UNIVERSITÄT BONN

# OPERATION HYDROMETEORS II

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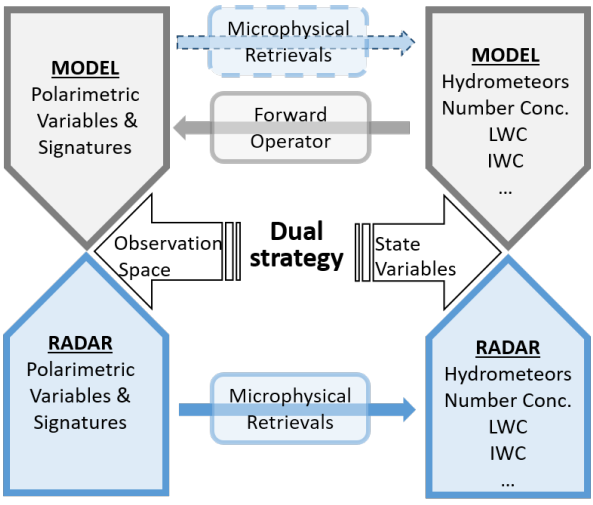
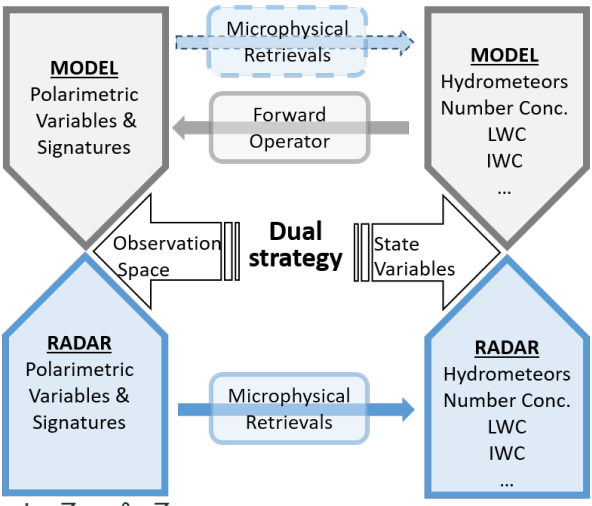
# Validate ICON and pol. forward operator EMVORADO with C-band radars



# Validate ICON and pol. forward operator EMVORADO with C-band radars

→ settings of ICON

→ parameters for EMVORADO




DWD C-band network

→ correct $\rho_{HV}$

→ calc. $\Phi_{DP}$ offset

→ smoth $K_{DP}$

→ calibrate $Z_{DR}$

→ correct for attenuation in $Z_{DR}$ & $Z_H$

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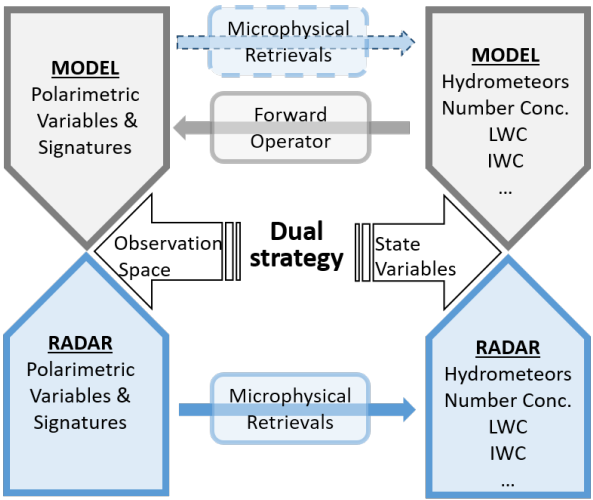


OP HM I:
10 stratiform cases:
→ 25-07-2017
…

OP HM II
(250 m resol.):
2 stratiform cases:
→ 14-07-2021
…
8 convective cases:
→ 20-05-2022
…

DWD C-band network

→ correct $\rho_{HV}$
→ calc. $\Phi_{DP}$ offset
→ smoth $K_{DP}$
→ calibrate $Z_{DR}$
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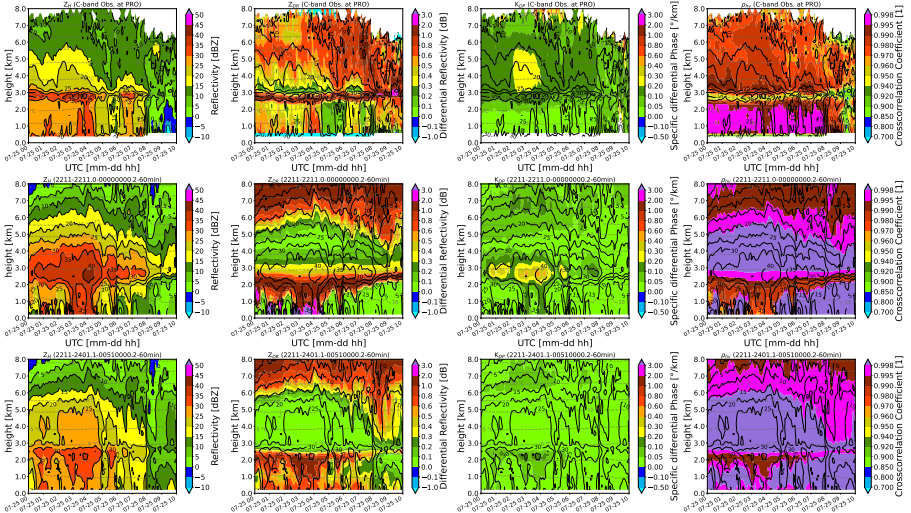
# OP HM I: 25-07-2017

# QVPs(12°) for PRO on 25-07-2017 00:00-09:55 for stratiform PPIs




## Observation

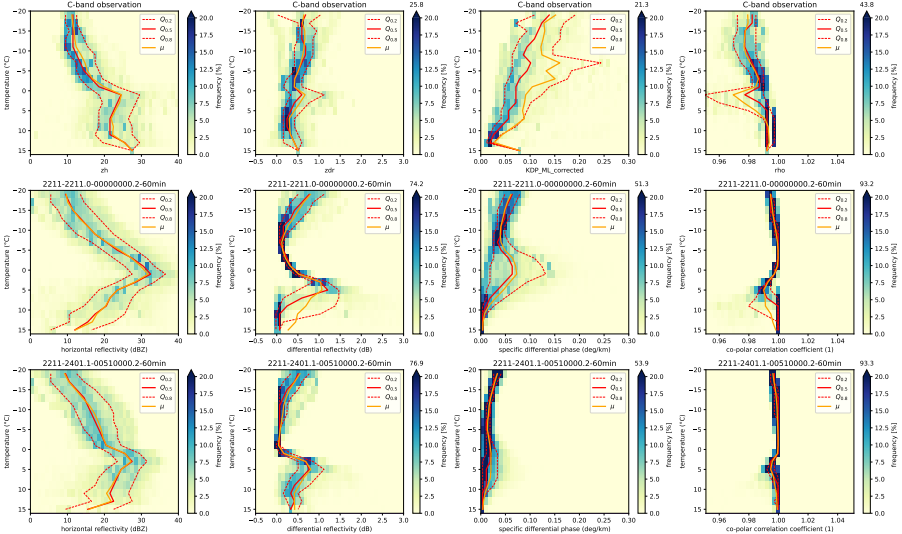
## 'Bringi-book run'

- no sharp ML
- too high $Z_{DR}$ below ML
- long surviving graupel

## 'state-of-our-art run'

- finer ML
- more realistic $Z_{DR}$

# CFTDs(12°) for all DWD radars on 25-07-2017 00:00-23:55 for stratiform PPIs




## Observation

**'Bringi-book run'**

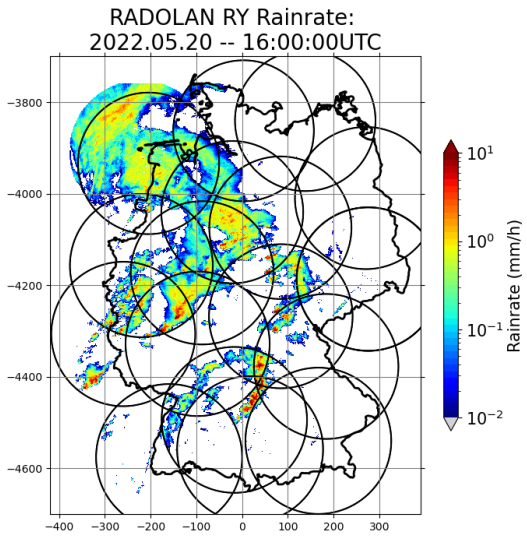
- broad ML
- high $Z_{DR}$ spread below ML

**'state-of-our-art run'**

- finer ML
- realistic $Z_{DR}$ spread

# OP HM II: 20-05-2022

# RADOLAN RY for on 20-05-2022 15:00 - 15:55



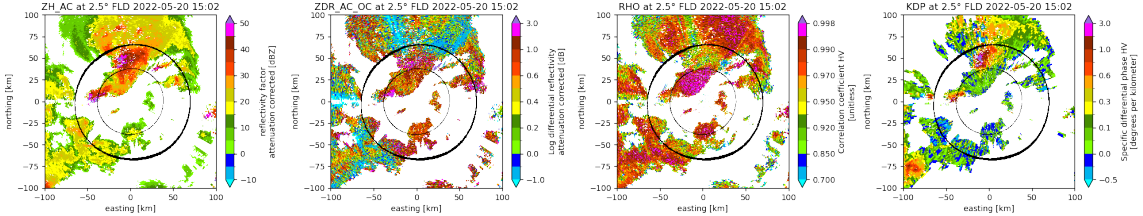

- convective day with many storms

5 tornadoes in Germany:

$\rightarrow$ 15:00 UTC in Paderborn

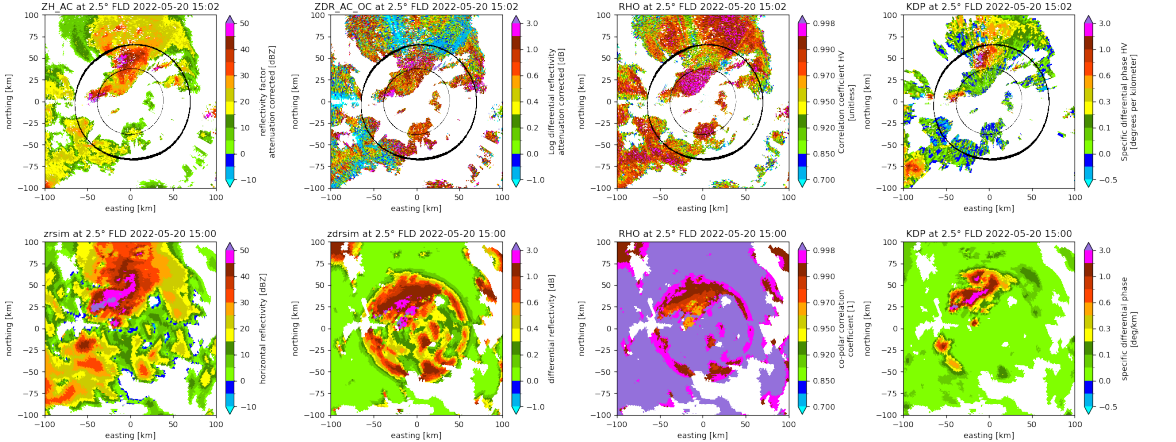
(FLD radar)

# PPI (2.5°) for FLD on 20-05-2022 15:02




→ obs with strong attenuation

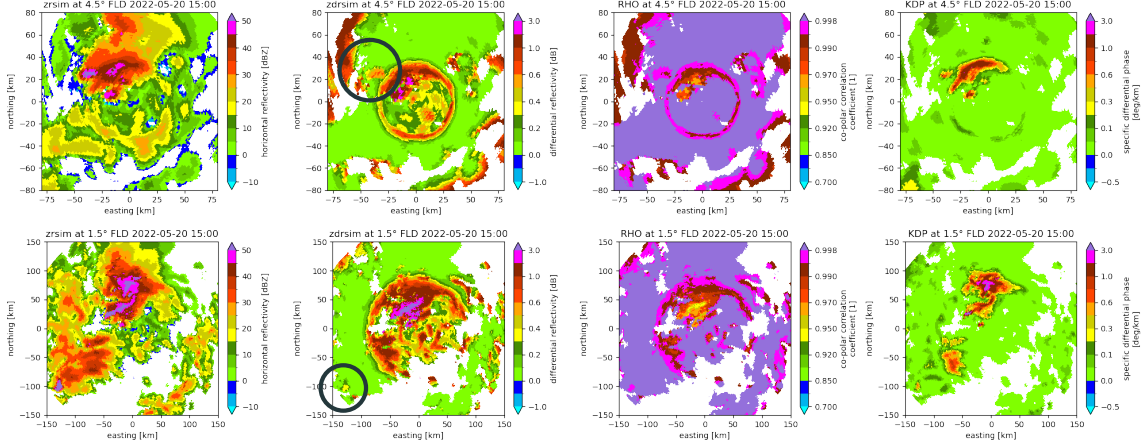
# PPI (2.5°) for FLD on 20-05-2022 15:00




→ obs with strong attenuation

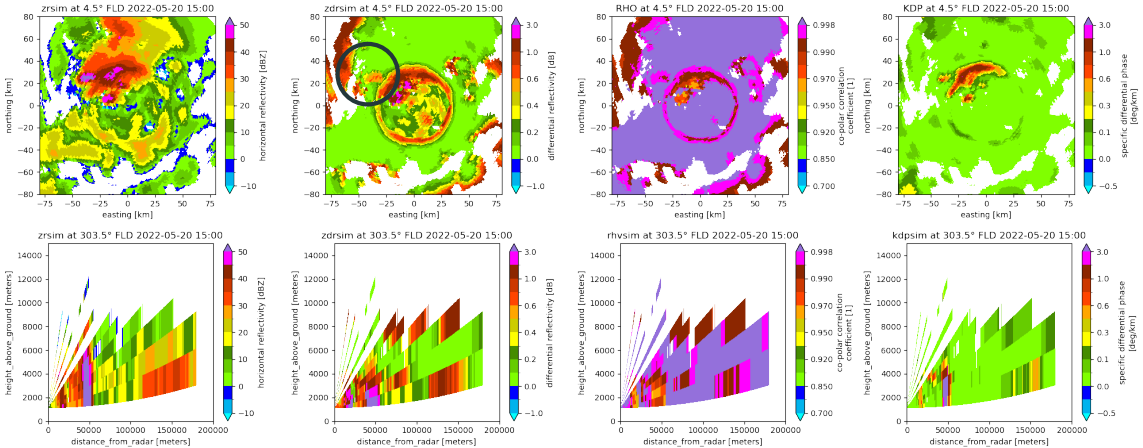
→ mod with broader rain field

# PPIs (4.5°, 1.5°) for FLD on 20-05-2022 15:00 with $Z_{DR}$ columns



However: two $Z_{DR}$ columns apparent (C1, C2)
(high $Z_{DR}$ above ML in convective situation indicates uplifted rain)

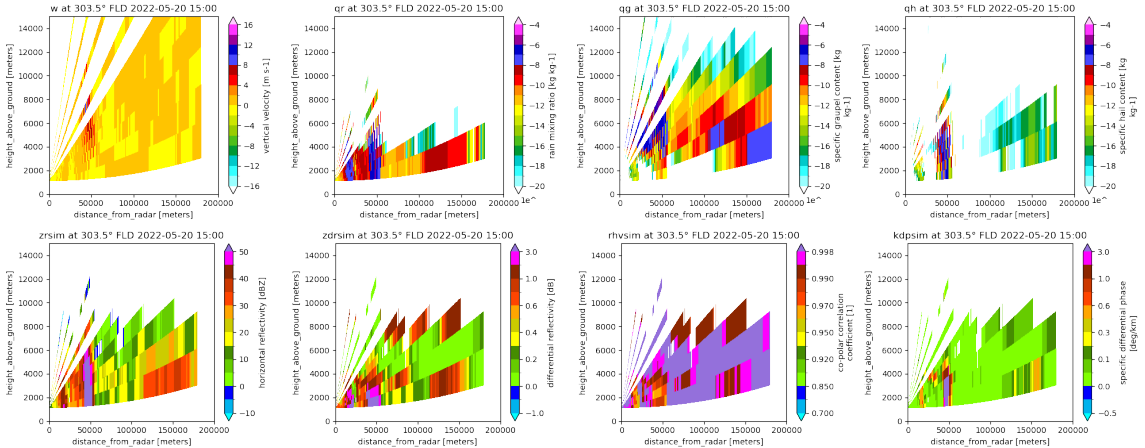
# C1: PPIs (4.5°) and pseudoRHIs (303.5°) for FLD on 20-05-2022 15:00




→ high values of $Z_H$ in all levels

→ vertical extend of high values in other moments smaller

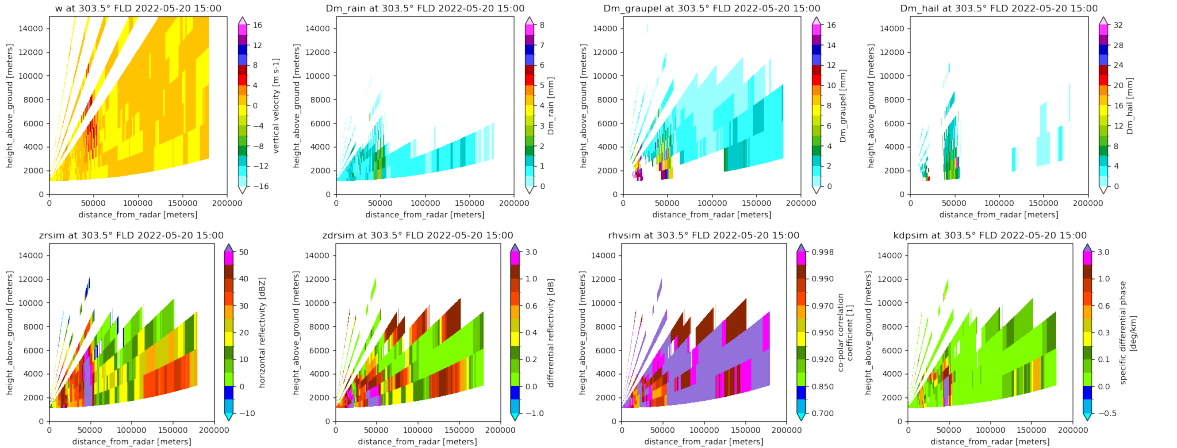
# C1: pseudoRHIs (303.5°) with w, qr, qg, qh for FLD on 20-05-2022 15:00




→ core updraft of $w \sim 10\,\mathrm{m/s}$

→ specific contents for rain, graupel, and hail are high

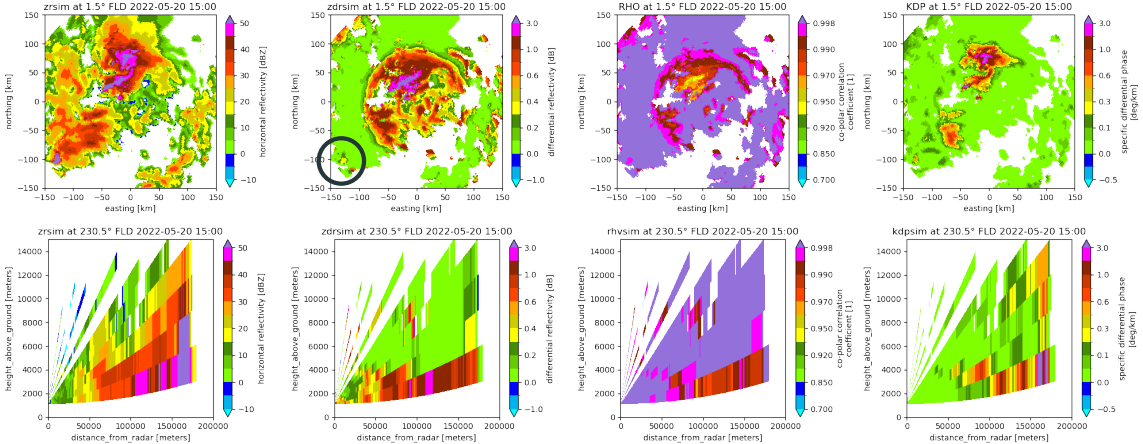
# C1: pseudoRHIs (303.5°) with median volume diameters of r, g, and h




→ raindrops $\sim$ 1 mm are to small for producing significant $Z_{DR}$

→ hail $\sim$ 5 mm dominates signal

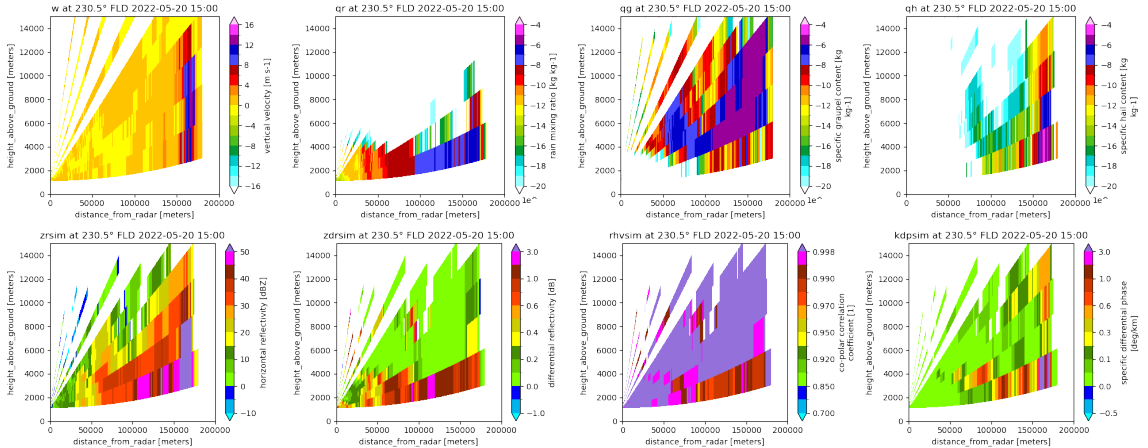
# C2: PPIs (4.5°) and pseudoRHIs (230.5°) for FLD on 20-05-2022 15:00




→ C2 higher than C1 ($\sim 12\,\text{km}$) with $Z_H$, $Z_{DR}$, and $\rho_{HV}$ similar structure

→ enhanced $K_{DP}$ values in 12 km

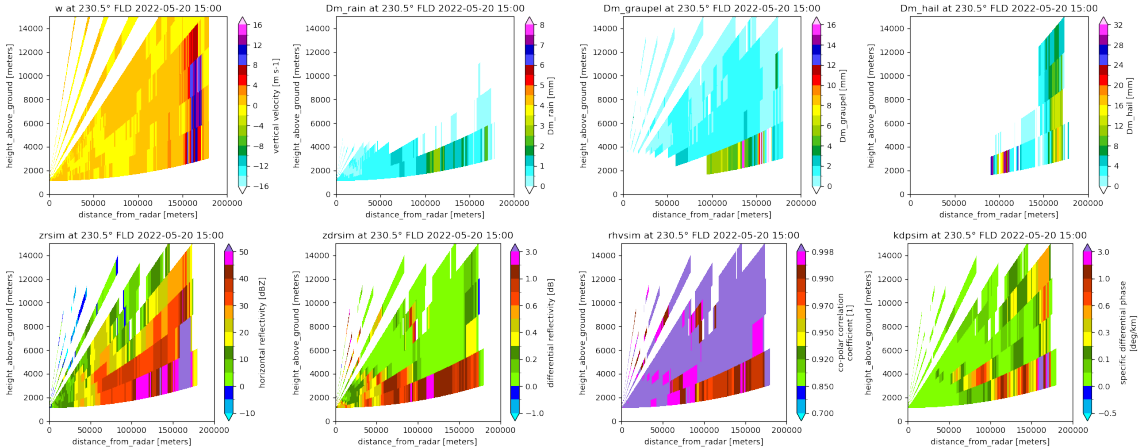
# C2: pseudoRHIs (230.5°) with w, qr, qg, qh for FLD on 20-05-2022 15:00




→ core updraft of $w \sim 12\,\mathrm{m/s}$

→ specific contents for rain, graupel, and hail are high but differ: more graupel mass

# C2: pseudoRHIs (230.5°) with median volume diameters of r, g, and h




→ small raindrops $< 0.5\,\text{mm}$

→ bigger hail stones $\sim 15\,\text{mm}$ dominates signal

# C1 + C2: $Z_{DR}$-columns in ICON/EMVORADO for FLD on 20-05-2022 15:00

→ $Z_{DR}$-columns are there, however with a weak $Z_{DR}$ signal

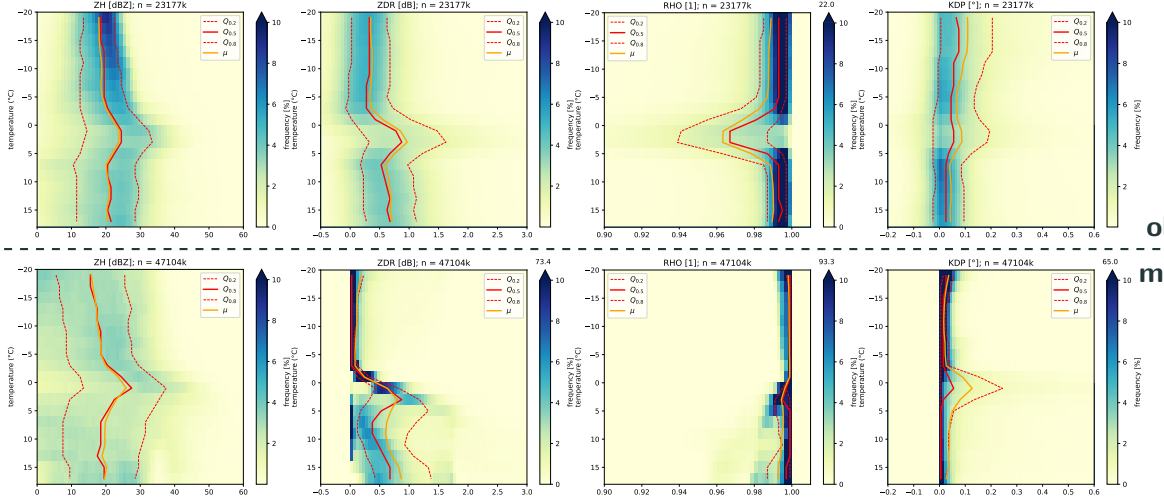
→ following two moment scheme produces only small rain drops

→ updrafts generates hail and graupel (quicker than in obs?!)

? adjust PSD for rain in convection ?

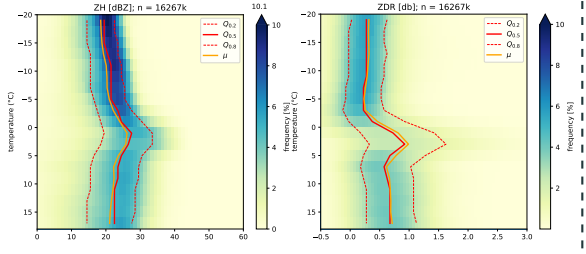
? slow down freezing in updraft ?

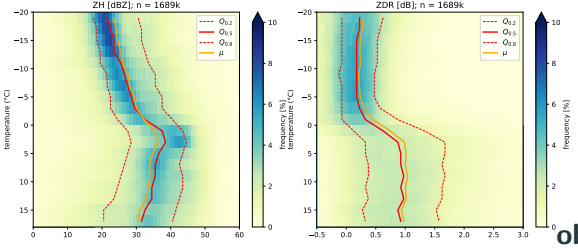
# CFTDs for FLD on 20-05-2022 (whole day & VOL)



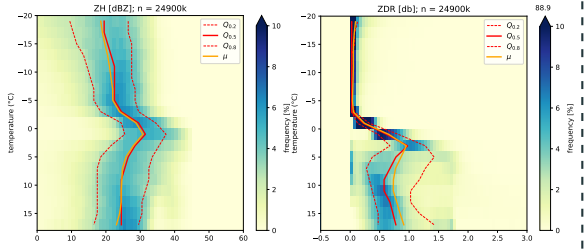

→ limited meaning for the storm areas

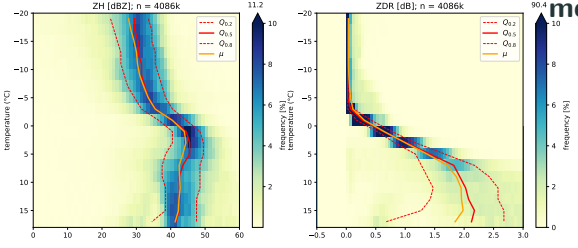
# CFTDs for FLD on 20-05-2022 (whole VOL and storm area, only $Z_H$ and $Z_{DR}$)




obs




mod

**boundary:** $25 \leq \max(Z_H) < 45$ in column

**storm core:** $45 \leq \max(Z_H)$ in column

# Conclusion

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ICON/EMVORADO is further improved towards

$\rightarrow$ a more realistic ML

$\rightarrow$ a better representation of $Z_H$ and $Z_{DR}$ below ML

$\rightarrow$ showing $Z_{DR}$-columns

However:

$\rightarrow$ too high $Z_{DR}$ values in storm cores (below 0°C)

$\rightarrow$ too low $Z_{DR}$ values in storm cores (above 0°C)

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