

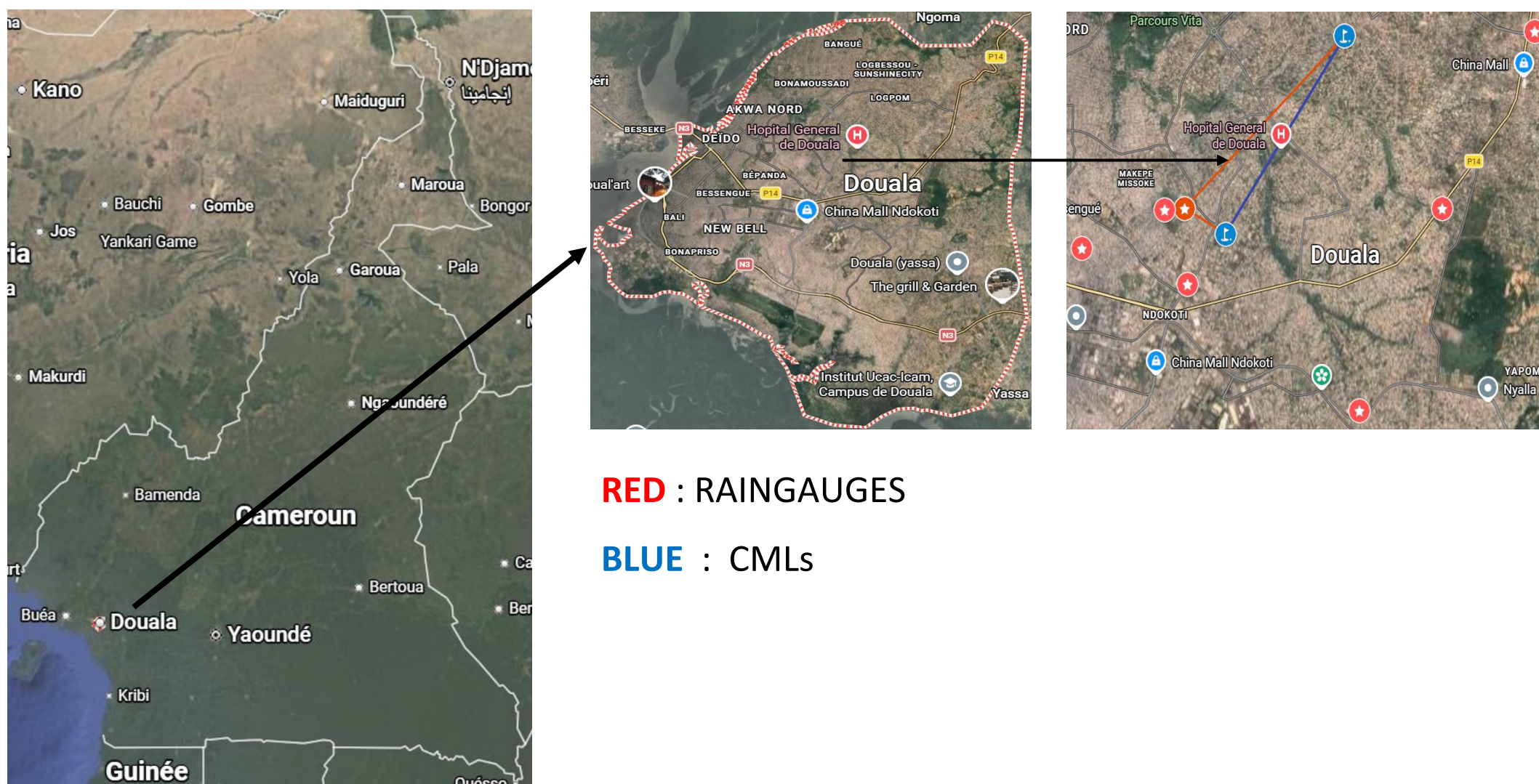
DETECTION AND ESTIMATION OF RAINFALL WITH A DUAL-FREQUENCY 18-80 GHz LINK IN TROPICAL AFRICA (DOUALA, CAMEROUN)

A. Kodji¹, M. Kacou¹, M. Gosset², B. Tanga³, R. Onguene³, E. P. Zahiri¹

1 Université Félix Houphouët Boigny (UFHB) ; 2 Institut de Recherche et de Développement (IRD) ; 3 Orange Cameroun (OCM)

Context and Data

- In Africa as in most of the Tropics, links operating below 20 GHz have been favored in order to avoid strong attenuation by intense rainfall
- However as the user demand for better quality of service is increasing, telecommunication operators are interested in investigating if higher frequency links could be viable in the Tropics
- In this study, data from a dual frequency 18-80 GHz microwave link in Douala, Cameroun was provided by Orange to analyze the sensitivity to rainfall using high resolution rain gauges from a hydrological research project in Douala
- Comparative statistics on rainfall attenuation and possible loss of communication was studied
- The complementarity of the 2 frequencies for rainfall detection and estimation was also investigated.



Dual frequency link of length $L = 3,5 \text{ km}$ with a 80 GHz V sublink and a 18 GHz with dual polarisation H and V.

For each sublink, in this experiment the data is recorded (with precision 0.1 dBm) at irregular time intervals, whenever a delta in RSL of 1 dB at least is detected. 15 minutes average attenuation are derived from this instantaneous data.

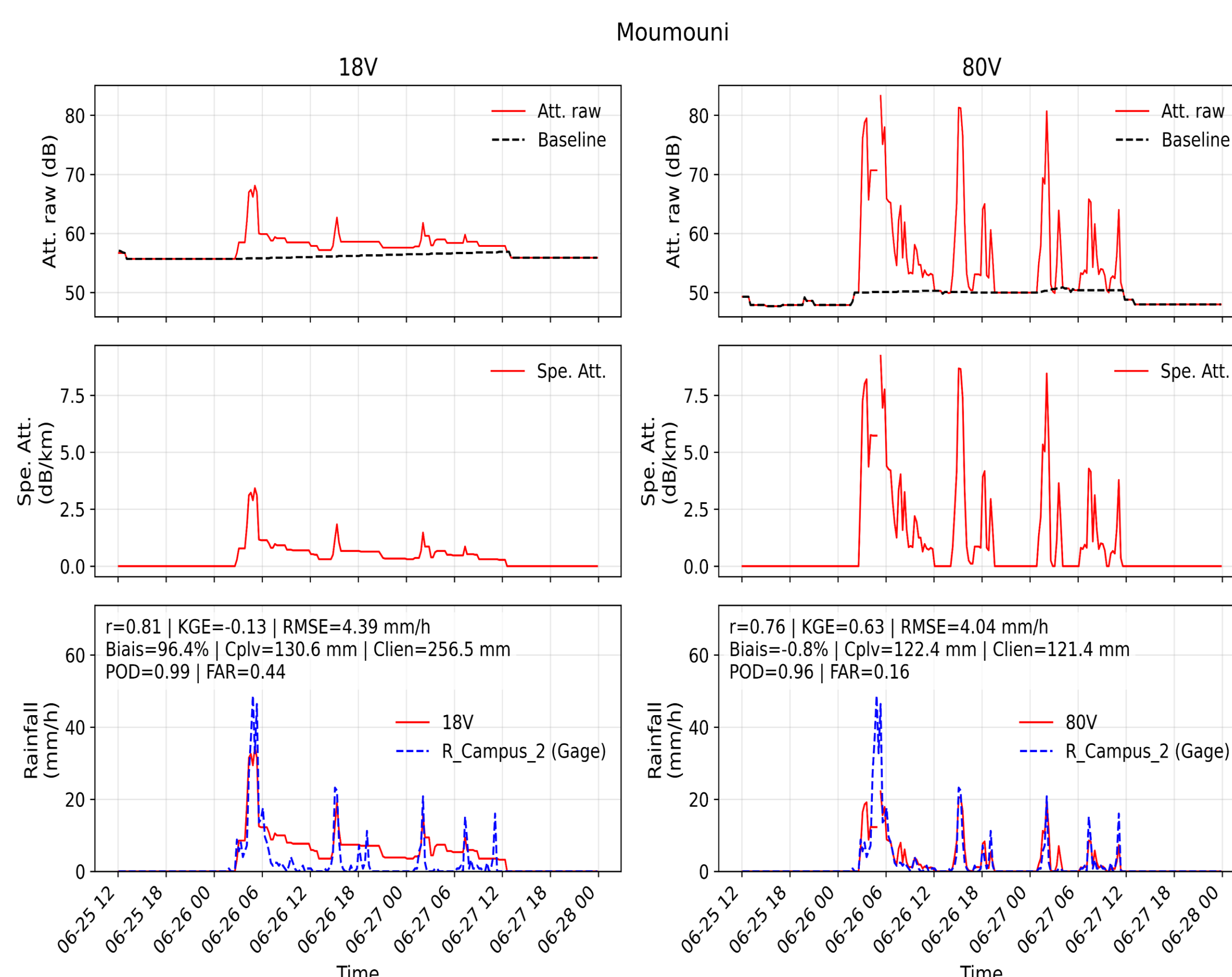
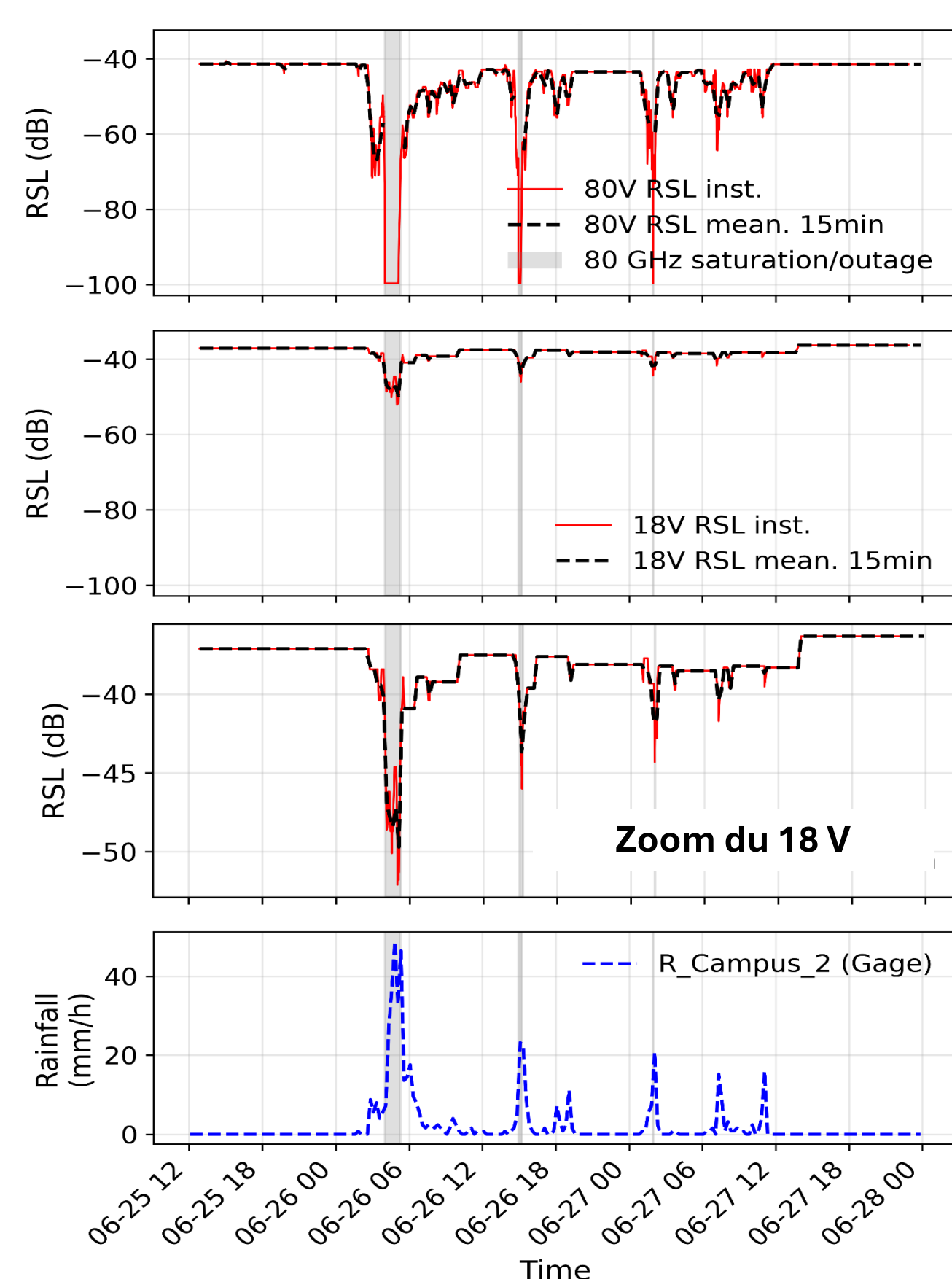
Data was provided between 06 of June and 19 of August 2019.

8 rain gauges are located in the vicinity (< 5 km) of the link.

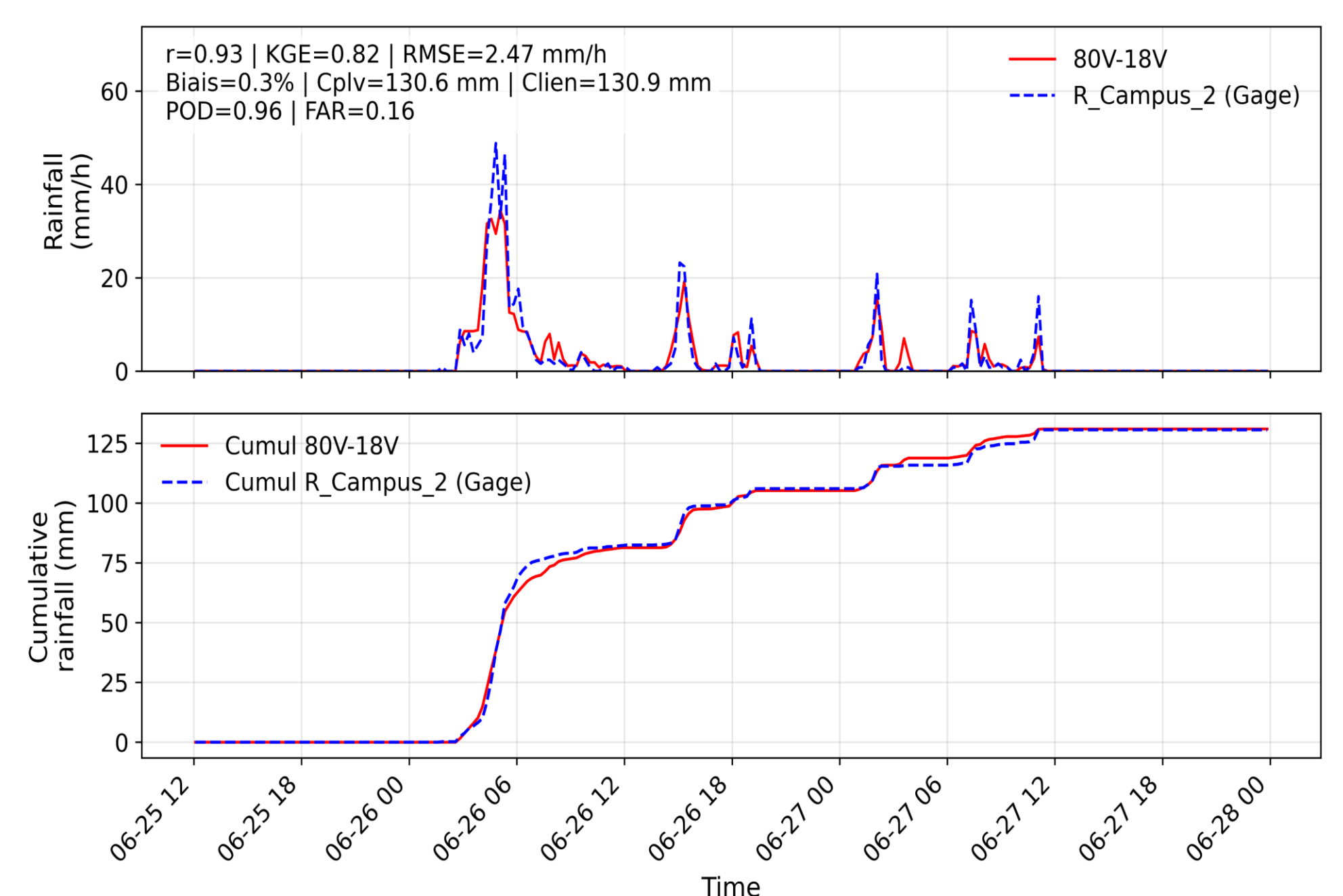
RESULTS

Example of rainy event as seen by both frequency

Sens 250 — 2019-06-25 12:00:00 to 2019-06-28 00:00:00



Combination 80V-18V — Moumouni — 2019-06-25 12:00:00 to 2019-06-28 00:00:00



The combined 18-80 GHz dual frequency estimation improves rainfall estimation statistics compared to 18 or 80 alone :

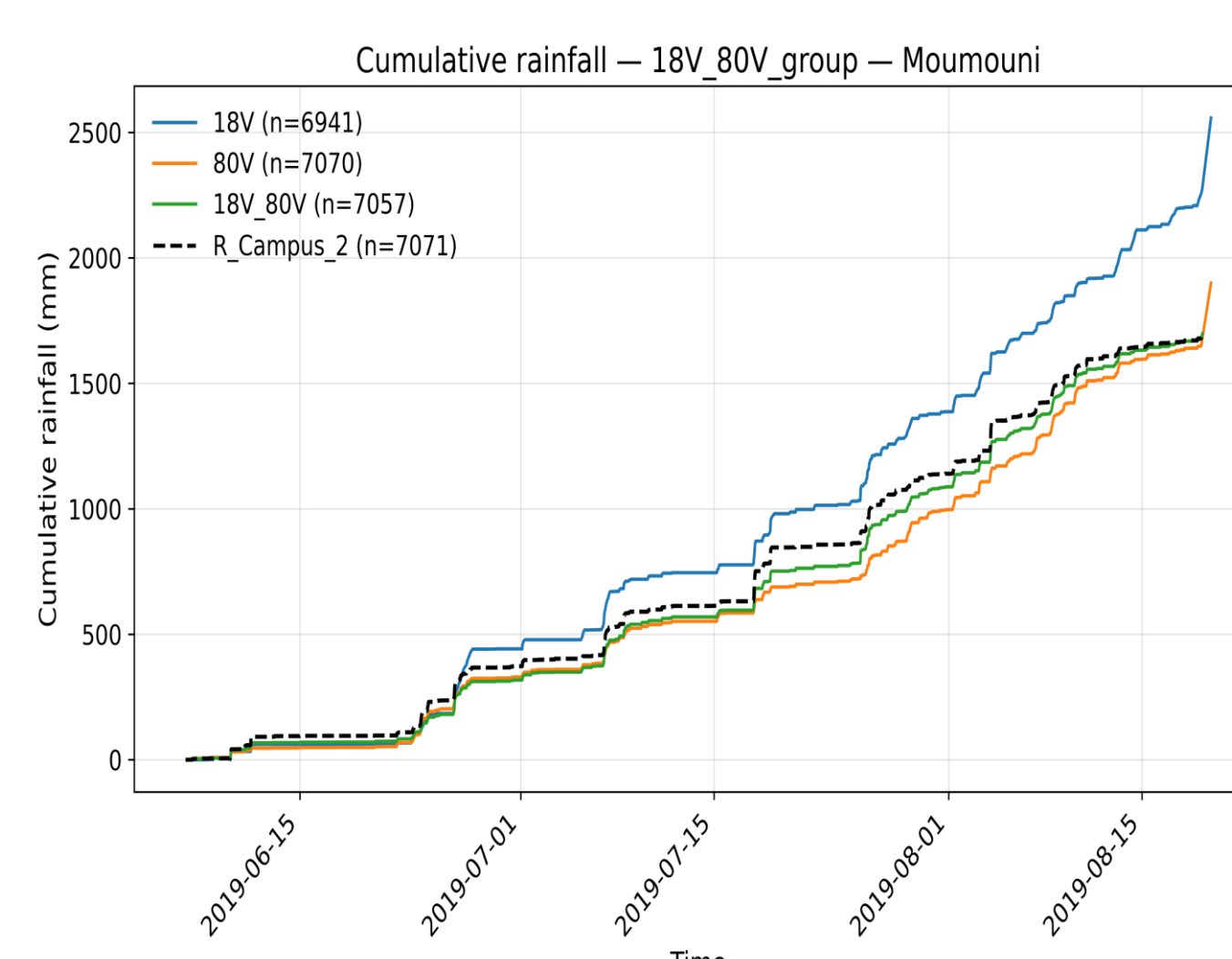
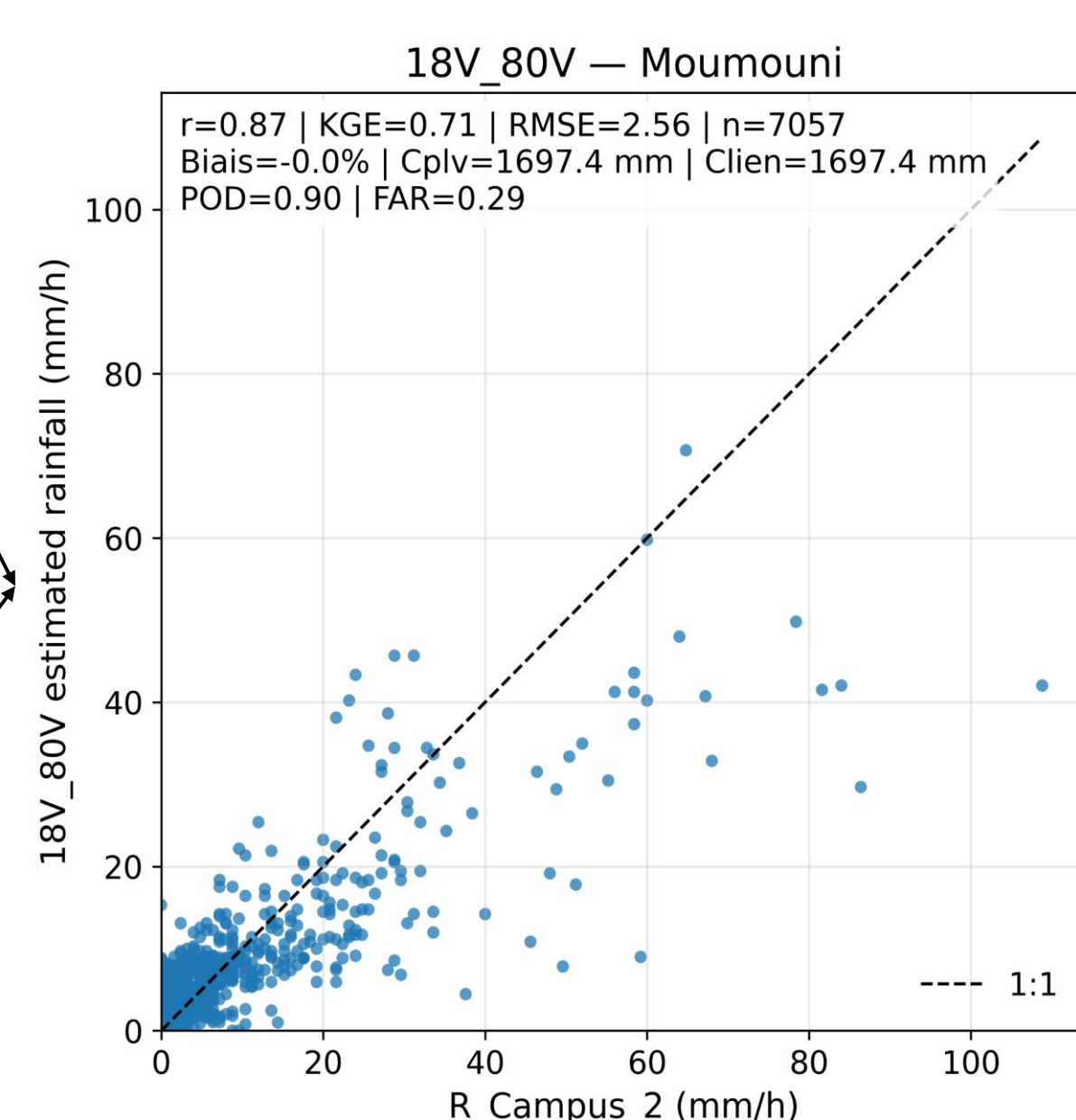
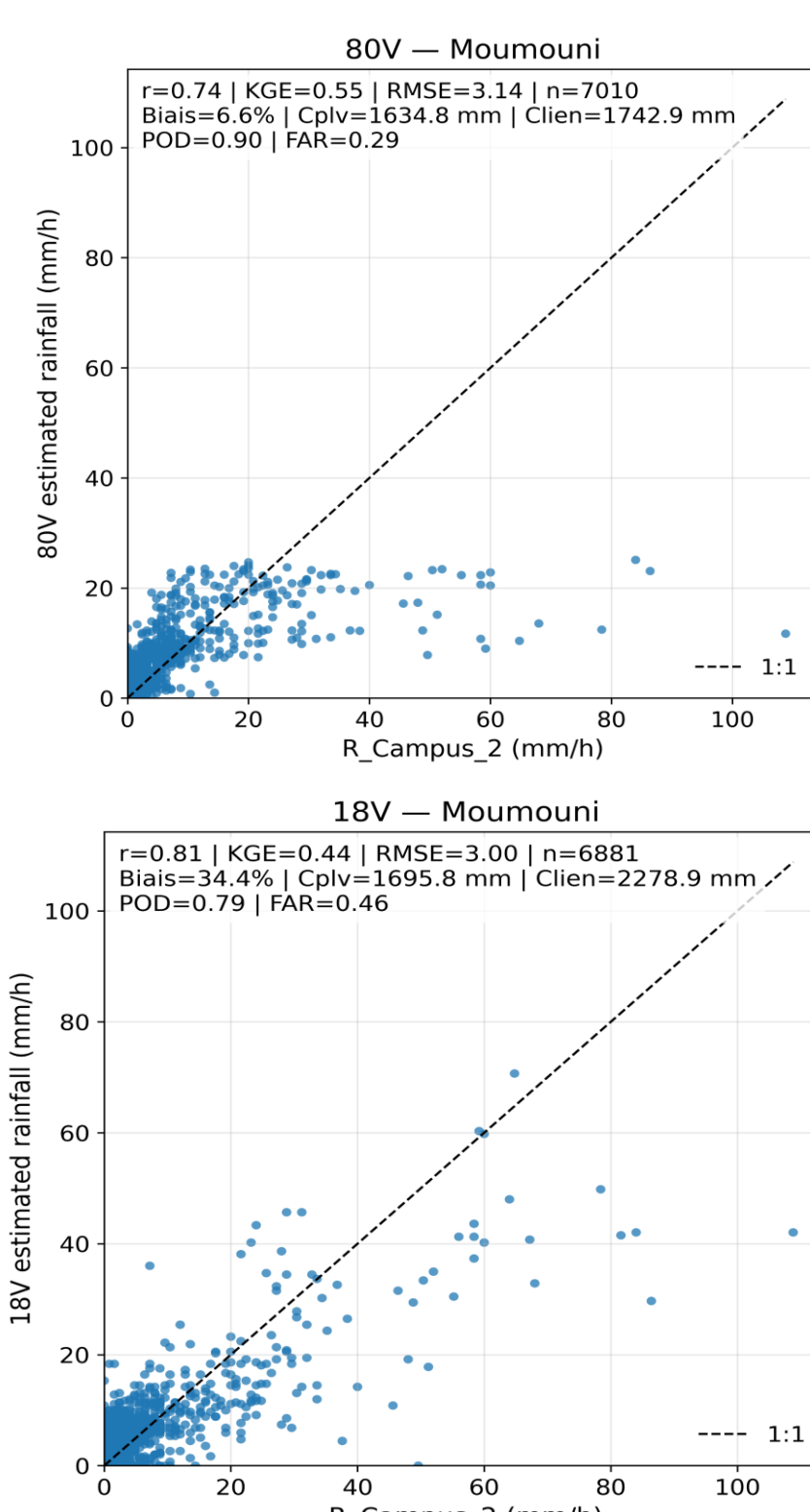
- Entire rendition of the rain event (no wet time steps missed because of low sensitivity or on the opposite saturation/extinction)

80 GHz is more sensitive to rainfall, and more able to detect the lowest rainfall rates but also subject to communication loss for high rainfall. On the contrary the 18 GHz may miss low rain rates but is usable to monitor the highest rain rates without saturation effects.

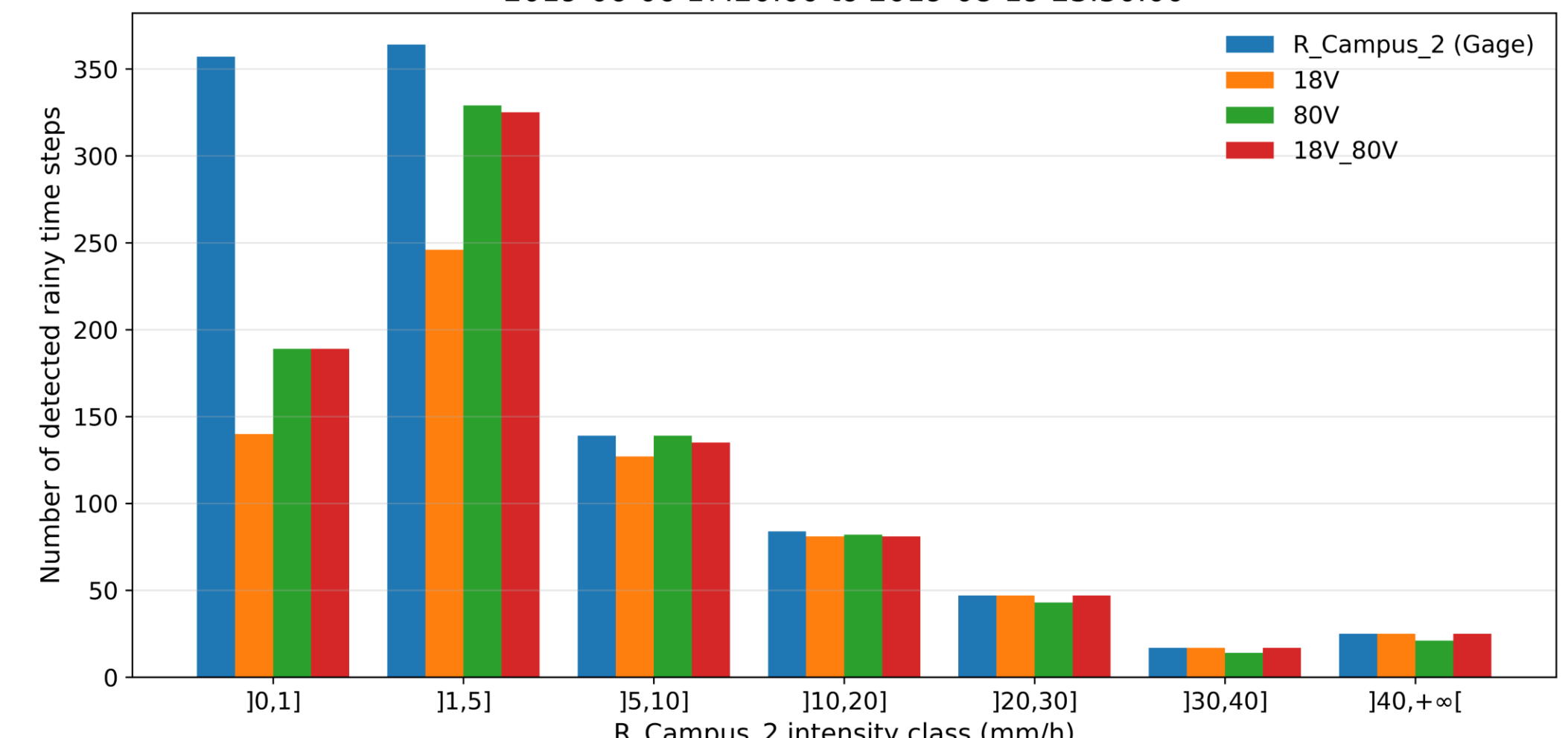
The best rainfall estimation statistics are obtained by combining both frequency :

-80 GHz for rainfall detection and estimation of rain rate below a threshold (5 to 10 mm/h)

-18 GHz for rainfall estimation in the high intensity convective rain (> 10 mm/h)



Detection by gauge intensity class — 18V_80V_group — Moumouni
2019-06-06 17:20:00 to 2019-08-19 23:50:00



CONCLUSION

Dual frequency 18-80 GHz are a promising solution for rainfall estimation in tropical areas where the range of rainfall rates is large. Combining both frequency improve rainfall detection and estimation statistics at both end of the intensity spectra

The research needs to be further developed with more data as dual frequency links are now being integrated in the network for better bandwidth and higher quality service in Africa.

Rainfall estimation combining both frequency over a 3 month period