



Human and technical performance aspects in RPAS integration trials in controlled airspace

The DEMORPAS Project

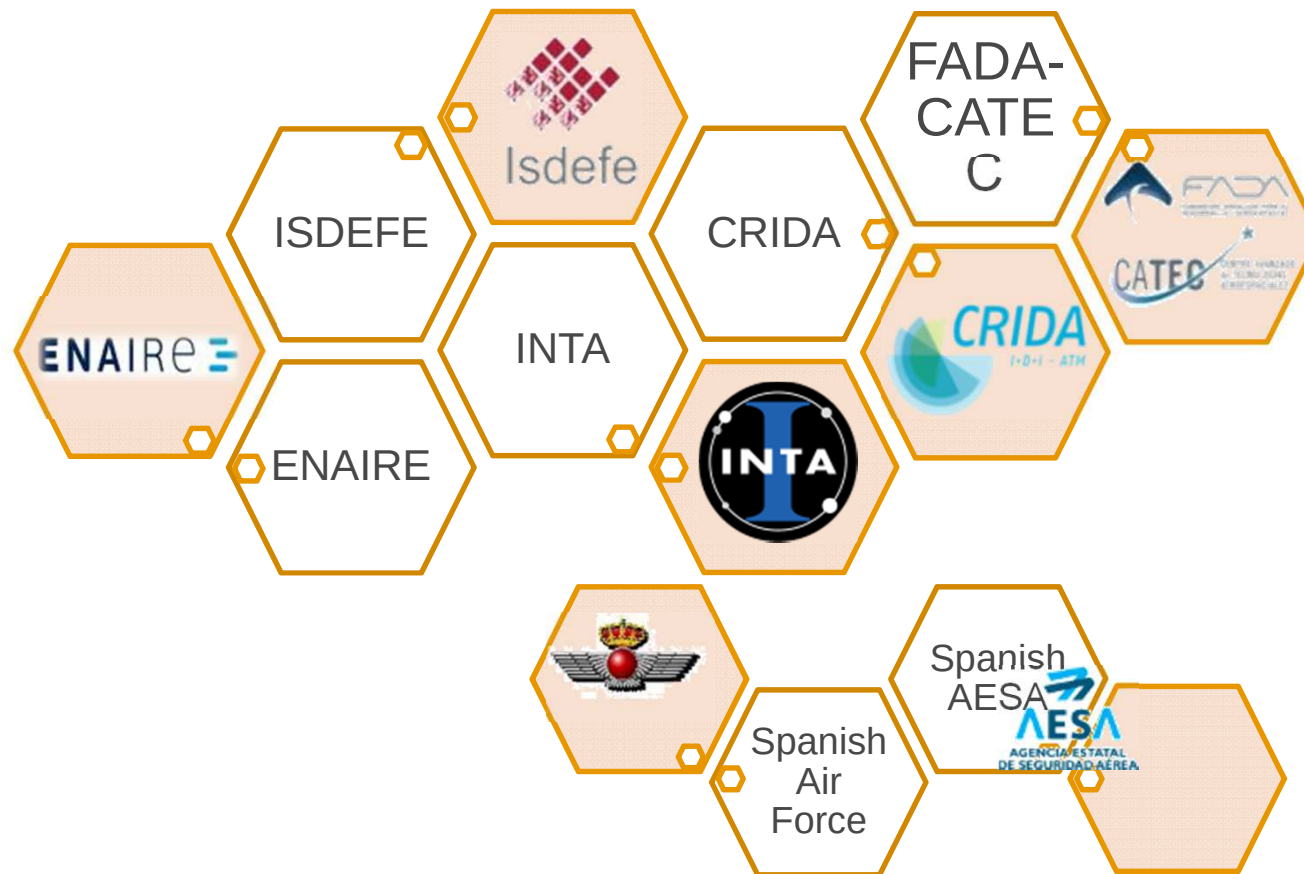


9th November 2016, SIDs, Delft

Mission Statement and objectives

*“DEMORPAS has been a demonstration project that aimed at demonstrating **how to integrate RPAS into non-segregated airspace in a manned and unmanned multi-aircraft flight environment**”*

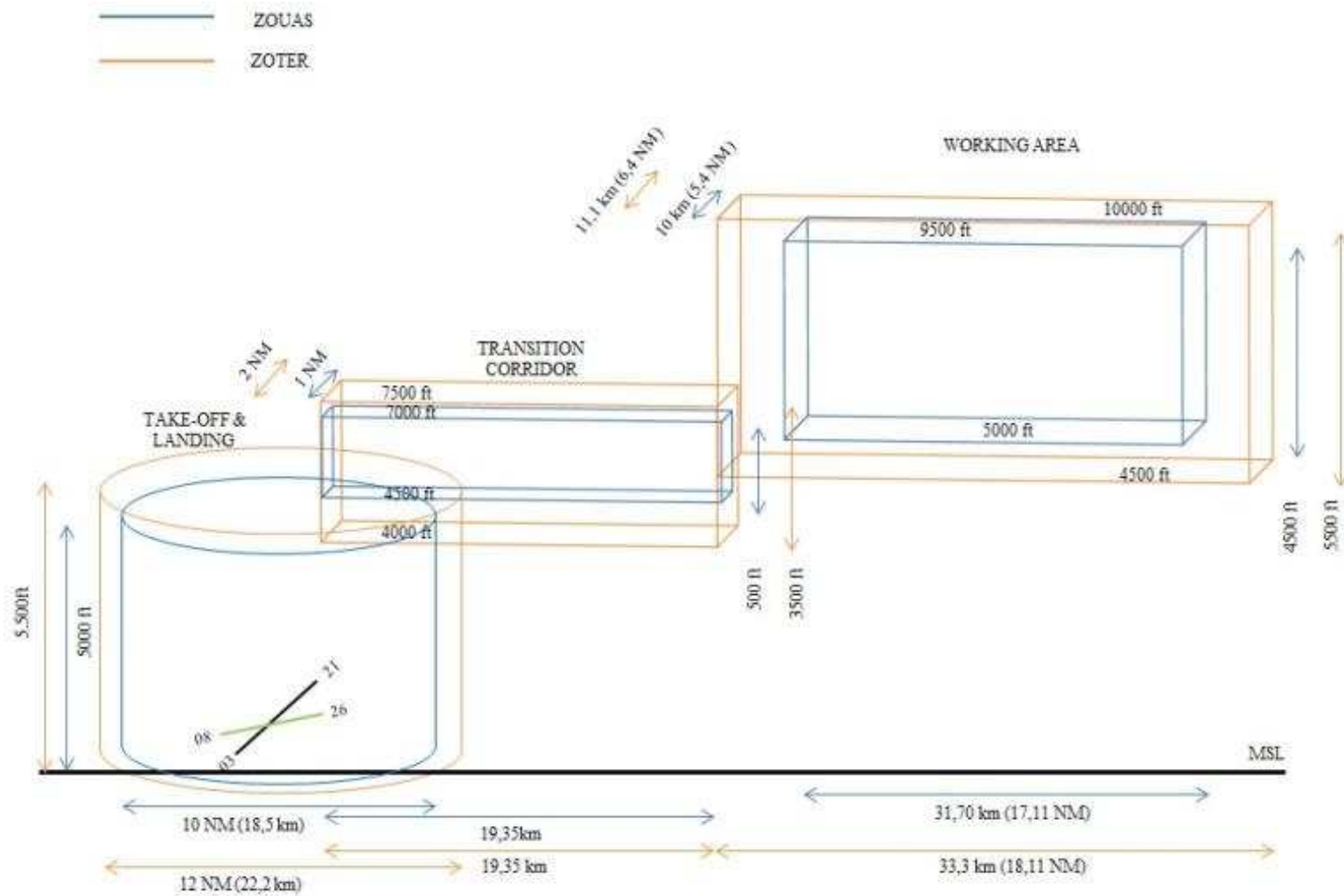
-  Demonstration of the **feasibility** of introducing **RPAS in non-segregated airspace**
-  Potential **solutions** in the areas where integration problems exist
-  Performance of **real RPAS flights** in a mixed environment under air traffic control
-  Assessment on the impact of RPAS integration with manned aircraft on **human actors**
-  Assessment on the **reliability on RPAS trajectories** and their capability of flying standard procedures



SESAR Innovation Days 2016 - Delft



Operational Environment



Resources

- RPAS ALO
- STEMME S-15
- SINA position

STEMME S-15	
Wingspan	18 m
MOTW	1100kg
Maximum Cruising Speed	113Kts (210 km/h)
Range	1100 km
Ceiling	16000 ft (4880 m)
Operational endurance	6 hours

system



Exercises

■ First Exercise

◆ RPAS ALO

◆ ATC

- Remote Pilots and Air Traffic Controllers→ get used to each other and to RPA behavior.



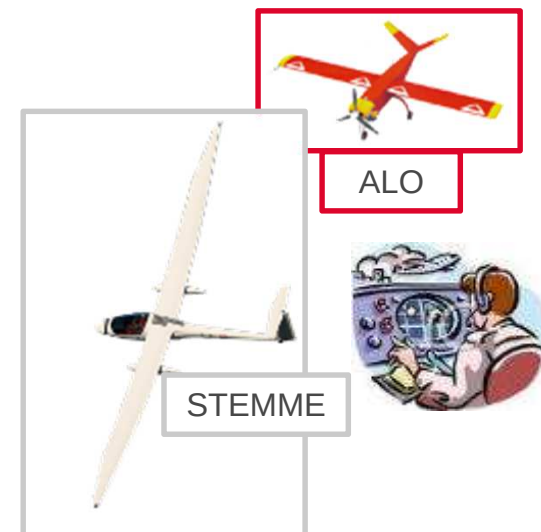
■ Second Exercise

◆ RPAS ALO

◆ STEMME S-15

◆ ATC

- RPAS and Manned Aircraft sharing airspace→ assess perception of the actors.
- Conclusions about stress can be derived.



1st Exercise execution

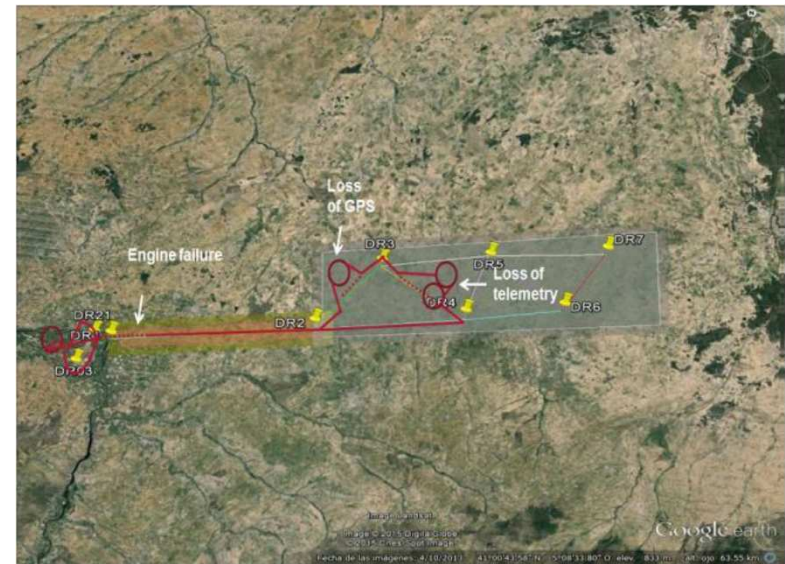
■ Operational Scenario

- ◆ Execution of ad-hoc procedures.
- ◆ RPA asks to modify its flight plan to perform a surveillance mission.



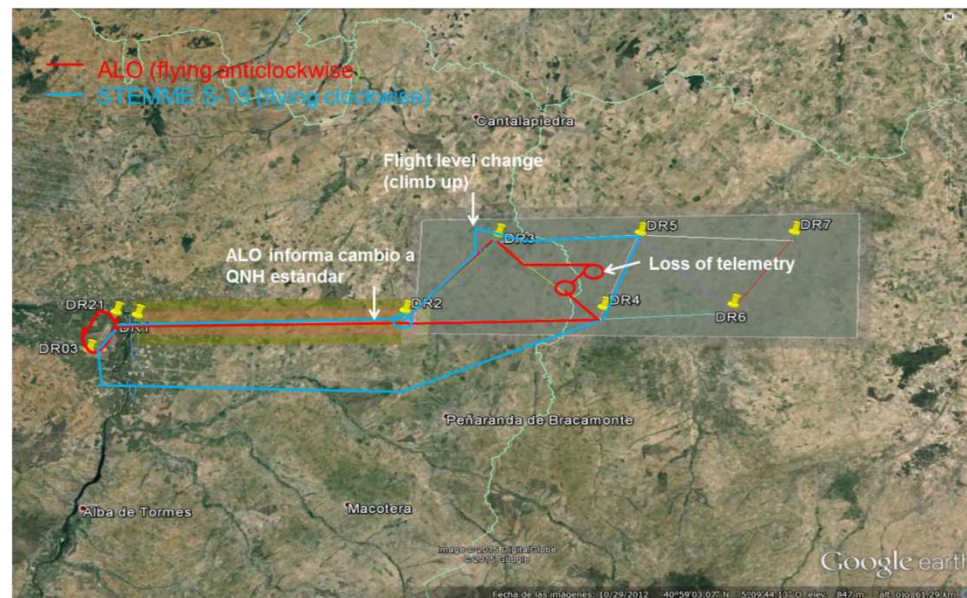
■ Emergency Scenario

- ◆ How RPAS emergencies can be handled by Air Traffic Controllers.
- ◆ Simulated emergencies.



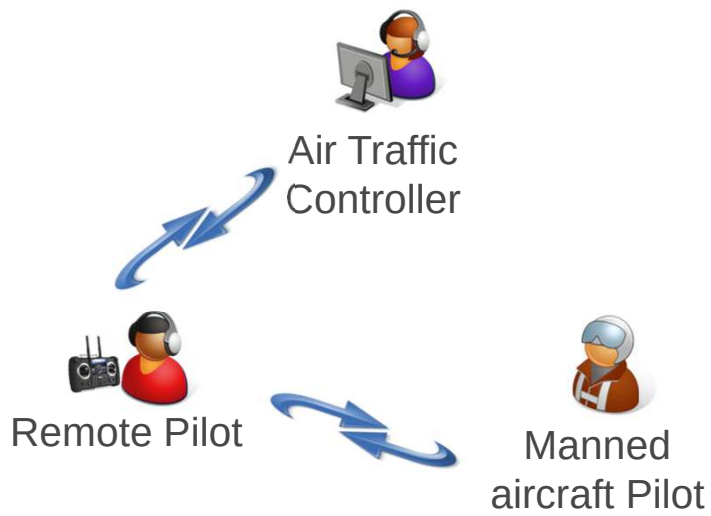
2nd Exercise execution

- Mixed Operational & Emergency Scenario
 - ◆ Execution of ad-hoc procedures.
 - ◆ RPA simulated loss of telemetry → trajectory change.
 - ◆ Conflict between both aircraft detected and solved by ATC.

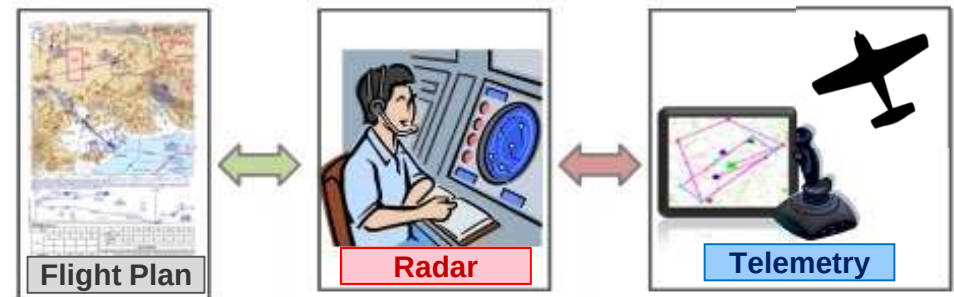


Qualitative and quantitative results

■ Human Factor assessment



■ Trajectory analysis

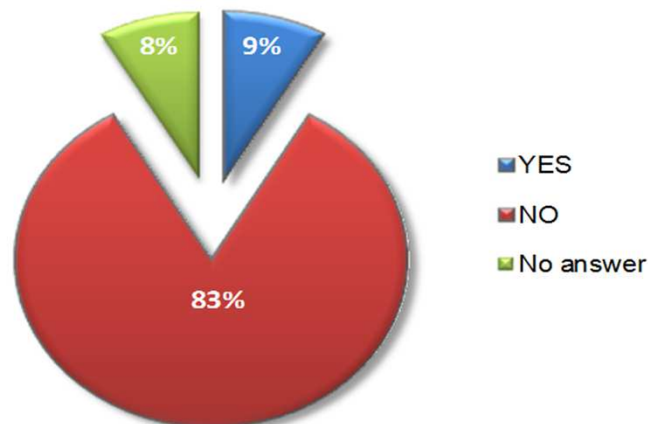


Human factors

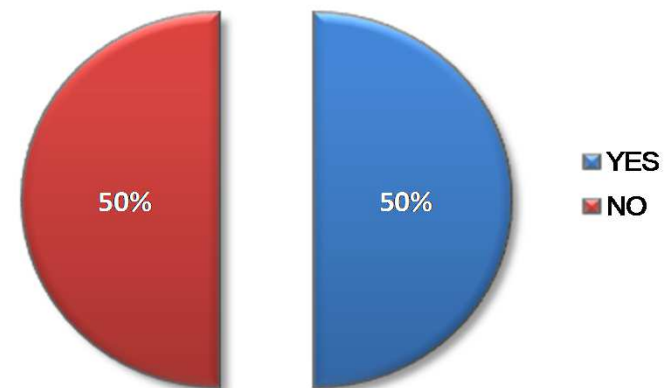
■ Remote pilots

- ◆ Situational awareness – improved thanks to the ATC radar information (SINA position).
- ◆ Workload – too many tasks assigned to the same person.
- ◆ Communications and phraseology – Improved thanks to the training.

Were communications similar to those with
manned aircraft?
EXE-1



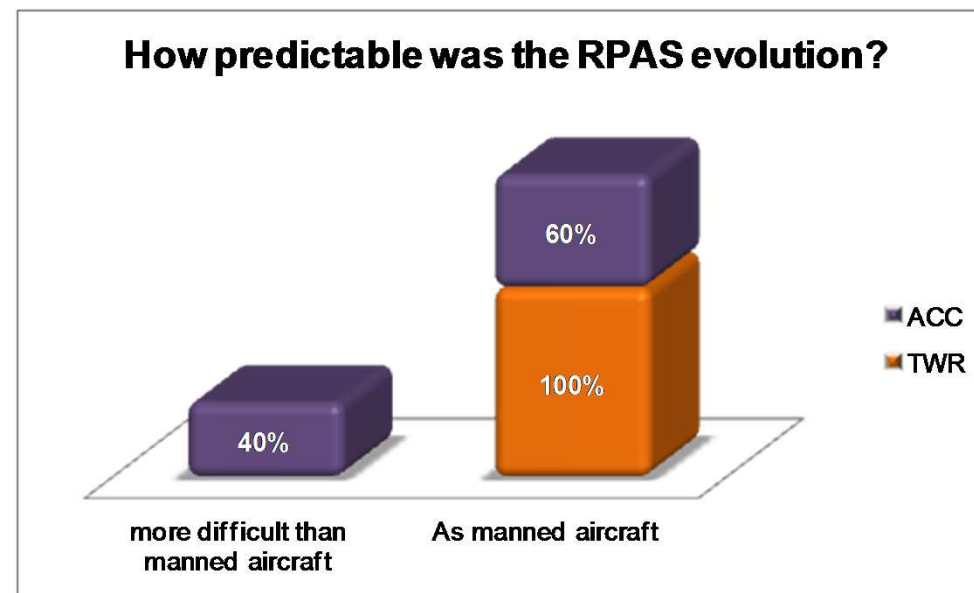
Were communications similar to those with
manned aircraft?
EXE-2



Human factors

■ ATCOs

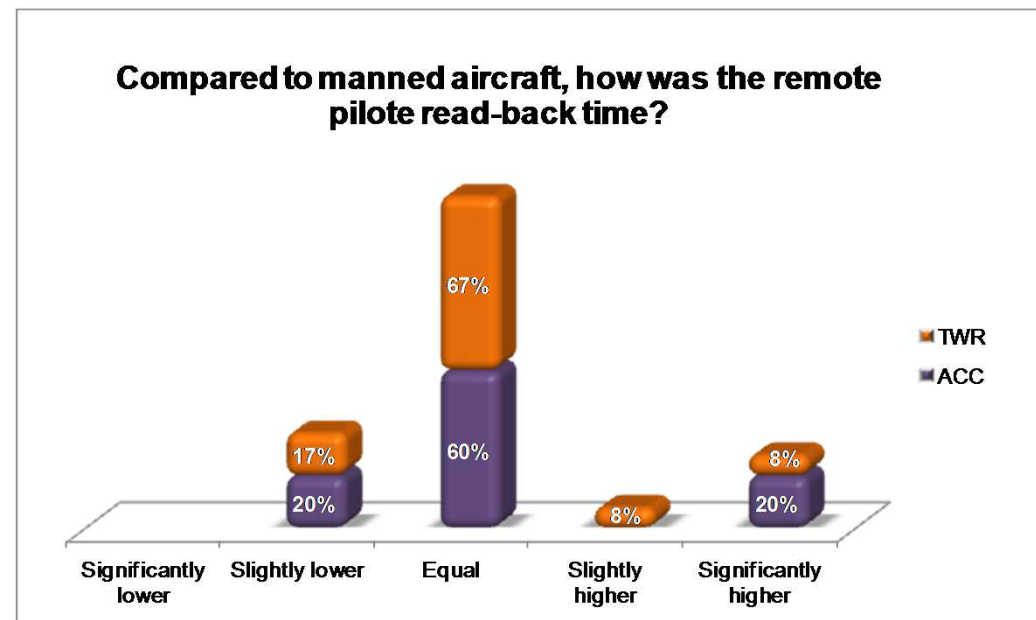
- ◆ Feasibility to follow ATC instructions and procedures (e.g. Transference of control between ATC units).
- ◆ Situational awareness – Good prediction of RPAS evolution.



Human factors

■ ATCOs

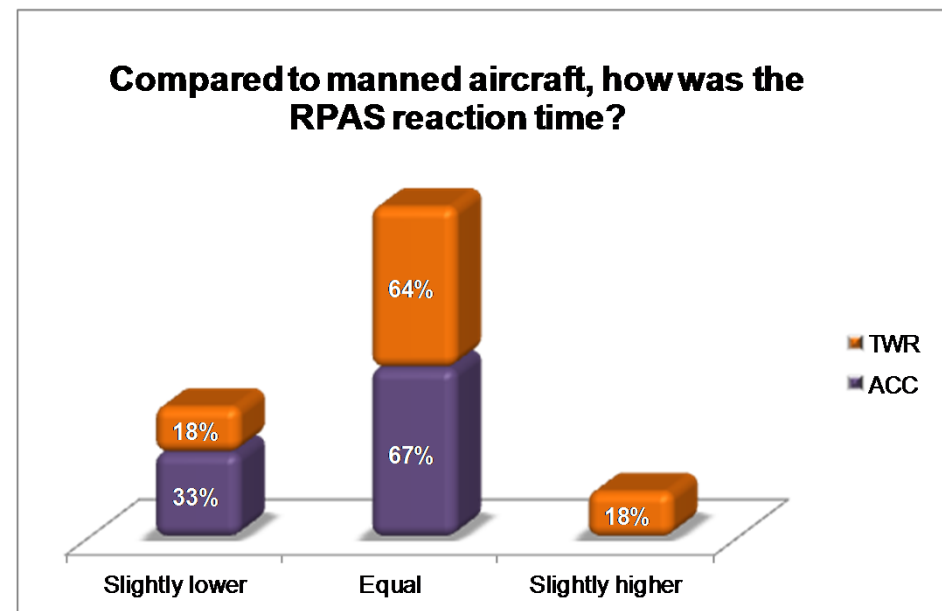
- ◆ Feasibility to follow ATC instructions and procedures (e.g. Transference of control between ATC units).
- ◆ Situational awareness – Good prediction of RPAS evolution.
- ◆ Workload – More demanding due to communications.
- ◆ Latency:
 - Read back was appropriate.



Human factors

■ ATCOs

- ◆ Feasibility to follow ATC instructions and procedures (e.g. Transference of control between ATC units).
- ◆ Situational awareness – Good prediction of RPAS evolution.
- ◆ Workload – More demanding due to communications.
- ◆ Latency:
 - Read back was appropriate.
 - RPAS reaction time was similar to manned aircraft.

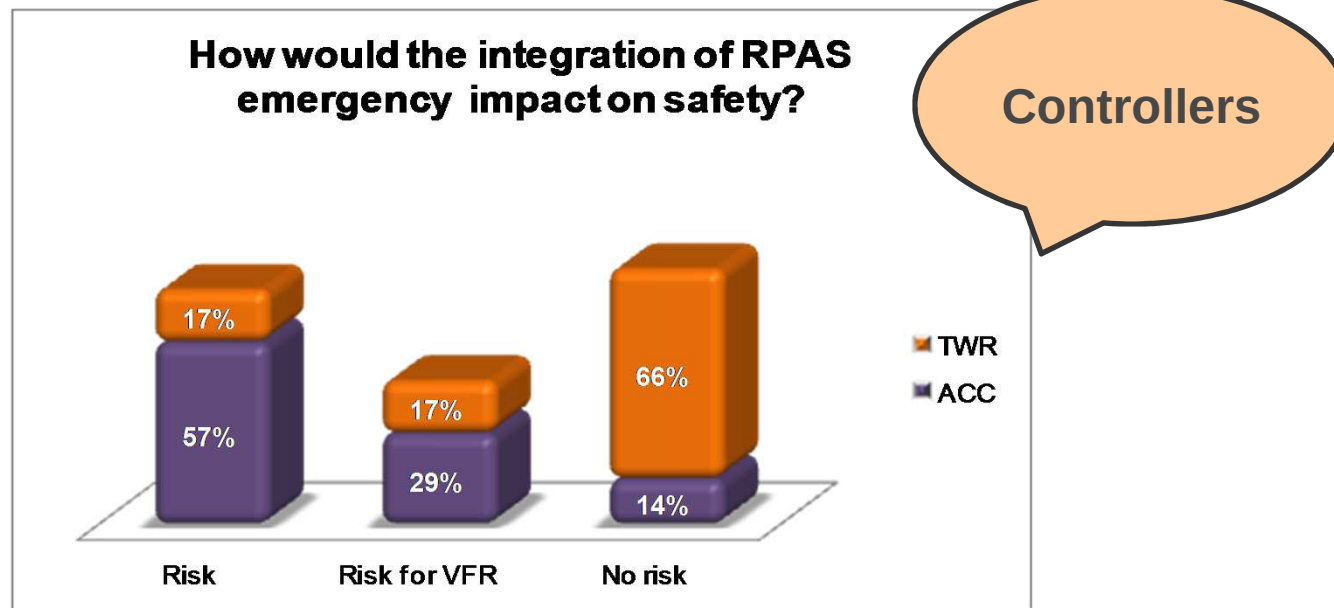


Human factors

■ Manned aircraft pilots

- ◆ RPAS take-off and landing procedures
- ◆ RPAS emergency procedures

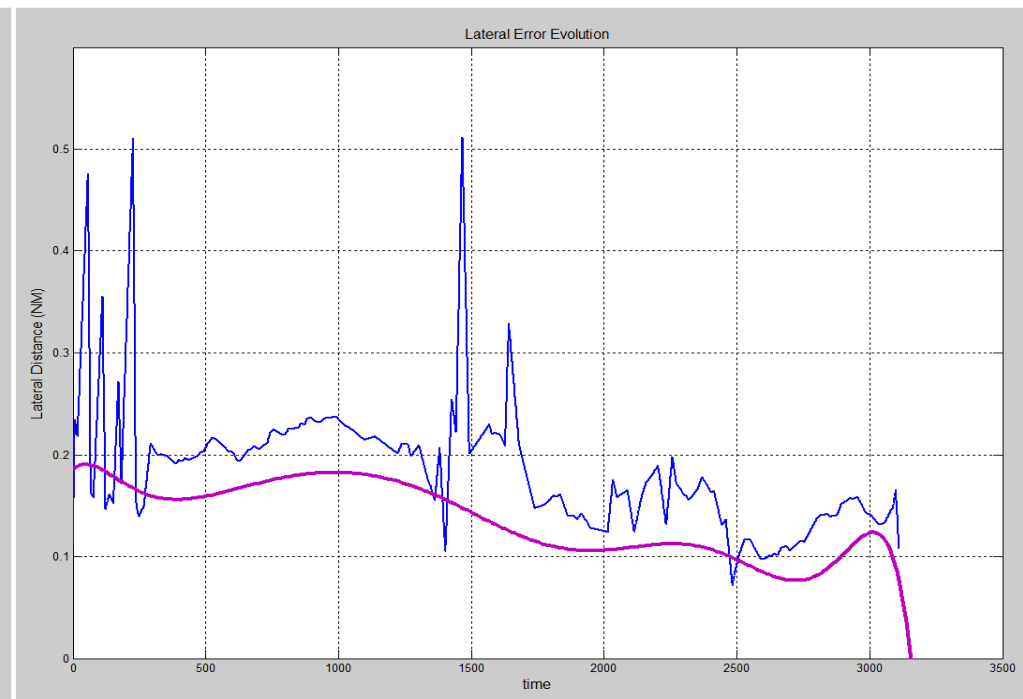
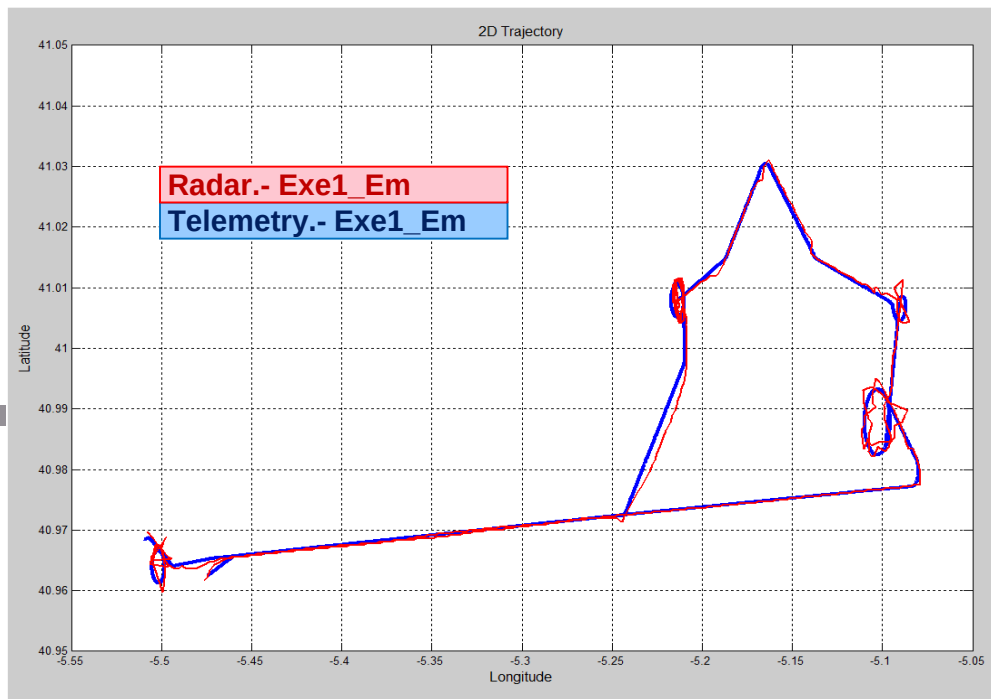
} risk for VFR mainly



Trajectory Analysis

- Comparison of RADAR and Telemetry
 - ◆ Horizontal plane – Controllers considered acceptable the difference.

NM	Max	Average
Exe1_Op	0.41	0.0723
Exe1_Em	0.51	0.137
Exe3	0.49	0.046

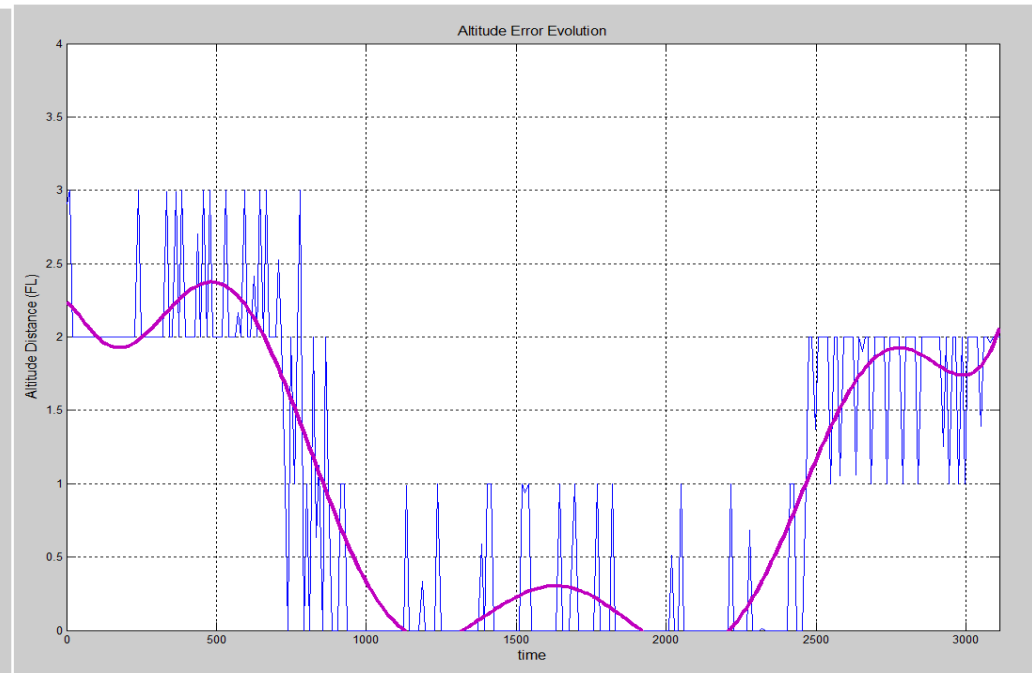
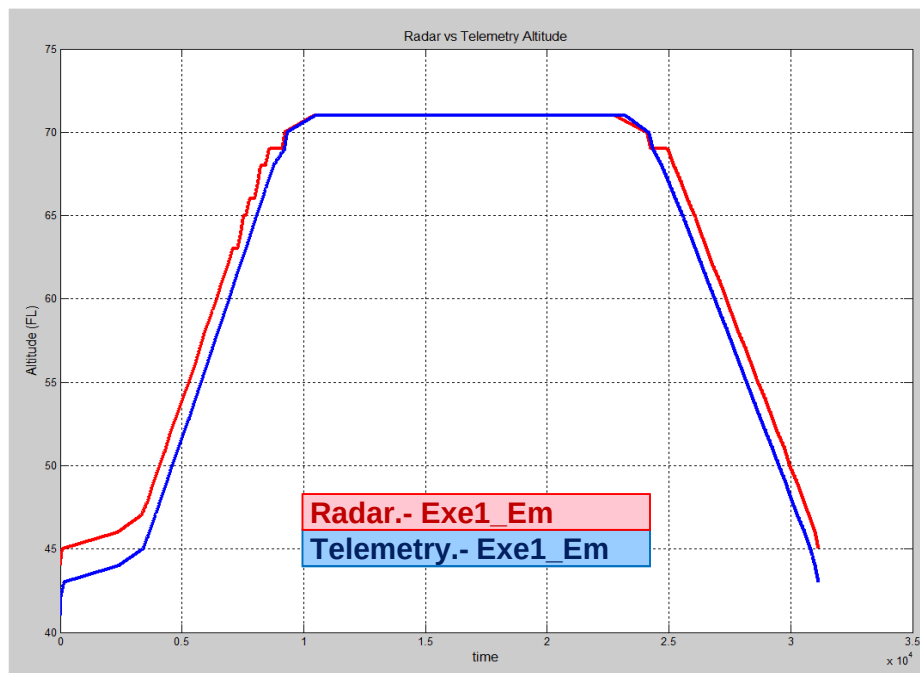


Trajectory Analysis

■ Comparison of RADAR and Telemetry

- ◆ Vertical plane – ATC background is essential.

FL	Max	Average
Exe1_Op	2.73	1.27
Exe1_Em	3	1.0063
Exe3	2.72	0.65



Communications

Operational
Procedures

Emergency
procedures

Remote pilot
workload





Isdefe



ENAIRe



FADA
FUNDACIÓN ARGENTINA PARA
DESARROLLO AGROPECUARIO



CRIDA
F.O.A. - ATN



CATEC
CENTRO NACIONAL
DE ESTADÍSTICA
AGROPECUARIA