

VARIABILITIES IN JOHOR RIVER DISCHARGE

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A dissertation submitted in partial fulfillment of the
requirements for the award of the degree of
Master of Science (Mathematics)

Faculty of Science
Universiti Teknologi Malaysia

JANUARY 2017

Very Special dedication to:

My beloved father: Hashim Bin A. Rahman

My beloved mother: Maryani Binti Omar

My beloved husband: Mohd Ridzuan Bin Azman

My beloved daughter: Aina Nasuha Binti Mohd Ridzuan

My beloved father in law: Azman Bin Ansar

My beloved mother: Suryani Binti Md Noh

To my beloved siblings and all my friends

Thanks for everything.

ACKNOWLEDGEMENT

All thanks and praise is to Allah for His blessings and guidance as I have completed this dissertation with success.

I would like to express my deepest gratitude to my supervisor, Dr Norhaiza Ahmad, who has dedicated in showing her guidance and sharing her brilliant suggestions throughout the duration of completing the dissertation. Without her time and moral support much of this research could not have been accomplished.

A special thanks to Dr Arien Heryansyah from Faculty of Civil Engineering UTM for his help, time, kindness and especially his knowledge that has helped me to understand the hydrological aspect of river discharge.

I also want to thank my family for their support and prayers in completing this dissertation. Last but not least, I want to thank all my friends who have directly and indirectly contributed ideas throughout my work. Thank you.

ABSTRACT

River discharge is the volume of water which flows through a river channel within a specific time. Discharges are normally used by the hydrologist in order to measure variability of a flow. The aim of this study is to compare the variability of different period of hydrological time series discharge among the eight rivers in the State of Johor. We also aim to identify the high and low variabilities of river discharge using Wavelet Analysis. Our main data source is the daily river discharge series from 1st January 1980 to 31st December 2008 for eight gauging stations in Sungai Johor, Sungai Sayong, Sungai Lenik, Sungai Bekok, Sungai Kahang, Sungai Lenggong, Sungai Muar and Sungai Segamat. The results show that the variability exist in this study as we compared the daily data between the years through time series plot. The temporal variability is determined using different period of hydrological time series i.e. daily and half month. We also demonstrated Wavelet Analysis using half month data for Sungai Sayong and Sungai Muar. Finally, we identified the high and low variabilities for the eight rivers in Johor. The result obtained shows that high variabilities occur in shorter period compared to low variabilities.

ABSTRAK

Pelepasan sungai adalah jumlah isipadu air yang mengalir melalui saluran sungai dalam masa yang tertentu. Pelepasan sungai biasanya digunakan oleh ahli hidrologi dalam usaha untuk mengukur kebolehubahan aliran. Tujuan kajian ini adalah untuk membandingkan kebolehubahan tempoh yang berbeza hidrologi pelepasan siri masa antara lapan sungai di Negeri Johor. Kami juga berhasrat untuk mengenal pasti kepelbagaian yang tinggi dan rendah dengan menggunakan Analisis Wavelet. Sumber data utama kami adalah siri pelepasan sungai setiap hari dari 1 Januari 1980 hingga 31 Disember 2008 untuk lapan stesen tolok di Sungai Johor, Sungai Sayong, Sungai Lenik, Sungai Bekok, Sungai Kahang, Sungai Lenggong, Sungai Muar dan Sungai Segamat. Dalam kajian ini, kami dapati bahawa kebolehubahan wujud setelah dibuat perbandingan dalam data harian antara tahun-tahun menerusi plot siri masa yang dibuat. Kepelbagaian tempoh masa ditentukan menggunakan tempoh yang berbeza siri masa hidrologi iaitu setiap hari dan setengah bulan. Kami juga mendemonstrasi Analisis Wavelet dengan menggunakan dua buah batang sungai, Sungai Sayong dan Sungai Muar. Akhir sekali, kami memeriksa kepelbagaian yang tinggi dan rendah untuk lapan sungai di Johor. Hasil kajian ini mendapati bahawa kepelbagaian yang tinggi berlaku dalam tempoh yang lebih singkat berbanding kepelbagaian yang rendah.

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

River discharge is defined as the volume of water which flows through a river channel within a specific time. Discharge is normally measured at gauging stations that are situated at different points along the river and is measured in cubic meters per second (m^3/s). In general, the discharge is important to help hydrologists to determine the frequency of occurrence of discharge above a specific level. Besides, hydrologists can also determine the duration of discharge of a particular flow event and make predictions of the next flow event that will occur. The flows of these rivers can be subjected to change through time. Changes or variability of a river flow may be caused by human activities and natural ecosystem effect. One of the methods to measure the flow variability is based on changes in river discharge.

In general, variability refers to the extent to which data points differ from each other. Variability of a river discharge can be referred to as the changes in the characteristics of river discharge at a particular river. There are several methods used by hydrologists to identify the discharge variability. However, there are only few methods that consider time-frequency space in investigating river discharge variability. One such method is Wavelet Analysis. Wavelet Analysis decomposes a time series into time-frequency space while preserving all information from the original data. In particular, Wavelet Analysis has the ability to allow filter to be constructed for stationary and non-stationary signals in the data (Sifuzzaman *et.al*,

2009). In this study, we focus on measuring the river discharge variability at eight rivers in the state of Johor. These rivers are selected as they are located in several flood prone area districts within the state.

River discharge data can be observed at different period intervals i.e daily, monthly and annually. However, the data achieved may display different river discharge variabilities. For instance, half month data could highlight which part of the month that show high or low variabilities. According to Sang *et.al* (2013), investigating different periodic characteristics of river discharge data at multi-temporal scale could reveal the local and global characteristics of these rivers. Thus, investigating the variabilities at different periodic intervals could highlight certain dominant variability patterns contained in the data (Wang *et.al*, 2005; Githui *et.al*, 2005; Vezzoli *et.al* , 2012; Santos *et.al*, 2001).

1.2 Problem Statement

There are several methods used by hydrologists to identify the discharge variability. However, not many methods are able to decompose a time series into time-frequency space while preserving all information from the original data. In addition, different period of river discharge records may reveal different dominant hydrological periodic characteristics in data.

1.3 Objective of Study

To investigate the variation of river discharge at eight rivers in the State of Johor from the year 1980 to 2008, we aim:

- i. To compare the variability of the dominant period of hydrological time series river discharge between daily and half month data
- ii. To detect the period and frequency of high variability of river discharge using Wavelet Analysis
- iii. To detect the period and frequency of low variability of river discharge using Wavelet Analysis

1.4 Scope of Study

In this study, we focus on the variability of eight rivers located in eight districts in Johor. These rivers are located in flood prone area district. The rivers are Sungai Johor and Sungai Sayong (Kota Tinggi), Sungai Bekok (Batu Pahat), Sungai Lenggong (Mersing), Sungai Kahang (Kluang), Sungai Lenik, Sungai Muar and Sungai Segamat (Segamat).

This data set is a time series data of river discharge covering 29 years, starting from 1st January 1980 to 31st December 2008. These data were successfully obtained from the Department of Irrigation and Drainage Malaysia with the help of Dr Arien Heryansyah from UTM Faculty of Civil Engineering. Analysis was done by using daily and half month average of discharge data.

1.5 Significance of Study

By comprehending the patterns of the river characteristics and river variability in the State of Johor, we can detect period and frequency of the high and low variability. We can also unveil the dominant variability pattern that occurs between the two different period such as daily and half month. It is very important to have better understanding about the variability of the rivers in order to manage the water resource allocation, prediction of flood and impact of climate change on its time series trends. We hope to achieve better understanding of the river flow dynamics which is useful for further analysis.

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