Deutsches Zentrum
für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft
Institut für Physik der Atmosphäre

ATM4E

ATM4E – Air Traffic Management for Environment

Environmental impact functions – How to link environmental impact information for planning environmentally-optimal trajectories

S. Matthes[1], S. Stromatas[2], F. Linke[3], V. Grewe[1,4], F. Yin[4], K. Shine[5], E. Irvine[5], L. Lim[6], D. Lee[6]

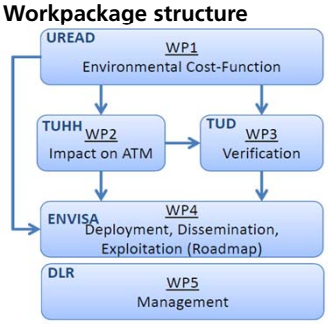
(1) DLR-Institute Atmospheric Physics, D, (2) Envisa, FR, (3) Hamburg University of Technology, D,
(4) Delft University of Technology , NL, (5) University of Reading, UK, (6) Manchester Metropolitan University, UK

SESAR JOINT UNDERTAKING

Abstract

- The **ATM4E** project will explore the feasibility of a concept for environmental assessment of ATM operations towards environmental optimization of air traffic operations in the European airspace.
- The European project **ATM4E** (*SESAR 2020 Exploratory Research*), coordinated by the DLR-Institute of Atmospheric Physics, aims at **integrating existing methodologies** for assessment of the environmental impact of aviation, in order to evaluate the implications of environmentally-optimized flight operations to the European ATM network, considering **climate, air quality and noise impacts**.
- **Algorithms** will be developed which will allow in the future to determine environmental impacts directly from meteorological information available in SWIM (System Wide Information Management).
- Different **traffic scenarios** (present-day and future) will be analyzed to understand the extent to which environmentally-optimized flights that are planned and optimized based on multi-dimensional environmental criteria (assessment) would lead to **changes in air traffic flows** and create challenges for ATM.
- These findings will be used to prepare a **roadmap compliant with SESAR2020** principles and objectives which would consider the necessary steps and actions that would need to be taken to introduce environmentally-optimized flight operations on a large scale in Europe.

Workpackage structure

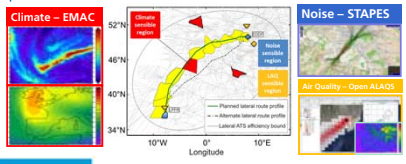


Flowchart workplan organised in five workpackages.

Environmental Route Optimization

Environmental impact of non-CO_2 aviation emissions (climate, air quality, noise) depends on
- time and position of aircraft
- actual weather conditions (processes, transport pathways, temperature, humidity)
- background concentrations of key species.

Minimizing overall environmental impact of aviation can be achieved by avoiding regions with high environmental impact characterised by individual ECFs during route optimisation [2,4].



Objectives of **ATM4E** are to explore the feasibility of a concept for **environmental assessment** of ATM operations towards environmental optimization of air traffic operations in the European airspace [5].

Impact on ATM

- The project aims at optimising trajectories to minimise the environmental impact of an air traffic sample in the European airspace, considering **climate impact, air quality and noise impacts**.
- After the reference flight plans of the European air traffic sample have been optimised a **hot spot analysis** will be carried out to identify sectors that would be primarily affected
- Based on the hot spot analysis **recommendations** will be given to SESAR JU for the implementation of environmental optimised trajectories

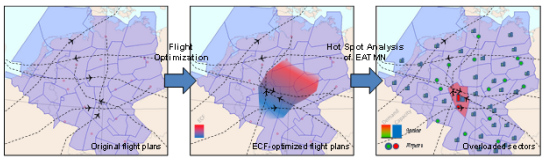
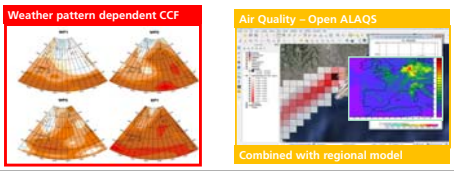


Figure: Schematic process implemented in ATM4E to analyse changes in the Demand-Capacity situation due to environmentally-optimized flight operations

Environmental Change Functions

- Climate change functions (**CCF**) are provided **as predictors for the climate impact** of localized air traffic emissions using REACT4C results (EU, 2010-2014).
- Then, environmental change functions (**ECFs**) quantify air quality and noise impacts via **environmental metrics** considering local impacts versus global impacts.
- Here, a **reliable algorithm based ECF** is derived for use in weather prediction models to expand the environmental change function (currently driven by climate change considerations).

Figure: ECF approach combines global climate impacts [1,3] with local impacts (AQ, noise) by providing MET information relevant for environmental performance.



Verification

- **Algorithm based** Environmental Change Functions (aECFs) are verified to evaluate **environmental impact reduction** by avoiding climate sensitive regions
- **Tool:** EMAC/AirTraf [6] an Earth-System Model including routings and optimization options.

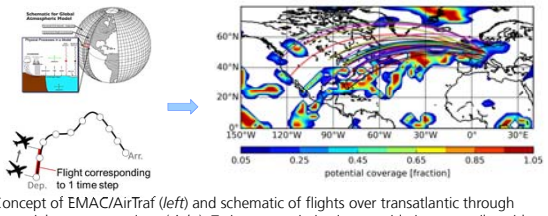
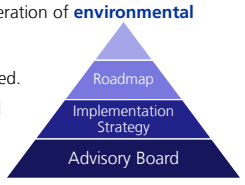


Figure: Concept of EMAC/AirTraf (*left*) and schematic of flights over transatlantic through contrail potential coverage regions (*right*). Trajectory optimization considering contrail avoidance.

Assessment and Exploitation

- The project aims at identification of **intermediate solutions** and milestones towards an ATM system that **fully integrates** consideration of **environmental** impact within the European Flight Planning system
- An Advisory Board with external experts having expertise in ATM and environment has been established.
- A conceptual roadmap with recommendations and an **implementation strategy** for environmental-assessment of aircraft trajectories will be delivered jointly with stakeholders



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Acknowledgements

This project ATM4E has received funding from the SESAR Joint Undertaking under grant agreement No 699395 under European Union's Horizon 2020 research and innovation programme. The project received HPC resources from DKRZ Hamburg.

Research Consortium

DLR Oberpfaffenhofen (D)
Envisa SAS (FR)
Delft University of Technology (NL)
Manchester Metropolitan University (UK)
Hamburg University of Technology (D)
University of Reading (UK)

Contact Dr. Sigrun Matthes (DLR, Coordinator), *sigrun.matthes_AT_dlr.de*