Overview

The Global-scale Observations of the Limb and Disk (GOLD) instrument, scheduled for launch in 2017, will image the Earth’s thermosphere and ionosphere in the far ultraviolet from geo-stationary orbit. GOLD will measure a number of critical geophysical parameters, including thermospheric temperature and composition, by continuously scanning the Earth’s disk and limb 16 hours per day. GOLD will also provide a direct measurement of the atmospheric slant path transmission profile in the O(1) Schumann Runge continuum, which will be used to retrieve O3 density profiles between approximately 120 and 280 km altitude. In nominal operational mode GOLD will measure approximately 12-15 occultation events per day. These measurements will occur at latitudes ranging from 65S to 65N at two longitudes. Results of detailed retrieval simulations show that the precision and accuracy of the retrieved O3 density will be 10-20% depending on star brightness. We present a summary of the expected spatial, temporal and local time sampling of the GOLD Level 2 O3 data products. This data set will shed light on the general morphology of the thermosphere and ionosphere density profile and its response to geomagnetic disturbances and solar UV variability, and help address the extent to which the O3 density is determined by simple diffusive equilibrium as opposed to chemistry, which can operate on much shorter timescales.

GOLD O3 Science Objectives

The GOLD O3 data will be used to address two of the primary GOLD Science Questions:

- How do geomagnetic storms alter the temperature and composition structure of the thermosphere?
- What is the global-scale response of the thermosphere to solar extreme-ultraviolet variability?

Potential storm-time studies

- Redo calibrations from the 30-day mission to get vertical structure variations (changes in scale height, etc.)
- Observe the same star one day after day to estimate a time series at fixed locations and local time (2-3 week time series taken every 4 hours local time change).
- Characterize the O3 local time variation. Identify observation of multiple stars at similar latitudes at one longitude (see plot at bottom right of poster).
- Characterize the O3 latitudinal variation in each hemisphere.
- Characterize O3 hemispheric differences at fixed local time.
- Study the relationship between local time variations in O3 at the limb and O3 at the disk.

Potential campaign options

- Use multi-day to multi-week campaign modes to maximize occultation measurements.
- Relate storm-time O3 variation to the thermospheric O3 vertical profile.
- Look at the latitude gradient during storms.
- Options are to maximize latitude spread to see average latitude gradient, or focus near the equatorial anomalies to get latitudinal variation in each hemisphere.
- Requires observation of multiple stars at similar latitude at one longitude (see plot at bottom right of poster).
- What is the global-scale response of the thermosphere to solar extreme-ultraviolet variability?

GOLD Occultation Implementation

- Occultations are performed using the GOLD DET all configuration. The DET all is a 1 degree slit width (H) and 18 degree long slit (N). The slit width covers ~70 km in tangent altitude and is referred to as the nominal slit.
- It is positioned on the limb and held fixed during occultation.
- All stars can be observed in both rising and setting mode and in both north and south hemispheres.
- Level QL data has 100 ms time resolution, 0.05 nm tangent altitude (0.05 km) and 0.01 nm spectral resolution.
- Level QL data has been integrated at 0.05 nm tangent altitude and 0.05 nm spectral sampling.

O Retrieval Algorithm

- O Retrieval is performed using POAM-URAL retrieval algorithm. It has also been previously used to retrieve thermospheric O3 profiles from EUV/IRGOS solar occultation measurements and POLARIS/URAL occultation measurements. Retriever will utilize 8 - 15 nm spectral channels between 132 and 162 nm, using the spectral dependence from 300-1500 K. Blue curve in the SOLSTICE/SORCE stellar occultation measurements. Retrieval will utilize several 1- to 2-nm spectral channels between 132 and 162 nm, using the spectral dependence from 300-1500 K. Green curves are the O3 profile to what GOLD sees at the same time on the disk.

Occultation Sampling Predictions

- GOLD occultations are distributed in the Northern and Southern hemispheres corresponding to the IfS and West limbs in a similar light. Dotted lines denote solar safe mode – events occurring to left or right of STD at the same time on the disk.
- The occultation time/latitude sampling at equinox and solstice. Each occultation event, including scan to position, setup and dwell time, is 5 to 7 minutes.
- Star sets at 115°, rises at 33.5°.

Table 1. List of 30 potential GOLD target occultation stars. There are 28 stars in the list. G - Some stars may be occulted or too bright (potential detection and occultation thresholds).