ESA-JAXA Pre-Launch EarthCARE Science and Validation Workshop

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

EVID10: MORECALVAL : MObile Radar-Lidar-Radiometer EarthCare CAL/VAL project

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**LATMOS, DLR[+], LMD[#], LaMP[o]*

MObile Radar-Lidar-Radiometer EarthCARE CAL/VAL project

German-French tandem for **Calibration of EarthCARE's instruments** (CPR, ATLID, MSI)
Validation of cloud, precipitation and aerosol synergistic products

Calibration and validation

1. Assessing EarthCARE measurements performances
2. Calibrating EarthCARE measurements (radar Doppler velocity and reflectivity, lidar mol and particulate, depolarisation measurements)
3. Validating EarthCARE products (L1)
4. Validating EarthCARE synergistic products and algorithms (L2)

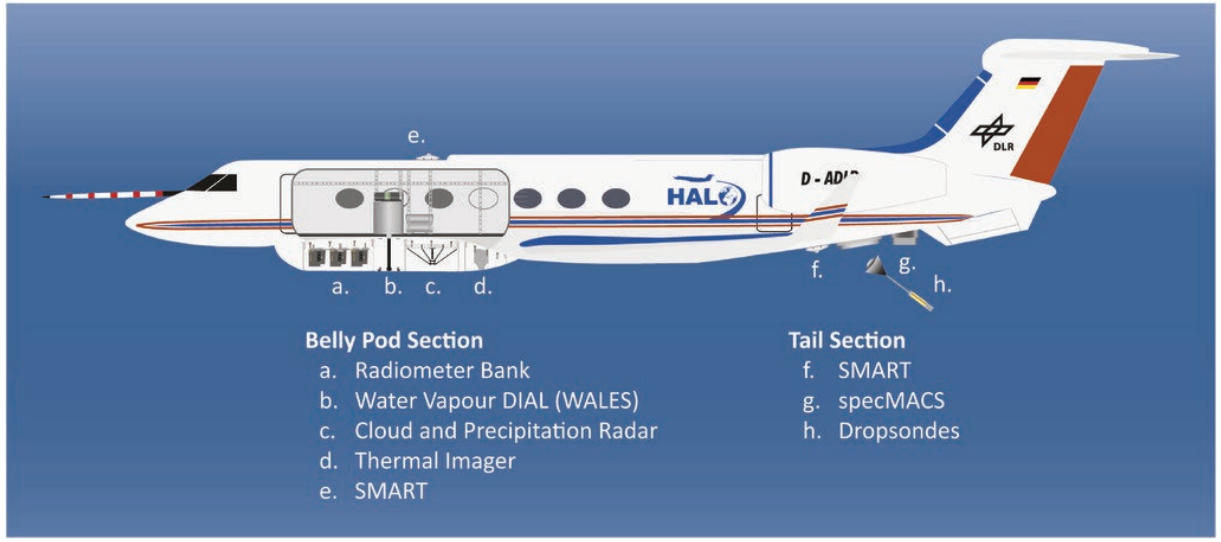
Targeted products

- ATLID Level 1/CPR Level 1 / ATLID Level 2a (FM, AER, ICE, TC, EBD, CTH, ALD)
- CPR Level 2a (FMR, CD, TC, CLD)/CPR Level 2a JAXA (ECO, CLP)
- Level 2b (TC)/Level 2b (CAP, COM, 3D, RT)

- Making the most of our instruments capabilities (HSRL at different wavelengths, Doppler radars with high sensitivity), higher horizontal&vertical resolutions.
- Performing independent measurements from mobile platforms (similar or extended payloads to EarthCARE).
- Comparing the measurements with direct underpasses
- Comparing and interpreting the measurements by performing simulation of our "in situ" and EarthCARE HSR lidar and Doppler radar observables
- Running our own retrievals combining more instruments than EarthCARE or with different wavelengths.
- Comparing our products to EarthCARE's

Airborne platforms : HALO (German)

Stevens et al., 2019



- WALES HSRL and WV/Ozone DIAL
- MIRA 35 high power Doppler radar
- specMACS multi-sprectral Imager
- Baseline in-situ measurements

Instruments /Objectives	Aerosols	Clouds/ precip	Water vapour/ Temp	Wind	Turbulence
WALES (Lidar)	■	■	■		
MIRA35 (Radar)		■			■
specMACS (Imager)	■	■			
Aircraft's baseline information (in-situ)			■	■	■

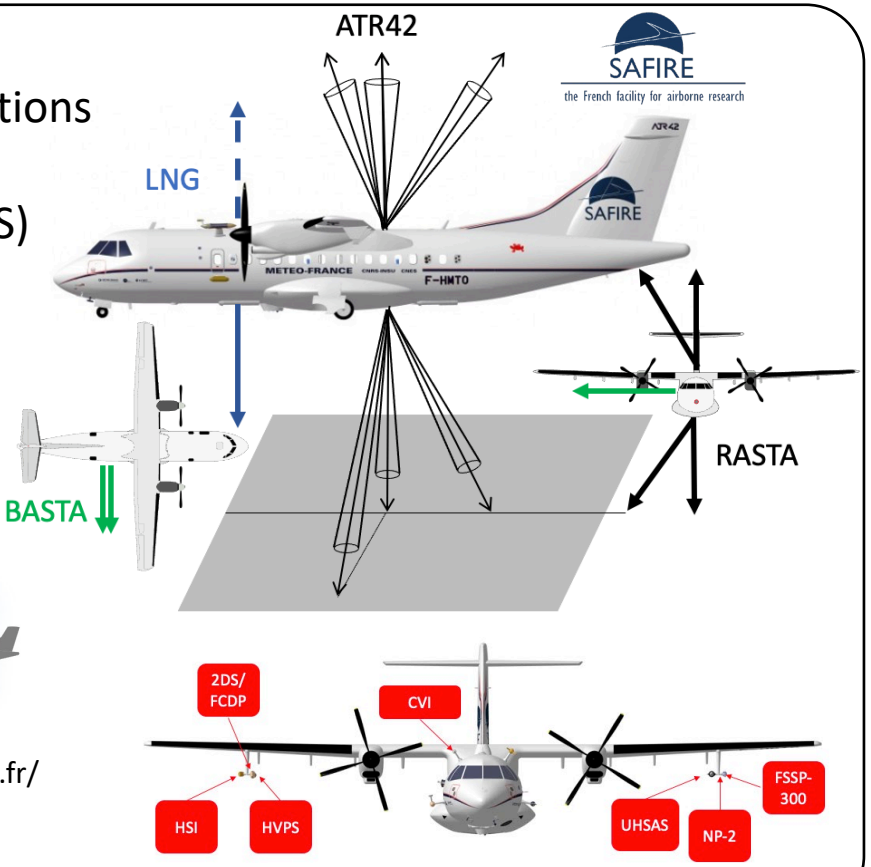
Airborne platforms : ATR42 (French)

- 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			heterog eneities			
In-situ	FCDP/HVPS/2DS/UHSAS/CVI/NP/FSSP						
	Aircraft's baseline information				clear sky/cloud/aerosol		
Radiometry	CLIMAT						SST
	Pyrano-& pyrgeometers						

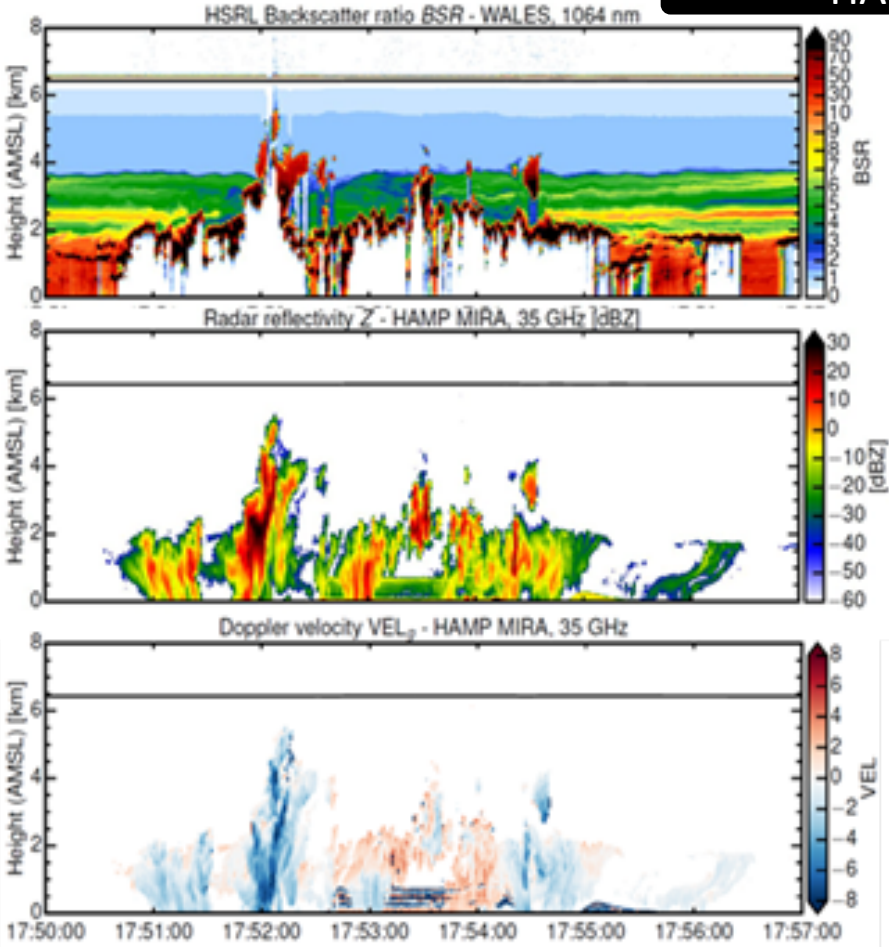
RADAR
A
LIDAR
I

https://rali.aeris-data.fr/



Examples of measurements : HALO & ATR42

HALO



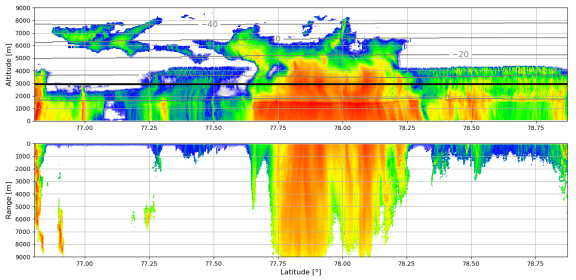
Backscatter ratio

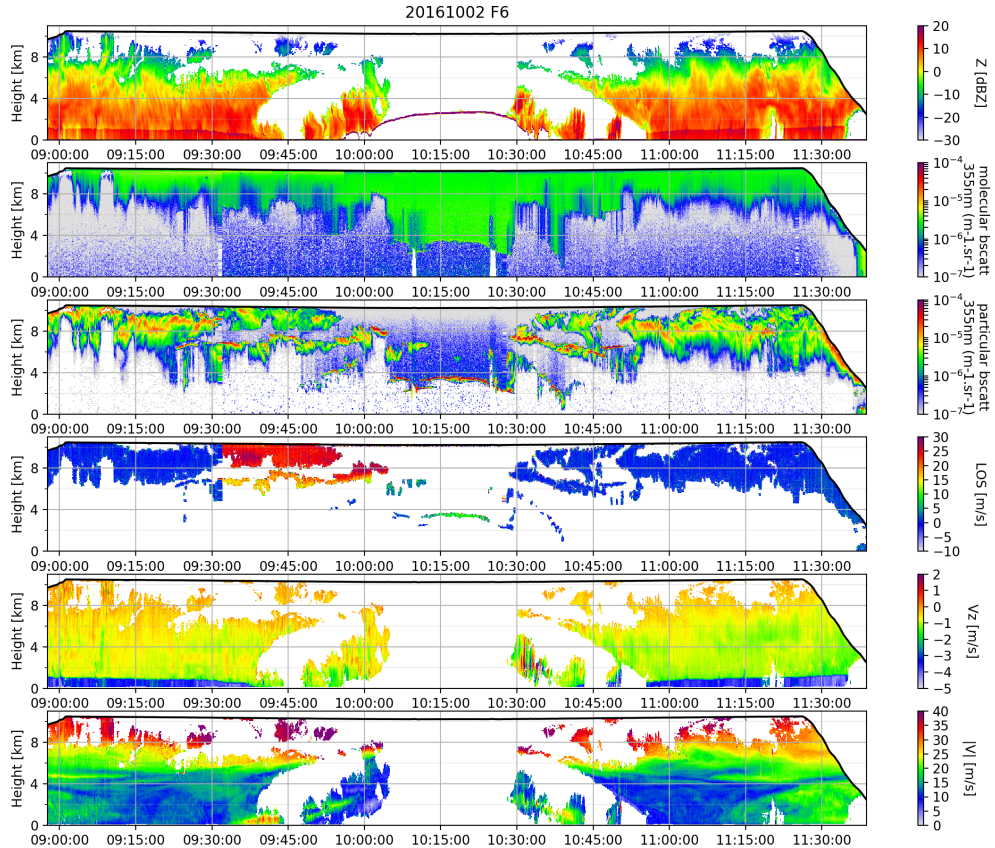
Z 35GHz

Doppler Velociy

ATR42

Sidewards looking W-band





Z W-band

Ray channel

Mie channel

Doppler Mie

V_z

horizontal|V|

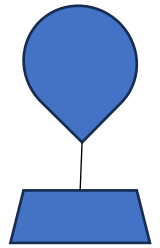
Airborne platforms : field campaigns

- PREMASTRO (July 2024, ATR42) – funded (CNES/ESA)
  - Dedicated to EC's Cal/Val, Toulouse
- ORCHESTRA (MAESTRO and PERCUSSION (Silke's presentation)) – (August-Sept, HALO+ATR42) – funded (MAESTRO ERC)
  - Cloud organisation, convection from shallow to deep, Cape Verde
- BACCOPA (Sept 2025, ATR42) – funded (ANR)
  - Cloud aerosol interaction, Central equatorial Africa
- NAWDIC (Feb 2026, ATR42) – not funded yet
  - Strong winds, Ireland - Brittany
- STACCATO (fall 2027, HALO) – not funded yet
  - Aerosol-cloud interaction, coupling clouds and circulation, Africa
- AC3-PND (2028, HALO) – not funded yet
  - Water vapor clouds and aerosols in the Arctic region

Proposal submitted

Balloon-borne platform : LATMOS&CNES (French)

CNES STRALI project (W band Doppler radar + 808nm lidar) onboard CNES stratospheric Balloon – first flights June 2024 - Kiruna



Ground based platforms : DLR&LATMOS

- BASTA radars (W-band) network plus highly portable system
- BALI system (scanning BASTA+ulidar 532/808 nm)
- Synergistic Poldirad+BASTA (C-band+W-band, less mobile but can be moved)

Our expertise on our data (common DLR and LATMOS)

- Calibration:

Airborne radars are calibrated using both lab and external calibration (Ewald et al. 2019)
ground based radars are calibrated using ACTRIS procedure (Toledo et al. 2020, Jorquera et al. 2023)
our lidars are calibrated using lab and external calibration (Esselborn et al. 2008, Wirth et al. 2009, Bruneau et al. 2015)

- Target categorisation & retrieval:

Similar products as DARDAR for both HALO and RALI (Delanoë and Hogan 2010, Cazenave et al. 2019, Marinou et al. 2020, Ewald et al. 2021, Aubry et al. 2023)