UNIVERSITI PUTRA MALAYSIA

COASTAL CIRCULATION OFF KUALA TERENGGANU

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COASTAL CIRCULATION OFF KUALA TERENGGANU

By

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TABLE OF CONTENTS

LIST OF TABLES

Table **Page**

LIST OF FIGURES

LIST OF PLATES

Plate **page**

Abstract of thesis submitted to the Senate of Universiti Pertanian Malaysia in fulfilment of the requirements for the degree of Master of Science

COASTAL CIRCULATION OFF KUALA TERENGGANU

By

MAGED MAHMOUD MARGHANY

SEPTEMBER 1994

Chairman : Mohd. Nasir Saadon, Ph.D

Faculty : Faculty of Fisheries and Marine Science

The aim of this study was to determine the type of the current patterns in the coastal waters of Kuala Terengganu. This study was divided in two parts. The first part was to determine the pattern of thermohaline circulation. This was done by sampling 25 stations along the coastal water of Kuala Terengganu. The second part was to measure the subsurface current by ONO-self recording current meter and drogue.

The thermohaline circulation was dominated by mixing during the north-east monsoon period (October 1992, February and March 1993) due to the turbulence

resulting from the action of wind and tide. A dominant feature of this study was the occurrence of upwelling during the south-west monsoon period (May to August 1992). The downwelling occurrences are in the north-east monsoon.

The study showed that the subsurface current in the coastal waters of Kuala Terengganu were influenced by the tide. The current speed throughout this study varied from 0.012 to 2.6 m/s. The tide throughout this study was diurnal in nature. A dominant feature through this study was tidal current while, the winds have no impact on the water movement. Finally the data of surface current illustrated that the water meanders in the month of April 1993. Meander rotated in clockwise direction from the north to south-west direction with an average current speed of about 0.4 m/s.

Abstrak tesis yang dikemukakan kepada Senat Universiti Pertanian Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains.

PUSINGAN PERSISIRAN DI KUALA TERENGGANU

Oleh

MAGED MAHMOUD MARGHANY

SEPTEMBER 1994

Pengerusi : Mohd. Nasir Saadon,Ph.D

Fakulti : Fakulti Perikanan dan Sains Samudera

Tujuan kajian ini adalah untuk menentukan jenis corak-corak arus di perairan pantai Kuala Terengganu. Kajian ini dibahagikan kepada dua bahagian. Bahagian pertama adalah mengenai kitaran termohalin. Ini dilakukan ke atas 25 buah stesen kajian sepanjang perairan pantai Kuala Terengganu. Bahagian kedua pula adalah untuk mengukur arus sub-permukaan menggunakan meter arus "ONO self recording" dan "drogue".

Kitaran termohalin telah didominasikan percampuran khasnya semasa tempoh Monsun Timur Laut (Oktober, 1992; Februari dan Mac, 1993) akibat daripada penggeloraan hasil

dari tindakan angin dan pasang surut. Satu ciri dominan dalam kajian ini adalah kejadian julang air yang tinggi semasa berlakunya Monsun Barat Daya (Mei hingga Ogos, 1992) berbanding dalam tempoh Monsun Timur Laut (Oktober, 1992; Februari dan Mac, 1993). Tetapi, kejadian junam air adalah lebih kerap pada Monsun Timur Laut berbanding Monsun Barat Daya.

Kajian ini menunjukkan bahawa arus sub-permukaan di perairan pantai Kuala Terengganu adalah dipengaruhi oleh pasang-surut. Kelajuan arus sepanjang kajian adalah berubah-ubah dari 0.012 hingga 2.6 m/s. Pasang-surut sepanjang kajian adalah diurnal. Arus pasang-surut adalah ciri yang dominan sepanjang kajian, sementara angin tidak mempunyai kesan terhadap aliran air. Akhirnya, data bagi arus permukaan yang diperolehi menggambarkan bahawa pembelokan air berlaku pada bulan April 1993. Pembelokan berlaku mengikut arah jam dari arah utara ke barat-daya dengan kelajuan purata arus lebih kurang 0.4 m/s.

CHAPTER I

INTRODUCTION

Factors Inducing Water Circulation

The study of the ocean is always a challenging and intriguing process considering its size and the expanse of the earth it covers. Features of sea circulation are complex and a challenge for humans to comprehend. All life and climatical changes depend on circulation. There is no doubt that water circulations of the world are important to life in this planet. It is not easy to understand water circulations because there are many factors controlling them. Scientists cannot study the factors separately as this will give them an imperfect answer.

Most scientists identify the forces which induce circulations to be the wind (Watten, 1973; Gross, 1977) and the tide (Horrer, 1967) but there are many other factors that play a role in water circulations.

Many of the surface currents are wind driven. So studies of water movements in the shallow coastal regions as well as in the open sea require knowledge of atmospheric forces, including pressure and wind stress. Momentum exchange is the most direct and immediate link between atmospheric and oceanic circulations and occurs whenever wind blows over any part of the sea. Some of the momentum causes turbulence drag, or shearing stress between the water layers (Bowden, 1960; Beer, 1983). The integrated action of wind system results in a large-scale translation of water masses. Turbulence drag and shearing stress between water layers disturb the seas inherent kinetic energy. The influence of the earth's rotation, on the other hand, is the primary driving force of the world's major current systems such as the huge anticyclonic gyres (Csanady, 1980).

Density differences between water masses is another driving force that induces water movement, usually the vertical movements. The flow of the major deep water currents are caused by gravity pulling the denser water masses downwards, displacing lighter water masses upward. Since the density is controlled by the water temperature and salinity, these currents are usually called thermohaline currents (Horrer, 1967; Pickard and Emery, 1982).

The third factor that generates water movements is the tidal force. Being oscillatory in nature the tides cause net water movement which is averaged over a period of weeks or months. There are other large scale currents which are superimposed on this type of water movement. Small-scale oscillatory currents can sometimes be observed where water is confined in harbours or estuaries (Davis, 1977).

Water Circulation in the South China Sea

To understand the water movement pattern of Kuala Terengganu, one should get more information about water circulation in the South China Sea. This is because, Kuala Terengganu water is a part of the South China Sea and therefore knowing more about the water properties in the South China Sea will help researchers to understand the water circulation off Kuala Terengganu.

The South China Sea is the largest water body in Southeast Asia (Figure 1). It is surrounded by the Asian continent, the Indonesian Archipelago, West Malaysia, the Philippines and Formosa. The seafloor of the south china sea can be divided into 3 distinct areas. They are; (1) Northern Sunda Shelf, (2) Gulf of Thailand and (3) China sea basin.

The Northern Sunda Shelf extends between Sumatra and Borneo north eastwards as a narrow belt (50-100 km) along the Asian Continent Borneo and Philippines. Average depth of the shelf is 50 m with its deepest part at 100 m.

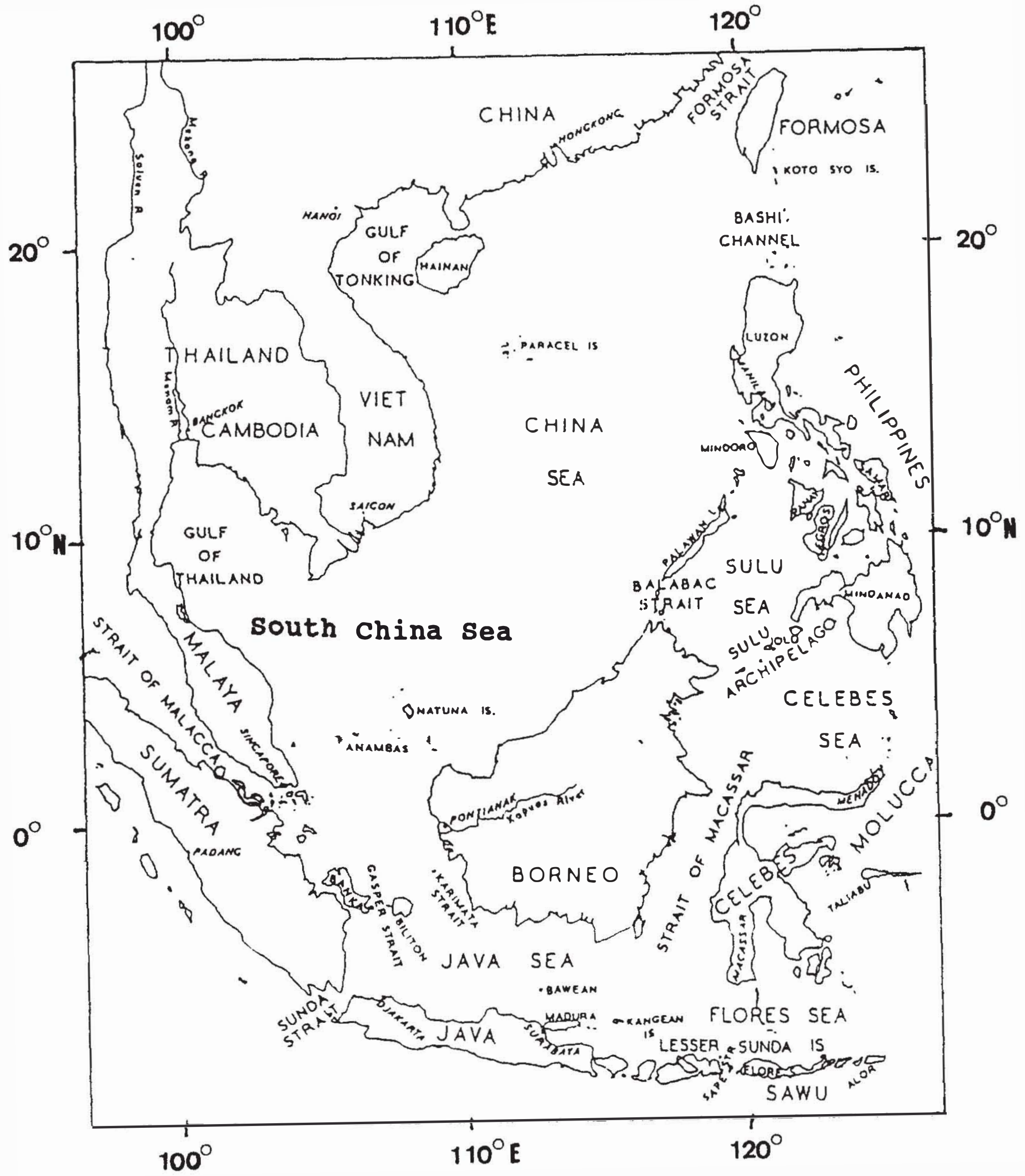

Figure 1. Geographical Location of South China Sea (From Pohlmann, 1987)

To the north-west is the Gulf of Thailand. The Gulf is about 400 km wide and it has a maximum depth of 85 m. The China Sea basin is the deepest part of South China Sea. This area is characterized by a combination of bathymetric features. Off the Sabah Coast is the Palawan Trench with a maximum depth of 3475 m. Away from the Palawan Trench, the seafloor turn into a broad irregular plateau. This area posses numerous seamount and fringing reefs that protrude to the surface appropriately named Dangerous Grounds (Wyrtki 1961).

One of the main features of the South China Sea is its location in the tropical low latitudes, which have two important effects on the circulation. Firstly, the reduction of the Coriolis parameter near the equator makes nonlinear and frictional force become increasingly important. Secondly, the South China Sea is dominated by the monsoon regime and is strongly influenced by semi annual reversing circulation of the atmosphere (Pohlmann, 1987).

Figures 2 and 3 show the wind stress distribution in January and July. In January north-easterly winds prevail over the whole region with an average magnitude of 9 m/s. In July the wind distribution is totally reversed. Weaker southwesterly winds dominate over most parts of the South China Sea with an average magnitude of 6 m/s (Hellerman, 1968; Pohlmann, 1987).

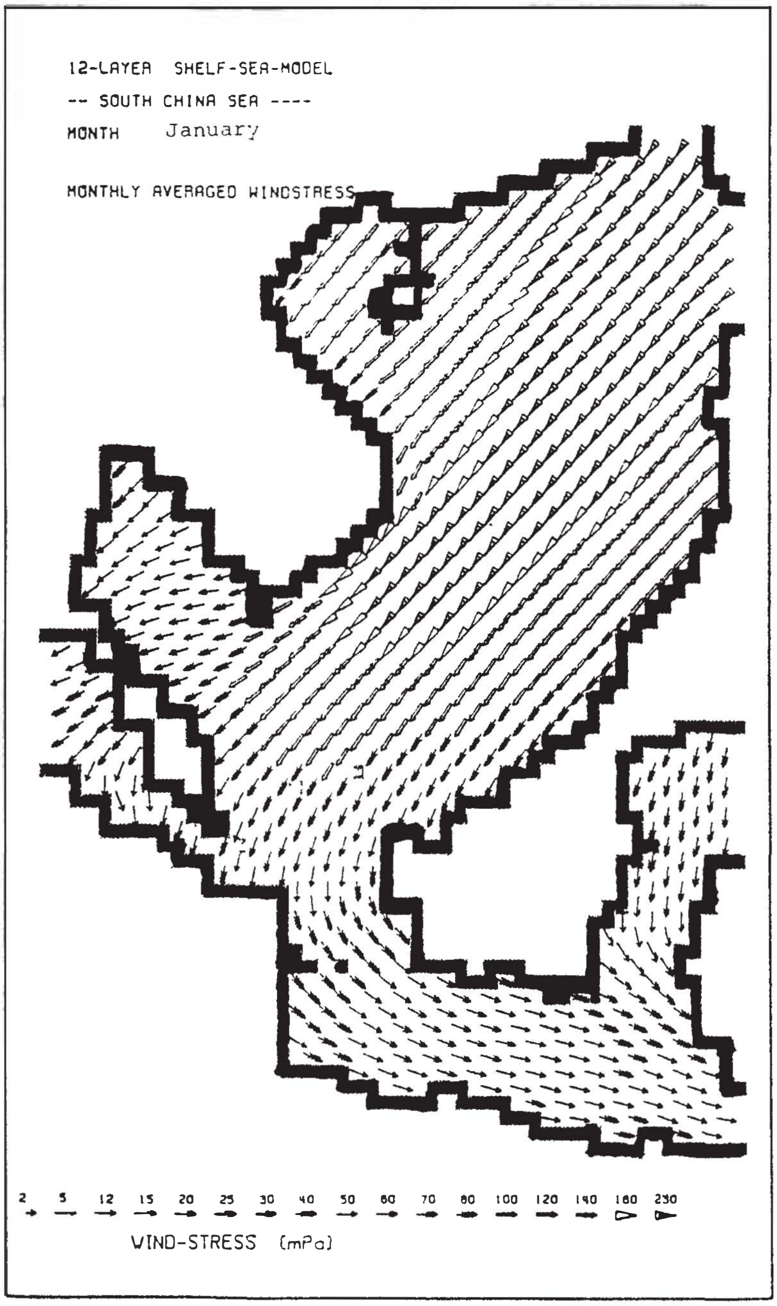

Figure 2. Wind Stress Distribution in January (From Hellerman, 1968)