Session I: Overview, Key Results and Student Academy

Impact assessment of aviation
Björn Nagel (DLR)

Project overview and vision
Prajwal Shiva Prakasha (DLR)

Toolbox: Practical guidance for complete cycle of holistic impact assessments of European aviation R&I
Michel van Eenige (NLR)

Demonstration use cases and key results: Assessing the impact of aviation at multiple levels
Thierry Lefebvre et al. (ONERA)

Academy: An educational initiative to broaden the horizon of young talents
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Demonstration Use Cases and Key Results

Assessing the impact of aviation at multiple levels

Thierry Lefebvre, Atif Riaz, Jordi Pons-Prats, Inge Mayeres, Marko Alder, Patrick Ratei, Prajwal Shiva Prakasha

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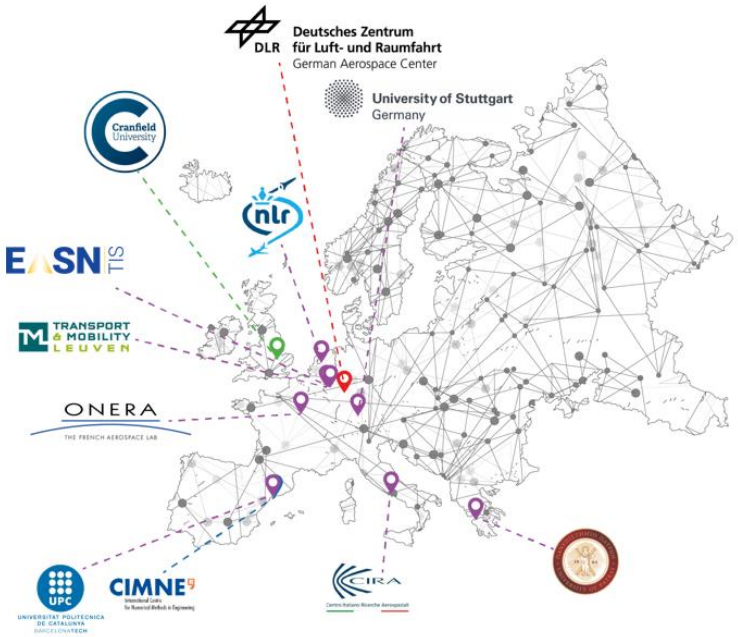
Content Overview

- Impact Monitor overview
- Demonstration Use Cases “philosophy” and objectives
- Demonstration Use Cases implementation process
- Demonstration Use Cases status and key results
- Conclusion and perspectives

Impact Monitor at a glance

- Impact Monitor is a 2-year EU Project to deliver a **coherent, collaborative and holistic demonstration framework and toolbox** for technology and policy assessment of the environmental, economic, and societal impact of European aviation R&I.
- Focus of the Impact Monitor project is to **demonstrate with approximate use cases** the collaborative assessment of future Technologies, Vehicles and Operational Strategies.



Use Cases – “Philosphy“

Demonstration UCs

- Cover up to **3 assessment levels** (aircraft, airport, and ATS).
- Produce key performance indicators (**KPI**s)

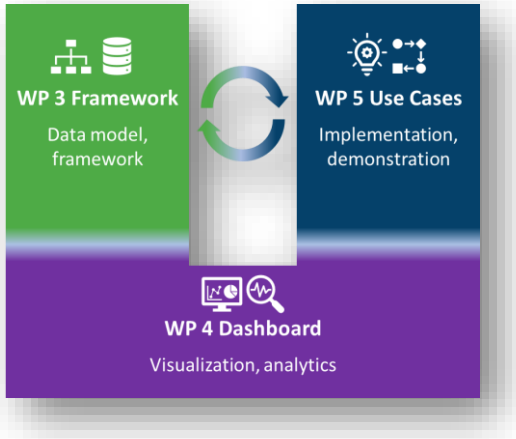
&

- Implemented in the **Impact Monitor framework**
- Results accessible though the **Impact Monitor Dashboard Application**

But **representative UCs**

- Inspired from R&I from Horizon Europe for 3 streams:
  - **Aircraft technology/concepts** (e.g. Clean Aviation),
  - **ATM and aircraft operations** (e.g. SESAR3),
  - **Policies/regulations/market-based** measures (e.g. CORSIA).

→ The Impact Monitor Framework should be able to **demonstrate its capabilities to assess** the impact of such R&I at the appropriate assessment level(s)



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Use Cases – Main Objectives

- **UCs specificity**

Each UC should focus on **specific demonstration** aspects

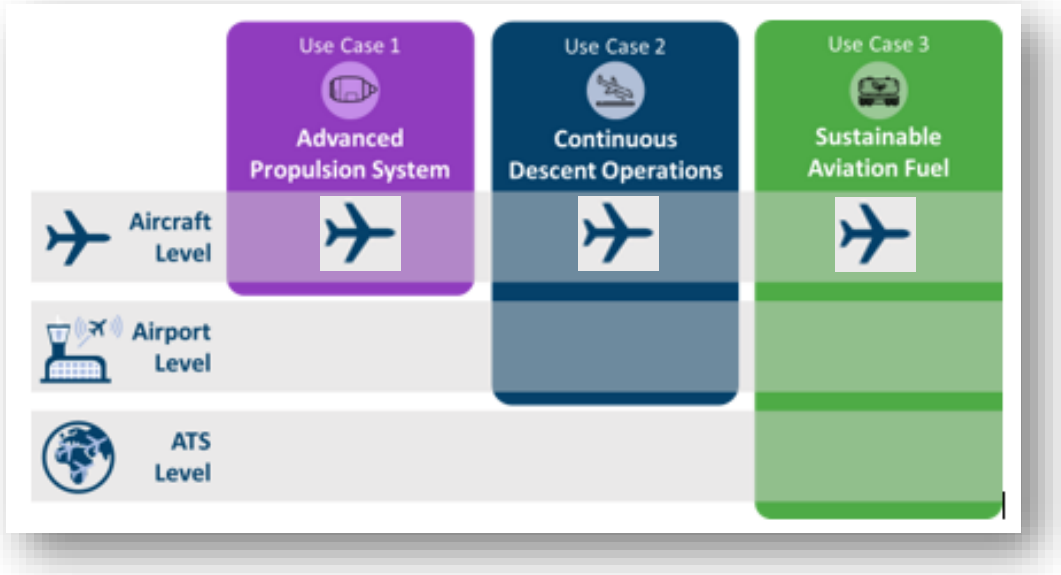
  - In terms of **assessment level(s)** coverage
    - *Aircraft / Airpot /ATS*
  - In terms of **R&I streams**
    - *Technos/ operations / policies*
  - In terms of **Framework & Dashboard** development
    - *Data model extension, Technos*

- **UCs Commonality**

All UCs should share **common features**

  - **SAF** topic is common to all UCs
  - **New Aircraft concepts** generated in UC1 are considered in UC2 / UC3 studies

SAF



Use Cases as part of Impact Monitor

Assessment framework & toolbox

assessment toolbox that provides a systematic approach of the complete cycle of performing holistic environmental, economic and societal impact assessments of European aviation R&I

Drives the approach applied in the UCs

Interfaces with key stakeholders

interfaces with key stakeholders in European aviation R&I

Highlights the expectations for UCs

Multi-level use cases

Demonstrate the collaborative framework robustness via multi-level use cases

Provides framework to implement the UCs

Collaborative assessment framework

Develop a scalable, open source, distributed, multidisciplinary, modular, and model independent collaborative assessment framework & toolbox to support holistic impact monitoring

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Starting Point

Models catalogue

- More than **15 models** selected for the 3 UCs
  … but **none was already compliant** with the Framework technos

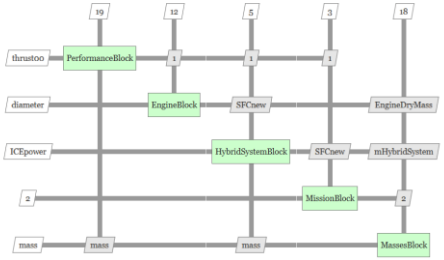
Framework initial «building blocks »

cpacs
A Common Language for Aircraft Design

data schema for system of interest representation

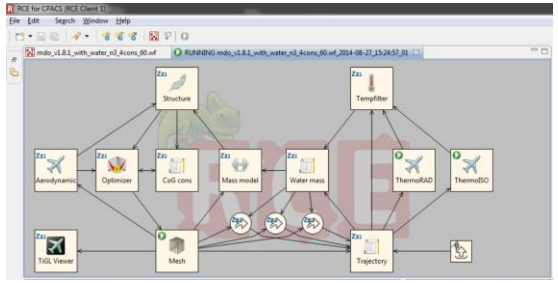
MDAx
MDO Workflow Design Accelerator

MDO system formulation environments



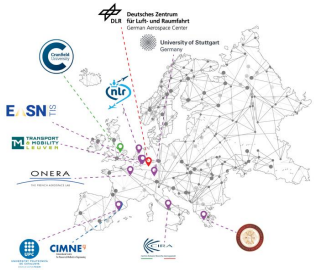
RCE

Executing simulation workflows



RCE Uplink
BRICS

Cross-organization workflow enabler



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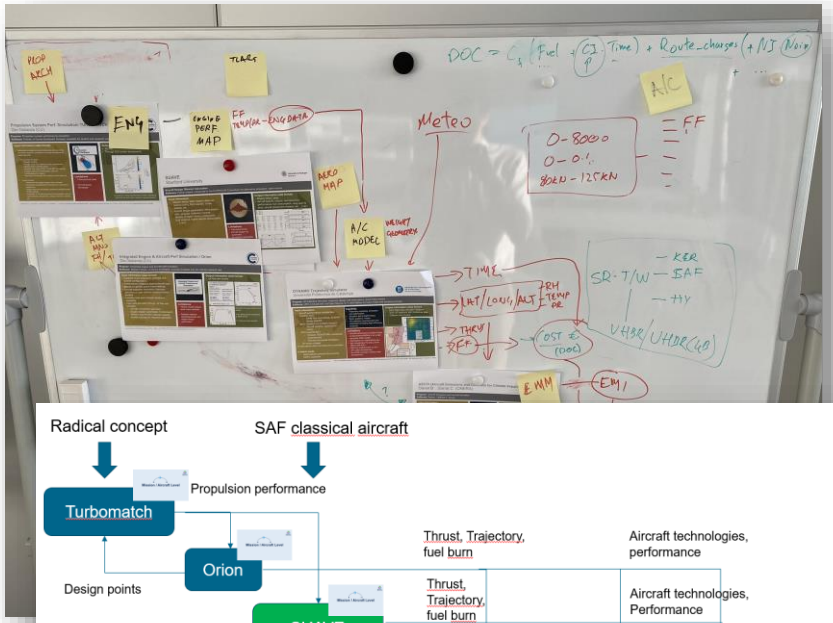
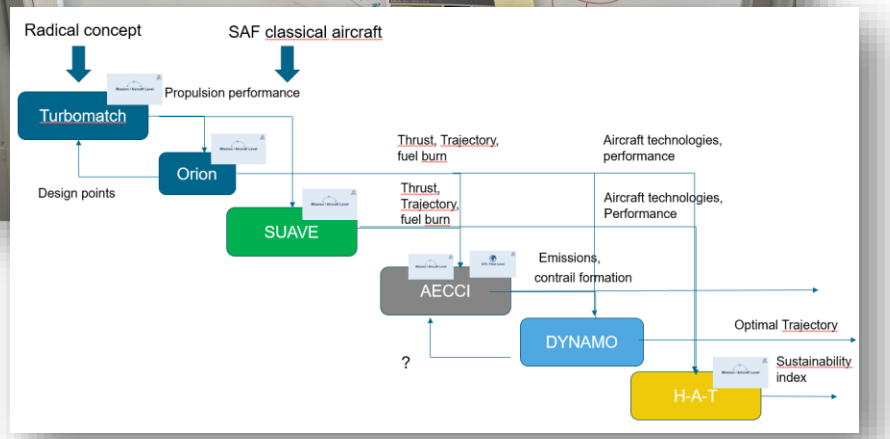
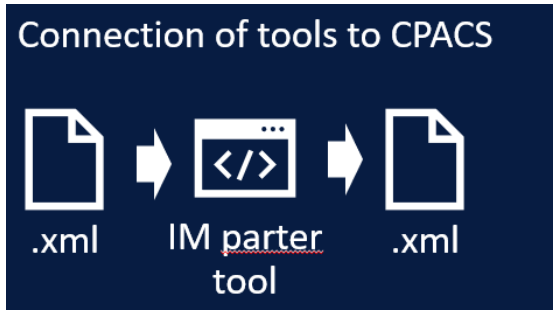
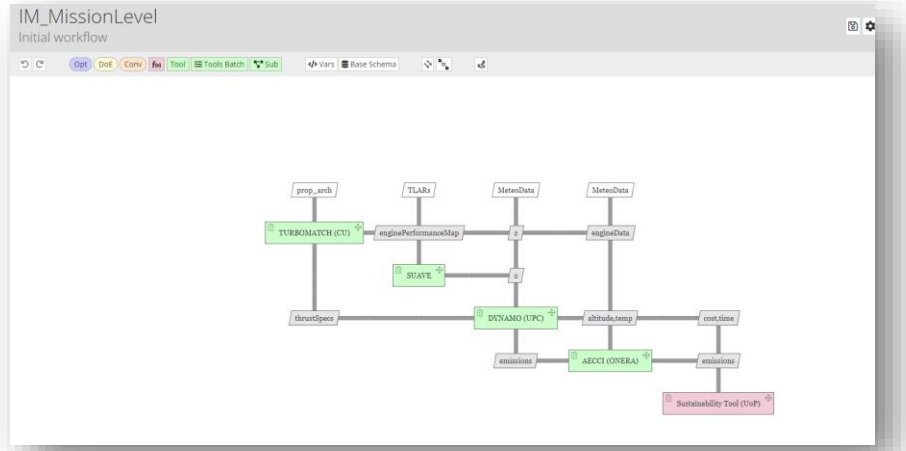
Overall Approach – UC1 Workflow Story

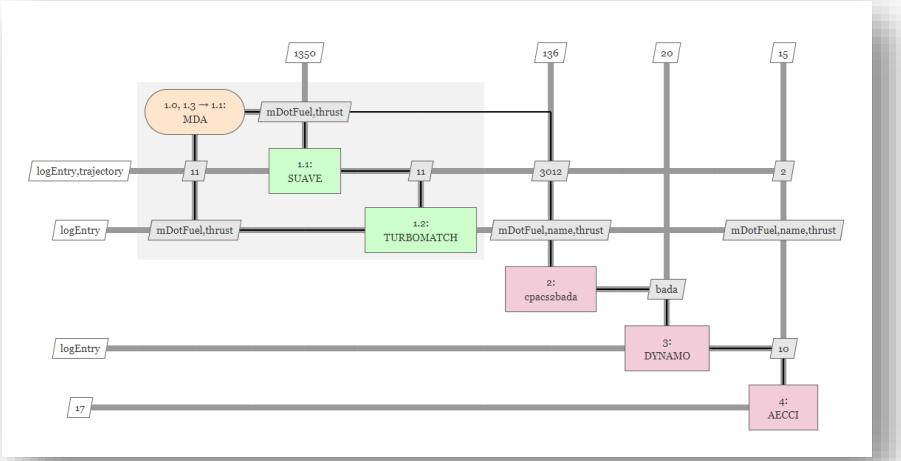




Example: UC1 – Aircraft techno







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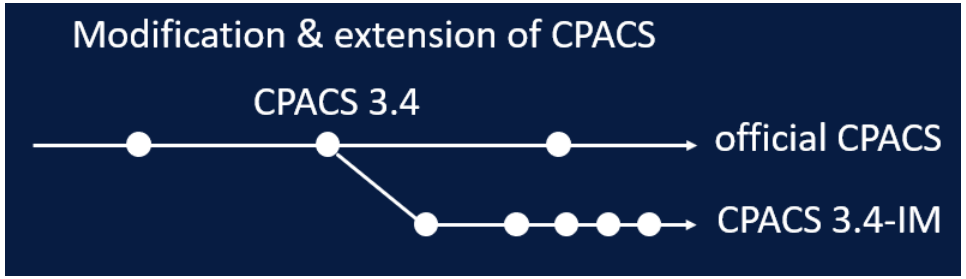
Overall Approach – Framework & Dashboard

Framework



- CPACS schema extended:
  - Schedules
  - Flights
  - Missions
  - Airports
  - Studies

Dashboard

"*Impact Monitor Framework: Development and implementation of a collaborative framework for aviation impact assessment*"
16:20 - 16:40 Room Maurice Saltiel II

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Use Case 1 – Advanced Propulsion System

Objective :

- Investigate the viability and competitiveness of **future SAF fuelled** long range **aircraft concepts**

Scenario :

- Design Mission + Long range mission + Payload Range analysis + Trajectory amendment for contrail avoidance

Aircraft and Engine Models :

- Single Aisle (SMR) , Wide Body (LR)
- **VHBR** (9-10) , **UHBR** 15+ with Gearbox - **KER + SAF**

Metrics:

- Fuel burn - design mission and operating mission
- Emissions - CO2, NOx, SOx, CO, HC, H2O and contrail formation
- Sustainability

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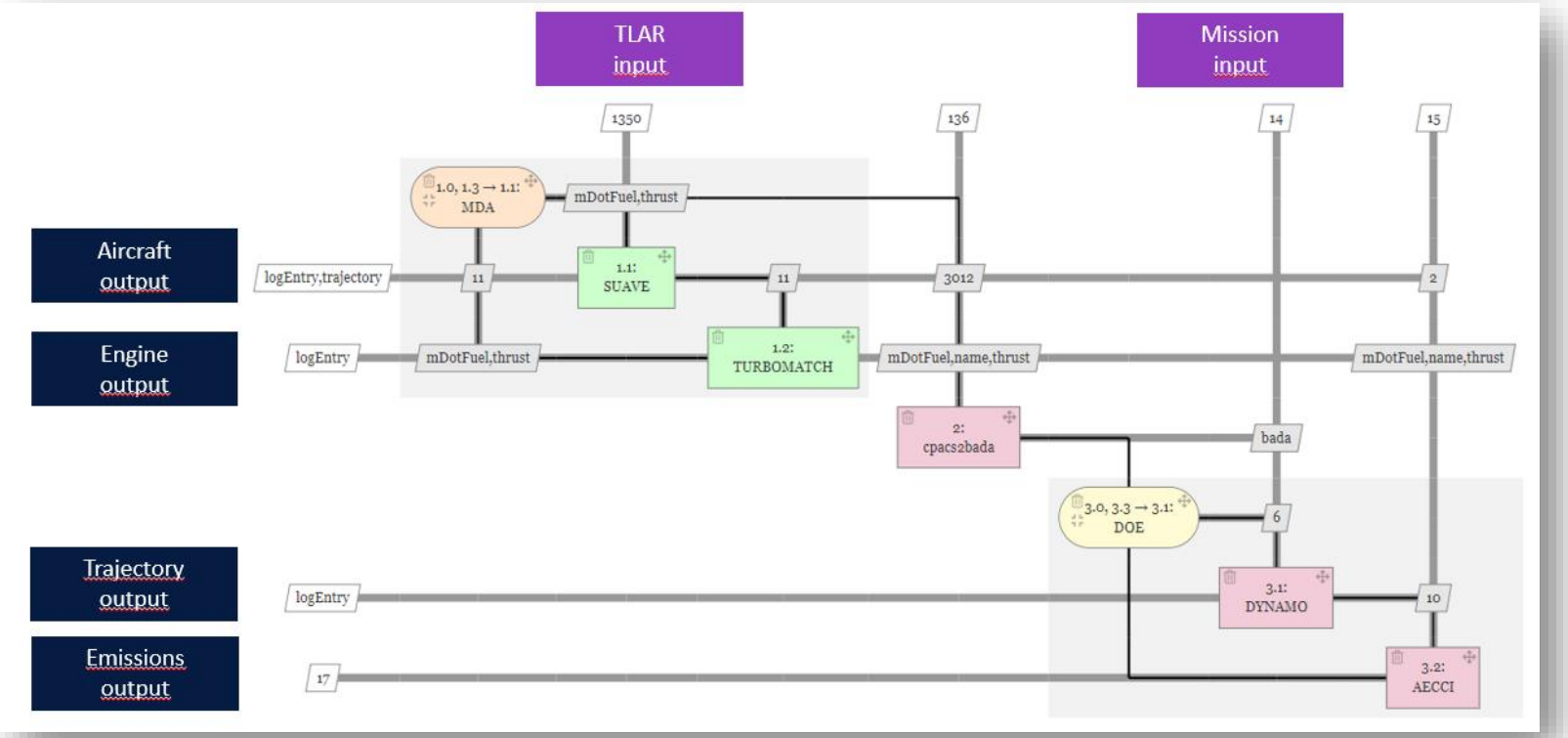
Use Case 1 – Advanced Propulsion System



UC approach

- 2 steps approach
  - Aircraft / engine sizing loop
  - Analysis of emissions (incl. contrails) on a set of realistic trajectories

Framework focus

- Take advantage of **RCE** capabilities with
  - MDA loop
  - DOE loop

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"Assessing advanced propulsion systems using the Impact Monitor Framework "
16:40 - 17:00 Room Maurice Saltiel II

Use Case 2 – Continuous Descent Operations

Objective:
- Investigate the implementation of **continuous descent operations at airports**

Scenario:
- Continuous descent operations for a reference and future scenario at an **example airport**

Main Models:
- Fleet and schedule forecast model
- Airport and airspace simulation
- Noise and emissions model
- Risk assessment model

Metrics:
- Punctuality
- Fuel burn
- Emissions and noise
- Social cost benefit analysis

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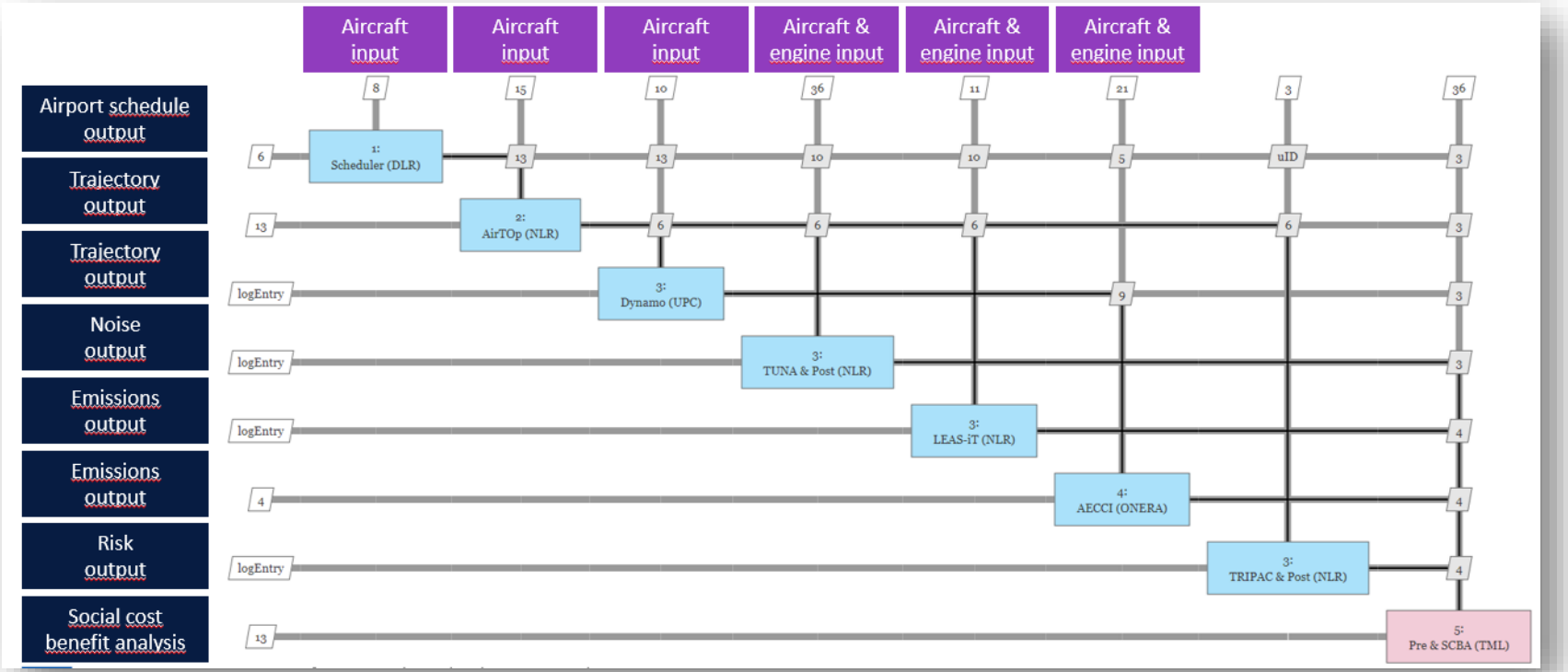
Use Case 2 – Continuous Descent Operations



UC approach

- Extension of classical approach with
  - Social cost benefit analysis
  - Refined analysis with higher fidelity tools for a set of trajectories

Framework focus

- Collaborative versatility with the use of both BRICS and Uplink
- Scalability assessement

"*Assessing continuous descent operations using the Impact Monitor Framework*"
17:00 - 17:20 Room Maurice Saltiel II

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Use Case 3 – Sustainable Aviation Fuel

Objective:

- Analysis of **SAF policies at the air transport system level**

Scenario:

- Future forecast of global fleet operations and demonstrative impact assessment for Reference scenario + **two policy scenarios for 2035 and 2050**

Main Models:

- Transport fuel market model
- Fleet and schedule forecast model
- Emissions tool
- Economics assessment model

Metrics (selection)

- Total fuel demand and CO2 emissions over the entire life cycle
- Flight schedule and fleet forecast
- Gross value added and employment impacts in the aviation sector

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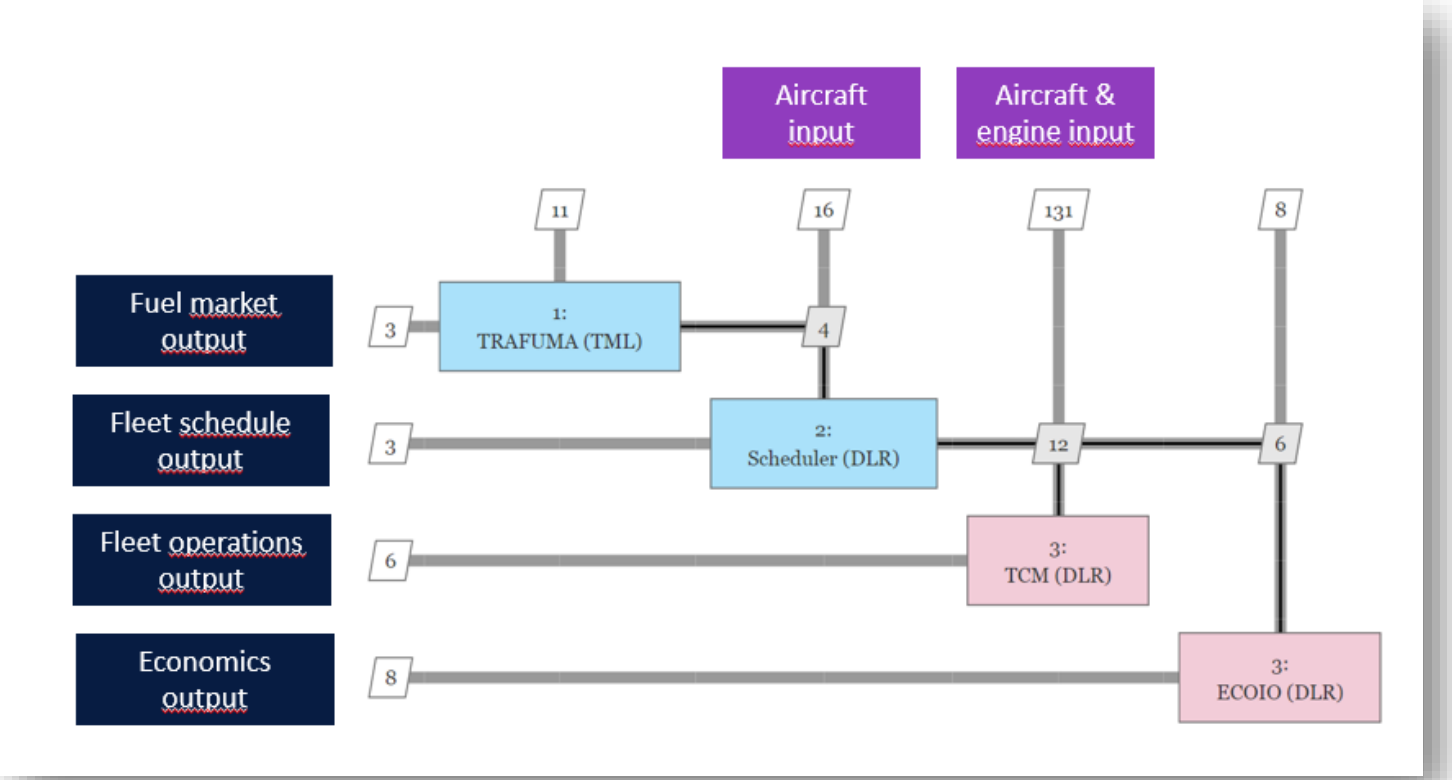
Use Case 3 – Sustainable Aviation Fuel



UC approach

- 2 – steps approach
  - Calibration exercice to tune TRAFUMA elasticity
  - Scenario analysis

Framework focus

- Inclusion of complex / costly models not natively exchanging data
- Scalability assessement

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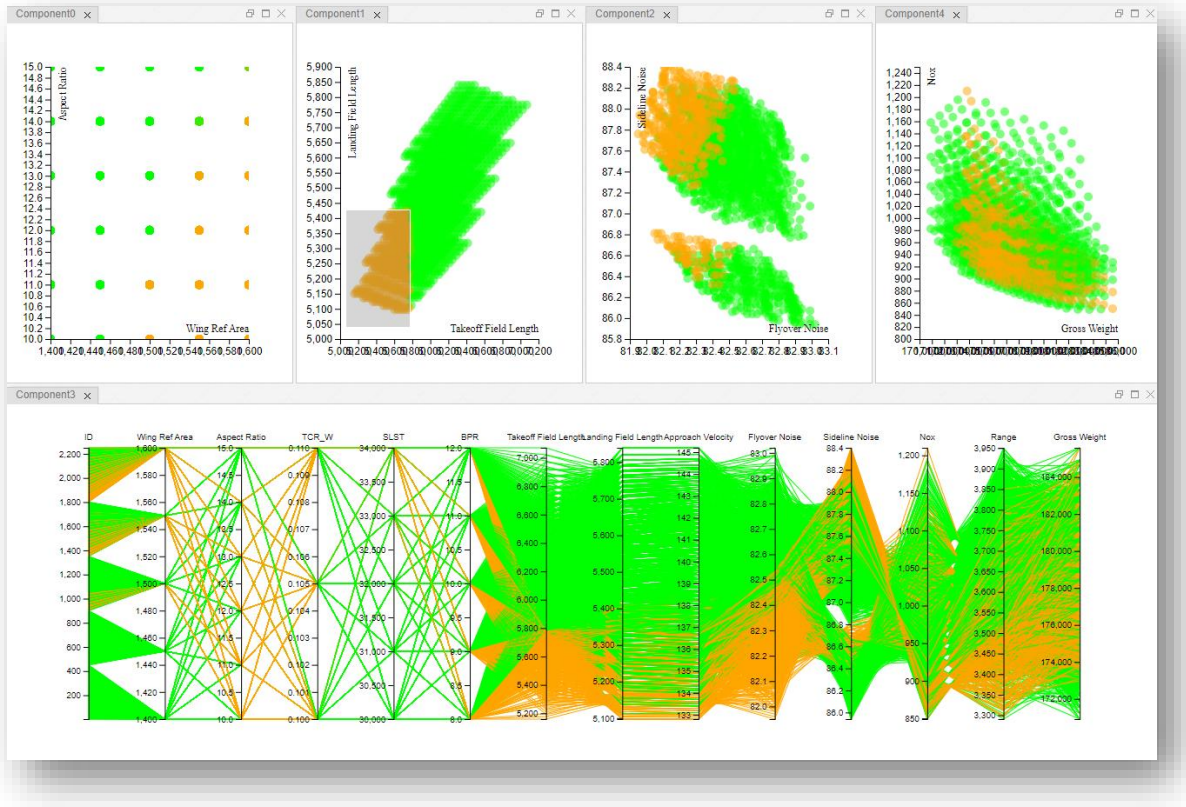
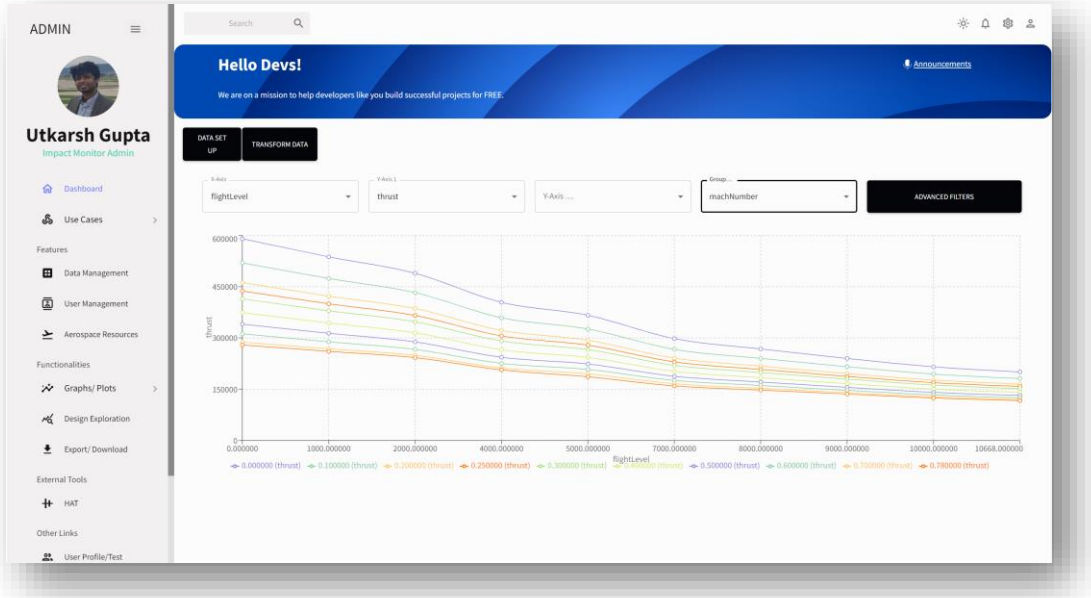
"*Assessing policies for the uptake of sustainable aviation fuels using the Impact Monitor Framework*"
17:20 - 17:40 Room Maurice Saltiel II

Overview of Results: UC1

UC1 – Engine / airframe exploration



UC1 – Performance focus



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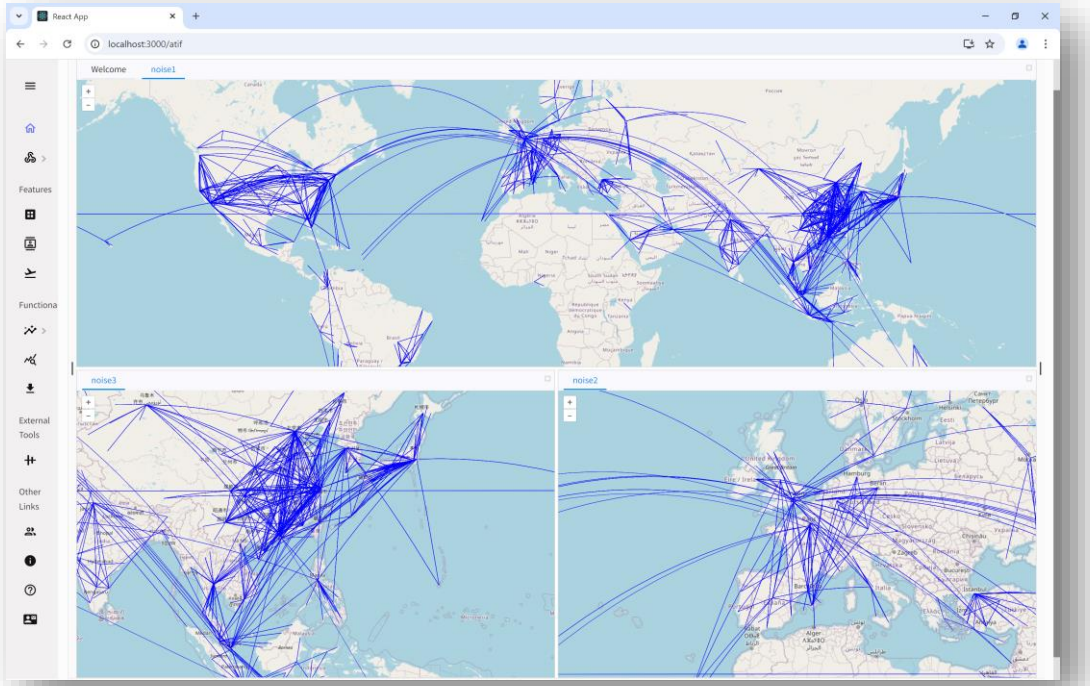
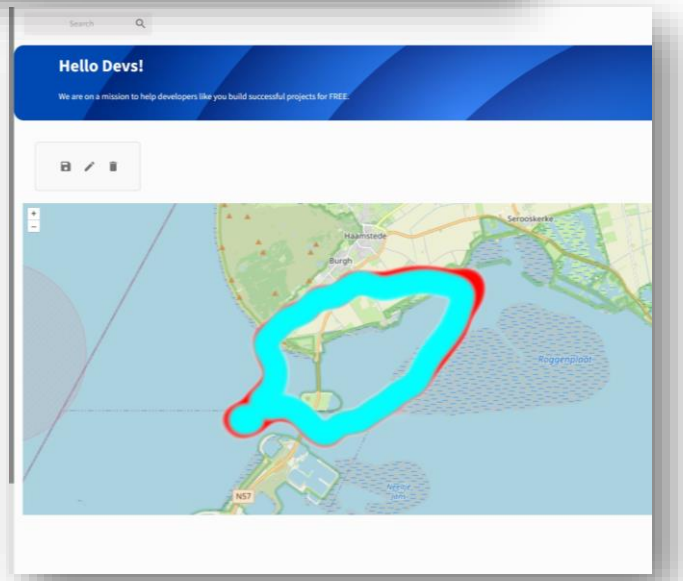
Overview of Results: UC2

UC2 – Trajectories overview



UC2 – Emissions on 1 selected trajectory

UC2 – Risk contour (example !)



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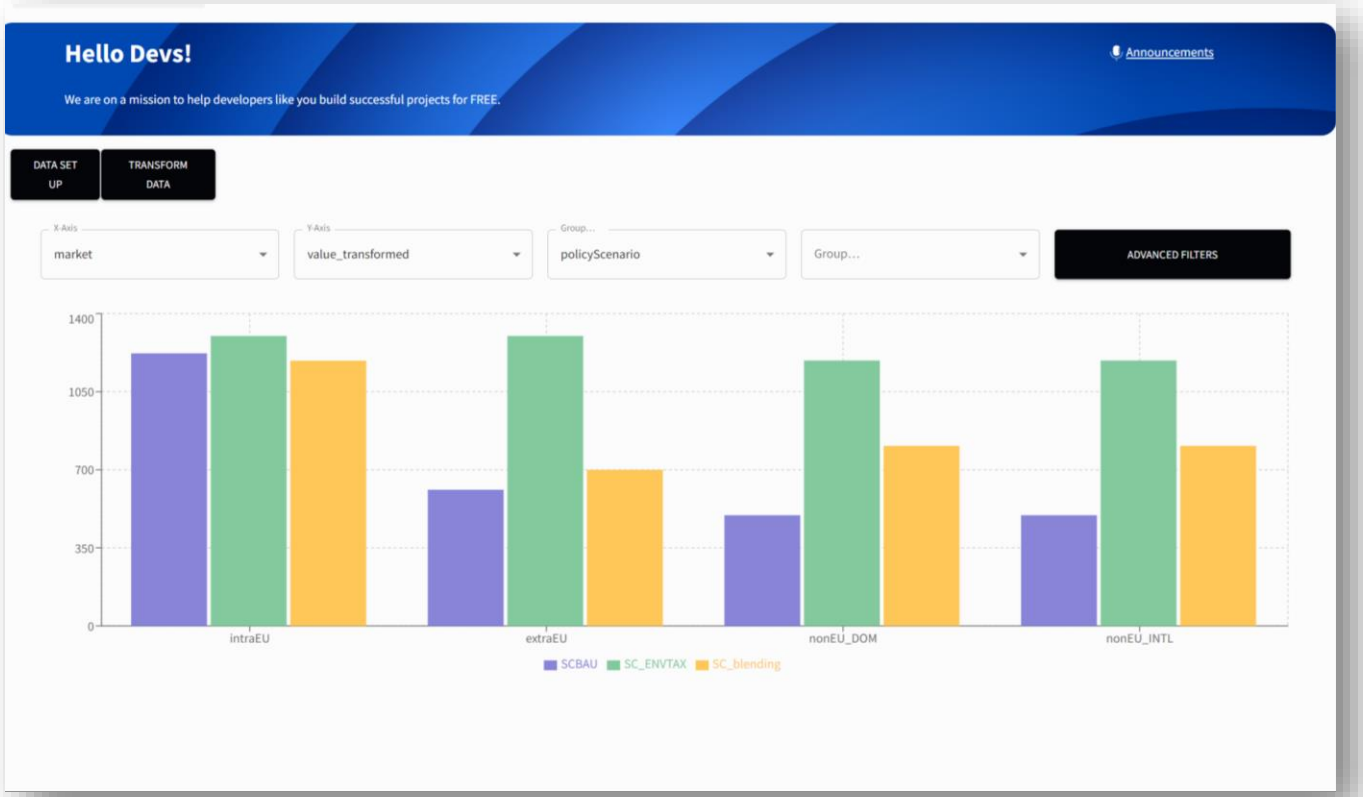
Overview of Results: UC3

UC3 – Fuel cost per market



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Conclusion and perspectives

Achievements

- **Set up phase**
  - UC **scenario** including **models**, **studies** and **metrics** have been **defined**
  - All selected models / associated workflows have been **implemented** in the **Framework**

- **Operational phase**
  - **Collaboratives cross organizational** workflows are running
  - **Results** can be visualized through the **Dashboard**
  - Studies are still on going !

→ The Impact Monitor framework is on **the right track** to **demonstrate its capabilities to assess** the impact of such R&I at the appropriate assessment level(s)

Perspectives

- Collect and provide **lessons learnt** and **roadmap** (in addition to **final results**) to the community

→ **Extend** IM catalogue with **more models** / partners : *New models - Air quality, Non CO2 impact / Higher fidelities models - Propulsion …*
  - Consider **new studies** according to stakeholders' expectations (and available funding)
  - Move to **assessment workflows** !

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Thank you!

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