Nguyen Quoc Long - Pham Thi Lan
Nguyen Viet Nghia - Khuong The Hung
Le Thi Thu Ha - La Phu Hien

Geo-spatial Technologies and Earth Resources (GTER 2017)

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Hanoi University of Mining and Geology (HUMG) and the International Society for Mine Surveying (ISM) organize the International Conference on Geo-Spatial Technologies and Earth Resources in Hanoi, Vietnam, from 5th to 6th October 2017 (GTER 2017). The conference is to mark the 50th anniversary of the Vietnam mine surveying education (1967-2017), the special event of Vietnamese mine surveyors.

The conference theme, "Geo-spatial Technologies and Earth Resources" is an invitation to researchers, academics and professionals to present their research results and exchange their new ideas and application experiences face-to-face. GTER 2017 is also an excellent opportunity for attendees to establish research or business relations and to find partners for future collaboration.

The conference's call for papers was answered by 288 abstracts, of which 216 papers were under a double-blind review process. After the thorough reviews and selection process, 119 qualified papers from 20 countries were selected for the proceedings.

The major topics announced for GTER 2017 are listed below:
- Geo-spatial technologies;
- Advance in mining and tunneling;
- Geological engineering;
- Environmental engineering.

The content of the proceedings book provides a broad overview of recent advances in the fields of geo-spatial technologies and earth resources for readers.

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Foreword

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The conference program represents the efforts of many people. We would like to express our gratitude to the members of the Organizing Committee, Scientific Committee, and the external reviewers for their hard work in reviewing submissions. Full recognition is accorded to the kind and generous sponsors: Vietnam National Coal - Mineral Industries Holding Corporation Limited, Dong Bac Corporation, SISC Vietnam JSC, GPS Lands (Malaysia), and Henan Polytechnic University (China).

Finally, my greatest appreciation goes to Nguyen Quoc Long, Pham Thi Lan, Nguyen Viet Nghia, Khuong The Hung, Le Thi Thu Ha, and La Phu Hien for their dedication and tireless work in organizing the conference and editing this volume of the proceedings.

GETR-2017 Conference Chair

Prof. Le Hai An

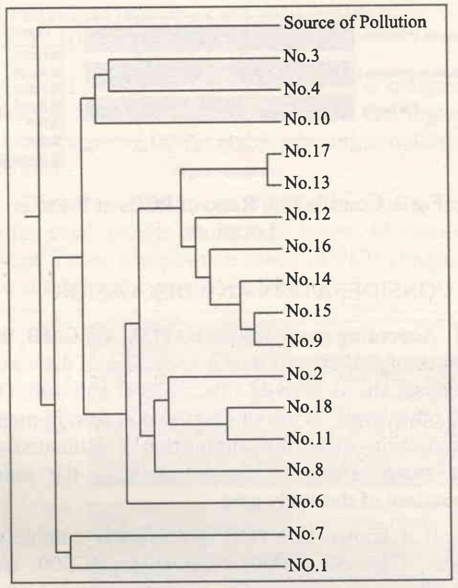

Fig 4. Results of Cluster Dendrograms

9. CONCLUSION

Many monitoring wells were installed inside and outside the site to observe the periodical change of water level and chemical conditions. The source of pollution located in the center of the waste disposal site is derived from KC300 and 400 based on PCA and CMBM. As the estimated contribution rates by CA were similar between inside and outside, the PCB pollution was not considered to spread outside the site. PCA, CMBM, and CA are useful methodology to identify the origin of the pollution source or status of its spread at PCB polluted waste-disposal sites.

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Capability to apply remote sensing data in forest fire risk fastly mapping: a case study in Ba Vi, Hanoi (Vietnam)

Do Thi Phuong Thao[a*], Bui Ngoc Quy[a], Nguyen Van Loi[a], Tran Thi Tuyet Vinh[a]

[a]*Hanoi University of Mining and Geology, Hanoi, Vietnam*
[*]*Corresponding author: dothiphuongthao@humg.edu.vn*

ABSTRACT: Warning and preventing forest fires to protect forest ecosystems is essential and must be managed and monitored effectively. Remote sensing data provides extensive information on a wide area that predicts and assesses where and when the risk of forest fires occurred. Nine factors which were extracted from remote sensing data of forest fires was weighted according to the level of influence and overlapped into Ba Vi District's fire risk maps, where the natural national park was located as the largest forest acreage in Ha Noi that needs to be preserved. The results of forest fire occurrence prediction are presented in four levels: low, medium, high and very high. They showed grass, shrubs, pine forest, acacia, etc. and area that near the residential (3670.20 hectares) has the higher probability fire at the dry season, needs to perform effective forest fire prevention first.

KEY WORDS: remote sensing, forest fire, risk map, Ba Vi

1. INTRODUCTION

Forest is a valuable resource for economic development, climate regulation, reducing natural hazards, preserving water resource and reducing air pollution. However, the forest area has been reducing due to many reasons, including forest fire. As of 31/12/2015, Vietnam has 14,061,856 ha of forest, including about 6 million ha of flammable forest. Ba Vi District is a unit where has the largest natural forest area in Hanoi, Vietnam. There are 15 organizations of tourism around Ba Vi Mountain. A resident living next to Ba Vi National Park is mainly ethnic people. They still use fire without safety in the field working, burning wood, keeping warm cattle etc. Another hand, the forest in Ba Vi has big vegetation cover, grasslands, jungle, reed, reed grass etc, The Ba Vi National Park is classified as high risky of forest fire. The forest fire is always a real risk in this area. Preventing forest fire in Ba Vi National Park is extremely important and necessary. The according to statistics of forest fire in the past three years, Ba Vi National Park has occurred seven fires. Practice shows that apart from objective factors like lightning (not yet), the main cause of forest fire is human being. Therefore, in order to limit forest fires, it is necessary and urgent to develop forecasting maps and identify areas and locations where there is a high risk of fire, mobilizing communities living close to the forest to improve their sense of responsibility for forest protection.

In order to determine where fires can occur, consideration should be given to factors for causing such as vegetable type, climate, and topography. Traditional data from stations is limited because of lack of approaches to analyze complex factors and to manage large amounts of data (Yakubu et al., 2015). Another face, the traditional analysis is also difficult to consider spatial data and attribute data together. As a result, the fire estimation model is rough with many uncertainties. Today, the development of new remote sensing instruments provides an opportunity to advance studies and researches on forest fire (Jesus et all., 2011). Satellite remote sensing can provide valuable data for all the factors above, example: NDVI (Normalized Difference Vegetation Index), NDWI (Normalized Difference Water index) that is extracted from the infrared visible regional band arithmetic can exhibit the health and moisture contents of the vegetation. Slope, aspect and the altitude used from Aster GDEM are important topographic parameters that can help identify potential areas for forest fire (because elevation relates to precipitation and temperature). The distance from settlement and road were produced by using satellite images classification. Also the temperature distribution was analyzed to associate with the forest fires by using the thermal band of the Landsat image.

Many studies in Vietnam also use remote sensing data for extraction forest fire information. Luu The Anh et al. (2014), using the Landsat ETM image identifies parameters: forest type, temperature, slope, aspect to warn of the danger of forest fires polluting the dust of Dac Lac province. Vu Thanh Minh et al. (2016), using the Landsat 8 OLI image, extracted fire factors at Cham Chim National Park including biomass density, vegetation type, moisture, surface temperature, water sources and residential areas then overlapping thematic maps show fire-sensitive maps. These methods also have limitations that do not take into account all the factors that affect forest fires.

This paper presents a quick method to extract information for identification of most risky areas of forest fire, help forest department staff, authorities choose the suitable protecting priority area to prevent, minimize damages during fire season in the Ba Vi National Park.

2. STUDY AREA

Ba Vì, where is between 21°00' and 21°20' northern parallels, 105°15' and 105°30' eastern meridians, belongs to the northwest of Hanoi, covering an area of 424 km², the population is over 265,000 people (Fig 1). The elevation of terrain in this area decreases from the southwest to the northeast. The mountains cover 47.5% of the area, including Ba Vi National Park that has several over high 1000m peaks, the slope is quite large, so the travel in the National Park is not easy. There are only a few streams in the Ba Vi National Park, so water reserve in this area is very low, especially in the dry season. The climate of hot and humid tropical and monsoon in Ba Vi is divided into two distinct seasons: rainy season lasts from late April to October, dry season from November to the end of April. The annual rainfall is about 2500 mm. The average annual temperature is about 23.4°C. The hottest time of the year is May to August, the temperature can reach 37°C. On driest days, the humidity in the air is very low. The total area of forest land in Ba Vi district is 11,160.3 ha. Forest land is 10,224.6 ha, including natural forest area is 1.754.8 ha and plant forest is 8,465.8 ha. Natural forest is covered by many varied vegetation types, with many species of oily plant and broadleaf trees, which are deciduous in winter and highly flammable.

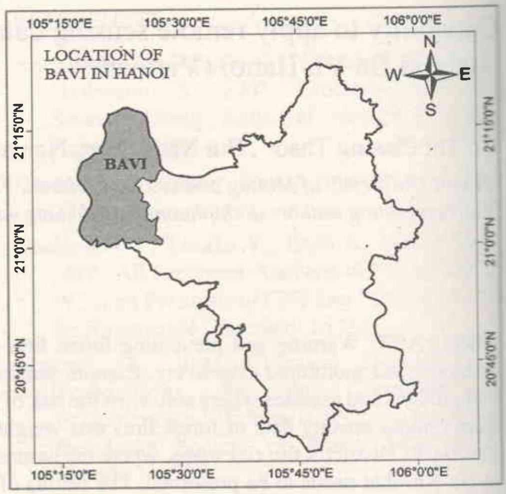

Fig 1. Study area

3. MATERIALS AND METHODS:

3.1. Materials

The main data used in this study is the Landsat 8 OLI_TIR acquired on 01/6/2016 (in the dry season) was used to classify vegetable types and obtain Land Surface Temperature (LST) values. Near infrared, middle infrared and visible red bands of image were used to obtain actual NDVI, NDWI values. Also Aster GDEM digital elevation model was used to create elevation, slope and aspect maps; high-resolution (0.6m) Quickbird data at the same time is also used as a supporting document in the selected sample training for classification and during post-test results. In addition, the topographic map in 1: 25,000 scale was updated in 2014 used to the establishment of geographic basis for thematic maps and reference for classification image.

3.2. Methods

In this study, unsupervised and supervised classification algorithms were used to classify Landsat OLI_TIR images. The images were grouped into 70 clusters using unsupervised classification method with having a number of iterations as 30 and using ISODATA algorithm. After unsupervised classification, the supervised classification was applied for the vegetation type combined with NDVI index and topography maps. The vegetation cover density on the ground is represented by the NDVI index, calculated from the Landsat 8 image.

$$NDVI = \frac{NIR - RED}{NIR + RED} \quad (1)$$

where, NIR is near infrared, RED is the red channel (the highest absorption and reflectance of chlorophyll).

To determine moisture in plants, NDWI is often applied. Roughly optimal wavelengths to calculate NDWI for humidity leaves are from 0.86 µm to 1.24 µm. NDWI is calculated by formulas:

$$NDWI = \frac{NIR - MIR}{NIR + MIR} \quad (2)$$

where, MIR is middle infrared channel.

To obtain temperature distribution of Ba Vi from Landsat 8 thermal band 10 was used (because band 11 is significantly more contaminated stray than band 10). The Landsat sensors acquire temperature data that is in the form of digital number (DN) with a range between 0-255. First, these have to be converting DN to radiance using the following equation:

$$L\lambda = ML * Qcal + AL. \quad (3)$$

where, Lλ: TOA spectral radiance [W / (m².sr.µm)]; ML: Band-specific multiplicative rescaling factor from the metadata (RADIANCE_MULT_BAND_x, where, x is the band number); AL: Band-specific additive rescaling factor from the metadata (RADIANCE_ADD _BAND_x, where, x is the band number). In the next step, we convert our reflectance values into Satellite Brightness Temperature (TB, which in Kelvin). The conversion formula radiance to temperature was:

$$TB = \frac{K_2}{(\ln\frac{K_1}{K_2} + 1)} \quad (4)$$

where, K1, K2 are constants applied for Landsat 8. According to the laws of Planck and Stefan Boltzmann, the estimates of the surface temperature (Ts) can then be calculated as follows:

$$Ts = \frac{TB}{1 + \left(\frac{\lambda * TB}{\rho}\right) * \ln\varepsilon} \quad (5)$$

where, Ts = the surface temperature (in Kelvin); λ = the wavelength of the emitted radiation; ρ = h × c / σ (1.438 × 10⁻² m K); h = the Planck constant (6.26 × 10-34 J s), c = the speed of light (2.998 × 108 m / s); σ is constant by Stefan Boltzmann (1.38 × 10-23J K-1) and ε the emissivity.

Finally, convert Kelvin values to Celsius = Kelvin - 273.15 unit transformation is used. The buffer maps of settlement and road were produced by using classification image to show the human effect on forest fire as a parameter. AsterGDEM was used for slope, aspect and elevation maps with the GIS technology . Forest fire risk map of the study area was created by performing a multi-criteria analysis by using these data (Jesus et all., 2011).

The forest fire risk map is a combination of parameters, elements will be comparing, AHP (Analytic Hierarchy Process) analysis and numerical weighting are given as: firstly level of the hierarchy is the type of vegetation, the NDVI, secondly the distance to the population, traffic, then temperature, NDWI, and finally elevation, slope and aspect. These weights are calculated based on a matrix that combines from experts in the forestry sector and has a consistency ratio of less than 0.1 for the study area. Forest fire risk prediction (FFRP) was calculated according to the formula:

$$FFRP = 0.15 * \text{"settlement"} + 0.11 * \text{"roads"} + 0.03 * \text{"slope"} + 0.05 * \text{"aspect"} + 0.02 * \text{"altitude"} + 0.21 * \text{"NDVI"} + 0.05 * \text{"Ts"} + 0.3 * \text{"vegetation type"} + 0.07 * \text{"NDWI"} \quad (6)$$

4. RESULT

Land surface are classified in 6 different classes can be seen in Fig 2a: (1) agriculture, (2) crops, (3) pine forest, (4) Shrubs, (5) settlement and (6) hydrology. Agricultural land and residential areas are closely related to the risk of forest fire, but the types of vegetation (pine forest, acacia, shrubs, etc) have the greatest impact on the appearance of fire. The overall classification accuracy for Landsat product is 87%. The forest area is 8484.62 ha, the crop vegetation is 2016.97 ha, agriculture is 18119 ha, the shrub is 1501 ha and the water area is 4808 hectares. The NDVI values that are mostly between 0.02 - 0.55 can be seen in Fig 2b reflect the vegetation situation clearly. Similar to the NDWI values show in Fig 2f with values from -0.4 to 0.03. The slope values are not high about 1°-6° in plain, in mountain area the values up to 22° (Fig 2h). The Ts shows that the temperature values vary between 24 - 38°C in the study area (Fig 2e).

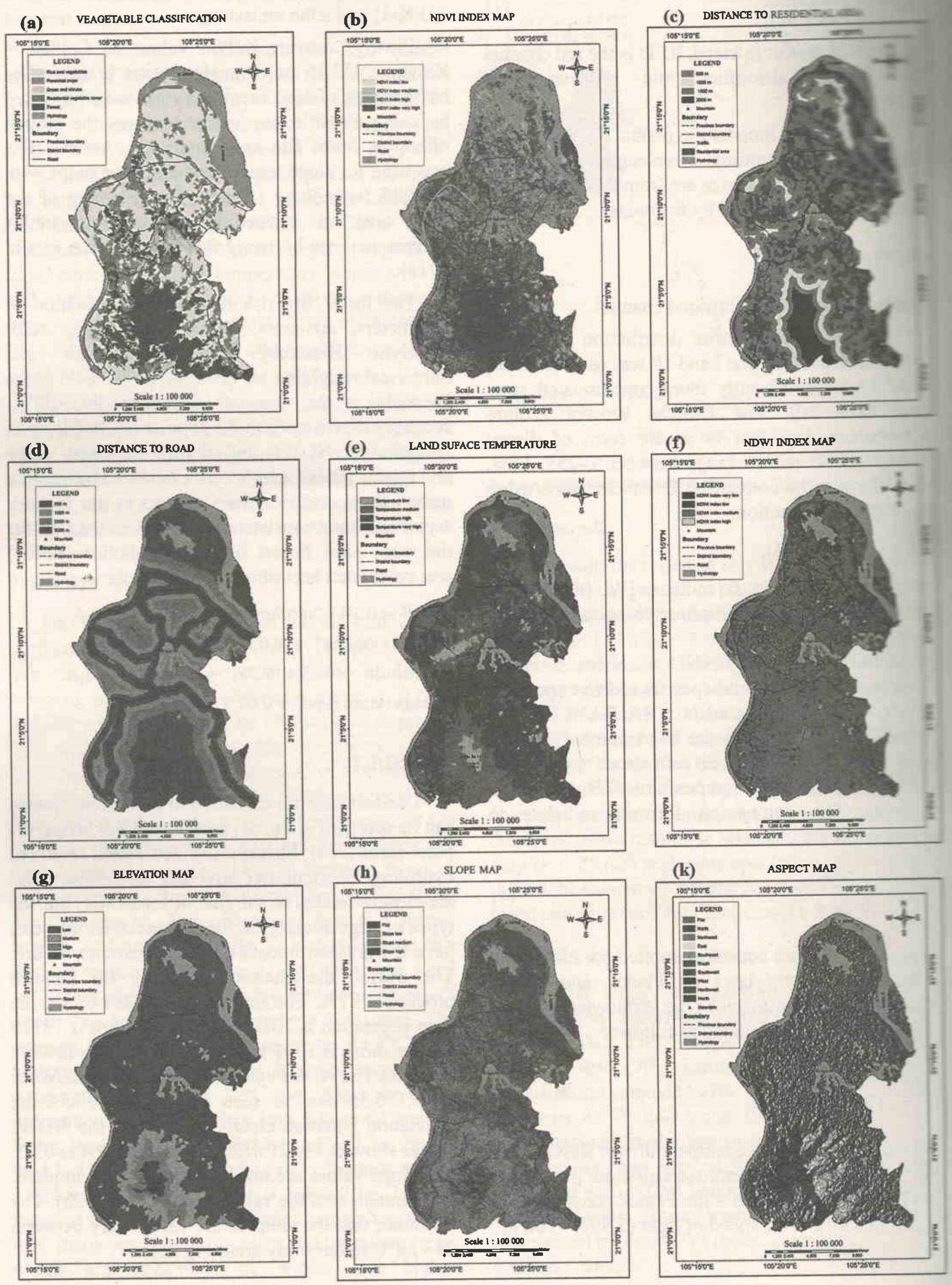

Fig 2. Thematic maps

Aspect is one of dangerous values too, the risk order of the aspect is West > South West > South > North West >North > South East > North East > East (Fig 2k) and the last, with increasing altitude, the temperature values decrease which causes slowly spread of the fire, therefore, high places supposedly safer. Ba Vi only a few places on the 1000m high (Fig 2g). In the study area, the settlement and the road areas are very dense which create very high risk (Fig 2c, d). All parameters (vegetable types, distance to roads, distance to the settlement, slope, aspect, elevation, NDVI, NDWI and LST) are a device in four groups: low, medium, high, and very high. The warning levels are ranked from very low to very high (Table 1), based on Decision No. 127 / QD-BNN- KL on fire risk ratings of Forest Protection Department on December 11, 2000. These results (Fig 3) indicate that Quang Minh commune, Ba Trai commune and the West of Ba Vi district show the risk of fire from "high to very high" compared to other communes in "too low". In addition, the fire risk varies from "medium to high" for different areas of the same commune, such as for the communes at the down of Ba Vi National Park Mountain. As a result, 8.92% of the study area is very high, which means that 3782 hectares area is in fire danger.

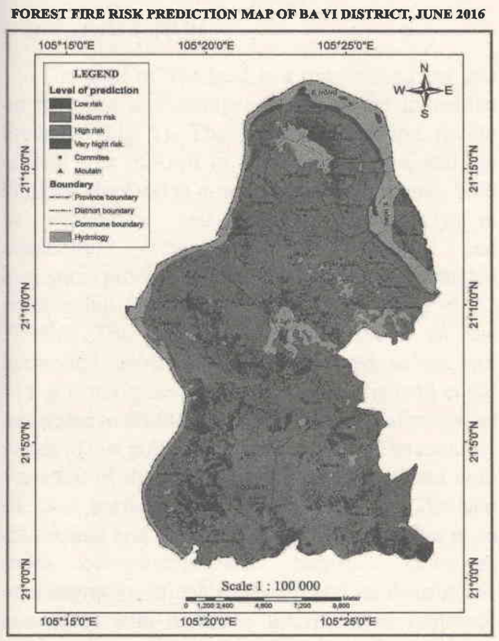

Fig 3. Forest fire risk prediction map

Table 1. Fire risk value, spatial and percentage distribution

Risk Value	Lever	Area (ha)	Percentage (%)
I	low	6461.19	15.69
II	medium	17846.55	43.34
III	high	13196.43	32.05
IV	very high	3670.20	8.92

The accuracy of prediction maps have been checked by using one of the available fire warning maps which was extracted from the Global Fire Management System for this area, then making overlay with the forest fire risk prediction map to assess overall accuracy. Although the direct comparison between the two maps is not absolutely accurate due to the time, space and dynamic of fires, forest fires prediction maps also play an important role in Ba Vi National Park area.

5. CONCLUSION

The causes of forest fires are varied, although the number of fires has been negligible in the study area, the development in fast fire prediction fast maps from remote sensing data are required to management must have a valid plan about the communication, residential area or build fire protection barriers around high risk areas. The combined approach of remote sensing, GIS can be used effectively to forecast forest fire areas from a number of fundamental factors. In this study, the risk of fire in the Ba Vi National Park forest area was analyzed in favor of the vegetation type, human, climatic conditions and natural terrain. The results are quite helpful in describing "fire risk" areas that can also be used as a tool to address national or greater fire risk concerns. The relevant component map elements can vary flexible depending on the data provided and depending on the geographic features of the study area to increase the predicted future risk of fire risk.

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Monthly phytoplankton blooms associated with monsoon activity in the gulf of Thailand in El Nino year 2002

Le Van Thien[a*]

[a]*Hanoi University of Natural Resources and Environment*
**Corresponding author: thienmet@gmail.com*

ABSTRACT: The Gulf of Thailand is a semi-closed Gulf on the west and southwest side of the Indochina Penisula and experienced reversal monsoon. The object of the present study is to investigate monthly and spatial distributions of the phytoplankton in the Gulf of Thailand during whole El Nino year 2002 by using remote-sensing measurements of chlorophyll-a (Chl-a) and surface wind vectors. Results show that monthly and spatial variations of the phytoplankton blooms are primarily associated with the monsoonal winds. In general, the average monthly Chl-a concentrations were quite low (<0.5 mg m^{-3}) most area of the Gulf, with a belt of higher Chl-a concentrations along the coast during throughout year. Phytoplankton blooms extensively offshore in the near-coastal area of the Gulf in January and February, which is consistent with the winter northeast monsoon. In particular, one peak of Chl-a concentrations was observed in December. Areas with higher Chl-a concentrations along the coast were observed in winter and summer monsoon months.

KEY WORDS: phytoplankton blooms, monsoon, Gulf of Thailand, El Nino

1. INTRODUCTION

The Gulf of Thailand is a semi closed sea and on the west and southwest side of the Indochina Penisula (Fig 1). The human population in the coastal area of Gulf of Thailand is large, and the Gulf of Thailand is a rapidly developing area both in economics and society, particularly in aquaculture sectors. Physical, chemical and biological processes in the ocean are in an intimated relationship (Chaturvedi et al., 1998; Tang et al., 2004b). The physical properties such as the horizontal distribution of bottom cold, saline, and heavy water masses in the Gulf of Thailand could be related to the incidence and direction of monsoon winds in that gulf (Yanagi et al., 2001). The monthly variation of the heat flux could be correlated with the sea surface wind in the Gulf of Thailand (Stansfield and Garrett, 1997). Chlorophyll-a is an index of phytoplankton biomass. However, characteristics of chlorophyll-a and its distribution associated with monsoon activity have remained unknown or poorly known for most of the gulf. In the present study, we investigate monthly and spatial variations of Chlorophyll-a (Chl-a) and sea surface wind conditions in the Gulf of Thailand during whole El Nino year by examining satellite measurements.

2. STUDY AREA AND SATELLITE DATA, AND METHODS

2.1 Study area

The study region is the Gulf of Thailand (area in Fig 1, 100^0E – 104^0E, 6^0N – 12^0N). The average depth of Gulf of Thailand is about 40m. This region experiences reversal monsoon with the southwest monsoon in the summer and northeast monsoon in the winter.

2.2 Satellite-derived Chlorophyll-a

Sea viewing Wide Field-of View Scanner (SeaWiFS) derived Chlorophyll-a were processed using the Ocean Color 4-band algorithm (OC4) (O'Reilly et al., 1998, 2000). Monthly averaged Chl-a concentrations with 3x3km spatial resolution were obtained and processed for the study region. Ocean Color and Temperature Scanner (OCTS) aboard Advanced Earth Observing Satellite observed the Chl-a concentration in the surface layer from October 1996 to June 1997 with quality similar to that of SeaWiFS (Kawamura and OCTS