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Evaluation Of Rainfall Retrievals from SEVIRI Reflectancs over West Africa using TRMM-PR and CMORPH

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We present comparisons of rain occurrence frequency and rain rate retrievals of the Cloud Physical Properties - Precipitation Properties (CPP-PP) algorithm against Tropical Rainfall Measurement Precipitation Radar (TRMM-PR), Climate Prediction Center Morphing Technique (CMORPH), and a subset of African Monsoon Multidisciplinary Analysis (AMMA) rain gauge data over West Africa for two monsoon seasons (May – September of 2005 and 2006). Special focus is put to the evaluation of the seasonal monsoon progression and the daytime cycle of precipitation.

The Spinning Enhanced Visible and Infrared Imager (SEVIRI) onboard the Meteosat Second Generation (MSG) satellites is the first satellite instrument with the potential to provide frequent retrievals of rain occurrence frequency and rain rate from a single instrument, thereby taking advantage of information on cloud physical properties derived from visible and near-infrared observations (Roebeling and Holleman, 2009). For the 2005 and 2006 monsoon seasons it is investigated whether the CPP-PP algorithm is capable of retrieving rain occurrence frequency and rain rate over West Africa with sufficient accuracy, using Tropical Rainfall Measurement Mission Precipitation Radar (TRMM-PR) observations as reference. The second goal of this research is to assess the capability of CPP-PP to monitor the seasonal and daytime evolution of rain occurrence frequency and rain rate during the West African Monsoon (WAM) using CMORPH rainfall observations.

It is shown that the median instantaneous rain occurrence frequency and rain rate from CPP-PP are 10% and 8% higher, respectively, than observed by TRMM-PR. Further, from examination of CPP-PP and TRMM-PR relative frequency distributions it follows that relative differences between CPP-PP and TRMM-PR are within +/- 10%. In addition, CPP-PP shows very good agreement with the rain gauge observations up to 5 mm/h. However, between 5 and 16 mm/h CPP-PP overestimates relative to the rain gauge observations. With respect to the second goal, it is shown that both the accumulated precipitation and the seasonal progression of rainfall throughout the WAM is in good agreement with CMORPH, although CPP-PP retrieves higher amounts in the coastal region of West Africa. Using latitudinal Hovmüller diagrams, a fair correspondence between CPP-PP and CMORPH is found, which is reflected by high correlation coefficients ($\sim$0.7) for both rain occurrence frequency and rain rate. The daytime cycle of rainfall from CPP-PP shows distinctly different patterns for three regions in West Africa throughout the WAM, with a decrease in dynamical range of rainfall near the Inter Tropical Convergence Zone (ITCZ). The dynamical range as retrieved from CPP-PP is larger than that from CMORPH. It is suggested that this results from both the better spatio-temporal resolution of SEVIRI, as well as from thermal infrared radiances being partly used by CMORPH, which likely smoothes the daytime precipitation signal, especially in case of cold anvils from convective systems.