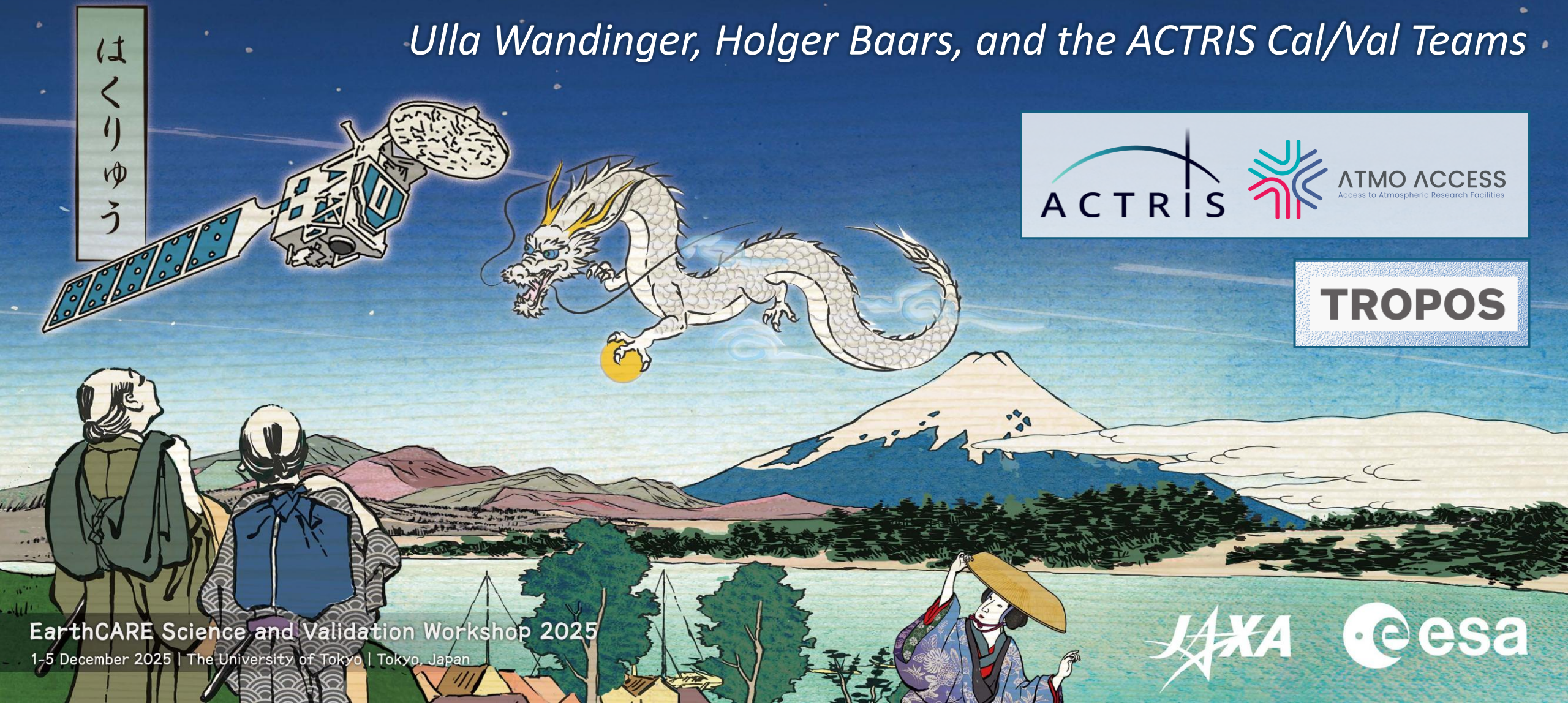
ACTRIS and ATMO-ACCESS

Aerosol and Cloud Remote Sensing for EarthCARE Cal/Val

Ulla Wandinger, Holger Baars, and the ACTRIS Cal/Val Teams



ACTRIS

ATMO ACCESS
Access to Atmospheric Research Facilities

TROPOS

EarthCARE Science and Validation Workshop 2025
1-5 December 2025 | The University of Tokyo | Tokyo, Japan

JAXA

esa

Outline

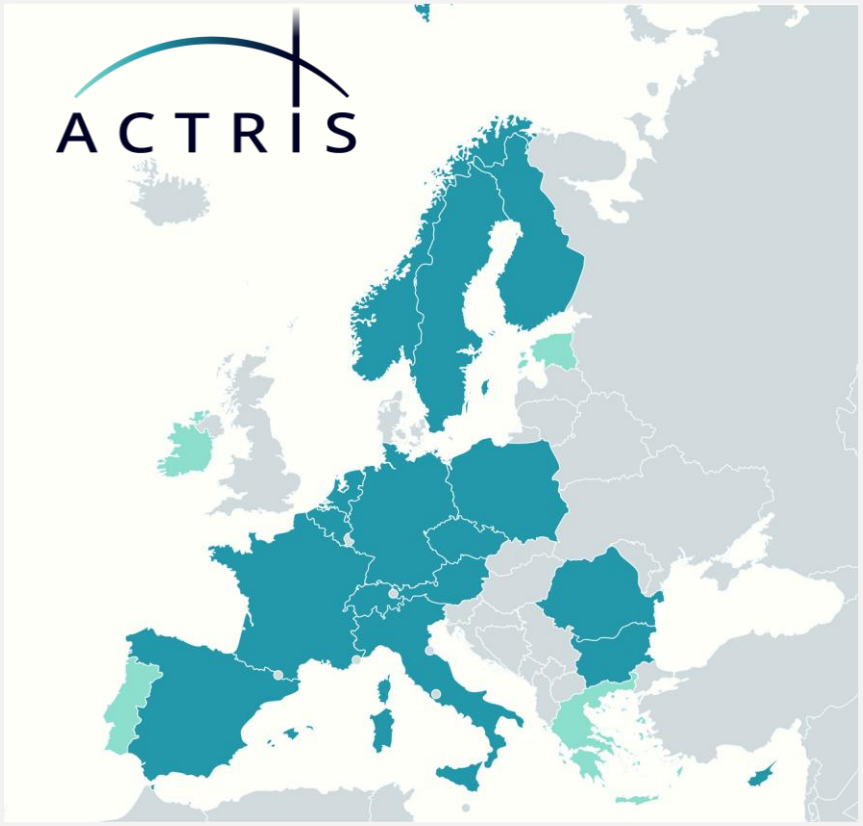
- ACTRIS and ATMO-ACCESS
- ATMO-ACCESS Pilot for EarthCARE Validation
- Results from ACTRIS Observational Platforms
- Results from ACTRIS Mobile Platforms
- Conclusions and Lessons Learnt

ACTRIS
Exploring the Atmosphere

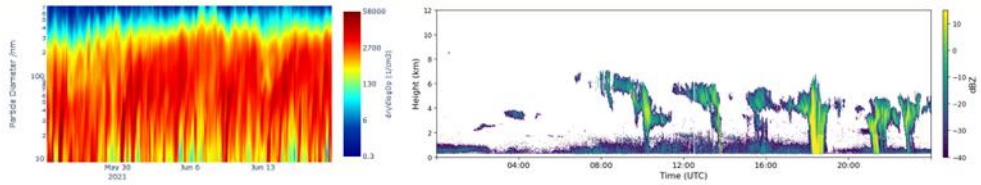
ATMO ACCESS
Access to Atmospheric Research Facilities

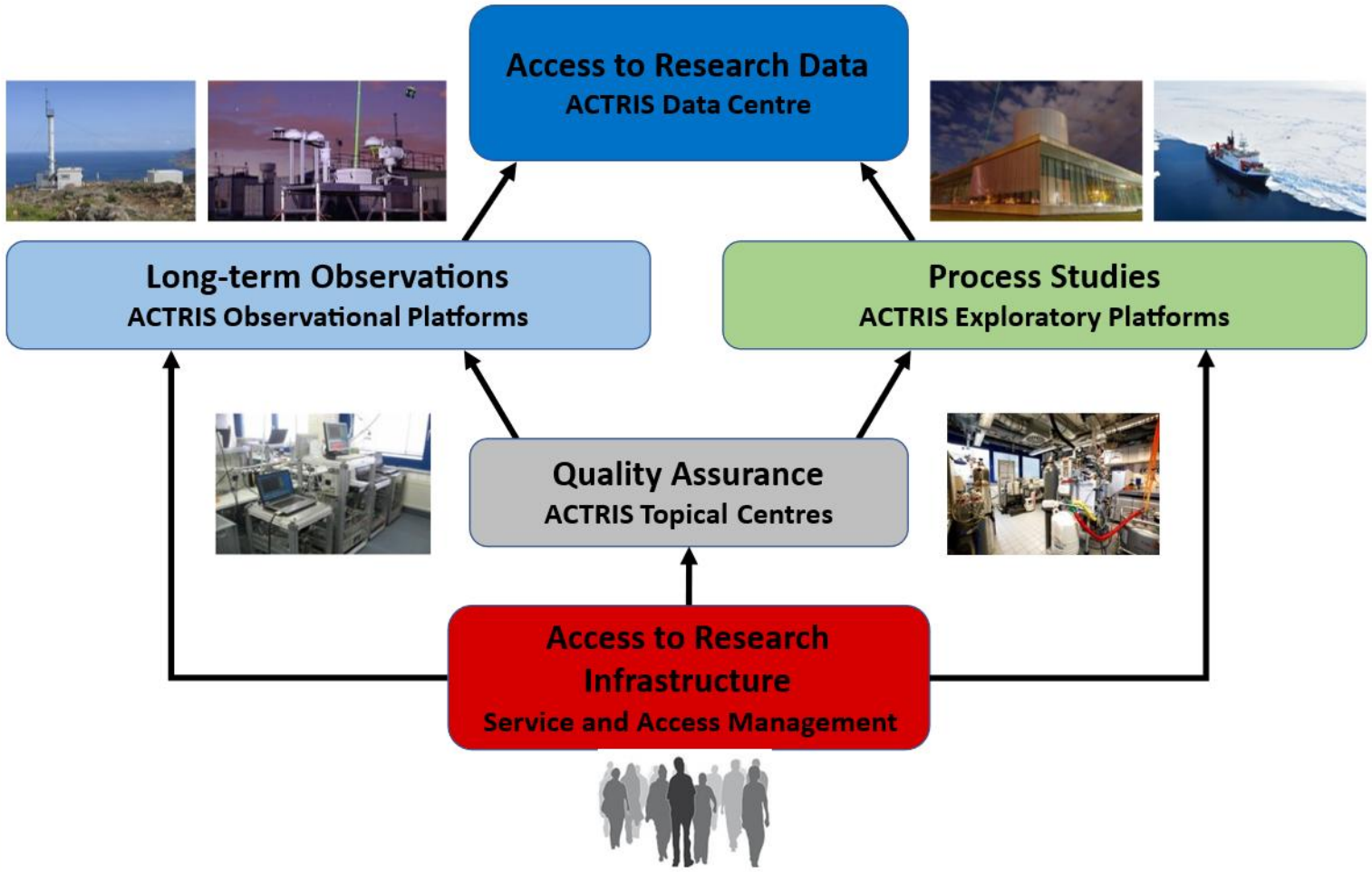
TROPOS

ACTRIS Aerosol, Clouds and Trace Gases Research Infrastructure

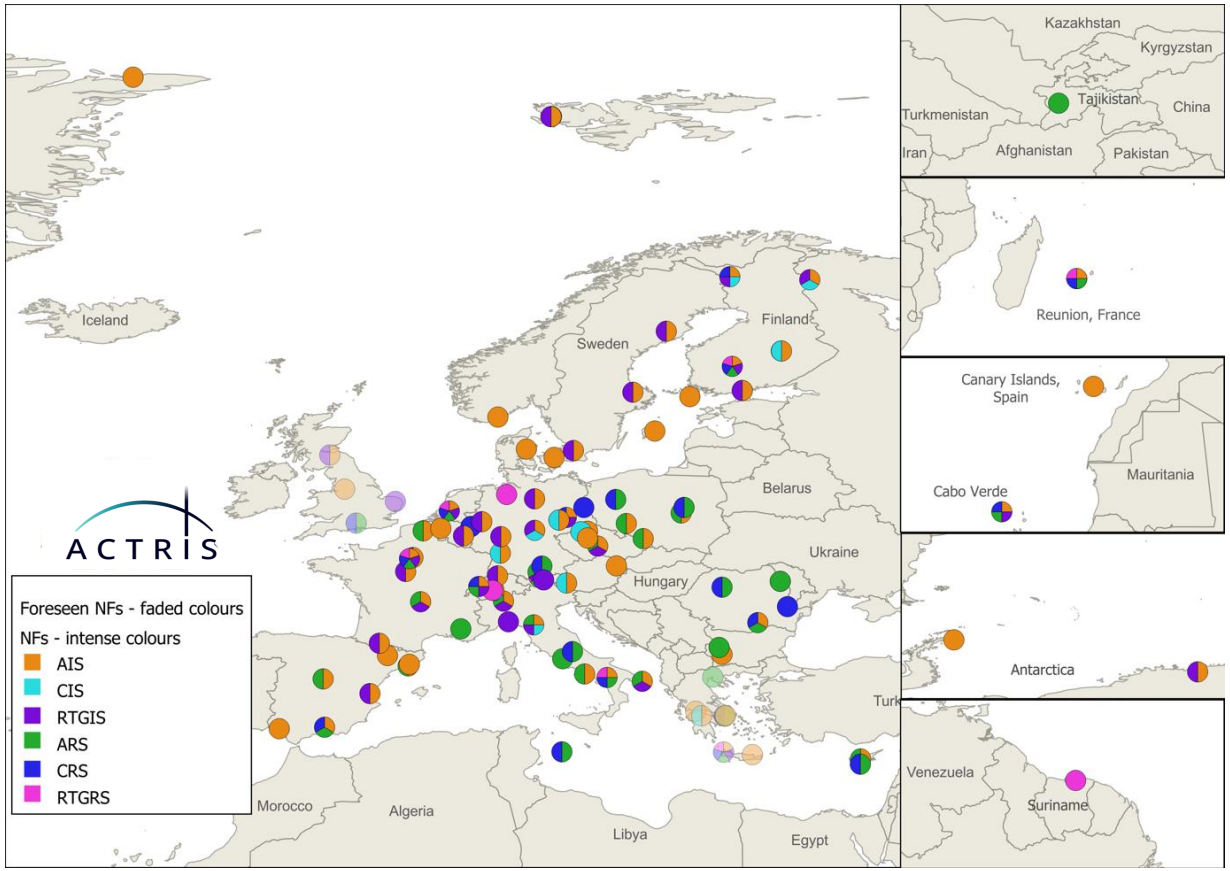


European Research Infrastructure
Implemented as ERIC legal entity for > 25 years
17 Member countries (+ 4 candidates)
81 Observational Platforms
19 Mobile Platforms, 14 Simulation Chambers
6 Topical Centres, Data Centre, Head Office





ACTRIS Observation Network



Laj et al., Bull. Amer. Meteor. Soc., 2024

Six Topical Centres provide operation support for the National Facilities

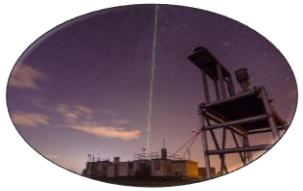
- Aerosol in-situ measurements
- Cloud in-situ measurements
- Reactive trace gas in-situ measurements
- Aerosol remote sensing
- Cloud remote sensing
- Reactive trace gas remote sensing






ACTRIS Aerosol and Cloud Remote Sensing

ARS = Aerosol Remote Sensing



High-power idar

Sun/sky/lunar photometers

CRS = Cloud Remote Sensing

Doppler Cloud Radar

Microwave radiometer

Doppler lidar

Low power lidar and ceilometer

Disdrometer

High-power aerosol lidar

Capabilities (optimum) EARLINET	• Backscatter • Raman extinction • Depolarization @355, 532, 1064 nm
Height resolution (raw)	3.75 - 15 m
Time resolution (raw)	10 - 60 s
Full overlap	100 - 300 m
Maximum altitude	≥ 15000 m

Doppler cloud radar

Capabilities Cloudnet	Polarization sensitivity, Scanning ability, Record of Doppler spectrum (optimum)
Height resolution (raw)	10 - 60 m
Time resolution (raw)	1 - 30 s
Velocity resolution	5 - 10 cm/s
Frequency	35 or/and 94 Ghz

ATMO-ACCESS Horizon-2020 Project

ATMO ACCESS
Access to Atmospheric Research Facilities

ACTRIS
Exploring the Atmosphere

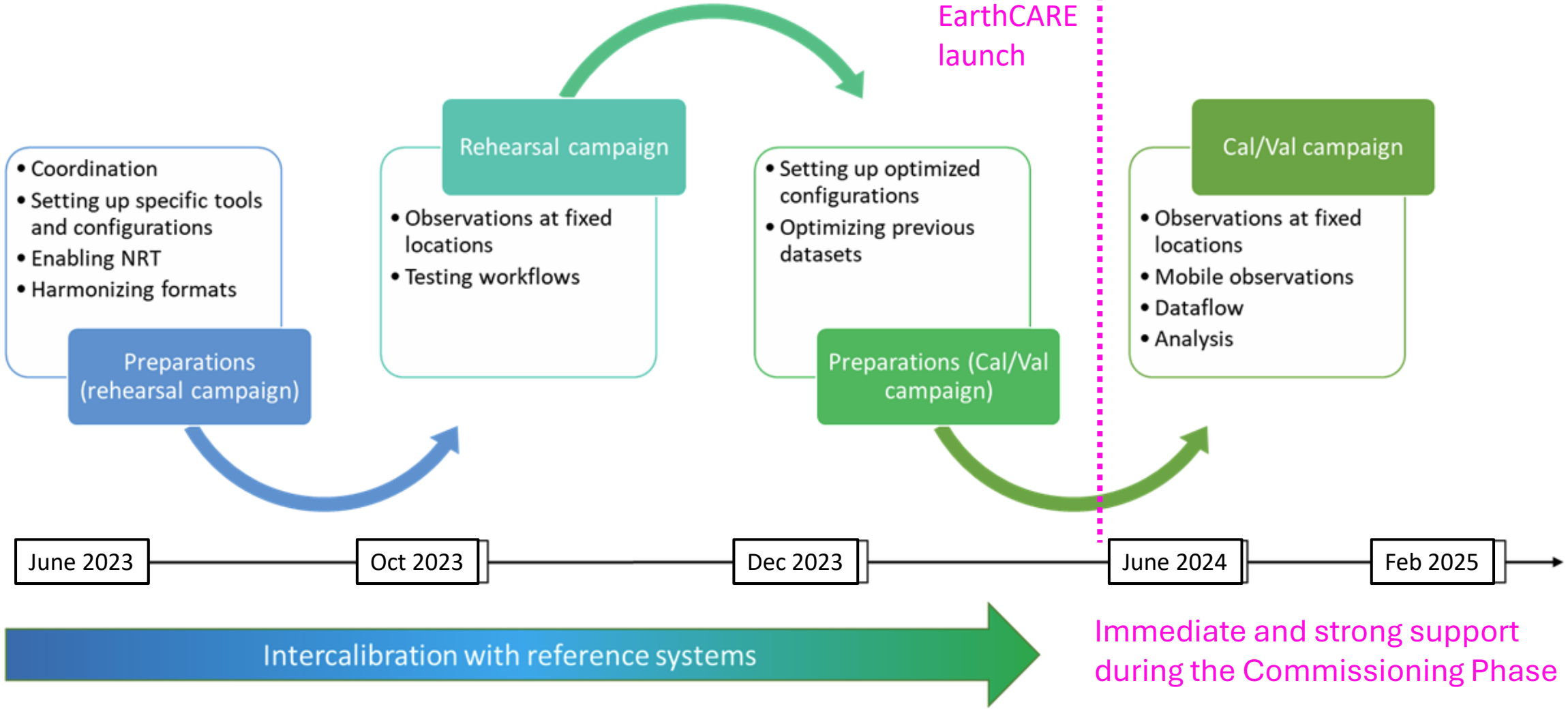
ICOS INTEGRATED CARBON OBSERVATION SYSTEM

IAGOS
IN-SERVICE AIRCRAFT FOR A GLOBAL OBSERVING SYSTEM

Horizon-2020 EU project (2021-2025)

- Support trans-national access to European atmospheric research infrastructures
- Develop and test new access methods
  - ➢ Pilot activities to provide access to international stakeholders
  - ➢ Access for ESA to ACTRIS facilities for EarthCARE Cal/Val
  - ➢ Support for Cal/Val activities, in particular EVID05 = AECARE (ACTRIS for EarthCARE L2 product evaluation)

The ATMO-ACCESS Pilot Project for EarthCARE



ESA-ACTRIS Co-design for Fast Data Provision

ACTRIS
Aerosol and Cloud Remote Sensing
National Facilties

Fast data submission

ACTRIS
Data Centre
(Units)

(SCC/Aeronet/Cloudnet)

Preliminary automated Quality Control

ESA Validation Data Center (EVDC)

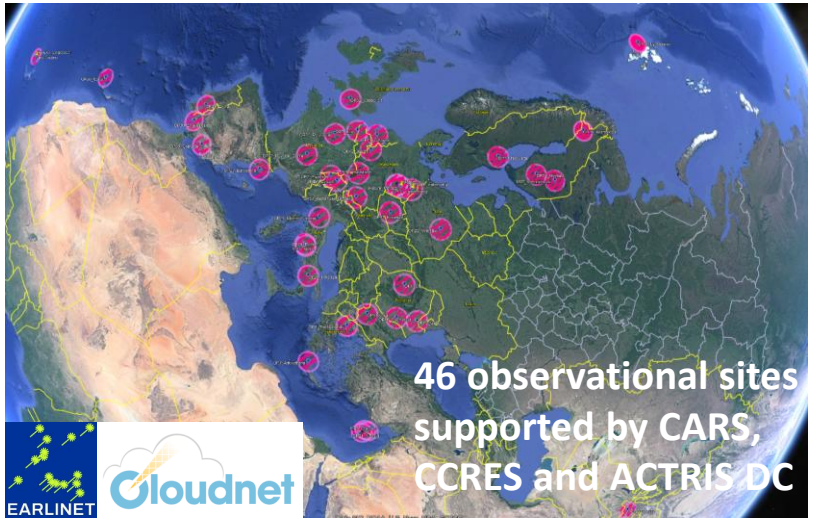
evdc

ACTRIS
Quality Assurance
(QA)

Near Real Time

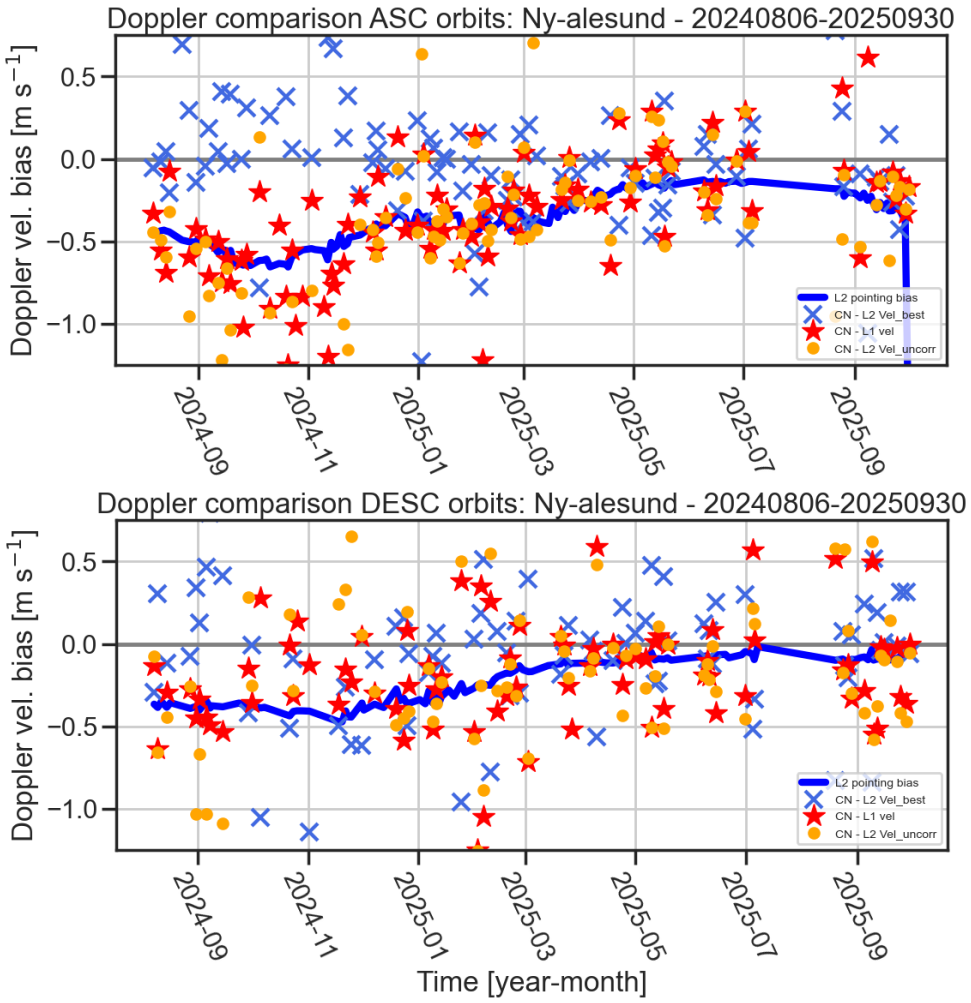
ACTRIS
Topical Centres

Other (network) instrument (MPLNet, eVe, FRM4Radar)



ACTRIS Network Validation: CPR Doppler velocity

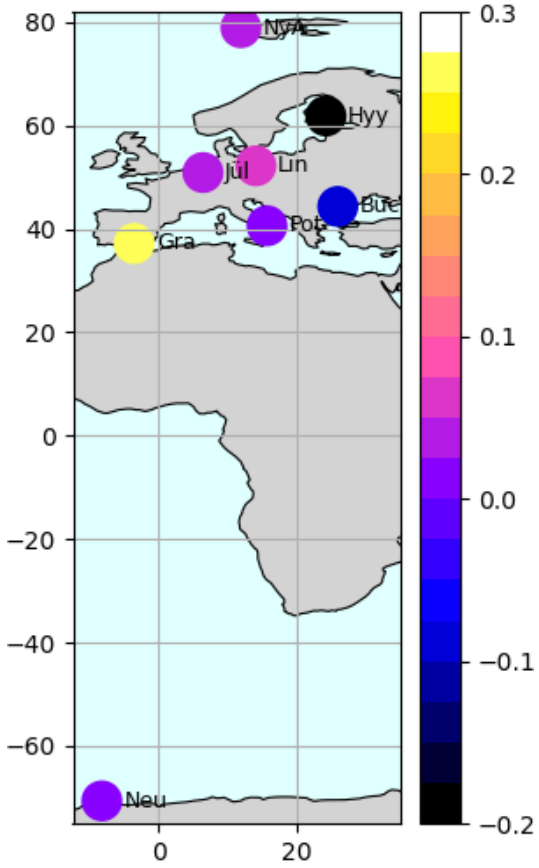
ASC and DESC orbits show differences in their behaviour and statistics



H213, Tuesday, 13:10: Doppler velocity validation of EarthCARE cloud profiling radar using ACTRIS ground-based cloud radar network (Lukas Pfitzenmair et al.)

ACTRIS can act as a validation platform for EarthCARE Doppler velocity products

- L2a best estimates < +/- 0.1 ms^{-1}



ACTRIS
Centre for Cloud Remote Sensing

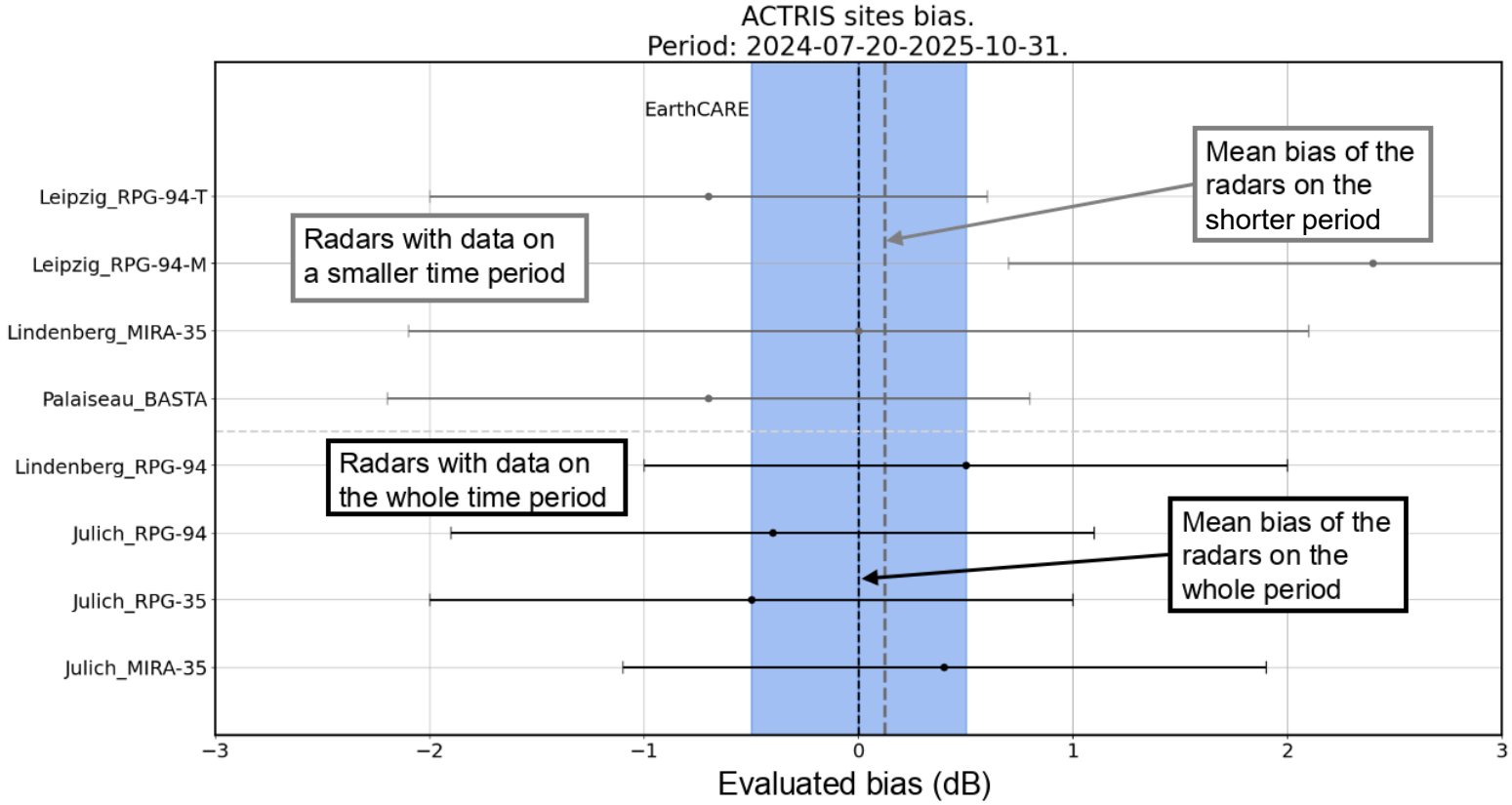
UNIVERSITY OF COLOGNE

cnes

ACTRIS Network Validation: CPR Ze

- Excellent Ze agreement between EarthCARE L2a products and 8 ACTRIS calibrated sites → Mean bias < 0.1 dBZ.
- Bias uncertainty is sensitive to time period and scene characteristics.
- Long-term calibration monitoring is be possible.

Annex54: Reflectivity Validation of EarthCARE Cloud Profiling Radar Reflectivity using ACTRIS ground-based Cloud Radar Network (Nathan Feuillard et al.)



More about ACTRIS for EarthCARE Cal/Val

- **H216, Tuesday, 13:40:** Validating EarthCARE ***cloud profiling target categorisation*** using the ACTRIS cloud radar network (Ewan O'Connor et al.)
- **H410, Thursday, 10:30**: Validation of ***ATLID-retrieved aerosol products*** against co-located ACTRIS/EARLINET ground-based lidar measurements (Christina-Anna Papanikolaou et al.)
- **Annex2**: Validation of ***ATLID L2 products*** using ground-based lidar measurements at Cabo Verde, Tajikistan, Germany and on the Atlantic Ocean – case studies (Holger Baars et al., online)
- **Annex4**: : ACTRIS/EARLINET insights for EarthCARE's ***aerosol classification*** (Kalliopi Artemis Voudouri et al., online)
- **Annex6**: Validation of EarthCARE ***ATLID aerosol products*** using EARLINET measurements (Ping Wang et al.)
- **Annex43**: Method for correcting ***multiple scattering in cirrus clouds*** in ACTRIS-SCC retrievals for the validation of ***ATLID L2 optical products*** (EVID14) (Diego Gouveia et al., online)
- **Annex42**: Statistical Validation of EarthCARE ***MSI L1 Data*** Using MSI Forward Simulator at ACTRIS Stations (Nils Madenach et al.)

ACTRIS Global Validation Activities

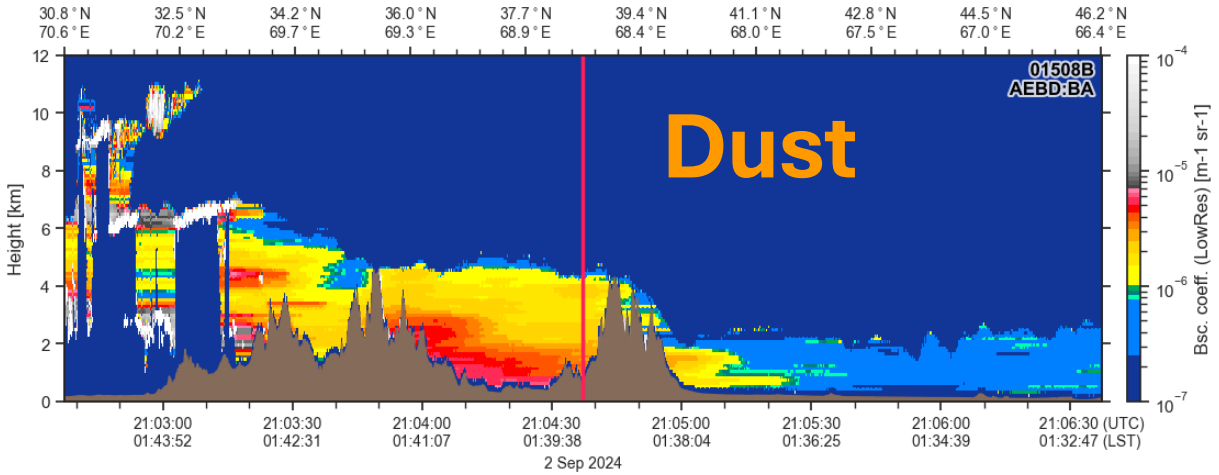
Dushanbe

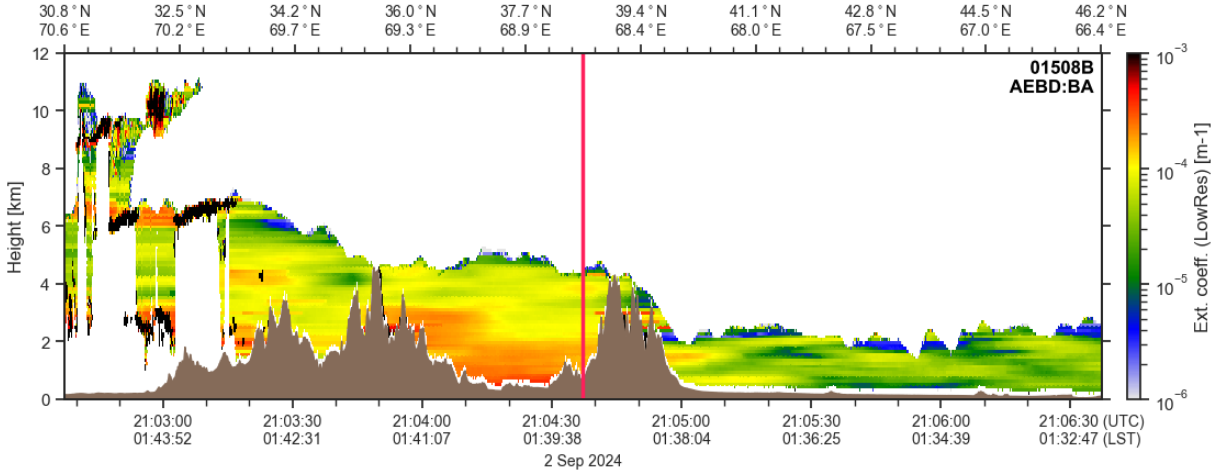
Mindelo

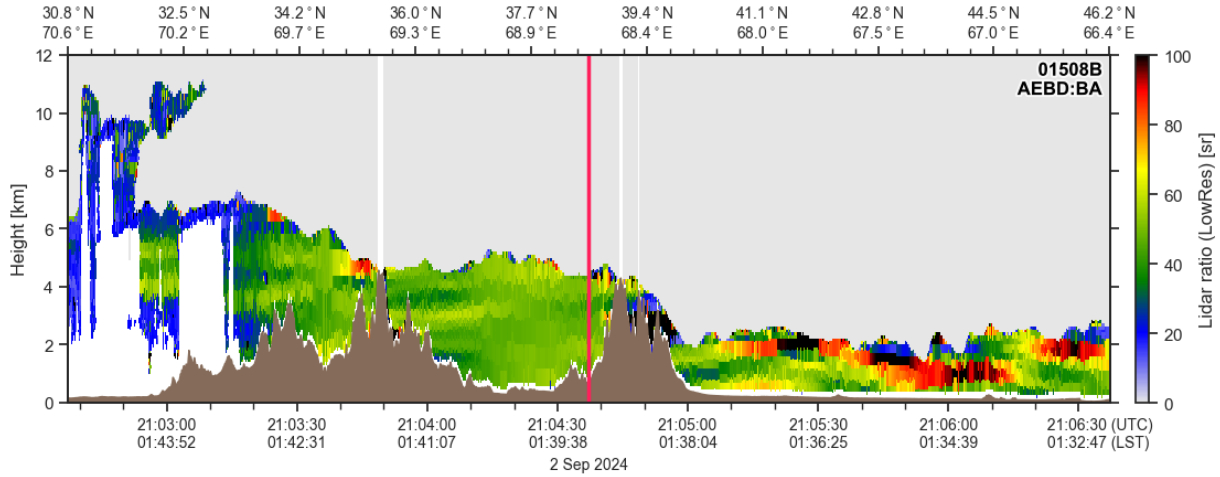
RV Meteor

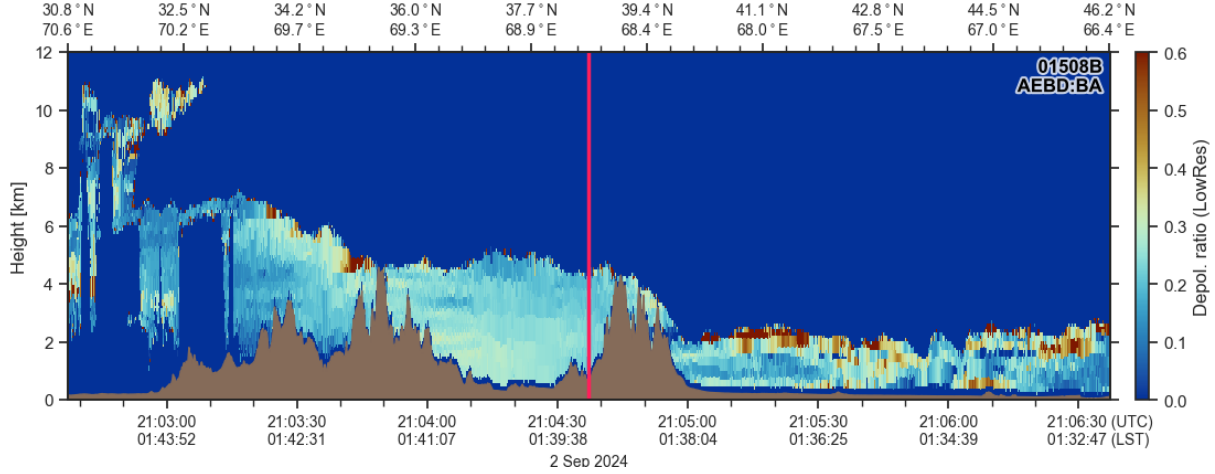
Invercargill

Dushanbe, Tajikistan, 2 September 2024



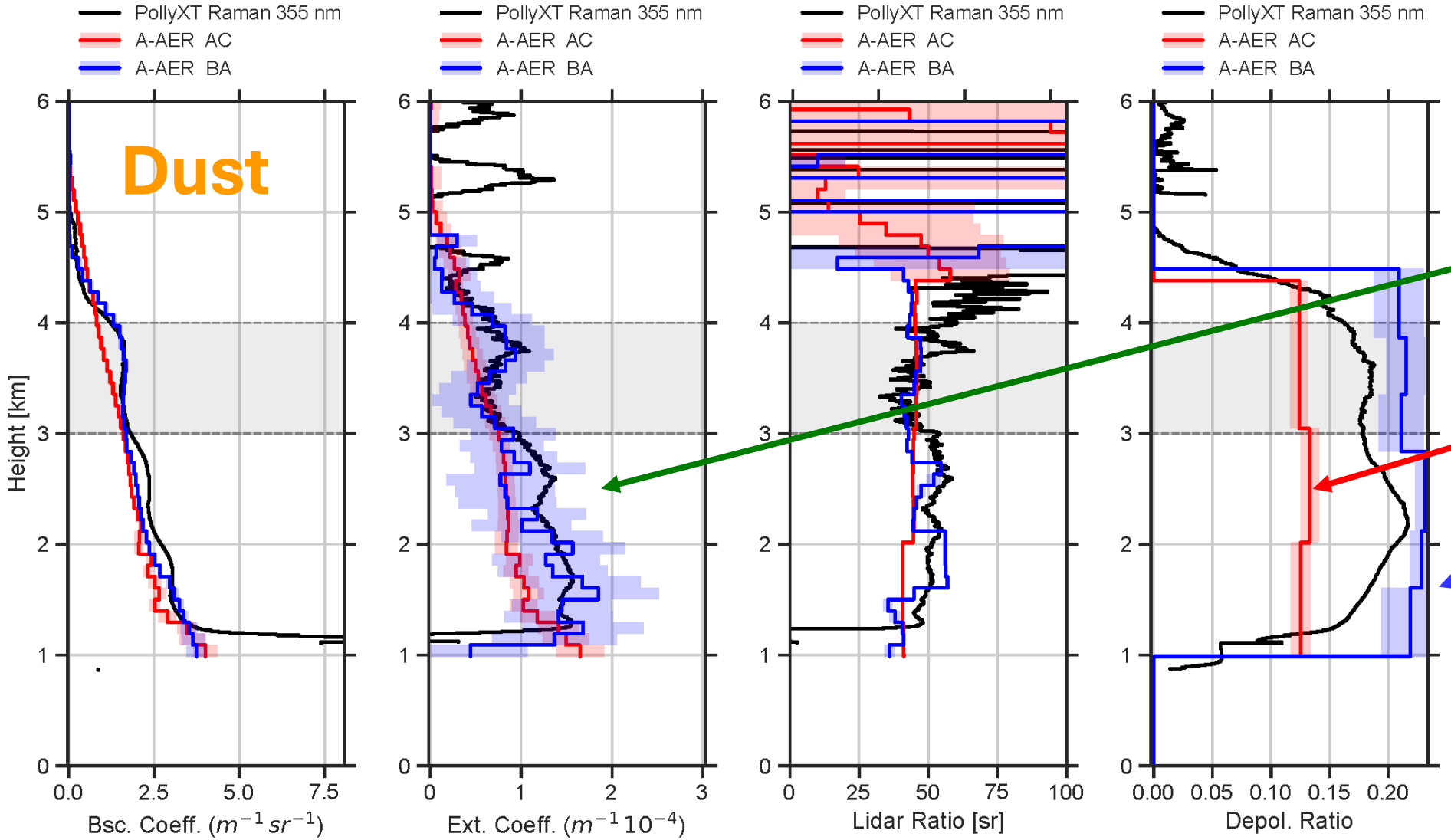






A-EBD, low resolution, baseline BA, frame 1508B, 17 km distance

Dushanbe, Tajikistan, 2 September 2024



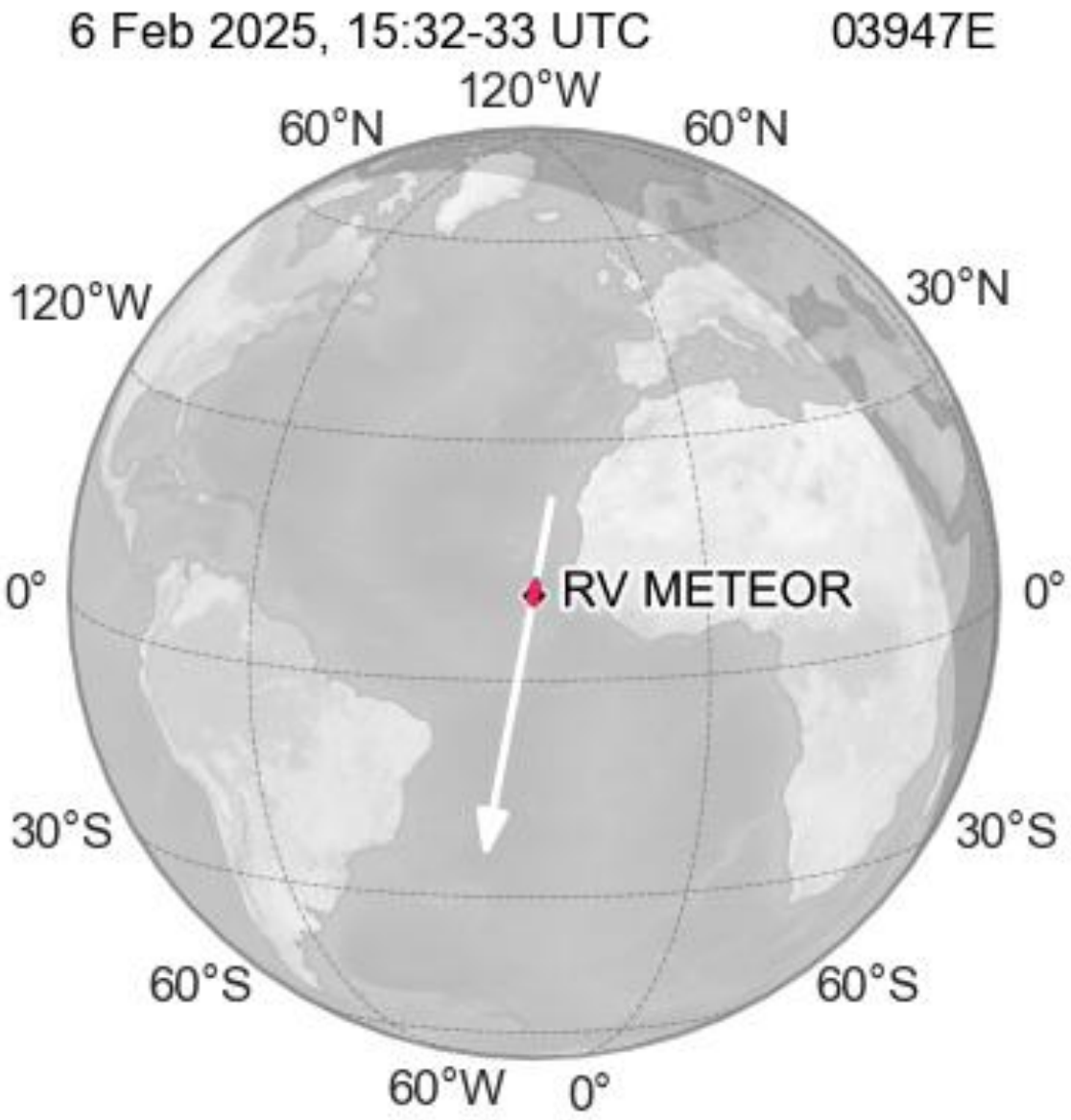
A-AER

Significant improvement for extinction

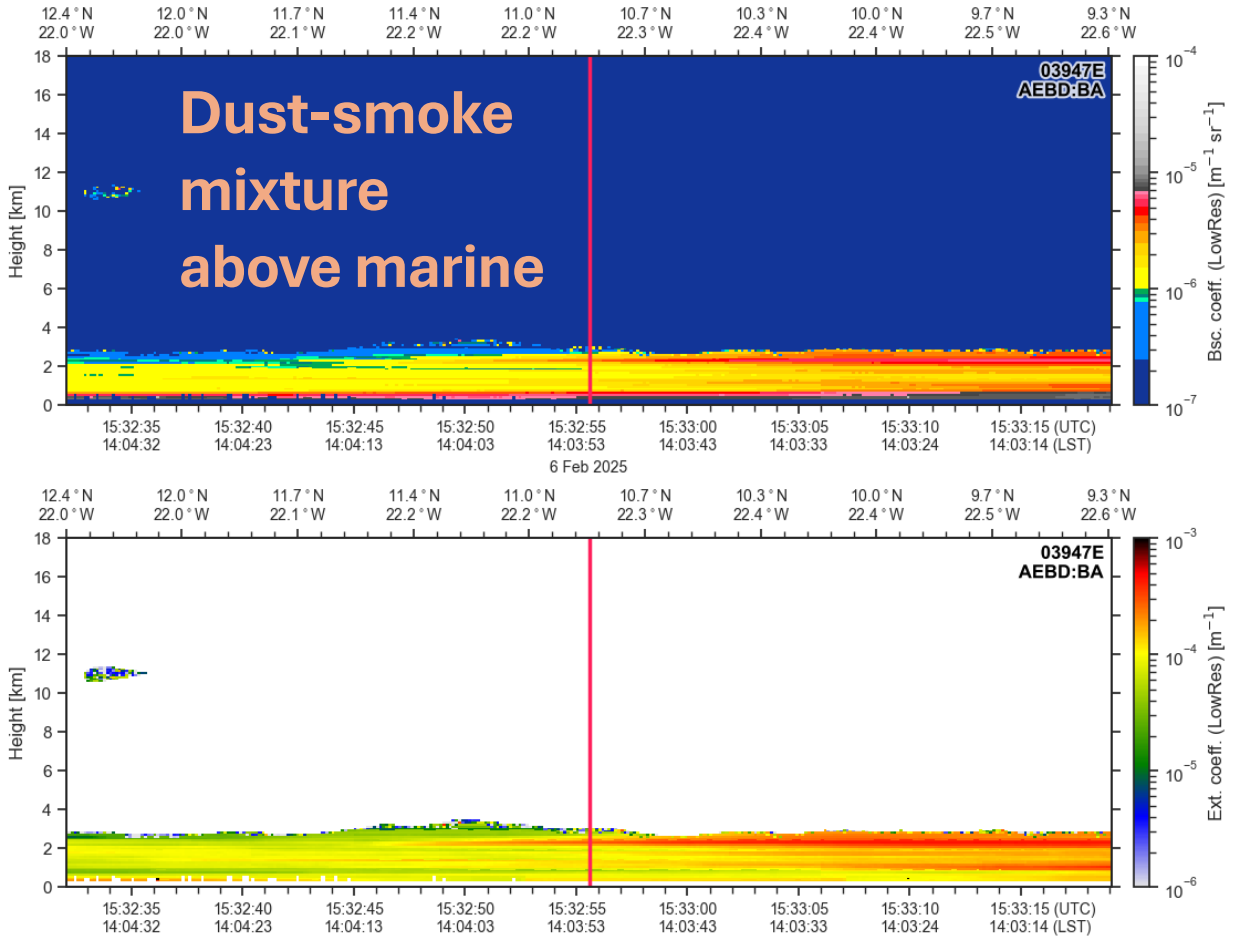
Strong improvement for depol ratio, but now slightly too high

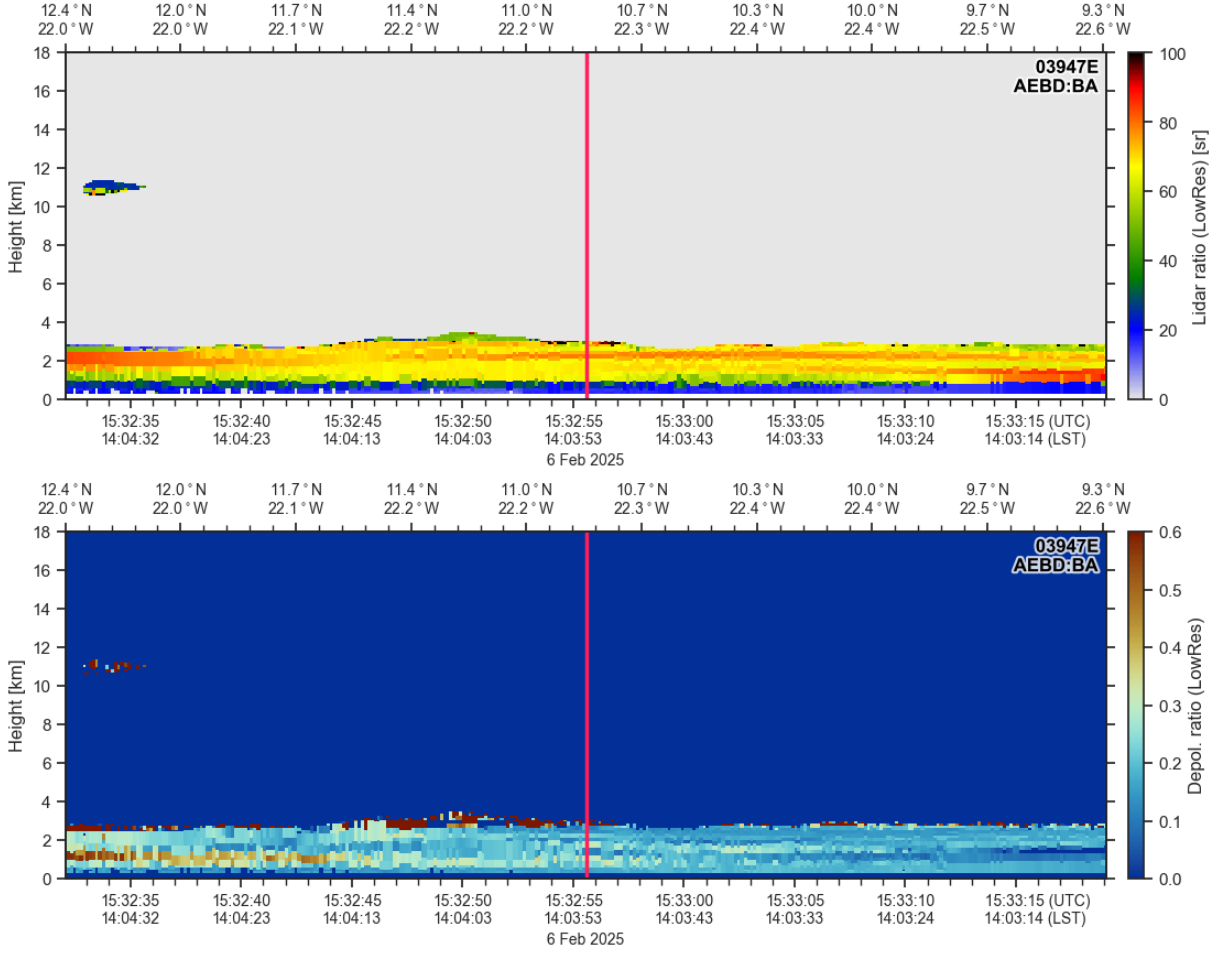
A-AER, baseline BA vs. AC, frame 1508B, 17 km distance


OCEANET-Atmosphere
RV Meteor ship campaign
4 Jan – 12 Feb 2025
Brazil – Cabo Verde
TROPOS
IFTU 160122 4
22SG


6 Feb 2025, 15:32-33 UTC
03947E
120°W
60°N
60°N
120°W
30°N
0°
RV METEOR
0°
30°S
30°S
60°S
60°S
60°W
0°

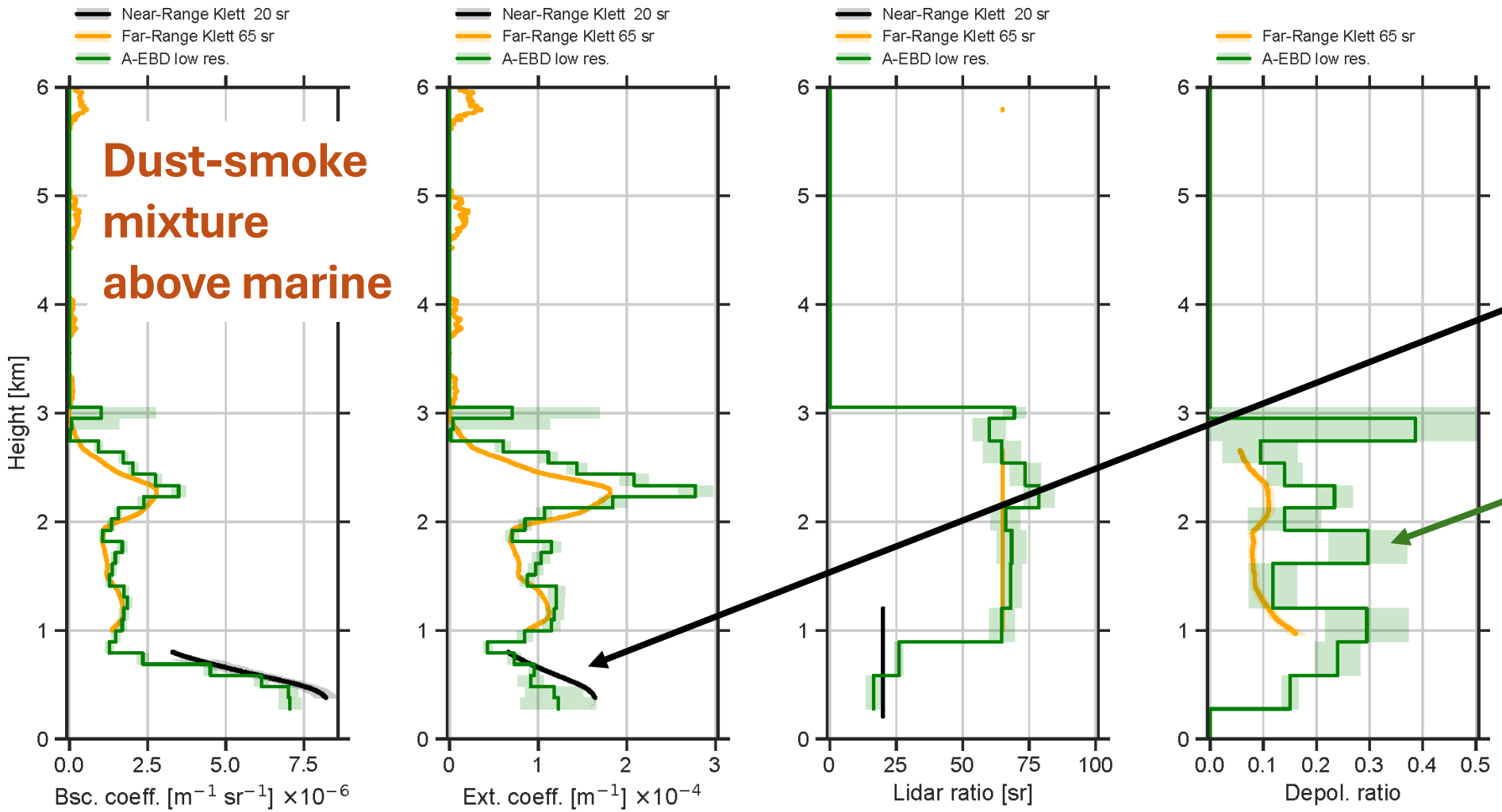
RV Meteor, Tropical Atlantic, 6 February 2025





A-EBD, low resolution, baseline BA, frame 3947E, <1 km distance

RV Meteor, Tropical Atlantic, 6 February 2025



A-EBD

low resolution

Very good near-surface comparisons

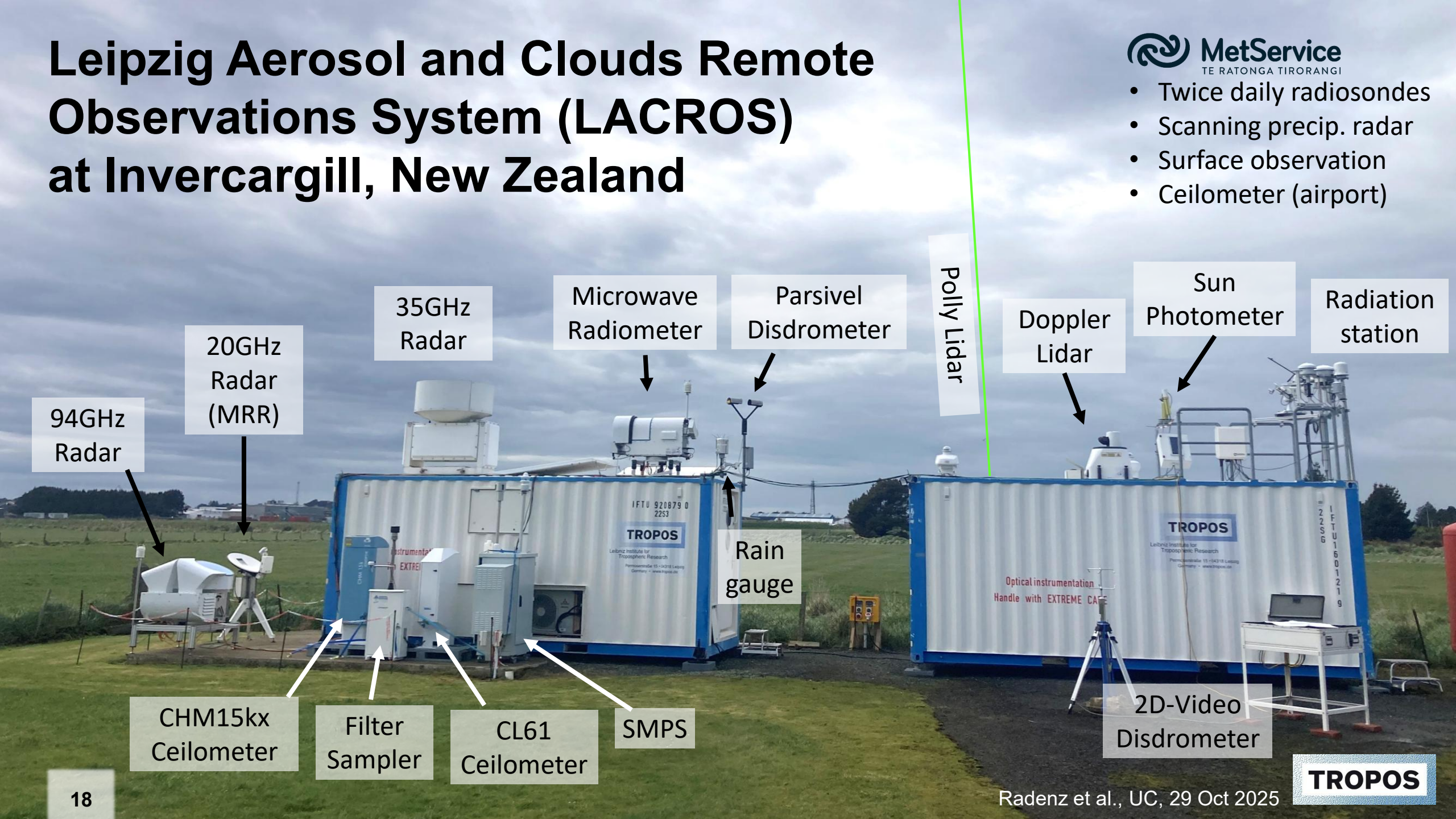
Depol. ratio too high as well

A-EBD, low resolution, baseline BA, frame 3947E, <1 km distance

Leipzig Aerosol and Clouds Remote Observations System (LACROS) at Invercargill, New Zealand

MetService
TE RATONGA TIRORANGI

- Twice daily radiosondes
- Scanning precip. radar
- Surface observation
- Ceilometer (airport)



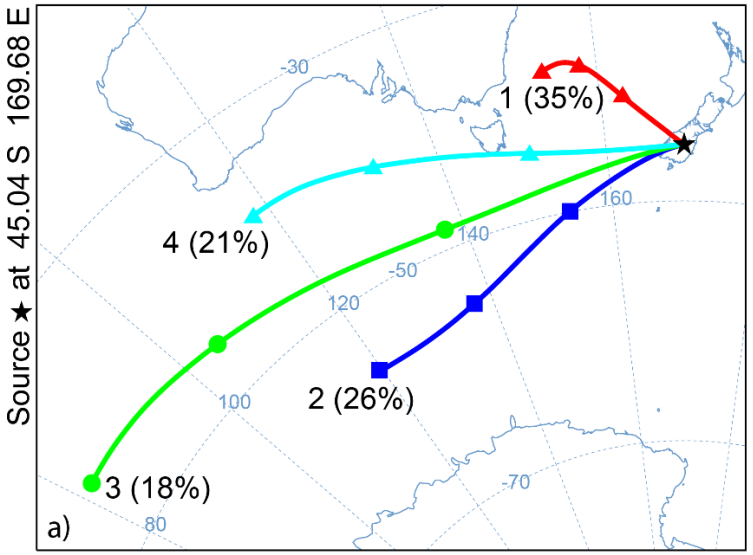
Radenz et al., UC, 29 Oct 2025

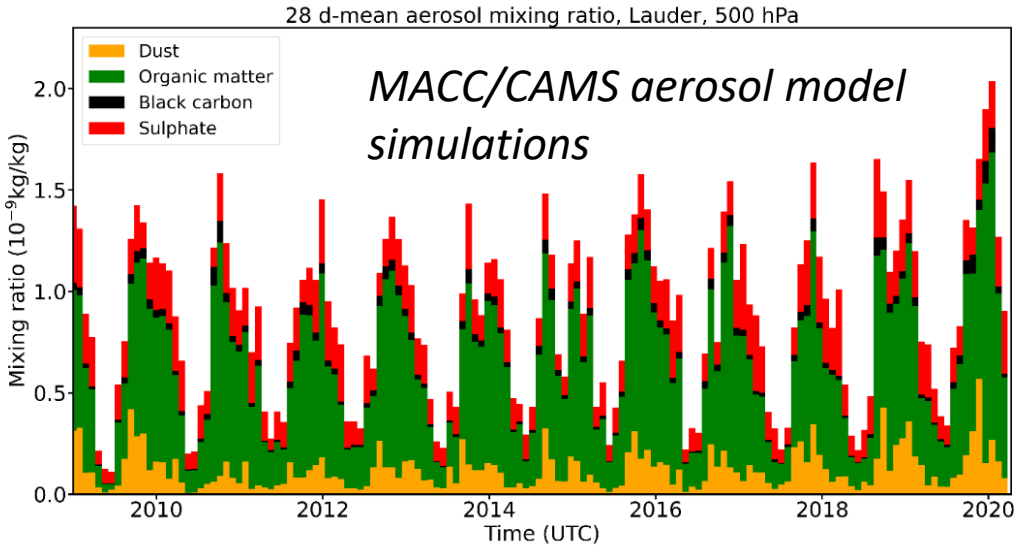
TROPOS

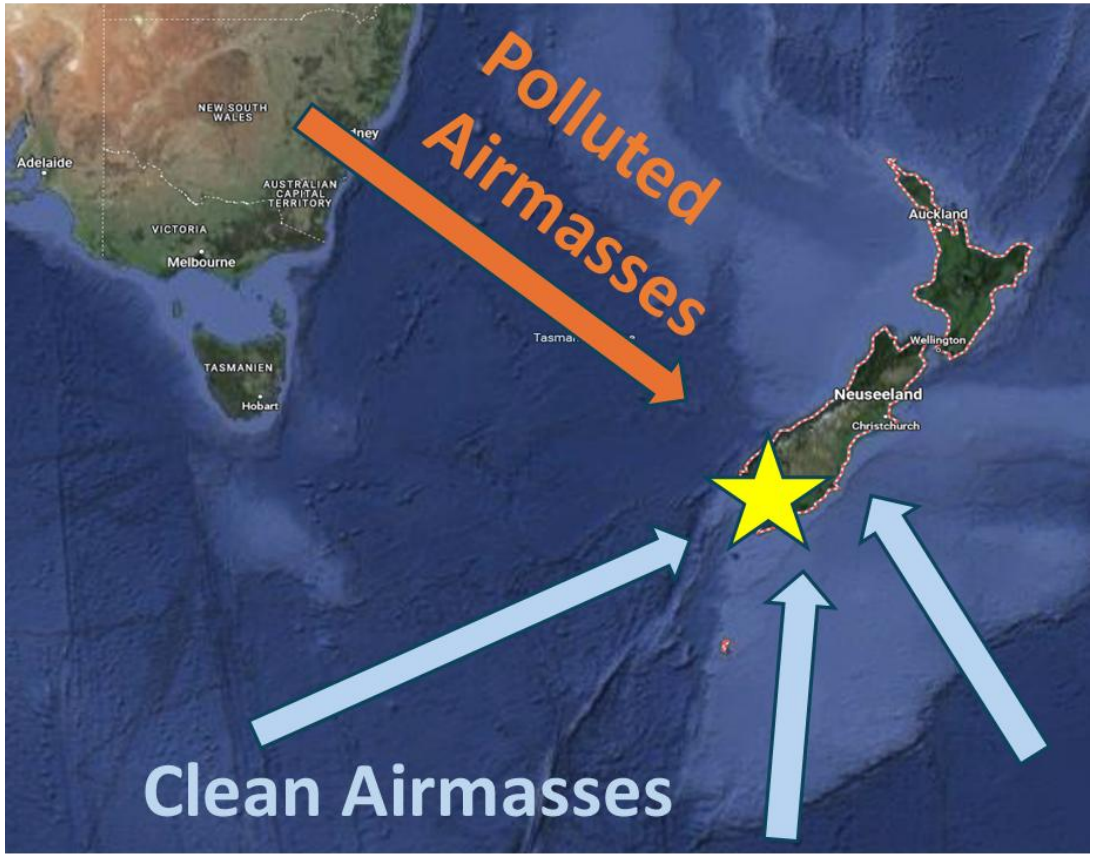
Southern Ocean Activities: goSouth-2 & HALO-South

Aerosol-limited cloud regime

- ~35% slightly polluted air from Australia
- ~40% clean air from Southern Ocean







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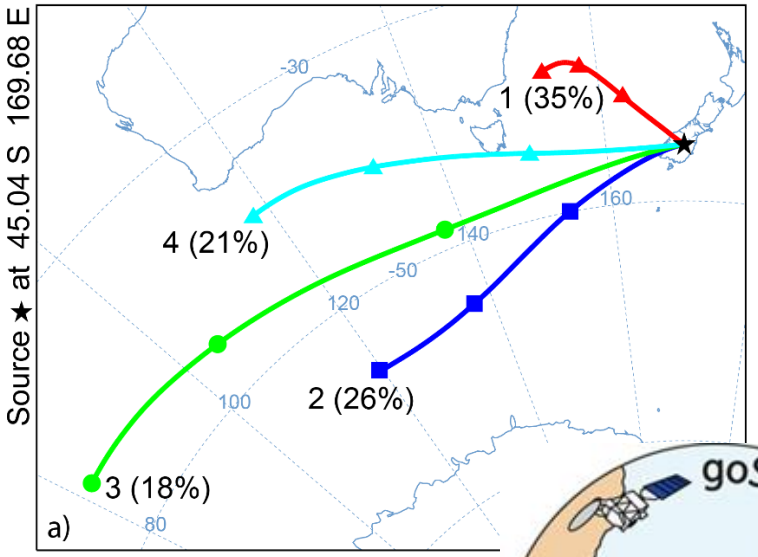
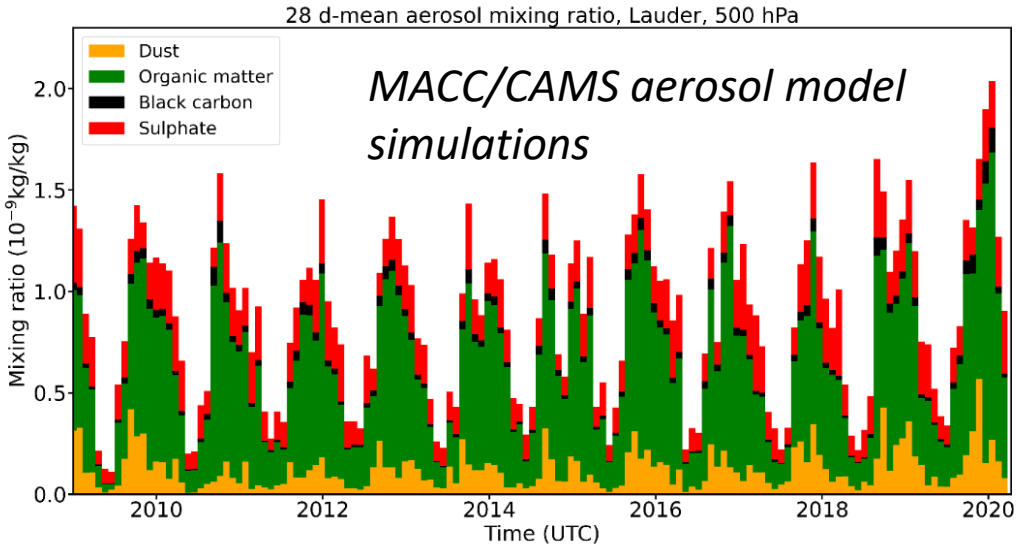
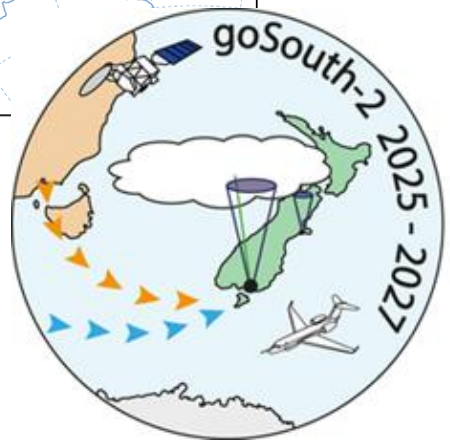
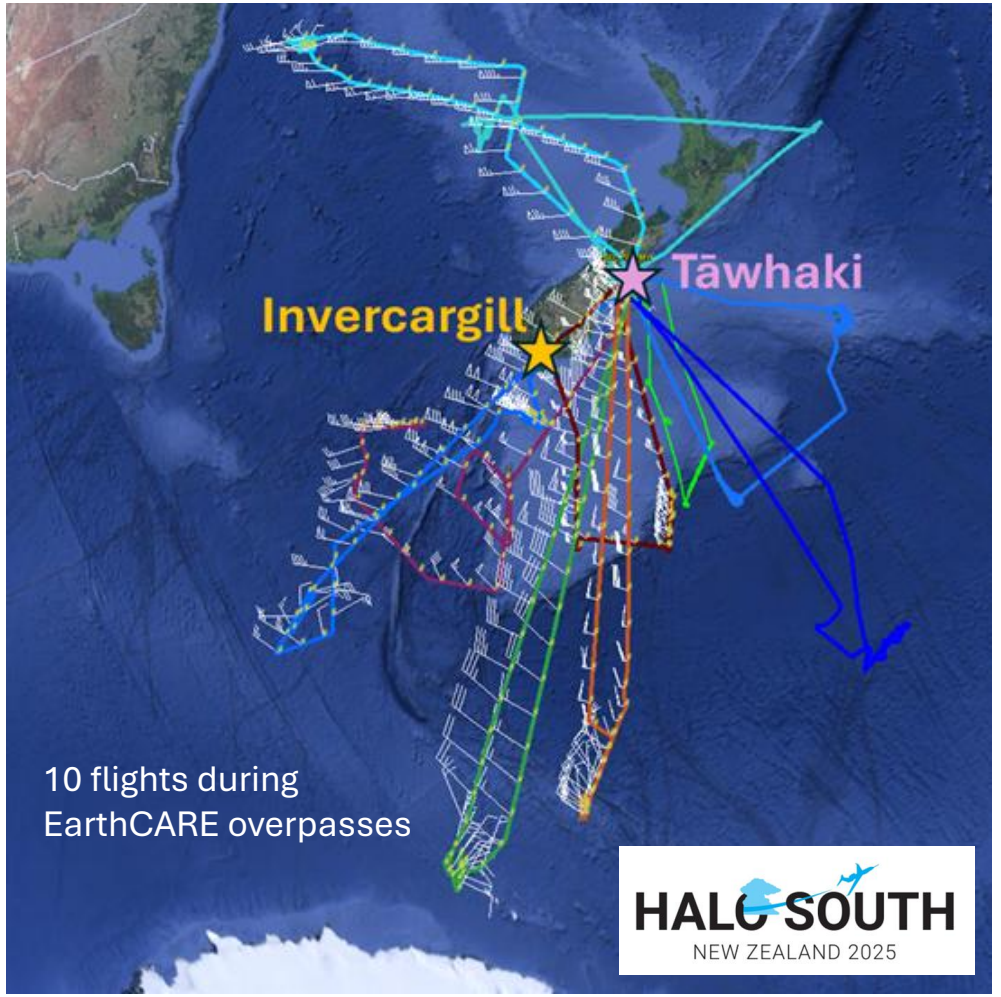


HALO-South Sep – Oct 2025

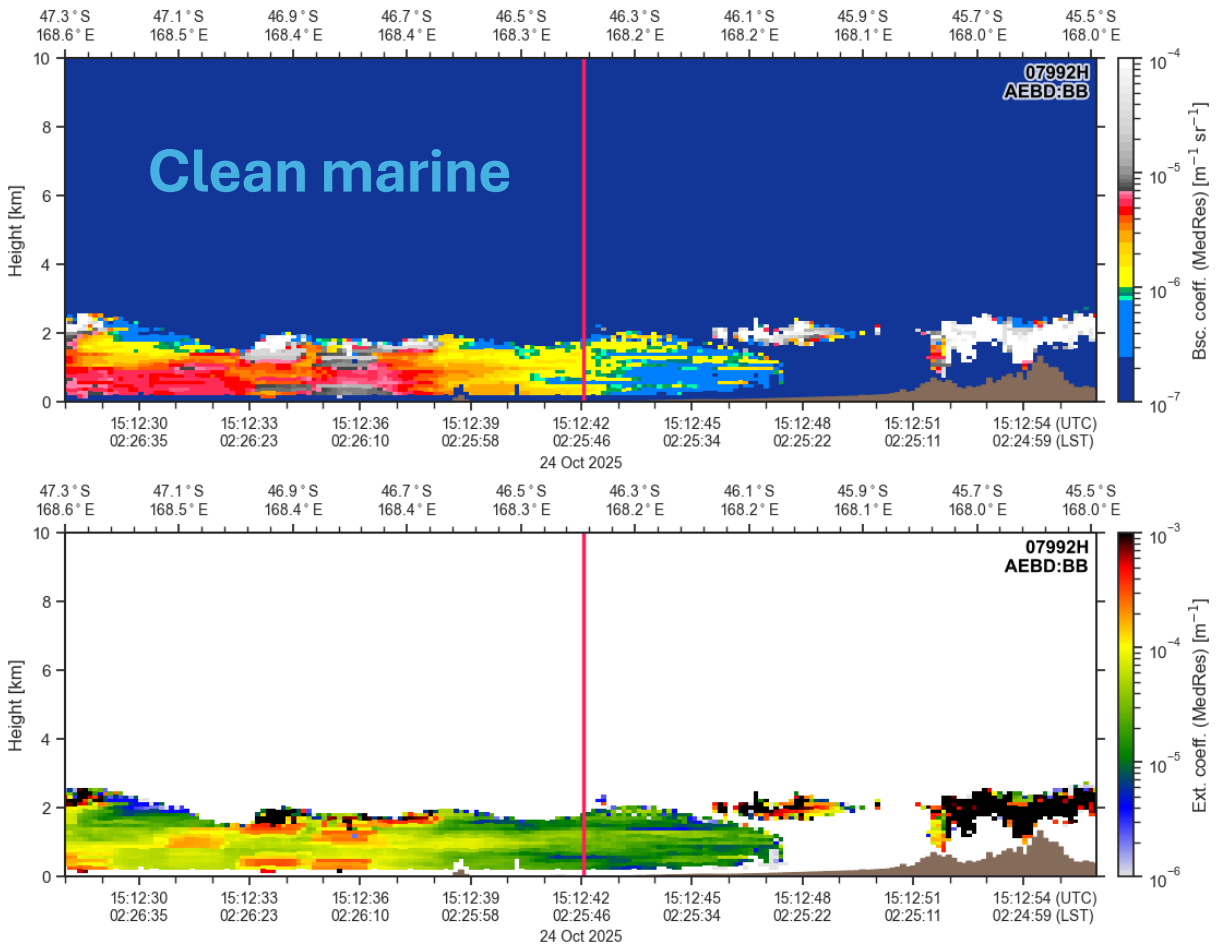


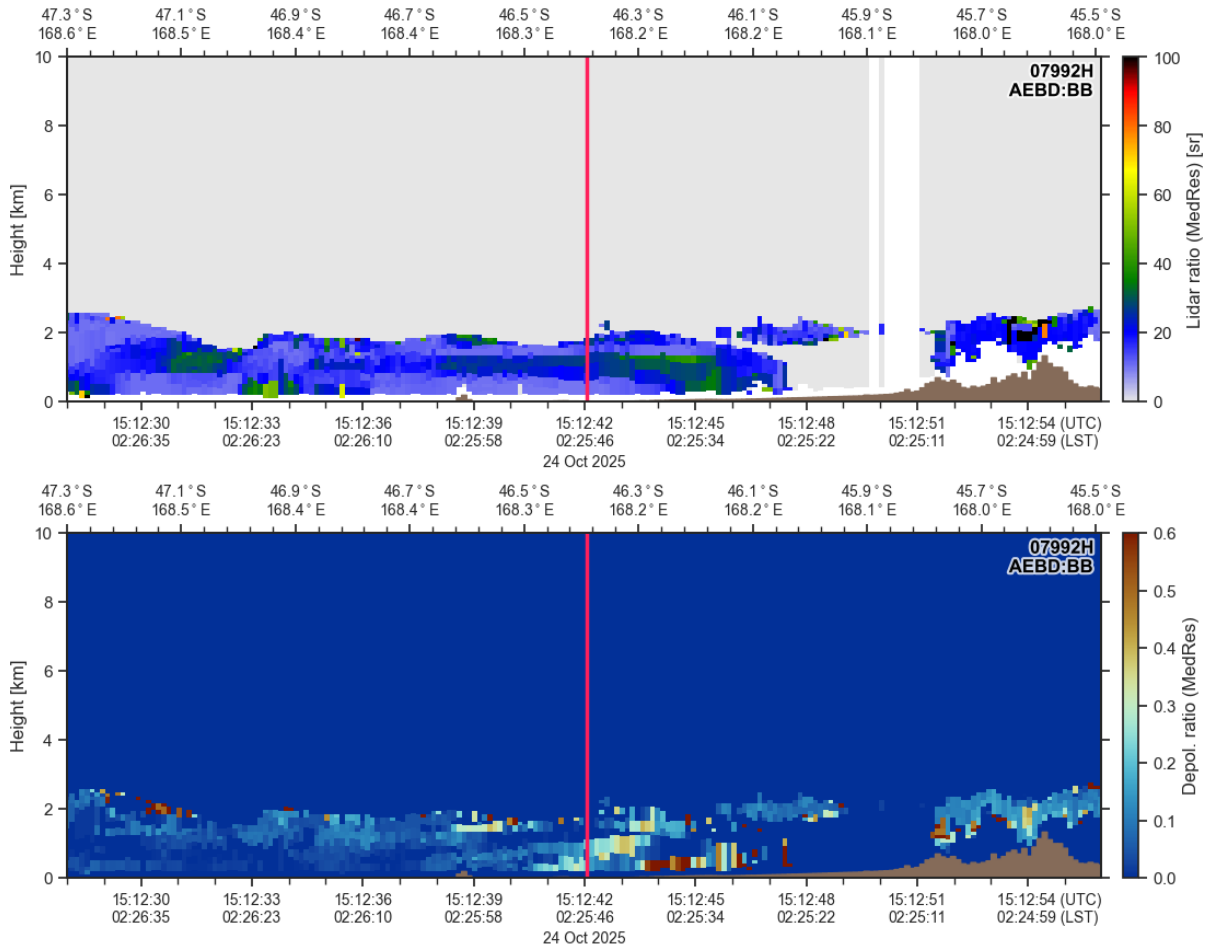


goSouth-2 Aug 2025 – Mar 2027



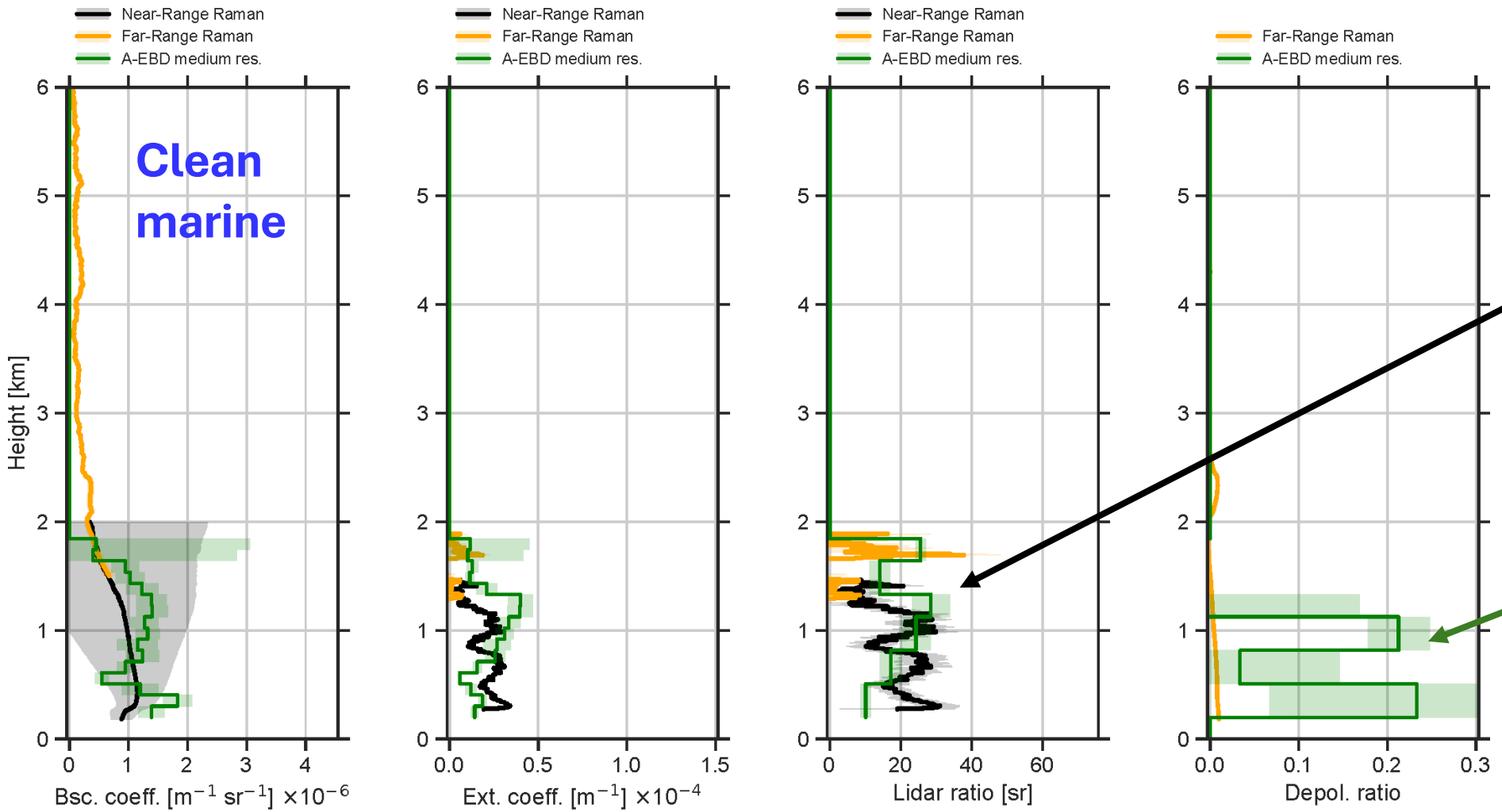
Invercargill, New Zealand, 24 October 2025





A-EBD, medium resolution, baseline BA, frame 3992H, 3.5 km distance

Invercargill, New Zealand, 24 October 2025



A-EBD
medium res.

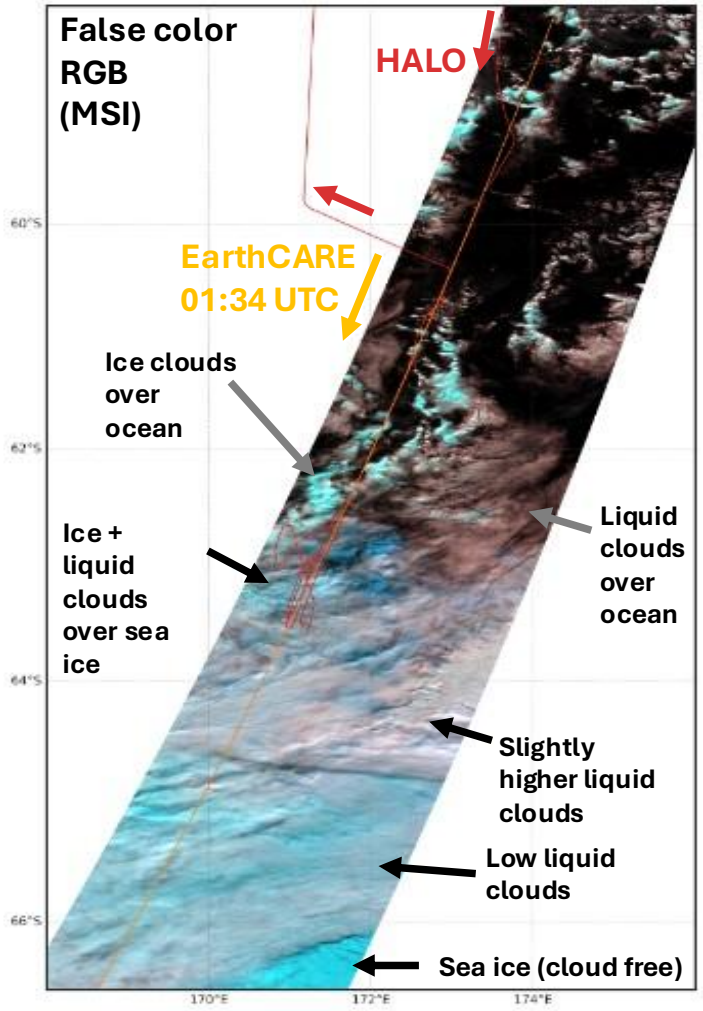
Very good near-surface comparisons under extreme clean condition

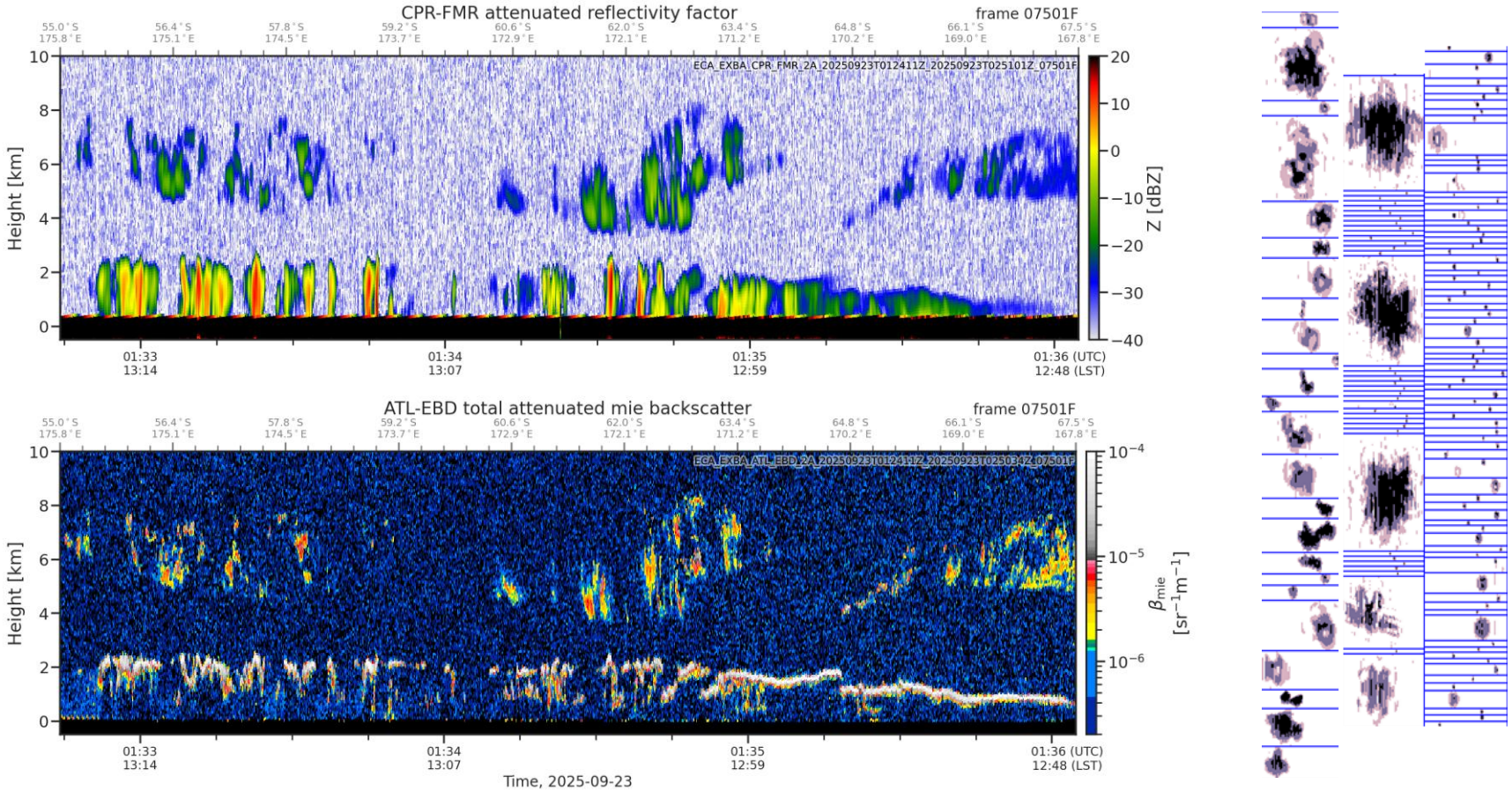
Depol. ratio highly uncertain

A-EBD, medium resolution, baseline BA, frame 3992H, 3.5 km distance

Outlook: Validation of microphysical products

EarthCARE Frame 07501F
22 September 2025





Comprehensive set of aerosol and cloud microphysical data available for EarthCARE validation (10 HALO flights related to EarthCARE overpasses)

Patric Seifert, Martin Radenz (TROPOS) & Deniz Menekay (DLR)

Conclusions and Lessons Learnt

+ As a permanent research infrastructure, ACTRIS can provide long-term Cal/Val support.
+ With the help of ATMO-ACCESS, in a collaborative ESA-ACTRIS effort, sustainable structures for standardized quality-assured operation and NRT data submission could be established.
+ Thanks to the intensive preparations, Cal/Val activities could start immediately after launch.
+ Hundreds of correlative observations were already performed in the Commissioning Phase.
+ ACTRIS Mobile Platforms have added value by providing data from specific areas of interest.
+ ESA effort for establishing access to EarthCARE data is highly appreciated.

BUT

– Production and submission of data to EVDC is only the first step. Analysis of the data needs extra support ⇨ funding of „access to expertise“.
– EVDC data management must follow the mission standards. GEOMS format is outdated!

Thank you!

ACTRIS
Exploring the Atmosphere

ATMO ACCESS
Access to Atmospheric Research Facilities

TROPOS