

## Distribution Service of Geostationary Ocean Color Imager in KOSC

Sang-Soo Bae\*, Suk Yoon, Tai-Hyun Han, Hee-Jeong Han, Joo-Hyung Ryu and Yu-Hwan Ahn  
\*Korea Ocean Satellite Center, Korea Ocean Research & Development Institute,  
787, Hae-an-ro(st), Sangrok-Gu, Ansan-si, Gyunggi-do, South Korea (426-744);  
Tel: + 82-31-400-7701;  
E-mail: realbss@kordi.re.kr

**KEY WORDS:** Geostationary Ocean Color Imager, Korea Ocean Satellite Center, Data Distribution Service, Communication, Ocean and Meteorological Satellite

**ABSTRACT:** GOCI (Geostationary Ocean Color Imager) is the first ocean color observation satellite, it was launched in June 2010, that is real-time monitoring of the ocean environment around Korean Peninsula (include China, Taiwan, Japan, Russia, etc.) by daily 8 times. So it is best satellite to monitor Northeast Asia ocean environment. The KOSC (Korea Ocean Satellite Center), the primary operational organization for GOCI, was established in KORDI (Korea Ocean Research & Development Institute). Since April 2011, KOSC is distributing GOCI data (02~04 UTC Level 1B RGB Composite Image and GOCI Viewer) for users by KOSC website (<http://kosc.kordi.re.kr>) in free of charge. Now, August 2011, KOSC has 420 GOCI data and 340 users (Korea and other countries) are registered by website. At Sep. 2011, KOSC will distribute Level 2 product (nLw, CHL, TSS, CDOM, etc.) and other satellites data (NOAA, MODIS) to compare with GOCI data. Also, KOSC will serve GDPS (GOCI Data Processing System) that was developed by KOSC for generation of GOCI Level 2 and Level 3 products. In this paper, we will introduce GOCI operation and service systems, plan of GOCI data service, how to register users and get GOCI data.

### 1. Introduction of COMS and KOSC

#### 1.1 GOCI (Geostationary Ocean Color Imager)

The COMS (Communication, Ocean and Meteorological Satellite) is middle sized geostationary ocean complex satellite. It was launched at June 2010, and has 3 payloads (ocean observation payload, meteorological observation payload, communication payload). The GOCI (Geostationary Ocean Color Imager), is one of 3 payloads on COMS, is the world's first ocean color observation satellite. GOCI is planned for use in real-time monitoring of the ocean environment around Korean Peninsula (2,500km x 2,500km centered at 130°E, 36°N, include China, Taiwan, Japan, Russia, etc.) by daily analysis of ocean environment measurements of chlorophyll concentration, dissolved organic matter, and suspended sediments taken eight times per day for seven years. GOCI primary data will support a fishery information service and red tide forecasting, and ocean climate change research (Seongick Cho, 2010a).

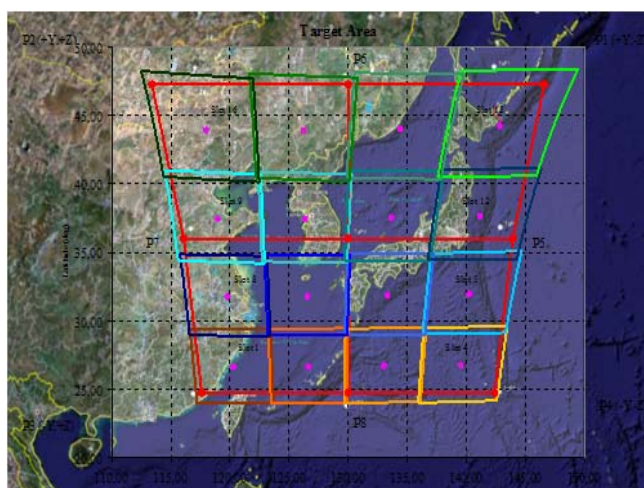


Figure 1 GOCI observation coverage

**Table 1** Spectral Bands Characteristic and Requirements of GOCI

<i>Band</i>	<i>Central wavelengths</i>	<i>Band Width</i>	<i>SNR</i>	<i>Type</i>	<i>Primary Application</i>
B1	412 nm	20 nm	1,000	Visible	Yellow substance and turbidity
B2	443 nm	20 nm	1,090	Visible	Chlorophyll absorption maximum
B3	490 nm	20 nm	1,170	Visible	Chlorophyll and other pigments
B4	555 nm	20 nm	1,070	Visible	Turbidity, suspended sediment
B5	660 nm	20 nm	1,010	Visible	Baseline of fluorescence signal, Chlorophyll, suspended sediment
B6	680 nm	10 nm	870	Visible	Atmospheric correction and fluorescence signal
B7	745 nm	20 nm	860	NIR	Atmospheric correction and baseline of fluorescence signal
B8	865 nm	40 nm	750	NIR	Aerosol optical thickness, vegetation, water vapor reference over the ocean

## 1.2 KOSC (Korea Ocean Satellite Center)

KOSC (Korea Ocean Satellite Center), the primary operational organization for GOCI, was established in KORDI (Korea Ocean Research & Development Institute). KOSC has several missions as follows.

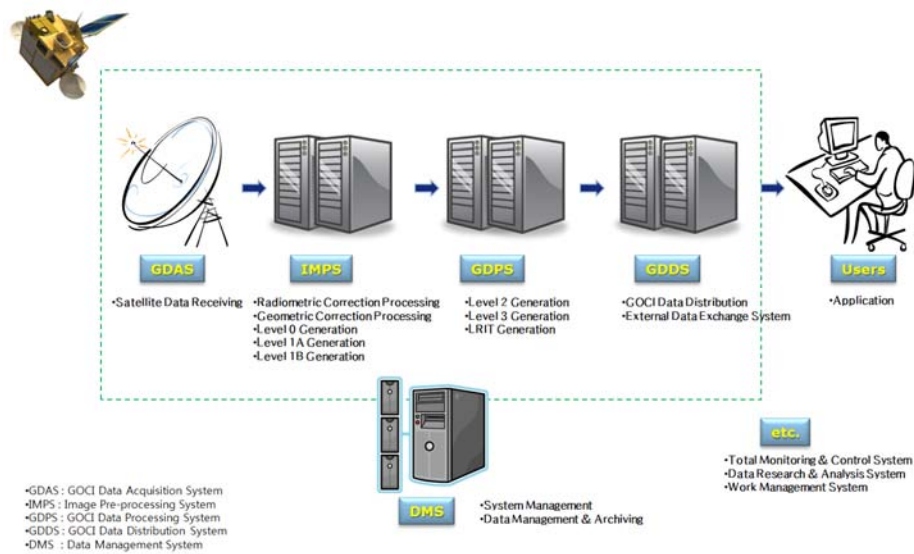
- 1) Role of the principal operator of GOCI data
  - Observation schedule management
  - Satellite data reception, processing and distribution services
  - Research support for maximizing satellite data applications
    - Education for user groups, workshops, Expert Group formation
  - Development and improvement of satellite data processing systems
- 2) Quality control (Calibration/Validation)
  - Calibration and validation of satellite data through field surveys, scientific bases, monitoring towers, and buoys, as well as inter-satellite comparisons
  - Formation and operation of a Cal/Val advisory group for systematic quality control at the national and international level
- 3) Application technique development
  - Satellite data quality improvement through marine environment analysis technology
  - Application research using GOCI and polar ocean observation satellites (MODIS, NOAA, etc...)
  - Technology development for maritime defense and pollution monitoring using high-resolution optical data and SAR data
- 4) Design and development
  - Development of future satellites to continue and enhance the GOCI missions
  - Capacity improvements for a more active contribution to the field of geostationary ocean observation at the international level
- 5) International cooperation
  - Establishment of a joint development and cooperation system for application techniques of ocean observation satellites
  - Hosting and/or participation at international meetings such as the GOCI Principal Investigators workshop and the Korea-Japan ocean color remote sensing workshop
  - Data exchange and cooperative research with foreign institutes in the field of ocean satellite remote sensing

## 2. GOCI Operational Systems

### 2.1 Overview of GOCI data flow

GOCI Data Acquisition System (GDAS) receives the GOCI raw data from satellite with L-band. Image Pre-Processing System (IMPS) produces Level 0, Level 1A and Level 1B data from GOCI raw data. GOCI Data Processing System (GDPS) produces Level 2 and LRIT, Radiometric Calibration Gain Matrix from IMPS output data. Data Management System (DMS) manages unified data archive in KOSC. Total Monitoring Control System (TMC) monitors the status of all systems in KOSC. GOCI Data Distribution System (GDSS) is used to distribute data to users through EDES and Data Distribution Policy. External Data Exchange System (EDES) is developed for the data

exchange among KORDI, KARI (Korea Aerospace Research Institute) and KMA (Korea Meteorological Administration) for the purpose of LRIT (Low Rate Information Transmission) distribution and sharing GOCI browser image (Chan-su Yang, 2010b).



**Figure 2** Basic Flow chart of GOCI data

## 2.2 GDAS (GOCI Data Acquisition System)

GDAS receives the GOCI raw data from satellite, and send to IMPS. GDAS is consisted 9m L-Band Gregorian Antenna, LNA, Down Converter, Modem/BB, C&M Systems, Timing Units, Weather Station, and so on. Observed data in satellite is sent to 9m L-Band Gregorian Antenna in KOSC. Received GOCI data is transformed to usable format through RF systems (LNA, D/C, Modem/BB) and sent to IMPS's DM. All equipment of GDAS is managed by C&M system.

## 2.3 IMPS (Image Pre-processing Systems)

IMPS generate Level 0, Level 1A/1B, IMC (Image Motion Compensation) data and radiometric/geometric correction from GOCI raw data. IMPS is consisted DM (Decomposition Module), INRSM (Image Navigation and Registration Software Module), IMPS DB, PMM (Product Management Module). PMM has a GUI (Graphic User Interface), so Operator can see only PMM. IMPS is developed with KARI and Astrium company (in France).

## 2.4 GDPS (GOCI Data Processing Systems)

GDPS generate Level 2, Level 3 and LRIT image from IMPS output data. GDPS is consisted GDPS R1A, GDPS R1B, GDPS R2, GDPS UI. GDPS R1A/B, R2 are redundant. GDPS is developed by KOSC. The GDPS generates Level 2 products, such as optical properties and optically active constituents of seawater and its environment information, from the radiance measured by the GOCI (Hee-Jeong Han, 2010c).

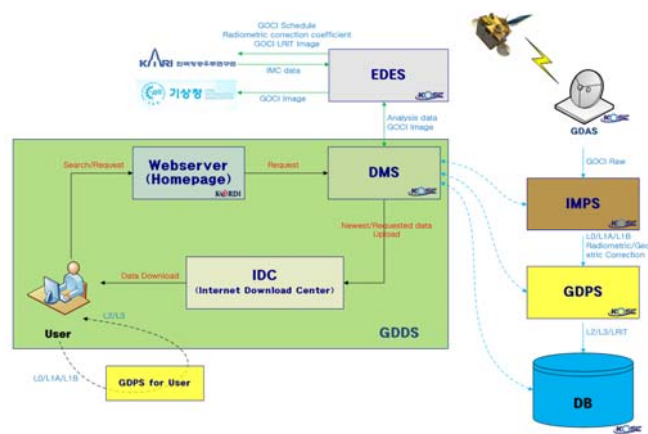
**Table 2** GDPS Products and applications

PRODUCTS	DESCRIPTION	APPLICATION
<b>Water-leaving radiance</b>	The radiance assumed to be measured at the very surface of the water under the atmosphere	Indispensable for water color analysis algorithms
<b>Normalized water leaving radiance</b>	The water leaving radiance assumed to be measured at nadir, as if there was no atmosphere with the Sun at zenith	Input data for the water analysis algorithm
<b>Optical properties</b>	K-coefficient	Ocean optical properties analysis

<b>of water</b>	Absorption coefficient Backscattering coefficient	
<b>Chlorophyll</b>	Concentration of phytoplankton chlorophyll in ocean water	Ocean primary production estimation, dumping site monitoring, climate change monitoring
<b>TSS</b>	Total suspended sediment concentration in ocean water	Coastal ocean environmental analysis and monitoring TSS movement and transfer monitoring
<b>CDOM</b>	Colored dissolved organic matter concentration in ocean water	Indicator of ocean pollution Ocean salinity estimation
<b>Red tide</b>	Red tide index information	Ocean pollution and ecological monitoring Movement and transfer monitoring of red tide
<b>Fishing ground information</b>	Fishing ground probability index, fishing ground prediction	Fishing ground detection Fishing ground environmental information
<b>Underwater visibility</b>	Degree of clarity of the ocean observed by the naked eye	Navy tactics, ocean pollution map, sea rescue work
<b>Sea surface current vector</b>	Sea surface current direction/speed	Understanding of sea surface currents and estimation of pollutant movements
<b>Atm. &amp; earth environment</b>	Yellow dust, Vegetation Index	Atmospheric environment and land application
<b>Water quality level</b>	Coastal water quality level estimation	Coastal ocean eutrophication Coastal water quality control/monitoring
<b>Primary productivity</b>	The production of Organic compounds from carbon dioxide, principally through the process of photosynthesis	Carbon cycle Long-term climate change monitoring

### 2.5 GDDS (GOCI Data Distribution Systems)

GOCI Data Distribution System is systems for GOCI data service for users. It is consisted GDDS and EDES. GDDS is consisted a web-server and website (<http://kosc.kordi.re.kr>). Users can request, search and download ocean satellite observation data through website and IDC. It will be improved continually for best GOCI data service. EDES is a system to exchange with SOC (Satellite Operation Center in KARI) and KMSC (Korea Meteorological Satellite Center in KMA). Three organizations (KOSC, SOC, KMSC) are connected by dedicated line.



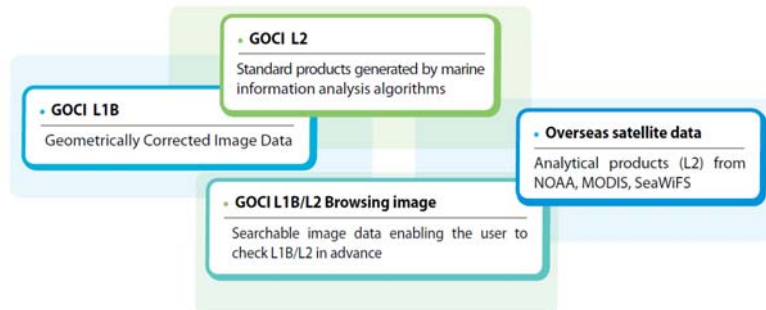
**Figure 3** Basic flow concept of GDDS

### 2.6 DMS (Data Management Systems)

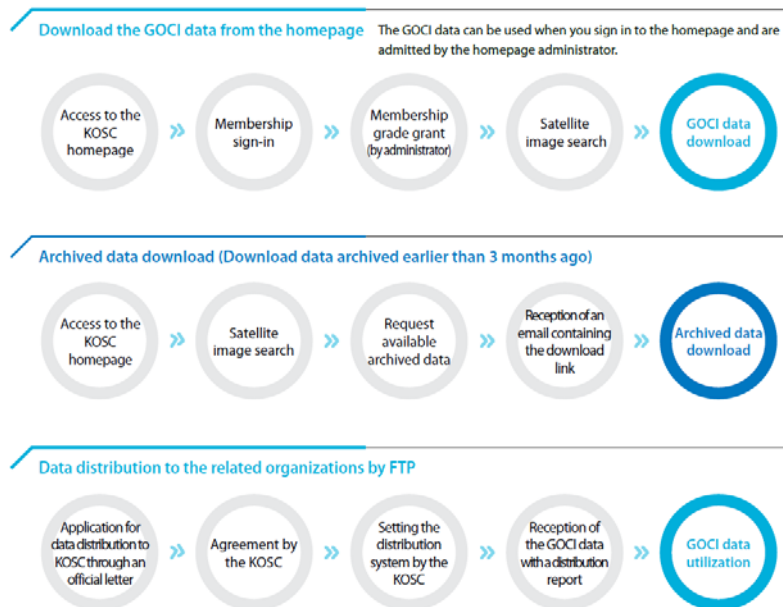
DMS manages and stores all data in KOSC. It has 2 DB servers which are redundant structure and storage for satellite data. DMS is very important system in KOSC, so it is consisted DR (Disaster Recovery) system with SAN and NFS. Also, DMS has backup system.

### 3. GOCI Data Service

The Korea Ocean Satellite Center (KOSC) has been providing Geostationary Ocean Color Imager (GOCI) data through its homepage (<http://kosc.kordi.re.kr>) free-of-charge for non-commercial users since April 20, 2011. For commercial users, charges do apply. No users are permitted to re-distribute the satellite image data without authorization. The GDDS of the KOSC's homepage also allows you to access a diverse range of data from overseas satellites that the KOSC receives, such as NOAA and MODIS. Also, users can be provided through mobile website (<http://kosc.kordi.re.kr/m/index.kosc>).



**Figure 4** Available data service



**Figure 5** How to use for data service

#### 4. Conclusions

As the main operation and research center of the GOCI, KOSC establishes a foundation for world class research activity with the development of the key technologies for GOCI operation. On the basis of this, KOSC has a plan to operate real time ocean environment and marine eco-system monitoring, short and long term coastal area and marine bio-physical phenomena variability monitoring. With these research and service activities, KOSC will contribute to spread productive research outcome of oceanography and to encourage the activity of marine industries and academic fields.

#### 5. Acknowledgments

This paper was supported by KOSC 3 projects.

- The Functional Improvement of Korea Ocean Satellite Center (PE98620)
- The Application Research of Geostationary Ocean Color Imager (PM56310)
- The Satellite Application Research for marine (PG47600)

## **6. References**

Seongick Cho, 2010a. Development of Geostationary Ocean Color Imager. Korean Journal of Remote Sensing, 26(2), pp157~165.

Chan-Su Yang, 2010b. Distributing Service for Geostationary Ocean Color Imager data. International Symposium on Remote Sensing 2010, 1(1), pp309~311.

Hee-Jeong Han, 2010c. Development the Geostationary Ocean Color Imager Data Processing System. Korean Journal of Remote Sensing, 26(2), pp239~249.