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Extreme flooding in the West African cities of Dakar and Ouagadougou – atmospheric dynamics and implications for flood risk assessments

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In this study, two extreme, high-impact events of heavy rainfall and severe floods in West African urban areas (Ouagadougou in 2009, Dakar in 2012) are investigated in terms of their atmospheric causes and statistical return periods. In terms of the synoptic-convective dynamics, the Ouagadougou case is truly exceptional. A succession of two strong and temporarily slow-moving African Easterly Waves (AEWs) caused record-breaking values of tropospheric moisture and low-level relative vorticity, thereby providing the synoptic forcing for the nighttime genesis of Mesoscale Convective Systems (MCSs). Ouagadougou was hit by two successive MCSs, the latter being possible due to the rotation and swift moisture refuelling by the strong convergence in the AEW-related vortex. It is speculated that this case may allow a glimpse of a new type of extreme Sahelian rainstorms. Similarly to the Ouagadougou case, an AEW was instrumental in the overnight development of an MCSs to the east of Dakar, but neither the AEW vortex nor the tropospheric moisture content was as exceptional as in the Ouagadougou case.
The Return Value (RV) analysis suggests that TRMM 3B42 data appears to be suitable to estimate centennial RVs using the "peak-over-threshold" approach with a GPD fit, though the good performance might be a result of errors in estimating extreme rainfall over the arid Sahel. On the contrary PERSIANN-CDR is inappropriate for this purpose, despite having a twice as long observational period. The Ouagadougou event also shows that highly unusual dynamical developments can create extreme situations well outside of any RV estimates from century-long daily rainfall observations.