

Standardized collection and processing of rainfall data from telecommunication networks

*“First Results from the Global Microwave Data
Collection Initiative (GMDI)”*

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Global Microwave Link Data Collection Initiative (GMDI)



GMDI aims to improve access to rainfall data from telecom. networks

<https://gmdi.eu/>



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Kick-off meeting - November 2025, ITU Headquarters



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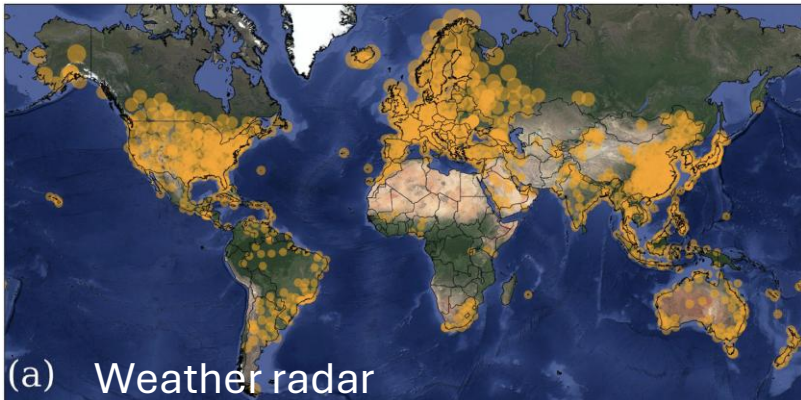
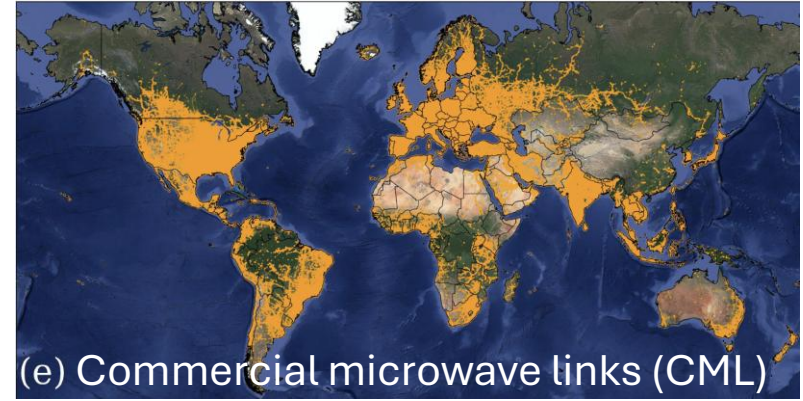
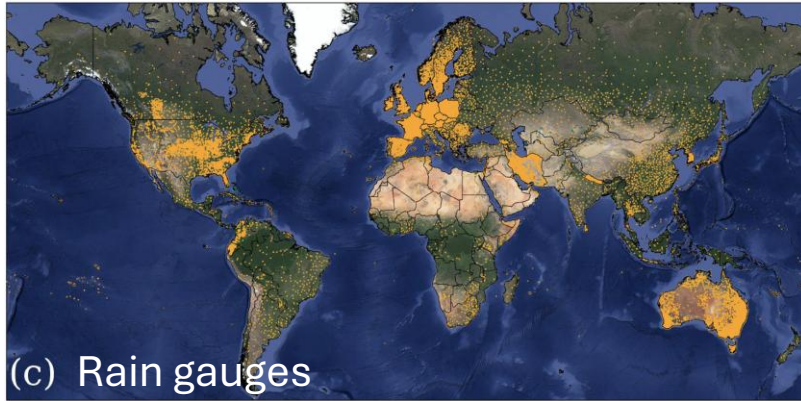


Thomas Basikolo



Washington Otieno

To increase the number of near-ground rainfall observations



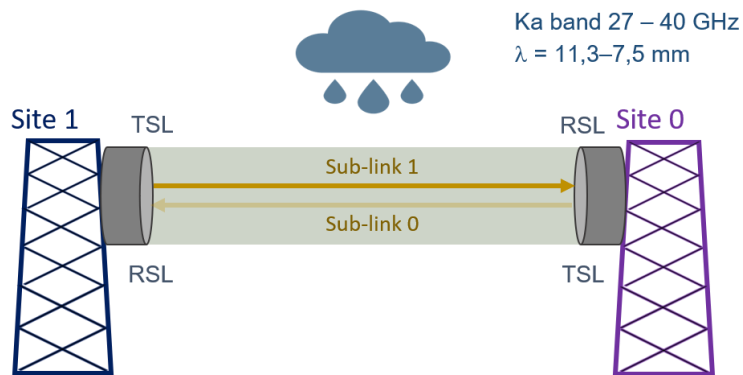
10.5 M

microwave links deployed
worldwide

Potential to improve ground observations

- in ungauge regions in Global South
- in cities with dense telecom networks

Commercial microwave link (CML) as a rainfall sensor

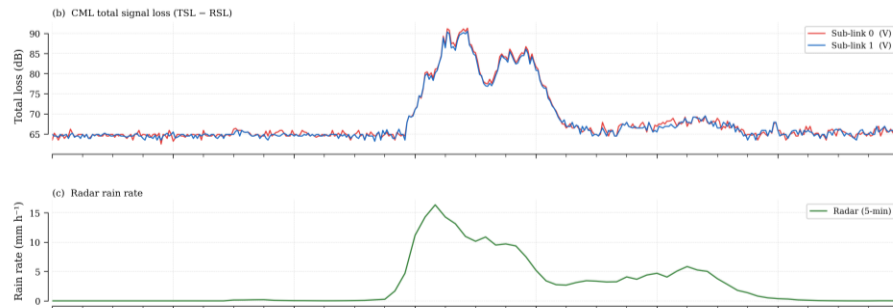


$$k = \frac{A_r}{L} = \alpha R^b [dB.km^{-1}]$$

$$A_r = TL - B$$



$$R = \alpha k^\beta [mm.h^{-1}]$$



- Existing infrastructure
- Near-real time data
- Near-ground observations
- High sensors numbers
- High temporal resolution – 10 sec – 15 min



- Complicated data access
- Errors, uncertainties, heterogenous networks
- Fixed positions of the sensors



CML rainfall estimation works — scaling remains difficult



2021-2025

Demonstrated:

Case studies

- Rainfall retrieval in diverse climatic regions
- Urban and regional CML networks
- Independent validation against gauges and radar
- Promising complement to radar and satellite QPE

Interoperability of processing tools

- Data format conventions
- Community processing software

Reproducibility of methods

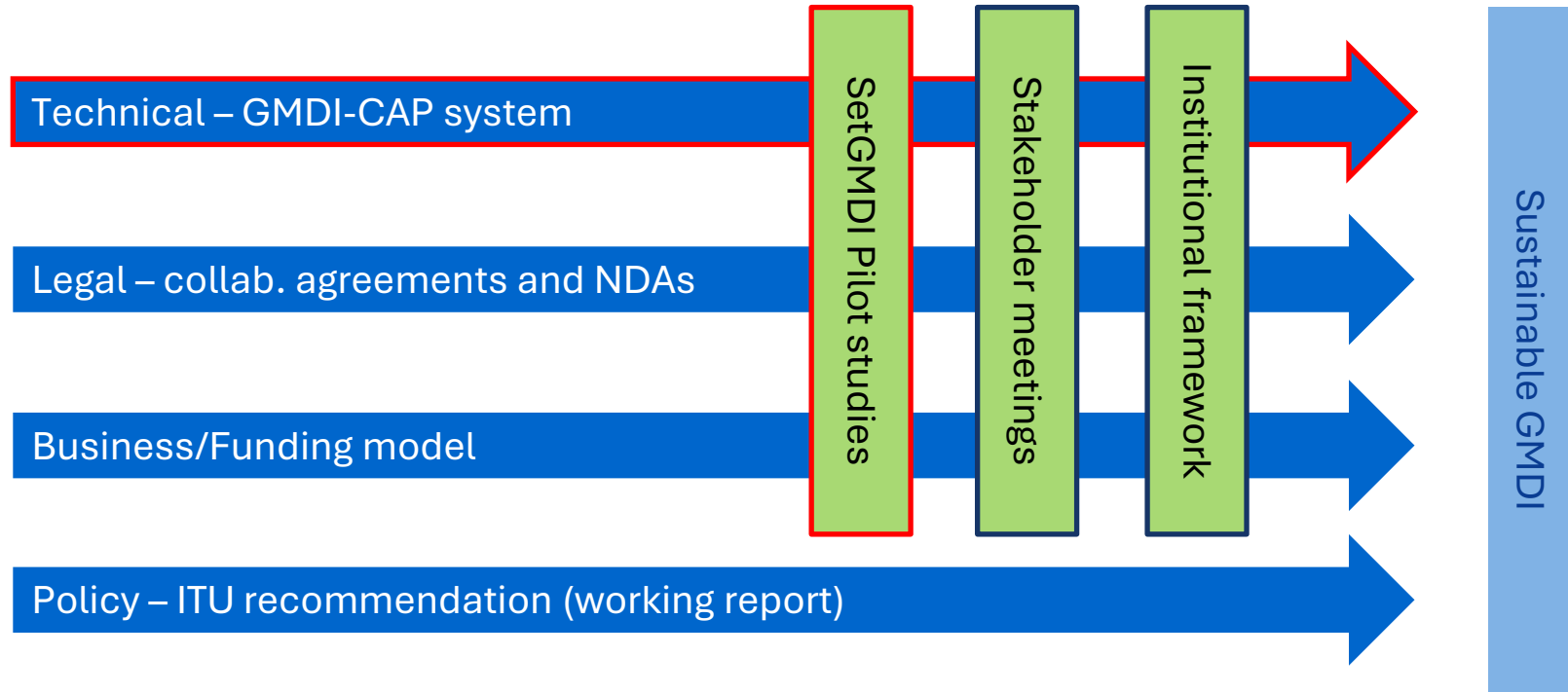
- Open-access CML datasets EU
- Intercomparison studies across EU

Still fragmented:

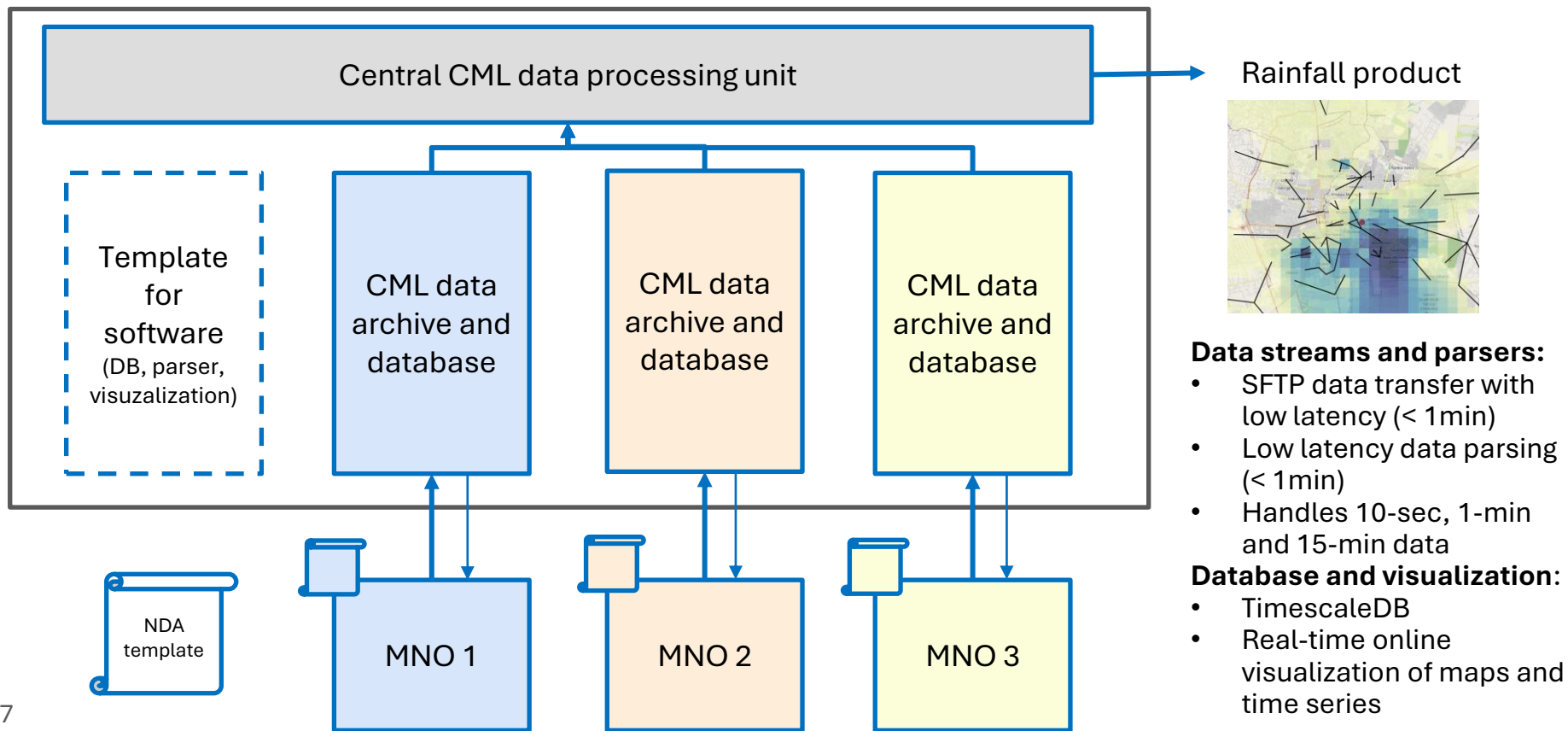
- Individual agreements with MNOs
- Limited continuity beyond research projects
- Different NMS and vendor interfaces
- Heterogeneous data and metadata
- Different processing approaches

The bottleneck is shifting from demonstrating feasibility to enabling scale.

GMDI pillars and tracks



The centralized scalable CAP system for Collecting, Archiving and Processing data



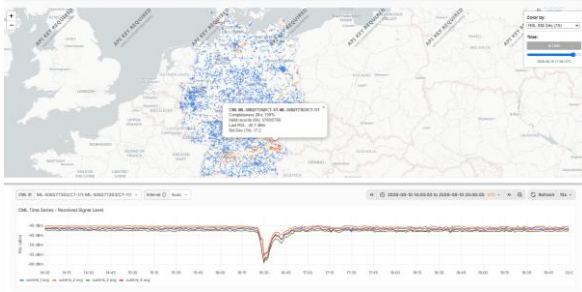
GMDI pilots test the concept across heterogeneous networks

Czechia		T-Mobile	Real-time dt = 1 min	Existing contract					
							Setup	Data flowing	Validated
Germany		Telefonica	Real-time dt = 1 min	New agreement					
							Setup	Data flowing	Validated
Ghana		AT Ghana	Real-time dt = 15 min	Addendum					
							Setup	Data flowing	Validated
Cameroon		Orange Cameroon	Historical dt = 15 min	Past agreement					
							Setup	Data flowing	Validated
Italy		Lepida	Real-time dt = 1 min	Addendum (in progress)					
							Setup	Data flowing	Validated

Different operators • different vendors • different network characteristics • **one CAP framework**

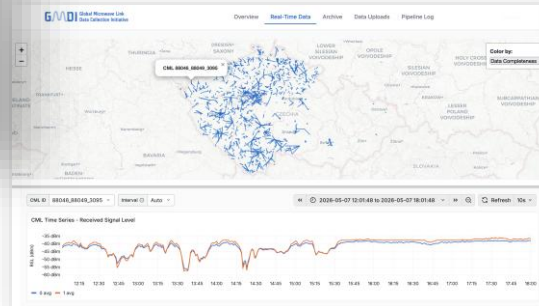
GMDI pilots test the concept across heterogeneous networks

Germany



SNMP collection
6000+ CMLs
1 min TRSL

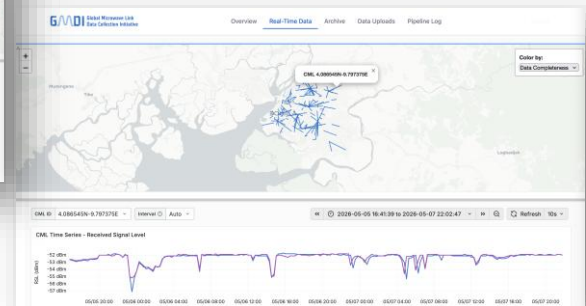
Czechia



SNMP collection
1500+ CMLs
1 min TRSL

NMS collection
150+ CMLs
15 min MinMax RSL

Cameroon



Different operators • different vendors • different network characteristics • **one CAP framework**

GMDI pilots validation study

Data Processing chain

- Baseline separation
- Wet-dry classification CNN model – SEVIRI CPP + CMLs
- Wet antenna attenuation correction
- Rainfall retrieval
- QC filters

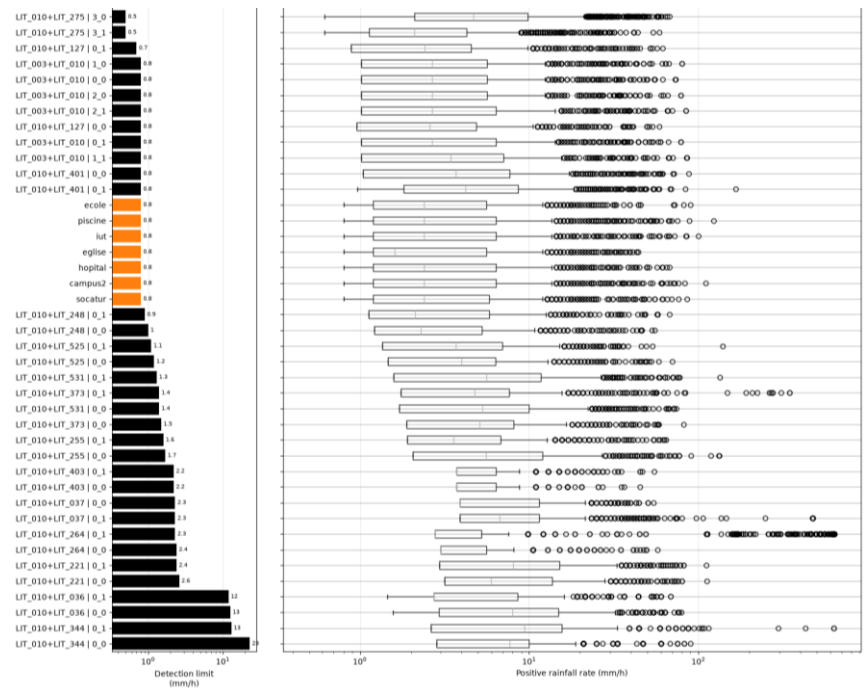
Validation to

- Ground observations – CML to rain gauges (distance < 5km)
- IMERG products

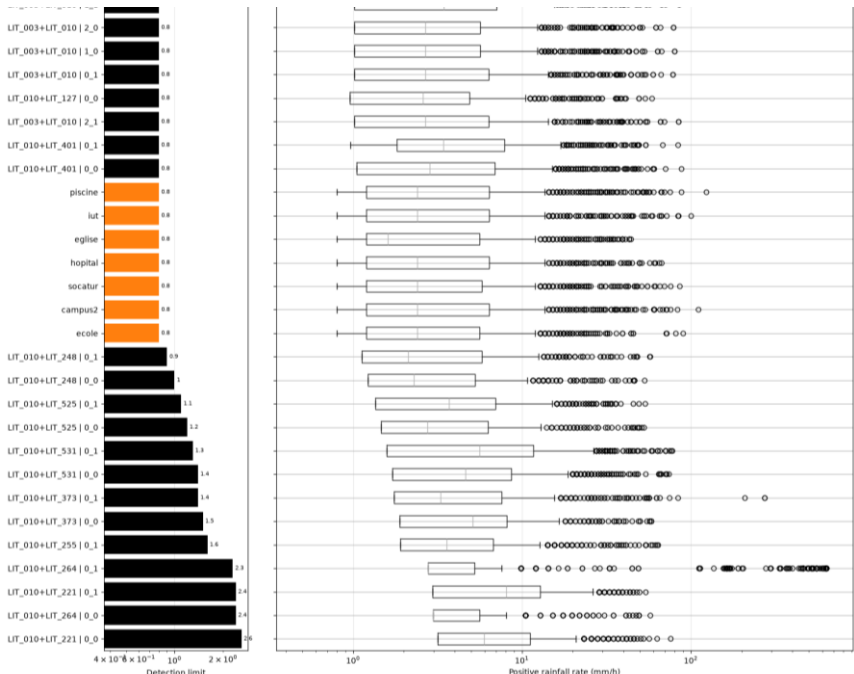
Locations - pilots + other available data sets

- **Cameroon**, Ghana, Niger, Zambia
- Italy, Czech Republic, Germany, Sweden

Cameroon - sensors detection limits and observation distribution

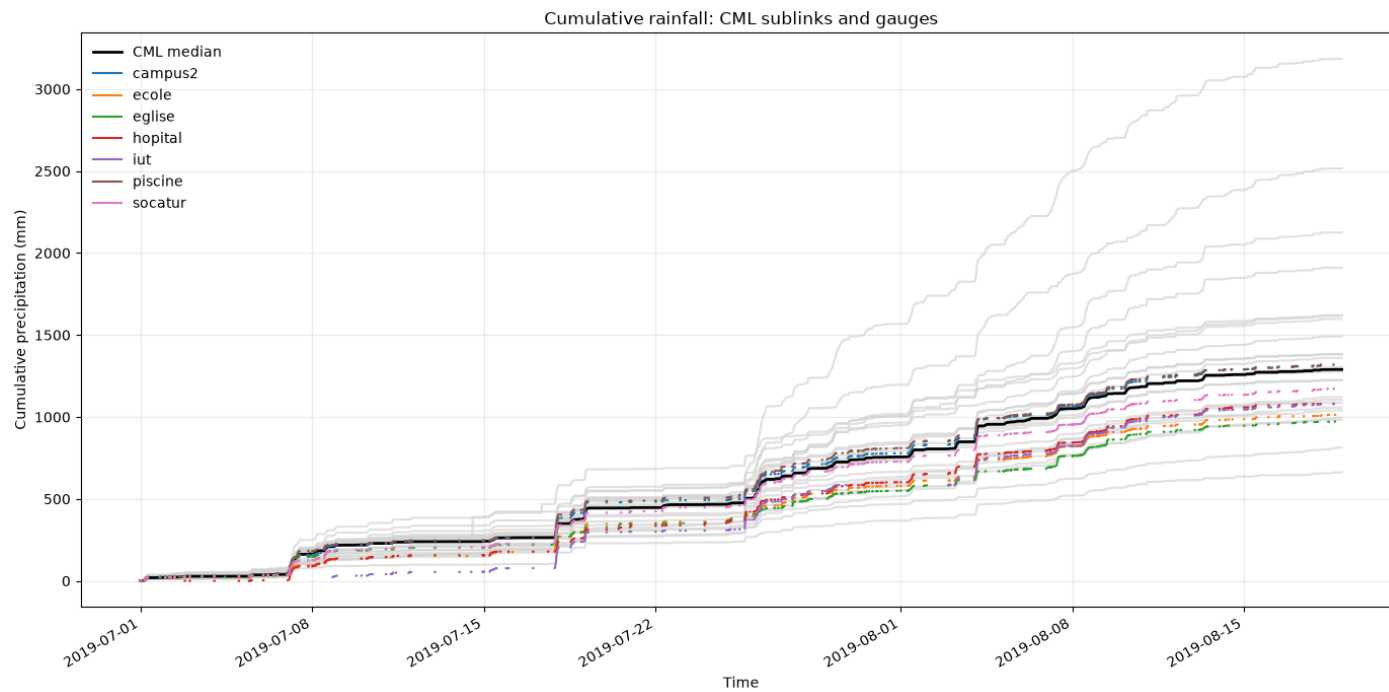


before QC



after QC

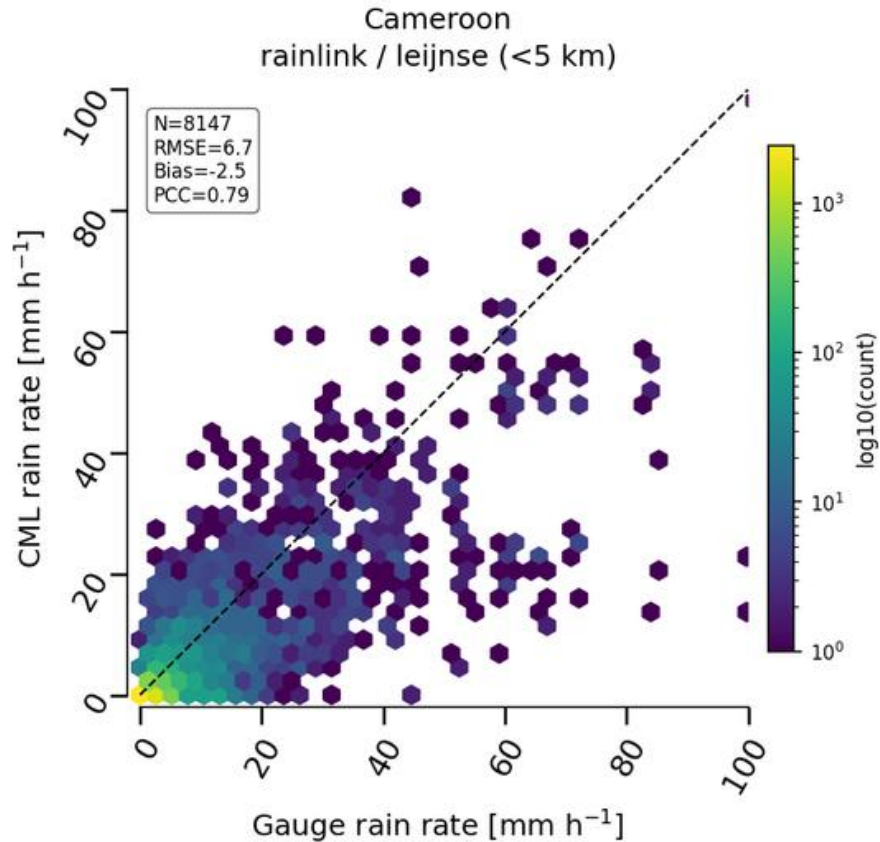
Cameroon – cumulative rainfall curves



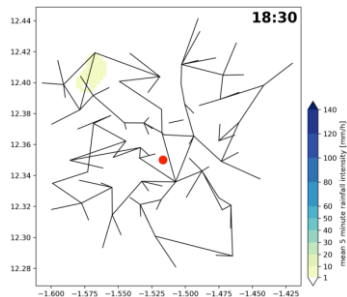
before QC

after QC

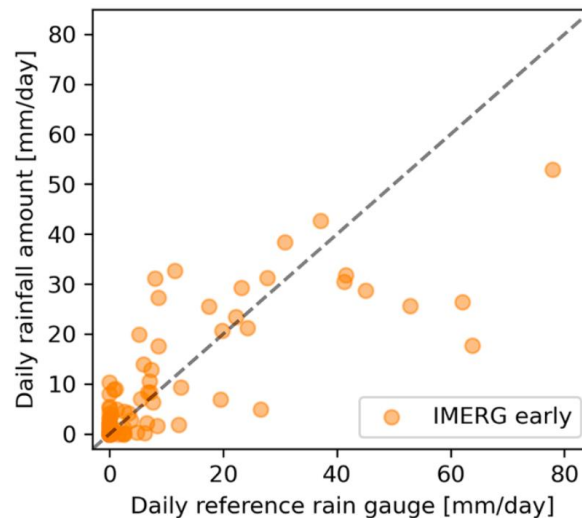
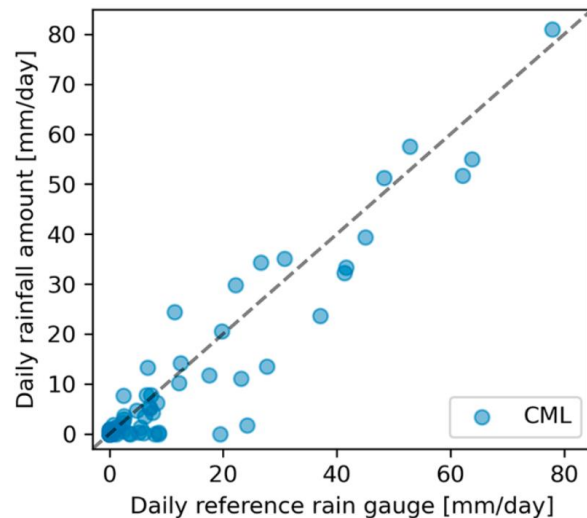
Cameroon – scatter plot CML / RG



Validation to IMERG product – Burkina Faso example



CML rainfall maps show better performance than satellite products when validated against rain gauge



Conclusions

- GMDI – CAP
 - allows to integrate data from different MNOs from different continents in diverse formats
 - is capable to provide rainfall data with low latency
 - provides long-term operational statistics for MNOs
- Validation studies on African and European data sets in progress
 - First results show reasonable agreement with reference
 - African data sets contain large number of low frequency CMLs which can be critical
 - Solid QC filters reduce large amount of data samples and number of sensors

Outlook

- Goals for this year
 - **GMDI Workshop at WMO, Geneve, 26.-27. October 2026**
 - Connect data streams for Italy and Ghana
 - Extend CAP system based on user feedback (e.g. analytics based on data archive)
 - Carry out validation of rainfall products following WMO guidelines
 - Finalize ITU recommendation (or report) on importance of CML data collection
 - Acquire funding (2 positions) for an initial operational phase of GMDI for 2 years
- Long-term goals
 - Found an own legal entity for GMDI
 - Connect massively more data sources (going from 10 to 100)
 - Open question: Will GMDI be more attractive when reaching a critical mass, or do we need a business model, or regulations that enforce/encourage data sharing?



Unlocking the rainfall data inside every telecom network



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