SA12A-0679 1330h POSTER

Climatology and interannual variability of diurnal water vapor heating

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Tropospheric heating by water vapor insolation absorption is a leading drive of the propagating diurnal tide. A climatology of monthly diurnal radiative heating due to water vapor insolation absorption is derived using specific humidity from NCEP/NCAR reanalyses, and global precipitable water from the NASA Water Vapor Project. The new climatology complements and extends an existing one published by Groves in 1982 that provides seasonally averaged heating at tropical latitudes. The updated heating rates are of higher temporal and spatial resolution, and also enable an examination of year-to-year variability in water vapor heating over the 10-year span of the precipitable water dataset.

SA12A-0680 1330h POSTER

4-8 day planetary waves in the middle and upper atmosphere: What can theory and modeling tell us about the observations we make.

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Planetary waves with periods ranging from four to eight days are often observed in the mesosphere and lower thermosphere. At times these global scale waves exhibit characteristics like those of the 1st symmetric Rossby normal mode for zonal wave number one, often referred to as the 5-day wave. At other times the period and seasonality of these waves suggest behavior unexpected from a normal mode propagating upward from the troposphere.

Planetary wave propagation theory and a series of modeling experiments will be used to study global scale oscillations with periods around 5 days. Vertical propagation characteristics will be examined over the course of a year using realistic representations of the atmosphere, dissipation, and of lower atmospheric forcing. Mechanisms other than lower atmospheric forcing, such as an in-situ realization of normal mode in the face of broad-band forcing, and instabilities of the mean state will also be examined.

SA12B MC: Hall D Monday 1330h

Magnetic Storm Effects on the Middle- and Low-Latitude Ionosphere and Upper Atmosphere I *(joint with SH, SM)*

Presiding: **S Basu,** Air Force Research Laboratory

SA12B-0681 1330h POSTER

The Causes of Time Variations of Winds and Temperatures in a Geomagnetic Storm

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Space Weather Month occurred in September and October 1999. It is being intensively studied by both experimentalists and theorists as a special S-RAMP campaign (see http://worktools.si.umich.edu). During this period some small geomagnetic storms occurred. A series of these storms (September, 12-17, 1999) has been simulated using the Thermosphere-Ionosphere Nested Grid (TING) model coupled with the Lyon-Fedder-Mobarry (LFM) MHD model. This simulation is used in this presentation to study how the neutral temperature and wind changes evolved during the storms. In addition, postprocessors have been applied to the model outputs to aid in understanding how the processes forcing the winds and temperatures also change with time. Of particular interest is the means by which the low latitude temperature increases that occur at midnight are forced. The thermal postprocessor indicates that temperature increases in this region are mainly driven by convergence of the horizontal winds and downwelling leading to compressional heating. The momentum processor is applied to aid in understanding how and why this convergence evolves.

SA12B-0682 1330h POSTER

Case study of Bastille Day storm effects on the ionosphere using DMSP ion density measurements and TEC maps

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Magnetic storm effects on the ionosphere were investigated using the ion density measurements from the DMSP (Defense Meteorological Satellite Program) F13, 14, and 15 spacecrafts and using total electron content (TEC) maps for a selected interval the Bastille Day storm of July 15, 2000. During the expansion phase of the storm the negative storm effects developed from the high-latitude region in the northern (summer) hemisphere and then expanded equatorward as far as to the low-latitude region in the southern (winter) hemisphere. At the same time, the positive storm effects were observed in the broad range of middle-latitude region in the southern hemisphere during nighttime. Several hours later a stronger negative storm developed near the south magnetic pole, and its equatorward expansion confined the positive storm extent to a narrow middle-latitude region. The strong summer-to-winter hemisphere neutral wind surge on the nightside expanded the molecule-rich atmosphere to a broad latitude region in the northern hemisphere. On the other hand, owing to the weak equatorward wind surge in the southern hemisphere, the molecule-rich atmosphere expanded vertically producing stronger negative storm effects at narrow high- and middle-latitude regions. The nighttime equatorward neutral wind surge converged and downwelled in the middle-latitude region in the southern hemisphere. The downwelling of molecule-rich atmosphere reduces the recombination rate of the O^+ ions with molecular gases causing an increase of O^+ density and consequently the total ion density. The observation of positive storm effects in the winter hemisphere and their long duration even after the storm cessation imply that the positive storm is controlled by the change of molecular composition rather than by the change of *F* layer heights. We will present the results of the analysis of DMSP and TEC observations and show that, for this particular event, the data support this interpretation.

SA12B-0683 1330h POSTER

An Analysis of the Ionospheric Storm of October 14, 1981 Using Ground Based Ionosonde Data and DE-1 FUV Images

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A major ionospheric storm occurred over Europe and Asia on October 14, 1981, as a consequence of a geomagnetic storm that began with an SSC at 2240 UT on October 13. The maximum negative excursion of Dst (-133 nT) occurred at 0600 UT on October 14. Using an algorithm developed by Strickland et al. [*J. Geophys. Res.*, vol. 104, no. 3, pp. 4251-4266, 1999] and DE-1 FUV images taken near 0540 UT on October 14, Strickland, Daniell, and Craven [*J. Geophys. Res.*, in press, 2001] observed a large region of reduced thermospheric O/N2, which correlated well with the negative ionospheric storm observed in ground based ionosonde data obtained from NGDC. A preliminary report on modeling the f_oF_2 data from Podkamennaya, Russia, during the ionospheric storm was presented at the Fall 2000 AGU meeting and has been accepted for publication [Daniell and Strickland, *J. Geophys. Res.*, in press, 2001]. Here, a more complete analysis of f_oF_2 data and h_mF_2 data (estimated from M3000 using the Dudeny algorithm) from all available ionosonde stations in the region of reduced O/N_2 using a first principles ionospheric model coupled to a modified version of the MSIS-86 thermospheric model and the HWM-90 wind model will be presented. We will quantitatively characterize the spatial extent and temporal evolution of the thermospheric and ionospheric disturbances during the storm. Limitations of our modeling approach will also be discussed as well as how they might be overcome using a coupled thermosphere-ionosphere model. Implications for monitoring ionospheric storms using satellite-based FUV imaging techniques will also be addressed.

SA12B-0684 1330h POSTER

Altitude Variation of Average Daytime Disturbance Winds in the Middle and Lower Thermosphere Measured by WINDII

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We use extensive wind measurements from the Wind Imaging Interferometer on board UARS to study average changes in global wind circulation in the daytime middle and lower thermosphere during geomagnetic storms. We will examine the storm-time evolution of disturbance winds as a function of height above 90 km at middle and low latitudes (0°-60°). We will also examine how the winds respond to increasing levels of geomagnetic activity. Our preliminary results show that within 24 h after the onset of enhanced geomagnetic activity, significant wind perturbations develop at heights above 110 km. These disturbance winds are generally height-independent above 150 km but can change strongly with storm time. They decrease sharply below 120-150 km, and become insignificant below about 110-120 km. Our meridional disturbance wind patterns show equatorward wind perturbations that are strongest in the 06-09 LT sector, increase with latitude, and decrease with local time. For typical storms, the equatorward disturbances reach amplitudes on the order of 50 m/s at mid-latitudes. Westward disturbance winds develop at low and mid latitudes in the 06-09 LT sector, also within 24 h after storm onset. These perturbations are largest in the 120-140 km height range, with values on the order of 50 m/s. At upper mid latitudes (above 50°), strong eastward perturbations are observed in the morning sector; these turn westward after 09 LT and extend to lower latitudes with increasing local time. These features increase sharply with latitude, reaching westward values in excess of 100 m/s for typical storms.

SA12B-0685 1330h POSTER

Determining HF communications channel parameters using SuperDARN

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Space weather effects can strongly influence high-frequency (HF) communications by changing the ionospheric environment through which the radiowaves propagate. As many systems utilize HF communications, the ability to make real time assessments

of propagation conditions is an important part of space weather monitoring systems. In this paper we present new techniques for measuring HF communications channel parameters using data from Super-DARN radars. These techniques use ground-scatter returns to define the variation in skip distance with frequency. From these data, the maximum usable frequency (MUF) as a function of range is determined and ionospheric critical frequecies are estimated. These calculations are made in near-real time and the results are made available on the world wide web. *F* region critical frequencies calculated using this method show good agreement with ionosonde data.

SA12B-0686 1330h POSTER

Structuring of full plasma patches in the high latitude with realistic drives

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We will present two investigations using our three-dimensional code for the structuring of high latitude plasma patches. We have extended our code to study the structuring of the full patch. All our earlier investigations have dealt with half the patch. With a constant drive, the patch begins structuring on only one side and nonlinearly the structuring penetrates the patch. The issue that we will address with this study is if the structuring will nonlinearly proceed to the stable side of the patch and to identify signatures of this structuring process, which can be seen in satellite data. The second investigation is to introduce realistic drive (both due to the electric field and the neutral wind). The patch convection would then be time-dependent and can also have the possibility of convecting in opposite directions thereby initiating structuring on both sides(leading as well as trailing edges) of the patch. We use data for the convection from MHD code simulations of real events to input into our structuring code.

SA12B-0687 1330h POSTER

Stormtime Mid-latitude E Region Electric Field Variability as Inferred From Millstone Hill Coherent Scatter Observations

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The sub-auroral electric field in the vicinity of the mid-latitude polarization jet and SAID (sub-auroral ion drift) can exhibit dramatic variability during times of moderate to high geomagnetic activity. In particular, the fine-scale structure of this field requires measurement techniques with high temporal and spatial resolution for full characterization. The Millstone Hill 440 MHz UHF radar is well positioned to observe the polarization jet, and is a sensitive diagnostic of electric field structures when operated in a coherent backscatter mode. In particular, due to the large Farley-Buneman irregularity backscatter cross-section and the linear relation between backscattered power and electric field amplitude at 34 cm wavelength, E region ionospheric electric field structures can be routinely resolved at the one-second and one-kilometer level, and such resolutions are necessary to accurately capture the dynamics of this region.

We present Millstone Hill fixed position observations during a $K_p = 6$ disturbance on May 25, 2000 which illustrate several features of mid-latitude polarization jet electric fields. Over a field of view spanning 2 - 3 degrees geomagnetic latitude, we observe E region electric field configurations with magnitudes of $\sim$50 mV/m and variations on timescales as short as 1-2 minutes. The structures move equatorwards with overall range rates of 150 - 200 m/s, but possess internal structures with nearly three times this apparent range rate. We use simultaneous DMSP satellite observations of westward ion drift across our experimental field of view to place the radar measurements in context, relate our measurements to other recent Millstone Hill coherent backscatter events, and discuss the implications of this very dynamic activity for models of subauroral ionospheric convection.

URL: http://www.haystack.mit.edu/coherent

SA12B-0688 1330h POSTER

Effects of the March 31, 2001 Geomagnetic Storm on the Lower Thermosphere and Ionosphere at Mid-Latitude.

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We present the main features of the lower ionosphere and thermosphere observed by the Millstone Hill incoherent scatter radar (42.6N, 71.5W) during the major geomagnetic storm of March 31, 2001. The Millstone Hill measurements show that during the most disturbed time 06-10 UT (Kp = 8.7, DST $\sim$ -380) the radar was located within the auroral oval and observed an increase in electron temperature up to 200-500 K and an increase in electron density in the local E-region. During a second storm maximum at 18-23 UT (Kp = 8.3, Dst $\sim$ -284), the auroral oval was located $\sim$4 degrees to the north of the radar. The observations show that a predominantly southward electric field of >40 mV/m existed in the morning hours, changing to the $\sim$50 mV/m northward in the evening sector and producing horizontal ion drifts at E-region altitudes of the order of 300-1000 m/s. We have initiated a comparison of the radar observations with simulations from the global upper atmosphere model (UAM) which calculates electric fields, electron, ion and neutral gas densities, temperatures, and composition, ion drift and neutral wind velocity vectors at altitudes above 80 km. For these simulations, we selected a realistic set of input values: cross polar cap potential drop, polar cap and auroral zone boundary locations, precipitating electron fluxes and zone 2 Field-aligned current intensity - all depending on the Kp index. We obtain a good agreement between observed and calculated electric fields and ion drifts, as well as for Te and Ne. Some disagreement is also found due to the fact that the model auroral zone has less steep walls than observed by DMSP, and find large differences in horizontal neutral winds results, especially in the meridional component. The sources of such differences will be discussed.

SA12B-0689 1330h POSTER

Observations of large-scale traveling ionospheric disturbances using GPS networks

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The generation and propagation mechanisms of large-scale traveling ionospheric disturbances (LSTIDs) were studied using the total electron content (TEC) data derived from GPS earth observation network (GEONET), international GPS service (IGS), and Continuously Operating Reference Stations (CORS). A dense and wide-area GPS network in Japan, GEONET, has about 1,000 GPS receivers and provides GPS data every 30 seconds. With GEONET, it is possible to reveal spatial structures and temporal variations of LSTIDs in detail over Japan. The GPS data of the global network, IGS, and a regional network, CORS, enable to clarify the global-scale characteristics of the propagation.

In this study, LSTIDs during a large geomagnetic storm on September 22, 1999 were investigated in detail. Two LSTIDs were seen to travel southward in the dawn region from 0730 to 0900 LT (from 2230 to 2400 UT) and were dissipated as they traveled over Japan. Their damping rates were larger at mid latitudes than at high latitudes. In the afternoon region, several LSTIDs were observed around 1300 LT (2100 UT) and their damping rate is higher than that in the dawn region. LSTIDs were observed in these two regions. No LSTID was, however, detected in the night region, despite the geomagnetic activities in the auroral night region were very large.

The dissipation of the LSTIDs was more intense at lower latitudes and in the afternoon region than at higher latitudes and in the dawn region. In the regions where the LSTIDs were rapidly damped, the values of background TEC found to be larger than those in the other regions. This feature indicates that the intense dissipation is caused by the ion drag effect that is proportional to the background TEC. It is also noted that the LSTIDs were not always generated when the geomagnetic activities are large in the auroral region. We believe that the other ionospheric conditions also contributes to the generation of the LSTIDs.

URL: http://www-step.kugi.kyoto-u.ac.jp/~tsug/study/study_e.html

SA21A MC: 301 Tuesday 0830h

Magnetic Storm Effects on the Middle- and Low-Latitude Ionosphere and Upper Atmosphere II *(joint with SH, SM)*

Presiding: **M J Keskinen,** Naval Research Laboratory**; B G Fejer,** Utah State University

SA21A-01 0830h

Large Swift Flow Variations at the Sunrise Topside Equatorial Ionosphere During a Storm

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At the onset of the August 12, 2000 magnetic storm, ROCSAT-1 at 600 km altitude observed a continuous descent of the topside ionosphere to reach a minimum density of 500 ions/cm-3. The largest descending velocity was about 400 m/s which occurred at the density minimum and was followed by a rapid upward velocity reversal to 200 m/s. Accompanied by this swift vertical velocity reversal, the field-aligned flow also indicated a large inter-hemispheric flow reversal. The rapid density and flow variations occurred in a longitude span of 1100 km region at the dip equator. By removing the quiet-time density and flow background, we have constructed a storm-time density and flow variations across the dawn terminator. A flux-tube of excess positive charge apparently appeared temporarily at the onset of the storm above the ROCSAT orbit to cause the observed rapid flow changes as ROCSAT traversed under it. This flux-tube should be initially connected to the sub-auroral zone but was depressed closer to the Earth at the time when the topside ionosphere was descending and the excess charge began to appear due to the non-divergence of the zonal density flux. A positive bay which occurred in the auroral zone could be related to the equatorward movement of the sub-auroral flux tube and the whole auroral activity is caused by the impinging of an interplanetary magnetic sector boundary on the Earth magnetosphere.

SA21A-02 0845h

Modeled and Observed F-Region Ion Composition During Ionospheric Storms

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The field line interhemispheric plasma (FLIP) model has been compared with ionosonde and AE-C satellite ion measurements during both quiet and disturbed periods in September 1974 when the satellite was in an elliptical orbit with perigee over Australia. These comparisons yield two important results, 1) the observed changes in F-region O and N2 neutral densities may not be sufficient, to account for changes in ion densities during magnetic storms, and 2) even