Validation of EarthCARE Doppler Velocity and microphysical precipitation products using weather radar observations

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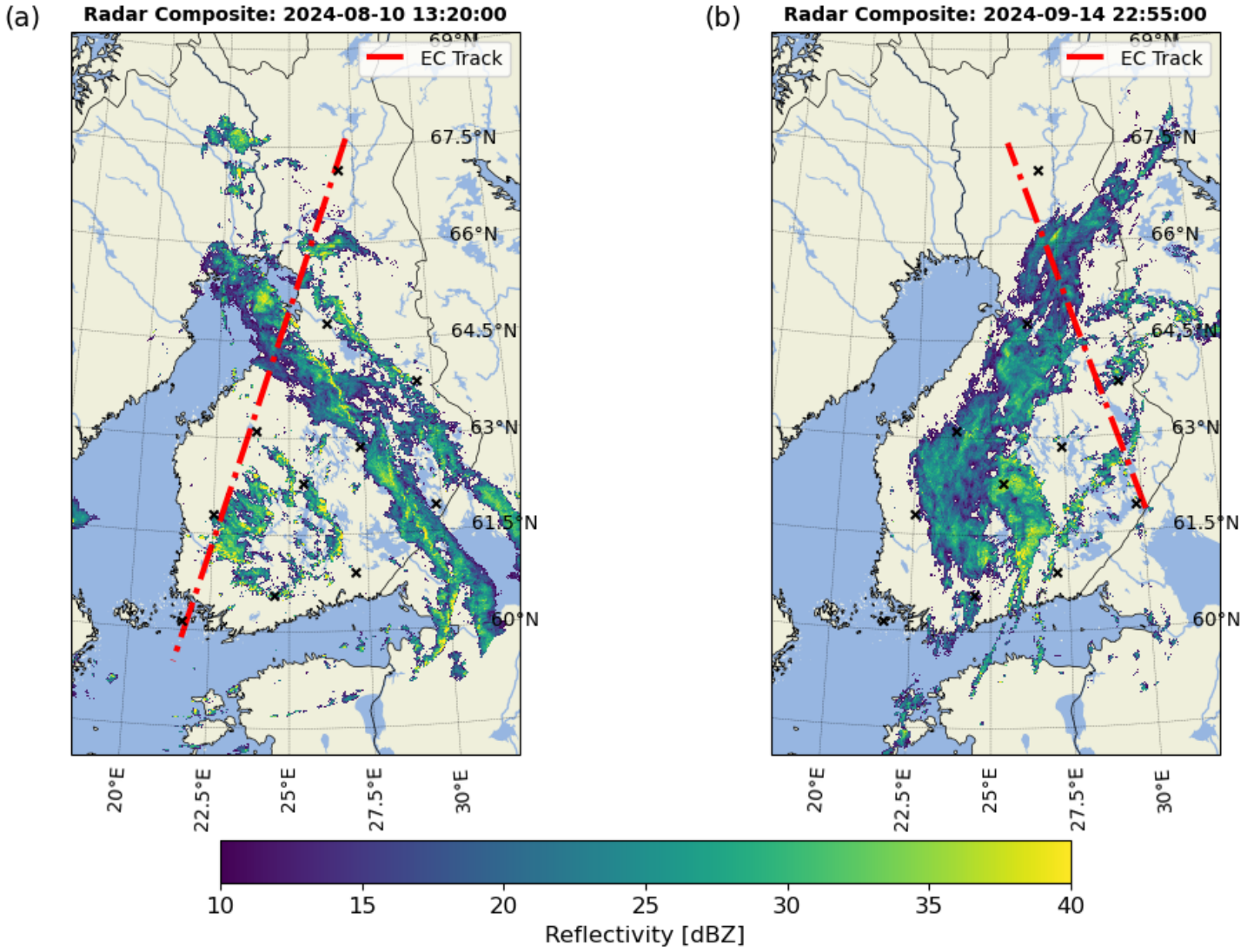

Using weather radar observations in Finland to validate EarthCARE Doppler CPR observation in rain

- Lvl 1 Doppler velocity observations
- Lvl 2 Sedimentation velocity
- Lvl 2 Characteristic size

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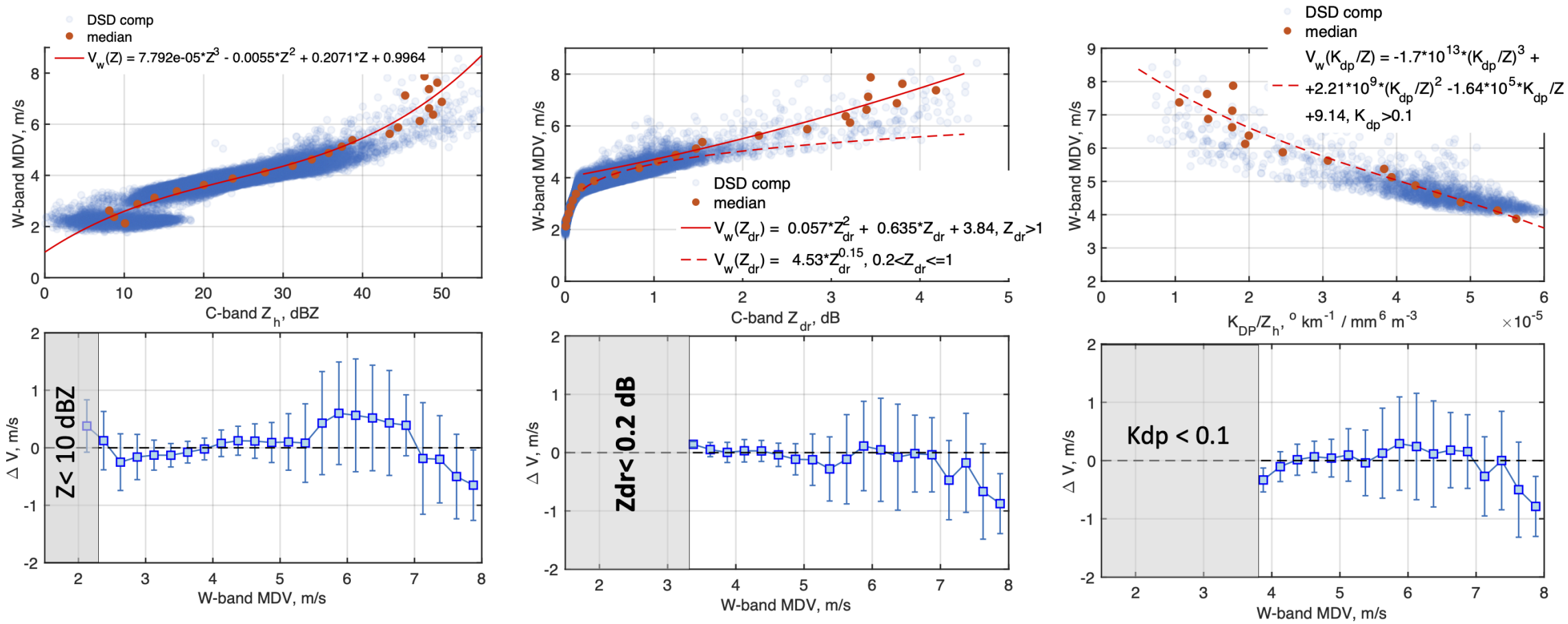
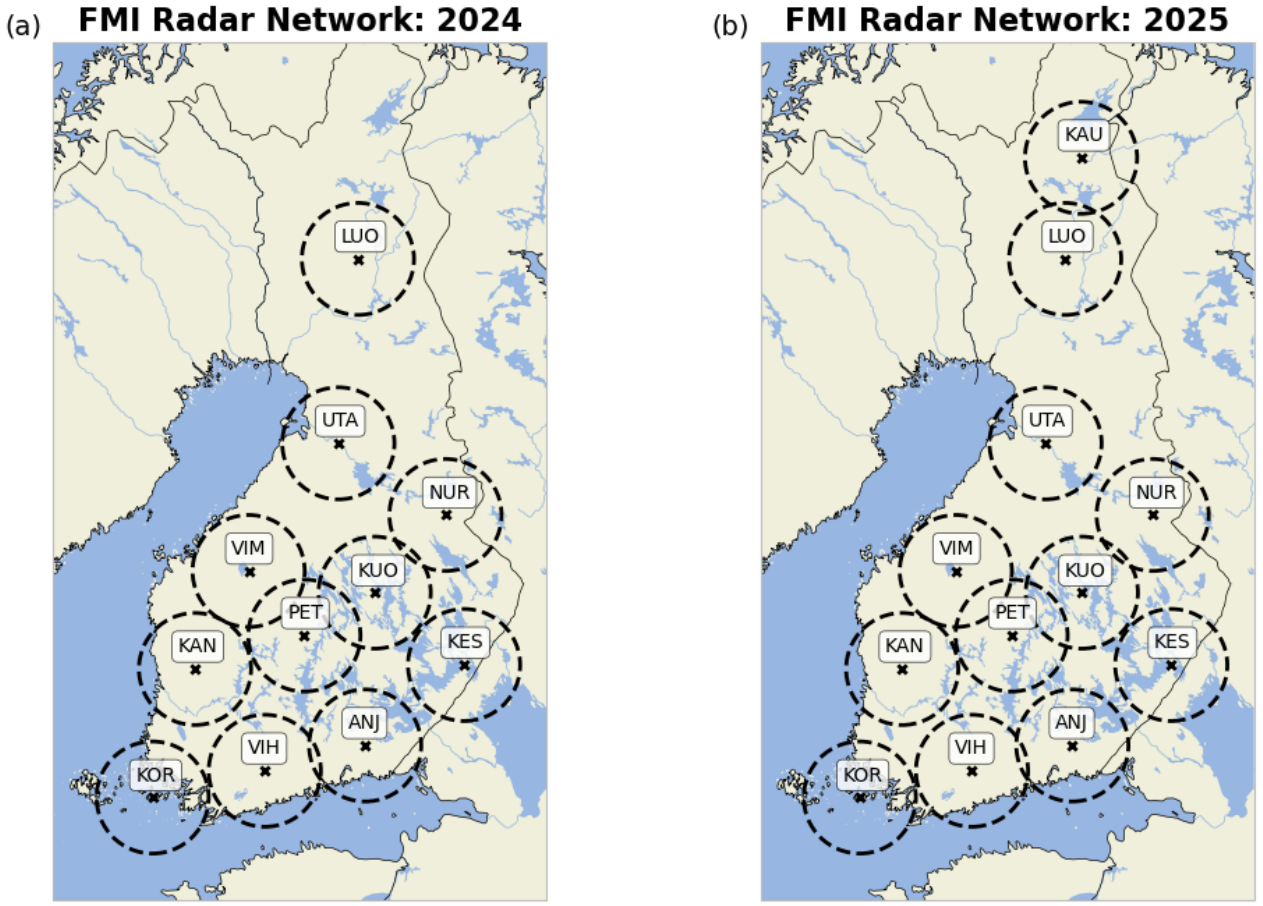
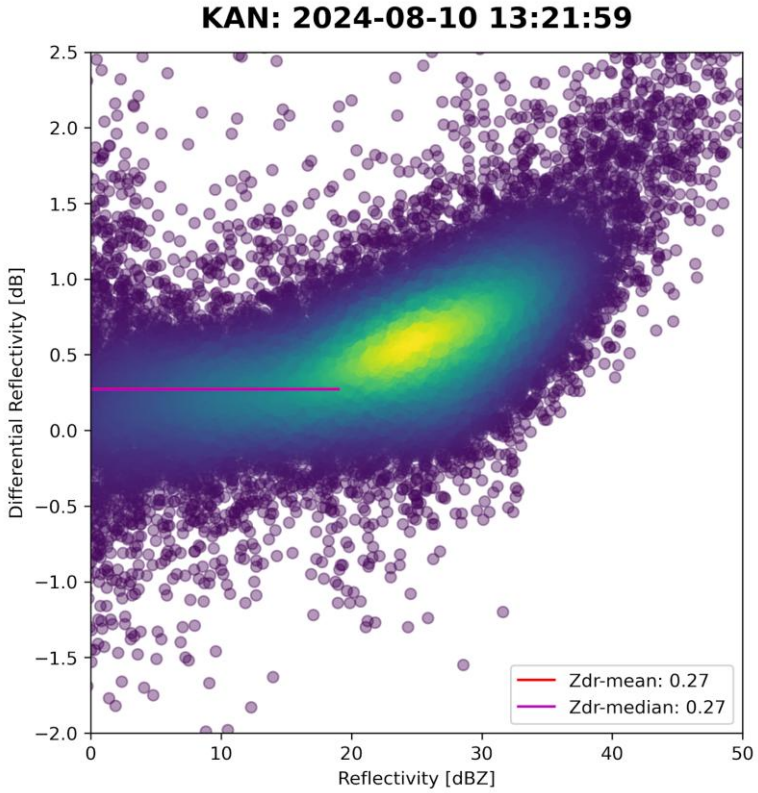


- Using disdrometer data from 2014-2024 relations linking C-band weather radar observaitons and W-band reflectivity weighted sedimentation velocity were computed
- Z, Zdr and Kdp are used, because they provide different sensitivity to rain drop size
- Additionally $Z_{dr} - D_m$ relation is also derived

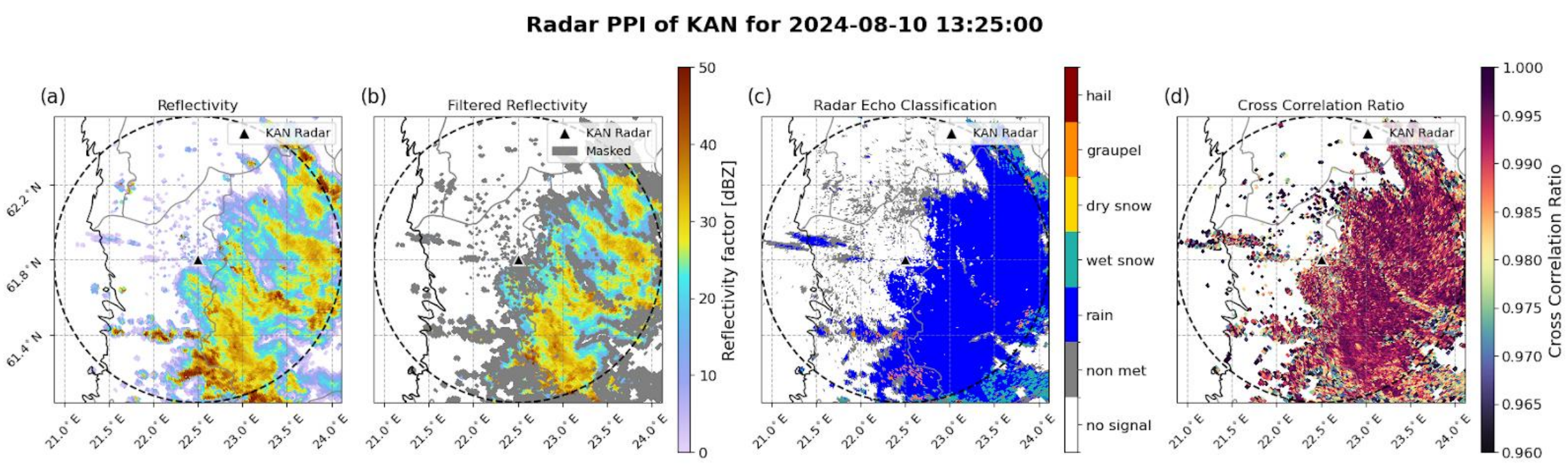


FMI weather radar network in 2024 and 2025

- CPR observations are matched to FMI weather radar observations
- We are not using radar composite data
- Raw volume data from individual radars are used
- Data from each radar is quality controlled
- Calibration of Z and Z_{dr} is checked and performed if needed

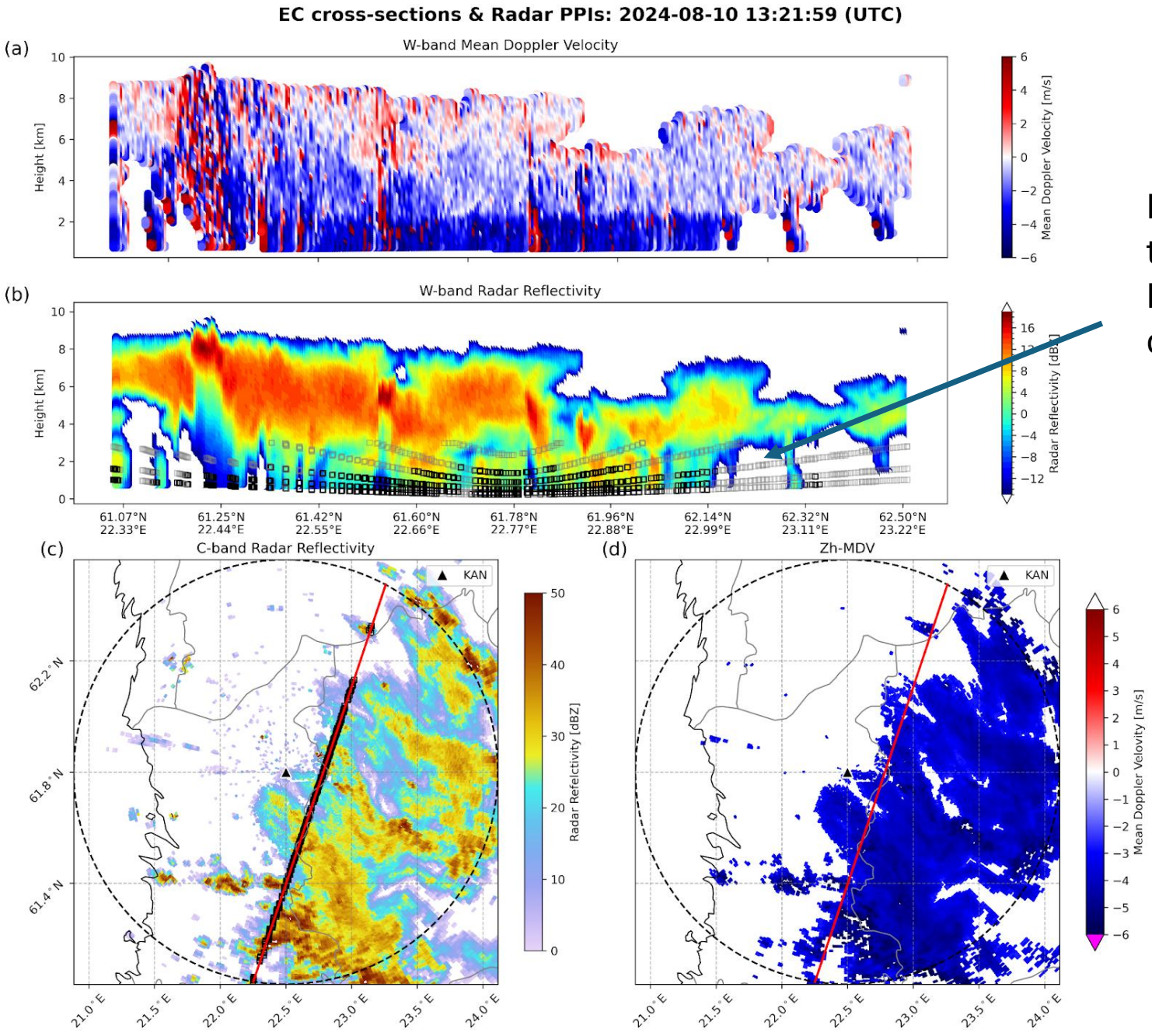


Example of Z_{dr} calibration verification using rain observations



Steps taken to filter weather radar data

- Only data where Z > 10 dBZ (C-band) is used (to remove small velocities not resolved by disdrometer observations)
- Hydrometeor classification and co-polar correlation coefficient are used to remove non rain data

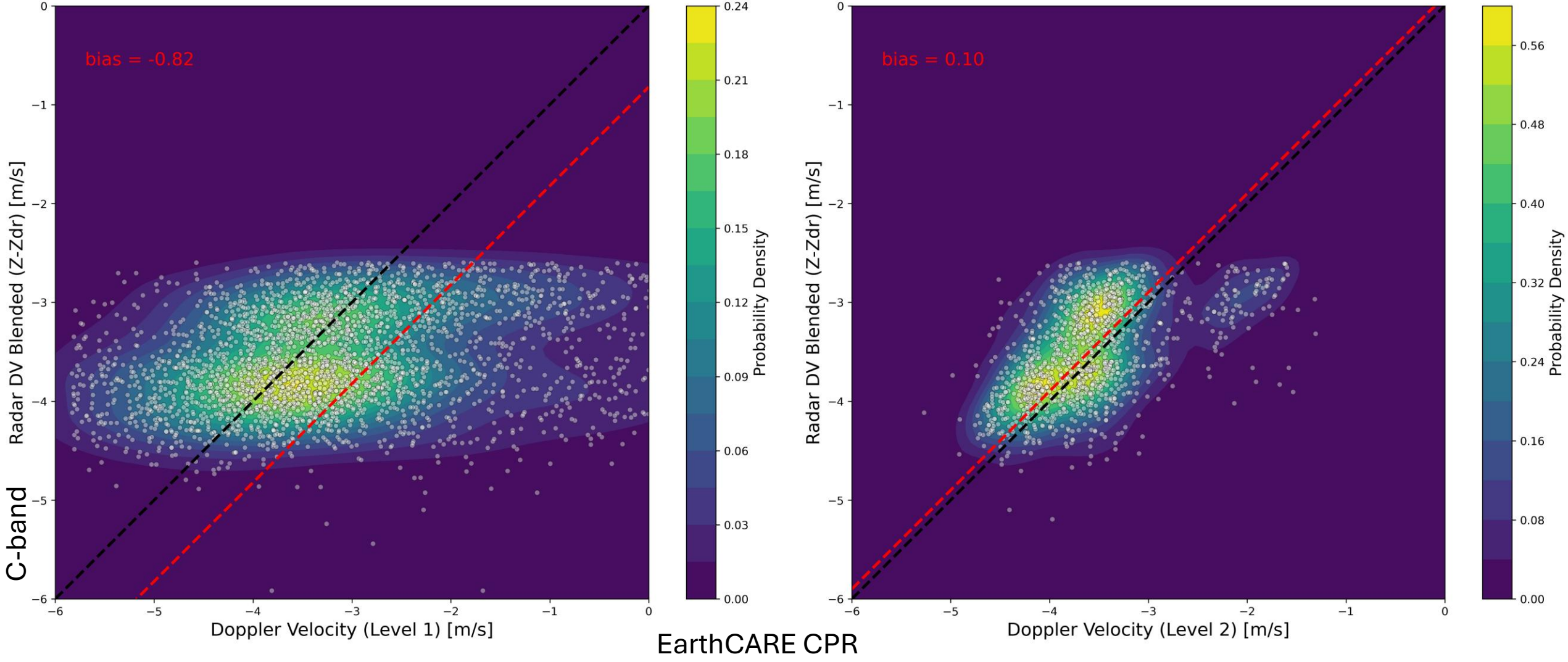


Rectangles show weather radar volumes that match CPR observations
Black rectangles – data that passed quality control

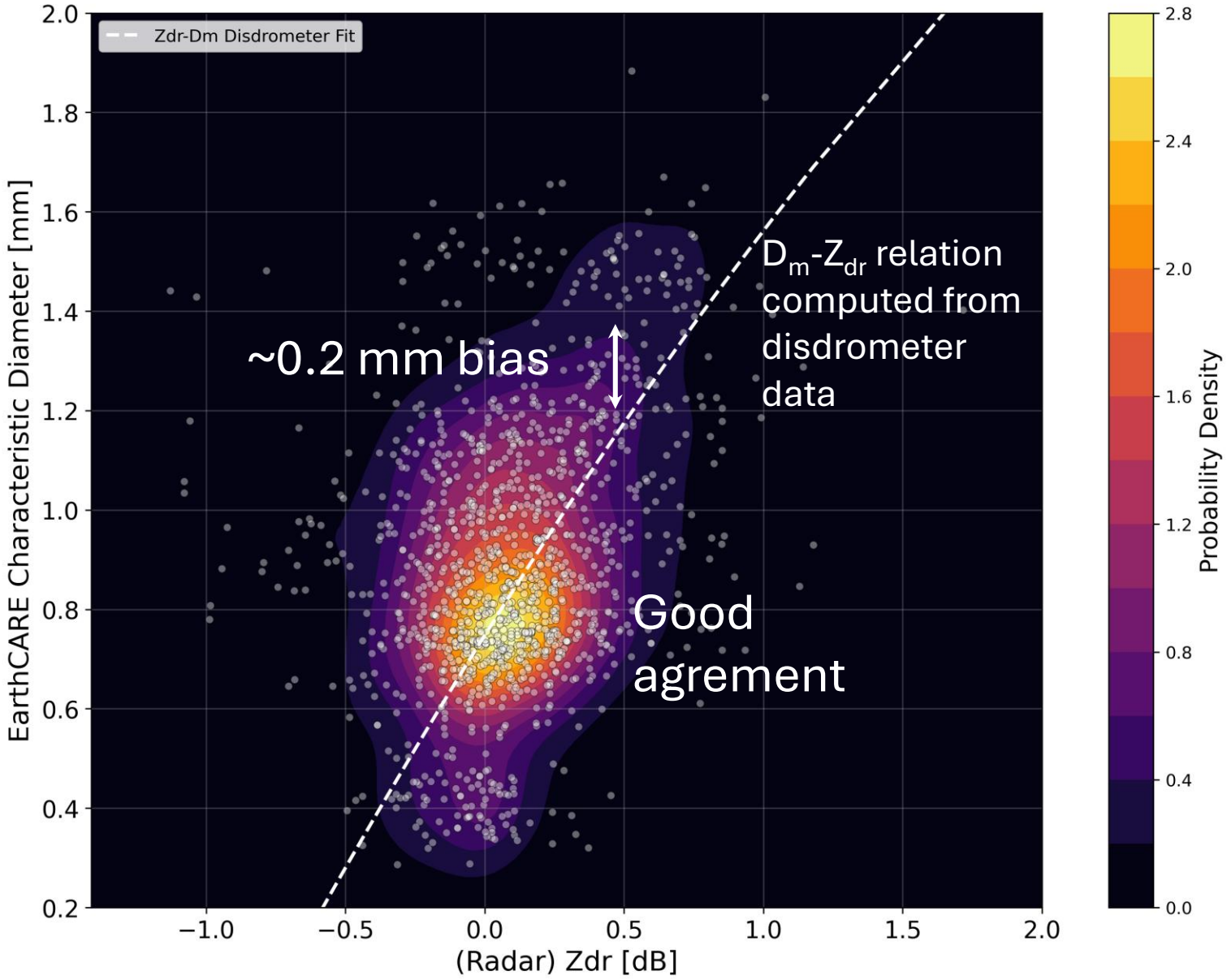
- Matching CPR and weather radar observations (Lvl 1 example)
- Weather radar observations are converted to reflectivity weighted rain sedimintation velocity
- Bias in velocity is detected, which is consistent with antenna pointing error

CPR Level 1 velocity

CPR Level 2 velocity



- After the antenna pointing correction in lvl2, velocity bias is reduced from -0.82 m/s to 0.1 m/s (CPR sedimentation velocity is larger)
- C-band radar velocity estimate is the blended product based on Z, Z_{dr} and K_{dp} observations



Validation of the characteristic diameter

- Differential reflectivity is linked to D_m
- There is a good agreement between C-band Z_{dr} and D_m for smaller D_m values
- For D_m > 1 mm, there seems to be a bias of about 0.2 mm, CPR overestimates D_m

Conclusions

- Matching of weather radar and CPR observations is performed
- Lvl1 and Lvl 2 cases from summers of 2024 and 2025 were analyzed
- Lvl1 velocity data exhibited orbit dependent bias in Doppler velocity observations
- Lvl2 velocity does not depend on orbit and residual bias is less than 0.1 m/s
- There is a good agreement between C-band Z_{dr} and D_m for smaller D_m values
- For D_m > 1 mm, there seems to be a bias of about 0.2 mm, CPR overestimates D_m

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