Investigating the Impact of Projected Timing of Climate Departure on Crop Yield over West Africa

Temitope S. Egbebiyi, Chris Lennard, Olivier Crespo, Modathir Zaroug
Climate System Analysis Group, Department of Environmental and Geographical Science, University of Cape Town, South Africa
tsegbebiyi@gmail.com

Climate System Analysis Group

Background

➢The impact of climate change is projected to affect food security in the future. Further warming (i.e. a time when mean local temperature exceeds historical high) are projected may aggravate the current risk and introduce new ones (Mora et al., 2013, IPCC,2014a).

➢Hence, the 2015 Paris Agreement concludes with a two point resolution on temperature to; holding the increase in the global average temperature to well below 2^{o}C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5^{o}C with the aim to reduce the impact of climate change.

The West African Region

➢West Africa, whose livelihood and economy is mainly rain fed agriculture, is one of the most vulnerable regions and has suffered significantly from climate change impacts with large impacts on food production owing to its low adaptive capacity.

➢Climate departure are projected to occur by 1-2 decades earlier than the global average in tropical West Africa and warming above 2°C are projected to have negative effects on crop yield over the region mostly in the savannah than the Sahel

➢Therefore, there is a need to Investigate the the projected time of reaching the 1.5 and 2^{o}c warming (timing of climate departure from historical period), climate-crop thresholds and how it may affect crop yield over West Africa.

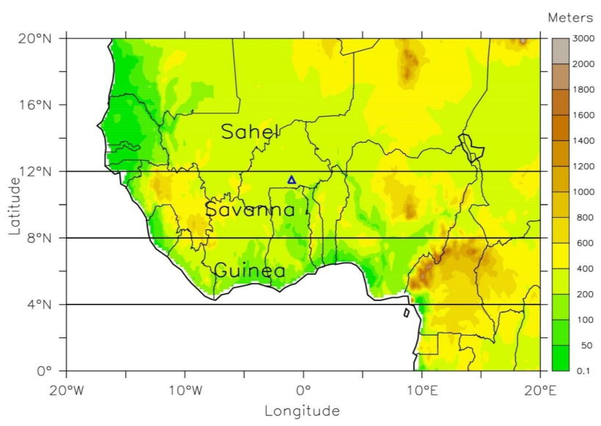

Figure 1: West African topography and ecological zones, designated as Guinea, Savannah and Sahel, respectively. (Abiodun et al., 2012a)

Data and Methodology

➢10 Global Climate Models, GCMs (ACCESS1-0, ACCESS1-3, bcc-csm1-1, BNU-ESM, CESM1-BGC, CMCC-CM, CMCC-CMS, FGOALS_g2, GISS-E2-H_p1, GISS-E2-H_p2) simulations from the Couple Model Intercomparison Project. phase 5 (CMIP5) were analysed for the study for the pre-industrial period of 1850-1900 and 2006-2100 under RCP8.5 emission scenario

➢The projected time of reaching the 1.5 and 2^{o}c warming (timing of climate departure from historical period) was calculated using a 30-year moving global average for temperature and rainfall over West Africa

➢Statistical methods, standard deviation and z-score values were used to test significance and timing of climate departure from pre-industrial period baseline

➢Standard deviation values below or above 2 were significant . Z-score values are significant at 95% (below or above 1.99) and we reject the null hypothesis for value between -1.99 and +1.99

Preliminary Result (Temperature)

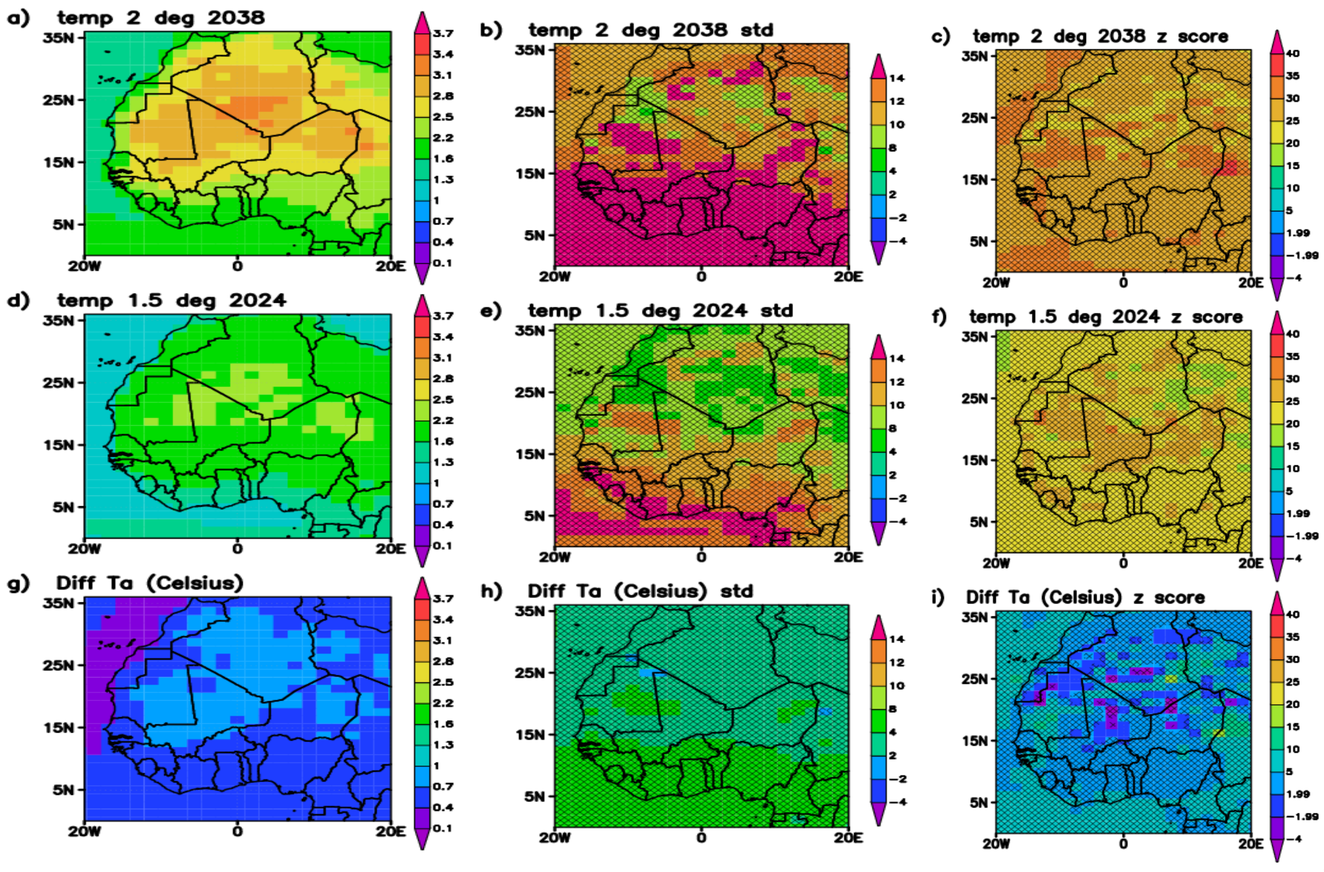

Figure 2: The projected timing of reaching 1.5 & 2^{o}c warming over West Africa .Timing was calculated using a 30-year moving global average temperature anomaly from 10GCMs using the pre-industrial period,1850-1900 as baseline and up to 2100 under RCP8.5 emission scenario.

Preliminary Result (Rainfall)

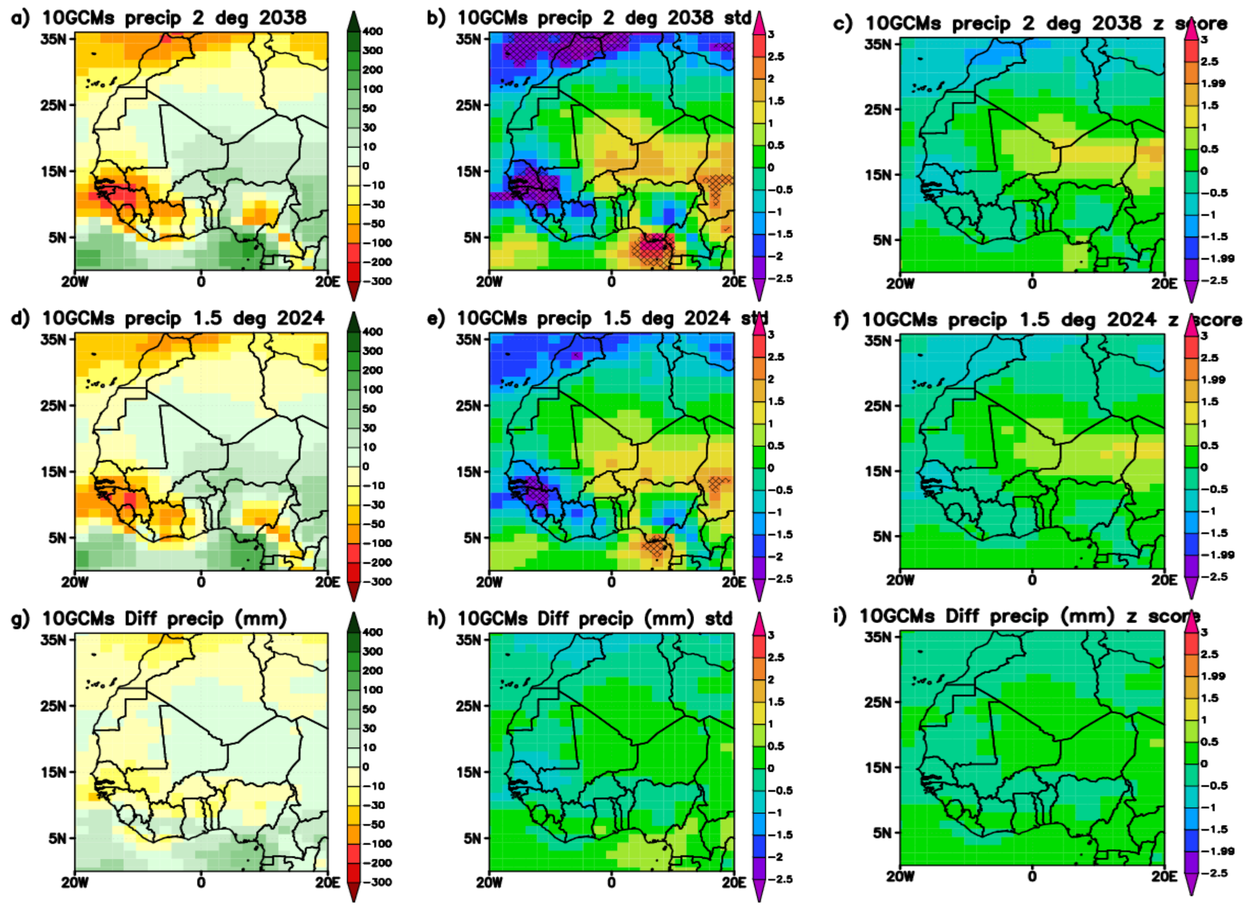

Figure 3 : Same as figure 2 but for precipitation

➢The 1.5 & 2^{o}c warming (i.e. temperature and rainfall departure from historical range) are projected to occur in 2024 and 2038 respectively over West Africa and Morocco in northern Africa

➢The temperature departure from local historical mean are more pronounced South of 15^{o}N of the region shown from the Standard deviation and Z score values

➢However, the are uncertainty in the projected timing of precipitation departure from historical range over West Africa in comparison to that observed in temperature

➢The projected temperature departure from historical mean will occur by about a decade earlier (2038) over West Africa as compared to the global average temperature departure (2047) as projected in Mora et al. (2013)

Conclusion

➢Warming 1.5 & 2^{o}c is projected by 2024 and 2038 respectively over West Africa and may lead to exceedance of historical local mean of temperature and precipitation over the region

➢The projected temperature and rainfall departure from historical range may be aggravate decline in agricultural production of the region whose mainstay economy is rain fed owing to its vulnerability and low adaptive capability

Further Work

➢To investigate the time of reaching 1.5 & 2^{o}c warming (timing of climate departure from historical period) at a higher resolution using Regional Climate Models (RCMs)

➢To define climate-crop threshold and examine the impact of this warming on crop yield and agricultural production over West Africa

➢To to develop and investigate how the timing of adaptation to the projected timing of climate-crop departure will influence crop yield over West Africa

References

➢IPCC: Climate Change 2014: Synthesis Report, in: Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, IPCC Geneva, Switzerland, 151 pp., 2014a.

➢Mora, C., Frazier, A. G., Longman, R. J., Dacks, R. S., Walton, M. M., Tong, E. J., ... & Ambrosino, C. M. (2013). The projected timing of climate departure from recent variability. Nature, 502(7470), 183-187.

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