Flight report

Research Flight RF15
ATR-2024-0827
SAFIRE flight as24037
Sal (SID-SID), 19:00 - 22:30 UTC

PI: **Sandrine Bony**

27 August 2024

1 Objectives

- MAESTRO-type of flight along 22.5 W
- Coordination with HALO + Meteor (SeaPol radar) + RCM1/SAR overpass at 19:29 UTC
- Sampling of a convergence line and weak wind conditions + precipitating shallow cumuli

2 Cal/Val activity: No

3 Crew

SAFIRE	Name	Lab
Pilot (CDB)	Guillaume Seurat	SAFIRE
Pilot (OPL)	Dominique Duchanoy	SAFIRE
Mechanics	Thierry André	SAFIRE
Expé Principal	Claude Lainard	SAFIRE
Expé	Hubert Bellec	SAFIRE
SCIENTISTS		
PI seat	Sandrine Bony	LMD
LNG seat	Emmeline François	LATMOS
aWALI seat	Frédéric Laly	LSCE
Microphys seat 1	Pierre Coutris	LAMP
Microphys seat 2	Alfons Schwarzenboeck	LAMP
RASTA seat	Julien Delanoë	LATMOS
BASTA seat	Giovanni Biagioli	ICTP

4 Synoptic situation

- The synoptic situation was associated with both the suppressed phase of an Easterly African Wave (AEW) and a Northward excursion of the Northern edge of the ITCZ.
- A Saharian Aerosol Layer (SAL) was present between 3 and 4.5 km

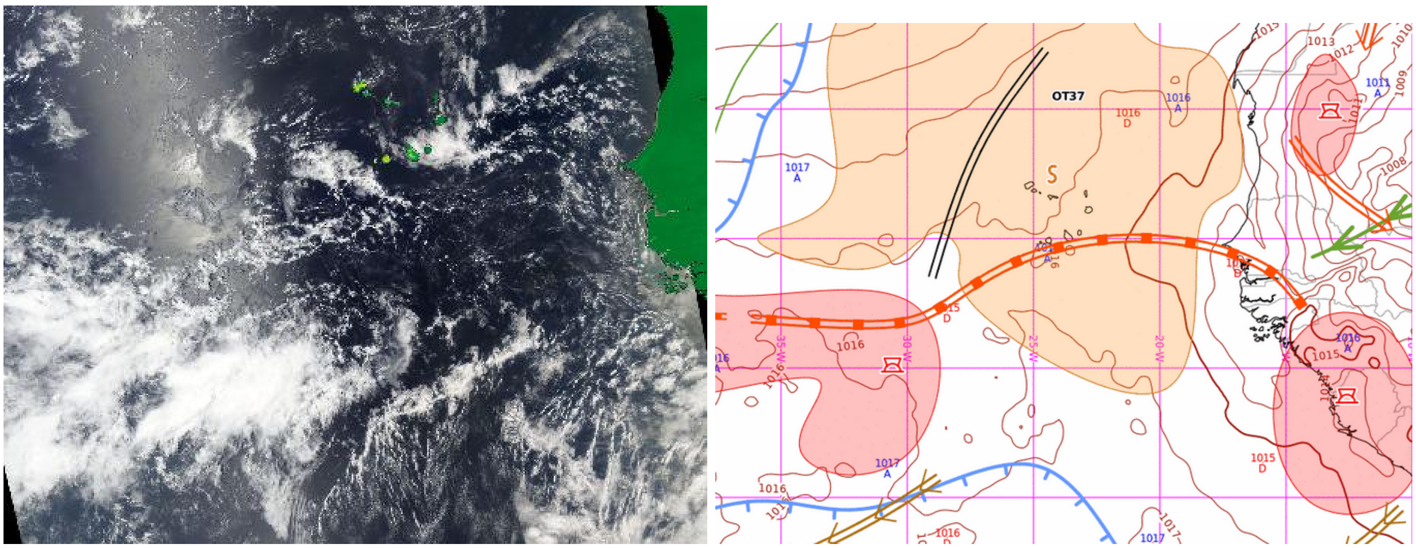

Figure 1: Left: Aqua/MODIS imagery showing the 'Northern branch of the ITCZ' near Cape Verde. Right: MISVA Anasyg analysis for Aug-28 at 00Z suggesting that the convergence line sampled by the ATR in the evening of Aug-27 corresponds to the 'Northern branch of the ITCZ' (red lines). Note also the presence of dust (Saharian Aerosol Layer).

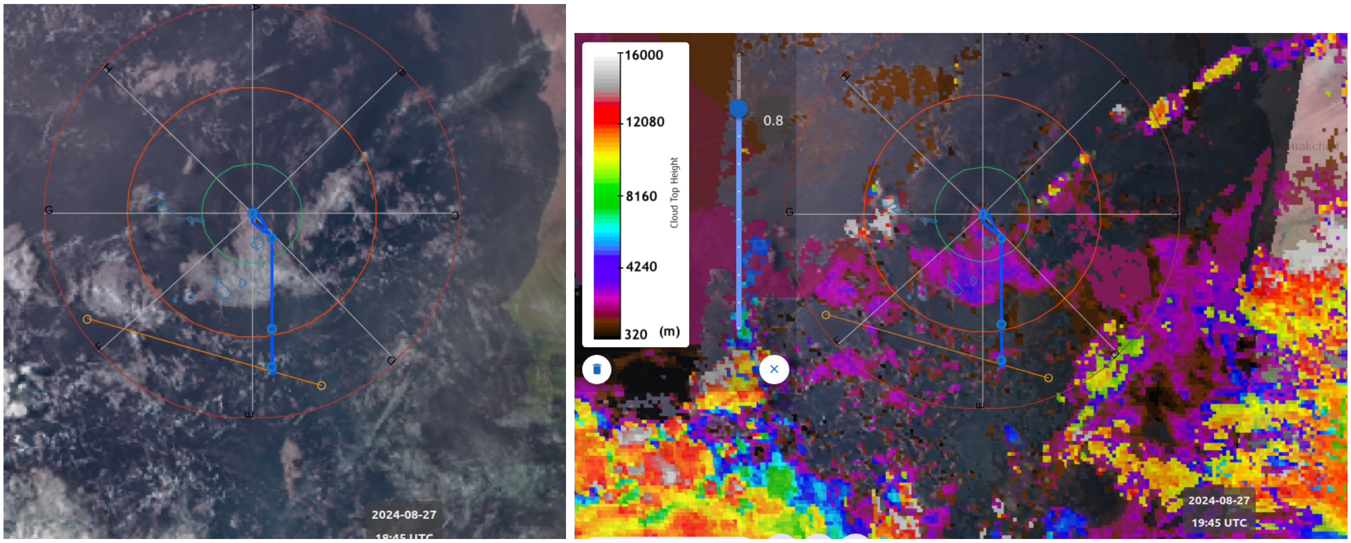

Figure 2: (left) MSG RGB (at 18:45 UTC) and MSG cloud top height (19:45 UTC, when the ATR flew across the convergence line). The ATR trajectory (in blue) is reported on it.

5 Flight elements

- WP1 (N): 16.2^{o}N; 22.5^{o}W
- WP3 (intermediate): 14.22^{o}N; 22.5^{o}W
- WP2 (S): 13.38^{o}N; 22.5^{o}W
- ATR circle (by HALO): planned at N14^{o}30', W022^{o}30' but was aborted because of a sonde receiver problem; Note that HALO flew above the ATR transect along 22.5^{o}W on its way back to Sal.
- The take-off for this flight was initially planned for 1800 UTC but turned out to be delayed by about an hour because of an electric problem on board the ATR right before take off.

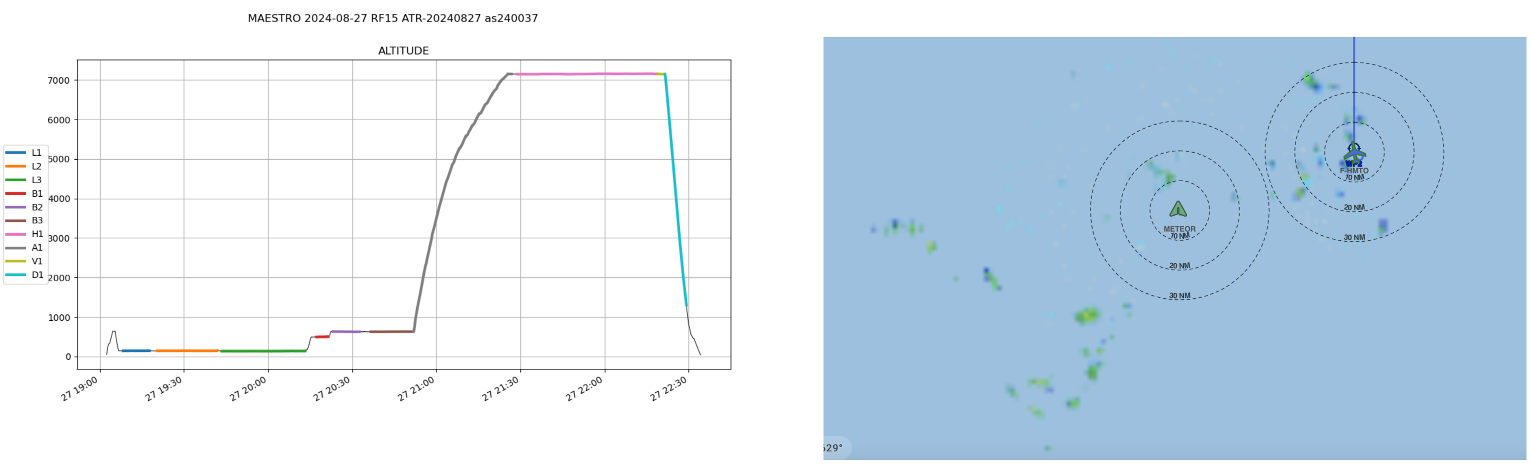

Figure 3: Left: Flight segmentation of the ATR-20240827 flight (also named RF15 or as24037). This segmentation is reported in the yaml file named $ATR_a s240037.yaml$ (the times of individual segments are not repeated in the table below). Right: Screenshot from Planet showing the precipitation measured from Sea-Pol (the radar on board R/V Meteor).

RF15 elements	Time (UTC)	Flight Level (FL)	Position	Notes
Takeoff	19:02		GVAC	
L1+L2	19:06 – 20:13	500 ft	WP1 (N) → WP2 (S)	Subcloud (around 150 m)
B1	20:17 – 20:32	500-630 m	WP2 (S) → WP3	Cloud base
B3	20:36 – 20:51	630 m	WP3 → WP2 (S)	Cloud base
A1	20:51 – 21:26	ascent to FL220	WP2 (S)	
H1	21:28 – 22:18	FL220	WP2 (S) → WP1 (N)	Mid-troposphere (7.1 km)
V1	22:18 – 22:21	FL220 (7.1 km)	WP1 (N)	VAD (roll: 26 deg)
Landing	22:34		GVAC	

6 Quicklooks and Comments

- The ATR flew across a convergence line that might correspond to the Northern edge of the ITCZ. During its subcloud layer at 500 ft (150 m), the ATR was flying below the line when the RCM1/SAR satellite overpassed the transect. The line was associated with drizzle and rain (originating from clouds having a cloud top around 2.5 km), an abrupt drop of the surface wind speed (from about 5-6 m/s to almost zero: doldrums?), or the air temperature (by a bit more than 1 deg), and an increase of relative humidity. Conditions returned to 'normal' after about 15 min (about 100 km). Note that the convergence line was also observed by HALO at the end of its flight, on its way back to Sal. The cloud tops on the line were similar to those measured by the ATR.

- During the legs at cloud base (in the southern part of the transect, between WP2 and WP3), the ATR sampled a spectrum of shallow cumuli, including very shallow ones (with cloud tops only a few hundred meters above cloud base) and deeper, precipitating cumuli (with cloud tops ranging from 1.2 and 1.8 km). The precipitation from these deeper cumuli was observed by the Sea-Pol radar on board Meteor.

- A Saharian Aerosol Layer (SAL) was present between 3 and 4.5 km

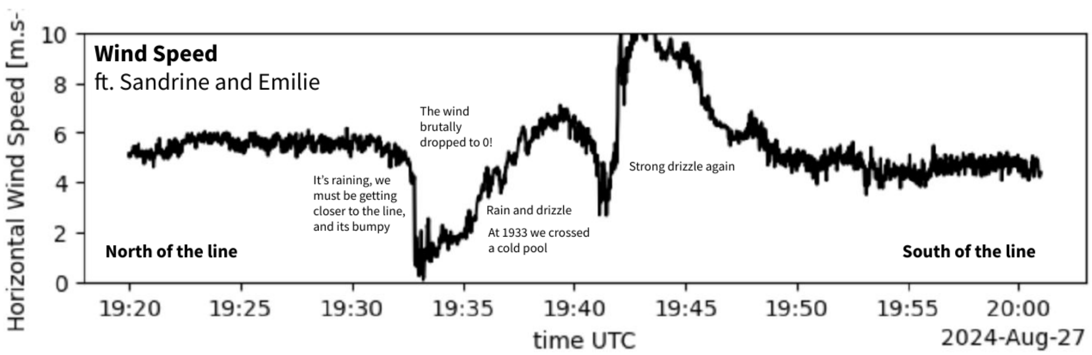

Figure 4: Time evolution of the wind speed measured by the ATR at an altitude of about 150 m when crossing the convergence line (courtesy Brett McKim and Emilie Fons).

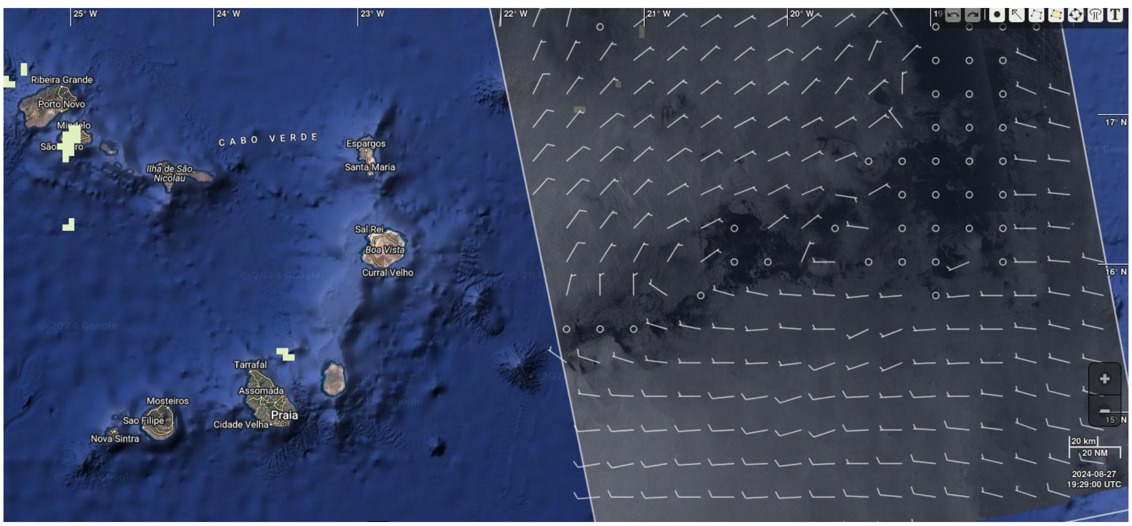

Figure 5: Sentinel-1/SAR image of surface roughness (shading) with the 10m wind speed and direction. The ATR actually flew within the field of view of RCM1/SAR, which was located just West of the Sentinel1/SAR field of view. Note the low wind speed below the line of convergence. (Source: OVL)

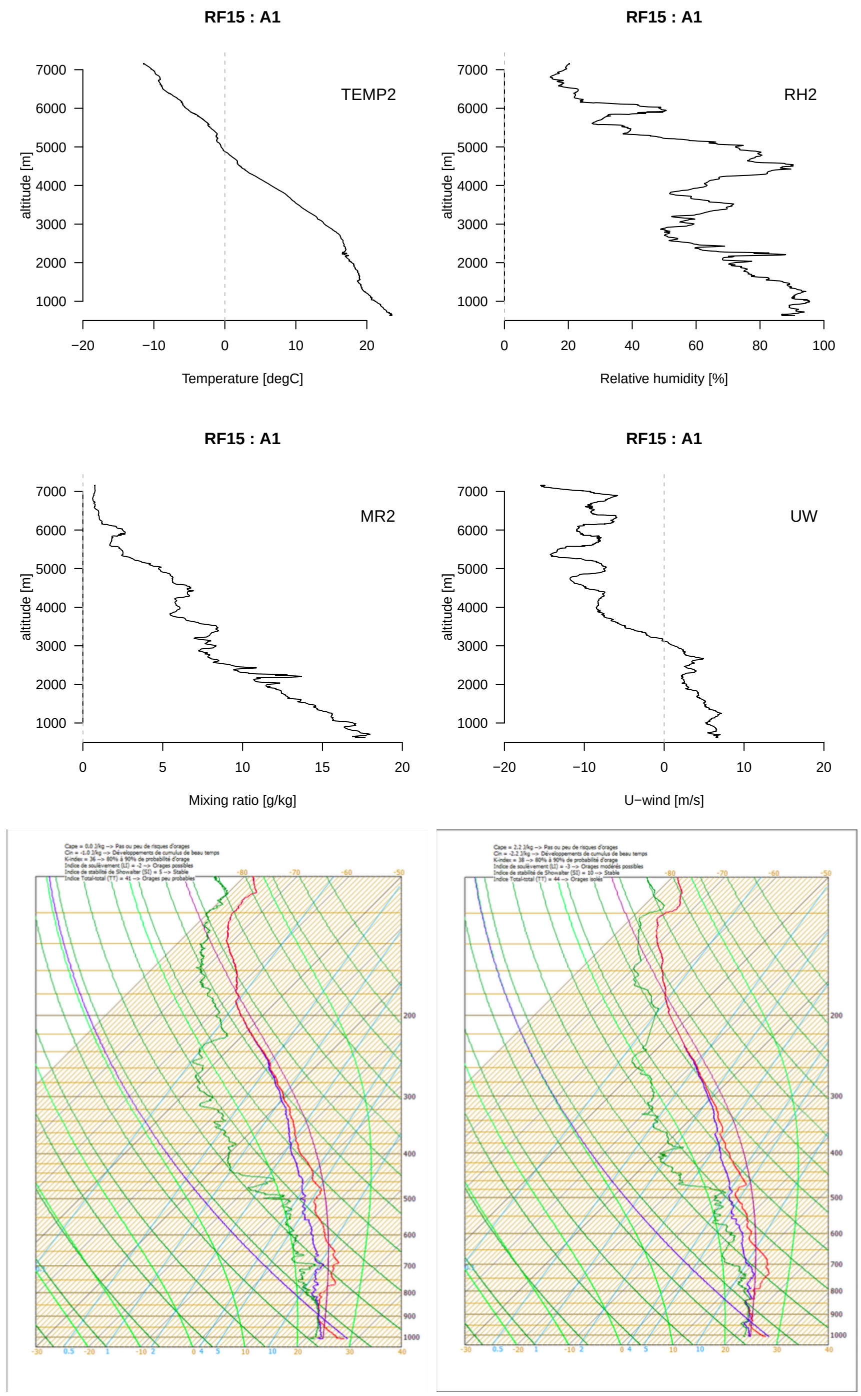

Figure 6: Top: Vertical profiles of temperature, humidity mixing ratio, relative humidity and zonal wind measured by in-situ sensors during the ascent of the ATR from cloud base to FL220. Bottom: Sal radiosoundings at 1800 and 2100 UTC.

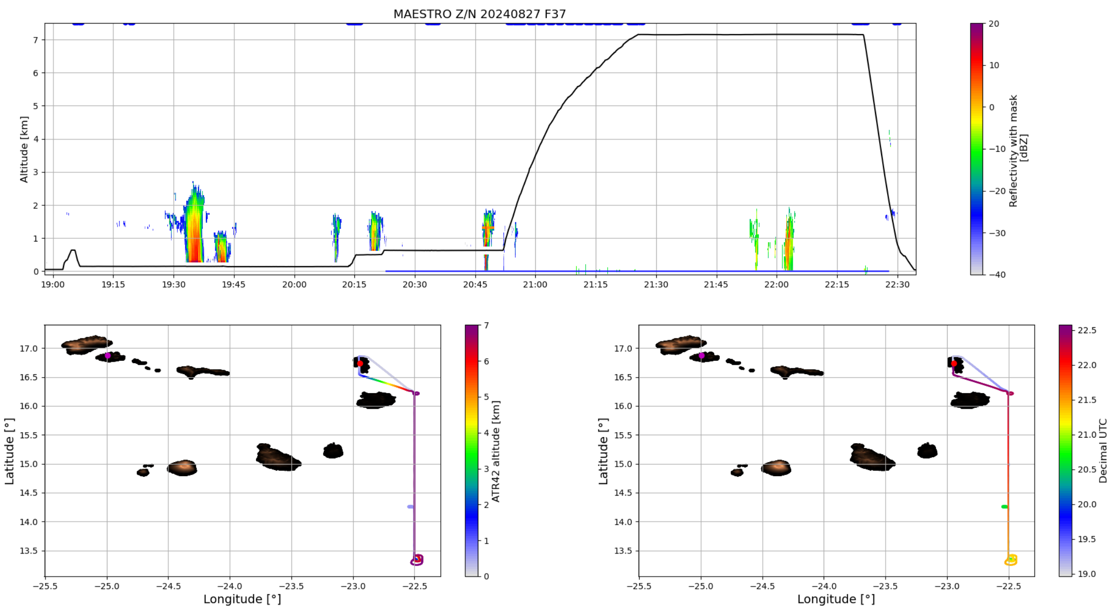

Figure 7: Radar reflectivity measured by the vertically-pointing RASTA Doppler cloud radar (courtesy Julien Delanoë).

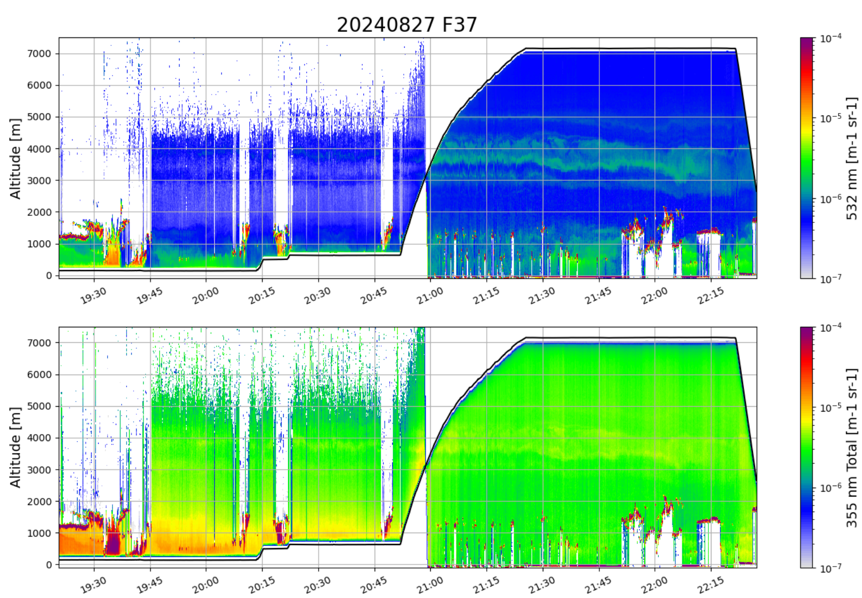

Figure 8: Backscatter signal measured at 355 and 532 nm by the vertically-pointing- HSRL Doppler lidar LNG (courtesy Emmeline François, Sophie Bounissou and Julien Delanoë).

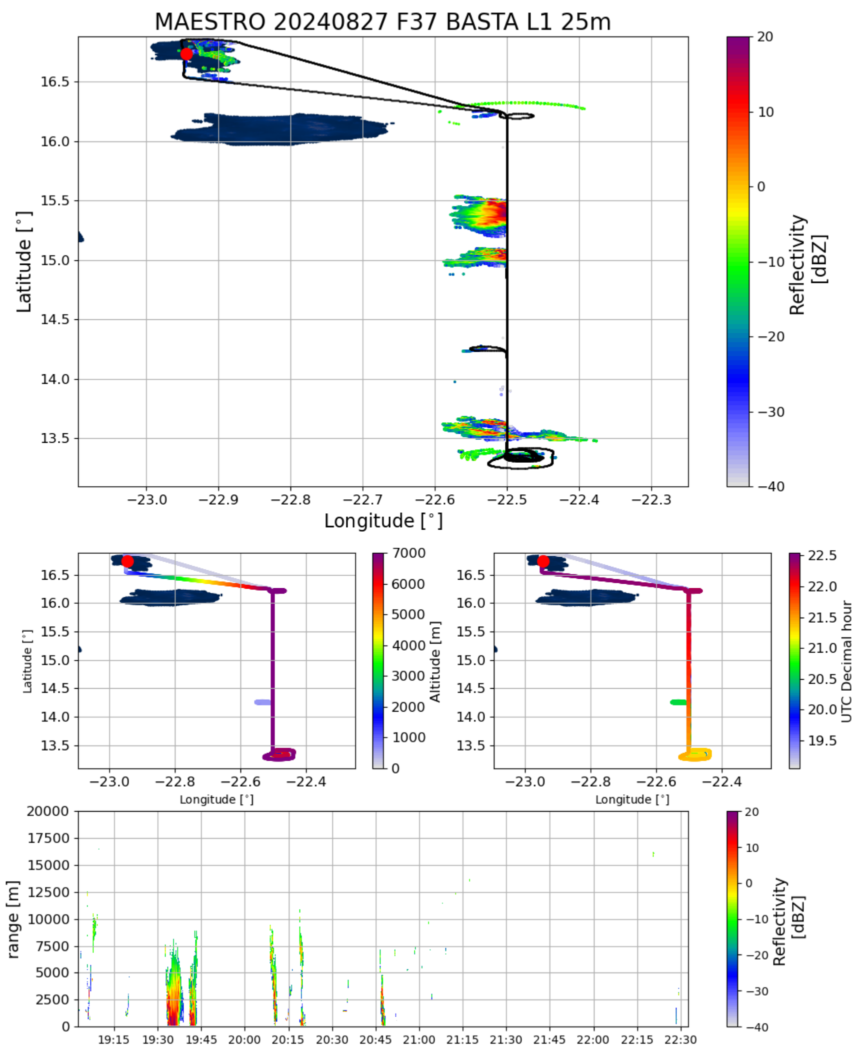

Figure 9: Radar reflectivity measured by the horizontally-pointing BASTA Doppler cloud radar (courtesy Julien Delanoë). Note that the radar used the 25m resolution mode on this flight (courtesy Julien Delanoë).

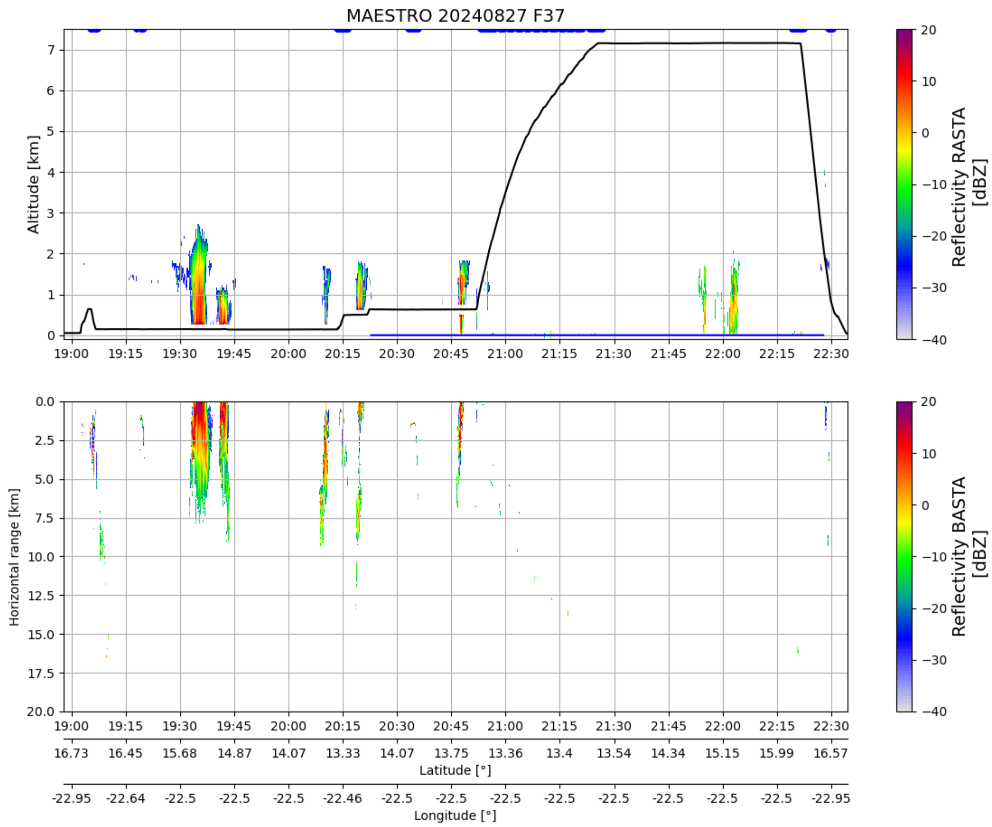

Figure 10: Radar reflectivity measured by the vertically-pointing radar RASTA and the horizontally-pointing radar BASTA (courtesy Julien Delanoë).

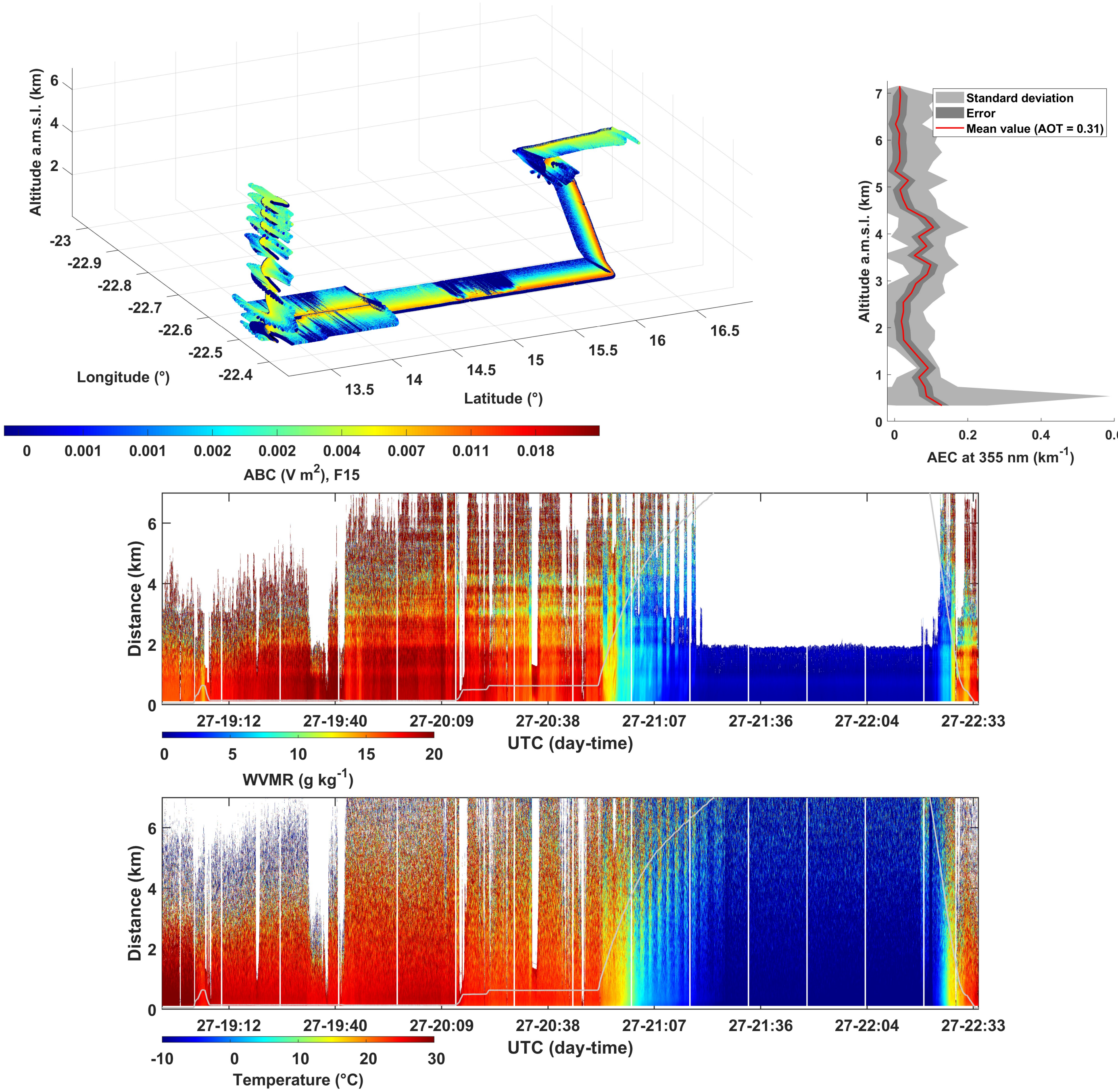

Figure 11: (Top left) Evolution of lidar backscatter ratio in the aerosol/cloud channel; (Top right) Vertical profile of the aerosol extinction, and (Bottom) 2D variation of the elastic backscatter signal, and the water vapor mixing ratio (stripes will be removed after processing) and temperature measured by the horizontally-pointing Raman lidar AWALI during RF11. (courtesy Frédéric Laly).

7 Instrument status

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	Ok but night flight provokes negative values
	ray_rg_down_crsensor_1	Downwelling Shortwave radiation clear dome- Attitude correction for pitch/roll $<\pm 3°$	SWDC	OK	Negative values filtered
	ray_pir_down_1	Downwelling Shortwave radiation red dome (no attitude correction)	SWD_RED	OK	Ok but night flight provokes negative values
	ray_pir_down_crsensor_1	Downwelling shortwave radiation red dome-Attitude correction for pitch/roll $<\pm 3°$	SWDC_RED	OK	Negative values filtered
	ray_rg_up_1	Upwelling Shortwave radiation clear dome (no attitude correction)	SWU	OK	Ok but night flight provokes negative values
	ray_pir_up_1	Upwelling shortwave radiation red dome (no attitude correction)	SWU_RED	OK	Ok but night flight provokes negative values
	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	ref
	vit_v_tas_adc_1	True Air Speed	TAS2	OK	noisy
	alt_ralt_15_m_1	Height	HEIGHT	OK	-
	att_aoa_radom_deg_1	Angle of Attack	AOA_RAD	OK	-
	att_aos_radom_deg_1	Angle of Sideslip	AOS_RAD	OK	-

DATA	SAFIRE_name	DESCRIPTION	PARAMETER	STATUS	COMMENT
	ven_wind_v_vp_imu_1	Upward Wind	WW	OK	Ok but baseline values seems to increase slowly and lineary
	ven_wind_FF_vp_imu_1	Horizontal Wind Speed	WS	OK	ref
	ven_wind_DD_vp_imu_1	Horizontal Wind Direction	WD	OK	ref
	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	ref
	tpr_ts_rtd_1	Air Static Temperature, deiced sensor	TEMP2	OK	-
	tpr_tt_rt_1	Total Temperature, non-deiced sensor	TTEMP1	OK	ref
	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	PB	oscillations in altitude
	hum_hutd_wvs_rs_1	Dew Point Temperature from WVSSII	DP2	OK	ref
	hum_hutd_rtd_aero_1	Dew Point Temperature from humaero enviscope	DP3	PB	saturated during first half part of the flight
	hum_humr_1011_rs_1	Water Vapor Mixing ratio from 1011C	MR1	PB	oscillations in altitude
	hum_humr_wvs_rs_1	Water Vapor Mixing ratio WVSSII	MR2	OK	ref
	hum_humr_srtd_aero_1	Water Vapor Mixing ratio from humaero enviscope	MR3	PB	saturated during first half part of the flight
	hum_huabs_rt_1011_1	Abolute Humidity from 1011C	HABS1	PB	oscillations in altitude
	hum_huabs_wvs_rs_1	Abolute Humidity from WVSSII	HABS2	OK	ref
	hum_huabs_srtd_aero_1	Abolute Humidity from enviscope	HABS3	PB	saturated during first half part of the flight
	hum_hurel_rt_1011_rs_1	Relative Humidity from 1011C	RH1	PB	oscillations in altitude
	hum_hurel_wvs_rs_1	Relative Humidity from WVSSII	RH2	OK	ref
	hum_hurel_stat_rt_aero_1	Relative Humidity from enviscope	RH3	PB	saturated during first half part of the flight
	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	NOK	Instrument out of service
FW	hum_humolfra_fw_crh_100	Mole fraction of water vapour in air measured by FastWave	FW_MOLFRA	PB	Datation issues => will be solved quickly
	hum_humr_fw_100	Water Vapor Mixing ratio from FastWave	MR6	PB	Datation issues => will be solved quickly

DATA	SAFIRE_name	DESCRIPTION	PARAMETER	STATUS	COMMENT
	pre_pb_fw_100	Air Pressure measured by Fast-Wave	FW_P	PB	Datation issues => will be solved quickly
	tpr_tt_fw_100	Temperature measured by Fast-Wave	FW_T	PB	Datation issues => will be solved quickly
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	NOK	Instrument out of service
	mic_somcount_SPP300_1	SPP300 total particles count	SPP300_TCOUNT	NOK	Instrument out of service
	mic_tabconc_SPP300_1	SPP300 particles concentration bin[1]...bin[30]	SPP300_CONC	NOK	Instrument out of service
	mic_totalconc_SPP300_1	SPP300 Total particles concentration	SPP300_TCONC	NOK	Instrument out of service
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	
	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	