Performance through innovation

EUROCONTROL

BRIDGING RESEARCH AND OPERATIONS THE MAASTRICHT UAC ADVANCEMENTS IN ATM TECHNOLOGY

EASN CONFERENCE, SALERNO
5 SEPTEMBER 2023

Maastricht Upper Area Control Centre

member of FABEC

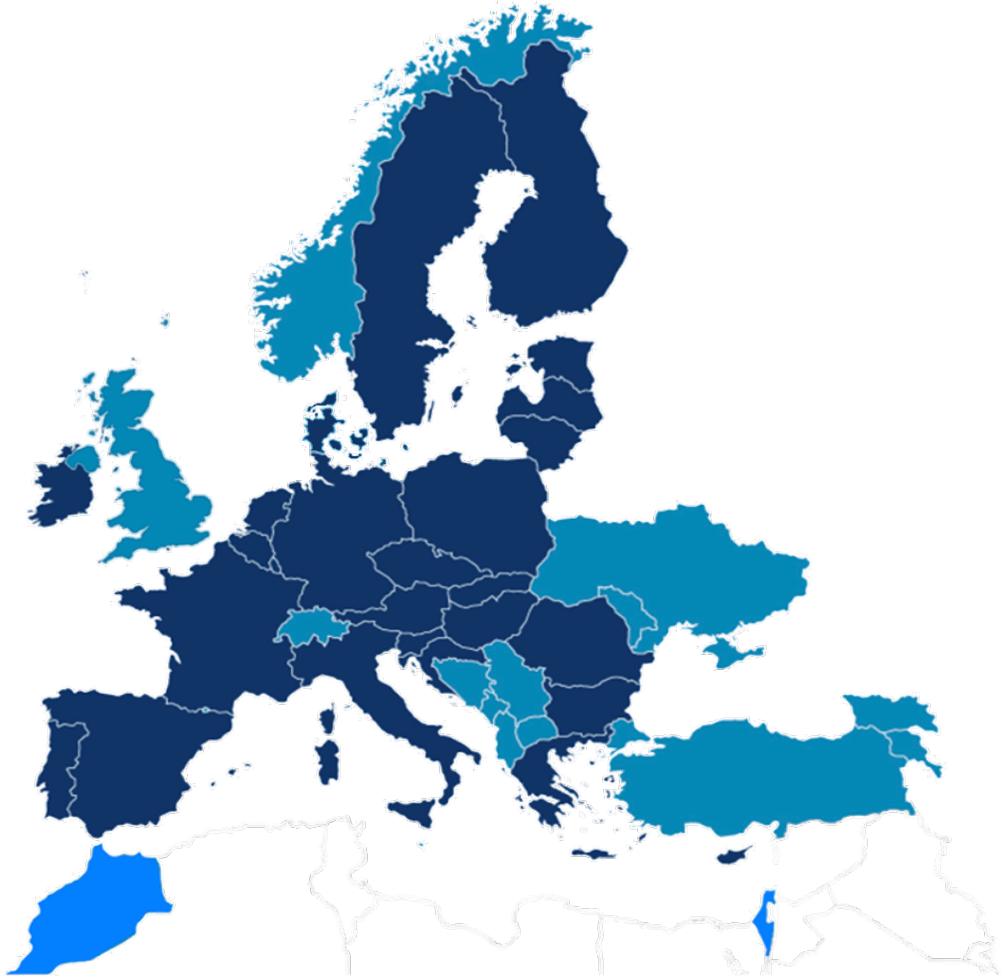
41 EUROCONTROL Member States

EUROCONTROL & EU

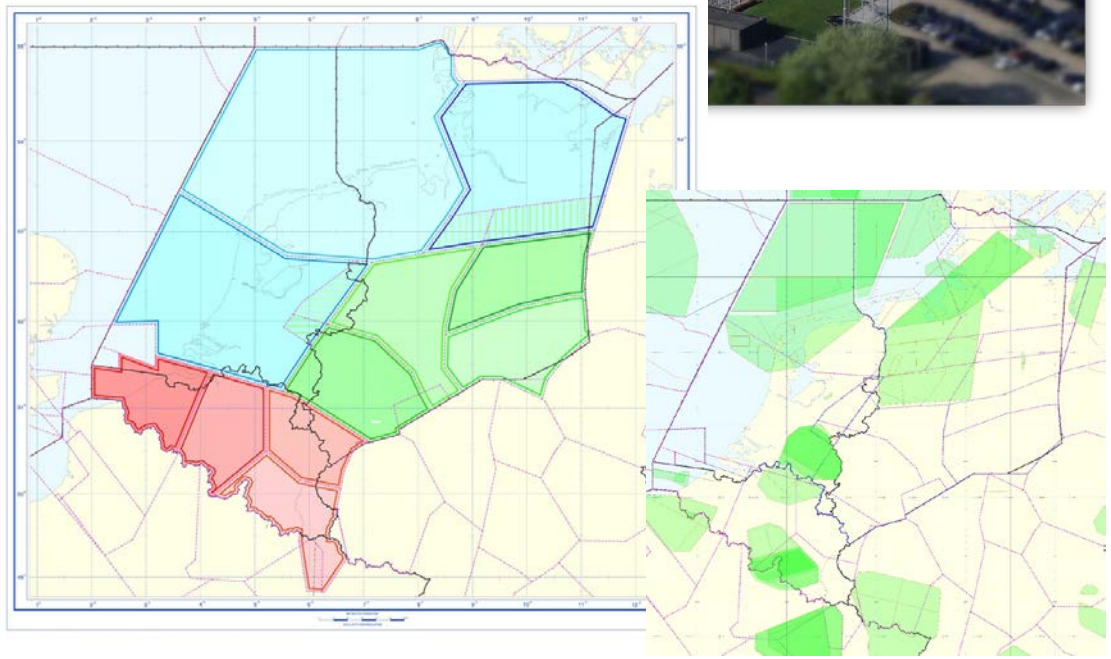
EUROCONTROL but not EU

2 Comprehensive Agreement States:
Israel and Morocco

**Iceland to join as 42nd member state in 2025*



MAASTRICHT UAC (MUAC) – essential facts & figures



- **190 million** passengers are transported safely across MUAC airspace each year
- On busy days, MUAC controls more than **5,700** aircraft
- **80%** of MUAC's traffic is climbing and descending (not purely overflights)
- One of the most complex airspaces in the world
- Cross-border sector boundaries
- International integrated civil-military Air Traffic Management

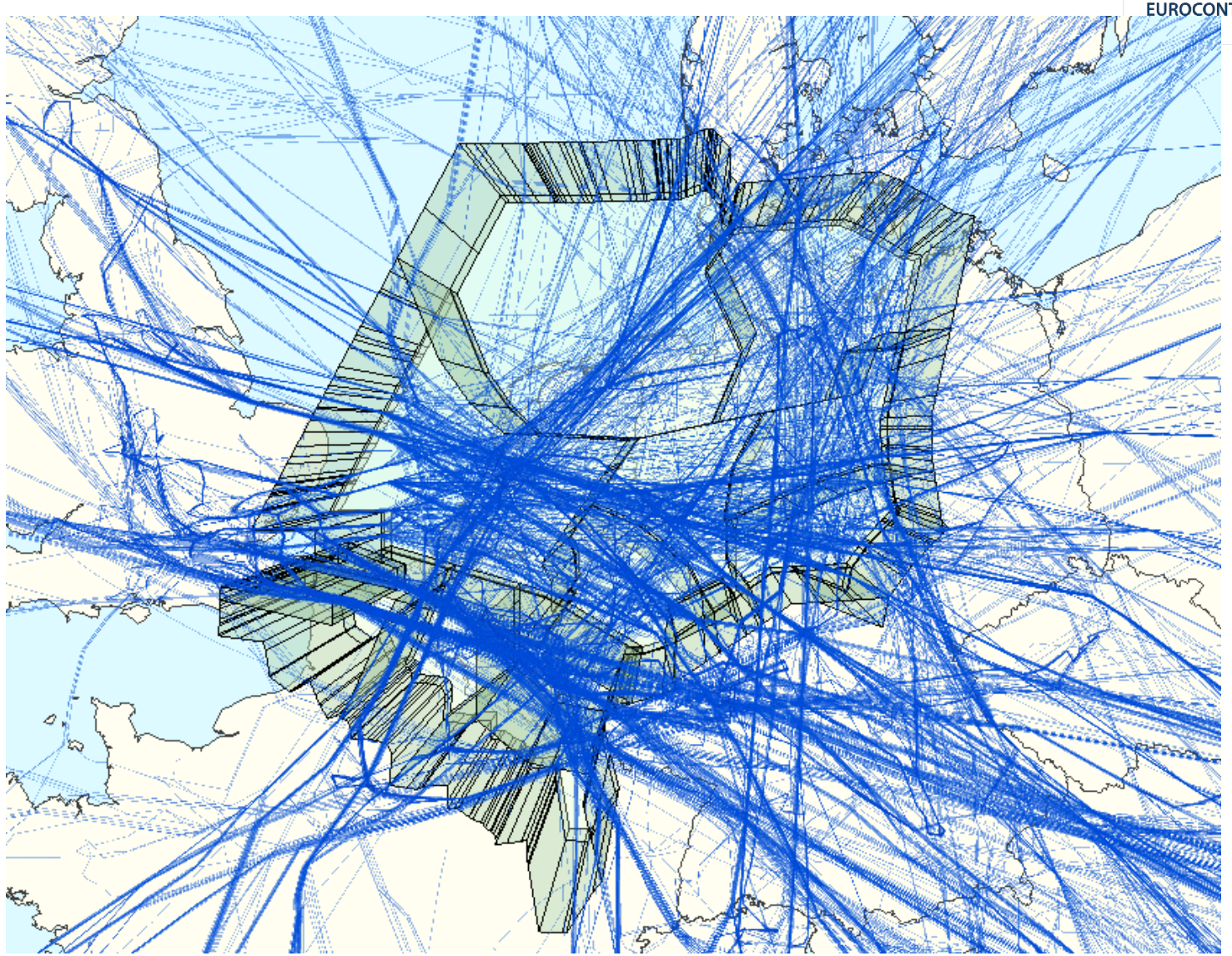
Traffic streams

2022 traffic peak:

8 July 2022: 5,221 flights

All-time traffic peak:

29 June 2018: 5,702 flights



MUAC innovations for the network

MUAC has been, since its inception, a validation center for innovative ATM concepts and tools

Year	Objectives & Benefits	Exposure
1980	First Short Term Conflict Alert (STCA) system in the world Improving safety by alerting controllers on potential separation infringements	Was a blueprint for European-wide specification of STCA systems
2001	First operational continental Air/Ground Data Link in the world	Was a blueprint for European-wide specification of Air/Ground Data Link
2008	First trajectory-based ATC system in the core area of Europe	Enabler for increased ATCO productivity and advanced SESAR features such as ADS-C/EPP downlink
2012	World's first initial 4D (i4D) flight together with Airbus and partners	Demonstrated the feasibility of downlinking FMS data into ATC ground systems and flying to a time constraint
2015	iFMP: integrating traffic prediction, sector configuration / complexity / airspace management and man-power planning functions; full digital data exchange between ANSPs, airlines, FPSP and NM.	In operations by DFS Karlsruhe Upper ATC since 2023
2018	First operational use of A.I. in ATM worldwide (neural network-based traffic predictions)	SES Innovation Award 2019
2020-2022	Pre-ops and fully operational use of the FMS Extended Projected Profile (EPP) to compare with ATC ground trajectory	ATM Award 2020 Enabling Technology ATM Award 2022 Airspace Management
2021	World's first contrail prevention operational trials	

MUAC innovation streams moving from R&D into operations

- Air-ground integration
- Complexity management
- Eco services

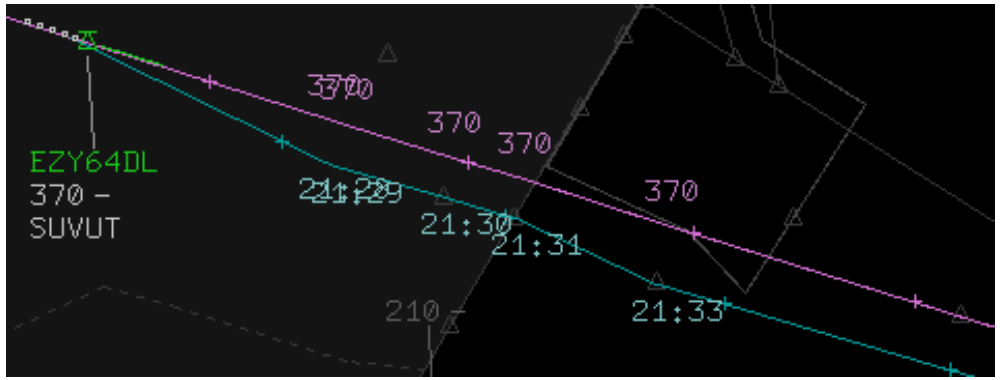
- Objective: bring (mature) research into operations to achieve business / operational benefits

AIR-GROUND INTEGRATION

Downlink of FMS trajectory via ADS-C

Benefits

- FMS trajectory can be checked anytime, discrepancy warnings reduce the need for monitoring → **ATCO/pilot workload reduction**



- Reduced need for monitoring the vertical profile (Top of Climb / Top of Descent display) → **ATCO/pilot workload reduction**

Flight efficiency and reduced environmental impact

- Optimized climb and descend profiles
- Optimized routes, less miles flown
- Fuel saving + Reduced CO2 emissions → greener flights
- Already available in MUAC's airspace


CRI
ARC ID
ADEP
ADES
WZZ36HK EPKT EGGW 45
AFR89RR LFPG EDDB 54
RYR47XE LFBO LMML 0
NM B2B
EOBT 21:15
EOBD 28-11-2021
EOBT 23:15
PRIO
MUAC
ATMP Info Card FMP.pdf
ATMP Info Card AO 20210506.pdf
ATMP CI21 Procedures support.pdf
COBRA West AO Briefing.pdf
MUAC AO AIRAC 2111 Brief.pdf
CI21 Trial - Interim Report.pdf
MUAC AO AIRAC 2112 Brief.pdf
COMPLEXITY MANAGEMENT
Historical
Vertical Profile
Horizontal Profile
ICAO Route
Next Legs - FGKXY
Extra flight
Taxi 00:10
ETOT 23:25
CTOT 01:25
ACT DLA 240
REG DLA 120
ARR DATE 29-11-2021
ARR TIME 04:30
LF/LU - / -
Operator RHH / RHH
E-Helpdesk Tickets
EBBR
EHBK
EDLN
EDDK
EBLG
EDFH
EDRT
EDDR

- **Traffic Prediction Improvements**

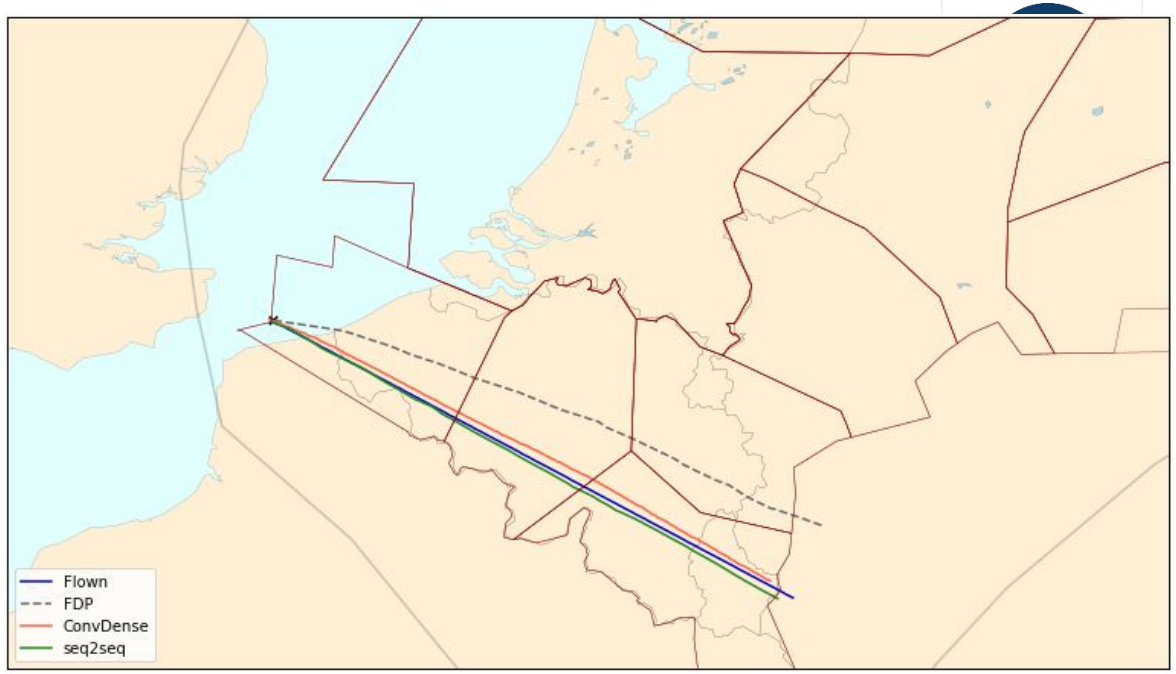
  (using machine learning algorithms)

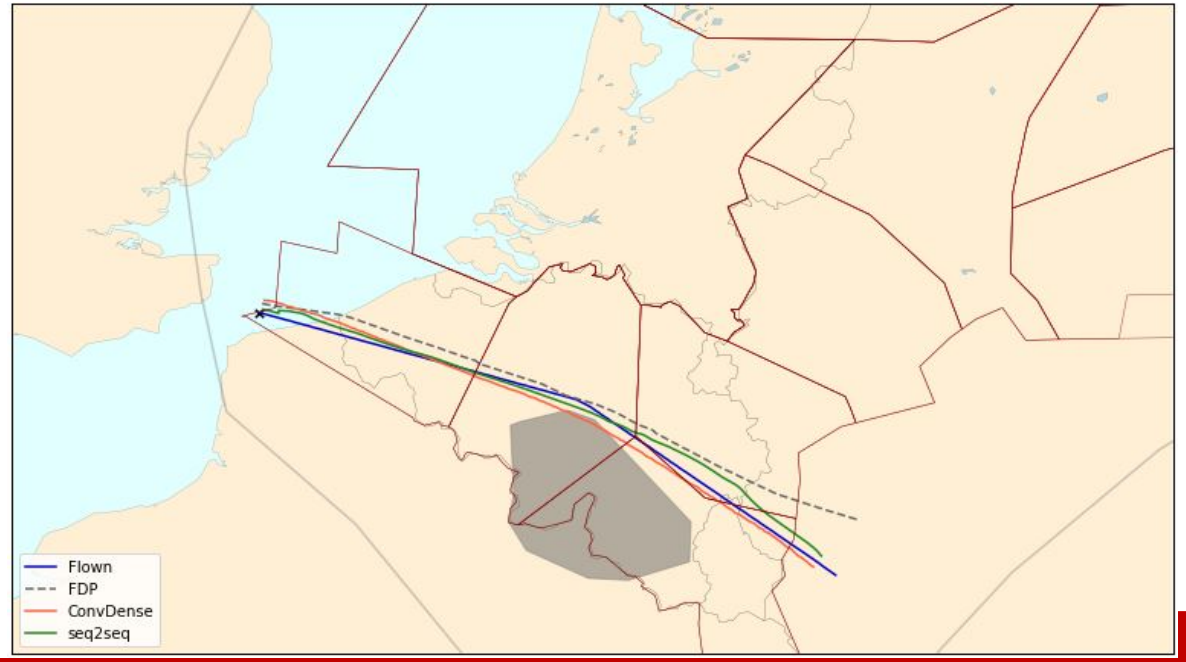
  - Route deviations – due to predicted military activity
  - Take-off times
  - Sector skip/bypass

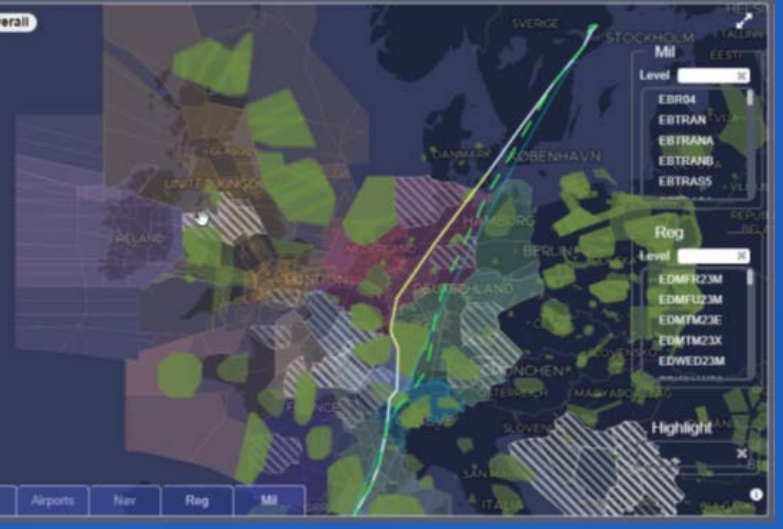
- **Automated conflict resolution**

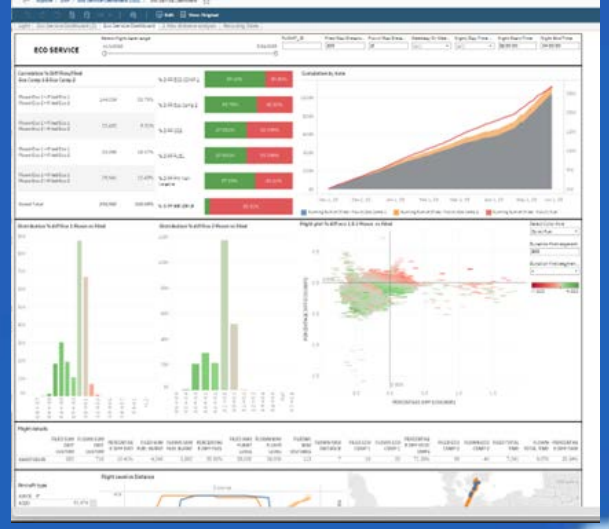
  MUAC ARGOS project (under development)

  - analytical cinematic equations with (potentially) aircraft speed profiles derived by A.I. algorithms

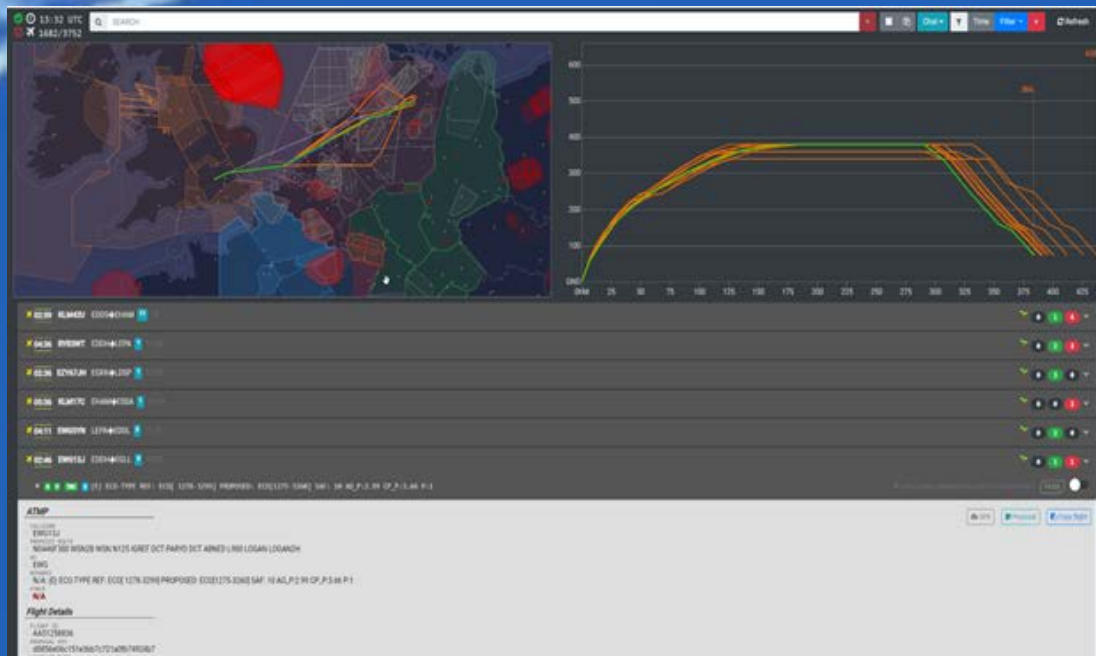








ECO SERVICES

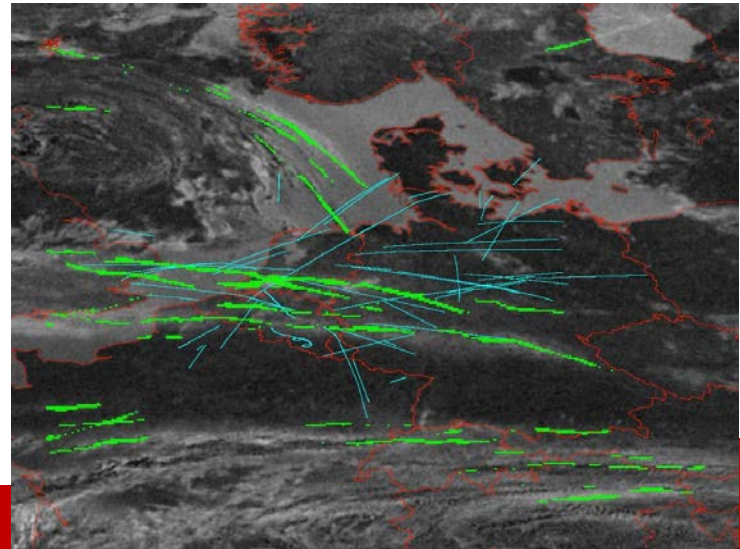


MUAC Contrail Avoidance Project

- In collaboration with The ***Deutsches Zentrum für Luft- und Raumfahrt (DLR)***
- Live trial 2021: world-wide fist operational trial (publication in *Meteorologische Zeitschrift* and 15th ATM R&D Seminar 2023)
- Real-Time simulation April 2023: sector capacity estimates (report is available)
- Live trials 2023-2024:
  - AKKL (Arbeitskreis Klimaneutrale Luftfahrt) trial
  - Google flight trials: new concept validation

More research necessary:

- Magnitude of the non-CO2 effect contribution
- Prediction of ice super-saturation regions (ISSRs)
- Observations with satellite and ground-based cameras



LERA Low Emissions Route Advisor

- **LERA (Low Emissions Route Advisor)**

- It is an experimental Prototype which primary objective is to identify environmentally friendly routes prior to departure.
- The service scope currently consist of delivering rerouting advise to AO's, targeting lowest achievable Flight Emissions
- To accurately assess the emissions, we have integrated the Advanced Emission Model (AEM), a tool developed by the EUROCONTROL innovation Hub in Bretigny (France).

- integrates Machine Learning Techniques:
  - ANN (Artificial Neural Networks): Used for the runway prediction.
  - PCA (Principal Component Analysis): Used for emissions measurement summarization.
  - MLR(Machine-Learned Ranking): Used for ranking the proposal acceptance and the user experience.

“CLEARED FOR … QUESTIONS”