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Updates and new developments at NF Lindenberg

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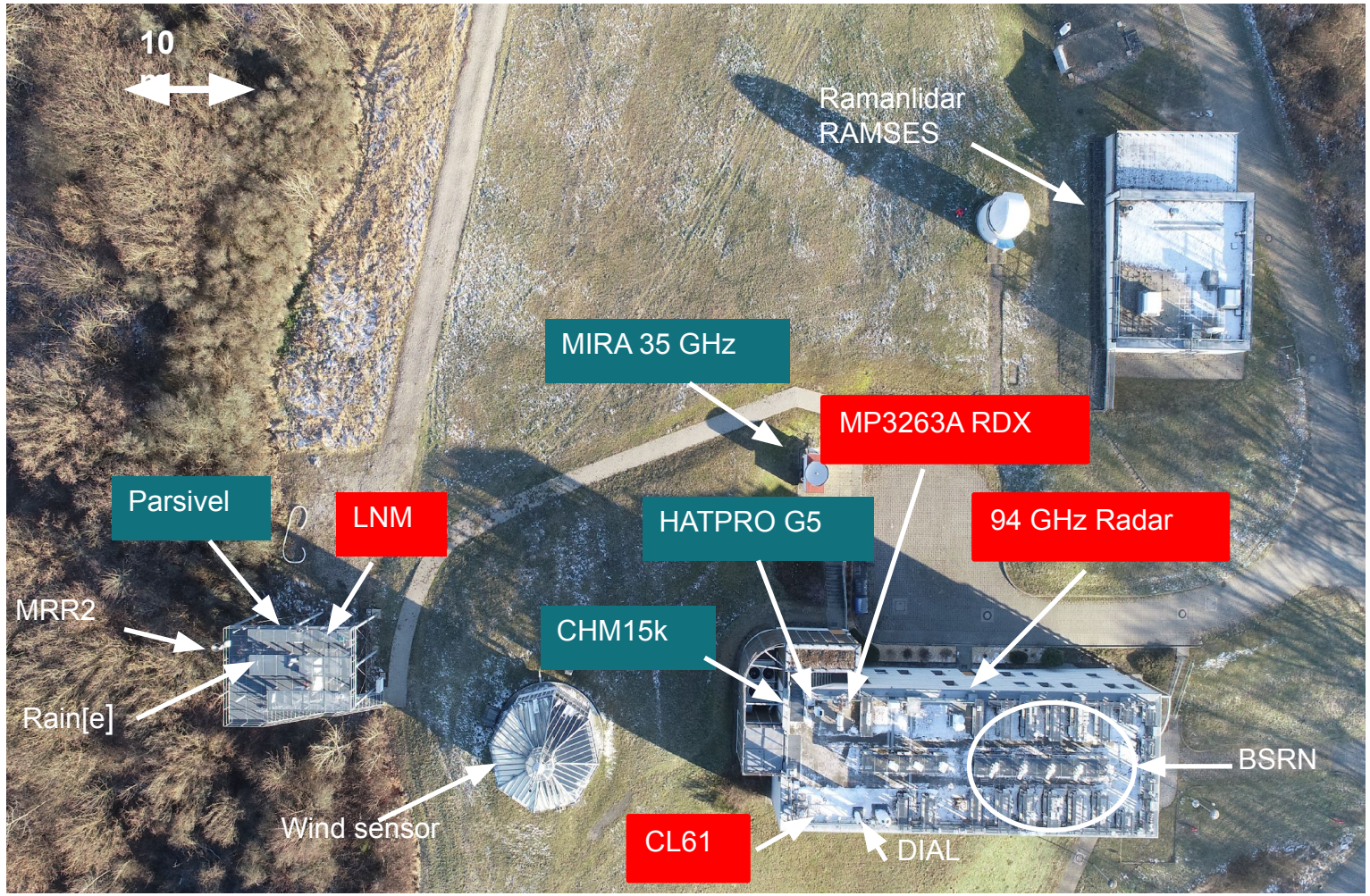
CCRES/CLU Workshop, Matera – November 7th, 2024

Operation of two cloudnet stations since March 2024



Objective

To study the reproducibility of the Cloudnet products depending on the use of various cloud remote sensors

Station 1 (NF):
35 GHz radar MIRA35
HATPRO G5
CHM15k
Parsivel

Station 2:
94 GHz radar RPG
MP3263A RDX
CL61
LNM

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Status of instruments (2024)

Station 1 (NF)

- **MIRA 35 GHz**, continuous operation, renewal in November/December 2024, Delivery date 13. 12., Main radar parts have now arrived Metek from Ukraine
- **HATPRO G5**, continuous operation, LN2 calibration (July 2024)
- **CHM15k**, continuous operation, replacement of processor board

Station 2

- **94 GHz Radar**, continuous operation, LN2 calibration, replacement of Radoms (July 2024)
- **MP3263 RDX**, continuous operation, new firmware with automated (absolute) calibration, no LN2 calibration required
- **CL61**, continuous operation

Supplementary instruments

- **Parsivel**
- **LNM**
- **Rain[e]**

} repeated problems with data acquisition, change to pyAtmosLogger for all systems, adaptation also to Lambrecht rain[e] (Ronny Leinweber)

Evaluation of new instruments

- Vaisala DIAL DA10 since 28 November 2023

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Comparison of Cloudnet Products generated by Station 1 and Station 2

Methodology

- Independent processing for both stations at DWD server with CloudnetPy v1.65.8
- Using level1b instrument data processed by CLU and ECMWF model data as input
- Comparison based on the daily files only if the number of profiles of both stations agree
- Period March – September 2024
- **Target classification:** Calculation of the proportion of the target type to the total number of measurements (profiles)
- **LWC and IWC:** Calculation of 2d- and 1d histograms and of mean vertical profiles for all time-height pixels with retrieval_status = “reliable”

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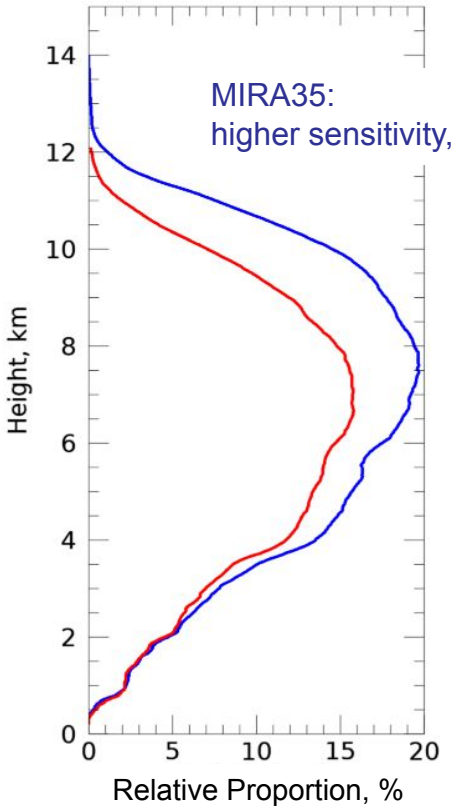
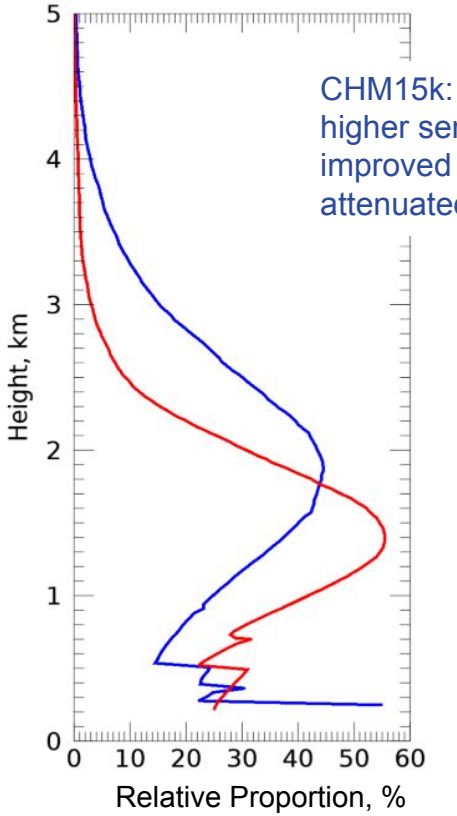
Mean vertical profiles of various target types for Station 1 (blue) and Station 2 (red)

Ice



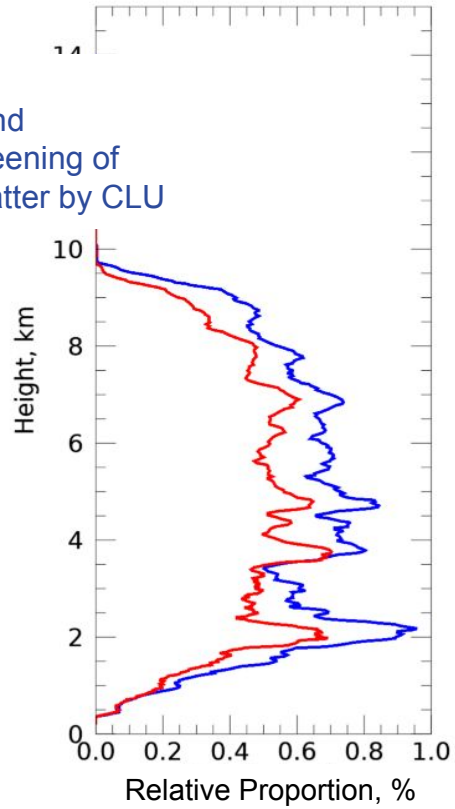
MIRA35:
higher sensitivity, detection rate

Aerosol

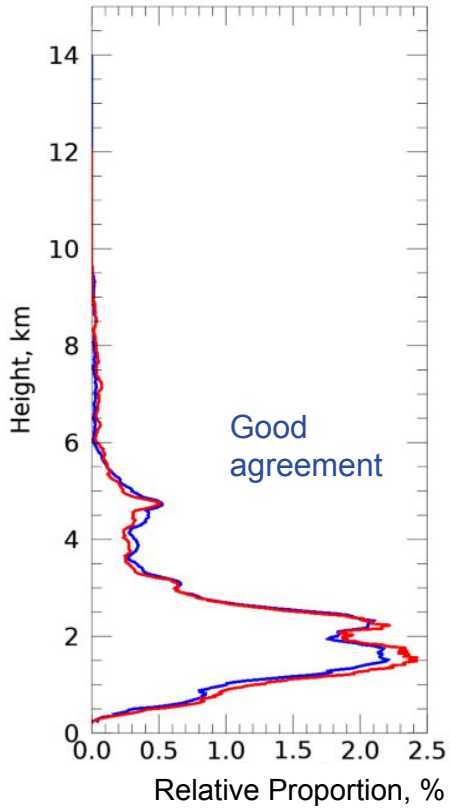


CHM15k:
higher sensitivity and
improved SNR-screening of
attenuated backscatter by CLU

Ice + super cooled droplets

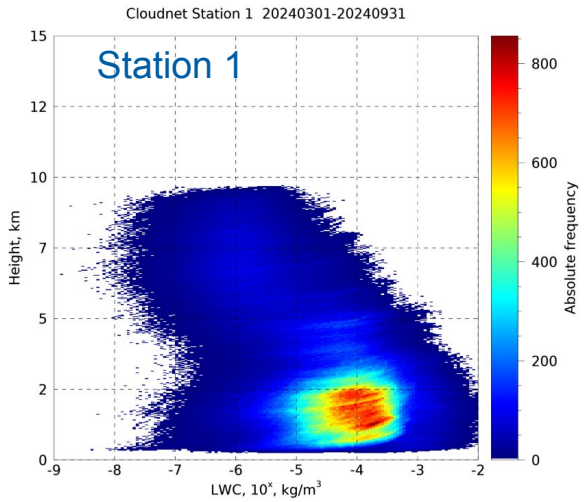


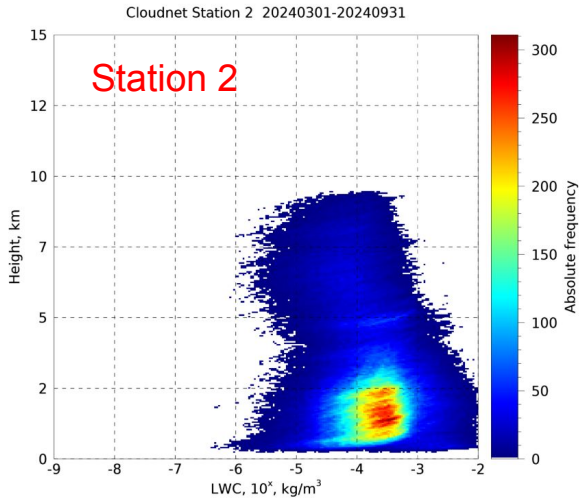
Cloud liquid droplets



Good agreement

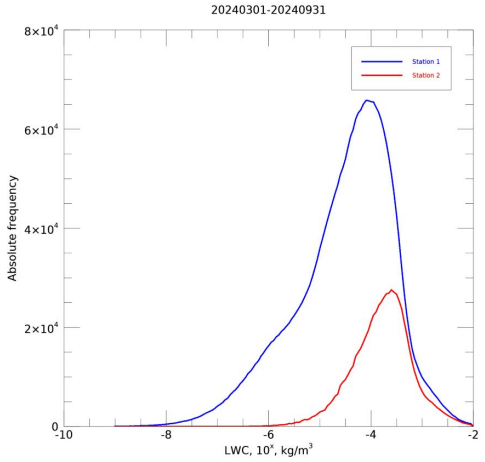
Comparison of LWC

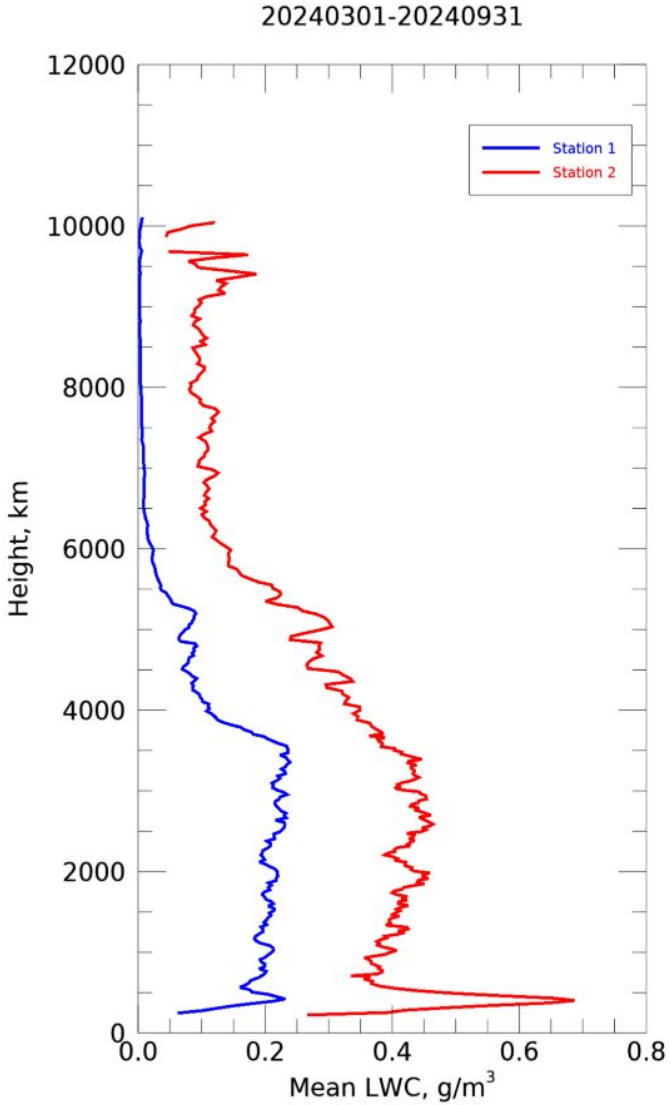




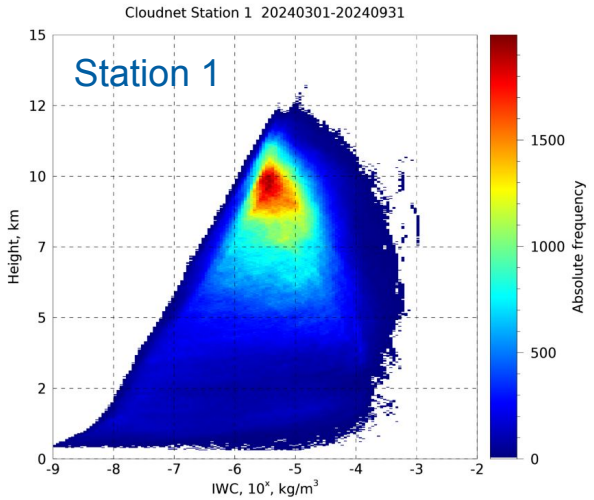
- Mean: $LWC_{ST2} > LWC_{ST1}$ (Factor 2)
- Var: $LWC_{ST2} < LWC_{ST1}$

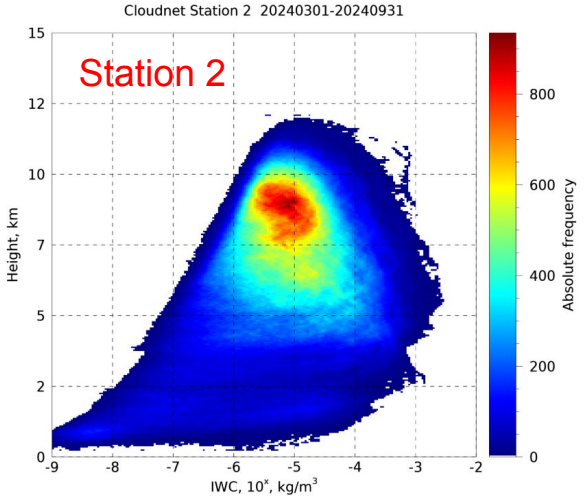
- Cause: LWP from MWR(RDX) twice as large as LWP from HATPRO





Comparison of IWC





- $IWC_{ST2} > IWC_{ST1}$ (Factor 2..3)

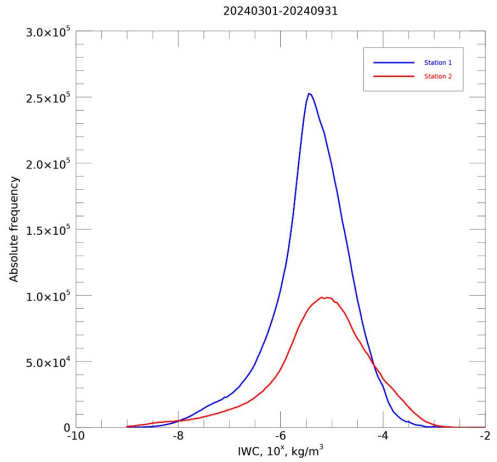
Possible cause(s):

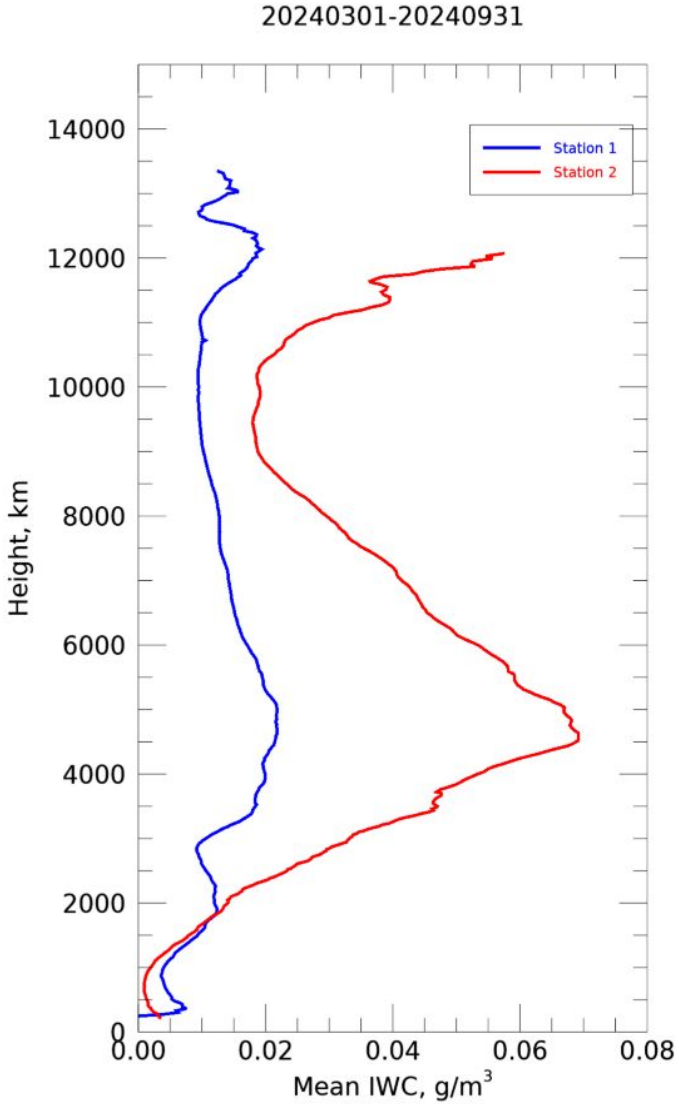
- Different calibration of both radars
- Empirical equation (Hogan 2006) not suitable (different equations for 35 GHz

$log_{10}(IWC)=(0.000242)ZT+0.0699Z-0.0186T-1.63$

and 94 GHz:

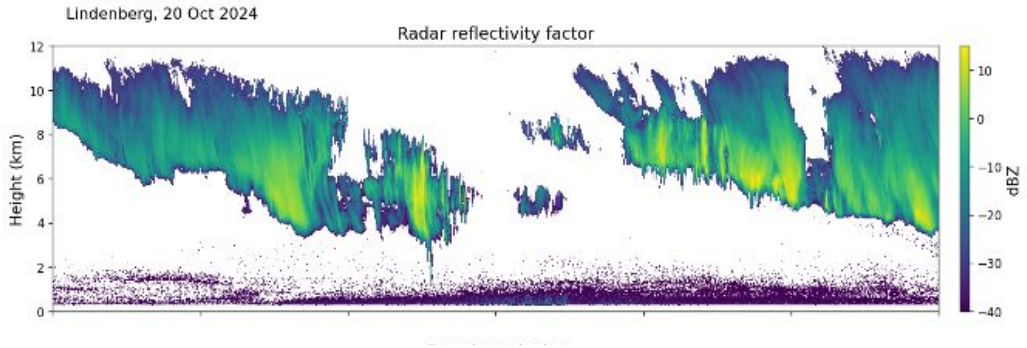
$log_{10}(IWC)=(0.000580)ZT+0.0923Z-0.00706T-0.992$



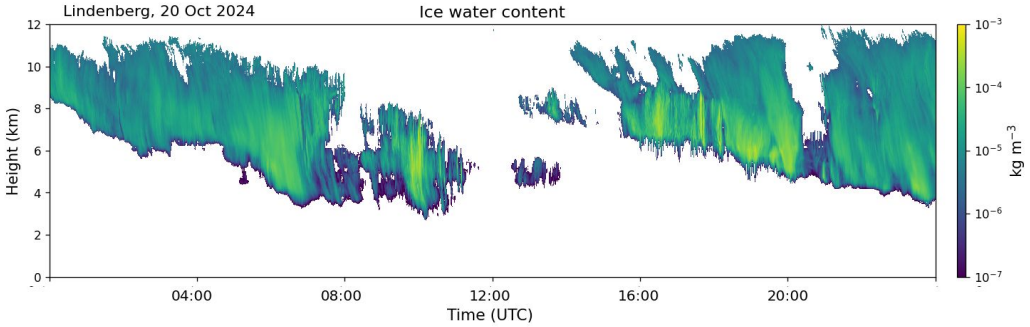


Case study, Cirrus without liquid water clouds below 20.10.2024

Cloudnet Station 1

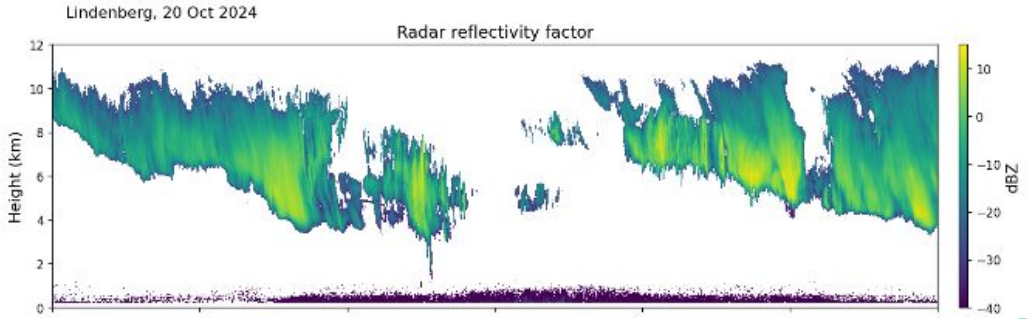


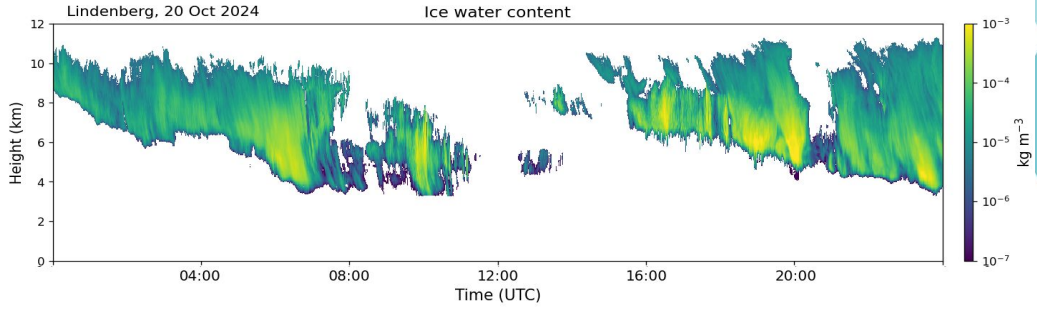
Z_e



IWC

Cloudnet Station 2





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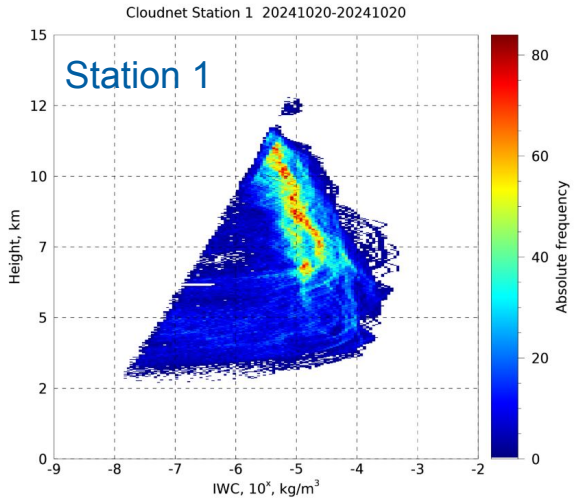
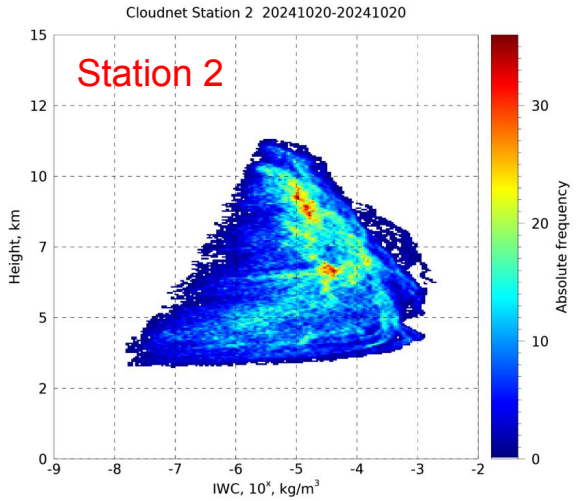
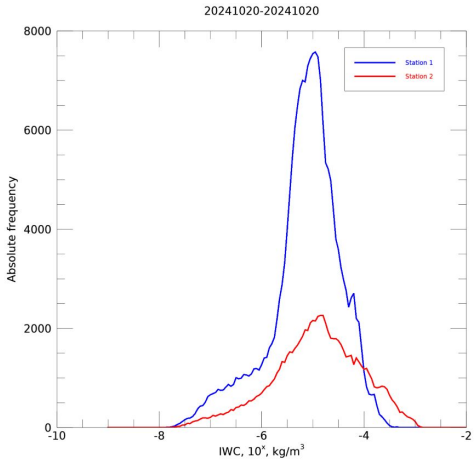
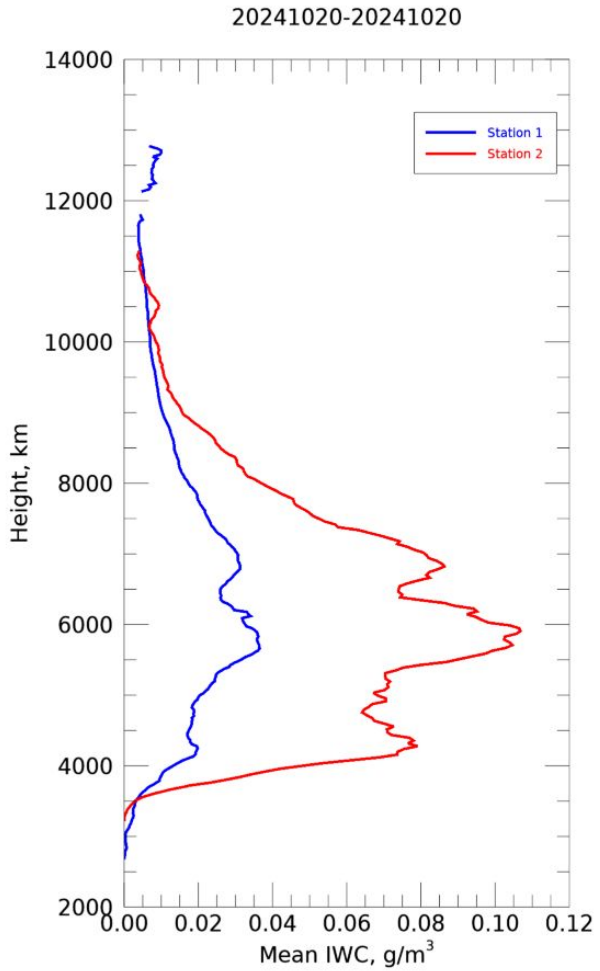
Comparison of IWC for 20.10.2024





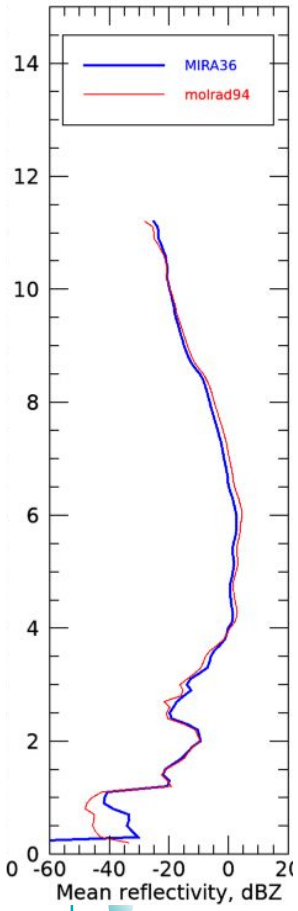
Same behaviour of IWC between station 1 and 2 as for half-year statistics

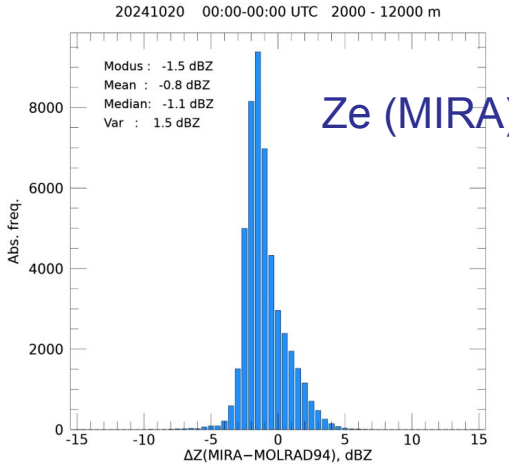


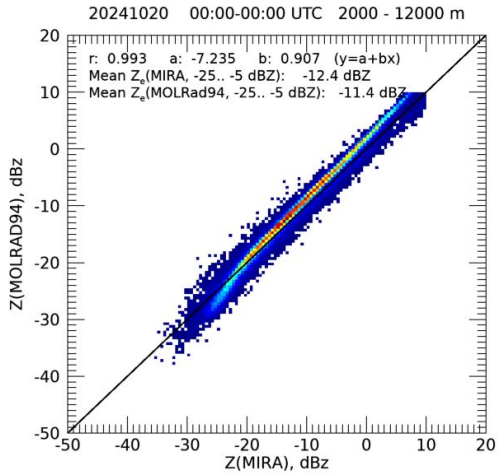


Comparisons of Z_e between 35 GHz and 94 GHz radar

- Attenuation correction regarding atmospheric gases
- Mie correction for 94 GHz
- Correction of refractive index

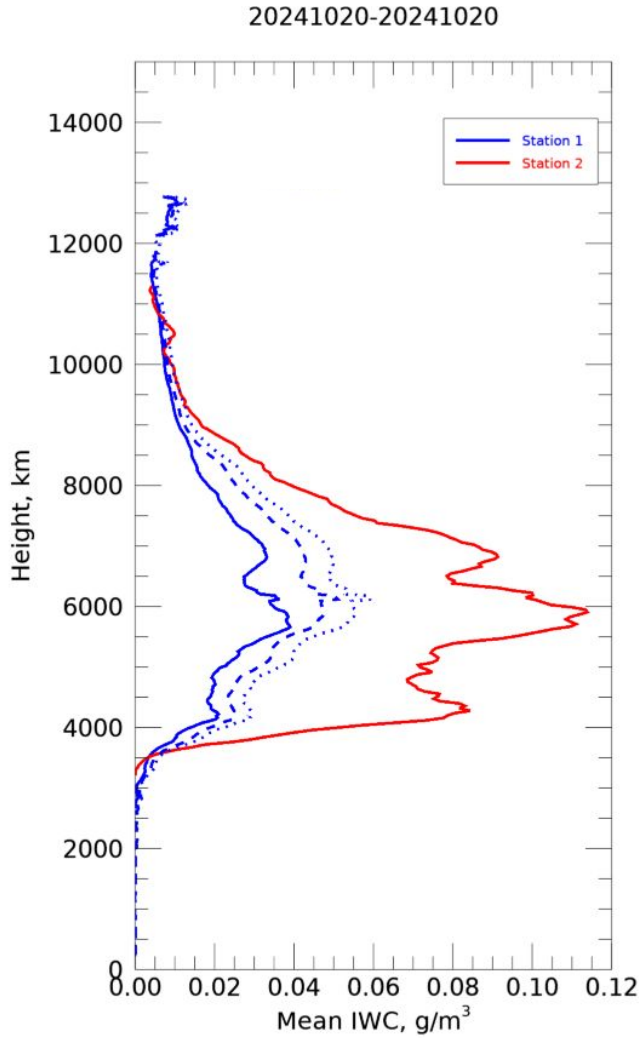






Ze (MIRA) – Ze(MOLRAD94) ≈ -1 dB

Reprocessing IWC with Z_e (MIRA) + 1dB + 2 dB



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Summary

- Cloudnet products LWC and IWC of the two co-located stations show significant differences

- Some of these differences can be easily explained by different instrument characteristics (e.g. radar sensitivity), others need more investigations (IWC)

- Further analysis planned regarding
  - Independent IWC estimation by Raman-lidar spectrometer,
  - LWC calculation using homogenized LWP retrieval (CCRES MWR unit DE),
  - Cloud base and cloud top
  - MWR (RDX) included in MWR unit ?, bias correction ??

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Thank you