

Workshop on Aviation non-CO2 emissions

13⁻14 December 2023

European Commission, Brussels BREY Auditorium - Avenue d'Auderghem 45

Background

For over 25 years, successive European aviation Strategic Research and Innovation Agendas set ambitious environmental and climate goals (i.e. ACARE Flightpath 2050¹) and the achievements are very good. However, only last year, in the latest edition of Europe's Vision for Sustainable Aviation by ACARE, the importance of **all non-CO2 effects** was adequately recognised. The "**Fly the Green Deal**" came roughly at the same time as ICAO Assembly, at its 41st Session, adopted Resolution A41-21 which set the **long-term global aspirational goal for international aviation (LTAG) of net-zero CO2 emissions by 2050,** in support of the Paris Agreement's temperature goal.

Yet, for over 25 years, the European Commission together with Member States have invested heavily on atmospheric science as well as aviation research and technologies on "Aviation, Aerosols, Contrails and Cirrus Clouds" (A²C³). That was the name of the European Workshop that took place in Seeheim near Frankfurt, in 2000 (July 10-12). That was the result of another European workshop in Seeheim in July 1998, which was tasked to review the draft of the IPCC Special Report on Aviation "Aviation and the Global Atmosphere" (1999). Since then, more than 40 EU-funded research projects, many European workshops² on Aviation, Atmosphere and Climate (AAC), the successful actions of the Network of Excellence ECATS³ and in-flight measurements have followed.

These European research efforts, at large, allow us today to estimate the climate impact of all non-CO2 aviation emissions, as well as the remaining uncertainties. The **Sixth IPCC report**⁴ pays particular attention to **Short-Lived Climate Forcers (SLCF) from aviation** and transportation at large. It concludes that the largest SLCF effects are those from the formation of persistent condensation trails (contrails) and NOx emissions. Persistent contrails are ice-crystal clouds, formed around aircraft soot particles (and water vapour from the engine), injected in ambient cold and ice-supersaturated atmosphere, which can

¹ reduce CO2 emissions per passenger kilometre by 75%, NOx by 90% and perceived noise by 65% all relative to the year 2000.

² <u>https://www.pa.op.dlr.de/aac/proceedings/AAC-proceedings-complete.pdf</u>

³ <u>http://www.ecats-network.eu/about/background/more-background</u>

⁴ <u>https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter06.pdf</u>



spread and form contrail cirrus clouds. The 'net NOx' effect arises from the formation of tropospheric ozone, counterbalanced by the destruction of ambient methane and associated cooling effects of reductions in stratospheric water vapour and background ozone. The IPCC reports suggests that the net temperature response from aviation emissions was determined by **similar contributions from contrails, contrail cirrus and CO₂ over a 20-year time horizon, and dominated by CO₂ in a 100-year perspective.**

Objectives

The workshop is organised jointly by the European Commission (DG-RTD, DG-MOVE, DG-CLIMA, DG-ENV), including the two aviation Horizon Europe Partnerships (Clean Aviation and SESAR) and the European Aviation Safety Agency. Given the many parallel initiatives in the last two years, it presents a great opportunity to work even closer together with the industry, airlines, research establishments and academia towards cost-optimum solutions for aviation and climate.

The objectives of the workshop are fourfold:

- To provide an overview of the **state-of-play of aviation non-CO₂ impacts**, notably:
 - o Dependence of contrails on altitude and geographic region
 - Predictive accuracy of met conditions that promote persistent contrails
 - Sensors on-board
 - Satellite contrail detection & tracking overestimation of persistent contrails
 - \circ $\;$ $\;$ Percentage of flights that are really affected in Europe and globally $\;$
 - Expectations from hydrogen-powered aviation and water-enhanced turbofan
 - Impact of SAF on contrails
 - o Can simplified calculation methods be trusted and verified?
 - Climate restricted airspaces
 - Metrics for CO2 and non-CO₂ aviation emissions AGTP ATR100 or what?
 - ATM trade-offs for CO₂, NOx and contrails
 - \circ Can the complexity of non-CO2 emissions be represented by a CO₂ multiplier?
- To listen to all relevant stakeholders, identify research and policy gaps, and gather recommendations, that have the potential to actually reduce the aviation non-CO₂ impacts, mainly via new technologies and optimised operations, in the short- and medium-term.
- To contribute to a quantified and scientifically-agreed **roadmap** towards minimising all non-CO₂ aviation impacts towards 2050 (and 2070), considering all possible measures (i.e. new technologies, optimised operations, new fuel options, and market-



based measures) in combination as well as the trade-off between CO₂ and non-CO₂ emissions. The workshop is confined primarily to the climate effects of non-CO₂ aviation emissions, while Local Air Quality (and noise) will be the subject of an upcoming workshop in Q3 2024.

• To **communicate the findings** of the workshop and contribute towards clearing the fog that surrounds the issue, for the benefit of aviation and the climate.

Organisation

The workshop will take place in Brussels, Avenue d'Auderghem 45, 1000 (Building BREY⁵), on 13-14 December 2023, with maximum number of **150 in-person participants** and the **possibility of web-based connection**. There are no delegate fees or other charges. All confirmed in-person participants cover their own expenses. Register at:

https://research-innovation-community.ec.europa.eu/events/icGlke5cMVCM3scpfmT8d/overview

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⁵ <u>https://commission.europa.eu/about-european-commission/visit-european-commission/buildings-commission-and-executive-agencies-brussels_de?building=BREY</u>



Workshop Programme

13-14 December 2023

<u>Day 1</u>

9h00 Registration and Welcome Coffee/Tea

9h30 Opening Address

DG RTD / Roselinde van der Vlies, DG CLIMA / Bea Yordi

9h45 Session 1 - Non-CO₂ Aviation Emissions/Impacts – State-of-the-art Chair: Michael Kyriakopoulos (DG RTD)

- Keynote: 25 years of non-CO₂ aviation emissions research after Seeheim DLR & TU Delft / Volker Grewe
- Better contrail understanding and mitigation options *DLR / Christiane Voigt*
- Aircraft and engine influence on CO₂ and non-CO₂ emissions Airbus / Charles Renard
- Q&A (10 min)

11h30 Coffee Break

11h45 Session 1 - Continued

- Progressing toward a better estimate of the climate impact of aviation ISPL & ONERA / Nicolas Bellouin, Philippe Novelli
- Climate assessment of single flights
 DLR / Katrin Dahlmann, Sigrun Matthes
- Significant factors influencing the net effect of single contrail Technische Universität Dresden / Judith Rosenow, Hartmut Fricke
- Q&A (10 min)

13h00 Lunch Break

13h45 Session 2 – Innovative Technologies I

Chair: Niclas Dzikus (DG-RTD)

- Expectations from hydrogen-powered aviation *Airbus /* Glenn Llewellyn, Frédérique Rigal
- Challenges and non-CO₂ impact of hydrogen-burning engines *Rolls-Royce* / Paul Madden



- Multi MW fuel cell systems challenges and potentials MTU / Dominik Wirth
- Current knowledge of the impacts of NOx IPSL & ONERA / Didier Hauglustaine and Etienne Terrenoire
- Q&A (10 min)

15h15 Coffee Break

15h30 Session 2: Innovative Technologies II

Chair: Jean-Francois Brouckaert (Horizon Europe Clean Aviation)

- A significant reduction in NOx emissions SAFRAN / Valérie Guenon, Nicolas Jeuland
- The Water-Enhanced Turbofan A revolutionary gas turbine concept *MTU* / Christopher Pfennigs
- Low NOx Technologies GE Aerospace / Thomas Ripplinger
- CS2 Technology Evaluator and CA ACAP Impact Monitor *Airbus /* Matthias Meussen
- Q&A (10 min)

17h30 Discussion

18h00 Close Day 1



<u>Day 2</u>

9h00 Registration and Welcome Coffee/Tea

9h30 Opening Address DG MOVE / Filip Cornelis

9h45 Session 3: Market-Based Measures – EU-ETS - MRV

Chair: Dimitar Nikov (DG-CLIMA)

- Regulatory/Certification issues related to EU-ETS Directive Art 30(4) EASA / Joonas Laukia
- Tender CLIMA/2023/OP/0005 Support for establishing an MRV system for non-CO2 effects in aviation - revision of the ETS Directive *To70 – DLR - AerLabs /* Liam Megill
- Climate metrics for aviation CO₂ and non-CO₂ impacts: technical and policy implications
 - Airbus / Philippe Mattei
- Aviation Impact Accelerator on fleet impact of new technologies University of Cambridge / Rob Miller
- Q&A (10 min)

11h15 Coffee Break

11h30 Session 4: Fuel Options

Chair: Andreas Busa (EASA)

- Unveiling nucleation mechanism in aircraft engine exhaust and its link with fuel composition options ONERA / Ismael Ortega
- Cleaner aviation fuels have the potential to reduce contrail cloudiness DLR / Patrick Le Clercq, Tina Jurkat-Witschas, Christiane Voigt
- A full environmental life cycle assessment (eLCA)
 BHL / Mirko Hornung, Andreas Sizmann, Valentin Batteiger
- Energy Transition in Aviation future fuel options TU Delft / Arvind Gangoli Rao
- Q&A (10 min)

13h00 Lunch Break



13h45 Session 5: Optimised Operations I

Chair: Andrei Mungiu (DG-MOVE)

- Towards Climate-Optimized Operations THALES / Julien Lopez
- Mitigation strategies studied in the ClimOP project NLR / Elisabeth van der Sman
- Satellite and ATC data for contrail detection, tracking and matching *Airbus/ Remi Chevallier*
- Satellite detection of contrails using AI and changes COVID-19 DLR / Luca Bugliaro
- Q&A (10 min)

15h15 Coffee Break

15h30 Session 5: Optimised Operations II

Chair: Olivia Nunez (Horizon Europe SESAR)

- CICONIA Climate effects reduced by Innovative Concept of Operations Airbus / Philippe Mattei
- CONCERTO Traffic Flow optimizations based on total climate impact THALES / David Antonello
- MUAC Contrails prevention the global picture and main challenges *EUROCONTROL* / Ilona Sitova, Rüdiger Ehrmanntraut ContrailHub® - Sharing contrails data to facilitate research *EUROCONTROL* / Philippe Very, Gabriel Jarry
- Actual and Time-Optimized Flight Trajectories *KLM – Air France / Lisanne van Wijngaarden*
- Q&A (10 min)

17h00 Conclusions - Discussion Panel

Moderated: Michael Kyriakopoulos (DG RTD)

- DG RTD / JANE AMILHAT
- DG MOVE / Maria DE LAS FLORES DIAZ PULIDO
- DG CLIMA / POLONA GREGORIN
- DG ENV / FRANÇOIS WAKENHUT
- EASA / ALAIN LEROY

18h00 Workshop closure



Annex 1 – Links to representative EU-funded projects

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AHEAD Advanced Hybrid Engines for Aircraft Development https://cordis.europa.eu/project COST 723 Data Exploitation and Modeling for the Upper Troposphere and Lower Stratosphere https://www.cost.eu/actions/72	EFACA	Environmentally Friendly Aviation for all Classes of Aircraft	https://cordis.europa.eu/project/id/101056866
COST 723 Data Exploitation and Modeling for the Upper Troposphere and Lower Stratosphere <u>https://www.cost.eu/actions/72</u>	AHEAD	Advanced Hybrid Engines for Aircraft Development	https://cordis.europa.eu/project/id/284636
	COST 723	Data Exploitation and Modeling for the Upper Troposphere and Lower Stratosphere	https://www.cost.eu/actions/723/





Annex 2 - Address: Avenue d'Auderghem 45, 1000 Bruxelles / Brussel, Belgium





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