UNIVERSITÄT BONN institut für geowissenschaften METEOROLOGIE PROM SPP 2115

PrePEP Conference 2025

A detailed 10 year climatology of quasi-vertical profiles (QVPs) in stratiform rain

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photo of Bonn X-band radar by Velibor Pejcic

Motivation

Long-term climatology obtained from 10 years of radar data from the Bonn X-band radar (BoXPol)

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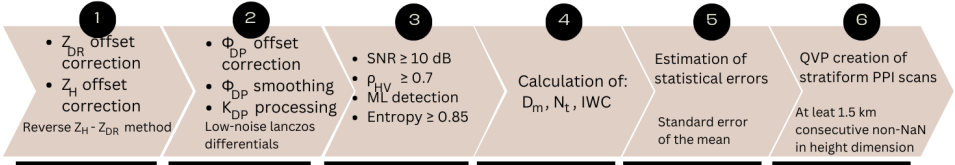
Workflow to obtain large climatology of QVPs from BoXPol data



Calibration Validation (1)
using GPM information

Calibration Validation (2)
using self-constency

Large climatology
1011.66 hours from 671 different days

Statistical analysis
CFTDs and error analysis

- CFTDs of Winter and Summer season
- Annual cycles of extreme variables defining different layers e.g. the metling layer (ML) with Z_H - max.
- Mean Doppler velocities (V_B) from the birdbath scan are interpolated to the QVPs.

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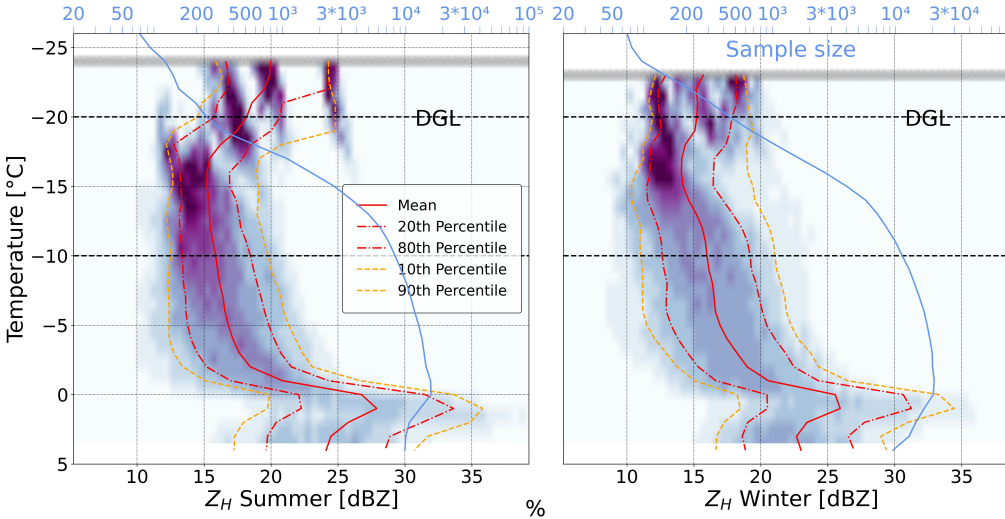
Z_H in Summer (left) and Winter (right) season



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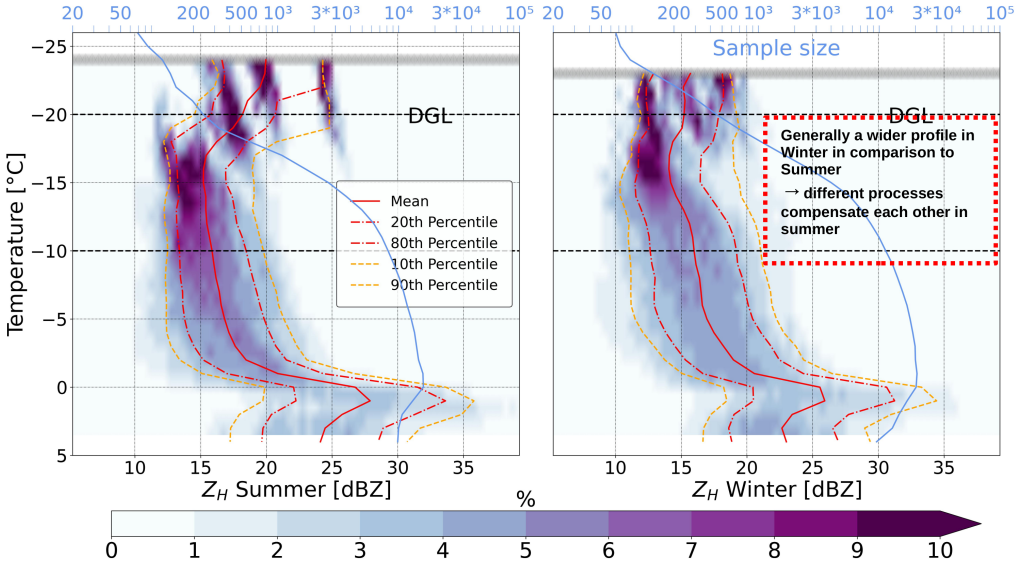

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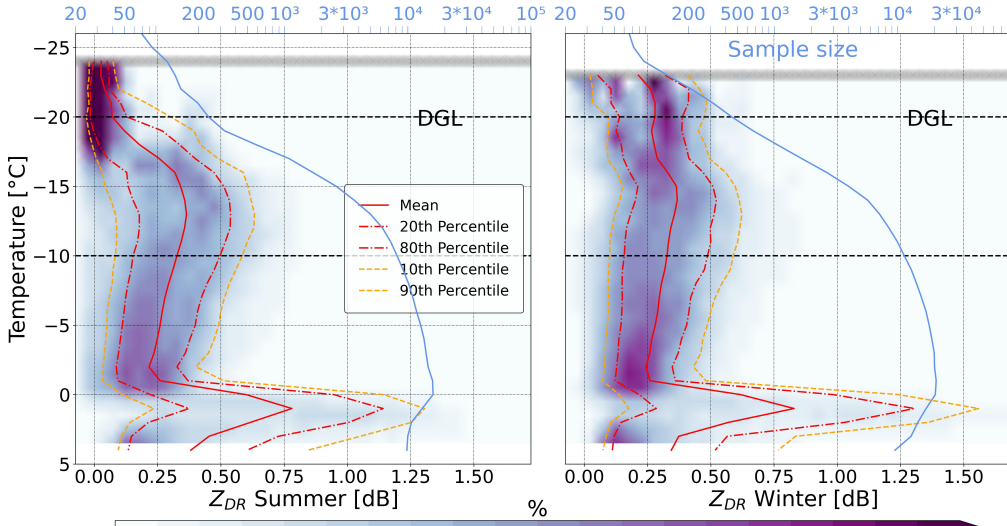
Z_{DR} in Summer (left) and Winter (right) season



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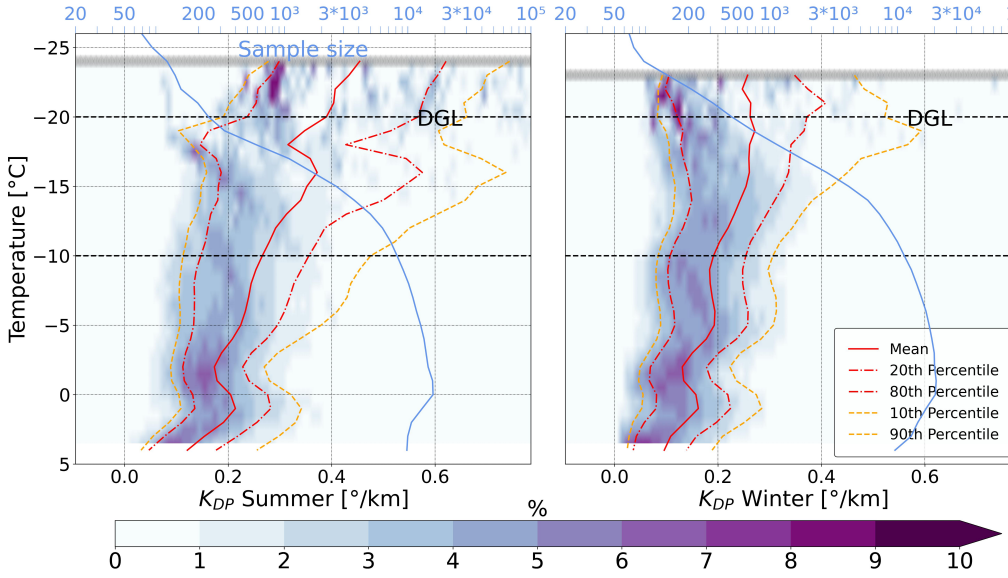
K_{DP} in Summer (left) and Winter (right) season



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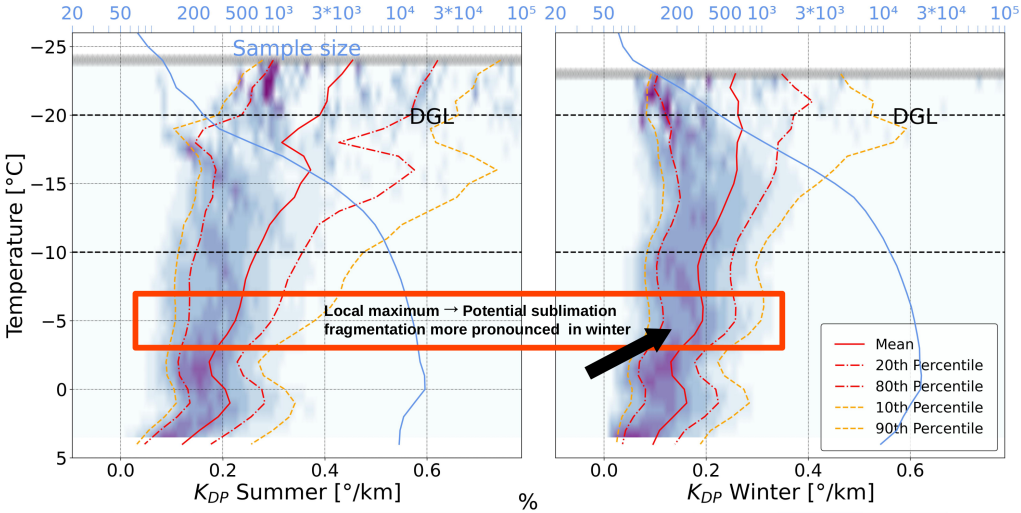

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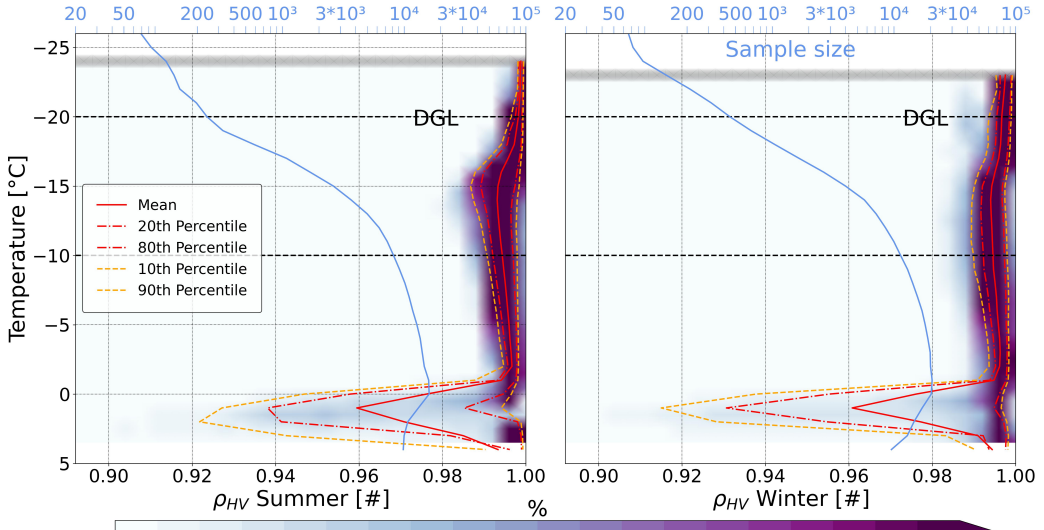
ρ_{HV} in Summer (left) and Winter (right) season



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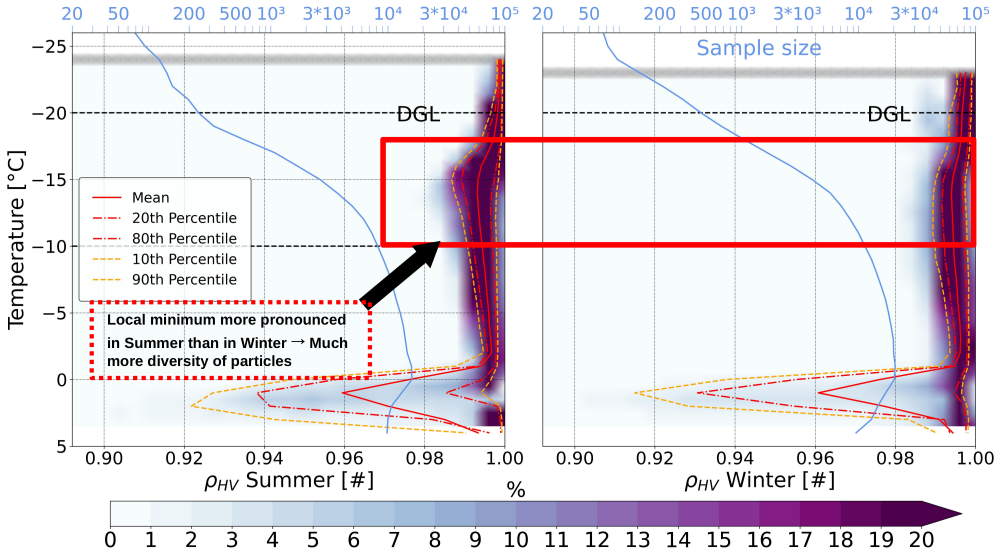
ρ_{HV} in Summer (left) and Winter (right) season



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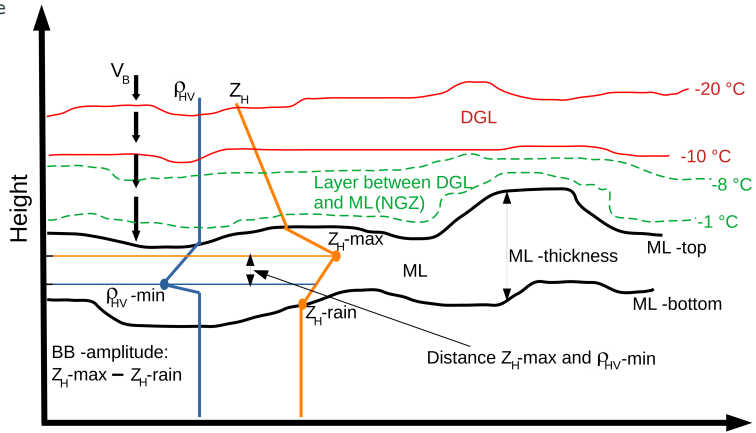
Annual cycles of the variables describing the ML, the DGL and the NGZ

- Extreme values of (polarimetric) variables inside the ML, DGL and the layer between the ML and the DGL

  $\rightarrow$ also referred to needle growth zone (NGZ).

- Annual cycles of (polarimetric) variables: Averaging of the extremes over each month (e.g. all January's) over all years.



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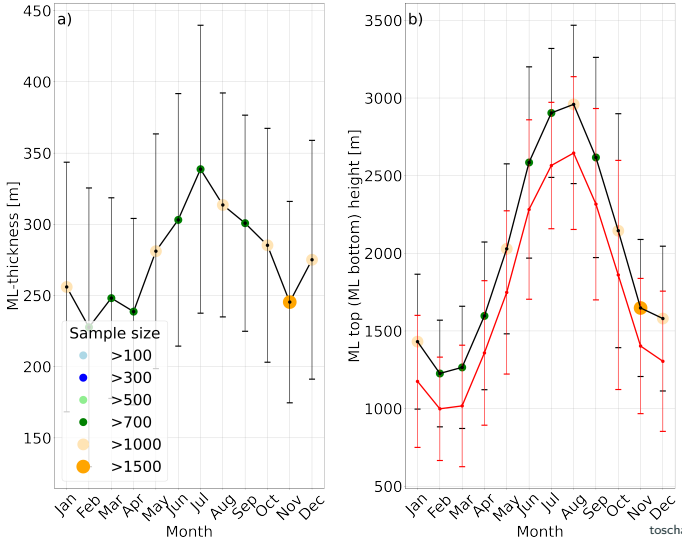
Annual cycles of ML-thickness (left) and ML top and ML bottom height (right)

- Clear annual cycles of ML-thickness, ML top and bottom

  → stronger aggregation/riming.



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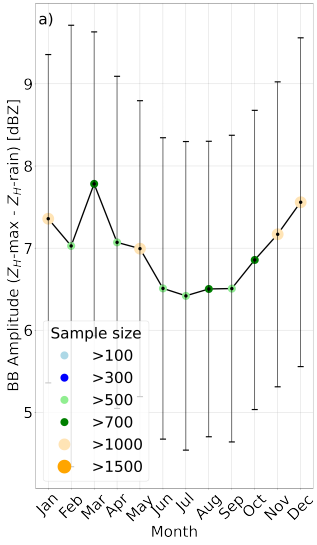
Annual cycles of BB Amplitude (left) and distance between ρ_{HV}-min and Z_H-max (right)

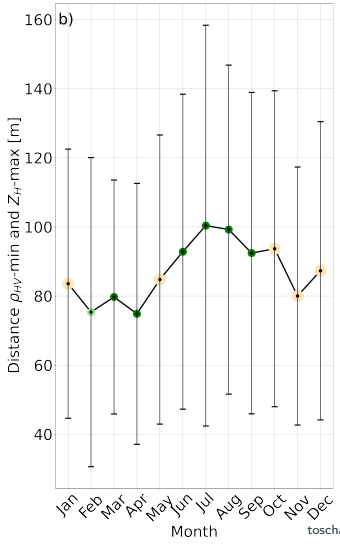
- Clear annual cycles of ML-thickness, ML top and bottom

  $\rightarrow$ stronger aggregation/riming.

- Smaller BB-Amplitude in the warmer months

  $\rightarrow$ increased particle sizes due to aggregation/riming.





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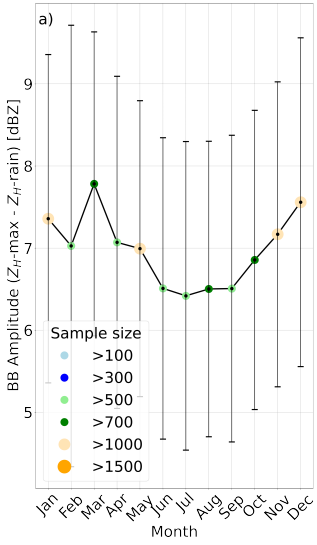
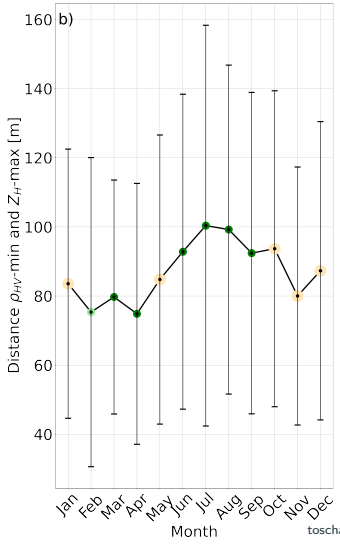
- Larger distance between ρ_{HV}-min and Z_H-max in the warmer months

  $\rightarrow$ increased number concentrations of particles in the ML.





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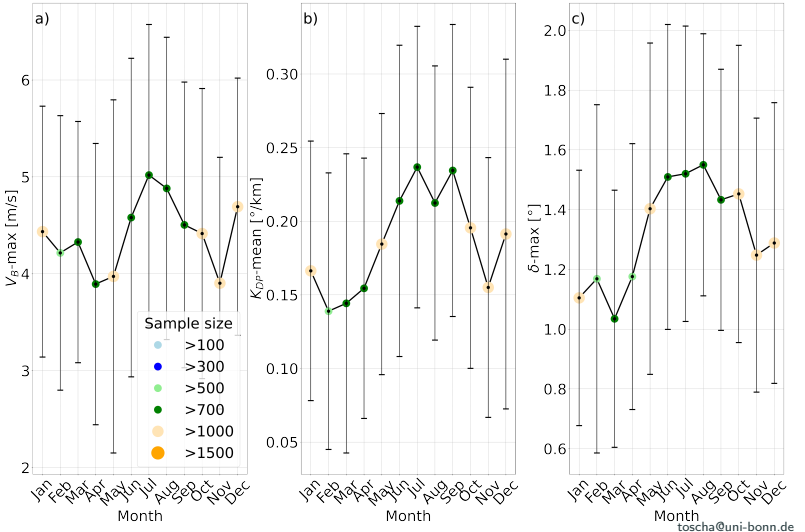
Annual cycles of V_B (left), K_{DP}-mean (middle) and δ-max (right) in the ML

- V_B-max increases towards warmer months

  $\rightarrow$ supports more riming and/or aggregation.



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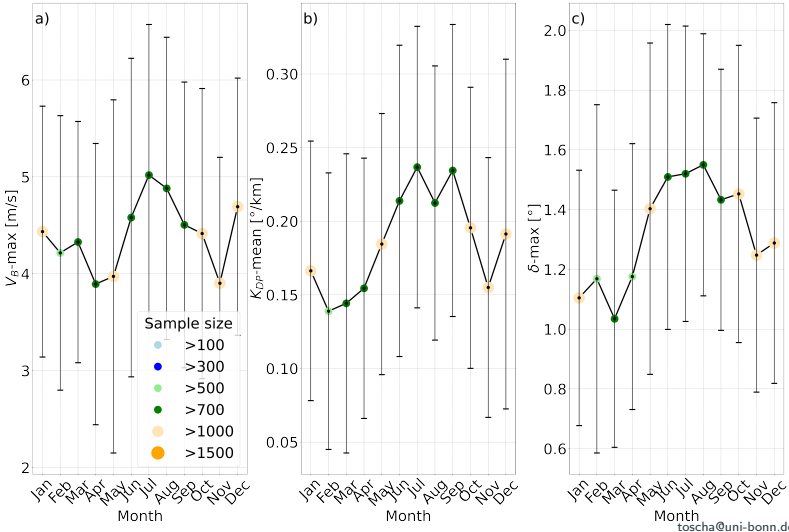

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Annual cycles of V_B (left), K_{DP}-mean (middle) and δ-max (right) in the ML

- V_B-max increases towards warmer months

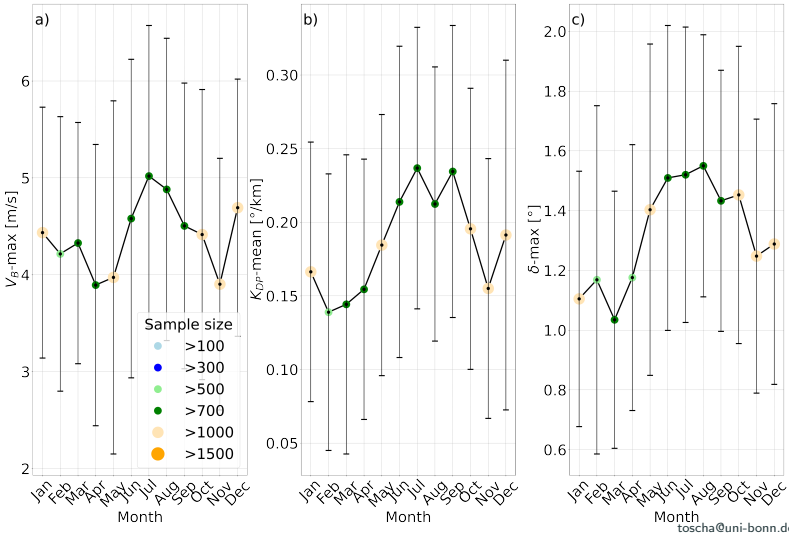
  $\rightarrow$ supports more riming and/or aggregation in summer.

- K_{DP}-mean increases towards warmer months

  $\rightarrow$ larger number concentrations.

- δ_{max} increases towards warmer months

  $\rightarrow$ larger melting particles reaching resonance sizes.



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Annual cycles of K_{DP}-max (left) and V_B-max (right) for the DGL (black) and for the NGZ (green)

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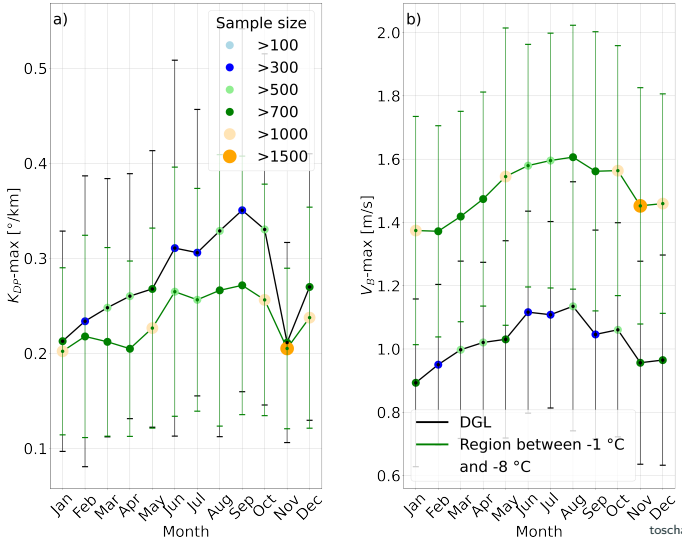

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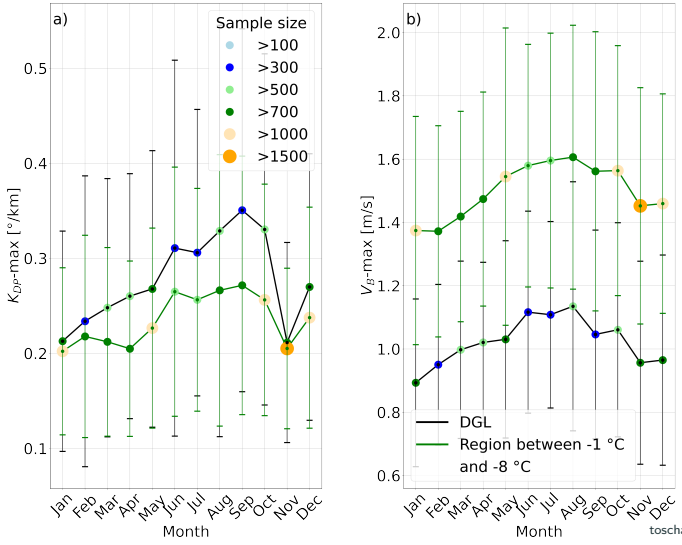

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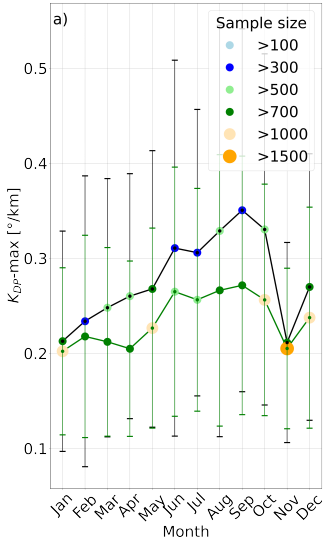
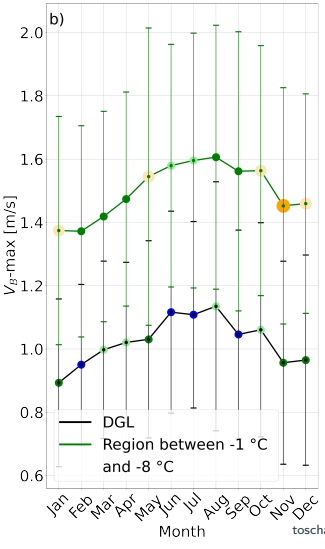
- Larger differences between the DGL and the NGZ in K_{DP}-max for warmer months

  $\rightarrow$ also indicates more aggregation/riming.





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- Z_H and Z_{DR} do not show large differences in the overall profiles of Summer and Winter.
- Generally larger K_{DP} in Summer and local maximum in K_{DP} at -5 °C in Winter (potentially sublimation fragmentation).

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