High-resolution spatiotemporal measurement of air and environmental noise pollution in sub-Saharan African cities: Pathways to Equitable Health Cities Study protocol for Accra, Ghana

Raphael E Arku, Sc.D.
University of Massachusetts Amherst

www.equitablehealthycities.org

Multi-country and multi-institution effort

Abosede Sarah Alli

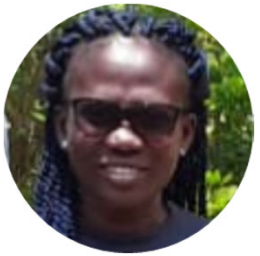
University of Massachusetts Amherst

Sierra Clark

Imperial College London

Solomon Baah

University of Ghana



Josephine Moses

University of Ghana

James Nimo

University of Ghana

Jiayuan Wang

University of Massachusetts Amherst

Allison Hughes

University of Ghana

Raphael E Arku

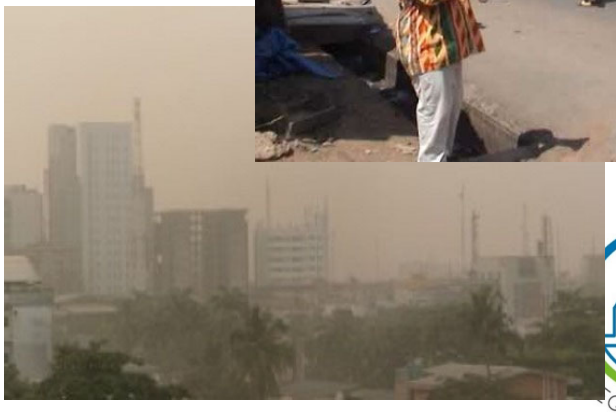
University of Massachusetts Amherst

Other contributing Pathways team members

Imperial College London: Majid Ezzati; James Bennett; Frank Kelly; Ben Barratt;
University of Ghana: Samuel Agyei-Mensah; Ernest Agyemang; George Owusu
University of British Columbia: Michael Brauer
McGill University: Jill Baumgartner

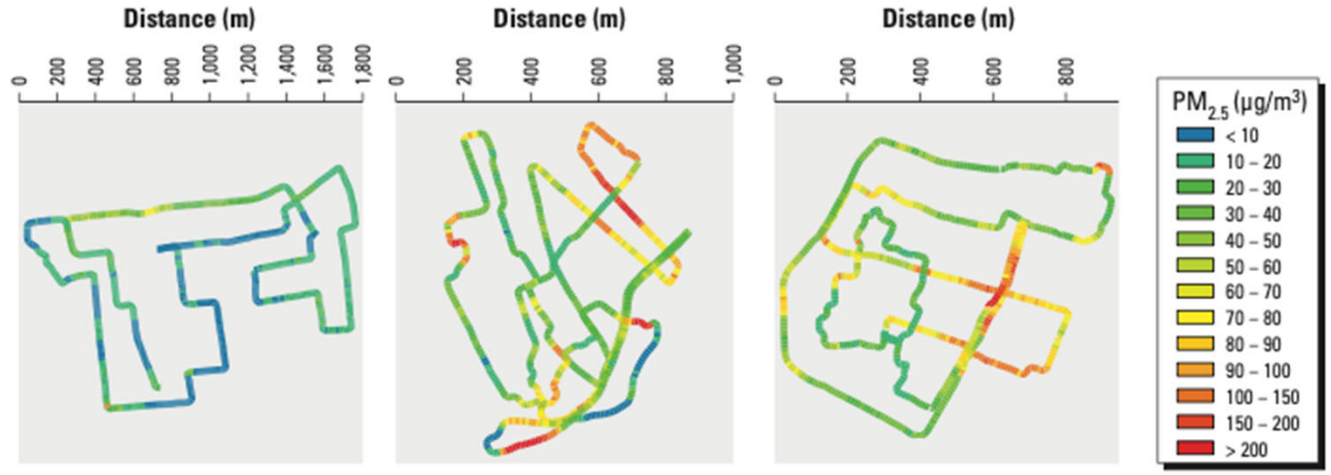
PATHWAYS TO EQUITABLE HEALTHY CITIES

Diverse pollution sources in SSA cities



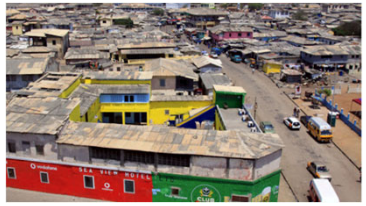
Inequalities and sources of pollution

Within & between neighbourhood variation in $PM_{2.5}$ air pollution in Accra (2006-2007)



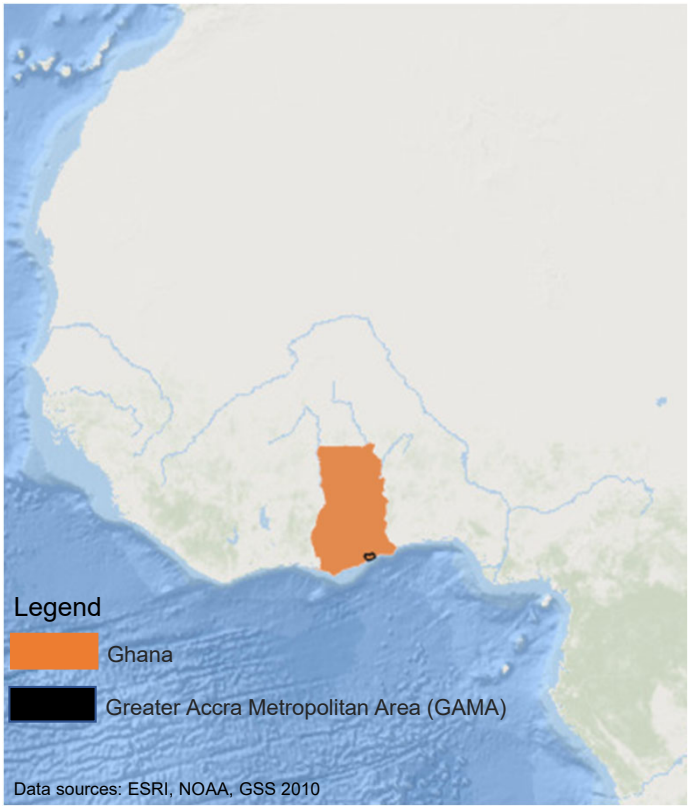
High-income neighborhood

Low-income neighborhoods



Dionisio et al. EHP. 2010; Zhou et al. PNAS. 2011

Urban and economic expansion in Accra, Ghana

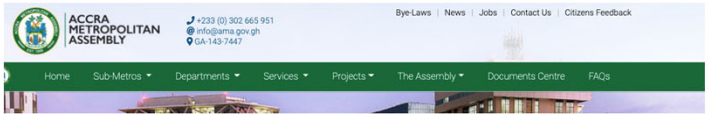


- Population doubled in past three decades.
- Vehicle ownership and use is increasing.
  - 59% of all vehicles are in GAMA.

Kwame interchange ~2012

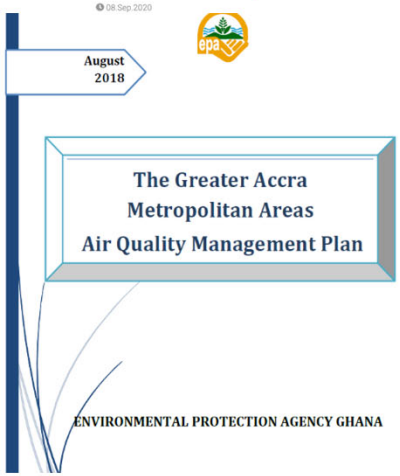
Kwame interchange 2016

Air and noise pollution in Accra



AMA Boss calls for concerted efforts to address air pollution, disclose interventions to promote non-motorised transport in Accra

08 Sep 2020



Accra first African city to join BreatheLife Campaign

Ghana: EPA Sensitizes Stakeholders On Noise Pollution

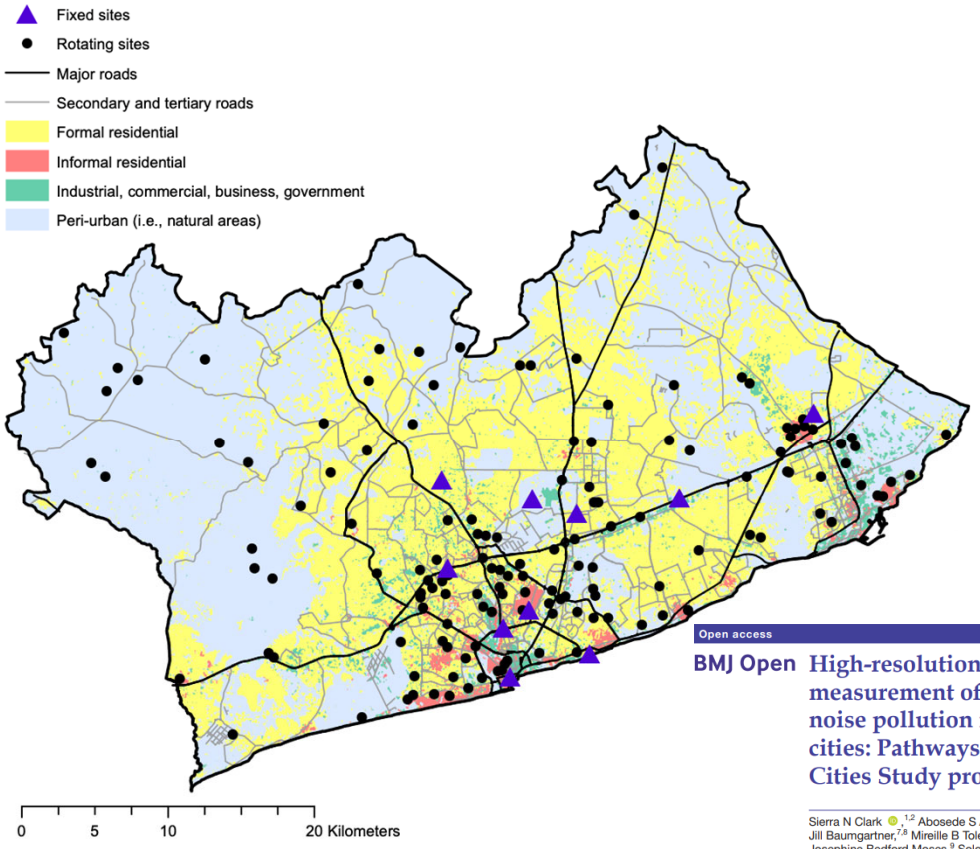
Government of Ghana (Accra)

17 OCTOBER 2016

PRESS RELEASE

Research engagement workshop with societal partners Oct 2019

Pathways measurement campaign (April 2019 – current)



Adapted from Clark et al. BMJ Open. 2020

Open access Protocol
BMJ Open

High-resolution spatiotemporal measurement of air and environmental noise pollution in Sub-Saharan African cities: Pathways to Equitable Health Cities Study protocol for Accra, Ghana

Sierra N Clark ,[1,2] Abosede S Alli,[3] Michael Brauer,[4] Majid Ezzati,[1,2,5,6] Jill Baumgartner,[7,8] Mireille B Toledano,[1,2] Allison F Hughes,[9] James Nimo,[9] Josephine Bedford Moses,[9] Solomon Terkpertey,[9] Jose Vallarino,[10] Samuel Agyei-Mensah,[11] Ernest Agyemang,[11] Ricky Nathvani,[1,2] Emily Muller,[1,2] James Bennett,[1,2] Jiayuan Wang,[3] Andrew Beddows,[2] Frank Kelly,[2,12] Benjamin Barratt,[2,12] Sean Beevers,[2] Raphael E Arku[3]

Examples of sites

Motorway

Peri-urban greenspace

New Developments

High-density commercial and residential

Pollutants monitored

Particulate Matter ($PM_{2.5}$) concentrations

Oxides of Nitrogen (NO_x, NO_2)

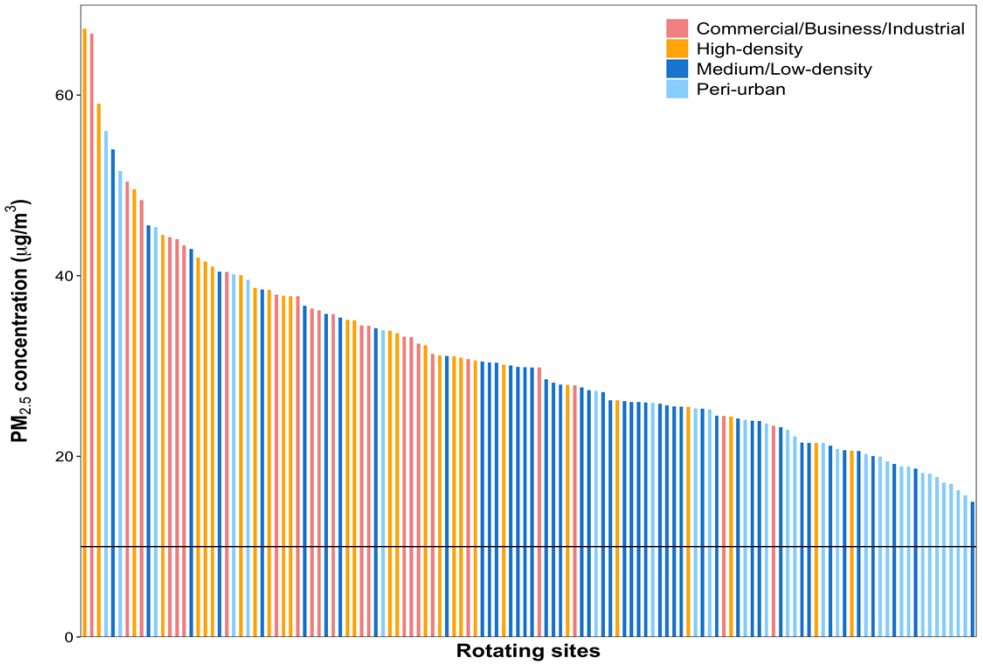
Sound levels

Meteorology

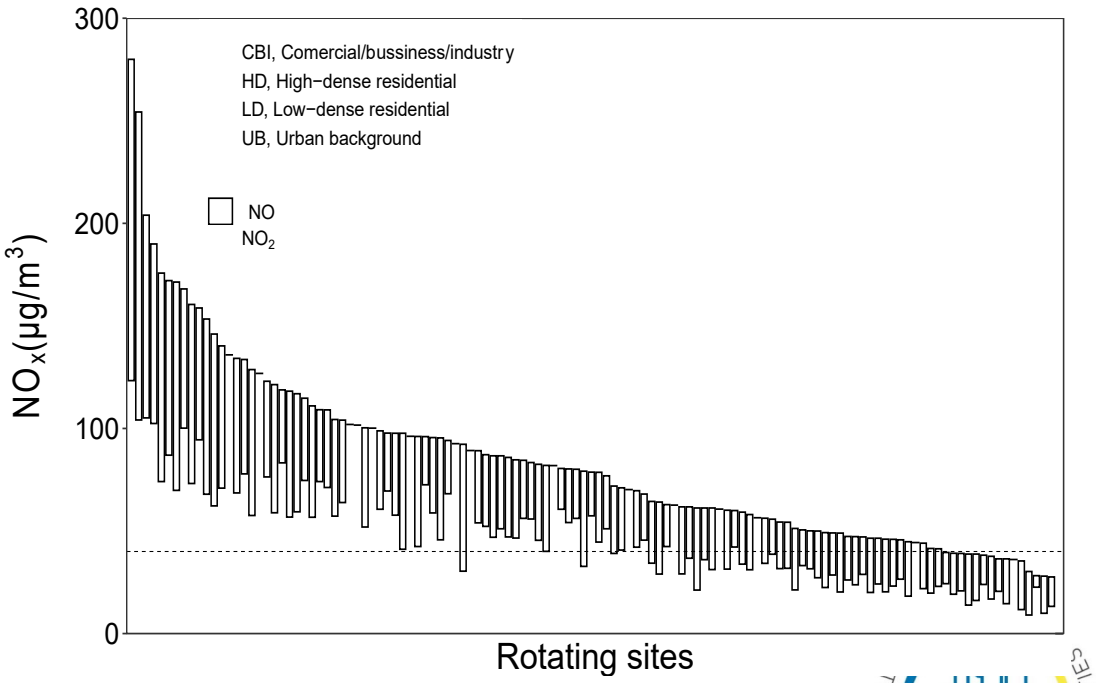
Adapted from Clark et al. BMJ Open. 2020

$PM_{2.5}$ and NOx ($NO+NO_2$) pollution varied widely by space

Spatial variation in $PM_{2.5}$



Spatial variation in NOx ($NO + NO_2$)



Horizontal lines represent WHO annual $PM_{2.5}$ guideline (10μg/m^3) and NO_2 guideline (40 μg/m^3)

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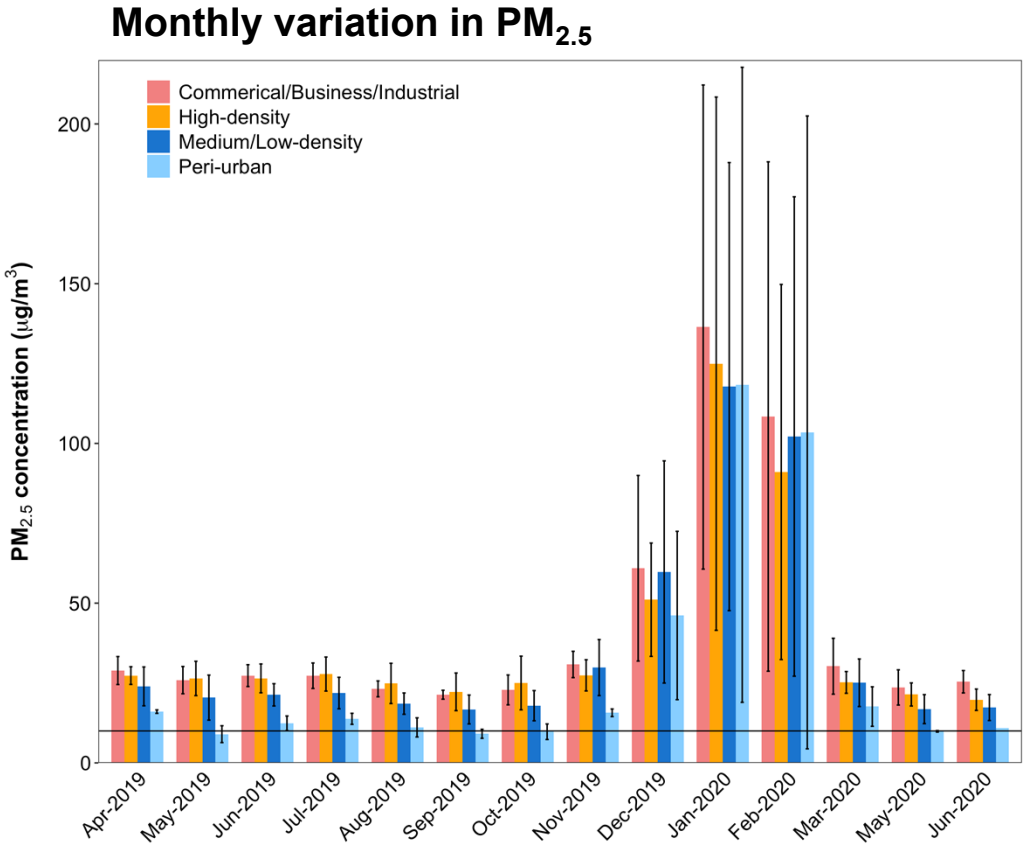
Levels also varied by season (Harmattan vs non-Harmattan)



- NO_2 levels also elevated during the Harmattan period (Dec – Feb)
- Same as BC

Horizontal lines represent WHO annual $PM_{2.5}$ guideline (10µg/m^3)

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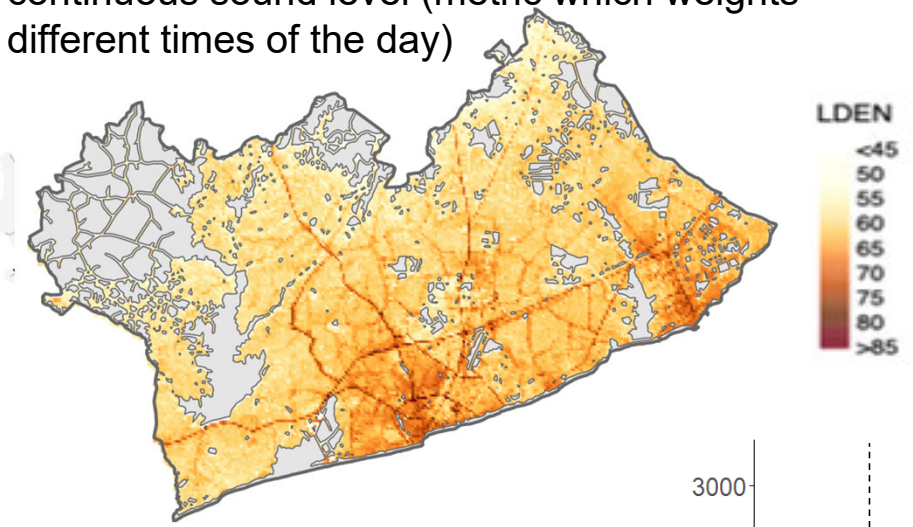
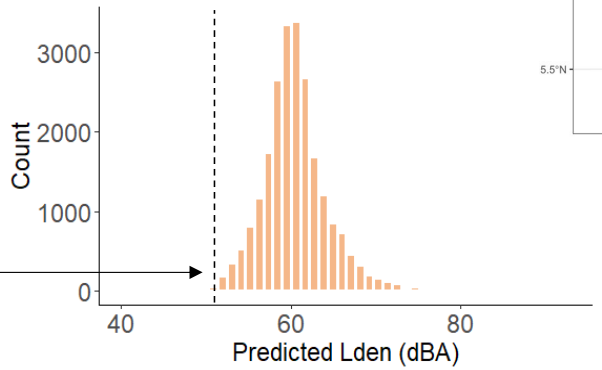
Space-time land use regression models

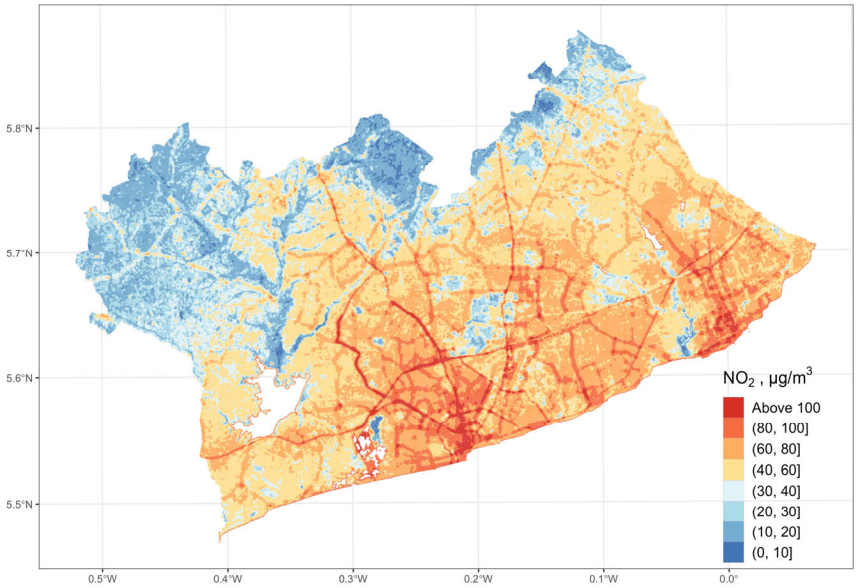
L_{den}: Day-evening-night weighted equivalent continuous sound level (metric which weights different times of the day)





WHO – European guideline exposure to road-traffic noise (53 dBA)

NO_2 concentrations



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Recap of findings/implications

- Substantial spatial variation in air pollution and noise levels in the GAMA
  - Socioeconomic inequalities in noise exposure
- Air pollution ($PM_{2.5}$, NO_2) and noise levels exceeded international (i.e., WHO) health-based guidelines almost everywhere
- Air and noise pollution levels higher than many other North American and European cities, though for $PM_{2.5}$ air pollution levels still lower than major cities in China and India
- Both $PM_{2.5}$ and NO_2 were elevated during harmattan due in part to contribution of dust and changes in local meteorology, which might have enhanced local levels
- A multisectoral policy approach is needed to improve environmental quality and protect public health

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Ongoing/planned analyses and next steps

Measurement

- Develop land use models to predict at all locations in the GAMA:
  - $PM_{2.5}$/Black Carbon
  - NO_2
  - Temperature
  - Chemical composition/sources

- Characterize human environment and activity with street images and deep convolutional neural network

Health impact

- Impacts of the measured parameters on maternal health, child survival and developmental outcomes

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Our Planet, Our Health

University of Massachusetts Amherst

CIHR IRSC

Canadian Institutes of Health Research | Instituts de recherch en santé du Canada

Imperial College London

UNIVERSITY OF GHANA