Effect of spatially distributed radar-gauge rainfall products on simulated urban flows

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Urban hydrology and radars

- Urban hydrological studies require a **fine temporal and spatial resolution.**
- **Dense rainfall** gauge (RG) networks are **rarely available.**

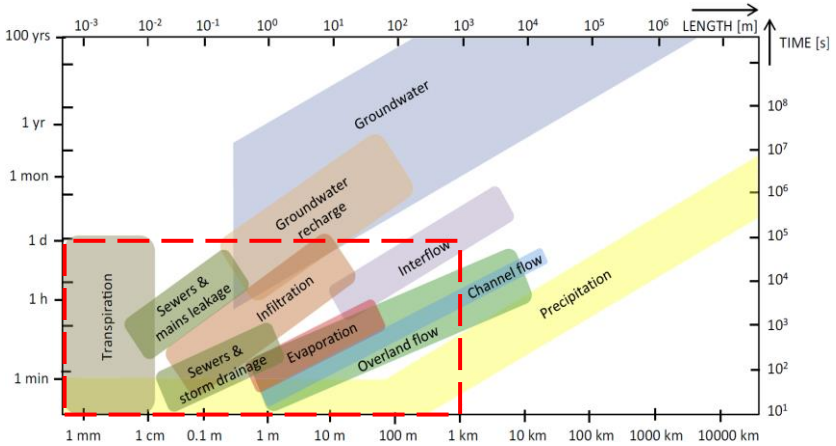


Fig. 1: Spatial and temporal scales of hydrological processes in urban areas

Source: from (Salvadore et al., 2015)

- **Weather radars** provide **high spatial and temporal** resolution, **RG high accuracy** for a (small) area**.**
- **Several merging radar-gauge methods** in the literature, **mainly validated with rain gauges** few with flow simulation (Ochoa-Rodriguez et al., 2019).

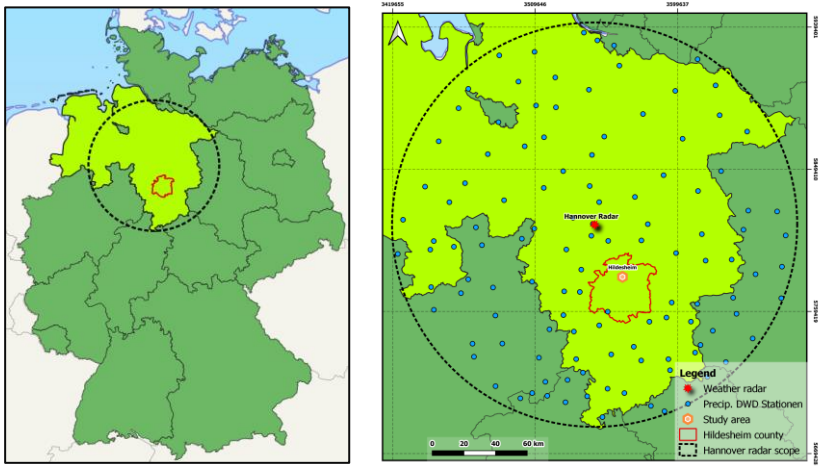


Fig. 2: Low rain gauge density in Hildesheim, Lower Saxony, Germany

Study area

- Area of 133 ha **without operational structures**
- Two monitoring sites for the period **February 2021 until October 2021** (each **1-5 min**).
- Twenty-two **(22) events** with duration ranging 2-14-hours
- **Calibration/Validation** -> **7/22 events**

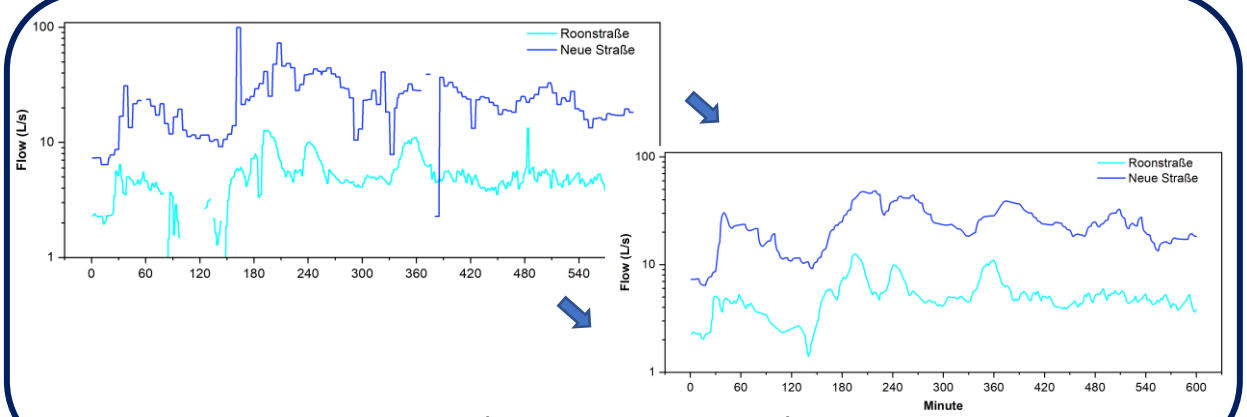


Fig. 4: Measurement corrections

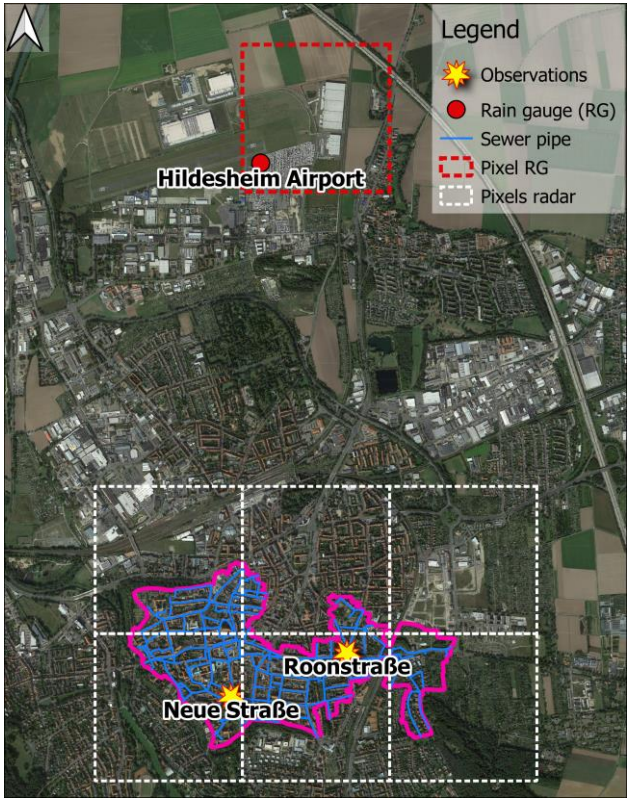


Fig. 3: Monitoring sites in the Study area

Methods

Radar processing

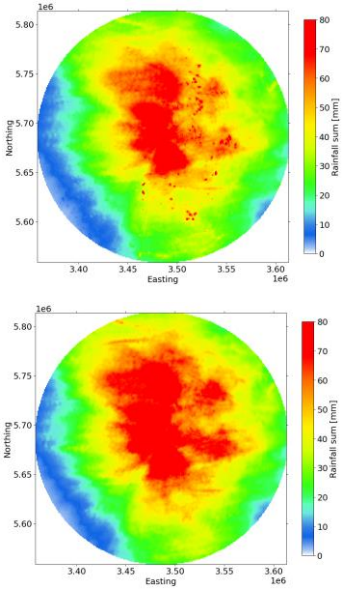


Fig. 5: Radar processing FLD Radar (2021-03)

Temporal and Spatial Smoothing (TSS)

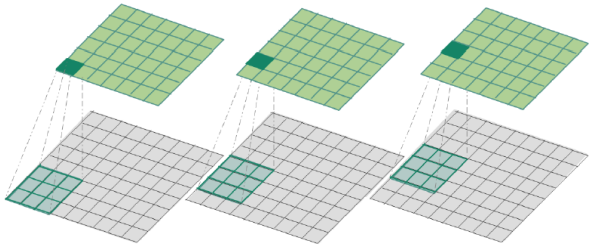


Figure 6. Spatial smoothing with a 3x3 kernel size
Source: (Shehu, 2021)

1

Conditional Merging (CM)

(Ehret, 2003)

2

Kriging with external drift (KED)

3

QM Bias Correction (FB)

(Rabiei and Haberlandt, 2015)

KED hourly basis

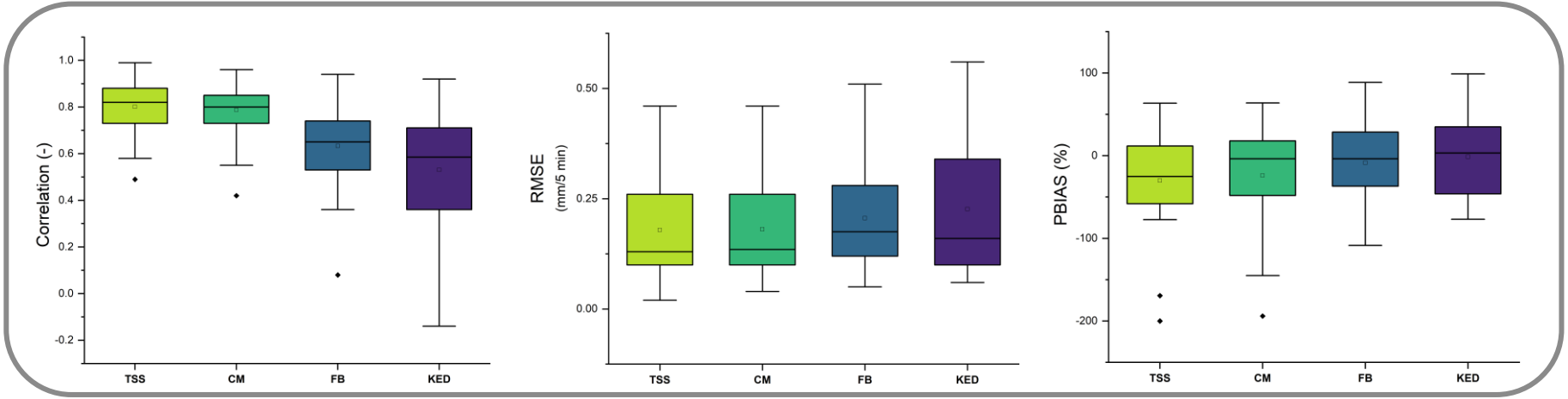
Disaggregation to 5'

(Rabiei and Haberlandt, 2015)

4

Rainfall performance

- **TSS** is the best for capturing the **event occurrence but not their magnitude**
- **Merging methods** performance could be **limited** due to the **low density of rain gauges**

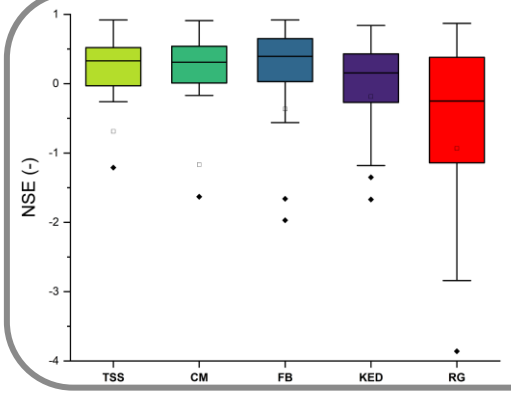


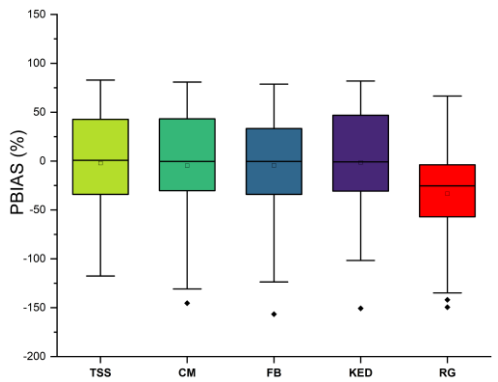
TSS: Temporal and spatial smoothing, **CM**: Cond. Merging, **FB**: Field Bias, **KED**: Kriging with External Drift

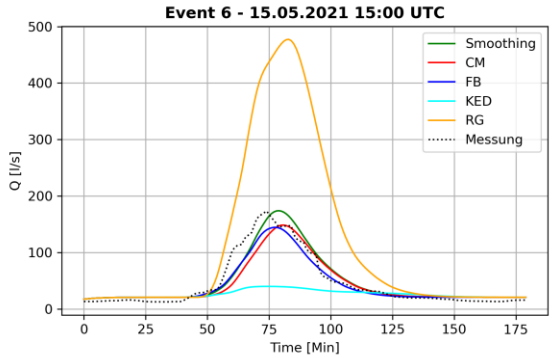
Results

Flow performance

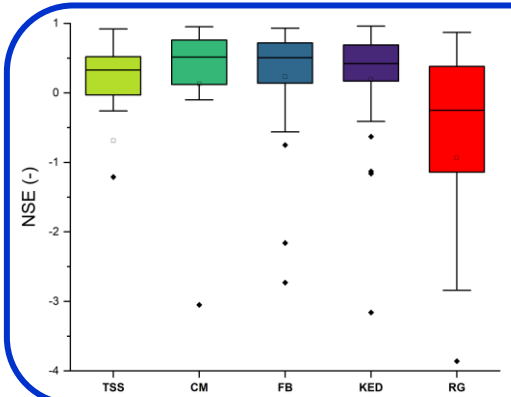
Without RG

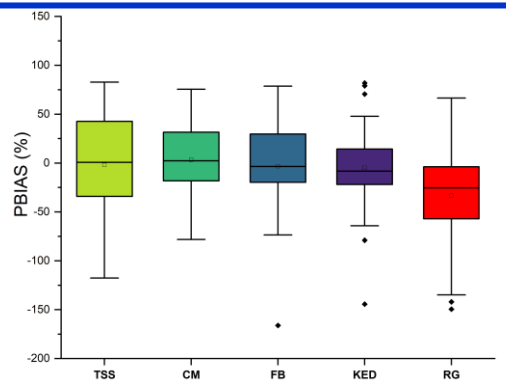


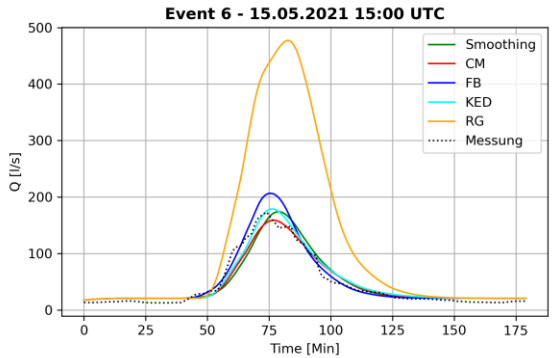




With RG







Conclusions and outlook

- **Merging methods** and **flow simulations** are **strongly affected** by the **density of rain gauges (KED is the most influenced, CM is more robust)**.
- **Only the smoothed** radar data delivered **better simulation** results **than one gauge** station in the vicinity**.**
- **The inclusion of the RG** in interpolation improved considerably the merging results, which might **require adjustments in the model parameterization (new calibration).**

Thanks

Thank you for your time and interest!

This work was possible thanks to:

DAAD

Leibniz Universität Hannover

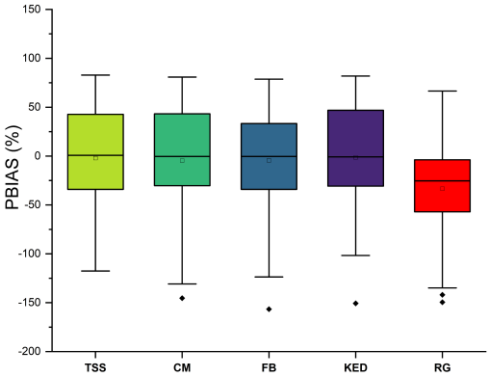
SEHi Alles klar!

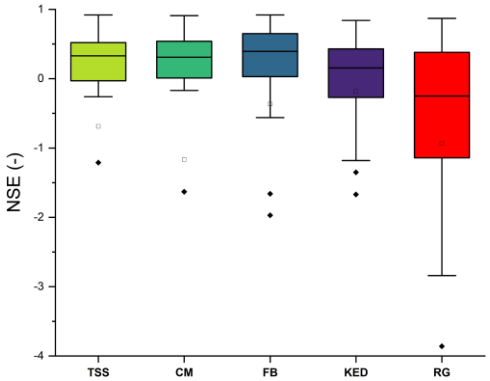
DWD Deutscher Wetterdienst

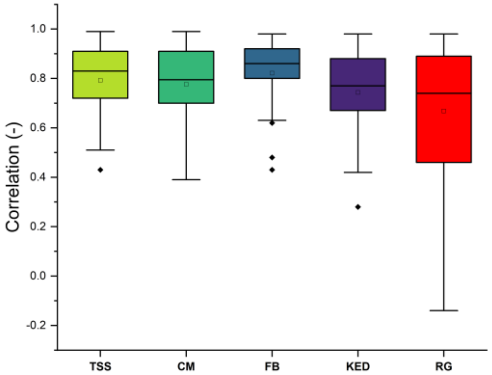
NLWKN

Results

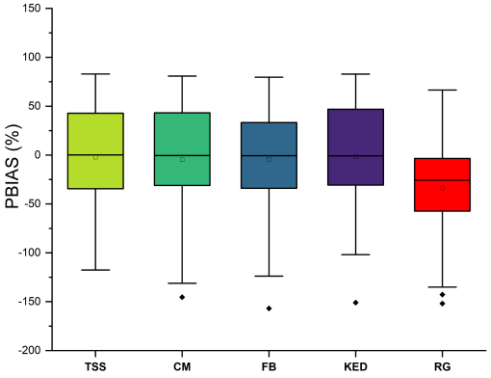
Not shifted, without RG at Airport

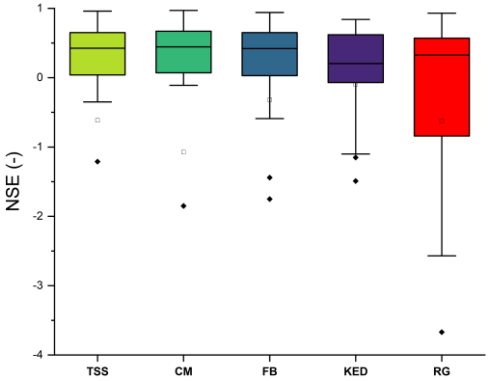


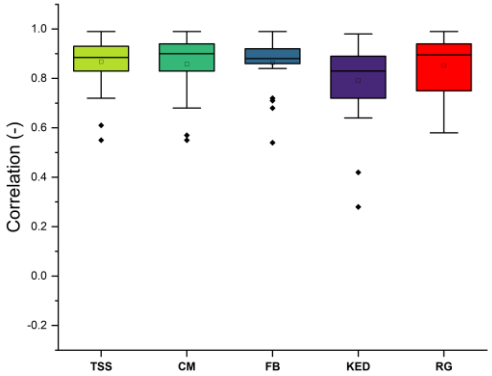




Shifted, without RG at Airport







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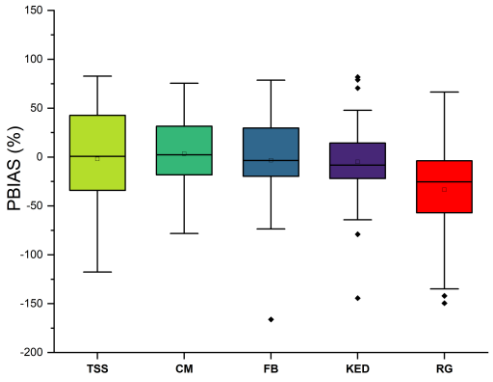
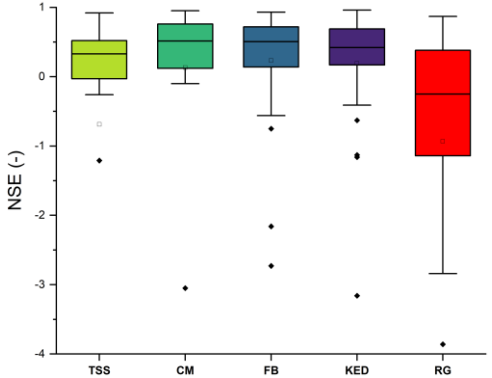
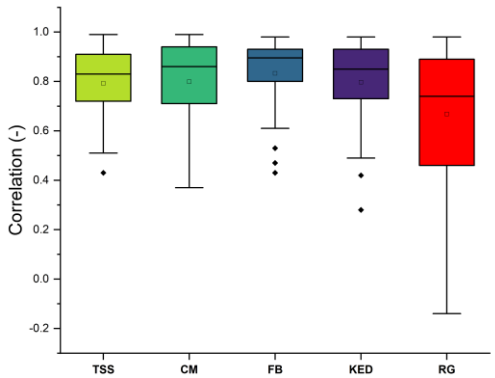
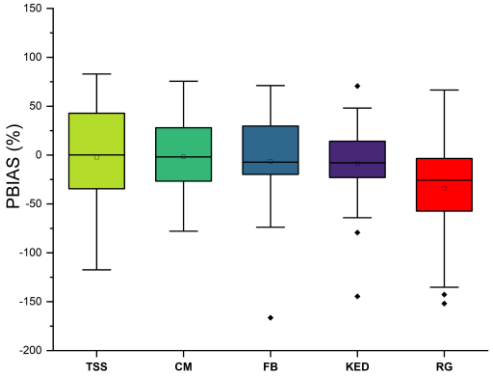
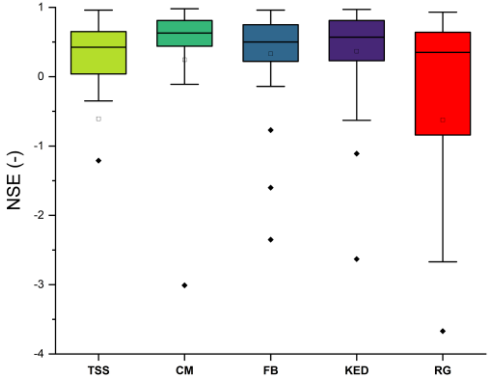


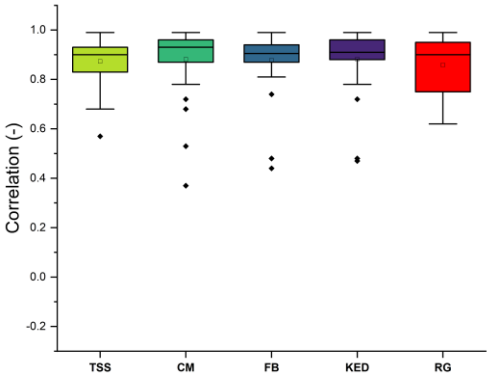




Shifted, without RG at Airport







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