Reply to Comments of Referee 1 to the Manuscript of Jungandreas et al. "How does the explicit treatment of convection alter the precipitation-soil hydrology interaction in the Holocene African humid period?"

Thank you for this very useful review!

Main comments:

1.) Throughout the text the authors refer to the period as "mid-Holocene" but in the title it says "Holocene" which of course is not wrong, but maybe a bit inconsistent.

To avoid misunderstanding, we will change the title to "… mid-Holocene African humid period".

2.) The manuscript starts with the term "storm-resolving" simulations in the second line of the abstract, which means resolved deep convection on the kilometer scale. However, the authors refer to it simply as "explicitly resolved convection" throughout the text, before calling it "deep-convection" in the last sentence of the conclusion. The terminology could be clarified in the beginning.

We will clarify the terminology. As it has now become common, we will use the term "storm-resolving" throughout the manuscript to refer to our simulations. We will also define what we mean by storm-resolving at the beginning of the manuscript to avoid confusion.

3.) The authors refer to the simulations with present day vegetation cover as "Desert Sahara". The word "Sahara" is derived from the Arabic word for desert, making the naming "Desert Deserts". A more applicable nomenclature without changing the abbreviation "DS" could be "Dry Sahara".

This is a valid point and a good suggestion. We will use the term "Dry Sahara".

4.) In line 102 the authors note: "We select two years after this 15-year soil moisture-spinup phase and start our nesting experiments for the boreal summer monsoon season." I would like to know why these two years were chosen and which of them was/were used in the analysis?

We selected the two years based on the same procedure as in Jungandreas et al. (2021). Based on the 30-year monthly mean timeseries of the 40-km simulation, JAS-mean values and the latitudinal extent of the monsoon for every year over the WA-domain, we selected a relatively strong and a relatively weak monsoon year (in terms of precipitation amount and northward extent).
In the analysis we used the strong monsoon year.
We will clarify this in the manuscript.

5.) I would be interested to know whether the precipitation in the GS and GS-cSM simulations is sufficient to sustain the prescribed vegetation cover.

For a model-consistent answer, we would need to implement a vegetation model into the regional climate model, which is beyond the scope of this study.

However, a quick first guess could help. Vegetation needs roughly 200mm/year (Joussome et al, 1999) for a transition from desert-like vegetation to steppe.

If we assume that most, if not all, monsoon precipitation falls during the months from June to September, then a value of 200 mm/year corresponds to some 1.7 mm/d in our simulation. In Figure 12c, we see that the value of 1.7 mm/d is crossed at around 24°N in the GS-cSM simulation and a bit further south in the GS simulation. This is roughly consistent with the prescribed vegetation cover, keeping in mind that north of 24°N, the Libyan Sand Sea exists in the eastern Sahara, prescribed as bare area in the model. Hence in principle the precipitation would be sufficient to maintain the vegetation cover. Wew ill add this in the revised version.

6.) In Figure 10 a) there seems to be a "separation" of 40 km-P data-points at about 10 % runoff and between 2 and 4 mm/day precipitation. This "separation" is also visible in Fig. 10 b) at about 10 % runoff with a wide range of corresponding soil moisture changes. I would be interested in an explanation for these results. Are these data- points related to a specific time during the JAS season (and thereby maybe also a region)? This is particularly interesting to me because, if these data-points are neglected, the precipitation (mm/day) to runoff (%) relationship appears to be similar for the 40 km-P and 5 km-E simulations in the overlapping range of 2.5 to 4.5 mm/day, i.e. all data-points roughly follow a linear trend.

We find that these circles indeed correspond to the first 20 days of the analyzed period. During this period, soil moisture is still low compared to later in the monsoon season. Therefore soil moisture storage is not filled. Much of the widespread light precipitation (drizzle) can be taken up by soil moisture. Later in the season when soil moisture is higher, much more of precipitation (also in form of drizzle) goes into runoff.
However, we could not identify coherent larger regions that these points correspond to. We will add these considerations.

7.) In some Figures the dpi seems to be too low (e.g. Fig. 3 or 5).

We will adjust this.

Formalities and Typos:

• Figure 1 and 8: Change "sahel" and "sahara" to "Sahel" and "Sahara".

• Figure 11 and 12: The meaning of the black dashed lines is not described in the caption.

• Line 34: Change “feed back” to “feedback”.

• Line 246: Change “becomes” to “becoming”.

• Line 282: Change “daily-change” to “daily change”.

We will revise the manuscript with respect to the Formalities and Typos.