

## ***Interactive comment on “A review of droughts in the African continent: a geospatial and long-term perspective” by I. Masih et al.***

### **Anonymous Referee #2**

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The paper is a review of droughts of the African continent at the continental, regional and country level by drawing on analyses using observations, models, and proxy reconstructions. The review covers the results of several studies grouped by region as well as by the physical mechanisms involved. The review focuses primarily on droughts from 1900–2013 but addresses past centuries as well and goes on to draw conclusions about the future intensity and frequency with which droughts are likely to occur.

A review of the current state of knowledge about drought across the African continent is a topic relevant to the readership of HESS, however, the article as it stands requires substantial revisions.

General Comments:

C1257

Although evaluating a complex phenomenon such as droughts from the past, present and future at multiple spatial scales and across the entire continent may have merit, doing so in a single review article doesn't seem feasible. Perhaps limiting either the spatial or temporal scale of the scope of the article would make the topic more tractable. This would allow the authors to adequately cover the topic in an article of manageable length. As it stands, aspects of the article provide a discussion that is too brief to be useful.

Section 3.3 (Causes of Drought) is, in places, inadequate in its representation of the literature. The description of the causes of drought in each region focuses primarily on ENSO, and largely ignores - or notes as an aside - other influencing factors. In East Africa and Southern Africa, for example, inadequate consideration is given to the influence of the Indian Ocean or the Walker circulation (Funk et al., 2008; Park and Funk 2011). Neither is there any discussion of the influence of the Atlantic Ocean and the Atlantic Multidecadal Oscillation for this region (Giannini et al., 2013). The description of causes of drought for Northwest Africa is virtually nonexistent. Northwest Africa should either be removed from this study, or this section needs to be substantially expanded.

The conclusion that droughts will continue to become more frequent in the future based on comparisons of the four most intense droughts of the first half of the 20th century vs. the second half is not adequately supported. Without a physical mechanism, the difference is neither clear nor distinguishable between a one-time shift in climate and a continuing trend. Although the authors reference Giannini et al. (2008), this discussion should be emphasized (i.e. reference Fig. 1 from Giannini et al.). Choosing only four events for their figure leaves the reader wondering why only four were chosen and whether the relationship of increasing drying holds true across severities of drought as defined by intensity and frequency. The chosen diagram, for instance, tells the reader nothing about the evolution of the frequency of middle-intensity droughts across the continent.

C1258

Droughts of the recent past are often listed as evidence of the increasing intensity of drought. Due to possible observation bias, listing droughts of the recent past is not sufficient to demonstrate that droughts have become more frequent (i.e. recent droughts have been well recorded while the more distant past is less well documented).

The discussion of future droughts across the African continent seems muddled. The majority of the evidence – and of the description in the text – speaks to the difficulty of simulating droughts in GCMs, but the authors then conclude that despite the many complexities and limitations that droughts will almost certainly be “widespread and extreme” in the future. This seems to be implying that droughts will certainly intensify in the future, which is unsupported by the evidence provided. If this is not the case, it should be clarified. Additionally, it is unclear if this conclusion applies to the entire continent uniformly or whether different regions will experience differing patterns of drought in the future.

Specific Comments: p 2685 lines 0-10: The authors note several ways that others have divided the continent into regions, but do not explicitly state how they will do so for this study.

p2688 lines 27-28: Given the limited temporal coverage for most countries, as noted in lines 9-11 of the same page, is the EM-DAT data reliable for diagnosing this?

p2688 lines 28-29 refers to the three most intense droughts in the text but the actual figures show four droughts from each time period. What is the justification for the number of droughts chosen, and does this relationship hold true across a greater number of droughts?

p2689 lines 6-9: clarify this sentence, I'm not sure I understand it completely (i.e. which areas are vulnerable, and why is that information relevant to the frequency?)

p2689 lines 11-13: provide references for multi-year droughts in the Sahel being more common, and being less common in East Africa

C1259

p2689 lines 23-28: it seems unnecessary to list out all of the regions indicated as vulnerable. A figure could be useful, but the information in text form is cumbersome

p2692 lines 8-15: A mass-citation of studies is inappropriate. Please separate the references into more specific citations so as to be useful for the reader. For example, they could be separated based on those looking at natural phenomenon only, those that sought to identify anthropogenic causes and those that did both.

p2695 lines 10-20: Line 18 seems to imply increasing frequency and severity of droughts, which contradicts the uncertainty expressed in line 10. Please clarify.

Technical Comments:

Throughout the text the phrase “vulnerable” is used to refer to two separate concepts: the idea that an area frequently experiences droughts (exposure), and the idea that a region has limited capability to mitigate the consequences of those droughts (vulnerability). These should be separated as some readers will interpret the phrase “vulnerable to drought” as referencing only the ability of a region to cope with droughts, not the frequency with which they occur.

Works Cited:

Williams a. P, Funk C. A westward extension of the warm pool leads to a westward extension of the Walker circulation, drying eastern Africa. *Clim Dyn.* 2011;37(11-12):2417–2435. doi:10.1007/s00382-010-0984-y.

Funk C, Dettinger MD, Michaelsen JC, et al. Warming of the Indian Ocean threatens eastern and southern African food security but could be mitigated by agricultural development. *Proc Natl Acad Sci U S A.* 2008;105(32):11081–6. doi:10.1073/pnas.0708196105.

Giannini a, Salack S, Lodoun T, Ali a, Gaye a T, Ndiaye O. A unifying view of climate change in the Sahel linking intra-seasonal, interannual and longer time scales. *Environ Res Lett.* 2013;8(2):024010. doi:10.1088/1748-9326/8/2/024010.

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