TIDI Observations of Mesosphere and Lower Thermosphere Tides in Neutral Winds


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Summary of Presentation

- Overview and status of the TIMED Doppler Interferometer
- Measurements of migrating diurnal and semi-diurnal tides
- Amplitude and phase analysis of migrating tides, and comparison to GSWM
- Non-migrating tidal analysis and model comparisons
- Use of a data assimilation model in TIDI measurement analysis
- New data from the O₂ Atm (0,0) P-branch “broadband” filter
**TIDI Overview**

The TIMED Doppler Interferometer (TIDI) is a 4-telescope Fabry-Perot interferometer for measuring global winds and temperatures in the Earth’s upper atmosphere.

**Primary measurement goal:**
Global wind field, 60–180 km

**Additional measurements:**
Temperature, O₃ (day), O (night)

**Primary emissions observed:**
\( \text{O}_2 \, ^1\Sigma (0-0) \, \text{P}_9 \) line

**Additional emissions observed:**
\( \text{O}_2 \, ^1\Sigma (0-0) \, \text{P}_{15} \), O(1S) “green line”

**TIDI Viewing Geometry**

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**Major Subsystems**

- Telescope Assembly
- Fiber Optic & Electrical Harnesses
- Profiler
- Electronics Stack
- Power
- TIMED Spacecraft & MOC
- Internet
- TIDI POC and Data Processing System
Reduction in Cross-Talk

Improvement of White Light Throughput
Data Reduction — Spectral Fit

Forward model fit to spectrum

Measurement of the Migrating Diurnal Tide

Meridional wind, South side telescopes  
lat=66N, Desc node

Zonal wind, South side telescopes 
lat=66N, Desc node

Meridional wind, South side telescopes  
lat=115S, Desc node

Zonal wind, South side telescopes 
lat=115S, Desc node
Measurement of the Migrating Semi-Diurnal Tide

Tidal Amplitude and Phase Analysis

- Tidal analysis based on daily zonally averaged meridional winds
- Performed during each 60-day yaw period from 2003 to 2004
- Least square fit results for diurnal and semi-diurnal tides
- GSWM-00 model comparison
Example of TIDI Measurement Tracks

Example of Daily Zonally Averaged Neutral Winds
Meridional Wind Tidal Amplitudes, Days 143-204 of 2003

GSWM Amplitudes, June 2003

Meridional Wind Tidal Amplitudes, Days 143-204 of 2004

GSWM Amplitudes, June 2004
Diurnal Non-migrating Amplitude at 95 km, October 2003

Non-Migrating W2 Tidal Analysis at 95 km

TIDI

GSWM (latent heat)

TIME-GCM (PW-1/tidal interaction)
TIDI Data Assimilation Model – Preliminary Results

Data from March 1, 2004, meridional & zonal, descending node, warm side

New Data from the O$_2$ Atm (0,0) P-branch Broad Filter

Spectrum (dots), model fit (cross), and residuals (red)

Filter transmission
Conclusions

• TIDI data quality has been greatly improved by detector ice removal procedure and through remediation by processing algorithms.

• Migrating and non-migrating tidal features are recovered through analysis of multi-day data sets.

• New data assimilation model has potential for daily estimation of tidal parameters.

• \(O_2\) (0-0) P-branch broadband filter results have great promise for high-precision wind field measurements.