Editorial: Urban air pollution: sources, characterization and mitigation

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Editorial on the Research Topic
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Access to clean air is a fundamental human right which is not yet well achieved globally. There is no safe level of air pollution as even very low air pollution levels (e.g., <5 μg/m^3 of PM$_{2.5}$) could cause significant mortality risks (Weichenthal et al., 2022). Therefore, the World Health Organisation (WHO) further tightened the air quality guidelines (AQGs) in 2021, leading to a concerning fact that almost everyone (99%) on this planet are breathing air that cannot meet the WHO standards. Outdoor and indoor air pollution problems together cause approximately seven million premature deaths every year and achieving the new WHO AQGs could help save millions of lives (WHO, 2021).

The air pollution problems are usually highly synchronised with the human activities both spatially and temporally: i.e., urban areas and day times are usually experiencing higher air pollution levels than rural areas and night times. The monitoring, formation, source, characteristics and control of urban air pollution are long-existing and complex topics (Brimbl and ecombe, 2006). Many sources have contributed to urban air pollution, such as transboundary transport, residential, commercial and industrial activities, road transport and other sources (Coelho et al., 2022). In addition, the urban geometries and meteorological conditions could reduce the dispersion rates of air pollutants and affect the formation of secondary pollutants, which lead to highly temporal and spatial variations and further complicate the air pollution problems (Huang et al., 2021). Therefore, a thorough understanding on urban air pollution problems is of great significance to the liveability and sustainable developments of our cites.

The aim of this Research Topic was to provide a platform for researchers to share their latest studies on the formation, characterisation and control of air pollutants in the urban atmosphere, as well as their impacts on public health. This Research Topic received 14 submissions, of which 5 papers were accepted for publication after peer reviews. These papers provide in-depth discussion and valuable datasets on urban air pollution. Some highlights are summarised as follows.

First, characterising the chemical compositions of particulate matters (PM) is of great significance for identifying the sources of urban air pollution and thus developing effective control measures to improve air quality. Qian et al. measured the compositions, sources and evolutions of inorganic and organic aerosols in January 2018 in Shanghai, China. They found

that the non-refractory submicron aerosols (NR-PM$_1$) mainly contained organics, nitrate, sulfate and ammonium, and the organic aerosols (OA) mainly consisted of hydrocarbon-like, less-oxygenated and more-oxygenated OA. Their contributions showed obvious variations between clean and pollution episodes, underlining the important effects of relative humidity, aqueous-phase chemistry reactions, photochemical oxidation and atmospheric oxidative tracers.

The meteorological factors also have important effects on air pollution. Lin et al. examined the air quality monitoring data of PM concentrations and their influencing factors during 2014–2021 in Xiamen, China. Their analysis showed that PM was the lowest in the summer of a year and the noon of a day, but the highest in the winter of a year and the early morning and evening of a day. Further, PM concentrations were positively correlated with other pollutants including SO$_2$, NO$_2$, CO and O$_3$, but negatively correlated with meteorological factors including temperature, wind speed, height of the cloud ceiling and dew point.

Combustion of fossil fuels such as coal, oil and natural gas is the most important source of air pollutants. Among them, coal is usually considered as the direst fuel but still is widely used in many countries, causing transboundary transport of air pollution. Jeong et al. measured the multi-isotopic compositions of coals used in Korean power plants to judge if the air pollutants in Korean atmosphere were transported from neighouring countries. The results showed that the δ^{13}C and δ^{15}N values of Korean coals were different to those of Chinese coals, in particular for δ^{15}N. However, multi-isotope compositions may not be suitable tracers for determining transboundary transport of air pollutants due to the complex chemical reactions between NO$_x$ and other N-bearing compounds in the atmosphere.

Air pollution includes many harmful pollutant species which vary significantly among cities. Thus, determining the key factors for each disease is important for effective air pollution control. Chen et al. evaluated the links between the chronic obstructive lung diseases (COPDs) and the air pollution and meteorological factors in Taiwan. Their results showed that COPDs were associated with high temperature, high relative humidity and low rainfall. In addition, a synergistic effect of temperature, SO$_2$ and PM on COPDs was observed.

The climate change crisis may complicate the air pollution problem and the associated health risks. Yu et al. investigated the effects of extreme temperatures and air pollutants on daily non-accidental deaths (NADs) during 2019–2021 in Jining, China. They found that both temperatures and air pollutants had significant but non-linear effects on NADs. High temperatures had immediate but shorter effects (2–3 days) on NADs than low temperatures did (6–12 days). Regarding air pollutants, PM$_{2.5}$, NO$_2$ and SO$_2$ had the highest effect on NADs in winter and the lowest in autumn, while O$_3$ had the highest effect on NADs in spring but unobvious effect among other seasons.

This Research Topic includes original research and data report on experimental and epidemiological analysis of urban air pollution and the associated health risks. The above discussion demonstrates that urban air pollution is an important and complex issue that needs efforts from many sectors. We hope the publication of this Research Topic will inform the readers the importance and latest progress of this Research Topic, and inspire them conduct further research towards a better understanding and more effective control of urban air pollution. The guest editors would like to greatly thank the authors and reviewers for their valuable contributions to this Research Topic. We look forward to having further interactions and engagements on this important Research Topic.

Author contributions

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Conflict of interest

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Publisher's note

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