

**UNIVERSITI TEKNOLOGI MARA**

**UTILIZING SATELLITE REMOTE  
SENSING AND GIS TECHNIQUES FOR AIR  
QUALITY MONITORING**

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## ABSTRACT

Air quality monitoring is needed to control air pollution in urban areas. A limited number of air quality monitoring stations, limits the initial strategy of pollution prevention program in Malaysia in air quality monitoring especially at micro-scale level. The technique used to monitor air quality involves manual measurement of pollution concentrations within the area of measuring station. A more practical approach is needed to study air quality at micro-scale. One possibility is the use of satellite remote sensing and Geographical Information System (GIS) technologies.

The aim of this study is to evaluate the suitability of satellite remote sensing and GIS techniques for air quality monitoring. Three (3) different LANDSAT 7 Enhance Thematic Mapper Plus (ETM+) datasets dated the 15<sup>th</sup> of July 2000, 31<sup>st</sup> of May 2001 and 20<sup>th</sup> of September 2001 and eight (8) Continuous Air Quality Monitoring (CAQM) data are used to determine the relationship between digital number (DN) of the thermal infrared band and five pollutant parameters, i.e. Sulfur Dioxide (SO<sub>2</sub>), Nitrogen Dioxide (NO<sub>2</sub>), Carbon Monoxide (CO), Ozone (O<sub>3</sub>) and Particulate Matters (particles less than 10 micron in size – PM<sub>10</sub>).

The study area for this research covers the whole of Klang Valley Region and part of Negeri Sembilan. A limited area, which covers only part of the Shah Alam city is used for micro scale study. Since there are limited numbers of CAQM stations available, the concept of “Virtual Stations” is introduced to densify these stations. Based on these stations, kriging interpolation method (available in the GIS software) is used to generate the pollutant maps of different pollutant parameters of the study area.

Results from this research have indicated that SO<sub>2</sub>, NO<sub>2</sub>, CO and PM<sub>10</sub> have positive correlation while O<sub>3</sub> has negative correlation with digital number of the thermal infrared band. Initial analysis has shown that there is a strong correlation between satellite digital number (thermal band) and SO<sub>2</sub> pollutant. Maps of pollution

## Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This topic has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

In the event that my thesis be found to violate the conditions mentioned above, I voluntarily waive the right of conferment of my degree and agree be subjected to the disciplinary rules and regulations of Universiti Teknologi MARA.

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# CHAPTER 1

## INTRODUCTION

### 1.1 Background

Air pollution is one of the most concerned environmental problems throughout the world today. Air pollution can affect the environment or the general population at the local regional, national, or global level (Bishop, 2000). Malaysia as one of the most developed country among developing nations also faces similar air pollution problem. The increase in the number of vehicles such as cars, trucks and buses as well as rapid growth of industries have contributed to the environmental pollution.

According to Sham (1987), one aspect of the environmental problems, which has been affected by development, is air quality. As highlighted in **The Star** dated **September 10, 2001**, more than 70 percent of the air pollution load in Kuala Lumpur is contributed by motor vehicle emissions, making it the most serious cause of air pollution in the country. The pollutants released by vehicles are Carbon Monoxide, Volatile Organic Compounds, Nitrogen Oxides, Particulate Matter and others. Although legislation has been revised several times since the Environmental Quality Act was first introduced in Malaysia in 1974, pollution levels are on the increase, mainly in the main metropolitan area i.e. the Klang Valley Region.

From 1983 to 1993, the Department of Environment (DOE) Malaysia and a team from the Japanese International Cooperation Agency (JICA) studied the air quality in the Klang Valley Region (DOE, 2003). The Air Quality Management Study for Klang Valley Region published in 1983 indicated that traffic, industries and open burning contributed to a high level of particulates. Industrialization and transportation are the main contributing factors to poor air quality in the Klang