THE 6th ASIAN / 15th KOREA-JAPAN WORKSHOP ON

OCEAN COLOR 2018

3 – 5 December 2018
Miyoshi Memorial Hall
Yokohama Institute for Earth Sciences
Japan Agency for Marine-Earth Science & Technology (JAMSTEC)

4 December 2018
JAMSTEC Headquarters Tour

JAMSTEC

YOKOHAMA National University

KIOST
KOREA INSTITUTE OF OCEAN SCIENCE & TECHNOLOGY

KOSC
KOREA OCEAN SATELLITE CENTER

NAGOYA UNIVERSITY
ISEE
INSTITUTE FOR SPACE-EARTH ENVIRONMENTAL RESEARCH

APN
Asia-Pacific Network for Global Change Research

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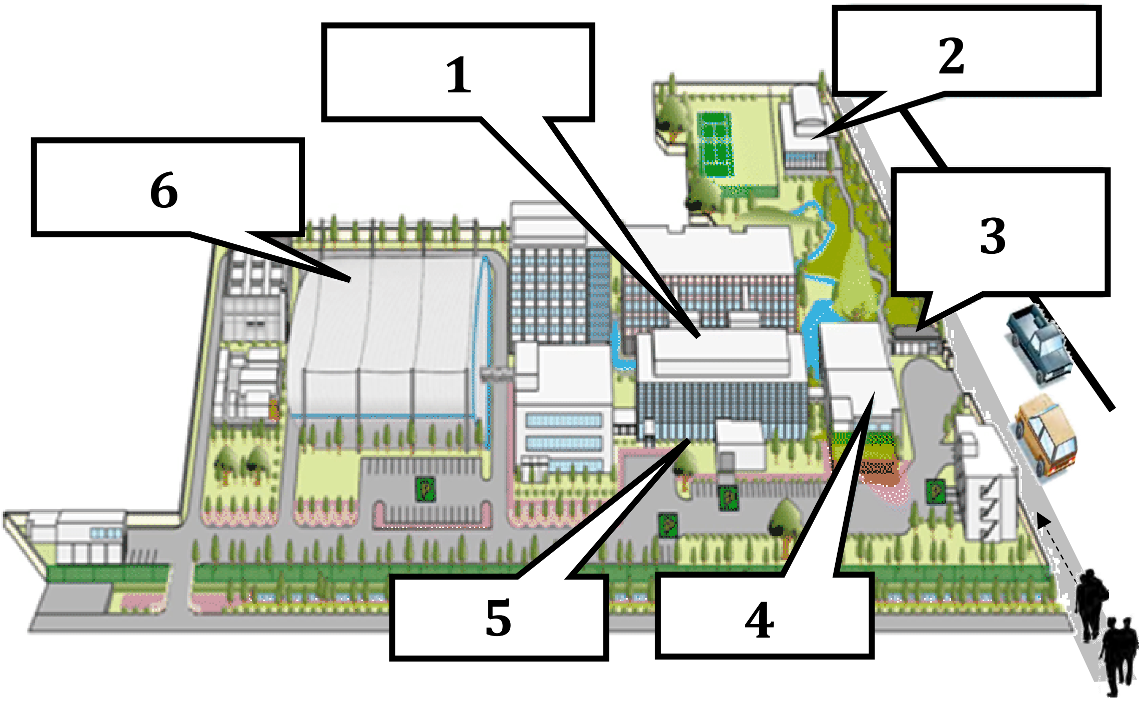
Layout of Yokohama Institute for Earth Sciences (YES), JAMSTEC



[Address]
3173-25, Showa-machi, Kanazawa-ku, Yokohama-city, Kanagawa, 236-0001, Japan
PHONE:+81-45-778-3811
FAX : +81-45-778-5498

1.Miyoshi Memorial Hall
2.Guest House
3.Security Guard
4.Earth Science Museum
5.Cafeteria
6.Earth Simulator

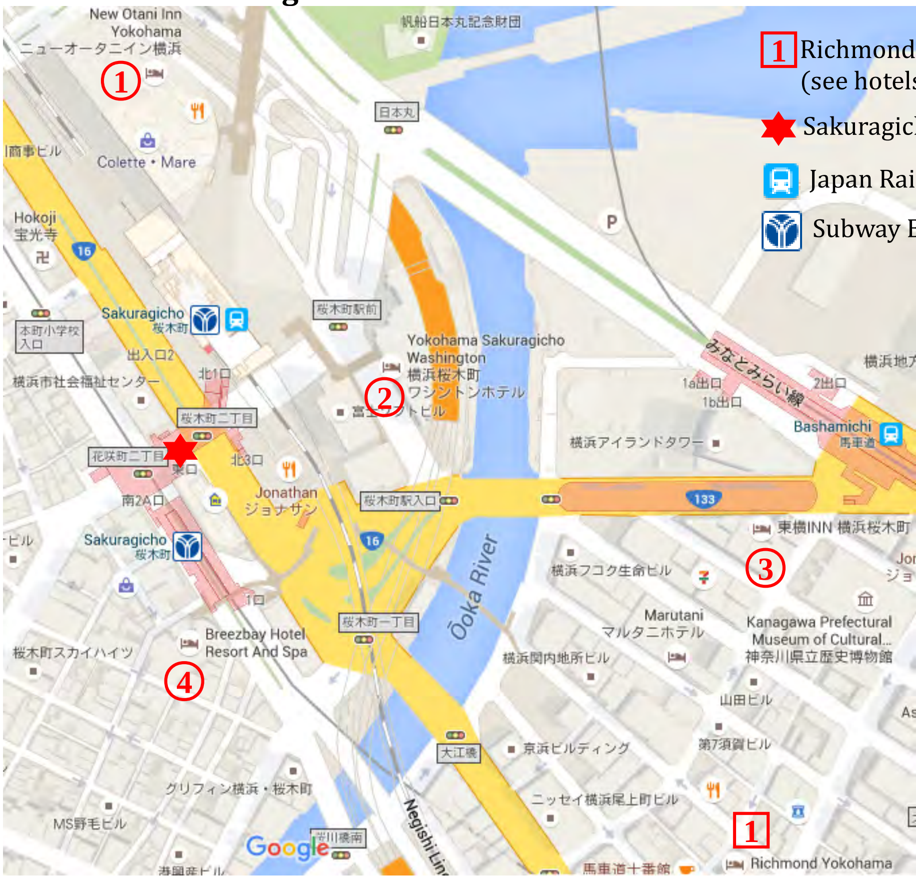
Transportation and Accommodation

Hotels in Downtown Yokohama

We recommend hotels near 2 Japan Railways (JR) or subway stations i.e., Sakuragicho and Kannai Stations. We have not contacted any hotel below, so the hotel rates shown here are based on internet booking sites. Free Wi-Fi is available in all hotels on the list.

Basically, JAMSTEC does not book the hotel room for participants. **So, please kindly make a room reservation yourself**.

Hotels near Sakuragicho Station



1 Richmond Hotel (see hotels near Kannai st. below)

Sakuragicho st.

Japan Railway (JR) Line gate

Subway Blue Line gate

① New Otani Inn Yokohama
1 min. from Sakuragicho Station. From 9,500 JPY/night
http://www.newotani.co.jp/en/innyokohama/index.html?GRP

② Washington hotel Yokohama Sakuragicho
1 min. from Sakuragicho Station. From 7,500 JPY/night
http://yokohama-s.washington-hotels.jp/

③ Toyoko INN Yokohama Sakuragicho
5 min. from Sakuragicho Station. From 8,300 JPY/night
http://www.toyoko-inn.com/hotel/00050/index.html

④ Breezebay Hotel Resort&Spa
3 min. from Sakuragicho Station. From 5,600 JPY/night
http://www.breezbay.co.jp/

Hotels near Kannai Station

1 Richmond Hotel Yokohama Bashamichi
5 min. from Kannai Station (10 min. from Sakuragicho Station). From 9,800 JPY/night
http://yokohama.richmondhotel.jp/

2 Daiwa Roynet Hotel Yokohama Kannai
3 min. from Kannai Station. From 7,600 JPY/night
https://www.daiwaroynethotelyokohamakannai.com/

3 APA Hotel Yokohama Kannai
3 min. from Kannai Station. From 6,500 JPY/night
https://www.apahotel.com/hotel/shutoken/08_yokohamakannai/

4 Comfort Hotel Yokohama Kannai
3 min. from Kannai Station. From 6,500 JPY/night
https://www.choice-hotels.jp/hotel/kannai/

5 Hotel Wing International Yokohama Kannai
5 min. from Kannai Station. From 5,300 JPY/night
https://www.hotelwing.co.jp/yokohama-kannai/en/

Transportations for

Airports –> Yokohama Station –> Sakuragicho/Kannai Stations

1. Airports to Yokohama Station

1a. Haneda International Airport – Yokohama Station

From Haneda airport, you can take either Keikyu railway or Keikyu bus to Yokohama Station. Depending on the time, you may take direct (no transfer but with several stops) railway train (e.g., train to Shinzushi) or the trains with one-transfer at Keikyu Kamata Station (e.g., train to Shinagawa).
Please visit the link below for the details of Keikyu railway routes.
http://www.haneda-tokyo-access.com/en/transport/trainlinemap.html.

Keikyu bus to Yokohama Station departs from platform/pole no.7 of Haneda Airport International Terminal. Please get off at the last stop, Yokohama City Air Terminal (YCAT). It will take around 40 minutes to reach YCAT. Keikyu bus is more convenient than railways especially for participants who have large/much luggage.

Please visit the links below:
http://www.ycat.co.jp/en/route/haneda/ for bus fare;
http://www.ycat.co.jp/en/route/haneda/haneda2ycat.php for bus timetable; and
http://www.ycat.co.jp/en/route/haneda/movie.php the movie for getting on the bus to YCAT.
From YCAT, please follow the link below to reach Yokohama Station by walk.
http://www.ycat.co.jp/en/access/ycat2station.php

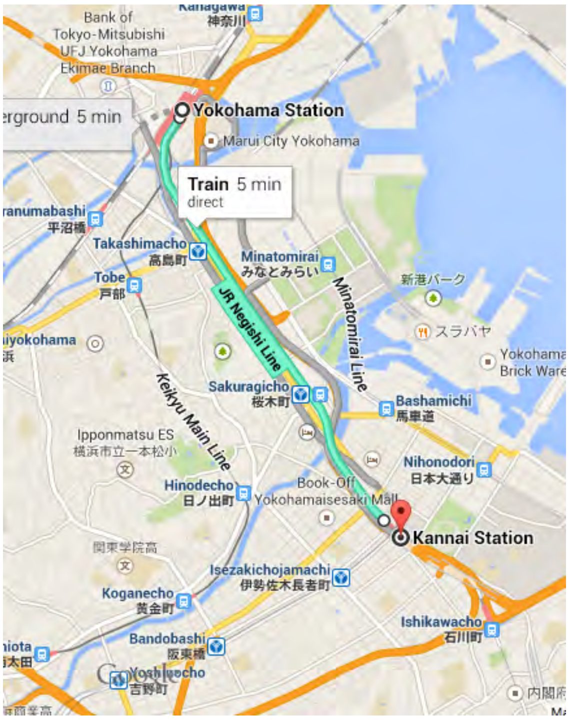
1b. Narita International Airport – Yokohama Station

You can take either Narita Express Railway (N'EX) or bus (Keikyu or Keisei buses), both are convenient. The N'EX will take you to Yokohama Station (not the last stop) and take around 100-110 minutes. Please visit the following links:
http://www.jreast.co.jp/e/nex/ for N'EX detail information, and
http://www.eki-net.com/pc/jreast-shinkansen-reservation/english/wb/common/timetable/e_nex_u/index.html for NEX timetable.

The bus will connect Narita Airport to YCAT in approximately 85 minutes. Please visit the following links:
http://www.ycat.co.jp/en/route/narita/ for bus fare;
http://www.ycat.co.jp/en/route/narita/narita2ycat.php for timetable, platform/pole no; and
http://www.ycat.co.jp/en/route/narita/movie.php the movie for getting on the bus to YCAT.
From YCAT, please follow the link below to reach Yokohama Station by walk.
http://www.ycat.co.jp/en/access/ycat2station.php

2. Yokohama Station to Sakuragicho or Kannai Stations

From Yokohama Station, please take either **JR Negishi Line** (~140 JPY) or **Subway Blue Line** (~210 JPY) to reach Sakuragicho or Kannai Stations. It takes around 5 minutes. JR Negishi Line is also called as JR Keihin-Tohoku Line.

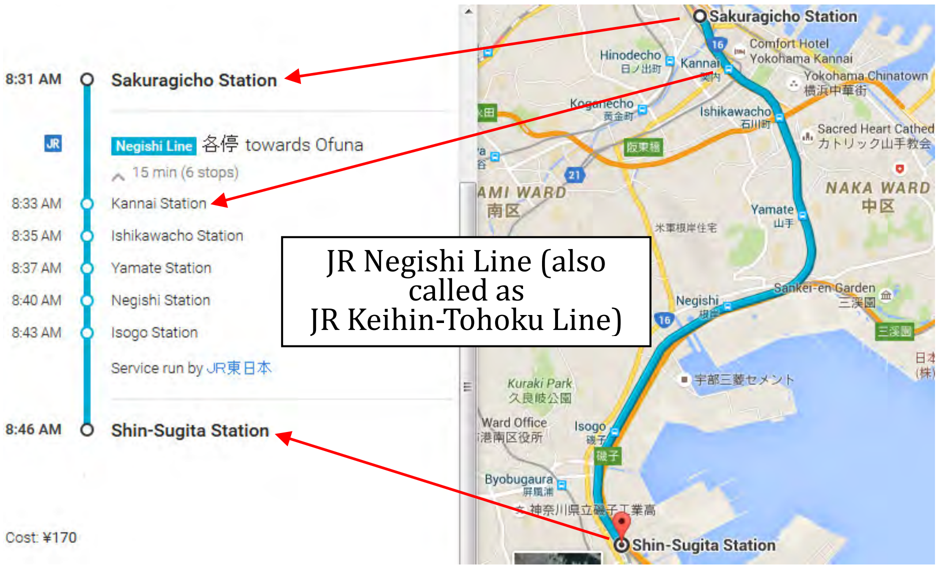


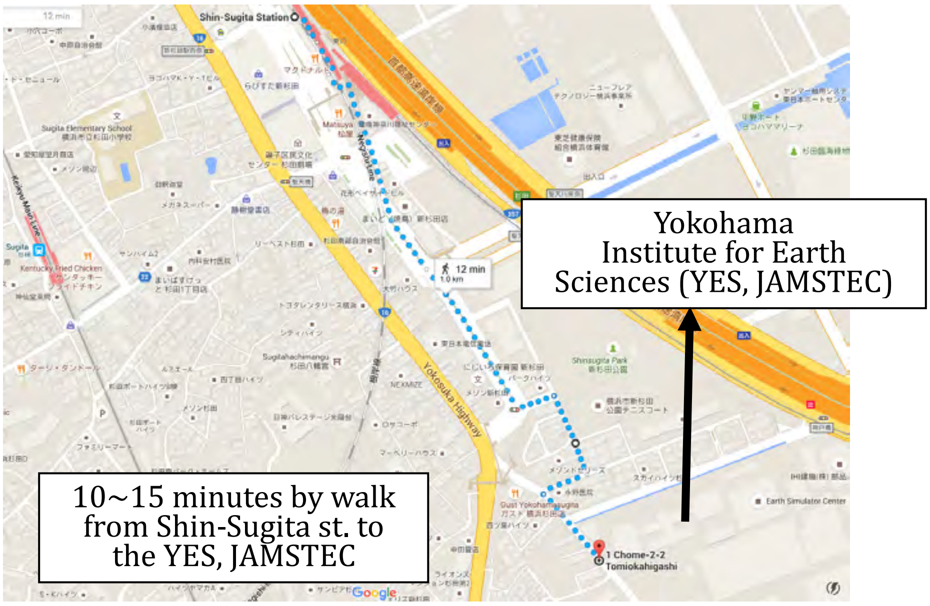
The link below is useful to find timetable from Yokohama st. to Sakuragicho or Kannai St.:
http://www.hyperdia.com/cgi/en/search.html?dep_node=YOKOHAMA&arv_node=KANNAI&via_node01=&via_node02=&via_node03=&year=2018&month=10&day=09&hour=12&minute=00&search_type=0&search_way=&transtime=undefined&sort=1&max_route=10&faretype=0&ship=off&lmlimit=null&search_target=route&facility=reserved&sum_target=7

Transportation/Guide for

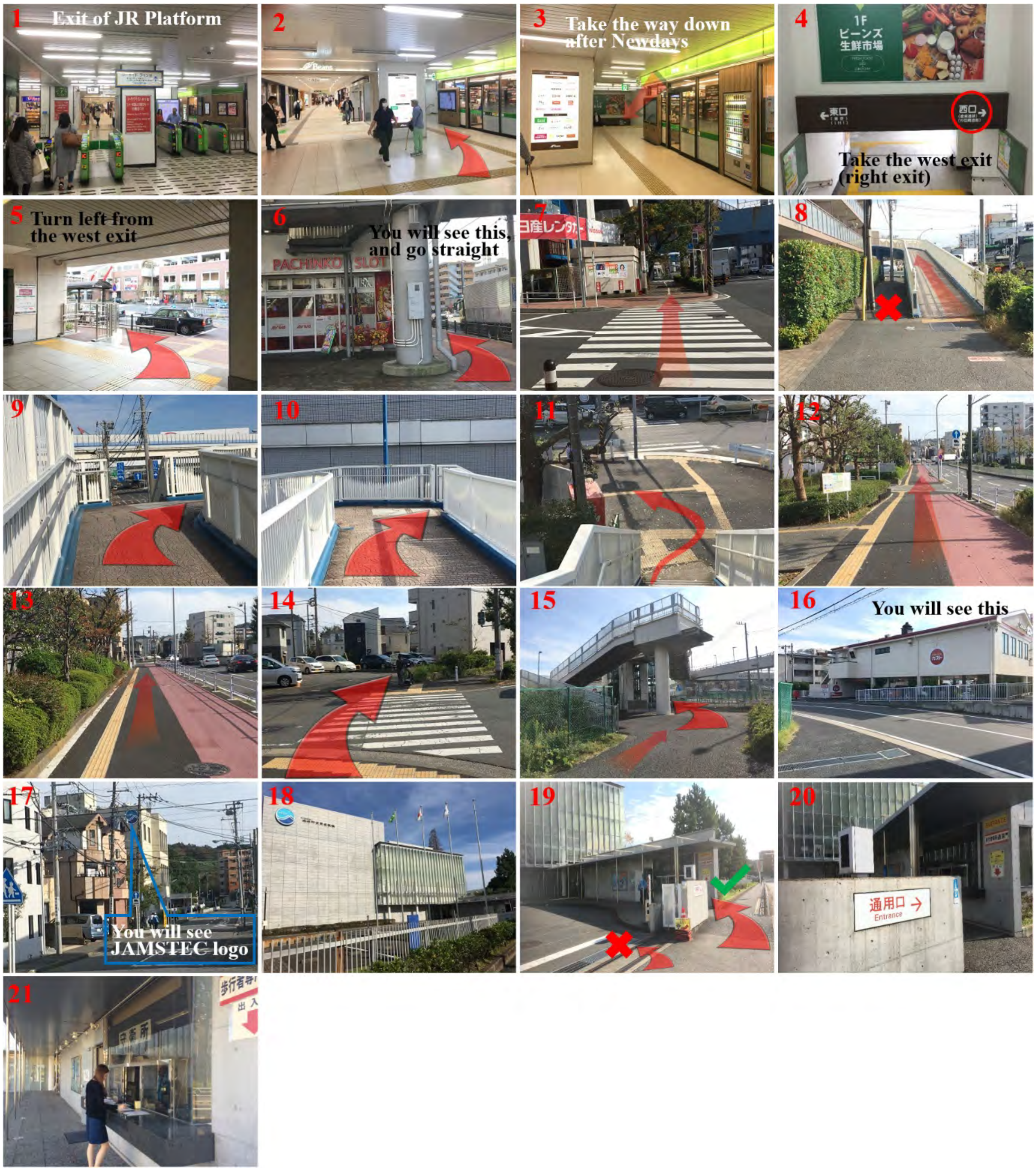
Sakuragicho or Kannai St. – Yokohama Institute for Earth Sciences (YES, JAMSTEC)

1) From Sakuragicho or Kannai St., please take JR Negishi Line (towards Ofuna) to reach JR Shin-Sugita St. (around 15 minutes, cost: 170 JPY). Subway is not available to Shin-Sugita St. Click the link below to search JR timetable:
http://www.hyperdia.com/cgi/en/search.html?dep_node=SAKURAGICHO&arv_node=SHIN-SUGITA&via_node01=&via_node02=&via_node03=&year=2018&month=10&day=09&hour=12&minute=00&search_type=0&search_way=&transtime=undefined&sort=1&max_route=10&faretype=0&ship=off&lmlimit=null&search_target=route&facility=reserved&sum_target=7





2) It will take 10~15 minutes by walk from Shin-Sugita Station to Yokohama Institute for Earth Sciences (YES, JAMSTEC). Pictures below may help you to reach JAMSTEC.



3) You will report to JAMSTEC security officers at the JAMSTEC gate, so they will check your name on the participant list.

Cafeteria

There is a cafeteria for lunch break in the 1st floor. Tickets for lunch can be purchased from a vending machine that accepts 10, 50, 100, 500 JPY coins and 1,000, 2,000 JPY notes.

Presentation Instructions

Instructions for oral presentation

In order to ensure a smooth workshop program, we kindly ask you to follow the following instructions.

Please kindly adhere strictly to **20 minutes** allocated to each presentation. Plan for **15 minutes** presentation followed by **5 minutes** for Q&A. Follow any additional instructions given by your session chairpersons.

Chairperson may ring the bell once at the first **10 minutes** and twice when **15 minutes** have passed. Chairperson will ring the bell three times **just before the end of presentation time** to signal the presenters that they have to stop the presentation, to allow smooth transition to the next presenter.

Instructions for poster presentation

Please prepare your poster to fit the following dimensions. The poster boards are portrait in orientation, and the dimensions are **170 cm high x 120 cm wide**.

Posters can be mounted from 09:30 on the 1st day (3 December) and should be removed after the last session on the 3rd day (5 December). Short pins for the mounting of posters will be available at the Poster Help Desk in the Poster area.

Your poster numbers will be attached on poster boards. Please refer to the final program that you will receive upon arrival at the venue for the poster board number assigned to your poster.

Poster presenters are requested to stand by their posters during the Poster Session for discussion.

Workshop Program

DAY-1, 3 December 2018

Time	Program/Session/Title — *Presenter/Chairperson*	Page
09:30~10:10	Registration	
10:10~10:20	Welcome remarks *Eko Siswanto*	
10:20~11:40	**Session 1 : Operational Ocean Color** *Chair: Hiroto Higa, Co-chair: Wataru Nakamura*	
10:20~10:40	System operation and data services in GOCI-II Ground Segment (G2GS) *Hee-Jeong Han*	1
10:40~11:00	Impact of meteorological ancillary data on GOCI products *Sinil Yang*	2
11:00~11:20	Exploring the potentials of Google Earth Engine for ocean colour studies *Elígio de Raús Maúre*	3
11:20~11:40	Clarification of the light environment characteristics in coastal areas and lakes for unification of water quality estimation method for ocean color remote sensing *Hidehito Taki*	4
11:40~13:00	**Lunch break**	
13:00~14:40	**Session 2 : Ocean Color Optical Property Validation and Retrieval (part-1)** *Chair: Tong Phuoc Hoang Son, Co-chair: Jutarak Luang-on*	
13:00~13:20	Validation of SGLI-retrieved nLw at visible bands in Ariake Bay using AERONET-OC data *Mitsuhiro Toratani*	5
13:20~13:40	SGLI and GOCI validation in East China Sea and Ise Bay *Joji Ishizaka*	6
13:40~14:00	Initial validation of GCOM-C SGLI ocean products immediately after launch in the Seto Inland Sea *Yuji Sakuno*	7
14:00~14:20	An estimation method of salinity distribution based on optical property of color dissolved organic matter using COMS/GOCI in a heavily eutrophic coastal area, Tokyo Bay, Japan *Hiroto Higa*	8
14:20~14:40	An improved method to estimate secchi disk depth from remote sensing in various waters *Dalin Jiang*	9
14:40~14:45	**Group photo**	
14:45~15:00	**Tea/coffee break**	

Time	Program/Session/Title — Presenter/Chairperson	Page
15:00~17:00	**Session 3 : Ocean Color Optical Property Validation and Retrieval (part-2)** *Chair: Jonson Lumban-Gaol, Co-chair: Hidehito Taki*	
15:00~15:20	Retrieval of inherent and apparent optical properties of water bodies in a global scale using Deep Neural Network *Salem Ibrahim Salem*	10
15:20~15:40	Neural network algorithms for detecting *Cochlodinium polykrikoides* blooms *Sinjae Yoo*	11
15:40~16:00	A spectral remote sensing approach for detecting *Noctiluca scintillans* blooms from Landsat 8 – OLI imagery *Tong Phuoc Hoang Son*	12
16:00~16:20	Phytoplankton abundance of the Jakarta Bay, Indonesia observed by remote sensing reflectance of Aqua MODIS satellite data *Sam Wouthuyzen*	13
16:20~16:40	Modeling of optical properties for blue tides considering light scattering of sulfur colloid particles in Tokyo Bay *Wataru Nakamura*	14
16:40~17:00	Global assessment of marine and coastal eutrophication using remotely sensed chlorophyll-a concentration *Genki Terauchi*	15
17:00~18:00	**Poster session**	
18:00~20:00	**Gathering at the JAMSTEC guest house**	

DAY-2, 4 December 2018

Time	Program/Session/Title — *Presenter/Chairperson*	Page
09:30~11:30	**Session 4 : Land-Ocean-Atmosphere Interactions (Part-1)** *Chair: Anukul Buranapratheprat, Co-chair: Siraporn Tong-u-dom*	
09:30~09:50	Exploring the impact of climate change on terrestrial productivity in southeast Asian coastal region *Md Latifur R Sarker*	16
09:50~10:10	Temporal and spatial variations in tidal fronts estimated from satellite monitored SST data *Menghong Dong*	17
10:10~10:30	The impacts of the Three Gorges Dam on the East China Sea marine ecosystem revisited *Christina Eujin Kong*	18
10:30~10:50	Riverine influence on ocean color in the equatorial South China Sea *Che Sun*	19
10:50~11:10	Impacts of cyclonic eddy on phytoplankton in the Kuroshio Extension region *Eko Siswanto*	20
11:10~11:30	Interannual variability of marine ecosystem in the Kuroshio Extension region *Yoshikazu Sasai*	21

11:40~13:00	**Lunch break**	
13:00~14:00	**Session 5 : Applications of Ocean Color** *Chair: Benny Peter, Co-chair: Taiga Nakayama*	
13:00~13:20	Red tide in the eastern coast of the upper Gulf of Thailand related to surface currents revealed by High Frequency Radar during the southwest monsoon *Siraporn Tong-u-dom*	22
13:20~13:40	The residence time of water mass in the upper Gulf of Thailand *Dudsadee Leenawarat*	23
13:40~14:00	Mechanism for the accumulation of *Noctiluca scintillans* in the eastern coast of the upper Gulf of Thailand *Anukul Buranapratheprat*	24
14:00~14:15	**Tea/coffee break**	
14:15~14:45	**Move to JAMSTEC Headquarters, Yokosuka**	
15:00~16:30	**JAMSTEC facility tour**	
16:45~17:15	**Back to JAMSTEC YES, Yokohama**	

DAY-3, 5 December 2018

Time	Program/Session/Title *Presenter/Chairperson*	Page
09:30~10:50	**Session 6: Land-Ocean-Atmosphere Interactions (Part-2)** *Chair: Sam Wouthuyzen, Co-chair: Qurnia Wulan Sari*	
09:30~09:50	Inter-annual variability of chlorophyll a distribution of the Bay of Bengal and its relation with mesoscale surface circulation *Benny N Peter*	25
09:50~10:10	Are the ocean color and SST good predictors of fishing ground in the Indonesian tropical waters? *Jonson Lumban-Gaol*	26
10:10~10:30	Spatio-temporal variability of surface chlorophyll-a in the Halmahera Sea and its relation to ENSO and Indian Ocean Dipole *Iskhaq Iskandar*	27
10:30~10:50	Detailed spatiotemporal impacts of ENSO and IOD on phytoplankton biomass in the Indonesian Seas *Eko Siswanto*	28
10:50~12:00	**Discussion & closing remarks**	

Poster Presentation

DAY-1, 3 December 2018 (17:00~18:00)

Schedule for facility tour at JAMSTEC Headquarters

Time and date : 15:00 – 16:30, Tuesday, December 4, 2018
Venue : JAMSTEC Yokosuka Headquarters
Guests : AWOC/KJWOC 2018 attendees

Timetable :

Time	Facility
15:00~15:15	Briefing on JAMSTEC at Main Lecture Room on the 1st floor in main building in HQ (included watching DVD)
Group A	
15:20~15:40	R/V YOKOSUKA
15:45~16:00	ROV URASHIMA" "SHINKAI 6500" at ROV maintenance shop
16:05~16:20	SHINKAI 6500 model and the display of samples, at Exhibition Hall
16:25~16:30	Q&A, Leaving from HQ at Main Lecture Room on the 1st floor in main building
Group B	
15:20~15:40	SHINKAI 6500 model and the display of samples, at Exhibition Hall
15:45~16:00	R/V YOKOSUKA
16:05~16:20	ROV URASHIMA" "SHINKAI 6500" at ROV maintenance shop
16:25~16:30	Q&A, Leaving from HQ at Main Lecture Room on the 1st floor in main building

Guide :

- Naoko Mori, Public Relations Division, Public Relations Department
- Hiroko Ooya, Public Relations Division, Public Relations Department
- Ayumi Suzuki, Public Relations Division, Public Relations Department
- Kayoko Okazaki, Public Relations Division, Public Relations Department

System operation and data services in GOCI-II Ground Segment (G2GS)

Hee-Jeong Han[1]*, Jae-Moo Heo[1], Hyun Yang[2], Young-Je Park[1]
[1] Korea Ocean Satellite Center, Korea Institute of Ocean Science and Technology, Pusan, Korea
[2] Maritime ICT R&D Center, Korea Institute of Ocean Science and Technology, Pusan, Korea

*Corresponding e-mail: han77@kiost.ac.kr

Geostationary ocean color imager-II (GOCI-II), the Korean second ocean color sensor in geostationary satellite, will be planned to launch in 2019. GOCI-II ground segment (G2GS) is under development as a new ground segment system for the GOCI-II. G2GS provides system operation environment (SOE) and data service environment (DSE) intend for system operators and data users. SOE should generate ocean color products automatically just after receiving GOCI-II sensor data. It has external interfaces for GOCI-II operation, telemetry and re-distribution by satellite.

All information generated by G2GS SOE like GOCI-II Level 1B and GOCI-II Level 2 data is stored and distributed to data users by DSE. GOCI-II data will be uploaded as a slot-level NetCDF4 files on DSE storage. When users define those regions of interest, DSE will make new download links for each ROI. Also, GOCI toolbox (GTBX), which is GOCI-II data analysis tool like GOCI data processing system (GDPS) for GOCI, will be distributed as a plug-in program on SNAP framework. GTBX can access GOCI-II data in DSE data repository. Though GOCI-II data policy is not established yet, GOCI-II data will be available few day after data receiving with free of charge for public research purposes if we follow GOCI data policy. After in-orbit test of GOCI, we believe that we will provide various comfortable data services through GOCI-II DSE.

Impact of meteorological ancillary data on GOCI products

Sinil Yang*, Jae-Hyun Ahn, Young-Je Park
Korea Institute of Ocean Science and Technology (KIOST), Republic of Korea

*Corresponding e-mail: siyang@kiost.ac.kr

We investigate improvements to the quality of Geostationary Ocean Color Imager (GOCI) operational ocean color data processing, which requires routine ocean color product production in near real-time (NRT) and scientific reprocessing. The product can be made with the appropriate choice of the meteorological ancillary data sources which are used in the processing of Level-2 (L2) ocean color products for deriving ocean color products, e.g., the normalized water-leaving radiances as well as the bio-optical products further derived from these radiances using empirical algorithms. The ancillary dataset includes meteorological data (e.g., wind speed, atmospheric pressure, relative humidity) and concentrations of atmospheric gases (e.g., water vapor, ozone, nitrogen dioxide).

Recently, new reanalysis dataset, ERA5, is released from the European Centre for Medium-Range Weather Forecasts (ECMWF). The ERA5 has the high-resolution compared to the previous version of the ERA-Interim. Also, the candidates of ancillary dataset include the National Centers for Environmental Prediction (NCEP) reanalysis-II and its climatology. Therefore, we quantify the uncertainty of each ancillary data sources compared to the observation of the weather buoy, which is collected from the Korean Meteorological Agency (KMA). Then we have re-processed the products of the ocean color images for the period of the in-situ observation (i.e., about three years) using each ancillary data. All results of ocean color data processing have been investigated and evaluated with the in-situ observation, which includes the measurements of the station (i.e., Ieodo and Gageocho site of the AERONET-OC) and the ship.

The studies were carried out over the GOCI region for four seasons (e.g., JJA; June-July-August) when the in-situ observation is available. Based on the evaluation results, we propose to use the best ancillary data produced for the operational processing and reprocessing of the ocean color data from candidates of appropriate ancillary data inputs. The effects of the individual meteorological variable on the accuracy of the derived ocean color products are also investigated and discussed.

Exploring the potentials of Google Earth Engine for ocean colour studies

Elígio de Raús Maúre*, Genki Terauchi
Dept. of Research and Study, Northwest Pacific Region Environmental Cooperation Center, 5-5 Ushijimashin-machi, Toyama City, Toyama 930-0856, Japan

*Corresponding e-mail: eligiomaure@gmail.com

This presentation provides introductory examples of the Google Earth Engine (GEE) potentials for large data processing to the ocean colour community. The GEE combines a multi-petabyte catalogue of satellite imagery and geospatial datasets with planetary-scale analysis capabilities. The study of marine water quality based on satellite observations, for instance, provide a means for investigating environmental issues like coastal eutrophication or harmful algal blooms over large spatial and temporal scales. However, such studies often require high-resolution maps which are computationally expensive to produce and involve several time-consuming steps (e.g. downloading, screening and mapping) to produce a useful map. Moreover, with increasing number of sensors collecting data at even higher resolution, say 500m for GOCI or 250m for GCOM-C, the time required to process these data becomes increasingly overwhelming.

GEE provides a ready-to-use datasets without the need of downloading and the analysis can be done over the global ocean in a fraction of seconds. So, GEE can prove to be a powerful tool for large data processing. Currently, in the GEE catalogue only level 3 data is available from ocean biology dedicated sensors. This is due to limited demand from ocean colour users. So, this presentation strives to make the GEE known to the ocean colour community so as to make use of its capability in large data processing.

Clarification of the light environment characteristics in coastal areas and lakes for unification of water quality estimation method for ocean color remote sensing

Hidehito Taki*, Hiroto Higa, Yoshiyuki Nakamura
Department of Civil Engineering, Yokohama National University

*Corresponding e-mail: taki-hidehito-zr@ynu.jp

The development of the water material estimation method using remote sensing is difficult due to the optical complexity in Case2 waters and the different estimation method is suggested in various water areas respectively. In this study, we did the optical observation in closed waters which has different optical characteristics such as Tokyo bay and Seto inland sea, addition to this, Thailand bay and Camranh bay(Vietnam) which has significant sediment inflow. We tried to reveal light environments in each water areas.

As a result, a strong correlation was found between insitu $R_{rs}(709)$/ $R_{rs}(665)$ and insitu Chl-a concentration with a determination coefficient of R^2 =0.71 (N=120) despite the different light characteristics in each water areas to some extent. Besides, we also found a strong correlation between $R_{rs}(660)$ and turbidity (FNU) with a determination coefficient of R^2 =0.94 (N=68) so that we indicate the possible of unified estimation in Case2 water areas.

Furthermore, we simulated by the Hydrolight model based on the Inherent Optical Properties (IOPs) and we found out that we can calculate R_{rs} with a high accuracy in Tokyo Bay and Kasumigaura lake which is dominated organic matters. Therefore, we checked the relationship between calculated $R_{rs}(709)$/ $R_{rs}(665)$ by Hydrolight when Chl-a, Detritus and CDOM concentration is varied and input Chl-a concentration. It follows that the slope of regression line was different in each water areas. We clarified that this result is due to the different phytoplankton species and cell sizes so that the changes of specter of specific phytoplankton absorption coefficient (a_{ph}*). As identified above, it is suggested that considering the composition of phytoplankton is one of the important factors in Chl-a estimation in Case2 waters.

However, in order to enable unified radiation transfer simulation in case2 waters, it is necessary to improve the accuracy of the scattering model. Therefore, we measured scattering coefficient b_b (/m) by using HydroScat-6P (HOBI Labs, Bellevue, WA, USA) and tried to reveal the characteristics of scattering in Tokyo Bay, Kasumigaura lake and Thailand Bay. We can estimate b_b in Tokyo bay to some extent except blue tide and the other water areas (Lee et al., 2002).

Addition to this, we found that the similar mountain spectral of b_b in short wavelengths and confirmed the spectral changes in each water areas. We predict that b_b (/m) is significantly affected by the different plankton species, amount of the pigments and river discharge.

Validation of SGLI-retrieved nLw at visible bands in Ariake Bay using AERONET-OC data

Mitsuhiro Toratani[1]*, Kota Katano[1], Kazunori Ogata[2] , Joji Ishizaka[3]
[1] Tokai University
[2] EORC/JAXA
[3] Nagoya University

*Corresponding e-mail: tora@keyaki.ccu-tokai.ac.jp

GCOM-C/SGLI was launched by JAXA in Dec. 2017. Currently, the validation of SGLI ocean color products is on-going. SGLI-retrived normalized water leaving radiance (nLw) was validated in Ariake Bay using AERONET-OC data.

Without consideration to suspended mater concentration, the nLw at visible bands is underestimated because of relatively high turbid water in Ariake Bay. In order to conform performance of atmospheric correction, SGLI atmospheric correction was processed by inputting nLw at near infrared bands (670nm and 865nm) by AERONET-OC, and the SGLI retrieved-nLw at visible bands (412-565 nm) are matched with AERONET-OC observation.

We tried to two method to improve nLw estimation at visible bands. The in-water model was used to estimate nLw at near infrared bands in consideration with total suspended matter concentration for aerosol model selection. Other atmospheric correction using short wave infrared bands (1050nm and 1630nm) for aerosol selection was processed to avoid influence of high suspended matter concentration. We show in the workshop validation result of two atmospheric correction schemes.

SGLI and GOCI validation in East China Sea and Ise Bay

Joji Ishizaka
Institute for Space-Earth Environmental Research (ISEE), Nagoya University

Corresponding e-mail: jishizaka@nagoya-u.jp

For the verification of SGLI and GOCI, we have observations at the west of the Kyushu Island, Japan, and across Kuroshio in the East China Sea in July and eutrophicated Ise Bay, Japan, in October. I will show the results of verification of SGLI, GOCI and other ocean color satellite data with the data.

Initial validation of GCOM-C SGLI ocean products immediately after launch in the Seto Inland Sea

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The latest earth observation satellite, GCOM–C1 (Global Change Observation Mission - Climate 1) / SGLI (Second - generation Global Imager) was launched on December 23, 2017. The initial check of the satellite and sensor was finished by March 2018. The calibration / validation of the product has been carried out until the general data release on December, 2018. As a member of the validation team of SGLI ocean products, the authors have been conducted in Tokyo Bay, Lake Kasumigaura, Seto Inland Sea, and so on.

In this presentation, initial validation results of ocean products (mainly SST and chlorophyll a concentration [Chla]) data in Seto Inland Sea from April 2018 to September 2018 are reported. Automatic observation data provided by MLIT (Ministry of Land, Infrastructure, Transport and Tourism) in the Osaka Bay (surface data at 11am JST) was used as validation data. As a result, the initial target accuracy is almost satisfied except for noise such as influence of clouds and cloud shadows.

On the other hand, the West Japan heavy rain disaster from July 6th to 7th, 2018, occurred mainly in Hiroshima Prefecture. The water quality before and after this disaster in the sea is also introduced using SGLI ocean products.

An estimation method of salinity distribution based on optical property of color dissolved organic matter using COMS/GOCI in a heavily eutrophic coastal area, Tokyo Bay, Japan

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Salinity is one of important parameters determining flow and ecosystem of coastal areas and it is continuously monitored by ship observations and water qualities mooring systems. Specially, in a semi-enclosed bay in which rivers inflow, salinity significantly varies in a short scale, therefore, it is extremely difficult to monitor the spatial and temporal variation of the salinity distribution. In this study, we examined to estimate colored dissolved organic matter (aCDOM) by a method of ocean color remote sensing and considered an availability of salinity estimation as using alternative index the estimated aCDOM in semi-enclosed and eutrophic water area, Tokyo Bay. In addition, special variation of salinity distributions when river discharge increased in the bay on October, 2012, were discussed, by applying the aCDOM method to GOCI images which are superior for spatial and temporal observations.

As the result that it validated an availability of aCDOM estimation by using the developed bio-optical model in Tokyo Bay, it was found that variation of light absorption coefficient of particulate (ap(490 nm)) would be an error factor of the aCDOM estimation when using two ratio model of Rrs(660)/Rrs(490). In addition, the salinity estimation was relatively available by applying the model to GOCI images when Chl-a was low concentration. Furthermore, it was confirmed a process that low salinity water mass from Edo-river inflowed to Urayasu offshore and river waters from Ara-river and Sumida-river spread to the bay at the same time and then they gradually mixed with ocean water.

An improved method to estimate secchi disk depth from remote sensing in various waters

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The Secchi Disk Depth (Z_{SD}), also termed as transparency or water clarity, is an important water quality parameter as it directly relate to water color. Lee et al. proposed a new theory of underwater visibility, and developed a new model for retrieving Z_{SD} from remote sensing data in 2015. The new model includes three steps: retrieving absorption and back scattering coefficients (a and b_b) from remote sensing reflectance (R_{rs}) using the 6th version of Quasi-Analytical algorithm (QAA_v6), estimating the diffuse attenuation coefficient of downwelling irradiance (K_d) from absorption and backscattering coefficients, retrieving the Z_{SD} from the minimum K_d within visible wavelength and the corresponding R_{rs}. While, the QAA_v6 was reported having low accuracy in absorption and backscattering coefficients retrieval in turbid waters, and the assumption of the constant between the diffuse attenuation of upwelling radiance from the Secchi disk (K_T) and the K_d (i.e.K_T=1.5K_d) may introduce errors in Z_{SD} estimation, as this value is not a constant according to previous studies.

In the present study, we first proposed a QAA_hybrid for a and b_b retrievals in various waters, it was validated using 392 in situ absorption data collected from various lakes in Japan, results showed it can retrieve reasonable absorption coefficient with RMSE=1.02m^{-1} and MAPE=26.45%. Apart from this, we also proposed a model to estimate the realistic K_T/K_d ratio, and thus proposed an improved Z_{SD} model. The improved Z_{SD} model was validated using 361 pairs of in situ measured spectra and corresponding Z_{SD} (220 collected in USA, and 141 collected in Japan), which covering inland water, coastal and ocean waters, with Z_{SD} ranges from 0.2m to 45m. Results showed that the K_T/K_d ratio ranges from 0.90 to 1.70 with an average of 1.28, which is lower than the constant used in Lee's original model (i.e. 1.5). The K_T/K_d ratio in clear water (Z_{SD}>4m) is lower than that in turbid water (Z_{SD} <=4m), for turbid waters, the K_T/K_d ratio ranges from 0.97 to 1.70, with an average of 1.32; for clear waters, the K_T/K_d ratio ranges from 0.90 to 1.41, with an average of 1.14. The improved Z_{SD} model enhanced the Z_{SD} estimation accuracy with RMSE=0.96m and MAPE=31.70%, compared with the original Lee's model with RMSE=1.45m, MAPE=43.86%. These results indicate that the improved model can be appropriately applied to various waters for Z_{SD} estimation.

Retrieval of inherent and apparent optical properties of water bodies in a global scale using Deep Neural Network

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Reflected sunlight from water bodies, which records by ocean color sensors, contains information of optical properties of water bodies (e.g., chlorophyll-a concentrations, absorption and backscattering coefficients). During the last few decades, researches have been proposed many approaches for monitoring water bodies by retrieving their optical properties. These approaches include bands ratio, semi-analytical algorithms, and spectrum matching. However, there is no accurate continuous monitoring on a global scale, particularly over inland lakes and coastal regions. This is mainly due to the nonlinear complexity of water environment. In additions, there are a few studies that used the synthetic simulated reflectance to train artificial neural network (ANN) models to be applied on a global scale. However, the recent revaluation of these ANN models over the Japanese and European lakes revealed their limitation to provide accurate monitoring of these water bodies.

These results could be attributed to two main reasons; (1) inappropriate ANN architecture with one hidden layer which could not be suitable to represent the complex situation of water bodies. (2) the limitation of the synthetic simulated reflectance that used to train these models. The deep neural network (DNN) with multiple hidden layers could provide a promising approach to overcome these complexities. Up to 2006, there is no way to accurately train a DNN due to a Vanishing gradient problem. the recent advances of DNN enable researchers to efficiently use the DNN models with low cost. During the current research, the performance of a DNN model with three-hidden layers under different architecture conditions will be presented. These conditions include different activation functions (i.e., sigmoid, Relu and TanH), different optimization technique (i.e, Adam optimizer and stochastic gradient descent) and with/without applying dropout technique. The DNN model was designed to receive water leaving reflectance of twelve bands from Ocean and Land Colour Instrument (OLCI) onboard of Sentinel 3a satellite. Nine water quality parameters are generating from the DNN model. Two independent simulated datasets comprising 100,000 water leaving reflectance spectra each were generated for training and testing the DNN models. The two simulated datasets cover wide ranges of Chla (0.01–250 $mg \cdot m^{-3}$), NAP (0.01–250 $g \cdot m^{-3}$), and CDOM (0.001–10 m^{-1}) concentrations, representing the open ocean, coastal areas, and inland lakes. The results reveal that Adam optimizer outperforms gradient descent optimizer. In addition, the results show the ability of DNN to provide high retrieval accuracy over wide ranges of constituent concentrations.

Neural network algorithms for detecting *Cochlodinium polykrikoides* blooms

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This study is to develop algorithms for detecting blooms of *Cochlodinium polykrikoides*, which has caused serious HABs for more than two decades in Korean waters. Various algorithms have been proposed to detect HABs. However, most of those algorithms are empirical and therefore limited in their applicability in the coastal areas where the bio-optical conditions are highly variable spatially and temporally. In a previous study, I have shown that the remote sensing reflectance of *Cochlodinium polykrikoides* exhibits a distinctive depression in the blue-green wavelength band based on a large data set of remote sensing reflectance simulated using the HydroLight software and the IOCCG IOP data. Based on this, a probabilistic neural network algorithm and a back-propagation neural network algorithm have been developed for in-water and satellite applications.

A preliminary test using the simulated and satellite data shows that the success rate of the in-water algorithm was 95%. The success rate of satellite algorithms were 72-88% depending on screening the training data. Compared with the sighting data, the bloom distribution maps derived from MODIS data showed consistent but more realistic distributions of *C. polykrikoides* blooms.

A spectral remote sensing approach for detecting *Noctiluca scintillans* blooms from Landsat 8 – OLI imagery

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We describe a novel spectral approach for detecting Noctiluca blooms using high- resolution images from Landsat-8 Operational Land Imager (LC8/OLI). In order to exploit the spectral bands available in LC8/OLI, we developed three HAB detection algorithms, whose application was specific to the water type the blooms are associated with. The first and second HAB algorithms was meant specifically for use in case 1 as well as turbid coastal waters, and the third algorithm is used for detecting Noctiluca blooms open ocean waters.

The three HAB algorithms were applied to LC8/OLI images obtained from 14 different sites with known histories of Noctiluca bloom occurrence. These sites included the coastal waters of countries in Southeast Asia and in East Asia as well as open waters of Arabian Sea and Gulf of Aden. Maps of Noctiluca blooms derived from the application of these algorithms to LC8/OLI images revealed their remarkable capacity for detecting Noctiluca and also for discriminating between red and green Noctiluca blooms. In many cases, the resulting maps could capture and resolve small, narrow bloom features that were often not possible by medium-resolution sensors such as MODIS-Aqua as well as SENTINEL-3. A similar development for detection Noctiluca blooms base on Sentinel2-Muttiple Spectral Imager (SEN2/MSI) will be carried out in near future.

Phytoplankton abundance of the Jakarta Bay, Indonesia observed by remote sensing reflectance of Aqua Modis satellite data

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The Jakarta Bay is a semi-enclosed bay which experiences pressure from severe eutrophication. This is indicated by very high nutrients loads from the activities of around 20 million populations living in the greater city of Jakarta and its big hinterland that discharged the loads into the bay through 13 rivers. As a consequence, the phytoplankton population exploded followed by a drastic reduction in oxygen levels of the bay and sometimes followed by mass fish kills. This study aims to determine the abundance of phytoplankton (cell/m^3) by using remote sensing reflectance at the blue, green and red bands of Aqua MODIS satellite data. Study was conducted in the Jakarta Bay from 2008-2011, 2013 and 2015. A total of 37 fixed sampling sites was established. Phytoplankton sampling was carried out twice a year at those fixed sites for 3-4 days. Sampling mostly conducted during the transition season from the rainy to the dry seasons (April-July). Remote sensing reflectance (RSR) 8-daily of Aqua MODIS images at blue bands (420, 443, 469 and 488, nm), green bands (531, 547 and 555 nm), and red bands (647, 667 and 678 nm) that obtained from GIOVANNI (Geospatial Interactive Online Visualization ANd aNalysis Infra-structure)'s web, which developed and maintained by GES DISC.(Goddard Earth Sciences Data and Information Services Center), NASA at ground resolution of 4 km x 4 km were used in the analysis. The RSR data to be used is selected which coincides with the sampling time. Simple linear regression analysis was used to see the strong relationship between phytoplankton abundance and RSR data of Aqua MODIS satellite images. From the field sampling, results show that the abundance phytoplankton ranges from $0.431x10^6$ to $6,814x10^6$ cell/m^3 with an average of $348x10^6$ cell/m^3. From 27 generas of phytoplankton (diatoms), the 5 most abundance generas are *Skeletonema, Chaetoceros, Thalassiosira, Nitzchia* and *Bacteriastrum*, but the composition of those dominant genera can be changed over time.

The abundance of phytoplankton has a weak relationship with blue bands of 420, 443, 469, 488 nm and the average of all blue bands ($R^2 \sim 0.2$), but no correlation at all to the green and red bands, as well as the average of all green and all red bands. However, the transformation of the ratio of the average of all green band to red band (Green/Red) show a stong relationship with the abundance of Phytoplankton (R^2=0.901). We found also high correlation between abundance of phytoplankton and chlorophyll-a concentration derived from Aqua MODIS satellite (R^2=0.899). This study shows that it seems the phytoplankton abundance can be estimated using RSR of Aqua MODIS data, in which the RSR data available on the web of GIOVANNI NASA. However, it still needs a lot of validation so that the results of this study can be applied as an empirical model to estimate and monitor phytoplankton abundance of the Jakarta Bay, especially to include data from other seasons (August-December).

Modeling of optical properties for blue tides considering light scattering of sulfur colloid particles in Tokyo Bay

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Blue tide is a serious environmental problem in the enclosed coastal area where organic pollution is significant such as Tokyo Bay. The blue tide occurs when the water mass containing hydrogen sulfide upwells to the surface layer from the bottom layer due to external force such as wind and then the hydrogen sulfide reacts with oxygen to generate sulfur particles. Although monitoring of the blue tides is important to figure out the mechanism of the blue tide dynamics and as a water environment management and conservation, it is extremely difficult to capture by field observations because it occurs suddenly on a short-time scale. Under such circumstance, satellite remote sensing is expected to be effective technique that can easily estimate the spatial behavior of the blue tides. In this study, we developed bio-optical model including sulfur colloid particles as a parameter, for considering an appropriate blue tide estimation model for ocean color remote sensing.

The ship observation was conducted on 28th Aug 2018. Total light backscattering ($b_{bt}(\lambda)$) was measured by Hydroscat-6P at the several layers which sulfur colloid particles were existed. The layers were found from anoxic waters and high turbidity points based on measured DO and turbidity of multiple water qualities sensor. Using the measured $b_{bt}(\lambda)$, the backscattering of sulfur ($b_{bs}(\lambda)$) was derived based on calculated $b_{bt}(\lambda)$, which specific backscattering coefficient in Tokyo Bay was used by Salem et al (2017). For the sulfur absorption coefficients, they were measured by subtracting light absorption coefficients of detritus without sulfur particles, which was measured by heating filtrated papers, from that containing sulfur particles.

It was found that the proportion of $b_{bs}(\lambda)$ in $b_{bt}(\lambda)$ in the anoxic water mass accounted for around 90%. Likewise, it was found that the $a_s(\lambda)$ influence the $a(\lambda)$about 20% as well. We also developed a bio optical model considering these optical properties of sulfur particles and verified its accuracy by comparing the measured remote sensing reflectance which was acquired in the field observation when the blue tide occurred.

Global assessment of marine and coastal eutrophication using remotely sensed chlorophyll-a concentration

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Eutrophication is an emerging environmental problem in many parts of the world ocean where a significant number of red tides and hypoxic conditions have been reported in coastal waters - possibly due to anthropogenic influences such as extensive chemical fertilizer use and sewage effluent. One of responses to eutrophication is an increase of phytoplankton biomass. Therefore, chlorophyll-a concentration (Chl-a), a proxy of phytoplankton biomass, can be utilized as a useful indication of eutrophication.

Remote sensing of ocean color from space has enabled monitoring of Chl-a for a long term, especially after the success of the Sea-viewing Wide Field-of view Sensor (SeaWiFS) and the follow-on Moderate Resolution Imaging Spectroradiometer on board the Aqua satellite (MODIS-A) launched by NASA in 1997 and 2002, respectively. This study aims to explore use of remotely sensed Chl-a by satellite sensors (satellite Chl-a) for assessment of marine and coastal eutrophication on a global scale. Monthly mean of satellite Chl-a over the period from 1998 to 2017 were computed globally by merging the data of SeaWiFS and MODIS-A. The assessment of marine and coastal eutrophication was then conducted by the level and trend of satellite Chl-a.

Exploring the impact of climate change on terrestrial productivity in southeast Asian coastal region

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The impact of climate change on terrestrial ecosystem is an important issue to the scientific community because of several reasons. However, very little has so far been know especially the impact of climate change on the terrestrial productivity in Southeast Asian coastal region. In this study, an effort was made to examine the spatial and temporal variation of terrestrial ecosystem in response to climate change. Two remote sensing variables namely Normalized Difference Vegetation Index (NDVI) and Land Surface Temperature (LST) were used and robust statistical analysis was carried out to explore the terrestrial ecosystem behaviors in responses to climate change.

Results indicate a clear spatial and temporal variation of NDVI and LST over the Southeast Asian coastal region. Nevertheless, no clear trend of NDVI and LST was observed which can be seen as an indication of the impact of climate change. It is highly suggested that more investigation should be carried out by incorporating remote sensing and other ancillary data in order to make a conclusive conclusion about the impact of climate change on terrestrial ecosystem in Southeast Asian coastal region.

Temporal and spatial variations in tidal fronts estimated from satellite monitored SST data

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Temporal and spatial variations in the position and sharpness of tidal fronts around the Hayasui Strait in the Seto Inland Sea, Japan are estimated using SST data from Himawari monitor that provides hourly data with a spatial resolution of nearly 2 km. The tidal fronts in the Bungo Channel and Iyo Nada, hereafter called southern front and northern front, are generated in March and later in April and both disappear in September due to the variation of heat flux through the sea surface. They do not change their average positions with this seasonal variation.

The tidal fronts move in a range of tidal excursion with the position of northern front (southern front) close to (farther from) the Hayasui Strait and the sharpness of northern front (southern front) decreasing (increasing) during ebb tide. These variations are reversed during flood tide. The southern front increases (decreases) its sharpness and locates away from (near to) the Hayasui Strait on spring tide (neap tide). However, the fortnightly variations in the northern front are not apparent.

The impacts of the Three Gorges Dam on the East China Sea marine ecosystem revisited

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The East China Sea ecosystem has undergone drastic changes over the past decades. The changes in the ecosystem are attributable to both the natural and anthropogenic stressors including the operation of the world's largest dam, the Three Gorges Dam. We analyzed the seasonal and inter-annual variability of the sea surface chlorophyll-a in the East China Sea using a suite of satellite data (1998-2012). Contrary to some previous studies, our analysis clearly showed that the summer-autumn averaged chlorophyll-a decreased by about 14 % in a large area (circa 178,000 km^2) in the northeastern East China Sea after the operation of the Three Gorges Dam. However, there was an increasing trend in the vicinity of the Changjiang River mouth, while there was a decreasing trend in the southeastern slope area, which can be attributed to anthropogenic nitrogen enrichment and warming, respectively.

Riverine influence on ocean color in the equatorial South China Sea

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Analysis of SeaWiFS data off Northwest Borneo reveals coastal chlorophyll bloom extending more than 200 km to deep South China Sea during winter. A combination of remote sensing products is used to untangle its statistical relation with various forcing factors. River discharge rate is estimated from satellite measurements of land rainfall, and surface chlorophyll over the middle shelf is shown to vary with river discharge and lag by one month. Strong (weak) chlorophyll blooms tend to occur in La Niña (El Niño) years. The study provides evidence that river runoff from maritime continent has major influence on equatorial ocean color.

Impacts of cyclonic eddy on phytoplankton in the Kuroshio Extension region

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Remote sensing data were used to comprehend the impact of cyclonic eddies on phytoplankton biomass and phenology in the Kuroshio Extension region (KE) of the western North Pacific Ocean. The analysis was mainly focused on the winter season (January – March) because oceanographic conditions during the winter largely control phytoplankton spring bloom. Based on winter sea surface height anomaly (SSHa), cyclonic eddies (negative SSHa) were dominant mainly within the periods of 1998 ~ 2001 and 2005 ~ 2009, whereas anti-cyclonic eddies (positive SSHa) were dominant mainly within the periods of 2002 ~ 2004, and 2011 ~ 2015.

Although it was not always the case, the concurrences of negative SSHa and positive phytoplankton chlorophyll anomaly (CHLa) were observed, indicating an eddy-induced nutrient flux likely promoted phytoplankton growth. Such a concurrence of low SSHa and high CHLa was less obvious during the winter indicating that another factor (i.e., winter mixing) was more important than the cyclonic eddies in controlling nutrient flux, and hence CHLa variability. Overall temporal mean indeed showed that the active cyclonic eddy area (approximately south of the Kuroshio Current main axis) was characterized by high CHLa, low SSHa, and shoaled mixed layer. In this study, a Cumulative Sum method was adopted to find the time of phytoplankton spring bloom onset. Correlation between SSHa and spring bloom onset time was investigated, and it was found that approximately over the active cyclonic eddy area, positive correlation between winter/late winter SSHa and time of spring bloom onset was observed. Such a positive correlation indicates that cyclonic eddies during the winter likely tended to advance the time of spring phytoplankton bloom.

Interannual variability of marine ecosystem in the Kuroshio Extension region

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Interannual variability of marine ecosystem in the Kuroshio Extension (KE) region is investigated using an eddy-resolving coupled physical-biological model. The model reproduces the observed interannual variability of sea surface height anomaly (SSHA) in the KE region along a zonal band of 32 – 34 °N from 2000 to 2012. The negative SSHA (KE unstable state) is shown in 2000 to 2002, 2006 to 2010, and 2012, and the positive SSHA (KE stable state) is shown in 2003 to 2005, and 2011. Distributions of high (low) nitrate and phytoplankton concentrations correspond to negative (positive) SSHA.

Cyclonic eddies (negative SSHA) are found to detach from the KE jet near 150°E and 158°E, and propagate westward. The westward propagating cyclonic eddies lift the nutrient-rich water into the euphotic zone, and maintain high levels of phytoplankton concentration in summer to fall. When the passing of strong cyclonic eddies (strong negative SSHA), especially, in 2012, the high nitrate water is lifted close to the surface layer, and appears the high surface phytoplankton concentration. Every winter, deep convection inside the eddy entrains high levels of nutrients into the mixed layer, increasing production, resulting in high phytoplankton concentration throughout the surface mixed layer. By contrast, anticyclonic eddies (positive SSHA) depress the nutrient-rich water (maintain oligotrophic condition), and the surface phytoplankton concentration in summer remains low, in 2003 to 2005.

Red tide in the eastern coast of the upper Gulf of Thailand related to surface currents revealed by High Frequency Radar during the southwest monsoon

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The data from High Frequency (HF) Radar operating around the coast of the upper Gulf of Thailand (UGoT) were used to investigate surface currents during the southwest monsoon. Hourly HF Radar from June – August 2018 were averaged to get daily and monthly data. Monthly surface currents mainly directed eastward in the central part of UGoT and southeastward in the northern and the southern part of UGoT. Daily surface currents were changed day-by-day due to daily wind. However, area-averaged surface currents mainly directed southeastward.

It is well-known that the influence of nutrient load from river discharge is the major cause of red tide frequently occurring in UGoT. Wind and circulation during the southwest monsoon make such phytoplankton blooming intensified in the eastern coast of UGoT. During late July and early August 2018, the blooming of green *Noctiluca* sp. was found along the eastern coast from Chon Buri bay to Ao Udom.

Green *Noctiluca* sp. was first accumulated in the offshore area of Bangsaen Beach (approximately 7 kilometers from the shoreline) on July 30, where the convergence of surface currents developed. Coastal current transported the blooming patch to Bangpra Beach and Bangsaen Beach on the following days. It was then widespread farther to Ao Udom, located approximately 15 kilometers from Bangsaen Beach to the south, by southward surface current. The movement of red tide from place to place was supposedly induced by surface currents revealed by HF Radar data.

The residence time of water mass in the upper Gulf of Thailand

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The residence time of water mass is one of significant factors for biogeochemical processes in an estuary and a coastal sea. This study aims to investigate the residence time of water mass in the upper Gulf of Thailand (UGoT) by using a 3-dimensional hydrodynamic model namely The Princeton Ocean Model (POM) coupled with a dispersion model. Tide and climatological data of wind, salinity, temperature and river discharge are the major forcing of the model. A conservative dissolved matter was filled into UGoT domain and then tracked to investigate the dynamic of water mass in each month. The Remnant Function was applied to estimate the residence time of water mass in the computational domain.

The results illustrate that short residence time occurs when the southwest and the northeast monsoon were well developed. The shortest resident takes place in November (101 days) while the longest resident time occurred in January and September (219 days). The results from the sensitivity analysis suggest that wind be a significant factor to control the variations of the residence time in UGoT. Tidal current makes the residence time longer while the influence of river discharge to the residence time in UGoT is insignificant. The accumulation of the conservative tracer seasonally in some area is related to strong phytoplankton blooms in UGoT, reveled by long-term monthly chlorophyll-a data (2004-2014) from MODIS Aqua level-3. The relationship between monthly-averaged residence time and chlorophyll-a, however, is unclear, except during second transition period (September to October) when the residence time is very long. This evidence suggests that the residence time of water mass alone cannot explain the seasonal variations of chlorophyll-a in UGoT.

Mechanism for the accumulation of *Noctiluca scintillans* in the eastern coast of the upper Gulf of Thailand

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There was a strong green *Noctiluca scintillans* bloom along the northeastern cost of the upper Gulf of Thailand (UGoT) during last week of July and the first week of August 2018. The blooming occurred at 4 local beaches namely Bangsaen Beach, Bangpra Beach, Sriracha Beach and Ao Udom Beach, located from the north to the south of a same beach system. We coincidentally conducted field observation in UGoT to investigate the movement of water mass by using drogue with GPS tracking during July 26 – 30, 2018. The condense accumulation of *N. scintillans* in a long way parallel to the coast was observed at around 7 km away from the shoreline. The results of the drogue study and a hydrodynamical modeling suggest that the accumulation of *N. scintillans* in offshore area be related to the development of surface current convergence. Such a phenomenon can transport floating materials not only phytoplankton cell but also plastic debris to accumulate along the frontal zone. The observation reveals the mechanism of the aggregation process of *N. scintillans* before a massive bloom hit the shoreline afterward.

Inter-annual variability of chlorophyll *a* distribution of the Bay of Bengal and its relation with mesoscale surface circulation

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The Bay of Bengal is receiving much attention as it is subjected to large seasonal and interannual variations in circulation and associated processes. The present study analysed the satellite derived Chlorophyll *a* (Chl *a)* concentration of the Bay and the high resolution surface circulation using satellite observations. The monthly Chl *a* concentration data from SeaWiFS mission during the period September 1997 to December 2007 was used. High resoultion Eulerian velocity field is derived by combining the available satellite tracked surface drifter data with satellite altimetry and ocean surface winds. The drifter data used in this study includes Argos and surface drifter data from Global Drifter Program. The satellite altimeter data used were Maps of Sea Level Anomaly (MSLA) weekly files with a resolution of 1/3° in both latitude and longitude for the period 1993-2012. The weekly ocean surface mean wind fields derived from the scatterometers onboard ERS 1/2; Quikscat and ASCAT had been employed to estimate the wind driven current.

The Bay of Bengal surface circulation is highly varying with respect to space and time. The seasonal variations are mostly due to the monsoon winds and inter-annual variability is dominated by the IOD events. The Chl *a* distribution of the Bay of Bengal is significantly modified by the convective motions caused by mesoscale eddies as well as the flow variability during IOD periods. In positive IOD period, highChl *a* is found in northwestern Bay, north of Sumatra and near equator. During negative IOD years the western Bay shows enhanced Chl *a* than in normal year. The strong southward East Indian Coastal Current brings more nutrient-rich river plumes through the western boundary towards the south during negative IOD years. In addition to the coastal currents, the equatorial Jet and tropical cyclones also have significant influence on Chl *a* distribution in the Bay.

Are the ocean color and SST good predictors of fishing ground in the Indonesian tropical waters?

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Indonesia is an archipelago composed of 17,000 islands, which explains why it has the second longest coastline in the world. Based on the optical properties, the Indonesian coastal waters dominated by case-2 waters. However, the case-2 water ocean color algorithm has not been developed for Indonesian waters. The Java Sea is one example of case-2 water in Indonesia. These waters are classified as shallow waters and many rivers containing suspended solid matter flow into the Java Sea. Based on several field surveys, the average of total suspended solids (TSS) in the Java Sea >3 mg/m^3 and the chlorophyll-a (Chl-a) concentration ranged from 0.1-2.5 mg/m^3. However, the Chl-a concentration derived ocean color sensors ranged from 0.1-20.0 mg/m3 using the case-1 algorithm.

Generally, the Chl-a derived ocean color sensor is higher than Chl-a field measurement. The concentration of Chl-a derived ocean color sensor in the Java Sea classified as a mesotrophic (Chl-a ranged from 0.1-1.0 mg/m^3) and eutrophic (Chl-a ranged from 1.0-10.0 mg/m^3). The sea surface temperature (SST) range in the Java Sea is 2 ^{o}C. Spatially, the distribution of Chl-a and SST concentrations in the Java Sea is relatively uniform so that it is difficult to identify the SST and Chl-a fronts are commonly used as indicators of the fishing ground.

Spatio-temporal variability of surface chlorophyll-a in the Halmahera Sea and its relation to ENSO and Indian Ocean Dipole

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Novel and long-term satellite data are used to investigate the variability of ocean surface chlorophyll-a (Chl-a) concentration in the Halmahera Sea (HS) under influence of the Australian-Indonesian Monsoon (AIM), the El Niño-Southern Oscillation (ENSO), and the Indian Ocean Dipole (IOD). In this study, we first analyzed the seasonal variability of Chl-a, and then examine the relationship between surface Chl-a, SST, and sea surface wind stress in the area. Our results suggest that the prevailing southeasterly wind plays a fundamental role in generating Chl-a bloom in the HS. Particularly on seasonal time scale, the strengthening of southeasterly wind stress (up to ~0.01 N m^{-2}) during the southeast monsoon season enhances Chl-a concentration (~0.59 mg m^{-3}) associated with the ocean surface cooling (~28.8 °C) in the HS. On the other hand, the Chl-a bloom completely diminished during the northwest monsoon season.

On interannual time scale, sea level pressure and wind stress are coherent with the ENSO and IOD. During El Niño and positive IOD event (La Niña and negative IOD event) both sea level pressure and wind stress largely increases (decreases) over the HS. This condition causes an anomaly in southerly (northerly) wind stress, which will be favorable to an enhancement (reduction) of the Chl-a concentration in the region. The present study demonstrates that sea level pressure and wind stress are the critical factor in determining the magnitude of Chl-a bloom in the HS.

Detailed spatiotemporal impacts of ENSO and IOD on phytoplankton biomass in the Indonesian Seas

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Merged ocean color data (monthly, 4-km spatial resolution) within the period from September 1997 to June 2016 were analyzed to reveal the footprints of El Nino/Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) climate variability on phytoplankton biomass (hereafter Chl) in the Indonesian seas. Correlation analysis between Chl and climatic indices was applied to assess Chl sensitivity to climate change in detail spatial feature. In this study we used Nino3.4 and dipole mode index (DMI) to determine El Nino/La Nina and positive/negative (+/-) IOD phases. DINEOF-based interpolation was applied to fill ocean color data gaps due to cloud cover, as the spatiotemporal analysis in this work required spatiotemporally complete Chl data.

Analysis of correlation between climate indices and physical oceanographic variables of mixed layer depth (MLD), sea surface temperature (SST), and sea surface height (SSH) was also conducted to assess the probable forcing factors determining Chl changes associated with climate variability. The variance analysis indicated open oceans of south of Java, west of Sumatra, Arafura Sea, and coastal regions of Borneo and Sumatra had large interannual variability.

Correlation analysis revealed that the areas of Banda Sea, Molucca Sea, and west Pacific Ocean north of New Guinea exhibited the most positively sensitive to El Nino event. The areas west of Sumatra and south of Java showed moderately positive response to El Nino event, but the most positively sensitive to positive IOD (+IOD). Moderate positive response to +IOD was observed over Banda and Molucca Seas. In contrast, the coastal regions of Borneo, east of Sumatra, and Arafura Sea showed negative response to both El Nino and +IOD. It is obvious that over the areas where Chl tended to increase during El Nino, SSH and MLD in contrast tended to decrease. Such an inverse change between Chl and SST was however less obvious. We therefore concluded that increases in Chl during El Nino and/or +IOD in the Indonesian seas could be attributed to nutrient supply from deeper layer caused by strengthened Ekman divergence (upwelling) as depicted by low SSH and MLD.

Optical properties of red tides in the upper Gulf of Thailand

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Red tides have intensively occurred several times a year in the upper Gulf of Thailand (uGoT), especially near the major river mouths and the eastern coast during the southwest monsoon season. It sometimes causes the mass mortalities of fish and shellfish, due to sudden oxygen reduction, and tourism disruption. The dinoflagellate *Noctiluca scintillans* and *Ceratium furca* are the major red-tide species in the uGoT as well as diatoms. The seawater discolorations although are typically red or reddish-brown, the apparent colors of *N. scintillans* in the uGoT is green due to containing the photosynthesis endosymbiont *Pedinomonas noctilucae*. The co-occurrence of these dominant species was also reported regularly. Heretofore, the phenomenon has been recognized by eye observation and study under a microscope. The method is difficult to monitor red tides in the whole area and unaccommodating to understand the behavior of red tides.

This study thus focused on using the RAMSES hyperspectral radiometer (320 nm – 950 nm), measuring remote sensing reflectance (R_{rs}) at the sea surface, to investigate the spectral characteristics of the dominant red tides in the uGoT considering with the chl-a concentrations and phytoplankton pigment composition and absorption. The R_{rs} spectra of super green *Noctiluca* blooms (>1,500,000 cell L^{-1}) was observed near the western coast in July 2017. The high cell density revealed the important features of green *Noctiluca* in near-infrared wavelengths. A different feature between green *Noctiluca* and *C. furca* was also found between 500 nm and 560 nm. The investigated features will be applied to develop a local algorithm to detect the red tides on satellite image in near future.

Harmful algae species detection in Ariake Sea by satellite

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Algae blooms are becoming more frequently in the coastal environment. It is reported that HABs happens frequently in Ariake Sea in recent years, which damage aquatic product cultures and human health. In-situ HABs data of research field have been and the dominate harmful algae species vary by season. Satellite data of MODIS has been used to analysis the difference between species. It is found that SS (645) is an effective indicator to distinguish bloom and non-water. Slope 555-645 of flagellate bloom water is much smaller compare with diatom bloom water. Besides, previous red tide detection methods also be applied in Ariake Sea while the results are not so good. And the lagging peak of chlorophyll a (chl a) is thought to be the main reason.

Study of the influence of total suspended matter on phytoplankton concentration in the upper Gulf of Thailand using remote sensing

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The Upper Gulf of Thailand (UGoT) is a highly turbid coastal area influenced by high total suspended matter (TSM) from four main rivers, Chao Phraya, Bang Pakong, Tha Chin and Mae Klong. Increase of freshwater and TSM discharge usually occurred in the period of southwest monsoon from especially Chao Phraya and Bang Pakong rivers at the central and east parts of UGoT. High turbidity water can affect the photosynthesis of phytoplankton as primary producer.

Empirical algorithm was used to estimate TSM from measured Remote Sensing Reflectance (Rrs). Total of 111 data with TSM range of 0.2 – 32 mg L^{-1} were taken from Matsumura *et al*. (2005) and Kobayashi *et al.* (2011) and sampled during Kasetsart cruise in 2017. 10 algorithms by the relationship between Rrs and TSM were analyzed. A strong correlation (R^2 = 0.73) was obtained between Rrs667/Rrs547 and TSM with the exponential regression. This algorithm was validated with the TSM retrieval from Moderate Resolution Imaging Spectroradiometer (MODIS). A significant coefficient of determination (R^2 = 0.93) is observed between the in-situ TSM and satellite TSM. However, underestimation was observed because the satellite Rrs was lower than the in-situ Rrs. Using the regression to improve Rrs, the developed local algorithm can be used to estimate TSM in the UGoT.

During southwesterly monsoons, the TSM distribution extended northeastwards to the head of the gulf; during northeasterly monsoons, it moved southwestward to the mouth of the gulf as the distribution of chlorophyll-a (Chl-a). To examine the influences of TSM on Chl-a, Chl-a derived from the local Chl-a algorithm through a 14 years period will be investigated.

Aeronet – ocean color time series in Ariake Bay

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The AERONET (**AE**rosol **RO**botic **NET**work) project is a federation of ground-based remote sensing aerosol networks established by **NASA** and **PHOTONS** and is greatly expanded by networks from national agencies, institutes, universities, individual scientists. AERONET – Ocean Color (AERONET-OC) provides the additional capability of measuring the radiance emerging from the sea. In April 2018, a new station of AERONET-OC has been set by JAXA for GCOM-C validation in Ariake Bay located in Kyusyu, Japan where the seaweed (Nori) culture very famous. Aerosol Optical Depth (AOD) and remote sensing reflectance (Rrs) is considered as the most important products of AERONET-OC because the estimation of chlorophyll-a concentration by ocean color satellite is usually not so accurate in coastal areas because of the inaccurate satellite remote sensing reflectance (Rrs) influenced by aerosol. This study is to make a brief description of the time series of the AERONET-OC data from April to October 2018. The in-situ AOD and Rrs data will be compared to ocean color satellite data (GCOM-C, GOCI) and help to make better ocean color products in Ariake Bay.

Estimation of chlorophyll-a from RGB digital camera data collected in Ise-Mikawa Bay

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Development for survey methods for phototrophs and/or environmental condition using RGB digital camera data has been increasingly studied for two decades. In examples for the ocean are studies of estimation of water quality using smart phone's camera (Goddijin et al. 2009, Leeuw and Boss 2018), detection of sea grass from aerial photo images and estimation of chlorophyll-a (Goddijn and White 2006). The portability and convenience of the digital camera are the reasons of interest for the RGB data. It is possible to be used as supplementary observation of satellite sensing because digital camera can use regardless of the cloud. Also, citizen participation surveys may be possible because anyone can take photographs using his or her digital camera. Thus, we attempted to develop estimation method for chlorophyll-a from RGB digital camera data for Ise-Mikawa Bay, Japan.

For Ise-Mikawa Bay, method of estimation of chlorophyll a concentration form SeaWiFS and MODIS data was developed by Hayashi et al (2015), but estimation method with digital camera data was not developed yet. We used chlorophyll-a concentration, RGB data from photo images of surface water, sky and a photographer's 18% reflectance gray card during monthly survey cruises in Ise-Mikawa Bay. Above water spectral radiance data from RAMSES/TriOS was also obtained. We calculated RGB from above water spectral radiance data and compared RGB from digital camera. Digital camera RGB ratio was correlated with RGB ratio from spectral data. We also found the correlation between in-situ chlorophyll-a concentration and R/G and R/B ratio. In the future, we will try to reduce the effect of direct reflection of sunlight for estimation of chlorophyll-a concentration using photographs of sky and gray card.

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Spatial and temporal variation of phytoplankton community structure in Ise/Mikawa Bay using multiple excitation fluorometer

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Understanding the variation of phytoplankton community structure is very important to understand the biological production in the ocean. The information from size fractionation of chlorophyll *a* concentration and high-performance liquid chromatography (HPLC) have been used to investigate community structure of phytoplankton. In this study, multiple excitation fluorometer was utilized for estimating phytoplankton community in addition to previous methods in a semi-closed mesotrophic to eutrophic water of Ise/Mikawa Bay.

Principle Component of the multiple excitation fluorometer data were regressed to HPLC data in order to obtain the accurate phytoplankton community structure. Large number of data from vertically continuous multiple excitation fluorometer data clearly showed the brown algae was mostly dominated, and cyanobacteria were dominated at the middle and the mouth of Ise/Mikawa Bay in June 2013.

Multiple excitation fluorometer is useful to understand the spatial and temporal variation of phytoplankton community structure.

Variability of the surface chlorophyll-a in the Karimata Strait during 2003-2015

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This study investigated the spatial and temporal variability of surface chlorophyll-a (chl-a) in the Karimata Strait based on the Moderate Resolution Imaging Spectroradiometer (MODIS) Aqua ocean color data for a period of January 2003 to December 2015. The analysis revealed coherence variations of chl-a, sea surface temperature (SST) and surface winds. On seasonal time scale, the surface chl-a concentration increases (decreases) during the southeast (northwest) monsoons. Interestingly, the surface chl-a concentrations significantly increased and spread offshore during La Niña and/or negative Indian Ocean Dipole (IOD). This situation is in contrast with that occurring off South Java and West Sumatra, in which surface chl-a bloom was observed during El Niño and/or positive IOD years we hypothesized that increased precipitation during La Niña and/or negative IOD years lead to increased river run-off that transport high nutrient towards the Sumatra and Kalimantan coast.

One-dimensional turbulence-ecosystem model reveals the triggers of the spring bloom in mesoscale eddies

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Mesoscale eddies are energetic swirling features, on the order of 100 km and lifespans of weeks to months, found almost everywhere in the ocean with strong impact on biogeochemical processes and ecosystems dynamics. This study employed a physical-biological coupled model to understand the influence of mesoscale anticyclonic and cyclonic eddies on the initiation of spring phytoplankton blooms. The model reproduced reasonably well the pattern of satellite and *in situ* chlorophyll-*a* concentration associated with mesoscale eddies.

The results showed distinct bloom initiation timings and grazing rates within the interior of the eddies. In the case of anticyclonic eddies with deeper mixed layers, blooms are triggered by suppression of turbulent mixing, which allows for increased phytoplankton light exposure. In contrast, cyclonic eddies with shallower mixed layers, blooms are triggered by increase in surface light that improves phytoplankton light exposure prior to the end of convective mixing. In the presentation, we reveal the mechanism by which eddies influence the dynamics of phytoplankton spring blooms, which suggest, therefore, that, in many parts of the global ocean, eddies play an important role in the regulation of the dynamics of phytoplankton blooms.

Increase of the amount of phytoplankton due to volcanic ash deposition in the low-nutrient low-chlorophyll areas

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Previous studies show that the deposition of volcanic ash would improve the growth rate of phytoplankton. However, the influence of volcanic ash on the ocean surface is not clear yet. We aim to use the Geostationary Meteorological Satellite Himawari-8 to observe the reaction of phytoplankton. Himawari-8 is operated from July 2015. The number of bands of Himawari-8 has about three times greater than that of Himawari-7; hence, chlorophyll-a concentration (Chl-a) is retrievable using the blue (470 nm) and green (510 nm) bands ratio during daytime by Himawari-8.

The spatial and temporal resolutions also become approximately 2 and 3-12 times greater than those of Himawari-7. If clouds are present at a certain time, Chl-a is not retrievable. If there is no cloud at another time, Chl-a is retrieved. Thus, the higher temporal resolution cause less sensitive for clouds. We focus on Nishinoshima Island located in the Ogasawara Islands. It is located about 1,000 km south of Tokyo and 130 km west from the closest manned island. The waters are the low-nutrient low-chlorophyll. Nishinoshima erupted from April 20 to August 10 in 2017. The data in July and August is analyzed because of less bloom. The eruption would enhance Chl-a because the chi-squared test shows deposition of volcanic ash would increase Chl-a to more than twice its amount and because the previous studies showed that nutrients of phytoplankton were detected from the volcanic eruption component of Nishinoshima.

Estimation of water reflectance in near-infrared wavelengths for the atmospheric correction of GOCI-II

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Atmospheric correction is a necessary process in ocean color remote sensing that estimates water reflectance at the surface from the top-of-atmosphere by removing the atmospheric path reflectances. The traditional atmospheric correction algorithms use two near-infrared (NIR) bands to estimate aerosol radiances in visible wavelengths based on the black pixel assumption (BPA) in NIR. However, the BPA is no more valid over turbid water due to relatively strong backscattering of in-water suspended sediments, thus an NIR water reflectance models have generally been applied to iteratively estimate aerosol reflectance and water reflectance in NIR.

We describe near infrared (NIR) water reflectance models for turbid water atmospheric correction of the Second Geostationary Ocean Color Imager (GOCI-II) which will be following the GOCI mission. While GOCI uses 660 nm band to estimate water reflectances in NIR, the GOCI-II can additionally use 620 and 709 nm band which makes it more advantageous for the estimation. We first suggest water reflectance relationships between 709 nm and two NIR wavelengths as an extension of GOCI turbid water atmospheric correction. An alternative NIR water reflectance model using a spectral relationship of inherent optical properties of water constituents between different wavelengths is provided as well. These reflectance models are preliminarily verified by simulation data and in situ measurements.

Atmospheric correction for SGLI standard ocean color products: Algorithm outlines, early validation results and image examples

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Second Generation Global Imager (SGLI) aboard GCOM-C satellite is to provide global ocean color observation data with spatial resolution of 250 m for coastal region and of 1 km for open ocean. The Level-2/3 standard products are to be released for public in late 2018.

We first summarize the sensor characteristics and observation features, and then briefly describe the atmospheric correction algorithm that inherited from the GLI ocean color atmospheric correction. One significant difference from the past algorithm is the selection of NIR band pair in terms of aerosol type/optical thickness determination: that is, lacking 750 nm band observation in SGLI channels, we use (673nm, 869nm) band pair with an iterative procedure to estimate Rrs (673), or remote sensing reflectance at 673 nm band. Another feature of atmospheric correction is the use of (865nm, 1630nm) band pair observation, in addition to (673nm, 869nm), to ensure the quality of aerosol reflectance estimation over potentially turbid waters where inaccurate Rrs(673) estimates will cause significantly large error.

In the latter half of the poster, we present early phase validation results based on match-up data set of satellite-derived and in situ observation data. Level-2/3 image examples will be also presented, in the hope of giving data users an idea of SGLI data quality and potentiality. Future plan for further enhancement of the atmospheric correction algorithm will be summarized.

Ocean color algorithm development environment for GOCI-II data processing

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The interdisciplinary field of ocean color remote sensing is experiencing tremendous growth. Geostationary Ocean Color Imager (GOCI), the world's first ocean color sensor operated in geostationary orbit, has drawn immense attention from industry, universities and research institutes. GOCI-II, the follow-up satellite sensor platform of GOCI, will be launched in 2019. This new sensor will have 13 spectral bands (8 bands for GOCI) and observe 10 ocean color images (8 images for GOCI) a day. Also, the spatial resolution of GOCI-II will be more precise as 250 m (500 m for GOCI) and its number of products will be increased to 26 (13 for GOCI). For estimating ocean color information from GOCI-II data, the dedicated ocean color algorithms will be newly developed. However, the existing ocean color algorithm development methodology without consideration for the high-speed data processing will not be employed because the amount of GOCI-II data will be significantly large and their data will have to be processed and distributed in real time.

In this study, therefore, we designed the ocean color algorithm development environment to support high-performance computing and storage using the parallelism. Also, the proposed environment enables the source code projects for GOCI-II ocean color products to be automatically built and deployed. We expect that GOCI-II ocean color algorithm developers will easily create and manage their parallelized source code projects at any time and any place through the cloud service under the proposed environment. Additionally, they will be able to validate the output and evaluate the processing performance under the proposed environment in real-time. We believe that the proposed environment will contribute to the field of massive satellite data processing.

Initial validation of SGLI and OLCI radiometric products in semi-enclosed coastal areas

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Sentinel-3/Ocean Land Colour Instrument (OLCI), which has 300m resolution, was launched by European Space Agency (ESA) in February 2016. Subsequently, Global Change Observation Mission (GCOM-C)/Second Generation Global Imager (SGLI), which has 250m resolution, was launched by Japan Aerospace eXploration Agency (JAXA) in December 2017. In the current time, it is not enough to validate the accuracy of water quality estimation of these sensors in coastal areas where eutrophication is occurring because the number of collecting in-situ data is limited for the validation.

In this study, we performed the validation for the products of remote sensing reflectance, Chlorophyll-a and Turbidity which was estimated by SGLI and OLCI, using in situ data from ship field observations and mooring post for water quality monitoring as an initial validation. In addition, SST estimated by SGLI was also validated the accuracy using the in-situ data.