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Radio-wave scintillations are space weather effects caused by ionospheric plasma density irregularities. The subauroral ionosphere, at magnetic latitudes corresponding to the northeastern US, is generally free of such irregularities and consequently scintillations. Recently, Basu et al. [JGR, 106, 30389, 2001] and Ledvina et al. [GRL, 29, 10.1029/2002GL014770] reported observations of strong GPS phase and amplitude scintillations at 1.5 GHz at Hanscom AFB, MA and Ithaca, NY during the magnetic storms of 23 September, 1999 and 25 - 26 September, 2001, respectively. We report results of a survey of small-scale plasma density and electromagnetic oscillations detected by DMSP F13, 14, and 15 satellites while flying over the affected regions at altitude of 840 km. Langmuir probe data, sampled at a rate of 24 Hz, show that during the scintillation intervals the amplitudes of density oscillations in the frequency range of 3-10 Hz increased by a factor of 100. The enhanced fluctuations appeared at the poleward edges of large-scale density troughs, embedded within subauroral polarization streams. When Doppler-shifted from spacecraft frames of reference the oscillations correspond to irregularities with spatial scales of 2-0.7 km. Most likely these irregularities are responsible for radio-signal scintillations at frequencies near 1 GHz.

SH52B MCC: 2008 Friday 1600h

Space Science Research With Societal Consequences V *(joint with SA, SM, AE)*

Presiding: **R Pfaff,** NASA Goddard Space Flight Center**; R Robinson,** National Science Foundation

SH52B-01 1600h INVITED

Response of the Low Latitude Thermosphere and Ionosphere to Geomagnetic Storms

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Electrodynamics dominates the structure of the low latitude ionosphere. During a storm, equatorial electric fields are severely disrupted by a combination of magnetospheric penetration and neutral wind dynamo electric fields. The result is a dramatic change in the plasma structure and the local-time occurrence of plasma irregularities. Numerical simulations using a coupled thermosphere, ionosphere, plasmasphere, electrodynamic model have been used to unravel the complex storm-time response of the upper atmosphere, and aid in the understanding and interpretation of the phenomena. Contrary to previous expectations, the dynamo action of the neutral winds can be large and rapid, and follow closely behind the penetration fields. The rapid dynamo fields are forced by the meridional wind surges that drive zonal Pedersen currents, causing charges to build up at the terminators that immediately leak to the equator. The global wind system is highly dynamic during these disturbances as winds "slosh" from one hemisphere to the other. The electrodynamics responds quickly to the dynamics and exhibits rapid and large changes in the electric fields and in the equatorial plasma distribution. If the dynamo and penetration electrodynamic processes act constructively, plasma at the magnetic equator can be completely decimated and the anomaly peaks can move well into mid-latitudes.

SH52B-02 1620h

The Advantages of Cheap, Connected, and Plentiful GNSS Observations

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During the next solar maximum GNSS (Global Navigation Satellite System) technology will enable TEC and scintillation measurements with inexpensive receivers that are conveniently sited on roof tops, simply connected via the web, and easily operated at universities, science centers, and schools. This development presents a singular opportunity beyond current strategies for investigating the ionosphere. Ionospheric disturbances, irregularities, and societal impact have been investigated for decades at equatorial latitudes and high latitudes. Mid-latitude disturbances have largely been neglected until recently because of the relative infrequency of events. At equatorial latitudes investigations have primarily been from single sites prior to the advent of GPS. Even at high latitudes ionospheric measurements relating to density and irregularities have primarily been from single sites. With GNSS technology enabling ionospheric instrumentation equivalent to weather buoys, the extreme events with societal impact at mid-latitudes can be characterized and the dynamic global ionospheric behavior and response to forcing can be investigated. We show several examples to support this conclusion.

SH52B-03 1635h

GPS Occultation Sensor Observations of the Ionospheric E-Region

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GPS occultation sensor measurements of the GPS L1 (1575 MHz) and L2 (1227 MHz) signal phase can be used to derive line-of-sight total electron content (TEC). The GPS TEC values are highly precise in a relative sense, with noise levels on the order of 0.01 TECu. Limb-viewing occultation profiles of vertical TEC may be converted into electron density profiles by means of the Abel transform. The high relative TEC accuracy potentially leads to very precise profiles, resulting in an ability to remotely sense density features below the 10E4/cc level. Thus one would expect GPS occultations to provide a new means for observing E-region features. This is particular true because the E-region often has significant vertical refractivity gradients, to which the occultation technique is particularly sensitive. However, the absolute accuracy of these retrievals can be compromised by the presence of F-region gradients, which violate the Abel assumption of spherical symmetry. We present an initial analysis of the gradient effects on E-region retrievals and discuss methods to mitigate the effects of asymmetry. Examples from simulations and actual observations from the Ionospheric Occultation Experiment (IOX) will be presented to illustrate our results. The utility of low-density E-region measurements will be discussed in the context of validation of models predicting the evolution of the structure of the post-sunset equatorial anomaly region.

SH52B-04 1650h

Towards a Predictive Model of Low Latitude Ionospheric Space Weather

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Space weather in the earth's equatorial ionosphere, in the form of rising bubble structures, can have significant effects on space-based satellite communications and navigation system and, as a result, have important societal consequences. For example, the Global Positioning System (GPS) can suffer severe scintillation and fading due to the ionospheric density structures associated with equatorial ionospheric bubbles. The development of a predictive model of equatorial ionospheric bubbles will help to mitigate against the deleterious effects of low latitude ionospheric structure and variability. A fully three-dimensional model of the evolution of equatorial ionospheric bubbles is needed to develop a predictive capability. Using numerical simulation techniques we have studied the 3D linear and nonlinear evolution of equatorial ionospheric bubbles. The background ionosphere used to initialize the 3D mesoscale bubble model is computed from a first-principles macroscale equatorial fountain model. Near the prereversal enhancement the 3D mesoscale bubble model is initialized using the background parameters over the entire geomagnetic flux tube. We find that bubble-like structures with extremely sharp gradients can be generated off the equator at anomaly latitudes. We study the effects of various parameters, e.g., prereversal drifts, neutral wind effects, background Pedersen conductivity, and parallel conductivity on the evolution and triggering of equatorial bubbles. Initial studies using data assimilation will be presented as well as comparision with experimental data.

SH52B-05 1705h

Conjugate Point Equatorial Experiments in Brazil: Preliminary results on Space Weather Related Variabilities in Spread F and Ionization Anomaly.

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We will present some preliminary results from a conjugate point equatorial observational campaign (COPEX) conducted in Brazil during October to December 2002. The COPEX utilized digital ionosondes, digisondes, all-sky imagers and other different 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, and are complemented by other digisondes at eastward longitudes in Brazil. Conjugate point symmetry/ asymmetry conditions of the equatorial ionization anomaly and associated ionosphere-thermosphere dynamics, disturbance electric fields and winds, arising from magnetosphere / ionosphere coupling and conductivity distributions are among the most suspected causes of the widely observed variability in the ESF intensity. These questions are addressed using the analysis of selected days during quiet and disturbed intervals of the capaign period.

URL: http://www.dae.inpe.br

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SH52B-06 1720h

Solar Cycle Variation in the Ozone Distribution Simulated by a Two-dimensional Chemistry Transport Model

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The meridional circulation derived from the NCEP/NCAR Reanalysis II data from 1979 to 2000, combined with the solar UV radiation with the 11 year variation, is used to drive the Caltech/JPL two-dimensional (2-D) chemistry and transport model (CTM). The monthly UV fluxes are generated using the monthly solar cycle variation of the 10.7 cm flux data and the solar cycle maximum and minimum flux data measured by UARS/SOLSTICE as a function of wavelength. The wavelength range is from 119.5 nm to 318.5 nm, encompassing the most important wavelengths influencing the production and destruction of ozone. A principal component analysis is applied to the model simulated ozone distribution from 1980 to 2000. The decadal signal is found in the column ozone density, but the signal is smaller than that found in a similar analysis of the merged TOMS/SBUV ozone data. The main source of the decadal variations in the column ozone density is the meridional circulation. However, the direct effect of the UV variation can be seen primarily in the upper stratosphere and above.

SH52B-07 1735h

Statistical Study of Slot Region Protons

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Using data from NOAA's Polar Orbiting Environmental Satellites (POES), we have performed a statistical study of > 36 MeV protons in the "slot" region for $1.5 < L < 3$; this study includes data from 1978 onward. We have been most concerned with the formation and decay of transient proton belts similar to the one which formed in March 1991. Between 1978 and 1993, we observed a number of events at L=2.5 in which the > 36 MeV proton flux was greater than "nominal" levels. In all, the flux at L=2.5 was above "nominal" about 27% of the time. Although the March 1991 event was the only one observed in this period for $L < 2$, for $2.5 < L < 2.75$, a number of events were observed with magnitudes similar to the March 1991 event. We discuss these events, as well as a number of events where long-term decreases in the flux were observed.

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Pfister, R. G., and M. S. Nestler, Sharing community data, services and tools using the EOS clearinghouse (ECHO), *Eos Trans. AGU, 84*(46), Fall Meet. Suppl., Abstract U41B-0006, 2003.