THE GOCI INSTRUMENT ON COMS MISSION

THE FIRST GEOSTATIONARY OCEAN COLOUR IMAGER

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The COMS mission

The Communication Ocean and Meteorological Satellite (COMS) is developed by Korea Aerospace Research Institute (KARI) to provide to South-Korea with three Services from Geostationary Orbit:

- **A Meteo mission**:
  - Continuous monitoring of imagery and extracting of meteorological products with high resolution (1kmx1km) and multi-spectral imager (1 visible and 4 IR)
  - Early detection of special weather such as storm, flood, yellow sand, etc.
  - Extraction of data on long-term change of sea surface temperature and cloud

- **An experimental Ka band telecommunication mission**

- **An Ocean Imager mission**:
  - Monitoring of marine environments around Korean peninsula with a resolution of 500m
  - Production of classical ocean color information (Chlorophyll, etc.)
  - Monitoring of long-term/short-term change of marine ecosystem
GOCI – Mission Overview (1)

GOCI is the Geostationary Ocean Color Imager for the COMS satellite

The GOCI is designed to provide multi-spectral data to detect, monitor, quantify, and predict short term changes of coastal ocean environment for marine science research and application purpose.
The GOCI is providing full target area images in 8 narrow spectral bands selected for Ocean color monitoring.

<table>
<thead>
<tr>
<th>Band</th>
<th>center</th>
<th>Bandwidth</th>
<th>Main Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>412 nm</td>
<td>20 nm</td>
<td>Yellow substance and turbidity extraction</td>
</tr>
<tr>
<td>2</td>
<td>443 nm</td>
<td>20 nm</td>
<td>Chlorophyll absorption maximum</td>
</tr>
<tr>
<td>3</td>
<td>490 nm</td>
<td>20 nm</td>
<td>Chlorophyll and other pigments</td>
</tr>
<tr>
<td>4</td>
<td>555 nm</td>
<td>20 nm</td>
<td>Turbidity, suspended sediment</td>
</tr>
<tr>
<td>5</td>
<td>660 nm</td>
<td>20 nm</td>
<td>Baseline of fluorescence signal, chlorophyll, suspended sediment</td>
</tr>
<tr>
<td>6</td>
<td>680 nm</td>
<td>10 nm</td>
<td>Atmospheric correction and fluorescence signal</td>
</tr>
<tr>
<td>7</td>
<td>745 nm</td>
<td>20 nm</td>
<td>Atmospheric correction and baseline of fluorescence signal</td>
</tr>
<tr>
<td>8</td>
<td>865 nm</td>
<td>40 nm</td>
<td>Aerosol optical thickness, vegetation, water vapor reference over the ocean</td>
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</tbody>
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GOCI Global spectral response: 8 narrow bands

GOCI Spectral bands center wave and main use
GOCI – Imaging Principle And Major Requirements

Imaging is step and stare based on a dedicated 2Mpixels CMOS detector (1400x1400) passively cooled and regulated around 10°C.

Total Target area is 2500 x 2500 km in all bands acquired and downloaded in 30 minutes.

Ground Pixel Size is 500x500m at centre of field (130°E – 36°N), equivalent to 360 m NADIR.

GOCI CMOS Detector (with temporary window)
GOCI – Major Requirements

Dynamic of signal is coded on 12 bit per pixel. For each image, two gains High (for sea) and Low (for clouds) images are acquired to build a non saturated / large dynamic image.

High gain images are averaged onboard by GOCI electronic unit, with a programmable image acquisition time from 0.1 to 8 seconds.

Resulting SNRs is > 1000 on all bands

An High accuracy pointing assembly is used to select slots positions
  • LOS anywhere in a 4° cone
  • Pointing accuracy is < 0,03 ° (500 μrad)
  • Precise position knowledge < 10 μrad

System MTF > 0.3 on all bands after ground processing

Nominal Life time 8 years, with 10 images/day and calibration every night

Radiometric accuracy is obtained using in-orbit calibration on sun light with a full Pupil Solar diffuser
GOCI – Design Overview (1)

Size: 1.00 (PIP 1.4m) x 0.80 x 0.80 m³

Total Mass < 78 Kg

Power about 40W electronics + thermal control < 60W

Instrument is split into Main Unit (optical module, including focal plane and proximity electronics) and Electronic Unit.
8 band pass filters are mounted on a filter wheel in front of the focal plane. A 9th position is used for dark signal acquisition.

Calibration is achieved by sunlight at night through a full pupil diffuser, made of fused Silica insensitive to radiation aging.

A second diffuser of smaller size is used to monitor main diffuser.
Ocean Color From Geo Orbit – Main Technical Challenges

Advantages of Geostationary Orbit are numerous from a mission point of view:

- Continuous observation of the scene of interest, with images provided every hour
- Maximizing chance of clear observation of all scene even in cloudy season
- Possible short term (daily) operational monitoring and long term analysis
- Full pupil Calibration with sun light is possible every night
- No Sun glint thanks to the “perpendicular” observation

However such advantages mean also some technical challenges which were overcome:

- Radiometry is critical: geo orbit, narrow filter bands, low luminance on water, and high SNR required. This has been achieved thanks to the use of a dedicated CMOS matrix, thermally regulated allowing integration times of few seconds per pixel.

- Challenging Mass/volume target together with strong environment due to compatibility with all launchers and instrument outside satellite structure. This was met with a compact and stable full Sic telescope not requiring fine thermal control
Project Status

- GOCI Development started mid 2005 together with COMS satellite

- GOCI FM model is now ready and completing its test sequence for delivery and integration onto COMS satellite by end 2008

- Launch is foreseen in 2009 and operational mission will start after a half-year commissioning.
GOCI Flight Model pictures

During alignment tests
Optical axis is horizontal

During integration, without MLI