

Improved QPE for the Ahr flooding event using weather radar and CML data

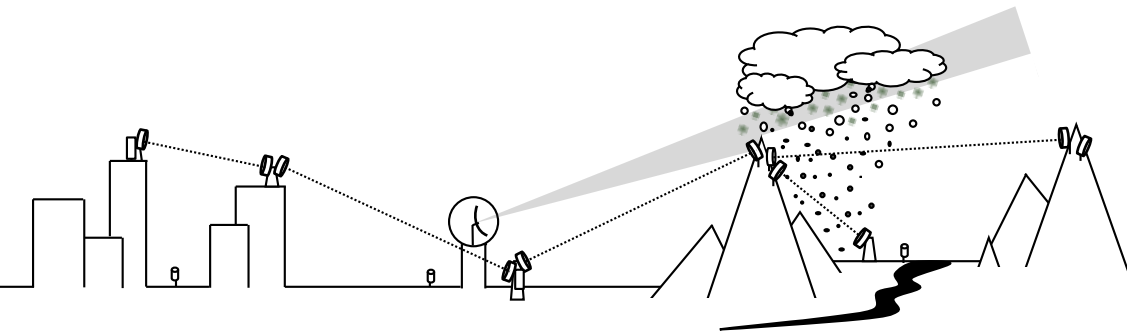
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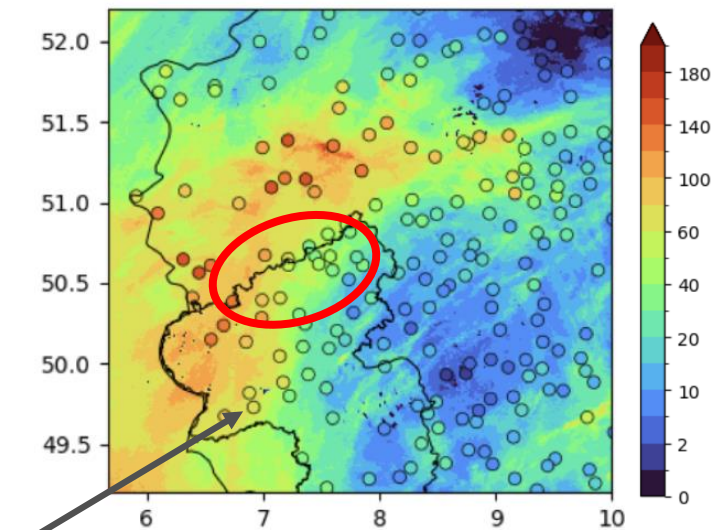
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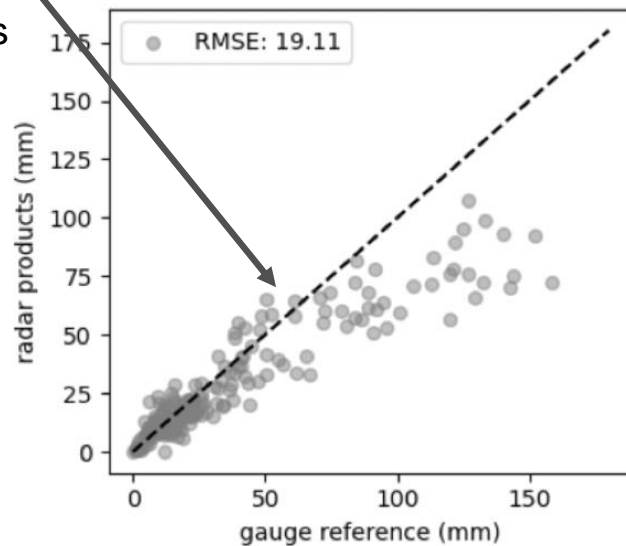
Motivation – flooding of Ahrtal, Germany in July 2021

unadjusted weather radar



three day rainfall sum
in western Germany

validation on
independent
daily rain gauges

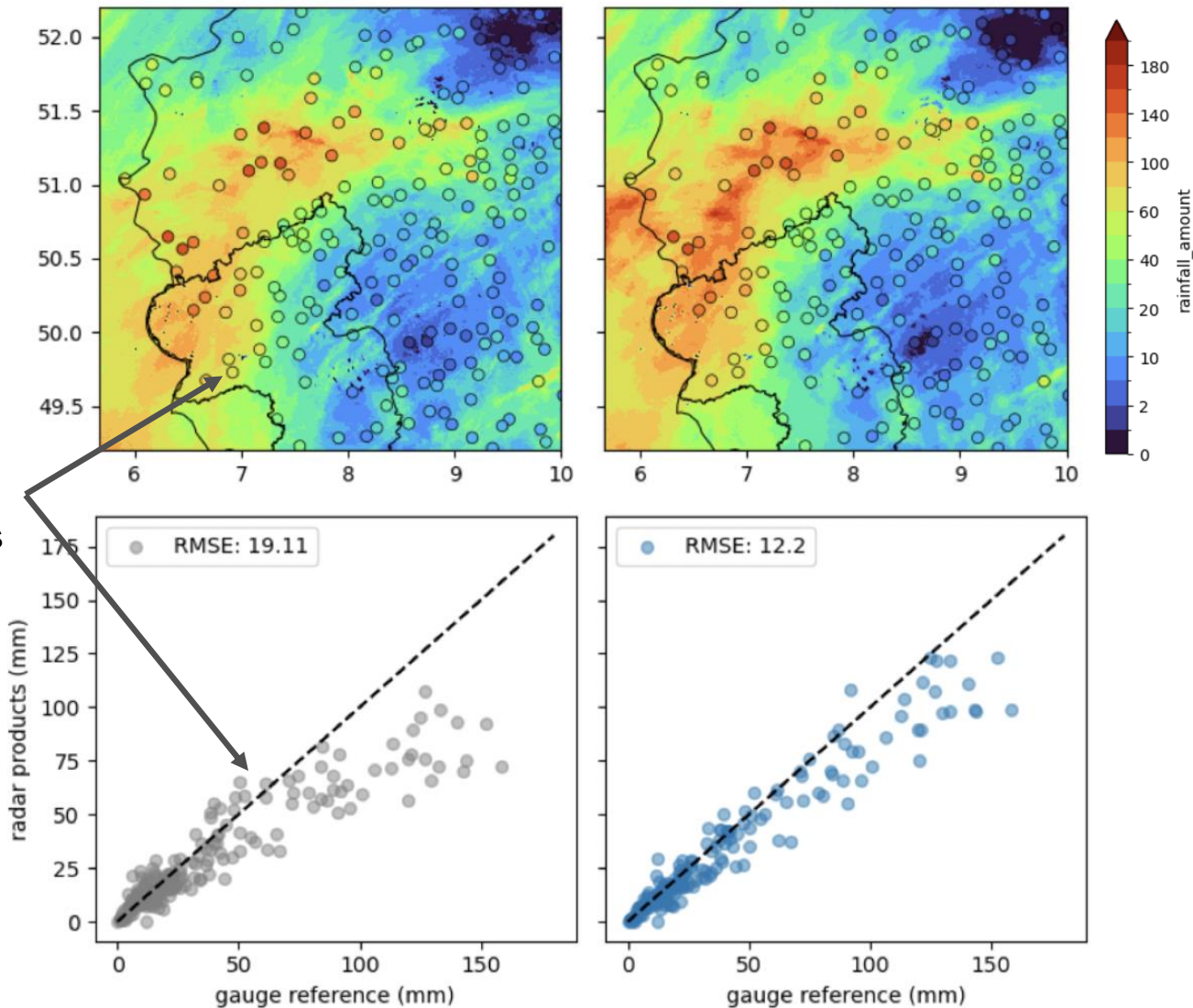


Massive flooding on 14 July 2021 in the Ahr valley caused fatalities and massive damage (faz.net)

Objectives

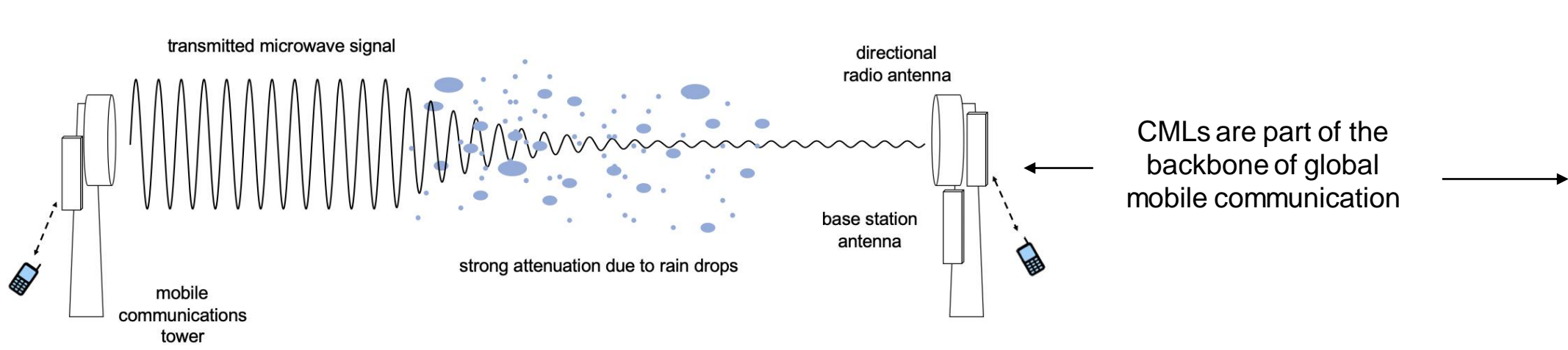
unadjusted weather radar

gauge-adjusted



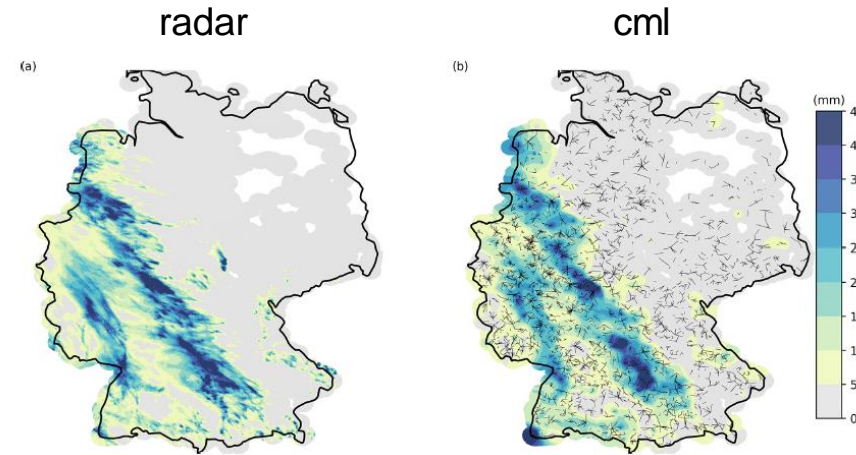
1. New rainfall sensors for adjustment
→ commercial microwave links
2. Enhanced radar products
→ polarimetry

Rainfall estimation with commercial microwave links (CML)



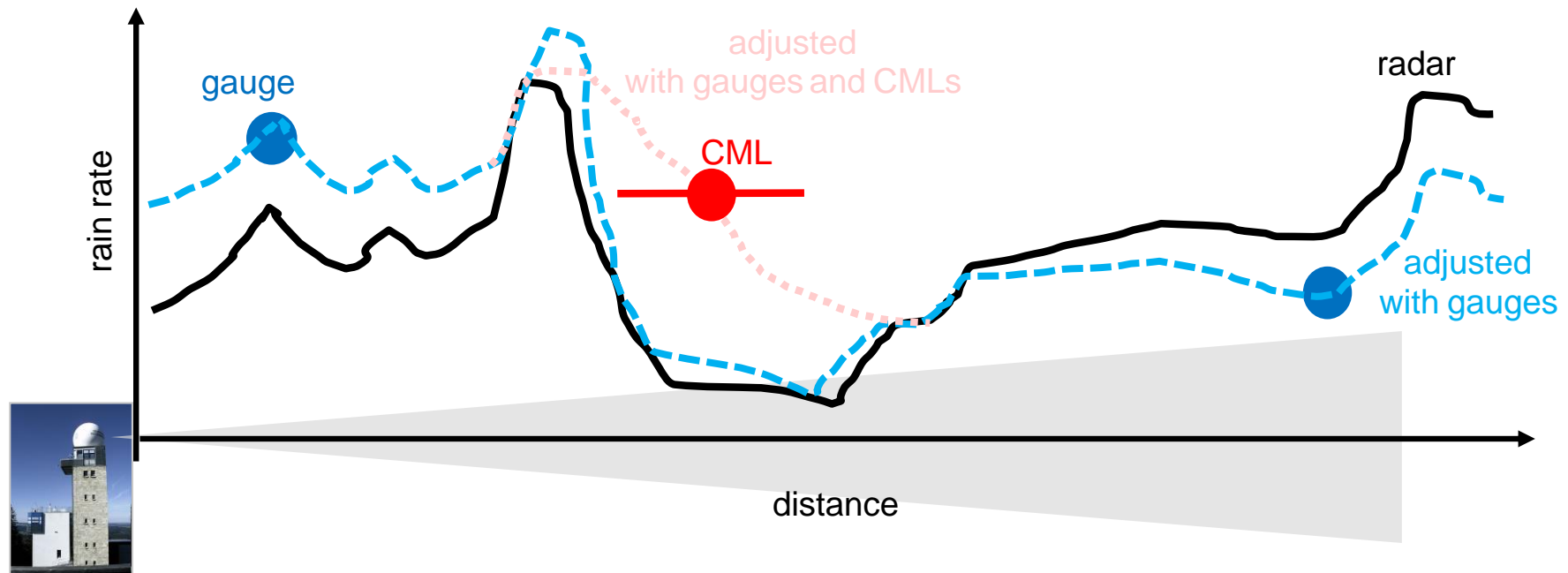
Motivation to use CMLs for radar adjustment

- good stand-alone performance
- beneficial $k-R$ -relation
- integral information
- large, „free“ measurement network
- real time availability

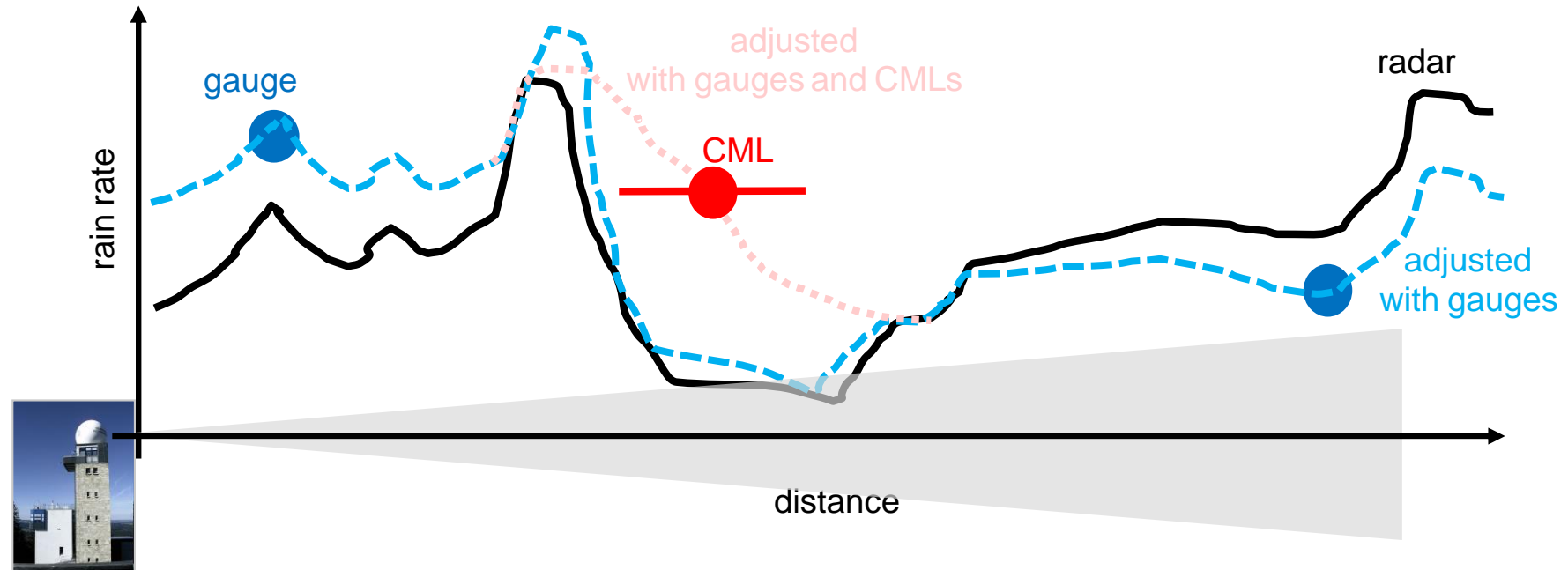


CML based rainfall maps
Graf et al. (2020), HESS
Blettner et al. (2022), WRR

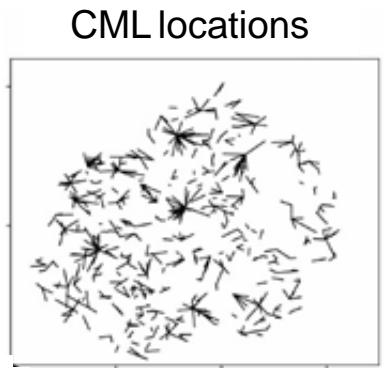
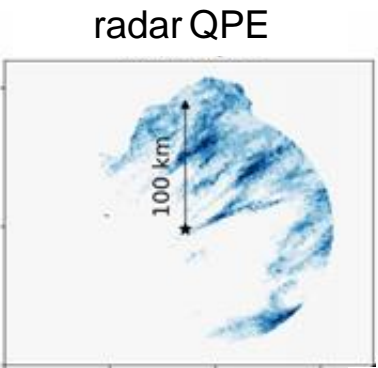
Radar adjustment



Radar adjustment



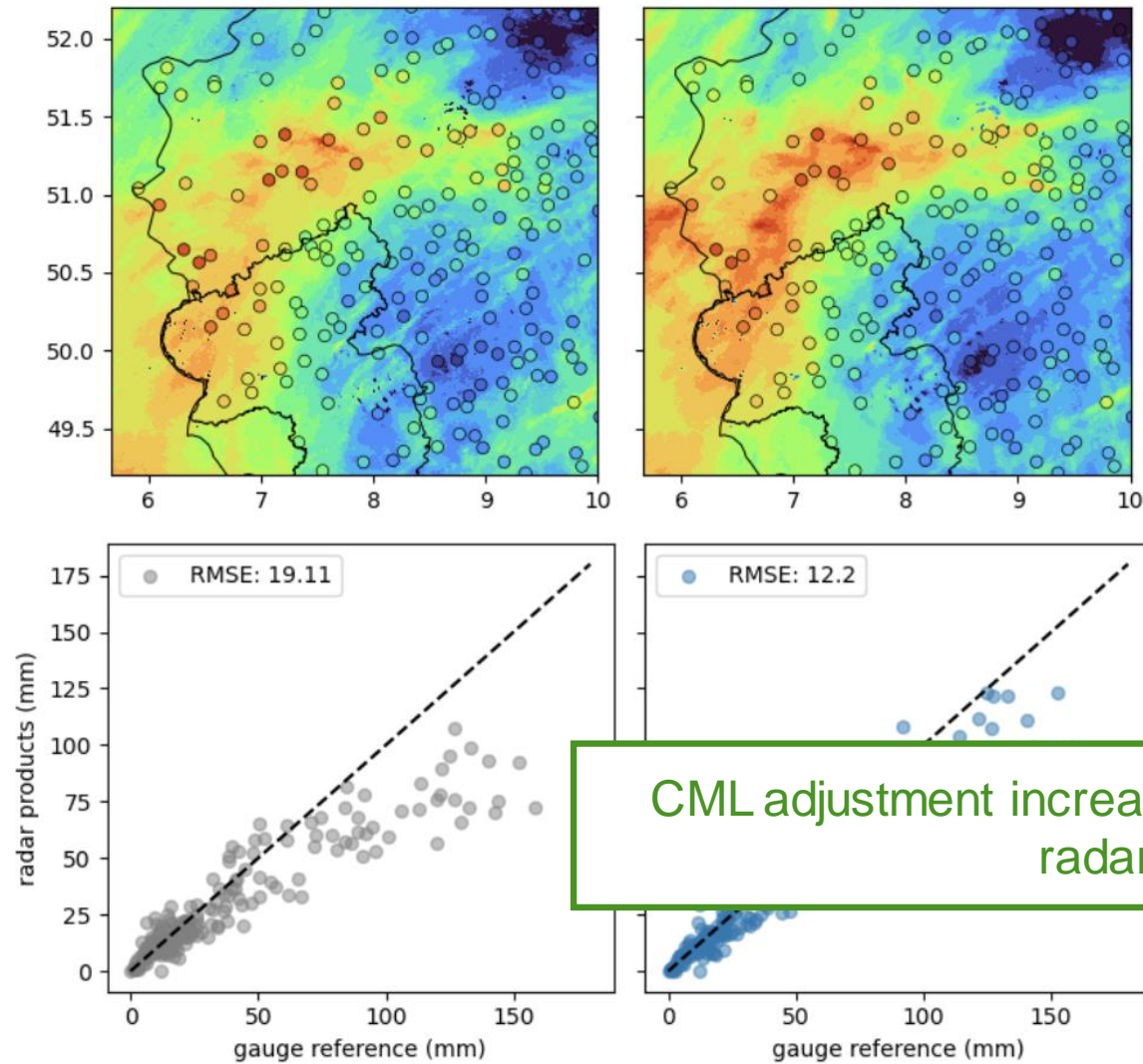
CML adjustment
in RADOLAN
(DWD)



Radar adjustment 13. – 15. July 2021

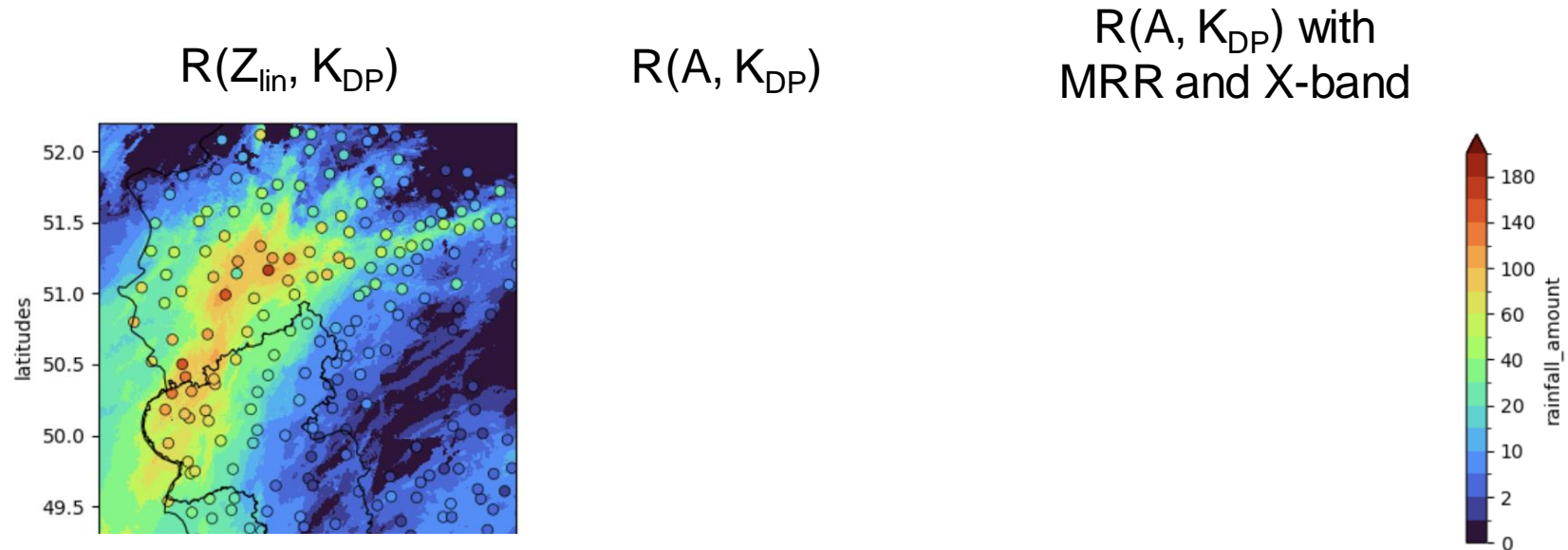
not adjusted

radar+gauge



CML adjustment increases the performance of the radar product

Polarimetric radar products for 14.07.2021



$R(Z_{lin}, K_{DP}) = R(Z_{lin})$ combined with $R(K_{DP})$ for $Z > 40$ dBZ

$R(A, K_{DP}) = R(A)$ combined with $R(K_{DP})$ for $Z > 40$ dBZ

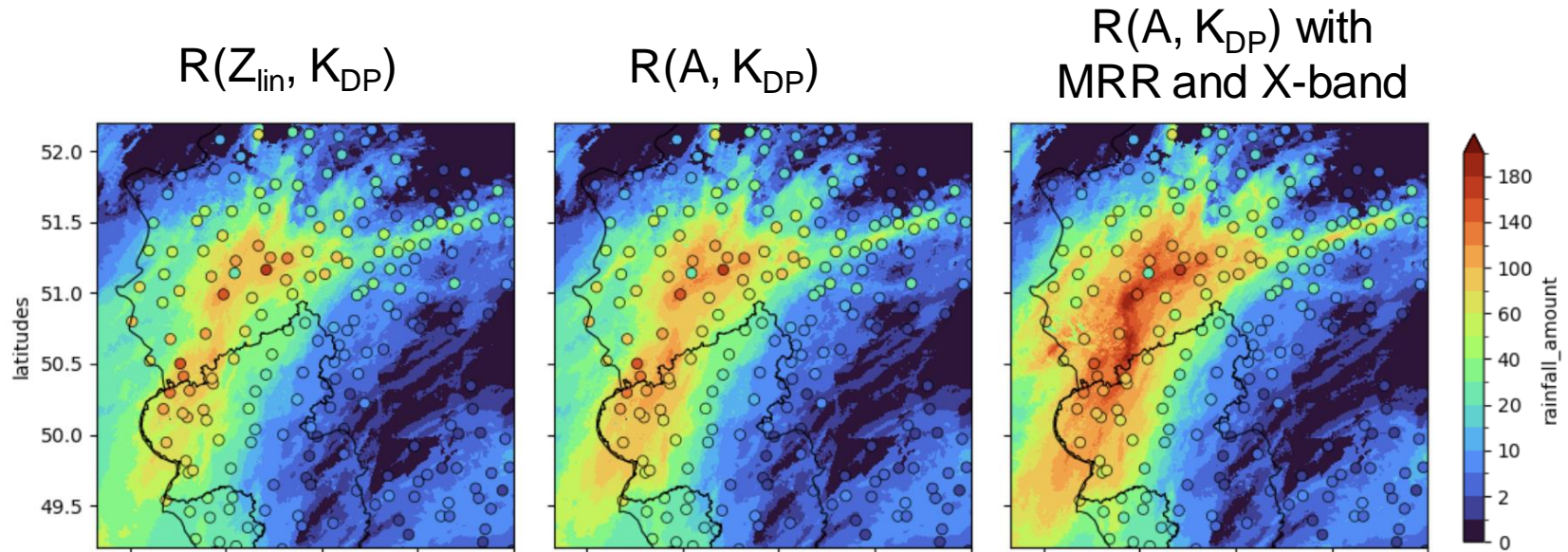
$R(A, K_{DP})$ with

- MRR (vertical profile correction of Z and K_{DP})
- gap filling with X-band radar observations

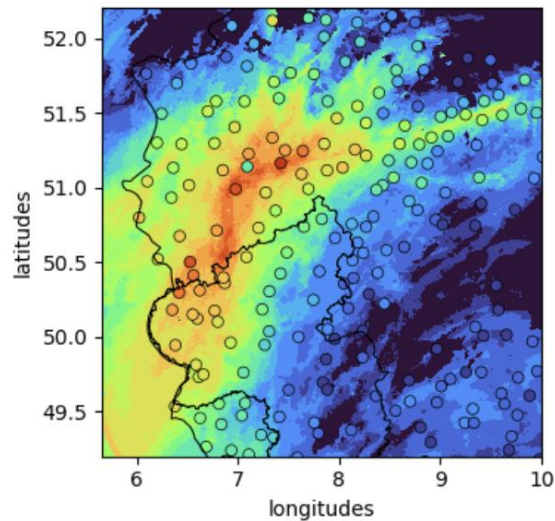
Chen et al. (2023), JHM

Polarimetric radar products with CML adjustment (14.07.2021)

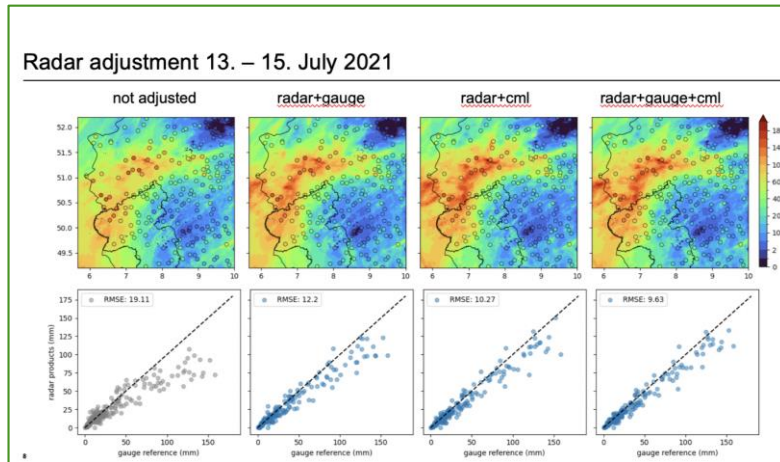
not adjusted



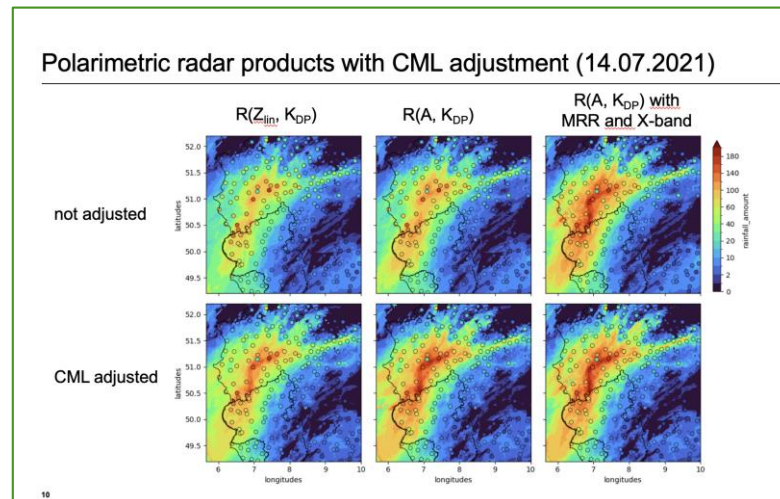
CML adjusted



Conclusion



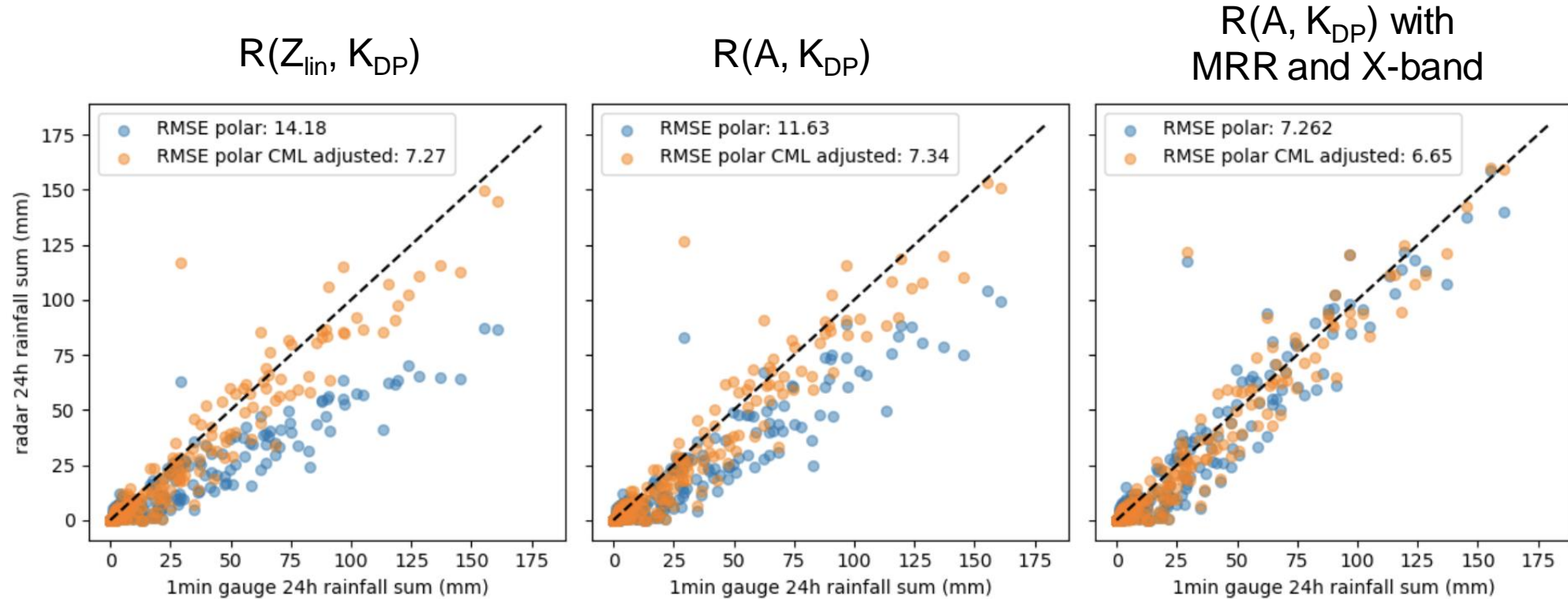
- **benefit of CMLs for radar adjustment**
- reduction of the error
- potential for more flexible adjustment



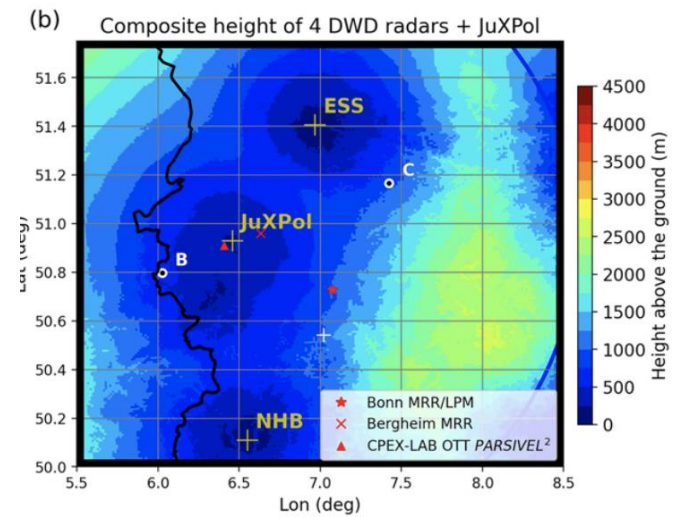
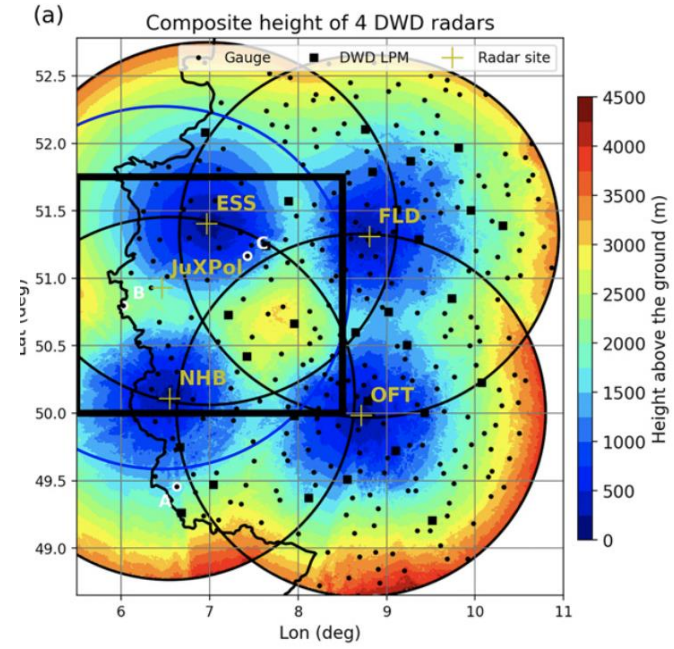
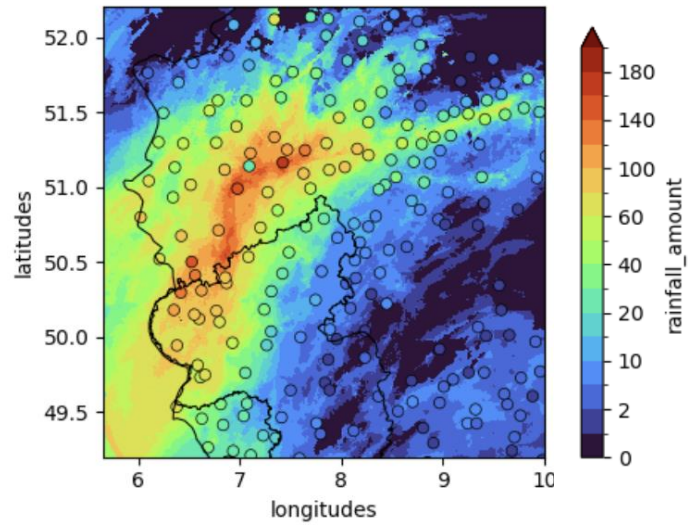
- **benefit of polarimetric radar products**
- not all methods can be applied operationally
- highly sophisticated products benefit little from additional adjustment

Backup

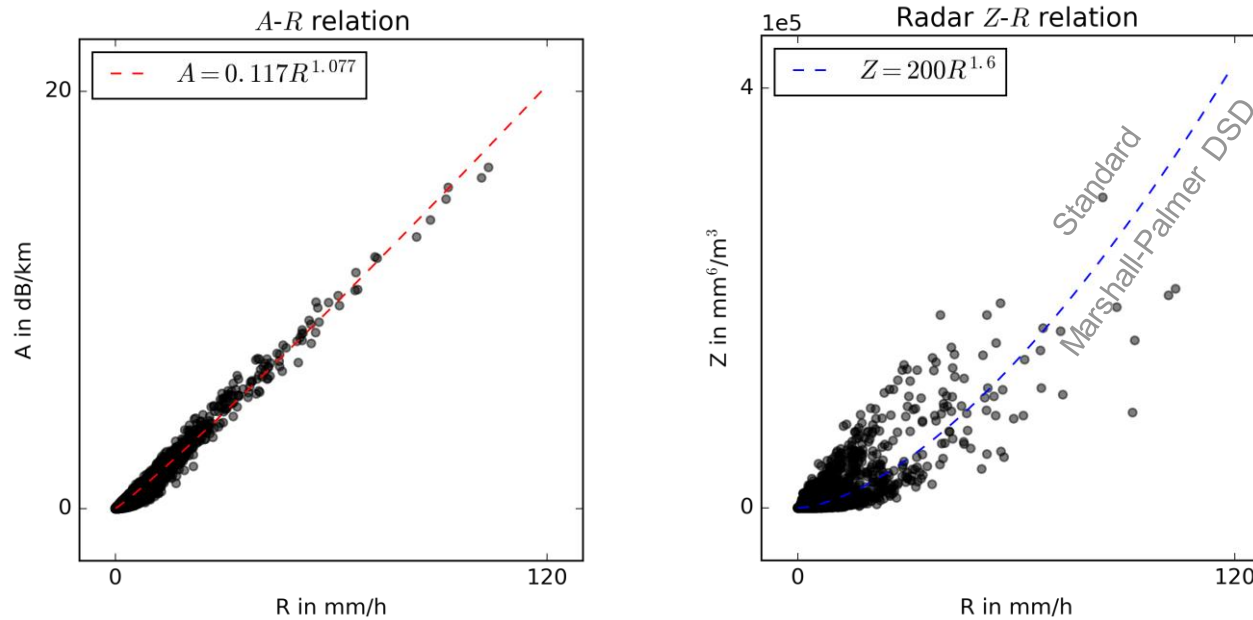
Polarimetric products (with and without CML adjustment)



Device locations polarimetry



A-R relation



[mm/h]

↓

A-R power law: $A = aR^b$

↑

[dB/km]

pyRADOLAN

pyRADMAN

