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Representation of precipitation and top-of-atmosphere radiation in a multi-model convection- permitting ensemble for the Lake Victoria Basin (East-Africa)

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Extreme weather events, such as heavy precipitation, hail storms, heat waves, droughts and strong wind gusts have a detrimental impact on East African societies. The Lake Victoria Basin (LVB) is especially vulnerable, due to a large and growing population at risk from flooding. Moreover, nightly storms on the lake often catch fishermen by surprise. As the frequency and intensity of weather and climate extremes in the region is projected to further increase substantially with climate change, so do the risks. This has potentially major consequences for livelihoods and policy. The ultimate aim of the CORDEX Flagship Pilot Study ELVIC (Climate Extremes in the Lake Victoria Basin) is therefore to investigate how extreme weather events will evolve in the future in the LVB and to provide improved information to the impact community. ELVIC brings together different research groups that perform simulations with multiple high-resolution regional climate models operating at the convection-permitting scale (CPS) (https://ees.kuleuven.be/elvic). As a first step towards this overall goal, the added value of the CPS on the representation of deep convective systems in Equatorial Africa is assessed. For this purpose, 10-year present-day model simulations were carried out with five regional climate models at both parameterized and convection-permitting scales, namely COSMO-CLM, RegCM, AROME, WRF and MetUM .

Similarly to other regions in the world, there is no unanimous improvement nor deterioration in the representation of the spatial distribution of total rainfall and the seasonal cycle when going to the CPS. Moreover, substantial biases in the multi-annual averages (up to 30 W m^{-2}) and seasonal cycle in Top-Of-Atmosphere (TOA) upward radiative fluxes remain, both in some models with parameterized and with explicitly resolved convection. Most substantial systematic improvements were found in the representation of the diurnal cycle in precipitation, the diurnal cycle in TOA

radiation, some metrics for precipitation intensity and number of rain events. More specifically, the timing of the daily maximum in precipitation is systematically delayed when going to the CPS, thereby improving the agreement with observations. In particular, peaktime of precipitation strongly improves over land, especially at the shores of the lake, indicative of a better representation of the impact of the lake-land-mountain circulations on the convection at CPS. The underestimation in the 90th rainfall quantile of three-hourly precipitation in the parameterized models is alleviated. For the 95th and 99th percentile of precipitation no clear improvement nor deterioration is found, which might be related to poor observational constraints on extreme precipitation. The large overestimation in the total number of rainy events is alleviated when going to the CPS. The diurnal range in the radiative fluxes at the TOA strongly improves when going to CPS, especially for the longwave. All this indicates that the representation of the convective systems is strongly improved when going to CPS, giving confidence that the models are a valuable tool for studying how extreme precipitation events evolve in the future in the LVB.