

NOWPAP/PICES/WESTPAC Training Course on Remote Sensing Data Analysis

by Leonid Mitnik, Genki Terauchi and Vyacheslav Lobanov



A training course on “Remote sensing data analysis” was organized by the Special Monitoring and Coastal Environmental Assessment Regional Activity Centre (CEARAC) of the Northwest Pacific Action Plan (NOWPAP), co-sponsored by the North Pacific Marine Science Organization (PICES) and the Intergovernmental Oceanographic Commission’s Sub-Commission for the Western Pacific (WESTPAC), supported by the International Ocean Color Coordinating Group (IOCCG), and carried out by the V.I. Il’ichev Pacific Oceanological Institute (POI) of the Far Eastern Branch of the Russian Academy of Sciences (FEB RAS) and the Far Eastern Federal University (FEFU) from October 8–12, 2011, in Vladivostok, Russia.

The goal of the course was to provide an opportunity for students, early career scientists and coastal managers to obtain useful skills and knowledge on utilizing remote sensing data to monitor and assess the coastal and marine environment. This is especially timely and important for the Russian Far East, where huge investments have been recently put by the Russian government into the development of the region, including the establishment of FEFU, with a capacity of 50,000 students.

POI and the Institute of Automation and Control Processes (IACP) of FEB RAS have good experience in satellite data analysis for marine research. POI’s main focus is on

passive and active microwave sensing of the sea surface that allows retrieval of the oceanic and atmospheric parameters independently on sun illumination and cloudiness. The applications of microwave sensing include oil spill detection and monitoring as well as monitoring of severe marine weather conditions and sea ice. POI scientists emphasize the necessity of a multi-sensor approach to study various oceanic phenomena including harmful algal blooms. To do this they process and analyze Landsat visible and infrared images together with Envisat ASAR and ALOS PALSAR radar images that have a spatial resolution of several tenths meters. A regional monitoring center established at IACP provides operational data received from various satellites. POI and IACP specialists have also developed original algorithms for satellite data processing that are used for efficient monitoring of the Far Eastern Seas.

The training course was organized immediately prior to the 2011 PICES Annual Meeting held in Khabarovsk, the nearest major city to Vladivostok, to allow participants to attend the Meeting after the course was finished.

The CEARAC Secretariat, along with members of the Organizing Committee, Drs. Leonid Mitnik (POI, Russia; representing NOWPAP), Rafael Kudela (University of California Santa Cruz, U.S.A.; representing PICES) and

Teruhisa Komatsu (University of Tokyo, Japan; representing WESTPAC), prepared a course program and selected 22 trainees from 58 applicants. Participants from China, India, Indonesia, Japan, Korea, Russia and the Philippines were made up of postgraduate students, professional researchers and local government officers working in the field of marine sciences. The sponsoring organizations and FEFU were able to cover the costs of the course, so training was provided free of charge.

The course consisted of lectures and practical training, and included themes of satellite oceanography, global ocean observing systems, new satellites, software for data processing and new available products, problems of data analysis for remote sensing of ocean color, calibration and validation of satellite data, estimation of chlorophyll-*a* concentration and primary production, levels of eutrophication, red tides, estimation and monitoring of oil pollution, and mapping of marine habitats. As well as receiving theory through lectures, participants had the opportunity to practice with new software for satellite data analysis. Ten lecturers from China, Germany, Japan, Korea, Russia and the United States delivered lectures on remote sensing applications for monitoring and assessment of the marine and coastal environment in the Northwest Pacific Region.

Dr. Leonid Mitnik introduced the participants to satellite oceanography, focusing on the physical basis of remote sensing of the ocean and atmosphere in visual, infrared and microwave bands, recent advances in observing system capabilities and application of remote sensing data in marine sciences.

Lectures by Dr. Roland Doerffer (Helmholtz Center, Germany) were related to remote sensing of the coastal ocean, which is the most complicated aspect of ocean remote sensing. He explained the factors that influence the retrieval of chlorophyll-*a* and suspended matter concentrations in the water, and reviewed existing algorithms providing their assessment and conditions needed for their application. Then he discussed the problem of atmospheric correction and presented a new software, BEAM, designed

by Brockmann Consult (Germany) for MERIS (MEDIUM Resolution Imaging Spectrometer), and gave detailed instructions on how to use it for satellite data processing. This software can be downloaded free of charge from <http://www.brockmann-consult.de/cms/web/beam/>.

Dr. Vyacheslav Lobanov (POI, Russia) reviewed the current status of the Global Ocean Observing System (GOOS), its component in North East Asia (NEAR-GOOS), and various kinds of oceanographic data and products available through GOOS in real-time and delayed modes.

Presentations by Dr. Matti Kahru (Scripps Institution of Oceanography, U.S.A.) provided a detailed description of WIM software for processing, visualizing and verifying satellite data. The trainees were able to make practical use of the software on their computers, working on a few examples prepared by the lecturer. Dr. Kahru also discussed the problem of time series analysis and introduced a method to detect changes using ocean color and other satellite data, which is especially interesting for understanding climate change impacts on the global ocean.

Drs. Raphael Kudela and Joji Ishizaka (Nagoya University, Japan) talked about the estimation of primary production and level of eutrophication in marine and coastal waters using satellite remote sensing. They highlighted the basics of the primary production process, and reviewed current methods and problems of its quantitative estimation.

Dr. Yu-Hwan Ahn (Korea Ocean Research and Development Institute, Korea) introduced the potential of GOCI (Geostationary Ocean Color Imager), onboard the recently launched new Korean Communication, Ocean and Meteorological Satellite (COMS). He reported on the work being done on radiometric calibration and development of algorithms for data processing and the availability of a new source of ocean color data from geostationary satellites.

Dr. Teruhisa Komatsu presented an application of remote sensing to map marine habitats such as coral reefs, mangroves and marine algae, and to estimate their status



In the class (left photo) and during a coffee break (right photo).

and dynamics, which is especially important under current global changes and response of marine ecosystems.

Dr. Sung Ling (National Satellite Meteorological Center, China Meteorological Administration, China) introduced Chinese activities on radiometric calibration of satellite solar reflective bands. She considered an absolute onboard calibration and vicarious calibration based on *in-situ* measurements, invariant target tracking and inter-calibration for satellites without onboard calibration. She presented information about new sensors, in particular MERSI (ME^Dium Resolution Spectral Imager), which is a MODIS-like sensor with 20 bands covering a VNIR/SWIR/TIR spectral region onboard the second generation Chinese polar-orbit meteorological satellite, FengYun-3.

Dr. Natalia Evtushenko (ScanEx Center, Russia) presented lectures on the application of high resolution optical and radar satellite information to monitor the state of the marine coastal area, focusing on methods for detecting and estimating oil pollution. She also demonstrated software for satellite data analysis developed by ScanEx Center (Moscow), and 25 sets of the ScanMagic software were presented to the trainees.

A problem of oil pollution detection was also discussed in another lecture by Dr. Mitnik. He reported on the results of oil spill monitoring by POI over the northwestern Pacific based on SAR (Synthetic Aperture Radar) images of Envisat and ALOS satellites, in particular recent identification of oil leakages from a platform in the Bohai Sea, and

presented various examples of case studies collected at the special internet site <http://cearac.poi.dvo.ru>. Then he talked about the possibility of using widely optical sensor data observed by Landsat satellite for coastal zone monitoring. Although the information with high spatial resolution (30–60 m) used to be expensive in the past, it may be obtained free of charge at <http://landsat.usgs.gov/> or <http://earthexplorer.usgs.gov>. Dr. Mitnik also lectured on the problem of operational monitoring and estimation of parameters of tropical storms and typhoons such as wind speed, vapor and heat content and other parameters which could be done using a multisensory approach based on microwave and optical bands satellite data.

On the last day, the effectiveness of the training course was tested using practical assignments developed by Mr. Genki Terauchi of CEARAC. He gave two tasks to the class: (1) determine the variation of plankton bloom magnitude and (2) estimate its trends in the northwest Pacific during the period 1997–2011. All participants were requested to select satellite data from a region of their interest and to prepare time series data with WIM software for their individual presentations. The tasks were successfully fulfilled. At the closing of the course program, each trainee received a certificate from NOWPAP, PICES and WESTPAC.

After a farewell party, some of the participants took a train from Vladivostok to Khabarovsk to attend the 2011 PICES Annual Meeting, and enjoyed a night ride along the famous Trans-Siberian railroad.



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