Comment on egusphere-2022-1058
Anonymous Referee #3


This work focuses on multiyear meteorological drought in the future as reproduced by General Circulation Models (GCMs). For this, long drought events are identified by a run-theory approach within the long historical rainfall daily series that is available in Bologna, and then reproduced by different GCMs. The capability of these models to assess multiyear droughts is analyzed from their performance in reproducing, firstly, monthly and annual rainfall and, secondly, drought spells during the historical period. Future projections of the target variables are also generated by these GCMs, and the results are discussed in the context of the likely trends arising from the historical time series.

The capability of GCMs to produce reliable data of rainfall on different time scales is a relevant topic due to the use of the derived projections of future climate to identify adaptation needs and strategies in a warmer world, and the results highlight how uncertain rainfall representation can be in these models, which propagates to derived variables, such as drought occurrence, duration, and magnitude. The work is neatly presented, and fits very well within the scope of this journal.

A very comprehensive introduction is followed by a clear and sound methodology, with key and updated references throughout the work, that lead to a to-the-point description of results, and a concise discussion of their implications. The manuscript is well written and the tables and figures are useful and adequately presented. My only comment refers to the fact that the use of historical time series to predict the future occurrence and characteristics of multiyear drought is not really included in the work, which should be more explicitly said when retrieving conclusions on the comparison of historical time series and future projections by GCMs.

Some minor issues are also listed,
Lines 149-150. Please, include some comment on the choice of these threshold values. Are they scaled in Figure 3?

Lines 193-196. This paragraph starts by including all models in the same category, with poor capability to represent annual rainfall during the historical period, including their ensemble result, but the final sentence points out to the latter reproducing the mean of the observations. I suggest to redact this more clearly.

Figures 6 and 7. Please, add "of annual rainfall" in the captions.

Figure 8. Please, increase the width of the lines in the legend for observations and ensemble to facilitate their identification in the graph.

Table 4. Are DD and DI mean values during the studied period? I suggest writing "Some statistics" in the caption, instead.

Line 245. I would drop the use of "significantly" here, since no significance test is really done, even if the values show this apparent difference. This also holds in other places in the text (e.g. line 267).

Figure 11. The 30-yr moving average for the projections under the different future climate scenarios could also be added as in the historical observations.

Line 285. I would write "of SOME statistics", not so general as it is in the text.

Lines 290-294. Related to my previous comment on Table 4, these sentences would then refer to mean values and, thus, these comments should clarify that less critical mean behaviour are produced by models, although extremes are not assessed. This might also affect the run theory application if alternating extremes take place, resulting in less drought events being identified in the future projections.