สหสัมพันธ์ระหว่างฟลักซ์ความร้อน ความชื้น และรูปแบบลมในมหาสมุทรอินเดีย กับความรุนแรงของมรสุมตะวันตกเฉียงใต้ของประเทศไทย โดยใช้แบบจำลองเชิงตัวเลข เอ็มเอ็ม 5

นายภูเวียง ประคำมินทร์

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรดุษฎีบัณฑิต

สาขาวิชาวิทยาศาสตร์ทางทะเล ภาควิชาวิทยาศาสตร์ทางทะเล

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CORRELATION BETWEEN HEAT FLUX, MOISTURE AND WIND PATTERN OVER THE INDIAN OCEAN AND SOUTHWEST MONSOON INTENSITY IN THAILAND BY USING MM5 NUMERICAL MODEL

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A Dissertation Submitted in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy Program in Marine Science
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Thesis Title	CORRELATION BETWEEN HEAT FLUX, MOISTURE AND WIND PATTERN OVER THE INDIAN OCEAN AND SOUTHWEST MONSOON INTENSITY IN THAILAND BY USING MM5 NUMERICAL MODEL
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ภูเวียง ประคำมินทร์ : สหสัมพันธ์ระหว่างฟลักซ์ความร้อน ความชื้น และรูปแบบลมในมหาสมุทรอินเดียกับความรุนแรงของมรสุมตะวันตกเฉียงใต้ของประเทศไทยโดยใช้แบบจำลองเชิงตัวเลข เอ็ม เอ็ม 5 (CORRELATION BETWEEN HEAT FLUX, MOISTURE AND WIND PATTERN OVER THE INDIAN OCEAN AND SOUTHWEST MONSOON INTENSITY IN THAILAND BY USING THE MM5 NUMERICAL MODEL) อ. ที่ปรึกษา : รศ. อัปสรสุดา ศิริพงศ์, อ.ที่ปรึกษาร่วม : อ.ดร. ดุษฎี ศุขวัฒน์ 140 หน้า.

NCAR's Mesoscale Model MM5 ได้ถูกนำมาใช้คำนวณฟลักซ์ความร้อน ความชื้น และ รูปแบบลมเหนือมหาสมุทรอินเดีย จากละติจูด 30 องศาใต้ถึง 30 องศาเหนือ ลองจิจูด 40 องศาตะวันออกถึง 120 องศาตะวันออก เป็นเวลา 5 ปี ใช้ข้อมูลเฉพาะช่วงมรสุมตะวันตกเฉียงใต้จากพฤษภาคมถึงตุลาคม จากปี 1996 ถึง 2000 ครอบคลุมปีเอลนินโญ (1997) และลานินญา (1998) สหสัมพันธ์ของพารามิเตอร์เหล่านี้กับข้อมูลฝนที่สถานีอุตุนิยมวิทยาหลักในประเทศไทย 13 สถานีในปีปกติ ค่อนข้างสูง ด้วยค่า $R^2 = 0.723$ ในปีปกติ เมื่อฟลักซ์ความร้อนเหนือด้านตะวันออกเฉียงใต้ใกล้ฝั่งทะเลด้านตะวันตกของออสเตรเลียเพิ่มขึ้นคงที่เป็นเวลาประมาณ 5 วันก่อนวันเริ่มต้นของฤดูฝนปกติเฉลี่ย(15 พฤษภาคม) ราว 11 วัน สาเหตุนี้เชื่อมโยงให้เกิดการเริ่มต้นของฤดูฝนที่สถานีอุตุนิยมวิทยา 9 สถานีเริ่มใกล้เคียงกับวันเริ่มต้นฤดูฝนปกติ ในปีเอลนินโญ การเริ่มต้นของฤดูฝนที่สถานีอุตุนิยมวิทยาส่วนใหญ่ล่าช้ากว่าวันเริ่มต้นฤดูฝนปกติราว 50 วัน โดยมีความรุนแรงของฝนน้อยกว่าปีปกติ ในปีลานินญา การเริ่มต้นของฤดูฝนที่สถานีส่วนมากเร็วกว่าวันเริ่มต้นฤดูฝนปกติราว 5 วัน โดยมีความรุนแรงของฝนมากกว่าปีปกติ กรมอุตุนิยมวิทยาจะได้นำผลของการศึกษานี้ไปใช้ในการพยากรณ์การเริ่มต้นของฤดูฝน เพื่อใช้ในกิจกรรมการเกษตรให้ละเอียดถูกต้องมากกว่าวิธีการที่ใช้ในปัจจุบัน

ภาควิชา วิทยาศาสตร์ทางทะเล ลายมือชื่อนิสิต..............................

สาขาวิชา วิทยาศาสตร์ทางทะเล ลายมือชื่ออาจารย์ที่ปรึกษา..............................

ปีการศึกษา 2550 ลายมือชื่ออาจารย์ที่ปรึกษาร่วม..............................

4673822223 : MAJOR MARINE SCIENCE
KEY WORD: MONSOON / HEAT FLUX / MOISTURE / WIND PATTERN / EL NIÑO / LA NIÑA / MM5 MODEL

PHUWIENG PRAKHAMMINTARA : CORRELATION BETWEEN HEAT FLUX, MOISTURE AND WIND PATTERN OVER THE INDIAN OCEAN AND SOUTHWEST MONSOON INTENSITY IN THAILAND BY USING THE MM5 NUMERICAL MODEL. THESIS ADVISOR : ASSOC. PROF. ABSORNSUDA SIRIPONG, THESIS COADVISOR : DUSADEE SUKAWAT, PH.D., 140 pp.

The NCAR's Mesoscale Model MM5 was used to compute the heat flux, moisture and wind pattern over the Indian Ocean from Latitude 30^0 S to 30^0 N and longitude 40^oE to 120^o E for 5 years. The data are used only during the southwest monsoon season from May to October in 1996 to 2000, which covered El Niño year (1997) and La Niña year (1998). The correlation of these parameters was relatively high with R^2 = 0.723 in normal year to the rainfall pattern at the 13 synoptic weather stations in Thailand. In normal year, when the heat flux over the southeast Indian Ocean near the west coast of Australia was increased and persist for approximately 5 days before the average onset date of wet monsoon season (on 15 May) for 11 days, this caused the onset of southwest monsoon at 9 stations in Thailand to start around the average of the southwest monsoon date In El Niño year, the onset of southwest monsoon at most stations was delayed than the average date for 50 days with lesser intensity than normal year. In La Niña year, the onset of the southwest monsoon at most stations were sooner than the averages date for 5 days with stronger intensity than normal. The result of this study will be used by Thai Meteorological Department to predict the onset of southwest monsoon for agricultural activities more accurately than the present method.

Department: Marine Science — Student's signature......................................

Field of study: Marine Science — Advisor's signature......................................

Academic year : 2007 — Co-advisor's signature......................................

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CHAPTER I

INTRODUCTION

Background

The summer monsoon or “wet season” in many parts of Thailand is very important due to the majority of Thai people are agriculturist and nearly all of the productions depend on precipitation. Monsoon onset which is officially announced by the Thai Meteorological Department (TMD) is very useful for planning or conducting any projects relating to agricultural activities. The wet phase refers to the rainy season during which warm, moist, and very turbulence wind blows inland from the warm tropical sea and ocean (Fein et al., 1980).

The southwest monsoon season in most parts of Thailand usually starts on mid-May but some years it was later than normal and some years sooner. In this regard, a few researchers in Thailand have studied the cause and effect of the abnormal monsoon onsets. The normal monsoon onset in Thailand is defined based on statistics of wind directions to be between 220 to 240 degree for at least 3 days, daily precipitation not less than 10mm and falling consecutively for at least 3 days. Sometimes, the monsoon was already onset before the official announcement from TMD, which made it too late for some activities.

From 1952 to present, there are very few methods to predict the summer monsoon onset and no research paper on the correlation of precipitation over Thailand to summer monsoon in the country. Some weather forecasters solely made predictions from the statistical data and their own experiences. This is one of the reasons which cause error in predictions of southwest monsoon onset over Thailand in some years especially “when exactly?” the monsoon will onset.

The Asiatic monsoon is a large atmospheric circulation. Generally, during July to November, Most of Asia is dominated by a gigantic anticyclones wind at 200hPa (hectopascal) over Tibet’s plateau with prominent easterly to its south. Wind at 850hPa on southern Thailand flowing from the Andaman Sea to the land (from southwest to northeastward) and brings huge humidity from the sea to the land as well.

Nowadays, people from agricultural area are realized that the information from the Thai Meteorological Department is useful and necessary for their production planning. The demands of precipitation data especially the onset of the southwest monsoon from TMD by other government and non-government agencies have been increasing. If TMD announces the starting of monsoon onset late, this may cause some damages to agricultural activities. A later or earlier onset of the monsoon rain can have devastating effects on agricultural activities even if the mean annual rainfall is normal. Increasing the ability of weather forecasters in predicting the monsoon onsets accurately is one of the ways from government to fulfill the need of people.

The southwesterly winds in Thailand usually blow from the Andaman Sea which is a part of the Indian Ocean, therefore the southwest summer monsoon is originated from the Indian Ocean. There are three factors which control the monsoon phenomena in the atmosphere; the first one is heat content, the second one is moisture content and the third one is wind intensity that can transfer momentum from place to places. When the southwesterly wind from the Indian Ocean is prevalent over southern Thailand, it causes rain in this region.

The more intense the southwesterly winds, the heavier the precipitation in southern Thailand, therefore there must be some correlation between wind pattern and rainfall intensity.

The heat flux, moisture and wind pattern are very important to characterize the southwest monsoon season in Thailand. Investigation on their correlations and linkages are necessary for prediction of the monsoon onset. The limitation of this study is the lack of data over the Indian Ocean in which most of the study area is covering by water and there are few weather observation stations over there. One of the efficient ways to solve this problem is numerical modeling.

The other air-sea interaction phenomena such as El Niño and La Niña or ENSO have some effects on the southwest monsoon pattern, thus cause the different onset from the normal year. This study includes the monsoon characteristics in El Niño, La Niña and normal years. The result of this study can be compiled in a database for the forecasters to decide when the southwest monsoon in Southeast Asia will start or end.

The Thai Meteorological Department is now developing processes for better weather forecast. This study can improve the ability and accuracy of the weather forecast in the future. If the forecast is accurate, the damages in the agricultural activities and other activities relating the weather effects will be minimized.

The development and maintenance of Asian summer monsoon are closely regulated by the complex distribution of heat and moisture sources over the ocean with the sink over Asian continent (Johnson, 1991). This study is based on the hypothesis, that heat flux, moisture over the Indian Ocean and wind pattern are related to precipitation over the southern part of Thailand during the period of pre-summer monsoon season. If these correlations are understood, prediction the onset of summer monsoon can be more accurately.

Problem Identification

In general, it is well-known that the source of southwest monsoon or wet season in Thailand is over the southeast of Indian Ocean near the western side of Australia. This wind flow over eastern coast of Africa and India before reaching Thailand, this will bring moisture and heat which are the major sources to produce precipitation in Thailand and Southeast Asia (Fein et al., 1980). The source of northeast monsoon is on the Asian continent which is usually cold such as Mongolia and Russia. Thailand is an agricultural country therefore the most precious thing from nature is rain or precipitation. Rainfall can be one of the important precursory to predict the agricultural products of the country. To study the pattern of rainfall in Thailand, the characteristics of the source as shown in Figure 1 must be known.

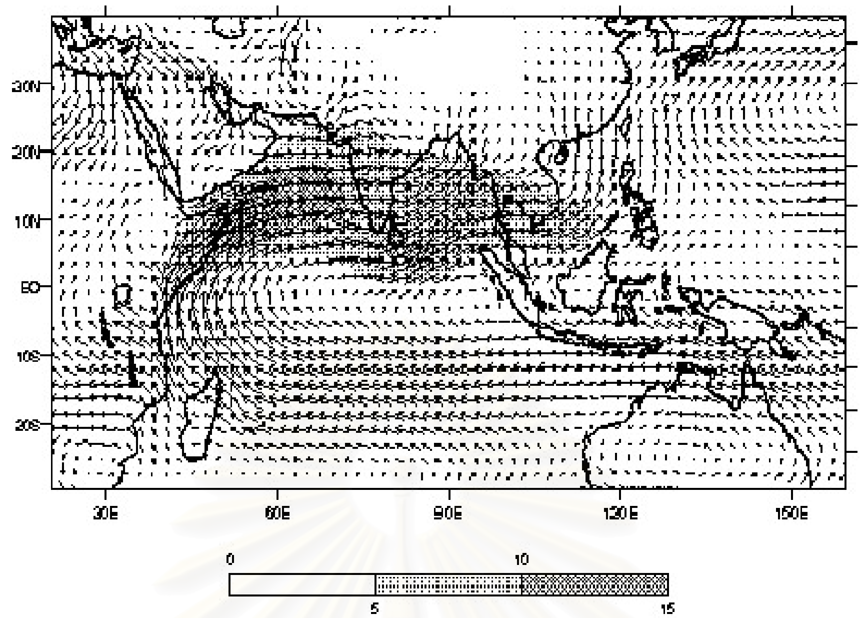


Figure 1 Wind pattern of southwest monsoon with the source over the Indian Ocean (west of Australia).

If the characteristics and changing pattern of all factors which control the monsoon variation in Thailand are known, prediction the onset of monsoon in the area can be done as well. The heat flux represents the heat transfer between the Earth surface and the atmosphere. The moisture is also the cause of changing weather, while wind can transfer energy from place to place.

The Thai Meteorological Department is the official center for weather prediction which is required by all private sectors and government agencies for their own plans to produce their products or conduct activities. The prediction of monsoon onset is usually sent to the media and those who work on early warning system. If the prediction is wrong, it may cause some damages due to improper decisions or unsuitable planning.

Halley (1968) found that monsoon circulation is driving by the different of temperature over land and sea which is ultimately driven by the sun. The different of heat also causes different of atmospheric pressure (Webster, 1980). Nowadays it is believed that there are three factors which cause monsoon system, as follows.

1. The different of heat over land and sea cause pressure gradient and cause wind flow from high pressure to low pressure areas.
2. Wind circulation cause by earth rotation.
3. Moisture process can be the factor which indicated intensity, frequency of rainfall and wet area of monsoon system in the tropical and semitropical area.

The different of heat over land and sea is the most important mechanism to drive monsoon system. The remaining of heat which is the result of incoming and outgoing heat source is *the heat balance* which is accumulated in the atmosphere and also is the important engine to drive monsoon system (Fein et al., 1980).

Even thought these factors are important another factor is also important as well, that is heat transfer process. In this study the heat flux is determined from the equation below:

$$Q'' = Q/A$$

Where Q'' is heat flux

Q is heat transfer ratio
A is area

Young (1995) found that the temperature of atmosphere is decreased or increased depending on the following equation:

$$Q = Q_{rad} + Q_{sens} + Q_{lat}$$

where Q_{rad} is net radiation heating or cooling
Q_{sens} is sensible heating
Q_{lat} is latent heat

The Need for More Researches

This study assumes that all characteristics of heat flux, moisture and wind pattern over the Indian Ocean are correlated with monsoon intensity in Thailand. When these characteristics changed it will induce some changes in terms of monsoon in Thailand. In addition, this study also analyzes the correlations of the heat and moisture with southwest monsoon intensity during El Niño, La Niña and normal year which never been studied before in Thailand. Comparison of these results for each year can show the difference in trend of monsoon process in Thailand as well.

Objective of the Research

The specific objectives are formulated to achieve the general objective of this research study.

<u>General Objective</u>

The research will assess new technique and methodology to predict the southwest monsoon onset in Thailand by using the MM5 model. Difference of summer monsoon in Thailand in El Niño, La Niña and normal years will be studied.

<u>Specific Objective</u>

1. To assess the characteristics of heat flux, moisture and wind pattern over the Indian Ocean.
2. To explore the correlation of heat flux, moisture and wind pattern over the Indian Ocean and monsoon intensity in Thailand.
3. To analyze the changes of heat flux, moisture and the wind pattern over the Indian Ocean during the pre-onset of the southwest monsoon, monsoon onset, monsoon peak and monsoon withdrawal.
4. Compare the summer monsoon during El Niño and La Niña year with normal year.

Scope and Limitation

The research is carried out over the areas of the Indian Ocean and Southeast Asia within latitude 30°S to 30°N and longitude 40°E to 120°E (Figure 2). There are 2 areas in this study. Area 1 is between latitude 30°S to 30°N and longitude 40°E to 120°E. Area 2 is between latitude 3°S to 28°N and longitude 77°E to 109°E.

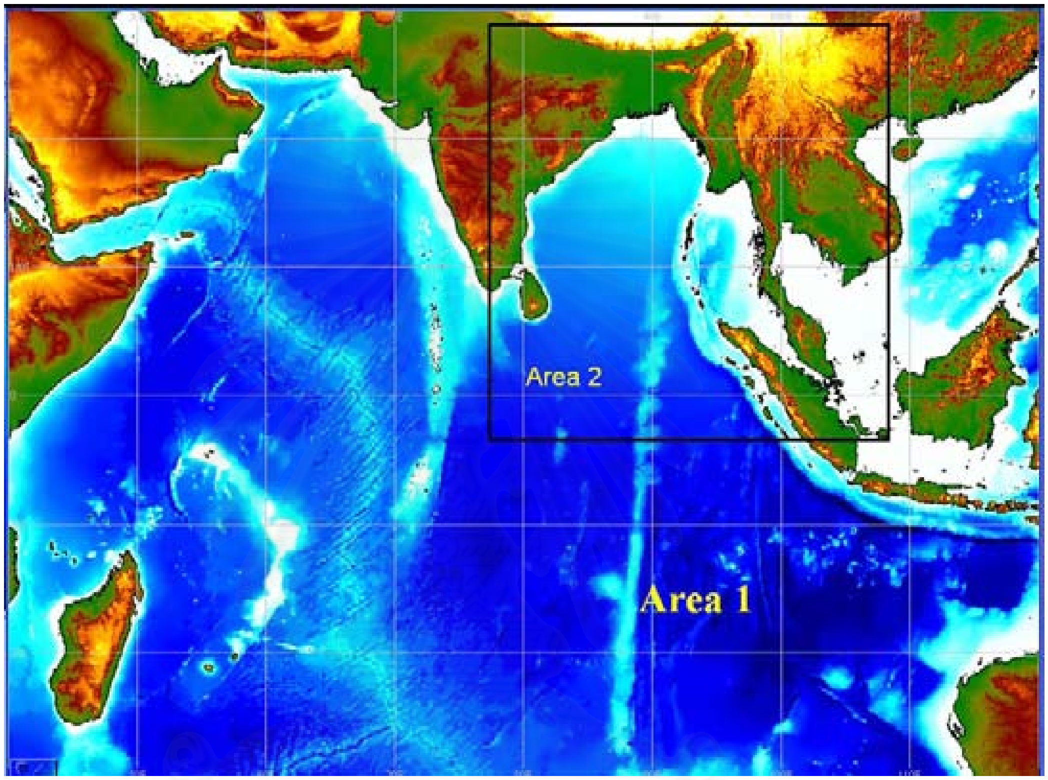


Figure 2 The study areas.
Source: The General Bathymetric Chart of the Oceans (GEBCO)

In this study, observation data from Somalia, Yemen, Oman, India, Sri Lanka and Thailand are used. Data from Thailand are compiled from 13 stations; Phetchabun, Ayutthaya, Prachinburi, Kamphaengsaen (Nakornphathom), Bangkok, Rayong, Chanthaburi, Khlongyai (Trad), Ranong, Takuapa (Pang-Nga), Phuket airport and Phuket which are the most affected area by the southwest monsoon (TMD, 1992) In some cases, if the data are missing the data from other stations are used such as Seychelles, Maldives, Nicobar and Andaman Islands of India. For the wind pattern the upper air data from radiosonde which is available from the web site The Department of Atmospheric Science, The University of Wyoming (1996-2000). Some data from ships which were reported to IOC (Intergovernmental Oceanographic Commission) and WMO (World Meteorological Organization) and also data from the numerical simulation of the European Centre for Medium-Range Weather Forecasts (ECMWF) are also used.

All data are compiled for 00 and 12 UTC (Universal Time, Coordinated) but in some case, every 3 hours as well. The MM5 model is run with the resolution of 30 ×30 km^2 for 24 hours.

The initial data to run MM5 model are from European Centre for Medium-Range Weather Forecasts (1996-2000) such as T: Air temperature (K), U: grid-relative u-component of horizontal wind (m/s), V: grid-relative v-component of horizontal wind (m/s), RH: relative humidity (%), HGT: geopotential height (m), PMSL: sea level pressure (pa), SST or TSEASFC or SKINTEMP (sea surface temperature or skin temperature (K)). All data from this center are already passed quality control with high standard.

In this research, the value of R^2 of 0.6 (or 60%) is selected as the criteria which can be accepted. The time duration of the study covers April to October of the years 1996 to 2000 which covering all El Niño, La Niña and normal year (National Ocean and Atmosphere Administration, 2002).

Expected Results

1. The characteristics of heat flux, moisture and wind pattern over the Indian Ocean during the southwest monsoon onset in Thailand are known.
2. The intensity of the southwest monsoon in Thailand can be identified.
3. The differences of summer monsoon during El Niño, La Niña and normal year are known.

CHAPTER II

THEORY AND LITERATURE REVIEW

Monsoon Theory

Monsoon came from the Arabic words "Mausim" which mean “season” or "the season of winds". This was in reference to the seasonally shifting winds in the Indian Ocean and surrounding regions, including the Arabian Sea. These winds blow from the southwest during one half of the year and from the northeast during the other. There are seasonal changes which are particularly noticed as northeast winds prevailing in the winter in the Southeast Asia and southwest winds in the summer. Monsoons also occur in other parts of the world like Australia and in the southwest portions of the United States. As monsoons have become better understood, the definition now indicates climatic systems anywhere in which the moisture increases dramatically in the warm season. The Asian monsoon, which affects the Indian subcontinent and southeast part of the Asia, is probably the most noted of the monsoons (Webster, 1981).

Thailand is affected from both northeast monsoon (Pacific Ocean side) and southwest monsoon (Indian Ocean side). Southwest monsoon in Thailand by average starts from the middle of May and lasts till mid October, while northeast monsoon starts from the middle of October and lasts till February. The southern part of Thailand is a maritime continent and is affected by both northeast and southwest monsoons.

Monsoons are characterized by their seasonality, geographical preference, and strength. Monsoon rain and winds are the end results of heating (Q) patterns produced by the sun and the distribution of land and ocean. The heating may be positive or negative. Monsoon may be understood by ignoring vertical structure and daily changes in the heating and emphasizing typical horizontal pattern that changes slowly with the seasons. It is convenient to think of these patterns separately into three idealized categories;

$$Q\,(x,y,t) = Q_{GC}\,(y) + Q_{IH}\,(y,t) + Q_{EC}\,(x,t)$$

Where x and y are distance measure eastward and northward, respectively, and t is time.

Q_{GC} represents the heating which would be produced on a homogenous (ocean or land covered) earth on the average, given a sun fix directly above the equator

Q_{IH} represents the inter-hemispheric difference brought about by the annual cycle.

Generally the southern hemisphere is a maritime hemisphere dominated by ocean while the northern hemisphere is a more continental one. This distinction is especially pertinent in the eastern hemisphere, where the massive Asian continent lies to the north of the Indian Ocean.

The heating, Q_{EC}, is associated with equatorial continentally. This zonal asymmetry arises because of the uneven longitudinal distribution of continents in the tropical belt. It may also have an annual cycle; Q_{EC} is determined by intricate physical processes and is the hardest component to understand (Fein et al., 1980).

Monsoon Motion

The wind is an integral part of the entire water cycle of the monsoon: it scours water from the ocean surfaces, then transports the resulting water vapor and humid air mass over land, and finally rises to produce clouds and rain.

Monsoon Intensity

The intensity of monsoon in Thailand is defined here as the amount of rainfalls at a station divided by 5 years mean of that station;

$$MI = \frac{Rf}{Rm}$$

where : MI=Monsoon Intensity
Rf = the amount of rainfall (mm)
Rm= the 5 years mean of rainfall (mm)

Heat Balance of Earth's and Atmosphere

Since the surface area of a sphere is 4 times that of a great circle, solar radiation intercepted by the planet earth is averaged, for the globe as a whole, one-fourth the solar constant, or about 340 W/m^2. The net air-sea heat flux;

[solar + longwave] + [sensible heat flux] + [latent heat flux]

positive if out of the ocean, negative if into the ocean (Tao et al., 1995).

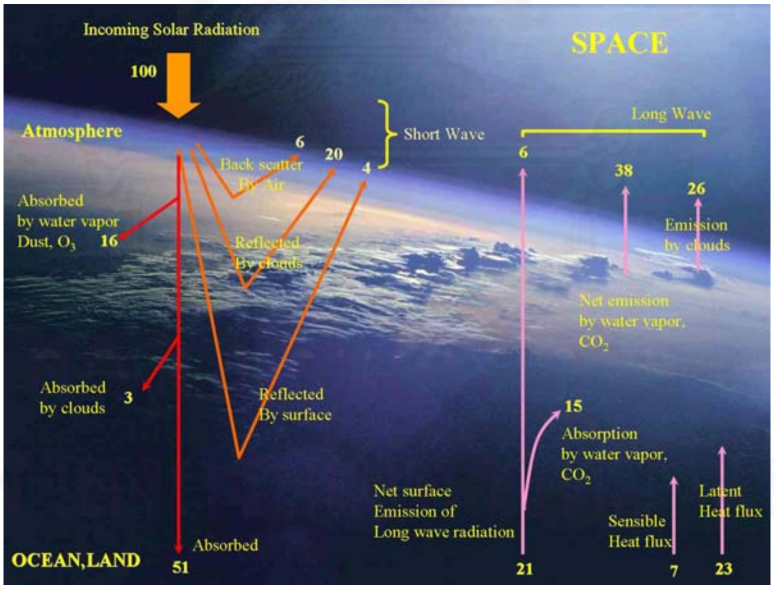


Figure 3 Components of earth's average annual heat balance in percentage unit (Rumny, 1968)

This amount is arbitrarily set at 100 units in Figure 3, which presents estimates of the various components of earth's heat balance. This figure also shows the average annual values of the radiation balance of the earth's surface, i.e., the difference between the absorbed shortwave radiation and the effective longwave radiation.

The Annual Cycle of Radiative Heating

The monsoon involves the atmospheric reaction to differential heating. Heating at a particular location is actually the net radiative heating, that is, the sum of heating from the sun and the cooling of the earth to space, rather than just the distribution of solar heating itself.

The heat balance of the earth is accomplished by a continuous radiation of heat from the earth surface and the atmosphere to space. But from the perspective of understanding the basic driving force of the monsoon, the important point is that the distribution of the heat loss is very different from the heat gain from the sun. Because the heat which loss to space depends on the temperature of the system. Specifically, the loss of heat is proportional to the fourth power of its absolute temperature.

Because of their warmer temperatures, the equatorial regions and the summer hemisphere lose more energy to space than does the winter hemisphere. However the loss varies by less than 30 % over the entire globe at anytime of the year.

Thermal Circulation

If the earth were non-rotating sphere, the equator receives more solar radiation than higher latitude. Equatorial air, being warmer, is lighter and tends to rise. As it rises it is replaced by cooler air from high latitudes. The only way the air from higher latitude can be replaced is from above by the poleward flow of air rising from equator. But the true, circulation is not being like this because of earth's rotation. When the atmosphere is cooled in the North and warmed to the south, isobars bunch close together in the North while in warmed south, they spread apart this dipping of the isobars produces pressure gradient force that causes the air to move from higher pressure to lower pressure. During southwest monsoon the atmosphere over the Indian Ocean is cooler than land (temperature contrasts) then, the wind will blow from ocean to land same as sea breeze characteristic, which is a type of thermal circulation.

Effects of the Earth's Rotation

When the earth rotates from west to east, a point at the equator is moving at about 1,670 km/hr while one at 60^0 latitude moves at one- half this speed. From the principle of conservation of angular momentum, if follows that parcel of air at rest relative to the earth surface at the equator would attain a theoretical eastward velocity of 2,505 km/hr, relative to earth surface, if moved northward to 60^0 latitude. Conversely, if a parcel of air at the North Pole were move southward to 60^0 latitude it would reach theoretical westward velocity of 835 km/hr. However, wind speeds of this magnitude are never observed in nature because of friction (Linsley, et al., 1988).

The direction of air parcel is affected by the Coriolis force, which is an apparent force arising from the earth's rotation. The deflection of this force is to the right in northern hemisphere and to the left in the southern hemisphere.

Base on this idea, the source of wind from southern hemisphere when blow across the equator to northern hemisphere, it is changed direction to be southwesterly wind.

Jet Streams

The Jet Streams are a prominent feature of the general circulation. They are caused by air masses being into motion by strong pressure gradient forces resulting from steep meridional temperature gradients and by angular momentum imparted by rotation of the earth's surface. Jet streams are quasi-horizontal, sinuous, undulating of air traveling near the tropopause at speed raging from about 30 m/s to over 135 m/s. This jet stream, which, over the south Asia such as India and Bangladesh can be the cause to produce upper wind as westerly trough prevails over Northern Thailand. When westerly trough is prevailing over Thailand, rainfall might occur depending on intensity of this trough.

In Thailand the intensity of westerly trough will be defined by upper wind at 200hPa levels and depth of trough axis. If the intensity of westerly trough is high, even in winter season, it can produce rainfall. The wind which blew from southern hemisphere through along the coast of Africa to Somalia can affect from temperature contrast air mass on land. Then the stream line will bend and merge together and increase wind speed sometime the speed can rise up to over 135 m/s as jet stream. If the source of wind speed from southern hemisphere is high southwest monsoon which prevails Southeast Asia should be high as well. So the jet stream near the coast of Somalia can be one of the conditions that can be precursory of southwest monsoon.

Moisture

The moisture divergence has been computed as the difference between the evaporation and precipitation. A detailed knowledge of the moisture flux divergence over the tropical Indian Ocean is essential for identifying the source of the moisture for the summer monsoon rainfall which contributes to about 80 to 90% of the mean annual rainfall over Thailand. A major difficulty in assessing the relative role of the contributions from the Indian Ocean has been the paucity of the evaporation estimates and precipitation measurements over the oceanic regions.

Several investigators (Howland and Sikdar, 1983: Murakami et al., 1984: Cadet and Greco, 1987: Sadhuram and Kumar, 1988) looked into the role of the moisture flux divergence over Arabian Sea and Indian Ocean with limited amount of available data over specific regions or specified seasons.

The mean annual evaporation estimates for the tropical Indian Ocean has been computed following Bunker (1976) using the unpublished pinker data set, as follows:

$$E = P_a C_e (Q_s - Q_a) U$$

Where

E = evaporation rate (mm)

P_a = air density (kg/m^3)

C_e = exchange coefficient for water vapor

Q_s = specific humidity at sea surface temperature (g/kg)

Q_a = specific humidity at the air temperature (g/kg)

U = wind speed (ms^{-1})

The data needed for computing the evaporation estimates for the Arabian Sea have been extracted from the Indian Daily Weather Reports, and the data pertaining to precipitation over the Arabian Meteorological Division of India Meteorological Department.

From the conservation of water (Bunker, 1976),

$$\frac{\partial w}{\partial t} + \nabla Qw = E - P$$

where, W is the total column water mass , Qw the divergence of the moisture flux throughout the column, E is the rate of evaporation, and P the rate of precipitation. Note that $\frac{\partial w}{\partial t} = 0$ for the long term annual mean.

At the annual mean precipitation, values used in the present study are extracted from TMD precipitation values for the year 1995-2000 over Thailand using rain gauge network.

Equation and Numerical Method of MM5

The mesoscale model MM5 has been developed by National Center of Atmospheric Research (NCAR) and is being used in mesoscale meteorological modeling (nest grid ~ 100 km^2), including real-time forecasting, by government agencies and well-known universities, both in the U.S. and abroad (e.g., Europe, Hong Kong and Taiwan). The MM5 model requires extensive computer resources and it normally runs on powerful and expensive computers such as a Cray supercomputer or high-end UNIX workstation. Recently, AMI has ported the complete MM5 package to run on an Intel/AMD PC under the Linux operating system.

This numerical model is base on derivation of thermodynamic equation, derivation of pressure tendency equation, the vertical momentum equation, and coordinates transformation. These equations are shown below.

Derivation of Thermodynamic Equation

First Law of Thermodynamics is the application of the conservation of energy principle to heat and thermodynamic process.

$$dQ = c_v dT + pd\alpha = c_p dT - \alpha dp$$

From the gas law

$$Rdt = pd\alpha + \alpha dp$$

and

$$c_p - c_v = R.$$

Temperature tendency therefore is given by

$$c_p \frac{DT}{Dt} = \frac{1}{\rho}\frac{Dp}{Dt} + \dot{Q}$$

where p is pressure (absolute)

V is volume
T is absolute temperature (T_C + 273.15)
T_C is temperature in Celsius
R is ideal gas constant (8.314472 J/mol.K)

$\gamma = \frac{c_p}{c_v}$ is adiabatic index (ratio of specific heat)

$\rho = \frac{m}{v}$ is density

c_v is specific heat at constant volume

c_p is specific heat at the constant pressure

Derivation of Pressure Tendency Equation

From Gas Law

$$\frac{1}{p}\frac{Dp}{Dt} = \frac{1}{\rho}\frac{D\rho}{Dt} + \frac{1}{T}\frac{DT}{Dt}$$

Continuity and Thermodynamics equations lead to

$$\frac{1}{p}\frac{Dp}{Dt} = -\nabla \cdot \mathbf{v} + \frac{\dot{Q}}{c_p T} + \frac{1}{c_p \rho T}\frac{Dp}{Dt}$$

However, $c_p \rho T = \left(\frac{c_p}{R}\right)p$, so

$$\frac{1}{p}\frac{Dp}{Dt}\left(1 - \frac{R}{c_p}\right) = -\nabla \cdot \mathbf{v} + \frac{\dot{Q}}{c_p T}$$

But $1 - \frac{R}{c_p} = \frac{c_v}{c_p} = \frac{1}{\gamma}$, therefore

$$\frac{Dp}{Dt} = -\gamma p \nabla \cdot \mathbf{v} + \frac{\gamma p \dot{Q}}{c_p T}$$

The Vertical Momentum Equation

$$\frac{D_w}{D_t} + \frac{1}{\rho}\frac{\partial p}{\partial z} + g = D_w$$

Defining $\alpha = \frac{1}{\rho}$ then

$$\frac{D_w}{D_t} + \alpha\frac{\partial p}{\partial z} + g = D_w$$

Defining hydrostatic reference and perturbation,

$$\alpha = \alpha_0 + a', p = p_0 + p'$$
$$\frac{D_w}{D_t} + (\alpha_0 + \alpha')\left(\frac{\partial p_0}{\partial z} + \frac{\partial p'}{\partial z}\right) + g = D_w$$

By definition, $\alpha_0 \frac{\partial p_0}{\partial z} = -g$, so

$$\frac{D_w}{Dt} + \alpha' \frac{\partial p'}{\partial z} + \alpha_0 \frac{\partial p'}{\partial z} + \alpha' \frac{\partial p_0}{\partial z} = D_w$$

This can be written as

$$\frac{Dw}{Dt} + \alpha \frac{\partial p'}{\partial z} - g\frac{\alpha'}{\alpha_0} = D_w$$

which can be expanded as

$$\frac{Dw}{Dt} + \alpha \frac{\partial p'}{\partial z} - g\frac{\alpha - \alpha_0}{\alpha_0} = D_w$$

In terms of ρ, this is

$$\frac{Dw}{Dt} + \frac{1}{\rho}\frac{\partial p'}{\partial z} - g\frac{\frac{1}{\rho} - \frac{1}{\rho_0}}{\frac{1}{\rho_0}} = Dw$$

Which is :

$$\frac{Dw}{Dt} + \frac{1}{\rho}\frac{\partial p'}{\partial z} + g\frac{\rho'}{\rho} = D_w$$

This can be expressed in terms of temperature and pressure perturbations for the buoyancy term because

$$-\frac{\rho'}{\rho} = \frac{\rho_0}{\rho} - 1 = \frac{p_0 T}{p T_0} - 1 = \frac{p_0}{p}\left(\frac{T}{T_0} - \frac{p}{p_0}\right) = \frac{p_0}{p}\left(\frac{T'}{T_0} - \frac{p'}{p_0}\right)$$

So

$$\frac{Dw}{Dt} + \frac{1}{\rho}\frac{\partial p'}{\partial z} - g\frac{p_0}{p}\left(\frac{T'}{T_0} - \frac{p'}{p_0}\right) = D_w$$

Coordinate Transformation

General coordinate transformation $(x, y, z) \rightarrow (x, y, \sigma)$

$$\left(\frac{\partial}{\partial x}\right)_z \rightarrow \left(\frac{\partial}{\partial x}\right)_\sigma - \left(\frac{\partial z}{\partial x}\right)_\sigma \frac{\partial}{\partial z}$$

but $$\delta z = \frac{-\delta p_0}{\rho_0 g} = -\frac{(p^* \delta\sigma + \sigma\delta p^*)}{\rho_0 g}$$, so

$$\left(\frac{\partial}{\partial x}\right)_z \rightarrow \left(\frac{\partial}{\partial x}\right)_\sigma - \frac{\sigma}{p^*}\frac{\partial p^*}{\partial x}\frac{\partial}{\partial \sigma}$$

Derivation of $\dot{\sigma}$ Relation

$$\sigma = \frac{p_0 - p_{top}}{p_{surf} - p_{top}} = \frac{p_0 - p_{top}}{p^*}$$

where p_{top} and p_{surf} are the values of p_0 at the top and surface

while $p^* = p_{surf} - p_{top}$

$\dot{\sigma} = \frac{D\sigma}{Dt}$. Therefore $\dot{\sigma} = \frac{1}{p^*}\frac{Dp_0}{Dt} - \frac{(p_0 - p_{top})}{(p^*)^2}\frac{Dp^*}{Dt}$

Expanding total derivatives noting that $p_0 = p_0(z)$ and $p^* = p^*(x, y)$ also that p_0 is hydrostatic

$$\dot{\sigma} = -\frac{\rho_0 g}{p^*}w - \frac{\sigma}{p^*}\left(u\frac{\partial p^*}{\partial x} + v\frac{\partial p^*}{\partial y}\right)$$

Literatures Review

Johnson (1991) reviewed the structures and properties of heat and moisture sources and sinks of the Asian monsoon and found that the results from GARP (Global Atmospheric Research Program) Experiment have yielded important information on these sources, ranging from the planetary scale down to the scale of individual convective system. The emerging picture is one of complex spatial and temporal distributions of heat sources over the enormous area covered by the Asian monsoon with the detailed structure of this distribution determined in large part by a wide variety of types of precipitating systems. Several recent experiments (EMEX), the 1987 Australian Monsoon Experiment (MEX), the 1987 Equatorial Mesoscale Experiment (EMEX), the Taiwan Area Mesoscale Experiment (TAMEX), the 1988-1990 Down Under Doppler and Electricity Experiment (DUNDEE), have provided new knowledge concerning the nature of mesoscale convective systems within the monsoon and their contributions to monsoon heat and moisture sources and sinks. Some of the findings of these experiments confirm previous conceptual models of precipitating systems, but also provide new insight into convective process in the Asian Monsoon.

Murakami et al. (1991) investigated the structure of the July mean local Hadley circulation by utilizing wind, surface pressure, sea surface temperature (SST), and outgoing long wave radiation (OLR) data along 90°E and 110°W. The objective is to compare two types of monsoon, one is driven by land sea contrast (Asiatic summer monsoon) and the other primary induces by SST contrast (Eastern North Pacific summer monsoon). In July, there exists large-scale Hadley circulation covering both hemispheres along 90°E. Superimposed upon this are distinctly separated regional scale Hadley cell, one over each hemisphere. The northern hemisphere Hadley cell is associated with southerly surface wind accelerating from the equator toward monsoon trough as a low-level branch, vigorous summer monsoon rains near the Bay of Bengal representation and updraft leg, and 200hPa northerly winds as an upper-level return flow. The northern cell is completed by an ill-defined down draft leg due to divergent southerly surface wind over the equatorial Bay of Bengal. Continentally with high mountains is the major contributor to enhancement of the summer monsoon over the Bay of Bengal, while the contribution due to SST is minimal. The southern hemisphere Hadley cell is supported by low-level southerly surges bursting out of the mid latitude anticyclone and subjected to considerable warming and air mass modification due to strong SST gradients between 20°S and 10°S. Modified air converges into the near equatorial trough and causes winter time rains near 2°– 8°S, where an updraft leg of the southern hemisphere Hadley cell is located. The southern Hadley cell interacted with the northern counterpart via low-level cross equatorial southerly that is generated as a response to an overall heat contrast between the winter and summer hemispheres.

Pearce (1991) described the main features of the monsoon, particularly its essentially inter-hemispheric character and showing how the latent heat released was associated with the rainfall over Indian and its neighbors and radiative cooling the Indian Ocean determined the monsoon flow at lower and upper levels. An area is then selected between 22.5°N to 32.5°S and 37.5°E to 117.5°E for estimating surface transfer of latent and sensible heat and net tropospheric heating for the six half-monthly periods of June to August 1990 using ECMWF operational analyses. The result shows that less than a quarter of a surface energy input is exported from the region; the rest is offset by radiative cooling, mainly over the South Indian Ocean. It is inferred that much of the observed variability is associated with the location and intensity of monsoon rainfall, at least on time scale up to about a month. It is proposed that such studies, carried out routinely and linked to the limited area of numerical experiments, could contribute substantially to understanding of these processes. At the same time analyses of the much smaller lateral boundary fluxes could enable the nature of the interaction of the monsoon circulation with larger scale phenomena such as ENSO to be separately identified and quantified.

Perovich et al. (2002) estimated heat flux in the Indian Ocean at SHEBE (Observation of sea ice mass balance and temperature made during the year long surface heat budget of the Arctic Ocean) and found the period of maximum heat flux on 15 July to 15 August.

Siripong et al. (2001) found that during strong El Niño years the atmospheric temperatures were relatively higher than normal year, while precipitations were uncertain in the coastal area of Thailand. In that study, they did not include any factors from the Indian Ocean.

Tomiya et al. (2002) found that the heat flux changing at the sea surface of the Indian Ocean has been increased since 1970, and also the trend of average wind speed and humidity is increasing. It also had correlation with El Niño event.

Webster et al. (1998) in the Tropical Ocean-Global Atmosphere (TOGA) program, sought to determine the predictability of the coupled ocean-atmosphere system. The World Climate Research Program's (WCRP) Global Ocean-Atmosphere-Land System (GOALS) program seeks to explore predictability of the global climate system through investigation of the major planetary heat sources and sinks, and interaction between them. The Asian-Australian monsoon system, which undergoes aperiodic and high amplitude variation on intraseasonal, annual, biennial and interannual time scales, is a major focus of GOALS. Empirical seasonal forecasts on the monsoon have been made with moderate success for over 100 years. More recent modeling efforts have not been successful. Even simulation of the mean structure of the Asian monsoon has proven elusive and the observed ENSO-monsoon relationship has been difficult to replicate. Divergence in simulation skill occurs between integrations by different models or between members of ensembles of the same model. This degree of spread is surprising given the relative success of empirical forecast techniques. Two possible explanations are presented: difficulty in modeling the monsoon regions and nonlinear error growth due to regional hydro dynamical instabilities. It is agued that the reconciliation of these explanations is imperative for prediction of the monsoon to be improved.

Yanai et al. (1991) used the objectively analyzed of First GARP Global Experiment (FGGE) II-b upper air data, the large-scale circulation, heat sources and moisture sinks over Tibetan plateau and surrounding areas are examined for 9 months from December 1978 to August 1979. In addition to the FGGE data, special soundings obtained during the Chinese Qinghai Xizang (Tibet) Plateau Meteorological Experiment (QXPMEX) from May to August 1979 are also used in the objective analyses. The evaluation of the large scale flow patterns, temperature, out going long wave radiation (OLR) and vertical circulation is described in order to identify the distinct seasonal change from winter to summer that lead to the onset of Asian summer monsoon. The Tibetan Plateau maintains the huge scale thermally driven vertically circulation which is originally separated from the planetary scale monsoon system. The rising motion exists only on the western plateau in winter and then spread to the whole plateau as the seasonal progresses. The monsoon onset over Asia is an interaction process between the plateau reduced circulation and the circulation associated with the principle rain belt migrating northward. The onset of Southeast Asian monsoon in May and of the Indian monsoon in June reveals that the increased temperature over the eastern plateau during the first onset was mainly the result of diabatic heating, whereas that over Iran-Afghanistan western plateau region leading to the second onset was cause by intense subsidence.

Yawinchan (2002) studied the process of convective cloud developing from convection process by using the MM5 model for 5 cases as summer, rainy season, winter, tropical storm, and drought periods. The Betts Miller Scheme is found to be the best for study grid area over 30×30 km^2 but the disadvantage of this scheme is the over prediction of precipitation.

Yihui (1971) studied the climate of summer monsoon rainfall in China, regional pattern of the summer monsoon rainfall, including the pre-summer rainfall over the south China, the Meiyu season and the rainy season in north China, the low level jet associated with summer monsoon rainfalls, mesoscale features of precipitating systems during the summer monsoon season, atmospheric heat source and their effected on the change in the general circulation in east Asia, and numerical experiments and operational prediction of the summer monsoon precipitation in China.

CHAPTER III

RESEARCH DESIGN

Research Questions

Some specific research questions were raised to attain the research objectives. Research questions are as follow.

1. What are the characteristics of heat flux, moisture and wind pattern over the Indian Ocean?
2. What are the correlation between heat flux, moisture and wind pattern and monsoon intensity in Thailand?
3. What are the changing of heat flux, moisture and wind pattern over the Indian Ocean during, before, peak, weak and withdrawal of southwest monsoon in Thailand?
4. What are the differences of these characteristics during the El Niño, La Niña and normal years?

Data and Method

Most of the studying areas are over the ocean; which are usually lack of meteorological observation stations, so that enough real data that were directly measure from the studying area could not be obtained. Some data were observed from the shore stations and some from the island stations in the Indian Ocean. Fortunately, the upper wind data could be obtained from website of the University of Wyoming (1996-2000) and also the surface wind (10 meters height) from satellite of the National Oceanic and Atmospheric Administration – NOAA (1996-2000) if needed and also data from ECMWF that verified such a good data to study in this area.

Over the ocean, there is not enough data for study air sea interaction phenomena. One of the best ways to solve this problem is that numerical model is developed to predict some phenomena. The Fifth-Generation NCAR / Penn State Mesoscale Model (MM5) are one of the best models to be used. This is one in a series that was developed from a mesoscale model used by Anthes at Penn State in the early 70's which was later documented (Anthes and Warner 1978). This MM5 can be used to study the characteristics of heat flux, moisture and wind pattern over the Indian Ocean. To run this model, the initial data is required. These data can be down loaded from web site of the European Centre for Medium-Range Weather Forecasts – ECMWF (1996-2000) such as air temperature (K), U (Grid – relative with u-component of horizontal wind (m/s), V (Grid – relative with v-component of horizontal wind (m/s), RH- relative humidity (%), HGT – Geopotential height (GPM), PMSL (Sea-level pressure), SST or TSEASRF or SKINTEMP (Sea-surface temperature or Skin Temperature (K)). The resolution of the model for this research is 36×36 km^2. All data are from 00 UTC and 12 UTC.

The outputs from the model are meteorological parameters. More than 20 parameters are obtained including heat flux, moisture and wind. There are 23 vertical levels in the model. Thus it can show the parameters over the Indian Ocean in detail. The model outputs can be evaluated by comparing the results from the model with observation data from the meteorological stations nearby.

The change of these parameter characters obtained from the model might have some correlation with precipitation over southern part of Thailand. Statistical techniques can be used to verify the correlation.

Research Techniques and Data Collection

Data: The required data have been described earlier, these are air temperature (K), U (Grid – relative with u-component of horizontal wind (m/s), V (Grid – relative with v-component of horizontal wind (m/s), RH- relative humidity (%), HGT – Geopotential height (gpm), PMSL (Sea-level pressure (pa)), SST or TSEASRF or SKINTEMP (sea-surface temperature or skin temperature (K)) with grid side 36×36 km^2 as initial data. All data were obtained from the ECMWF database with 2.5×2.5 degree resolution.

Accessary Data: From literatures review, using books, journals, internet resources, newsletters, and other publications including previous thesis and research reports, etc.

Research Sampling and Design

The research sampling and the research design were carried out in five stages as shown in Figure 4.

To review of monsoon onset, prediction process in Thailand.

⇩

Explore the existing prediction processes within the public institutions, which affect directly and indirectly in the context of monsoon onset prediction process.

⇩

Assess the existing knowledge of weather forecaster and monsoon prediction processes

⇩

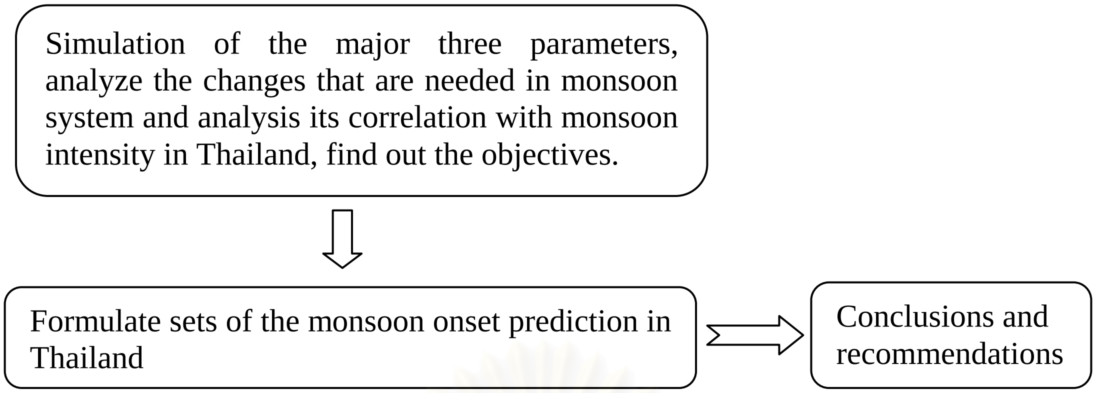


Figure 4 The Research Design.

In the first stage, review of monsoon onset prediction process in Thailand and neighboring countries. Books, Journals, Newsletters, Internet resources and other publications were used to analyze monsoon predictions. This stage relied greatly on a review of the literature in order to learn about sustainability and possible contributions of monsoon onset prediction.

In the second stage, explore the existing monsoon onset prediction process and management practices within the public institutions, which affect directly and indirectly towards sustainable development in the context of monsoon onset prediction techniques.

In the third stage, assess the existing levels of practice, knowledge of weather forecaster and monsoon prediction processes.

In the forth stage, Simulation of heat flux, moisture and wind pattern, analyze the changes that are needed in monsoon system and analysis its correlation with monsoon intensity in Thailand and also find out majors purpose, that is to compare the monsoon onset date of El Niño, La Niña year with the normal year.

Finally, Formulate sets of the monsoon onset prediction and monsoon intensity in Thailand

To illustrate the idea, the processes of this study are shown in Figure 5.

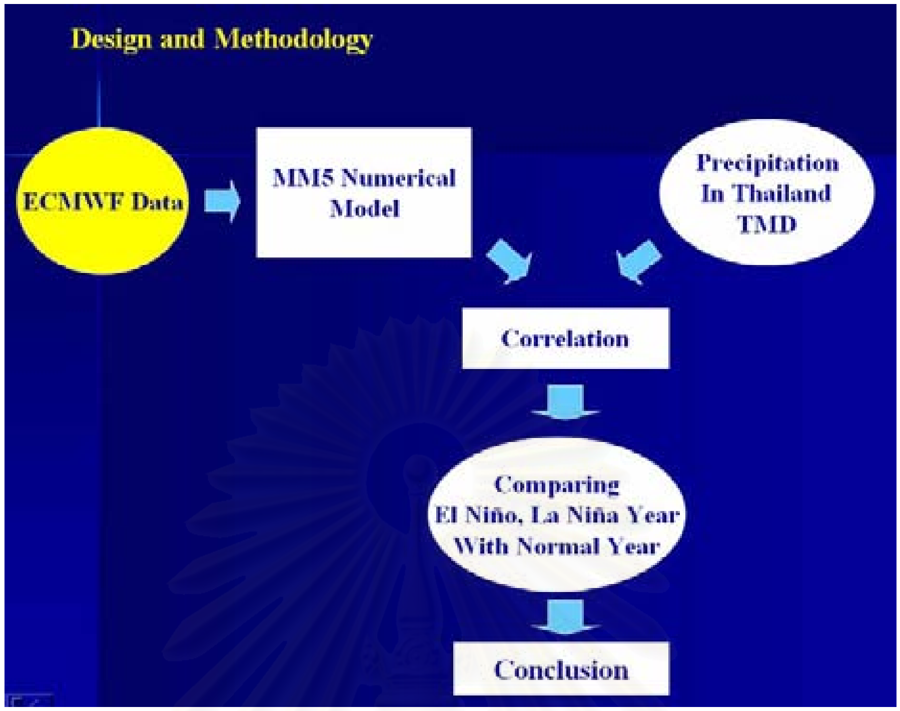


Figure 5 The basic idea of studying process.

Figure 5 shows the basic idea that is used in this study. The MM5 numerical model is setup and the data is obtained from ECMWF. When the outputs of MM5 model came out, the correlation between the outputs and precipitation from 13 synoptic stations in Thailand are computed. Comparisons between El Niño, La Niña and normal years are done to find the difference. Finally, the conclusion is written.

MM5 Model

The numerical model MM5 is a model that can be used to simulate and predict the mesoscale phenomena of the atmospheric. It is written in FORTRAN language. This model is developed by Mesoscale Prediction Group in the Mesoscale and Microscale Meteorology Division of the National Center for Atmospheric Research (NCAR). Flow chart of the model is shown in Figure 6.

In this study the model is run on a PC platform with Red Hat LINUX operating system. The study domain is divided into 2 areas. Area 1 covering latitude 30°S to 30°N and longitude 40°E to 120°E and Area 2 covering latitude 3°S to 28°N and longitude 77°E to 109°E. There are 15 experiment cases for the periods of pre-monsoon, onset, peak, weak and withdraw. The time step of the model is 300 seconds. The model is nested between Area 1 with1-degree resolution and Area 2 with 20-seconds resolution. The initial data from ECMWF between May to October 1996 to 2000 are used as initial data. For each initial data, the model is run for 24 hours.

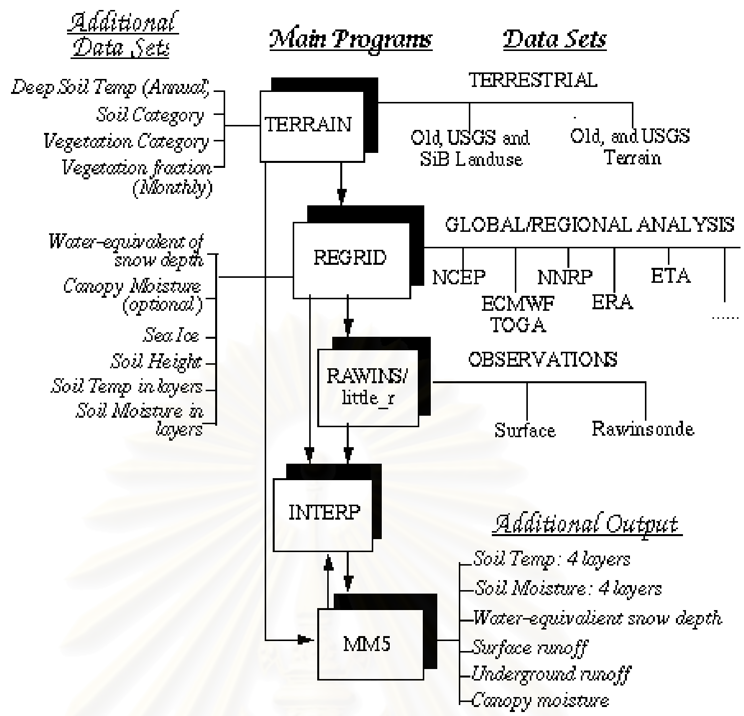


Figure 6 Flow chart of MM5 model processing
(Source: The Pennsylvania State University /
National Center for Atmospheric Research numerical model, 2003)

The output of MM5 model consists of many parameters. For this study, heat flux, moisture (mixing ratio), relative humidity, sea surface pressure, wind speed and direction at 10m, 925, 850, 500 and 200hPa levels, are used. To consider characteristics of heat flux, moisture, and wind pattern, 1 to 14 May is selected as the period of “pre-onset” of the monsoon, 15 May is the monsoon onset, 1 to 15 July is “monsoon breaking period”, 1 August to 15 September is “peak period” and 1 to 15 October is the period monsoon withdrawal (TMD, 1992).

The correlations between the selected model parameters and rainfall are verified using the regression technique. During the years 1996-2000, the specific events are already included, i.e., El Nino and La Niña events as well as normal year event.

CHAPTER IV

RESULT

Some of the heat flux, moisture and wind outputs from the model are shown in Appendix A. (Regarding to huge of output pictures, only necessary picture of output were shown.) The number of output picture all together is more than 50,400 pictures of every 3 hours display from May to October of the year 1996 to 2000.

In Thailand the average day of the summer monsoon onset is 15 May (TMD, 1992). During the El Niño (1997), the provinces whose monsoon onset departs from the average are Phetchabun, Ayutthaya, Prachinburi, Kampaengsaen (Nakhonphathom province) and Bangkok while La Niña (1998) years, only Phetchabun, Kampaengsaen (Nakhonphathom province) and Rayong were departed (Figure 7).

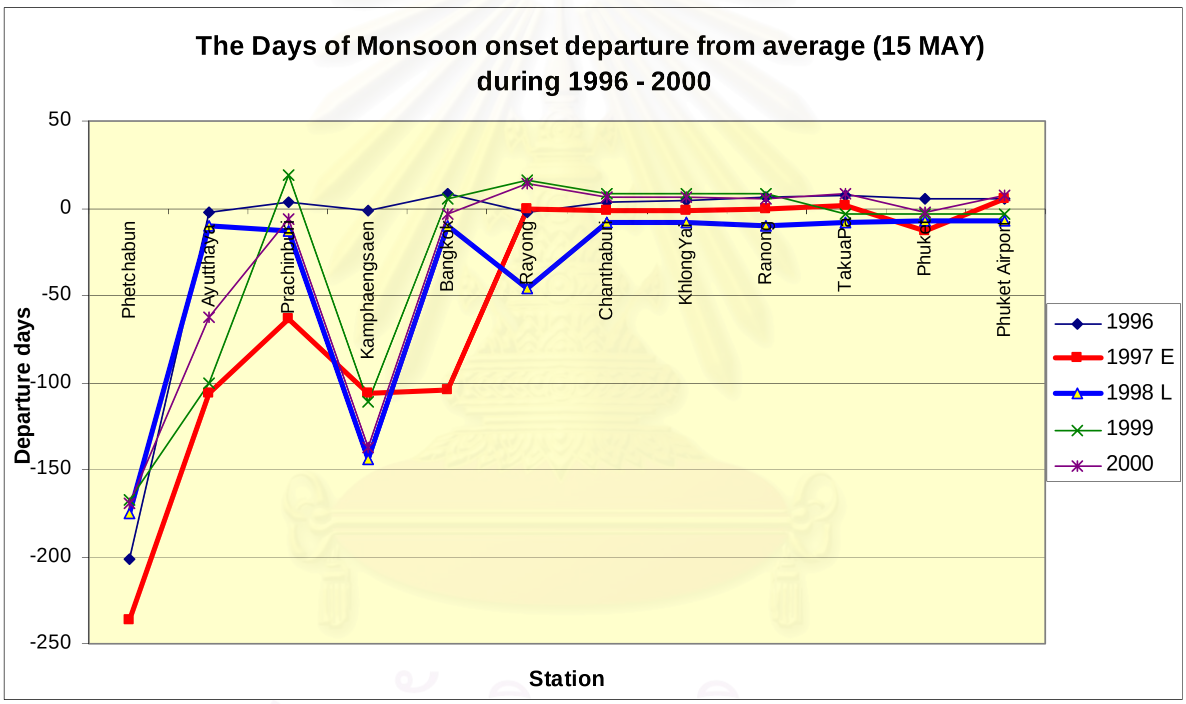


Figure 7 The days of monsoon onset.

The Characteristic of Heat Flux, Moisture and Wind Pattern over the Indian Ocean

Heat Flux

In Thailand, the period 1-15 May of every year is considered as pre monsoon-onset period. The heat flux over the Indian Ocean during the pre monsoon-onset period of the years 1996, 1999 and 2000, do not show much change. Concerning daily variation, heat balance is increased from 00 UTC to 18 UTC while the maximum is at 15 UTC, generally most of the regions have small change except in the Bay of Bengal. In the Bay of Bengal, heat flux near the coast of eastern of India is lower than the other parts of the Indian Ocean.

During 5 to 6 May before monsoon onset, heat flux over the east of Madagascar Island or in the region between 15°S to 30°S 60°E to 100°Et is clearly changed, and in the

Bay of Bengal as well. Regarding the changing heat flux in the Bay of Bengal, it is still lower than the other regions. This sign might be one of the precursors that monsoon is setting up. On 9 May 1996 the changing of heat flux over the Bay of Bengal is moving eastward close to Myanmar coast. This character may trigger the monsoon onset in Myanmar because by the average the monsoon in Myanmar is onset on 10 May (Webter et al., 1998). For the rest of this period, 10 to 15 May 1996, characteristics of all regions are slightly changed (Appendix A).

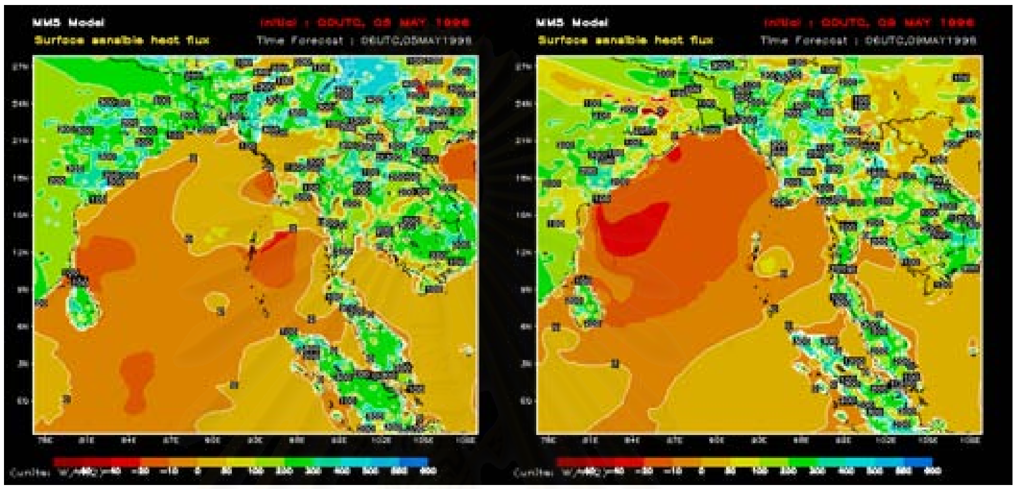
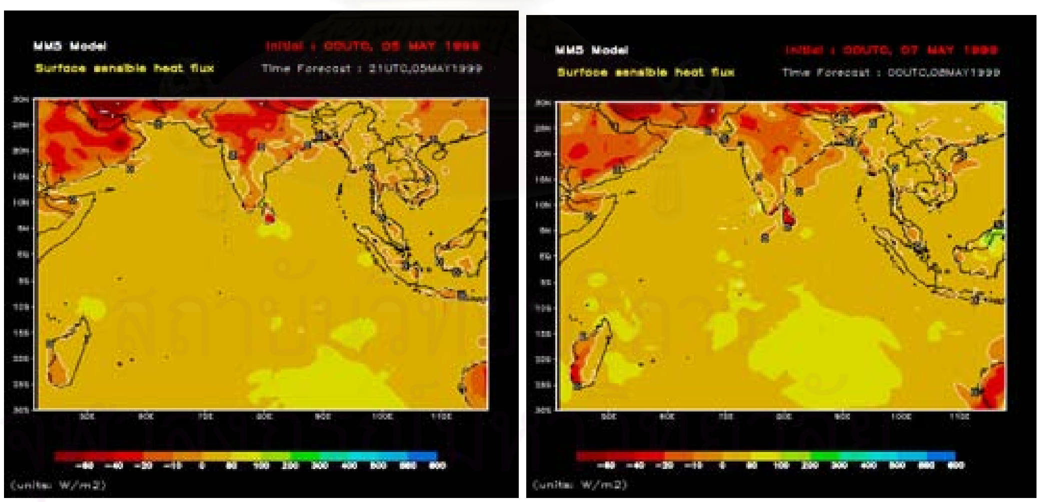


Figure 8 The heat flux in the Bay of Bengal east coast of India
is lower than other regions in the Indian Ocean on 5 May 1996 (left)
then the changing shift to the coast of Bangladesh and Myanmar on 9 May 1996 (right).



(a) (b)

Figure 9 (a) 5 May 1999 heat fluxes over the Indian region between 15°S to 30°S and 75°E to 105°E has increased.
(b) 7 May 1999, the area of increasing heat flux is expanding.

During the period of the pre monsoon-onset in Thailand (by average 1-15 May) in the years 1996-2000 that are used in this study, there was no change in terms of heat flux at the stations from which the data were collected. Most of these stations are located in the central and eastern parts of Thailand which are close to the sea and are affected by southwest monsoon. According to Table 1, the date of monsoon onset was slightly different from the average. When considering the results from MM5 Model, there was no significant change in heat flux in Area 1, except for the Bay of Bengal where the heat flux decreased. Such reduced heat flux could be the precursor of monsoon onset in Thailand.

In 1999 the changing of heat flux had clear trend of increasing during 5 to 7 May within the region between 15° S to 30° S and 75° E to 105° E as shown in Figure 9, while over the Bay of Bengal the heat flux changed slightly.

On 9 May 1999 outlook to 10 May the area of lower heat flux over the Bay of Bengal changed slightly but over the region between 3° N to 6° N and 80° E to 100° E the heat flux was increased as shown in Figure 10.

According to Figure 7 in the page 23, it is noticeable that the average monsoon onset date in the normal years at the stations along the coast of Thailand (namely; Khlongyai, Chanthaburi, Rayong , Bangkok, Ranong, Takuapa, and both of Phuket stations) are close to the average date.

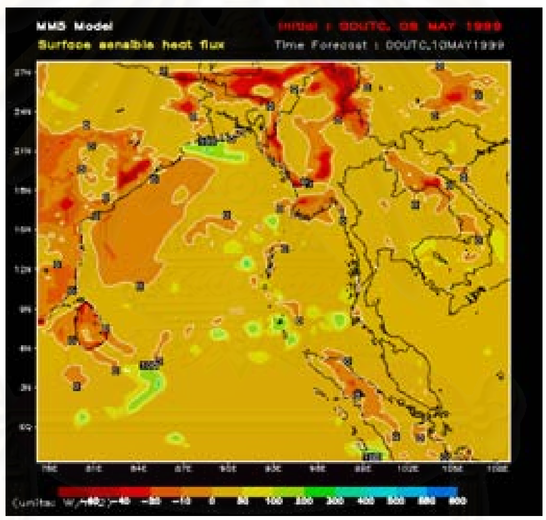


Figure 10 At 00 UTC the heat flux at Bay of Bengal increased, especially in the area within latitude 3 degree north to 6 degree north and 80 degree east to 100 degree east longitude.

In the year 2000, some change was observed. Since 1 May, the heat flux in the east of Madagascar Island slightly increased while the heat flux along the coast of Bangladesh and eastern coast of India decreased.

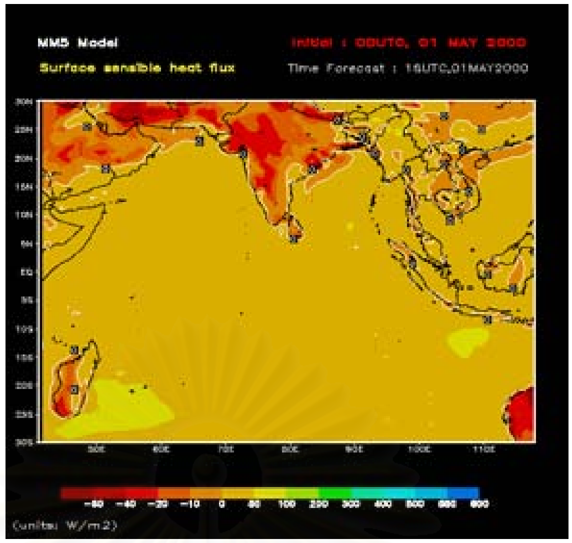
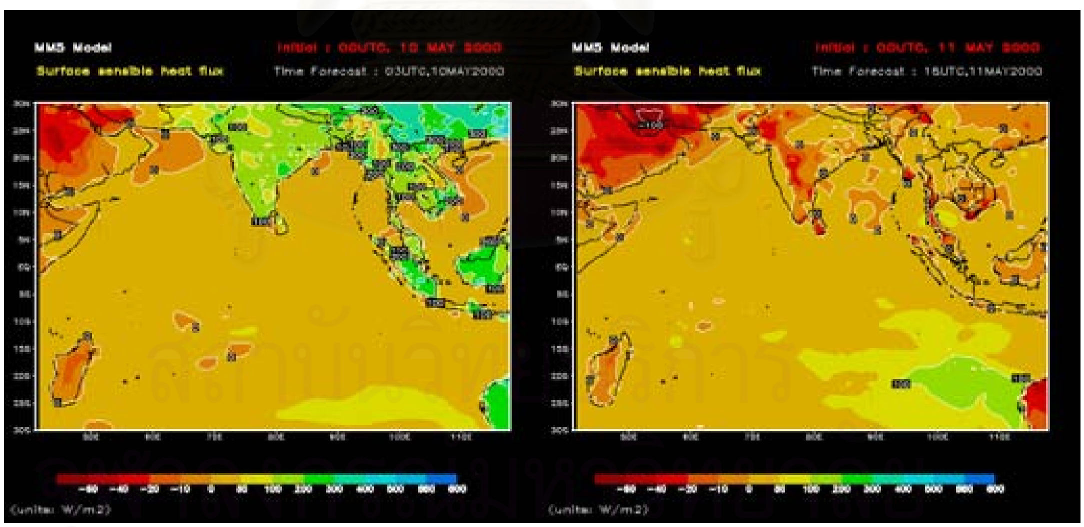


Figure 11 The heat flux in the eastern part of Madagascar Island increased while the heat flux at the coast of Bangladesh and eastern coast of India declined.

In general, there was minimal change in the Indian Ocean and the Bay of Bengal. The heat flux slightly increased in the eastern part of Madagascar Island during 4-6 May. The increase in heat flux was clearly seen on 10 May in the area near Australia between 20° S to 30° S and 80° E to 110° E (Figure 11a) and expanded to other areas on 11 May as shown in Figure 12b.



(a) (b)

Figure 12 the area of heat flux changing in the Indian Ocean at 03 UTC (a) and 18 UTC of 11 MAY 2000 (b).

Another heat flux changing is over the Bay of Bengal. It had some narrow area of change that can be seen clearly on 12 and 14 May especially on 18 UTC (Figure 13).

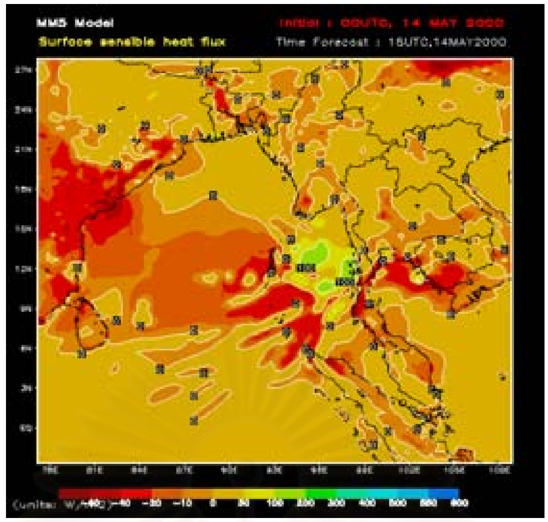
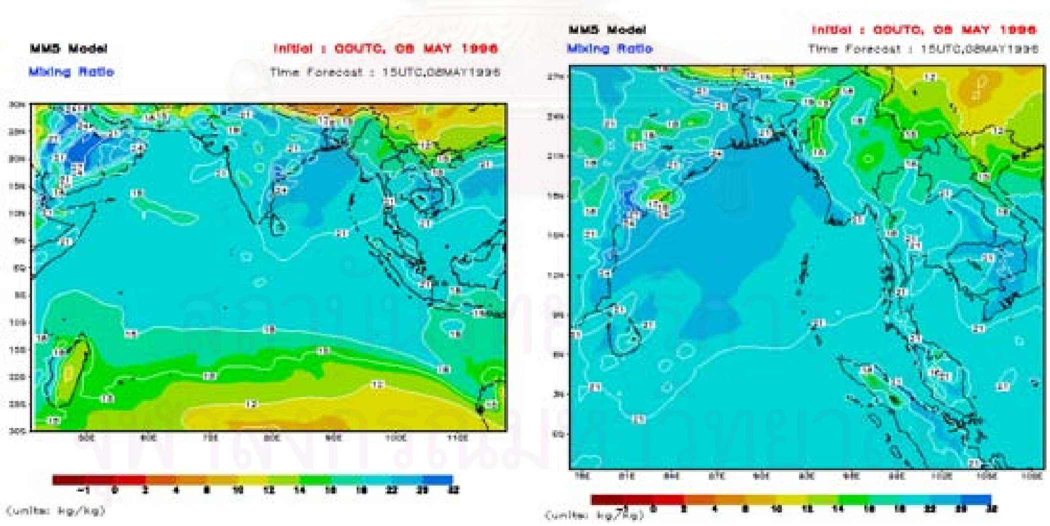


Figure 13 The pattern of heat flux in the Andaman Sea has increased near the coast of Myanmar and Thailand on 14 May 2000, 18UTC.

Moisture

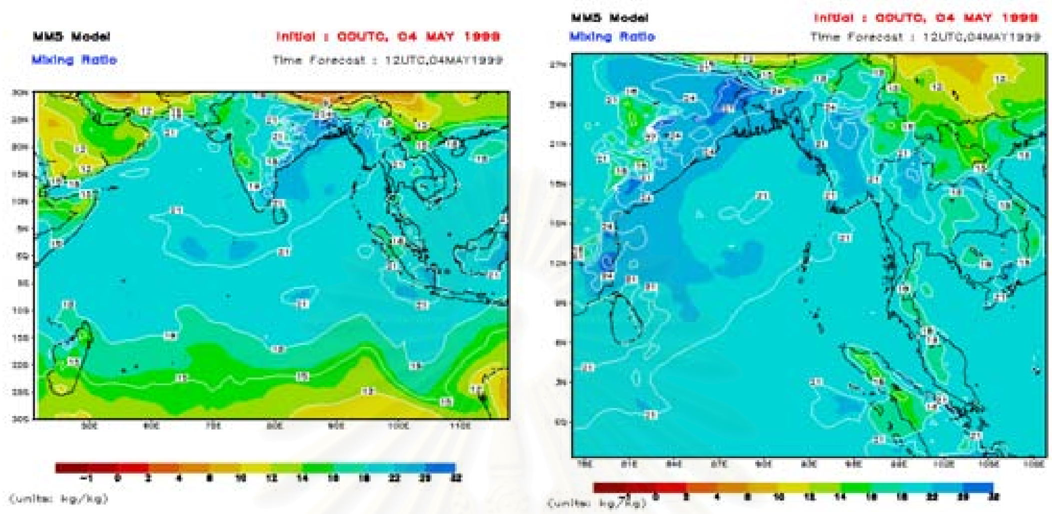
The mixing ratio over the Bay of Bengal was increased while over the other regions in the Indian Ocean it was decreased. During 1 to 5 May 1996, usually at the east of Indian coast and Bangladesh the moisture fluxes were higher than elsewhere. This characteristic persisted until 8 May 1996. On that day, the moisture over Oman was increased rapidly (Figure 14 a), but a small cell of moisture on the east of India was decreased (Figure 14 b). This dry cell persisted at this place for several days and was dispersed later.



(a) (b)

Figure 14 (a) Over Oman region the moisture had increased rapidly and sustain until the end of May 1996. (b) Dry cell which occurred over eastern part of Indian coast on 8 May 1996, 15 UTC.

In the normal year 1999, all characteristics of moisture were the same as in 1996. The moisture was increased on 4 May 1999 near the equator at the region covers latitude 5° S to 5° N and longitude 60° E to 80° E. Also over the Bay of Bengal rim such as east of India, Bangladesh, Myanmar and Thailand moisture had increased (Figure 15). In the year 2000 monsoon in Thailand especially along the eastern coast was onset between 7 to 10 May. That means it had started 5 days before the average.



(a) (b)

Figure 15 Increasing of moisture in the Indian Ocean (a)
and the Bay of Bengal rim (b) on 4 May 1999,12 UTC.

The next factor that has to be considered and obtained from the MM5 model is moisture. The moisture within this model is considered as mixing ratio. The mixing ratio outputs are shown in Figure 16. These pictures of 1 May at 00 UTC and 12 UTC show that the Bay of Bengal, Thailand and nearby area, have higher moisture than neighboring regions. This characteristic of moisture has show about the changing of moist in the study area. During premonsoon and monsoon onset there are not clear of the changing over the Indian Ocean near the coast of Australia but in the Bay of Bengal the moisture had increase continuously then moving to eastward. While in the weak period is conform to wind pattern that the moisture had decrease as well.

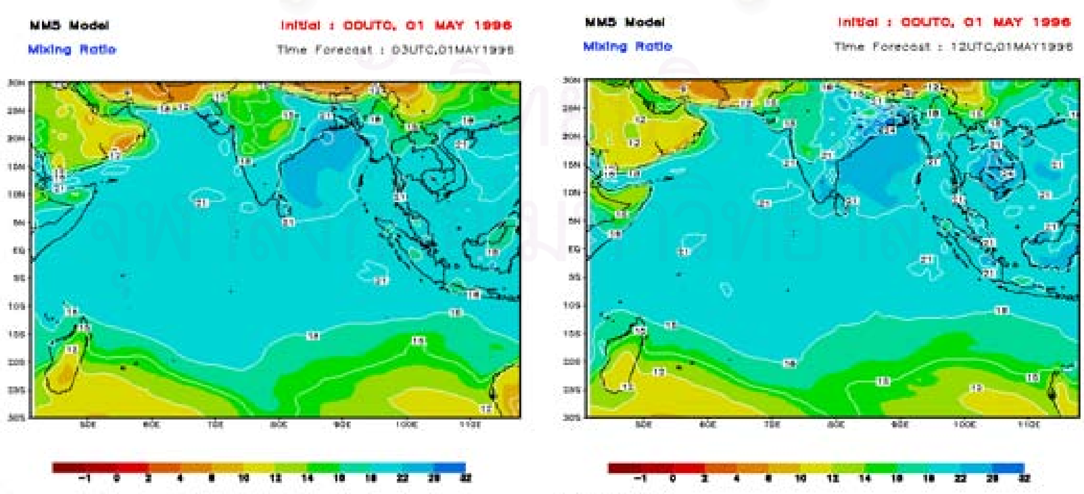


Figure 16 Mixing ratio of 1 MAY 1996 -03 and 12 UTC

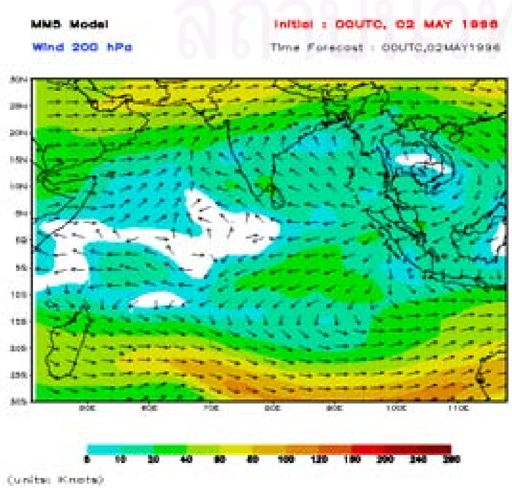
All the major factors: MF (heat flux, moisture and wind) in the periods 1 to 15 May, 1 to 15 July, 1 to 31 August, 1 to 15 September and 1 to 15 October in 1996-2000 are shown in Appendix A. From this study on premonsoon and monsoon onset period, on the normal year the MF usually increase heat flux increase moisture in the Bay of Bengal and wind become steadier and increase speed. When considering the correlation between the MF with monsoon intensity in the coastal of Thailand and in station which located far from the coast, the affect had clearly show at the station which located near shore of eastern and central part of Thailand especially show the type of correlation as lack of correlation at Rayong province. In this case the station along the coast of southern Thailand did not show the change of monsoon intensity. The El Niño year most of stations show that the monsoon intensity is decrease and monsoon onset date were later than normal year excepted southern part, the onset date were near the average. The southern part of Thailand is peninsular which extending to the Sea and had affected from both the Pacific Ocean and the Indian Ocean. On La Niña year the monsoon intensity were intensify and the monsoon onset of most stations were shift average 5 days later than normal year, excepted Chanthaburi was near the average.

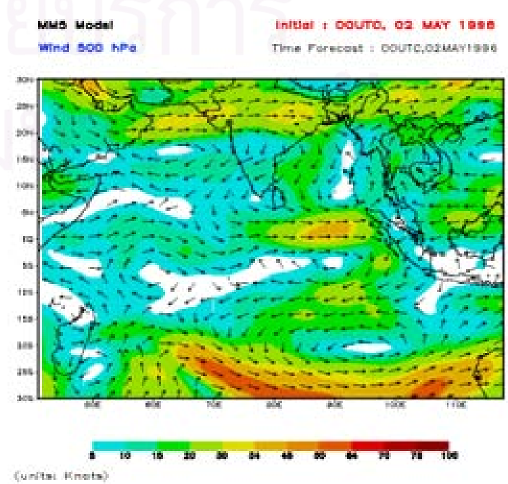
Wind Patterns

On 1 May 1996, at the upper level (200 hPa) the center of anti-cyclonic cell was prevailed over Thailand. This means that the air mass over Thailand was subside, the wind speed was relatively low. Wind speed at 21 UTC had slightly increased relatively to the wind at 00 UTC.

On 2 to 4 May 1996, the wind at the level of 200 hPa was increased. At the level of 500 hPa there was a confluence over Southeast Asia. At 850hPa level, there was a cyclonic vortex over the Andaman Sea, which slightly moved west-northwestward and caused the increase of wind speed in the nearby region. This output wind pattern from the MM5 model (Figures 33 and 34), supports the theory that during pre-monsoon period in the Bay of Bengal, a storm was set up and later developed into a tropical cyclone, inducing summer monsoon onset conditions in Thailand.

These results are conform Webster et al. (1998) that the onset of the summer monsoon can be recognized by the rapid acceleration of southwesterly winds in the western Indian Ocean in early June. Also strong westerly winds established itself from longitude 45° E to 100° E and dominate the Southeast Asia region until October.





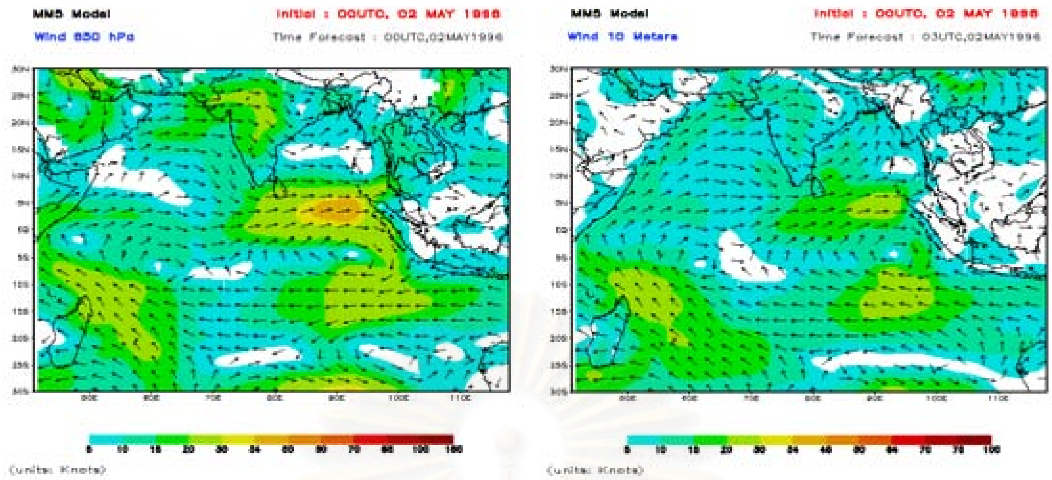


Figure 17 wind patterns at 200, 500, 850 hPa and 10 meter levels on 2 MAY 1996.

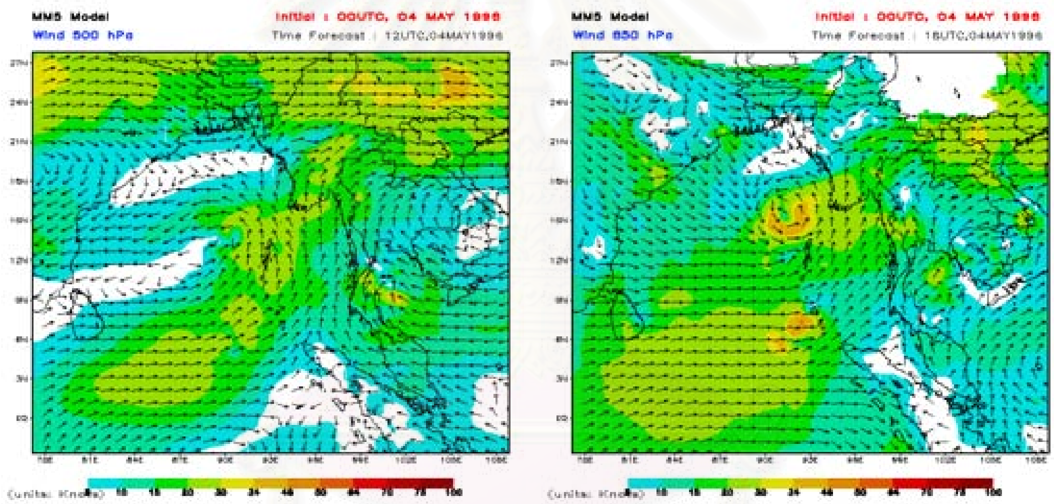


Figure 18 A tropical cyclone in the Bay of Bengal on 2 May 1996 at 12 and 18 UTC, was forming which indicated that the southwest monsoon in Thailand will start sooner.

In this study, in the normal years (1996, 1999 and 2000), at 850 hPa level, there was a cyclonic vortex (which can be developed into a tropical cyclone) in the Bay of Bengal and an anticyclonic vortex in the southern hemisphere between latitude 5° S to 15° S. The anticyclonic cell lied across this area from west to east, while another anticyclonic cell occurred near the coast of Australia. In the southern part of Thailand the wind blows from the west while in the northern part the wind blows from the east. When the southwesterly wind became stronger at 21UTC compared to 00UTC (Figure 18), it induced summer monsoon onset conditions in Thailand.

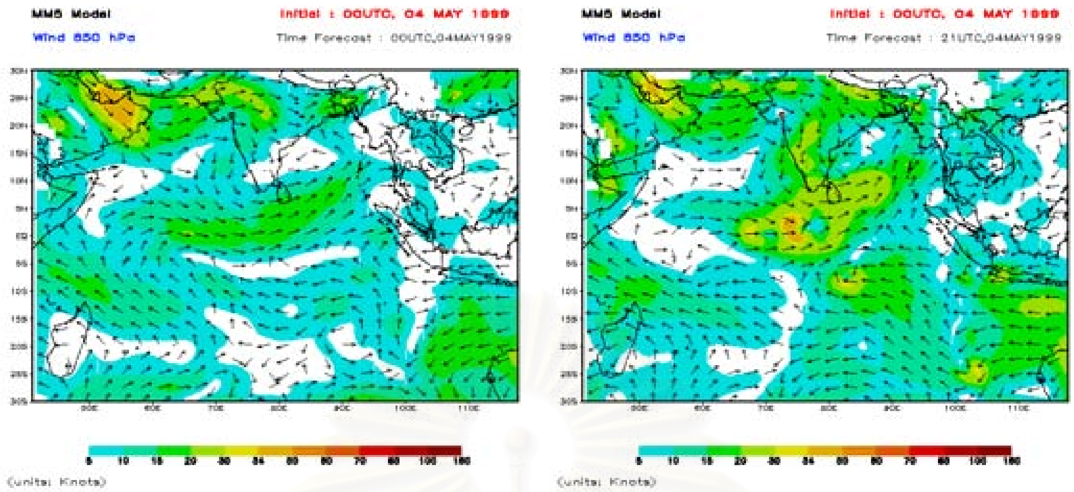


Figure 19 The wind pattern at 850 hPa on 4 May 1999, 00UTC and 21UTC.

The patterns of wind which blew from the southern hemisphere to northern hemisphere are regular according to the pattern of summer monsoon. In the Bay of Bengal the wind at 850hPa level blew more southwestward. The confluence of wind occurred over Myanmar. This could induce more precipitation in Myanmar, which marked the onset of monsoon in Myanmar. All these characteristics are continued without major change for one week. The wind patterns of 850hPa around Thailand were southwesterly winds over the Andaman Sea, but southerly and easterly winds over the South China Sea, indicating the sign onset of southwest monsoon in Thailand (Figure 20).

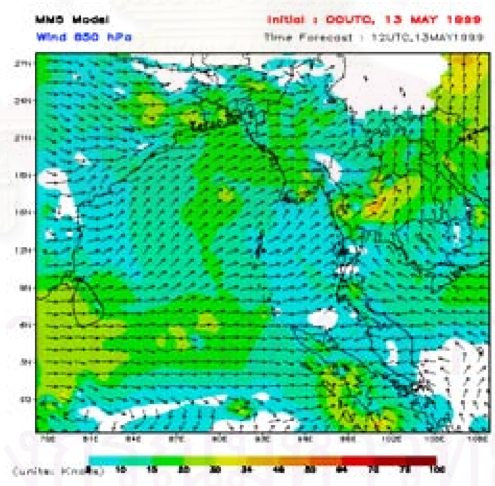


Figure 20 Southwesterly winds at the level of 850 hPa
on 13 may 1999 at 12 UTC, are prevailing over Thailand and the Bay of Bengal.

To consider the characteristics of rainfalls in the years 1996 to 2000 during the period of “pre onset” and “monsoon onset”, observations from the selected stations of TMD are considered as displayed in Figures 21 to 33.

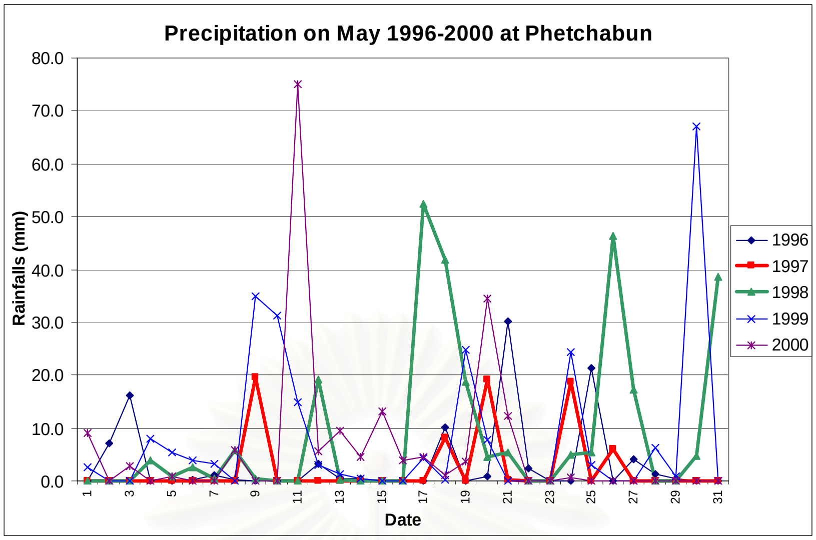


Figure 21 Precipitation on May for the years 1996-2000 at Phetchabun.

Comparing precipitation of the El Niño year (1997), La Niña year (1998) and normal years (1996, 1999 and 2000) at Phetchabun province during 1 to 15 May, during the La Niña event the amount of precipitation was more than that of the El Niño year (Figure 21).

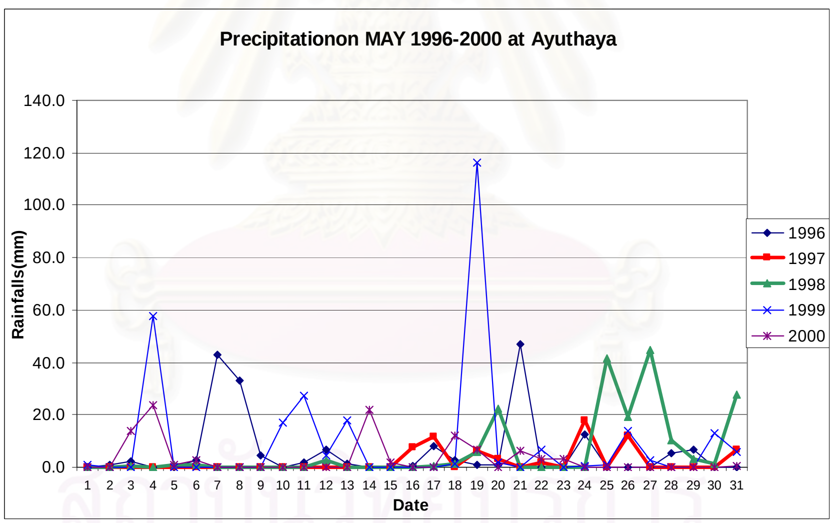


Figure 22 Precipitation on May for the years 1996-2000 at Ayuthaya.

Figure 22 shows that there was small amount of precipitation before the average date of monsoon onset in El Niño year comparing to normal year, while in La Niña year the rainfall was higher than normal years. Due to the mountainous topology of this province, local effect must be considered as an important factor for rainfall such that for some years in normal years the precipitation amount were high and started before the average monsoon day.

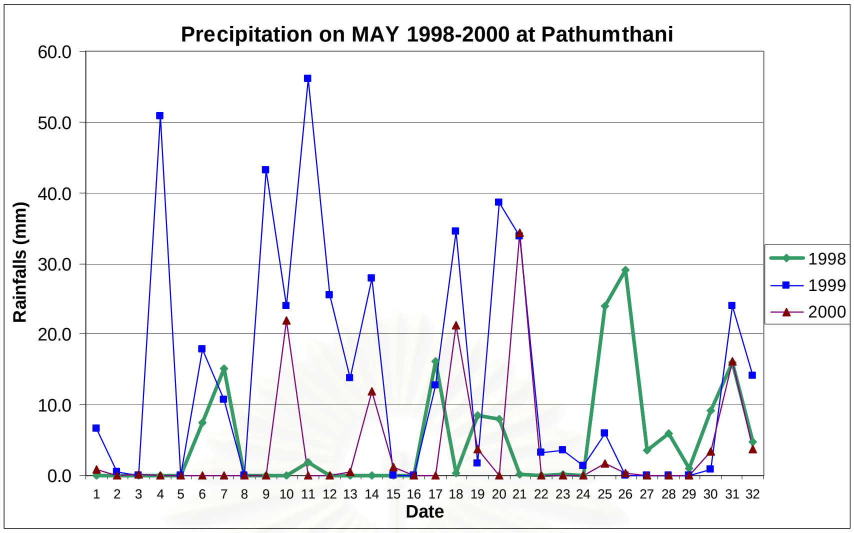


Figure 23 Precipitation on May for the years 1998-2000 at Pathumthani

Precipitation collection at Pathumthani (Figure 23) started in 1998. The comparison of the rainfall amount in this area between the normal years and the La Niña year showed no difference.

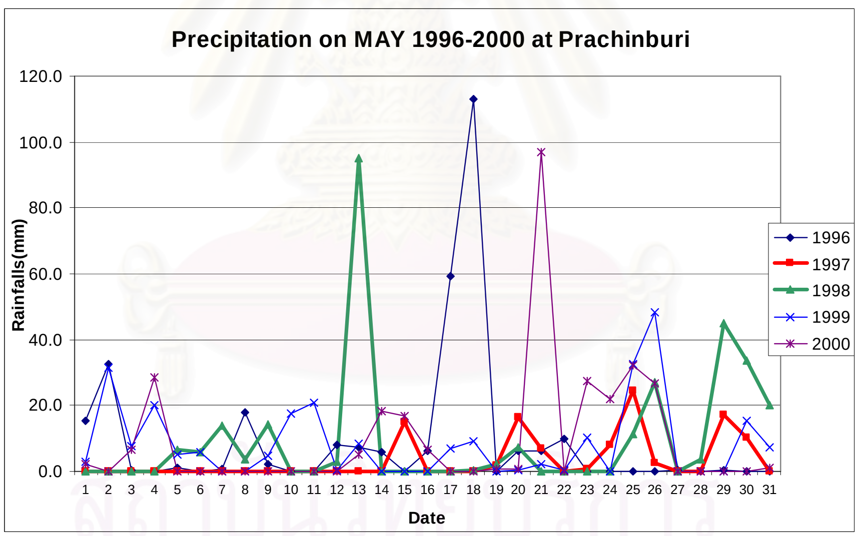


Figure 24 Precipitation on May for the years 1996-2000 at Prachinburi.

Prachinburi is located at the eastern part of Thailand. At this station in the La Niña year rainfall started before that of the El Niño year and with higher amount. When comparing La Niña year with the normal years there was no difference. The day when rainfall started for the El Niño year was later than that of the La Niña year (Figure 24).

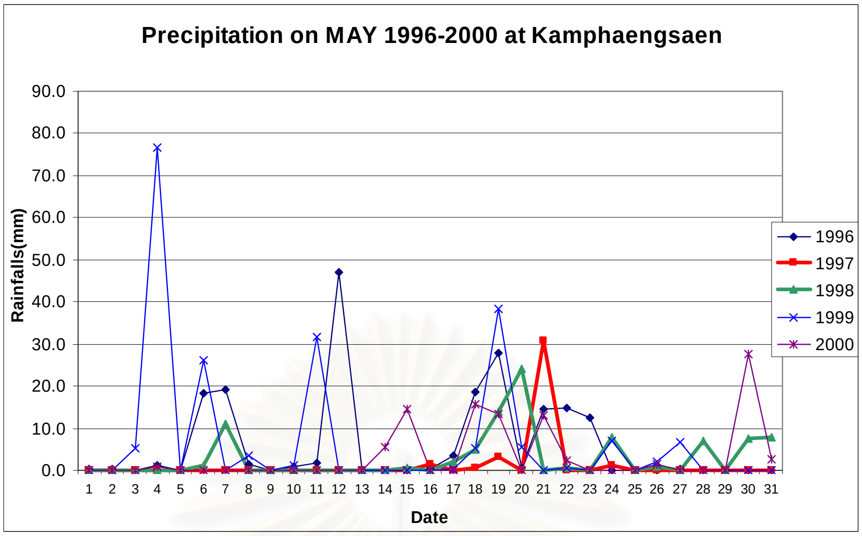


Figure 25 Precipitation on May for the years 1996-2000 at Kamphaengsaen

Figure 25 shows that the rainfall amount at Kamphangsaen was dense on after 3 days of the average monsoon onset day (17 to 24 May) in the normal years, and during 18 to22 May in the El Niño year and 18 to 21 on La Niña years. It also shows that on the El Niño year this station had lack of rainfall through out the month excepted on 21 May.

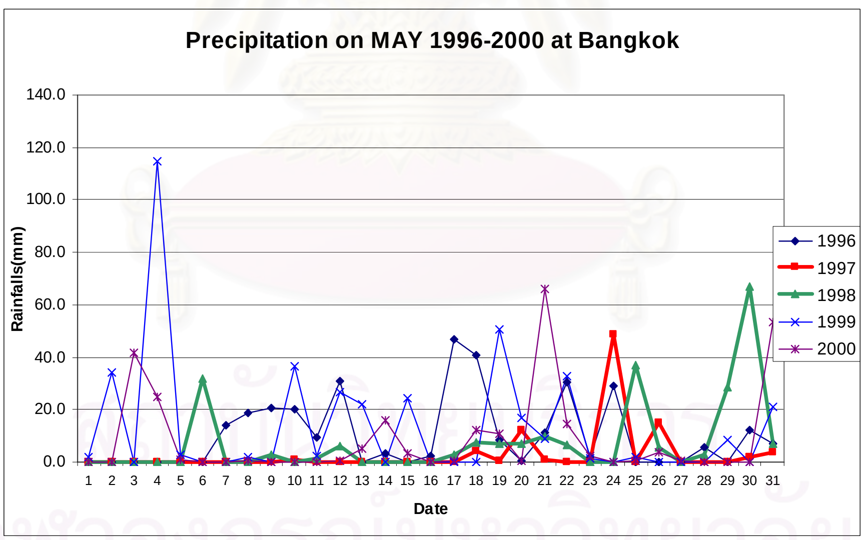


Figure 26 Precipitation on May for the years 1996-2000 at Bangkok

Figure 26 shows that in the normal year, rainfall spread out throughout the whole month. The figure also shows the effect of the unusual events. The rainfall amount of El Niño and La Niña years were seen during 17-31 May but the rainfall amount in the El Niño year was lower than the La Niña year.

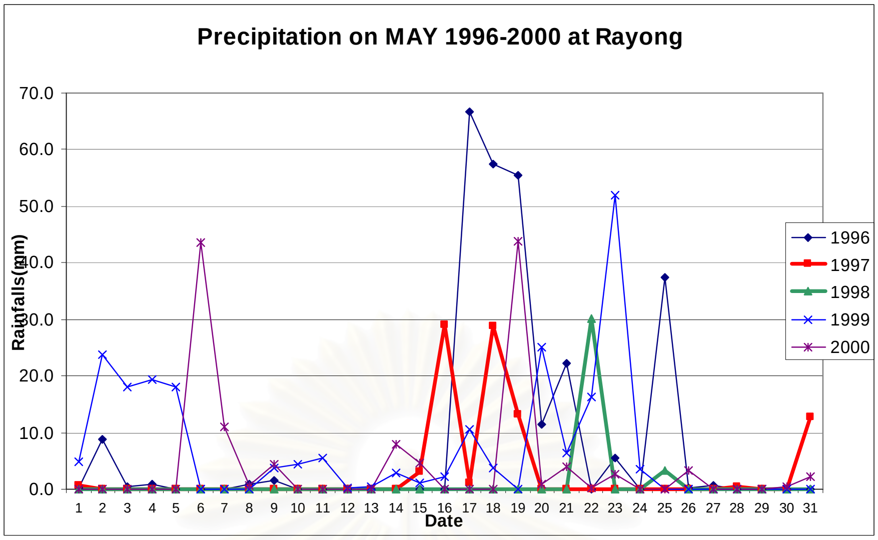


Figure 27 Precipitation on May for the years 1996-2000 at Rayong

This station (Figure 27) shows the amount of rainfall on the average monsoon onset days for all events - El Niño, La Niña and normal years. Rainfall was high after 15 May and the amount of rainfall in the normal years was higher than abnormal years. There was no significant difference in rainfall between the El Niño and La Niña years but during 21-30 May there was no rain in the El Niño year.

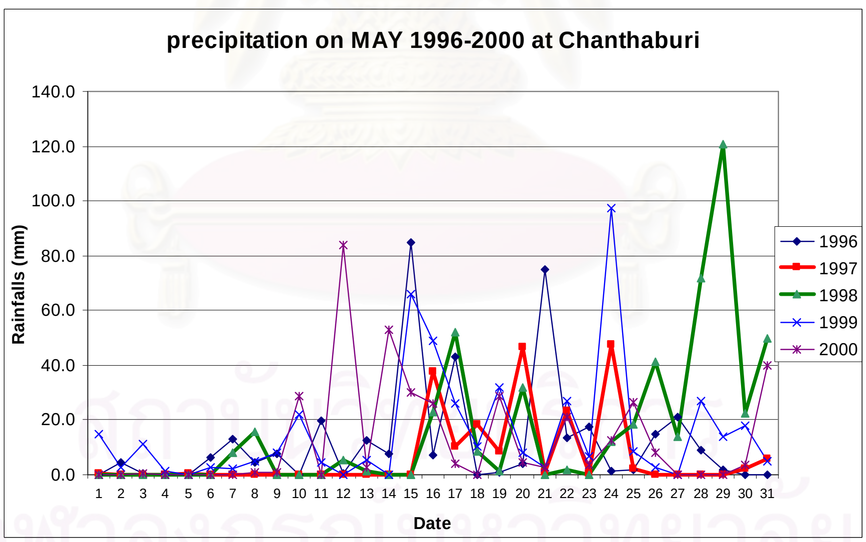


Figure 28 Precipitation on May for the years 1996-2000 at Chanthaburi

Figure 28 shows that the amount of rainfall on the average monsoon onset day increased and continued. The difference of El Niño and La Niña years is clearly seen. The rainfall amount in the La Niña year was higher than the normal and the El Niño years.

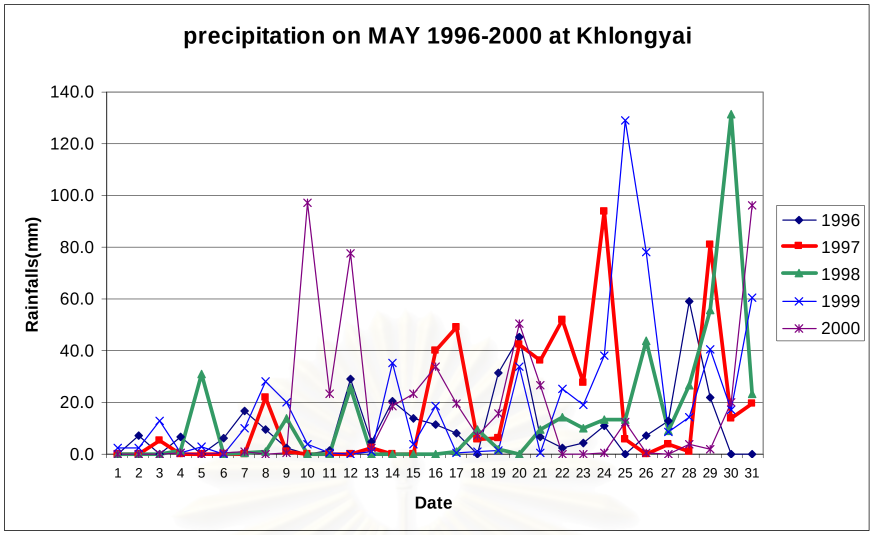


Figure 29 Precipitation on May for the years 1996-2000 at Khongyai

Figure 29 demonstrates that in the El Niño and La Niña years, the rainfall at this station was dense after the average of monsoon onset day while in the El Niño and La Niña years the rainfall amount was also high. This station was located on the seashore where the topology is in good condition for rainfall. The station is close to the shore line, facing the sea and behind the station is a hill. Such local effects are the causes of dense rainfall in this area.

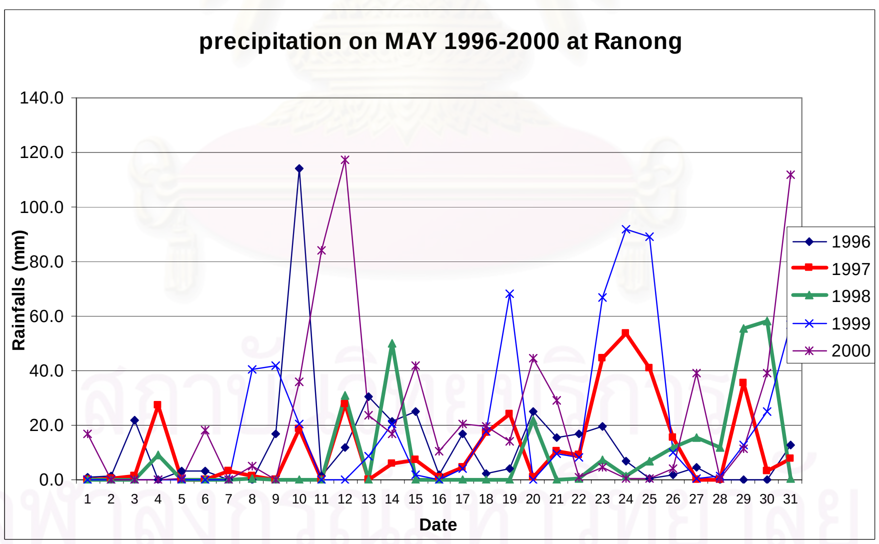


Figure 30 Precipitation on May for the years 1996-2000 at Ranong

Figure 30 displays the results collected at Ranong station. This station is also located near the seashore and the topology is similar to Khlong Yai station. This station is among the stations that get the highest rainfall in Thailand and thus no difference of El Niño and La Niña years was seen.

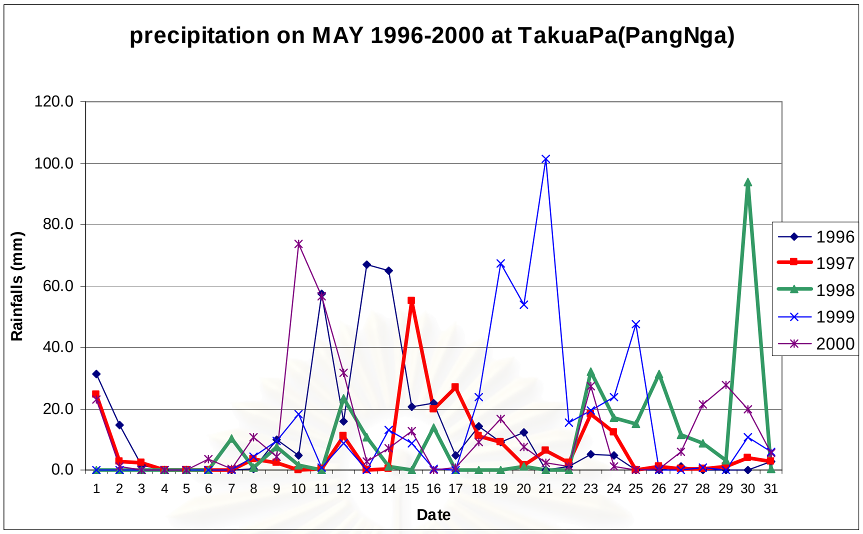


Figure 31 Precipitation on May for the years 1996-2000 at Takuapa (PangNga)

The data shown in Figure 31 was collected at Takuapa station. This station is located in the southern part of Thailand and is affected by the factors from both the Indian Ocean and the Pacific Ocean. The difference of El Niño and La Niña years was clearly seen after 20 May. The La Niña year got higher rainfall amount than the El Niño year.

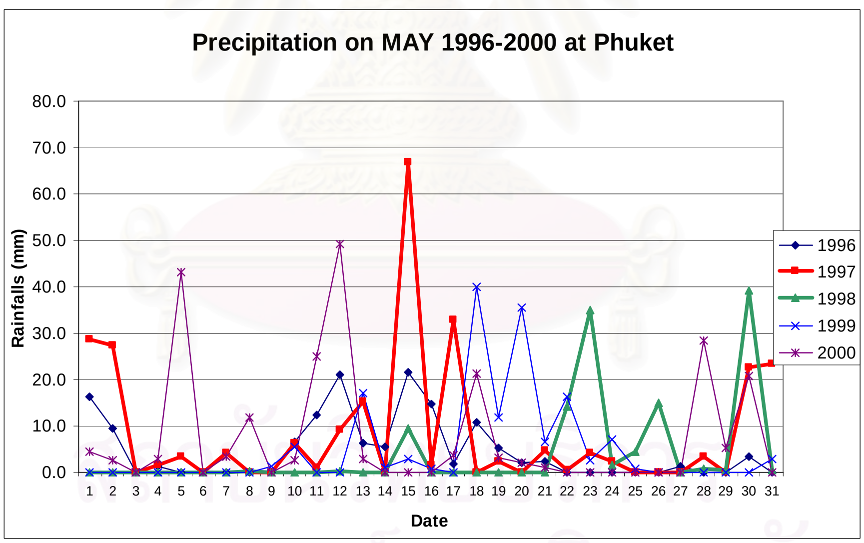


Figure 32 Precipitation on May for the years 1996-2000 at Phuket

As shown in Figure 32, after 15 May there was a gap in rainfall between the El Niño and the La Niña years. The rainfall amount in the La Niña year amount increased while that of the El Niño year decreased.

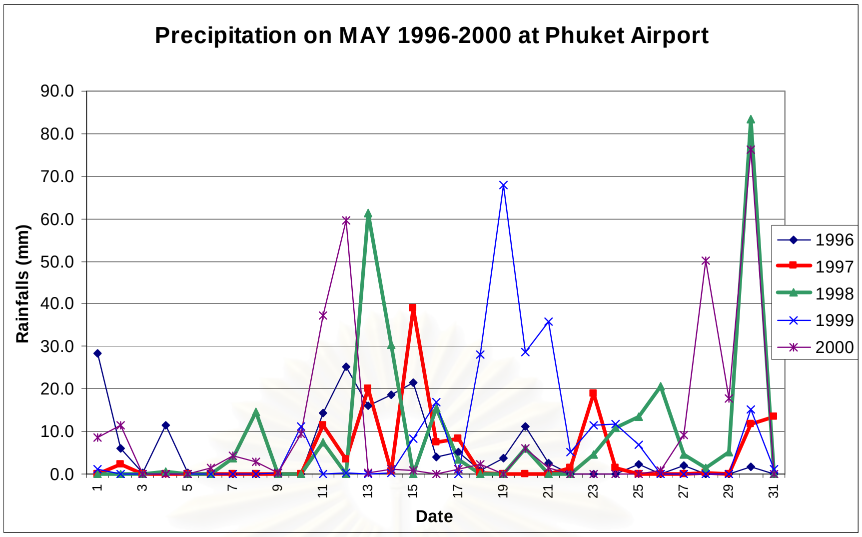


Figure 33 Precipitation on May for the years 1996-2000 at Phuket Airport

According to Figure 33, the rainfall at the Phuket airport increased during 9-11 May in the normal years, the El Niño and the La Niña years, which was sooner than the average monsoon onset day in Thailand. However, during 22-31 May the rainfall increased rapidly in the La Niña year whereas in the El Niño year the rainfall was lower.

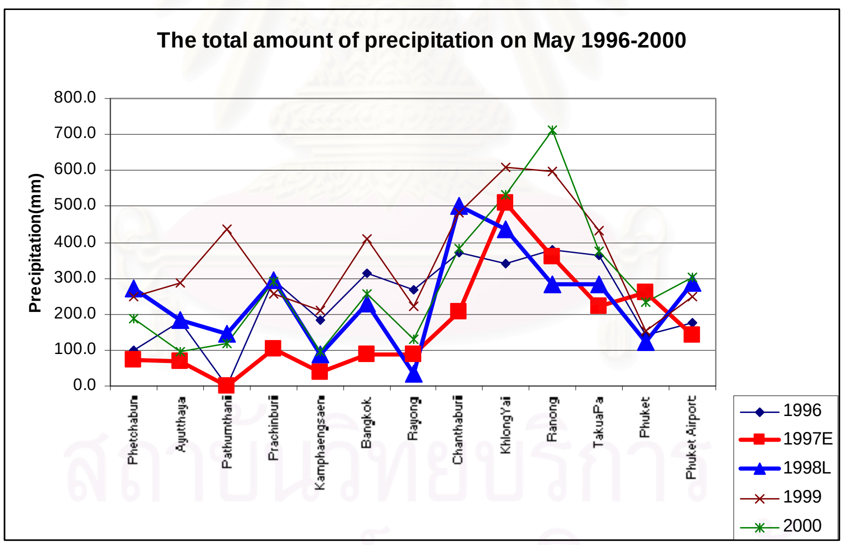


Figure 34 The total amount of precipitation on May 1996-2000.

Figure 34 show the amount of precipitation on May of 1996 to 2000 at all selected station. The precipitation on El Niño year had lower than normal and La Niña year at Phetchabun, Ayutthaya, Prathumthani, Bangkok and Chanthaburi.

For the wind patterns on 1 to 15 May, 1996 to 2000, three upper levels are considered, i.e., 200hPa represents high level wind, 500hPa represents middle level wind and 850hPa represents low level wind. In the case of considering of speed convergence in low level near the western coast of Thailand, wind at the level of 10 meters is also considered because this is the level that is the nearest to surface. Examples of wind pattern for Area 1 are shown in Figures 35 to 37..

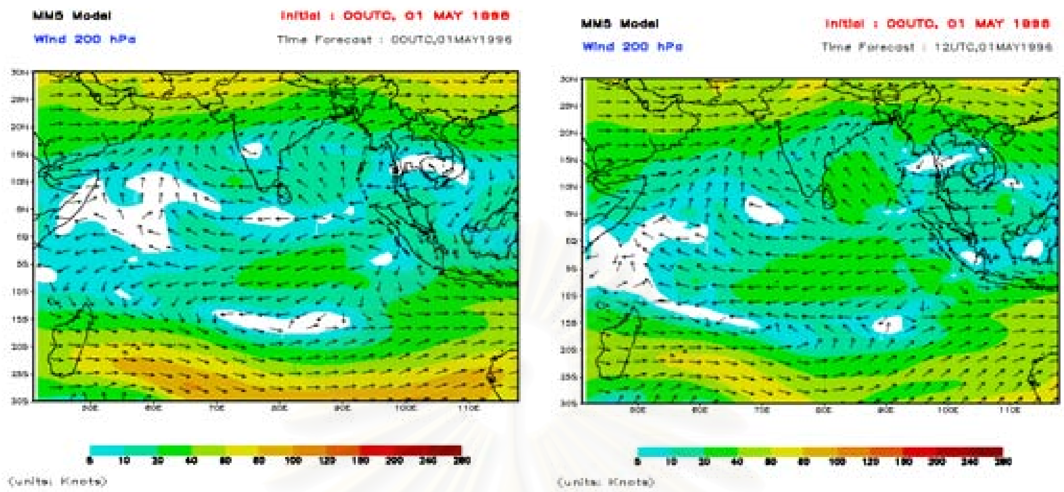


Figure 35 Wind field at 200hPa, 1 MAY 1996, 00 and 12 UTC for Area 1

Figure 35 shows examples of wind field at 200hPa level at 00 UTC and 12 UTC. This level can show the upper level circulation that the direction of the wind opposite with the wind at the low level (850hPa). Other outputs of the model for the period 1 to 15 May are shown in Appendix A.

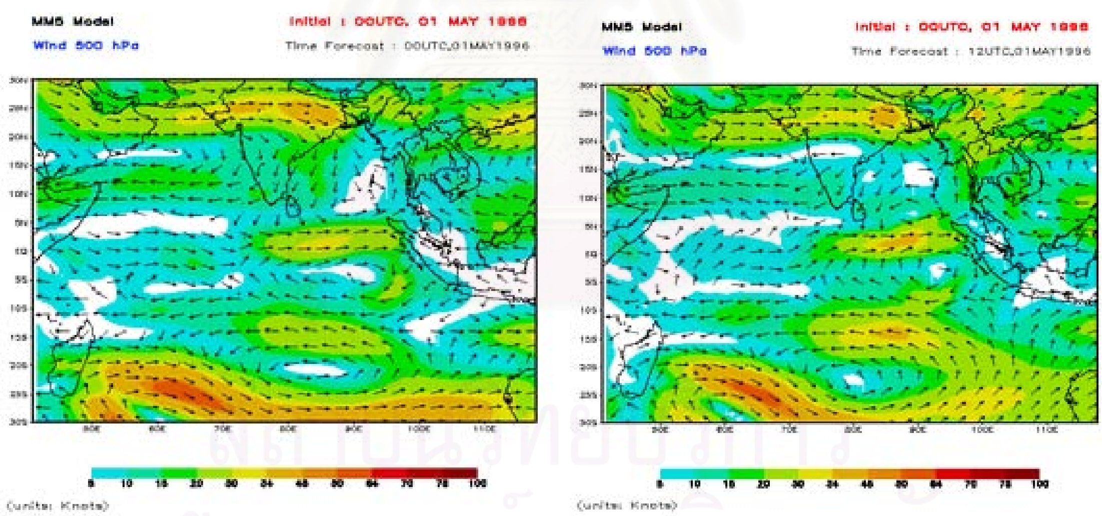


Figure 36 Wind Field at 500 hPa, 1 MAY1996, 00 and 12 UTC for Area1

The Figure 36 is middle level of wind field, that can be consider as stirring current of wind field. In the case of tropical cyclone in the Bay of Bengal movement, this 500 hPa wind will be helpful for considering. The Figure 37 is the wind at the 850 hPa level. This level is important regarding to the developing process to onset southwest monsoon in Thailand. In the period of premonsoon and onset wind field at this level had changed from unsteady form to steady form and usually in creasing wind speed especially at near Somalia coast and lower part of the Bay of Bengal. During the weak period, the wind field is become unsteady again and turning to northeast direction when changing to northeast monsoon period.

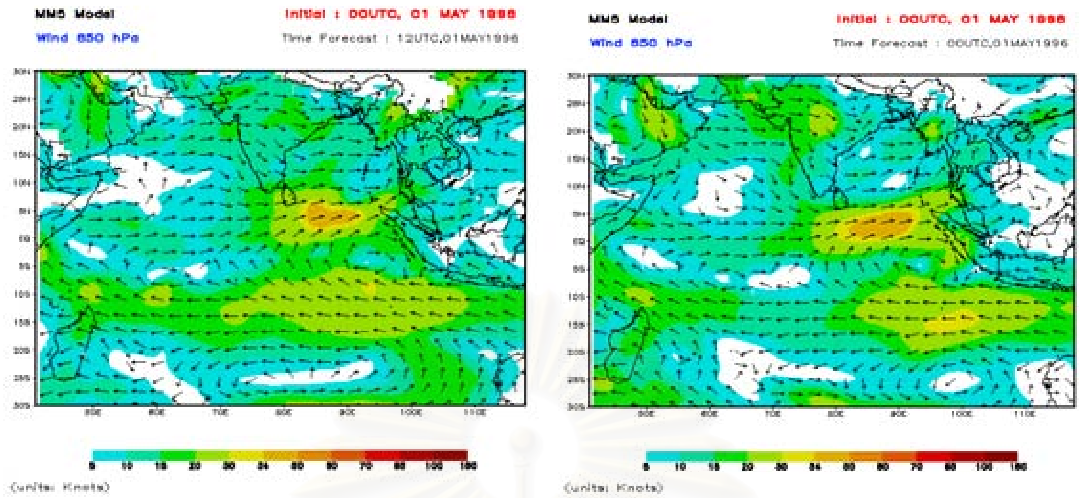


Figure 37 Wind Field 850 hPa, 1 MAY1996, 00 and 12 UTC for Area1

The correlations of these three major factors (MF) were analyzed using a statistic technique, linear regression, and these results are shown in Appendix B. That is most of the result of the analysis conform to the idea, which the heat flux and moisture were shown that characteristics had correlated with monsoon intensity in Thailand, while wind speed had low correlation.

According to Table 1 which shows the number of day that of monsoon onset departs from the average day, the precipitation that started nearest to the average day is at Kamphaengsaen and Rayong. In this case, the synoptic station is selected for correlation testing. All testing of correlation between the three major factors and precipitation are conform to these correlation during El Niño was lack for 11 day later and La Niña year was near the average.

Table 1 The day of monsoon onset at during 1996 to 2000 that departs from the average day of the monsoon onset in Thailand (15 May).

Station	1996	1997	1998	1999	2000	Sum	Ave
Phetchabun	-201	-236	-175	-167	-169	-158	-31.6
Ayutthaya	-2	-106	-10	-100	-63	-281	-56.2
Prachinburi	3	-64	-13	19	-6	-61	-12.2
Kamphaengsaen	-1	-106	-144	-111	-137	-499	-99.8
Bangkok	8	-104	-10	5	-3	-104	-20.8
Rayong	-2	0	-46	16	14	-18	-3.6
Chanthaburi	3	-1	-8	8	6	8	1.6
KhlongYai	4	-1	-8	8	6	9	1.8
Ranong	6	0	-10	8	5	9	1.8
TakuaPa	7	1	-8	-3	8	5	1
Phuket	5	-13	-7	-3	-2	-20	-4
Phuket Airport	5	5	-7	-3	7	7	1.4

The Correlation of Heat Flux, Moisture Flux and Wind Pattern with Monsoon Intensity in Thailand

Table 2 Moisture, heat flux, wind speed and rainfalls data for Thailand in 1996

Moisture , Heat Flux, Wind data and Observation Rainfall Data at eastern, central and southern Thailand

1996

Date	Mixing Ratio(g/kg)		HeatFlux(W/m2)		Wind Speed			Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa													
1	24	24	-20	-40	0	30-34	30-35	0.0	0.0		15.5	0.2	0.4	0.2	0.0	0.0	1.1	31.2	16.3	28.4
2	24	24	-20	-20	20-40	20-40	35-50	7.1	0.9		32.4	0.4	0.1	8.8	4.6	7.3	1.5	14.8	9.5	6.1
3	27	27	-10	-20	20-40	20-30	30-35	16.1	2.4		0.2	0.0	0.0	0.5	0.5	0.0	21.7	1.5	0.1	0.3
4	25	25	-10	-20	20-40	20-30	20-30	0.0	0.0		0.0	1.3	0.0	0.8	0.0	6.5	0.0	0.0	1.4	11.4
5	25	25	-10	-20	20-40	20-30	20-30	0.0	0.0		1.2	0.0	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.2
6	25	25	200	100	20-40	20-30	30-35	0.2	2.9		0.0	18.4	0.0	0.0	6.5	6.2	3.2	0.0	0.0	0.0
7	25	24	100	100	20-41	20-30	30-35	1.0	43.0		0.7	19.2	14.1	0.0	13.0	16.8	0.0	0.0	0.0	0.0
8	24	25	100	100	20-40	20-30	20-30	0.2	33.2		18.0	1.4	18.9	0.8	4.7	9.3	0.0	0.2	0.0	0.0
9	24	32	-40	-20	20-40	20-30	20-30	0.1	4.6		2.3	0.0	20.7	1.5	7.5	2.5	17.0	9.8	0.0	0.0
10	24	24	-40	-20	20-40	20-30	30-50	0.0	0.0		0.0	0.9	20.1	0.0	0.0	0.0	114.1	4.8	6.6	0.1
11	28	30	-20	-40	20-40	15	15	0.0	1.6		0.0	1.6	9.2	0.0	19.8	1.6	1.5	57.6	12.3	14.4
12	24	24	-20	-20	20-40	10	20-30	3.3	6.8		8.2	47.1	30.8	0.0	0.4	29.2	11.6	16.0	21.0	25.1
13	24	24	-40	-40	20	20	30	0.4	1.3		7.2	0.0	0.0	0.0	12.5	4.7	30.5	66.8	6.4	16.0
14	24	24	-20	-40	15	20	15-20	0.4	0.0		5.8	0.0	3.5	0.0	7.8	20.4	21.5	65.0	5.6	18.7
15	24	24	-20	-10				0.0	0.0		0.0	0.0	0.0	0.0	84.7	13.9	24.8	20.5	21.6	21.4
16								0.0	0.4		6.4	0.4	2.3	0.0	7.0	11.6	1.8	21.8	14.8	4.0
17								0.0	8.2		59.2	3.6	47.0	66.6	43.1	8.0	16.7	4.9	1.8	5.3
18								10.1	2.6		112.9	18.5	40.6	57.5	0.0	0.0	2.4	14.1	10.9	0.9
19								0.0	1.0		0.0	27.9	8.5	55.5	0.7	31.2	4.1	9.0	5.3	3.6
20								0.9	1.1		6.4	0.7	0.4	11.4	4.0	45.3	24.8	12.4	2.0	11.2
21								30.1	46.8		6.1	14.4	11.1	22.2	74.9	6.8	15.6	0.0	2.5	2.6
22								2.3	0.0		9.7	14.9	30.6	0.0	13.5	2.5	16.9	1.2	0.0	0.0
23								0.0	0.0		0.0	12.4	2.1	5.4	17.3	4.3	19.7	5.1	0.0	0.0
24								0.0	12.5		0.0	0.0	29.2	0.0	1.2	10.8	6.7	4.9	0.0	0.0
25								21.4	0.0		0.0	0.0	0.0	37.5	2.0	0.0	0.6	0.0	0.0	2.4
26								0.0	0.0		0.0	0.0	0.0	0.2	14.6	7.0	1.6	0.0	0.0	0.0
27								4.1	0.0		0.5	0.2	0.1	0.7	21.3	13.0	4.7	1.1	1.4	1.9
28								1.4	5.4		0.0	0.0	5.6	0.0	9.1	59.0	0.0	0.0	0.0	0.0
29								0.4	6.5		0.3	0.0	0.0	0.0	1.9	22.1	0.0	0.0	0.0	0.0
30								0.0	0.0		0.0	0.0	12.3	0.0	0.0	0.0	0.0	0.0	3.5	1.6
31								0.0	0.0		0.0	0.0	6.8	0.0	0.0	0.0	12.5	2.6	0.0	0.0

Remake: *Yellow color* mean rainy season had started due to Thailand rainy season.

Rainfall Data Source: Thai Meteorological Department (TMD)

Using the linear regression procedure, the strong correlation is seen (with $R^2 = 0.723$) between heat flux over the Indian Ocean and the precipitation at Rayong province in Thailand (the reason that Rayong station was used here is this station because it is near the seashore facing the sea and thus is strongly affected by the southwest monsoon). In fact, such correlation did not appear when the data collected on the same day were used for calculation, both at the Indian Ocean and at Rayong. As a result, during the test the start date of monsoon intensity in May was shift one at a time, until 11 days later where the correlation was seen.

According to the correlations of these factors it can be concluded that there is correlation between heat flux over the Indian Ocean and precipitation at Rayong province, Thailand. On the other hand, the changing of heat flux over the Indian Ocean will affect summer monsoon in Thailand about 11 days later. This correlation is very useful for those who are in charge on prediction of the summer monsoon onset in Thailand.

During the El Niño year (1997) most of synoptic stations in central Thailand showed clearly decreasing rainfall (Appendix B), but for the stations along the eastern and southern coasts of Thailand, the monsoon onset day were near the average.

In the La Niña year (1998) for most of the selected synoptic stations, the days of monsoon onset were later than the average by 7 to 8 days.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The NCAR’s Mesoscale Model MM5 was used to compute the heat flux, moisture and wind pattern over the Indian Ocean from Latitude 30^{0} S to 30^{0} N and longitude 40^{o}E to 120^{o} E for 5 years. The data are used only during the southwest monsoon season from May to October in 1996 to 2000, which covered El Niño year (1997) and La Niña year (1998). The correlation of these parameters was relatively high with $R^2 = 0.723$ in normal year to the rainfall pattern at the 13 synoptic weather stations in Thailand mostly along the coastal area. In normal year, when the heat flux over the southeast Indian Ocean near the west coast of Australia was increased and persist for approximately 5 days before the average onset date of southwest monsoon season in Thailand (on 15 May) for 11 days because of the distance between the Indian Ocean and Thailand, and also some tropical cyclone were in the Bay of Bengal. This caused the onset of southwest monsoon at 9 stations in Thailand to start around the average of the southwest monsoon date. The moisture and wind pattern when intensified, it was induce the monsoon intensity in Thailand reach up too.

In El Niño year, the onset of southwest monsoon at most stations was delayed than the date 15 May for 50 days average with lesser intensity than normal year.

In La Niña year, the onset of the southwest monsoon at most stations were sooner than the averages date for 5 days with stronger intensity than normal.

Recommendation for Further Research

There are some specific area need to be conduct further research as it could not accommodated in this research due to various limitations.

- Verify the sea current in the Indian Ocean and the Bay of Bengal
- Explore correlation between ENSO and three major characteristics in the Indian Ocean area of Western Australia to understand process of Monsoon source before moving to north hemisphere.
- We don’t know what exactly cause of this phenomena, it is may be due to topology or sea current, so if those who want to study about monsoon in this region should include the sea current in their study.

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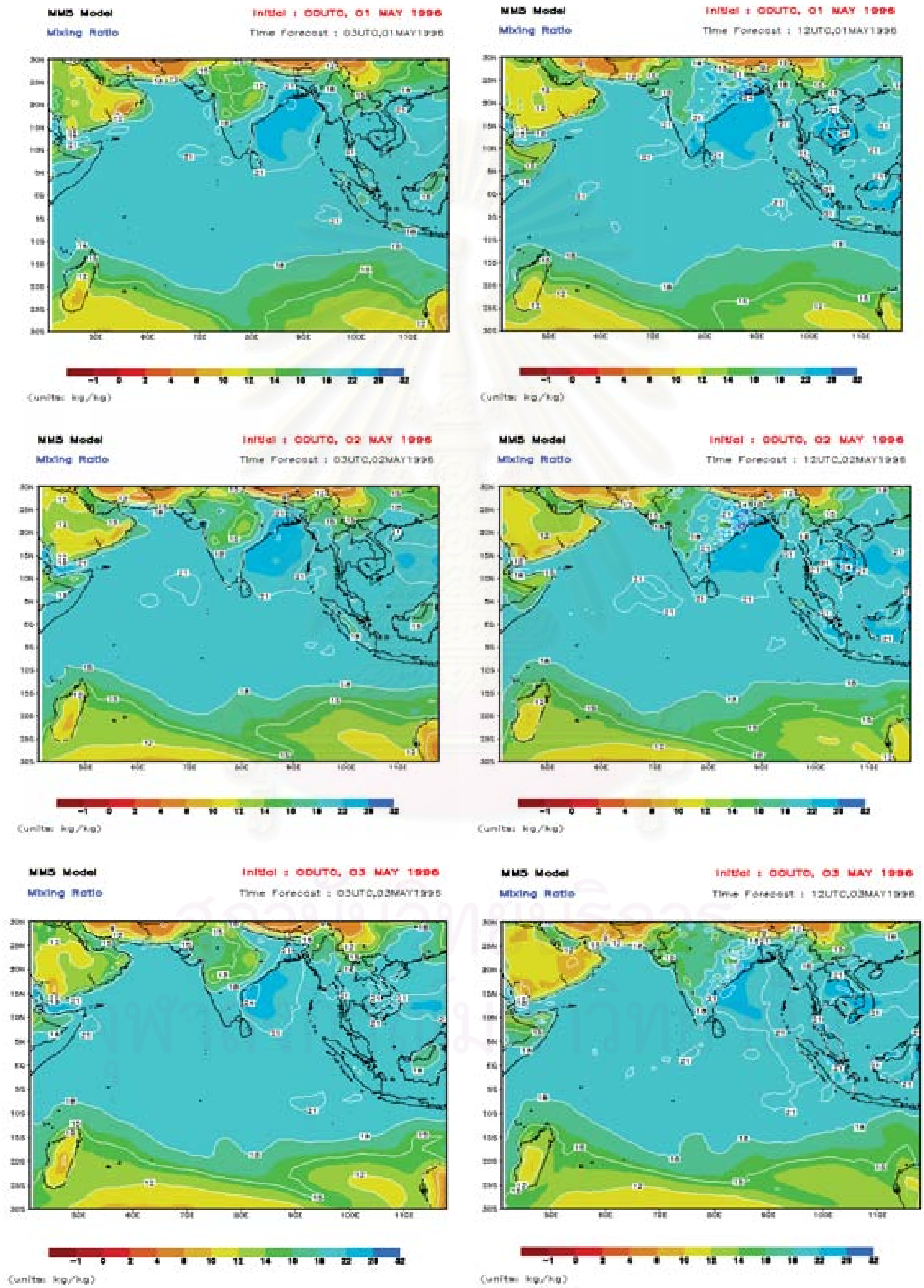
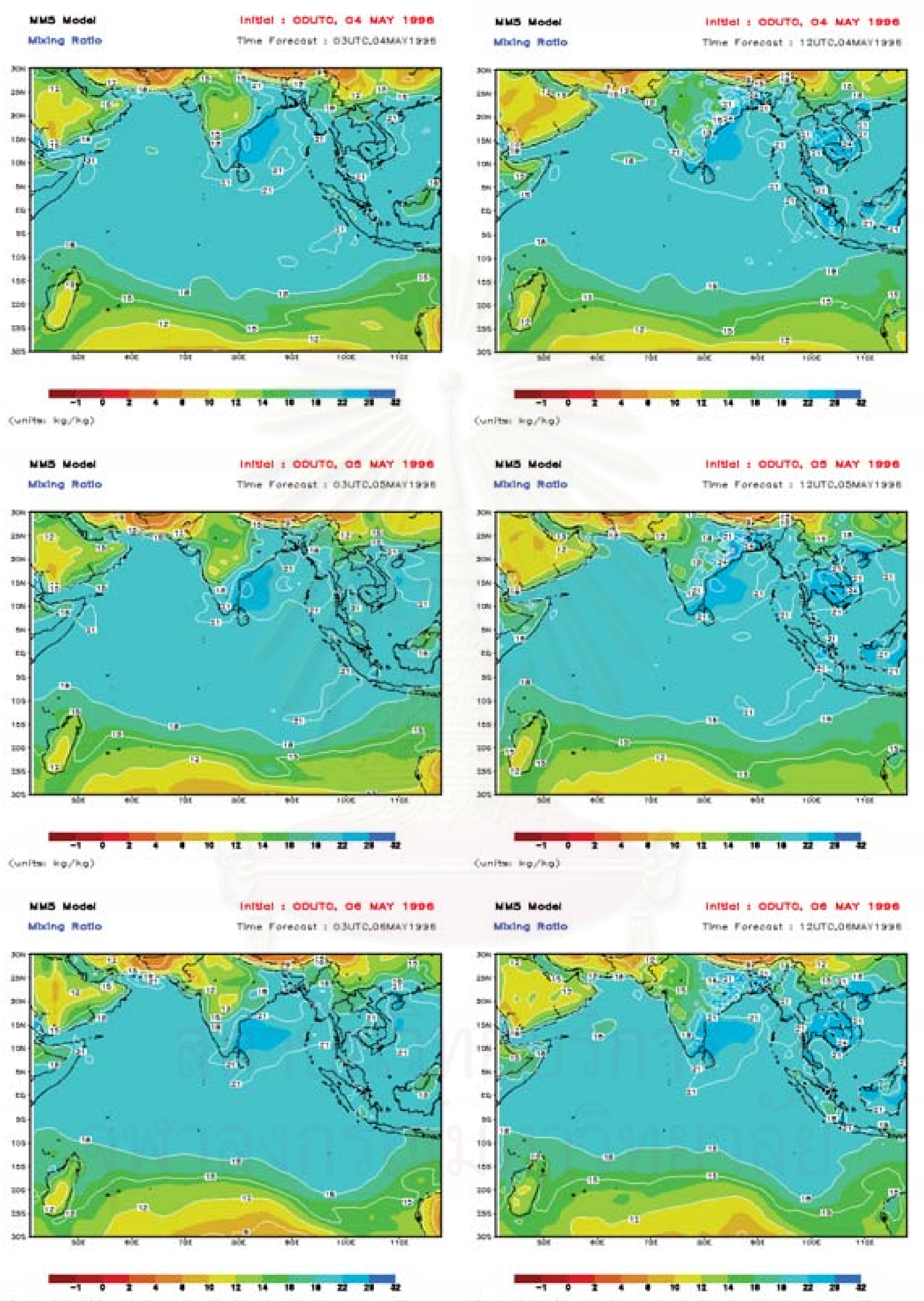
APPENDICES

Appendix A

Product result moisture, heat, and wind pattern during 1-15 MAY 1996 Area 1
Area 1

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(units: kg/kg)
MM5 Model
Mixing Ratio
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Time Forecast : 12UTC,04MAY1996
(units: kg/kg)
MM5 Model
Mixing Ratio
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Time Forecast : 03UTC,05MAY1996
(units: kg/kg)
MM5 Model
Mixing Ratio
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Time Forecast : 12UTC,05MAY1996
(units: kg/kg)
MM5 Model
Mixing Ratio
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Time Forecast : 03UTC,06MAY1996
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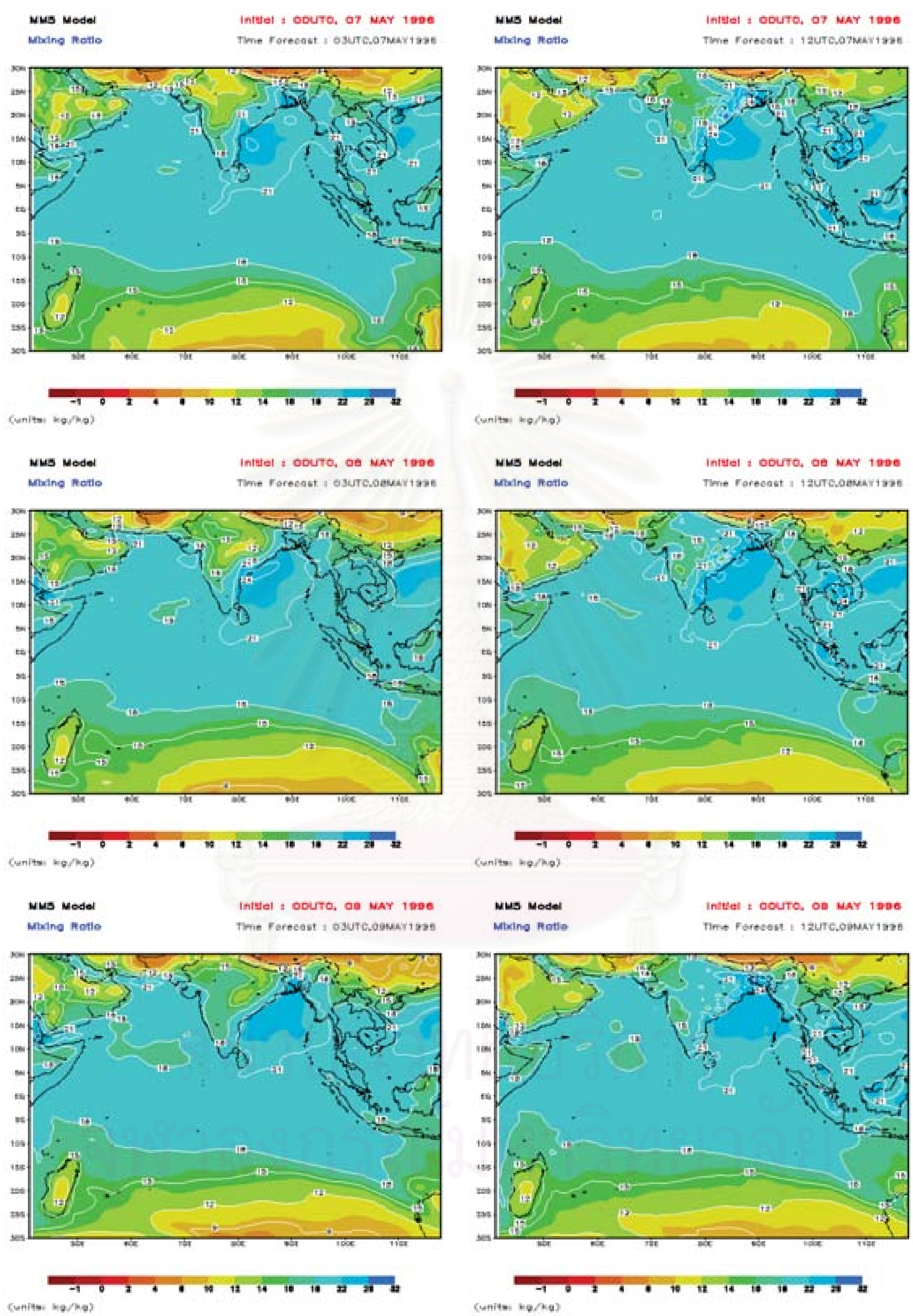
(units: kg/kg)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Time Forecast : 12UTC,07MAY1996
(units: kg/kg)
MM5 Model
Mixing Ratio
Initial : 00UTC, 08 MAY 1996
Time Forecast : 03UTC,08MAY1996
(units: kg/kg)
MM5 Model
Mixing Ratio
Initial : 00UTC, 08 MAY 1996
Time Forecast : 12UTC,08MAY1996
(units: kg/kg)
MM5 Model
Mixing Ratio
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Time Forecast : 03UTC,09MAY1996
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MM5 Model
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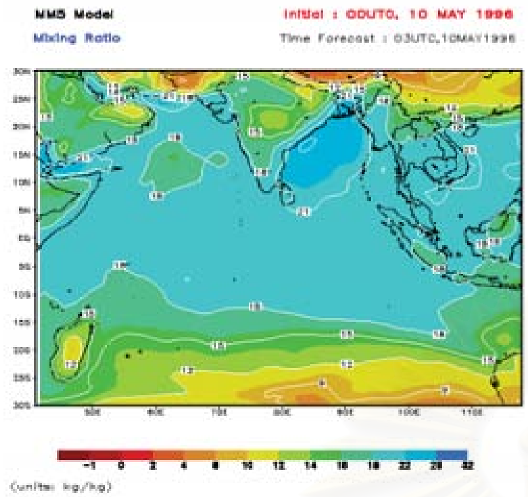
(units: kg/kg)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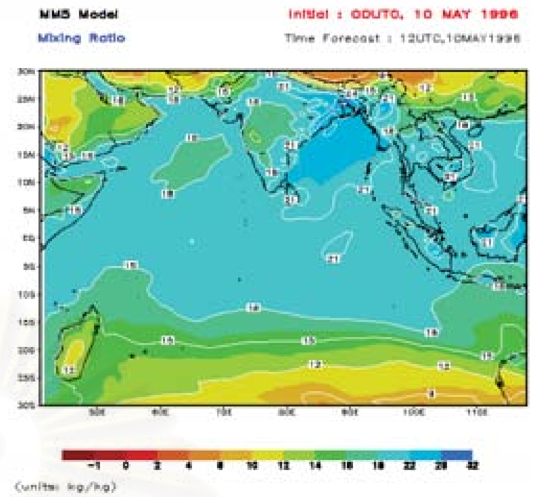
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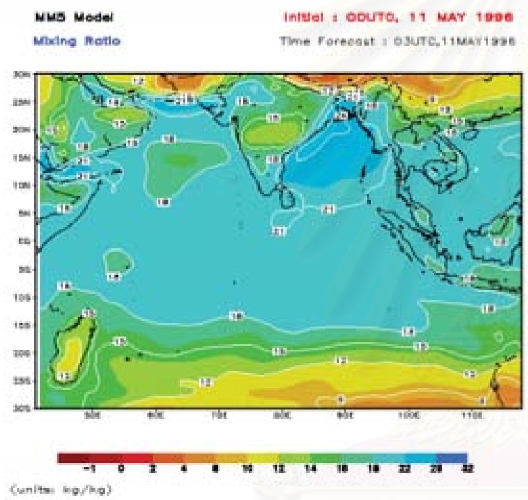
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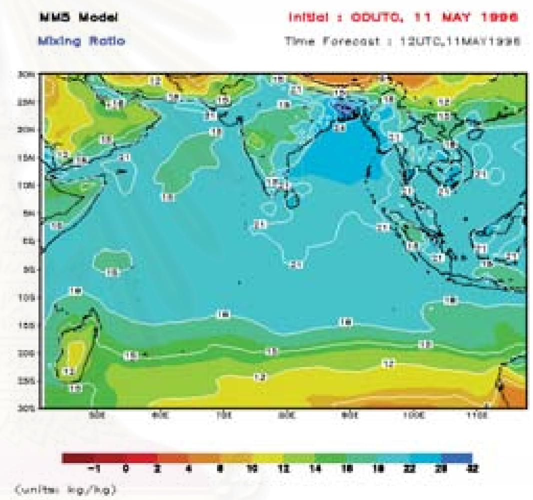
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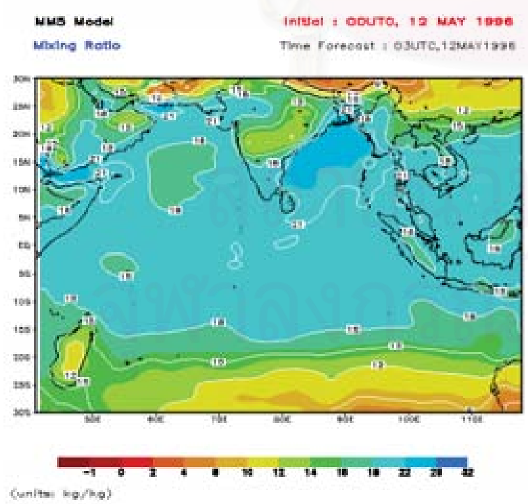
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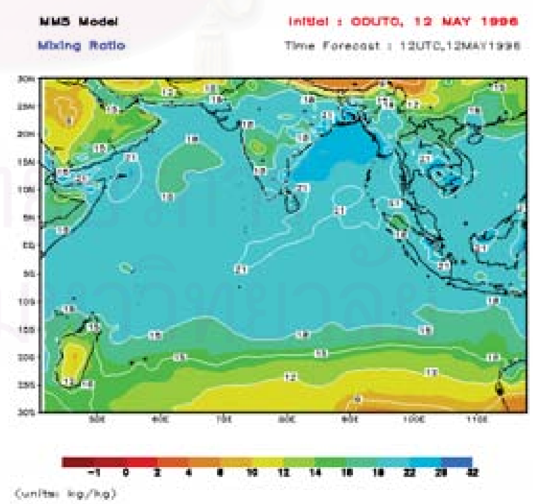
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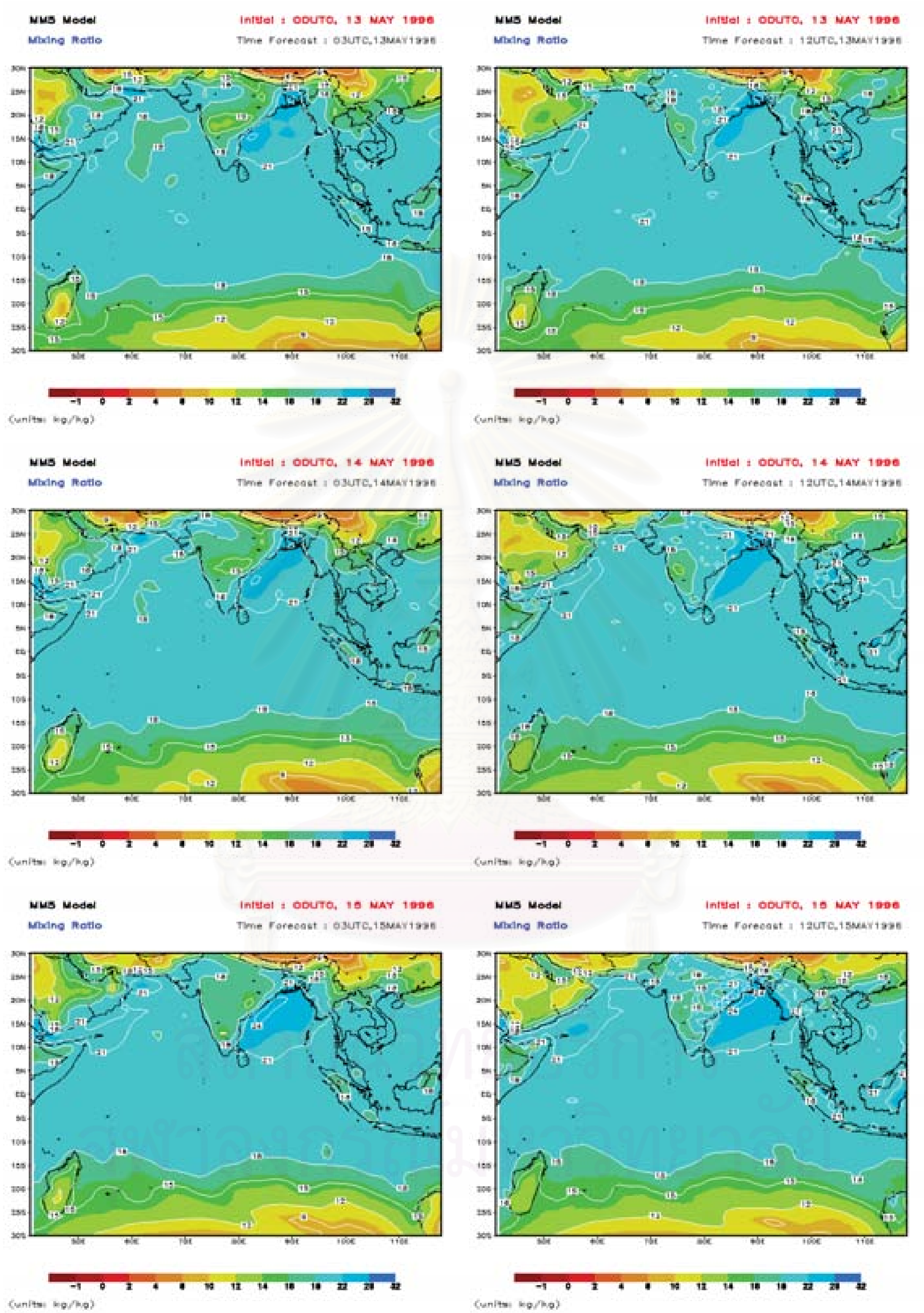
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(units: kg/kg)
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Mixing Ratio
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Mixing Ratio
Time Forecast : 03UTC,15MAY1996
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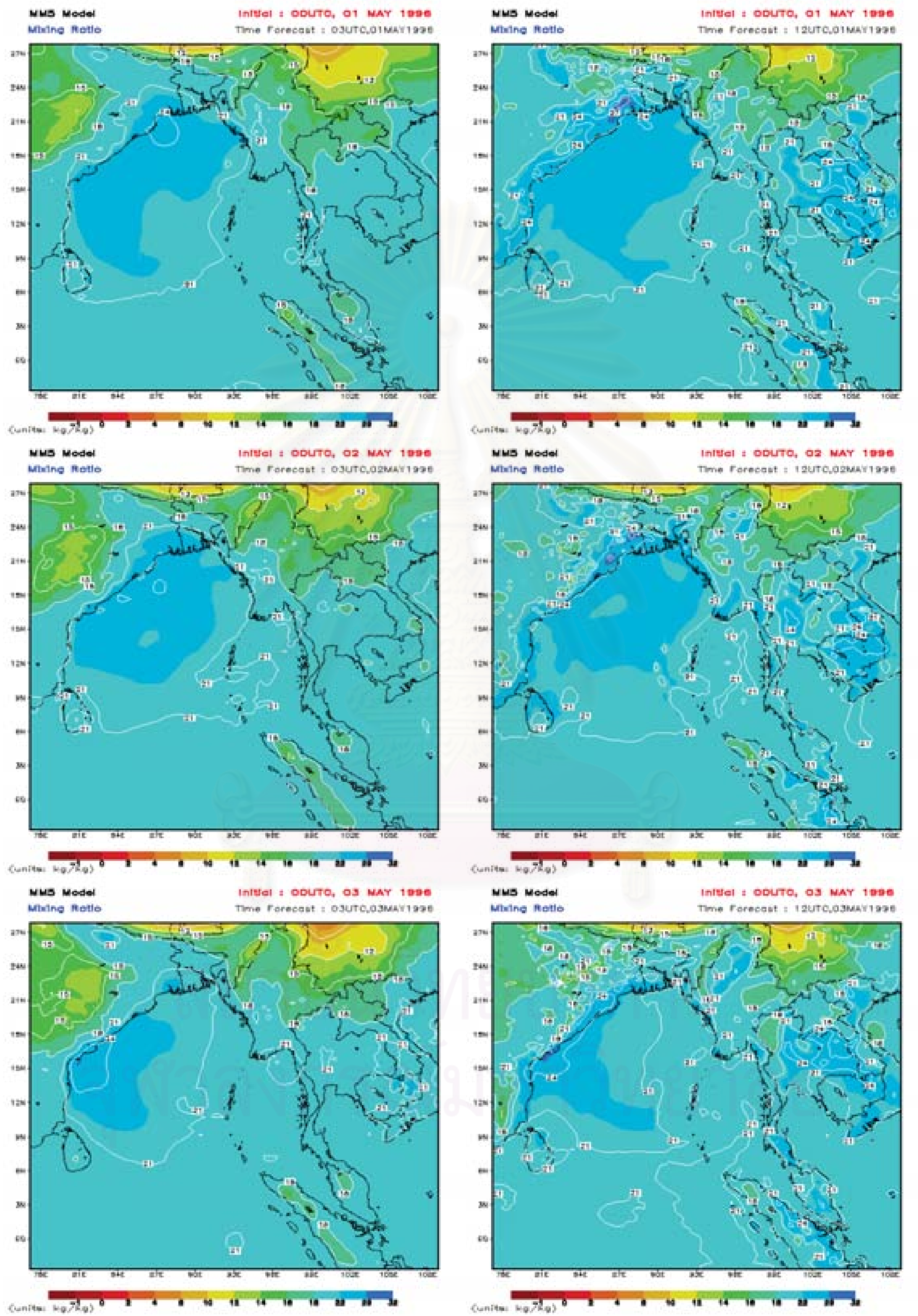
Mixing Ratio
Time Forecast : 12UTC,15MAY1996
(units: kg/kg)

Area2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Mixing Ratio
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Time Forecast : 03UTC,02MAY1996
MM5 Model
Mixing Ratio
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Time Forecast : 12UTC,02MAY1996
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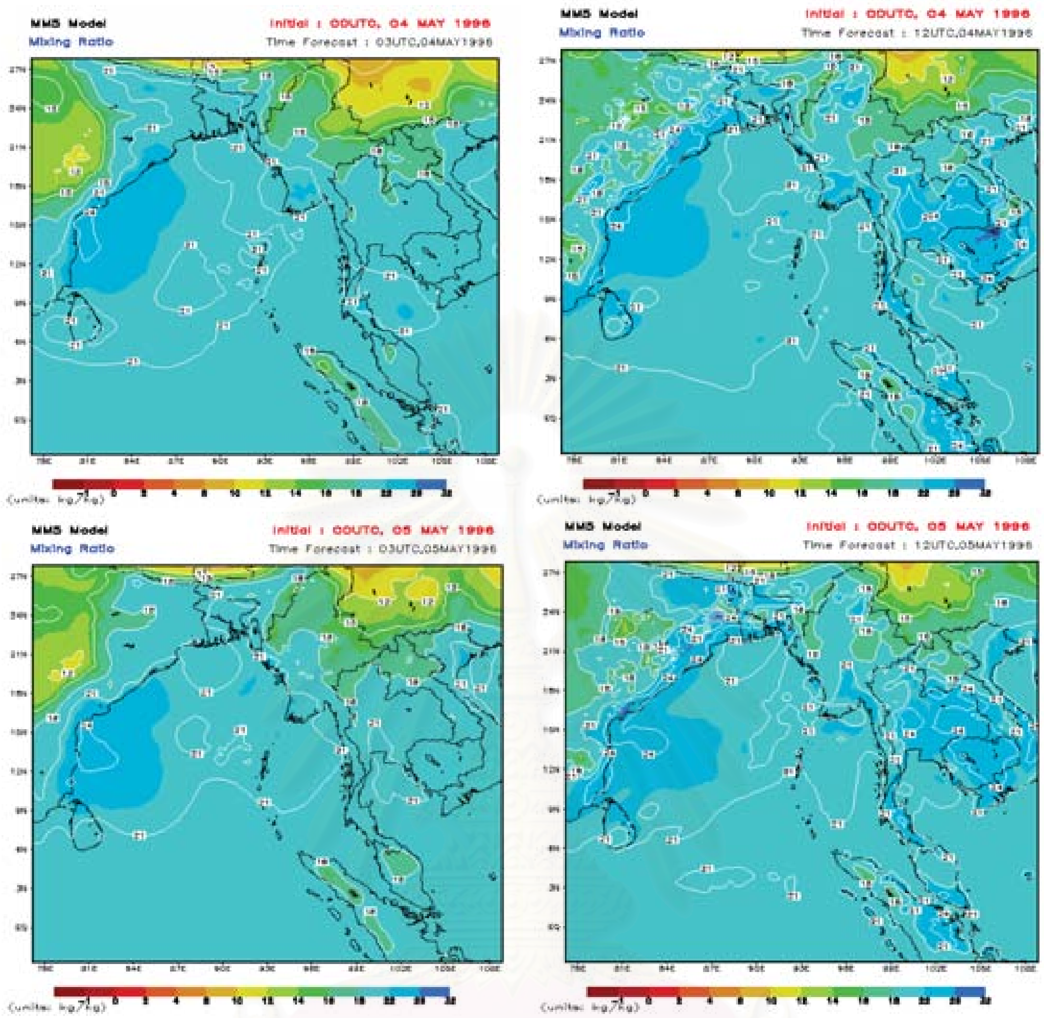
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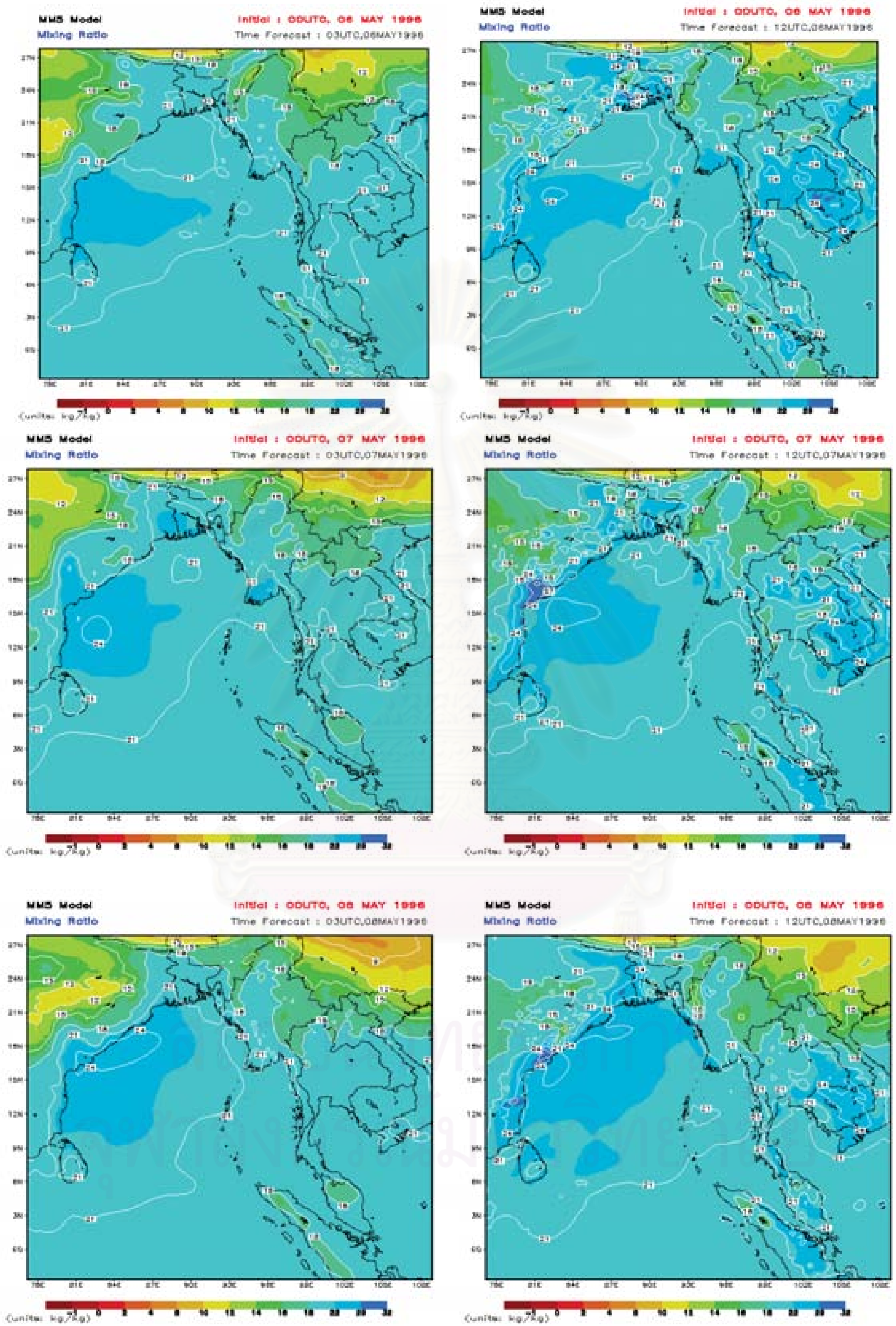
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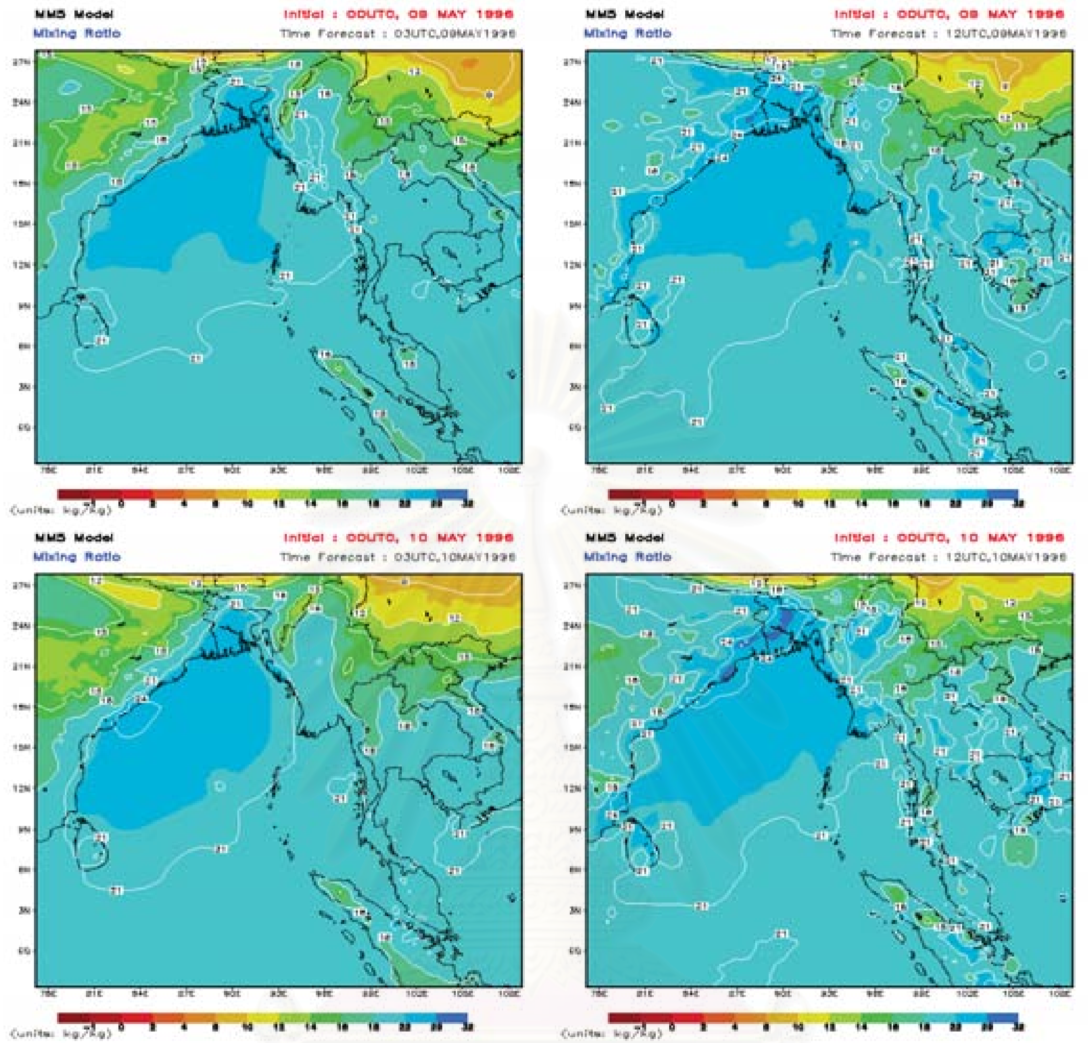
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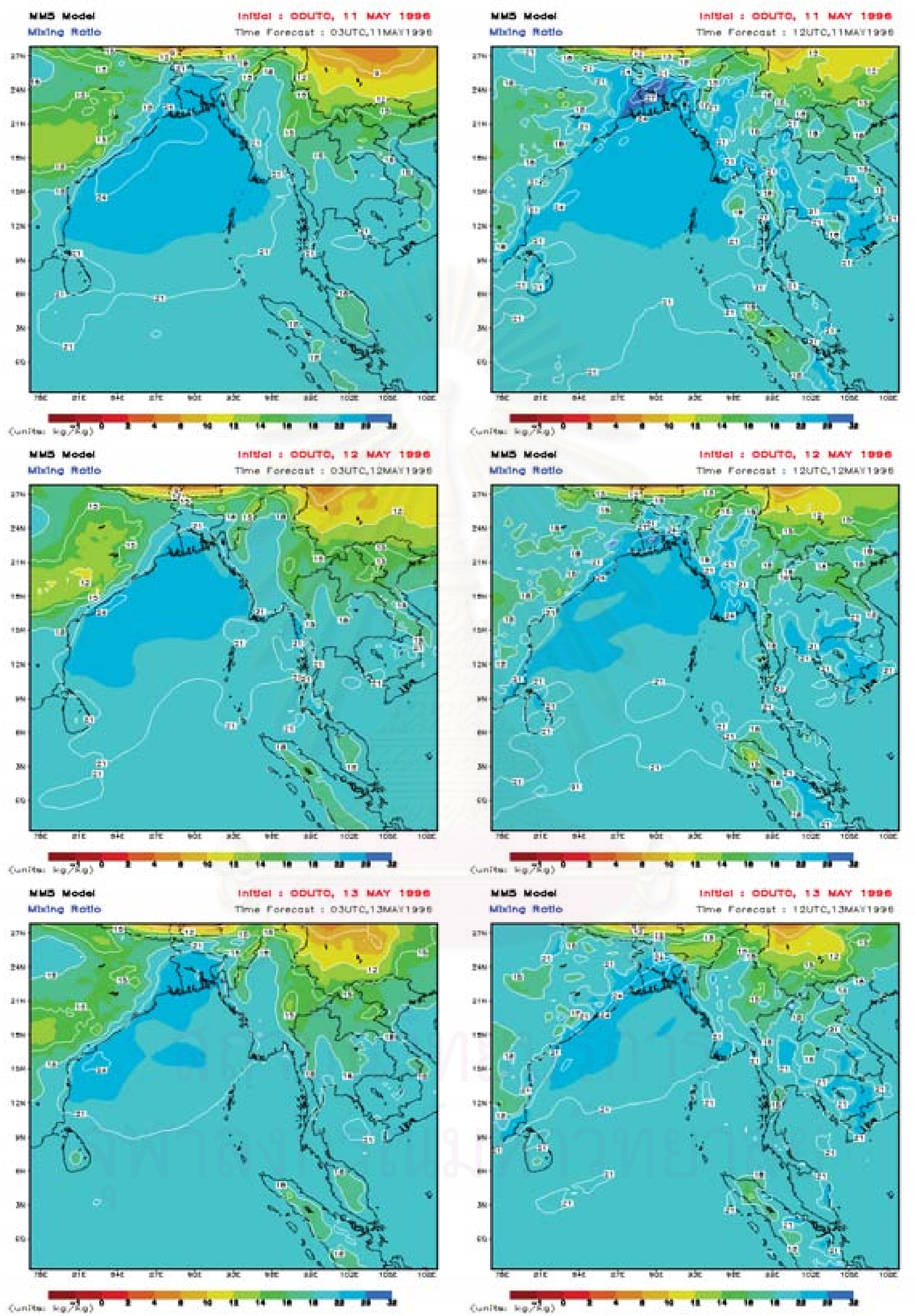
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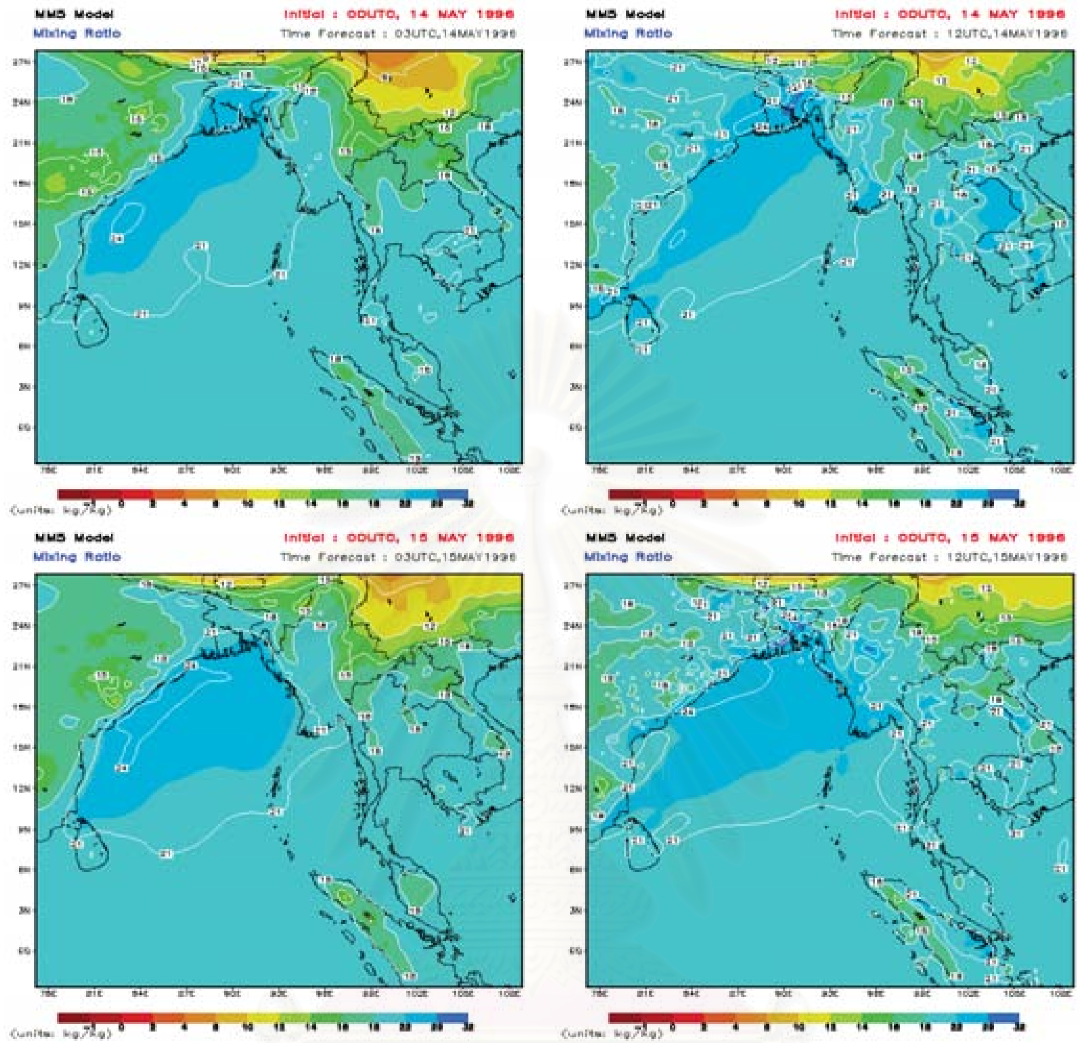
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Mixing Ratio
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Time Forecast : 03UTC,15MAY1996
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Mixing Ratio
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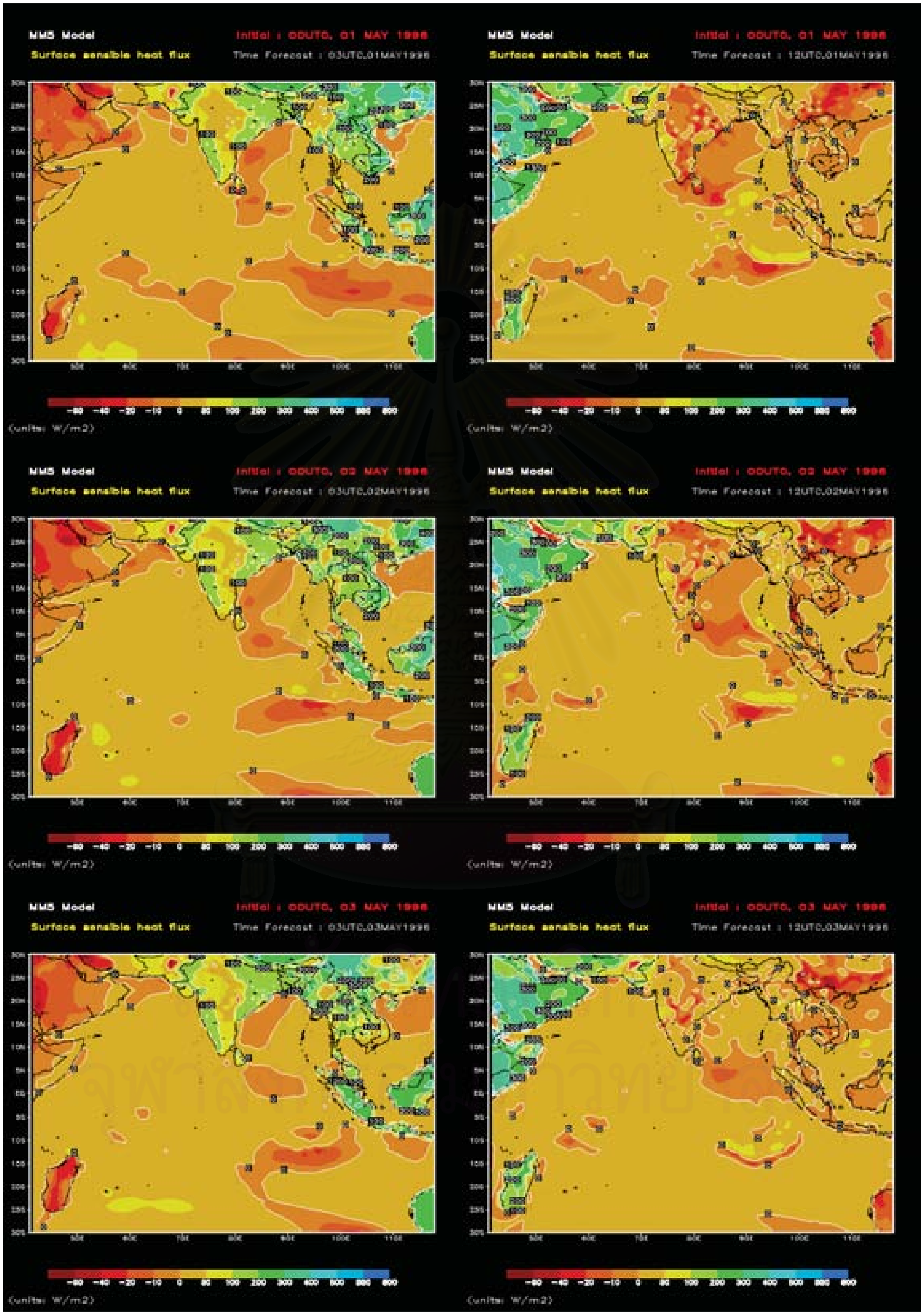
(units: kg/kg)

Area1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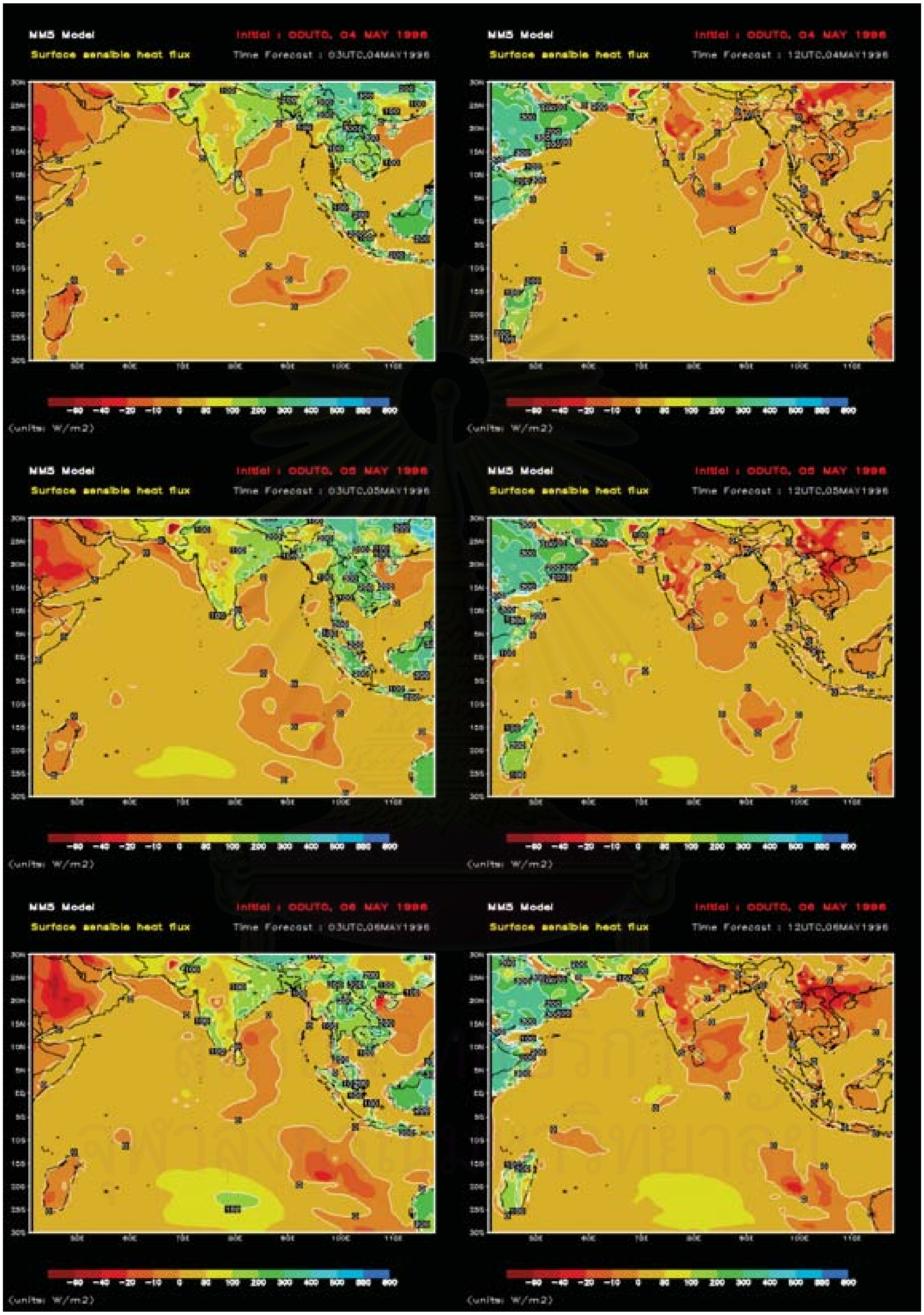
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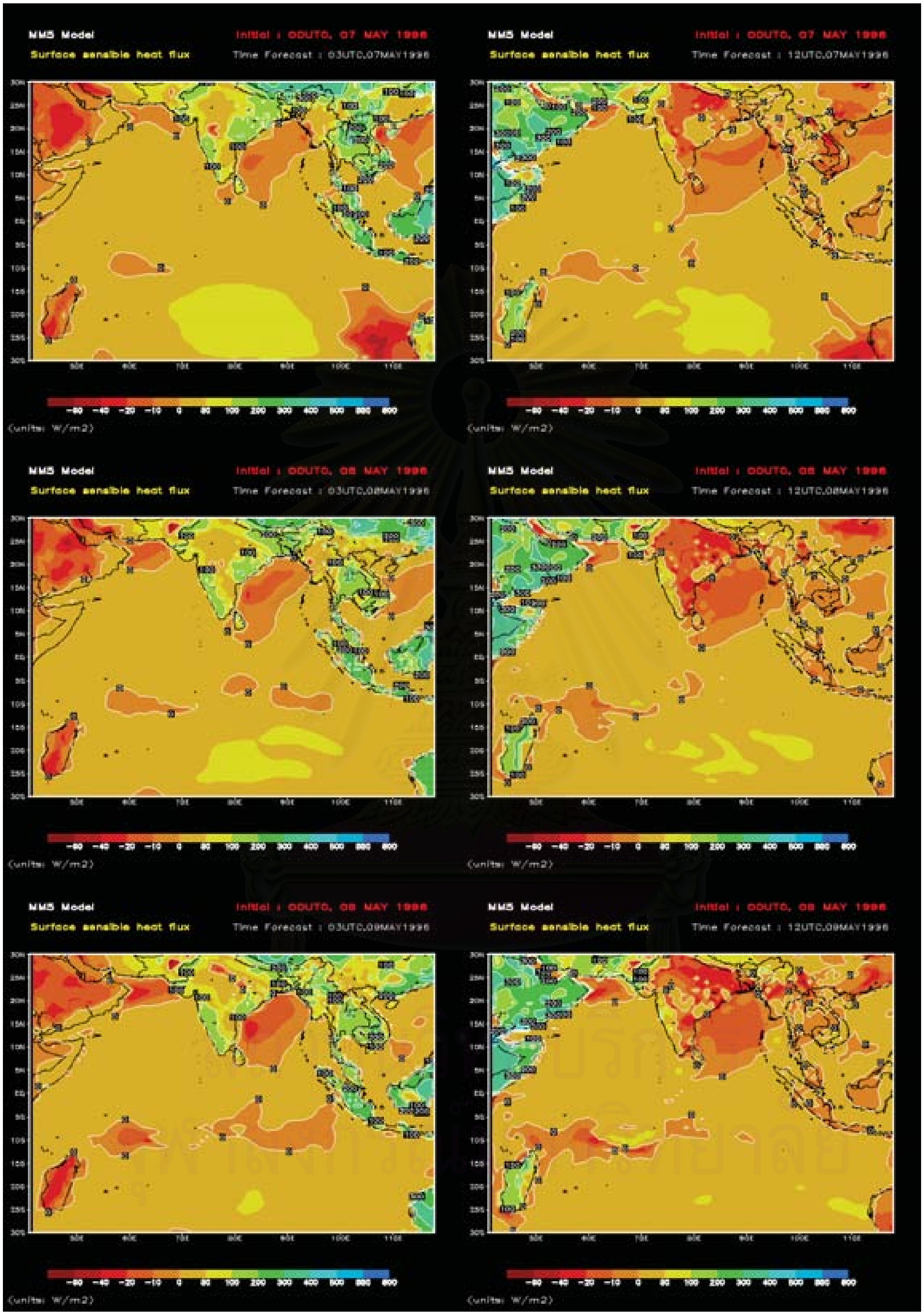
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Time Forecast : 12UTC,07MAY1996
(units: W/m2)
MM5 Model
Initial : 00UTC, 08 MAY 1996
Surface sensible heat flux
Time Forecast : 03UTC,08MAY1996
(units: W/m2)
MM5 Model
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Surface sensible heat flux
Time Forecast : 12UTC,08MAY1996
(units: W/m2)
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Time Forecast : 03UTC,09MAY1996
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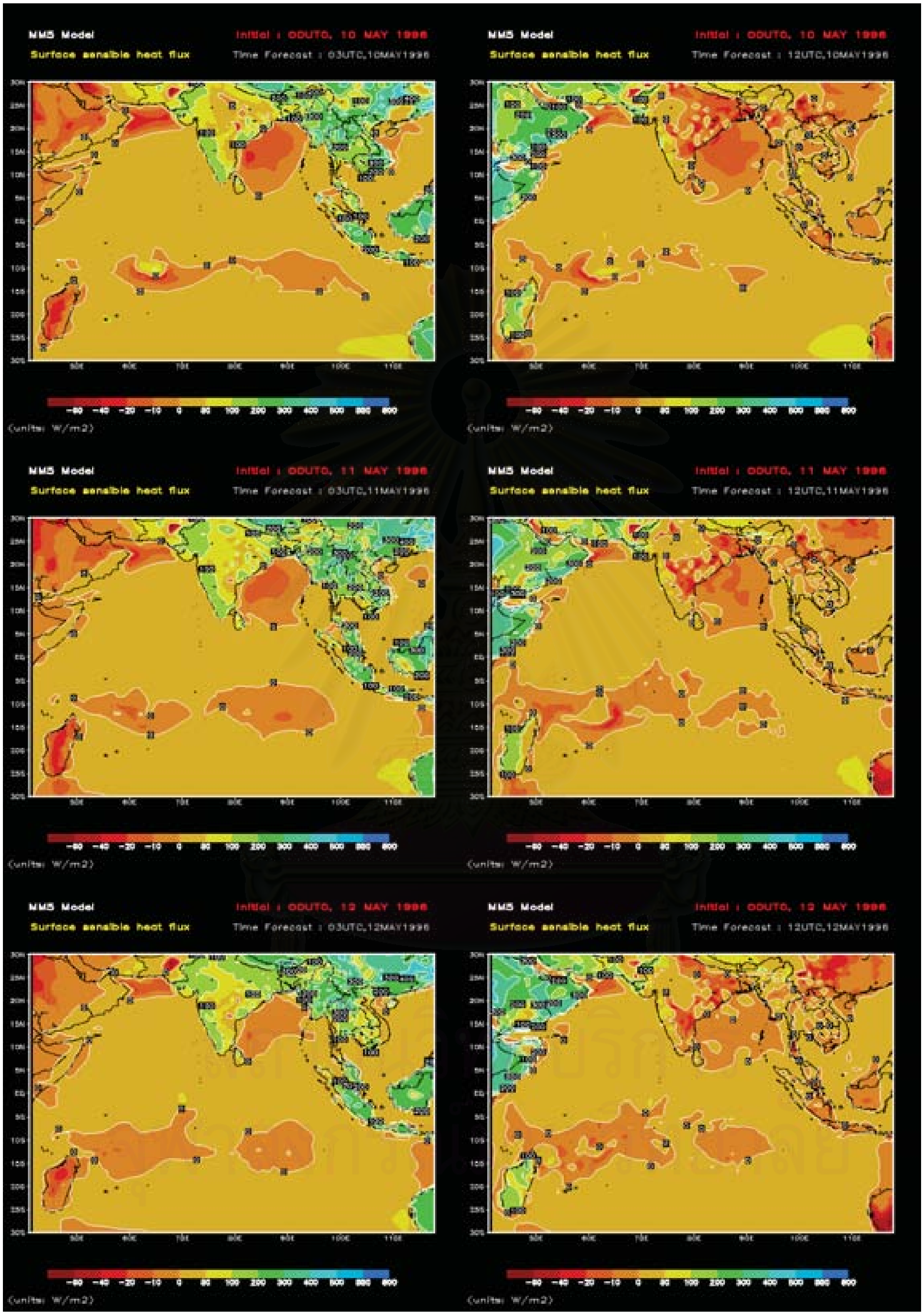
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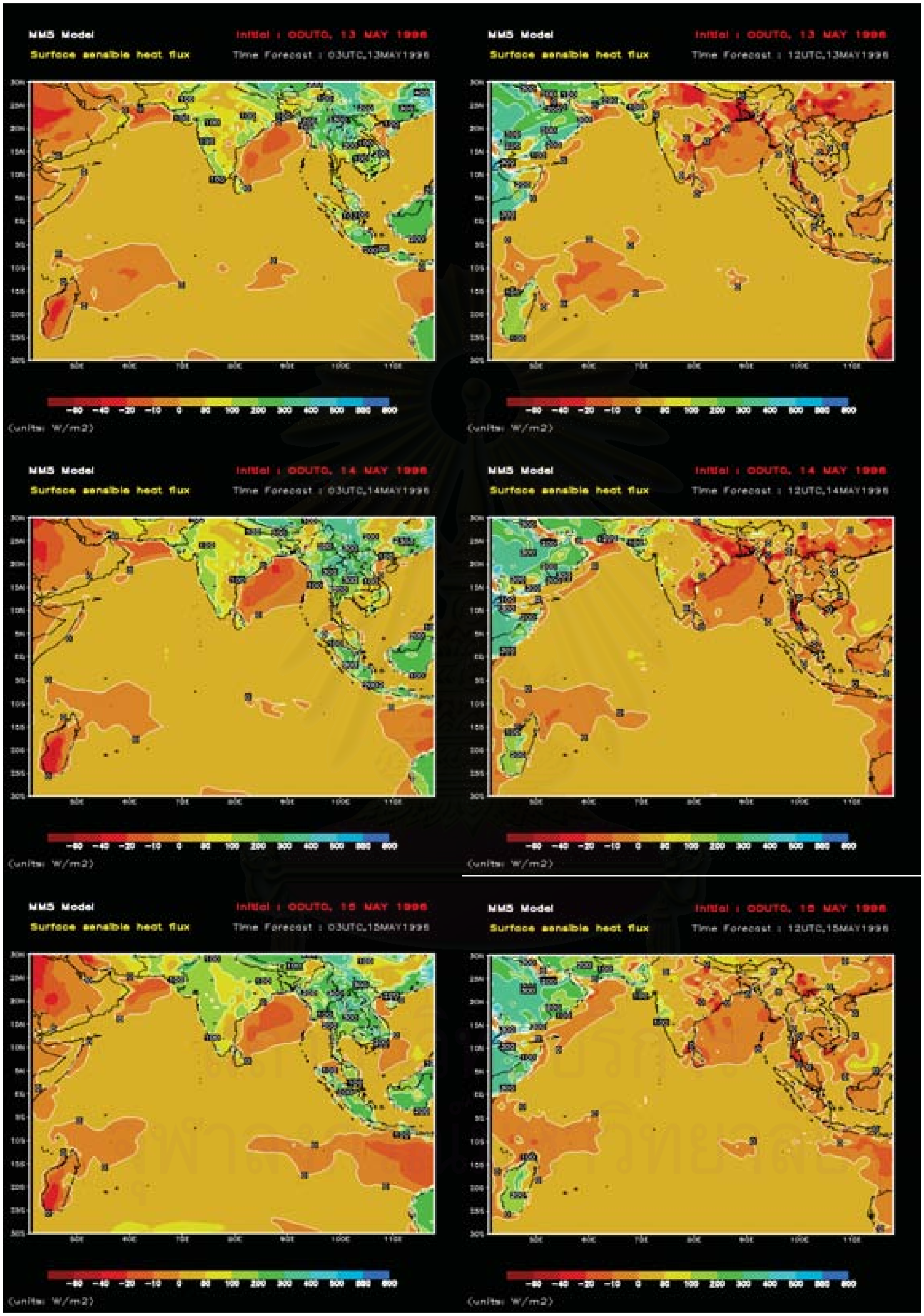
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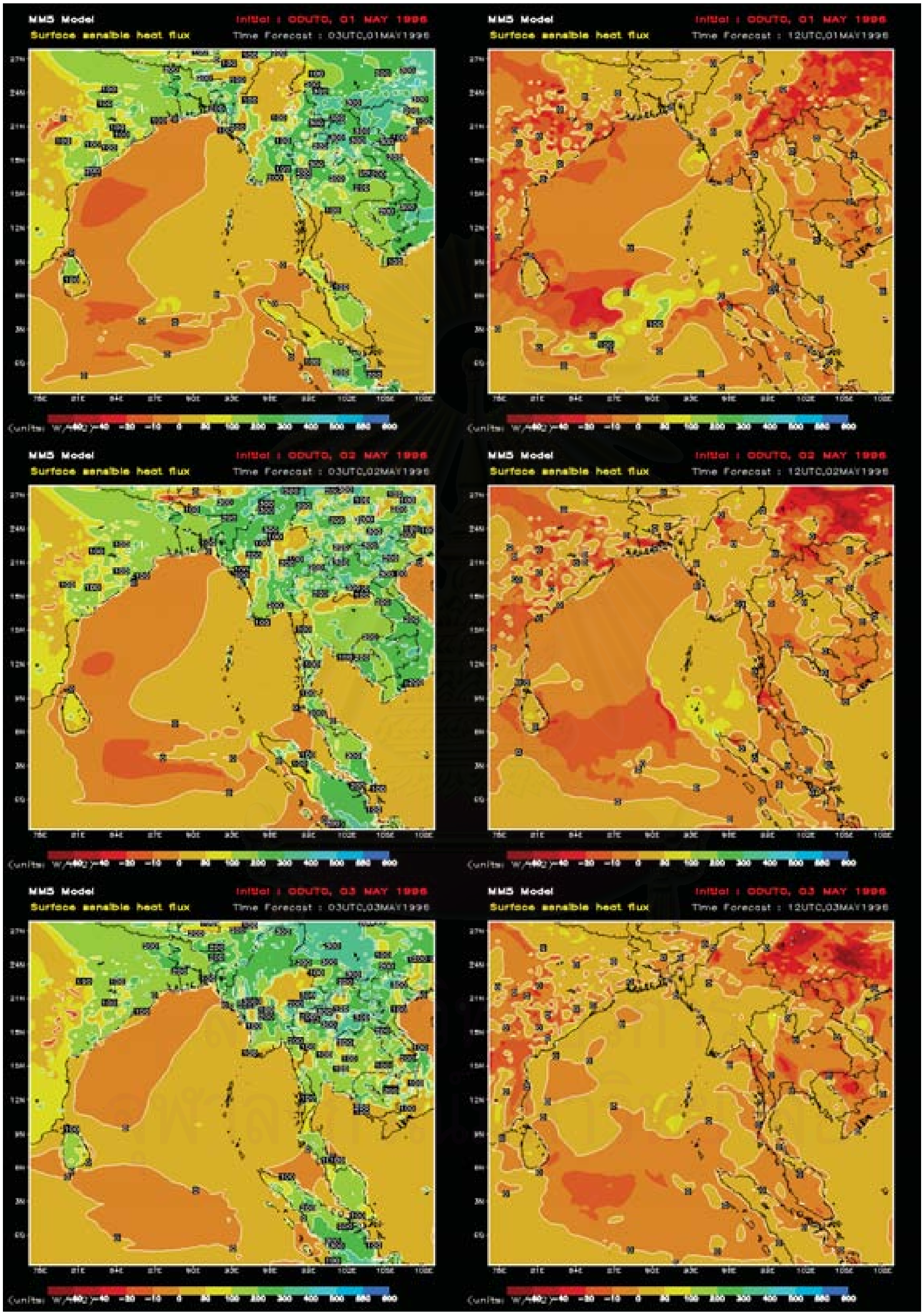
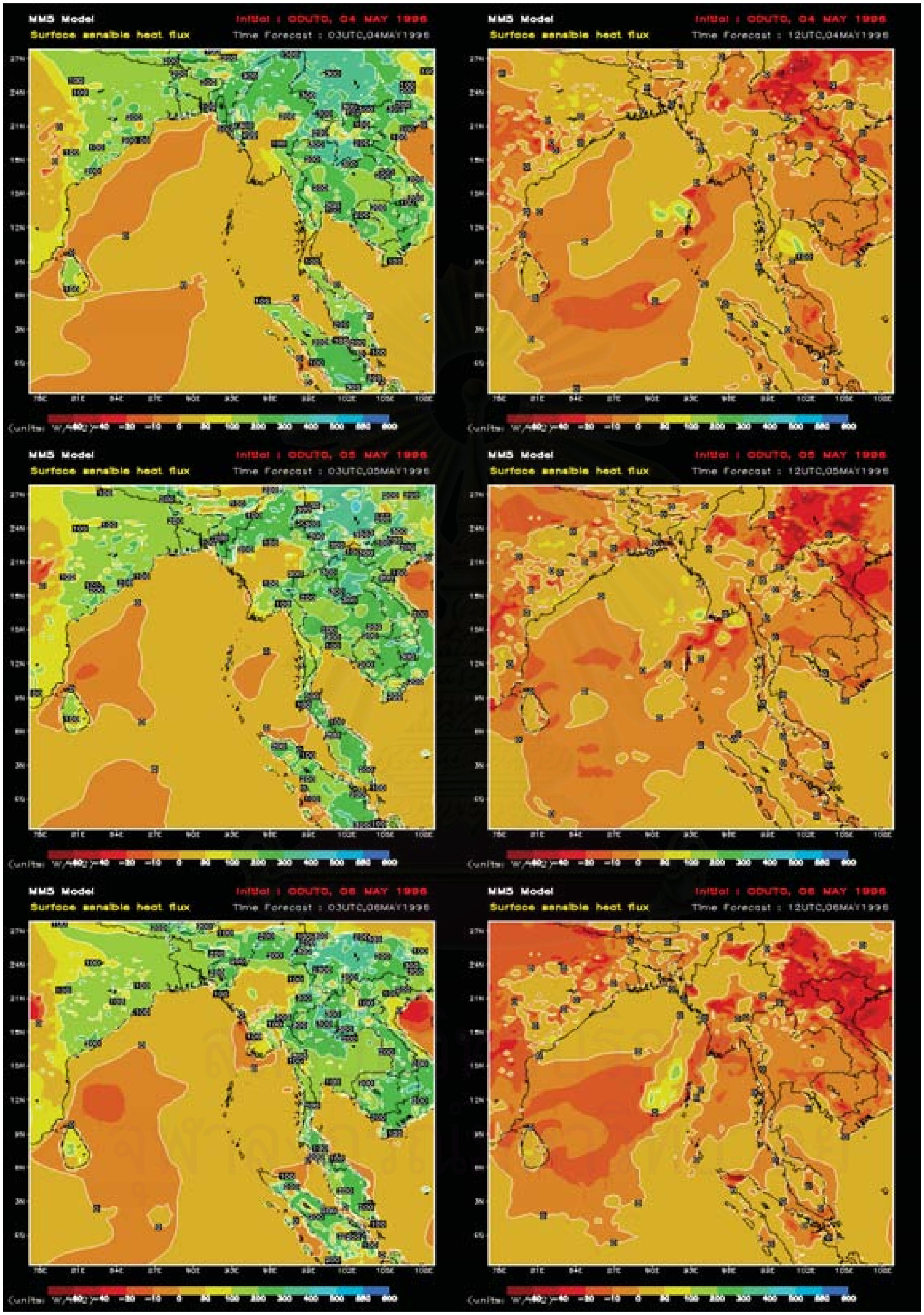
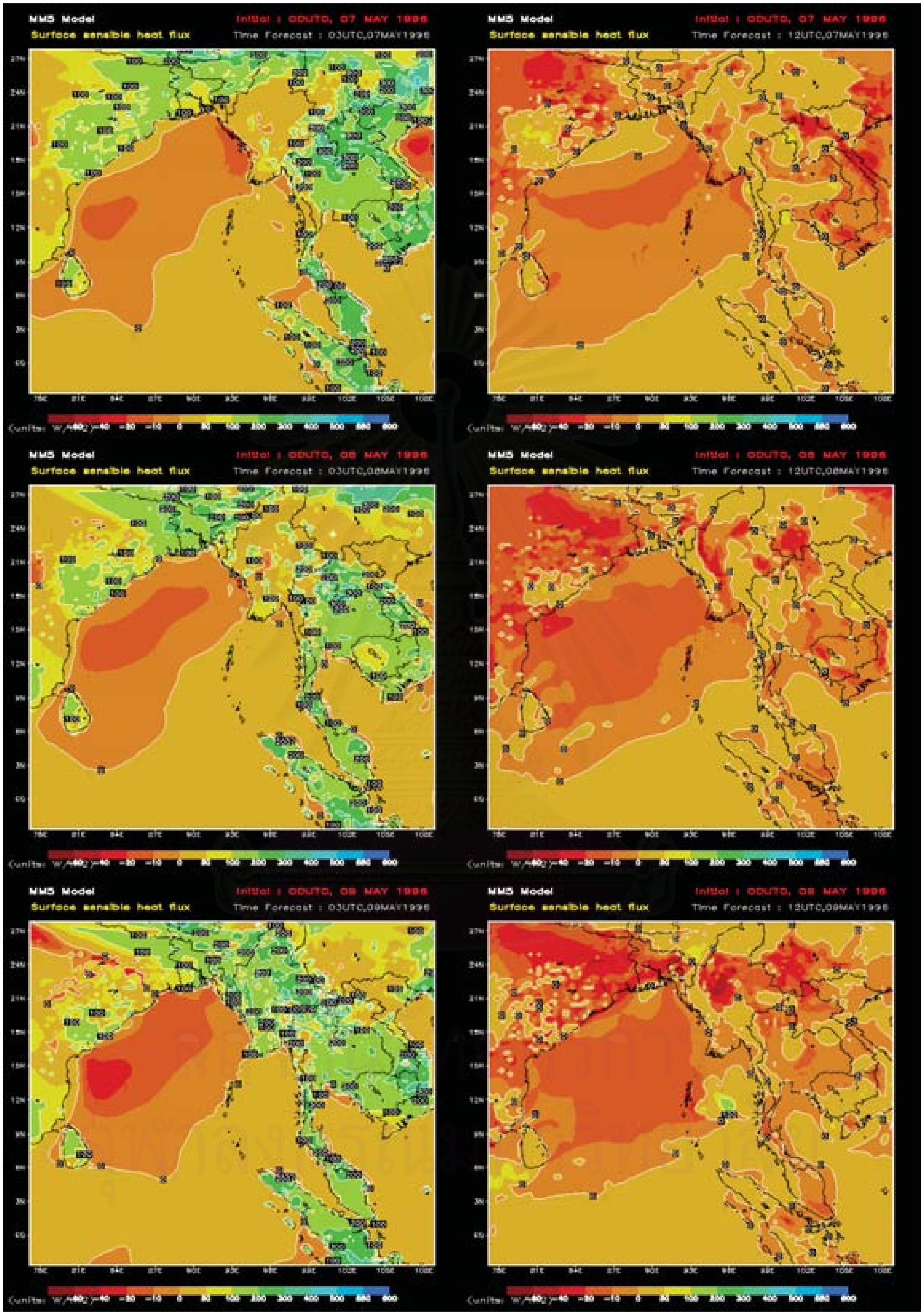
Time Forecast : 12UTC,13MAY1996
(units: W/m2)
MM5 Model
Initial : 00UTC, 14 MAY 1996
Surface sensible heat flux
Time Forecast : 03UTC,14MAY1996
(units: W/m2)
MM5 Model
Initial : 00UTC, 14 MAY 1996
Surface sensible heat flux
Time Forecast : 12UTC,14MAY1996
(units: W/m2)
MM5 Model
Initial : 00UTC, 15 MAY 1996
Surface sensible heat flux
Time Forecast : 03UTC,15MAY1996
(units: W/m2)
MM5 Model
Initial : 00UTC, 15 MAY 1996
Surface sensible heat flux
Time Forecast : 12UTC,15MAY1996
(units: W/m2)

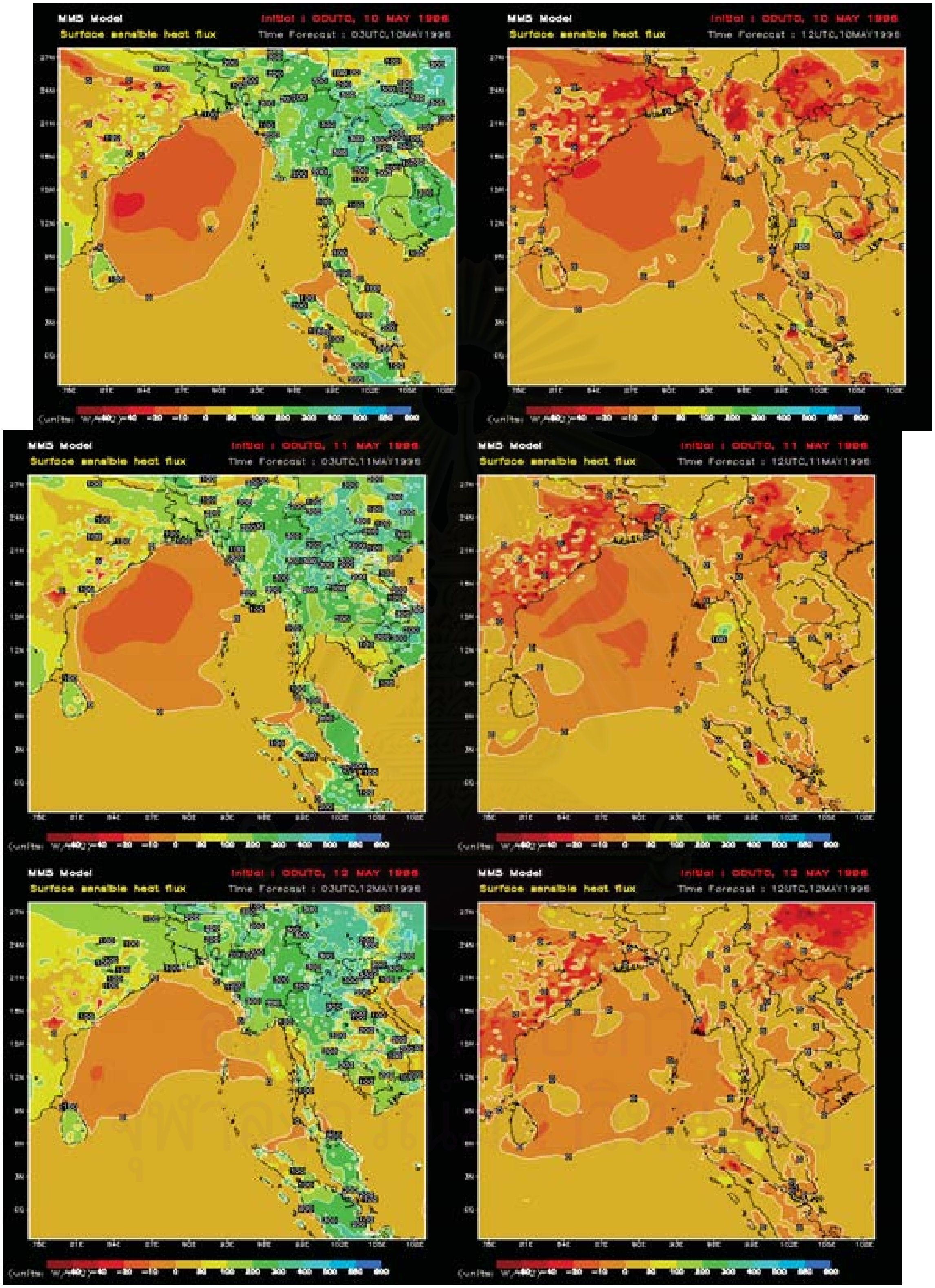
Area2

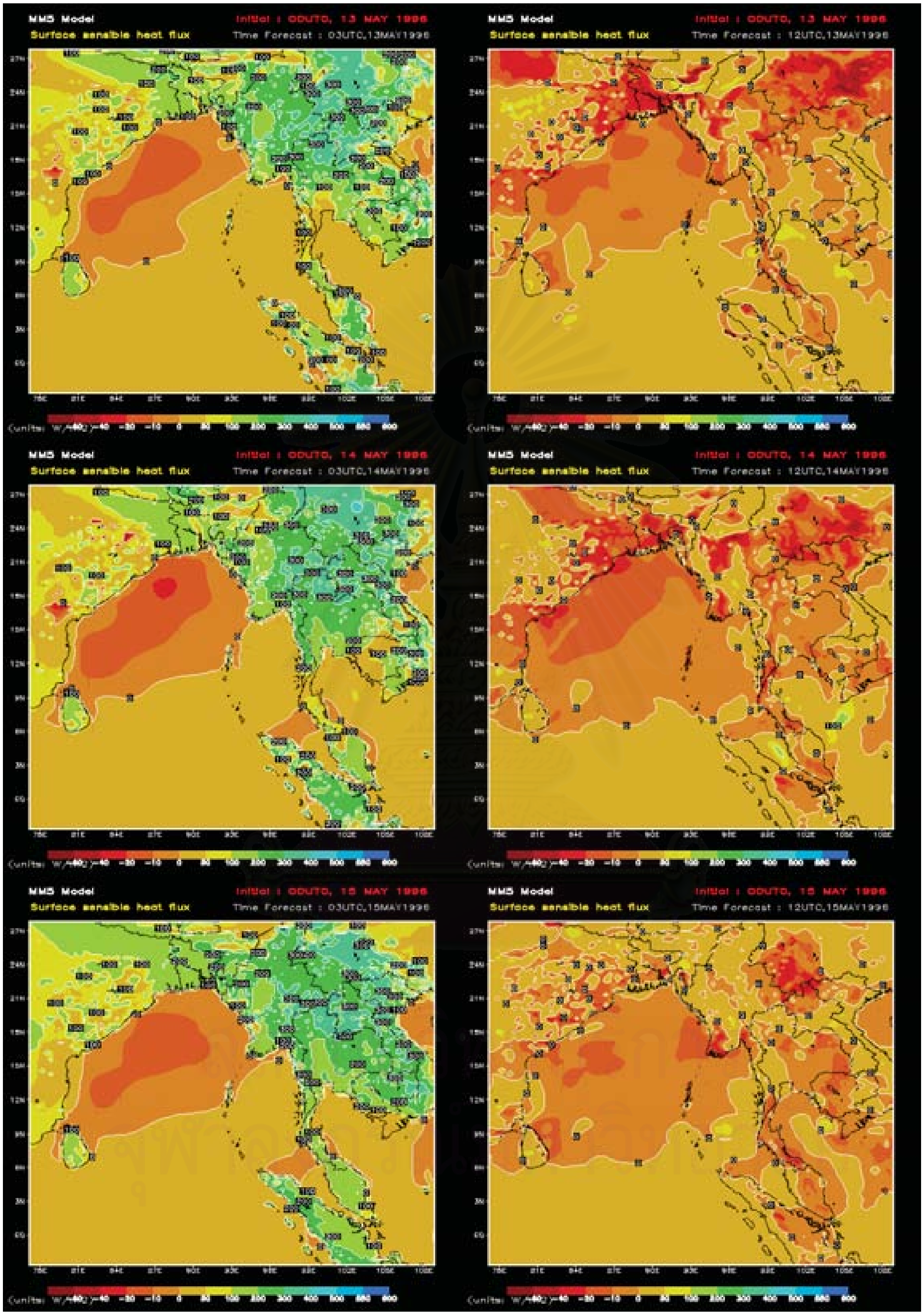


MM5 Model
Initial : 00UTC, 01 MAY 1996
Surface sensible heat flux
Time Forecast : 03UTC,01MAY1996
MM5 Model
Initial : 00UTC, 01 MAY 1996
Surface sensible heat flux
Time Forecast : 12UTC,01MAY1996
MM5 Model
Initial : 00UTC, 02 MAY 1996
Surface sensible heat flux
Time Forecast : 03UTC,02MAY1996
MM5 Model
Initial : 00UTC, 02 MAY 1996
Surface sensible heat flux
Time Forecast : 12UTC,02MAY1996
MM5 Model
Initial : 00UTC, 03 MAY 1996
Surface sensible heat flux
Time Forecast : 03UTC,03MAY1996
MM5 Model
Initial : 00UTC, 03 MAY 1996
Surface sensible heat flux
Time Forecast : 12UTC,03MAY1996


MM5 Model
Surface sensible heat flux
Initial : 00UTC, 04 MAY 1996
Time Forecast : 03UTC,04MAY1996
MM5 Model
Surface sensible heat flux
Initial : 00UTC, 04 MAY 1996
Time Forecast : 12UTC,04MAY1996
MM5 Model
Surface sensible heat flux
Initial : 00UTC, 05 MAY 1996
Time Forecast : 03UTC,05MAY1996
MM5 Model
Surface sensible heat flux
Initial : 00UTC, 05 MAY 1996
Time Forecast : 12UTC,05MAY1996
MM5 Model
Surface sensible heat flux
Initial : 00UTC, 06 MAY 1996
Time Forecast : 03UTC,06MAY1996
MM5 Model
Surface sensible heat flux
Initial : 00UTC, 06 MAY 1996
Time Forecast : 12UTC,06MAY1996

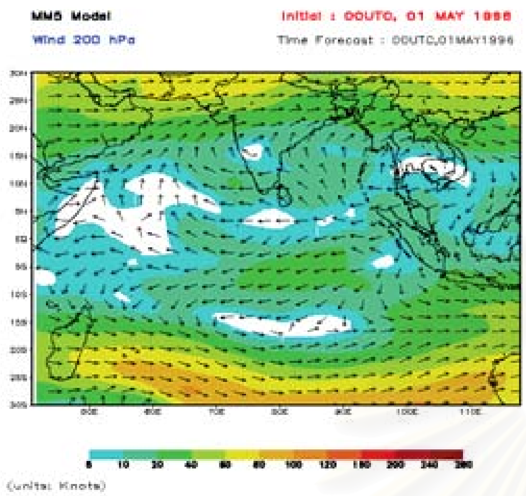

MM5 Model
Initial : 00UTC, 07 MAY 1996
Surface sensible heat flux
Time Forecast : 03UTC,07MAY1996
MM5 Model
Initial : 00UTC, 07 MAY 1996
Surface sensible heat flux
Time Forecast : 12UTC,07MAY1996
MM5 Model
Initial : 00UTC, 08 MAY 1996
Surface sensible heat flux
Time Forecast : 03UTC,08MAY1996
MM5 Model
Initial : 00UTC, 08 MAY 1996
Surface sensible heat flux
Time Forecast : 12UTC,08MAY1996
MM5 Model
Initial : 00UTC, 09 MAY 1996
Surface sensible heat flux
Time Forecast : 03UTC,09MAY1996
MM5 Model
Initial : 00UTC, 09 MAY 1996
Surface sensible heat flux
Time Forecast : 12UTC,09MAY1996

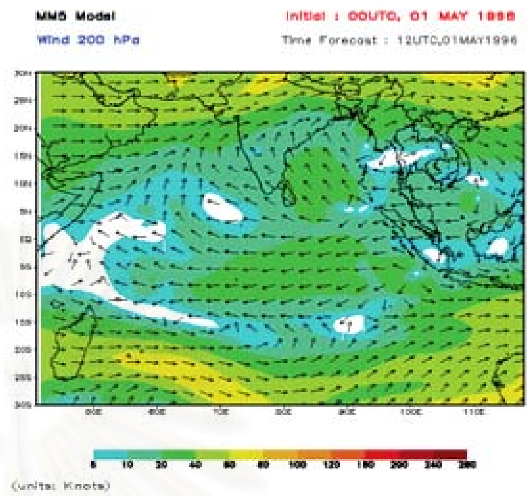

MM5 Model
Surface sensible heat flux
Initial : 00UTC, 10 MAY 1996
Time Forecast : 03UTC,10MAY1996
MM5 Model
Surface sensible heat flux
Initial : 00UTC, 10 MAY 1996
Time Forecast : 12UTC,10MAY1996
MM5 Model
Surface sensible heat flux
Initial : 00UTC, 11 MAY 1996
Time Forecast : 03UTC,11MAY1996
MM5 Model
Surface sensible heat flux
Initial : 00UTC, 11 MAY 1996
Time Forecast : 12UTC,11MAY1996
MM5 Model
Surface sensible heat flux
Initial : 00UTC, 12 MAY 1996
Time Forecast : 03UTC,12MAY1996
MM5 Model
Surface sensible heat flux
Initial : 00UTC, 12 MAY 1996
Time Forecast : 12UTC,12MAY1996

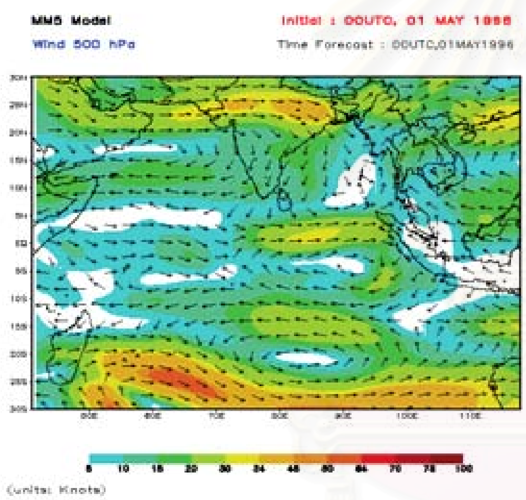

MM5 Model
Surface sensible heat flux
Initial : 00UTC, 13 MAY 1996
Time Forecast : 03UTC,13MAY1996
MM5 Model
Surface sensible heat flux
Initial : 00UTC, 13 MAY 1996
Time Forecast : 12UTC,13MAY1996
MM5 Model
Surface sensible heat flux
Initial : 00UTC, 14 MAY 1996
Time Forecast : 03UTC,14MAY1996
MM5 Model
Surface sensible heat flux
Initial : 00UTC, 14 MAY 1996
Time Forecast : 12UTC,14MAY1996
MM5 Model
Surface sensible heat flux
Initial : 00UTC, 15 MAY 1996
Time Forecast : 03UTC,15MAY1996
MM5 Model
Surface sensible heat flux
Initial : 00UTC, 15 MAY 1996
Time Forecast : 12UTC,15MAY1996

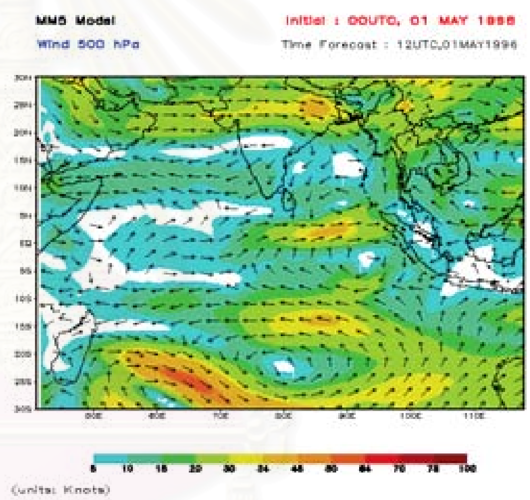
Area1

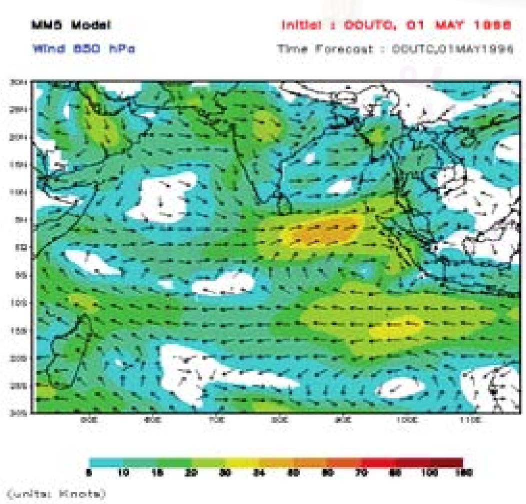
Upper Wind 200-850 hPa

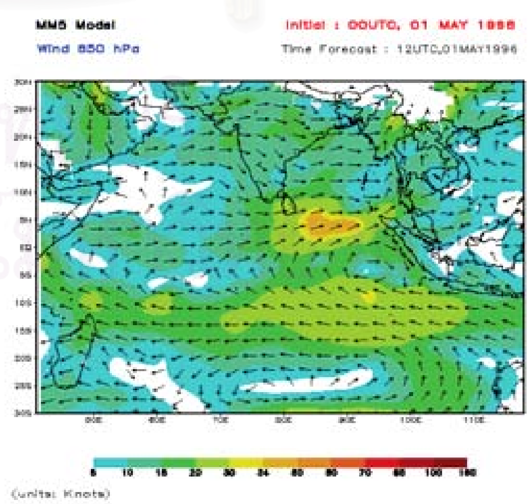


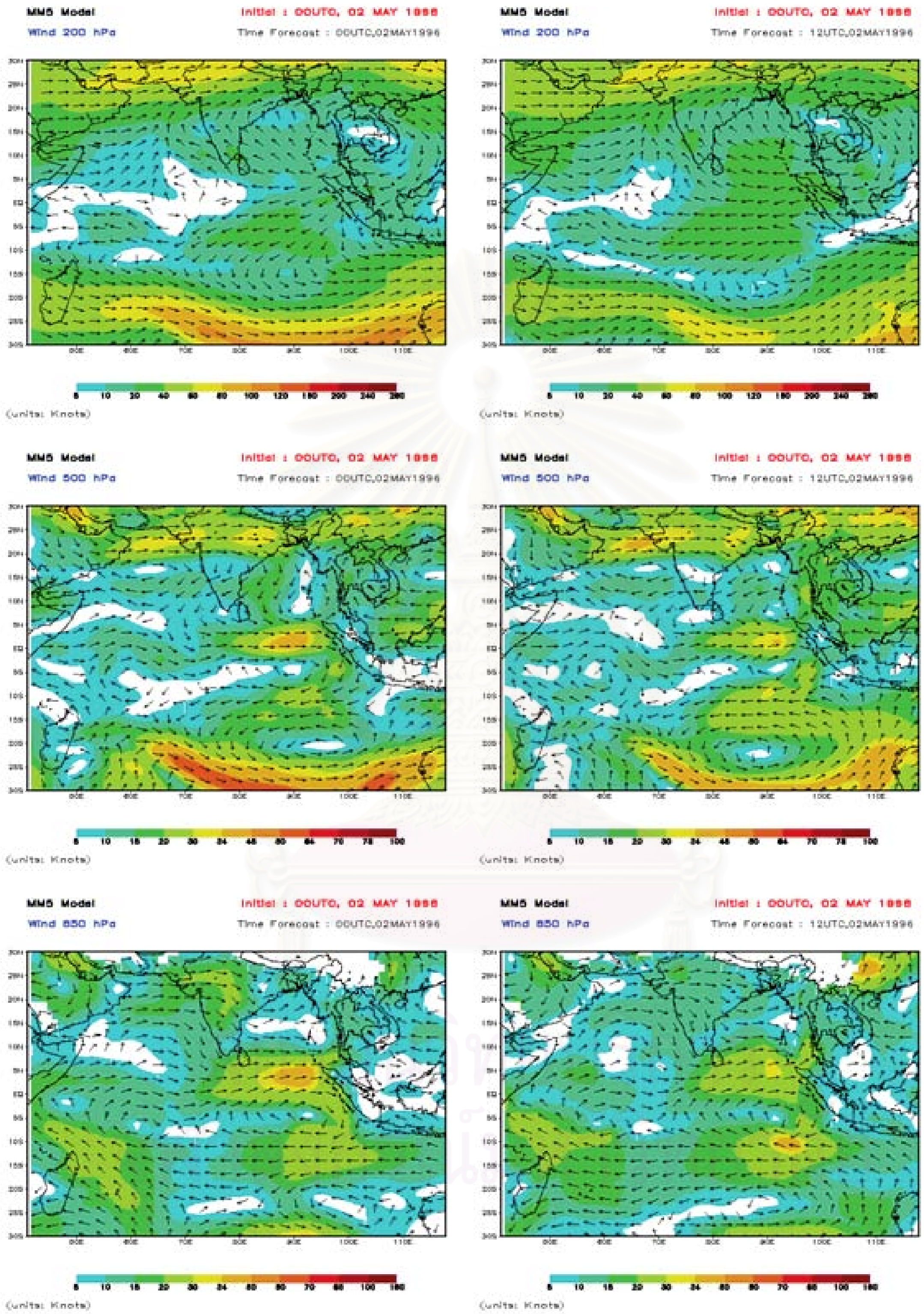


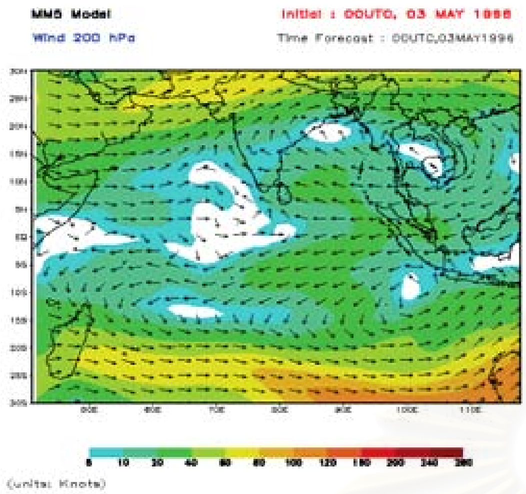


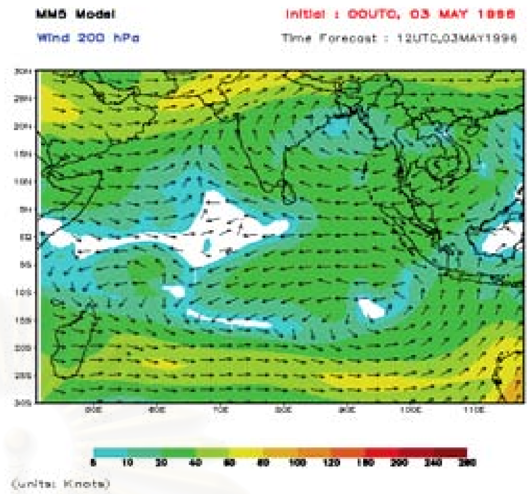


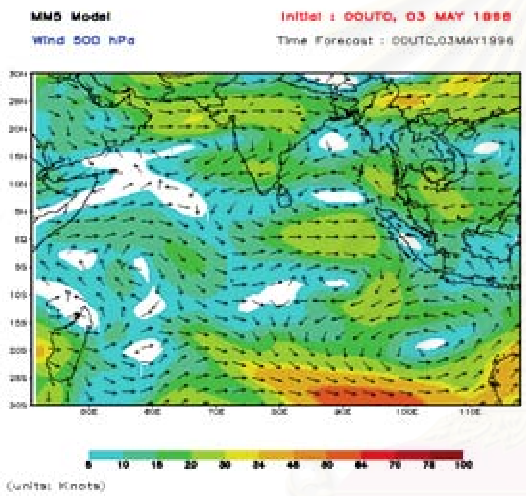


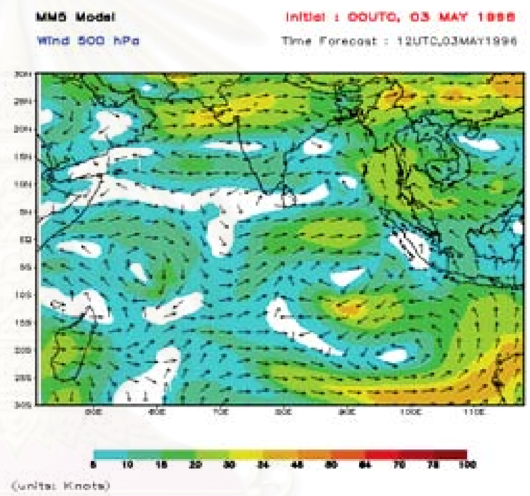


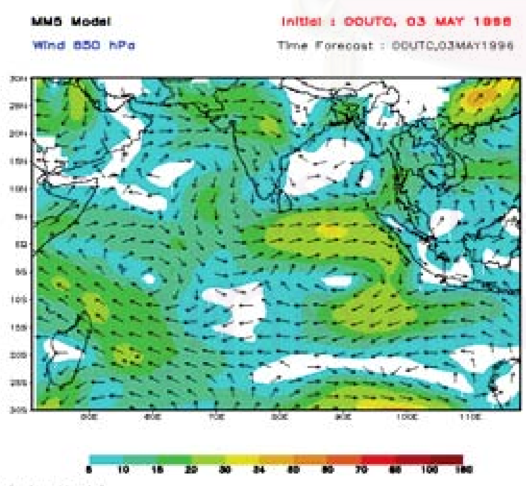

MM5 Model
Initial : 00UTC, 02 MAY 1996
Wind 200 hPa
Time Forecast : 00UTC,02MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 02 MAY 1996
Wind 200 hPa
Time Forecast : 12UTC,02MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 02 MAY 1996
Wind 500 hPa
Time Forecast : 00UTC,02MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 02 MAY 1996
Wind 500 hPa
Time Forecast : 12UTC,02MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 02 MAY 1996
Wind 850 hPa
Time Forecast : 00UTC,02MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 02 MAY 1996
Wind 850 hPa
Time Forecast : 12UTC,02MAY1996
(units: Knots)

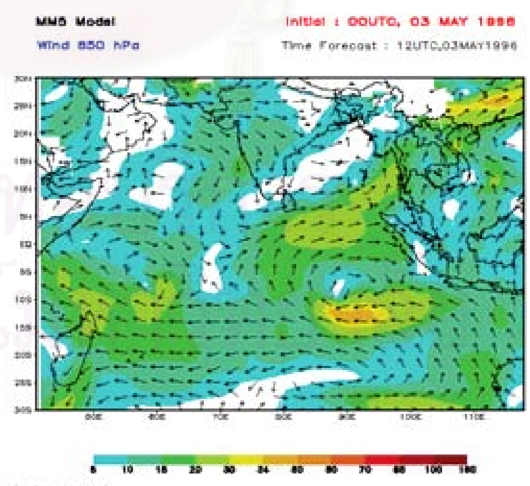

MM5 Model
Wind 200 hPa
Initial : 00UTC, 03 MAY 1996
Time Forecast : 00UTC,03MAY1996
(units: Knots)

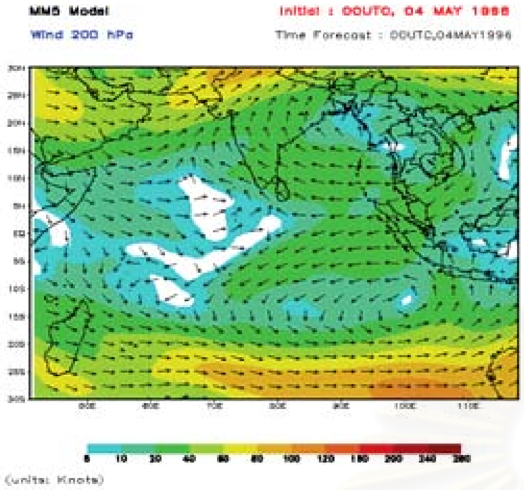

MM5 Model
Wind 200 hPa
Initial : 00UTC, 03 MAY 1996
Time Forecast : 12UTC,03MAY1996
(units: Knots)

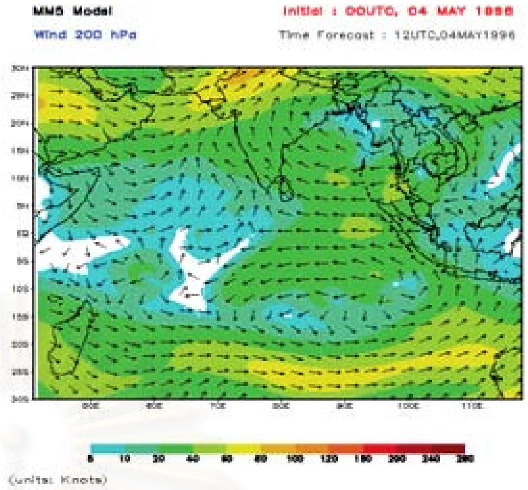

MM5 Model
Wind 500 hPa
Initial : 00UTC, 03 MAY 1996
Time Forecast : 00UTC,03MAY1996
(units: Knots)

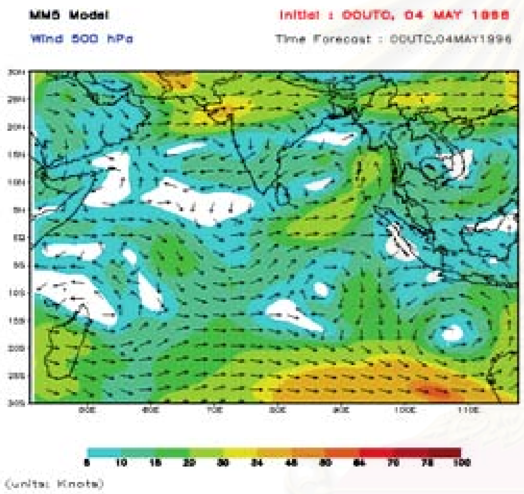

MM5 Model
Wind 500 hPa
Initial : 00UTC, 03 MAY 1996
Time Forecast : 12UTC,03MAY1996
(units: Knots)

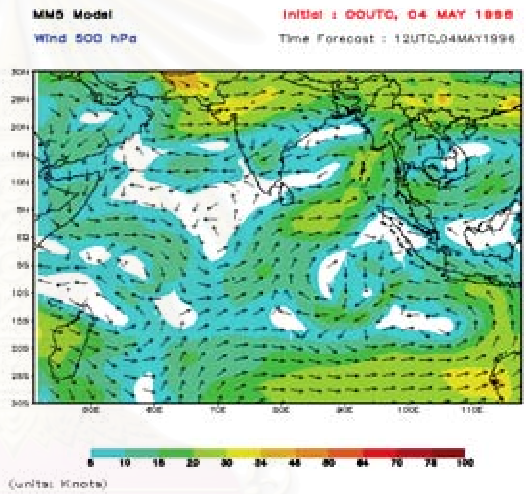

MM5 Model
Wind 850 hPa
Initial : 00UTC, 03 MAY 1996
Time Forecast : 00UTC,03MAY1996
(units: Knots)

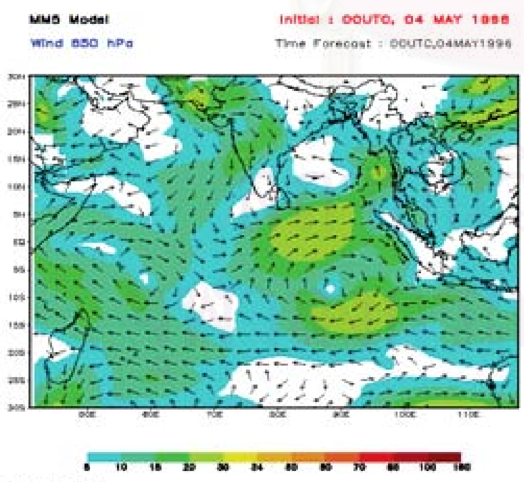

MM5 Model
Wind 850 hPa
Initial : 00UTC, 03 MAY 1996
Time Forecast : 12UTC,03MAY1996
(units: Knots)

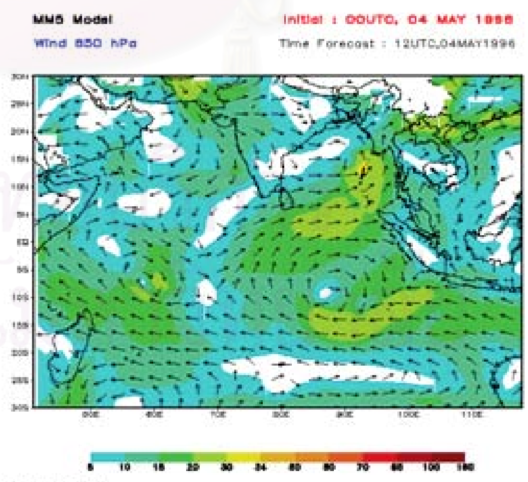

MM5 Model
Wind 200 hPa
Initial : 00UTC, 04 MAY 1996
Time Forecast : 00UTC,04MAY1996
(units: Knots)

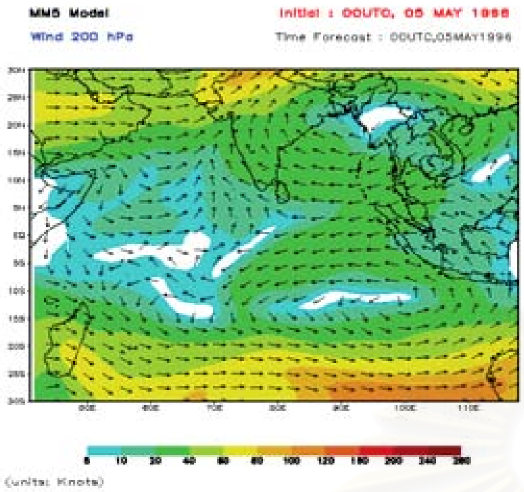

MM5 Model
Wind 200 hPa
Initial : 00UTC, 04 MAY 1996
Time Forecast : 12UTC,04MAY1996
(units: Knots)

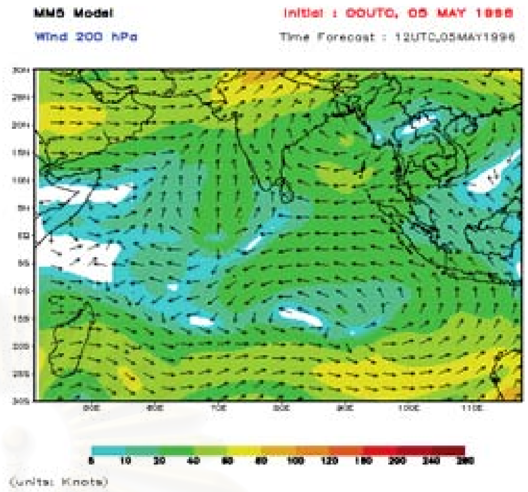

MM5 Model
Wind 500 hPa
Initial : 00UTC, 04 MAY 1996
Time Forecast : 00UTC,04MAY1996
(units: Knots)

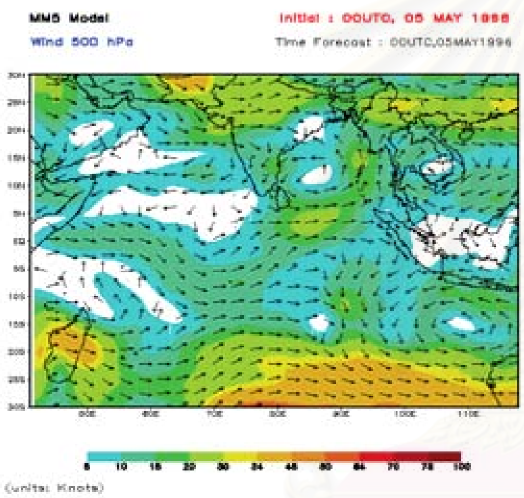

MM5 Model
Wind 500 hPa
Initial : 00UTC, 04 MAY 1996
Time Forecast : 12UTC,04MAY1996
(units: Knots)

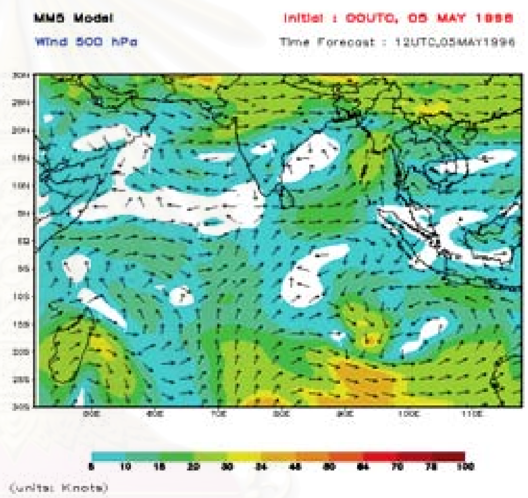

MM5 Model
Wind 850 hPa
Initial : 00UTC, 04 MAY 1996
Time Forecast : 00UTC,04MAY1996
(units: Knots)

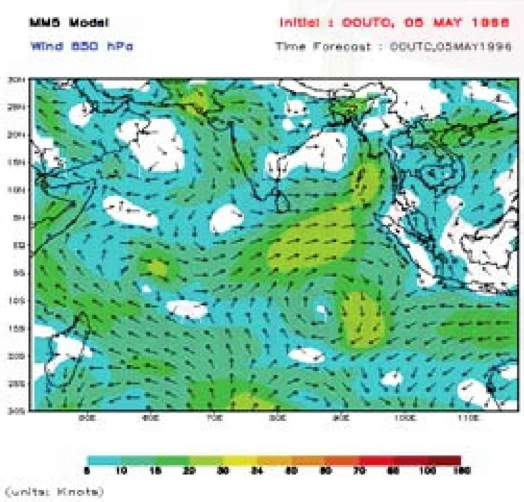

MM5 Model
Wind 850 hPa
Initial : 00UTC, 04 MAY 1996
Time Forecast : 12UTC,04MAY1996
(units: Knots)

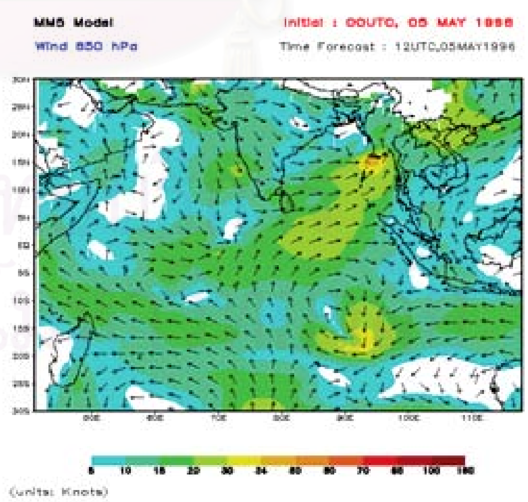

MM5 Model
Initial : 00UTC, 05 MAY 1996
Wind 200 hPa
Time Forecast : 00UTC,05MAY1996
(units: Knots)

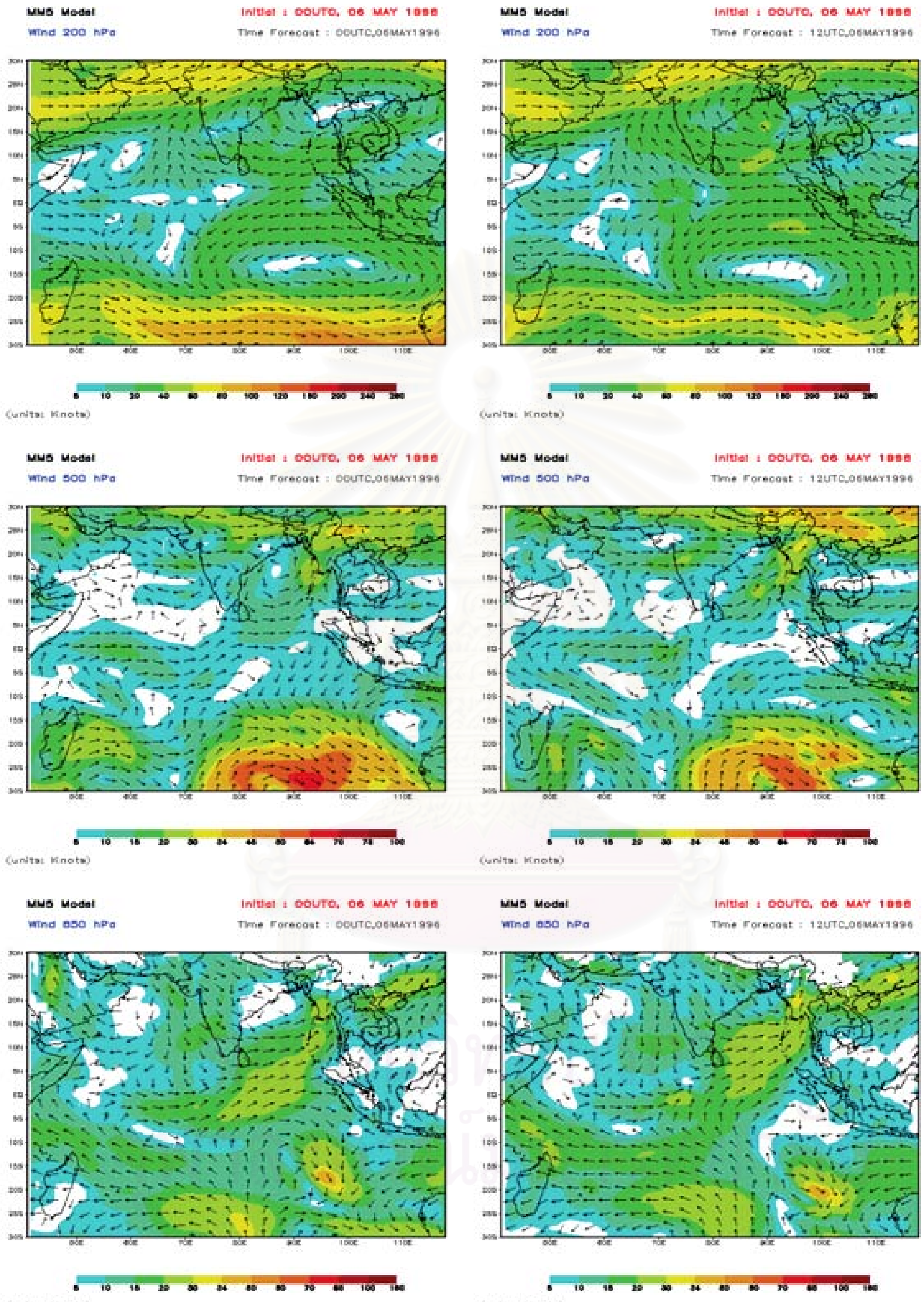

MM5 Model
Initial : 00UTC, 05 MAY 1996
Wind 200 hPa
Time Forecast : 12UTC,05MAY1996
(units: Knots)


MM5 Model
Initial : 00UTC, 05 MAY 1996
Wind 500 hPa
Time Forecast : 00UTC,05MAY1996
(units: Knots)

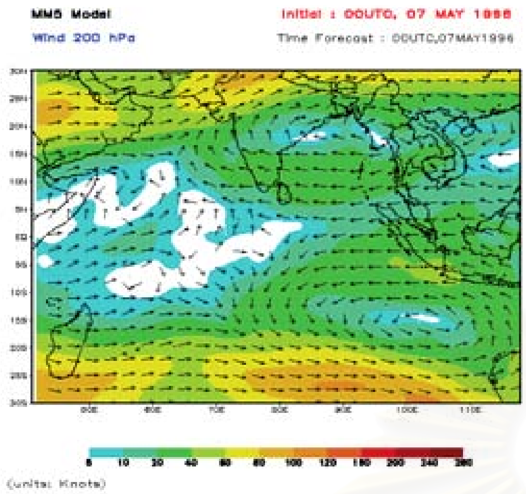

MM5 Model
Initial : 00UTC, 05 MAY 1996
Wind 500 hPa
Time Forecast : 12UTC,05MAY1996
(units: Knots)

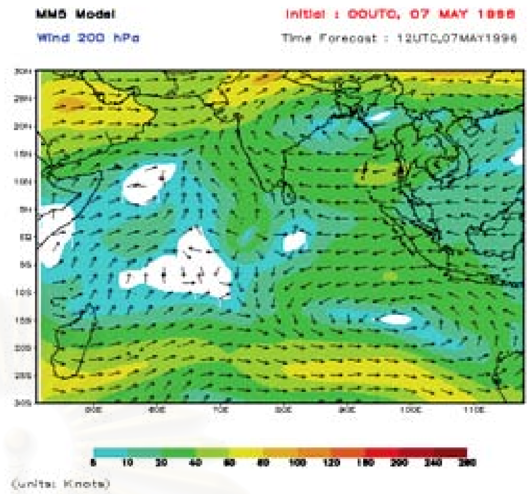

MM5 Model
Initial : 00UTC, 05 MAY 1996
Wind 850 hPa
Time Forecast : 00UTC,05MAY1996
(units: Knots)

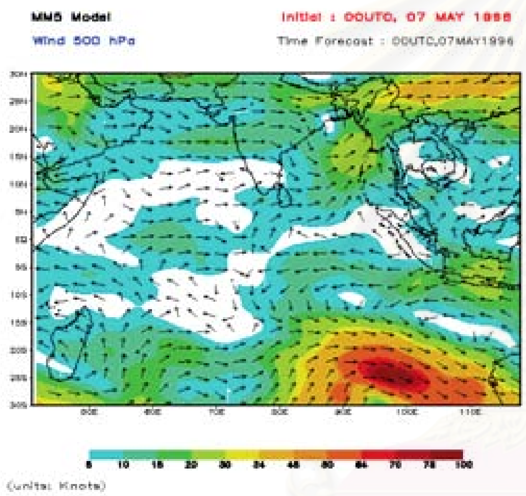

MM5 Model
Initial : 00UTC, 05 MAY 1996
Wind 850 hPa
Time Forecast : 12UTC,05MAY1996
(units: Knots)

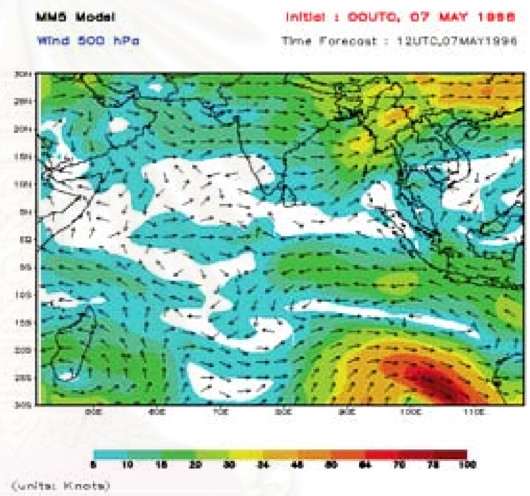


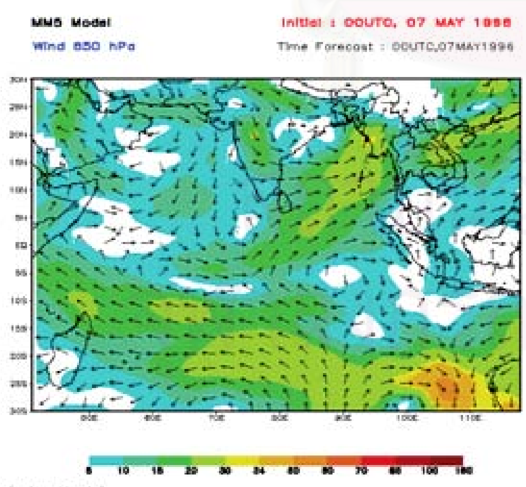
MM5 Model
Initial : 00UTC, 06 MAY 1996
Wind 200 hPa
Time Forecast : 00UTC,06MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 06 MAY 1996
Wind 200 hPa
Time Forecast : 12UTC,06MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 06 MAY 1996
Wind 500 hPa
Time Forecast : 00UTC,06MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 06 MAY 1996
Wind 500 hPa
Time Forecast : 12UTC,06MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 06 MAY 1996
Wind 850 hPa
Time Forecast : 00UTC,06MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 06 MAY 1996
Wind 850 hPa
Time Forecast : 12UTC,06MAY1996
(units: Knots)

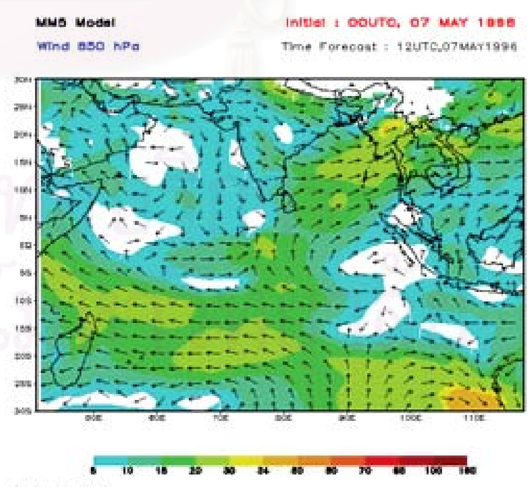

MM5 Model
Initial : 00UTC, 07 MAY 1996
Wind 200 hPa
Time Forecast : 00UTC,07MAY1996
(units: Knots)

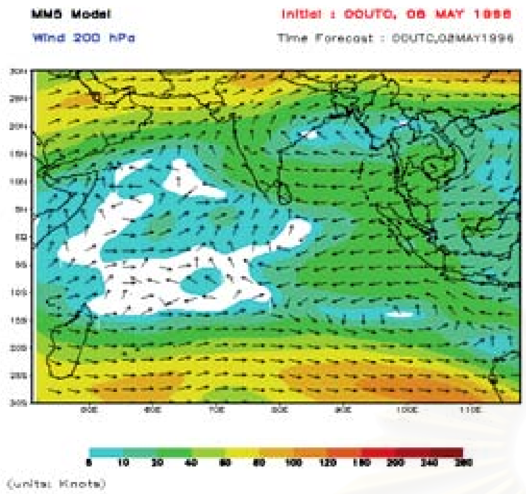

MM5 Model
Initial : 00UTC, 07 MAY 1996
Wind 200 hPa
Time Forecast : 12UTC,07MAY1996
(units: Knots)

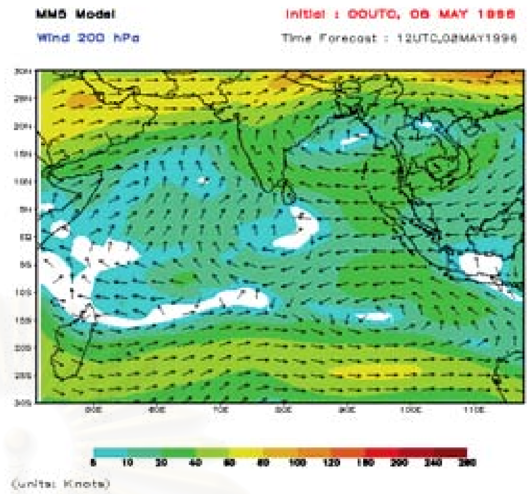

MM5 Model
Initial : 00UTC, 07 MAY 1996
Wind 500 hPa
Time Forecast : 00UTC,07MAY1996
(units: Knots)

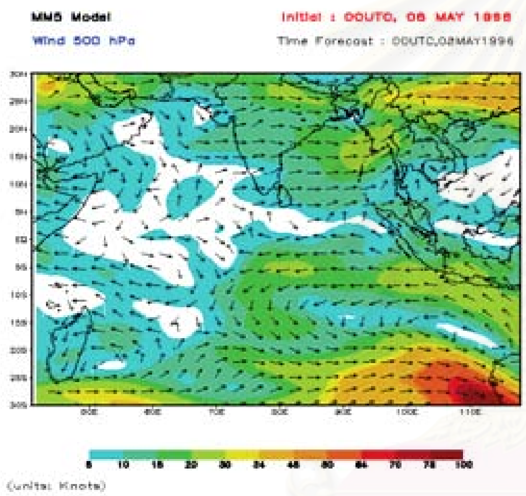

MM5 Model
Initial : 00UTC, 07 MAY 1996
Wind 500 hPa
Time Forecast : 12UTC,07MAY1996
(units: Knots)

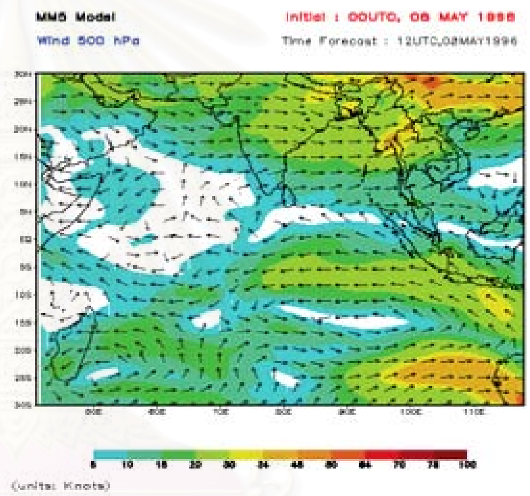

MM5 Model
Initial : 00UTC, 07 MAY 1996
Wind 850 hPa
Time Forecast : 00UTC,07MAY1996
(units: Knots)

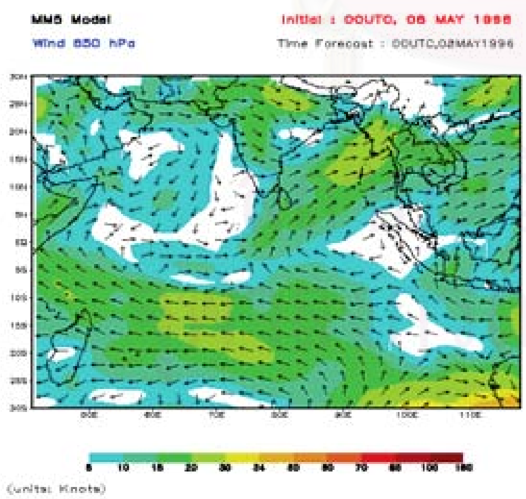

MM5 Model
Initial : 00UTC, 07 MAY 1996
Wind 850 hPa
Time Forecast : 12UTC,07MAY1996
(units: Knots)

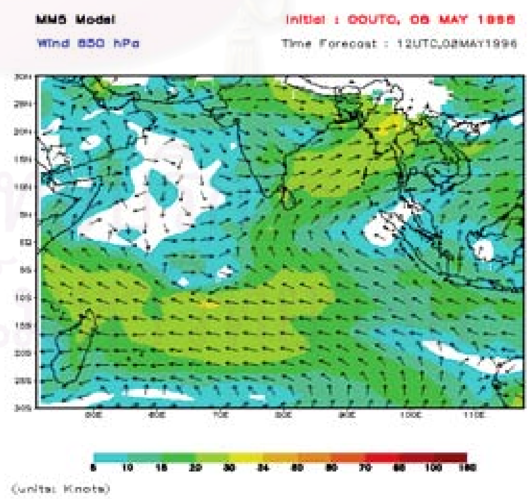

MM5 Model
Wind 200 hPa
(units: Knots)

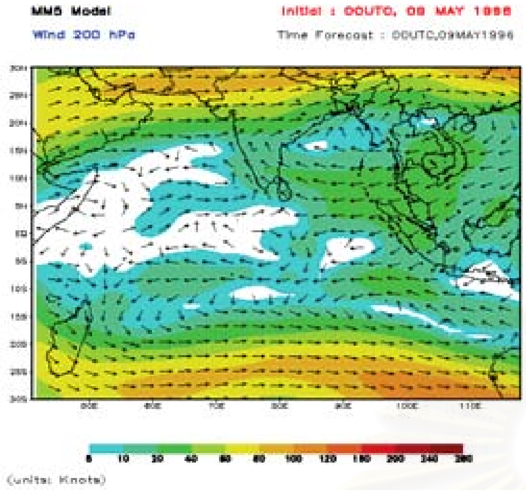

MM5 Model
Wind 200 hPa
(units: Knots)

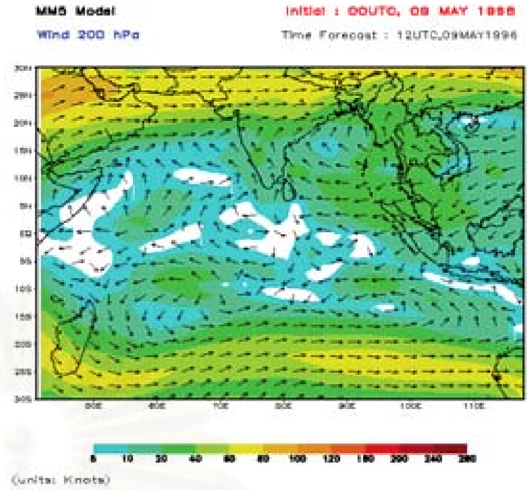

MM5 Model
Wind 500 hPa
(units: Knots)

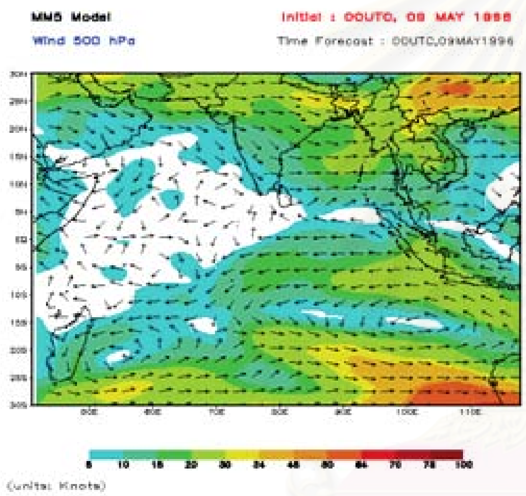

MM5 Model
Wind 500 hPa
(units: Knots)

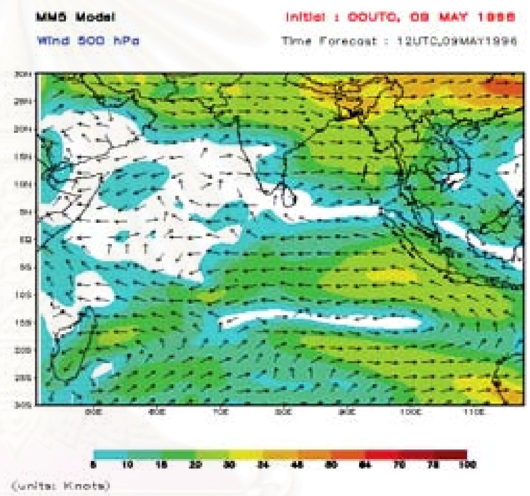

MM5 Model
Wind 850 hPa
(units: Knots)

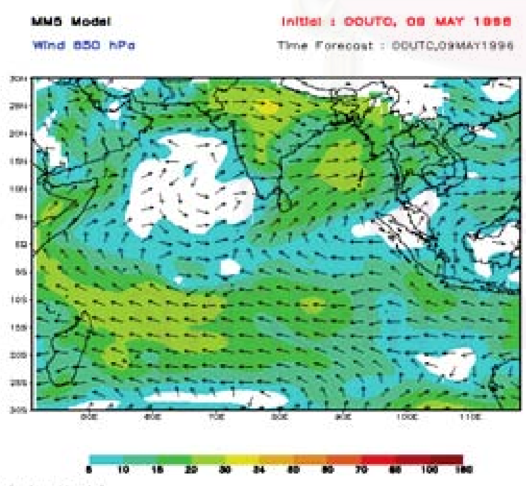

MM5 Model
Wind 850 hPa
(units: Knots)

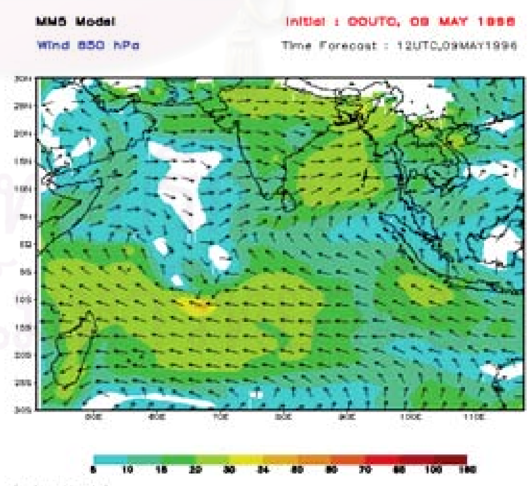

MM5 Model
Initial : 00UTC, 09 MAY 1996
Wind 200 hPa
Time Forecast : 00UTC,09MAY1996
(units: Knots)

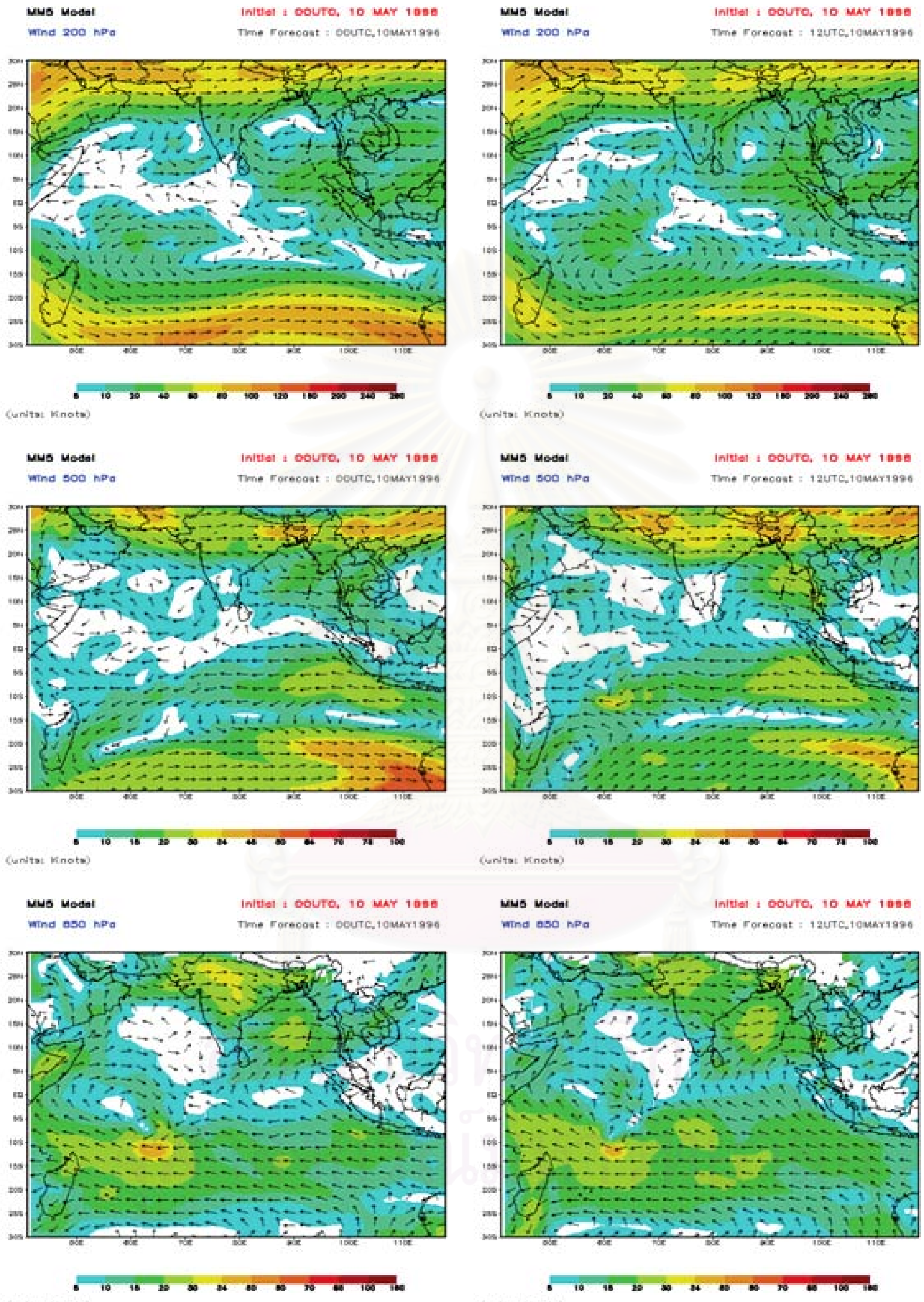

MM5 Model
Initial : 00UTC, 09 MAY 1996
Wind 200 hPa
Time Forecast : 12UTC,09MAY1996
(units: Knots)

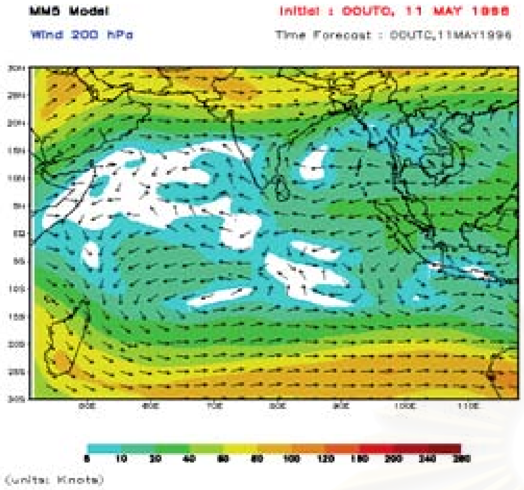

MM5 Model
Initial : 00UTC, 09 MAY 1996
Wind 500 hPa
Time Forecast : 00UTC,09MAY1996
(units: Knots)

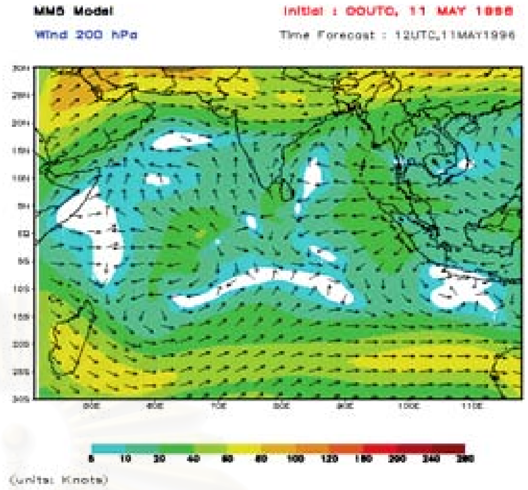

MM5 Model
Initial : 00UTC, 09 MAY 1996
Wind 500 hPa
Time Forecast : 12UTC,09MAY1996
(units: Knots)

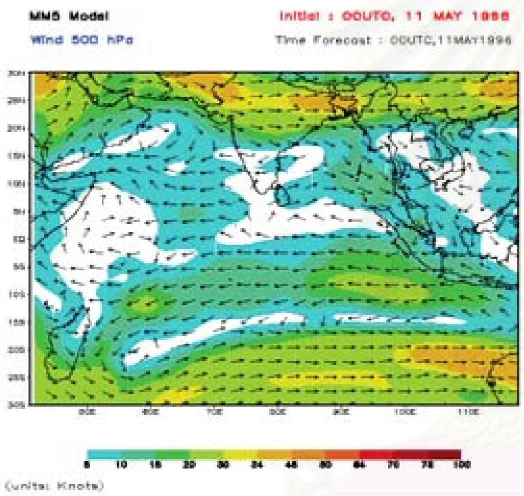

MM5 Model
Initial : 00UTC, 09 MAY 1996
Wind 850 hPa
Time Forecast : 00UTC,09MAY1996
(units: Knots)

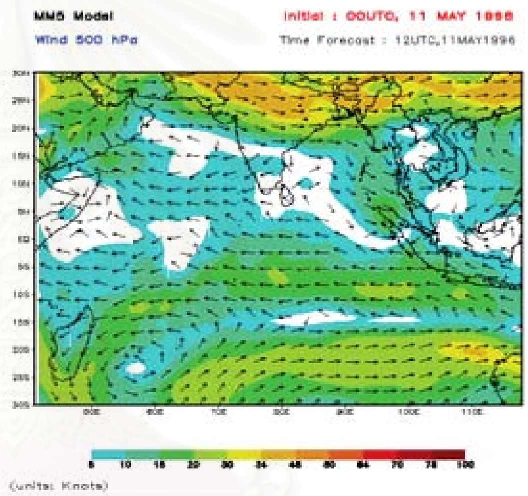

MM5 Model
Initial : 00UTC, 09 MAY 1996
Wind 850 hPa
Time Forecast : 12UTC,09MAY1996
(units: Knots)

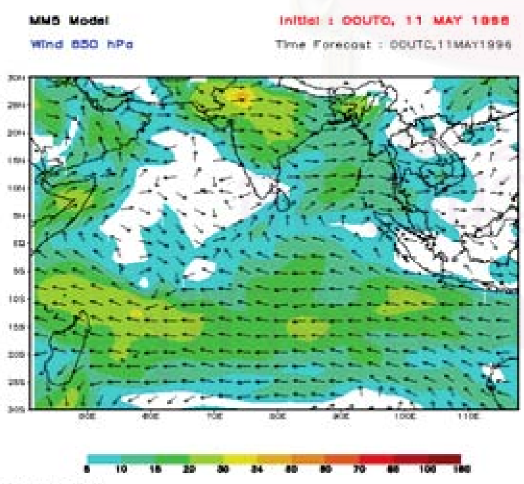

MM5 Model
Initial : 00UTC, 10 MAY 1996
Wind 200 hPa
Time Forecast : 00UTC,10MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 10 MAY 1996
Wind 200 hPa
Time Forecast : 12UTC,10MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 10 MAY 1996
Wind 500 hPa
Time Forecast : 00UTC,10MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 10 MAY 1996
Wind 500 hPa
Time Forecast : 12UTC,10MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 10 MAY 1996
Wind 850 hPa
Time Forecast : 00UTC,10MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 10 MAY 1996
Wind 850 hPa
Time Forecast : 12UTC,10MAY1996
(units: Knots)

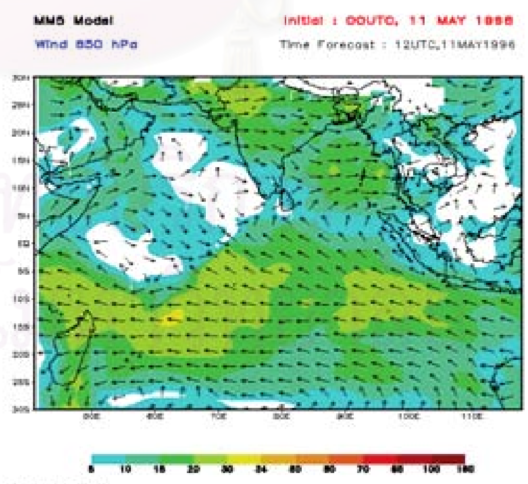

MM5 Model
Initial : 00UTC, 11 MAY 1996
Wind 200 hPa
Time Forecast : 00UTC,11MAY1996
(units: Knots)

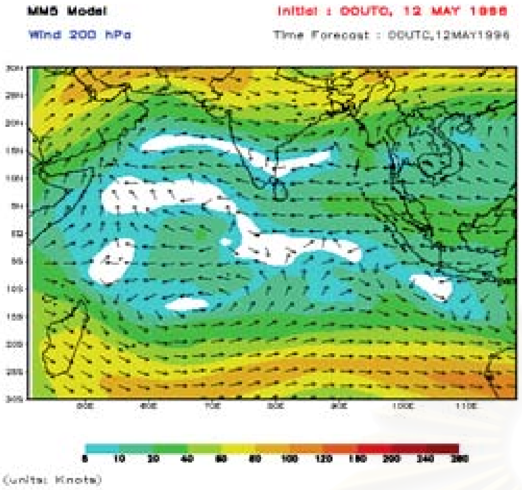

MM5 Model
Initial : 00UTC, 11 MAY 1996
Wind 200 hPa
Time Forecast : 12UTC,11MAY1996
(units: Knots)

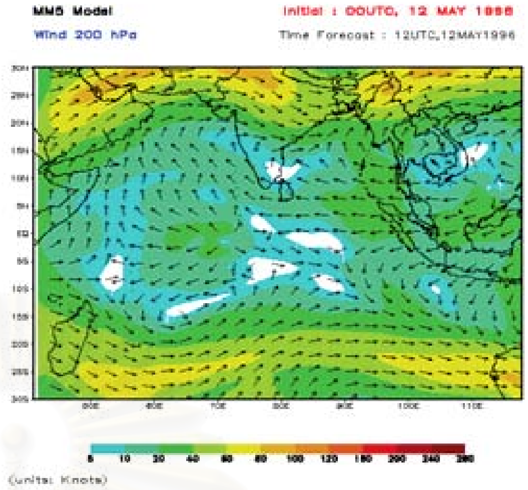

MM5 Model
Initial : 00UTC, 11 MAY 1996
Wind 500 hPa
Time Forecast : 00UTC,11MAY1996
(units: Knots)

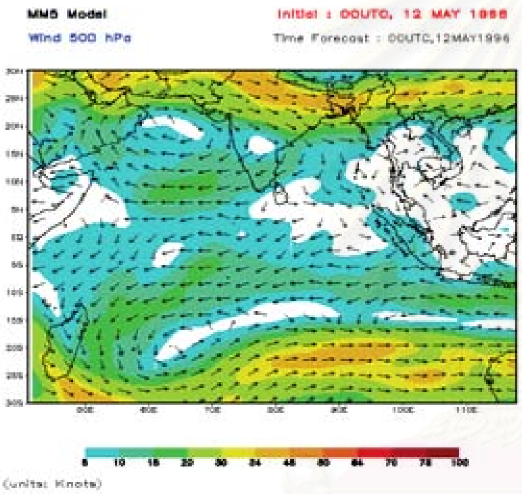

MM5 Model
Initial : 00UTC, 11 MAY 1996
Wind 500 hPa
Time Forecast : 12UTC,11MAY1996
(units: Knots)

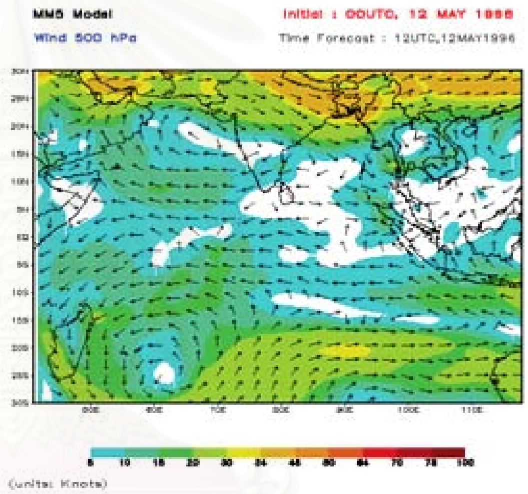

MM5 Model
Initial : 00UTC, 11 MAY 1996
Wind 850 hPa
Time Forecast : 00UTC,11MAY1996
(units: Knots)

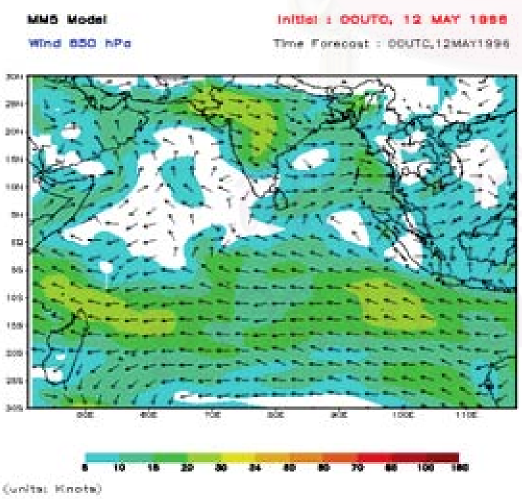

MM5 Model
Initial : 00UTC, 11 MAY 1996
Wind 850 hPa
Time Forecast : 12UTC,11MAY1996
(units: Knots)

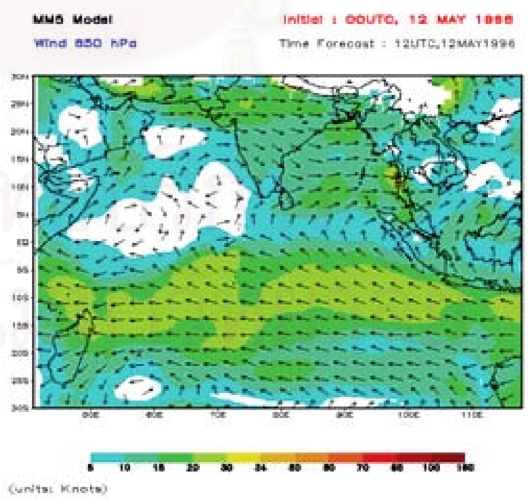

MM5 Model
Initial : 00UTC, 12 MAY 1996
Wind 200 hPa
Time Forecast : 00UTC,12MAY1996
(units: Knots)

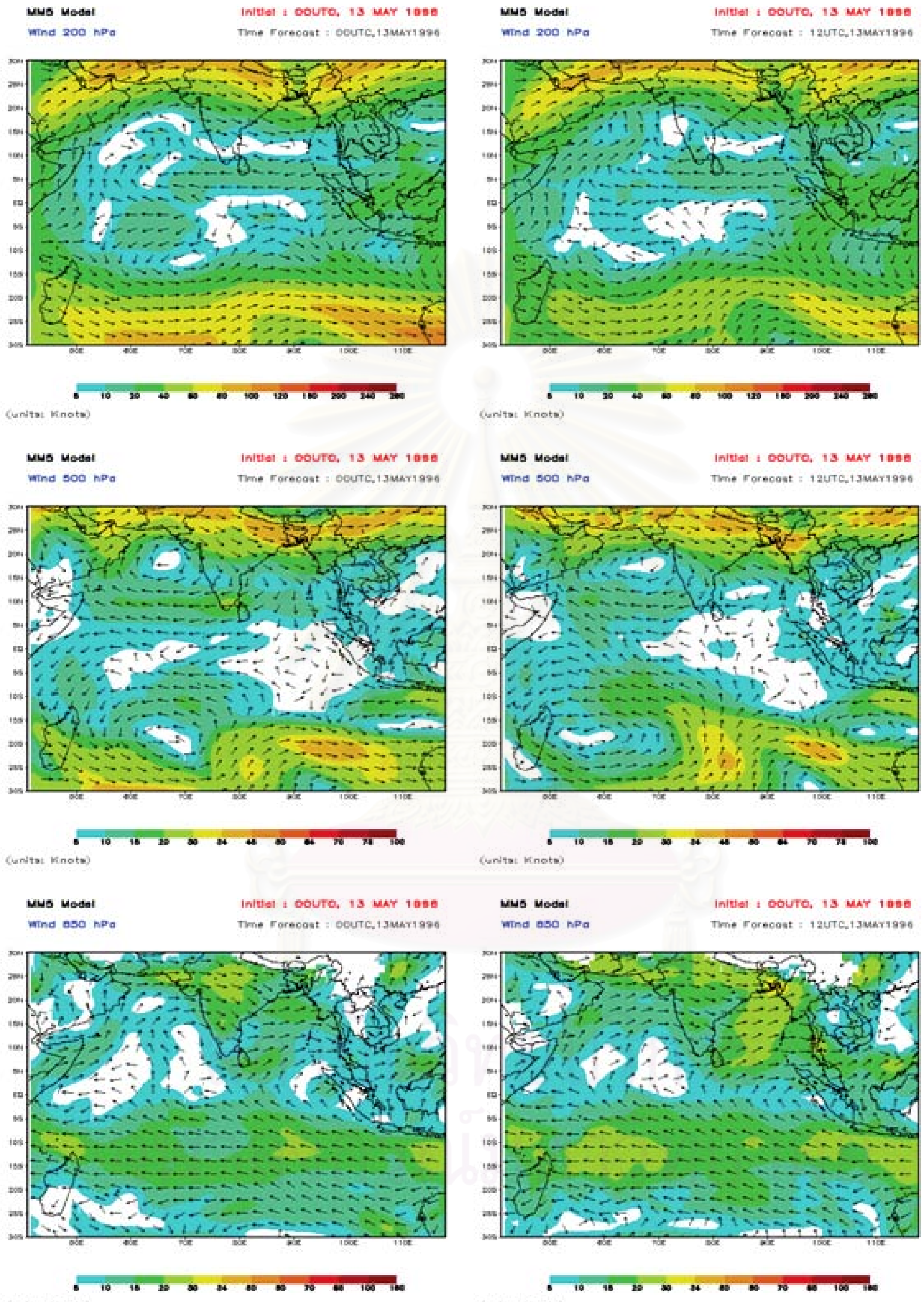

MM5 Model
Initial : 00UTC, 12 MAY 1996
Wind 200 hPa
Time Forecast : 12UTC,12MAY1996
(units: Knots)

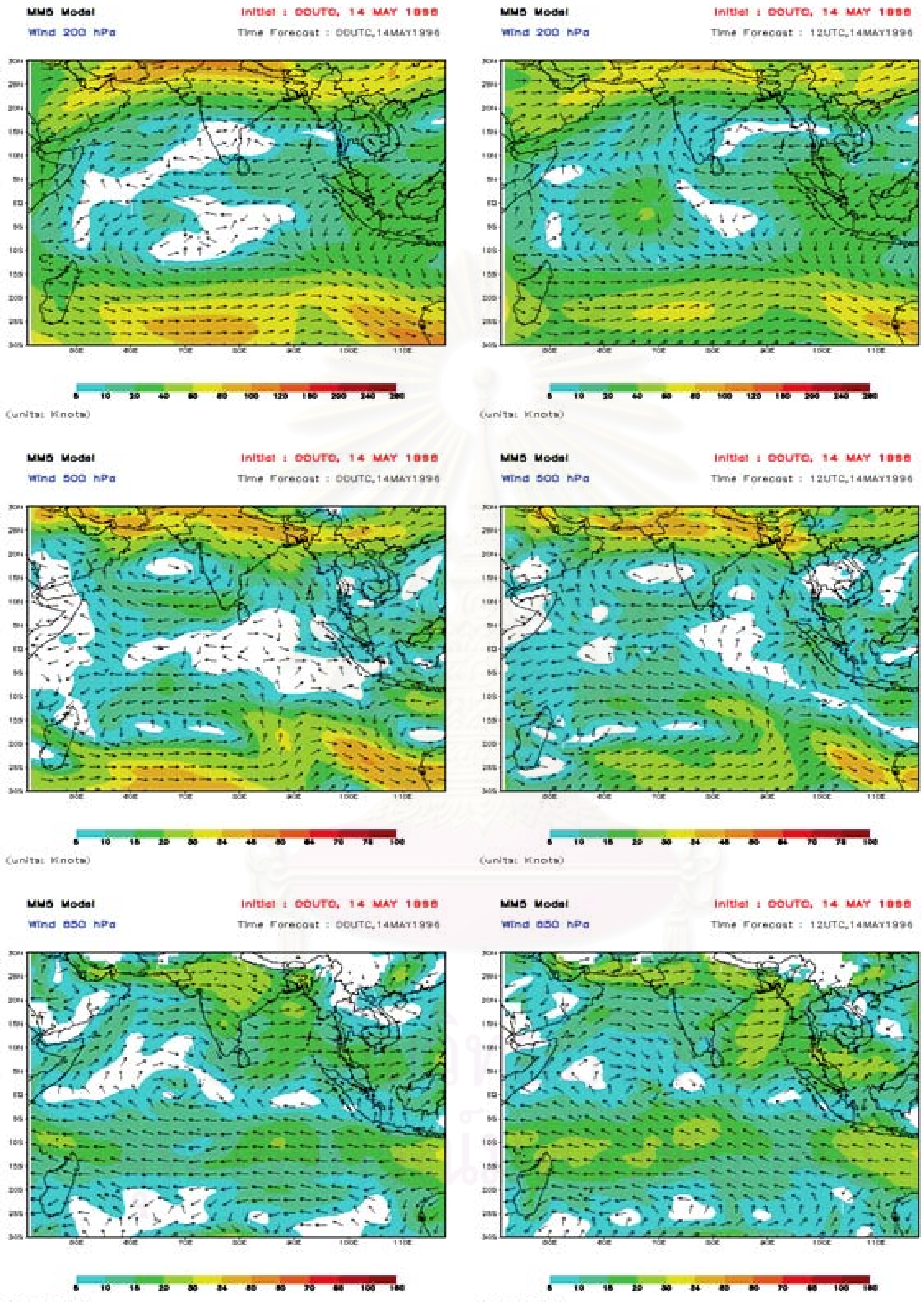

MM5 Model
Initial : 00UTC, 12 MAY 1996
Wind 500 hPa
Time Forecast : 00UTC,12MAY1996
(units: Knots)

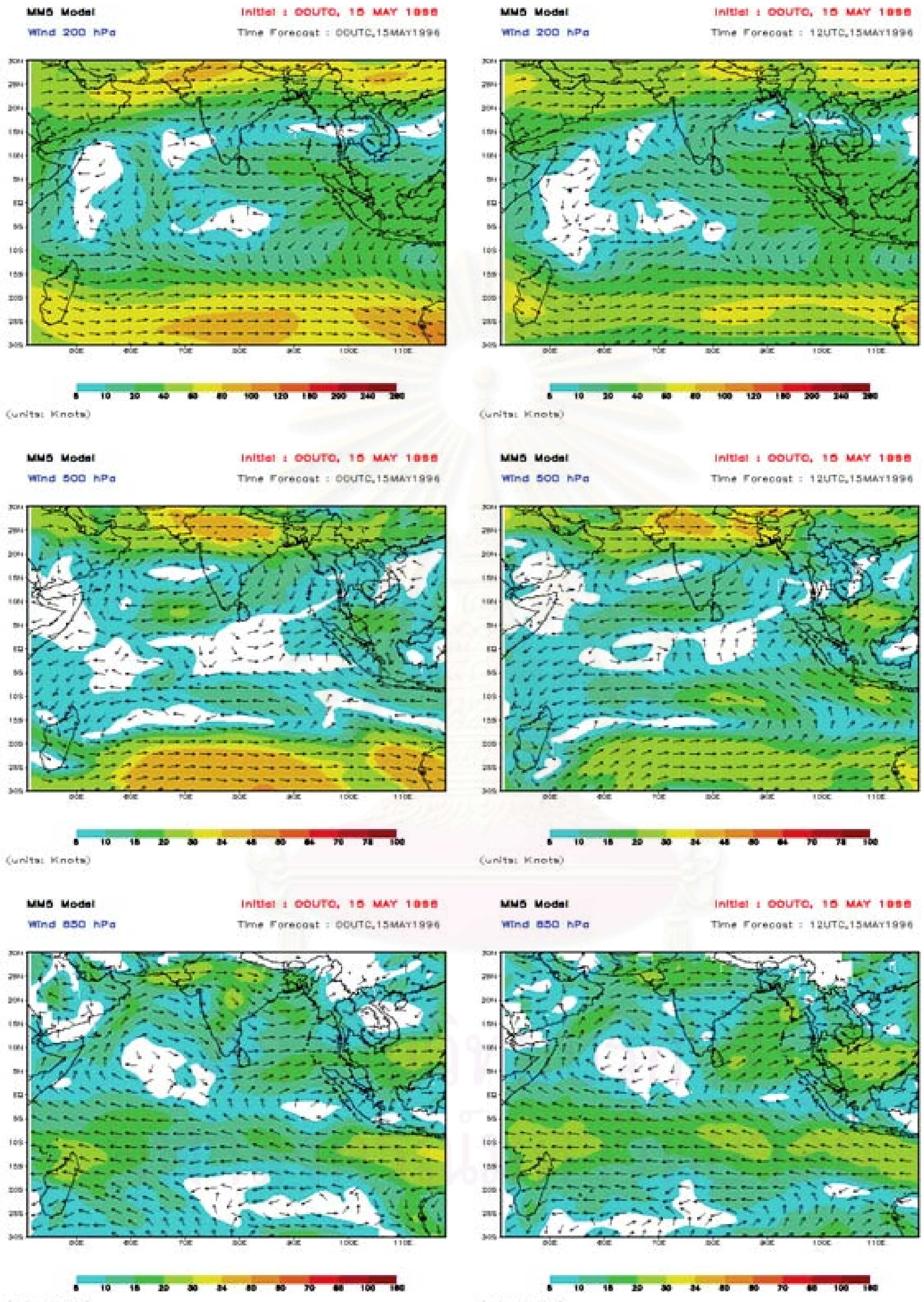

MM5 Model
Initial : 00UTC, 12 MAY 1996
Wind 500 hPa
Time Forecast : 12UTC,12MAY1996
(units: Knots)


MM5 Model
Initial : 00UTC, 12 MAY 1996
Wind 850 hPa
Time Forecast : 00UTC,12MAY1996
(units: Knots)

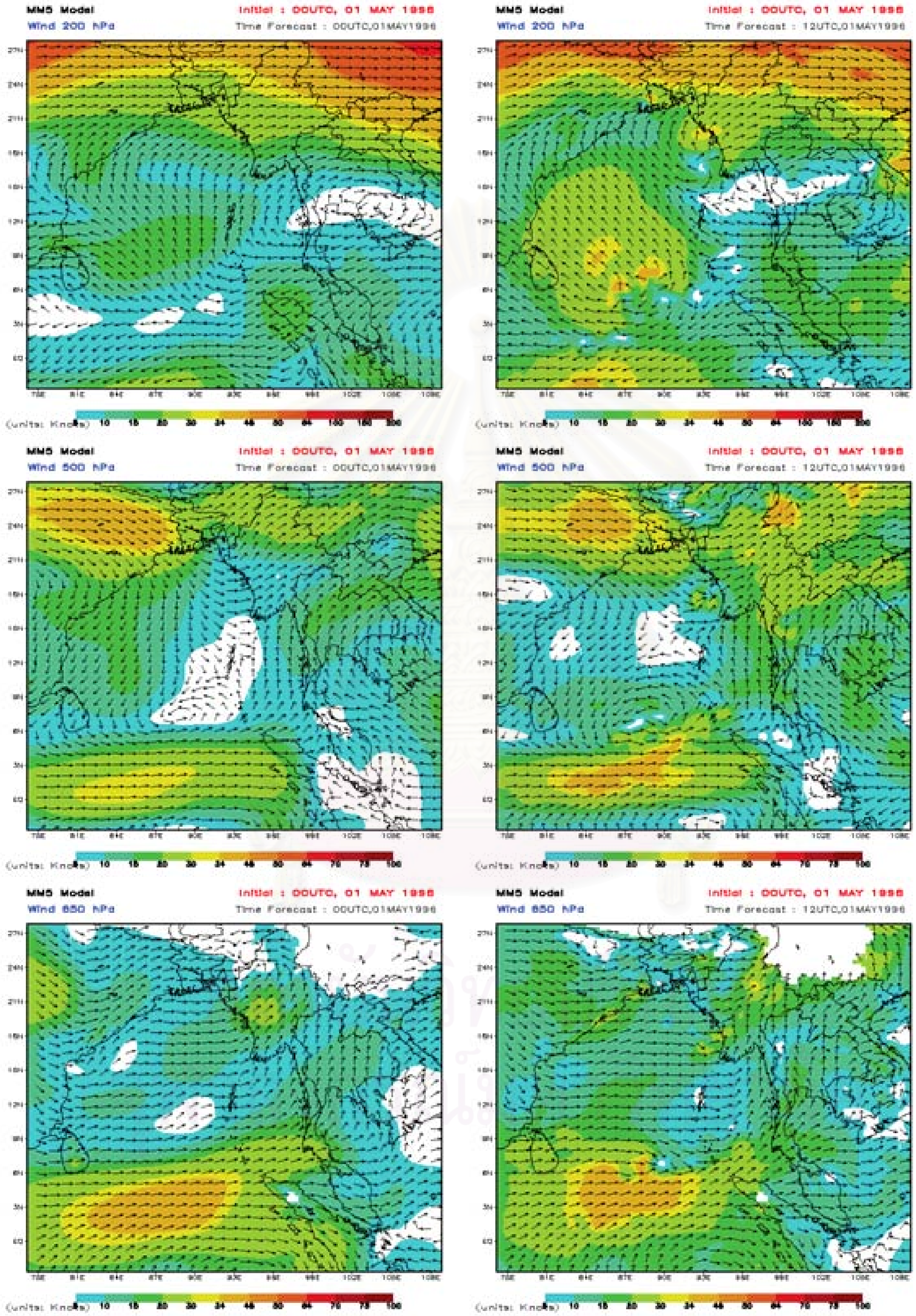

MM5 Model
Initial : 00UTC, 12 MAY 1996
Wind 850 hPa
Time Forecast : 12UTC,12MAY1996
(units: Knots)

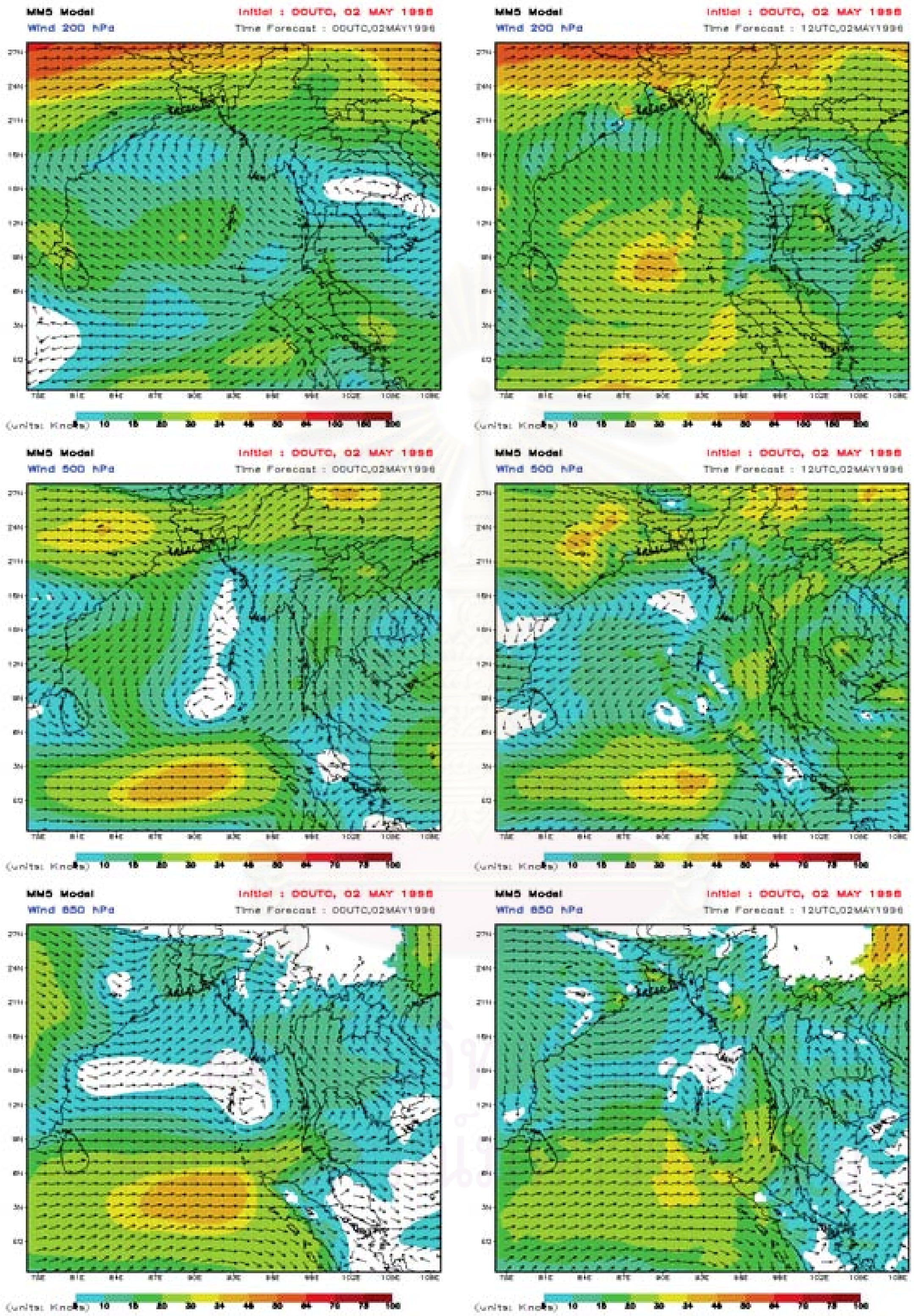

MM5 Model
Initial : 00UTC, 13 MAY 1996
Wind 200 hPa
Time Forecast : 00UTC,13MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 13 MAY 1996
Wind 200 hPa
Time Forecast : 12UTC,13MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 13 MAY 1996
Wind 500 hPa
Time Forecast : 00UTC,13MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 13 MAY 1996
Wind 500 hPa
Time Forecast : 12UTC,13MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 13 MAY 1996
Wind 850 hPa
Time Forecast : 00UTC,13MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 13 MAY 1996
Wind 850 hPa
Time Forecast : 12UTC,13MAY1996
(units: Knots)

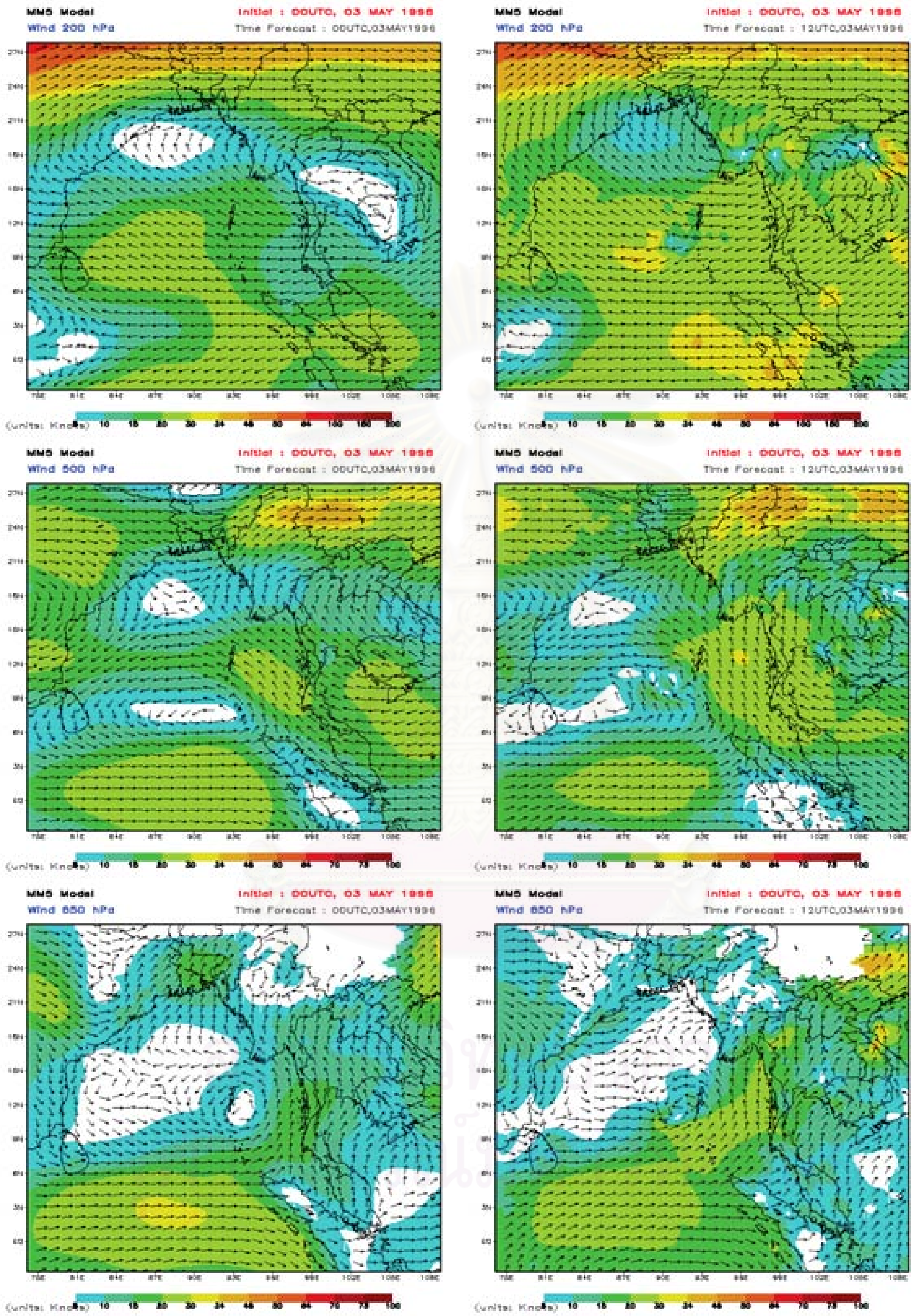

MM5 Model
Wind 200 hPa
Time Forecast : 00UTC,14MAY1996
MM5 Model
Wind 200 hPa
Time Forecast : 12UTC,14MAY1996
(units: Knots)
(units: Knots)
MM5 Model
Wind 500 hPa
Time Forecast : 00UTC,14MAY1996
MM5 Model
Wind 500 hPa
Time Forecast : 12UTC,14MAY1996
(units: Knots)
(units: Knots)
MM5 Model
Wind 850 hPa
Time Forecast : 00UTC,14MAY1996
MM5 Model
Wind 850 hPa
Time Forecast : 12UTC,14MAY1996
(units: Knots)
(units: Knots)

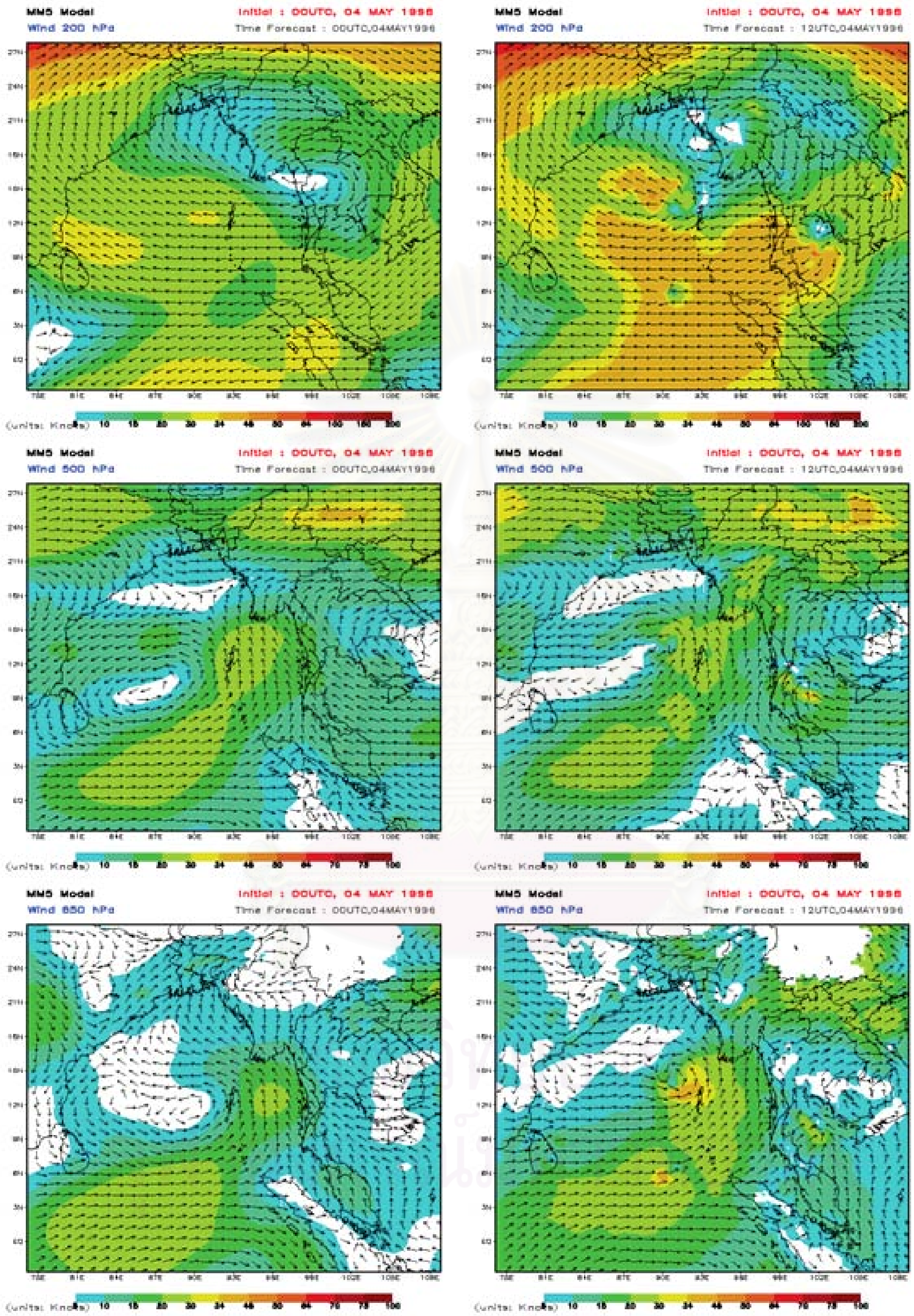

MM5 Model
Wind 200 hPa
Initial : 00UTC, 15 MAY 1996
Time Forecast : 00UTC,15MAY1996
(units: Knots)
MM5 Model
Wind 200 hPa
Initial : 00UTC, 15 MAY 1996
Time Forecast : 12UTC,15MAY1996
(units: Knots)
MM5 Model
Wind 500 hPa
Initial : 00UTC, 15 MAY 1996
Time Forecast : 00UTC,15MAY1996
(units: Knots)
MM5 Model
Wind 500 hPa
Initial : 00UTC, 15 MAY 1996
Time Forecast : 12UTC,15MAY1996
(units: Knots)
MM5 Model
Wind 850 hPa
Initial : 00UTC, 15 MAY 1996
Time Forecast : 00UTC,15MAY1996
(units: Knots)
MM5 Model
Wind 850 hPa
Initial : 00UTC, 15 MAY 1996
Time Forecast : 12UTC,15MAY1996
(units: Knots)

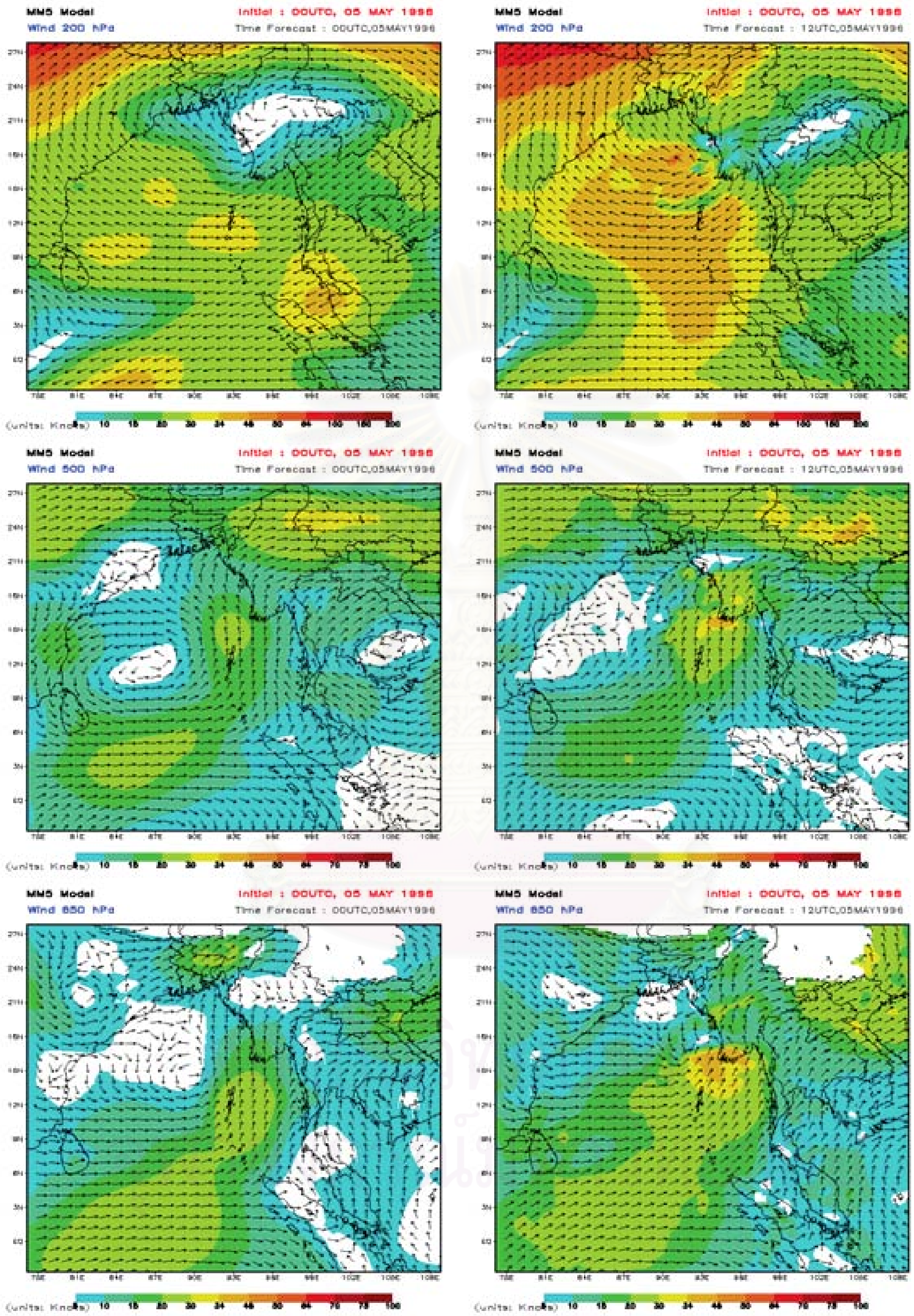
Area2


MM5 Model
Wind 200 hPa
Initial : 00UTC, 01 MAY 1996
Time Forecast : 00UTC,01MAY1996
MM5 Model
Wind 200 hPa
Initial : 00UTC, 01 MAY 1996
Time Forecast : 12UTC,01MAY1996
MM5 Model
Wind 500 hPa
Initial : 00UTC, 01 MAY 1996
Time Forecast : 00UTC,01MAY1996
MM5 Model
Wind 500 hPa
Initial : 00UTC, 01 MAY 1996
Time Forecast : 12UTC,01MAY1996
MM5 Model
Wind 850 hPa
Initial : 00UTC, 01 MAY 1996
Time Forecast : 00UTC,01MAY1996
MM5 Model
Wind 850 hPa
Initial : 00UTC, 01 MAY 1996
Time Forecast : 12UTC,01MAY1996

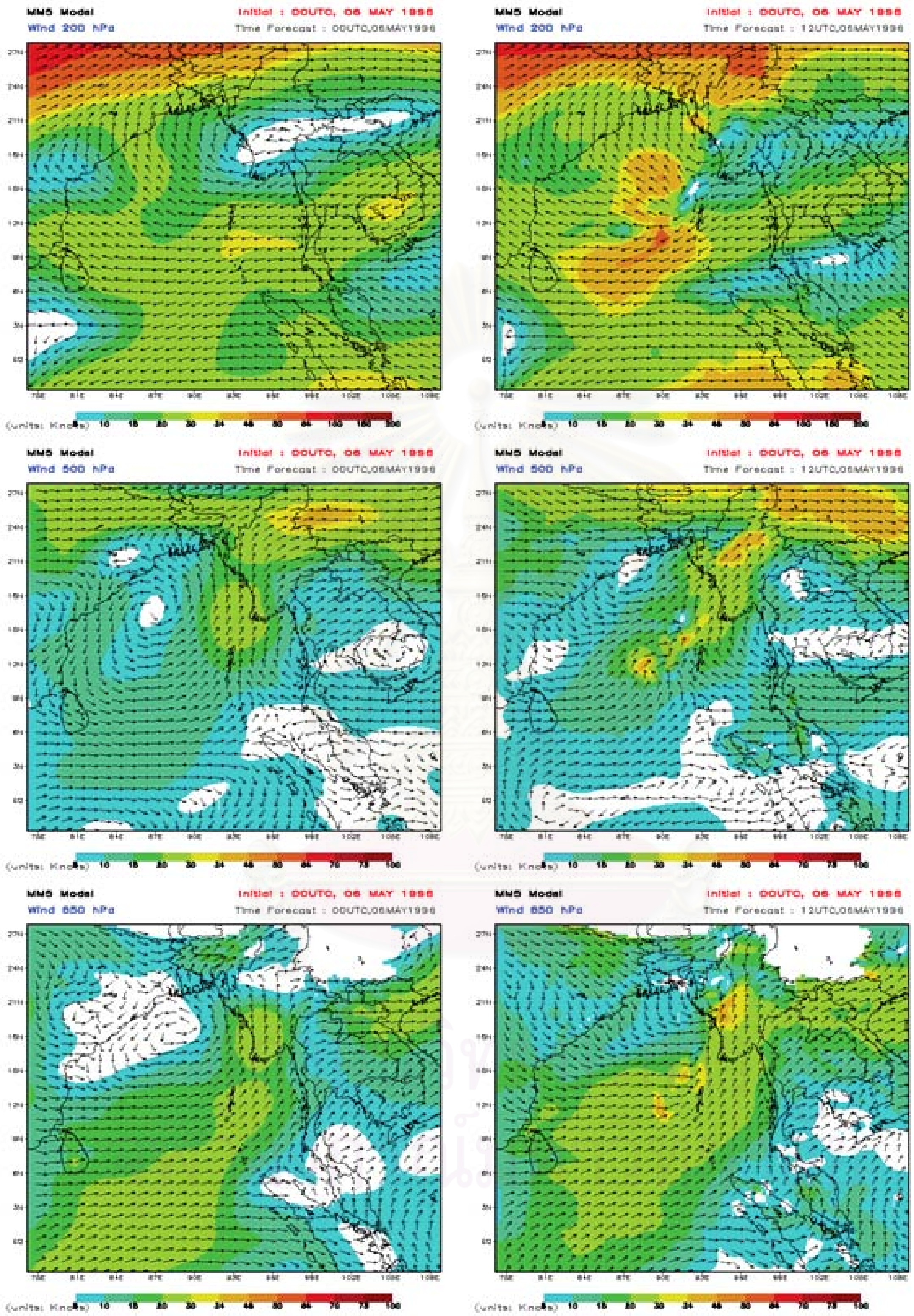

MM5 Model
Wind 200 hPa
Initial : 00UTC, 02 MAY 1996
Time Forecast : 00UTC,02MAY1996
MM5 Model
Wind 200 hPa
Initial : 00UTC, 02 MAY 1996
Time Forecast : 12UTC,02MAY1996
MM5 Model
Wind 500 hPa
Initial : 00UTC, 02 MAY 1996
Time Forecast : 00UTC,02MAY1996
MM5 Model
Wind 500 hPa
Initial : 00UTC, 02 MAY 1996
Time Forecast : 12UTC,02MAY1996
MM5 Model
Wind 850 hPa
Initial : 00UTC, 02 MAY 1996
Time Forecast : 00UTC,02MAY1996
MM5 Model
Wind 850 hPa
Initial : 00UTC, 02 MAY 1996
Time Forecast : 12UTC,02MAY1996
(units: Knots)

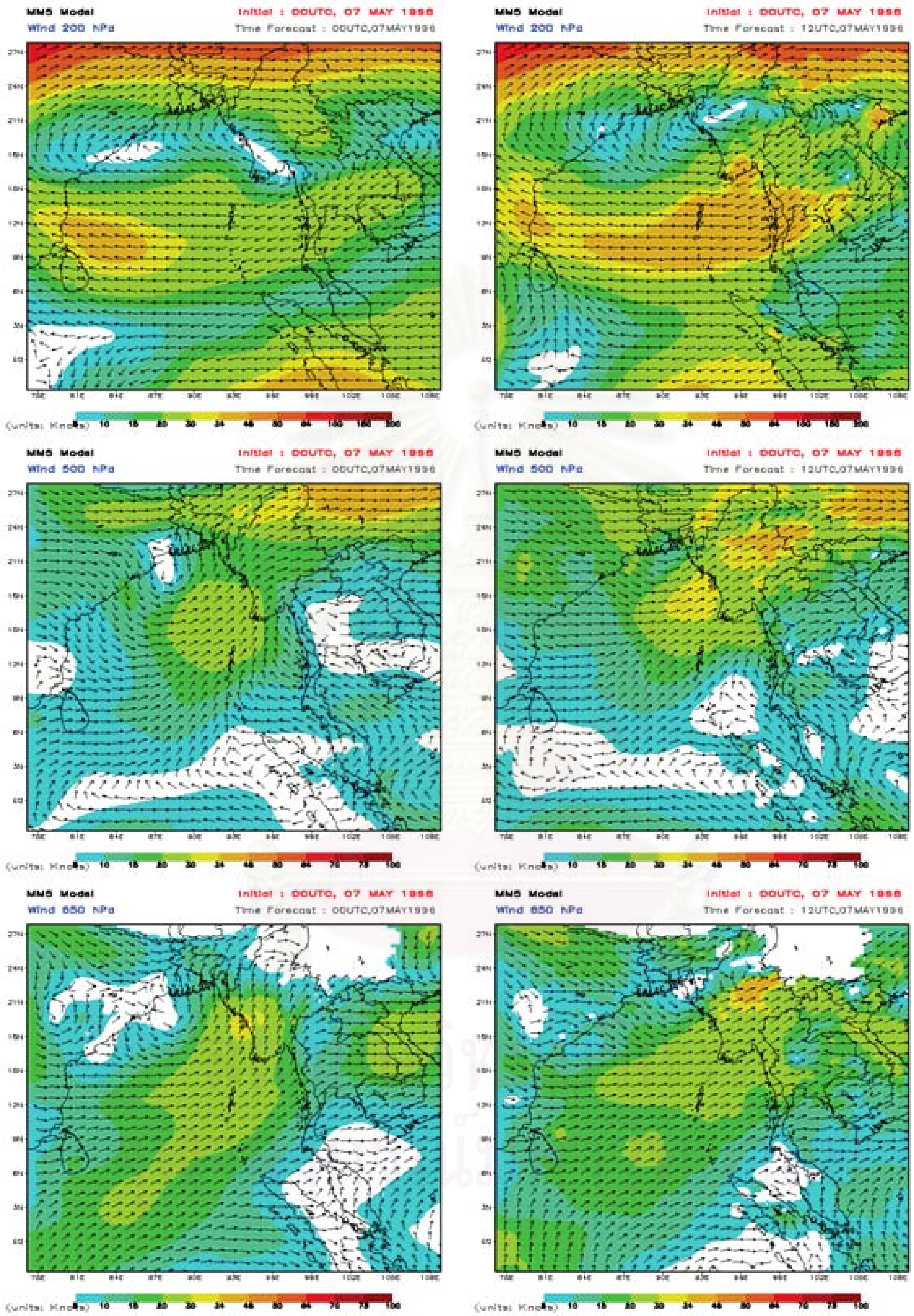

MM5 Model
Wind 200 hPa
Initial : 00UTC, 03 MAY 1996
Time Forecast : 00UTC,03MAY1996
(units: Knots)
MM5 Model
Wind 200 hPa
Initial : 00UTC, 03 MAY 1996
Time Forecast : 12UTC,03MAY1996
(units: Knots)
MM5 Model
Wind 500 hPa
Initial : 00UTC, 03 MAY 1996
Time Forecast : 00UTC,03MAY1996
(units: Knots)
MM5 Model
Wind 500 hPa
Initial : 00UTC, 03 MAY 1996
Time Forecast : 12UTC,03MAY1996
(units: Knots)
MM5 Model
Wind 850 hPa
Initial : 00UTC, 03 MAY 1996
Time Forecast : 00UTC,03MAY1996
(units: Knots)
MM5 Model
Wind 850 hPa
Initial : 00UTC, 03 MAY 1996
Time Forecast : 12UTC,03MAY1996
(units: Knots)

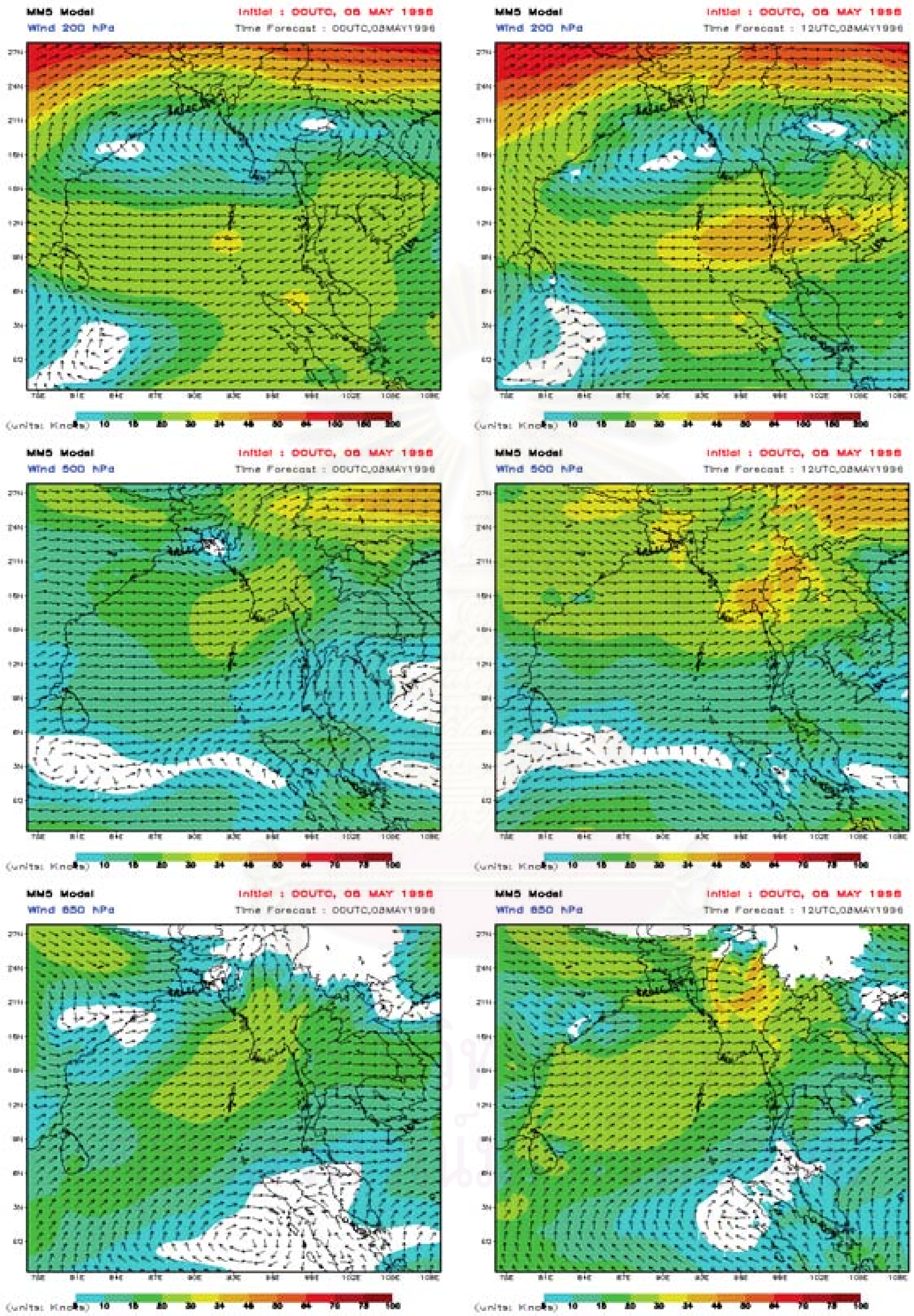

MM5 Model
Wind 200 hPa
Initial : 00UTC, 04 MAY 1996
Time Forecast : 00UTC,04MAY1996
(units: Knots)
MM5 Model
Wind 200 hPa
Initial : 00UTC, 04 MAY 1996
Time Forecast : 12UTC,04MAY1996
(units: Knots)
MM5 Model
Wind 500 hPa
Initial : 00UTC, 04 MAY 1996
Time Forecast : 00UTC,04MAY1996
(units: Knots)
MM5 Model
Wind 500 hPa
Initial : 00UTC, 04 MAY 1996
Time Forecast : 12UTC,04MAY1996
(units: Knots)
MM5 Model
Wind 850 hPa
Initial : 00UTC, 04 MAY 1996
Time Forecast : 00UTC,04MAY1996
(units: Knots)
MM5 Model
Wind 850 hPa
Initial : 00UTC, 04 MAY 1996
Time Forecast : 12UTC,04MAY1996
(units: Knots)

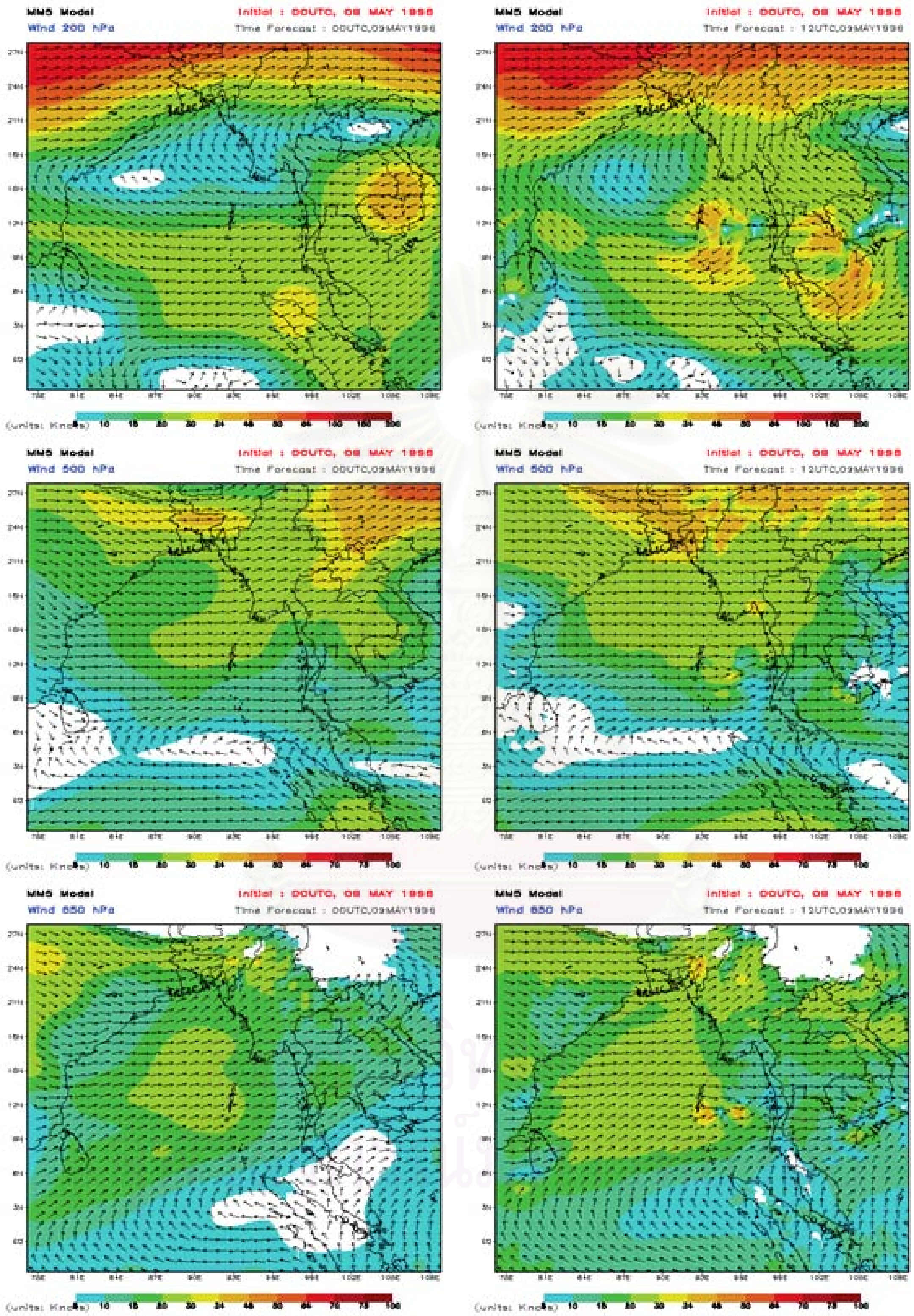


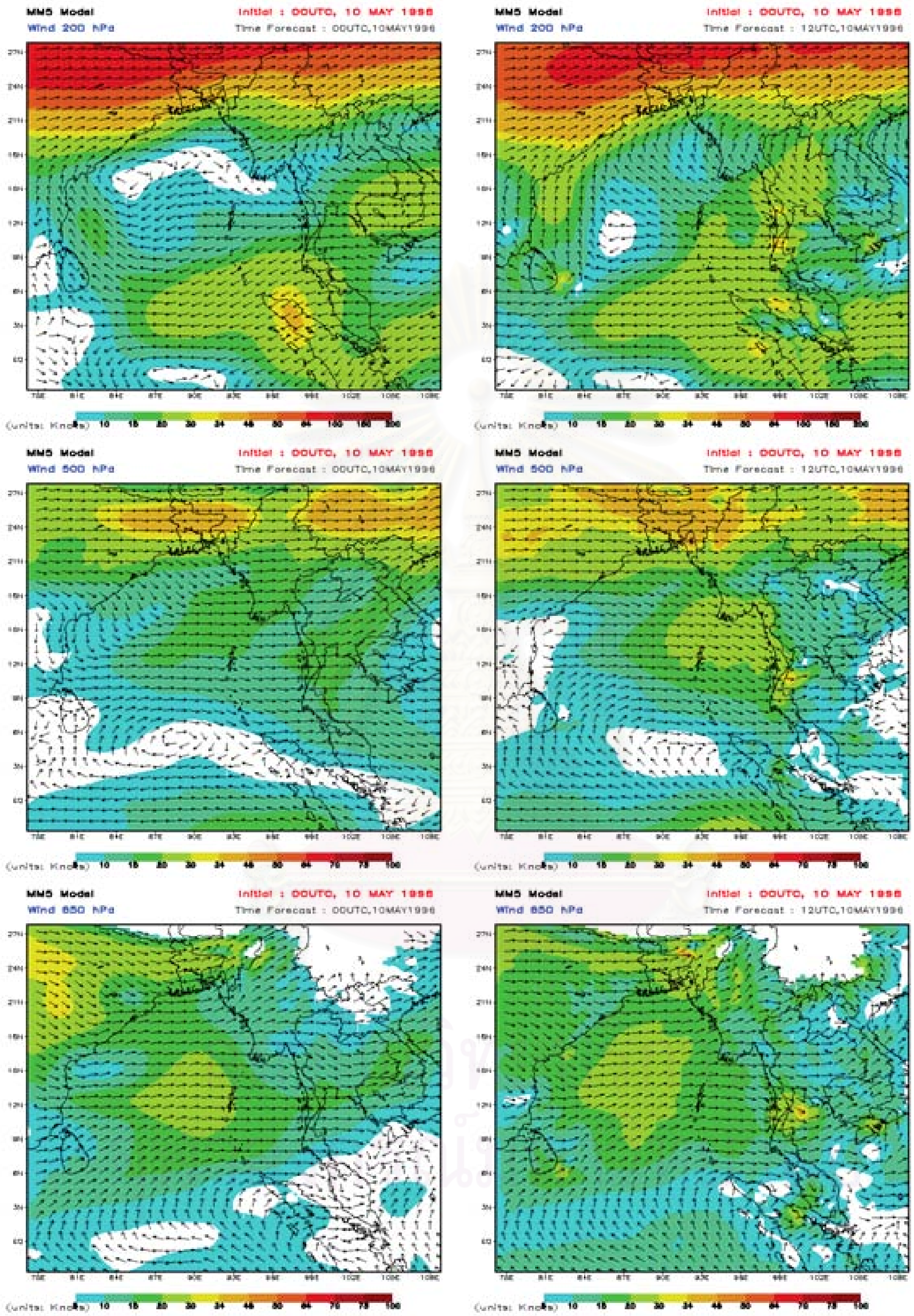
MM5 Model
Wind 200 hPa
Initial : 00UTC, 05 MAY 1996
Time Forecast : 00UTC,05MAY1996
(units: Knots)
MM5 Model
Wind 200 hPa
Initial : 00UTC, 05 MAY 1996
Time Forecast : 12UTC,05MAY1996
(units: Knots)
MM5 Model
Wind 500 hPa
Initial : 00UTC, 05 MAY 1996
Time Forecast : 00UTC,05MAY1996
(units: Knots)
MM5 Model
Wind 500 hPa
Initial : 00UTC, 05 MAY 1996
Time Forecast : 12UTC,05MAY1996
(units: Knots)
MM5 Model
Wind 850 hPa
Initial : 00UTC, 05 MAY 1996
Time Forecast : 00UTC,05MAY1996
(units: Knots)
MM5 Model
Wind 850 hPa
Initial : 00UTC, 05 MAY 1996
Time Forecast : 12UTC,05MAY1996
(units: Knots)

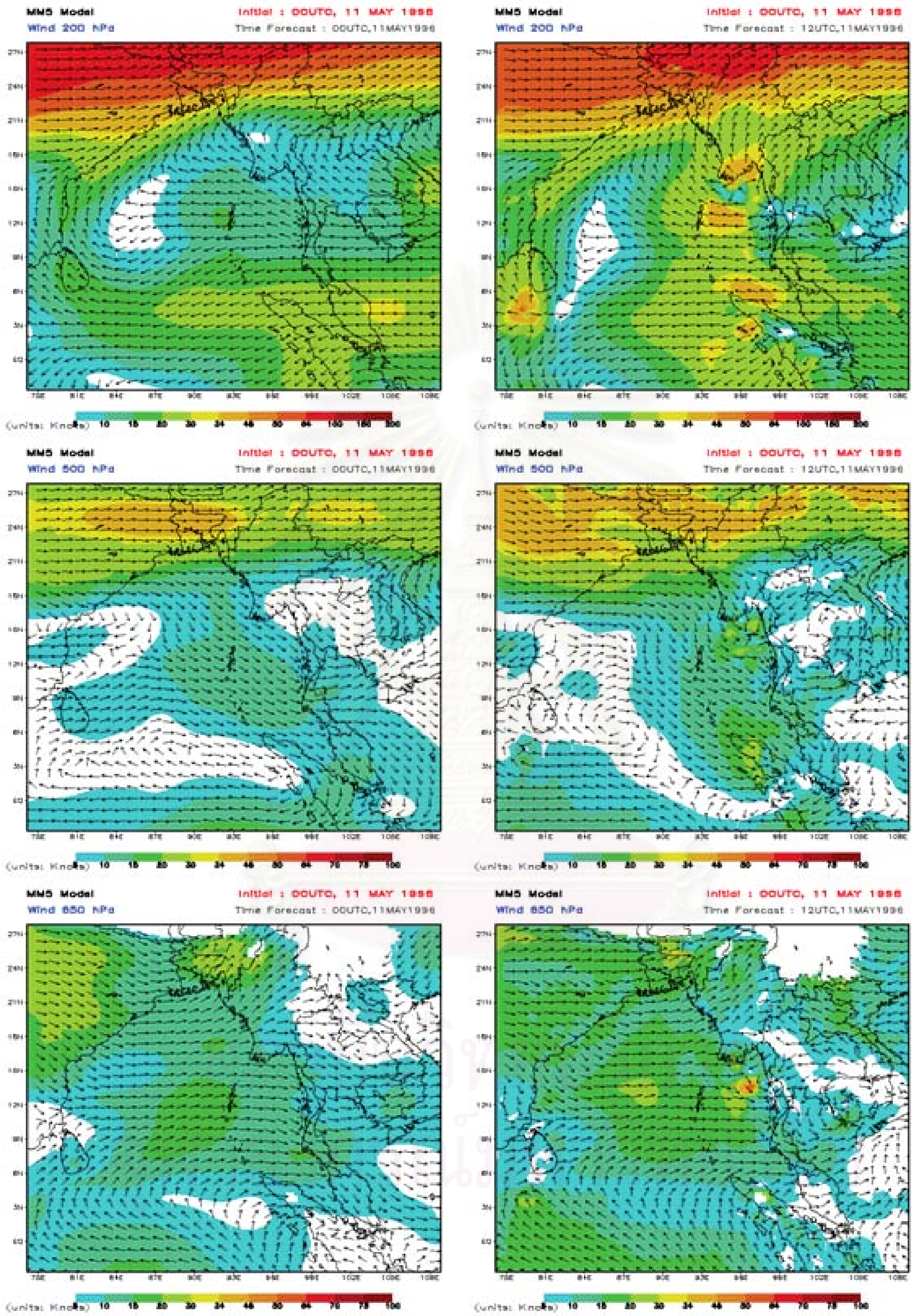

MM5 Model
Initial : 00UTC, 06 MAY 1996
Wind 200 hPa
Time Forecast : 00UTC,06MAY1996
MM5 Model
Initial : 00UTC, 06 MAY 1996
Wind 200 hPa
Time Forecast : 12UTC,06MAY1996
MM5 Model
Initial : 00UTC, 06 MAY 1996
Wind 500 hPa
Time Forecast : 00UTC,06MAY1996
MM5 Model
Initial : 00UTC, 06 MAY 1996
Wind 500 hPa
Time Forecast : 12UTC,06MAY1996
MM5 Model
Initial : 00UTC, 06 MAY 1996
Wind 850 hPa
Time Forecast : 00UTC,06MAY1996
MM5 Model
Initial : 00UTC, 06 MAY 1996
Wind 850 hPa
Time Forecast : 12UTC,06MAY1996
(units: Knots)


MM5 Model
Initial : 00UTC, 07 MAY 1996
Wind 200 hPa
Time Forecast : 00UTC,07MAY1996
MM5 Model
Initial : 00UTC, 07 MAY 1996
Wind 200 hPa
Time Forecast : 12UTC,07MAY1996
MM5 Model
Initial : 00UTC, 07 MAY 1996
Wind 500 hPa
Time Forecast : 00UTC,07MAY1996
MM5 Model
Initial : 00UTC, 07 MAY 1996
Wind 500 hPa
Time Forecast : 12UTC,07MAY1996
MM5 Model
Initial : 00UTC, 07 MAY 1996
Wind 850 hPa
Time Forecast : 00UTC,07MAY1996
MM5 Model
Initial : 00UTC, 07 MAY 1996
Wind 850 hPa
Time Forecast : 12UTC,07MAY1996
(units: Knots)

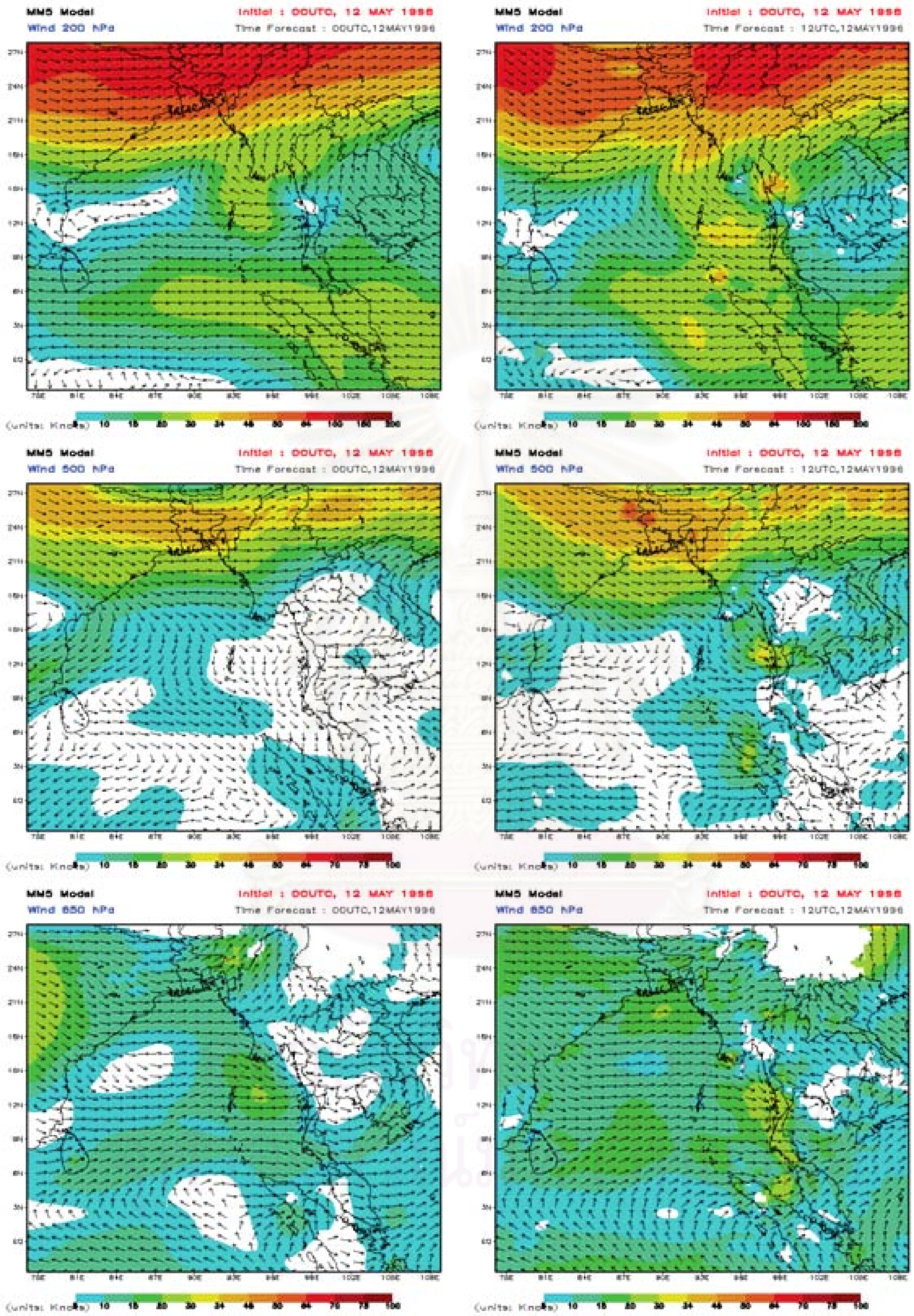

MM5 Model
Initial : 00UTC, 08 MAY 1996
Wind 200 hPa
Time Forecast : 00UTC,08MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 08 MAY 1996
Wind 200 hPa
Time Forecast : 12UTC,08MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 08 MAY 1996
Wind 500 hPa
Time Forecast : 00UTC,08MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 08 MAY 1996
Wind 500 hPa
Time Forecast : 12UTC,08MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 08 MAY 1996
Wind 850 hPa
Time Forecast : 00UTC,08MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 08 MAY 1996
Wind 850 hPa
Time Forecast : 12UTC,08MAY1996
(units: Knots)

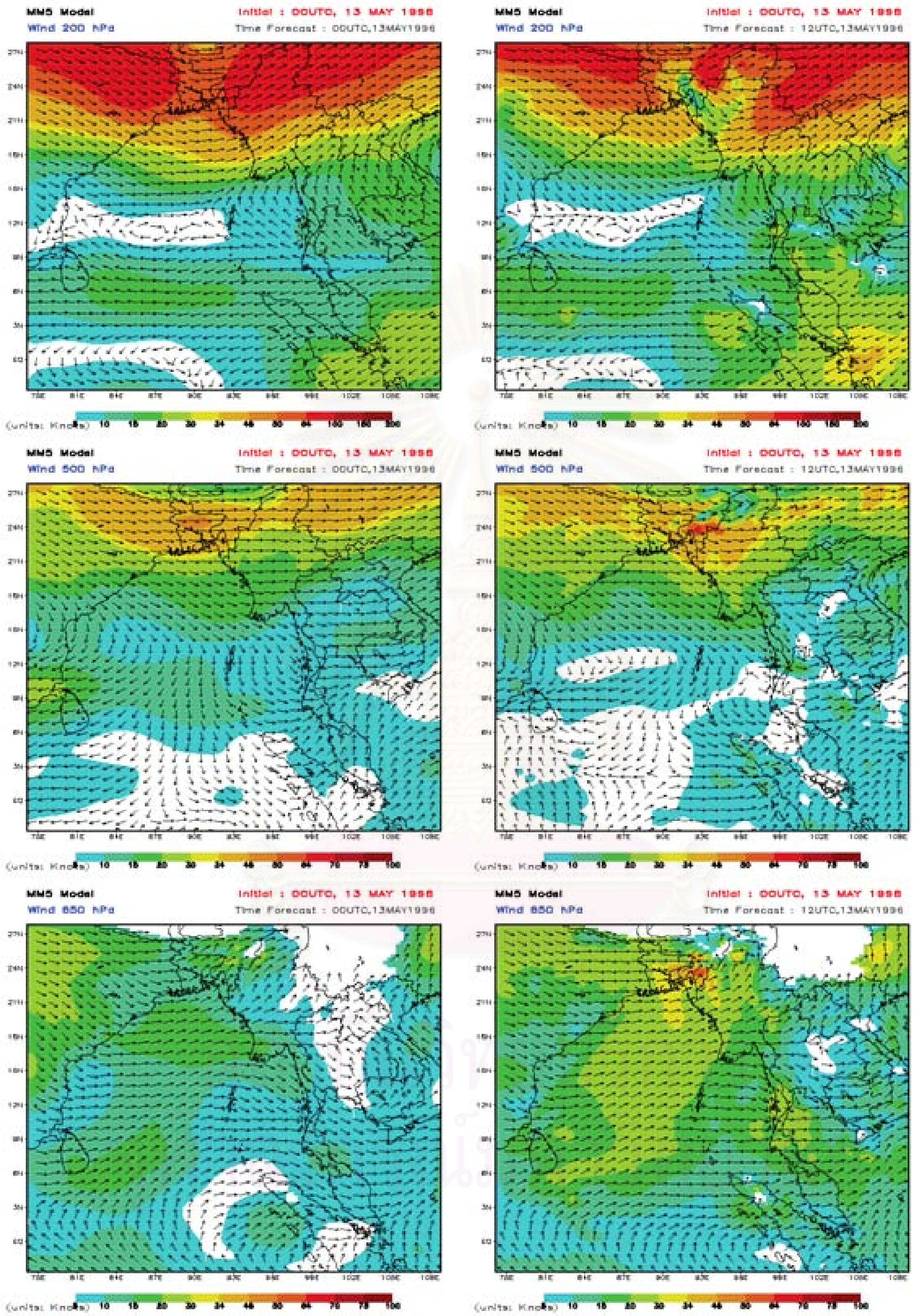

MM5 Model
Wind 200 hPa
Time Forecast : 00UTC,09MAY1996
(units: Knots)
MM5 Model
Wind 200 hPa
Time Forecast : 12UTC,09MAY1996
(units: Knots)
MM5 Model
Wind 500 hPa
Time Forecast : 00UTC,09MAY1996
(units: Knots)
MM5 Model
Wind 500 hPa
Time Forecast : 12UTC,09MAY1996
(units: Knots)
MM5 Model
Wind 850 hPa
Time Forecast : 00UTC,09MAY1996
(units: Knots)
MM5 Model
Wind 850 hPa
Time Forecast : 12UTC,09MAY1996
(units: Knots)

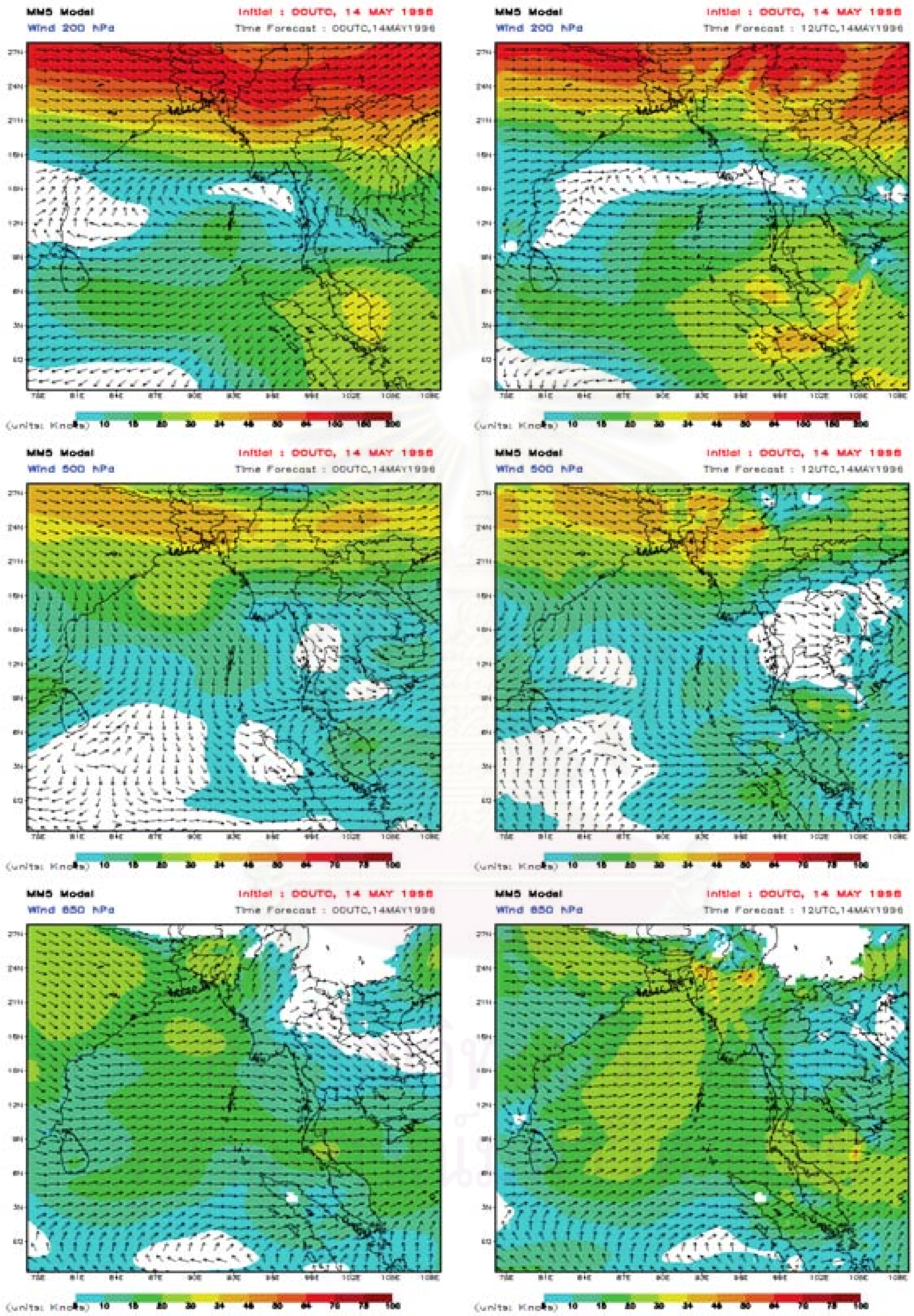

MM5 Model
Initial : 00UTC, 10 MAY 1996
Wind 200 hPa
Time Forecast : 00UTC,10MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 10 MAY 1996
Wind 200 hPa
Time Forecast : 12UTC,10MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 10 MAY 1996
Wind 500 hPa
Time Forecast : 00UTC,10MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 10 MAY 1996
Wind 500 hPa
Time Forecast : 12UTC,10MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 10 MAY 1996
Wind 850 hPa
Time Forecast : 00UTC,10MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 10 MAY 1996
Wind 850 hPa
Time Forecast : 12UTC,10MAY1996
(units: Knots)

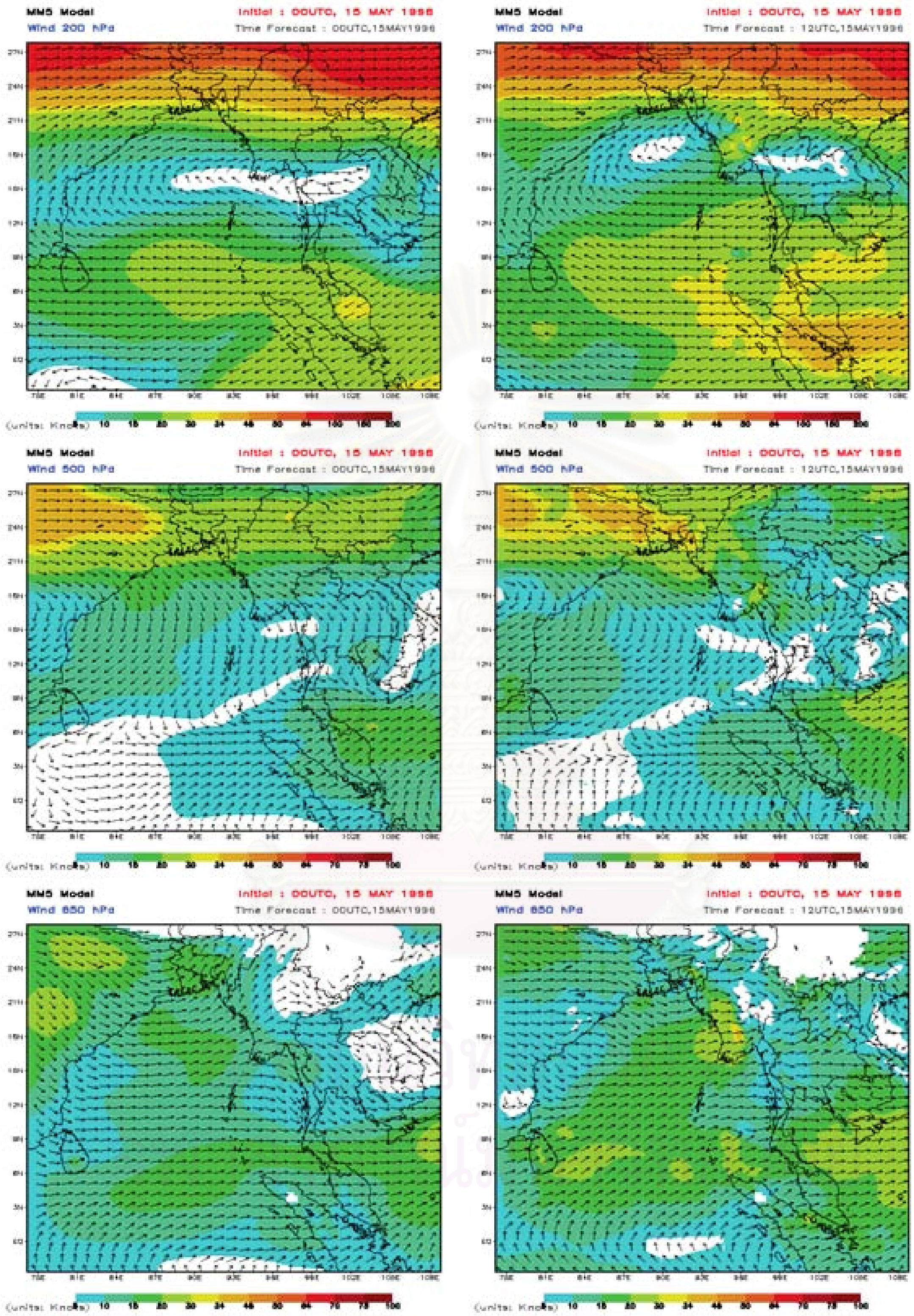


MM5 Model
Wind 200 hPa
Initial : 00UTC, 11 MAY 1996
Time Forecast : 00UTC,11MAY1996
MM5 Model
Wind 200 hPa
Initial : 00UTC, 11 MAY 1996
Time Forecast : 12UTC,11MAY1996
MM5 Model
Wind 500 hPa
Initial : 00UTC, 11 MAY 1996
Time Forecast : 00UTC,11MAY1996
MM5 Model
Wind 500 hPa
Initial : 00UTC, 11 MAY 1996
Time Forecast : 12UTC,11MAY1996
MM5 Model
Wind 850 hPa
Initial : 00UTC, 11 MAY 1996
Time Forecast : 00UTC,11MAY1996
MM5 Model
Wind 850 hPa
Initial : 00UTC, 11 MAY 1996
Time Forecast : 12UTC,11MAY1996
(units: Knots)


MM5 Model
Wind 200 hPa
Initial : 00UTC, 12 MAY 1996
Time Forecast : 00UTC,12MAY1996
(units: Knots)
MM5 Model
Wind 200 hPa
Initial : 00UTC, 12 MAY 1996
Time Forecast : 12UTC,12MAY1996
(units: Knots)
MM5 Model
Wind 500 hPa
Initial : 00UTC, 12 MAY 1996
Time Forecast : 00UTC,12MAY1996
(units: Knots)
MM5 Model
Wind 500 hPa
Initial : 00UTC, 12 MAY 1996
Time Forecast : 12UTC,12MAY1996
(units: Knots)
MM5 Model
Wind 850 hPa
Initial : 00UTC, 12 MAY 1996
Time Forecast : 00UTC,12MAY1996
(units: Knots)
MM5 Model
Wind 850 hPa
Initial : 00UTC, 12 MAY 1996
Time Forecast : 12UTC,12MAY1996
(units: Knots)


MM5 Model
Initial : 00UTC, 13 MAY 1996
Wind 200 hPa
Time Forecast : 00UTC,13MAY1996
MM5 Model
Initial : 00UTC, 13 MAY 1996
Wind 200 hPa
Time Forecast : 12UTC,13MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 13 MAY 1996
Wind 500 hPa
Time Forecast : 00UTC,13MAY1996
MM5 Model
Initial : 00UTC, 13 MAY 1996
Wind 500 hPa
Time Forecast : 12UTC,13MAY1996
(units: Knots)
MM5 Model
Initial : 00UTC, 13 MAY 1996
Wind 850 hPa
Time Forecast : 00UTC,13MAY1996
MM5 Model
Initial : 00UTC, 13 MAY 1996
Wind 850 hPa
Time Forecast : 12UTC,13MAY1996
(units: Knots)


MM5 Model
Wind 200 hPa
Initial : 00UTC, 14 MAY 1996
Time Forecast : 00UTC,14MAY1996
MM5 Model
Wind 200 hPa
Initial : 00UTC, 14 MAY 1996
Time Forecast : 12UTC,14MAY1996
MM5 Model
Wind 500 hPa
Initial : 00UTC, 14 MAY 1996
Time Forecast : 00UTC,14MAY1996
MM5 Model
Wind 500 hPa
Initial : 00UTC, 14 MAY 1996
Time Forecast : 12UTC,14MAY1996
MM5 Model
Wind 850 hPa
Initial : 00UTC, 14 MAY 1996
Time Forecast : 00UTC,14MAY1996
MM5 Model
Wind 850 hPa
Initial : 00UTC, 14 MAY 1996
Time Forecast : 12UTC,14MAY1996
(units: Knots)


MM5 Model
Wind 200 hPa
Initial : 00UTC, 15 MAY 1996
Time Forecast : 00UTC,15MAY1996
(units: Knots)
MM5 Model
Wind 200 hPa
Initial : 00UTC, 15 MAY 1996
Time Forecast : 12UTC,15MAY1996
(units: Knots)
MM5 Model
Wind 500 hPa
Initial : 00UTC, 15 MAY 1996
Time Forecast : 00UTC,15MAY1996
(units: Knots)
MM5 Model
Wind 500 hPa
Initial : 00UTC, 15 MAY 1996
Time Forecast : 12UTC,15MAY1996
(units: Knots)
MM5 Model
Wind 850 hPa
Initial : 00UTC, 15 MAY 1996
Time Forecast : 00UTC,15MAY1996
(units: Knots)
MM5 Model
Wind 850 hPa
Initial : 00UTC, 15 MAY 1996
Time Forecast : 12UTC,15MAY1996
(units: Knots)

Moisture, Heat flux, Wind data and Observation Data at Eastern, Central and Southern thailand in May

1996

Date	Mixing Ratio(g/kg)		HeatFlux(W/m2)		Wind Speed			Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa													
1	24	24	-20	-40	0	30-34	30-35	0.0	0.0		15.5	0.2	0.4	0.2	0.0	0.0	1.1	31.2	16.3	28.4
2	24	24	-20	-20	20-40	20-40	35-50	7.1	0.9		32.4	0.4	0.1	8.8	4.6	7.3	1.5	14.8	9.5	6.1
3	27	27	-10	-20	20-40	20-30	30-35	16.1	2.4		0.2	0.0	0.0	0.5	0.5	0.0	21.7	1.5	0.1	0.3
4	25	25	-10	-20	20-40	20-30	20-30	0.0	0.0		0.0	1.3	0.0	0.8	0.0	6.5	0.0	0.0	1.4	11.4
5	25	25	-10	-20	20-40	20-30	20-30	0.0	0.0		1.2	0.0	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.2
6	25	25	200	100	20-40	20-30	30-35	0.2	2.9		0.0	18.4	0.0	0.0	6.5	6.2	3.2	0.0	0.0	0.0
7	25	24	100	100	20-41	20-30	30-35	1.0	43.0		0.7	19.2	14.1	0.0	13.0	16.8	0.0	0.0	0.0	0.0
8	24	25	100	100	20-40	20-30	20-30	0.2	33.2		18.0	1.4	18.9	0.8	4.7	9.3	0.0	0.2	0.0	0.0
9	24	32	-40	-20	20-40	20-30	20-30	0.1	4.6		2.3	0.0	20.7	1.5	7.5	2.5	17.0	9.8	0.0	0.0
10	24	24	-40	-20	20-40	20-30	30-50	0.0	0.0		0.0	0.9	20.1	0.0	0.0	0.0	114.1	4.8	6.6	0.1
11	28	30	-20	-40	20-40	15	15	0.0	1.6		0.0	1.6	9.2	0.0	19.8	1.6	1.5	57.6	12.3	14.4
12	24	24	-20	-20	20-40	10	20-30	3.3	6.8		8.2	47.1	30.8	0.0	0.4	29.2	11.6	16.0	21.0	25.1
13	24	24	-40	-40	20	20	30	0.4	1.3		7.2	0.0	0.0	0.0	12.5	4.7	30.5	66.8	6.4	16.0
14	24	24	-20	-40	15	20	15-20	0.4	0.0		5.8	0.0	3.5	0.0	7.8	20.4	21.5	65.0	5.6	18.7
15	24	24	-20	-10				0.0	0.0		0.0	0.0	0.0	0.0	84.7	13.9	24.8	20.5	21.6	21.4
16								0.0	0.4		6.4	0.4	2.3	0.0	7.0	11.6	1.8	21.8	14.8	4.0
17								0.0	8.2		59.2	3.6	47.0	66.6	43.1	8.0	16.7	4.9	1.8	5.3
18								10.1	2.6		112.9	18.5	40.6	57.5	0.0	0.0	2.4	14.1	10.9	0.9
19								0.0	1.0		0.0	27.9	8.5	55.5	0.7	31.2	4.1	9.0	5.3	3.6
20								0.9	1.1		6.4	0.7	0.4	11.4	4.0	45.3	24.8	12.4	2.0	11.2
21								30.1	46.8		6.1	14.4	11.1	22.2	74.9	6.8	15.6	0.0	2.5	2.6
22								2.3	0.0		9.7	14.9	30.6	0.0	13.5	2.5	16.9	1.2	0.0	0.0
23								0.0	0.0		0.0	12.4	2.1	5.4	17.3	4.3	19.7	5.1	0.0	0.0
24								0.0	12.5		0.0	0.0	29.2	0.0	1.2	10.8	6.7	4.9	0.0	0.0
25								21.4	0.0		0.0	0.0	0.0	37.5	2.0	0.0	0.6	0.0	0.0	2.4
26								0.0	0.0		0.0	0.0	0.0	0.2	14.6	7.0	1.6	0.0	0.0	0.0
27								4.1	0.0		0.5	0.2	0.1	0.7	21.3	13.0	4.7	1.1	1.4	1.9
28								1.4	5.4		0.0	0.0	5.6	0.0	9.1	59.0	0.0	0.0	0.0	0.0
29								0.4	6.5		0.3	0.0	0.0	0.0	1.9	22.1	0.0	0.0	0.0	0.0
30								0.0	0.0		0.0	0.0	12.3	0.0	0.0	0.0	0.0	0.0	3.5	1.6
31								0.0	0.0		0.0	0.0	6.8	0.0	0.0	0.0	12.5	2.6	0.0	0.0
								99.5	181.2	0.0	293.0	183.5	314.4	269.6	372.6	340.0	379.8	365.3	143.0	175.6

1997

Date	ng Ratio(g/kg)		HeatFlux(W/m2)		Wind Speed			Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa													
1	21	21	-10	-10	40	30	15	0.0	0.0		0.0	0.0	0.0	0.7	0.5	0.0	0.0	24.4	28.7	0.0
2	21	21	-10	-20	40	10	10	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.8	27.5	2.3
3	24	21	-10	-10	20	15	10	0.0	0.0		0.0	0.0	0.0	0.0	0.0	5.2	1.2	2.4	0.0	0.0
4	21	21	-10	-10	40	30	20	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	27.2	0.0	1.5	0.0
5	21	21	0	0	40	15	20	0.0	0.0		0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	3.3	0.0
6	21	21	-10	-20	40	45	30	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	21	24	-10	-40	20	20	10	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.0	4.2	0.0
8	24	24	-20	-40	10	15	10	0.0	0.0		0.0	0.0	0.0	0.0	0.0	22.0	1.5	3.6	0.0	0.0
9	24	21	-20	-20	40	35	35	19.6	0.0		0.0	0.0	0.2	0.0	0.0	1.0	0.0	2.4	0.0	0.0
10	21	21	-20	-40	40	35	35	0.0	0.0		0.0	0.0	0.8	0.0	0.0	0.0	18.5	0.0	6.2	0.1
11	24	24	-10	-20	40	30	35	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.0	11.5
12	21	21	-20	-20	20	30	40	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	27.5	11.2	9.2	3.4
13	24	24	-20	-10	10	30	30	0.0	0.0		0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	15.2	20.0
14	21	21	-10	-10	40	30	30	0.0	0.0		0.0	0.0	0.1	0.0	0.0	0.0	5.9	0.2	0.0	0.7
15	21	18	50	-10	40	30	35	0.0	0.0		15.1	0.0	0.0	3.1	0.0	0.0	7.3	55.2	66.8	38.9
16								0.0	7.6		0.0	1.4	0.0	29.0	37.8	40.0	0.8	20.0	1.6	7.5
17								0.0	11.8		0.0	0.0	0.0	1.0	10.2	48.9	4.5	26.8	32.8	8.3
18								8.2	0.0		0.0	0.5	4.0	28.8	18.6	5.9	17.2	11.2	0.0	0.3
19								0.1	6.4		1.8	3.2	0.6	13.2	8.4	6.0	23.9	9.2	2.5	0.0
20								19.1	3.3		16.5	0.0	12.4	0.0	46.7	42.4	1.0	1.4	0.0	0.0
21								0.2	0.0		6.9	30.9	0.8	0.0	1.0	36.2	10.6	6.4	4.8	0.0
22								0.0	1.6		0.0	0.0	0.0	0.0	23.3	51.8	9.0	2.4	0.5	1.5
23								0.0	0.0		0.9	0.0	0.0	0.0	0.3	27.6	44.5	18.2	4.1	18.9
24								18.8	17.7		8.1	1.1	48.5	0.0	47.5	94.0	53.8	12.4	2.3	1.4
25								0.0	0.0		24.4	0.0	0.0	0.0	2.1	5.8	40.7	0.0	0.0	0.0
26								6.0	12.0		2.4	0.0	14.8	0.0	0.0	0.0	15.5	1.3	0.0	0.0
27								0.0	0.0		0.0	0.0	0.0	0.0	0.0	3.7	0.0	0.2	0.0	0.0
28								0.0	0.0		0.0	0.0	0.0	0.4	0.0	1.1	0.0	0.2	3.4	0.2
29								0.0	0.0		17.1	0.0	0.0	0.0	0.0	80.9	35.4	1.3	0.1	0.1
30								0.0	0.0		10.1	0.0	2.0	0.0	2.2	13.8	3.1	4.0	22.6	11.7
31								0.0	6.6		0.0	0.0	3.9	12.8	5.7	19.7	7.6	2.9	23.4	13.4
								72.0	67.0		103.3	37.1	88.1	89.0	204.9	508.3	360.4	220.5	261.7	140.2

1998

Date	Mixing Ratio(g/kg)		HeatFlux(W/m2)		Wind Speed															
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1	21	24	-10	-10	80	50	20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	21	24	50	50	100	35	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	21	24	50	50	100	35	35	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	21	24	50	50	80	35	30	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	9.2	0.0	0.0	0.5
5	21	21	50	50	100	30	20	0.9	0.7	0.0	6.5	0.0	0.0	0.0	0.0	31.1	0.0	0.0	0.0	0.0
6	21	24	50	50	100	45	30	2.5	0.7	7.5	6.0	1.2	31.9	0.0	0.0	0.1	0.0	0.0	0.0	0.0
7	24	24	100	100	100	40	30	0.5	0.1	15.2	13.8	11.0	0.0	0.0	8.3	0.7	0.0	10.2	0.0	3.8
8	24	24	100	50	120	35	35	5.8	0.0	0.0	3.7	0.0	0.0	0.0	15.8	1.0	0.3	0.6	0.2	14.6
9	24	24	50	50	100	50	25	0.4	0.0	0.0	14.3	0.0	3.0	0.0	0.0	14.0	0.0	7.5	0.0	0.0
10	24	27	50	100	120	45	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0
11	24	27	50	100	120	45	45	0.0	0.0	1.8	0.0	0.0	1.3	0.0	0.0	0.1	0.0	0.0	0.0	7.5
12	21	24	50	100	120	30	40	19.1	2.5	0.0	3.1	0.0	6.0	0.0	5.2	25.5	30.7	23.4	0.3	0.0
13	21	24	-20	-20	100	30	35	0.3	0.1	0.0	95.3	0.0	0.0	0.0	1.3	0.0	0.0	10.6	0.0	61.3
14	21	24	-40	-20	80	30	50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.2	1.2	0.0	30.3
15	21	24	-20	-20	100	35	50	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	9.4	0.0
16								0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.8	0.0	0.0	14.0	0.0	15.4
17								52.3	0.4	16.1	0.0	1.9	3.0	0.0	52.0	1.0	0.0	0.0	0.0	3.3
18								41.9	1.3	0.3	0.3	5.0	7.3	0.0	8.5	9.5	0.0	0.0	0.0	0.0
19								18.8	5.9	8.5	2.2	13.9	6.8	0.0	1.5	1.9	0.0	0.0	0.0	0.0
20								4.5	22.3	8.0	7.5	24.0	7.2	0.0	31.8	0.0	22.0	1.2	0.0	6.0
21								5.4	0.0	0.2	0.0	0.0	9.9	0.0	0.0	9.4	0.0	0.0	0.0	0.0
22								0.0	0.0	0.0	0.0	0.6	6.6	30.2	1.6	14.5	0.4	0.0	14.3	0.0
23								0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	10.2	7.4	31.9	35.0	4.6
24								4.9	0.0	0.0	0.0	7.9	0.0	0.0	12.3	13.5	1.5	16.9	1.7	10.8
25								5.3	41.4	24.0	11.2	0.0	36.9	3.4	18.5	13.3	6.6	15.0	4.4	13.6
26								46.3	19.4	29.1	27.0	1.0	5.8	0.0	41.1	44.0	11.7	31.2	15.0	20.5
27								17.3	44.8	3.6	0.0	0.0	0.0	0.0	13.8	9.0	15.6	11.5	0.1	4.5
28								0.0	10.3	5.9	3.8	7.0	2.9	0.0	72.0	26.8	11.9	8.6	0.8	1.3
29								0.0	3.2	1.1	45.1	0.0	28.7	0.0	120.9	55.7	55.3	3.1	0.4	5.1
30								4.8	1.5	9.1	33.5	7.5	67.0	0.0	22.6	131.5	58.1	93.8	39.1	83.3
31								38.5	27.8	15.9	20.3	7.9	7.1	0.0	49.8	23.1	0.5	0.2	0.4	0.0
								273.4	182.8	146.5	293.6	89.4	231.4	33.6	499.8	437.2	281.4	282.3	121.1	286.4

1999

Date	ng Ratio(g/kg)		HeatFlux(W/m2)		Wind Speed															
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1	18	21	50	50	60	30	20	2.5	1.0	6.6	2.8	0.0	2.0	4.8	14.6	2.5	0.0	0.0	0.0	1.2
2	18	21	50	50	60	30	20	0.0	0.0	0.5	31.3	0.0	34.2	23.7	2.7	2.5	0.0	0.0	0.0	0.0
3	21	21	50	50	50	15	20	0.0	0.0	0.0	7.7	5.3	0.0	18.0	11.3	12.7	0.0	0.0	0.0	0.0
4	21	21	50	50	60	15	20	8.0	57.5	50.9	20.0	76.7	114.5	19.3	1.5	0.3	0.1	0.0	0.0	0.0
5	21	24	50	50	60	30	30	5.3	0.0	0.0	5.2	0.0	3.0	18.0	0.0	2.8	0.1	0.0	0.0	0.0
6	21	21	50	50	60	30	30	3.8	0.0	17.9	5.8	26.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0
7	21	21	50	50	60	35	30	3.3	0.0	10.7	0.0	0.0	0.0	0.0	2.1	9.8	0.1	0.0	0.0	0.0
8	21	21	50	100	80	30	30	0.0	0.0	0.0	0.0	3.4	2.0	0.0	5.0	27.9	40.6	4.4	0.0	0.1
9	18	21	-10	100	60	30	35	35.0	0.0	43.1	4.9	0.0	0.0	3.7	8.0	20.1	42.0	9.6	1.3	0.3
10	18	21	50	50	60	30	30	31.2	17.0	23.9	17.5	1.3	36.6	4.3	22.2	3.8	20.6	18.4	5.5	11.1
11	21	21	50	50	60	20	30	14.9	27.1	56.1	21.0	31.7	2.2	5.4	4.3	0.5	0.1	0.7	0.0	0.0
12	18	21	50	50	40	20	30	3.0	4.6	25.5	0.5	0.0	26.9	0.3	0.0	0.0	0.0	8.8	0.0	0.2
13	18	21	50	50	40	20	30	1.2	18.0	13.8	8.5	0.0	21.8	0.4	5.5	1.0	8.6	0.0	17.1	0.0
14	18	21	100	50	40	30	30	0.4	0.0	27.9	0.0	0.0	0.0	2.8	0.0	35.2	20.6	13.1	1.1	0.3
15	21	21	100	100	40	20	30	0.0	0.0	0.0	0.0	0.0	24.2	1.0	66.1	3.9	2.0	8.8	2.8	8.2
16								0.0	0.0	0.0	0.0	0.0	0.0	2.2	48.9	18.4	0.1	0.2	0.7	17.0
17								4.4	0.0	12.7	6.8	0.4	0.0	10.6	26.2	0.4	3.9	0.0	0.0	0.0
18								0.3	1.5	34.5	9.1	5.2	0.0	3.8	10.5	1.1	17.6	23.9	39.9	28.1
19								24.7	116.1	1.7	0.0	38.3	50.5	0.0	32.0	1.4	68.4	67.3	11.9	68.0
20								7.7	1.8	38.6	0.5	5.6	17.0	25.2	7.9	34.0	0.1	54.0	35.5	28.6
21								0.0	0.0	33.9	2.3	0.0	9.1	6.4	2.7	0.3	9.7	101.4	6.7	35.8
22								0.0	6.5	3.2	0.3	0.7	33.0	16.2	26.7	25.4	8.2	15.5	16.3	5.3
23								0.0	0.0	3.6	10.3	0.0	1.4	52.0	6.7	19.1	67.0	19.5	2.6	11.4
24								24.4	0.4	1.4	0.0	7.0	0.0	3.5	97.5	38.0	91.6	23.8	7.0	11.7
25								3.0	1.1	6.0	32.5	0.0	1.7	0.0	8.6	128.9	89.3	47.6	0.9	6.9
26								0.0	13.9	0.0	48.3	2.0	0.0	0.0	2.8	78.1	10.1	0.0	0.0	0.0
27								0.0	2.5	0.0	0.0	6.8	0.0	0.0	0.1	8.6	0.3	0.0	0.0	0.0
28								6.2	0.0	0.0	0.0	0.0	0.0	0.0	26.8	14.2	1.4	0.7	0.0	0.0
29								0.8	0.0	0.0	0.0	0.0	8.2	0.0	13.9	40.3	12.5	0.0	0.0	0.0
30								67.1	13.1	0.9	15.3	0.0	0.0	0.0	18.1	17.1	24.9	10.8	0.0	15.2
31								0.0	5.8	23.9	7.2	0.0	21.3	0.0	4.8	60.6	57.0	5.8	2.8	1.2
								247.2	287.9	437.3	257.8	210.4	409.6	221.6	480.4	608.9	596.9	434.3	152.1	250.6

2000

Date	ng Ratio(g/kg)		HeatFlux(W/m2)		Wind Speed															
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1	18	21	50	50	60	45	30	9.0	0.0	0.8	2.1	0.0	0.0	0.0	0.0	0.0	16.9	22.9	4.4	8.7
2	24	21	50	50	40	45	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	1.0	2.6	11.6
3	21	21	50	50	60	30	30	2.9	13.8	0.2	6.5	0.0	41.6	0.0	0.5	0.0	0.0	0.0	0.0	0.0
4	18	21	50	50	60	30	30	0.0	23.5	0.0	28.6	0.8	24.9	0.0	0.0	0.6	0.0	0.0	3.0	0.0
5	18	18	50	50	80	30	30	0.8	1.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.4	0.0	43.1	0.0
6	18	21	50	50	40	20	25	0.0	2.8	0.0	0.0	0.0	0.0	43.6	0.0	0.7	18.1	3.5	0.0	1.3
7	18	21	100	50	60	20	20	0.0	0.0	0.0	0.0	0.0	0.1	11.0	0.0	0.9	0.0	0.3	3.5	4.3
8	18	21	50	50	60	20	15	5.8	0.0	0.0	0.0	0.0	0.4	0.6	1.1	0.0	5.2	10.8	11.8	3.0
9	18	21	50	50	80	35	10	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.9	0.3	0.0	4.4	0.0	0.2
10	21	24	100	50	60	30	15	0.0	0.0	22.0	0.0	0.0	0.0	0.0	28.6	97.2	36.0	73.6	2.7	9.5
11	18	21	50	50	60	40	20	75.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	23.5	84.2	56.7	25.1	37.3
12	18	21	50	50	60	35	30	5.6	0.0	0.0	0.0	0.0	0.5	0.0	83.9	77.6	117.4	31.7	49.1	59.6
13	21	24	50	50	40	35	30	9.5	0.0	0.5	5.1	0.0	5.0	0.0	2.8	2.2	23.6	2.6	2.8	0.4
14	21	24	50	50	20	35	35	4.5	22.0	11.9	18.3	5.6	15.9	7.9	52.9	18.7	16.9	7.2	0.0	1.1
15	21	24	50	50	10	30	50	13.1	1.6	1.2	16.7	14.5	3.2	4.7	30.0	23.4	42.0	12.8	0.0	0.9
16								3.9	0.0	0.0	6.6	0.0	0.0	0.0	25.9	34.0	10.6	0.0	0.0	0.0
17								4.5	0.0	0.0	0.0	0.0	0.4	0.0	4.1	19.6	20.5	0.7	3.8	1.1
18								1.1	12.3	21.3	0.0	15.7	12.3	0.0	0.2	7.0	19.6	9.3	21.4	2.2
19								3.6	6.6	3.7	0.6	13.4	10.9	43.9	28.9	15.9	14.0	16.7	3.1	0.0
20								34.4	0.0	0.0	0.7	0.1	0.3	0.8	4.4	50.7	44.4	7.7	2.1	5.9
21								12.3	6.3	34.4	96.8	13.1	65.8	4.0	2.8	26.5	29.2	2.2	1.1	1.4
22								0.0	3.0	0.0	0.0	2.2	14.4	0.3	20.9	0.0	0.8	1.0	0.0	0.0
23								0.0	3.2	0.0	27.3	0.0	2.5	2.7	3.6	0.0	4.5	27.4	0.0	0.0
24								0.6	0.0	0.0	22.1	0.0	0.0	0.0	12.5	0.6	0.4	1.0	0.0	0.0
25								0.0	0.0	1.7	32.1	0.0	0.7	0.0	26.6	12.3	0.5	0.0	0.0	0.0
26								0.0	0.0	0.4	26.8	1.5	3.6	3.2	8.0	0.3	4.1	0.4	0.0	1.0
27								0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.1	0.0	39.1	5.9	0.0	9.1
28								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	0.3	21.5	28.3	50.2
29								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	11.2	27.7	5.3	17.9
30								0.0	0.0	3.4	0.0	27.5	0.0	0.4	3.4	19.8	39.1	19.7	20.8	76.1
31								0.1	0.3	16.2	1.1	2.5	53.3	2.3	39.8	96.1	111.9	5.4	0.0	0.1
								186.7	96.4	117.7	291.4	96.9	257.3	129.7	382.1	533.7	710.9	374.1	234.0	302.9

Moisture, Heat flux, Wind data and Observation Data at Eastern, Central and Southern thailand in July

1996

Date	Mixing Ratio(g/kg)		HeatFlux(W/m2)		Wind Speed															
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1	18	18	50	100	40	20	20	0.5	0		0	0	0	0	0	0	0	1.2	1.2	4.5
2	18	21	50	50	60	20	30	0	3.2		2.6	0	24.7	0	0	1.1	0.4	15.4	0	2.2
3	18	21	-10	-20	60	10	15	0	0		0	0	18.7	0	0	0	6.5	68.9	1	80.8
4	18	18	-10	-10	60	20	20	0	0		0	0	0	0.4	0	0	17.8	14.5	7.8	0
5	18	18	100	100	60	15	30	0	0		0	54	92.5	0	3.9	0	0.5	15.1	12.1	33.5
6	18	18	200	100	60	15	50	0	0		13.5	0.4	3.8	1.2	16.4	2.6	30.6	17.9	16.3	57.7
7	18	18	200	100	60	20	35	0.1	0		0	2.4	0.8	18.4	3.1	3.3	0	0	44.7	44.5
8	18	18	100	50	60	15	30	2.7	14		12.3	1.3	0	3.8	22.9	1.2	6.3	1.9	13.5	10.2
9	18	18	50	50	60	15	35	0	0		0	2.7	0	1.6	5.1	0.9	11.3	14.1	9.8	7.8
10	18	18	50	50	60	10	50	0	0		0.6	0	6.2	28.7	0.6	1.7	5.7	74.4	17.3	32.9
11	18	18	100	100	40	15	50	0	11.2		2.3	0.1	17.1	28.5	22.2	0.5	6	22.4	15	18.4
12	18	18	100	100	40	15	50	0	0.3		0	2.3	5.8	50.2	14.3	8.9	7.7	21.1	19.5	15.6
13	18	18	100	200	60	20	50	0	0.6		0	0	2.5	2.3	0	0	11.1	39.5	0.1	0
14	18	18	200	200	40	20	50	0	0.1		0	0	0.2	0	0	0	22.9	0.2	0	0
15	18	18	200	100	60	20	35	0	0		0	0	16.1	12	16.6	1.6	3.3	10	24.1	27.3
16								3.6	1.4		0	0	0.4	8.1	17.1	7.2	13.2	22.4	4.3	22.2
17								0.1	0		8.9	6	0.5	58.8	36.2	11.7	20.8	1.3	7.6	0.2
18								11.1	0		0	0.2	0.1	19.9	27.2	24.1	25.1	0	2.2	0
19								0	1.4		6.5	2.9	19.6	48.7	31.7	3.5	0.2	0	0	0
20								2	18.1		10.1	0	2.5	6.2	13.8	57	29	0	0	0
21								0	0		0	0	0	0	22.3	76.7	44.4	1	0	0
22								3.1	0.6		1.4	1.5	0	0.5	1.3	31.6	25.6	0.8	0	0
23								3.5	0.1		1.5	0.4	0.2	0	0	54.9	60.7	3.9	2	9.8
24								20	6.8		0.8	2.5	2.2	0	13.9	111.1	43.4	0.2	0	4
25								19.6	5.1		15.3	14.1	25.6	3.5	47.1	109.7	0	0	0	0
26								0.6	0.5		13	7.7	1.1	7.6	10.2	38.2	4.8	0	0	0
27								0	0.2		0.6	11.5	5.6	4.2	24.5	68	6.4	0.7	0	3.3
28								10.9	1.2		0.4	3.3	8.2	7.8	10.8	66	6.8	6.3	1.1	0
29								1.2	9.5		18.4	1.9	10.9	0	6	55.1	32.6	0	0	0.2
30								0	11.7		20.8	1.9	4.5	0	49	52.6	26.6	5.9	0.5	3.3
31								0	0.2		0.5	0.5	0	0.2	1.1	10.3	5.5	1.8	0	0

1997

Date	Mixing Ratio(g/kg)		HeatFlux(W/m2)		Wind Speed															
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1	18	21	200	200	40	10	35	0	0		0	0	0	5.7	0.2	92.4	39.3	29.4	26.4	12.1
2	18	21	100	100	40	10	50	16.2	0		0	0	0	0	0	0.2	6.7	5.4	23.3	0.8
3	18	21	50	50	40	30	35	2	0		0	0	0.2	0	0	0.6	0	0	0	0
4	18	18	200	100	40	30	50	1.9	0		0	0	0.6	0	4.9	2.9	1.7	7.1	0	4.6
5	18	21	200	100	40	30	50	16.4	0		0	0	0	0	29.9	42.5	1.8	0	0	0
6	18	21	100	100	40	30	30	5.3	0		0	0	0	0	8.6	36.4	13	0	0	0
7	18	21	100	100	40	15	50	0	0		0	0	0	0	0	57.6	2.7	20.8	0	0.3
8	18	21	50	50	60	15	50	0	0		0	0	0	0	0	39	29.8	4.4	0	3.1
9	18	21	-20	-10	40	15	50	11.4	0		0	0	0	0	0	15.3	37.6	6	6.6	0
10	18	18	-10	50	40	30	50	0	0		1.1	0	0.4	0	16.2	412.4	32.7	29.4	3.9	0.2
11	18	21	200	200	60	30	50	0.1	0		6.7	0	0	0	17.1	253.7	56.2	8.6	12.8	0.1
12	18	21	100	100	60	15	50	0	1.9		0.9	0	0	0	1.1	123.5	45.4	53.2	19.5	12.3
13	18	21	50	50	40	20	50	0	0.3		0	0	5.1	0	0	5.1	132.7	0.8	0.5	0
14	18	18	50	50	40	15	50	0.9	0		0.2	0.9	0	0	0.1	27.4	53.1	3.4	4.8	0.7
15	18	21	50	50	40	50	50	27.1	13.9		0	0	0	0	2.9	13.3	63.1	36.3	18.3	0
16								0	0		9.3	12.2	0	0	20.9	37.7	45.7	68.4	29.2	12.9
17								26.3	0.1		0	0	0	3.3	87.5	87.5	5.2	0.8	0	0
18								36.4	0.4		3	26.7	0	0	1.2	6.6	0	0	0	0
19								3	0		41.2	0	8.9	0	1.2	0	0	0.8	0	0.3
20								0.5	0		10.7	3.3	9	0	18.6	0.6	21.1	80.6	11.7	29.7
21								17.1	0		19.5	1.2	1.3	0.4	25	43.5	56.3	25.2	29.9	6.9
22								13.2	2.6		2.4	2	0.8	0	0	151.3	122.6	28.2	23.6	69.7
23								1.5	0		6.9	0.4	0.6	0	6.3	199.3	34.2	7.6	16.9	15.8
24								0	0		4.7	0	0	0	0.6	20.7	17	0.6	10.6	1.9
25								9.4	0		0	0	0	0	4.8	48	23.7	1.6	0	0
26								4.5	0		0.2	1.1	1.7	0	3.3	41.3	8.3	0	0	0
27								4.7	0		0	0.4	0.1	0.3	14.2	104.3	0	0	0	0
28								1.6	0.3		7.7	0.2	0.6	6.8	29.2	43.2	0	0	0	0
29								10.4	2.9		0	0.7	0	7.8	47.2	49.4	0	0	0	0
30								48.3	19.1		22	1.6	4.7	17.2	78.1	76.7	0	0	0	0
31								1.6	0		0.4	0.1	0	10.1	92.9	73.8	16	0	0	0

1998

Date	ng Ratio(g/kg)		HeatFlux(W/m2)		Wind Speed															
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1	18	21	100	100	40	35	50	24.8	42.8	38.5	65.1	12	30.2	41.3	96.6	19.7	8.9	3.3	12.2	0
2	21	24	200	200	40	30	50	43.7	0	0.6	10.5	0	6.1	17.1	12.8	21.3	0	0.3	27.3	0
3	21	21	200	200	40	20	50	15	7.7	8.7	3.1	0	32.3	16.5	1.6	0	13.7	0.1	0	0
4	18	21	100	100	40	15	35	3.9	16.7	53.8	11.4	23.8	30.5	46	3.5	5.1	6.6	31.4	3.9	0.4
5	18	21	50	100	40	15	30	0.3	0	0	0	0	0	33.6	0	0	0	5.1	1.2	105.9
6	18	21	50	50	40	20	50	5.2	33.4	1.1	67.7	0	8.3	28.4	0.2	1.7	0.5	0.2	0	67.5
7	18	21	50	50	50	15	50	0.4	2.6	41.5	1.4	19.5	30.1	3	38	25.9	22.9	4.4	22.4	6.1
8	18	21	50	50	60	15	50	2.1	9.9	2.9	27.2	69.9	5.4	3.5	46.7	62.9	23.6	41.8	15.8	6.1
9	18	21	100	200	40	20	50	20.4	0.5	11.8	1.3	13	5.9	0	1.2	6.4	0	0	0	5
10	18	21	200	200	40	20	50	0	0	0	6.9	7	3.2	23.5	5.8	1.3	3.1	0	0	5.6
11	18	21	100	100	40	20	50	0	0	0	2.4	0	0	16.2	13.6	0	0	0	0	13.4
12	18	21	100	100	40	15	50	0	0	2.1	0	11.5	0.9	0.4	1	0.2	0.3	47.3	2.6	19.4
13	18	21	100	50	40	10	50	23.5	72.7	34.4	47.4	4	2.1	34.6	43.1	5.4	0	0	5.6	1.8
14	18	21	50	50	40	15	30	3.7	13.3	24	10.8	26.5	0	9.2	9.4	1.5	0	0	0	2
15								7.7	14.7	6.4	0	0	15.7	0	0.5	0	0.1	0.4	0	31.2
16								0	0	0	0	0	0	0	0	0	15.3	12.8	3.3	30.3
17								0	0	3.2	0	0	0	0	0	6.3	5.7	73.5	0	18.2
18								0	0	5	0	0	0	0	0	0	2.6	5.2	4.1	1.6
19								0	0	0	0	0	0	0	2.1	0	0	1.6	0.7	23.9
20								0	0	0	0	0	0	0	0	0	0	0	0	9.1
21								0	0	0	0	0	0	0	0.6	0	3.3	48.5	4.9	17
22								0	0	0	0	0	0	1	35.1	1	6	18.1	29.6	0
23								0	44.9	1.7	0	0	0	12.8	59.7	5.6	61.3	37.8	1.3	0.2
24								0	10.9	0	0	39.7	0	2.9	41	1.2	6.1	33.7	2.3	0
25								0	0	0.6	0	0	0	0	1.4	73.1	77.3	31.2	2	1.4
26								0	0	0	0	0	0	0	7.5	87.6	9.3	2.9	1.5	0
27								0	0.2	16.8	0	0	0	0	0	16.4	17.7	0.4	1.8	37.3
28								0	0	0	1.7	0	6.7	78	73.5	68.8	5.2	2	4.2	0
29								0	0.6	0	0	0	1.4	0.3	9.6	17	13.2	50	55.7	84.6
30								14.8	8.1	22.9	23.7	31.2	40.6	2.4	3.3	25.7	17.6	14.2	7.2	27.8
31								2.6	0	19.2	1	6.4	50	3	12.5	2	7.6	61.2	2.4	15.8

1999

Date	Mixing Ratio(g/kg)		HeatFlux(W/m2)		Wind Speed															
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1	18	18	100	100	60	15	30	0	7.7	0	0	0	0	0	4.2	63.3	51	6.4	54.1	0
2	18	18	100	100	60	15	30	0	0	0	0	0	0	0	43.1	166.3	8.9	20.2	8.9	8.6
3	18	21	100	100	40	10	30	2.1	1.2	0	0	0	0	0	37.2	40.3	6.9	4.8	23.9	2.1
4	18	18	50	100	40	15	30	2	0.3	0	4.1	0	0	0	32.5	42.9	15.6	8.9	0.9	0
5	18	21	100	100	40	10	35	8.7	0.4	5	18.5	20.5	0.4	6.3	35.9	42.8	13.7	2	0	0
6	18	21	50	50	40	10	30	3.3	0.3	1.5	13.4	1.4	0.7	0	0	0.6	0	1.4	11.8	0.2
7	18	18	100	200	60	10	30	0	0	0	0	0	0	0	11.8	0.1	6.7	6.9	0	0.5
8	15	18	200	200	60	10	30	0	0	0	7.6	0	0	0	18.4	0.1	4.5	0	0	0
9	18	18	200	100	60	10	30	0.7	6.8	0	0	0	0	0	10.5	19.9	23.4	0	1	0
10	18	18	100	50	60	10	30	31.1	0	0	0	0	0	0	0	0.8	15.1	18.7	0	0
11	15	18	50	50	60	10	30	5.2	7.8	0	1.1	0	4.7	0	0	20.5	60.2	22.2	2.6	1.1
12	15	18	50	50	40	10	50	5.5	0	0.3	4.3	0	0	0	0	20.7	171.1	89.5	23.7	0
13	18	18	50	50	40	10	35	0	0	0.1	4.9	2.9	0	6.5	29.9	22.6	13.5	21.4	36.8	0
14	18	18	50	100	40	15	35	0	0	1	18.1	0	0	0	81.7	36.1	8.1	10.2	16.5	0
15	18	18	50	100	40	10	30	0	0.9	0	4.6	0	2.9	0	2.5	66.8	50.2	27.6	0.3	0
16								0	17.2	0	0	0	0	0	0	3.7	0.1	1.7	0	1.1
17								5.7	25.9	8.4	4.6	3.4	0	0	0.1	107	9.6	0	0	0
18								0	96.4	4.3	12.9	0	0.1	2.3	38.3	85.3	2.1	0	0	17.3
19								17.6	0	3.5	0	2.1	13.5	11.2	96.1	10.1	17.6	32.2	0	1.5
20								0	0.3	3.5	6.9	1.2	11.2	2.3	31.7	34.8	5.7	62.3	0	25.9
21								0	0.1	0	0	19.7	2.2	0	6.3	29.6	23.1	19.2	18.6	5.9
22								0	1.4	5.6	4.1	0	1.1	0	0.9	14.7	24.5	13.5	6.9	82
23								0	0	0	0	0	0	7.8	0	4.6	20.1	23.7	6.7	52.2
24								12.5	0.6	0.1	12.7	0.2	0	3.4	25.8	27.8	30	0.4	0	68.2
25								13.1	9.8	13.4	12.4	3	3.4	16.6	47.1	45.6	5.2	0	0	0
26								1.7	5.4	0.3	12.6	0	0	15.1	7.6	22.2	4.7	0	0	7.9
27								11.6	0	8.3	5.2	4.1	4.8	0	0	10.1	76.7	3.4	3.8	2
28								0	0	0	0	0	6.8	0	0	2.4	17.6	2.1	2.8	2.6
29								0	0.9	0.3	9.3	0	2.7	3.9	27.2	262	47.8	3	4.4	0
30								3	0.3	6	55.2	0	7.5	18.6	137.9	362.7	130.2	0.2	0.6	0
31								20.8	6.6	2.8	52.6	0	10.3	0.2	4.7	42.6	52.4	0.9	0	1.2

2000

Date	Mixing Ratio(g/kg)		HeatFlux(W/m2)		Wind Speed															
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1	18	18	100	200	40	10	35	0	0	0	0	1.1	0	5.3	1.6	6.6	28.8	14.2	12.9	19.5
2	18	18	100	100	40	30	50	3.7	0	2.4	1.7	1.9	2.1	3.5	15.9	0	0	6.4	6.7	7.1
3	15	15	100	100	40	20	50	0	0	0	0	0	6.9	0	0.3	17.7	17.7	23	3.5	5.5
4	18	15	100	100	50	30	50	0	0	0	0.7	0	17.1	7.2	42.7	91.3	38.1	14.9	1.3	16
5	18	18	100	50	50	30	50	10.9	0	1	60.8	0	55.3	60.3	132.1	173.5	3.9	5.7	0.4	0
6	18	15	50	50	40	15	50	0.3	28.5	3.3	2	1.1	36.7	0.8	12.7	5.9	5.1	0	0	0
7	18	18	50	50	40	15	50	26.8	0.1	0	6.3	0.1	0	0	18.6	15.9	5.2	7.8	0	0
8	18	18	100	100	40	30	50	13.2	4.1	1	7.6	0.2	0	0	4.4	3.1	0.8	0	0	0
9	15	18	200	100	40	20	35	3.5	0	0.2	1.6	9.2	0.5	0	20.2	36.9	27.7	20.8	5.2	12.3
10	18	18	100	100	40	15	35	6.1	5.2	0.3	0.5	0	1	2.2	17.3	65.7	61.8	0.4	0	0
11	18	18	100	100	40	30	45	13.9	3.3	3.5	45.6	1.8	1	13.3	29.5	60.1	30.8	0	0	0
12	18	18	100	100	40	30	50	11.3	8.1	3.2	10	0	1	0.2	4.4	53.9	0.6	0	0	0
13	18	18	100	50	40	35	50	0.3	0	4.8	2.3	8.5	25.8	8.3	8.7	65.7	0	0	0	0
14	18	18	100	100	40	30	50	0	0	0	2.8	5.8	0.3	1.8	2.4	173.7	48.1	0	0	0
15	18	18	50	50	40	30	35	0	0.6	0.4	8.2	0	13.6	0	0	146	0.8	10.4	0	0
16								4.7	0	0	12.5	0	3.9	0	6.5	248.5	3.1	0	0	0
17								5.6	1.3	0.1	6.9	0	0	61.1	31.2	76.5	9.3	0	0	0
18								2.5	0.4	0	0	0	0	0	0	0.2	2.6	0	0	0
19								0.2	23.9	10.4	9.7	0.3	1.7	0	28	6.5	0	0	0	0
20								0	0.6	10	9.3	1.3	19.1	0	35.9	6.9	0	0	0	0
21								2	0.6	0.5	8.4	0	1.2	0	3.3	15.8	0	3.6	0	0
22								0	0	0	0	0	2	0	0	25	19.7	7.2	0	0
23								0	0	0	0	0	3.2	0	0.3	0.9	0	0	0	1.1
24								0	0.1	0	2.5	0	0.5	0	7.8	23.4	2.3	2.1	0.2	2
25								0	1.1	20.9	33.5	0	1	0	2.7	91.3	1.5	32.1	1	1.2
26								0	0	0	0	0	0	0	4.4	75.6	14.4	15.4	4.9	9.5
27								0	1	3.8	3.8	0	0	0	1.3	30.4	10.8	25.4	21.6	3.1
28								0	0	0	30	0	0	0	56.7	85.9	7	15.1	7.6	12.9
29								0	0	17.8	3.4	5.9	18.5	0	1.7	12	9.8	2.2	0	0.2
30								0.6	0	0	0	0	13.2	0	5.5	0	0	0.3	0	7.3
31								0	0	0	0	0	35.4	0.2	20.6	0	0	0	0	0

Moisture, Heat flux, Wind data and Observation Data at Eastern, Central and Southern thailand in August

1996

Date	lixing Ratio(g/k		HeatFlux(W/m2		Wind Speed															
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1	18	18	50	50	40	30	50	0	0		3	0	0	0	0	10.6	0	0	0	0
2	18	18	50	50	60	35	50	4.7	0		3.2	0	3.1	0	0	11.1	1.9	0.4	0.3	0
3	18	18	50	50	60	30	50	5.1	0.9		0	0	0.1	0	0	11.4	1	0	0.1	2
4	18	18	50	50	60	15	30	23	2.1		4.2	0	0.3	0	0.2	2.1	5.5	0	0	0
5	18	18	50	100	40	15	30	29.8	1.4		76.8	0.1	0.3	2	6.3	39	9.6	0	0.1	0
6	18	18	-10	-10	40	30	35	0.6	1.9		5.5	0	0.2	0	3.7	13.3	11.8	8.6	0	0
7	15	15	100	50	40	30	35	0	0		0	0	0	0	0	0	19.1	5.7	2.8	9.6
8	18	18	200	100	40	30	35	4.6	0.3		0	0	0	0	1.7	14.7	14.3	18	22.4	13.6
9	18	18	200	100	40	10	30	0	0		0	0	0	0	0.3	3.7	6	125.3	34.2	15.5
10	18	18	200	100	40	15	30	0	0		0	0	0	0	9.6	11.9	19.4	20	15.6	42.7
11	18	18	100	100	40	30	35	0	1.8		0	0.3	1.8	0	5.8	29.1	2	27.7	2	1
12	18	18	100	100	60	20	30	13.1	0		0	1.8	0.1	0	10.7	47.2	24.8	10	17.1	0.6
13	18	18	100	50	40	15	50	20.3	0		15.4	0	0.3	4.1	8.9	43.4	25.6	5.3	0	0
14	18	18	50	50	40	10	50	0.2	5.4		3.9	0	0.8	2.8	34.9	12.6	0	0	0	0
15	18	18	50	50	60	10	50	1.5	0.8		0	5.5	0	6	40.9	0	21.4	17.8	1.2	3
16	18	18	50	50	40	10	35	0.6	0		0	0	0	0	0	0	0	0	0.4	0
17	18	18	50	50	40	30	30	0	0		0	0	8.3	0	0	0	1.3	0	5.5	0.4
18	18	15	100	100	40	20	30	0.2	30.6		0	1.7	3.9	0	3.4	63.3	12.2	0	15	62.5
19	15	15	200	100	40	15	30	0.1	0.1		27	0	32.4	0.8	0	0.1	1.6	0	0	21.4
20	15	15	200	100	40	10	30	10.6	16.7		7.1	0	0	11.5	15.5	13.3	0	0	0	0.2
21	15	15	100	100	40	15	30	0	0		10.9	6	1.1	25.1	9.3	7.6	1	3.2	1.5	0.5
22	15	15	100	50	40	10	30	0	0.5		0	3.9	15	0	11.3	37.1	10.6	3.4	3.4	0
23	15	15	50	50	20	10	30	0	0		2.6	1.4	16.8	0.2	24.9	54.1	77.7	10.7	29.6	32.5
24	15	15	50	50	40	15	30	39.4	0		35.8	1.3	0.5	63.2	59.5	159.6	163.2	54	55.2	39.2
25	15	15	0	50	40	30	35	4.7	3.8		8.5	26	6	43.7	43.7	133	42.8	11.2	10.2	14.9
26	15	15	50	50	40	30	30	20.7	0.2		12.8	0	0.2	3.5	16.9	17.8	3	0	2.5	5.9
27	15	15	50	50	40	30	35	0	0		0	0	0	0	0	0.1	20.4	43.6	5.2	10.3
28	12	12	50	50	40	30	30	0	0		0	0	0	0	1.9	3.9	3.1	47.2	0.6	9.4
29	15	15	50	50	40	10	30	11.8	0.5		0.7	7.7	1.6	0	0.5	0	3.6	46.4	7	5.5
30	12	12	50	50	40	30	30	5	0.1		2.8	0	0	0	3.2	0	6.6	10	0	1.6
31	12	12	50	50	40	15	30	8.8	0		0	6.6	0.6	3.1	12.4	74.4	2.5	30	12.9	16.2

1997

Date	Mixing Ratio(g/kg)		HeatFlux(W/m2)		Wind Speed			Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa													
1	15	15	100	100	40	30	50	17.5	4.8		3.3	1.5	0	0	0	86.3	2.8	0	0	0
2	15	15	200	100	40	30	50	0.5	2.4		33	1.7	0.9	0	7.2	5.5	6.6	0	0	0
3	12	12	100	100	15	45	50	0.7	0.8		43	11.7	14.8	0.5	4	56.3	113.9	18.6	3.3	4.1
4	12	12	200	200	20	35	50	5.2	0		18.1	2.9	2.8	0.2	46.7	138.1	32	62.8	0	8.1
5	12	12	100	50	20	35	50	7.1	0		51.8	3.5	17.9	0	19.5	45.7	77	8	20.6	26.7
6	12	15	50	50	40	15	30	0	7.2		70.6	0	0	0	28.9	50.4	122.1	29.4	31.7	28.8
7	12	15	50	50	40	10	30	9.6	0.1		0	0	6.6	0	0	3.2	91.7	21.4	0.9	10
8	12	12	200	200	60	10	30	9.5	0		0.1	2.9	0	0	0	0.7	0	1.4	0	0
9	12	15	100	50	60	10	30	0	0		1.2	0	0	0	0	0	0	0	0	0
10	12	15	50	50	60	10	30	4	0		0	0	1.5	0.6	6.2	11.5	0	0	0	0
11	12	12	100	50	40	10	35	0.6	0		0	0	0	0	0	5.2	0	0	0	0
12	12	15	50	100	60	10	30	16.2	0		0	0	0	0	0.5	2.1	0	0	0	0
13	12	15	100	50	60	15	30	0	0		0	0	0	0	63.7	44.8	2.1	0.8	0	0
14	12	15	100	100	60	10	30	0	0		7.3	2.7	4.2	0	5.6	4.5	0	0	0	0
15	12	15	100	50	40	10	30	0	31.8		1.9	0	0	0	0	14.9	10.3	0.1	0.2	0
16	15	15	50	50	40	10	30	9.9	0		11.6	14.7	0	0	0	0	3	0.6	0	0.9
17	12	15	50	50	40	10	35	0	0		0	0	0.1	0	0	2.5	15.2	6	4.1	2.2
18	12	15	50	50	20	15	30	7.6	0		3.5	0.2	0	0	0	0.3	0	10.2	10.4	5.3
19	12	15	50	50	20	10	35	0	0.6		0	0	0	0	0	8.2	16.7	7	1.5	0
20	12	15	50	50	20	10	30	0	1.1		9.2	0.4	0	0	0	17.6	113.9	5.6	5.4	5.6
21	15	15	50	50	40	20	30	0	82.5		3.2	5.2	4.8	0	13.9	185.7	52.1	5	0	0.2
22	15	15	50	50	40	20	50	14.2	3.6		16.4	0.3	0	0	3.9	58	132.5	71.4	39.2	116.2
23	15	15	50	50	40	20	50	39.3	0		15.2	0	0	0	0	0	111.8	29.2	35.3	42.2
24	12	15	50	50	40	20	50	0	0		3.3	0	0	2.2	22.2	4	142.7	84.8	8.1	16.4
25	12	12	100	100	20	20	30	9.4	0.1		2.5	5.9	2.1	4.2	61.7	22.5	89	44	10.1	37
26	12	15	200	200	40	20	35	0.4	7		0	2.6	0	1.8	38.9	22.2	20.1	7.7	9.9	0
27	12	12	200	100	40	30	35	0	0		0	4.5	4.2	0.1	0	0	1.6	6.6	0	8.1
28	12	15	50	50	40	30	35	3	0		1.4	0	0.1	11.1	27.1	102.4	1.4	0	0	0
29	12	12	50	50	40	20	35	26.6	15.1		44.3	6.1	26.5	2.1	15.4	2	7.4	2.2	0	0
30	12	15	50	50	40	15	30	18.2	25.4		84.5	30.4	24.6	0	13	99.3	16.8	21	2.1	0.2
31	12	12	100	100	40	10	20	0	1.3		9.6	56.2	11.5	0	0.5	9.3	27.3	28.2	2	5.4

1998

Date	lixing Ratio(g/k		HeatFlux(W/m2		Wind Speed															
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1	12	15	100	100	60	10	20	0.3	0.9	2.3	25.4	2	57.1	0.8	11.4	10.8	0.2	6.7	0	0
2	12	15	100	100	60	10	20	0	31	4.1	69.8	39.2	6.9	2.2	35	1.2	0	0	0	0
3	12	15	100	100	60	10	30	3.8	18.5	15.7	5	0.3	1.3	4.5	0	5.8	0	0	0	0
4	12	15	100	100	60	10	30	0	0	0	24.5	0	0.1	0	0	29.6	4.6	1.2	7.7	0.4
5	12	15	100	100	40	10	30	0.1	4.5	1.5	3.8	0	29.7	0	0.3	181.6	127.6	105.3	34.2	105.9
6	12	15	50	50	40	15	30	0	21.2	0	6.5	75.9	0	1	61.5	292.6	58.2	160.4	30.3	67.5
7	12	12	50	100	40	20	30	1.7	11.6	7.7	77.5	0	0.4	6.7	150.3	184.4	18.8	13	9.4	6.1
8	12	15	200	200	60	20	30	4.7	0	3.2	23.5	0	24.6	21.8	12.8	36.4	44.7	25.2	2.1	6.1
9	12	15	100	100	60	20	30	2.2	0	0	32.2	0	9.5	0.3	21.7	15.2	13.1	7.7	0	5
10	12	15	100	100	40	10	30	0.4	11.2	51.9	27.2	2.7	32.2	21.3	21.7	23.7	0.2	3.6	24.1	5.6
11	12	15	50	50	50	30	35	2.9	0	0	0	0	0	1.3	0	14.5	0.1	0	63	13.4
12	14	14	50	50	60	15	30	2	0.4	7.3	31.3	0	0.8	6.1	16.2	0	25.6	0.4	0	19.4
13	13	14	50	50	40	10	30	30.1	6.4	6.3	11.4	20.4	8.7	25.4	0	0.3	0.6	23.2	7.3	1.8
14	13	14	50	50	40	10	20	0.2	1.1	0	0	0	0	0	0	1.3	2.7	13.2	11.4	2
15	13	14	50	50	60	20	10	2.3	0	0	0	0	0	6	8.9	0.1	0.3	7.3	67.8	31.2
16	14	14	50	50	50	30	10	0	0	14.6	0.2	0	0	0	1.8	0.4	0	8.2	39	30.3
17	14	14	50	50	40	15	15	18.9	16.7	0	0.1	0	1.7	28.4	9.5	0.8	8.5	23.2	4.6	18.2
18	14	14	50	50	40	15	10	5.5	0.4	9.4	19.5	0	1.9	0.6	37.5	3.2	13.7	18.3	16.7	1.6
19	14	15	50	50	60	15	10	2	0.8	0	30.8	0	29.1	7	0	0	8.3	57	36.6	23.9
20	14	15	50	50	60	10	10	0.1	50.1	0	3.6	0	31	49.1	7.1	21.3	40.2	14.2	11.3	9.1
21	13	15	50	100	40	15	20	3.6	6.1	3.5	38.9	7.3	22.8	9.7	1	2.2	2.3	24.2	16.7	17
22	13	12	100	100	20	20	20	1.3	4.1	16.4	8	0.2	67.4	9	3.1	0.2	0.6	0	0	0
23	13	13	50	50	40	20	30	24.4	2.5	2.7	21.3	2.2	0	0	0	0	0.1	0.2	5.1	0.2
24	13	14	50	50	50	30	30	0.5	0	0	0	13.8	0	0	0	0	0	0.8	8.7	0
25	13	14	200	200	40	40	30	0	52.6	3.4	10	0	6.6	1.8	1.1	0.5	48.6	1.9	3.9	1.4
26	15	15	100	100	40	30	20	0	0	0	0	3.5	22.5	0	0	0	1.1	0.1	0	0
27	16	17	100	50	50	15	15	0	0	0	0	0	0	0	0	0	5.6	4.2	0	37.3
28	17	17	100	100	60	10	20	0	0	0	2.2	0	0	0	17.7	12	0.3	0	0	0
29	17	17	100	100	60	15	20	0	0	4	0	0	0	0	0.4	2.8	39.3	69.9	25.7	84.6
30	15	15	50	50	40	15	30	0	0	11.4	0.7	0	28.2	0	24.3	5.7	20.2	1.8	26	27.8
31	16	16	50	50	40	15	15	16.6	6	2	0	1.1	59.5	38.9	0.1	13.7	1.6	15.6	1.8	15.8

1999

Date	lixing Ratio(g/k		HeatFlux(W/m2		Wind Speed															
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1	13	14	100	100	40	30	35	19.2	0	0.4	0.6	0	0.1	3	39.7	18.4	0.3	0	0	0
2	13	14	50	50	40	35	35	3.7	0	1	24	0.3	3.1	4.4	19.2	139.6	38	10.8	6.4	8.6
3	14	15	50	50	40	30	50	0	5.9	1	5.7	0.5	1.2	0.9	3.4	42.8	78.1	0.1	0.3	2.1
4	15	15	50	50	40	30	50	6	0.6	1.1	0.2	5.2	0	0.1	0.2	6.6	6.5	0	0	0
5	15	16	50	50	40	30	50	5.1	0.1	1	22.7	0.1	1.1	0	1	24.8	4.3	1	0	0
6	15	15	50	50	60	30	50	2.6	0	0	0.1	1.2	1.4	17.2	26.3	0.6	0	1.6	1.1	0.2
7	15	15	50	50	40	35	50	0	2.1	2	3	0	5.3	0	1.2	0.3	1.4	0	6.8	0.5
8	15	15	50	50	40	20	50	0	0	5.1	0	1.5	0	0	0	0	0.9	2.2	0	0
9	14	14	50	50	40	20	50	0	13.9	6.3	0.2	0	11	0	1.3	0	0	0	0	0
10	14	14	50	50	40	30	30	6.8	16.6	0	1.1	0	1.2	0	0.3	44.1	0	1.2	0.1	0
11	14	14	50	50	40	15	20	7.4	0	0	0	0	0	0	0	12.9	0	0	0.1	1.1
12	13	15	50	50	40	10	30	8.9	1.1	1.3	14.7	1.6	0	0	1	0	1.6	10.9	0	0
13	15	15	50	50	40	10	30	13.6	1.2	15.7	0	8.9	0	0	0	0	6.6	1.3	5.4	0
14	15	15	50	50	40	10	30	0.1	0.2	0	5.5	1.6	0	0	25.5	0	0	0	0	0
15	15	15	50	100	40	10	30	0.3	0	0	0	0	0.4	0.4	0.2	0.9	0	0	0	0
16	15	15	200	100	40	15	30	0	44.1	21.5	0.1	20.4	36.8	0	0	0	0	0	0	1.1
17	14	14	100	50	40	15	30	0.5	0	0	0	0	6.3	0	0	8.3	32.3	3.8	0	0
18	13	15	50	50	20	10	30	0	0	0	0	0.5	1.1	0	0	0.5	10.5	17.3	6.6	17.3
19	13	13	50	50	40	10	30	25.1	37.2	5.5	55.7	0.7	9.5	0	19.5	40.8	5.1	6.7	3.2	1.5
20	13	15	100	100	60	15	30	0	0	0	0.2	0	0	5.4	5.8	22.2	7.3	49.3	50.7	25.9
21	14	15	100	100	60	15	35	0	0	0	0	0	0	0	0	0	42	86.2	17.6	5.9
22	14	15	100	100	60	15	50	0	0	0	0	0	0	0	40.8	1.1	19.4	72	67.1	82
23	13	15	100	100	40	35	30	10.2	2.2	20.6	12.5	2.8	12.6	24.5	13.4	7.6	2.9	39.4	27	52.2
24	15	15	100	100	40	30	35	2.1	4.5	28.9	25.6	3.1	0.1	3.7	7.1	62.4	20.6	57.3	31.2	68.2
25	14	14	100	50	40	15	35	7.4	0.1	0	30.4	0.2	0	0.3	0	23.7	22.2	0.1	0	0
26	14	15	50	50	60	20	30	12.6	46.1	5.4	2.4	7.8	0	0.2	33.2	51.9	19.8	9.2	88.5	7.9
27	14	15	50	50	40	15	30	0	1.4	4.3	22	5	6.6	18	67.4	16	39.5	2.3	15.4	2
28	15	15	50	50	40	10	30	17.8	0	0	3.1	0	0	1.6	14.3	18.3	40	2.1	8.9	2.6
29	14	14	50	50	40	10	35	3.5	12.3	65.8	12	5.5	48.2	33.6	7.7	0.8	6.5	3	0	0
30	14	14	50	50	20	15	35	26.8	0	0	0	0	1.2	0	2	4.9	7.9	0	0	0
31	15	15	50	50	20	10	30	0.5	0	0	74.4	0	11.5	0	1.2	6.8	15	0	1.5	1.2

2000

Date	lixing Ratio(g/k		HeatFlux(W/m2		Wind Speed																
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1	14	14	50	50	40	30	30	0	0	0	0	0	0	2	9.3	3.7	3.1	0	0	0
2	16	16	50	50	40	20	30	0	0	38.4	0	0	10.8	33	25.2	36.9	0	0	0	0
3	15	15	100	100	40	15	20	0	0	36.6	0.4	0	3.1	3.2	21.2	89.9	27.8	5.4	10.7	10.5
4	14	15	200	100	40	15	30	0	40.4	0	0	0	0	0	0	15.8	25.2	6.8	0.6	0.1
5	14	15	200	100	40	10	30	16.7	1.3	0	0	2.5	0.2	0	1.3	16.5	30.4	33.8	14.7	5.1
6	15	15	100	100	40	15	35	0.8	1.3	6.6	1.2	0.1	0	0	43	34.6	40.2	34.4	28	17.3
7	16	16	50	50	60	10	50	58	7.9	7.2	11.2	1.8	17.6	17.6	38.3	38.5	38.4	74	26.2	118.2
8	17	17	50	50	60	20	50	56	8	6.8	45	11.5	28.1	0	32.5	15.3	11.4	33.9	0.7	6.3
9	17	17	50	50	60	20	50	27.9	6.4	10.8	11.4	0	0.3	5.2	0	0	33.3	31.5	42.6	43.5
10	17	17	50	50	60	30	50	0	0	5.3	0	0	0	0	0	0	0	0	0	0
11	15	15	50	50	60	30	50	0	0	0	0	0	0	0	0	0	0.3	0.9	0	0
12	15	15	50	50	40	30	30	0	0	0.7	0.1	0	39.3	0	0	0.3	3.2	1.3	0	16.1
13	15	15	50	50	40	30	20	0	3.1	0	0	0.3	8.9	0	74.1	4.6	4.8	24.7	0	6.3
14	15	15	50	50	40	15	30	0	3.7	0.4	28.3	0	4.2	20.9	8	9.1	18.4	47.5	25.4	13.8
15	15	15	50	50	40	10	35	0	0	7	0	0	6.2	0	6.9	13.1	32.7	61.4	0.4	2.7
16	14	14	50	50	40	15	30	0	0	0	0	0	0	0	16.8	170.4	33.7	68.9	1.2	9.9
17	14	14	50	50	40	15	35	1	2	1	194.9	0	0	6.2	43	114.5	47.7	63.3	22.8	29.9
18	14	14	50	50	60	30	35	14.7	2.1	36.1	3.5	5.9	28.9	4.9	23.2	200.8	60.3	54.5	1.1	2.5
19	15	15	50	50	60	30	35	0	6.8	1.4	0	0	0.2	0	0.3	25.5	25.3	89.5	58.5	34.3
20	15	15	50	50	60	45	50	4.8	0	0	0.7	0	0	0	1.4	65.4	81.9	30.5	32.5	20.1
21	15	15	100	100	40	30	50	0	0	0	1.6	41.5	0	0	1.6	44.1	129.2	118.4	76.7	88.1
22	14	14	100	100	40	35	50	8.9	40.4	10	32.1	4.6	3.9	1.3	11.9	13.9	14.5	10.8	25.6	45.5
23	15	15	100	100	60	45	50	41.8	30.4	13	91.4	2	2.6	2.2	4.1	5.7	8.2	0.9	0	0.2
24	13	13	200	100	60	35	50	52	4.9	3.7	11.1	0.3	0.4	0	36.7	51.4	31.1	6.7	0	0
25	13	13	100	50	60	20	50	6.2	3.9	7.5	0.3	0	13	15.2	0	42.7	7	0	0	0
26	13	13	100	100	60	15	50	0	0	4.1	3	0.6	4.2	0	0	13.2	2.7	0	0	0
27	13	13	100	100	60	20	50	16.2	0	0	15.4	0.9	2.5	0	0	13	25.5	0	0	0
28	14	14	100	100	60	20	35	12.5	0	0.1	22.1	1.5	2.6	0	0.6	17.2	25.1	0	0	0
29	15	15	100	50	40	20	50	2.1	1.6	1	54	3.4	36.1	4.7	17.4	73.8	48.8	0	0	0
30	15	15	100	100	40	20	50	1.4	0	1.6	7.2	0	0.1	0	10.8	125.2	66.7	8.9	0	0
31	15	15	100	100	40	20	50	0.3	0	9.6	14.2	3.8	12.8	14	61.2	343.8	8.7	48.1	0	0

Moisture, Heat flux, Wind data and Observation Data at Eastern, Central and Southern thailand in September

1996

Date	Mixing Ratio(g/kg		HeatFlux(W/m2		Wind Speed			Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa													
1	14	14	50	50	40	10	30	1.8	0		0	9.4	0.4	17.3	0	0.4	13.7	0	24	7.9
2	14	14	50	50	40	10	30	0.5	14.6		0.2	5.8	47.4	0.2	1	3.2	4.8	10.6	24.7	10.4
3	15	15	50	50	40	15	30	51.7	3.7		0.9	66.5	3.6	8.3	0	1.5	0	22.8	1.4	11.2
4	15	16	50	50	40	30	30	0	17.2		17.5	0.1	25	3.3	56	8.3	4.8	1.4	1.7	0.5
5	15	14	5	50	40	20	30	0	0		0	21.1	0.4	3	10	19.9	0.1	4	0	0
6	14	14	50	50	40	10	20	0	20.5		0	18	30.5	1.7	3.1	0.1	16	44.6	0.4	20.6
7	15	15	50	50	40	10	20	0.8	1.1		32.9	2.1	27.5	2.2	26	0	19.6	10	6.8	2.1
8	15	15	100	100	40	20	20	13	17.3		0	0	23.7	1.8	4.9	3.1	48.9	39.8	27.1	29.2
9	15	15	100	100	40	10	30	2.5	1.4		1.1	0	16.7	193	35.2	173.7	116.3	36.7	10.3	15
10	15	15	100	100	40	20	35	2.9	0		0.9	3.6	2.5	0	86	119.2	45.8	28.5	13	10.9
11	15	15	50	50	20	35	50	0.5	4		36.5	0.6	3.3	1.4	18.7	56.2	36.2	26.2	2.6	2.8
12	15	15	50	50	20	30	50	10	0		0	12.7	0	0	6.5	12.3	42.7	22.6	5.2	7.7
13	14	14	50	50	40	30	50	34.5	4.3		2.3	1.1	1.3	0.2	6.8	41.1	32	14	2	1.6
14	14	14	50	50	40	30	50	47	14.6		10.1	5.7	11.5	2.6	6.9	48.6	33.1	7	0.2	2
15	14	14	50	50	40	30	50	16	1		4	1	0.1	4.4	8.7	0.2	9.7	10.8	0	2.9
16								2.1	0.4		0	0	0.5	3	8.7	3.3	35.2	12.4	2.2	12
17								45.1	20		0	1.5	0.3	0	0.4	52.8	24	0.4	0.5	1.2
18								16	0.5		0	1.6	0	1.5	0.2	20.5	13	0	5.5	0.4
19								1.2	0		0.4	0	0	0	0	31.4	26.5	0	0	0
20								6.1	31.2		2.3	0	4.8	0.9	44.8	79.2	0	0	0	0
21								1.5	8.6		0	0	0.2	0	0	0.2	1	0.4	0	0
22								0.6	0		0.4	0	0	0.6	19.1	18.6	8.7	30	0	0
23								41.3	4.3		30.9	27.7	17.9	0	15.3	13.9	198.4	22.2	25.4	13.7
24								8.8	1.8		25	0.8	1.6	0.5	3.1	41.9	37.1	12	0	1.1
25								35.7	6.9		0	2.8	2.9	0	0.3	2.4	48	24.1	9.8	0.5
26								2.3	2.5		18.4	0.4	5.5	7	1.6	6	90.4	86	33.6	34.7
27								5.4	35.3		22.1	7.6	9.9	11.3	31.3	43.9	117.2	101.8	40.6	51.5
28								0	48.4		15.4	40.7	61.3	4.6	4.5	15.5	46.1	29.6	25.7	12.9
29								0	11.2		39.4	25.6	61.6	21.7	26.6	22.8	43.7	7.5	9.1	17
30								0	10.1		38.8	74.3	45	1.5	86.3	111.4	16.2	1.6	6.6	2.8
31																				

1997

Date	Mixing Ratio(g/kg		HeatFlux(W/m2		Wind Speed			Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa													
1	14	14	100	100	40	15	35	9.6	0.9		2.7	3.3	26.5	0	0	2.1	31.5	6.5	0.2	0.9
2	15	15	100	100	40	15	35	7.5	0.3		0.2	0	7	0	0	0.2	0.6	10.3	0.2	0
3	14	14	100	100	40	20	35	16.1	6.9		13.1	2.6	14.1	0	5.7	10.2	0	0	11.2	2.4
4	14	15	100	200	40	15	30	22.4	42.3		4.7	36.1	0.3	0.5	0	0	0.4	0	0	6.6
5	15	15	200	100	40	20	30	1.2	7.3		0	2.8	0	0	0	0	0	0	0	14.3
6	15	15	100	50	40	15	30	2.7	8.7		11.4	1.9	3.5	0	0.5	0	0	15.3	0	8.4
7	15	16	100	50	40	15	20	50.6	59.9		16.2	1.6	5	5.7	0	0.1	0	0.2	0	11.3
8	15	15	50	50	40	20	20	0.1	3.2		0	0.5	0	0	0	0	0	0	0.1	0
9	15	15	50	50	20	15	20	0.5	0		0	0	0	0	0	0	0	8.7	0	2.3
10	15	15	200	100	20	15	15	34.5	0.6		0	0	0	0	0	0	0.8	3.4	0	0
11	15	15	200	200	20	15	15	20.6	4.6		36.8	0	0.1	0	0	1.1	3	16	32.5	5.5
12	15	15	100	100	20	15	10	0	0		0	0	4.1	0	2.2	0	8.6	0	5.7	3.9
13	14	14	100	100	40	15	10	0	0		0	0	6.3	0	15.4	0.3	0	2.8	0	0
14	15	15	100	50	40	10	10	0	0		0	0	65.4	0	0	0	4.9	39.4	0.5	0
15	14	14	50	50	15	5	15	0	4.7		5.6	1.5	62.1	14	0	0.2	29.4	76.4	69.5	20.5
16								54.4	0		0	0	0	0.1	11.3	34.4	22.9	51.6	37.7	32.3
17								0	6.3		23.3	0	12.7	29.5	57.3	0.1	2.9	21	8.5	7.7
18								0	0		1.8	5.6	49.8	29.5	8.7	1.1	21.8	38	32	17.6
19								0	3.7		32.2	3.4	36.5	1	44.5	16.8	57.2	157.4	34.8	5
20								12.1	20.3		4.3	12.6	1.1	21	7.7	41.8	113.2	135	7.7	11.5
21								0	0		38.4	38.5	19.1	39.8	146.1	22	192.8	52.8	17.4	13.7
22								0	1.3		8	29.4	38	28.6	11	41.3	60.2	25.2	9.6	7
23								1.6	0		4.7	0.7	0	0	0	9	9.8	0	0	0
24								1.4	0		0	8	0	10.8	0.5	8.9	18.8	0	5.6	28.8
25								0.5	2.2		4.7	0	0	13.6	33.1	76.3	0.4	3.6	0	0
26								28.8	5.9		42.1	0	2.1	18	27.5	3.5	3.5	0	11.2	0
27								3.8	13.4		8.4	35.7	6.6	68.3	35.8	30.2	0.2	6.4	23.8	84.3
28								0.6	0		12.1	0	0	0	0.2	0.8	0	0	0	0
29								0	0		0	0	0	6.2	2	0	0	0.2	0	3.8
30								4.3	0		6.3	0	0	0.5	26.7	3.5	0	28	2.3	0
31																				

1998

Date	Mixing Ratio(g/kg		HeatFlux(W/m2		Wind Speed			Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa													
1	16	16	50	50	40	30	40	3.2	5.1	6.2	4.9	34.4	128.1	14.6	3.7	5.4	49.3	26.8	39.9	38.7
2	17	17	50	50	50	20	40	14.6	10.3	3.7	18	0.8	11.2	22.6	10.1	0.3	22.1	24.4	0.3	3
3	16	16	50	50	40	15	20	0	17	17.5	17.1	20.6	29.8	2.8	4.6	3.8	0.3	0	0	0
4	15	15	50	50	40	30	20	0	0	14.1	0	0	0	60	4.8	0.3	1.8	7.3	3.5	22.7
5	14	14	50	50	20	20	30	2.5	0	19.8	6.8	4.6	21	0	5	25.1	0	2	12.3	0.3
6	14	15	50	50	20	20	30	1.2	0.1	0	0.9	0	0.6	2.7	8	33.4	28.3	28.8	3.2	3.2
7	14	14	50	50	40	10	30	0.6	17.1	1	8.3	17.1	15.9	0.3	36.1	69.9	1.1	19.6	0	0.6
8	15	15	50	50	40	30	30	0	0	0	0	0	0	0	6.9	0	8.1	8.9	3.7	1.5
9	15	15	50	50	20	20	30	0.4	3.8	0.8	0.1	65.8	4.3	9	1.6	2.7	0.9	1.2	4.1	1.6
10	14	14	50	50	40	20	30	3.5	2.3	1	2	0.5	0	7.9	41.1	91.2	2	43.9	0	12.6
11	15	15	50	50	40	30	30	0	0.1	12.7	14.3	17	31.5	21.1	79.9	47	9.2	11	18	29.6
12	15	15	50	50	20	15	30	0.8	0	0	54	0.1	0	8.2	21	187.6	61.2	12.6	53.1	25.1
13	15	15	100	100	40	15	30	0	0	0	1.5	0	0	34.8	121.4	48.5	35.7	4	54.1	18.3
14	15	15	100	100	20	20	30	0	0	0.5	15.7	0	0	0.6	3.5	102.5	111.6	16.2	35.2	14.8
15								0	0	0	2.3	0	0	0	1.3	5.5	39.7	61.3	39.6	24.5
16								5.4	0	1.4	3.8	38.9	103.2	4.6	10.7	37.3	25.3	40.7	8.7	42.2
17								0.6	6.2	14.6	1.9	9.3	33.1	1.1	5.9	45.3	19.6	37.6	33.1	3.4
18								3.2	2.9	2.8	11	34.6	36.6	0	15.4	22.9	15.6	60	35.7	17.2
19								10.4	2.7	0	27.4	0	15.7	2.8	38.2	8.8	6.1	99.4	32.8	21.9
20								0	0	0	0	13	36.1	0	0	4.2	0	51.7	75.9	58.3
21								0	1.3	1.4	0	0	2	0	31	62.6	3.8	12.3	13.3	27.5
22								21.2	0	0	0	3.5	1	2.8	37.5	22.8	1.2	17	1.5	2
23								0	17.9	6.1	1.9	0	15.7	0	0.1	0	0.1	1.1	0.7	1
24								7.1	4.5	0	11.3	0	10.9	15.4	12.1	10.3	2.9	38.6	19.1	18
25								0	13.3	0	0	3.8	0	7.4	15.1	15	23.8	3.8	5.8	37.3
26								0	17.3	9.7	14.9	16.5	0.5	2.5	23.7	11	10.7	25.5	0.5	2.7
27								0	0	9.6	0.7	22.4	59.6	8.6	19.5	2.5	15.4	16	0	6
28								0	0	0	0	0	0.2	0	0	1.6	0	7.4	0.2	1.9
29								0	0	0	0.1	0	0	2.6	10.6	22.9	14	0.9	0	7.1
30								0	0	14.9	0.3	0	29.3	11.2	1.1	43.4	60.3	7.4	0	0.3
31																				

1999

Date	Mixing Ratio(g/kg		HeatFlux(W/m2		Wind Speed																
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1	14	15	100	100	40	15	30	0.2	0	0	0	0	0	1.6	31.2	40.9	5.4	5.5	0	0
2	15	15	100	100	40	20	30	0	57.3	3.7	40.1	0.1	29.6	0	1.6	4.2	36.4	25.3	7.2	16.3
3	15	15	100	100	40	20	35	0	0	0	1	6.7	0	0	55	4.9	81.7	31.8	37	56.4
4	15	15	100	100	40	20	30	0	0	0	0	5	0	10	22.7	21	30	22.8	44.6	15.8
5	15	15	100	100	40	20	30	12.7	0.3	12.3	0	10	4.7	73	34.7	29.1	49.6	54	94.1	83.1
6	14	15	50	50	40	20	30	7.1	0	2.1	11.6	0.2	37	18.2	49.6	60.3	28.2	26.9	56.1	25.8
7	14	14	50	50	40	30	35	6.4	41.1	14.1	90.9	32.5	7.4	0.3	146.3	10.1	12.1	37.2	21.5	21.3
8	15	15	50	50	40	20	30	14.6	0	0	34.3	0	0	0	58.5	13.9	1.5	4.3	0	1
9	14	14	50	50	40	10	35	6.3	0	4.8	35.6	0.1	0.5	54.8	73.7	17.4	1.4	0	1.1	5.9
10	14	14	50	50	40	10	30	19.4	18.3	20.3	2.2	1.3	0	12.8	34.4	3.6	0	0	0	0
11	14	14	50	50	40	10	30	4.4	7.8	2.5	51.7	16.8	17.7	0.8	0.7	11.2	0	0	0	0
12	15	15	50	50	40	10	30	0.3	8.7	16.7	6.3	0	5.1	1.3	12.5	14.5	0	1.7	0	0
13	15	15	100	50	40	10	35	0	0	0	6.8	0	0	3	15.9	0.6	1	0	0	0
14	15	15	50	50	20	10	30	0	0	4.5	0	0	0	0	3.3	0.2	88.3	24.2	25.9	53.7
15	15	15	50	50	20	10	30	1.4	5.7	0	19.9	0	0.1	0	0.1	2.7	9.1	33.7	2	0
16								23.9	4.2	0	0.2	4.5	0	0	1.2	1.2	59.1	2.7	6.7	3.4
17								3	0.2	4	0.3	0	0	0	0.1	1.7	19.9	1.2	1.3	13.5
18								6.1	0	0.6	0.2	40	11.5	0	1.8	0	6.5	11.4	0.5	1.5
19								0	0	0	0	2.3	0	0	44.5	0	4.7	15.3	0	0
20								0.2	9.8	1.3	34	0	0	0	0.7	0	0.1	0	0	4.9
21								1.8	34.2	0	2.1	0	51.8	0	0	2.8	0.1	0	45.2	0.9
22								0	2.1	0	2.1	8.3	0.2	8.5	0	7.4	0	31.6	0.1	2.1
23								16.5	0	0	1	7	0.2	0	0	0	0	0	0.3	0
24								24.8	0	3.7	0	25.1	25.2	13	1	0	0	8.4	0.9	11.6
25								0	0.7	52.5	0.6	0.7	2.9	0	2.2	7.1	4.7	14.7	4.3	0.3
26								0.6	0	3.6	0	0	0	0	0.6	0	1.5	26.6	6.8	6.5
27								0	1.8	1	0	10	2.2	0	14	2	12.5	59.7	3.6	4.6
28								0	2.6	26.3	2	3.7	0	0	3.5	4.2	11	8.3	14.6	2.5
29								0	0	14	0	0	0	0	1.6	0.4	3.5	6.7	2.8	2.3
30								0	11.9	6.4	14.4	15.1	15.1	0	8.5	20.5	1.6	24.8	5	28.4
31																				

2000

Date	Mixing Ratio(g/kg		HeatFlux(W/m2		Wind Speed															
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1	15	15	50	50	40	15	50	0	0.3	0.8	21.8	1.1	21.8	0	0.4	3.4	0	0	0	0
2	15	15	50	50	40	30	50	10.6	0.2	1.2	15.8	3	0	18.1	49.8	2.1	0	0	0	0
3	15	15	50	50	40	20	30	11.3	2.4	30.3	29.5	10	24.5	0	0.7	0	0	0	0	0
4	15	15	50	50	40	30	30	44.6	8.3	17	46.3	1.7	1.5	0	4.6	0	0.4	0	6.6	0
5	15	15	50	50	40	20	30	10.8	1	1.6	3.5	0	11.9	20.9	38.3	9.6	0	0.2	14.6	13.6
6	15	15	50	50	40	30	30	0.8	7.3	0.5	3.6	1	0.2	0	27.9	18.2	0	0	10	2.3
7	15	15	50	50	40	10	30	0	9.6	21.2	18.1	0	2.1	0	5.8	15.9	0	0.2	0	0
8	15	15	200	100	40	15	30	3.5	0	0	7.7	5.3	0	0	1.5	122.1	6.6	3.7	0	0
9	15	15	200	100	40	20	30	3.9	0	0	0	2.4	0	0	3.7	102.1	24.3	12.8	7.6	1.8
10	14	14	100	100	40	15	30	87.3	0	2.8	36.4	0	8.7	0	0	1	40.3	20.9	11.4	7.2
11	15	15	50	50	40	20	30	121.2	2.1	9.7	0	8.4	0	0	2.5	10.6	78.8	16.9	10.1	19.1
12	15	15	100	50	40	20	30	4.6	4.2	1.5	2.6	0	4.4	0	3.7	1.4	8.8	0	0	0
13	15	15	50	50	40	10	30	0	0.4	3	5.3	0	0	0	0	0	0	0	1.4	0
14	15	15	50	50	40	15	30	4.3	2.9	0.6	0.4	1.7	1.5	4.8	39.4	0	0.9	0	0	1.3
15	15	15	50	50	40	15	15	0	28.7	1.4	2.4	13.2	5	26.2	0	4.1	42.2	4.9	0	16.9
16								0	0	0	0	0	0	0.3	0	0	4.5	0	56.3	0
17								0	0	0	0	0	0	0	46.4	0	14.9	0	0	0.5
18								0	0	0	0	0	19.1	0	0.1	0	0	14.7	28	35.9
19								0	0	0	0	0	29.8	0	0	0	15.3	3	39	5.9
20								0	0	2.6	0	7.1	0.3	0	0	0.6	14.6	17.1	3.5	9
21								9.2	0.5	0.3	3.3	0	4.9	3.1	3.4	25.4	0.8	38.3	11.1	8.5
22								3	0	11.6	11.6	1.1	0	4.6	25.9	12.1	11.3	15.4	0.4	3.1
23								7.8	28.6	36.6	3.8	0.7	0	1.4	0	0	0	0	6.1	2.9
24								0	0	0.3	4.8	0	16.1	3.2	0	0	19.3	5.5	11.7	19.2
25								0	0	0	4.1	2	0	0	0	0.8	0	0	0	0
26								2	0	0	0	0	15.5	65.9	0	0	0.7	1.2	0	4.8
27								28.4	42.4	53	62.8	1.6	2.8	140	44.8	5.9	0	45.9	0.3	5.2
28								2.7	0.4	1.3	3.6	3.6	34.1	60.2	19.5	1.6	19.5	41.5	16.2	24.1
29								2	17.7	9.7	0.8	18	10.4	9.4	6.7	0	2.1	41.4	55.4	90.3
30								0	0.4	5.2	0.4	10.2	0	9	0	2	1.1	11.1	0.8	4.5
31																				

Moisture, Heat flux, Wind data and Observation Data at Eastern, Central and Southern thailand in October

1996

Date	ixing Ratio(g/k		leatFlux(W/m2		Wind Speed															
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1	14	14	50	50	10	15	35	22.2	63.9		52.7	12.8	0.9	20.7	21.8	22.8	11.3	10.6	0	0.1
2	14	14	50	50	20	15	35	0	1.7		25.3	76.7	30.6	4.3	1.3	0	0	0	0	0
3	14	14	50	50	40	30	30	0.2	0.1		0	0	0	3.3	0	0	3.4	0.8	0	32
4	13	13	50	50	60	20	30	23.3	2.5		0.6	0	0.5	0	0	5.4	14.1	8.4	14.2	1.8
5	13	13	50	50	40	20	20	2.6	4.7		0.9	0	0.9	0	0	0.2	0.2	9.6	0	0.7
6	13	13	100	100	40	20	20	16.6	0.1		6.6	4.6	3.1	7.9	3.2	0.8	28.9	10.2	31.7	14.7
7	15	15	100	100	40	15	20	0.4	24.3		0.4	0	0.3	0	0	0.8	12.6	0	1.5	0
8	14	14	100	100	40	20	20	7.7	4		0	29.2	0	0	0	0	5	1.4	0	8.5
9	13	13	100	100	40	15	30	0.1	4.9		1.3	20.2	61.7	49.4	32.8	0.5	5.8	0	0	0
10	14	14	50	50	40	20	30	0	0		0	0	4	12.6	12.1	12.8	8.2	103	3.6	10
11	14	14	50	50	60	15	20	0	0		2	0	1.7	15.3	33.8	8.1	16.3	5	1.5	0.2
12	14	14	50	50	40	20	30	0	0		0	0	0.1	15.7	7.2	2.3	8.7	3.9	8.6	0
13	13	13	50	50	40	30	30	0	0		4.4	0	0	0.8	0	16	6.8	0.8	0.2	2.1
14	13	14	50	50	40	20	20	0	0		0	0	0	0.4	0	1.7	52.2	60.4	27.3	24.8
15	15	15	50	50	60	20	30	0	0		0	0	0	0	0	7.5	34.5	0.2	0	0
16								0	0		0	0	0	0	0	0.2	0	0.2	10.9	21.9
17								0	0.6		0	0	0	11.8	60.1	37	0.2	14	0	0
18								0	0		0	0	0	7.7	21.5	16.6	21.8	11.2	11.5	3
19								0	0.1		15.5	0	1.9	50.8	0	11	0	0	0.1	0
20								0	0		0	0	0	0.2	8.6	17.4	1.9	21	48.3	2.2
21								0	0		0	0	0	0	0	20.7	15	155.4	68	64.1
22								0	0		0	0	0	0	10.4	28.6	3.1	42.8	24.8	8.3
23								0	0		0.4	0	2.5	35.4	1.9	4.9	5.1	2	9.4	0.6
24								0.8	0.1		0.7	0	6.2	1.9	2.1	0	0.1	5.3	0	0
25								13.1	6		3.2	9.2	21.8	10.7	58.9	39.9	32.8	13.2	25.2	0.3
26								0	0		0	0	0	9.5	0.2	0.8	37.6	37.8	28.4	37.3
27								0	0		0	0	0	0	0	0	0.4	4	16	1.2
28								0	0		0	0	0	0	0	0.9	0	0.8	0.5	1.5
29								0	1.4		5.8	24	4.5	0	0	0.4	22.8	41.6	0.6	3
30								0	11.4		18.1	6.1	0.9	7.6	24.7	1	21.2	25.8	17.8	44.7
31								1.2	0		0.4	0	61.3	23.7	2.6	1.6	15.8	17.6	0.1	1

1997

Date	ixing Ratio(g/k		leatFlux(W/m2		Wind Speed															
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1	14	14	50	100	80	20	20	0.6	0		0	0	26.5	0	7.4	0.1	2.3	12.2	3	3.3
2	12	12	50	50	60	15	15	0.1	0		0	0	7	0	0	0.7	2.7	0.2	0	0
3	14	14	100	100	60	20	15	0.6	0		0	3.5	14.1	0.3	28.7	1.8	14.6	21.2	0	10.5
4	15	15	100	100	60	30	15	78.4	9.1		27.4	0	0.3	16.5	38.7	2	10.6	76.3	41.9	50.6
5	15	15	100	50	60	30	20	21.6	1		4.2	10.8	0	43.4	34.9	17.5	24	41	17.6	13.4
6	15	15	50	50	60	20	30	35.3	0.1		10	24.6	3.5	3.3	0.6	13.4	5.3	27.6	2.1	0
7	15	15	50	50	60	20	20	0	0		0	0	5	0	0	4.3	12.9	1.6	17.9	4.6
8	15	15	50	50	60	30	20	0.4	0		0.6	0	0	0.2	0	0	0	3.6	13	0.4
9	15	15	50	50	60	20	20	0.3	0		0.5	0	0	27.2	18.9	9.9	0.5	23.2	1.2	1.4
10	15	15	50	50	60	30	20	0	1.8		1.1	23.5	0	0.4	15.6	10.4	0	0.2	1	16.9
11	15	15	50	50	60	15	20	0	0		0	0	0.1	0	0	37.3	9.2	41.7	0	2.8
12	15	15	50	50	80	20	20	0	4.5		0	0	4.1	0	10.1	0	41.5	0.6	1.3	0
13	15	15	50	50	60	15	20	0	4.1		0	0	6.3	10.6	21.1	0	0	8.6	0	16.9
14	13	13	50	50	60	20	15	0.1	0		0	0	65.4	6.5	21	60.3	2.9	19.6	8.3	35.3
15	14	14	5	50	40	15	15	0	0		0.6	0	62.1	2.7	10.3	0.5	0	15.2	36.1	16.2
16								0	14.9		0.3	0	0	0	28.2	33.7	0.3	9.8	0	0
17								2.1	12.9		0	36.4	12.7	0	0	0	1.6	0	2.7	0.2
18								0	0		0	3.8	49.8	0.1	0	2.3	0	16.6	1	1.7
19								12.3	2.7		0	0	36.5	0	0.4	1.6	0	47.9	9.4	13.9
20								0	0		0	10	1.1	2	13.3	0	17.6	1.4	11.7	3.8
21								0	0		0.9	0	19.1	1.3	7	47.2	6.3	4.4	0	0
22								0	0		0	0	38	0	0	0	0	1.2	12.6	0.4
23								0	0		0	0	0	0	0	1.9	0	3.2	0	1.2
24								0	49.2		6.7	5.3	0	29	0	3.5	0	19.4	1.8	0
25								0	0		0	0	0	0	0	39.7	0	75.6	13.8	11
26								0	3.7		0	14.5	2.1	0	1.6	12.7	0	0.7	0	0
27								0	0		0.6	1.1	6.6	0	0	13.4	1	2.6	1.2	10.6
28								0	0		0	0	0	42.5	0	2	0	38	16.9	7.9
29								0	0		0	0	0	0	0	0	2.3	7	0.4	3.8
30								0	0		0	0	0	0	0	0	14.9	16	2.2	1.3
31								0	0		0	0		0	0	0	7.3	1.8	0.5	5

1998

Date	ixing Ratio(g/k		leatFlux(W/m2		Wind Speed																
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1								0	19.4	17.1	5.1	46.6	63.3	0	0	0.1	59.5	0.8	39.9	0
2	15	16	50	50	40	15	15	0	0	1.3	0	0	0	3.8	1.8	0	177.9	36	0.3	40.3
3	15	15	50	50	40	20	35	0	0	0	0	0	0	0	0	21.8	124.8	54.1	0	24.8
4	15	15	50	50	40	35	20	0	0	0	0	0	0	0.1	0	4.9	14.8	3.2	3.5	19.3
5	16	16	50	50	20	20	20	0	0	0	0	0	0	0	0	0.2	30.2	20.1	12.3	7.1
6	17	17	50	0	10	20	15	0	11.1	0	0	33.3	0	22	1.9	0.3	15.5	35.8	3.2	129.8
7	17	17	50	50	40	30	20	0.2	15.6	20.2	17.9	16.1	10.5	68	4.3	15	11.5	8.4	0	0
8	15	16	50	50	40	30	20	6.6	34	3.8	6.7	33.9	6.9	5	14.4	35.2	6.1	35.9	3.7	2.6
9	15	15	50	50	20	20	15	3.7	4.2	7.1	5	3	18.5	13.8	40.7	1.6	13.5	4.9	4.1	32
10	14	15	50	50	20	30	10	0	12.4	21.4	0.3	2	31.4	8.3	1.5	0	8.1	19	0	32
11	15	15	50	50	20	10	20	8.3	44.3	14.4	0	3.2	13.8	15.2	21.3	40.5	0.8	2	18	12.3
12	14	13	50	50	20	10	15	2.8	2.8	0.3	1.4	2.8	5.3	0	7.5	1.6	0.1	4.3	53.1	1.8
13	14	15	50	50	20	20	15	0.1	0	0	0	0	0.4	0	35.2	0.4	0.4	13.2	54.1	16
14	15	15	50	50	20	20	15	0	7.5	2.3	8.8	23	12.8	0	0.3	0.6	48.8	18.2	35.2	42.8
15	15	15	50	50	40	20	35	0	0	0.7	2.6	0	0.8	3	1.6	19.9	52	68.5	39.6	61.8
16								0	0	0	0	0	13.4	0	0	0	16.6	45	8.7	10.4
17								2.5	0	0	0	0	0	0	0.5	11.2	80.6	5.7	33.1	5.5
18								9.1	1.1	1.2	3.5	3.3	0	5.1	14.4	0.2	55.5	16.8	35.7	10.9
19								0	7.2	18.2	6.3	29.4	9	13.1	18.6	27.7	16.6	13.9	32.8	9.4
20								0	0	0	0	0	2.1	0.2	0	0	0	2.1	75.9	0
21								0	0	0	0	0	0	0	0	0.1	0.6	42.3	13.3	5.6
22								0	0	0	0	0	0	0	0	0	23	0	1.5	0
23								0	0	0	0	0	0	0	0	0	58.1	0	0.7	3.2
24								0	0	0	0	0	0	4.1	3.8	6.9	7	0	19.1	3.3
25								0	0	0	0	0	0	0	0.1	1.7	4.1	63.9	5.8	21.6
26								0	0	0	0	0	0	3.6	0	0	12.7	12.3	0.5	0.2
27								1.3	0	0	0	0	0	0	0	0	0	0	0	0
28								0	0	0	0	0	0	0	0	0.1	0	9.7	0.2	3.7
29								0	0	0	0	0	0	21	0	0.5	5.7	7.9	0	6.5
30								0	0	0	0	13.2	6	0	0.1	6.7	15	9.7	0	6.4
31								5.4	1.2	15	0	0	8.1	1.4	0.6	0.2	8.6	17.3	0	0

1999

Date	ixing Ratio(g/k		leatFlux(W/m2		Wind Speed			Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa													
1	15	15	100	100	20	20	20	3.5	4.7	14	11.1	20	18.5	0	0	6.5	0	7.8	1.1	3.1
2	15	15	50	50	20	15	20	1.2	17.7	25.9	3.6	0.1	0	5.8	0	6.8	17.4	31.6	21.5	0
3	15	15	50	50	20	20	30	0	7.3	5.8	7.4	25.5	96.4	0	2	2.1	1.7	13.7	0.4	13.7
4	15	15	50	50	20	20	30	33	0	0	0	0	0	0	6.7	0	0.2	2.9	19.2	0.1
5	15	15	50	50	20	30	50	0	0.3	2.3	0	0	0	0	0	0.6	0.5	6.4	0	0.3
6	15	15	50	50	40	20	30	3.8	0.4	0	2.7	0	0	0.3	0	0.7	0	2.8	20.2	13.3
7	15	15	50	50	40	30	20	0	0	0	2.2	72.1	0.4	17.3	33.9	26.3	0	0	15	0
8	15	15	200	200	40	20	20	0	0	0	0	0	0	0	1.5	0	0	0	0	0
9	15	15	200	200	40	20	20	0.2	12.4	2.7	0	0	0.8	2.5	0.8	9.2	1.9	9	2	2.5
10	13	13	200	100	40	15	15	37	2.1	22	5.7	0.8	0.3	0	0	0	0	0.9	0	0
11	14	14	100	100	40	15	15	8.5	3.4	1.3	10.1	3.7	0	0	6.1	18.2	7.9	46.9	0	21.2
12	13	13	100	50	40	30	30	0	0.4	0	0	0	4.4	3.8	0.5	14.2	0	17.5	0	33.5
13	13	13	50	50	40	20	30	0.3	7.9	13.7	13.3	3.7	32.5	5.9	6.8	7.8	25.6	80.6	24.9	56.2
14	14	14	50	50	40	30	30	0	20.2	17.5	6.4	41	41.1	12.1	106.6	18	11.9	31.6	21.3	34.1
15	13	13	50	50	40	30	35	0	50.9	12	29.7	70.9	26.6	33.2	0	14.4	34.5	70.1	35.1	17.6
16								0	0.3	0.7	1	24.8	13.5	0	0.8	0.5	7.1	10.1	0.4	0.2
17								0	0	0	2.7	16.9	62.6	13.6	5.5	2.5	0	1.5	0	5.1
18								0	0	0	0	0	0	0	0	0.2	7.2	4	15.6	0.2
19								0.8	0	0	0	0	0	0	0	0	0	0.2	13.6	0
20								0.1	1.5	0	0	0	0	0	0	0	6.7	1	5.6	0
21								2.6	0	0	0	0	0	0	0	0.3	51.3	1.1	1.4	3
22								0	0	0	0	0	0	0	0	0	6.9	2.1	0.3	0.2
23								0	0	0	0.3	0	0	3.9	6.8	25.3	24	6.8	20.6	39.9
24								0.1	25.7	16.6	21.1	14.8	17	14.1	16.4	39.1	89	117.6	98.3	77.3
25								11.3	6.1	14.2	13.4	71.2	31	97	86.2	18	75.6	32.5	73.1	51.6
26								2.6	1.8	3.7	6.4	43.7	18.6	32.7	8.7	1.4	52.6	49.7	8.4	11.9
27								1.7	0	2.4	0.3	0.3	0	4.4	0	0	22.9	41.4	2.1	2.1
28								12.4	0	0	0	0	7.7	0.2	0	10.4	22.3	26.5	6.6	4.1
29								0.4	18.5	25.6	0.1	0.2	0	12.4	0.8	1.2	6.8	31.9	1.1	6.4
30								0	0	0	0	0	0.6	6.4	0.5	24.3	5.8	34.9	7.1	21.4
31								0.3	7.2	0	1.1	32.4	11.8	16	17.9	4.5	41.9	8.9	11.4	23.9

2000

Date	ixing Ratio(g/k		leatFlux(W/m2		Wind Speed															
	00Z	12Z	00Z	12Z	200hPa	500hPa	850hPa	Phetchabun	Ayutthaya	Pathumthani	Prachinburi	Kamphaengsaen	Bangkok	Rayong	Chanthaburi	KhlongYai	Ranong	TakuaPa	Phuket	Phuket Airport
1	15	15	50	50	40	30	30	0.6	0	0.5	1.5	0.1	21.8	1.9	1.5	19.9	1.1	1.5	1	6
2	15	15	50	50	40	20	30	0	4.2	0	5.3	2.8	0	6.2	0	0	11.2	1.1	9.8	3.6
3	15	15	50	50	40	20	20	0.5	11.7	67.8	0.7	47.6	24.5	4.5	0.9	0.3	0.3	23.5	47.4	8.2
4	15	15	50	50	40	20	20	9.9	0	0	0	0	1.5	0	0.4	1.9	6.5	3.6	8.4	2
5	15	15	50	50	40	20	15	2.6	4.8	2.8	0.2	1	11.9	6.6	26.7	78.2	3.8	0.2	12	2.6
6	15	15	100	100	40	20	20	48.8	9.1	1.9	50	0	0.2	0	0	0	13.5	5.4	1.7	6.9
7	15	15	50	50	40	20	20	0	0	0	0	36.5	2.1	0	7.3	7.8	6.6	5.9	1.2	0.4
8	15	15	50	50	40	20	20	0	0	0	0	0	0	1.1	0.3	0.2	83.9	15.3	4.7	21.5
9	15	15	50	50	20	20	30	0	0	0	3.9	0	0	0.7	18.3	28	144.4	61	7.7	15.2
10	15	15	50	50	40	35	50	0	0	3.8	0.6	0	8.7	2.5	5.1	26.9	87.4	34.5	14.3	5.4
11	15	15	50	50	40	30	50	0	0.3	8.3	0	0.1	0	10.7	21.6	30.4	13.9	18.1	11.8	5.1
12	15	15	100	100	40	30	50	0	10.1	6.6	24.9	0	4.4	10.7	34	12.6	35.6	19.8	37.1	15.2
13	15	15	100	100	60	30	50	1.7	0	0.9	76.8	0	0	1.3	16.1	75.1	65.1	39.3	46.7	32.6
14	15	15	50	50	60	30	50	10.2	5	53.5	6.4	5.5	1.5	0	13.9	71.6	25.7	30.3	5.3	6.3
15	15	15	50	50	40	30	35	0	0	0	2.7	32.7	5	0.5	38.8	29.6	24.2	7.4	0	0
16								0	0	0	3.6	5.5	0	2.2	0	0.3	54.2	19.8	1.1	4.2
17								0	0	0	0	0	0	0	0	0.5	13.5	47.9	45.4	27.1
18								0	0	0	0	0	19.1	0	0	17.6	0	0.8	1.6	1.1
19								0	0	0	21.2	0	29.8	0	0	12.1	1.8	22.4	29.7	10
20								0	0	1.6	0	0	0.3	3.6	0	1.2	31.2	29.1	30.7	90.3
21								0	43.2	19.5	0	3.1	4.9	0	0.8	15.5	0.2	141.6	18.8	34
22								5.3	0	0.7	7.8	32.7	0	10.7	7.4	0.1	10	25.9	4.3	13.5
23								23	5.2	0.3	18.6	8.4	0	32	9.9	0.8	0.2	35.3	11.7	19.6
24								0	0.7	4.6	5.3	1.2	16.1	1	4.2	0	0.3	20.8	9.2	8.8
25								0.7	2.2	6.9	3.2	1.2	0	0	4.5	18.2	0.4	29.2	1.2	9
26								0	0.5	0	4	25.9	15.5	1.5	0	10.3	7.6	3.6	6.2	0
27								0	0	0	0	0	2.8	0	0	7.1	0	8.5	0.5	12.5
28								2.2	0	11.7	2.5	9.5	34.1	0.3	5.9	2.3	34.8	14.2	8	10.9
29								31.9	0	0.8	0	12.9	10.4	10.2	3.8	15.6	4.5	73.2	19.5	25.2
30								0	0	0.5	0	12.3	0	2	13.8	8.7	19.8	23.8	0.3	1.3
31								6	0	0	0	5.1	0	2.3	0.3	4.1	14.8	8.4	19.6	11.8

Appendix B

1. Heat flux and monsoon intensity 1996(Normal Year)

The correlation between the heat fluxes with monsoon intensity on May 1996 at Phetchabun.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.088(a)	.008	-.069	71.17749

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1996 at Ayutthaya.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.103(a)	.011	-.072	73.48556

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1996 at Prachinburi.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.241(a)	.058	-.021	71.70515

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1996 at Kamphaengsaen (Nakhonphathom).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.332(a)	.111	.042	67.38854

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1996 at Bangkok

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.023(a)	.001	-.076	71.43441

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1996 at Rayong.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.850(a)	.723	.701	37.63058

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1996 at Chanthaburi.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.270(a)	.073	.002	68.79272

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1996 at Khlongyai.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.149(a)	.022	-.053	70.65132

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1996 at Ranong.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.347(a)	.120	.053	67.01516

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1996 at Takuapa (Phang-Nga).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.329(a)	.108	.039	67.48798

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1996 at Phuket.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.293(a)	.086	.016	68.31100

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1996 at Phuket airport.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.445(a)	.198	.136	64.00553

a Predictors: (Constant), VAR00002

2. Heat flux and monsoon intensity 1997 (El Niño Year)

The stations which monsoon did not onset on this month were not considering of correlation.

The correlation between the heat fluxes with monsoon intensity on May 1997 at Rayong.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.927(a)	.858	.848	6.74008

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1997 at Chanthaburi.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.941(a)	.885	.876	6.08233

a Predictors: (Constant), VAR00002
Note: 1 day late

The correlation between the heat fluxes with monsoon intensity on May 1997 at Khlongyai.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.833(a)	.693	.670	9.92475

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1997 at Ranong

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.135(a)	.018	-.057	17.75381

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1997 at Takuapa (Phang-Nga).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.835(a)	.697	.674	9.85500

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1997 at Phuket.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.011(a)	.000	-.077	17.91611

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1997 at Phuket airport.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.757(a)	.572	.540	11.71630

a Predictors: (Constant), VAR00002

3. Heat flux and monsoon intensity 1998 (La Niña Year)

The correlation between the heat fluxes with monsoon intensity on May 1998 at Phetchabun.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.254(a)	.064	-.008	41.64317

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1998 at Ayutthaya.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.342(a)	.117	.049	40.46036

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1998 at Prathumthani

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.038(a)	.001	-.075	43.01907

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1998 at Prachinburi.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.595(a)	.354	.304	34.60003

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1998 at Bangkok.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.450(a)	.202	.141	38.45269

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1998 at Chanthaburi.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.087(a)	.008	-.069	42.88666

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1998 at Khlong Yai.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.533(a)	.284	.229	36.42985

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1998 at Ranong.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.637(a)	.406	.360	33.19106

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1998 at Takuapa.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.333(a)	.111	.043	40.58719

a Predictors: (Constant), VAR00002

The correlation between the heat fluxes with monsoon intensity on May 1998 at Phuket

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.137(a)	.019	-.057	42.64419

a Predictors: (Constant), VAR00002

4. Moisture and monsoon intensity 1996 (Normal Year)

The correlation between the moisture with monsoon intensity on May 1996 at Phetchabun.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.229(a)	.053	-.020	2.46838

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1996 at Prachinburi.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.388(a)	.150	.085	2.33736

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1996 at Kamphaengsaen.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.147(a)	.022	-.054	2.50833

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1996 at Bangkok.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.058(a)	.003	-.073	2.53163

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1996 at Rayong.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.017(a)	.000	-.077	2.53553

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1996 at Khlong Yai.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.383(a)	.147	.081	2.34221

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1996 at Ranong

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.137(a)	.019	-.057	2.51190

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1996 at Takuapa.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.030(a)	.001	-.076	2.53476

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1996 at Phuket.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.245(a)	.060	-.012	2.45835

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1996 at Phuket Airport.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.280(a)	.078	.007	2.43458

a Predictors: (Constant), VAR00002

5. Moisture and monsoon intensity 1997 (El Niño Year)

The correlation between the moisture with monsoon intensity on May 1997 at Rayong.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.031(a)	.001	-.076	2.53464

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1997 at Chanthaburi

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.276(a)	.076	.005	2.43742

a Predictors: (Constant), VAR00002
Note : 6 days of lack correlation.

The correlation between the moisture with monsoon intensity on May 1997 at Khlong Yai.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.150(a)	.023	-.053	2.50714

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1997 at Ranong.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.058(a)	.003	-.073	2.53166

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1997 at Takuapa.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.813(a)	.661	.635	1.47544

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1997 at Phuket.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.502(a)	.252	.159	2.25673

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1997 at Phuket Airport.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.227(a)	.052	-.021	2.46942

a Predictors: (Constant), VAR00002

6. Moisture and monsoon intensity 1998 (La Niña Year)

The correlation between the moisture with monsoon intensity on May 1998 at Phetchabun.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.616(a)	.379	.331	1.12286

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1998 at Ayutthaya.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.292(a)	.085	.015	1.36294

a Predictors: (Constant), VAR00002 Note : 9 days late.

The correlation between the moisture with monsoon intensity on May 1998 at Prachinburi

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.641(a)	.411	.366	1.09378

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1998 at Kamphaengsaen (Nakhonphathom).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.416(a)	.173	.098	1.40637

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1998 at Bangkok

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.197(a)	.039	-.035	1.39721

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1998 at Chanthaburi.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.669(a)	.448	.406	1.05858

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1998 at Khlongyai.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.052(a)	.003	-.074	1.42314

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1998 at Ranong.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.134(a)	.018	-.058	1.41224

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1998 at Takuapa (Phang-Nga).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.558(a)	.312	.259	1.18244

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1998 at Phuket

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.702(a)	.492	.453	1.01557

a Predictors: (Constant), VAR00002

The correlation between the moisture with monsoon intensity on May 1998 at Phuket airport.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.138(a)	.019	-.056	1.41138

a Predictors: (Constant), VAR00002

7. Wind speeds and monsoon intensity 1996 (Normal Year)

The correlation between the wind speeds with monsoon intensity on May 1996 at Phetchabun.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.438(a)	.192	.130	8.72012

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1996 at Ayutthaya.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.495(a)	.245	.182	8.45922

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1996 at Prachinburi

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.383(a)	.147	.076	8.99273

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1996 at Kamphaengsaen (Nakhonphathom).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.008(a)	.000	-.083	9.73576

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1996 at Bangkok

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.332(a)	.110	.036	9.18278

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1996 at Rayong.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.324(a)	.105	.031	9.21030

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1996 at Chanthaburi

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.278(a)	.078	.001	9.35120

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1996 at Khlongyai.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.212(a)	.045	-.035	9.51553

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1996 at Ranong.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.450(a)	.202	.136	8.69625

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1996 at Takuapa (Phang-Nga).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.525(a)	.275	.215	8.28737

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1996 at Phuket.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.041(a)	.002	-.081	9.72786

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1996 at Phuket airport.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.349(a)	.122	.049	9.12226

a Predictors: (Constant), VAR00002

8. Wind speeds and monsoon intensity 1997 (El Niño Year)

The correlation between the wind speeds with monsoon intensity on May 1997 at Rayong.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.371(a)	.138	.071	10.75301

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1997 at Chanthaburi

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.482(a)	.233	.174	10.14410

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1997 at Khlongyai.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.459(a)	.211	.150	10.28534

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1997 at Ranong.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.055(a)	.003	-.074	11.56289

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1997 at Takuapa (Phang-Nga).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.334(a)	.111	.043	10.91705

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1997 at Phuket.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.240(a)	.058	-.021	11.28484

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1996 at Phuket airport.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.397(a)	.157	.092	10.63103

a Predictors: (Constant), VAR00002

9 Wind speeds and monsoon intensity 1998 (La Niña Year)

The correlation between the wind speeds with monsoon intensity on May 1998 at Phetchabun.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.438(a)	.192	.130	8.72012

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1998 at Ayutthaya.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.353(a)	.125	.057	9.07633

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1998 at Prachinburi

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.402(a)	.162	.092	8.09290

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1998 at Bangkok.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.565(a)	.319	.267	8.00532

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1998 at Chanthaburi

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.563(a)	.317	.265	8.01650

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1998 at Khlongyai.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.601(a)	.361	.312	7.75302

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1998 at Ranong.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.584(a)	.341	.290	7.87639

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1998 at Takuapa (Phang-Nga).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.673(a)	.453	.411	7.17304

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1998 at Phuket.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.519(a)	.270	.214	8.28986

a Predictors: (Constant), VAR00002

The correlation between the wind speeds with monsoon intensity on May 1998 at Phuket airport.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.230(a)	.053	-.020	9.44035

a Predictors: (Constant), VAR00002

These are the correlation between heat flux, moisture and wind speed of premonsoon and monsoon onset period (1 to 15 May) of the normal, El Niño and La Niña years. With the same technique, we can analyze the correlation on period of weak monsoon (1 to 15 July) of the normal, El Niño and La Niña years as well. Then do the same thing on monsoon peak period (1 to 31 August and 1 to 15 September) of normal, El Niño and La Niña years as well. Last the period of withdrawal of southwest monsoon were considered.

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