# WATER CHARACTERISTICS AND CURRENT CIRCULATIONS OFF EAST COAST PENINSULAR MALAYSIA

**NUR HIDAYAH BINTI ROSELI**

**MASTER OF SCIENCE
UNIVERSITI MALAYSIA TERENGGANU**

**2014**

**WATER CHARACTERISTICS AND CURRENT CIRCULATIONS OFF EAST COAST PENINSULAR MALAYSIA**

**NUR HIDAYAH BINTI ROSELI**

**Thesis Submitted in Fulfilment of the Requirement for the**

**Degree of Master of Science in the School of Marine Science and Environment**

**Universiti Malaysia Terengganu**

**2014**

# DEDICATION

*I dedicated this thesis*

*To my parents and family*

*(Ayah, Mak, Yop, Nyah, Acik, Uda and Adik)*

*For your endless love and support*

*To my husband*

*(Safuan)*

*For giving me your beautiful love, courage and happiness*

*To my supervisors*

*(Dr. MohdFadzilMohdAkhir & Dr. MohdRazakZakariya)*

*For your inspiration, belief and coaching*

*And last but not least*

*To all my friends*

*For always being there for me through good times and bad*

*Every bit of this thesis contains every memory of all of you*

# ABSTRACT

Abstract of thesis presented to the Senate of University Malaysia Terengganu in fulfilment of the requirement for the degree of Master of Science

## WATER CHARACTERISTICS AND CURRENT CIRCULATIONS OFF EAST COAST PENINSULAR MALAYSIA

## NUR HIDAYAH BINTI ROSELI

## MAY 2014

**Main Supervisor**     :Mohd. Fadzil Mohd. Akhir, Ph.D.

**Co-Supervisor**     :Razak Zakariya, Ph.D.

**School**     : Marine Science and Environment

A descriptive analysis on water characteristics and current circulation at the east coast Peninsular Malaysia was done by using different available sources of data. The main dataset was the in-situ data collection obtained from three different cruises taken in September 2011 (Cruise 1), June 2012 (Cruise 2) and October 2012 (Cruise 3). In –situ CTD parameters of temperature, salinity, density and dissolved oxygen were selected to explain the water characteristics while in-situ ADCP data was used to measure currents at the study area. Because of some limitations in this in-situ data to explain the seasonal variations, satellite tracked drifter data of SVP and assimilated model outputs of BRAN were added to this study.

According to the moored ADCP result that was deployed for about 17 hours at the offshore area, the currents behaviour was prominently influenced by diurnal cycles, which is tides. The effect of tides to the currents here were more prominent in the meridional current (v-component) compared to zonal current (u-component). At the same time, the currents also are changing seasonally as observed from SVP and BRAN model outputs. However, CTD data that was taken every two hours within

the mooring period did not show any significant diurnal variability in the water properties. The vertical profiles of the snapshots data that were taken in different months also did not show any diurnal changes. The different in vertical profiles was more obvious in between months. BRAN's model outputs of temperature and salinity also confirmed that the study area had a prominent seasonal variability of water properties.

The T-S diagram of the in-situ temperature and salinity showed that these three cruises shared similar characteristics of southwest monsoon. Cluster analysis that was done to determine the number of water masses existed showed that there were three water masses which can be classified. Even though they shared similar southwest monsoon characteristics, the horizontal and cross sectional plots of these properties showed different degree of stratification. The most pronounced stratification was during Cruise 2 while less stable stratification was observed during Cruise 3. Salinity front (Cruise 2) and bottom front (all cruises) can be observed to form from these stratifications. Other than that, the sign of upwelling was also observed by the elevation of cold, saline and high oxygenated of stratified water from offshore to nearshore subsurface area during Cruise 2. The cross shelf currents (u-component) also showed the strong westward movement towards the nearshore 20m depth. In Cruise 2 where the stratification was the greatest, the winds were the lowest, water level was the minimum and the sea surface temperatures were the highest. Cruise 3, taken in transition month showed that northeast monsoon winds already blew at the study area. Stronger winds recorded and high water level maximum caused the water to mix well until almost the bottom column.

# ABSTRAK

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu

sebagai memenuhi keperluan untuk ijazah Master Sains.

## CIRI-CIRI AIR DAN PEREDARAN ARUS DI LUAR PESISIR PANTAI TIMUR SEMENANJUNG MALAYSIA

## NUR HIDAYAH BINTI ROSELI

## MEI 2014

**PenyeliaUtama**            **:Mohd. Fadzil Mohd. Akhir, Ph.D.**

**PenyeliaBersama**         **:Razak Zakariya, Ph.D.**

**Pusat Pengajian**           **: Sains Marin dan Sekitaran**

Analisis deskriptif mengenai ciri-ciri air dan peredaran arus di pantai timur Semenanjung Malaysia telah dilakukan dengan menggunakan beberapa data yang berlainan. Data utama merupakan data yang diperolehi hasil daripada pengumpulan secara in-situ dari tiga pelayaran berbeza dalam bulan September 2011 (Pelayaran 1), Jun 2012 (Pelayaran 2) dan Oktober 2012 (Pelayaran 3). Parameter in-situ daripada CTD digunakan untuk menerangkan ciri-ciri air manakala in-situ data daripada ADCP digunakan bagi mengukur arus di kawasan kajian. Disebabkan data in-situ ini terhad bagi menerangkan kepelbagaian mengikut musim, kajian ini kemudian ditambah data hanyutan yang dikesan oleh satelit daripada SVP dan keputusan model asimilasi, BRAN.

Menurut hasil ADCP berlabuh yang dipasang kira-kira 17 jam di kawasan luar pesisir, tingkah laku arus itu jelas dipengaruhi oleh kitaran harian, iaitu pasang surut air laut. Kesan pasang surut air laut terhadap arus di sini lebih menonjol di dalam arus garis bujur (komponen v) berbanding dengan arus zon (komponen u).

Pada masa yang sama, arus juga berubah mengikut musim seperti yang dilihat dari SVP dan output model BRAN. Walaubagaimanapun, data CTD yang diambil setiap dua jam dalam tempoh ADCP berlabuh tidak menunjukkan kepelbagaian harian ketara dalam sifat-sifat air. Profil menegak bagi data yang telah diambil pada bulan yang berbeza juga tidak menunjukkan apa-apa perubahan harian. Perbezaan dalam profil menegak lebih jelas berlaku di antara bulan. Model output BRAN bagi suhu dan kemasinan juga mengesahkan bahawa kawasan kajian mempunyai kepelbagaian bermusim yang lebih menonjol.

Gambarajah TS bagi suhu dan kemasinan menunjukkan bahawa ketiga-tiga pelayaran berkongsi ciri-ciri yang serupa iaitu monsoon barat daya. Analisis kelompok yang telah dilakukan untuk menentukan bilangan jisim air yang wujud menunjukkan bahawa terdapat tiga jisim air yang boleh diklasifikasikan. Walaupun mereka berkongsi ciri-ciri monsun barat daya yang sama, lakaran keratan melintang dan menegak menunjukkan tahap stratifikasi yang berbeza bagi setiap pelayaran. Stratifikasi paling ketara dilihat semasa Pelayaran 2 manakala stratifikasi kurang stabil telah diperhatikan semasa Pelayaran 3. Perenggan kemasinan (Pelayaran 2) dan perenggan dasar (semua pelayaran) boleh diperhatikan terbentuk akibat daripada stratifikasi ini. Selain daripada itu, tanda – tanda wujudnya julang air dapat dilihat semasa Pelayaran 2. Ia diperhatikan oleh kenaikan air laut yang sejuk, masin dan tinggi oksigen dari dasar luar pesisir air ke kedalaman separa di kawasan berhampiran pantai. Arus secara menegak merentasi pelantar benua (komponen u) juga menunjukkan pergerakan yang kuat ke arah barat dan arus ini naik ke kedalaman 20m di pesisir pantai. Dalam Pelayaran 2 di mana stratifikasi adalah yang paling besar, angin adalah paling rendah, paras air adalah minimum dan suhu

permukaan laut adalah yang tertinggi. Pelayaran 3 yang diambil dalam bulan peralihan monsun menunjukkan bahawa angin monsun timur laut telah pun bertiup di kawasan kajian. Angin yang lebih kuat dan paras air laut maksimum menyebabkan air laut dipermukaan bercampur dengan baik sehingga hampir mencapai dasar.