Clim. Past Discuss.,
https://doi.org/10.5194/cp-2019-69-AC1, 2019

Climate of the Past Discussions

Interactive comment on "South Pacific Subtropical High from the late Holocene to the end of the 21st century: insights from climate proxies and general circulation models" *by* Valentina Flores-Aqueveque et al.

Valentina Flores-Aqueveque et al.

vfloresa@uchile.cl

Received and published: 19 October 2019

Answer to Referee #2

1.- Based on previous literature, the authors discuss the link between the ITCZ and the SPSH and hypothesize that the differences in the SPSH strength, position and associated SWW between LIA and CWP is related to changes in the ITCZ and Hadley circulation. However, climate models do not simulate the expected changes in the position of the ITCZ and ERA-Interim differs substantially from models. Therefore, the

mechanisms proposed here cannot be verified. Even though changes in the ITCZ cannot be supported, Figure 4 depicts a nice schematic with different position in the ITCZ. At least a cautionary note should be added here to not mislead the readers. Figure 4 (now Figure 6) represent the integration of paleorecord information and models results for the extratropical climate features as contains elements of both sources of information. The misrepresentation of ITCZ in the models used in this work (and other models not analyzed here) is a known weakness of simulation models. However, reconstructions based on paleoclimate records are very consistent among them (all ITCZ reconstructions suggest that ITCZ was located further south during the LIA (n=12) and shifted equatorward in the CWP (n=5)) and in agreement with the expected physical mechanisms (e.g., Sachs et al., 2009; Lee et al., 2011; Schneider et al., 2014). In order to clarify the integrative character of Figure 6, a note in 'Concluding Remarks' was included. In addition, few sentences explaining the incongruencies observed for the tropical system between our models and recent observations and therefore, the need of complementary analyses, were also added in this section.

2.- As mentioned in the discussions, extratropical dynamics may also play a role in those changes. For example, could different sea-ice extension between the two periods a possible driver of the SPSH changes? In addition to that, the differential heating between land and ocean (see Fig. S1 for the difference in temperature between the South Pacific and South America) can create a pressure gradient that by geostrophy can accelerate the SWW. Exploring these other mechanisms could help in the interpretation of the paleoclimate records. Or at least it is worth a discussion in the manuscript. R: In fact, any factor (e.g., SAM seasonality, ENSO, changes of ice cover in Antarctica) that affects surface temperature can influence the general convection pattern, which controls position and extension of SPSH. In particular, as we discussed in section 3.3, according to Bently et al. (2009) the increase of sea-ice around Antarctica during cold periods would produce an equatorward shift of the SWW. This migration could block the SPSH limiting its expansion and latitudinal movement. The same 'blockling' effect could be produced by an increase of SWW intensity driven by a decrease in the latitu-

dinal temperature gradient. We added a few sentences developing this idea in Results and Discussions (section 3.3).

3.- ERA-Interim is used in this study. Note that this reanalysis has been superseded by the newest generation of ECMWF reanalysis, ERA5, and discontinued this year. Not a big deal for this study and the type of analysis presented here, but keep in mind when justifying dataset choice in future studies. R: Although recently replaced, ERA-Interim is a widely used reanalysis which favors the comparison between our results and other works based on this same data set. Furthermore, we considered Era-Interim due to its spatial scale of 0.75°x0.75° which gives a better comparison with the interpolated horizontal scale (1°x1°) that we used in the models.

On page 10, p.30, this text needs rewording: "This behaviour can be interpreted as a contraction of the tropics in response to anthropogenic forcing, : : :" It is not intuitive that increase in greenhouse gases would lead to a contraction of the tropics. There is also no mechanism to explain how this can happen. In fact, climate models suggest the opposite, i.e. an expansion of the tropics due to increase in greenhouse gases. Rewording this sentence may be needed. R: This sentence was simplified and reworded.

On page 15, para 10, there is a citation to Fig. 5 that is not in the manuscript. R: Yes, it was a mistake. In this revised version we added a new figure at the beginning and the previous Figure 4 is now Figure 6.

Figure 2: The magenta and red lines are hard to distinguish. R: We changed magenta for a brighter color and we darkened the color red to increase contrast. In addition, color blue was replaced by cyan.

Figure 3: All axis labels need to be enlarged. Lines are too thin, barely can see the dashed lines. R: We enlarge labels and legends, and we also increase the thickness of all lines.

Please also note the supplement to this comment:
https://www.clim-past-discuss.net/cp-2019-69/cp-2019-69-AC1-supplement.pdf

Interactive comment on Clim. Past Discuss., https://doi.org/10.5194/cp-2019-69, 2019.

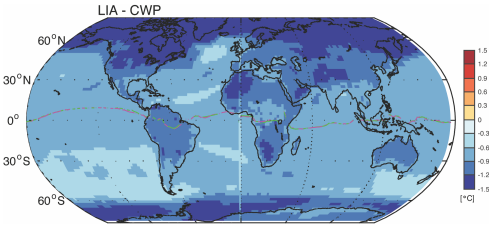

Figure S1: Model ensemble mean temperature difference between the LIA and the CWP. Note that models reproduce a small temperature variation (≤0.3°C) between both periods in most of the Pacific Ocean. Magenta line: ITCZ position during the CWP; green line: ITCZ position during the LIA.

Fig. 1.