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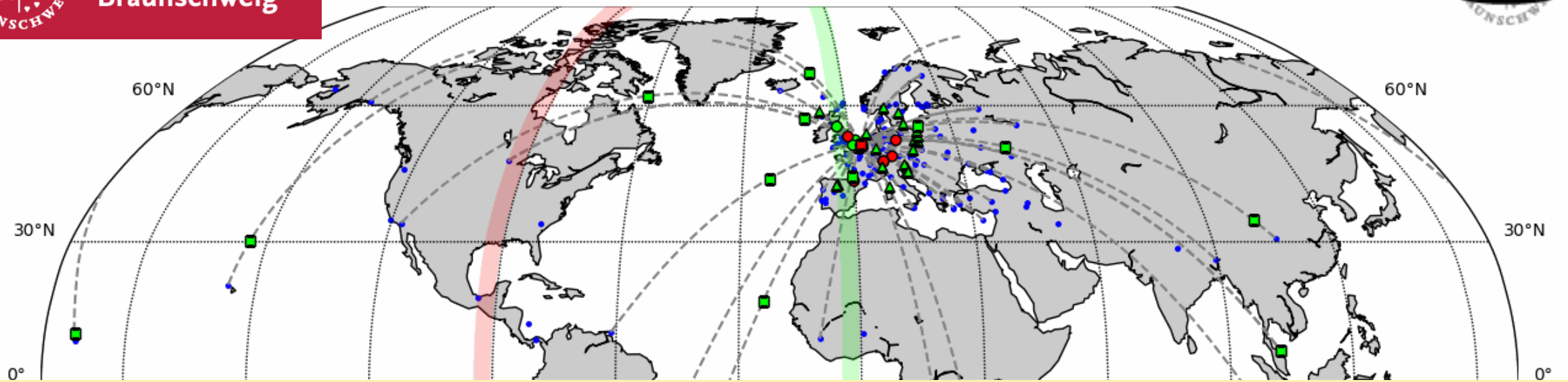


DiSpAtCH

Decision Support Tool for Airline Operation Control Hub Centre

Engage Summer School 2021

Jonas Langner
jonas.langner@tu-braunschweig.de

This project has received funding from the SESAR Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 783287. The opinions expressed herein reflect the authors' view only. Under no circumstances shall the SESAR Joint Undertaking be responsible for any use that may be made of the information contained herein.

Contact:
Jonas Ernst Bernhard Langner
Institute of Flight Guidance
Technische Universität Braunschweig
Braunschweig, Germany
jonas.langner@tu-braunschweig.de

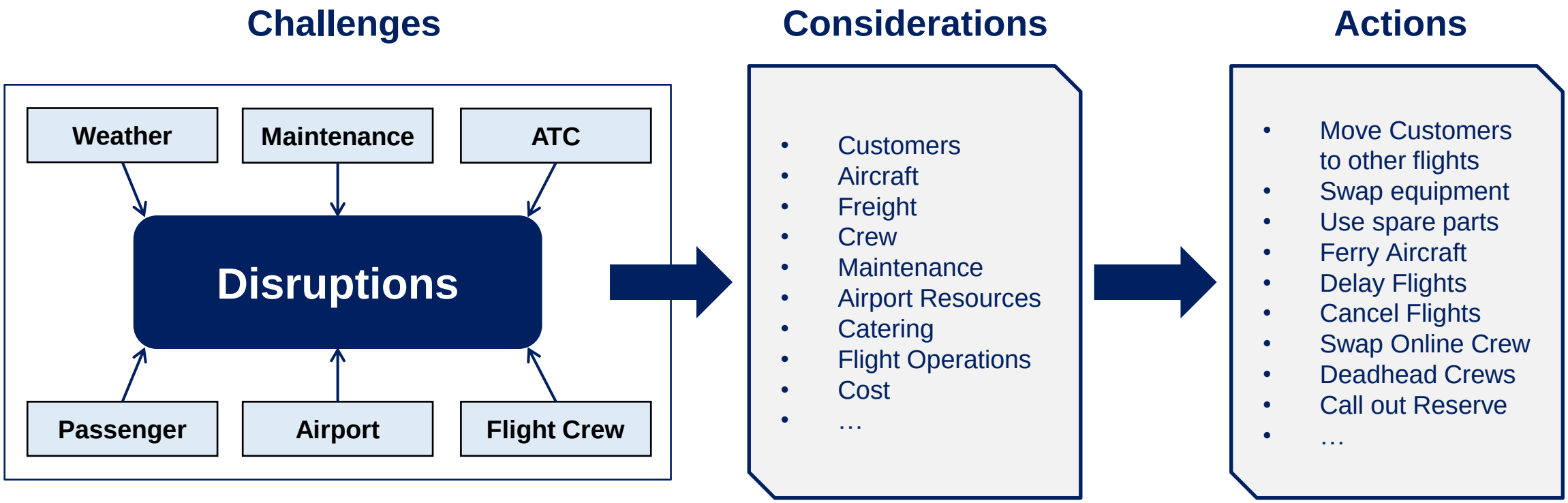
INTRODUCTION

Disruptions in Airline Operations

Maintenance	scheduled and unscheduled maintenance (AOG)
Flight Crew	strike of flight crew, holiday, illness
Weather	adverse weather, snow, storm, higher forces
Passengers	delayed, illness, no-show, medical emergencies
Airport Operations	exceeding airport capacity, strike of the airport staff
ATC/ATM	system shutdown, missed slot, NOTAM

Sources:
P.J. Bruce, Y. Gao, and J.M.C. King, Airline Operations. A Practical Guide, Milton: Taylor and Francis, 2017.
C. Barnhart, and V. Vaze, Irregular Operations: Schedule Recovery and Robustness in The global airline industry, P. Belobaba, A. Odoni and C. Barnhart (Eds.), Chichester: Wiley-Blackwell, 2016.

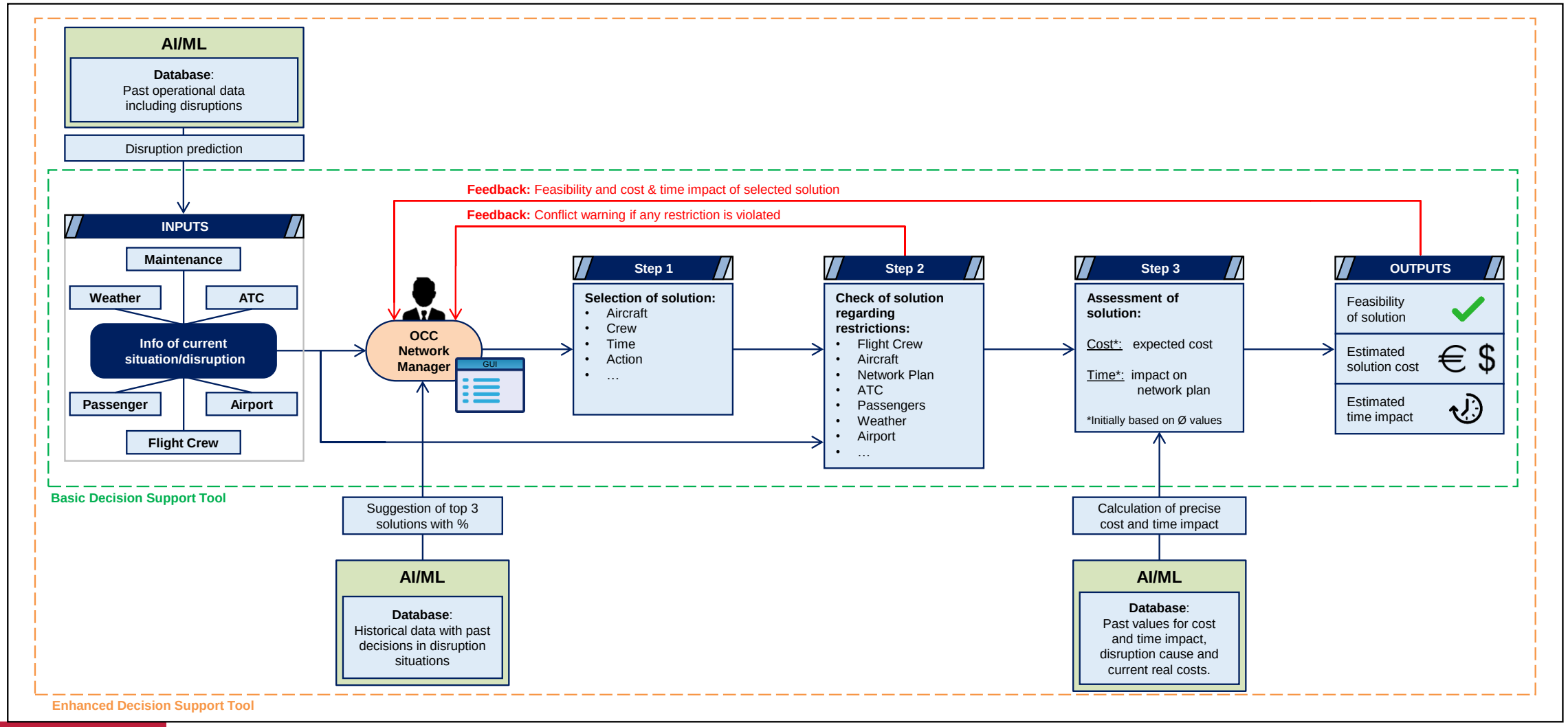
Decision Making Modell



Source:
P.J. Bruce, Y. Gao, and J.M.C. King, Airline Operations. A Practical Guide, Milton: Taylor and Francis, 2017.

DiSpAtCH FRAMEWORK

DiSpAtCH Framework



AI / ML Modules

Module 1

AI/ML

Database:
Past operational data including disruptions

Output:
Disruption prediction

Module 2

Experience + AI/ML

Database:
Historical data with past decisions in disruption situations

Output:
Suggestion of top 3 solutions with %

Module 3

Experience + AI/ML

Database:
Past values for cost and time impact, disruption cause and current real costs.

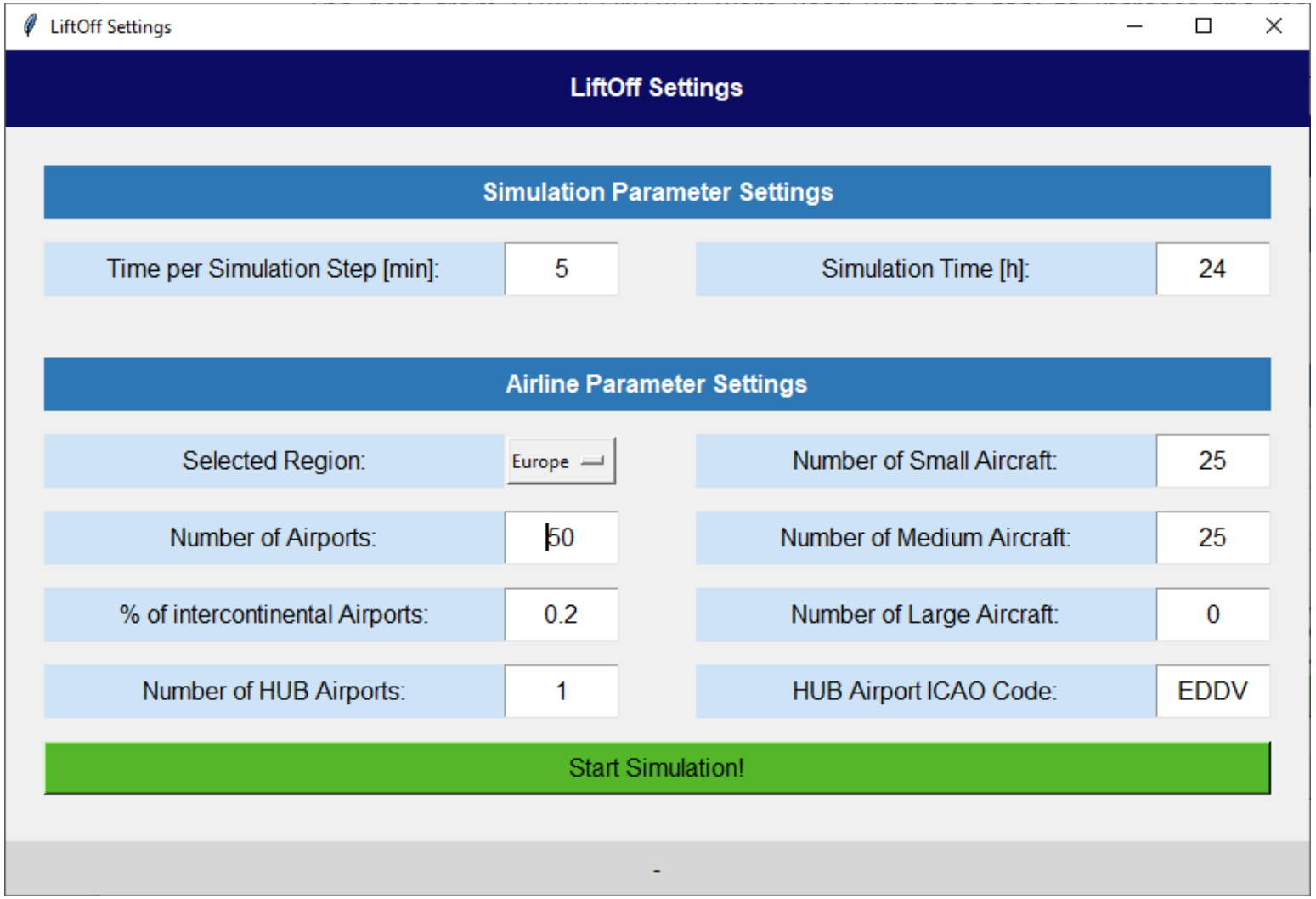
Output:
Calculation of precise cost and time impact

Airline Simulation needed for data generation

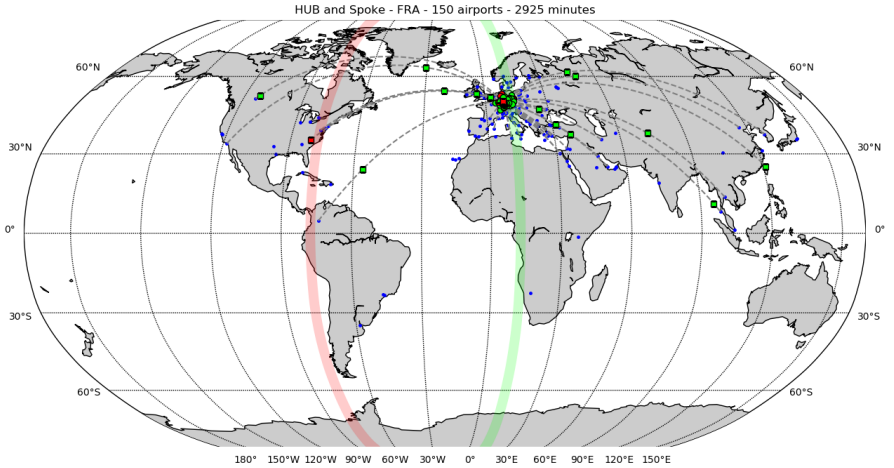
AIRLINE SIMULATION / RESULTS

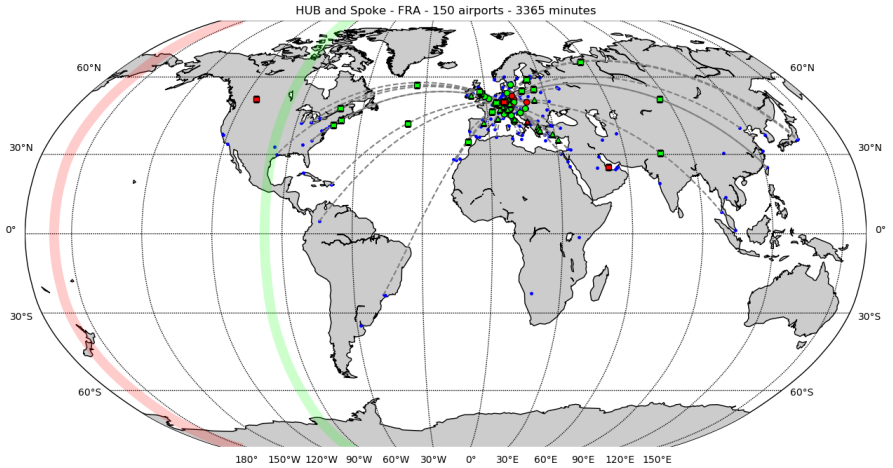
GUI - Settings

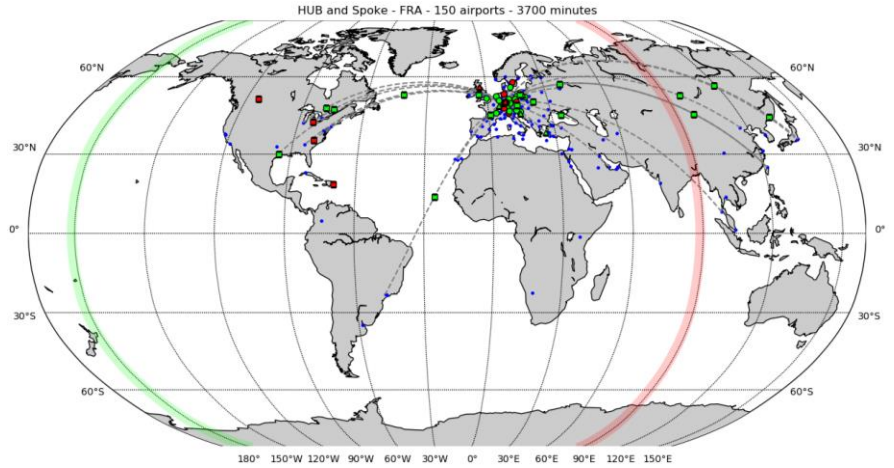
Individual airline- and network-settings

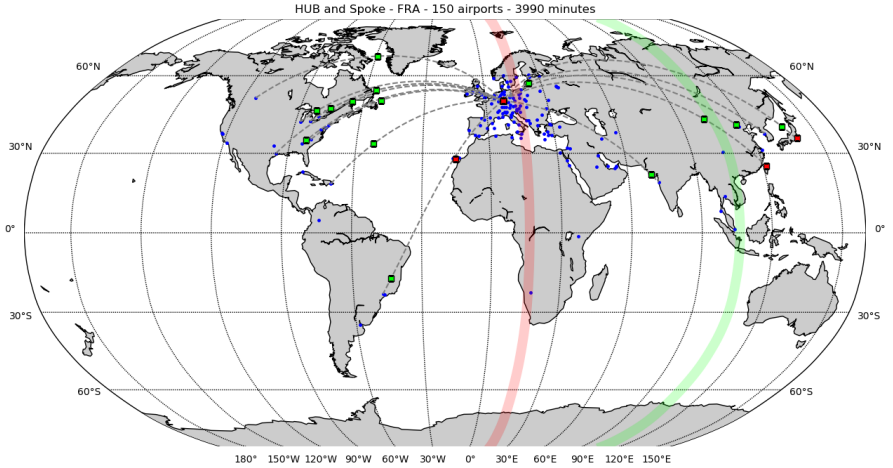


Example: European Global Airline









Airline Sim - Overview

- Night curfew at all airports with local times
- Visualisation of all aircraft movements
- Crew & Passenger allocation to each flight
- Random disruptions based on real disruption statistics (delay min and the delay reason
- Different network structures (Hub & Spoke etc.)
- EUROCONTROL data from 2015 to 2018 used to generate more realistic network structure as well as a more realistic number of flights on certain connections
- Implementation of KPI calculation per day for each simulation run
- Adjustable airport departure
- …

Use of EUROCONTROL data for more realistic networks

Inputs

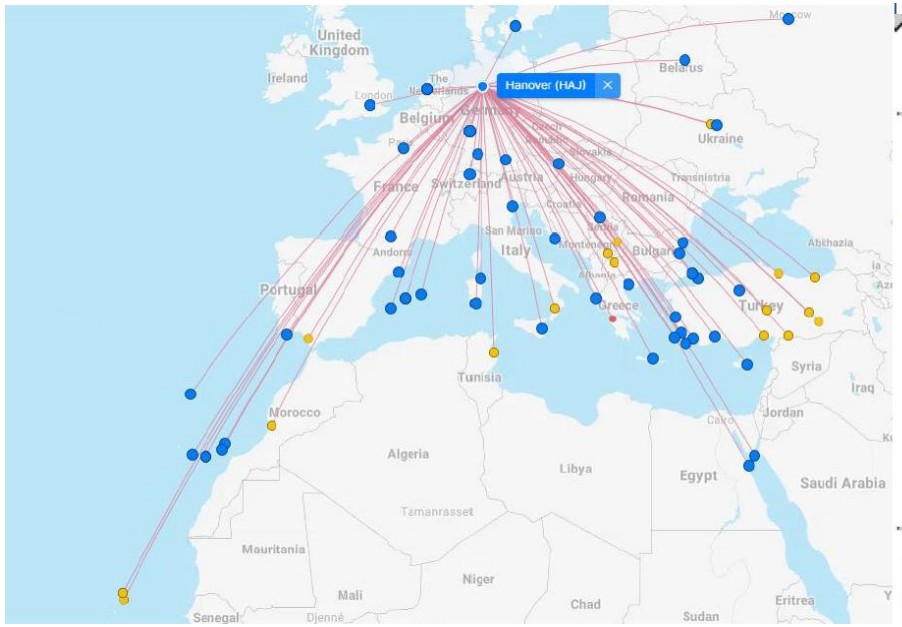
1. Number of Airport
2. Selected HUB airport

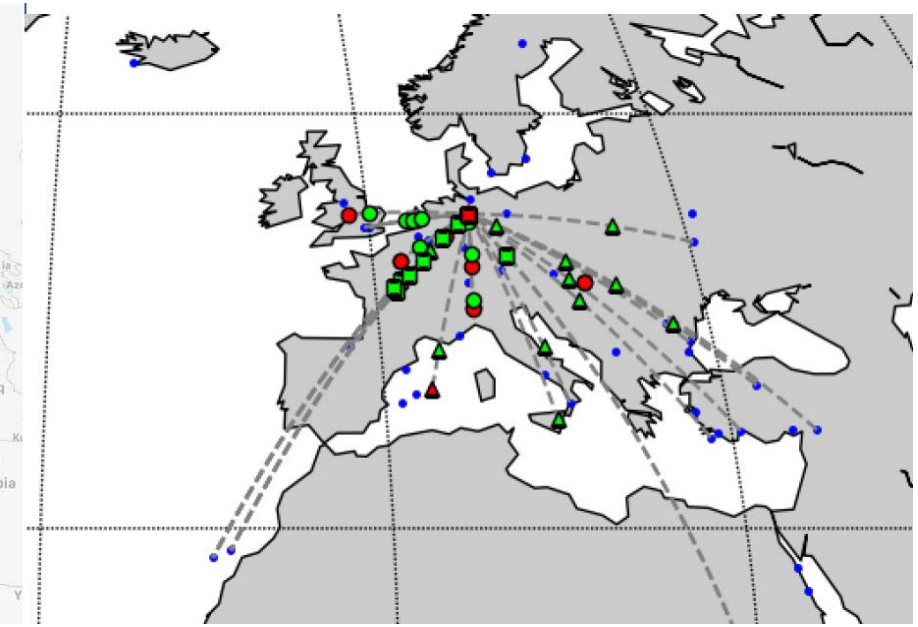
EC Data

Calculation of the proabilities for each connection from the HUB airport

Results

Selected airports for simulated network





KPI Calculation

An overall of 5 Key Performance Indicator were selected.
Additional KPIs can be added if it turns out to be useful. For now, the following 5 KPIs are used:

1. Number of flights per day (completed flights per 24h)
2. Number of PAX per day (passengers travelled per 24h)
3. Overall delay minutes per day (sum of delay in minutes per 24h)
4. Number of delayed flights (number of flights with a delay >15 min per 24h)
5. Overall cost per day (cost of disruptions and implemented solutions per 24h)

	Average value over 5 days		
KPI	Disruption ON	Disruption OFF	% Change
Number of flights per day	947,8	1022,2	7%
Number of PAX per day	178710	194700	8%
Overall delay minutes per day	9151,8		
Number of delayed flights	165,8		
Overall cost per day	1.080.980 €	- €	

NEXT STEPS / FUTURE WORK

Methodology for disruption and solution cost calculation

For the solution finder to work properly, cost for solutions must be able to be compared to disruption cost. Therefore it is necessary to define a methodology to calculate the cost.

The cost basis for the currently implemented actions/solutions are:

Action/Solution	Cost Basis
Delay a Flight	Delay cost statistic from Westminster University
Cancel a Flight	Cancellation cost based on cost report from EUROCONTROL
Use of backup crew	Fixed organisational cost (1500€), Delay cost statistic from Westminster University, Delay reduction (savings), changed aircraft operating cost based on cost report from EUROCONTROL.
Use of backup aircraft	Fixed organisational cost (1500€), Delay cost statistic from Westminster University, Delay reduction (savings)

EUROCONTROL, “EUROCONTROL Standard Inputs for Economic Analyses”, Edition 9.0, December 2020.
A.J. Cook and G. Tanner,.” European airline delay cost reference values”, EUROCONTROL Performance Review Unit, Version 4.1, 2015.

Development of Solution Finder and Data Generation

The solution finder should be able to select the best solution, based on what is selected to be optimised

- cost reduction
- specific KPI increase

With the selected solution for a specific disruption, a database will be generated including many events. This database can then be used to train an algorithm for solution prediction on new events, which are not included in the training database.

Since the solution finder needs information about the exact cost of solutions, the precise definition of disruption and solution cost needs to be finished first.

OPERATIONAL CONTEXT

Operational Context / Possible Applications

- Airline simulation gives the opportunity to simulate different airlines/networks
- Solution finder can help to generate data for algorithm training
- Database of solutions/actions for each disruption could be used to train a ML algorithm for solution prediction
- An airline can use the airline simulation in combination with the solution finder to generate data to train algorithms. Since storing real operational data is time consuming, the airline simulation can help to reduce the time by providing generated data. The simulation can be adjusted to each airline/network structure.
- An airline can save time and money by generating synthetic data really fast instead of storing real operational data over a long time. Therefore algorithm training can start earlier.

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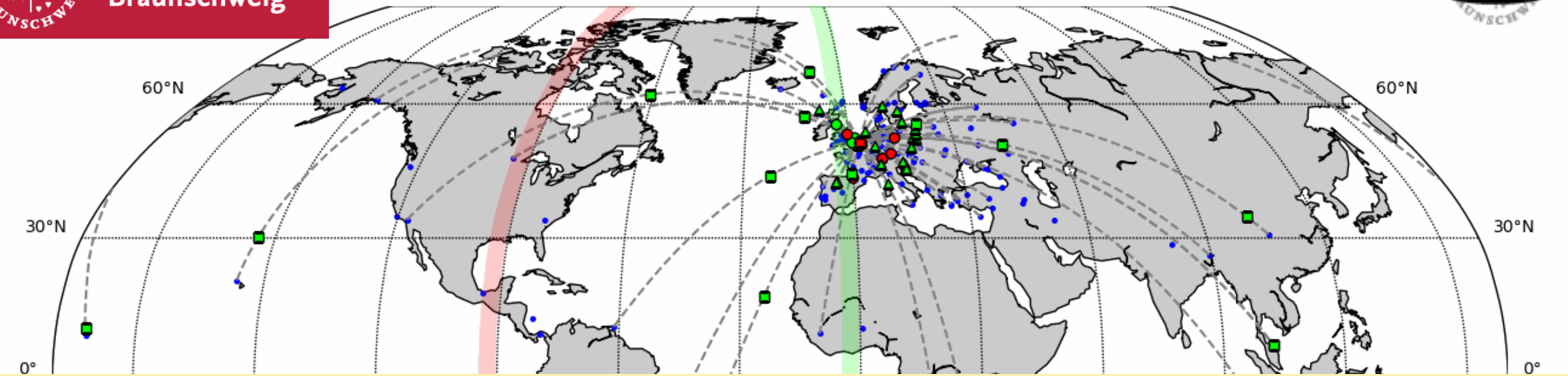

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