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Sensors as a component of urban air quality management planning: a case study with AirGradient OpenAir PM monitors from Accra, Ghana.

Collins Gameli Hodoli[1,2,3] and the Network for Atmospheric and Air Quality Research (NAAQR)*
[1]School of Environmental, Chemical, Agricultural and Mechanical Engineering, College of Engineering, University of Georgia, Athens, USA
[2]Clean Air One Atmosphere, Accra, Ghana
[3]School of Sustainable Development, Department of Built Environment, University of Environment and Sustainable Development, PMB, Somanya, Eastern Region, Ghana
*A full list of authors appears at the end of the abstract

Millions of premature deaths across Africa every year are attributed to air pollution. Of specific mention is exposure to fine particles, $PM_{2.5}$. We present in this study a novel concept using the non-parametric wind regression approach and low-capital-cost (LCC) air sensor data to identify sources of $PM_{2.5}$ pollution. This study is based on $PM_{2.5}$ data collected at the University of Ghana (Afri-Set), Accra using the AirGradient OpenAir $PM_{2.5}$ monitor from June 01 to September 15, 2023. Using the raw, calibrated, and regulatory grade data from the Teledyne API PM Mass Monitor T640, we found a good agreement between the identified sources of $PM_{2.5}$. Additionally, we observed that high $PM_{2.5}$ levels (21 μgm^{-3}) were experienced during S, W, SW and SE winds. At low wind speeds (≤ 1 ms^{-1}), $PM_{2.5}$ pollution was high suggesting a possible local source. Although there were differences in concentrations comparing the raw and the reference grade data, our results showed that $PM_{2.5}$ sources were similar. A diurnal pattern of the observed $PM_{2.5}$ also shows a high similarity between the 3 sets of data. Peak levels (15-20 μgm^{-3}) were observed at 07:00 to 14:00 hrs and 18:00 to 23:00 hrs associated with SW winds. Between 00:00 and 04:00 hrs, low levels (below 15 μgm^{-3}) were observed and associated with W and SW winds. Southerly observations were below 15 μgm^{-3} with high levels (15-20 μgm^{-3}) easterly between 04:00 and 08:00 hrs. This indicates that the raw data from the LCC PM air sensor is suitable for developing and tracking air pollution mitigation strategies, especially in environments with similar characteristics, with some caveats. We recommend a further investigation of the site tied to prevailing background activities to provide a vivid understanding of the potential contributing factors from the observed wind directions.

Keywords: Air Pollution; Source Identification; Air Sensors; Ghana; $PM_{2.5}$

Network for Atmospheric and Air Quality Research (NAAQR): Collins Gameli Hodoli1,2,3*,Solomon Otoo Lomotey3*, Adwoa Oforiwa Antwi3, Cynthia Naa Adoley Acquaye3, Jacob Kwamina Dodoo3, Kwaku Adu4, Henrietta Ngmentoma Nabiebakye3, Eunice Stella Nyarko3,

Stanley Owuotey Bonney3, Mawutor Humphrey-Ackumey Korda3, Seyram Kofi Loh3, Kassum Braimah3, Amanda Owusu3, Mawufemor Afi Danyo3, Matthias Napar Neina3, Kwame Benyibaling Bour3, Achim Haug6, Reginald Quansah7, James Nimoo8, Allison Felix Hughes8, Iq Mead9, Carl Malings5, Daniel M. Westervelt10 1School of Environmental, Civil, Agricultural, and Mechanical (ECAM) Engineering, College of Engineering, University of Georgia, Athens, USA 2Clean Air One Atmosphere, Accra, Ghana 3Department of Built Environment, School of Sustainable Development, University of Environment and Sustainable Development, PMB, Somanya, Eastern Region, Ghana 4Department of Applied Economics, School of Sustainable Development, University of Environment and Sustainable Development, PMB, Somanya, Eastern Region, Ghana 5Morgan State University and NASA Goddard Space Flight Center, Maryland, USA 6AirGradient, Chiang Mai, Thailand 7School of Public Health, University of Ghana, Legon, Accra, Ghana 8Department of Physics, University of Ghana, Legon, Accra, Ghana 9Imperial College, London, UK 10Lamont Doherty Earth Observatory, Columbia University, Palisades, NY, USA