ATR-0211 (11 February 2020)

Flight #17 and #18 – as200017 and as200018

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1. Objective

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

2. Crew

Flight A (05:55 –10:21 UTC):
Cyrille Flamant (Mission PI, Lidar), Julien Delanoë (BASTA), Florian Ewald (RASTA), Pierre Coutris (Microphysique), Gregory Cato (Picarro), Andreas Fix (Turbulence), Tetyana Jiang (SAFIRE Engineer), Michel Cluzeau (SAFIRE Engineer), Dominique Duchanoy (Pilot), Christophe Lendroit (Pilot), Thierry André (Mechanics)
Flight-level support on ground: Raphaela Vogel, Jessica Vial, Nicolas Rochetin, Sandrine Bony

Flight B (11:30 – 15:50 UTC):

Pierre-Etienne Brioulet (Mission PI, Turbulence), Julien Delanoë (BASTA), R. Chewitt-Lucas (RASTA), Julien Totems (Lidar), Alfons Schwarzenboeck (Microphysics), Bjorn Stevens (Picarro), Hubert Bellec (SAFIRE Engineer), Gille Vergez (SAFIRE Engineer), Dominique Duchanoy (Pilot), Christian Lendroit (Pilot), Kevin Salaun (Mechanics)
Flight-level support on ground: Raphaela Vogel, Nicolas Rochetin, Sandrine Bony, Jessica Vial

2. Synoptic Situation

According to the weather forecast, Atlantic high pressure maintains steep pressure gradient and strong wind across domain and scatterred showers and isolated cumulus towers were expected. During the night, the convective activity was quite important associated with moist air masses transported by the easterly wind. Easterly wind conditions at 20 to 25 kts gusting to 30 kts.

Flight #17
The aircraft took-off 30 min late. At the time of take-off there was a lot of convection in the HALO circle, with an extended stratiform layer. The lidar picked up depolarization below and above the clouds while ascending to FL80. The ATR performed its 1st rectangle at ~1800 m above sea level, i.e. in the stratiform layer. The choice was made to start with the southern half of the rectangle as convection was more active there at the time the ATR reached the NOTAM area. Indeed, it encountered active convective cells along the track. The ATR then descended to perform 2 rectangles at CBH (717 m). It experienced rain many times. The lidar sampled plenty of clouds on all 2 rectangles performed at 717 m. The aircraft then descend to 570 and 285 m to perform the L-shape pattern (1st at 570 m). The presence of a cell in the corner of the L-shaped pattern resulted in a slight adjustment of the flight track in order to sample it from one end to the other. Because it was still dark, the usual 7 min leg in the surface layer at 60 m could not be performed. After the L, the ATR then climbed to FL140. The lidar provided evidence that there was very little depolarization while the aircraft descended towards the airport, suggesting that dust may have scavenged by rain.

Flight #18
From the take-off to the ferry leg, a dust layer is observed at 450 m up to 1600 m on the Lidar, a LCL at ~ 500 m is estimated, which is lower than the LCL estimated from the ground support on the sampling area at ~ 700 m. A stratiform layer is crossed between 2 km and 2.4 km. The first rectangle is sampled, starting by the south part, with an ajusted height of 760 m. Due to convective conditions, heterogeneities appeared on the cloud base height but 760 m was an optimal choice, kept along the three rectangles. Inhomogeneous structure of the boundary layer was observed on the Lidar with "burst" of aerosols (mainly dusty aerosol, apparently). A detrainement layer was formed at the back of the large convective cells (see GOES image below). After the three rectangles at CBH, two L-shape patterns have been performed at 550 m and 300 m, respectively. During the first flight, the larger precipitation areas have led to aerosol leaching which is not the case for this second flight. The aerosol concentration is even higher than the previous flying days. Nevetheless, post-processing will be necessary to separate the marine aerosols from the dust. The surface leg at 60 m has been performed across the wind direction, on a S-N branch of the rectangle. We then climbed up to sample the stratiform layer that was 4 km high (a height well estimated by RASTA), for 5 min, before leaving and being in clear skies. During the descent, before landing, the other stratiform layer at 2.5 km could be briefly sampled. The cloud structure thus appeared relatively complex with multi-layers combined shallow cumulus, cumulus towers and differents stratiform layers.

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 #15:	**(ºN, ºW)**	**Flight Level (FL)**	**Time (UTC)**	**Notes**
Takeoff	GAIA		05:55	
Ferry	To EP	FL80	06:04-06:17	Reference for lidar and Picarro
R1		1800 m	06:24-07:09	Top of stratiform layer then below the inversion in the stratiform clouds
R2		2200-2300 ft	07:13-07:58	Cloud base
R3		2300 ft	07:58-08:45	Cloud base
L1		570 m	08:52-09:20	Top subcld layer
L2		285 m	09:24-09:49	Mid subcld layer
Ferry back	From EP	FL140	10:00-10:09	Reference for lidar and Picarro
Landing	GAIA		10:21	

Flight #16:	**(ºN, ºW)**	**Flight Level (FL)**	**Time (UTC)**	**Notes**
Takeoff	GAIA		11:30	
Ferry	To EP	2400 m	11:37 – 11:51	Inside a stratiform layer
R1		775 m	11:58 – 12:47	At cloud base

Flight #16:	(ºN, ºW)	Flight Level (FL)	Time (UTC)	Notes
R2		775 m	12:47 – 13:34	At cloud base
R3		775 m	13:34 – 14:21	At cloud base
L1		560 m	14:27 – 14:49	Top subcloud layer
L2		265 m	14:53 – 15:14	Mid subcloud layer
Low level		72 m	15:16 – 15:23	Surface leg
High level		3820 m	15:32 – 15:37	In stratiform layer
Landing	GAIA		15:50	

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.

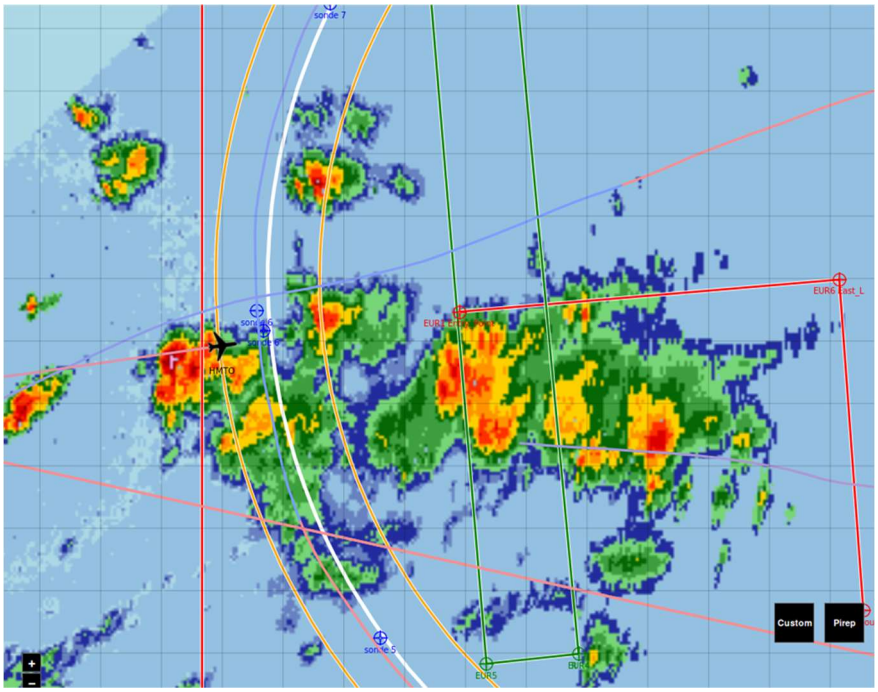
Picarro: Worked fine.

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

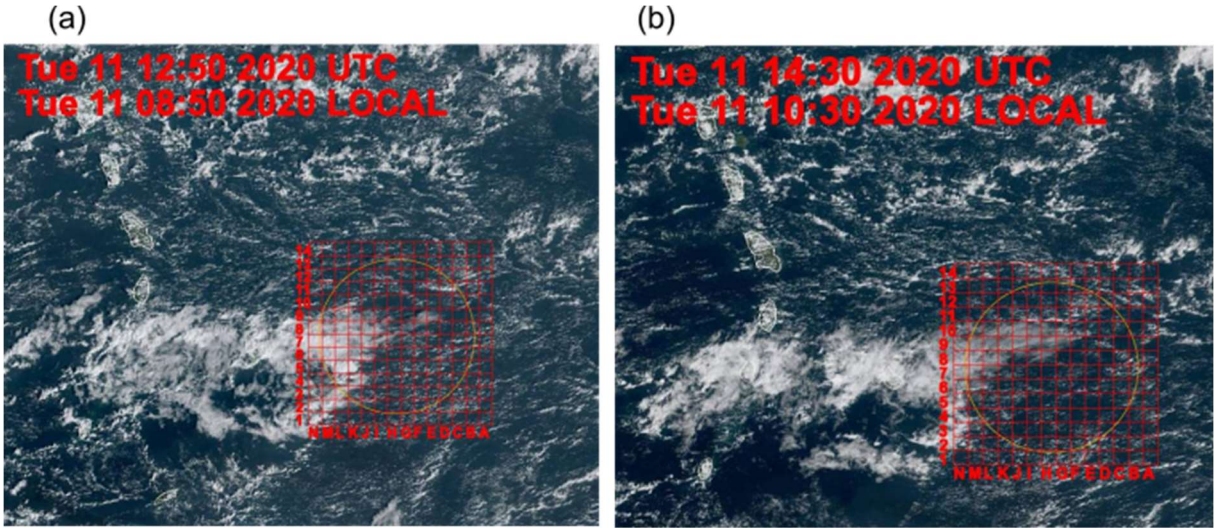
Base:

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

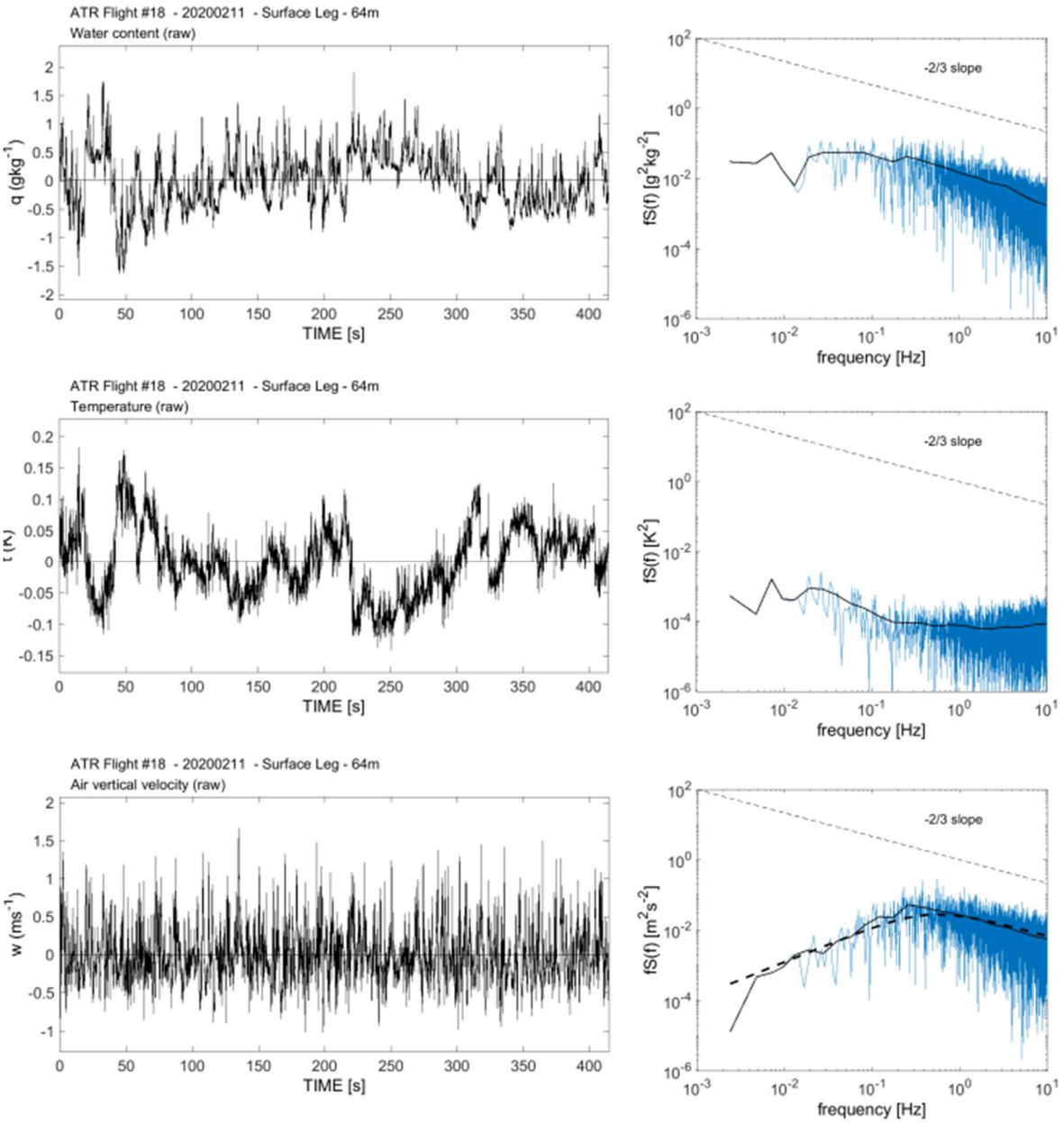
Figures



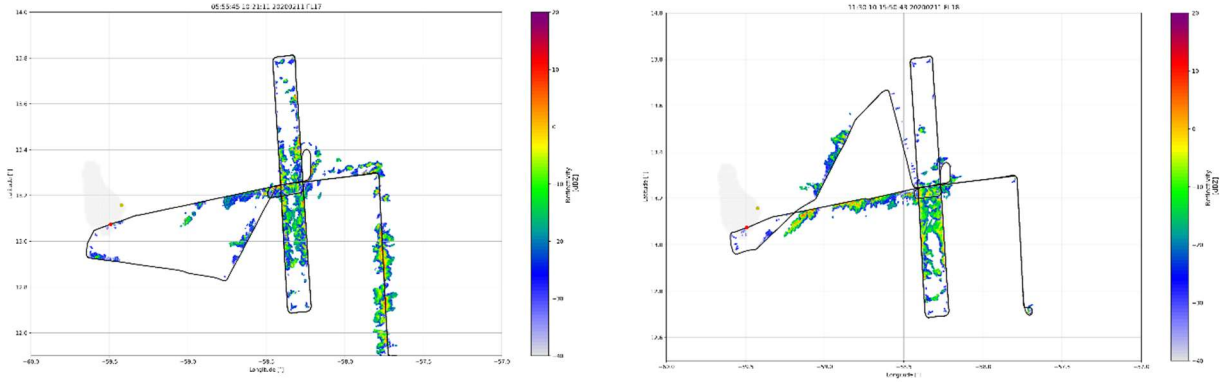
Approching the sampling area, at the beginning of the second flight (11:43UTC), with large active cells detected on Poldirad.



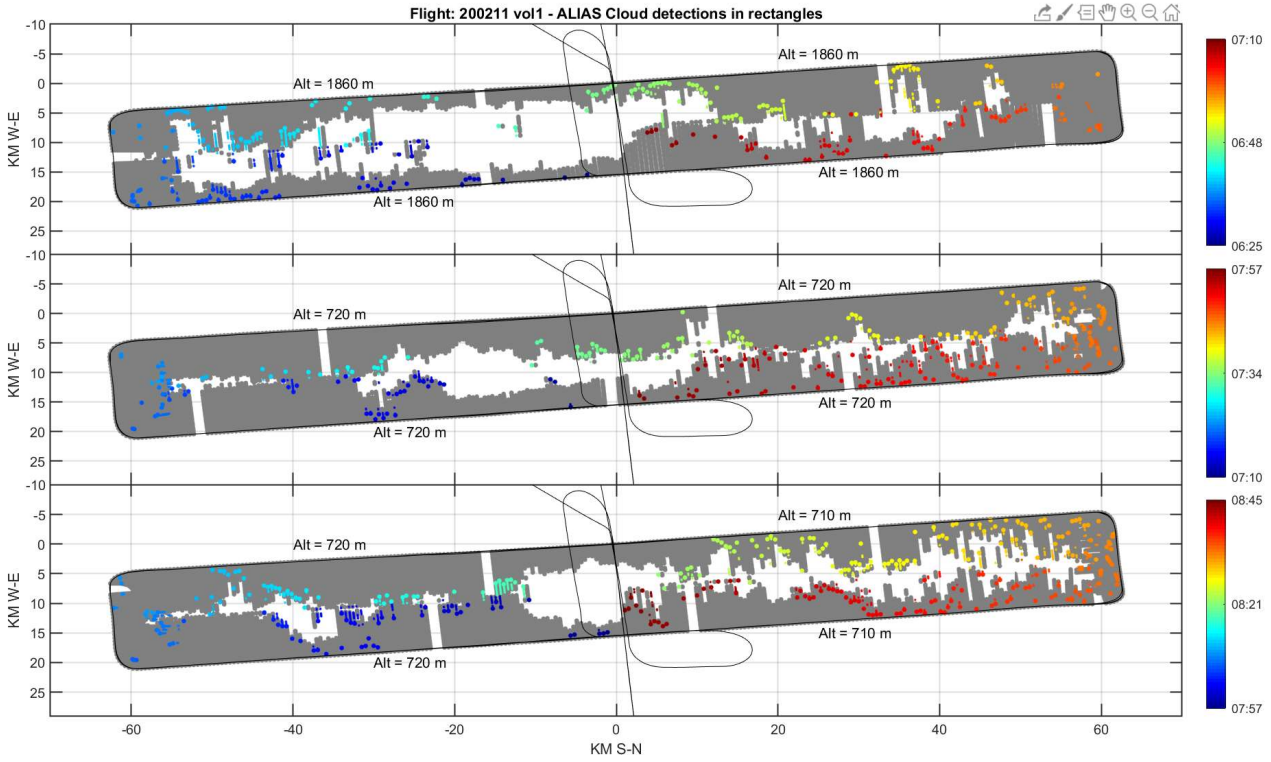
Target area superimposed on GOES satellite picture during the second flight. A detrainment layer appears on the back of the large convective cells.



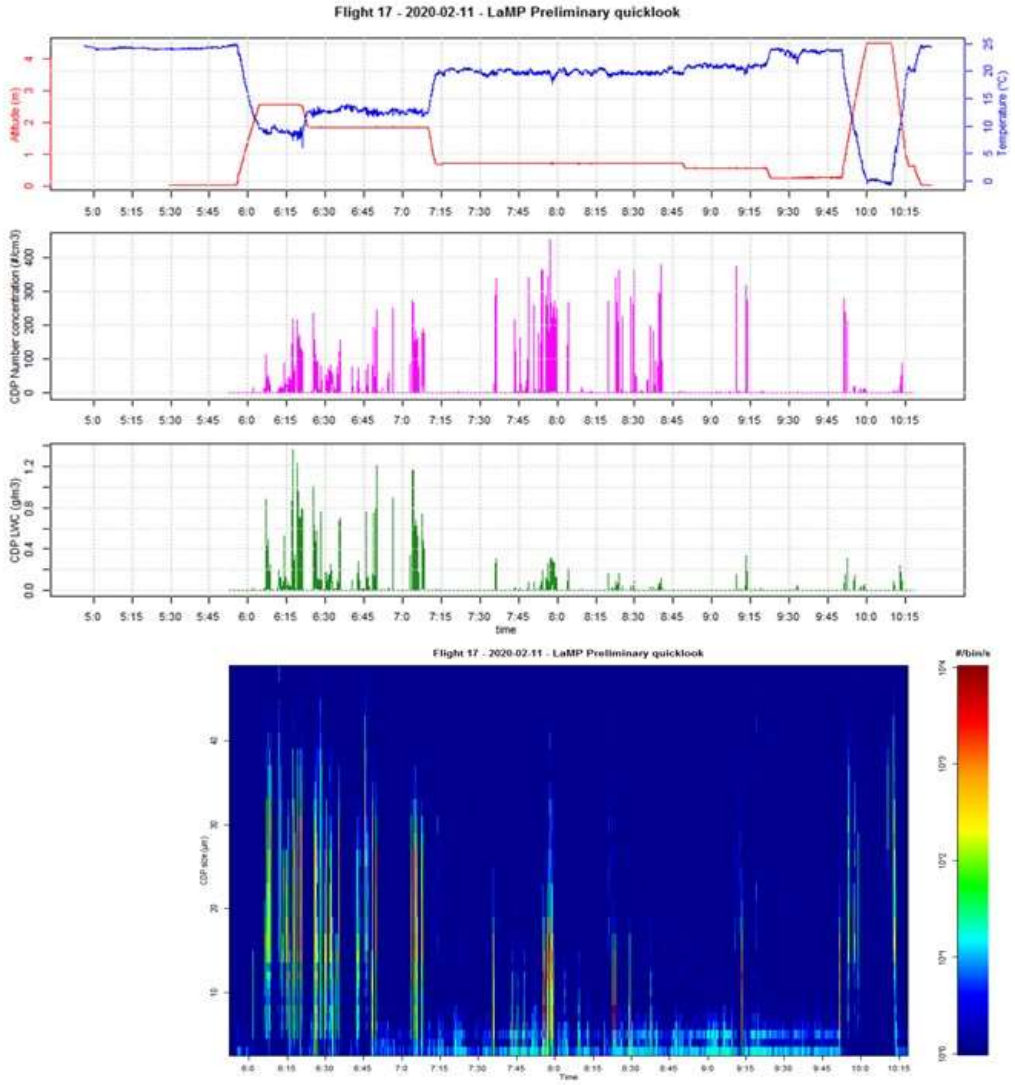
Time series and associated spetra of specific humidity, temperature and vertical wind component during the surface leg at ~60m.



BASTA reflectivity acquired during Flight #17 (left) and Flight #18 (right).



Cloud mask based on ALIAS data for rectangles R1, R2 and R3 during Flight #17. The grey areas correspond to the areas of the rectangle where the lidar signal-to-noise ratio allows cloud detection. Color dots represent the location of the clouds detected at CBH for data acquired in each rectangle. Dots are color-coded according to time (see scale).



Time series of altitude, temperature, and liquid Water Content (LWC) for Flight #17, as well as contour plot of particle size distribution (PSD) from the CDP for particles with a diameter ranging from 2 to 50 µm.