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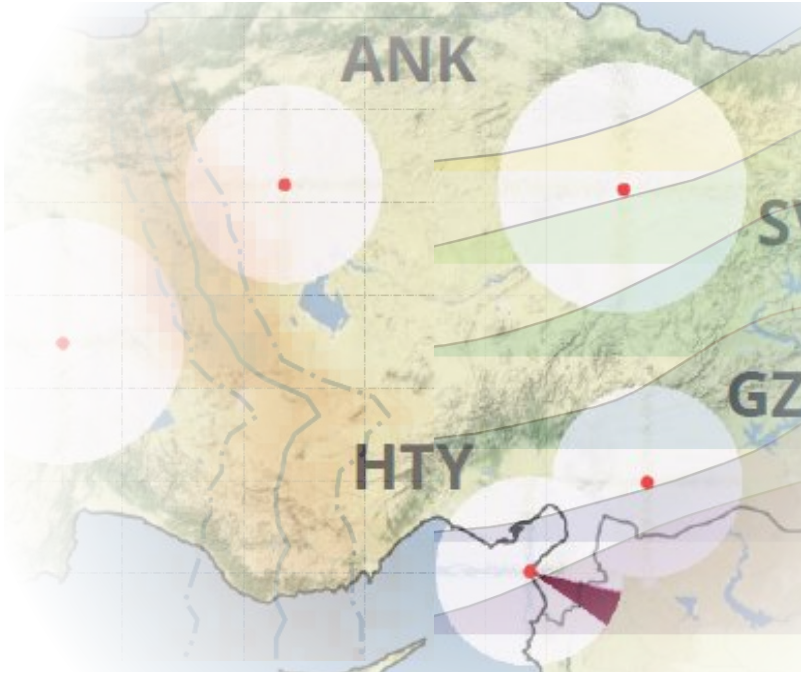
From Cloud Tops to Surface: Statistical Insights into Stratiform Microphysics over Germany and Türkiye



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21 March 2025

PrePEP - Conference

Motivation

Statistical analyses of polarimetric radar data are important for:

- Improving the **understanding** of **precipitation**-generating **processes** and their regional and seasonal differences.
- **Model evaluation** and improvement, particularly in terms of microphysical parameterizations.

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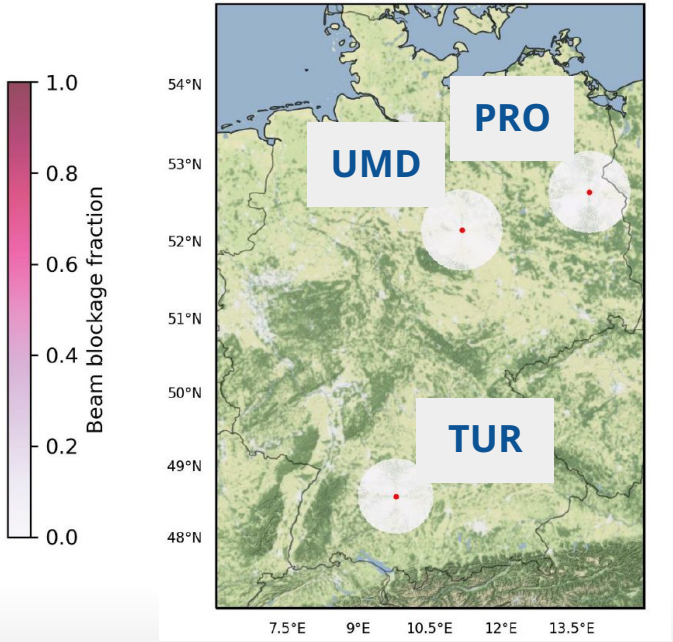
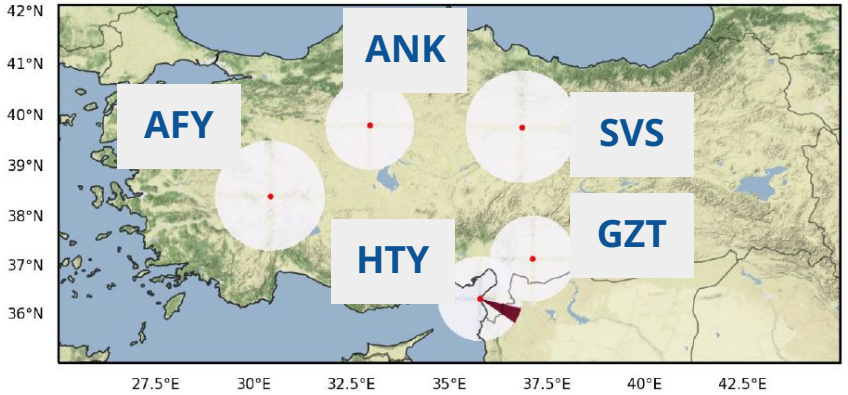
We aim to analyze a large radar database

Data

From operational C-band polarimetric radars: 3 in Germany and 5 in Türkiye



Period: 2015-2020



10° or 12° elevation angle beam blockage

Data

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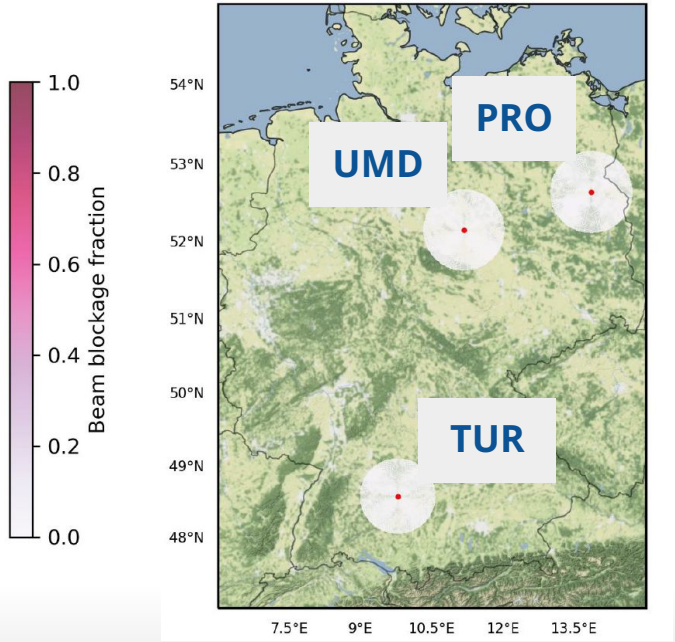

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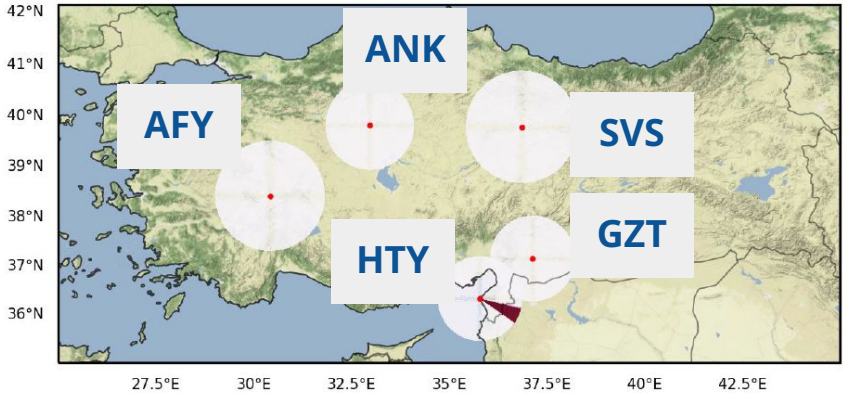

10° or 12° elevation angle beam blockage

From ERA5: 3D temperature

Processing chain

1. RHOHV noise correction.
2. ZDR offset correction.
3. PHIDP offset correction and smoothing. KDP calculation.
4. Melting layer detection.
5. Microphysical retrievals calculation.
6. Stratiform classification.
7. QVP generation.
8. Riming detection.

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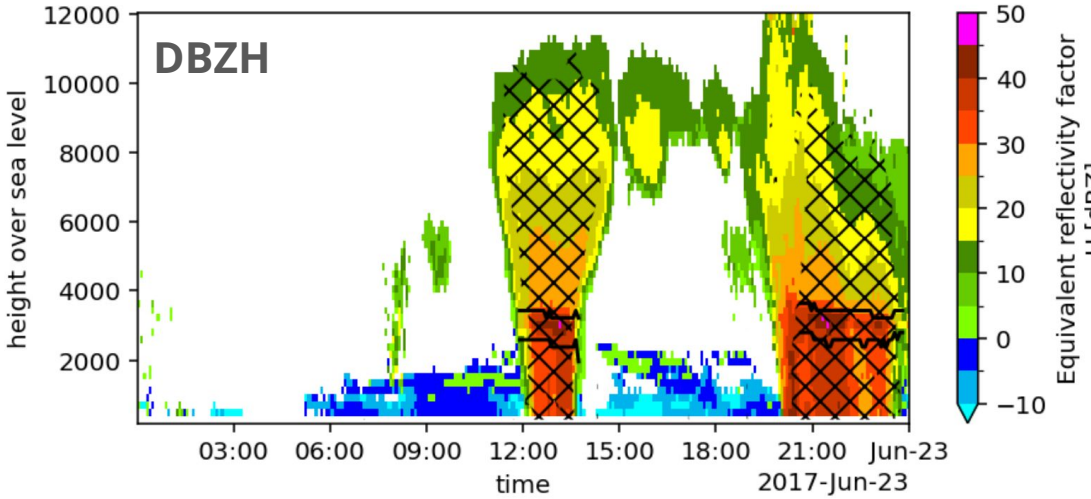
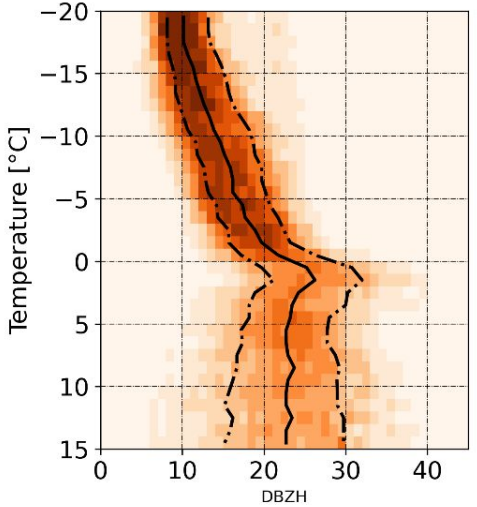
Only data points classified as stratiform from QVPs with melting layer detected are included in the statistics

Results: what can we extract?

Example QVPs: PRO 2017-06-22



Frequency diagram of DBZH vs temperature

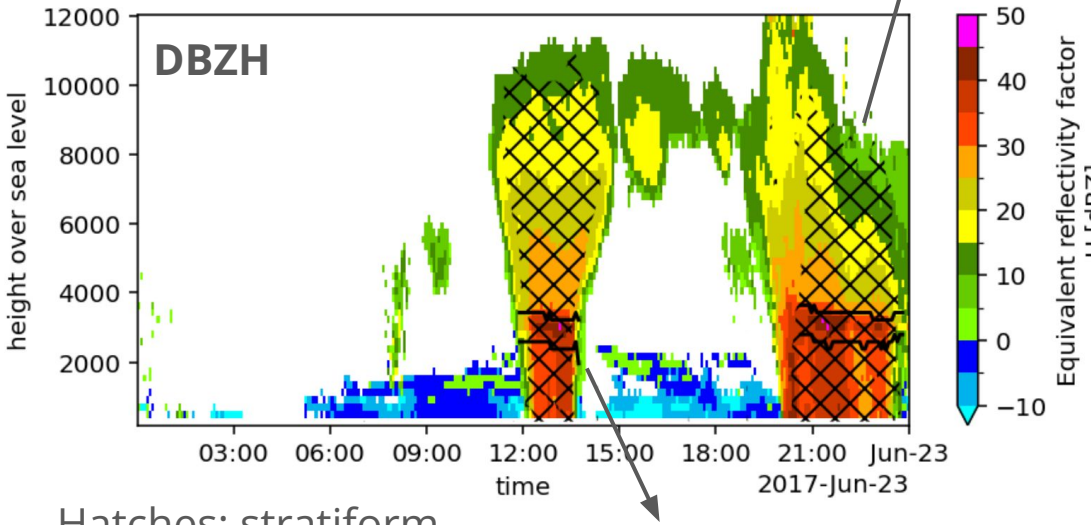


Hatches: stratiform according to information entropy method (developed by Tobias Scharbach)

Results: what can we extract?

Cloud top height and temperature

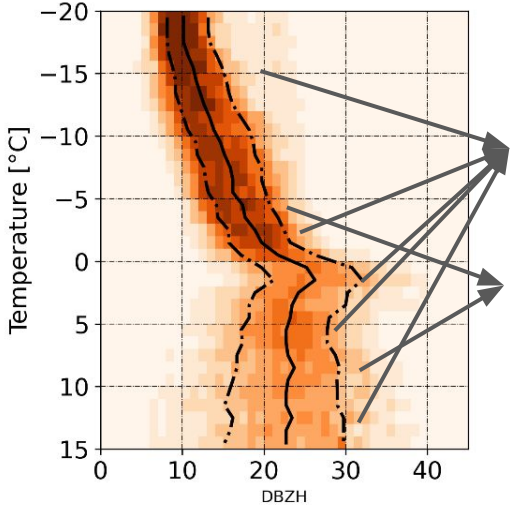
Example QVPs: PRO 2017-06-22



Hatches: stratiform

ML thickness

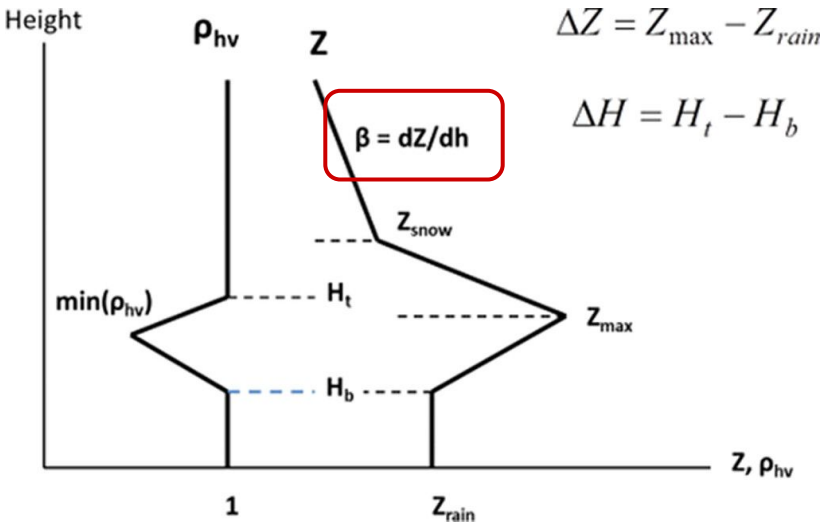
Frequency diagram of DBZH vs temperature



Min, max, mean

Gradients

Results: implications for QPE



$$\Delta Z = Z_{\max} - Z_{rain}$$

$$\Delta H = H_t - H_b$$

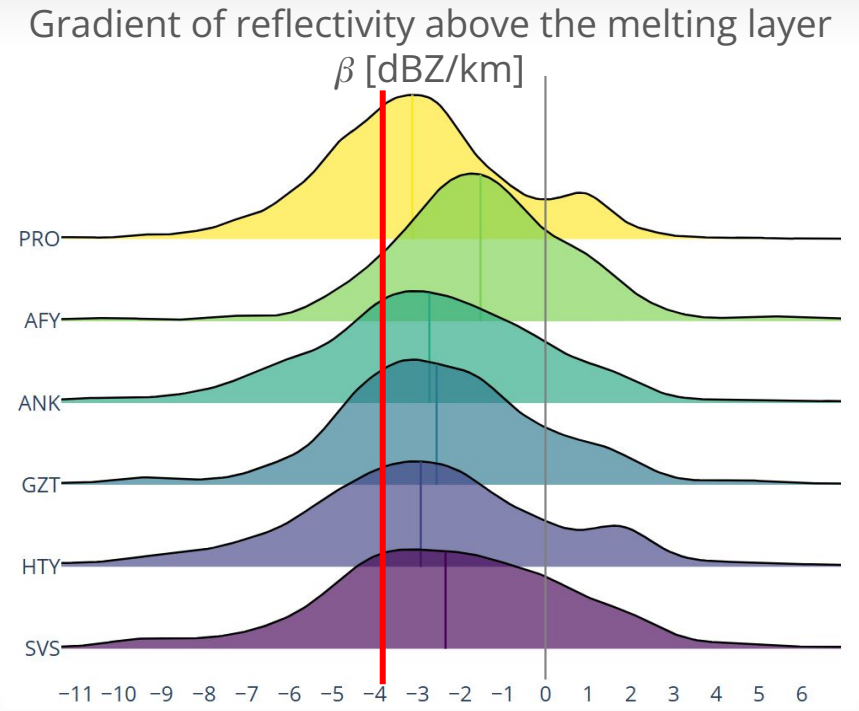
Modeled vertical profiles according to Ryzhkov and Krause (2022)

The value of β has large impact in the modeling of the vertical profiles of reflectivity for QPE correction.

➔ Talk by Raquel Evaristo on Monday

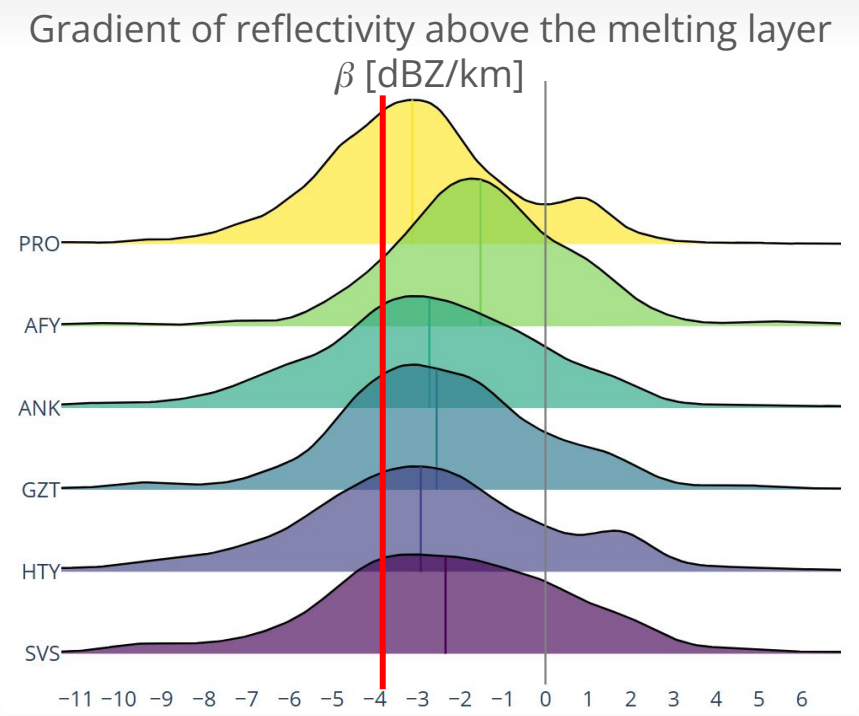
Reference β in the USA: -4 dB/km

Results: implications for QPE

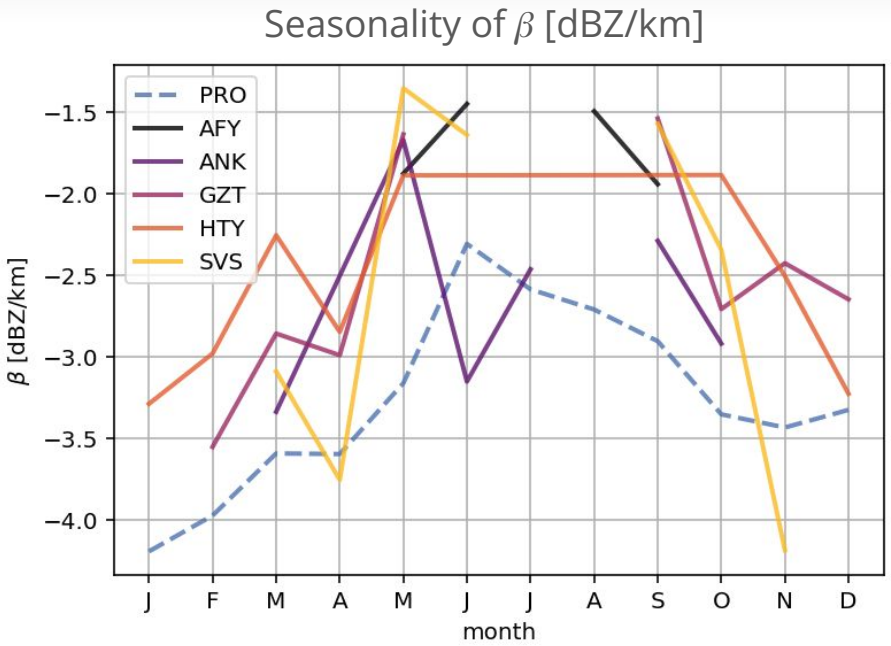


USA reference

Results: implications for QPE



USA reference



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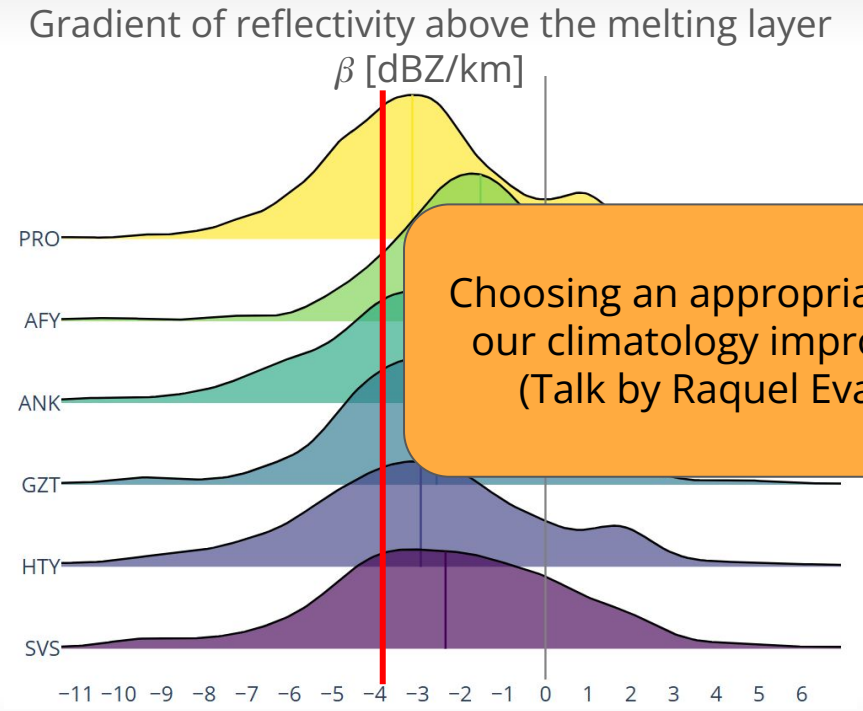

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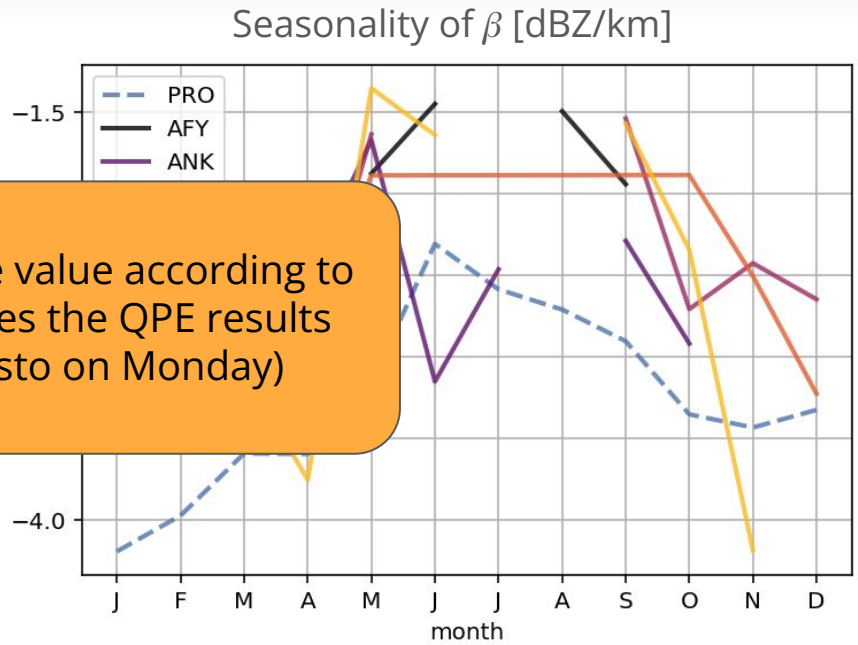
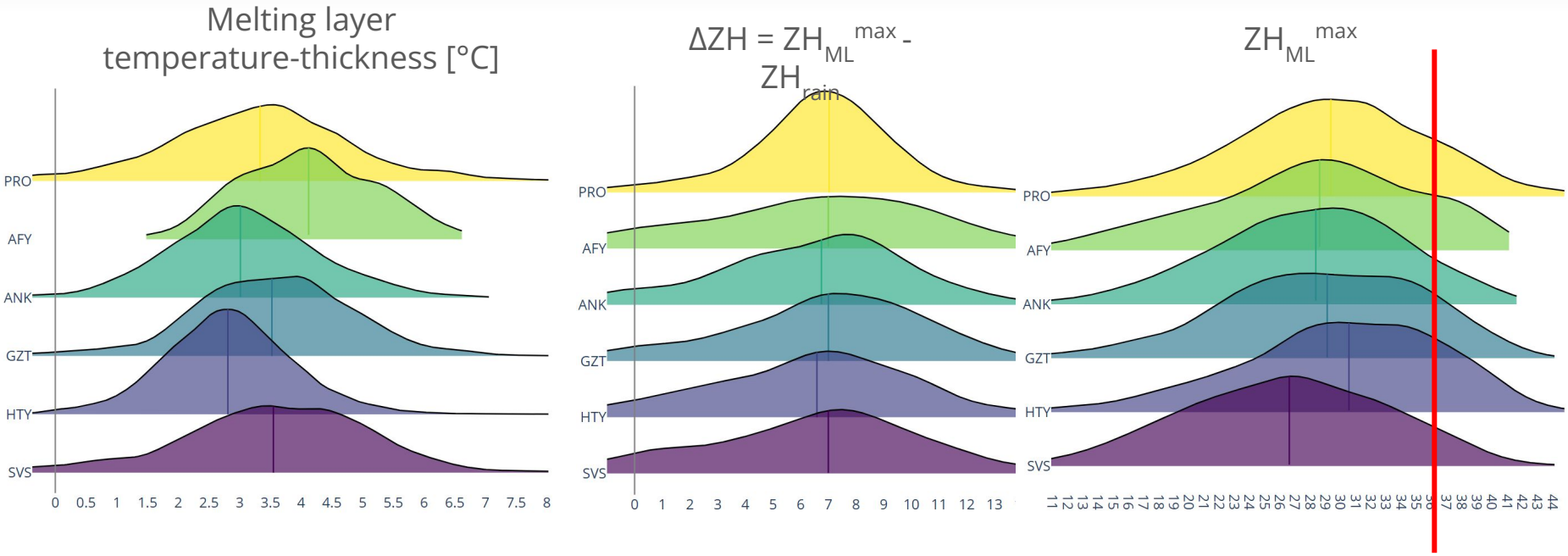


Choosing an appropriate value according to our climatology improves the QPE results (Talk by Raquel Evaristo on Monday)

Results: melting layer regional differences and similarities



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Results: riming characterization

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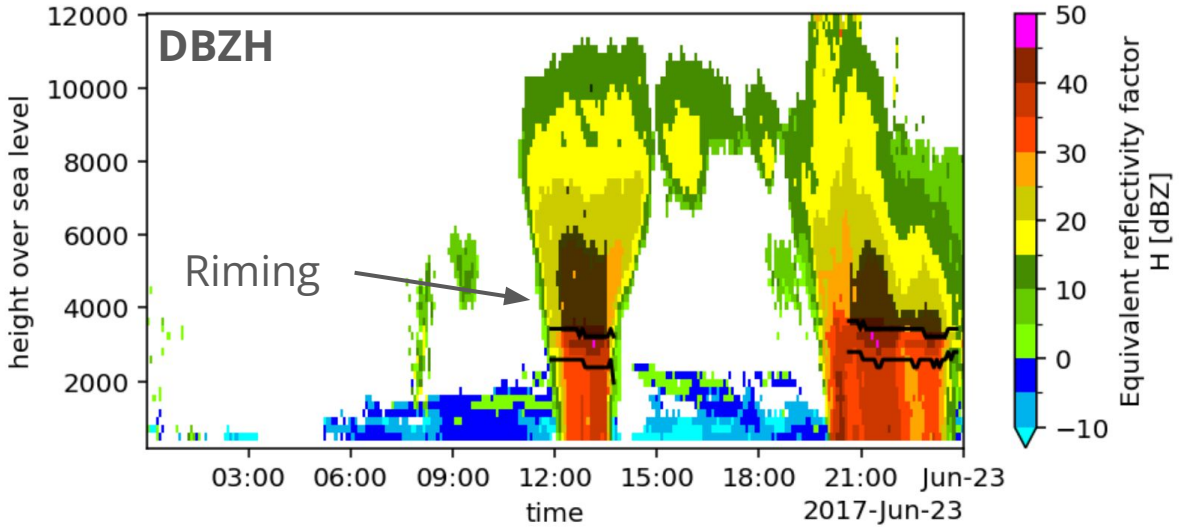
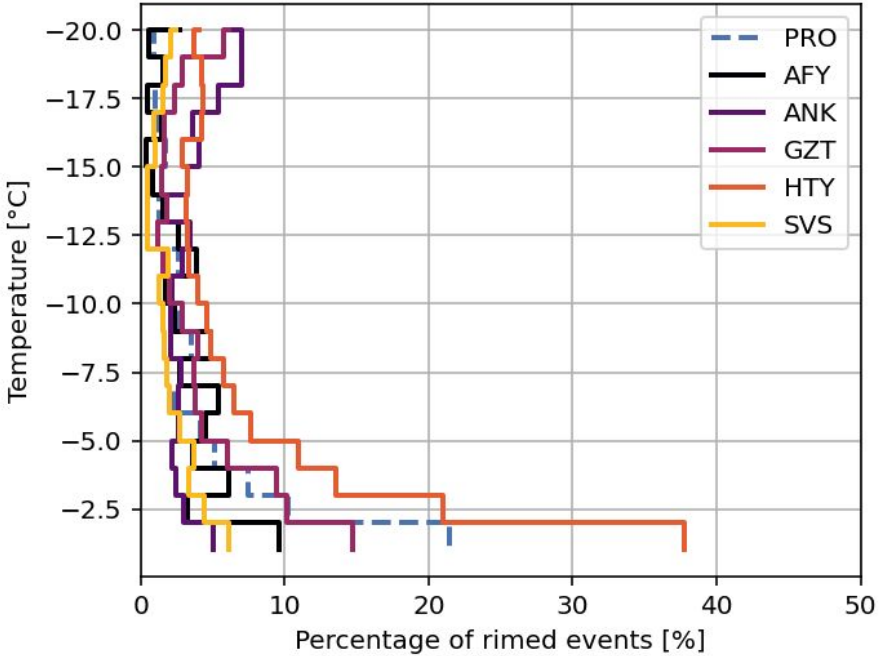


Machine learning method for riming/no riming classification (Blanke et al. 2024)

➔ Talk by Armin Blanke on Wednesday

Results: riming characterization

Percentage of data points with riming per temperature level



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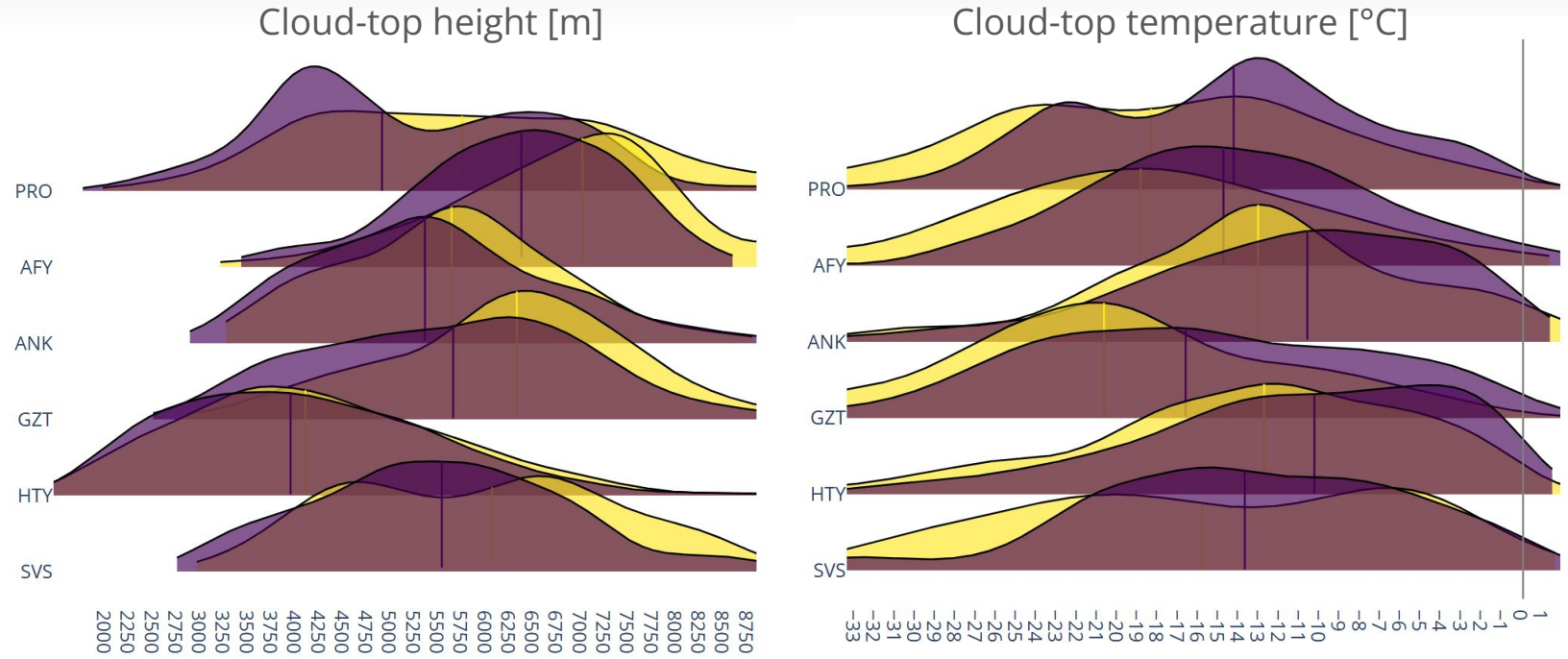
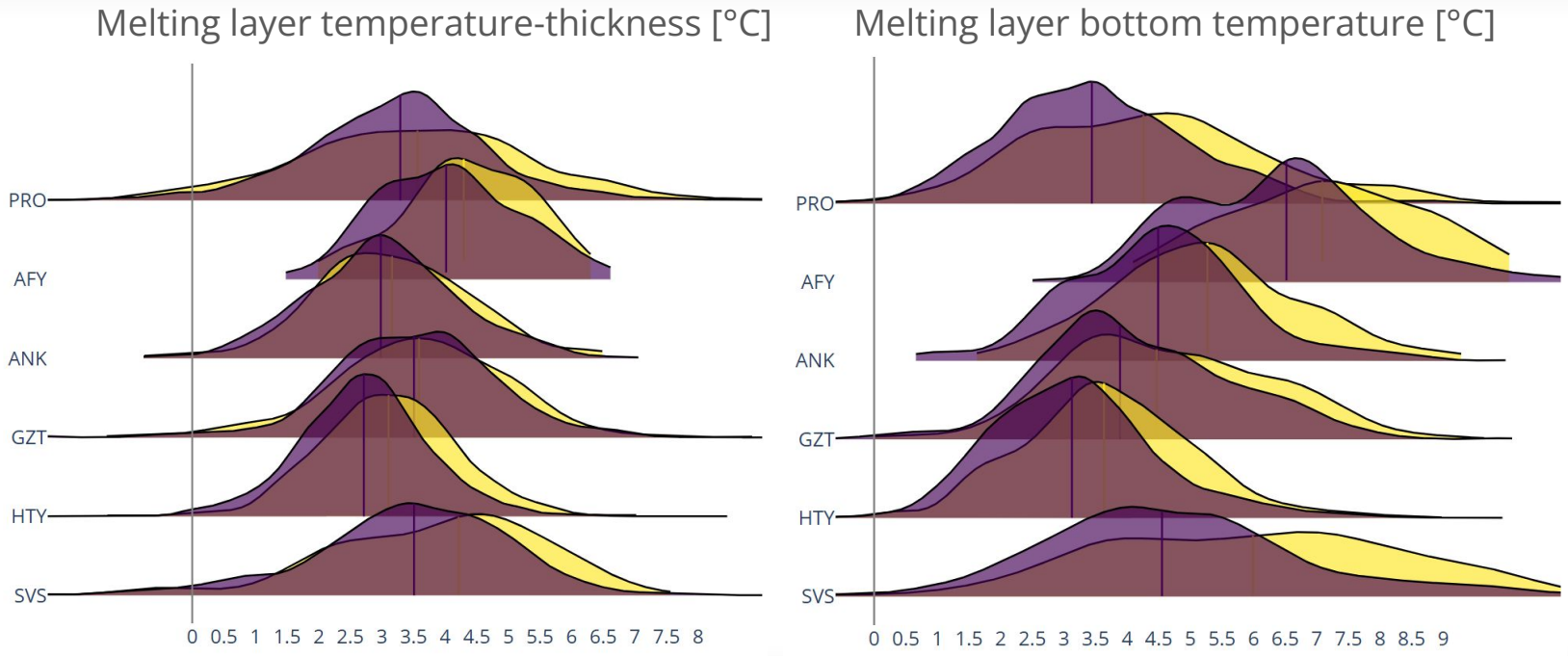


Yellow: QVPs with riming
Purple: QVPs without riming

Results: riming characterization



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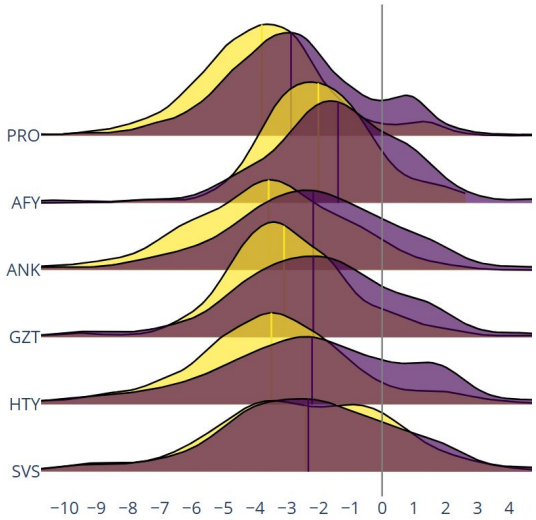
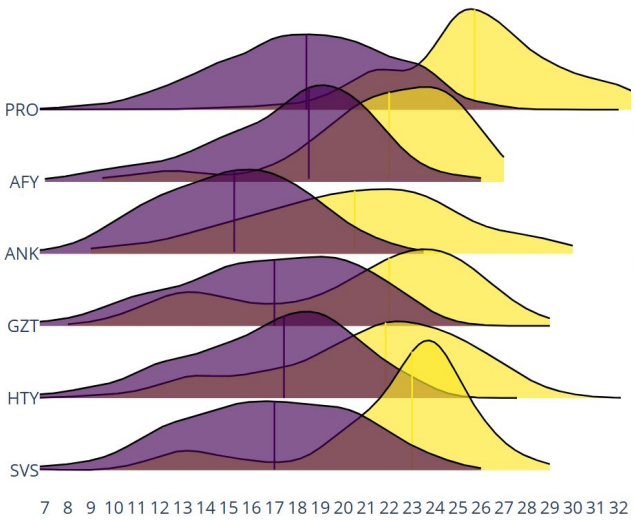
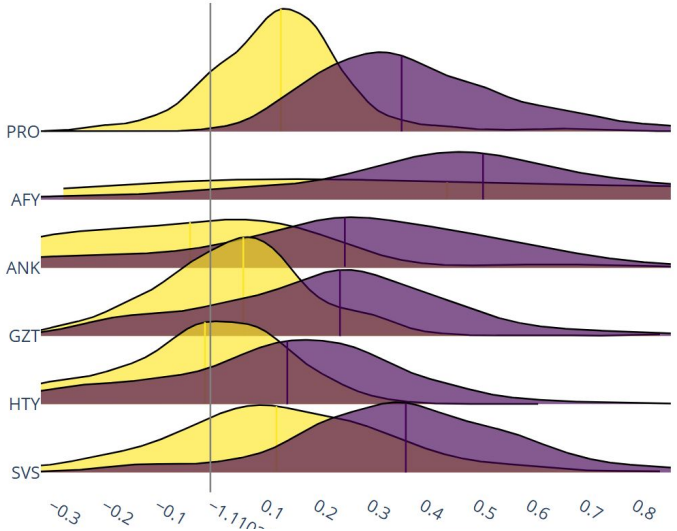
β [dBZ/km]



DBZH above the melting layer



ZDR above the melting layer



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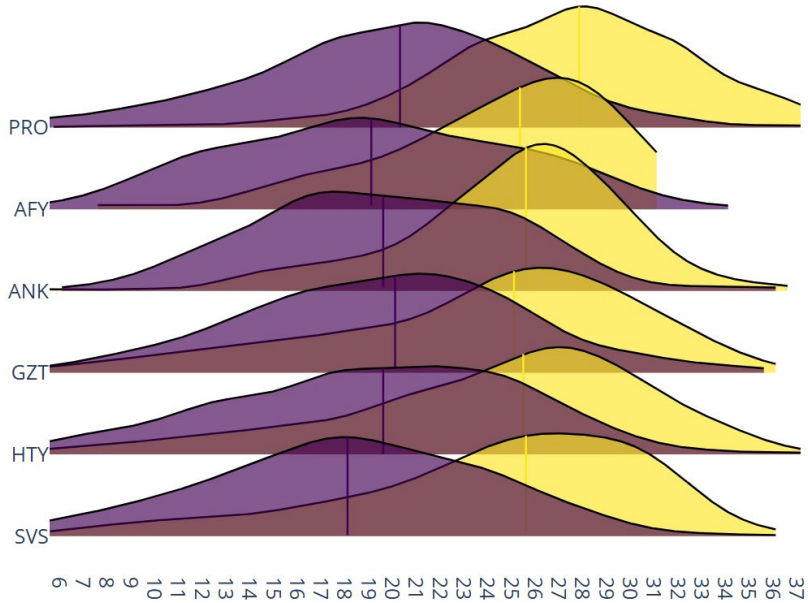
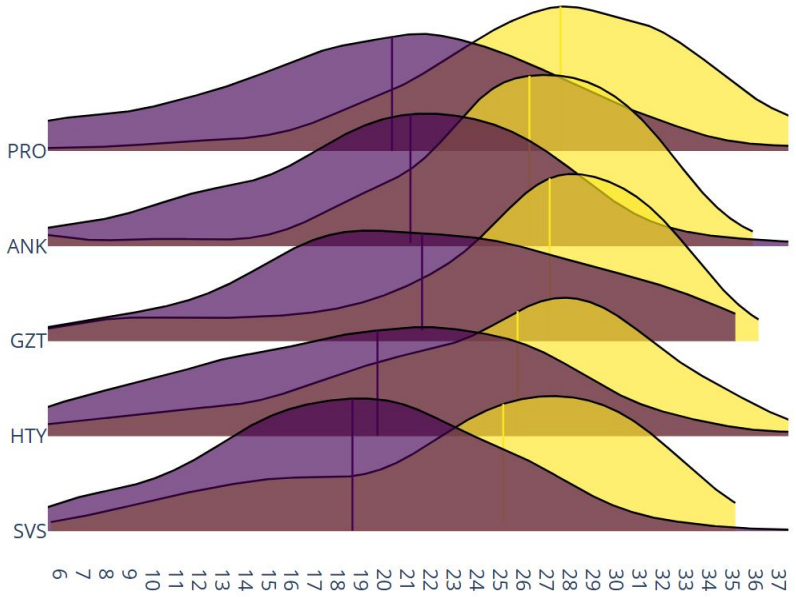
Results: riming characterization

DBZH below the melting layer



DBZH at surface



Yellow: QVPs with riming
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Conclusions

- ★ A large radar database allows us to characterize stratiform precipitation
  - Identify regional and seasonal differences.
  - Analyze different precipitation-generating processes.

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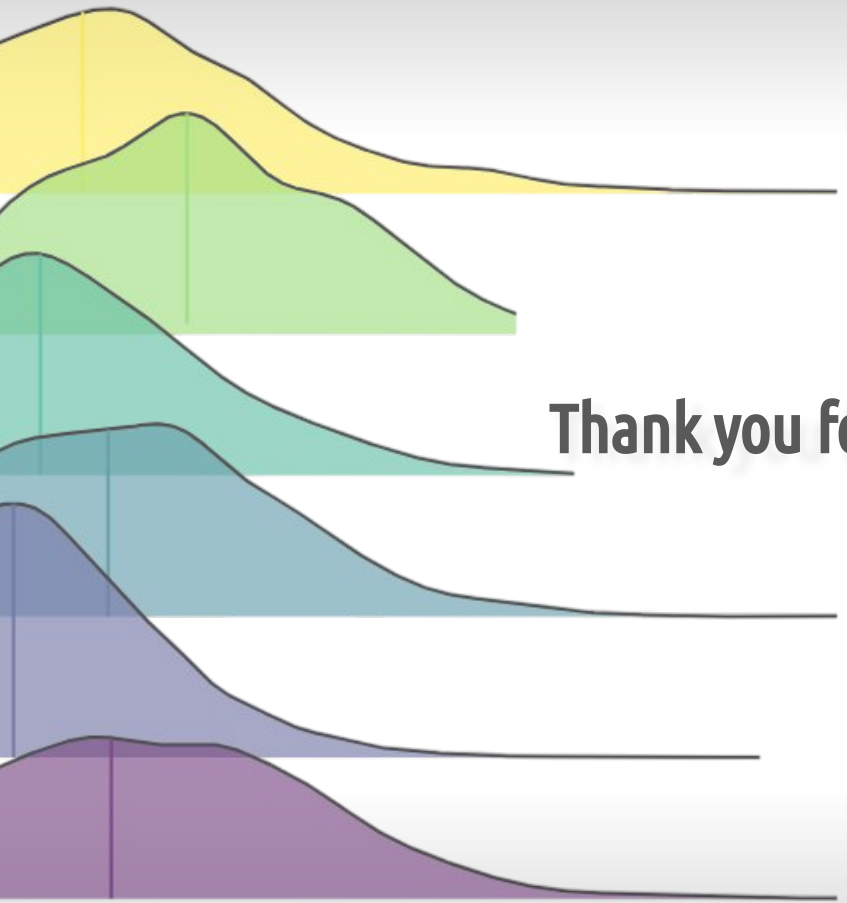
- Identify regional and seasonal differences.
- Analyze different precipitation-generating processes.

➔ Future plans: validate model runs (ICON+EMVORADO)

- Are the microphysical processes well represented?
- Does the model reproduce the seasonal and regional differences?



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Thank you for your attention!

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References

- Ryzhkov, A., and J. Krause, 2022: New Polarimetric Radar Algorithm for Melting-Layer Detection and Determination of Its Height. J. Atmos. Oceanic Technol., 39, 529–543, https://doi.org/10.1175/JTECH-D-21-0130.1
- Blanke, A., Gergely, M., and Trömel, S.: A new aggregation and riming discrimination algorithm based on polarimetric weather radars, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2024-3336, 2024.