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Long term assessment of air quality from a background station on the Malaysian Peninsula

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HIGHLIGHTS

- We analysed air quality data recorded at background station on Malaysian Peninsula.
- Principal component regression and sensitivity analysis have been employed.
- Wind direction influences the transport of air pollutants to the background station.
- Diurnal variations of major air pollutants contribute by motor vehicle emissions.

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ABSTRACT

Rural background stations provide insight into seasonal variations in pollutant concentrations and allow for comparisons to be made with stations closer to anthropogenic emissions. In Malaysia, the designated background station is located in Jerantut, Pahang. A fifteen-year data set focusing on ten major air pollutants and four meteorological variables from this station were analysed. Diurnal, monthly and yearly pollutant concentrations were derived from hourly continuous monitoring data. Statistical methods employed included principal component regression (PCR) and sensitivity analysis. Although only one of the yearly concentrations of the pollutants studied exceeded national and World Health Organisation (WHO) guideline standards, namely PM_{10}, seven of the pollutants (NO, NO_2, NO_x, O_3, PM_{10}, THC and CH_4) showed a positive upward trend over the 15-year period. High concentrations of PM_{10} were recorded during severe haze episodes in this region. Whilst, monthly concentrations of most air pollutants, such as: PM_{10}, O_3, NO_x, NO_2, CO and NmHC were recorded at higher concentrations between June and September, during the southwest monsoon. Such results correspond with the mid-range transport of pollutants from more urbanised and industrial areas. Diurnal patterns, rationed between major air pollutants and sensitivity analysis, indicate the influence of local traffic emissions on air quality at the Jerantut background station. Although the pollutant concentrations have not shown a rapid increase, an alternative background station will need to be assigned within the next decade if development projects in the surrounding area are not halted.

1. Introduction

Background stations can provide invaluable information on pollutant exposure to humans and vegetation at distances from a few km^2 to a few thousand km^2. A rural background station is also useful in providing air quality information on a regional scale (USEPA, 1998; EU, 2005). Such a station must be located in an area with a natural ecosystem, low population density and be a good distance from anthropogenic emission sources (EU, 2005). Hence, continuous air quality monitoring data collected from a rural background station allows the observation of regional trends in air pollutant concentrations with minimal enhancement resulting from local emissions. The expansion of greater urban areas, however, has led to the movement of pollutants from city centres towards suburban areas, which not only affects the level of air pollutant concentrated in the city centres but also that of background areas (Agrawal et al., 2003; Grawe et al., 2013). For example, a study by Donnelly et al. (2011) showed that even cities located more than 50 km away from a background station can influence the NO_2 concentrations at such stations. The concentration of pollutants

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