Chapter 1

Introduction

1.1 Background

Global warming is the phenomenon which brings about the noticeable effects on people, animals and the environment in the current decades. It is the increase in the average temperature of earth's atmosphere and oceans. The Earth's temperature is influenced by many factors. Scientists classify these factors as either climate forcing or climate feedbacks depending on how they operate. A forcing is something that is imposed externally on the climate system such as excess greenhouse gases, and aerosols produced by industrial processes (National Academies Report, 2008).

In the past three decades from 1975-2005, average global surface temperature has increased by about 0.20^{o}C per decade (Hansen et al, 2006). Intergovernmental Panel on Climate Change (IPCC) reported that the global surface temperature has increased about 0.75^{o}C. Land surface temperature has increased 0.25^{o}C while the sea surface temperatures increase 0.13^{o}C per decade respectively (IPCC, 2007).

Different regions have different temperature variation. In the south eastern Mediterranean sea from 1948-1985, the trend of temperature decreased about 0.30^{o}C and then increased after 1985 (Maiyza and Kamel, 2009). In the Pacific Ocean the temperature from 1951-1975 increased sharply. The increase was about 3.10^{o}C when compared to average temperature from 1951-1975 (Hartmann and Wendler, 2004). In Australia from 1981-2005, temperature has increased about 0.32^{o}C (Collins et al., 2000). Last century in Asia, the magnitude of surface warming has been largest in

Japan, Tokyo with 2.80^{o}C, followed by Korea, Seoul with 2.50^{o}C and Thailand in Bangkok 1.80^{o}C (Taniguchi et al., 2007). The distribution of surface temperature are varies in both time and space. There were several studies investigated the temperature trend using different statistical methods such as detrended fluctuation analysis: DFA (Kiraly et al, 2006), Autoregressive Moving Average: ARMA (Hughes et al, 2006) and Empirical orthogonal function analysis (Borzelli and Ligi, 1999)

In this study the surface temperature trends in the Southeast Asia region was investigated using statistical methods. There are simple linear regression model to investigate the temperature trend, autoregressive process to account for the autocorrelation and spline linear regression model to investigate the temperature trend at the different periods.

1.2 Objective

To investigate the monthly surface temperature trend's pattern in South East Asia from 1973-2008 by using simple linear regression model and spline linear regression model.

1.3 Literature reviews

Hansen et al. (2000) described the global surface temperature change for the period 1880-1999 based primarily on meteorological station measurements. The global surface temperature in 1998 was the warmest in the period of instrumental data. The rate of temperature change was higher in the past 25 years than at any previous time in the period of instrumental data. The study suggested that the mean global

temperature, averaged over 2-3 years, has moved to a higher level, analogous to the increase that occurred in the late 1970s.

Hansen et al. (2006) found that global temperature increase about 0.20ºC per decade in the past 30 years, similar to the warming rate predicted in 1980s in initial global climate model simulation with transient greenhouse gas change.

Jones et al. (1999) reviewed the surface air temperature record in the past 150 years, considering the homogeneity of the basic data and the standard errors of estimation of the average hemispheric and global estimates. They presented global fields of surface temperature change over the two 20-year periods of greatest warming this century, 1925–1944 and 1978–1997. Over these periods, global temperatures rose by 0.37^{o}C and 0.32^{o}C, respectively. In recent decades there have been much greater increases in night minimum temperatures than in day maximum temperatures. They then provide a globally complete absolute surface air temperature climatology on a 1^{o}x1^{o} grid. This is primarily based on data for 1961–1990. The annual average surface temperature of the world is 14.08^{o}C in the Northern Hemisphere and 13.48^{o}C for the Southern Hemisphere.

Folland et al. (2001) presented the first analysis of global and hemispheric surface warming trend that attempt to quantify the major source of uncertainties. They calculated global and hemispheric annual temperature anomalies by combining land surface air temperature and sea surface temperature through an optimal averaging technique. Then fit linear to annual global surface temperature gives an increase of 0.61 ± 0.16 from 1861-2000.

Akasofu (2009) studied about global temperature changes during the last millennium and the prediction for 2100. The study found that the global average temperature change during the last century can be approximated by a linear increase of 0.50°C per century. It caused a prominent temperature rise from 1910 to 1940. The study strongly suggested that the linear change is a natural change which is similar to that from 1975 to 2000.

Smadi (2006) examined changes in annual and seasonal mean temperatures variations in Jordan during the 20th century. The occurrence of changes and trends were examined by using cumulative sum charts and bootstrapping and the Mann-Kendall rank test. The analysis showed significant warming trends after the years 1957 and 1967 for the minimum and maximum temperatures, respectively.

Maiyza and Kamel (2009) presented climatological trend of sea surface temperature anomalies (SSTA) in the south eastern mediterranean sea. They found that the linear and quadratic regressions have been used to investigate the relationship between SSTA and time (month or year) to get the general SSTA possible trends. The linear regression revealed the trend of general decrease of sea surface temperature (SST) with time about -0.3^{o}C from 1948 to 2008. The quadratic regression revealed the trend of monthly and annual means of SST in parabola form. The parabolas show the decrease of SST from 1948 -1985 then show the increase after 1985.

Hartmann and Wendler (2004) examined Alaska climate index shifted in 1976 for 25 years. The temperatures were negative since 1951 - 1975 to positive values from 1977- 2001. Annual and seasonal mean temperatures for the positive phase were up to 3.10°C which were higher than the negative phase.

Vincent et al. (2005) presented climate change indices in South America in August 2004 in Brazil. Scientists from eight southern countries brought daily climatological data from their region for a meticulous assessment of data quality and homogeneity, and for the preparation of climate change indices that can be used for analyses of changes in climate extremes. This study revealed an examination of the trends over 1960–2000 in the indices of daily temperature extremes. The results indicated no consistent changes in the indices based on daily maximum temperature while significant trends were found in the indices based on daily minimum temperature.

Box et al. (2009) studied ice sheet surface air temperature variability in Greenland from 1840-2007 by Meteorological station records. The regional climate model output were combined to develop a continuous 168 years (1840-2007) spatial reconstruction of monthly, seasonal, and annual means of Greenland ice sheet near surface air temperatures. Independent observations are used. The study presented the annual whole ice sheet 1919 -1932 warming trend is 33% greater in magnitude than the 1994 -2007 warming. It is expected that the ice sheet melt rates and mass deficit will continue to grow in the early twenty-first century.

Hughes (2003) found that Australia has warmed about 0.80^{o}C over the last century with minimum temperatures warming faster than maxima. The projections for future climatic changes indicate increases in annual average temperatures of 0.40-2.00^{o}C by 2030 (relative to 1990) and 1.00-6.00^{o}C by 2070.

Vermeer and Rahmstorfb (2009) proposed a simple relationship linking global sea-level variations to global mean temperature in their study. This relationship was tested on synthetic data from a global climate model for the past millennium and the next

century. When applied to observed data of sea level and temperature for 1880-2000, and taking into account known anthropogenic hydrologic contributions to sea level, the correlation is >0.99, explaining 98% of the variance.

Chotamonsaka et al. (2011) project a global climate model by applied at 60-km horizontal resolution to estimate the changes from 1990-1999 to 2045-2054 of temperature and precipitation over Southeast Asia. The regional climate model projected warming varies from 0.10 to 30^{o}C depending on the location and season, with greater warming at night than daytime for all seasons.

1.4 Thesis outline

This outline describes plan of this study, there are consist of 5 chapters. In the first Chapter has explained about background, why we have chosen to investigate the trend's pattern of temperature data, reviewed some relevant literatures and described the objectives of this study. Chapter 2 the data source and the methods used for this study are described. These methods comprise descriptive statistics, simple linear regression, autoregressive process and linear spline model. The graphs of correlogram are also interpreted in this section. Chapter 3 gives preliminary result, including temperatures data summary, temperatures plot against time for example regions, autoregressive process of second order and simple linear regression model fitted line for whole 25 regions. Chapter 4 temperature pattern in different periods are revealed by using linear spline model. Finally, conclusions and discussion, the limitations of the study and recommendation for further study are described in the last chapter.