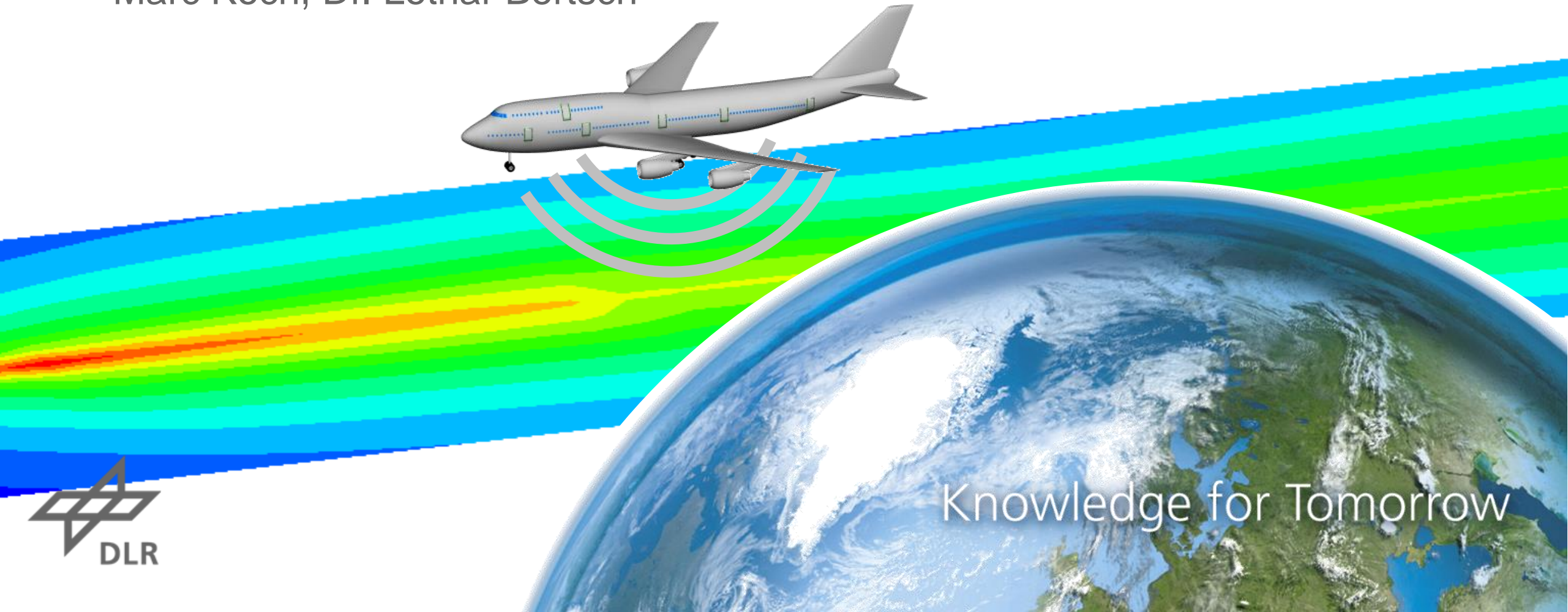


# Low Noise Flight Performance by Wing Design

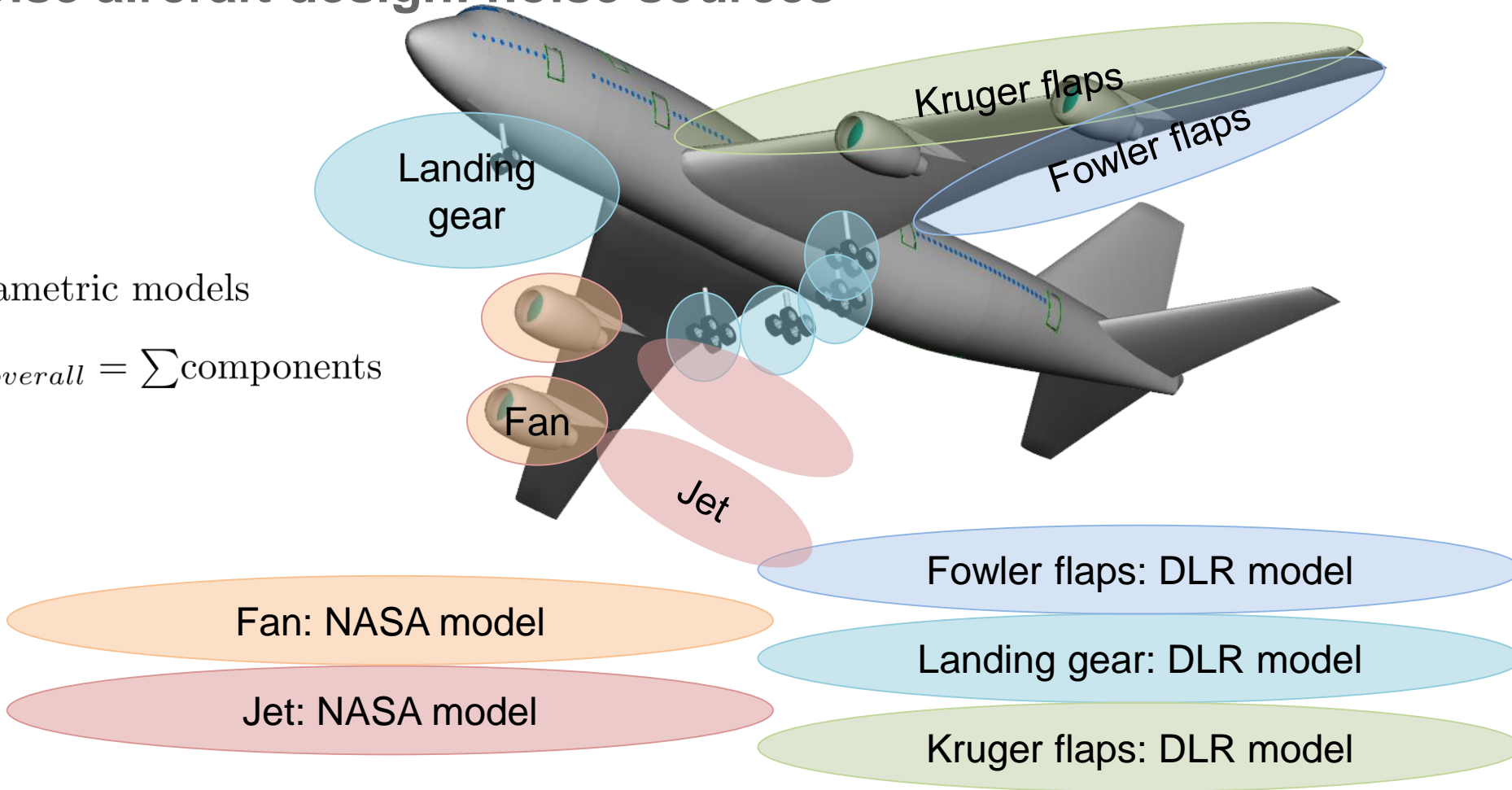
Marc Koch, Dr. Lothar Bertsch



Knowledge for Tomorrow

# Low-noise aircraft design: noise sources

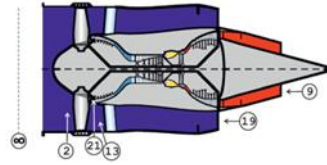
- parametric models
- $L_{p,overall} = \sum \text{components}$



# Ground noise calculation

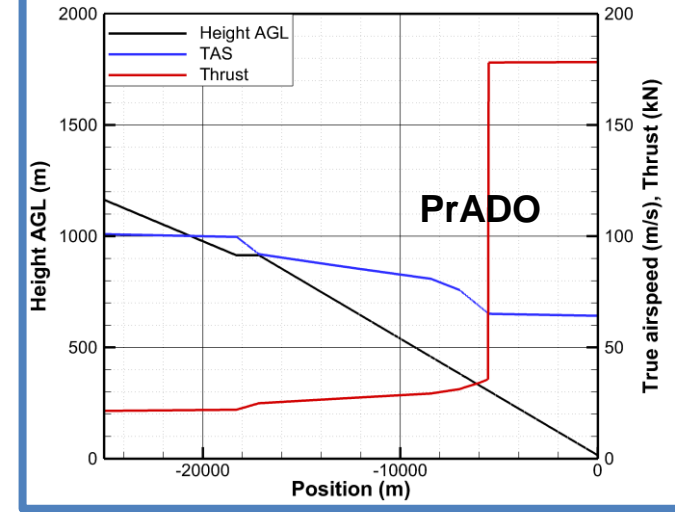
## Engine map

CF6-80 C2,  
**GTlab**, DLR  
Cologne,  
Florian Wolters



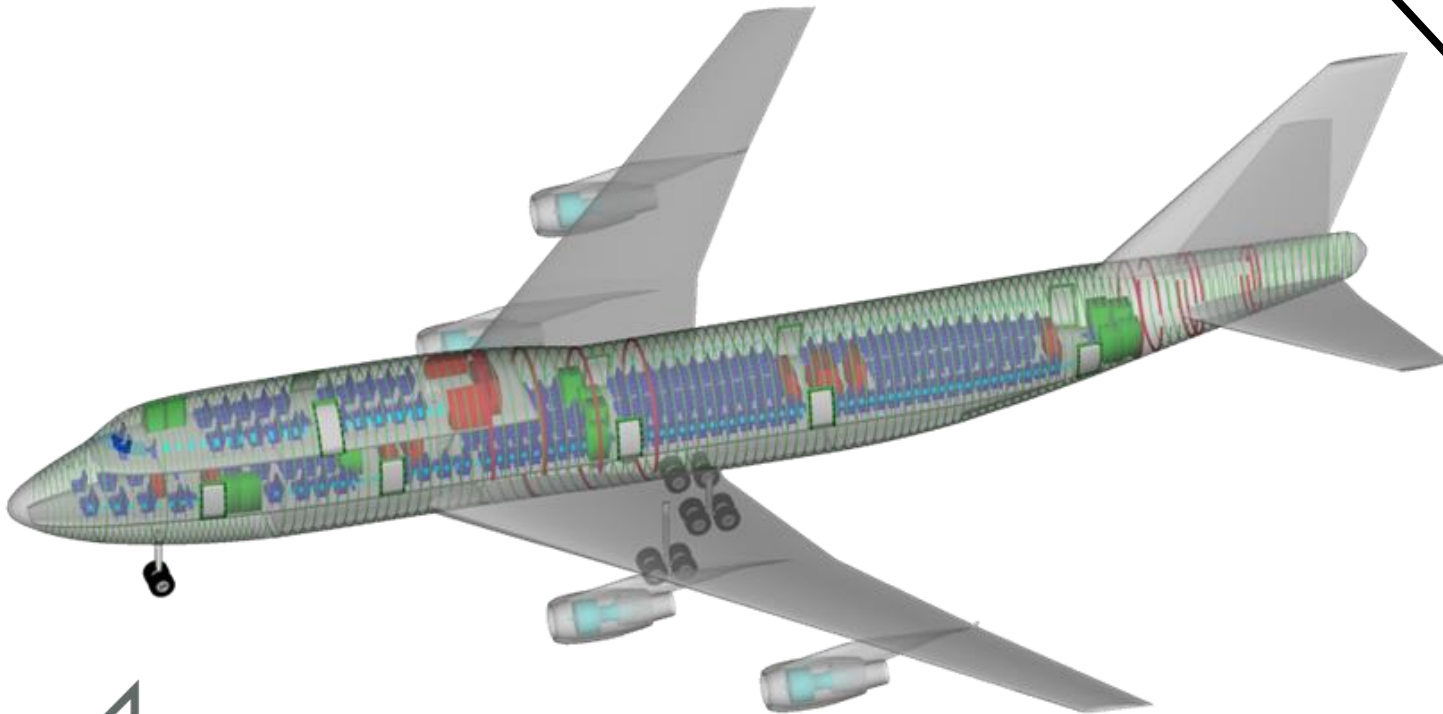
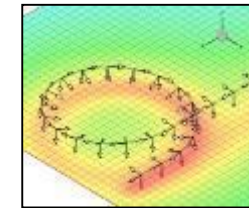
## Trajectory

### FLIPNA

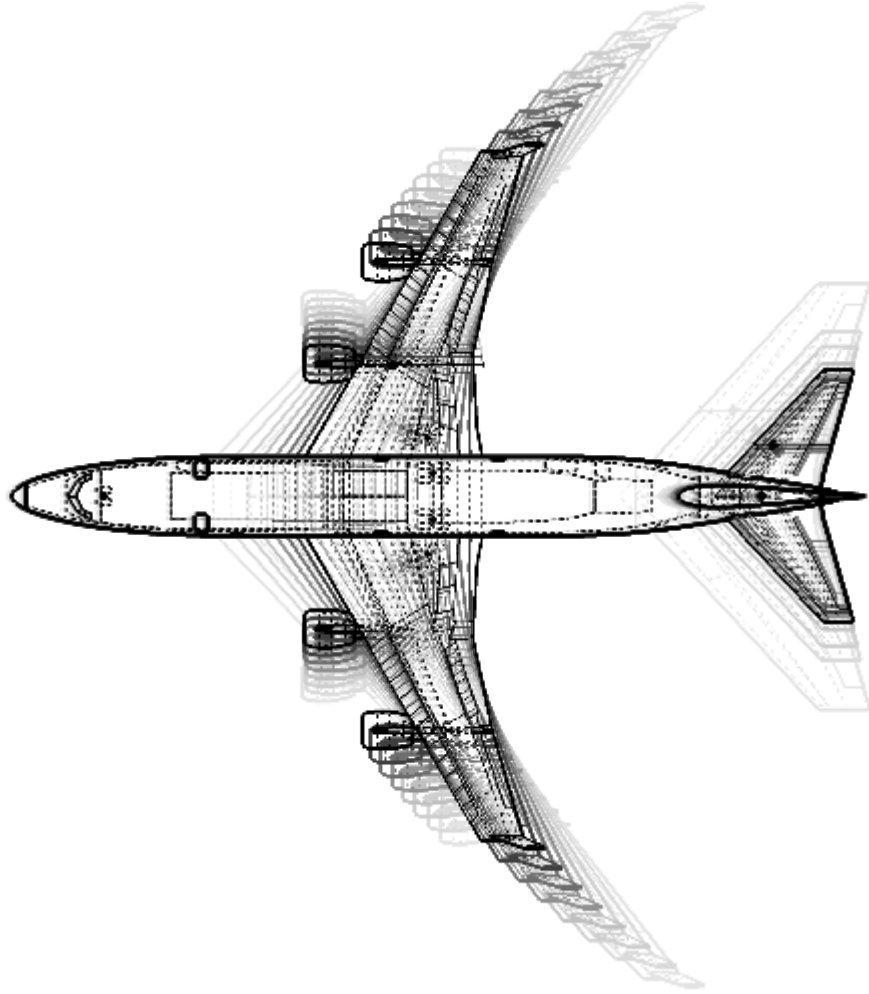


### PANAM

Noise prediction



# Does the wing design influence ground noise?

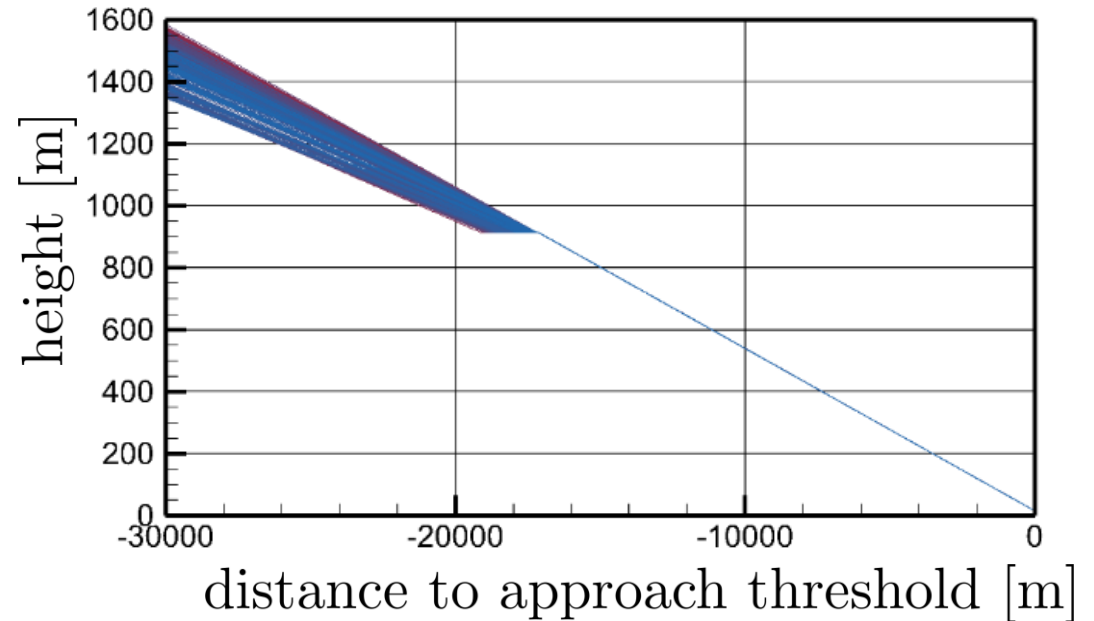
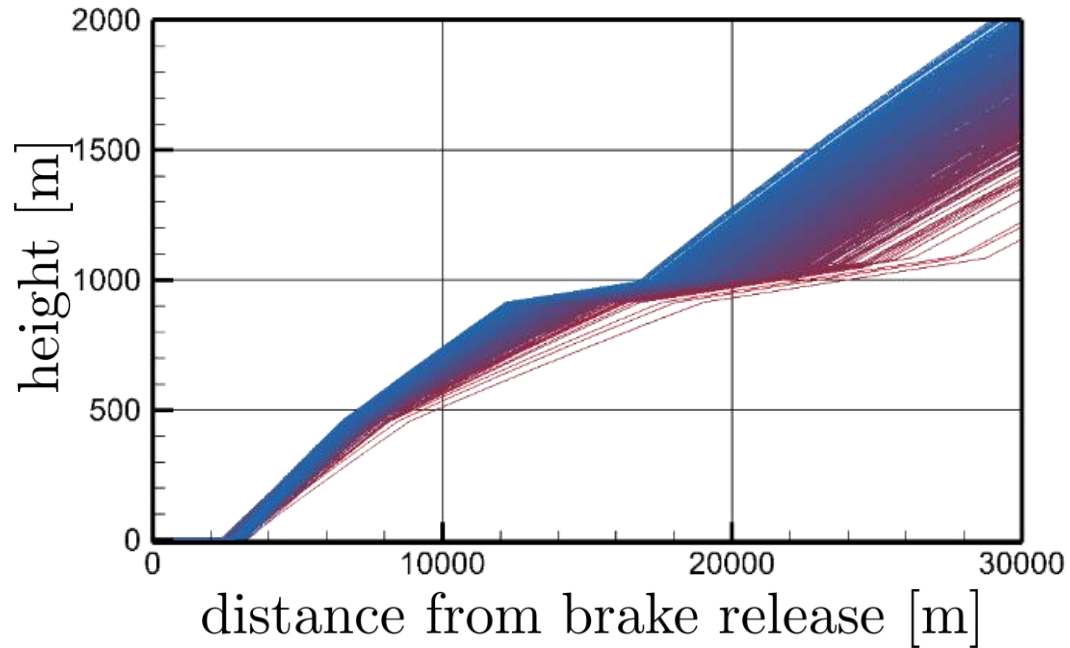


Parameter	Minimum	Maximum	Resolution
l.e. sweep [°]	26	44	2
wing area [m <sup>2</sup> ]	500	660	20
aspect ratio [-]	6.5	10.0	0.5





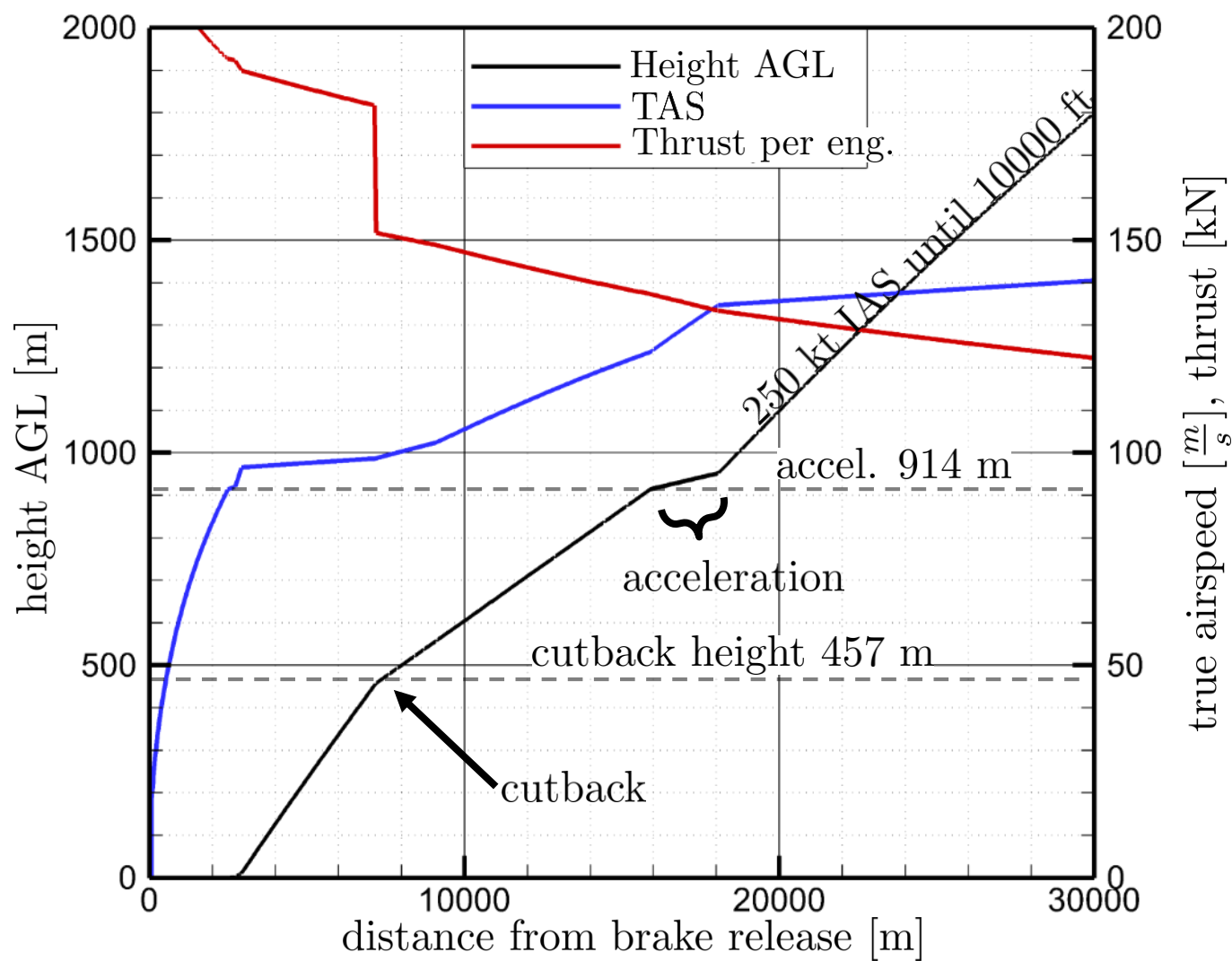
## Individual trajectories for each aircraft



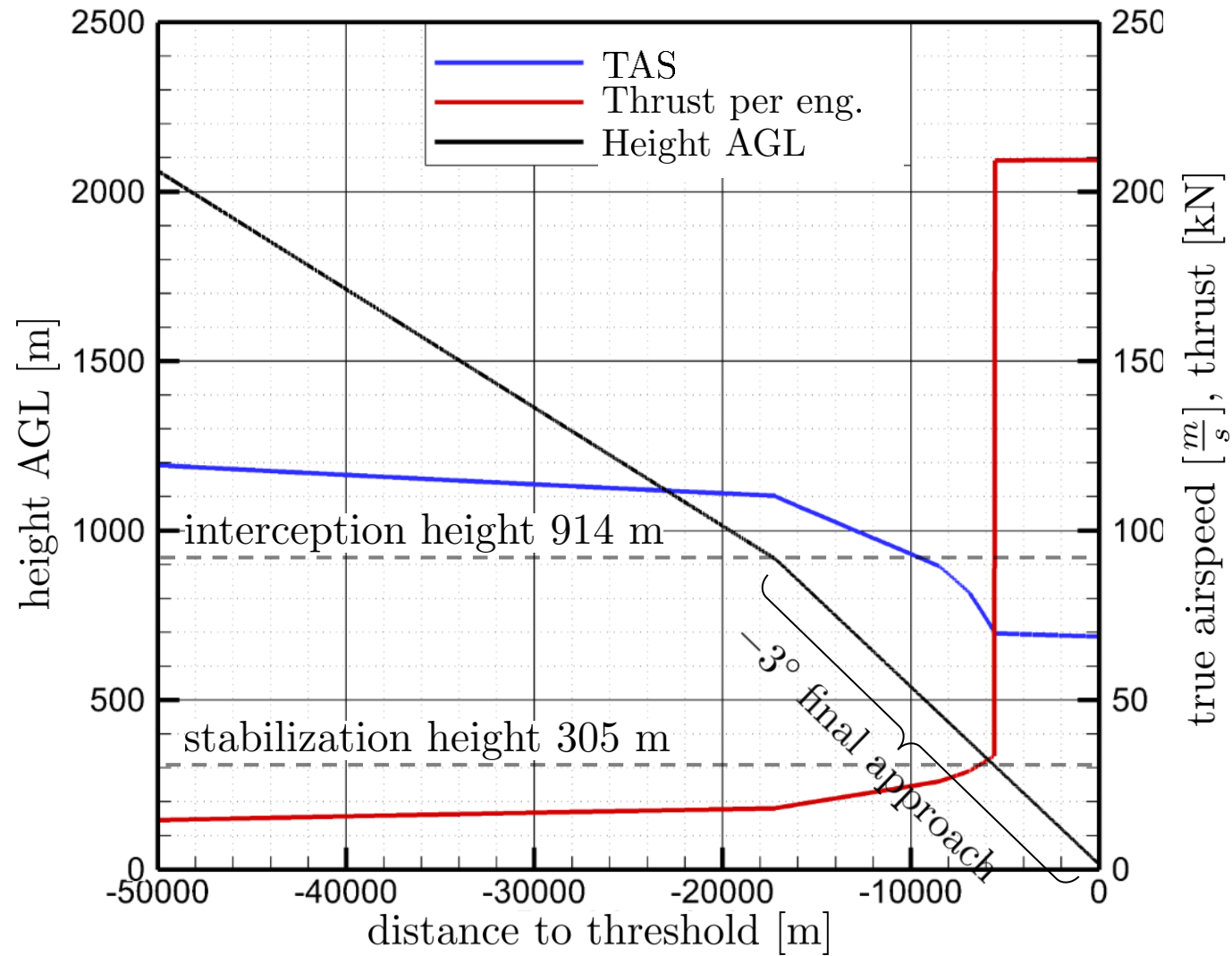
⇒ variation of planform parameters affects flight performance



# Departure procedure

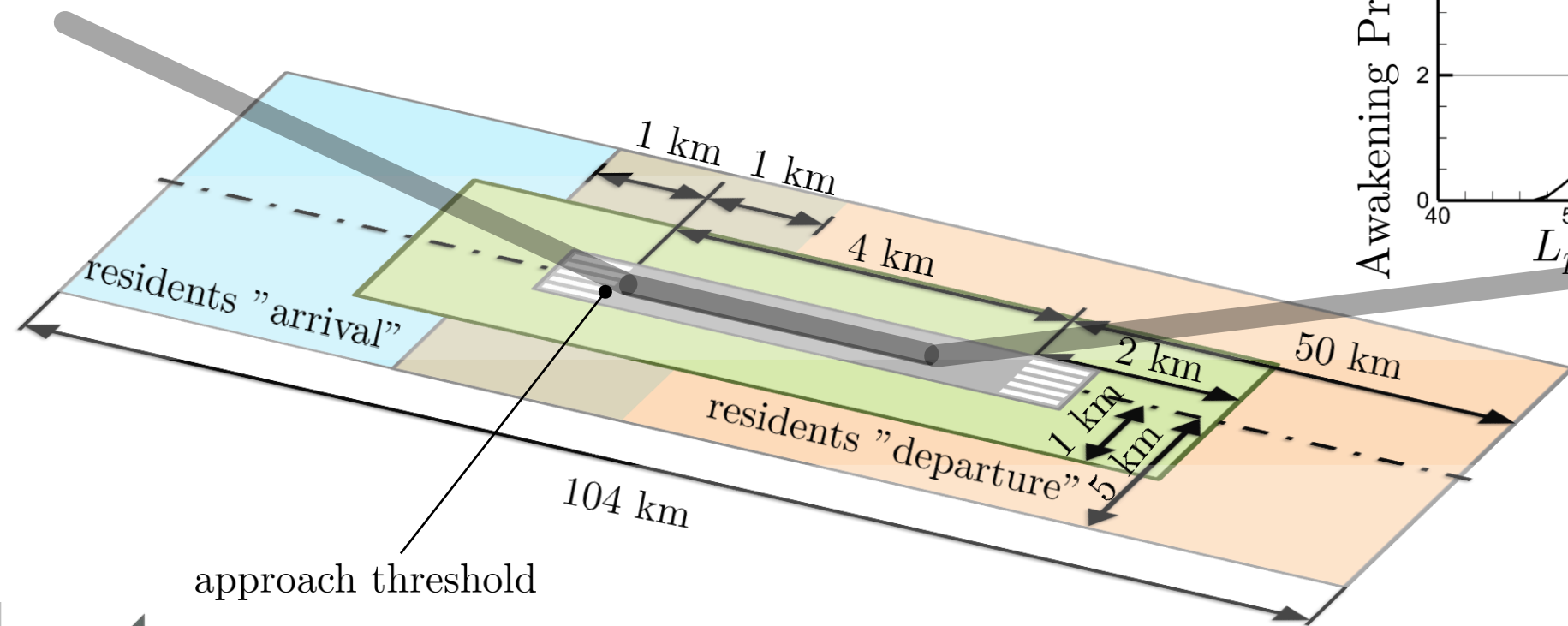
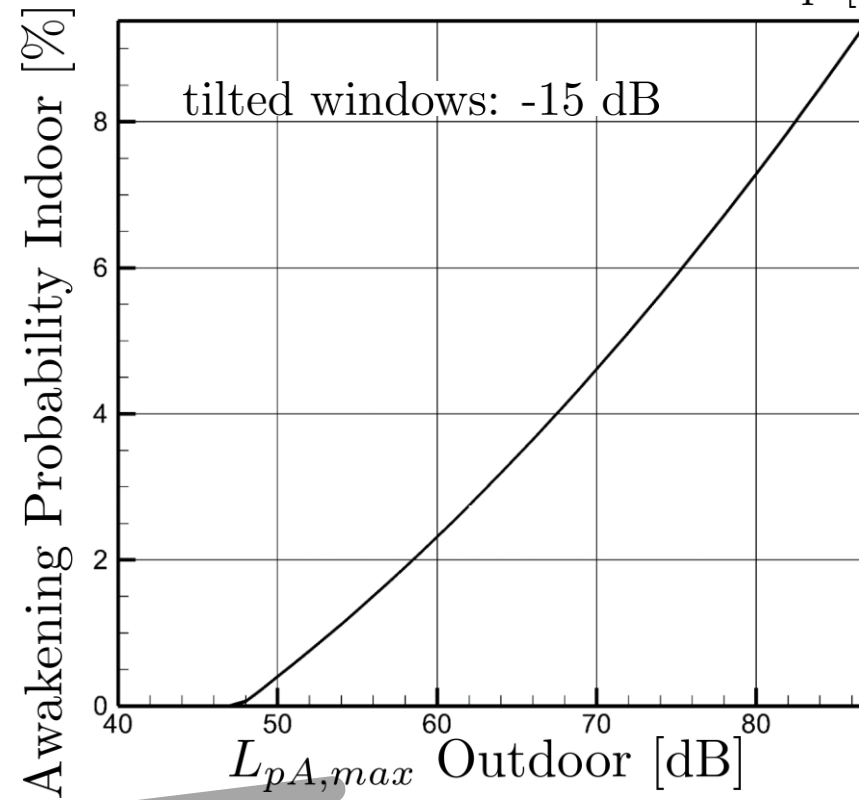


# Approach Procedure



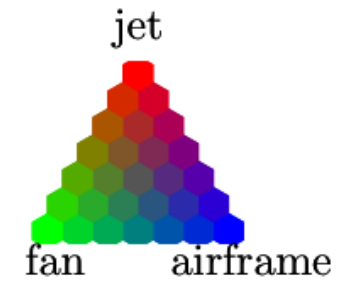
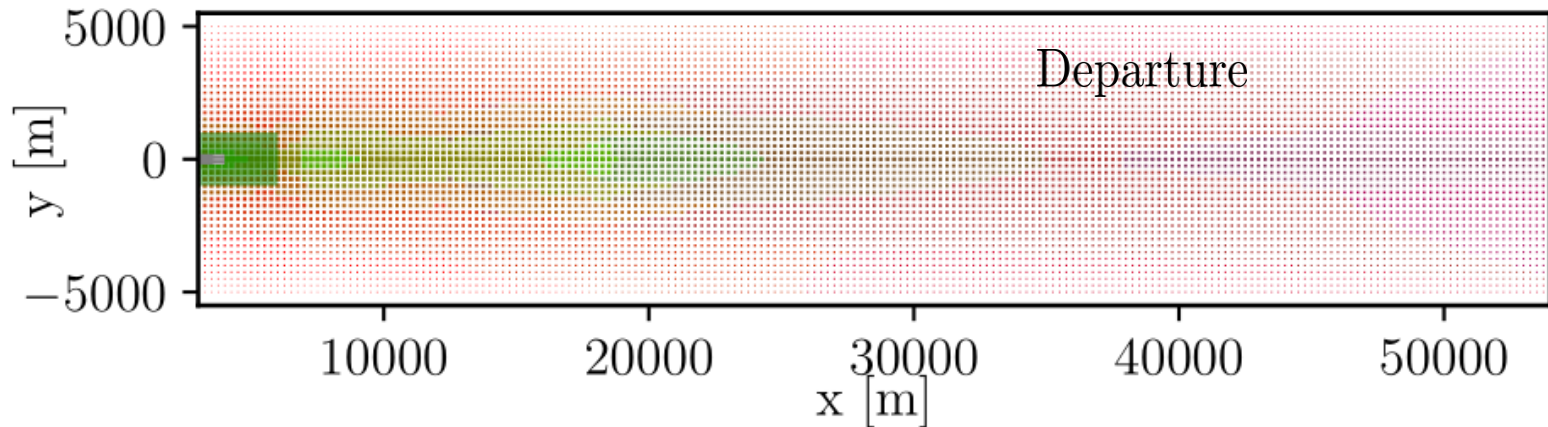
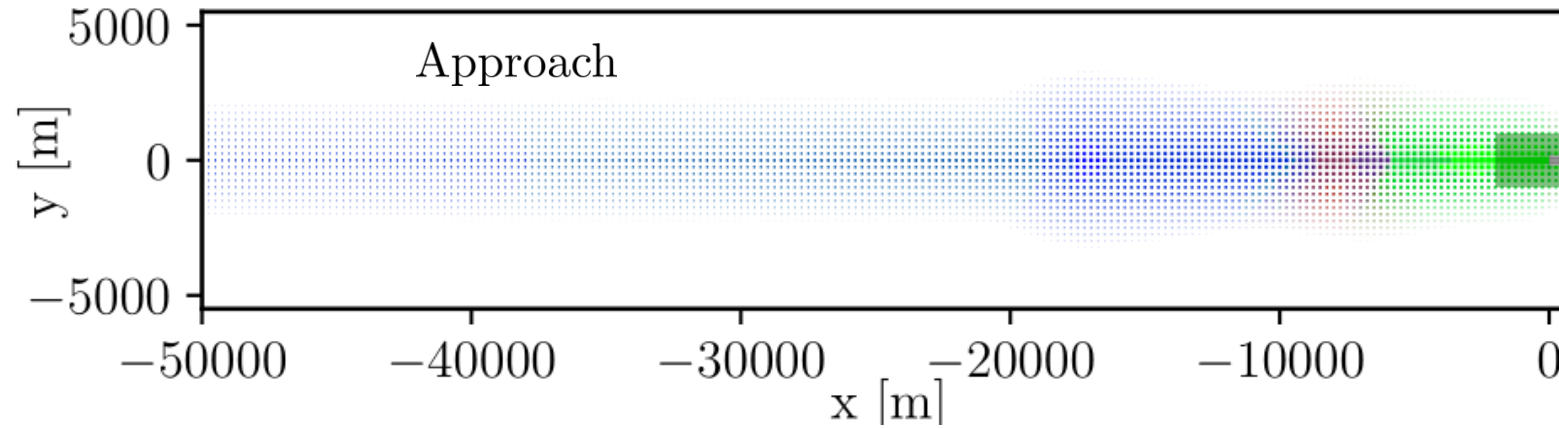
# How to measure the ground noise? Area under investigation

Basner 2006: "Aircraft noise effects on sleep [...]"





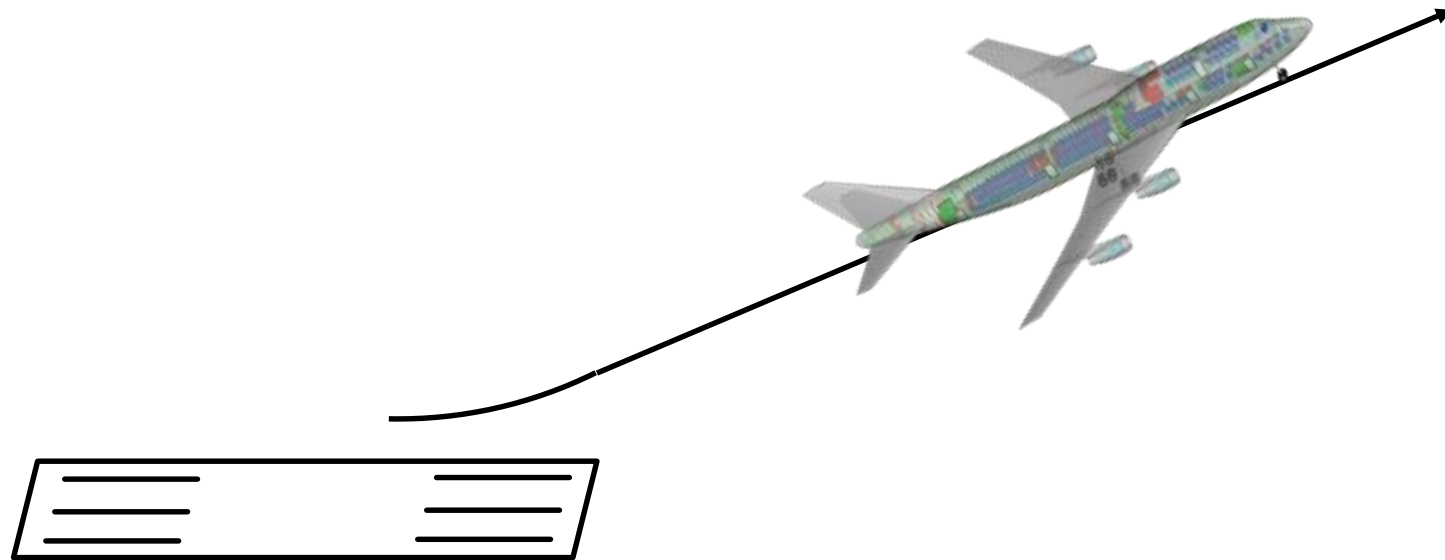
# Awakening Index



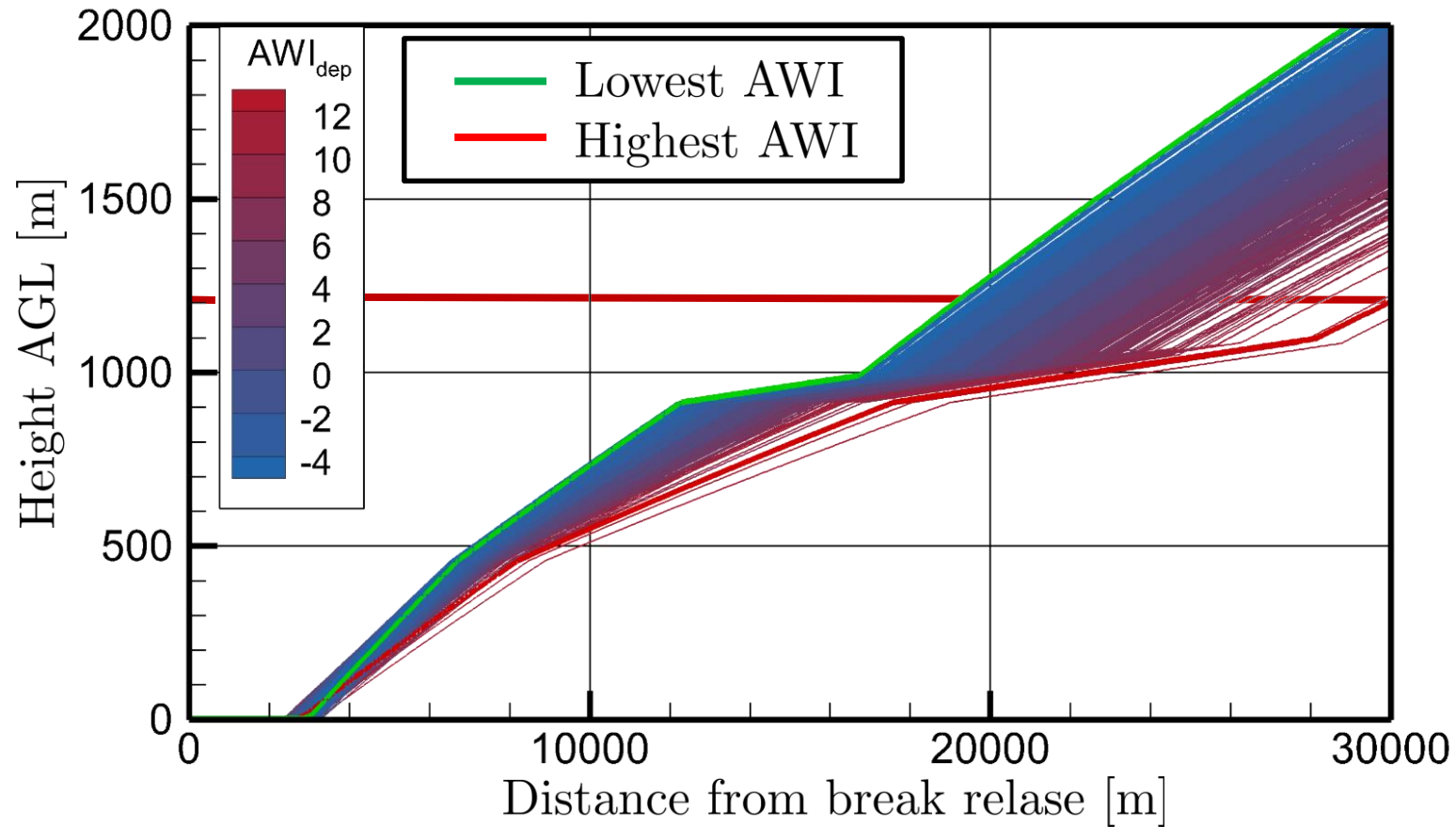
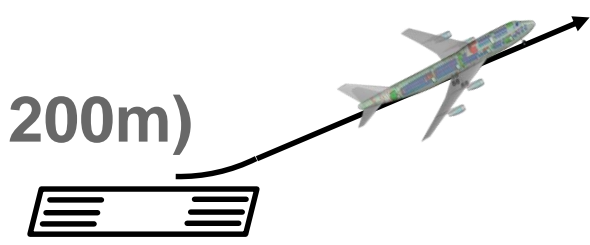
$$AWI [\%] = \frac{N_{awak,A/C} - N_{awak,ref}}{N_{awak,ref}} \cdot 100\%$$



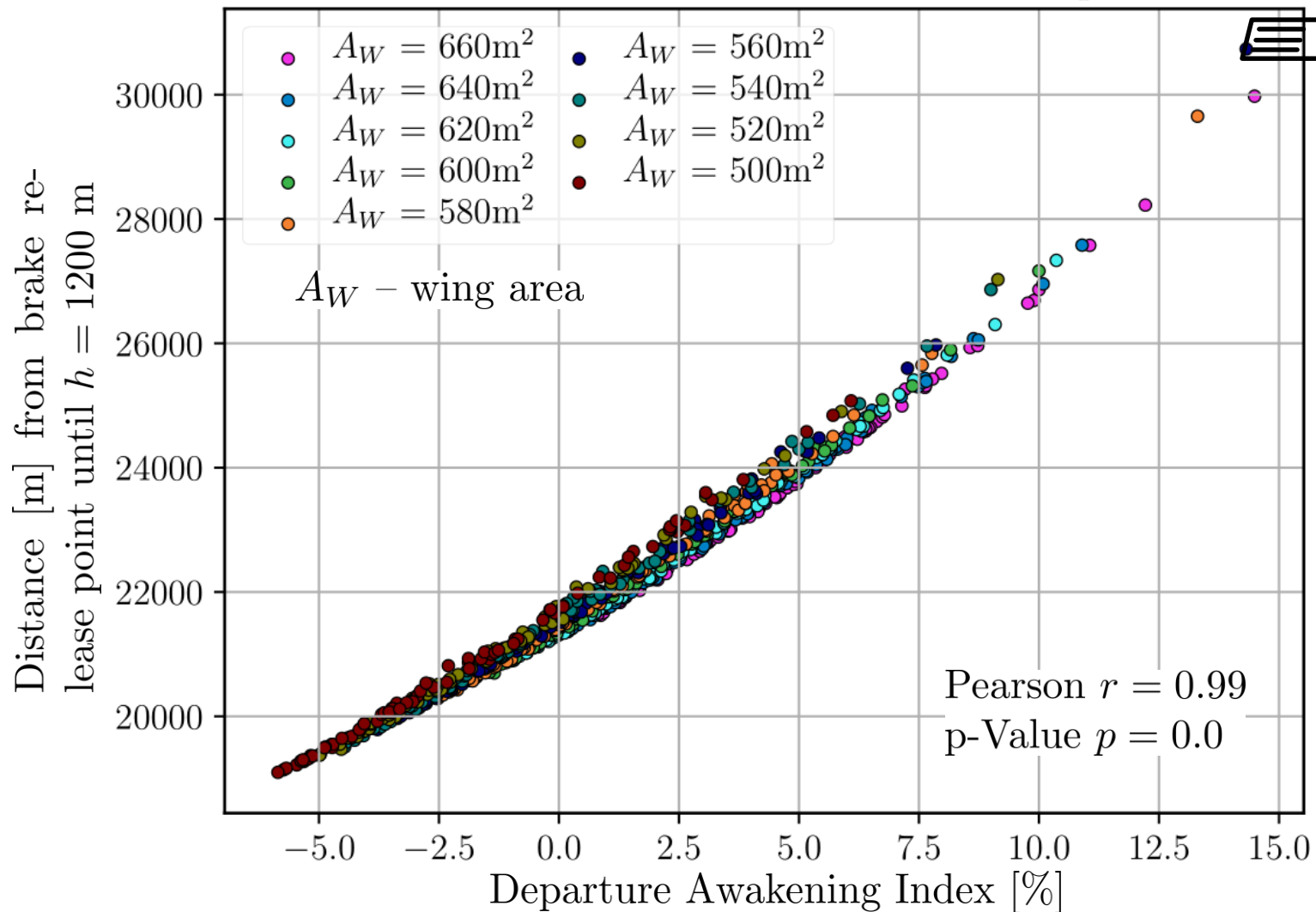
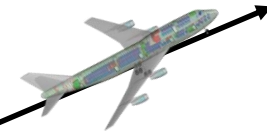
# Departure



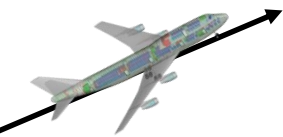
# Departure: correlation between AWI and climb response (1200m)



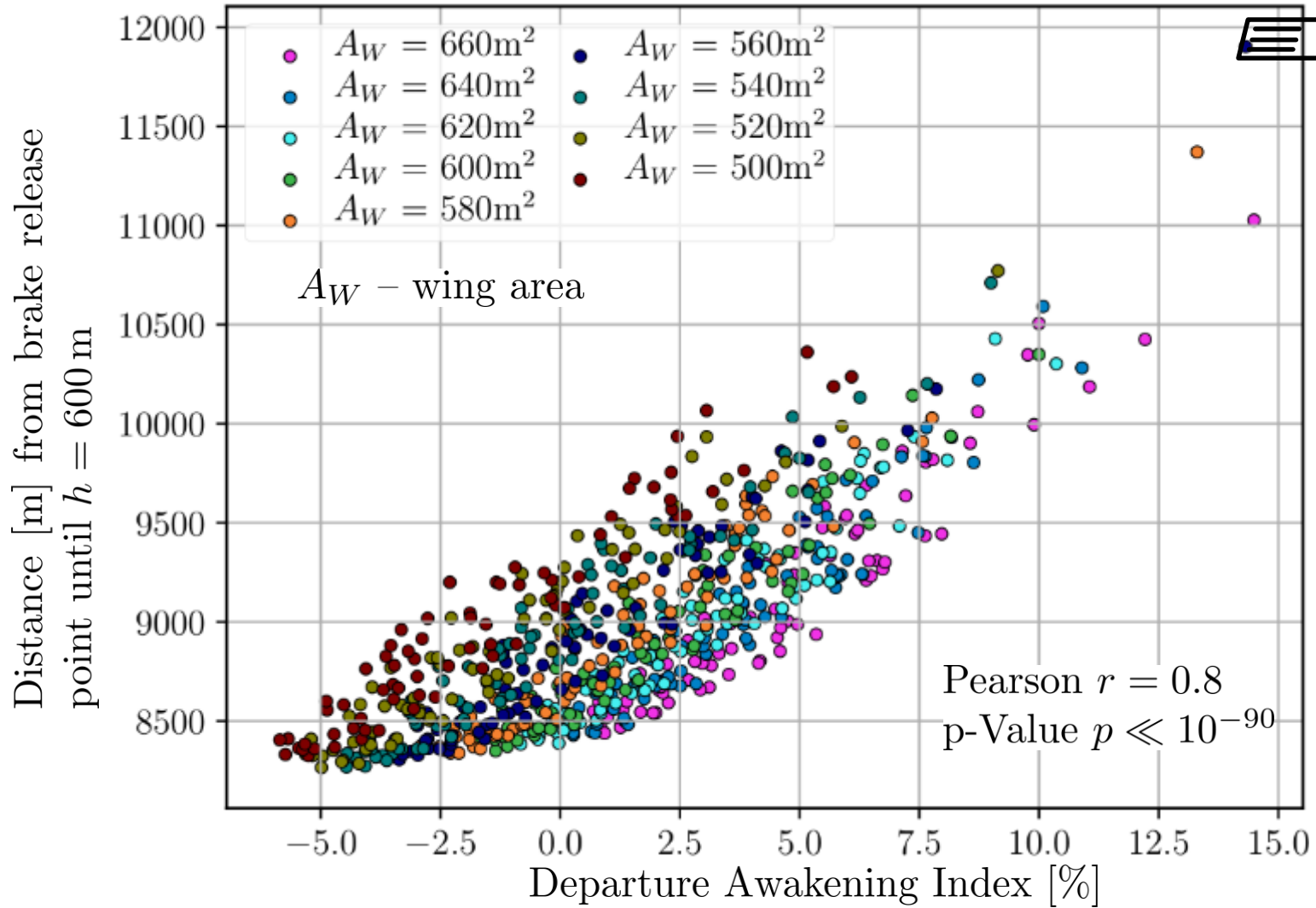
# Departure: correlation between AWI and climb response (1200m)



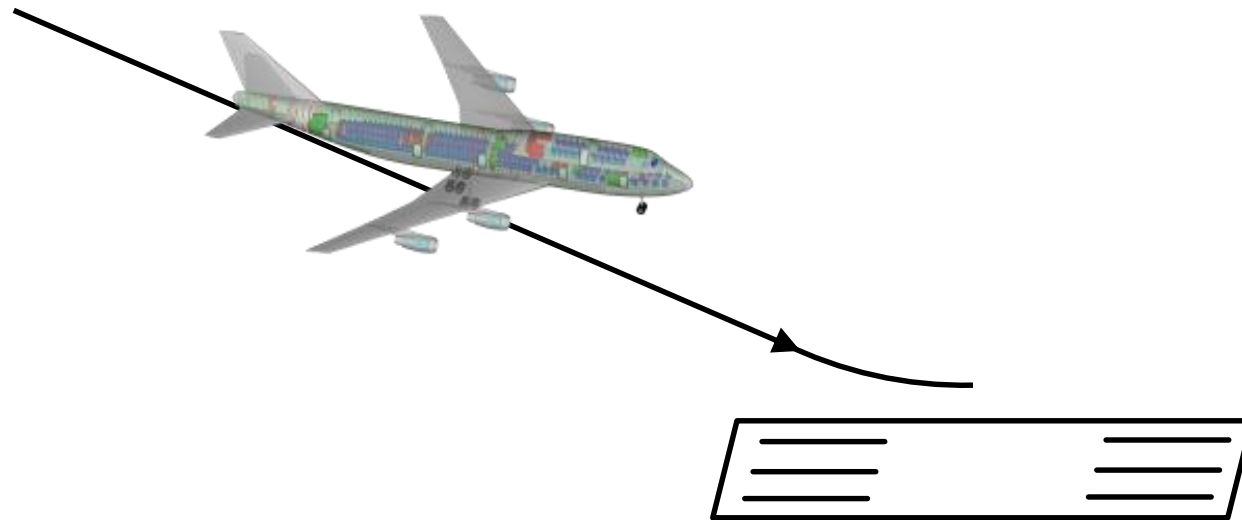


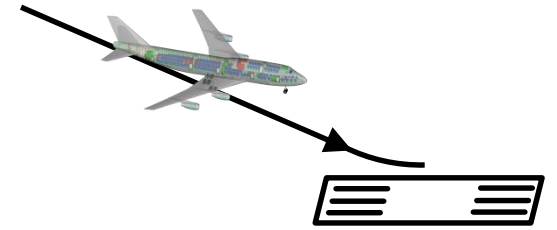


# Departure: correlation between AWI and climb response (600m)

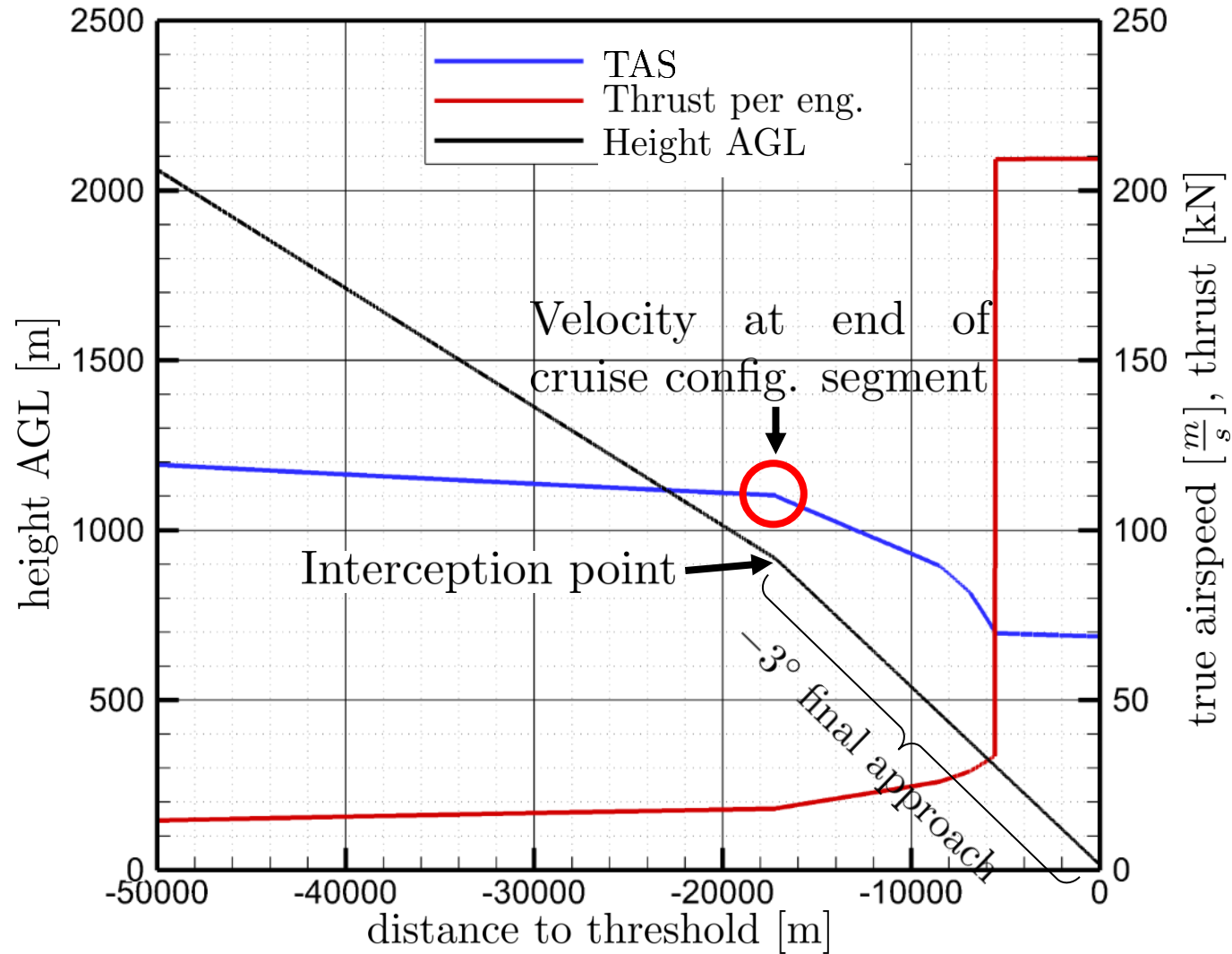


# Approach

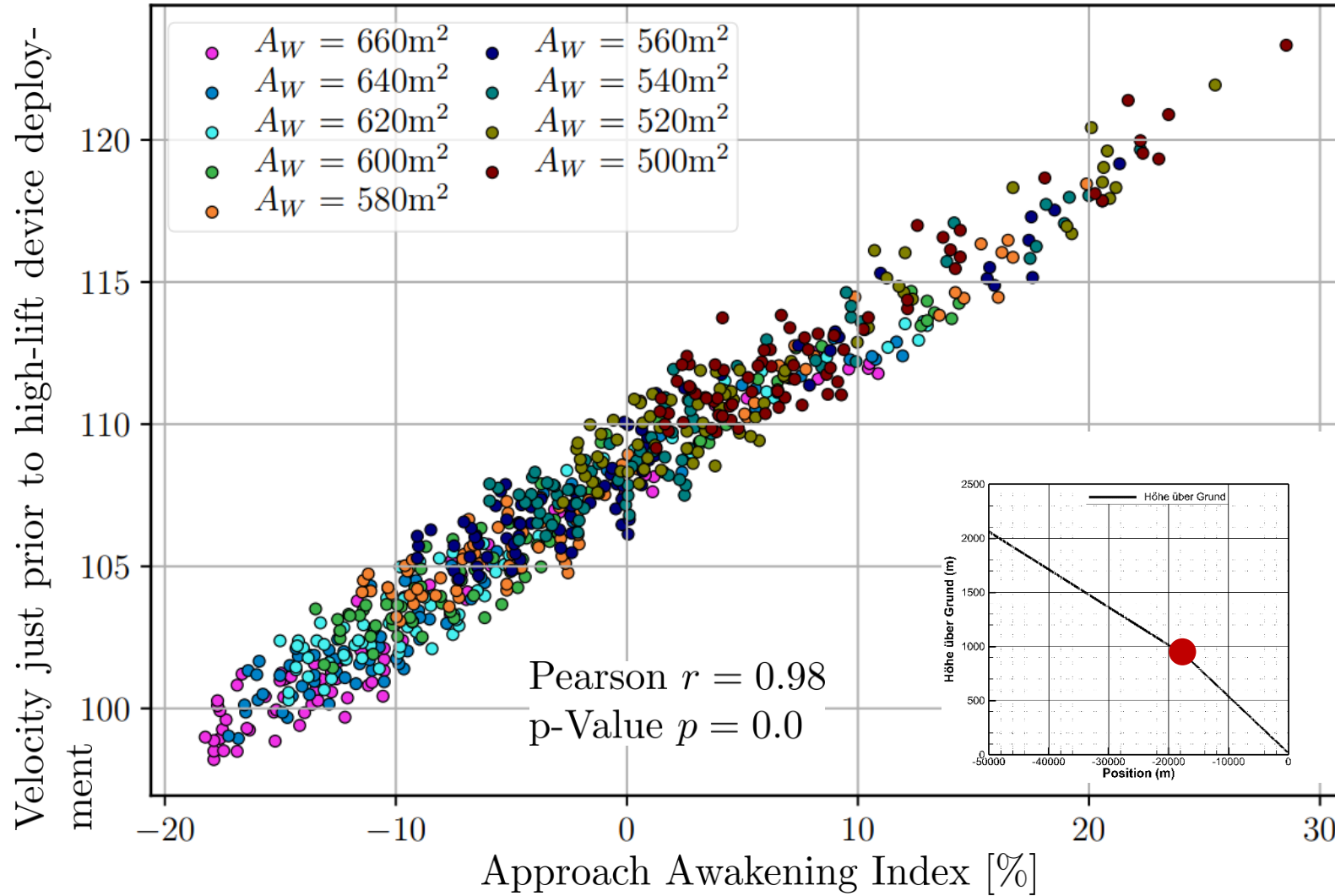
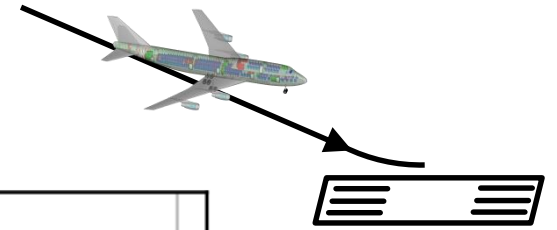




# Approach: Correlation between approach velocity and AWI



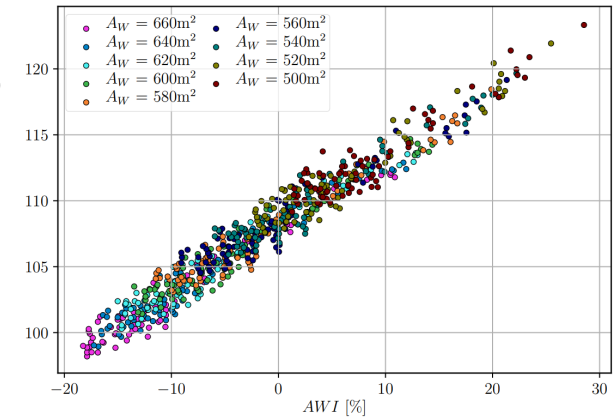
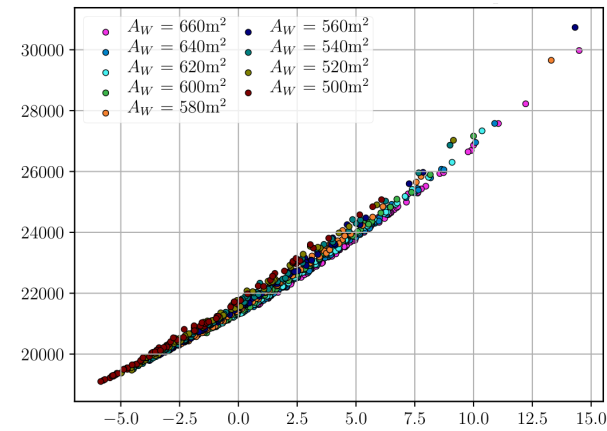
# Approach: Correlation between approach velocity and AWI





# Summary

- **Departure**  
High climb performance  $\Rightarrow$  Quiet departure  
(engine & departure procedure = const.)
- **Approach**  
Slow approach  $\Rightarrow$  quiet approach
- Optimum = combination of optimal departure  
and approach design



## Take Home Message



- An adjusted planform might support your goal of a quiet aircraft design

