Presented by

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Cayenne 2015 – Overview & SAFIRE F20 and HWL B757 Achievemetns

HAIC/HIWC International Field Campaign
Cayenne International Field Campaign Overview

- Conduct a 3 weeks field campaign out of Cayenne, French Guyana to collect data in deep convective clouds with the **primary objective to provide 99th percentile total water content statistics, as a function of distance scale**, to industry and regulators.

SAFIRE Falcon 20 (atmosphere characterization)

NRC Convair 580 (atmosphere characterization)

  - Use the **SAFIRE Falcon 20** aircraft equipped with active remote sensing (airborne Doppler cloud radar) and *in situ* microphysics probes to sample -50°C/-10°C Flight Level
  - Use the **NRC Convair 580** aircraft equipped with active remote sensing (airborne Doppler cloud radar) and *in situ* microphysics probes to sample -10°C Flight Level and vicinity of clouds
  - Use the **Honeywell B757** aircraft equipped with enhanced weather radar to validate radar ice crystals awareness function thanks to other A/C in-situ measurements

Honeywell B757 (weather radar)

  - Use satellite, ground-based radar, lightning networks, and weather models & nowcasting tools to determine test areas and to support post-test data analysis

HAIC/HIWC International Field Campaign
Cayenne International Field Campaign Overview

- The field campaign took place from **May 9, 2015 to May 29, 2015 (1 month campaign)**

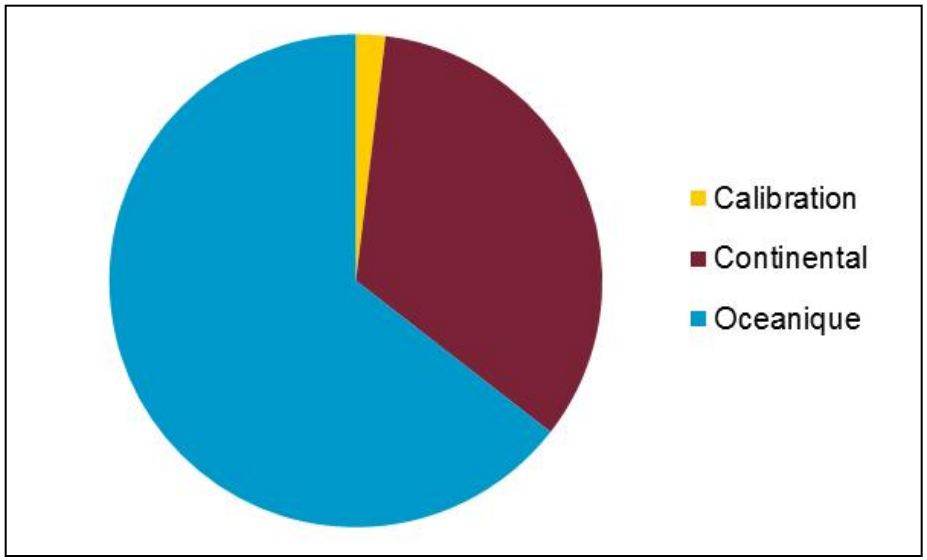
Items	Schedule
Falcon 20 departure from Toulouse and arrival in Cayenne	May 3 to May 6, 2015
Instruments installation, Power ON and Ground tests	May 7-8, 2015
Start of the campaign	May 9, 2015
Preliminary F/T in dry air and high IWC regions	May 9, 2015
HAIC/HIWC Field Campaign	May 11, 2015
End of the campaign	May 29, 2015
Instruments unmounting	May 30, 2015
Falcon 20 departure from Cayenne and arrival in Toulouse	May 31 to June 3, 2015

A/C	Deployment	Flight Hours
SAFIRE Falcon 20	6-31 May 2015	102,4F/H including ferry flight → 59,4F/H on-site
NRC CONVAIR	6-29 May 2015	~45F/H on-site
HWL B757	14-30 May 2015	~35F/H on site

HAIC/HIWC International Field Campaign
Cayenne International Field Campaign Overview

➔ Intense / very demanding and fruitful campaign which allowed collecting a large set of data to support regulatory objectives, science and the development of new ice crystals awareness system.

19 flights performed:
- 1 A/C = 5 flights
- 2 A/C = 8 fligths
- 3 A/C = 6 flights



Repartition of flights (Flight Hours)

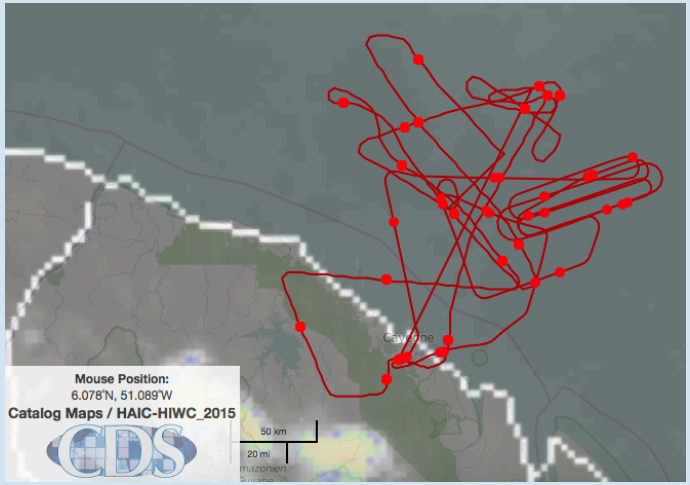
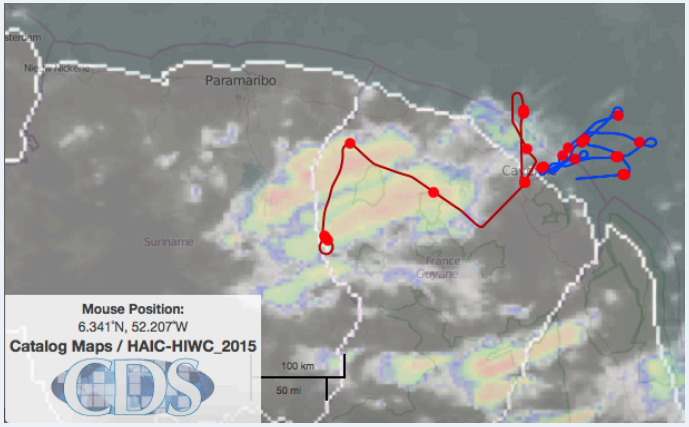
➔ Large dataset collected
International collaboration for data post-treatment (HAIC/HIWC)

<u>Next Steps:</u>
- Data Post-processing (preliminary RASTA and Robust data already available)
- Assessment of the relevance of App D/P & Recommendations (2016)

HAIC/HIWC International Field Campaign
Cayenne International Field Campaign Highlights

- Weather conditions
  - Weak at the begining of the campaign but continuous improvement
  - GO/NO-GO decision strategy adaptation
- SAFIRE Falcon 20
  - Very good A/C and instrumentation behavior and functioning during the whole flight campaign
    - Windscreen seal damaged and replaced after flight FS15015 on 16/05/2015
    - Lightning diverter strips on the radome needs to be replaced after flights FS15017 (19/05/2015) and FS15021 (25/05/2015)
  - 3rd pilot and 2nd mechanic allow to ensure the continuity of the operations
    - Possibility to operate 7days a week with 2 flights a day
- HWL B757
  - Most of the flight outside IWC regions, Few ICI encounters: Ozone smell, accumulation on wippers

HAIC/HIWC International Field Campaign
Campaign

Flight	Observations	
09/05/2015 **F20: FS15009, 2,7 F/H, 16:08 – 18:36 UTC**	Objective: Instrument calibration & Aerosol measurement (UHSAS) in clear sky **RASTA not working** PLANET: issue with MSG images update and display, No TWC display, connection issue	
10/05/2015 F20: FS15010, 2,4 F/H, 19:03 – 21:22 UTC CV580: F7, 2,3F/H, 15:50 – 17:57 UTC	F20: Continental convection, 7 legs performed at FL -45°C CV580: Oceanic convection Instrument checkout Erosion on Radome / Repair needed	

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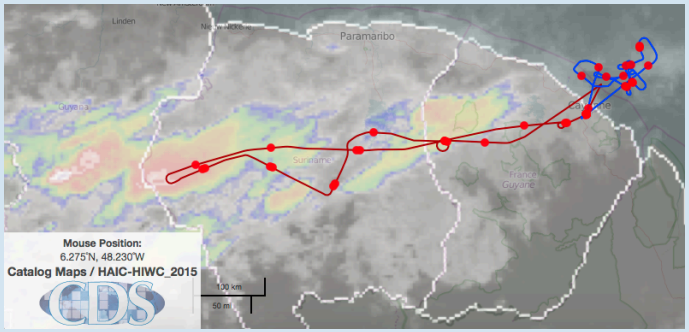
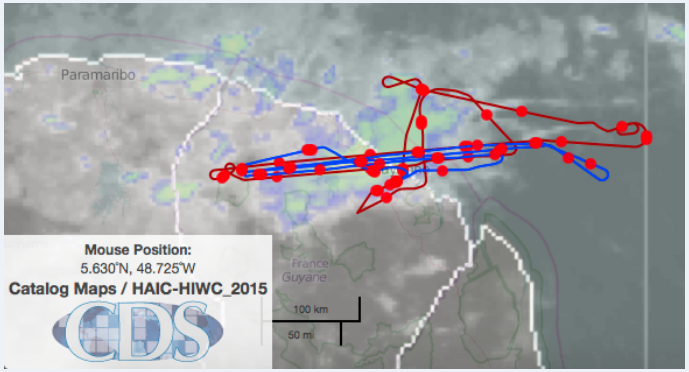
Campaign

Flight	Observations	
12/05/2015 F20: FS15011, 2,5 F/H, 20:20 – 22:27 CV580: F8, 2,4F/H, 19:17 – 21:26 UTC	Dissociated flights: CV580 in oceanic clouds and F20 in continental convection Light conditions	
14/05/2015 F20: FS15012, 3,1 F/H, 14:17 – 17:15 UTC CV580: F9, 3,7 F/H, 13:31 – 16:58 UTC	Oceanic convection Scientific coordinated flight for radar intercomparison. 3 legs were performed, low IWC < 1.0g/m3	

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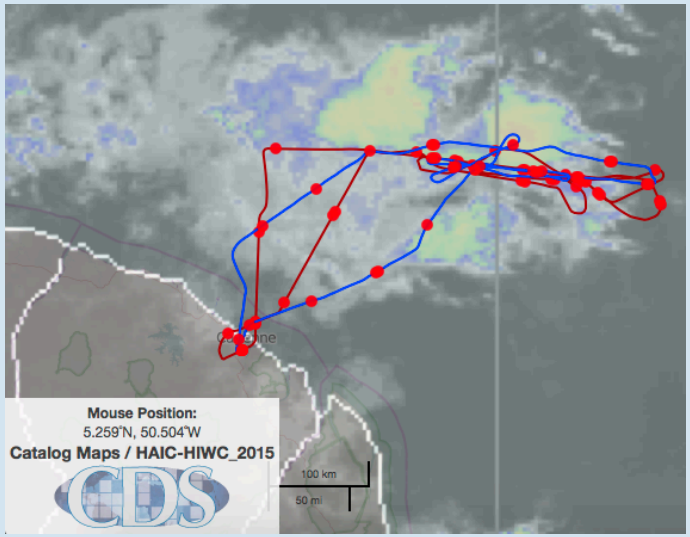
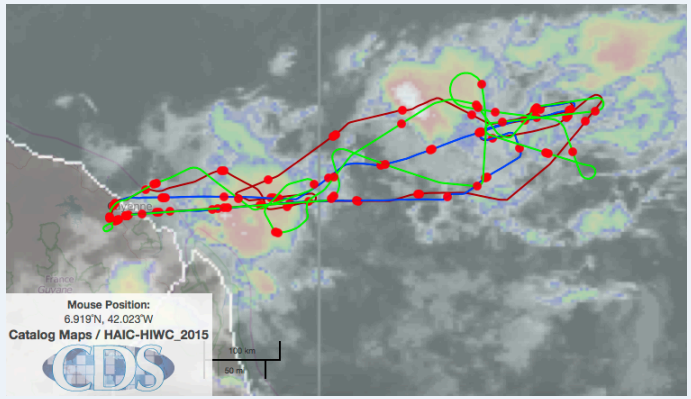
Campaign

Flight	Observations	
15/05/2015 F20: FS15013, 3,7 F/H, 08:35 – 12:10UTC CV580: F10, 4,2 F/H, 08:56 – 12:57 UTC	Regulatory flight within Oceanic convection F20: FL -10°C to FL -45°C, IWC 3g/m3 peak and 2,0-2,5g/m3 sustained CV580: FL -5°C to FL -15°C, IWC ~1,0-1,5g/m3, IKP down for repair	
16/05/2015 **F20: FS15014, 3,6 F/H** **CV580: F11, 3,9 F/H** **B757: F09, 3,7 F/H**	**First flight with the 3 A/C, Oceanic convection** **F20: FL -10°C to FL -30°C, IWC 3g/m3 peak and 2,0-2,5g/m3 sustained** **CV580: FL -5°C to FL -15°C, IWC ~3g/m3 peak**	

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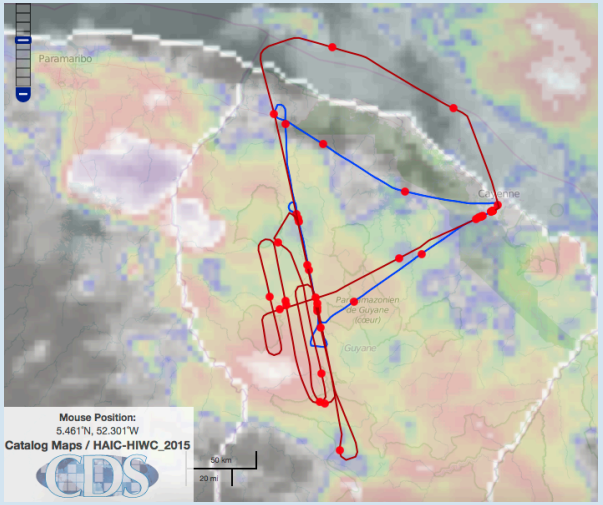
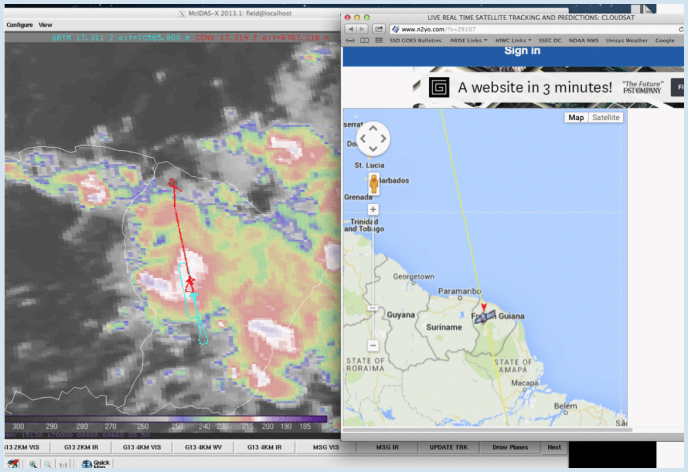
Campaign

Flight	Observations	
16/05/2015 F20: FS15015, 3,6 F/H CV580: F12, 3,9 F/H	Cloudsat overpath, Continental convection The timing was very good with the satellite overpass during a convective storm perfectly in line. After satellite overpass, both aircraft performed additional tracks for regulatory data collection F20: FL -30°C to FL -10°C, IWC 3g/m3 peak and 2,0-2,5g/m3 sustained, ICD installed on fuselage, windscreen seal damaged CV580: FL -5°C to FL -15°C, IWC ~3g/m3, fuel pump failure	 

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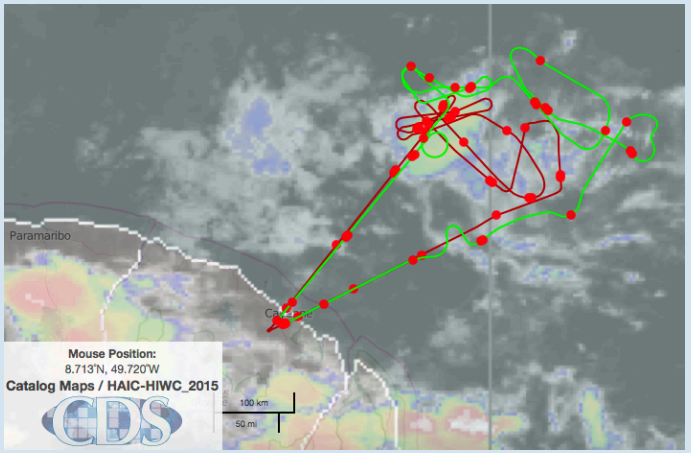
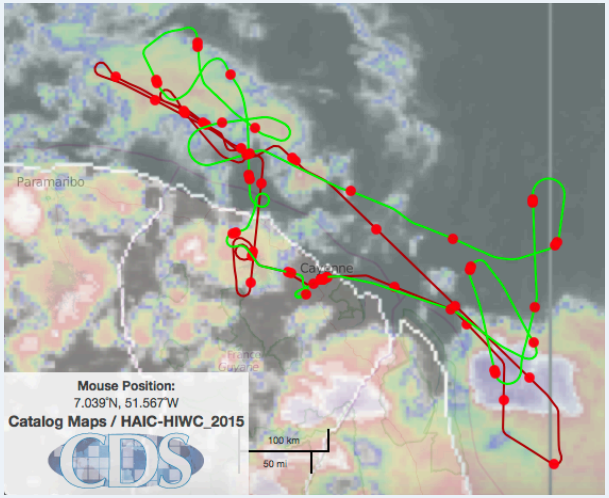
Campaign

Flight	Observations	
18/05/2015 F20: FS15016, 3,3 F/H B757: F10, 3,4 F/H	Oceanic convection F20: 4 legs at FL -30°C, IWC 2.5g/m3 ; 4 legs at FL -45°C, IWC 1g/m3 ; 2 legs at FL -10°C, IWC 1.5g/m3 2nd Robust installed on fuselage	
19/05/2015 **F20: FS15017, 3,4 F/H** **B757: F11, 3,5 F/H**	**Oceanic convection** **Brazil military commanded the A/C to leave the airspace** **F20: FL -30°C and -45°C ; IWC 1.5-2.0g/m3, lightning diverter strips on the radome needs to be replaced**	

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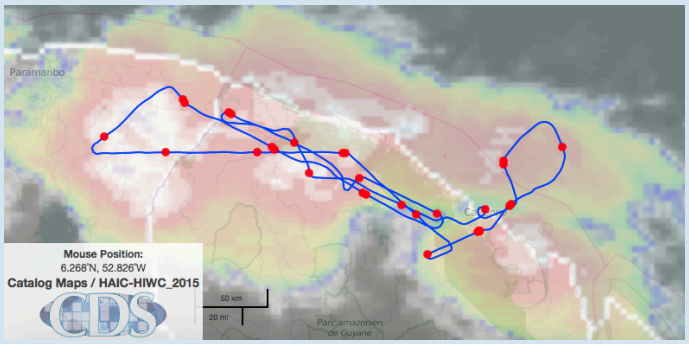
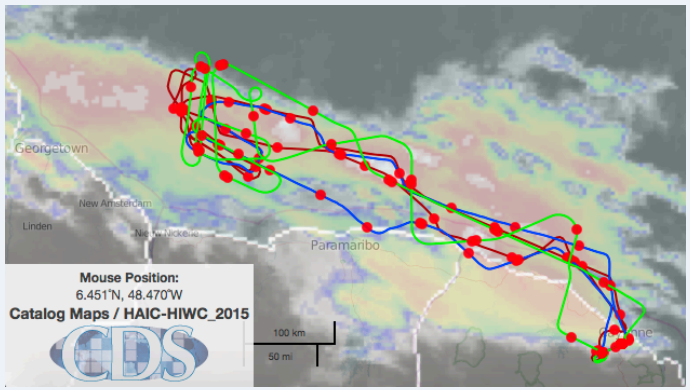
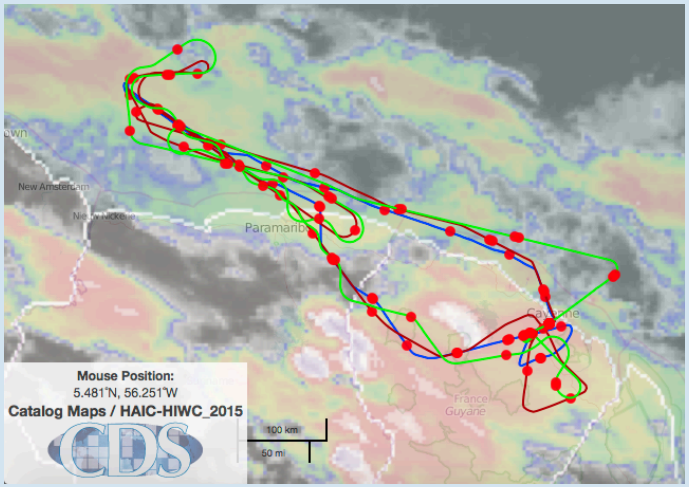
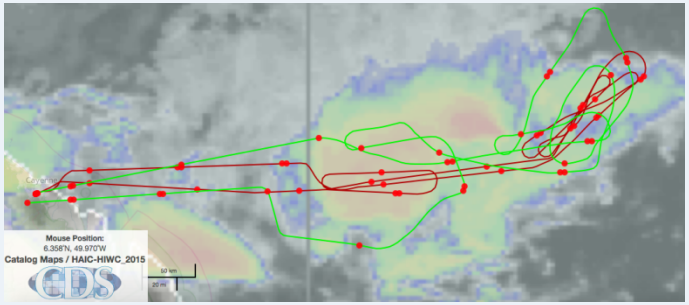
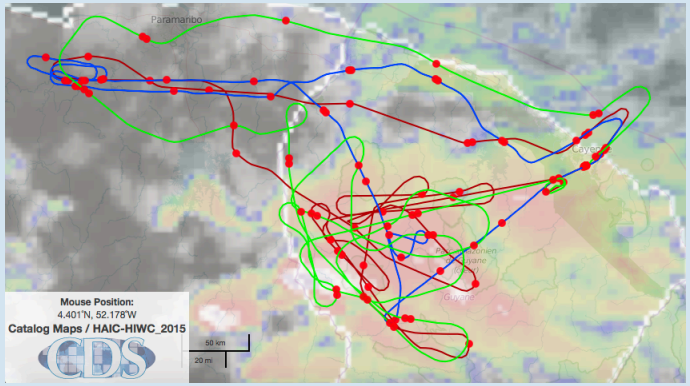
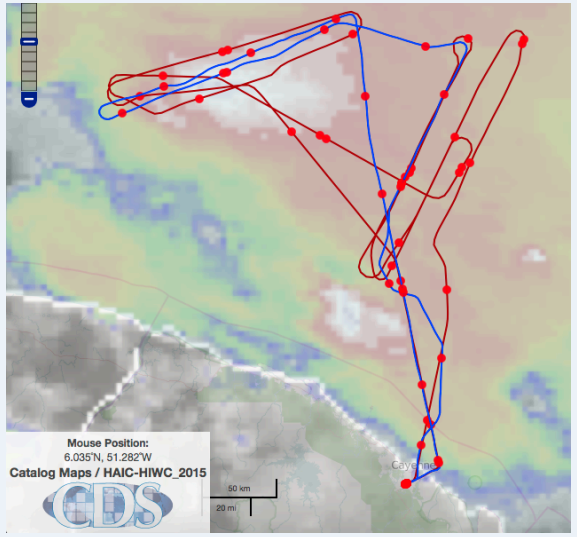
Campaign

Flight	Observations	
20/05/2015 CV580: F13, 3,5 F/H	Oceanic/continental convection 4 legs performed at FL -10°C with TWC 3-4g/m3	
23/05/2015 **F20: FS15018, 3,6 F/H** **CV580: F14, 3,4 F/H** **B757: F12, 3,4 F/H**	**Oceanic convection** **F20: FL 280 to FL 300 (~-30°C), ~10 legs performed, IWC 3g/m3 peak, small cells 5NM to 20NM large** **CV580: , FL -5°C to FL -15°C, IWC ~3g/m3**	

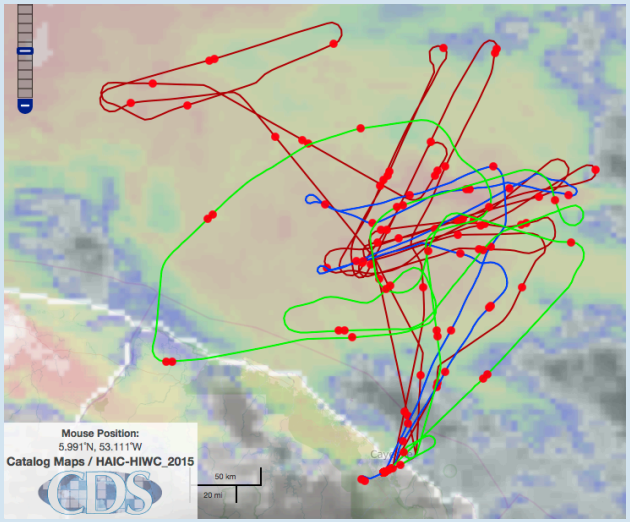
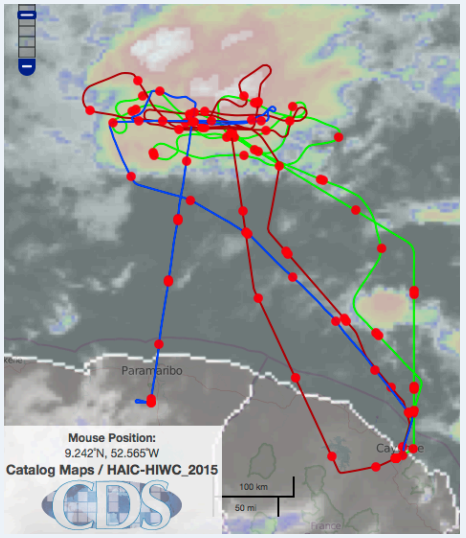
HAIC/HIWC International Field Campaign
Campaign

Flight	Observations	
23/05/2015 F20: FS15019, 3,8 F/H CV580: F15, 3,8 F/H B757: F13, 3,8 F/H	Oceanic/continental convection F20: FL 200 (-10C°) to FL 360 (-45°C) ; ~5 legs performed ; IWC 3g/m3 peak with 2g/m3 sustained over more than 20NM at FL200 (-10°C), peak IWC 2g/m3 at FL360 (-45°C) CV580: , FL -5°C to FL -15°C	
24/05/2015 **F20: FS15020, 3,5 F/H** **B757: F14, 3,5 F/H**	**Oceanic convection, complementary objective to collect data for the WXR at intermediate FL from -30°C to –45°C** **F20: FL 300 (~-30°C) to FL 360 (~-45°C) ; ~10 legs performed, IWC 4g/m3 peak, sustained IWC 1,0-1,5g/m3 over 20NM ; small cells <50NM**	

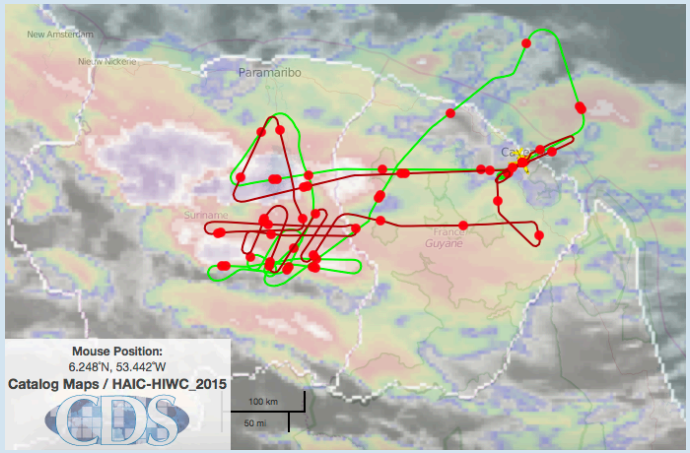
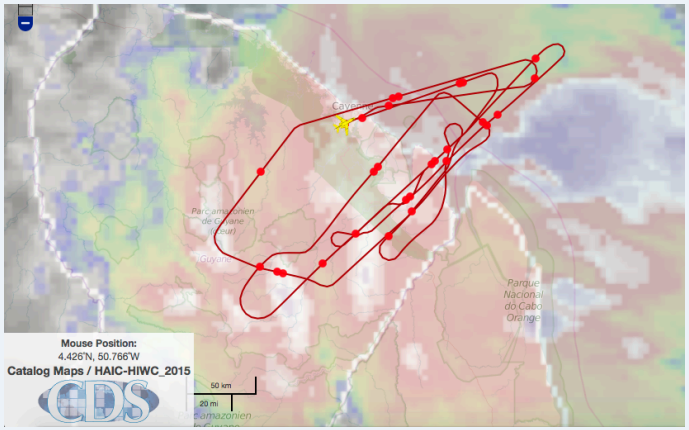
HAIC/HIWC International Field Campaign
Campaign

Flight	Observations	
25/05/2015 F20: FS15021, 3,7 F/H CV580: F16, 3,9 F/H B757: F15, 3,8 F/H	Continental convection F20: FL300 (-30°C) to FL360 (-45°C) ; IWC 4g/m3 peak and some 3g/m3 sustained at FL360 (-45°C) , LWC probe installed, lightning diverter strips on the radome needs to be replaced CV580: FL 200 (-10°C), IWC > 2.0g/m3	
26/05/2015 **F20: FS15022, 3,5 F/H** **CV580: F17, 3,1 F/H**	**Oceanic convection** **F20: FL210 (-10°C) to FL360 (-45°C) ; 2 legs at FL210, 1 leg at FL300, 5 legs at FL360 ; IWC 5g/m3 peak and some 3g/m3 sustained** **CV580: FL 200 (-10°C), IWC > 3.0g/m3**	

HAIC/HIWC International Field Campaign
Campaign

Flight	Observations	
26/05/2015 **F20: FS15023, 2,8 F/H** **CV580: F18, 3,0 F/H** **B757: F16, 3,0 F/H**	**Oceanic convection, Quick turn arround** **F20: FL210 (-10°C) to FL360 (-45°C) ; 4 legs at FL210, 3 legs at FL360 ; IWC 3g/m3 peak and some 1.0-2.0g/m3 sustained at FL210, IWC 0.5-1.5g/m3 at FL360** **CV580: FL 200 (-10°C), IWC > 2.0g/m3 sustained**	
27/05/2015 **F20: FS14024, 3,9 F/H** **CV580: F19, 4,0 F/H** **B757: F17, 3,5 F/H**	**Oceanic convection, System with very short life cycle leading to very difficult coordination** **F20: FL300 (-30°C, conditions not good enough to climb to FL360) ; IWC 2g/m3 peak and some 2g/m3 sustained at FL300 (-30°C)** **CV580: , FL 200 (-10°C), IWC > 2.0-3.0g/m3, last flight**	

HAIC/HIWC International Field Campaign
Campaign

Flight	Observations	
28/05/2015 **F20: FS15025, 3,7 F/H** **B757: F18, 3,5 F/H**	**Continental convection, Cloud top at 16km+. Surprisingly, quite low IWC: IWCmax ~2g/m3 at FL300 (-30°C) and IWCmax ~1g/m3 at FL360 (-45°C)** **F20: FL300 (-30°C) to FL360 (-45°C) ; 13 legs performed ; IWC 2g/m3 peak and some 1.0g/m3 sustained**	
29/05/2015 F20: FS14026, 3,5 F/H	Oceanic/continental convection F20: FL210 (-10°C) to FL360 (-45°C) ; 10 legs performed ; IWC 2.5g/m3 peak and some 1.0-1.5g/m3 sustained Last flight!	

HAIC/HIWC International Field Campaign
Conclusion & Lessons learnt

- Darwin 2014 lessons learnt successfully implemented allowing to ensure the continuity of the operations
- A/C & Team
  - Very good A/C and instrumentation behavior and functioning during the whole flight campaign
  - 3rd pilot and 2nd mechanic allow to ensure the continuity of the operations
  - Need to duplicate flight guidance team to manage fatigue
- Logistics
  - Few issues eg red badges but no major impact on the operations
- PLANET
  - Major improvements (protocol, HMI, 3 A/C,…) leading to some issues at the begining of the campaign. Support on-site mandatory.

HAIC/HIWC International Field Campaign
Conclusion & Lessons learnt

High Altitude Ice Crystals (HAIC, 314314)

Project co-funded by the European Commission within the Seventh Framework Programme (2012-2016)