# AirSensEUR: An open sensor box for air quality monitoring
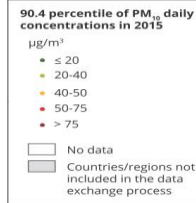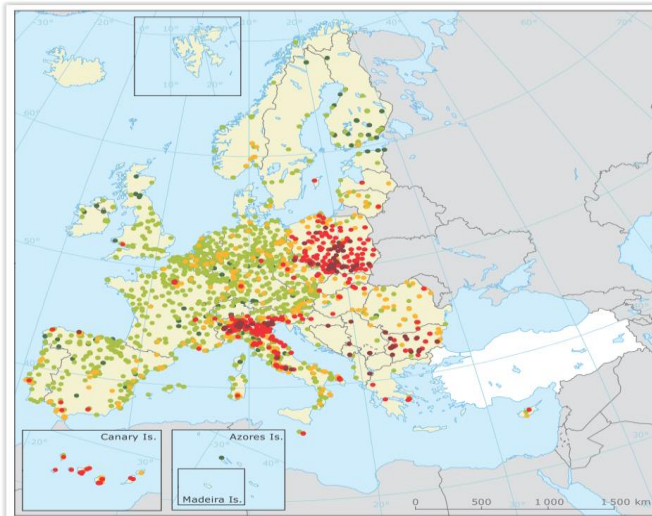
Michel Gerboles[1], Alexander Kotsev[1], Sven Schade[1], Massimo Craglia[1], Laurent Spinelle[2], and Marco Signorini[3]

[1] European Commission - Joint Research Centre,
[2]INERIS (F),
[3]Liberaintentio Srl (I)

Air Sensors International Conference
12-14 Sep 2018

**UC Davis Air Quality Research Center
Oakland Convention Center
California, USA**

European Commission
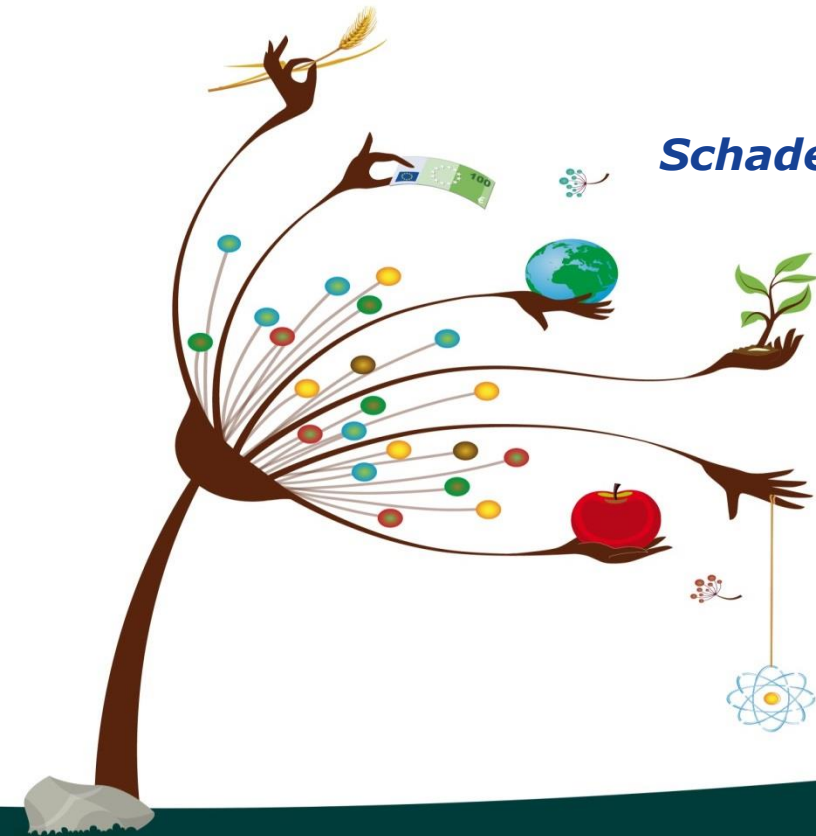
Air quality in Europe — 2017 report EEA Report No 13/2017

- INSPIRE Directive: all EU geo-referenced data

- About 5500 air quality stations in Airbase (EEA)

- e-reporting data + metadata

- The OGC Sensor Model Language (SensorML) standard is used in the Sensor Observation Services as one of the Download Services for INSPIRE data

- Include AirSensEUR in this SOS scheme
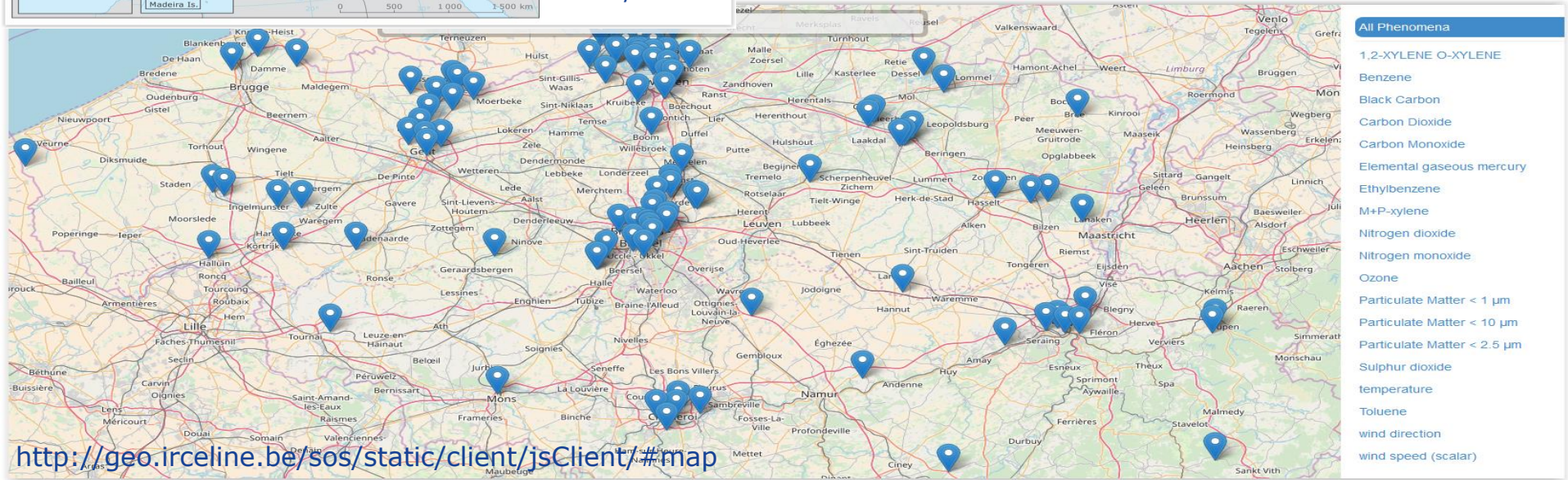
http://geo.irceline.be/sos/static/client/jsClient/#map

AirSensEUR objectives

JRC & partners are working on the AirSensEUR project since 2015

- Objective: "Create open and interoperable sensor nodes which provide observation data", and meet the requirements of

    A) European Air Quality Directive

    B) European INSPIRE Directive

- **Specifications, data quality and calibration:** JRC Air and Climate Unit (ERLAP, Michel Gerboles, Laurent Spinelle currently at INERIS-F)
- **Data management:** JRC Digital Economy Unit (Alex Kotsev, Sven Schade, Max Craglia)
- **Platform design and software:** Liberaintentio srl (Marco Signorini)
- **Growing community of sensor testers**: RIVM-NL, NILU-NO, Geonovum (NL) …

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# Objective of AirSensEUR: diminishing development and user cost

- Open source, European Public Licence

- AirSensEUR: cpu host controlling a sensor bus with shields ; electrochemical sensors and T/RH/pressure board; OPC, MOx; OPCs CO_2 and radon sensors.

- WIFI or GSM push of sensor + GPS data

- Many commercial sensors accepted

- Transparent data treatment, traceability of sensor data, filtering and calibration of sensor data

- Scientific community both of users and/or developers

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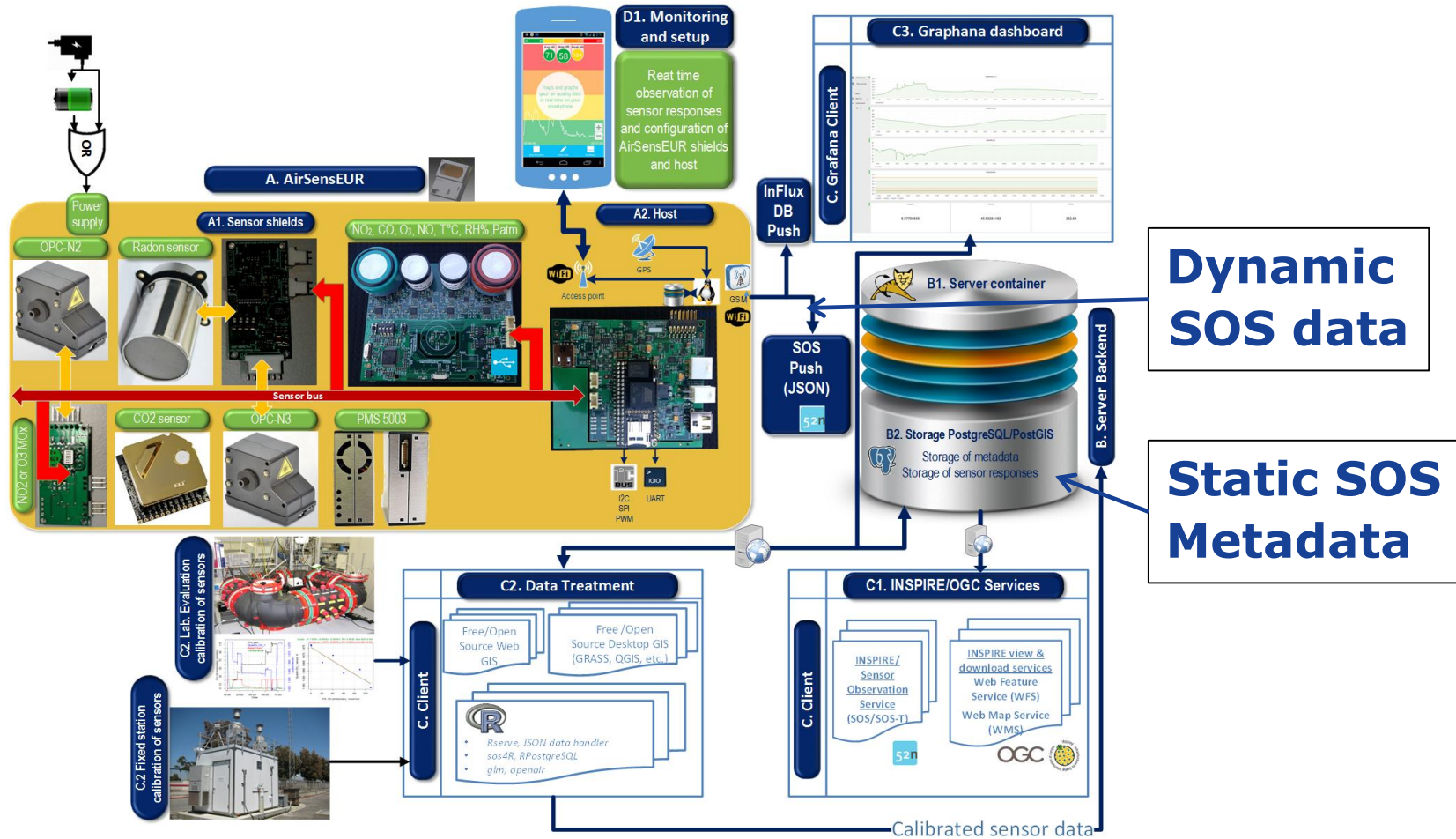
AirSensEUR Architecture

Temperature, Humidity, pressure sensor

Electrochemical Sensors e. G. NO2, CO, O3 and NO
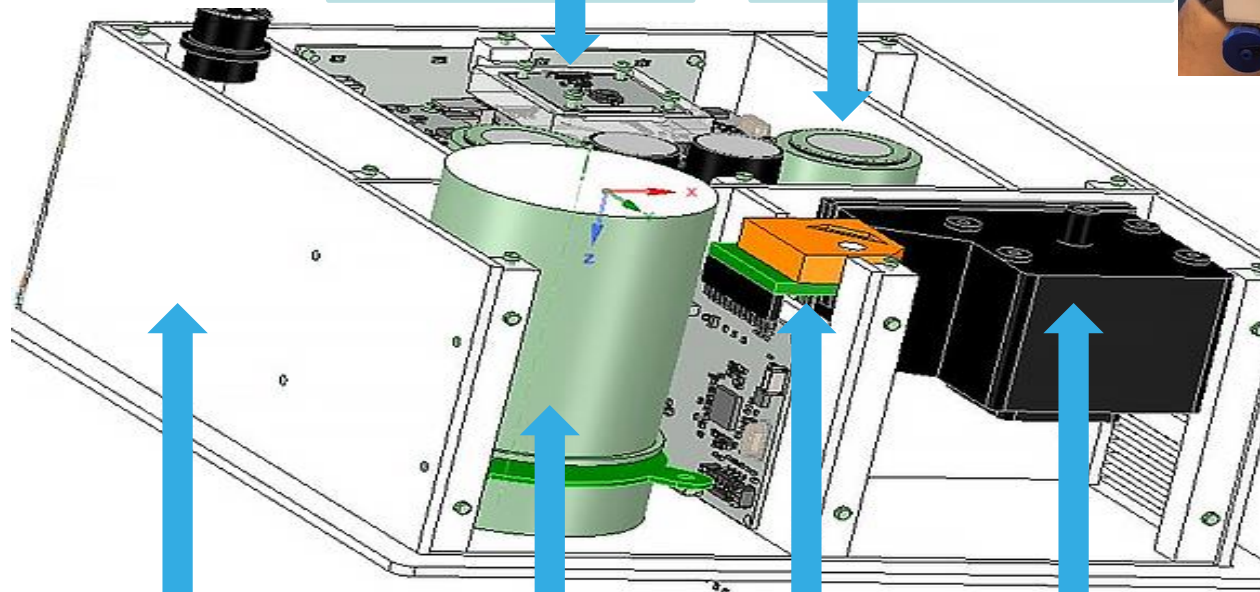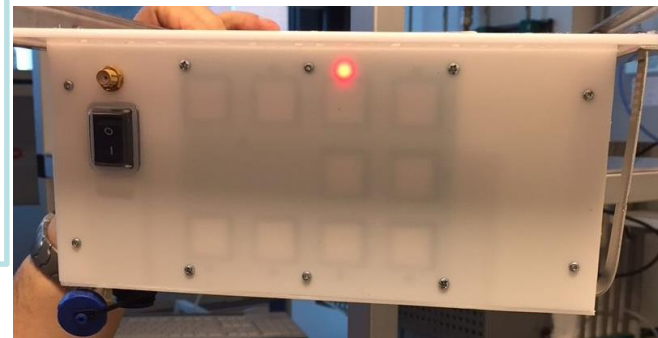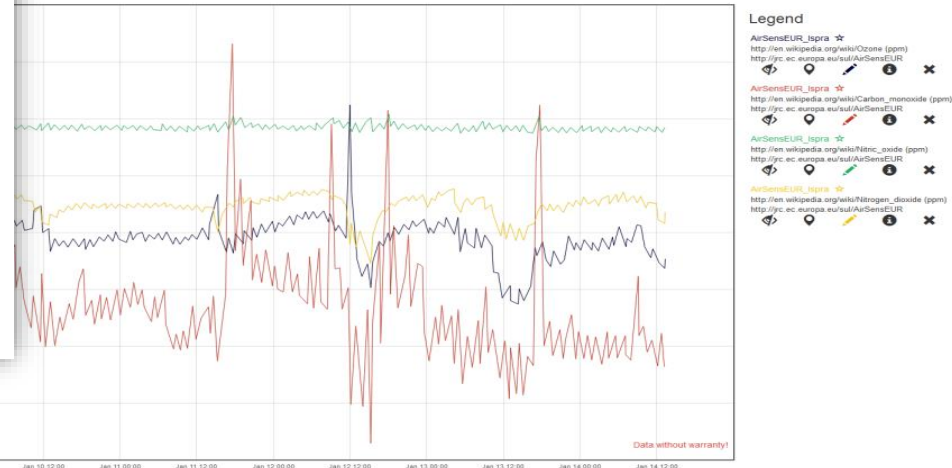
Teflon Protective box
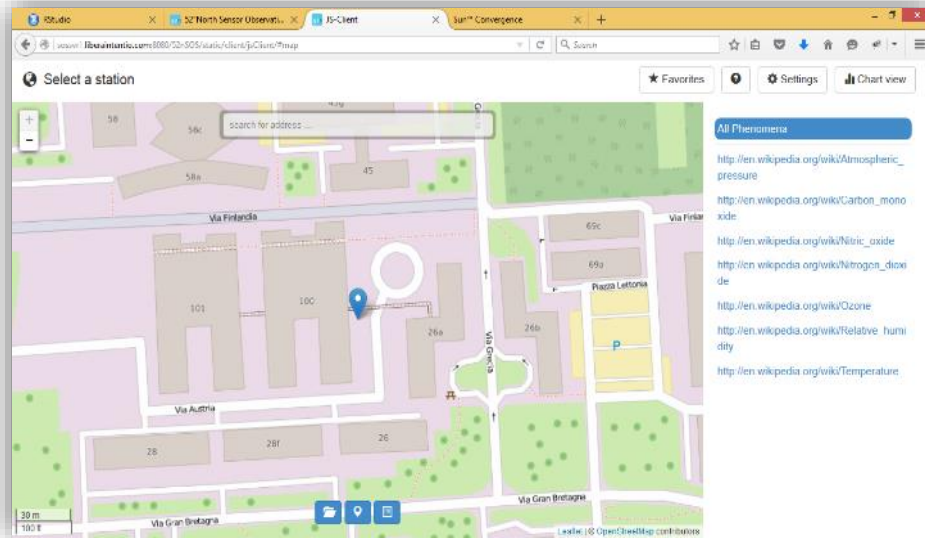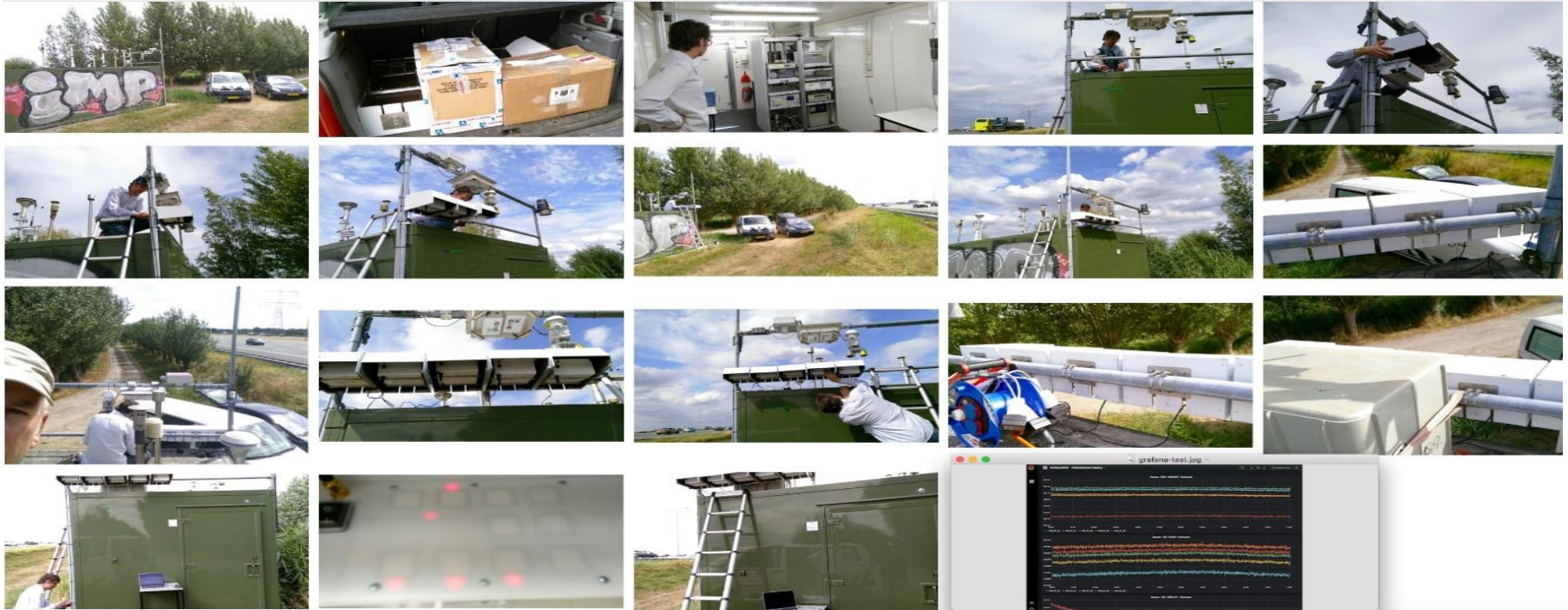
Radon sensor

CO2 sensor

PM OPC sensor

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SOS client (in line with legislation)

- **Aggregate samples with GPS information, periodically update an external server through WiFi or GPRS channels**

- **Own SOS-T Java client (open source, EUPL) – consistent with the Inspire Directive**

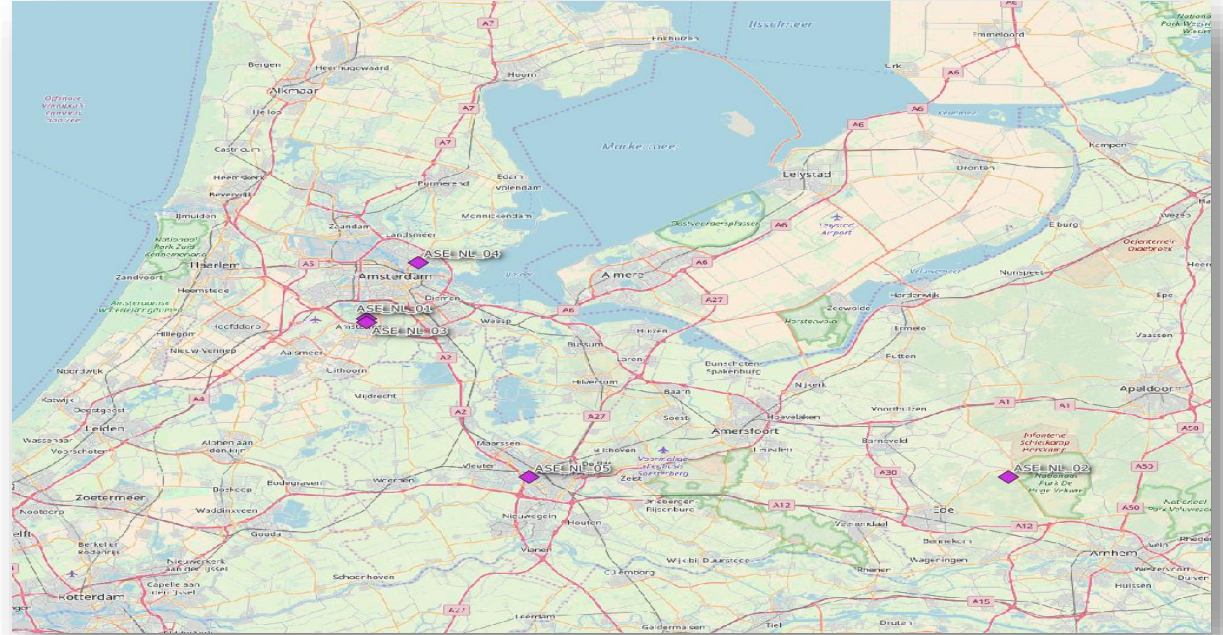# Deployment in NL

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Deployment in NL

1) Co-location with a RIVM station

   - 52N SOS available

   - Calibration

2) Deployment at 5 different sites

   - Heterogeneity

- Reuse of the Smart Emissions architecture for data
- Done by JustObjects B.V.

Automatic transfer (SOS, InfluxDB)

ASE   AirSensEUR   GetData   Calibration

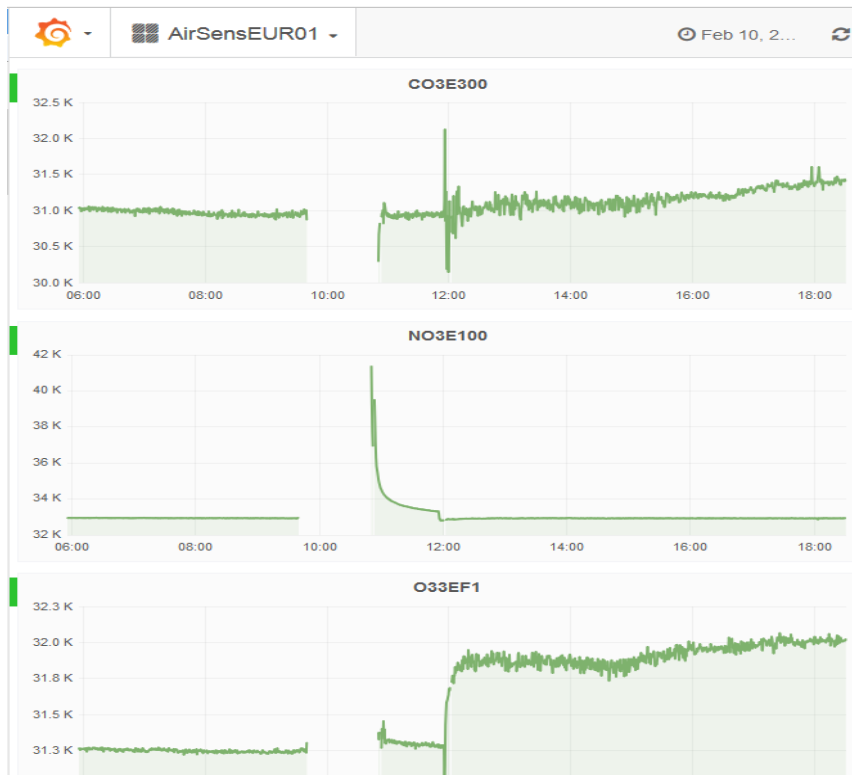| Time | shield | Proxy | InfluxDB | SOS-T | Reference |

☑ Download SOS data

SOS server URL

http://sossvr1.liberaintentio.com:8080/AirSenSOS/api/v1/

SOS ID of the AirSensEUR box

LANUV01

52°North
IMI_HR
JRC_B6_01
LANUV01
LANUV02
LANUV03
MET_HU

Automatic list of AirSensEUR box at Rest API

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Filtering and valid data (outliers)

1. **Discard negative reference data**

2. **Select valid of sensor data**

	From	To
•1	2016-10-25 15:00:00	2016-11-08 01:30:00
•2	2016-11-26 14:00:00	2016-11-29 12:30:00
•…		

3. **Warming time of each sensor**

4. **Limit temperature and humidity range**

5. **Discard outliers**

Simplify data treatment with R and shiny

➢ R scripts for data transfer and data treatment
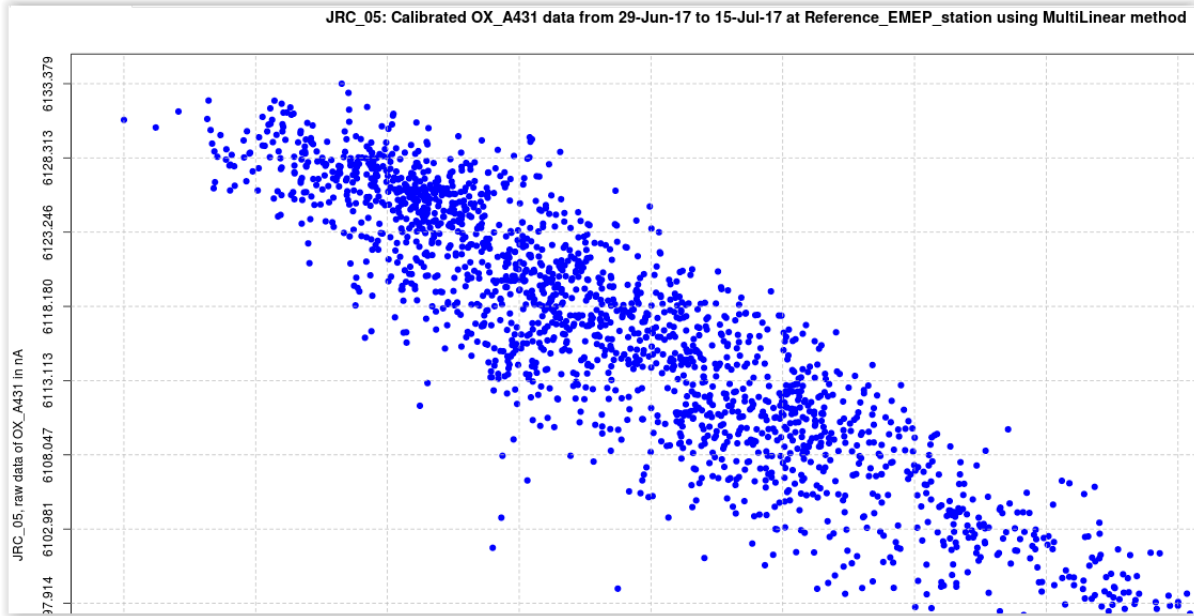➢ Web shiny application for easy configuration of the scripts

Calibration –
Selection of method

ASE Shiny/R web application

- Data transfer of 52North SOS data and InfluxDB , SOS reference data works fine

- Using SOS, sensor and reference data are easily embedded and mapped

- The open AirSensEUR architecture simplifies the integration of new sensors

- The shiny/R web interface offers a user friendly Graphical User Interface for filtering and calibration of sensor data

- For now a few calibration models are available (linear, quantile regression, MLR, GAM, Quadratic, Cubic …). Next step: add further calibration models using the shiny App design

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