HICO Data User's Proposal

Evaluating Water Quality Monitoring

Using HICO imagery several in the coastal zones of Vietnam

Principal investigator

Name: **Nguyen Ba Duy**

Address: **Department of Photogrammetry & Remote Sensing**

Faculty of Surveying & Mapping, Hanoi University of Mining and Geology

Dong Ngac, Tu Liem, Hanoi, Vietnam

Phone: +84-904485651

Email: nguyenbaduy@humg.edu.vn

Co-Investigator 1

Name: Tran Thi Huong Giang

Address: **Department of Cartography**

Faculty of Surveying & Mapping, Hanoi University of Mining and Geology

Dong Ngac, Tu Liem, Hanoi, Vietnam

Phone: +84-972192012

Email: tranthihuonggiang@humg.edu.vn

Co-Investigator 2

Name: To Trong Tu

Address: Remote Sensing Application Department, Space Technology Institute (STI),

Vietnam Academy of Science and Technology (VAST)

18 Hoang Quoc Viet st., Cau Giay dist., Hanoi , Vietnam

Phone: +84-437 562 895 or +84-988088555

Email: tttu83_mdc@yahoo.com or tttu83mdc@gmail.com

Abstract

Water quality is an important indicator of the health of an environmental system. Traditionally, water quality analysis has involved directly sampling areas in question. This method is difficult, if not impractical, to apply to large areas where data needs to be taken frequently. Remote sensing offers the possibility of covering a large spatial area with a high temporal frequency. It also provides a spatial distribution of the constituents which direct sampling cannot economically accomplish. Spatial distributions provide deeper insight into many of the hydrologic and biological processes that are directly affected by the concentrations of water constituents. The drawback of remote sensing data, however, is that these physical quantities must be derived with little or no physical sampling of the water. Fortunately, there are many indicators of water quality, one of which is the spectral character of the light leaving the water surface. This project attempts to monitor water quality through the use of radiative transfer models that simulate water optical properties for varying levels of constituents. These simulated signals are then matched against those observed by an airborne instrument. The thrust of this project is to determine the accuracy and sensitivity of the water quality extraction algorithms to key input parameters by comparing against ground truth. Details of the techniques will be presented along with an analysis of the errors.

The main objective of this study using HICO data is to establish a method for identifying diatoms or other phytoplankton groups in coastal waters because it is important to quantify the contribution of each phytoplankton functional group to marine biogeochemical cycles. The coastal zones of Vietnam are three of the most important aquaculture regions for scallop and kelps in Vietnam. It is well known that diatoms as well as harmful algae like din flagellate influence the cultured aquatic organisms in HaLong bay and ThaiLan bay, subsequently leading to fisheries marketing and human health concerns. One of the objectives in our ongoing project is to monitor and assess coastal waters in HaLong bay and ThaiLan bay for conservation and sustainable use of natural resources in aquatic biota and aquaculture. Therefore, ocean color remote sensing having a much greater spatial and spectral resolution, that is HICO, is a powerful tool for monitoring the spatial-temporal variability of optically complex coastal waters in aquatic ecosystems. Within this ongoing project, we would like to apply our method for identifying using light absorption coefficient of phytoplankton derived from hyperspectral remote sensing reflectance through the inversion method of quasi-analytical-algorithm to HICO data.

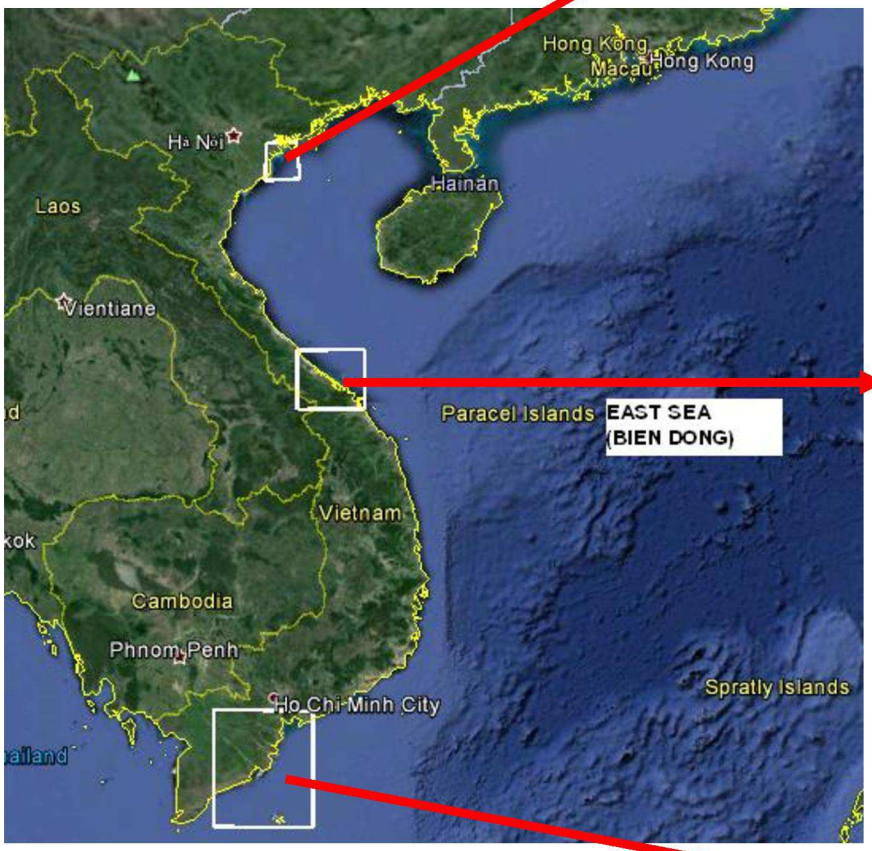
The data from HICO will be of great benefit for a wide range of assessment of environmental impacts in HaLong bay and ThaiLan bay. Our objective in this study will be achieved only when used in combination with the HICO product.

1. Statement of work/project description

These study areas, which is located in north-east, central-east and south-esat, Vietnam, and opened to East Sea (Bien Dong) (Fig.1), is one of the most important coastal regions for aquaculture in Vietnam, especially scallops and kelps. In coastal ecosystem, since phytoplankton plays a major role in not only aquatic carbon cycle but also aquaculture, it is essential to quantify the contribution of each phytoplankton functional group to marine biogeochemical cycles and their spatial and temporal variability. Recently, the hyperspectral approach is becoming more powerful tool for detecting specific phytoplankton species (Craig et al., 2006; Lubac et al., 2008; Mao et al., 2010) or bio-optical province (Taylor et al., 2011) and estimating phytoplankton pigments (Torrecilla et al., 2011). Our main objective in this study is to establish a method for identifying diatoms with hyperspectral approach in coastal waters. In order to achieve our goal, we have conducted in situ measurement and sampling for light absorption of particle, detritus, phytoplankton, and colored dissolved organic carbon (CDOM), phytoplankton pigments with HPLC, and hyperspectral remote sensing reflectance, Rrs(λ), in Funka bay (Fig. 1) from 2010 April to 2012 January. Based on the in situ data set, the algorithm for identifying diatoms using light absorption coefficient of phytoplankton derived from hyperspectral remote sensing reflectance through the inversion method of quasi-analytical-algorithm (Lee et al., 2004:2009) wasdeveloped. However, since the spectral resolution of MODIS is limited, our method was not applied to MODIS data. By contrast, HICO is the first spaceborne hyperspectral spectrometerdesigned to specifically sample the coastal ocean and has 88 spectral channels ranging from 400 to 900 nm with a ground sample distance of 90 m (Lucke et al., 2011). Therefore, HICO is only suitable tool for investigating coastal waters, which considerably changing the intensity and quality of light field. Through the use of HICO data, we would like to apply our method to the HICO hyper-spectral product in coastal regions of study, Japan. Our objective in this study will be achieved only when used in combination with the HICO product.

Our project focuses on monitoring and assessing coastal waters around coastal zones along Vietnam beach, leading to the key to support fisheries resources and to evaluate carrying capacity. Therefore, the use of HICO data is very important beneficial to the ongoing project in various ways. For example, currently, the most suitable sites-selection model based on satellite remote sensing (SeaWiFS and MODIS) and geographic information system (GIS) for cultures of Vietnamese scallop and kelp in East Sea. The HICO data will enhance the refinement of the models.

The region of specific interest for this study is bound by the following coordinates:



Northern Boundary 20°50'N
Southern Boundary 20°10'N
Western Boundary 106°25'E
Eastern Boundary 107°15E

Northern Boundary 17°00'N
Southern Boundary 15°55'N
Western Boundary 107°05'E
Eastern Boundary 108°20E

Northern Boundary 10°35'N
Southern Boundary 8°25'N
Western Boundary 105°30'E
Eastern Boundary 107°15'E

Figure 1: Map of sampling in this study. Red circles represent sampling sites

We would like to request the level 1 data and the standard level 1 and level 2 HICO products including chlorophyll, inherent optical properties, and hyperspectral image of ocean remote sensing after atmospheric correction by HICO team. Data from HICO will be used to calculate the following aims;

• To estimate light absorption coefficient of phytoplankton with such as quasi-analytical-algorithm (QAA, Lee et al., 2004; 2009)

• Derivative analysis of the Rrs-derived aph(λ) for calculating similarity index (Mille et al., 1997).

Available facilities

For processing data and imagery of HICO products, we have the latest versions of software as follows: ENVI / IDL (ITT VIS), Matlab (Mathworks) and SeaDAS (NASA).

3. Output and deliverables

It will be possible to compared in situ hyperspectral remote sensing reflectance using HyperProII with HICO data after atmospheric correction. Algorithm developed in this study and resulting processed imagery will be shared with the HICO project. We will attend the annual HICO team meeting to present and discuss our study results.

References

1. Bukata, R. P., Jerome, J. H., Kondratyev, K. Y., Pozdnyakov, D. V., Optical Properties and Remote Sensing ofInland and Coastal Waters, CRC Press, NewYork, 362 pp.,1995.

2. Cornette, W. M., and Shanks, J. G., "Physically reasonable analytic expression for the single-scattering phasefunction," Applied Optics, Vol. 31, No. 16, pp. 3152-3160, 1992.

3. Engman, E. T., and Gurney, R. J., Remote Sensing in Hydrology, Chapman and Hall, New York, 225 pp., 1991.

4. Fournier, G. R., and Forand, J. L., "Analytical phase function for ocean water," SPIE, Vol. 2258, Ocean OpticsXII, J. S. Jaffe, ed., pp. 194-201, 1994.

5. Haltrin, V. I., "Exact solution of the characteristic equation for transfer in the anisotropically scattering andabsorbing medium," Applied Optics, Vol. 27, No.3, pp. 599-602, 1988.

6.Haltrin, V. I., "An analytic Fournier-Forand scattering phase function as an alternative to the Henyey-Greenstein phase function in hydrologic optics," IEEE International Geoscience and Remote Sensing