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Large-scale versus regional drivers of climate change in the Lake Victoria basin

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Severe thunderstorms pose a constant threat to more than 30 million people living along the shores of Lake Victoria (East Africa). Thousands of fishermen lose their lives on the lake every year, and capsizing accidents with passenger ferries and transport boats are frequently reported. Moreover, hazardous thunderstorms affect people living inland, continuously facing flood risks.

In this data scarce region, atmospheric models are particularly useful tools to better understand the region's complex climate, especially when simulated at convection-permitting resolution. For example, such models already demonstrated the importance of the lake in determining the diurnal precipitation cycle, and highlighted the role that mountain blocking of easterly trade winds plays in explaining the regional rainfall pattern.

Such models also allow us to generate high-resolution future projections for this region. In this study, a surrogate global warming approach has been applied. In a first simulation, the ensemble mean of the recent global climate projections from the CMIP6 data set was used to perturb the lateral boundary conditions from the ERA 5 reanalysis. In this ensemble mean, variations in (large scale) atmospheric dynamics are negligible and the climate change signal is mainly determined by the increased water vapour related to the warming and the response of the mesoscale circulation to differential lake/land heating. Specifically, while increased water vapour tends to increase total precipitation, weakened mesoscale circulation makes the over-lake rainfall to reduce instead. In a second simulation, a CMIP6 member with larger large-scale dynamical changes in the region was chosen to perturb the ERA5 lateral boundary data, thereby changing both the thermodynamics and the dynamical fields. Combining both simulations enables us to study the effects of changed large-scale dynamics and its interaction with the mountain peaks on mean and extreme precipitation in the region, thereby gaining insight in expected future changes of the region's hazardous thunderstorms.