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Identification and Diagnosis of Rainfall Types over Southern West Africa Using Satellite and Rain Gauge Data

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Rainfall over Southern West Africa (SWA) is mainly controlled by the West African Monsoon circulation. Not much is known, however, about the (thermo-)dynamic environmental conditions and storm dynamics of various regional rainfall systems that contribute to the total annual rainfall. This study exploits both satellite and rain gauge measurements to quantify the contribution and to examine the importance of different rainfall types in SWA.
For the period of the Tropical Rainfall Measuring Mission (TRMM) 1998-2014, the rainfall types are identified by analyzing the 3-D reflectivity structure using scans of the TRMM Precipitation Radar (TRMM-PR). Since TRMM-PR scans only provide instantaneous snapshots, the rainfall events are then traced back and forward in time with observations from the Spinning Enhanced Visible and Infrared Imager (SEVIRI) over the overlapping period of 2004-2014 to obtain information about their life cycle.
The composition of the ensemble of the different rainfall types exhibits a substantial regional variability across SWA. Strong convection (Radar echo > 40 dBZ) generally makes a dominant contribution to the number of rainfall events and to the total rainfall amount. However, the influence of deeper (40 dBZ echo at altitudes > 10 km) and wider (Area of 40 dBZ echo > 1000 km^2) systems on the total rainfall amount increases going farther northward into the continent. Additionally, the number of tracks of those systems features relative minima along the Ivorian and Ghanaian-Togolese coast, the latter reflecting the climatologically dry Dahomey Gap. In contrast, local warm rain from isolated shallow convection develops more often along the immediate coast line. Yet, their contribution to total rainfall remains negligible and is almost non-existent further north. Compared with high-resolution rain gauge data around Kumasi, Ghana, for the year 2016, it can be assumed that warm rain events show an even higher occurrence frequency. Likewise, their fraction to total registered rainfall is low. Due to the fact that the phase of the precipitation clouds is not known, a more detailed quantification of rainfall from warm clouds (including the super-cooled phase) remains an ongoing challenge. The examination of (microphysical) cloud properties from CLAAS-2 data (Cloud Property Dataset Using SEVIRI, Edition 2) and from data of the X-band radar deployed in Savé, Benin, during the DACCIWA field campaign (Dynamics-Aerosol-Chemistry-Cloud Interaction in West Africa) in summer 2016 is considered to be an appropriate option to realize this.