

Country-wide analysis of CML rainfall estimation in Zambia: Strengths, weaknesses and the way forward

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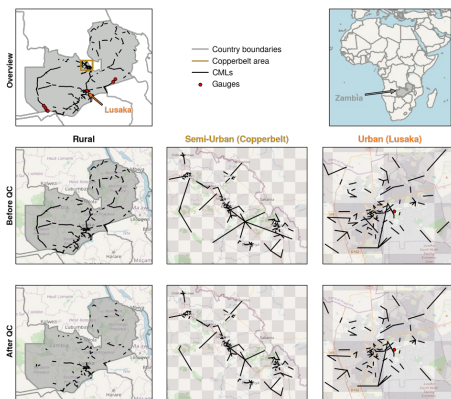
Main findings

Motivation

- Rain gauge observations are scarce in the Global South
- CMLs, from the backbone of the mobile phone network, are abundant and can be used for rainfall estimation
- But: Can existing methods, developed with European CML data, perform well there?

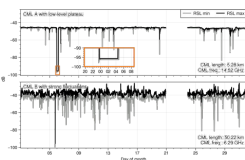
Data

- Subset of CML network of a mobile phone operator, mainly 6-8 GHz and 12 GHz
- IMERG and TAHMO data as reference

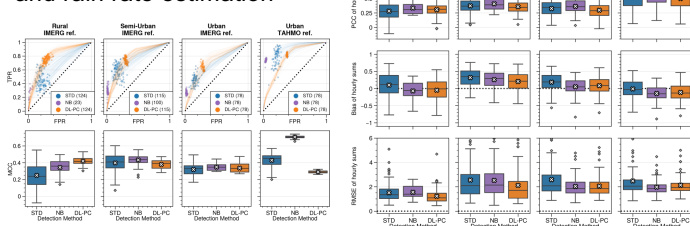


Methods

- QC: Quality control methods to sort out too noisy or anomalous data
- Rain event detection:
 - STD: Using rolling std-dev of attenuation timeseries
 - NB: Nearby-link approach using similarity of data from neighboring CML during rain
 - DL-PC: Custom precipitation probability (PC) product from SEVIRI using Deep Learning (DL)



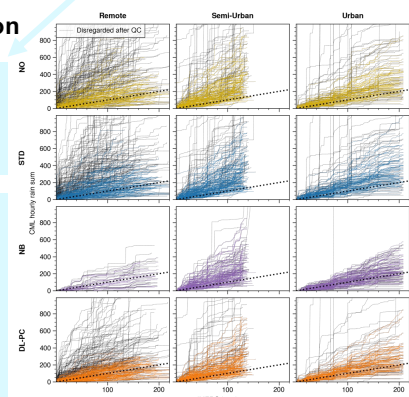
Metrics for rain event detection and rain rate estimation



QC and wet-dry classification

QC is crucial but skill is dependent on CML network density in different regions.

NB methods performs best in urban regions with dense CML network, but rural regions require satellite data with DL-PC method which can be applied to all CMLs in sparser network.

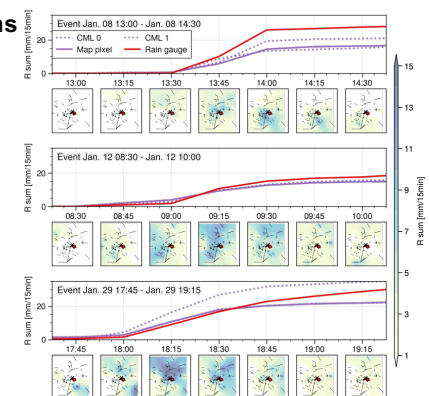


Comparison of rainfall accumulation of CML vs. IMERG for different regions, different wet-dry methods and QC on or off.

Rainfall maps in urban regions

Processed CML rainfall maps show very good skill at (the only available) rain gauge in Lusaka.

High-density CML networks in African cities can provide unprecedented rainfall maps with high spatial and temporal resolution (1km, 15-minute).

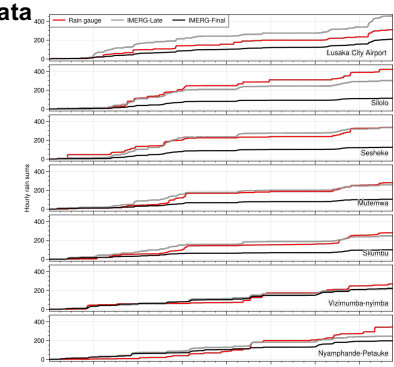


CML rainfall maps (processed with the NB method and then spatially interpolated) and rainfall accumulation at the pixel of the rain gauge for three different rain events in Lusaka.

Discrepancies in reference data

There are significant differences between TAHMO rain gauges (red), IMERG-Late (gray) and IMERG-Final (black).

Optimizing and validating CML processing is limited by quality of reference data in Zambia.



Rainfall accumulation for January 2022 at different TAHMO rain gauges compared to IMERG-Late and IMERG-Final.

Outlook

- Data collection and sharing is still an issue, which will be solved by a global data collection initiative.
- Processing in rural regions will be improved via combination of GEO data and time-series methods.