Practical challenges of using PurpleAir-II-SD Low-cost sensors for Air Quality Monitoring in sub-Saharan Africa

Air Sensors International Conference - 11 May 2022

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The Gambia…Smiling Coast of Africa

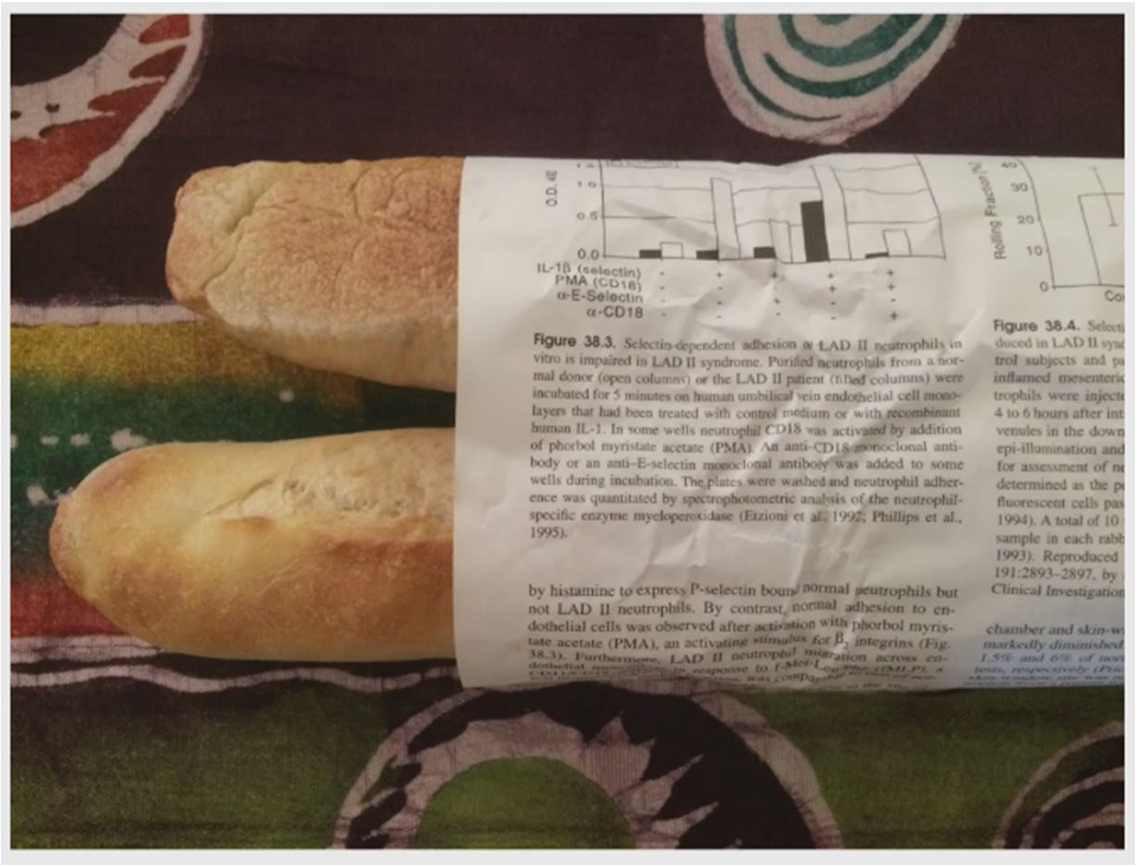

Figure 38.3. Selectin-dependent adhesion of LAD II neutrophils in vitro is impaired in LAD II syndrome. Purified neutrophils from a normal donor (open columns) or the LAD II patient (filled columns) were incubated for 5 minutes on human umbilical vein endothelial cell monolayers that had been treated with control medium or with recombinant human IL-1. In some wells neutrophil CD18 was activated by addition of phorbol myristate acetate (PMA). An anti-CD18 monoclonal antibody or an anti-E-selectin monoclonal antibody was added to some wells during incubation. The plates were washed and neutrophil adherence was quantitated by spectrophotometric analysis of the neutrophil-specific enzyme myeloperoxidase (Etzioni et al., 1992; Phillips et al., 1995).

by histamine to express P-selectin bound normal neutrophils but not LAD II neutrophils. By contrast, normal adhesion to endothelial cells was observed after activation with phorbol myristate acetate (PMA), an activating stimulus for β2 integrins (Fig. 38.3). Furthermore, LAD II neutrophil migration across en-

Figure 38.4. Selecti
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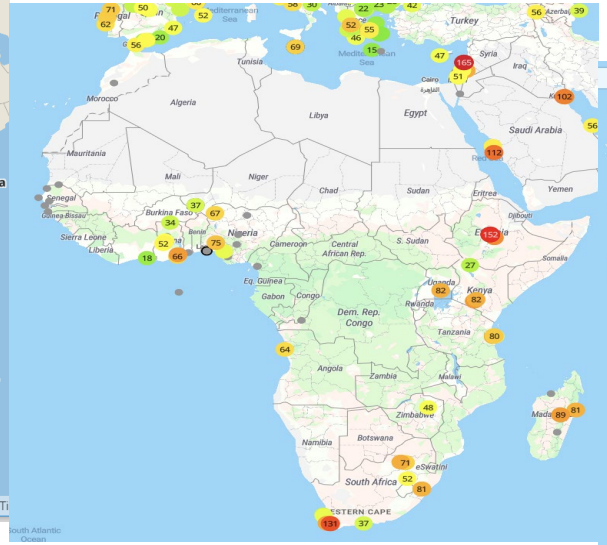
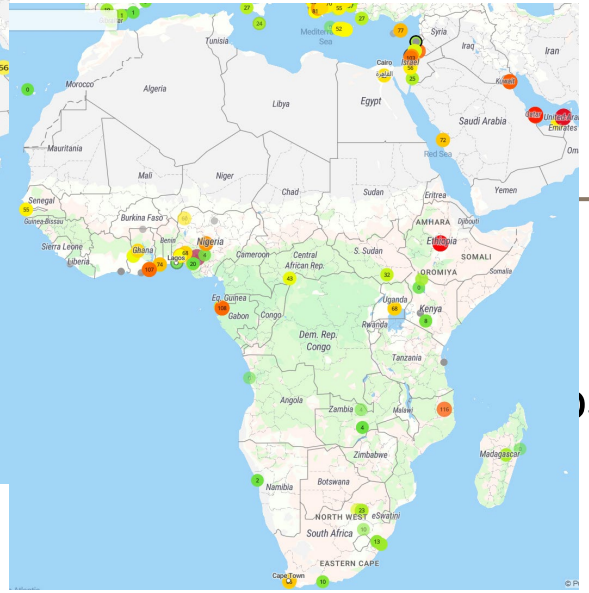
Conflict of Interest

I have no disclosures to make

I do not have any conflict of interest

Background





- The future of cit
  Africa and other
  sensor networks.
  ost

- As attractive as this prospect is, the deployment of the latter is froth with challenges that affect the overall aim of continuous air pollutant measurement.

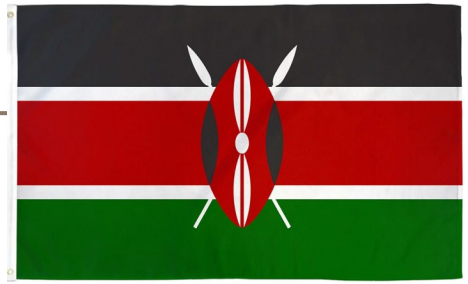
- We report the practical challenges we experienced during the pilot project “Measuring Air Quality in Africa for Advocacy” (MA3) in seven African countries.

The MA3 Consortium

- Initiative of the MA3 Consortium (ACCA, LSTM, Lancaster University, University of Stirling)
- Exposure scientists from nine different countries in sub-Saharan Africa
- Sole goal is to organize a network of low-cost sensors for continuous Ambient $PM_{2.5}$ measurement in urban cities in SSA
- Launched in May 2019 at Pan African Thoracic Society MECOR course in Dar Es Salaam, Tanzania. Training was facilitated by Dr Gabriel Okello, Prof Sean Semple & myself.

MA3 Participating Countries






Ambient $PM_{2.5}$ to be collected by 15 Exposure Scientists from 9 countries trained in air quality monitoring under the measuring air quality for advocacy initiative (MA3).

Methodology

- PurpleAir-II-SD devices were given to 15 participants at an AQM workshop. Thirteen exposure scientists from seven countries (Gambia, Kenya, Uganda, Benin Republic, Burkina Faso, Cameroon and Nigeria) eventually installed the instruments and participated in pilot data collection throughout July 2019.

- The ambient $PM_{2.5}$ data was downloaded from the SD memory cards weekly, zipped and passworded and sent via email to the PI who then cleaned and analysed the data

- A log of challenges encountered was kept by all exposure scientists, zipped and sent to the Principal Investigator weekly alongside the site datasets.

- Coordination and remote support provided via a WhatsApp® platform

Methodology- PurpleAir Installation Site Agreements

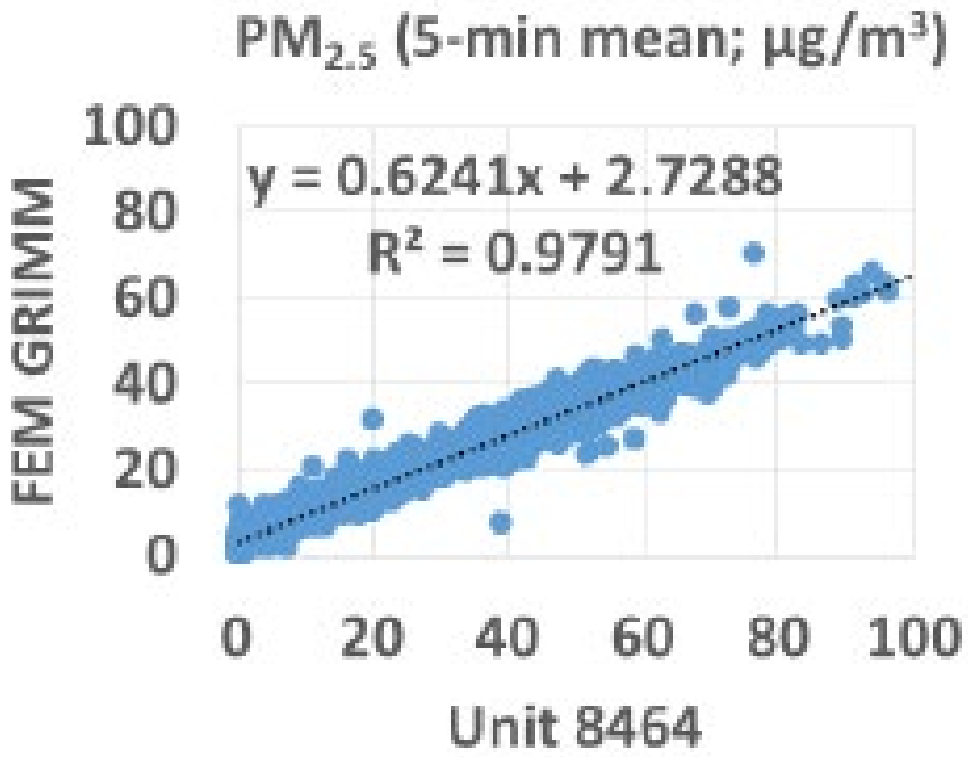
- Purple Air-II-SD device and one 20,000 mAh long-lasting portable Anker® power bank (Anker Innovations, Changsha, China).

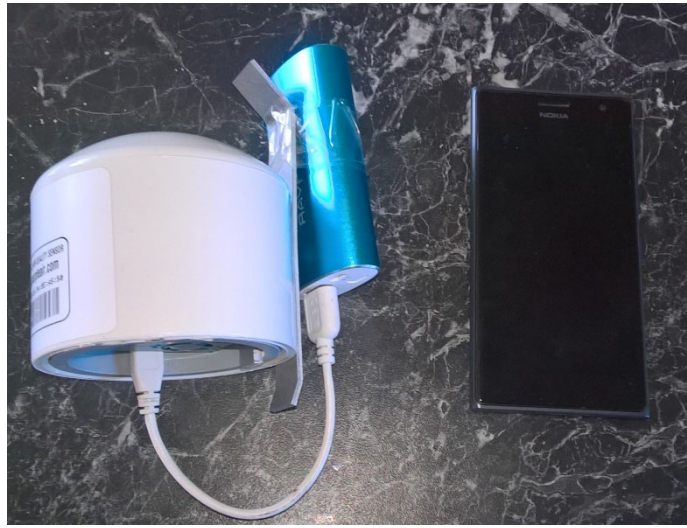
- Standard operating procedures for installing and mounting the Purple Air-II-SD device at each site : Device is
  - (i) Sited away from obstructions e.g. walls, big trees etc;
  - (ii) A good distance away from a road with heavy traffic i.e., minimum 100 m ;
  - (iii) Placed at two meters from the ground level for uniformity and ease of data comparability;
  - (iv) Sited away from non-traffic particulate matter sources such as grills, generators, incinerators, AC vents etc.

- *NB: Post installation pictures were taken and sent to the group.*

Purple Air-II-SD : ubiquitous tool. Undergone validation

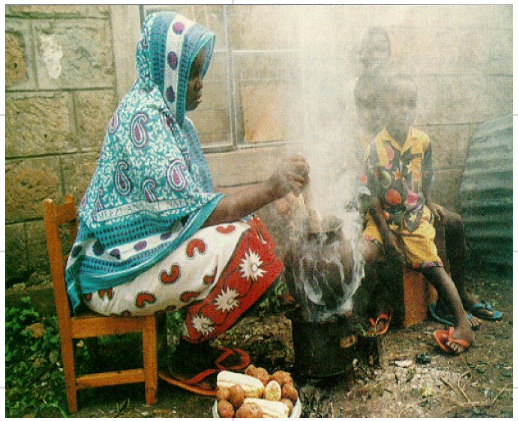
- Independent evaluation data shows very good agreement (R^2>0.95) with gold standard instruments





http://www.aqmd.gov/aq-spec/evaluations/field

Does the Purple Air accurately measure high concentrations of smoke?



Results- Data recovery from the sensors at the MA3 sites

Country*	Town & City	Number of Records logged (n)	PA° time periods (N)	Data recovery rates (%)	Daily period average (µg/m³)
The Gambia	Fajara, Kombo	20,636	22,320	94.7%	15.6
Burkina Faso	Balkuy, Ouagadougou	21,142	22,320	94.7%	19.4
Benin Republic	Akpakpa, Cotonou	30,799	33,480	92.0%	22.1
Nigeria	Abakaliki Rd, Enugu	32,999	33,480	98.6%	28.8
Nigeria	Trans-Ekulu, Enugu	31,139	33,480	93.0%	30.3
Nigeria	Goshen, Enugu	35,322	33,480	105.5%	22.1
Nigeria	New Haven, Enugu	31,241	33,480	93.3%	30.3
Nigeria	Awka, Anambra	31,500	33,480	94.1%	33.0
Kenya	Ngong Rd., Nairobi	22,320	22,320	100.0%	38.8
Nigeria	Nnewi, Anambra	21,078	22,320	94.4%	52.3
Uganda	Ntinda, Kampala	21,312	22,320	95.5%	91.1
Nigeria	Bariga, Lagos	24,148#	33,480	72.1%	56.3

Results- Data recovery from the sensors at the MA3 sites

- Data recovery ranged from 72.1% (Bariga-Lagos-Nigeria) to 100% (Nairobi, Kenya);
- The overall median recovery rate was 94%.
- All sites recorded daily $PM_{2.5}$ averages higher than 15 µg/m^3 (WHO recommended threshold);

Results- Practical Challenges encountered

- Practical challenges experienced in the process of use of the Purple Air-II-SD sensors were
  - Power and power pack outages,
  - Device set-up issues
  - SD memory card issues,
  - Internet connectivity problems and
  - Sensor hardware maintenance concerns.

- *NB: Only two sites could sustain wi-fi access for one month*

Issues	Specific Characteristics	Reports n (%)
Power Issues	– No power problems reported	5 (41.7%)
	– Irregular electricity supply	4 (33.3%)
	– Additional Power bank needed	1 (8.3%)
	– Use of electricity generators	2 (16.7%)
Device Set-up	– No set-up issues reported	6 (50%)
	– Finding suitable location for device set-up	2 (16.7%)
	– Incurring extra cost for assisted device set-up	2 (16.7%)
	– Keeping device safe from theft, children, etc.	1 (8.3%)
	– Connecting to Wifi	1 (8.3%)
Memory Card	– No SD memory card problems	10 (83.3%)
	– Problems with removal and re-insertion of SD card	2 (16.7%)
Data download	– No data downloaded problems reported	8 (66.7%)
	– Extracting data from wifi	1 (8.3%)
	– Card reader issues	3 (25%)

Conclusions

- Main challenges identified were power, device set-up issues, internet connectivity & SD memory card problems.
- These challenges were overcome through creative solutions;
- $PM_{2.5}$ longitudinal measurement can be reasonably satisfactorily executed in sub-Saharan African countries using the Purple Air-II-SD device.

Acknowledgements

Prof. Kevin Mortimer
Dr. Gabriel Okello

Dr. Chris Jewell
Dr. Olatunji Johnson

Prof Graham Devereux

Ass. Prof Sean Semple
Dr. Ruaraidh Dobson

Dr. Annette Erhart

African Centre for Clean Air
MA3 Consortium & Associates

Air Sensors Int. Conf.

CAMS-Net

Endurance Awokola

Air sensing to action in the African context: design and deployment of a community-driven digital air quality sensing network for African cities. -

Engineer Bainomugisha, AirQo/Makerere University

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Session Q&A Discussion

Please submit your questions for the session speakers through Whova – on your mobile or desktop device.

Make sure to note WHOM your question should be addressed to.

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Thank you for joining Part 1 of the session!

Part 2 will begin momentarily.

<u>Session 5A Part 2 Speakers:</u>

Dan Westervelt, *CAMS-Net*
Michael Johnson, *Berkeley Air*
Priyanka deSouza, *University of Colorado Denver*
Michael R Giordano, *AfriqAir*

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