The monitoring of airborne pollutants by developing a low-cost sensor network as part of AVIATOR

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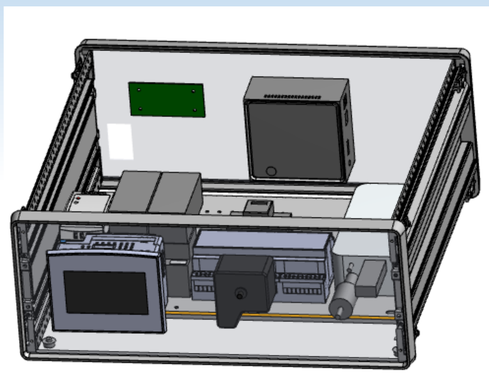


Aims & Objectives

Emissions from aircraft have adverse effects on the air quality in and around airports, contributing to public health concerns within neighbouring communities. AVIATOR (Assessing aViation emission Impact on local Air quality at airports: TOwards Regulation) will adopt a multi-level measurement, modelling and assessment approach to develop an improved description and quantification of the relevant aircraft engine emissions, and their impact on air quality under different climatic conditions. Engine particulate and gaseous emissions in the test cell (INTA, Madrid) and on-wing from an in-service aircraft will be measured to determine pollutant plume evolution from the engine and APU exhaust.

AVIATOR will develop and deploy across multiple airports, a proof-of-concept low cost sensor (LCS) network for the monitoring of UFP, PM and gaseous species such as NOx and SO_2, across airport and surrounding communities. **The goals of the project and the pathways to policy, the design for the new proof-of-concept LCS are outline here.**

Global project goals of AVIATOR are:

- To measure, quantify and characterise airborne pollutant emissions from aircraft engines during flight operations at airports, such as parking (with functioning APU), taxiing, approach, take-off and climb-out, with specific reference to total UFPs, NOx, SO_2 and VOCs under different climatic conditions.

- To develop understanding of main engine and APU exhaust plume evolution, dispersion, micro-physics and chemistry. To improve the ability of existing dispersion models to describe the impact of aircraft emissions on air quality in and around airports.

- To establish interdependencies in the air quality causality chain that better link the current engine emission certification methods with local air quality regulation that is designed for health protection.

- To develop protocols and sampling techniques for the extraction of representative material suitable for *in-vitro* and *in-vivo* analysis. To develop detailed guidance for Regulators and Airports on the measurement and modelling of aircraft engine emissions, and its dispersion with specific reference to UFP, VOC and SVOC.

Methodology

The novel approach of AVIATOR in delivering science and innovation is based on:

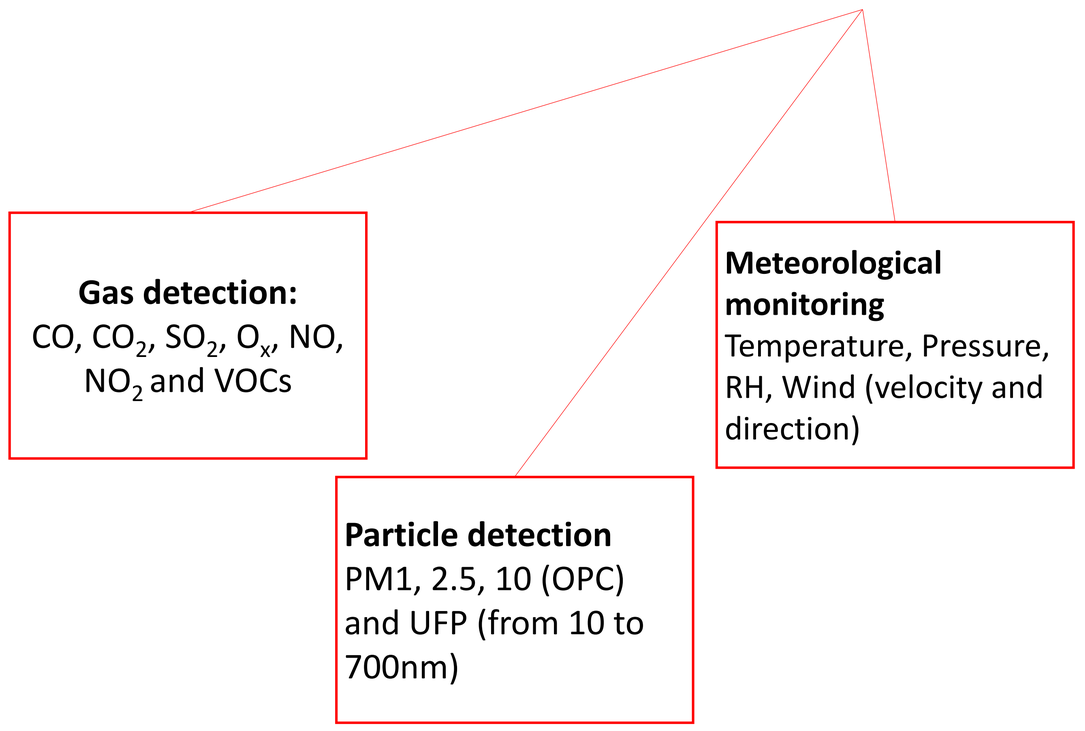
Development of traceable, high-fidelity measurement approaches to understand total PM emission concentrations across different scales including:

i) certified test cell aircraft engine exit and in exhaust stack;
ii) aircraft on-wing engine exit and in-plume (and APU); and
iii) in and around airports.

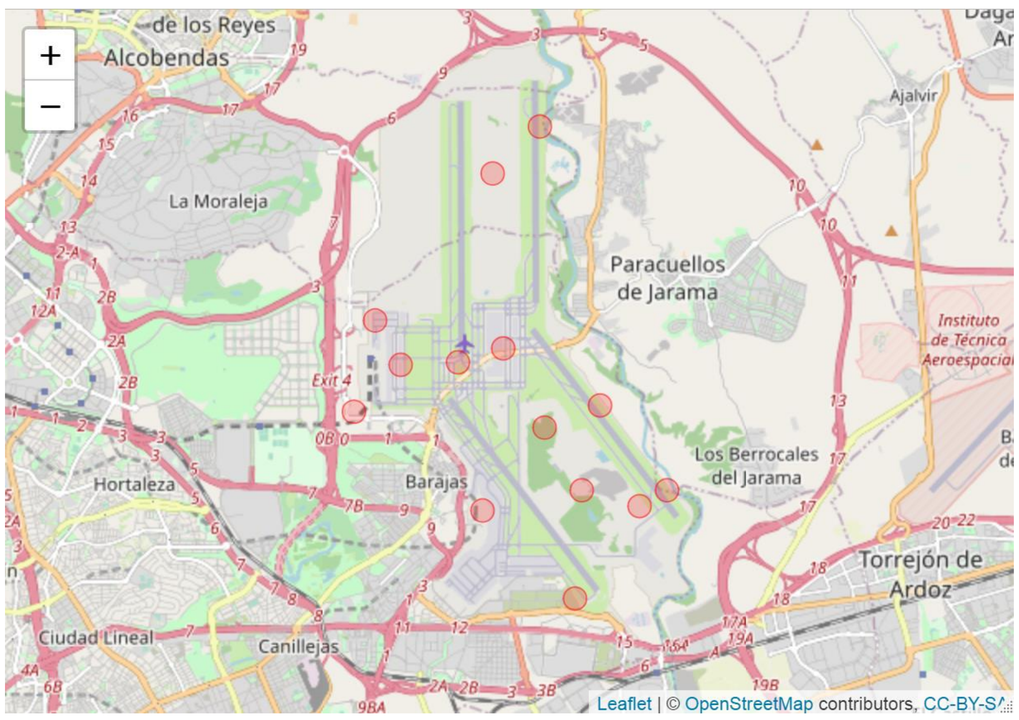
Developing, validating and demonstrating the value and utility of a low-cost sensor network for airport application to provide temporally and spatially resolved information on the key pollutants including both gases and aerosol.

An LCS node typically consists of several electrochemical gas sensors and PID and/or metal oxide sensors for gas phase monitoring and an Optical Particle Counter (OPC) for particle size distributions and PM mass. The LCS nodes designed for AVIATOR use low-cost gas-sensors and low-cost OPCs.

Further reference: https://aviatorproject.eu/



Sensor Network Development & Outlook



The nodes, located around Madrid-Barajas Adolfo Suárez Airport, will measure gases, particles with meteorological data via LCSs.

AVIATOR will innovate by:
i) applying a clustering approach to the gas sensors (each species will be measured by 4 sensors); and
ii) by incorporating a measure of UFP using aerosol analyzers

The prototype node will be developed to accommodate the range of environmental conditions at the three campaign airports and will additionally address data management requirements.

Data from the network will stored in a cloud platform which will provide dashboard, users' control, alarms, thresholds, real time readings per node, averaging period and trending plots. This will be available on-line from computers, tablets and mobile devices

Finally, a high-fidelity instrumentation system will be deployed at Madrid Airport to: i) better characterise air quality in and around airports with specific reference to PM, VOC and SVOC; ii) validate a proof of concept low-cost sensor network; iii) provide data for model validation; and iv) augment the on-wing measurement campaigns. An element of the high-fidelity instrumentation will additionally be deployed at Zurich and Copenhagen Airports to provide additional information on how climate may influence the pollution burden and to continue to benchmark the performance of the low-cost sensors.

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