Available online at www.sciencedirect.com

ScienceDirect

Procedia Environmental Sciences 36 (2016) 176 – 179

Procedia Environmental Sciences

International Conference on Geographies of Health and Living in Cities: Making Cities Healthy for All, Healthy Cities 2016

Atmospheric impacts of Indonesian fire emissions: Assessing remote sensing data and air quality during 2013 Malaysian haze

De Lin Show[a]*, Su-Chin Chang[a]

[a]*Department of Earth Sciences, The University of Hong Kong, Pokfulam Road, Hong Kong.*

Abstract

The 2013 Malaysian haze event coincided temporally with rising trends of hotspots detected in Sumatra, Indonesia. Based on satellite remote sensing, air quality data and wind vector maps, our study aims to provide a preliminary assessment on the remote effects of Indonesian forest fires on the Malaysian haze. In order to locate and detect the occurrence of active fires in Sumatra, MODIS Active Fire Data was retrieved from NASA/LANCE – FIRMS for satellite imagery and analysis. Air quality at Petaling Jaya was assessed based on PM_{10} concentration and meteorological data provided by the Malaysian Meteorological Department. Wind vector maps for the Indian Pacific region were constructed with the NCEP/NCAR Reanalysis Product developed by NOAA-ESRL. In June, southwesterlies prevailed in the region and brought substantial amounts of particulate matter from Sumatra to Peninsular Malaysia, with Petaling Jaya being one of the most severely inflicted cities.

Peer-review under responsibility of the organizing committee of Healthy Cities 2016

*Keywords:*Haze; PM10; Active Fire Data; hotspot; forest fires

1. Introduction

Haze events have been plaguing Peninsular Malaysia in the summer monsoon season almost every year since 1983, with the 1997 and 2005 cases being the most severe outbreaks[1,2]. The recent most Malaysian haze occurred in 2013 severely diminished nationwide horizontal visibility as thick smoke blanketed Peninsular Malaysia. On 23 June 2013, a state of emergency was declared in two southern districts on the Peninsular Malaysia as the air pollution worsened to extremely hazardous levels unprecedented in Malaysian history[3].

* Corresponding author. Tel.: +852-92399465.
E-mail address: sdelin@connect.hku.hk

Peer-review under responsibility of the organizing committee of Healthy Cities 2016
doi:10.1016/j.proenv.2016.09.029

Extensive areas of land and forest grounds are cleared for palm oil plantations, leading to the recurrent problem of uncontrolled wildfires in Sumatra, Indonesia over the past few decades[4,5]. The ongoing problem stems from the agricultural roots of the nation[6]. The purpose of our study is to provide a preliminary assessment on the remote effects of Indonesian forest fires on the Malaysian haze. Particular emphasis will be on assessing satellite remote sensing over Sumatra and air quality data at Petaling Jaya. Wind vector maps will be constructed for monthly analysis of wind vector variation over the Indian Pacific region.

2. Methodology

2.1. Air quality data

Assessment of air quality at Petaling Jaya was performed based on concentration of particulate matter, PM_{10} provided by the Malaysian Meteorological Department. Measurements for air quality data were collected daily over a sampling period of 1 April to 31 August 2013. Daily PM_{10} concentrations were recorded using β-ray attenuation mass monitor (BAM-1020) as described in relevant studies[2,7,8]. As southern districts were most affected by the 2013 Malaysian haze[3], our study area has focused on Petaling Jaya (3° 06' N, 101° 39' E). Situated in the southern districtof Peninsular Malaysia, Petaling Jaya is a city where the highest loadings are concentrated[8]. In addition, PM_{10} data of Petaling Jaya are easily accessible and relatively well documented compared to other cities.

2.2. Satellite remote sensing

In order to locate and detect the occurrence of active fires in Sumatra, satellite remote sensing was employed to retrieve active fire data for hotspots coverage over the Central Sumatra basin. Satellite remote sensing retrievals were obtained using the Moderate Resolution Imaging Spectroradiometer (MODIS) from the Terra and Aqua satellite. MODIS Active Fire Data was requested from the NASA/LANCE – FIRMS to study the distribution of hotspots occurring in the designated polygon area. A polygon area was delineated to include Riau (0° 32′ N, 101° 27′ E) and Jambi (1° 35′ S, 103° 36′ E) province in Sumatra. Fire pixels in the active fire shapefile mark the center point location in which there is at least one fire activity occurring within 1km radius from the flagged pixel. Only hotspot counts with confidence level higher than 30% were included in this study.

2.3. Wind vector maps

Daily mean composites of wind vector were computed at an upper air analysis level of 925mb in the Indian Pacific region. The Indian Pacific region has been selected as our base map to fully capture the monsoonal wind patterns on a regional scale. It strategically depicts tropospheric flow patterns in the region where Indonesia and Malaysia are situated. For monthly analysis of wind vector variation, the daily mean composites were averaged and plotted into monthly wind vector maps from April to August 2013. A Cylindrical Equidistant projection was used to construct a mapping domain of 20 °N to 20 °S latitudes and 60 °E to 180 °W longitudes for our intended area of study. The maps were constructed with the NCEP/NCAR Reanalysis Product developed by NOAA-ESRL[9].

3. Results and Discussion

3.1 PM_{10} concentration at Petaling Jaya

The plot of PM_{10} concentration (Fig.1) is characterized by a peak concentration on 23 June 2013 during the dry summer monsoon. The prominent peak represents PM_{10} concentration reaching a record high of 290 $\mu g/m^3$. The abrupt peak in PM_{10} concentration is likely due to stronger transport energy in the atmosphere during summer monsoon season. Packets of atmospheric pollutants are lifted, suspended and transported away from the fire emission sources in Sumatra with greater amount of energy available.

PM_{10} variations at Petaling Jaya were influenced by the direction and strength of wind transport, in addition to the proximity of emission sources to the target area. Principal component analysis by Juneng et al.[8] has shown that PM_{10} concentration fluctuates seasonally in two timescale bands, with the largest variance found in summer.