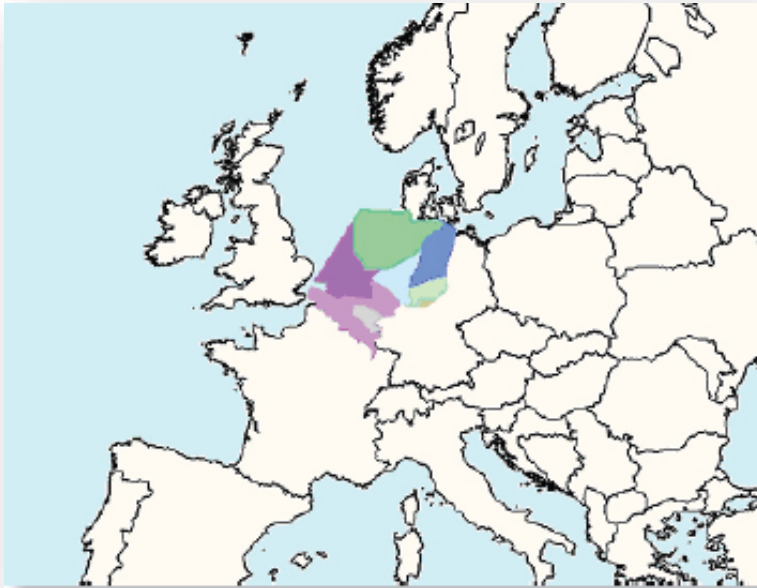


MUAC TP Research Needs

Presentation to the Engage KTN Workshop on TC#2 - Data-Driven TP

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MUAC/ENG→CHG
06 Nov 2018

MAASTRICHT UAC



260,000 km² (above DFL 245) extending over Belgium, the Netherlands, Luxembourg and north-west Germany

1.7 Mio IFR flights controlled in 2015 (+1.9%)

Punctuality (2015): 97.7% (0.34 min/flight)

Annual budget (2015): € 135 Mio

Revenues generated (2015): € 517 Mio

Delays generated (2017): 1.2Mmin \approx € 120 Mio

614 employees:

306 air traffic controllers

106 other operational staff

144 engineers

Video: [MUAC - The Future. Today](https://youtu.be/0sfSC2fIAi0)

(<https://youtu.be/0sfSC2fIAi0>)



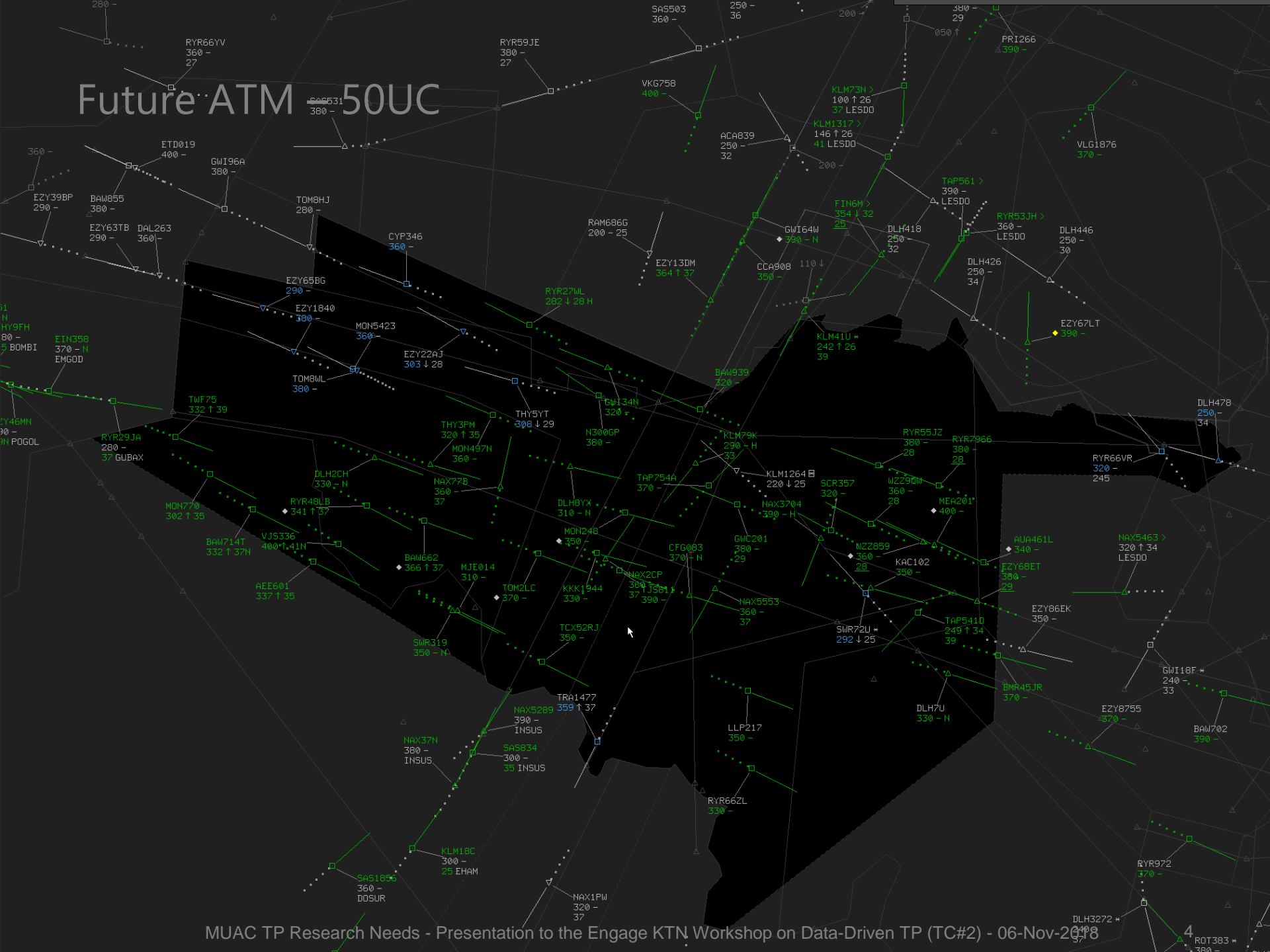
Current ATM Situation at (Maastricht) UAC

- Current MUAC OPS Concept achieves highest sector productivity in class (ref. ACE) by measures beyond TBO (e.g. FUA), inducing uncertainty.
- Summer traffic exceeds MUAC capacity, generating significant delay.
- Traditional means of increasing capacity (more sectors/ATCOs) come to an end in the densest areas.

In 2017, the introduction of a 7-sector configuration in BRU (also featuring three layers instead of two) did not increase total sector group capacity over 6-sector config anymore.

- PCP productivity improvements are not sufficient for MUAC. Some (e.g. AMAN) are even detrimental to en-route capacity.

Future ATM - 50UC



MUAC TP Research Needs – Ongoing @ MUAC

- TPI Machine Learning of ATOT and En-route 3D Trajectory
- AAPF Clustering and Choke Point Bunching Prediction
- CB Upper Volume Contour Nowcast Display
- Trajectory Programming (CFL/Heading for Simple Traffic)
- ...

MUAC TP Research Needs – Engage TC#2

- Starting point is TC#2 1.0 Aug 2018.
- ATOT, ROCD, ATC identified as sources of uncertainty. Add FUA.
- Quantitative probabilistic data is hard to digest for end users.
- AI safety is hard to prove and fails on special occurrences.
Fallback is to use AI to learn to build deterministic solutions.
- ATC interventions serve a purpose. Some are done late to await certainty, and thereby spoil TP certainty elsewhere and later.
- Solution seems to advise a trajectory, addressing the purpose, and then to assume the advice is taken.
- Trajectory advisory system modules heavily under-researched.

MUAC TP Research Needs – TA System Concept

- Trajectory Advisory System – “Predicting the Advice”
 - a. Trajectory data sources (IFPS, ACDM/DMAN, OLDI/IOP-G, Radar, ADS-C/EPP downlink/IOP-A)
 - b. LOAs and other static constraints (including how to express existing written and unwritten LOAs in machine-readable form)
 - c. Upstream and downstream requests and coordination (OLDI, IOP-G)
 - d. Traffic dispersion respectively, closer to now-time, traffic separation, embracing historically observed uncertainty
 - e. Pilot requests (CPDLC, IOP-A)
 - f. FUA, CB avoidance, CDM, AMAN and other dynamic constraints, considering observed uncertainty
 - g. Pilot emergency actions, non-compliance, or other observations of non-conformance (e.g., unexpected traffic)
 - h. ATCO preferences and other human factors (advisory issue time synchronised with handovers, OPS room roles, ...)
 - i. Downstream sector capacities and workloads
 - j. AO business needs and equity
 - k. Emergency descent path blockage avoidance

MUAC TP Research Needs – Themes

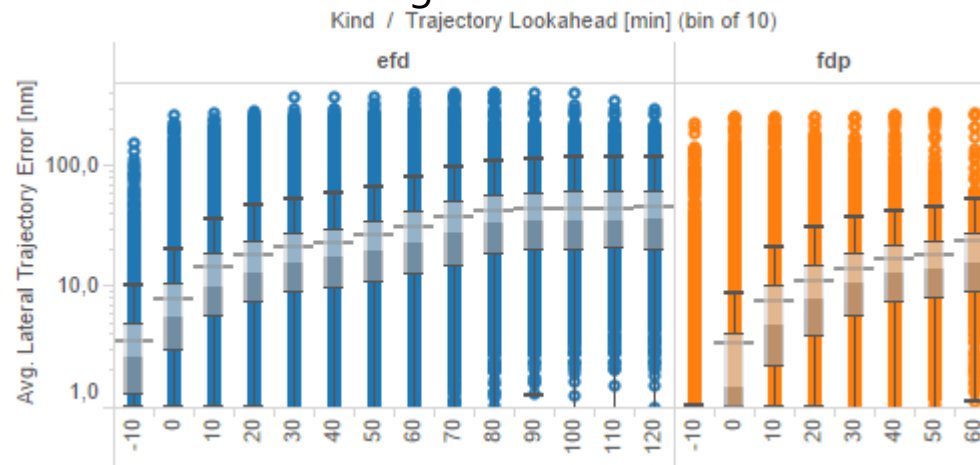
A. Safety/HF Aspects

Evolution of operational concept towards TBO

Resilient transition to fallback mode of operations, re-gaining human situational awareness

B. Observed Uncertainty

Topic solutions must be robust against observed uncertainties. Don't under-estimate:



Biggest sources of uncertainty are ETOT, climb/descent rates, and then ATCO actions

C. Realistic Validation Platform

All actors in TBO validation environment (AO, ATFCM, airports, pilots, ATCOs, FUA, ...) to expose probabilistic behaviour matching historic gestalt of certainty development