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Statistical and dynamical downscaling in CORDEX-Africa: differing views on the regional climate

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The need for credible regional climate change projections for use in adaptation actions and decision making is well recognised. The CORDEX activity has evolved in large part as a response to this need. For the most part, CORDEX has so far been dominated by regional climate modelling (RCM) activities. However, implicit in CORDEX is the use of statistical downscaling (SD) as a complement to RCMs, although the SD activities lag that of the RCMs. For Africa, the CORDEX RCM work is well advanced with the control climate simulations completed, and a number of RCM-based projections also available. The early results indicate the RCMs produce a credible representation of the regional climate when aggregated in time and/or space, and provide an initial multimodal suite of regional climate change projections for Africa. The SD activities are catching up with this process and the emerging challenge is how to integrate and compare the results from the two downscaling methods.

The two approaches, SD and RCMs, have respective strengths and weaknesses, but are considered in the literature to be of comparable overall skill. Where climate change stationarity is not considered a major issue, such as on timescales out to perhaps 2050, it is arguable that SD (comprehensively undertaken) may possibly be more skillful.

From the perspective of users of regional scale projections, decision makers and policy developers, it is critical to compare, and assess the relative strengths of the methods on a regional basis. To avoid confusion the contradictions and/or robust messages emerging from the two methods needs to be clearly understood and articulated.

The inter-comparison between the RCMs is already the subject of a number of papers, and here we present an initial comparison of early results between the SD and the envelope of RCM downscaling for CORDEX-Africa. Using the available SD results, we consider where the overlap and/or marked differences lie between the two methods. The focus is primarily on the control climate, where the downscaling is forced by the ERA-reanalysis data set, to avoid complicating factors possibly arising from non-stationarity issues with both SD and the RCMs. Following this we consider some early results of future climate projections based on the boundary conditions from CMIP5 GCM data.

The primary consideration is how the statistical downscaling results fall within the envelope of the regional climate models. In this we consider both the bias of the regional climate models, the seasonal cycle, and the shorter time scales of weather events and the histogram distribution of daily events including extremes. Of particular concern is how the downscaling methods handle both the high and low frequency variance of the regional climate systems. The SD method uses daily data to derive the deterministic response to the large-scale forcing and adds the high-frequency variants or stochastic component. From this time and space aggregates comparable to the RCM data may be compiled.

The primary difference between SD and RCMs lies in the fact that the SD is inherently bias corrected by virtue of the method. Thus the first major difference is accountable for by the RCM bias. Following this the differences are regionally and seasonally dependent and examples of these are presented from which preliminary conclusions about the two methods are drawn