# Flight report

Research Flight RF17

ATR-2024-0830

SAFIRE flight as24039

Sal (SID-SID), 19:00 - 22:30 UTC

PI: **Sandrine Bony**

30 August 2024

## 1 Objectives

- MAESTRO-type of flight
- Sampling of a convergence line and 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 | Michel Cluzeau | SAFIRE |
| SCIENTISTS | | |
| PI seat | Sandrine Bony | LMD |
| LNG seat | Emmeline François | LATMOS |
| aWALI seat | Laurent Forges | LSCE |
| Microphys seat 1 | Pierre Coutris | LAMP |
| Microphys seat 2 | Guy Fevre | LAMP |
| RASTA seat | Christophe Le Gac | LATMOS |
| BASTA seat | Nicolas Rochetin | LMD |

# 4 Synoptic situation

- A convergence line (oriented SW - NE) was present over the region. It was associated with deep convection earlier in the afternoon, but convection weakened and the line disagregated at the end of the afternoon. Cloud tops did not exceed 2-2.5 km along the ATR transect.
- This convergence line was associated with the passage of a weak Easterly African Wave (EAW).
- In Sal radiosoundings, an inversion was present at the top of the mixed layer (Figure 5). The precipitable water was around 47 mm.

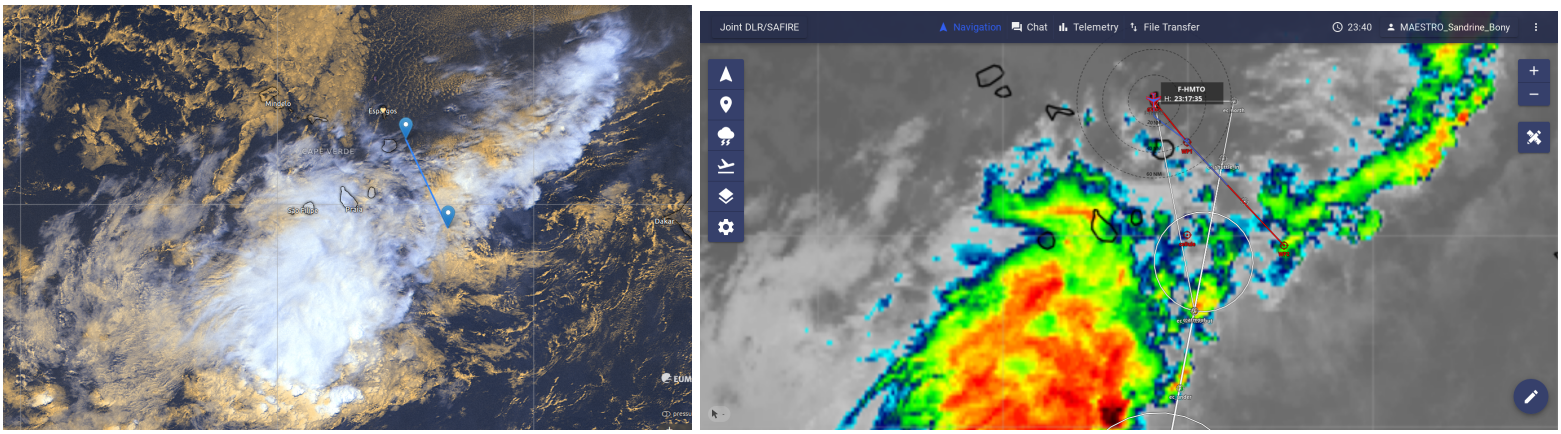


Figure 1: Left: MSG imagery at 18:30 UTC. Right: MSG IR from Planet at the end of the flight (23:30 UTC). Botton: MSG WV channel at 20:00 UTC.

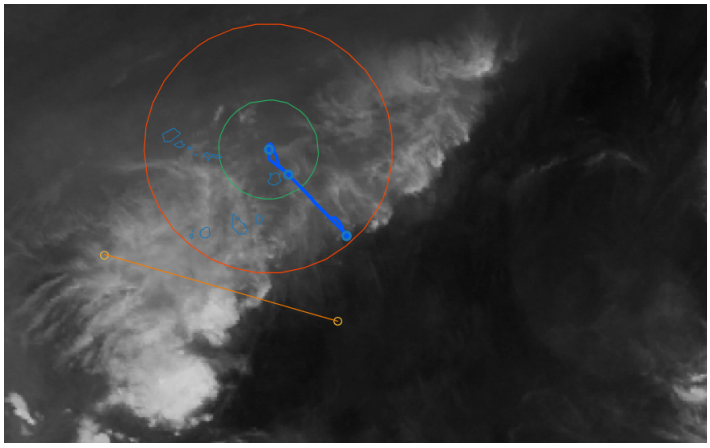

Figure 2: MSG WV channel at 20:00 UTC.

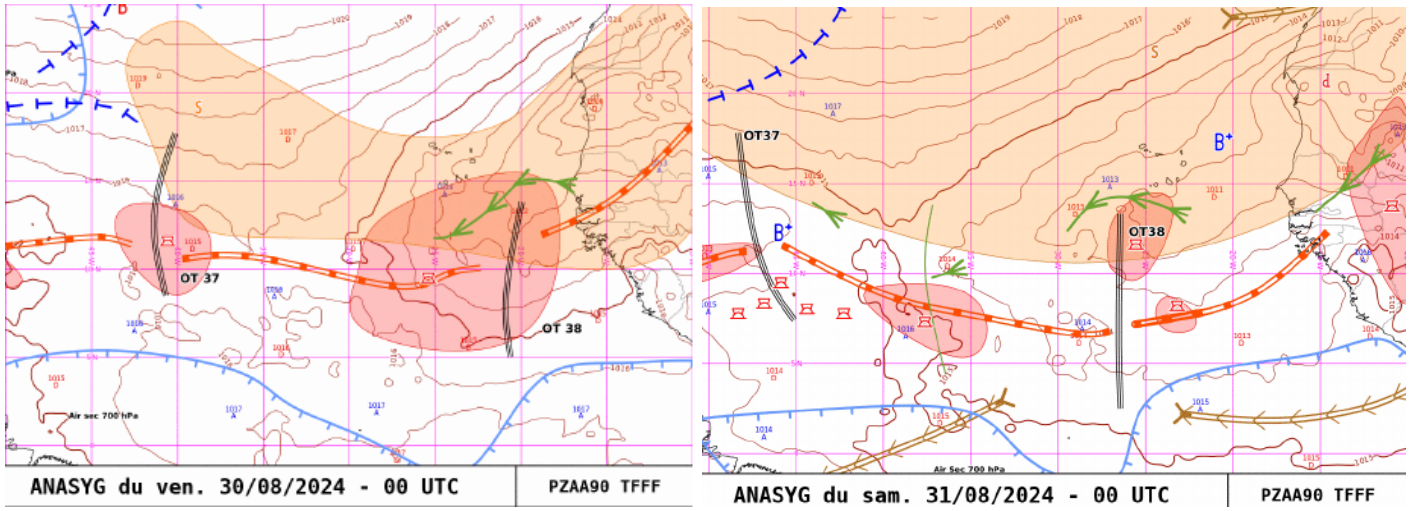


Figure 3: Anasyg for Aug 30 OO Z (left) and Aug 31 00 Z (right) showing the passage of the AEW through South of Cape Verde on Aug 30. Note also the presence of the Saharian Aerosol Layer.

# 5 Flight elements

- WP1 (N): 16.2$^o$N; 22.5$^o$W
- WP2 (S): 14.86$^o$N; 21.2$^o$W
- The take-off for this flight was initially planned for 1900 UTC but turned out to be delayed by almost an hour because of a failure of the VHF. The VHF1 was exchanged with VHF2 and during the flight the VHF3 turned out to also work! Unfortunately, the delay was detrimental to the flight because the convection weakened considerably between 19 and 20 UTC.
- The subcloud leg started at 800 ft (during daytime) and ended up at 1000 ft after sunset.

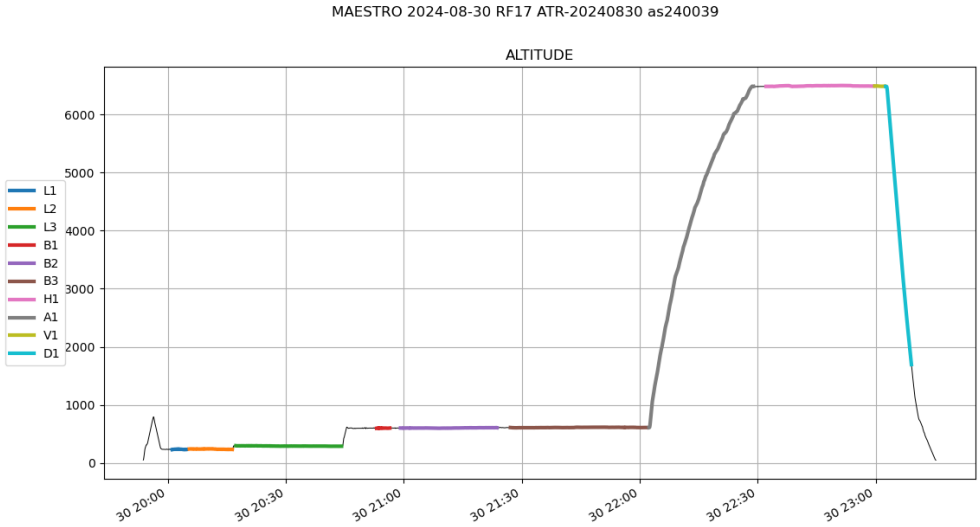


Figure 4: Flight segmentation of the ATR-20240830 flight (also named RF17 or as24039). This segmentation is reported in the yaml file named $ATR_a s240039.yaml$ (the times of individual segments are not repeated in the table below). Courtesy Jean-Louis Dufresne.

| RF15 elements | Time (UTC) | Flight Level (FL) | Position | Notes |
|---|---|---|---|---|
| Takeoff | 19:53 | | GVAC | |
| L1+L2 | 20:01 – 20:16 | 800 ft | WP1 (N) → sunset | Subcloud (about 240 m) |
| L3 | 20:17 – 20:44 | 1000 ft | sunset → WP2 (S) | Subcloud (about 300m) |
| B1+B2 | 20:53 – 21:23 | 600 m | WP2 (S) → WP1 (N) | Cloud base |
| B3 | 21:27 – 22:02 | 610 m | WP1 (N) → WP2 (S) | Cloud base |
| A1 | 22:02 – 22:29 | ascent to FL200 | WP2 (S) | |
| H1 | 22:32 – 22:59 | FL200 | WP2 (S) → WP1 (N) | Mid-troposphere (6.5 km) |
| V1 | 22:59 – 23:02 | FL200 (6.5 km) | WP1 (N) | VAD (roll: 26 deg) |
| D1 | 23:02 – 23:09 | descent | WP1 (N) | |
| Landing | 23:15 | | GVAC | |

# 6 Quicklooks and Comments

- During the leg at 800 ft, we observed many shallow cumuli with a cloud base around 600 m (fed by thermals visible on LNG backscatter signal) and cloud tops around 1 km. Some of them were producing drizzle. Another stratiform layer of cloudiness was present around 1.5 km, that was precipitating (rain drops of 200-300 $\mu$m were observed).
- As we approached the convergence line, we felt turbulence in the aircraft, cumuli became deeper (tops exceeding 2 km) and strongly precipitating (rain drops of 1 mm were measured), and the surface wind speed dropped.
- When flying at cloud base, large cloud base widths were measured (several km), both by BASTA and AWALI. Overall, AWALI detected many small cumuli along this transect while RASTA and LNG were still observing a stratiform layer of cloudiness around 1.5 km.
- At the end of the flight, the convective clouds on top of the convergence line were decaying (cloud tops below 2 km).
- An atmospheric layer rich in aerosols was present around 1.5 km

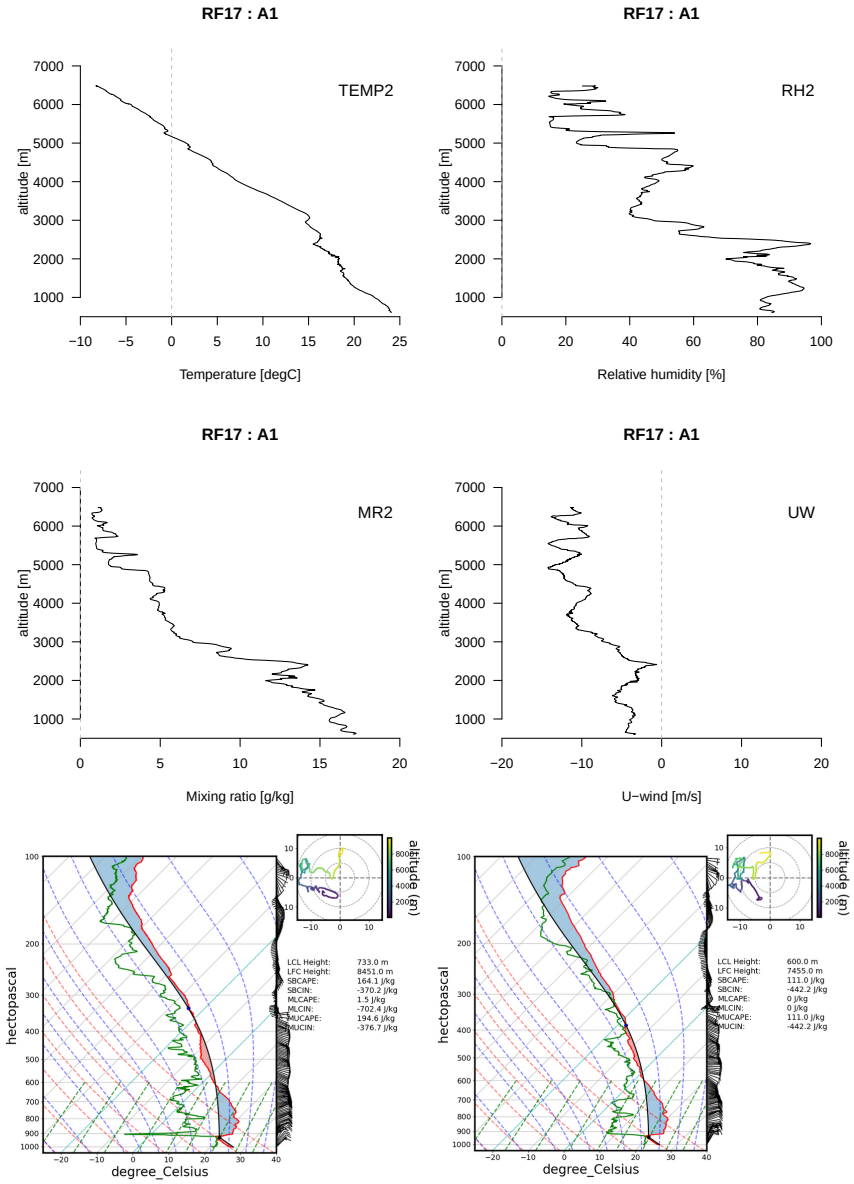


Figure 5: Top: Vertical profiles of temperature, humidity mixing ratio, relative humidity and zonal wind measured by in-situ sensors during the ascent of the ATR from cloud base to FL220. Bottom: Sal radiosoundings at 1800 and 2100 UTC.

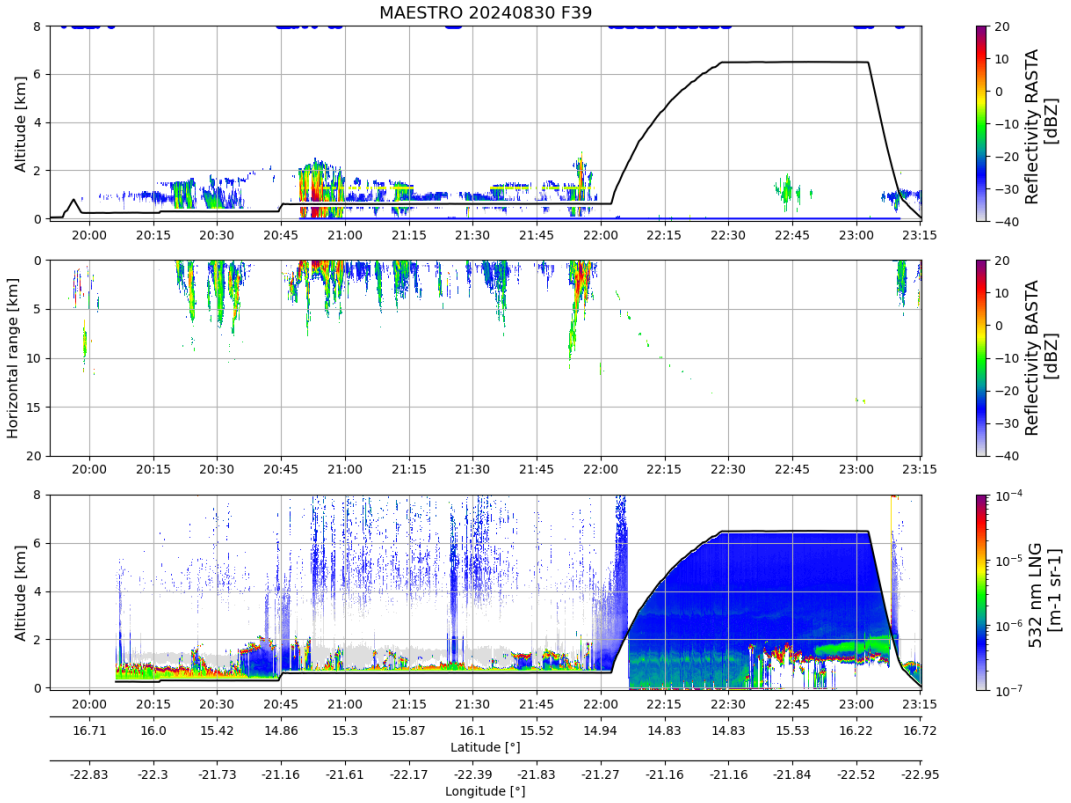


Figure 6: Measurements from the (top) vertically-pointing Doppler cloud radar RASTA (middle) horizontally-pointing Doppler cloud radar BASTA and (bottom) vertically-pointing Doppler lidar LNG (courtesy Julien Delanoë, Emmeline François and Sophie Bounissou).

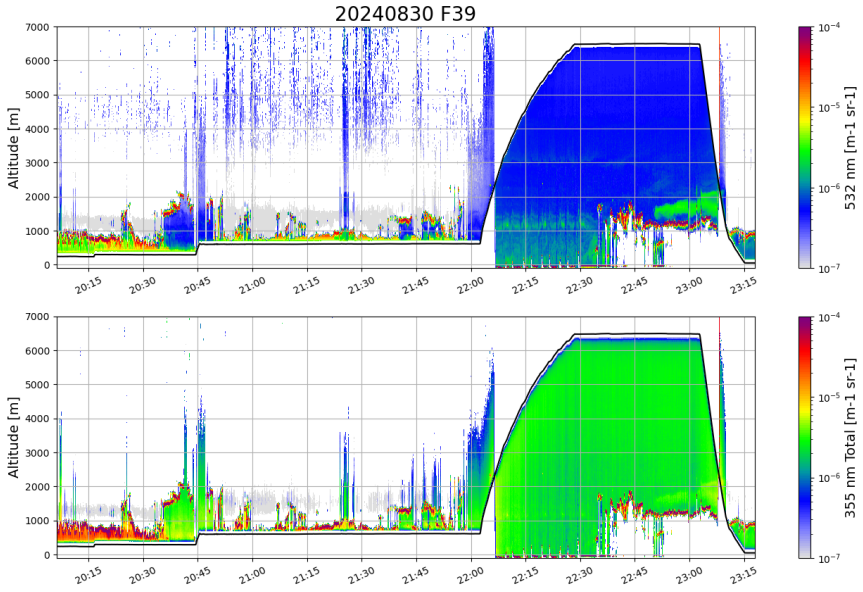


Figure 7: Backscatter signal measured at 355 and 532 nm by the vertically-pointing- HSRL Doppler lidar LNG (courtesy Emmeline François, Sophie Bounissou and Julien Delanoë).

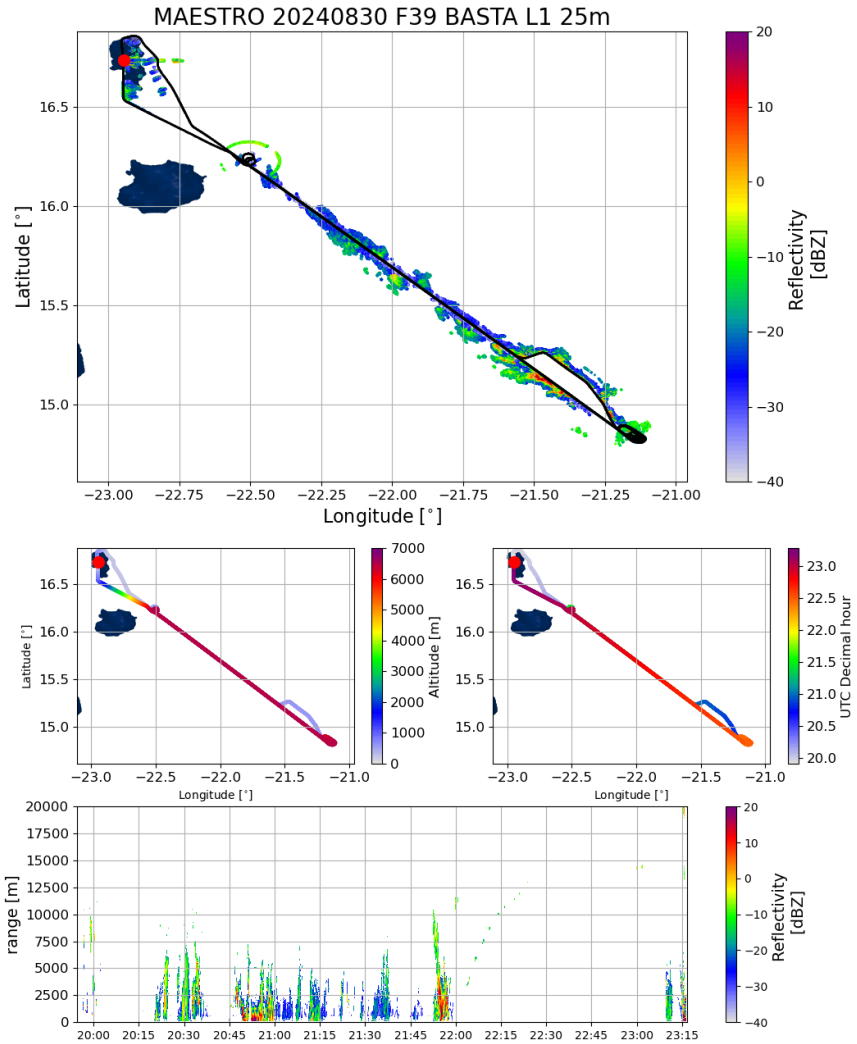


Figure 8: Radar reflectivity measured by the horizontally-pointing BASTA Doppler cloud radar (courtesy Julien Delanoë).

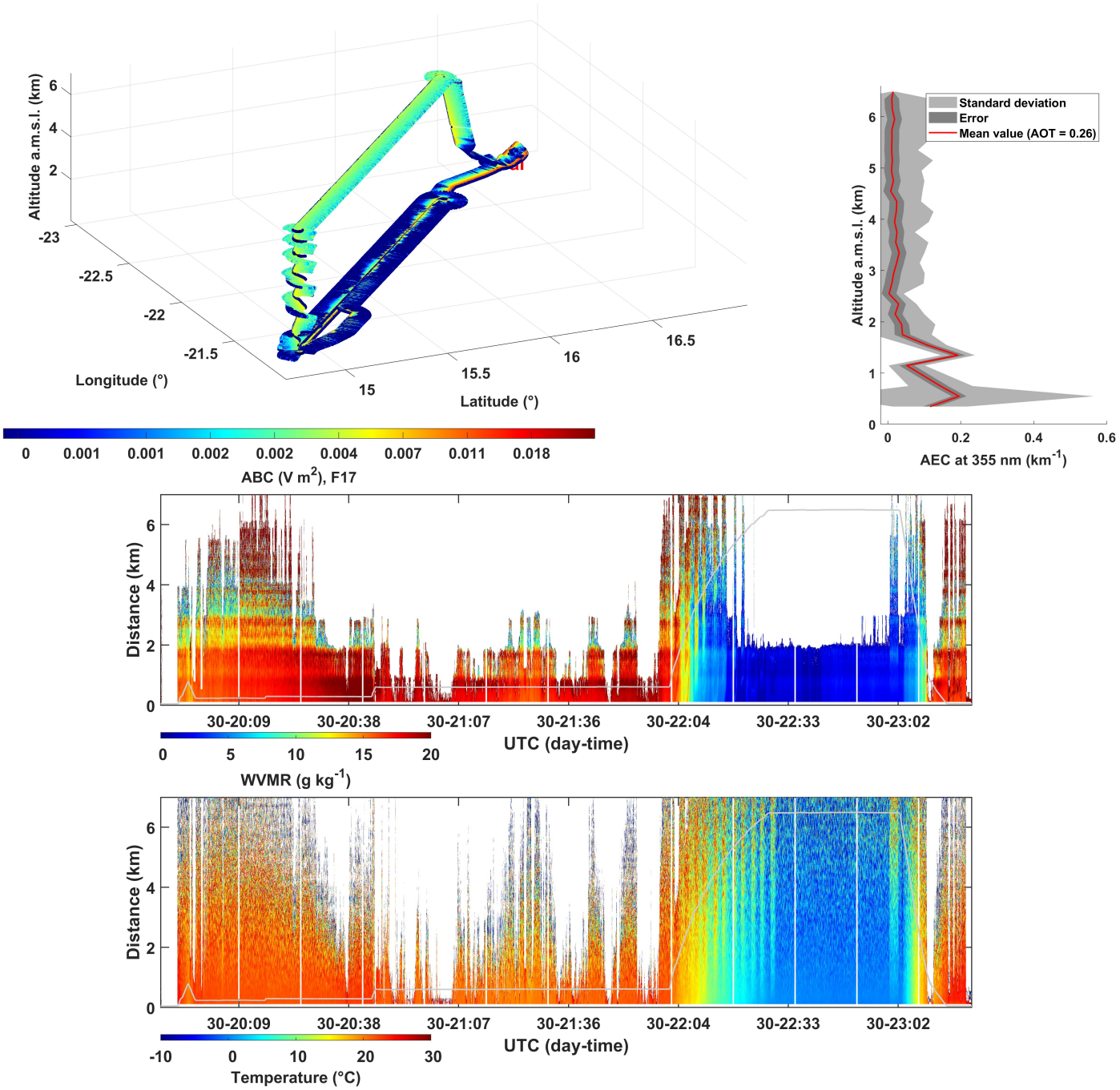


Figure 9: (Top left) Evolution of lidar backscatter ratio in the aerosol/cloud channel; (Top right) Vertical profile of the aerosol extinction, and (Bottom) 2D variation of the elastic backscatter signal, and the water vapor mixing ratio (stripes will be removed after processing) and temperature measured by the horizontally-pointing Raman lidar AWALI during RF11. (courtesy Valentin Guillet and Laurent Forges).

# 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, 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 (8.7$\mu$m) ce332 radiometer | TB_C1 | OK | - |
| | ray_tb_ce332_c2_1 | Brightness temperature channel2 (10.6$\mu$m) ce332 radiometer | TB_C2 | OK | - |
| | ray_tb_ce332_c3_1 | Brightness temperature channel3 (12$\mu$m) ce332 radiometer | TB_C3 | OK | - |
| | ray_lum_ce332_c1_1 | Radiance, channel1 (8.7$\mu$m) from ce332 radiometer | RAD_C1 | OK | - |
| | ray_lum_ce332_c2_1 | Radiance channel2 (10.6$\mu$m) from ce332 radiometer | RAD_C2 | OK | - |
| | ray_lum_ce332_c3_1 | Radiance channel3 (12$\mu$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 |
| | vit_v_tas_adc_1 | True Air Speed | TAS2 | OK | Noisy |
| | alt_ralt_15_m_1 | Height | HEIGHT | OK | - |

| DATA | SAFIRE_name | DESCRIPTION | PARAMETER | STATUS | COMMENT |
|---|---|---|---|---|---|
| | 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 |
| | 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 | Oscillations |
| | hum_hutd_wvs_rs_1 | Dew Point Temperature from WVSSII | DP2 | OK | - |
| | hum_hutd_rtd_aero_1 | Dew Point Temperature from humaero enviscope | DP3 | OK | Reference |
| | 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 | Reference |
| | 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 | Reference |
| | 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 | 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 | 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 |
| | pre_pb_fw_100 | Air Pressure measured by FastWave | FW_P | PB | Datation issues => will be solved quickly |
| | tpr_tt_fw_100 | Temperature measured by FastWave | FW_T | PB | Datation issues => will be solved quickly |

| DATA | SAFIRE_name | DESCRIPTION | PARAMETER | STATUS | COMMENT |
|---|---|---|---|---|---|
| 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 | At a range of 600m, some artifact (repliement) due to ground echo |
| | BASTA | Cloud radar (sidewards) | Z, V, Doppler spectrum | OK | Echos up to 8-10 km |
| | LNG | Lidar (Up or Down) | Backscatter(355nm/532/1064) – HSRand Doppler 355nm | OK | |
| | aWALI | Raman Lidar (sidewards) | Backscatter and inelastic(RH/Temp) | OK | OK after restart. Telescope to be checked (echo between injection and emission) |
| MICRO | CVI | | TWC | OK | |
| | HSI | | | OK | |
| | 2DS | | Images and Spectrum | OK | A bit too warm at low levels. |
| | HVPS | Hydrometeors imagery | Images | OK | |
| | FCDP | Droplets (2?m - 50?m) | Spectrum | OK | |
| | NP-2 | | | OK | |