



## **Using CloudSat cloud retrievals to assess differences between satellite rainfall products over Africa**

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Precipitation retrievals over Africa from three commonly used near real-time satellite algorithms (TRMM 3B42, CMORPH and FEWS RFE2.0) are compared to co-located CloudSat retrievals of cloud liquid water, ice amount and cloud fraction to document the cloud structures associated with rainfall location and intensity. While all three precipitation algorithms use information from infra-red and microwave sensors, the different retrieval approaches and the use of the 14 GHz active precipitation radar in the TRMM product leads to contrasting sensitivities. In particular the CMORPH rain rate is shown to be markedly more sensitive to the presence of upper tropospheric ice cloud, while the FEWS and especially the TRMM algorithms show rainfall increasing in response to mid and lower tropospheric cloud amounts. The dependence on ice also leads to the CMORPH rainfall rate increasing with cloud top height, while TRMM shows little sensitivity to this characteristic of cloud. The contrast is best illustrated examining zonal averages of the west Africa monsoon. CMORPH produces precipitation further to the north relative to FEWS and TRMM and is associated with upper tropospheric cold cloud, while FEWS and TRMM both produce the peak further south where the deep convective structures are seen. This would imply that in some circumstances CMORPH may overestimate surface precipitation, and the algorithm may be improved by increasing the impact of information pertaining to the cloud liquid water structure.