Response to reviewers of Suli S. et al.: Storylines of extreme summer temperatures in southern South America.

We are grateful to the referees for the time they have taken to review the manuscript. We appreciate their comments, which have helped improve the manuscript. Our replies (normal font) are given after their comments (bold font). We have updated the manuscript following most of their recommendations.

Referee #1

Line 63: Where is Iberia located?

Iberia is located in southwestern Europe and comprises Spain and Portugal. To clarify it, we have changed this to *"Iberian Peninsula"* (line 64).

Lines 114-115: How did you interpolate the data? Have you considered interpolating all data to the coarser resolution? It should be explained as well.

We interpolated all datasets to the coarser resolution of the GCMs, which corresponds to $2.5° \times 2.5°$, as shown in Table S1. In the text, this is explained as: *"A common 2.5° x 2.5° horizontal grid and the austral summer season (…)"* (line 118).

In the original manuscript (lines 119–121 of the revised manuscript) we explained that we used a bilinear interpolation. In the revised version we have included the following information: *"Bilinear interpolation was used for TX, SST, Z500 and OLR data, while a conservative remapping was applied to SM data to avoid spurious values (Jones, 1999)"*. Conservative remapping assigns values based on the overlapping area between the original and new grids, ensuring that the overall field is conserved during interpolation.

I recommend not abbreviating southern South America (SSA) as it may be confused with southern southern South America (SS).

We understand the reviewer's concern regarding the potential confusion between southern South America (SSA) and southern subregion (SS). However, for consistency with our previous work (Suli et al., 2023) and to avoid excessive repetition of "southern South America" throughout the manuscript (this region is cited more than 35 times), we prefer to retain the acronym SSA to denote the broader region.

Section 2.3: Please specify which drivers are local and which are remote (and why, preferably) in this Section rather than in the Introduction.

We have clarified in Section 2.3, adding between brackets the driver type: "local driver" and "remote driver" (e.g., *"Sea surface temperature in Niño 3.4 region (N3.4, remote driver)"*). We also added the following lines in the same section (lines 153-154 of the revised manuscript): *"Local drivers are proximate factors that directly influence regional temperature, whereas remote drivers represent large-scale influences or teleconnections affecting the region"*.

The manuscript has too many abbreviations. I recommend adding a table with all of them to support the reader.

We have reduced the number of abbreviations (e.g., Pc90, AR6, HW) where possible to improve readability. However, we believe that including a full table of acronyms is not standard procedure and would not necessarily make the manuscript easier to follow.

I suggest using grey dots in areas where changes are statistically significant in Figure 2.

Thank you for the suggestion. We tested plotting grey dots in statistically significant regions (see Figure R1). For some variables (e.g., ΔTXx), the entire domain is statistically significant, and for others (e.g., ΔZ500*) highlighting significant regions would hide the main circulation patterns. Therefore, for the sake of clarity, we prefer to keep the original plot.
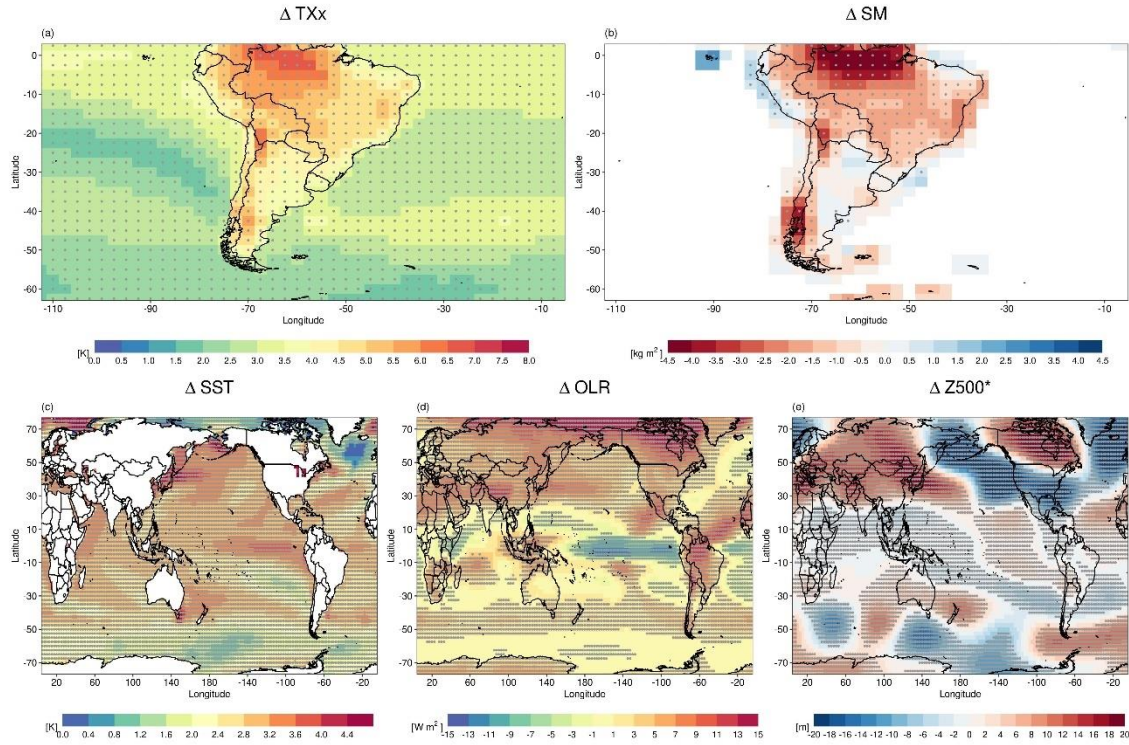

Figure R1. Multi-model mean (MMM) summer (DJF) changes in (a) Maximum Temperature (TXx, K), (b) Soil Moisture (SM, kg m^{-2}), (c) Sea Surface Temperature (SST, K), (d) Outgoing Longwave Radiation (OLR, W m^{-2}) and (e) Geopotential Height at 500 hPa with the zonal mean removed (Z500*, m). Changes are computed as the difference between the periods 2070–2099 and 1979–2014. Grey dots indicate areas where changes are statistically significant at the 95% confidence level, based on a two-tailed t-test.

Lines 276-278. This sentence should be tied to the last paragraph.

We have revised the text to improve the flow of the paragraph, better connecting the storylines with the regional ΔTXx examples in Figure 4 and the subsequent description of Figure 5. In the revised manuscript, the paragraph now reads as follows (lines 303–304): *"Each storyline characterises the summer ΔTXx as the combined response in b_x and c_x (see Eq. 2), yielding distinct patterns of warming depending on how the two drivers change."*

I am not sure if Table 2 is relevant to the manuscript. Results are not discussed in

the text.

We understand that Table 2 is not extensively discussed in the text. However, we believe it provides a useful summary of the storyline results. Given the number of regions and the four driver combinations per region, the table allows readers to quickly identify the best and worst combinations of drivers for each storyline, which could be confusing if described only in the main text.

Line 297: What does weak ZCAS intensification mean?

According to a comment from Reviewer #2, we revised the interpretation of this index and now refer to it as OLRg. The definition based on the OLR gradient remains unchanged, but it is now interpreted in a broader sense, involving changes in atmospheric stability. In this context, a "weak OLRg intensification" refers to a small strengthening of the OLR gradient (as observed in ST3 and ST4 of CES region; see black stars in Figure 4). This positive ΔOLRg indicates a slight increase in OLR over the equatorward box and/or a decrease over the poleward box of Fig. 3b, d, f, thereby inhibiting convection in the former and reinforcing it in the latter. Such a pattern could result from an intensified or extended subtropical Atlantic anticyclone, or from changes in convection associated with the SACZ.

The conclusions are quite long, and the writing is confusing. I recommend shortening it to something between 700 and 900 words.

Despite the new analyses performed in the revised version, we have slightly shortened Section 4 (Conclusions and discussion), as requested, while keeping its overall structure. The revised version keeps the main results of the study: (i) projected changes in the key drivers, (ii) the identification of the most relevant drivers explaining the sources of uncertainty in ΔTXx, and (iii) the storylines of ΔTXx. This is followed by discussion comparing our findings with more complex extreme temperature indices.