
# The INTEGREEN mobile system for traffic and environmental monitoring

## 2nd INTEGREEN workshop

24/06/2014

# Outline

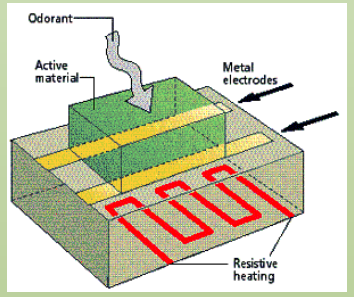
**Table of contents**

- Environmental sensors
- Traffic and environmental monitoring systems
- Tests and calibration
- Field measurements
- Further deployment
- Summary

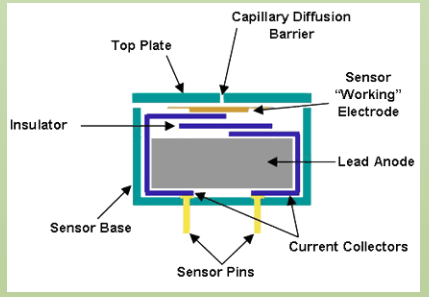
# Environmental sensors

Evaluation of mobile air pollution sensing techniques:

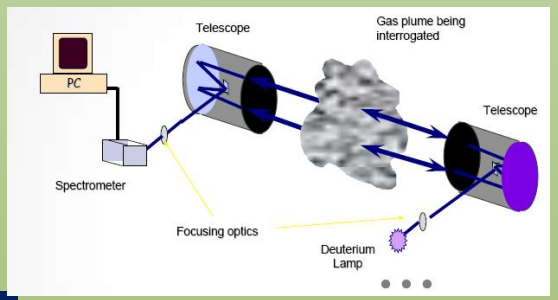
- **Chemo-resistive MOX**: based on variations of sensor resistivity
- **Electrochemical sensors**: active measurement principle (gas oxidation / reduction)
- **Optical gar sensors**: measurement of the impact that gas have on light absorption




*Souce: University of Siena*




*Souce: equipcoservices.com*



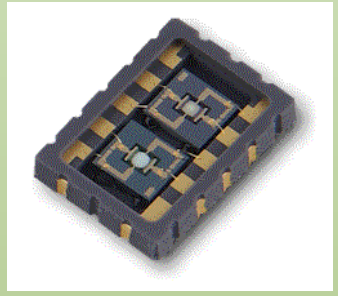

*Souce: DUVAS*

Evaluation based on different specifications, in particular: response time, non-linearity, zero drift and cross-sensitivity

# Environmental sensors

**Air pollution sensor selection**

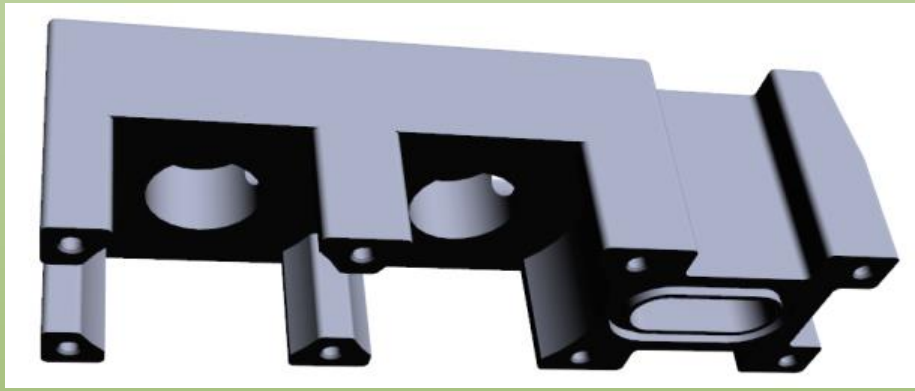
- **Nitron dioxide** ($NO_2$):
  - $NO_2$ (Alphasense) – electrochemical sensor
  - $NO_2$ (SGX) – MOX sensor
- **Ozone** ($O_3$):
  - $O_3$ (Alphasense) – electrochemical sensor
- **Carbon monoxide** (CO):
  - CO (SGX) – MOX sensor



# Traffic and environmental monitoring systems

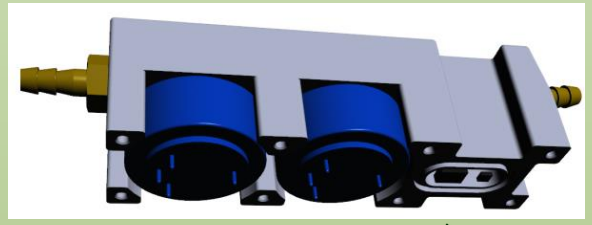
**Components detailed design**

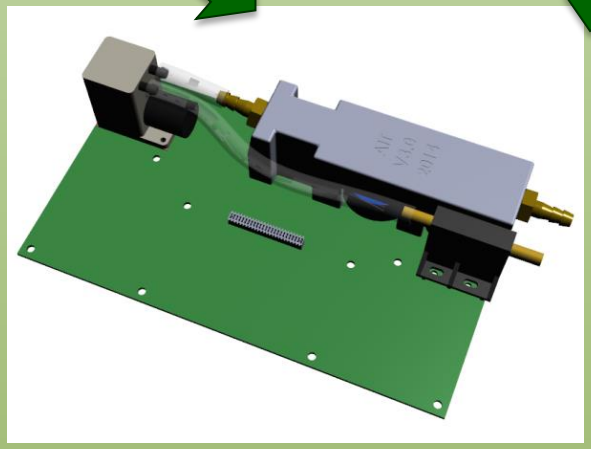
- **Analog-to-digital converter** (sensors are analogue)
- **Temperature and humidity** sensors
- **Sensor Control Unit** (data reading and communication with on-board telematic unit)
- **GPS receiver**
- **Ad-hoc air guide**

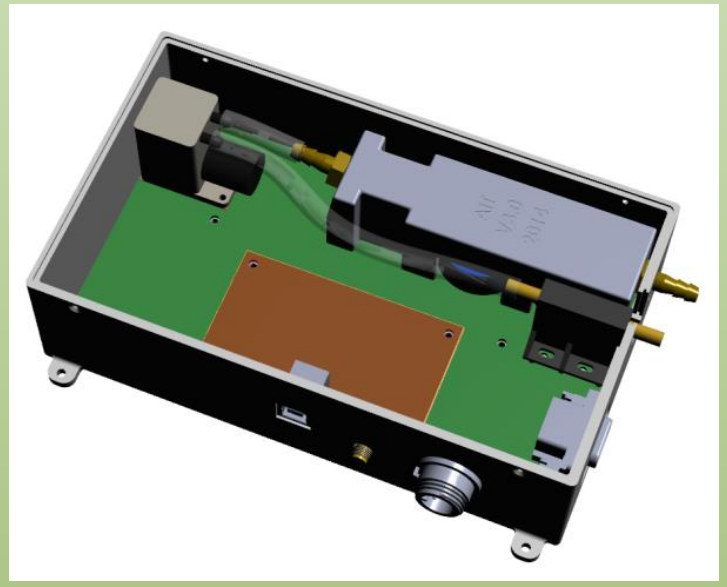


# Traffic and environmental monitoring systems

## Components detailed design







# Traffic and environmental monitoring systems

- Most of the design choices replicated for the on-board traffic unit as well.
- Integration and selection of precise **accelerometers**: this will allow to make specific measurement campaign on the correlation between fuel consumption and driving parameters.
- An interface is available with the **CAN-Bus network** in order to collect the available vehicular data as well.

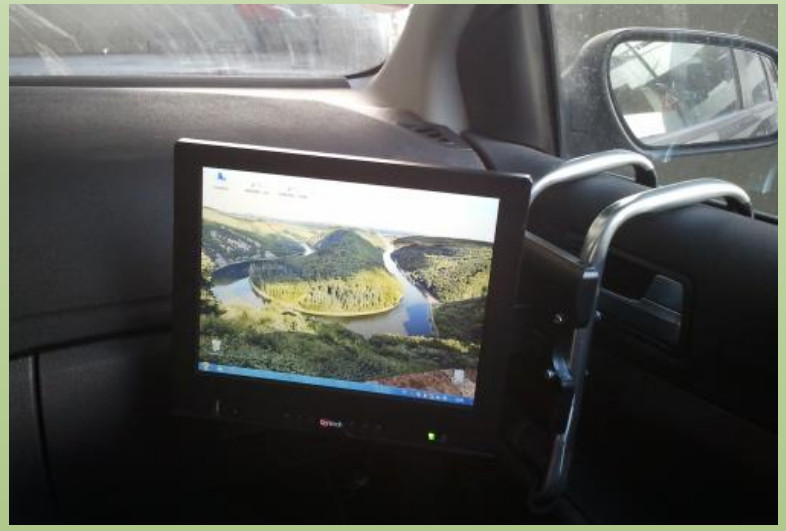
# Traffic and environmental monitoring systems

- The core «engine» of the mobile system:
  - ❑ Receives the data from the monitoring units
  - ❑ Pre-processing of the raw measurements
  - ❑ Remote data transmission to the vehicle front-end
- Detailed design activities:
  - ❑ **PC Car selection**
  - ❑ **Real-time interface to the on-board sensors**
  - ❑ **Local data management and communication system**


Powerful unit that supports advanced telematic applications

# Traffic and environmental monitoring systems

- Two types of HMIs are going to be considered:
  - **«Professional»** HMI – for detailed testing and valitation purposes
  - «**General purpose**» HMI – to be easily used by generic test drivers. Simply one of the applications (e.g. BZTraffic) optimized for driving conditions.



# Traffic and environmental monitoring systems

- **Mobile system first prototype available**
  - ❑ Electronic design phase.
  - ❑ PCB layout design and production
  - ❑ Component purchase
  - ❑ Electronic components mounting
  - ❑ Labelling and testing of the mounted PCBs
  - ❑ Final housing and integration

# Traffic and environmental monitoring systems

- **On-board monitoring units**

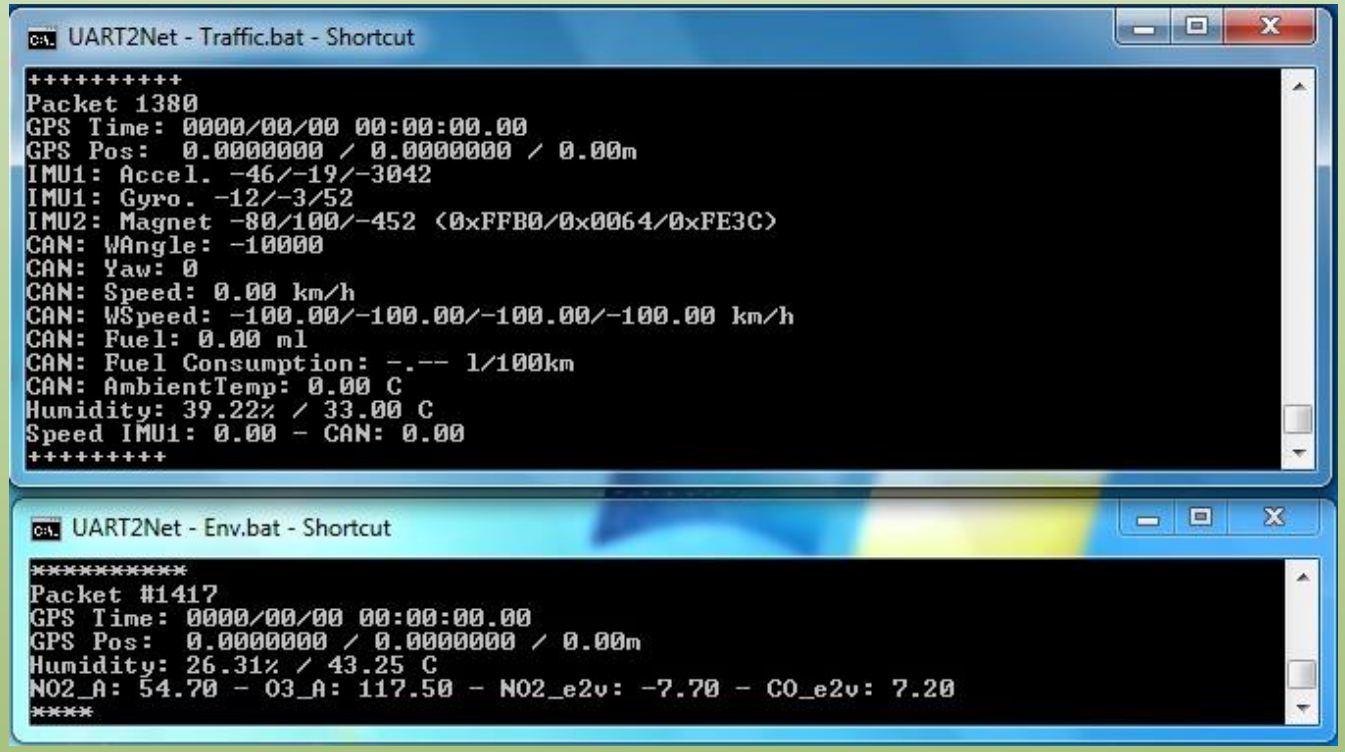

**On-board traffic monitoring unit**


**On-board environmental unit**

# Tests and calibration

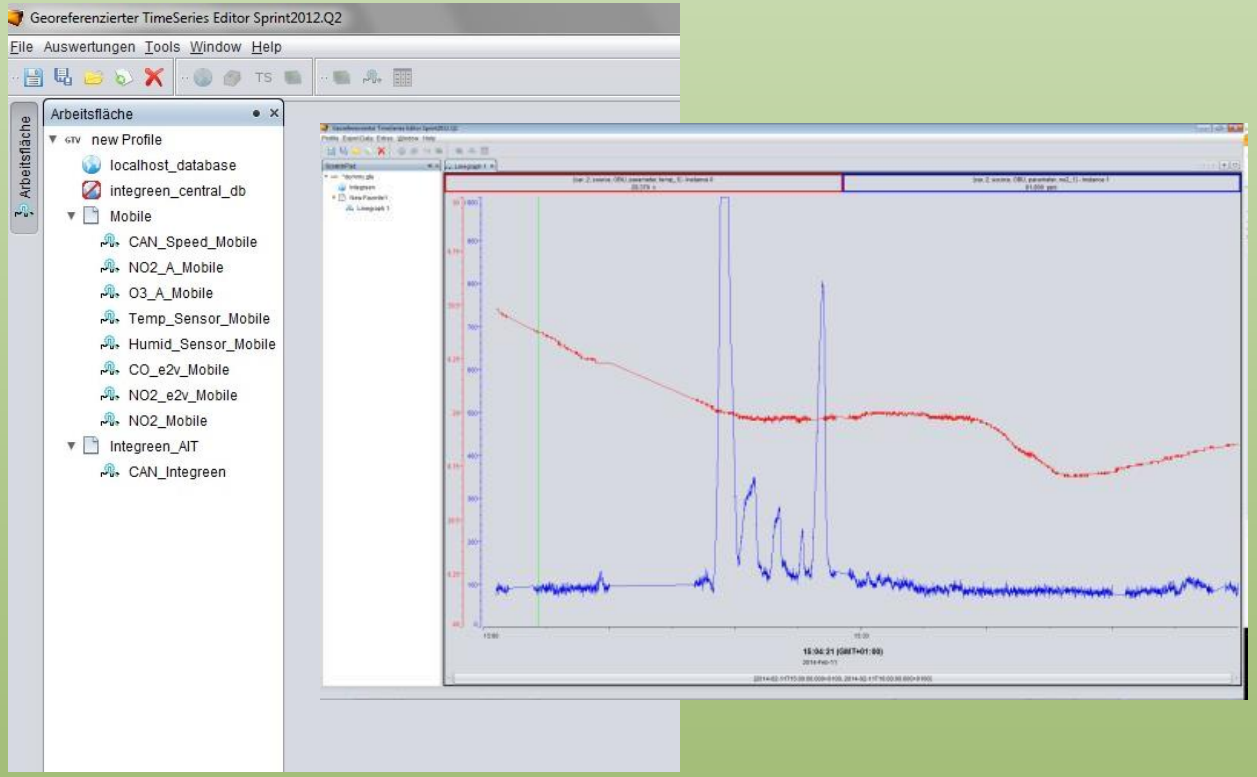
- **On-board HMI**

Detailed evaluation of the real-time measurements gathered by the two on-board monitoring units



# Tests and calibration

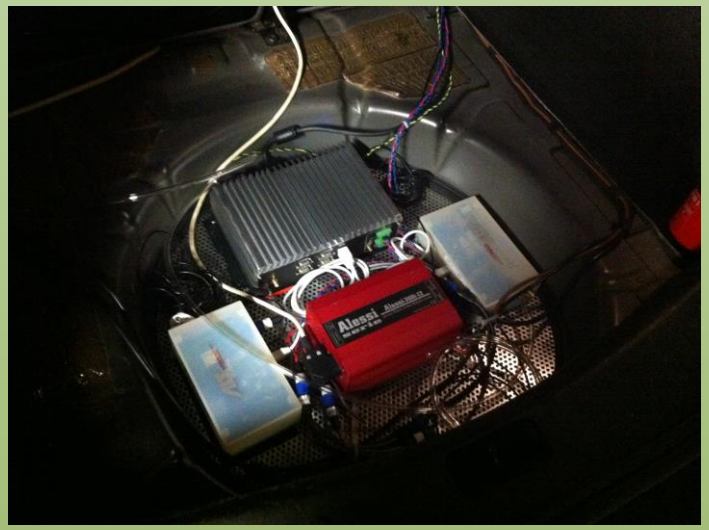
- **On-board HMI**




Graphical visualization of the measurements trends, immediate assessment of the mobile system performance

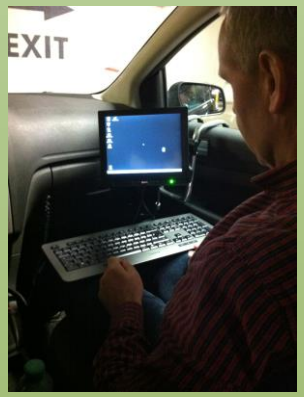
# Tests and calibration

- **Joint component test session**
  - ❑ Verification of the entire communication chain
  - ❑ Verification of the performance of the mobile system (and XFCD data analyzer)



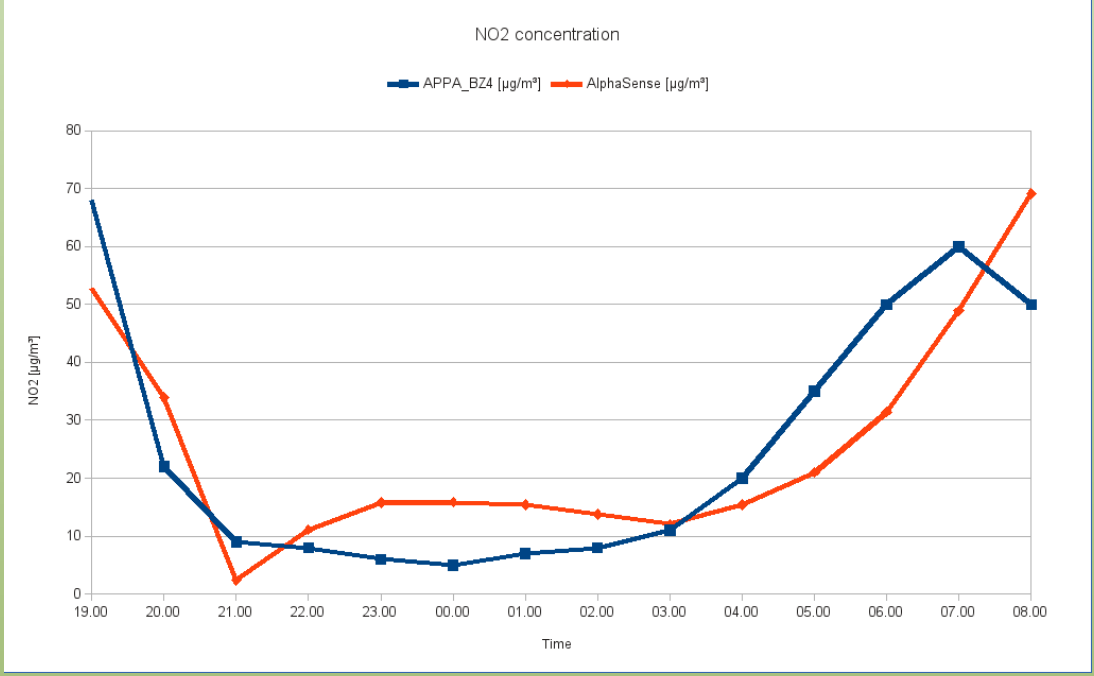
# Tests and calibration

- **Joint component test session**
  - **Different use cases** analyzed: static measurements near official air quality stations; mobile measurements on the reference test route and in harsh environments, including the A22 highway.



# Tests and calibration

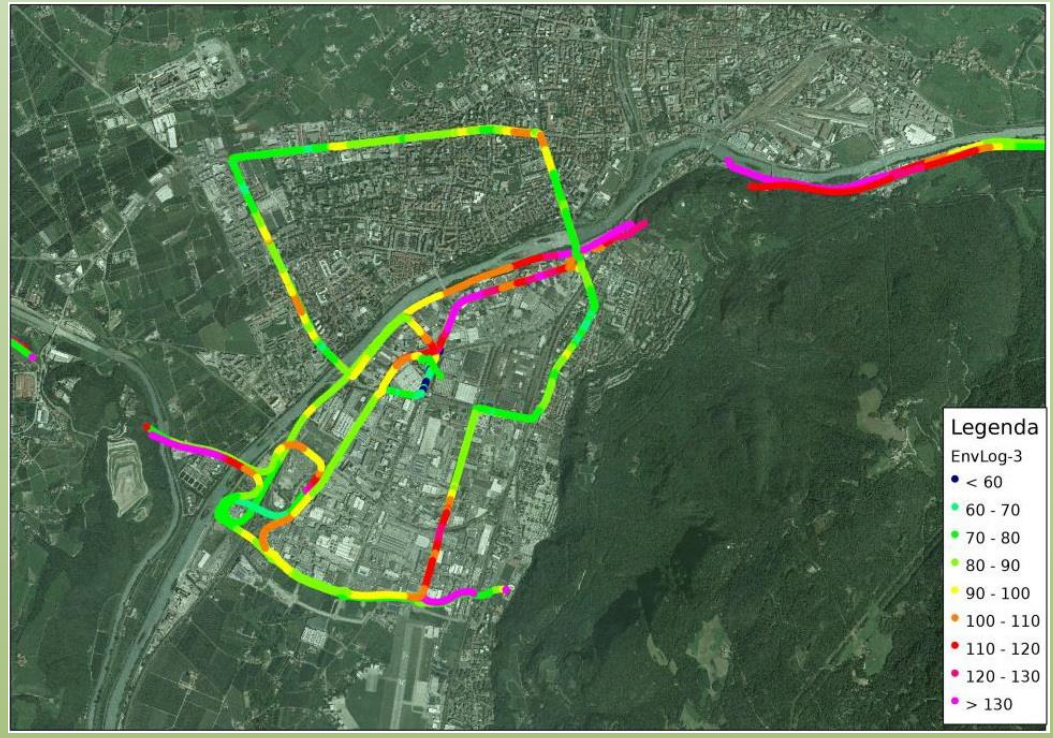
- **Calibration with static measurement station**




- Comfortable behavior in **static conditions**, if compared to reference air pollution stations.
- More tests are needed in order to improve the compromise between **fast and accurate measurements capability**

# Field measurement

- **Joint component test session**
  - **Results:** identification of minor errors in the communication chain, improvement of XFCD data analyzer, suggestion for operative application and maintenance of mobile system units, data visualization output test results



# Field measurement

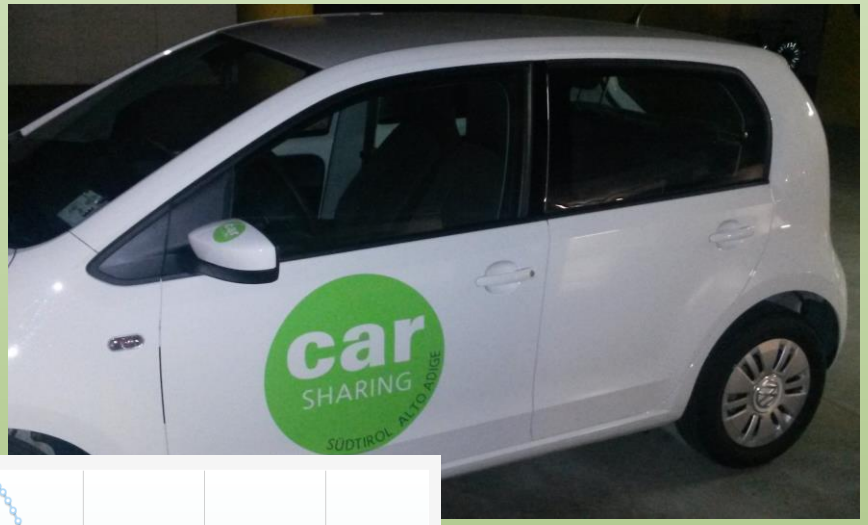
- **New compact Mobile INTEGREEN System**

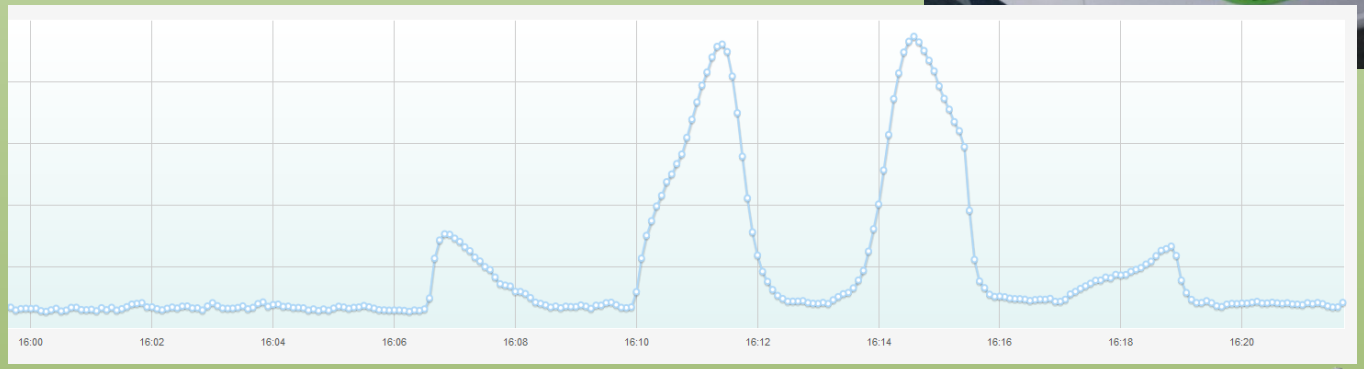
# Field measurement

- **Mounting on the bolzano car sharing test vehicle**


# Field measurement

- **Measurement results with the Mobile System 23/06/2014**



# Summary

**Summary**

- Ad-hoc design of traffic and environmental monitoring unit
- Air-guide and air flow control, fast measurement
- Real-time data transmission to INTEGREEN server
- Portable test system for generic vehicle use
- Test on car sharing vehicle and SASA bus planned
- Miniaturisation