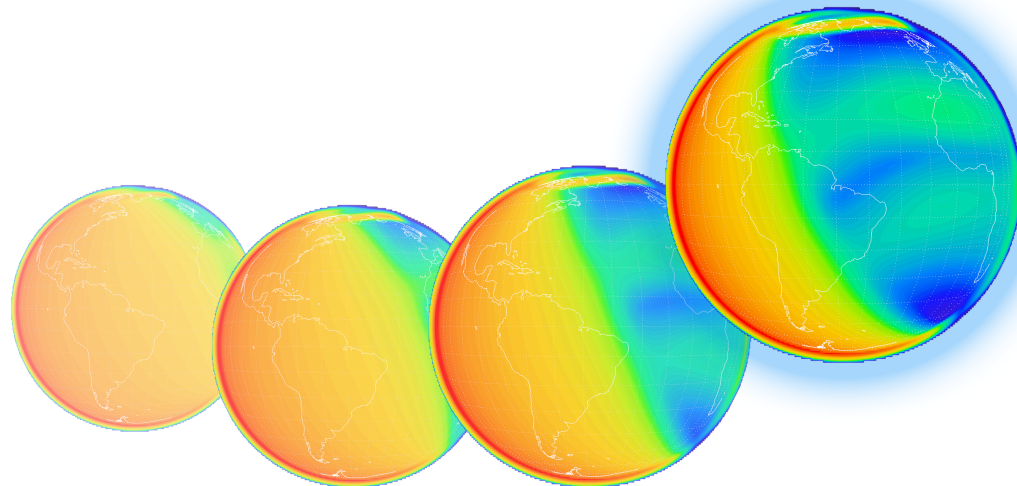
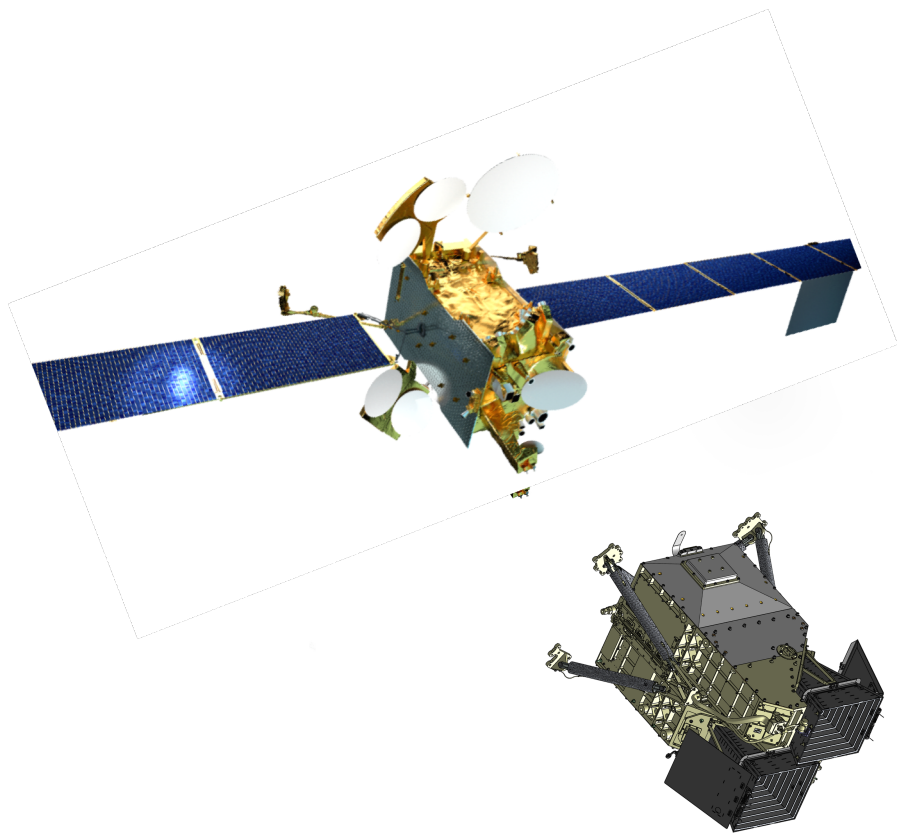
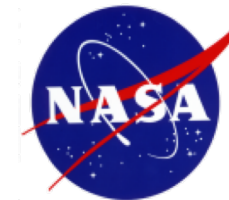


# Global-scale Observations of the Limb and Disk (GOLD) – First Light Observations

Richard Eastes, Alan Burns,  
William McClintock, and the  
GOLD Science Team

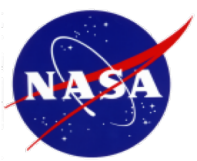


6/15/19



Laboratory for Atmospheric and Space Physics  
University of Colorado Boulder





# GOLD Mission Overview



## • Host Mission

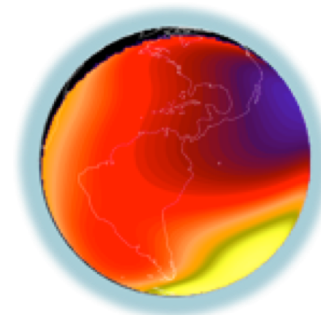
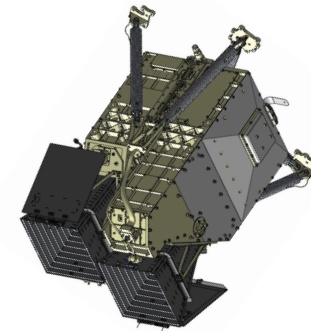
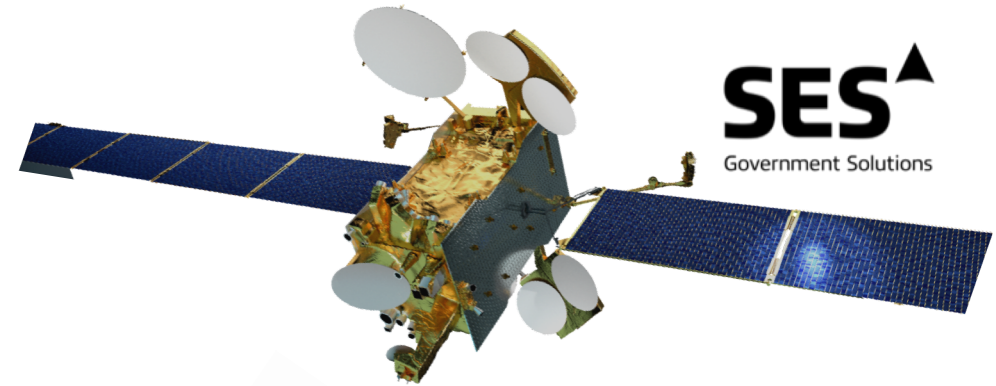
- SES-14, in geostationary orbit at  $47.5^\circ$  west (over mouth of the Amazon River)

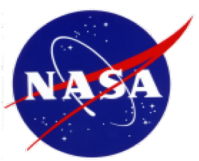
## • GOLD Instrument

- Two identical, independent imaging spectrographs covering 132-162 nm

## • Measurements

- Earth's disk
  - Tdisk & O/N<sub>2</sub> - Daytime: from spatial-spectral image cubes of O-135.6 nm and N<sub>2</sub>-LBH emission
  - Nmax - Nighttime: from images of O-135.6 nm emission
- Earth's limb
  - Texo - Altitude profiles of N<sub>2</sub>-LBH emission
  - O<sub>2</sub> density profile - Stellar occultations



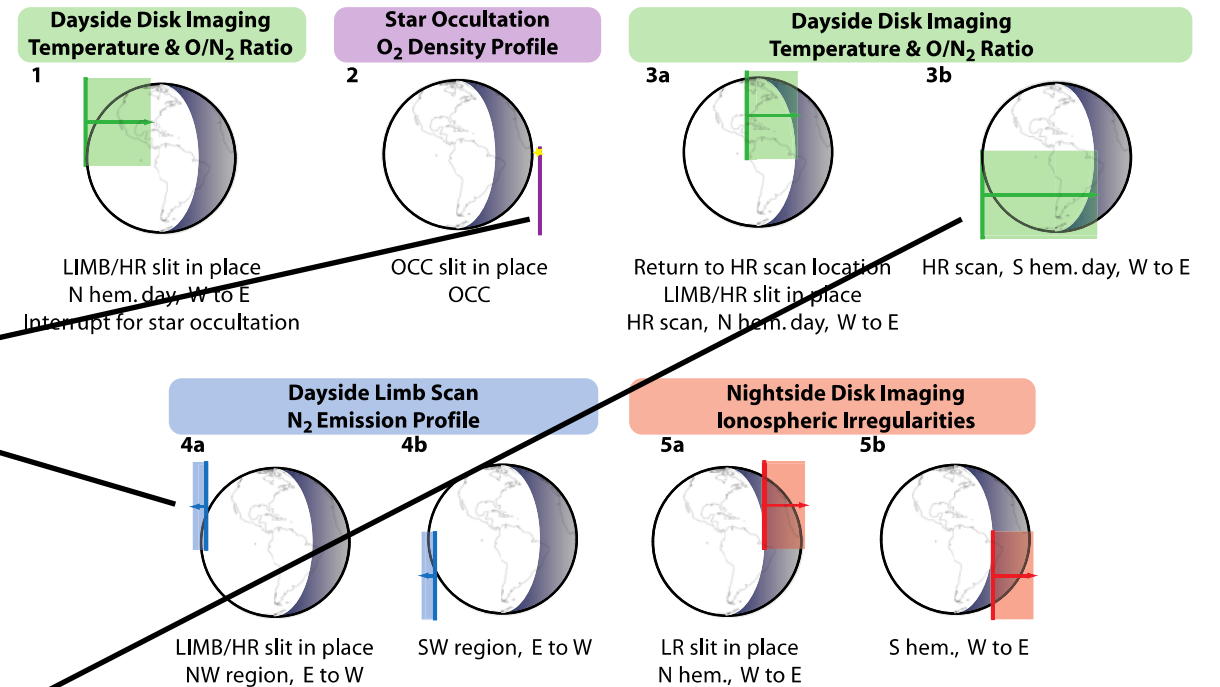


# GOLD Uses Whiskbroom Imaging to Build Spatial-Spectral Image Cubes

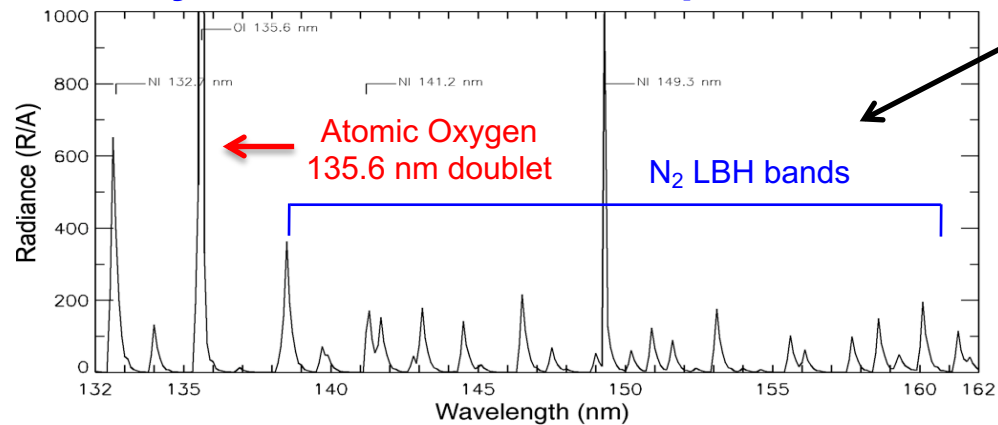


## Technique

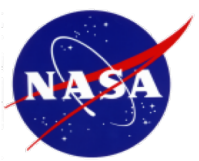
- Telescope equipped with a scan mirror images the T-I system onto the slit of an imaging spectrograph.
- The limiting resolution is ~ 50 km.
- Measurements include stellar occultations and altitude profiles on the limb



## Daytime Far-Ultraviolet Spectrum



The spectrograph records spectra as a function of slit height at each point on the disk.

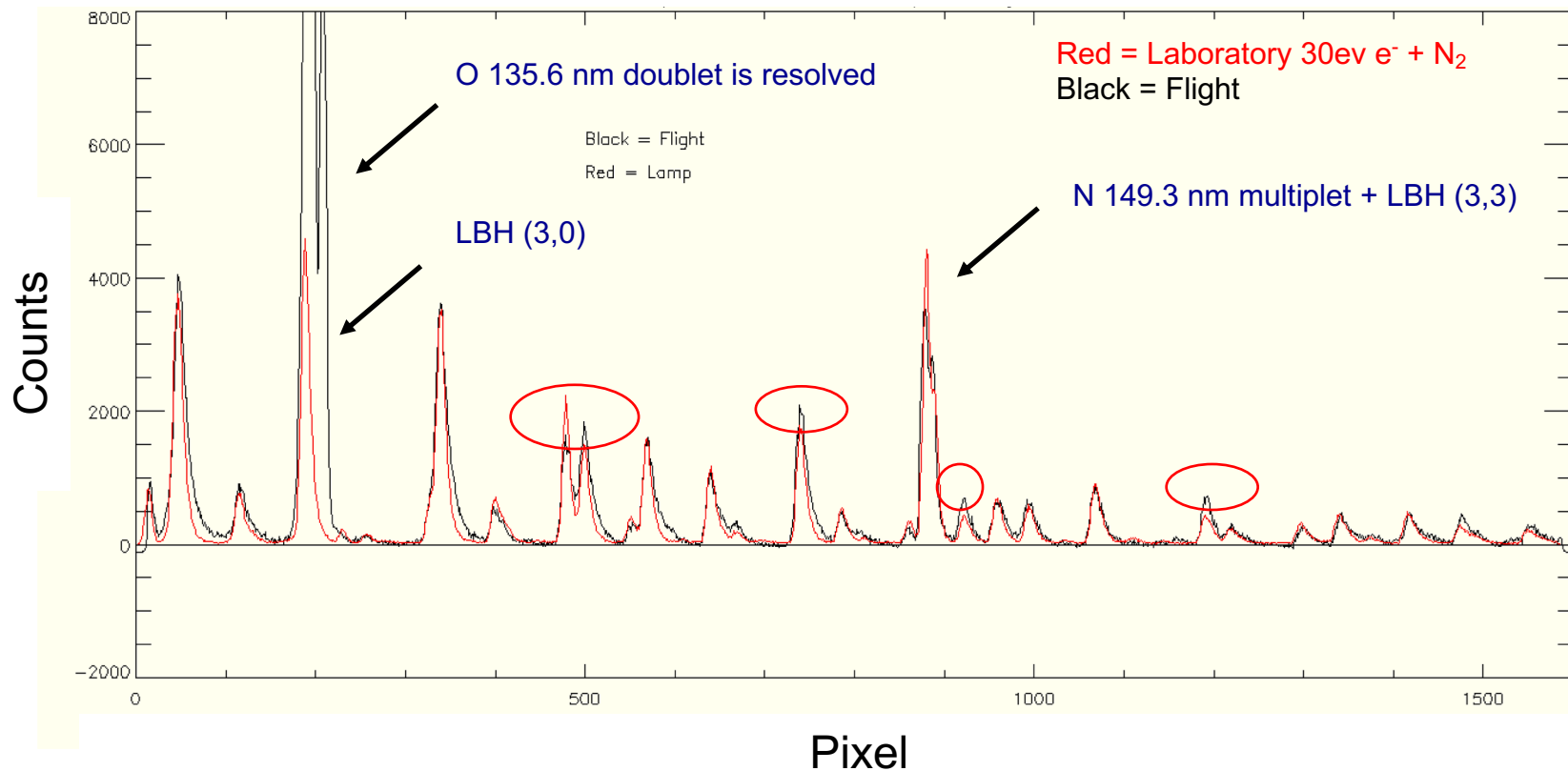


# Flight - Laboratory Comparison

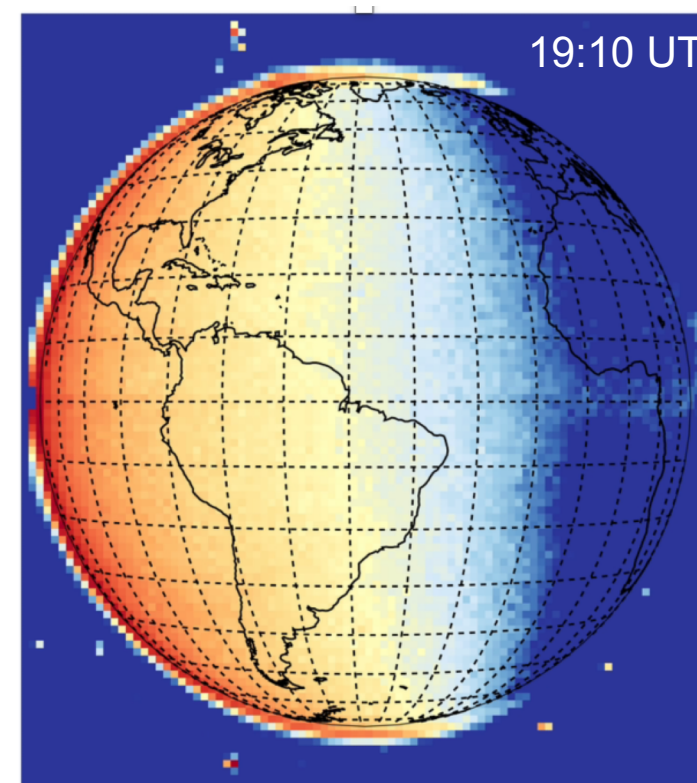
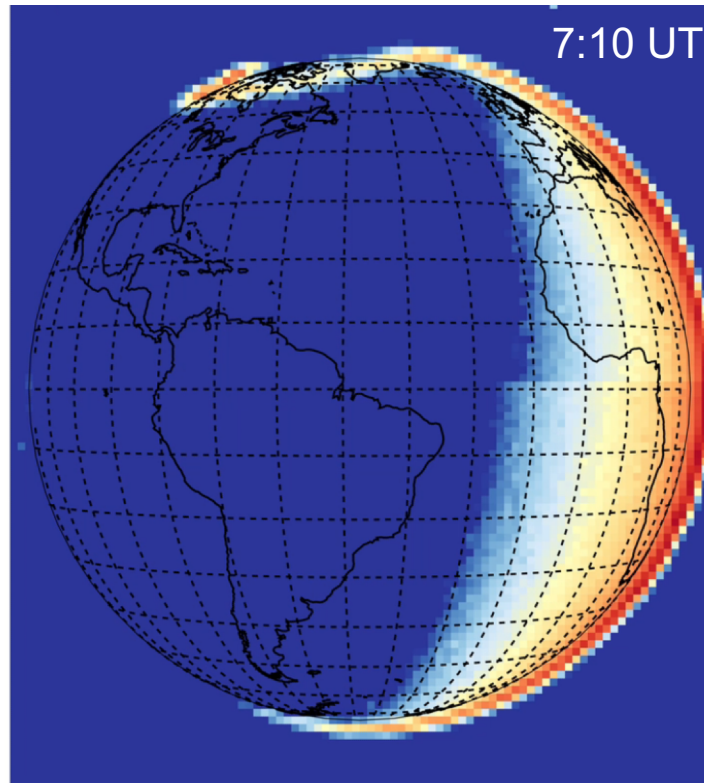


Direct comparison with electron lamp spectra acquired during ground calibration shows that the relative band strengths are in **good but not perfect** agreement with Franck- Condon factors derived in the laboratory

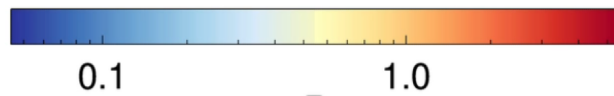
## Comparison of Laboratory Electron-Impact Spectrum and Flight Data



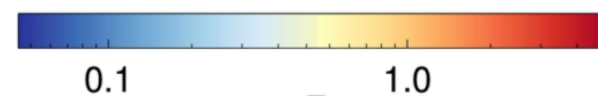




30-minute disk images



Brightness (kR)



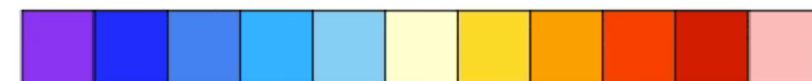
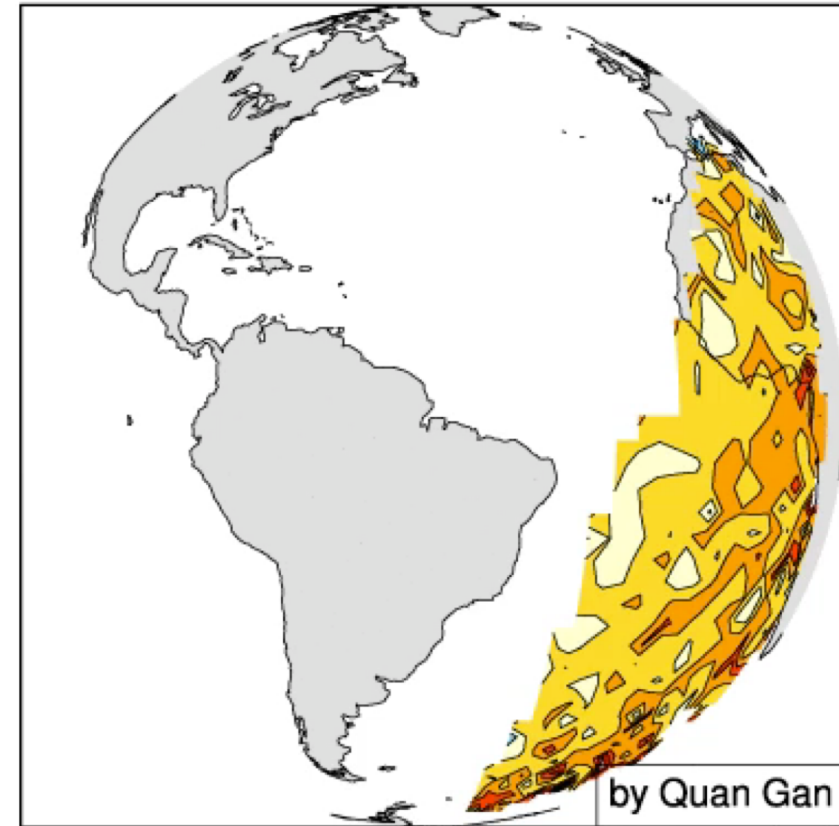
## Morning

- 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

Day = 308 0800UT



200 400 600 800 1000  
Tdisk (K)

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

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

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

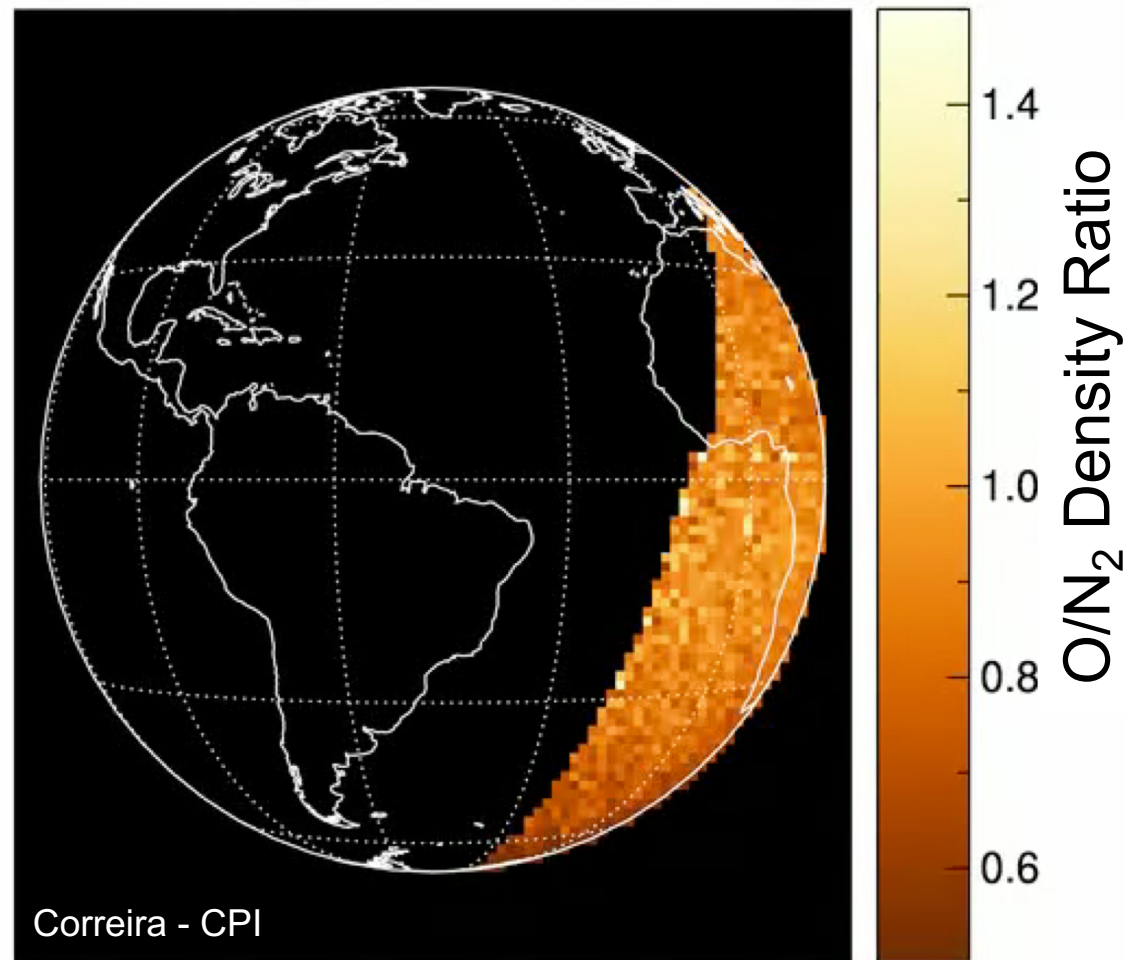
**On that day oxygen density (relative to N<sub>2</sub>) decreases significantly at high latitudes, equatorward of the aurora**

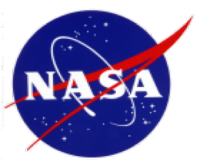
***Oct. – Dec. 2018 data are available***

**Updating data products soon with O/N<sub>2</sub> through Feb. 2019; adding correction for detector changes**

(note: O/N<sub>2</sub> values valid only outside the regions with energetic particle precipitation)

DOY 308 / 2018-11-04T07:16:10Z



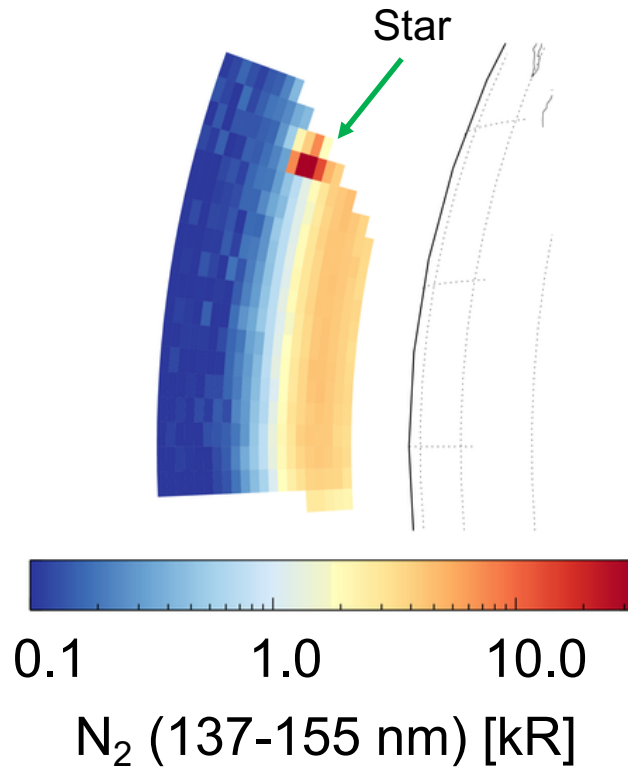


# Limb Scans for Exospheric Temperature

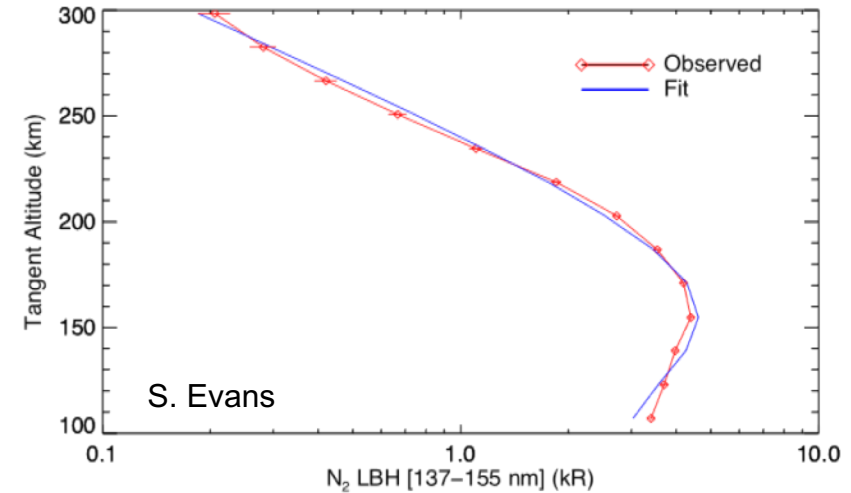


Exospheric temperature ( $T_{\text{exo}}$ ) derived from limb scans near the equator

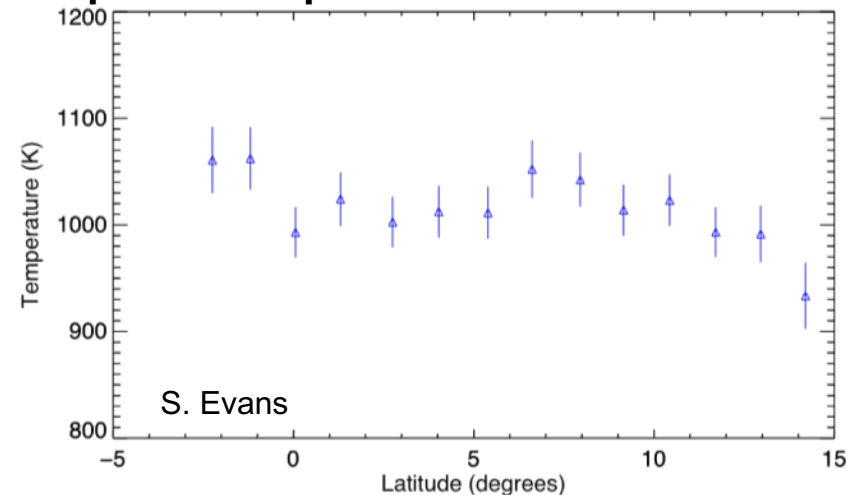
Day 254 20:07 UT limb scan

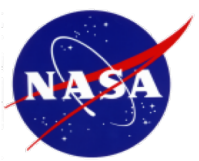


Fit to  $N_2$  emission the profile at 2.75 N latitude



Exospheric temperature is derived from each profile



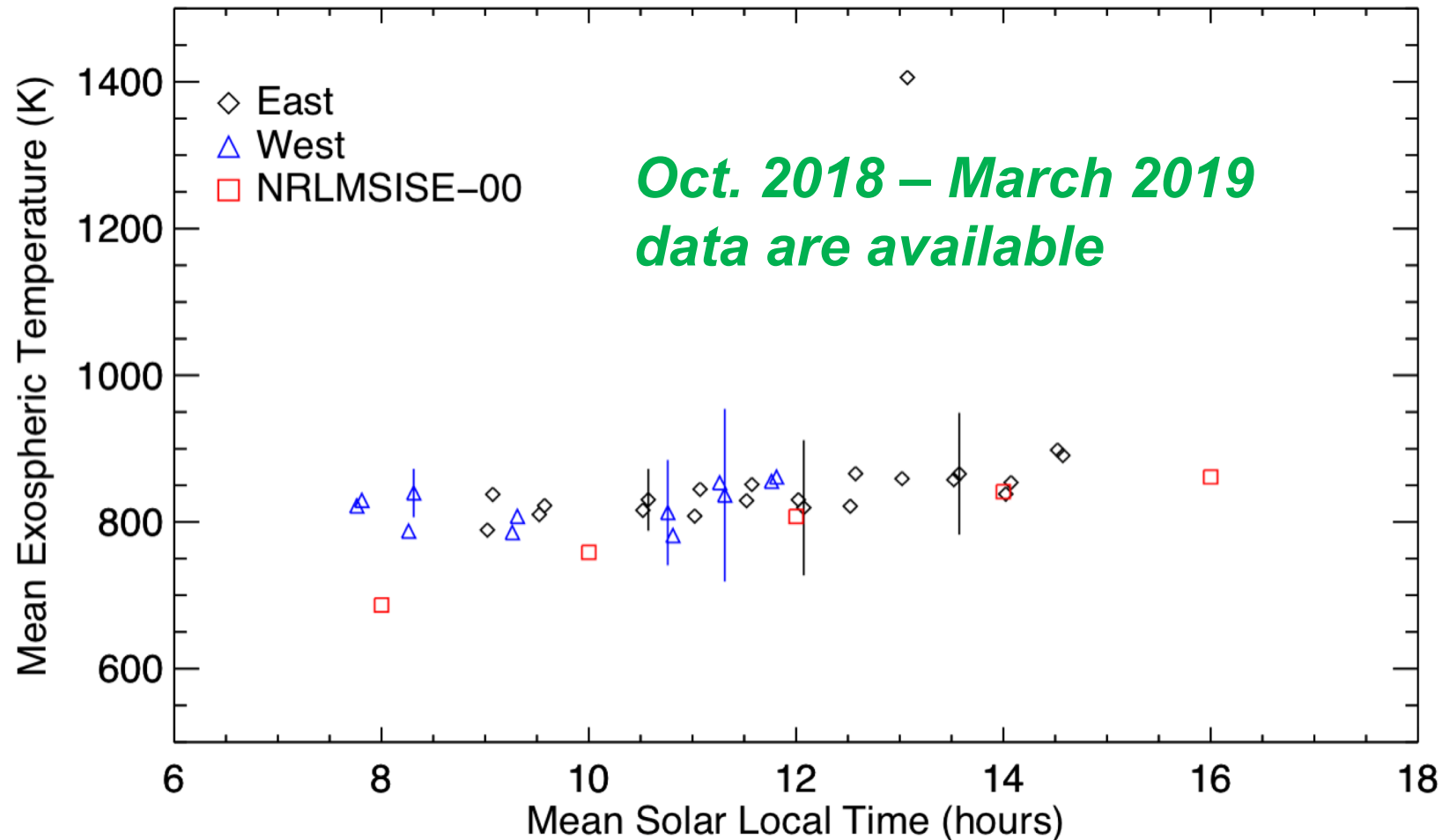


# Limb Scans for Exospheric Temperature

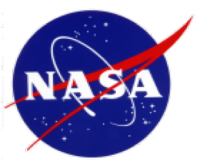


Exospheric temperature (Texo) derived from limb scans near the equator

## GOLD vs. MSIS





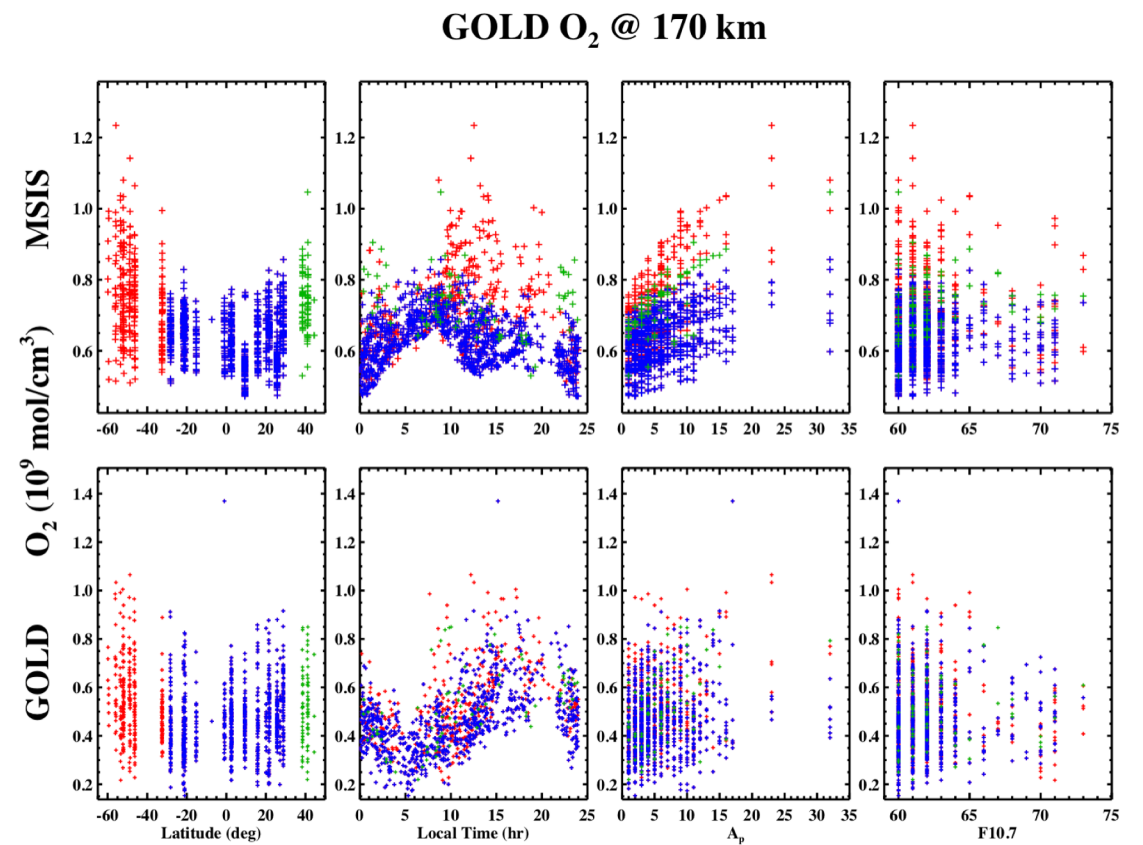
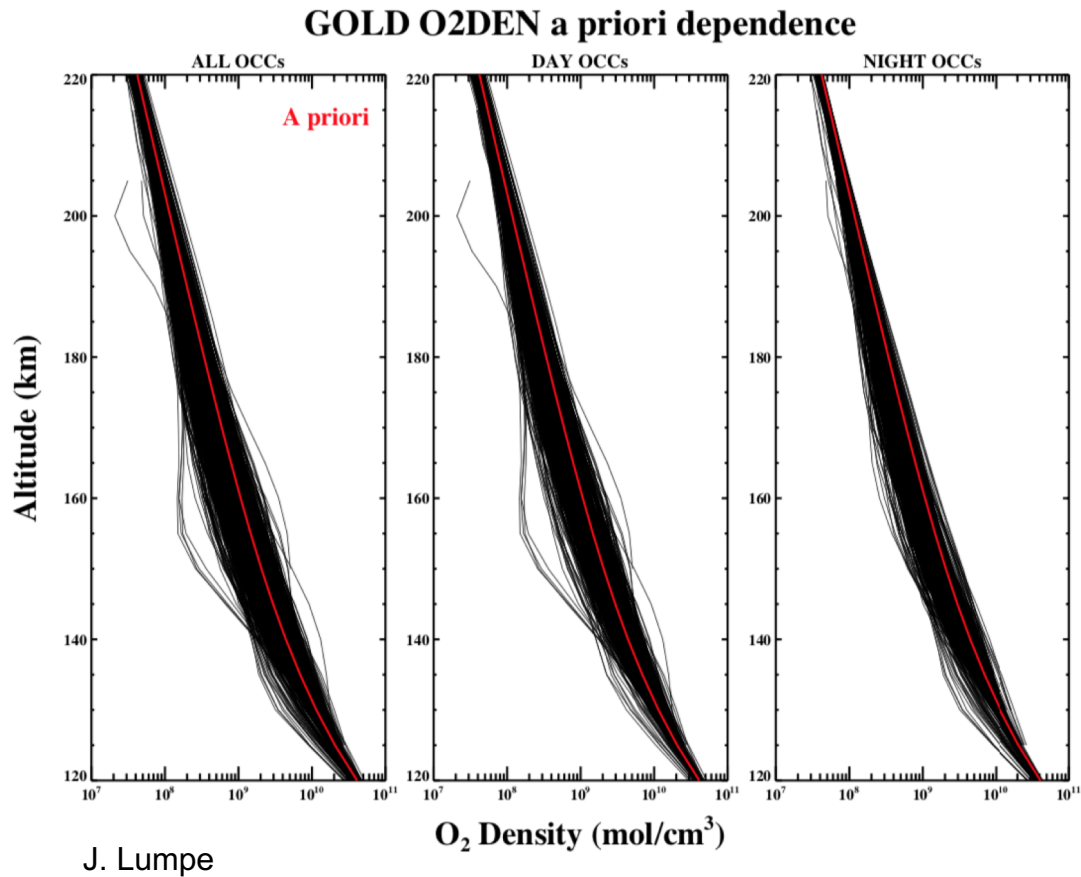


# O<sub>2</sub> Density Profile



## O<sub>2</sub> Density Profiles (black) vs. a priori (red)

## O<sub>2</sub> Morphology compared to MSIS



**October 2018 – March 2019 data are available**

Observing O 135.6 nm emissions  
from Appleton anomaly

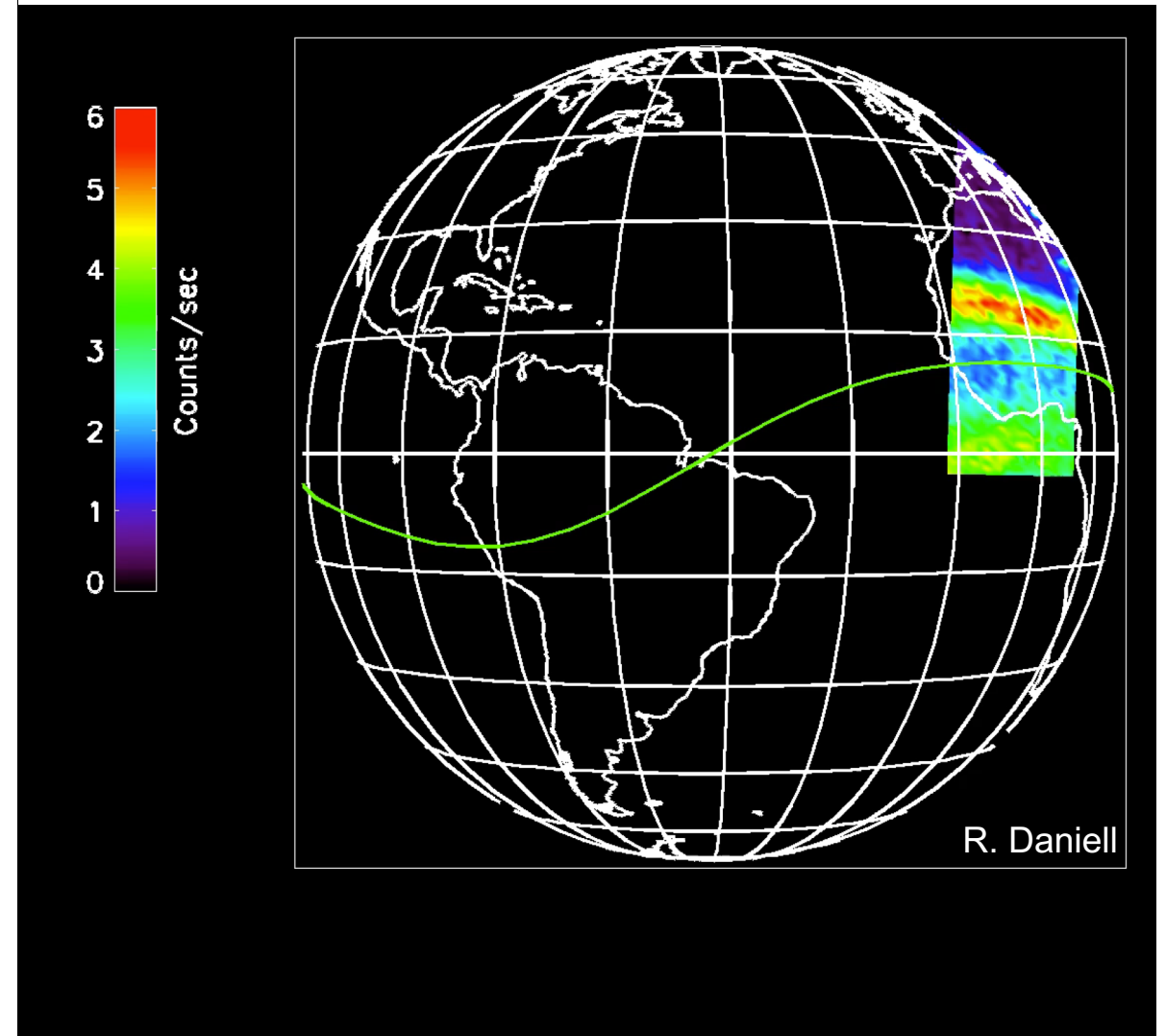
*Single channel 17-20 LT; 30 min  
imaging cadence*

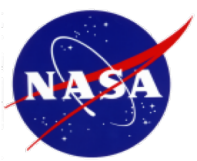
Both channels 20-21 LT; 15 min  
imaging cadence

*Green line on magnetic equator*

October 2018 – March 2019 data  
are available

October 17, 2018 (day 290)



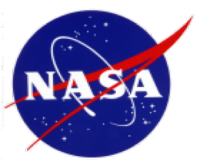


# Status



- **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)**
  - Tdisk, Texo, O<sub>2</sub> density profiles – October 6, 2018 – March 14, 2019
  - O/N<sub>2</sub> – October 6, 2018 – December 31, 2018; *through February 2019 after reprocessing*

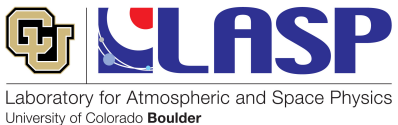


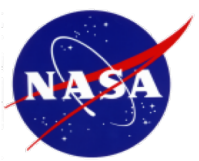


# Summary



- 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 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





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Thank You