Quality assurance of air quality data

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Quality Assurance

Why is this necessary;

Improve and increase of confidence levels in data and analyses

- Maintain accuracy
- Ensure consistency of measurements
- Minimise measurement errors
- Ensure data reliability

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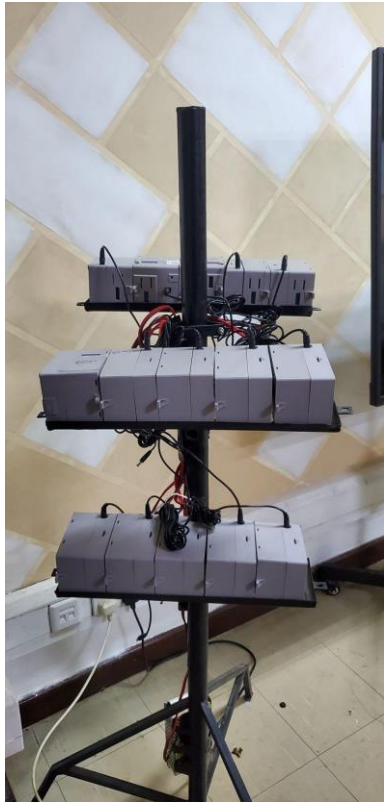
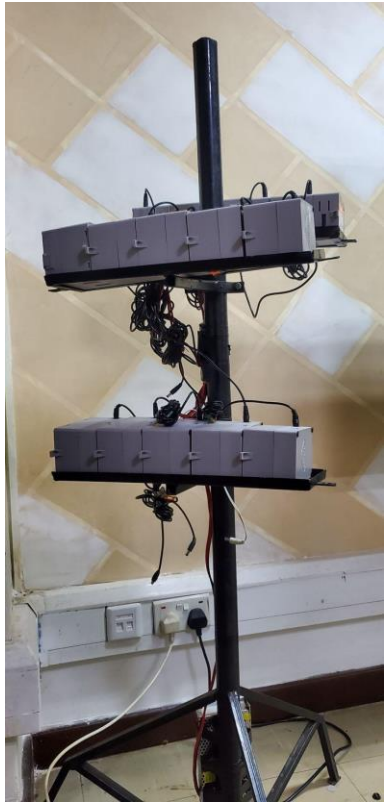
Quality assurance Procedures

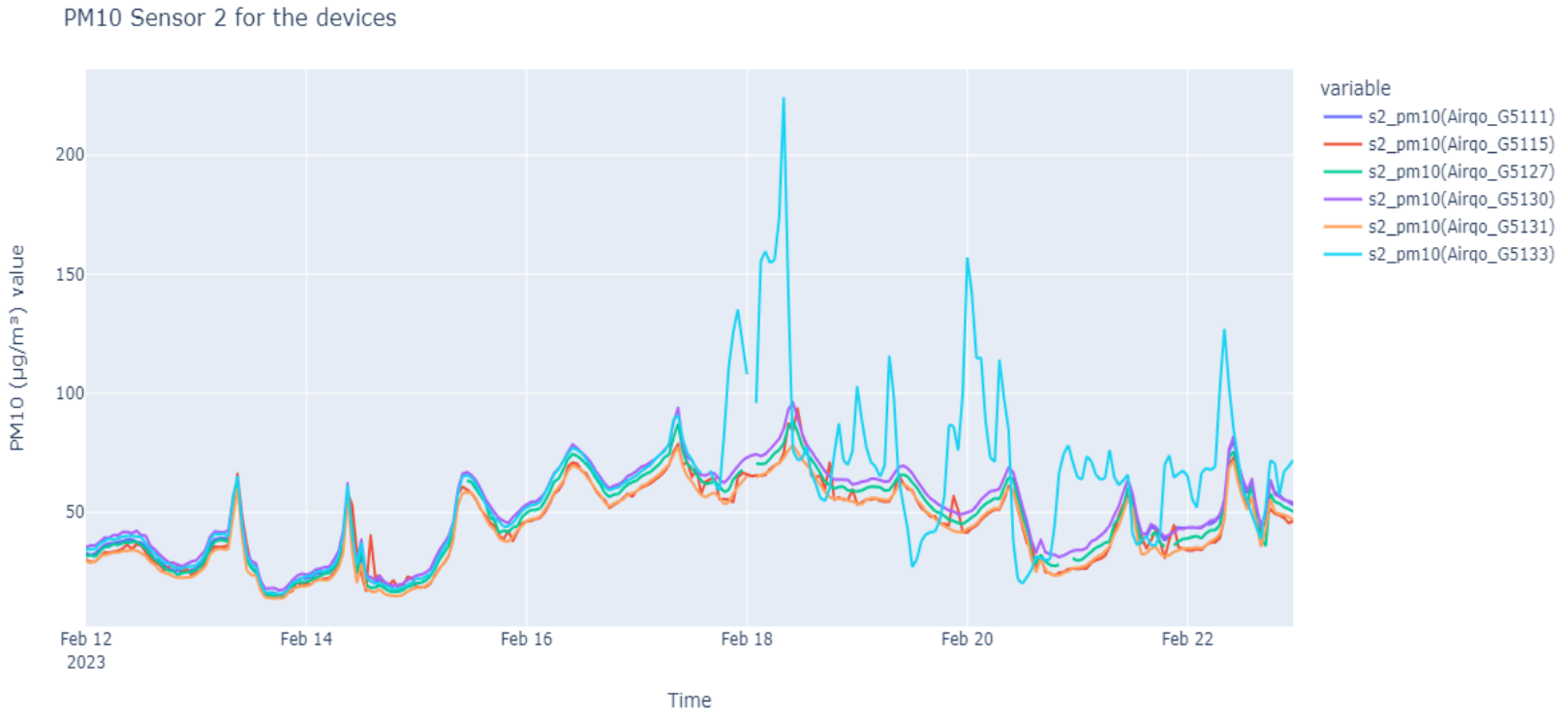
In Lab Colocation for AirQo monitors





- Inter Device **Performance evaluation** in lab setting**.**
- Evaluation of performance against organisation threshold
- Sensor1, Sensor2, internal and external temperature and humidity sensor performance review.

In Lab Colocation for LCS

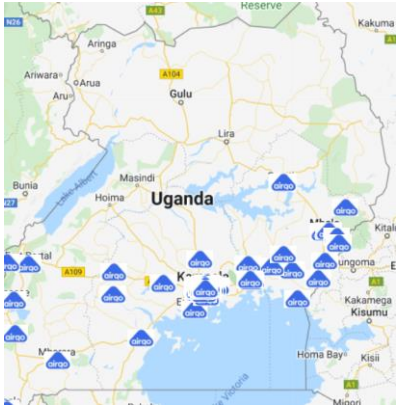


Field Colocation for LCS

- Inter Device **Performance evaluation** in field setting**.**
- Sensor1, Sensor2, internal
- External temperature and humidity sensor performance review.
- Performance evaluation VS Met One BAM1022

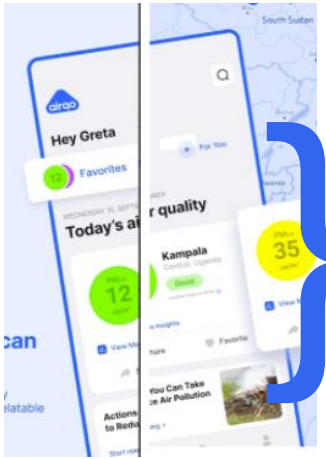
Device monitoring and maintenance

Overview of the Air quality data pipeline



Physical network

1. Custom sensor network monitoring
2. Data (pre)processing and storage
3. AI-powered calibration model
4. Analytics modelling: spatial and temporal modeling
5. Air quality data access: digital platforms and API



Public data access through custom digital platforms and API

Data Sources and Collection Methods

- AirQo monitors
  - streamed via GSM network to the analytics platform
- Reference monitors (AirQo)
  - Streamed via GSM network to the analytics platform (Involves using the BAM logger)
  - Collected via flash disk
- Reference monitors (partners)
  - Streamed via GSM network to the analytics platform (UNEP)
  - Downloaded via CSV from partner websites (e.g. https://www.airnow.gov)

Data Sources and Collection Methods

- Low-cost monitors (partners)
  - Data integrated into the AirQo analytics platform (e.g Clarity devices installed by KCCA)
- Weather data
  - Streamed from Tahmo
  - Accessed via CSV from Met office
- Satellite data (potential)
  - Can be downloaded via various platforms including Google Earth Engine, official websites or code

Preprocessing: data quality metrics

- Accuracy
  - Correctness of the data
- Completeness
  - Affects the outcomes & insights of data analysis
- Timeliness
  - Important for near realtime applications e.g mobile APP

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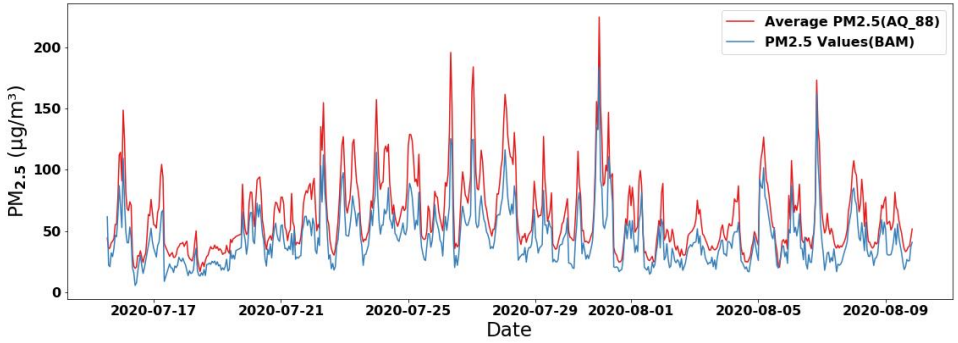
Field Calibration

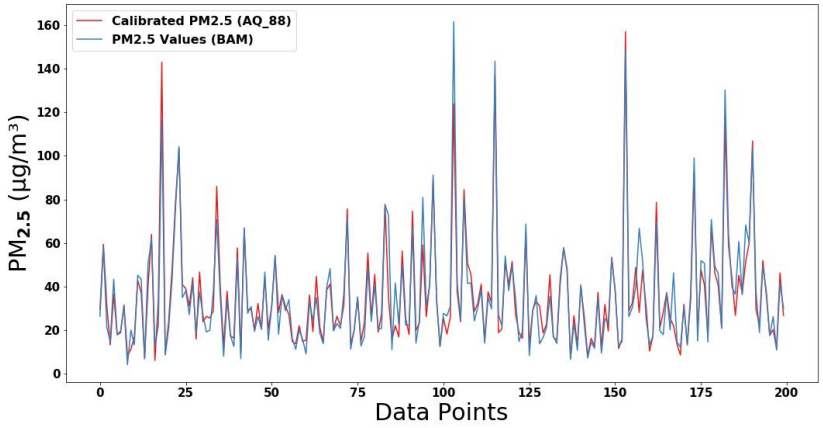
Field calibration infrastructure

- Several calibration methods, we opted to use ML
- 2 permanent colocation sites in Kampala with BAM 1022 and AirQo monitors
- Co-location data used develop $PM_{2.5}$ and PM_{10} ML-based calibration methods

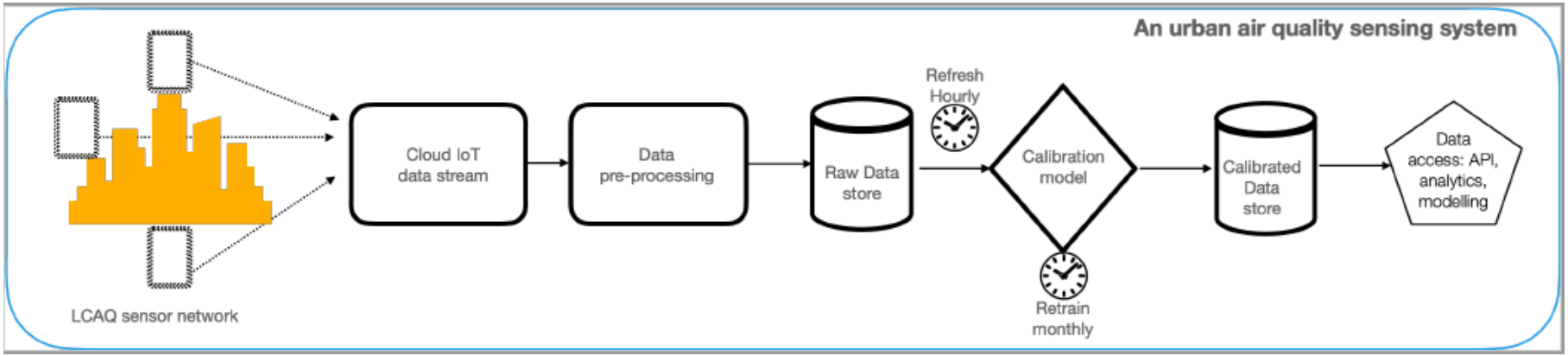
Performance against reference monitors

- Correlation values reaching up to 0.97 after calibration
- Cross-unit and cross site validation.
  - Uganda
  - Addis Ababa
  - Nairobi (Inprogress)
  - AirQo and Purple air devices
- Calibration applied to the entire network



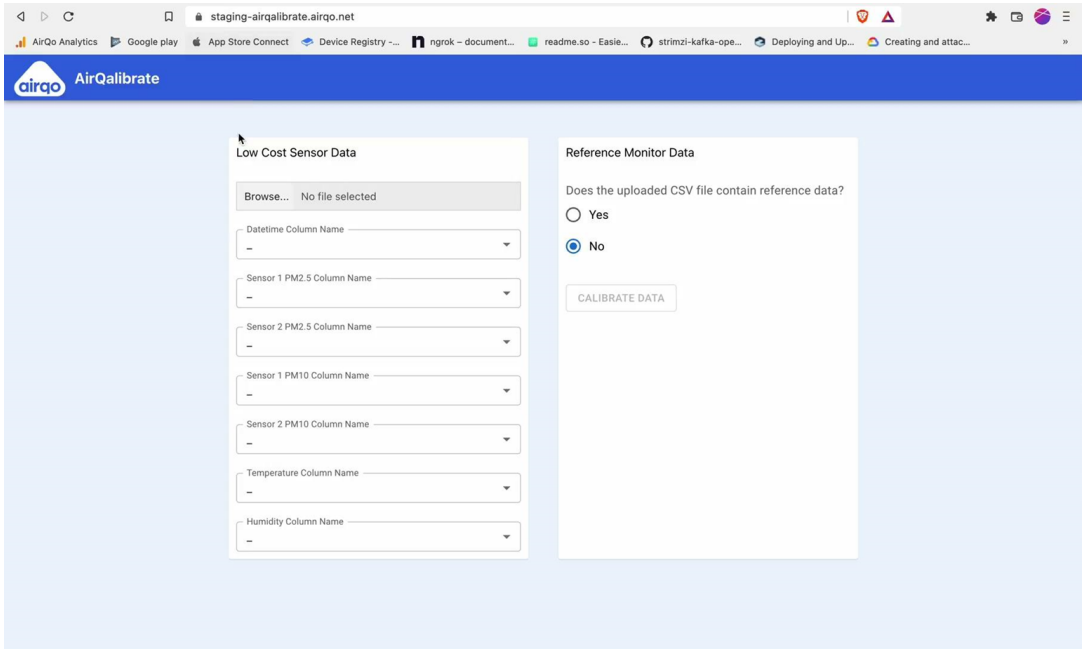


Field calibration pipeline



Calibration as a usable product

- A number of low-cost sensor initiatives emerging from the continent
- Data quality assurance still a challenge for individual networks
- Opportunity to leverage a data platform for quality assurance and data access



https://airqalibrate.airqo.net/

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Lessons & Challenges

- Quality assurance is a multi step process
  - Right from production of devices
- Limited access to reference monitors in other cities still a major challenge (Almost none monitor PM_{10})
- Intermittent internet & power supply affects data completeness
- Meteorology data access was a main hindrance for calibration in several locations across Africa
  - We are improving AirQo devices to provide ambient temp & humidity

Data Integration

- Difference in temporal resolutions (minute, hour and daily intervals)
- Difference in spatial resolutions - effect on Macro analysis
- Automated processes vs manual processes
- The need for standardised formats and protocols for data integration.


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