Compression on final approach and Time Based Separation for optimized runway delivery

Bologna – Young Scientist Award

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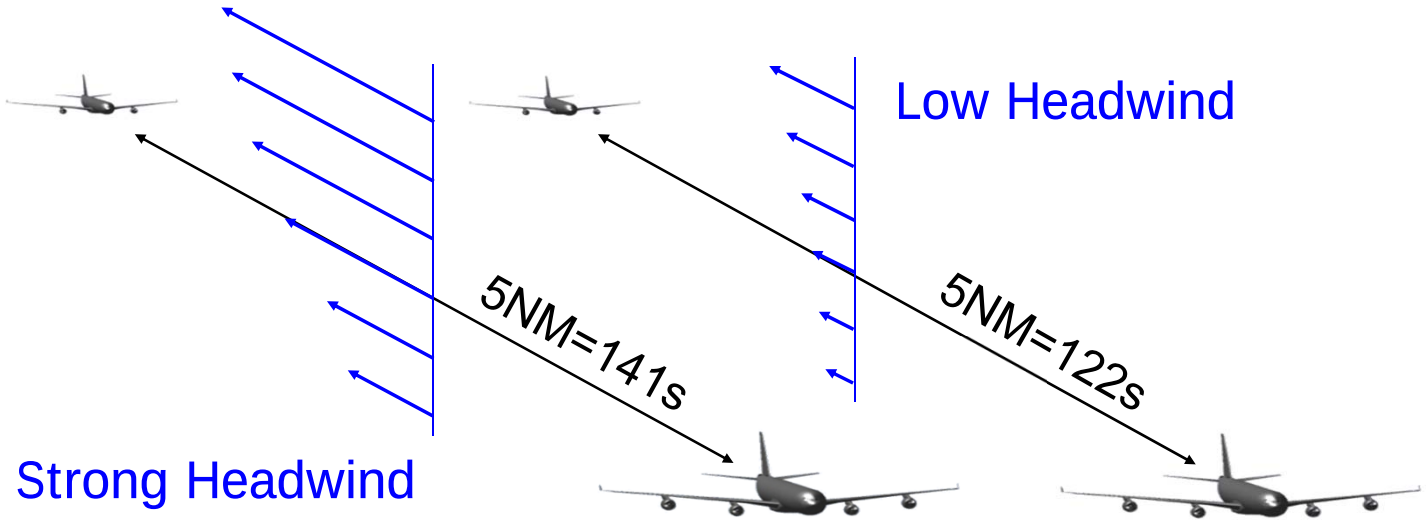
Overview

- Background
- Characterization analyses
- Verification
- Validation
- Conclusions and deployment

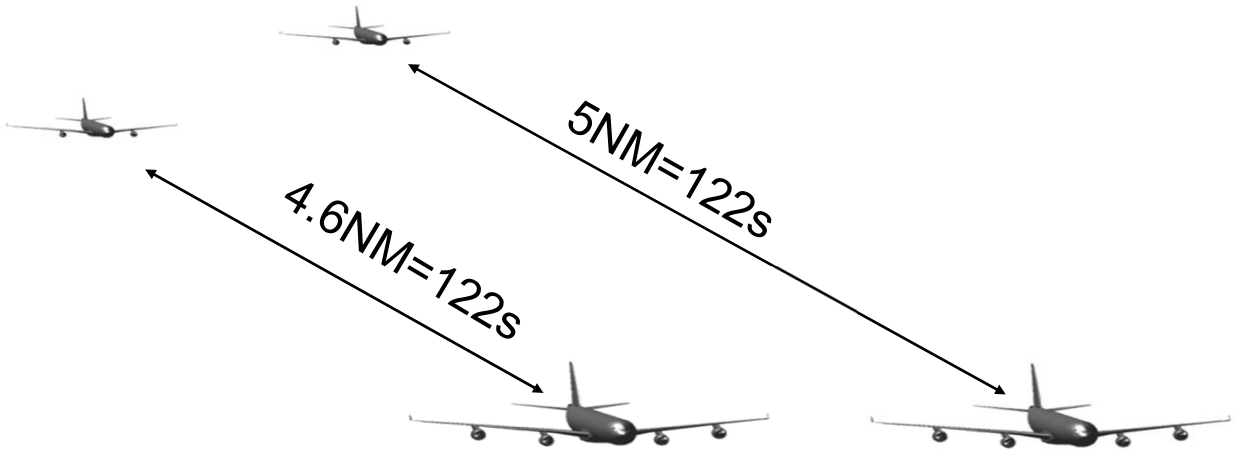
Background

Distance Based Separation (DBS) versus Time Based Separation (TBS)



Background

DBS versus TBS



Background

Can we better predict the speed profile?

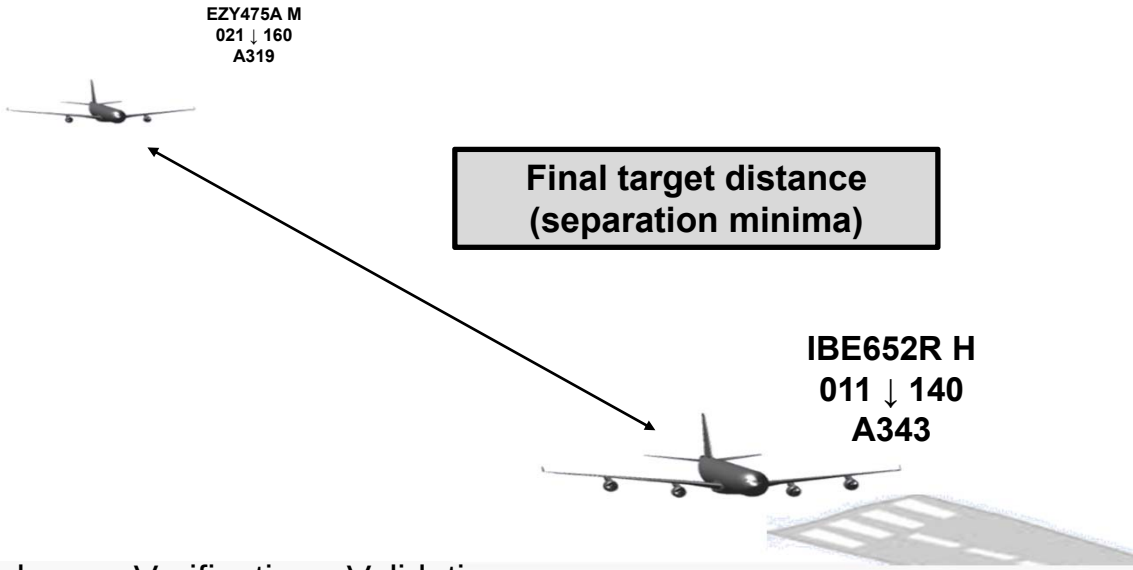
- We are working on solutions maintaining runway througput in all wind conditions.
- As a first outcome of this process we have looked at **“better predictability of the aircraft speed profile**” for better predicting the compression between aircraft pairs
- This produced interesting first descriptive results
- This is the objective of my study….

To quantify and model the potential performance compression improvements on final approach for the TBS

Background

TBS concept

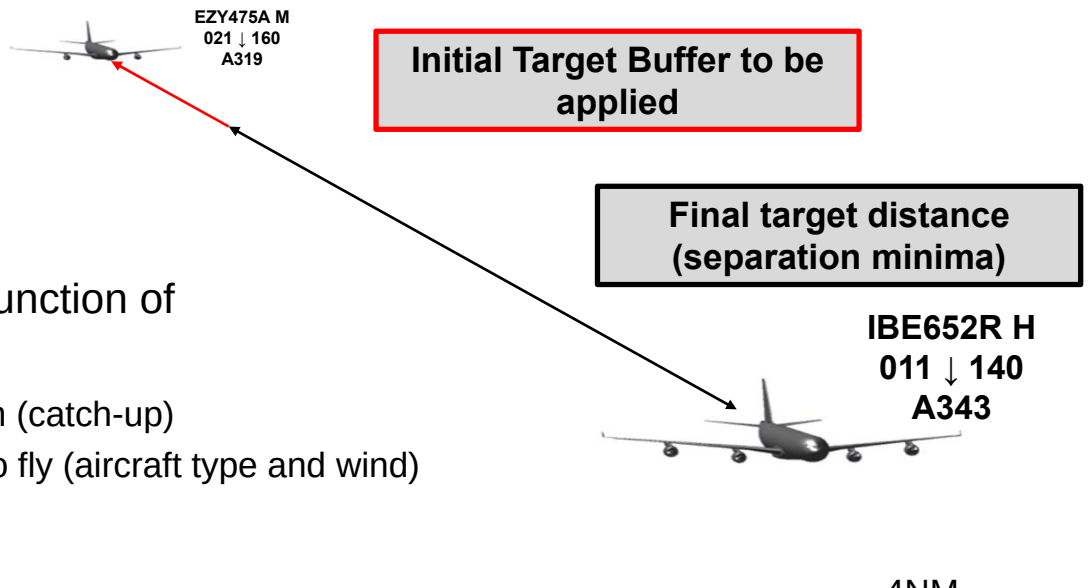
- An additional spacing buffer is needed for the follower aircraft for delivering separation minima



Background

TBS concept

- An additional spacing buffer is needed for the follower aircraft for delivering separation minima

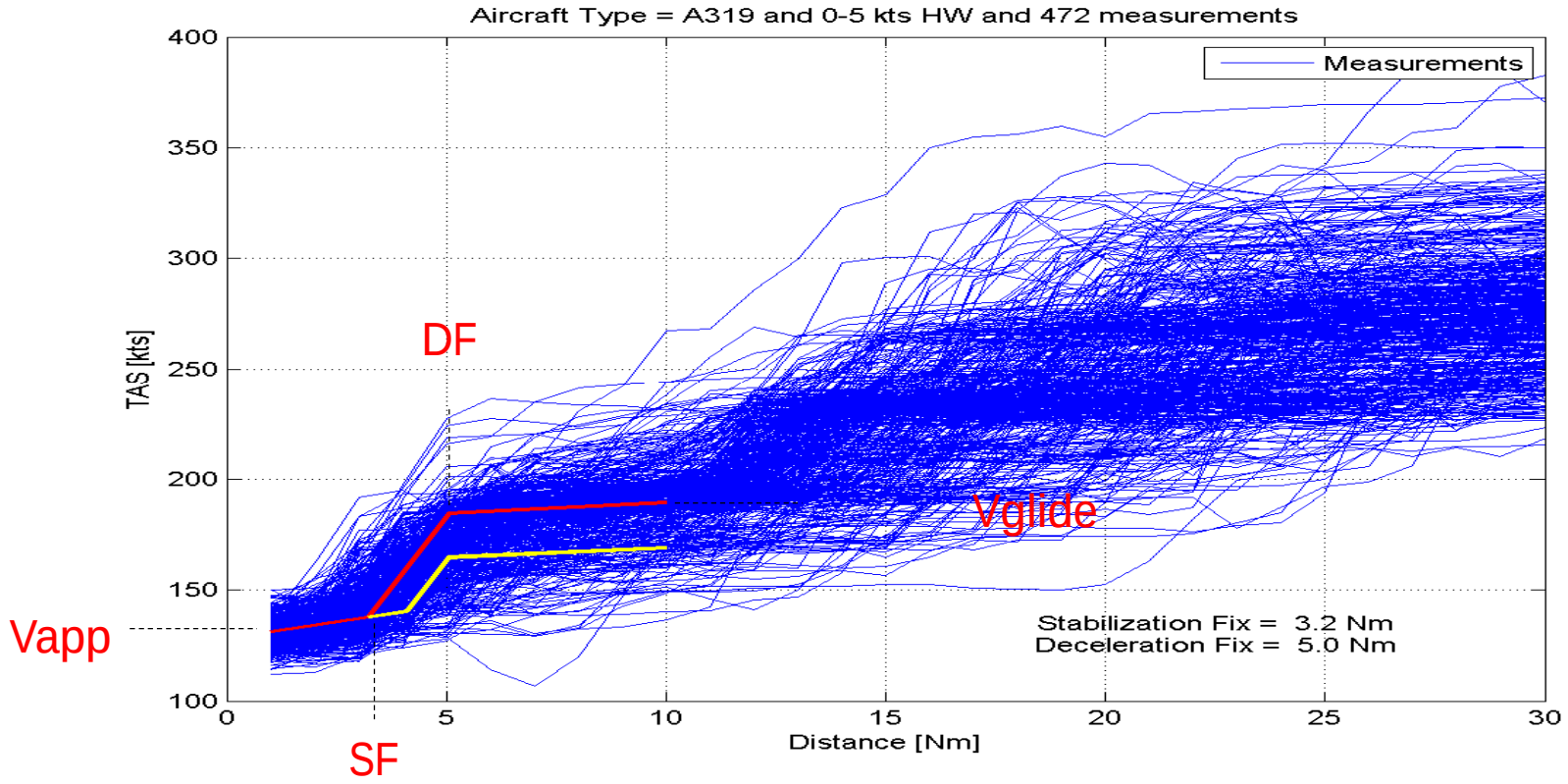


- This additional buffer is a function of

  First order : global deceleration (catch-up)
  Second Order : Specific time to fly (aircraft type and wind)

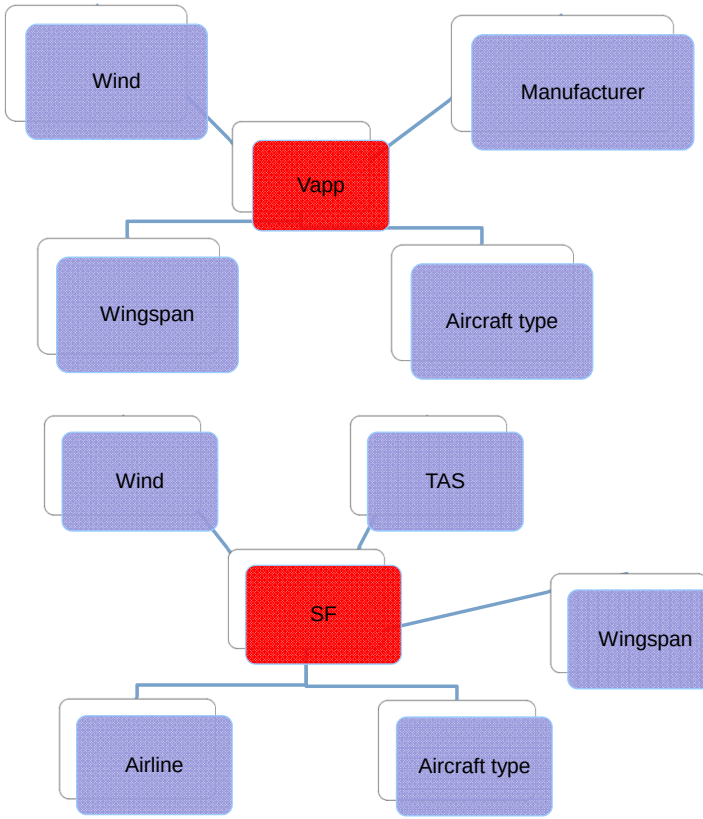
Characterization analyses

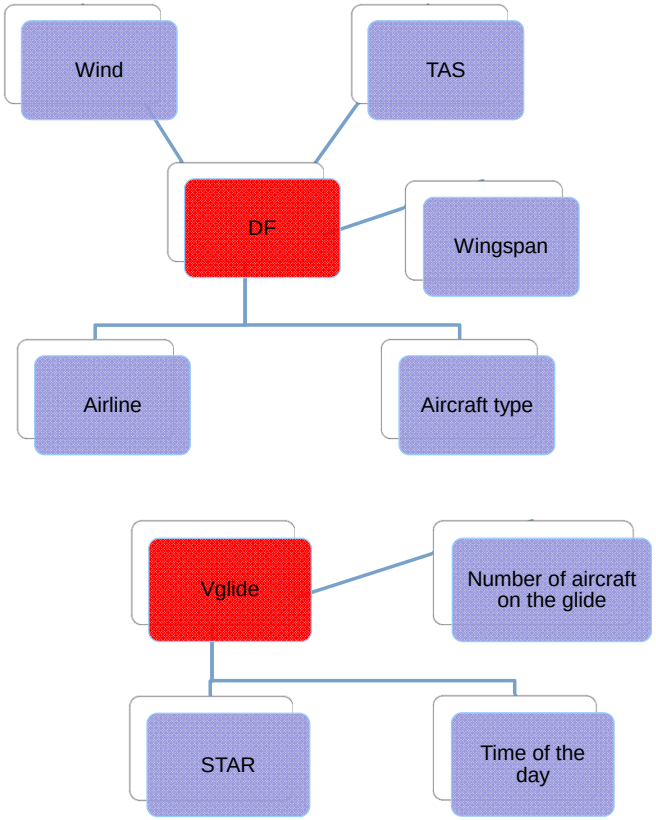
Radar track data measurement for the 4 parameters



Characterization analyses

We know what influence what





Verification

What do we do with this?

- We know what influence what…

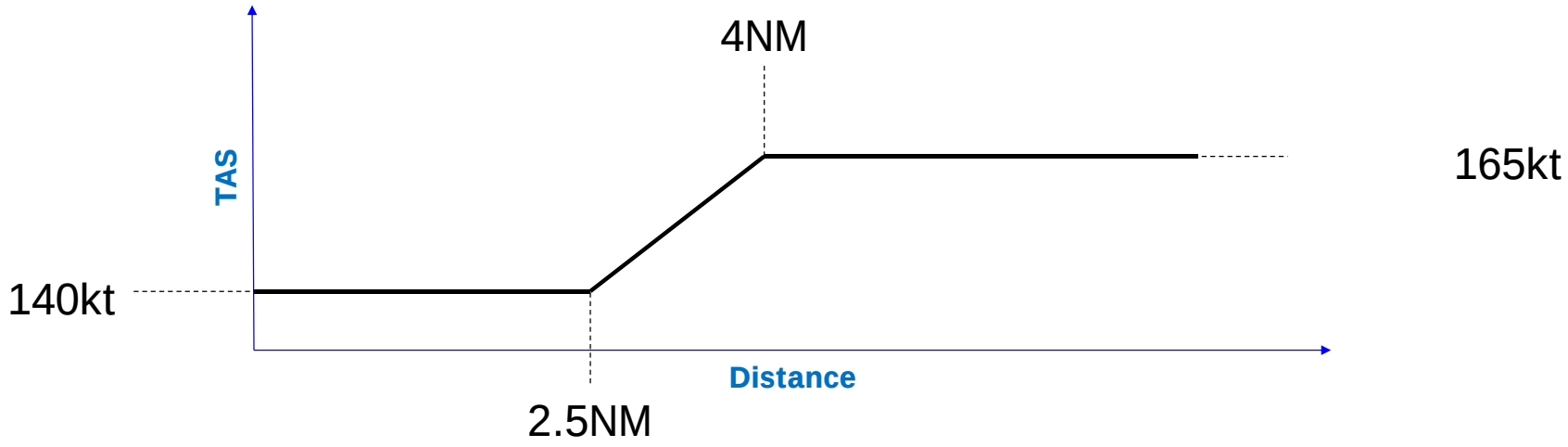
- Remember the question:
- Can we better predict the speed profile?
  - for better predicting the catch up
    - for better predicting the separation buffer to consider
      - for better predicting the TBS

YES!

Verification

TBS EUROCONTROL vs Floris Friso Herrema (FFH) tool

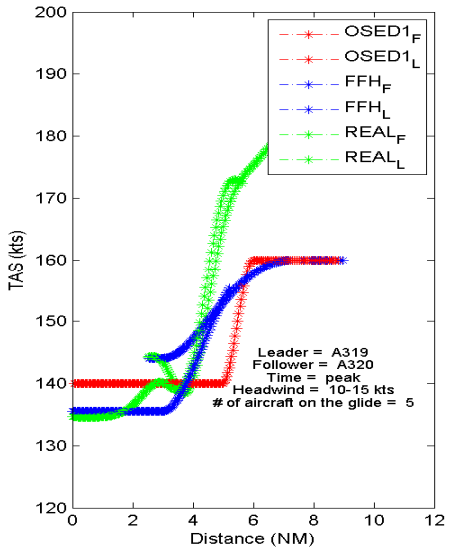
- Before fixed speed profile → TBS OSED 1 from EUROCONTROL
- Flying time for leader and follower were computed using a unique air speed profile (FFH)

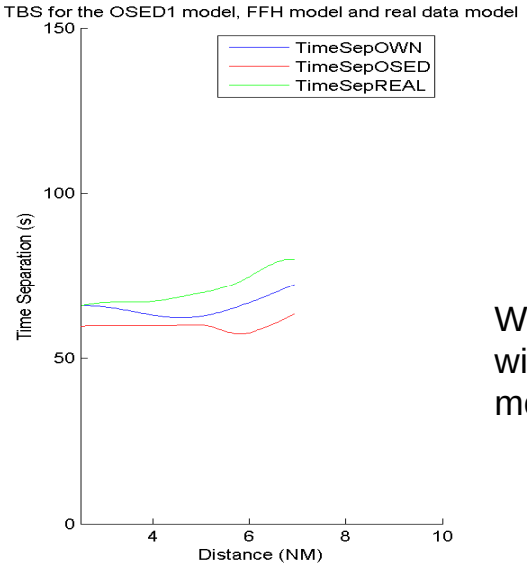


Verification

What does it tell me?

For knowing the separation to apply for the follower on the glide one needs to know the expected variation down to threshold





We observe a better prediction with the developed advanced mode than with the “original” one

Verification

Vienna & Boeing

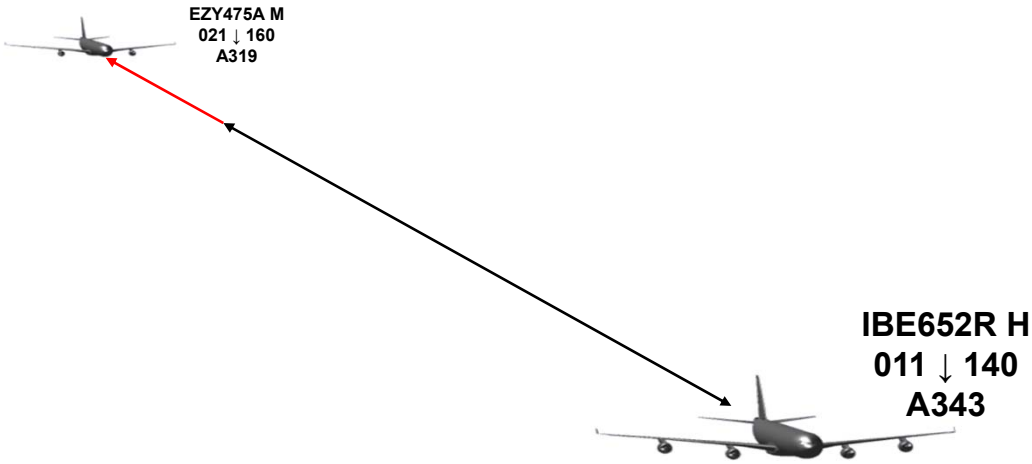
- Comparing the Vapp profiles with Boeing data results shows also good similarities. On average the speed profiles differ between 2 and 5kts.

- Vienna radar data shows that the standard deviation for the four parameters differs between 3 and 8%. However the DF and SF is higher 5-10% due to local ILS and IAP procedures.

Validation

What is the purpose of this

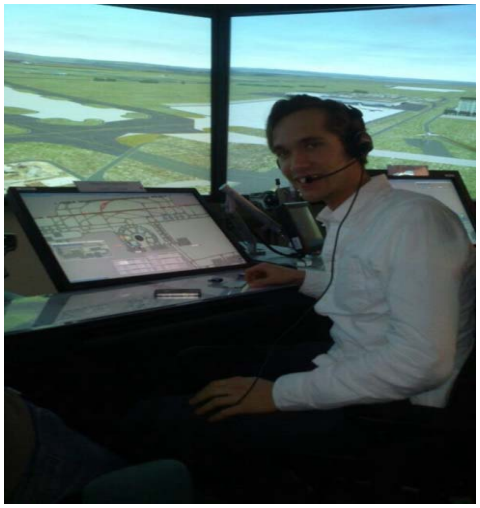
- Remember buffer is calculated based on wind, catch up and different speeds on final approach



Validation

Real time simulation

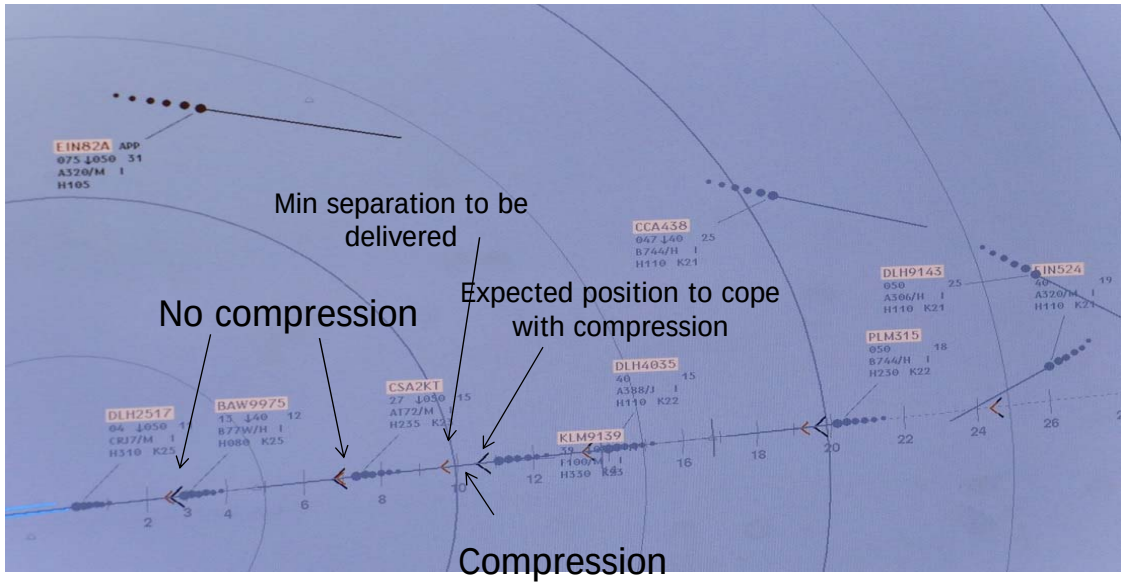
- The speed profile is described by: Vapp, DF, SF and Vglide from this study.
- 2 ATC from Charles De Gaulle and 4 pilots from Air France



Validation

What is the purpose of this

- For providing the ATC with the relevant information
- You need to know expected aircraft behaviour (speed profile)



Compression based on wind and because ATR 72 land a lower speed and reduce earlier than the F100

Conclusion – Thesis

FFH tool and validation

- Vienna data shows that the standard deviation for the four parameters (Vapp, SF, DF and Vglide) differs between 3 and 8%. Comparing the Vapp profiles with Boeing data results shows also good similarities.
- The FFH tool has been made and can be used for a better understanding of the speed profile and the TBS compression effect between aircraft pairs.
- By comparing the outcome of the TBS FFH tool with real radar flights in both case studies, it turns out that the FFH tool performs better than the TBS EUROCONTROL OSED 1 model.
- Primary results from the validation: 50% throughput recovery can be expected by comparing the low wind with the high wind conditions and applying the new TBS methodology.

Conclusion – Deployment

Together with NATS

- TBS for final approach shall be operated at 16 European Airports by 2024.
- Operationally at London Heathrow this summer 2015 (first TBS airport in the world).
  - **TBS is on track to save 80.000 minutes of delay per year at Heathrow.**
  - **Recovery 2 landings per hour during strong headwinds**
  - **Benefit to the airlines in the range of 6 to 7.5 million pound per year**



Thank you

Any questions?

- With this thesis a better prediction is established of the compression effect on final approach, this research will stimulate further TBS studies….