Quiet and Stormtime Thermospheric Composition Distribution and Variability.


TIMED SWG
Thermosphere-Ionosphere Session
TI-08 17:45-18:00
Introduction

- Show how GUVI data can be used to deduce composition changes
- Show how modeling provides a framework for understanding observations
- ASPEN-TIMEGCM 3-D model
Code Heritage

TGCM
TIGCM
TIEGCM
TIMEGCM

Parallelized - TIMEGCM

Thermosphere Ionosphere Mesosphere Electrodynamics
General Circulation Model

ASPEN-TIMEGCM
(Advanced SPace ENvironment Model)
Topics of Discussion

- Quiet Time $\Sigma O/N2$ ratio
- Storm time variation
April 2002

- Single UT maps
- GUVI Slices
- How it relates to model
QUIET DAY
Latitude Variation
Longitude Variation

GUVI O/N₂ Ratio  April 16, 2002
MSIS_86 O/N₂  April 16, 2002
TGCM_FQJ O/N₂  April 16, 2002
TIME-GCM Col O/N2  UT = 0.0

Vectors: UN + VN

LATITUDE (DEG)

LONGITUDE (DEG)

LOCAL TIME (HRS)

AVEHT=383.4
CONTOUR 0.100 TO 1.10 BY 0.0909
300.000 (M/S)

U+V MAGNITUDE MIN,MAX = 1.60, 552. (M/S)
16 April, UT = 0.0

20 April, UT = 0.0
October - November 2003 Super Storms
Nov 20-21 2003

Estimated Planetary K Index (3 hour data) Begin: 2003 Nov 19 0000 UTC

Updated 2003 Nov 22 02:45:03 UTC
NOAA/SEC Boulder, CO USA
Comparison of GUVI O/N\textsubscript{2} with TIME-GCM
Initial Results for Day 324 (11/20/2003)

**GUVI O/N\textsubscript{2}**
Day 324 (11/20) 2003

**ASPEN TIME-GCM Model**
TIME-GCM FIXED LOCAL TIME GUVI O/N\textsubscript{2}
SLT = 13.00 ZP = 2.00 DOY = 324
Note: Time goes from left to right.
October 29-30, 2003

• Note: Time goes from left to right

Oct 29th (Day 302)

Oct 30th (Day 303)
Preconditioned response?

Oct 31st  
(Day 304)

Oct 30\textsuperscript{th}  
(Day 303)

Oct 29\textsuperscript{th}  
(Day 302)
Conclusions

- GUVI is providing an exciting new view of the neutral atmosphere in terms of O,O2, N2 and TN profiles, in addition to column O/N2 discussed here (sweet spot!)
- Quiet and Storm times are very different
- The features observed by GUVI are beginning to revolutionize our ideas about thermospheric (and ionospheric) behavior
- The GUVI data is allowing us to test our models more rigorously than before (relevance to Space Weather)
- The model provides a framework for understanding the observed features
- The Oct-Nov 2003 period was well-observed by GUVI and contains features never seen before
- TIMED provides new understanding of Geospace that makes much of solar and heliospheric research relevant
Important Inputs to the Thermosphere – Ionosphere System

Solar EUV Input

Coupled Thermosphere – Ionosphere-Electrodynamics

Tides and Gravity Waves

High Latitude Inputs
E-fields
Particles

Neutral density
Composition
Temperature
Wind
Electron density
Dynamo E-fields

Temperature
Wind
Electron density
Dynamo E-fields
Kp Runs (3-hr cadence)
Look-up Table
POTDIF = f(Kp)

TimeGCM
- Potential Distribution Model
  - HEELIS (With By)
- Auroral Particle Model
  - Roble et al

Cross-Cap Potential Diff. (kV)

WEIMER POTENTIAL MODEL

AMIE (10 min cadence)

Hemispheric Power (GW)
- IMF (B_X,Y,Z)
- Sol. Wind speed
- Dipole Tilt Angle

Other Electrodynamic Parameters
- E-fields (ISR, SuperDARN)
- Magnetic fields (Magnetometers)
- Particle flux/energy (PEM, DMSP, GUVI)

Hemispheric Power Obs
- NOAA, DMSP (20 min cadence)
- Kp Runs (3-hr cadence)
  - Look-up Table
  - HEMPOW = f(Kp)