Flight report

Research Flight 9 (RF09)
ATR-2024-0820
SAFIRE flight as240031
Sal (SID-SID), 14:00 - 17:30 UTC

PI: **Marie Lothon**

20 August 2024

1 Objectives

- Earth Care Cal/Val in shallow convection or clear air
- Test of strategy change, with first EC segment at low level, instead of high level, before the high level meeting point segment.

2 Cal/Val activity

Yes, with Earth-Care.

3 Crew

SAFIRE	Sandrine Bony	LMD
Pilot (CDB)	Guillaume Seurat	SAFIRE
Pilot (OPL)	Jean-François Bourdinot	SAFIRE
Mechanics	Maxens André	SAFIRE
Expé Principal	Clément Bezier	SAFIRE
Expé	Greg Ehses	SAFIRE
SCIENTISTS		
PI seat	Marie Lothon	LMD
LNG seat	Kevin Huet	LATMOS
aWALI seat	Frédérique Laly	LSCE
Microphys seat 1	Antoine Baudoux	LAMP
Microphys seat 2	Thierry Latchimy	LAMP
RASTA seat	Julien Delanoë	LATMOS
BASTA seat	Sophie Bounissou	LSCE

4 Synoptic situation

A AEW front is approaching, but it is way out to the north, which is unusual. Maximum PW are in NE, and we are not very far from the transitional gradient. The wind is north in the area. We chose the nothern optionof the EC track (rather than southern) in order to get closer to the front, in case the clouds ahead of the trough can reach us during the flight (which was not the case in the EC track exploration area). There is also deep convection south of Sal, but too far south (ITCZ has a northern position). Sal island are still influenced by the dust plume, even if less than some earlier days (see Fig. 1b).

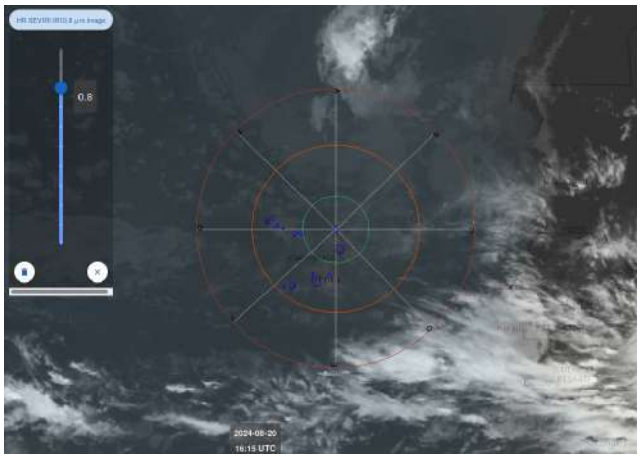
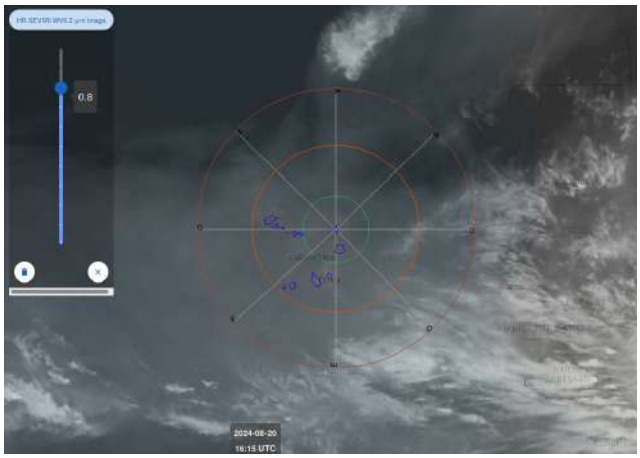
(a)  (b) 

Figure 1: Satellite image SEVIRI (a) 10.8 μm, (b) 6.2 μm

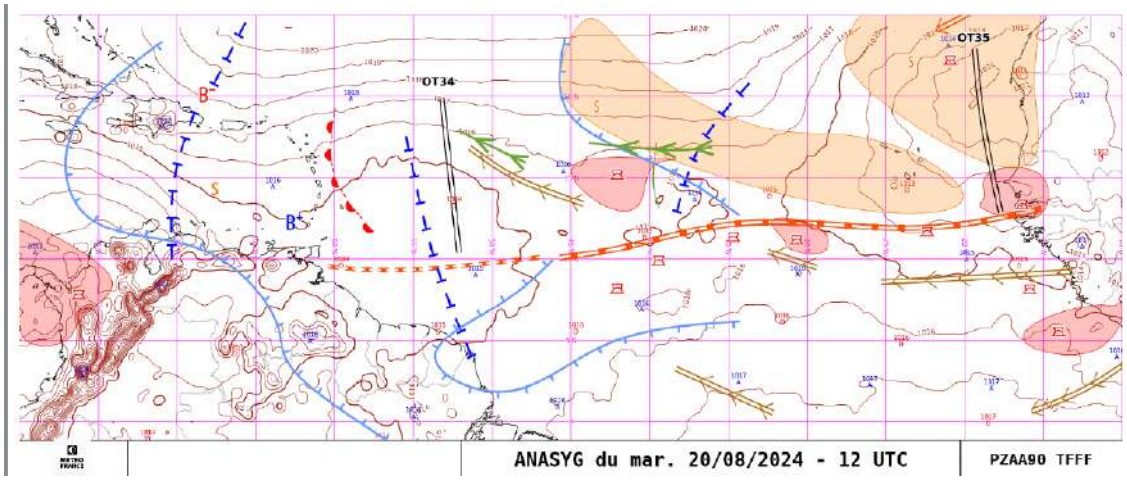


Figure 2: MISVA schematic analysis

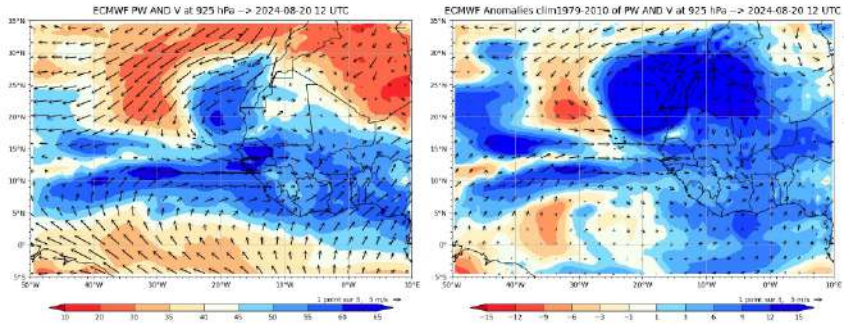


Figure 3: Precipitable water from AROME, 20 August 2024 1200 UTC.

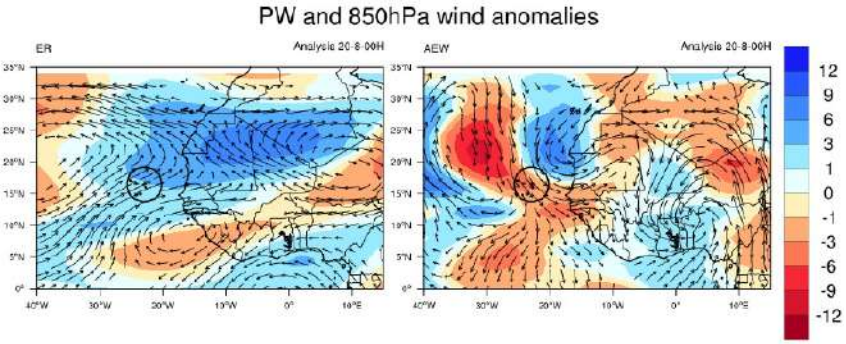
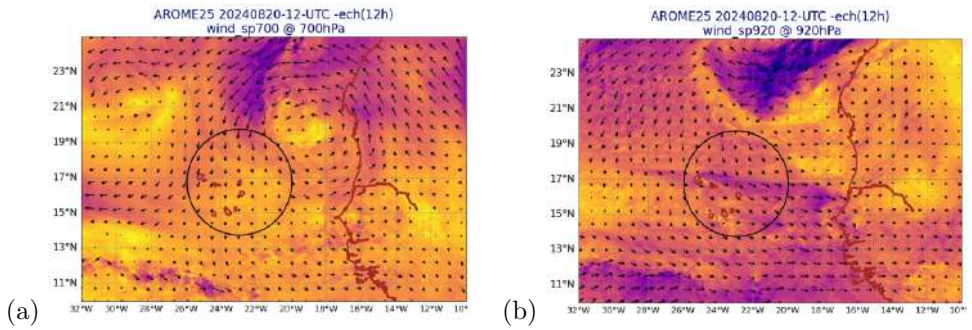


Figure 4: Precipitable water and wind anomalies, Rossby waves and African Easterly Waves, for 20 August 2024.



(a) (b)

Figure 5: Forecasted (a) Wind at 700 hPa (b) Wind at 920, 20 August 2024 1200 UTC hPa

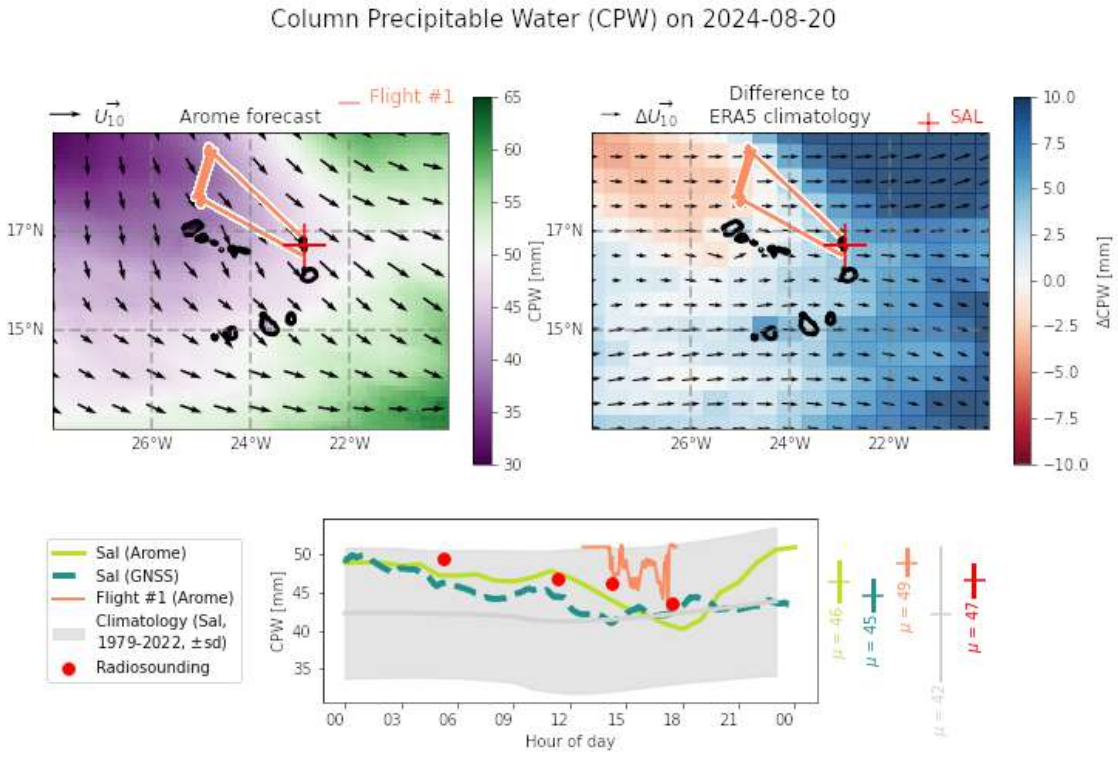


Figure 6: 24h average of Column of Precipitable Water, from ECMWF analysis and GNSS.

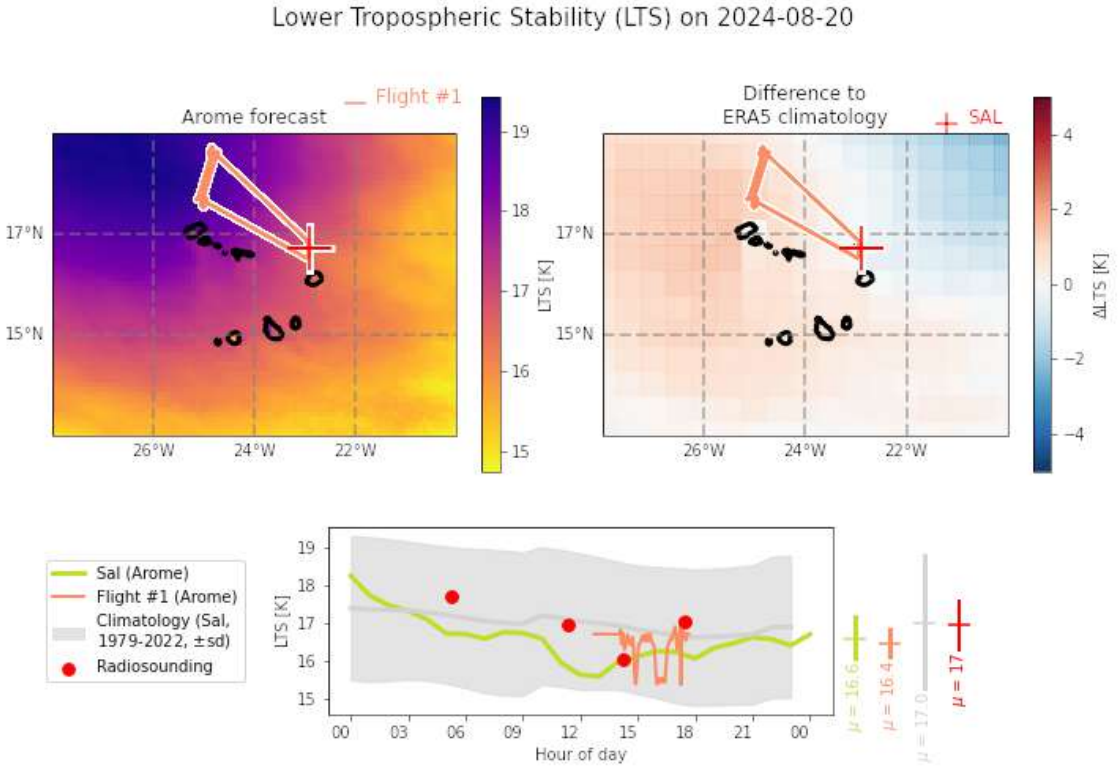


Figure 7: Lower Tropospheric Stability on 20 August 2024, from AROME, ERA5, soundings

5 Flight elements

Description of the legs

RF02 elements	Time (UTC)	Flight Level (FL)	Position	Notes
Takeoff	14:03		SID-SID	
A	14:03 - 14:07	$0 \rightarrow 2500ft$	Sal	Ascent from Sal fly out
D	14:03 - 14:07	$0 \rightarrow 2500ft$	near Sal	Descent to low
B	14:10 - 14:52	1500 ft	Sal $\rightarrow WP1$	Cloud base leg - with several adjustments
L1	14:55 - 15:11	500 ft	WP1 $\rightarrow EC1$	Low level leg - mostly clear
A	15:11 - 15:40	500 ft $\rightarrow FL200$	EC1	Climb to FL200
H	15:43 - 15:59	FL200	EC1 $\rightarrow EC2$	High level leg
VAD	15:59 - 16:03	FL 200	EC2	2 two in a row
D	16:03 - 16:24	FL200 $\rightarrow 500ft$	EC2	Descent from FL200 to 500ft
L2	16:25 - 16:42	500 ft	EC2 $\rightarrow WP2$	Low level leg - mostly clear
L3	16:44 - 16:47	500 ft	WP2 $\rightarrow$ *home*	Low level leg
B2	16:49 - 16:58	2600 ft	WP2 $\rightarrow$ *home*	Cloud base leg - Few Cu couds
L4	17:00 - 17:27	500 ft	WP2 $\rightarrow$ *home*	Low level leg - mostly clear
Landing	17:33		SID-SID	

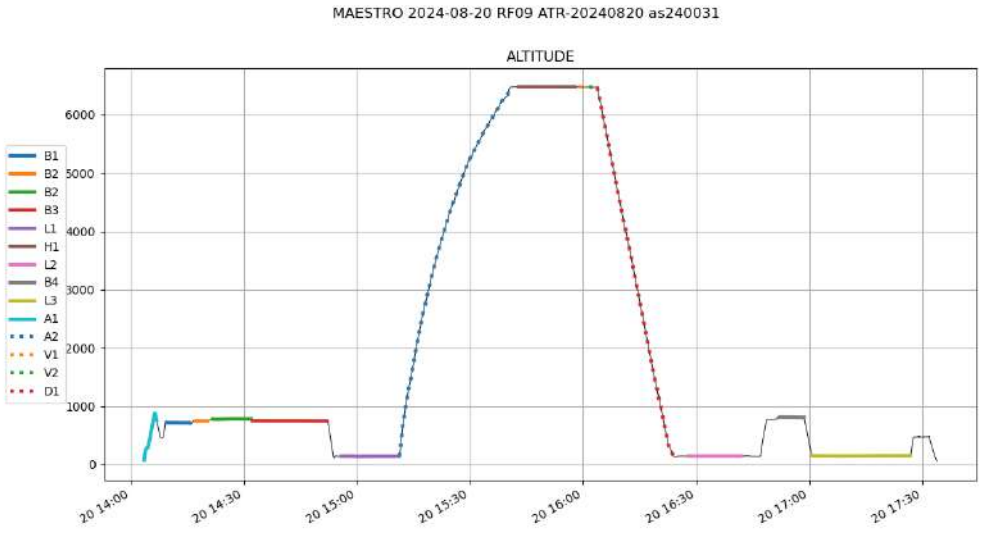


Figure 8: Flight segmentation as described in the table.

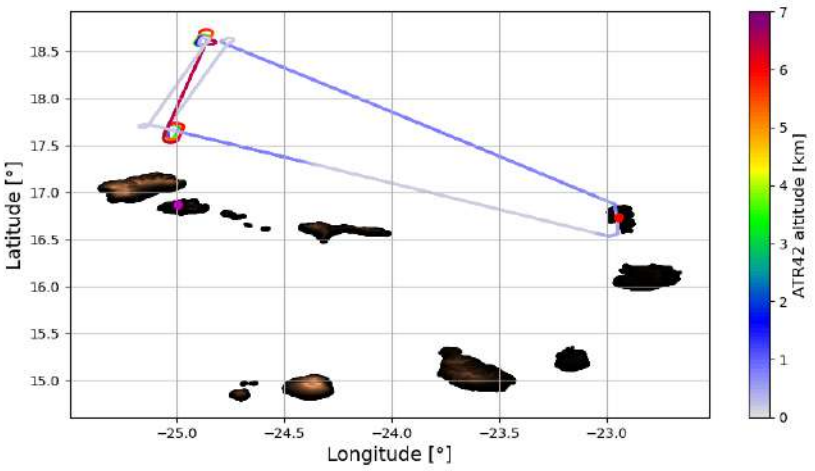


Figure 9: Trajectory

6 Quicklooks and Comments

On the way to the Cal/Val area, nice cumuli cloud field. Ferry leg was done at cloud base level. We had to adjust several times, because of a gradient of CBH (higher toward the EC track, but then back to lower at the end). Cloud base was around 2000 ft.

In the EC track area, the sky was much clearer, but found clouds at the southern end of the EC legs. We past a smallish flower (around 15:08 UTC) at the end of the first 500 ft leg, wrom WP1 to EC1. At this low level, wind was 5 m s^{-1} at 350°, r_v=15 g kg^{-1} (smaller than previous days), and temperature around 25°C, with nice variability of water vapour according to AWALI. The aerosol layer is lower and smaller than previously, according to AWALI and LNG.

At EC1, on the way up to FL200, we crossed the cloud base at 1100-1200 m, and inversion at 1200 m, with temperature jump of about 10°C, and moisture jump of 10 g kg^{-1}, and a very dry dusty layer above (SAL, see Fig; 1b). SAL top inversion detected around 5000-5100 m. Cleaner air above.

At FL200, weak wind (below 5 m s^{-1}) from NW in one side to NE at the other side, T=-5.7°C, r_v=0.2(?) g kg^{-1}. No clouds along the EC track leg. Meeting point was met right on time, coordinated with King Air.

Descenging at EC2, we can see that there are a few cumulus clouds NW and NE of us, but not where we will be heading, toward WP2. Inversions detected at 3000 m, 1150 m (temperature jump 6°C), and another small on at 680 m. EC2-WP2 is made at 500 ft, because Cu is estimated at 1/8 or lower. Note on profile Fig. **??** that the dry layer seen at EC1 is not seen at EC2 anymore. There is a much moister layer instead. It is mostly clear along the leg from EC2 to WP2.

We start the last leg WP2-to-home at 500 ft, and later get up to 3000 ft due to two lines of cumulus clouds. We come back down to 500 ft once the sky is clear ahead of us. On this last part of the way back, LNG detects a stratus abov us at 2500 m several times.

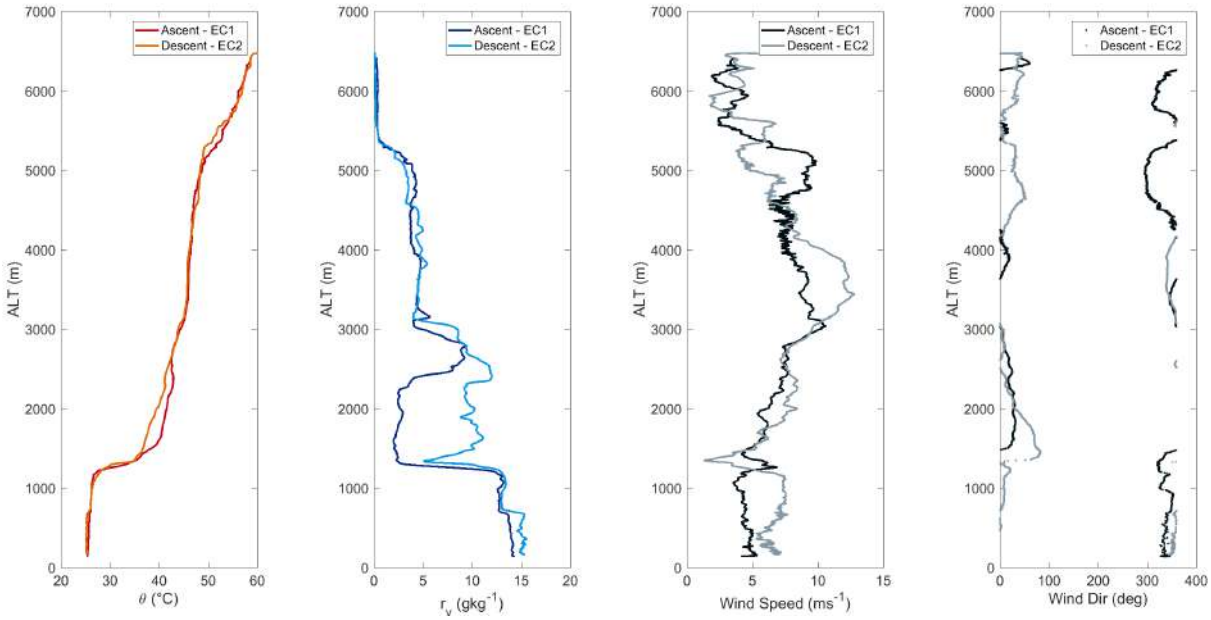


Figure 10: Profiles of potential temperature, water vapour mixing ratio, windspeed and windir during the ascent at EC1 and descent at EC2.

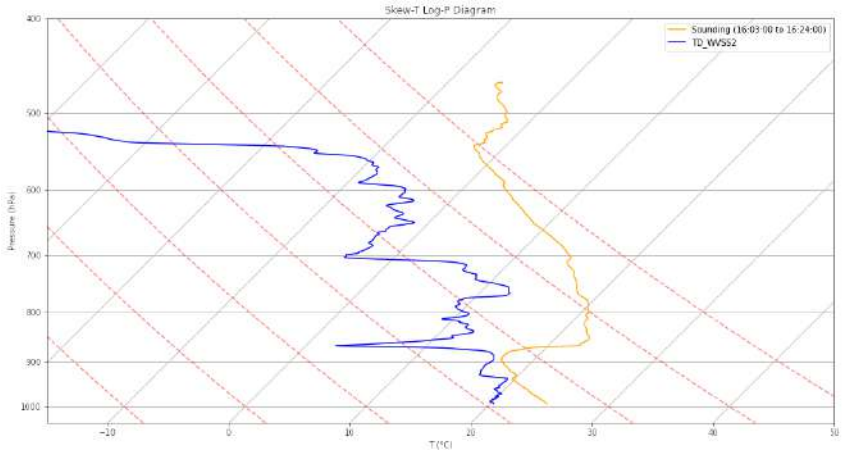


Figure 11: Skew-T diagram during ascent to FL200 at EC1

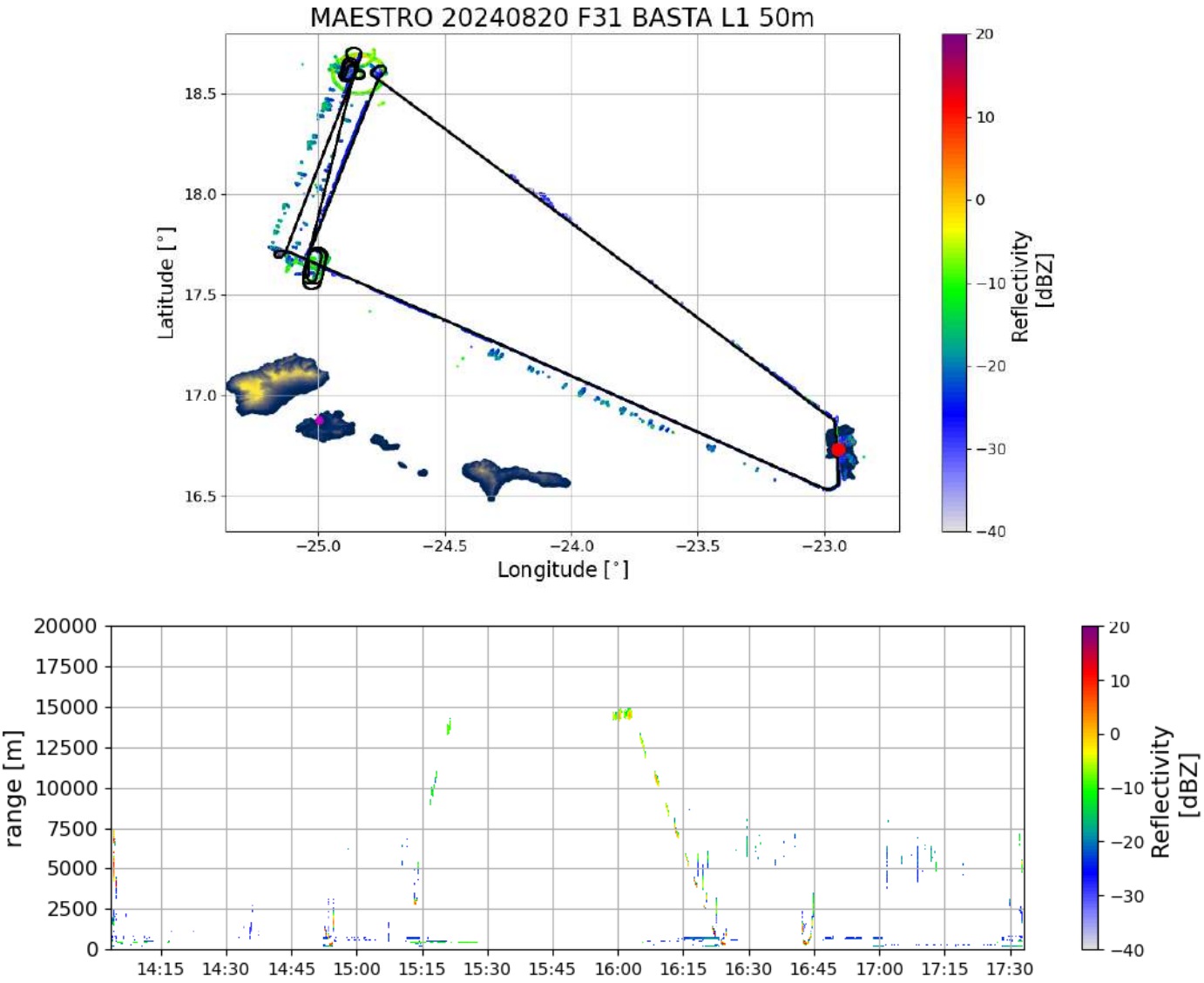


Figure 12: BASTA observations along the entire flight.

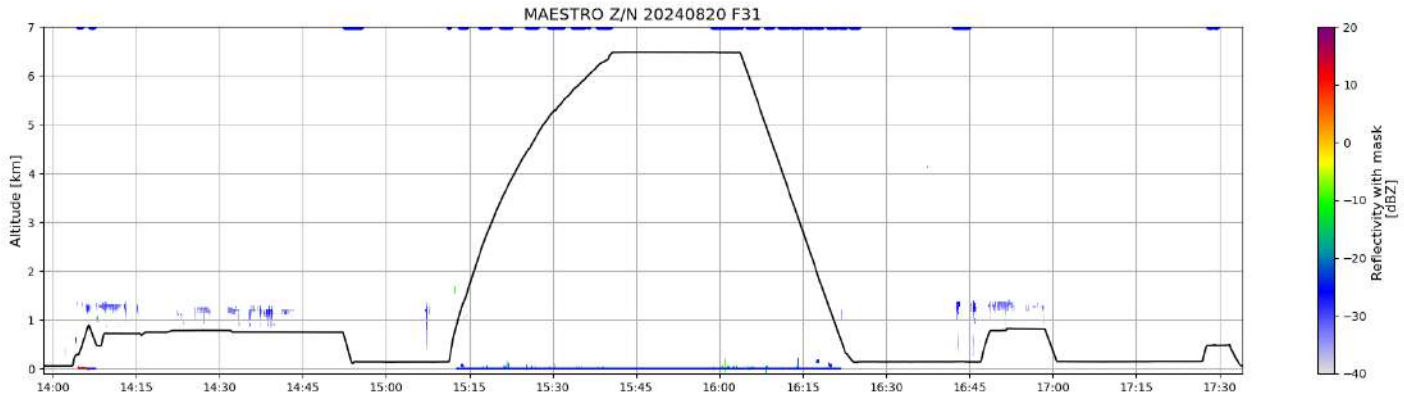


Figure 13: RASTA observations along the entire flight.

7 Instrument status

All instruments seemed to work well. We just made two VAD at EC2, to wait for LNG to be back (software issue). In Core instrumentation, Licor seemed to loose a lot of dynamics at the end of the flight.

DATA	SAFIRE_name	DESCRIPTION	PARAMETER	STATUS	COMMENT
NAV	pos_lat_imu_1	Latitude from AIRINS	LATITUDE	OK	-
	pos_lon_imu_1	Longitude from AIRINS	LONGITUDE	OK	-
	alt_alt_imu_1	Altitude from AIRINS	ALTITUDE	OK	-
	nav_track_imu_1	Course	COURSE	OK	-
	att_thead_imu_1	True Heading	THEAD	OK	-
	att_roll_imu_1	Platform Roll angle	ROLL	OK	-
	att_pitch_imu_1	Platform Pitch angle	PITCH	OK	-
	vit_v_n_imu_1	Platform North speed	VN	OK	-
	vit_v_e_imu_1	Platform Eastward speed	VE	OK	-
	vit_v_w_imu_1	Vertical speed	VV	OK	-
	vit_v_gs_imu_1	Ground speed	GS	OK	-
RAD	ray_rg_down_1	Downwelling Shortwave radiation clear dome (no attitude correction)	SWD	OK	-
	ray_rg_down_crsensor_1	Downwelling Shortwave radiation clear dome- Attitude correction for pitch/roll $<\pm 3°$	SWDC	OK	reference
	ray_pir_down_1	Downwelling Shortwave radiation red dome (no attitude correction)	SWD_RED	OK	-
	ray_pir_down_crsensor_1	Downwelling shortwave radiation red dome-Attitude correction for pitch/roll $<\pm 3°$	SWDC_RED	OK	reference
	ray_rg_up_1	Upwelling Shortwave radiation clear dome (no attitude correction)	SWU	OK	-
	ray_pir_up_1	Upwelling shortwave radiation red dome (no attitude correction)	SWU_RED	OK	-
	ray_ir_down_1	Downwelling longwave radiation (no attitude correction)	LWD	OK	-
	ray_ir_up_1	Upwelling longwave radiation (no attitude correction)	LWU	OK	-
	ray_tb_ce332_c1_1	Brightness temperature channel1 (8.7μm) ce332 radiometer	TB_C1	OK	-
	ray_tb_ce332_c2_1	Brightness temperature channel2 (10.6μm) ce332 radiometer	TB_C2	OK	-
	ray_tb_ce332_c3_1	Brightness temperature channel3 (12μm) ce332 radiometer	TB_C3	OK	-
	ray_lum_ce332_c1_1	Radiance, channel1 (8.7μm) from ce332 radiometer	RAD_C1	OK	-
	ray_lum_ce332_c2_1	Radiance channel2 (10.6μm) from ce332 radiometer	RAD_C2	OK	-
	ray_lum_ce332_c3_1	Radiance channel3 (12μm) from ce332 radiometer	RAD_C3	OK	-
TDYN	pre_ps_av1_1	Static pressure corrected for flow distorsion	PRES	OK	-
	vit_v_dp2_crs_1	Dynamic pressure corrected for flow distorsion	DYNP	OK	-
	vit_v_p_av1_1	True Air Speed	TAS1	OK	reference
	vit_v_tas_adc_1	True Air Speed	TAS2	OK	noisy
	alt_ralt_15_m_1	Height	HEIGHT	OK	ok below FL180
	att_aoa_radom_deg_1	Angle of Attack	AOA_RAD	OK	-

DATA	SAFIRE_name	DESCRIPTION	PARAMETER	STATUS	COMMENT
	att_aos_radom_deg_1	Angle of Sideslip	AOS_RAD	OK	-
	ven_wind_v_vp_imu_1	Upward Wind	WW	OK	-
	ven_wind_FF_vp_imu_1	Horizontal Wind Speed	WS	OK	reference
	ven_wind_DD_vp_imu_1	Horizontal Wind Direction	WD	OK	reference
	ven_wind_FF_simp_1	Horizontal Wind Speed WITHOUT Radome angles, with non-deiced Air Static Temperature	WS_RAW	OK	-
	ven_wind_DD_simp_1	Horizontal Wind Direction WITHOUT Radome angles, with non-deiced Air Static Temperature	WD_RAW	OK	-
	tpr_ts_rt_1	Air Static Temperature, non-deiced sensor	TEMP1	OK	reference
	tpr_ts_rtd_1	Air Static Temperature, deiced sensor	TEMP2	OK	-
	tpr_tt_rt_1	Total Temperature, non-deiced sensor	TTEMP1	OK	reference
	tpr_tt_rtd_1	Total Temperature, deiced sensor	TTEMP2	OK	-
	tpr_tp_rt_1	Potential Temperature	THETA	OK	-
	hum_hutd_1011_sync_1	Dew Point Temperature 1011C	DP1	OK	strong oscillations from 15:32 to 16:08
	hum_hutd_wvs_rs_1	Dew Point Temperature from WVSSII	DP2	OK	reference
	hum_hutd_rtd_aero_1	Dew Point Temperature from humaero enviscope	DP3	OK	too low values from 15:55 to 16:05
	hum_humr_1011_rs_1	Water Vapor Mixing ratio from 1011C	MR1	OK	oscillations in altitude and artefact at 16:21
	hum_humr_wvs_rs_1	Water Vapor Mixing ratio WVSSII	MR2	OK	reference
	hum_humr_srtd_aero_1	Water Vapor Mixing ratio from humaero enviscope	MR3	OK	rejected values from 15:53 to 16:08
	hum_huabs_rt_1011_1	Abolute Humidity from 1011C	HABS1	OK	oscillations in altitude and artefact at 16:21
	hum_huabs_wvs_rs_1	Abolute Humidity from WVSSII	HABS2	OK	reference
	hum_huabs_srtd_aero_1	Abolute Humidity from enviscope	HABS3	OK	rejected values from 15:53 to 16:08
	hum_hurel_rt_1011_rs_1	Relative Humidity from 1011C	RH1	OK	oscillations in altitude and artefact at 16:21
	hum_hurel_wvs_rs_1	Relative Humidity from WVSSII	RH2	OK	reference
	hum_hurel_stat_rt_aero_1	Relative Humidity from enviscope	RH3	OK	-
	ctl_CTL_P_CABINE_1	Cabin Pressure	P_CABIN	OK	-
	ctl_CTL_T_CABINE_1	Cabin Temperature	T_CABIN	OK	-
LWC	lwc_lwc300_rebase005_1	LWC calculation according to DMT PADS Hotwire LWC	LWC2	OK	-
FW	hum_humolfra_fw_crh_100	Mole fraction of water vapour in air measured by FastWave	FW_MOLFRA	OK	-
	hum_humr_fw_100	Water Vapor Mixing ratio from FastWave	MR6	OK	-
	pre_pb_fw_100	Air Pressure measured by FastWave	FW_P	OK	-

DATA	SAFIRE_name	DESCRIPTION	PARAMETER	STATUS	COMMENT
	tpr_tt_fw_100	Temperature measured by FastWave	FW_T	OK	very noisy and slow signal
OZONE	chm_cc_o3_2b_ppb_RS_cal_%10	O3 2493DB OzoneMonitor mixing ratio	O3_MONITOR2	OK	-
	chm_cc_o3_2b_ppb_anlg_%10	O3 2493DB OzoneMonitor concentration analogical	O3_MONITOR2_ANALOG	OK	-
	ctl_CTL_CELL_T_2B_RS_cal_%10	O3 2493DB OzoneMonitor cell temperature	TCELL_MONITOR2	OK	-
	ctl_CTL_CELL_P_2B_RS_cal_%10	O3 2493DB OzoneMonitor cell presure	PCELL_MONITOR2	OK	-
	ctl_CTL_VOLFR_2B_RS_cal_%10	O3 2493DB OzoneMonitor volumetric flow rate	VOLFLRATE_MONITOR2	OK	-
SPP300	mic_tabcount_SPP300_1	SPP300 particles count bin[1]...bin[30]	SPP300_COUNT	OK	
	mic_somcount_SPP300_1	SPP300 total particles count	SPP300_TCOUNT	OK	-
	mic_tabconc_SPP300_1	SPP300 particles concentration bin[1]...bin[30]	SPP300_CONC	OK	
	mic_totalconc_SPP300_1	SPP300 Total particles concentration	SPP300_TCONC	OK	-
UHSAS	mic_tabcount_uhsas_sync_1	UHSAS particles count	UHSAS_COUNT	OK	
	mic_somcount_uhsas_sync_1	UHSAS total particles counts	UHSAS_TCOUNT	OK	-
	mic_tabconc_second_uhsas_sync_1	UHSAS Particles concentration	UHSAS_CONC	OK	
	mic_totalconc_uhsas_sync_1	UHSAS total particles concentration	UHSAS_TCONC	OK	-
	ctl_sample_flow_uhsas_sync_1	UHSAS sample flow	UHSAS_FLOW	OK	-
	ctl_sheath_flow_uhsas_sync_1	UHSAS sheath flow	UHSAS_SHEATH	OK	-
REMOTE	RASTA	Cloud radar (Up and down)	Z, V, Doppler spectrum	OK	
	BASTA	Cloud radar (sidewards)	Z, V, Doppler spectrum	OK	
	LNG	Lidar (Up or Down)	Backscatter(355nm/532/1064) – HSRand Doppler 355nm	OK	20 min loss of data
	aWALI	Raman Lidar (sidewards)	Backscatter and inelastic(RH/Temp)	OK	
MICRO	CVI		TWC	OK	
	HSI			OK	
	2DS		Images and Spectrum	OK	
	HVPS	Hydrometeors imagery	Images	OK	
	FCDP	Droplets (2?m - 50?m)	Spectrum	OK	
	NP-2			OK	