

TCAS pilot compliance assessment based on radar data

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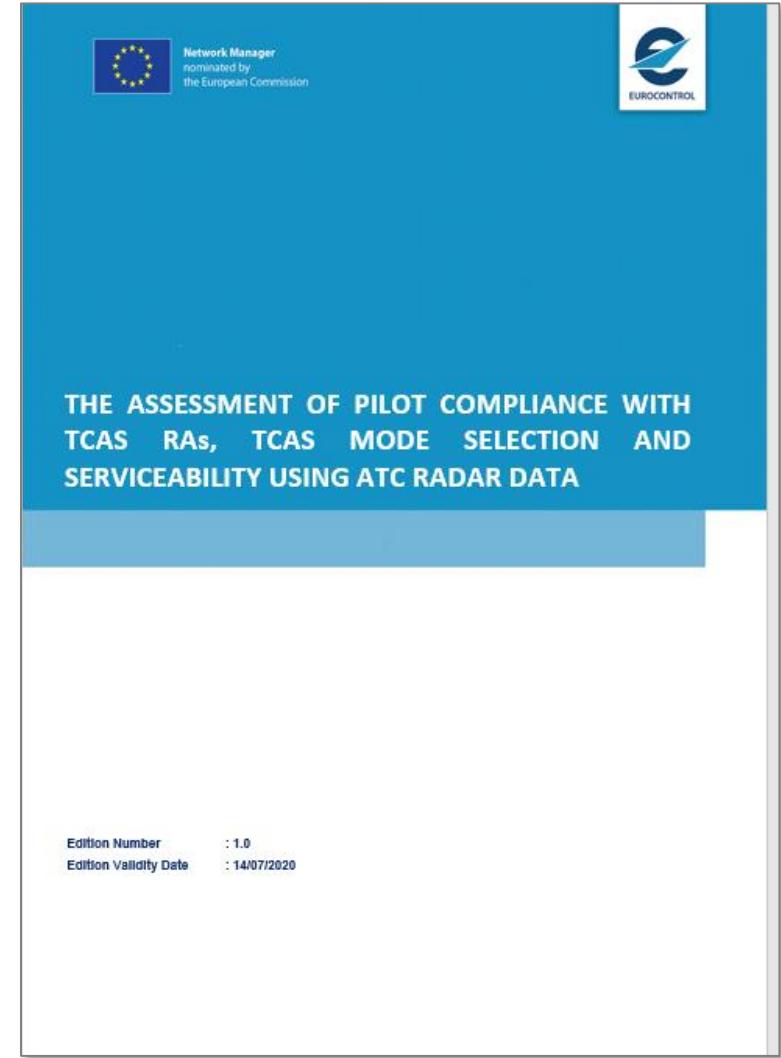
Data analysis – Mateusz Michalski

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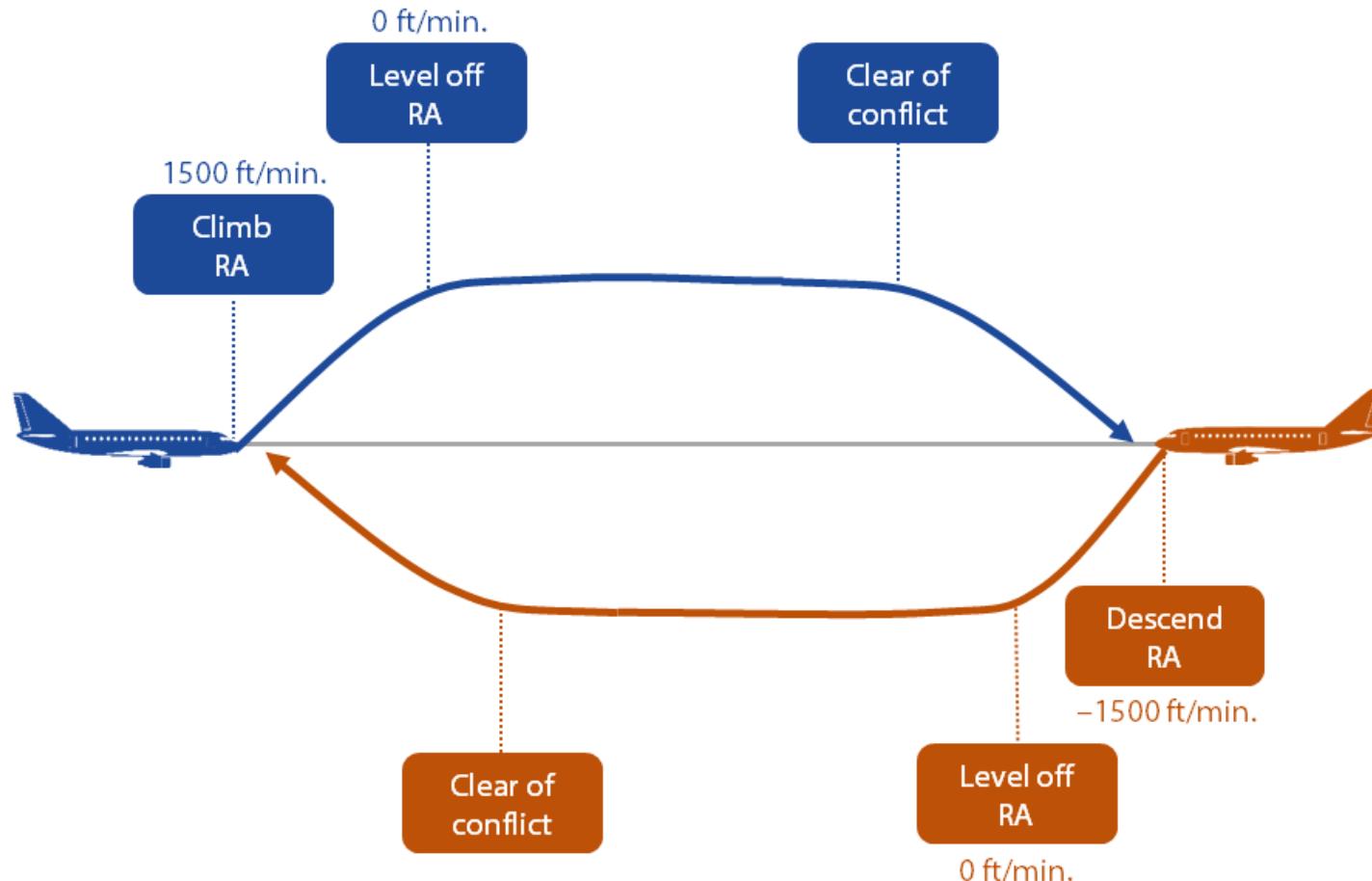
21 September 2020, SAFOPS

Full report

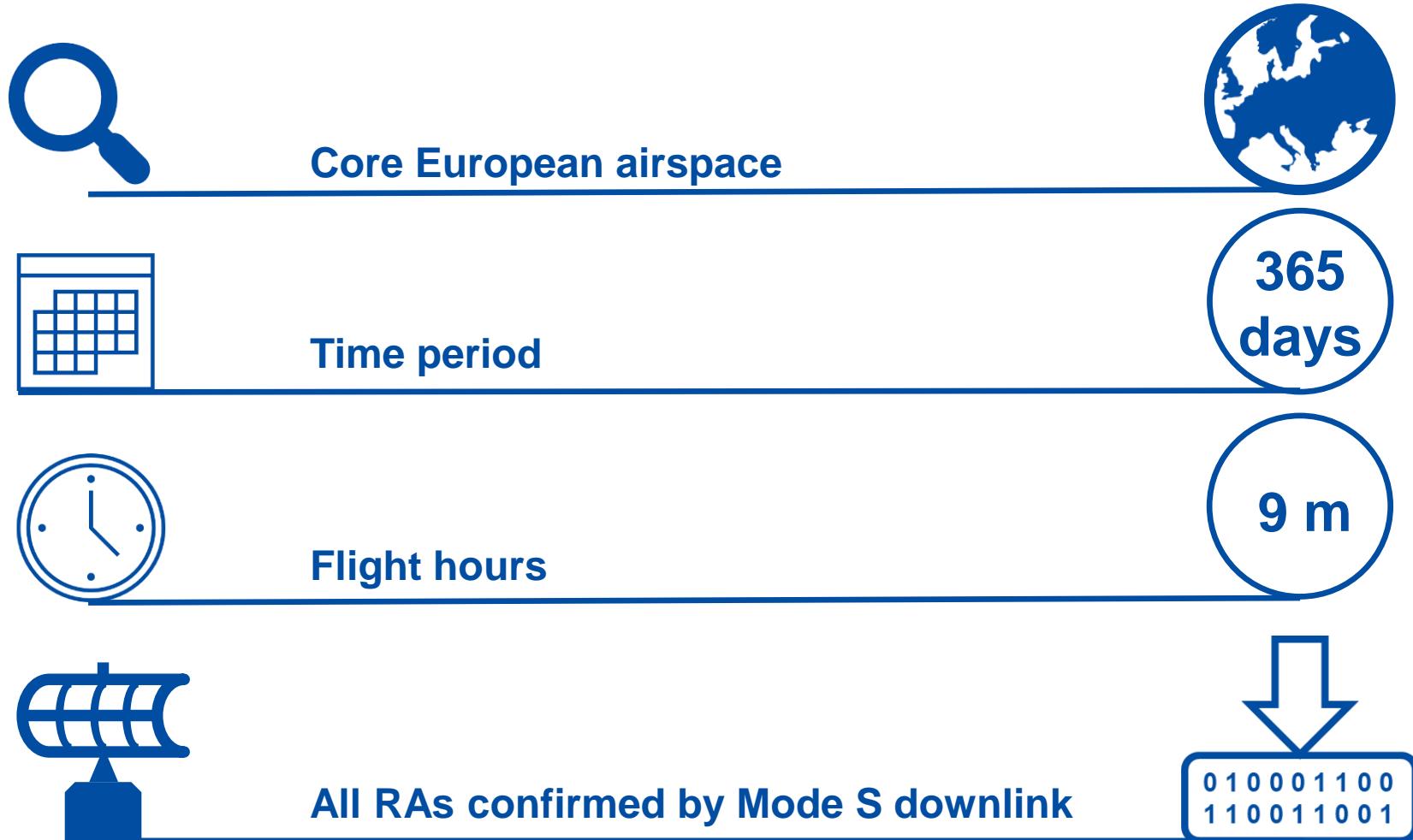
- This presentation is a summary of full pilot compliance study.
- Currently, the report is subject to external and internal review.
- The report contains detailed data and statistics as well as the description of the methodology.



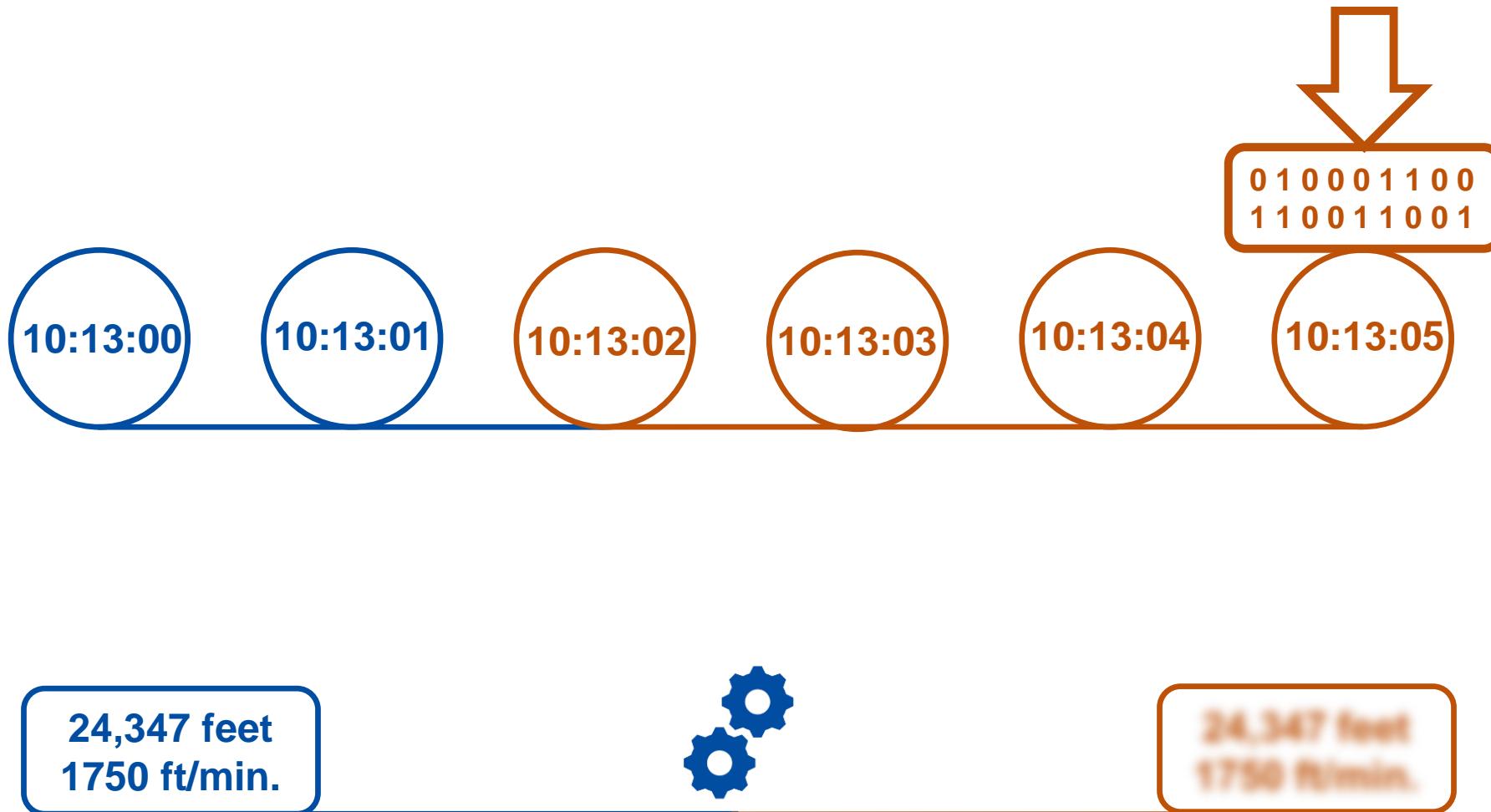
What are TCAS II and Resolution Advisories?



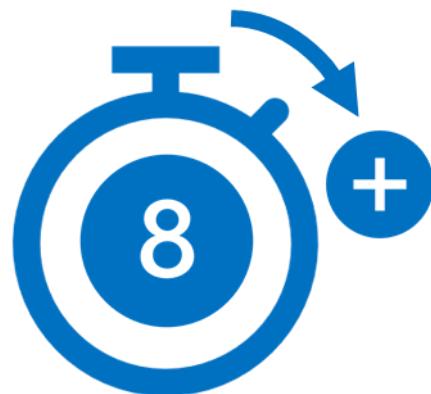
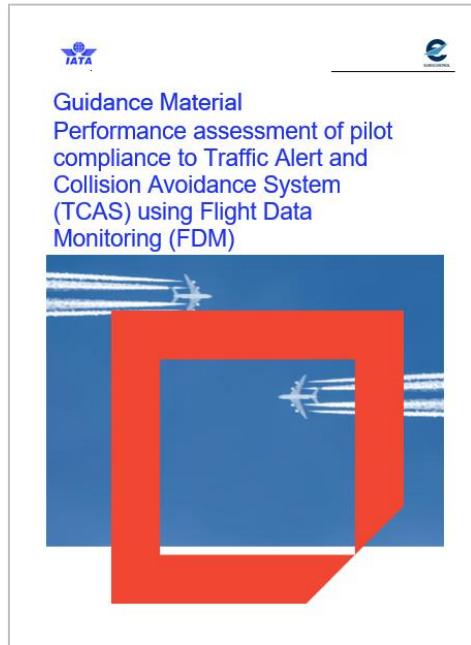
Comprehensive assessment



Limitations



Assessment criteria of pilot responses



Followed

Correct pilot response
(with a margin of error)

***Not followed
too weak response***

Response with insufficient vertical rate
subsequently, referred to as “not followed”

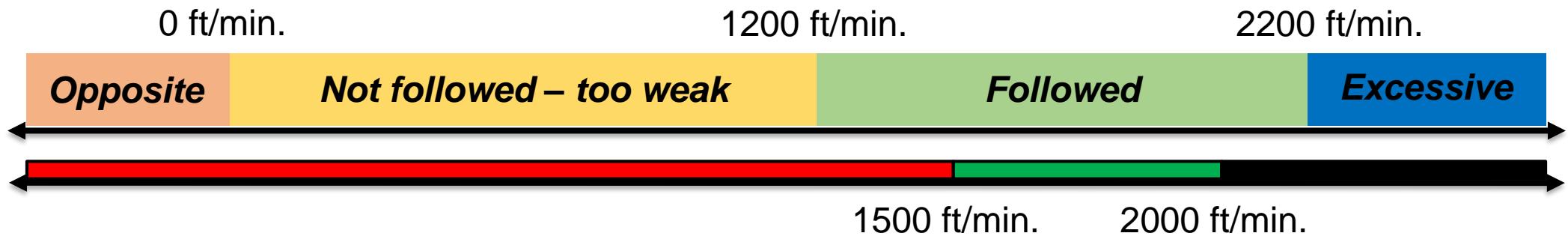
Opposite

Opposite (vertical) sense response

Excessive

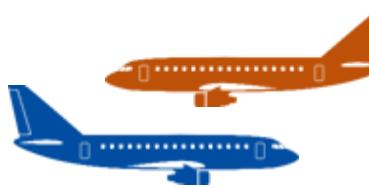
Response with excessive vertical rate

Example – Climb RA



Not to scale

General results



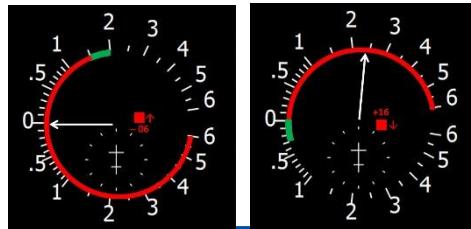
Encounters

1022



RAs (> 8 sec.)

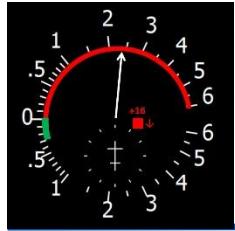
1184



Subsequent RAs

188

Types of first RAs (> 8 sec.)



Level off (while climbing)

407



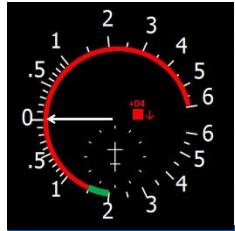
Level off (while descending)

354



Climb

151



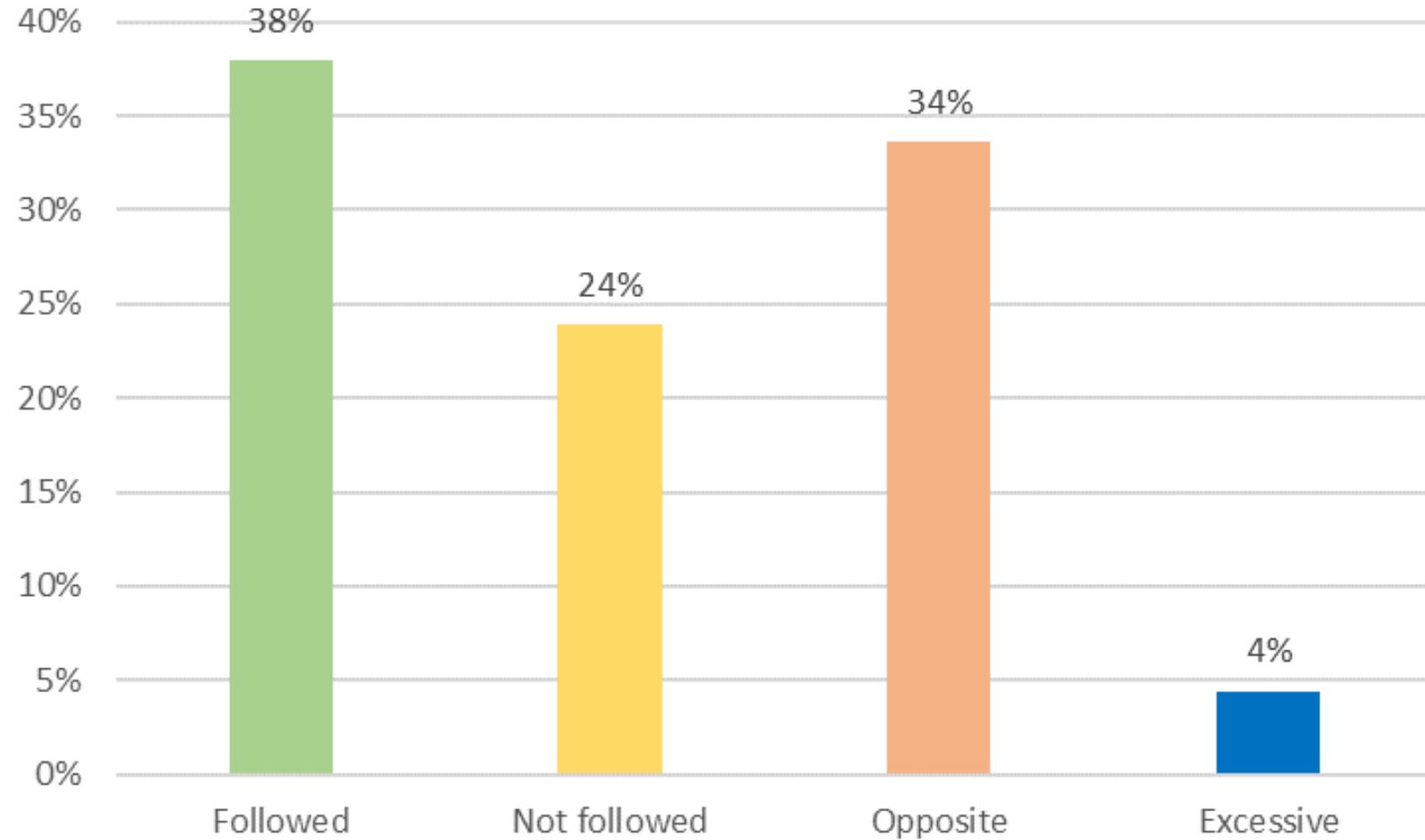
Descend

122

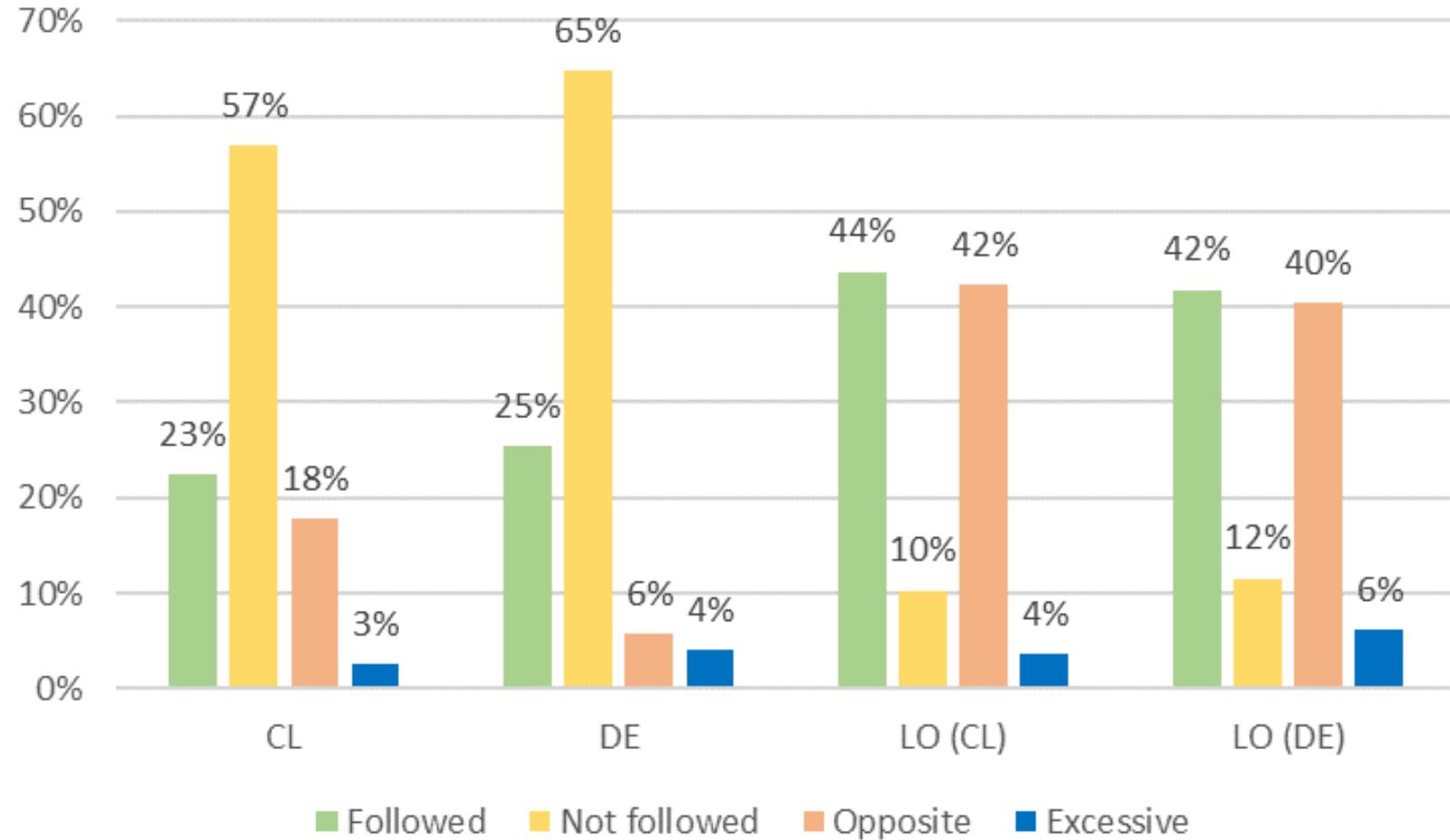
Other RAs
(not assessed)

150

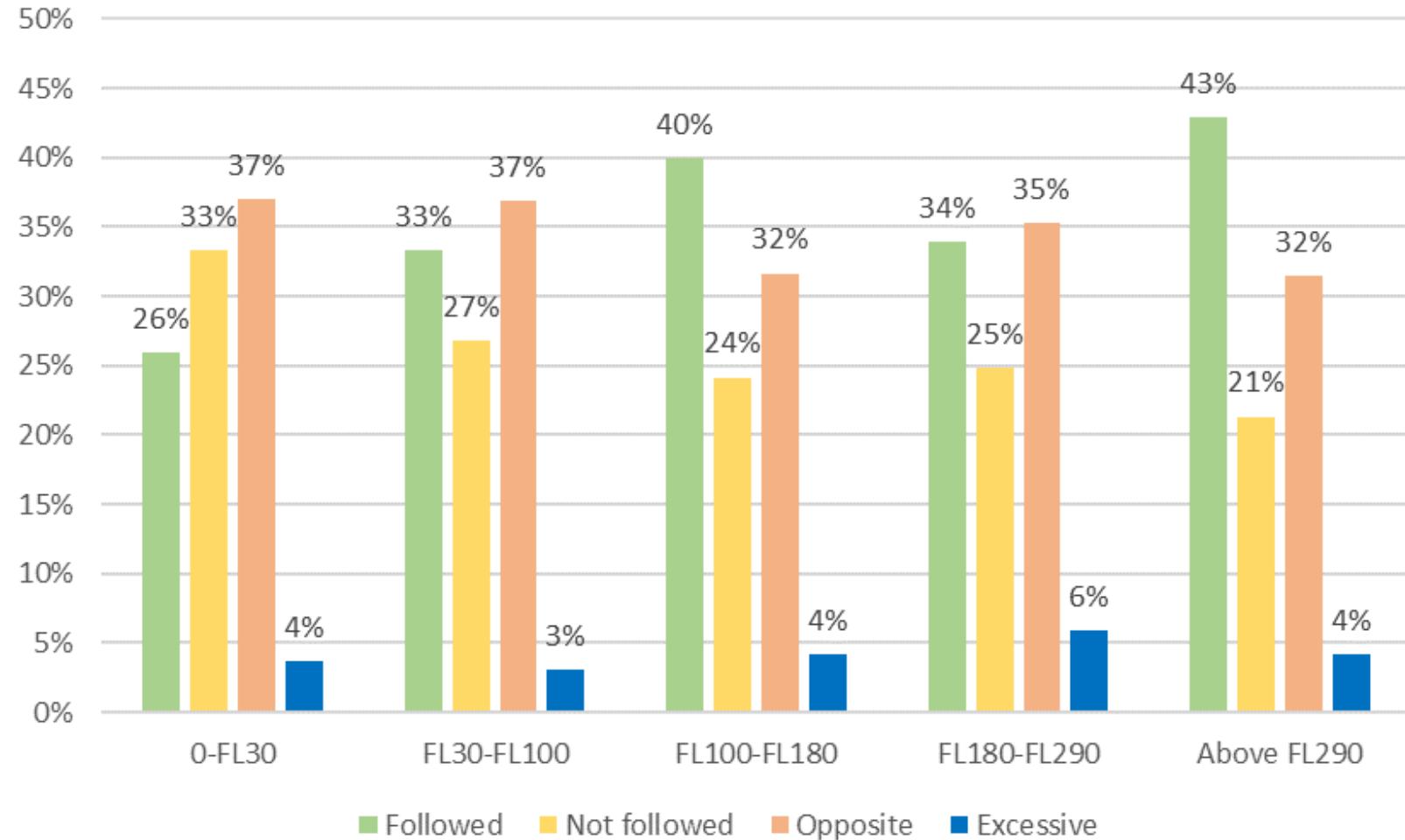
Pilot compliance 1st RA



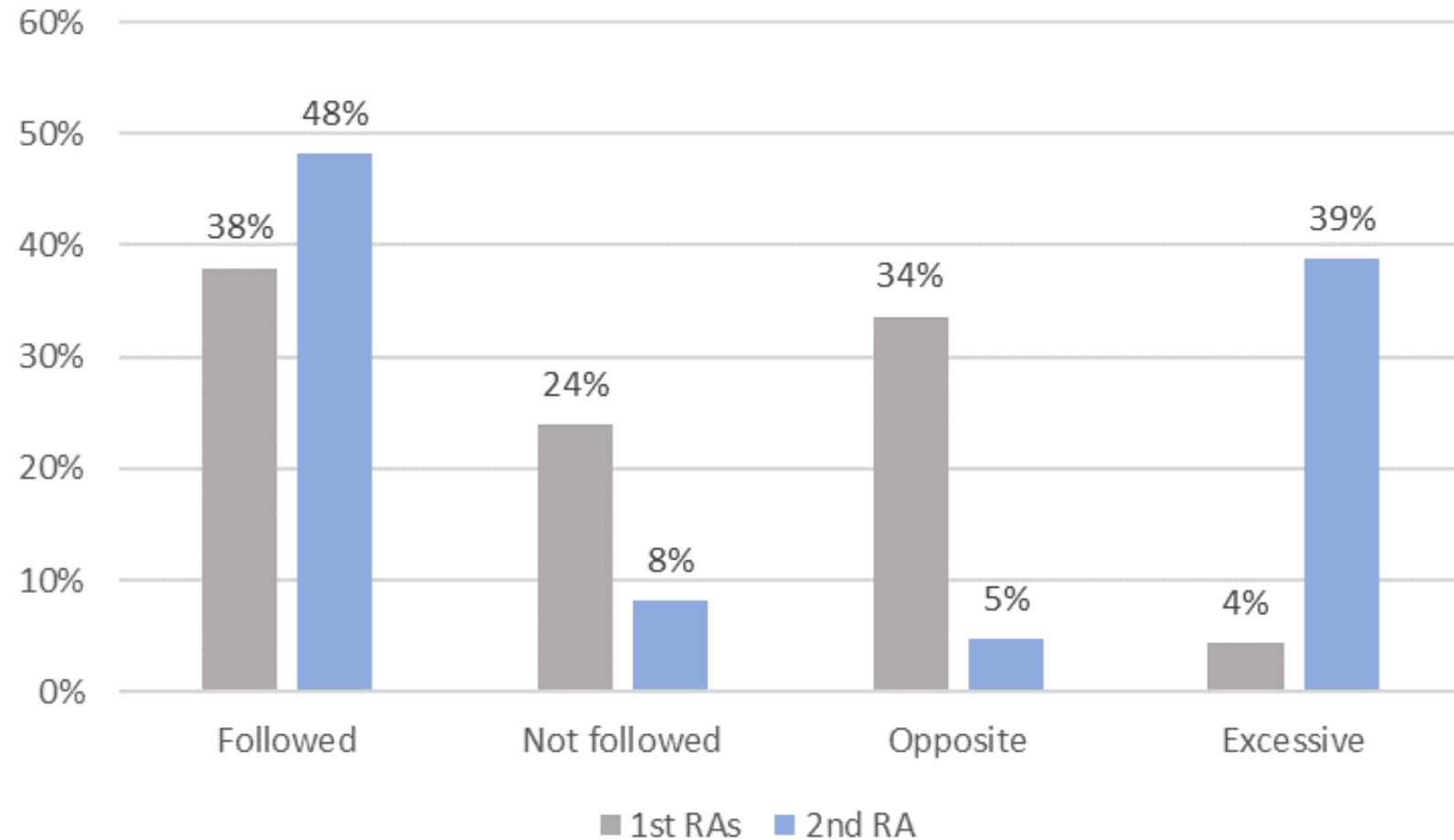
Pilot compliance 1st RA: by RA type



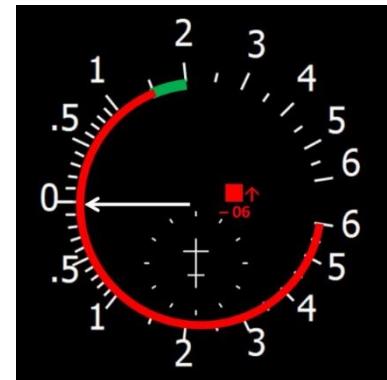
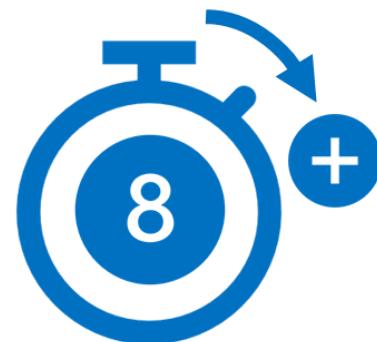
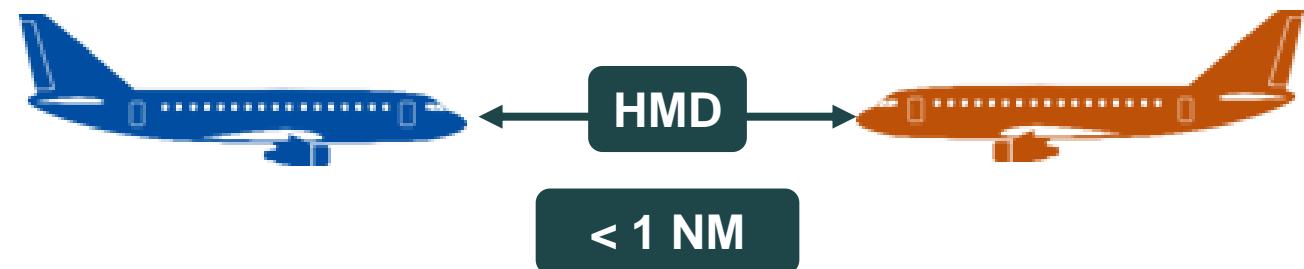
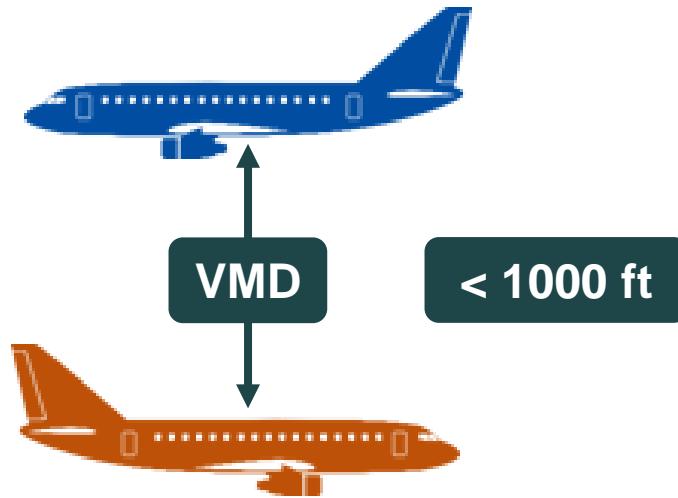
Pilot compliance 1st RA: by altitude



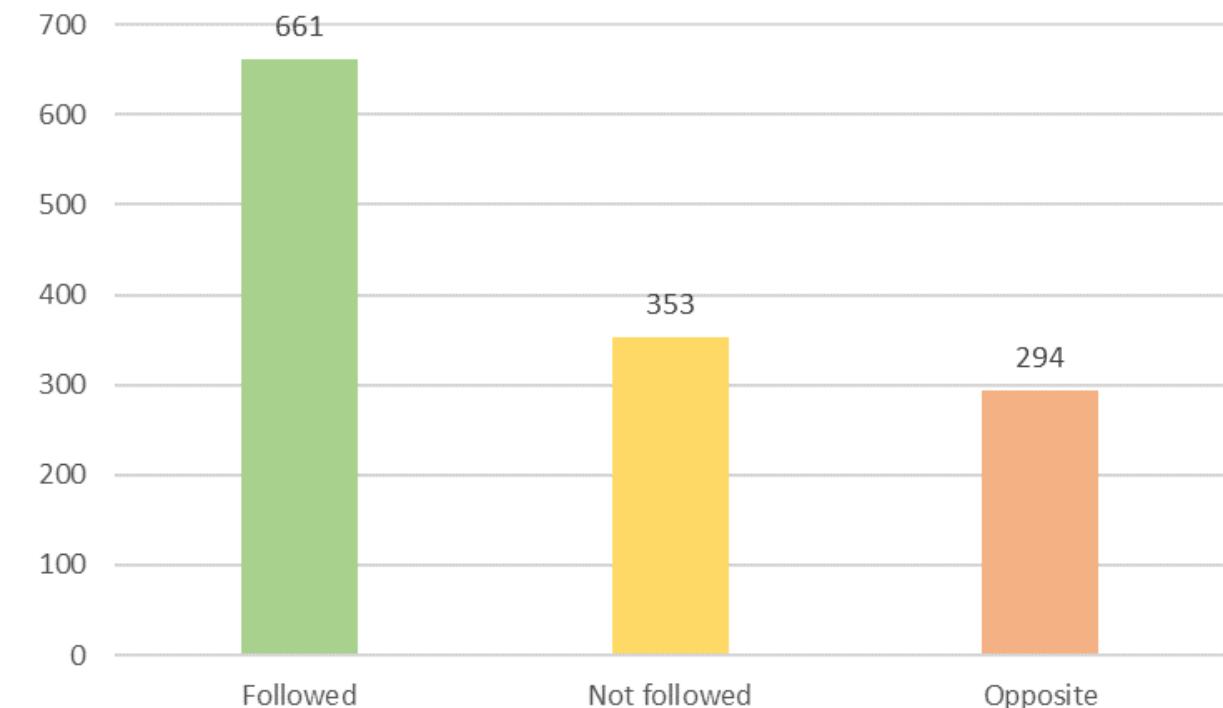
Pilot compliance 2nd RA



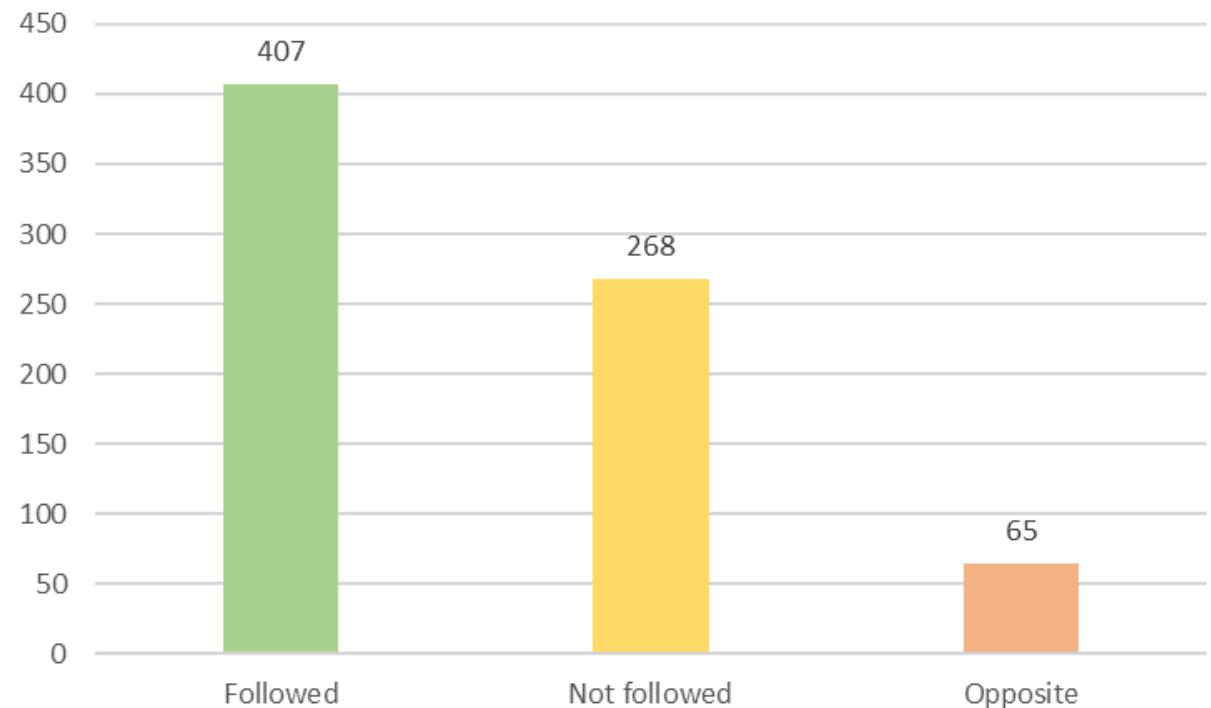
Pilot compliance vs. Vertical Miss Distances (VMD)



Average VMD



Average VMD – Climb RAs



Average VMD – Descend RAs

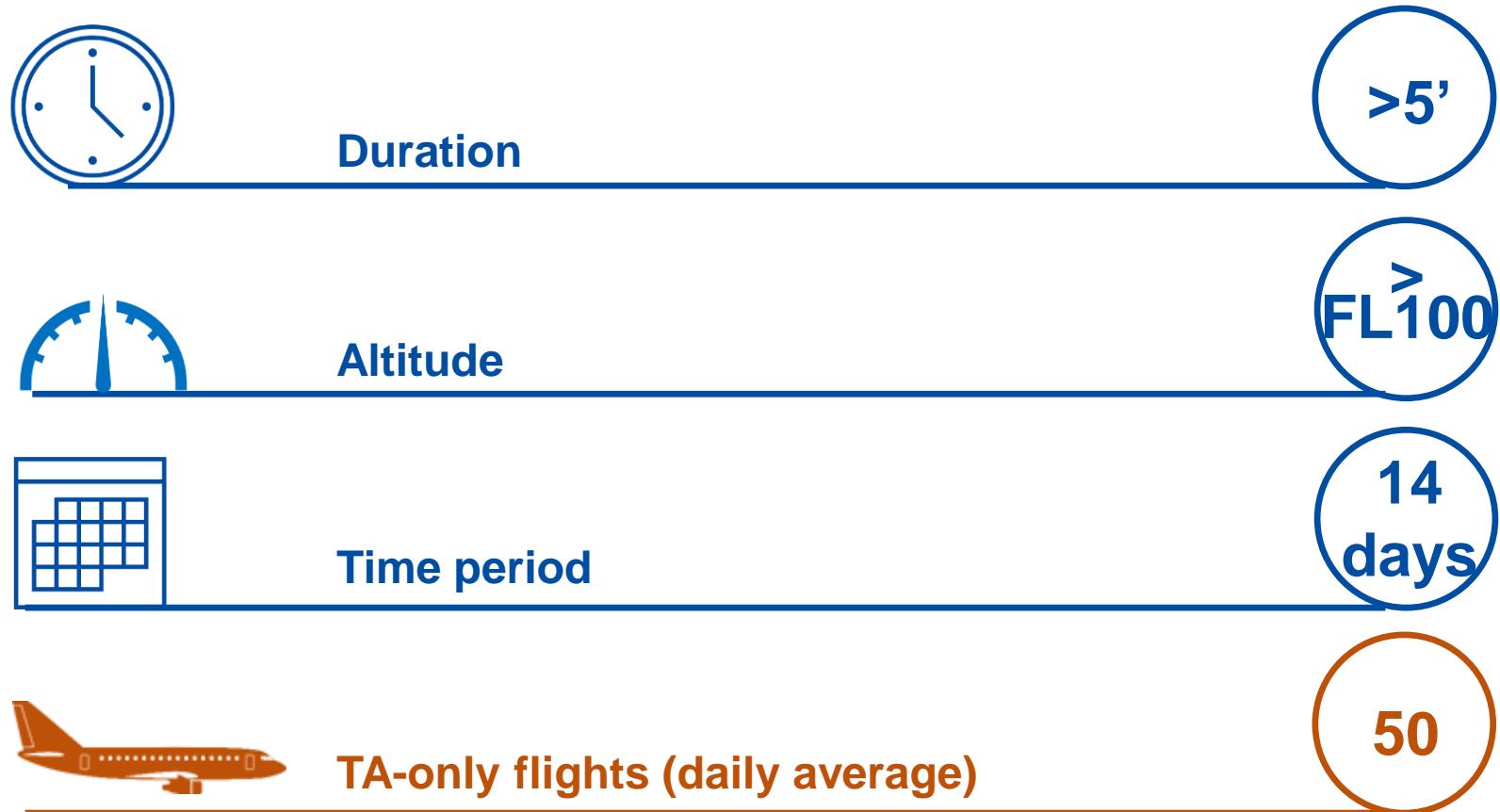
Pilot TCAS RA compliance conclusions

- A significant proportion of RAs are not flown correctly.
- Level Off RAs have with the highest level of compliance. The number of Level Off RAs are also the most frequent RAs.
- For Climb and Descend RAs, the compliance never exceeded 30%, with opposite reactions reaching 22%.
- The examination of Vertical Miss Distances confirmed that in the absence of correct pilot response, the vertical separation at the Closest Point of Approach is significantly reduced.

Assessment of TCAS operating mode selection



Assessment of TCAS operating mode selection



Assessment of TCAS serviceability

