Flight report

Research Flight 12 (RF12)
ATR-2024-0825
SAFIRE flight as240034
Sal (SID-SID), 19:15 - 22:40 UTC

PI: **Marie Lothon**

25 August 2024

1 Objectives

- SAR overpass along its track
- Typical MAESTRO/ORCESTRA flight sampling shallow convection
- Night-time conditions for most of the flight

2 Cal/Val activity

No.

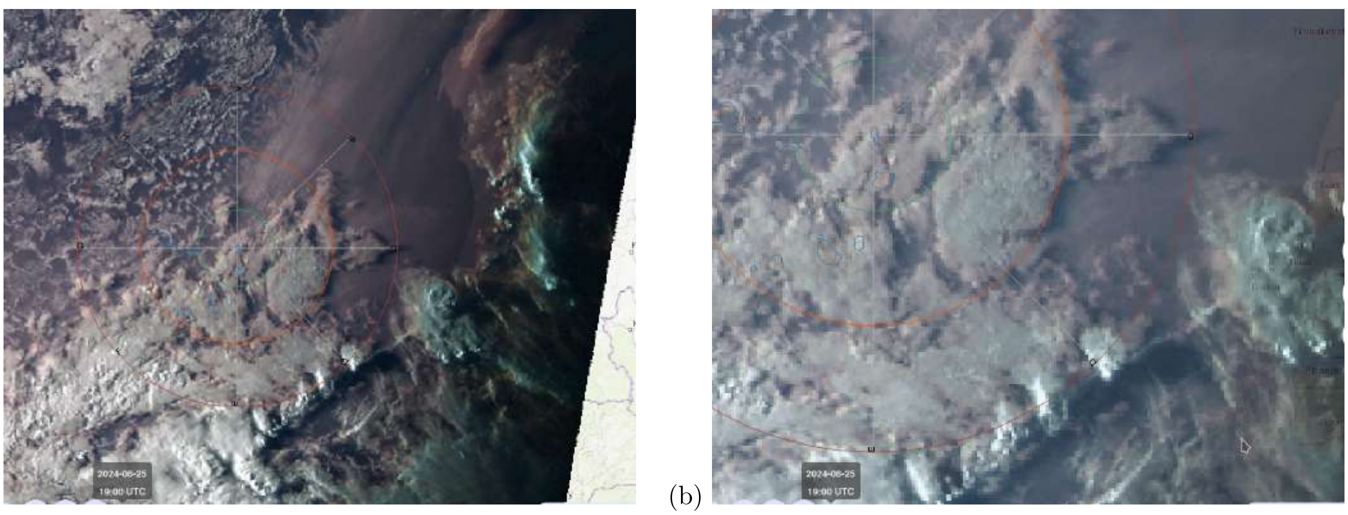
3 Crew

SAFIRE	Name	Lab
Pilot (CDB)	Dominique Duchanoy	SAFIRE
Pilot (OPL)	Guillaume Seurat	SAFIRE
Mechanics	Thierry André	SAFIRE
Expé Principal	Tania Jiang	SAFIRE
Expé	Greg Ehses	SAFIRE
SCIENTISTS		
PI seat	Marie Lothon	LMD
LNG seat	Sophie Bounissou	LATMOS
aWALI seat	Frédérique Laly	LSCE
Microphys seat 1	Pierre Coutris	LAMP
Microphys seat 2	Guy Lefebvre	LAMP
RASTA seat	Julien Delanoë	LATMOS
BASTA seat	Kevin Huet	LSCE

4 Synoptic situation

This day corresponds to a negative phase of AEWs, in between two passages of AEWs. We are in a rather dry phase, even if in a slightly positive anomaly of Rossby Wave. Wind is weak close to surface, and the AEJ is moderate. Due to the dry air, convection is shallow in the area. SAL still present.

The satellite image Fig. 1 shows large stratocumulus clouds in Cabo Verde area, and active deep convection along the ITCZ to the south.



(a) (b)

Figure 1: Satellite image MSG

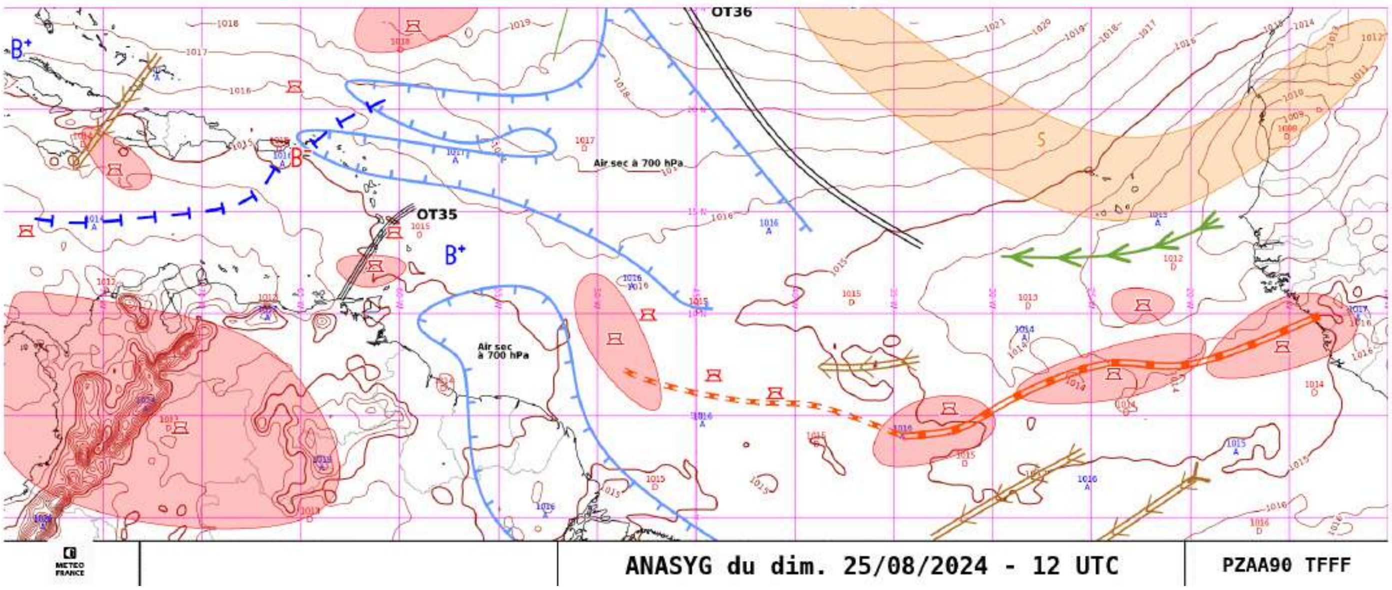


Figure 2: MISVA schematic analysis

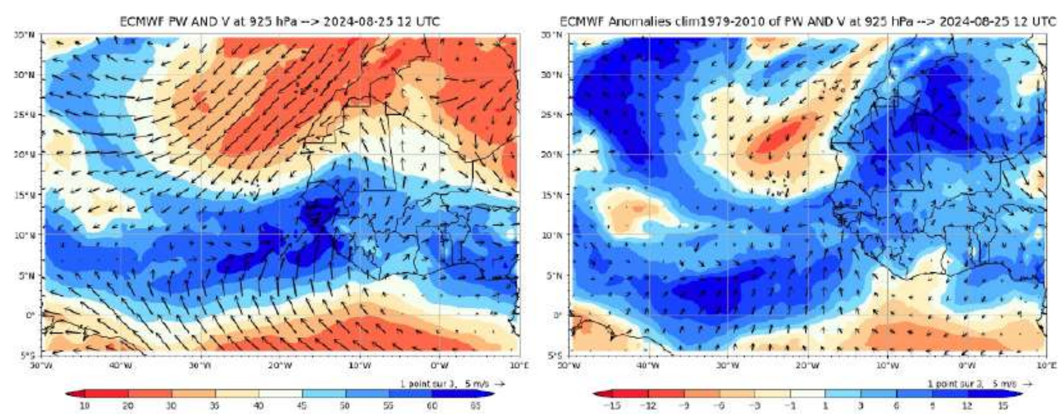


Figure 3: Precipitable water from AROME, 25 August 2024 1200 UTC.

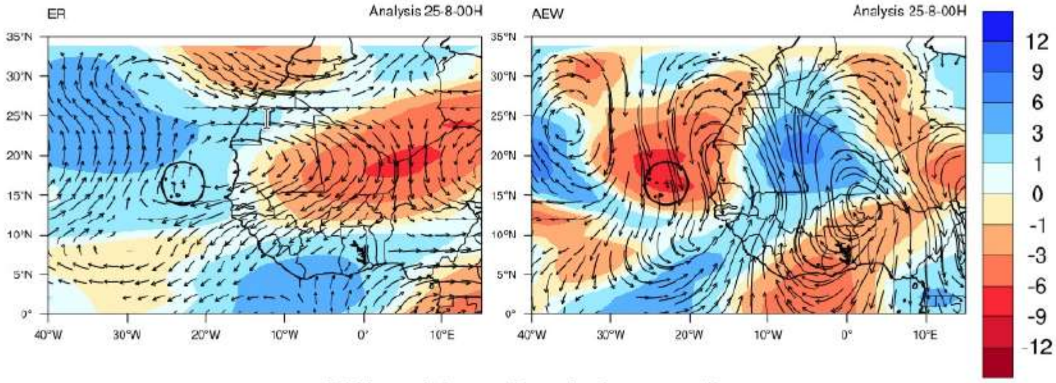
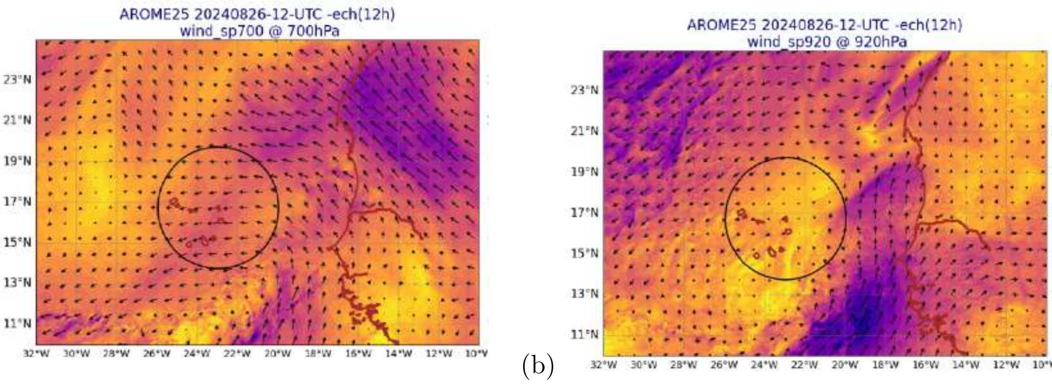


Figure 4: Precipitable water and wind anomalies, Rossby waves and African Easterly Waves, for 25 August 2024.



(a) (b)

Figure 5: Forecasted wind (a) at 700 hPa (b) at 920, 25 August 2024 1200 UTC hPa

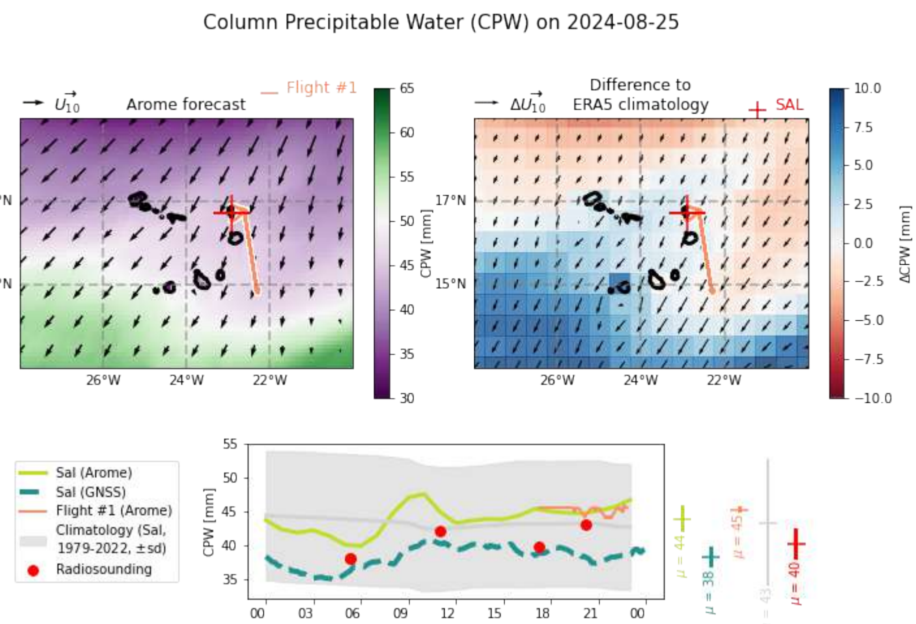


Figure 6: 24h average of Column of Precipitable Water, from ECMWF analysis and GNSS.

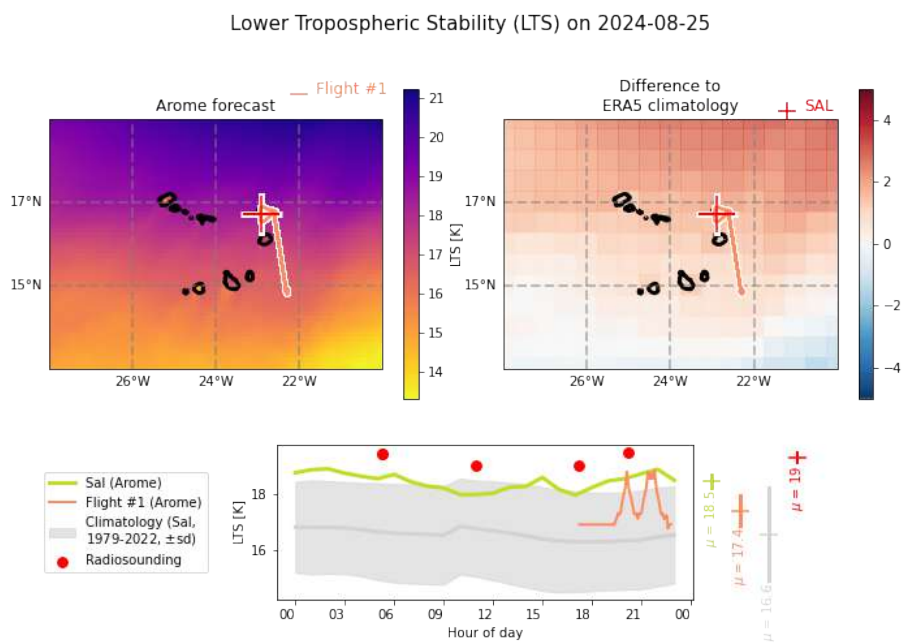


Figure 7: Lower Tropospheric Stability on 20 August 2024, from AROME, ERA5, soundings

5 Flight elements

Description of the legs

RF12 elements	Time (UTC)	Flight Level (FL)	Position	Notes
Takeoff	19:20		SID-SID	
L	19:32 - 20:06	500 ft	WP1 $\rightarrow WP2$	Low level leg - shallow clouds field
B1	20:08 - 20:45	2600 ft	WP2 $\rightarrow WP1$	Cloud base leg - Many clouds crossed
B2	20:49 - 21:22	2600 ft	WP1 $\rightarrow WP2$	Cloud base leg - clouds over 2/3 of leg
A	21:22 - 21:50	2600 ft $\rightarrow FL200$	WP2	Ascent to FL200 at WP2
H	21:50 - 22:21	FL200	WP2 $\rightarrow WP1$	High level leg in Ac clouds
Landing	22:41		SID-SID	

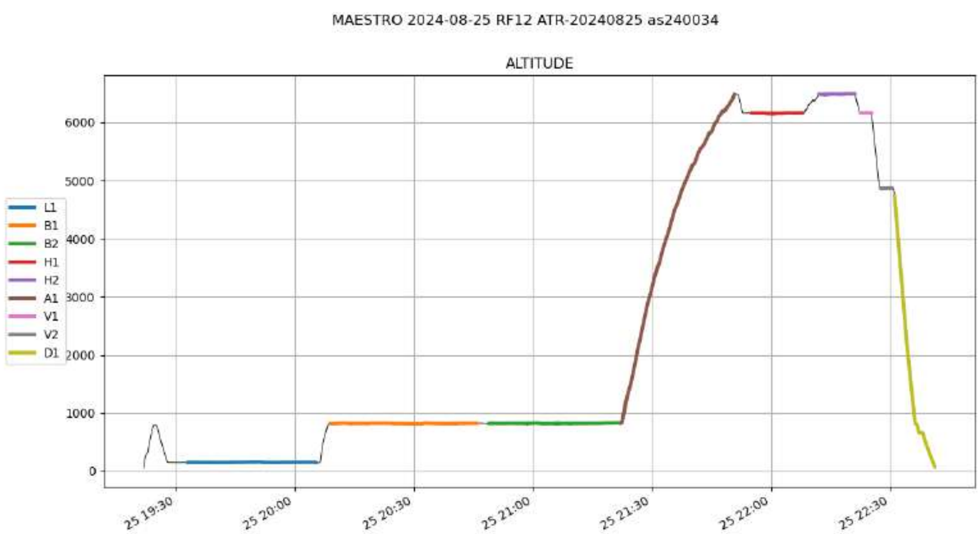


Figure 8: Flight segmentation as described in the table.

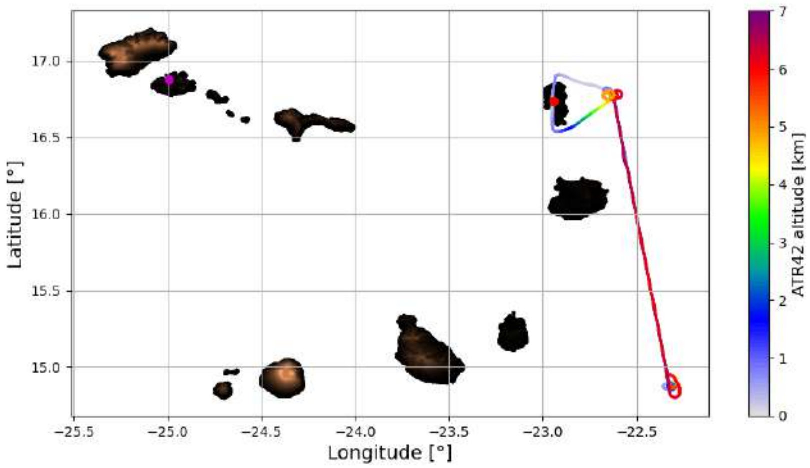


Figure 9: Trajectory

6 Quicklooks and Comments

There were many low cumulus clouds, and a large field of cirrus clouds at the top of the SAL (see Fig. 13).

Low clouds had there bases distributed over two levels, between 750 m and 1000 m (see the LNG observations in Fig. 13(b). The cirrus clouds were supercooled water cirrocumulus, separated in two layers (5500 m and 6500 m). The higher one was sometimes precipitating (ice precipitation), merging the two layers.

During the low leg at 500 ft, we could feel increased turbulence below cumulus clouds. We could also see showers around us (bright and foggy areas), and crossed some of them. In this subcloud layer, water vapour mixing ratio was 15 g kg^{-1} and wind was northerly, 7 m s^{-1}.

At cloud base, we crossed several clouds (with associated turbulence). AWALI and BASTA detected many of them on the side.

In turns AWALI catches a very pronounced inversion (hugh jump in moisture). As we go up to FL200, we cross it, and confirm the very strong inversion : r_v jump is 12 g kg^{-1} and temperature jump is $8°C$. The extremely dry air layer above is only 300 m, the air gets lets dry above. (See sounding Fig. 10.) It ends with saturation at 5500 m (first cirrocumulus layer). we stop the ascent in the second layer of cirrus clouds, with 100 to 150 mg m^{-3} and turbumence. We had then to go down due to icing, and get back to the 5500 m layer. Wehen this layer breaks, we come back up and reach again the 6500 m layer. Navigation is adapted to stay up there despite the icing possibility. Turbulence is observed. We have then to go down again and make two VAD: one at FL200, and one at FL150 (no icing anymore) where the LNG has a better cover below, with no attenuation by clouds.

When we cross again the inversion close to WP1, the jump in moisture is still larger (from 1 g kg^{-1} to 15 g kg^{-1}!).

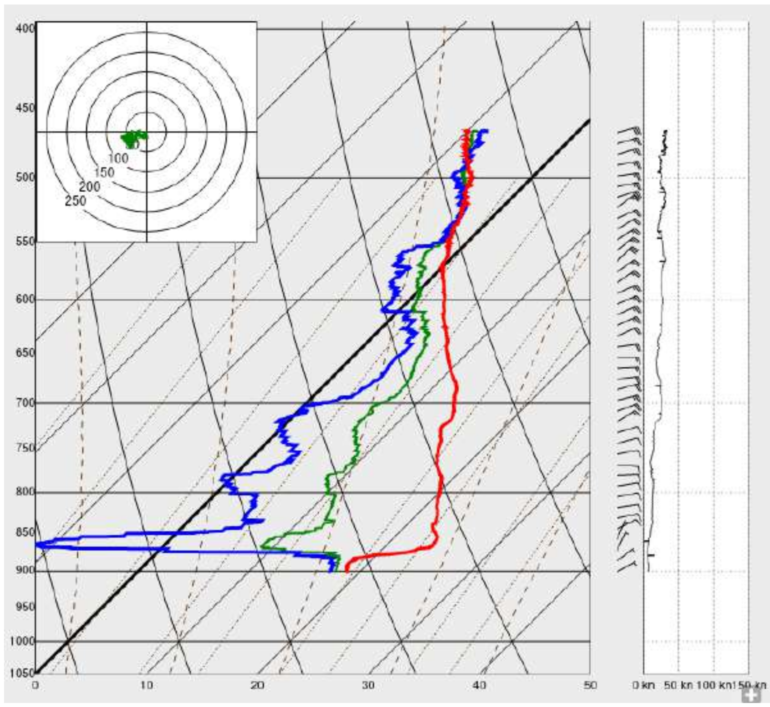


Figure 10: Skew-T diagram during ascent to FL200 at EC1

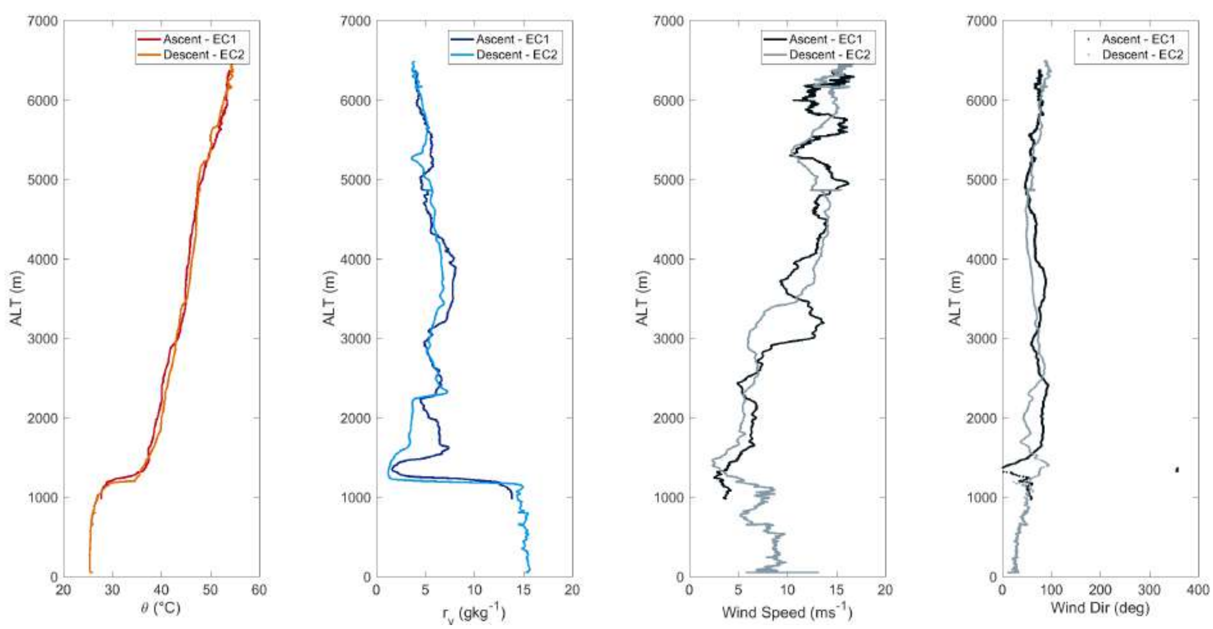


Figure 11: Profiles of potential temperature, water vapour mixing ratio, windspeed and windir during the ascent at WP2 and descent at WP1.

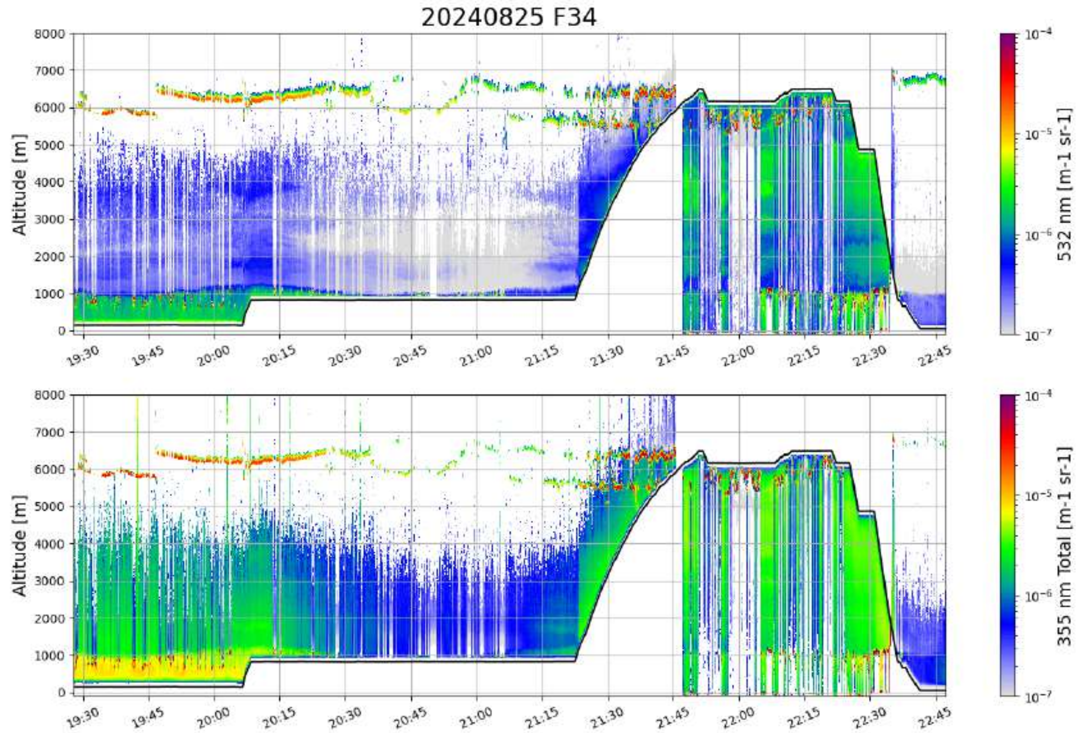
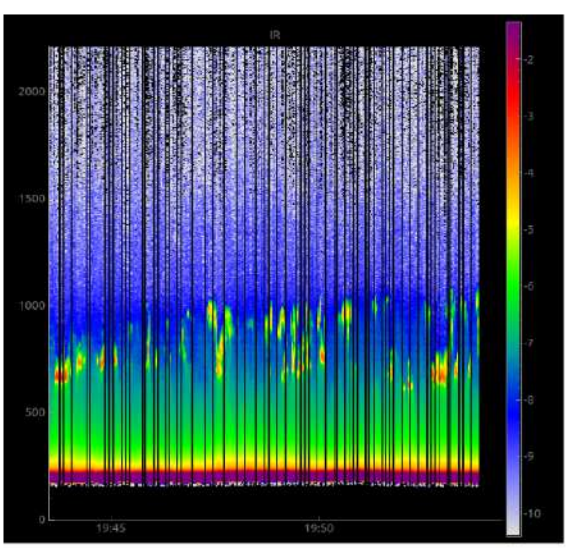


Figure 12: Observations made by LNG during the entire flight

(a) 

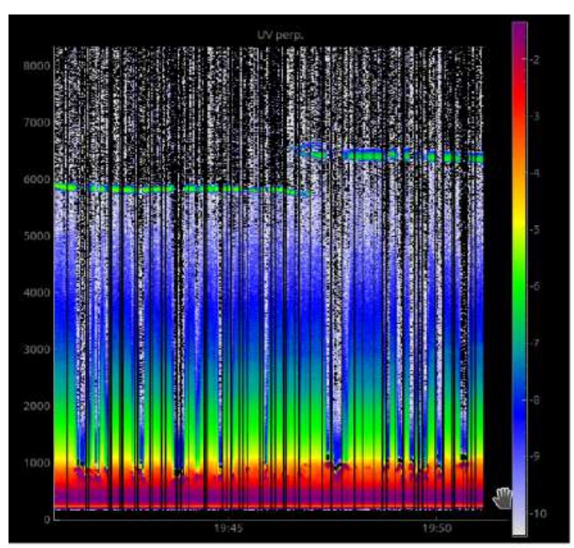
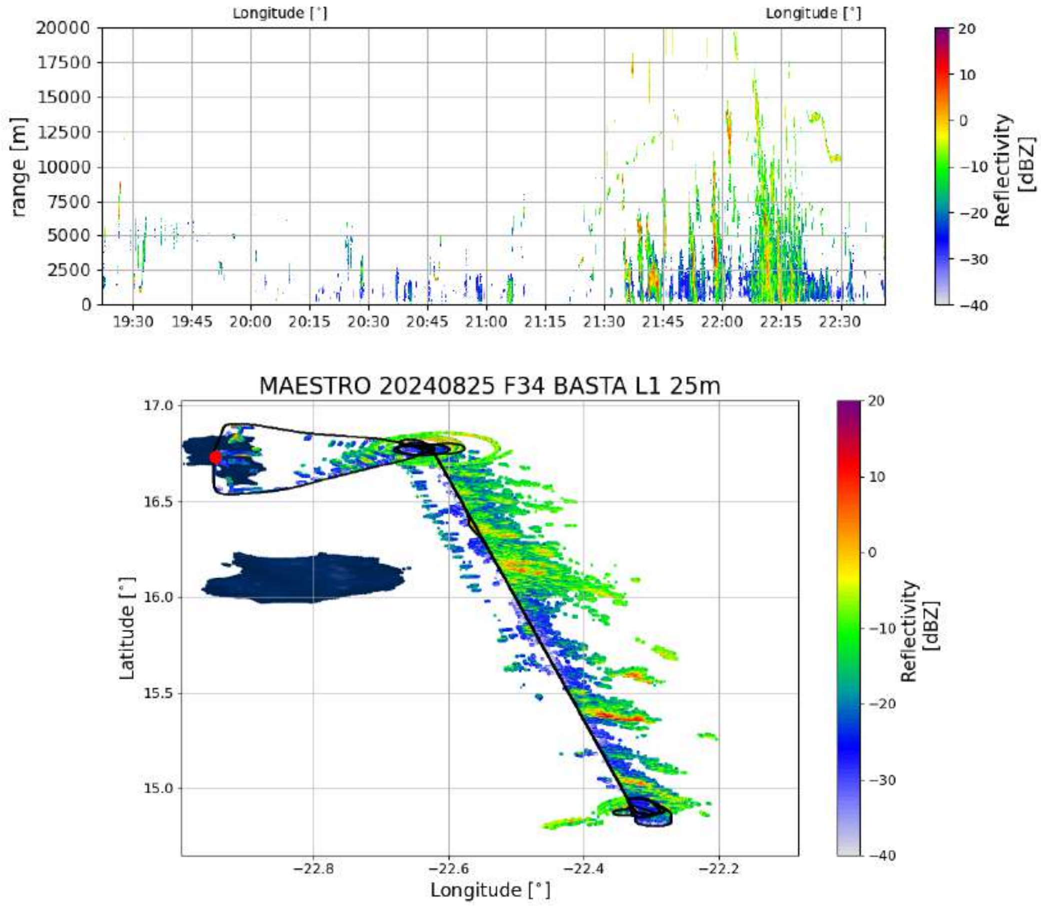
(b) 

Figure 13: Observations made by LNG during the flight (a) low clouds, (b) all layers observed.



(a) (b)

Figure 14: BASTA observations, (a) upward and (b) sideways.

Figure 15: RASTA observations along the entire flight.

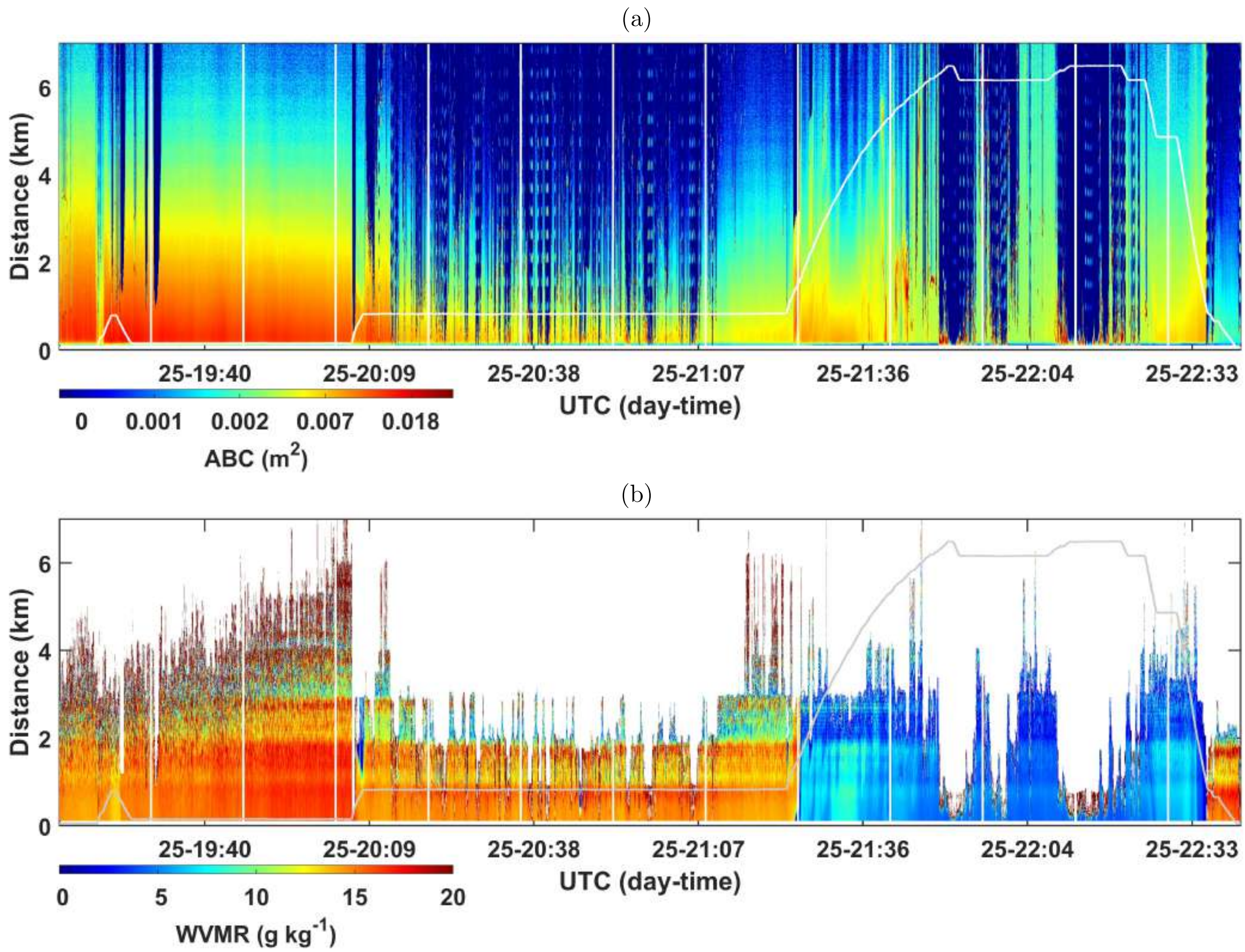


Figure 16: Observations made by AWALI during the flight (a) Apparent Backscatter Coefficient, (b) water vapour mixing ratio.

7 Instrument status

All instruments worked well.

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 don't care about negative values
	ray_rg_down_crsensor_1	Downwelling Shortwave radiation clear dome- Attitude correction for pitch/roll $<\pm 3°$	SWDC	OK	Negative values filtred
	ray_pir_down_1	Downwelling Shortwave radiation red dome (no attitude correction)	SWD_RED	OK	OK but Night flight don't care about negative values
	ray_pir_down_crsensor_1	Downwelling shortwave radiation red dome-Attitude correction for pitch/roll $<\pm 3°$	SWDC_RED	OK	Negative values filtred
	ray_rg_up_1	Upwelling Shortwave radiation clear dome (no attitude correction)	SWU	OK	OK but Night flight don't care about negative values
	ray_pir_up_1	Upwelling shortwave radiation red dome (no attitude correction)	SWU_RED	OK	OK but Night flight don't care about 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	Reference
	vit_v_tas_adc_1	True Air Speed	TAS2	OK	Noisy

DATA	SAFIRE_name	DESCRIPTION	PARAMETER	STATUS	COMMENT
	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	-
	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	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 but noisier in altitude due to presence of liquid water
	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	-
	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	-
	hum_humr_1011_rs_1	Water Vapor Mixing ratio from 1011C	MR1	OK	-
	hum_humr_wvs_rs_1	Water Vapor Mixing ratio WVSSII	MR2	OK	-
	hum_humr_srtd_aero_1	Water Vapor Mixing ratio from humaero enviscope	MR3	OK	-
	hum_huabs_rt_1011_1	Abolute Humidity from 1011C	HABS1	OK	-
	hum_huabs_wvs_rs_1	Abolute Humidity from WVSSII	HABS2	OK	-
	hum_huabs_srtd_aero_1	Abolute Humidity from enviscope	HABS3	OK	-
	hum_hurel_rt_1011_rs_1	Relative Humidity from 1011C	RH1	OK	-
	hum_hurel_wvs_rs_1	Relative Humidity from WVSSII	RH2	OK	-
	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	Ok but peak at 21:30
	hum_humr_fw_100	Water Vapor Mixing ratio from FastWave	MR6	OK	Ok but peak at 21:30
	pre_pb_fw_100	Air Pressure measured by FastWave	FW_P	OK	Ok but peak at 21:30

DATA	SAFIRE_name	DESCRIPTION	PARAMETER	STATUS	COMMENT
	tpr_tt_fw_100	Temperature measured by Fast-Wave	FW_T	OK	Noisy and not dynamic
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	PB	
	mic_somcount_SPP300_1	SPP300 total particles count	SPP300_TCOUNT	PB	Very noisy
	mic_tabconc_SPP300_1	SPP300 particles concentration bin[1]...bin[30]	SPP300_CONC	PB	
	mic_totalconc_SPP300_1	SPP300 Total particles concentration	SPP300_TCONC	PB	Very noisy
UHSAS	mic_tabcount_uhsas_sync_1	UHSAS particles count	UHSAS_COUNT	OK	
	mic_somcount_uhsas_sync_1	UHSAS total particles counts	UHSAS_TCOUNT	OK	ok but misval from 20:50:25 to 20:51:15
	mic_tabconc_second_uhsas_sync_1	UHSAS Particles concentration	UHSAS_CONC	OK	
	mic_totalconc_uhsas_sync_1	UHSAS total particles concentration	UHSAS_TCONC	OK	ok but misval from 20:50:25 to 20:51:15
	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	