



ESA-JAXA Pre-Launch EarthCARE Science and Validation Workshop

13 – 17 November 2023 | ESA-ESRIN, Frascati (Rome), Italy

PERCUSION (former EC-TOOC)

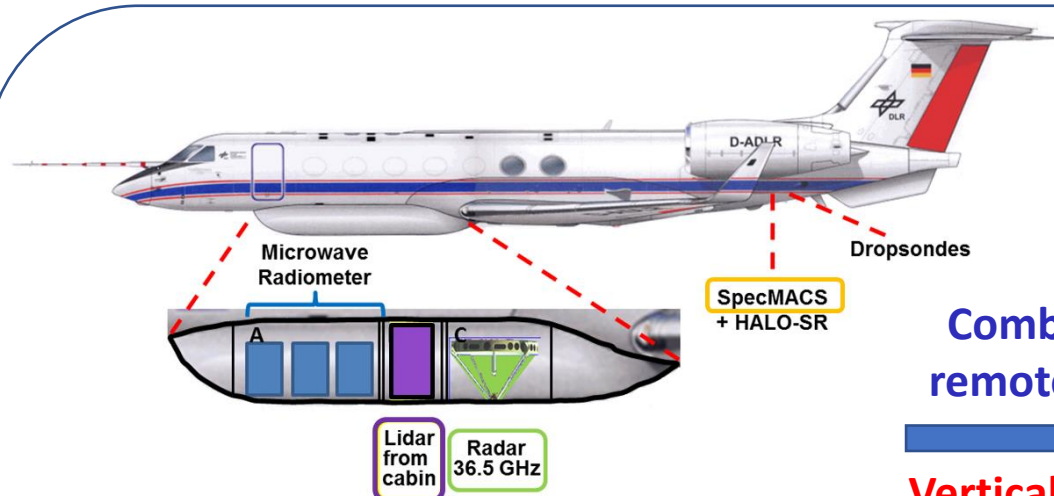
Airborne EarthCARE-like payload for preparation and validation

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Airborne platform: HALO (German)



Combined active and passive remote sensing measurements

Vertical structure and horizontal distribution of aerosols and clouds (+ turbulence and humidity)

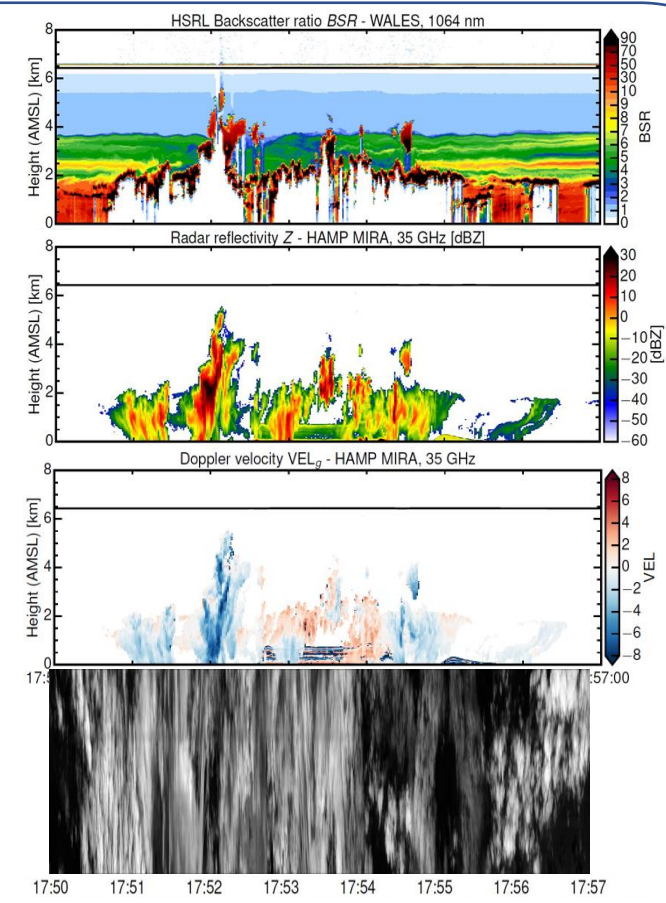
Instrumentation:

HSRL-Lidar (WALES) + WV DIAL

Cloud-Profiling Radar (MIRA35)

Hyper-Spectral Imager (specMACS) / VELOX

Microwave Radiometer (HAMP)





Target classification mask and aerosol typing

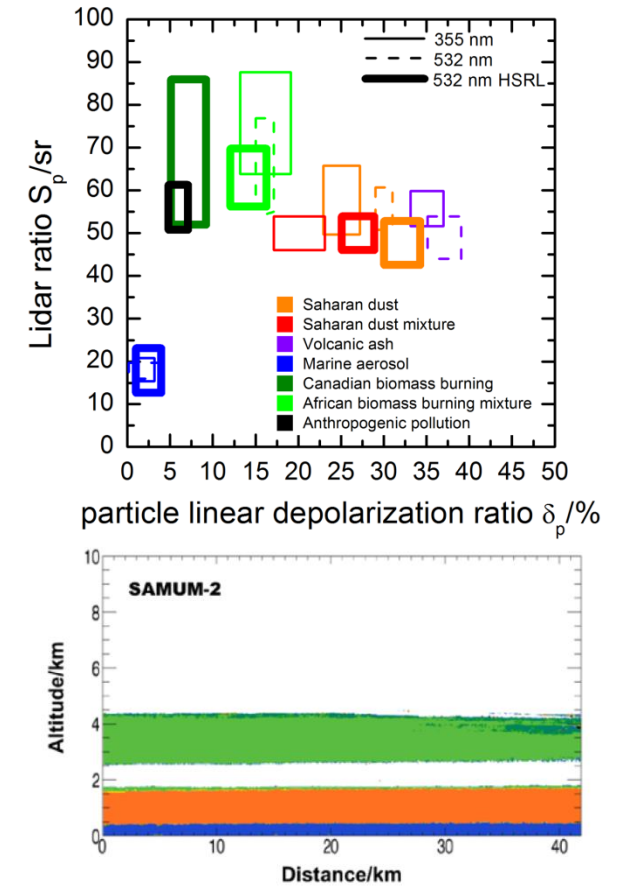
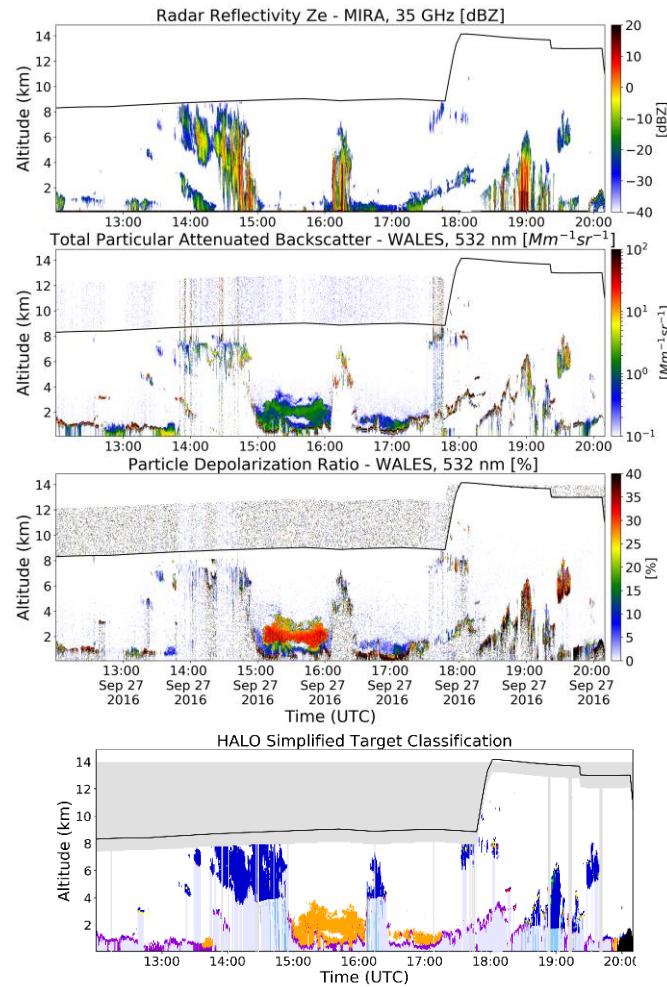
INPUTS

- Radar: Reflectivity
- Lidar: particulate Backscatter, Depolarization & their spatial variances
- Model: Temperature
- Cloudnet* definition of cloud top/bottom
- For $T < 0$ C:
 - Feature horizontal & vertical extend (area size, orientation)
 - Feature vicinity to other targets

OUTPUTS

- 5 categories:
 Clear air, **Totally Attenuated**, **Cloud**, **Aerosol**, Unknown feature

Ceccaldi et al., 2013; Marinou et al., 2019

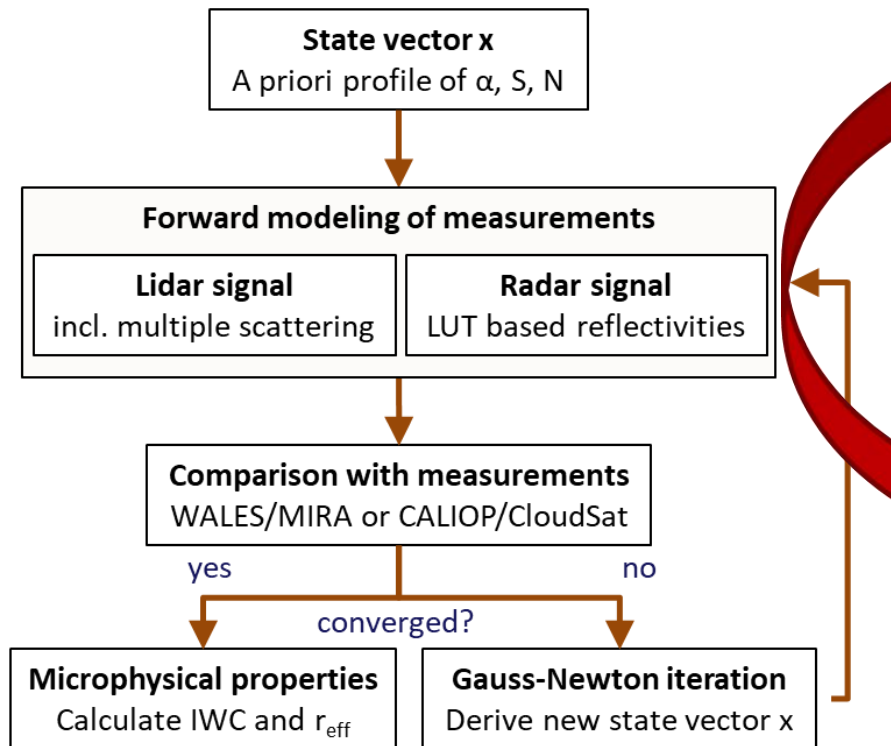


Groß et al., 2013, 2015

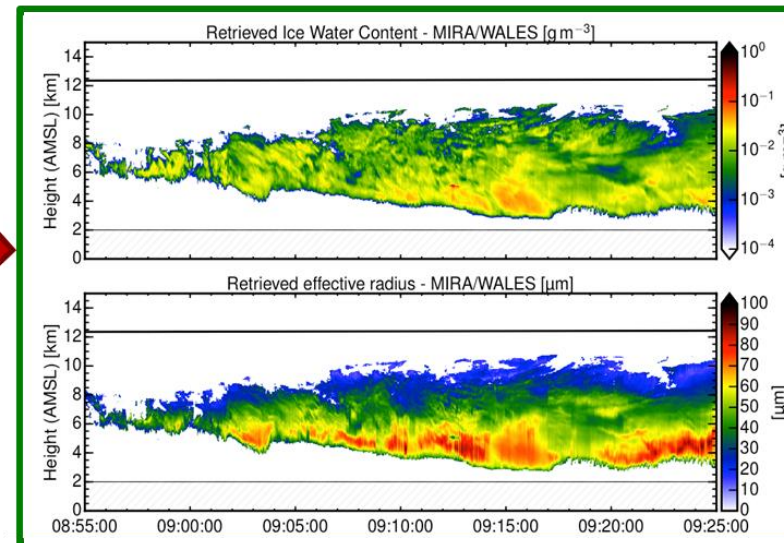
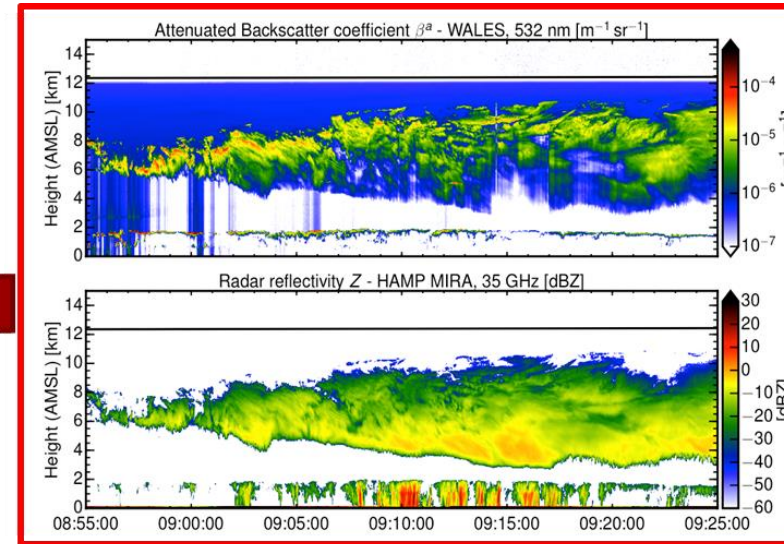


Synergistic retrieval

Optimal estimate approach (Delanoë et al., 2008)



Cazenave et al., 2019; Aubry et al., in preparation



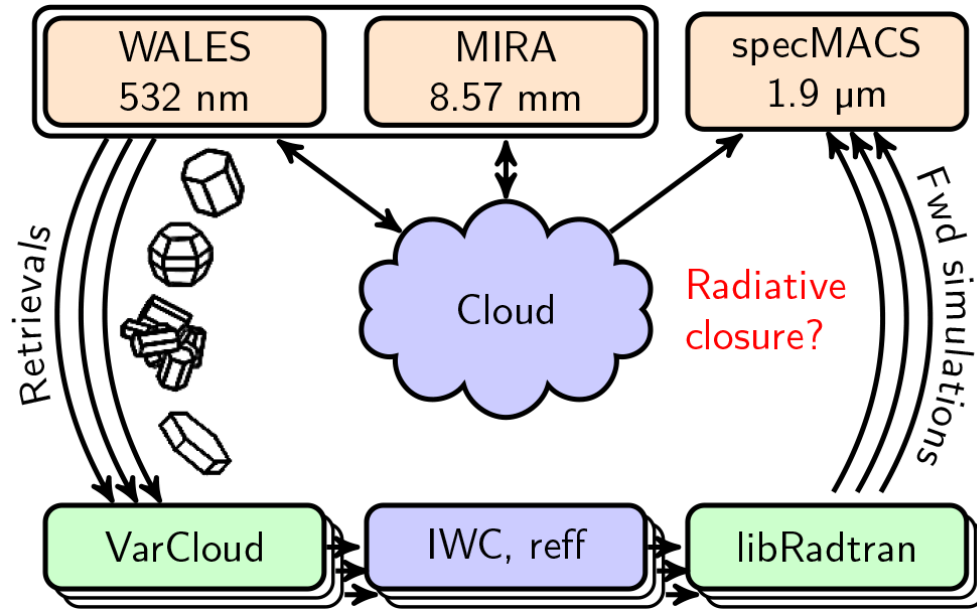
Ewald et al., 2021



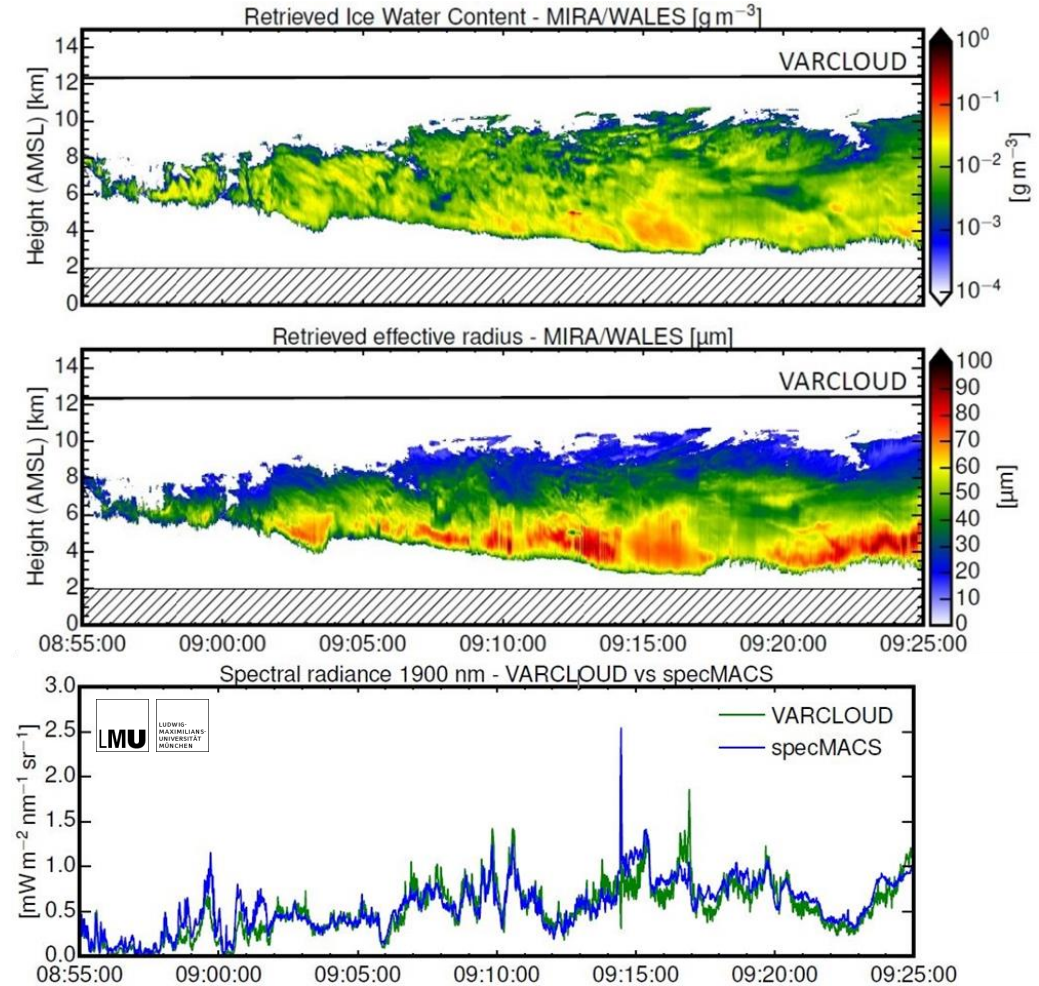


Closure study

Radar-Lidar vs. specMACS – 1 October 2016



Good agreement of simulated and measured spectral radiance at 1900 nm



Ewald et al., 2021



Validation strategy



Campaign period – August to November 2024

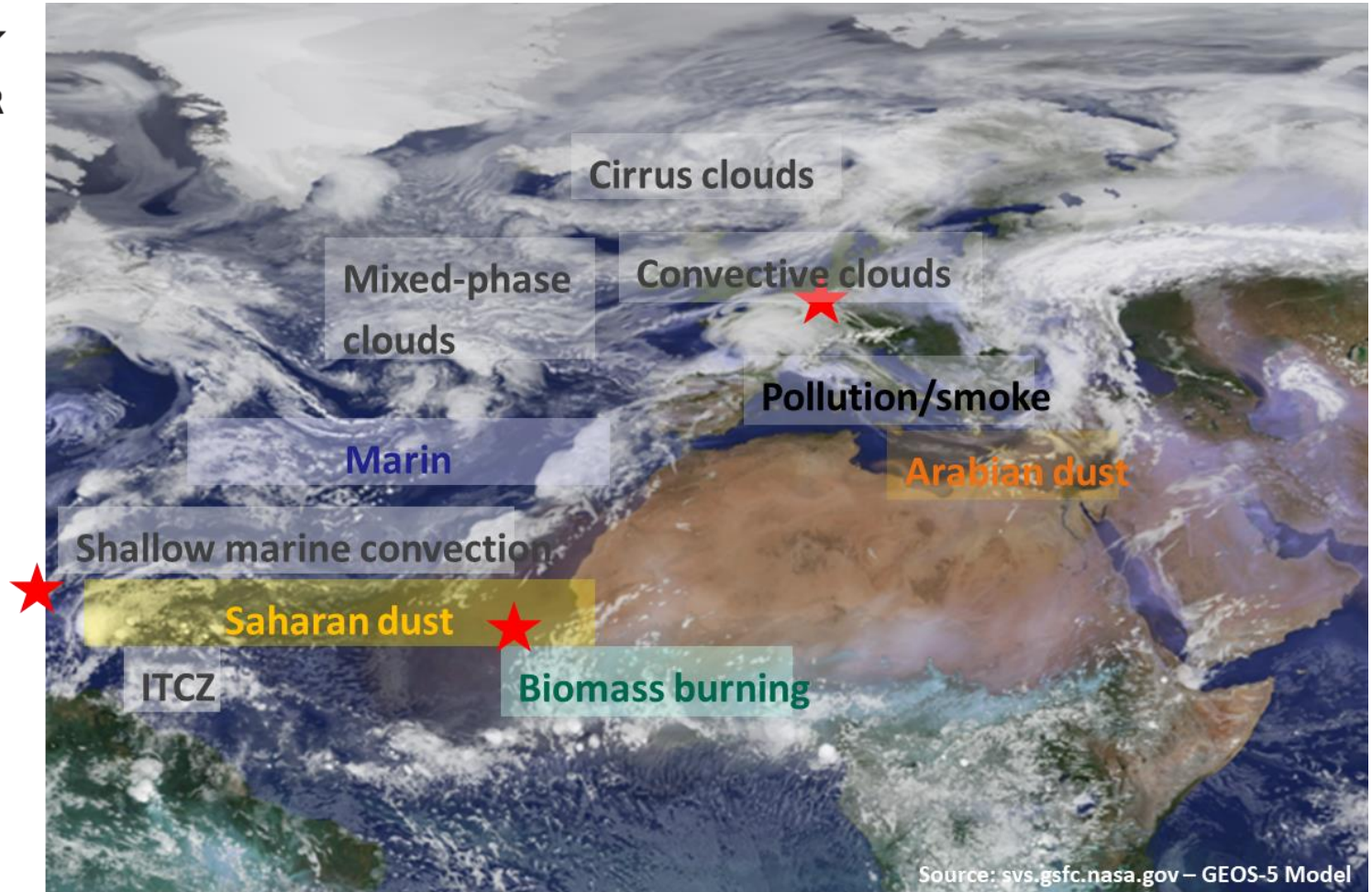
Campaign locations

- Germany: Dedicated validation flights
- Barbados: ITCZ, Trades
- Cape Verde: ITCZ, Trades

Campaign duration:

9 weeks of active measurements

- ~246 flight hours (incl. transfer)
- ~ 5-6 flights / 50 flight hours from Oberpaffenhofen (5-6 underpasses)
- ~ 10 flights / 100 flight hours from Barbados (8-10 underpasses)
- ~ 10 flights / 96 flight hours from Cape Verde (9-10 underpasses)

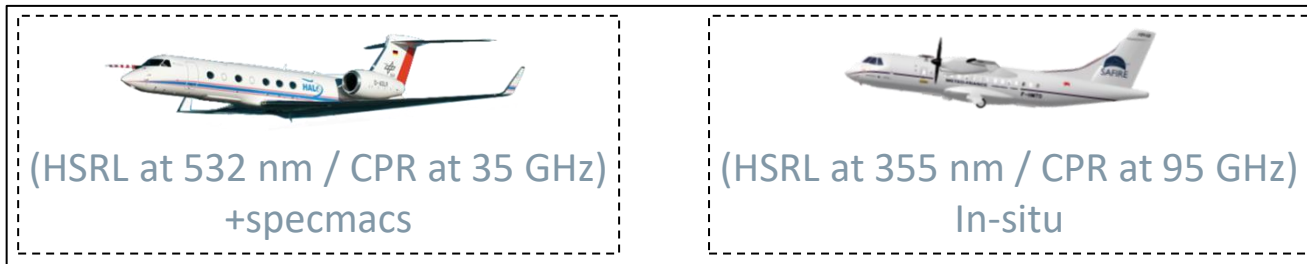




Measurement strategy



Co-located measurements



Evaluation of EarthCARE data products

Coordinated measurement:

- Possibility of coordinated flights with ATR42 (radar + lidar + in-situ) and/or additional in-situ aircraft measurements
- Coordination with ground-based (mobile) sites is aspired (e.g. Mindelo, TROPOS; Barbados, MPI-M; Antikythera; NOA)
- Ship-borne measurement on METEOR

Measurement strategy:

- Dedicated (coordinated) underflights with systems at different wavelengths, resolution and sensitivity
- Overpasses over ground-based stations
- Characterization of the general situation

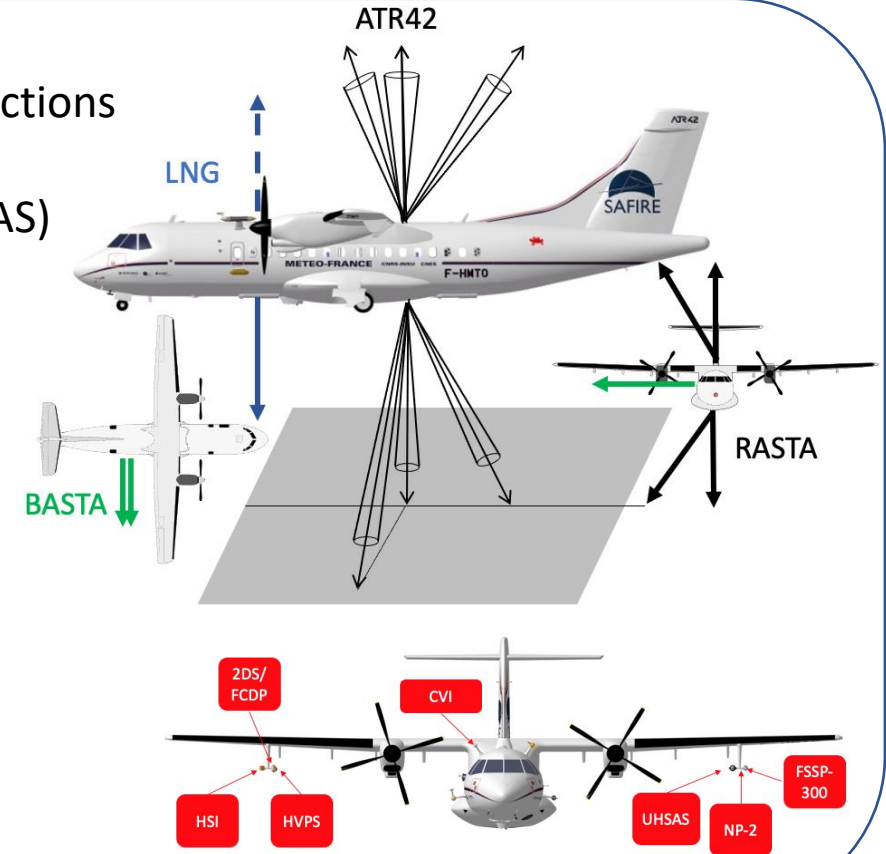


Coordinated flights with ATR42 (French) – MAESTRO



- RASTA looking up and down 6 antennas (**Doppler W-band**)
- **HRSL LNG** new generation (new laser, new acquisition) 2 pointing directions
- Sideward looking W-band Doppler radar (BASTAir)
- Sideward looking 355 raman (aWALI) or 355 nm backscatter lidar (ALIAS)
- 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			heterogeneities			
In-situ	FCDP/HVPS/2DS/UHSAS/CVI/NP/FSSP						
	Aircraft's baseline information				clear sky/cloud/aerosol		
Radiometry	CLIMAT						SST
	Pyrano- & pygeometers						



→ See MORECALVAL – Julien Delanoë



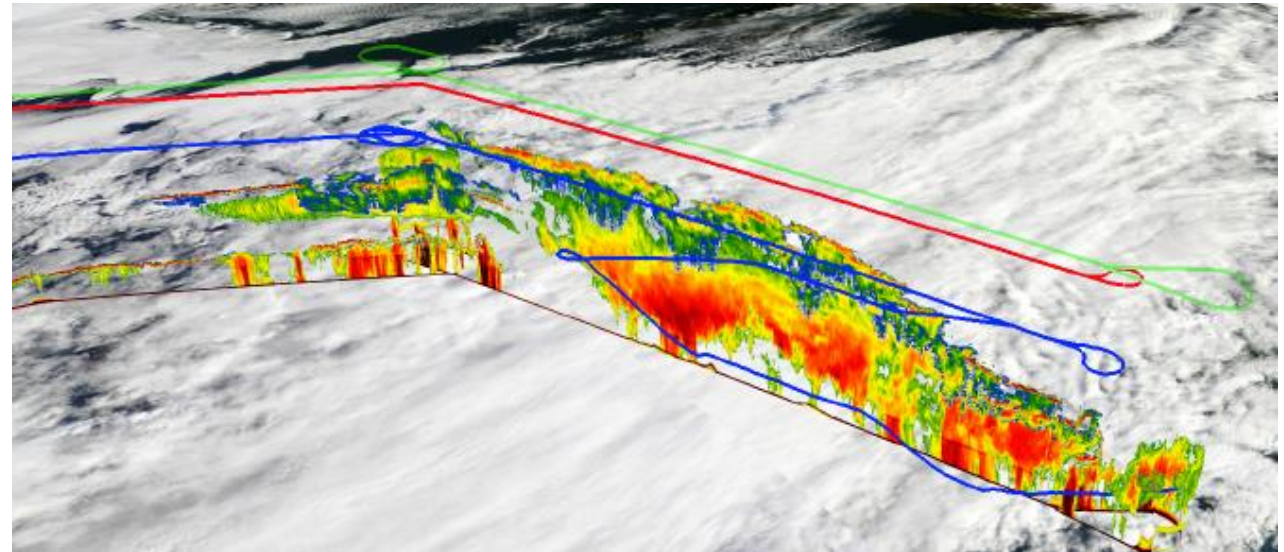
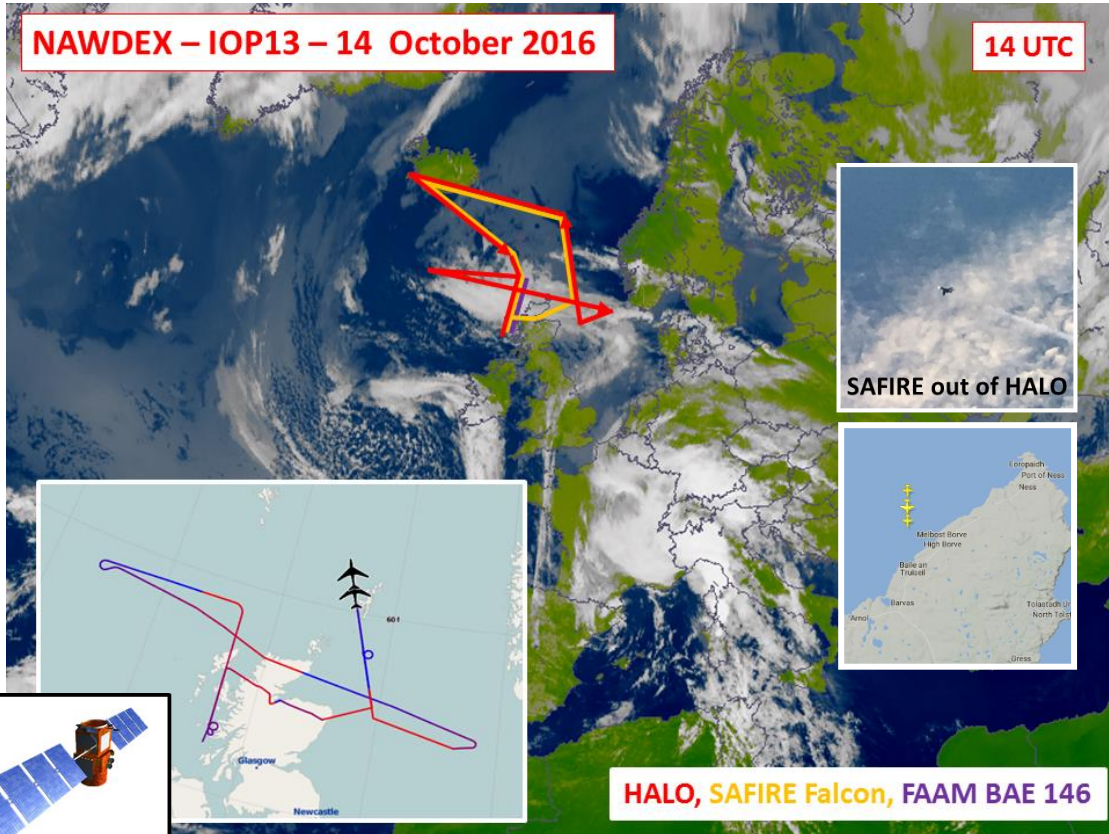
Validation of synergistic retrieval

Example: Combined HALO, SAFIR and FAAM BAe146 flight

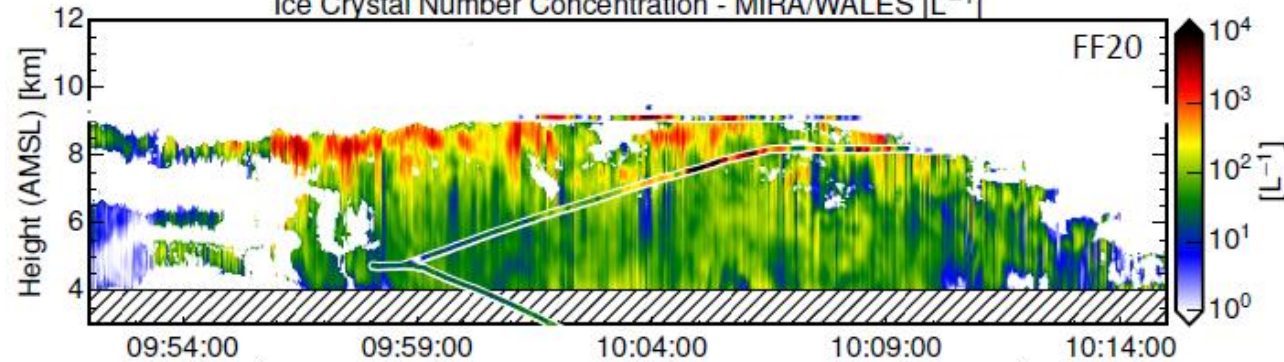


NAWDEX – IOP13 – 14 October 2016

14 UTC

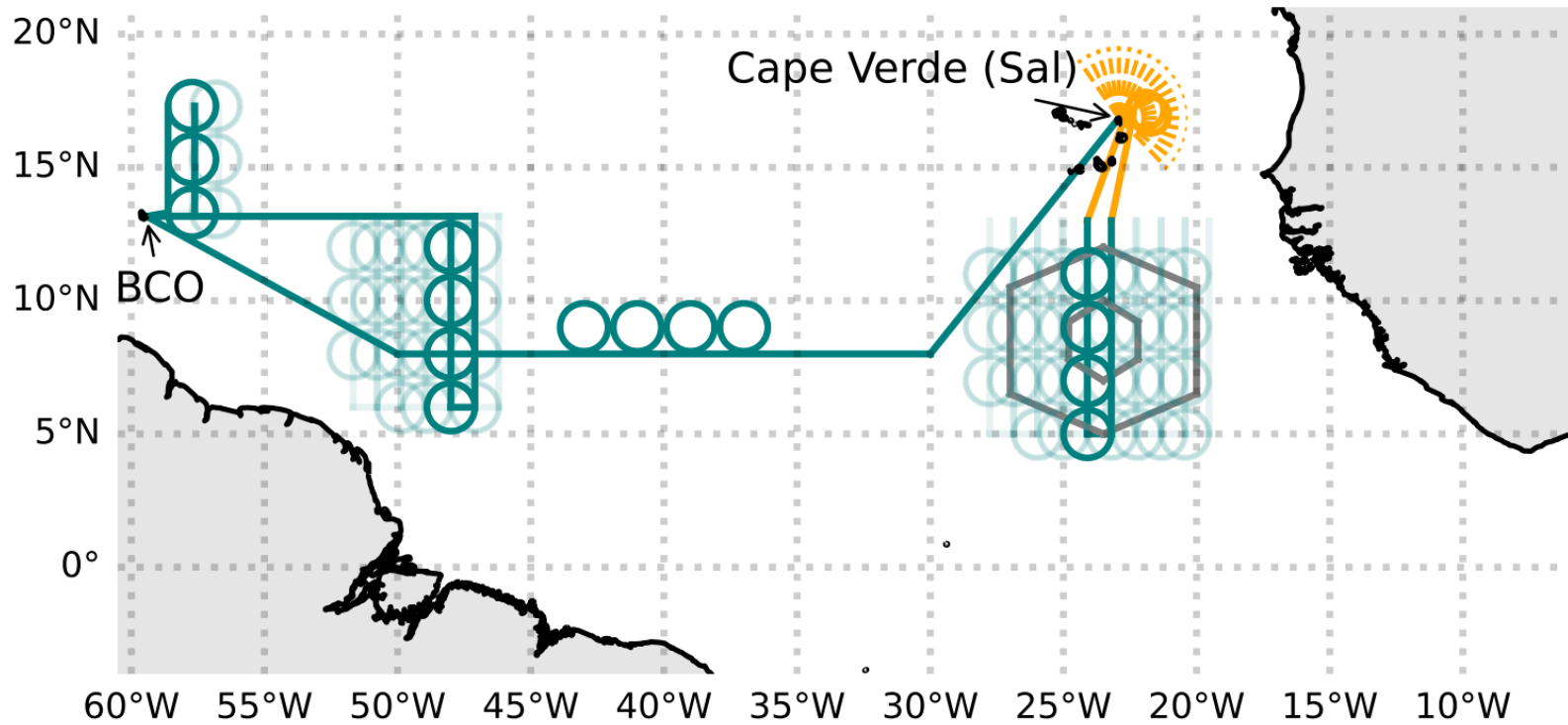


Ice Crystal Number Concentration - MIRA/WALES [L^{-1}]





Validation strategy in tropics / sub-tropics



- It is planned to have **co-located flights with French ATR** out of Cape Verde. (**MORECALVAL – J. Delanoë**)
→ ATR will be equipped with **radar-lidar + in-situ** payload
- Measurements will be supported by shipborne measurements (**BOWTIE – Julia Windmiller**)

→ **Each flight will incorporate an EarthCARE underflight**





Summary



- EarthCARE-like measurements on HALO over sub-tropical/tropical North-Atlantic Ocean (Cape Verde and Barbados) and out of Oberpfaffenhofen in summer/fall 2024

Sub-tropics/Tropics:

- Co-located flights with French ATR equipped with radar-lidar + in-situ payload out of Cape Verde
- Supported by shipborne measurements
- Ground-based measurements in Mindelo (TROPOS) and Barbados (MPI-M)

Europe:

- Dedicated validation flights
- Overpasses over ground stations (e.g. ACROSS – Antikythera; Vassilis Amiridis / Eleni Marinou)
- Characterization of general measurement situation

