# DEMOCRATIA

## DEMOCRATIA - AQUA - TECHNICA

# IoT Sensor Evaluation and Air Quality Monitoring at the Fruška Gora Pre-Pilot Site within the REMARKABLE Project Framework

S. Dmitrašinović, M. Turk Sekulić, M. Brborić, D. Vukobratović, J. Radonić

[1]University of Novi Sad, Department of Environmental Engineering and Ocupational Safety and Health, Trg D. Obradovica 6, 21000 Novi Sad, Serbia

[2]University of Novi Sad, Department of Power, Electronic and Telecommunication Engineering, Trg D. Obradovića 6, 21000 Novi Sad, Serbia

➢ **IoT and data analytics drive today's digital transformation, offering strong potential to improve environmental monitoring management, especially in rural areas that often lag behind due to limited infrastructure.**

## REMARKABLE project goal:

❖ To use IoT and ML technologies to reduce disparities in air quality data between rural and urban areas and to support sustainable environmental protection through reliable and accessible monitoring solutions.
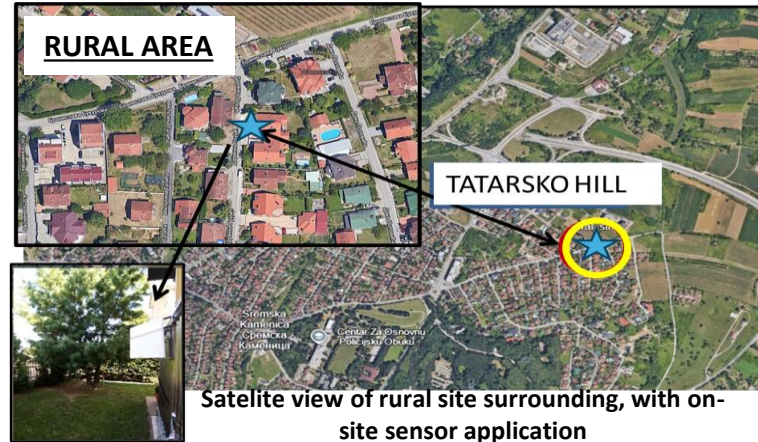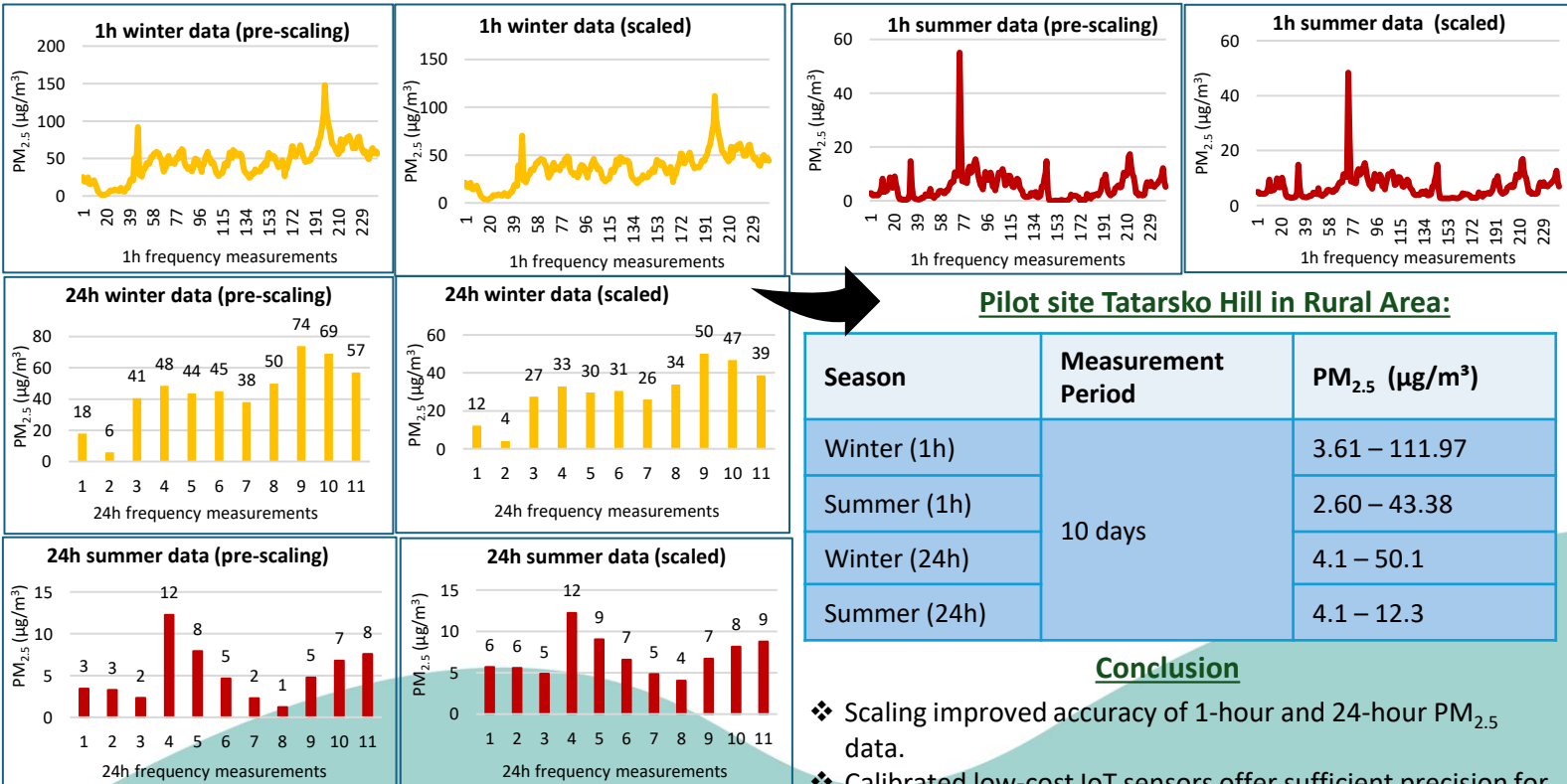
## Pre-pilot acitivites and Iot sensor data collection

❖ Pre-pilot activities focused on $PM_{2.5}$ air quality monitoring using IoT sensors.
❖ Sensors were co-located with a reference station for 14 days to assess accuracy.
❖ Two datasets were collected: 1-hour and 24-hour $PM_{2.5}$ readings.
❖ Datasets were scaled using regression coefficients to align with reference measurements.



**RURAL AREA**

**TATARSKO HILL**

Satelite view of rural site surrounding, with on-site sensor application

## Data Quality & Accuracy

| Data Type | Precision | MAE (Mean Absolute Error) | Error Percentage |
|---|---|---|---|
| **1-hour $PM_{2.5}$** | Lower precision, higher deviation | 1.2–1.3 µg/m³ | 16–20% |
| **24-hour $PM_{2.5}$** | Higher precision, better consistency | 0.7–0.77 µg/m³ | 9–10% |



1h winter data (pre-scaling)



1h winter data (scaled)



1h summer data (pre-scaling)



1h summer data (scaled)



24h winter data (pre-scaling)



24h winter data (scaled)

## Pilot site Tatarsko Hill in Rural Area:

| Season | Measurement Period | $PM_{2.5}$ (µg/m³) |
|---|---|---|
| Winter (1h) | | 3.61 – 111.97 |
| Summer (1h) | | 2.60 – 43.38 |
| Winter (24h) | 10 days | 4.1 – 50.1 |
| Summer (24h) | | 4.1 – 12.3 |



24h summer data (pre-scaling)



24h summer data (scaled)

## Conclusion

❖ Scaling improved accuracy of 1-hour and 24-hour $PM_{2.5}$ data.
❖ Calibrated low-cost IoT sensors offer sufficient precision for practical use.
❖ Suitable for rural areas lacking reference-grade monitoring.
❖ Scalable and cost-effective solution for wider air quality data coverage.

HTTPS://DEMOCRATIA-AQUA.ORG
HSHD_WATER_TECHNOLOGY
DEMOCRATIA AQUA

srh

UNIVERSITAS STUDIORUM NEOPLANTENSIS

DAAD Deutscher Akademischer Austauschdienst German Academic Exchange Service

Federal Foreign Office