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Extreme events evaluation over African cities with regional climate simulations

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The warming of the climate system in recent decades is evident from observations and is mainly related to the increase of anthropogenic greenhouse gas concentrations (IPCC, 2012). Given the expected climate change conditions on the African continent, as underlined in different publications, and their associated socio-economic impacts, an evaluation of the specific effects on some strategic African cities on the medium and long-term is of crucial importance with regard to the development of adaptation strategies. Assessments usually focus on averages climate properties rather than on variability or extremes, but often these last ones have more impacts on the society than averages values.
Global Coupled Models (GCM) are generally used to simulate future climate scenarios as they guarantee physical consistency between variables; however, due to the coarse spatial resolution, their output cannot be used for impact studies on local scales, which makes necessary the generation of higher resolution climate change data. Regional Climate Models (RCM) describe better the phenomena forced by orography or by coastal lines, or that are related to convection. Therefore they can provide more detailed information on climate extremes that are hard to study and even harder to predict because they are, by definition, rare and obey different statistical laws. The normal bias of the RCM to represent the local climatology is reduced using adequate statistical techniques based on the comparison of the simulated results with long observational time series.
In the framework of the EU-FP7 CLUVA (Climate Change and Urban Vulnerability in Africa) project, regional projections of climate change at high resolution (about 8 km), have been performed for selected areas surrounding five African cities.
At CMCC, the regional climate model COSMO-CLM has been employed: it is a non-hydrostatic model. For each domain, two simulations have been performed, considering the RCP4.5 and RCP8.5 emission scenarios, and forced by the global model CMCC-MED (whose atmospheric component is ECHAM5). At CSIR, the CCAM variable-resolution atmospheric global circulation model has been used: when applied in stretched-grid mode, it effectively functions as a regional climate model. All the projections are for the A2 emission scenario. The model has been forced with the output of six different Coupled General Circulation Models (CGCMs) used in AR4.
The availability of climate simulations covering the period 1950-2100 gives the possibility to investigate temperature and precipitation extreme events over the cities of interest. The variations of these fundamental climate parameters will condition different hazards at different time-scales, having a stronger impact on goods and populations. For both of them, the computation of several indicators has been done on daily time basis over four seasons. Particularly relevant for Africa is the frequency and duration of heat waves and the increase of highest temperature values, but also the occurrence of droughts. A way to assess extreme events in natural phenomena is through the concept of average recurrence intervals, often referred to as ‘return periods’, defined as the average period between exceedances of a given value.
Results obtained with both the models for the time period 1971-2000 will be compared with CRU dataset and with observational data provided by local municipalities. Finally, results related to future periods for different scenarios will be analysed.