COMPARISON OF HOMOGENEOUS AND VARIABLE ELEVATION SCANS ON THE UNCERTAINTY OF THE QUANTITATIVE PRECIPITATION ESTIMATION

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For the hydrological use of radar data, a reliable quantitative precipitation estimation at the ground level is necessary.
In Germany different radar scans with a high spatial resolution (1° x 250 m) exist. The orography following precipitation scan is the most common used data source for quantitative precipitation estimation. The second data source is the volume scan with static elevation settings. This case study aims to investigate the influence of both scan products on the quality of adjusted radar data.

Data set

For this case study data from the German Weather Service radar located in Essen (North Rhine-Westphalia) and rain gauge data over a period of 1 year (01 Nov. 2021 – 01 Nov. 2022) were used.

- **Precipitation scan (PCP):** spatial resolution 1° x 250 m; variable elevation angle 0.78° - 1.26°; range 150 km
- **Volume scan (VOL):** spatial resolution 1° x 250 m; constant elevation angle 0.50°; range 180 km
- **Rain gauge time series** from 850 locations

Main differences of VOL (lowest elevation) to PCP are on the one hand:

- a significantly higher amount of clutter pixel
- areas with partial beam blockage

and on the other hand:

- the lower measuring height
- homogeneous elevation
- higher range

Data preparation

A careful preparation of both radar data sets (Figure 1 and 2) as well as the rain gauge data set is essential:

- **Quality enhancement of raingauge data**
  - data check with data of neighbouring stations and corresponding radar time series
- **Quality enhancement of single radar data by data quality control algorithms**
  - ground clutter / beam blockage / attenuation / anomalous propagation / advection correction

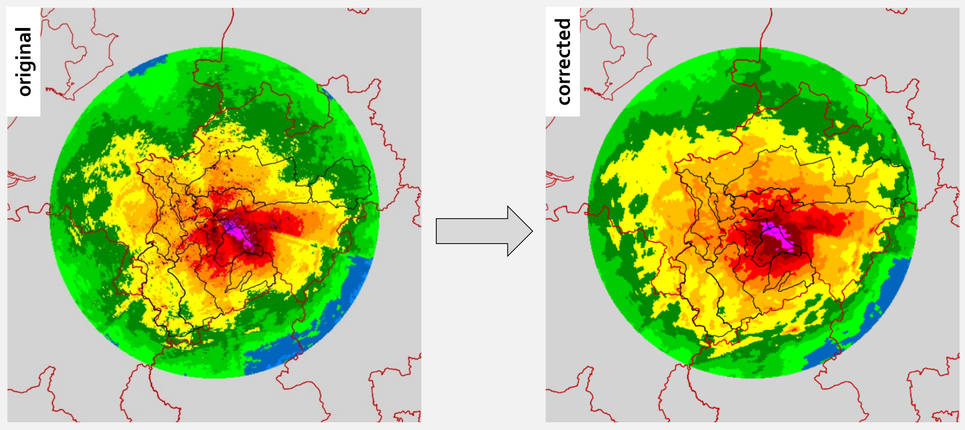

Figure 1: unadjusted radar sum of the precipitation scan

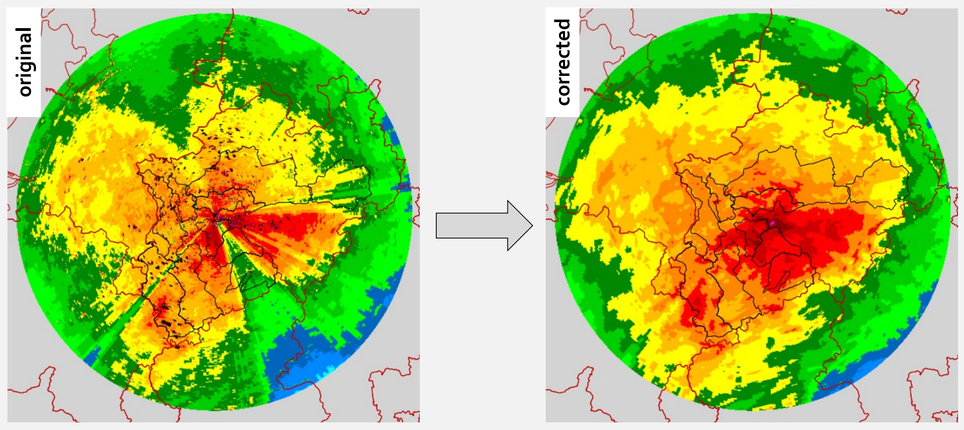

Figure 2: unadjusted radar sum of the volume scan (lo.5°)

- **Adjustment procedure**
  - daily factor field + daily difference field (for smaller values)

Results

A comparison between rain gauge data and the corresponding radar pixel took place at approx. 170 validation stations.
Main criteria for the evaluation are the daily/ yearly precipitation sum and the factor between rain gauge and adjusted radar.

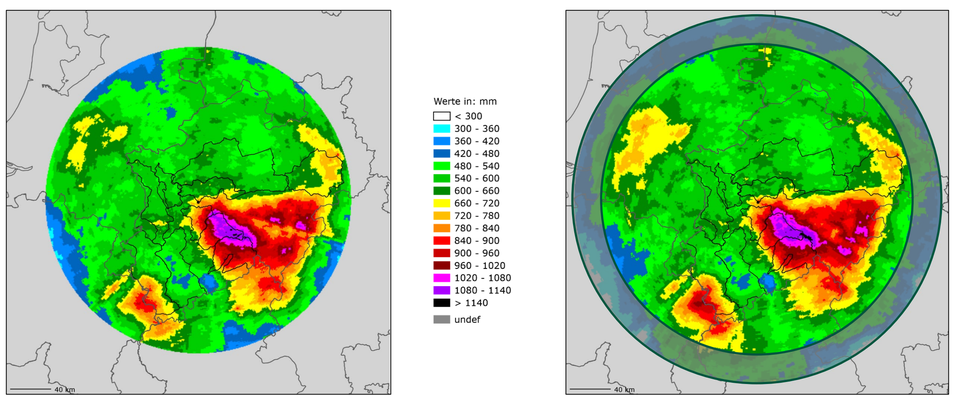

Figure 3: adjusted radar sum - PCP(left) – VOL 0.5° (right)

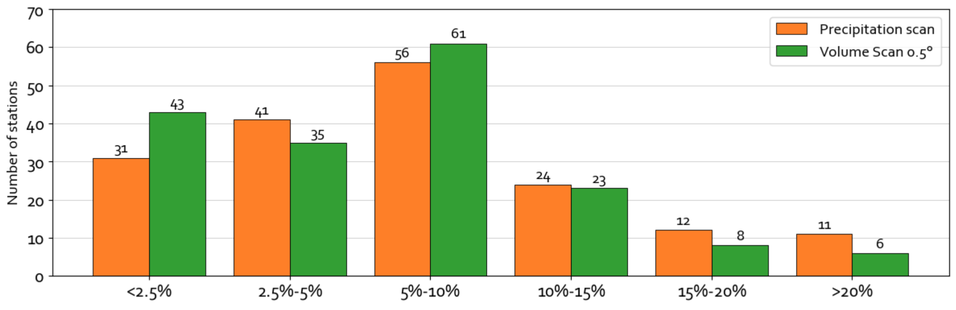

Figure 4: number of validation stations with differences in % between rain gauge - radar

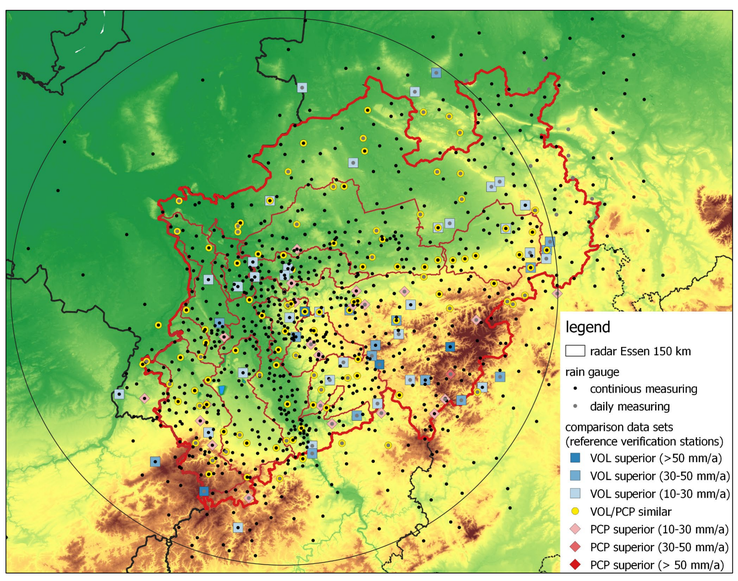

Figure 5: Comparison PCP vs. VOL (0.5°) at validation stations

validation	radar adjusted	rain gauge	factor	difference rain gauge - radar > 10 mm	5 - 10 mm	3 - 5 mm
	[mm]	[mm]	[-]	[-]	[-]	[-]
precipitation scan	105984	107982	1.019	66	434	1009
volume scan (0,5°)	107119	108102	1.009	51	366	897

Table 1: Results of the evaluation

Conclusions

- similar uncertainty in areas of partial beam blockage and ground clutter by using the volume scan
- high uncertainties of the precipitation scan in sectors with frequently changing radar elevation and areas with high distance to the radar location
- better consistency between adjusted radar and rain gauge data by using the lowest elevation of the volume scan

References: Jessen, M., Einfalt, T.; Frerk, I.; Improvement of the adjustment procedure on a long-term radar data set // ERAD Proceedings. - Ede-Wageningen: ERAD, 2018

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