function of latitude on a given magnetic meridian is lacking. During the Oct-Nov 2002 Conjugate Points Equatorial Experiment (COPEX) campaign was conducted at three sites in western Brazil; one site was situated at the magnetic equator while the other two were selected at magnetic conjugate locations approximately ± 10° MLat. The campaign was organized and coordinated by the Aeronomy Group at the Brazilian National Institute for Space Research (Instituto Nacional de Pesquisas Espaciais- INPE). A number of diagnostic instruments, including digisondes, GPS scintillation and TEC diagnostics, VHF scintillations and plasma drifts, and all-sky imagers were operated routinely throughout the campaign period. The work presented here focuses on the meridional variations of GPS and VHF scintillations from the northern to the southern anomaly regions (± 15° MLat) and their correlation with total electron content over the same spatial extent. The key issue for consideration is whether the scintillation intensity is directly proportional to electron density (i.e., TEC) across a flux tube implying constant $\Delta N/N$ within the instability region, or whether some other relative scaling between the density and scintillation exists. The results provide insight into the distribution of irregularities and, indirectly, the energetics of instabilities within a flux tube. The outcome of this investigation directly impacts techniques to extrapolate local measurements to other latitudes based on knowledge of the meridional density structure from, for example, an ionospheric model of the ambient density.

SA43B-06 1445h INVITED

Equatorial Spread F Variability Investigations in Brazil: Preliminary Results from Conjugate Point Equatorial Experiments Campaign - COPEX

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Equatorial spread F variability can result from diverse conditions of the coupling processes that control the dynamic state of the ambient ionosphere-atmosphere system of the evening hours. While the sunset associated prereversal electric field enhancement (PRE) is known to be the most basic prerequisite for initiating ESF development, the intensity of an event seems to be controlled also by other factors, such as the symmetry/asymmetry of the ionization anomaly, flux tube integrated conductivities, and a possible (but largely unknown) perturbation source. An evaluation of the possible contributions from some of these factors to the observed ESF variability can be possible from measurements carried out over equatorial and conjugate points locations. A conjugate point equatorial observational campaign (COPEX) was conducted in Brazil during October to December 2002. The COPEX used digital ionosondes, all-sky imagers, GPS receivers, and other complementary instruments at the magnetic equatorial and conjugate point stations in the western longitude sector of Brazil. The campaign objective was to investigate the equatorial spread F/plasma bubble irregularity (ESF) generation conditions in terms of the ambient ionosphere-thermosphere properties along the magnetic flux tubes in which they occur. The COPEX digisonde observations permitted field line mapping of the conjugate E layers to dip equatorial F layer peak/bottomside. Other digisondes at eastern longitudes in Brazil complemented these measurements . Our results are based on the analysis of selected data sets, and we address the questions concerning: Trans-equatorial thermospheric winds and their effect on the ESF development; ESF variability under magnetospheric forcing through disturbance electric fields and winds; and the possible role of sporadic E layers on the ESF variability

SA44A CC: 519 A Thursday 1530h

New Frontiers in Equatorial Ionospheric Physics: Irregularities II

Presiding: **M Kelley,** Cornell University**; R Pfaff,** NASA Goddard Space Flight Center

SA44A-01 1530h

Space-Time Variabilty of Ionospheric Scintillaion in the Equatorial Region

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The marked day-to-day variability of equatorial ionospheric irregularities (scale lengths of tens of m to hundreds of m) has been investigated by performing multi-frequency scintillation observations at specific locations by many investigators worldwide. In addition to such temporal variability, multi-satellite observations from one station reveal extreme spatial variability when a region with intense irregularities may remain separated from a benign region by only 500 km over an entire night. In this paper, we show that the GUVI sensor on the TIMED satellite can image the equatorial anomaly on a global scale and such images can be used to specify in space and time the scintillating and non-scintillating regions. We present a case study of GUVI images on two successive nights during an equinoctial period. On one night the equatorial anomaly was well-developed at all longitudes when the crests of the equatorial anomaly were widely separated in latitude. This indicated the presence of a strong zonal electric field at the magnetic equator, which is also a pre-requisite for the formation of ionospheric irregularities. It is shown that on this night scintillations were indeed observed at widely separated locations around the globe. The adjacent day showed the collapse of the equatorial anomaly over a wide longitude swath implying that irregularities are not likely to be formed in these regions. The scintillation observations at Calcutta, India and at Singapore located in this region indicate the absence of scintillation. The study reveals that the GUVI images of the equatorial anomaly can be used to specify scintillating and non-scintillating regions on a global scale.

SA44A-02 1545h INVITED

Bottom-type scattering layers and equatorial spread *F*

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Jicamarca radar observations of bottom-type coherent scattering layers in the postsunset bottomside *F* region ionosphere are presented and analyzed. The morphology of the primary waves seen in radar images of the layers indicates that wind-driven gradient drift instabilities are operating. In one layer event when topside spread *F* did not occur, irregularities were distributed uniformly in space throughout the layers. In another event when topside spread *F* did occur, the irregularities within the bottom-type layers were horizontally clustered, the clusters separated by about 30 km. The same horizontal periodicity was evident in the radar plumes and large-scale irregularities that emerged later in the event. We surmise that horizontal periodicity in bottom-type layer irregularity distribution is indicative of large-scale horizontal waves in the bottomside *F* region that may serve as seed waves for large-scale Rayleigh Taylor instabilities.

SA44A-03 1600h

Fully kinetic simulations and linear theory of thermally modified E-region instabilities

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We present new results of our continuing efforts to simulate and model turbulent E-region plasma driven by a strong ambient DC electric field. Such processes, including the Farley-Buneman (FB) and gradient drift instabilities, have been studied experimentally and theoretically for four decades. In the last decade, two new thermally driven instabilities have been described along with some supporting observational evidence. In this talk, we will show the significant role played by ion thermal effects in fully kinetic, 2-D, simulations. These simulations demonstrate that thermal effects become especially pronounced when the E-region instability is driven by a large DC electric field, well above the threshold of the FB instability, as typically found in the high-latitude electrojet. For more moderate driving electric fields, the 2-D turbulent waves show some modifications due to thermal effects. We will also discuss the linear theory of thermal waves based on simplified fluid models. These models predict that ion thermal effects play an important role at the top of the E-region (∼105-130 km), while electron thermal effects should prove important in the lower E and upper D regions (∼75-105 km). They also show that both the ion and electron thermal driving mechanisms strongly modify the linear behavior of the FB instability in a homogeneous plasma. We conclude by arguing that thermal effects will have consequences for the saturated behavior of the electrojet waves and, hence, for radar and rocket observations and electrojet conductivities.

URL: http://bu-ast.bu.edu/∼meerso

SA44A-04 1615h

Characteristics of low latitude E-region plasma irregularities observed by the Gadanki radar.

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The Indian MST radar at Gadanki (13.5 deg N, 79.2 deg E, 6.4 deg N magnetic dip) is a high power coherent pulsed Doppler radar operating at a frequency of 53 MHz. By steering its antenna beam at 13 deg N off zenith, it can be used to observe field aligned irregularities in the E-region. Experiments to study such irregularities have been conducted regularly at Gadanki since 1994. At its 'tropical' rather than 'equatorial' position, the latitude of the Gadanki radar is such that it should be both a bit too high to observe field-aligned irregularities generated by the equatorial electrojet and a bit too low to observe mid-latitude field-aligned irregularities associated with blanketing Es layers (the latter are usually confined to higher latitudes). In spite of these differences, the radar has observed many types of echoes that are reminiscent of both the middle and the equatorial latitudes. For instance, the Gadanki echoes are not limited to the nighttime, as would be the case for mid-latitude situations. Instead, echoes are seen both during the day and at night, and are observed in multiple layers, in similarity to equatorial situations. On the other hand, contrary to the equatorial situation, the Gadanki echoes are typically devoid of "type I" spectra. Their predominantly "type II" signatures makes them rather similar to midlatitude echoes instead. In addition, the Gadanki radar has sometimes observed QP echoes, which is a mid-latitude phenomenon that is not observed at the equator. Finally, the Gadanki radar has also detected the so-called '150 km echoes', which up until now has always been thought to be strictly an equatorial phenomenon. Taken as a whole, the various observations suggest that while the tropical latitudes are indeed a region of transition in echo morphology, they are at times an extension of the midlatitude phenomena, while at other times being an extension of the equatorial latitudes. This discovery could become useful when trying to assess the strength of the excitation mechanisms from neighboring altitudes, since their appearance at tropical latitudes should presumably be a matter of driving the phenomena particularly hard.

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SA44A-05 1630h

Equatorial and mid-latitude spread-F associated with large-scale traveling ionospheric disturbances

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Near dawn on October 2, 2002, intense pre-dawn plasma irregularities were detected over Arecibo, PR and at equatorial stations in Brazil and Jicamarca. The F-peak in the mid-latitude ionosphere was well over 400 km at this time, having been driven to this height by a large-scale traveling ionospheric disturbance. The mapping of electric fields from the equatorial region to mid-latitudes cannot explain the mid-latitude irregularities, nor can standard linear instability theory. We suggest instead that eastward, gravitationally driven currents may have dominated and caused perturbations in the bottomside region to polarize and grow. Evidence is presented for an initial corrugation, perhaps associated with higher frequency gravity waves. In the equatorial region, a large uplift of the F layer was also observed, however such a layer motion cannot be explained by neutral wind effects due to the small dip angle. In addition, uplifts appear to occur fairly regularly in the post-midnight sector in the equatorial region, at least near equinox. If such a motion were due to electric fields, one would expect the field to switch direction, from westward to eastward, however this has not typically been observed. Instead, we show evidence that the southern crest of the anomaly moved equatorward, implying that advection of a higher density, higher altitude plasma into the equatorial region may be able to cause an uplift. Such an effect implies a new source for equatorial spread-F.

SA44A-06 1645h

Evidence of Localized and Anisotropic Irregularity Growth Associated With Equatorial Spread-F Plasma Depletions Observed by the San Marco Satellite Electric Field Instrument

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Irregularities in equatorial spread-F develop from a variety of plasma instabilities, for which the Rayleigh-Taylor mechanism is the most dominant at scales of tens of kilometers and longer. Shorter scale waves also contribute to the spectra, and develop from drift wave instabilities, turbulent cascades, and other processes. In situ observations permit in-depth understanding of both the evolving irregularity spectra and the instability processes at work. Important observable parameters include the vector spectral distributions, the local DC electric field, and the local plasma density and associated gradients. In situ electric field measurements provide detailed knowledge of both the irregularities and their wavevector directions since the wave electric field is parallel to the k-vector in an electrostatic wave. Although the San Marco data set is very limited in bandwidth, its measurements nonetheless contribute to our knowledge of spread-F irregularities. We present filter bank data that provide evidence for non-uniform short scale (10's of meter and shorter) wave growth associated with the walls of plasma depletions. In addition, by filtering the DC electric field components, we also show evidence of km-scale irregularities that are highly anisotropic and relate them to the driving DC electric fields within the depletion region. The results are used to help elucidate our current understanding of spread-F instabilities.

SA51A CC: 220 C-E Friday 0830h

New Frontiers in Equatorial Ionospheric Effects Posters

Presiding: **B Basu,** Air Force Research Laboratory**; P R Straus,** Aerospace Corporation

SA51A-01 0830h POSTER

The COSMIC-TIP (Tiny Ionospheric Photometer) InfoBase Data Products

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The Tiny Ionospheric Photometer (TIP) is a scientific experiment on the ROCSAT-3/COSMIC constellation. These six micro satellites to be launched in the fall of 2005 will fly in 700-800 km circular orbits with 72-degree inclinations. Each satellite also contains two other science instruments, the GPS Occultation Receiver (GOX) and the Tri-Band Beacon (TBB). The constellation will collect atmospheric remote sensing data for weather prediction, ionosphere, climate, and gravity research. The TIP is a small, simple instrument for observing the Earth's far-ultraviolet airglow narrow-band at the 135.6 nm wavelength to characterize the ionosphere. This emission is produced by recombination of O^+ ions and electrons, which is the natural decay process for the ionosphere. At night, the strength of the emission is proportional to the square of the electron density. This measurement will be used to produce a number of ionospheric data products. This measurement will also be combined with vertical gradient measurements, provided by GPS occultation, to reconstruct highly accurate electron density profiles in the nighttime ionosphere. The TIP InfoBase is a relational database management system that provides the TIP data products to the scientific community. The InfoBase breaks from the traditional approach, in which a database is simply a catalog to a set of flat-files. Instead, the InfoBase stores all the TIP data products internally within the relational database. Thus all data products may be searched by user-defined queries over the entire mission period and returned to the user without the hindrance of file boundaries. Custom code provides for direct delivery of data products to science users' IDL sessions for reduction, modeling and analysis.

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

SA51A-02 0830h POSTER

Traveling Ionospheric Disturbance Characteristics Over Texas Using the TIDDBIT HF Doppler Radar

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Atmospheric gravity waves (AGW) are generated by numerous lower atmospheric processes, such as storms, and by auroral processes in the ionosphere. At ionospheric heights, the motion of the neutral gas in the AGW sets the ionosphere into motion. The waves displace the isoionic contours, resulting in a travelling ionospheric disturbance (TID). TIDs can be thought of as traveling corrugations in the ionosphere, and they can seriously affect HF radio communications and surveillance systems. Consequently, one of the most sensitive methods for detecting transient changes in the ionosphere is the HF Doppler technique operating in the 3-10 MHz band. A simple Doppler system consists of a CW (continuous wave) radio transmitter and receiver, which are highly frequency-stable. When a HF radio wave is reflected from the ionosphere, movement of the reflection point during passage of a TID produces a change in phase path and a Doppler shift proportional to the time rate of change of the phase path. The Doppler system is sensitive to motions of the ionospheric reflection point, and it therefore provides an accurate measure of both the TID and AGW periods. Similarly, because the TID velocity is determined simply from triangulation using the time-delays between perturbations at different reflection points, the TID velocities are also an accurate estimate of the underlying gravity wave horizontal and vertical trace velocities. HF Doppler systems have advantages over all other techniques for the measurement of TID characteristics. They are more amenable to analysis than data from ionosonde chains , and their time resolution (30 sec) is much higher than that of ionosondes . Unlike total electron content (TEC) methods, which respond to height-integrated TID effects, the HF Doppler radar responds to TIDs at the altitude of the radio reflection point. Finally, HF Doppler systems have low power consumption, so that both spatial and temporal resolution can be maintained for many days without the costs that would be associated with an incoherent-scatter radar. SwRI recently designed, built and deployed an HF Doppler sounding system for three months, in Texas, to investigate TIDs. The TIDDBIT radar consisted of three transmitters (Austin, Uvalde and St. Hedwig) and a receiver in San Antonio, Texas. Using cross-spectral analysis and triangulation of the TIDDBIT signals, TID speeds and azimuths were obtained for each wave frequency. We provide a synoptic survey of the TID characteristics observed over Texas during January-March 2002. Such a system would be of great utility for the study of gravity wave seeding of low latitude ionospheric irregularities.

SA51A-03 0830h POSTER

First 630 nm daytime and nighttime observations of thermospheric winds and temperatures with the Second Generation Optimized Fabry Perot Doppler Imager (SOFDI)

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The Second Generation Optimized Fabry Perot Doppler Imager (SOFDI), a state-of-the-art triple-etalon Fabry Perot interferometer with 4 independent field-of-views, has been successfully constructed and is now making initial observations of 630 nm OI emission in upstate New York during both day and night. In this paper we report on results from four different experiments. First, we present the results of a uninterrupted 48-hour calibration run which demonstrates the pressure and temperature stability of the system. Second, we show that SOFDI can make measurements of thermospheric winds with an accuracy of 15 ms^{-1} within 20 minutes for the daytime and 5 ms^{-1} within 5 minutes for the nighttime. Third, we report on nighttime observations of thermospheric vertical winds. Finally, we report the first recent observations of continuous 24-hour observations of thermospheric winds and temperatures, demonstrating SOFDI's daytime and nighttime observational capabilities. In conclusion, we highlight both 1) immediate scientific goals of the SOFDI instrument in combination with the Cornell all-sky imager and the MIT-Haystack optical observatory, and 2) long range plans which involve placement of the SOFDI observatory at the magnetic equator for measurements of equatorial winds and temperatures.

SA51A-04 0830h POSTER

Ionospheric profiles from dayside UV limb scans

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