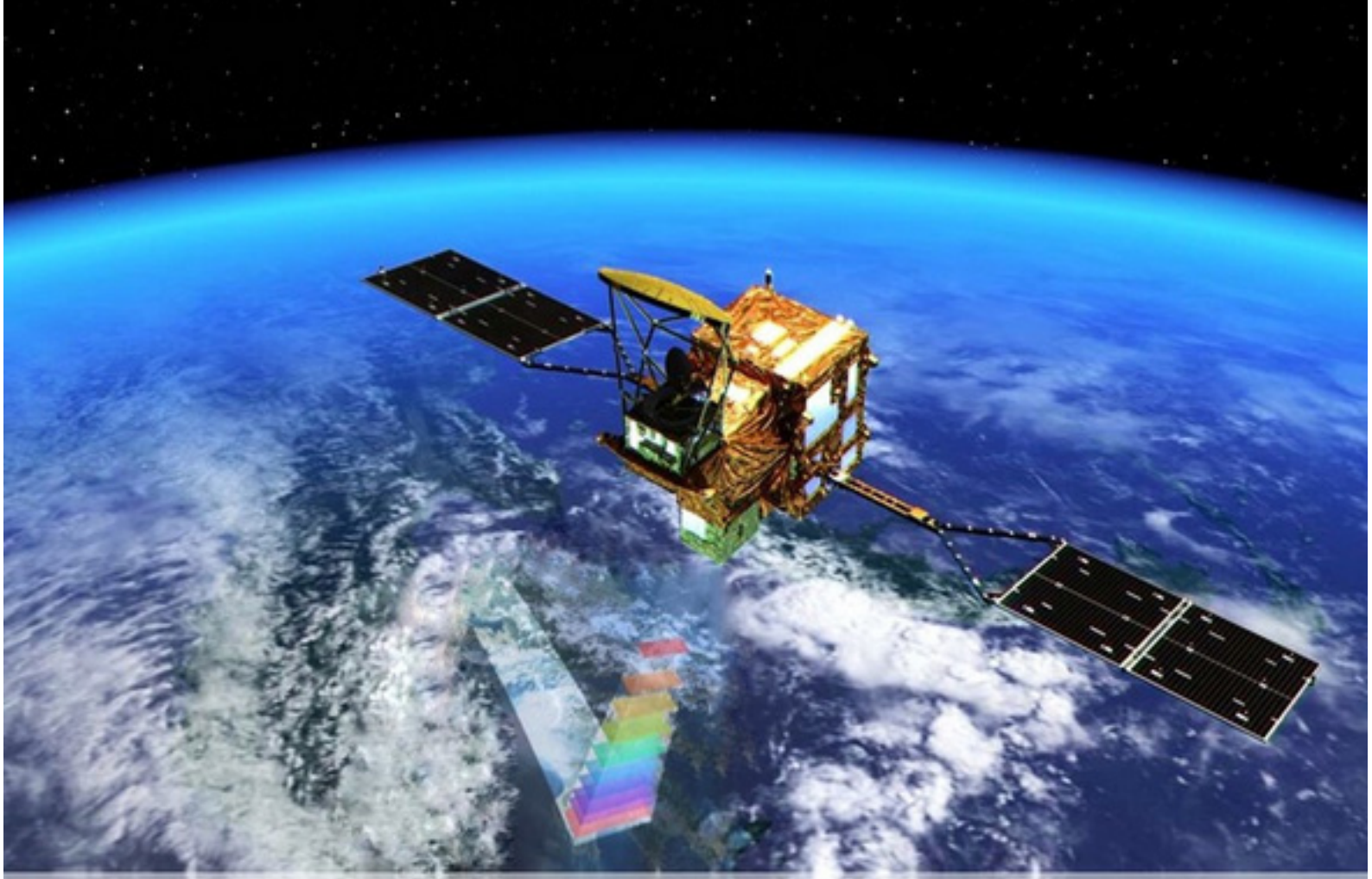
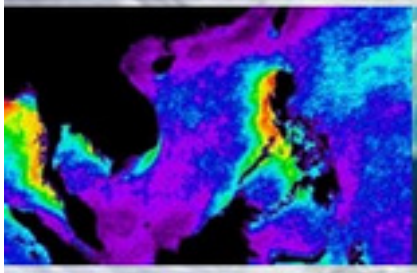
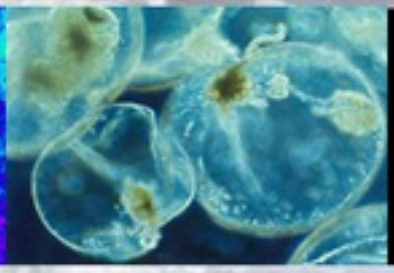
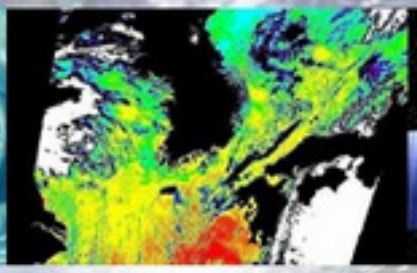
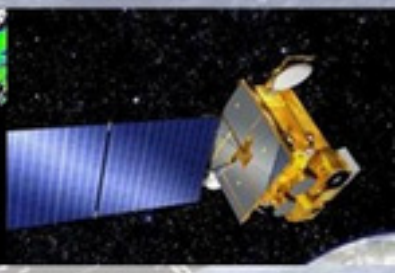










THE 4th ASIAN / 13th KOREA-JAPAN WORKSHOP ON OCEAN COLOR

13 – 16 December 2016

Central Laboratory Burapha University Thailand

E-mail: anukul@buu.ac.th

BURAPHA UNIVERSITY

APN

NAGOYA UNIVERSITY

ISEE

KOSC Korea Ocean Satellite Center

KIOST KOREA INSTITUTE OF OCEAN SCIENCE & TECHNOLOGY

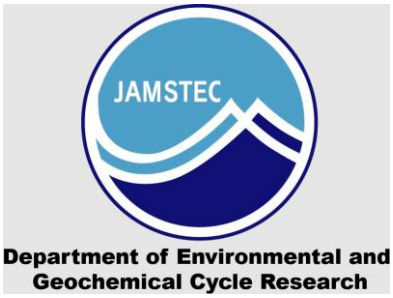
JAMSTEC

Department of Environmental and Geochemical Cycle Research

The 4th Asian/13th Korea-Japan Workshop on Ocean Color
(4th AWOC/13th KJWOC)

13 – 16 December 2016
Central Laboratory Building
Faculty of Science
Burapha University, Thailand

NAGOYA
UNIVERSITY



OVERVIEW

Since 2003, Joji Ishizaka (Nagasaki University, presently Nagoya University, Japan) and Yu-Hwan Ahn (Korea Ocean Research and Development Institute, presently Korea Institute of Ocean Science and Technology, Korea) started an annual workshop on ocean color called as the Korea-Japan Workshop on Ocean Color (KJWOC), which has been held either in Japan or Korea, and attended mostly by Japanese and Korean ocean color community. Later, the community has agreed and decided to hold the Asian Workshop on Ocean Color (AWOC) once in several years of KJWOC series. By also inviting scientists and students from other Asian/southeast Asian countries, the AWOC is held to promote the application of ocean color remote sensing technology especially in the Asian/Southeast Asian regions by initiating and/or establishing bilateral/international research collaborations. The 1st AWOC in 2011, which was also the 8th series of KJWOC, was held in Hokkaido University, Japan by the efforts of Taka Hirata. The 2nd AWOC 2013 was held in National Cheng Kung University, Taiwan and chaired by Cheng-Chien Liu. The 3rdAWOC 2015 or the 12th KJWOC was held at the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) in Yokohama. This year, Faculty of Science, Burapha university will host the 4thAWOC or the 13th KJWOC in Chon Buri, Thailand during December 13 – 17, 2016.

Welcome Message

Understanding in earth and ocean environments like never before is possible because of satellite technology that can provides synoptic view of environmental changes both in spatial and temporal aspects. This state-of-the-art technology is undoubtedly very useful for the study of global climate change, which becomes one of our serious concerns nowadays. Ocean color technology provides opportunity for monitoring and investigation on the responses of marine ecosystem from local to global scales, from coastal sea to open ocean. However, those complex and interrelated phenomena are not easy to understand and raise many unanswered scientific questions needed to be clarify. Yes, we still have a long way to go!

Asian Workshop on Ocean Color (AWOC) and Korea-Japan Workshop on Ocean Color (KJWOC) provide a great platform for discussion and collaboration on the application of satellite ocean color technology to address the Asian marine environmental issues among scientists from country members. Since 2003 for KJWOC and 2011 for AWOC, the collaborations have been intensified and the new collaborations have also been established. This year, the 4th AWOC/13th KJWOC 2016, a wide range of ocean color remote sensing applications on physical and biological oceanography, ecosystem modeling and atmospheric-ocean optics will be discussed through 23 oral and 13 poster presentations.

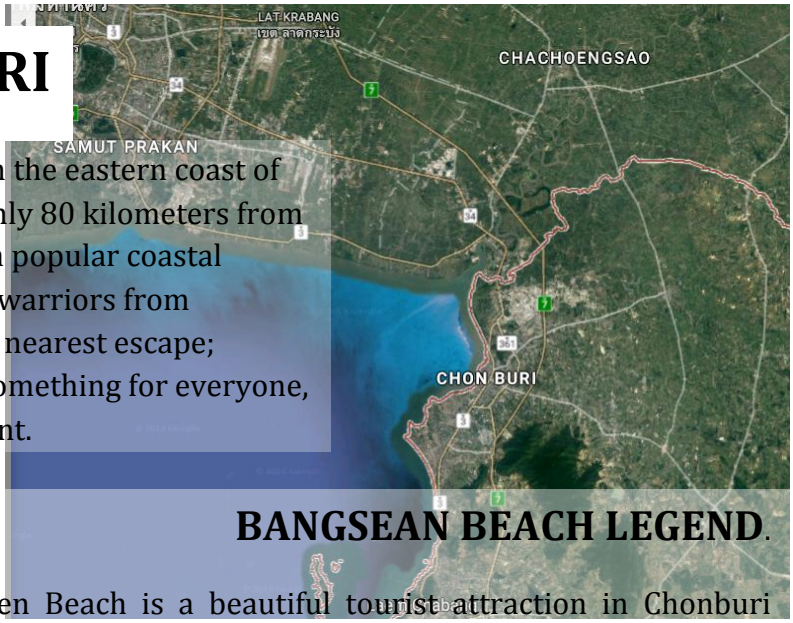
I hope, the workshops will not only offer solutions to current marine environmental problems through new knowledge and case studies but also initiate bilateral or international new research collaborations among the participating countries.

Acknowledgement has to be addressed here to the Institute for Space-Earth Environmental Research-Nagoya University (ISEE), Korea Ocean Satellite Center-Korea Institute of Ocean Science & Technology (KOSC), Japan Agency for Marine-Earth Science & Technology (JAMSTEC), and the Asia-Pacific Network for Global Change Research (APN) for their supports to make the workshops possible.

On behalf of the organizing committee and Burapha University, it is my great pleasure to welcome you to participate the 4rd AWOC/13th KJWOC 2016. Please make it at home and hope that the workshops will be completed successfully.

Associate Professor Dr.Somnuk Theerakulpisut
President, Burapha University

CHON BURI



Chon Buri is located on the eastern coast of the Gulf of Thailand, only 80 kilometers from Bangkok. Chonburi is a popular coastal province for weekend warriors from Bangkok who seek the nearest escape; Chonburi, which has something for everyone, rarely fails to disappoint.

BANGSEAN BEACH LEGEND.

Bangsaen Beach is a beautiful tourist attraction in Chonburi that has a legends of love story in a fisherman's village. There is a couple who flight to living together even though they had to face many obstacles.A long time ago in Chonburi province, Thailand

ANG SILA: VILLAGE, COMMUNITY

A charming seaside-fishing village situated approximately 5 kilometers from Chonburi City center. People here are famous in fishing where visitors can come to buy dried and fresh seafood in cheap price. Apart from the market, visitors can touch the old charm beautiful of the town by walking through its 100-year-old market in the middle of the town. Ang Sila is also well known for its granite products that range from giant rock sculpture to famous Thai kitchenware like mortars.

PATTAYA

Pattaya is a city on Thailand's eastern Gulf coast known for its beaches. A quiet fishing village as recently as the 1960s, it's now lined with resort hotels, high-rise condos, shopping malls, cabaret bars and 24-hour clubs. Nearby, hillside Wat Phra Yai Temple features an 18m-tall golden Buddha. The area also features several designer golf courses, some with views of Pattaya Bay.

BURAPHA UNIVERSITY

Burapha University has been consistently developed in terms of physical environment, personnel, and administration. In order to do so, a number of new organizations were established and the administration was also extended, aiming for more effective pedagogical management; for instance, Chanthaburi Campus was established in 1996 and one year later Sakaeo Campus was established. Burapha University offers numerous educational levels: Bachelor's Degree, Master Degree, and Doctoral Degree in Social Sciences, Health Science, and Science and Technology

Nowadays, Burapha University has become autonomous under government supervision in which its status is juristic according to Burapha University Act 2550 B.E. in government gazette volume 125 section 5 A, dated January 9, 1998 and effective from January 10, 1998.

CENTRAL LABORATORY BUILDING

THE FACULTY OF SCIENCE, BURAPHA UNIVERSITY

The Faculty of Science, initially The Faculty of Science and Mathematics, has existed since the beginning of the Bangsaen College of Education, established in 1955. Since then, the Faculty of Science has developed and expanded dramatically as the original teacher training college evolved, fi rst to become Srinakharinwirot University, Bangsaen Campus, and ultimately Burapha University, a comprehensive institution of higher education within the national university system.

CONTACT US

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169 Long-Hard Bangsaen Road, Saen Sook Sub-district, Mueang District,
Chon Buri Province, 20131 (1,035,340 square meters)
Tel : 0-3810-2222
Fax : 0-3839-0353 , 0-3839-0351
http://www.sci.buu.ac.th

A: Tao-Thong Hotel, Burapha University
B: Central Laboratory Building
C: Food Center of International College Building
D: Street of food zone (Soi Sod Sai)
E: Institute of Marine Science (Aquarium)
F: Laem Thong Department stores


CENTRAL LABORATORY BUILDING
TAO-THONG HOTEL,
BURAPHA UNIVERSITY
FOOD CENTER OF
INTERNATIONAL
COLLEGE BUILDING
A
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Google Earth


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STREET OF FOOD ZONE
(SOI SOD SAI)
TAO-THONG HOTEL,
BURAPHA UNIVERSITY
ปะหมี่-เกี๊ยว
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Google Earth


LAEM THONG
DEPARTMENT STORES
F
E
INSTITUTE OF MARINE SCIENCE
(AQUARIUM)
Google Earth


BURAPHA
UNIVERSITY
GISTDA
FLOATING MARKET, PATTAYA
NONG NOOCH TROPICAL GARDEN
1 h 56 min
Google

Workshop Schedule

The 4th Asian/13th Korea-Japan Workshop on Ocean Color (4th AWOC/13th KJWOC)

13 – 16 December 2016
Central Laboratory Building, Faculty of Science Burapha University, Thailand

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13 December 2016

Time	Programs
8:30 – 9:30	Registration
9:30 – 10:00	Welcome remarks
10:00 – 10:30	Group photos and coffee break
10:30 – 12:00	**Session 1 -** *Chair: Vipoosit Muntanachitra, Co-chair: Siraporn Tong-u-dom*
	O-01: VIIRS Mission-Long Ocean Color Data Reprocessing *Menghua Wang, Lide Jiang, Xiaoming Liu,* ***SeungHyun Son****, Junqiang Sun, Karlis Mikelsons, Wei Shi, Liqin Tan, Xiaolong Wang and Veronica Lance*
	O-02: OCView - online display and monitoring of ocean color product imagery *Menghua Wang, Karlis Mikelsons, Lide Jiang, Xiaoming Liu and* ***SeungHyun Son***
	O-03: Effective screening methods for near-cloud pixels: application to GLI and GOCI Data ***Hajime Fukushima****, Kazunori Ogata and Mitsuhiro Toratani*
12:00 – 13:30	Lunch
13:30 – 15:00	**Session 2 -** *Chair: Hiroshi Kobayashi, Co-chair: Wirote Laongmanee*
	O-04: Atmospheric correction scheme using the Spectral Relationships in the Aerosol Multiple-Scattering reflectance (SRAMS) ***Jae-Hyun Ahn****, Young-Je Park, Wonkook Kim and Boram Lee*
	O-05: Influence of absorbing aerosols in the atmospheric correction ***Mitsuhiro Toratani***
	O-06: An analysis of diffuse attenuation coefficients for downward irradiance in The Korus-OC dataset and GOCI data ***Boram Lee****, Young-Je Park, Wonkook Kim, Jae-Hyun Ahn1 and Sang-Wan Kim*
15:00 – 15:30	Coffee break

13 December 2016

15:30 – 17:00	**Session 3 -** *Chair: Mitsuhiro Toratani, Co-chair: Sung Yong Kim*
	O-07: Tracing high temperature and low salinity waters in the East China Sea: A novel approach using wave glider and satellite ***Young Baek Son**, Taejun Moh, Seom-Kyu Jung, Taehee Lee, Jong Kuk Choi, In Sung Han, Dae Hyun Kim, GwangSeob Park, Sang-Hyun Kim and Sinjae Yoo*
	O-08: Tracing Changjiang Diluted Water (CDW) in the East China Sea during summer season by use of satellite data and particle tracking ***GwangSeob Park**, Young Baek Son and Dong-kyu Lee*
	O-09: An analysis of GOCI measurements for internal waves in the East/Japan Sea ***Hyuna Kim**, Young-Heon Jo and Young Baek Son*
17:00 – 18:00	Free time
18:00 – 22:00	Welcome party

14 December 2016

Time	Programs
8:30 – 10:00	**Session 4 -** *Chair: Genki Terauchi, Co-chair: Jutarak Luang-on*
	O-10: Disappearance of upwelling phenomena in South Vietnam Sea (Western South China Sea) during post El-Nino periods ***Tong Phuoc Hoang Son**, Tran Van Chung, Nguyen Huu Huan, Lau Va Khin, Joji Ishizaka and Eko Siswanto*
	O-11: An analysis of timing of phase changes in chlorophyll concentration in the East/Japan Sea ***Young-Heon Jo**, Hyun-Cheol, Kim, Seunghyun Son and Dohoon Kim*
	O-12: Mapping potential eutrophic zones in the Norhtwest Pacific Region ***Genki Terauchi**, Zhiming Yu, Zaixing Wu, Changkyu Lee and Vladimir Shulkin*
10:00 – 10:30	Coffee break
10:30 – 12:00	**Session 5 -** *Chair: Tong Phuoc Hoang Son , Co-chair: Wonkook Kim*
	O-13: Open Access Satellite Image Service (OASIS) of Taiwan ***Cheng-Chien Liu***
	O-14: Unusual high primary productivity in the Kuroshio surface water of the East China Sea ***Eko Siswanto**, Yongjiu Xu and Joji Ishizaka*
	O-15: Detection of red tide and non-red tide in Korean coastal waters using model, in situ and satellite data ***Yeseul Kim**, Sinjae Yoo and Young Baek Son*
12:00 – 13:30	Lunch

14 December 2016

13:30 – 15:00	**Session 6 -** *Chair: Young Baek Son, Co-chair: Eko Siswanto*
	O-16: Surface chlorophyll-a bloom in the southeastern tropical Indian Ocean during various types of the Indian Ocean Dipole *Qurnia Wulan Sari, Eko Siswanto, Dedi Setiabudidaya, ndra Yustian and* ***Iskhaq Iskandar***
	O-17: Estimation of phytoplankton community in Ise Bay by multiple excitation fluorometer ***Joji Ishizaka****, Koji Tanigawa, Risa Ibuki, Qian Xu, Masataka Hayashi and Shengqiang Wang*
	O-18: Neural network algorithms for detecting *Cochlodinium polykrikoides* blooms ***Sinjae Yoo****, Yeseul Kim and Young Baek Son*
15:00 – 15:30	Coffee break
15:30 – 17:00	**Session 7 -** *Chair: Hiroto Higa , Co-chair: Iskhaq Iskandar*
	O-19: Satellite optical characteristics of Green *Noctiluca* bloom in the upper Gulf of Thailand ***Jutarak Luang-on*** *and Joji Ishizaka*
	O-20: Optical characterization of red tide in the presence of suspended material loadings ***Wonkook Kim****, Boram Lee, Jae-Hyun Ahn, Naeun Kim and Young Je Park*
	O-21: Optical properties of particulate matter measured in Bangpakong river estuary and development of new shipborne aureolemeter ***Hiroshi Kobayashi****, Mitsuhiro Toratani, Satsuki Matsumura, Absornsuda Siripong, Thaithaworn Lirdwitayaprasit, Pachoenchoke Jintasaeranee and Masataka Shiobara*
17:00 – 18:30	Poster presentations

15 December 2016

Time	Programs
7:30 – 12:00	Visiting GISTDA, Sriracha Chonburi
12:00 – 13:30	Lunch
13:30 – 15:00	**Session 8 -** *Chair: Seunghyun Son, Co-chair: Anukul Buranapratheprat*
	O-22: Observations of submesoscale surface chlorophyll concentrations off the east coast of Korea *Jang Gon Yoo and* ***Sung Yong Kim***
	O-23: VIIRS-derived chlorophyll-a using ocean color index method ***Seunghyun Son*** *and Menghua Wang*
	O-24: Discussion: Collaborations & next AWOC/KJWOC
15:00 – 15:30	Coffee break
15:30 – 16:00	Closing remarks

16 December 2016

Time	Programs
8:00 – 16:30	Excursion

Poster session

Poster presentation

No.	Titles
P-01	Interannual variations of phytoplankton communities in response to nutrient supply from different water masses in summer East China Sea *Qian Xu, Chiho Sukigara, Watanabe Yuji, Takeshi Matsuno, Sinjae Yoo and Joji Ishizaka*
P-02	Mechanism for Chl a variability after the passage of typhoons in East China Sea in 2012 by GOCI and JCOPE2 *Akina Matsushima, Hidenori Aiki and Joji Ishizaka*
P-03	Current status of the primary production in the East/Japan Sea *Jae Hyung Lee, Huitae Joo, SeungHyun Son, Jung-Woo Park, Jae Joong Kang, Dabin Lee and Sang Heon Lee*
P-04	Spatio-temporal variability in sea surface temperatures for the Yellow Sea based on MODIS dataset *Chunli Liu, Qiwei Sun, Qianguo Xing, Zhenlin Liang and Yue Deng*
P-05	Development of sulfur estimation model for monitoring of blue tides by COMS/GOCI in a semi-enclosed water area *Hiroto Higa, Shogo Sugahara, Yoji Tanaka, Yoshiyuki Nakamura, Hikaru Ito and Takayuki Suzuki*
P-06	Estimating Absorption Coefficients of CDOM using Correction Method for the Atmospheric Correction Error of COMS/GOCI in Tokyo Bay *Tomohiro Fukuda, Hiroto Higa, Yoshiyuki Nakamura, Takayuki Suzuki and Hiroshi Kobayashi*
P-07	Ongoing research on an optical characterization of the Particulate Organic Carbon (POC) by using in-situ measurements *Jung Hyun Kim, Wonkook Kim and Young-Je Park*
P-08	Remote sensing of Sargassum using an anomaly detection technique in the Yellow Sea with GOCI data *Naeun Kim, Wonkook Kim, Boram Lee, Jae-Hyun Ahn and Young Je Park*
P-09	Estimation of potential fishing zone for Chub Mackerel (*Scomber Japonicus*) using remote sensing data *Joonseok Oh, Wonkook Kim and Young-je Park*
P-10	Preliminary remote sensing observation of sea surface temperature increase during *Ulva prolifera* blooms *Sufen Wang and Danling Tang*
P-11	The value of coral reefs in Pangkep Regency, Indonesia, estimated by in-situ and multi-temporal LANDSAT imagery data *La Ode Muhammad Yasir Haya and Masahiko Fujii*
P-12	Applications of Artificial Neural Networks to Chl-a, TSS and CDOM Assessment in The Upper Gulf of Thailand *Songkot Dasananda, Anukul Buranaprattheprat and Prasarn Intacharoen,*
P-13	Application of Geostationary Ocean Color Imager (GOCI) Data for Flood Induced Debris Trace *Kwangseok Kim, Young-Je Park, Seongick Cho, Joung mi Ryu, Young-Gyu Park , Seongbong Seo and Il-ju Moon*

ABSTRACT

Oral session

VIIRS Mission-Long Ocean Color Data Reprocessing

Menghua Wang[1], Lide Jiang[1,2], Xiaoming Liu[1,2], SeungHyun Son[1,2], Junqiang Sun[1,3], Karlis Mikelsons[1,3], Wei Shi[1,2], Liqin Tan[1,2], Xiaolong Wang[1,2], and Veronica Lance[1,3]

[1]NOAA/NESDIS Center for Satellite Applications and Research (STAR), 5830 University Research Ct., College Park, MD, USA
[2]CIRA, Colorado State University, Fort Collins, CO, USA
[3]Global Science and Technology, Greenbelt, Maryland, USA

Corresponding e-mail: seunghyun.son@noaa.gov

In this presentation, we provide an overview of the progress on producing accurate ocean color products from the Visible Infrared Imaging Radiometer Suite (VIIRS). To meet requirements from broad users (e.g., operational, research, modeling, etc.), we have proposed and now been routinely producing two VIIRS ocean color data streams, i.e., the near-real-time (NRT) and delayed science quality ocean color product data. The NRT ocean color data stream has the advantage of quick data turn around with data latency ~12-24 hours, while the science quality data stream has highly consistence (with the mission-long data reprocessing) and accuracy of ocean color products. The implementation details for the two data streams will be discussed. In addition, with significantly improved satellite data processing algorithms, as well as considerably improved sensor on-orbit radiometer calibration using both solar and lunar methods, VIIRS mission-long ocean color data have been successfully reprocessed using the NOAA Multi-Sensor Level-1 to Level-2 (MSL12) ocean color data processing system. VIIRS ocean color data have been significantly improved over the global open ocean, as well as turbid coastal and inland waters. In particular, VIIRS-derived water property data over global high altitude lakes (e.g., Lake Victoria in South Africa with altitude of 1.1-km) are now very much improved, providing a significant progress for satellite remote sensing of inland water properties. Some detailed evaluation of VIIRS ocean color products will also be discussed. Results show that VIIRS can provide high-quality global ocean color products in support of the science researches and operational applications.

Satellite Ocean Color Data Monitoring Tool

Menghua Wang[1], Karlis Mikelsons[1,3], Lide Jiang[1,2], Xiaoming Liu[1,2], and SeungHyun Son[1,2]

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5830 University Research Ct., College Park, MD, USA
[2]CIRA, Colorado State University, Fort Collins, CO, USA
[3]Global Science and Technology, Greenbelt, Maryland, USA

Corresponding e-mail: seunghyun.son@noaa.gov

In this presentation, we introduce and demonstrate a useful and powerful web tool for routine satellite ocean color data monitoring and sensor performance evaluation. The NOAA Ocean Color Team has developed the satellite ocean color data monitoring website, and has been routinely providing daily global ocean color images and calibration and validation (Cal/Val) results for various ocean color data products (mainly, VIIRS ocean color products) (http://www.star.nesdis.noaa.gov/sod/mecb/ color/). In particular, the Ocean Color Viewer (OCView) is designed for an interactive display of various satellite ocean color data products generated by NOAA Ocean Color Team from the data acquired by the Visible Infrared Imaging Radiometer Suite (VIIRS) instrument onboard the Suomi National Polar-orbiting Partnership (SNPP) satellite. In addition, OCView can provide routine global daily true color images from VIIRS and now also true color and ocean color product images acquired from Sentinel-3 Ocean and Land Color Instrument (OLCI) and Korean Geostationary Ocean Color imager (GOCI). Some other current and future satellite data will also be included. Furthermore, the NOAA ocean color monitoring website provides routine Cal/Val results from VIIRS global oligotrophic waters and deep waters, as well as from various coastal and inland water regions. There are also routine VIIRS data monitoring and evaluation, compared with in situ data, e.g., measurements from the Marine Optical Buoy (MOBY) and various AERONET-OC sites.

Effective screening methods for near-cloud pixels: application to GLI and GOCI data

Hajime Fukushima[1], Kazunori Ogata[2], and Mitsuhiro Toratani[3]
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[2] Earth Observation Research Center, JAXA, Japan
[3] School of Engineering, Tokai University, Japan

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Some types of satellite ocean color imagers including GLI and SGLI have residual inter-band registration error which causes spectrally blurred imagery or noise in ocean color products near-by cloud edge or around cloud fragments. GOCI imagery has also similar characteristics around fast-moving cloud because of inter-band scan time difference of 7∼50 seconds, which may produce cloud-contamination effect up to few to ten GOCI pixels from cloud edges. Effective screening of such cloud-affected pixels is highly demanded in order to secure high quality of ocean color products especially those of Level 3.

We have been studying and testing several QC methods of near-cloud pixel screening and have reported several times in the past AWOC/KJWOC meetings. In this presentation, we propose two other testing methods, which are intended for GLI and GOCI product generation. The first one, which we named "Convexity Sequence Test (CST)", is to check the pixel-wise spectral smoothness in the Rayleigh-corrected satellite reflectance, by counting number of convexity change in the sequence of triplets of satellite reflectance ordered in wavelength. The second one, "Local Coherency Test (CST)" is to test the spatial coherency of pixel-wise two-band satellite reflectance difference. Although we can generally consider any pair of band or any set of those pairs, we, for this study, applied the method only on two NIR bands that affect the quality of the ocean color images mostly through the atmospheric correction process. The two methods were tested against several GLI and GOCI data to evaluate their performance and effectiveness.

Atmospheric correction scheme using the spectral relationships in the aerosol multiple-scattering reflectance (SRAMS)

Jae-Hyun Ahn[1,2], Young-Je Park[1], Wonkook Kim[1], Boram Lee[1,3]
[1] Korea Institute of Ocean Science and Technology, Korea Ocean Satellite Center, Ansan, South Korea
[2] Ocean Science & Technology School, Department of Convergence Study on the Ocean Science and Technology, Busan, South Korea
[3] Sejong University, Geoinformation Engineering, Seoul, South Korea

Corresponding e-mail: youngjepark@kiost.ac.kr

An important part of the atmospheric correction process in ocean color remote sensing from a satellite is an estimation of the aerosol multiple-scattering reflectance. Utilization of two near-infrared (NIR) bands to determine the appropriate aerosol model and concentration has been widely adopted for the aerosol reflectance correction. To know the most two closest aerosol models with their mixing factor regarding an optimization in two NIR bands, the first atmospheric correction algorithm for Geostationary Ocean Color Imager (GOCI) has used a relationship between single-scattering and multiple-scattering aerosol reflectance, which was developed for the processing of the Sea-viewing Wide Field-of-view Sensor (SeaWiFS).

In this study, a methodologically accurate and straightforward aerosol multiple-scattering reflectance correction scheme for the GOCI atmospheric correction is suggested. We found that the spectral relationships in the aerosol multiple-scattering reflectance between different wavelengths (called SRAMS) can be established while the aerosol optical thickness varies for different aerosol models and solar-sensor geometries. In the aerosol correction scheme using SRAMS, the multiple-scattering reflectance from aerosols in the presence of air molecules is directly calculated without separately considering the single-scattering model. It first determines the two most appropriate aerosol models by comparing the observed aerosol reflectance at the shorter NIR wavelength with the reflectances of all candidate models using SRAMS and subsequently computes their mixing ratio with no residual errors in the NIR while the SeaWiFS algorithm produces some residual errors in NIR. To assess the performance of the new algorithm regarding the errors in the remote-sensing reflectance (R_{rs}) retrieval, we first validated and compared the SRAMS atmospheric correction results with other primary aerosol correction schemes (i.e., SeaWiFS/MODIS, OCTS, and MERIS algorithms) using both simulations and *in situ* match-ups with the GOCI data.

Influence of soot type aerosol in the atmospheric correction

Mitsuhiro Toratani
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Water-leaving radiance is negative infrequently after atmospheric correction. In that case, the estimation of aerosol scattering light has been overestimated in the atmospheric correction. If the absorptive aerosol such as soot is present, it is known that such a phenomenon occurs. In this study, I investigate the impact of soot type aerosol using a radiative transfer simulation, and consider its correction scheme.

I use radiative transfer model Pstar (Ota et al., 2010). It computes the polarized radiation in the coupled atmosphere-ocean system. As an reference of non-absorptive aerosol model, I set aerosol model composition ratio tropospheric(5.14) and maritime (1.0). Soot type aerosol model as absorptive aerosol was added to it in ratio from 0 to 7.
Several MODIS/Aqua scenes were selected to contain negative water-leaving radiance that is the existence of absorptive aerosol. Pstar calculation used geometric conditions as same as the satellite observations. The presence of absorbing aerosols was also confirmed by Chemical weather FORecasting System (CFORS) (Uno et al., 2003). CFORS is a numerical simulation to estimate the transport of the aerosol.

According to the simulation results, when the absorbing aerosols increases, the aerosol radiance was decreased at all wavelength. The reduction of aerosol radiance at 412nm continues over aerosol component ratio 7. The satellite-observed radiance was sometimes less than the radiance of Rayleigh scattering only due to absorptive aerosol.
At less than 490nm, absorptive aerosol has more impact at shorter wavelength. At 550nm or more, aerosol radiance was decreased until absorptive aerosol composition ratio of 4. Over 4, the aerosol radiance was substantially constant about 40% down.

I show in the workshop it is insufficient correction of the soot type absorptive aerosol in conventional atmospheric correction scheme. And I show investigation for the improvement of atmospheric correction scheme to consider absorptive aerosol.

An analysis of diffuse attenuation coefficients for downward irradiance in the KORUS-OC dataset and GOCI data

Boram Lee[1,2], Young-Je Park[1], Wonkook Kim[1], Jae-Hyun Ahn[1,3] and Sang-Wan Kim[2]

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The diffuse attenuation coefficient for downward irradiance (K_d) is an important property for estimation of clarity of ocean, and it is closely related to the in water visibility. The models for estimating the K_d from ocean color imagery can be divided into an empirical (Austin and Petzold, 1981; Mueller and Trees, 1997; Mueller, 2000; Morel, 1988; Morel and Maritorena, 2001) and semianalytic algorithm (Sathyendranath and Platt, 1997; Lee et al., 2005).

In this study, the K_d models are evaluated using *in situ* and GOCI data and modified for accurate GOCI-derived K_d. The *in situ* data is analyzed firstly using the Korea-US joint field campaign for ocean color research (KORUS-OC) data. The K_d and remote sensing reflectance were measured using the profiler-II, which provides optical measurements of downward irradiances and upwelling radiances. Especially this study focuses on a highly turbid region (i.e. Total suspended matter concentration is over than 100 g/m^3), where many existing algorithms tend to underestimate K_d. We also discuss the effect of the K_d accuracy on the GOCI Secchi disk depth which represents optical visibility.

Tracing high-temperature and low-salinity waters in the East China Sea : A novel approach using wave glider and satellite

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The Changjiang river water in summer disperses toward Jeju Island and then into the East/Japan Sea due to dominant southerly wind. The Changjiang freshwater contributes to the upper ocean variability in the East China Sea (ECS) and Yellow Sea (YS). Recently, the surface water in summer 2016 showed the highest sea surface temperature that increased >2~3 degree C compared to 2015 in the ECS. The Changjiang river also was loaded the wide range of the freshwater to offshore ECS with the highest value from 2000. From the hydrographic cruise around the coast of Jeju Island, surface water temperature is > 32 degree C and low-salinity water (~28 psu) stratifies under 10~15 m depth.

To trace offshore high-temperature and low-salinity waters in the ECS, a proxy was developed using the wave glider and satellite date during summer 2016. The wave glider (wave-propelled autonomous vehicle) instrumented with a variety of oceanography (CTD, fluorometer, turbidity, wave height, ADCP, etc) and meteorological sensors (air temperature, air pressure, wind, camera, etc) were launched from the south of Jeju Island in Aug. 19, 2016 and navigated along and across lines (~1000 km) until Sep. 22, 2016. Wave glider navigated the west side and then the east region of Jeju Island along longitudinal and latitudinal lines. A comparison of ocean color and wave glider-measured data revealed the high-temperature and low-salinity waters with west-east direction in the west of Jeju Island. Although wave glider-measured water temperature and salinity showed the various ranges, the higher water temperature and lower salinity were > 32 degree C and < 26 psu. Glider-measure chlorophyll fluorescence were negatively correlated with salinity. The matching data of wave glider and satellite also showed that the high temperature water observed along the west part of Jeju Island compared to the east part of Jeju (e.g. Kuroshio branch region). From this result, ocean color data provided the estimate of the temporal and spatial variation of low-salinity water plumes.

Tracing Changjiang Diluted Water (CDW) in the East China Sea during summer season by use of satellite data and particle tracking

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Low-salinity water plumes have been observed throughout the East China Sea (ECS), which connected to the Korea with the Pacific. The Changjang River, the major plume source, loads the wide range of river discharge in the Changjiang river mouth and transports the mass of suspended particulate matter and dissolved organic matter along and/or across the ECS. Especially, during summer, low-salinity water makes the Changjiang Diluted Water (CDW) and transports the south sea of Korea and the East/Japan Sea. This research traces the pathway and contribution of CDW from the East China Sea to the East/Japan Sea. This study used HYCOM data (sea surface velocity and sea surface salinity data) to determine the trace trajectory and influence of CDW during summer (July to September) in 2009 to 2016. MODIS-Aqua ocean color image used the comparison of the spatial and temporal variation of CDW.

Daily particles with low-salinity water under 32 psu were released in 123^{O}E near Changijiang estuary and dispersed by surface current. The simulated particles passed the Jeju Island and then transported the East/Japan Sea throughout Korea and Tsushima Strait. The saline water was generally transported into the eastern channel than the western channel in the Korea and Tsushima Strait, which originated from the southern part of the Changjing river mouth. The ocean color images showed the similar spatial and temporal distribution and variation. The pathway and variation of CDW might be linked to the Changjiang river discharge flow and surface wind in the ECS.

An analysis of GOCI measurements for internal waves in the East/Japan Sea

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A two-layer condition occurs Internal Waves in stratified density structure. Physical characteristics of them have been studied around the world with plenty of CTD, Synthetic Aperture Radar and Acoustic Doppler Current Profiler data so far. However, as limitation of discrepancy in field observation, satellite measurements is also widely used to identify them. Propagation and vertical mixing by Internal Waves brings bottom waters up and uplifted nutrient sources which allows optic sensors to define Internal Waves. Optic sensors with a built-in polar-orbit satellite are hard to observe continuous ocean phenomena like a propagation of Internal Waves. Using 1 hourly GOCI measurements, elevations and depressions of Internal Waves can be detected with chlorophyll-a concentration images.

Ulleung Basin where Internal Waves frequently occurs is relatively flat bathymetry (-1900m) except abrupt change with Dok island in East/Japan Sea. At least Internal Waves with a scale of ~6km maximum wavelength can appear on 500m spatial resolution GOCI images. In July 2015, 2 packets of Internal Wave are continuously propagated northward across the Dok island during 5 days. To estimate amplitude η of Internal Waves using GOCI images, Hybrid Coordinate Ocean Model and Korteweg-de Vries equation were used for nonlinear coefficient α and linear speed C0. From phase speed C derived from GOCI, amplitudes were extracted by relation with α, C0, η and C. We will also compare references and estimated values with GOCI.

Disappearance of Upwelling in South Vietnam Sea (Western South China Sea) During Post El-Nino Periods.

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Based on reanalysis of assimilation data derived from HYCOM/NCODA model combination with analysis temporal variation of oceanography parameters from ocean colour data, disappearance or weakening of upwelling phenomena during El Nino period in South Vietnam Sea was found. Long term warming and upwelling influence play important roles in formation, weakening or disappearance of surface cold tongue (typical for upwelling phenomena) in normal and post El Nino periods, respectively. Some denaturizing features of water masses in post El Nino period (in comparison with normal period) are found: 1) Cold water tongue and axis of dipole structure was shifted to northward. 2) Surface thermo-haline structure was not able to extend to eastward and offshore. 3) Thermal field was extended into deep layers and 4) Current structure in both surface and deeper layers was changed strongly. Clearly, these changes happened abruptly and strongly influence to ecological characteristics in upwelling water. The organisms living in this area is difficult to adapt timely for the rapid environmental changes, and reduction of bio-resource may occur.

An Analysis of Timing of Phase Changes in Chlorophyll Concentration in the East/Japan Sea

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Geographically heterogeneous linear and non-linear chlorophyll-a (CHL) trends in the East Sea/Japan Sea (EJS) region were analyzed based on the monthly mean Moderate Resolution Imaging Spectroradiometer (MODIS) CHL data from January 2003 to December 2012. The non-linear trends were derived from residuals of decomposed CHL time series using an ensemble empirical mode decomposition (EEMD). In order to understand the general spatial and temporal variability of the non-linear CHL trends, a complex empirical orthogonal function (CEOF) was employed. The first two CEOF modes show that while the upward CHL trend occurred in 2007 with 95.6% variance, the downward CHL trend occurred in 2009 with a 4.1% variance. Furthermore, the specific timing of phase changes in CHL was calculated based on upward or downward CHL non-linear trends based on six major regions of interests.

In order to examine the dominant forcing on phase changes in CHL, the Multivariate El Nino-Southern Oscillation (ENSO) Index (MEI) was used. We determined that the local turning patterns of CHL in the last ten years were closely related to changes in the ENSO events, which were also associated with changes in total fish catch amount off the east coast of the Korean Peninsula. These results also suggest that the short-term total catch of fish amount may be predictable based on the remotely sensed non-linear CHL observations.

Mapping potential eutrophic zones in the Northwest Pacific region

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The Northwest Pacific region, which includes parts of northeast China, Japan, Korea and southeast Russia, is one of the most densely populated areas of the world. Eutrophication is an emerging environmental problem in this region, 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. Although no international legislation has been passed in this region to address the problem, the Action Plan for the Protection, Management and Development of the Marine and Coastal Environment of the Northwest Pacific Region (NOWPAP) of the United Nations Environmental Program (UNEP) has been implemented by China, Japan, Korea and Russia since 1994.

Within the framework of NOWPAP, the Special Monitoring and Coastal Environment Assessment Regional Activity Centre (CEARAC) has developed "Procedures for assessment of eutrophication status including the evaluation of land-based sources of nutrients for the NOWPAP region" (NOWPAP Common Procedures). The NOWPAP Common Procedures include the screening procedure to detect symptoms eutrophication within the selected parameters; trend in Chemical Oxygen Demand (COD) or Total Organic Carbon(TOC), frequencies of red tide and hypoxia events and level and trend in satellite derived chlorophyll-a concentration (Chl-*a*). To prepare satellite Chl-*a* dataset, SeaWiFS and MODIS on board Aqua were combined to make a long-term time series data sets. Two different empirical in-water algorithms, NASA standard and a regionally developed one for turbid water, were applied in eastern part and western part of the Northwest Pacific region, respectively.

Mapping potential eutrophic zones in the Northwest Pacific region a web GIS system is being carried out and will be made available for the public.

Open Access Satellite Image Service (OASIS) of Taiwan

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Formosat-2 was officially decommissioned on 15 July 2016, after more than twelve years of operation (originally designed for a five-year mission). It's follow-on mission, Formosat-5, is scheduled to launch on October 2016 and switch to operational mode sometime in the first season of 2017. There is a significant gap of a reliable and stable satellite observation over Taiwan area, at least for the next few months. This paper presents the Open Access Satellite Image Service (OASIS) of Taiwan, which includes the data from GOCI, Himawari-8, Sentinel-2 and Landsat-8. To enable the users to browse the image of their regions of interest from all kinds of devices at any time, without tedious data downloading, decompressing and processing, all satellite images have been processed by various techniques of image processing, including pan-sharpening, geo-referencing, adaptive contrast enhancing, and superoverlaying. Based on the free and open map service powered by Openlayer 3, these browsable image tiles in the vicinity of Taiwan can be viewed from any platform with ordinary web browsers, such as Chrome, Internet Explorer, Firefox, Safari, etc. Two examples of landslide inventory and pathlines are given to demonstrate how these multi-sensor and multi-scale data can be integrated and converted to useful information.

Unusual high primary productivity in the Kuroshio surface water of the East China Sea

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The Yangtze River (Changjiang) discharge and the Kuroshio subsurface upwelling northeast of Taiwan are two main sources of nutrient supporting phytoplankton primary productivity (PP) in the East China Sea (ECS) (e.g., Chen et al., 1999). Kuroshio surface water is normally characterized by low nutrients and thereby low in phytoplankton biomass (Chl) and PP (e.g., Zhang et al., 2007). The PP in the nutrient-limited or oligotrophic area of the ECS (including Kuroshio surface water) shows less seasonality and is relatively stable at < 400 mgC m^{-2} d^{-1} (e.g., Gong et al., 2003).

A rare condition of high Chl and PP (> 1000 mgC m^{-2} d^{-1}) along the Kuroshio axis was however observed by ocean color observation in July 2010. Based on ocean color-based surface salinity data derived from colored dissolved organic matter absorption coefficient, Sasaki et al. (2014) reported that in July 2010, low surface salinity plume was transported further southeastward to reach the Kuroshio water in the ECS. The low surface salinity was then transported northeastward by the Kuroshio to reach the area south of Japan. They further mentioned that large extension of low surface salinity in July 2010 was attributed to high Changiang discharge.

Siswanto et al. (2008) mentioned that over the area in the ECS largely influenced by the Changjiang discharge, low surface salinity is strongly associated with high nutrients. The Kuroshio axis in July 2010 may thus contain not only low surface salinity, but also high nutrients from Changjiang discharge, the fact being the reason for high Chl and PP along the Kuroshio axis in July 2010. High Changjiang discharge in summer 2010 which was responsible for high supplies of freshwater and nutrients was likely associated with 2010 moderate La Niña event. This analysis mentions how climate change in the tropical region through the atmosphere-land-ocean interaction influences biogeochemical processes in the ECS.

Detection of red tide and non-red tide in Korean coastal waters using model, *in situ*, and satellite data

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Red tide have occurred and caused large damages to the fishery industry in the coastal waters of Korean peninsula since late 1980s. To effectively detect and monitor the spatial and temporal distributions of widespread red tides, *in situ* optical measurements and/or satellite remote sensing can be used. In this study, we investigated the possibility of optically discriminating red tide focusing on *Cochlodinium polykrikoides*, the major harmful algal bloom (HAB) causative dinoflagellate species in Korean waters. We produced a large dataset of simulated remote sensing reflectance (R_{rs}) spectra in a wide range of bio-optical conditions using Hydrolight software and bio-optical data provided by the International Ocean-Color Coordinating Group (IOCCG). We estimated the apparent optical properties (AOPs) from the inherent optical properties (IOPs) of *C. polykrikoides* blooms based on forward calculation to use the optical characteristics for discriminating *C. polykrikoides* blooms from non-red tides. The characteristics of phytoplankton coefficient are translated in to a depressed R_{rs} in the blue-green region for *C. polykrikoides*, while no similar depression was observed for non-red tides. The two R_{rs} band ratios (R_1: $R_{rs}(555)/R_{rs}(531)$, R_2: $R_{rs}(488)/R_{rs}(443)$) were determined to be most effective for detecting high-density *C. polykrikoides* blooms. Even under optically complex water conditions, the distribution of *C. polykrikoides* blooms in the space of R_1-R_2 was separated clearly from that of non-red tides. The results were consistent with *in situ* observations and seem applicable to diverse coastal environments. We also applied to two R_{rs} band ratios approach to ocean color data. Our findings provide theoretical and quantitative criteria upon which in-water HAB detecting algorithms can be developed.

Surface chlorophyll-a bloom in the southeastern tropical Indian Ocean during various types of the Indian Ocean Dipole

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Thirteen years remotely sensed surface chlorophyll-a data obtained by the Moderate Resolution Imaging Spectroradiometer (MODIS) are used to evaluate interannual surface chlorophyll-a bloom in the southeastern torpical Indian Ocean (SETIO). The analysis is based on the occurrence of positive and negative Indian Ocean Dipole (IOD) events. During the period of analysis (January 2003 – December 2015), there were 7 (seven) positive and 1 (one) negative IOD events. It is found that the spatial patterns of surface chlorophyll-a bloom closely related to the pattern of sea surface temperature anomaly (SSTA), surface wind anomaly and mixed layer depth (MLD) anomaly. Each IOD event shows typical SSTA, surface winds and MLD evolutions that influences the spatial patterns of surface chlorophyll-a bloom. In addition, the intensity and time of occurrence of surface chloropyhll-a blooms is following the evolution of the IOD events. Detailed analysis on the spatio-temporal evolution of surface chlorophyll-a and other oceanic parameters will be discussed.

Estimation of Phytoplankton Community in Ise Bay by Multiple Excitation Fluorometer

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It is known that phytoplankton community structure is very important for food chain and material flow in ecosystem. Recently multiple excitation fluorometer was developed and used in mostly freshwater environment; however it is still not popular in marine environment. Here we verified the phytoplankton community estimated by a multiple excitation fluorometer, Multi-Exciter (JFE Advantec), by HPLC/CHEMTAX data in Ise Bay. It clearly showed the discrepancy of the estimate, and this is probably because the original calibration data of the fluometer based on several cultured phytoplankton species is not suitable for the Ise Bay. We developed a statistical new method of calibration of the multiple excitation flurometer with in situ HPLC/CHEMTAX data. The new method is essentially interpolation of the HPLC/CHEMTAX data with the florescence data. We found sporadic appearance of high abundance of small cyanobacteria in the diatom dominated eutrophic Ise Bay.

Neural network algorithms for detecting *Cochlodinium polykrikoides* blooms

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This study is to develop detection algorithms for the 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 bio-optical conditions are highly variable spatially and temporally. In a previous study, we have shown that remote sensing reflectance of *Cochlodinium polykrikoides* exhibit a distinctive depression in the blue-green wavelength band (Kim et al., *in press* Optics Express) based on a large data set of remote sensing reflectance simulated using HydroLight and IOCCG data. We also showed that *Cochlodinium polykrikoides* can be clearly separated from unspecified phytoplankton assemblages in the two waveband ratio space (Rrs(555)/Rrs(531), Rrs(488)/Rrs(443)). Based on this, we are developing probabilistic neural network algorithms for in-water and satellite applications. Our preliminary test using simulated and satellite data shows that the success rate of the in-water algorithm ranges from 71.6% (chl-a > 5 mg m^{-3}) to 89.8% (chl-a > 30 mg m^{-3}). The success rate of satellite algorithms are comparable.

Satellite optical characteristics of Green *Noctiluca* bloom in the upper Gulf of Thailand

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The dinoflagellate *Noctiluca scintillans* in the upper Gulf of Thailand (uGoT), called Green *Noctiluca*, contains a photosynthetic symbiont *Pedinomonas noctiluca*e and its bloom discolors seawater to be green. This characteristic is significantly different from other red tide species in this area such as *Ceratium furca* and *Cheatoceros* spp. which their red tides usually become red and brown, respectively. The study is focused on using satellite reflectance (R_{rs}) to reveal the specific spectral characteristics of each bloom and examine for the distinction of each red tide species. The chlorophyll-a concentration was considered to reduce its effect on the characteristic of R_{rs} spectrum. The primary results based on MODIS data showed the satellite spectrum of green *Noctiluca* in the uGoT peaks between R_{rs} 531 and 547, unlike *C. furca* which peaks between R_{rs} 531 and 555 and the R_{rs} value is relatively low. The results will be used for further studies on using satellite sensor to distinguish species of red tide in the uGoT.

Optical characterization of red tide in the presence of suspended material loadings

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In Korean, a red tide bloom usually started in the coastal area (mostly in the southern coast) and spread out along the coastal area while causing critical damage in the aquaculture farms. Remote quantification of red tide concentrations using above-water radiometric measurements is important for synaptic identification of red tide distribution. Red tide signals emerging from the ocean are, however, impacted by other optically active water constituents such as suspended sediments, and complicating quantification of red tide.

This study characterizes inherence optical properties (IOP's) of red tide waters in the presence of moderate to high loadings of suspended materials, to better explain the water-leaving radiance emerging from the ocean waters. Vertical profiles of ACS and Hydroscat are first used to characterize the IOP's of the red tide waters, and radiometric fields in the water are analyzed with the Profiler (in-water radiometer) data by depth. In the resultant measurements, the effect of suspended sediments is quantified to better relate the remote sensing reflectance to the red tide concentrations.

Various red tide algorithms are tested to the in-situ radiometric measurements and the effect of suspended sediments are quantified. A modified quantification is proposed in the study that better quantifies the red tide in terms of chlorophyll-a concentrations.

Optical properties of particulate matter measured in the Bangpakong river estuary and development of a new shipborne aureolemeter

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1. Optical properties of particulate matter measured in Bangpakong river estuary

The optical property of inorganic particulate matter (IPM) was evaluated using an optical model in highly turbid coastal water, whose IPM concentration reached several hundred grams per cubic meter. The measurements were conducted in the Bangpakong river estuary. The backscattering coefficient of the IPM was calculated using the Lorenz–Mie scattering theory. On the basis of the measurement, the IPM size distribution was parameterised as a function of its concentration. The result shows a non-linear relationship between the backscattering coefficient of the IPM and its concentration in highly turbid water.

2. Development of a new shipborne aureolemeter

A new shipborne aureolemeter was developed to improve the sun-tracking performance for accurate measurements of not only direct but circumsolar radiation, even on a rolling and pitching vessel. Sun position is determined by a real-time image processing system with a CMOS camera. A round shape is extracted from the captured image. The centroid position of the round shape is used as the sun position. The radiometer can track the sun under a feedback control with the derived sun position. For a sky radiance distribution measurement, the control target position on the camera image is shifted a pixel corresponding to a measuring scattering angle. In the case of a scattering angle larger than 7°, the radiometer's tracking is conducted under feedforward control on the basis of the roll and pitch angles monitored with a gyroscope. The full performance of the newly developed aureolemeter is checked.

Observations of submesoscale surface Chlorophyll concentrations off the east coast of Korea

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The temporal and spatial variability of submesoscale surface Chlorophyll concentrations off the east coast of Korea for a period of recent four years (2012 to 2015) is investigated with remotely-sensed concurrent observations of geostrophic currents, submesoscale surface currents, and sea surface temperature. As an initial data quality assurance and quality control prior to scientific research, the data flags are applied, and the probability density function of log-scaled Chlorophyll concentrations under a given flag exhibits Gaussian statistics, which can justify our data analysis. The seasonal blooms and their difference near-shore and offshore are presented in a context of mesoscale and submesoscale variability. The wavenumber energy spectra of Chlorophyll concentrations decay with a slope of k^{-1} at the scales longer than 5 km and slopes of k^{-2} and k^{-3} at the scales shorter than 5 km. Moreover, seasonal stratification have nearly negligible influence on the decay slope of the wavenumber spectra of passive tracers.

VIIRS-derived Chlorophyll-a using Ocean Color Index Method

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An implementation approach using the ocean color index (OCI)-based chlorophyll-a (Chl-a) algorithm for the Visible Infrared Imaging Radiometer Suite (VIIRS) on the Suomi National Polar-orbiting Partnership (SNPP) has been developed. The OCI Chl-a algorithm for satellite-derived Chl-a data was originally developed by Hu et al. (2012) for the Moderate Resolution Imaging Spectroradiometer (MODIS). It uses two Chl-a algorithms, i.e., the color index (CI)-based (reflectance difference-based) algorithm for oligotrophic waters and the usual ocean chlorophyll-type (OCx)-based (reflectance ratio-based) algorithm (e.g., OC3M for MODIS and OC3V for VIIRS), and merges the two algorithms for different Chl-a range applications (named OCI algorithm). In this study, we use the in situ Marine Optical Buoy (MOBY) optics data to demonstrate conclusively that using the CI-based Chl-a algorithm can significantly improve VIIRS Chl-a data over oligotrophic waters with much reduced data noise from instrument calibration and the imperfect atmospheric correction. Using the VIIRS-measured global Chl-a data derived from the Multi-Sensor Level-1 to Level-2 (MSL12) ocean color data processing system, we have developed the CI-based algorithm specifically for VIIRS, and further improved the two Chl-a algorithms merging method using the bluegreen reflectance ratio values. Extensive evaluation results show that the new OCI Chl-a algorithm for VIIRS can produce consistent Chl-a data compared with those from the OC3V algorithm. In particular, the data transition between the CI-based and OC3V-based Chl-a algorithm is quite smooth, and there are no obvious discontinuities in VIIRS-derived Chl-a data. The new OCI-based Chl-a algorithm has been implemented in MSL12 for routine production of VIIRS global Chl-a data.

ABSTRACT

Poster session

Interannual variations of phytoplankton communities in response to nutrient supply from different water masses in summer East China Sea

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Phytoplankton distributions in the central East China Sea (ECS) are complicated and highly variable influenced by the high nitrogen low salinity Changjiang Diluted Water (CDW) and high temperature saline Kuroshio Water (KW), which pass in the eastern and southern side, respectively. Surface phytoplankton compositions in different water masses were observed during our study periods in July, 2009-2011 and 2013 as: cyanobacteria as well as prochlorophytes dominated in KW, prymnesiophytes widely spread in coastal mixed water. Corresponding to excess nitrate (ExcN) condition in CDW, diatoms and dinoflagellates dominated in 2009 and 2013, whereas cyanobacteria and cryptophytes increased in 2010 and 2011. The low ExcN resulted from high phosphate concentration may be contributed to the high diatoms and dinoflagellates biomass in 2009 and 2013. Cluster analysis identified the geographical position that showed similar phytoplankton composition and water property; clusters mainly composed by diatoms and cyanobacteria, existed in the northern ECS and KW region where high phosphate concentration and high temperature was observed, respectively. It is expected that the potential upwelling may occurred in the high phosphate areas, and that the source of nutrients may be the cause of the dominance of different phytoplankton groups.

Mechanism for Chl a variability after the passage of typhoons in East China Sea in 2012 by GOCI and JCOPE2

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Every year, many typhoons pass in East China Sea (ECS) in summer. It is suggested that passage of typhoons can induce ocean mixing and upwelling, which bring nutrient rich deep water to the surface layer and enhance increase phytoplankton biomass. In June 2010, GOCI (Geostationary Ocean Color Imager) was launched by Korean Institute of Ocean Sciences and Technology. It acquires hourly intervals up to 8 times during daytime with a spatial resolution of 500 m. Therefore, the short-term variability of Chlorophyll a (Chl a) and total suspended sediment (TSS) can be observed by GOCI in ECS.

In January 2015, the latest GDPS (GOCI Data Processing System, ver. 1.3) was released and some new functions were added to it. Moreover, accuracy of Chl a is expected to be better than ver. 1.2. In this study, the accuracy of GDPS ver. 1.3 was evaluated by using in-situ data set for 5 years in ECS. When OC2v2 algorithm was used to evaluate the accuracy, the correlation between in-situ Chl a and satellite Chl a in the OC2v2 algorithm was almost same as the result obtained by ver. 1.2. The correlation in the YOC algorithm was also much better than ver. 1.2; however, it is notice that the GDPS ver. 1.3 YOC was not switching algorithm and applied even non-turbid water. We decided to calculate Chl a by switching of OC2v2 and YOC with Rrs555.

By using the ocean color data, we could observe the changes of Chl a and TSS induced by typhoon DAMREY and TEMBIN-BOLAVEN in 2012 in ECS. As a result, it was observed that Chl a decreased on coastal area along China and increased offshore area. In our further study, we will examine the distribution of water mass and the flow field by reanalysis data of JCOPE2 (Japan Coastal Ocean Predictability Experiment 2), and report the cause of the variability of Chl a and TSS induced by typhoon DAMREY and TEMBIN-BOLAVEN.

Current status of the primary production in the East/Japan Sea

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The East/Japan Sea (hereafter, the East Sea) is located in the northwest region of the Pacific Ocean. There are recently dynamic changes in its physical structure, biological characteristics and vertical distribution of chemical properties. Especially, the sea surface temperature of winter and spring has been steadily increased in the southern region of the East Sea since 1980s and extreme changes in vertical distribution of chemical properties occurred in the East Sea during the last 50-60 years, indicating a shift in the ventilation system. However, the knowledge of temporal/spatial variations in the primary production as a basic food source is very limited to date.

The current trend of primary production in the East Sea was analyzed based on the MODIS-derived monthly values from the 2003-2012 period to detect the current status. The mean daily primary productivity was 719.7 mg C m^{-2} d^{-1} (S.D. ± 197.5 mg C m^{-2} d^{-1}) and 632.3 mg C m^{-2} d^{-1} (S.D. ± 235.1 mg C m^{-2} d^{-1}) for the southern and northern regions of the East Sea, respectively. In the Ulleung Basin which is an important biological "hot spot" in the East Sea, the mean daily primary productivity was 766.8 mg C m^{-2} d^{-1} (S.D. ± 196.7 mg C m^{-2} d^{-1}, n=120). Based on the daily productivities, the overall annual primary production in the East Sea was 246.8 g C m^{-2} y^{-1} whereas the annual primary production in the Ulleung Basin was 280.2 g C m^{-2} y^{-1}. These results are substantially higher than the estimates previously reported in deep oceans. However, a decreasing trend in the annual primary production was observed in the East Sea within the study period. Further intensive interdisciplinary field studies are needed to better understand the declining trend of annual primary production and the subsequent effects on the marine ecosystem in the East Sea.

Spatio-temporal variability in sea surface temperatures for the Yellow Sea based on MODIS dataset

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The spatio-temporal variabilities in sea surface temperature (SST) were analyzed using a time series of MODIS datasets for the Yellow Sea (YS). The space variant temporal anomaly was further decomposed using an empirical orthogonal function (EOF) for estimating spatially distributed SST. The monthly SSTs showed similar temporal patterns in each region, which ranged from 2.4°C to 28.4°C in the study years 2011 to 2013, with seasonal cycles being stronger at the higher latitudes (Region 1) and weaker at the lower latitudes (Region 4). The coefficients of variation in the four regions all exhibited opposite seasonal cycles as compared with those of the SST variations, which had higher values from January to March and lower values from July to October. Spatially, there were no significant differences among the four regions ($p < 0.05$) in any year. However, the geographical distribution of SST was characterized by an obviously gradient whereby SST decreased along a south to north axis in the YS. The maximum monthly thermal difference between Region 1 and Region 4 was 2.0°C and 6.1°C in summer and winter, respectively. The EOF1 mode accounted for 56% of the total spatial variance and revealed the changes in solar shortwave radiation energy and air temperature occurring at the sea surface with changes in latitude. The EOF2 mode accounted for 8% of the total variance and indicated the warm current features in the YS. The EOF3 mode accounted for 6% of the total variance and indicated the topographical features, and presented similar distributions to those of the SST climatology patterns. This study suggests that EOF is a promising method that could be used for detecting the spatial and temporal variability of ocean parameters.

Development of Sulfur Estimation Model for Monitoring of Blue Tides by COMS/GOCI in a Semi-Enclosed Water Area

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Blue tides occur every year in Tokyo Bay, a representative semi-enclosed water area in Japan, due to significant eutrophication. The occurrences of blue tide are recognized as an important environmental problem because these often cause mass mortality and damage to fisheries. Therefore, it is important to monitor blue tides but it is difficult to observe temporal variation of blue tide spatial distributions using field observations with ship or installed monitoring system with water quality sensors at several points in the bay. Although satellite remote sensing technique for the monitoring of blue tide distributions have been considered effective, it was difficult to implement because spatial resolution and observation frequency of satellites have been not good enough. Hence, with stationary ocean color satellite COMS/GOCI, which was launched in 2010, satellite remote sensing technique is expected as a new monitoring method for blue tides because it became possible to capture blue tide distributions in high resolution and high observation frequency.

In this study, estimation model of sulfur concentration was developed based on the observation results of optical properties of blue tides. In addition, accuracy verification of the developed model was conducted through a synchronous observation using a ship and GOCI satellite.

We conducted field observations when a huge blue tide occurred on August 24th, 2015 and no blue tide on September 1th, 2016. In the observations, remote sensing reflectance (R_{rs}) was derived from the measured upward radiance and downward irradiance. Water samples were also collected on the blue tide area during the satellite acquisition time (11 samples in August 2015 and 5 samples in September 2016)

Based on relationships between the derived R_{rs} and the measured sulfur concentrations, optimal wavelengths of the R_{rs} was searched for high accuracy estimation of the sulfur concentration. As a result, it was found that R_{rs} at 660nm and R_{rs} at 680nm were suitable to retrieve the sulfur concentration. These reflectance might be able to capture the light scattering of sulfur colloid particles clearly because light absorption effect of CDOM and detritus is small at these wavelengths.

Furthermore, the developed sulfur estimation model based on the observed data was applied to a GOCI image to evaluate the estimation accuracy. As a result, the model was also capable of estimating the sulfur concentration with high accuracy. Hence, it would be available to monitor the blue tides distributions in

terms of the sulfur concentrations.

Estimating Absorption Coefficients of CDOM using Correction Method for the Atmospheric Correction Error of COMS/GOCI in Tokyo Bay

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Tokyo Bay is a highly eutrophication water area in Japan. Therefore, environmental monitoring is required for the water environment management. In the water qualities monitoring, salinity is one of the important parameter. Hence, satellite remote sensing is expected for a useful monitoring technique of the salinity because it would be valid to monitor the surface salinity distributions temporally and spatially estimating absorption coefficient at 440nm of CDOM (a_{CDOM}) using high correlation with the salinity and the a_{CDOM} from satellites. However, calculation errors of atmospheric correction occur in remote sensing reflectance (R_{rs}) at the short wavelength of COMS/GOCI images, which is used as a_{CDOM} estimation models. Thus, the estimation error of the a_{CDOM} should be large with occurrences of the atmospheric correction error.

In this study, a correction method for the atmospheric correction error of R_{rs} at 412nm was developed to estimate a_{CDOM} using COMS/GOCI with high accuracy.

We conducted field observations at four stations from 2011 to 2016 in Tokyo Bay. In the observations, R_{rs} was derived from the measured upward radiance and downward irradiance and surface water samples were also collected to measure the a_{CDOM}. As a result, the relationship between the a_{CDOM} and the salinity show R^2=0.62. In addition, it has a roughly relationship between the observed a_{CDOM} and the derived $R_{rs}(412)/R_{rs}(680)$. (R^2 = 0.4607)

After applying the a_{CDOM} estimation model to COMS/COCI images, the estimation error was large because $R_{rs}(412)$ is overestimated or underestimated by the effect of the atmospheric correction error. Therefore, one point of the a_{CDOM} was estimated from the observed salinity of a monitoring post in the bay based on regression equation of the a_{CDOM} and the salinity. By assuming the $R_{rs}(680)$ of the atmospheric correction error are small, the $R_{rs}(412)$ was estimated from the $R_{rs}(680)$ and the estimated a_{CDOM} using the a_{CDOM} estimation model. In order to extract minus value of the $R_{rs}(412)$, the difference between the minimum value of the $R_{rs}(412)$ in the bay and zero was derived and added it to all bands of the GOCI images. As a result, spatial distributions of a_{CDOM} could be estimated by the method with high accuracy.

Ongoing research on an optical characterization of the Particulate Organic Carbon (POC) by using in-situ measurements

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Environmentally the earth has been affected by carbon which causes global warming. Global warming is an international issue and tasks for a human being and consistently we make an effort to reduce the carbon dioxide for all over the world. Particulate Organic Carbon (POC) which is one of the primary components of the ocean is a significant key for carbon cycling. POC settle from the upper layer to the deeper ocean, absorbing carbon dioxide from the atmosphere by biological process. Therefore, we need to understand how carbon dioxide is consumed and recycled by POC in the ocean.

In this study, we carry out fundamental research on POC and at the same time we survey several studies of POC distribution at regional and global scales in the ocean. In addition, we not only estimate POC concentration surrounding Korea peninsula but also seek to understand the optical characteristics such as absorption, attenuation and backscattering coefficient of the POC based on a literature review and in-situ measurements.

Remote sensing of Sargassum using an anomaly detection technique in the Yellow Sea with GOCI data

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A large amount of the Sargassum horneri (*S.horneri*) came to the Yellow Sea in 2015. This resulted in a scarcity of oxygen in the ocean, which in turn caused the deaths of many fish and other marine organisms. Not only did the arrival of the *S.horneri* caused harm to the inhabitants but it was also responsible for the insufferable stench. Since the *S.horneri* is a nuisance to deal with, it is crucial to detect it before it inflicts more damage.

This study presents the results of *S.horneri* detection using Geostationary Ocean Color Imager (GOCI) data during the period between January and June in 2015. GOCI data are one of the best tools for detecting the *S.horneri* because it collects data 8 times per day. The data can also be used to observe the temporal variations of the *S.horneri* distribution in the ocean frequently.

We first used normalized difference vegetation index (NDVI) using 660nm and 745nm of GOCI to detect all floating vegetation algae. With NDVI only, however, *S.horneri* detection is challenging in turbid waters because NDVI is elevated by the high NIR signals due to mineral particles in turbid waters. So, in the next step, we employed an anomaly detection technique to increase the detection rate of *S.horneri* both in clear and turbid waters. Finally, we tried to differentiate between *S.horneri* and other floating algae and estimated its coverage within a pixel.

Estimation of potential fishing zone for Chub Mackerel (Scomber Japonicus) using remote sensing data

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Chub mackerel(Scomber Japonicus) is closely related to the marine environmental factors like Sea Surface temperature and chlorophyll-a concentration. Chub mackerel is important fishing target in Yellow Sea, East China Sea, and Straits of Korea for Korean Purse seine fishery. This study exploit fishery data from Korea purse seine fisheries cooperative union for Chub mackerel during 2010 to 2014 and environmental factors including sea surface temperature(SST), sea surface chlorophyll-a concentration (Chl-a), and sea surface height(SSH) to estimate potential fishing zone for Chub mackerel. The CPUE of estimated fishing zone is higher when compared to non-potential fishing zone.

Preliminary remote sensing observation of sea surface temperature increase during *Ulva prolifera* blooms

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A massive bloom of green macroalgae Ulva prolifera occurred in June of 2008 in the Yellow Sea (YS), resulting in perhaps the largest “green tide” event in history. The covered area is about 1200 km2 and impacted area reached 40,000 km2 on 31th May. It also occurred in the followed two years, 2009 and 2010. We analyzed the satellite data from MODIS, the results showed that sea surface temperature (SST) increase 1-30C in Ulva prolifer blooms location. The macroalgae in the water maybe increase the sea surface temperature. Rapid increases of Ulva prolifera biomass during the blooms may increase radiation absorption of water, and thus enhances the rate of heating at the sea surface. The present study represents a preliminary observation, which is an important step for understanding influences of macroalgal on ocean surface condition.

The Value of Coral Reefs in PANGKEP Regency, Indonesia, Estimated by In-situ and Multi-Temporal LANDSAT Imagery Data

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This study aimed to quantify the economic value and loss of coral reefs using Landsat data and in-situ measurement data. Landsat data used were multi-temporal Landsat imagery data (1994, 2002 and 2014), which data processing included image processing, water column correction, classification, accuracy test, and post classification. While the in-situ data were coral reef condition which were obtained using method of point intercept transect and classification guidelines by Gomez and Yap (1988). On the other hand, in-situ data included social survey data, which were analyzed using economic valuation methods such as effect on production, travel costs, benefits transfer, replacement cost and willingness to pay. Economic losses were calculated from the present value of the coral reef benefits and the total area of coral reef degradation by adjusting the rate of inflation and discount factor.

Based on the analysis of multi-temporal Landsat imagery data over the last 20 years, it was concluded that live coral cover area reduced from 7,716 ha in 1994 to 4,236 ha in 2014 or 174 ha/year degradation rate. Analysis of coral reef condition showed that the coral reef belonged to the category of "poor" with an average of 24% of the live coral cover. Total economic value of coral reefs in the PANGKEP Regency in 2014 was calculated to be USD 11.96 billion or USD 2.83 million/ ha, while total economic loss of coral reefs due to degradation from 1994 to 2014 was USD 1 billion or USD 50.18 million/ year.

This study suggests that the loss of economic value will continuously increase in the future if the destructive fishing is still practiced and in this case, management programs need to be established to protect the coral reefs.

Applications artificial neural network to Chl-a, TSS and CDOM assessment in the upper Gulf of Thailand

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In this study, the artificial neural network (ANN) was applied to extract data of the Chl-a, TSS and CDOM concentration over the Upper Gulf of Thailand (UGoT) from the satellite-based daily MODIS imagery. To achieve this task, the applied ANN model was primarily trained using the actual data of Chl-a, TSS and CDOM gained during cruise surveys over the UGoT area in years 2003 and 2004 in connection with the concurrent MODIS reflectance data at 10 spectral bands. The attained knowledge from the training session was then applied for the extraction of each referred constituent's concentration over the area from the examined MODIS reflectance data at some dates and results were reported as thematic maps. It was found that the applied ANN model gave satisfactory prediction of the concentration outcome for each studied constituent with correlation level (R) of the ANN generated data and the in situ data counterpart of 0.75 (for Ch-a), 0.85 (for TSS) and 0.88 (for CDOM), respectively, with relatively low apparent errors. And also, MODIS blue bands were seen in the training process to be the most influential factor in the effective application of the stated ANN model for all the listed constituents under evaluation.

Application of Geostationary Ocean Color Imager (GOCI) Data for Flood Induced Debris Trace

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In the September 2016, piles of empty cans and destructed debris were found on the beaches of east coast of the Republic of Korea. Many articles reported that they might have come from the Tumen River Flood in the DPRK induced by the Typhoon Lionrock in late August that year. Actually the authority reported that the big flood swept buildings, farmlands and so on carrying them to the sea. Their debris might have been moved toward the South by the winds and coastal currents.

This study tried to manifest the applicability of GOCI data to identify the patches of the floating debris and to trace their movement on the surface of the sea down to the coast of the Republic of Korea. The study tried to confirm the results of the numerical ocean model, the Hybrid Coordinate Ocean Model, using also the Landsat-8's near-infrared (NIR) data.

The results of the study confirmed that the source of the ocean debris was really the Tumen River Flood in the DPRK and that it takes about 20 days for the debris to reach to the 38th north parallel, which verify moreover the results of the numerical model. It is believed that the GOCI's Total Suspended Sediment Algorithm would be very useful for identifying and tracing patches of floating matters on the sea surface. The results of the study manifest indeed that GOCI data is quite useful for tracing the flood induced debris' movements on the surface of the sea.

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