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Earth System Dynamics Discussions

Interactive comment on "Non–linear intensification of Sahel rainfall as a dynamic response to future warming" *by* Jacob Schewe and Anders Levermann

Anonymous Referee #2

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Recommendation: Accepted after minor revisions

The present paper is concise, well written and contributes in a clear manner for the discussion of a relevant problem: what may drive rain anomalies in a future climate scenario. More precisely, the authors suggest that the SST anomaly during a warming future period in the African-Equatorial region will induce an enhancement of the moisture-advection feedback and an abrupt intensification of the African monsoon. The authors also argue that neither the local radiative land forcing nor the remote SST influence would be sufficient to explain the expected rain change. However some points must be clarified.

Major points

1 - Authors have chosen the wettest models (wet7 subset of models from the CMIP5 ensemble) in the Sahelian region by the end of 21th century. Any other criterion could be chosen (e.g. the driest models). There is no explicit evidence in the paper why the wet7 subset is the one from which one expects better future rain predictions in Sahel. Models have biases, both in the average, standard deviation, extremes etc. as we compare model simulations with a reference observed period (like that shown in Fig. 1: from $\sim$1900 to $\sim$2000).

Moreover, authors say in pg. 2 lines 19-21: 'At the same time, we note that the Wet7 models perform better than average in reproducing the magnitude of the 1970–1989 drought period'. I should stress that, from Fig. 1 you cannot conclude the above sentence from information displayed on Fig. 1.

Therefore, a simple table of statistical biases should be included to clarify the performance of wet7 subset in the reference period as compared with other models.

2 - The non-linear response P-SST (on Fig. 8), which is the main paper's result is quite interesting but deserves much explanation. Only a single phrase at the end of Section 2 refers Fig. 8 and the non-linear relationship. Authors should clarify some points.

3 - Fig. 8 shows the non-linear relationship P-SST. It is evident that some smoothing and composite averaging is done to minimize noise. Please clarify that. Do P and SST are taken over some running averages? Do results change if the binning length is shortened? What is the delay in the proposed moisture-advection feedback?

Minor points

4 - In pg. 1, line 13: Precise in the text the periods with episodes of heavy rainfall in the text.

5 - Fig. 1 In the caption, the thick grey curves are quite indicative of the trend. However, the light grey lines for the two sets of models are totally overlapped becoming useless. It would be much clear to show the temporal curves of the interval range, i.e. the

minimum and the maximum over each model set (the 7-model set and the 23-model set).

6 - pg. 2, lines 27-28 Authors say: 'This suggests that the rainfall increase is not simply a consequence of thermodynamic changes, but part of a shift in West African monsoon circulation dynamics' Justify the first sentence please.

7 - Fig 2. Caption is 'Solid black line shows the difference in average summer precipitation (mm/day, averaged over 0-30_E, 10-20_N) between the 1970–1989 drought period and the rest of the observational period ("non–drought", 1901–1969 and 1990–2009).'Therefore we expect a negative anomaly: 'drought period' minus 'observed non-drought period'. Like in other parts of the paper, it is not understood what Is the subtrahend and the minuend of the subtraction.

8 - Fig. 3. Caption: Change the word 'Difference' to the word 'Deviation from'. Difference between A and B is A minus B, so please clarify the caption.

9 - Fig. 4 There is no grey color bar for the SST anomalies. At least indicate where is the zero value.

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