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Industries and Vehicles Add to Bad Air Days

Pollutants from Forest Fires in the Region Caused One-third of Low-visibility Days in Singapore, New Study Shows

Forest fires in the region are not the only source of Singapore's bad air days. A new study has suggested that domestic pollution may also be responsible for hazy skies. The study by Dr. Lee Hsiang-He from the Singapore-MIT Alliance for Research and Technology (Smart) suggested that, on average, about one-third of the low-visibility days in Singapore were caused by pollutants from forest fires, called fire aerosols. Her findings were published in the scientific journal Atmospheric Chemistry and Physics.



• Dr. Lee Hsiang-He

While the study did not identify the other sources of pollution, Dr. Lee has some theories, which she plans to explore. “The pollution could also be partially coming from local sources, such as emissions from industries, the maritime sector or even vehicles. The next step in our research is to pinpoint the exact sources, so measures can be taken to reduce emissions,” said the post-doctoral associate at Smart's Centre for Environmental Sensing and Modelling.

Dr. Lee worked on the study with two colleagues from the Massachusetts Institute of Technology in the United States.

The burning of forests in South-east Asia has for decades been pinpointed as the source of bad air quality in Singapore and the region. But Dr. Lee said these fires have had a varying impact in various parts of South-east Asia, due to factors such as general wind direction, local weather conditions and the location of the fires. For example, Bangkok often receives smoke haze from fires on mainland South-east Asia, which includes Malaysia and Cambodia. Singapore and Kuala Lumpur, on the other hand, are affected mainly by forest fires raging in Sumatra, whereas Kuching in Sarawak gets haze from forest fires in Borneo.

Using visibility data from Changi Airport, Dr. Lee found that Singapore experienced an average of 96 low-visibility days every year over a 12-year period from 2003 to 2014. These are defined as days when it is not possible to see beyond 10km. Low-visibility days due to rain are excluded from this count. Dr. Lee then sought to clarify how many of these days were caused by fire aerosols. This was done by inputting fire-emission data - taken from two burning emission databases compiled by research organisations in the US - using a weather research and forecasting model.

The model is able to trace the pathways of fire aerosols under the different weather conditions over past years. It showed that in Singapore, 34 per cent of the 96 bad air days experienced yearly over the period were due to fire aerosols. This was also the case for other parts of South-east Asia.

The model also showed that about half of the 200 low-visibility days experienced yearly in cities such as Jakarta, Bangkok, Hanoi and Yangon were caused by fire aerosols. However, Dr. Lee pointed out that the fire emissions might have been underestimated. Since the study considered only emissions from fires, she plans to conduct further research to quantify the impact of local sources, such as industries. "But, overall, the results suggest that in order to improve air quality in South-east Asia, besides reducing or even prohibiting planned or unplanned fires, mitigation policies targeting pollution sources other than fires also need to be implemented," said Dr. Lee.

Tiny pollutant particles known as PM_{2.5} are dominant during periods of haze. These particles are 30 times smaller than the diameter of a strand of human hair and are what make haze dangerous, as they are small enough to enter the bloodstream and be carried to the organs. In 2015, when Singapore experienced the worst haze on record, the National

Environment Agency said that visibility does not directly correlate with PM2.5 concentration levels, as other chemical compounds or reactions and weather factors may be involved. Dr. Lee's findings were consistent with these observations, said a spokesman for the Ministry of the Environment and Water Resources (MEWR).

“PM2.5 is contributed not only by transboundary haze, but also by domestic sources, with vehicles and industries being the two largest domestic contributors,” noted the spokesman. Measures have been implemented recently to curb domestic pollution. These include the tightening of emission standards for new vehicles and industries, as well as the introduction of incentive schemes to promote early retirement of old diesel commercial vehicles. “The recent announcement in this year's Budget statement on the extension and enhancement of the Early Turnover Scheme will help encourage the retirement of older and more pollutive diesel commercial vehicles and buses,” added the spokesman.

Audrey Tan, 3rd March 2017

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