

Flight report

Research Flight 0 (RF04)
 ATR-2024-0813b
 SAFIRE flight as240026
 Sal (SID-SID), 19:15 - 22:30 UTC

PI: **Sandrine Bony**

13 August 2024

1 Objectives

- Typical MAESTRO/ORCESTRA flight sampling shallow convection
- Coordination with HALO (ATR circle) and SAR on Sentinel 1 (19:42 UTC)
- Nighttime conditions during most of the flight

2 Cal/Val activity: No

3 Crew

SAFIRE	Sandrine Bony	LMD
Pilot (CDB)	Guillaume Seurat	SAFIRE
Pilot (OPL)	Jean-François Bourdinot	SAFIRE
Mechanics	Thierry André	SAFIRE
Expé Principal	Clément Bezier	SAFIRE
Expé	Gilles Vergez	SAFIRE
SCIENTISTS		
PI seat	Sandrine Bony	LMD
LNG seat	Kevin Huet	LATMOS
aWALI seat	Patrick Chazette	LSCE
Microphys seat 1	Pierre Coutris	LAMP
Microphys seat 2	Thierry Latchimy	LAMP
RASTA seat	Sophie Bounissou	LATMOS
BASTA seat	Jérémie Lagarrigue	LSCE

4 Synoptic situation

- Behind the trough of an African Easterly Wave.
- Northern edge of the ITCZ around position
- Strong Saharian Aerosol Layer (SAL) between 2 and 4 km.
- Moisture and stability conditions consistent with climatological values at this date.
- PRW: 45 mm (GNSS); LTS: 17.7 K (AROME)

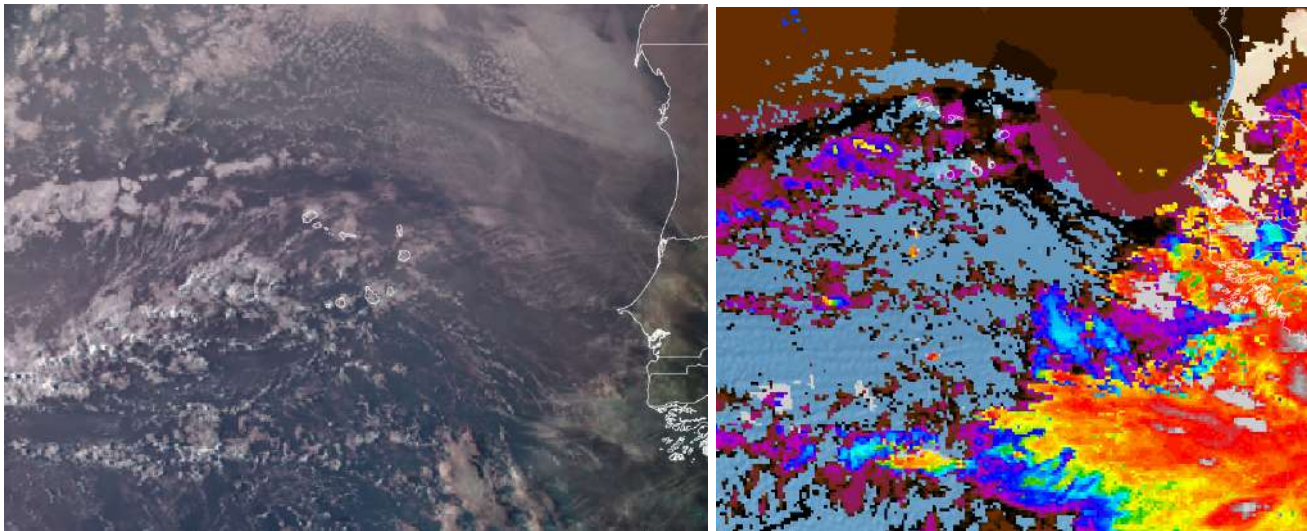


Figure 1: MSG imagery (left: RGB, right: cloud top height) on 2024-0813 at 19:00 UTC.

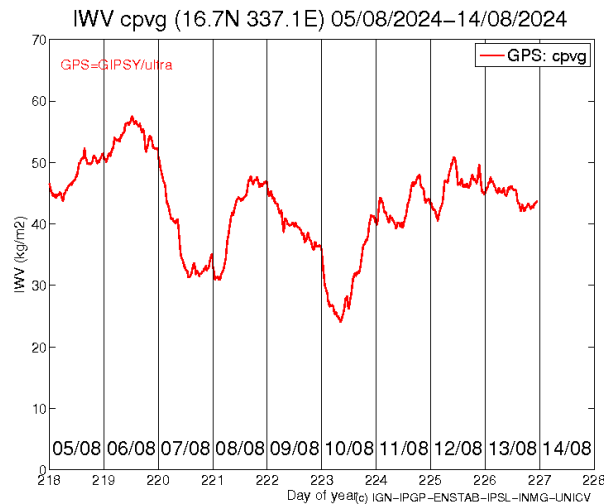


Figure 2: Evolution of the vertically-integrated water vapor measured at Sal by GNSS over the last 10 days (Courtesy Olivier Bock).

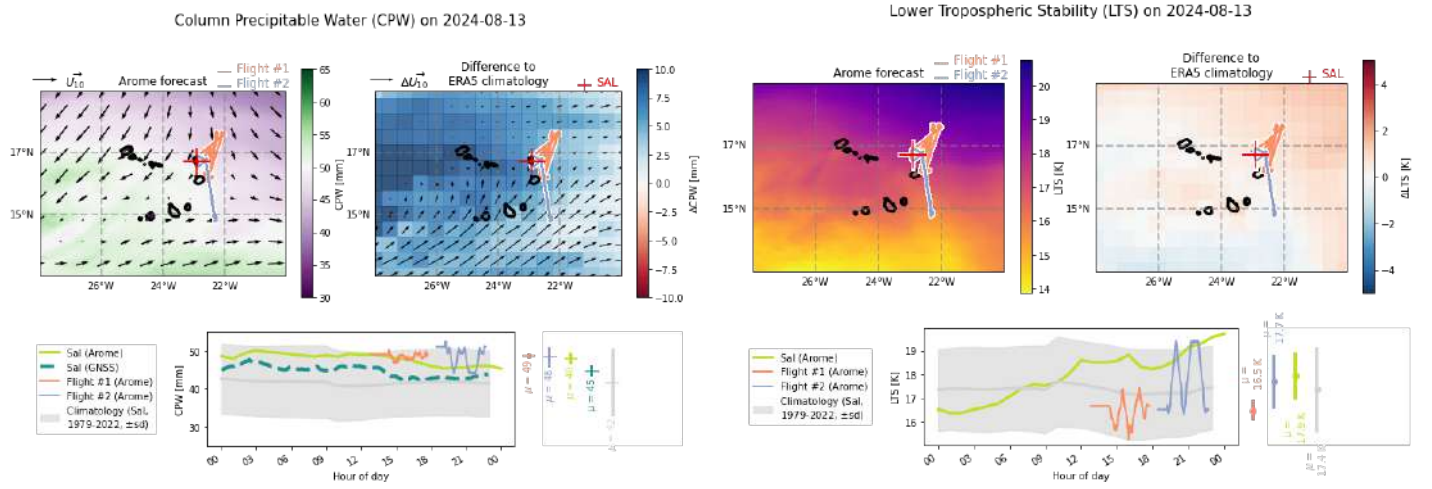


Figure 3: Comparison of the precipitable water (PRW or IWV) and lower-tropospheric stability (LTS) predicted by AROME or measured (GNSS) with the climatology. (Courtesy Emilie Fons).

5 Flight elements

- Typical MAESTRO flight pattern South-East of Sal
- WP1: N 16° 45' 12"; W 22° 37' 19"; WP2: N 14° 55' 44"; W 22° 19' 35"
- The flight pattern started with the subcloud-layer leg to be close to the ocean surface during the passage of SAR (at 19:42 UTC), and ended with the free-tropospheric leg.
- The cloud base level as initially around 800 m (as in Mindelo) but then adjusted visually from the cockpit to 565 m (where AWALI also detected many small clouds).
- The sunset occurred at 19:57 UTC, so that starting at cloud base, the flight occurred during nighttime.

RF04 elements	Time (UTC)	Flight Level (FL)	Position	Notes
Takeoff	19:11		GVAC	
L1	19:22 – 19:56	500 ft	WP1 (N) → WP2 (S)	Subcloud layer (150 m)
B1	20:00 – 20:35	1900 ft	WP2 (S) → WP1 (N)	Cloud base (560 m)
B2	20:39 – 21:15	1900 ft	WP1 (N) → WP2 (S)	Cloud base (560 m)
A1	21:15 – 21:46	to FL210	WP2	Ascent
V1	21:47 – 21:50	FL210	WP2	VAD (roll: 26 deg)
H1	21:50 – 22:24	FL210	WP2 (S) → WP1 (N)	Free-tropospheric leg (6.8 km)
Landing	22:35		GVAC	
ATR circle	22:20 – 23:00	FL350 (11.5 km)	(15.5N, 22.1W), 70km radius	HALO: 12 dropsondes



Figure 4: (Top left) ATR trajectory on top of the SAR/Sentinel-1 swath and screenshot of Planet showing the position of the ATR trajectory relative to the HALO/ATR circles. (Bottom) flight segmentation of the ATR-20240813b flight (also named RF04 or as240026) as described in the table.

6 Quicklooks and Comments

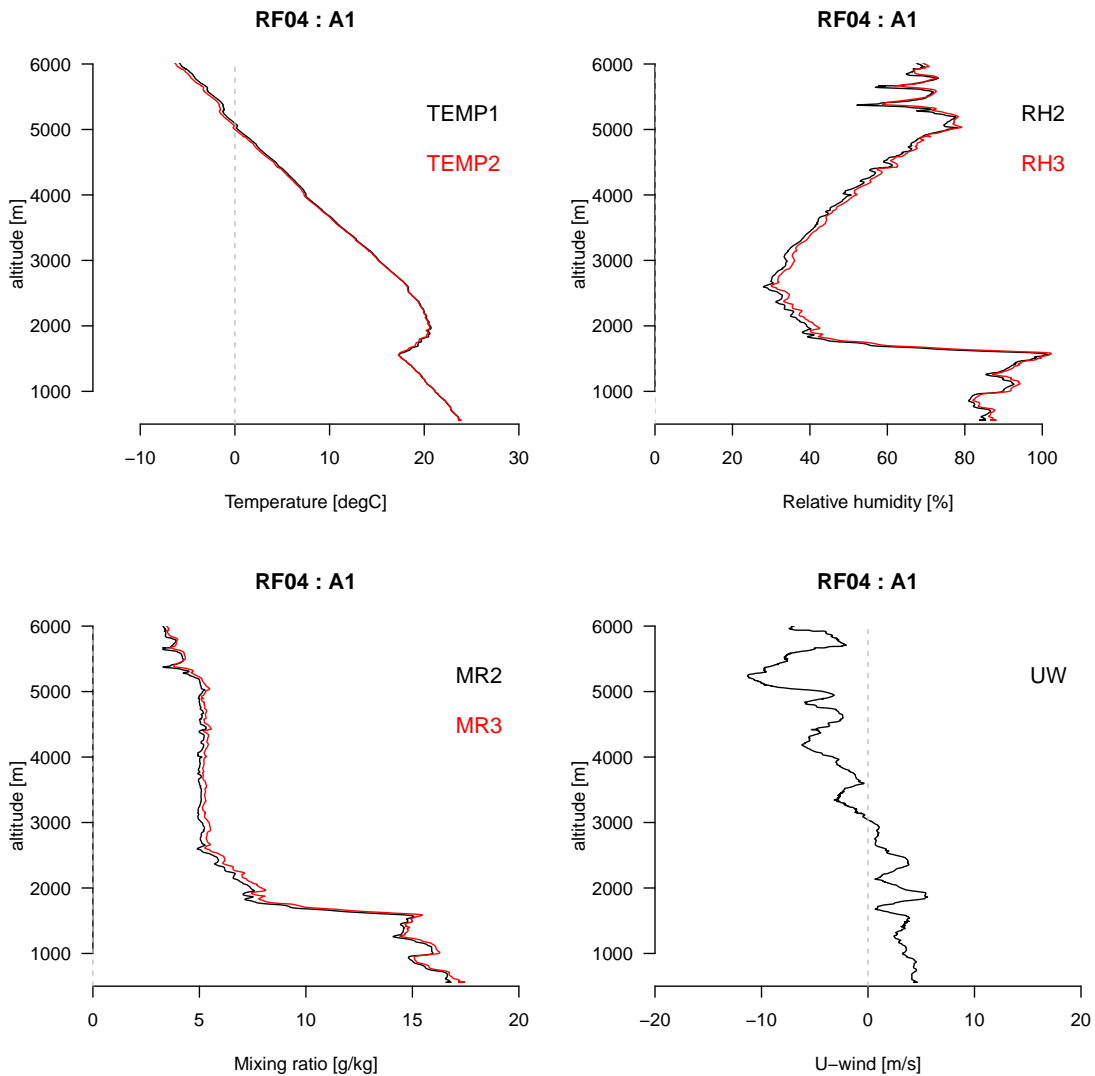


Figure 5: Vertical profiles of temperature, humidity mixing ratio, relative humidity and zonal wind measured by several in-situ sensors during the ascent of the ATR from cloud base and FL210. Note the strong inversion and hydrolapse around 1600 m.

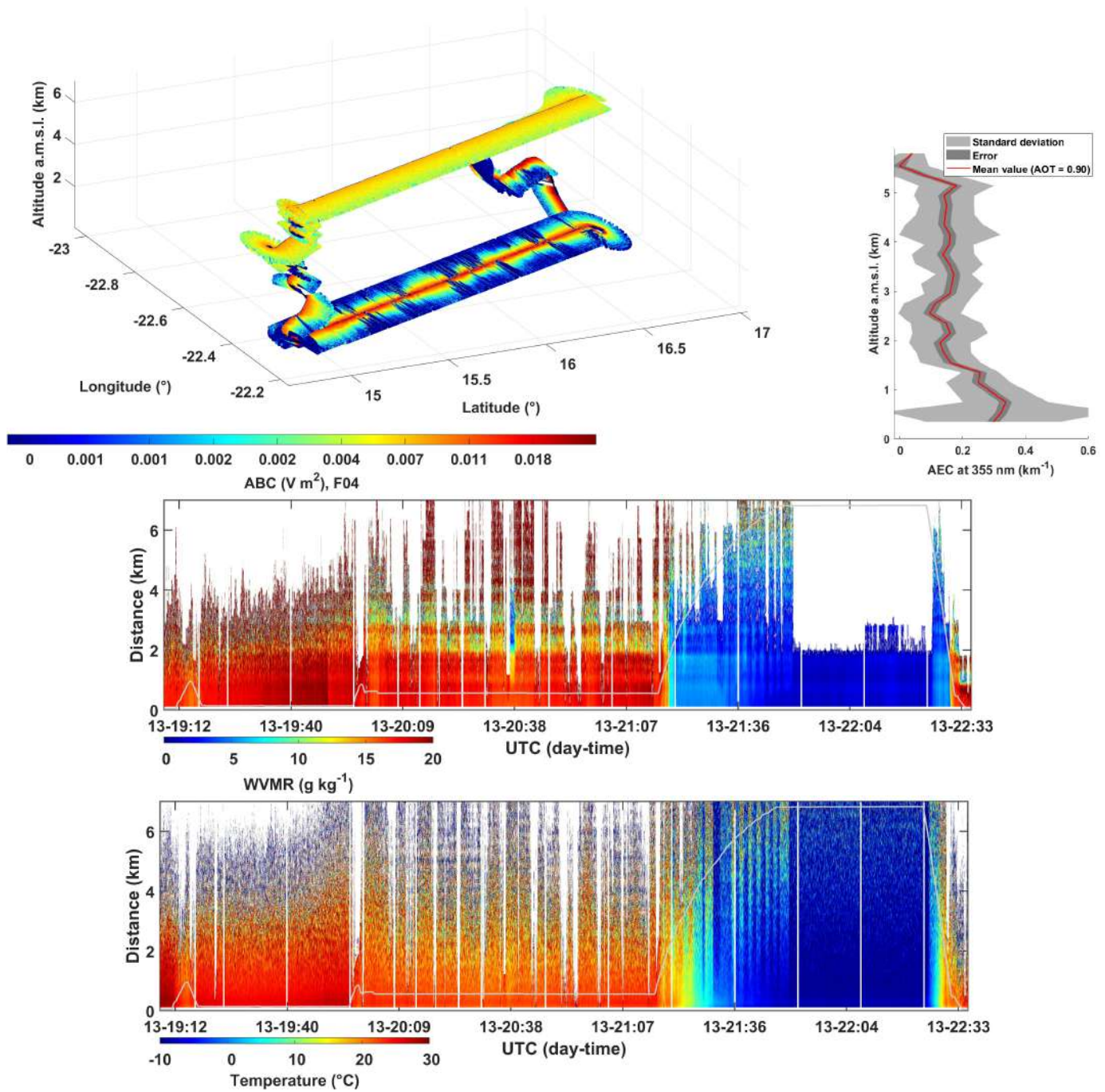


Figure 6: (Top left) Evolution of lidar backscatter ratio in the aerosol/cloud channel; (Top right) Vertical profile of the aerosol extinction, and (Bottom) 2D variation of the water vapor mixing ratio and temperature measured by the horizontally-pointing Raman lidar AWALI during RF04 (courtesy Patrick Chazette).

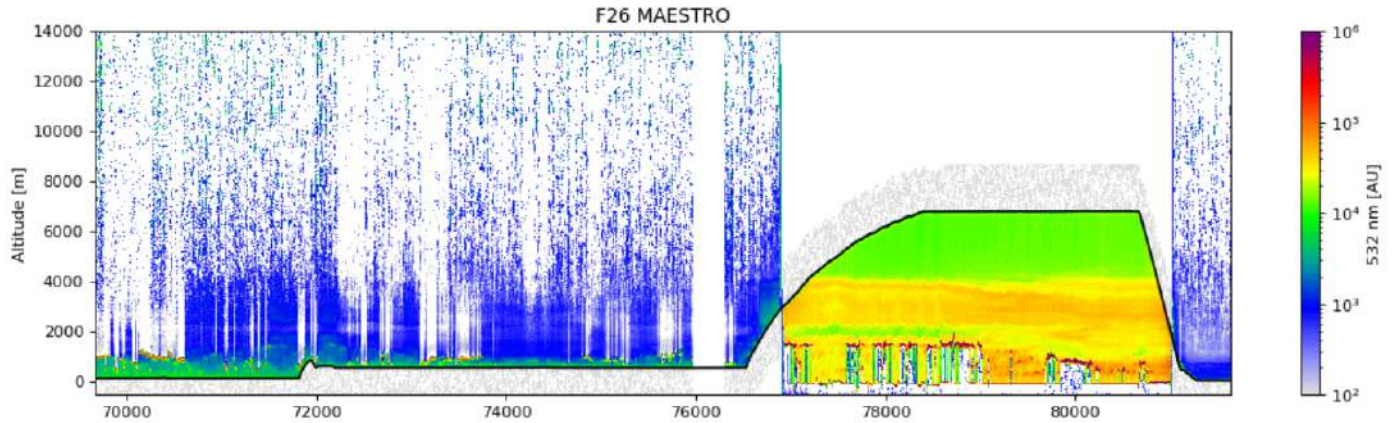


Figure 7: Backscatter signal measured at 532 nm by the vertically-pointing LNG HSRL lidar. Note the Saharan Aerosol Layer between 3-5 km, the presence of very shallow clouds and of slightly deeper clouds topping around the inversion level (1500 m) (courtesy Emmeline François).

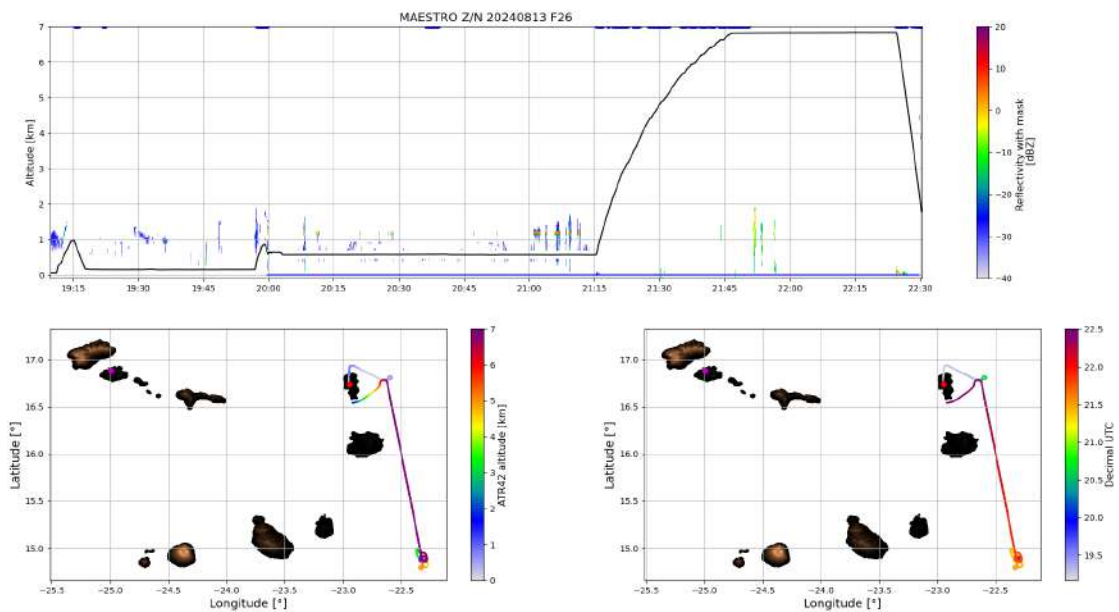


Figure 8: Radar reflectivity measured by the RASTA Doppler cloud radar (courtesy Julien Delanoë).

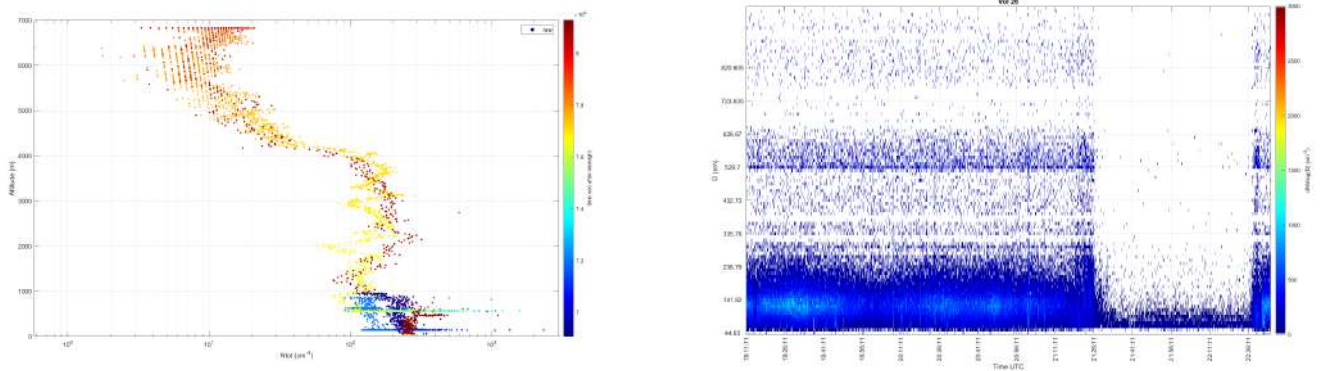


Figure 9: Left: Time-height evolution of the total concentration in aerosols measured by UHSAS during the flight and Right: the associated size distribution. Note the marked SAL. (courtesy Pierre Coutris).

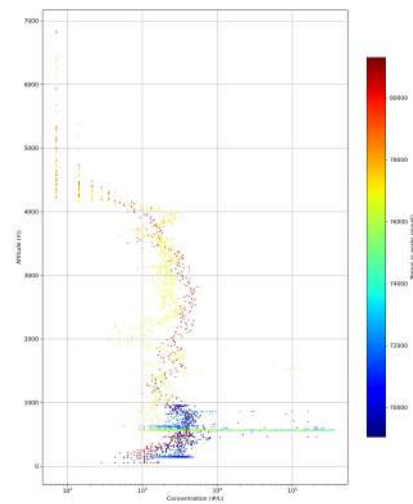


Figure 10: Vertical distribution of particles measured by the FCDP during RF04. (courtesy Antoine Baudoux).

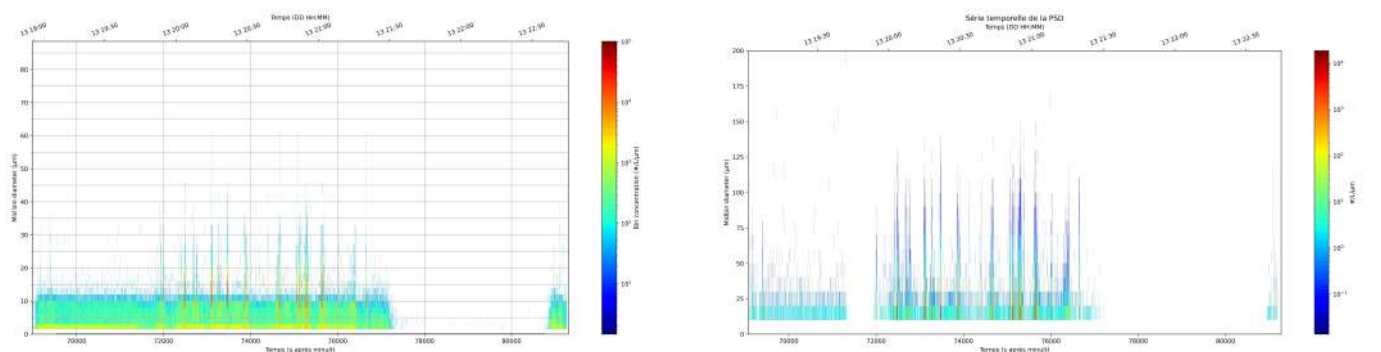


Figure 11: Concentration in particles measured by (left) the FCDP and (right) 2D-S during RF04. (courtesy Antoine Baudoux).

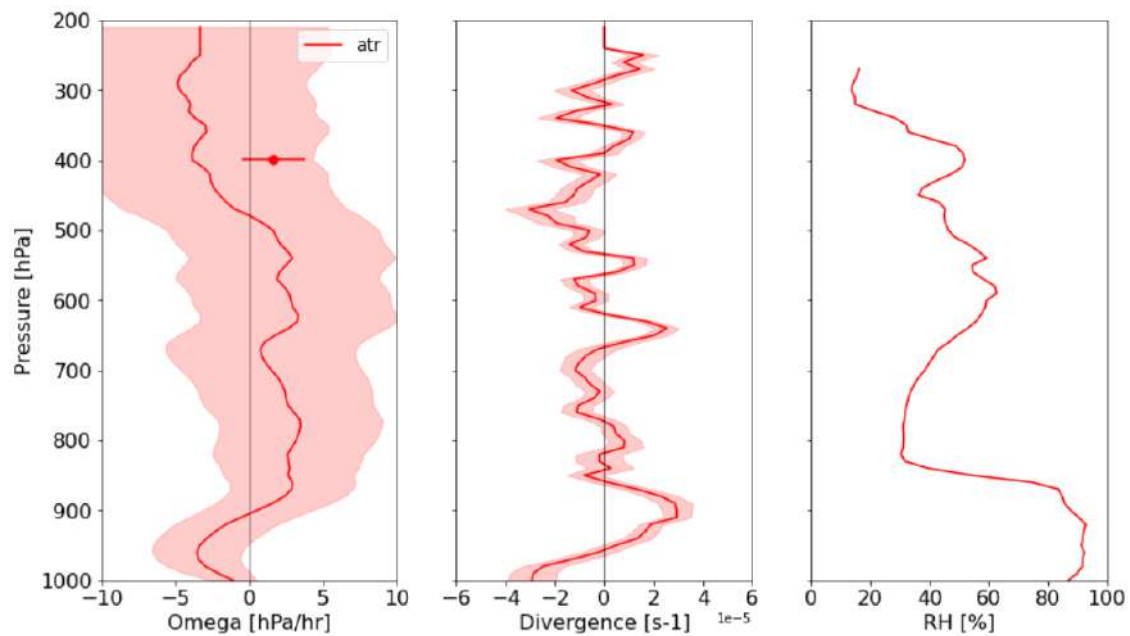


Figure 12: Vertical profiles of mesoscale vertical velocity (with uncertainty), mass divergence and relative humidity derived from the 12 HALO dropsondes dropped by HALO during its 'ATR circle' at the end of the ATR flight. Note the mass convergence and mesoscale ascent in the subcloud layer and the subsidence in the free troposphere. The value of the clear-sky vertical velocity retrieved from MSG during the ATR circle is reported on the omega profile (courtesy Basile Poujol).

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	-
	ray_rg_down_crsensor_1	Downwelling Shortwave radiation clear dome- Attitude correction for pitch/roll $<\pm 3^\circ$	SWDC	OK	reference, ignore artefact at 19:55, night flight
	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 $<\pm 3^\circ$	SWDC_RED	OK	reference, ignore artefact at 19:55, night flight
	ray_rg_up_1	Upwelling Shortwave radiation clear dome (no attitude correction)	SWU	OK	peak at 19:15 due to strong roll (sunset ?)
	ray_pir_up_1	Upwelling shortwave radiation red dome (no attitude correction)	SWU_RED	OK	peak at 19:15 due to strong roll
	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 (8.7 μ m) ce332 radiometer	TB_C1	OK	-
	ray_tb_ce332_c2_1	Brightness temperature channel2 (10.6 μ m) ce332 radiometer	TB_C2	OK	-
	ray_tb_ce332_c3_1	Brightness temperature channel3 (12 μ m) ce332 radiometer	TB_C3	OK	-
	ray_lum_ce332_c1_1	Radiance, channel1 (8.7 μ m) from ce332 radiometer	RAD_C1	OK	-
	ray_lum_ce332_c2_1	Radiance channel2 (10.6 μ m) from ce332 radiometer	RAD_C2	OK	-
	ray_lum_ce332_c3_1	Radiance channel3 (12 μ m) 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, ignore artefact at 19:55, night flight
	vit_v_tas_adc_1	True Air Speed	TAS2	OK	-

DATA	SAFIRE_name	DESCRIPTION	PARAMETER	STATUS	COMMENT
	alt_ralt_15.m_1	Height	HEIGHT	OK	limited at 15000ft (5800 m)
	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 0,2 m/s offset
	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	better in low level, oscillations on high level
	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	a bit slow
	hum_humr_1011_rs_1	Water Vapor Mixing ratio from 1011C	MR1	OK	oscillations on high level
	hum_humr_wvs_rs_1	Water Vapor Mixing ratio WVS-SII	MR2	OK	reference, but a little bit slow on low level
	hum_humr_srted_aero_1	Water Vapor Mixing ratio from humaero enviscope	MR3	OK	a bit slow
	hum_huabs_rt_1011_1	Abolute Humidity from 1011C	HABS1	OK	oscillations on high level, better in low level
	hum_huabs_wvs_rs_1	Abolute Humidity from WVSSII	HABS2	OK	slower in low level
	hum_huabs_srted_aero_1	Abolute Humidity from enviscope	HABS3	OK	a bit slow
	hum_hurel_rt_1011_rs_1	Relative Humidity from 1011C	RH1	OK	oscillations on high level, better in low level
	hum_hurel_wvs_rs_1	Relative Humidity from WVSSII	RH2	OK	slower in low level
	hum_hurel_stat_rt_aero_1	Relative Humidity from enviscope	RH3	OK	a bit slow
	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	-

DATA	SAFIRE_name	DESCRIPTION	PARAMETER	STATUS	COMMENT
FW	hum_humolfra_fw_crh_100	Mole fraction of water vapour in air measured by FastWave	FW_MOLFRA	NOK	investigating
	hum_humr_fw_100	Water Vapor Mixing ratio from FastWave	MR6	NOK	investigating
	pre_pb_fw_100	Air Pressure measured by FastWave	FW_P	NOK	investigating
	tpr_tt_fw_100	Temperature measured by FastWave	FW_T	NOK	investigating
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 pressure	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	miss value on high level
	mic_somcount_SPP300_1	SPP300 total particles count	SPP300_TCOUNT	OK	miss value on high level
	mic_tabconc_SPP300_1	SPP300 particles concentration bin[1]...bin[30]	SPP300_CONC	OK	miss value on high level
	mic_totalconc_SPP300_1	SPP300 Total particles concentration	SPP300_TCONC	OK	miss value on high level
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	RAS
	BASTA	Cloud radar (sidewards)	Z, V, Doppler spectrum	OK	RAS
	LNG	Lidar (Up or Down)	Backscatter(355nm/532/1064) HSRand Doppler 355nm	NOK	RAS. Some stability issues of the IHM sometimes but acquisition ok
	aWALI	Raman Lidar (sidewards)	Backscatter and inelastic(RH/Temp)	PB	RAS. Only a few hickups at cloud base sometimes
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	