RAPTOR

Research of Aviation PM Technologies, MOdelling and Regulation

Start and Duration: 1st of Nov 2019, 24 months

Clean Sky 2

Core Team

Meet the dedicated team members of RAPTOR Project

2 SMEs

4 UNIVERSITIES

3 RESEARCH ORGANISATIONS

nvPM

RAPTOR

Grant agreement ID: 863969

Status
Ongoing project

Start date
1 November 2019

End dat
31 October 202

Funded under:
H2020-EU.3.4.5.10.

Overall budget:
€ 995 210

EU contribution
€ 995 210

Coordinated by:
ENVISA SAS
France

MEASUREMENT

MODELLING

HEALTH IMPACT

JTI-CS2-2018-CFP09-THT-06: Research for the development of Particulate Matter (PM) regulations and guidelines

- Cleansky objectives for the project
  - Bring together European state-of-the-art research efforts on understanding, predicting and modeling aviation particulate matter [PM] emissions in order to support a **European roadmap** for developing new NvPM technologies;
  - Deepen the understanding of PM emitted by aircraft engines and provide a better understanding of **their impact on health at and around airports** and on the global atmosphere.
  - Support the development of **guidelines and methodologies** for aircraft engine data and modelling capabilities related to PM, in view of ICAO CAEP 11 and beyond.
  - Assist EASA and the European Commission (RTD, MOVE, CLIMA, ENVI) in developing nvPM **regulations** and guidelines.

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Project Objectives

- **Aim 1:** ***Synergize current aircraft engine PM understanding and produce a roadmap for future advancements***
  - Collate the state-of-the-knowledge
  - Assess uncertainty & knowledge gaps
  - Dependencies between measurement, modelling and health impact
  - Potential improvements adoption of future regulation

Roadmap Beyond CAEP 11

- **Aim 2:** ***Quantification and reduction of uncertainty in CAEP/11 nvPM emission standard:-*** **Use historic and combustor rig testing data to support improvement of current CAEP/11 standards, assessing potential correction methodologies towards accurate prediction of aircraft engine exit nvPM and hence airport LAQ modelling for consideration during CAEP/12 and beyond.**
  - Uncertainty in reported EI nvPM (system variability, drift, calibration, fuel composition and ambient variations on the small-scale combustor rig
  - Evaluate total uncertainty in reported EI nvPM number and mass and associated corrections necessary for LAQ modelling
- **Aim 3:** ***Improved understanding of the health impacts of aircraft engine nvPM***
  - Review of toxicological effects of aircraft PM

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How RAPTOR is positioned

Rig Test (Line loss, ambient conditions, fuel composition, exhaust aerosols …)
Calibrations uncertainties at low mass loadings
Small engines (exhaust aerosols with relative mass & number concentrations

Air quality modelling Capabilities, LAQ prediction source terms, emission/concentration in early aircraft exhaust, interdependencies

Health (the hazard of fresh and aged aviation PM, toxicity studies, dose-response relationships)

ROADMAP

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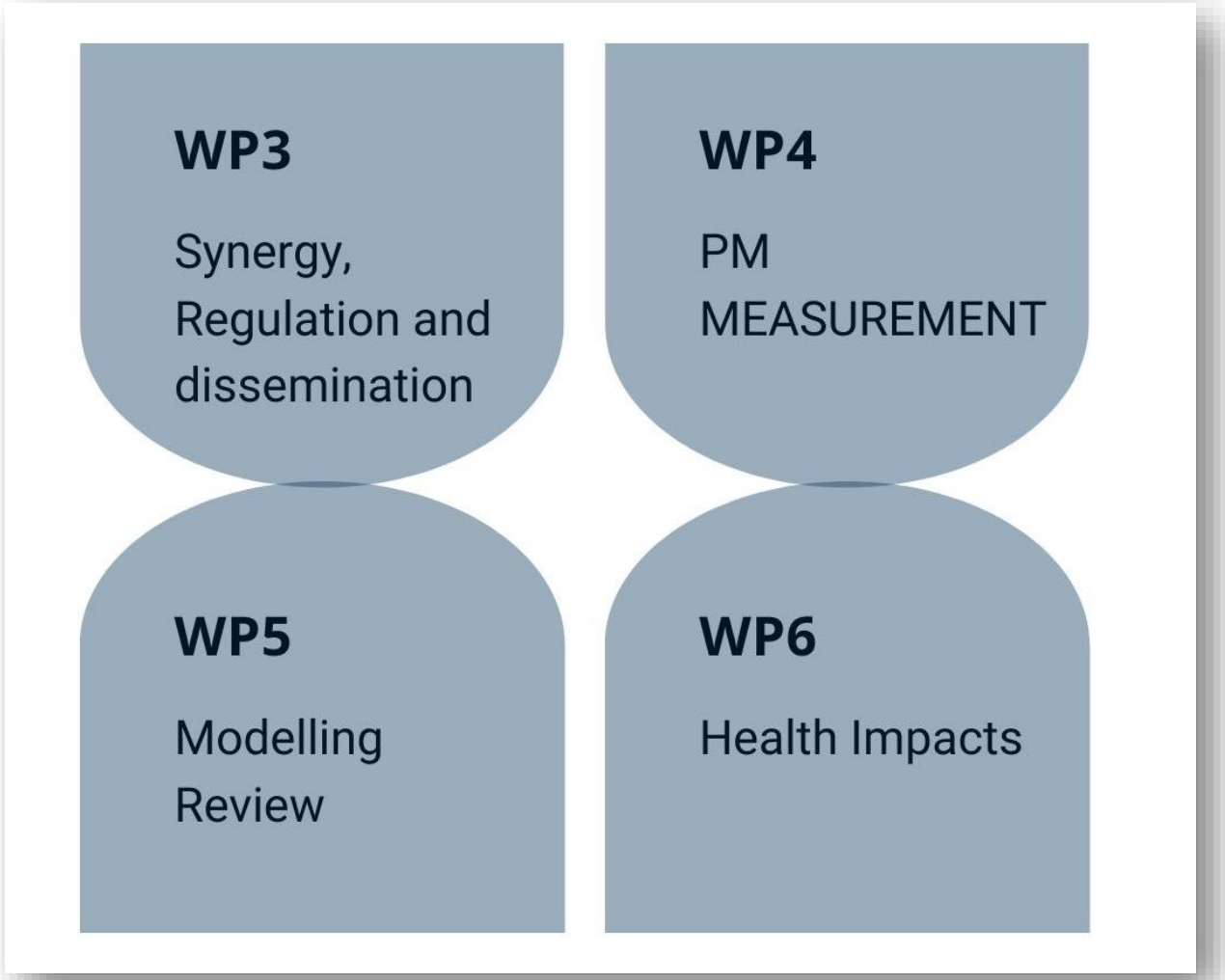
Synergies



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WP2 Management/ Coordination/ Communication/Dissemination

WP3 Regulatory Support

- Current state of knowledge
- Co-ordinated actions – bringing regulatory community together – EASA, ENV, etc
- Roadmap
- Interdependencies / Trade-offs – initial assessment
- Support for EASA

WP6 Health

- Current state of knowledge
- Co-ordinated actions – knowledge gaps
- Small /piggyback empirical work
- Holistic assessment

WP4 PM Emission measurements

Current state of knowledge (SAMPLE, APRIDE, JETSCREEN, DG-MOVE, EMPAirEx, ECLIIF??)

CAEP 11 nvPM measurement Data Uncertainties

Calibration
LOD/ LOQ
VPR penetration*

CAEP 12 & beyond

System loss assessment & improvement towards potential regulatory adoption*
Sampling system improvements/ novel approaches
Assessment of requirement of Ambient corrections (Humidity, T30, P30)*
Fuel composition effects*
Non-regulated engines (<26.7kN)
Further measurements (size, volatile,)*

*small scale testing

WP5 Modelling

- Current state of knowledge (emissions as input for models Eurocontrol, Eurostat, EDGAR, TNO-MACC, CAMS/REG(TNO)).
- Co-ordinated actions – knowledge gaps
  - Gridded data only contains LTO
  - Emission modelling: emission factors(WP4) and activity data to provide 4D emission data.(Deliverable)
  - Source apportionment to allow for comparison to other (transport sectors)
  - Concentrations+people density → exposure input to WP6
- New paramaterisations – based on plume models

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WP3 Objectives

1. Assist the European Commission and EASA to develop PM related policy, regulations and guidelines.
2. Develop a holistic approach to combining data from the technical work packages.
3. Communicate, disseminate and exploit the project results. (*)Ensure education of future professionals.
4. Transpose the scientific findings of RAPTOR into formats and tools that are useable by both the scientific and non-scientific community.
5. Create a RAPTOR platform to communicate to both end-users (e.g. regulators, airports, OEMs) and to the wider stakeholder community.
6. Contribute to maximizing the impact of the project results by taking measures to maintain the datasets and tools created within RAPTOR after the end of the project.

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WP3 Key Actions

i. support EASA in the field of PM regulation;

ii. identify knowledge gaps and set out a road map for future work and establish a co-ordinated action to bring together the regulatory community and associate stakeholders.

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WP4: Aim & Objectives

Quantification of uncertainty associated with current and future ICAO standards using historic, contemporary and new PM data acquired from representative gas turbine sources.

- Quantification of uncertainty associated with CAEP/10 nvPM standard (WP4.1)
- Improvement in nvPM regulatory uncertainty during CAEP/11 (WP4.2)
- Potential reduction of impact of aviation nvPM post CAEP/11 (WP4.3)

Literature Review & 3 distinct test campaigns will be used

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WP4: Deliverables

AVIATOR Tests– Madrid Sept 2020 & Jan 2021

M4.1 & D4.1 – Rig Test 1 & Current uncertainty Data Report

- Assessment of previous data – Montecarlo uncertainty - ongoing
- Joint calibration of EU & Swiss systems – TBC Spring 2020
- Rig Test 1 GTRC – Jun 2020 (M8)?
- Data Report “Uncertainties” (M10 – Sept 2020)

M4.2, 4.3 & D4.2 – ONERA Test, Rig Test 2 & Corrections Data Report

- ONERA Test: Feb 2020?
- Rig Test 2 GTRC – Spring 2021??
- Data report “Correction Requirements” (M21 – July 2021)

D4.3 – Report with recommendations for future regulation and technology adoption

- Analysis of unregulated engine data - ongoing
- Analysis of future technologies/ Fuels - ongoing
- Analysis of total PM regulation
- Report “recommendations” (M22 – Aug 2021)

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WP5 Modelling Review

Task 5.1: Modelling review (M1-M18), JC, TNO, ONERA

Task 5.2: Test case national inventory (M1-M18), TNO

Task 5.3: Beyond CAEP/12 modelling (M12-M24), ENV, JC, TNO, ZHAW

D5.1 (D16): Emission and dispersion modelling review and recommendations (M22), Public Report (JC, TNO, ONERA, ENV, ZHAW)

In addition, RAPTOR will explore the possibility of a free, Open-Source software tool that allows to estimate PM aircraft emissions at an airport.

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WP5 Modelling Review

Task 5.1: Modelling review

- Collect approaches and data for engine non-volatile PM emissions (mass and number)
- Collect approaches for volatile PM
- Main focus airport level, cruise and other key parameters (NO_x, CO_2, noise) also considered
- Strong linkage to CAEP/12 work and to outcomes of AVIATOR
- Assessment of uncertainties and levels of certainties in view of standardization
- Explore possibility of a PM/UFP data repository / emission calculator

Task 5.2: Test case national inventory

- Provide context for aircraft emissions in national inventory
- Review current Dutch emission model CLEO against ICAO EEDB for PM and components
- Extend CLEO model with UFP as a test case

Task 5.3: Beyond CAEP/12 modelling

- From regulated to real emissions
- Recommendations for emissions modelling
- Identification of future activities

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WP6 Health impact

- Objective
  - Determine and improve the understanding of the health impact of aviation emissions to serve regulation

- Task 6.1 Toxicological impacts review: literature survey current state of knowledge to assess critical factors for hazard. Focus on oxidative potential to assess toxicity

- Task 6.2 For estimation of hazard of full mixtures an extensive assessment is needed. In RAPTOR only small empirical work foreseen (oxidative potential on PM collected on filters). Relative ranking of emissions based on oxidative potential as an indicator for health effects

- Task 6.3 Identify the major gaps in knowledge that prevent a proper hazard and risk assessment. This task will not only summarize these gaps but also provide suggestions on to close these gaps for a toxicological point of view including research recommendations

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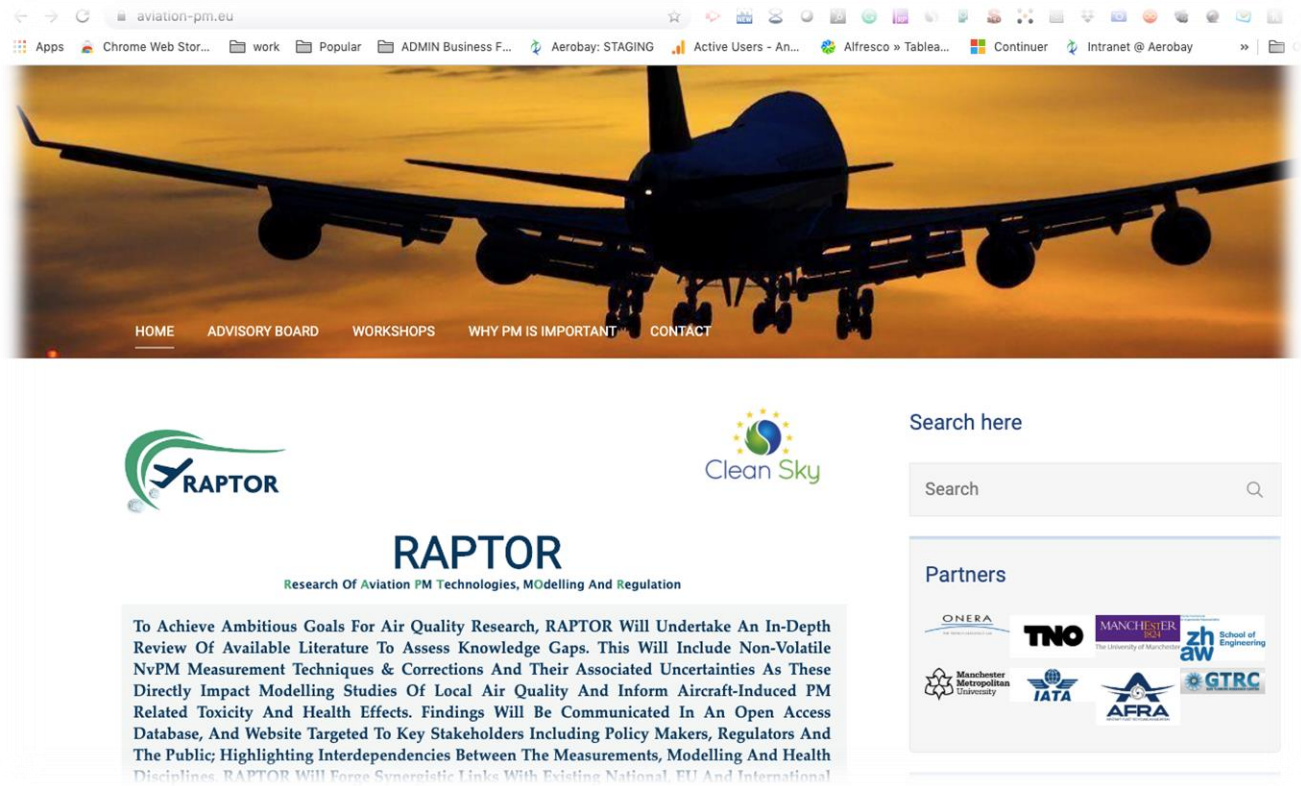
aviation-pm.eu



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