

Estimating urban rainfall using a dense CML network in Nigeria

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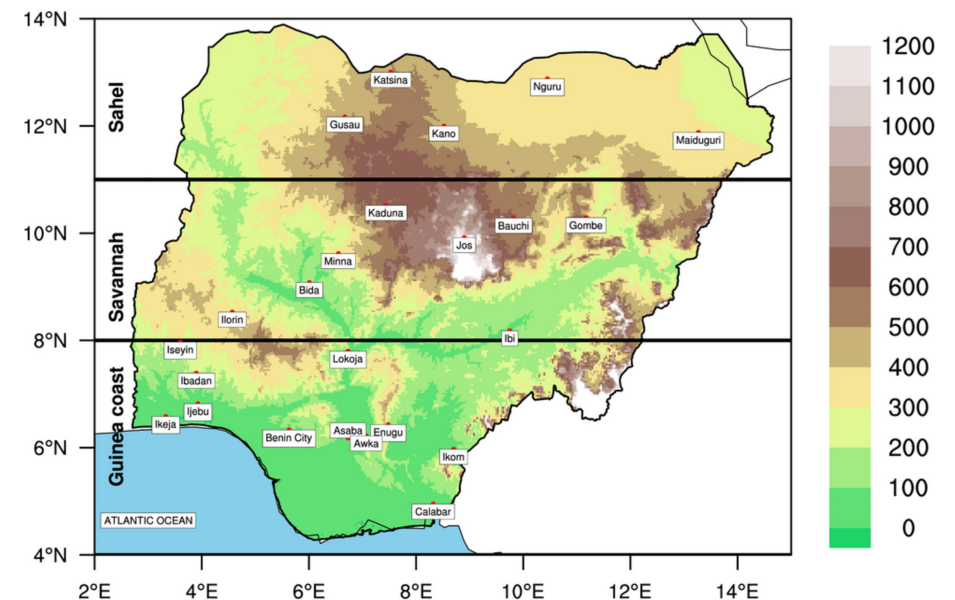
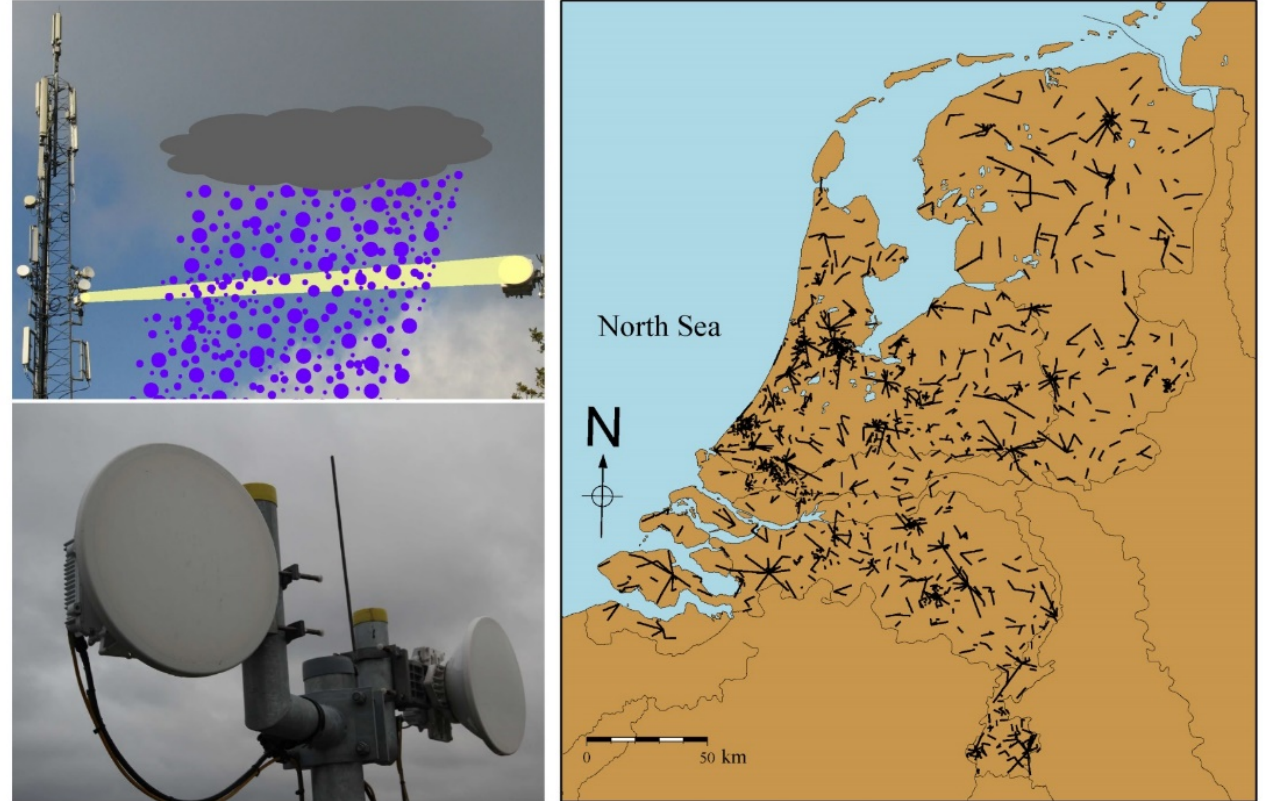


Figure from Gbode et al., 2019, DOI: 10.1002/met.1791

An alternative solution for rainfall estimation: CMLs

Rainfall attenuates electromagnetic signals transmitted from the antenna of one telephone tower to another.

Estimate path-averaged rainfall intensity from rain-induced attenuation.

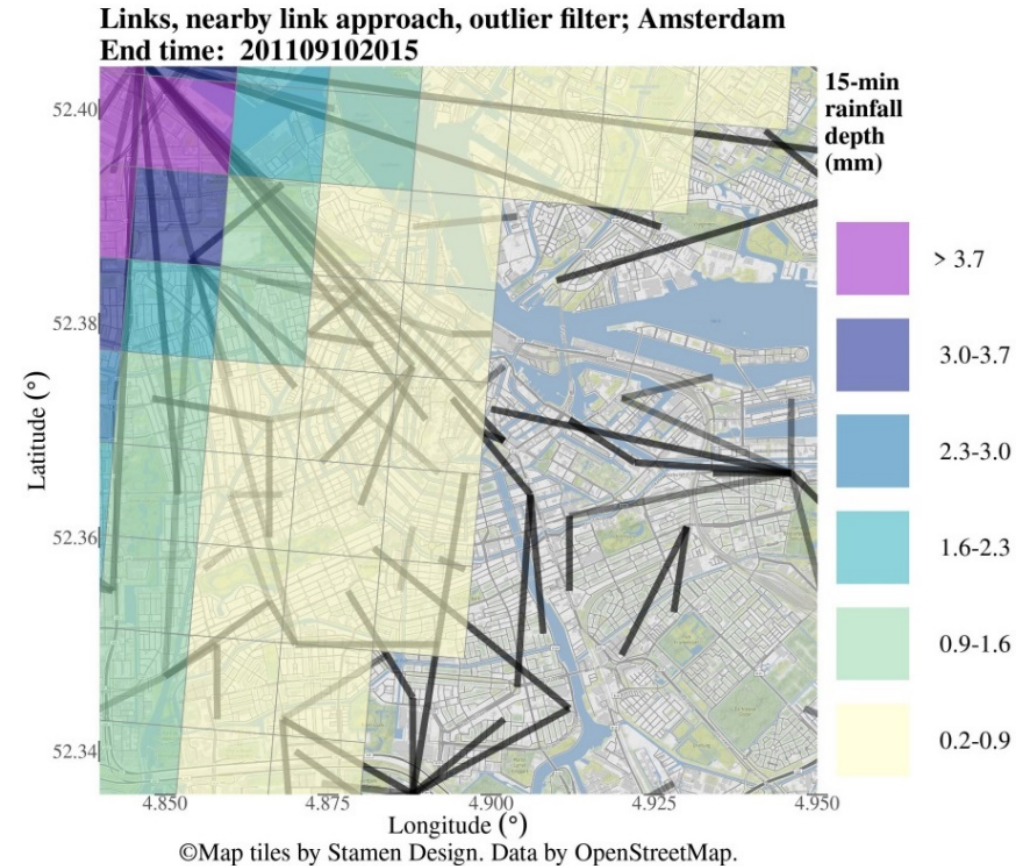


<http://www.pnas.org/content/110/8/2741.full>

R-package RAINLINK

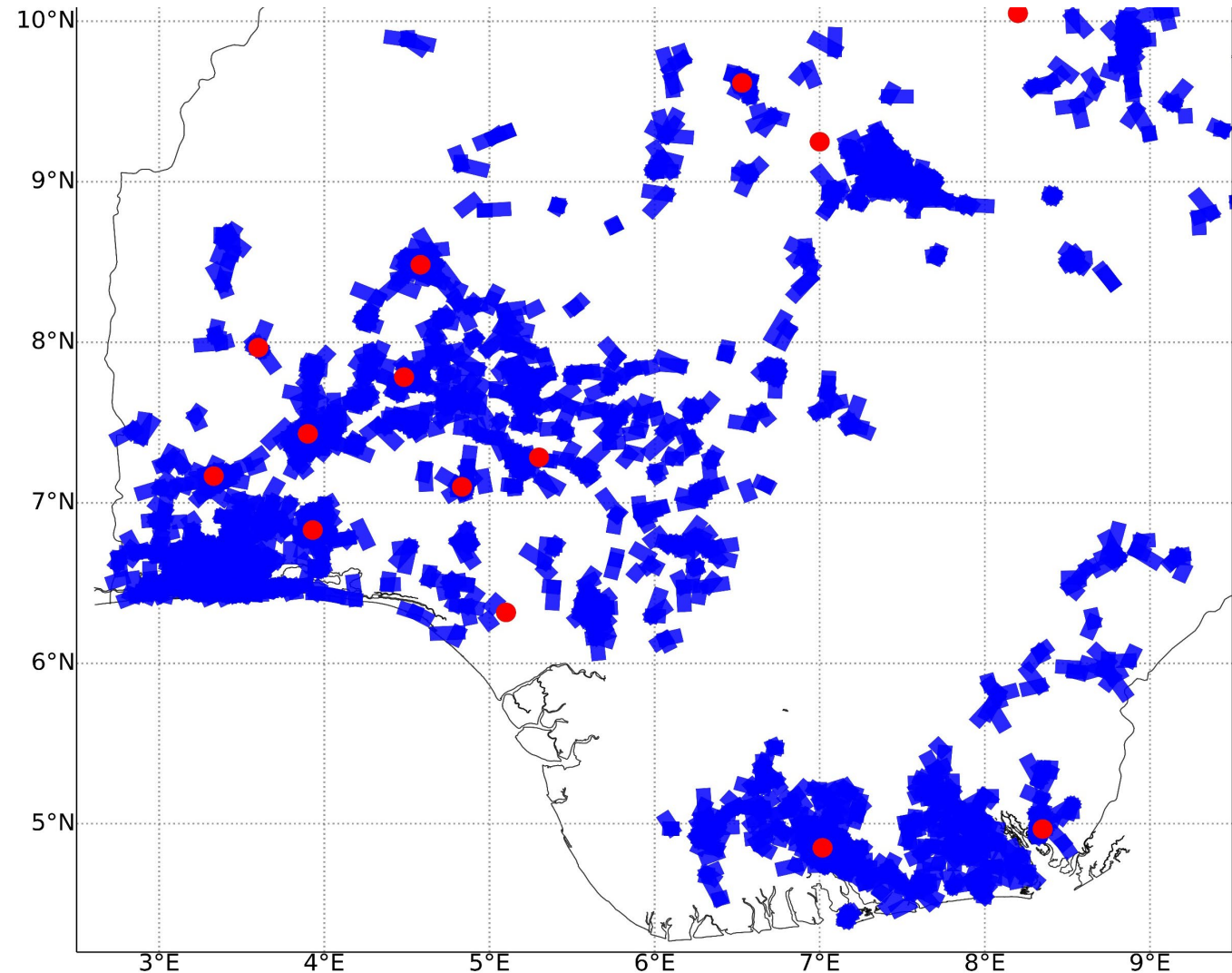
R-package “RAINLINK” for rainfall retrieval using microwave links. Processing steps:

- Preprocessing of CML data
- Wet-dry classification
- Reference level determination
- Outlier filter
- Rainfall retrieval of path averages
- Interpolation of path averages to map (for Nigeria: 0.01° , $\sim 1 \text{ km}^2$)



CML Network Nigeria

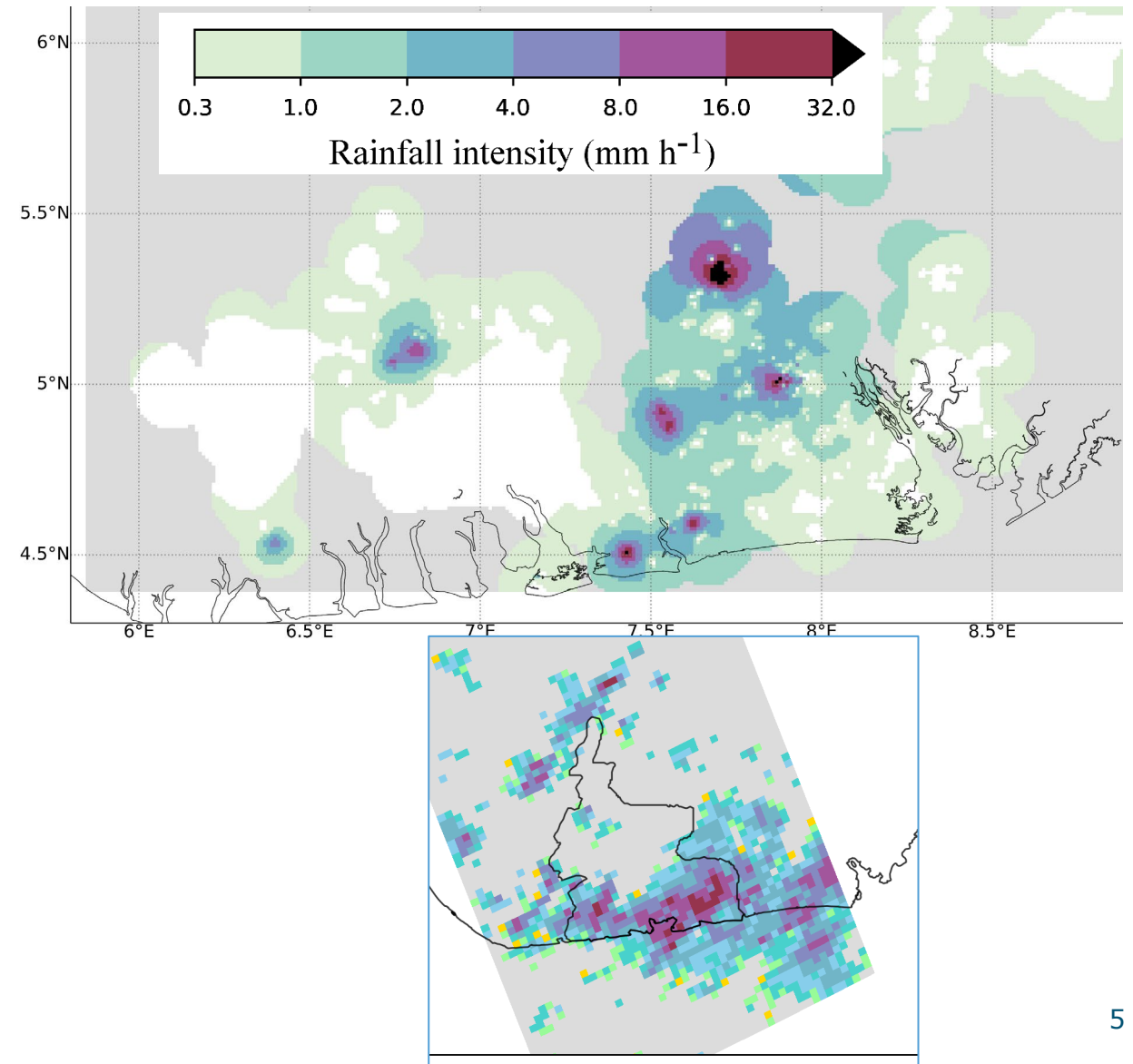
- CML data covering south part of Nigeria, including urban centres (Lagos, Abuja, Port Harcourt)
- Dense network (12,000 link paths) & long period (Apr – Oct 2020)
- Limited ground data available, so lot of potential for CML data



CML network (blue); rain-gauges in red

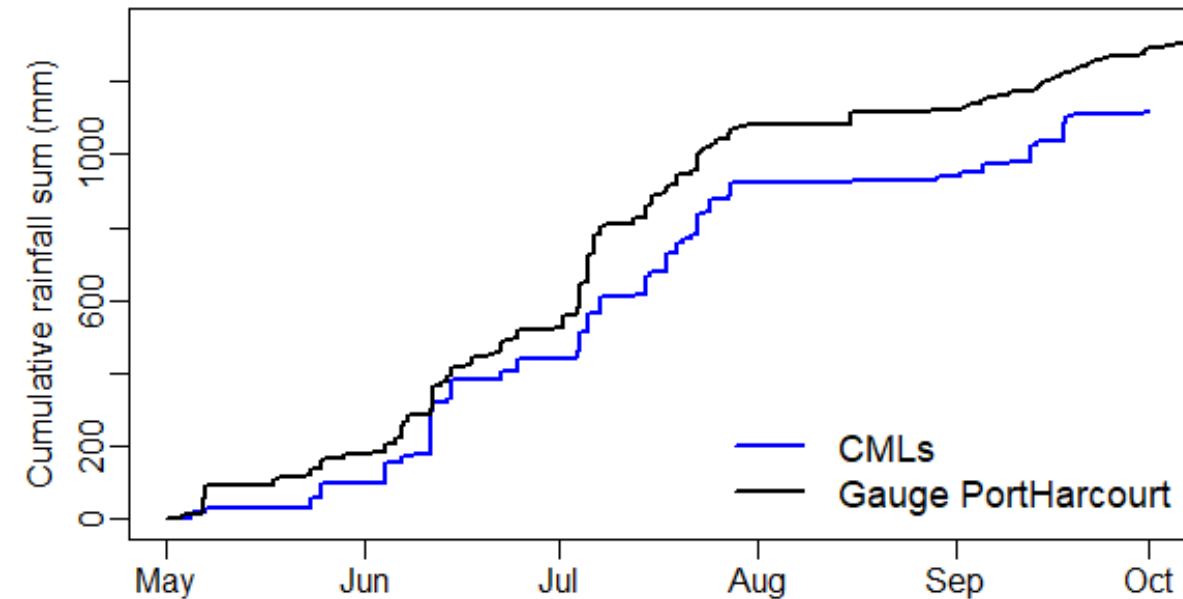
Spatial analysis using satellite data

- Example event for Port Harcourt, interpolated data to a 1 x 1 km grid. Areas within 10 km of a link-path are considered, rest is N/A (grey areas)
- **Ongoing:** comparison to CORE satellite-data (bottom inset) – initial results look decent though location varies.



Volume analysis using ground data

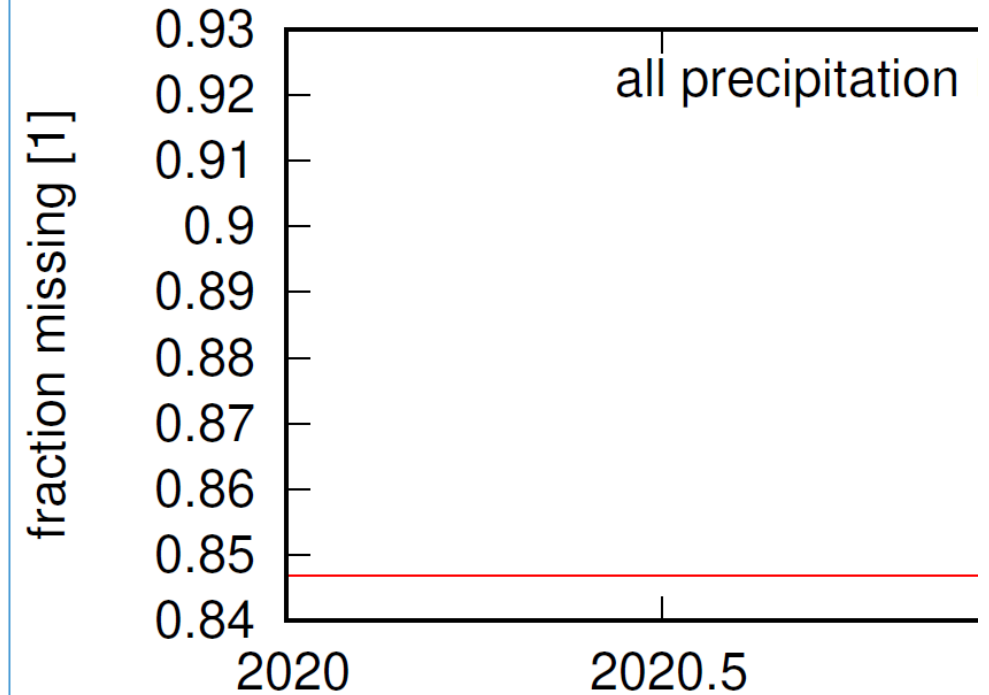
- Long-term analysis of accumulated precipitation shows good correspondence of events, but underestimation of peaks.
- **Ongoing:** using local DSD data to optimize k-R relation to better suit local precipitation forms.



Missing data Lags

- Lagos raingauge data is unfortunately very incomplete (Fraction missing data on the right)
- Have to resort to cases rather than volume validation

#	PRCP [mm/day]	precipitation
20200229	0.000000	
20200314	11.900000	
20200315	0.000000	
20200324	14.000000	
20200405	4.100000	
20200406	0.000000	
20200411	0.000000	
20200426	4.100000	
20200510	15.000000	
20200520	10.900000	
20200521	0.000000	
20200610	0.000000	
20200615	23.100000	
20200617	3.000000	
20200618	73.900000	
20200619	0.000000	
20200622	5.100000	
20200623	0.000000	
20200628	19.100000	
20200630	54.100000	
20200701	8.900000	
20200702	0.000000	
20200713	0.000000	
20200807	0.000000	
20200823	0.000000	
20200915	3.000000	



Work in progress

- Relation network density vs quality of accumulated precip estimates
- Optimize RAINLINK for local conditions (DSD & calibration data)
- Satellite comparison for spatial extent