A CONCEPTUAL MODEL RELATING THE QUASI-BIENNIAL OSCILLATION AND THE TROPOSPHERIC BIENNIAL OSCILLATION

KWAN KOK FOO

MASTER OF PHILOSOPHY
UNIVERSITY OF MALAYA
2002

A Conceptual Model Relating The Quasi-Biennial Oscillation And The Tropospheric Biennial Oscillation

By

KWAN KOK FOO

Dissertation Submitted in Fulfilment of the Requirements for the
Degree of Master of Philosophy
Institute of Postgraduate Studies
University of Malaya

August 2002

DEDICATION

To my beloved wife, Qui Ching,

and

my daughters, Mei Sham, Mei Fong and Mei Fern,

for their unwavering support and understanding.

ACKNOWLEDGMENTS

My heartfelt appreciation to Associate Professor Dr. Azizan Hj Abu Samah for his time, devotion, guidance and constructive comments in seeing through this research project to its end. If not for his encouragement, this academic pursuit would not have been possible. I am greatly inspired by his virtues of methodical and rigour in research development.

Special mention of thanks especially to Dr. Lim Joo Tick and Mr Ooi See Hai, former Director General and former Director of Research Division respectively of the Malaysian Meteorological Service, for their valuable guidance, precious advice and encouragement. My thanks also to the dedicated lecturers for their diligence and excellent lectures and discussions, as well as to the staff of the Institute of Postgraduate Studies of University of Malaya who have assisted me in every way possible.

I am indeed indebted to the Malaysian Public Service Department for the trust in granting me study leave and sponsoring my postgraduate studies, and to the Malaysian Meteorological Service in giving me the opportunity to carry out this research. Special thanks also to the National Centre of Environment Prediction (NCEP) and Mr Brian Doty in the United States of America in providing me the resourceful NCEP/NCAR Reanalysis Monthly Mean data which forms the basis of this project and the GrADS software respectively.

My sincere thanks extended to my friends and colleagues of the Malaysian Meteorological Service, especially those from the Research, Library and Climate divisions, who have helped me either directly or indirectly to carry out this research work smoothly and efficiently.

These acknowledgments would not be complete without giving credits to my beloved wife, Qui Ching, for her constant support, inspiration and loving encouragement throughout. Last but not least to my three loving daughters Mei Sham, Mei Fong and Mei Fern for their understanding and patience. Thank you for constantly keeping up my spirit, enthusiasm and determination. Together we share the belief that this is a worthwhile endeavour.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

EASM	East Asian summer monsoon
ENSO	El Nino Southern Oscillation
GrADS	Grid Analysis and Display System
NCEP	National Centre of Environment Prediction
QBO	Quasi-Biennial Oscillation
SST	Sea Surface Temperature
SSTA	Sea Surface Temperature Anomaly
TBO	Tropospheric Biennial Oscillation
UAO	Upper Air Observation
UTC	Universal Time Coordinate
WMO	World Meteorological Organization

ABSTRACT

A survey of the zonal wind throughout the troposphere and the lower stratosphere near the equator is made for the 41-year period of 1958-98. A similar survey of the 500-hPa geopotential height, sea surface temperature (SST) and tropopause height is also made, except that the survey period for the tropopause height is shorter than 41 years due to unavailability of data.

Other than the well-known Quasi-Biennial Oscillation (QBO) feature in the lower stratosphere and the Tropospheric Biennial Oscillation (TBO) feature exhibited by the SST, similar oscillation features are found throughout the whole troposphere by both surveys. Autocorrelation functions, Pearson cross correlation functions and smoothed power spectrums of all meteorological parameters used in the surveys indicate that all these features are statistically significant at the 90-95% confident level.

The Pearson cross correlation functions are further used to deduce a conceptual model relating the QBO in the lower stratosphere and the TBO feature found in the interannual variability of monsoon pattern at and near the surface of the earth. The QBO and TBO seem to be interrelated to each other thermodynamically.