Smoke from controlled burn offs and surface dust found to be leading source of particle air pollution in Australia

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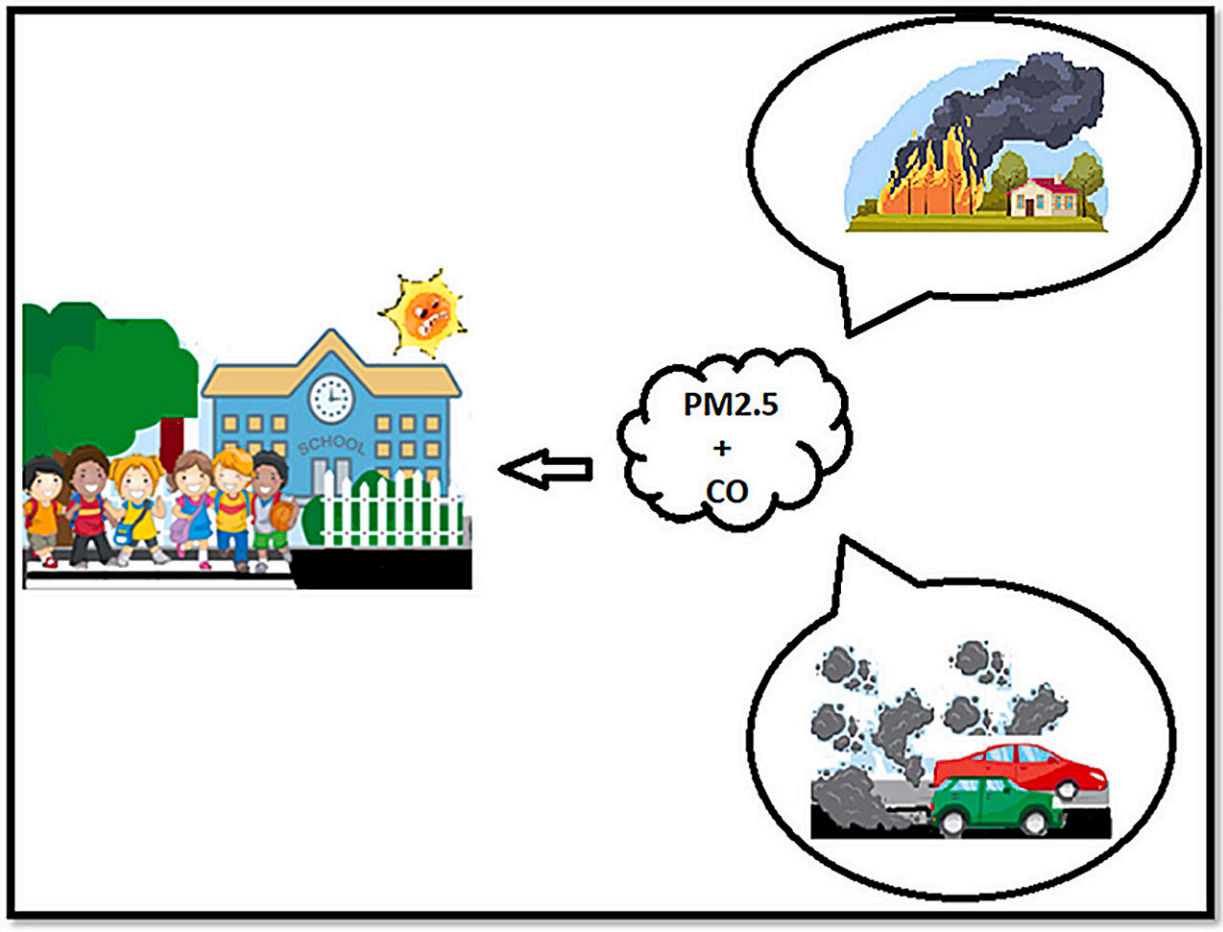

Credit: *Atmospheric Environment* (2024). DOI: 10.1016/j.atmosenv.2024.120424

Outdoor air pollutants monitored at five Queensland schools in a year-long QUT study found that most of the tiny particles ($PM_{2.5}$) that lodge in the lungs came from the environment, such as smoke from controlled burns, rather than vehicles.

The study, "An application of low-cost sensors to monitor children's exposure to air pollution at five schools in Queensland, Australia," was published in the journal *Atmospheric Environment*.

First author, Ph.D. researcher Basant Pradhan from the QUT School of Earth and Atmospheric Sciences, said the local outdoor air quality monitoring study was a citizen science project with students.

"We chose schools for our citizen science project because children are particularly susceptible to pollution-related health effects as their lungs are still developing," Pradhan said.

"A second reason is that the measurements of two main air pollutants $PM_{2.5}$ and carbon monoxide (CO) are a better representation of the levels of local pollution in the suburbs where the children live rather than those from the distant monitoring network."

Among the findings:

- The two Brisbane schools showed the greatest difference between the seasons in $PM_{2.5}$ levels, with winter averages that were 46% and 71% higher than the summer averages.
- The average $PM_{2.5}$ for the Gold Coast school, close to a major highway, came out the highest while the two regional schools had the lowest concentrations.
- $PM_{2.5}$ concentrations peaked during the night while CO concentration peaked late afternoon.
- All five schools showed similar daytime trend of $PM_{2.5}$

concentrations being at their lowest during the day. They began to rise in the evenings to a maximum between midnight and 7 am after which there was a sharp decrease to daylight levels.

- These $PM_{2.5}$ concentrations were notable because they did not match the well-known daily trend in traffic density during the daytime indicating the traffic emissions were not the prime source of $PM_{2.5}$.
- In contrast, the CO concentrations peaked with the rush-hour traffic period around 7 am and 5 pm, showing the dominant source of CO is motor vehicle emissions.

At the start of the study in July 2021, the researchers placed low-cost monitor KOALAs (Knowing Our Ambient Local Air quality) outdoors at five different schools—in north Brisbane and south Brisbane, both about 12 km from the city centre; Gold Coast near a major highway, and regional towns Moranbah and Longreach to monitor $PM_{2.5}$ and CO concentration.

An additional KOALA was also installed at each of the schools in North Brisbane and Gold Coast.

The schools with two KOALAs, had one placed in the school grounds fewer than 30 m from the edges of the nearest roads and the other was at least 150 m away from major roads, enabling the background concentrations to be monitored simultaneously.

The main aim was to monitor concentrations of $PM_{2.5}$ and CO in real time over 24-hour, monthly and annual time scales between July 2021 to June 2022.

Australia's outdoor air quality standards are a maximum of 25 $\mu g/m^3$ (micrograms per cubic meter) in 24 hours and an annual average of 8 $\mu g/m^3$.

Pradhan said the readings showed many short-term spikes in pollution due to particle and CO emissions from passing motor vehicles and smoke events.

"The data showed $PM_{2.5}$ concentrations were seasonal with all schools, showing a maximum during the winter months and a minimum during the summer months," Pradhan said.

"The seasonal difference of $PM_{2.5}$ concentrations could be attributed to more smoke during winter due to hazard reduction burning and wood fires for heating.

"Moreover, the boundary layer (lowest layer of the troposphere) is lower and thicker in winter and therefore traps pollution closer to the ground.

"Also, relative humidity is higher in winter leading to condensation on particles, so when the boundary layer lifts during the day it disperses pollution upwards, away from ground level.

"All schools except one exceeded Australia's annual air quality standard of 8 $\mu g/m^3$, however, both the 8-hour and 24-hour averages were well below the Australian air quality standard of 25 $\mu g/m^3$.

"While the CO concentrations aided in the identification of pollution originating from combustion sources, they were not of concern as a health risk," Pradhan said.

"Although it is thought that most of the particles in the air near a road come from motor vehicles, this study shows that only 37% of the mass of particles ($PM_{2.5}$) originate from motor vehicle exhaust."

Pradhan said the project had proved to be a valuable teaching tool to get high school students and the community interested in air quality and

involved in basic research analysis.

More information: Basant Pradhan et al, An application of low-cost sensors to monitor children's exposure to air pollution at five schools in Queensland, Australia, *Atmospheric Environment* (2024). DOI: 10.1016/j.atmosenv.2024.120424

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