

upper atmosphere, and to ensure a consistent representation of the dynamical transport and tides. With the perspective of the numerous future Mars landers and to answer the questions related to local martian meteorology, the model is used at a relatively high resolution (down to 1 km) with in a 40 km high resolution domain with the zoomed configuration. The Canadian G3M though in an early stage of development shows good potential for reproducing the climate features and simulating the local flow over the complex terrain.

SA41A-06 0830h POSTER

The Global Ionosphere Thermosphere Model and it's Application to Planetary Atmospheres

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We present results from a new global ionosphere thermosphere model (GITM). The model is a self-consistent first-principles models of the coupled ionosphere thermosphere system of the Earth from 95 km to 500+ km. GITM solves for the non-hydrostatic thermospheric state in altitude coordinates, having a stretched grid in both the altitude and latitude directions. The combination of grid structure and a non-hydrostatic solution allows an investigation of small-scale, highly variable phenomena and their influence on the global structure of the system. In addition, the solver allows for supersonic flows, so planetary systems with high flow speeds can be easily investigated. The high-latitude electrodynamics are specified by input from external models, while the low-latitude electrodynamics are controlled by the self-consistent coupling between the ion and neutral flows. We present thermospheric and ionospheric results from a number of test problems, and discuss the application of this model to other planetary atmospheres such as Mars, Saturn, and Jupiter.

SA41A-07 0830h POSTER

The Global Ionosphere Thermosphere Model Results of the April 2002 Storm

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We present results from a new global ionosphere thermosphere model (GITM). The model is a self-consistent first-principles models of the coupled ionosphere thermosphere system from 95 km to 500+ km. GITM solves for the non-hydrostatic thermospheric state in altitude coordinates, having a stretched grid in both the altitude and latitude directions. The high-latitude electrodynamics are specified by input from AMIE, while the low-latitude electrodynamics are controlled by the self-consistent coupling between the ion and neutral flows. We present thermospheric and ionospheric results from the April 2002 storm period, comparing those results to observations from global imagers and measurements of NO. We further show the effects of small-scale structures in the aurora and ion flows on the global solution.

SA41A-08 0830h POSTER

Response of High Latitude Thermosphere Density and Composition to Magnetic Activity and IMF-By Effects

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Changes in the density and composition of the neutral atmosphere create variable satellite drag, adversely affecting missions involving space assets, such as collision avoidance. Existing empirical density models do not adequately account for dynamic changes in neutral density, leading to errors in predicted satellite positions. The major discrepancies between empirical models and data are at high latitudes, where extreme density variability is caused by the varying auroral inputs. There is still much to be learned about the behavior of the high latitude composition and density, and we report a modeling study that explores and discusses some of their basic characteristics. The model used for this study is the Thermosphere Ionosphere Mesosphere Electrodynamics General Circulation Model, which is a 3-D fully coupled global model of the ionosphere-thermosphere system driven by high latitude inputs. We present the results of numerical experiments to characterize the high latitude thermospheric density and composition response to different levels of magnetic activity. Finally, we include their IMF By dependence. We predict what are the likely UV signatures of these composition variations, and how they might be observed with UV imagers that are being flown today.

SA41A-09 0830h POSTER

Terrestrial thermospheric storm effects during the first weeks of the Dynamics Explorer 1 mission

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Global far-ultraviolet (FUV) images of Earth provide an unparalleled view of the development of thermospheric storms during periods of enhanced magnetic activity. More than 20 years ago, the Spin Scan Imager onboard the Dynamics Explorer 1 satellite obtained the first global images of the development of thermospheric perturbations caused by enhanced auroral activity. This capability comes from the FUV component of the imager, that by measuring the bright OI 130.4-nm triplet originating in the thermosphere can monitor variations in the relative thermospheric column abundances of O and N₂. Short-term variations in the ratio of these parameters usually indicate the recent occurrence of high-latitude Joule heating. The first several weeks of operation of the instrument (beginning in September, 1981) were marked by a particularly interesting series of magnetic substorm and storm events which all had an effect, to varying degrees, on the OI FUV dayglow brightness. In this study the O/N₂ variations are simulated for the entire period using the NCAR TIMEGCM in order to identify the causative factors in the development of O/N₂ depletions. This period was also marked by good measurements of the solar wind speed, density, and embedded magnetic field from the ISEE-3 satellite. These are important inputs for the TIMEGCM. Particular attention is paid to the sense of IMF By, which has a strong effect on the magnitude and local time of the peak in the high latitude neutral circulation speed.

SA41A-10 0830h POSTER

The Annual Cycle of Non-migrating Tides in the Extended Canadian Middle Atmosphere Model

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Temperature signatures associated with migrating and non-migrating tides have been diagnosed from one

year of a four year run of the extended Canadian Middle Atmosphere Model. Significant temperature amplitudes are observed for eastward and westward non-migrating diurnal and semidiurnal wave 1 and wave 2 modes which in the mesopause region are of a similar magnitude to the better known migrating tides. The amplitudes of the the non-migrating tides vary significantly in time. For most modes there are episodic enhancements in the amplitudes and changes in their latitudinal structure. Annual and semi-annual variations in the amplitudes are also observed. The variability of these modes is likely the result of variability in the tropospheric forcing and non-linear interactions between tides and planetary waves.

SA41B CC: 519 A Thursday 0830h

New Frontiers in Equatorial Ionospheric Observations and Models I

Presiding: O de La Beaujardiere, Air Force Research Laboratory; V Eccles, Space Environment Corporation

SA41B-01 0830h INVITED

Simultaneous observations of equatorial plasma bubbles from ground-based imagers and ROCSAT-1

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Using a set of ionospheric imagers located on the Haleakala Volcano on Maui, Hawaii a large database of observations of equatorial plasma bubbles in the Pacific sector has been compiled since data collection began in January 2002. These images provide information on the spatial structure of the depleted regions in electron density associated with equatorial spread-F. Often times, the bubbles drift into the fields-of-view of the imagers fully developed, implying a growth region to the west of the observing location. At other times, the development of individual bubbles can be tracked over almost an hour's time allowing for estimation of the bubble's upward velocity at the equator. Combining an entire night's worth of observations, a composite image can be formed allowing for the estimation of the growth region for the fully formed bubbles observed later in the night. Using simultaneous observations made by the ROCSAT-1 satellite (in a 600 km circular orbit with a 35° inclination) we can confirm these growth region estimates. In addition, the ROCSAT-1 provides in-situ measurements of the ion drift that can be compared to the bubble velocity derived from the images when developing bubbles are seen. This study highlights the insight gained by combining in-situ satellite measurements with ground-based observations. More studies of this type will become possible as additional satellites, such as C/NOFS, are launched in the future.

SA41B-02 0845h INVITED

Far Ultraviolet Imaging of the low-Latitude Nightside Ionosphere with the GUVI Instrument on TIMED

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The Global Ultraviolet Imager (GUVI) on the NASA TIMED spacecraft gives a unique and powerful window into the global ionosphere. Because TIMED is in a near polar 74.1 deg inclination orbit and precesses through all local solar times in just 60 days, we have the opportunity to study the behavior of the ionosphere as a function of season and local solar time. We are also able to investigate the coupling with the neutral atmosphere as well. The technique that we employ uses the radiative recombination of ionospheric O^+ with electrons to produce a signal that we can invert into an electron density profile. This technique is most readily employed on the nightside but can be used, at solar maximum, during the day as well. In this paper we show the results of our analysis of typical and atypical i.e. disturbed days and the response of the thermosphere to changing magnetospheric and solar inputs. We find that the International Reference Ionosphere climatology does not reproduce the behavior observed by GUVI on any typical day and that even the global circulation models like the TIMEGCM have difficulty replicating the observed behavior. We discuss the reasons why this is and what can be done to improve the modeling efforts.

SA41B-03 0900h INVITED

Measurements of Equatorial Thermospheric Dynamics - Quo Vadis?

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Observations of equatorial thermospheric winds and temperatures at Arequipa, Peru, have been carried out over two decades with a pressure scanning Fabry-Perot interferometer. The results from this long series of measurements will be summarized, and new plans for the future presented. The work for the future will be based upon the upgrade of the instrument sensitivity to be obtained through the replacement of the photomultiplier detector with a CCD camera producing an expected increase of sensitivity by a factor of 15 and decreasing measurement errors to less than 5 ms^{-1} and 20 K in 2 to 5 minutes of signal collection. The new plans include the initiation of twilight studies of the 732 nm airglow emission, which is generated by radiative ionization of $[O]$. This will enable the study of atomic oxygen concentration variations combined with ion drift measurements during the evening and morning twilight periods. Results from the first series of measurements with this new capability will be presented.

SA41B-04 0915h

Electron Density Profiles and Total Electron Content at Low Latitudes During Magnetic Storms

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Magnetic storm effects on the electron density profiles and the total electron content (TEC) at low-latitude are presented. The data correspond to two storms: April 17-18, 2002 and October 29-31, 2003. The observations include data from ionosondes, GPS receivers, satellite altimeters, as well as in situ density from Challenging Minisatellite Payload (CHAMP) and Defense Meteorological Satellite Program (DMSP). These polar orbiting satellites are in circular orbits, at 400 and 830 Km altitude, respectively. The observations are compared with results from several models. These models include: climatological models, assimilative physics-based models, as well as the TIME-GCM model. Because CHAMP orbit is so low, its in situ density data are particularly useful in testing the ability of the models to capture important profile features such as the bottom-side density profile and F region height. In addition, CHAMP provides the density latitudinal variation. During the October 2003 storm, CHAMP was in a noon-midnight plane. Around midnight, the in situ density appears erratic. For example, it is very low south of the equator - lower than the satellite lowest detectable value. It becomes very large, $2 \cdot 10E6$

el/cc, north of the equator. Around noon, the density meridional variations start off exhibiting symmetric twin peaks (e.g. at 07:15 UT, Oct 29). Meridional variations then become asymmetric, and the asymmetry tends at times to increase to extremes (e.g. 06:20 UT, Oct 30). We speculate that these asymmetries may be attributed to changes in the neutral wind.

SA41B-05 0930h

Inter-Hemispheric Comparisons of the Latitude Extent of Thermosphere-Ionosphere Disturbances

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All-sky imagers located at Arecibo, Puerto Rico (18.3° N, 66.7° W, 28° N dip) and El Leoncito, Argentina (31.8° S, 69.3° W, 18° S dip), are used to compare 6300 Å airglow emission features. Airglow depletions associated with Rayleigh-Taylor instability (ESF) and brightness waves associated with the midnight temperature maximum (MTM) are frequently observed at both sites. While not at conjugate points, these two sites allow the evaluation, for the first time, of statistical occurrence patterns and, occasionally, simultaneous case-study events from the same longitude sector in both hemispheres. While both types of disturbances are well studied at near-equatorial latitudes ($L \sim 1.15$), we find the intrusion of those processes to lower-mid latitudes ($L \sim 1.35$) on a relatively frequent basis. These studies suggest that the traditional role of latitude coupling (from high to low-latitude) needs to be expanded by the study of how equatorial aeronomy phenomena reach into mid-latitude domain.

SA41B-06 0945h

A Comparison of LORAAS and GUVI Observations of the Low-Latitude Ionosphere

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The Low Resolution Airglow and Aurora Spectrograph (LORAAS) aboard the Advanced Research and Global Observation Satellite (ARGOS) collected numerous spectra of Earth's airglow in the extreme ultraviolet and far ultraviolet regimes (80 - 170 nm) from 1999-2002. From the limb scans made of the 135.6 nm ultraviolet emission, profiles of the nighttime (0230 LT) electron density in the ionosphere can be derived. The Global Ultraviolet Imager (GUVI) aboard NASA's Thermosphere, Ionosphere, Mesosphere, Energetics and Dynamics (TIMED) satellite scans a nadir-to-limb swath in five spectral channels, including 135.6 nm. In early March 2002, the paths of ARGOS and TIMED nearly coincided, providing an opportunity to compare the 135.6 nm observations of both LORAAS and GUVI in the low-latitude region at various longitudes. In this study, we compare the electron density profiles derived from the LORAAS and GUVI limb data. We vertically integrate the density profiles to obtain the total electron content (TEC) as a function of latitude and compare these results with TEC derived from GUVI images of the disk on the nightside as well as TEC obtained from the global network of GPS receivers. We further compare these observations to first principles ionospheric models.

SA42A CC: 519 A Thursday 1030h

New Frontiers in Equatorial Ionospheric Observations and Models II

Presiding: O de La Beaujardiere, Air Force Research Laboratory; V Eccles, Space Environment Corporation

SA42A-01 1030h INVITED

Data Assimilation Studies of the Equatorial Ionosphere Using the USU GAIM Model

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The ionosphere is a highly dynamic medium that can vary appreciably from day to day and from hour to hour at a given location, and these variations can have detrimental effects on military and civilian systems. In an effort to mitigate these detrimental effects, a physics-based data assimilation model of the ionosphere is under development. This Global Assimilation of Ionospheric Measurements (GAIM) model provides both specifications and forecasts on a spatial grid that can be global, regional, or local. GAIM uses a physics-based ionosphere-plasmasphere-polar wind model and a Kalman filter as a basis for assimilating a variety of data sources. The new ionosphere-plasmasphere-polar wind model includes six ion species (NO^+ , O_2^+ , N_2^+ , O^+ , H^+ , He^+) and extends from 90 to 20,000 km at mid-latitudes and 90 to 10,000 km at high latitudes. Currently, the GAIM physics-based model assimilates in situ electron densities from the DMSP satellites, occultation TECs from three low altitude satellites (IOX, CHAMP, SAC-C), bottomside electron density profiles from several ionosondes, and GPS-TEC from a global network of 160 ground stations. The primary GAIM output is a 3-dimensional electron density distribution at specified times. However, GAIM also provides ancillary parameters ($N_m F_2$, $h_m F_2$, etc.) and global distributions of the self-consistent ionospheric drivers (neutral winds, electric fields, etc.). In addition to the full physics Kalman filter model, both regional and global Gauss-Markov Kalman filter models have been developed. The global Gauss-Markov model can assimilate four data types, including Ne profiles from digisondes, in situ satellite densities, occultation data, and GPS-TECs from 900 ground stations. The status of these models and the relevant equatorial applications will be presented.

SA42A-02 1045h INVITED

Assessing a Low-Latitude Ionosphere Model Driven by Data-Determined ExB Drifts

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The Low-Latitude Ionosphere Sector (LLIONS) model is a single sector ionosphere model capable of using data-determined drivers. The important drivers for the low latitude ionosphere are the vertical ExB plasma drift and the cross-equator neutral wind. The western coast of South America (Peruvian sector) is well instrumented with magnetometers, ionosondes, GPS-TEC monitors, ionosondes and radars. Magnetometer data, ionosonde data, and radar data from