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Characterising the probability of warm rain over West Africa using multi-satellite observations

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Monitoring rainfall is vital for the African continent, because many livelihoods highly depend on rain-fed agriculture. Unfortunately, rainfall estimates from passive satellite observations over Africa heavily rely on cold cloud signatures and thus could inaccurately represent precipitation from shallow, warm, low-altitude clouds. In contrast, spaceborne radar measurements have the ability to probe the vertical structure of precipitation and detect warm rain. However, due to limited swaths and infrequent temporal sampling, on their own these radar measurements are unsuitable for rainfall monitoring. In this paper, we aim to fully use the probing ability of CloudSat to improve warm rain estimates from passive satellite observations, focusing on southern West Africa, strongly linked to the West African monsoon and prevailed by low clouds. Specifically, we will investigate probability of precipitation for various cloud regimes using CloudSat and quantify the relative importance of shallow precipitation. We will also introduce a new warm rain delineation method that uses geostationary shortwave radiation measurements, and validate delineation results against CloudSat and rain gauge data. This study will provide an opportunity not only for enhancing geostationary rainfall estimates, but also for studying aerosol-precipitation interactions over southern West Africa because of its rich mix of natural and anthropogenic aerosols.