



# The effects of synoptic and local meteorological condition on CO<sub>2</sub>, CH<sub>4</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> at Bachok Marine Research Station (BMRS) in Peninsular Malaysia

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Received: 26 April 2019 / Accepted: 4 January 2020  
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## Abstract

This study is focused on Bachok Marine Research Station (BMRS) which is exposed to different scales of meteorological condition during the northeast (NE) and southwest (SW) monsoons. BMRS experiences both synoptic and land–sea breeze events during the NE monsoon, but only the land–sea breezes are dominant during the SW monsoon. Two case studies were investigated in which the first case study (CS1) was conducted from 25 to 27 January 2016 while the second one (CS2) from 3 to 5 June 2016. BMRS experienced strong synoptic effect during CS1 with strong northeasterly winds (wind speed > 10 ms<sup>-1</sup>) up to an altitude of 2500 m and vertical thermal gradient only up to 600 m. Using Concentrated Weighted Trajectory (CWT) analysis, BMRS was shown to be influenced by the regional sources of pollutants originated from the central region of China and areas along coastal Vietnam during CS1. Meanwhile, CS2 was associated with daily land–sea breeze event, strong diurnal effect and closely linked to the local source of pollutants from areas along the east coast of Peninsular Malaysia. The concentrations of PM<sub>10</sub> and PM<sub>2.5</sub> were two times higher when offshore winds dominated BMRS, suggesting its great relation to the local emissions. Overall, BMRS presents a valuable opportunity to study the influence of regional and local atmospheric flows to the variabilities of air pollutants, thus enabling better understanding and providing a key reference to formulate effective pollution abatement strategies.

## 1 Introduction

Southeast Asia (SEA) is a fast emerging region with a rapidly growing economy (OECD 2019) and future energy demand and rapid industrialization are expected to increase the emissions of anthropogenic aerosols from this region if not properly managed (Masson-Delmotte et al. 2018; Page et al. 2011). Air pollutants can be transported across continents and ocean basins due to fast long-range transport, resulting for example in trans-oceanic and trans-continental plumes of atmospheric brown clouds (ABCs) containing atmospheric aerosols (Ramanathan and Feng 2009) such as soot and dust. Greenhouse gases such as CO<sub>2</sub> and CH<sub>4</sub> are among the most concerning and continuously monitored air pollutants due to their contribution to global warming (IPCC 2014). Additionally, atmospheric aerosols have also become a great concern in Southeast Asia as a result of biomass burnings, traffic and industrial emissions (Dominick et al. 2015). Atmospheric aerosols arising from biomass burning are usually comprised of high amounts of organic pollutants and are able to move far from their sources due to their

Responsible Editor: M. Telisman Prtenjak.

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