Examples of sensor applications for urban air quality monitoring in Switzerland

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Source: Olga Saukh, ETH Zurich, OpenSense project

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Nationales Beobachtungsnetz für Luftfremdstoffe (NABEL)


Basel: vorstädtisch


Bern: Stadt, starker Verkehr


Chaumont: ländlich, oberhalb 1000m ü. M.


Davos: ländlich, oberhalb 1000m ü. M.


Dübendorf: vorstädtisch


Härkingen: ländlich, an Autobahn


Jungfraujoch: Hochgebirge


Lägeren: ländlich


Lausanne: Stadt, starker Verkehr


Lugano: Stadt


Magadino: ländlich


Payerne: ländlich


Rigi: ländlich, oberhalb 1000m ü. M.


Sion: ländlich, an Autobahn


Tänikon: ländlich


Zürich: Stadt

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Bundesamt für Umwelt (BAFU)

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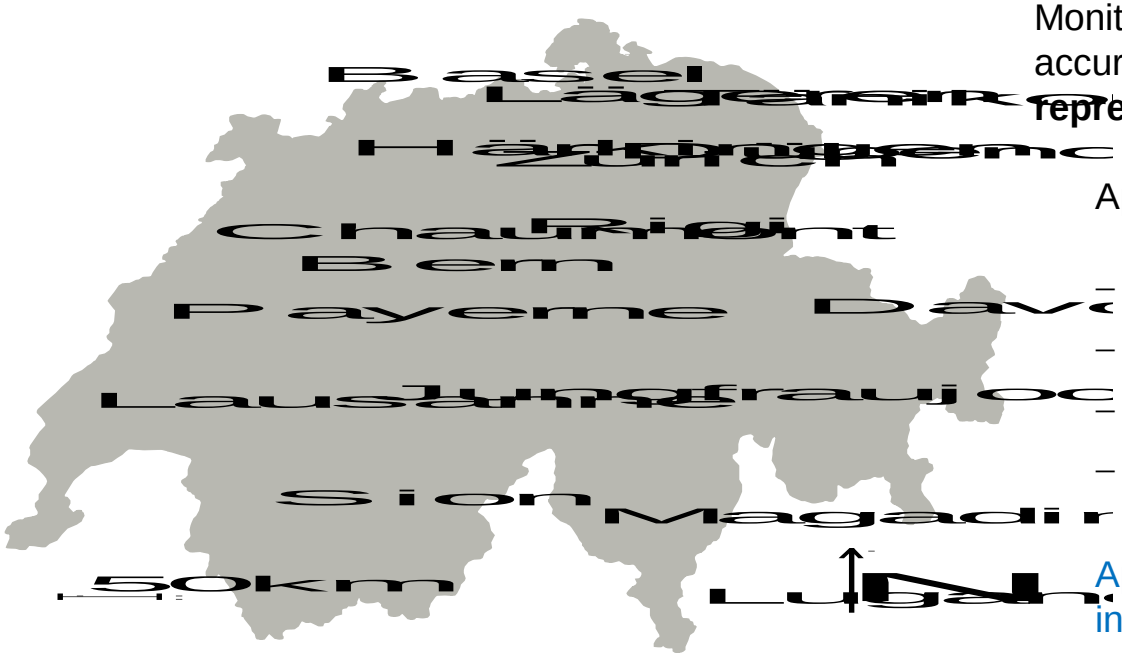
Air Quality Monitoring Today – e.g. Swiss National Air Pollution Monitoring Network



- Urban, kerbside
- Urban, background
- Rural, motorway
- Suburban
- Rural < 1000 m asl.
- Rural > 1000 m asl.
- Forest
- High-alpine

Monitoring networks provide reliable and accurate information about air quality at **representative** sites

Approach suitable for

- compliance measurements
- assessment of temporal trends
- action planning
- …

Approach not ideal (AQ networks not indended) for

- assessment of spatial variability at ***small scales*** (e.g. urban scale)
- exposure assessment / health effects studies

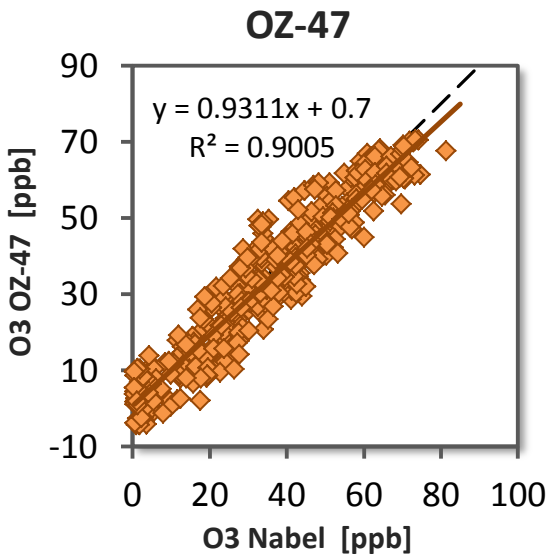
Main interest in sensors for ambient air quality measurements

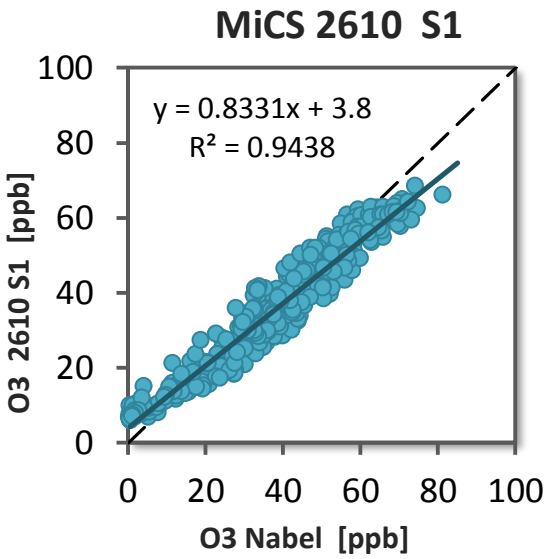
- **Possibilities and limitation of available sensors?**
- **How to operate a sensor network (assurance of data quality)?**
- **How to use data from sensor networks for calculation of air pollution maps?**

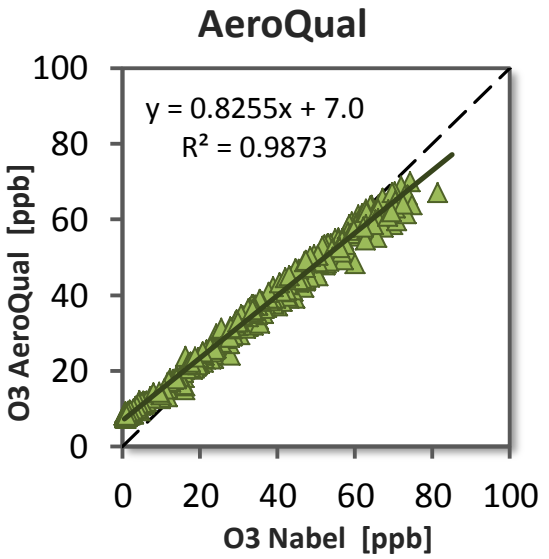
Side by side measurements at fixed (reference) site

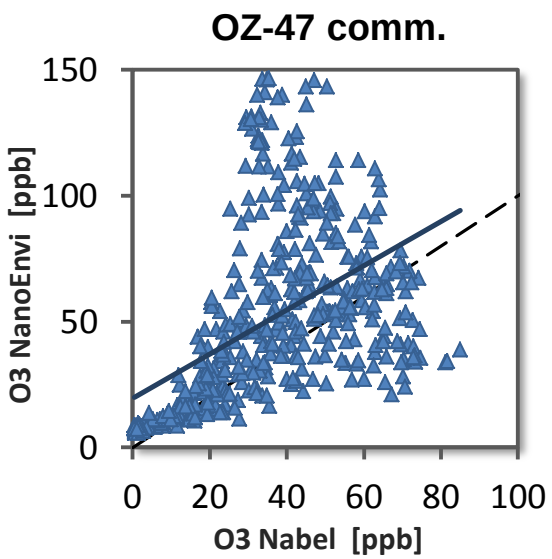
- O_3 summer 12
- NO_2 winter 12/13

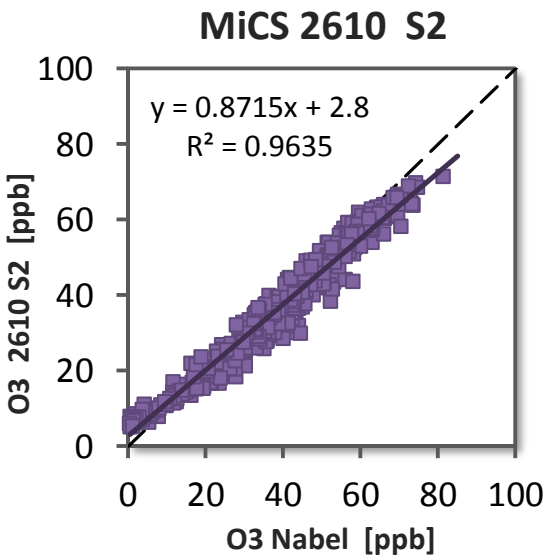
Side by side measurements of O_3 using sensors and a reference monitor (TEI 49i) at Duebendorf (hourly values 31.07.12 – 27.08.12)

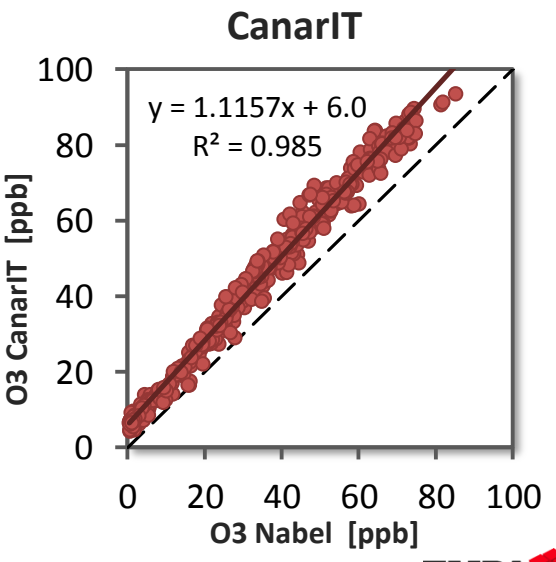












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Mobile sensor network – OpenSense project (ETH Zurich)

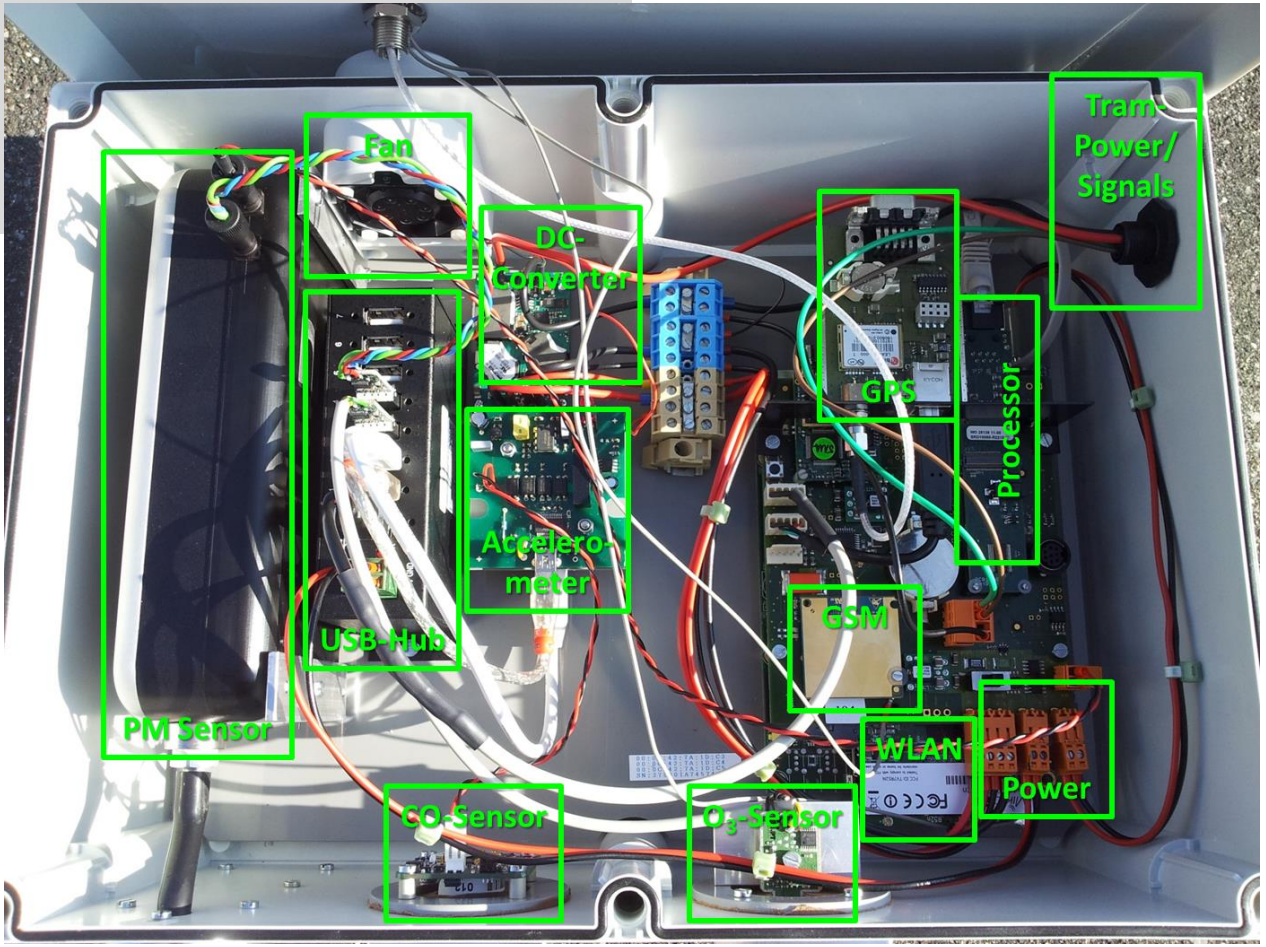
OpenSENSE

ETH Eidgenössische Technische Hochschule Zürich Swiss Federal Institute of Technology Zurich

opensense.ethz.ch

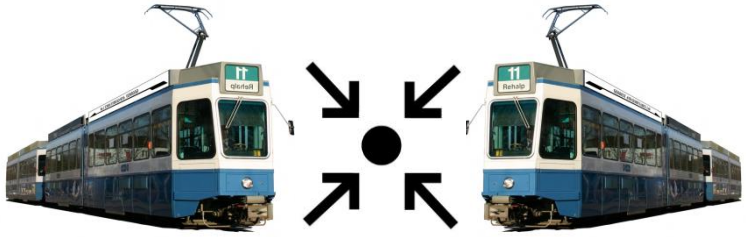
OpenSense nodes

- Currently 5 stations (end 2012: 10 stations)
- Sensors: **O_3**, CO, **particle number concentration (PNC)**, temperature, humidity, accelerometer
- GPS
- Communication: WLAN, Ethernet and GSM
- External power supply

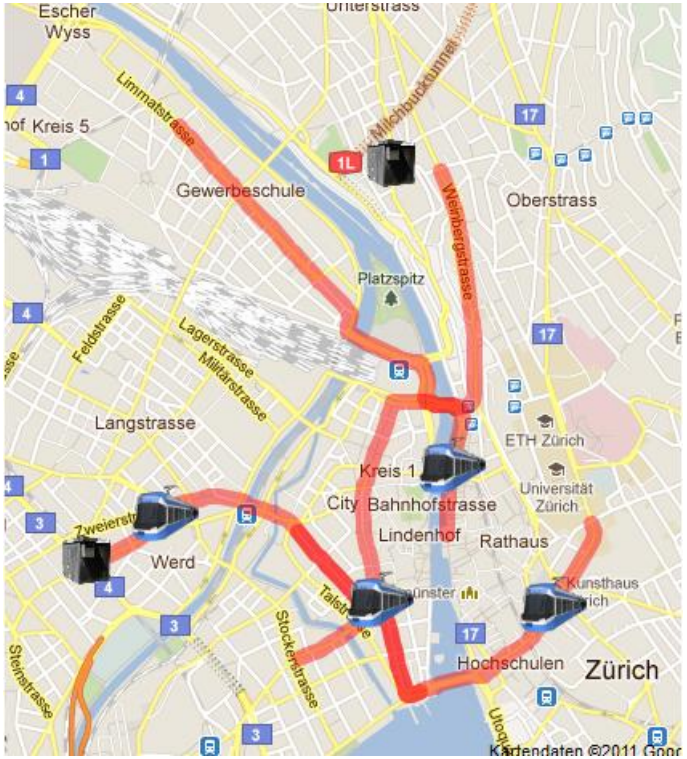


Possibilities for sensor calibration and testing!

SENSOR CHECKPOINTS



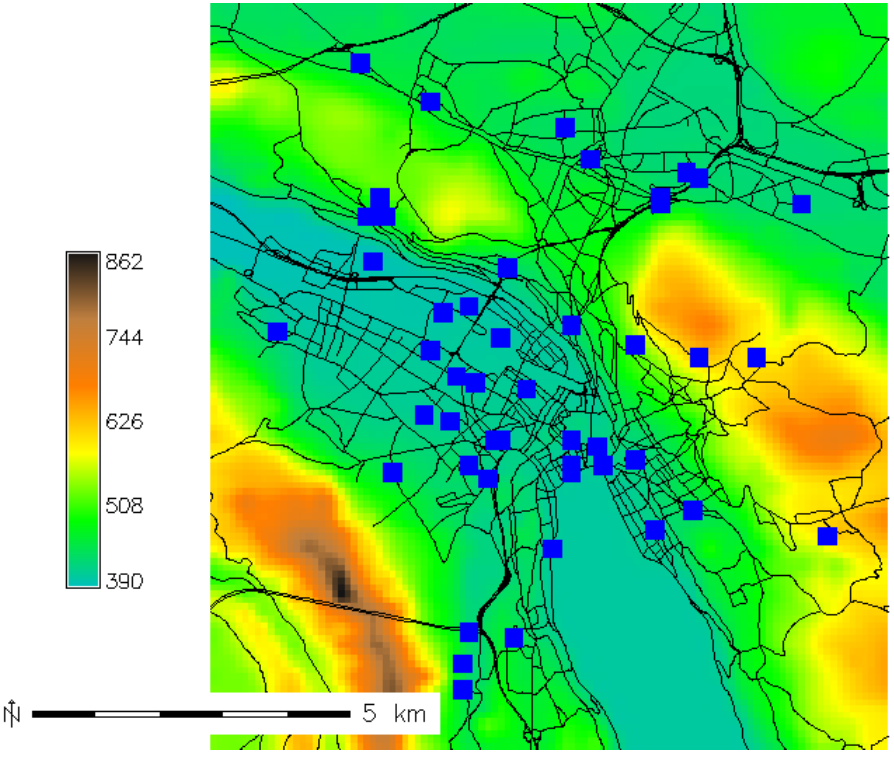
- Two vehicles make a **checkpoint** if the distance between them is below a certain threshold.
- **Checkpoints** are used for:
  - Relating measurements in space and time
  - Comparing sensor readings and sensor calibration
  - Recognizing faulty sensors
- Types of checkpoints:
  - Between two nodes
  - Between node and a reference station



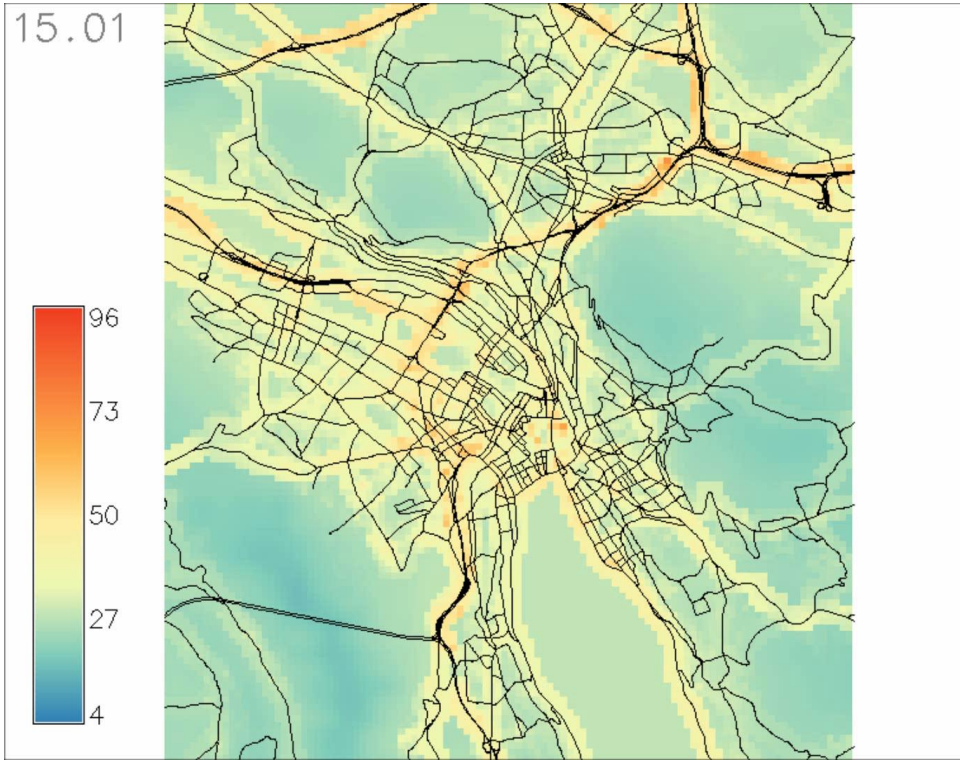
OpenSENSE ETH Eidgenössische Technische Hochschule Zürich Swiss Federal Institute of Technology Zurich

Estimation of air pollution maps

50 NO_2 - passive sampler tubes deployed in Zurich
(14d mean concentration)



LUR model 2008



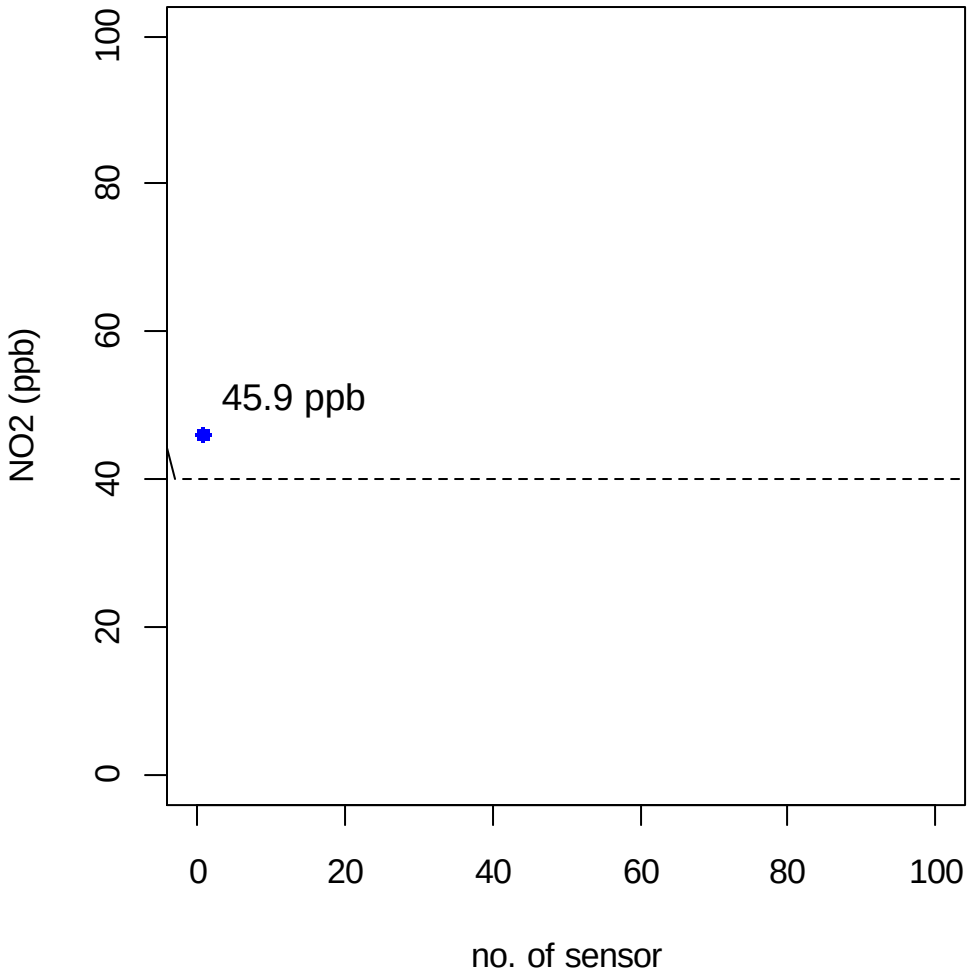
Barmpadimos and Hueglin ES&T, 2012, submitted

Outlook

- Systematic review of sensor performance (commercial and if possible prototype sensors)
- Opensense sensor network as a research platform:
  - Further development (new sensors, additional stationary nodes, etc.)
  - Strategies for operation of sensor networks (calibration, QA/QC in general)
  - Demonstration of usefulness (air pollution maps with high temporal spatial resolution)

Required quality of sensor data ?

synthetic data



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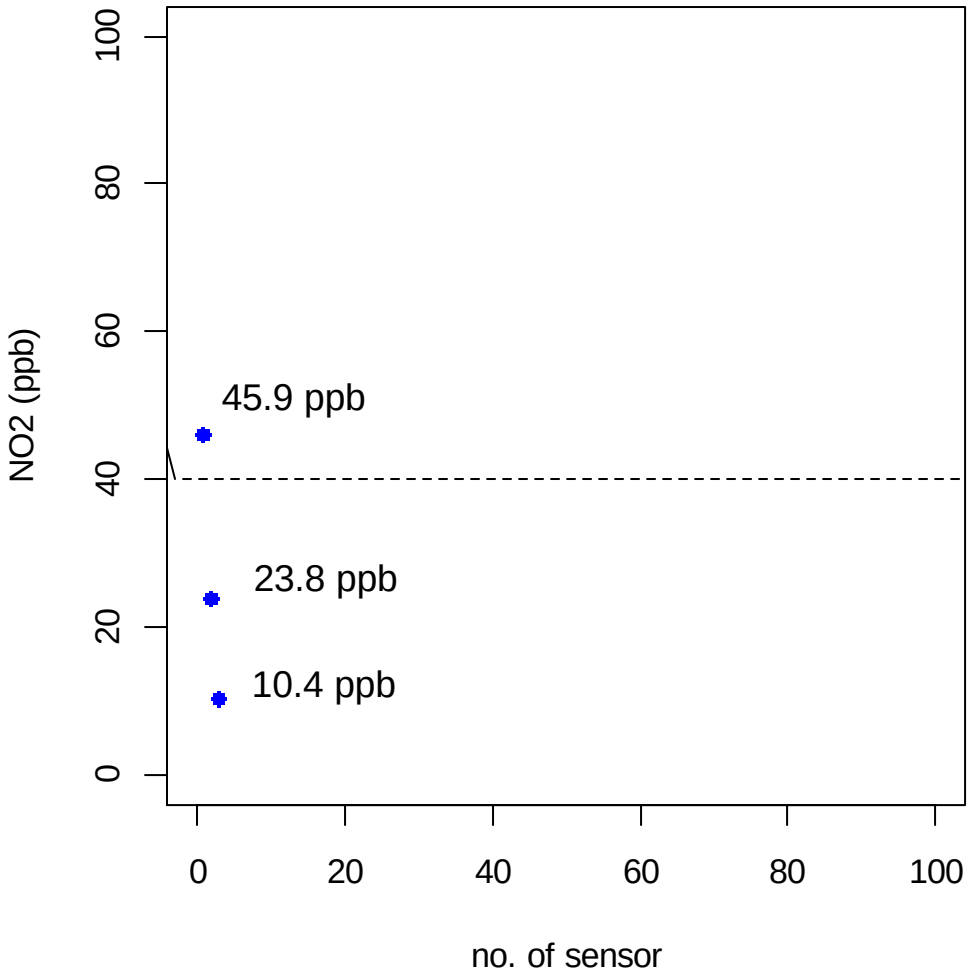

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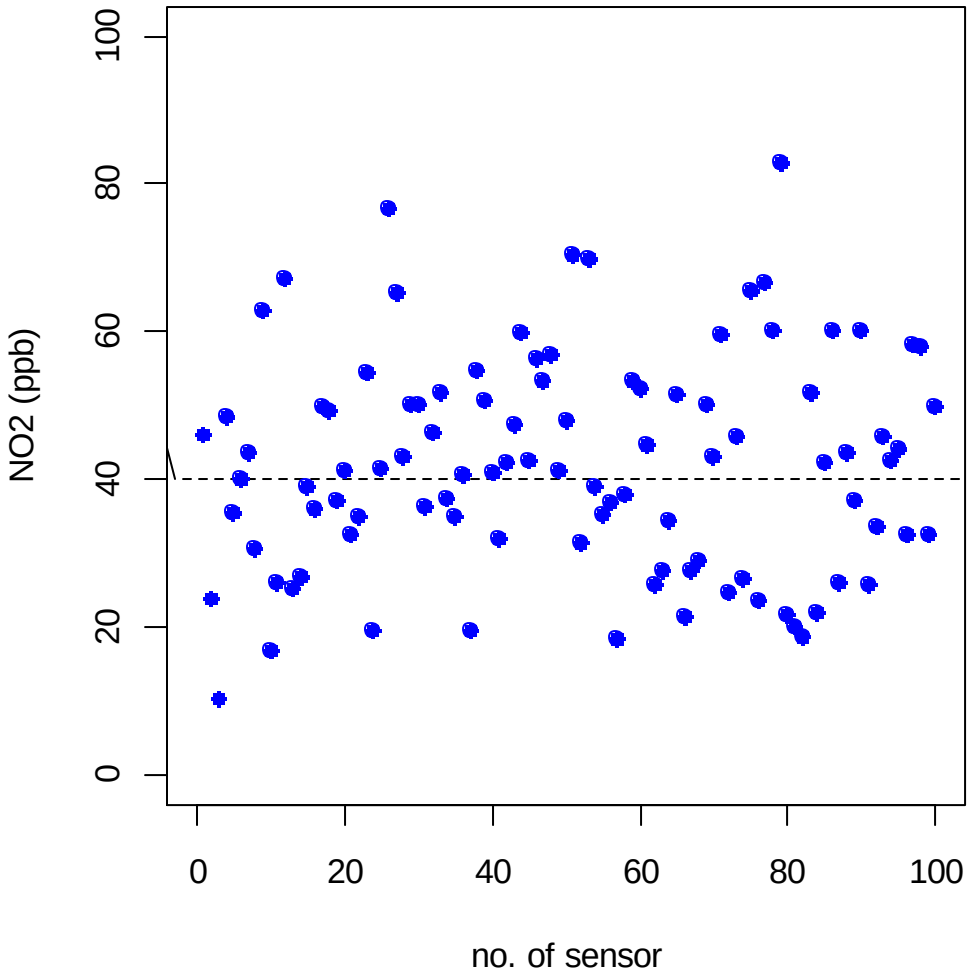

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