ACTRIS
CCRES

NF Lindenberg Observatory

Christine Knist, Ulrich Görsdorf, Ardhra Sedhu-Madhavan, Markus Kayser, Ronny Leinweber and Volker Lehmann

CCRES/CLU Autumn Workshop, Evora, 22 October 2025

Status
May to today

Instrumentations @ NF Lindenberg

Doppler Cloud Radar (DCR)

- **MIRA-35**: Software update Metek May 2nd: **S**ensitivity **T**ime **C**ontrol (limited saturation during rain)
- **RPG-FMCW-94-DP**

Microwave Radiometer (MWR)

- **HATPRO G5:** LN_2 calibration and T_b comparisons against HATPRO G5 from TU Berlin
- **Radiometrics MP-3263A:** Software problems/reinstallation RDX in June/July, LWP bias

Lidar

- **CHM15k**
- **CL61:** New transmitter unit since April 28th
- **DIAL DA10:** Data upload to Cloudnet since 1st of October
- **StreamlineXR+:** Unit from AWI, data upload to Cloudnet since April, DL data gap 11/24 to 04/25

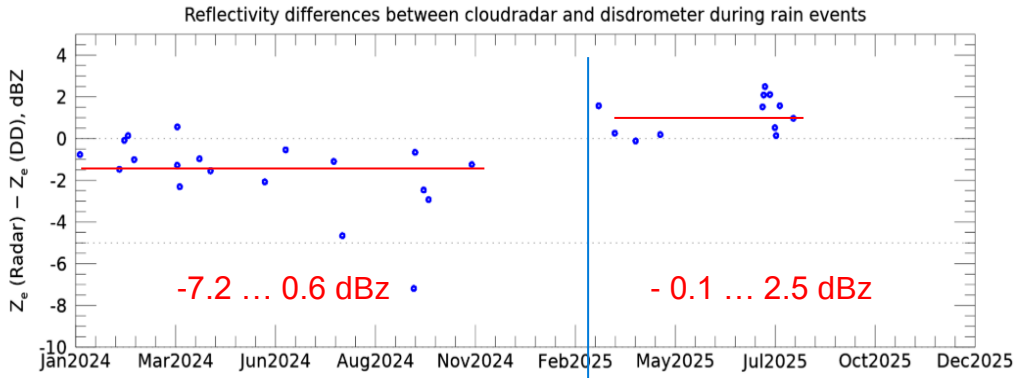
Distrometer, Rain gauge

- **Parsivel², LPM, rain[e]H3**

DCR

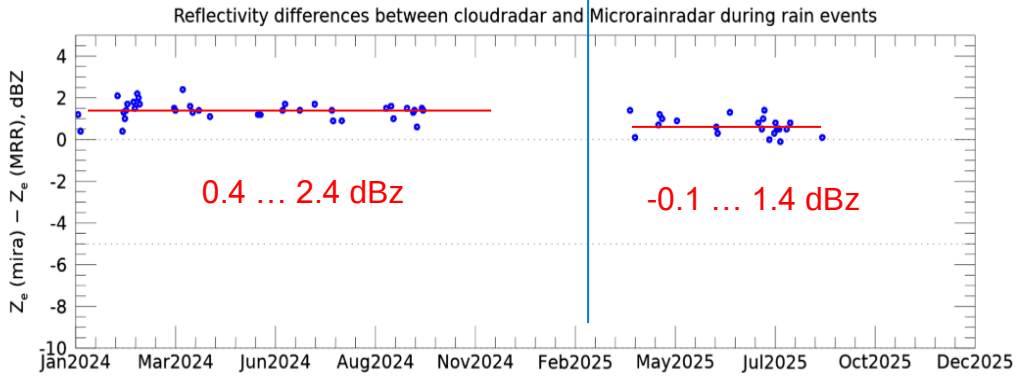
Monitoring Cloud Radar Calibration

CCRES Method: MIRA35 vs. Parsivel



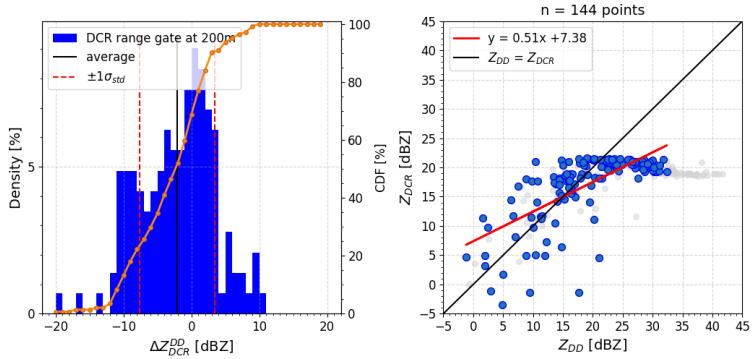
MIRA35 renewal

MOL-RAO Method: MIRA35 vs. MRR @500m



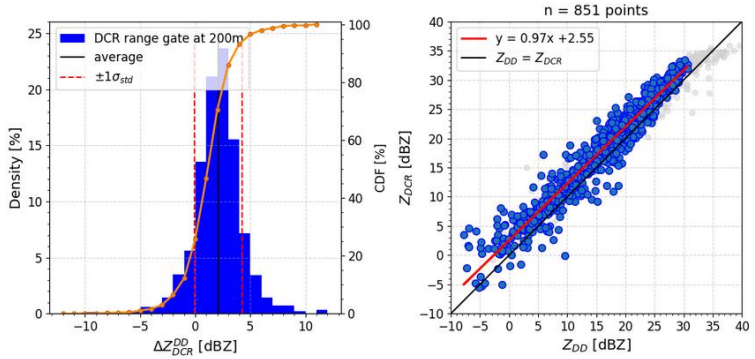
CCRES: 20240602 before **S**ensitivty **T**ime **C**ontrol

Mean (DCR-DD) = -2.08 dBz Mode = 0.5 dBz



CCRES: 20250712 after **S**ensitivty **T**ime **C**ontrol

Mean (DCR-DD) = 2.09 dBz Mode = 2.5 dBz



Both cloud radar calibration monitoring methods show jumps after radar renewal

Absolute differences are different (and to be discussed?)

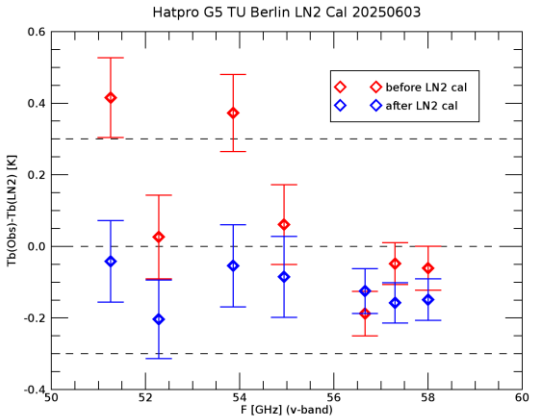
Software update limits saturation during rain
→ may make calibration monitoring more stable

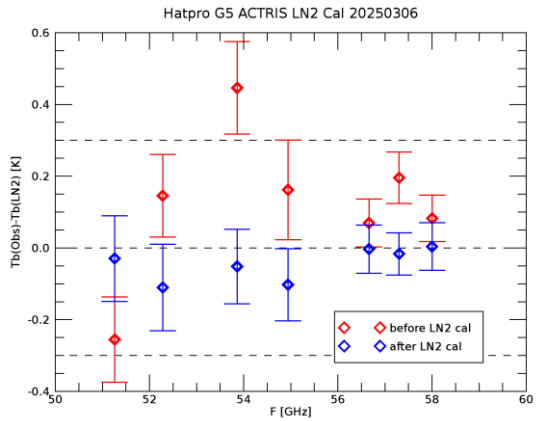
Ulrich Görsdorf

HATPRO G5 Comparison

HATPRO G5 from TU Berlin @Lindenberg (June/July 2025)

DWD: with IR camera

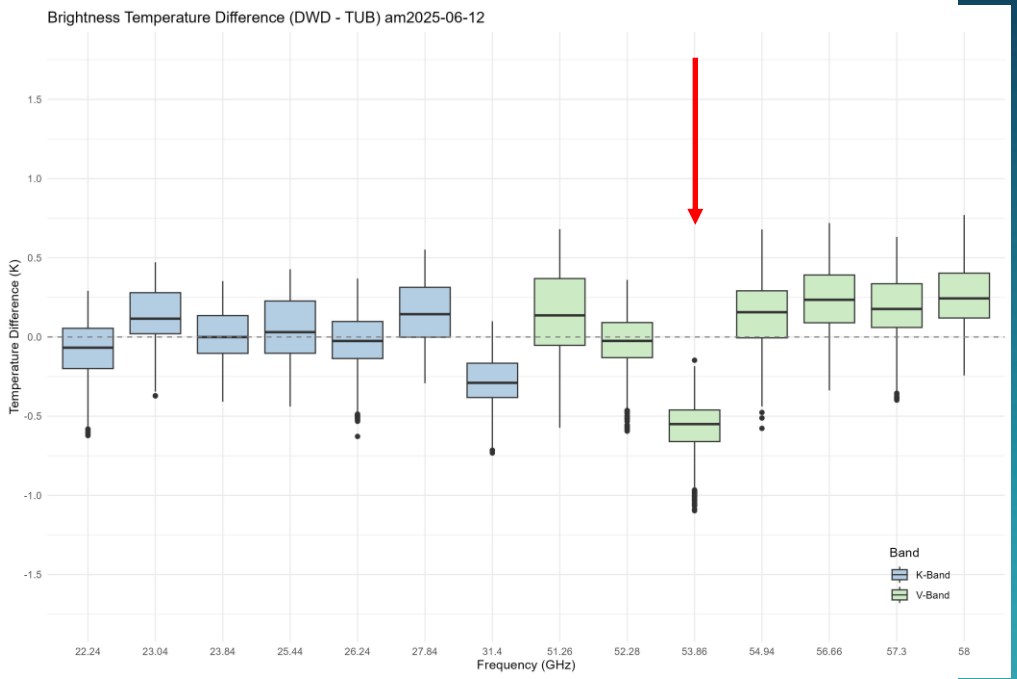




Before and after LN2 calibration: V-band

Clear sky comparison 20250612

Fred Meier, David Richard (TU Berlin)



Differences are in the range of uncertainty

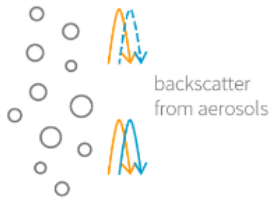
@53.86 GHz about 0.5K

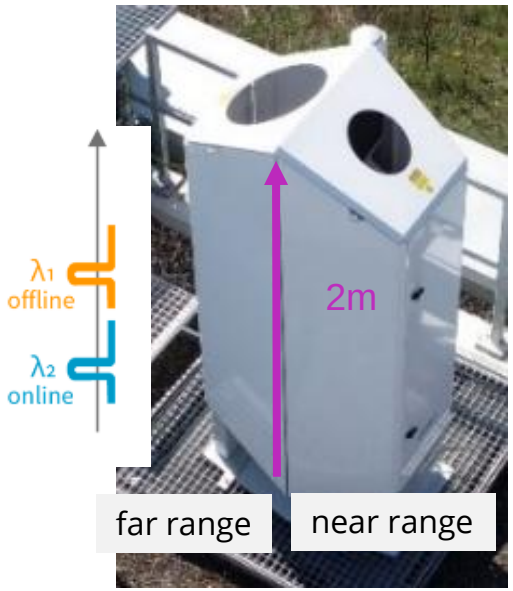
→ DWD HATPRO channel on 53.86 GHz showed larger instrument bias (related to frequency accuracy, filter function?) @ FESSTVaL campaign

Böck et al., 2025, AMT, https://doi.org/10.5194/egusphere-2025-1727

Vaisala Dial DA10 observations @Cloudnet

available since 1st October





LV1:
Attenuated backscatter coefficient

@Cloudnet

- range resolution: 4.8 m
- maximal height coverage: 18km
- averaging time: 60 s
- cloud base height

LV2:
Water vapor mixing ratio

- maximal height coverage: 3 km
- range resolution: 9.6 m
- averaging time: 20 min

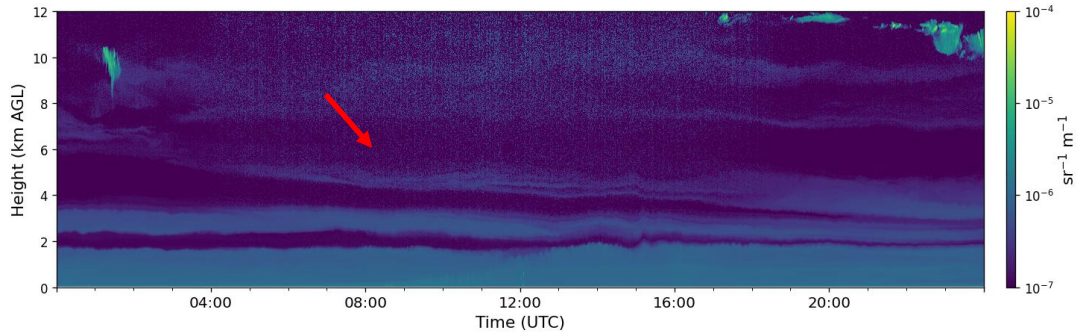
- Serial device in operation since November 2023 at Lindenberg
- 10 .. 14 units in DWD network (Project **LIDIA**)

Attenuated backscatter coefficients

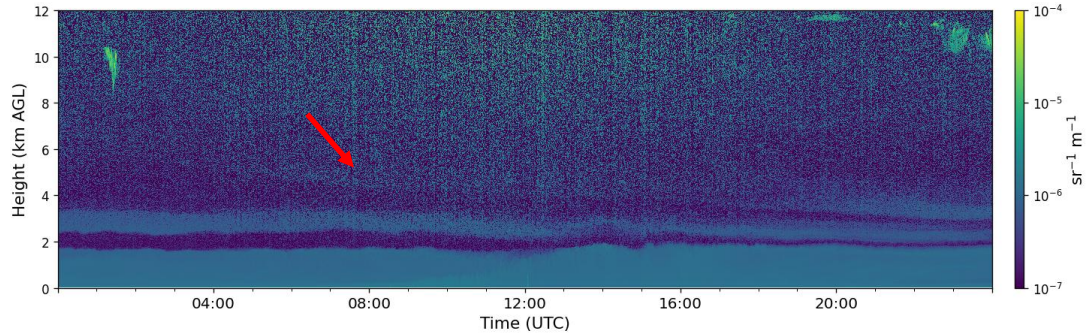
before Cloudnet screening: Weak background smoothed using Gaussian 2D-Kernel. SNR-Threshold: 5

20250814

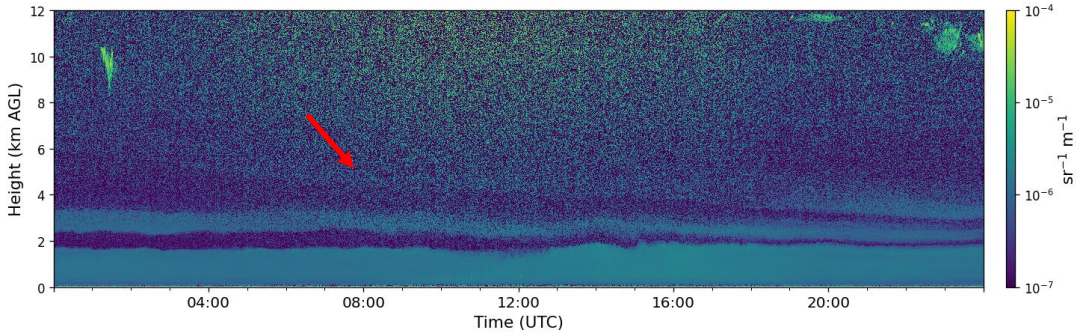
Dial DA10



CL61



CHM15K



Detection of high aerosol layer

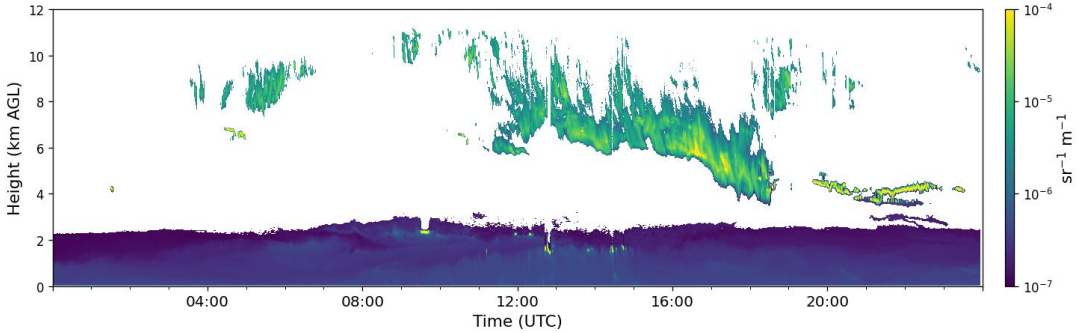
Standard Cloudnet screening sufficient?

Attenuated backscatter coefficients

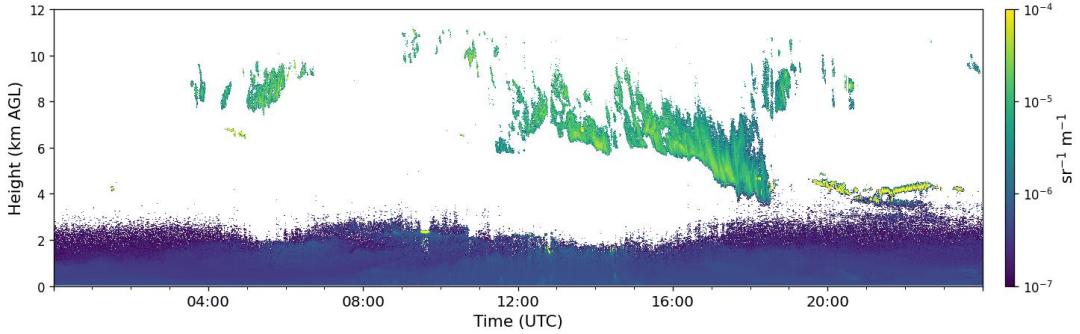
after Cloudnet screening: Weak background smoothed using Gaussian 2D-Kernel. SNR-Threshold: 5

20250904

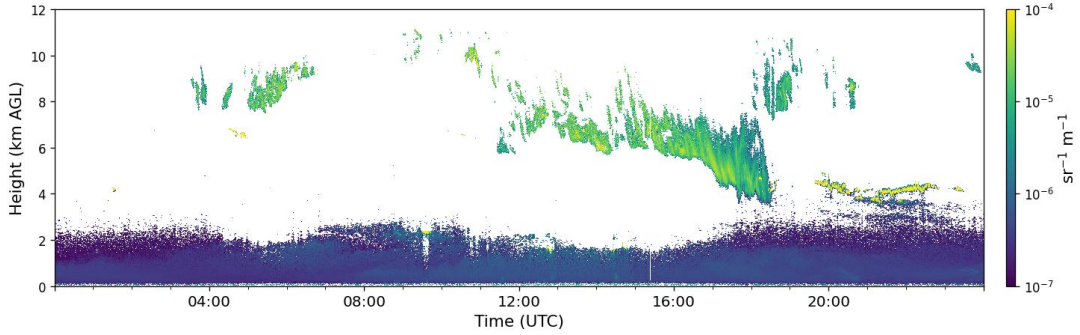
Dial DA10



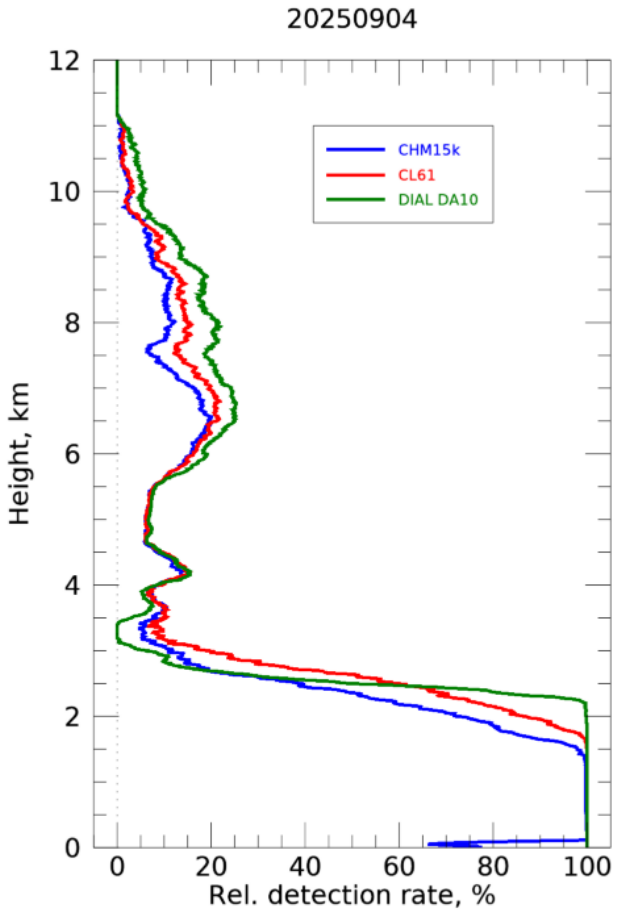
CL61



CHM15K



backscatter coef. rate after screening



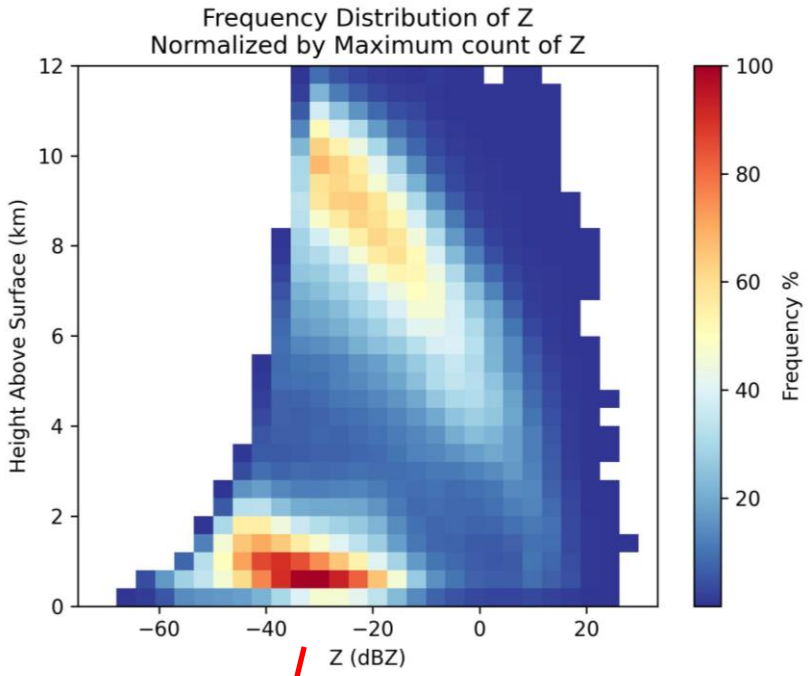
Dial DA10 is a powerful ceilometer

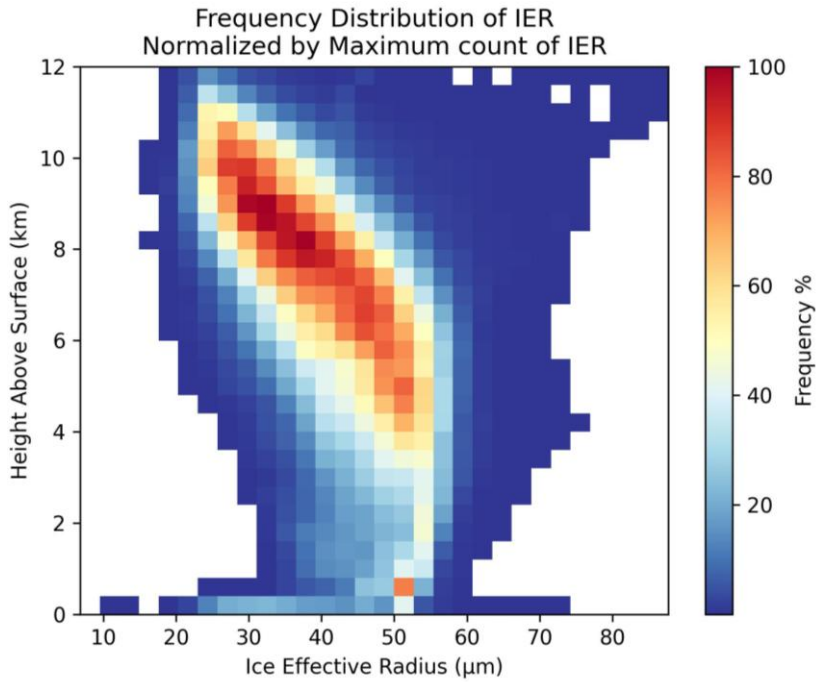
Higher ice-cloud detection rate after screening

CL61 as well compared to CHM15K

Cloud Statistics Lindenberg (2020-2024)

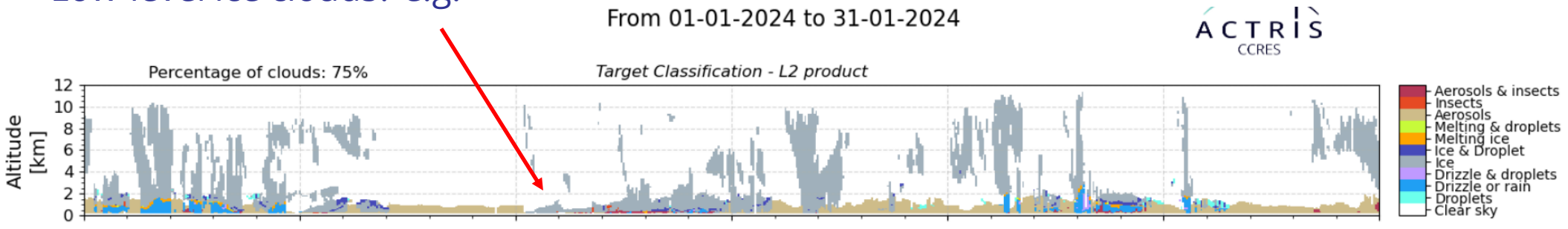
Single layer **ice clouds** filtered from Cloudnet Target Classification plus reliable IER





IER:
directly related to temperature:
Higher IER values at lower heights

Low-level ice clouds? e.g.



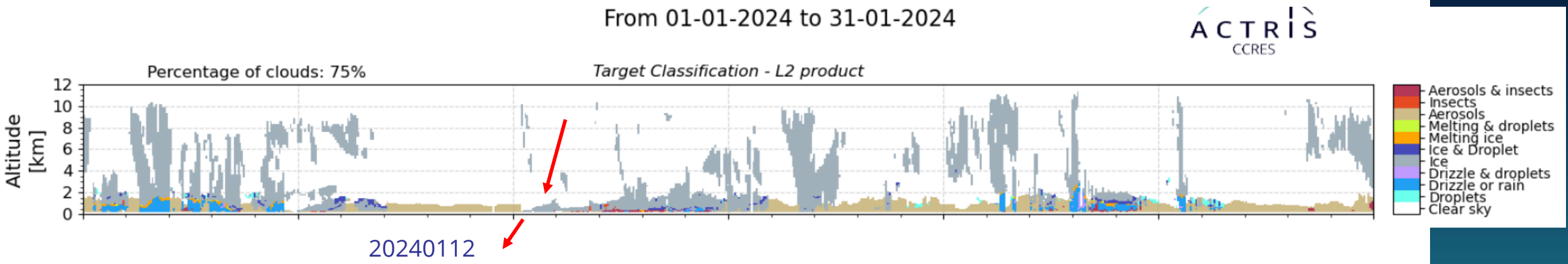
High frequency of ice clouds < 2 km (occur in winter months)

Misclassifications?

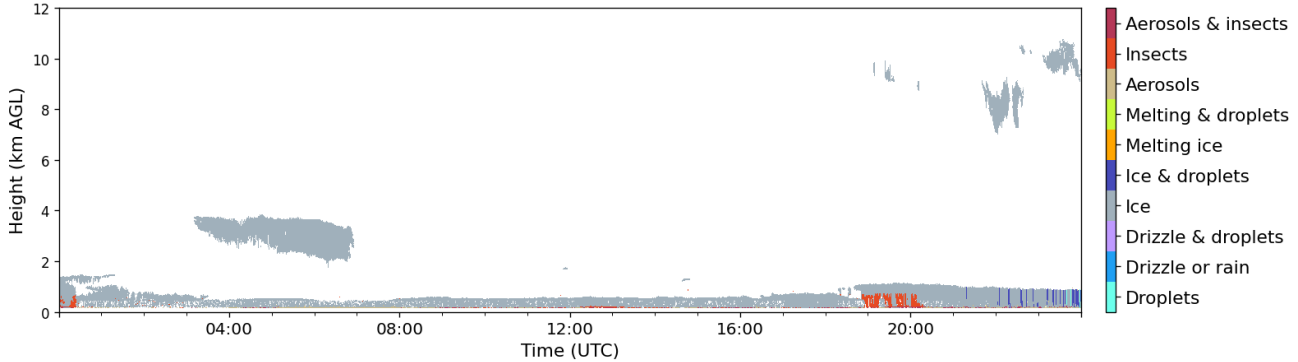
A. Sedhu-Madhavan

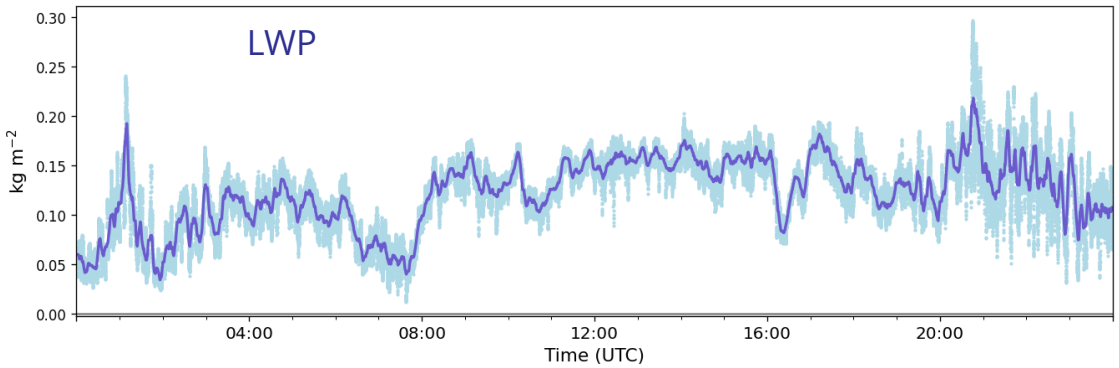
Cloud Statistics Lindenberg (2020-2024)

Low-level **ice clouds** filtered from Cloudnet Target Classification



20240112





Misclassification:
low-level stratus, T < 0, mixed-phase or super-cooled droplets

Persistent low level stratus clouds in winter

Mixed-phase

Misclassification
→ Detailed analysis in progress

A. Sedhu-Madhavan

Summary and Future Perspectives

DCR:
- calibration monitoring methods (CCRES Disdro and MRR comparison) show impact of instrument change
- MIRA35 Software update reduces saturation during rain

MWR:
- HATPRO G5s Tb differences are in the range of uncertainty
- RDX MP3236A: LWP bias (not discussed today)

Dial DA10:
- powerful ceilometer, higher ice-cloud detection rate and high layers of aerosols

→ requires adapted Cloudnet screening?

Cloud statistics of 5 years:
- high frequency of ice clouds < 2 km (occur in winter months)

→ Misclassification in target classification: Detailed analysis in progress

ACTRIS

CCRES

Thank you !

CCRES/CLU Autumn Workshop, Evora, 22 October 2025

Vaisala Dial DA10 observations @Cloudnet

Technical Specs

	Dial	CL61	CHM15k
Laser	InGaAs diode laser	InGaAs diode-Laser	Nd:YAG
Wavelength	911.0, 910.6 nm	910.55 nm	1064 nm
Detektor	Silicon Avalanche Photodiode (APD)	Silicon Avalanche Photodiode (APD)	Photodetector Photo Counting
Optical design	coaxial	coaxial	biaxial
FOV		0.56 mrad	0.45 mrad
Range	15 .. 18000 m	0 .. 15720 m	0 .. 15340 m
Averaging Intervall	60 s	10 s	15 s
Range Intervall	4.8 m	4.8 m	10 m

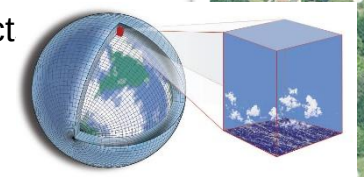
Updates

C3SAR Campaign May to August 2026

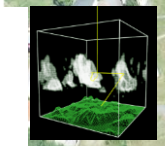
Cloud 3D Structure And Radiation (C3SAR): Closing the 3D-gap

Lindenberg Observatory

P1: **Modelling** cloud micro- and macrophysical properties and their radiative effect



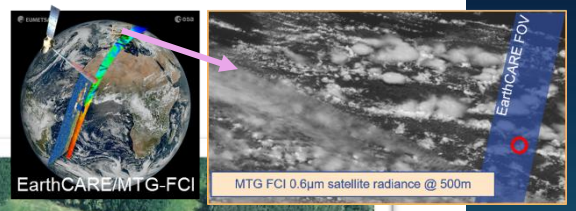
P2: **Cloud structure** and regime dependence of 3D radiative effects



P3: Cloud radiative effects from **ground-based observations**

2 Cloudnet stations + BSRN station
- Pyranometer network, spectral radiation
- Cloud cameras

P4: **Satellite-based** cloud remote sensing & 3D effects

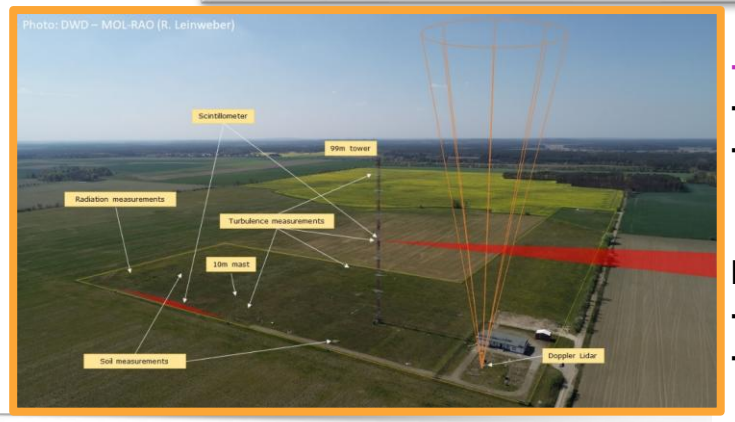


Lindenberg EarthCare cloud radar

Summer school for PhD students 3rd week of July 2026 (call for tenders follows soon)

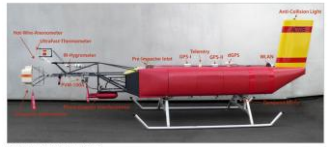
Plus Falkenberg site

Boundary layer observations:
99m tower
ICOS station (10m mast)
Doppler lidar
Turbulence observations
Radiation station



- 1 Cloudnet station (Oceannet container)
- Pyranometer network
- Cloud cameras

Plus in-situ observations:
- ACTOS (helicopter-based)
- UAV flights (D. Brus et al., ACTRIS CIS)



Cloud In-situ and Remote Sensing Working Group

Kostas Konstantinos (FMI) and Christine Knist (DWD)

Join the joint working group!

Not on the WG mailing list yet?
Please subscribe @:https://forms.gle/qA3c3PSL27NHs5gZ9

Motivation:

Lack of reference data for evaluating remotely sensed cloud property retrievals, e.g. microphysical properties

Collaborate, share knowledge and explore optimal ways to combine cloud, in situ and remote sensing data

Regular Online Meetings:

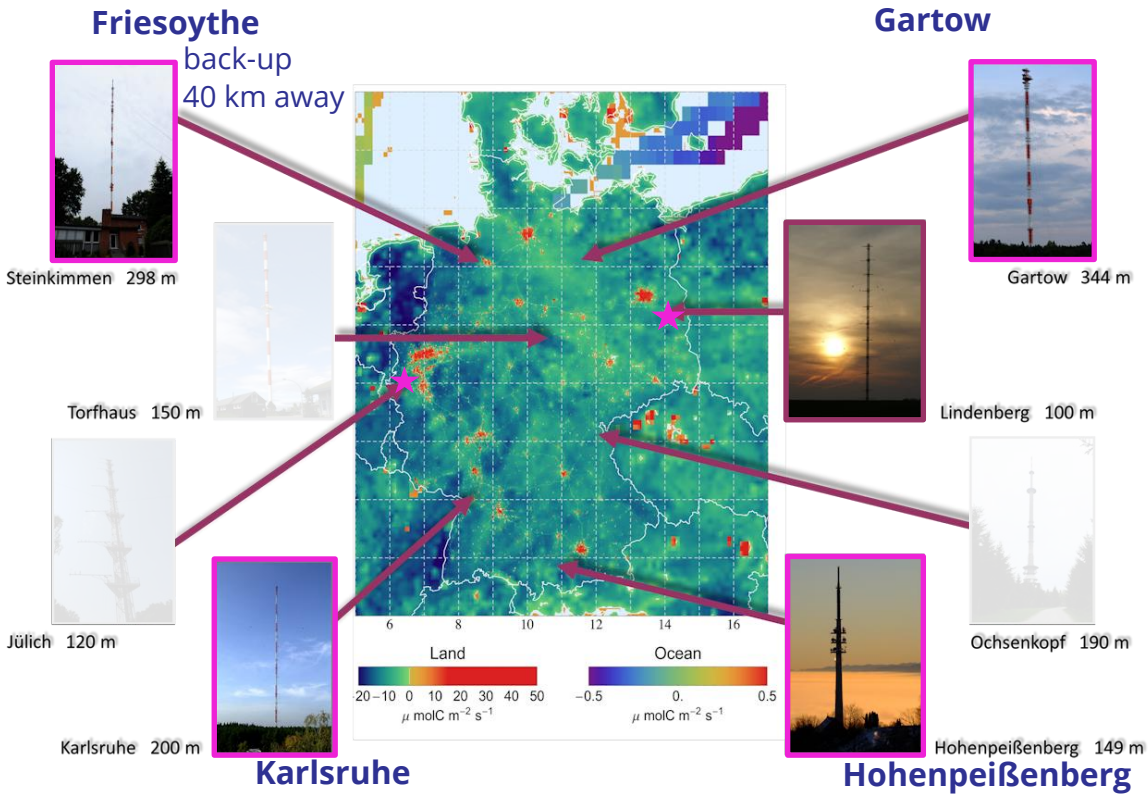
Scientific presentations with speakers from both communities, open discussions

Shared materials: ACTRIS Intranet
→ Cloud IS&RS Folder

First collaboration and impact:
FMI joins the C3SAR Lindenberg campaign (May 2026) with UAV observations in clouds

Status of Doppler Lidar Network

Installation finished in Juli 2024



Installed at/near existing **ICOS infrastructure**

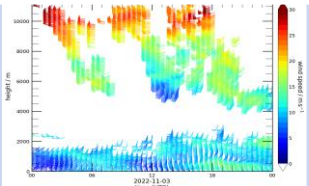
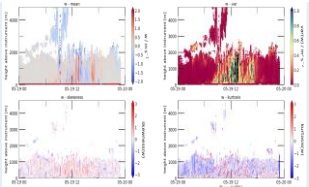
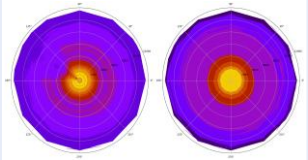
- 4 Halo Photonics VS+ at/near ICOS sites
- 1 Windcube 200s at Aachen/Orsbach (DWD)
- 1 Halo Photonics XR (DWD) and/or XR+ at Lindenberg

Testing and Product Development

Using and extending **DWD's Doppler Lidar toolbox**

works for Halo Photonics Streamline and Vaisala Windcube

download from https://github.com/mkay-atm/dl_toolbox

mean wind		done & working
w-statistics		in progress/ testing
depolarisation test of in-field calibration		in progress/ Master thesis
new variables for monitoring		done/ testing

Connects infractures: ACTRIS + ICOS

All 4 ACTRIS systems are installed, plus 2 additional lidars at DWD sites

Extensions to DWD's toolbox are being tested and developed.

Additional products/variables increase measurement capabilities and facilitate operational monitoring.

New feature will be available once testing is complete.

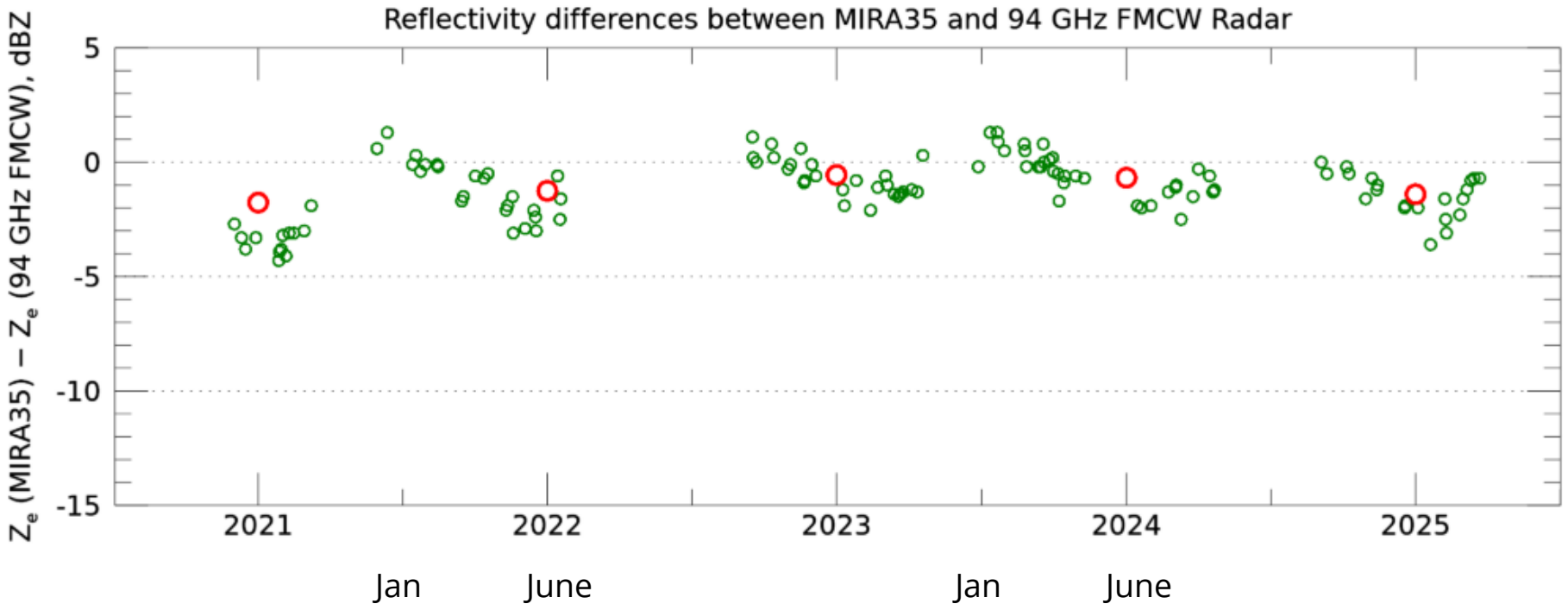
M. Kayser

DCR

Reflectivity Differences MIRA35 and RPG FMCW 94

Daily mean differences of selected days and Yearly Mean Differences

- Selected days: Cloudy cases between 5 to 12 km (without thick clouds below)
- Mie-scattering correction (dBZ94 = dBZ35-10^(-16.8251)*((dBZ35+100.)^8.4923), Kollias 2019)
- Refractivity index correction for ice (after Hogan, 2006)



Daily mean differences are slightly higher in summer months cases

Yearly differences are relatively stable and low

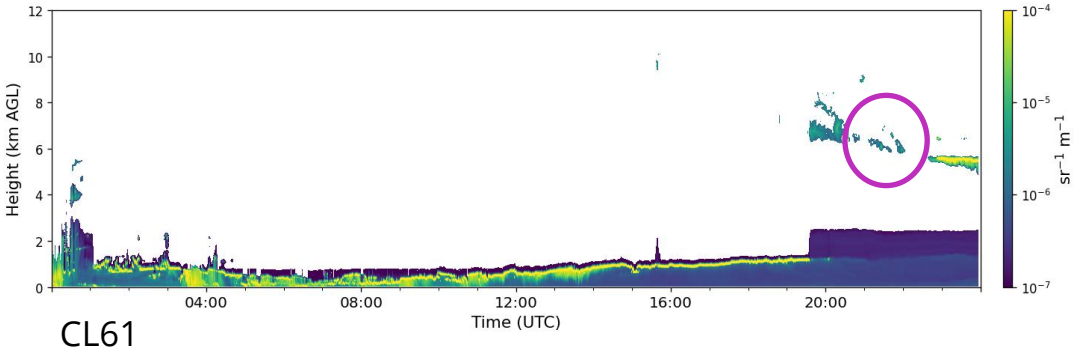
→ requires a more comprehensive statistical analysis

Ulrich Görsdorf

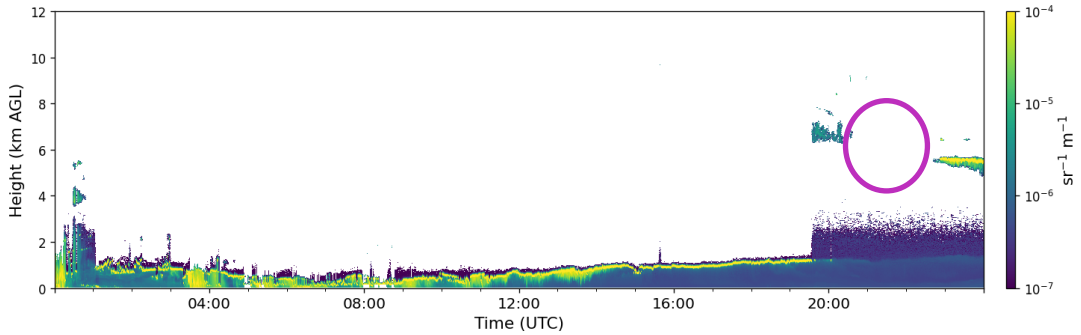
Attenuated backscatter coefficients

after Cloudnet screening: Weak background smoothed using Gaussian 2D-Kernel. SNR-Threshold: 5

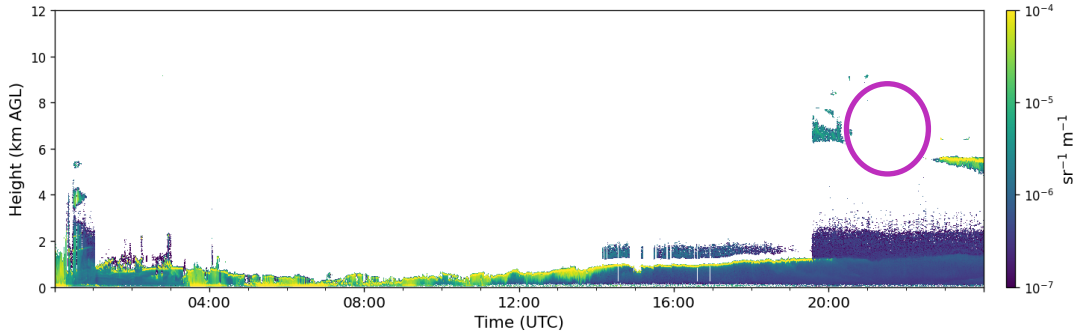
Dial DA10 20250726



CL61

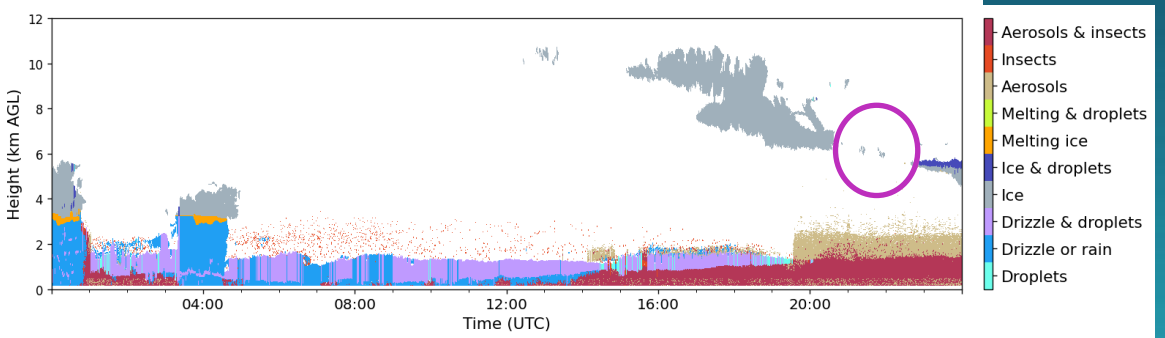


CHM15K

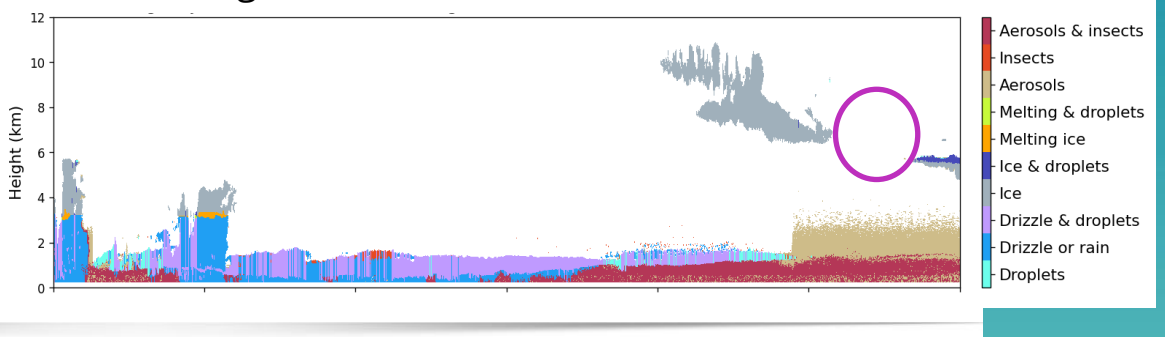


Cloudnet target classification with DA10
under progress/discussion

Cloudnet target classification with CL61 (local computation)

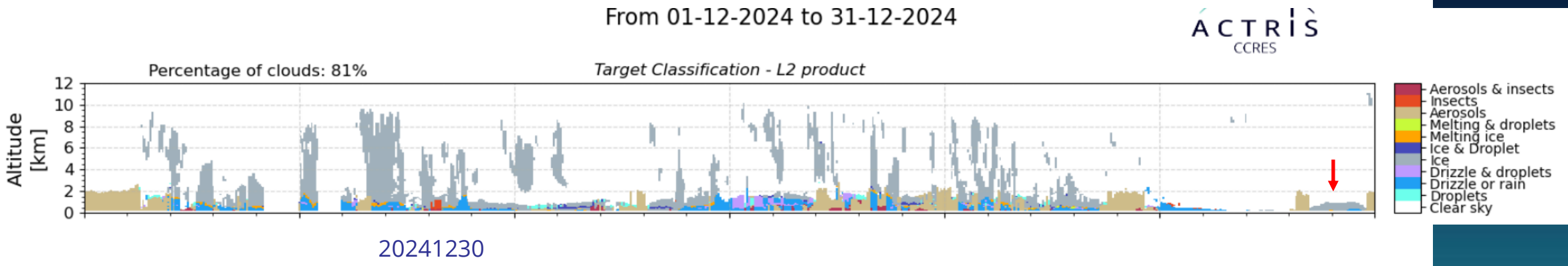


Cloudnet target classification with CHM15K (nominal)

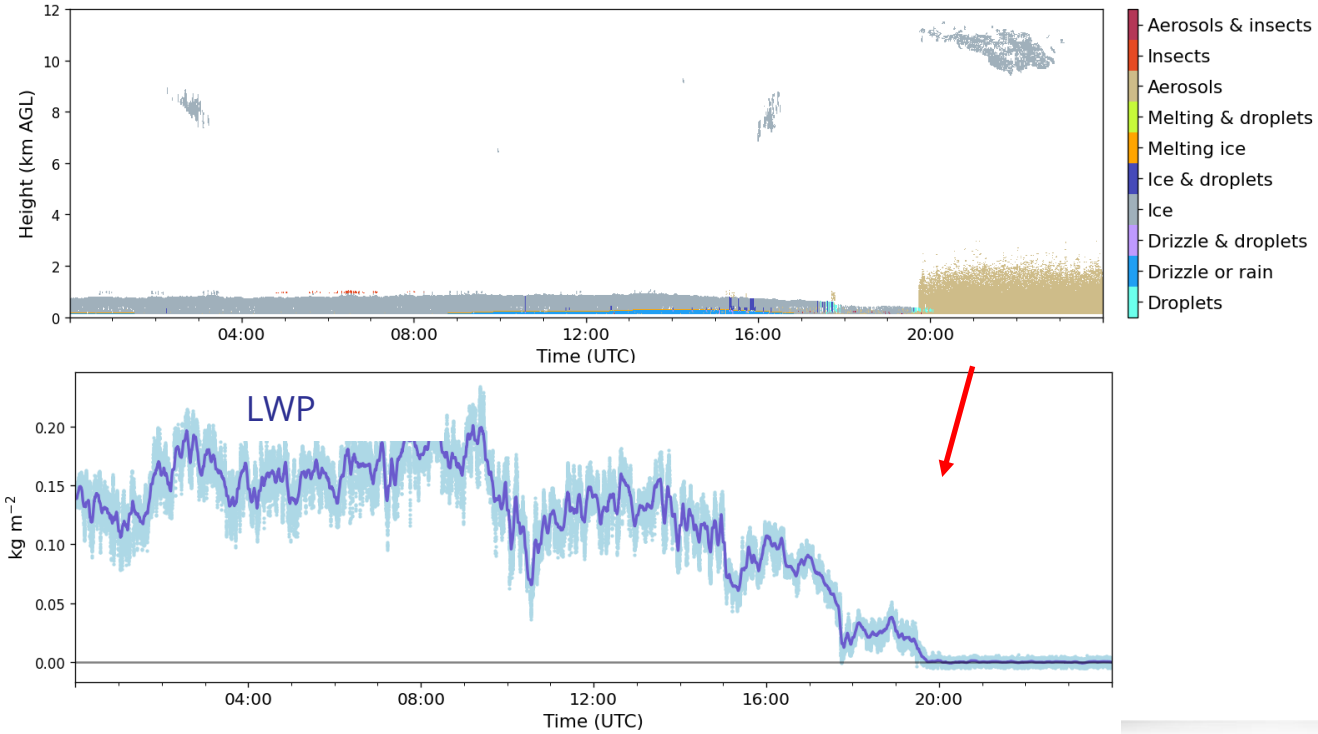


Cloud Statistics Lindenberg (2020-2024)

Low-level **ice clouds** filtered from Cloudnet Target Classification



20241230



Misclassification:
low-level stratus, T < 0, mixed-phase or liquid droplets

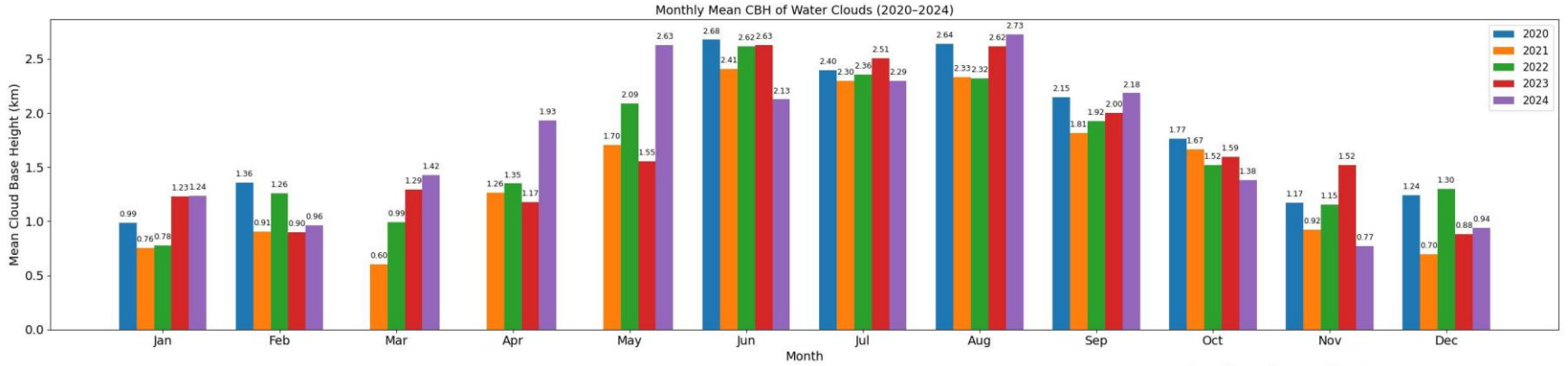
classified low-level ice cloud require a more detailed analysis

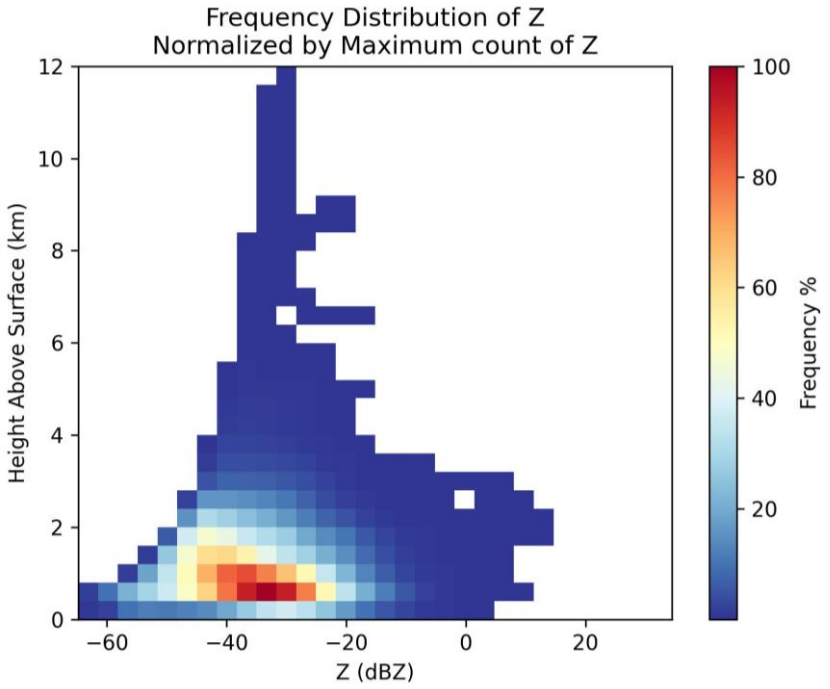
→ in progress

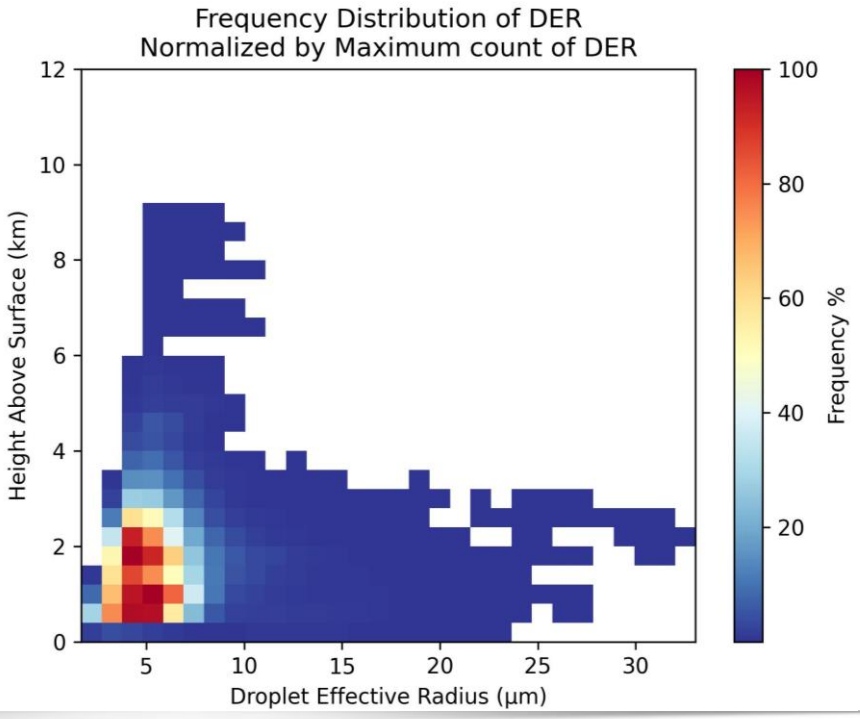
A. Sedhu-Madhavan

Cloud Statistics Lindenberg (2020-2024)

Single layer **water clouds** filtered from Cloudnet Target Classification plus reliable DER



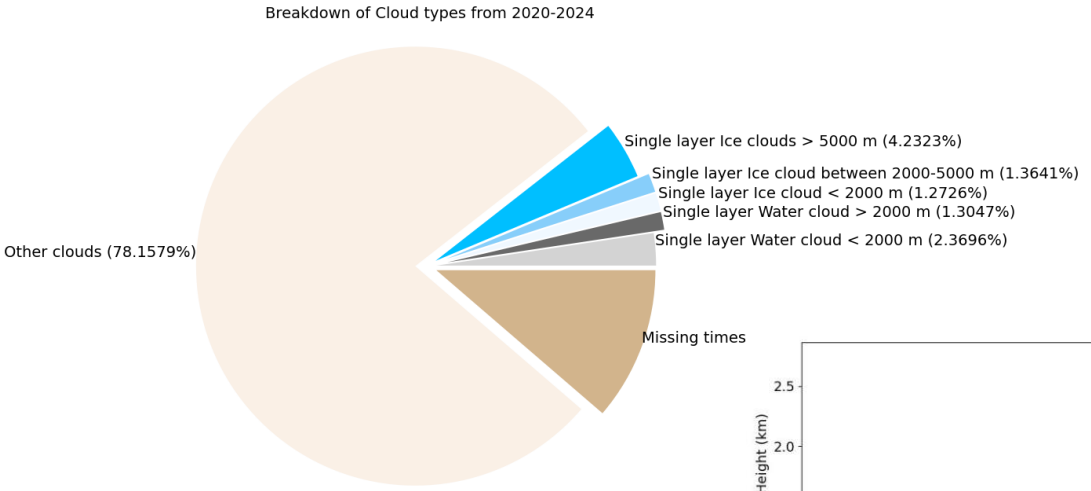




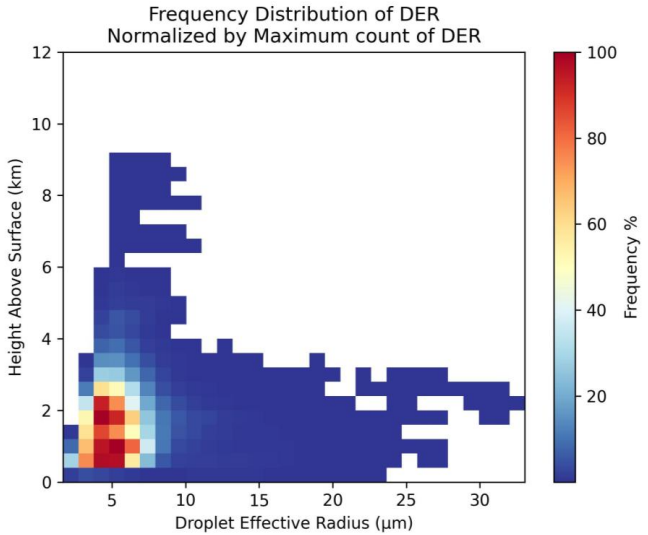
DER:
most frequent values < 3 km with sizes between 2.5 and 8 μm

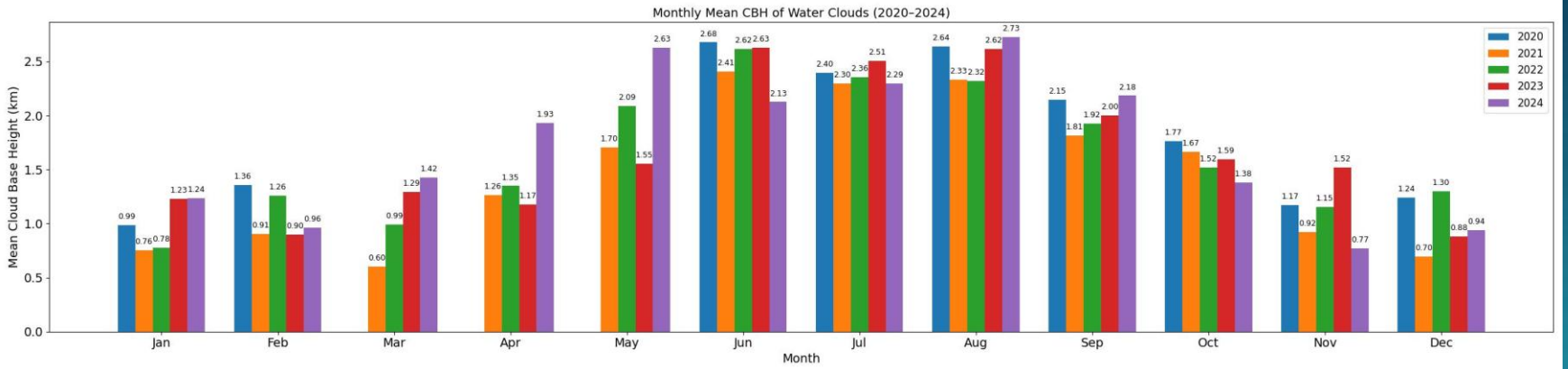
A. Sedhu-Madhavan

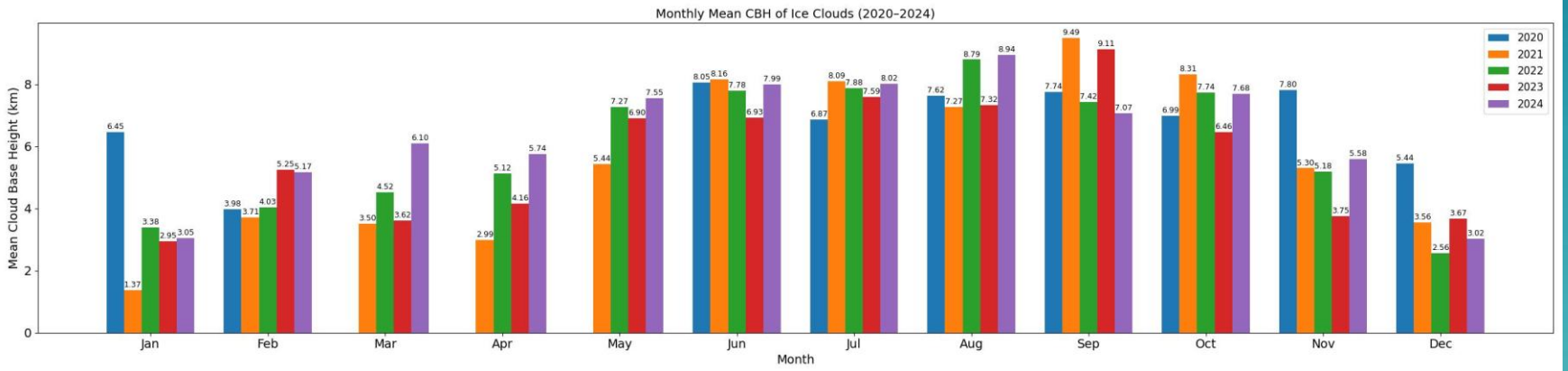
Cloud Statistics Lindenberg (2020-2024)



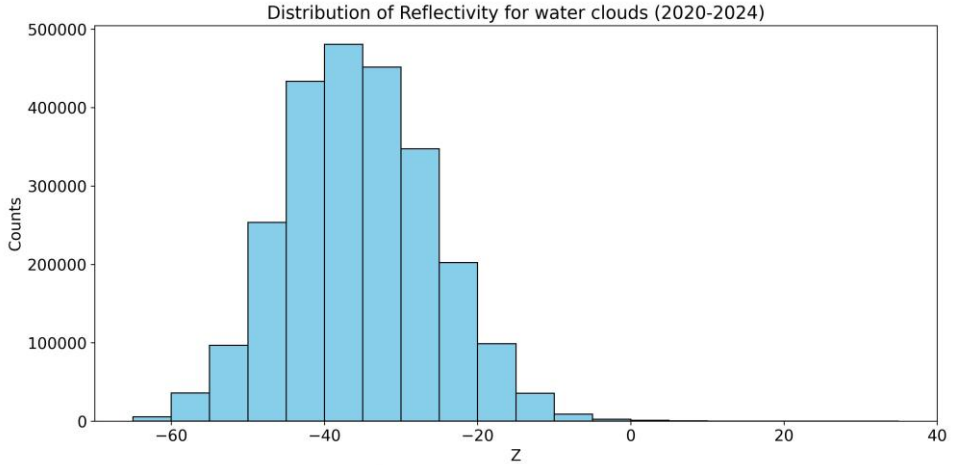
Distribution of DER by height

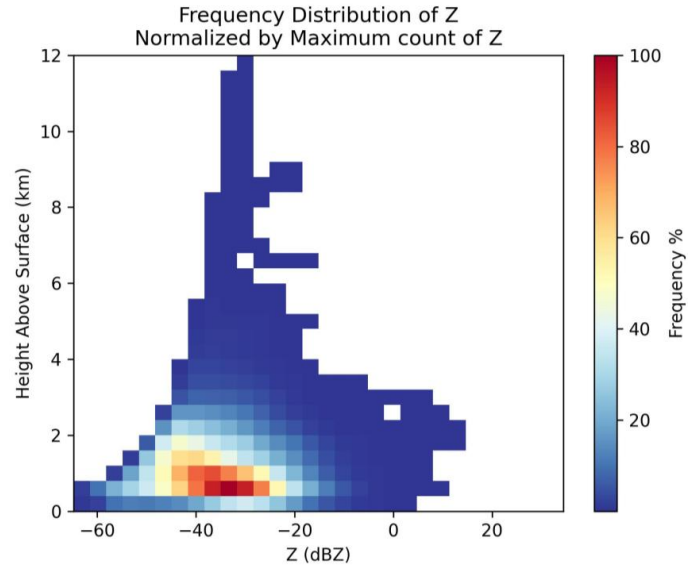




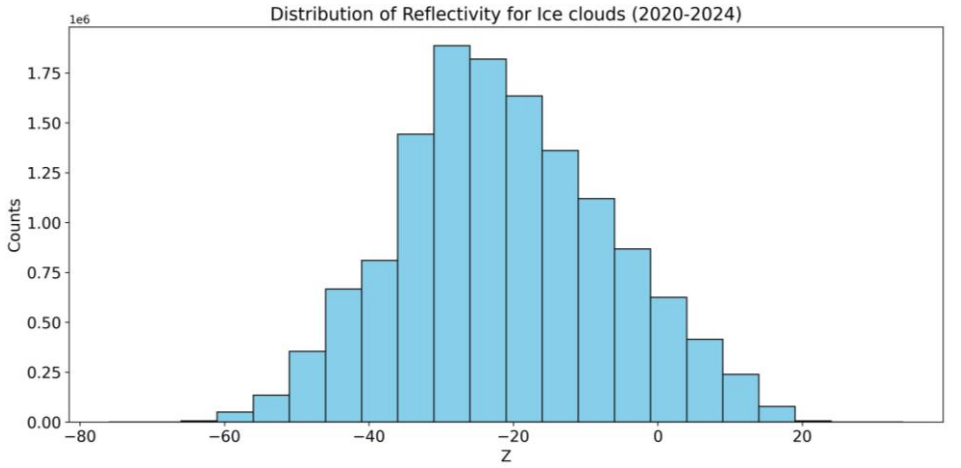


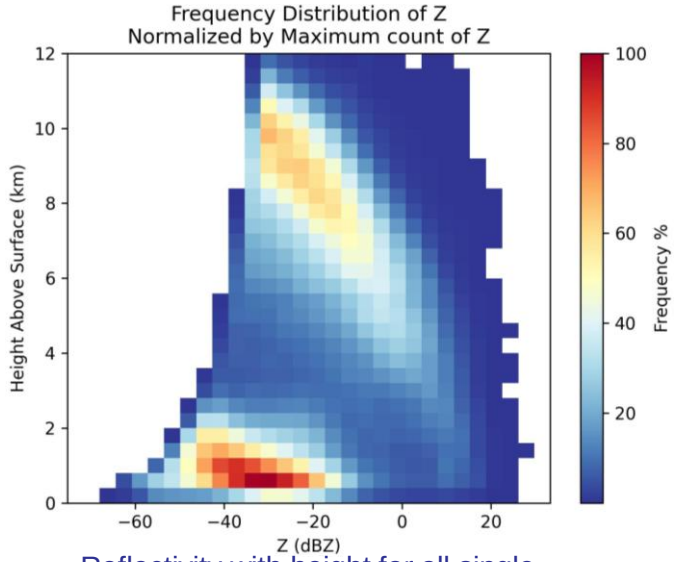
Radar Reflectivity distribution from Water clouds and Ice clouds (2020-2024)



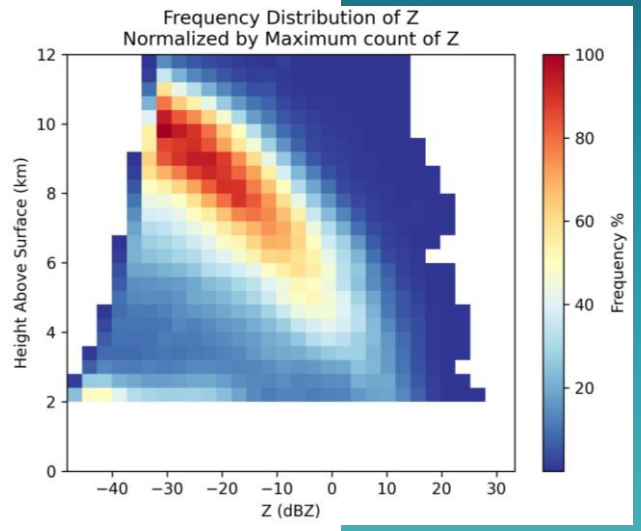


Reflectivity with height for all single layer Water clouds



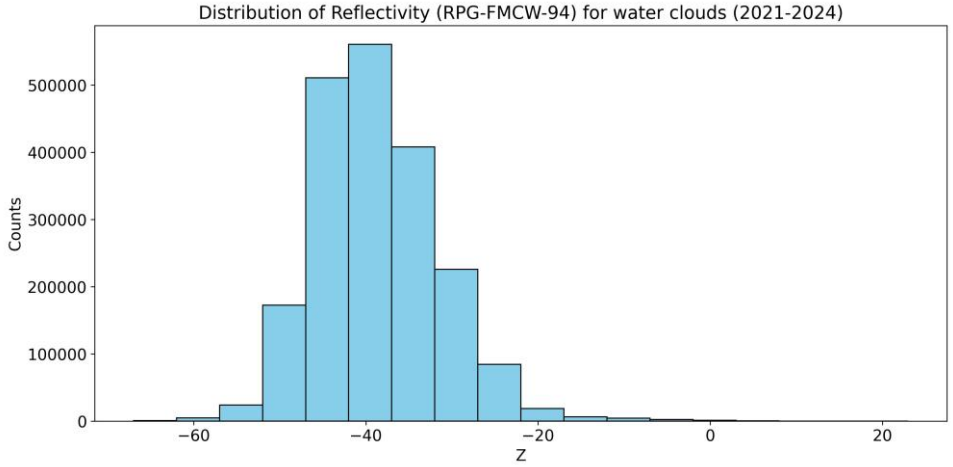


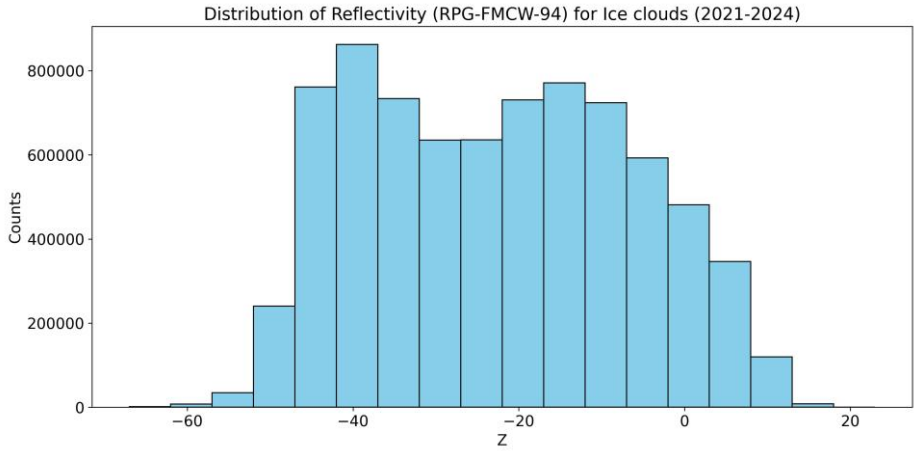
Reflectivity with height for all single layer Ice clouds

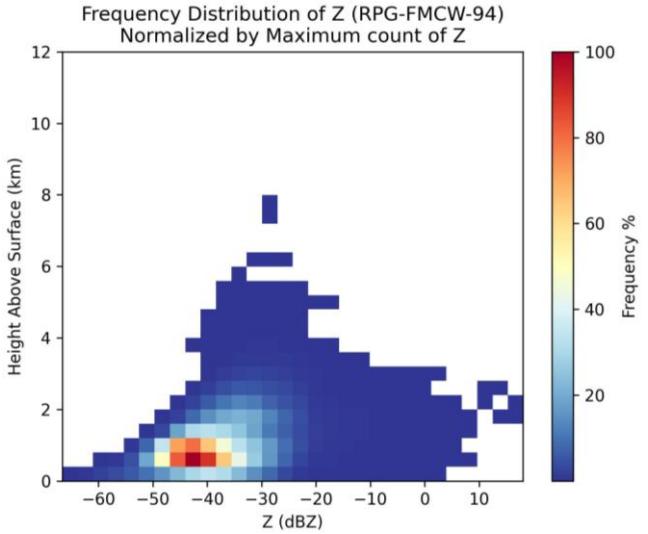


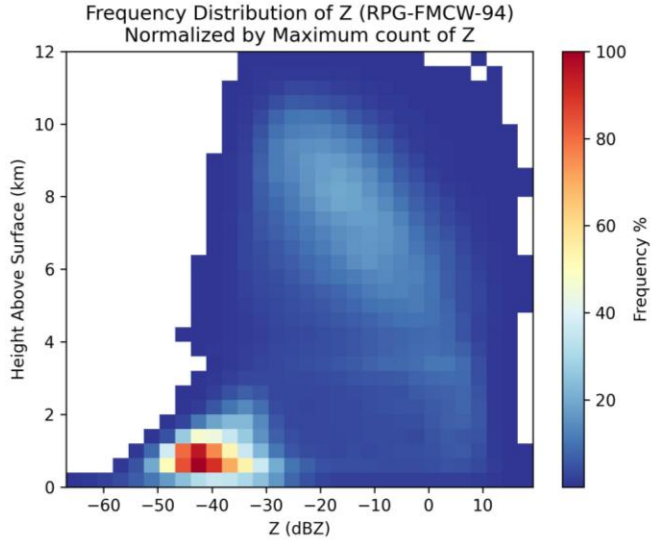
Reflectivity with height for sigle layer ice clouds > 2000 m

Radar Reflectivity distribution from Water clouds and Ice clouds for RPG-FMCW-94 (2020-2024)









Reflectivity with height for all single layer Water clouds

Reflectivity with height for all single layer Ice clouds

Reflectivity with height for sigle layer ice clouds > 2000 m