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# *Interactive comment on* "Vegetation-climate feedbacks modulate rainfall patterns in Africa under future climate change" *by* M. Wu et al.

**Anonymous Referee #1**

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This paper presents analysis of simulations with a regional climate model constrained by an earth system model (ESM) and coupled with a dynamic vegetation model (DVM). In the 21st c. simulation forced with the RCP8.5 scenario, including vegetation feedback led to drying in central Africa.

A clarification on the model setup is needed. The authors mention (lines 478-481) that "SSTs were prescribed from CanESM2, therefore the land-ocean thermal contrast . . . originated solely from the changes . . . induced by vegetation dynamics". As far as I can see, this is the last mention of the prescribed SSTs in the paper, but exactly what are these prescribed SSTs? Climatology? For what period? Given the known sensitive of the West and central African climate to SSTs, this needs to be explained carefully and the SSTs prescribed need to be evaluated. A coupled model such as the Can ESM2 is not necessarily producing correct SSTs for the observational period. Of particular



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concern for the region of the analysis is the seasonal formation of the Atlantic cold tongue which, I believe, generally fails to form in coupled GCMs.

The biases in the regional model are significant (Fig. 1). The dry bias in the Congo Basin in the regional model (Fig. 1. b2), while common in models, seems extreme but it is similar to the dry bias in the ESM (Fig. 1.b3). It is important to consider how these biases influence the results, especially since one of the big results is additional drying in central Africa.

The wet bias in the Sahel in the regional model is unusual – many models fail to bring rainfall into the Sahel, as is the case for the ESM that is providing boundary conditions for the regional simulation (Fig. 1.b3). Is it relevant to the results that the regional model over-produces rainfall primarily in the spring?

I am puzzled by the large differences between the GPCP and CRU precipitation observations shown in the Sahel ("northern savanna") Fig. 2.b1. I think this is more related to the choice of averaging region than to a disparity in the observations, given the difference in the resolution of these 2 data sets. Please check this.

References to the Charney (1975) and related studies are problematic since the idea that vegetation changes (i.e., "over-grazing") caused the precipitation decline in West Africa during the 1960's and 70's has been thoroughly refuted in the mode modern literature. It's SSTs forcing, of course.

The authors note (lines 240-242) that "The simulated patterns and magnitude of precipitation for this area are similar to a previous study using an earlier version of RCA, RCA3.5, without dynamic vegetation". So doesn't that mean that dynamic vegetation is not influential, in contrast to the findings of this paper?

I would appreciate seeing an evaluation (e.g., a comparison with the ERAI reanalysis) of the circulation and specific humidity at 850 hPa wind and specific humidity from the present day, NFB simulation since the authors are pointing to changes in the circula-

tion/moisture advection as relevant. This seems more crucial than evaluating LAI, for example.

There's not a lot of literature on the dynamics of the Walker circulation in this region and its sensitivity to SSTs (and/or land/sea contrast), but these recent papers will help:

Pokam WM, Djiotang LAT, Mkankam FK, 2012: Atmospheric water vapor transport and recycling in equatorial central Africa through NCEP/NCAR reanalysis data. Climate Dyn. 38, 1715-1729.

Pokam MW, Bain CL, Chadwick RS, Graham R, Sonwa DJ, Kamga FM, 2014: Identification of processes driving low-level westerlies in West Equatorial Africa. J. Climate 27, 4245-4262.

Cook, K. H., and E. K. Vizy, 2015: The Congo Basin Walker Circulation: Dynamics and Connections to Precipitation, Climate Dynamics, DOI 10,1007/s00382-015-2864-y.

A couple of minor points:

Please note that "Savannah" is the city in Georgia, U.S., while "savanna" is the grassland.

Figure A1 caption needs to be improved to provide more detail about what is plotted.

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