

**ATR-0205 (05 February 2020)**  
**Flight #11 and #12 – as200011 and as200012**  
*Marie Lothon, Cyrille Flamant*  
*Sandrine Bony, Julien Delanoë*  
*03 February 2020*

## 1. Objective

The objective of this flight is to characterize the cloud and boundary layer properties within the HALO circle, focusing on the cloud base level and the subcloud-layer.  
HALO, TO, P3, Boreal flew this day.

## 2. Crew

### **Flight A (8:45 – 13:15 UTC):**

Cyrille Flamant (Mission PI, Lidar), Julien Delanoë (RASTA), Benjamin Fildier (BASTA), Alfons Schwarzenboeck (Microphysics), Franziska Aemisegger (Picarro), Pierre-Etienne Brilouet (turbulence), Michel Cluzeau (SAFIRE Engineer), Tetyana Jiang (SAFIRE Engineer), Dominique Duchanoy (Pilot), Guillaume Seurat (Pilot)

Flight-level support on ground: Jessica Vial, Nicolas Rochetin, Sandrine Bony

### **Flight B (13:45 – 18:15 UTC):**

Marie Lothon (Mission PI), Christophe Le Gac (RASTA), Jessica Vial (BASTA), Julien Totems (Lidar), Pierre Coutris (Microphysique), Anna Lea Albright (Picarro), Hubert Bellec (SAFIRE Engineer), Gilles Vergez (SAFIRE Engineer), Dominique Duchanoy (Pilot), Guillaume Seurat (Pilot)

Flight-level support on ground: Raphaëla Vogel, Nicolas Rochetin, Sandrine Bony

## 3. Synoptic Situation

A ridge dominates the observation area, with increased wind of about 10m/s.

During the first flight, the cloud pattern was a succession of Flower patterns (with brisk showers), which changed to Gravels and Sugar during the second flight.

During the two flights, the cloud fraction was larger than previous days. The clouds were generally more developed, with showers for some of them.

### Flight #11

The ATR performed the 1<sup>st</sup> of its 3 rectangles at around 1900m in the stratiform part of a flower present in the center and the southern part of the rectangle, with large patch of clear air outside. The profile obtained during the take-off climb of the aircraft to the Ferry (see Skew-T diagram below) shows a very well defined inversion height at ~2000 – 2100m. Liquid water content was significant in the cloud layer. The ATR then descended to CBH for the 2 remaining rectangles and operated around 750 m AMSL, while the flower slowly moved out of the rectangle. At this time, a large flower was observed to the east of the ATR operation area, producing gust and nebulosity that ultimately was sampled along the L-shaped track after the 3<sup>rd</sup> rectangle. The boundary layer appeared to be very hazy with clouds at its top, the base of which was difficult to see clearly. The cloud organization also looked multi-layered. The clouds were inclined, which could be the result of high wind shear in the cloud layer. The wind conditions were a little stronger than the previous days with ~26kts instead of the common ~13kts before. The sea surface thus appeared less quiet with a few whitecaps. At the end of the surface leg, during the ascent to FL100, the skew-T diagram (see below), shows a inversion height of ~2300m which is around 400m higher than at the beginning of the flight.

### Flight#12

The stratiform layer of the flower was disappearing, and only small areas of thin stratus remained. The first ferry leg to Entry Point was flown at this height.

In the area of exploration, a mix of Sugar pattern and Gravels cold pools were sampled.

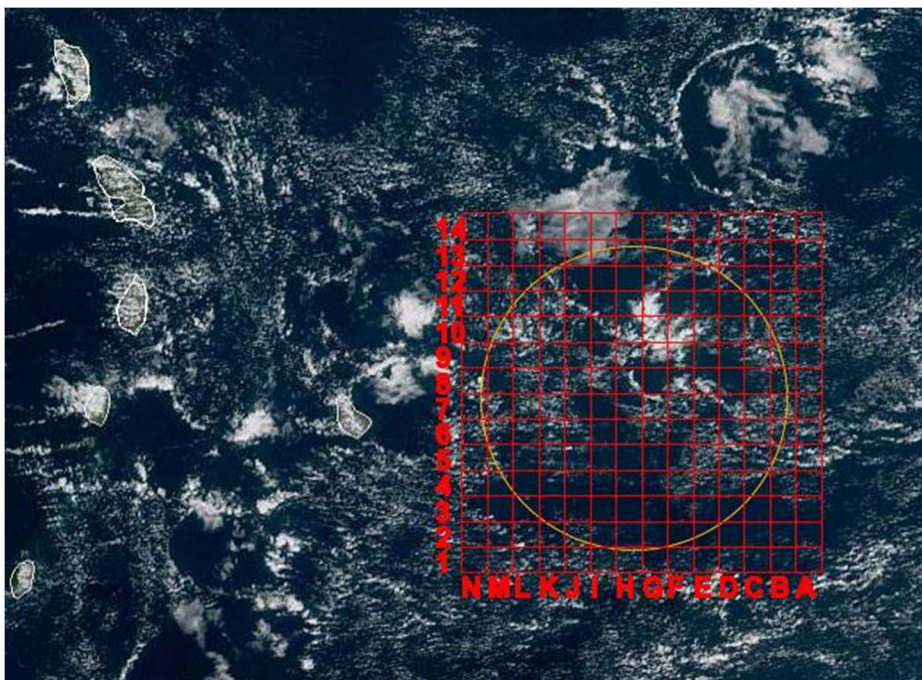
The clouds were generally less active and developed than the first flight, but still numerous. There was a clearer area in the southeastern part of the rectangle. Slight NS gradient of cloud base, from lower at North to higher at South.

A few very small clouds had their base lower than the most active and biggest clouds. Those very small cumulus clouds were consequently missed in our scanning flight, as we were flying above.

During the first subcloud leg, we flew toward a cold pool, with much lower cloud bases. So that the end of the leg was flown within the base.

Turbulence was generally weak, but less than previous flight, and intermittently moderate.

Aerosol layer was found up to 2350 m. Dense mist between clouds with large extinction coefficient. Marine aerosol below cloud base.



Target area superimposed on GOES satellite picture at 15:30 UTC during first flight

### 3. Flight Elements

R: Rectangular (race track) pattern starting at Entry Point, starting with the northward heading leg to the west; L: L-shape pattern round trip (one leg along wind, one crosswind); EP: Entry Point race track (13.25N, 58.41W)

Flight #11:	(°N, °W)	Flight Level (FL)	Time (UTC)	Notes
Takeoff	GAIA		8:45	
Ferry	To EP	FL100	8:57-9:07	2500m
R1		FL60	9:11-9:56	Cloud top, stratiform clouds
R2		2250-2440 ft	9:58-10:44	Cloud base
R3		2350 ft	10:44-11:32	Cloud base

Flight #11:	(°N, °W)	Flight Level (FL)	Time (UTC)	Notes
L1		1750 ft	11:34-11:58	Top subcl layer
L2		850 ft	12:01-12:21	Mid subcl layer
Low level		200 ft	12:26-12:35	Turbulence
Ferry back	From EP	FL100	12:42-12:50	Reference for lidar and Picarro, sounding
Landing	GAIA		12:59	

Flight #12:	(°N, °W)	Flight Level (FL)	Time (UTC)	Notes
Takeoff	GAIA		13:48	
Ferry	To EP	FL70	13:57-14:13	In inversion / St layer
R1		FL26	14 :16-15 :04	Cloud base (790m)
R2		FL26	15:04-15 :51	Cloud base (790m)
R3		FL26	15 :51-16:42	Cloud base (790m)
L1		FL18 FL15	16:45-16:58 16:58-17:08	Below and within base Below base
L2		FL08	17:10-17:31	Mid subcloud layer
Leg	To EP	220 ft	17:38-17:44	Close-to-surface
Ferry back		FL100	17:51-17:58	
Landing	GAIA		18:04	

A detailed report of the start time and ending time of all legs is accessible on EUREC4A AERIS website (EUREC4A Operational Center, <https://observations.ipsl.fr/aeris/eurec4a/#/>)

#### 4. Instrument Status

**Radars:** RASTA now works well (and concentrated) on the vertical beam. No other beam.  
BASTA worked fine.

**Lidar:** Worked fine.

**Picarro:** Worked fine.

**Microphysics:** CDP-2, 2DS and FCDP worked well.

#### Base:

INS degraded to 50Hz instead of 100Hz normally.

Fast wind: OK.

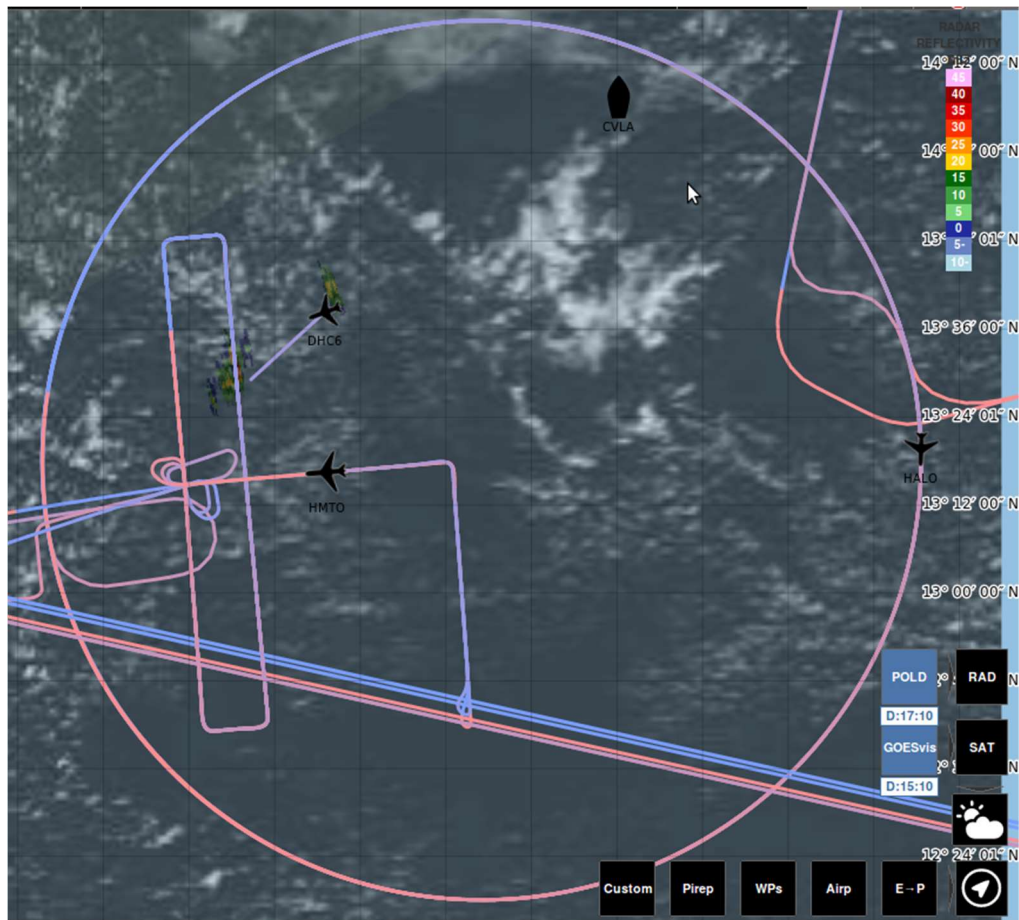
Water vapour: some uncertainties on the KH20 after the calibration.

Temperature: OK.

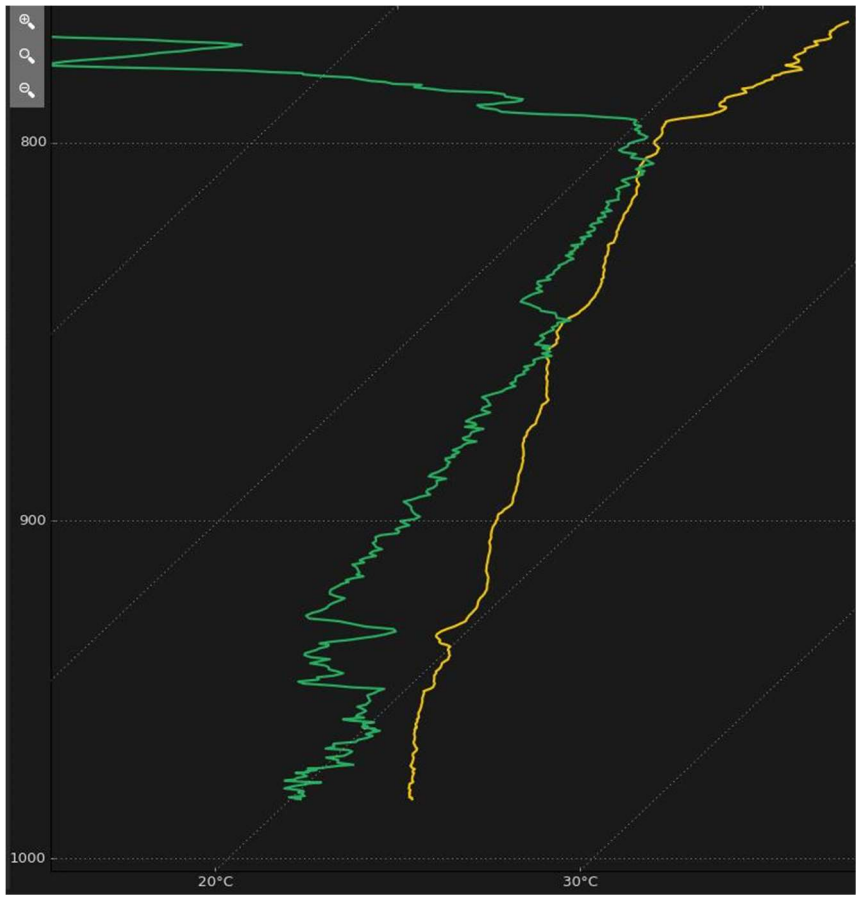
PVM, LWC-300, Aerosol, microphysics: OK except Nevzorov (LWC).

Uncalibrated LWV Gerber and LWC300

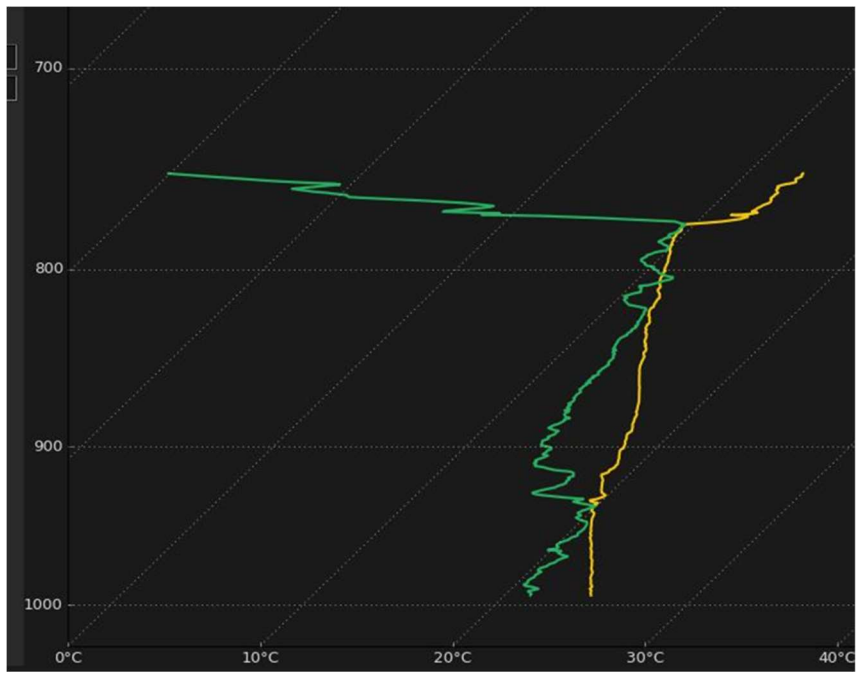
# Figures



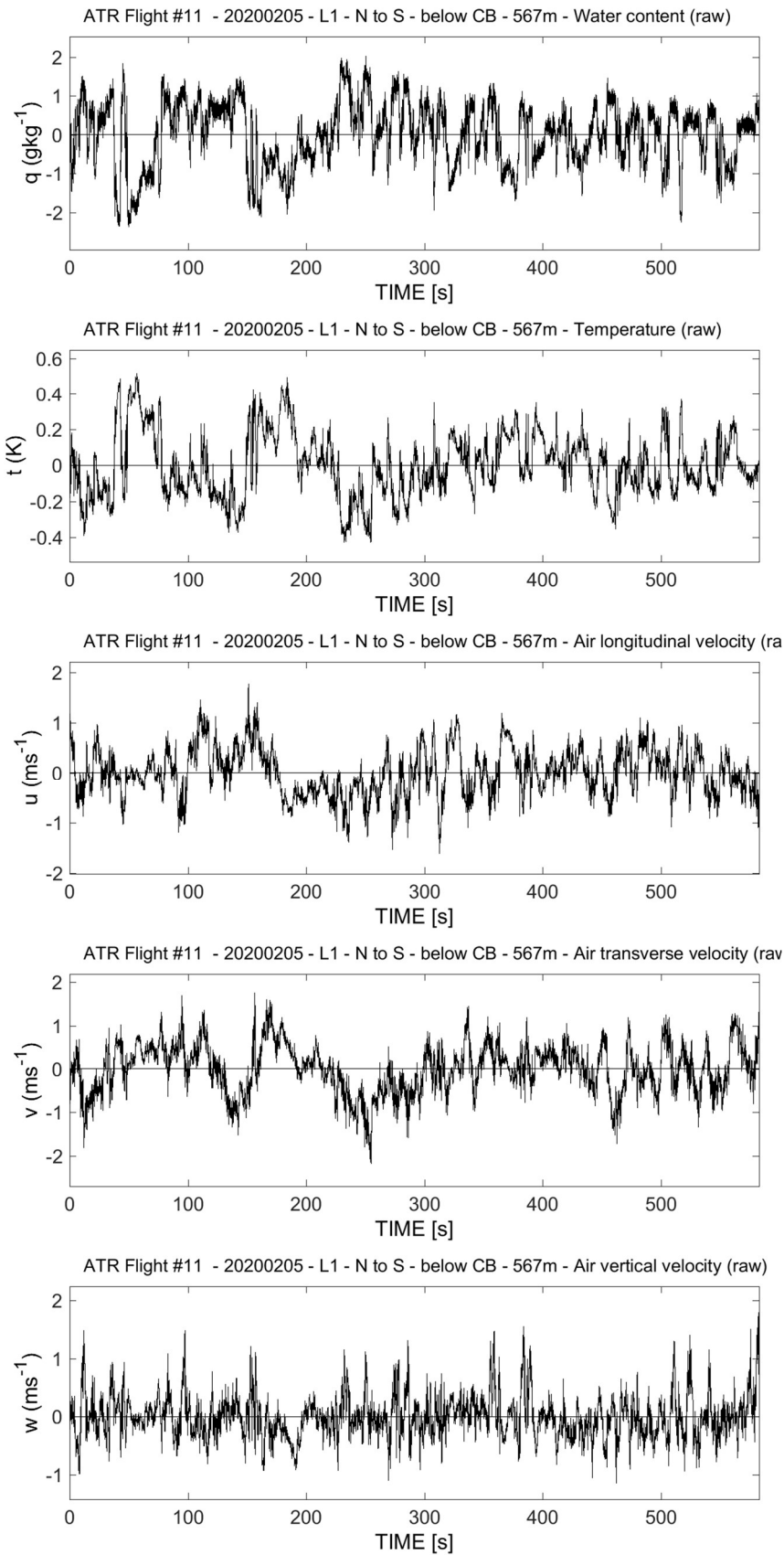
*Trajectory at the end of first flight at 17:24utc (with superimposed HALO circle and start of eastward excursion, and P3 ferry).*



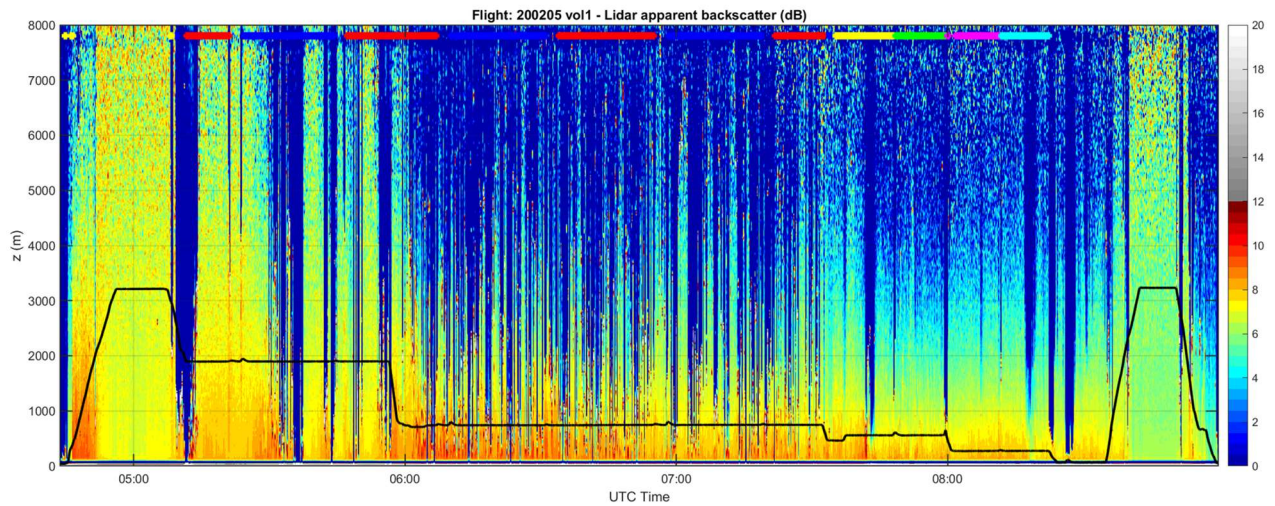
*Skew-T diagramme during ascent of first flight from TO to ferry leg*



*Skew-T diagramme during ascent of first flight from EP to FL100*

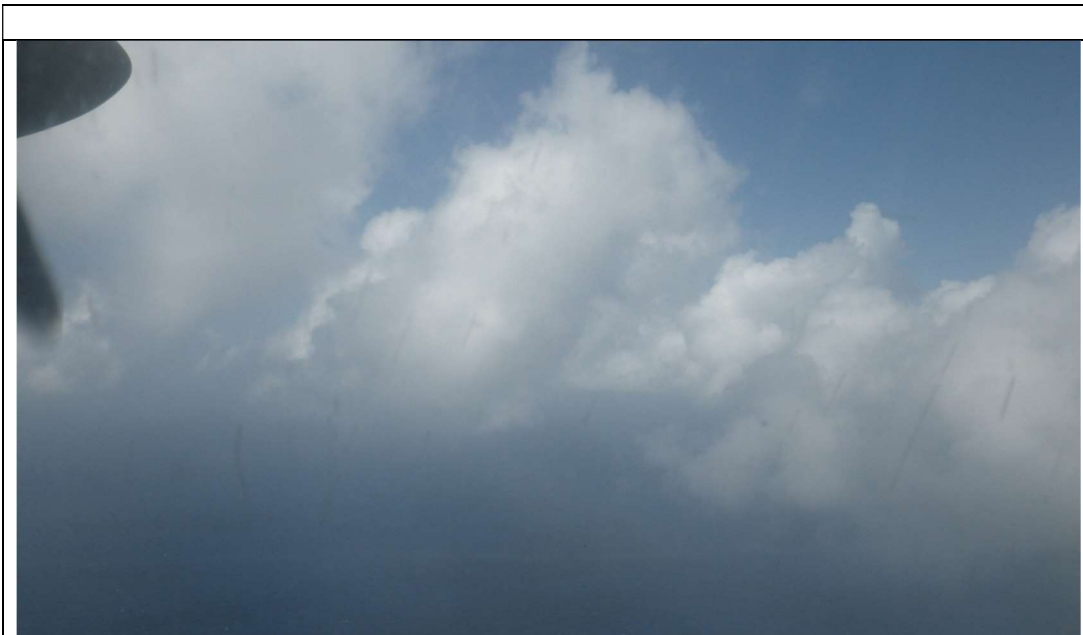


*Time series of the fluctuations of moisture, temperature, and three components of the wind below cloud base on the NS axis of the L pattern. (Unfiltered but detrended raw data).*



*Along line of sight ALIAS backscatter signal during Flight #11. The black line at the bottom of the plot is the altitude. The color code at the top of the plot indicates the rectangle pattern (blue=aircraft heading southward, red: aircraft heading northward) and the L-pattern (yellow= aircraft heading eastward, green = aircraft heading southward, magenta= aircraft heading northward, light blue= aircraft heading westward).*

#### 4. Pictures



*Picture taken at cloud base at 15:52 UTC durnig second flight*