Assessing aviation emission impacts on local air quality at airports and routes towards regulation

https://aviatorproject.eu

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This Project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 814801.

Genesis (1 of 6 projects)

LC-MG-1-1-2018: InCo flagship on reduction of transport impact on air quality

A) Low-emission oriented driving, management and assistance (UCARES)

B) GREEN VEHICLE index

C) Sensing and monitoring emission in urban road transportation system (CARES)

D) Characterising and quantifying particulate matter from shipping (SCIPPER)

E) Measurement of airborne pollutants emissions from aircraft (AVIATOR)

F) In-vitro and in-vivo assessment of health effects of ultrafine nanoparticles (TUBE)

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Context

- Air Quality is an increasingly important issue for the aviation industry.
- Impact - possible health implications for communities who live close to airports.
- Historical focus has been on NOx. But gathering momentum to examine UFP (ultrafine particulate) and SVOC (semi-volatile organic compounds (e.g. brown carbon).
- Concern over volatile PM and emission of PM precursors.
- Connection between engine emissions and LAQ measurements.

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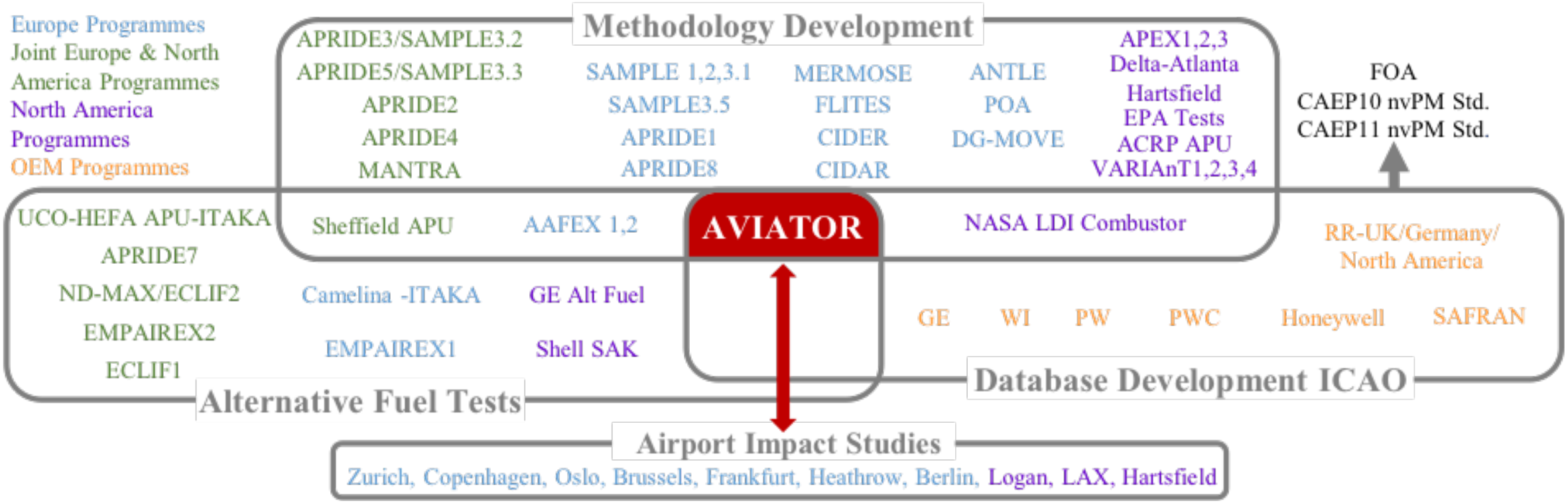
Building on existing knowledge and understanding



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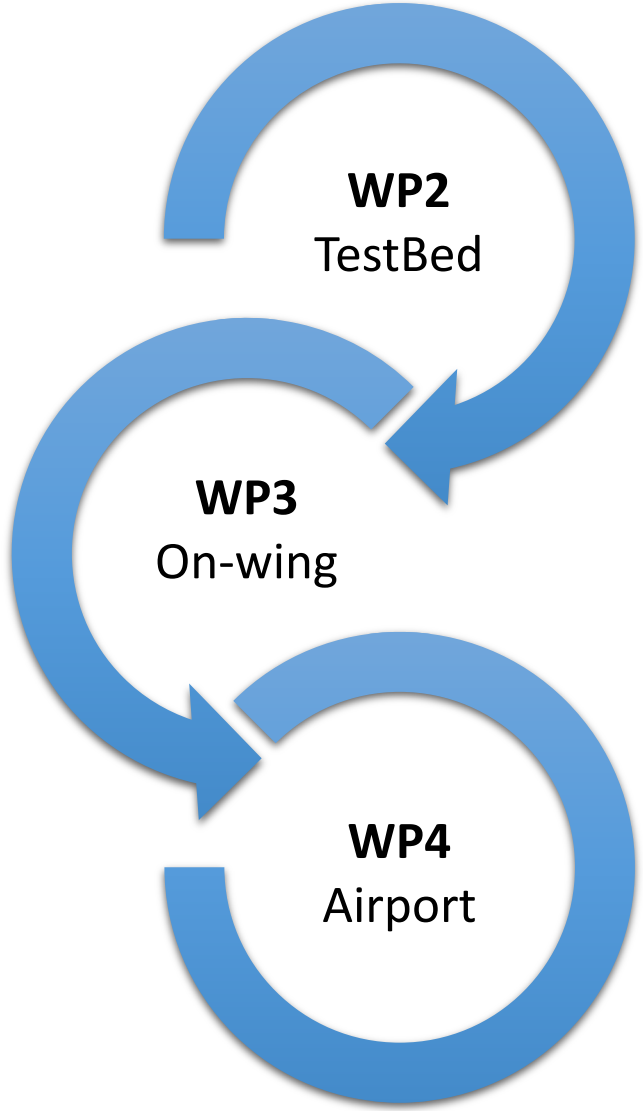
Aims and objectives

AIM 1: Develop Measurement Systems for Aircraft Engine Emissions including volatile precursor and total PM.

AIM 2: Create new knowledge on Aircraft exhaust and Airport pollutants Modelling.

AIM 3: Bridge the gap between Aircraft Engine Certification and Local Air Quality (LAQ) Regulations.

AIM 4: Improve Protocols and Guidance for Air Quality and Health.



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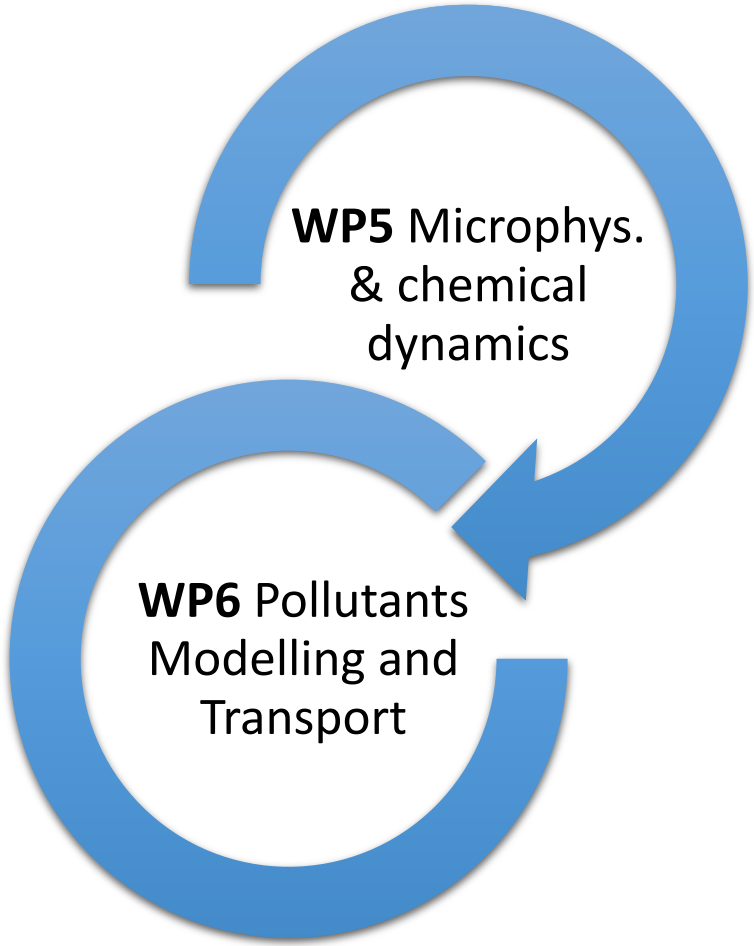

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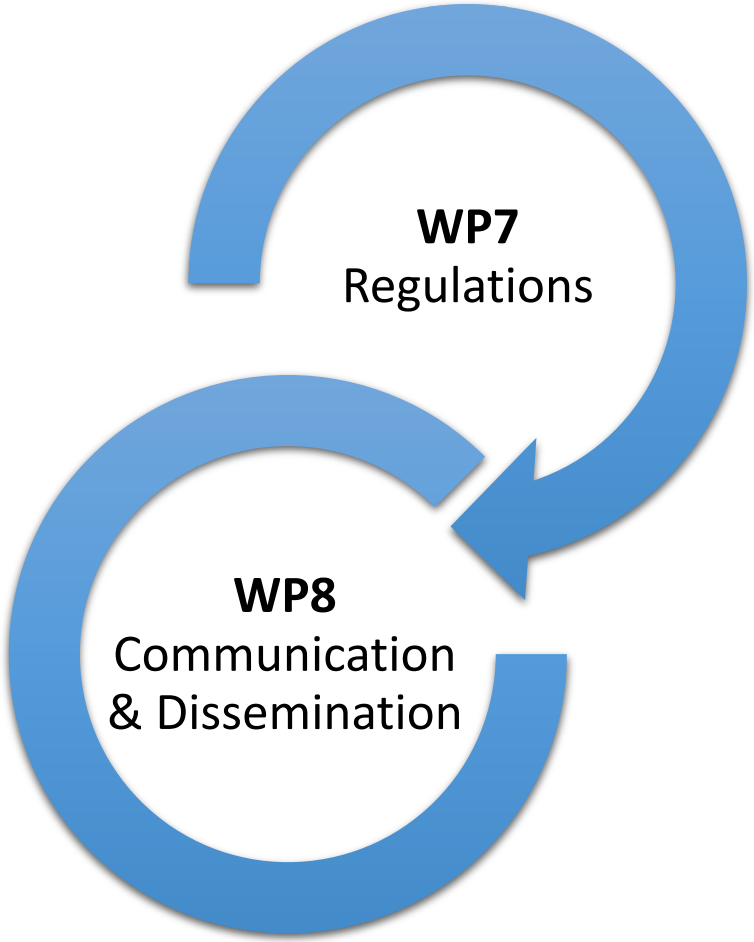

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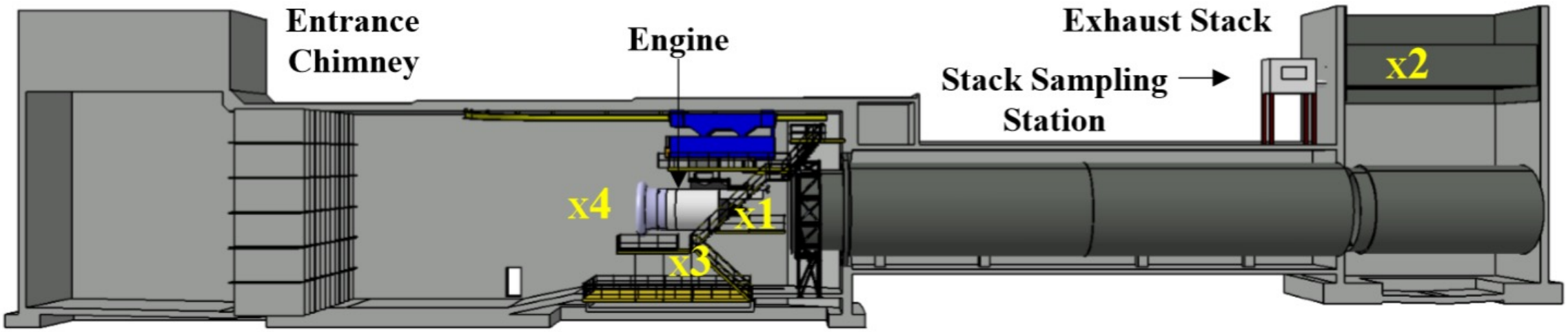
WP2: Test-cell engine exit and in-stack plume measurements



x3 BREATHER SYSTEM (Dedicated)

- Non-refractory speciated PM mass conc.
- Total PM number conc.

Off line analysis

- Total PM mass conc.
- Chemical composition

x1 COMPREHENSIVE SYSTEM (Dedicated)

- vPM mass and composition
- Total PM mass and VOC composition
- SOA gaseous precursors)
- VOC gas composition
- Smoke

EASA Reference System (>10 nm)

- nvPM number conc.
- nvPM mass conc.

Off line analysis

- Total PM mass conc.
- Chemical composition (morphology)

x4 Background

- Total PM number & size dist.
- Gases: UHC, CO_2, CO, NO_x, SO_2
- T
- P
- RH

x2 BASELINE SYSTEM (Piggyback & Dedicated)

- Total PM number conc. (>7 nm)
- PM size dist. (>5 nm)
- nvPM number conc. (>7 nm)
- CO/CO_2 conc.
- nvPM mass conc.
- nvPM size dist.

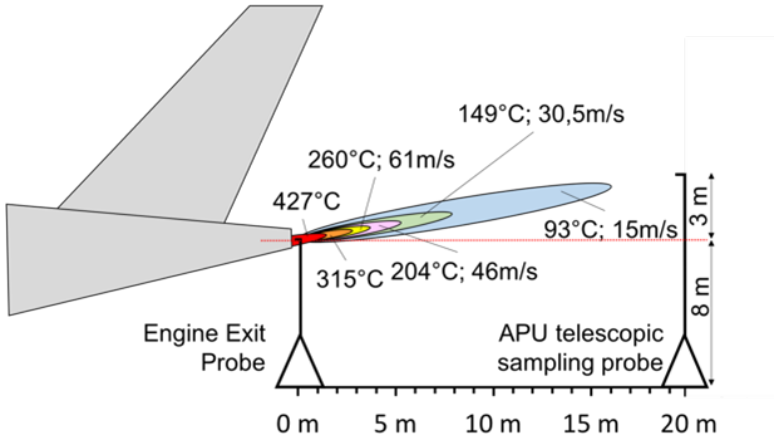
Off line analysis

- Total PM mass conc.
- Chemical composition (morphology)

WP3: On-wing engine exit and downstream plume measurements

To develop sampling probes for the measurement of main engine and APU exhaust plume evolution during on-wing engine tests.

High-fidelity emissions measurements (gaseous and PM) on-wing at engine exit and in the evolving plume of main engine and APU to determine the impact seasonal variation and fuel composition.



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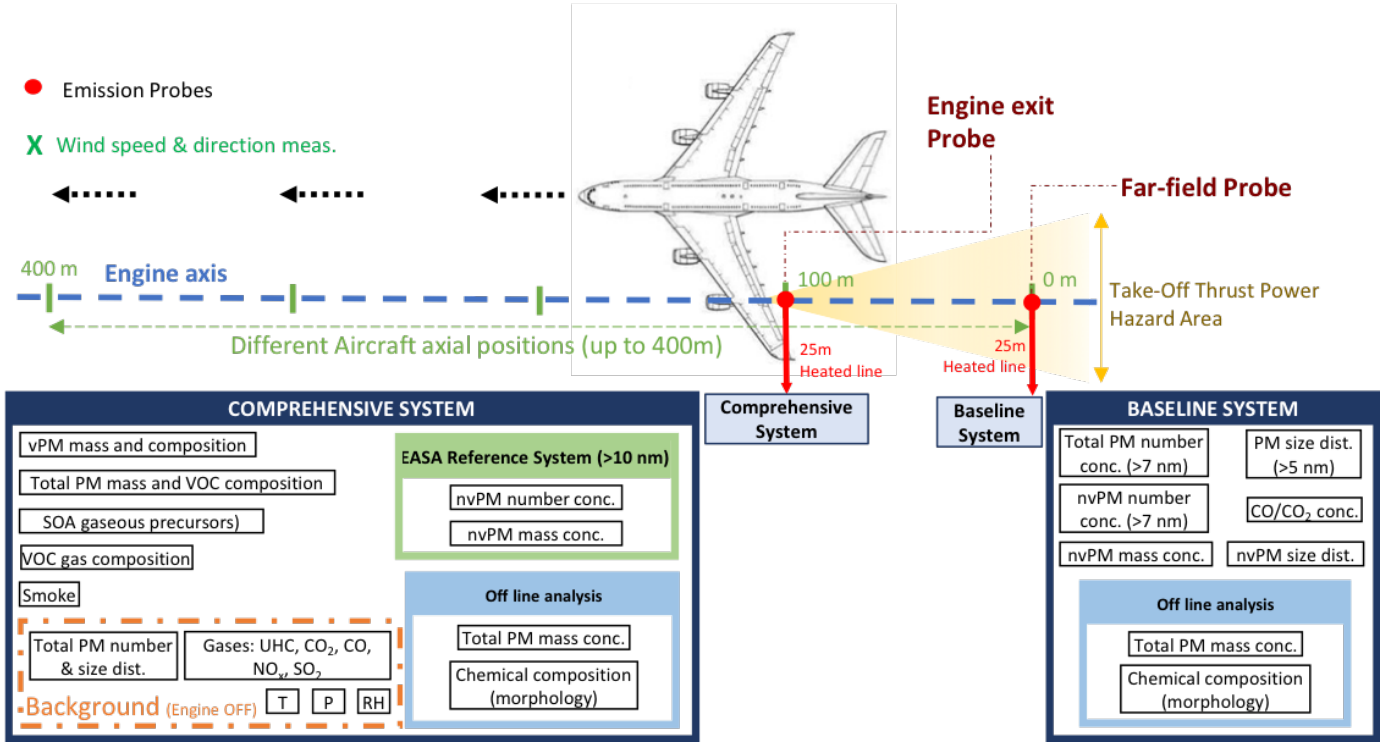

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WP4: Ambient measurements and sensor network development

MADRID-BAJARAS

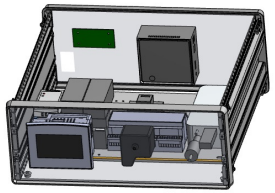
Comprehensive / High-resolution system for monitoring ambient air quality (winter and summer):

- Aerosol:
  - Composition, size, total number and mass
  - BC, EC, OC
  - Scattering and absorption
  - Meteorology
  - Offline filter analysis (TD-GC-MS)
- Standard gases (O3, CO, CO2, NOx, SO2)
- VOCs (PTR-ToF-MS)

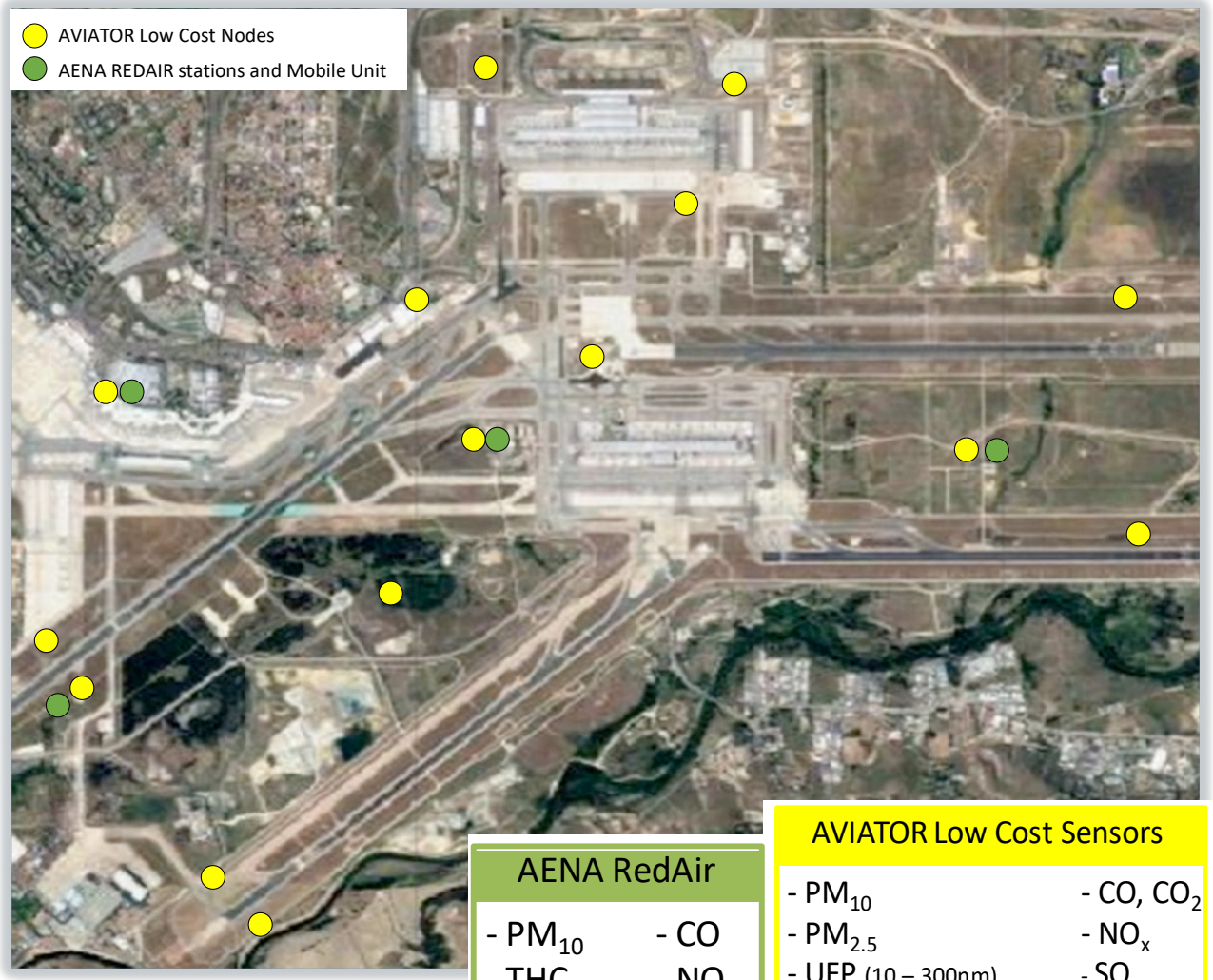
ZURICH & COPENHAGEN

- Compliment on-going research at both airports.
- Provide data of climatically different airports.

Low-cost sensor network
(around 15 nodes)



Low-cost sensor proposal



AENA RedAir	
- PM_{10}	- CO
- THC	- NO_2
- O_3	- SO_2

AVIATOR Low Cost Sensors	
- PM_{10}	- CO, CO_2
- $PM_{2.5}$	- NO_x
- UFP (10 – 300nm)	- SO_x
- VOCs	- O_3

WP5: Modelling of plume microphysics, chemistry and dynamics

CFD intra-engine box model (ETS):

PROVIDES exhaust concentrations

REQUIRES engine and aircraft specifications, and ambient conditions

MADE3 chemical box (DLR):

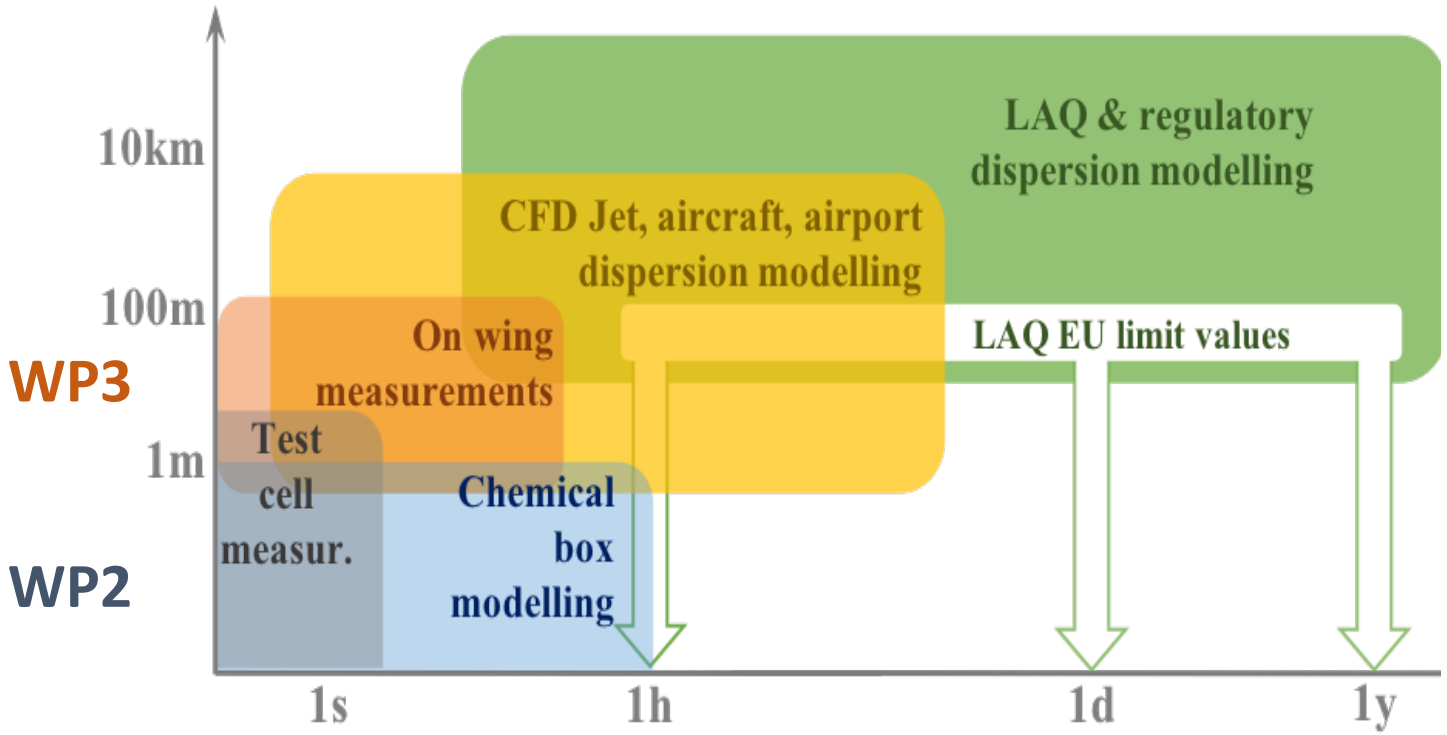
PROVIDES EIs and conversion rates for vPM and nvPM

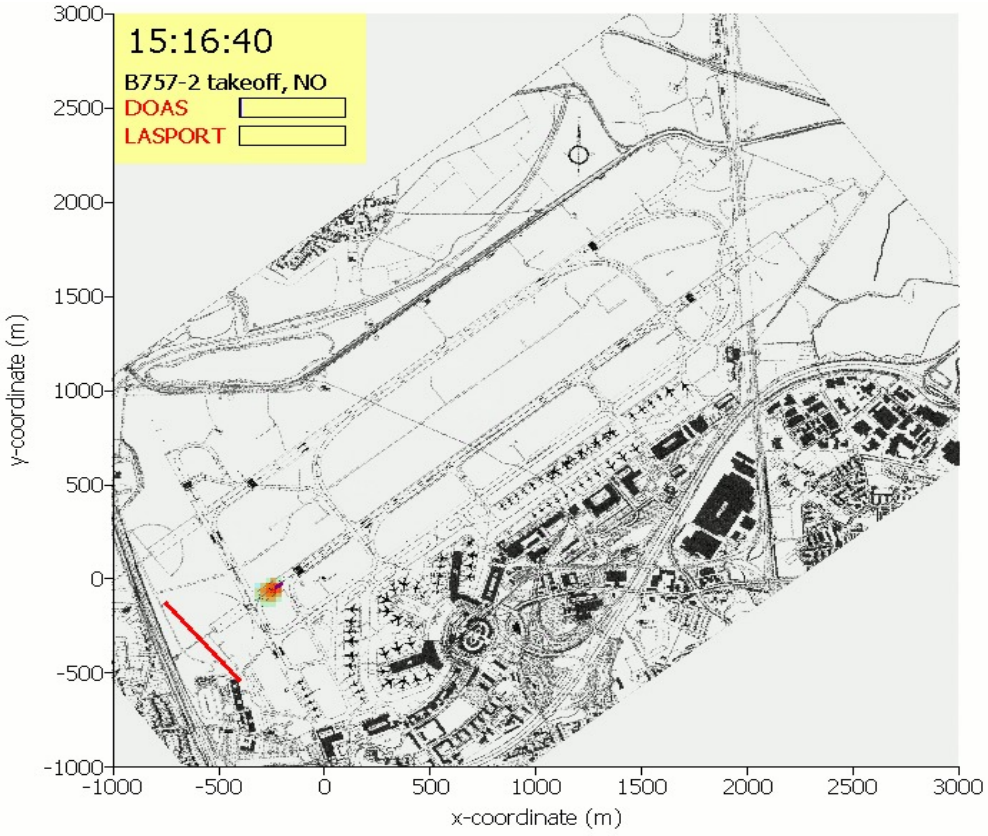
REQUIRES ambient conditions, exhaust concentrations

LASPORT (JC) / CEDRE (ONERA/INTA):

PROVIDES concentration maps at and around airports.

REQUIRES EIs and conversion rates.

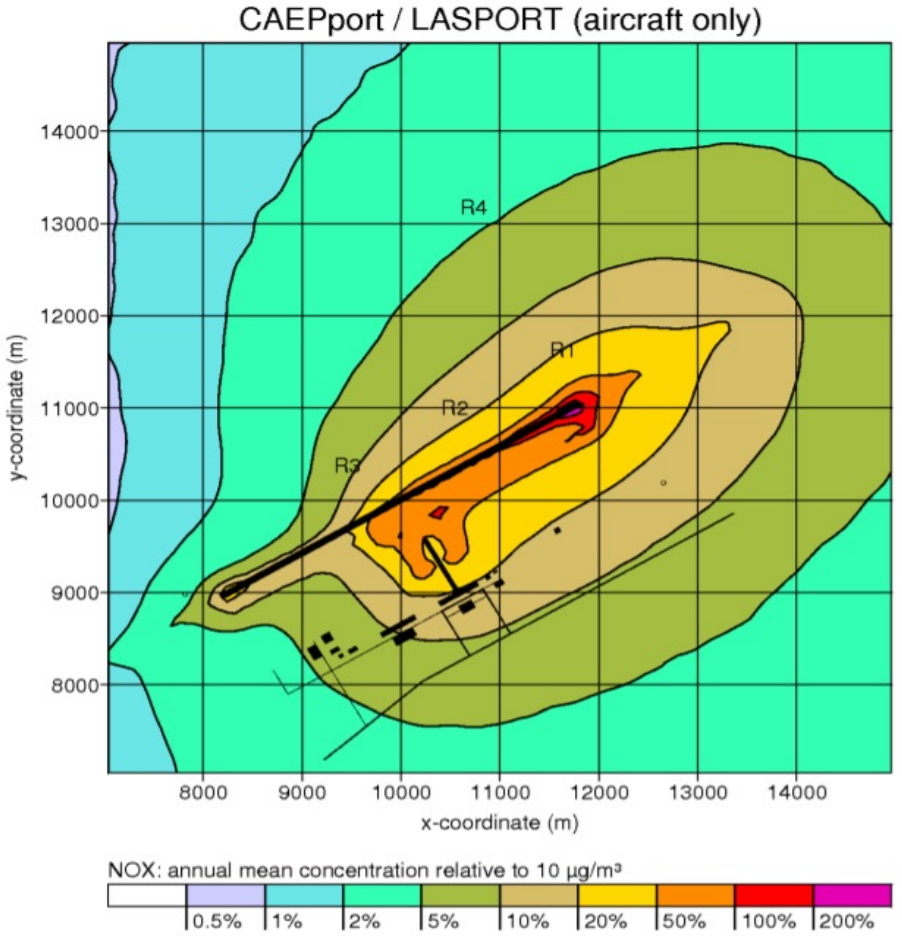




WP6: Pollutant modelling and transport in and around airports

Objectives

- Assess dispersion modelling in and around the airport.
- Assimilate description of the interaction of engine, airframe, airport operations and boundary surface.
- Enhancement of dispersion models used in regulation and research.



Method

- Airport model setup
- Emission and dispersion calculation
- Cross-comparison of modelled and measurement data
- Validate / improve model parameterisation

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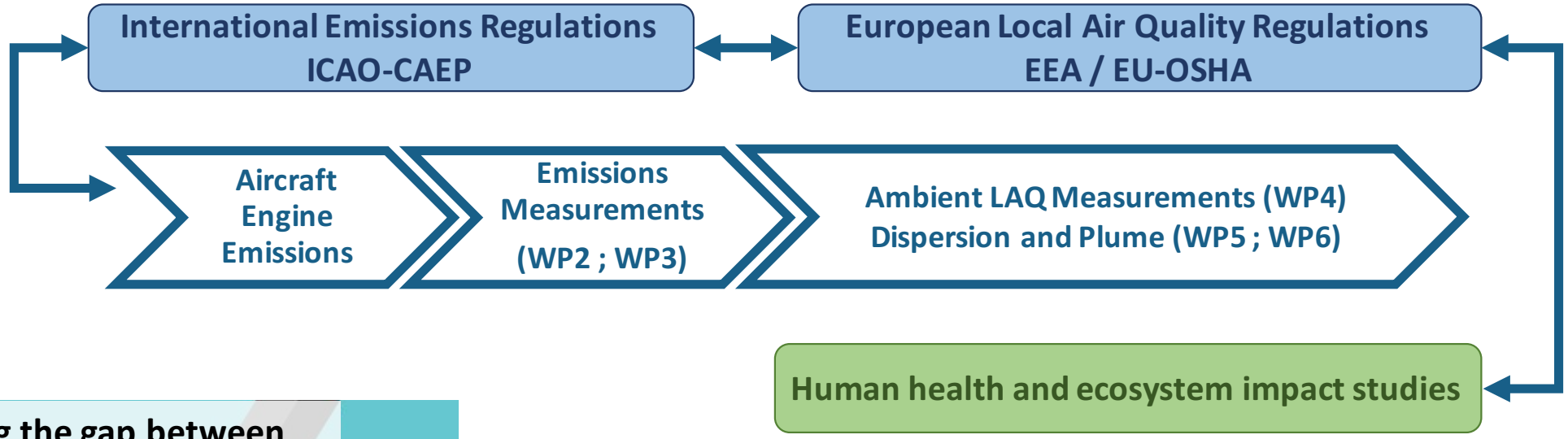
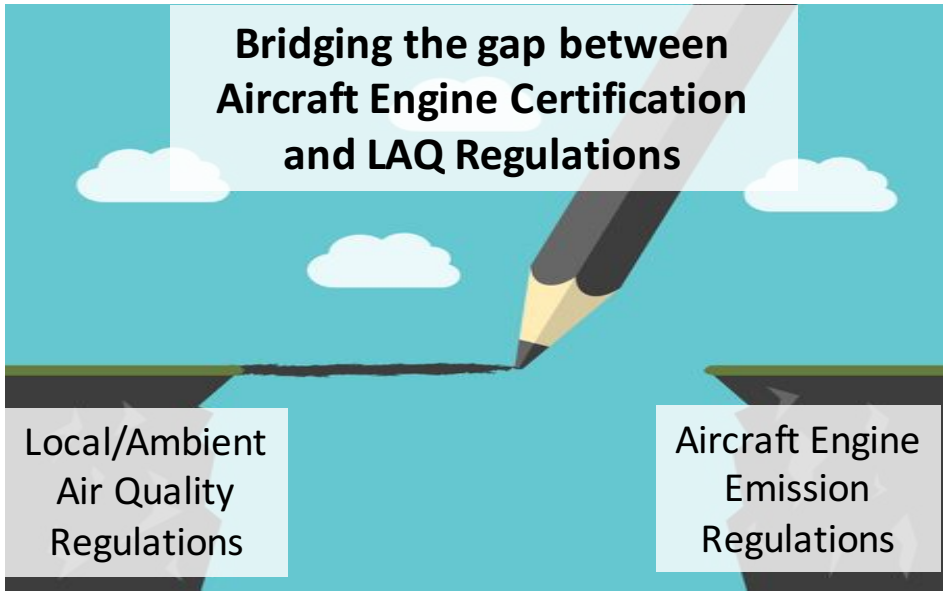
WP7: Regulation





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Thank you for your attention

AVIATOR Consortium

17 partners
(7 countries)

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