Identifying regional air quality trends from sensor network data: An analysis of PM2.5 measurements in Hampshire

Christina Vanderwel[1]

[1]Department of Aeronautical and Astronautical Engineering, University of Southampton, SO16 7DY, UK
Keywords: air quality monitoring, particulate matter, sensor networks
Presenting author email: c.m.vanderwel@soton.ac.uk

Poor air quality is the UK's greatest environmental health hazard and a particular concern in major cities across the country. It contributes to poor health, such as heart and lung disease, and increased mortality, disproportionately effecting the young, the elderly, and vulnerable populations [1].

In Hampshire, major sources of air pollution include road traffic, shipping and port activities, the airport, and local industry. There are over 30 air quality management areas (AQMAs) in the region where national Air Quality Objectives are locally not being met. The improvement of outdoor air quality is therefore a priority for local authorities who are engaged with local monitoring and have developed air quality action plans [2-5].

This investigation by the University of Southampton aimed to analyse air quality sensor measurements from across Hampshire to:

1. Investigate the extent and severity of air pollution in the region.
2. Identify trends that could lead to targeted interventions and an improvement in quality of the air we breathe.

Our analysis focused on a dataset of measurements of particulate matter smaller than 2.5 µm (PM2.5), the major cause of the negative health effects of poor air quality. The data was collected from a network of 17 EarthSense Zephyr [6] ambient air quality monitors spread across the region (Figure 1), measured every 15-minutes over the period of January 2023 – March 2024, supplemented with data from DEFRA's Automatic Urban and Rural Network [7] and weather data from the Met Office [8]. We applied statistical and machine learning techniques to identify trends in the data.

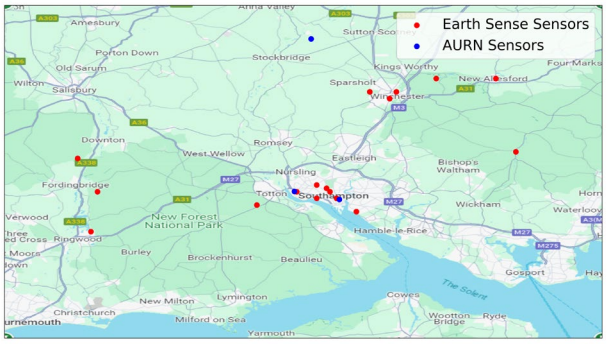

Figure 1: Map of the sensor locations

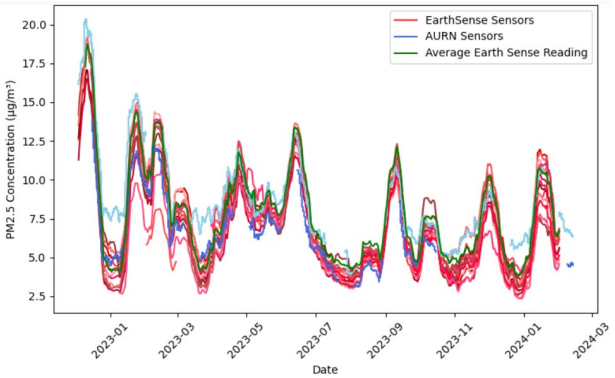

Figure 2: Measurements from all the sensors follow the same trends in time with little regional variation. Peak episodes, such as the one resulting from a large fire in June 2023, were often felt across the region. The annual average PM2.5 level was 7.5 µg/m³.

We gratefully acknowledge Southampton City Council, Winchester City Council, Eastleigh Borough Council, and the New Forest District Council who provided access to the air quality data measured in their communities funded by DEFRA's Burn Better Campaign. Funding for this research was provided by the University of Southampton's Low Carbon Comfort Centre of Excellence and the Public Policy|Southampton New Things Fund.

References

[1] Blake, E., & Wentworth, J. (2023). Urban outdoor air quality. Parliamentary Office of Science & Technology, UK Parliament. https:// doi.org/10.58248/PN691

[2] Southampton City Council (2024). https://www.southampton.gov.uk/ our-green-city/council-commitments/clean-air/improving-air-quality/

[3] Winchester City Council (2024). https://www.winchester.gov.uk/ environment/air-quality

[4] Eastleigh Borough Council (2024). https://www.eastleigh.gov.uk/ environment/environmental-health/pollution/air-quality

[5] New Forest District Council (2024). https://www.newforest.gov.uk/ article/1002/Air-pollution

[6] EarthSense (2024). https://www.earthsense.co.uk/

[7] DEFRA (2019). Automatic Urban and Rural Network (AURN). https:// uk-air.defra.gov.uk

[8] Met Office (2019). https://www.metoffice.gov.uk/.