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CCRES EarthCARE Cal/Val overview and perspectives

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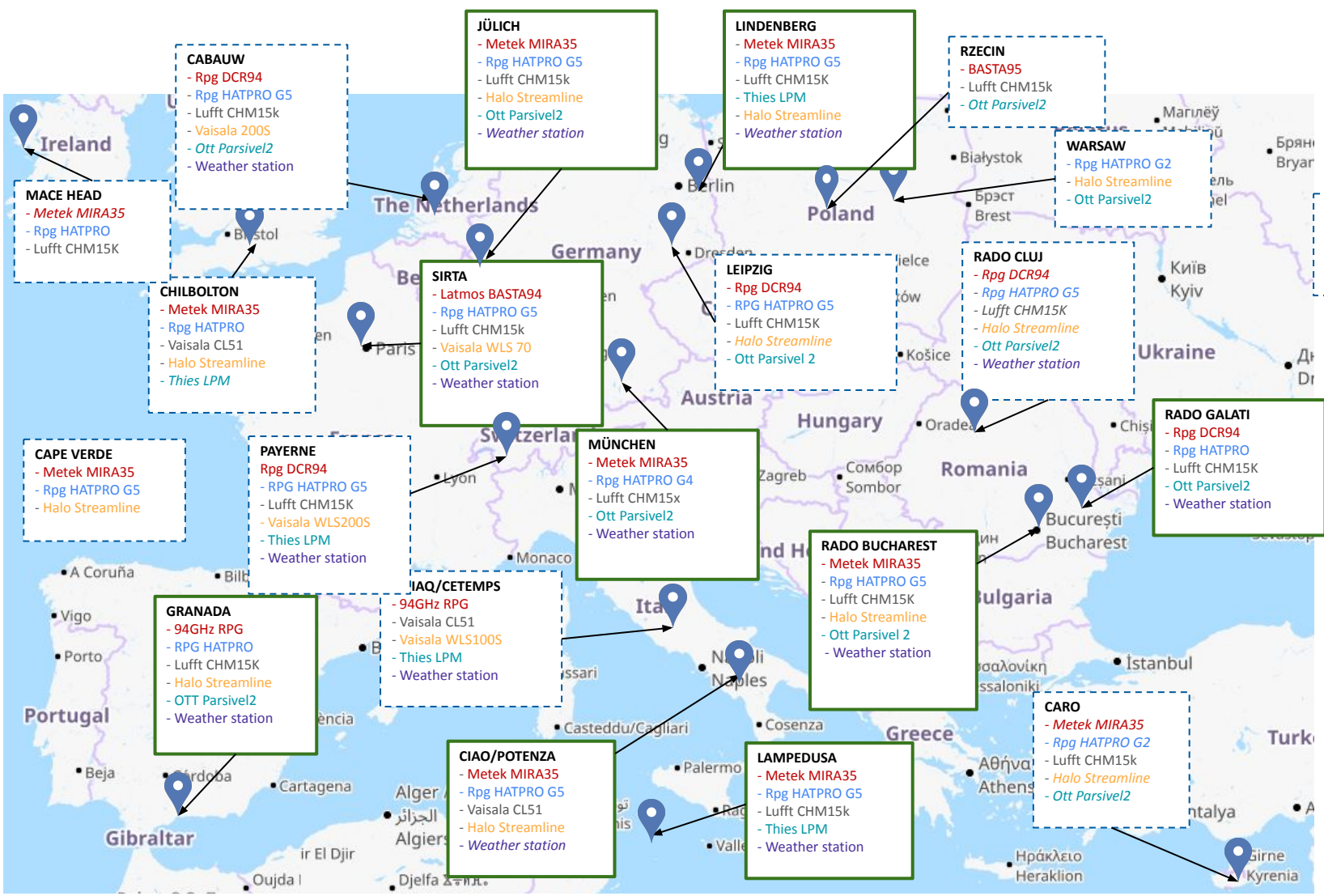
CRS sites and instruments in 2024



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Ground-based Doppler Cloud Radar calibration and monitoring

4 complementary DCR calibration methods (developed by CCRES)

- Absolute calibration using corner reflectors (Toledo et al 2021)
  - Works well for BASTA-DCR, not for other DCRs (traveling reference DCR)
- Calibration transfer with reference DCR (Jorquera et al., 2023)
  - Useful by combining calib. and uncalib. DCRs but time consuming (~ 2 months each time)
- Calibration constant monitoring with disdrometer
  - Require stratiform rain events but allows to monitor DCRs drifts, …over long term period
  - Disdrometer measurements implement at all CRS NFs
- Calibration transfer with satellite DCR
  - Extending the spatial consistency of ACTRIS DCR calibration by combining all methods

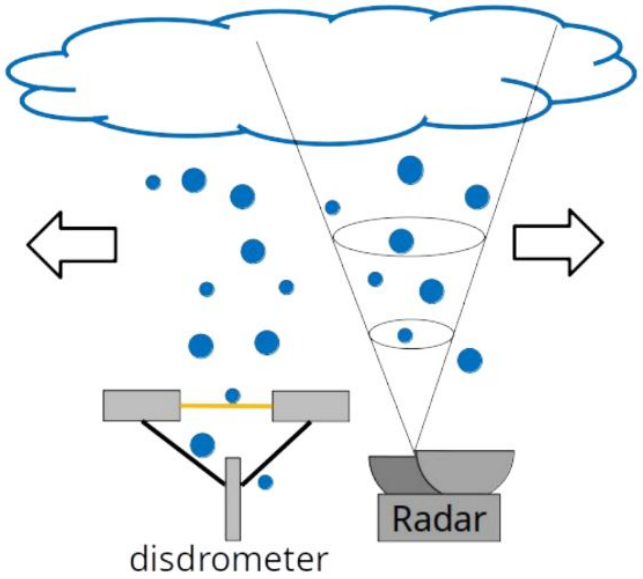
Perspectives

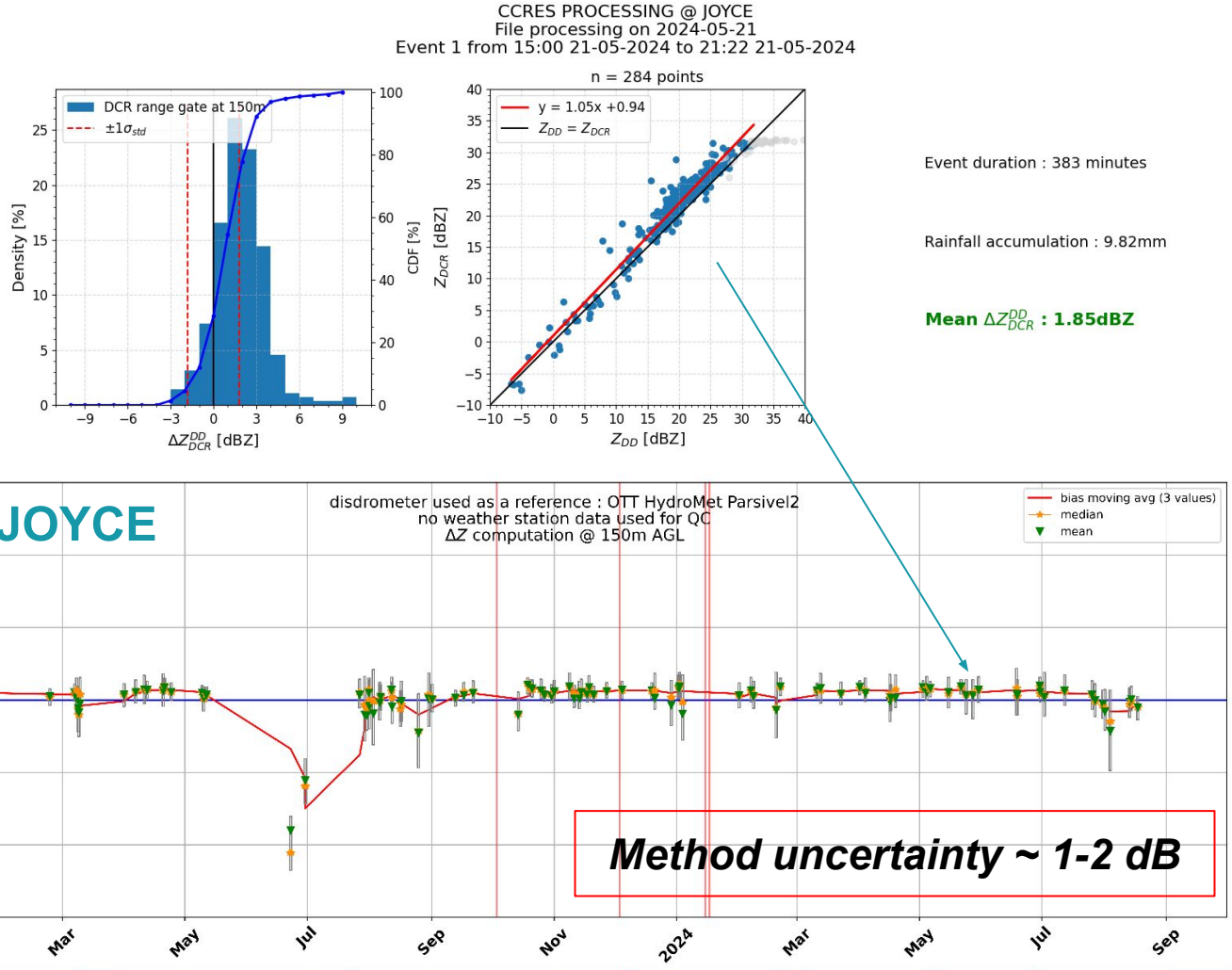
- Disdrometer calibration with iron balls (coop. with S. Kneifel at LMU)
- Self consistency method for dual polarisation cloud radar (Myagkov et al., 2020)
- Extended calibration period based on AI method

Method #3: calibration constant monitoring with disdrometer

(Kollias et al., 2019; Myagkov et al., 2020; Chellini et al., 2022)

- Automatically compare **DCR Zh** and **derived disdrometer Zh** in **stratiform rain events**
  → Ongoing CCRES activities
  - Aims to monitor time shifts, drifts, DCR calibration constant deviation





Monitoring available on https://ccres.aeris-data.fr/en/data-visualization/

Motivations

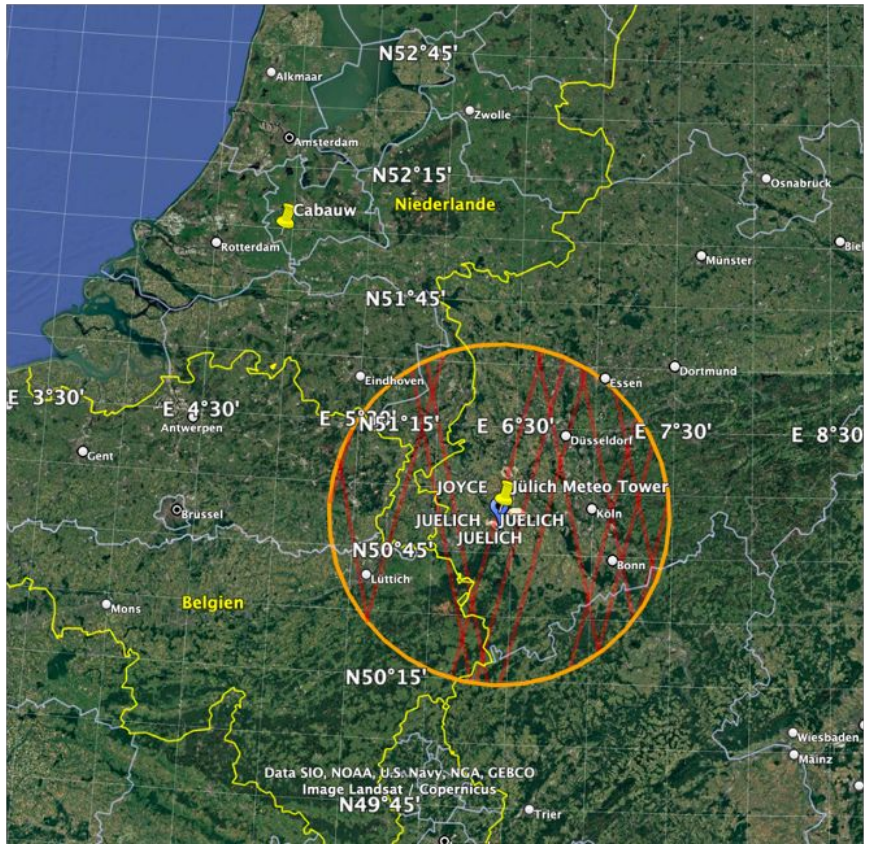
Goal:

validation of EarthCARE CPR Level 1 data with ACTRIS ground-based radar measurements.

Method:

Statistical comparison of ground-based and satellite radar data on certain periods (Protat et al. 2009, Kollias et al. 2019).

→ Relative sensor comparison (stability monitoring)



Current stage of the work:

Code developed based on CloudSat and Cloudnet data – switch to EarthCARE data till end of the year

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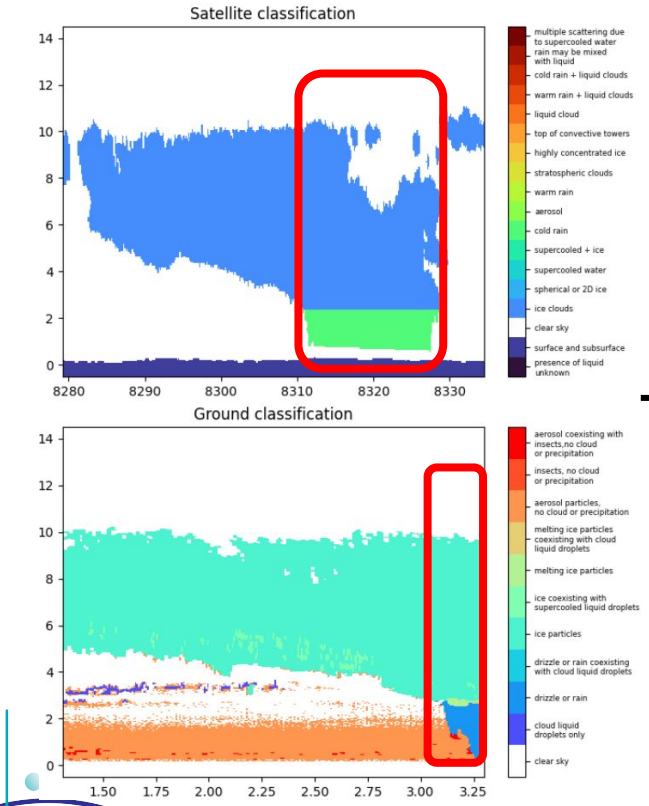
Data selection

An overpass is defined as a passage of the satellite in a 200 km radius around a site.

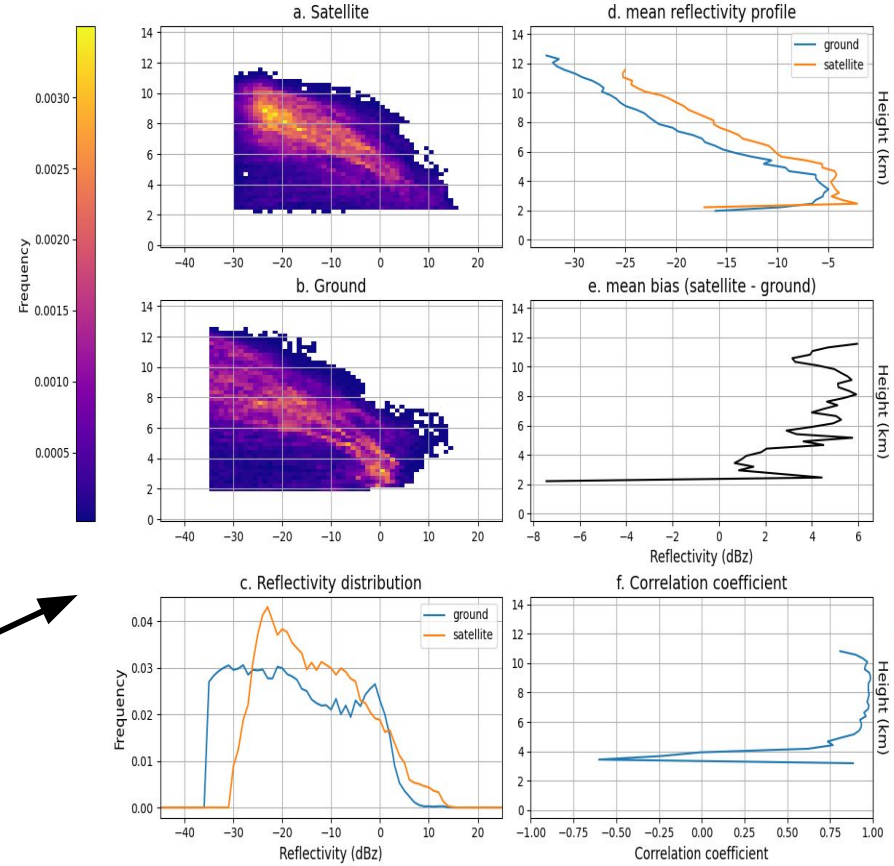
- Satellite: data selected is the trace in the 200 km radius.
- Ground: data selected is in a ±1 h window around the overpass.



Cloudnet and satellite data for an overpass.

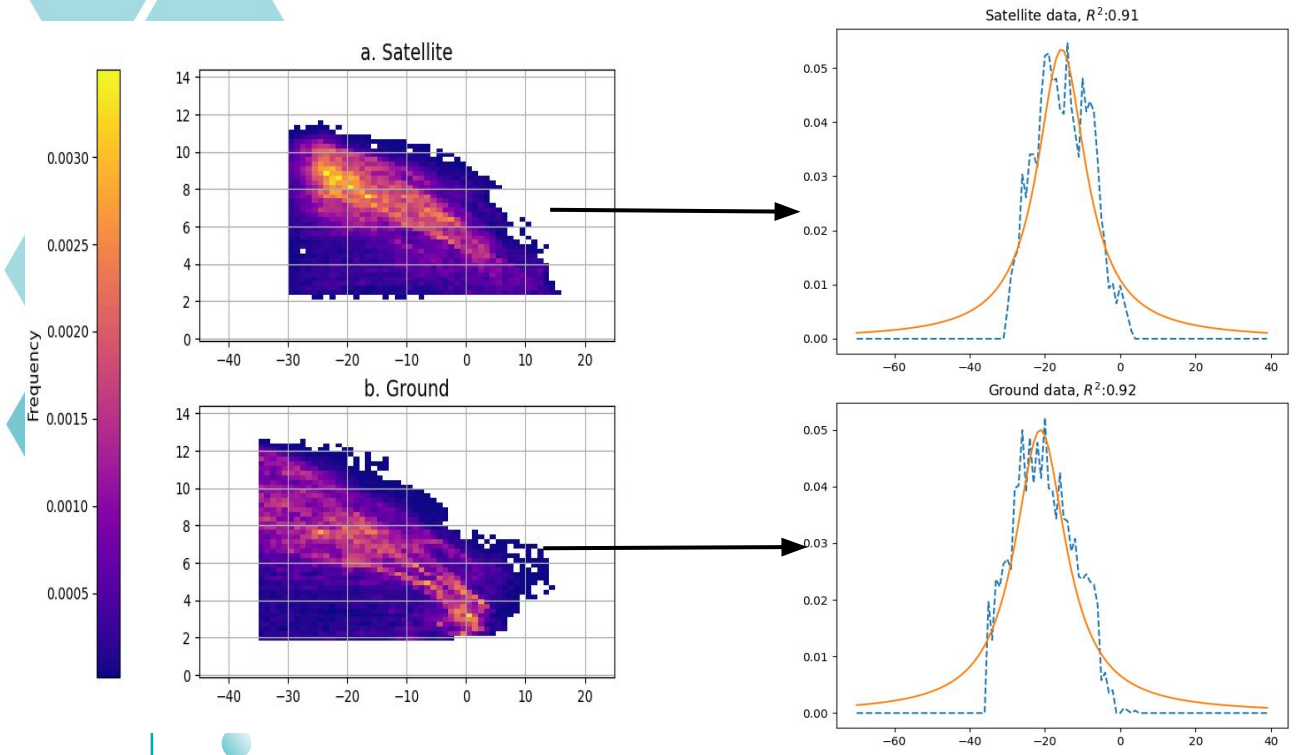
- Data windowing
- Liquid water columns removal
- Resample ground data to satellite's resolution

Combine the data of all overpasses



Statistical comparison

We assume that both radars observe the same statistical behavior. Thus their statistical behavior per height should be similar. We compare the statistics per height by fitting a Lorentzian model as it provides a good estimate of the main behavior.



$$f(x; A, \mu, \sigma) = \frac{A}{\pi}\left[\frac{\sigma}{(x-\mu)^2 + \sigma^2}\right]$$

Lorentzian model:

- Amplitude: A
- Center: μ
- Full Width Half Maximum (FWHM): 2σ
- R^2: goodness of the fit

Bias and uncertainty estimation

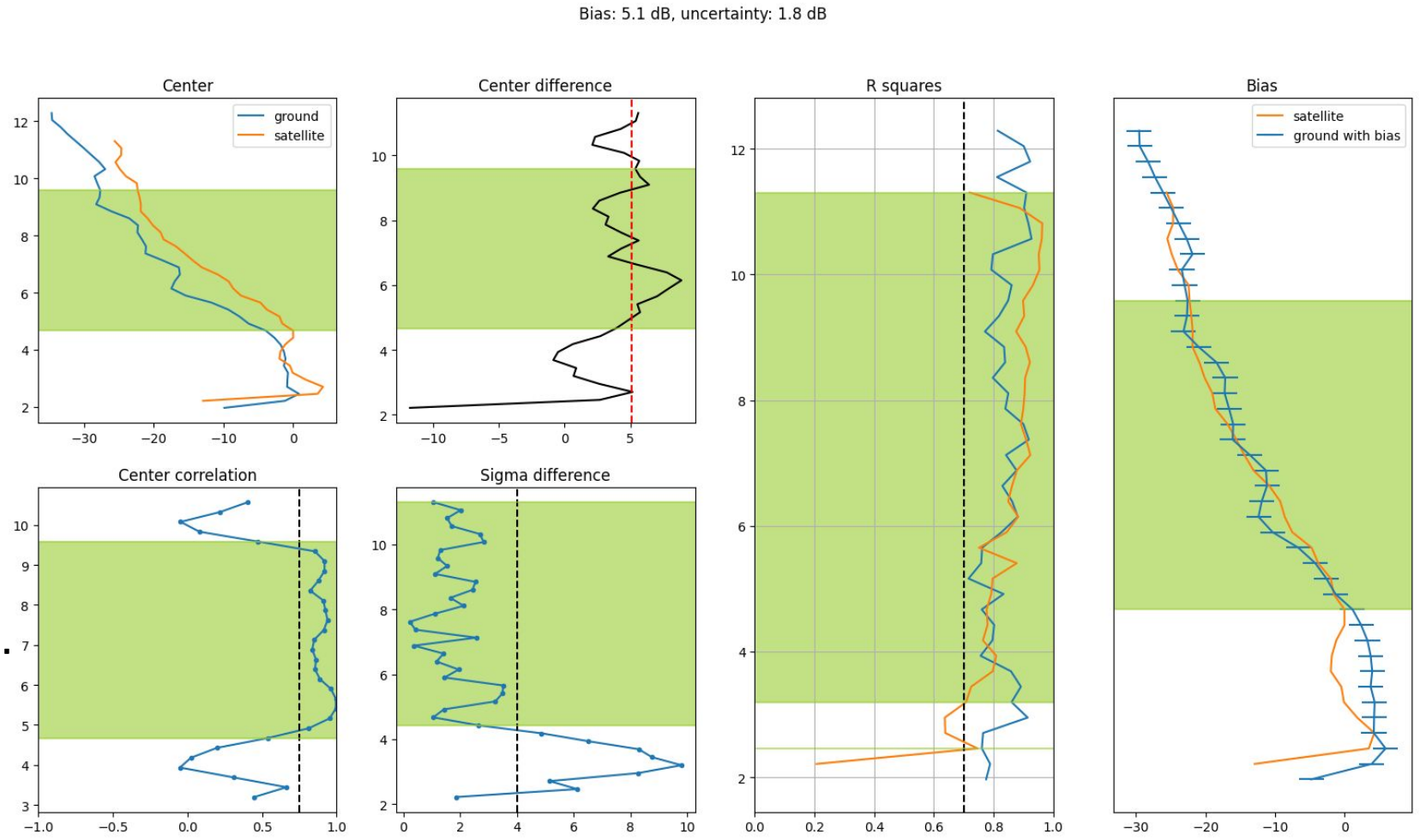
Bias is estimated at the heights for which the parameters fulfill a certain criteria.

Parameters used to select heights:

- Center's correlation.
- σ differences.
- R^2.

Bias: mean(center differences).

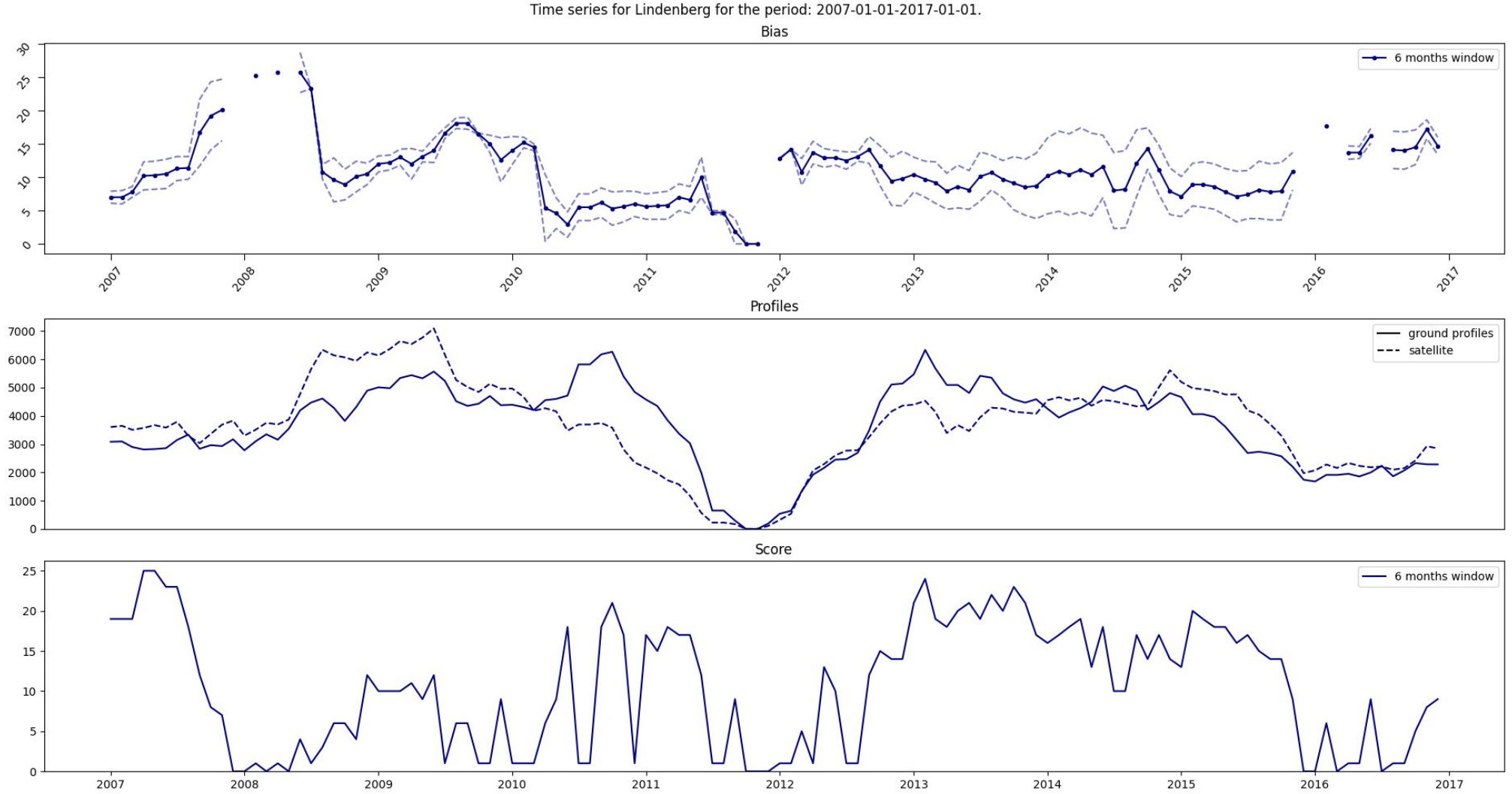
Uncertainty: std(center differences).



These criteria will have to be verified and refined with sensitivity analyses.

Time series

For a given site we can estimate a bias for each month, selecting data ±6 months around.



Results are not definitive, validation will still be needed.

EarthCARE status

- The code is ready to receive EarthCARE data.
  - First comparisons should be performed soon.

- No EarthCARE comparisons has been done yet.
  - Desire to have a fully functional code.
  - Problems on the CPR.
  - Problems accessing the data.

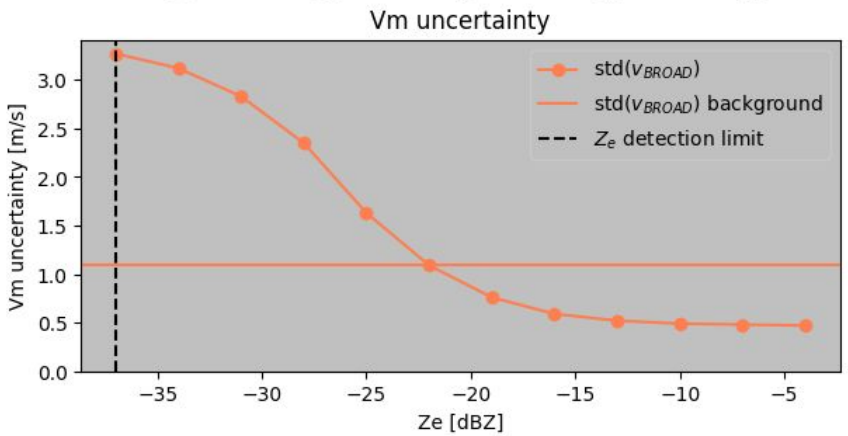
- Note: data classification release will be needed for a full integration to the code.

Doppler velocity: Study with synthetical CPR data

Doppler velocity statistics based on synthetical EarthCARE data

Convert ground based ACTRIS data to synthetical CPR data using orbital-radar tool (Pfitzenmaier et al., 2024, GMD)

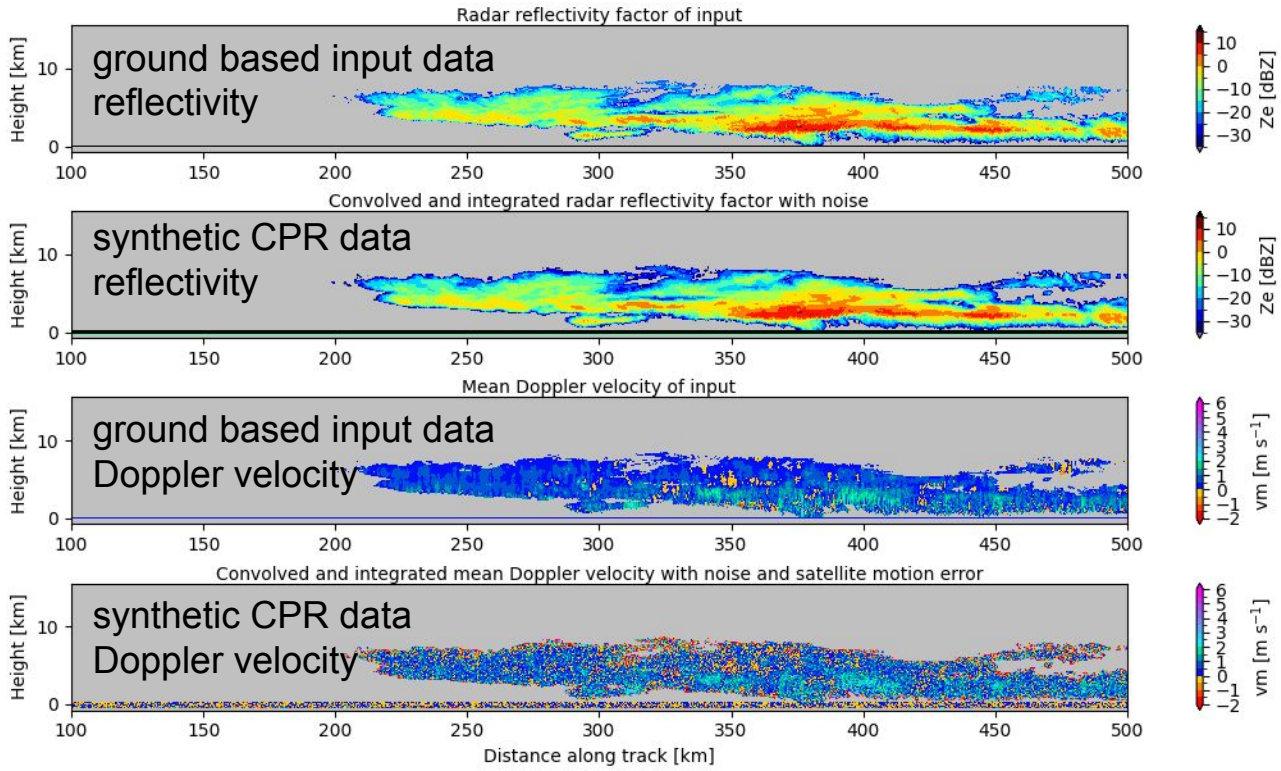
Doppler velocity data are noisy:



Kollias et al., 2022, AMT

Comparison challenging -> filtering necessary

Example data from NyÅlesund, 29th January 2024



Paper

Code on GitHub

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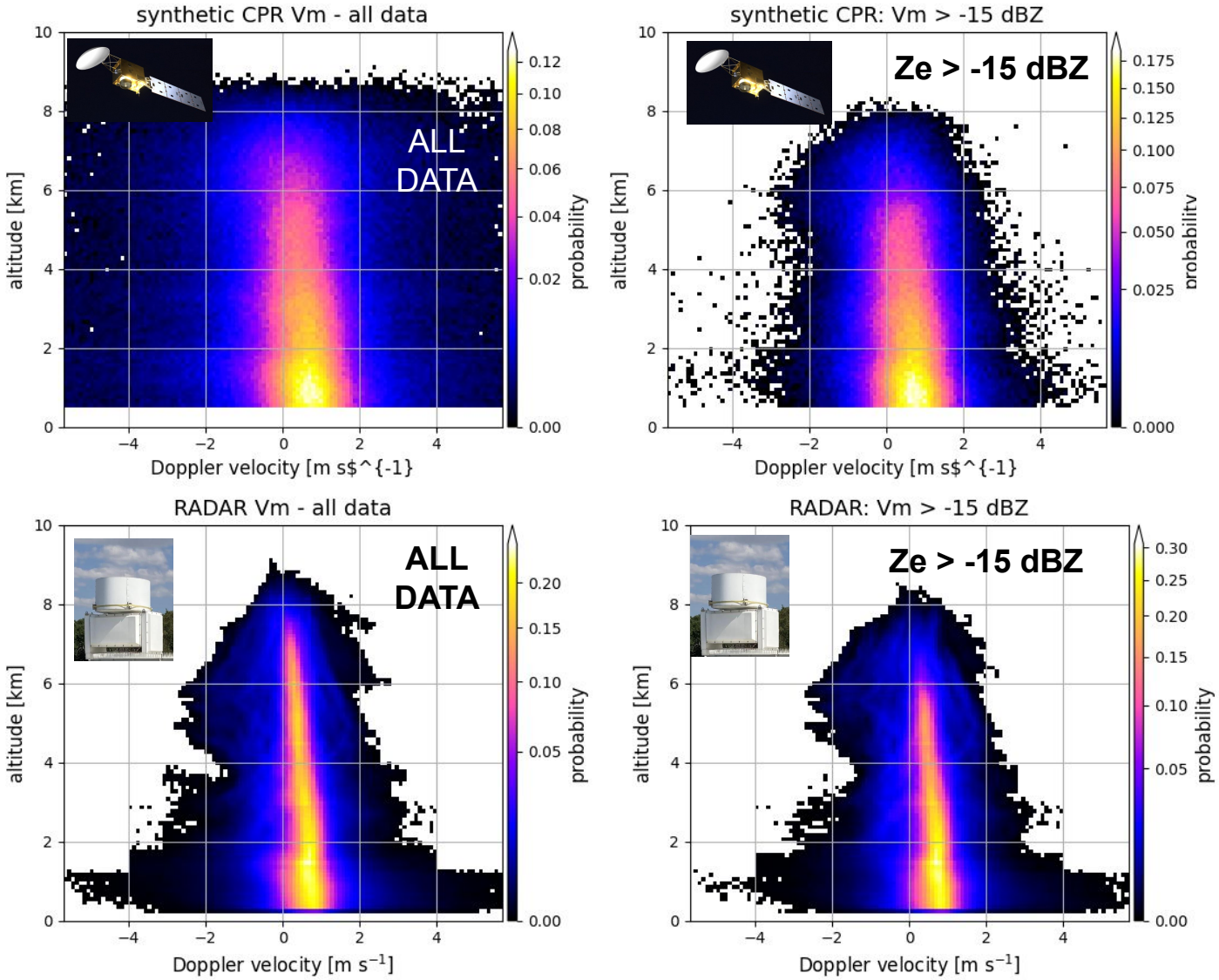
Doppler velocity: statistics

Example data set NyÅlesund, 30 days Jan-Feb 2024



Good comparison passible for data Ze > -15 dBZ

Longer sampling for convective cloud environments

Doppler velocity: correlation EarthCARE vs ground-based

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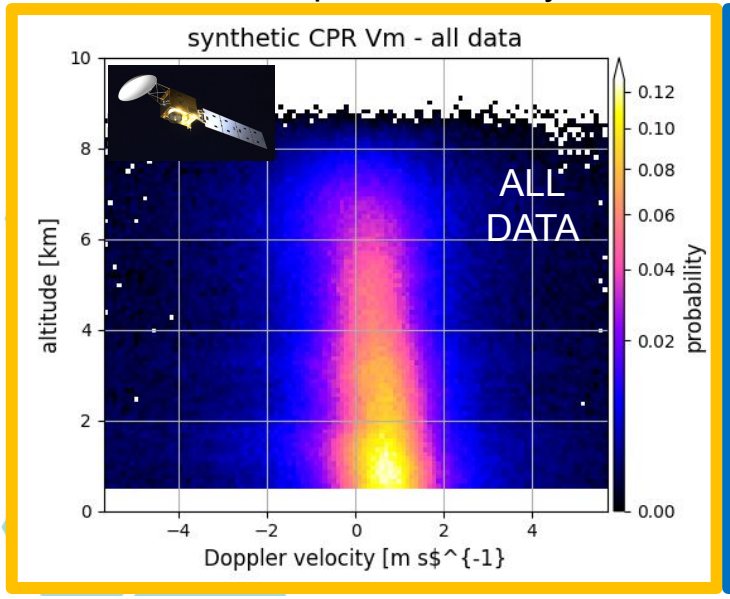

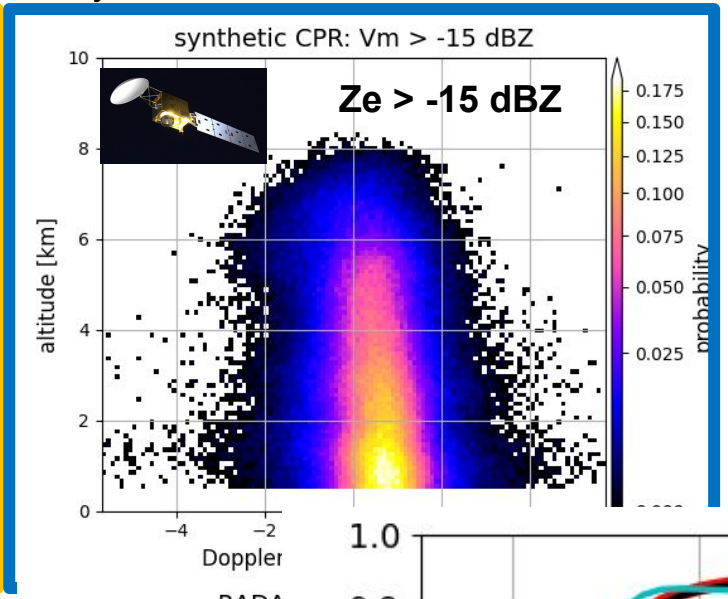

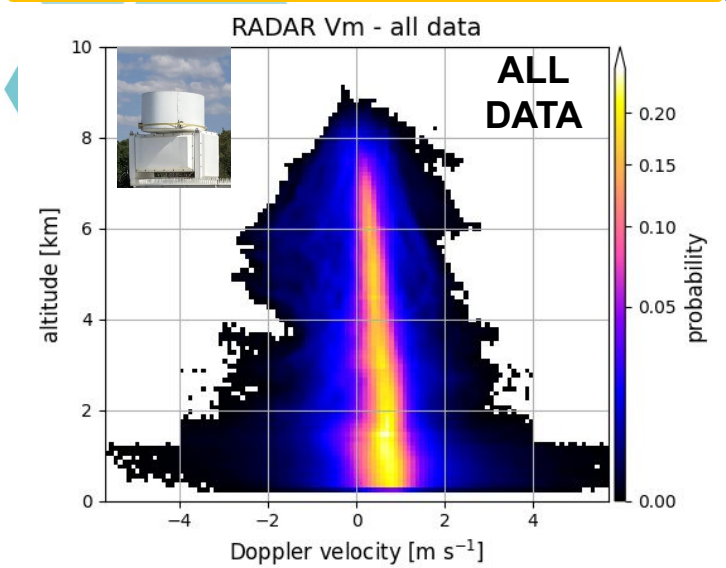

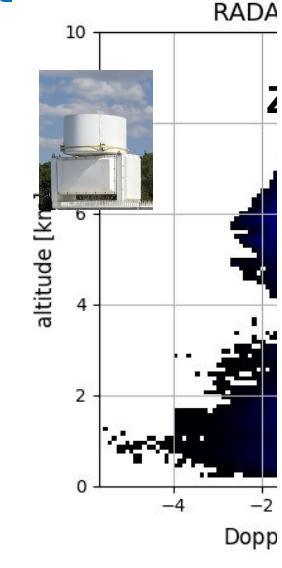

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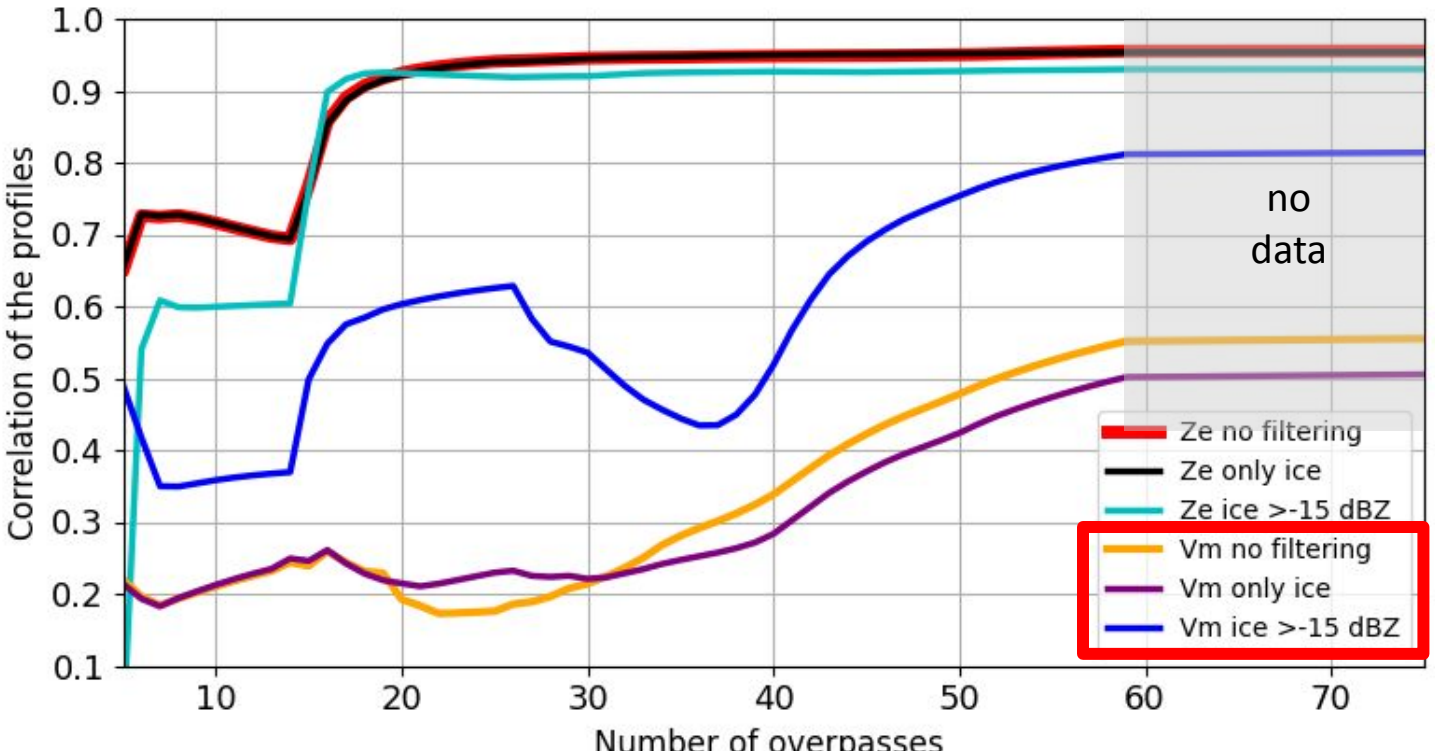
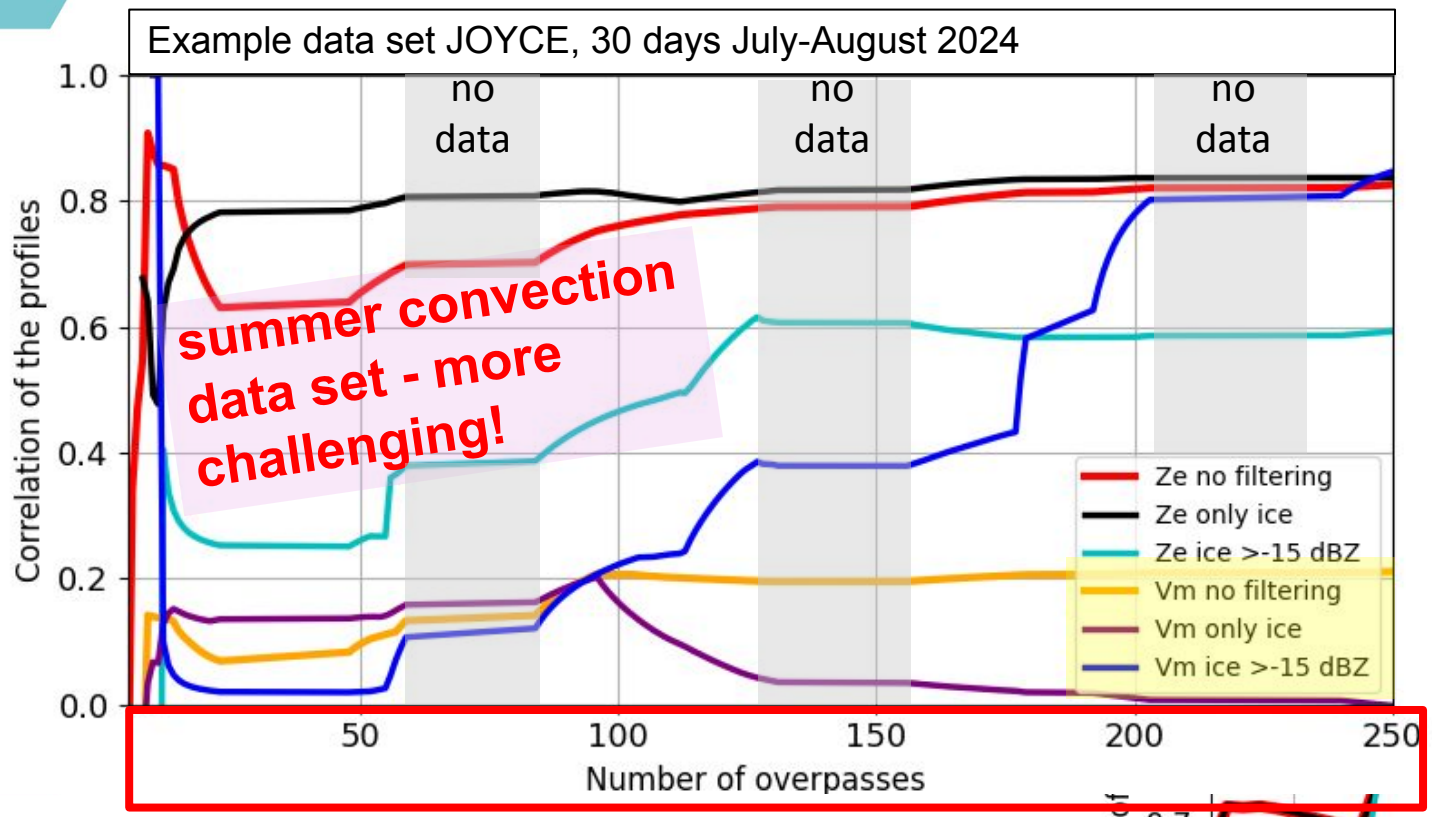
Longer sampling for convective cloud environments

Lower correlation between ground based and CPR Doppler velocity data than for Ze data



Doppler velocity: correlation EarthCARE vs ground-based



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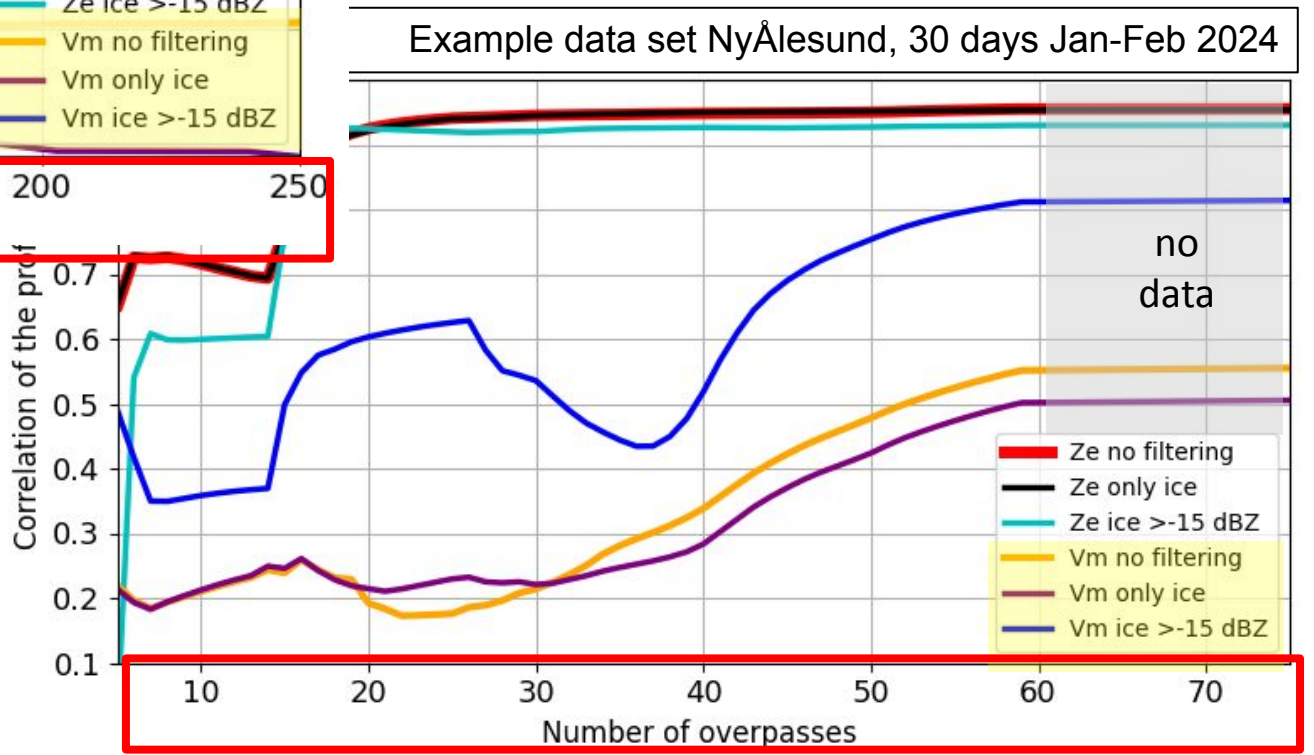

Next:

- If and how smoothing will improve the CPR Vm profiles
- Improve the filtering of the CPR Vm data
- Use EarthCARE observations

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Perspectives

- Run sensitivity analyses for the heights selection criterias.
- Validate time series with well ground characterized sites (e.g. CCRES calibration, disdrometer tracking).
- Comparisons with EarthCARE data (Cal/Val).
- Full historical comparisons with CloudSat for each site with enough data.
- Article planned for 2025.
- Development of an inter-comparison code for doppler velocities.

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Thank you