagan, Arthur Richmond, and Raymond Roble

High Altitude Observatory, National Center for Atmospheric Research, Boulder, CO, USA

Observations during the last very low solar minimum showed that the ionosphere and thermosphere are not only influenced by geospace but also by tropospheric weather. One of the extreme meteorological events is sudden stratospheric warming (SSW) when the polar vortex of eastward winds in the winter hemisphere is abruply slowed down or even splits. SSW is caused by strong planetary wave activity in the troposphere. Due to the strong planetary wave activity the dynamics of the mesosphere and thermosphere are changed. There is observational evidence of signals of SSW events in the neutral temperature and winds, equatorial zonal electric fields, and electron and neutral densities.

The National Center for Atmospheric Research (NCAR) Thermosphere-Ionosphere-Mesosphere-Electrodynamics General Circulation Model (TIME-GCM) can model the observed features in the stratosphere and mesosphere during SSW events. We will examine the effects of SSW under realistic geospace variability for 2006. We quantify the effects of strong planetary wave forcing by comparing with a control simulation. The tidal propagation is changed due to different background winds and the nonlinear interaction between the planetary wave and tides. We quantify the changes of major tidal components. We examine their influence on the zonal electric fields, and the changes in the ionosphere and upper thermosphere. Finally, we will assess the simulation of the SSW event in the context of observations.

TYPE: ORAL
DATE: 2012-03-12 – 12:45

P3.02 SEASONAL VARIABILITY OF GRAVITY WAVE MOMENTUM FLUX IN THE MLT OVER SAO JOAO DO CARIRI (7°S; 36°W).

V.F. Andrioli[1], Dave Fritts[2], Paulo Prado Batista[1], and Barclay Robert Clemesha[1]

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In the present work we have used Hocking's (2005) technique to infer the monthly mean gravity wave (GW) momentum fluxes and their seasonal variability over Sao Joao do Cariri (7°S; 36°W). We also have used numerical simulations to test the ability of Skyimet meteor radars to measure GW momentum fluxes. From theses tests we can conclude that, provided allowance is made for contamination by tides, we can measure GW momentum fluxes with reasonable accuracy on a monthly basis, at least at altitudes at which meteor counts are relatively high, typically from 87 to 94.5 km, with greater accuracies near the peak of the meteor distribution in altitude. We have analyzed the data from June 2004 to December 2008 and the results are encouraging. We observed mainly annual variability in the u'w' component, being positive from March to August. On the other hand, we observe mainly a 4 month oscillation in the v'w' component, being positive from February to April, July to August, and October to November.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P3.03 STUDY OF MESOSPHERE-THERMOSPHERE-IONOSPHERE COUPLING AT LOW LATITUDE

Alan Monteiro[1], Marcio Muella[1], Fabio Vargas[2], José Valentin Bageston[3], José Ricardo Abalde[1], and Paulo Fagundes[1]

[1] Universidade do Vale do Paraíba, Sao Jose dos Campos, Brazil
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[3] Instituto Nacional de Pesquisas Espaciais - INPE, Sao Jose dos Campos, SP, Brazil

Coupling between mesosphere-thermosphere regions is a very activity research field. Gravity waves (GWs) propagating upwards transport momentum and energy from lower/middle atmosphere to upper atmospheric layers. The study of the coupled Mesosphere-Thermosphere system due to gravity waves at low latitudes requires observations of multiple airglow layers via all-sky imaging system. The OH, OI557.7 and OI630 nm airglow emission and ionospheric observations using a CADI type ionosonde were carried out at Sao Jose dos Campos (23.2oS, 45.9oW)-Brazil, near the southern crest of equatorial ionospheric anomaly. In this study were analyzed four different cases in the airglow emissions as follow: A) with presence of GWs in the OH and absence of GWs in OI 557.7nm, B) absence of GWs in OH and presence of GWs in OI 557.7 nm, C) presence of GWs in both OH and OI 557.7 nm, D) absence of GWs in both OH and OI 557.7 nm. The response of the thermosphere and ionosphere to the presence (or absence) of GWs at mesospheric heights is analyzed during 4 events in each case A-D listed above.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P3.04 EVIDENCE OF COUPLING BETWEEN MIDDLE ATMOSPHERE AND IONOSPHERE DURING 2009 SUDDEN STRATOSPHERIC WARMING THROUGH LUNAR SEMIDIURNAL TIDES

Jiangang Xiong[1], Weixing Wan[2], Libo Liu[1], and Baiqi Ning[1]

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[2] Institute of Geology and Geophysics, Chinese Academy of Sciences, China

The sudden stratospheric warming (SSW) in the winter of 2008/2009 is the strongest recorded SSW event. The middle atmosphere and ionosphere over Beijing (39o50'N, 116o30'E)

were also affected by the SSW. The response of middle atmosphere and io-nosphere over Beijing to the SSW was not the same as that over high latitude or low lati-tude sites, based on in situ observations of meteor radar and ionosonde in Beijing, and data of satellite and other equipment. On 24 January of 2009, all conditions of Major SSW were satisfied. We call the day as SSW peak. A few days before the SSW peak, zonal winds in the mesosphere and stratosphere reversed from eastward to westward. The westward zonal wind persisted for several days around the SSW peak. Both temperatures in the stratosphere and mesosphere decreased during the SSW. That means the tempera-ture variations over Beijing at mesosphere and stratosphere were affected by circulations at high latitude and low latitude respectively. The critical frequency of F2 layer ( ) and peak height (hmF2) decreased 1 MHz and 8 km in the afternoon during the SSW. TEC (Total electron content) increased in the morning and dropped in the afternoon. The lunar semidiurnal tides of mesospheric wind also increased rapidly. The semidiurnal var-iation of TEC and zonal semidiurnal tide at 100km were almost in phase around the SSW peak. This is the first observational evidence that enhanced lunar semidiurnal tides in the mesosphere resulted in the variation of the TEC through electrodynamic process during daytime.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P3.05 IONOSPHERIC VARIABILITY DURING SSW 2009 EVENT – TIME-GCM AND GSM TIP MODEL RESULTS AND OBSERVATIONS

Maxim Klimenko[1], Hanli Liu[2], Vladimir Klimenko[1], Fedor Bessarab [1], Jurij Nina Korenkov[1], Raymond Roble[2], Konstantin Ratovsky[3], Larisa Goncharenko[4], Yogeshwar Sahai[5], Jurij Nina Korenkov[1], Ivan Karpov[1], Artem Vesnin[3], Marina Chernigovskaya[3], Paulo Fagundes[6], Alessandro De Abreu[5], Rodolfo De Jesus[5], and Percy Condor[7]

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[3] Institute of Solar-Terrestrial Physics, Irkutsk, Russia
[4] Haystack Observatory, Massachusetts Institute of Technology, Westford, Massachusetts, USA
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[7] Radio Observatorio de Jicamarca, Instituto Geofísico del Perú, Lima, Perú

Interaction between the lower and upper atmospheric layers is a challenging problem. In general, some of the underlying mechanisms responsible for the coupling between the stratosphere, thermosphere and ionosphere are currently known. The Sudden Stratospheric Warming (SSW) is an interesting phenomenon to investigate the interrelation between different atmospheric regions. SSW events have recently received significant attention, with overwhelming experimental evidence of strong effects in the ionosphere and thermosphere. However, the understanding of physical mechanisms leading to such effects is not sufficient. This report presents an investigation of ionospheric response to the 2009 SSW event, which was during a period characterized by low solar and geomagnetic activity. We performed model runs using the Thermosphere Ionosphere Mesosphere Electrodynamics General Circulation Model (TIME-GCM) with the boundary conditions at 30 km according to data from European Centre for Medium-Range Weather Forecasts (ECMWF) data. Then TIME-GCM output at 80 km was used as lower boundary conditions for driving Global Self-consistent Model of the Thermosphere, Ionosphere and Protonosphere (GSM TIP). Thus we obtained the stratospheric warming ionospheric effects with used the TIME-GCM and GSM TIP models. We compare two models' results with ground-based ionospheric data at middle and low latitudes obtained by Incoherent Scat-

ter Radar (ISR) in Millstone Hill, ionosondes in Kaliningrad, and Siberia (Norilsk, Yakutsk, Irkutsk), South America (Jicamarca, Palmas and Sao Jose dos Campos), and GPS receivers in North and South America.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P3.08 SIGNATURES OF SUDDEN STRATOSPHERIC WARMING ON THE EQUATORIAL IONOSPHERE-THERMOSPHERE SYSTEM

S. G. Sumod, T. K. Pant, C. Vineeth, and M. M. Hossain

Space Physics Laboratory, Vikram Sarabhai Space Centre, Trivandrum, India

The present study comprehensively brings out the quiet time equatorial ionosphere/thermosphere variability over Trivandrum (8.5° N, 77°E, 0.5° N diplat.), in India, during both night and daytimes, vis-à-vis the SSW event of January 2008. It has been observed that the entire EITS exhibits significant variability during the SSW period. EITS parameters like Equatorial Electrojet (EEJ), F2 layer critical frequency (foF2), F1 layer base height (h'F), Total Electron Content (TEC) and 630 nm thermospheric dayglow showed clear cut signatures of the SSW induced effects. Important observations are : (1) Enhanced EEJ in the morning and occurrence of unusually strong CEJ during the afternoon periods (2) consistent decrease in foF2 at 10:00 IST, followed by an afternoon increase and another decrease after 21:00 IST and (3) Strong Pre-Reversal Enhancement (PRE) at 18:30 IST followed by a significant decrease in the h'F at 21:00 IST (4) diurnal maximum of TEC occurring at an earlier local time, compared to non SSW period, and a decrease in the afternoon-evening period and (5) unusual decrease in overall 630 nm dayglow and presence of strong noon time bite outs. It is suggested that dynamical perturbations associated with the SSW and subsequent modifications in the semi diurnal tidal components through wave-tidal interactions are responsible for such changes in the equatorial electrodynamics. For the 'first time', the study brings out the response of night time equatorial ionosphere and daytime thermosphere to the SSW induced effects.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P3.09 DIURNAL TIDE AND 2-DAY WAVE COUPLING IN THE METEOR WINDS AT CACHOEIRA PAULISTA AND SãO JOãO DO CARIRI, BRAZIL, OBSERVED DURING JUNE-JULY 2008

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During the time interval from June to July 2008 the neutral winds obtained in the MLT region by meteor radar systems at São João do Cariri (7.4°S, 36.5°W) and Cachoeira Paulista (22.7°S, 45.0°W) presented typical variations consistent with nonlinear coupling between atmospheric wave modes. The spectral analysis of the hourly winds for both sites shows distinct power spectrum with peaks associated with diurnal and semidiurnal tides, quasi-two-day waves and 16-hour oscillations, mainly in the meridional wind component. The quasi simultaneous presence of these waves suggested that the 16-hour waves could have been generated from nonlinear interactions between the diurnal tide and 2-day waves. Additionally,

these relationships have been investigated using bispectral analysis and the results reinforce our interpretation.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P3.10 MESOSPHERIC AND LOW THERMOSPHERIC DYNAMICS OVER 7.4 S AND 22.7 S

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Neutral winds estimated from meteor radar data have been used to investigate the dynamics of the MLT region over São João do Cariri (7.4ºS, 36.5ºW) and Cachoeira Paulista (22.7ºS, 45.0ºW). For both places, the spectral analysis of the hourly-average winds shows distinct power spectrum with peaks in the tidal periods as well as in the low-frequency oscillations. Mean zonal winds over São João do Cariri show a structure characterized by a semi-annual oscillation, with a flow westward most of the time. The mean zonal wind at Cachoeira Paulista is eastward in most time and presents a semi-annual variation in the 80-90 km altitude range and an annual variation in altitudes above. The amplitudes of the mean meridional winds were weaker than zonal and present an annual variation for both localions. The meridional diurnal tide amplitudes showed semi-annual variation with maximum during February-April and August-September. The spectral energy associated with low-frequency oscillations ranging from 2 to 20 days can be seen in the zonal wind component along the time. The meridional wind component exhibit intense spectral energy associated with quasi-two-day wave during January-February and during other times of the year, but with less intensity.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P3.12 IONOSPHERIC MIGRATING TIDE MODIFICATION DURING THE 2008-2009 STRATOSPHERIC SUDDEN WARMING

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In this paper, modifications of the ionospheric tidal signatures during the 2008-2009 stratospheric sudden warming (SSW) event are studied by applying atmospheric tidal analysis to ionospheric electron densities observed using radio occultation soundings of FORMOSAT-3/COSMIC. The tidal analysis indicates that the zonal mean and major migrating tidal components (DW1, SW2 and TW3) decrease around the time of the SSW, with 1.5-4 hour time shifts in the daily time of maximum. The typical ionospheric SSW signature: a semi-diurnal variation of the ionospheric electron density, featuring an earlier commencement and subsidence of EIA, can be reproduced by differencing the migrating tides before and during the SSW period. Our results also indicate that the migrating tides represent 80% of the ionospheric tidal components at specific longitudes, suggesting that modifications of the migrating tides may be the major driver for producing ionospheric changes observed during SSW events, accounting for greater variability than the nonmigrating tides that have been the focus of previous studies.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P3.13 COMPARATIVE STUDY OF IONOSPHERIC RESPONSE TO RECENT STRATOSPHERIC SUDDEN WARMINGS

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We use GPS TEC, Jicamarca ISR, and ECMWF ERA interim data to study effects of different stratospheric sudden warming (SSW) events on low-latitude ionosphere in winters of 2009, 2010, and 2011. Well documented January 2009 major SSW event was the strongest SSW on record, and was associated with enhanced activity of planetary wave 2. The January 2010 SSW event was marked by a moderate and prolonged increase in high-latitude stratospheric temperature, and was associated with enhanced planetary wave 1. The February 2011 SSW event was a minor short-lived warming driven by enhancements in both planetary waves 1 and 2. We examine ionospheric response to these events at three distinct longitudes: 75W, 25E, and 120E. We report significant ionospheric disturbances during all SSW events, including a minor event in 2011. The strength and temporal development of ionospheric response varies with longitude, with largest variations due to SSW observed at 75W and 120E. Analysis of stratospheric parameters indicates that SSW events lead to the increase in ozone concentration in the low-latitude stratosphere as well as to the increase in longitudinal variation of ozone. Variations in ozone density could potentially contribute to the variability of the semidiurnal tide excited by ozone heating. Longitudinal asymmetry in ozone density can lead to the excitation of non-migrating tides. Combined effects of these stratospheric variations can significantly contribute to the variability of the equatorial ionosphere

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P3.14 AN EMPIRICAL MODEL OF MIDDLE AND UPPER ATMOSPHERE CLIMATOLOGY DERIVED FROM TIMED OBSERVATIONS

Jeng-Hwa Yee[1], Elsayed Talaat[1], Xun Zhu[1], Jim Russell[2], Martin Mlynczak[3], Wilbert Skinner[4], and Larry Paxton[1]

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The Stratosphere, Mesosphere and Lower Thermosphere (SMLT) is a region of the Earth atmosphere that is very sensitive to external influences from the sun above and lower atmosphere below it. Its chemical, momentum and thermal balance, thus basic states (i.e. pressure, density, and temperature, and winds) can change in different time scales due to naturally-occurring and/or human-induced changes to the composition and energy contained within this region. The NASA Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics (TIMED) mission, since its successful launch in December 2001, has provided for the first time a comprehensive view of the basic structure and its variabilities of the SMLT system during the descreasing phase of past solar cycle, extended solar minimum and current ascending phase of this solar cycle. This paper gives a 10-year climatological view of the SMLT system as observed by the TIMED spacecraft and reports the characteristics and magnitudes of its temporal and spatial variabilities including tides (migrating and non-migrating tides) and planetary waves. Examples of the observed climatology and variabilities will be used to examine and assess our basic understanding of coupled radiative/chemical/dynamical processes that occur in the system.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P3.15 QUIET-TIME VARIABILITY OF THE GPS TEC AND EEJ STRENGTH OVER INDIAN REGION AND THEIR

CONNECTION TO THE MAJOR SUDDEN STRATOSPHERIC WARMING (SSW) EVENTS DURING 2005/2006

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Indian Institute of Geomagnetism, Navi Mumbai, India

In this paper, quiet-time variabilities of the GPS-TEC collected at several locations in India along with simultaneous observations of EEJ strength obtained from geomagnetic field variations during Jan-Mar 2006 are presented when Sudden Stratospheric Warming (SSW) events occurred. Analysis of the observations presented here suggests that strong correlation exists among the variabilities in EEJ strength and GPS-TEC observations. Further investigations using spectral analysis suggest that there exists a large-scale wave like structures with periodicity of quasi 16-day wave in the TEC observations near EIA quite similar to that of EEJ strength. Our observations also indicate the existence of morning enhancement and evening reduction of TEC and EEJ strength and vice versa during SSW events quite similar to that reported elsewhere. Using these observations, it is suggested that the quiet-time variabilities seen in the present observations could be caused due to the interaction of upward propagating planetary wave (PW) with atmospheric tides and produce variabilities in both EEJ strength and vertical EXB drift over equator which in turn affecting the TEC over EIA. Wind measurements in the mesospheric altitude over Trivandrum, an equatorial station at the same time reveal existence of quasi 16-day wave period in the zonal winds. Since similar periods have been noticed in the mesospheric winds, EEJ strength and TEC observations over EIA region, it is conjectured that the large-scale wave like structures seen in TEC might be associated with PWs that is modifying both EEJ strength and primary eastward electric field through non linear interactions with atmospheric tides.

TYPE: POSTER

DATE: 2012-03-13 – 17:35

P3.16 OBSERVED GRAVITY WAVE-GRAVITY WAVE INTERACTION AT MESOSPHERIC HEIGHTS

Paulo Fagundes[1], José Valentin Bageston[2], José Ricardo Abalde[1], and Paulo Prado Batista[2]

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This study presents and discuss two simultaneous mesospheric fronts observed through the OH nightglow emission, using an all-sky imaging system at Palmas (10.2° S, 48.2° W), Brazil. On May 29-30, 2008, an uncommon event of gravity-wave was observed and identified as an interaction between two mesospheric gravity-wave type fronts. After the two waves cross each other in almost opposite direction, a great depletion in the OH emission rate was observed between these fronts. The two wave fronts extended throughout the north-south extension and propagated in southwest and northeast direction, respectively. In fact, the gravity-waves moved in almost the opposite directions, and when they crossed each other during their passage, a region between the wave fronts showed a band of airglow depletion. The airglow depletion between the two fronts became wider as the waves moved away from each other. The two mesospheric fronts showed distinct horizontal wavelengths and periods, but very similar observed phase speed. In addition, meridional and zonal wind components were obtained by a meteor radar operated in Sao Joao do Cariri (7.4°S, 36.5°W), Brazil, and temperature observations from the TIMED/SABER satellite were used together with the wind measurements to characterize the vertical propagation characteristics of the observed waves. The large airglow depletion seen between the two fronts after the wave-wave interaction is a puzzle, but could be explained by photochemistry models forced by dynamics. Essentially, the observed OH emission

depletion will depend on the photochemistry that forms the excited OH and on the local temperature.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P3.18 ATMOSPHERIC LUNAR TIDE OBSERVED BY METEOR RADAR AT MIDDLE AND LOW LATITUDES IN BRAZIL

Ana Roberta Paulino[1], Paulo Prado Batista[1], Barclay Robert Clemesha[1], Ricardo Arlen Buriti[2], and Nelson J. Schuch[1]

[1] Instituto Nacional de Pesquisas Espaciais - INPE, Sao Jose dos Campos, SP, Brazil
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Using meteor radar data from three Brazilian stations [São João do Cariri (7.4° S; 36.5° W), Cachoeira Paulista (22.7° S; 45.0° W) and Santa Maria (29.7° S; 53.8° W)], the atmospheric semidiurnal lunar tide in the mesosphere and lower thermosphere has been studied from January 2005 to December 2008. Monthly tidal amplitudes and phases were determined using hourly mean winds in seven layers of four kilometer thickness each, centered in 81, 84, 87, 90, 93, 96 and 99 km of height. Most of the amplitudes and phases profiles of the lunar tide showed characteristics of vertically propagating waves in the atmosphere. Over São João do Cariri, during almost all year, the amplitudes of the meridional component were greater than the zonal one, and the phases presented equatorial characteristics of Southern Hemisphere. Over Cachoeira Paulista, the mean amplitudes were greater in meridional component and the phases also presented characteristics of Southern Hemisphere. Santa Maria presented meridional amplitudes greater than zonal between November and April. In several aspects, the three sites have similarities with the Vial and Forbes (1994) atmospheric semidiurnal lunar tidal model.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P3.19 GRAVITY WAVE SIGNATURES IN MULTIPLE INSTRUMENT DATASETS OBSERVED AT THE ANDES LIDAR OBSERVATORY

Fabio Vargas and Gary Swenson

University of Illinois at Urbana-Champaign, Urbana, IL USA

The Andes Lidar Observatory (ALO) has been built at an altitude of 3000 m on the top of Cerro Pachon Montain, Chile (30.3S, 70.7W). The station is now fully operational due to the efforts of the Remote Sensing and Space Science Laboratory (RSSS) at the University of Illinois at Urbana-Champaign (UIUC). Na Lidar and meteor radar systems were deployed with four airglow sensors that are running in a regular basis (All Sky Imager, Mesosphere Temperature Mapper, Aerospace Infrared Camera and Multichannel Photometer). This work will present data from the campaign to be held on January 2012 and will show complete characterization of waves (low and high frequency) perturbing multiple airglow layers, quantify their momentum flux, flux divergence and downward heat flux. Because the wind and thermal structure of the mesosphere can limit the vertical propagation of gravity waves into ionospheric heights, special attention will be given to the onset of to dynamic and convective instabilities in the region of the mesosphere and lower thermosphere (75-105 km).

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P3.20 F3 LAYER VARIABILITY DURING SSW EVENTS

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[5] Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation RAS, Troitsk, Moscow Region, Russia

The ionospheric effects of the sudden stratospheric warming (SSW) event have being hotly investigated recently. During an SSW, the global thermospheric wind system is changed, producing abnormal dynamo electric fields. This results in a change of vertical plasma drift at geomagnetic equator. As it is known, the vertical plasma drift at geomagnetic equator is the main driving force for the formation and maintenance of the additional layer (F3 layer) in the near-equatorial ionosphere. So it is evident the occurrence of relationship between the F3 layer and SSW effects. The aim of our study is to clarify this relationship. For this reason, we used the observational data of Incoherent Scatter Radars (ISRs) in Jicamarca during different SSW events. Also we performed model runs using the Global Self-consistent Model of the Thermosphere, Ionosphere and Protonosphere (GSM TIP) with the boundary conditions at height of 80 km according to the Thermosphere Ionosphere Mesosphere Electrodynamics General Circulation Model (TIME-GCM) output. GSM TIP model reproduce the post-sunset F3 layer before and during 2009 SSW event. So we have possibility to consider in detail the variations of the additional layers in an equatorial ionosphere during SSW events.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P3.22 SPECTRAL ANALYSIS OF THE MIDLATITUDE ION TEMPERATURE RESPONSES TO THE SUDDEN STRATOSPHERIC WARMING EVENT.

Christiano GM Brum [1], Vicki Hsu [2], Larisa Goncharenko[3], Johathan Fentzke[4], and Sixto Gonzalez[1]

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Although the primary drivers of ionospheric variability, such as solar ionizing flux and geomagnetic activity, are relatively well understood, the effects of the lower atmosphere onto the ionosphere remain elusive. This study focuses on the Sudden Stratospheric Warming (SSW) events that occurred in January 2010, and presents the spectral analysis results performed on the ion temperatures measured by the Millstone Hill incoherent scatter radar (42.6°N, 288.5°E). The period in study occurs in the last solar minimum which minimizes any influences of the solar activity variation in our analysis. Preliminary results show the dominance of the 15-to18 hours, 12 hour and 6-to-7 hours periodicities in the oscillations starting on Jan. 21, 2010, and lasting for approximately 2 days. The domain of these three oscillations vary with altitude.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P3.23 SUDDEN PHASE ANOMALIES DETECTED AT PUNTA LOBOS 2007-2009, PERU

Cristian Ferradas[1], Edith Macotela[1], Walter Guevara[1], and Jean-Pierre Raulin[2]

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We present results of Sudden Phase Anomalies (SPAs) detected at Punta Lobos

Station (PLO), Peru. Our work focuses in the study of ionospheric-D layer disturbances due to solar X ray flux through VLF waves propagation. We calculate the VLF phase advance due to these disturbances for signals coming from NAA, NWC, NAU, NDK, NPM, and NLK stations. Additionally, we obtain and compare the values of the minimum X ray flux input capable of producing a detectable SPA at PLO for each path.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P3.24 AN INVESTIGATION OF THE ACTIVITY OF THE EQUATORIAL PLANETARY SCALE WAVES BY USING WIND OBSERVATIONAL MEASUREMENTS AND MODEL SIMULATIONS

Fabio Egito [1], Yasunobu Miyoshi[2], Ricardo Arlen Buriti[3], Hisao Takahashi[1], Paulo Prado Batista[1], and Barclay Robert Clemesha[1]

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[3] Universidade Federal de Campina Grande - UFCG, Brazil

Using wind measurements obtained by a meteor radar located in the equatorial region at São João do Cariri (7.4ºS, 36.5ºW) and simulations by the Kyushu University General Circulation Model (Kyushu GCM), we studied the activity and characteristics of equatorial planetary scale waves with periods ranging between 3 and 8 days in the MLT region. In this analysis a data set of the zonal and meridional wind components, obtained between July 2004 and December 2006, and model simulations corresponding to this time interval are used. Preliminary analysis shows that the wave activity is significant in the period range of 3-4 days and 5-7 days in both meteor winds and model simulations. Wave activity predicted by the model in the MLT shows a reasonable agreement with observational results. In this presentation we will show the main features of the wave activity in these two frequency bands and discuss the interpretation of these findings in terms of the theoretical predictions.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

Session 4

PLASMA NEUTRAL COUPLING

A systems approach to research requires the identification of the key components of the system and of the pathway through which those components couple. In the upper atmosphere, treating the neutral and ionized fluids as components of the system is attractive, since paradigms are well established for understanding each one separately. However, distinctly new, emergent phenomena occur when the two components act together, and understanding these requires close examination of the coupling and the ways it contributes to feedback and complexity. The coupling can be local in space, as in the case of sporadic ionization layers driven by sheared neutral flows or of neutral atmospheric heating and forcing by neutral and plasma instabilities driven by local sources of free energy. Important also are processes initiated nonlocally, by waves propagating upward from the lower atmosphere or by coupled E and F region and plasmaspheric electrodynamics, for example. Important coupling takes place not only across spatial boundaries (altitudinal, latitudinal) but also across spatial and temporal scales.

This session seeks contributions that will help elucidate the most important communication pathways between the neutral and ionized components of the system and the phenomena they create.

Conveners: P. Roddy, R. Heelis, and E. Nossa

INVITED - EFFECTS OF THERMOSPHERIC VARIABILITY ON TOPSIDE EQUATORIAL PLASMA TEMPERATURES

Roger H. Varney[1], David Hysell[1], and Joseph Huba[2]

[1] Cornell University, Ithaca, NY, USA
[2] Plasma Physics Division, Naval Research Laboratory, USA

Using the incoherent scatter radar (ISR) technique and full profile analysis the Jicamarca Radio Observatory is capable of measuring electron and ion temperatures up to 1500 km. These measurements display a surprising amount of day-to-day variability, even during extremely quiet conditions. The daytime electron temperatures above 1000 km can differ by 500 K or more from one day to the next. We argue that this variability is readily explained by variability in the neutral thermosphere. Using the recently developed SAMI2-PE model we demonstrate how relatively modest changes to the empirically specified background neutral temperatures, neutral densities, neutral winds, and electric fields can all substantially change the plasma temperatures. For example, a reduction of the exospheric temperatures by 100 K will lower the electron temperatures in the equatorial F-region by 100 K while simultaneously raising the electron temperatures in the equatorial topside by over 100 K. SAMI2-PE is an extended version of the SAMI2 ionospheric model which includes a detailed treatment of photoelectron transport. Even though the topside plasma is far above the exobase, it is still intimately connected to the thermosphere below through photoelectron transport processes. The primary heat sources for the topside plasma are photoelectrons which are produced at lower altitudes and escape into the topside. Changes to the thermospheric density profiles will both change the altitudes where photoelectrons are produced by the absorption of solar EUV and change the ability of photoelectrons to escape into the topside. The neutral winds and electric fields have no effect on the production rates of photoelectrons, but still indirectly affect the transport of photoelectrons by rearranging the plasma density. The plasma and neutral density profiles both play equally important roles in controlling photoelectron escape into the topside. The examples we present demonstrate important physical links between quantities an ISR can measure and other variables which the ISR cannot measure directly.

TYPE: ORAL
DATE: 2012-03-13 – 10:30

INVITED - THE IMPACT OF THE JANUARY 15, 2010, ANNULAR SOLAR ECLIPSE ON THE IONOSPHERIC PROPERTIES AT AND NEAR THE MAGNETIC EQUATOR.

Jean-Pierre St-Maurice[1], Raj Kumar Choudhary[2], and K. M. Ambili[2]

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The path of maximum obscuration for the annular solar eclipse of January 15, 2010, crossed the magnetic equator at Trivandrum, India, in the early afternoon hours. A strong counter-electrojet was observed shortly after maximum obscuration. An unexpected observation was that, as the eclipse passed overhead, the F region density peak underwent a large amplitude vertical oscillation, indicating that the zonal electric field had been oscillating in response to the passage of the eclipse. Indeed the inferred oscillation in the zonal electric field could also be seen in the magnetometer data, indicating that the electric field turned westward after the time of maximum obscurity, reaching its largest westward value one hour before the end of the local eclipse. These data are consistent with a fast eastward moving local neutral wind dynamo generated by a low pressure system that would have been triggered by the cold temperatures centered on the region of maximum obscuration with electrodynamical processes reminiscent of a double "Pre-Reversal-Enhancement" in the electric

field. The unusual solar eclipse-induced electrodynamics was also accompanied by a reduction in the Total Electron Content depletion not just at the magnetic equator (in response to increased recombination as the plasma was pushed downward) but also, more markedly, in the Equatorial Ionization Anomaly (EIA) zone, a further 10 degrees to the north. This latter point clearly shows that the eclipse led to a cut-off in the supply of plasma provided through the equatorial fountain, by altering a fundamental aspect of the equatorial electrodynamics.

TYPE: ORAL
DATE: 2012-03-13 – 10:50

GEOMAGNETIC CONJUGATE OBSERVATIONS OF NIGHTTIME MEDIUM-SCALE TRAVELLING IONOSPHERIC DISTURBANCES AND THERMOSPHERIC NEUTRAL WINDS AT MIDDLE LATITUDES

Kazuo Shiokawa[1], Yuichi Otsuka[1], and Phil Wilkinson [2]

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The nighttime medium-scale traveling ionospheric disturbances (MSTIDs) over Japan tend to have a NW-SE phase surface and propagate southwestward, particularly in summer and winter solstice. This phase-surface direction suggests that they are caused by ionospheric Perkins instability which occurs when the thermospheric neutral wind is equatorward. The nighttime MSTIDs have geomagnetic conjugacy between Japan and Australia, suggesting electromagnetic coupling between the northern and southern hemispheres. In this presentation, we show preliminary results of simultaneous measurements of nighttime MSTIDs using all-sky airglow imagers at geomagnetic conjugate points at Sata (31.0N, 130.7E, geomagnetic latitude=21.2N) and Darwin (12.4S, 131.0E, MLAT=22.1S) and Fabry-Perot interferometers (FPIs) at Shigaraki (34.8N, 136.1E, MLAT=25.4N) and Darwin. The FPIs measure thermospheric winds through Doppler shift of the 630-nm airglow emission. From these observations we found a case of MSTIDs on July 23, 2011, when the thermospheric neutral wind was equatorward in the northern hemisphere (favorable to the Perkins instability) and poleward in the southern hemisphere (unfavorable to the Perkins instability), suggesting that the northern hemisphere was a driver of the MSTIDs for this case.

TYPE: ORAL
DATE: 2012-03-13 – 11:10

MEASUREMENT OF THE CHARACTERISTICS OF TIDS USING SMALL AND REGIONAL NETWORKS OF GPS RECEIVERS

Cesar Valladares[1], Roibert Sheehan[1], and Matthew Hei[2]

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This report presents the results of dedicated experiments that were conducted within the framework of the LISN observatory to measure the characteristics of medium-scale (hundreds of km) TIDs as they transit through the low-latitude ionosphere. Small arrays of 3 GPS receivers separated from 5 to 20 kms and placed at the vertices of a triangle were installed at different locations in Peru to be used as radio-interferometers. The first campaign was conducted in Huancayo between July 17 and July 30. TIDs were observed daily, but they appear at different times of the day and their effect on the TEC traces varies markedly. The second campaign was carried out near Lima on March 2009. The high coherence of the TEC perturbations within the few km separation allows us to estimate the TID travel velocity, its propagation direction, and the scale-size of the disturbance. These parameters were calculated using two algorithms: the Statistical Angle of Arrival and Doppler Method for GPS interferometry (SADM-GPS) [Afraimovich et al., 1998, 2003]

and the cross-correlation method (CCM). Both methods indicate that on July 20, 2008 between 22 and 24 UT several TIDs moved across the small array of GPS receivers with a velocity near 130 m/s, were directed northward and had wavelengths close to 450 km. The CCM method was also applied to TEC values collected by other LISN GPS receivers that were operating hundreds of km away from Huancayo. Regardless the large distances, the coherence of the TEC traces was high and a phase velocity equal to 150 m/s was obtained using data from Piura, Cuzco and Huancayo. Other GPS receivers placed in the countries of Bolivia, Brazil, Chile, Colombia, Ecuador and Peru also detected TIDs on July 20, 2008. Based on this positive result, we conclude that small and/or regional arrays of GPS receivers can be used at low latitudes to study the role that gravity waves may have on seeding plasma bubbles.

TYPE: ORAL
DATE: 2012-03-13 – 11:25

INVITED - ICON : THE IONOSPHERIC CONNECTION EXPLORER

Thomas Immel[1], Stephen Mende[1], Chris Englert[2], Roderick Heelis[3], Harald Frey[1], Jerry Edelstein[1], Geoff Crowley[4], Scott England[1], Jeffrey Forbes[5], John Harlander[6], Joseph Huba[7], Farzad Kamalabadi[8], Astrid Maute[9], Jonathan J. Makela[8], Gary Swenson[8], Andrew Stephan[2], Jean-Claude Gerard[10], Benoit Hubert[10], David Hysell[11], and Pierre Rochus[10]

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[2] Naval Research Laboratory, USA
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[9] High Altitude Observatory, National Center for Atmospheric Research, Boulder, CO, USA
[10] University of Liege, Belgium
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Earth's ionosphere, the 'inner edge of space', is a highly variable boundary - influenced from below by variations in our weather and from above by solar and geomagnetic activity. It is an accessible natural laboratory to study plasma-neutral coupling in weakly ionized plasmas relevant to processes occurring in all planetary atmospheres. ICON will address the most compelling science issues that deal with the coupling of the ionosphere to the atmosphere below and space above: 1) The highly variable nature of the electric field in the ionosphere and its potential link to thermospheric wind, 2) the effect of forcing from below: how large-scale atmospheric waves couple to the ionosphere, and 3) the effect of forcing from above: how ion-neutral coupling changes during solar and geomagnetically active periods. To address these, ICON will measure all key parameters of the atmosphere and ionosphere simultaneously and continuously by an elegant compilation of remote sensing and in-situ measurements. If selected for development by NASA, ICON will launch in late 2016 into a low-inclination orbit that is particularly well suited to address the above scientific problems as they pertain to equatorial aeronomy, and to make numerous coordinated measurements with ground-based facilities in the region of interest. The observational capabilities of ICON will be presented as well as an overview of operations plans.

TYPE: ORAL
DATE: 2012-03-13 – 11:40

IONOSPHERE-THERMOSPHERE COUPLING DURING DEEP SOLAR MINIMUM

S. H. Delay[1], P. A. Roddy[2], E. K. Sutton[2], Russell Stoneback[3], Robert Pfaff[4], and Cheryl Y. Huang[2]

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[4] NASA Goddard Space Flight Center, Greenbelt, MD, USA

Detrended average plasma densities from the Planar Langmuir Probe, zonal drifts from the Vector Electric Field Instrument, and meridional drifts from the Ion Velocity Meter on C/NOFS show wavenumber-4 periodicity in the equatorial region. These wave-like structures are most prominent during deep solar minimum. Their climatology appears to be approximately similar to that of DE3 nonmigrating tides. In addition, broad plasma decreases (BPDs), deep reductions in plasma density (up to 90%) occurring over large longitudinal extents (up to 4.5 hours of local time), appear as minima in the tidal pattern. Reductions in neutral density were observed in the same locations during the same periods of time. Dawn depletions [Gentile et al., JGR (2011)] observed at DMSP altitudes have been compared with the C/NOFS observations. These large plasma depletions which coincide in longitude with the BPD observations, occur in regions of downward meridional drift. We suggest that these features are related to tidal forcing propagating upwards from low altitudes.

TYPE: ORAL
DATE: 2012-03-13 – 12:00

THEORETICAL MODEL FOR ES IRREGULARITIES CAUSED BY NEUTRAL WINDS

Eliana Nossa and David Hysell

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Ionospheric echoes have been detected by coherent radars at midlatitudes during summer nights when the Es is strong but patchy. One of the possible causes of this irregularity is the interaction between charged and neutral particles. Big neutral wind shears have been observed at these latitudes and heights. This paper presents a theoretical analysis, characterizing the phenomena as if it was originated by neutral winds alone and neglecting other electromagnetic interactions.

First a neutral wind model is created to recreate radar and rocket observations at locations where the irregularities have been detected. An analytical solution of the problem of stratified shear flow is found using hypergeometric functions for three-dimensional conditions of the neutral wind. Theoretical expressions for the parameters that predict the morphology of the irregularities are found. A validation of the theoretical model is done by comparing the results with radar observations.

A sensibility analysis of the model allows us to find an interdependence between wind parameters and the Brunt-Väaisälä frequency, creating a novel methodology to determining the neutral scale height based in the characteristics of the observed irregularities.

TYPE: ORAL
DATE: 2012-03-13 – 12:15

P4.02 COMPARISON OF OBSERVATIONS OF SPORADIC-E LAYERS IN THE NIGHTTIME AND DAYTIME MIDLATITUDE IONOSPHERE

Robert Pfaff[1], Henry Freudenreich[1], Doug Rowland[1], Jeff Klenzing[1], James Clemmons[2], Miguel Larsen[3], Erhan Kudeki[4], Steven Franke[4], Julio Urbina[5], and Terry Bullet[6]

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[6] University of Colorado Boulder, CO, USA

A comparison of numerous rocket experiments to investigate mid-latitude sporadic-E layers is presented. Electric field and plasma density data gathered on sounding rockets

launched in the presence of sporadic-E layers and QP radar echoes reveal a complex electrodynamics including both DC parameters and plasma waves detected over a large range of scales. We show both DC and wave electric fields and discuss their relationship to intense sporadic-E layers in both nighttime and daytime conditions. Where available, neutral wind observations provide the complete electrodynamic picture revealing an essential source of free energy that both sets up the layers and drives them unstable. Electric field data from the nighttime experiments reveal the presence of km-scale waves as well as well-defined packets of broadband (10's of meters to meters) irregularities. What is surprising is that in both the nighttime and daytime experiments, neither the large scale nor short scale waves appear to be distinctly organized by the sporadic-E density layer itself. The observations are discussed in the context of current theories regarding sporadic-E layer generation and quasi-periodic echoes.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P4.03 GEOMAGNETIC CONJUGATE OBSERVATIONS OF PLASMA BUBBLES AND THERMOSPHERIC NEUTRAL WINDS AT EQUATORIAL LATITUDES

Daisuke Fukushima[1], Kazuo Shiokawa[1], Yuichi Otsuka[1], Michi Nishioka[2], Minoru Kubota[2], Takuya Tsugawa[2], and Tsutomu Nagatsuma[2]

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The zonal propagation of plasma bubbles is a manifestation of plasma and neutral coupling in the equatorial thermosphere. The plasma bubbles show clear geomagnetic conjugacy [e.g. Otsuka et al., 2002]. However, the relation between drift velocity of the plasma bubbles and neutral wind velocity was not quite investigated at geomagnetic conjugate points. In this study, geomagnetic conjugate observations of the plasma bubbles at low latitudes with thermospheric neutral winds and airglow images were reported for the first time. The plasma bubbles were observed at Kototabang (0.2S, 100.3E, geomagnetic latitude (MLAT): 10.0S), Indonesia on 5 April 2011 from 13 to 22 UT (from 20 to 05 LT). These plasma bubbles were observed in 630-nm airglow images taken by using a highly-sensitive all-sky airglow imager. They propagated eastward with horizontal velocities of about 100-120 m/s. Similar eastward-moving plasma bubbles were observed in airglow images at Chiang Mai (18.8N, 98.9E, MLAT: 8.9N), Thailand, which is a geomagnetic conjugate station of Kototabang. Background thermospheric neutral winds were also observed at both stations by using two Fabry-Perot interferometers (FPIs). Eastward neutral-wind velocities observed by FPIs were about 70-130 m/s at Kototabang, and about 50-90 m/s at Chiang Mai. The drift velocities of plasma bubbles tend to be about 20 m/s larger than the eastward neutral velocities at Kototabang. In the presentation, we discuss these results by considering the F-region dynamo effects.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P4.SB1 VERTICAL COUPLING BETWEEN MESOPAUSE AND EQUATORIAL IONOSPHERIC F REGION: A NEW INSIGHT

S. G. Sumod, T. K. Pant, and M. M. Hossain

Space Physics Laboratory, Vikram Sarabhai Space Centre, Trivandrum, India

This paper presents unique observations, illustrating the vertical coupling between the daytime mesopause and F region of the ionosphere over a magnetic dip equatorial station Thiruvananthapuram (8.5° N, 76.5°E, 0.5° N dip lat.) in India. For the 'first time', it has been shown that the temporal variations in the mean trends of the daytime mesopause temperature (MPT), for geomagnetically quiet days

spanning over different months during the years 2005-2007, corroborate well with that of the base height changes (h'F) of the ionospheric F region. The MPTs are measured using the unique Multi-Wavelength Dayglow Photometer while the h'Fs are derived using a co-located digital Ionosonde. However, there exist some characteristic time delays between these two, which vary from 0 to 90 minutes. The observed time delays are attributed to the inter-competing processes namely the diffusion and wave-dynamical processes, in modulating the transport of atomic oxygen at these altitudes. The results are new and significant, and provide a new insight into the chemical coupling ubiquitous in the equatorial Mesosphere-Lower Thermosphere Ionosphere (MLTI) region.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P4.SB2 PLASMA NEUTRAL COUPLING DURING SUDDEN STRATOSPHERIC WARMING EVENTS

Larisa Goncharenko[1], Jorge Chau[2], and Anthea Coster[3]

[1] Haystack Observatory, Massachusetts Institute of Technology, Westford, Massachusetts, USA
[2] Radio Observatorio de Jicamarca, Instituto Geofísico del Perú, Lima, Perú
[3] MIT Haystack Observatory, Massachusetts Institute of Technology, MA, USA

Recent experimental and modeling studies have presented significant evidence that the coupling between the neutral atmosphere and the low-latitude ionospheric plasma is strongly affected by sudden stratospheric warming events. As stratospheric warming events are driven by strong enhancement in high-latitude quasi-stationary planetary wave activity, these studies raise many questions about communication pathways between the high-latitude neutral stratosphere and low-latitude ionosphere. We will discuss several mechanisms for the communication between these two regions and describe how they might be affected during SSW events . These include variations in excitation of migrating and non-migrating tides, changes in the dynamics and temperature of the middle atmosphere that can affect upward propagation of tides, interaction between planetary waves and global tidal field, and modulation of ionospheric dynamo that in turn affects the generation of the equatorial ionization anomaly. We will then postulate how changes in these communication pathways due to SSW might contribute to the observed ionospheric changes.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

Session 5

LOW AND MID LATITUDE AERONOMY AND ELECTRODYNAMICS

The main emphasis of session S5 is to focus on the behavior of electric fields and current systems on a global large scale during quiet times. The aim would be to provide a broad overview of how the ionosphere behaves during geomagnetic quiet times and weak solar activity and during the transition to a more intense solar activity period. Emphasis would be placed upon the description of the plasma component in regard to composition, density, temperature, and the background climatology of the neutral winds and ion drifts. Papers devoted to phenomenological features such as the equatorial ionization anomaly, pre-reversal enhancement, midnight temperature maximum/pressure bulge, and the electrodynamics at the terminators during quiet times and their relationships to the wind systems and tides would be welcomed.

Specific topics may be:

1. Studies of the electrodynamics of the ionosphere: description of recent results in composition, density, temperature, electric fields, ion drifts, transport, gravitational and magnetic field effects, mainly during quiet times or during the transition from quiet to storm time.
2. Ground-based in-situ measurements and related modeling.
3. Climatological studies (latitudinal, longitudinal, altitudinal, seasonal variation, solar conditions) and particular events relating to gravity wave perturbations and tidal variability.

Conveners: J. Meriwether, S. Gonzalez, and E. Pacheco

INVITED - QUIET TIME VARIABILITY IN THE ELECTRODYNAMICS OF THE LOW LATITUDE IONOSPHERE

Bela G. Fejer

Utah State University, Logan, UT, USA

The low latitude ionosphere exhibits very large variability over a broad range of temporal and spatial scales during geomagnetic quiet times. Satellite measurements have recently determined the season and longitude dependent climatology of the low latitude electrodynamic plasma drifts, equatorial electrojet and plasma irregularities. Over the last few years, significant effort has been dedicated to the study of short term (less than about a month) variability of low latitude electrodynamic processes and plasma density driven by lower atmospheric planetary and gravity waves, tides. These quiet time perturbations are particularly during sudden stratospheric warming events. In this presentation, we first review the climatology of low latitude electrodynamic plasma drifts. Then, we use radar measurements from the Jicamarca Radio Observatory and satellite measurements to examine the main characteristics of the short term variability of low latitude electrodynamic plasma drifts during low and high solar flux periods, and their effects on the generation of equatorial plasma irregularities and spread F.

TYPE: ORAL
DATE: 2012-03-13 – 14:00

CLIMATOLOGY OF TOPSIDE MAGNETIC FIELD-ALIGNED ION DRIFTS AT SOLAR MINIMUM

Angeline Burrell, Roderick Heelis, and Russell Stoneback

University of Texas at Dallas, TX, USA

During solar minimum between solar cycles 23 and 24 the low levels of extreme ultraviolet radiation led to a cool, contracted atmosphere. The affects of the neutral atmosphere on the ionosphere have been observed in phenomenological and climatological features, including the behavior of field-aligned plasma drifts. Temporal and spatial variations in the field-aligned ion drifts near the magnetic equator in the topside ionosphere are presented using observations from the Coupled Ion Neutral Dynamics Investigation (CINDI) onboard the Communications/Navigation Outage Forecast System (C/NOFS) satellite. These observations were obtained during the period of extremely low solar activity present in 2008 and 2009, allowing the seasonal, geographic, and local time variations at solar minimum to reveal the relative importance of the atmospheric and ionospheric processes responsible for topside field-aligned plasma drifts.

TYPE: ORAL
DATE: 2012-03-13 – 14:20

LOW AND MID-LATITUDE CLIMATOLOGY ASSESSMENT OF IONOSPHERE/THERMOSPHERE MODELS DURING SOLAR MINIMUM

Barbara Emery[1], David Anderson[2], Jorge Chau[3], Anthea Coster[4], John Emmert[5], Mariangel Fedrizzi[6], Larisa Goncharenko[7], Ludger Scherliess[8], Ja Soon Shim[9], and Qian Wu[1]

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[4] MIT Haystack Observatory, Massachusetts Institute of Technology, MA, USA
[5] Naval Research Laboratory, USA
[6] LASP, University of Colorado, Boulder, CO, USA
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[8] Center for Atmospheric and Space Sciences, Utah State University, Logan, UT, USA
[9] University of Maryland, College Park, MD, USA

The performance of Ionosphere/Thermosphere (IT) models at low and mid-latitudes during the solar minimum period from March 2007 to March 2008 is evaluated, with particular emphasis on November 2007 to February 2008. For this study, the physical parameters selected are median values of the electron peak density and the height of this peak from COSMIC LEO satellites, median total electron content (TEC) from GPS satellites around 20,000 km observed at many ground stations, observed and estimated vertical ion drifts at Jicamarca, Peru, and global mean daily neutral densities from satellite drag analyses. Most of the IT models have been run at the Community Coordinated Modeling Center (CCMC) at the Goddard Space Flight Center using appropriate geophysical inputs. Double resolution TIEGCM model runs using SABER and TIDI temperature and wind lower boundary conditions are also evaluated. Climatological days are found using median values of observations and model outputs, where medians reflect the quiet solar minimum conditions. We examine 5 degree geographic latitude and 5-25 degree geographic longitude bins located in 8 longitude swaths with good ground TEC coverage. Percent deviations of model values from data are evaluated for low and middle latitudes as a function of day or night.

TYPE: ORAL
DATE: 2012-03-13 – 14:35

CHANGES IN THE EQUATORIAL IONOSPHERE OVER JICAMARCA DURING RECENT TWO SOLAR MINIMA

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[2] Institute of Geology and Geophysics, Chinese Academy of Sciences, China

The deep low minimum of solar cycle 23/24 has extremely extended and low solar activity in 2007-2009. It is a critical issue that whether or not this deep solar minimum brought serious influences on the Earth's space environment. In this study, we collected the ionograms recorded by a DPS ionosonde at Jicamarca (12.0º S, 283.2º E) and manually scaled these data to retrieve F-layer parameters and electron density profiles. A comparative study is performed to evaluate the difference in the equatorial ionosphere between solar cycle 22/23 minimum (1996-1997) and recent deep minimum (2008-2009). Compared to 1996-1997, the seasonal median values of the critical frequency of F2-layer (foF2) were identified to be remarkably reduced during the deep solar minimum. It is the first time to find that lower values prevail at most times in 2008-2009 in the F2-layer peak height (hmF2) and Chapman scale height (Hm). In contrast, the bottomside profile thickness (B0) in 2008-2009 shows higher values than that in 1996-1997 at some daytime intervals, although it is also smaller during the rest times. Furthermore, the ionogram-retrieved electron density profiles demonstrate that the ionosphere in 2008-2009 is contracted strongly at altitudes above hmF2 and more perceptible in the afternoon hours. The decrease in Ne is strongest in September equinox and weakest in June solstice. The reduction in solar EUV input from solar minimum to minimum mainly contributes to the ionospheric responses, but the involved ionospheric processes are competed and variable in different time scales and played roles in the complicated variations in different seasons and altitudes. Acknowledgments. The authors would like to thank B. W. Reinisch of the Center for Atmospheric Research, University of Massachusetts Lowell for the ionogram data of DIDBase. This research was supported by National Natural Science Foundation of China (40725014, 41074112, 41174137).

TYPE: ORAL
DATE: 2012-03-13 – 14:50

IONOSPHERIC VARIABILITY AT EQUATORIAL AND LOW LATITUDES DURING PERIODS OF EXTREME SOLAR

QUIESCENCE

Joei Sroten

Boston University, MA, USA

The years 2008 and 2009 were periods of extreme solar minimum conditions, a unique occurrence for solar-terrestrial science in the modern era. Observations made during these years provide an opportunity to explore the baseline state of the upper atmospheric system. In this study we examine the question "Is this particular solar minimum merely a prolonged period of solar quiescence, or a fundamentally different condition from previous solar minima?" We address the issue using a set of ionosonde measurements from stations at equatorial and low latitudes. We examine the day-to-day variability of both the E-layer and the F2-layer, and compare their morphologies with concurrently measured parameters for solar and geomagnetic activity. With anticipated minimal coupling from above, does this period offer any special insights into the role(s) of coupling from below?

TYPE: ORAL
DATE: 2012-03-13 – 15:05

THE DAY-TO-DAY LONGITUDINAL VARIABILITY OF THE GLOBAL IONOSPHERIC DENSITY DISTRIBUTION AT LOW LATITUDES DURING LOW SOLAR ACTIVITY

Edgardo Pacheco and Endawoke Yizengaw

Boston College, MA, USA

One important characteristic of longitudinal variability of the ionosphere is the global wavenumber-four signature. Recent investigations have focused mainly in its climatological pattern during daytime and evening sector. In this study, we investigate the day-to-day variability of the longitudinal structure of the ionospheric density for the first time using the global total electron content (TEC) measurements from GPS receivers on the ground and onboard LEO satellites. The day-to-day variabilities are described as a function of longitude, latitude, local time, and seasons during periods of low solar flux conditions. The daytime TEC measurements show clear wavenumber-four structure and can persist until post-midnight hours. The bottom side E-region zonal wind observations, using the TIDI instrument onboard the TIMED satellite, indicate very good correlation with the density wavenumber-four structures. However, the meridional wind component near the bottom side of the E region shows no correlation with the density four cell pattern that we observe from GPS TEC measurements.

TYPE: ORAL
DATE: 2012-03-13 – 15:20

ON THE NOCTURNAL WESTWARD DRIFTS OF THE LOW-LATITUDE IONOSPHERE: AN OVERVIEW

Jose Sobral

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The electrodynamical processes that lead to westward drifts of the nocturnal ionosphere at geomagnetic low latitudes are briefly reviewed here in the light of the theory for drifts of the geomagnetic flux tubes. The zonal drifts during geomagnetically disturbed periods, including during the prompt global perturbations are also considered here.

TYPE: ORAL
DATE: 2012-03-13 – 15:35

OBSERVATIONS OF THE VERTICAL AND ZONAL IONOSPHERIC PLASMA DRIFT VELOCITIES, OBTAINED BY IONOSONDES AND INCOHERENT SCATTER RADAR AT THE BRAZILIAN AND PERUVIAN SECTORS OF GEOMAGNETIC LONGITUDE

Fernando C. P. Bertoni[1], Mangalathayil Ali Abdu[2], Inez Staciarini Batista[2], Jean-Pierre

Raulin[1], Bodo W. Reinisch[3], Jose Sobral[2], and Jonas Rodrigues De Souza[2]

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The studies presented in this work show the vertical and zonal drift velocity time series that were obtained in two periods of observation in October and November, 2002, during the COPEX campaign. Three instruments provided the data: two Digisondes (DPS-4 type), one located at Cachimbo (9.5°S, 54.8°W, dip -4.25°), Brazil, other one located at the Jicamarca Radio Observatory (11.95°S, 76.87°W, dip 1°), where operates the third instrument used, the Incoherent Scatter Radar. The values of the vertical velocity measurements at the two longitude sectors, Jicamarca (JIC) and Cachimbo (CAC), presented very reasonable correlation, around sunset/evening hours, during moderate magnetic activity. Our results show that the Digisonde drift velocity local time variation, for both the vertical and zonal components, follows the same behavioral trends as those from the ISR measurements, during most of the nighttime hours, as well as part of the afternoon and sunrise hours. It motivates us to use the zonal velocity of the ionospheric plasma (driven by vertical dynamo electric fields) obtained by Digisondes, in order to further discuss the behavior of zonal and vertical plasma drifts, for quiescent and disturbed magnetic and solar activity periods.

TYPE: ORAL
DATE: 2012-03-13 – 15:50

LUNAR SIGNALS IN THE VARIATIONS OF THE DAYTIME EQUATORIAL IONISATION ANOMALY FROM CHAMP

Patricia Ritter [1], Hermann Lühr[1], Jaeheung Park[1], Claudia Stolle[2], and Chao Xiong[3]

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[2] Technical University of Denmark, DTU Space, Denmark
[3] Wuhan University, Department of Space Physics, China

The temporal variations of the equatorial electrojet (EEJ) amplitude show clear relation to solar and lunar tides and to seasons. Like the EEJ, the formation of the equatorial ionisation anomaly (EIA) is driven by an eastward electric field. This study looks into the response of the EIA strength to the lunar phase. A measure to quantify the strength of the EIA is the crest-to-trough ratio (CTR) of the ionisation anomaly. These data were obtained from CHAMP electron density readings during passes across the equatorial region. The CTR values are sorted by local time (LT), moon phase, solar cycle, and season. On the dayside, between 09h and 18h LT, CTR peaks as expected around noon. This diurnal variation is modulated by the lunar tide, giving largest amplitudes, as expected, around new moon and full moon. The modulation of the CTR strength amounts to about 10%. The lunar semi-diurnal wave exhibits largest CTR amplitudes around December solstice. During June solstice the CTRs are generally weaker. When comparing periods of high solar activity with solar minimum conditions, the overall CTR values are higher around maximum, but the lunar tidal signal is clearer during low solar activity. The phase of the semi-diurnal signal follows the moon age with a delay of 1.7h between moon phase and local time. Compared to the EEJ, the lunar tidal signal of CTR appears 1-2 hours later in local time. Shortly after sunset the determination of the CTR tidal signal is disturbed by equatorial plasma irregularities.

TYPE: ORAL
DATE: 2012-03-13 – 16:05

SOLAR FLUX BEHAVIOR OF THE EQUATORIAL VERTICAL E×B DRIFT VELOCITIES OBTAINED FROM IONOGRAMS AT LONGITUDE 358.5OE SECTOR

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Ionosonde measurements made at Ouagadougou in Burkina Faso (12.4oN, 358.5oE; dip latitude: 1.5oN) in the West African sector between January 1987 and December 1990 are examined with the purpose of deriving solar flux behavior of the vertical plasma drifts in the evening and nighttime equatorial ionosphere for quiet-condition. The results demonstrate that low solar flux vertical drift values fluctuate significantly than the high solar flux drift velocities between 1800 and 0600 local time for the three seasons, December solstice, equinoxes, and June solstice periods. In addition, percent vertical drift variability varies between 97-162% and 105-132% for low and high solar flux, respectively. Also, low solar flux absolute drift variability is fairly larger than high solar flux absolute variability. The rate of change in the evening pre-reversal velocity enhancement for unit change in F10.7 is considerably higher in value during low solar flux year than moderate and high solar flux periods. An outstanding feature is that the evening velocity peak is strongly anti-correlated with F10.7 at high solar activity years and worst for F10.7>200 units. On the other hand, analysis of corresponding post-sunset peaks in F2-layer, hmF2p show good correlation relationship with solar flux values at low and moderate solar activity years, although post-sunset peak in F2-layer peak (hmF2p) versus F10.7 again exhibits low correlation values during high solar activity periods. We also show that the link between velocity peak Vzp and hmF2p exhibits large variations from low to high solar activity years, with typical correlation values of approximately 20-86%. The significant ionospheric variation of vertical E×B drift velocities observed during low solar flux conditions provide proof that ionospheric changes cannot be only ascribed to solar variability, but to non solar activity sources.

TYPE: ORAL
DATE: 2012-03-13 – 16:20

THE OSCILLATION OF THE F REGION PEAK ALTITUDE IN THE EQUATORIAL IONOSPHERE AT SUNRISE: EVIDENCE FOR AN INTERPLAY BETWEEN FIRST ORDER CHEMICAL EFFECTS AND SECOND ORDER ELECTRODYNAMICAL EFFECTS.

K. M. Ambili[1], Jean-Pierre St-Maurice[2], and Raj Kumar Choudhary[1]

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We have investigated the behavior of ionosphere during sunrise using observations from a Digital Ionosonde (Digisonde) at Trivandrum, India. Of particular interest was an oscillation in the height of the F region peak inferred from a Digisonde measurements, with a sharp up and down oscillation starting shortly before sunrise. However, the effect was not always seen, being often hidden by sporadic E layers or plasma density remnant from the previous night. Using a histogram-based technique we were however able to pull out a quantitative description of the effect in spite of the sporadic screening effects. Since the vertical oscillation closely resembled the oscillation of the well-known 'pre-reversal enhancement' observed at sunset, we wanted to investigate a possible electrodynamical origin for the observed sunrise oscillation. However, using a one-dimensional model of the equatorial ionosphere, we were able to show that the sunrise oscillation phenomenon was mostly due to a quick descent of the shadow height during sunrise, which created a downward motion of the F region peak as the plasma was rebuilding from high altitudes (600 km) at first, subsequently steadily moving down to lower altitudes as the density was building up. One point that became apparent with the simulations was that the Digisonde could only probe densities that were sufficiently high to accommodate the lower Digisonde probing frequencies. Another point was that we could also derive the second order corrections to chemistry that were produced by the vertical motion of the plasma introduced by the vertical plasma drift induced by zonal electric field. We showed

in the process that the plasma motion was typically downward before sunrise but underwent a sharp upward transition two hours after sunrise.

TYPE: ORAL
DATE: 2012-03-13 – 16:35

THE SÃO LUÍS 30 MHZ COHERENT SCATTER RADAR: ONE SOLAR CYCLE OF EQUATORIAL IONOSPHERIC MEASUREMENTS

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The São Luís (2.33oS, 44.21oW), Brazil, coherent scatter ionospheric radar has been in operation since December 2000. The addition of two antenna sets in 2005 allowed the construction of in-beam radar images of scattering structures. The radar has been routinely measuring equatorial electrojet irregularities and 150-km echoes during day-time, and equatorial spread F at night. Using the radar data we have been investigating: storm-time behavior of equatorial electrojet irregularities, coupling between the lower- and upper atmosphere, drift characteristics, seasonal and solar flux behavior of 150 km echoes, longitudinal variation of electric fields over the east and west coasts of South America, large scale waves in the bottom-side F region at the onset of equatorial spread F, and night-time vertical coupling between the E and F regions.

TYPE: ORAL
DATE: 2012-03-13 – 16:50

A STUDY ON THE NIGHT TIME EQUATORWARD MOVEMENT OF IONIZATION ANOMALY USING THERMOSPHERIC AIRGLOW IMAGING TECHNIQUE

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In the post sunset low latitude ionosphere, the equatorial ionization anomaly (EIA) crest move towards the equator as a result of change in the direction of the zonal electric field. This is referred to as reverse fountain effect. On some nights, imaging observations of OI 630 nm thermospheric nightglow taken from low latitude Indian sector during deep solar minimum period revealed southward movement of a broad region of enhanced intensity. This could be seen in the meridional keograms and is interpreted as the equatorward passage of the EIA crest. In addition to the equatorward motion, the thickness of the crest region decreases as a result of recombination. This reduction in thickness is pronounced in the earlier part of the night and brings about an apparent drift that is added to the true equatorward drift of the EIA crest. We have measured the equatorward drift speed of the EIA crest in the night time from the all-sky airglow images. The contribution from the apparent drift is also estimated and corrected. The drift speed varies widely between 28 m/s to 88 m/s with an average speed of 52 m/s. A part of the variability might be due to variations in thermospheric meridional wind. We have also estimated that the EIA crest reaches up to about 5 deg N dip latitude in this solar epoch over Indian sector. Further, no noticeable differences are seen in the equatorward drift speeds obtained on quiet and disturbed days. The studies that concentrate on the evolution of EIA with the help of airglow observations are rare. In this preliminary work, we have attempted to study the reverse fountain effect and its variabilities by means of careful analysis of thermospheric airglow images.

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RESULTS FROM THE FIRST TWO YEARS OF MEASUREMENTS OBTAINED FROM RENOIR IN BRAZIL

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In 2009, a suite of instruments composing the Remote Equatorial Nighttime Observatory of Ionospheric Regions (RENOIR) experiment was installed in northeastern Brazil at Cajazeiras (6.86?S, 38.56?W) and Cariri (7.38?S, 36.53?W). Here we primarily discuss results obtained from the optical instruments in RENOIR, a wide-angle imaging system at Cajazeiras and a bi-static Fabry-Perot interferometer (FPI) array with one imaging FPI installed at each site. When operating individually, each FPI provides measurements of the zonal or meridional neutral winds in the cardinal look directions. When operating in the common volume mode, the FPI array provides collocated measurements of both the zonal and meridional winds at two locations. Using data from the FPIs, we present a climatology of thermospheric neutral winds and temperatures obtained over two years, spanning from the deep solar minimum to present. The imaging system provides observations of the spatio-dynamic properties of equatorial plasma bubbles (EPB). Analysis of the structures in the images yields an estimation of the EPB magnetic zonal drift velocity, which can be compared to the zonal neutral wind velocity measured by the FPIs to investigate the coupling between the neutrals and plasma during passage of EPBs. In general, the simultaneous measurements of the EPB drift velocities and the neutral winds agree quite well. However, the EPB drift velocity is slower than that of the neutral winds in the early evening hours on several occasions suggesting the F-region dynamo is not fully activated. We present several case studies of the results from RENOIR and discuss their implications for understanding the relationship between the neutrals and plasma, especially during periods showing the presence of EPBs.

TYPE: ORAL
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THERMOSPHERIC WIND AND TEMPERATURE CLIMATOLOGY FOR THE EQUATORIAL REGION: RESULTS AND COMPARISONS WITH THE WAM PREDICTIONS FOR THE 2009-2011 PERIOD

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Fabry-Perot Interferometer (FPI) measurements of nighttime thermospheric winds and temperatures from multiple sites in South America have been obtained for the period of 2009-2011. These observations were made from the Jicamarca Radio Observatory (11.96ºS, 76.86ºW) and Nazca (14.97°S,

74.89°W) in Peru and from Cariri (7.38°S, 36.53°W) and Cajazeiras (6.89°S, 38.56°W) in Brazil. A thermospheric wind and temperature climatology record covering the extended solar minimum 2009-2011 period has been obtained for 24 months from the two Brazilian FPI sites. The observations from the Peruvian sector were more limited due to weather and logistics problems but good results were obtained between April and September of 2011. The analysis of the simultaneous results shows zonal winds that are 50 to 75% faster at Jicamarca, as compared to the zonal wind speeds observed at the two Brazilian sites, with peak winds near 135 to 150 ms-1. This finding is consistent with increased plasma density in the equatorial ionization anomaly over the Brazilian sites, which would produce increased ion drag. During the equinoctial period for both longitudinal sectors, the meridional winds show similar behavior of generally weak winds with northward surges of 50-75 ms-1 occurring at around 22-23 LT and 04-05 LT. This similarity suggests the dominance of the winds by tidal wind forcing from below and is supported by comparison with the WAM meridional wind nighttime behavior. The temperature observations show the appearance of the midnight temperature maximum (MTM) for both longitudinal sectors at almost the same local time (23-24 LT) with similar peak amplitudes of 100-150 K. The Jicamarca temperatures are seen to be slightly warmer by 25 to 50 K. These results are found to be reasonably consistent with the predictions of the WAM model, which successfully produced a MTM amplitude of much the same magnitude as is observed for all four seasons. Near the evening twilight period the observed Brazilian temperatures are 25 to 35 K warmer than the WAM predictions. This may be an indication of a temperature enhancement related to the tidal penetration of the thermosphere by tidal harmonics that is not captured in the model

TYPE: ORAL
DATE: 2012-03-15 – 11:00

COMPARING GRAVITY WAVE AND MESOSPHERIC TEMPERATURE VARIABILITY OVER THE ANDES MOUNTAINS (30 S) AND THE CENTRAL PACIFIC OCEAN (20.8 N)

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The Andes region provides an excellent natural laboratory for investigating gravity wave influences on the Upper Mesospheric and Lower Thermospheric (MLT) dynamics with dominant gravity wave forcing expected from deep convection during the summer months replaced by strong orographic forcing during the wintertime, due to intense prevailing zonal winds blowing over the towering Andes mountain range. In contrast, gravity wave forcing over oceanic sites such as Hawaii, is expected to be less intense and controlled year-round by local weather disturbances. The Na lidar, meteor radar and airglow imaging instrument suite that comprised the very successful Maui-MALT program was relocated from Hawaii (20.8°N) to the new Andes Lidar Observatory (ALO) sited high in the Andes mountains (2,520 m) at Cerro Pachon, Chile (30.3°S, 70.7°W). As part of this instrument set the Utah State University (USU) Mesospheric Temperature Mapper (MTM) was operated continuously from Maui (2002-2005) and from ALO over the past two years (August 2009-to date) measuring the nocturnal near infrared OH(6,2) band and the O2(0,1) Atmospheric band intensity and temperature perturbations to investigate a broad range of mesospheric wave forcings, their seasonal variability and effects on the MLT environment. This presentation introduces new results from ALO using collaborative measurements of selected wave events, including exceptionally large tidal perturbations

(70-100 K), unusual "jumps" in OH/O2 temperature possibly associated with wave breaking, mesospheric bore events, and new evidence for an 90 day seasonal oscillation in mesospheric temperature. These are compared with our lower-latitude Maui-MALT measurements from Hawaii to investigate differences in the wave forcing over the Andes Mountains and the central pacific ocean.

TYPE: ORAL
DATE: 2012-03-15 – 11:15

EFFECT OF COMPOSITIONAL VARIATIONS ON THE SEASONAL VARIABILITY IN THE OXYGEN DAYTIME OPTICAL EMISSIONS OVER MID-LATITUDES

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Optical daytime airglow intensity variability provides us with a means of remote investigations of the upper atmospheric behaviour. The daytime OI 630.0 nm (redline) airglow emission has three primary contributions, namely, photoelectron impact on atomic oxygen, photodissociation of molecular oxygen, and dissociative recombination of ionic molecular oxygen. The redline emissions over mid-latitudes typically show a diurnal pattern with a peak around noontime, especially during geomagnetically quiet conditions. The empirical model shows that the emissions vary as a function of solar flux and solar zenith angle. Both, larger solar flux magnitudes and smaller solar zenith angles, contribute to a larger dayglow brightness as the yield of excited oxygen atoms is greater as can be seen from the production mechanisms listed above. However, analysis of systematic observations of daytime optical OI 630.0 nm emissions from a mid-latitude station for over a year during 2003 – 04 showed a decrease in the emission intensities during summer months although, on an average, the solar zenith angle is smaller in summers (when compared to winters) and the solar flux was high during that period. This is in contrast to the predictions of the optical emission models as mentioned above. This apparently controversial observation is explained to be due to the compositional variability brought in by the heating of the upper atmosphere during the summer season wherein there is a transport of neutral oxygen atoms to the winter hemisphere from the summer hemisphere. Evidences to this effect will be presented. This will be discussed in the context of the significant potential of the daytime optical emission measurements in the investigations of upper atmospheric dynamics.

TYPE: ORAL
DATE: 2012-03-15 – 11:30

GENERAL BEHAVIOR AND INTRASEASONAL OSCILLATION OF TEMPERATURE OBSERVED IN A LOW LATITUDE MLT REGION BY METEOR RADAR, PHOTOMETER AND SABER/TIMED.

Ricardo Costa

Universidade Federal de Campina Grande - UFCG, Brazil

This work presents some results concerning the temperature of the high atmosphere observed by meteor radar, photometer and SABER/TIMED over Cariri Observatory (7.4°S, 36.5°W). The data series, depending on the instrument, are from January 2004 to December 2006. In general, the temperature observed by the meteor radar was the highest (mean of 225.4 K) while SABER was the lowest one (190.1 K). On average, the difference was around 17%. All instruments showed a strong semiannual oscillation with maxima on equinox seasons and minima on solstices. Annual oscillation with amplitude of 50% of the semiannual one was also observed. Oscillations of 60-70 day were observed on temperature obtained

by the radar and SABER at 90km of altitude. We also included in this work a Lomb-Scargle analysis of zonal wind observed by the meteor radar. This analysis also shows an oscillation of about 60 days on zonal wind. SABER temperature show a very pronounced 60 day oscillation above 105km. Initially these oscillations can not be attributed specifically to Kelvin waves because data from other sites on different longitude and latitude should also be analysed. The temperatures observed by the meteor radar in operation since July 2004 at Cariri are compared to OH(6,2) rotational temperatures and SABER/TIMED for validation.

TYPE: ORAL
DATE: 2012-03-15 – 11:45

INVITED - LOW AND MIDLATITUDE THERMOSPHERE/IONOSPHERE PROCESSES DURING EXTREME SOLAR ACTIVITY CONDITIONS

Carlos Martinis, Jeff Baumgardner, Paul Zablowski, Joei Wroten, and Michael Mendillo

Boston University, MA, USA

Processes observed near the crests of the Equatorial Ionization Anomaly, between 10-20o mag lat, in general have a strong dependence on solar and magnetic activities. We use all-sky imaging systems that provide observations of specific airglow emissions occurring in the thermosphere. Information on the spatial 2-D, in latitude and longitude, and temporal variations of the processes can be obtained. The inclusion of line-of-sight GPS and in-situ satellite data complements and augments the analysis. We look at how solar activity affects the occurrence of equatorial Spread-F (ESF), medium scale traveling ionospheric disturbances (MSTIDs), and midnight temperature maximum (MTM). A significant occurrence of MSTIDs at low latitudes is observed during low solar activity while ESF is the dominant feature observed at high solar activity. Solar activity seems not to have a significant effect on MTM characteristics. The effects of geomagnetic activity are also discussed. In addition to local observations we use optical data from both hemispheres and show measurements from geomagnetically conjugate locations.

TYPE: ORAL
DATE: 2012-03-15 – 12:00

INVITED - PROSPECTS FOR MODELING AND FORECASTING TIDAL VARIABILITY AND LOW LATITUDE ELECTRODYNAMICS

Tim Fuller-Rowell[1], Rashid Akmaev[2], Houjun Wang[1], Fei Wu[1], and Tzu-Wei Fang[1]

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Quiet-time electrodynamics at low latitude is largely driven by E-region dynamo winds on the dayside, and E- and F-region dynamo winds on the nightside. The dayside winds are strongly forced by migrating and non-migrating tides propagating upward from the lower atmosphere. These winds are quite variable from day-to-day, responding to changes in lower atmosphere circulation and interaction of the tides with planetary waves and gravity waves as they propagate upwards into the lower thermosphere. Whole atmosphere model numerical simulation can now simulate the degree of variability in the winds, and hence in the dayside electrodynamics at equatorial and low latitudes. These simulations, together with observations, have also shown that during large-scale changes in atmospheric circulation, such as during a sudden stratospheric warming, there is not just an increase in variability, but that the increases and decreases in vertical plasma drift are coherent. When combined with a data assimilation system, the whole atmosphere model is able to follow the dynamics of real events with high fidelity, and the electrodynamic consequences. Since the lower atmosphere is predictable several days in advance, it opens up the prospect of also forecasting the consequences in the electrodynamics and the ionosphere. The challenge remains if the upper atmosphere response to

more modest changes in atmospheric circulation is also predictable, or if the signal becomes lost in the natural variability.

TYPE: ORAL
DATE: 2012-03-15 – 14:00

LISN MODEL-DATA ASSIMILATION RESULTS: SOLAR TIDES, LUNAR TIDES, AND OTHER DRIVERS

Vince Eccles

Space Environment Corporation, Providence, UT, USA

A physics-based model of the ionosphere and electric fields is combined with data of vertical TEC from GPS monitors, magnetic field variations from magnetometers, and F2 critical frequencies from ionosondes to best determine the drivers underlying the ionospheric variations. The basic neutral wind drivers of the solar and lunar tides provide a predictable variation. We examine the variations beyond these standard tides. As well as the difference in longitude for these tidal winds.

TYPE: ORAL
DATE: 2012-03-15 – 14:20

EVALUATING THE DYNAMIC AND ENERGETIC VARIATIONS OF THE IONOSPHERE AND PLASMASPHERE ASSOCIATED WITH THE GEOMAGNETIC FIELD VARIATIONS

Naomi Maruyama[1], Phil Richards[2], Tzu-Wei Fang[1], Leslie Mayer[1], Catalin Negrea[1], Tim Fuller-Rowell[1], Arthur Richmond[3], and Astrid Maute[3]

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Longitudinal variations of the observed ionospheric and plasmaspheric signatures are often associated with the forcing from the lower atmosphere, such as the longitudinal variations of the upward propagating tides. It has been difficult to separate out the relative contribution between the lower atmospheric forcing and geomagnetic field variations when interpreting the observed signatures. Furthermore, little effort has been made so far to evaluate the different responses of the dynamics and energetics to geomagnetic field variations between the ionosphere and plasmasphere in a quantitative manner. In order to quantify the impact of the geomagnetic field variations in the ionosphere and plasmasphere, we have developed the new Ionosphere-Plasmasphere-Electrodynamics (IPE) model. It consists of a physics based model of an ionosphere and plasmasphere using the IGRF geomagnetic field configuration (APEX). Furthermore, the global ionospheric potential is solved self-consistently on the same grid. In this presentation, we will make comparisons of the modeled properties of the ionosphere and plasmasphere using the full IGRF and a dipole geomagnetic field. Furthermore, we will quantify the impact of the geomagnetic field variations in observed signatures of the plasma densities and temperatures and electrodynamics.

TYPE: ORAL
DATE: 2012-03-15 – 14:35

INVESTIGATION OF THE EQUATORIAL F3 LAYER CHARACTERISTICS USING THE INTERCOSMOS-19 DATA

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We studied the characteristics of the equatorial F3 layer during the period of high solar activity using the Intercosmos-19 (IK-19) topside sounding large data set (about 3600 passes

across the equator). The F3 layer manifested itself as a cusp on the topside ionograms and identified as an ionization ledge, i.e. a local enhancement in electron density at heights over the F2 layer maximum. IK-19 data show that this enhancement reaches 10–15% in the daytime, and 30% at night. We revealed diurnal, seasonal, latitudinal and longitudinal variations in the F3 layer occurrence probability (P), in maximum height and critical frequency of the F3 layer, hmF3 and foF3. The F3 layer appears together with the equatorial ionization anomaly (EIA) at around 08:00 LT. The F3 layer occurrence probability in the LT interval from 12:00 LT until 22:00 LT averages 40–45% regardless of the season. The occurrence probability decreases towards morning, as a result the F3 layer does not appear at 05:00–07:00 LT. Three local peaks in P appear in diurnal variations for all seasons: at 12:00–14:00 LT, 17:00–18:00 LT and 20:00–22:00 LT. All these peaks are connected with diurnal variations of the equatorial vertical plasma drift. The F3 layer height increases from 450 km in the early morning to 600–750 km in the afternoon and reaches the maximum of 950 km at 21:00 LT. The F3 layer is usually observed within a geomagnetic latitude range from –10 deg to 10 deg around the geomagnetic equator. This interval increases up to +-15 deg when EIA is well-developed. The F3 layer and EIA crests exist near the same geomagnetic field line. Longitudinal variations in P depend on the EIA longitudinal variations which are mainly determined by variations in vertical plasma drift at geomagnetic equator. In addition we analyzed the IK-19 data during 10 geomagnetic storm events with Kp > 5. The F3 layer was generally absent during two storm events, was weakly manifested during five storms and was clearly seen only during three storms. In this report, we also consider in detail the formation mechanism of the additional layers in the equatorial ionosphere during quiet and disturbed geomagnetic conditions.

TYPE: ORAL
DATE: 2012-03-15 – 14:50

EQUATORIAL TEC OVER SOUTH AMERICAN SECTOR WITH LARGE LONGITUDINAL VARIATION IN MAGNETIC DECLINATION ANGLE

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We study the climatology of the Total Electron Content (TEC) as observed by GPS receivers over two equatorial stations in South America with large difference in magnetic declination angle, São Luís (2.33° S, 315.8ºE, declination: -19o) in Brazil and Arequipa (16.5°S, 288.5ºE, declination: 0.5o) in Peru. The TEC variations for three solar activity levels (high, moderate and low) have been analyzed. The TEC values recorded over São Luís are larger than those over Arequipa. The rate of increase of the TEC with intensification of the solar activity is also different at the two sites, independent of the season and local time. One of the main aims of the present work is to investigate the longitudinal differences in the TEC values associated with the large variations in the magnetic declination angle using the Sheffield University Plasmasphere Ionosphere Model (SUPIM). The zonal electric field effects on the TEC magnitudes over the two South America stations will be discussed.

TYPE: ORAL
DATE: 2012-03-15 – 15:05

EQUATORIAL-PRIMO (PROBLEMS RELATED TO IONOSPHERIC MODELS AND OBSERVATIONS)

Tzu-Wei Fang[1], David Anderson[1], Tim Fuller-Rowell[1], Rashid Akmaev[2], Mihail Codrescu[2], George Millward[1], Jan Sojka[3], Ludger Scherliess[3], Vince Eccles[4], John Retterer[5], Joseph Huba[6], G. Joyce[7], Arthur Richmond[8], Astrid Maute[8], Geoff Crowley[9], and Aaron Ridley[10]

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We do not fully understand all the relevant physics of the equatorial ionosphere, so that current models do not completely agree with each other and are not able to accurately reproduce observations. To understand the strengths and the limitations of theoretical, time-dependent, low-latitude ionospheric models in representing observed ionospheric structure and variability and to better understand the underlying ionospheric physics and develop improved models, we initiated a multi-year Equatorial-PRIMO workshop at the CEDAR meeting this year. Two sets of ionosphere-plasmasphere models are participated: non self-consistent models including Ionospheric Forecast Model (IFM), Ionosphere-Plasmasphere Model (IPM), Low Latitude Ionosphere Sector Model (LLIONS), Physically Based Model (PBMOD), Global Ionosphere and Plasmasphere (GIP), SAMI2 is Another Model of the Ionosphere (SAMI2) and self-consistent models including SAMI3 is Also a Model of the Ionosphere (SAMI3), Thermosphere-Ionosphere-Electrodynamics general circulation model (TIE-GCM), Thermosphere-Ionosphere-Mesosphere-Electrodynamics general circulation model (TIME-GCM), Global Ionosphere-Thermosphere Model (GITM), the Coupled Thermosphere Ionosphere Plasmasphere Electrodynamics (CTIPe), Integrated Dynamics through Earth's Atmosphere (IDEA). In order to have fair comparisons, we assume the same ion-neutral collision frequency and set F10.7 to 120. All the models are run under geomagnetic quiet conditions in equinox. For non-coupled models, diurnal variation of electron density at Jicamarca and Asia longitudes at equatorial region are compared. Model results with only neutral wind or electric field will also be presented to identify the causes of differences. For coupled models, the diurnal variation of electron density in E- and F-region, neutral wind and electrodynamics are compared. We will present these results, discuss the differences, and describe our vision of the way forward for Equatorial-PRIMO.

TYPE: ORAL
DATE: 2012-03-15 – 15:20

DC AND STRUCTURED ELECTRIC FIELDS OBSERVED ON THE C/NOFS SATELLITE AND THEIR ASSOCIATION WITH LONGITUDE, PLASMA DENSITY, AND SOLAR ACTIVITY

Robert Pfaff, Henry Freudenreich, Doug Rowland, and Jeff Klenzing

NASA Goddard Space Flight Center, Greenbelt, MD, USA

Observations of DC electric fields and associated E x B plasma drifts gathered by the Vector Electric Field Investigation (VEFI) on the Air Force Communication/Navigation Outage Forecasting System (C/NOFS) satellite are presented. We show statistical averages of the vector fields and resulting E x B plasma flows for the first three years of operations as a function of season, longitude, local time, and F10.7 conditions. Magnetic field data from the VEFI science magnetometer are used to compute the plasma flows. Although typically displaying eastward and outward-directed fields during the day and westward and downward-directed fields at night, the data from DC electric field detector often reveal variations from this pattern that depend on longitude, solar activity, and plasma density. Clear "wave-4" tidal effects in

both electric field components have been detected and will be presented. Zonal plasma drifts show a marked variation with solar activity and may be used as a proxy for neutral winds at night. Evidence for pre-reversal enhancements in the meridional drifts that depend on solar activity is present for some longitudes, and are corroborated by clear evidence in the plasma density data that the spacecraft journeyed below the F-peak during evenings when the rise in the ionosphere is most pronounced. In addition to DC electric fields, the data reveal considerable electric field structures at large scales (100's of km) that are usually confined to the nightside. Although such electric field structures are typically associated with plasma density depletions and structures, what is surprising is the number of cases in which large amplitude, structured DC electric fields are observed without a significant plasma density counterpart structure, including their appearance at times when the ambient plasma density appears relatively quiescent. We investigate the mapping of structured electric fields along magnetic field lines from distant locations and consider tropospheric thunderstorm sources to explain some of the observations. The dependence of the structuring on season and solar activity will be reported and discussed.

TYPE: ORAL
DATE: 2012-03-15 – 15:50

MERIDIONAL WINDS IN THE EQUATORIAL IONIZATION ANOMALY OBSERVED BY THE STREAK MISSION

James Clemmons and Richard Walterscheid

The Aerospace Corporation, USA

New analyses of thermospheric measurements from the ionization gauge on the Streak mission are presented and discussed. These measurements, returned from the dusk bottomside ionospheric F-layer, show strong signatures in the neutral gas impressed through the action of the equatorial ionization anomaly (EIA). These signatures are interpreted as being due to very rapid (several hundred meters per second) meridional winds associated with the equatorial ion fountain at dusk. The winds are shown to be consistent with a picture of the EIA at dusk developed from DE-2 measurements and discussed as the Equatorial Temperature and Wind Anomaly. The present measurements show how these winds depend on altitude. Furthermore, the wind structure exhibits a set of convection rolls that extends to high latitudes and is thus a form of coupling from low latitude to high latitude.

TYPE: ORAL
DATE: 2012-03-15 – 16:05

NEW MEASUREMENT OF THE EFFECTS OF ION-NEUTRAL COLLISIONS IN THE E-REGION OVER ARECIBO

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Recently we have implemented a new experimental mode using the 430 MHz Arecibo transmitter in which a coded long pulse is interleaved with a pulse-to-pulse scheme to provide an enhanced resolution in the lower E-region. The purpose of this experiment is to measure the effects of ion-neutral collisions on the incoherent scatter spectrum and to improve the understanding of the process that modifies the spectrum in the lower E-region of the ionosphere between approximately 85 - 150 km under the assumption of Brownian [Chandrasekhar, 1943], Bhatnagar-Gross-Krook (BGK) [Bhatnagar et al., 1954], and Hard-Sphere collisions [Chapman and Cowling, 1970] in the absence of magnetic field influences, for operating frequencies representative of the chain of NSF-sponsored incoherent scatter radars (ISRs), which range from 50 MHz - 1290 MHz. Also, we extend the computationally limited modeling examples in

Hagfors and Brockelman [1971] of this phenomena and compare our updated modeling results to the measured experimental results from Summer 2011. We show that the original non-dimensionalized examples from Hagfors and Brockelman [1971] were representative of spectra at approximately 95 km, 105 km, and 150 km. Additionally; we discuss the potential impact of these new measurements on the determination of various ionospheric parameters.

TYPE: ORAL
DATE: 2012-03-15 – 16:20

P5.01 LOW-LATITUDE IONOSPHERIC EFFECTS BEFORE STRONG EARTHQUAKES: THEORY, MODEL RESULTS, NEW ASPECTS AND RECENT ADVANCES

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Recent studies was shown that the ionospheric effects before strong near-equatorial earthquakes might be in the form of equatorial ionization anomaly (EIA) strengthening (deepening and widening electron density trough over the geomagnetic equator and displacement of EIA crests away from the equator) or EIA weakening (the EIA trough decreasing and equatorward displacement of the EIA crests). The explanation problems of possible physical mechanisms formation of the seismo-ionospheric effects are under discussion now. Earlier in the numerical experiments with used the Global Self-consistent Model of the Thermosphere, Ionosphere, Protonosphere (GSM TIP) it has been shown that the local disturbances of the zonal electric fields allow reproducing the morphology of ionospheric disturbances observed in the seismic active periods. At the analysis of these numerical experiments the formation mechanisms of such local zonal electric fields were not discussed. The formation mechanism of the zonal electric field over earthquake preparation area was proposed recently. The analysis of the basic hypotheses of lithosphere-atmosphere-ionosphere coupling shows that the large-scale seismo-ionospheric anomalies some days prior to strong earthquakes located in immediate proximity from earthquake epicentre can be explain only by the small-scale IGWs and/or seismogenic electric fields in the Earth's ionosphere. In this study, we present the results of GSM TIP model runs to reproduce the observed changes in the ionosphere prior to earthquakes: Koyna (11.12.1967), New Guinea (16.07.1980), Sumatra (26.12.2004), Peru (25.09.2005), and Wenchuan (12.05.2008). The obtained results confirm the proposed formation mechanisms of low-latitude seismo-ionospheric effects by the seismogenic vertical electric field penetrated from the atmosphere into the ionosphere. The obtained results may also help to reveal other ionospheric variations before strong earthquakes not considered earlier, for example, equatorial electrojet (EEJ) and the F3 layer variations.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P5.02 WHISTLER WAVE-INDUCED IONOSPHERIC PLASMA TURBULENCE: SOURCE MECHANISMS AND REMOTE SENSING

Min-Chang Lee[1], Rezy Pradipta[2], Mike Sulzer[3], Sixto Gonzalez[3], Craig Tepley[3], Nestor Aponte[3], Maria De Soria-Santacruz Pich [2], Rui Hu[2], Manuel Martinez-Sanchez[2], Kangping Hu[1], Lisa Rooker[1], Lindsey Whitehurst[1], and Aydan Uyar[1]

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We present a tutorial lecture to report a series of experiments conducted at Arecibo Observatory, in the past several years, aimed at the investigation of 40.75 kHz whistler wave interactions with ionospheric plasmas and the inner radiation belts at L = 1.35. The whistler waves are launched from a Naval transmitter (codenamed NAU) operating in Aguadilla, Puerto Rico at the frequency and power of 40.75 kHz and 100 kilowatt, respectively. Arecibo radio and optical instruments [i.e., 430 MHz radar, CADI, Fabry-Perot Interferometer] in conjunction with All Sky Imaging System and GeoMagnetic Observatory System have been used to monitor the background ionospheric conditions and detect induced ionospheric plasma effects. An intriguing phenomenon known as "explosive spread F" motivates this work, which was first reported by Woodman and LaHoz [1976] in experiments carried out at Jacamarca Radio Observatory. It has been associated with the occurrence of lightning [Woodman and LaHoz, 1976; Woodman et al., 1984]. A characteristic feature of this phenomenon is a train of short-lived, backscatter radar echoes with a period of 6 sec, which occurred at two altitudes in F region. A theory was subsequently presented by Liao et al.[1989], based on a four-wave interaction process [Lee and Kuo, 1984], to interpret that "explosive spread F" was caused by lightning-induced whistler waves. It was suggested that the Jicamarca 50 MHz radar detected the whistler wave-excited field-aligned, zero-frequency modes and lower hybrid waves. In our Arecibo experiments, we depend on NAU-launched, rather than lightning-induced, whistler waves for the controlled study of aforementioned four-wave interaction process [Labno et al., 2007], direct acceleration of ionospheric electrons by whistler waves, and triggered precipitation of energetic electrons from the radiation belts [Pradipta et al., 2007]. Radar and optical measurements can distinguish wave-wave and wave-particle interaction processes occurring at different altitudes. Electron acceleration by different mechanisms can be verified from the radar measurements of plasma lines. To facilitate the coupling of NAU-launched 40.75 kHz whistler waves into the ionosphere, we rely on naturally occurring spread F irregularities to serve as the ionospheric ducts. However, artificial waveguides can be favorably generated by HF heater waves, as demonstrated in our earlier Arecibo experiments [Lee et al., 1998] and further confirmed in our recent Gakona experiments at HAARP [Cohen et al., 2010]. The newly constructed Arecibo HF heater will be employed in our future experiments for further study of whistler wave interactions with the ionosphere and the magnetosphere/radiation belts as well as the whistler wave conjugate propagation between Arecibo and Puerto Madryn, Argentina [Starks and Lee, 1999; Starks et al., 2002; Lee et al., 2006 Arecibo Workshop].

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P5.04 CLIMATOLOGY DURING A LOW SOLAR ACTIVITY AND ENHANCEMENTS IN THE CRITICAL FREQUENCY FOF2 OVER CYPRUS IN THE ABSENCE OF PRONOUNCED GEOMAGNETIC ACTIVITY

Vryonides Photos[1], Economou Lefteris[2], and Haris Haralambous[1]

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[2] Intercollege, Cyprus

A new ionospheric station was established three years ago in Nicosia (Cyprus) to initiate ionospheric research on the island. As the Nicosia station is the lowest-latitude operating station in Europe the deployment of a DPS-4D (digisonde) is considered very beneficial to the ionospheric scientific community, taking into account the lack of adequate scientific infrastructure, especially at low latitudes of the European sector, for continuous ionospheric monitoring. Its operation will contribute to international networks for ionospheric nowcasting and forecasting and to the validation of ionospheric models in the eastern Mediterranean region. In this study we present the climatology of the critical frequency of the F2-region during two years of operation (2009-2010) of the

ionospheric station based on manually scaled foF2 values and cases during the three year operation of the station where significant enhancements in the critical frequency of the F2 layer foF2 were observed in the absence of pronounced geomagnetic activity.

TYPE: POSTER
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P5.07 RADAR AND OPTICAL OBSERVATIONS OF SUDDEN ZONAL WIND DECREASE IN THE EQUATORIAL ZONAL NEUTRAL WIND

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[2] New Jersey Institute of Technology, The Center for Solar-Terrestrial Research, NJ, USA
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[4] Radio Observatorio de Jicamarca, Instituto Geofísico del Perú, Lima, Perú
[5] Universidade Federal de Campina Grande - UFCG, Brazil

During the CORRER summer campaign in August, 2011, the Fabry-Perot interferometer located at Jicamarca, Peru, and also at Huancayo, Peru, observed simultaneously on 9-10 and 10-11 August an interesting event in which the zonal neutral wind decreased within 20-30 minutes from the nominal speed of 125 ms-1 eastward to nearly zero. This reduction lasted for perhaps 30 minutes and then the zonal wind speed recovered to its nominal level prior to the event. The zonal ion drift observed by the Jicamarca incoherent scatter radar also showed a marked reduction in speed. The electron density profiles showed no marked change during this period but there was indication of the existence of the bottom side Spread F. The question arises as to what might have caused such a marked change in the zonal wind as there was no indication of marked modulation that would be characteristic of gravity wave activity.

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P5.08 ROCKET OBSERVATIONS OF ELECTRON TEMPERATURE AND ENERGY DISTRIBUTION IN THE LOWER F-REGION PRIOR TO THE ONSET OF EQUATORIAL PLASMA BUBBLES

Polinaya Muralikrishna[1] and Francisco Carlos De Meneses[2]

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Height profiles of the ionospheric electron density and temperature were made from Brazil on different occasions under different ionospheric conditions. During one of the launches the rocket passed through well-developed plasma bubbles on both upleg and downleg. During the second launch the ionospheric F-region did not show the presence of prominent plasma bubbles. During the third launch the rocket on its upleg passed through an F-region without plasma bubbles while on its downleg it passed through an F-region that showed a large number of well-developed plasma bubbles. Electron temperatures were estimated by applying sweep potentials to Langmuir probes. During the first and second launches the electron temperatures estimated were comparable to those given by models. But during the third launch the electron temperatures estimated showed abnormally high values of more than 3000 deg. K in the lower F- region only on the rocket upleg. The maximum electron temperature observed above the F-peak was only about 700 deg. K. The region below the base of the F-region seems to be associated with very large electron temperatures just before the development of plasma bubbles. An attempt is made here to get the electron energy distribution function (EEDF) from the second derivative of the current-voltage characteristic curves.

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P5.09 MTM CHARACTERISTICS FROM ARECIBO INCOHERENT SCATTER RADAR

Dustin Hickey, Carlos Martinis, Ashley Wright, and William Oliver

Boston University, MA, USA

We conduct a comprehensive study of the midnight temperature maximum (MTM) using data from the Arecibo Incoherent Scatter Radar from 1966 to 2006. The MTM is a local maximum in the neutral temperature around midnight. A direct consequence of the MTM is the downward descent of the F-region plasma, termed 'midnight collapse' or 'midnight descent'. The absence of any plasma production by absorption of EUV radiation during the night allows the electron and ion temperatures to relax to the neutral temperature in the thermosphere. Thus variations in the nighttime plasma temperatures Te and Ti, determined by ISR techniques, should reflect variations in the neutral temperature Tn. We characterize the MTM in terms of amplitude, time of occurrence and width. These parameters are obtained by fitting the radar data with a function that takes into account diurnal, semidiurnal and terdiurnal components. Under the hypothesis that the MTM is related to the amplification of the terdiurnal wave, a Gaussian window is included in the fitting. This allows an automatic determination of the time of occurrence, temporal duration, and amplitude of the MTM observed.

The ISR data contains information from multiple heights ranging from about 100 to 600 km. This study focuses on altitudes near 300 km, the typical height of MTM observations from Fabry Perot Interferometers. More than 200 nights are used in this study with approximately 80% of the nights showing an MTM with typical amplitudes ranging between 20 and 100 K. A seasonal dependence on the local time of occurrence and amplitude is observed.

One of the advantages of using ISR data is the possibility of exploring the altitude dependence of the MTM. Preliminary results indicate that between 250 and 400 km significant variation of MTM characteristics is observed. We also discuss ongoing studies that include the use of Millstone Hill Incoherent Scatter Radar data, in particular low elevation angle runs that allow the determination of thermospheric Ti near 25-30o GLAT.

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P5.10 COMPARISON OF GLOBAL MODEL AND IONOSONDE VERTICAL DRIFTS OBSERVATIONS IN THE POSTSUNSET EQUATORIAL IONOSPHERE

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In this paper, vertical plasma drift velocities deduced from ionosonde measurements made at the Ibadan Radio Observatory (7.4oN, 3.9oE, dip latitude 2.3oS), in Nigeria, between January and December 1958 during International Geophysical Year, are compared with the empirical IRI-2007 model predictions in the postsunset equatorial F region ionosphere over West African sector. The analysis covers geomagnetically quiet-day and very high solar activity periods. We explore the relationship between ionosonde drifts and the Scherliess-Fejer climatological E×B drift velocity curves between 1700 and 2200 local time. On average, our qualitative and quantitative comparisons are reasonably good. The results of the study also indicate that in the seasonal variation of the F region vertical drift variability, the absolute variability is smaller in June solstitial months than in equinoxes and December solstice months. In addition, month-to-month variability of the vertical drifts is higher in simulation results, about 16-40 m/s than in ionosonde-inferred drifts, 9-23 m/s. The evening prereversal enhancement (PRE) of

the vertical plasma drift signifies large month-to-month variations with amplitudes of about 20-45 m/s and 19-50 m/s, respectively, for ionosonde and IRI model. The magnitudes of the modeled evening peak velocities are consistently larger than the values of ionosonde evening PRE of the upward drift velocities up to 40%, except for February and November. We demonstrate that the evening reversal times are roughly comparable during December solstice and September equinox, while March equinox and June solstice (except August) reversal times exhibits notable significant differences. The occurrence local time of the peak PRE E×B drift velocity for both Ibadan and model essentially show up at 1900 LT, apart from March and November that occurs late and earlier, in that order. We also show that the rate of change of the peak postsunset eastward drifts for unit change in solar flux F10.7 is approximately 0.16 m/s and 0.54 m/s, respectively, for Ibadan ionosonde drifts and IRI-2007 model predictions. This study demonstrates that realistic ionosonde-inferred E×B drifts can be obtained on quiet days in the West African sector and relates to the occurrence of small scale plasma irregularities that occurs just after sunset. Our observations are useful for validating the IRI model representations of the vertical drift velocities in the equatorial ionosphere.

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DATE: 2012-03-13 – 17:35

P5.12 SOLAR FLUX AND EXB DEPENDENT FEATURES OF F3 LAYER OBSERVED FROM INDIAN LOW LATITUDE STATIONS

Pavan Chaitanya Peddapati[1], Amit K. Patra[2], and S. Vijaya Bhaskara Rao[1]

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Solar flux and ExB dependent features of F3 layer observed from Indian low latitude stations P Pavan Chaitanya1, A K Patra2, and S Vijaya Bhaskara Rao1 1Department of Physics, Sri Venkateswara University, Tirupati, India 2National Atmospheric Research Laboratory, Gadanki, India

In this paper we present and discuss the results on F3 layer based on observations made from Gadanki and Sriharikota, both are located in southern India with same latitude but longitudinally separated by 100 km. Importantly we present for the first time two important aspects of the F3 layers: (1) the variability of the F3 layer properties during extreme low solar activity (LSA) period and compare them with those observed during the high solar activity (HSA) period, and (2) the variation in the F3 layer property with varied ExB values. The ExB drifts were estimated using the daytime 150-km echoes observed simultaneously using the Gadanki MST radar. The results show that while the occurrence rate of F3 layer is nearly equal in summer and September equinox of both HSA and LSA periods with occurrence percentage close to 100 %, in March equinox and winter the occurrence rate is lower during LSA period than in the HSA period. Also, in summer the layer occurs earlier and last longer than in other seasons. The critical frequency of the F3 layer is in the range of 5-7 MHz during LSA whereas it is 10-13 MHz during HSA, which is 5-6 MHz higher than those observed during LSA. The virtual height of the F3 layer is found to be 100 km higher both in summer and winter of HSA period (600-700 km) than those of LSA period (500-600 km). During equinox, however, it is found to be 100 km higher in LSA period (600-700 km) than in HSA period (500-550 km). We also found that the height of the F3 layer correlates extremely well with the ExB drift indicating the dominant role of zonal electric field in determining the height of the F3 layer due to the close proximity of Gadanki/Sriharikota to the magnetic equator, where the role of meridional neutral wind in layer movement is possibly not so significant. These results are discussed in the light of current understanding on F3 layer.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P5.13 A STUDY OF DIFFERENT BLANKETING ES LAYERS DURING THE SOLAR CYCLE 23

Laysa Cristina Araújo Resende, Clezio Marcos De Nardin, Inez Staciarini Batista, Juliano Moro, and Lais Maria Guizelli

Instituto Nacional de Pesquisas Espaciais - INPE, Sao Jose dos Campos, SP, Brazil

We investigate the behavior of blanketing frequency (fbEs) measured by a digital ionosonde over São Luís, Brazil (2.33°S, 44.2°W, dip: -4.5°), associated with different types of Es, according to the magnetic disturbance level and, in relation to the phase of strong magnetic storms that occured during the solar cycle 23. Our preliminary results showed that there are expressive changes in the fbEs characterized by occurrence of peaks that exceeds the ambient background values, mainly during the recovery phase of strong magnetic storms. These peaks are associated to the presence of blanketing Es types, which are not the common Es at the dip equator but replaced the Esq, a non-blanketing layer observed in ionograms due the plasma irregularities in the equatorial electrojet electric field. Therefore, we suppose the wind shear mechanism is taking place at latitudes close to the dip equator, where it is not supposed to operate efficiently. The results are discussed in terms of the statistics of the abnormal enhancement taking into account the magnetic disturbance level and phase of the magnetic storm, when applicable.

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P5.14 DIFFERENCES BETWEEN THE DEPENDENCES OF EQUATORIAL F REGION EVENING VERTICAL DRIFT ON F10.7 AND EUV FLUXES OVER BRAZIL

Angela M. Santos, Mangalathayil Ali Abdu, Jose Sobral, Paulo Nogueira, and Claudia Candido

Instituto Nacional de Pesquisas Espaciais - INPE, Sao Jose dos Campos, SP, Brazil

In this work we study the dependence of the evening F region vertical peak velocity magnitude (Vzp) which is associated to the prereversal enhancement in the zonal electric field (PRE), as a function of solar flux index F10.7 and EUV flux over the Brazilian region. The Vzp magnitude calculated from Digisonde data from Fortaleza (3.9°S, 38.45°W) and São Luís (2.33° S, 44.2°W) during October, November and December from 2001 up to 2009 for quiet and disturbed days have been analyzed. The results show that the Vzp is strongly dependent on the F10.7 and it presents higher magnitudes in November than in the other months for all F10.7 levels both at São Luís and Fortaleza. It was also observed that the correlation between the Vzp and F10.7 parameters shows better results during low solar activity. Recent works have reported a better correlation of daily values of mean TEC with EUV rather than with F10.7. The objective of the present study is to improve our understanding of the Vzp correlation with solar activity intensity, which will be potentially of help for the PRE and plasma bubble forecasting. For that purpose we are verifying whether or not the dependence of the Vzp with the solar EUV is similar to that with F10.7 considering that the electric field responsible for the vertical drift is produced basically by thermospheric winds which in turn are closely associated to the EUV index. The main focus of this investigation therefore is to discuss the differences of the the Vzp dependence with the F10.7 and the EUV indexes.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P5.15 SYNOPSIS OF LOW FREQUENCY ELECTROMAGNETIC WAVES DETECTED BY C/NOFS: IMPLICATIONS FOR EQUATORIAL IONOSPHERIC MODELING

Fernando Simões and Robert Pfaff

NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Communications/Navigation Outage Forecasting System (C/NOFS) satellite is equipped with a three-axis double probe electric field detector that provides continuous DC and AC electric field measurements, and two optical sensors for lightning detection. Among the significant measurements thus far, C/NOFS detected low frequency electromagnetic wave signatures related to Ionospheric Alfven Resonator (IAR) and Schumann resonance phenomena. We present these findings in the context of troposphere-ionosphere coupling mechanisms, namely lightning activity, electromagnetic wave propagation in the ionosphere, and tropospheric-space weather connections. We discuss how these measurements can be combined with other techniques to improve empirical models of the ionosphere, in particular during the last solar minimum. Specifically, IAR spectral signatures measured by C/NOFS contribute to refine ion composition and the electron density profile.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P5.17 VERTICAL EXB DRIFT DURING PRE-REVERSAL PEAK HOURS AT MAGNETICALLY CONJUGATE STATIONS IN BRAZIL (COPEX CAMPAIGN) USING DIGISONDE DATA

Cláudia Vogel Ely[1], Inez Staciarini Batista[1], and Alexander José Carrasco[2]

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[2] Universidad de Los Andes, Mérida, Venezuela

The time variation of the F layer height at specific frequencies (dh(f)/dt) can be used to estimate the vertical plasma velocity of the F layer. This apparent velocity has contributions from the electromagnetic ExB drift, from the meridional neutral wind and from the height variations due to recombination, but close to the magnetic equator and near sunset, when the F layer is high enough for the recombination process to be considered negligible, the electromagnetic ExB becomes the most important component. This paper will present the temporal variations of the vertical drift approximated with the above technique and also the vertical plasma velocity derived using a new technique based on the numerical solution of the continuity equation, both obtained for the quietest days from the COPEX campaign (October to December of 2002, high solar activity) near sunset hours. We will compare the vertical ExB drift simultaneously in two magnetically conjugated stations and at a magnetic equator station, and analyze the differences and their possible causes in terms of meridional winds.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P5.18 COORDINATE INVESTIGATION OF THE F2 LAYER STRATIFICATION AT LOW-LATITUDE IONSOPHERE: RESULTS FROM THE COSMIC AND GIRO

Biqiang Zhao

Institute of Geology and Geophysics, Chinese Academy of Sciences, China

Global observations of electron density profile (EDP) from the COSMIC/FORMOSAT?3 satellites were used to investigate, for the first time, the additional stratification of the F2 layer over the equatorial ionosphere on a global scale, which is called F3 layer. The F3 layer in EDP was recognized through the altitude differential profile featured by two maxima existing from 220 km to the peak height of the electron density. There were 9,400 cases of F3 layer selected out of 448, 000 occultation events at low and equatorial areas during the period of April 2006 - September 2011. Statistical results show that the highest occurrence of F3 layer appears at dip latitude 7 8°/-7 -8° for Northern/Southern Hemisphere and is more pronounced during summer months at 10:00

- 14:00 LT. The occurrence also has a clear longitude dependence during boreal summer, with relatively higher occurrence at -80 -100°, -20 20°, 80 120° and -160 -170° longitudes, that is possibly associated with the wavenumber-3 diurnal tide (DE3). Meanwhile, the characteristic of the sunset F3 layer is first investigated using a solar cycle of ionosonde data (1995–2010) from the magnetic equatorial station at Jicamarca, and compared with the features derived from the GIRO stations at Sao Luis, Fortaleza, Kwajalein, Sanya, Fuke. Evidence shows that the local time distribution of the occurrence of the F3 layer can extend to the postsunset time (1800–2100 local time). The sunset F3 layer has a strong seasonal dependence occurring mainly during the summertime and with a preference at Jicamarca. Unlike the daytime F3 layer, the occurrence of the sunset F3 layer clearly increases with increasing solar activity. These features of the dependence on the season, solar activity, and longitude are clearly related to the geomagnetic control of the evening prereversal enhancement of the equatorial zonal electric field and meridional winds modulated by the geomagnetic configuration.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

P5.19 SEASONAL AND DIURNAL BEHAVIOR OF THE IONOSPHERIC F LAYER OVER INDIAN REGION DURING EXTREMELY LOW SOLAR ACTIVITY CONDITIONS AS OBSERVED BY COSMIC

Samireddipalle Sripathi

Indian Institute of Geomagnetism, Navi Mumbai, India

Solar activity during the year 2007-2009 was the deepest and longest among other low solar activity periods in the last century. In the present paper, an attempt has been made to study the seasonal, diurnal and latitudinal variation of electron density profiles obtained using COSMIC radio occultation (RO) measurements over Indian low latitude region during the year 2008 when such deepest solar minimum occurred. These observations are compared with previous low and high solar activity periods. The diurnal variation of electron density suggests that enhanced electron densities are observed in the equinox season as compared to that of winter and summer seasons. However, there is a shift in the time and altitude at which the peak of the electron density occurs during equinox. While these observations further re-confirm that these results are quiet similar to that of high solar activity period, however, the peak electron density obtained during low solar activity is relatively low as compared to that of high solar activity period. The latitudinal and seasonal variation of peak electron density (NmF2) indicates an enhanced EIA on either-side of the equator during equinoxes as compared to the other seasons. Seasonal variation of EEJ strength during the same year also shows enhanced EEJ strength during equinoxes indicating that EEJ strength is indeed partly controls the EIA development. Further, NmF2 over EIA are correlated very well with solar flux. In addition, the observed mean NmF2 and hmF2 obtained using COSMIC at different seasons are compared with SAMI2 model. The results suggest that while observed NmF2 are much higher than that of model, hmF2 observations show that COSMIC observed values are lower than that of model results. While some discrepancies exist between model and COSMIC which needs further investigation, overall, the model seems to agree with COSMIC observations for the Indian longitudes.

TYPE: POSTER
DATE: 2012-03-13 – 17:35

Session 6

IONOSPHERIC STORMS AND SPACE WEATHER EFFECTS AT LOW AND MID LATITUDES

Response of the equatorial-, low-, and mid-latitude ionosphere to geomagnetic storms is extremely complex and calls for focused attention addressing the consequences of various space weather effects. During geomagnetic storms, time varying magnetosphere-ionosphere-thermosphere interactions at high latitudes cause a host of disturbances, such as, large scale traveling atmospheric/ionospheric disturbances, under/overshielding and disturbance dynamo electric fields, and dramatic variations in the total electron content. All these show global scale signatures, and do have a great influence on ionosphere/thermosphere at mid-, low-, and equatorial latitudes, which could also result in the generation of plasma irregularities. Human activities today depend so much on the high technology applications in the near earth space, such as satellite operations, aviations, radio wave communications, and Global Navigation Satellite System (GNSS) positioning, and the accuracies in these measurements are adversely affected by the gradients in electron contents and plasma irregularities. Thus, experimental, theoretical, and modeling efforts are all extremely essential for improving our understanding of the ionospheric/thermospheric disturbances at all latitudes during geomagnetic storms and substorms. Recent progress in space-based (TIMED, CHAMP, COSMIC, C/NOFS), and ground-based (Radars, GNSS receivers, optical sensors, magnetometer chains) observations has allowed us to diagnose space weather effects in geospace. Furthermore, advancement in theory and modeling efforts help us elucidate the underlying physics in the observations. Specific topics to be discussed in this session are: (1) Storm time variations in ionospheric plasma and electrodynamics, (2) Prompt penetration and disturbance dynamo contributions in the storm time electric field, (3) Ionospheric scintillations due to space weather during both quiet and disturbed conditions, at low and mid-latitudes. This session, therefore, welcomes presentations of all aspects of the response of the equatorial-, low-, and mid-latitude ionosphere to the space weather effects.

Keywords:

- Experiment, theory, modeling efforts
- Magnetic storms and substorms
- Disturbance dynamo and promptly penetrated electric fields during the storm time condition

- Ionospheric plasma variations and electrodynamics during storms
- Space weather effects during quiet times.
- Ionospheric Scintillation during the quiet and disturbed conditions

Conveners: H. Takahashi, D. Pallamraju, and N. Maruyama

INVITED - THREE-DIMENSIONAL MODELING OF EQUATORIAL BUBBLES

Joseph Huba[1], G. Joyce[2], and J. Krall[3]

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[3] Naval Research Laboratory, USA

The NRL three-dimensional ionospheric simulation code SAMI3 is used to model the onset and evolution of plasma bubbles associated with equatorial spread F (ESF). SAMI3 is a comprehensive ionosphere model that has been modified to self-consistently solve for the global neutral wind driven dynamo electric field as well as the gravity driven electric field associated with plasma bubbles. The latter is achieved with a high resolution longitudinal grid in the pre- to post-sunset sector (i.e., 1630 MLT - 2230 MLT). Results from the new simulation model are presented. It is shown that ESF can be triggered by pre-sunset ionospheric density perturbations, and that an existing ESF bubble can trigger a new bubble. We will also discuss the generation of equatorial bubbles during disturbed times when storm-time penetration or dynamo disturbance electric fields affect the low-latitude ionosphere.

TYPE: ORAL
DATE: 2012-03-14 – 08:00

EQUATORIAL SCINTILLATION ACTIVITY DURING EXTENDED SOLAR MINIMUM

Keith Groves

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As space weather scientists and operational users anxiously await an increase in solar activity, satellite observations have led several investigators to report new ionospheric features purportedly unique to the low-latitude ionosphere during the recent prolonged solar minimum period. The most prominent of these is the occurrence of large-scale deep density depletions in the dawn sector first discovered from observations made by the Communications/Navigation Outage Forecast System (C/NOFS) equatorial satellite (O. de la Beaujardiere, private communication, 2010). Related discoveries suggest that the majority of solar minimum equatorial plasma bubbles occur post-midnight, in contrast to the typical post-sunset formation documented during previous solar cycles. This paper addresses the climatology and physics of ground-based scintillation observations during the same extended solar minimum period. The results show that scintillation occurrence is largely consistent with observations from all phases of the solar cycles and little to no enhancement in post-midnight F-region irregularities occurs. This suggests that the physical processes leading to the formation of ionospheric irregularities during the extended solar minimum period are in fact the same processes that cause irregularities throughout the solar cycle. The amplitudes and rates at which these processes occur may, however, vary significantly with solar activity. The disparity in the space- and ground-based results may be explained by considering two factors. First, the altitude bias of the in situ satellite observations results in a failure to detect irregularities below the satellite altitude. Direct radar observations of bubble formation indicate that bubble ascent rates and peak heights decrease during solar minimum. Many bubbles simply do not reach typical satellite altitudes above 500 km during periods of low solar flux; those that eventually do arrive later in local time due to lower vertical drifts. The altitude bias of space-based observations then results in a distribution of plasma bubbles that is both reduced in number and shifted to later local time. Second, scintillation observations are sensitive to the absolute differences in density along the radio wave raypath, not the relative variations. If the background electron density becomes sufficiently low the structured plasma simply cannot cause scintillations. Thus, scintillations may not occur during solar minimum in the low density post-midnight time period even though irregularities are present. A consideration of these factors leads to more consistent agreement between

space- and ground-based observations during solar minimum and helps to identify what ionospheric characteristics are unique to the extended solar minimum of 2006-2009.

TYPE: ORAL
DATE: 2012-03-14 – 08:20

INVITED - STORM TIME VARIABILITY IN EQUATORIAL SPREAD F/PLASMA BUBBLE IRREGULARITY DEVELOPMENT

Mangalathayil Ali Abdu, Inez Staciarini Batista, Jose Sobral, Angela M. Santos, and Paulo Nogueira

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The equatorial spread F/plasma bubble irregularity development is known to be controlled by sunset electrodynamics processes in which the rapid changes from the day-to-night transition of the background ionosphere-thermosphere system play major roles. The leading factors that determine the ESF growth process are: the enhanced prereversal vertical drift (PRE) associated with the plasma vortex flow, the thermospheric meridional/trans-equatorial winds, and gravity wave perturbations in plasma density and polarization electric fields as seed perturbations for the R-T instability growth. During magnetic storms the drastic change that occur in these parameters, especially in the first two, together with the modification of the large scale spatial distribution in ionospheric conductivity, can cause significant modifications to the development and dynamics of the plasma bubble irregularities. Enhanced development of the irregularities followed by their anomalous drifts, and suppression or disruption of the irregularity generation has been reported for the different storm phases. Prompt penetration electric fields of under-shielding and over-shielding types, the disturbance dynamo electric field originating from the storm energy input and auroral heating, as well as the disturbances in low latitude thermospheric zonal and meridional/trans-equatorial winds are the main agencies that control the storm time ESF development process, which is dependent also on season and longitudes. Our current understanding of the above factors and some outstanding questions of the ESF variability arising therefrom, as revealed by recent results from observational as well as modeling studies will be covered in this talk.

TYPE: ORAL
DATE: 2012-03-14 – 08:35

SPACE WEATHER AND GEOSPACE EFFECTS OF STORM-TIME THERMAL PLASMA REDISTRIBUTION

John Foster

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Storm-time thermal plasma redistribution provides an excellent example of the cross-discipline, system-level Geospace problems which are a focus of the recent CEDAR Strategic Plan. Many aspects of this Geospace process have been observed from the ground and space during the major geomagnetic storms of the past solar cycle. When viewed in the context of the geospace storm taken as a whole, plasma redistribution is seen as a multi-step system-wide processes involving the equatorial, low, mid, auroral, and polar-latitude regions. Penetration electric fields uplift the low-latitude dayside ionosphere and enhance the equatorial ionization anomaly peaks, while polarization electric field effects at the dusk terminator redistribute the low-latitude TEC in both longitude and latitude. Magnetic field geometry creates a preferred longitude for the enhancement of low and mid-latitude TEC in the American sector at the sunset. These TEC enhancements form a localized source for the intense storm enhanced density (SED) erosion plumes which originate over the Americas during major storms. High-TEC SED plumes produce significant space weather effects associated with

the steep TEC gradients which develop along their edges, particularly at their poleward border where the SED overlaps the SAPS flow channel. Magnetospheric and M-I coupling processes lead to the development of the subauroral polarization stream (SAPS), the erosion of the plasmasphere boundary layer, and the transport of SED material to the noontime cusp. These greatly-enhanced fluxes of lower-latitude heavy (O+) ions traverse the cusp and enter the polar cap forming the polar tongue of ionization and providing a rich source of ionospheric heavy ions for the magnetospheric injection and acceleration mechanisms which operate in these regions. Further geospace weather effects occur as the newly-injected ionospheric heavy ions alter reconnection, ring current, and WPI processes. These affect storm development, changes in the radiation belts, and energetic particle precipitation.

TYPE: ORAL
DATE: 2012-03-14 – 08:55

RESPONSE OF THE MID-LATITUDE IONOSPHERE TO GEOMAGNETIC STORM ON OCTOBER 11, 2008 AND OCTOBER 11, 2010

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The ionosphere behavior over European mid-latitudes during moderate geomagnetic disturbances which occurred on October 11, 2008 and October 11, 2010 was analyzed. These events are interesting as they occurred during a period of very low solar activity; the first one took place at the unusual extended solar minimum, the second one – at the beginning of new 24th solar cycle. Local time of the ionospheric storms' beginning was practically the same. Thus, the objective of this paper was to analyze similarities and differences of the ionosphere response to these events. Relatively weak but isolated geomagnetic disturbances were characterized by the well-pronounced positive effect observed in the ionosphere at the dayside. In the given study we used data of GPS TEC estimates retrieved from observations of European mid-latitudes GPS receivers, ionosonde measurements from DIAS network and FORMOSAT-3/COSMIC radio occultation (RO) measurements. The short-duration positive effect was revealed distinctly in GPS TEC and ionosondes' measurements. For the case of October 11, 2008 the strong TEC increase over European region has rather short duration (11-15 UT) and its amplitude reached the maximum value of 9 TECU (100% relative to the quiet conditions). This enhancement was clearly observed in the foF2 variations over ionospheric stations Juliusruh, Pruhonice and Rome. The clear positive effect was observed for the second event too. Special attention was paid to estimation of ionospheric electron content (IEC) during storms. The electron density profiles derived from the COSMIC RO measurements were also involved into analysis. These profiles were integrated up to the height of NmF2 and top in order to obtain COSMIC-derived IECb (bottom side) and IECt (topside) estimates. Ionosonde-derived Ne profiles were also integrated. The vertical GPS TEC estimates was split into two contributions, one part due to the bottomside ionosphere and other part due to the topside ionosphere. The topside part of TEC contains IECt and PEC (plasmaspheric electron content). So, the joint comparison of GPS TEC, COSMIC IEC and ionosonde IEC values was carried out in order to estimate redistribution of electron content for quiet and disturbed conditions.

TYPE: ORAL
DATE: 2012-03-14 – 09:10

IONOSPHERIC SUPERSTORM DRIVERS: THE ROLE OF THE ATLANTIC SECTOR POLARIZATION TERMINATOR

Philip Erickson and John Foster

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Large enhancements of ionospheric total electron content (TEC) in the coupled geospace system often occur during daytime geomagnetically disturbed intervals. Several potential mechanisms can contribute to these enhancements by causing increased production, reduced recombination, and/or redistribution of solar produced plasma from other spatial regions. These drivers can include uplift due to penetration electric fields, equatorial neutral winds, traveling atmospheric disturbances, strong poleward ionization drifts, changes in neutral chemistry and/or a greatly expanded auroral convection field. However, in the dusk sector, additional processes may be involved in creating spatially and temporally localized TEC increases. These effects can provide a significant dusk plasma buildup in the Caribbean sector and simultaneous enhancements in magnetically conjugate regions, through poleward and westward motion of low latitude plasma on the night side towards the vicinity of the dusk terminator.

In this presentation, we will emphasize ionospheric response mechanisms involving a combination of the stormtime penetration electric field, reduced magnetic field strength in the South Atlantic magnetic anomaly, and the geographic distortion of the magnetic field in the Atlantic sector. The resulting effects lead to characteristics of electric fields at the sunset terminator which can account for many observed plasma intensification and redistribution features in lower mid-latitudes in the American sector. In particular, the combination of effects characteristic of the unique magnetic field geometry in that sector lead to strong intensification of storm enhanced density plumes over the Americas, which are subsequently fed into the sub-auroral polarization stream and carried toward high latitudes. These qualities mark the Atlantic sector as a preferred longitude or Universal Time sector for extreme geospace responses to geomagnetic disturbances. For events when these mechanisms are prominent, the effects are predicted to be strongest for northern hemisphere summer conditions.

TYPE: ORAL
DATE: 2012-03-14 – 09:25

SPACE WEATHER PROGRAM IN BRAZIL

Hisao Takahashi, Joaquim E R Costa , Alisson Dal Lago, Clezio Marcos De Nardin, Eurico De Paula, Jonas Rodrigues De Souza, Antonio L. Padilha , Nilson Sant Anna , Rubens C. Gatto, and Oswaldo D. Miranda

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Brazilian Space Weather program (EMBRACE) started at INPE in 2008. It is aimed to establish "Space Weather Information and Prediction Center" upto 2012/2013. The center has objectives to monitor the solar activity and its impact on the earth´s space environment, and to predict the influence on the space-based and ground-based technological systems. Our specific concerns are to monitor peculiar physical processes in the equatorial ionosphere, such as equatorial electrojet, the ionization anomaly and the plasma bubbles. These processes affect radio wave propagation and GNSS applications. The South Atlantic geomagnetic anomaly (SAGA) is also a great concern for satellite operations. Groundbased monitoring system consists on solar radio telescopes, conjugate point ionospheric sounders, GNSS receivers, magnetometer arrays, optical imagers, radio frequency radars, as well as ground induced current sensors. Recent progress in these monitoring system and related space weather information will be presented.

TYPE: ORAL
DATE: 2012-03-14 – 09:40

INVITED - EFFECTS OF SPACE WEATHER OVER LOW LATITUDES: RECENT RESULTS USING OPTICAL AND OTHER TECHNIQUES

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It is known that the ionosphere over low-equatorial latitudes is subjected to radiative perturbations during solar flares. On the other hand, the electric field disturbances can arise due to the prompt penetration/overshielding effects of interplanetary electric field (IEF), disturbance dynamo, storm sudden commencement (SSC) and substorms. The time scales of these processes can range from a few minutes to several hours. Simultaneous presence of these effects can be a hindrance to gauge the impact of an individual process on the low latitude ionosphere. Therefore, observations by multiple techniques are needed to delineate these effects. The talk will address a few of such observations. In recent times, optical observations in conjunction with other independent measurements are used to decipher the effects of space weather over low latitudes. It is shown that narrow-spectral band, narrow field-of-view airglow photometry of the 630.0 nm nocturnal airglow emission can detect the prompt penetration of interplanetary electric field (IEF) into low latitude ionosphere with high temporal resolution. A scanning mirror arrangement on top of the photometer can provide observations at different spatial locations. Thus, the variations in 630.0 nm airglow intensity observed in two different directions are used to investigate the triggering of Equatorial Spread-F (ESF) under the influence of IEF. Using this instrument and monitoring 630.0 nm and 777.4 nm airglow emissions at two different view angles (zenith and 45o East), optical signature of shear in the zonal plasma flow along with a tilted plasma plume structure associated with ESF during a space weather event is identified. It is also shown that 630.0 nm airglow emission over low latitudes can get affected by the substorm-related transient electric field perturbations and it is possible to delineate the substorm-related signatures from the IEF-related perturbations. In addition to the above results, the delineation of the effects of lesser rank X-class solar flares from the transient effects of the magnetic storm/susbtorm on the equatorial ionosphere will also be discussed

TYPE: ORAL

DATE: 2012-03-14 – 10:25

BOUNDARY CONDITIONS ON MAGNETOSPHERIC CONVECTION AT THE DIP EQUATOR AND PENETRATING ELECTRIC FIELDS

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The flow pattern of magnetospheric convection is frequently described by specifying the electrostatic potential at the top of the ionosphere as function of latitude and local time. From magnetosphere/ionosphere coupling theory, this potential function is determined as the solution of a second-order partial differential equation of elliptic type, subject to suitable boundary conditions. Most attention is usually directed to the boundary condition at high latitudes, representing the direct effects of interaction with the solar wind, but the boundary condition at the equator must also be specified; conventionally it is taken as zero meridional current, applied not at the equator itself, however, but at latitude near 20 degrees (to avoid singularities of zero inclination angle). Alternatively, it could be taken as zero meridional flow. Mathematically, the two choices correspond to Neumann and Dirichlet conditions, respectively; physically, they represent different assumptions about the local interface between the ionosphere and the magnetosphere, with significant implications for the physical mechanism of establishing prompt penetration electric fields at low latitudes.

TYPE: ORAL
DATE: 2012-03-14 – 10:45

IONOSPHERIC EFFECTS OF SEVERAL SUPER STORMS AT LOWER LATITUDES IN SOUTH AMERICAN SECTOR

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This study presents the Global Self-consistent Model of the Thermosphere, Ionosphere and Protonosphere (GSM TIP) numerical simulations of the several super storms effects in the low-latitude ionosphere. It was considered the super storms with |Dst| > 250 nT, four periods with super storm events have been analyzed: 05–08 April 2000, 27–31 October 2003, 19–23 November 2003, and 06–11 November 2004. Recent modifications to the GSM TIP model include adding empirical model of high-energy electron precipitation and introducing a high-resolution (1-min) calculation of region 2 field aligned currents (R2 FAC) and a cross-polar cap potential (CPCP). We also have included the 30 min time delay of R2 FAC variations with respect to the variations of CPCP. These modifications resulted in better representation of such effects as penetration of magnetospheric convection electric field to lower latitudes and the overshielding. To compare the calculation results we used the experimental data of Total Electron Content (TEC) from GPS receivers in South America: Belem (BELE; 1.5°S,48.5°W), Imperatriz (IMPZ; 5.5°S, 47.5°W), Brasilia (BRAZ; 15.9°S, 47.9°W), Presidente Prudente (UEPP; 22.3°S, 51.4°W), Porto Alegre (POAL; 30.1°S, 51.1°W), La Plata (LPGS; 34.9°S, 57.9°W), and Bahia Blanca (VBCA; 38.7°S, 62.3°W). We gave a particular attention to the main ionospheric drivers, such as electric field dynamo and magnetospheric origin, meridional component of thermospheric wind and neutral atmosphere composition variations. The model results show both similarities and differences from the observational results. Large positive and negative variations in the TEC during the main and recovery phases compared to quiet day variation were observed in several super storm events studied. Salient features from these studies are presented and discussed. It is shown that during geomagnetic storms, the non-uniform in height zonal electric field at geomagnetic equator forms the additional peaks in the upper part of the electron density profile.

TYPE: ORAL
DATE: 2012-03-14 – 11:00

OBSERVATION OF UNEXPECTED FEATURES IN THE EQUATORIAL ELECTRODYNAMICS DURING A DISTURBANCE DYNAMO EPISODE AND THE NEUTRAL WIND SIGNATURES THAT THEY IMPLY

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A disturbance dynamo was observed in the magnetic equatorial region of the Asian subcontinent on May 31, 2005, one day after an intense magnetic storm of relatively short duration. At first sight, there was nothing unusual about the May 31 event, with ground-based magnetograms revealing the expected very strong reduction in the normal mid-day electrojet and basically a complete disappearance of the Equatorial Ionization Anomaly, as revealed by observations of Total Electron Content (TEC) data. However, a careful study of ionosonde data at the magnetic equator strongly suggested that, contrary to conventional thinking, the F region zonal electric field had remained eastward throughout most of the day (with possibly a very brief reversal before the noon hour), this in spite of indications for reversal in the magnetic perturbations observed from the ground. The most remarkable observation on that day was not that, however, but rather a large mid afternoon amplification of the eastward zonal field that was followed by a westward turning after 1600 IST. Interestingly, this oscillation triggered a depletion in the

equatorial TEC, but without an accompanying modulation of the TEC in the anomaly crest region. Instead, the equatorial TEC returned to its pre-depletion value when the plasma came through the downward phase of its oscillation. These unexpected signatures could all be explained if the disturbed dynamo neutral wind properties obeyed two constraints, namely, (1) the neutral wind circulation cell due to Joule heating did not reach the magnetic equator but came close enough to it to essentially kill the equatorial fountain effect while maintaining an eastward zonal field; (2) a weakening of the high latitude-driven Hadley cell circulation in the mid-afternoon hours could have easily produced the observed equatorial F region zonal electric field oscillation, creating a situation that was highly reminiscent of the equatorial "Pre-Reversal-Enhancement" signature normally observed near the terminator instead of the mid-afternoon.

TYPE: ORAL
DATE: 2012-03-14 – 11:15

ON THE VARIABILITY OF THE THERMOSPHERIC 630.0NM DAYGLOW OWING TO THE SIMULTANEOUS FORCING DUE TO STRONG NEUTRAL HEATING IN THE MESOPAUSE AND A NOON TIME PENETRATION OF INTERPLANETARY ELECTRIC FIELD

S. G. Sumod and T. K. Pant

Space Physics Laboratory, Vikram Sarabhai Space Centre, Trivandrum, India

The paper for the 'first time' presents the evidence for the strong neutral heating in the Mesosphere Lower Thermosphere Ionosphere (MLTI) region over a magnetic dip equatorial station, Trivandrum in India (8.50 N, 770 E, 0.50 N) concomitant with the penetration of noon time westward Interplanetary electric field. The day on April 09, 2006 was very special, as it is characterized by the eastward/westward penetration of interplanetary electric field over equator during morning/noon time. The morning eastward penetration electric field over the equator manifested as strong ExB vertical drift and subsequent formation of high altitude F3 layer inferred from the ionogram traces. Interestingly, the noon time westward penetration resulted in unexpected changes over the equator. It was characterized by strong depletion of thermosphere OI 630.0 nm dayglow. The dayglow observations were carried out using a unique Multiwavelength dayglow photometer (MWDPM). Further analysis of magnetometer observations over Trivandrum and an off equatorial station, Alibag (18.60 N, 72.9 0 E, dip 12.8 0 N) revealed that there is a drastic decrease in cowling conductivity during this time. It is verified that this is due to the strong neutral heating (30 K) at lower E region (90 km), the proof being high mesopause temperature, as estimated using MWDPM measurements. The adiabatic expansion of the MLTI region due to this strong heating in the lower E region resulted in the significant intrusion of more molecular N2 into higher altitudes. This significantly reduced the cowling conductivity at EEJ altitudes due to the increased ion-neutral collisions and subsequently quenched the O(1D) atoms at the dayglow emitting altitudes. The importance of the present study lies in showing the emphatic changes in the equatorial ionosphere thermosphere system including the mesopause regions in conjunction with the prompt penetration electric fields.

TYPE: ORAL
DATE: 2012-03-14 – 11:30

INSTALLATION OF ELECTRIC FIELD MONITORS AT PUNTA LOBOS AND ICA, PERU

Edith Macotela[1], Jean-Pierre Raulin[2], Walter Guevara[1], Cristian Ferradas[1], and Carlos Euribe[3]

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We present the installation and calibration of two electric field monitors (EFM-100) at Punta Lobos and Ica stations. The main objectives of the electric field monitoring operation are the study of diurnal and long term variations of the atmospheric electric field due to terrestrial (earthquakes) and solar phenomena. The stations started their operations in November and December respectively.

TYPE: ORAL
DATE: 2012-03-14 – 12:00

OBSERVATIONS OF ULF WAVE RELATED VERTICAL DRIFT VELOCITY AND DENSITY FLUCTUATIONS

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Global magnetospheric Ultra Low Frequency (ULF) pulsations with frequencies in the Pc 4-5 range (f = 1.0 – 8 mHz) have been observed for decades in space and on Earth. ULF pulsations contribute to magnetospheric particle transport and diffusion and play an important role in magnetospheric dynamics. However, only a few studies have been performed on ionospheric observations of ULF wave-related perturbations in the vicinity of the equatorial region. In this paper we report on Pc5 wave related electric field and thus vertical drift velocity oscillations at the equator as observed by ground magnetometers and radar. We show that the magnetometer estimated equatorial ExB drift oscillate with the same frequency as ULF Pc5 waves, creating significant ionospheric density fluctuations. For independent confirmation of the vertical drift velocity fluctuation, we used JULIA 150 km radar drift velocities and found similar fluctuation with the period of 8-10 minutes. We also show ionospheric density fluctuations during the period when we observed ULF wave activities. All these demonstrate that the Pc5 wave can penetrate to the equatorial ionosphere and modulate the equatorial electrodynamics. Finally, in order to detect the ULF activities both on the ground and in space, we use groundbased magnetometer data from African Meridian B-field Education and Research (AMBER) and the South American Meridional B-field Array (SAMBA). From space, we use magnetic field observations from the GOES 12 and the Communication/Navigation Outage and Forecast System (C/NOFS) satellites. Using the WIND spacecraft as the upstream solar wind monitor, we present direct evidence that solar wind number density and ram pressure fluctuations observed far upstream from the terrestrial magnetosphere are the main drivers of ULF wave activity inside the magnetosphere. Finally, we show that the ULF waves in the same frequency range are observed in the magnetosphere by the geosynchronous GOES spacecraft, in the ionosphere by the equatorial C/NOFS satellite, and on the ground by ground-based magnetometers, indicating that the magnetospheric origin ULF wave can penetrate to the ground equatorial region and modulate the equatorial electrodynamics

TYPE: ORAL
DATE: 2012-03-14 – 12:15

P6.05 FEATURES OF THE IONOSPHERIC STORMS' OCCURENCE AT LOW SOLAR ACTIVITY PERIOD

Iurii Cherniak and Irina Zakharenkova

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During the years of extended solar minimum and at the beginning of the new 24th solar cycle several geomagnetic storms took place. In this study we analyzed the geomagnetic disturbances occurred on October 2008, July 2009, May 2010 and March, August and September 2011, which caused the most appreciable ionospheric response. The ionospheric changes during these events were analyzed by using the multi-instrumental diagnostic facilities data such as "Parus" ionosonde in Kaliningard observatory, the ionospheric measurements data provided by European, Japanese and Australian ionosonde networks. The global ionospheric maps of TEC (GIMs TEC) provided by International GNSS Service were used in order to estimate global storm effects. For detailed analysis of the height ionospheric structure changes we combined ionosonde-derived data with the electron density profiles retrieved from FORMOSAT-3 / COSMIC radio occultation measurements. The peak electron density (foF2) variations, shape of the electron density profiles and global GPS TEC distribution were analyzed. The geomagnetic storms with similar magnitude lead to the different ionospheric response (positive and negative) over European, Japan and Australian regions. The temporal and quantitative characteristics of the ionosphere modification during selected geomagnetic storms were revealed. It was carried out the comparison of measurement results with IRI-2007 model, that have the storm-time option. It was obtained the qualitative agreement between the ionosonde-derived foF2 values and model calculations for cases of negative ionospheric storms. The best agreement between model and observations results corresponds to the Northern Hemisphere midlatitude stations. We acknowledge the European Digital Upper Atmosphere Server (DIAS), Australian IPS Radio and Space service and the National Institute of Information and Communications Technology (NICT) in Japan for providing ionosonde data. We are also grateful to International GNSS Service (IGS) for GIMs IONEX Data.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P6.08 RESPONSE OF THERMAL AND SUPRA-THERMAL IONOSPHERIC PLASMA TO ENERGY INPUT FROM MAGNETOSPHERE AND ATMOSPHERE DURING MAGNETOSPHERIC AND THUNDER-STORMS: DEMETER OBSERVATIONS

Elena Seran and Michel Godefroy

CNRS-LATMOS, France

We present and discuss few examples of plasma observations made in ionosphere at 700 km by CNES micro-satellite Demeter during magnetospheric and thunder-storms. The conjugated observations of onboard ion retarding & drift analysers and electric field antennas (both developed by the LATMOS team) together with remote optical imagers and VLF antennas allow to analyse the perturbations of the plasma parameters (ions composition, drift and field-aligned motion, temperature and density of thermal and suprathermal population) with respect to the variation of the field-aligned currents, the electron and proton precipitation, the power and localisation of electric discharges.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P6.09 THE AUGUST 2011 URSI WORLD DAY CAMPAIGN: INITIAL RESULTS

Thomas Immel and Guiping Liu

University of California Berkeley, CA, USA

A coordinated low-latitude atmospheric-ionospheric URSI World Day campaign was organized for 1st-10th August 2011. This campaign brought together observations from a wide-range of facilities, including the incoherent scatter radars (ISR) at Jicamarca, Arecibo, Millstone Hill and Kharkov, low-latitude meteor and medium frequency radars, ground-based Fabry-Perot interferometers and the C/NOFS and COSMIC satellites. All four ISRs were run

in complementary modes to identify the behavior of the atmosphere and ionosphere on hourly-to-daily time-scales. This campaign also coincided with some of the first scientific data to be taken by the CINDI wind instrument onboard C/NOFS. Here we present some of the initial results of the atmospheric and ionospheric behavior and coupling during this unique observational interval. Particular focus is placed on the response of the low-latitude system to the magnetic storm that occurred on August 6th when Dst reached below -100 nT.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P6.11 ALGORITHM FOR SOLAR FLARE DETECTABILITY USING VLF WAVES FROM SAVNET STATION -PLO, PERU

Riano Escate[1], Javier Rengifo[1], Walter Guevara[1], and Jean-Pierre Raulin[2]

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VLF waves are used to investigate the behavior of the lower ionosphere in response to the ionizing radiation which principal source is the Sun. We present the proposal for a method to perform statistic of SPA (Sudden Phase Anomaly) detected in the radio wave signal, and caused by solar flares, using digital records of the Punta Lobos SAVNET station (CONIDA). The method proposes to develop a software to determine the sudden deflection of the reconstructed curve from the VLF phase, during a solar flare event. For this propose, the digital data is operated in a matrix form, providing as a result the following parameters: linear regression slopes on different timescales, slope time variability, and SPA start time.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P6.12 A COMBINED OPTICAL AND RADAR APPROACH FOR DERIVING PARTICLE FLUXES IN THE DAYTIME DURING GEOMAGNETIC DISTURBANCES

Duggirala Pallamraju

Physical Research Laboratory, Ahmedabad, India

Particle energies and fluxes have predominantly been measured from instruments onboard satellites. A new approach is presented in this study wherein energy estimation is done by remote method of using optical emissions as sensors in the sky. Knowing the production mechanism of an emission and the energy required to excite such an emission, information on the incident particle energy can be inferred. Traditionally, ratios of emissions with known excitation energies were used to infer the particle energies. In one study, we used daytime ground?based oxygen redline (OI 630.0 nm) emission measurements, along with the ionospheric electron density, and electron temperature profiles measured from the incoherent scatter radar, and a physics?based modelling approach to derive the energy and flux of particles incident over Boston during the storm of 30 October 2003. Such approach has also been extended for investigations of particle energies at high-latitudes and a progress on such efforts will be presented. Such an approach not only offers another method to estimate the incident particle energies and fluxes but also enhances our understanding on the channels of energy deposition in the upper atmospheric region, especially during magnetic disturbances.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P6.13 IONOSPHERIC BEHAVIOUR OVER CYPRUS DRIVEN BY MODERATE GEOMAGNETIC STORMS IN THE RISING PHASE OF THE CURRENT SOLAR CYCLE

Haris Haralambous

Frederick University, Cyprus

In the course of the current year (2011) during the rising phase of solar cycle 24, three geomagnetic storms of moderate intensity occurred due to coronal mass ejection and solar wind stream impacting Earth's magnetic field. These storms occurred on March, May and August. In this paper, we present and discuss the ionospheric response during these storms using TEC (Total electron content) and ionosonde data over Cyprus. Variation of TEC and foF2 and hmF2 ionospheric characteristics is studied in correlation with geomagnetic indices to reveal temporal and spatial patterns during these events.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P6.14 ON THE SEASONAL AND SOLAR ACTIVITY VARIABILITY OF THRESHOLD HEIGHT FOR THE OCCURRENCE OF EQUATORIAL SPREAD F DURING MAGNETICALLY DISTURBED PERIODS

M. K. Madhav Haridas and G. Manju

Vikram Sarabhai Space Centre, India

On the seasonal and solar activity variability of threshold height for the occurrence of equatorial spread F during magnetically disturbed periods M. K. Madhav Haridas and G. Manju , Space Physics Laboratory, Vikram Sarabhai Space Centre, Trivandrum – 695 022, Kerala, India

Abstract:

During magnetically quiet period, the seasonal and solar activity variability of the threshold height (h'F)c of the base of the F layer, above which ESF is triggered irrespective of the magnitude and polarity of the meridional winds has been investigated by Manju et al. (2007). In the present study, the scope of this work has been increased by considering only magnetically disturbed days, so that the disturbance induced changes if any on threshold height and its implications for ESF are brought out. Ionosonde data, of Trivandrum (8.5° N, 76.5° E, dip = 0.5° N) and SHAR (13.7° N, 80.2° E, dip 5.5° N) in the Indian longitude sector, during winter and equinox seasons of 2002 (solar maximum) and 2005 (low solar activity) have been used for the study. The study revealed that for both the solar epochs, the threshold height is higher for magnetically disturbed periods compared to quiet periods. This means that the neutral dynamical control over ESF occurrence becomes more important during disturbed periods than during quiet period. It is also revealed that similar to the behaviour during magnetically quiet period, the threshold height increases with solar activity during disturbed period. It seems that the temperature related effects on scale height which is the suggested causative mechanism for increased threshold height during high solar activity of magnetically quiet period is equally effective in producing similar effects during disturbed periods. The details will be presented and discussed.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P6.15 GPS POSITIONING DATA ANALYSIS AND ITS RELATION TO EQUATORIAL IONOSPHERIC ANOMALIES

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In this study we are going to analyze GPS positioning data obtained from GPS stations in Peru, they are from LISN (Low Latitude Ionospheric Sensor Network) Project, which is an international distributed observatory to monitor the entire atmosphere from Equatorial Region in South America with the purpose of studying and forecast the Ionospheric anomalies which affect mainly among others, radio frequency signals, especially GPS signals. They

are located near the Equatorial Dip and the 70° Meridian, where the magnetic inclination is almost 0°, which is, in turn, an appropriate condition to study Earth Magnetic Field affecting Ionospheric behavior. We have selected 1 GPS station, namely Puerto Maldonado, which is a station with the most information available. We are going to make a Time Series Analysis, tendency, standard deviation and variance of those data hourly from one day, then one month, and finally one year. In this case, the selected years are 2009,2010 and 2011 although is a short time to determine Ionospheric Anomalies, because of 11 years solar cycle. It is a close approach to assess GPS signals which allow us to monitor the variability of the positioning data and then to estimate the budget error in terms of longitude (meters), and with this data we are going to compare with minimun required standards stated by OACI in its document 9849 about GNSS Handbook for Air Navigation. The results of this study will allow us to determine Augmentation Satellite System viability in order to provide safety and efficiency in air navigation service in our region according to OACI Standards.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P6.17 SOLAR FLARES DETECTABILITY USING TWO PARALLEL VLF PROPAGATION PATHS: NPM-PLO AND NPM-ATI

Edith Macotela[1], Jean-Pierre Raulin[2], and Walter Guevara[1]

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Solar flares are among the most important phenomena which alter the space weather conditions. These events emit intense X-ray fluxes that cause perturbations in the ionospheric D-region altering its electrical conductivity. VLF signals propagating on long distances within the earth-ionosphere waveguide can detect low ionosphere perturbations as phase variations or phase anomalies. Solar flares registered from April, 2007 to December, 2009 and from January to May, 2011 by two SAVNET (South America VLF Network) radio stations located at Punta Lobos (Peru) and Atibaia (Brazil) are used to study the flare detectability on both propagation paths. Our results show that the VLF technique is able to detect very small solar events, making the VLF detection technique very promising for the continuous monitoring of the geospace conditions.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P6.19 VALIDATION OF THE STORM TIME IONOSPHERIC ELECTRIC FIELDS AND CURRENTS BY USING MAGNETIC PERTURBATIONS

Naomi Maruyama[1], Arthur Richmond[2], Astrid Maute[2], Stan Sazykin[3], and Tim Fuller-Rowell[1]

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[2] High Altitude Observatory, National Center for Atmospheric Research, Boulder, CO, USA
[3] Rice University, USA

The low and mid latitude ionospheric electrodynamics responds to the balance/imbalance between region 1 and 2 current systems at high latitude that connect the ionosphere and magnetosphere. The storm time electric field is one of the critical causes of the remarkable plasma variations, such as in the observed global GPS-TEC. There have been a limited number of observations available that can provide us with a consistent picture of the global electric fields and currents during storms. Using a physics based model that electrodynamically couples inner magnetosphere, ionosphere, plasmasphere, thermosphere, and electrodynamics, we have a capability of predicting the time variation of the global storm time electric fields and currents including both

penetration and disturbance dynamo processes that are the two main sources of the mid and low latitude storm time electric fields. In this presentation, we will present a new technique to validate the modeled electric fields and currents by using a network of magnetometers from ground and a LEO satellite.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P6.20 LATITUDINAL DEPENDENCE OF COSMIC NOISE ABSORPTION IN THE IONOSPHERE OVER THE SAMA REGION DURING THE SEPTEMBER 2008 MAGNETIC STORM

Juliano Moro[1], Clezio Marcos De Nardin[1], Mangalathayil Ali Abdu[1], Emilia Correia[2], Laysa Cristina Araújo Resende[1], Lais Maria Guizelli[1], Sony Su Chen[3], Nelson Jorge Schuch[4], and Kazuo Makita[5]

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[3] Universidade de Taubate - UNITAU, Brazil
[4] Southern Regional Space Research Center in collaboration with the LACESM/CT-UFSM, Brazil
[5] Takushoku University, Japan

In this work we present and discuss some results of latitudinal dependence in the cosmic noise absorption (CNA) as observed by the South American Riometer Network (SARINET) operated in the South American Magnetic Anomaly (SAMA) region, during a moderate intensity geomagnetic storm that occurred on September 03, 2008. In our analysis, we used the data acquired by the imaging riometers installed at São Martinho da Serra (SSO - 29.4º S, 53.1º W), Concepcion (CON - 36.5º S, 73.0º W) and Punta Arenas (PAC - 53.0º S, 70.5º W) and by the single beam riometer installed at Trelew (TRW - 43.1º S, 65.2º W). A comparison among the selected riometer data showed that the mean CNA was more pronounced at SSO, which is the site located nearest to the center of the SAMA, but the second highest value was found at the farther station. Also, a second order polynomial curve fitting was performed in order to establish an empirical relationship between the mean CNA and the total intensity of the geomagnetic field at the riometer stations.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P6.21 OPERATIONAL IONOSPHERIC DYNAMICS PREDICTION IN BRAZILIAN SPACE WEATHER PROGRAM

Adriano Petry[1], Jonas Rodrigues De Souza[1], Haroldo Fraga De Campos Velho[1], André Grahl Pereira[1], and Graham John Bailey[2]

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[2] University of Sheffield, England, UK

It is shown the development and preliminary results of operational ionosphere dynamics prediction system for the Brazilian Space Program. The system is based on the Sheffield University Plasmasphere-Ionosphere Model (SUPIM), a physics-based model computer code describing the distribution of ionization within the Earth mid to equatorial latitude ionosphere and plasmasphere. The model outputs are given in a 2-dimensional plane aligned with Earth magnetic field lines, with fixed magnetic longitude coordinate. The code was adapted to provide the output in geographical coordinates. It was made referring to the Earth´s magnetic field as an eccentric dipole, using the approximation based on International Geomagnetic Reference Field (IGRF-11). During the system operation, several simulation runs are performed at different longitudes. The original code would not be able to run all simulations serially in reasonable time. So, a parallel version for the code was developed for enhancing the performance. After preliminary tests, it was frequently observed code instability, when negative ion temperatures or concentrations prevented the code

from continuing its processing. After a detailed analysis, it was verified that most of these problems occurred due to concentration estimation of simulation points located at high altitudes, typically over 4000 Km of altitude. In order to force convergence, an artificial exponential decay for ion-neutral collisional frequency was used above mentioned altitudes. This approach shown no significant difference from original code output, but improved substantially the code stability. In order to make operational system even more stable, the initial altitude and initial ion concentration values used on exponential decay equation are changed when convergence is not achieved, within pre-defined values. When all code runs end, an approximate neighbor searching technique was developed to obtain the ion concentration values in a regularly spaced grid, using inverse distance weighting (IDW) interpolation. A 3D grid containing ion and electron concentrations is generated for every hour of simulated day. Its spatial resolution is 1 degree of latitude per 1 degree of longitude per 10 Km of altitude. The vertical total electron content (VTEC) is calculated from the grid, and plotted in a geographic map. The whole process runs every day and predicts the VTEC values for South America region with almost 24 hours ahead. Recently, data from ionosondes can be assimilated in the system to improve its accuracy.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P6.26 GEOMAGNETIC DISTURBANCE AND SOLAR PARTICLE EVENTS AND THEIR EFFECTS ON THE LOWER IONOSPHERE, USING SAVNET DATA

Fernando C. P. Bertoni and Jean-Pierre Raulin

Centro de Radio Astronomía e Astrofísica Mackenzie, Universidade Presbiteriana Mackenzie, Brazil

Measurements performed by the VLF technique, using the South America VLF Network (SAVNET) are presented. The SAVNET project has been involved in the IHY activities (2004-2009) and since then in the International Space Weather Initiative (ISWI) program. Explosive solar events and emission of energetic particles have occurred in August 2011. The impacts on the upper atmosphere were observed through subionospheric propagation anomalies as seen in the temporal variations of the signal amplitude and phase recorded on long VLF-paths. In this connection, comparing quiet and disturbed days, the phase exhibited unusual higher values that might be associated with excesses of ionization in the lower ionosphere region. These and other aspects of these geomagnetic disturbances in the ionosphere will be further discussed.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

Session 7

NEW TECHNIQUES, EXPERIMENTS, CAMPAIGNS, AND RESULTS

In this session, we solicit papers describing new experimental techniques, experiments, and campaigns, that are, or will be, used to investigate the ionosphere and atmosphere at low latitudes. Examples of new techniques include daytime Fabry-Perot Interferometers (FPI), new radar modes and configurations, and new types of in situ probes, for example to measure neutral winds on satellites and sounding rockets. We also ask for papers describing new radiowave techniques, such as those that use tomography, GPS, satellite occultations, and beacons, to explore the low latitude ionosphere and upper atmosphere. Ideas for establishing a new heater facility at an equatorial or low latitude site along with optical instruments (daytime FPI, lidars, imagers) are also requested. Presentations are encouraged that show results from new multi-technique clusters and observatory chains that have recently emerged and that promise to reveal new insights regarding atmosphere-ionosphere coupling with both global and regional (i.e., continental) coverage. For example, papers with new results from magnetometer baselines, ionosonde chains, and GPS networks operating at low latitudes are solicited as well as presentations on new satellite or rocket missions, continuous conjugate observations using incoherent scatter radars (AMISR), imagers, and/or networks of instruments.

The session will include results from dedicated observing campaigns, such as those exploring the dynamics of the ionosphere in order to investigate the onset conditions for different types of plasma irregularities and structures which thus shed light on the causes of the day-to-day variability of the ionosphere. Comparative studies between continuous measurements or campaigns conducted at different equatorial regions of the globe (e.g., South America, Africa, India, and the West Pacific) are particularly encouraged. Finally, we request theoretical and modeling presentations that describe how to best use measurements from the new instrumentation and campaigns to further our understanding of the low latitude ionosphere-thermosphere coupling and the generation of plasma structures.

Conveners: R. Pfaff, C. Valladares, and S. Raizada

INVITED – SIGNIFICANT FINDINGS FROM THE C/NOFS SATELLITE MISSION

Odile De La Beaujardiere[1], Robert Pfaff[2], C. S. Huang[1], L. Gentile[1], P. Roddy[1], Y-J. Su[1], W. Burke[3], and J. Retterer[3]

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[2] NASA Goddard Space Flight Center, Greenbelt, MD, USA
[3] Boston College, MA, USA

The Communication/Navigation Outage Forecasting System (C/NOFS) satellite was launched in April 2008 into an equatorial orbit at altitudes between 400 and 850 km. The satellite sensors measure the following: ambient and fluctuating ion densities; ion and electron temperatures; neutral winds; AC and DC electric and magnetic fields, ion drift velocities, line-of-sight total electron content and ionospheric scintillation. The mission started during the lowest solar minimum in 100 years. As a consequence, the pre-reversal enhancement in the upward plasma drift, which is responsible for early evening irregularities and equatorial plasma bubbles (EPBs), was rarely seen. EPBs that might be expected in the evening were instead observed at the satellite after midnight, although UHF ground receivers and ionosondes continued to detect scintillation in the evening. The susceptibility of the ionospheric plasma to the instabilities that produce irregularities and EPBs, as determined by models using the ambient plasma drifts measured by the satellite's instruments, seems to explain these observations. The C/NOFS data seemed to contradict the well-accepted notion that plasma bubbles observed after midnight are dead fossil bubbles. Other unexpected features are deep depletions in the ambient ionosphere observed after midnight and at dawn. These density decreases were sometimes associated with upward plasma drifts and sometimes downward drifts, and sometimes associated with plasma irregularities and sometimes not. The longitudinal and seasonal variability of the ambient density, plasma irregularities and ion velocities suggest a possible association with atmospheric tides and waves originating from the troposphere. As the solar activity increased, the pre-reversal enhancement reappeared and triggered large EPBs at dusk. During the night, the satellite often flew below the F-region peak.

TYPE: ORAL
DATE: 2012-03-14 – 14:00

INFERRING VERTICAL ION DRIFTS FROM INCOMPLETE DATASETS

Russell Stoneback, Nabin Malakar, David Lary, and Roderick Heelis

University of Texas at Dallas, TX, USA

The extremely low solar activity during the recent solar minimum of 2007/8 resulted in a low ion density ionosphere that limited measurements of ion drifts by the Ion Velocity Meter (IVM) onboard C/NOFS to altitudes near perigee. Thus, a full local time description of vertical ion drifts near the equator could only be obtained by averaging over a 67 day period as perigee precessed through all local times. For time scales less than 67 days, ion drift data for local times that are not observed are interpolated by using Empirical Orthogonal Functions (EOFs). The method decomposes the data into a series of orthogonal functions, and retains only few statistically significant EOFs such that it could optimally reconstruct the given data. The basis functions are not parametric in nature and need not be set a priori, but are objectively generated by the EOF method using the input data. The application of non-parametric, EOFs to the vertical ion drifts measured by IVM on C/NOFS will be presented.

TYPE: ORAL
DATE: 2012-03-14 – 14:20

HIGH RESOLUTION IMAGES OF EQUATORIAL BUBBLES WITH RADIO BEACON TOMOGRAPHY

Paul Bernhardt[1], Matthew Hei[1], Carl L. Siefring[1], Matthew Wilkens[1], Cesar Valladares[2], Jorge Chau[3], and Tervor Garner[4]

[1] Naval Research Laboratory, USA
[2] Boston College, MA, USA
[3] Radio Observatorio de Jicamarca, Instituto Geofísico del Perú, Lima, Perú
[4] Applied Research Laboratories, University of Texas at Austin, TX, USA

Using the NRL CERTO beacon on the C/NOFS satellite and an East-West chain of receivers across Peru, electron density maps of equatorial irregularities have been produced showing late time structures in equatorial bubbles. The CERTO beacon radiates coherent frequencies at 150 and 400 MHz with a common phase reference. Transmitted continuously from C/NOFS, these signals are phase enhanced after passing through the ionosphere. The VHF and UHF signals are acquired using NWRA ITS30 receivers and converted into total electron content with an unknown absolute value using the differential phase technique [Bernhardt and Siefring, 2009]. Receivers located at Ancon, Huancayo, Ayacucho, Cuzco, and Puerto Maldonado recorded this relative total electron content (RTEC) between the C/NOFS satellite and the ground. Using an algebraic reconstruction technique (ART), tomographic images of equatorial irregularities with 10 km spatial resolution have provided a snapshot of equatorial bubble cross section in electron density. All of the examples of 2-D bubble images occurred post midnight when they had penetrated to the top-side ionosphere. After demonstration of the tomographic imaging capability, the ground receiver network in Peru will provide operated to provide routine measurements of the equatorial F-region.

Bernhardt, P.A., Siefring, C.L. Low-latitude ionospheric scintillations and total electron content obtained with the CITRIS instrument on STPSat1 using radio transmissions from DORIS ground beacons. J. Adv. Space Res. (2009), doi:10.1016/j.asr.2009.12.001

TYPE: ORAL
DATE: 2012-03-14 – 14:35

RESULTS OF CLUSTER EXPERIMENTS USING RADIO BEACON TRANSMISSIONS FROM THE C/NOFS SATELLITE: PACIFIC SECTOR

Roland Tsunoda[1], Mamoru Yamamoto[2], David Bubenik[1], and Smitha Thampi[3]

[1] SRI International, Menlo Park, CA, USA
[2] Research Institute for Sustainable Humanosphere, Kyoto University, Japan
[3] Ahmedabad, India

The identity of the source mechanism responsible for day-to-day variability in the occurrence of plasma structure in the nighttime equatorial F layer, often called equatorial spread F (ESF), has continued to elude researchers for more than 50 years. One possibility is that there is still some physics missing in the paradigm being used to describe this phenomenon. At present, there is a general acceptance that the vigor of the post-sunset rise of the F layer is largely responsible for the development of ESF. The nature of the initial plasma perturbation is considered to be unimportant. There is, however, mounting evidence that large-scale wave structure (LSWS), which appears in the bottomside F layer, is playing an important, if not central role. Progress in this regard has been severely restricted, until recently, by the lack of measurements capable of detecting and describing LSWS. With the launch of a dual-frequency radio beacon onboard the Communications/Navigation Outage Forecast System (C/NOFS) satellite, it has become possible, for the first time, to measure LSWS properties on a routine basis. In response to this opportunity, more than 20 ground-based receiving stations have been set up in equatorial regions to create a database of LSWS description, which can be used to address the seeding question. Instruments such as spaced ionosondes and a multi-beam radar have been clustered with the receivers in the Pacific sector to expand of the space-time coverage of LSWS description. These ground-based measurements, combined with the in situ measurements from C/NOFS, constitute the most comprehensive diagnostic database for studies specifically directed toward identifying the source mechanism of the day-to-day variability. Results from combining beacon, ground based,

and in situ measurements for some case studies will be presented.

TYPE: ORAL
DATE: 2012-03-14 – 14:50

INVITED - INVESTIGATING THE LOW LATITUDE IONOSPHERE WITH 10 YEARS OF CHAMP SATELLITE DATA AND PERSPECTIVES FOR THE SWARM SATELLITE CONSTELLATION MISSION

Claudia Stolle[1], Hermann Lühr[2], Nils Olsen[1], and Martin Rother[2]

[1] Technical University of Denmark, DTU Space, Denmark
[2] Helmholtz Centre Potsdam, German Research Centre for Geosciences, Germany

During its 10 years mission the CHAMP satellite made in situ observations of the magnetic field, electron density and temperature, as well as of thermospheric density and zonal winds at altitudes between 300 and 450 km. Its lifetime from 2000 to 2010 covered the decline of the long solar cycle 23. The analysis of the data revealed many interesting discoveries and contributed significantly to understand the low latitude MIT system. Special profit was obtained by joint analyses with other data and physical models. Examples are: the mass density anomaly, signatures of upward propagating atmospheric waves, magnetic signatures of equatorial plasma irregularities, and the negative solar cycle dependence of the morning overshoot in electron temperature, just to mention some of them. In this paper we will draw special attention to the post sunset electron density and temperature distribution at low latitudes. The CHAMP observations reveal an electron temperature anomaly in analogy to the equatorial ionisation anomaly at altitudes below 400 km, although this was not predicted by earlier models. The temperature peaks coincides with the density peaks and are increased during high solar flux. Its magnitude and global distribution will be analysed. Even more extended possibilities in investigating the MIT system are expected from the ESA Swarm satellite mission. It will consist of 3 spacecraft flying in formation with initial launch altitudes of 450 and 550 km. We will shortly discuss the more than 10 Swarm data products relevant for space science and application that will be provided.

TYPE: ORAL
DATE: 2012-03-14 – 15:05

INVITED - THE LISN DISTRIBUTED OBSERVATORY - SCIENCE HIGHLIGHTS

Cesar Valladares

Boston College, MA, USA

The Low-latitude Ionospheric Sensor Network (LISN) is a distributed observatory designed to nowcast the state and dynamics of the low latitude ionosphere and to develop forecasts of the electric fields, densities and equatorial spread F (ESF) over the South American continent. The LISN observatory includes 3 different types of instruments: GPS receivers, flux-gate magnetometers and Vertical Incidence Pulsed Ionospheric Radar (VIPIR) ionosondes. This report provides a succinct summary of recent observations obtained using the LISN GPS receivers and complemented with measurements from other instruments and GPS receivers that operate in South America. The observations consist of regional maps of TEC values, plots of TEC perturbations across the continent produced by the transit of gravity waves and equatorial plasma bubbles, and plots of scintillations in a geographic context. These measurements indicate that low-latitude GPS stations can observe TEC enhancements near-midnight produced by the reverse fountain effect that is driven by localized electric fields and meridional winds. Small arrays of GPS receivers can measure the morphology of gravity waves (GW) and together with the LISN GPS network indicate regions in South America where large GW activity occurs. Regional maps of TEC over South America have provided the variability of

TEC as a function of local time, season, magnetic activity, solar cycle and longitude. This presentation will also mention other projects that are being conducted employing electric fields measured with the LISN magnetometer baselines and the LISN VIPIR ionosonde.

TYPE: ORAL
DATE: 2012-03-14 – 15:25

DETERMINING THE SHARP, LONGITUDINAL GRADIENTS IN EQUATORIAL EXB DRIFT VELOCITIES ASSOCIATED WITH THE BOUNDARIES OF THE 4-CELL, NON-MIGRATING STRUCTURES

David Anderson

CIRES, University of Colorado Boulder, CO, USA

Previous studies have established the existence of a 4-cell, longitude pattern in equatorial F region ionospheric parameters such as TEC and electron densities and in daytime, equatorial ExB drift velocities. A recent paper, for the first time, quantified the longitude gradients in ExB drift associated with the 4-cell tidal structures and confirmed that these sharp gradients exist on a day-to-day basis. Using the Ion Velocity Meter (IVM) on the Communication/Navigation Outage Forecast System (C/NOFS) satellite to obtain daytime, vertical ExB drift velocities, it was found, for example, that for October 5, 6 and 7, 2009 in the Atlantic sector, the ExB drift velocity gradient was about 1m/sec/degree. For March 23, 24 and 25, 2009 in the Peruvian sector, it was about -4m/sec/degree. In this paper we present results from a multi-instrument study of the sharp longitude gradients in the daytime ExB drift velocities at the boundaries of each of the 4-cell, non-migrating structures. We utilize both the C/NOFS IVM observations of ExB drift velocities and the ground-based magnetometer-inferred ExB drift velocities. We incorporate the LISN (Low-latitude Ionospheric Sensor Network) magnetometer chains in the South American sector and the magnetometer chains in the West African and East African longitude sectors and compare these magnetometer-inferred ExB drift velocities with C/NOFS IVM ExB drift observations. Finally, we theoretically model the ionospheric response to these sharp longitude gradients using the Global Ionosphere Plasmasphere (GIP) time-dependent model. We present the observational ExB drift results and the calculated electron density distributions and suggest future studies that would be able to account for such sharp gradients in ExB drift velocities at the boundaries of the 4-cell structures.

TYPE: ORAL
DATE: 2012-03-14 – 15:45

EQUATORIAL IONOSPHERIC DENSITY DISTRIBUTION AND THE CORRESPONDING ELECTRODYNAMICS DIFFERENCE BETWEEN AFRICAN AND SOUTH AMERICAN SECTORS

Endawoke Yizengaw[1], Eftyhia Zesta[2], Mark Moldwin[3], Baylie Damtie[4], Cesar Valladares[1], and Robert Pfaff[5]

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[3] Department of Atmospheric, Oceanic and Space Sciences, University of Michigan, MI, USA
[4] Bahir dar University, Ethiopia
[5] NASA Goddard Space Flight Center, Greenbelt, MD, USA

The uneven distribution of ground-based instruments in the equatorial regions hinders our ability to obtain a global understanding of the dynamics and structure of the equatorial ionosphere. In Africa, which has been mostly devoid of ground-based instruments, the ionospheric density structure has been traditionally estimated by model interpolation over vast geographic areas, and that make difficult for the communication and navigation systems operating in the region. Recent ground- and space-based observations have shown that geomagnetic storms can have dramatic longitu-

dinal differences in equatorial ionospheric electrodynamics, such as enhanced generation of F-region plasma irregularities, and super fountain effect at low latitudes. The vertical structures of the equatorial density distribution can be reconstructed by applying tomographic reconstruction technique on the ground-based GPS TEC and occultation TEC from GPS receivers' onboard LEO satellites. One of the possible driving mechanisms that govern the equatorial electrodynamics is the vertical drift, which strongly affects the structure and dynamics of the ionosphere in the low/mid-latitude region. According to the observations performed at different longitudes, using recently deployed limited ground-based instruments, the vertical drift velocities and the vertical density distributions have significant longitudinal differences. This paper presents tomographically reconstructed density distribution and the corresponding vertical drifts observed at three different longitudes: East African, West African, and West American sectors. The vertical drift is estimated using pairs of ground-based magnetometers technique.

TYPE: ORAL
DATE: 2012-03-14 – 16:00

POST-MIDNIGHT IONOSPHERIC IRREGULARITIES OBSERVED WITH THE C/NOFS SATELLITE AND THE EQUATORIAL ATMOSPHERE RADAR (EAR)

Tatsuhiro Yokoyama[1], Robert Pfaff[2], Patrick A. Roddy[3], Mamoru Yamamoto[1], and Yuichi Otsuka[4]

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Since the launch of Communication/Navigation Outage Forecasting System (C/NOFS) satellite, post-midnight plasma density irregularities have frequently been detected in the low-latitude region during the present solar minimum period. Using the 47-MHz Equatorial Atmosphere Radar (EAR) in West Sumatra, Indonesia (10.36S dip latitude), it is shown that the post-midnight irregularities observed with the EAR are different from standard irregularities typically observed near the magnetic equator but instead, are quite similar to those observed with the MU radar in midlatitude (29.3N dip latitude). Utilizing rapid beam-steering capability of the EAR, it is found that their tilted spatial structures are the same as medium-scale traveling ionospheric disturbances (MSTIDs) which are frequently observed in midlatitude, and they usually propagate westward as opposed to typical plasma depletions that propagate eastward observed in the post-sunset period. The zonal and meridional ExB drift velocities measured by C/NOFS are consistent with the westward propagation of backscatter echoes and the line-of-sight Doppler velocities observed with the EAR, respectively. The density structures and EAR echo intensity do not show a clear correlation, but some echoes are observed at the edge of density depletions, which may be a manifestation of a secondary ExB instability to produce 3-m scale irregularities. During solar minimum, the nighttime zonal drift could be reversed from eastward to westward with increasing altitude because of very low Pedersen conductivity in the F region, which could explain the high occurrence of midlatitude-type irregularities in the low-latitude region that is connected with the topside equatorial ionosphere.

TYPE: ORAL
DATE: 2012-03-14 – 16:15

THE NEW EMBRACE MAGNETOMETER NETWORK IN SOUTH AMERICA

Clezio Marcos De Nardin[1], José Ricardo Abalde[2], S. S. Chen[1], Lais Maria Guizelli[1], Laysa Cristina Araújo Resende[1], Juliano Moro[1], Antonio L. Padilha [1], Paulo Fagundes[2], E. Correia[1], N. J. Schuch[1], S. Domingos[1], W. S.

C. Borges[1], F. P. V. Mesquita[1], Avicena Filho[1], A. Cunha-Neto[1], C. Castilho[1], W. Gargarela Jr[1], and R. A. A. Lima[1]

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We present the new EMBRACE Magnetometer Network in South America, which so far is planned to cover most of the Easter Southern American longitudinal sector displacing magnetometer in Belem-PA (BLM, 01°26'28" S, 48°26'40" W), Manaus-AM (MAN, 02°54'52" S, 59°59'40" W), Sao Luis-MA (SLZ, 02°35'36" S, 44°12'43" W), Eusebio-CE (EUS, 03°52'48 S, 38°25'28" W), Palmas-TO (PAL, 10°17'50" S, 48°21'41" W), Cachoeira Paulista-SP (CXP, 22°42'07 S, 45°00'52 W), Sao Jose dos Campos-SP (SJC, 23°12'38" S, 45°57'23 W), Sao Martinho da Serra-RS (SMS, 29°26'36" S, 53°49'22" W), and the Brazilian Antarctic Station - Ferraz, King George Island (FRZ, 62°05'06" S, 58°24'12" W). We discuss the purpose and scientific goals of the network. We provide details on the instrumentation, the inter-calibration procedure, and installations of equipments already interlaid. In addition, we present and discuss details on the data storage, near-real time display and availability.

TYPE: ORAL
DATE: 2012-03-14 – 16:30

THE SOUTH AMERICA VLF NETWORK (SAVNET): PROVIDING NEW GROUND-BASED DIAGNOSTICS OF SPACE WEATHER CONDITIONS

Jean-Pierre Raulin

Centro de Radio Astronomía e Astrofísica Mackenzie, Universidade Presbiteriana Mackenzie, Brazil

In this paper we present recent results obtained by the South America VLF Network (SAVNET). The use of the VLF technique by tracking subionospheric propagation anomalies appears as a very promising tool to study various aspects of Space Weather disturbances. On long timescales it is possible to indirectly monitor the solar Lyman-? radiation along the solar cycles. Short time phenomena like solar explosive events can be observed with 100% probability, even for the small intensity events. Finally, the same technique is relevant to study the low ionospheric perturbations caused by geomagnetic storms on typical timescales of a day to few days.

TYPE: ORAL
DATE: 2012-03-14 – 16:45

TID STUDIES IN PERU WITH THE TIDDBIT HF DOPPLER SOUNDER

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

March 2011. Spread-F conditions detected by TIDDBIT are also compared with GPS scintillation detected by ASTRA's CASES dual-frequency receiver in Jicamarca.

TYPE: ORAL
DATE: 2012-03-15 – 08:00

24-HR THERMOSPHERIC WINDS MEASURED DURING THE 2011 CORRER CAMPAIGNS: COMPARISONS TO CHAMP AND WINDI CLIMATOLOGIES AND THE IMPACTS ON PBMOD ESF FORECASTS

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In this paper we present both night and day thermospheric wind observations made with the Second-generation, Optimized, Fabry-Perot Doppler Imager (SOFDI), a novel triple-etalon Fabry-Perot interferometer (FPI) designed to make 24-hour measurements of thermospheric winds from OI 630-nm emission. These results were obtained from under the magnetic equator at Huancayo, Peru during the summer 2011 CORRER Campaigns. The thermospheric wind measurements from Huancayo replicate recently reported CHAMP zonal winds measurements during daytime periods; in disagreement with current empirical daytime wind climatologies. These differences are discussed in light of recent ESF formation theories.

TYPE: ORAL
DATE: 2012-03-15 – 08:15

STATUS REPORT ON MULTI-BEAM INCOHERENT SCATTER RADAR MEASUREMENTS FOR THE SIMULTANEOUS ESTIMATION OF F-REGION DRIFTS, DENSITIES AND TEMPERATURES AT JICAMARCA

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At Jicamarca, standard incoherent scatter radar experiments were typically classified in two groups, perpendicular and oblique modes, depending on whether the beam was pointed perpendicular to the Earth's magnetic field (B) or away from this direction. When the beam is pointed perpendicular to B, very accurate estimates of F-region plasma drifts can be obtained, while, measurements of plasma densities and temperatures were usually obtained using oblique beams. Recently, taking advantage of the modularity of the Jicamarca antenna array, we have implemented a new incoherent scatter radar mode in which the ionosphere is probed using multiple beams pointing into different directions. In this way, different modes of magneto-ionic propagation and regimes of the incoherent scatter signals are excited. By forward-modeling the signals measured by the different beams, we can maximize the number of ionospheric physical parameters that can be inverted simultaneously. In this work, we report on the description of this new mode of operation, the construction of the forward-model of the measured signals and the inversion procedure applied to the computation of the ionospheric parameters. A detailed analysis of the accuracy of the estimated plasma parameters is presented and compared to measurements carried out using standard experiments. Applying this technique, the simultaneous estimation of plasma drifts, densities, and temperatures is finally possible at Jicamarca.

TYPE: ORAL
DATE: 2012-03-15 – 08:30

A TWO-DIMENSIONAL APPROACH FOR FABRY-PEROT INTERFEROME-

TER IMAGE ANALYSIS: MODELING, FILTERING, AND PARAMETER ESTIMATION

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In Aeronomy, Fabry-Perot interferometers are used to detect the airglow emissions from the Earth's upper atmosphere. By analyzing the measured interferometric ring patterns, it is possible to determine the Doppler shift and spectral broadening of the airglow signals, and then obtain estimates of the neutral winds and temperatures of the upper atmosphere. Standard procedures collapse the interferometric images in a single dimension before applying any parameter estimation technique, this procedure, however, disregards possible distortions of the images due to misalignment of the optic devices. A new procedure is been developed that analyzes directly the images in two dimensions without any previous manipulation of the original data. We first notice that the acquired interferometric patterns are corrupted with Speckle (multiplicative) noise; therefore, as a pre-processing step, we denoise the images via a Speckle Total Variation model. Then, we proceed to fit the noise-free images using a Fourier model of the interferometric ring patterns, to finally assess the winds and temperatures in the upper atmosphere. Our preliminary results show that the proposed method gives superior parameter estimation for both synthetic and real images than the standard procedures; moreover, we also present a detailed analysis of the expected error in our estimations.

TYPE: ORAL
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FARADAY ROTATION LAG-PROFILE INVERSION AT JICAMARCA

Juha Vierinen

Sodankyla Geophysical Observatory, Finland

We present a novel dual-polarisation incoherent scatter radar analysis method called Faraday rotation lag-profile inversion. In addition to estimating the plasma backscatter autocorrelation function at each height, the propagation delay between the two different characteristic modes of propagation can be measured, which allows the absolute electron density to be measured independently of the target backscatter mechanism. The method has recently been demonstrated a Jicamarca as a part of a general purpose experiment, which allows the simultaneous measurement of the full atmospheric profile, including everything between the MST-region and the exosphere.

TYPE: ORAL
DATE: 2012-03-15 – 09:00

THE ROLE OF OPTICALLY-THIN AND BRAGG SCATTERING IN RADAR METEORS

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Radar meteor head- and trail-echoes have been variously described as "overdense" versus "underdense" (relative to plasma frequency) and, additionally, in terms of Bragg scattering. We argue that optically-thin, coherent scattering is largely sufficient to describe radar meteor observations and that, while appropriate to volume filled incoherent scattering, Bragg scattering is of limited use in interpretation of radar meteors. We present a relatively strict definition of optically-thin coherent scattering in terms of the net scattered E-field in the plasma relative to the incident E-field and note that the optically-thin scattering occurs even in cases of small—volume limited—plasmas that are strictly "overdense". We give modeling examples supporting this approach and note that, beyond meteors, radar phenomena such as 150 km echoes and PMSE may be the result

of radar scattering from limited ensembles of highly localized plasma features.

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SPACE PLASMA ON DEMAND – MODIFICATION OF THE IONOSPHERIC RF PROPAGATION ENVIRONMENT THROUGH CHEMICAL RELEASES

Ronald Caton

Air Force Research Laboratory, USA

The Air Force Research Laboratory will conduct an experiment on the artificial generation of ionization clouds with heavy metal vapor releases in the ionosphere from sounding rockets. The Metal Oxide Space Cloud experiment (MOSC) consists of multiple rocket launches from the Kwajalein Atoll with releases of samarium vapor near 200 km and 130 km. The exothermic reaction of vaporized samarium metal with background oxygen atoms will create a long-lived and localized plasma cloud: Sm + O ? SmO+ + e -. In at least two previous experiments, samarium gas releases in the ionosphere have shown evidence of significant ionization; however, no direct measurements of the densities were made. The primary objective of MOSC is to fully characterize the physical, spectral and plasma density composition of the artificial plasma as a function of release altitude and time. In addition to samarium canisters, the rocket payload will include a Coherent Electromagnetic Radio Tomography (CERTO) beacon with ground observing sites arranged for best reception of the signal through the cloud. Incoherent scatter probing of the ionization cloud with the ALTAIR radar facility will provide electron densities. GPS scintillation and TEC receivers will be collocated with All-Sky Imagers and HF receive equipment designed to monitor oblique returns from a digisonde on the island of Roi-Namur. An optical spectrograph will provide details on the spectral characteristics of the plasma cloud. Results will be used to improve existing models and tailor future experiments targeted at demonstrating the ability to temporarily control the RF propagation environment through an on-demand modification of the ionosphere. Among the many questions this experiment is designed to investigate is whether an artificially generated local enhancement to the E-region conductivity will result in a regional suppression of scintillation?

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COLLABORATIVE NETWORK FOR OBSERVATION OF TRANSIENT LUMINOUS EVENTS, IN BRAZIL AND WHOLE LATIN AMERICA

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Transient Luminous Events – TLEs, are the optical effect of lightning discharges in the upper atmosphere above thunderclouds. They were discovered in 1989 when sprites, the most spectacular of these events, were recorded for the first time in the United States with a low-light-level video camera. Sprites are reddish optical emissions, mainly from the N2 (1PG) band, emitted by the mesospheric plasma streamers that form them and initiate at 75 km. These plasma channels propagate upwards to the bottom of the nighttime ionosphere (90 km) and downwards to 30 km, lasting 5-300 ms. Other TLEs include Blue Jets, plasma streamers that propagate from the top of thunderstorms up to 40 km, Gigantic Jets, that start as Blue Jets but propagate up to 90 km and exhibit sprite-like shapes on the top 50 km, Elves, sub-ms optical enhancements of the ionosphere at an altitude of 100 km, and Halos, disk shaped optical emission produced by the same physical process that generates sprites. Observations obtained from the Space Shuttle, and during ground and aircraft campaigns conducted in the U.S., Peru, Central America, Australia, Japan, Europe, Taiwan, and Brazil have confirmed the global aspect of TLEs. Since 2002, five different field campaigns have been

performed in Brazil to make TLE observations. The first campaign was in 2002/2003, and the others occurred once a year starting in 2005. More than 700 events, mainly sprites, have been recorded over South American thunderstorms during the Brazilian campaigns so far. This paper will review the main concepts related to these phenomena, their generation, possible effects in the upper atmosphere and observations in Brazil. It will also show the current state of a network of cameras in the process of being installed in Brazil for continuous observation of TLE. The steps to form a collaborative Latin-American network for TLE observation will also be discussed.

TYPE: ORAL
DATE: 2012-03-15 – 09:45

P7.01 AN OVERVIEW OF SCIENTIFIC AND SPACE WEATHER RESULTS FROM THE COMMUNICATION/NAVIGATION OUTAGE FORECASTING SYSTEM (C/NOFS) MISSION

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The Communication/Navigation Outage Forecasting System (C/NOFS) Mission of the Air Force Research Laboratory is described. C/NOFS science objectives may be organized into three categories: (1) to understand physical processes active in the background ionosphere and thermosphere in which plasma instabilities grow; (2) to identify mechanisms that trigger or quench the plasma irregularities responsible for signal degradation; and (3) to determine how the plasma irregularities affect the propagation of electromagnetic waves. The satellite was launched in April, 2008 into a low inclination (13?), elliptical (? 400 x 850 km) orbit. The satellite sensors measure the following parameters in situ: ambient and fluctuating electron densities, AC and DC electric and magnetic fields, ion drifts and large scale ion composition, ion and electron temperatures, and neutral winds. C/NOFS is also equipped with a GPS occultation receiver and a radio beacon. In addition to the satellite sensors, complementary ground-based measurements, theory, and advanced modeling techniques are also important parts of the mission. We report scientific and space weather highlights of the mission after nearly four years in orbit.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.02 PRELIMINARY RESULTS AND COMPARISON OF TWO METEOR RADARS AT 40 MHZ AND 50 MHZ AT JICAMARCA RADIO OBSERVATORY

Luis Condori, Karim Kuyeng, Rita Abad, and Jorge Chau

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JASMET (a 50MHz Meteor Radar) has been operating at Jicamarca Radio Observatory since 2006 helping us in the studies of the Mesosphere and Lower Thermosphere dynamics. Recently(end of 2011), we have deployed a new 42.5MHz Meteor Radar at the same location. This presentation reports the preliminary results of simultaneous measurements conducted by Jicamarca staff. We have obtained interesting results that will be the core for this presentation. We will also present the future plans for these meteor radars.

Key words: Meteor Radar

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.05 ON THE CHARACTERIZATION OF RADAR RECEIVER SYSTEMS FOR METEOR-HEAD STUDIES

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We discuss the influence that radar receiver systems play on the determination of Signal to Noise Ratio (SNR) that are obtained from meteor-head returns due to intrinsic physical properties of these echoes. This influence is described by expressing the radar equation for meteor-head echoes in terms of the ambiguity function of the transmitter pulse envelope and the filter response of the radar receiver. As result of this relationship, SNR values from meteor-head echoes will exhibit temporal fluctuations, at any Doppler velocity. Furthermore, we present meteor radar data collected using the 50 MHz antenna array located at Jicamarca Observatory (JRO) to illustrate the theoretical findings of our analysis. We demonstrate the importance of characterizing radar systems to correctly determine SNR values from meteor-head echoes and consequently infer unbiased meteor parameters that are derived using SNR profiles. We also show a statistical analysis that reveals that at least 14% of the population collected each day at JRO exhibit these temporal fluctuations on SNR plots, and therefore any approach (e.g. inversion techniques) must include a correction procedure to correctly infer meteor parameters from these subset of events.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.07 LONG-TERM ISR AND CSR CAMPAIGNS

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For ISR campaigns, for many years the Jicamarca Radio Observatory (JRO) had to choose between getting Drifts (East West Drift mode) or getting electron densities, composition and temperatures (Double Pulse Faraday mode / Hybrid 2 mode) in order to fulfill the requirements of ISCOD experiments and other scientists. Since July 2011, a new operation mode started. This new mode is able to get electron densities, composition, temperatures and drifts simultaneously. For CSR campaigns a new mode have been running since 2010, the new JULIA EW + Imaging is a combination of a modified old Julia EW mode with an Imaging mode allowing us to get ESF images every night during this mode. In this poster we will present results of the new ISR mode obtained during two long campaigns and comparisons with results of previous modes. And for the new CRS mode we will present results and statistics obtained.

Key words: ISR, measured parameters on an ISR, CSR,ESF

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.08 CONJUGATE OBSERVATIONS OF IONOSPHERIC PROCESSES IN THE AMERICAN SECTOR

Carlos Martinis[1], Jeff Baumgardner[1], Claudio Brunini[2], Terry Bullet[3], Erika Gularte [2], Diego Janches[4], Michael Mendillo[1], and Paul Zablowski[1]

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The American sector at low-middle latitudes in the southern hemisphere presents some peculiarities like the South Atlantic Magnetic anomaly and sharp deviations between geomagnetic and geographic latitudes. This makes

a unique region regarding the dynamics and electrodynamics of the upper atmosphere. Initial optical observations from all-sky imagers at Arecibo, Puerto Rico (18.3N, 66.7W, + 28mag lat) and Mercedes, Argentina (34.6S, 59.4W, - 24.5mag) show phenomena that can be explained only through an electrodynamical coupling between both hemispheres. Coupling between local E and F regions seems to play a crucial role in some of the processes observed. Thus a proper understanding of the formation and evolution of these low and midlatitude processes needs our knowledge of parameters at both hemispheres and at both ionospheric heights. We present results from ionosonde observations from the USGS San Juan Observatory (18.11N, 66.15W) and La Plata (34.9S, 57.9W), near the Arecibo and Mercedes Observatories, respectively, as well as TEC and phase fluctuations observations from GPS receivers collocated with the radio and optical instruments. This setting allows the measurement of local and magnetically conjugate ionospheric parameters. These studies are performed in the framework of AIRES (Argentina Ionospheric Radar Experiment Station) and represent the initial attempts toward a comprehensive understanding of thermosphere-ionosphere processes at low-middle latitudes measured by clusters and networks of instruments.

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P7.09 EF-ATLEC MULTI-INSTRUMENTS GONDOLA

Michel Godefroy and Elena Seran

CNRS-LATMOS, France

EF-ATLEC multi-instruments gondola for balloon flights in stratosphere in conjunction with satellite TARANIS mission"

MG & ES /LATMOS

In frame of preparation of TARANIS mission (CNES micro-satellite; launch: 2015; geosynchronous orbit at 700 km) we are developing multi-instruments gondola for the CNES balloon flights in equatorial, mid-latitude stratosphere. The idea is to carry in-situ observations of lightning and associated stratospheric discharges (TLEs blue jets, elves, etc.) simultaneously and in conjunction with the satellite observations in the ionosphere. For this purpose we are developing a multi-instruments autonomous gondola for the balloon flights with low power instruments that required high data rate acquisition and accurate dating. The LATMOS EF-ATLEC gondola consists of the electric field instrument SDA (DC-few kHz), photometers, 3D cameras, sound recorder. The concept of this gondola is planned to be used by other high data rate instruments on Cobrat/Taranis balloon project, like search-coil magnetometers and gamma detector. Preliminary tests of multi-instruments gondola with two onboard instruments (SDA of LATMOS and Field Mill of SPRL/Michigan) were performed in 2011 during CNES campaign in Kiruna/Sweden. Results and future developments are discussed.

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DATE: 2012-03-15 – 17:30

P7.10 THE EFFECTS OF COULOMB COLLISIONS ON H+, HE+, AND O+ PLASMAS FOR INCOHERENT SCATTER RADAR APPLICATIONS AT JICAMARCA

Marco Milla[1], Erhan Kudeki[2], and Jorge Chau[1]

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[2] University of Illinois at Urbana-Champaign, Urbana, IL USA

The need for considering the effects of Coulomb collisions in modeling the spectrum measurements at Jicamarca was first suggested by Sulzer and González [1999]. Motivated by this work, Milla and Kudeki [2011] developed a collisional spectrum model that takes into account Coulomb collision effects at all magnetic

aspect angles including the direction perpendicular to B as needed for Jicamarca applications. The model has been applied in preliminary fittings of radar data providing encouraging results. However, the model was developed only for O+ plasmas, which limits its application to F-region measurements between 200 km and 600 km. As an extension of this work, we are in the process of developing a new multi-component collisional incoherent scatter spectrum model that considers O+, H+, and He+ plasmas as needed for perpendicular-to-B radar observations at Jicamarca. The development of the spectrum model is being carried out based on the simulation of charged particle trajectories embedded in a collisional magnetized plasma. In our approach, friction and diffusive forces model the effects of Coulomb collisions on the particle motion; the expected values of these forces are taken from the standard Fokker-Planck model of Rosenbluth et al. [1957]. Since the simulation process is a very demanding computational task, we have developed a CUDA-based simulation program in order to run the simulations in an NVidia Tesla GPU system. The detailed study of the statistics of the simulated trajectories will give us further insight into the physics of Coulomb collisions, which is needed for the interpretation of incoherent scatter measurements. For instance, we have found that the motion process of the ions can be approximated as a standard Brownian motions process, and thus analytical expressions for ion statistics functions can be determined. On the other hand, in the case of the electrons, their motion is more complicated than a Brownian process and requires a detail analysis, however, a simplification is possible since the characteristics of the electron motion are independent from the type of plasma considered. In this presentation, we will report on our advances on the development of this new spectrum model. The model will be used in the simultaneous estimation of drifts, densities, and temperatures of the equatorial ionosphere in perpendicular-to-B experiments at Jicamarca. This experimental evaluation will have a broader impact since the accuracy of the Fokker-Planck collision model will be tested.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.11 TOMOGRAPHIC IMAGING OF THE EQUATORIAL AND LOW-LATITUDE IONOSPHERE OVER CENTRAL-EASTERN BRAZIL

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A four-dimensional time-dependent tomographic algorithm, named Multi Instrument Data Analysis System (MIDAS), is used to image the equatorial and low-latitude ionosphere over the central-eastern sides of the Brazilian territory. From differential phase data obtained by a chain of ground-based GPS receivers the total electron content (TEC) is estimated and then, together with a modeled ionosphere from International Reference Ionosphere (IRI) model, the electron density distribution is reconstructed and the parameters of the F2-peak layer are accessed from the images. This paper presents the first study of ionospheric tomography using real dual-frequency data from the Brazilian Network for Continuous GPS Monitoring (RBMC). Ionospheric F2-peak electron density (NmF2) accessed from the images are compared to concurrent measurements from three ionosondes installed across Brazil. One year of data during the solar maximum period from March/2001 to February/2002 is used to analyze the seasonal and hourly variation of the F2-layer peak density. The accuracy with which MIDAS images the electron density during geomagnetic quiet periods is investigated through its correlation and deviation with the ionosonde and IRI model data, respectively. The main aspects of the reconstruction results at the equatorial ionization anomaly (EIA) region over Brazil are presented.

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P7.12 INVESTIGATION OF LOW-LATITUDE IONOSPHERE OVER CHINA WITH A TWO-MODE VHF RADAR

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A 47.5 MHz VHF radar with a peak power of 24 kW has been set up at Sanya (18.3° N, 109.6° E, dip latitude 12.8°N), China in 2009. The most important feature is that the radar can work alternately in coherent scatter and all-sky meteor modes for observing ionosphere and meteor, respectively. In the coherent scatter mode, the radar works like a Doppler coherent backscatter radar to detect ionospheric irregularities in the E and F region of ionosphere. While in meteor mode, the radar operates as an all-sky interferometric specular meteor radar to estimate neutral winds in a height range from 70 to 110 km. In this paper, a VHF radar sounding method for simultaneously measuring ionospheric irregularities and upper atmospheric winds is presented. Some results of low-latitude ionospheric E and F region irregularities from the VHF radar are also shown. Moreover, by tracking non-specular (coherent scatter mode) and specular (classical meteor mode) meteor trail echoes as netural winds transport the plasma trails, the radar provides a good opportunity for high-resolution measurements of lower thermospheric winds. Since the radar can nearly simultaneously get ionospheric irregularities and atmospheric winds in the same region, it will be very helpful to investigating the generation mechanism of E region field-aligned irregularities (FAIs) due to the wind shear effects.

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P7.13 PARTICLE IMAGE VELOCIMETRY (PIV) MEASUREMENTS OF THE VECTOR VELOCITY OF EQUATORIAL SPREAD F IRREGULARITIES OVER JICAMARCA

Miguel Urco and Jorge Chau

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Since the first report made in 1938, Equatorial Spread F (ESF) has been observed with great interest. At Jicamarca, this phenomenon has been observed continuously by the main radar operating in the CSR (Coherent Scatter Radar) mode since 1996 and recently a new mode of operation, called JULIA Imaging, have been implemented. This new mode provides ESF data with high resolution in altitude, space, and time. In this work, taking advantage of the similarity between the behaviour of ESF turbulence and fluid turbulence, we will use the particle image velocimetry (PIV) technique to estimate the 2-D velocity field measurements of the imaging data. Among other procedures, we will use two interrogation images separated by a known time that will be correlated to obtain the plasma displacement between two images.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.14 APPARENT ELECTRON DENSITY MODULATION UNDER RF HEATING AT EISCAT UHF AND ITS APPLICATION FOR ESTIMATING THE ELECTRON-ION TEMPERATURES RATIO

Henry Pinedo[1], Cesar La Hoz[1], Ove Havnes[1], and Mike Rietveld[2]

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In a co-located campaign with UHF radar and Heating EISCAT facilities on June 7 2010 in Tromsø-Norway, standard EISCAT analysis show an apparent electron density modulation during heating-on times. The modulation is

fairly evident at heights above 90 km of altitude and is manifested as a depletion of density of approximately 40% respect to the background level during heating-off times. The increase of electron temperature in a controlled way is an expected result of artificial heating perturbation. However, the amount of energy required to produce density modulations sensible to radar systems on the ground is much more than what the HF can produce and transfer to the plasma. The associated plasma transport process due to pressure gradients induced by electron temperature variations is slowed down by the ion mass according to ambipolar diffusion. Therefore, the plasma transport time scale to produce measureable plasma depletion is larger than the current 20sec Heating-on time. The apparent electron density modulation is attributable to how the corresponding parameters have been estimated. The assumed criterium of equal temperature for electrons and ions inside the involved region is not valid under heating conditions. This situation provides an opportunity for simple and reliable estimation of Te/Ti ratio during heating-on times, based on a density modulation-less process using the radar equation.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.15 INVESTIGATIONS ON VERTICAL COUPLING USING MULTI-WAVELENGTH DAYTIME OPTICAL EMISSIONS FROM LOW-LATITUDES

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We present high-spectral resolution daytime optical emission measurements at multiple wavelengths over a large (140o) field-of-view obtained from a low-latitude location. The measurements were carried out from Hyderabad, India, wherein three upper atmospheric oxygen emission lines at 557.7 nm, 630.0 nm and 777.4 nm that emanate from around 130 km, 230 km and 300 km, respectively have been measured simultaneously using the multi-wavelength High resolution Echelle spectrograph. Around 60 days of data obtained during January – April 2011 will be presented which show different wave features at different emissions (different altitudes), different diurnal patterns that signify the wave dynamics at that altitude, and latitudinal variations that reflect the effect of neutral- and electro- dynamics of the low-latitude region. Such simultaneous multiple wavelength emission measurements provide us with a means of comprehensive investigations of vertical coupling in the upper atmosphere. Initial results on the variabilities of these emissions will be presented.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.17 EFFECTS OF VERTICAL VELOCITY SHEAR ON MEAN WIND AND TURBULENCE KINETIC ENERGY ESTIMATES USING DOPPLER BEAM SWINGING AND SPACED ANTENNA TECHNIQUES

Danny Scipion[1], Robert Palmer[2], Phillip Chilson[2], and Evgeni Fedorovich[2]

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The two techniques most often used to retrieve three-dimensional winds (zonal, meridional, and vertical) from wind profiling radars are Doppler Beam Swinging (DBS) and Spaced Antenna (SA). These well-known techniques are based on the assumption of homogeneity across the region defined by the radar beam directions. However, this assumption is not always valid due to the presence of spatial inhomogeneities in the wind field and shear. The

present study employs a combination of a virtual radar and Large-Eddy Simulations (LES) in order to evaluate different wind-profiling methods of estimating wind in the presence of horizontal shear of vertical velocity. In the first stage, the ideal shear has been studied using only the virtual simulator with constant parameters for both techniques. Later, the shear effects of the vertical velocity sheer in the horizontal wind estimates are studied using the virtual radar over a realistic case for the LES fields. Finally, it is observed that the horizontal shear of vertical velocity affects estimates of turbulence kinetic energy, which are obtained from wind estimates in both techniques.

TYPE: POSTER
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P7.18 ANNUAL DISTRIBUTION OF NEUTRAL CALCIUM AND ITS DEPENDENCE ON ION VARIATION OBTAINED USING RESONANCE LIDAR AT ARECIBO

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Calcium, a non-volatile metal, displays different characteristics than other volatile metals like sodium. This is reflected in its deficiency compared to meteoric abundance. The vertically integrated densities of neutral Ca are about 100 - 150 times smaller when compared with Na. The lack of neutral Ca in the mesosphere and the lower thermospheric region is still controversial, with the role of meteor ablation and ion-neutral chemistry being the major factors governing the distribution of this metal. One of the indicators of efficient chemistry is the ion to neutral ratio, where high values suggest slow conversion of the former to the latter. Recent studies have pointed out that the Ca+/Ca ratio is altitude dependent and ranges between 0.5 - 3.0 around 90 km. However, at higher altitudes around 98 km, this ratio increases to 10. 0. This work will present the annual distribution of neutral Ca over Arecibo and investigate the ion-neutral ratio during different seasons. The study will illustrate the relative contributions of chemistry and meteor processes on the distribution of neutral Ca.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.19 DEVELOPMENT OF LOW-COST SKY-SCANNING FABRY-PEROT INTERFEROMETERS FOR AIRGLOW AND AURORAL STUDIES

Kazuo Shiokawa[1], Yuichi Otsuka[1], Shin-ichiro Oyama [1], Satonori Nozawa[1], Mitsugi Sato[1], Yasuo Kato[1], Yoshiyuki Hamaguti [1], Mamoru Yamamoto[2], and John Meriwether[3]

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[2] Research Institute for Sustainable Humanosphere, Kyoto University, Japan
[3] Physics and Astronomy, Clemson University, Clemson, SC, USA

We have developed four new-type Fabry-Perot interferometers (FPIs) that are designed to measure thermospheric winds and temperatures and also mesospheric winds through the airglow/aurora emissions at wavelengths of 557.7 nm and 630.0 nm. One FPI (FP01) possessing a large-aperture etalon (diameter: 116 mm) was installed at the EISCAT Tromsoe site in 2009. The other three FPIs (FP02-FP04) using 70-mm diameter etalons were installed in Thailand, Indonesia, and Australia in 2010-2011 with two pairs at geomagnetic conjugate sites. FP02-FP04 are low-cost compact instruments, suitable for multipoint network observations. All of these FPIs use low-noise cooled-CCD detectors with 1024x1024 pixels combined with a 4-stage thermoelectric cooling system that can cool the CCD temperature down to -80C. The large incident angle

(maximum: 1.3-1.4 degree) to the etalon increases the throughput of the FPIs. The airglow and aurora observations at Tromsoe by FP01 show wind velocities with typical random errors ranging from 2 to 13 m/s and from 4 to 27 m/s for mesosphere (557.7 nm) and thermosphere (630.0 nm) measurements, respectively. The 630-nm airglow observations at Shigaraki, Japan, by FP02-FP04 give thermospheric wind velocities with typical random errors that vary from 2 m/s to more than 50 m/s depending on airglow intensity.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.20 TOWARDS THE IMPLEMENTATION OF A COGNITIVE RADAR TO STUDY EQUATORIAL PLASMA INSTABILITIES

Robert Sorbello[1], Julio Urbina[2], and Zach Stephens[1]

[1] Pennsylvania State University, State Park, PA, USA
[2] Communications and Space Sciences Laboratory, Pennsylvania State University, University Park, PA, USA

A cognitive radar system is composed of three key components: 1) intelligent signal processing, which builds on radar interactions from the surrounding environment, 2) receiver feedback which is utilized by the transmitter to facilitate an intelligent response to detected signals, and 3) preservation of radar echo information contents. This paper describes initial steps in implementing a cognitive radar system for studying various Equatorial phenomena occurring in the Earth's ionosphere namely: Spread-F, 150 km echoes, electrojet, and meteors. These echoes are first categorized by signal parameters with known distributions, e.g., signal-to-noise ratio, changes in range, instantaneous frequency, periodicity, etc. This information is then parsed into an intelligent agent signal classifier that makes decisions from processed data and provides a synopsis of the results into a second intelligent agent. Initial processing details and some simulation outcomes with based-intelligence that uses a support vector machine (SVM) classifier will be presented. The SVM technique is used for adaptation and optimization of the real-time signals and data synopsis. The hardware needed to implement these processes, which includes low-cost FPGAs in addition to open source software tools, will also be described. Furthermore, using object-oriented programming (OOP) techniques and open-source tools, we illustrate a technique to provide a cost-effective, generalized software framework to uniquely define an instrument's functionality through a customizable interface. The new instrument is intended to provide instantaneous profiles of atmospheric parameters and climatology on a daily basis throughout the year in Huancayo, near the Peruvian Andes.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.21 A GPU-BASED MONTE CARLO ALGORITHM FOR THE SIMULATION OF PARTICLE TRAJECTORIES IN H+, HE+, AND O+ PLASMAS

Daniel Angel Suárez Muñoz, Marco Milla, and Jorge Chau

Radio Observatorio de Jicamarca, Instituto Geofísico del Perú, Lima, Perú

In order to study the effects of Coulomb collisions on incoherent scatter (IS) radar signals, Milla & Kudeki [2011] developed a Monte Carlo procedure to estimate the IS spectra for different sets of plasma parameters. This procedure is based on the simulation of charged-particle trajectories in ionospheric plasmas, a task that requires high computational power. In this poster, we report on the development of a GPU (Graphic Processing Unit) parallel computing algorithm that reduces the computational cost of particle-trajectory simulations. The algorithm takes advantage of the multithreaded processing capability of NVIDIA CUDA-enabled GPUs, such that each thread simulates independently the trajectory of a particle (either an

electron or an ion) in a given plasma configuration but considering different initial conditions. The simulation results are time series of particle velocities and displacements in three dimensions, results that are then used in the calculation of single-particle ACFs (Fourier transforms of the particle displacement distributions) and the subsequent estimation of IS spectra. The description of our GPU algorithm to perform the simulations and compute the correlations are presented together with statistics of our results.

Milla, M. A., and E. Kudeki (2011), Incoherent scatter spectral theories–Part II: Modeling the spectrum for modes propagating perpendicular to B, IEEE Transactions on Geoscience and Remote Sensing, 49(1), 329–345, doi:10.1109/TGRS.2010.2057253.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.22 OBSERVATION OF SIMULTANEOUS L-BAND SCINTILLATION FROM GPS AND GSAT-8

Surendra Sunda[1], P. V. Khekale[1], K. S. Parikh[1], A. S. Ganeshan[2], and S.V.Satish[3]

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[2] ISRO Satellite Centre, Bangalore, India
[3] Airports Authority of India, New Delhi, India

The geostationary satellite GSAT-8 carrying the GAGAN (GPS Aided Geo Augmented Navigation) payload was successfully launched on May 21, 2011 and was positioned at 55o E. The L1 and L5 downlink frequencies are used to transmit the WAAS correction messages, whereas uplink of data is carried on C band. It is the first satellite from ISRO with this kind of payload after the initial failure of GSAT-4. This has provided the fully functional capability to the ambitious project of Indian Satellite Based Augmentation System-GAGAN. GAGAN will provide the seamless navigation to civil aircrafts over the Indian flight information region. Using the ground network of GPS-TEC receivers installed at various airports under the GAGAN project, L-band scintillation was measured from GPS and GSAT-8 satellites simultaneously. Scintillation measurements using GPS are temporal and spatial in nature due to orbital period of 11h 56 min. GSAT-8, being the geostationary satellite provides the unique opportunity to measure the scintillation at specific fixed location depending upon the receiver location. It is well established that scintillation affects the user position accuracy and may lead to loss of lock of the satellite. Such high scintillation at user receiver in the line of sight of GSAT-8 can potentially result into short service outage. We will be presenting, for the first time, simultaneous observations of L-band scintillation from GPS and GSAT-8 over the Indian region. These results will highlight the occurrence pattern of scintillation to better understand the underlying phenomena. It will be complimented by the morphological studies on L-band scintillation over the Indian equatorial sector using the GPS-TEC data of 2004-2011.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.23 DEVELOPMENT OF A PASSIVE VHF RADAR SYSTEM USING SOFTWARE DEFINED RADIO FOR EQUATORIAL PLASMA INSTABILITY STUDIES

Burak Tuysuz[1], Julio Urbina[2], and Frank Lind[3]

[1] Pennsylvania State University, State Park, PA, USA
[2] Communications and Space Sciences Laboratory, Pennsylvania State University, University Park, PA, USA
[3] MIT Haystack Observatory, Massachusetts Institute of Technology, MA, USA

In this paper we describe a bistatic passive radar system named "Penn State University Passive Radar System (PSUPRS)" that uses open source hardware and software defined radio resources to utilize non-cooperative FM radio transmitters for upper atmosphere remote

sensing. The open source software defined radio toolkit GNU Radio is used to reduce signal processing needs and accompanied with the open source hardware Universal Software Radio Peripheral 2 (USRP2) for data acquisition. The resultant system is highly flexible compared to hardware based radio receivers and open to future developments. We will offer the design procedure and performance analysis of our instrument with early results. We aim to place PSUPRS near magnetic equator for a long term operation mainly because of the orientation of the Earth magnetic field lines in the region. We also propose target locations near Lima, Peru for the planned bistatic operation to observe ionospheric E and F region field aligned plasma irregularities.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.24 AN OVERVIEW OF A COGNITIVE RADAR SYSTEM TO STUDY PLASMA IRREGULARITIES NEAR THE PERUVIAN ANDES

Julio Urbina

Communications and Space Sciences Laboratory, Pennsylvania State University, University Park, PA, USA

We describe the implementation of a VHF coherent imaging radar in Huancayo, near the Peruvian Andes to initiate continuous monitoring of the plasma structuring in the equatorial ionosphere. The new radar system will utilize cognitive sensing techniques and complement the ionospheric observations conducted by the Jicamarca incoherent scatter radar (ISR), located about 170 km to the west of Huancayo along the geomagnetic equator. The main purpose of the new system will be to obtain uninterrupted images of ionospheric structuring and drifts from Huancayo, which are only probed and sampled intermittently from Jicamarca due to the operation costs and scheduling issues of the more powerful incoherent scatter system. It should be noted that the main advantage of operating an incoherent scatter system to measure the state parameters of the ionosphere is lost intermittently (in space and/or time) when thermal equilibrium conditions are violated and the ionosphere becomes unstable and turbulent. Since such "events" are quite routine near the geomagnetic equator – e.g., equatorial electrojet, 150 km irregularities, equatorial spread F – there is much to be gained by maintaining a continuous monitoring of the turbulent structures and studying their onset and evolution vis a vis ISR observations of ionospheric state parameters in time and space surrounding the turbulent structures and layers. The proposed Huancayo station is in effect a "child" of Jicamarca in the sense that most of the techniques to be used were first developed at Jicamarca – e.g., imaging radar interferometry, drift measurements using 150 km echoes, etc. We will report current progress of the construction of the system and initial steps for its deployment.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.26 RADIO OCCULTATION METHODS FOR MONITORING ATMOSPHERE AND IONOSPHERE OF THE EARTH

Victor Hugo Rios, Sebastian Leal, and Hernan Esquivel

Universidad Nacional de Tucuman, Argentina

The remote sensing satellite radio occultation method elaborated for monitoring of the earth's atmosphere and ionosphere with a global coverage is described. Comparison of theoretical results with experimental observations of radio wave propagation effects in the earth's atmosphere and ionosphere in the communication links satellite-to-satellite is provided. Directions in application of the radio occultation method are discussed: measuring vertical gradients of the refractivity in the atmosphere and electron density in the lower ionosphere, determination of the temperature regime in the stratosphere and tropo-

sphere, investigation of the internal wave activity in the atmosphere, and study of the ionospheric disturbances on a global scale. The radio occultation technique may be applied for investigating the relationships between processes in the atmosphere and mesosphere, study of thermal regimes in the intermediate heights of the upper stratosphere-lower mesosphere, and for analysis of influence of space weather phenomena on the lower ionosphere. Radioholographic methods are considered as a tool for determination of the altitude profiles of temperature, pressure, refractivity, internal wave activity in the atmosphere, and electron density in the ionosphere with usage of the radio links satellite-to-satellite. Results of radio occultation measurements of the atmospheric and ionospheric parameters are described. Comparative analysis of effectiveness of the radio occultation and other remote sensing methods is conducted.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.28 ESTIMATION OF ABSOLUTE TEC WITH GNU RADIO BEACON RECEIVER (GRBR)

Mamoru Yamamoto[1], Kensuke Hangyo[1], S. Tulasi Ram[2], and Roland Tsunoda[3]

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[2] Equatorial Geophysical Research Laboratory, Indian Institute of Geomagnetism, India
[3] SRI International, Menlo Park, CA, USA

GNU Radio Beacon Receiver (GRBR) is a simple digital receiver for satellite-ground beacon experiment to measure ionospheric total electron content (TEC). This is a unique instrument that is based on the open-source hardware "Universal Software Radio Peripheral (USRP)" and the open-source software "GNU Radio". TEC is measured from phase differences between dual-band beacon signals at 150 and 400MHz. One problem of this experiment is that raw product from an experiment is relative TEC along the slant ray-path from a satellite to the GRBR. Estimation of offset for each satellite pass is essential to obtain the absolute TEC. Well known technique for it is the two station method proposed by Leitinger et al. [1975]. In the study of day-to-day variability of the low-latitude/equatorial ionosphere, however, the GRBR network is too sparse to apply this method in many situations. In our study of large-scale wave structure (LSWS), we use the beacon signal from C/NOFS satellite, and estimate the offset by assuming linearly trended TEC distribution with longitude. S. Tulasi Ram et al. [2011] recently showed that this "one-station" approach can be very effective to to our study purpose. Now we try to use data from other polar-orbiting satellite at a single station, or with the very sparse receiver network. In this presentation we discuss problems and solutions to estimate offset of observations, and obtain the absolute TEC.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.31 COMPARISON OF EQUATORIAL TEC AT AFRICAN AND AMERICAN LONGITUDES DURING THE MINIMUM AND ASCENDING PHASES OF SOLAR CYCLE 24

Andrew Akala[1], Patricia Doherty[2], Cesar Valladares[2], Charles Carrano[2], Endawoke Yizengaw[2], Gopi Seemala[3], and Juan Carlos Espinoza[4]

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[2] Boston College, MA, USA
[3] K.L. University, India
[4] Radio Observatorio de Jicamarca, Instituto Geofísico del Perú, Lima, Perú

This study compares equatorial total electron content (TEC) at African and American longitudes during the minimum (2009) and ascending (2011) phases of solar cycle 24. GPS-TEC data, which were observed at the same local time at two equatorial stations

on both longitudes: Lagos (6.52oN, 3.4oE, 3.04oS magnetic latitude) [NIGERIA] and Pucallpa (8.38oS, 74.57oW, 4.25oS magnetic latitude) [PERU] were used for the investigation. These data were grouped into daily, seasonal and solar activity sets. Receiver and satellites biases were obtained from the Data Centre of the Bern University, Switzerland, and they have been carefully removed from the TEC data. Furthermore, in order to eliminate multipath effects from the data, elevation angle cut-off of 30o was adopted. The hourly averages of each data set were determined. In conclusion, the day-to-day variation in vertical TEC (VTEC) recorded the maximum during 1400–1600 LT hours and minimum during 0400–0600 LT hours at both longitudes. Seasonally, maximum VTEC values were observed during Equinoxes and minimum during Solstices. VTEC also increased with solar activity. On longitude by longitude comparison, the African sector recorded the highest VTEC values than the American sector. Overall, this study re-affirms the uniqueness of the dynamics of the African equatorial ionosphere, and the need for further research efforts that could support better understanding of these dynamics.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.32 INVESTIGATION OF THE PLASMASPHERE CONTRIBUTION TO THE GPS TEC UNDER SOLAR MINIMUM CONDITIONS

Irina Zakharenkova[1], Iurii Cherniak[1], Andrzej Krankowski[2], and Irk Shagimuratov[1]

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[2] Institute of Geodesy, University of Warmia and Mazury, Olsztyn, Poland

The plasmaspheric electron content (PEC) was estimated by comparison GPS observations and FORMOSAT-3/COSMIC radio occultation (RO) measurements at the extended solar minimum of cycle 23/24. GPS observations provide information about values of vertical total electron content (TEC) up to the 20,200 km. FormoSat-3/COSMIC now provides unprecedented global coverage of GPS RO measurements. Depending on the state of the constellation, COSMIC has been producing 1,500 – 2,500 good soundings of the ionosphere and atmosphere per day, uniformly distributed around the globe. This number of RO is much higher than even before. In this study, COSMIC RO data for different seasons corresponded to equinoxes and solstices of 2009 (March, June, September and December) were analyzed. All selected COSMIC RO electron density profiles were integrated up to the height of 700 km (altitude of COSMIC satellites), in that way the estimates of ionospheric electron content (IEC) were retrieved on a global scale. The final IGS combined global ionospheric maps (GIMs) were used to calculate the global maps of monthly medians of TEC values. As a result there were analyzed global distributions of GPS TEC and IEC estimates corresponded to the monthly median values for different seasons of 2009. We consider the quantitative differences PEC = TEC – IEC as a measure of the contribution of the PEC to GPS TEC. In order to analyze seasonal behaviour of PEC contribution to GPS TEC at the different regions we selected several specific points with coordinates, corresponded to the approximate positions of different, mid-latitude and low-latitude, ionospheric sounding stations. Such points were selected at Northern America, European and Asian regions, Southern America, Southern Africa and Australia. For each specific points GPS TEC, COSMIC IEC and PEC estimates were analyzed. Results of our comparative study revealed that for mid-latitude stations PEC estimates varied weakly with the time of a day and reached the value of several TECU (3-5 TECU) for the condition of solar minimum. Percentage contribution of PEC to GPS TEC indicates the clear dependence from the time and varies from a minimum of about 25-30% during day-time to the value of more than 60% at night-time.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

P7.33 LISN OBSERVATORY: DATA PRODUCTS AND RESULTS

César De La Jara[1], Juan Carlos Espinoza[1], César Valladares[2], and Jorge Chau[1]

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[2] Boston College, MA, USA

The Low-Latitude Ionospheric Sensor Network (LISN) monitors the low, middle and high atmosphere in the equatorial region with the purpose of studying and forecasting ionospheric phenomena. LISN is composed of an array of modern geophysical instruments deployed in South America, near the position reference of the magnetic equator and the meridian 70oW. This distributed observatory is mainly constituted by three types of instruments: GPS receivers, ionosondes and magnetometers, instruments that are continuously collecting data and send a heavy volume of information to a central server located at the Instituto Geofísico del Perú (IGP). In order to facilitate the access to the database for the LISN users, a collection of programs and web-oriented interfaces have been developed to carry out different tasks such as management, analysis, processing, and visualization of the measured data and estimated parameters. In this poster, a summary of the data products measured with the LISN server is presented. In addition, the tools developed for the data analysis will be described.

TYPE: POSTER
DATE: 2012-03-15 – 17:30

Session 8

FUTURE TRENDS AND CHALLENGES

- Altitude and latitude coupling as drivers for equatorial dynamics (stratospheric warming effects, migrating vs. non-migrating tides, F region/E region coupling effects in the equatorial region and for midlatitude irregularities).
- Extracting new information from existing techniques (e.g., radar imaging, meteor trail tracking, dynamical parameters from network measurements).
- Integrating large datasets (multiple instrument datasets, model output/dataset integration).
- Next-generation numerical models of the coupled geospace system.
- Meeting the operational needs for space weather prediction.

Conveners: M. Larsen, M. Hagan, and C. La Hoz

INVITED - STUDY OF SOLAR FORCING AND ATMOSPHERIC COUPLING EFFECTS TO THE IONOSPHERE BY USING FORMOSAT-3/COSMIC AND FORTHCOMING FORMOSAT-7/COSMIC-II MISSION

Chao-Han Liu[1], Jann-Yenq Liu[2], and Charles Lin[3]

[1] Academia Sinica, Taiwan
[2] National Space Organization, Taiwan
[3] National Cheng Kung University, Taiwan

The ionospheric electron density structures are modulated by forcing from the solar outputs and upward propagating tides/planetary waves of lower atmosphere origins. The modulated global ionospheric effects, including effects from the periodic solar wind, magnetic storm, troposphere excited tides and stratospheric sudden warming, are revealed by continuous observations of electron density profiles derived retrieved from GPS radio occultation soundings of FORMOSAT-3/COSMIC during 2006-2011. These results prove that the continuously available three-dimensional global observation of the ionospheric electron density is crucial for better understanding the dynamics of Earth's upper atmosphere. As the result, a continuous satellite constellation capable of performing more GNSS radio occultation soundings is planned and named as FORMOSAT-7/COSMIC-II. In this study, we first review scientific achievements of solar wind, ionosphere, and atmosphere coupling studies by using FORMOSAT-3/COSMIC observations. Following the brief review, the planned FORMOSAT-7/COSMIC-II mission and its potential application in further exploring the coupling ion effects are introduced.

TYPE: ORAL
DATE: 2012-03-16 – 10:30

INVITED - RADAR INSTRUMENTATION IN THE AFRICAN SECTOR: WHY AND HOW

Anthea Coster[1], Endawoke Yizengaw[2], and Mark Moldwin[3]

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[2] Boston College, MA, USA
[3] Department of Atmospheric, Oceanic and Space Sciences, University of Michigan, MI, USA

The distribution of equatorial ionospheric plasma is strongly influenced by multiple competing factors, including solar heating, tidal forces, equatorial electrodynamics, and the horizontal magnetic field geometry. Much of our understanding of this complex ionospheric region has been gained from observations made with the incoherent scatter radar at Jicamarca in the American sector. However, in the American sector, there is a fairly large excursion, or dip, between the geomagnetic and geodetic equators, a factor that adds to the complexity of the physics. In the African sector, where there is currently no incoherent (or coherent) scatter radar, the geomagnetic and geodetic equators are reasonably parallel, separated by at most 10 degrees. To further add to this already complex picture, the South Atlantic Anomaly, a region where the magnetic field is 'weaker', lies in between the American and African sectors.

Data from satellites (e.g. ROCSAT, C/NOFS, DMSP) have indicated that the equatorial ionosphere in the African sector responds differently than other sectors. For example, ionospheric bubbles have been observed to be much deeper and to occur more frequently in the African sector. It has also been reported that ionospheric depletions more frequently rise to higher altitudes (up to 1000+ km) in the African sector than those in other longitude sectors. To date, these observations have not been confirmed, validated or studied in detail by observations from the ground due to lack of suitable ground-based instrumentation in Africa. The causes or driving mechanisms of the unique density irregularities, bubbles, and depletions in the African sector remain unresolved.

To address these issues, the U.S. National Science Foundation has recently sponsored a workshop at Boston College to consider the possibility of relocating an Advanced Modular Incoherent Scatter Radar (AMISR) to Ethiopia. The primary purpose of this workshop was to define the science goals motivating such a move and to examine the technical and logistical issues involved. This talk will summarize the findings of this workshop.

TYPE: ORAL
DATE: 2012-03-16 – 10:55

INVITED - A PRELIMINARY LOOK AT VERTICALLY THIN TROPOSPHERIC RADAR ECHOES BOTH RADAR AND SITU MEASUREMENTS

Ben Balsley[1], Dale Lawrence[2], Ron Woodman[3], and Dave Fritts[4]

[1] CIRES, University of Colorado Boulder, CO, USA
[2] Aerospace Engineering Sciences, University of Colorado Boulder, CO, USA
[3] Instituto Geofísico del Perú, Lima, Perú
[4] NorthWest Research Associates, Colorado Research Associates Division, Boulder, CO, USA

We report results of an initial campaign designed to provide high-resolution in situ temperature profiles in conjunction with concurrent VHF radar measurements through the same tropospheric volume. The immediate focus is on clarifying the background atmospheric properties in the vicinity of vertically narrow regions of enhanced radar backscatter previously reported by Woodman et al. (20xx). Future focus will be on incorporating such temperature profiles, along with additional high-resolution in situ data on winds, humidity, and turbulence, into DNS models in order to establish the pertinent dynamical processes underlying the enhanced echo-producing mechanisms.

The present talk includes concurrent data from (1) the SOUSY Radar (for high-resolution backscatter returns), (2) the large JRO array (for winds), (3) standard meteorological balloon releases from Lima and (4) a miniature autonomous vehicle (MAV) that was carried to altitude by a conventional meteorological balloon. The MAV ('DataHawk') was then released to record temperature measurements during descent. The DataHawk was designed and instrumented at the University of Colorado in Boulder, and can provide all of the in situ data mentioned above to altitudes of at least 10 km in future experiments.

TYPE: ORAL
DATE: 2012-03-16 – 11:20

INVITED - APERTURE SYNTHESIS RADAR IMAGING FOR UPPER ATMOSPHERIC RESEARCH

David Hysell[1] and Jorge Chau[2]

[1] Cornell University, Ithaca, NY, USA
[2] Radio Observatorio de Jicamarca, Instituto Geofísico del Perú, Lima, Perú

Aperture syntheis imaging offers a means of observing upper atmospheric phenomena in three spatial dimensions with fixed-beam radars. The data supporting the imagery are cross-spectral visibility estimates obtained from spaced receivers on the ground. Extracting imagery from the data is an inverse problem and prompts an investigation of the existence, uniqueness, and stability of the solution. We describe an approach to the imaging problem based on the MaxEnt algorithm, a Bayesian inversion scheme that uses Shannon's entropy as a prior probability estimate. We discuss error propagation along with a few extensions to the basic algorithm useful for upper-atmospheric applications. Finally, we demonstrate the algorithm in the context of ionospheric plasma density irregularities using coherent scatter data from the Jicamarca Radio Observatory.

TYPE: ORAL
DATE: 2012-03-16 – 11:45

INVITED - COUPLING BETWEEN THE LOWER AND UPPER ATMOSPHERE DURING STRATOSPHERIC SUDDEN WARMINGS: TRENDS AND CHALLENGES

Larisa Goncharenko[1] and Jorge Chau[2]

[1] Haystack Observatory, Massachusetts Institute of Technology, Westford, Massachusetts, USA
[2] Radio Observatorio de Jicamarca, Instituto Geofísico del Perú, Lima, Perú

Sudden stratospheric warming events have recently received significant attention as a prime example of strong coupling between the lower and upper atmosphere, in particular at equatorial and tropical latitudes. New results on drastic changes in the plasma density during SSW events have stimulated numerous studies of possible connections between the lower and upper atmosphere and have raised many questions about the mechanisms of these connections. They also highlighted major challenges for both observational and modeling communities. For observational community, there is a critical need for obtaining global-scale mesospheric and ionospheric data sets with high temporal and spatial resolution that is necessary to extract tidal signatures in various parameters and examine roles of various tides (solar and lunar, migrating and non-migrating, diurnal, semidiurnal, and terdiurnal). For understanding the vertical and latitudinal coupling, atmosphere-ionosphere global coupled models need to treat seamlessly the neutral atmosphere from the troposphere to the thermosphere, as to include self-consistently electrodynamics. We will discuss these challenges and outline several outstanding questions that are particularly interesting for further research.

TYPE: ORAL
DATE: 2012-03-16 – 12:10

INVITED - UPPER ATMOSPHERE RESPONSE TO MAJOR AND MINOR STRATOSPHERE SUDDEN WARMING

Huixin Liu[1], Mamoru Yamamoto[2], Y. Yamazaki[1], and K. Yumoto[1]

[1] Kyushu University, Japan
[2] Research Institute for Sustainable Humanosphere, Kyoto University, Japan

Stratosphere sudden warming (SSW) is a local meteorological event with a global impact. Strong semi-diurnal perturbation in the vertical plasma drift and TEC has been frequently reported. A general depletion of the plasma and thermospheric density has also been observed during the 2009 major SSW, indicating a substantial cooling in the upper atmosphere. Now we ask, are these features common to all SSW? What are the differences between responses to major and minor SSW? Using ground and satellite observations, ionospheric electrodynamics, thermosphere variation and the global Sq current are investigated in Asian, Africa and Peruvian sectors to elucidate the above questions.

TYPE: ORAL
DATE: 2012-03-16 – 12:35

INVITED - POLAR AND EQUATORIAL MESOSPHERIC ENHANCED RADAR ECHOES REVISITED

Cesar La Hoz

University of Tromsø, Norway

Enhanced radar echoes from the mesosphere, regardless of geographic location, are caused by neutral air turbulence that drives the electron density fluctuations that ultimately produce the radar wave scattering. The key question is under what conditions the spatial spectrum of the electron fluctuations has components (at the radar's Bragg scale) of the appropriate strength to produce the observed signal intensity. The simpler case is when the neutrals couple directly to the electrons at the Bragg scale. This is the case in the lower mesosphere (below about 80 km) where the Kolmogorov scale length can be of the order of, or smaller than, the relevant Bragg scale (typically around or less than 3 metres for VHF radars).

This situation requires either, enhanced electron densities (possible at high latitudes via energetic auroral precipitation), or a powerful radar (such as the 50 MHz Jicamarca radar). The former case may apply to Polar Mesospheric Winter Echoes (PMWE), and the latter case to measurements obtained with the Jicamarca radar near the equator. The more involved case is when the electron fluctuation spectrum requires an additional agent to extend its inertial subrange beyond the neutral's Kolmogorov scale. This occurs in the upper mesosphere (80 km and above) where the Kolmogorov scale can be several tens of metres for typical energy dissipation rates. The agent are charged ice particles that occur only at high latitudes during summer. The electrons acquire the diffusion rate of the massive ice particles due to ambipolar coupling, thus prolonging the inertial subrange beyond the Kolmogorov scale and covering the Bragg scale of typical VHF radars. The enhanced echoes are known as Polar Mesospheric Summer Echoes (PMSE). A few issues still remain, such as the role of meteoritic smoke in both, the polar winter echoes and the equatorial echoes, as the overshoot effect (under artificial RF heating) has been observed in polar winter echoes. We present an alternative calculation of the cross section of the equatorial echoes and compare the results with the cross section of the polar winter echoes under the assumption that the electron fluctuations have a Kolmogorov spectrum.

TYPE: ORAL
DATE: 2012-03-16 – 13:00

AUTHOR INDEX

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STATISTICS

Monday March 12	08:30-10:40 (Auditorium)	
Session 3: Wave propagation between low/middle atmosphere and ionosphere (I) **Chairs: C. Lin and D. Scipion**		
08:45	Yee, Jeng-hwa	Solar cycle effects in the ionosphere: the relative contribution of solar variability and lower atmosphere driving
09:00	Liu, Hanli	INVITED - Large-scale ionospheric perturbations caused by atmospheric waves
09:20	Balsley, Ben	INVITED - Gravity Wave Coupling, Interactions, and Instabilities in the MLTI
09:40	Vincent, Robert	Gravity Wave generation by Convection and Middle Atmosphere Response
09:55	Swenson, Gary	Ground based observations in the MLT, damped GWs; and new lidar for the E-region (110-200 km).
10:10	Paulino, Igo	Study on vertical propagation of medium-scale gravity waves observed during the COPEX campaign
10:25	Saito, Akinori	Ionospheric disturbances after the 2011 off the Pacific coast of Tohoku Earthquake observed by the GPS receiver array in Japan
Monday March 12	**11:10 - 13:00 (Auditorium)**	
Session 3: Wave propagation between low/middle atmosphere and ionosphere (II) **Chairs: K. Shiokawa and L. Goncharenko**		
11:10	Takahashi, Hisao	Influence of 2-day Planetary wave in the equatorial ionosphere
11:25	Ren, Zhipeng	Simulated equinoctial asymmetry of the ionospheric vertical plasma drifts
11:40	Fang, Tzu-wei	INVITED - Impact of Planetary Waves on the Ionosphere during January 2009
12:00	Lin, Charles	Atmosphere-ionosphere coupling effects at low latitude observed by FORMOSAT-3/COSMIC
12:15	C, Vineeth	Impacts of Polar Stratospheric Sudden Warming on the Equatorial Atmosphere-Ionosphere Region
12:30	Forbes, Jeffrey	Gravitational Tides and Their Influence on the Thermosphere
12:45	Maute, Astrid	Effects of Sudden Stratospheric Warming simulated by the Thermosphere-Ionosphere-Mesosphere-Electrodynamics-GCM
Monday March 12	**14:35-16:30 (Auditorium)**	
Session 1: Irregularity Physics (I) **Chairs: E. Kudeki and T. Yokoyama**		
14:35	Hysell, David	INVITED - Hierarchy of processes behind F-region plasma density irregularities
14:55	Dao, Eugene	3D Electromagnetic Plasma Model: Electric and Magnetic Signatures of Plasma Irregularities
15:10	Aveiro, Henrique	On the equipotential field line approximation in the low-latitude ionosphere and its implication on spread F simulations
15:25	Yamamoto, Mamoru	Day-to-day variability of equatorial Spread-F observed with GNU Radio Beacon Receiver (GRBR) in Asia and Africa
15:40	Pfaff, Robert	Electric Field and Plasma Density Observations of Irregularities and Plasma Instabilities in the Low Latitude Ionosphere Gathered by the C/NOFS Satellite
15:55	Luehr, Hermann	INVITED - Ionospheric irregularities at low latitudes and their magnetic signatures
16:15	Sripathi, Samireddipalle	Study of equinoctial asymmetry in the Equatorial Spread F (ESF) irregularities over Indian region using multi-instrument observations in the descending phase of solar cycle-23
Monday March 12	**17:00-19:05 (Auditorium)**	
Session 1: Irregularity Physics (II) **Chairs: R. Varney and Y. H. Chu**		
17:00	Kelley, Michael	A Tutorial: Solutions to the Last Outstanding Equatorial Electrojet Problems
17:20	Hamza, Abdelhaq	On Nonlinear Farley-Buneman Irregularities
17:35	Sekar, Ramanathan	E-region plasma waves over Thumba, India: Recent results
17:50	Muralikrishna, Polinaya	Meteoric Dust Effect on the E-Region Plasma Instability Mechanisms
18:05	Mathews, John	Meteoroid Fragmentation and High-Altitude Meteors Observed at Jicamarca

18:20	Galindo, Freddy	The Role of Turbulence on the Evolution of Specular Meteor Echoes
18:35	Dyrud, Lars	Influence of ionospheric electrojets on meteor trail evolution
Tuesday March 13		**08:00-10:00 (Auditorium)**
Session 1: Irregularity Physics (III) **Chairs: M. Milla and D. Farley**		
08:00	Ilma, Ronald	Post-sunset irregularities in the equatorial upper E-region
08:15	Chau, Jorge	On the East-West structure of 150-km Perpendicular and Off-perpendicular to B echoes over Jicamarca
08:30	Kudeki, Erhan	Incoherent scatter and sounding measurements in the 150 km region of the equatorial ionosphere
08:45	Narayanan, Viswanathan Lakshmi	Characteristics of Equatorial Plasma Bubbles observed from Indian sector during winter months of deep solar minimum
09:00	Liu, Jann-yenq	Global S4 Index Observed by FORMOSAT-3/COSMIC
09:15	Bagiya, Mala	Forecasting L band scintillations when and for how long: a reality?
09:30	Sidorova, Larisa	He+ Density Depletions as Indicator of the Topside Ionosphere Plasma Bubbles
Tuesday March 13		**10:30 - 12:30(Auditorium)**
Session 4: Plasma neutral coupling **Chairs: E. Nossa and D. Hysell**		
10:30	Varney, Roger	INVITED - Effects of Thermospheric Variability on Topside Equatorial Plasma Temperatures
10:50	St-maurice, Jean-pierre	INVITED - The impact of the January 15, 2010, annular solar eclipse on the ionospheric properties at and near the magnetic equator.
11:10	Shiokawa, Kazuo	Geomagnetic conjugate observations of nighttime medium-scale travelling ionospheric disturbances and thermospheric neutral winds at middle latitudes
11:25	Valladares, Cesar	Measurement of the Characteristics of TIDs using Small and Regional Networks of GPS receivers
11:40	Immel, Thomas	INVITED - ICON : The Ionospheric Connection Explorer
12:00	Huang, Cheryl	Ionosphere-Thermosphere Coupling During Deep Solar Minimum
12:15	Nossa, Eliana	Theoretical model for Es irregularities caused by Neutral Winds
Tuesday March 13		**14:00 - 17:05 (Auditorium)**
Session 5: Low and mid latitude Aeronomy and Electrodynamics (I) **Chairs: T. Fuller-Rowell and J. Meriwether**		
14:00	Fejer, Bela	INVITED - Quiet Time Variability in the Electrodynamics of the Low Latitude Ionosphere
14:20	Burrell, Angeline	Climatology of Topside Magnetic Field-Aligned Ion Drifts at Solar Minimum
14:35	Emery, Barbara	Low and Mid-Latitude Climatology Assessment of Ionosphere/Thermosphere Models During Solar Minimum
14:50	Liu, Libo	Changes in the equatorial ionosphere over Jicamarca during recent two solar minima
15:05	Mendillo, Michael	Ionospheric Variability at Equatorial and Low Latitudes during Periods of Extreme Solar Quiescence
15:20	Pacheco, Edgardo	The day-to-day longitudinal variability of the global ionospheric density distribution at low latitudes during low solar activity
15:35	Sobral, Jose	On the nocturnal westward drifts of the low-latitude ionosphere: an overview
15:50	Bertoni, Fernando	Observations of the vertical and zonal ionospheric plasma drift velocities, obtained by ionosondes and incoherent scatter radar at the Brazilian and Peruvian sectors of geomagnetic longitude
16:05	Ritter, Patricia	Lunar signals in the variations of the daytime equatorial ionisation anomaly from CHAMP
16:20	Oyekola, Oyedemi	Solar flux behavior of the equatorial vertical E×B drift velocities obtained from ionograms at longitude 358.5oE sector
16:35	Kailasam Madathil, Ambili	The oscillation of the F region peak altitude in the equatorial ionosphere at sunrise: evidence for an interplay between first order chemical effects and second order electrodynamical effects.
16:50	De Paula, Eurico	THE SÃO LUÍS 30 MHZ COHERENT SCATTER RADAR: ONE SOLAR CYCLE OF EQUATORIAL IONOSPHERIC MEASUREMENTS
Tuesday March 13		**17:35 - 19:30 (Poster Area)**
Poster Session 1: S1, S3, S5 **Chairs: E. Pacheco, E. Miller, D. Scipion** **Session 1P: Irregularity Physics**		
P1.01	Ayoola, Muritala	CASE STUDIES OF SOME SPECTACULAR JET STREAMS IN THE TROPOSPHERE AND LOWER STRATOSPHERE OVER TWO MAJOR STATIONS IN NIGERIA
P1.03	Li, Guozhu	Characteristics of the ionospheric F-region irregularities over Sanya
P1.04	Thu Trang, Nguyen	On the relationship of multi-reflected echoes to large-scale wave structure and equatorial spread F
P1.05	Abadi, Prayitno	IONOSONDE OBSERVATIONS OF SPREAD F IRREGULARITIES AT LOW LATITUDE PAMEUNGPEUK (INDONESIA) DURING LOW SOLAR ACTIVITY
P1.07	Shi, Jiankui	Ionospheric strong range spread-F observed in the low latitude station Hainan
P1.08	Tiwari, Diwakar	New Network of spaced receiver VHF scintillation experiments over Indian region: Results on ESF irregularities.
P1.09	Banola, Sridhar	Importance of ionospheric equatorial VHF scintillation in the Indian region to study Sun-Earth interactions
P1.10	Klimenko, Maxim	Electron temperature enhancements in nighttime equatorial ionosphere under the occurrence of plasma bubbles
P1.11	Chakraborty, Shyamal Kumar	Variabilities of ionospheric scintillations around equatorial ionization anomaly crest of the Indian zone
P1.12	Bagiya, Mala	On the evolution of medium (hundreds of m) and small (few m) scale ESF irregularities: a new look through GPS window

P1.14	Tisnado, Gilberto	Plane Waves Forcing on Equatorial F-spread, Earth-Sun, Universe Phenomena and on Upcasting
P1.15	Valladares, Cesar	Morphology of plasma TEC depletions over South America
P1.16	Miller, Ethan	Extended observations of decameter scatter associated with the mid-latitude ionospheric trough
P1.18	Farley, Donald	Refining Measurements of the Spread in Aspect Angles of Radar Scatter from Equatorial Electrojet Irregularities
P1.19	De La Cruz, Ricardo Yvan	Statistical analysis of VHF radar plume parameters at three longitudinal sectors (São Luís, Jicamarca and Christmas Island).
P1.21	Guizelli, Lais	Climatological Study of the Daytime Occurrence of the 3-meter EEJ Plasma Irregularities Observed over the Jicamarca Close to the Solar Minimum (2007 and 2008)
P1.23	Sripathi, Samireddipalle	Seasonal and solar flux variation of ionospheric F-region ion density and drifts as observed by ROCSAT-1 and their comparison with ground based EEJ strength and VHF scintillations over Indian region
P1.26	Bhattacharyya, Archana	Intermediate scale length ESF irregularity spectrum and associated electric field fluctuations
P1.27	Chu, Yen Hsyang	Meridional electric field measurements of layer-type and blob-type plasma structures in mid-latitude sporadic E region: Plausible generation mechanisms
Session 3P: Wave propagation between low/middle atmosphere and ionosphere		
P3.02	Paulino, Ana Roberta	Seasonal variability of gravity wave momentum flux in the MLT over Sao Joao do Cariri (7°S; 36°W).
P3.03	Monteiro, Alan	Study of Mesosphere-Thermosphere-Ionosphere coupling at low latitude
P3.04	Xiong, Jiangang	Evidence of coupling between middle atmosphere and ionosphere during 2009 sudden stratospheric warming through lunar semidiurnal tides
P3.05	Klimenko, Maxim	Ionospheric variability during SSW 2009 event TIME-GCM and GSM TIP model results and observations
P3.08	Sg , Sumod	Signatures of Sudden Stratospheric Warming on the Equatorial Ionosphere-Thermosphere System
P3.09	Lima, Lourivaldo	Diurnal tide and 2-day wave coupling in the meteor winds at Cachoeira Paulista and São João do Cariri, Brazil, observed during June-July 2008
P3.10	Araujo, Luciana	Mesospheric and Low Thermospheric Dynamics over 7.4 S and 22.7 S
P3.12	Lin, Jia-ting	Ionospheric migrating tide modification during the 2008-2009 stratospheric sudden warming
P3.13	Goncharenko, Larisa	Comparative study of ionospheric response to recent stratospheric sudden warmings
P3.14	Yee, Jeng-hwa	An empirical model of middle and upper atmosphere climatology derived from TIMED observations
P3.15	Sripathi, Samireddipalle	Quiet-time variability of the GPS TEC and EEJ strength over Indian region and their connection to the major Sudden Stratospheric Warming (SSW) events during 2005/2006
P3.16	Fagundes, Paulo Fagundes	Observed gravity wave-gravity wave interaction at mesospheric heights
P3.18	Paulino, Ana Roberta	Atmospheric lunar tide observed by meteor radar at middle and low latitudes in Brazil
P3.19	Vargas, Fabio	Gravity wave signatures in multiple instrument datasets observed at the Andes Lidar Observatory
P3.20	Klimenko, Maxim	F3 layer variability during SSW events
P3.22	Brum, Christiano	Spectral analysis of the midlatitude ion temperature responses to the Sudden Stratospheric Warming event.
P3.23	Ferradas, Cristian	SUDDEN PHASE ANOMALIES DETECTED AT PUNTA LOBOS 2007-2009, PERU
P3.24	Egito, Fabio	An investigation of the activity of the equatorial planetary scale waves by using wind observational measurements and model simulations
Session 5P: Low and mid latitude Aeronomy and Electrodynamics		
P5.01	Klimenko, Vladimir	Low-latitude ionospheric effects before strong earthquakes: Theory, model results, new aspects and recent advances
P5.02	Lee, Min-chang	Whistler Wave-induced Ionospheric Plasma Turbulence: Source Mechanisms and Remote Sensing
P5.04	Haralambous, Haris	Climatology during a low solar activity and enhancements in the critical frequency foF2 over Cyprus in the absence of pronounced geomagnetic activity
P5.07	Meriwether, John	Radar and optical observations of sudden zonal wind decrease in the equatorial zonal neutral wind
P5.08	Muralikrishna, Polinaya	Rocket observations of electron temperature and energy distribution in the lower F-region prior to the onset of equatorial plasma bubbles
P5.09	Hickey, Dustin	MTM Characteristics from Arecibo Incoherent Scatter Radar
P5.10	Oyekola, Oyedemi	Comparison of global model and ionosonde vertical drifts observations in the postsunset equatorial ionosphere
P5.12	Peddapati, Pavan Chaitanya	Solar flux and ExB dependent features of F3 layer observed from Indian low latitude stations
P5.13	Resende, Laysa	A study of different blanketing Es layers during the solar cycle 23
P5.14	Santos, Angela	Differences between the dependences of equatorial F region evening vertical drift on F10.7 and EUV fluxes over Brazil
P5.15	Simoes, Fernando	Synopsis of Low Frequency Electromagnetic Waves Detected by C/NOFS: Implications for Equatorial Ionospheric Modeling
P5.17	Vogel Ely, Cláudia	Vertical ExB drift during pre-reversal peak hours at magnetically conjugate stations in Brazil (COPEX Campaign) using Digisonde data
P5.18	Zhao, Biqiang	Coordinate investigation of the F2 layer stratification at low-latitude ionsophere: results from the COSMIC and GIRO
P5.19	Sripathi, Samireddipalle	Seasonal and diurnal behavior of the ionospheric F layer over Indian region during extremely low solar activity conditions as observed by COSMIC
Wednesday March 14	**8:00 - 9:55 (Auditorium)**	

Session 6: Ionospheric storms and Space weather effects at low and mid latitudes (I) Bubbles/Scintillations, Space Weather related		
Chairs: D. Pallamraju and J.-P. St-Maurice		
08:00	Huba, Joseph	INVITED - Three-dimensional Modeling of Equatorial Bubbles
08:20	Groves, Keith	Equatorial Scintillation Activity During Extended Solar Minimum
08:35	Abdu, Mangalathayil A.	INVITED - Storm time variability in Equatorial Spread F/Plasma bubble irregularity development
08:55	Foster, John	Space Weather and Geospace Effects of Storm-Time Thermal Plasma Redistribution
09:10	Zakharenkova, Irina	Response of the mid-latitude ionosphere to geomagnetic storm on October 11, 2008 and October 11, 2010
09:25	Erickson, Philip	Ionospheric Superstorm Drivers: The Role of the Atlantic Sector Polarization Terminator
09:40	Takahashi, Hisao	Space Weather Program in Brazil
Wednesday March 14	**10:25 - 12:30 (Auditorium)**	
Session 6: Ionospheric storms and Space weather effects at low and mid latitudes (II) Prompt penetration, Disturbance dynamo, TIDs, VLF/ULF waves		
Chairs: Naomi Maruyama and John Foster		
10:25	Chakrabarty, Dibyendu	INVITED - Effects of space weather over low latitudes: recent results using optical and other techniques
10:45	Vasyliunas, Vytenis M.	Boundary conditions on magnetospheric convection at the dip equator and penetrating electric fields
11:00	Klimenko, Vladimir	Ionospheric effects of several super storms at lower latitudes in South American sector
11:15	St-maurice, Jean-pierre	Observation of unexpected features in the Equatorial Electrodynamics during a disturbance dynamo episode and the neutral wind signatures that they imply
11:30	Sg , Sumod	On the variability of the thermospheric 630.0nm dayglow owing to the simultaneous forcing due to strong neutral heating in the mesopause and a noon time penetration of interplanetary electric field
12:00	Macotela, Edith	Installation of electric field monitors at Punta Lobos and Ica, Peru
12:15	Yizengaw, Endawoke	Observations of ULF wave related vertical drift velocity and density fluctuations
Wednesday March 14	**14:00 - 17:00 (Auditorium)**	
Session 7: New techniques, experiments, campaigns, and results (I)		
Chairs: R. Pfaff, and C. Denardin		
14:00	De La Beaujardiere, Odile	Invited -- Significant Findings from the C/NOFS Satellite Mission
14:20	Stoneback, Russell	Inferring Vertical Ion Drifts from Incomplete Datasets
14:35	Huba, Joseph	High Resolution Images of Equatorial Bubbles with Radio Beacon Tomography
14:50	Tsunoda, Roland	Results of cluster experiments using radio beacon transmissions from the C/NOFS satellite: Pacific sector
15:05	Stolle, Claudia	INVITED - Investigating the low latitude ionosphere with 10 years of CHAMP satellite data and perspectives for the Swarm satellite constellation mission
15:25	Valladares, Cesar	INVITED - The LISN distributed observatory - Science highlights
15:45	Anderson, David	Determining the Sharp, Longitudinal Gradients in Equatorial ExB Drift Velocities Associated with the Boundaries of the 4-cell, Non-migrating Structures
16:00	Yizengaw, Endawoke	Equatorial Ionospheric Density Distribution and the corresponding electrodynamics difference between African and South American sectors
16:15	Yokoyama, Tatsuhiro	Post-midnight ionospheric irregularities observed with the C/NOFS satellite and the Equatorial Atmosphere Radar (EAR)
16:30	Denardini, Clezio	The New EMBRACE Magnetometer Network in South America
16:45	Raulin, Jean Pierre	The South America VLF Network (SAVNET): Providing new ground-based diagnostics of Space Weather conditions
Thursday March 15	**8:00 - 10:00 (Auditorium)**	
Session 7: New techniques, experiments, campaigns, and results (II)		
Chairs: C. Valladares and S. Raizada		
08:00	Crowley, Geoff	TID Studies in Peru with the TIDDBIT HF Doppler Sounder
08:15	Gerrard, Andrew	24-Hr Thermospheric Winds Measured During the 2011 CORRER Campaigns: Comparisons to CHAMP and WINDI Climatologies and the impacts on PBMOD ESF Forecasts
08:30	Milla, Marco	Status report on multi-beam incoherent scatter radar measurements for the simultaneous estimation of F-region drifts, densities and temperatures at Jicamarca
08:45	Navarro Dominguez, Luis	A two-dimensional approach for Fabry-Perot Interferometer image analysis: Modeling, filtering, and parameter estimation
09:00	Vierinen, Juha	Faraday rotation lag-profile inversion at Jicamarca
09:15	Mathews, John	The Role of Optically-Thin and Bragg Scattering in Radar Meteors
09:30	Groves, Keith	Space Plasma On Demand Modification of the Ionospheric RF Propagation Environment through Chemical Releases
09:45	São Sabbas, Fernanda	Collaborative Network for observation of Transient Luminous Events, in Brazil and Whole Latin America
Thursday March 15	**10:30 - 12:20 (Auditorium)**	
Session		

Session 5:	**Low and mid latitude Aeronomy and Electrodynamics (II)**	
Chairs: T. Fang and J. Chau		
10:30	Narayanan, Viswanathan Lakshmi	Astudy on the night time equatorward movement of ionization anomaly using thermospheric airglow imaging technique
10:45	Makela, Jonathan	Results from the first two years of measurements obtained from RENOIR in Brazil
11:00	Meriwether, John	Thermospheric wind and temperature climatology for the equatorial region: Results and comparisons with the WAM predictions for the 2009-2011 period
11:15	Taylor, Michael	Comparing gravity wave and mesospheric temperature variability over the Andes mountains (30 S) and the central Pacific ocean (20.8 N)
11:30	Duggirala, Pallam Raju	Effect of compositional variations on the seasonal variability in the oxygen daytime optical emissions over mid-latitudes
11:45	Buriti Da Costa, Ricardo Arlen	General behavior and intraseasonal oscillation of temperature observed in a low latitude MLT region by meteor radar, photometer and SABER/TIMED.
12:00	Martinis, Carlos	INVITED - Low and midlatitude thermosphere/ionosphere processes during extreme solar activity conditions
Thursday March 15	**14:00 - 17:00 (Auditorium)**	
Session 5:	**Low and mid latitude Aeronomy and Electrodynamics (II)**	
Chairs: B. Fejer and E. Pacheco		
14:00	Fuller-rowell, Tim	INVITED - Prospects for modeling and forecasting tidal variability and low latitude electrodynamics
14:20	Valladares, Cesar	LISN Model-Data Assimilation Results: Solar Tides, Lunar Tides, and Other Drivers
14:35	Maruyama, Naomi	Evaluating the Dynamic and Energetic Variations of the Ionosphere and Plasmasphere Associated with the Geomagnetic Field Variations
14:50	Klimenko, Maxim	Investigation of the equatorial F3 layer characteristics using the Intercosmos-19 data
15:05	Nogueira, Paulo	Equatorial TEC over South American sector with large longitudinal variation in magnetic declination angle
15:20	Fang, Tzu-wei	Equatorial-PRIMO (Problems Related to Ionospheric Models and Observations)
15:50	Pfaff, Robert	DC and Structured Electric Fields Observed on the C/NOFS Satellite and their Association with Longitude, Plasma Density, and Solar Activity
16:05	Pfaff, Robert	Meridional winds in the equatorial ionization anomaly observed by the Streak mission
16:20	Fentzke, Jonathan	New measurement of the effects of Ion-Neutral Collisions in the E-region Over Arecibo
Thursday March 15	**17:30 - 19:30 (Poster Area)**	
Poster Session 2: S4, S6, S7		
Chairs: M. Milla, T. Fang, F. Vargas		
Session 4P: Plasma neutral coupling		
P4.02	Pfaff, Robert	Comparison of Observations of Sporadic-E Layers in the Nighttime and Daytime Mid-Latitude Ionosphere
P4.03	Fukushima, Daisuke	Geomagnetic conjugate observations of plasma bubbles and thermospheric neutral winds at equatorial latitudes
P4.SB1	Sg , Sumod	Vertical coupling between mesopause and equatorial ionospheric F region: Anew insight
P4.SB2	Goncharenko, Larisa	Plasma neutral coupling during sudden stratospheric warming events
Session 6P: Ionospheric storms and Space weather effects at low and mid latitudes		
P6.05	Cherniak, Iurii	Features of the ionospheric storms occurence at low solar activity period
P6.08	Seran, Elena	Response of thermal and supra-thermal ionospheric plasma to energy input from magnetosphere and atmosphere during magnetospheric and thunder-storms: Demeter observations
P6.09	Immel, Thomas	The August 2011 URSI World Day Campaign: Initial Results
P6.11	Escate, Riano	ALGORITHM FOR SOLAR FLARE DETECTABILITY USING VLF WAVES FROM SAVNET STATION -PLO, PERU
P6.12	Duggirala, Pallam Raju	Acombined optical and radar approach for deriving particle fluxes in the daytime during geomagnetic disturbances
P6.13	Haralambous, Haris	Ionospheric behaviour over Cyprus driven by moderate geomagnetic storms in the rising phase of the current solar cycle
P6.14	C, Vineeth	On the seasonal and solar activity variability of threshold height for the occurrence of equatorial spread F during magnetically disturbed periods
P6.15	Taramona, Jorge	GPS POSITIONING DATAANALYSIS AND ITS RELATION TO EQUATORIAL IONOSPHERIC ANOMALIES
P6.17	Macotela, Edith	Solar Flares Detectability using Two Parallel VLF Propagation Paths: NPM-PLO and NPM-ATI
P6.19	Maruyama, Naomi	Validation of the Storm Time Ionospheric Electric Fields and Currents by Using Magnetic Perturbations
P6.20	Moro, Juliano	Latitudinal dependence of cosmic noise absorption in the ionosphere over the SAMAregion during the September 2008 magnetic storm
P6.21	Petry, Adriano	Operational Ionospheric Dynamics Prediction in Brazilian Space Weather Program
P6.26	Bertoni, Fernando	Geomagnetic Disturbance and Solar Particle events and their effects on the lower ionosphere, using SAVNET data
Session 7P: New techniques, experiments, campaigns, and results		
P7.01	Pfaff, Robert	An Overview of Scientific and Space Weather Results from the Communication/Navigation Outage Forecasting System (C/NOFS) Mission
P7.02	Condori, Luis	Preliminary results and comparison of two Meteor Radars at 40 MHz and 50 MHz at Jicamarca Radio Observatory
P7.05	Galindo, Freddy	On the characterization of radar receiver systems for meteor-head studies
	Kuyeng, Karim	

P7.07	Ruyeng, Kanth Milagros	Long-term ISR and CSR campaigns
P7.08	Martinis, Carlos	Conjugate observations of ionospheric processes in the American sector
P7.09	Godefroy, Michel	EF-ATLEC multi-instruments gondola
P7.10	Milla, Marco	The effects of Coulomb collisions on H+, He+, and O+ plasmas for incoherent scatter radar applications at Jicamarca
P7.11	Muella, Marcio	Tomographic imaging of the equatorial and low-latitude ionosphere over central-eastern Brazil
P7.12	Ning, Baiqi	Investigation of low-latitude ionosphere over China with a two-mode VHF radar
P7.13	Urco, Miguel	Particle Image Velocimetry (PIV) measurements of the vector velocity of equatorial spread F irregularities over Jicamarca
P7.14	La Hoz, Cesar	Apparent electron density modulation under RF heating at EISCAT UHF and its application for estimating the electron-ion temperatures ratio
P7.15	Duggirala, Pallam Raju	Investigations on vertical coupling using multi-wavelength daytime optical emissions from low-latitudes
P7.17	Scipion, Danny	Effects of vertical velocity shear on mean wind and turbulence kinetic energy estimates using Doppler beam swinging and spaced antenna techniques
P7.18	Raizada, Shikha	Annual distribution of neutral calcium and its dependence on ion variation obtained using resonance lidar at Arecibo
P7.19	Shiokawa, Kazuo	Development of low-cost sky-scanning Fabry-Perot interferometers for airglow and auroral studies
P7.20	Sorbello, Robert	Towards the Implementation of a Cognitive Radar to Study Equatorial Plasma Instabilities
P7.21	Suarez Muñoz, Daniel	A GPU-based Monte Carlo algorithm for the simulation of particle trajectories in H+, He+, and O+ plasmas
P7.22	Sunda, Surendra	Observation of Simultaneous L-band Scintillation from GPS and GSAT-8
P7.23	Tuysuz, Burak	Development of a Passive VHF Radar System Using Software Defined Radio for Equatorial Plasma Instability Studies
P7.24	Urbina, Julio	An Overview of a Cognitive Radar System to Study Plasma Irregularities near the Peruvian Andes
P7.26	Rios, Victor	Radio occultation methods for monitoring atmosphere and ionosphere of the earth
P7.28	Yamamoto, Mamoru	Estimation of absolute TEC with GNU Radio Beacon Receiver (GRBR)
P7.31	Valladares, Cesar	Comparison of Equatorial TEC at African and American Longitudes during the Minimum and Ascending Phases of Solar Cycle 24
P7.32	Zakharenkova, Irina	Investigation of the Plasmasphere Contribution to the GPS TEC under Solar Minimum Conditions
P7.33	De La Jara, César	LISN Observatory: data products and results
Friday March 16		**8:00 - 10:00 (Auditorium)**
Session 2:		**E and F region coupling (low and mid latitude coupling)**
Chairs: J. Urbina and C. Martinis		
08:00	Otsuka, Yuichi	INVITED - GPS Observations of Medium-Scale Traveling Ionospheric Disturbances over Europe
08:20	Yokoyama, Tatsuhiro	INVITED - Numerical modeling of medium-scale traveling ionospheric disturbances (MSTIDs) seeded by sporadic-E layers
08:40	Cosgrove, Russell	Mechanisms for E-F Coupling and their Manifestation
08:55	Miller, Ethan	MSTIDs from High to Low Latitudes
09:10	Cherniak, Iurii	Variations of the Es layer parameters over Europe and Asian region
09:25	Tiwari, Diwakar	Occurrence of Ionospheric F3 layer over equatorial station Tirunelveli under extremely prolonged low solar activity during 2007-2009.
Friday March 16		**10:30 - 13:35 (Auditorium)**
Session 8:		**Future trends and challenges**
Chairs: M. Hagan and C. La Hoz		
10:30	Liu, Jann-yenq	INVITED - Study of solar forcing and atmospheric coupling effects to the ionosphere by using FORMOSAT-3/COSMIC and forthcoming FORMOSAT-7/COSMIC-II mission
10:55	Coster, Anthea	INVITED - Radar Instrumentation in the African sector: Why and How
11:20	Balsley, Ben	INVITED - A Preliminary Look at Vertically Thin Tropospheric Radar Echoes Both Radar and Situ Measurements
11:45	Hysell, David	INVITED - Aperture synthesis radar imaging for upper atmospheric research
12:10	Goncharenko, Larisa	INVITED - Coupling between the lower and upper atmosphere during stratospheric sudden warmings: trends and challenges
12:35	Yamamoto, Mamoru	INVITED - Upper Atmosphere Response to Major and Minor Stratosphere Sudden Warming
13:00	La Hoz, Cesar	INVITED - Polar and equatorial mesospheric enhanced radar echoes revisited