

Spatiotemporal Monitoring of Particulate Matter in Amman

with Low-cost Sensor Network

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Introduction

- Particulate Matter (PM) is a critical component of urban air pollution that significantly affects human health.
- This study aims to:
 1. deploy a city-wide network of 12 low-cost PM sensors in Amman City, capturing both spatial and temporal patterns of PM_{2.5} over a full year (2025).
 2. provide a scalable framework for urban air quality monitoring in Amman City.
 3. address 3 key research questions:
 - Where are the most polluted areas in Amman?
 - What are the spatiotemporal trends in PM_{2.5} concentrations?
 - How do factors such as vegetation cover influence PM variability?

Methods for Monitoring Air Quality

1. Traditional Monitoring Stations:

- Fixed stations.
- High operational costs.
- Sparsely distributed.
- Best as a reference data source.

2. Low-cost Monitoring Sensors:

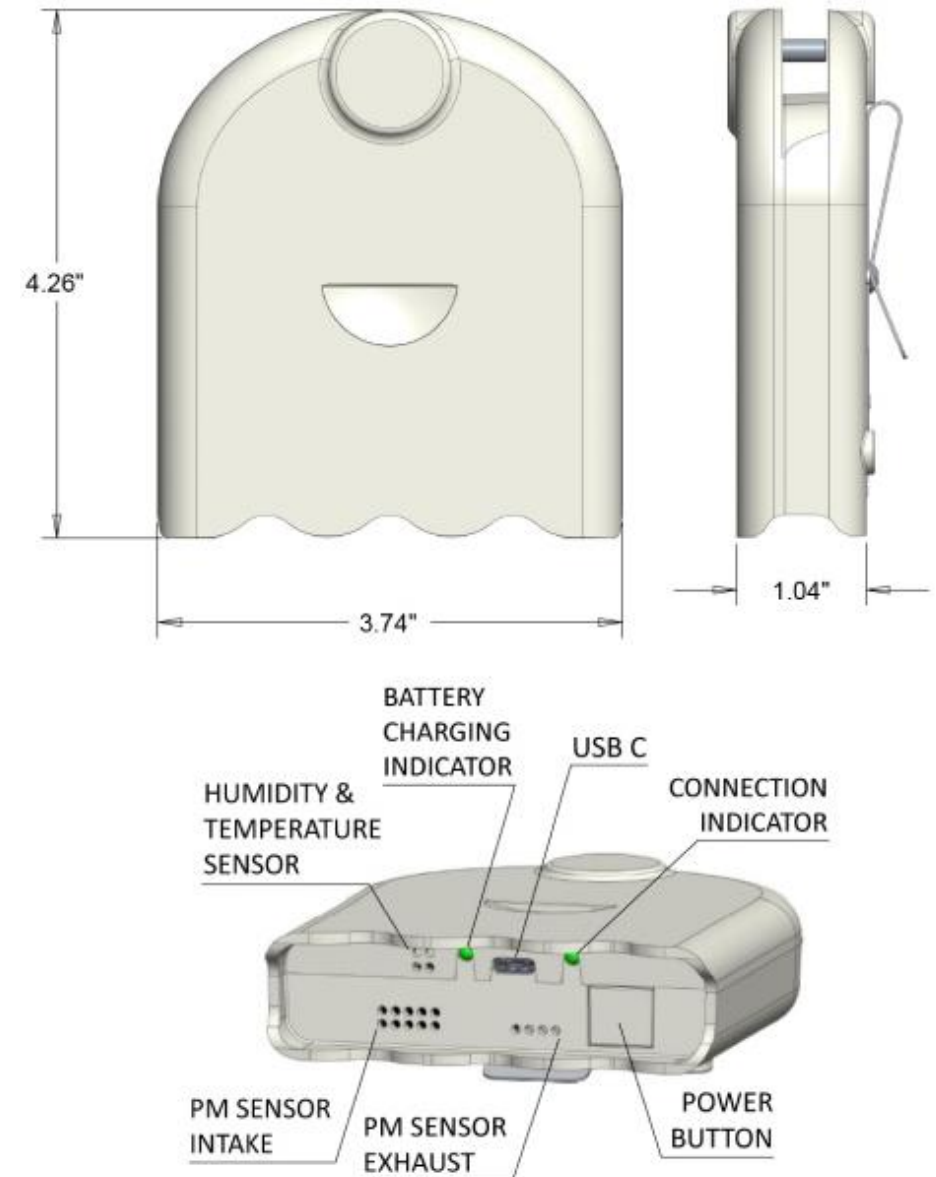
- Fixed or portable sensors.
- Low operational costs.
- Can be densely located or handheld.
- Complimentary monitoring of reference stations.

3. Remote Sensing:

- Mapping.
- Monitoring.
- Predicting.

Methodology

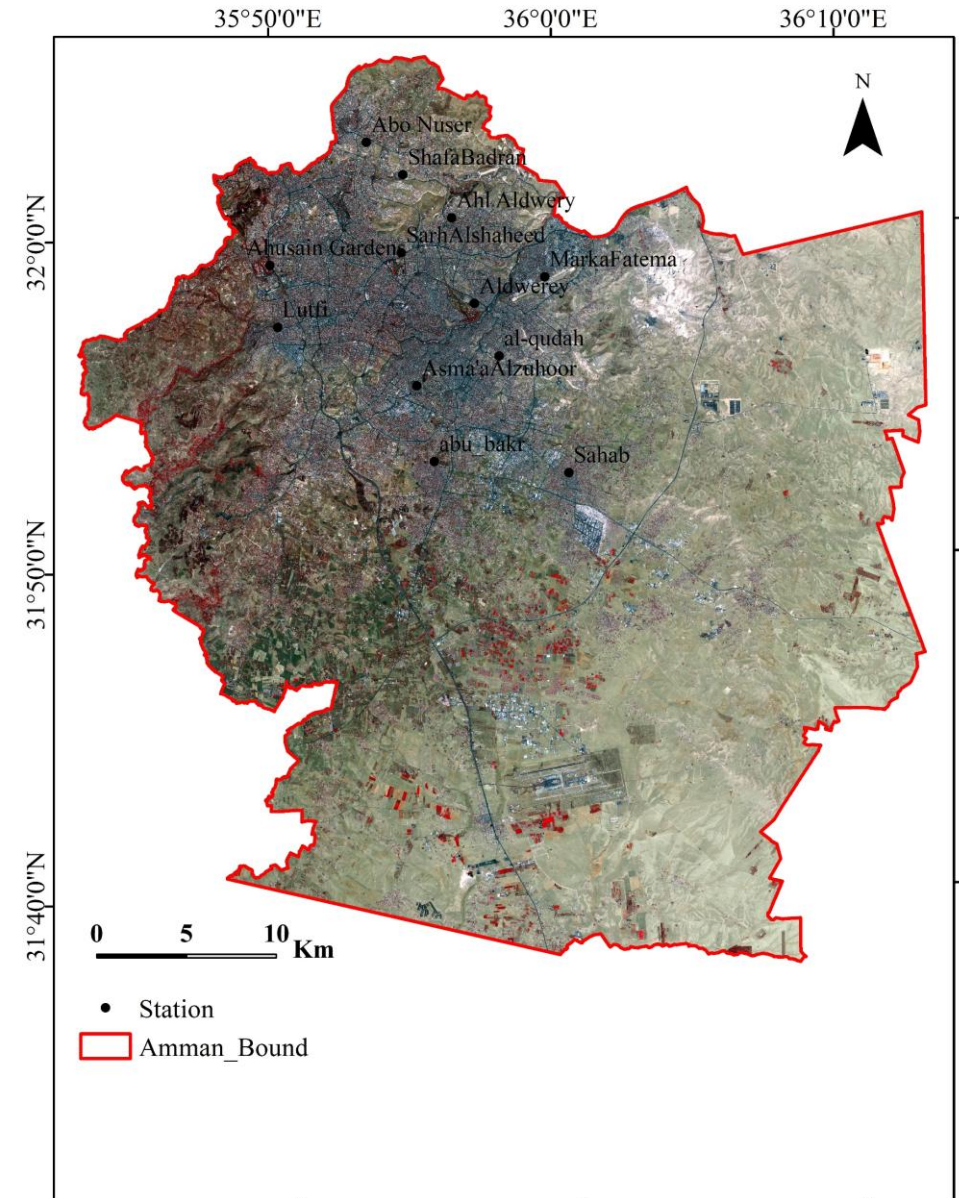
- The use of Low-Cost Sensors and Geospatial Techniques
 - Amman, Jordan
 - **AirBeam3** (\$250) (Palm size; 170 Gram)
 - Android smartphone running the AirCasting application.
 - Continuous measurement and mapping.
 - Measures PM1, PM2.5, PM10, temperature, and relative humidity.
 - **IDW** was used to generate the spatial distribution maps of PM2.5



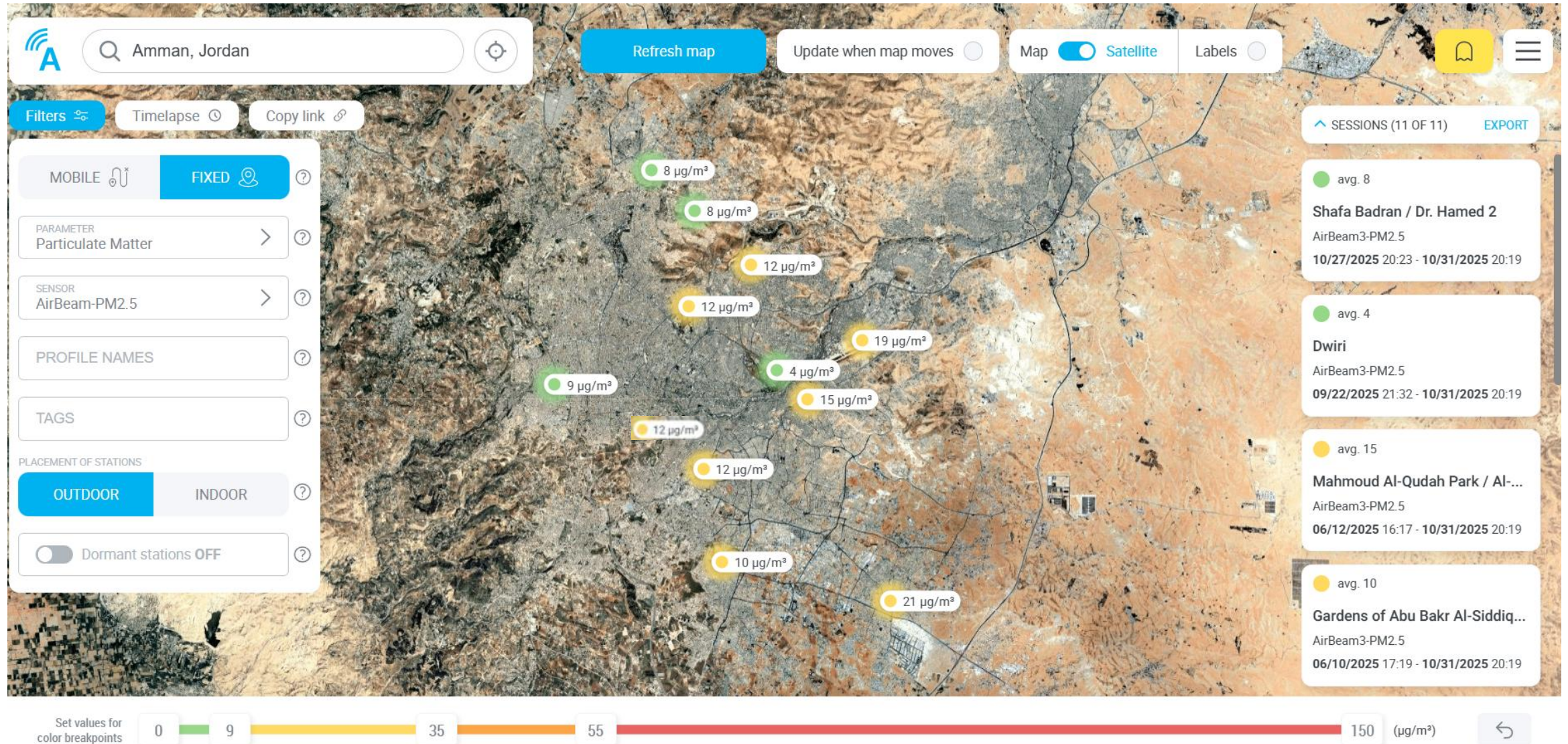
Methodology

- Using Sentinel-2 Data
 - Normalized Difference Vegetation Index (NDVI) was used to link vegetation health, density, and coverage with spatiotemporal distribution of PM_{2.5} within Amman City.

$$\text{NDVI} = \frac{\text{NIR} - \text{R}}{\text{NIR} + \text{R}}$$

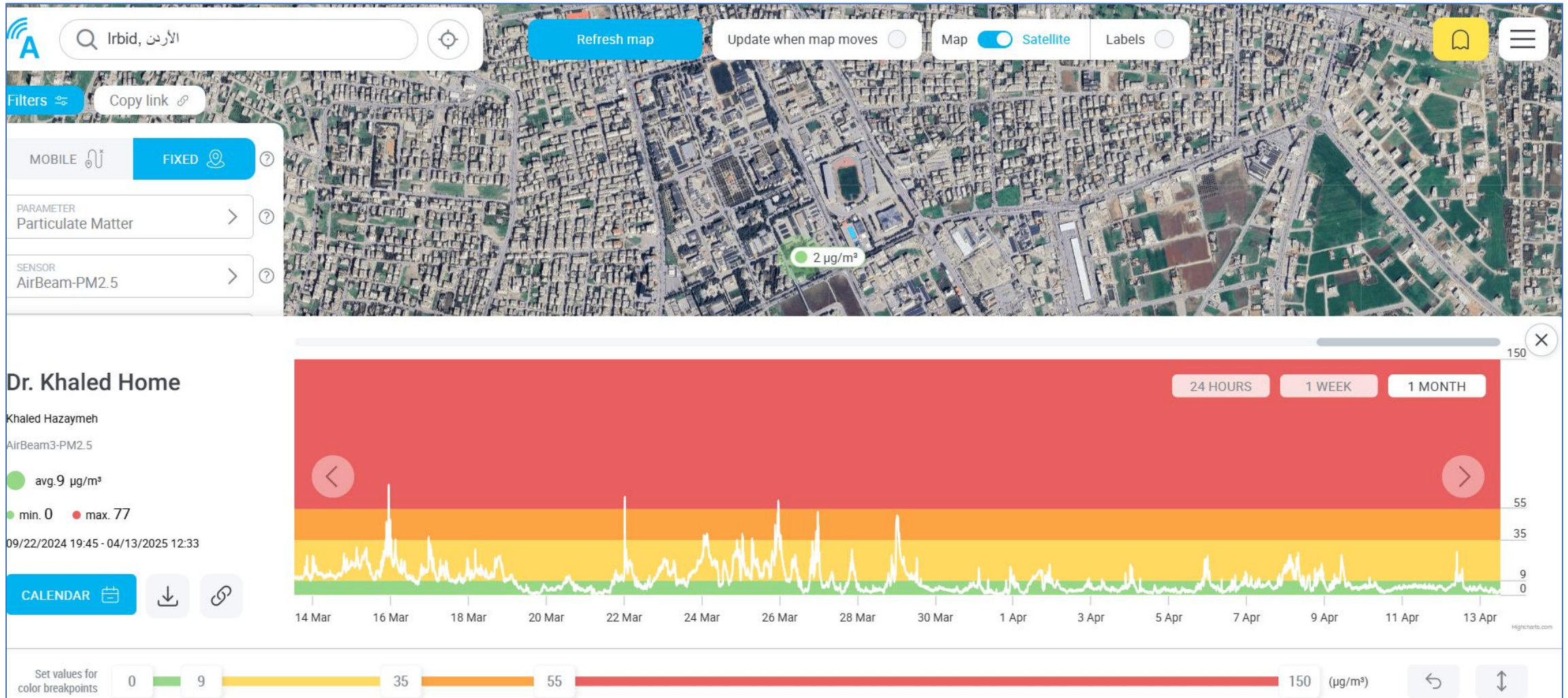


The Platform: AirCasting Map



Spatial Distribution of AirBeam3 Sensors in Amman City, Jordan

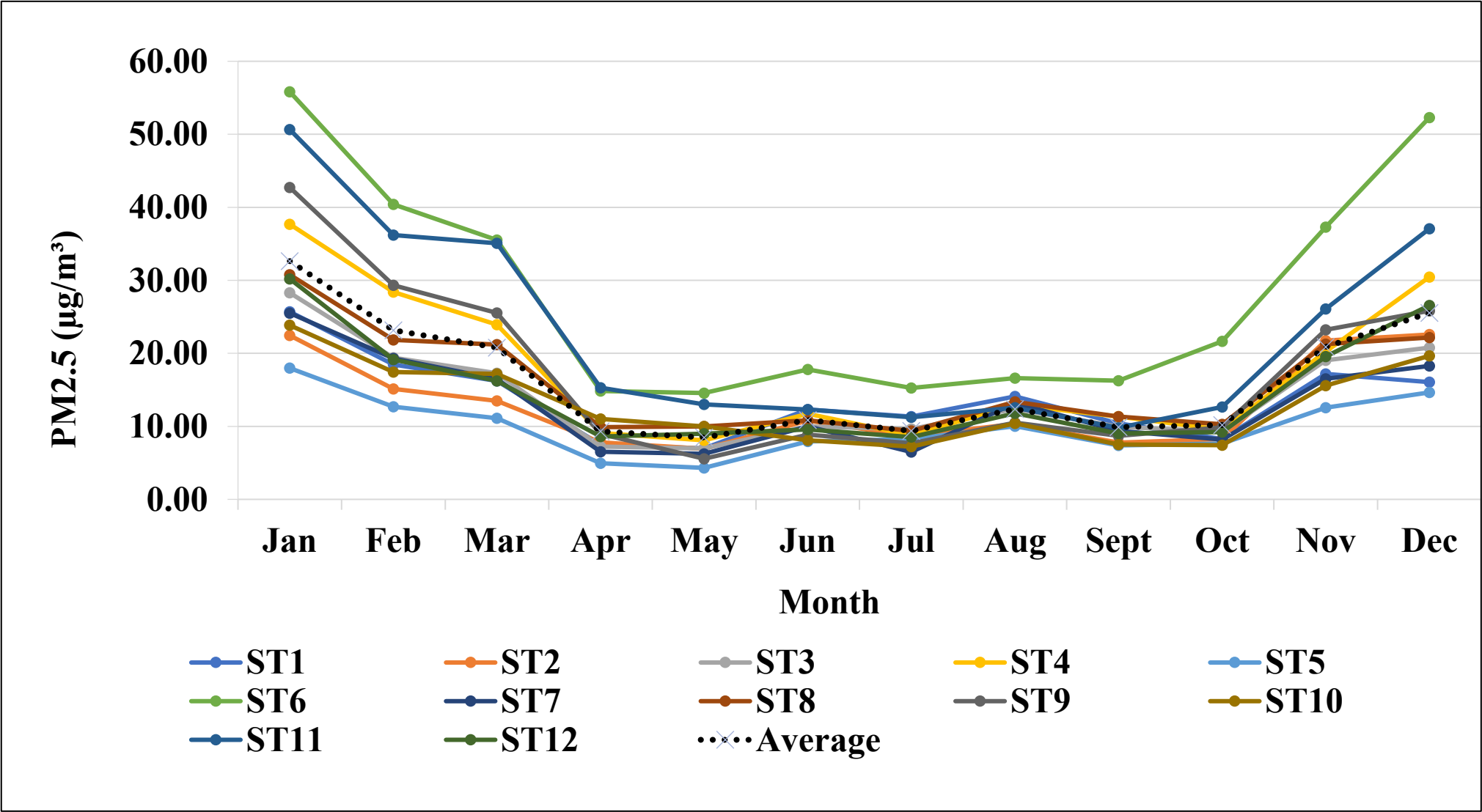
The Platform: AirCasting Map



- Data Collection

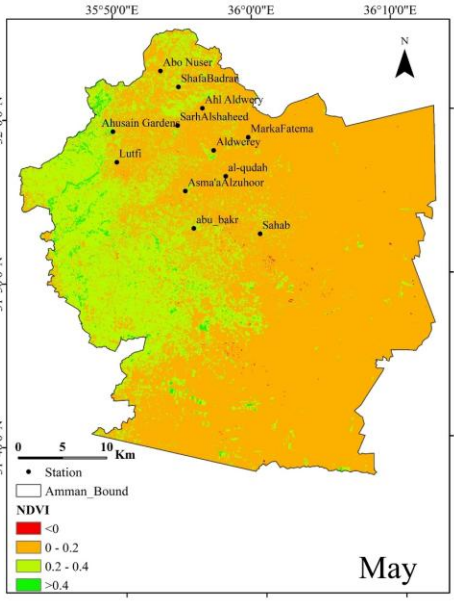
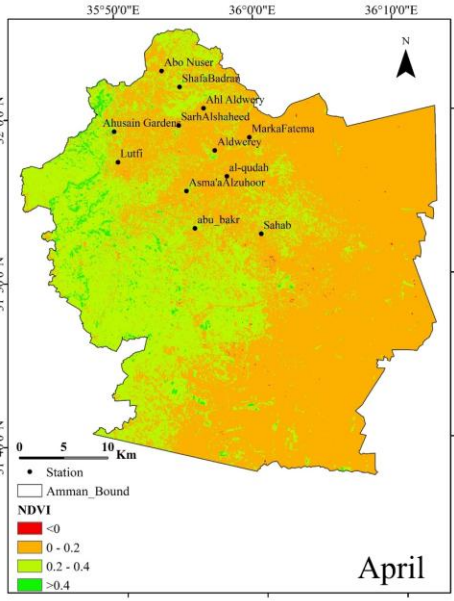
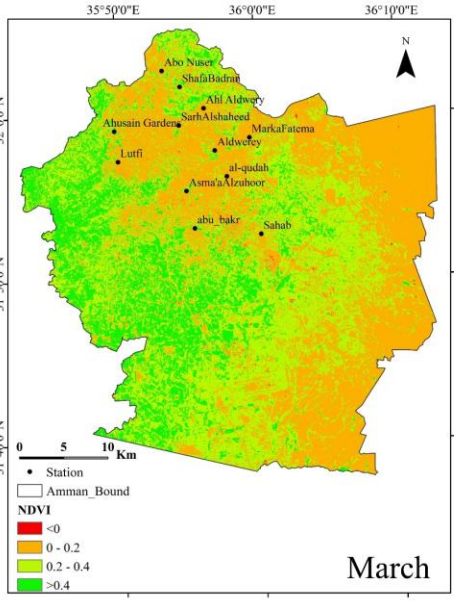
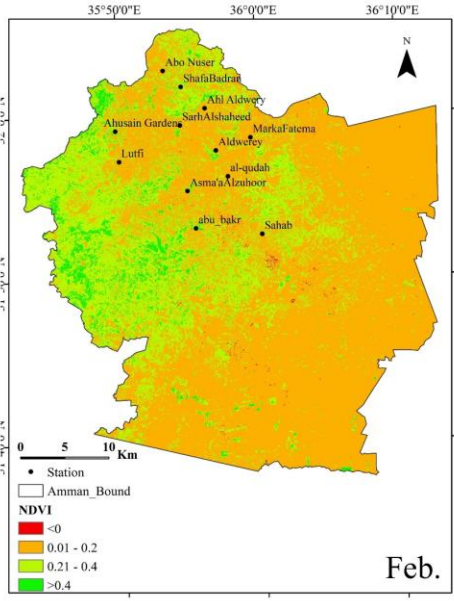
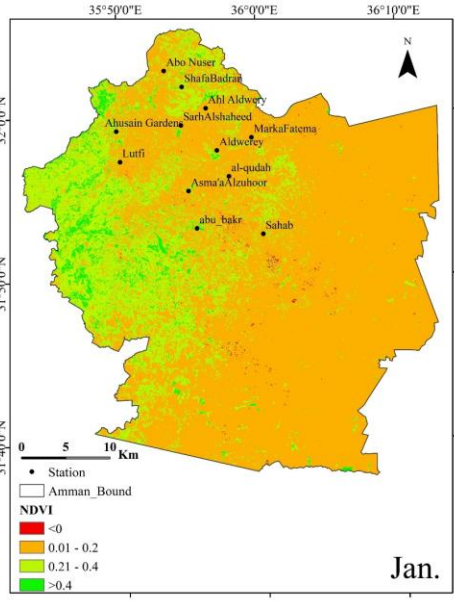
- Measuring PM1, PM2.5, PM10, Temperature, and Humidity / minute.
- Period of study, 1 year (01/Jan./2025 to 31/Dec./2025).

Results: Monthly Averages 2025

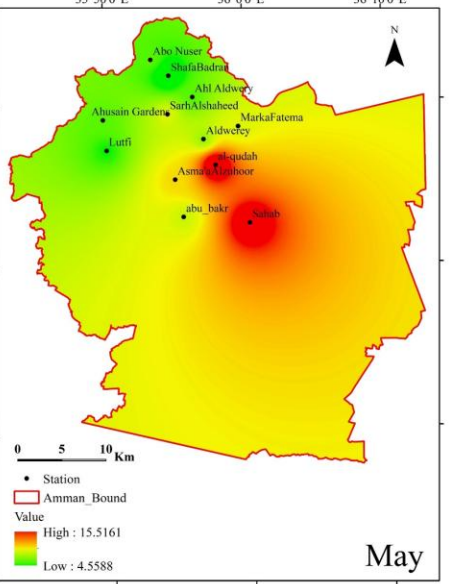
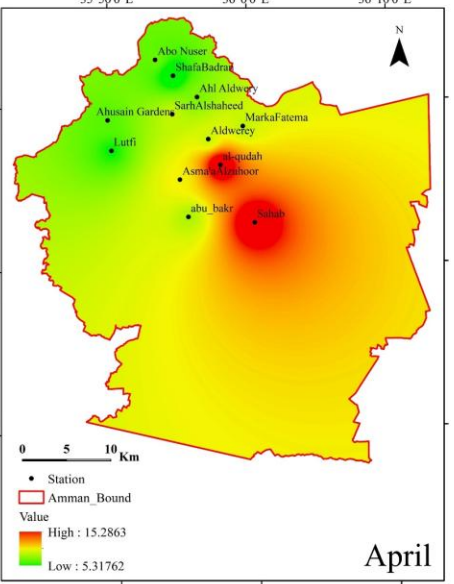
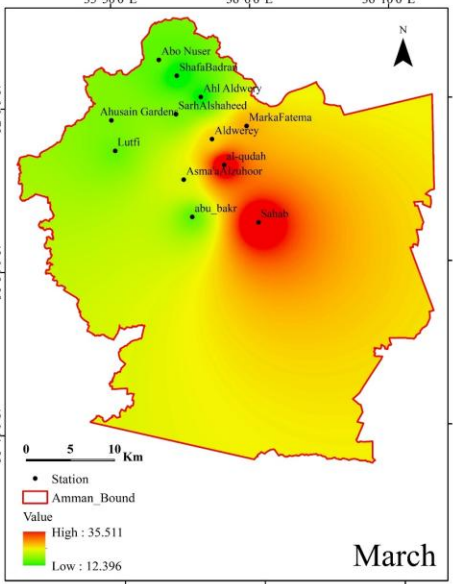
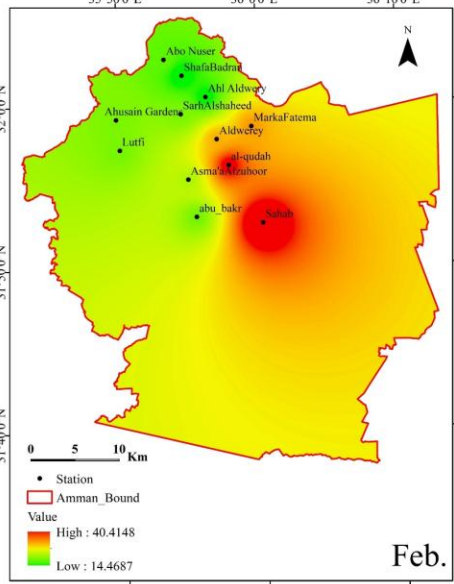
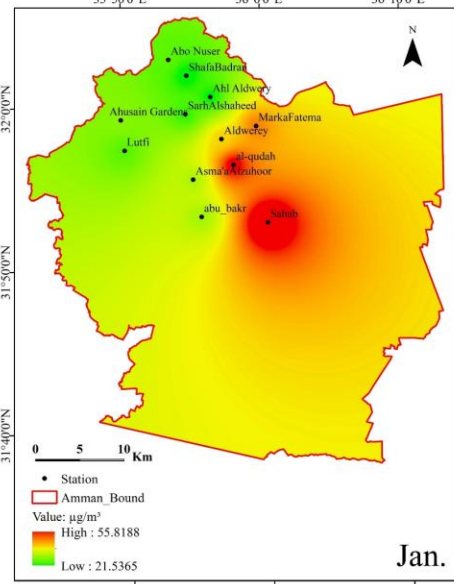


Results: Jan to May 2025

NDVI



PM2.5



Conclusion

- The use of AirBeam3 sensors provides a cost-effective, scalable method to monitor PM2.5 and analyze urban air pollution.
- The spatiotemporal analysis confirms that Amman's air quality varies significantly across space and time, with industrial and less vegetated zones in the eastern and southern parts being more affected.
- The data collected provide critical insights into pollution hotspots, seasonal fluctuations, and pollution sources.
- This study contributes to building a data-driven foundation for environmental policymaking in Jordan and demonstrates the value of low-cost technologies in supporting sustainable urban development.
- **Future work** throughout this ongoing project is to perform a health impact assessment based on the collected data within the study area.

Thank You

zoom Workplace

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Tareq Hussein

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Notes 65%