



SUPPORTING
EUROPEAN
AVIATION

Gate-to-gate CO₂ emissions

How efficient are we?

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Aviation Intelligence Unit

15/10/2025



EUROCONTROL

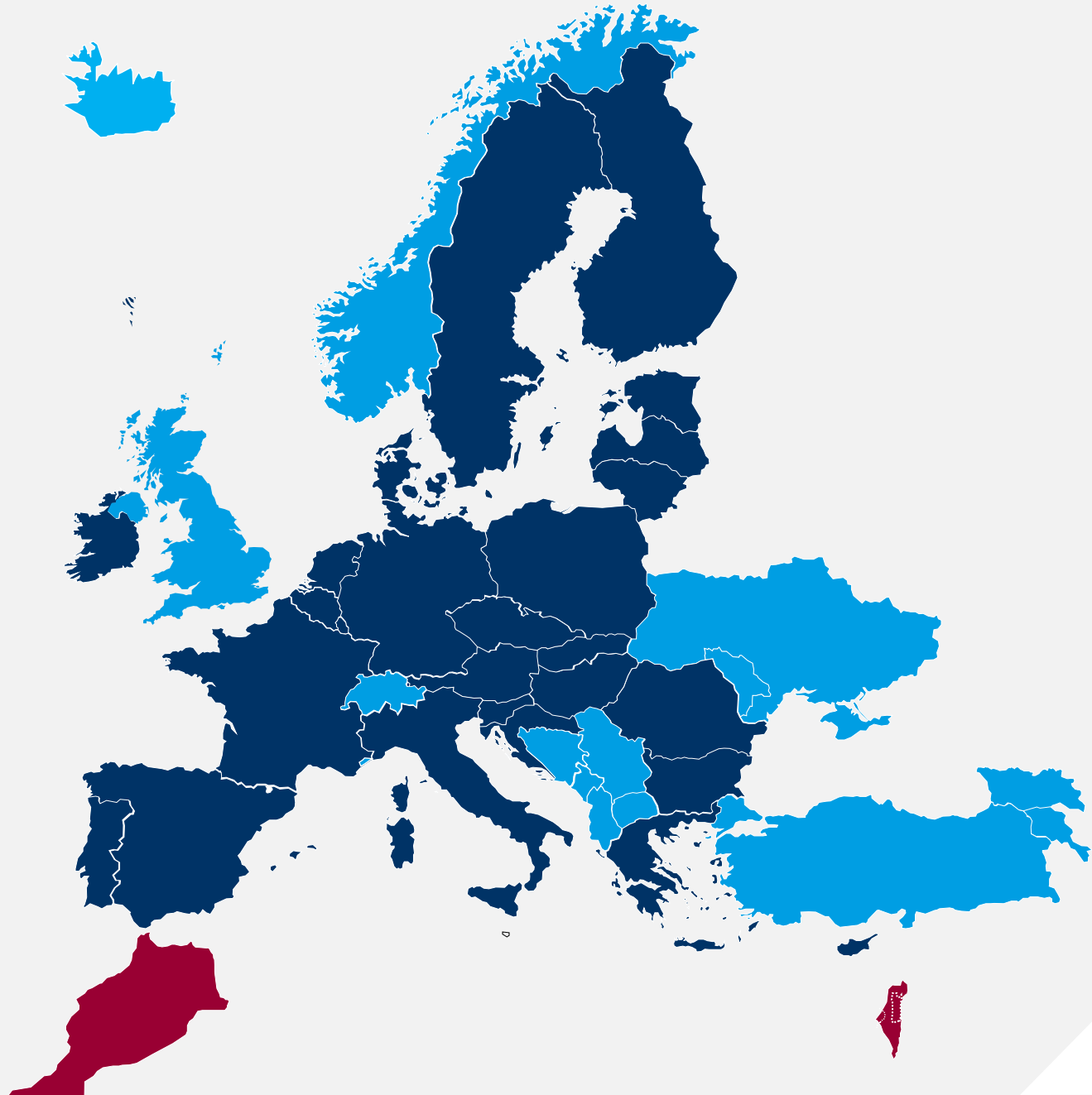
EUROCONTROL MEMBERS

42 Member States
& 2 Comprehensive Agreement States

EUROCONTROL and EU

EUROCONTROL but not EU

**Two Comprehensive Agreement
States: Israel & Morocco**



"The designations employed and the presentation of the material on maps in this presentation do not imply the expression of any opinion whatsoever on the part of EUROCONTROL concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries."

EUROCONTROL'S CENTRAL ROLE FOR EUROPEAN AVIATION

**Air Traffic Network
Manager** for all of Europe

Innovation Hub

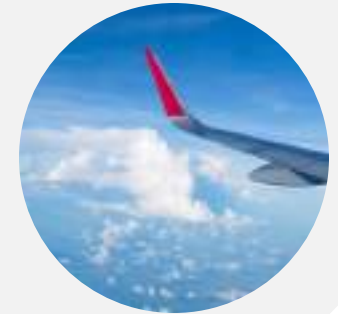
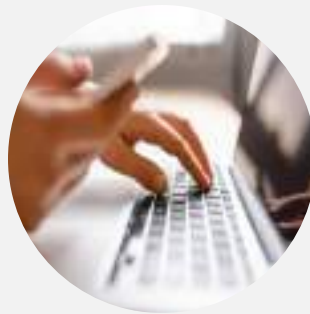
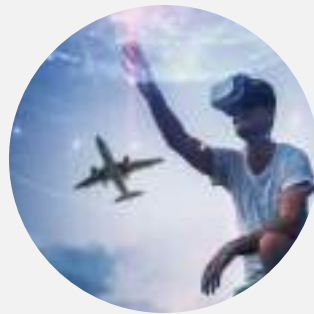
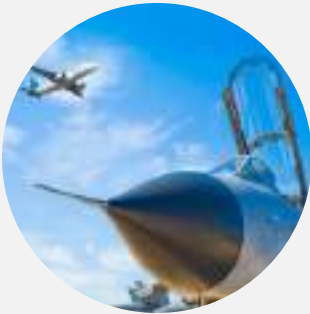
**Maastricht Air Navigation
Service provider**

ATC billing service

Civil-Military coordination

**Pan-European expert
support** including on data
and sustainability

Aviation **Learning** Centre



Gate-to-gate CO₂ emissions

Background



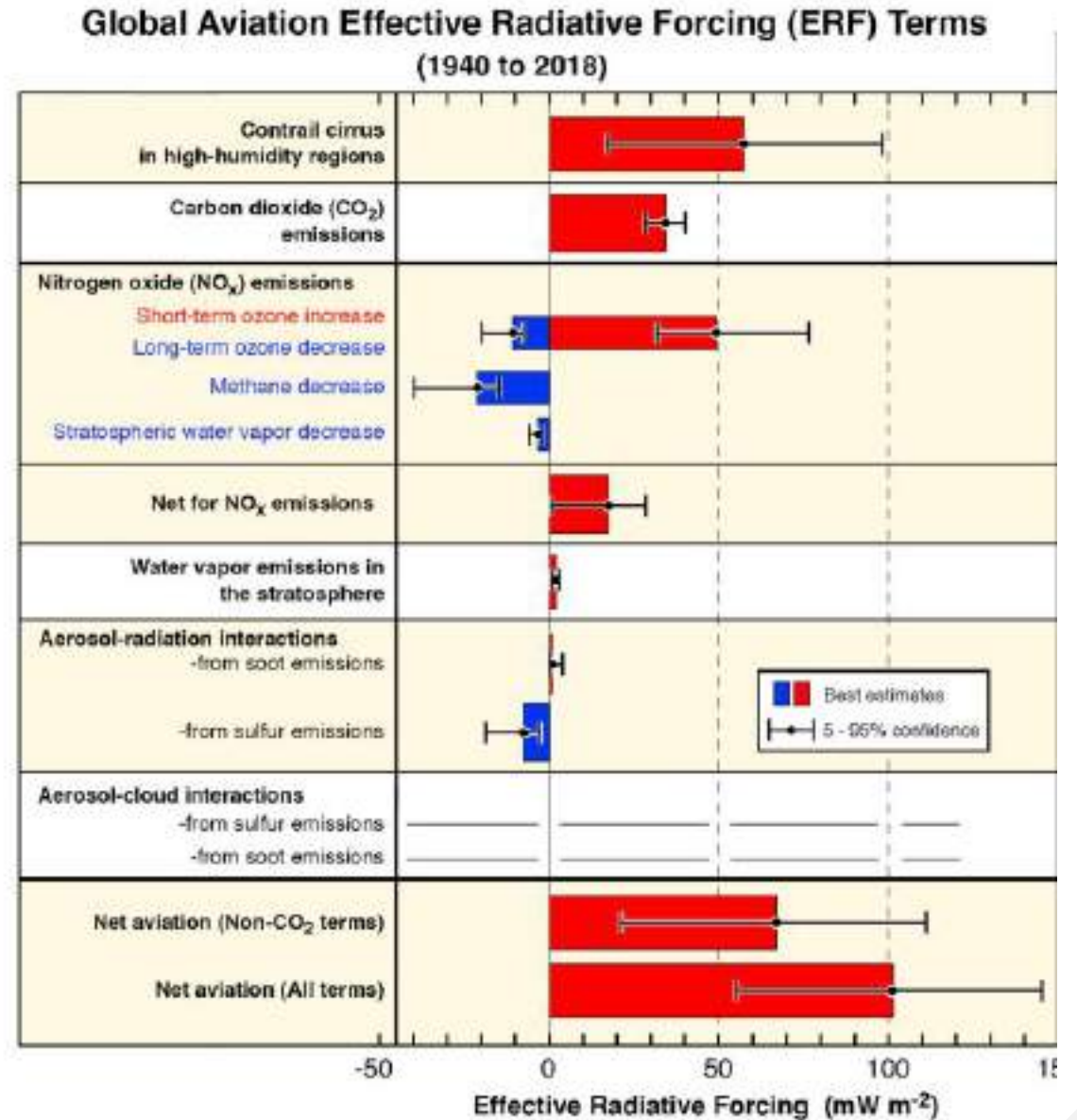
- **Goal:** analyse operational performance of flights to assess environmental impact



- **Focus:** CO₂ emissions

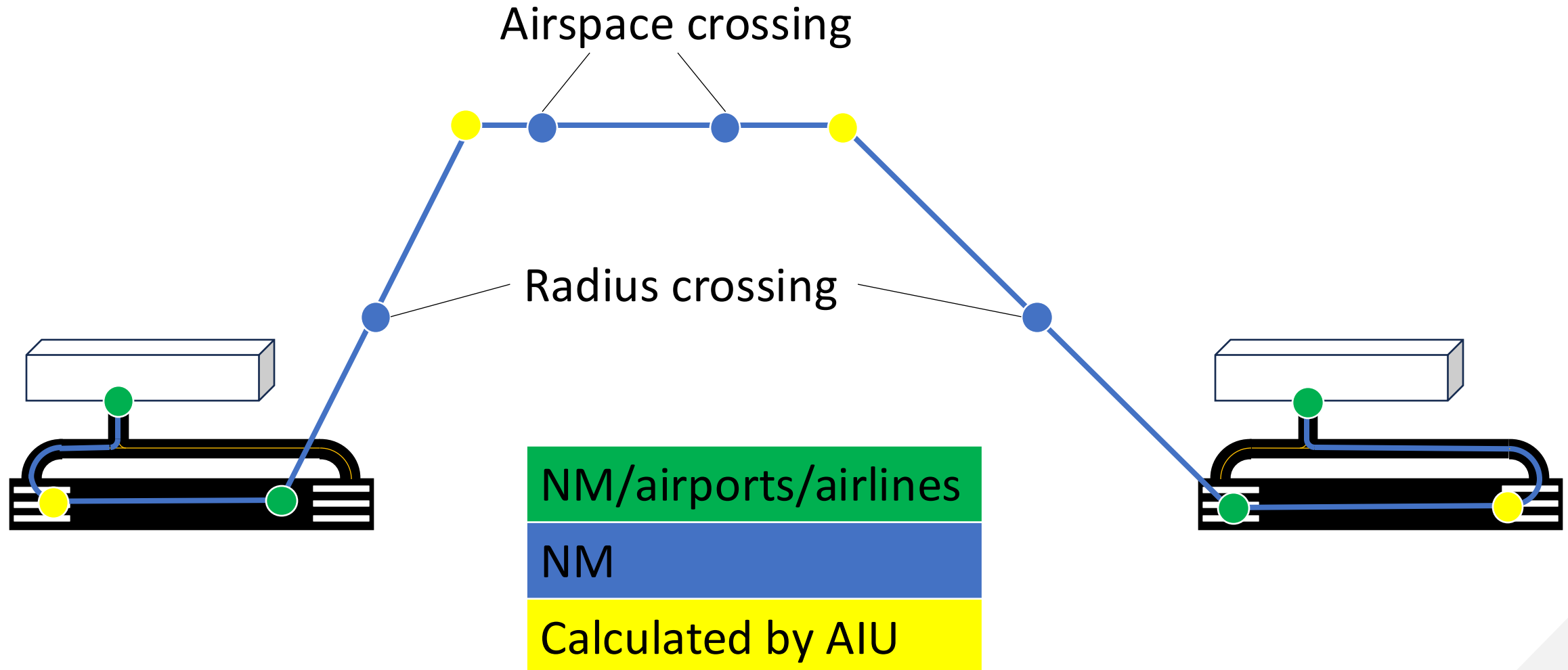


- **Gap:** Gate-to-gate CO₂ emissions or fuel burn data from airlines not consistently available at European level



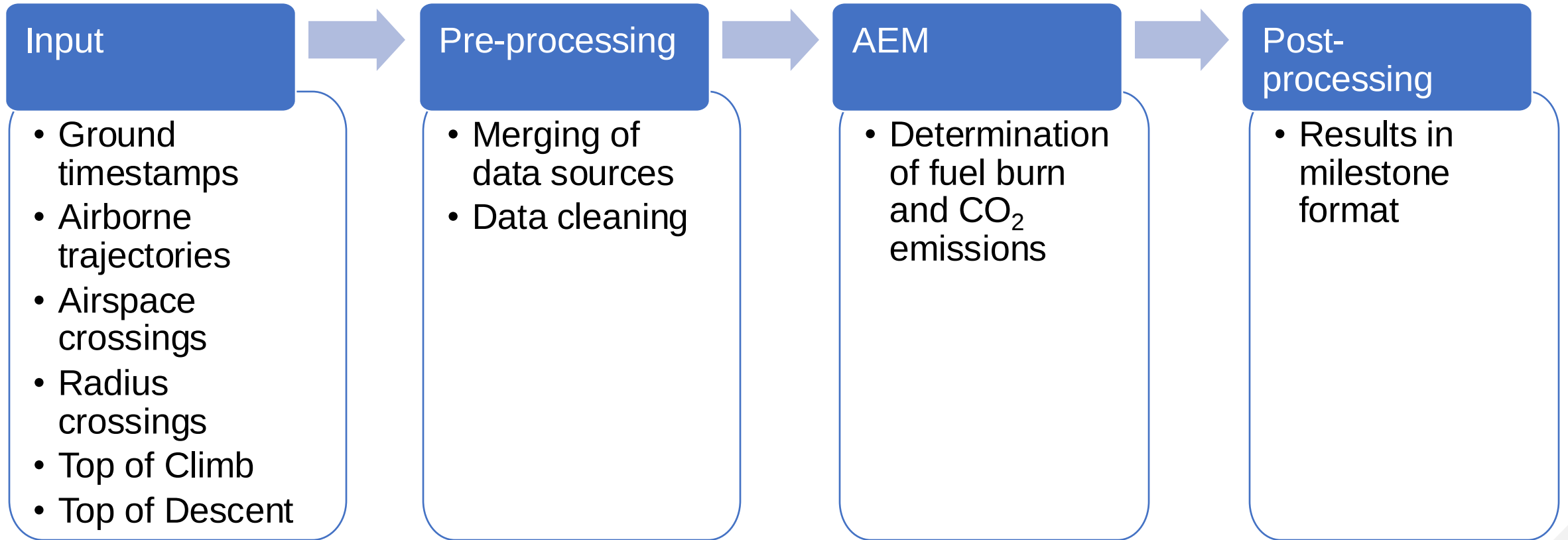


Milestone approach





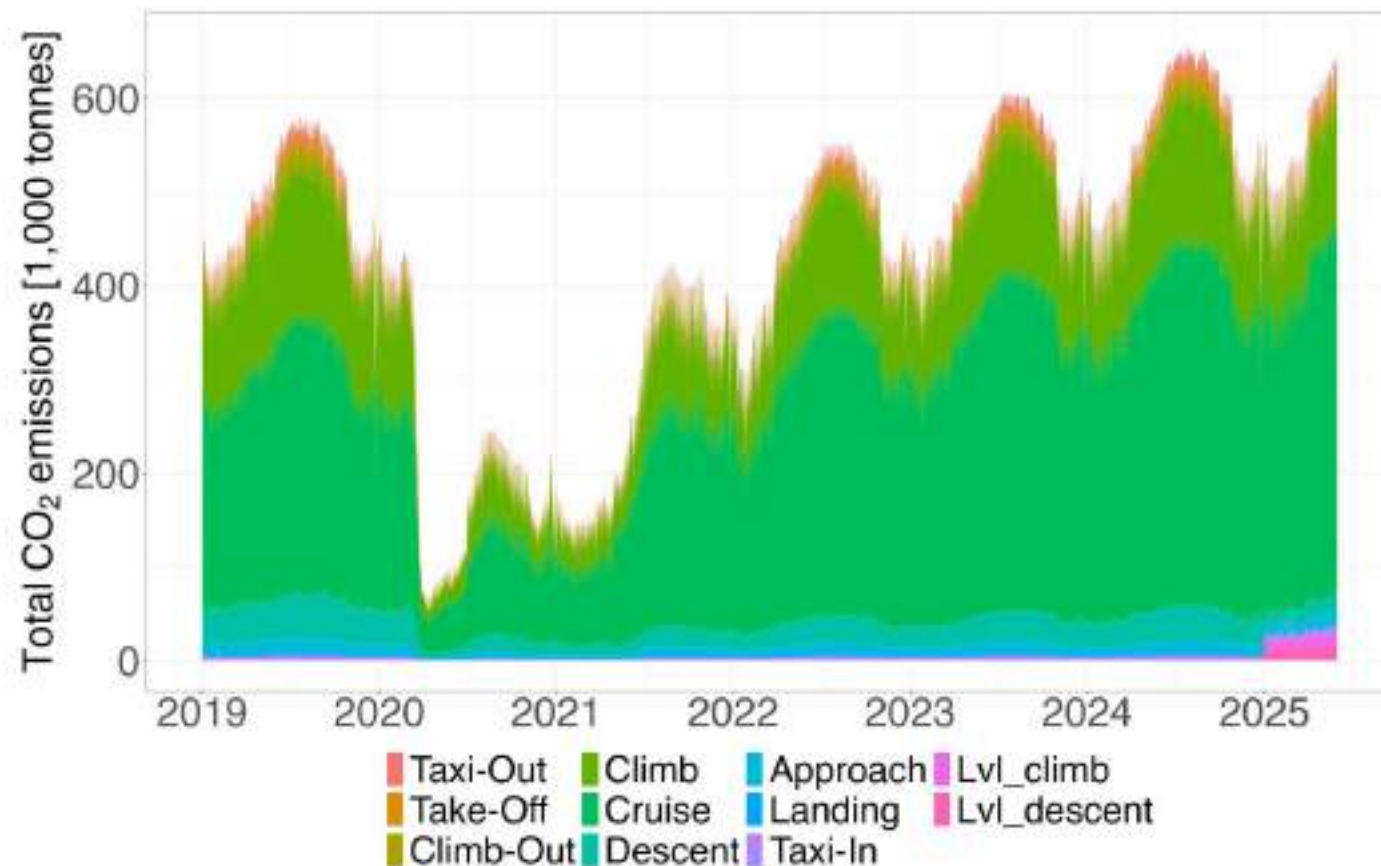
Calculating the CO₂ emissions





Results

- Results available from 2019
- Breakdowns per
 - Flight phase
 - Airline
 - Aircraft type
 - Airport pair
 - FIR
 - AUA





CO₂ Emissions | Aviation Intelligence Portal

Gate-to-Gate Emissions (Area Focus)

Level
Network

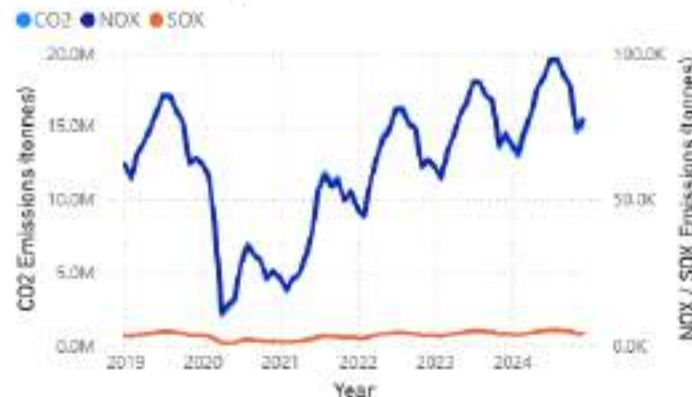
Area
ECAC

Flight Type (DAI/DI)
All

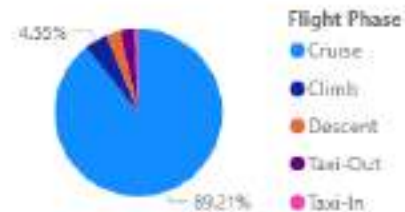
Market Segment
All

Flight Phase
All

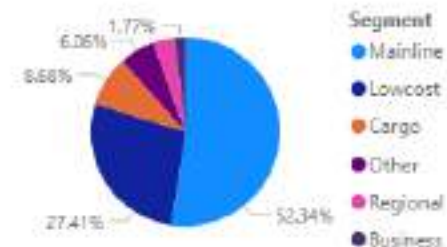
CO₂, NO_x and SO_x by Year and Month



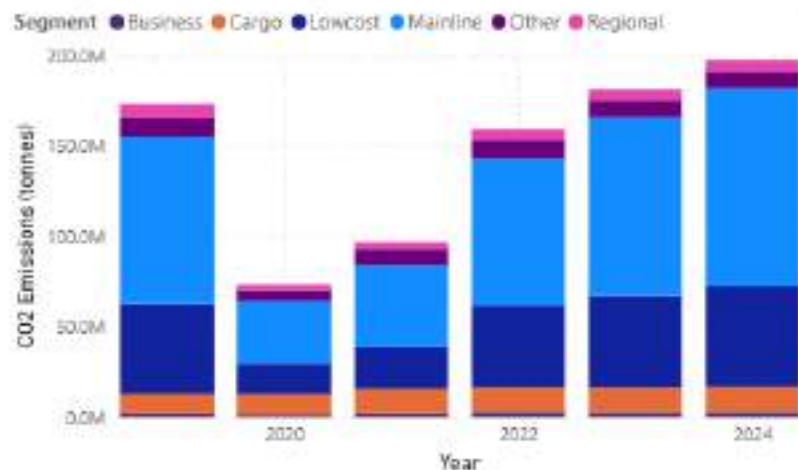
CO₂ by Flight Phase



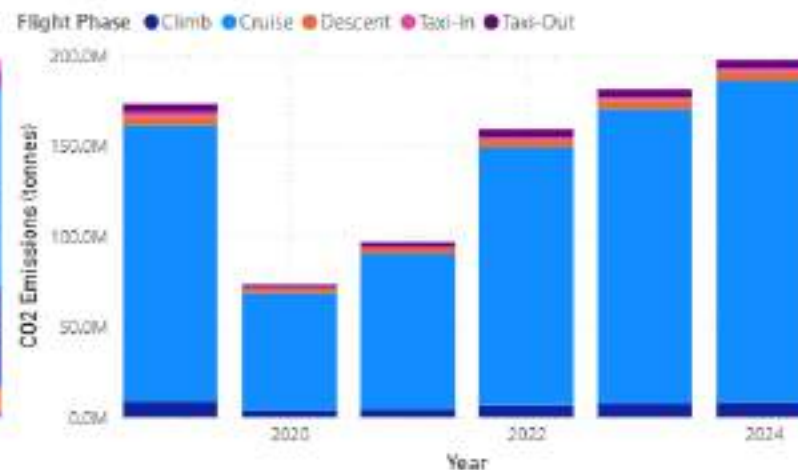
CO₂ by Market Segment



CO₂ by Year and Market Segment



CO₂ by Year and Flight Phase



Powered by

- Aviation Sustainability Unit
- Performance Review Unit
- Aviation Intelligence Unit

An initiative by

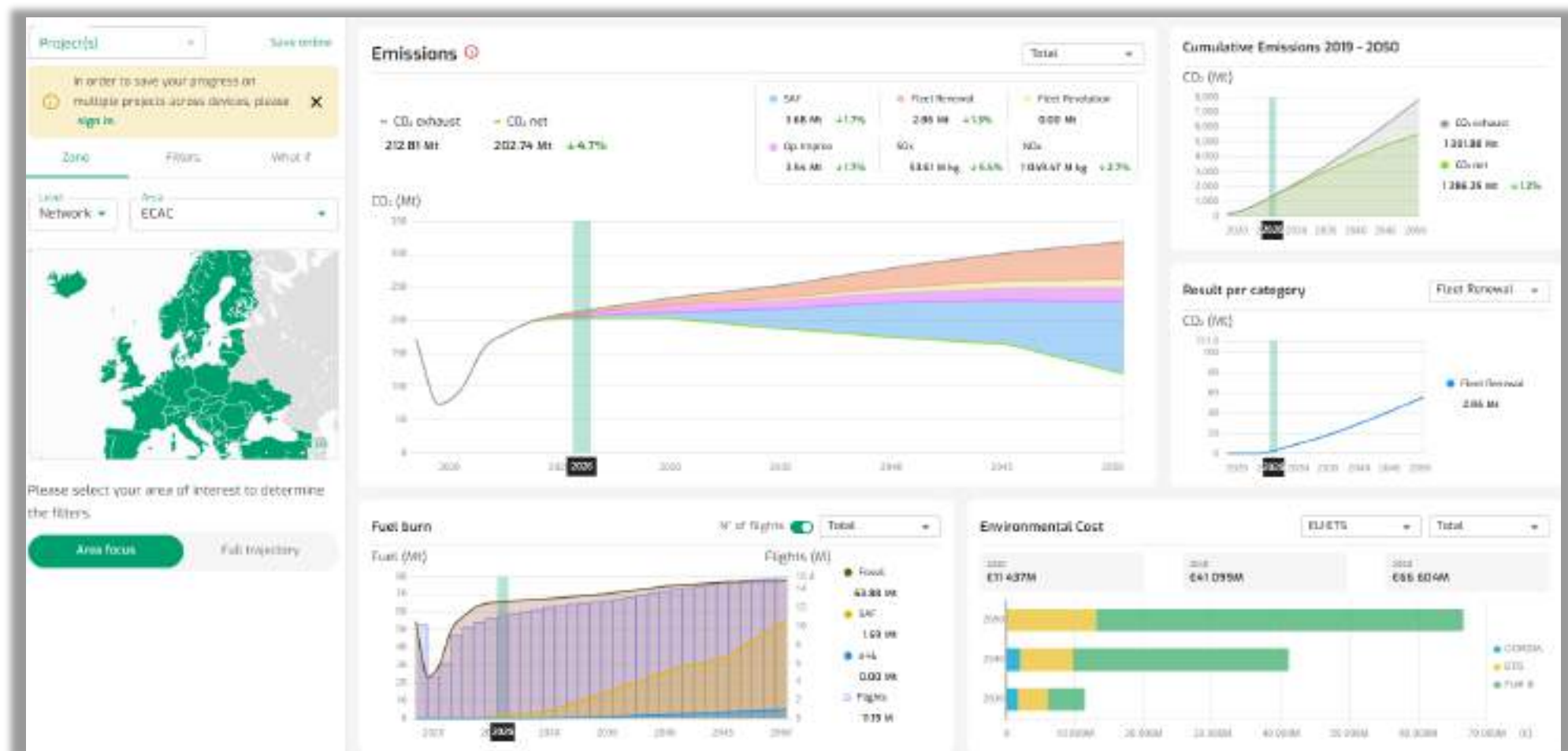
- Performance Review Commission (PRC)

In collaboration with

- EUROCONTROL FlyingGreen



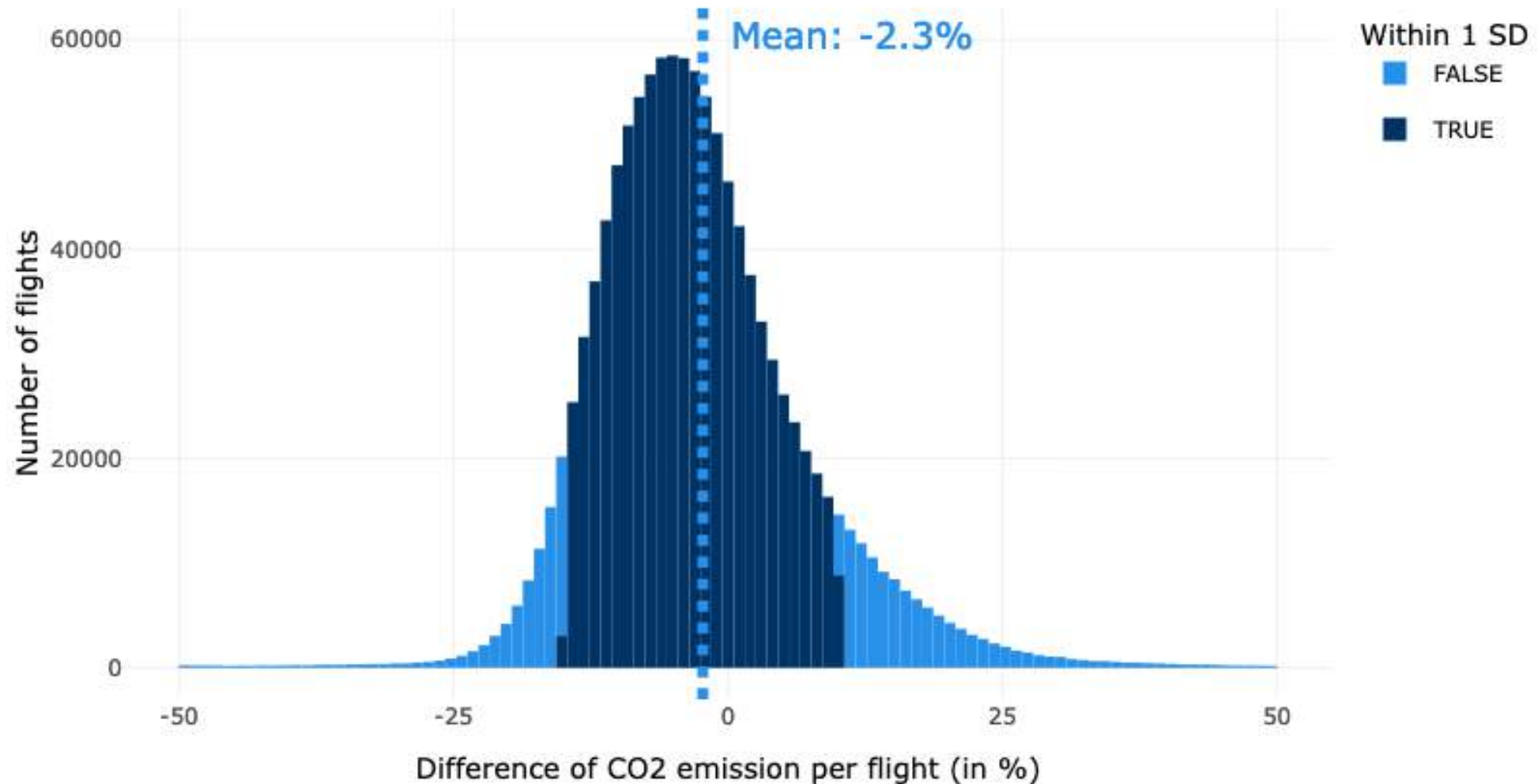
FlyingGreen Platform





Cross-validation of results

Comparison of AIU emission estimates with ASU data (2019, 1.19M flights)





EASA Data4Safety

Step 1

- FDM data (including fuel burn) for 5000 Vueling flights in 2023
- 5 airport pairs
- Gate-to-gate fuel burn by flight phase
- Ongoing



Step 2

- More airport pairs
- More airlines
- More aircraft types
- Complete by end 2025

Inefficiencies



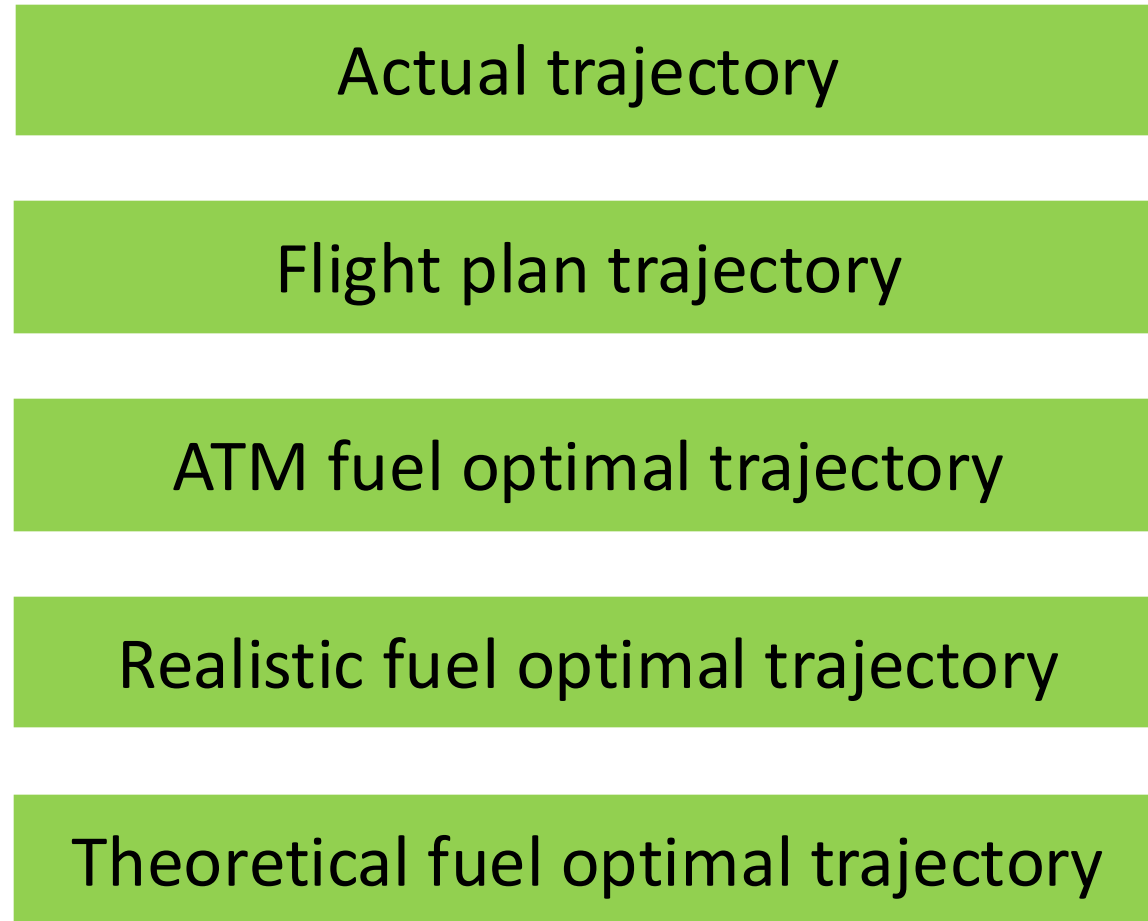
Determination of inefficiencies

- Requires CO₂ emissions for each type of reference trajectory
- Determination of impacting factors by measuring difference between CO₂ emissions of different reference trajectories
- We believe it's the first methodology based on a gate-to-gate trajectory



Reference trajectories

Theoretical benefit pool



Actual trajectory

Tactical ATC and crew interventions

Flight plan trajectory

Flight planning

ATM fuel optimal trajectory

ATM and Network constraints

Realistic fuel optimal trajectory

Weather phenomena

Theoretical fuel optimal trajectory

Airport pair

Aircraft type

Aircraft mass

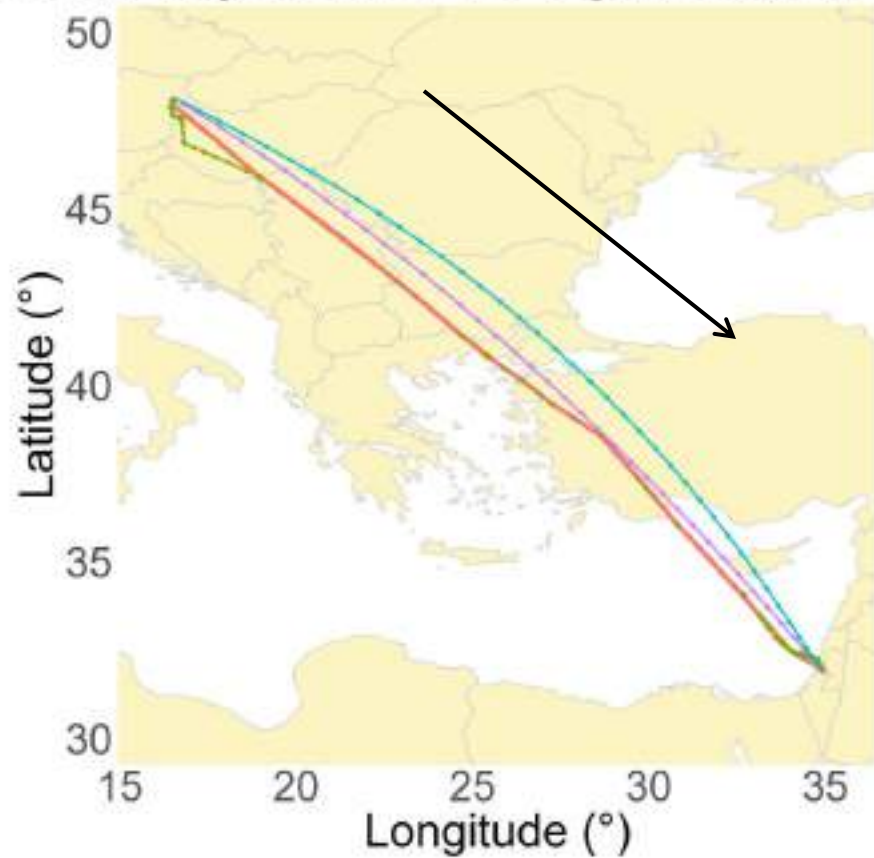
Take-off time

Wind (Runway configurations)

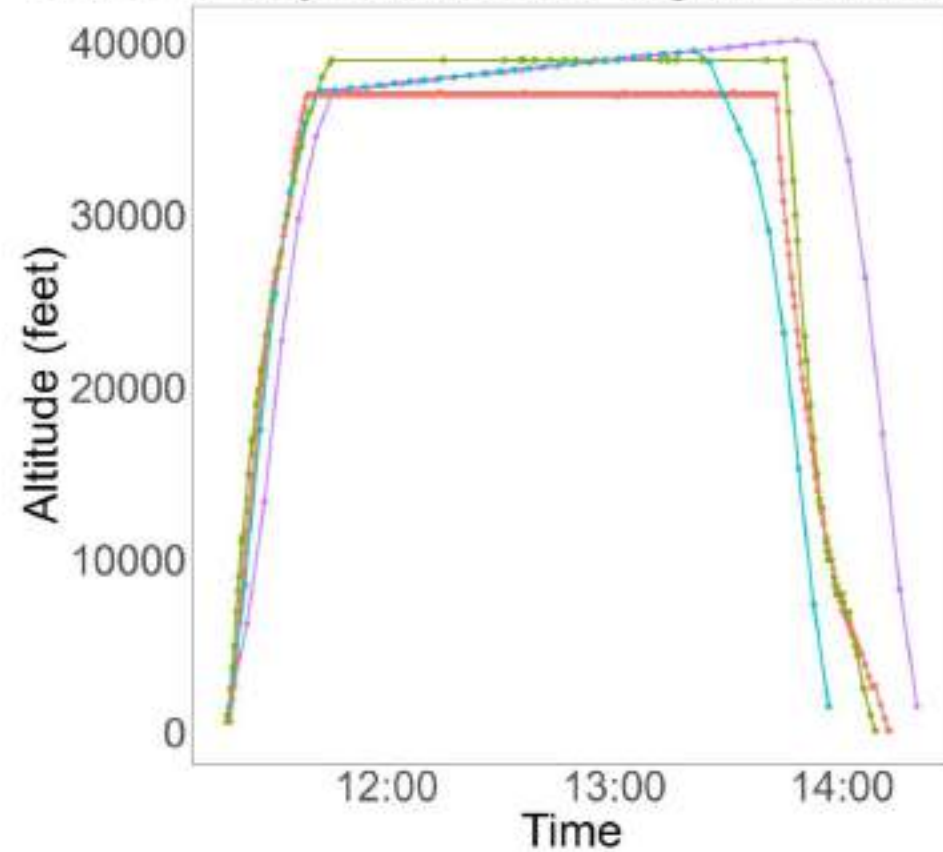


Reference trajectories

Lateral trajectories for flight LOWW-LLBG



Vertical trajectories for flight LOWW-LLBG



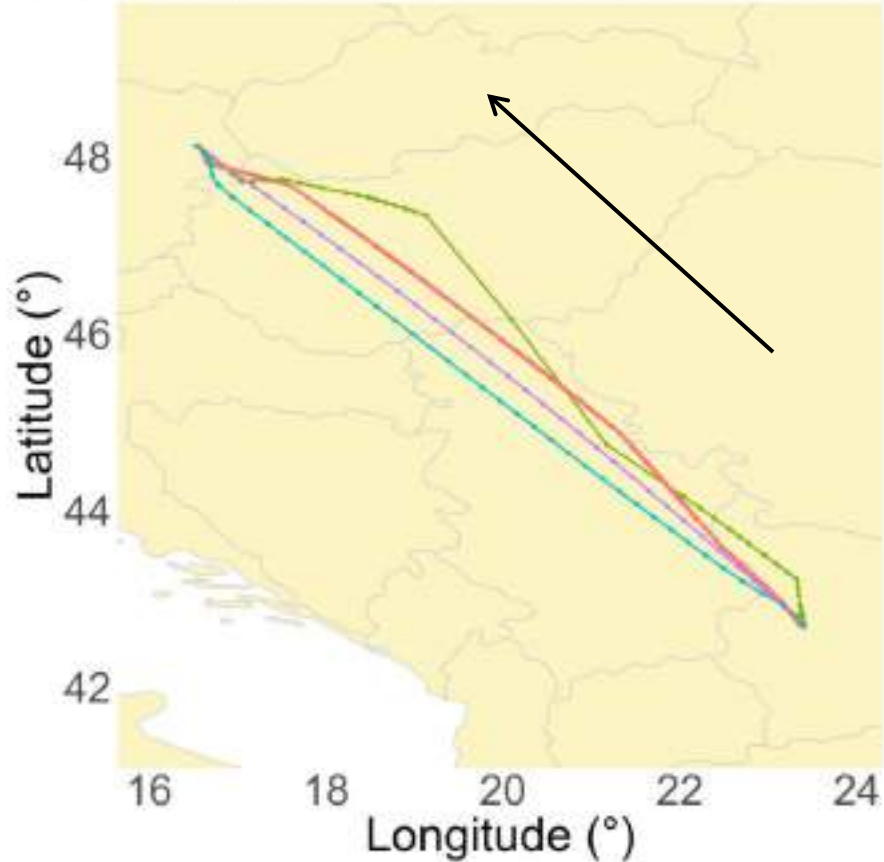
■ CPF ■ FTFM ■ Optimal with wind ■ Optimal without wind

■ CPF ■ FTFM ■ Optimal with wind ■ Optimal without wind

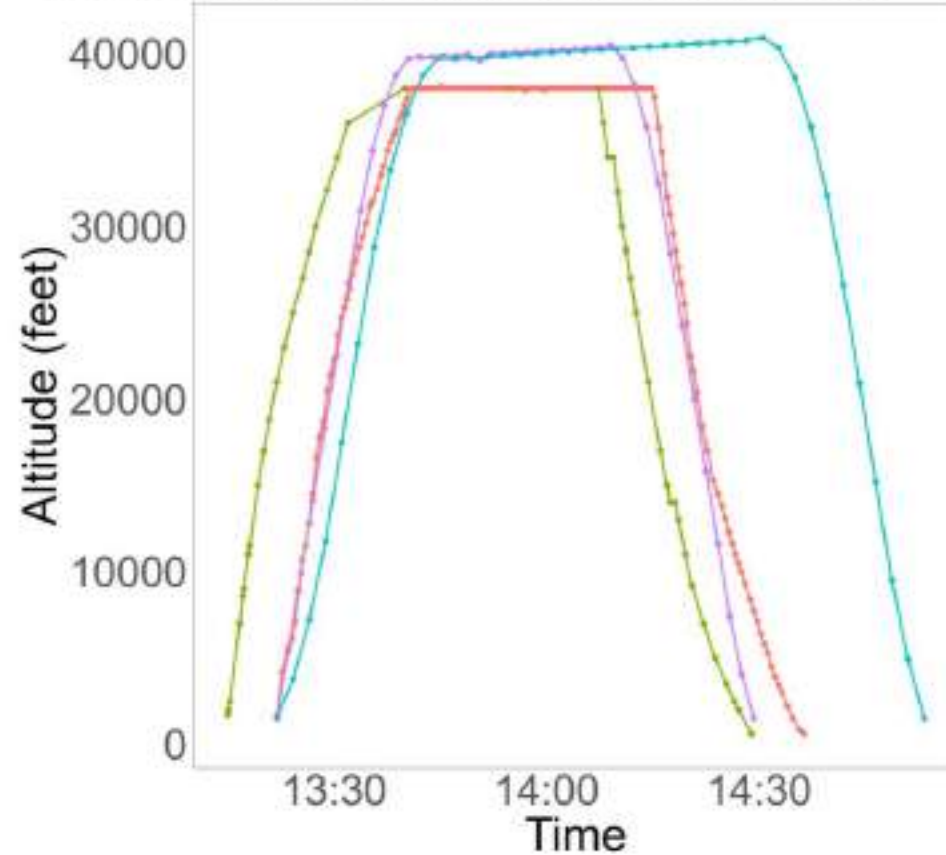


Reference trajectories

Lateral trajectories for flight LBSF-LOWW



Vertical trajectories for flight LBSF-LOWW



■ CPF ■ FTFM ■ Optimal with wind ■ Optimal without wind ■ CPF ■ FTFM ■ Optimal with wind ■ Optimal without wind



Reference trajectories

- Work with technical consultant TU Delft
- Integration of BADA4
- Adding constraints
 - Route network (waypoints and routes)
 - RAD constraints
 - ATFCM regulations
- Refinements with operational factors



Optimal Trajectory Task Force

- AVENIR Working Group
- Airlines and CFSPs
- Supported by A4E
- Data sharing and validation





Future work

- Use of actual weights
- En-route flight levels according to realistic flight levels
- Consider runway directions
- Extension beyond EUROCONTROL area
- Further alignment of environmental performance analyses and publications within EUROCONTROL



SUPPORTING
EUROPEAN
AVIATION

Thank you!

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NETWORK
MANAGER





Coordination and collaborations

- **Aviation Intelligence Unit**
 - CODA
 - STATFOR
- **Aviation Sustainability Unit**
 - AEM
 - FlyingGreen
- **Innovation Division**
 - BADA
- **Aviation Planning Division**
 - ATM Master Plan
- **Airport Unit**
 - LTO Emissions Estimator
- **EASA**
 - European Aviation Environmental Report
 - Data4Safety
- **MUAC Sustainability and Exploration Units**
- **AVENIR Working Group**