Supplementary material

Consistency of the regional response to global warming levels from CMIP5 and CORDEX projections
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We compare in this Supplementary Material the Global Warming Level (GWL) plots generated under two different approximations: 1) the approach used in the IPCC AR6 Interactive Atlas and in the paper (see section 2.2), and 2) the usual approach that forces specific GWL values. For consistency, decadal means are used for both approaches.

The only difference between both approaches is that the GWL plots obtained with our approach uses independent information from non-overlapping decades. This procedure displays results from independent samples of the regional response to global warming. Another advantage of this way of displaying the information is that time information is not completely removed, as it was used as a parameter and can be visualized (e.g. using colors for the different decades).
Conversely, the usual approach forces specific GWL values, using running (e.g. decadal) means, and can share years of data across different close GWLs. It also assumes a monotonic temperature increase, potentially wasting data in the most moderate scenarios or during warming hiatus. In principle, the GWL dimension can be divided as finely as desired, but at the cost of introducing much redundant information.

Figure SM1 shows that the results obtained with both approaches are comparable for temperature (top) and precipitation (bottom). The underlying data are the same. However, the number of data points on the left correspond to the actual independent decadal data available while the number of points on the right depend on the spacing between consecutive GWLs and whether a particular simulation actually reaches a particular GWL. On the left, all simulation decades contribute to sampling the regional response to global warming; if a given high GWL is not reached, the information is used to better sample lower GWLs. This information is simply lost when presetting the GWL values.

Figure SM2 shows the effect of sampling the GWL with a 0.5K step, and also using a running mean of 20 years instead of 10. The slopes β and overall plots are qualitatively very similar. The 20 year window just prevents reaching the +7K GWL, which can be explored with decadal means or 10-year running windows.

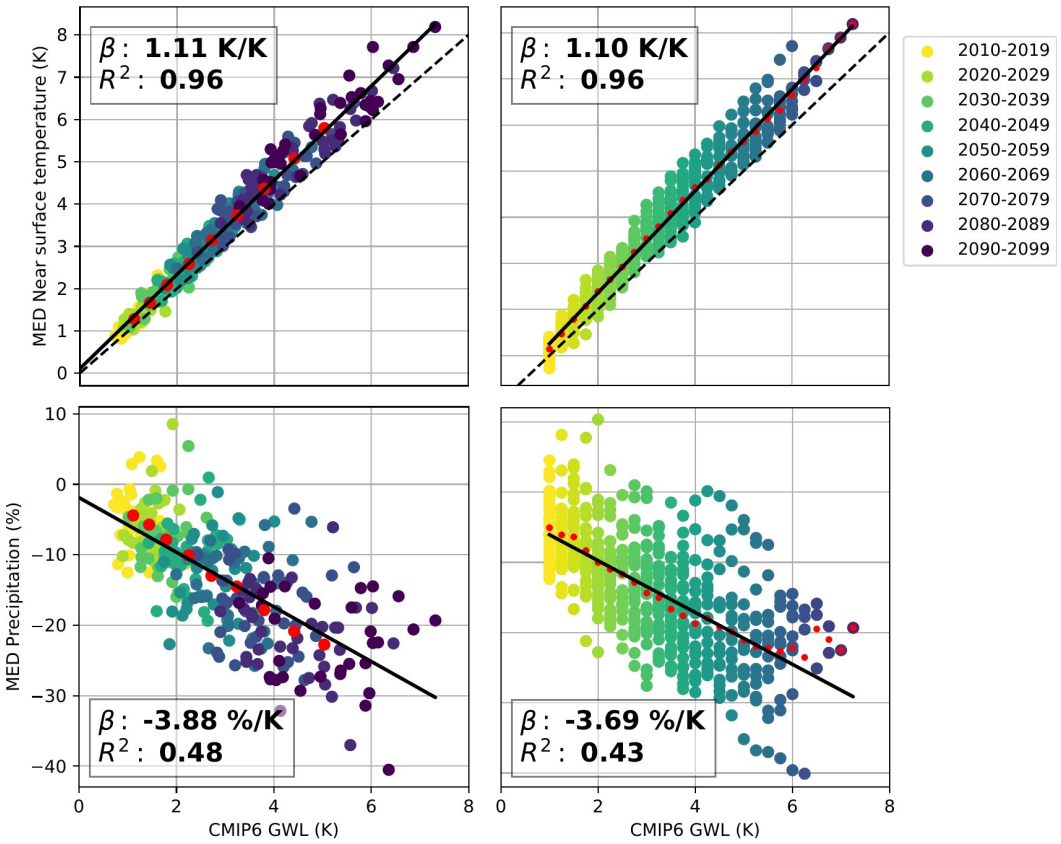

Figure SM1. GWL plots generated under two different approximations for temperature (top panels) and precipitation (bottom panels). Left panels show the approach used in the IPCC AR6 Interactive Atlas, which considers non-overlapping independent decadal means. Right panels show the usual approach that forces specific GWL values (in this case in 0.25K steps from 1 to 8 K) and uses a decadal running mean to identify the decade first reaching this value. The results are computed for the Mediterranean region using the CMIP6 models used in the IPCC Atlas.

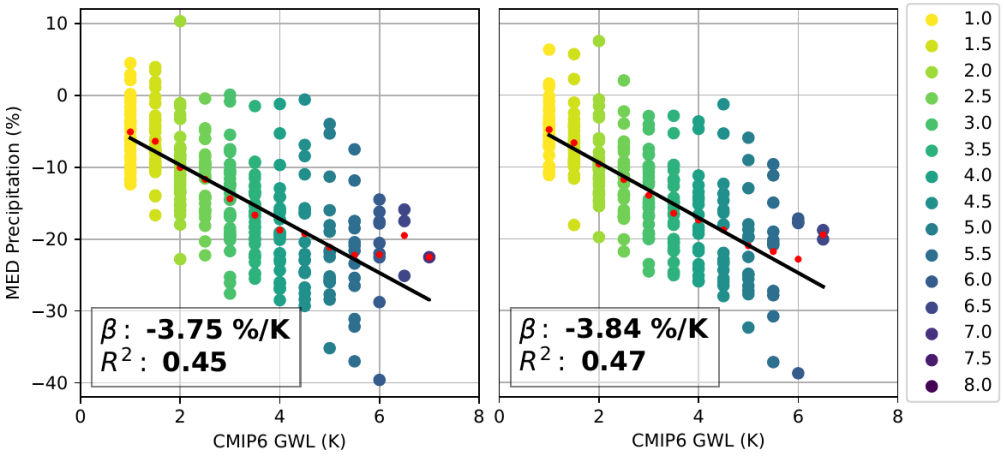

Figure SM2. As Figure SM1 bottom-right panel, but sampling the GWL values with a 0.5 K step (left). Additionally, the right panel shows the effect of using a running mean of 20 years instead of 10.

Figure SM3 shows the Temperature of Emergence (ToE) obtained for CMIP5 and CORDEX for the different IPCC reference regions (in rows) and for the different seasons (in columns). Regions are sorted according to magnitude of CMIP5 global warming (see Figure 5 in the paper), with higher values at the top of the figure. In order to facilitate the comparison of the results, each cell is divided in two, representing the results for CMIP5 in the upper triangle and for CORDEX in the lower triangle.

ToE is obtained for specific GWL values from 1 to 6 with 0.1K steps. For each GWL step we compute the regional change (20 years mean) with respect to the period 1986-2005. Then, the robustness of the multi-model mean signal is calculated using the advanced approach defined in IPCC-WGI AR6 (Gutiérrez et al., 2021, Cross-ChapterBoxAtlas.1). The robustness of those GWLs with less than 2 simulations contributing to the ensemble were discarded and they do not affect the ToE.

The results obtained in Figure SM3 are comparable to those obtained in Figure 6 of the paper. However, here, larger inconsistencies are found between CMIP5 and CORDEX in some regions due to the fact that the number of members of the ensemble are progressively reduced for higher GWL values. Note that not all GCMs reach the highest GWL values and, therefore, the number of simulations contributing to these GWLs is lower. Overall, both approaches find larger discrepancies for those regions in which the ensembles present a low variety of CMIP5 models.

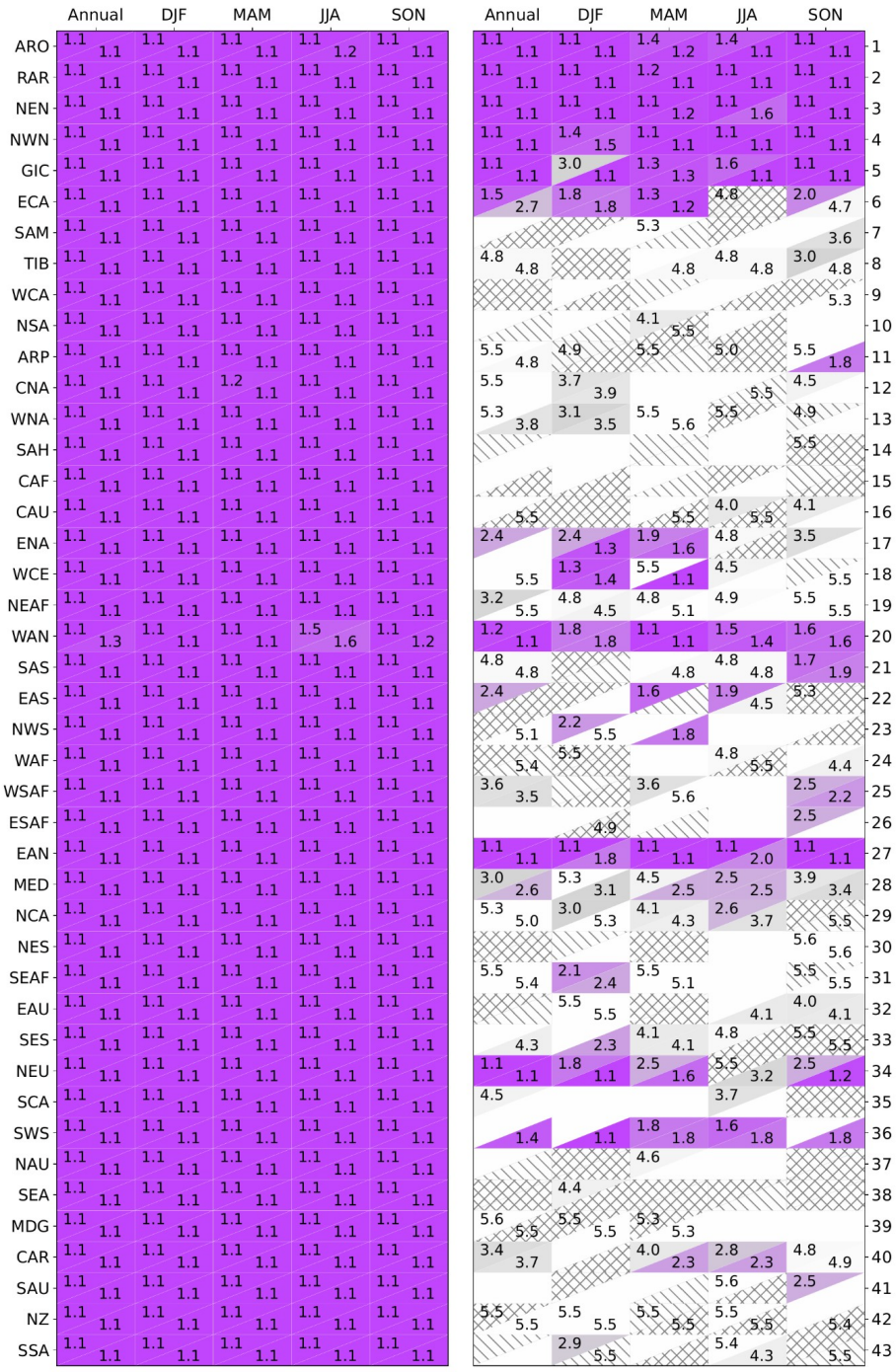

Figure SM3. Heat map for the ToE (units: ºC) of the regional temperature (left panel) and precipitation (right panel). Cells division represents the results for CMIP5 (top triangle) and CORDEX (bottom triangle). Different seasons are shown in columns and IPCC reference regions are in rows. Simple hatching hides non-significant slopes (see Figure 5 of the paper) to the 0.01 level (double hatching for those not significant to the 0.05 level).