

# A First Look at Commercial Microwave Link Data for Summer and Winter Precipitation Cases in Belgium



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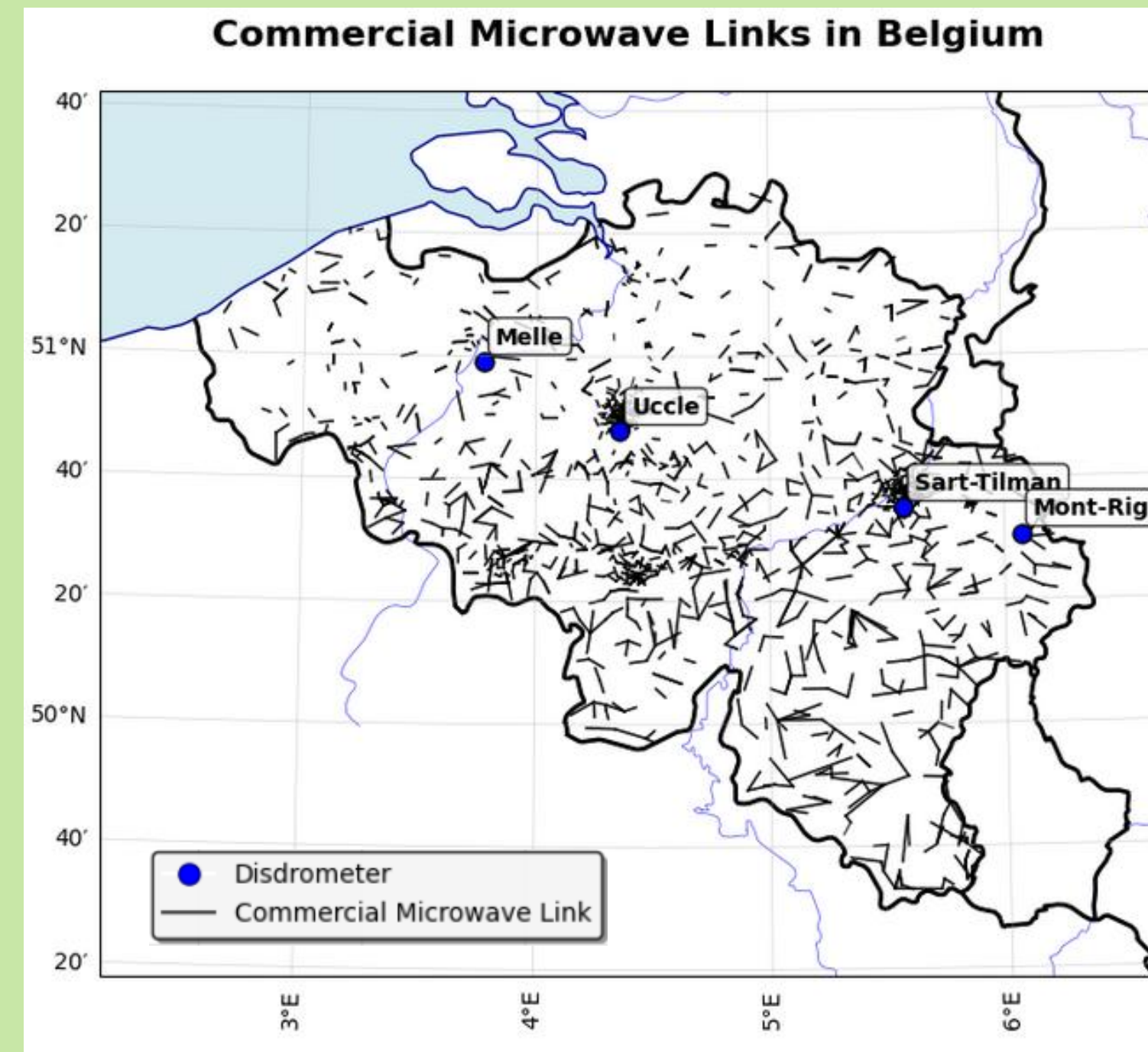
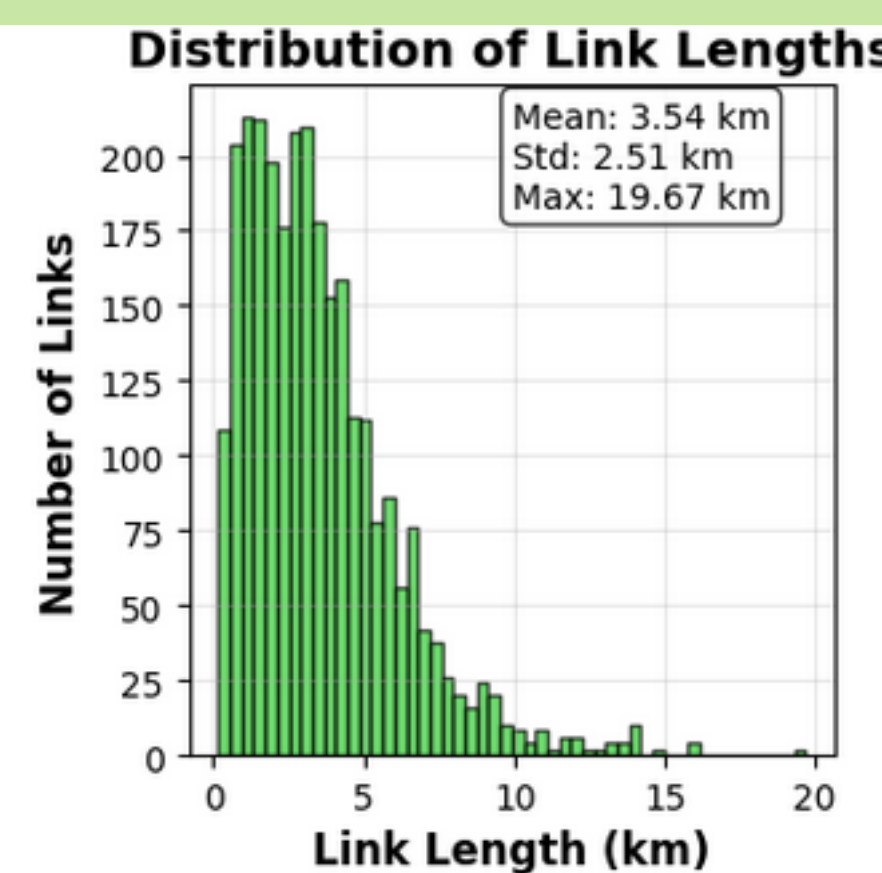
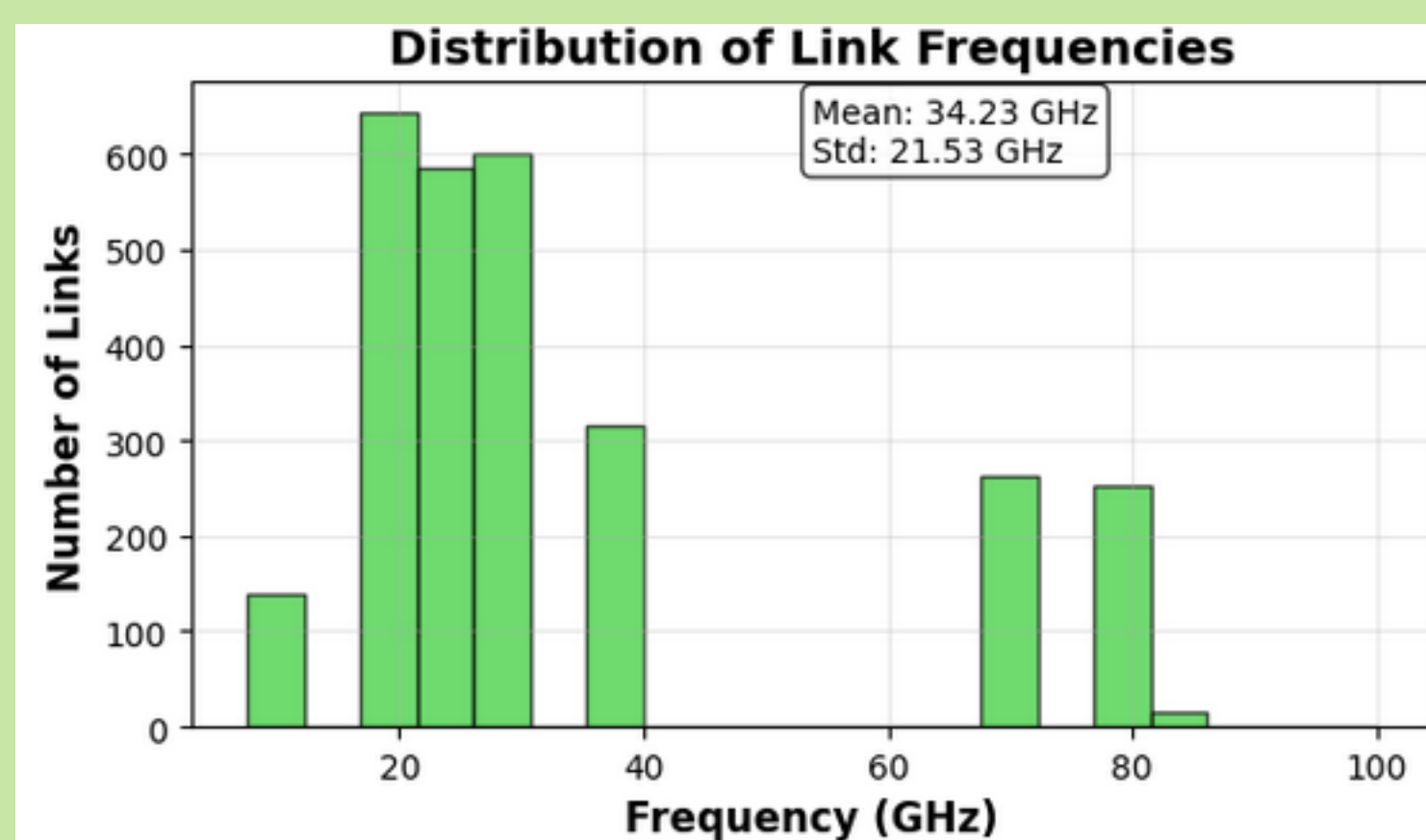


## Introduction:

- No research has been done on CML-derived rainfall estimates in Belgium so far, yet a dense network exists, particularly in the hilly South of the country and in a few major cities (Brussels, Charleroi, Liège).
- First dataset (~3000 links) obtained for 4 Summer cases and 4 Winter cases from Telenet NV.

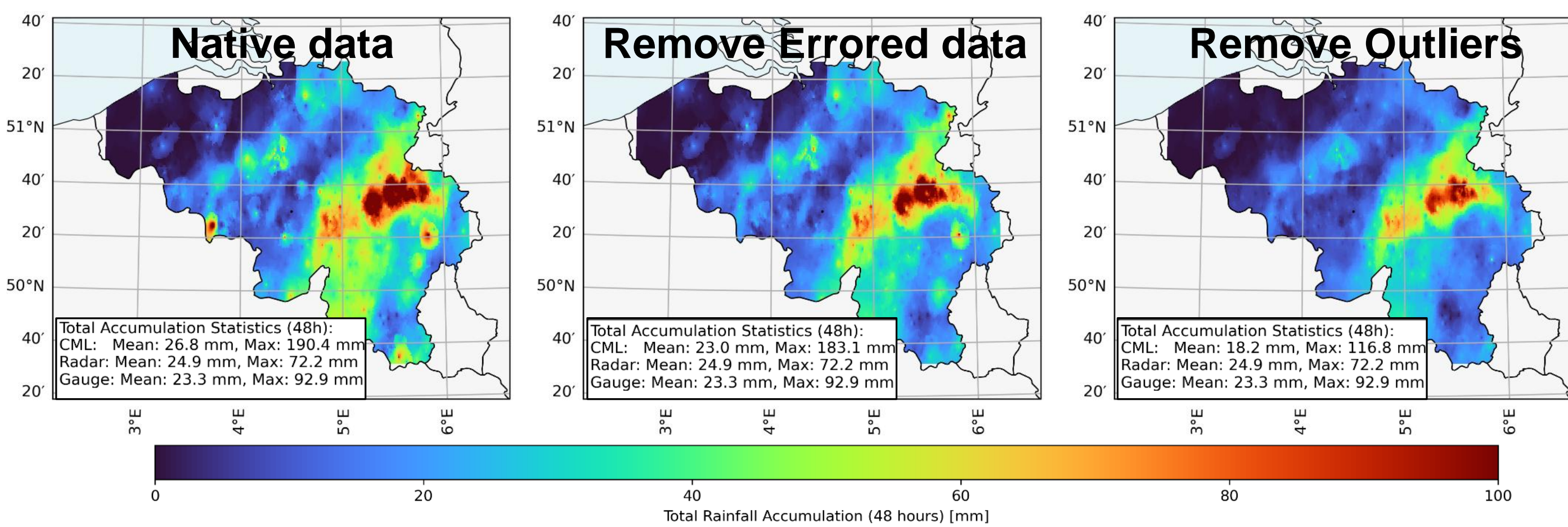
## Goal:

- Assess potential for improving quantitative precipitation estimates.
- Assess potential for identification of precipitation type near the surface (cfr. Øydvin et al. 2024).
- Gain experience for research in tropical Africa.



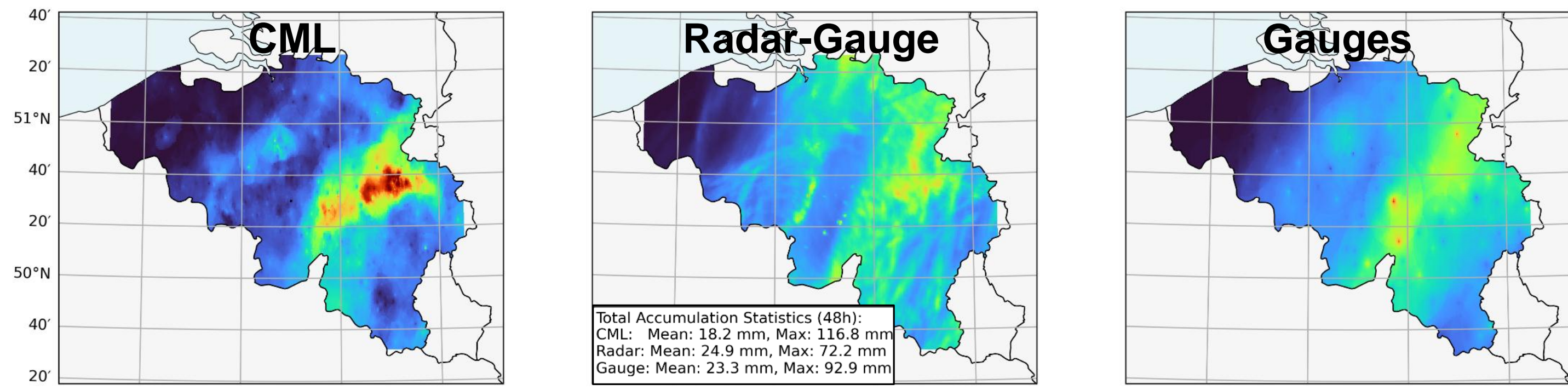
## Quantitative Precipitation Estimation and Evaluation

### Impact of error filtering strategies (22 June 2023)

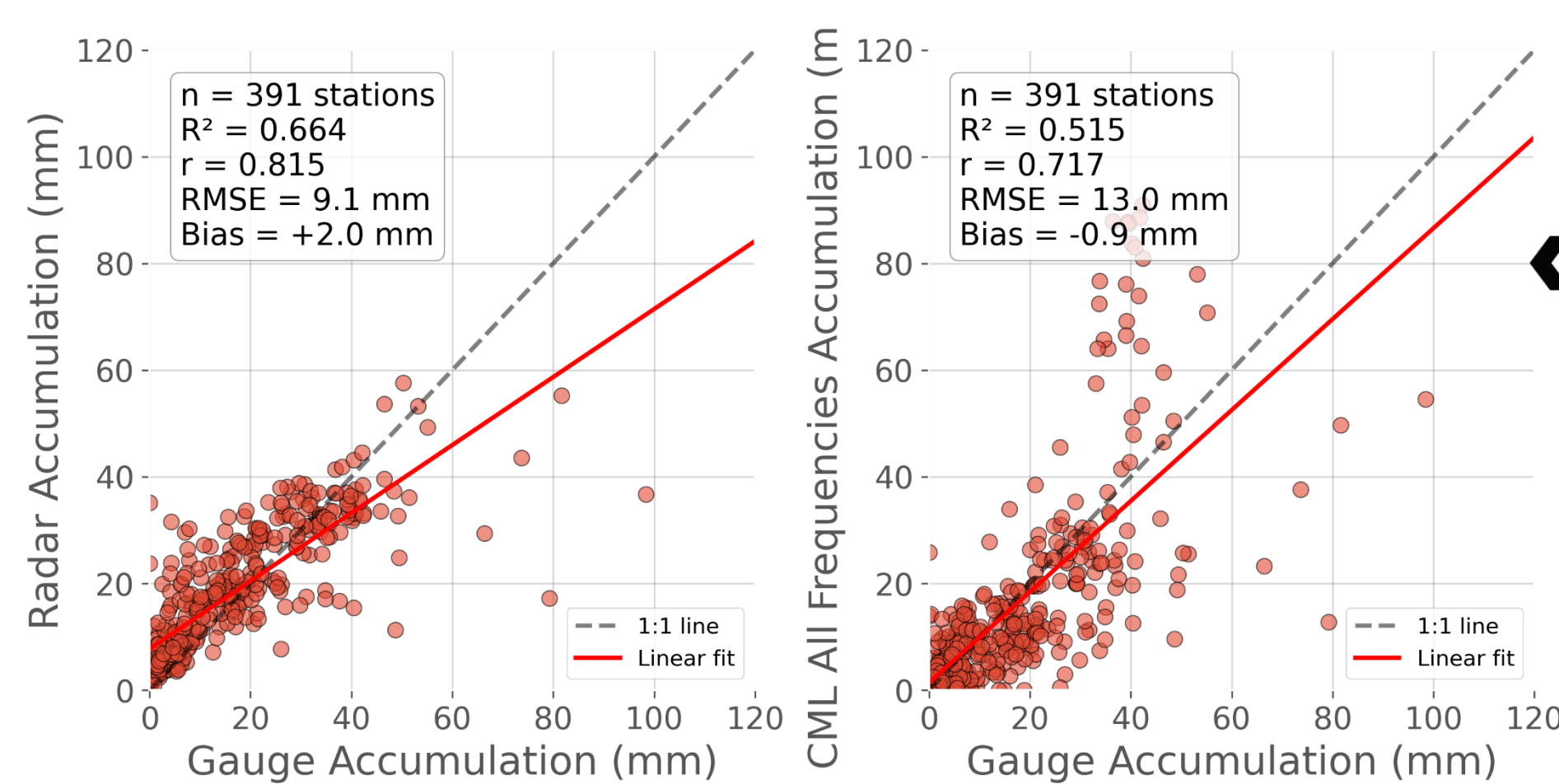


The use of errored seconds in the performance data is helpful as additional quality flag (Neutens 2024), but outlier removal is still necessary (outliers from surrounding independent (not sharing a site) cmls removed at 15 minute resolution).

### Comparison against existing rainfall products (22 June 2023)

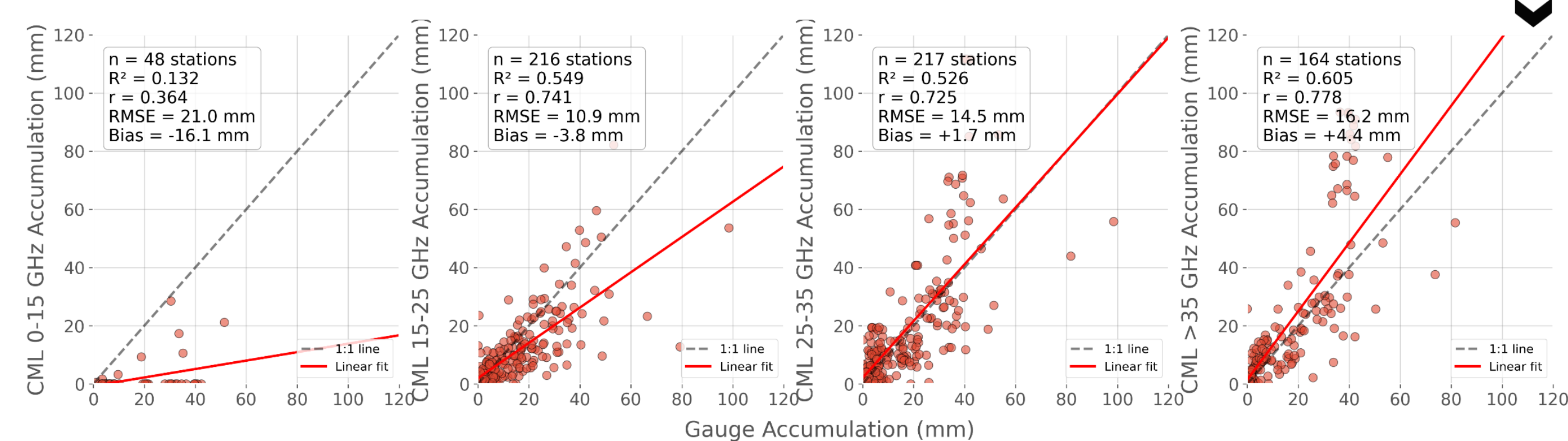


General patterns and quantities fairly well captured (similar results for other 4 cases), using default settings from Pycomlink (using ITU k-R relation; Chwala et al. 2021).



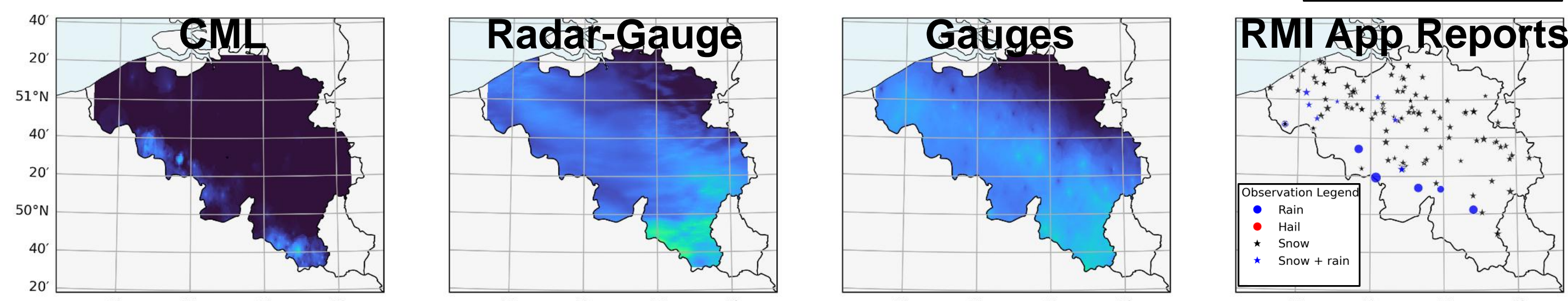
Performance of accumulated CML-rainfall (4 cases combined) is slightly worse for most metrics than adjusted radar, although bias is slightly better.

Strong frequency dependence of bias (higher frequencies tend to overestimate more).

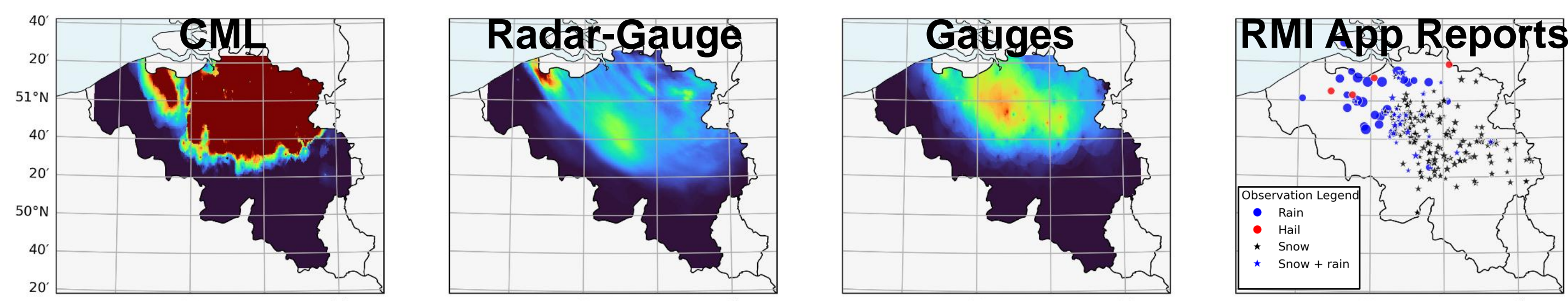


## Potential for Winter Precipitation Type Detection

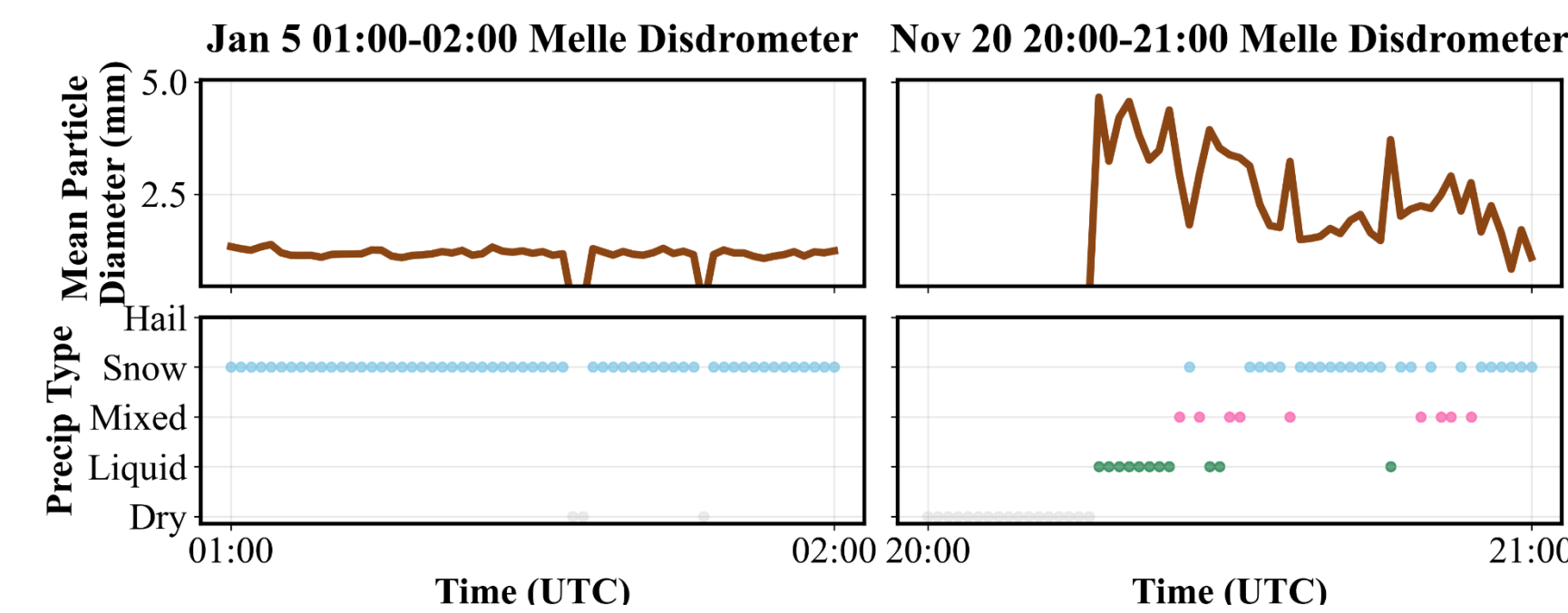
### Dry snow event (05 January 2025 02:00 UTC):



### Wet snow event (20 November 2024 21:00 UTC):



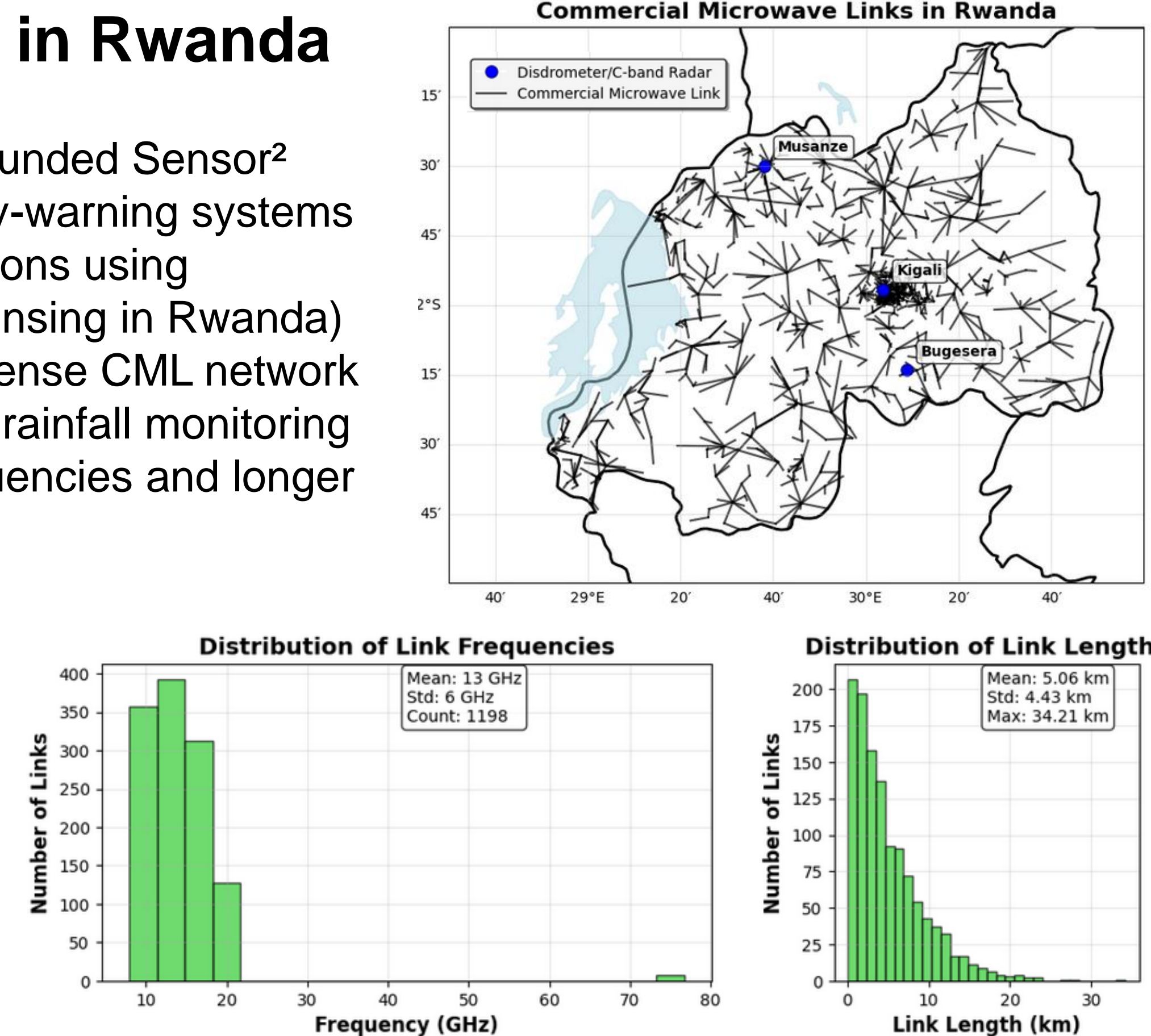
Four snow/mixed precipitation events elucidate applicability of precipitation type discrimination (Øydvin et al. 2024). Strong dependence of CML signal loss on precip type and size (RMI App reports and disdrometer Melle).



## Research Plans in Rwanda

The recently VLIRUOS funded Sensor<sup>2</sup> project (Supporting Early-warning systems and Nature-based Solutions using Opportunistic Rainfall sensing in Rwanda) aims at leveraging the dense CML network in Rwanda for improved rainfall monitoring (~1200 links, lower frequencies and longer links than in Belgium).

Disdrometers and new dual-pol C-band radars will be installed in Musanze, Kigali and Bugesera, providing a unique combination of measurements in a tropical environment.



## Conclusions and Outlook

- First look at CML data from Telenet NV over Belgium.
- CML has potential added value in combination with existing radar and rain gauge merged techniques, in particular in parts of Southern Belgium (minor partial beam blocking or during radar outages). Further tuning and re-calibration of the k-R relation will be performed using four disdrometers in Belgium (see map intro) by master student in 2025-2026.
- Potential for identification of winter precipitation type near the surface needs further exploration (will be done by master student in 2025-2026).
- Experience with Belgian data will help exploring the Rwandan datasets once they become available (negotiations still ongoing with telecom provider in Rwanda). Sensor<sup>2</sup> will potentially provide a step-change in rainfall monitoring for applications in geo-hazard prediction and prevention.

Chwala, C., Polz, J., Graf, M., Sereb, D., Blettner, N., Keis, F., & Boose, Y. (2021). pycomlink/pycomlink: V0.3.2. Zenodo. <https://doi.org/10.5281/zenodo.4810169>.

Neutens, N. (2024). Het gebruik van commerciële microwave links voor het kwantificeren van ruimtelijke neerslagvariabiliteit., master of science in Geography, Ghent University.

Øydvin, E., Gaban, R., Andersson, J., (C. Z.) van de Beek, R., Wolff, M. A., Kitterød, N.-O., Chwala, C., and Nilsen, V. (2025). Combining commercial microwave links and weather radar for classification of dry snow and rainfall, Atmos. Meas. Tech., 18, 2279–2293, <https://doi.org/10.5194/amt-18-2279-2025>.