Presented by

General HAIC Update

HAIC-HIWC Science Team Meeting

HAIC – High Altitude Ice Crystals
Introduction

- Main objectives of ice crystals research activities are
  - **To face challenges related to the evolution of regulation according to mixed phase and glaciated icing conditions** by characterising high IWC environment and developing the Acceptable Means of Compliance (test facilities and numerical tools),
  - **To improve aircraft operation** by developing appropriate detection and awareness technologies to be fitted on aircraft and be able to alert the flight crew when an aircraft is flying in high IWC environment and **to continuously enhance international flight safety**

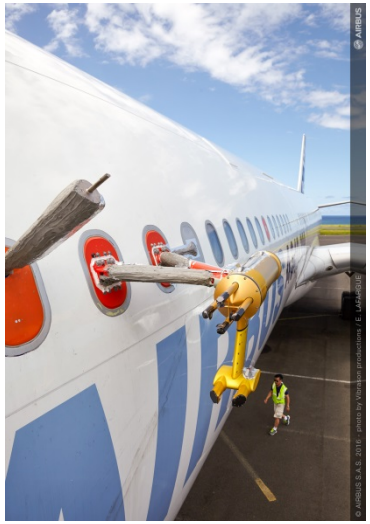
- Supported by a series of **research projects at European and International level**

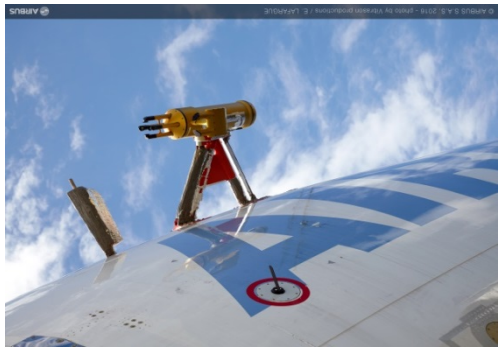
HAIC – High Altitude Ice Crystals
Main achievements - SP1

- Characterize, optimize, enhance and **select the most sophisticated cloud microphysics probes** to measure mixed phase and glaciated icing conditions during flight tests and to calibrate icing wind tunnels.

Instrument	Size range	Resolution	Sampling frequency
FCDP, CDP-2, CAS-DPOL, CPSPD	1-50 µm	0.5 µm	1 or 10 Hz
2D-S	10 µm – 1.2 mm	10 µm	1 Hz
CPI	10 µm – 2.3 mm	2.3 µm	300 images/s
Modular HSI	7 µm – 1.2 mm	7 µm	300 fps
HSI probe	7 µm – 1.2 mm	7 µm	300 fps
Modular PDI	1 µm – 2.5 mm	0.5 µm	Up to 50 kHz
C-IKP	TWC < 10 gm-3		1 Hz
SEA hot-wire / ROBUST	TWC < 10 gm-3		1 Hz – 10 Hz

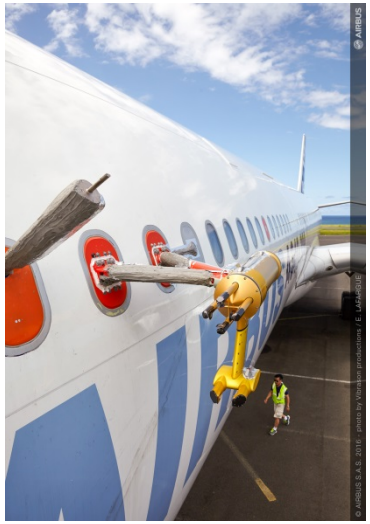
Table 6: Instrumentation for the intercomparison of aircraft and wind tunnel instruments





➢ **Support to the HAIC A340 field campaign & IWT/T calibration**

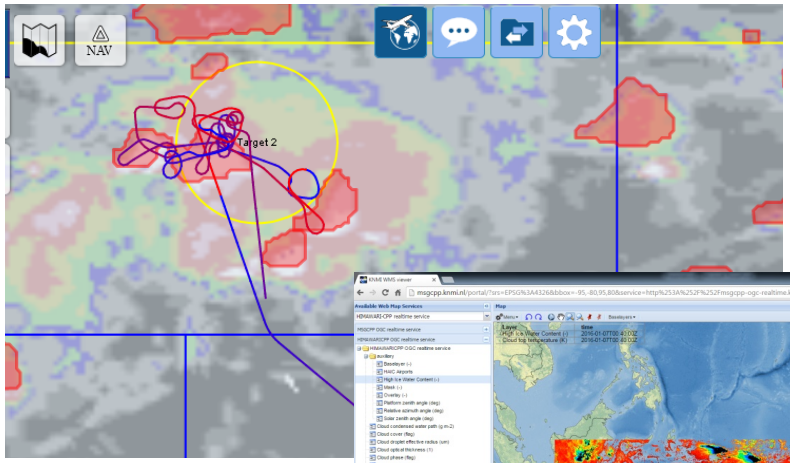
HAIC – High Altitude Ice Crystals
Main achievements - SP2

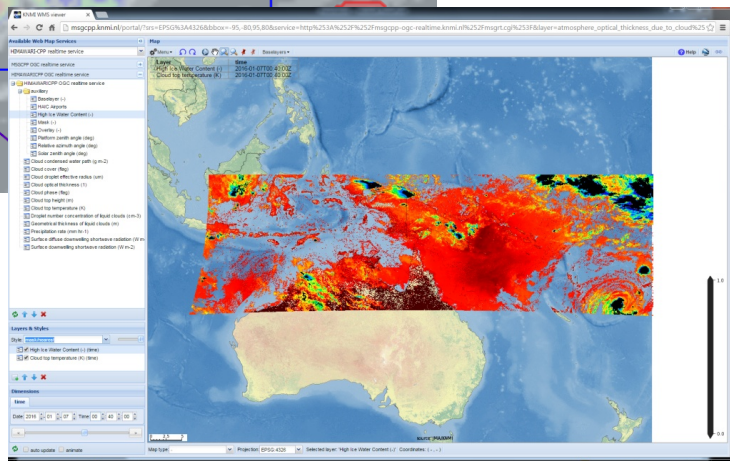


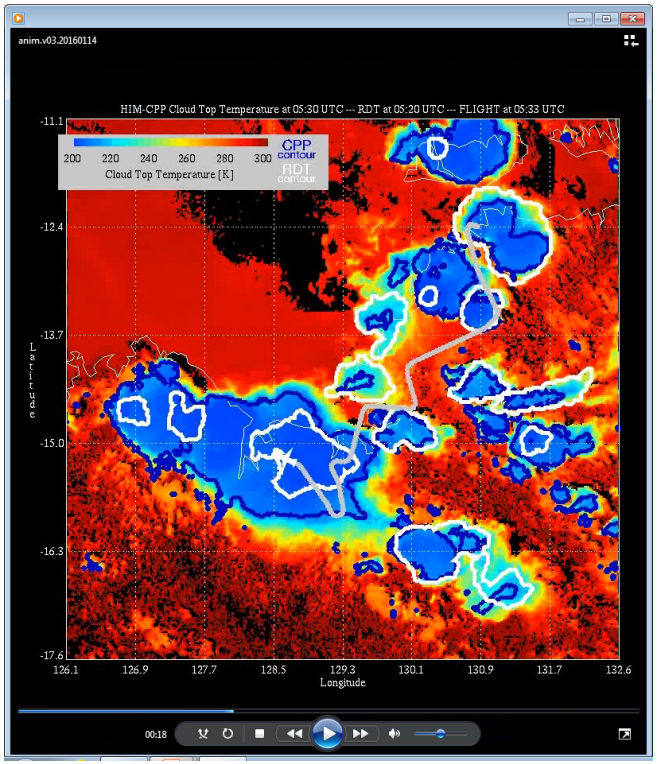
HAIC A340 field campaign – Darwin / Saint-Denis – January 2016

HAIC – High Altitude Ice Crystals
Main achievements - SP3

- To develop **space-borne remote detection and nowcasting techniques** to support the flight test campaigns and ultimately provide near real-time weather data through ATM as being studied as part of SESAR.



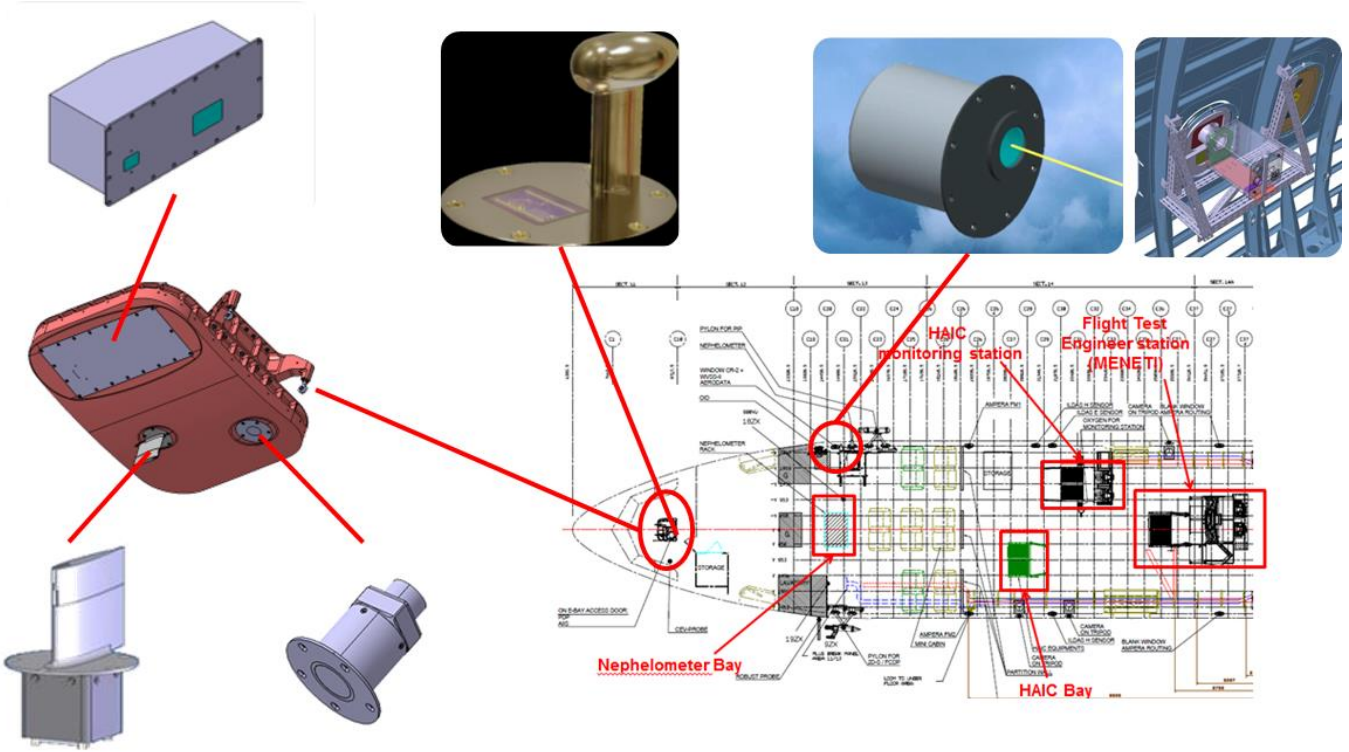




➢ **HAIC Key and Strategic TRL5 successfuly achieved & Support to HAIC A340 field campaign**

HAIC – High Altitude Ice Crystals
Main achievements - SP4

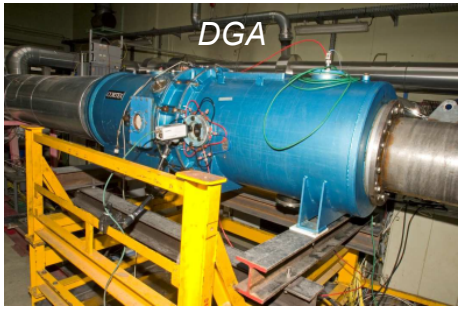
- **Develop and validate mixed phase and glaciated icing conditions awareness and detection technologies** to alert the crew of flight in these particular icing conditions or to adapt the flight path well in advance in order to avoid such weather conditions.

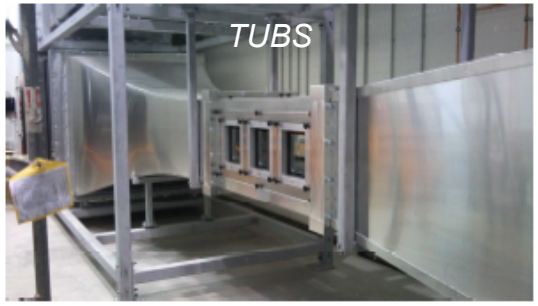


Delivery of **Detector & WXR prototype** & support to the **HAIC A340 field campaign**

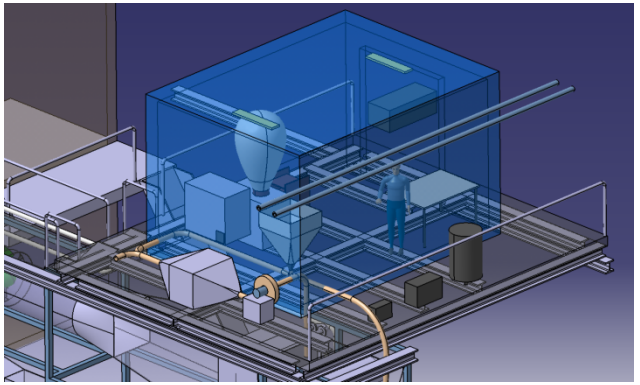
HAIC – High Altitude Ice Crystals
Main achievements - SP5

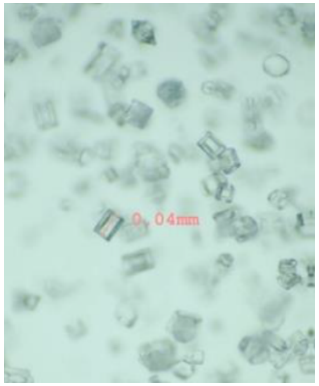
- **Upgrade European icing wind tunnels to allow reproduction of mixed phase and glaciated icing conditions** to allow the Aeronautical industry performing qualification of equipments.





DGA - Collection of supercooled droplets produced by the spray bars on rotating cylinders and scratching of ice layer by saw blades



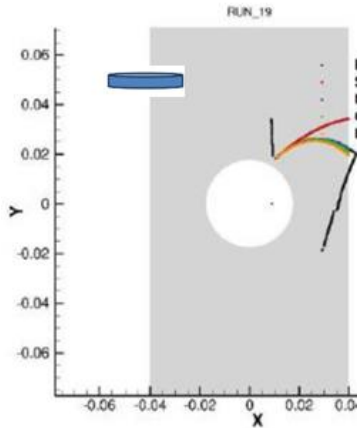


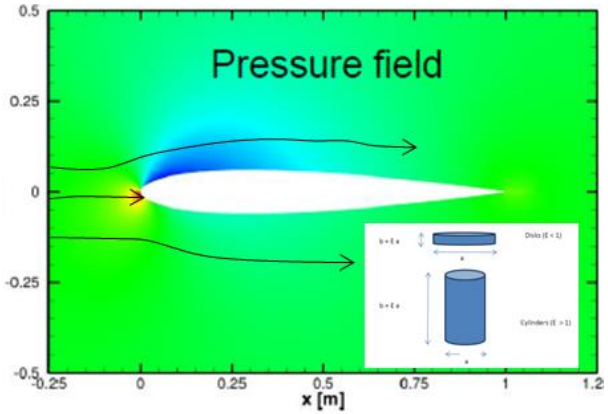
TUBS - Ice particles are produced inside a cloud chamber to obtain naturally shaped crystals by diffusive particle growth.

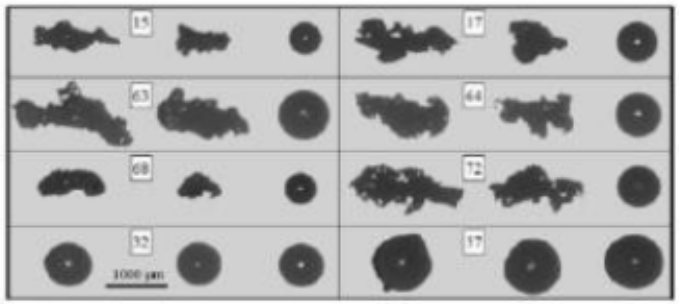
➢ **Calibration achieved, Technology stream on the route to TRL5**

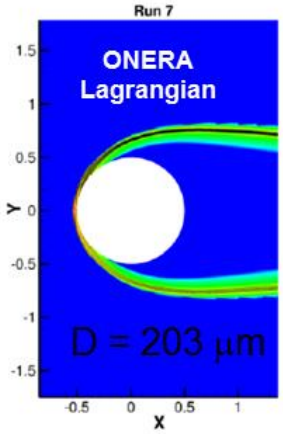
HAIC – High Altitude Ice Crystals
Main achievements - SP6

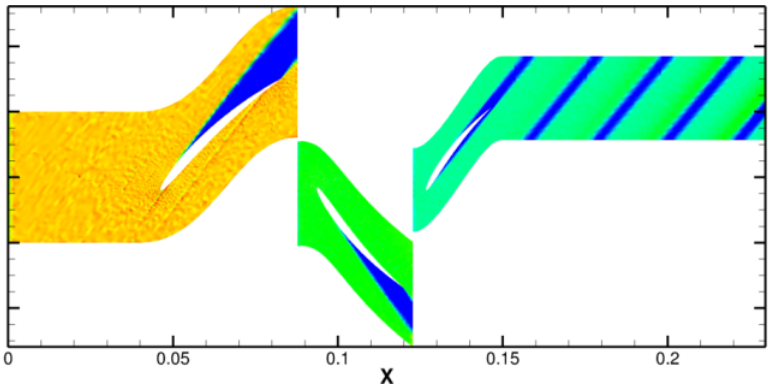
- Develop & validate **numerical capabilities** as **Acceptable Means of Compliance (AMC)** for the qualification and certification of future aircraft products (mainly probes and engines)

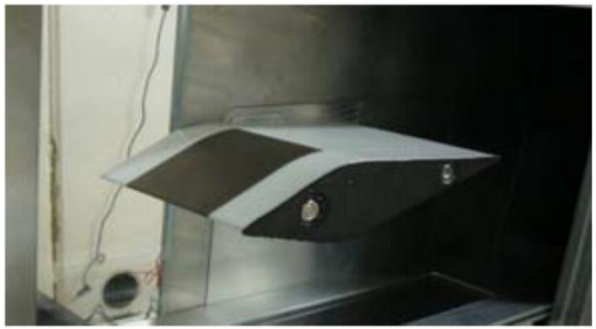












➢ **Benchmark completed, Technology stream on the route to TRL4 (May 2016)**

HAIC – High Altitude Ice Crystals
Main achievements - SP7

- Ice Detection System standardisation activities on-going as part of EUROCAE WG95 (ED-103)
- Standardisation activities for the weather radar ice crystals awareness function

Prepare the future

- High IWC Numerical tools: H2020 FSS2 proposal
- High IWC Detection: Cleansky 2
- High IWC Spaceborne detection & Nowcastinf: DGAC SONIC

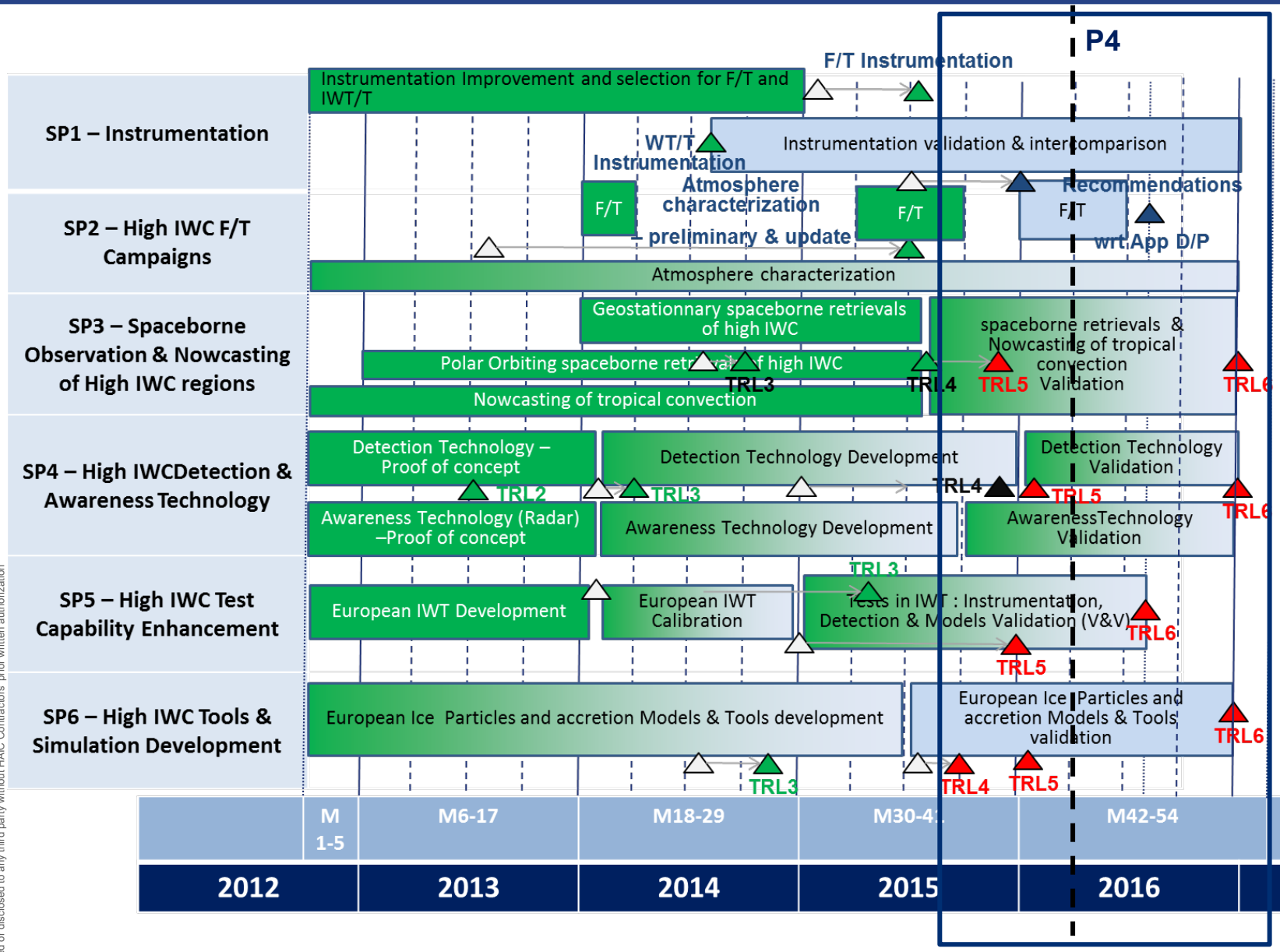
HAIC – High Altitude Ice Crystals
Conclusion

- Most of the technical objectives and management / dissemination objectives were achieved
  - **SP1**: Support to the HAIC A340 field campaign & IWT/T calibration, however delay on WP15
  - **SP2**: Processing of HAIC/HIWC dataset / Preparation & Conduction of the HAIC A340 field campaign out of Darwin / Saint-Denis in January 2016.
  - **SP3**: TRL5 for Satellite retrieval and nowcasting application
  - **SP4**: Delivery of Detector & WXR prototype & support to the HAIC A340 field campaign
  - **SP5**: High IWC test facilities on the route to TRL5/TRL6. Calibration completed and plan for SP1/SP6 IWT/T defined
  - **SP6**: Completion of TRL4 benchmark for High IWC numerial tools and good progress in the implementation of numerical models and tools into industrial environment
  - **SP7**: Standardisation through EUROCAE WG95 & Preparation of future activities beyond HAIC

HAIC – High Altitude Ice Crystals
Way Forward

- On top of the priorities for the coming months is
  - Complete outstanding **deliverables**
  - **Comparison of instrumentation** for flight test measurements (WP13) and icing wind tunnel test measurements (WP14)
  - Processing and analysis of the **HAIC A340 field campaign dataset** (SP2)
  - **Assessment of Appendix D/P** in coordination with HIWC/EASA-HighIWC
  - The completion of **TRL4/TRL5 for detection and awareness technologies** (SP4) in light of HAIC A340 field campaign analysis
  - The completion of **TRL5 for High IWC test facilities** (SP5) & **SP1/SP6 IWT/T**
  - The completion of **TRL4 for ice particle impingement and accretion model** and subsequent Strategic review (SP6), finalisation of the **integration of numerical models and tools** into industrial environment (snapshot/TRL5) & **International benchmark** (snapshot/TRL6)
  - **Prepare the future and activities/projects beyond HAIC**

HAIC – High Altitude Ice Crystals
Way Forward



High Altitude Ice Crystals (HAIC, 314314)

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EUROPEAN COMMISSION
European Research Area

HAIC – High Altitude Ice Crystals
Contacts

- Acronym: HAIC
- Name of the project: High Altitude Ice Crystals
- Instrument: L2
- Call: FP7-AAT-2012-RTD-1
- Project number: ACP2-GA-2012-314314
- Starting Date: August 2012
- Ending Date: July 2016
- Duration: 48 months

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