The GOLD Instrument Measures Temperature and Composition of the I-T System Using Imaging and Occultation Spectroscopy

Abstract
The Global-scale Observations of the Limb and Disk (GOLD) is a NASA mission of opportunity that will image the Earth’s thermosphere and ionosphere from geostationary orbit. It will investigate how the thermosphere-ionosphere (T-I) system responds to geomagnetic storms, solar variation, and cosmic ray propagating indices. Launched by an Ariane 5 rocket aboard SES 14, GOLD will be placed into orbit at 47,500 km. Its instruments, contained within the GOLD turret, will observe emissions from atomic oxygen and molecular nitrogen over a wavelength range of 100 nm and a longitudinal range of 47°, relative to spacecraft nadir.

GOLD Mission Science Measurement Requirements

1. Collect limb disk images of atomic oxygen (O) and molecular nitrogen (N2) with a spectral resolution of 0.1 nm and a longitudinal resolution of 6 arcminute.
2. Construct, on the axis portion of limb, images of:
   i. lower thermosphere temperature with a precision of ±55 K and a spatial resolution of 2°.
   ii. thermosphere column composition (O/N2 density ratio) with a precision of 10% and a spatial resolution of 250 km (at nadir).
3. Construct, on the nighttime portion of the disk, images of Nmax, at the peak of the equatorial arcs, with a precision of 10% and a lateral resolution of 2°.
4. Track thermospheric density (depletions) within a single equatorial arc with a precision of 20% in brightness and a spatial resolution of 30 minute cadence and 50 km (at nadir).
5. Measure exospheric temperature (near-equatorial) with a precision of ±40 K in the daytime.

Measurements

Emission Spectroscopy: O/N2, Tobs, Tres, O
1. Conduct spatial-spectral image cubes using whiskbroom imaging
2. Full disk image + limb profile on 30 minute cadence

Occultation Spectroscopy: O2
1. Star drifts through a 1° wide occultation slit
2. O2 line-of-eight column densities 150 – 240 km

Instrument
Pair of Identical Telescope-Spectrometers
1. 132 – 165 nm coverage
2. 0.2 – 1 nm spectral resolution
3. Scan mirror for independent fields of view
4. Mass, Power, Data Rate: 37kg, 60-90W, 900Mbps

Simulated GOLD Images of O-135.6 and N2-LBH Emissions, O/N2 Emission Ratio and Effective Temperature for 3 Successive Days Centered on the AGU 2006 Geomagnetic Storm

GOLD Exceeds Its Science Measurement Requirements

Spectral Resolution and Range

Radiometric Performance (SNR)

Composition, Disk Temperature, O Equatorial Arcs

GUVI measurements of O and N2 radiances at Solar min
Average 200kR and 10kR H – 121.6nm and O – 130.4nm radiances
Geostationary energetic particle fluxes calculated using AE-8 Model