

Performance
through
Innovation



MUAC Contrails Prevention project

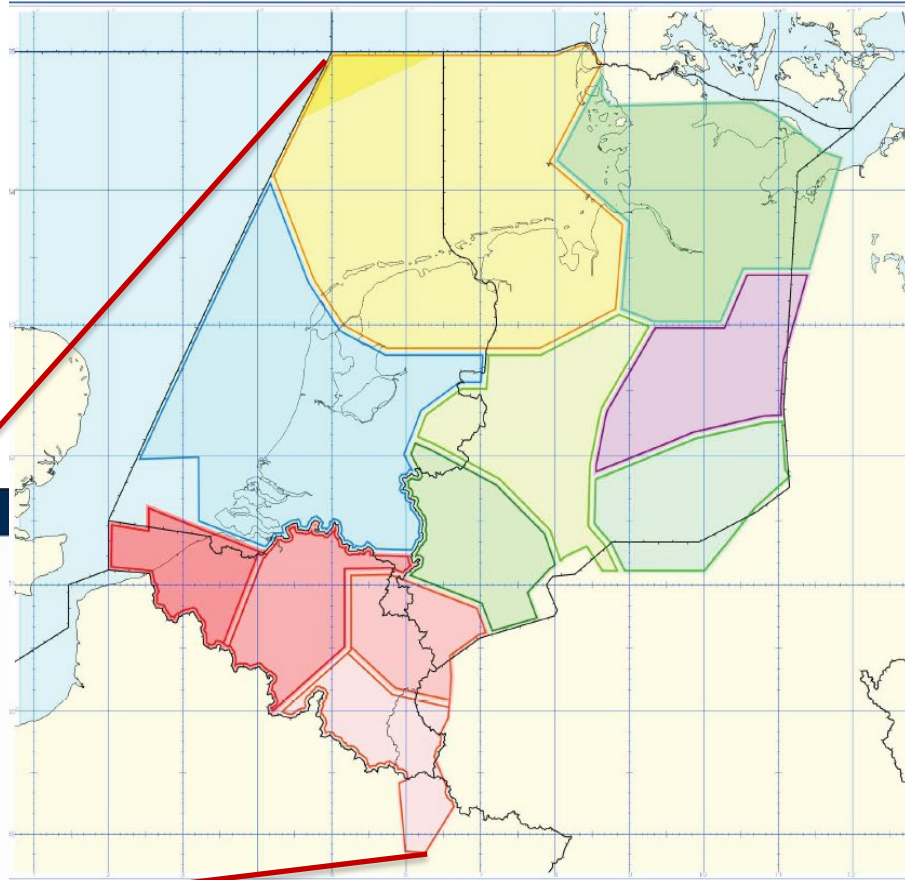
Ilona Sitova, Dr. R. Ehrmanntraut
MUAC

06-11-2023

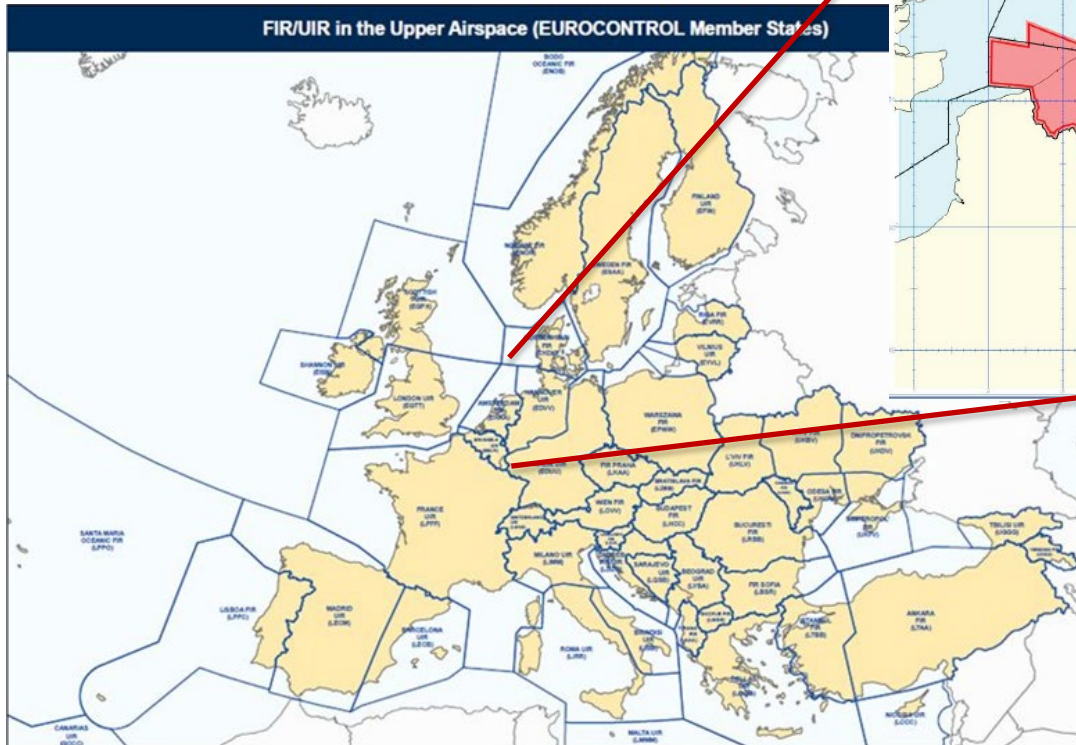
Maastricht Upper Area Control



EUROCONTROL's Maastricht Upper Area Control Centre (MUAC)



The MUAC airspace covers 260.000 km² over Belgium, Luxembourg, the Netherlands and north-west Germany.

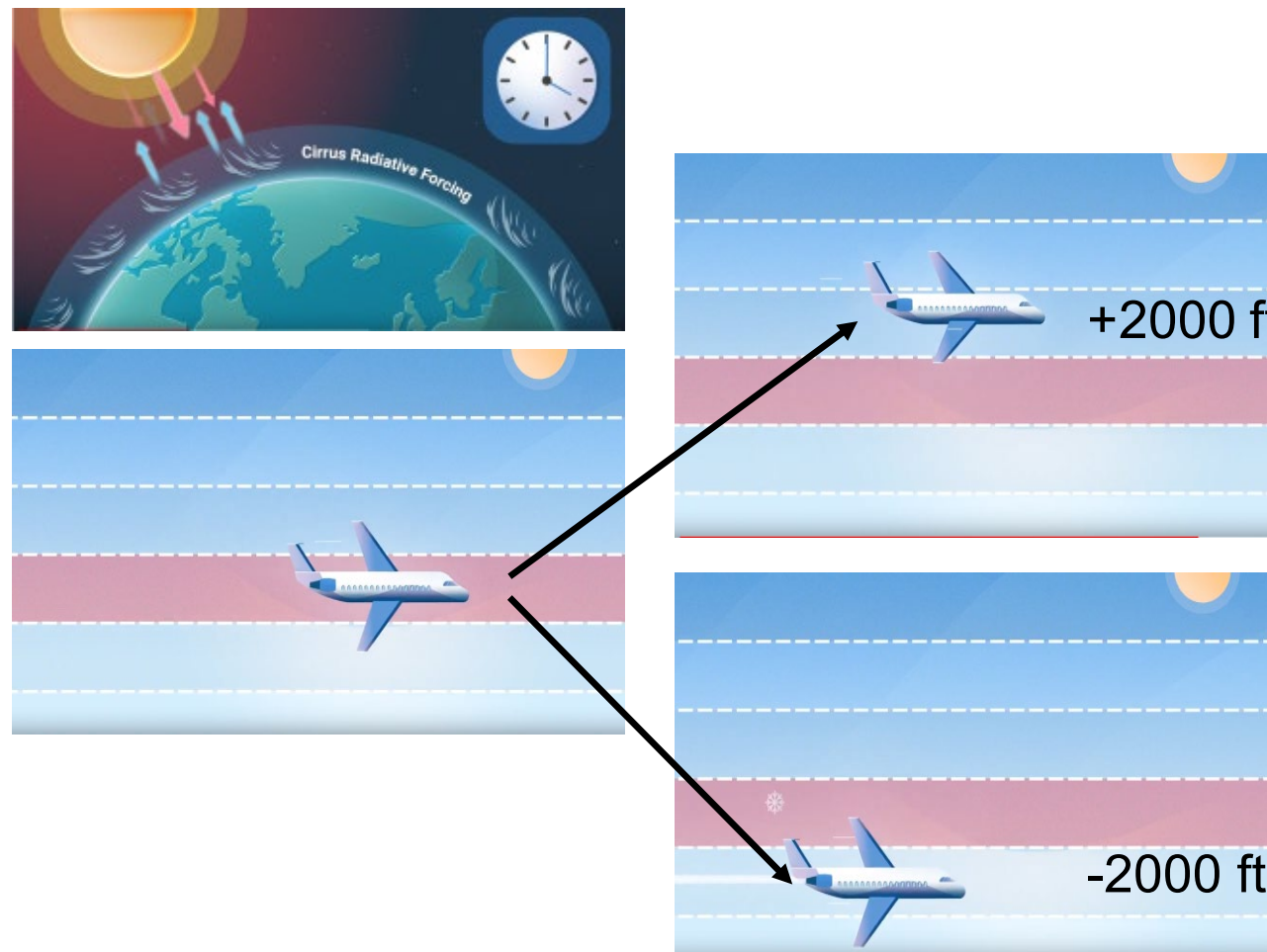


16% of all flights passing through Europe use MUAC's airspace.

MUAC in partnership with the German Aerospace Center (DLR)

From 25th January 2021 until 22nd October 2021
1500-0500 UTC winter and
1400-0400 UTC summer

Based on available ISSR forecast, flights were tactically requested to deviate from their planned/requested flight level by the sector controller.



- **Data being processed by DLR and statistical analysis showed that contrails were avoided.**
- **Operational procedures were successfully established for contrails prevention in MUAC AoR.**
- **Ice Super Saturated Region (ISSR) prediction was more complicated than expected and not fully reliable.**
- **Verification of contrails via geo stationary satellite images is more difficult than expected.**
- **Effect of contrail prevention (vs increased CO2 emission) needs to be further investigated.**

- Statements on the climate effect with measures of ERF were not objective of this trial
- Statements on fuel burn were not objective of this trial
- Statements on contrail cirrus were not objective of this trial
- **Due to the very low traffic counts no statement on airspace capacity could be given**

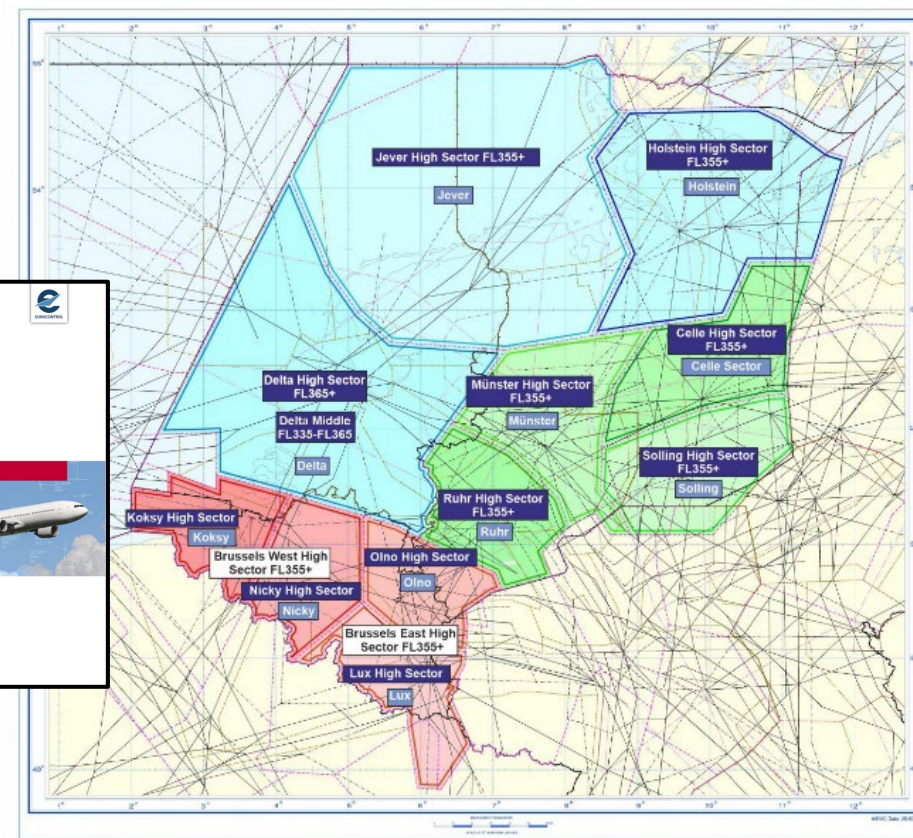
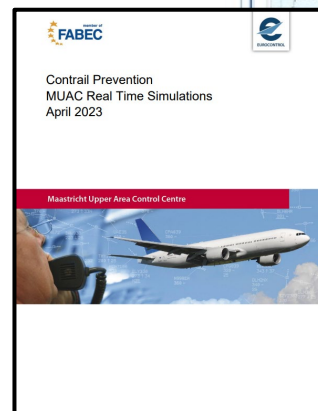
MUAC Real time simulation of contrail prevention, 2023

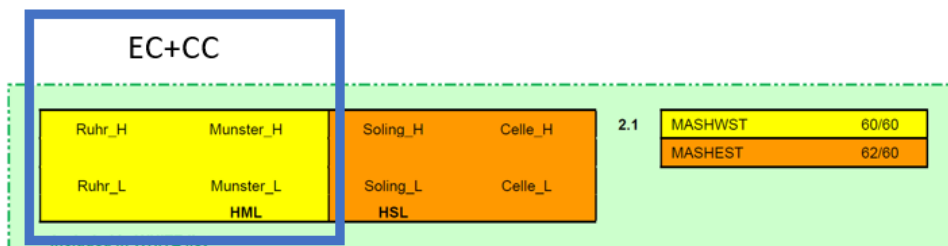
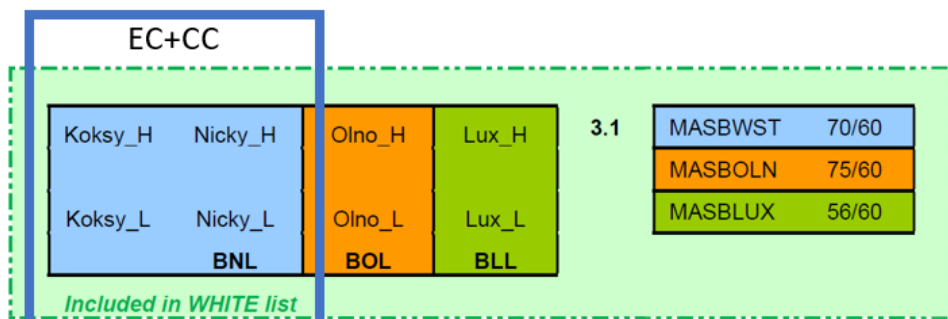
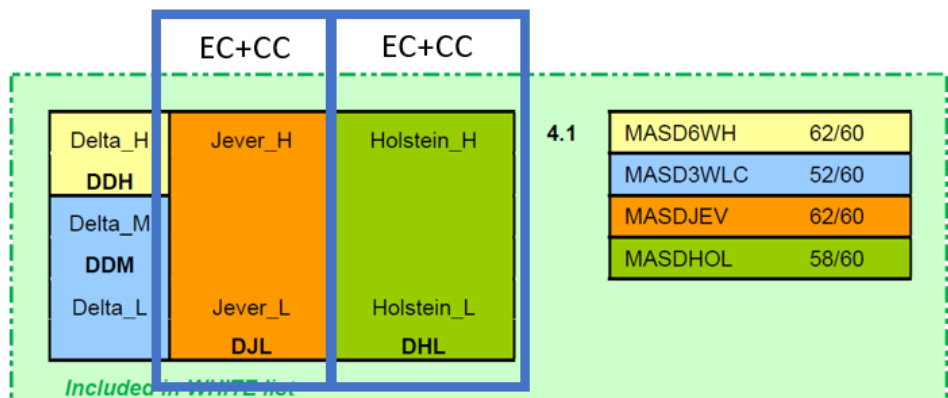
Objective:

- Simulate moderate traffic levels with contrail avoidance to understand the limitation of pre-tactical and tactical operations and impact on possible operational capacities.

Set-up:

- 3 days of simulations, one day for each sector group – Brussels, Deco and Hannover
- 21 ATCO participation
- High and low sectors combined
- Various traffic levels





Vertical airspace view

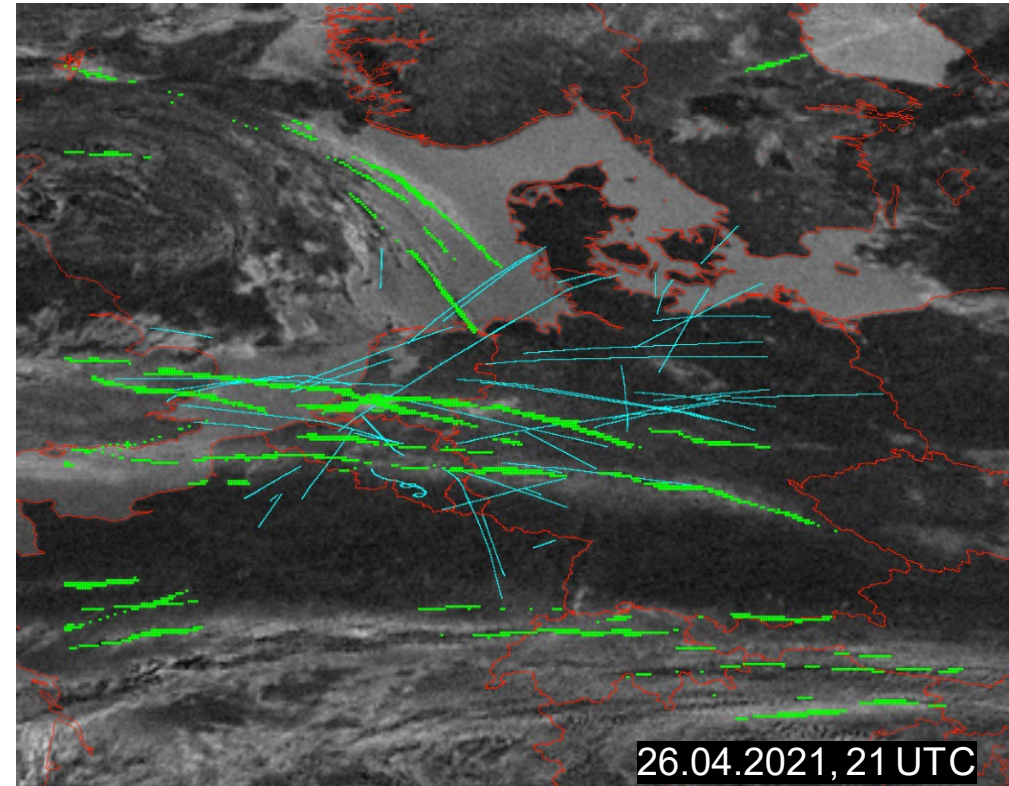
Tact				Break	Pre-Tact			
Start	20"	40"	60"		Start	20"	40"	skipped
400	400	400	400		400	400	400	400
390	390	390	390		390	390	390	390
380	380	380	380		380	380	380	380
370	370	370	370		370	370	370	370
360	360	360	360		360	360	360	360
350	350	350	350		350	350	350	350
340	340	340	340		340	340	340	340
330	330	330	330		330	330	330	330
320	320	320	320		320	320	320	320
310	310	310	310		310	310	310	310
300	300	300	300		300	300	300	300
290	290	290	290		290	290	290	290
280	280	280	280		280	280	280	280
270	270	270	270		270	270	270	270
260	260	260	260		260	260	260	260
250	250	250	250		250	250	250	250

Vertical blocked flight levels

With a busy day time traffic:

- Reduced capacity (at least 20%) for safety reasons
- Complexity increased exponentially depending on the number of flights levels blocked
- Unusual/unpredicted patterns are observed
- Workload overload for the coordinator controller CC
- Pre-tactical avoidance is the preferred option but both tactical and pre-tactical will require capacity reductions
- Effects on adjacent/subjacent units
- Unlikely a/c close to destination will climb back to best level
- Need to develop tools for visualization
- Need to develop tools for capacity management

- Verification by using satellite image recognition as done by DLR and Google is very useful but suffers from the low resolution of satellite images (1 pixel = 1.5 km). This will be improved with the next generation of satellites (Meteosat 3rd generation MTG). Unfortunately, it is still not enough.
- Verification with ground-based cameras provides quick feedback at high resolution, unfortunately it is limited in geographical scope and is more cumbersome during the night.



COAV

AI OFF/ON



LIVE DATA



Stream

Kermt West

Set

all

Select all

Add new set

NUMBER OF ENTRIES: 8261
ACTIVE FRAME: 329
20230503 08:47:43

Year

2023

Select all

Month

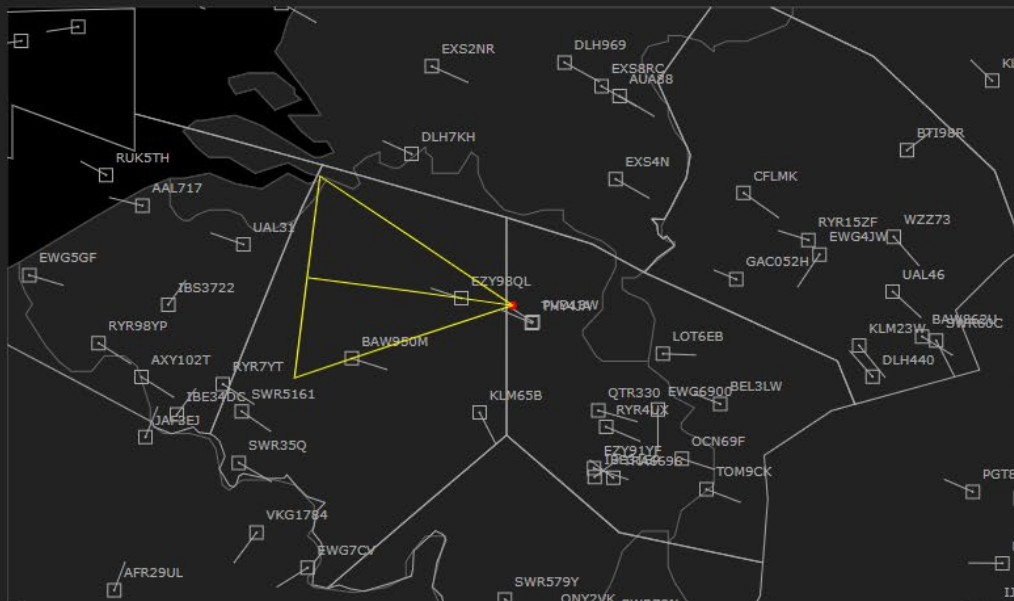
5

Select all

Date

20230503

Select all



Detected Contrails

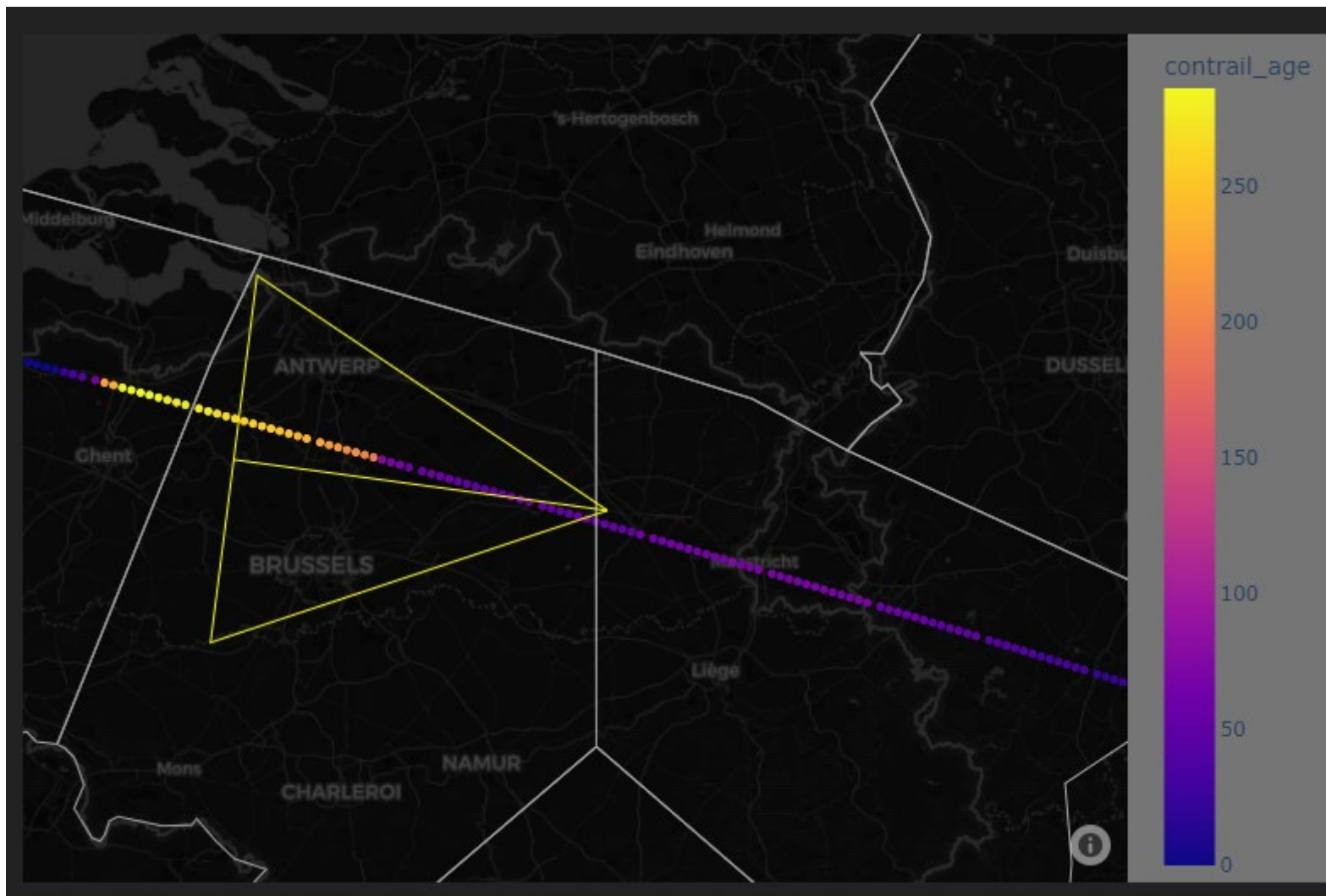
EZY98QL

FL380

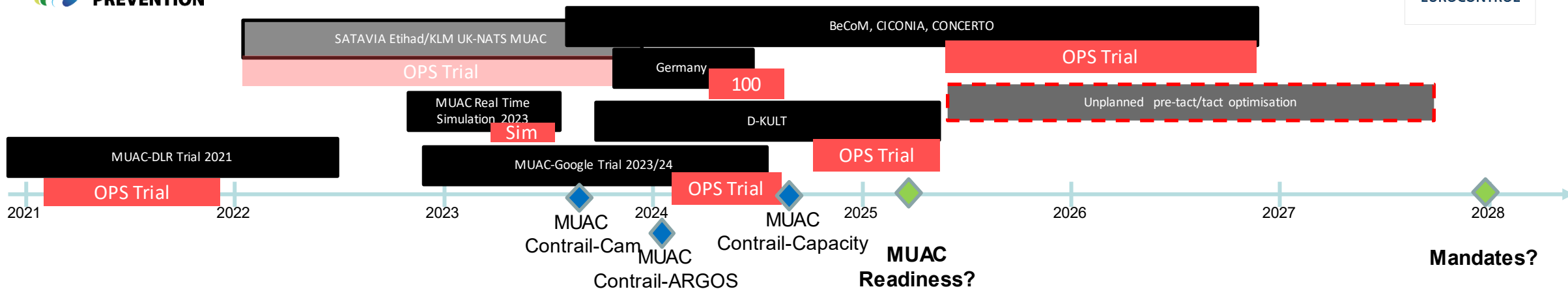
8 frames / 30 sec.

Log messages

Calibrate Camera



MUAC contrail project roadmap



MUAC Trial 2021	SATAVIA Trial 2022+	MUAC RTS 2023	MUAC Google 2023/4	D-KULT 2024/5	CICONIA / CONCERTO
<ul style="list-style-type: none"> • Deep night trial only. • Only ~250 deviated flights. (COVID, 'bad' weather) • Contrail prevention proved with satellite images by DLR. 	<ul style="list-style-type: none"> • First AO claiming wins in CO2 equivalent from contrail prevention. 	<ul style="list-style-type: none"> • Capacity reductions. • Safety criticality. • Late night OK. • Daytime feasibility depends on demand. • In general pre-tact better, but is considered unrealistic. 	<ul style="list-style-type: none"> • Operational trials with Google contrail prediction tool. • Day-time, selected flights or flows, verified by camera. • Hopefully using MeteoSat 3rd Generation images. 	<ul style="list-style-type: none"> • D-KULT flight trials with improved numerical weather prediction models from DWD, including DLR's CoCiP and aCCF tools for climate effect measures. • Partnership trial with KUAC. 	<ul style="list-style-type: none"> • EU Consortia: BeCoM, CICONIA, CONCERTO • Wide partnerships, partnering with UK NATS. • DSNA? • Wider scope, better tools.
<ul style="list-style-type: none"> • Requires far better weather prediction for contrail prone areas. • Better vertical prediction. • Needs automated processes. • Needs automatic monitoring, verification, and reporting. • Needs reporting on climate effect and direct feedback to ATCO. 	<ul style="list-style-type: none"> • Needs validation of SATAVIA tools. • Climate impact of single AO can be positive but is in general doubtful for core areas. 	<ul style="list-style-type: none"> • Requires automated support on radar screen. • Requires immediate feedback on climate usefulness. • Eventual introduction in the late night. • Gain operational experience in the early night. • Day-time operations, if needed, with safety monitor. 	<ul style="list-style-type: none"> • Better and quicker result than 2021 with DLR. • Monitoring of radiative forcing. • ARGOS for contrail prevention in MADAP-shadow. 	<ul style="list-style-type: none"> • Verification of the improved numerical weather prediction. • Extended airspace KUAC + MUAC. 	<div style="border: 2px dashed blue; background-color: yellow; padding: 5px;"> <p>To Be Done:</p> <ul style="list-style-type: none"> • Legislation framework. • Monitoring, verification, reporting. • Network Manager for 2 level optimisation. • Cooling contrails. </div>

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