Time effects of high particulate events on the critical conversion point of ground-level ozone

ABSTRACT

Particulate matter (PM), especially those with an aerodynamic particle size of less than 10 μm (PM10), is typically emitted from transboundary forest fires. A large-scale forest fire may contribute to a haze condition known as a high particulate event (HPE), which has affected Southeast Asia, particularly Peninsular Malaysia, for a long time. Such event can alter the photochemical reactions of secondary pollutants. This work investigates the influence of PM on ground-level ozone (O3) formation during HPE. Five continuous air quality monitoring stations from different site categories (i.e., industrial, urban and background) located across Peninsular Malaysia were selected in this study during the HPEs in 2013 and 2014. Result clearly indicated that O3 concentrations were significantly higher during HPE than during non-HPE in all the sites. The O3 diurnal variation in each site exhibited a similar pattern, whereas the magnitudes of variation during HPE and non-HPE differed. Light scattering and atmospheric attenuation were proven to be associated with HPE, which possibly affected O3 photochemical reactions during HPE. Critical conversion time was used as the main determining factor when comparing HPE and non-HPE conditions. A possible screening effect that resulted in the shifting of the critical transformation point caused a delay of approximately of 15–30 min. The shifting was possibly influenced by the attenuation of sunlight in the morning during HPE. A negative correlation between O3 and PM10 was observed during the HPE in Klang in 2013 and 2014, with −0.87. Essentially, HPE with a high PM concentration altered ground-level O3 formation.

Keyword: Ozone production; Anthropogenic sources; Ozone precursor; Photochemical reaction; Particulate matter