The 2014 drought in the Horn of Africa: attribution of meteorological drivers

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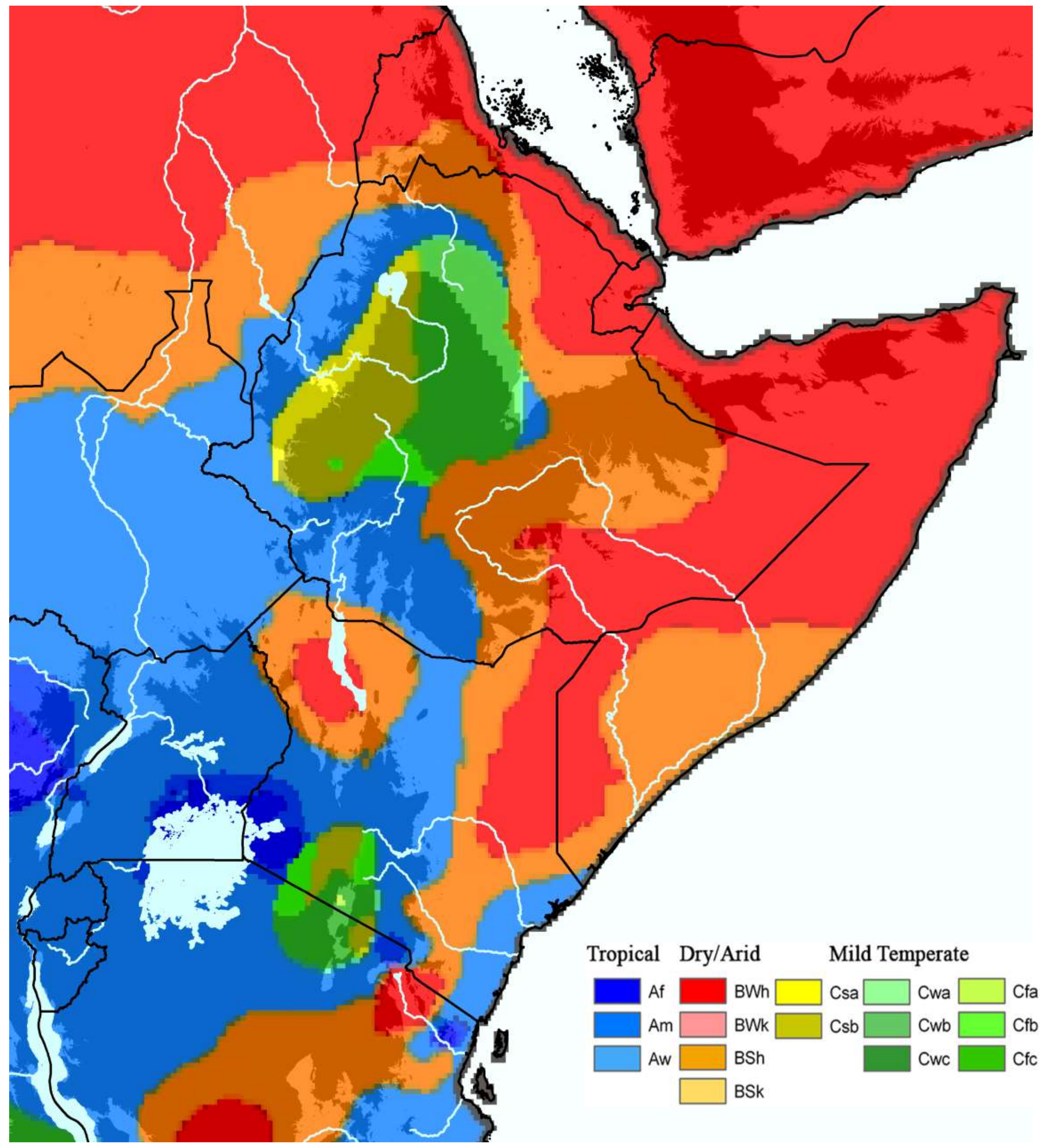
The Attribution of Climate-related Extremes (ACE) in Africa project, Univ. Oxford http://www.eci.ox.ac.uk/research/climate/ACEAfrica.php .



Summary

Ensemble modelling of the East African 2014 long rains season suggests no anthropogenic influence on the likelihood of low rainfall but clear signals in other drivers of drought.

Introduction

Drought has always been a natural part of climatic variability in Africa (Masih et al. 2014), but the Greater Horn of Africa region (GHoA, Fig. 1) is more vulnerable than most regions to the impacts of drought because of a unique combination of several adverse factors. Despite favourable soils, the GHoA has long experienced widespread poverty and high levels of food insecurity. Political instability and the high dependence of GHoA's population on rain-fed agriculture exacerbate the impacts of droughts.

The focus of this study is the 2014 drought in GHoA. In late 2013, the short rains failed almost completely in Kenya, South Sudan, Somalia and southern Ethiopia, leading to an abnormally-dry growing season January to March 2014, followed by a widespread drought in many agricultural areas of the GHoA because of much-reduced long rains during March to June. Identifying causal links between particular events and their underlying drivers is not trivial: causality is seldom clear-cut and events such as drought usually occur as a result of a combination of Earth system processes, not all of which (or perhaps none of which) are related to anthropogenic greenhouse gas emissions. In this study we ask whether human-induced climate change played a role in the meteorology of the 2014 East African long rains season that could have contributed to the 2014 drought in the GHoA.

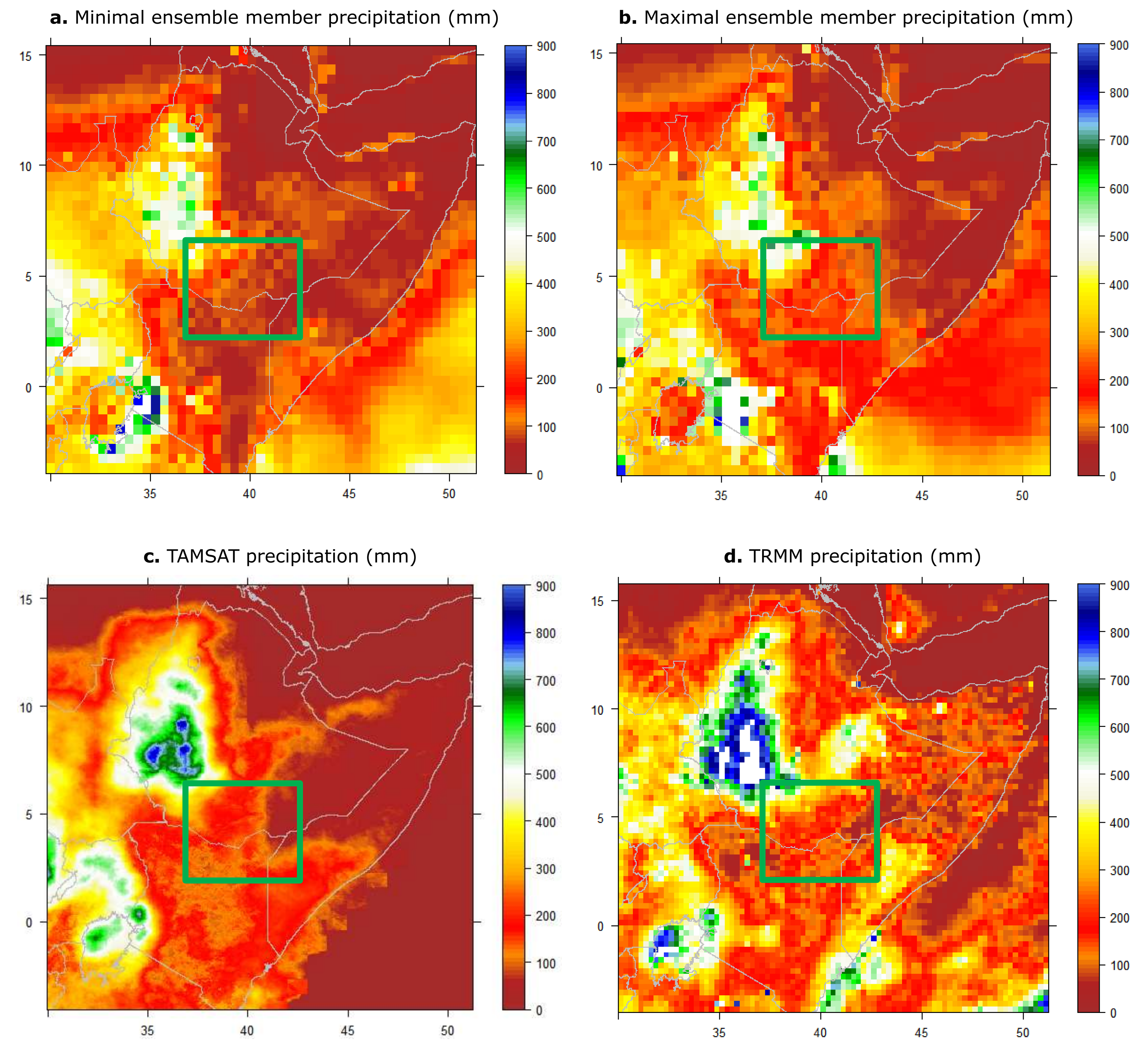


Fig. 1: Long rains (March to June) total precipitation for 2014 as simulated from the *weather@home* factual experiment, showing the two ensemble members that presented the (a) driest (mean=94 mm) and (b) wettest (mean=195 mm) seasonal means. For comparison, estimates of the observed precipitation for the same season are shown from (c) the TAMSAT (mean= 169 mm) (n.b. Yemen and oceanic points are not included in TAMSAT) and (d) TRMM datasets (mean=201 mm). The Centre of Desiccation during the 2014 drought is boxed.

Results and discussion

Two sets of simulations were employed: one *factual* set generated from multiple realisations of the event in question using observed climate forcings and one *counterfactual* set based not on the 'world that is' but rather the 'world that might have been without higher greenhouse gas emissions' (e.g., see Otto *et al.* 2013).

We focussed on the long rains season (Mar-Jun) total precipitation over the Centre of Desiccation during the 2014 drought (Fig. 1). From comparing factual and counterfactual ensemble runs, anthropogenic changes in greenhouse gas concentrations appear to have increased the occurrence frequency of higher temperatures at the surface at the same time as reducing radiation input and leaving precipitation unchanged (Fig. 2).

Although these findings are not a clear attribution of the 2014 drought to human influences, our results show that anthropogenic influence could well have contributed to drought conditions during the East African long rains. However, increased temperature and net incoming radiation at the surface both naturally enhance evaporation and, in the presence of sufficient water availability, promote enhanced vegetation productivity and both of these effects would have enhanced the conditions for either or both of hydrological or agricultural drought. Therefore, more comprehensive studies are required before more definitive statements can be made.

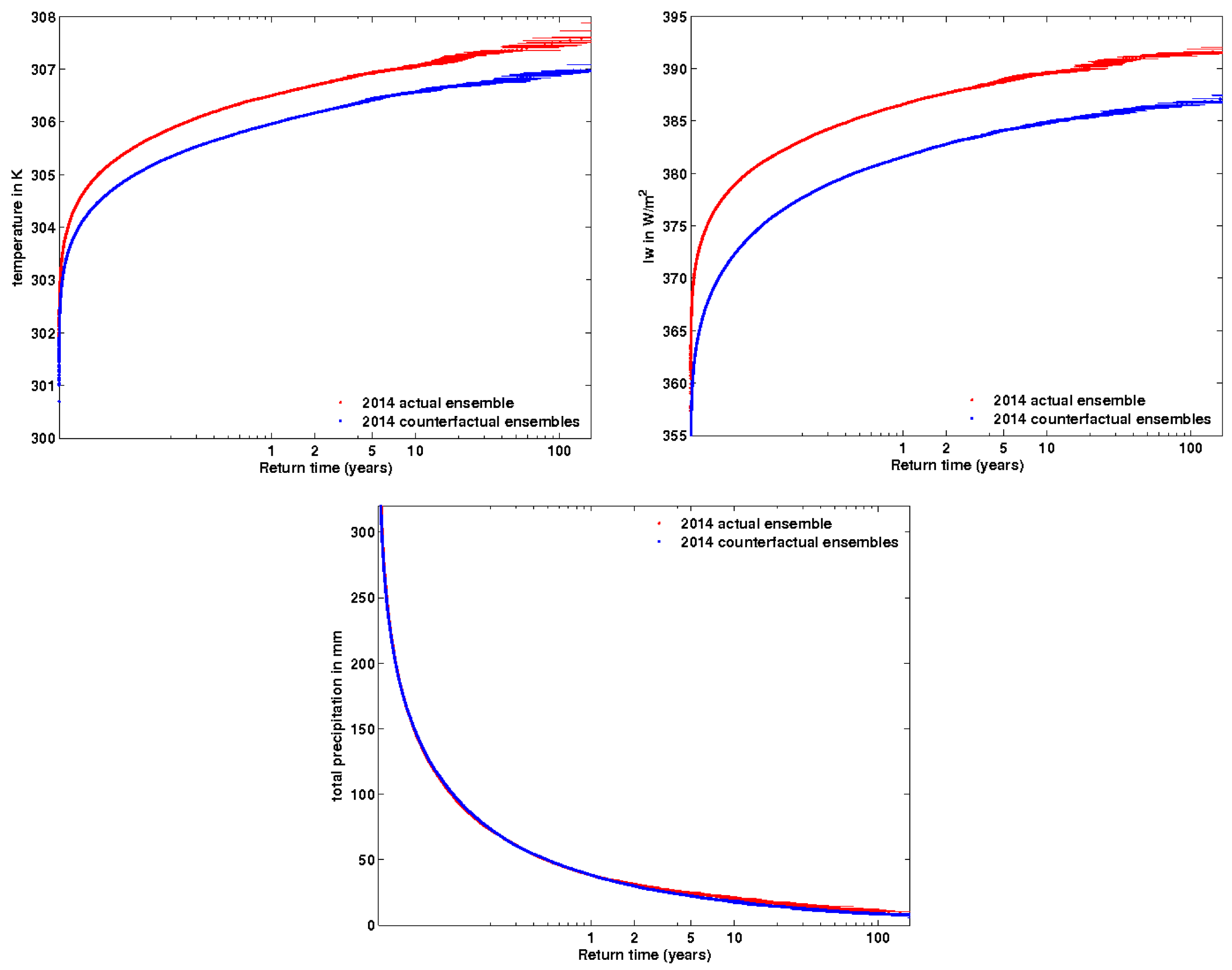


Fig. 2: Return-time periods from the regional model (HadRM3P) showing the change in occurrence frequency between simulations of the factual (red) and counterfactual (blue) ensembles for extreme values of a selection of climate model outputs (UPPER LEFT) Temperature, (UPPER RIGHT) Downward shortwave radiation received at the surface and (LOWER) Total precipitation. Means and 5-95% confidence intervals are calculated from bootstrapping for each threshold value across all ensembles (for details see Otto et al. 2013).

References

Masih, I., S. Maskey, F. E. F. Mussá, and P. Trambauer, 2014: A review of droughts on the African continent: a geospatial and long-term perspective. *Hydrol. Earth Syst. Sc.,* 18, 3635-3649.

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