

Overview of Air Quality Monitoring in Accra, Ghana



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Presentation Outline

- ▶ Introduction
- ▶ Characterization challenges in Ghana
- ▶ Standard Air Quality Network
- ▶ Low Costs Sensors - Co-location and validation
- ▶ Data Management
- ▶ Lessons learnt to date
- ▶ The Way Forward

Introduction



- ▶ Air pollution is a leading environmental health risk humans face.
- ▶ WHO estimates 6.5 million deaths/annum attributable to Ambient & Indoor Air pollution
 - ▶ Increased mortality from stroke, heart disease, lung cancer, chronic obstructive pulmonary diseases and respiratory infections, including pneumonia.
- ▶ Global urban population is expected to double by 2050, with most of this growth occurring in low and middle-income cities like Accra
 - ▶ Rapid urbanization is outpacing the provision of the necessary infrastructure and services.
- ▶ Nationwide in Ghana, 14,000 deaths/year from Household air pollution (HAP); 5,000 deaths of children under 5yrs (GHS, 2010).
- ▶ In Accra, current health burden:
 - ▶ Over 2,800 deaths/year from exposure to PM. (2015 data);
 - ▶ Projected to increase to over 3,000 deaths/yr in 2020 and over 4,500 deaths/yr in 2030.
 - ▶ Implementing new AQMP could save nearly 430 deaths per year by 2030 Source: EPA Ghana, 2018.

Characterization Challenges

- ▶ Current urban scale PM monitoring is by 6-day monitoring regime; and by gravimetric method
- ▶ Lack of monitoring of key gaseous pollutants (CO, SO₂, NO₂, O₃)
- ▶ Limited chemical speciation analysis and health benefit analysis after training by USEPA.
- ▶ Source apportionment (PMF) yet to be undertaken
- ▶ Impact attributions of Household Air Pollution (HAP) on ambient air quality in Gt. Accra is unknown
- ▶ Lack regulatory grade real time continuous ambient air quality monitors
- ▶ Unable to timely report air quality information to the public
- ▶ Real-Time Challenges & Requirements:
 - Lack regulatory monitors to validate low-cost sensors (planned for early 2019)
 - Computation of large vol. of data (8-hr and 24-hr averages) from low-cost sensors & converting into AQI for daily reporting
 - Possibility of misleading averages. Averages must not be misleading (and be easy and quick to compute)
 - *Need to look at USEPA's NowCast to relate hourly data to the AQI*

STANDARD AAQM EQUIPMENT & AAQ Sensors

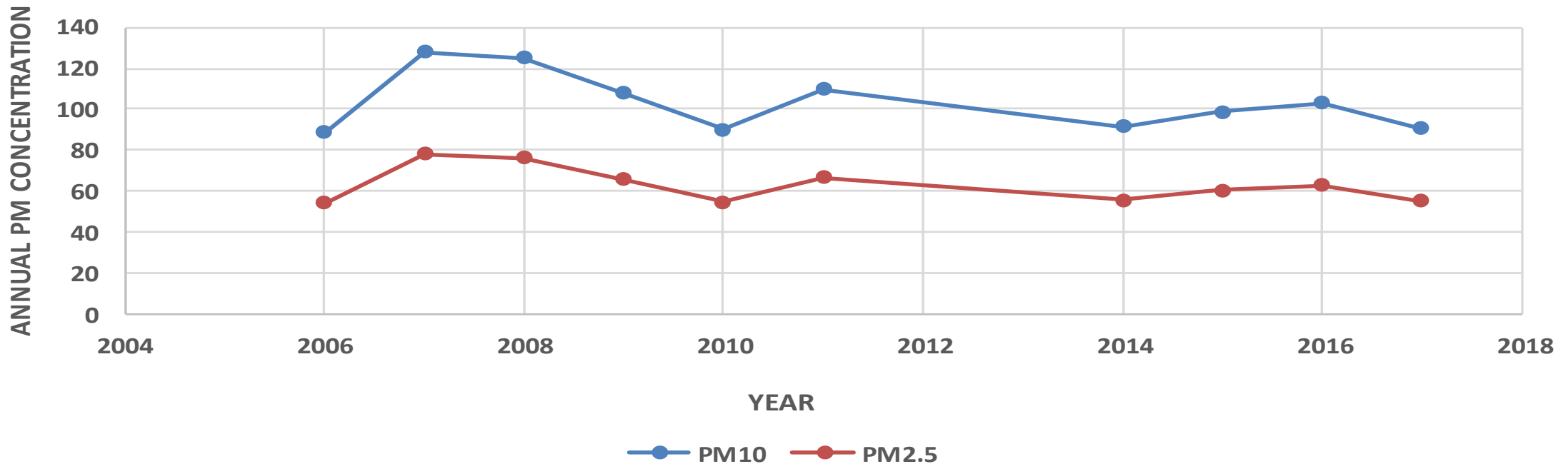


Current and Historical Air Quality



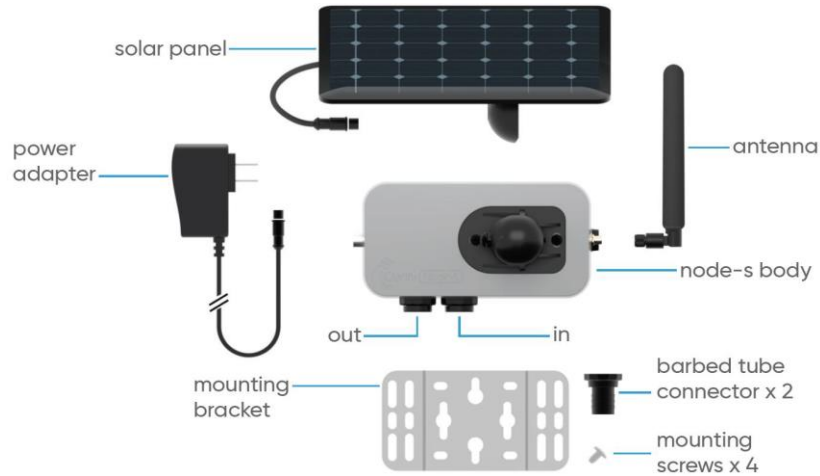
- ▶ Current conditions, as characterized by roughly 13 years of PM air quality monitoring results, present an unacceptable health burden for the population of Accra, and are not in line with international standards for air quality.

Fig. 1 Trend of Annual PM10 & PM2.5 Concentrations ($\mu\text{g}/\text{m}^3$) in Accra



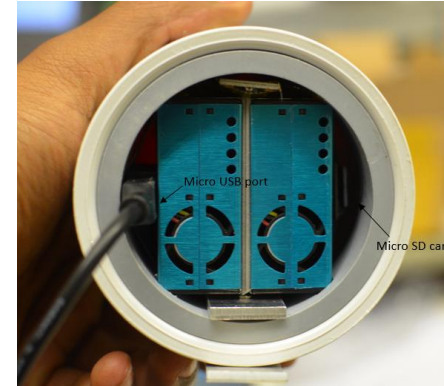
EPA Ghana Network-Low Cost Sensors

Clarity Sensor



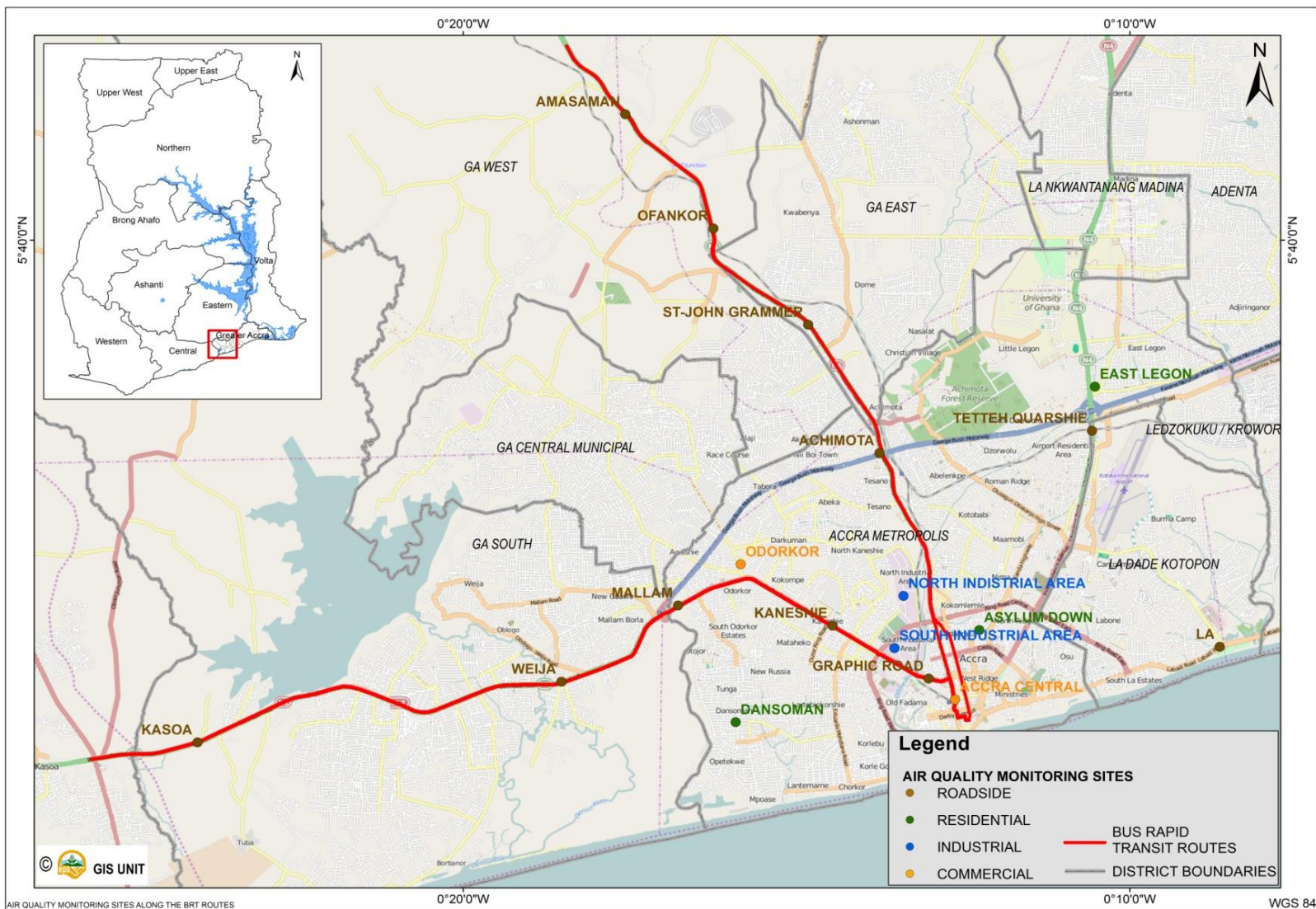
- ▶ Measures PM10, PM2.5 and PM1
- ▶ Line power units measure 90 sec every 5 minutes; solar every 15 minutes.
- ▶ Data transmitted in parallel to Clarity for performance/ troubleshooting and to AirNow-Ghana system using an API

Purple Air (using SD card for data retrieval)



- ▶ Measures PM10, PM2.5
- ▶ Line power, measures every 80 seconds and records in text file to SD card (offline mode)
- ▶ Data transmitted to AirNow-Ghana system via FTP. Data file retrieved every 3-4 weeks

2018 EPA Ghana Air Quality Monitoring and Sensor Network



15 Standard Gravimetric Samplers:

- 5 hi-vol
- 11 mini-vol

Low-cost Sensors

- 18 Clarity Node-S
- 5 Off-line purple air

Sensors Located at 10 sites

- 4 permanent sites w/power
 - 1 hi-vol
 - 3 Clarity Node-S
 - 1 purple air
- 1 permanent site w/o power
 - 1 Clarity Node-S on solar
- 5 roadside cages w/o power
 - 1 Clarity Node-S on solar

Meteorology Units

- 3 installed at powered sites

Co-location and Validation

- ▶ August 2018 - all sensors co-located at EPA Ghana for 6 days
- ▶ Sensor data will be compared to higher quality reference equipment data in order to calibrate the sensor data - this process is referred to as co-location
- ▶ Sensor data can also be compared between sensors to check for agreement



Co-location and Validation (part 2)

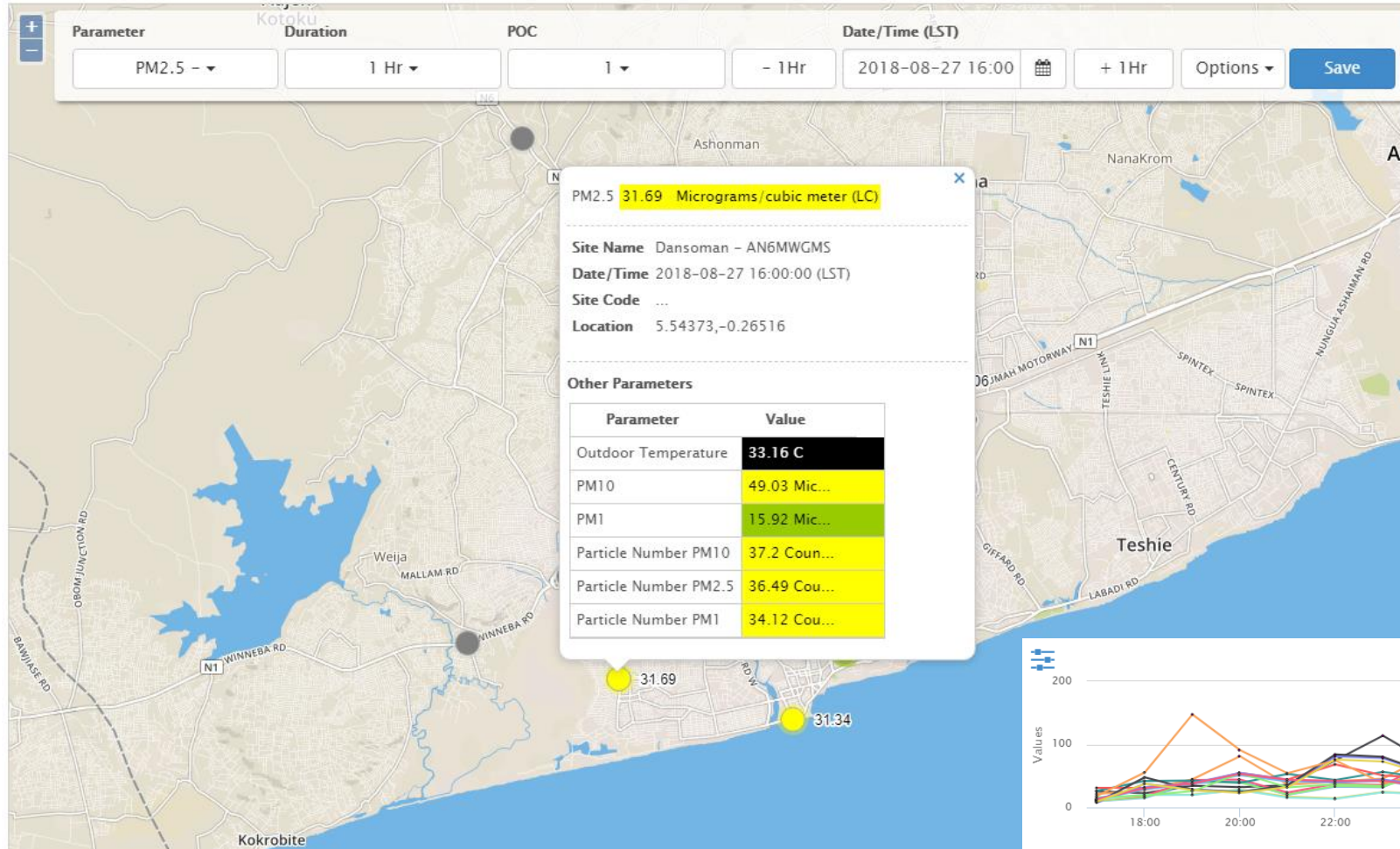
- ▶ World Bank Pollution Management and Environmental Health (PMEH) initiating project in Accra
 - ▶ In 2019 will be purchasing and siting 2 regulatory grade (federal equivalency method - FEM) monitors and accompanying met stations
- ▶ Once established, all sensors will be co-located with PMEH monitors for validation and calibration
- ▶ Establishing standards operating procedures for regular co-location and calibration.



Example of a regulatory grade (FEM) monitor station

Data Management: EPA Ghana-AirNow System

» My Dashboard

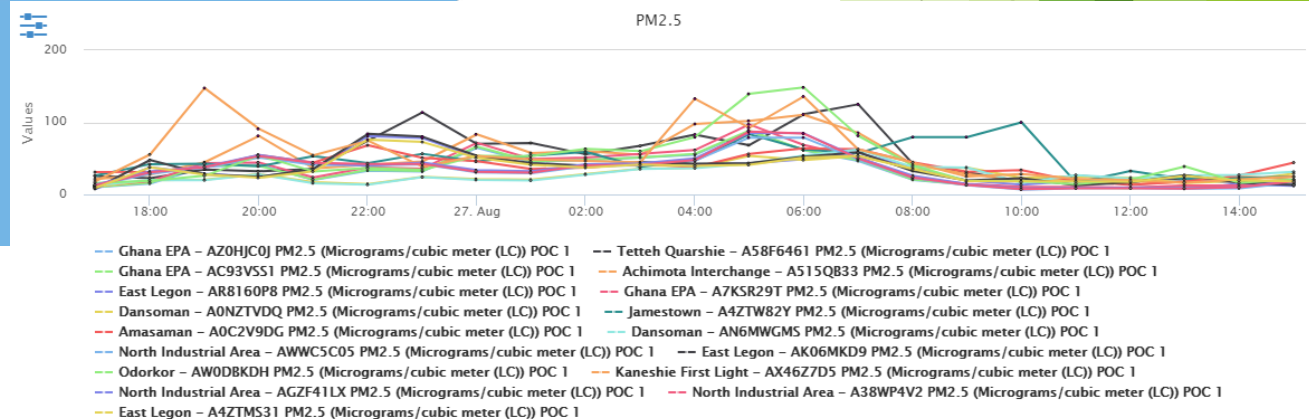


Management of real-time data:

- Clarity sensors
- Met data
- Historical data (including Purple Air sensors since running in off-line mode)
- Query and Reports

GIS Visualization

- Satellite data and air quality observations
- HYSPLIT and AOD
- Pollution/Wind Roses





Lessons Learnt to date in efforts to deploy sensors

- ▶ Air quality monitoring in Accra requires higher commitment to ensure continuity
- ▶ Need to discuss responsibilities and expected outcomes during design phase.
- ▶ Need to ensure adequate time & resources (equipment type/cal/measuring range/detection limit/accuracy & precision, consumable, adequate staff, budget etc.) are available
- ▶ Need to assess sensor capabilities and challenges; Discuss the data plan (e.g., analysis) and limitations of the data
- ▶ Need to conduct more studies into air quality (HAP & Ambient) problems for decision making
- ▶ Need to understand data ownership and management issues
- ▶ For accuracy, we need to allow free air flow to the sensor; inlets to personal exposure monitors should have access to the air the person is inhaling; taking preliminary measurements to help identify a good monitoring location).
- ▶ Calibration of sensors. Needed to compare one sensor with another or to compare with nearby regulatory grade monitors (Collocation with regulatory grade monitors:-Linear regression used to normalize sensor signals)
- ▶ Maintenance of sensor/monitoring equipment for effective performance; and data quality (QA/QC requirements) and management
- ▶ Security of the monitoring equipment/sensors

The Way Forward



► For Air Quality Monitoring

- Procure and install standard real-time continuous monitors and co-locate with the Low-Cost Real Time (LCRT) monitors
- Explore real-time air quality index via AirNow-Ghana available to the public
- Check the efficiency/accuracy of the LCRT monitor for future deployment across all regional capitals of Ghana, where there is lack of air quality monitoring.
- Other African countries who do not have air quality monitoring system could also be encouraged to use/deploy some of the LCRT monitors for AQ studies.

► For Air Quality Management Planning

- Facilitate the publication of the ambient and point source air quality standards, and all relevant regulations,
- Encourage all relevant players identified in the AQMP to implement their respective roles to ensure reduction of air pollution in the GAMA.
- Collect relevant information to support the review of Air Quality Standards in future

Let's join hands to reduce air emissions &
improve public health

Thank you!

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