Aggregation in the Dendritic Growth Layer:
A statistical analysis combining multi-frequency Doppler and polarimetric Doppler cloud radar observations

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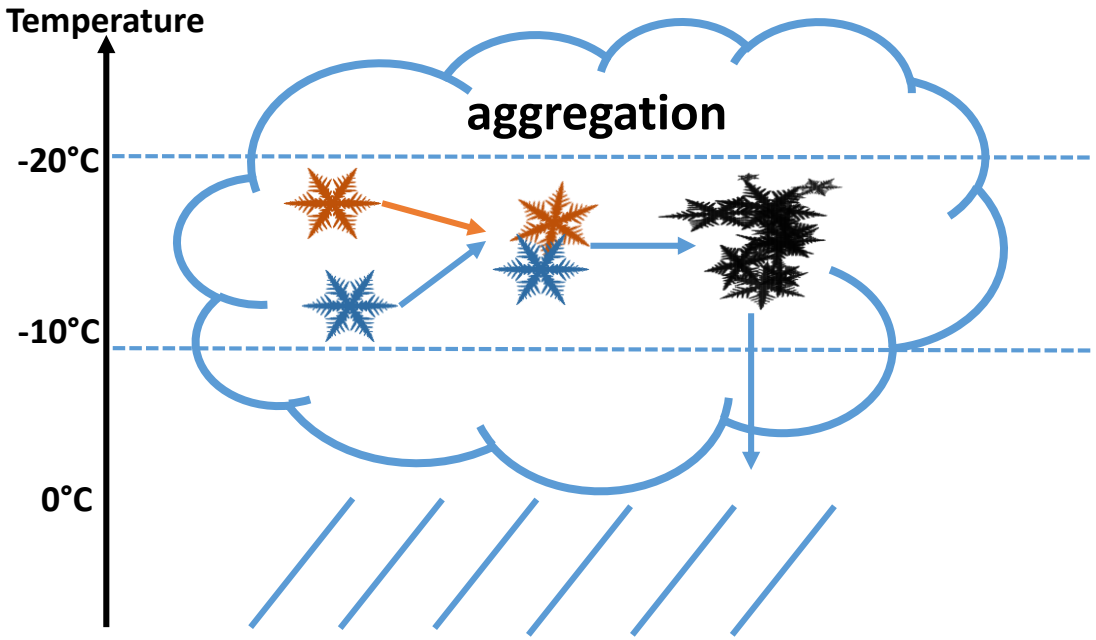
- DGL:
  - Between -20 and -10°C
  - dendritic particles grow efficiently

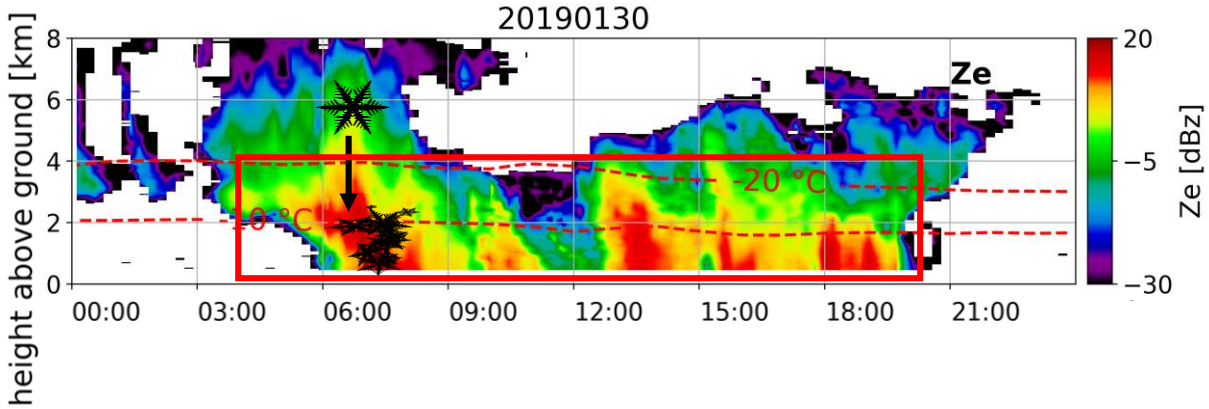
- First region with enhanced aggregation:
  - Aggregation: $D_{particle}$ ↑
    → important for precipitation formation



→ How can we measure aggregation?

Importance of Dendritic Growth Layer (DGL, -20 to -10°C)

- <u>Enhanced aggregation:</u>
  - Reflectivity Ze ↑ : $D_{particle}$↑, $N_{particle}$↑



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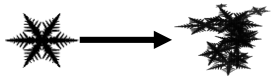
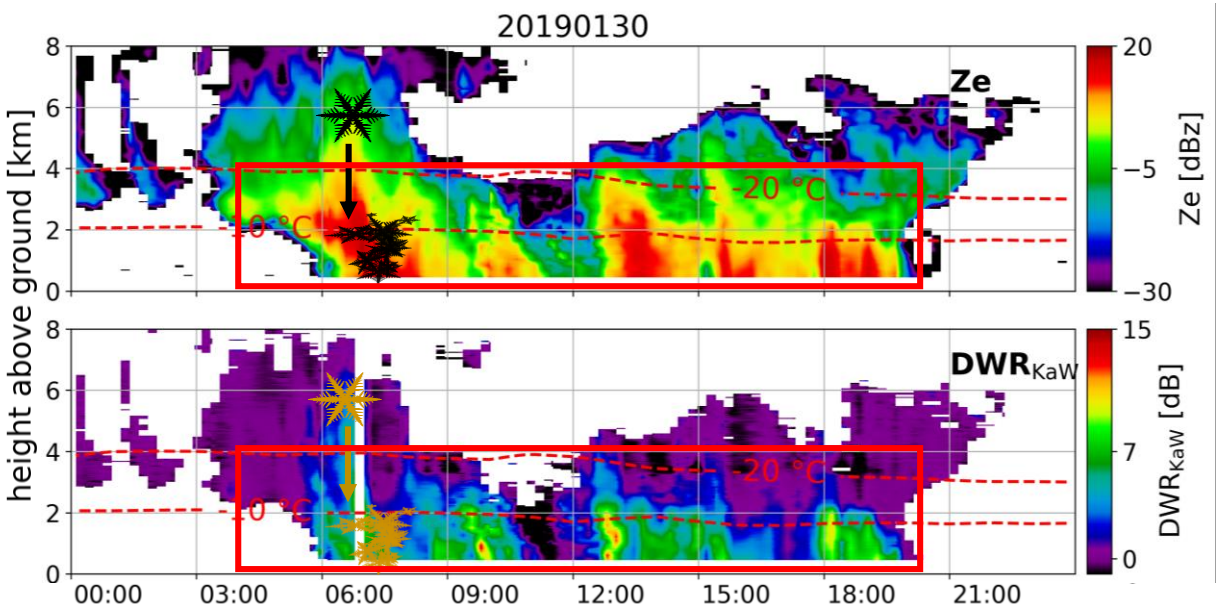
$$DWR_{\lambda_1\lambda_2} = Ze_{\lambda_1} - Ze_{\lambda_2}$$

  - **DWR** ↑ : $D_{particle}$ ↑ 



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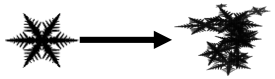
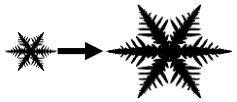
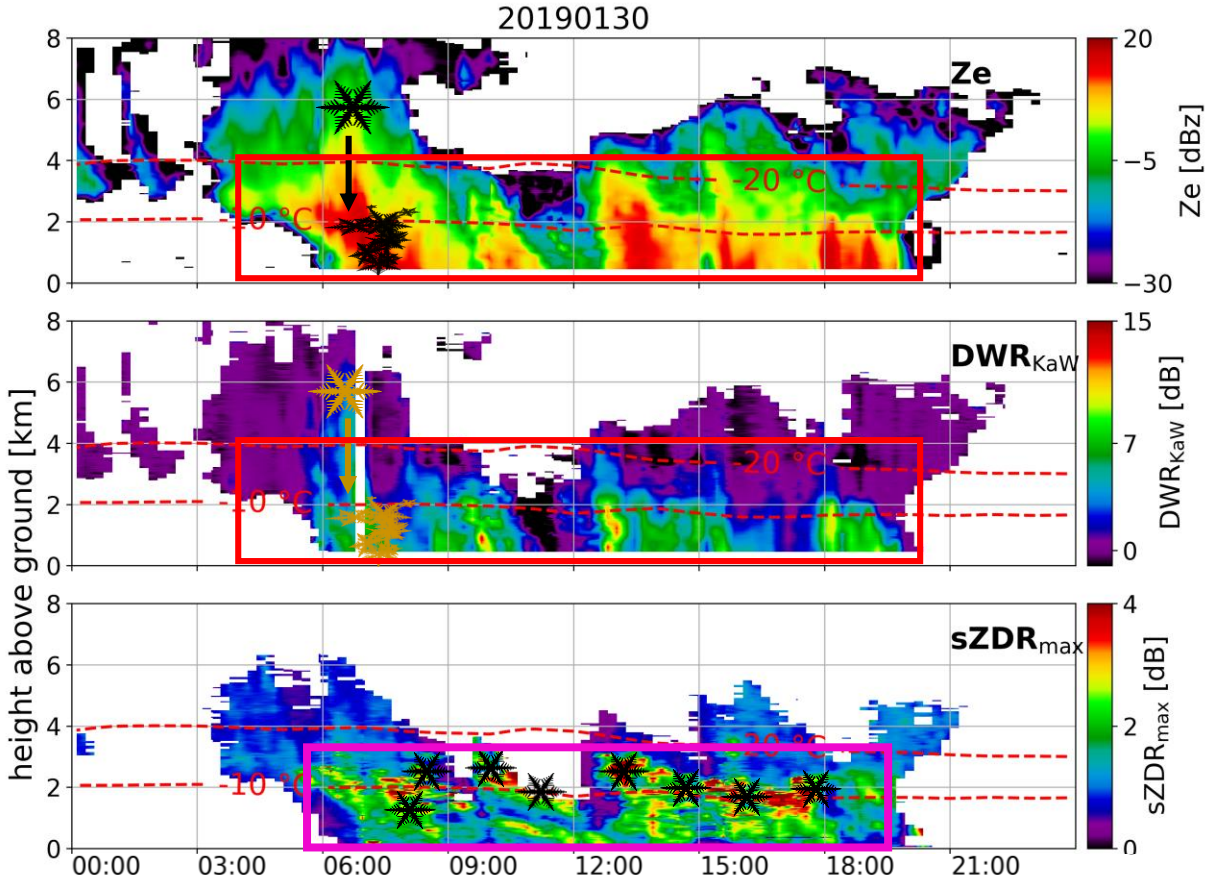
  - **DWR** ↑ : $D_{particle}$ ↑ 

- Growth of plate-like particles:
  - ZDR ↑: $ar_{crystal}$ ↑ 



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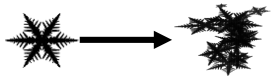
  - **DWR** ↑ : $D_{particle}$ ↑ 

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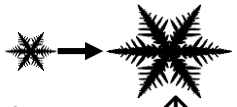
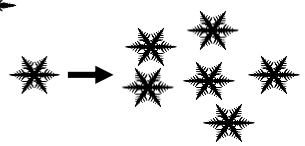
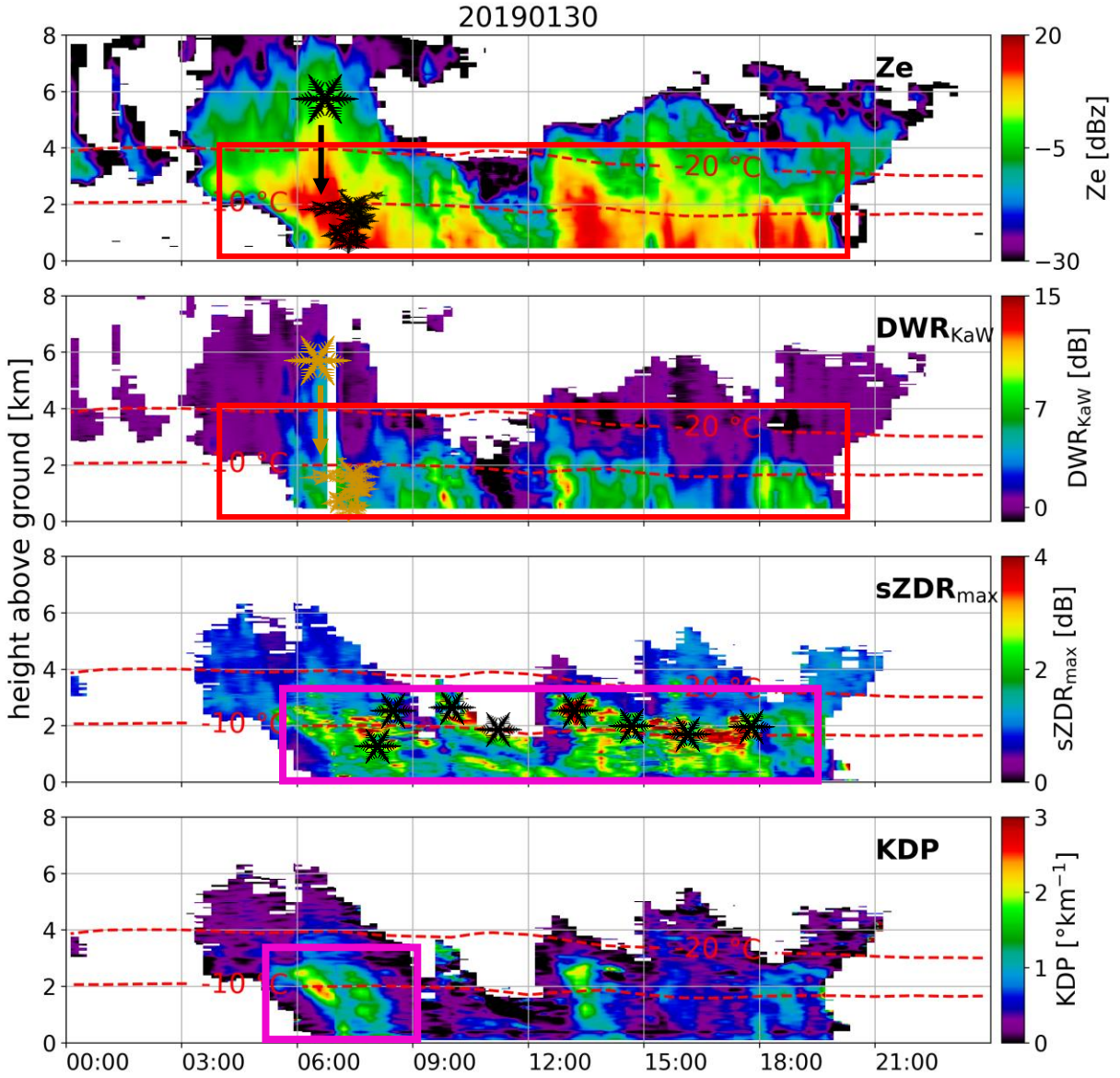
  - ZDR ↑: $ar_{crystal}$ ↑ 
  - KDP ↑: $concentration_{crystal}$ ↑ 



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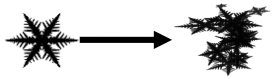
  - **DWR** ↑ : $D_{particle}$ ↑ 
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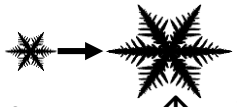
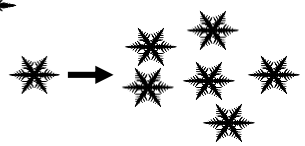
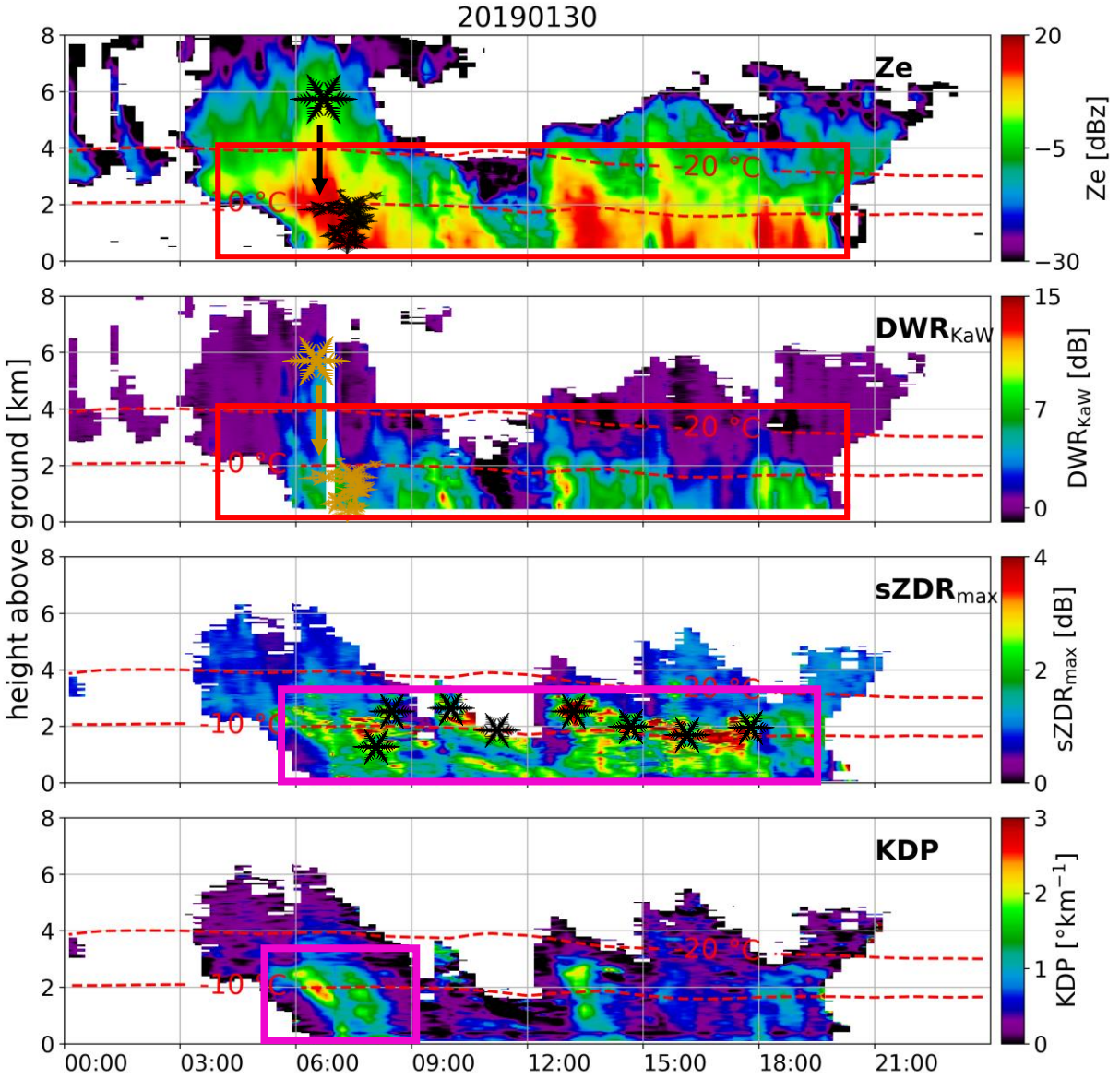
  - ZDR ↑: $ar_{crystal}$ ↑ 
  - KDP ↑: $concentration_{crystal}$ ↑ 

How are aggregation and growth of ice crystals related?

→ Statistical analysis of DGL combining multi-frequency Doppler radar observations with polarimetric Doppler cloud radar observations



Correlation between enhanced DWR in DGL and other radar observables

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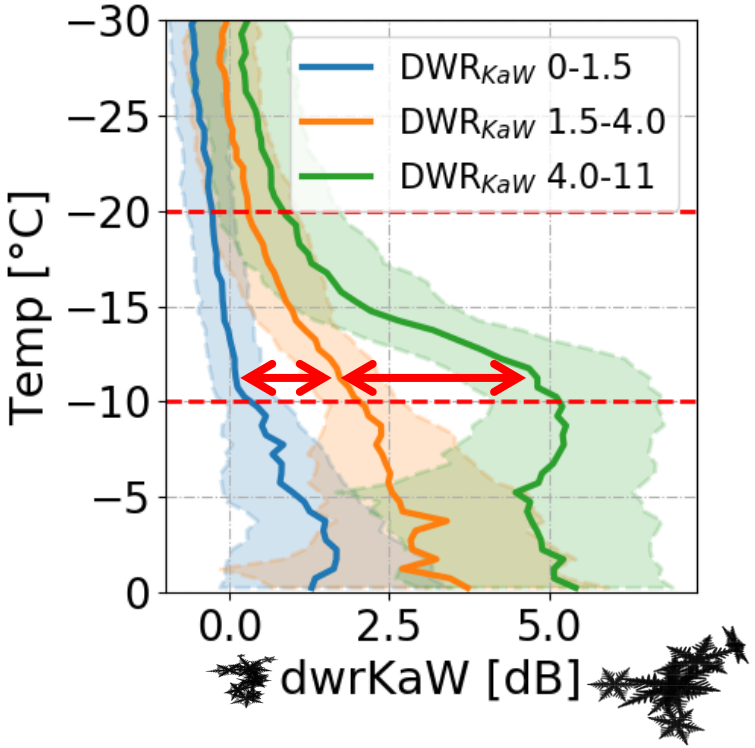

Increasing aggregate size with increasing DWR-KaW class

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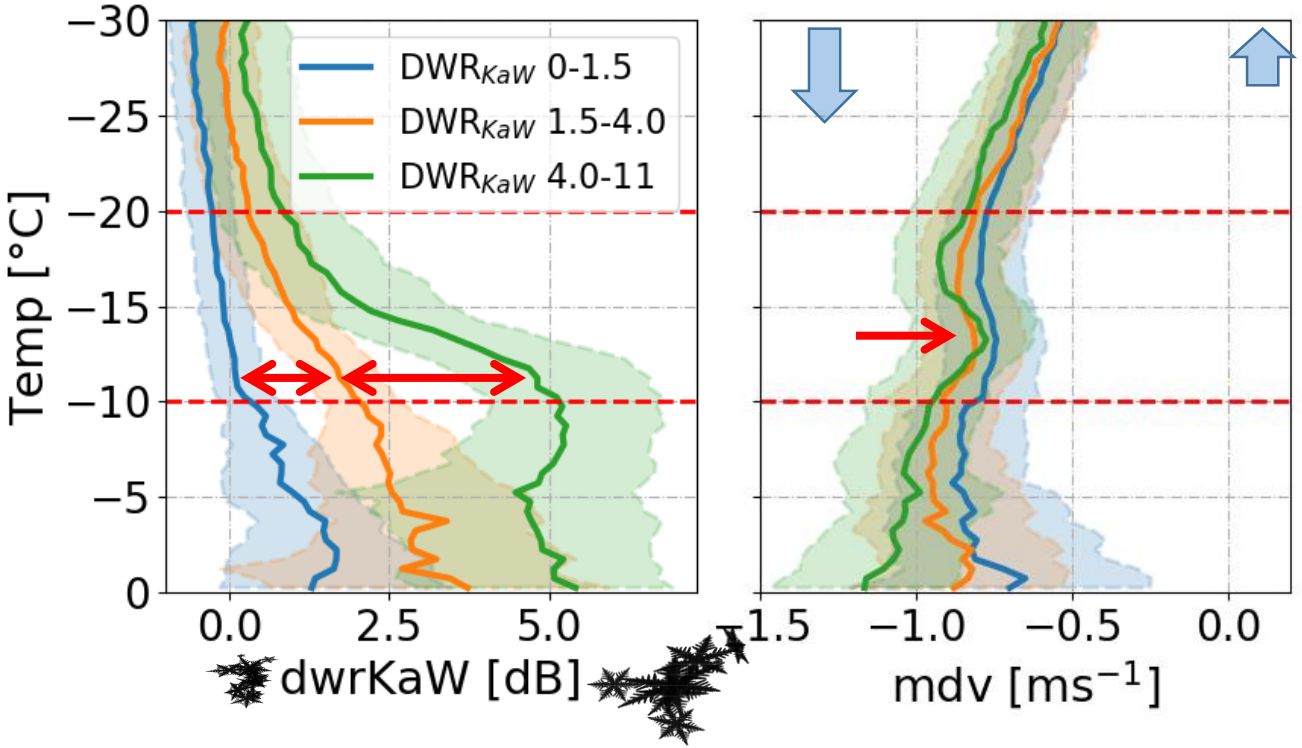

Increasing aggregate size with increasing DWR-KaW class

MDV reduction
→ combination of **new mode of small particles** and updraft

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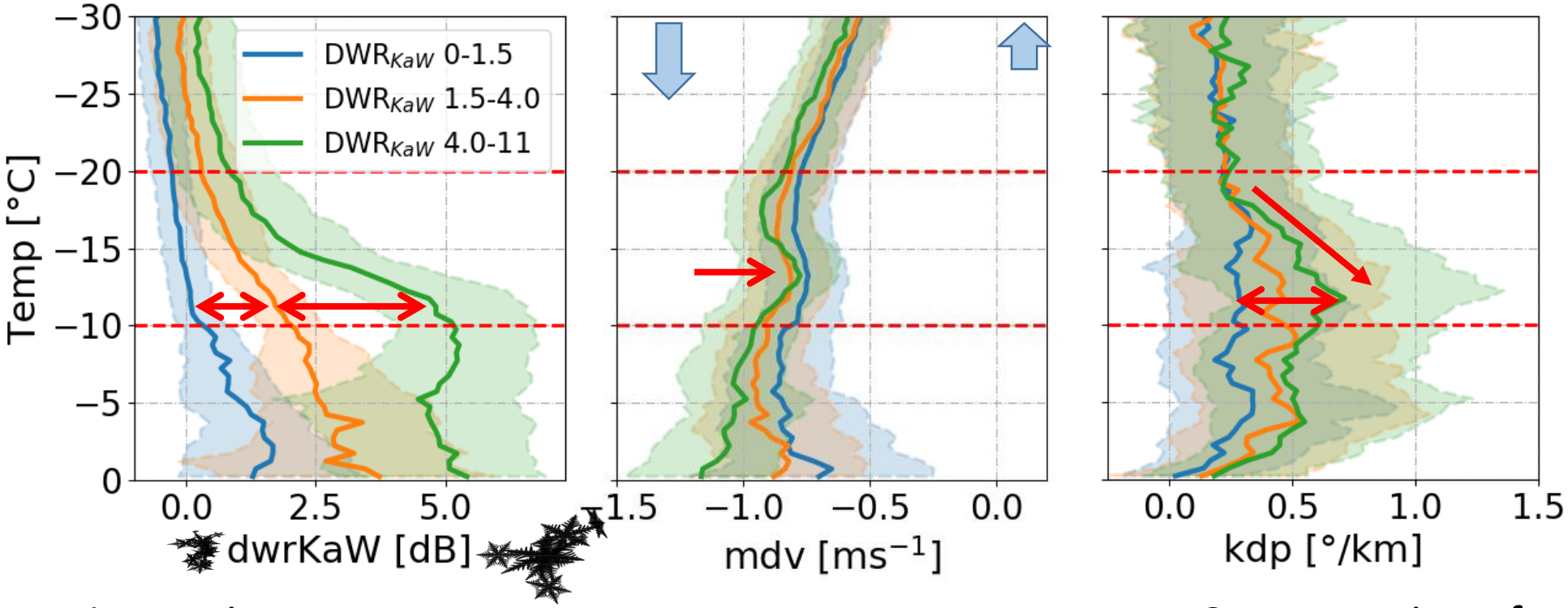

Increasing aggregate size with increasing DWR-KaW class

MDV reduction → combination of **new mode of small particles** and updraft

- Concentration of small particles continuously increases in DGL
- stronger increase for larger aggregates

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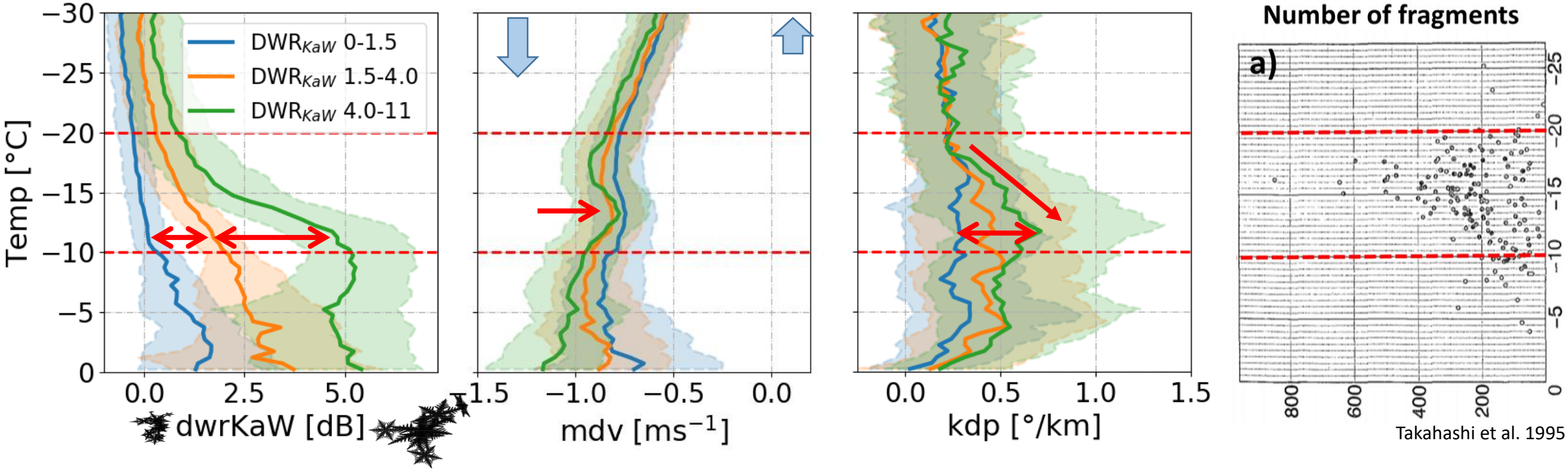

- Why is KDP increasing, aggregation should consume ice particles?

→ **Hypothesis: Fragmentation during aggregation process**

- Takahashi et al. 1993,1995: fragile arms growing on ice spheres were broken of during collision

→ Hypothesis can be further studied with e.g. Monte-Carlo Lagrangian particle models **following talk by Jan-Niklas Welss**

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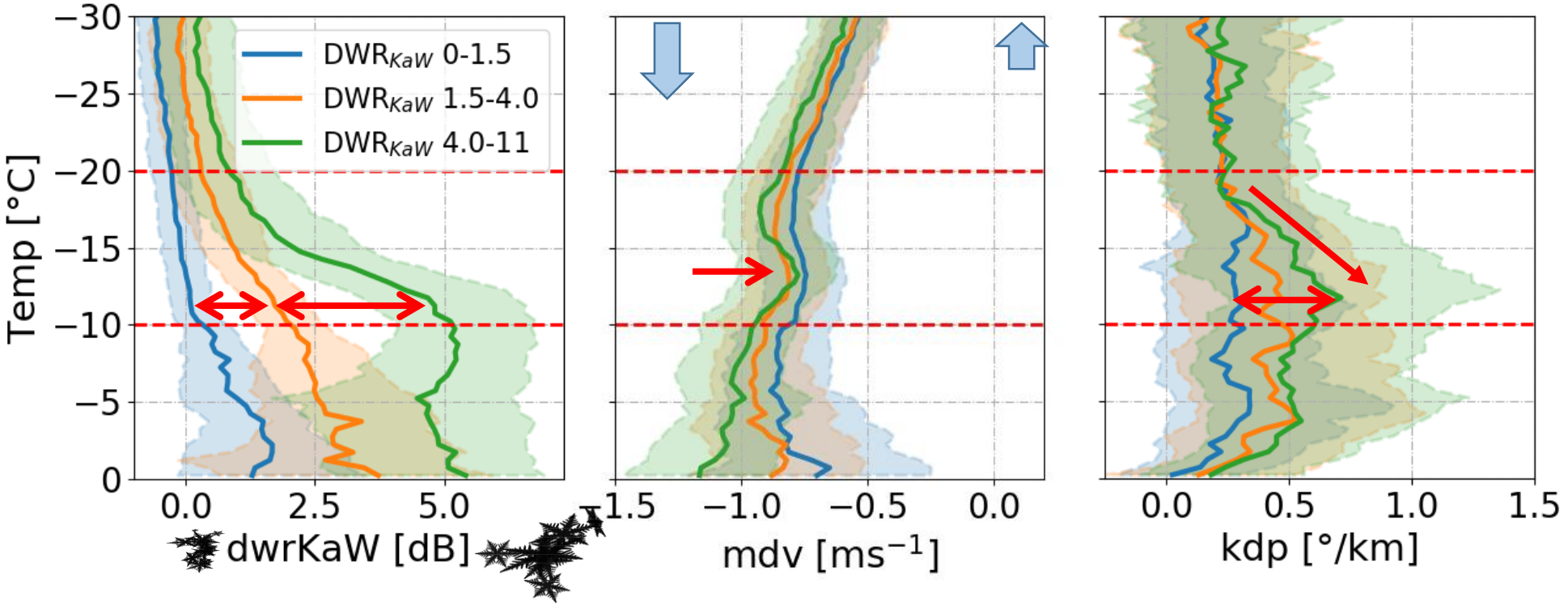

von Terzi et al. 2022, ACP
https://acp.copernicus.org/preprints/acp-2022-263/

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Further information: *von Terzi et al. 2022, ACP* (in review), contact me: lterzi@uni-koeln.de