MobiSpaces
new data spaces for green mobility

Air Quality Measurement Boxes within
Bosch Air Quality Solutions

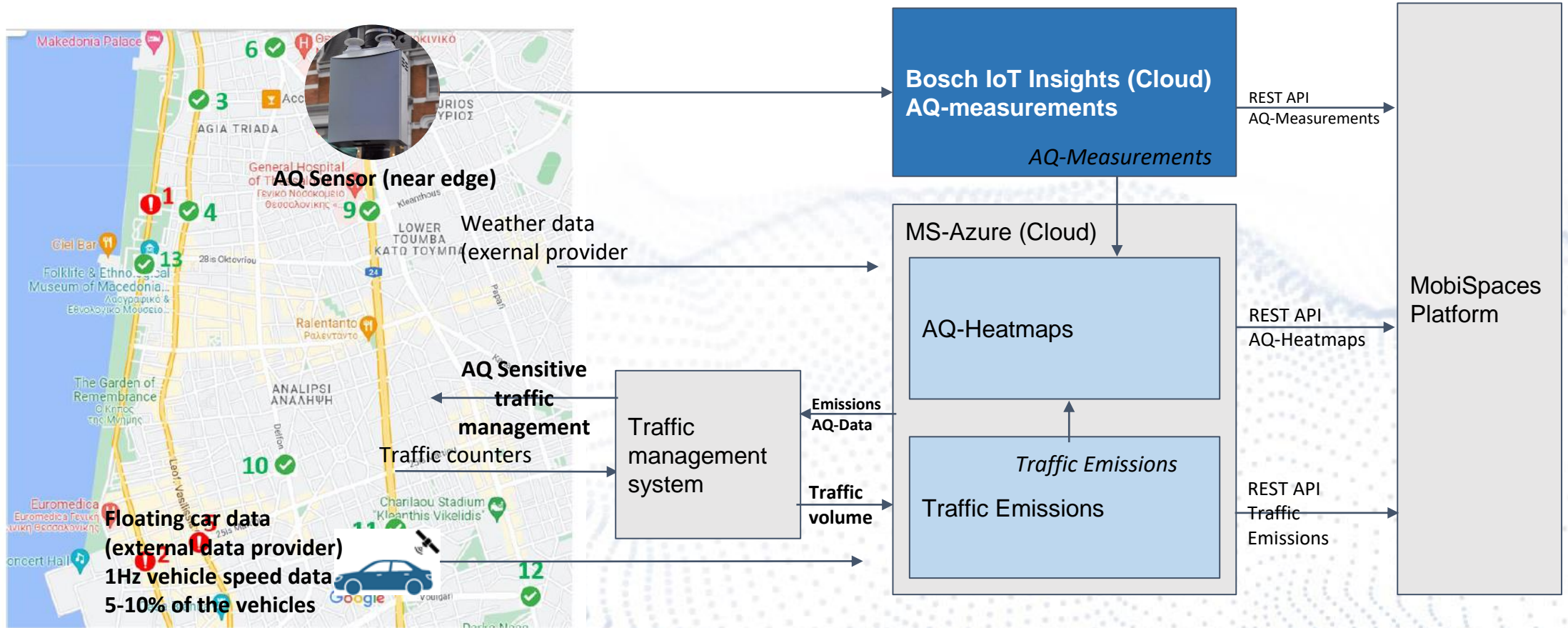Prof. Dr. Martin Schreivogel
Robert Bosch GmbH

31 October 2023, Webinar

Funded by the European Union

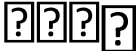High level Architecture cloud / near edge Testbed Thessaloniki

AQMB: Immission Monitoring Box (IMB)

We monitor with a high precision measurement device to gain an accurate view of the air quality and to identify pollution sources.

Immission Monitoring Box (IMB)

Parameters ????

Gases: NO_2, O_3, CO, SO_2

Particles: $PM_{2.5}$ and PM_{10}

Air data: relative humidity (RH), temperature, pressure

Certified

according to EU air quality directive 2008/50/EC (39. BImSchV) and BOSCH guaranty for data accuracy over life-time. [1]

Accurate

air quality monitoring with high time and spatial resolution.

Local measurement data

can be send to the cloud for analysis and further processing; wireless data connectivity offers remote monitoring.

Robustness

towards disturbances[2] due to intelligent correction functions and HW measures.

Sustainability

draw up precise air quality dispersion maps, make forecasts and enable emission sensitive traffic management to improve. [3]
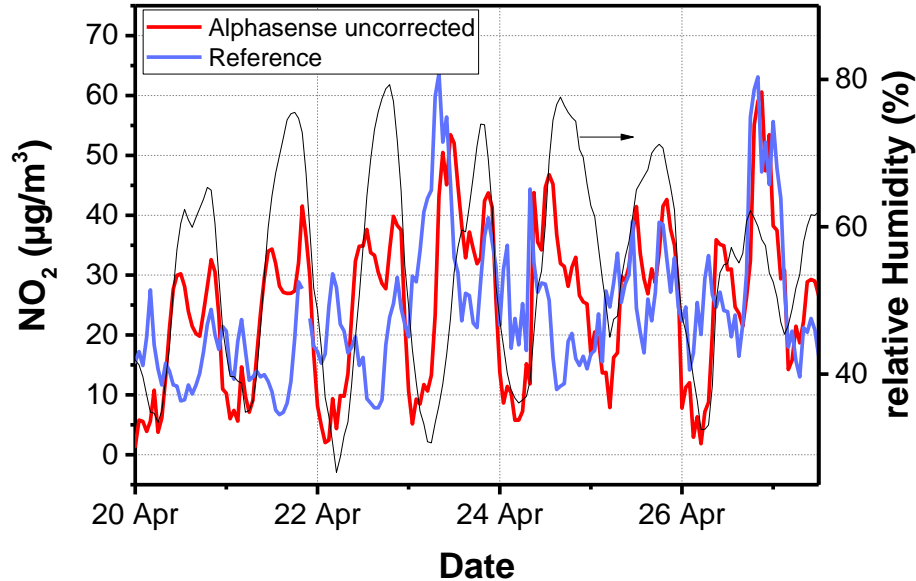
[1] through external test laboratory
[2] e.g. humidity, temperature
[3] By installing a network of IMBs, an Immission Monitoring System (IMS)

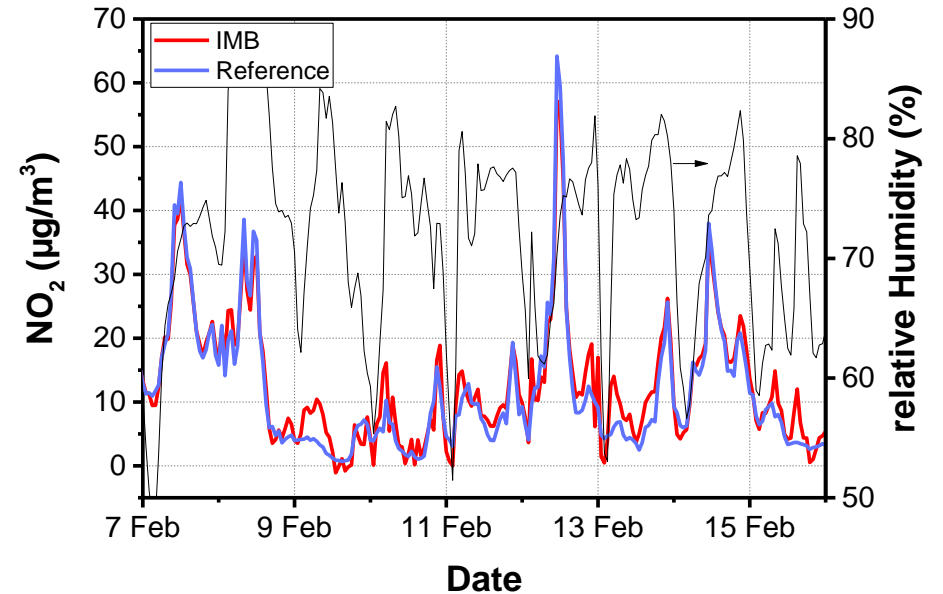**BOSCH**

Challenges for Air Quality Measurements

Changing weather conditions (humidity, temperature) might lead to sensor readings as high as the target gas.

Sensor operation with no correction measures

Strong humidity dependence leads to relative uncertainty of **60%** in this example
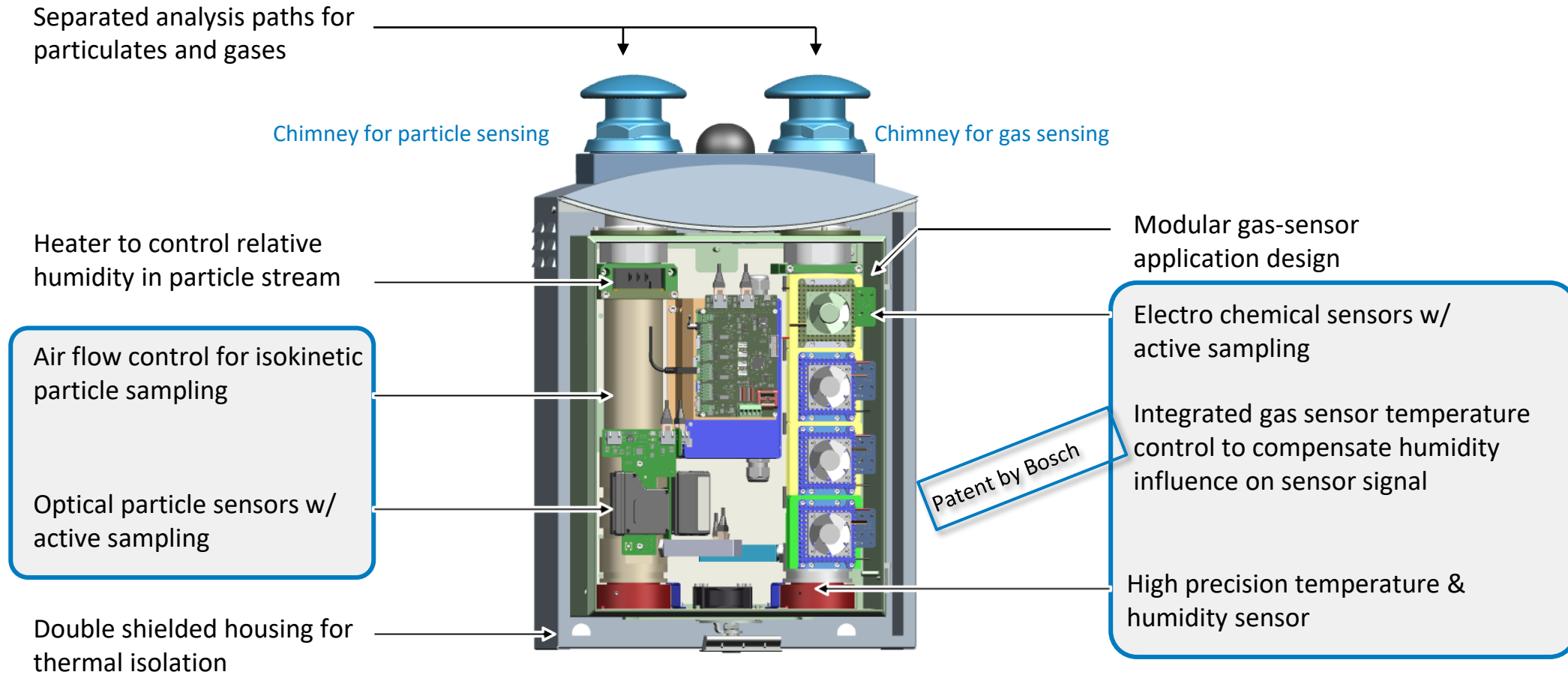
With Bosch sensor correction algorithms

Correction measures significantly reduce the humidity influence ➜ relative uncertainty **19%**

Next steps: Evaluate how smart correction functions with different devices work on the city scale.

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IMB: key design features

During a long research and engineering phase we achieved design solution to provide best sensor data already in our raw data

Separated analysis paths for particulates and gases

Chimney for particle sensing

Chimney for gas sensing

Heater to control relative humidity in particle stream

Modular gas-sensor application design

Air flow control for isokinetic particle sampling

Electro chemical sensors w/ active sampling

Optical particle sensors w/ active sampling

Patent by Bosch

Integrated gas sensor temperature control to compensate humidity influence on sensor signal

High precision temperature & humidity sensor

Double shielded housing for thermal isolation

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AQMB: Air Quality Monitoring Box ECoB

The new Air Quality Monitoring Box generation ECoB is much smaller and lighter then the IMB and has significantly reduced power consumption!

Validation of the new correction algorithms is ongoing, using reference data from environmental agencies or IMBs nearby.

New cooperation with particle measurement specialist Palas:
https://inside-ws.bosch.com/bzo/de/article_page_475008.html

Weight[1]	4 kg		Power supply	12V DC or 230V/ 110V AC
Dimensions	280 x 280 x 230 mm³		Power consumption	Typical 6W; Max 24W

Operating ranges for achieving sensor performance:

|	
Temperature T	-10 °C ... +45 °C
Humidity rH	25 % ... 95 %
Pressure p	80 kPa ... 120 kPa
Storage temperature	-10 °C ... + 50 °C

Performance Characteristics[2]

| Sensor	Measurement Range	Resolution	Measurement Uncertainty[3]
O_3	0-1000 µg/m³	1 µg/m³	< 25 % or +/- 20µg/m³ (1h average)
NO_2	0-2000 µg/m³	1 µg/m³	< 25 % or +/- 17,5µg/m³ (1h average)
PM_{10}	0-1000 µg/m³	1 µg/m³	< 60 % or +/- 3µg/m³ (24h average)
$PM_{2.5}$	0-1000 µg/m³	1 µg/m³	< 50 % or +/- 3µg/m³ (1h average)
SO_2	0-50000 µg/m³	1 µg/m³	<50 % or +/- 200µg/m³ (1h average)
CO	0-50000 µg/m³	1 µg/m³	<25 % or +/-0,2mg/m³ (1h average)
p	300 mbar ... 1100 mbar	1 mbar	0,6 hPa
T	-40 °C ... +85 °C	0,1 K	5 K
rH	0 % ... 100 %	0,1 %	25% rH

[1] Actual sample
[2] Inspection interval: annually
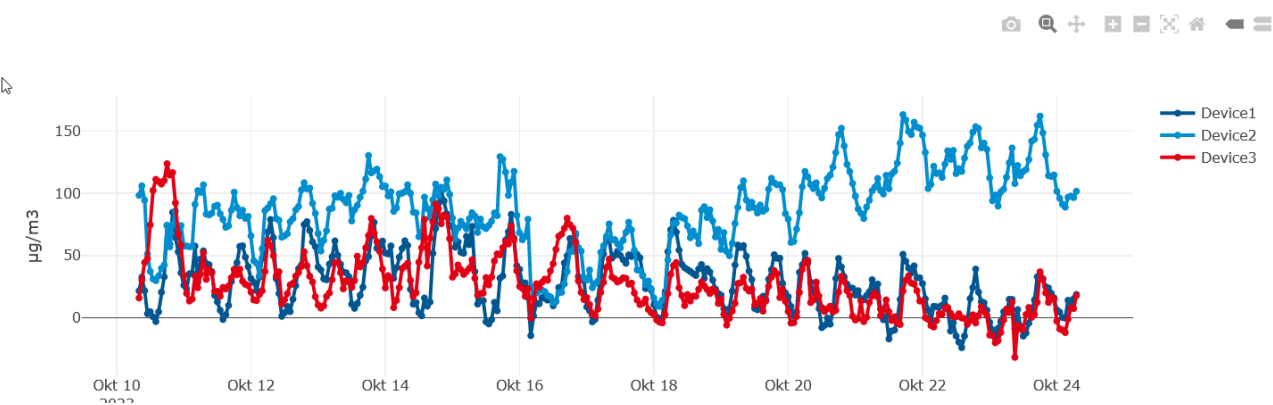[3] for indicative measurements according to EU guideline 2008/50/EG requirements

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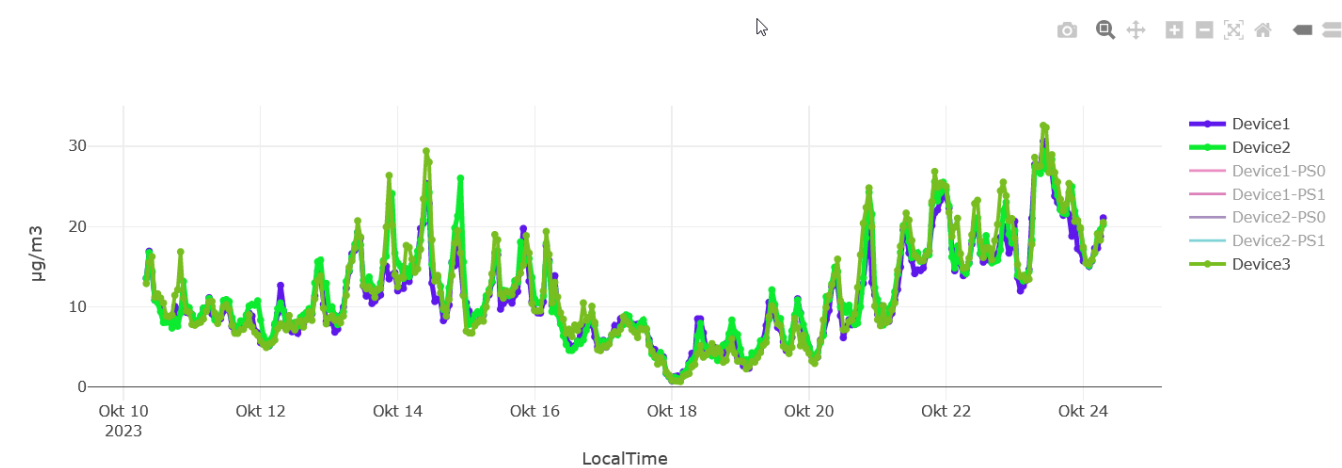
Air Quality Monitoring Boxes Thessaloniki

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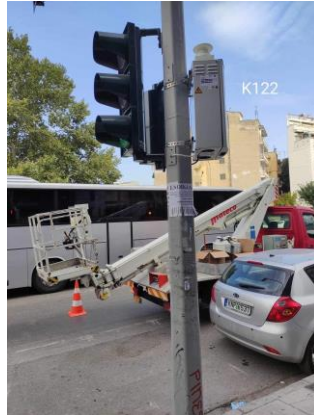
Air Quality Monitoring Boxes Thessaloniki Dashboard
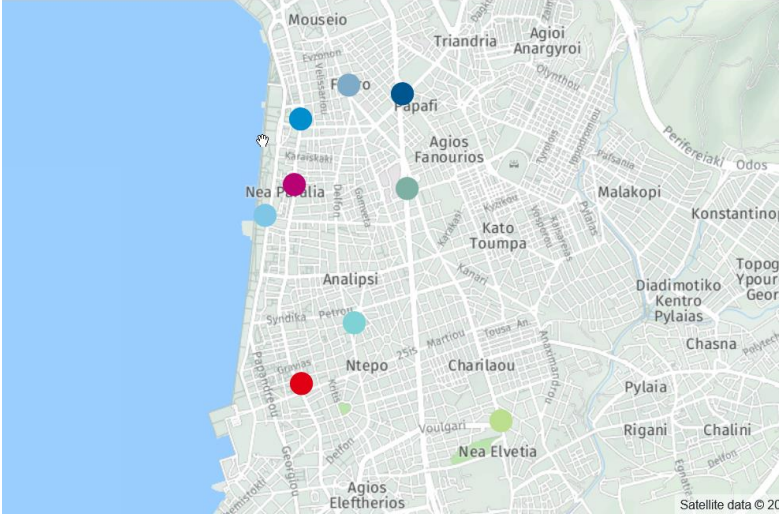
Next steps:

- Evaluation of collected data concerning plausibility

- Adaption of correction parameters if needed

- Discuss correlations with for example traffic effects with project partners

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