INCREASED USE RNP APPROACHES AT BRUSSELS AIRPORT (EBBR)

FABEC VFE Workshop

7 DEC 2022

member of FABEC

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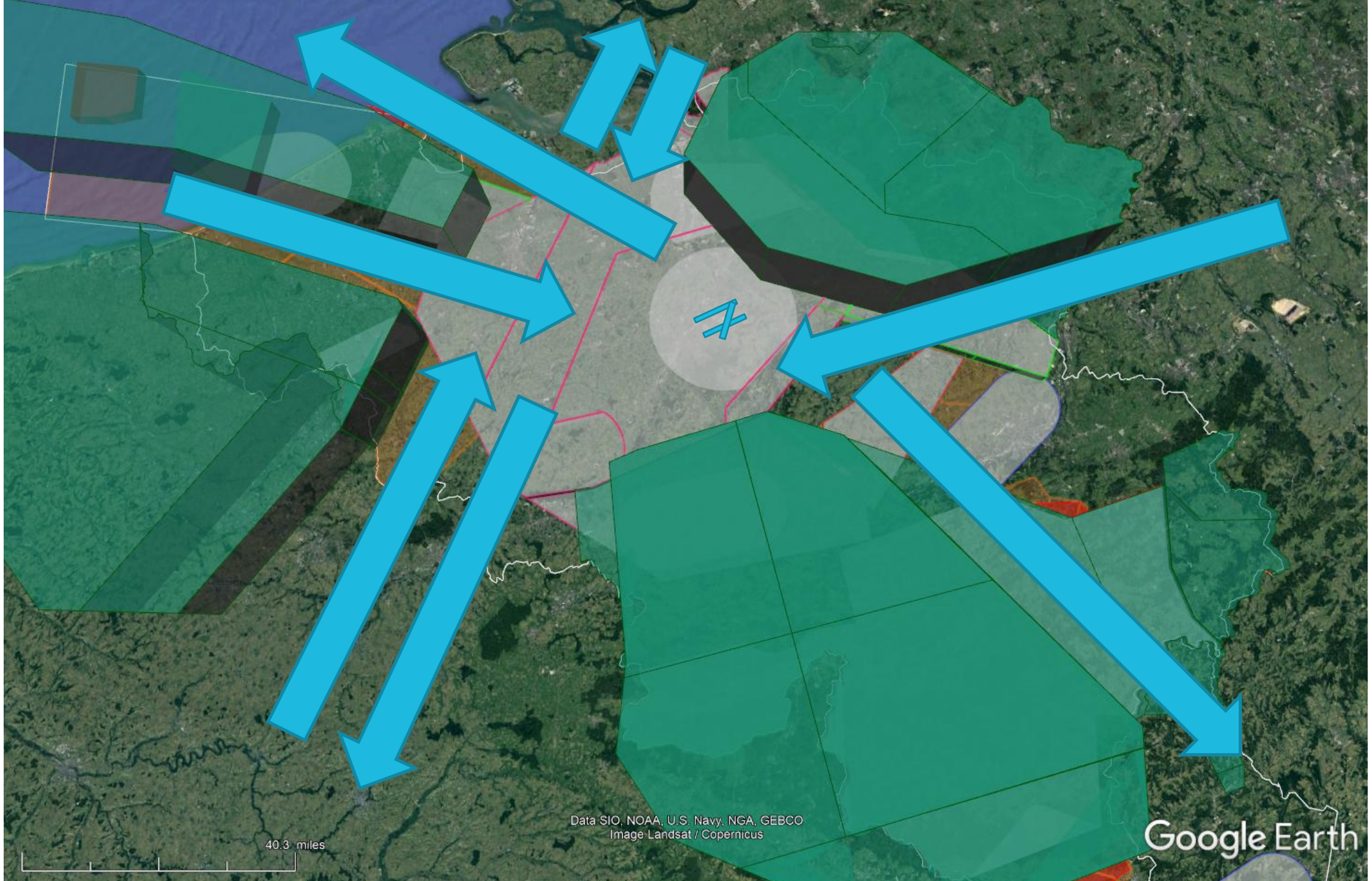
1/ RADAR VECTORING AT EBBR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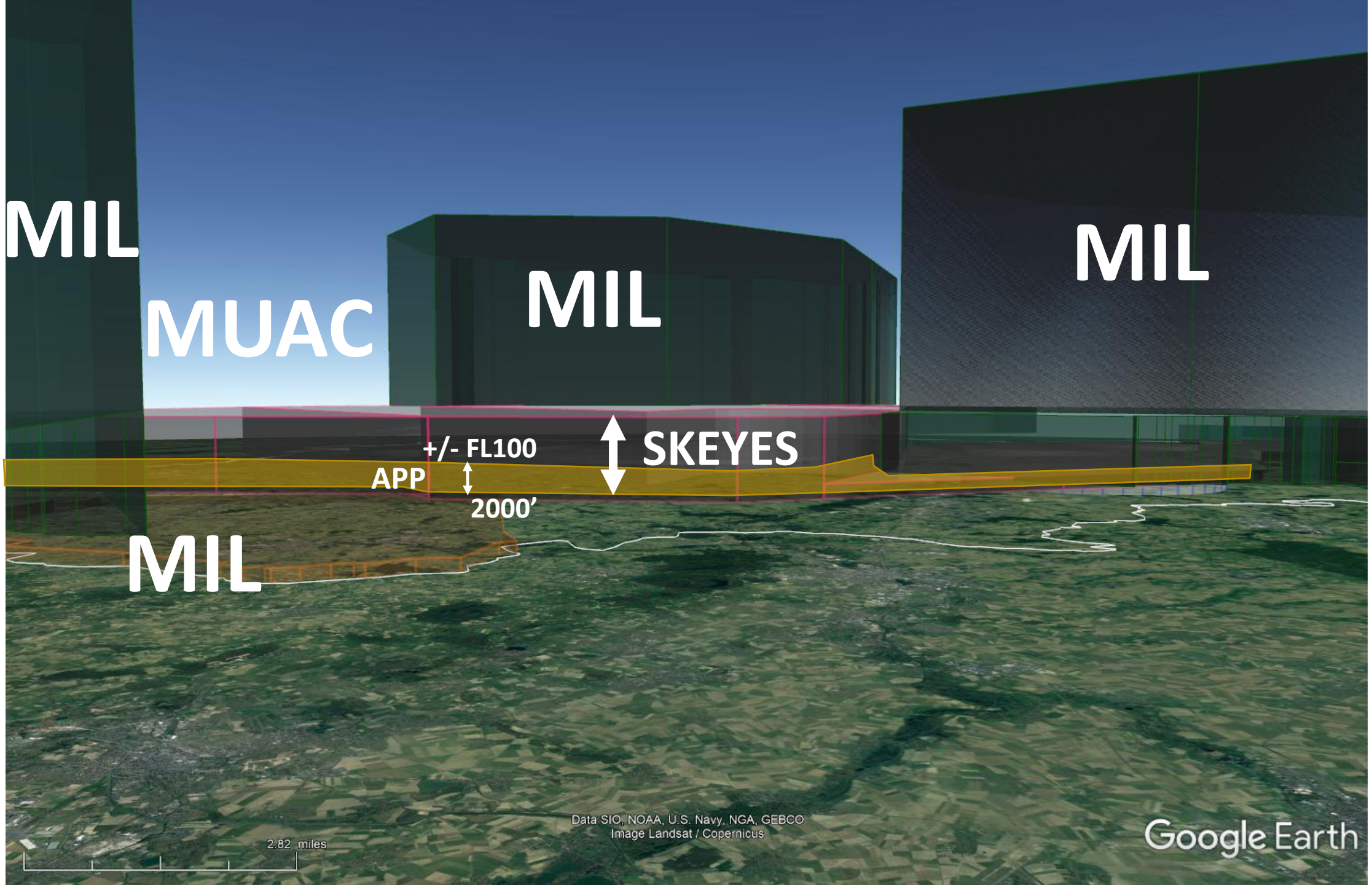
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
40.3 miles
Google Earth


MIL
MUAC
MIL
MIL
+/- FL100
APP
2000’
SKEYES
MIL
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
2.82 miles
Google Earth

2/ HOW TO IMPROVE VFE DURING DESCENT?

Improving Predictability

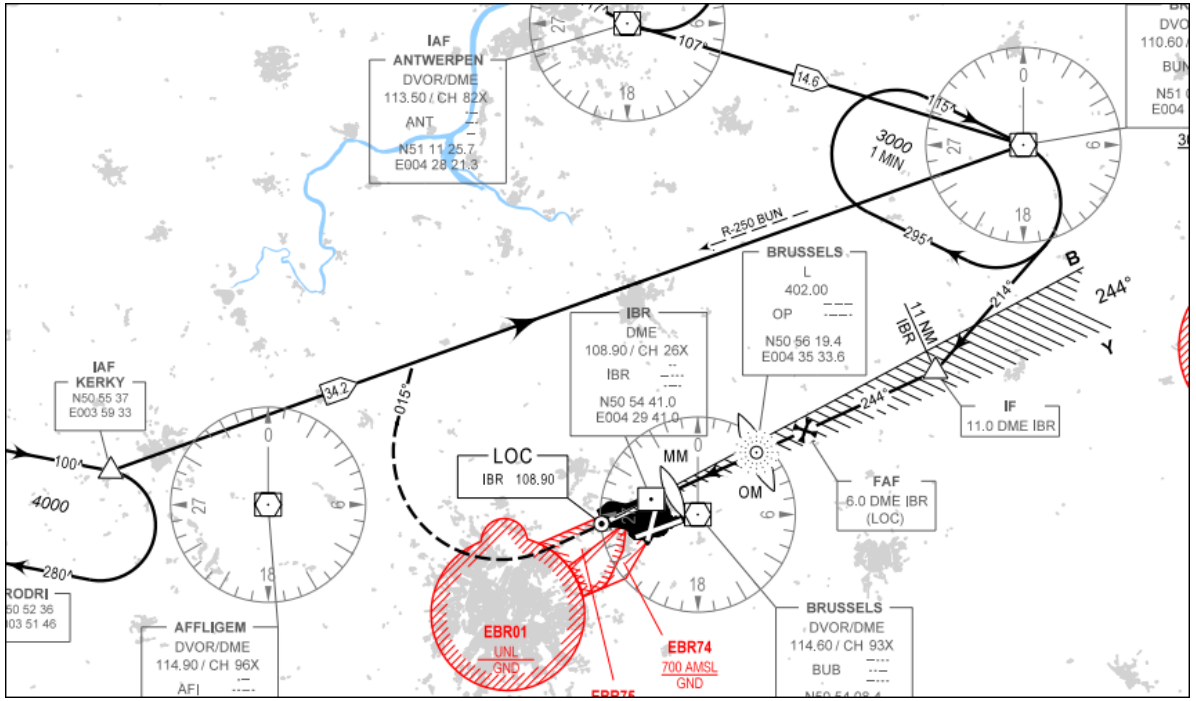
- **Predictability** is key enabler to improve VFE
- Ideally, flight crews know approach routing (transition) as early as possible

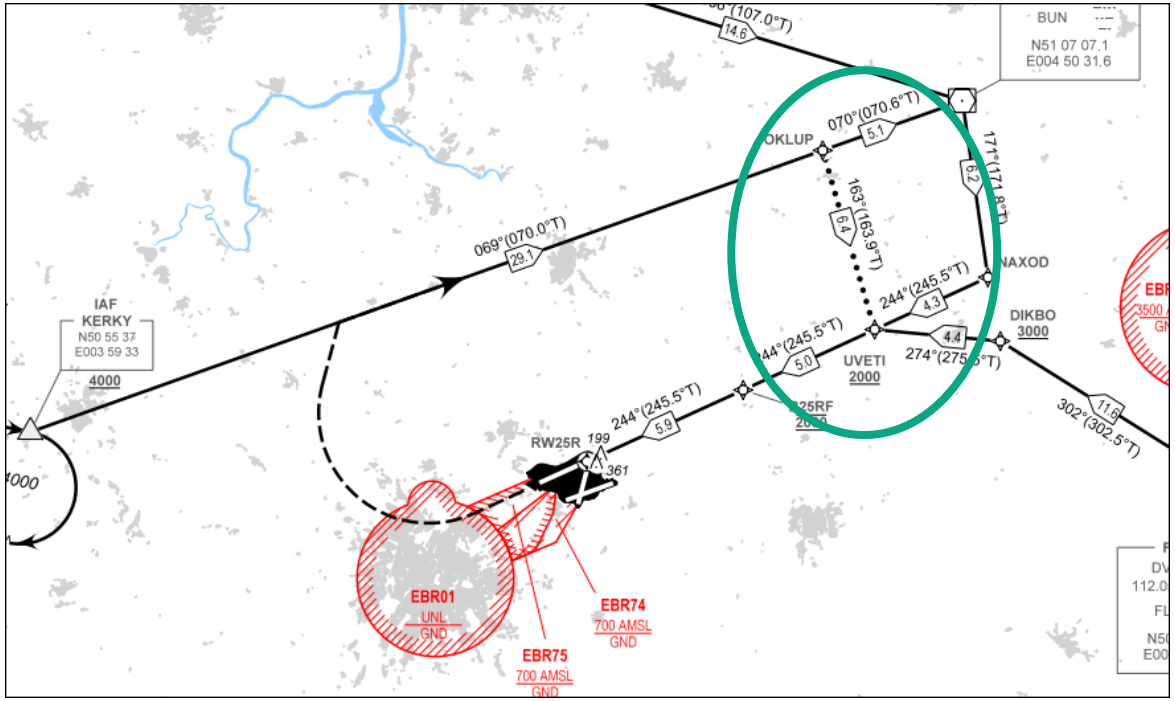
- **Vectoring**
  - Lower predictability (flight crews)
  - Higher flexibility/capacity (ATC)
  - Possible: shortcuts/route extensions

- **Published and known transitions**
  - Higher predictability (flight crews)
  - Lower flexibility/capacity (ATC)
  - Limited possibility: shortcuts/route extensions

- Business as usual: vectoring 24/7
- Set up **assessment phase**:
  - In medium/heavy traffic, stick to **vectoring**
  - In light traffic, shift towards **published transitions** (RNP only)

ILS <> RNP Transition





ILS RWY 25R

conventional transition
longer published routings

RNP RWY 25R

RNAV transition
more efficient routings
not possible: tactically intercept glide interception at higher altitude

Assessment Phase

- **RNP set as primary approach procedure**

- Objectives:
  - ATC: familiarize with RNP approaches and way of working, identify issues, etc
  - Flight crews: familiarize with RNP approaches at EBBR, better optimize descent, assess trade-off predictability <> additional track miles

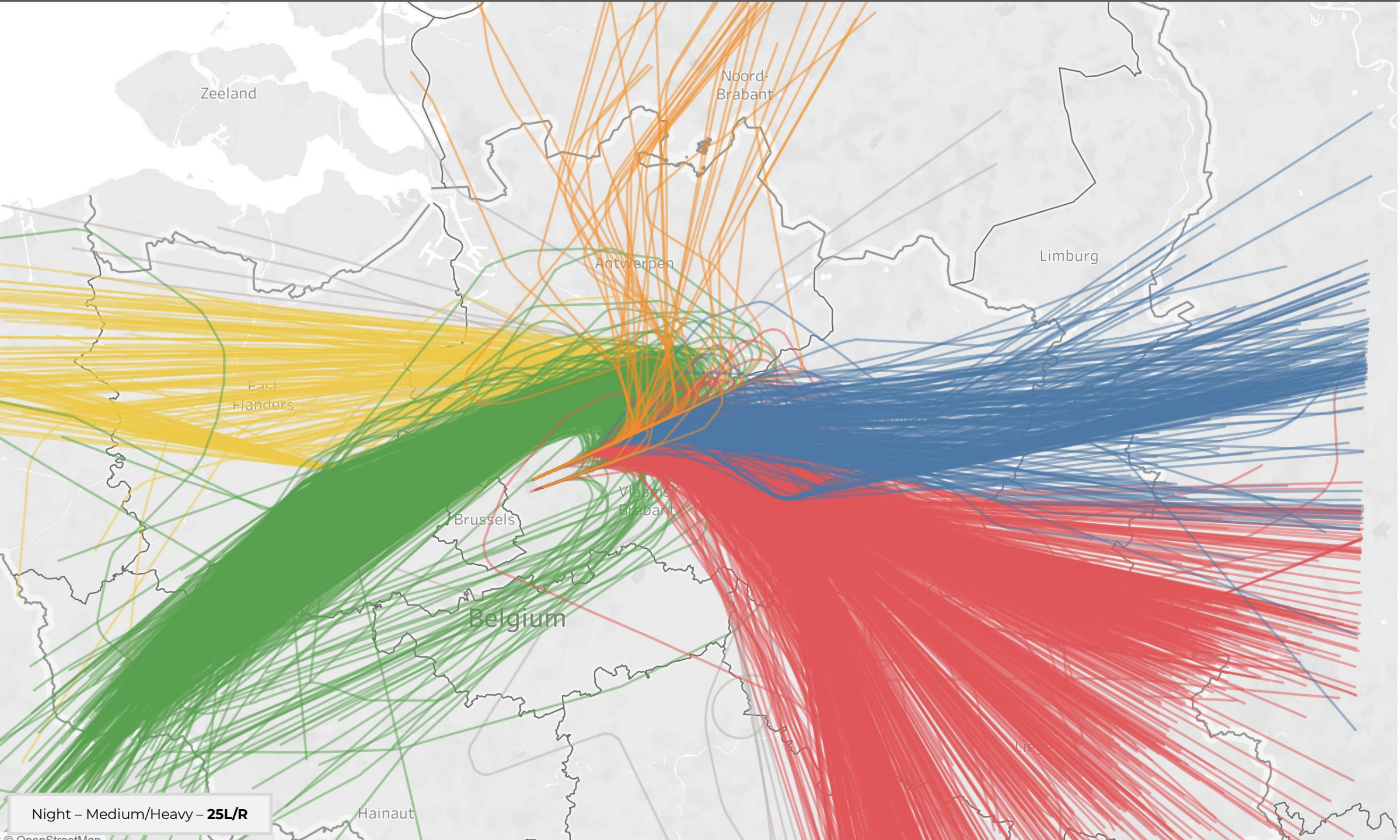
- Scope: all airlines (ATIS), night-time only (23h-6h LT), RWY 25R/L, traffic/meteo permitting

- Working methods (ATC):
  - ACC and APP involved
  - Avoid lateral deviations from published trajectories (incl. shortcuts)
  - Limit speed/altitude constraints to minimum
  - Avoid vectoring

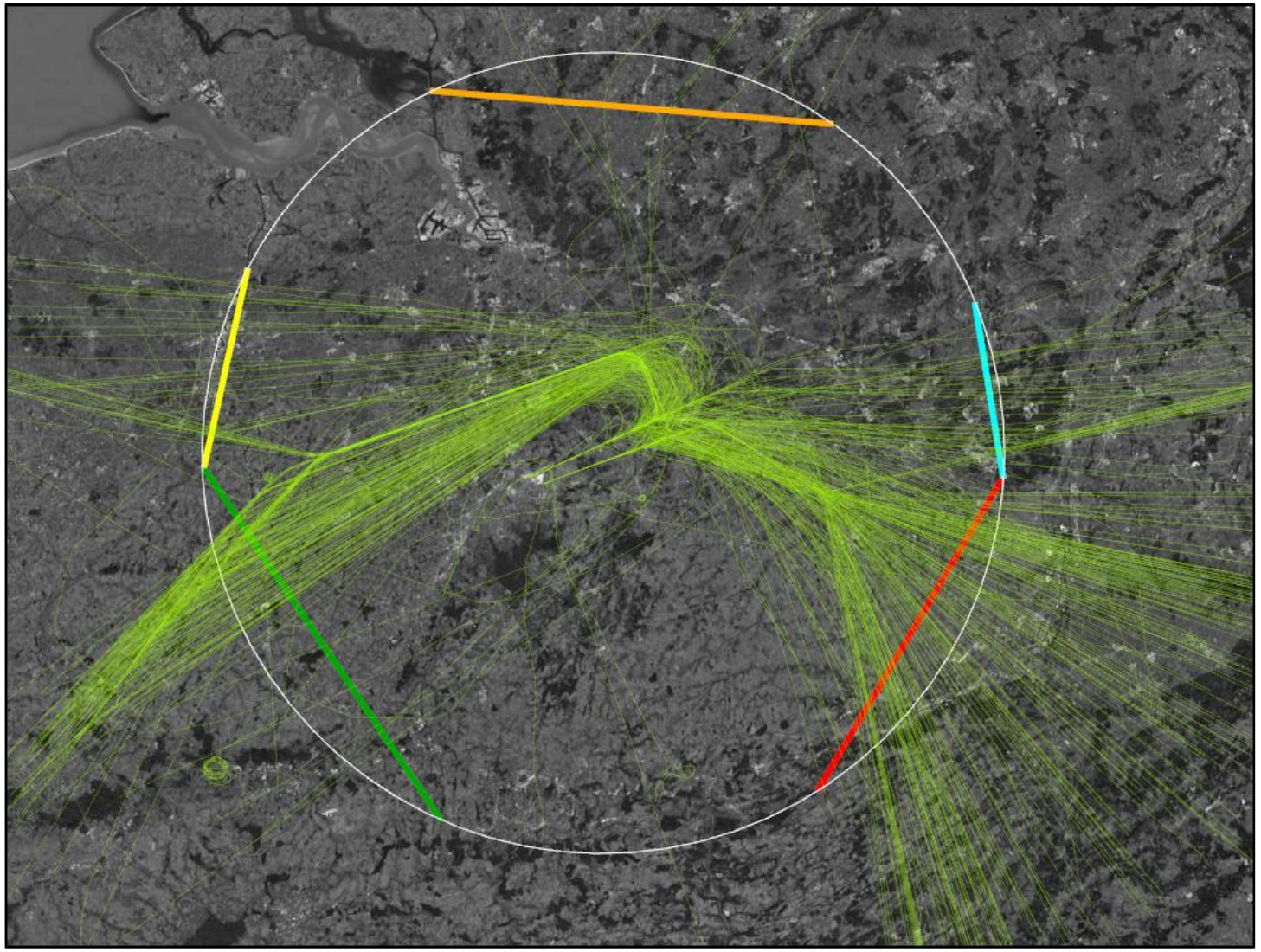
- Assessment period: 16 MAY 2022 – 26 AUG 2022

- Project set up using ATC and airline input (CEM EBBR)

3/ RESULTS


Traffic Flow
N
E
SE
SW
W
Other
Zeeland
Noord-
Brabant
Antwerpen
Limburg
East
Flanders
Vlaams
Brabant
Brussels
Belgium
Hainaut
Night – Medium/Heavy – **25L/R**
© OpenStreetMap

Traffic flows



Night – **25L/R**

Observations

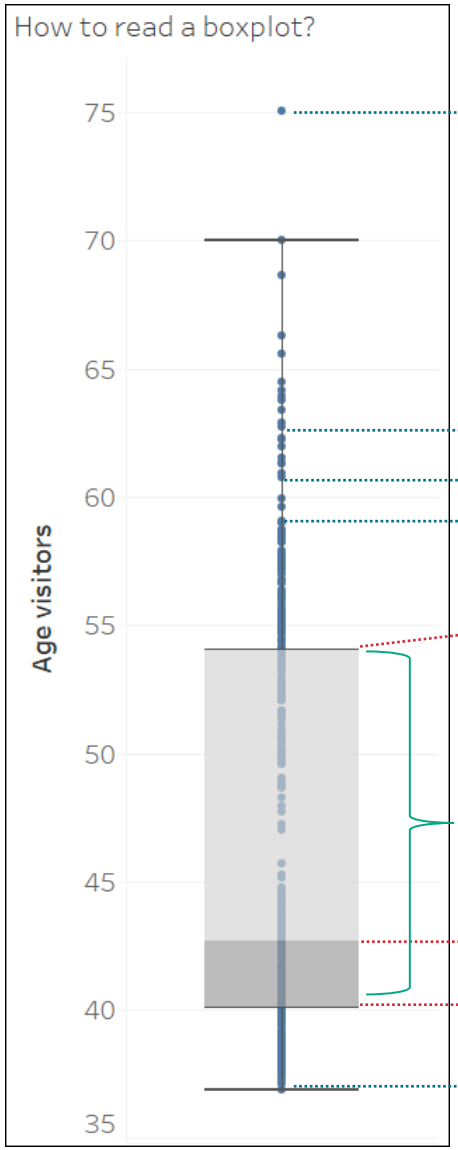
Arrivals are allocated to a flow:

N - North
E - East
SE - South-East
SW - South-West
W – West

For each flow, an ‘intersection gate’ is set up. For each arrival, the **track DTG** and **altitude/FL** intersection is recorded.

Circle: radius of 35 nm, centred around a point 6 nm East of RWY 25L/R (in between axes)

How to read a boxplot?



low -> high

Maximum (highest dot)

Each dot: age of 1 visitor

75th percentile

50% of the visitors (i.e. 'the middle 50%') has an age within this range

Median (50th percentile)

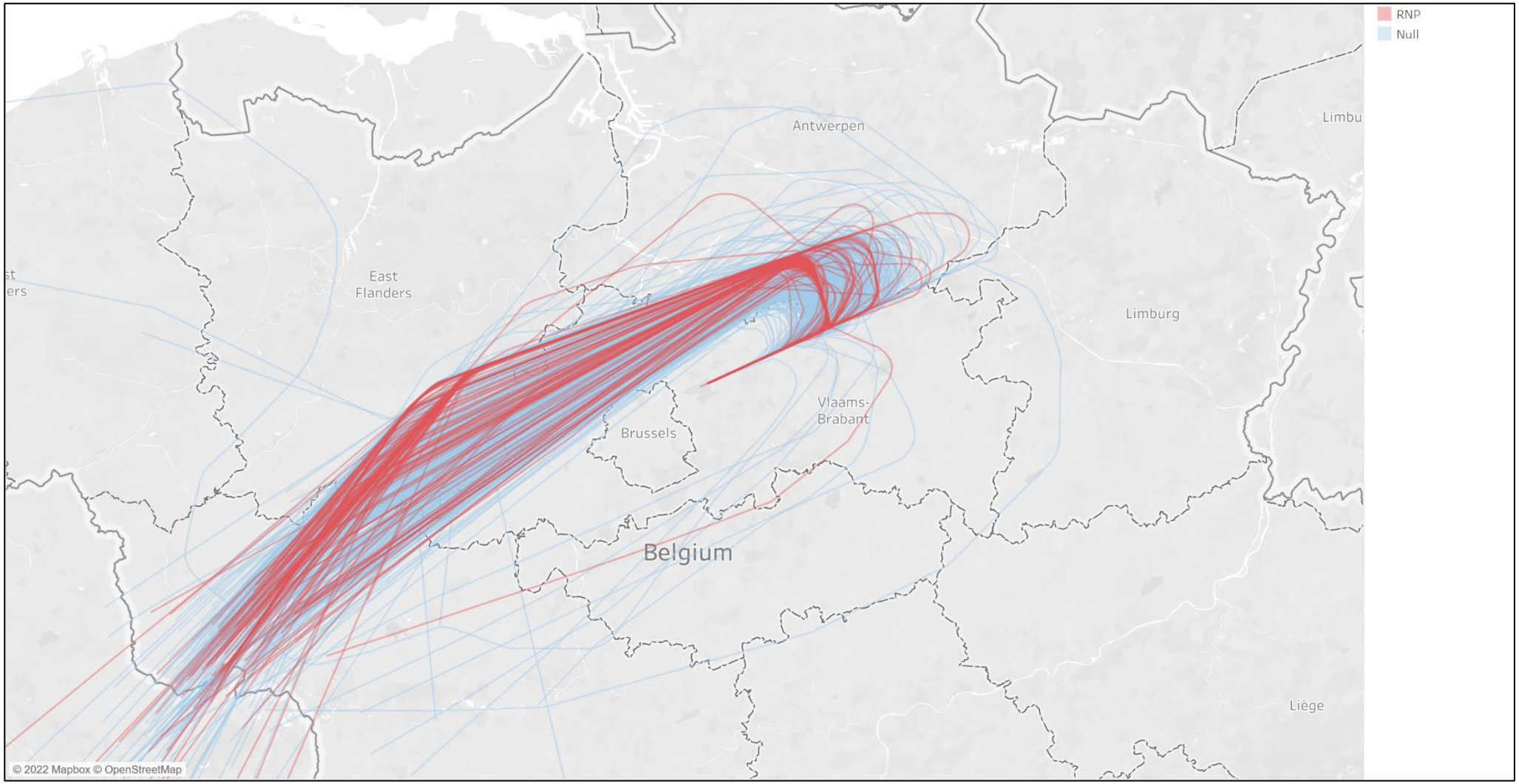
25th percentile

Minimum (lowest dot)

Statistical outlier

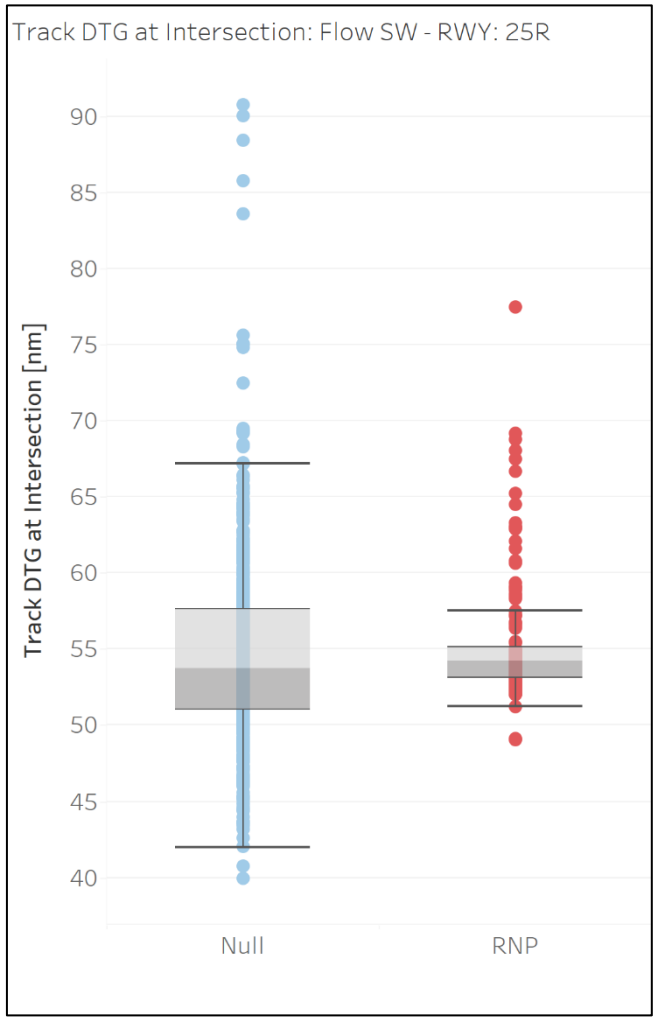
Indication for the overall spread

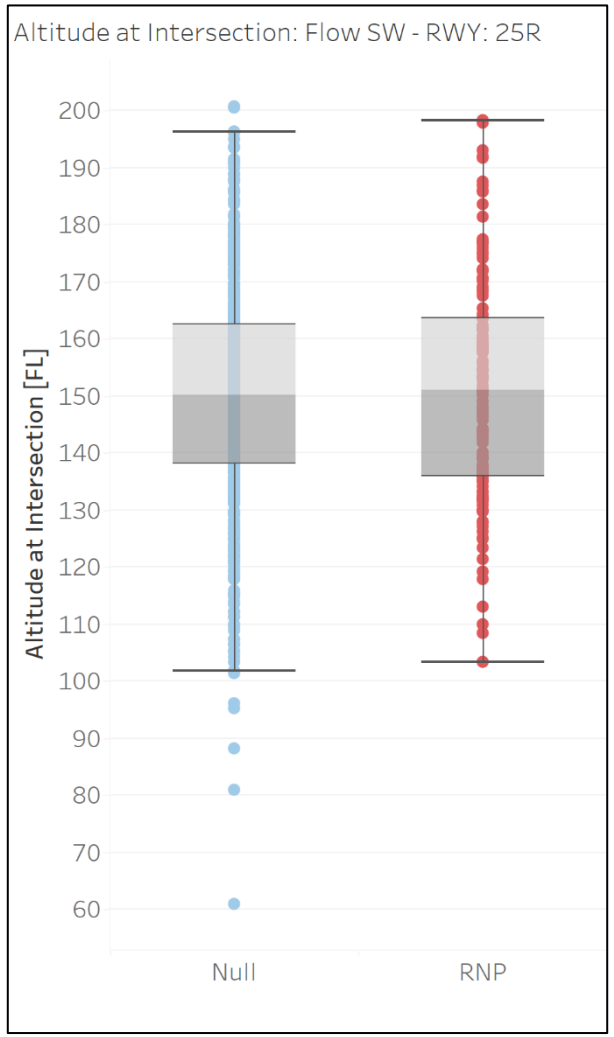
SW Flow – 25R



Night – Medium/Heavy – **SW Flow** – **25R**

SW Flow – 25R





Observations (RNP, compared to ILS)

Track DTG at intersection
median DTG very similar

less spread (-> predictability!)

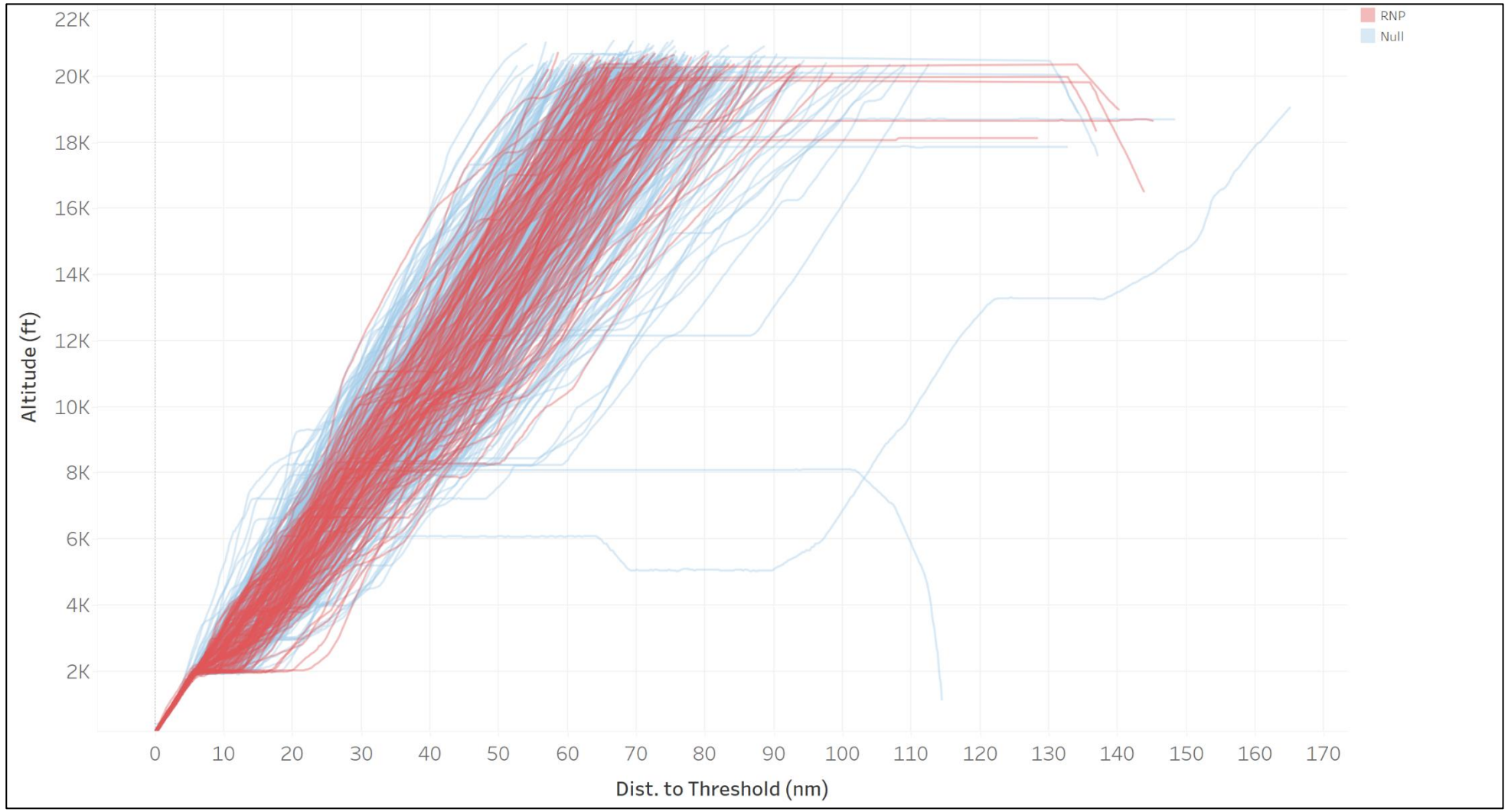
fewer 'very' short routes

fewer 'very' long routes (only required when vectoring in high traffic)

Altitude at intersection
no significant differences, although fewer flights at lower altitudes (< FL100)

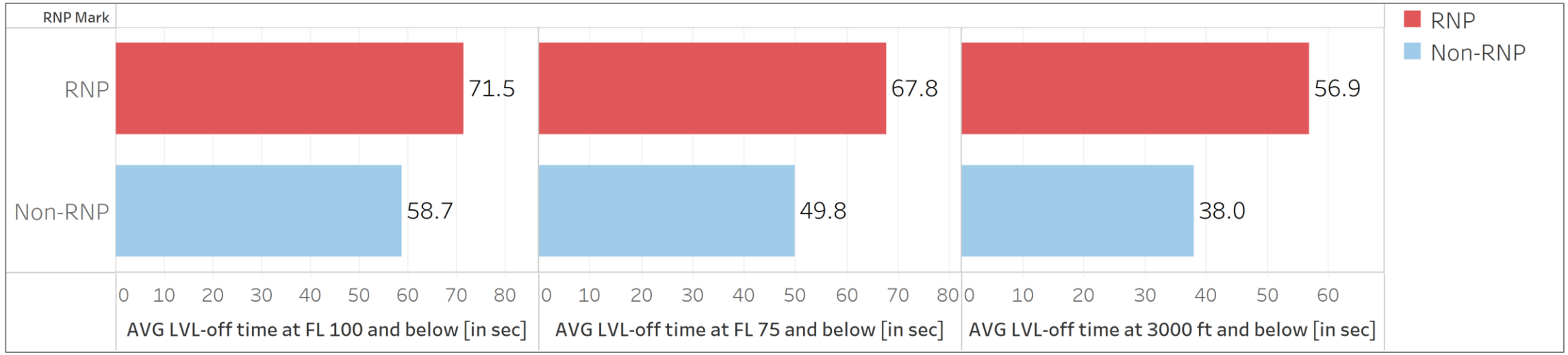
Night – Medium/Heavy – **SW Flow** – **25R**

SW Flow – 25R



Night – Medium/Heavy – **SW Flow** – **25R**

SW Flow – 25R

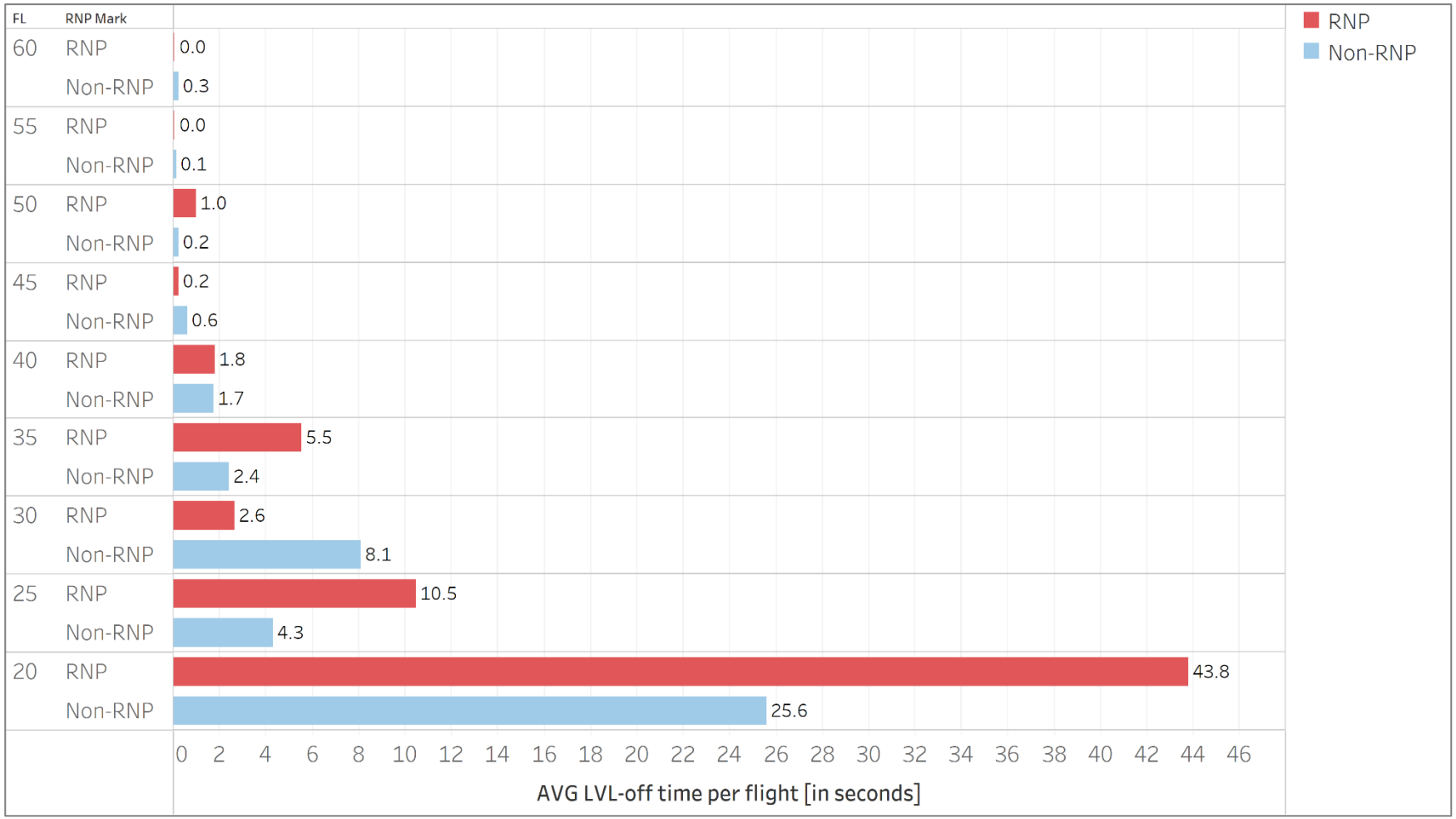


Night – Medium/Heavy – **SW Flow** – **25R – 10% of worst performing flights excluded**

Observations

Increased LVL-off time for RNP

SW Flow – 25R



Observations

When flying RNP, AVG LVL-off time at 3000 ft is 3-times shorter than non-RNP.

However, level-offs significantly longer at 2000 ft with RNP (compared to non-RNP).

Night – Medium/Heavy – **SW Flow** – **25R – 10% of worst performing flights excluded**

Discussion

- Results comparable for other flows
- RNP Acceptance Rate is very high: 76%
- Results discussed with ATC and airlines (CEM EBBR)
- Airline feedback:
  - Positive reports from flight crews (-> increased predictability, ability to optimize VFE, idle thrust descents, no additional workload)
  - Increased level-off times at 2000 ft:
    - Not necessarily fuel inefficient
    - Without ATC/procedure constraints, most aircraft descend at max speed (250 KIAS) until glide interception altitude (2000 ft). Level-off segment therefore flown in idle thrust.
    - Adding speed constraints in the procedure would avoid long level-offs at 2000 ft

Fuel Assessment – Data

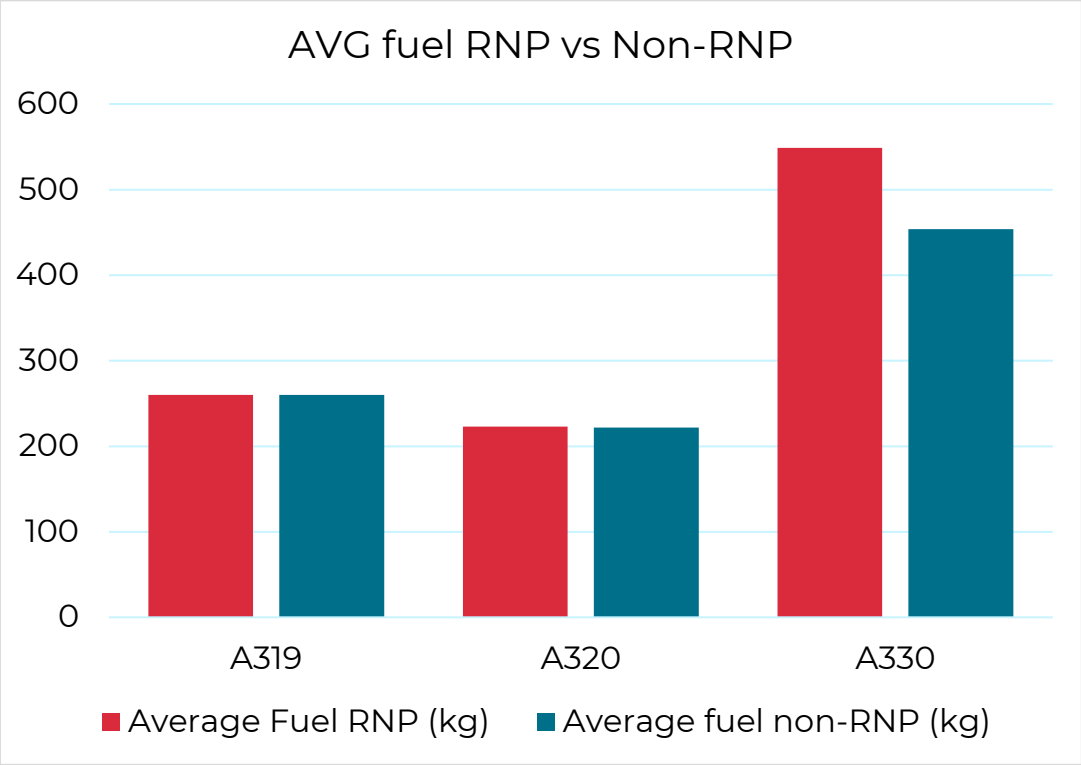
- skeyes and Operator data

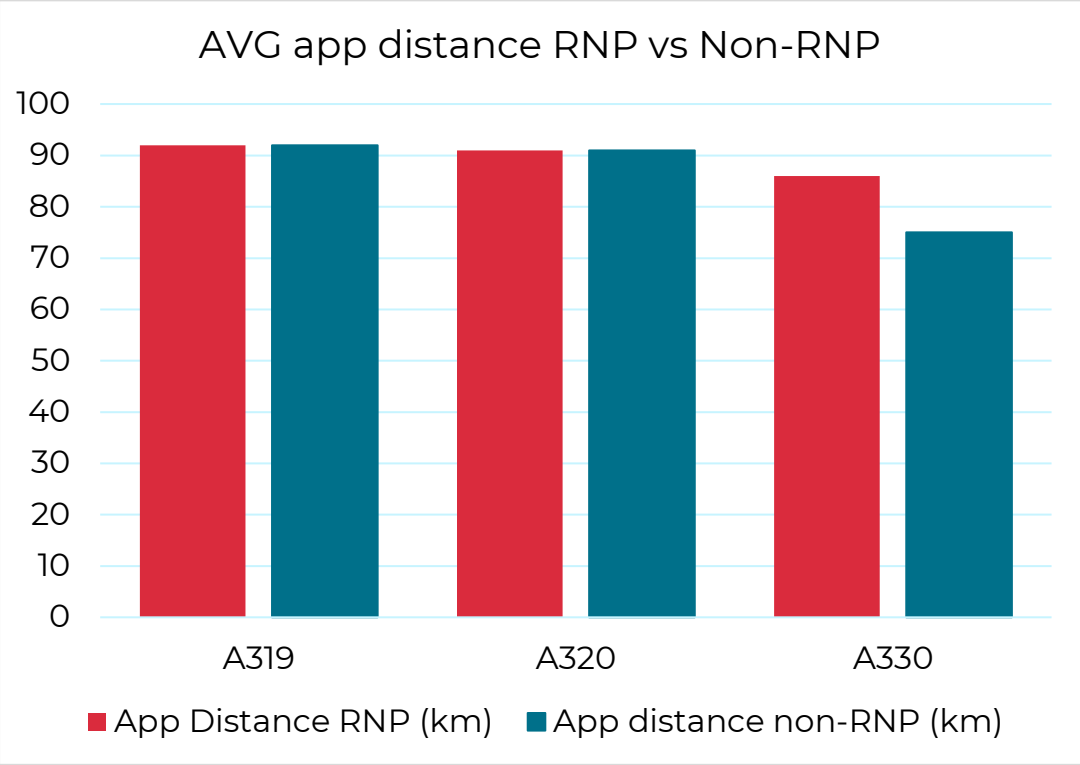
- BEL data

→Aviaso (FDM, ACARS, ATC, …)

- APP zone (30NM)
  - Snapshot (crossing and landing)

Fuel assessment: comparison





Strengths and Weaknesses

Strength

- Localized noise distribution
- Predictable
- Very ILS like (Airbus)
- Easier CDO

Weakness

- Localized noise distribution
- Usability during high traffic
- Less used than ILS
- Higher WX minima

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Airline feedback

- Performed during **low traffic** periods
  - Longer track miles (less directs)

  - RNP awareness needed
    - Lower and longer level-offs than ILS app
    - Should be flown same way as ILS

  - Above leads to no significant reduction in fuel

→ More assessments required in busier environments

Flight Crew feedback

- General positive
- Confirmed increased predictability
- Still able to use full automation
- Assessment done during quiet periods
  → no straight in approach

Key outcomes

- Is level-off time the right indicator for measuring VFE inefficiencies?
  What is an optimal descent? Optimized for fuel/noise, or simply no level-offs?
- Long level-offs at low altitudes to be avoided for noise purposes
- Large variability in flying behaviour. Therefore challenging to let (all) aircraft fly RNAV transitions when traffic demand increases.
- Some operators/aircraft types have improved VFE performance with RNP; for others, VFE deteriorated.
- Some aircraft types/FMS require a ca. 2 nm level segment prior to glide interception (FMS margin). Level-off can therefore not be fully eliminated.
- Addition of speed constraints in flight procedures is needed:
  - mitigate long level-offs at low altitudes
  - harmonized flying behaviour (-> sequencing/merging traffic).
- More training required for operational stakeholders
- Noise and fuel assessment required to get complete overview of results

4/ CONCLUSIONS & NEXT STEPS

Conclusions

- Increased Use of RNP Approaches' during period 16 MAY 2022 – 26 AUG 2022
- RNP acceptance very high: **76%** of the arrivals flies it (when RNP indicated in ATIS).
- In general, **RNP approaches do not result in (excessive) additional track miles**.
- For certain traffic flows (mainly SW flows), there is substantially less spread in the DTG results for RNP. There is less variability in the tracks, implying **predictability is substantially improved for airspace users.** This is confirmed by flight crew feedback.
- Overall, no significant 'altitude at intersection' differences between RNP and non-RNP.
- With RNP, there is **substantial increase of LVL-off times at 2000 ft**. To improve this, flight procedures will be amended to include speed constraints.

-> Working point: further reduce long level-offs at 2000 ft

Next Steps

- Fuel assessment (airlines)
- Noise assessment (Brussels Airport Company)

- Amendment of flight procedures (-> addition of speed constraints)
- **Next year, new assessment period to track progress**

- Project is part of Stargate

Stargate

Funded by the European Union

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