Global-scale Observations of the Limb and Disk (GOLD) – First Light Observations

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GOLD Mission Overview

• Host Mission
  - SES-14, in geostationary orbit at 47.5° west
    (over mouth of the Amazon River)

• GOLD Instrument
  - Two identical, independent imaging
    spectrographs covering 132-162 nm

• Measurements
  - Earth’s disk
    • Tdisk & O/N₂ - Daytime: from spatial-spectral
      image cubes of O-135.6 nm and N₂-LBH emission
    • Nmax - Nighttime: from images of O-135.6 nm
      emission
  - Earth’s limb
    • Texo - Altitude profiles of N₂-LBH emission
    • O₂ density profile - Stellar occultations
GOLD Uses Whiskbroom Imaging to Build Spatial-Spectral Image Cubes

**Technique**

- Telescope equipped with a scan mirror images the T-I system onto the slit of an imaging spectrograph.
- The limiting resolution is ~ 50 km.
- Measurements include stellar occultations and altitude profiles on the limb

The spectrograph records spectra as a function of slit height at each point on the disk.
Direct comparison with electron lamp spectra acquired during ground calibration shows that the relative band strengths are in good but not perfect agreement with Franck-Condon factors derived in the laboratory.

**Comparison of Laboratory Electron-Impact Spectrum and Flight Data**

![Graph showing comparison of laboratory and flight data](image)

- **O 135.6 nm doublet is resolved**
- **LBH (3,0)**
- **N 149.3 nm multiplet + LBH (3,3)**

*Red = Laboratory 30eV e⁻ + N₂, Black = Flight*
Images of 135.6 nm Radiance, Day 282

Morning
- Aurora is visible above North America

Afternoon
- Numerous stars in the galactic plane appear around the disk
- Equatorial arcs are visible in the nominal disk scan
Imaging Tdisk

Days 308-309 (Nov. 4-5, 2018)

Geomagnetic storm (Kp 6-) on day 309

Storm increases thermospheric temperature

Oct. – March 2018 data are available

Current data is at higher temporal and spatial resolution than planned
Imaging of O/N\textsubscript{2} Density Ratio

Days 308-310 (Nov. 4-6, 2018)

**Geomagnetic storm (Kp 6-) on day 309**

On that day oxygen density (relative to N\textsubscript{2}) decreases significantly at high latitudes, equatorward of the aurora

Oct. – Dec. 2018 data are available

Updating data products soon with O/N\textsubscript{2} through Feb. 2019; adding correction for detector changes

(note: O/N\textsubscript{2} values valid only outside the regions with energetic particle precipitation)
Exospheric temperature (Texo) derived from limb scans near the equator

Day 254 20:07 UT limb scan

Fit to N$_2$ emission the profile at 2.75 N latitude

Exospheric temperature is derived from each profile
Exospheric temperature (Texo) derived from limb scans near the equator

GOLD vs. MSIS

Oct. 2018 – March 2019 data are available
O$_2$ Density Profile

O$_2$ Density Profiles (black) vs. a priori (red)

O$_2$ Morphology compared to MSIS

GOLD O2DEN a priori dependence

GOLD O$_2$ @ 170 km

October 2018 – March 2019 data are available
Nightside Observations

Observing O 135.6 nm emissions from Appleton anomaly

*Single channel 17-20 LT; 30 min imaging cadence*

Both channels 20-21 LT; 15 min imaging cadence

*Green line on magnetic equator*

October 2018 – March 2019 data are available
GOLD began science operations on October 17, 2018

Routine observations include:
- Dayside disk scans, limb scans & stellar occultations (03:00 – 20:00 LT)
- Nightside disk scans (17:00 – 21:00 LT, to 21:30 LT in 2019)

Level 1 data released March 2019 (http://gold.cs.ucf.edu, also at SPDF)
- Channel A - October 6, 2018 – March 14, 2019

Level 2 data released June 3, 2019 (at same locations as L1)
- $T_{disk}, T_{exo}, O_2$ density profiles – October 6, 2018 – March 14, 2019
- $O/N_2$ – October 6, 2018 – December 31, 2018; through February 2019 after reprocessing
Instrument performance is nominal and consistent with planned performance

Level 1 & Level 2 data are online for download

Current data showing good agreement with other observations and modeling

Planning for focused observations for solar eclipse next month & for a yet to be drafted hurricane in the Atlantic

Already, unanticipated and surprising ‘weather’ in the I-T system
Thank You