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# CAMS-Net: The Clean Air Monitoring and Solutions Network

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There is a severe lack of air pollution data around the world. This includes large portions of low- and middle-income countries (LMICs), as well as rural areas of wealthier nations as monitors tend to be located in large metropolises. Low cost sensors (LCS) for measuring air pollution and identifying sources offer a possible path forward to remedy the lack of data, though significant knowledge gaps and caveats remain regarding the accurate application and interpretation of such devices.

The Clean Air Monitoring and Solutions Network (CAMS-Net) establishes an international network of networks that unites scientists, decision-makers, city administrators, citizen groups, the private sector, and other local stakeholders in co-developing new methods and best practices for real-time air quality data collection, data sharing, and solutions for air quality improvements. CAMS-Net brings together at least 32 multidisciplinary member networks from North America, Europe, Africa, and India. The project establishes a mechanism for international collaboration, builds technical capacity, shares knowledge, and trains the next generation of air quality practitioners and advocates, including domestic and international graduate students and postdoctoral researchers.

Here we present some preliminary research accelerated through the CAMS-Net project. Specifically, we present LCS calibration methodology for several co-locations in LMICs (Accra, Ghana; Kampala, Uganda; Nairobi, Kenya; Addis Ababa, Ethiopia; and Kolkata, India), in which reference BAM-1020 PM2.5 monitors were placed side-by-side with LCS. We demonstrate that both simple multiple linear regression calibration methods for bias-correcting LCS and more complex machine learning methods can reduce bias in LCS to close to zero, while increasing correlation. For example, in Kampala, Raw PurpleAir PM2.5 data are strongly correlated with the BAM-1020 PM2.5 ($r^2$ = 0.88), but have a mean bias of approximately 12 µg $m^{-3}$. Two calibration models, multiple linear regression and a random forest approach, decrease mean bias from 12 µg $m^{-3}$ to -1.84 µg $m^{-3}$ or less and improve the the $r^2$ from 0.88 to 0.96. We find similar performance in several other regions of the world. Location-specific calibration of low-cost sensors is necessary in order to obtain useful data, since sensor performance is closely tied to environmental conditions such as relative humidity. This work is a first step towards developing a database of region-specific correction factors for low cost sensors, which are exploding in popularity globally and have the potential to close the air pollution data gap especially in resource-limited countries.