

UNIVERSITI TEKNOLOGI MARA

**MODELLING THE RELATIONSHIP
OF SEA SURFACE TEMPERATURE
(SST) AND CHLOROPHYLL A
CONCENTRATION (*Chl-a*) USING
MODIS REMOTE SENSING DATA**

NURUL NADIAH BT ABDUL GHAFAR

Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science

Faculty of Architecture, Planning and Surveying

July 2017

ABSTRACT

Sea surface temperature (SST) and chlorophyll-a concentration (*Chl-a*) are two important parameters for oceanography and marine meteorology that need to be frequently studied and reviewed as a result of ocean dynamics and geodynamics phenomena such as Tsunami's and Hurricane, which may have great impact in due period of time. SST is water temperature close to the ocean surface whilst *Chl-a* concentration is that variable concerning the amount of green pigment found in phytoplankton. The intent of the study is to determine and interpret the seasonal variation of SST and *Chl-a* concentration by using two method which is through in situ measurement and satellite image data consist of 25 station along Kuala Terengganu waters. In situ measurement was taken at near shore data through four days of observation starting from 11 June until 14 June 2015 while satellite image data was taken for twelve years observation starting from 2004 until 2015 at near shore and open waters using Terra MODIS level 3 standard mapped image (SMI). From the result of both method, it is found that SST and *Chl-a* concentration is based on season dependence. In situ data were taken at near shore area were used to validate the data from MODIS image, however, the data from MODIS shows there is no significant relationship between two variables at the area. To investigate further about this, regression analysis for SST and *Chl-a* has been analyzed and it was found out that there is no correlation between SST and *Chl-a* from MODIS data with the correlation coefficient being 0.03524757 with p value is 0.86716. Since the MODIS data has proven that there is no correlation between both variables, the data from in situ measurement has the ability to predict unknown values of SST and *Chl-a* around sample point by using Inverse Distance Weighting (IDW) and Kriging method. Two methods were then compared and the result shows that SST and *Chl-a* at the surface of the ocean (0.5meter) has fit the model the most by having the lowest Root Mean Square Error (RMSE). Overall, from the analysis it were recognized that the temperature of SST is higher during dry season (May to September) while *Chl-a* is vice versa. Moreover, the trend of SST is similar at near shore and open waters while the concentration of *Chl-a* in Malaysia peninsular is always lower due to the geoparameter factor that Malaysia is located at shallow shelf of Sunda. Although *Chl-a* is recorded lower due its geoparameter factor, *Chl-a* distribution varies from near shore to open waters. It was found that *Chl-a* at coastal or near shore area has higher concentration of *Chl-a* with 5.4752 mg/m³. Basically the SST and *Chl-a* is porportionally inverse during dry and wet season. Higher *Chl-a* concentration at the area shown by the decrease of temperature indicates that *Chl-a* is actively bloom at the time.

ACKNOWLEDGEMENT

Firstly, all praises to Allah for giving me the opportunity to embark on my master and for completing this long and challenging journey successfully. My gratitude and thanks go to my supervisor Assoc. Prof. Dr Haji Juazer Rizal Abdul Hamid. Thank you for the support, patience and ideas in assisting me with this project.

I also would like to express my gratitude to the staff of the University Malaysia Terengganu who provided the facilities and assistance during field sampling. Also for providing the facilities, knowledge and assistance. Without their passionate participation and input, the validation survey could not have been successfully conducted.

Finally, I must express my very profound gratitude to my parents, my beloved husband, Wan Qamarul Hazimin bin Wan Deraman and my son, Wan Firas Muhammad for providing me with unfailing support and continuous encouragement throughout my years of study and through the process of researching and writing this thesis. This accomplishment would not have been possible without them. Thank you.

TABLE OF CONTENTS

	Page
CONFIRMATION BY PANEL OF EXAMINERS	ii
AUTHOR'S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	ix
LIST OF FIGURES	xi
LIST OF SYMBOLS	xix
LIST OF ABBREVIATION	xx
CHAPTER ONE: INTRODUCTION	1
1.1 Introduction	1
1.2 Problem Statement	3
1.3 Aim and Objectives	4
1.4 Scope and Limitation	5
1.5 General Description of Study Area	6
1.6 Outlines of Chapters	8
CHAPTER TWO: LITERATURE REVIEW	10
2.1 Introduction	10
2.2 Sea Surface Temperature	12
2.3 Remote Sensing to Measure Sea Surface Temperature	14
2.4 Chlorophyll a Concentration Chl- <i>a</i>	17
2.5 In situ measurement of Chlorophyll- <i>a</i> concentration (Chl- <i>a</i>)	18
2.6 Remotely sensed of Chlorophyll- <i>a</i> concentration (Chl- <i>a</i>)	19
2.7 In situ SST and Chl- <i>a</i> measurement	22

CHAPTER ONE

INTRODUCTION

1.1 RESEARCH BACKGROUND

Water is the most crucial element in all living organism. It has been discovered that the whole body of water covers about 71 percent of earth divided by region and countries. Previous studies at South Chinese Sea (SCS) has been discovered that the dynamicity of the ocean were affect marine organism at oceanic fronts. Physical changes at the front were driven by dynamic of the ocean for long term creates statistical number in ocean element such as salinity, Sea Surface Temperature (SST) and Chlorophyll *a* concentration (Chl-*a*) for annual and decadal years.

The abundant of chlorophyll *a* which always found in algae and plant were discovered around coastal and continental shelves (Blondeau-Patissier, Gower, Dekker, Phinn, & Brando, 2014) which favors from environmental condition such as water column stratification, light availability (Gohin et al., 2003; Kogeler and Rey, 1999), increase in water temperature (Thomas et al., 2003) and also nutrient levels (e.g., Santoleri et al., 2003; Siegel et al., 1999) in the water. Water temperature of sea surface plays the role in creating suitable environment for Chl-*a* to grow however the temperature of the ocean is vary according to the selected depth.

Previous study by Akhir, Zakaria, and Tangang, (2014) shows that the climate of South China Sea (SCS) was depend on monsoon season. Northeast monsoon season address as wet season usually occur from November to March while Southwest monsoon season indicates dry season are starting from April to August (Amin, Ahmad, Hussim et. al (2014). Previous research also has found that dry season and wet season become indicator of the growth and degrowth of algae and plant with the temperature of sea surface become the boost factor. Chlorophylls which always found in algae and plant reflected to eyes showing green part has been discovered vary at coastal and offshore area and also over a broad spectrum of time and space scales .The cycle of this climate were continued thus the pattern of SST and Chl-*a* is different during monsoon seasons.