



Validating from within: early Level 2 product intercomparison from CELLO-ORCESTRA

Tim Carlsen¹, Sorin Ghemuleț², Alex Vlad², Marius Corbu², Magdalena Ardelean², Robert O. David¹

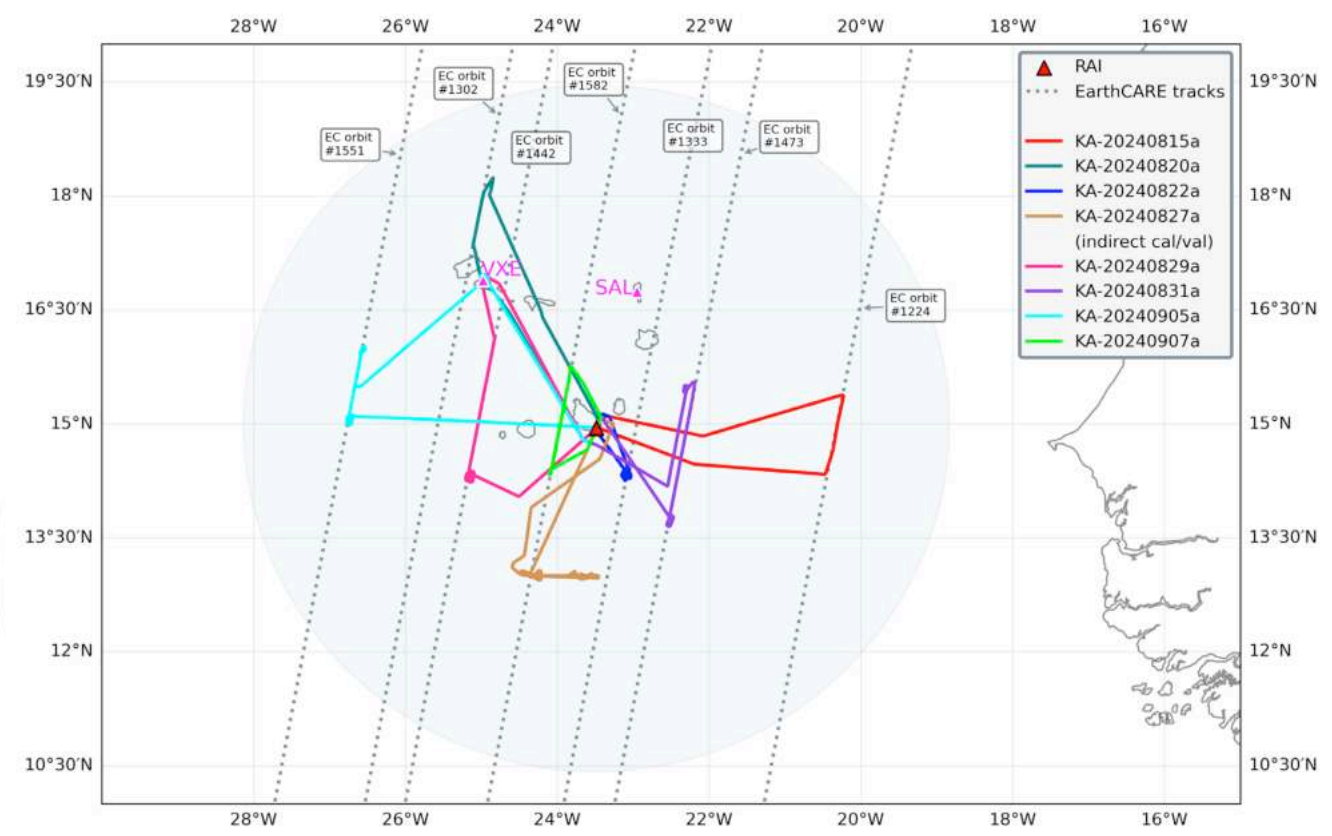
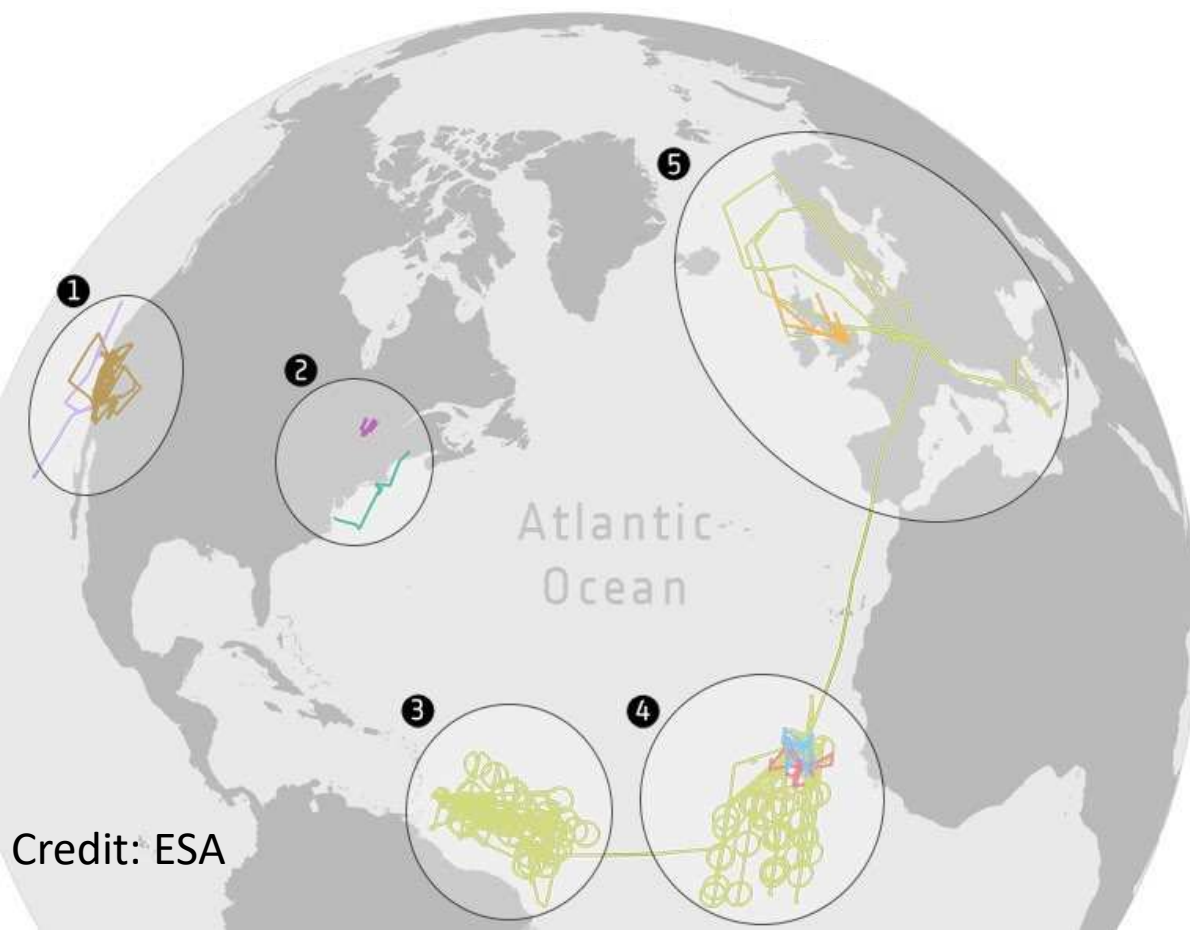
¹University of Oslo, Norway

²INCAS Bucharest, Romania

2nd ESA-JAXA EarthCARE In-Orbit Validation Workshop

17 – 20 March 2025 | ESA-ESRIN | Frascati (Rome), Italy

ORCESTRA



Credit: ESA

Research flights

7 targeted EarthCARE orbits
2 flights for indirect cal/val

3 aerosol flights
underneath EarthCARE

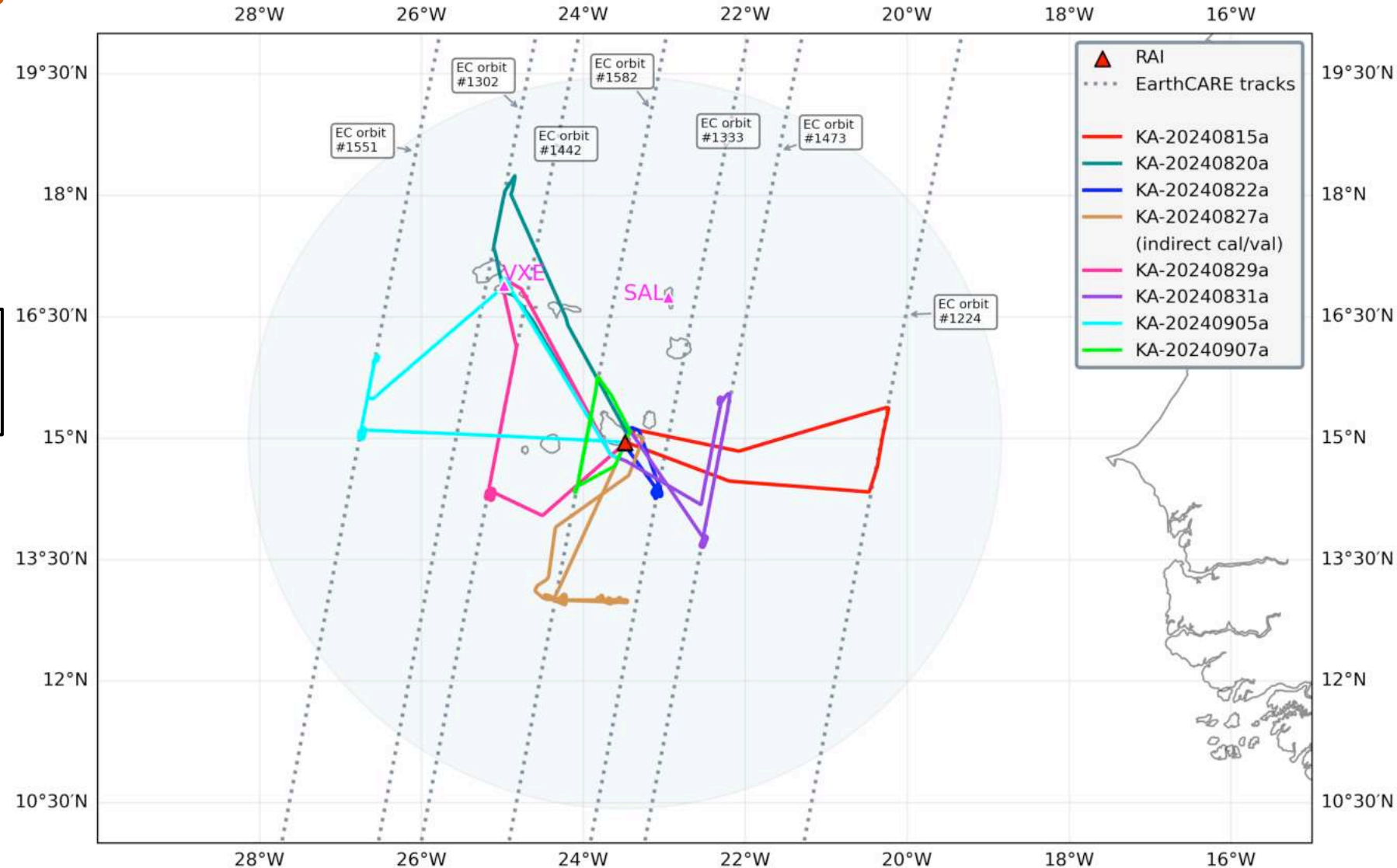
4 flights with in-cloud data
underneath EarthCARE

- Liquid-only clouds
- Mixed-phase clouds
(down to -19°C)

Coordination

- HALO (4 flights)
- ATR-42 (4 flights)
- Mindelo (3 flights)
- RV Meteor (1 flight)

August-September 2024



Instrumentation on the King Air

Aircraft specifics:

- Range: 2000 km (4-5 hours)
- Science speed: 70 m/s
- Transit speed: 125 m/s

In situ probes: SPEC Hawkeye, DMT CAPS

- Cloud droplets (2-50 μm)
- Ice crystals (up to 1.5 mm)
- Aerosols ($>0.61 \mu\text{m}$)



DMT CAPS probe

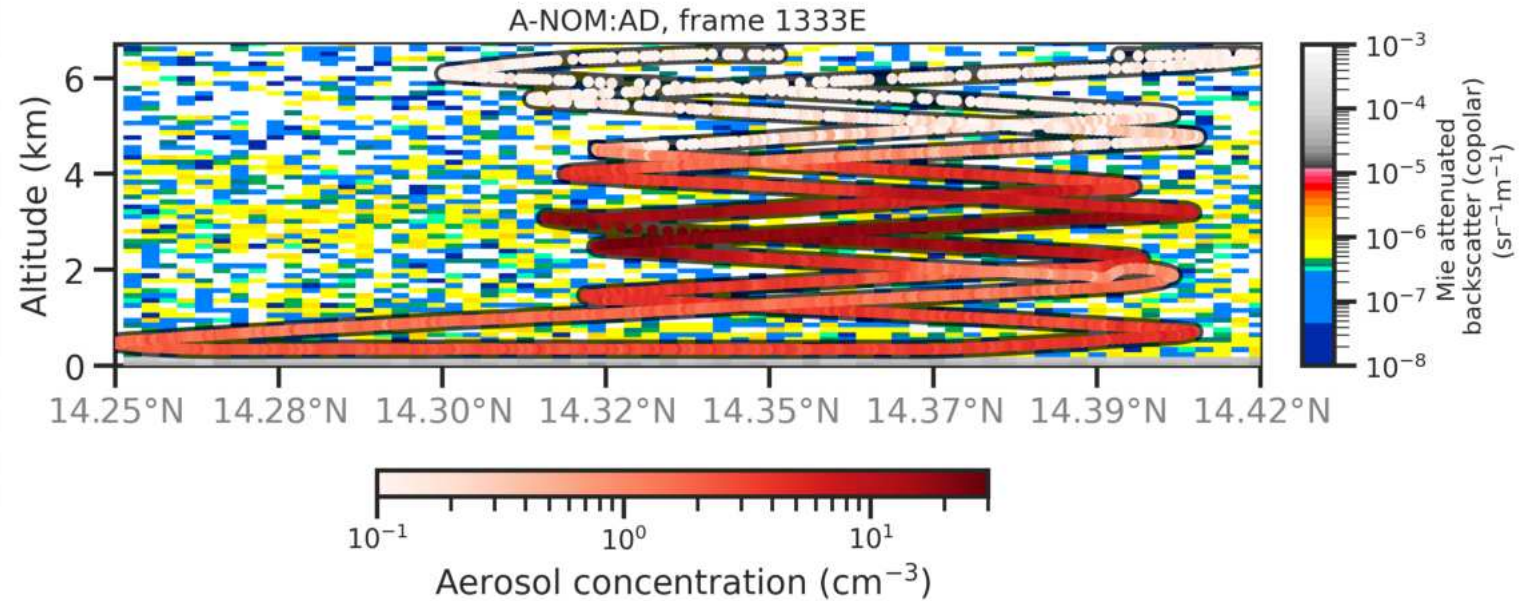
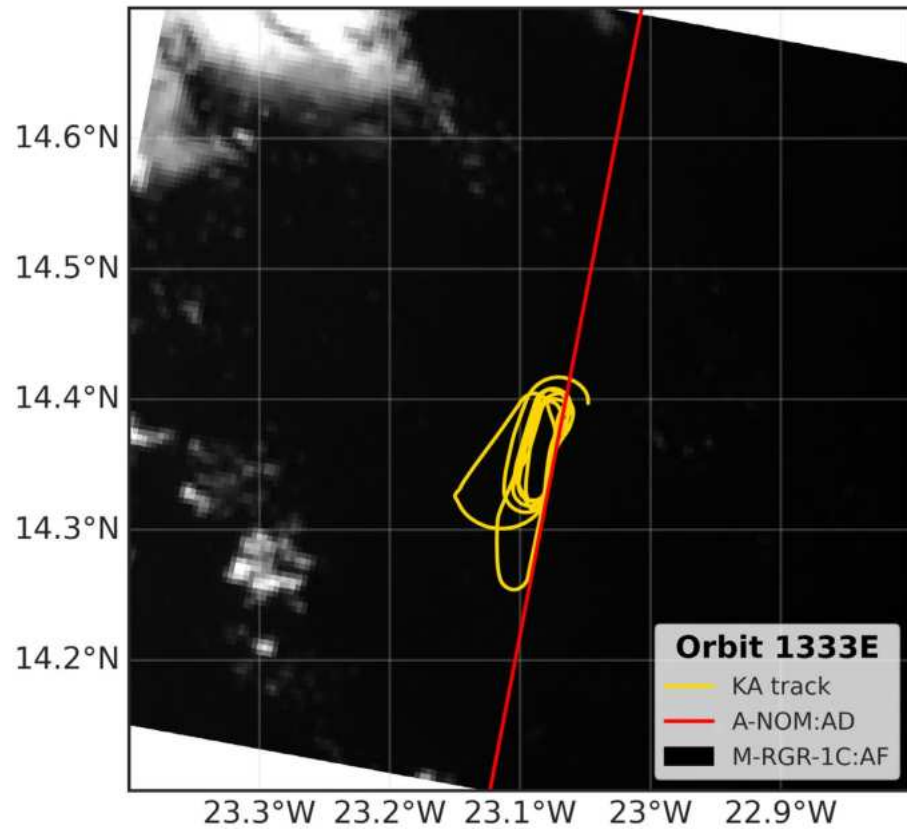


SPEC Hawkeye probe



Quicklook of
cloud droplets and
ice crystals
during the flight

Validating ATLID target classification



Flight on 22nd August 2024:

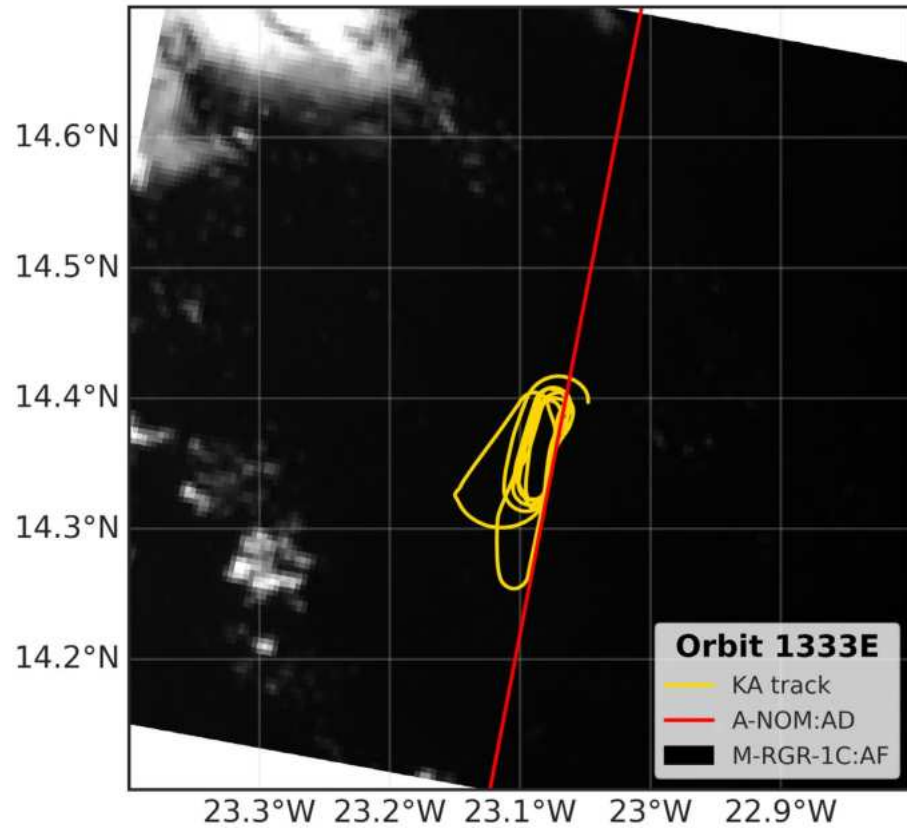
target orbit #1333

Strategy:

EarthCARE overpass (aerosol spirals)

Collocation with ATR-42 and HALO

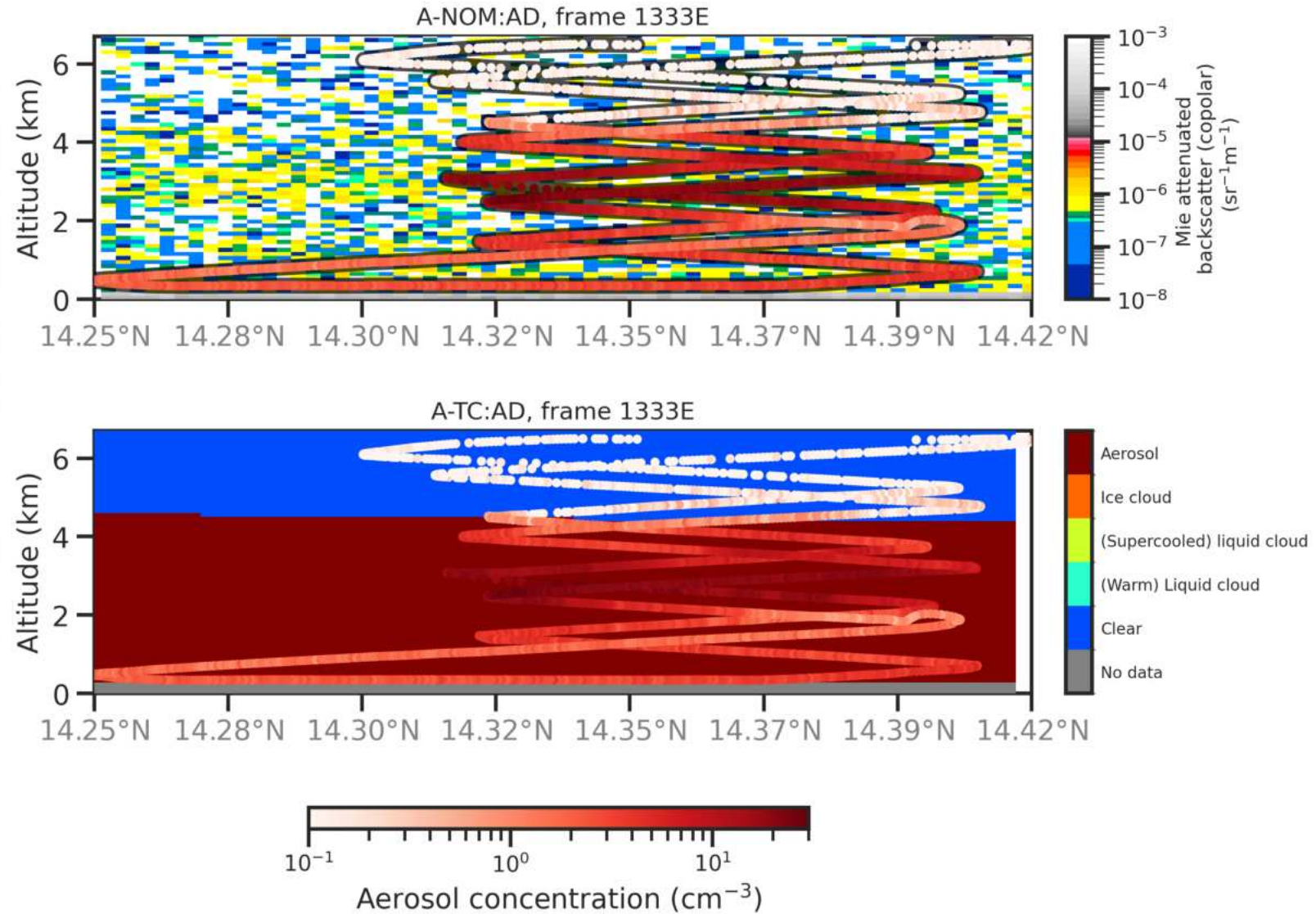
Validating ATLID target classification



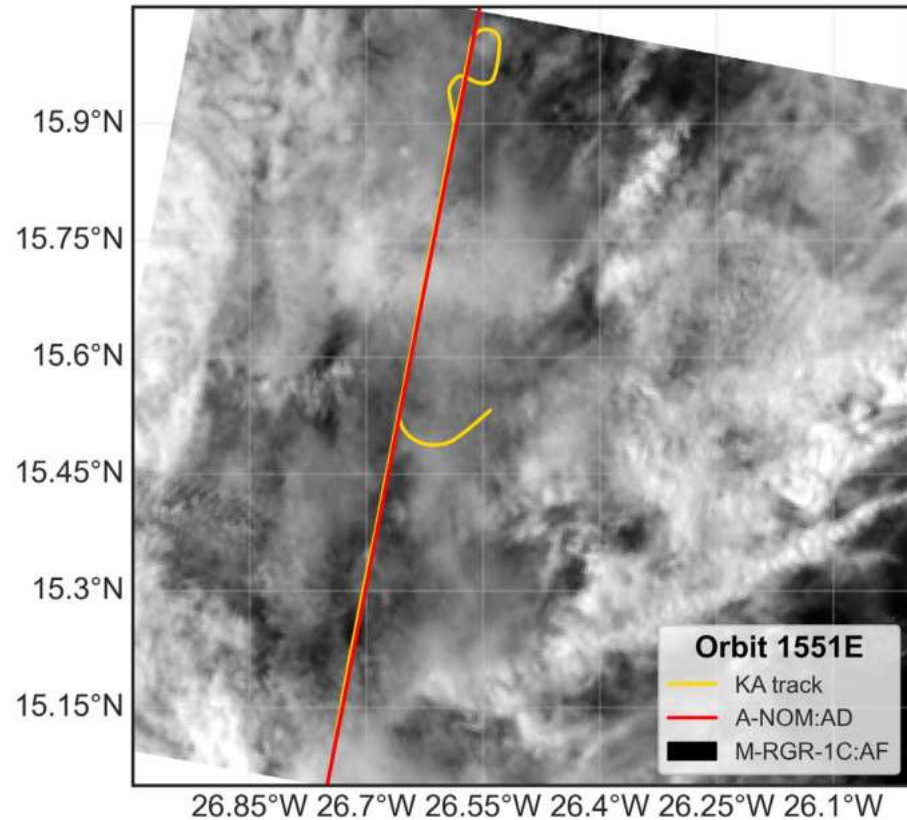
Flight on 22nd August 2024:
target orbit #1333

Strategy:

EarthCARE overpass (aerosol spirals)
Collocation with ATR-42 and HALO



Probing a thin liquid cloud



Flight on 5th September 2024:

target orbit #1551

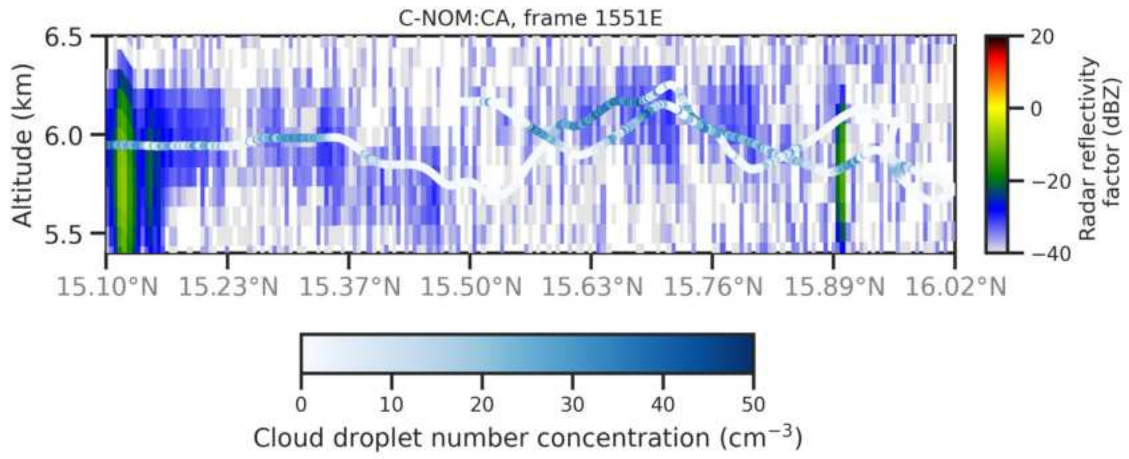
Strategy:

EarthCARE overpass

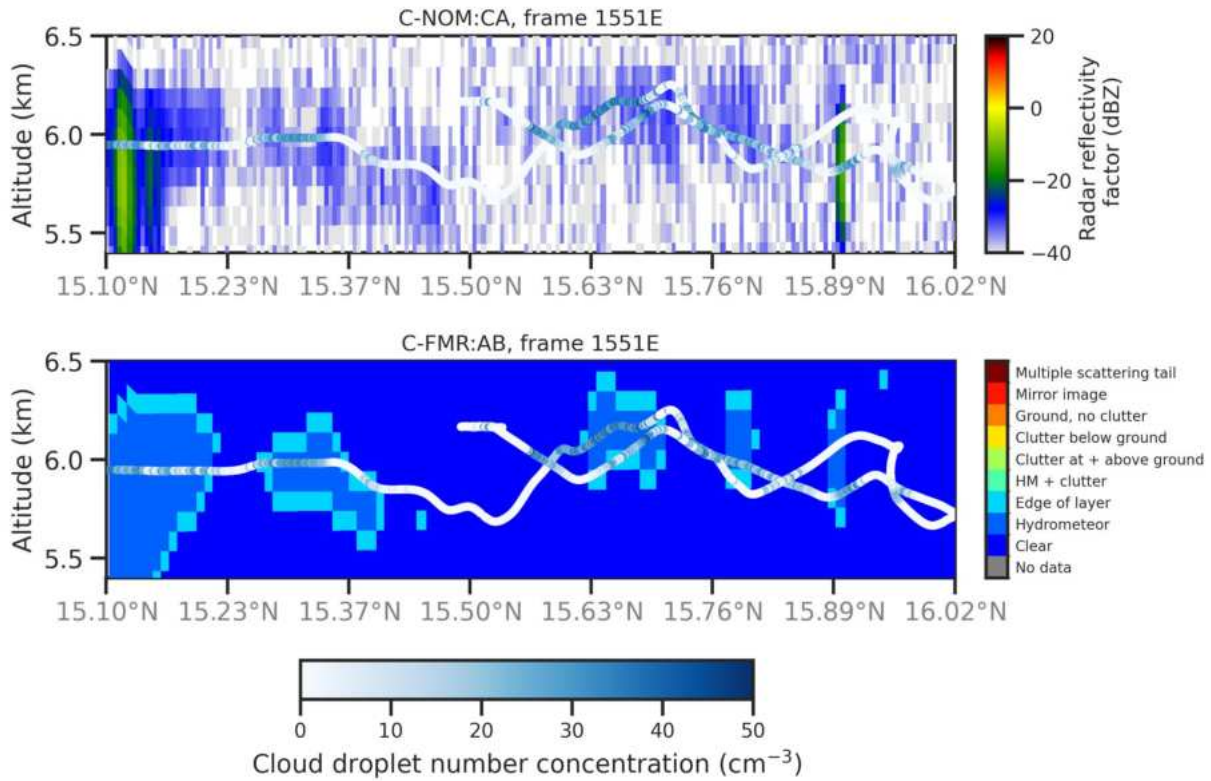
Porpoising to envelop cloud deck



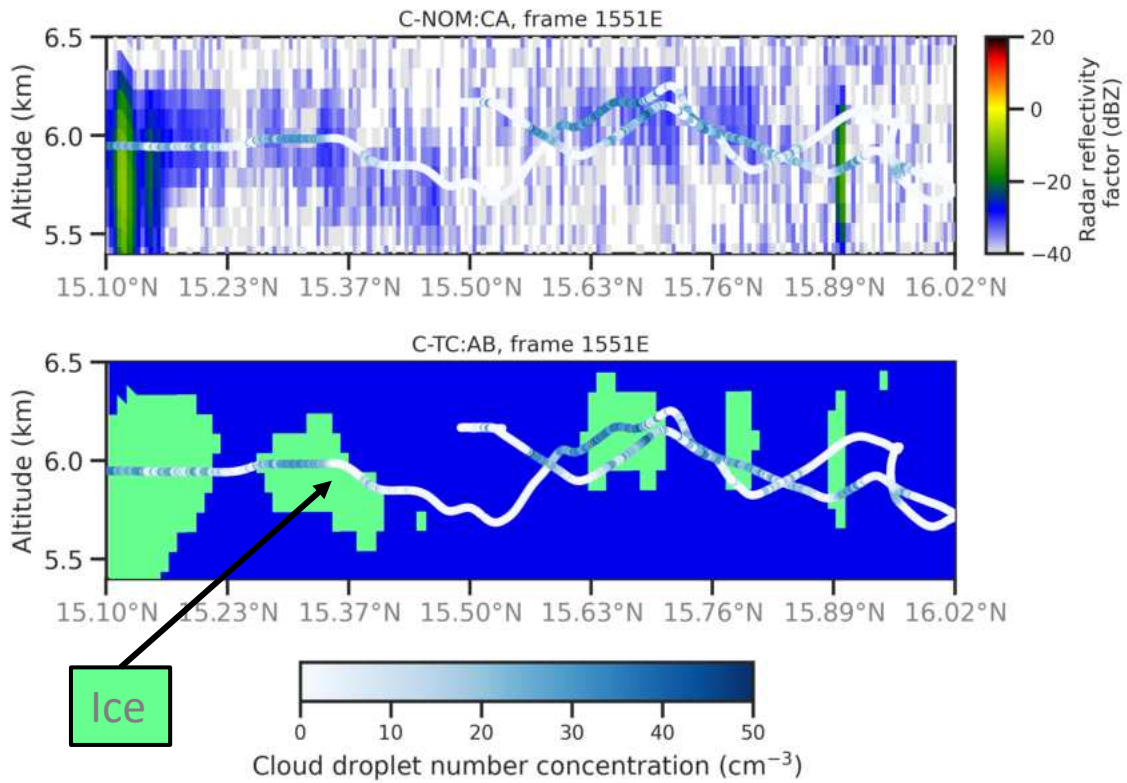
Probing a thin liquid cloud



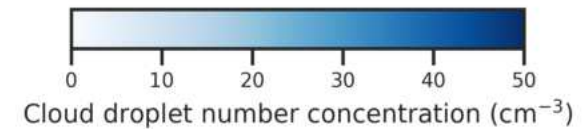
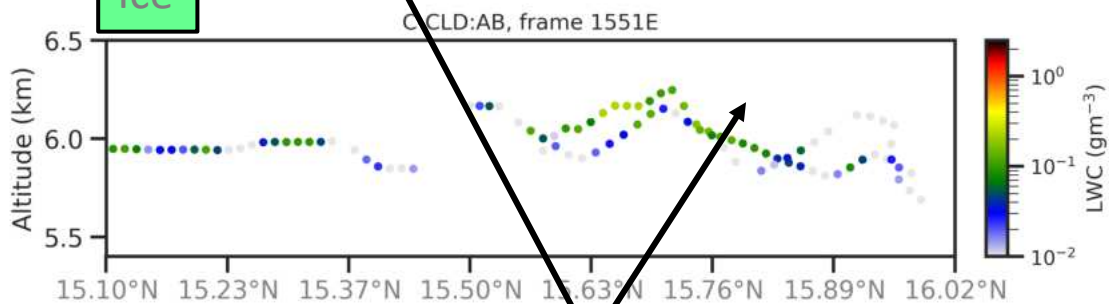
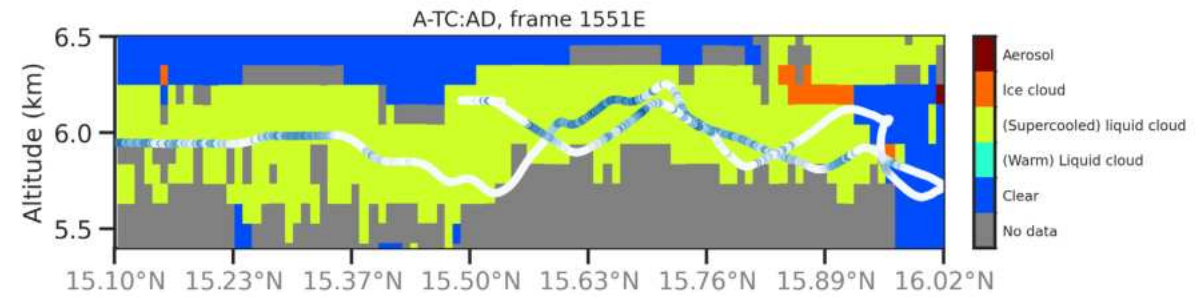
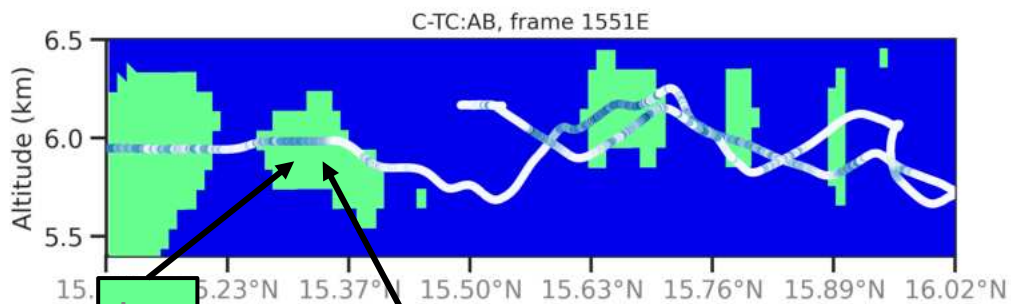
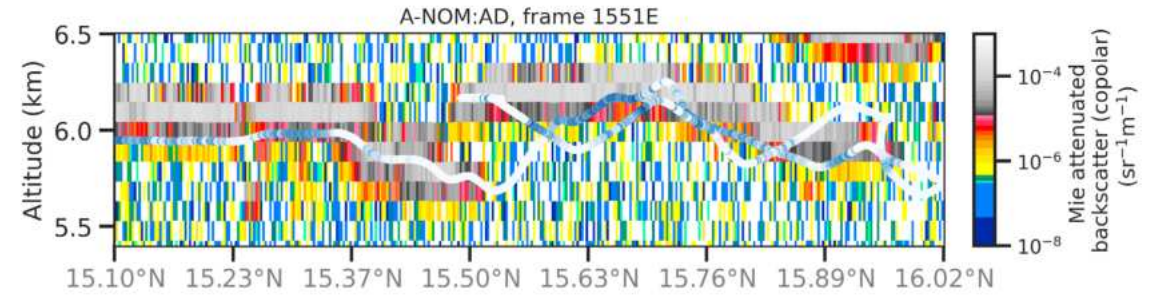
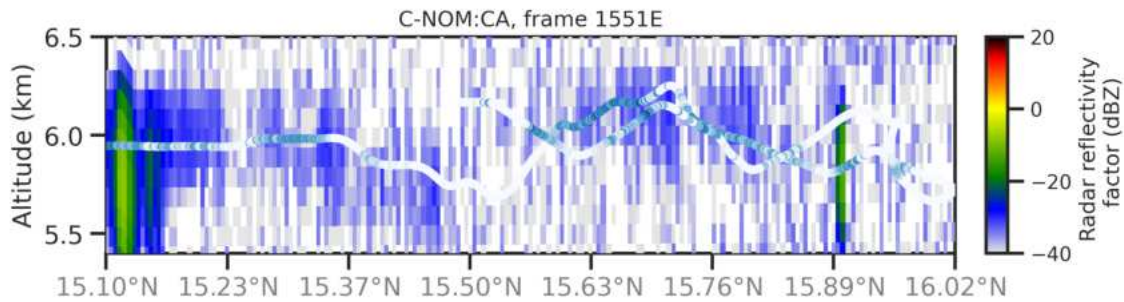
Probing a thin liquid cloud



Probing a thin liquid cloud



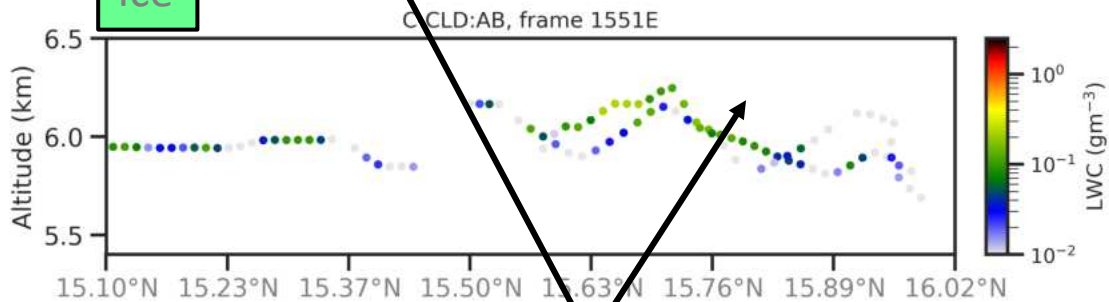
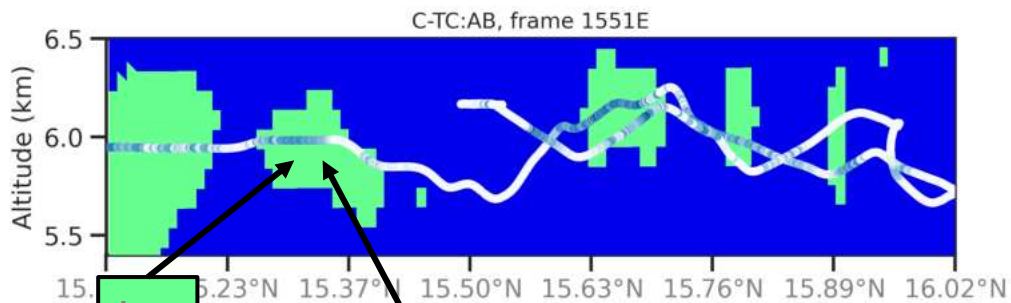
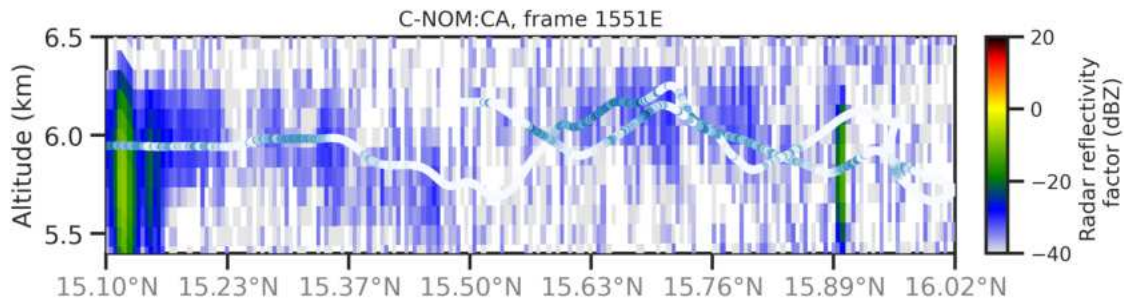
Probing a thin liquid cloud



Retrieval status

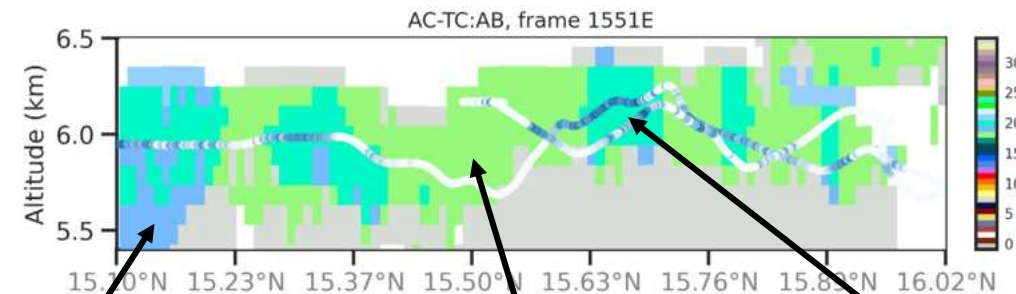
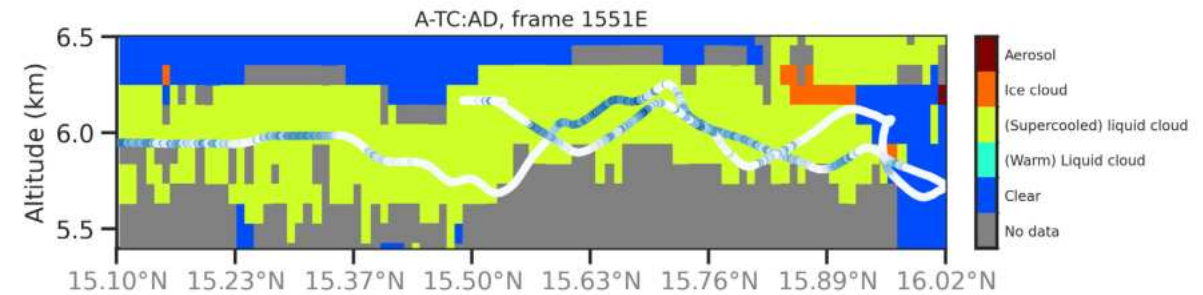
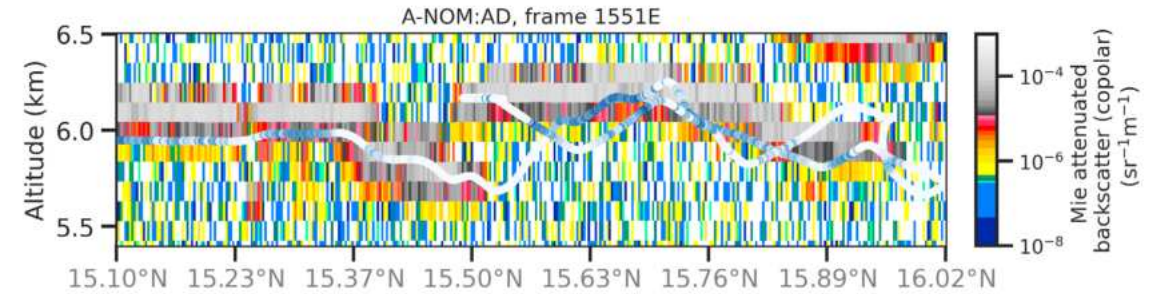
-2 = Retrieval not applied
(hydrometeor **not** present)

Probing a thin liquid cloud

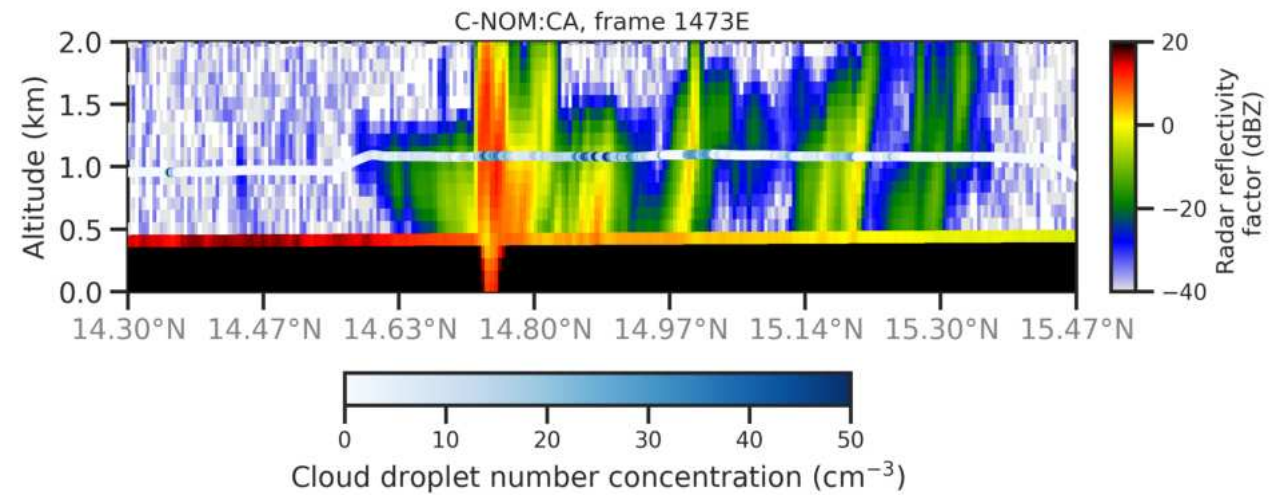
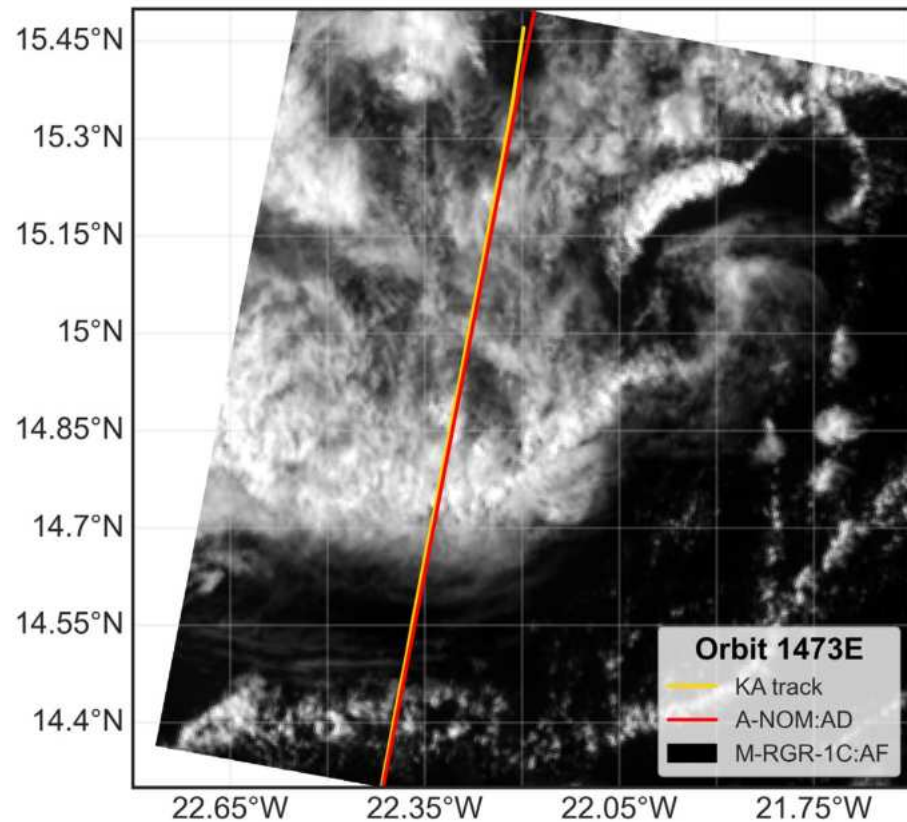


Retrieval status

-2 = Retrieval not applied
(hydrometeor **not** present)



Probing a convective cloud



Flight on 31st August 2024:

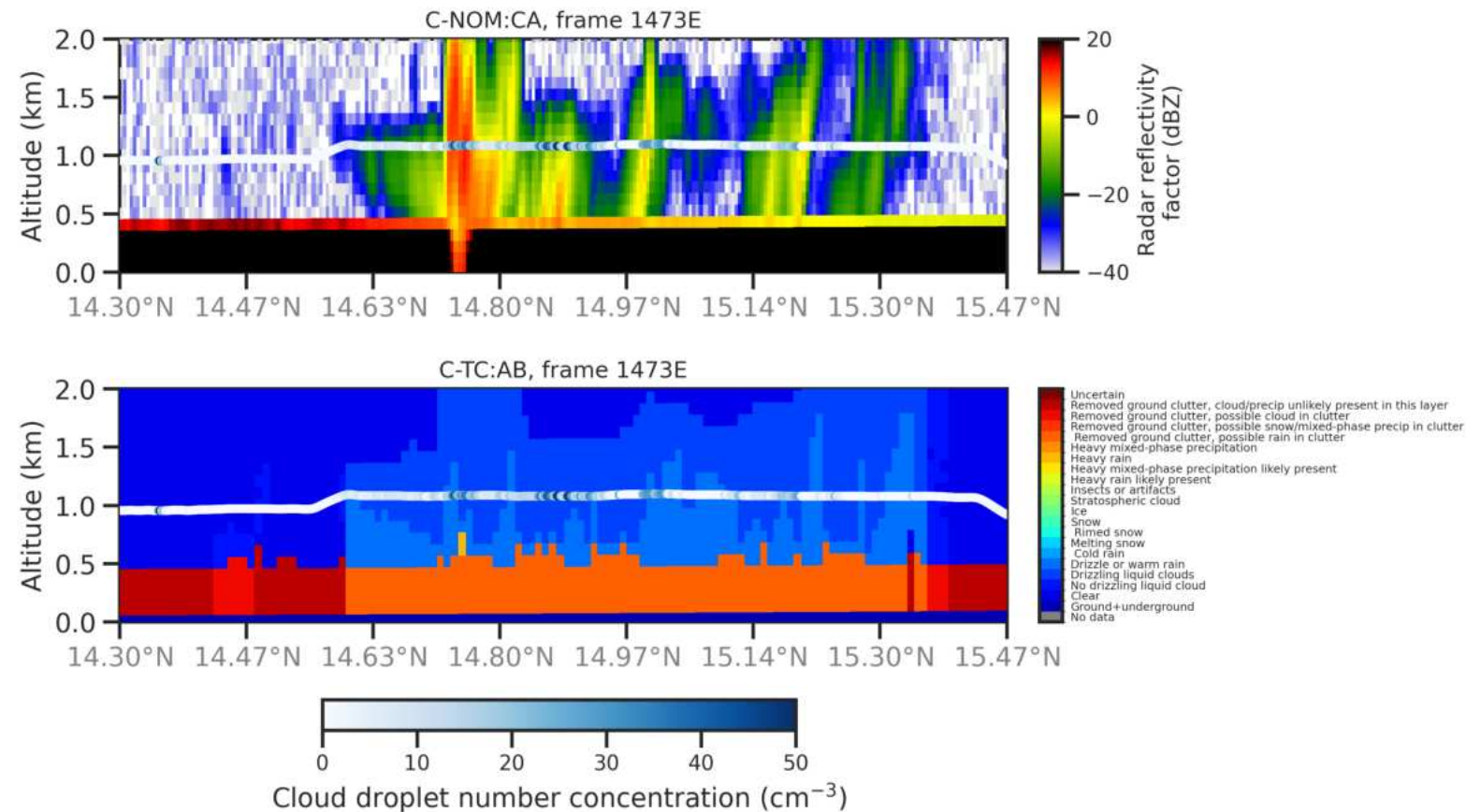
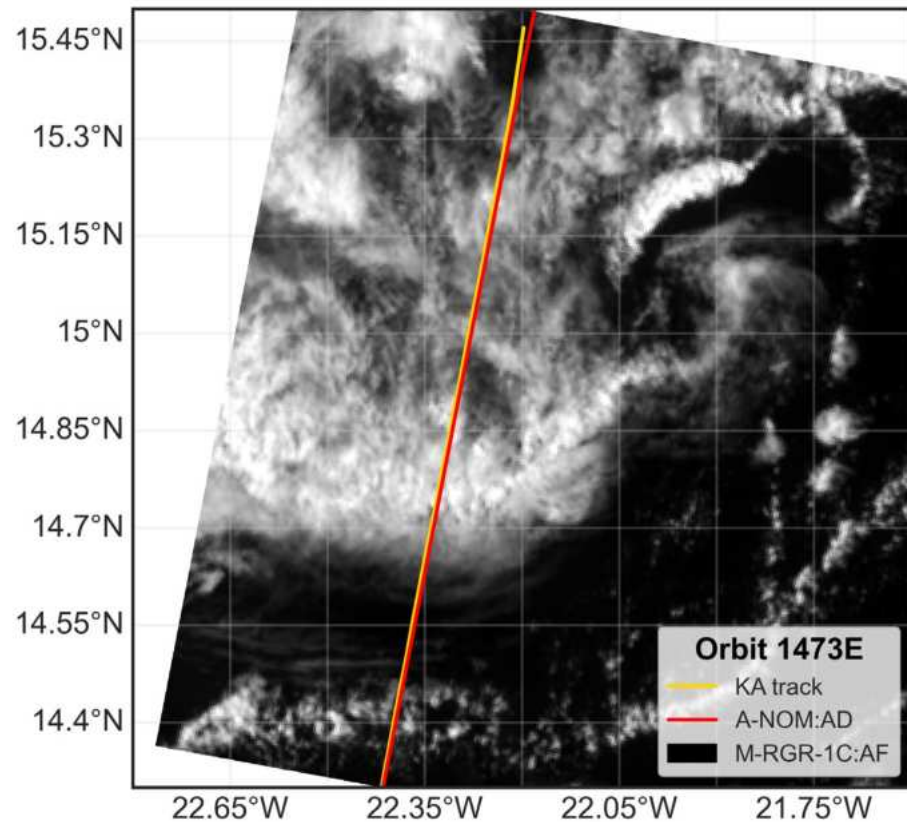
target orbit #1473

Strategy:

EarthCARE overpass

Constant altitude leg below ATR-42

Probing a convective cloud



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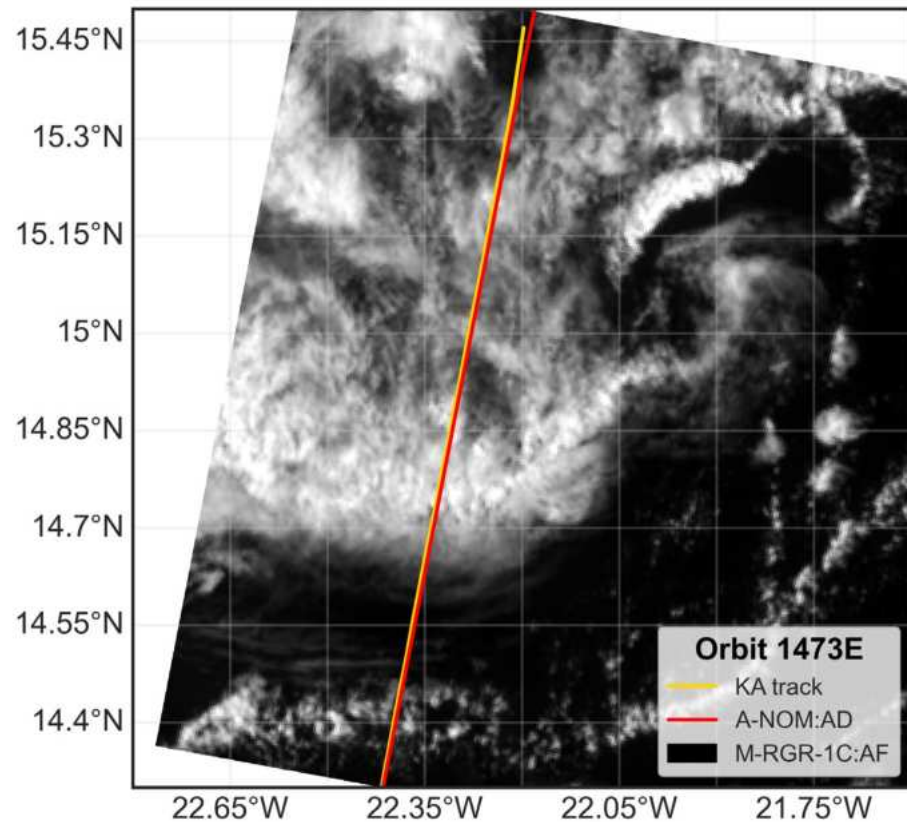
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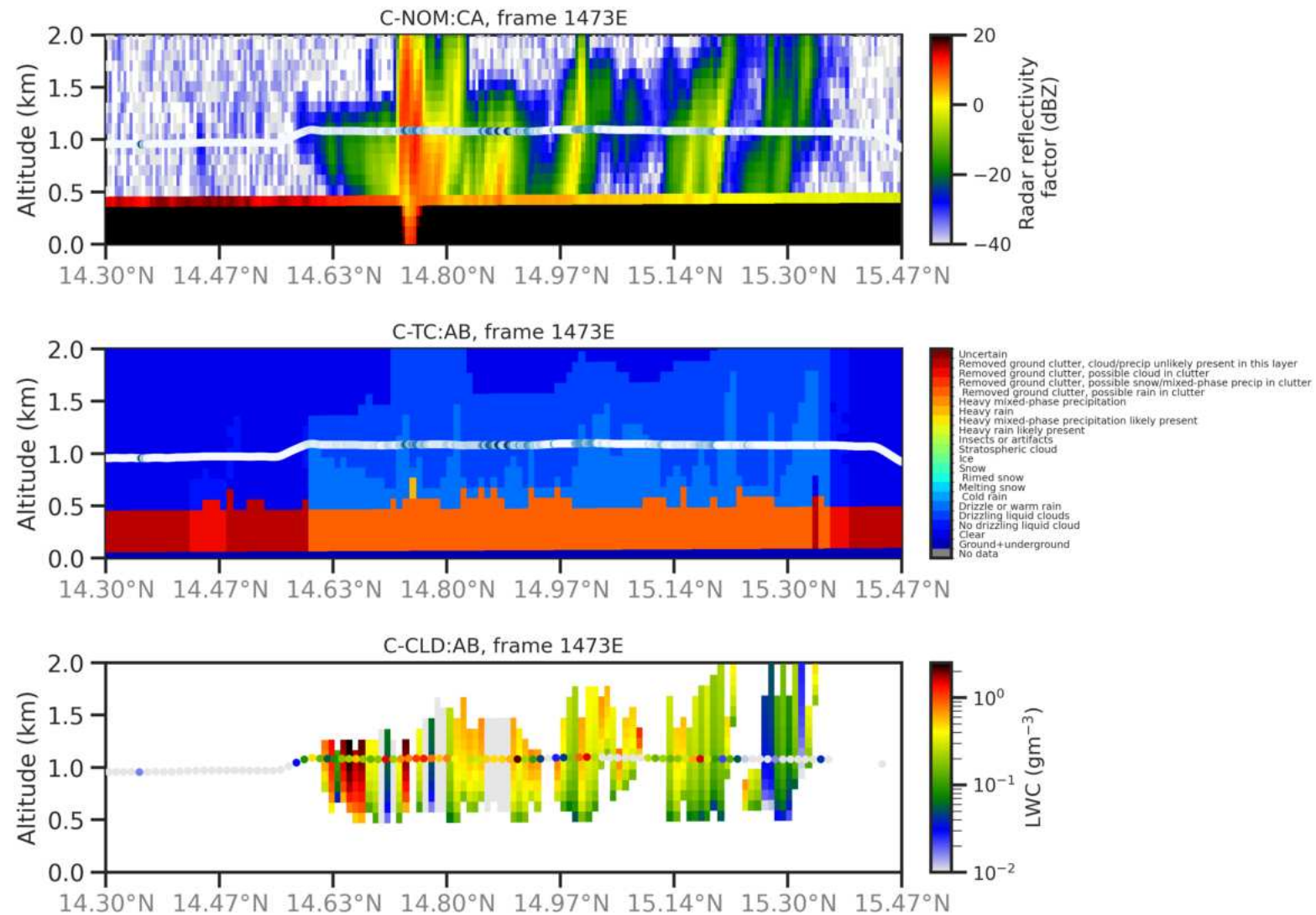
Constant altitude leg below ATR-42

Probing a convective cloud

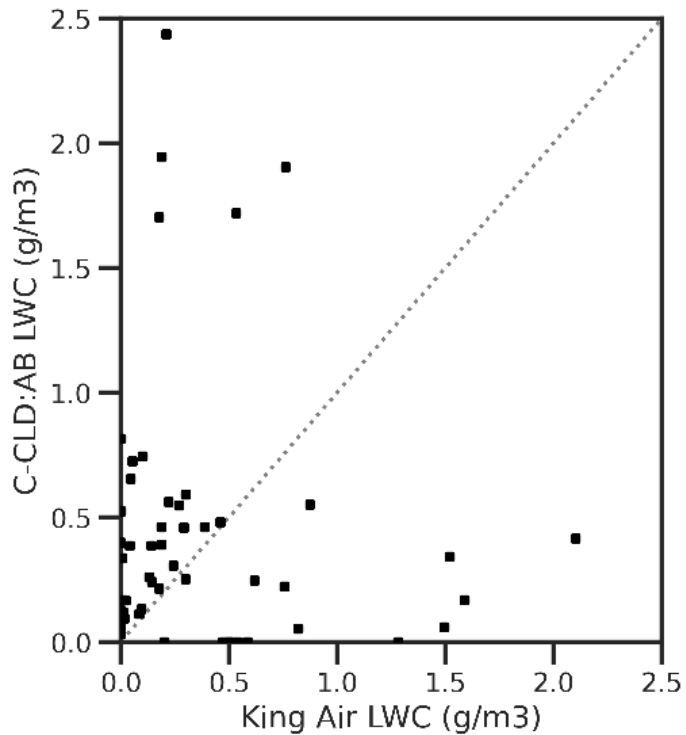


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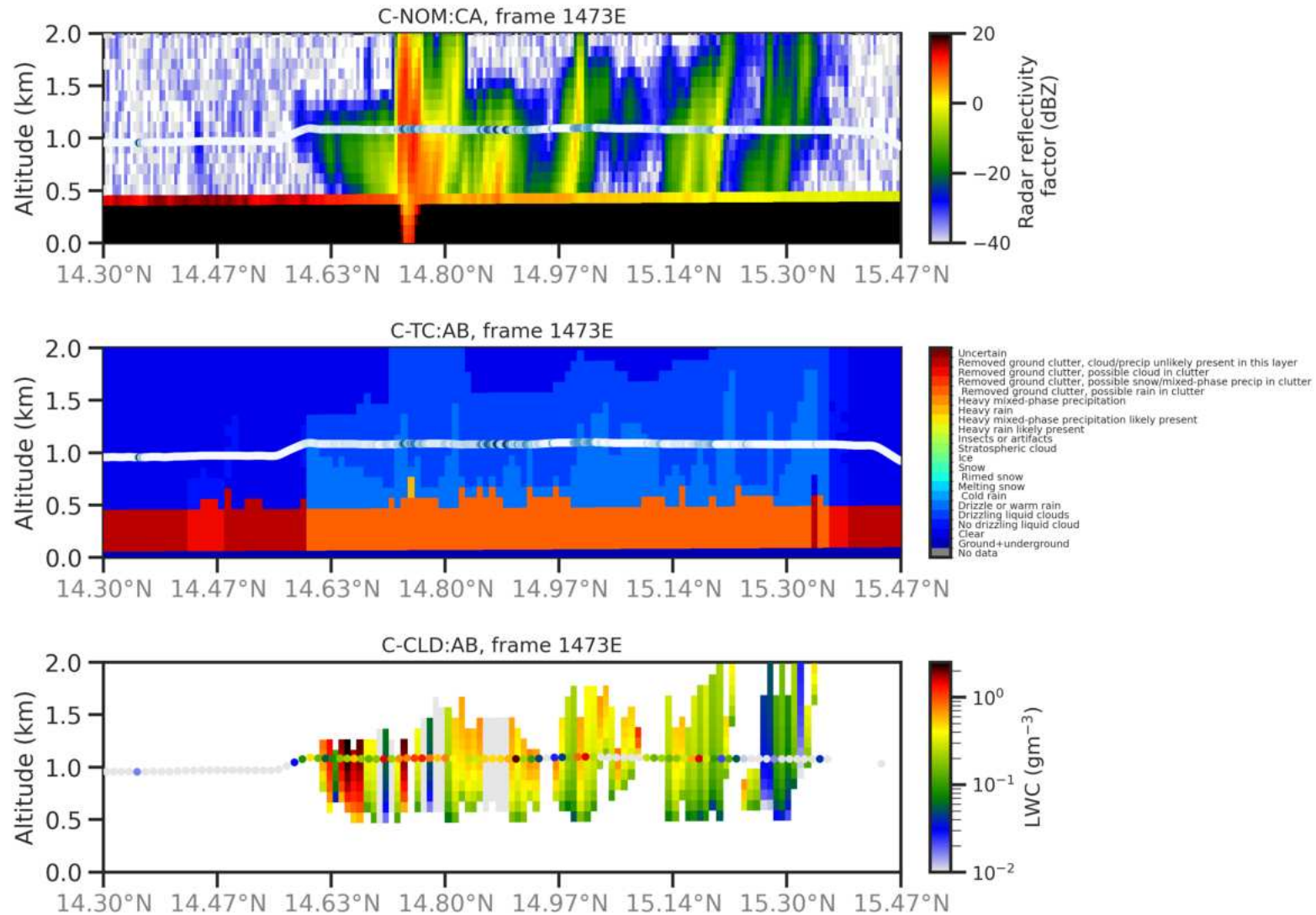


Probing a convective cloud

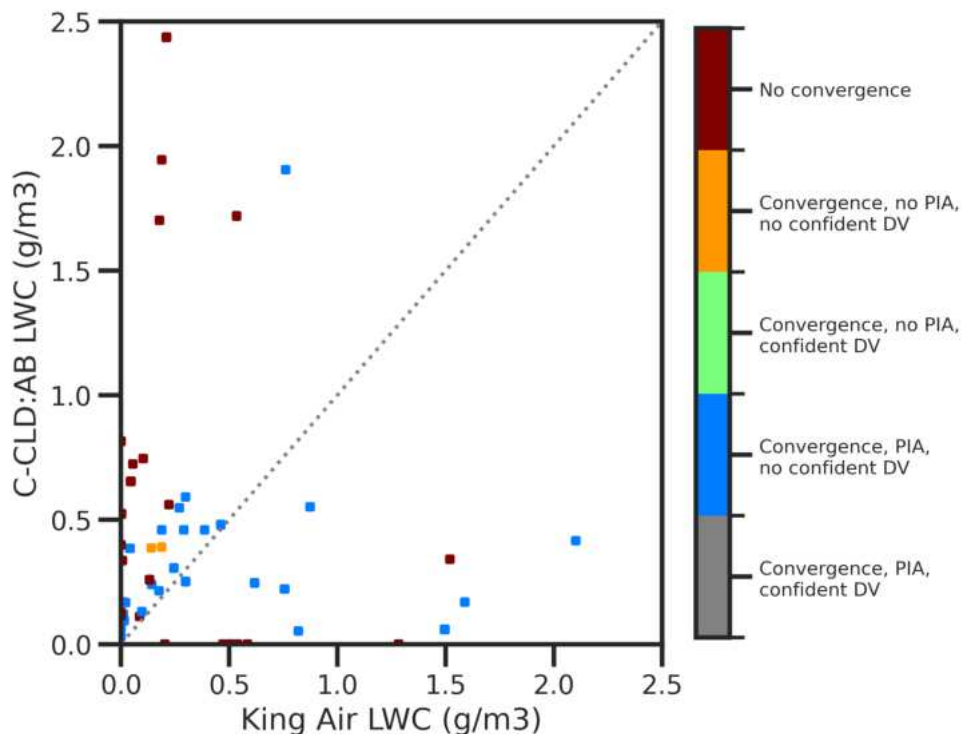


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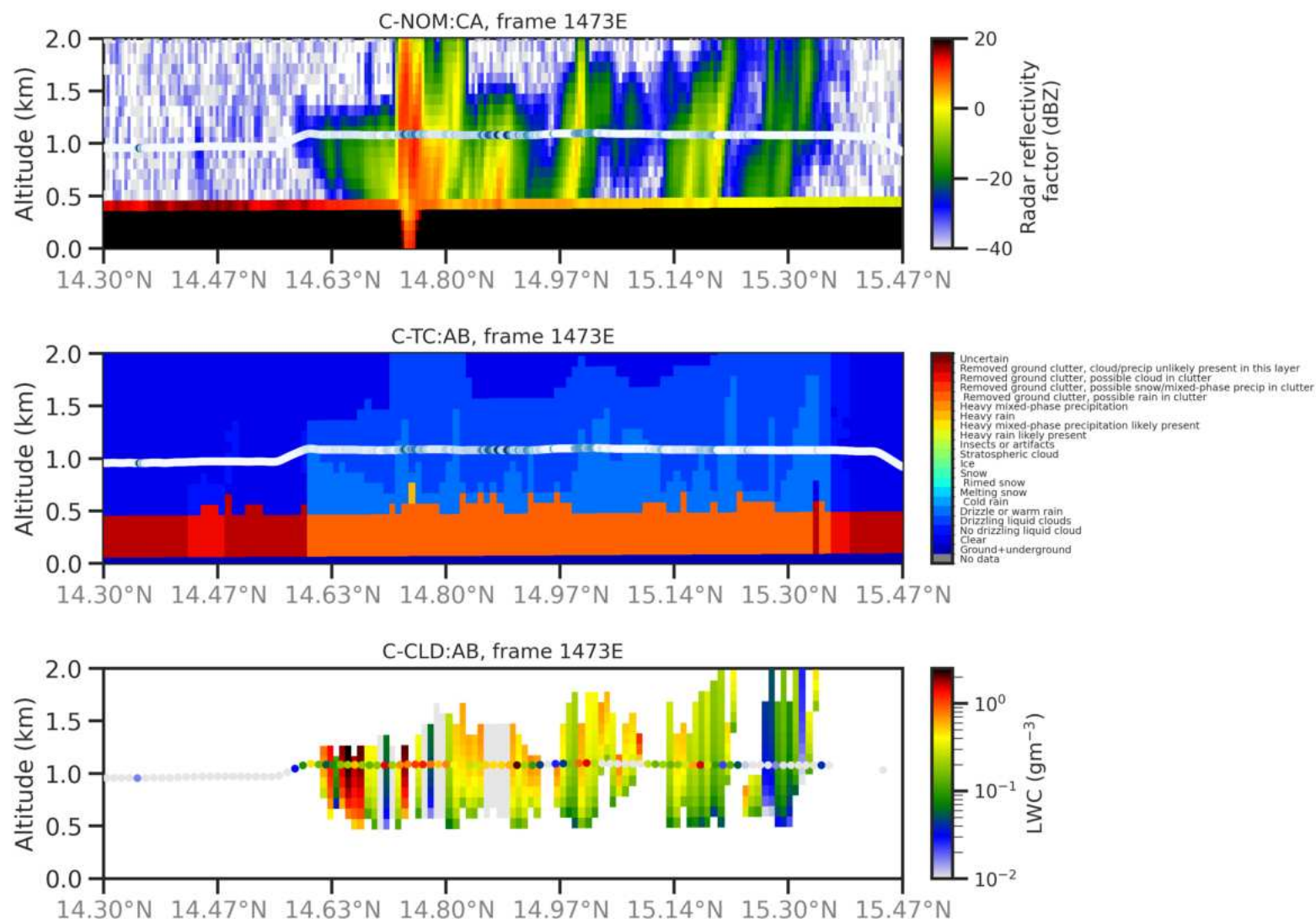


Probing a convective cloud



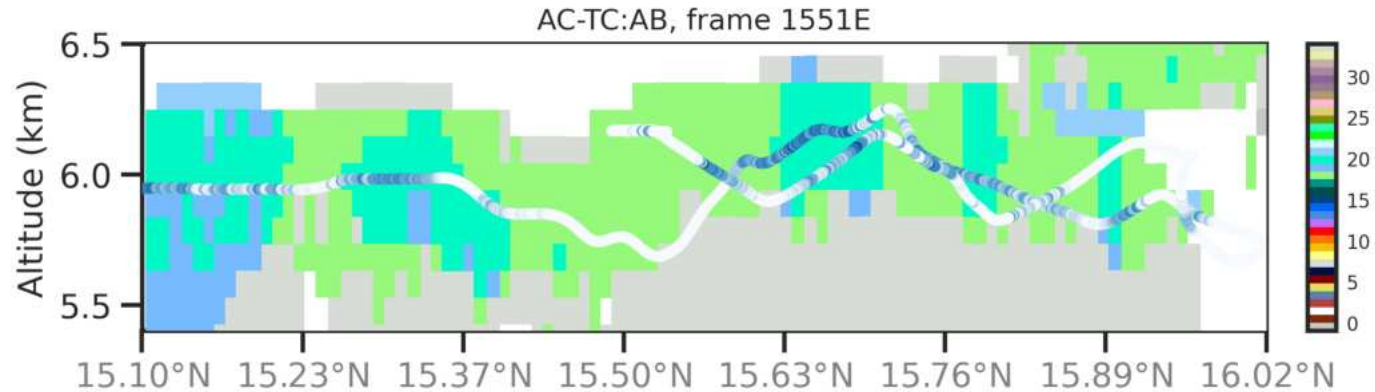
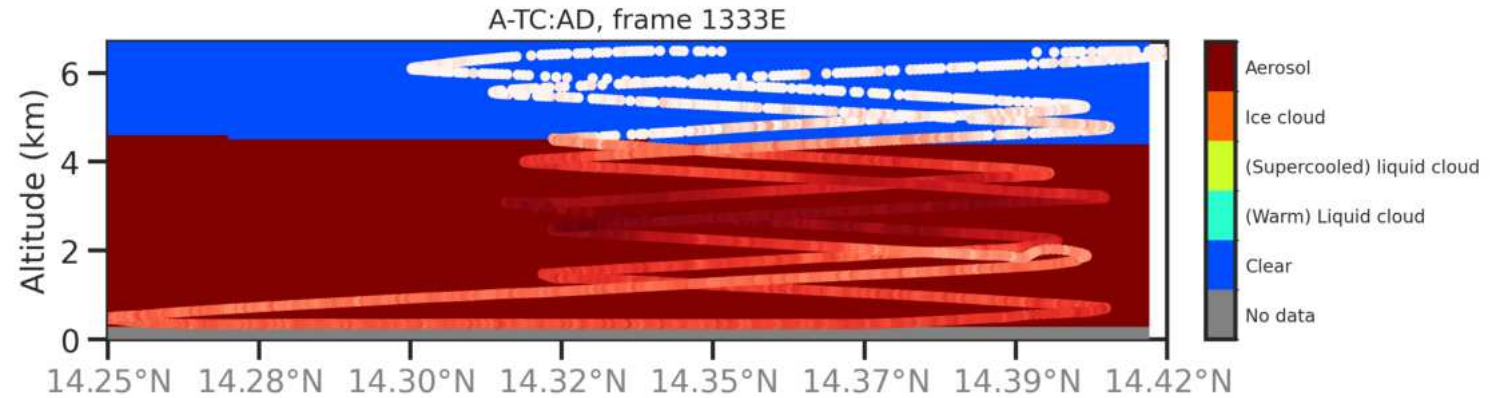
Flight on 31st August 2024:
target orbit #1473

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EarthCARE overpass
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Preliminary takeaways

Aerosol layer height from A-TC:AD matches in-situ observations.



CPR and ATLID retrieve **thin cloud**.

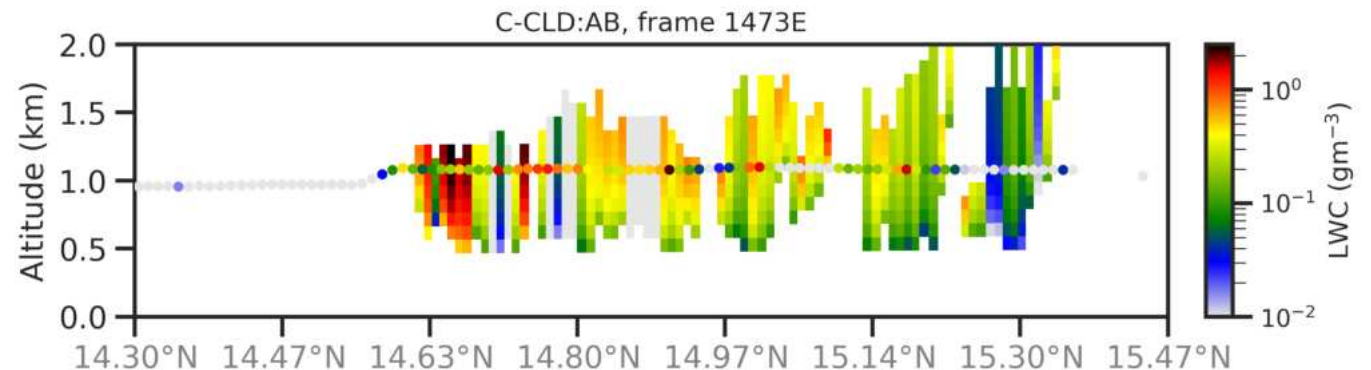
C-TC:AB classifies supercooled liquid cloud as ice, corresponding C-CLD:AB retrieves no water content.

Discrepancy between observed and retrieved C-CLD:AB LWC.

Collocation?

Measurement uncertainty?

Retrieval status?



Aeros matc

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² Department of Geodesy, University of Oslo, Norway

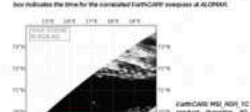
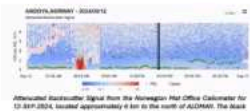
Upper left and right) The ALMA001 observatory, located on top of the 270 m high Hammar mountain at Andoya. Lower left) EarthCare satellite tracks within a 100 km radius of ALMA001 (in the period 12 FEB 2020 to 08 MAR 2020). Lower right) NASA Windrose satellite picture on 05 MAR 2020 showing the different cloud types that approached ALMA001 (see also

The ATL receiver will be equipped with orthogonal and parallel polarization channels.



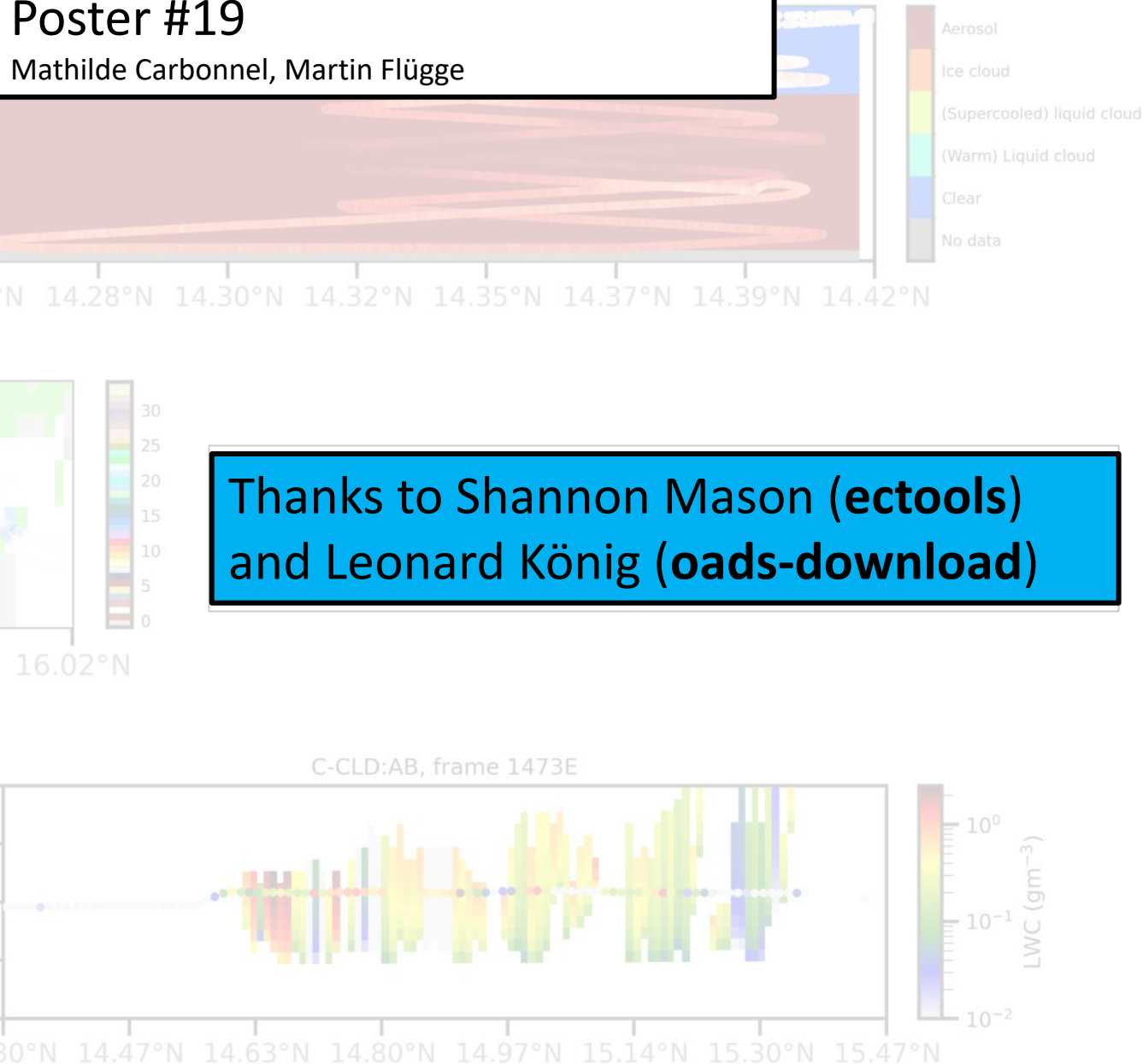
The CIMEL CE318-T is a high-precision multiband sun/moon photometer operated by the University of Valladolid (Spain) and Andaya Space. It uses direct measurements of the sun and moon irradiance to determine the attenuation in the air by aerosols and water vapor. By making these measurements at ten different wavelengths a better characterization of the aerosol and their scattering properties can be conducted. Although the CIMEL is capable of measuring radiation from the moon, it is not possible to retrieve the Aerosol Optical Depth at night due to the limited UV radiation reflected by the moon. The instrument is part of the AERONET network.

Correlated measurements between the CIMEL and EarthCARE on 12-SEP-2024 show good agreement with the EarthCARE ATL_ALD_2A optical thickness product for the part of the ATLID ground track (descending orbit, 01659C) that was over the ocean. The optical thickness derived from ATLID data shows an expected increase for the part of the ground track that was over land.



Furukawa HSI, NRP, VC product (Baseline, AL, and CHANC) during the completed Furukawa research on 12 SEP. 2024. No clouds were present at ALOMA during the Furukawa

Mathilde Carbonnel, Martin Flügge



Thanks to Shannon Mason (**ectools**)
and Leonard König (**oads-download**)

C-CLD:AB, frame 1473E

Disc
and
Coll
Mea
Retr