

## NOWPAP–PICES Joint Training Course on “Remote Sensing Data Analysis”

by Genki Terauchi and Young-Je Park

From October 21–25, 2013, the joint training course on “Remote sensing data analysis” was held at the Ocean University of China (OUC), Qingdao, China, by the Special Monitoring and Coastal Environmental Assessment Regional Activity Centre (CEARAC) of the Northwest Pacific Action Plan (NOWPAP) and the North Pacific Marine Science Organization (PICES), supported by the International Ocean Colour Coordinating Group (IOCCG), the China National Environmental Monitoring Center (CNEMC), as well as OUC. The goal of the training course was to provide postgraduate students, young professional researchers and coastal managers (including local government officials) in the Northwest Pacific Region and its adjacent area with opportunities to obtain useful skills and knowledge of remote sensing techniques and its application in marine environmental research.

This training course series started in 2007 as part of the capacity building activity of CEARAC, and since has been organized in one of the NOWPAP member states (Japan in 2007, Korea in 2008 and Russia in 2011). Through the help of CEARAC Focal Points in China, the fourth training course took place at OUC. The CEARAC Secretariat, along with the members of the Organizing Committee, Dr. Young-Je Park (Korea Institute of Ocean Science and Technology, Korea; representing PICES), Dr. Roland Doerffer (GKSS Research Center, Germany; representing IOCCG), Ms. Lihuan He (CNEMC, China), Dr. Ling Sun (Meteorological Administration, China; representing NOWPAP WG 4) and Dr. Chaofang Zhao (OUC, China) prepared the course program and selected 23 trainees from 75 applicants from the NOWPAP member states, other Asian countries, Canada, Africa, Europe and the Middle East. The sponsoring organizations covered the costs of the course, so the training was provided free of charge. Also, 5 trainees were chosen for financial support so their transportation and accommodation expenses were paid.

After welcome addresses by Ms. Lihuan He (Director, Ecological Monitoring Department, CNEMC) and Dr. Xuefen Chen (Deputy Director, International Cooperation and Exchange Office, OUC), Dr. Doerffer initiated the first day with an introduction to satellite oceanography and recent progress in ocean color remote sensing. His short film, “*The science of ocean color*”, helped the trainees to better understand the lecture, including issues of uncertainties of ocean remote sensing. Then, Dr. Zhihua Mao (Second Institute of Oceanography, China) introduced on-going and future ocean observation satellite missions in China, new algorithms for atmospheric correction, and remote sensing applications such as red tide monitoring. At the end of the day, Dr. Mati Kahru (Scripps Institution of Oceanography,

UCSD, USA) gave a lecture on WIM software and its challenges to utilize NASA ocean color data sets, and Dr. Doerffer introduced BEAM software and MERIS ocean color data sets.

The second day started with a lecture by Dr. Young-Je Park who introduced applications of ocean color remote sensing data, including oceanographic and operational uses, and gave an overview on the spatio-temporal variability of the bio-optical properties in the Northwest Pacific based on decade-long satellite observations. He then described the Korean Geostationary Ocean Color Mission, GOCI and GOCI-II, including its applications, data distribution and software, and encouraged the use of GOCI for marine environment monitoring to take advantage of its hourly observations. In the afternoon, Dr. Kahru gave the trainees opportunity to learn time series analysis of satellite data with WIM software. Sea ice data sets provided by NASA were chosen as an example, and the participants studied how to detect long-term changes of sea ice distribution in the Arctic. They then learned how to detect changes in time series of ocean color data obtained from the NASA ocean color webpage.



Photo 1 Dr. Joji Ishizaka lecturing on the third day of the training course.

Dr. Joji Ishizaka (Hydrospheric Atmospheric Research Center, Nagoya University, Japan) started the third day with a lecture on primary production (Photo 1). A brief explanation on primary production was given and evaluation of satellite-based ocean color models in coastal and pelagic region across the globe was presented. The trainees learned how to estimate primary production with ocean color satellite data. Dr. Ishizaka then introduced a chlorophyll-*a* estimation algorithm for turbid water produced under Yellow Sea Large Marine Ecosystem Regional Ocean Color Algorithm Development and discussed seasonal and interannual variations of chlorophyll-*a* concentration in the East China Sea and Yellow Sea and their possible linkages with eutrophication and other ecosystem changes such as macro algae blooms, occurrence of red tides and abundance

of giant jellyfish. Then, Dr. Kahru emphasized the importance of validating satellite-derived information and provided materials for hands-on exercises (Photo 2). The trainees learned how to validate satellite-derived chlorophyll-*a* with *in-situ* measured values using WIM software, and how to compare satellite derived chlorophyll-*a* values among different sensors for detecting long-term changes using a series of ocean color sensors.



Photo 2 Dr. Mati Kahru during hands on practice.

On Day 4, Dr. Leonid Mitnik (V.I. Il'ichev Pacific Oceanological Institute, FEB RAS, Vladivostok, Russia) gave a lecture on utilization of Landsat images for monitoring of the marine environment. He encouraged the use of Landsat images that have been available for more than 30 years since Landsat-1 was launched in 1972, and explained various uses of these images to detect oceanic phenomena such as sea surface currents, temperature, eddies, river plumes, algae blooms, and oil spills. Dr. Doerffer then introduced future Sentinel missions of the European Space Agency: Sentinel-2 for land applications and Sentinel-3 for ocean applications. An Ocean and Land Color Instrument (OLCI) will be onboard Sentinel-3 as a follow-on sensor of the MERIS instrument on board Envisat, and it is expected that long-term changes of the marine environment will be monitored by OLCI. In the afternoon, he conducted a hands-on exercise on correction, verification and validation of MERIS data using sample data sets on BEAM software.

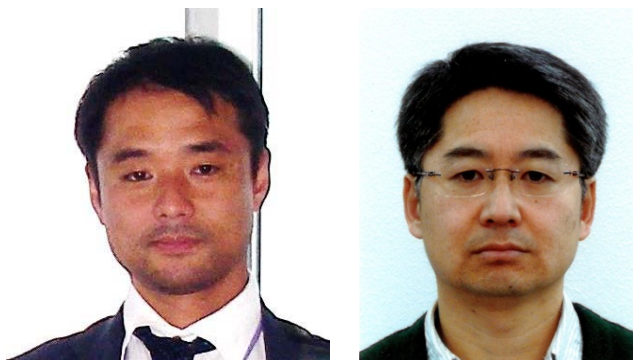
On the final day, two lectures on oil spill monitoring were given by Dr. Mitnik and Dr. Chaofang Zhao. Dr. Mitnik

reviewed theories of remote sensing of oil spills and sea slicks, and demonstrated satellite images on oil spills detected by synthetic aperture radar, optical sensors and laser fluorosensors. Dr. Zhao presented oil spill distribution maps of the Yellow Sea and East China Sea and introduced efforts to detect oil spills using remote sensing techniques and a Lidar system at the Ocean Remote Sensing Institute (OUC), showing fluorescence characteristics of different oil types. In the afternoon, all participants were given chances to ask the lecturers questions and to work by themselves to further follow the hands-on exercises conducted during the course. Dr. Fang Liu (Director of Marine Monitoring Department, CNEMC) then presented certificates to all trainees and congratulated them on their completion of the course. In the evening, all participants got to enjoy a farewell party hosted by CEARAC.

In the seven years since the first training course was held on remote sensing data analysis for marine environment conservation in the Northwest Pacific region, significant progress has been made in the field of satellite oceanography. Now, with more than a 15-year record of ocean color data of the global earth, we can detect mid-term changes in the marine environment. Furthermore, hourly observation of the sea surface has become possible with the success of the Korean GOCI mission that, for the first time in the history, carries an ocean color sensor on a geostationary satellite. The Northwest Pacific region is becoming the most active region in the field of satellite oceanography, and CEARAC continues to work in this field to develop tools for environmental planning and management.

This 5-day course provided all the trainees an opportunity not only to obtain and/or improve their knowledge on the marine environment and ocean remote sensing, but also to communicate and develop friendships and partnerships with people of the same interest.

Last, we would like to express our special thanks to Dr. Chaofang Zhao and his team for their tremendous efforts and help provided before and during the training course. With their warm hospitality, we all enjoyed the intensive 5 days in the beautiful marine city of Qingdao!



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Dr. Young-Je Park ([youngjepark@kiost.ac](mailto:youngjepark@kiost.ac)) is Director of the Korea Ocean Satellite Center (KOSC), Korea Institute of Ocean Science and Technology (KIOST), where he is leading the Geostationary Ocean Color (GOCI) Mission. His research area includes calibration and validation, algorithm development, applications of GOCI data.