UNIVERSITÄT BONN

OPERATION HYDROMETEORS PART II

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[2] PROM, SPP 2115, Operation Hydrometeors, Part II

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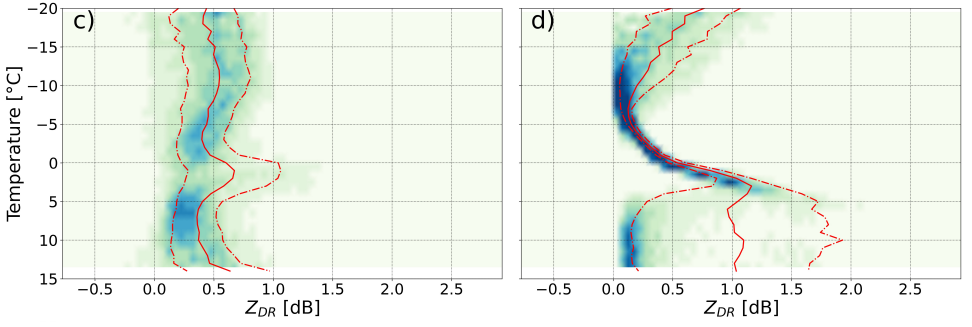
Operation Hydrometeors Part II

- Test ICON and polarimetric forward operator EMVORADO with respect to C-band (X-band) observations
- Study new cases with focus on convective events and finer C-band resolution (250 m radially)
- with respect to: hydrometeor classification, hydrometeor partioning ratios, Z_{DR}-columns, ...

Motivation: EMVORADO is generating too high Z_{DR} below ML

observed

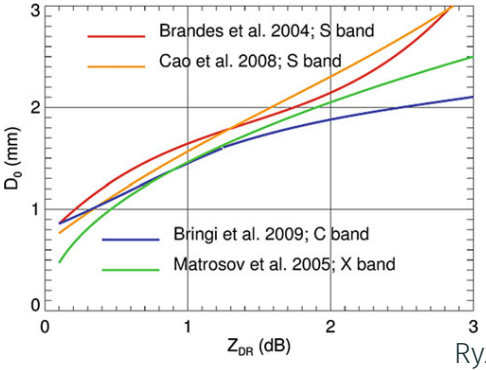
synthetic



CFADs of QVPs of Z_{DR}

Median volume diameter of rain

Raindrops from Z_{DR} [dB]



Ryzhkov and Zrnic (2019)

Median volume diameter D_0 [mm] following Bringi et al. (2009):

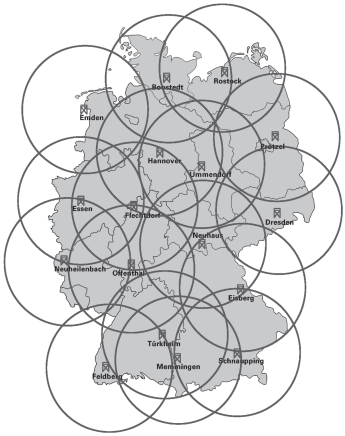
$$D_0 = 0.0203Z_{DR}^4 - 0.149Z_{DR}^3 + 0.221Z_{DR}^2 + 0.557Z_{DR} + 0.801 \quad \text{if } Z_{DR} < 1.25dB \quad (1)$$

$$D_0 = 0.0355Z_{DR}^3 - 0.0302Z_{DR}^2 + 1.06Z_{DR} + 0.684 \quad \text{if } Z_{DR} > 1.25dB \quad (2)$$

ICON vs. C-band

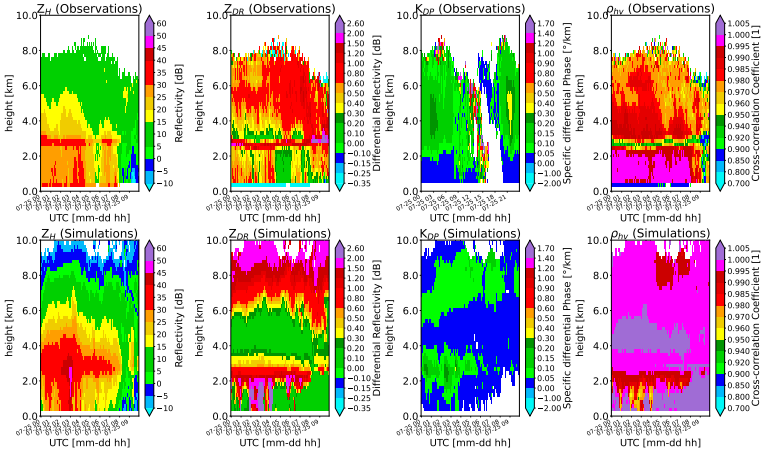
Data and filtering

- stratiform days: 20170719, 20170720, 20170724, 20170725, 20170726, 20170727, 20180728, 20180809, 20180923, 20181202
- use data only if:
  - ML is detected and below ML
  - Shannon entropy > 0.8
  - $Z_H > 0$
  - $\rho_{HV} > 0.7$
  - $K_{DP} > 0.01$
  - $Z_{DR} > -1$
- use quasi vertical profiles (QVPs)
- temperature from ERA5

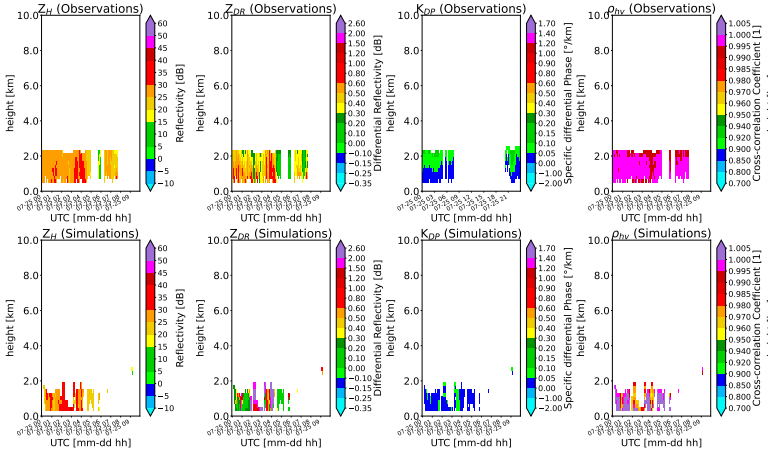


C-band network
Zeng et al. (2016)

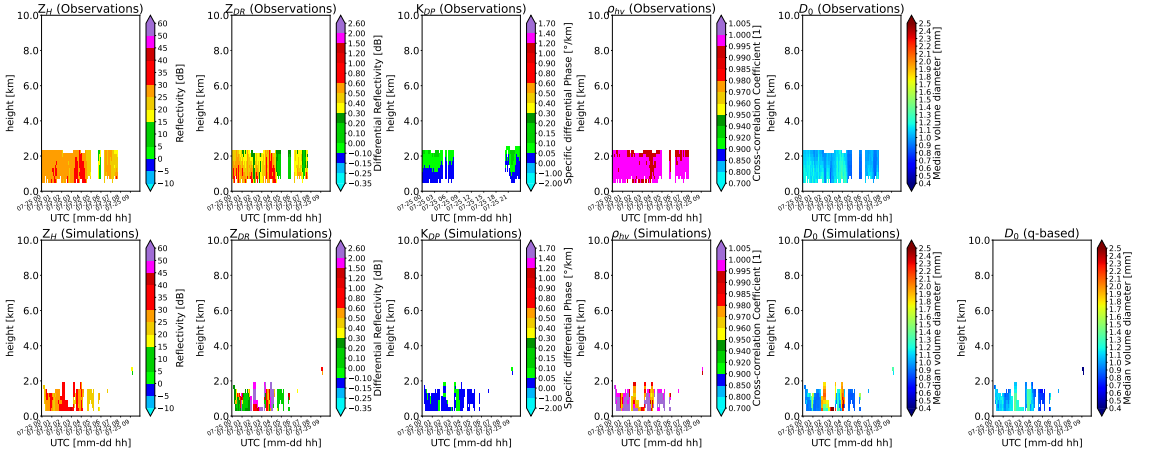
QVPs, 25-07-2017, Prötzel



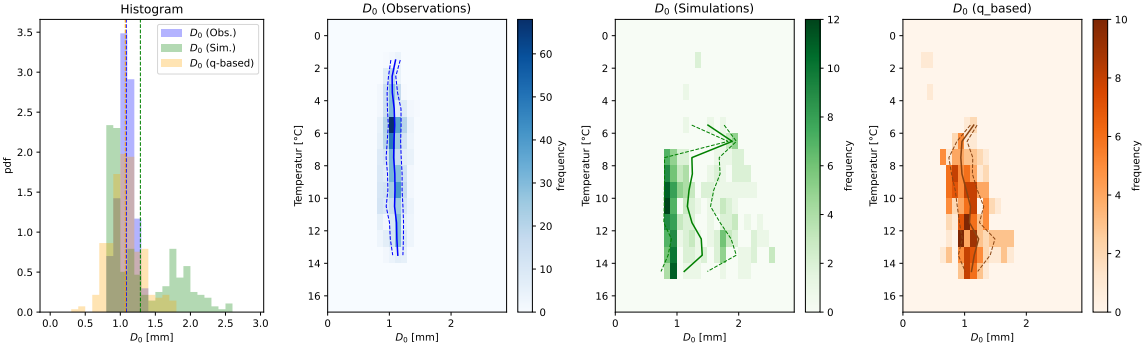
QVPs, 25-07-2017, Prötzel, below ML, only stratiform



QVPs, 25-07-2017, Prötzel, below ML, only stratiform, with D_0

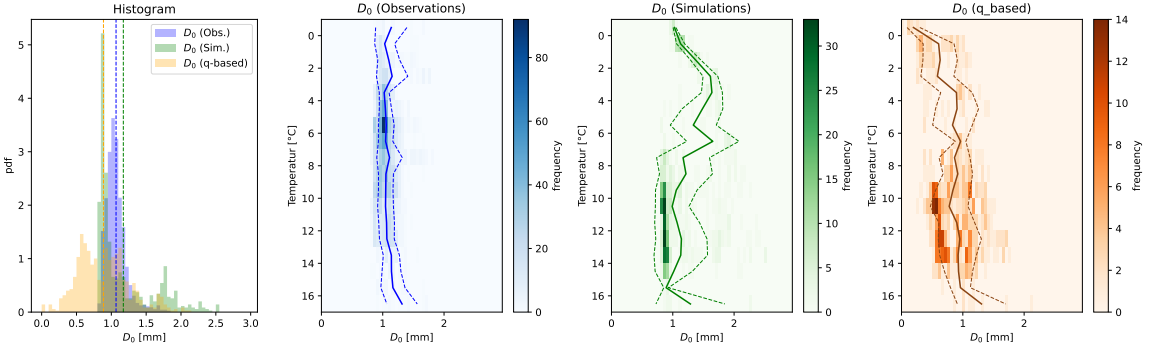


D_0 below ML in stratiform cases, 25-07-2017, Prötzel



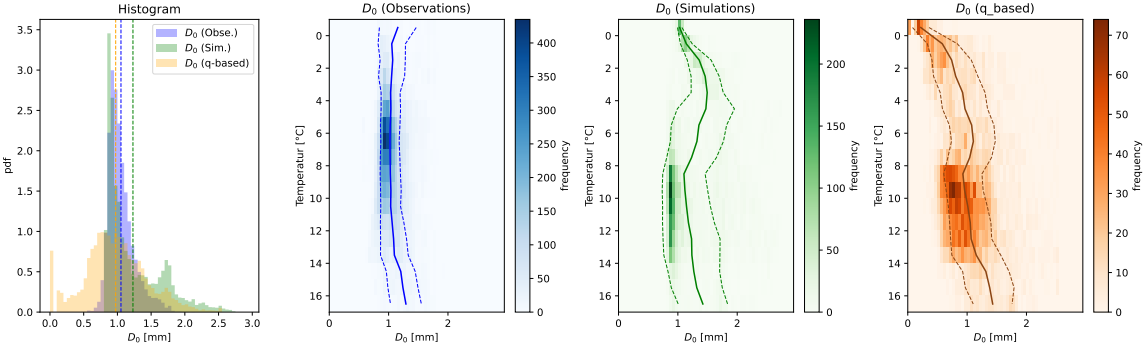
→ second mode in q-based (ICON) distribution,
even more pronounced by EMVORADO

D_0 below ML in stratiform cases, 8 of 10 days, Prötzel



→ smaller drops in q-based (ICON) distribution which are neither in observations or given by EMVORADO

All radars

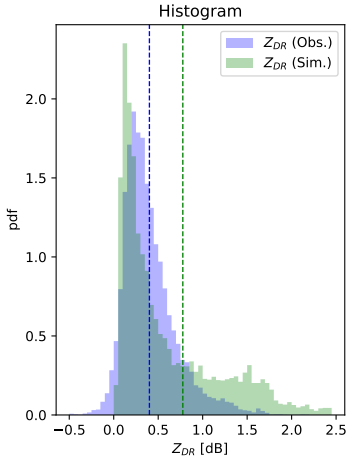


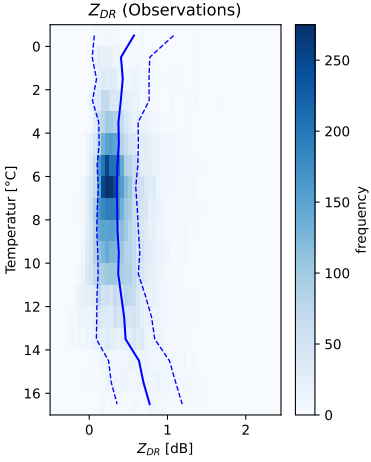
→ ICON gives broader distribution

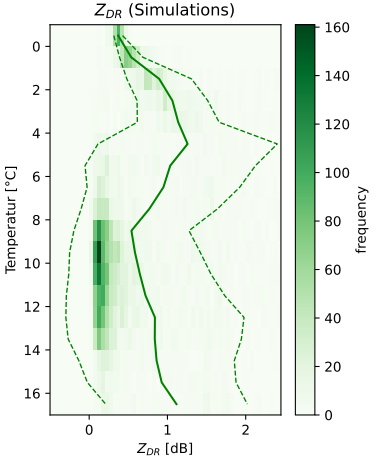
→ second mode in ICON/Simulations at bigger drops

→ drop size increase below ML in ICON/Simulations

All radars Z_{DR} statistics

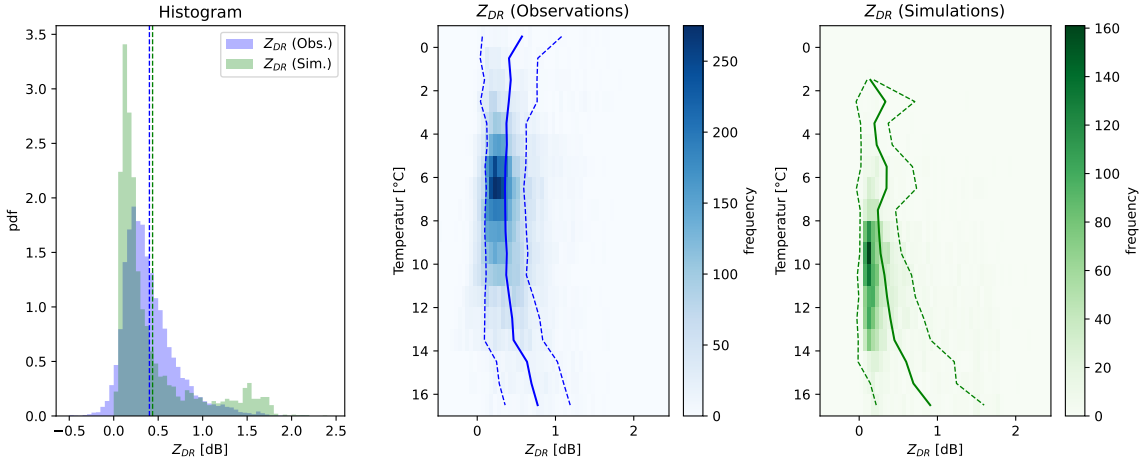






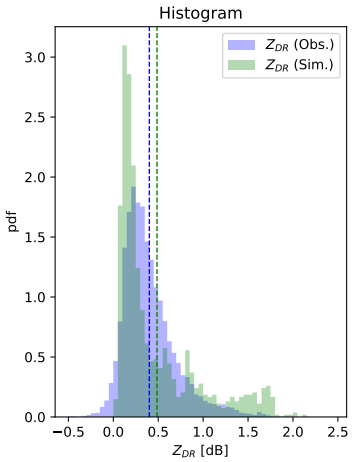
→ D_0 Simulation pattern inherits through the Z_{DR}

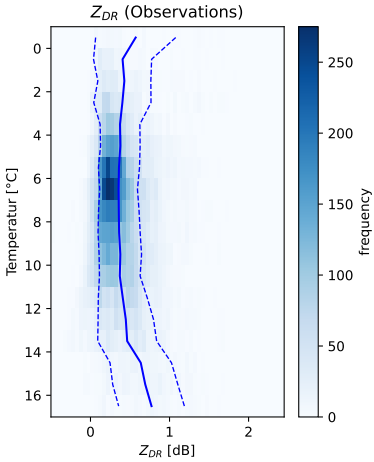
All radars Z_{DR} statistics with graupel filtering (i.e., a need of qg<1E-7)

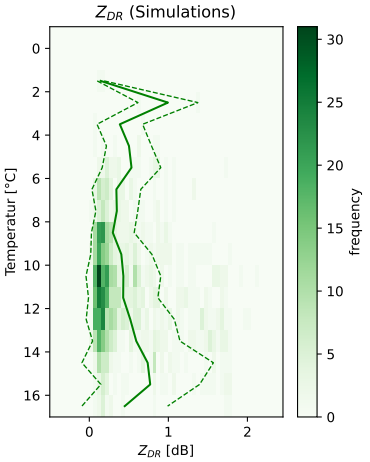


→ second mode is significantly reduced due to the graupel filtering

All radars Z_{DR} with column graupel filtering (need of qg<1E-7 & no qg>1E-5 above)







→ however, rigorous filtering leaves some high Z_{DR}

Summary

Summary

→ ICON's q-based D_0 distribution is broader than the observations,

→ ICON produces unobserved second mode of higher D_0 diameters ($\sim$ 1.8 mm)

→ directly below the ML, ICON's D_0 are increasing while falling

→ too high Z_{DR} values in the simulations are mostly related to graupel

? too big snow could increase ICON's rain drops

? apply new melting scheme in ICON

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References

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Ryzhkov, Alexander V. and Dusan S. Zrnic (2019). *Radar Polarimetry for Weather Observations*. Springer International Publishing. DOI: 10.1007/978-3-030-05093-1.

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