

Dear Editor,

thank you very much for your guidance and assistance through the review process. We appreciate that you took the time to perform a careful reading of the manuscript, which has undergone several reviews and check again its consistency. We have addressed the remaining comments, you will find below our answers and the markup pdf shows the edits to the manuscript. Hopefully this version is suitable for publication in ESD,

best Regards,  
Davide Faranda & Flavio Pons,  
on behalf of the authors

Dear Authors,  
thank you for addressing the remaining reviewer comments. After a careful reading by myself I have a few more comments that I would like to ask you to address before the manuscript can be accepted for publication.  
The comments are pasted below this message.  
Best regards,  
Jakob Zscheischler

L245: why does  $p$  need a subscript 1? Since there is no  $p_2$ , consider removing the subscript. Currently the subscript leads to some confusion e.g. in the first line of Table 1.

**Thank you for the suggestion, we now denote the critical probability value as  $p^*$**

L248: shouldn't  $\pi$  have the subscript  $i,r$  instead of  $1,r$ , with  $i=1,2$  for the two clusters?

**Thank you, this was indeed a typo we had not found before.**

L249: step 7, the definition of cold spell analogues is unclear. The equation is incorrect when  $p_1 \neq \pi_{1,r}$  and does not provide a selection of events. I guess you mean something like analogues should fulfil  $g_{t,r}^{Z500} \geq g_m^{Z500}$  where  $g_m^{Z500}$  is the  $p_1$  th quantile of  $g_{t,r}^{Z500}$  in the modelled fields, i.e.  $P(g_{t,r}^{Z500} \geq g_m^{Z500}) = p_1$ . Please adjust accordingly.

**Thank you. Indeed the formulation was not correct; however, the corrected version is different:  $g_{t,r}^{Z500} \geq g_c^{Z500}$ , where  $g_c^{Z500}$  is the threshold we used to find analogues within NCEP. This way, we embed the PlaSim Z500 fields in the phase space of NCEP, and we consider analogues those fields that fall within a hypersphere around the reference states defined by the cluster composites.**

Caption of Table 1: In step 7 in L249 cold spell analogues were defined to always have the same occurrence probability  $p_1$ . The use of “analogues” for different sets of event sets thus creates ambiguity. Please clearly state for which analysis which set of analogues is used and consider using different terminology. (This point has already led to some confusion in the last round of reviews.)

As pointed out in the editor's previous question, there was a mistake in step 7 of the procedure: we consider analogues the days characterized by a value of  $g_{\{t,r\}}^{Z500}$  larger than the threshold value  $g_c^{Z500}$  in the NCEP simulations. In practice, these are all the events, in each run of the model, that fall within the same hypersphere around the reference state in the phase space of NCEP. In our case, we do this for two reference states, corresponding to the composite Z500 fields of each cluster in the reanalysis.

L274: I assume the analogues used here are those taken from step 7 in L249, which would be fewer than the ones summarised in Table 1? Or where have the analogues that were selected in step 7 been used otherwise? Please clarify.

We have reformulated the sentence clarifying better this aspect:

*“Figure \ref{fig:comp\_zg} shows the composites of Z500 analogues fields in the CTRL (a,b) and RCP (c-h) runs for analogues of cluster 1 (a,c,e,g) and cluster 2 (b,d,f,h), found with the rule shown at step 7 of the procedure described above. Given that  $\pi_{\{i,r\}} < p^*$  in all cases, these analogues are less than the  $(1-p^*)\%$  of the days in each run; however, given that each PlaSim run in 450 years long, they are more in absolute number.”*