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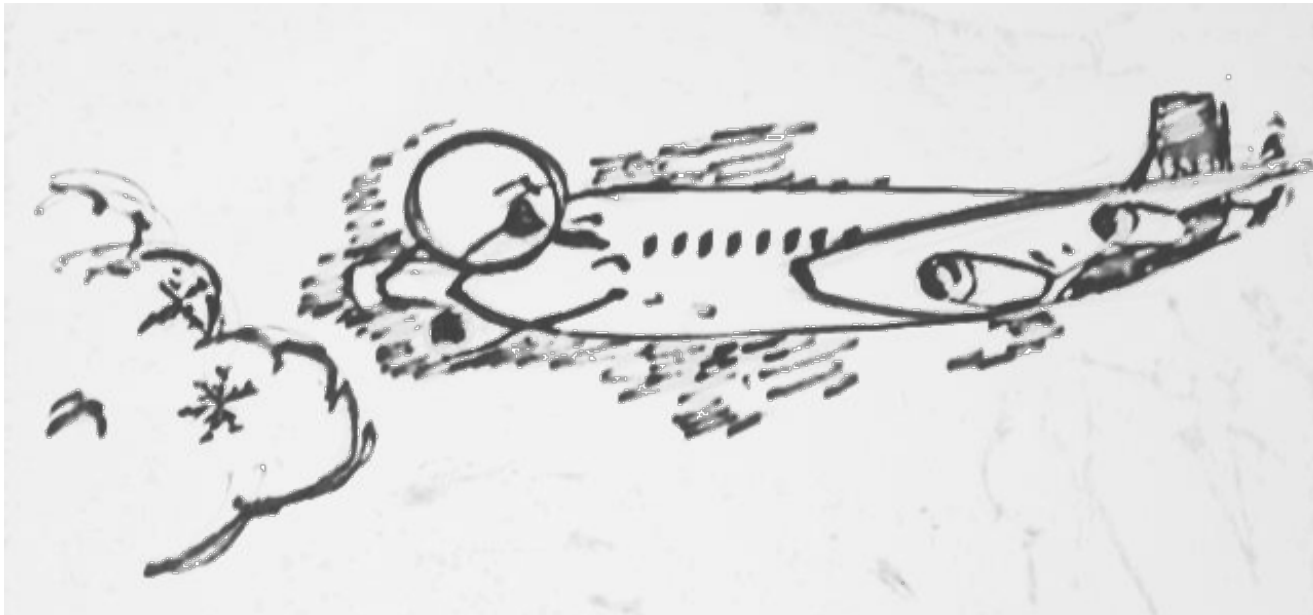
# A340 Measurements January 2016

HAIC-HIWC Science Team Meeting

# HAIC 3<sup>rd</sup> Flight Tests Campaign Content

## 3<sup>rd</sup> F/T campaign – January 2016 – Darwin/St Denis

- ▶ Flight Tests Aircraft
- ▶ Flight Tests Program
- ▶ Campaign Overview
- ▶ Campaign Results vs. Objectives



# HAIC 3<sup>rd</sup> Flight Tests Campaign

## Flight Tests Aircraft

|                        |   |
|------------------------|---|
| Model                  | A340-300  |
| Engines type           | 4 engines CFM56 -5C4  |
| Power supply available | 4 * 75 KvA 115 VAC/400 Hz   |
| Dimensions             | Length: 63.9 m<br>Height: 16.9 m  |
| Operation limits       | MMO = 0.86<br>VMO = 330 kt<br>Max ceiling = 40000 ft<br>Cruise speed = 0.82 |
| Maximum weight         | MTOW = 250 tons   |
| Autonomy               | 13350 km  |
| Radar                  | Honeywell WXR RDR-4000 v2   |
| COM                    | VHF / HF/ SATCOM / CPDLC / ADS-B  |



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**HAIC Flying Test Platform**  
(large payload & long endurance  
Airbus flight test A/C)

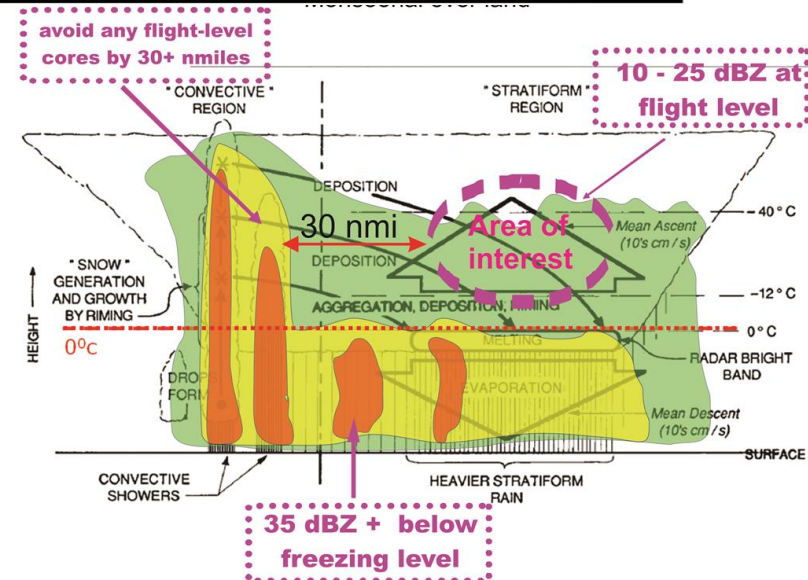
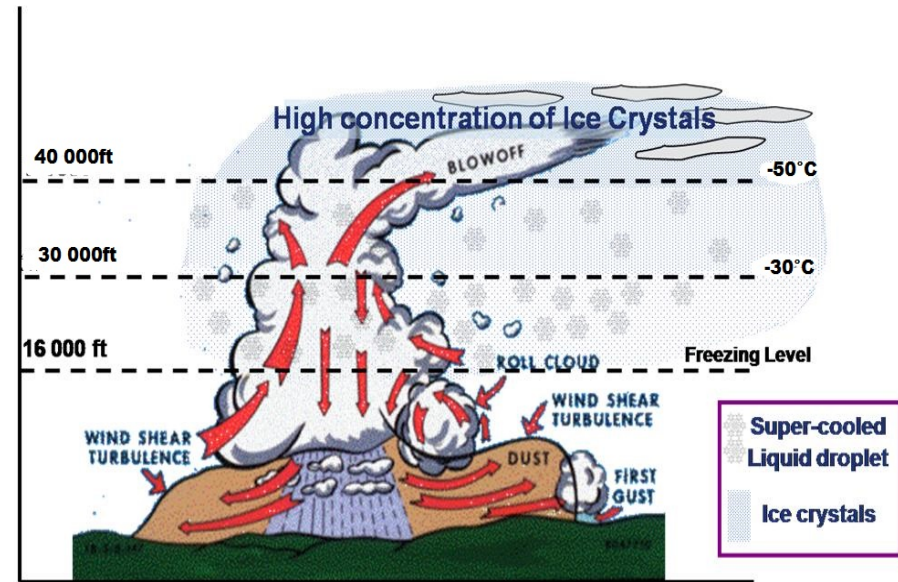
# HAIC 3<sup>rd</sup> Flight Tests Campaign Flight Tests Program

- **Two types of convection :**

- ▶ Oceanic convection (primary focus ~80% of the F/H)
- ▶ Continental convection (secondary focus ~20% of the F/H)

- **Three flight levels :**

- ▶ -50°C: a typical cruise altitude for commercial jet aircraft → Priority 1
- ▶ -30°C: a mid-altitude with intermediate particle size and high IWC → Priority 2
- ▶ -10°C: a low flight level just above the melting layer (mixed phase icing conditions) → Priority 3



# HAIC 3<sup>rd</sup> Flight Tests Campaign

## Flight Tests Program

- Flight Test Procedures & Techniques :
  - ▶ Based on a large experience
  - ▶ 3 AIRBUS High Altitude Icing campaigns already performed with the same a/c
    - Darwin - Australia in 2010
      - Over Timor Sea, Arafura sea & Australian land
    - Cayenne – French Guyana in 2010
      - Over Atlantic ocean & Brasilian Amazonia
    - Santiago – CHILE in 2012
      - Over Chile, Argentina (included Buenos Aires FIR) & Paraguay
  - ▶ AIRBUS Flight Test crew on board
    - 2 flight test pilots
    - 1 Test flight engineer
    - 3 Flight Test engineers

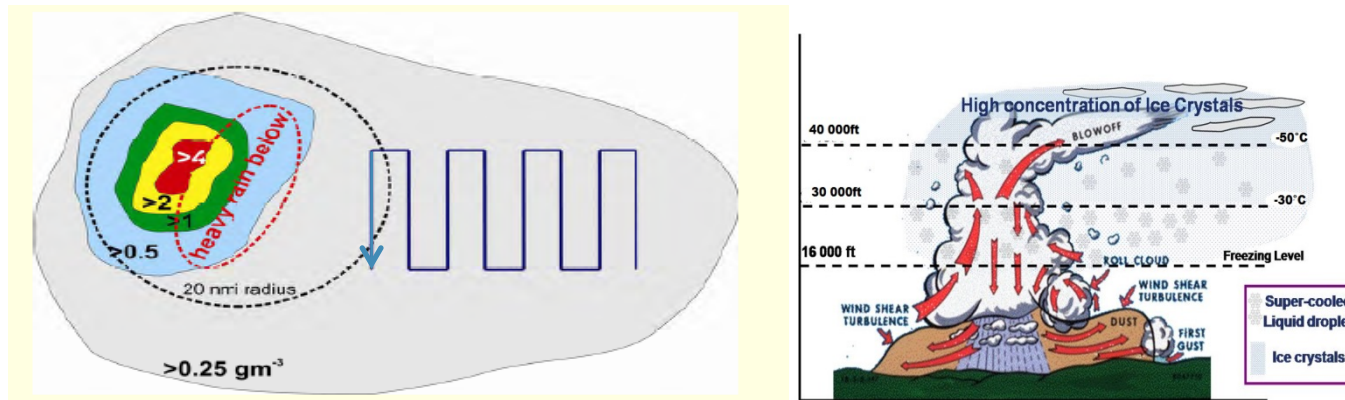
# HAIC 3<sup>rd</sup> Flight Tests Campaign Flight Tests Program

- Flight plan :

- ▶ Selection of the suitable area from the last satellite observations
- ▶ Reference position provided to ATC : reference point
- ▶ Volume around the reference point : 50NM radius - +2000ft / - 5000ft

- Flight technique :

- ▶ Cut across the anvil at different distances from the core and observe & measure the performance of the new technologies with the increase in IWC



- Test Procedures :

- ▶ Continuous monitoring of all a/c systems & engines operation

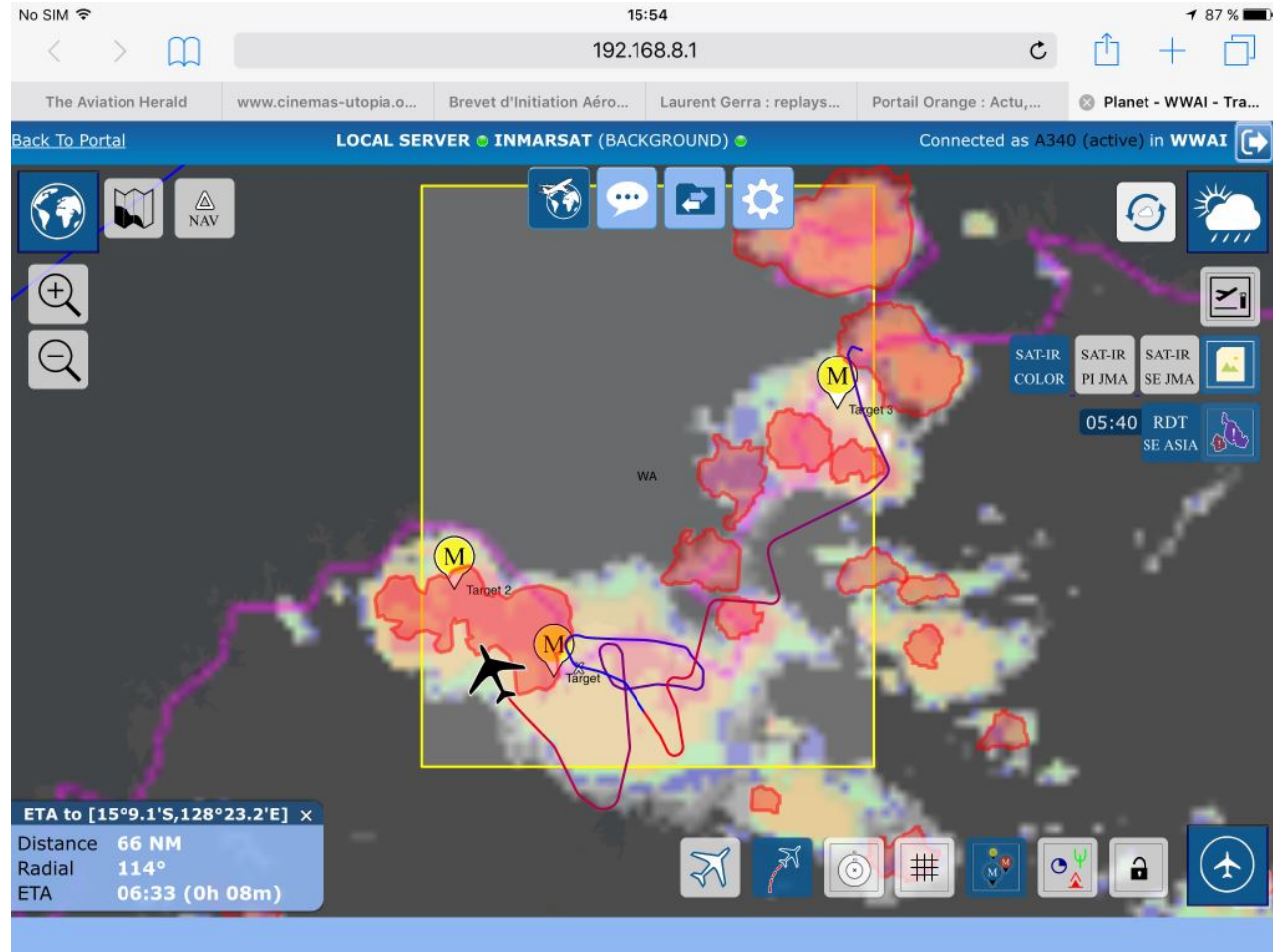


# HAIC 3<sup>rd</sup> Flight Tests Campaign Flight Tests Program

## PLANET tool :

Efficient solution for

- Weather images uplink
- Flight path management
- Communication with the ground all the flight through Chat function
- Real time data downlink (light telemetry)



# HAIC 3<sup>rd</sup> Flight Tests Campaign Campaign Objectives

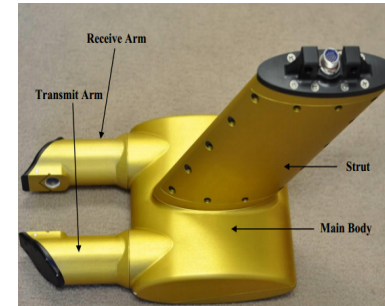
- ▶ **To measure the ice crystals conditions using state-of-the-art probes and to complement database for characterization of the atmosphere as part of HAIC rulemaking objectives (SP2)**



*PIP Probe*



*2D-S Probe*



*FCDP Probe*



*Nephelometer*

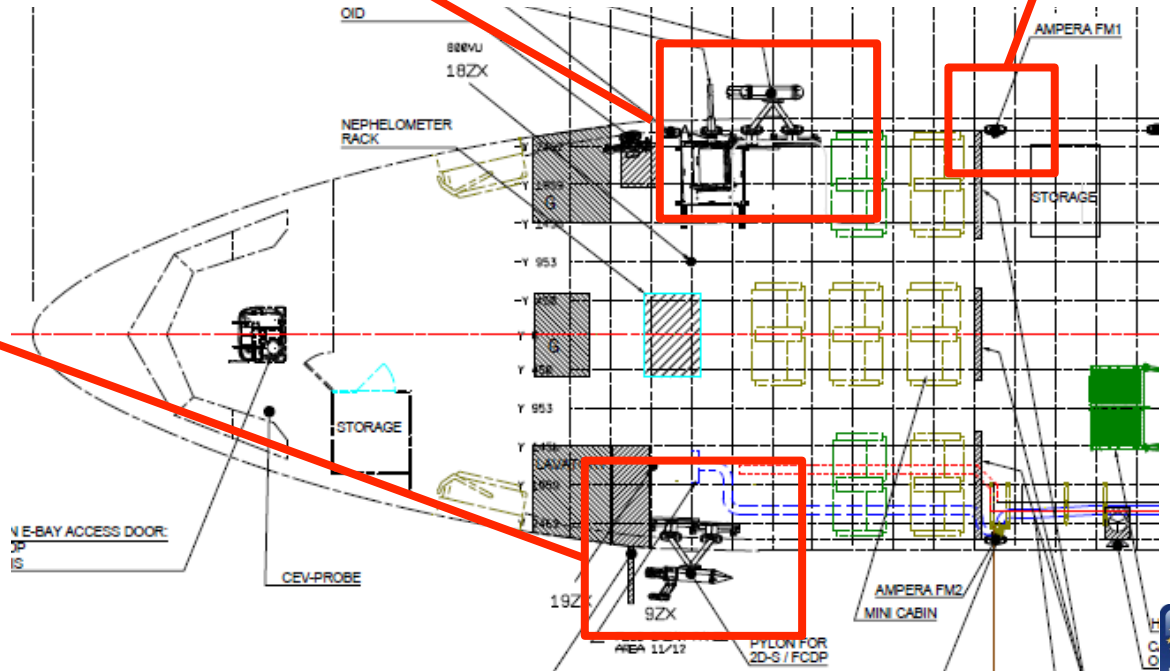
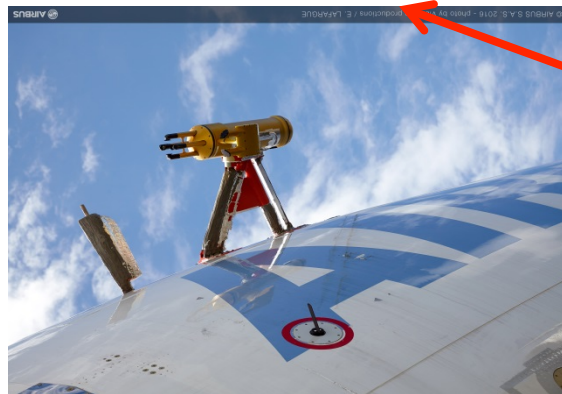
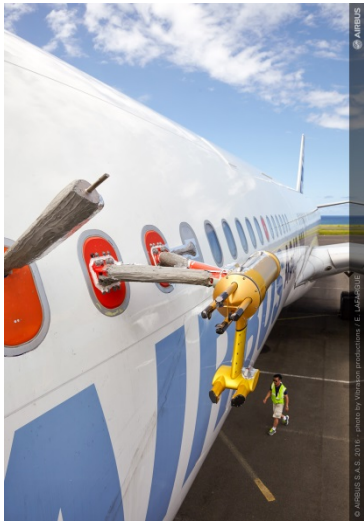


*Robust Probe*



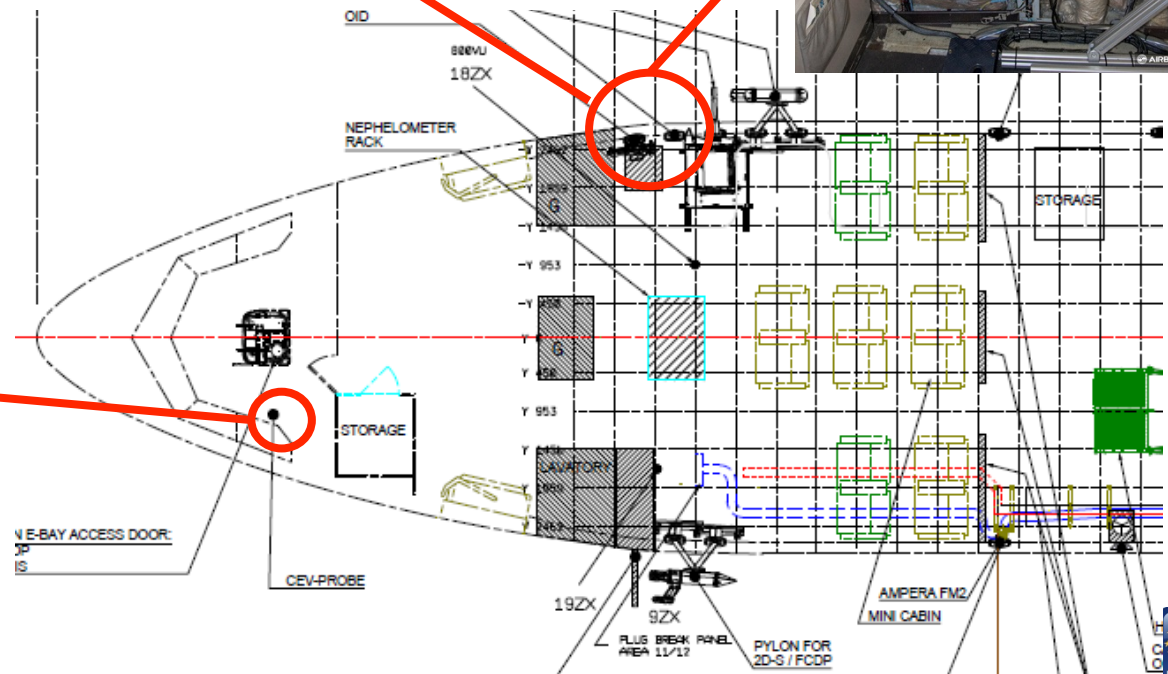
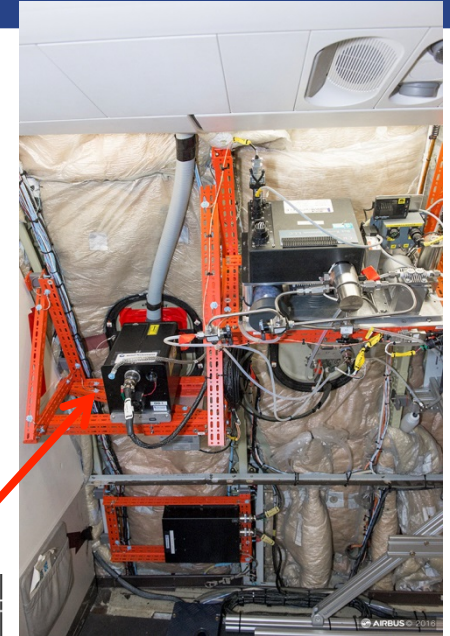
# HAIC 3<sup>rd</sup> Flight Tests Campaign Campaign Objectives

- Instrumentation overview:



# HAIC 3<sup>rd</sup> Flight Tests Campaign Campaign Objectives

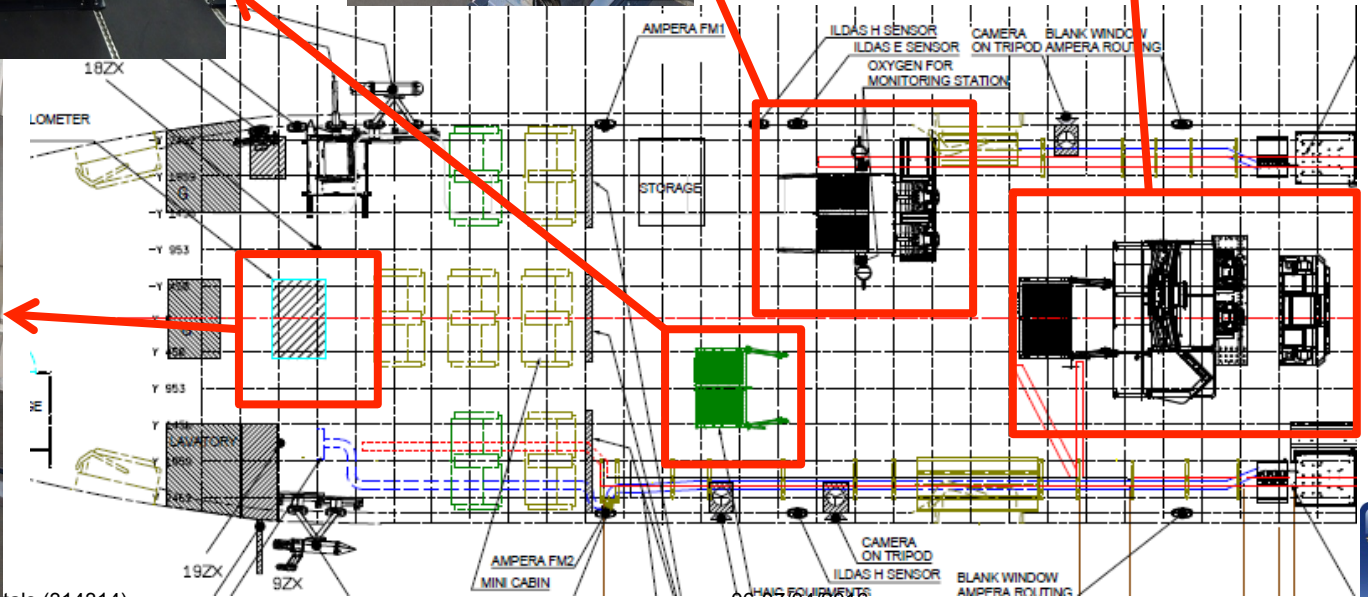
- Instrumentation overview:





# HAIC 3<sup>rd</sup> Flight Tests Campaign Campaign Objectives

- Instrumentation overview: Inside aircraft



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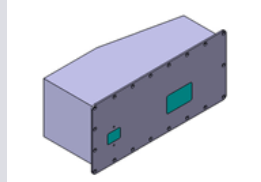
# HAIC 3<sup>rd</sup> Flight Tests Campaign

## Campaign Objectives

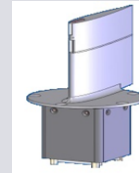
- ▶ **To test the ice crystals conditions awareness and detection technologies designed to alert the crew of flight in these particular icing conditions & to adapt the flight path well in advance in order to avoid such weather conditions.**

### Ice Crystals Detectors (SP4)

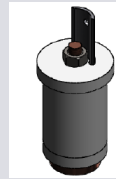
AIIS



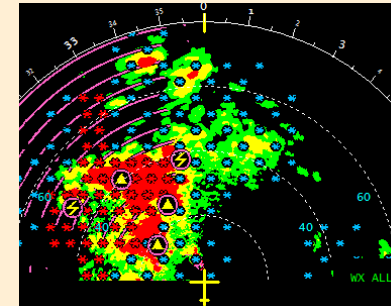
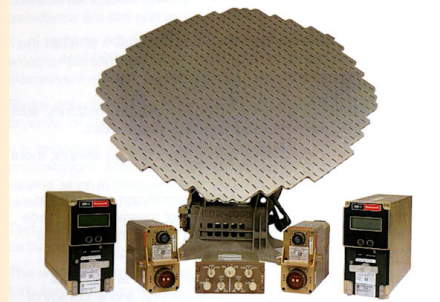
ICD



PDP

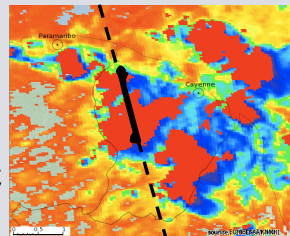


### Enhanced Weather Radar (SP4)



### Spaceborne Retrieval (Nowcasting) (SP3)

KNMI  
High IWC  
Mask



Meteo France  
RDT

# HAIC 3<sup>rd</sup> Flight Tests Campaign

## Campaign Overview

### Flight Hours

|                         |         |                        |
|-------------------------|---------|------------------------|
| Ferry flights :         | 38 FH   |                        |
| Darwin – Australia :    | 11.5 FH | Continental Convection |
| St Denis - La Reunion : | 20.5 FH | Oceanic Convection     |

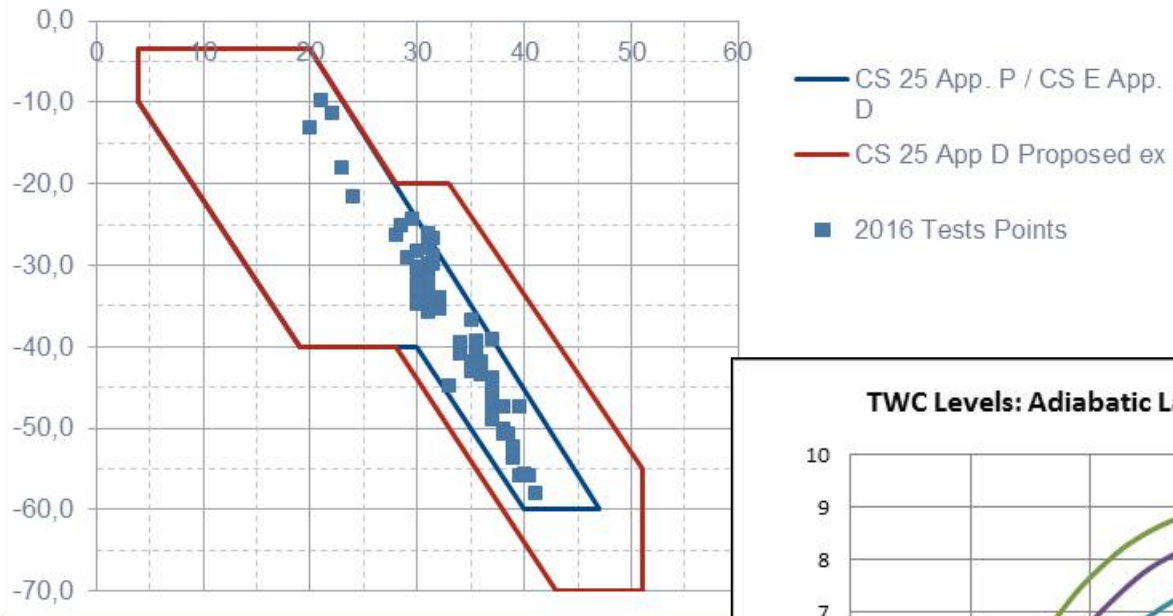
### Test Points

- Continental Convection
  - o 34 encounters in Continental Convection
  - o SAT Range : -8°C / -54°C
  - o TWC max 2.9 g/m<sup>3</sup> at FL310
- Oceanic Convection
  - o 46 encounters in Oceanic Convection
  - o SAT Range : -9°C / -52°C
  - o TWC max 4.9g/m<sup>3</sup> at -9°C, 3.9g/m<sup>3</sup> at -26°C, 3.7g/m<sup>3</sup> at -47°C



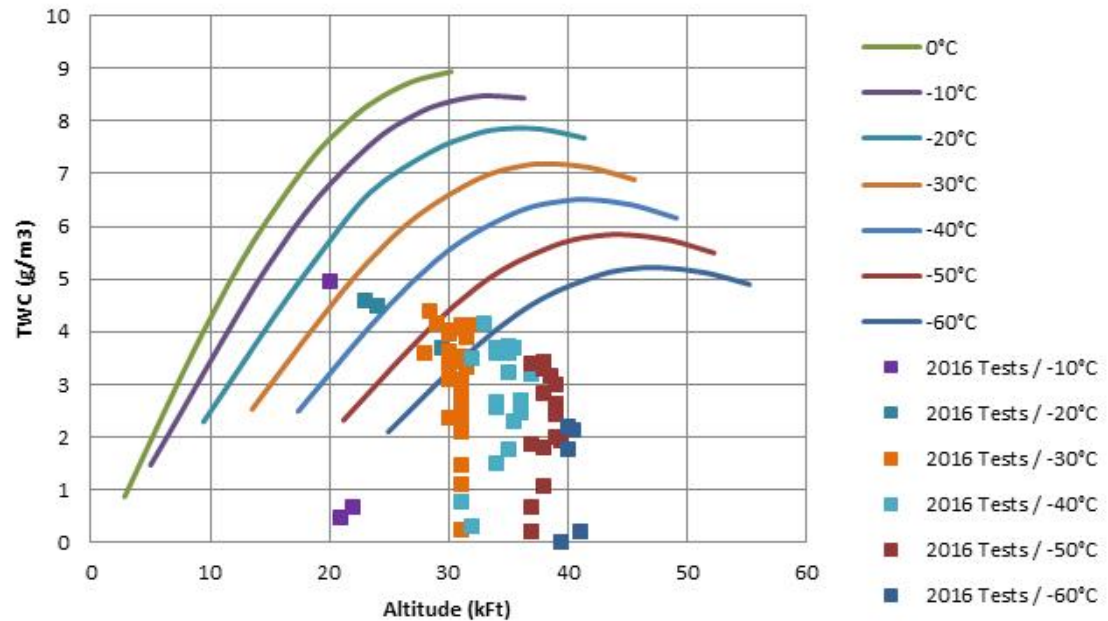
# HAIC 3<sup>rd</sup> Flight Tests Campaign Campaign Overview

### Altitude - Temperature



Good coverage of Appendix D conditions in terms of altitude – temperature envelope

### TWC Levels: Adiabatic Lapse from Sea Level @ 90% Relative Humidity



Ice Water Contents up to 75% of Appendix D Peak Values

(Robust probes values taking into account installation factor & 0.4 for collection efficiency)



High Altitude Ice Crystals (HAIC, 314314)

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