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Supplementary Information

A historical and future view of Elevation-Dependent Precipitation Change in CMIP6 models

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1 Supplementary results for CMIP6 historical simulation

Here are reported the Taylor diagrams for climatological R10mm (Fig. S1) and Rx1day (Fig. S2) over all mountain regions, comparing CMIP6 models with the ERA5 reference dataset for the period 1951–2020, that have not been included in the main text.

2 Supplementary results for CMIP6 projections

Similarly to Fig. 4 in the main text, Fig. S3 shows the clustering of CMIP6 projections of the elevational profiles of mean precipitation for summer (JJAS, left panel) and winter (DJFM, right panel). As discussed in the main text, the annual profiles are strongly driven by summer conditions, likely reflecting the influence of the monsoon system. In summer, all models project an overall increase in mean precipitation and cluster into two groups that differ mainly within a specific elevation band between approximately 3000 and 5000 m. In winter, a very weak enhancement appears at similar elevations, but it is barely discernible.

As shown in the main text for Pm trends (Fig. 6), Fig. S4 presents the spatial distribution of cluster-mean R10mm trends under the SSP5-8.5 scenario for the US Rockies. The three clusters identified from the vertical profiles of

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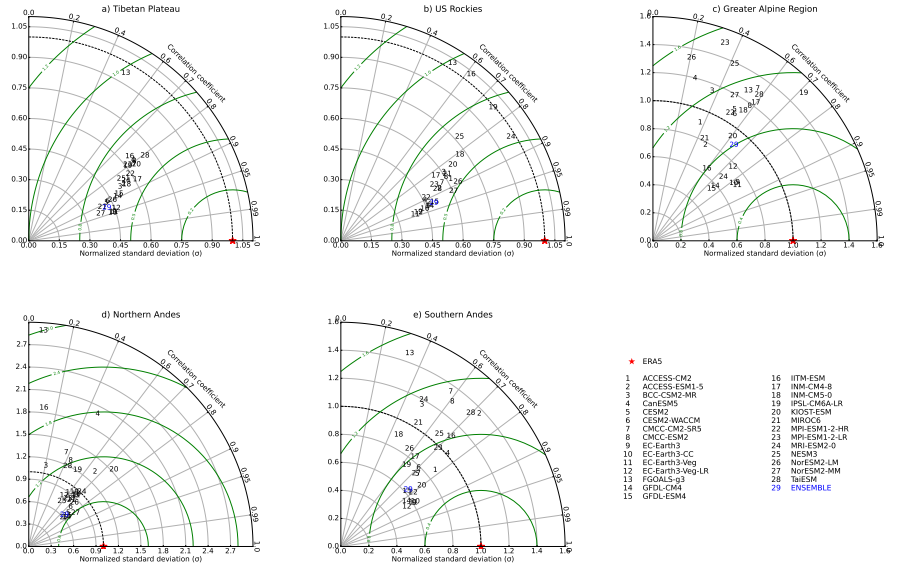

Fig. S1 Taylor diagrams for climatological R10mm over all mountain areas [TP (panel a), RO (b), GAR (c), ANN (d) and ANS (e)] comparing each of the 28 CMIP6 models and their MEM (in blue) with the ERA5 reference dataset (red star marker) for the period 1951–2020. The x-axis represents the standard deviation of each model normalised by the ERA5 value. Note that different radial scales are used for the various regions

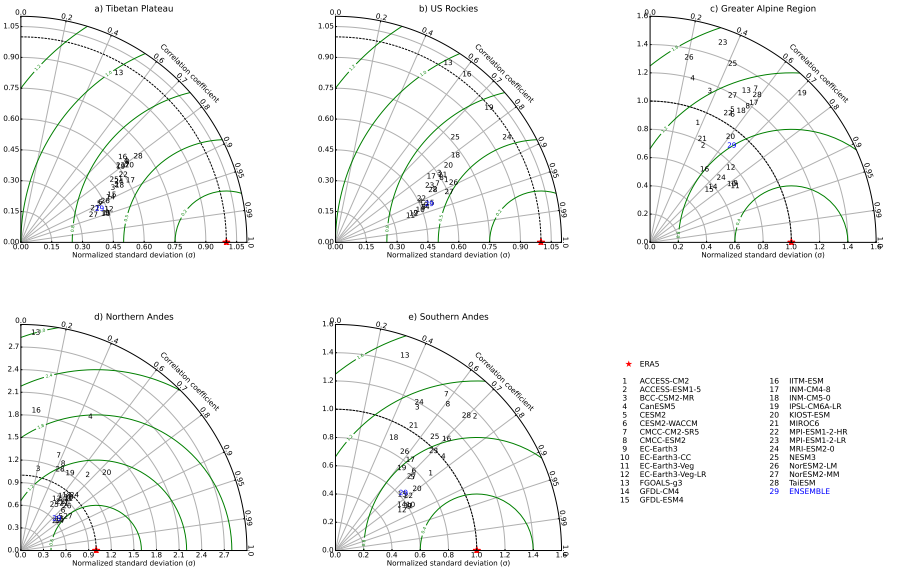

Fig. S2 Same as S1 but for Rx1day

future R10mm trends all exhibit positive EDPC values but with different sign in the trend – negative (violet), near-zero (green), and positive (blue) trends. Nevertheless, the intra-cluster mean maps indicate that models broadly agree on the spatial pattern of future changes, with positive trends in the northern regions and negative trends in the south, consistent with the mean precipitation results discussed in the main text.

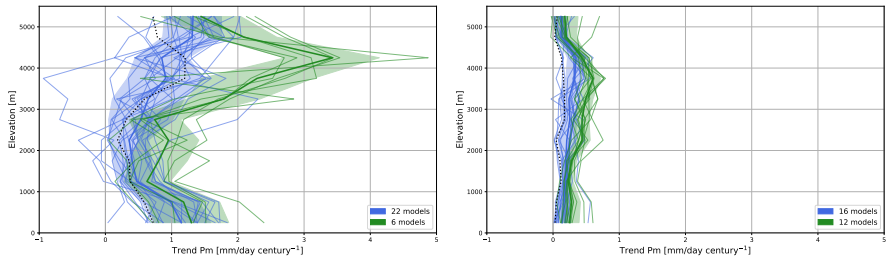

Fig. S3 Clusters of projections (2015–2099) of mean precipitation trends in the Tibetan Plateau for the SSP5-8.5 emission scenario, computed in summer (JJAS, left panel) and winter (DJFM, right panel). Individual models are represented by thin lines, the intra-cluster mean is highlighted in bold, the intra-cluster standard deviation is represented by the shaded area and the MEM is represented with a dotted line.

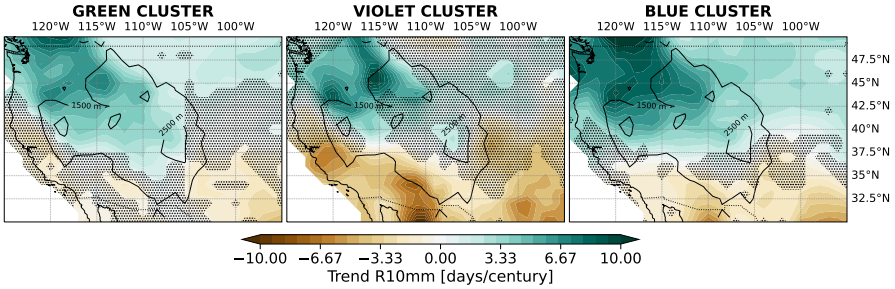

Fig. S4 Projected R10mm trends [days/century] calculated over the period 2015–2099 in the US Rockies, averaged across all CMIP6 models belonging to the green (left), violet (centre) and blue (right) cluster. Dotted areas indicate where fewer than 66% of models agree with the intra-cluster mean on the sign of the trend (thus indicating low inter-model agreement).