An Ozone-Climate Penalty in Greater Kuala Lumpur?

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Ozone (O_3) is an important ground-level pollutant that is harmful to humans and plants. Levels of O_3 are commonly found to be correlated with temperature (T), which acts as a convenient synthesis for a host of processes – meteorological, biophysical and chemical – that can increase O_3. The idea that increases in T owing to anthropogenic climate change can counteract efforts to reduce O_3 pollution is often described in terms of an "ozone-climate penalty". To date research on such a penalty has been largely confined to North America and Europe. But its importance may be greater for tropical regions, where rapid population growth and urbanization, along with year-round meteorological conditions that are conducive to high O_3 levels, are likely to lead to marked increases in exposure. Accordingly, in this paper we analyze a rare long-term (13 year; 2004-2016) record of O_3 and T observations from a large and growing tropical city – Greater Kuala Lumpur – with the objective of developing an understanding of the importance of T, and increases in T, for levels of O_3 pollution in tropical urban areas. A major finding is that while average O_3 levels in Greater Kuala Lumpur have changed little over the 13-year period of analysis, there are clear indications that increases in T are indeed acting to enhance O_3 in the urban area. Unlike past studies focused on a summer "ozone season" in temperate regions we have a year-round focus, so we will also examine the sensitivity of our findings to seasonal variations (e.g. related to monsoon circulations) and to the influence of occasional intense periods of "haze" pollution. Finally, the paper will discuss possible mechanisms that underlie our findings, and consider the availability of the evidence required to probe these mechanisms. A clear understanding of these processes will be vital in ensuring stresses on the health of tropical urban populations, from a combination of high T and air pollution including O_3, can be managed and mitigated effectively in to the future.

Keywords: Ozone, temperature, climate change, urban, Greater Kuala Lumpur