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Earth System Dynamics
Discussions

Interactive comment on "Intensification of the hydrological cycle expected in West Africa over the 21st century" *by* Stella Todzo et al.

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We thank the reviewer for the constructive comments. We particularly appreciate the discussion on how to account for the an ensemble of incomplete GCM-RCM combinations. All the comments have been accounted for.

Comments from Reviewer 2

This paper looks at the intensification of the hydrological cycle over West Africa, a small part of the CORDEX Africa region, using a number of the CORDEX simulations. Results are given for the multi-model mean. The paper is clearly written and describes the observational and model datasets used. The methods used to analyzed the data are not novel but are clearly described and referenced. The supplementary data is

used to show how well the individual regional simulations and the multi-model mean for the current climate agree with observations.

* Comment 1: One thing the paper omits is any justification of using a multi-model mean and any discussion of the set of CORDEX regional simulations chosen in Table 1. 8 of the 18 members using the same regional model SMHI-RCA4_v1. Does this impact on the results? Looking at Figure 3 to 5 it looks as though some of the results from the other regional model are on the edges of the ensemble of points. Dosio et al 2019 (Climate Dynamics) is not referenced and gives a comparison of the CORDEX Africa regional model results. Knutti et al 2010 (J Clim) Challenges in combining Projections from multiple models.

-> Response: We thank the reviewer for this constructive comment and useful references. They have all been accounted for in the revised manuscript as follows: "We use an ensemble of 18 high-resolution regional climate projections taken from the most up-to-date ensemble produced in the recent years for Africa: CORDEX-AFRICA (Giorgi et al., 2009; Jones et al., 2011; Hewitson et al. 2012; Kim et al. 2014). All the simulations available online at the time of the analysis have been used. In this ensemble, 5 Regional Climate Models (RCMs) are used to downscale 10 Global Climate Models (GCMs) under the climate scenario RCP8.5 (Table 1). Out of the 50 combinations possible, only 18 were available, from which 8 use the same RCM. Whereas this imbalance presents the disadvantage to slightly bias the results towards this RCM, it also presents the advantage of representing a large number of GCM, not accessible otherwise. Because the impact of the heterogeneity of the CORDEX-AFRICA GCM-RCM matrix on future precipitation changes is found mostly over Central and West Africa (Dosio et al., 2019), we choose to represent a maximum diversity of RCMs and GCMs. Furthermore, although averaging model output may lead to a loss of signal (such that the true expected change is very likely to be larger than suggested by a model average), there is too little agreement on metrics to separate "good" and "bad" models to objectively weight the models (Knutti et al., 2010). In the following, we thus use

the equal-weighted model average to illustrate the mean response of our ensemble (multimodel mean maps in Figures 1-2), and show the individual responses of each simulation using scatter plots (Figures 3-5). “

Specific comments:

* Comment 2 Page 2, L46 the first mention of CORDEX-AFRICA has no references.

-> Response: Thank you for this comment, the revised manuscript has been altered accordingly as follows: “... recent CORDEX-AFRICA (Giorgi et al. 2009; Jones et al. 2011; Hewitson et al. 2012; Kim et al. 2014) experiments ...”.

* Comment 3: Page 8 L 221 There are now published results for West Africa from a convection permitting resolution simulation over Africa. Berthou et al 2019 (Geophy Res Let).

-> Response: Thank you for this reference, it has been included in the revised manuscript as follows: “For instance, Berthou et al. (2019) have shown that over the West Sahel, future changes in extreme rainfall increase by a factor 5 to 10 at 4.5 km resolution (convection-permitting model allowing a good representation of MCSs), as compared to a factor 2 to 3 at 25 km resolution.”

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