

Presented by

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## Data status

RASTA Doppler cloud radar

# Data status

- ▶ RASTA system
- ▶ Reflectivity simulations - calibration
- ▶ Status of deliverables (version 5.2.3)
- ▶ How to use the data?
- ▶ RASTA and CloudSat

# RASTA-F20

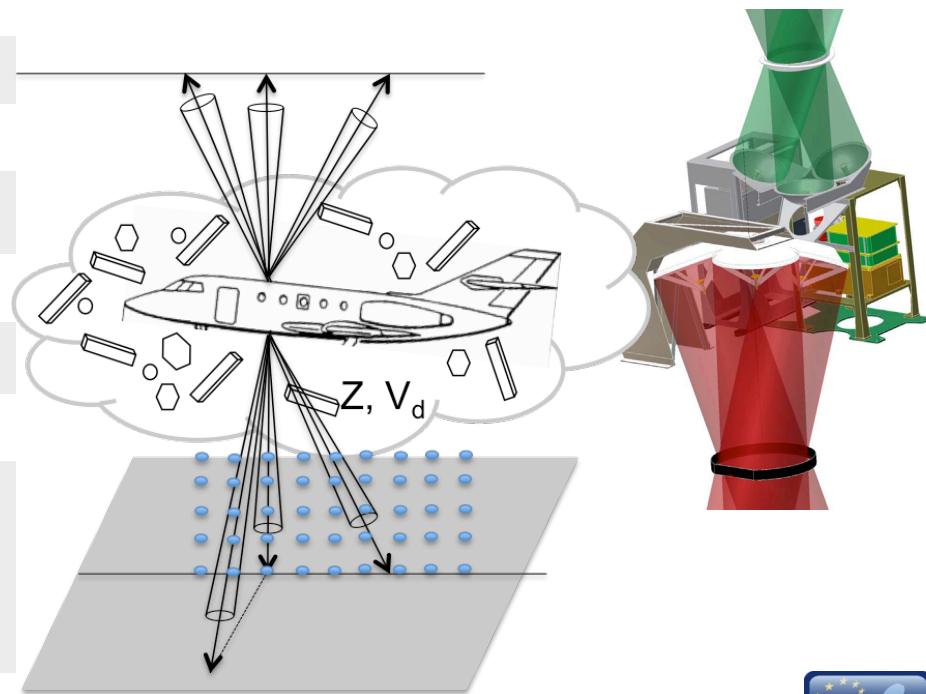
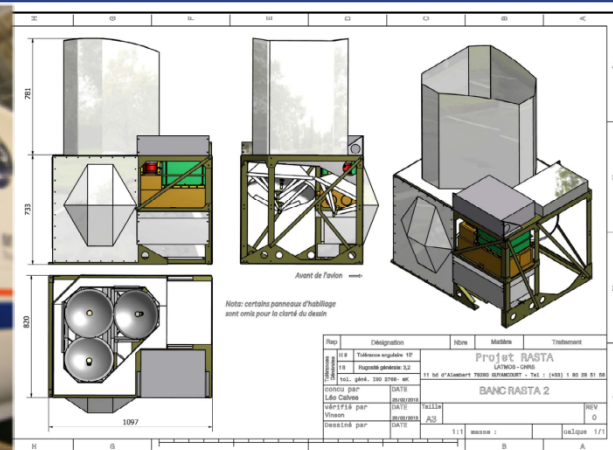
## RASTAI - Description

Cloud radar operating at 95 GHz (same as CloudSat)

- Unique feature is the 5-antenna system (only 2 flights with 6 antennas)
- Allows for 3D wind retrieval + cloud microphysics retrieval (including IWC)

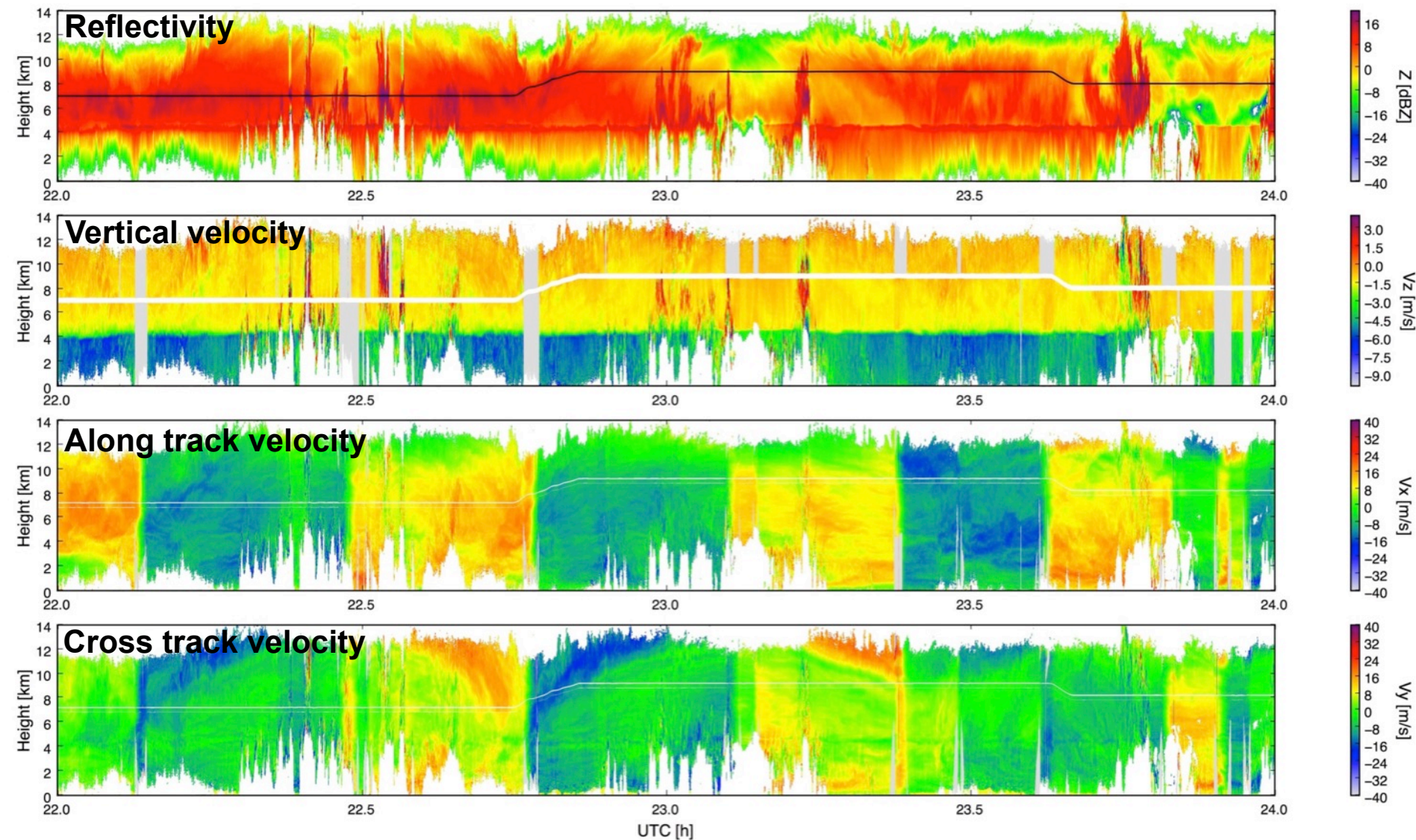
### 5-6 antennas

Frequency (GHz)	95 (3.2mm)
Vertical resolution (m)	60
Horizontal resolution (m)	225 to 300 depending on aircraft speed
Range (km)	15
Integration time (ms)	250 (measurement every 1.5 s for each antenna)
Energy (kW)	2 (pulse 0.4 $\mu$ s)
Ambiguous velocity (m s <sup>-1</sup> )	8
Antenna size (cm)	30 to 45 (0.7°/0.5° beam width)
Sensitivity at 1km (dBZ) – to be updated after calibration flight	<ul style="list-style-type: none"> <li>• Down backward: -30</li> <li>• Nadir: -30</li> <li>• Down transverse: -30</li> <li>• Zenith: -23</li> <li>• Up backward: -30</li> <li>• Up transverse: -19</li> </ul>
Weight (kg)/dimensions (cm)	110/82x102x150



# Cloud wind retrieval example

Darwin F23 2014/02/18



# RASTA : Data Processing Status

## Data availability from HAIC-HIWC

### • Darwin campaign

- ▶ 22 Flights out of 23 with RASTA (hatch problem, F18)
- ▶ Flights 1 to 21 : five antennas (only cloud wind along the flight track available above the aircraft), no limitation for microphysics
- ▶ Flights 22 to 23 : six antennas (full 3D wind above and below aircraft)

### • Cayenne campaign

- ▶ Flight 9 issue with RASTA => no data
- ▶ Flights 10 to 26 : 5 antennas and F15 with CloudSat!

**Data quality : excellent !**

# RASTA : Data Processing Status

## One file per antenna (Instrument oriented)

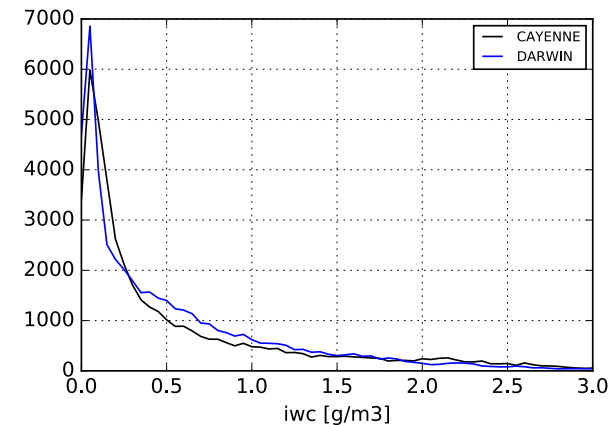
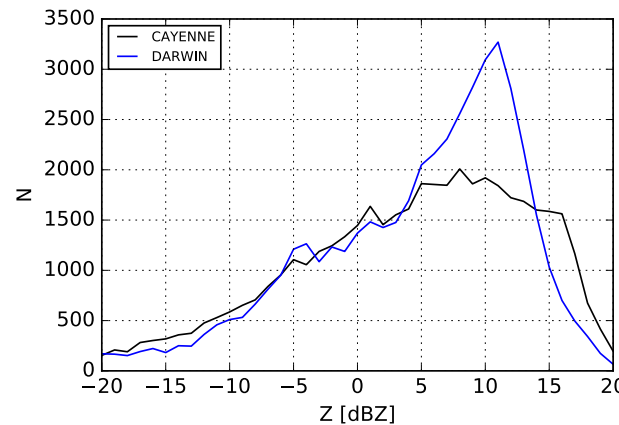
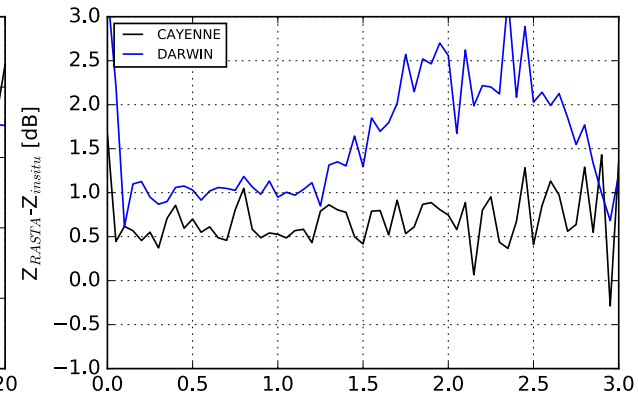
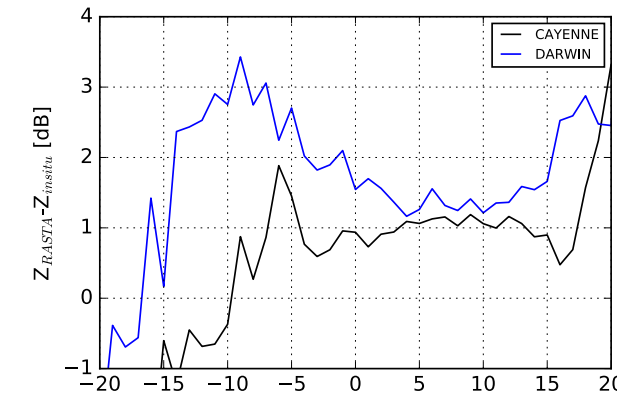
Data level	Description	status	Campaign	comments
L0	netcdf file containing Z and Doppler velocity uncorrected. 1.2 s horizontal / 60 m vertical	Ready (V4)	Darwin and Cayenne	
L1	netcdf file containing Z (calibrated) and Doppler velocity uncorrected. 1.2 s horizontal / 60 m vertical	Ready (V4)	Darwin and Cayenne	Data have been calibrated using Ocean return
L2	netcdf file containing Z (calibrated) and Doppler velocity (aircraft velocity component removed, unfolded). Radar gates are geo-located. Interpolation between upper/lower domain and correction of reflectivity near the aircraft. Z is corrected near the aircraft. 1.2 s horizontal / 60 m vertical	Ready (V4.1)	Darwin and Cayenne	V4.1 (minor corrections on unfolding technique) Antenna pointing angles measured and checked Ghost echo on upward antennas

# Reflectivity simulations

- Can we reconcile in-situ and remote sensing measurements?

T-matrix simulation  
 $N(D)$ ,  $Ar(D)$ ,  $M(D)$   
 from up to date  
 in-situ products

RASTA calibration  
 Correction?  
 -1dB (DARWIN)  
 -0.5dB (CAYENNE)



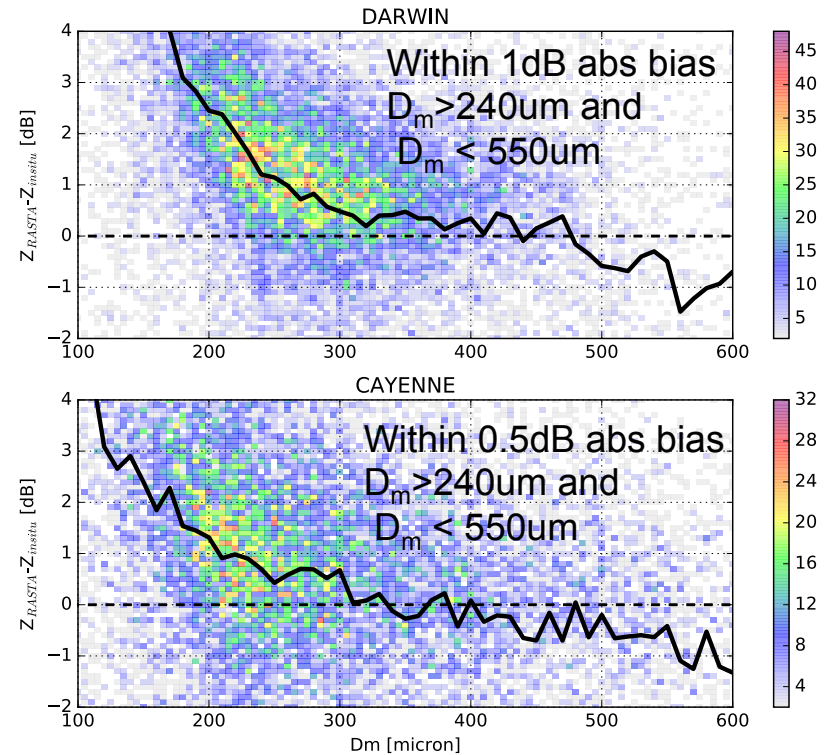
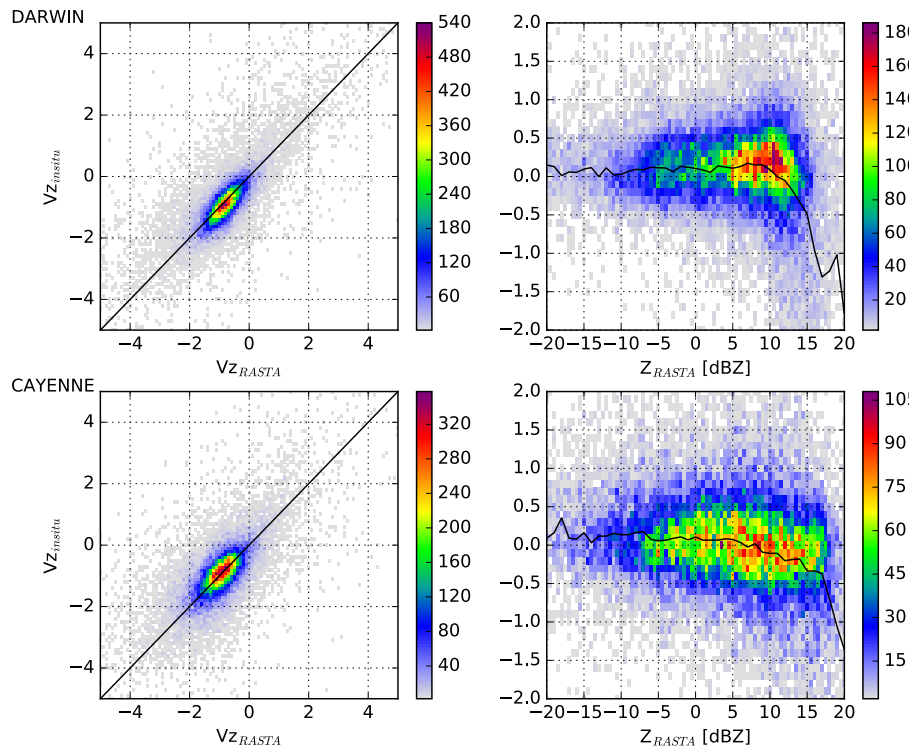
Due to small or large particles?

Remember : with 1dB error expected on RASTA calibration

# Reflectivity simulations

- Can we reconcile in-situ and remote sensing measurements?

T-matrix simulation,  $N(D)$ ,  $A_r(D)$ ,  $M(D)$  from up to date in-situ products (V(D) Heymsfield and Westbrook)



$Vz$  simulation => very good agreement

$$Vz_{insitu} = Vt_{insitu} + w_{insitu}$$



# Status of deliverables

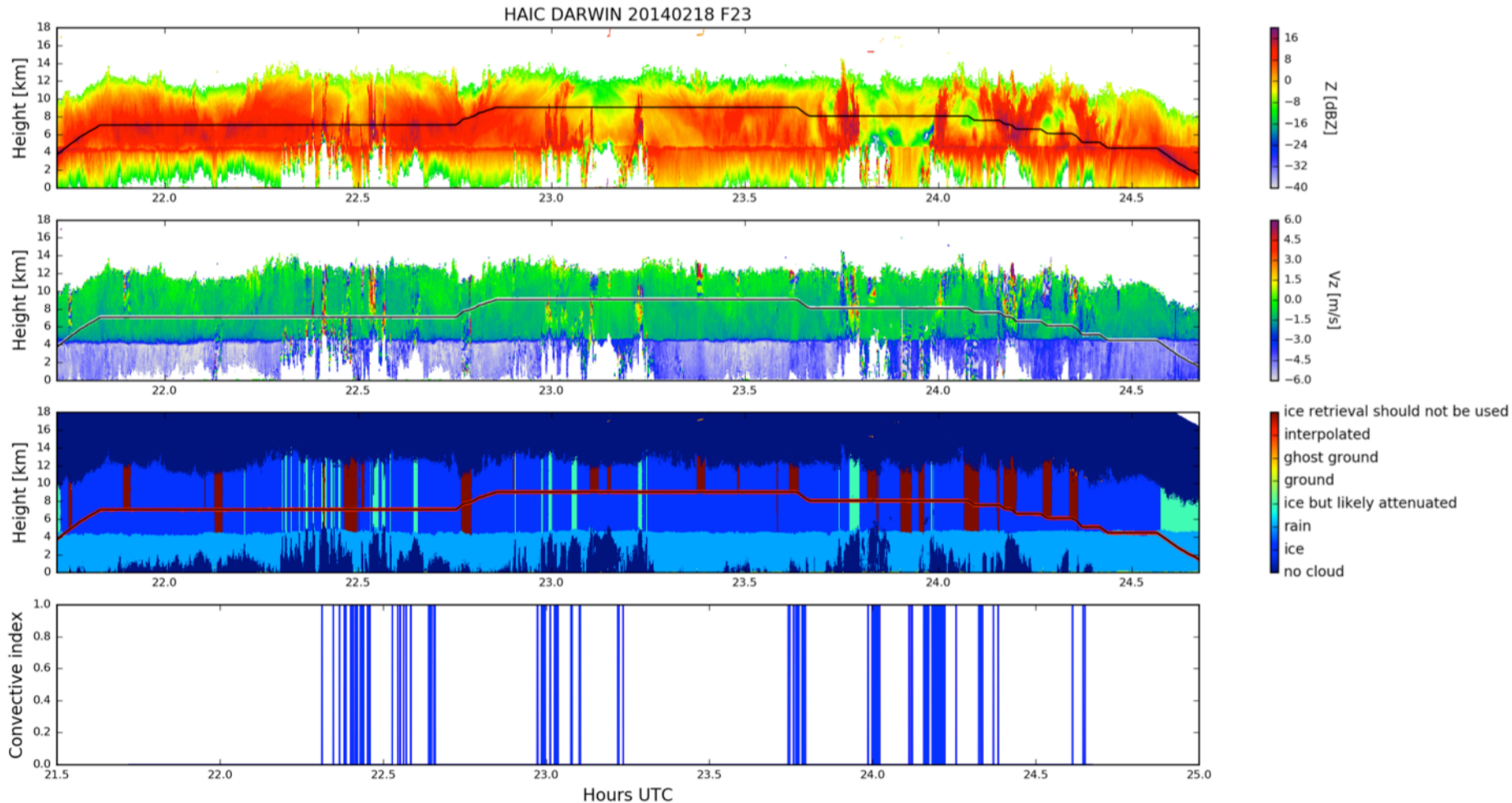
data	description	status	comments
3D WIND	Z (vertical reflectivity), $V_z$ (vertical velocity), $V_x$ (along track velocity), $V_y$ (cross track velocity) + including flags Variational technique DARWIN : Z -1 dB CAYENNE : Z - 0.5 dB	Ready (V5.2.3) Darwin and Cayenne	Validation using in-situ wind (aircraft) Wind flags modified
Ice cloud microphysics	IWC, $D_m$ (mean volume diameter), $R_e$ (effective radius), $W$ (vertical air motion), $V_t$ (ice terminal fall speed) Variational technique accounting for ice attenuation	Ready (V5.2.3) Darwin and Cayenne	Evaluation of our IWC retrieval using IKP and microphysical probes

**A file (dynamic+microphysics) per flight is available via our ftp:  
Address: [ftp.latmos.ipsl.fr](ftp://ftp.latmos.ipsl.fr) login: haicr password: GTAUIac!  
Then go to /RASTA/microphysics\_05\_2.3/ where you can find data for both campaigns**

# What is new in the v5.2.3?

- One single file with dynamic and microphysics
- Attenuation flag including ghost echo detection, interpolated region.
- Preliminary validation of IWC retrieval (not at aircraft altitude) using only one coordinated flight (Cayenne)
- In the V5.2, the a priori information on IWC for temperatures colder than  $-50^{\circ}\text{C}$  was incorrect and led to a small overestimation of IWC in this region.
- **V5.2.3 uses a new microphysical model developed using DARWIN and CAYENNE in-situ data.**
- In V5.2.3 the gaseous attenuation correction above the aircraft is corrected and the IWC a priori information will be improved for temperatures colder than  $-50^{\circ}\text{C}$ .
- A few corrections regarding the measurement flag

# Convective Index - Attenuation flag



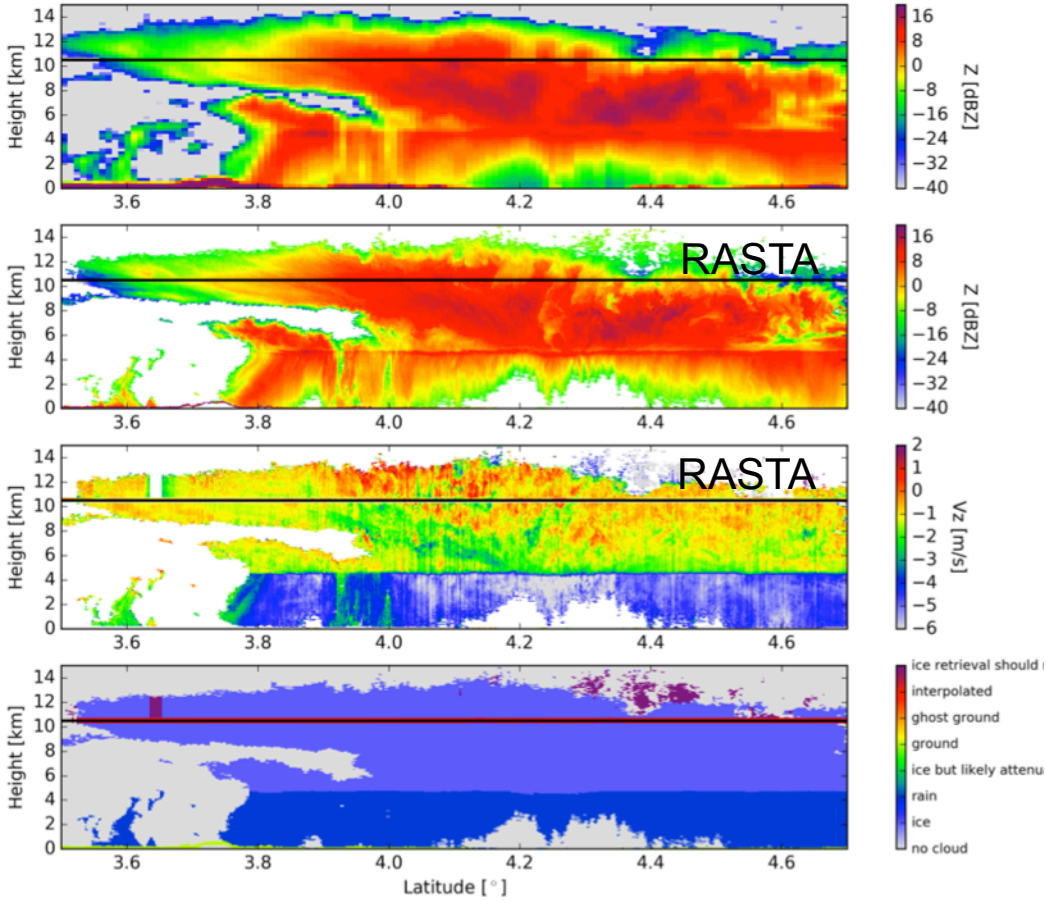
Attenuation flag: 0 no cloud / 1 ice / 2 rain (attenuated) / 3 ice but likely attenuated / 4 ground / 5 ghost ground / 6 interpolated / 7 ice retrieval should not be used

# Advice for using RASTA data

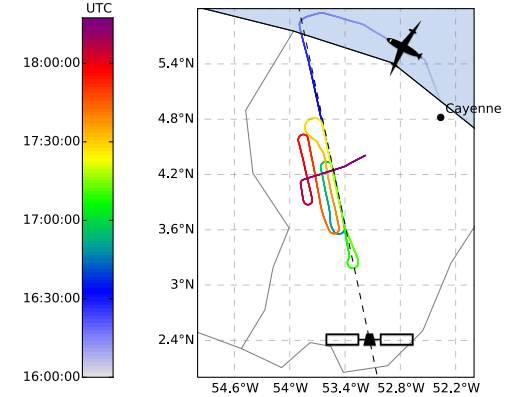
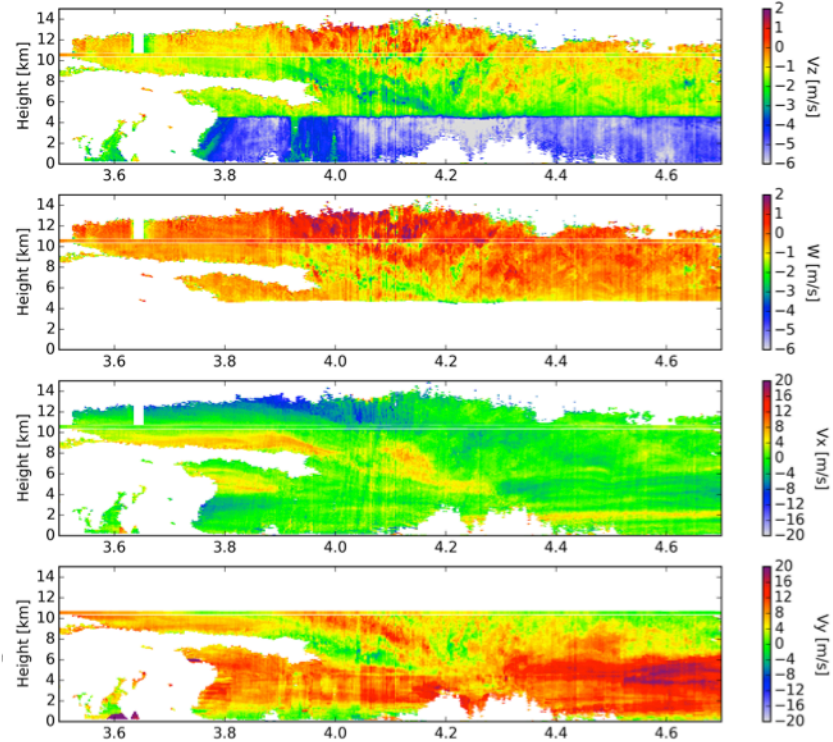
- Height\_2D for altitude measurement at each radar gate
- Use the flag ! “attenuation\_phase\_flag” = 1 (i.e. ice)

# CloudSat – F15 16/05/2015

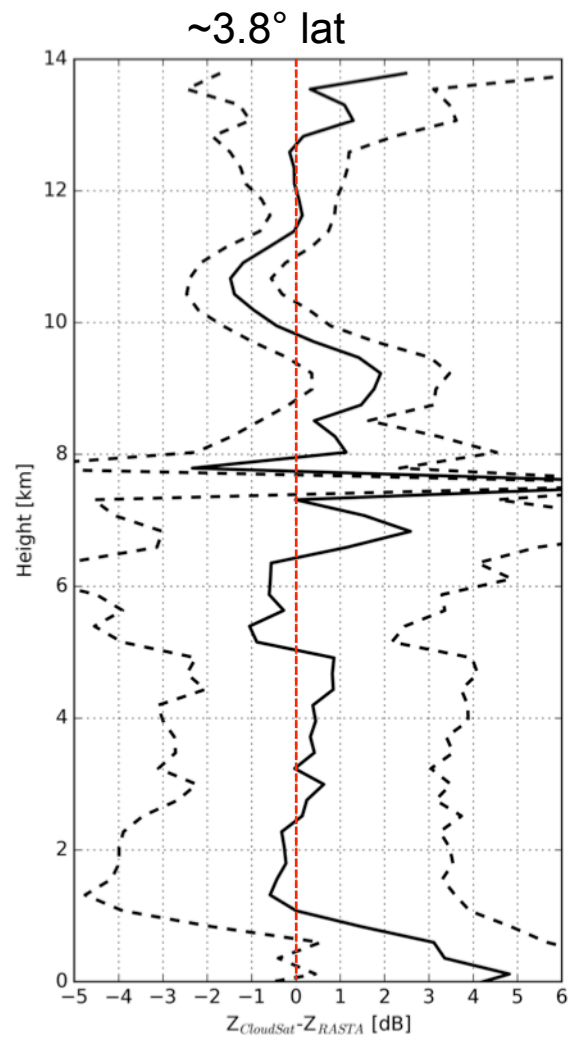
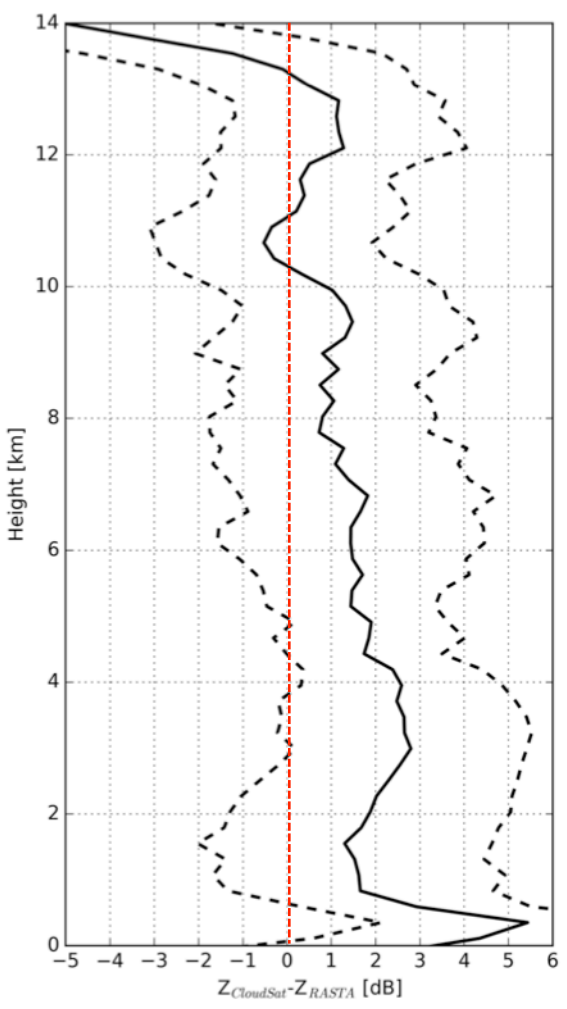
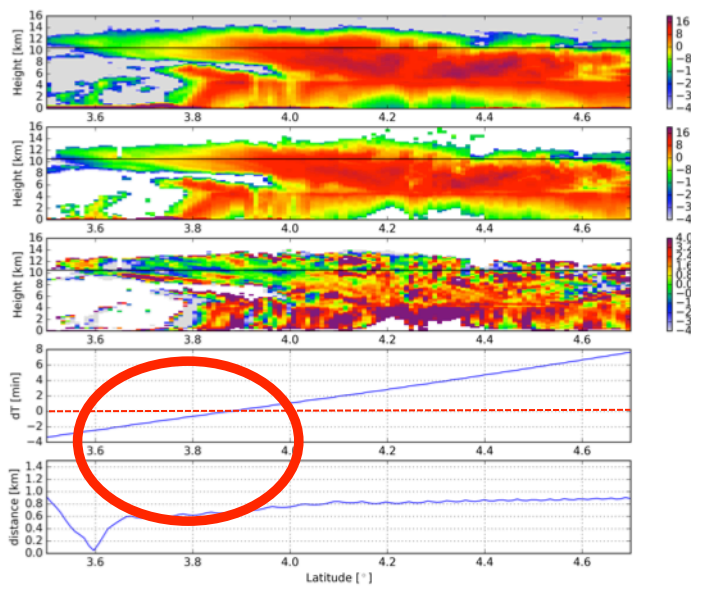
CloudSat



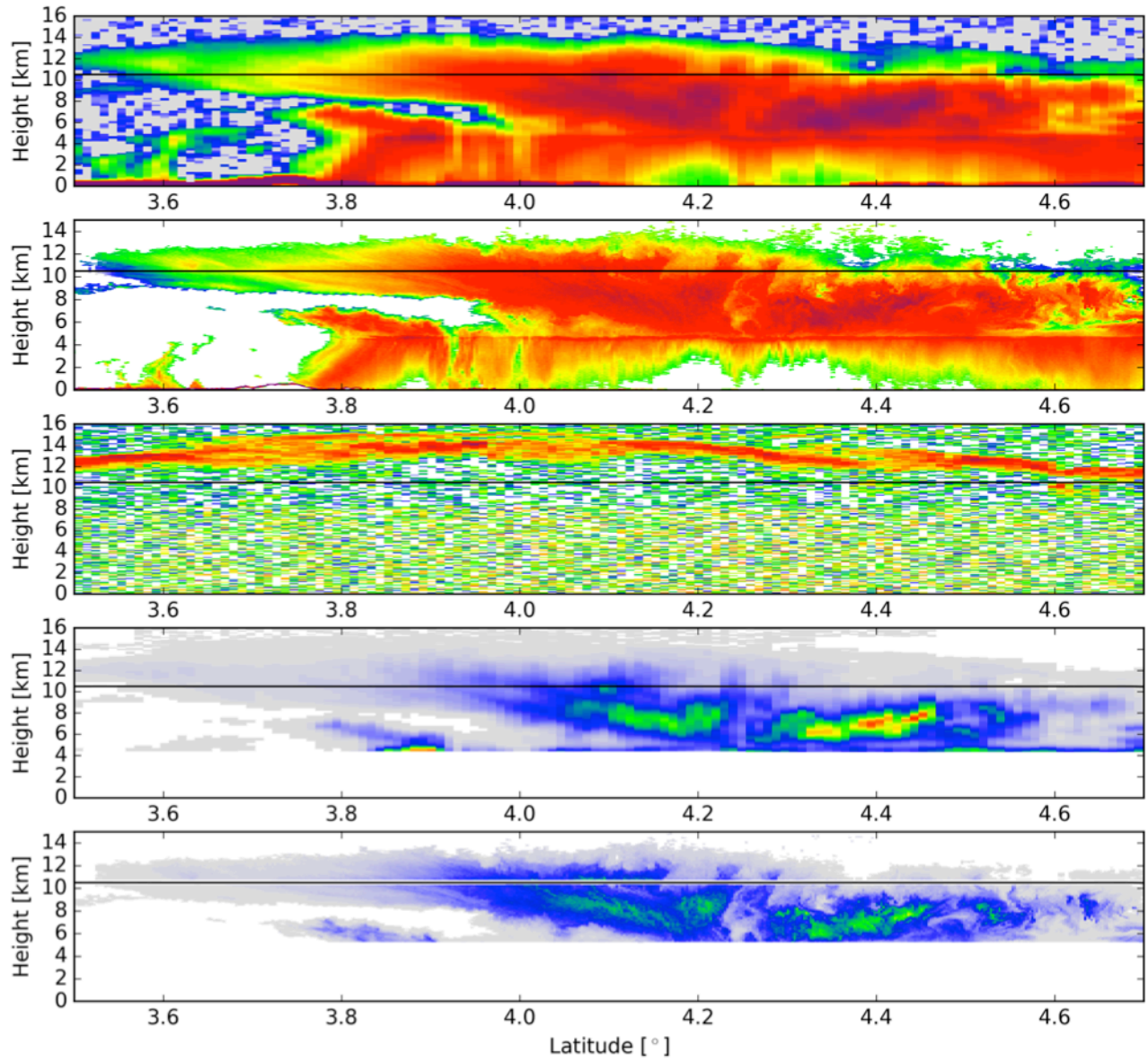
RASTA



16/05/16



# DARDAR – F15 16/05/2015



CloudSat

RASTA

CALIPSO  
LIDAR

DARDAR  
IWC  
Operational  
product

RASTA IWC

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# Remaining work

- ▶ Most of the work has been done on the microphysics:
  - New retrieval algorithm (variational approach) including ice attenuation
  - Need to be validated using extra measurements away from the aircraft (Cayenne data from Convair, IKP and X-W band radars)



## High Altitude Ice Crystals (HAIC, 314314)

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