Global cooperation to advance the understanding of Non-CO_2 effects in aviation

The Aviation Non-CO_2 Experts Network (ANCEN) experience

By Stephen Arrowsmith (EASA)

Introduction

Global environmental challenges require global cooperation to achieve agreed future goals. This cooperation is critical when the optimum measures to address these challenges are not completely clear. One such current issue in the aviation sector is the need to address its total climate impact considering both CO_2 and non-CO_2 emissions.

Main Challenges

In 2023, the WMO State of the Global Climate Report[1] and the European State of the Climate Report[2] both highlighted that records were once again broken for greenhouse gas levels, surface temperatures, ocean heat and acidification, sea level rise, Antarctic Sea ice cover loss and glacier retreat. A recent acceleration in the increase of atmospheric CO_2 concentrations in 2024 was also reported resulting in the highest ever level over the last 800 000 years of 427 parts per million. 2023 was confirmed as the warmest year on record with the global average near-surface temperature at 1.45°C above the pre-industrial baseline, culminating in the warmest ten-year period on record. Extreme weather events have impacted millions of lives and inflicted billions of euros in economic losses.

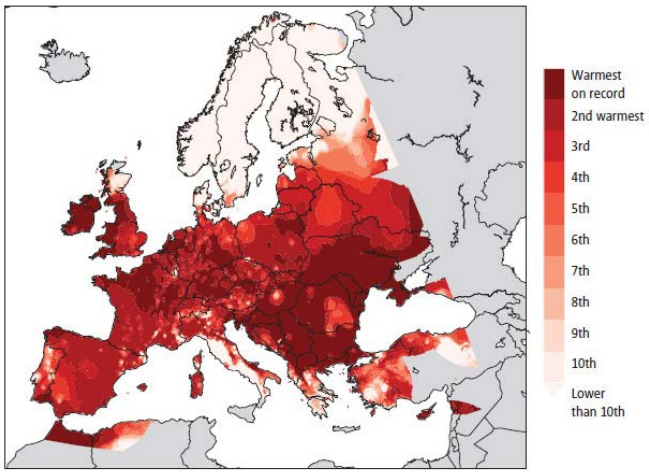

FIGURE 1: Ranking of annual average surface air temperature in 2023 (Copernicus Climate Change Service).

As with all other economic sectors, aviation is therefore under pressure to reduce its emissions in order to contribute to international climate objectives, including the Paris Agreement and ICAO's goal for international aviation of net-zero carbon emissions by 2050.

The climate impact from aviation emissions is a combination of both its CO_2 and non-CO_2 emissions that include Nitrogen Oxides (NO_X), Particulate Matter (soot), Sulphur Oxides (SO_X) and water vapour, as well as the subsequent effects

1 https://library.wmo.int/records/item/68835-state-of-the-global-climate-2023
2 https://climate.copernicus.eu/esotc/2023

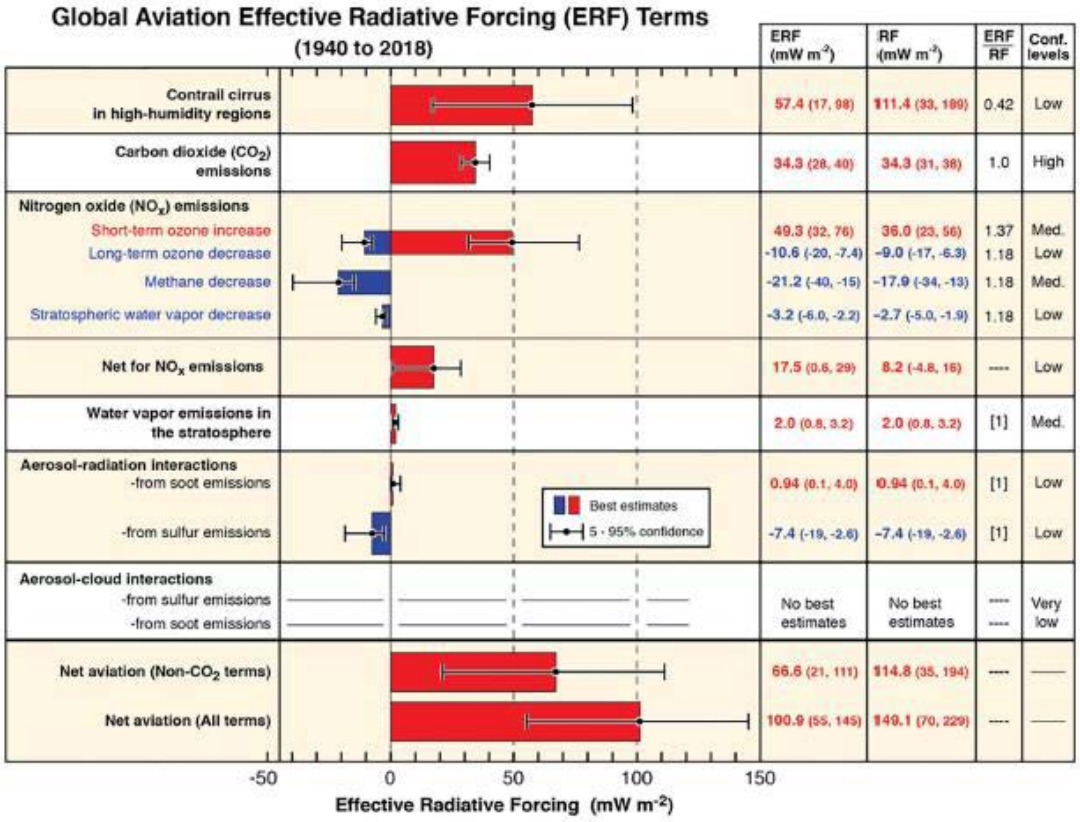

FIGURE 2: Latest best estimates for climate forcing terms of historic global aviation emissions from 1940 to 2018 (Lee et al., 2021).[3]

from the formation of persistent contrail-cirrus clouds and aerosol-cloud interactions. To inform a robust decision-making process and ensure that mitigation measure has the intended effect, the gaps in our understanding of the science of and impacts from non-CO_2 emissions need to be addressed.

Key gaps include accurate modelling of non-CO_2 emissions from different fuels and engine technology as well as the subsequent direct and indirect climate effects. These challenges are further compounded by potential trade-offs between CO_2 and non-CO_2 emissions, which can vary depending on how the CO_2 equivalent emissions are calculated and the associated time horizon.

ANCEN

In order to bring greater cohesion to the various European research initiatives in this area, the European Commission and EASA established the "Aviation Non-CO_2 Experts Network (ANCEN[4])" in 2024. The primary goal of the Network, which compromises of approximately 50 experts, is to facilitate a holistic approach to addressing non-CO_2 emissions through coordination across all relevant stakeholders (e.g. airlines, manufacturers, air navigation service providers, fuel producers, met services, intergovernmental organisations, research programmes, academia, policymakers and non-governmental organisations). The Network aims to reach a common

ANCEN
AVIATION NON-CO_2 EXPERT NETWORK

This project is funded from the European Union's Horizon Europe Programme

3 https://pubmed.ncbi.nlm.nih.gov/32895604/
4 https://www.easa.europa.eu/en/research-projects/ancen-nonco2

FIGURE 3: ANCEN Members Plenary Meeting, June 2024.

understanding on this complex topic that can act as a basis for objective, timely and credible technical advice. This would feed into discussions on the development, agreement and implementation of effective policy and operational actions within Europe and internationally, to mitigate the overall climate impacts caused by aviation CO_2 and non-CO_2 emissions.

Mitigation Measures

It is important to recognise that there are existing mitigation measures to reduce aircraft non-CO_2 emissions, such as the ICAO Annex 16 Volume II aircraft engine emissions certification standards, and the uptake of cleaner energies (e.g. Sustainable Aviation Fuels).

Since the EASA report[5] that was published in 2020, which provided an updated analysis of the non-CO_2 climate impacts of aviation and potential policy measures, there has been a significant increase in European research projects[6] looking to enhance our understanding on this issue and potential additional mitigation measures.

Key areas of research where there is a high level of uncertainty include methodologies to estimate aircraft emissions inventories with different fuels and the climate impact of induced changes in cloudiness from changes in operational initiatives. There is also a separate EU project to explore the feasibility of optimising fuel composition in order to reduce the environmental and climate impacts from non-CO_2 emissions without negatively impacting safety (e.g. lower aromatics, sulphur).

Work Programme

The current ANCEN Work Programme includes the following tasks:

1. Establish key common **terminology** to support discussions and assessment, drawing on Intergovernmental Panel on Climate Change (IPCC) language.

2. Develop a **framework to communicate the level of uncertainty** as a confidence level and likelihood for risk assessment and monitor how this evolves over time, including an example of how to implement the framework, drawing on IPCC approach.

3. Identify elements of a process on data / measurements / model development that are needed to ultimately support **robust decision-making** and implementation / monitoring / review of measures.

5 https://www.easa.europa.eu/en/document-library/research-reports/report-commission-european-parliament-and-council
6 https://www.easa.europa.eu/downloads/140090/en

4. Perform a research **gap and prioritisation analysis**, and maintain over time, to optimize future aviation related research in critical areas and avoid duplication.

5. Summarise current **best practices** on modelling aircraft emissions inventories.

6. Compile an overview of **historic and on-going work** linked to the effects of aviation non-CO_2 emissions on climate change.

7. Consider how to clearly **communicate** on climate impacts of short-term and long-term climate forcer emissions in different future scenarios to place non-CO_2 impacts in context with those from CO_2. Develop Fact Sheets / Briefing Notes / FAQs on topics linked to non-CO_2 emissions climate impacts

8. Perform outreach to relevant **international partners** working on the topic of climate impacts from aviation non-CO_2 emissions.

9. Provide **technical support** to policymakers, as requested, and input into the European Aviation Environmental Report[7].

There is a growing urgency for the aviation sector to turn sustainability goals into action, and thereby secure the future of the industry. This can only be done through a more ambitious, comprehensive and holistic approach involving all stakeholders. There is no single solution and the entire basket of measures (e.g. new technology, efficient operations, sustainable aviation fuels, market-based measures) needs to be applied.

Photo credit : Airbus SAS

7 https://www.easa.europa.eu/en/domains/environment/eaer