

SPACE FOR TWIN CITIES AIR QUALITY

19 November 2020 | 16:00 – 17:00 CET

Paris (FR) | Los Angeles (US)



ONLINE SEMINAR | Streamed by ESA Web TV | <https://esawebtv.esa.int>

AQP (Air Quality Platform) Project

Massimiliano Ferrante, 19-11-2020

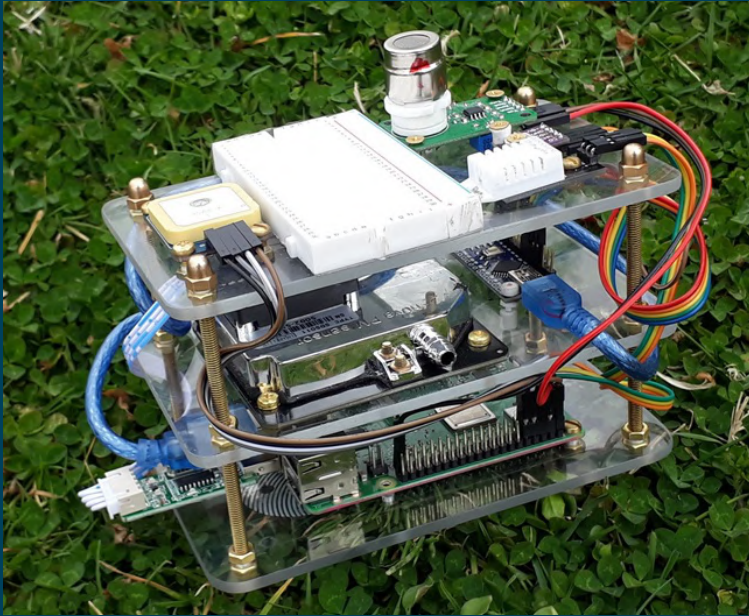
ESA ESRIN ,

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→ THE EUROPEAN SPACE AGENCY

AQP (Air Quality Platform) - Educational version



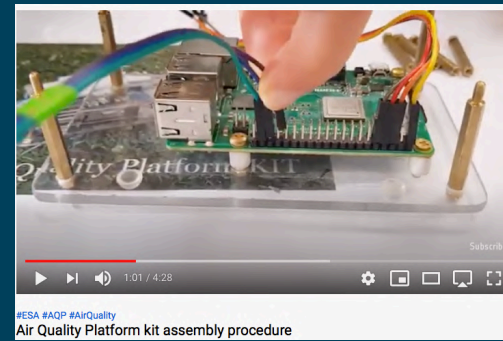
- It is an Assembly Kit (HW and SW) for a device capable to sense some local ambient parameters and send data to a central server.
- It was designed and built internally in ESA at the ESRIN EO Laboratory.
- Initially specified for the ESA Living Planet Symposium 2019 School Laboratory, for Educational purposes and built with consumer grade components.
- Dedicated Web Site (<https://aqp.eo.esa.int>)
- Quick Start Guide and video to integrate and test an AQP (https://aqp.eo.esa.int/wp-content/uploads/2019/04/QuickStartGuide_1.1.pdf - <https://youtu.be/RWstQtcBIQ4>)
- Application SW distributed as EE-CFI with an Open Source License (GNU GPL v3)



Kit



Guide



Assembly procedure video

It uses cheap sensors for measuring:

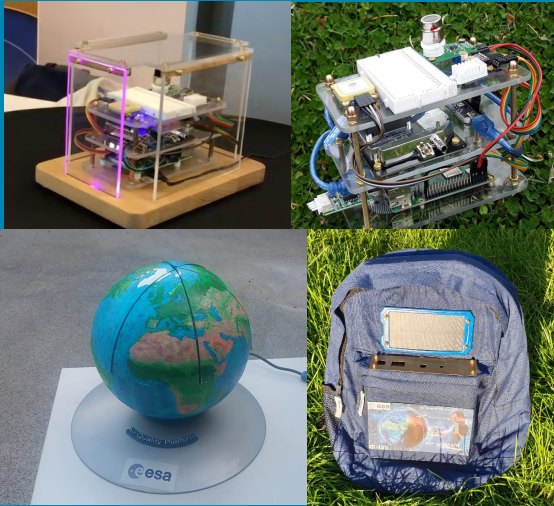
- Temperature, Humidity
- PM10, PM2.5,
- CO2, CO, NH3, NO2,
- GPS (position),
- CH4, Atmospheric pressure

Air Quality Platform – A multidisciplinary system

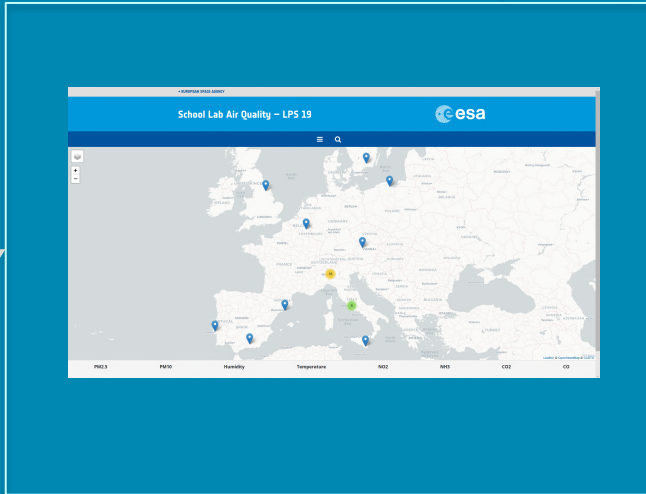
Platforms

Air Quality Platform

AQP Macro-Platforms



Esa web server



Satellite data (Sentinel 5p)

The on-going AQP project responds to the goal of expanding knowledge and awareness of the public about air quality.

Involved Topics:

- Satellite data (Sentinel 5p)
- Educational
- IoT devices
- Citizen science
- AI (with ML algorithms)
- Sensors Calibration
- Multidisciplinary (ie. Robotics etc)
- Wearable Platforms
- Automotive Platforms (on going)
- Mobile Platform (on going)

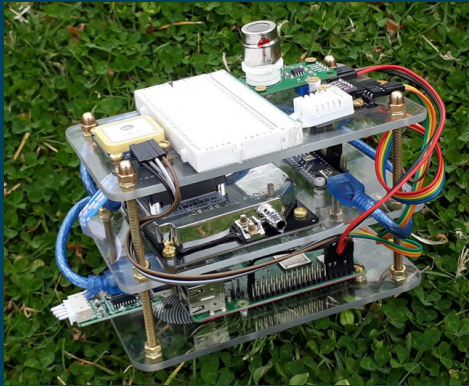
Universities,
schools,
ESERO,
Research groups

Users

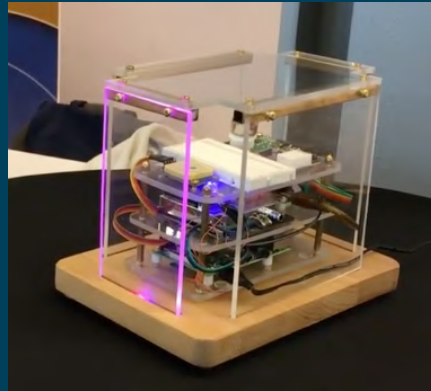
AQP IoT devices



Educational



Exhibition



Sensors Calibration



Automotive



**LOTUS
Multidisciplinary**



**Backpack
wearable device**

AQP mobile

On going

Temperature & Humidity



CO2



CO2



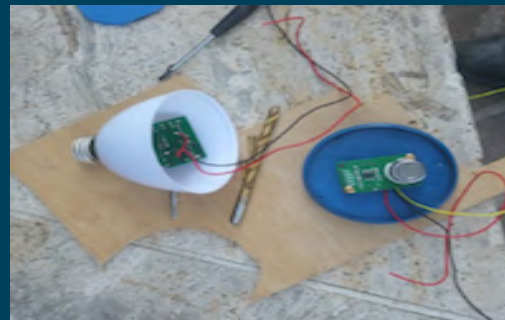
CO,NH3,NO2



Park - Garden



Lamp



Micro-usb



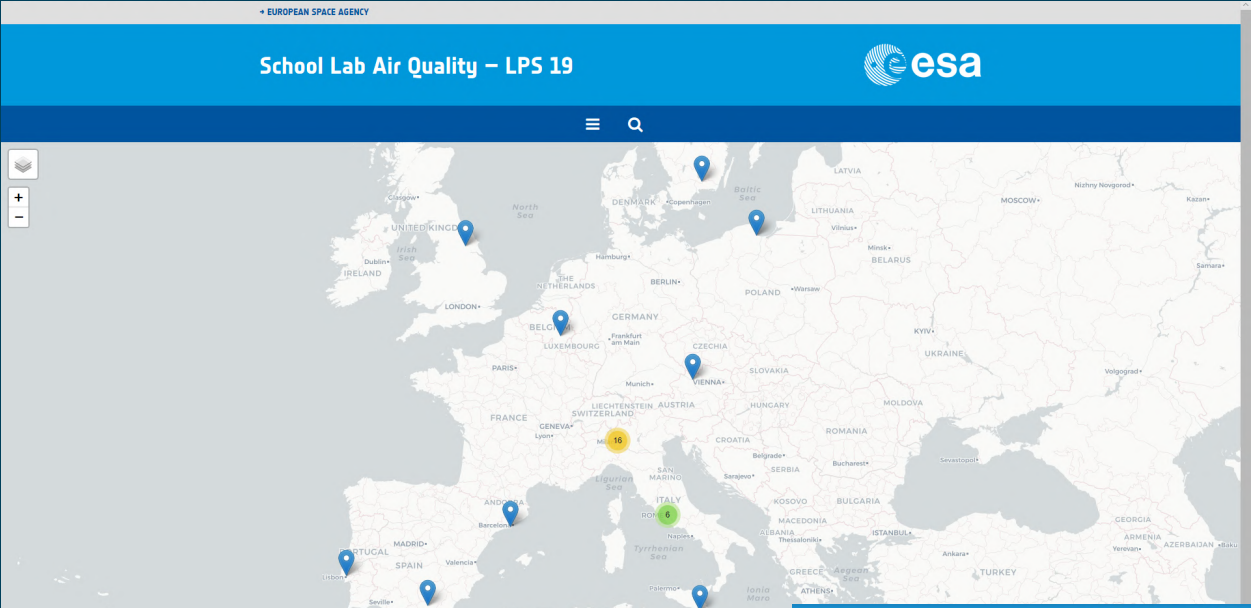
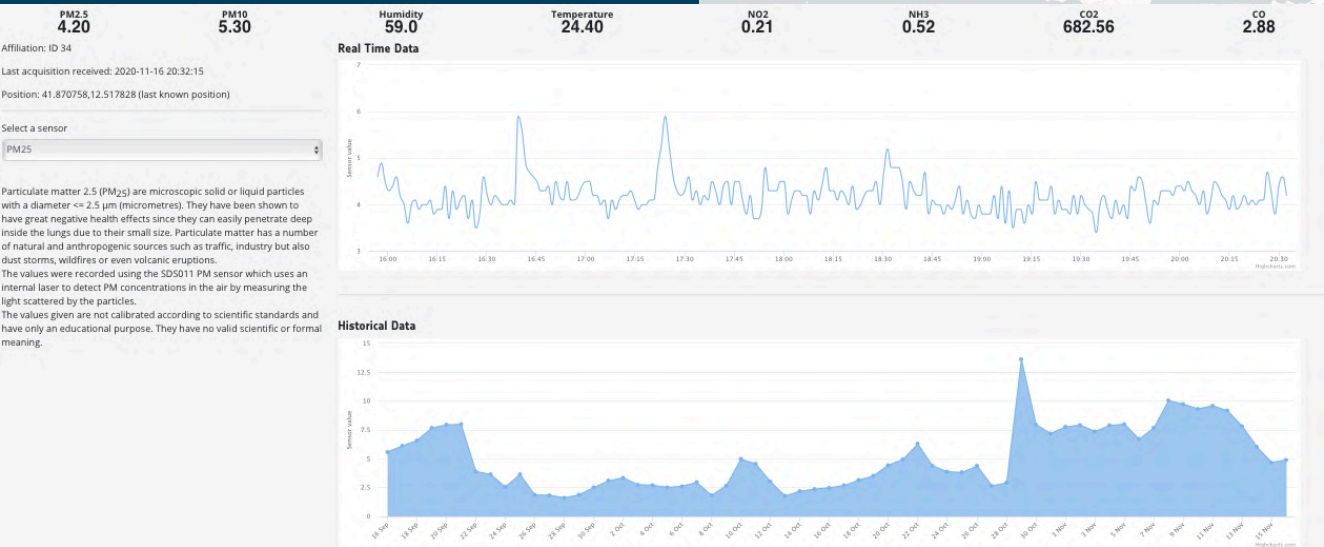
IoT In a bottle



Current AQP coverage



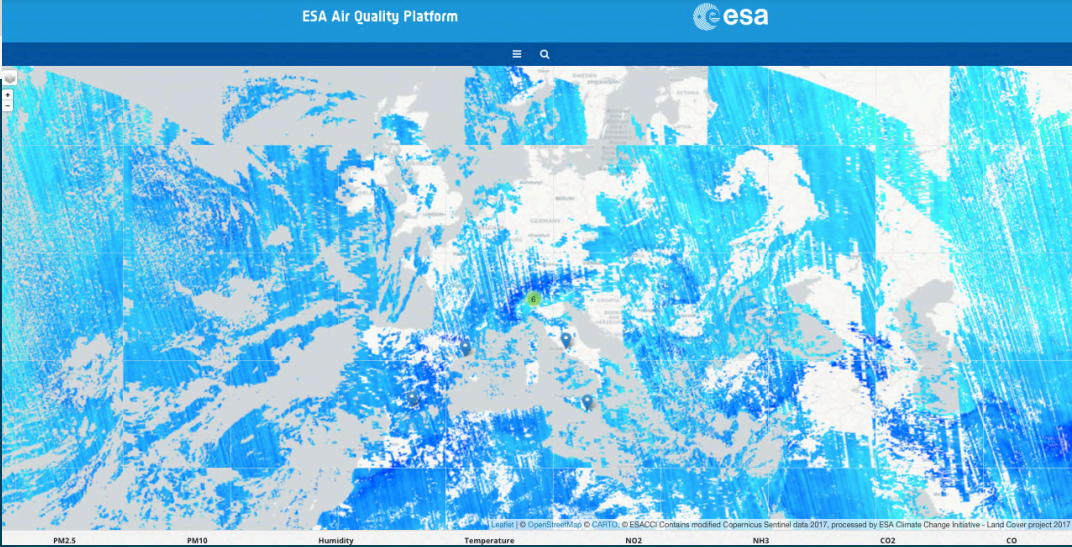
Real Time data



AQP Map

<https://aqp.eo.esa.int/map/>

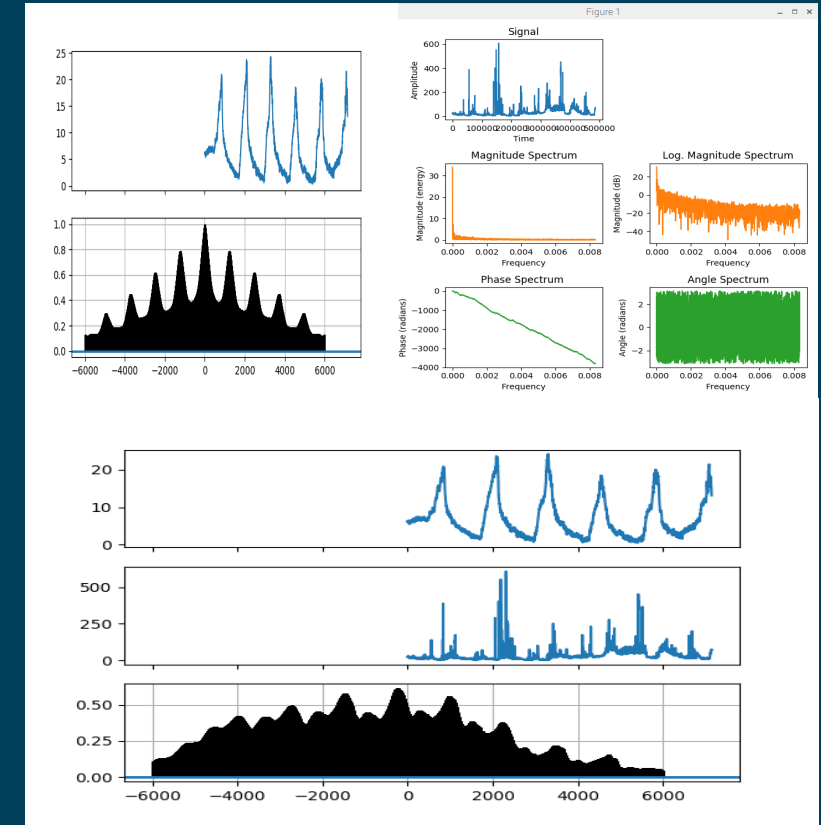
Overlay of Sentinel 5p data



Each AQP is able to implement data analysis:

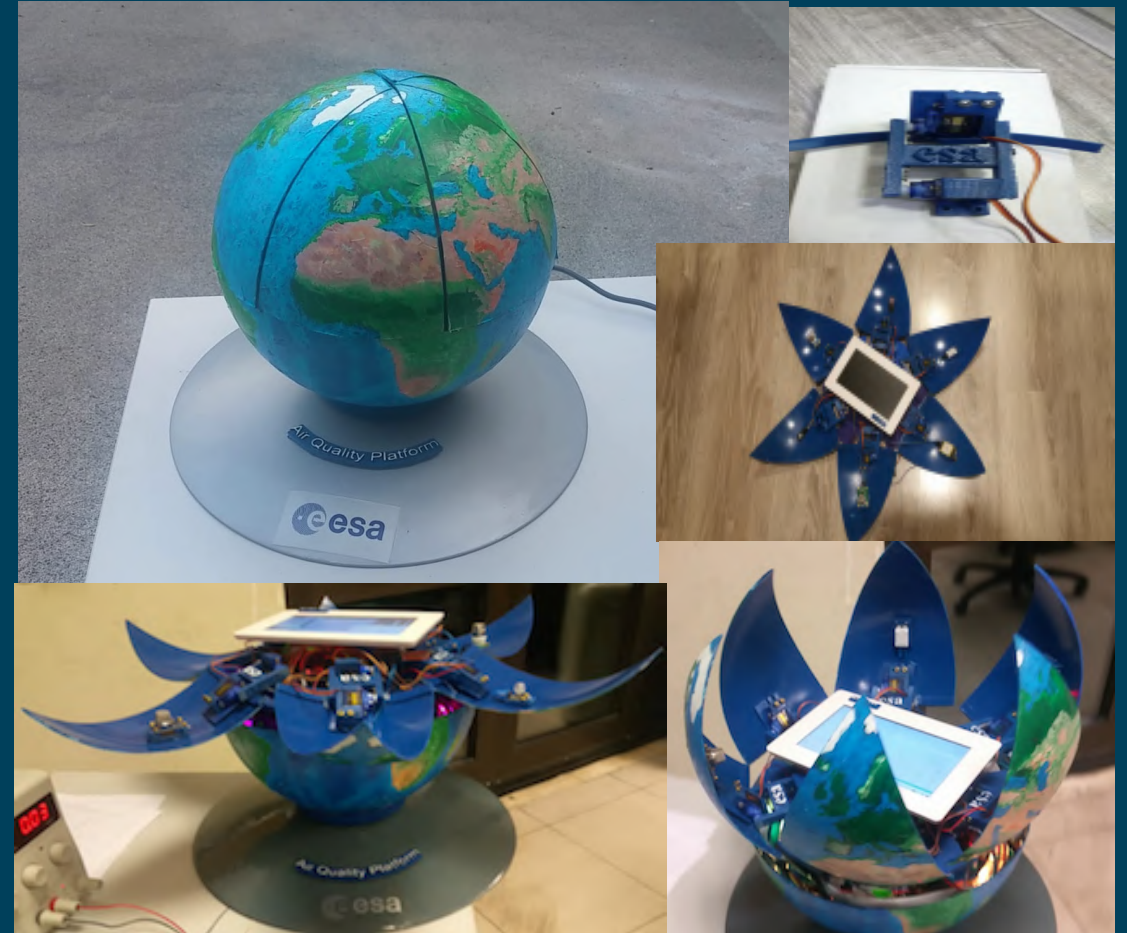
- Calculate the main statistic values (Average, variance, FFT, autocorrelation, filter acquired measurements, correlation between different sensors values etc.).
- Implement autoregressive models to estimate the anomalies in the values provided by sensors
- Implement of some AI algorithms to predict possible alarms/anomalies
- Integrate its data with an external Weather reports (on going)
- Remote Control of the AQP with the possibility of downloading/uploading data & programs
- Investigation and implementation of Machine learning algorithms to decrease the measurement uncertainty/error due to cheap sensors (on going)

Cheap sensors can not be used for scientific measurements. They require the resolution of associated data uncertainties and to the stability . For reducing their measurement errors, the availability of time series will open the possibility to apply auto-regression prediction models and Machine Learning algorithms.



Special Demo Unit - LOTUS

- Special multi-disciplinary project
- Globe opening as a Lotus Flower
- A sensor is installed on each of the 6 Petal
- Monitor installed in the platform
- Local Visualization of the acquired data
- Robotic/mechanical movement
- Audio functionality
- Fine arts painting of the globe
- It can be used as a central node of a IoT sensors
- Implements Machine Learning algorithms
- Video <https://youtu.be/JL-dcbtcOY8>



Walk with AQP backpack

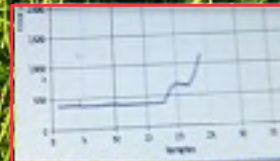
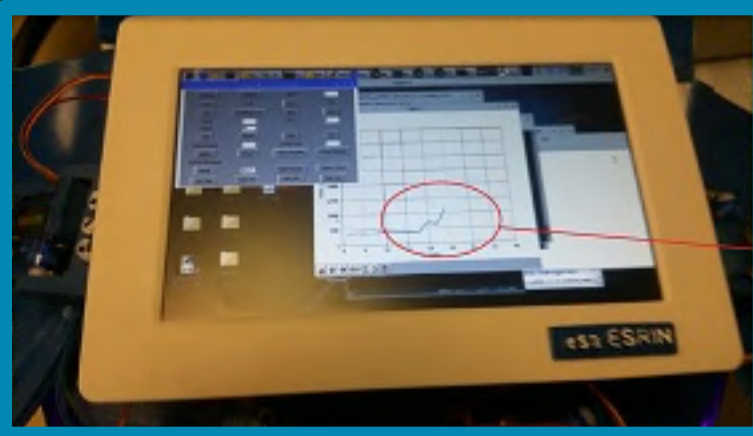
Real time position



Video - Walk with AQP backpack



Real time Sensors values



Micro-AQP IoT Lamp



Possible applications

Thank you

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