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Introduction to artificial intelligence and machine learning in environmental science

Hemi Luan *[a] and Zongwei Cai [b]

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Artificial intelligence (AI) and machine learning (ML) are rapidly growing fields that have made a significant impact in studies of environmental science and human health. Advances in AI and ML allow researchers to collect and analyze vast amounts of data, enabling them to better understand complex environmental systems and make more accurate predictions about future changes.

One of the most promising applications of AI and ML in environmental science is in the field of health impacts of climate change.[1] A compelling example of AI and ML providing valuable insights into the field of environmental science is demonstrated in the research paper by Wu and colleagues (**https://doi.org/10.1039/D2VA00303A**). The study investigated the relationship between air quality, climate change, population aging, and cardiovascular mortality in Guangzhou, China. Through this analysis, the authors revealed that the benefits of reduced air pollution may be offset by the health impacts of climate change, and population aging. The discussion started by highlighting that air pollution was a major public health concern in China, with high levels of particulate matter (PM) contributing to increased morbidity and mortality. However, there has been some progress in improving air quality in recent years. The authors noted that these improvements had led to reductions in cardiovascular mortality, but the potential impacts of climate change and population aging on this relationship have not been fully explored. To investigate this issue, the authors conducted a time-series analysis using data from 2013 to 2021 on daily $PM_{2.5}$ concentrations, temperature, humidity, cardiovascular mortality, and population demographics in Guangzhou. They found that improvements in air quality were associated with reductions in cardiovascular mortality, but the magnitude of this effect varied depending on temperature and population age.

The current status and prospects of the AI and ML techniques used for screening active metabolites through metabolomics studies in environmental science were reviewed by Luan (**https://doi.org/10.1039/D2VA00107A**). The author highlighted the importance of ML methods in processing large-scale unprocessed metabolomics data sets collected from analyses by mass spectrometry, nuclear magnetic resonance, and other analytical techniques, and provided an overall overview of the current state of ML for screening active metabolites in environmental science research. The author introduced numerous methodologies and their applications, and highlighted their strengths and limitations. Future challenges and opportunities for research in this field were also discussed, emphasizing the need for collaborations between environmental analytical chemists, biologists, and computational scientists to obtain accurate and effective metabolite identification and characterization.

Mottershead *et al.* (**https://doi.org/10.1039/D3VA00005B**) present a new approach to improve peak picking accuracy and efficiency in compound identification by using non-targeted high-resolution mass spectrometry. The use of deep learning algorithms, specifically convolutional neural networks, provided a powerful tool for processing large datasets and identifying potential environmental contaminants. The authors suggested that their approach could have broader applications in other fields of research, such as metabolomics and exposomics, and could potentially lead to the discovery of unknown compounds with important environmental effects.

In conclusion, AI and ML are rapidly transforming the field of environmental science, providing new tools for data analysis and modeling that can help us better understand and address some of the most pressing current environmental

[a]*School of Biomedical and Pharmaceutical Sciences, Guangdong University of Technology, 100 University Chengwaihuan West Road, Guangzhou, China. E-mail: luanhm@gdut.edu.cn*

[b]*Department of Chemistry, Hong Kong Baptist University, 224 Waterloo Road, Kowloon, Hong Kong*

challenges.[2] While there are still many issues to be addressed, including data quality and integration, interpretability and reliability of AI and ML models, ethical and social implications, as well as interdisciplinary collaborations, it is clear that AI and ML will continue to play a crucial role in the development of new solutions for environmental protection and sustainability.

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