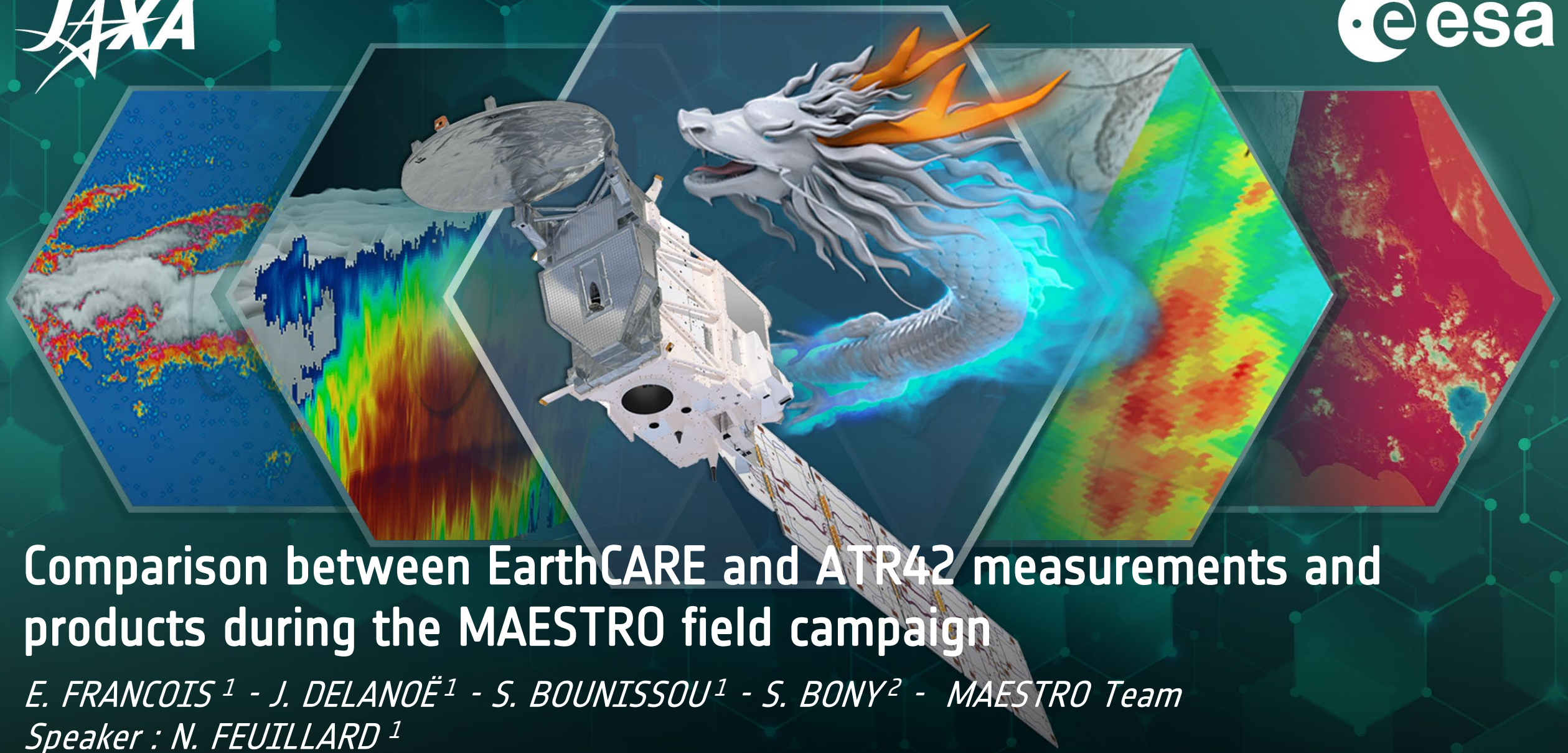


Comparison between EarthCARE and ATR42 measurements and products during the MAESTRO field campaign

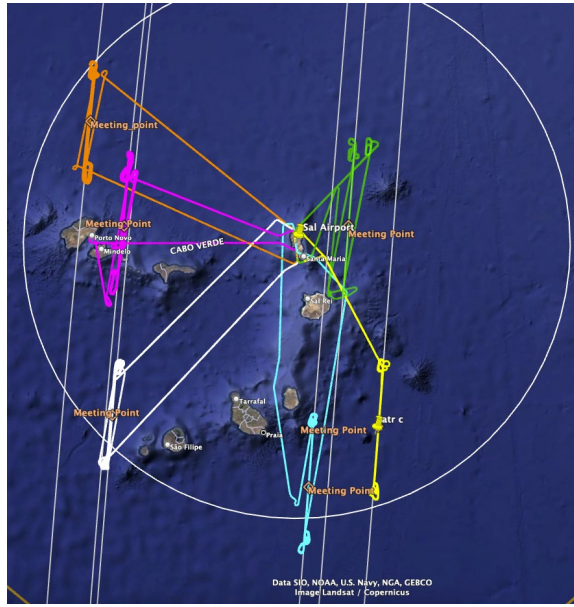
E. FRANCOIS [1] - J. DELANOË [1] - S. BOUNISSOU [1] - S. BONY [2] - MAESTRO Team
Speaker : N. FEUILLARD [1]

1 : LATMOS
2 : IPSL

2nd ESA-JAXA EarthCARE In-Orbit Validation Workshop
17 – 20 March 2025 | ESA-ESRIN | Frascati (Rome), Italy

Introduction

CalVal Flights for MAESTRO



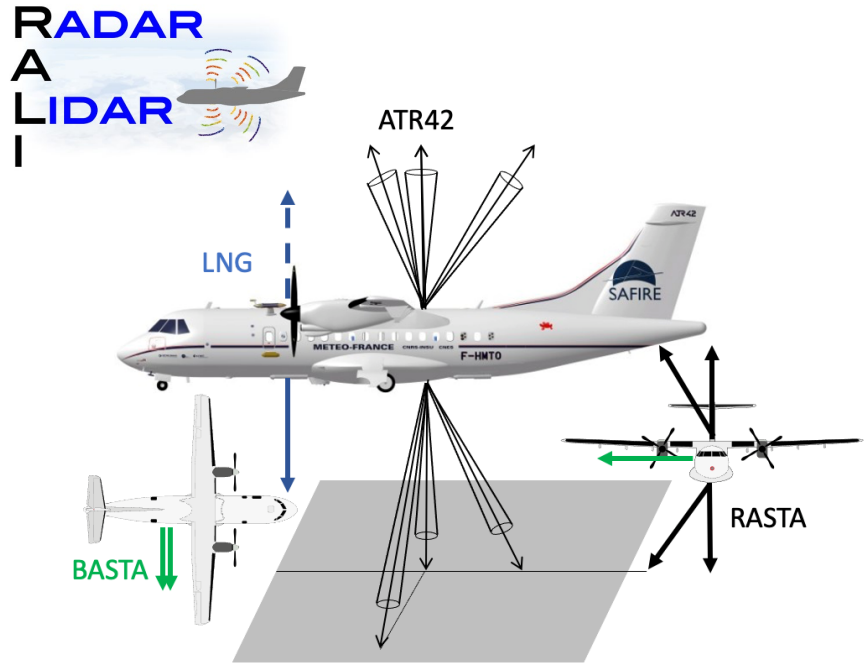
- MAESTRO *Mesoscale Organisation of Tropical Convection,* , PI: Sandrine Bony (LMD)
  - Operations out of Sal (Cape Verde), **10 Aug – 10 Sept 2024** → 86 F/H (24 flights)

- MORECALVAL- POST MAESTRO, PI: J. Delanoë (LATMOS)
  - Operations out of Toulouse (France), **13 March – 4 April 2025** → (about 9 flights expected)
  - CalVal campaign and scientific legs aimed to study clouds organisation at mid-latitudes
  - Same payload as MAESTRO
  - 2 w band cloud radars deployed on the ground (Lannemezan super site and Francazal)

Airborne Payload

- RASTA, looking up and down 6 antennas (Doppler W-band)
- **LNG, HRSL 355nm (backscatter 532&1064), 2 pointing directions**
- BASTAir, sideward looking W-band Doppler radar
- aWALI, sideward looking 355nm raman lidar
- Large in-situ payload

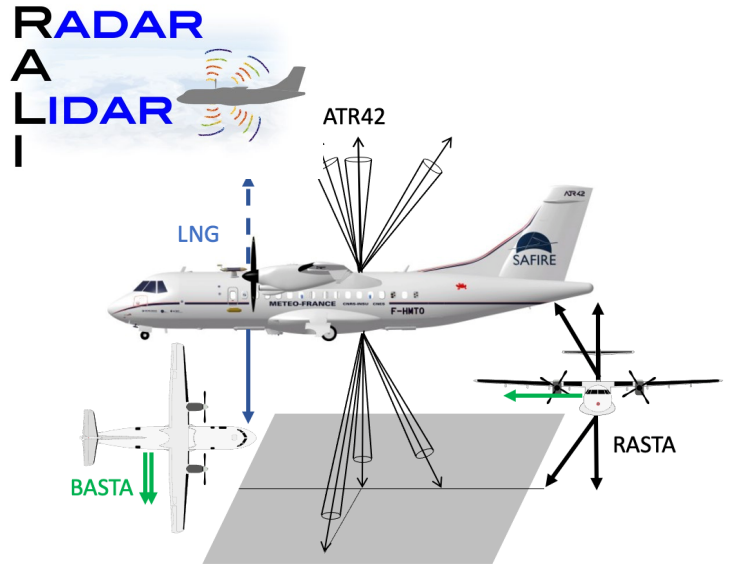
	Instruments \ Objectives	Aerosols	Clouds/precip	Water vapour/ Temp	Wind	Turbulence	Surface
Radar / lidar	LNG				cloud/aerosol		
	RASTA (6 antennas)				cloud/precipitation	cloud/precipitation	
	BASTA				cloud/precipitation	cloud/precipitation	
	aWALI			heterog eneities			
In-situ	FCDP/HVPS/2DS/UHSAS/CVI/NP/FSSP						
	Aircraft's baseline information				clear sky/cloud/aerosol		
Radiometry	CLIMAT						SST
	Pyrano-& pyrgeometers						



Airborne Lidar : LNG

LNG

- RALI platform → radar-lidar synergy (RASTA/BASTA)
- Upward or downward pointing
- 3 wavelengths : 1064 nm, 532 nm, 355 nm
- **High Spectral Resolution at 355 nm**
  - ↳ Mie attenuated backscatter
  - ↳ Rayleigh attenuated backscatter



lidars	ATLID	LNG
Vertical resolution	103 m (from the ground to 20 km)	30 m (native 1.8 m)
Horizontal resolution	282 m	400 m (400 shots integrated)
Frequency	51 Hz	100 Hz

L2 ATLID baseline :

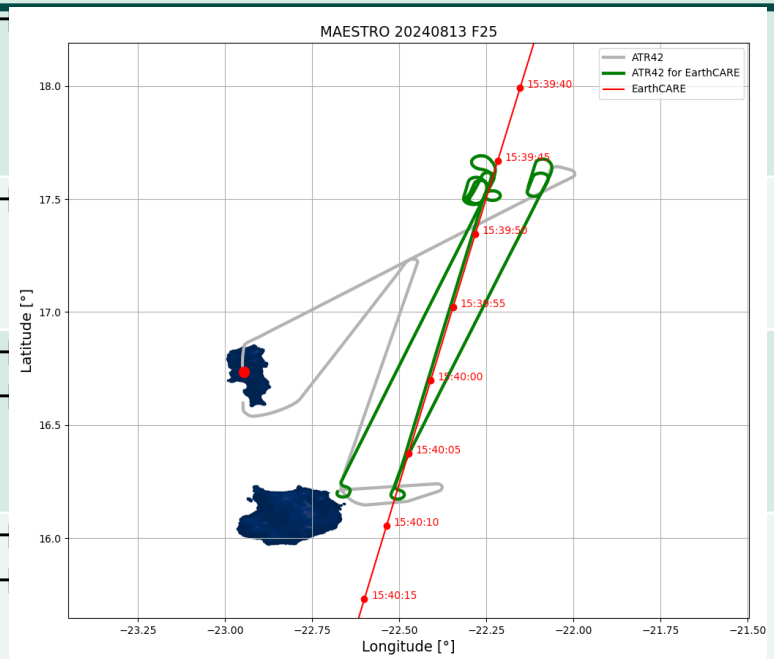
- *ECA_EX**AD**_ATL_EBD_2A*
- *ECA_EX**AD**_ATL_FM_2A*
- *ECA_EX**AD**_ATL_AER_2A*

Reference altitude : Mean Sea Level

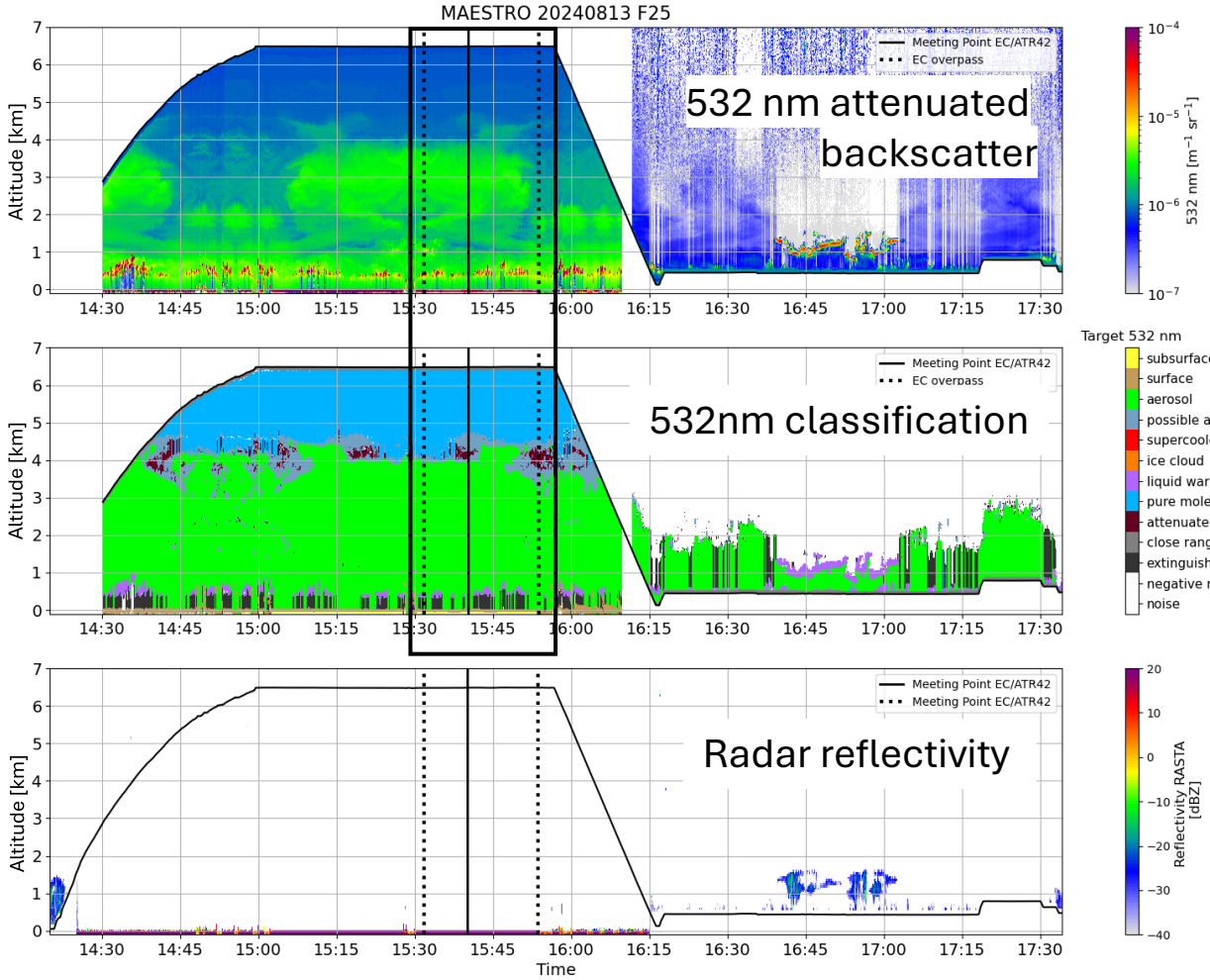
Frame E

Flight summary

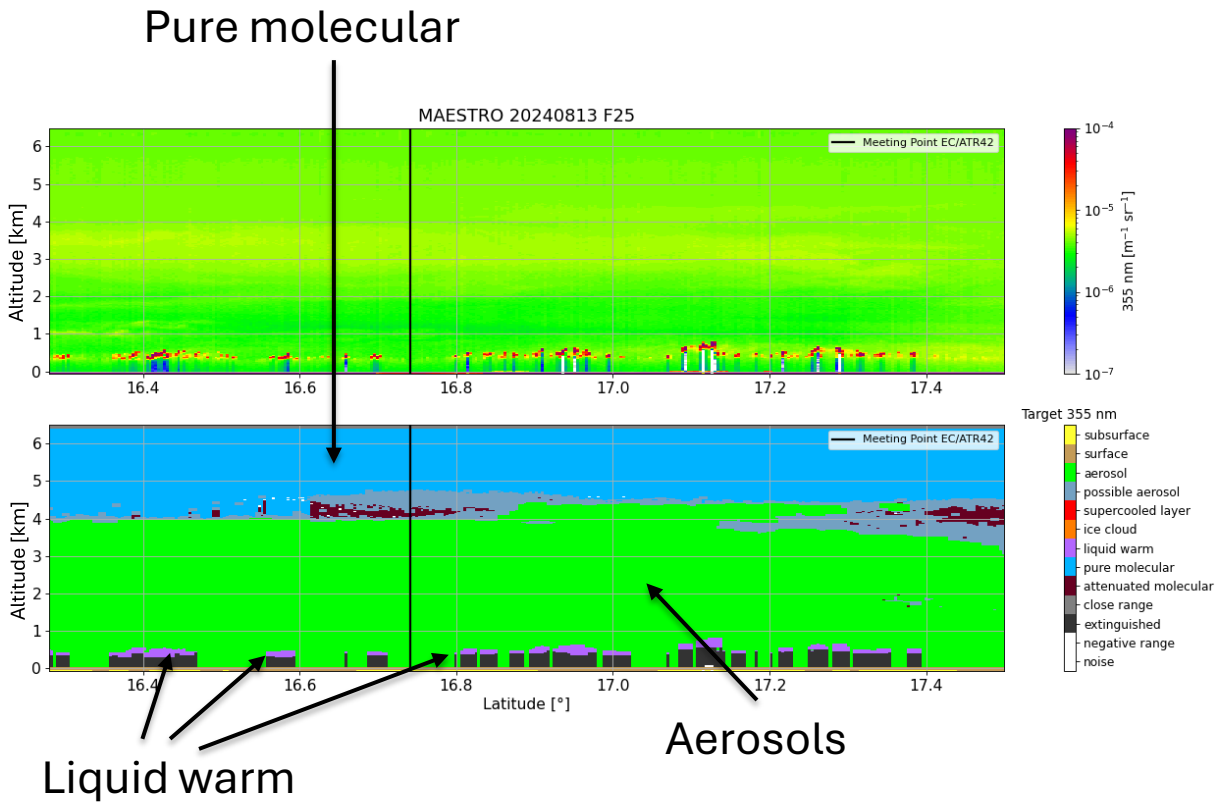
Date	Flight #	Take-off [TO] / Landing [LA]/ Meeting point [MP] times	Legs (convention from MAESTRO)	Comments
20240811	F24	TO 14:33:45.07Z LA 18:13:42.50Z MP 15:49	H1 6466m, time [s]: 54995.0 55718.0 H2 6467m, time [s]: 56379.0 57801.0	• Almost no radar signal (instrument OK) • Issue with LNG-lidar (part of track missing) • In-situ data OK
20240813	F25	TO 14:20:43.95Z LA 17:37:26.19Z MP 15:40	H1 6481m, time [s]: 54246.0 55595.0 H2 6483m, time [s]: 55898.0 57218.0	• Almost no radar signal (instrument OK) • LNG OK, good aerosol layer and tiny liquid clouds • In-situ data OK • Track slightly off due to issue in prediction
20240820	F31	TO 14:03:31.21Z LA 17:33:55.94Z MP 15:50	H	• No radar signal (instrument OK) • LNG OK, good aerosol layer and tiny liquid clouds • In-situ data OK
20240822	F32	TO 13:55:27.23Z LA 17:32:49.48Z MP 15:41	H	• No radar signal (instrument OK) • LNG OK, good aerosol layer and tiny liquid clouds • In-situ data OK
20240829	F38 X	TO 13:52:13.14Z LA 17:40:57.88Z MP 15:49	H H	• No radar signal (instrument OK) • **No LNG due to computer issue** • In-situ data OK
20240831	F40	TO 13:57:37.89Z LA 17:30:33.43Z MP 15:38	H H	• Radar and lidar signals • In-situ data OK



F25 2024/08/13



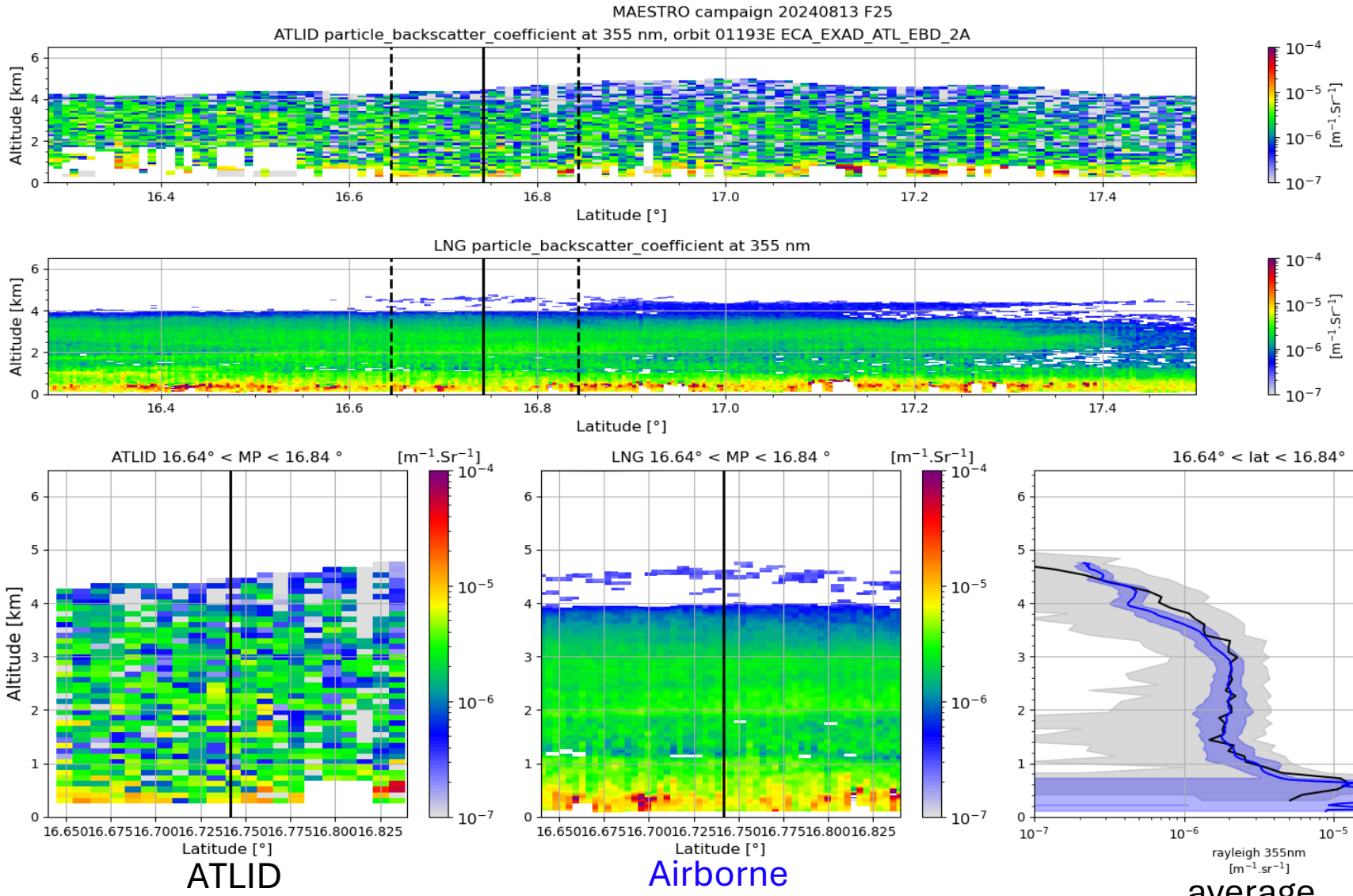
355 nm attenuated backscatter and target classification



F25: Particle backscatter coefficient

ATLID particle backscatter coefficient

LNG 355 nm particle backscatter coefficient



ATLID

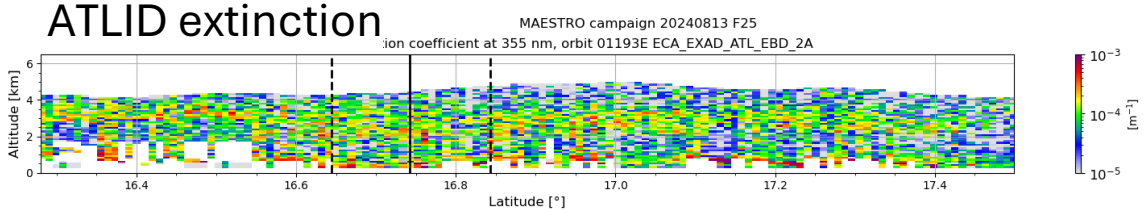
Airborne

average

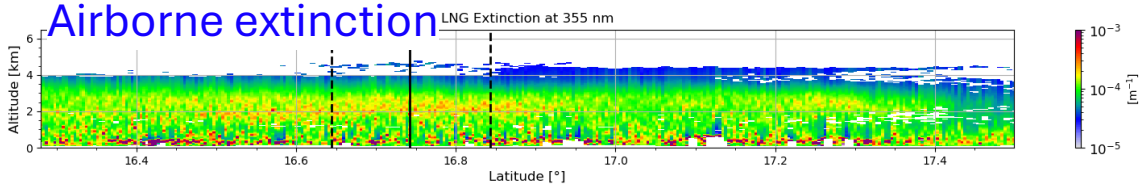
F25: Particle extinction coefficient and lidar ratio

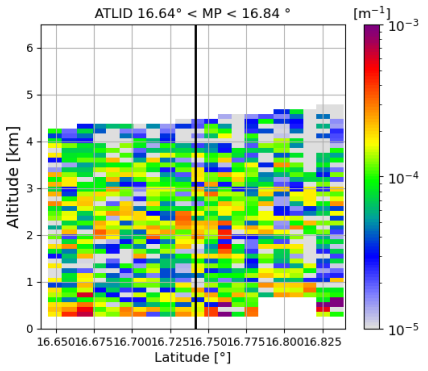
Particle extinction coefficient 355 nm

ATLID extinction

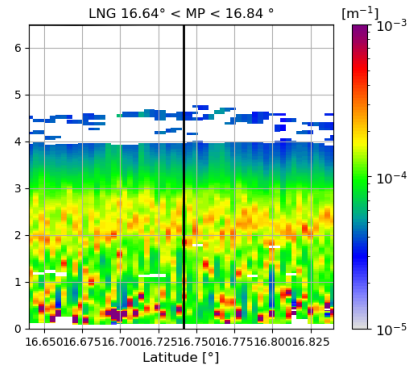


Airborne extinction

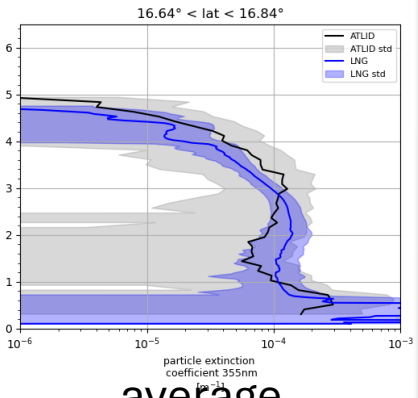




ATLID



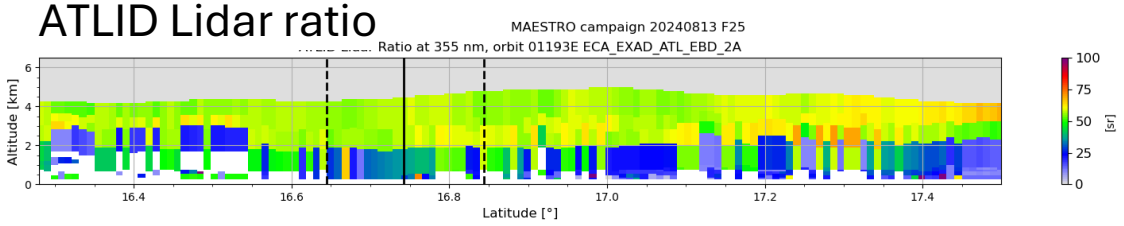
Airborne



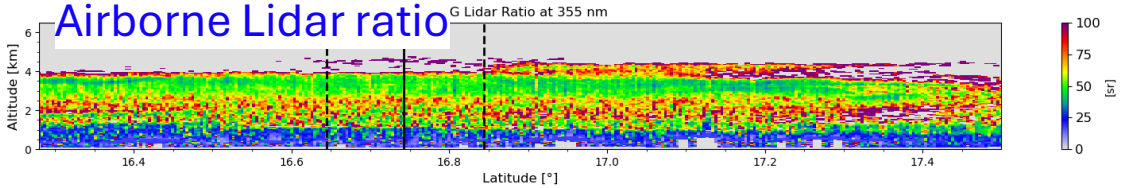
average

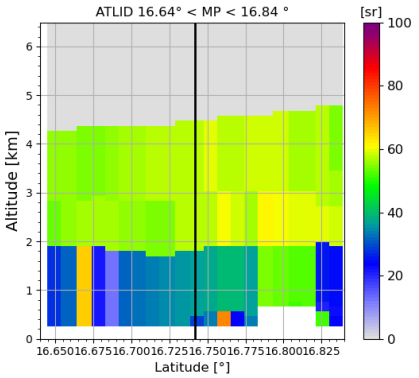
Lidar ratio 355 nm

ATLID Lidar ratio

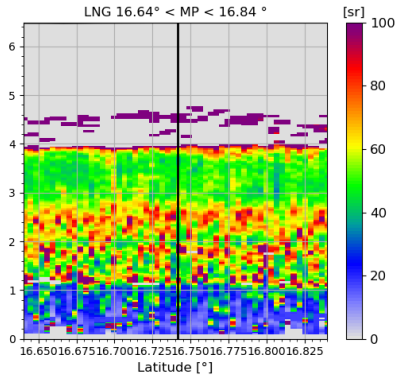


Airborne Lidar ratio

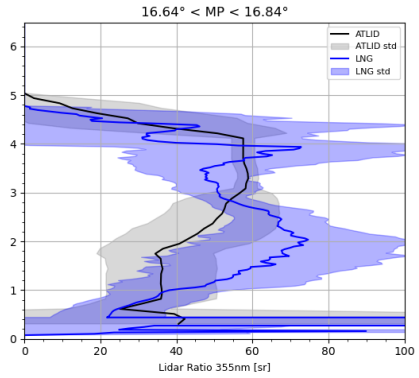




ATLID



Airborne



average

Marine aerosol in Cape Verde : 20.4 +/- 3.4 sr

Sahran Air Layer : 64.8 +/- 10.2 sr

Haarig et al. (2025)

F25: Target classification

LNG 355 nm classification

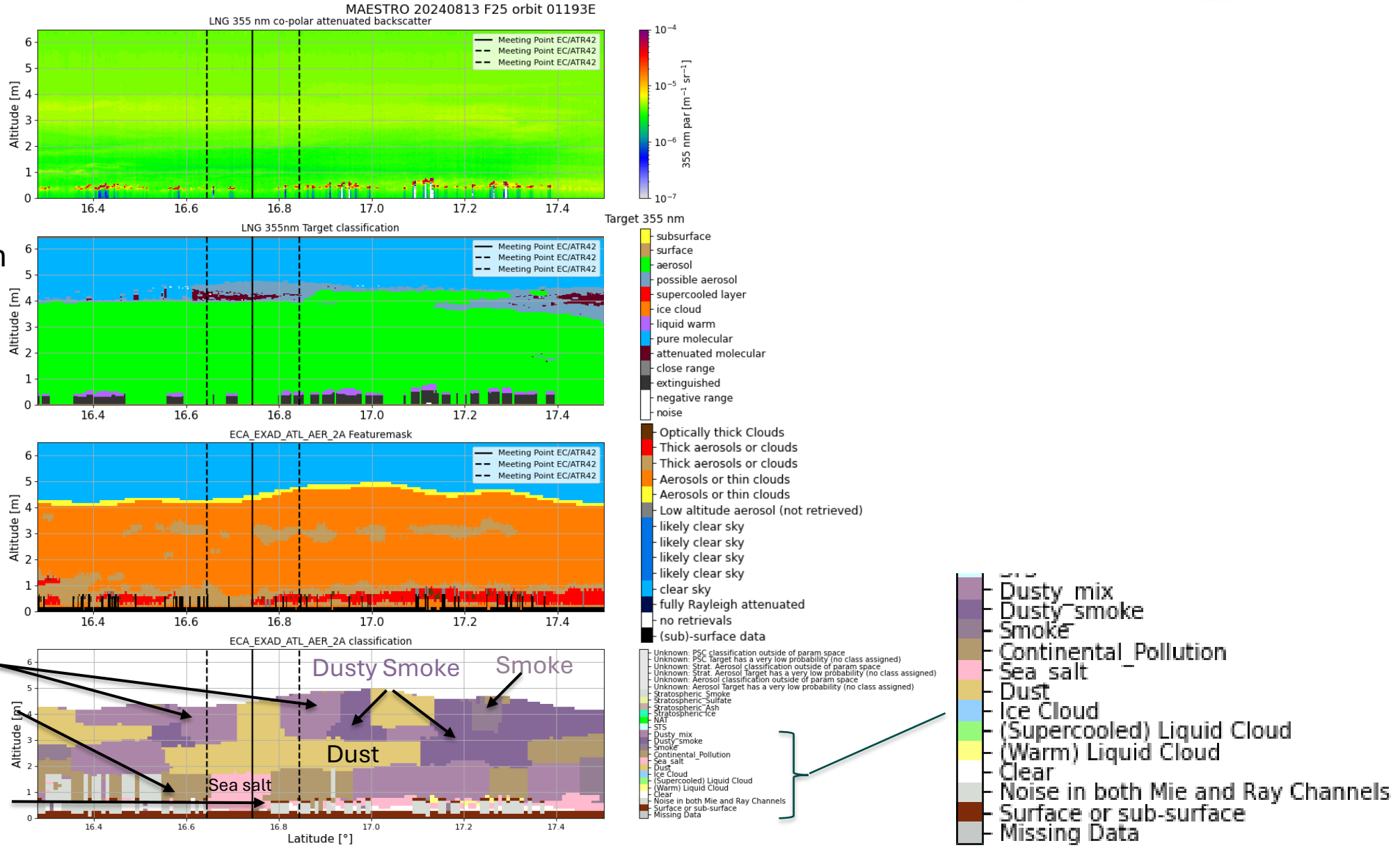
ATLID featuremask

ATLID classification

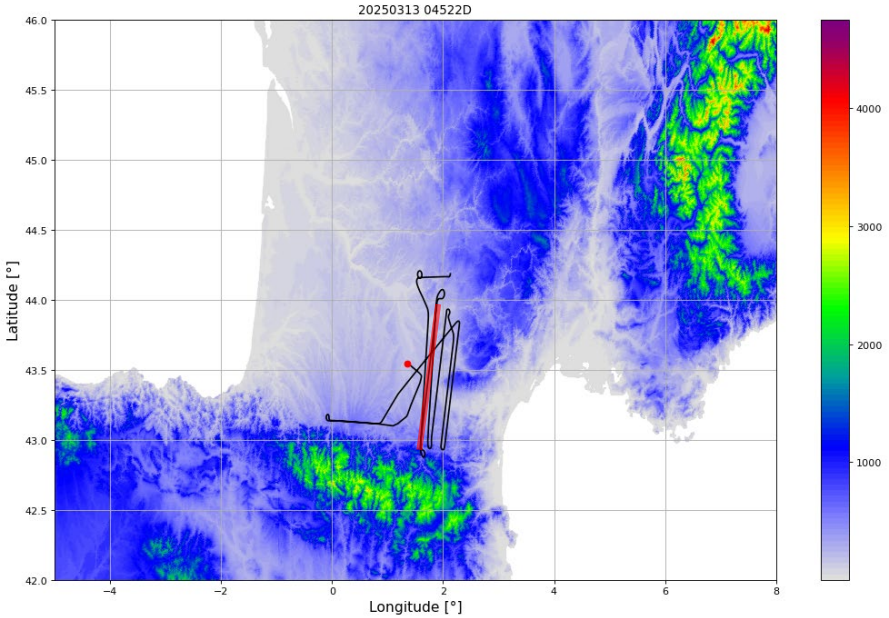
Dusty mix

Continental pollution

Sub-surface and surface in liquid cloud

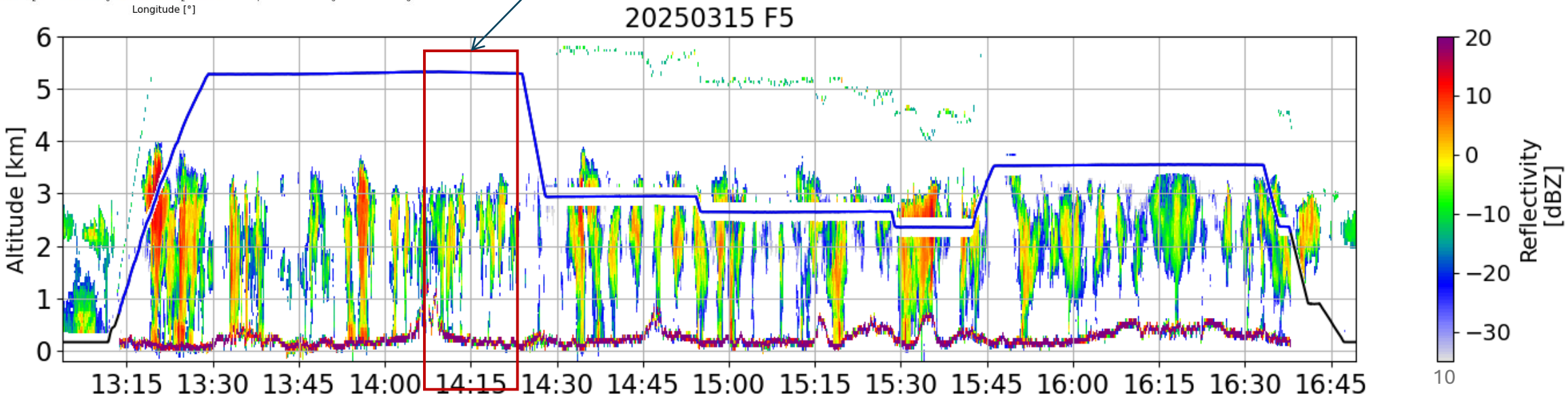


MORECALVAL : 2025/03/15 daytime



Raw data reflectivity from RASTA (airborne radar)

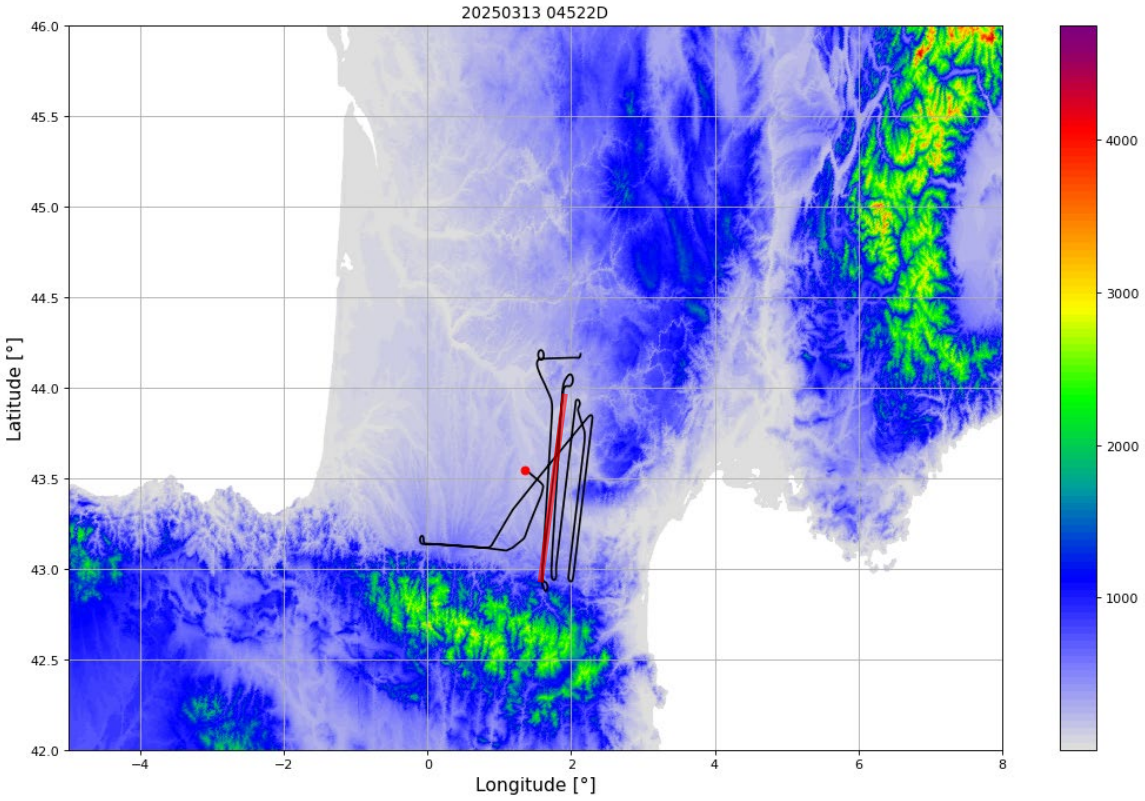
EarthCARE - ATR42 meeting

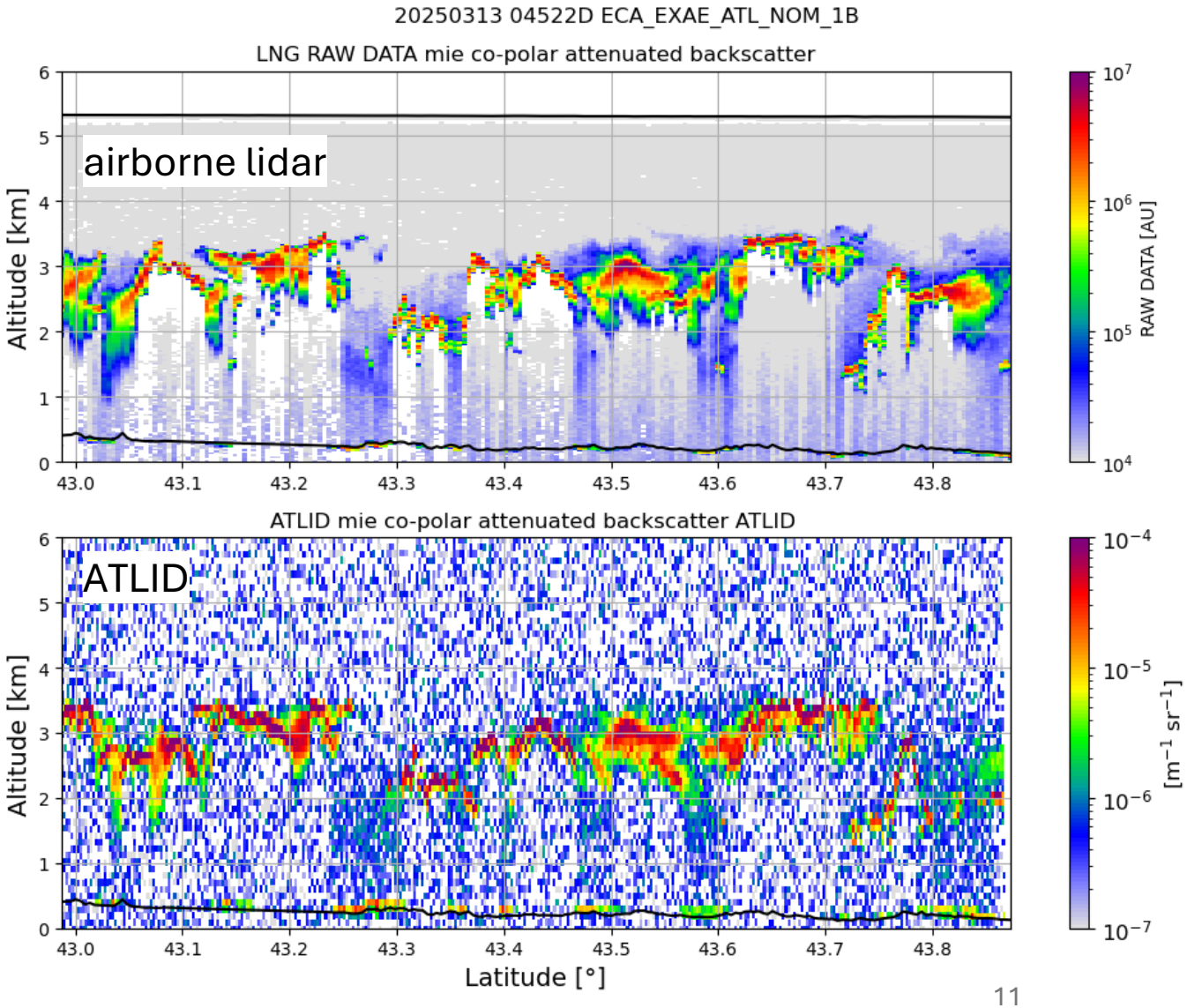


MORECALVAL : 2025/03/15 daytime

Raw data for LNG

EXAE_ATL_NOM_1B for ATLID





Conclusion

- Consistent comparisons (same orders of magnitude) of particle backscatter coefficient, particle extinction and lidar ratio despite the difference of vertical resolution between each instrument.

- Consistency comparisons of classification but there are some discrepancies with the surface or sub-surface classification instead of warm liquid cloud.

MORECALVAL :

- 3 flights already done
- A flight is scheduled tonight with a meeting at 01h10 UTC
- Early data are encouraging for the rest of the campaign