Present Status of GOCI and Preliminary GOCI–2 Mission & User Requirements

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Korea Ocean Satellite Center
KORDI
Mission of GOCI

• Detecting, monitoring and predicting short term biophysical phenomena
• Studies on biogeochemical variables and cycle
• Detecting, monitoring and predicting noxious or toxic algal blooms of notable extension
• Monitoring the health of marine ecosystem
• Coastal zone and resource management
• Producing an improved marine fisheries information to the fisherman communities
User Requirements

- GSD: 500m x 500m
- Target Area: 2,500km x 2,500km
User Requirements

• Spectral Requirements
  - State-of-the-art filter fabrication techniques
  - Intensified Optical analysis to satisfy High SNR

<table>
<thead>
<tr>
<th>Ch.</th>
<th>Band Center</th>
<th>Band width</th>
<th>SNR</th>
<th>Primary use</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>412nm</td>
<td>20nm</td>
<td>1077</td>
<td>Yellow substance and turbidity</td>
</tr>
<tr>
<td>B2</td>
<td>443nm</td>
<td>20nm</td>
<td>1199</td>
<td>Chlorophyll absorption maximum</td>
</tr>
<tr>
<td>B3</td>
<td>490nm</td>
<td>20nm</td>
<td>1316</td>
<td>Chlorophyll and other pigments</td>
</tr>
<tr>
<td>B4</td>
<td>555nm</td>
<td>20nm</td>
<td>1223</td>
<td>Turbidity, suspended sediment</td>
</tr>
<tr>
<td>B5</td>
<td>660nm</td>
<td>20nm</td>
<td>1192</td>
<td>Baseline of fluorescence signal, Chlorophyll, suspended sediment</td>
</tr>
<tr>
<td>B6</td>
<td>680nm</td>
<td>10nm</td>
<td>1093</td>
<td>Atmospheric correction and fluorescence signal</td>
</tr>
<tr>
<td>B7</td>
<td>745nm</td>
<td>20nm</td>
<td>1107</td>
<td>Atmospheric correction and baseline of fluorescence signal</td>
</tr>
<tr>
<td>B8</td>
<td>865nm</td>
<td>40nm</td>
<td>1009</td>
<td>Aerosol optical thickness, vegetation, water vapor reference over the ocean</td>
</tr>
</tbody>
</table>
User Requirements

- Comparison with other Ocean Color Sensor
  - High ground resolution
    - Sufficient for coastal monitoring
  - Very long focal length
    - For high ground resolution at GEO
  - Relatively high SNR in the spec. level with low deviation
    - Longer integration time is required at GEO

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Focal Length</th>
<th>Ground resolution</th>
<th>SNR</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSMI</td>
<td>128.9mm</td>
<td>1km</td>
<td>350~450 (Spec.)</td>
</tr>
<tr>
<td>SeaWiFS</td>
<td>114.9mm</td>
<td>1km</td>
<td>800~1200 (PFT)</td>
</tr>
<tr>
<td>MERIS</td>
<td>67.3mm</td>
<td>1.2km/300m</td>
<td>400~1900 (PFT)</td>
</tr>
<tr>
<td>MODIS</td>
<td>114mm</td>
<td>1.0km/250m</td>
<td>900~1400 (PFT)</td>
</tr>
<tr>
<td>GOCI</td>
<td>1171mm</td>
<td>&lt;500m</td>
<td>1009~1316 (Spec.)</td>
</tr>
<tr>
<td>Central wavelength (nm)</td>
<td>SeaWiFS (bandwidth, nm)</td>
<td>GOCI (bandwidth, nm)</td>
<td>Primary Use</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------</td>
<td>----------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>412</td>
<td>1(20)</td>
<td>1(20)</td>
<td>Yellow substance and turbidity</td>
</tr>
<tr>
<td>443</td>
<td>2(20)</td>
<td>2(20)</td>
<td>Chlorophyll absorption maximum</td>
</tr>
<tr>
<td>490</td>
<td>3(20)</td>
<td>3(20)</td>
<td>Chlorophyll and other pigments absorption, K(490)</td>
</tr>
<tr>
<td>510</td>
<td>4(20)</td>
<td></td>
<td>Chlorophyll absorption</td>
</tr>
<tr>
<td>555</td>
<td>5(20)</td>
<td>4(20)</td>
<td>Suspended sediment</td>
</tr>
<tr>
<td>660</td>
<td>5(20)</td>
<td></td>
<td>Fluorescence base 1, chlorophyll, suspended sediment</td>
</tr>
<tr>
<td>670</td>
<td>6(20)</td>
<td></td>
<td>Atmospheric correction</td>
</tr>
<tr>
<td>680</td>
<td>6(10)</td>
<td></td>
<td>Fluorescence signal, atmospheric correction</td>
</tr>
<tr>
<td>745</td>
<td>7(20)</td>
<td></td>
<td>Atmospheric correction, Fluorescence base 2</td>
</tr>
<tr>
<td>765</td>
<td>7(40)</td>
<td></td>
<td>Atmospheric correction, aerosol radiance</td>
</tr>
<tr>
<td>865</td>
<td>8(40)</td>
<td>8(40)</td>
<td>Aerosol optical thickness, vegetation, Water vapor reference over the ocean</td>
</tr>
</tbody>
</table>

Difference with SeaWiFS: 510nm not included, 670(20)nm -> 660(10)nm, 680nm added

Bandwidth of GOCI band6 (680 nm) is 10 nm for Flu. tech.
### GOCI vs. SeaWiFS (Differences)

<table>
<thead>
<tr>
<th></th>
<th>SeaWiFS</th>
<th>GOCI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Altitude</strong></td>
<td>700-800 km</td>
<td>36,000 km</td>
</tr>
<tr>
<td><strong>Scanning type</strong></td>
<td>1-axis scanning</td>
<td>Staring-frame capture</td>
</tr>
<tr>
<td><strong>Spatial resolution</strong></td>
<td>1000 m</td>
<td>500 m</td>
</tr>
<tr>
<td><strong>Spectral range</strong></td>
<td>400-900 nm</td>
<td>400-900 nm</td>
</tr>
<tr>
<td><strong>Temporal resolution</strong></td>
<td>1 day</td>
<td>1 hour</td>
</tr>
<tr>
<td><strong>Sun-Satellite position</strong></td>
<td>stable</td>
<td>variable</td>
</tr>
<tr>
<td><strong>Coverage</strong></td>
<td>global</td>
<td>Local</td>
</tr>
<tr>
<td><strong>Previous algorithms</strong></td>
<td>Case-1 (Case-2)</td>
<td>No previous result</td>
</tr>
</tbody>
</table>

Bi-directional correction & local bio-optical algorithm are required

Korea Ocean Satellite Center, KORDI
• GOCI Main Unit Overview (1/2)
  - Mass Budget : 83.305kg
  - Power Budget : 106W (Max)
• GOCI Main Unit Overview (2/2)
  - Mass Budget: 83.305kg
  - Power Budget: 106W (Max)
GOCI Development

- GOCI Assembly and Integration
  - No discrepancy in GOCI subsystem level test & integration.
  - GOCI Integration is successfully completed.

GOCI Main Unit before MLI Mounting

GOCI Main Unit with MLI
Cal/Val Activity for GOCI

- Lw and Ed obtained from spectroradiometer of IEODO & GAGEOCHO(2009) Ocean Research Station
- SeaPrism (Cimel, France) will be installed.
Following Activities

• Straylight at B2, B3 and Ghost at B6, B8 has been characterized by KORDI/KARI/Astrium and ground processing S/W will be developed by KORDI.

• Updated radiometric calibration algorithm and MTF De-convolution algorithm will be verified during IOT(In Orbit Test) period.

• Launch Schedule : Early 2010
GOCI–2 Mission & User Requirements
GOCI-2 Mission

- Succession and expansion of the GOCI missions

- Global Area (Full Disk)
  - Establishment of Ocean Observation System to monitor long-term climate change
  - Evaluation of the Primary Productivity in Ocean \(\rightarrow\) CO2 absorption capability of Ocean \(\rightarrow\) Estimating ‘global warming’
  - Ocean Environment Monitoring
    Variation of eco-system

- Local Area
  - Environment Monitoring for the efficient management of coastal waters
    Fresh water/Polluting material drifts & spreads, Pollution of coastal waters
  - Production of fishing ground environment information
    Searching fishing ground, Monitoring of aquaculture environment in coastal waters

- Common
  - For reducing the damage by disaster and catastrophe in Ocean, real time ocean environment monitoring
    Spreads of red tide, Monitoring of oil spill & tidal wave
Features of GOCI-2

- **Main Feature**
  - **High temporal resolution**
    =>$> \text{Observation by every hour}$
  - **Wide area coverage**
    =>$> \text{Full disk Coverage (1/3 of the full Earth surface)}$
  - **Local area coverage**
    =>$> \text{Monitoring on the region of Korean Peninsula}$
  - **High & Medium spatial resolution**
    =>$> \text{250m at local area & 1km at full disk coverage}$
  - **High reliability**
    =>$> \text{High SNR & MTF, Increased Spectral bands}$
Key Requirements

- Spectral Band: 13 bands (cf. GOCI = 8 Bands)
- Resolution (GSD): < 250m (cf. GOCI = 500m)
- Temporal Resolution: 1 hour, 8 times per day.
- Observation Coverage
  - Local Area (ex. Special Event Area) – GSD: ~250m
  - Full Disk Coverage – GSD: ~1000m
- Nighttime Observation (like DNB in VIIRS)
  - Additional Panchromatic Filter
    - Panchromatic Filter (400~900nm)
    - Dedicated Low Noise Detector for Nighttime Observation
GOCI-2 User Requirements

- Comparison with GOCI

<table>
<thead>
<tr>
<th></th>
<th>GOCI</th>
<th>GOCI-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orbit type</td>
<td>GEO</td>
<td>GEO</td>
</tr>
<tr>
<td># of Bands</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>Spatial Resolution</td>
<td>500m x 500m</td>
<td>250m x 250m, 1km x 1km</td>
</tr>
<tr>
<td>Coverage</td>
<td>Local Area (2500km x 2500km)</td>
<td>Local Area (1800km x 1800km, selectable) Full disk</td>
</tr>
<tr>
<td>SNR</td>
<td>~1000</td>
<td>~ 1000</td>
</tr>
<tr>
<td>Temporal Resolution</td>
<td>1 Hour</td>
<td>1 Hour</td>
</tr>
</tbody>
</table>
• Spatial Resolution Requirement
  - $< 250\text{m}$ (GOCI : 500m)
• Temporal Resolution
  - 1 hour, 8 times/day (day time) (same as GOCI) – Local Area
  - 4 times/day (day time) – Full Disk (Global Area)
  - Purpose: To observe the behavior of Tidal Flat, Red Tide, etc.

Floodgate open

After 2 hours

Spread to southern area

300 m grid
**GOCI–2 User Requirements**

- **Coverage: Selectable Local Area & Full Disk**
  - Local Area: 2,500km x 2,500km (GOCI) – GSD: 250m
    - Center Position: 130E, 36N and user defined position & area
  - Full Disk: 12,800km x 12,800km (GSD: 1,000m)
  - Purpose: Monitoring of long term global climate change
**GOCI-2 User Requirements**

- **Spectral Bands Requirements (TBD)**
  - **13 Bands (GOCI : 8 Bands)**
  - Phytoplankton type verification, Nighttime Observation, Enhanced Atmospheric Correction Accuracy

<table>
<thead>
<tr>
<th>Band</th>
<th>Heritage</th>
<th>Band Center</th>
<th>Band width</th>
<th>Nominal Radiance</th>
<th>Maximum Ocean Radiance</th>
<th>Saturation Radiance</th>
<th>Maximum Cloud Radiance</th>
<th>NEdL</th>
<th>SNR</th>
<th>Primary use</th>
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<tbody>
<tr>
<td>1</td>
<td>GOCI-2</td>
<td>380nm</td>
<td>20nm</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td>CDOM</td>
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<tr>
<td>2</td>
<td>GOCI-B1</td>
<td>412nm</td>
<td>20nm</td>
<td>100.0</td>
<td>150.0</td>
<td>152.0</td>
<td>601.6</td>
<td>0.100</td>
<td>1000</td>
<td>Yellow substance and turbidity</td>
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<td>3</td>
<td>GOCI-B2</td>
<td>443nm</td>
<td>20nm</td>
<td>92.5</td>
<td>145.8</td>
<td>148.0</td>
<td>679.1</td>
<td>0.085</td>
<td>1090</td>
<td>Chlorophyll absorption maximum</td>
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<tr>
<td>4</td>
<td>GOCI-B3</td>
<td>490nm</td>
<td>20nm</td>
<td>72.2</td>
<td>115.5</td>
<td>116.0</td>
<td>682.1</td>
<td>0.067</td>
<td>1170</td>
<td>Chlorophyll and other pigments</td>
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<tr>
<td>5</td>
<td>GOCI-2</td>
<td>520nm</td>
<td>20nm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Red Tide</td>
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<tr>
<td>6</td>
<td>GOCI-B4</td>
<td>555nm</td>
<td>20nm</td>
<td>55.3</td>
<td>85.2</td>
<td>87.0</td>
<td>649.7</td>
<td>0.056</td>
<td>1070</td>
<td>Turbidity, suspended sediment</td>
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<td>7</td>
<td>GOCI-2</td>
<td>625nm</td>
<td>20nm</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>SS &amp; Red Tide</td>
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<tr>
<td>8</td>
<td>GOCI-B5</td>
<td>660nm</td>
<td>10nm</td>
<td>32.0</td>
<td>58.3</td>
<td>61.0</td>
<td>589.0</td>
<td>0.032</td>
<td>1010</td>
<td>Baseline of fluorescence signal, Chlorophyll, suspended sediment</td>
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<tr>
<td>9</td>
<td>GOCI-B6</td>
<td>685nm</td>
<td>10nm</td>
<td>27.1</td>
<td>46.2</td>
<td>47.0</td>
<td>549.3</td>
<td>0.031</td>
<td>870</td>
<td>Atmospheric correction and fluorescence signal</td>
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<td>10</td>
<td>GOCI-B7</td>
<td>745nm</td>
<td>20nm</td>
<td>17.7</td>
<td>33.0</td>
<td>33.0</td>
<td>429.8</td>
<td>0.020</td>
<td>860</td>
<td>Atmospheric correction and baseline of fluorescence signal</td>
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<td>11</td>
<td>GOCI-2</td>
<td>765nm</td>
<td>20nm</td>
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<td>Aerosol Properties, Atmospheric Properties</td>
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<tr>
<td>12</td>
<td>GOCI-B8</td>
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<td>40nm</td>
<td>12.0</td>
<td>23.4</td>
<td>24.0</td>
<td>343.8</td>
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<td>Aerosol optical thickness, vegetation, water vapor reference over the ocean</td>
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<tr>
<td>13</td>
<td></td>
<td>650nm</td>
<td>500nm</td>
<td>6.5E-6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Night Band (Night time fishing boat activities)</td>
</tr>
</tbody>
</table>
GOCI and other Missions

- GOCI
- Geo-Oculus
- GOCI/GEOCO+
- GOCI-2
- MDI/GEO-CAPE
- COCOA/GEO-CAPE
## GOCI and other Missions

<table>
<thead>
<tr>
<th>Mission/Imager</th>
<th>Type</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDI (Multi Discipline Imager) / GEO-CAPE</td>
<td>Hyper-spectral Imager (1000 bands)</td>
<td>300–556nm (B1) 340–1319nm (B2) 1240nm (B3) 1640nm (B4) 350–1050nm</td>
</tr>
<tr>
<td>COCOA / GEO-CAPE</td>
<td>Hyper-spectral Imager (140 bands)</td>
<td>317–1040nm (VNIR) 3700nm (SWIR) 10850nm (TIR1) 12000nm (TIR2)</td>
</tr>
<tr>
<td>Geo-Oculus</td>
<td>Multi-spectral Imager (23 bands)</td>
<td>413, 443, 490, 560, 665, 709, 754, 886nm</td>
</tr>
<tr>
<td>GOCI/GEOCO+</td>
<td>Multi-spectral Imager (8 bands)</td>
<td>412, 443, 490, 520, 555, 605, 625, 660, 680, 745, 765, 865, 905nm</td>
</tr>
<tr>
<td>GOCI–2</td>
<td>Multi-spectral Imager (13 bands)</td>
<td>412, 443, 490, 520, 555, 605, 625, 660, 680, 745, 765, 865, 905nm</td>
</tr>
<tr>
<td>GOCI (Geostationary Ocean Color Imager) / COMS</td>
<td>Multi-spectral Imager (8 bands)</td>
<td>412, 443, 490, 555, 605, 660, 745, 865nm</td>
</tr>
</tbody>
</table>

### Spectral Bands Type

<table>
<thead>
<tr>
<th>Spectral Bands Type</th>
<th>Spectral Bands</th>
<th>Spectral Resolution</th>
<th>SNR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spectral Bands</strong></td>
<td>300–556nm (B1)</td>
<td>0.75nm (B1)</td>
<td>&gt; 1000 (B1, B2)</td>
</tr>
<tr>
<td></td>
<td>340–1319nm (B2)</td>
<td>0.8nm (B2)</td>
<td>&gt; 500 (B3, B4)</td>
</tr>
<tr>
<td></td>
<td>1240nm (B3)</td>
<td>5nm (B3)</td>
<td>&gt; 400 (400–900nm)</td>
</tr>
<tr>
<td></td>
<td>1640nm (B4)</td>
<td>10–40nm (VNIR)</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>350–1050nm</td>
<td>20–40nm</td>
<td>5nm</td>
</tr>
<tr>
<td></td>
<td>317–1040nm (VNIR)</td>
<td>10–40nm (VNIR)</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>3700nm (SWIR)</td>
<td>5nm (SWIR)</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>10850nm (TIR1)</td>
<td>5nm (TIR1)</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>12000nm (TIR2)</td>
<td>5nm (TIR2)</td>
<td>1000</td>
</tr>
</tbody>
</table>

### Spatial Resolution

- **300m**
- **200m**
- **100m ~ 1km**
- **200m**
- **250m**
- **500m**

### Coverage

- **500km**
- **~ 500km**
- **100km**
- **TBD (Swath 500km)**
- **2,500km, 12,500km Full Disk**
- **2,500km**

### Temporal Resolution

- **< 1 hour (6 times/day)**
- **< 1 hour (6 times/day)**
- **1 hour (6–7 times/day)**
- **1 hour (8 times/day)**
- **1 hour (8 times/day)**
- **1 hour (8 times/day)**
Conclusion

1. GOCI–2 will have full disk coverage with higher resolution and 5 more bands than GOCI.

2. By the result of the tentative study, all user requirements are feasible.

3. Detailed feasibility study and system design will be followed.
Thank You