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

ATM4E – Air Traffic Management for Environment

SESAR 2020, Exploratory Research Project

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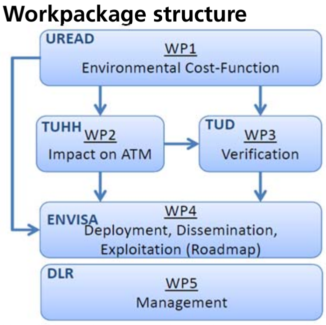
Abstract

- 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.
- 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

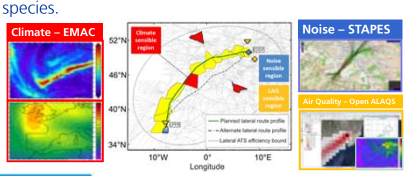


Flowchart workplan organised in five workpackages.

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

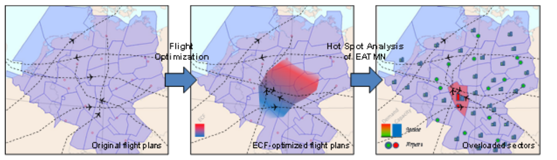
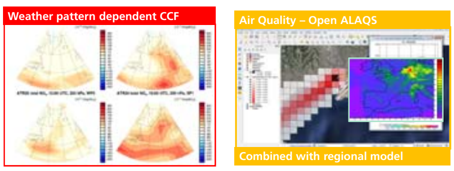


Figure: Schematic process implemented in ATM4E to analyse changes in the Demand-Capacity situation due to environmentally-optimized flight operations

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.

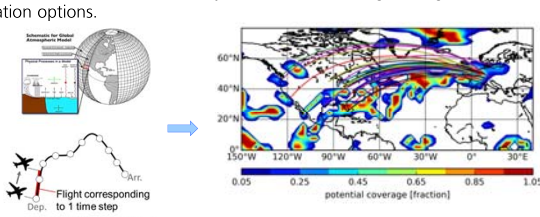
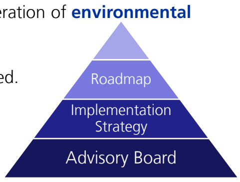


Figure: Concept of EMAC/AirTraf (*left*) and schematic of flights over transatlantic through contrail potential coverage regions (*right*). Trajectory optimization considering contrail avoidance.

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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Research Consortium

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