Triple-frequency Doppler retrieval of characteristic raindrop size

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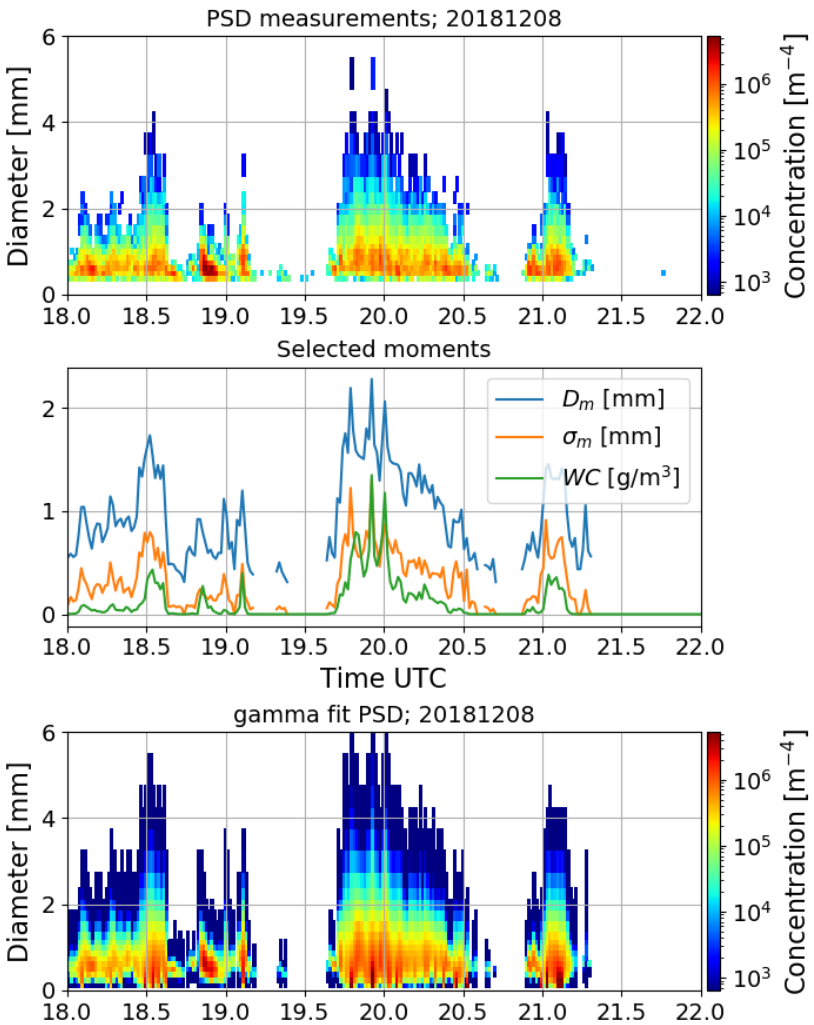
Drop Size Distribution (DSD)

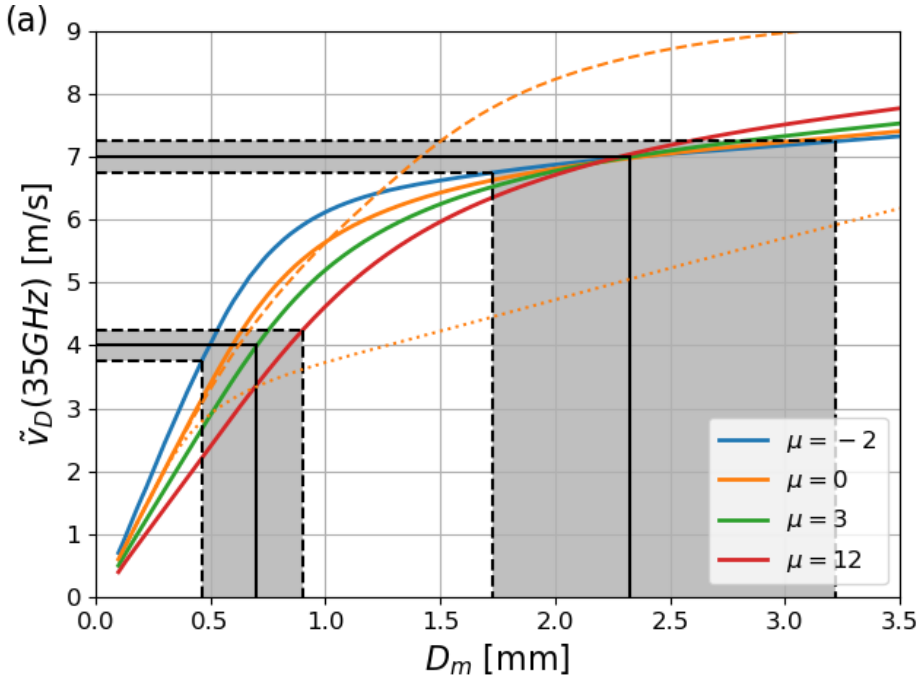
- Complete description of the rain microphysics
- Vertical changes of the DSD indicate processes like evaporation, condensation, coalescence or break-up of rain drops
- Measured directly by disdrometers or using remote sensing techniques
- Usually described by few parameters only and approximated by an analytical function

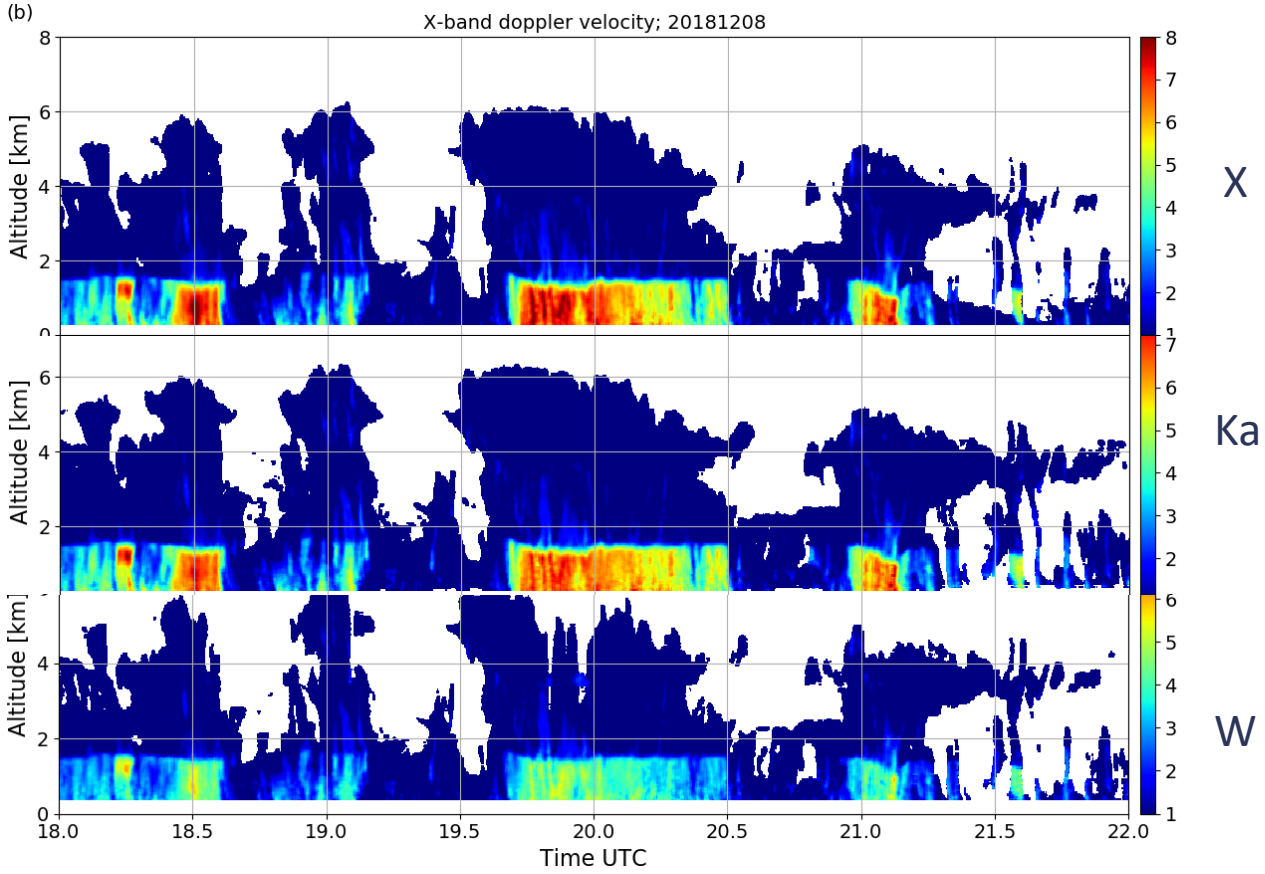
$$N(D) = N_0 D^{\mu} \exp\left[-\frac{(4+\mu)D}{D_m}\right]$$



Mean Doppler Velocity (MDV)

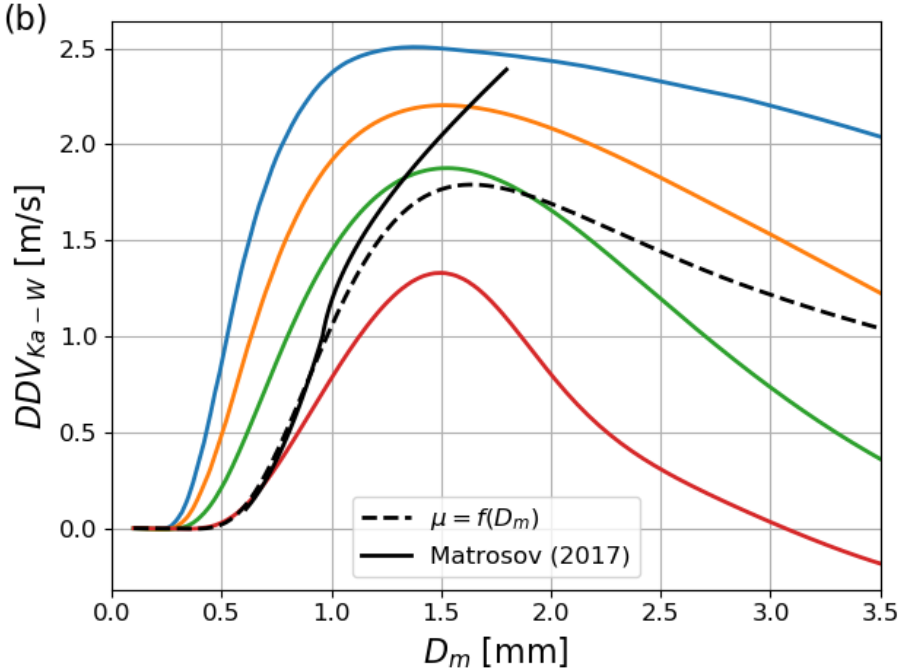
The mean velocity of the targets in the radar volume weighted by their backscattering cross-sections



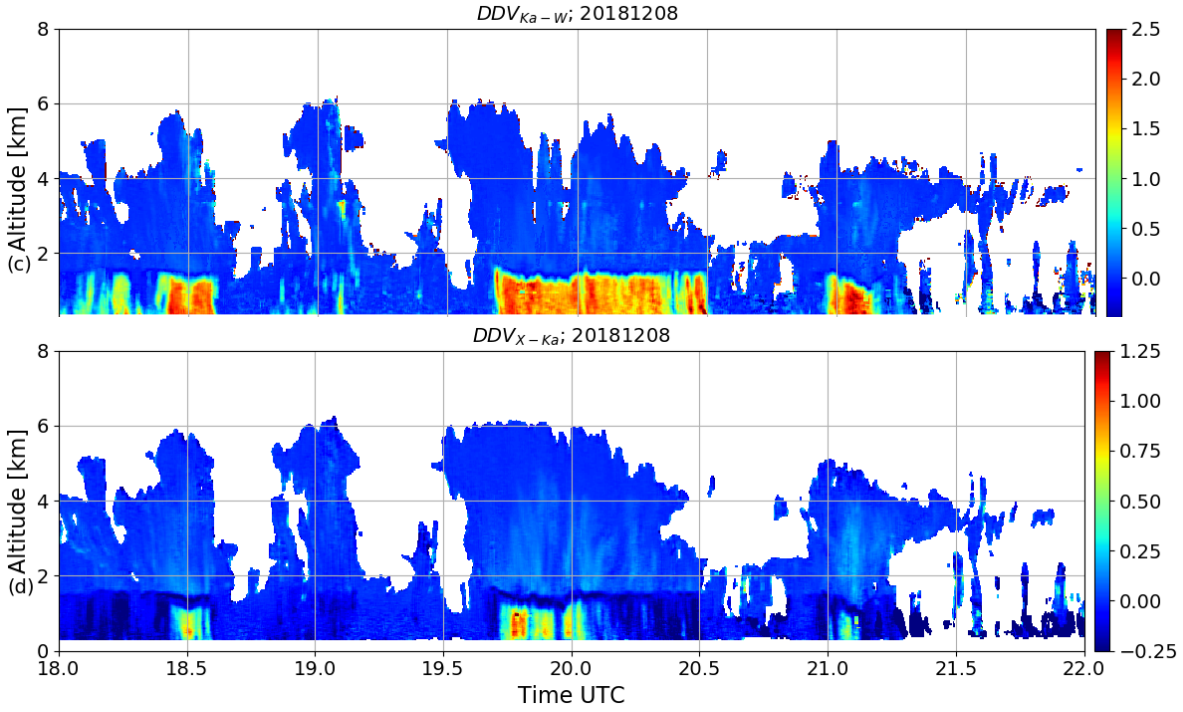


Differential Doppler Velocity (DDV)

The difference between MDV at different frequencies



Independent of the wind speed



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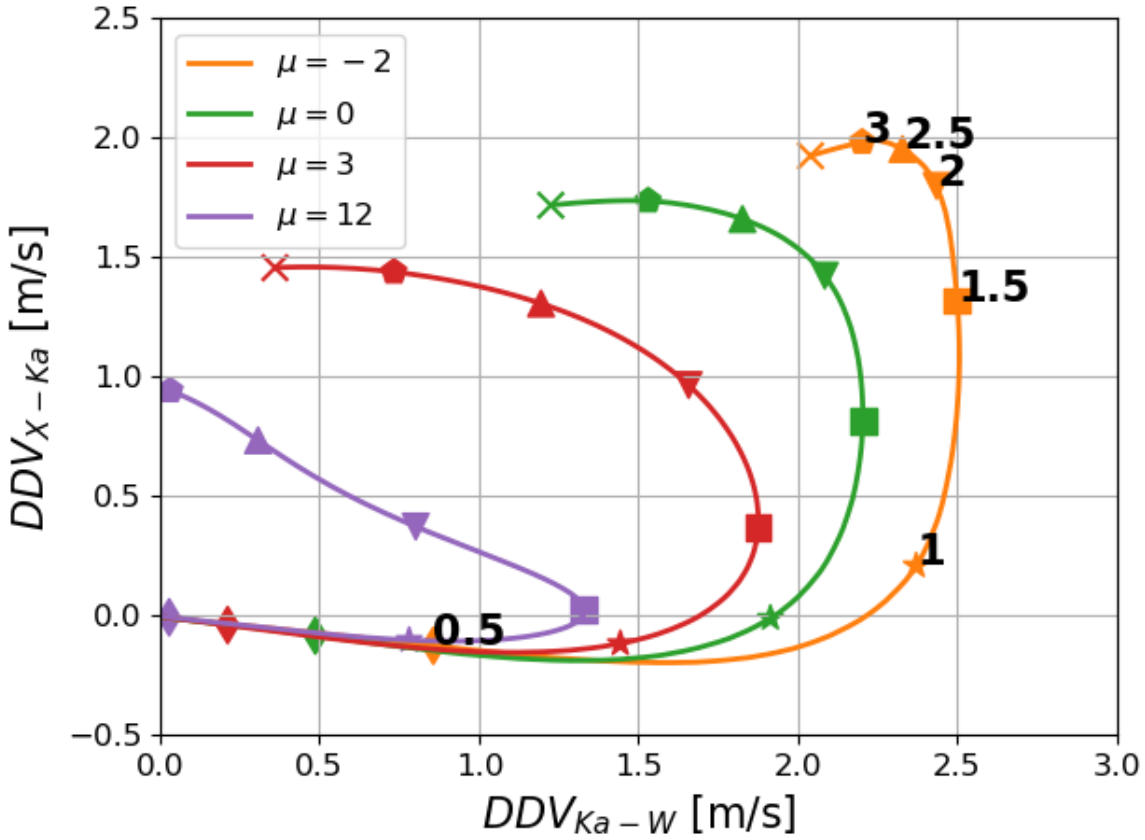
Triple Doppler Velocity (TDV) retrieval

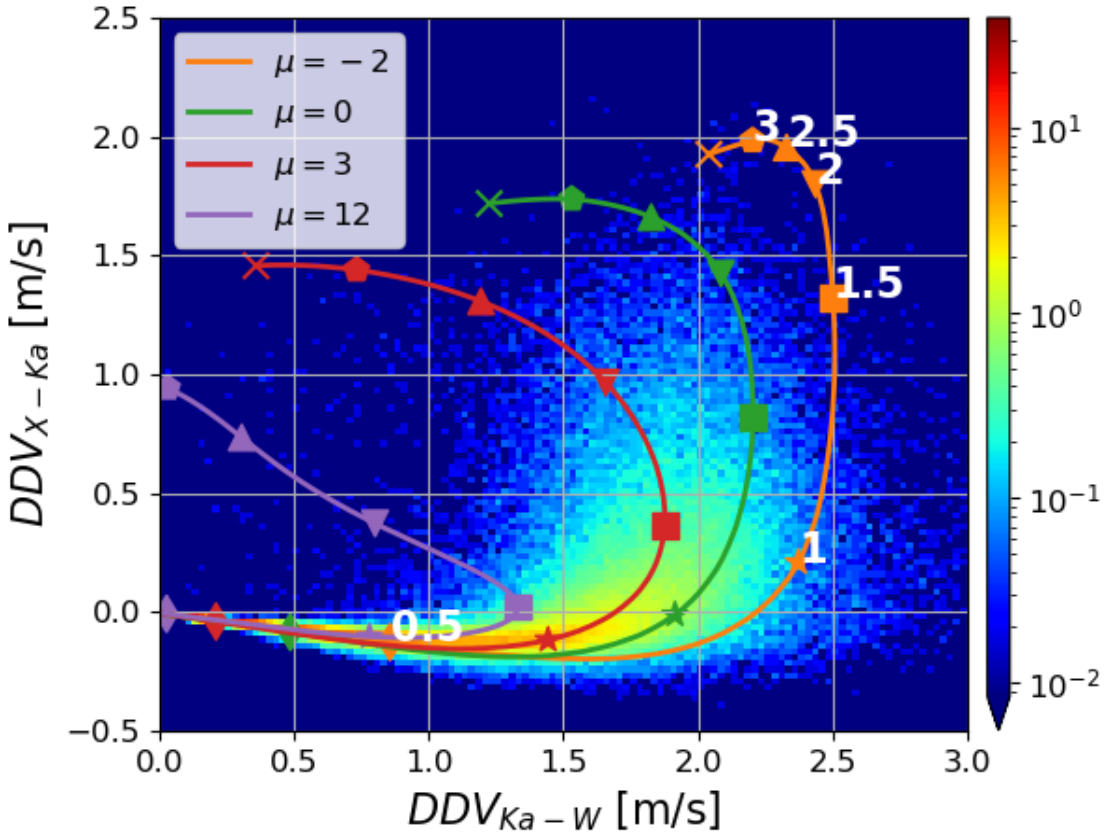
- independent of the wind speed
- No double solution region
- The shape and the characteristic size can be retrieved at the same time



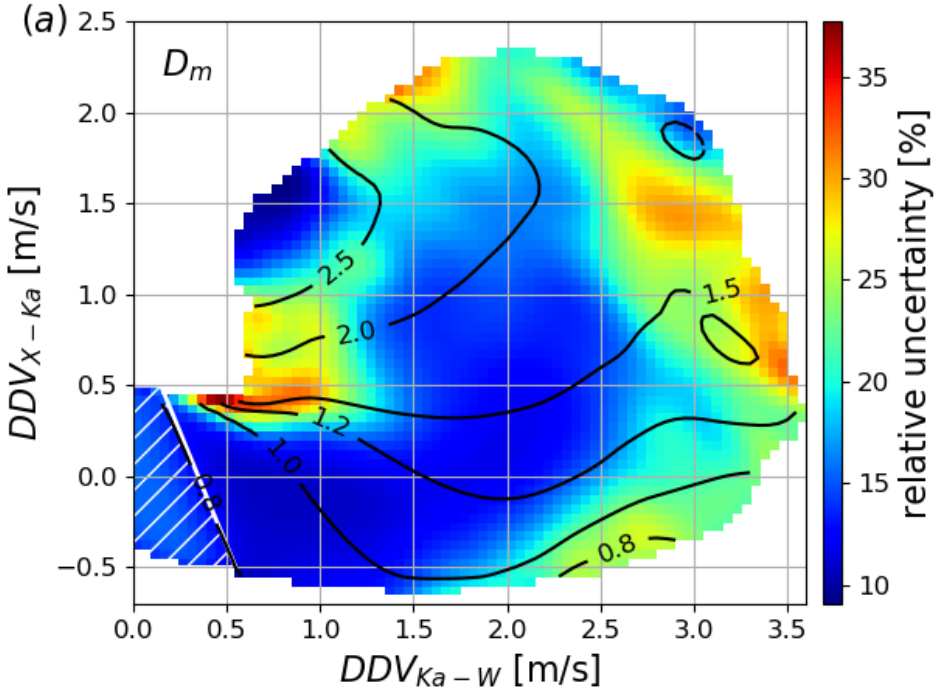
Statistical inverse model

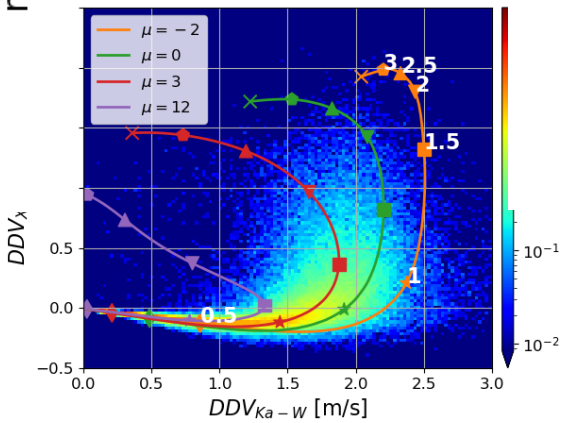
- 150 000 in-situ DSD measurements used
- No analytic form assumed
- D_m, σ_m assigned to each DSD
- V_X, V_{Ka}, V_W simulated

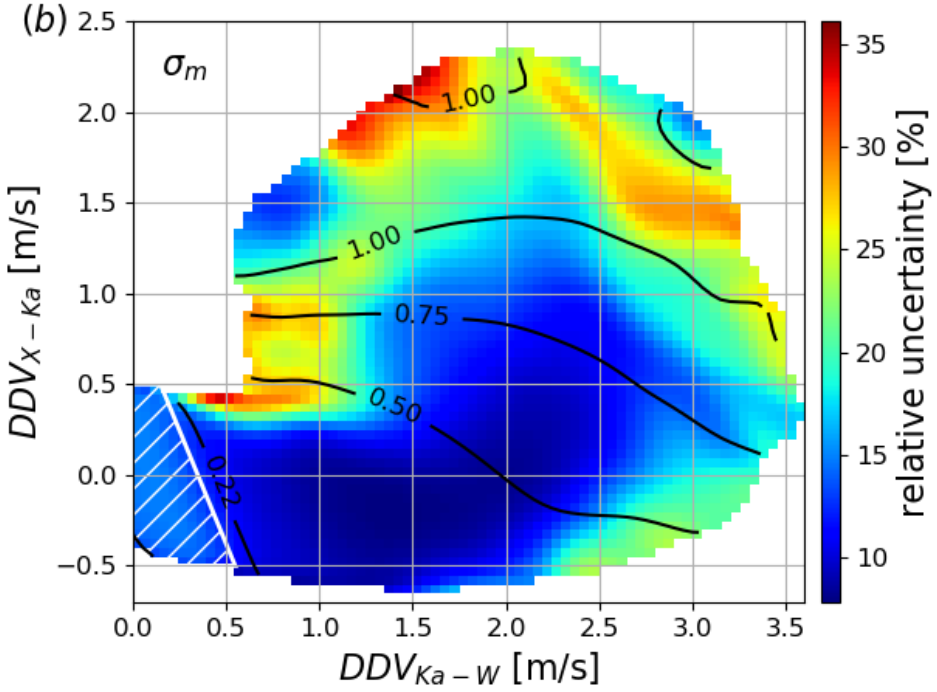
(T-matrix scattering model of Mishchenko & Travis 1994, droplet terminal velocity of Gunn and Kinzer 1949)



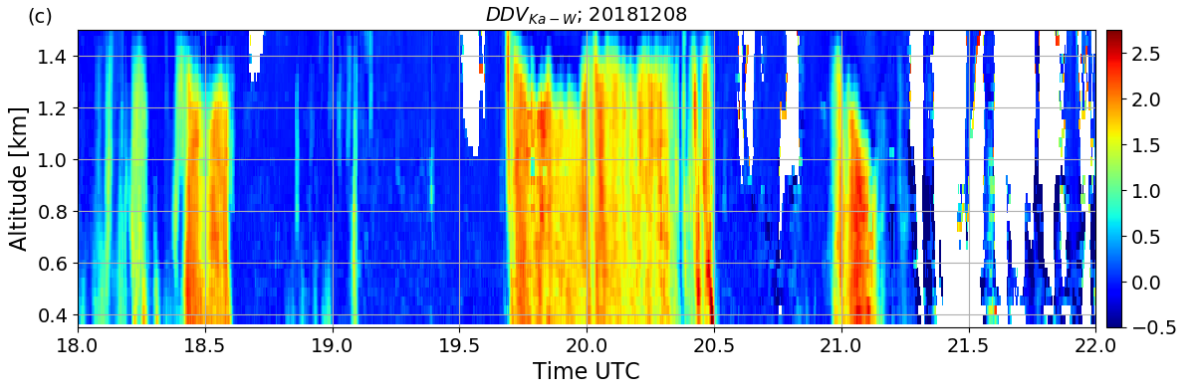
Statistical inverse model

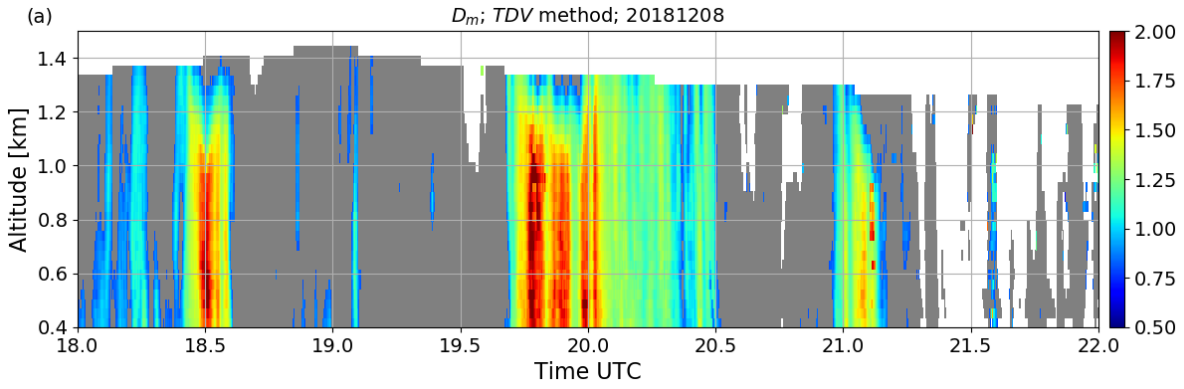






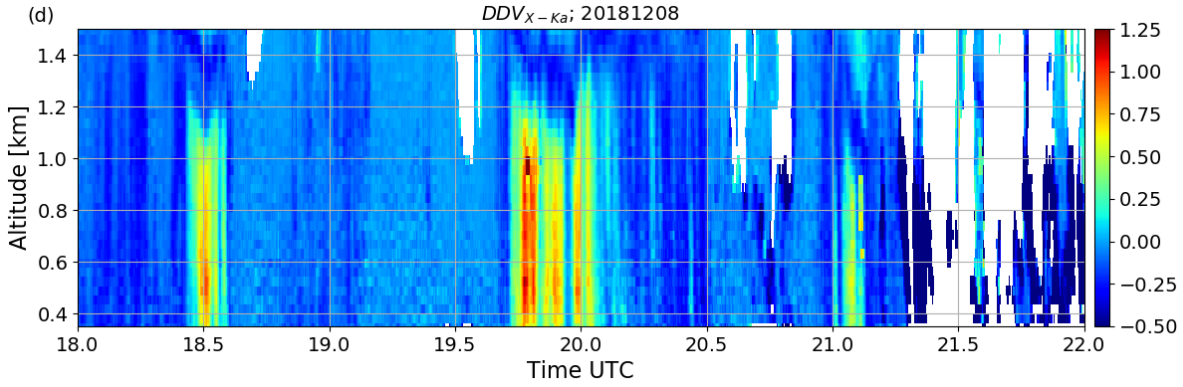
Application (TRIPEx dataset)

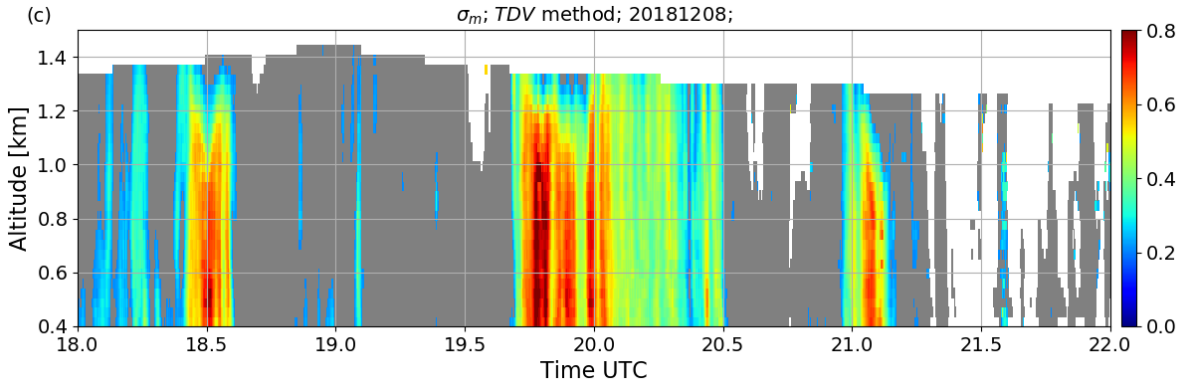




TDV retrieval

Characteristic size

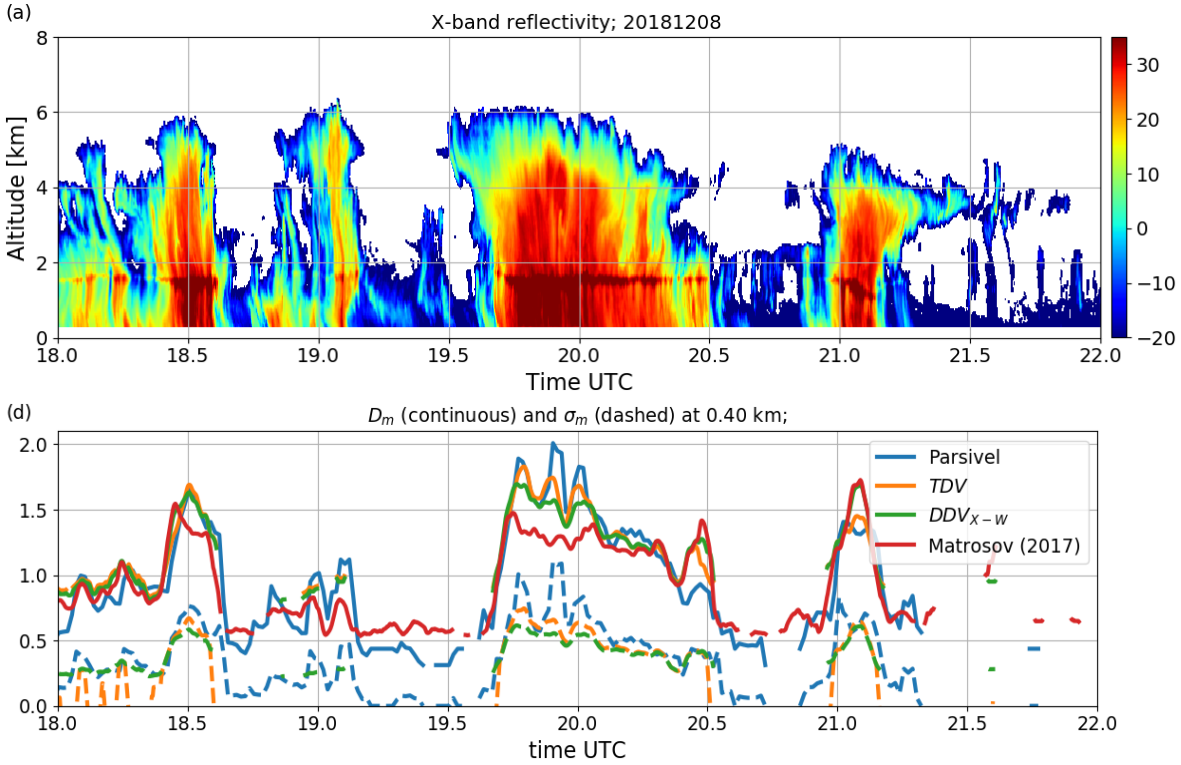




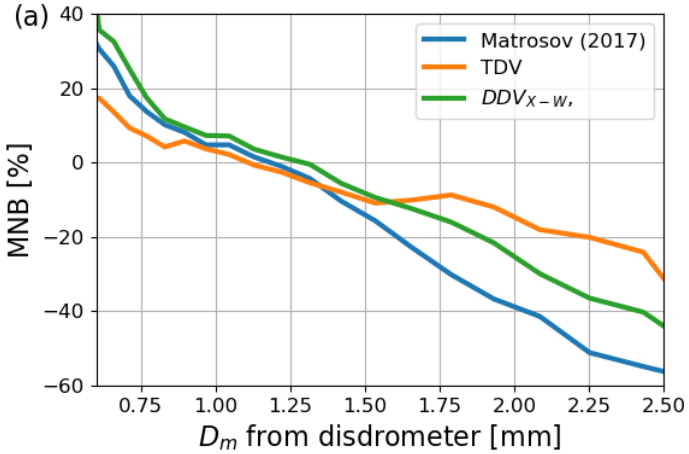
Width of the DSD

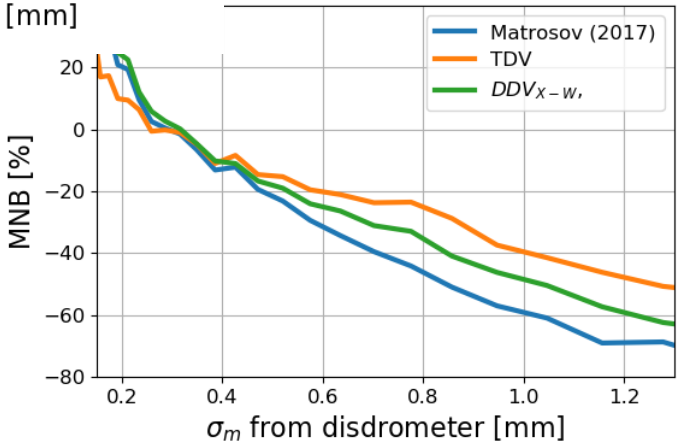
Validation with disdrometer measurements

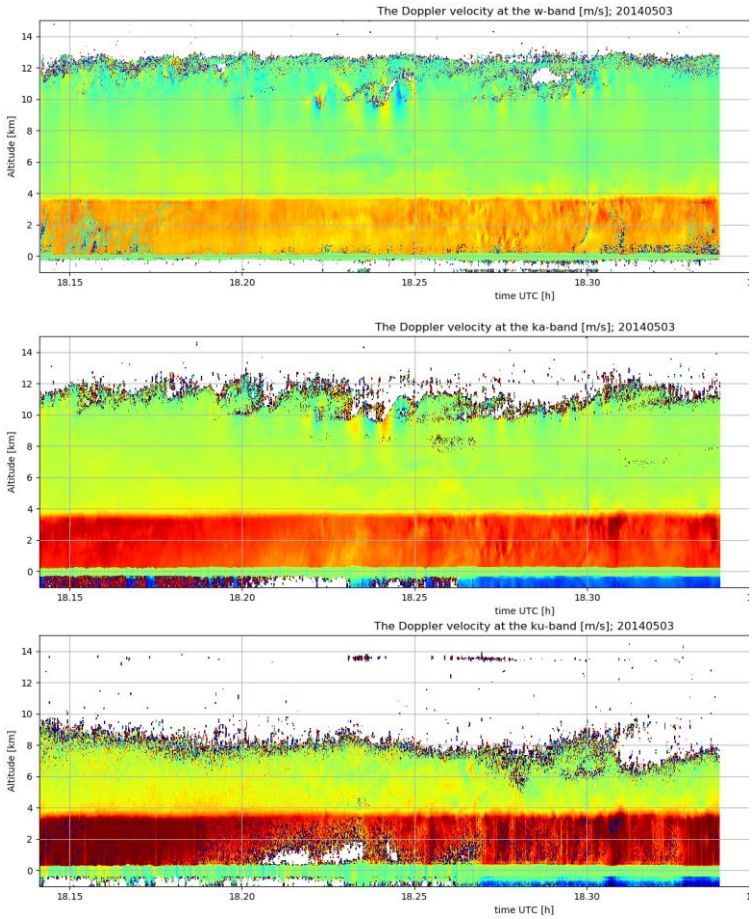
Single event



55 hours of the measurements (Nov-Jan, Jun)





Summary and future work

- Collocated multi frequency measurements of the MDV can be effectively used to estimate D_m, σ_m of the DSD
- The TDV algorithm outperforms DDV techniques
- The retrieval unaffected by the attenuation and the absolute radar calibration
- The integration of the Doppler and the reflectivity-based rain microphysics retrieval in a unified scheme is the topic of our future research