PLANNING A BETTER LAND USE COMPOSITION FOR CLEANER AIR IN ISKANDAR MALAYSIA

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INTRODUCTION

Historical data and several ambient air quality studies indicate that several large cities in Malaysia (including Johor Bahru; part of Iskandar Malaysia) are facing high concentration of air pollutants that are not always at acceptable levels (DOE, 2008). Among the major pollutants are particulate matter (PM10) and Nitrogen Dioxide (NO_2) which are the subject of this study. In climatic influence, particulate matters warm the air by absorbing sunlight and later release heat in the atmosphere (Carmichael and Ramanathan, 2008). In the meantime, the NO_2 emissions in Malaysia were estimated around 203,235 metric tonnes in 2008 and more than half of NO_2 emissions in Malaysia are from motor vehicles (DOE, 2010). Land use composition plays a major role in influencing the number of vehicles as well as other air polluting activities and therefore a significant factor in reducing PM10 and NO_2 emissions. This study sets out to investigate the relationship between the concentration of ambient PM10 and NO_2 and land use composition of Iskandar Malaysia, the study area.

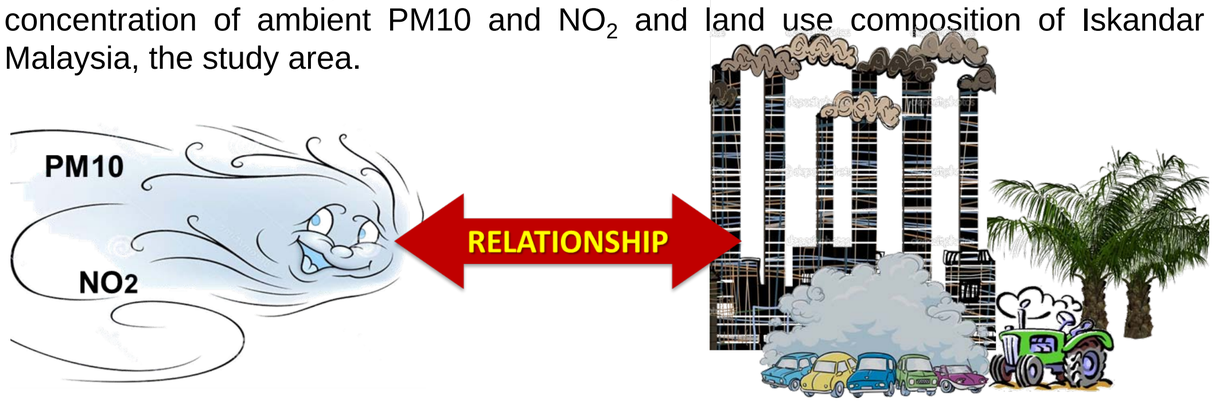

Figure 1: Investigating the relationship between land use composition and air pollution.

METHOD

Separating locally emitted particulate matters from transboundary particulate matters would enable us to investigate the relationship between local emission and land use. A baseflow separation process commonly used in hydrologic studies is employed to distinguish the perpetual local emission from the seasonal transboundary one.

Measurement of the air pollution by ground stations are accurate and a reliable source of information (EEA, 2009) but sometimes a limited number of measurement sites return limited spatial coverage. Replacing the conventional way of measuring air quality, PM10 and NO_2 can be estimated using interpolation based on satellite derived values (Benas *et. al.*, 2013). To compensate for the limited number of air quality monitoring stations in the study area, Terra MODIS Aerosol Optical Depth (AOD) level 2 products and Trace Gas Data (NO_2) of Ozone Monitoring Instrument were used to asses PM10 and NO_2 concentration spatially (Figure 2). Sparse Matrix Operator Kernel Emission (SMOKE), an air pollution modelling software, was then used to produce PM10 emission index map for the study area. Change detection is a process of identifying different state of phenomenon by observing it at several different times (Sudhakar and Kameshwara, 2002) and land use changes were detected using satellite images, Landsat Thematic Mapper (from 1984 to 2008). Finally, the relationship between land use composition and concentrations of both PM10 and NO_2 in the study area are explained using a series of ternary plots.

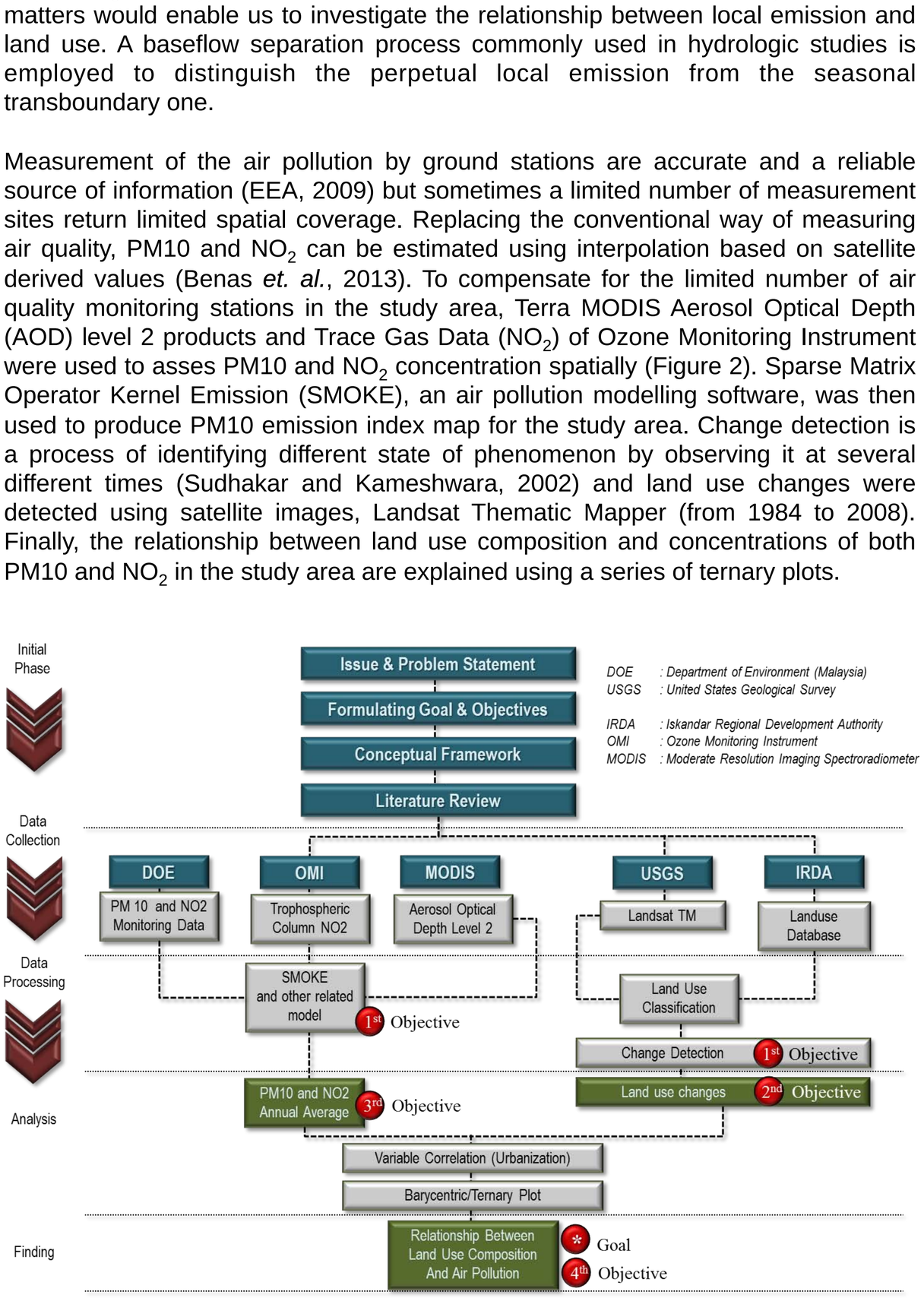

Figure 2: Method adopted for this study.

ANALYSIS AND FINDINGS

The ternary plots below illustrate the influence of land use compositions on PM10 and NO2 concentrations in rural area (Figure 3) and in urban area (Figure 4). When mixed with agriculture and/or forest as in rural areas, commercial and industrial areas tend to have similar impact on PM10 and NO_2 concentrations than residential areas. This can be attributed to higher density of pollution sources such as motor vehicles and factories. When residential, industrial and commercial land uses are together such as the composition in urban areas, the influence of commercial land use seems to be more prominent, especially in the case of PM10. It is suspected that major contribution is from transportation within the commercial areas.

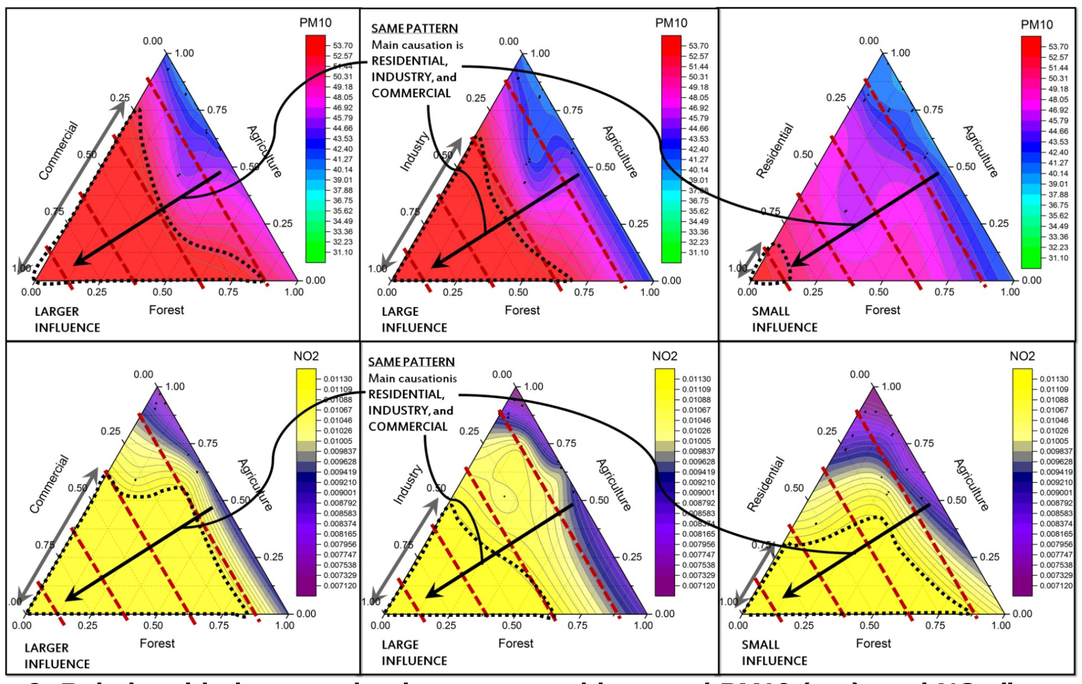

Figure 3: Relationship between land use compositions and PM10 (top); and NO_2 (bottom) in rural Iskandar Malaysia

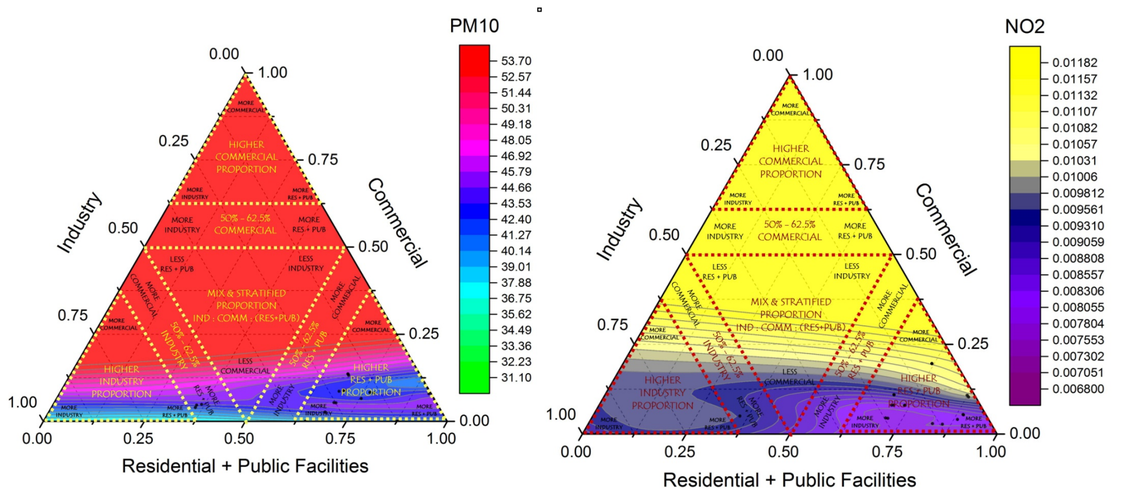

Figure 4: Relationship between land use compositions and PM10 (left); and NO_2 (right) in urban Iskandar Malaysia

Aspires to be a low carbon region and smart city, Iskandar Malaysia has to meet the social and economic needs of its growing population while taking care of all the environmental challenges that come with rapid urbanization. In order to better address air pollution from PM10 and NO_2, having the right composition of land use is important, especially in urban areas. Hence, responsible authorities in Iskandar Malaysia could control or reduce air pollution in an area by planning a better land use composition. In an area, the right mixture of grey (developed) and green (natural) is crucial in checking against the threat of air pollution.

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