Supplementary Information

Elevation-dependent warming in global climate model simulations at high spatial resolution

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Received: date / Accepted: date

1 Dependence of the temperature changes on elevation

We analysed EDW by exploring the dependence of temperature changes on elevation in each region and season and at the different model resolutions. Figures S1-S6 illustrate this dependence showing in black the regression line evaluated using all data, in green the regression line evaluated fitting the average of the temperature change data (green dots) in each elevational bin, superimposed to the PDFs of the temperature change calculated for each bin (purple shading, as explained in Sect. 2.3 of the main text). The curved LOESS fitting line is also shown in blue (see main text for details on LOESS).

2 Clarifications on the SPHINX ensemble

As discussed in the main text (Section 2.2), in the SPHINX experiment the EC-Earth Earth System Model was run at different horizontal resolutions, from T1279 to T159, with more than one member available for each of them. However, due to the computational costs of such an experiment, the number of model members is not the same at each resolution and it decreases as the

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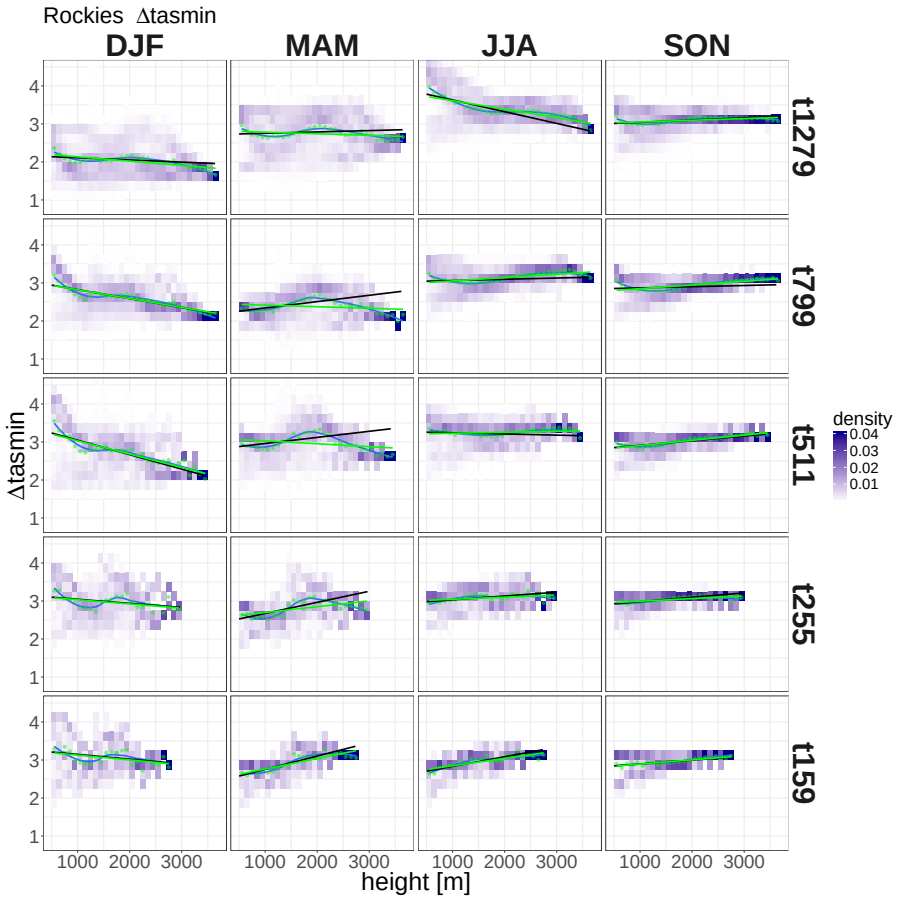

Fig. S1 Dependence of minimum daily temperature *tasmin* on elevation for the Rocky Mountains. The black line is the regression line evaluated using all data while the green line that evaluated fitting the average of the data (green dots) into each elevational bin. Superimposed is the PDFs of the temperature change calculated for each bin (shading), as explained in Sect. 2.3 of the main text. The LOESS curved fitting line is also shown in blue.

resolution increases (in fact, while twenty members were run at T159 and at T255, only two members are available at T1279). Further, a peculiarity of the SPHINX experiment is that half of the members at each resolution was run including base physics while the other half using stochastic parameterizations. We tested the impact of this choice on EDW results and found no significant distinction. Figures S7-S9 clarify this, showing the same as Figs. 3-5 discussed in the main text but, contrary to those, referring only to the model members run with base physics and to their average. The results shown here (Figs. S7-S9) do not distinguish significantly from those shown in Figs. 3-5 of the main text.

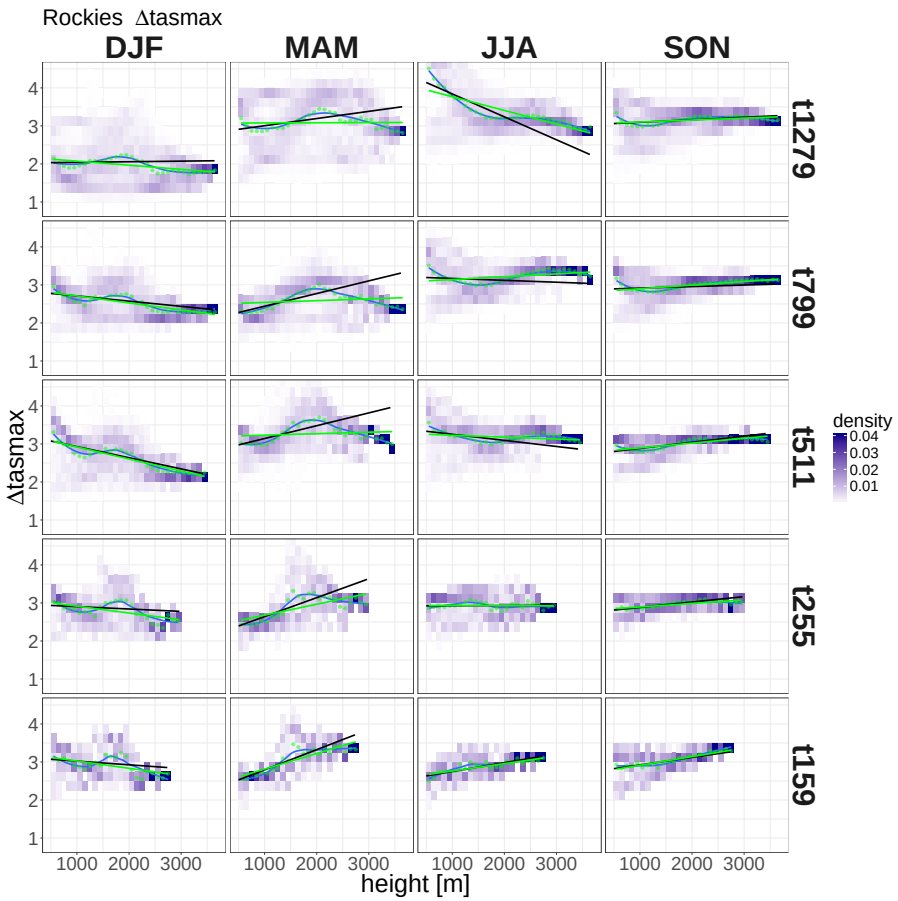

Fig. S2 The same as Fig. S1, for *tasmax* in the Rocky Mountains.

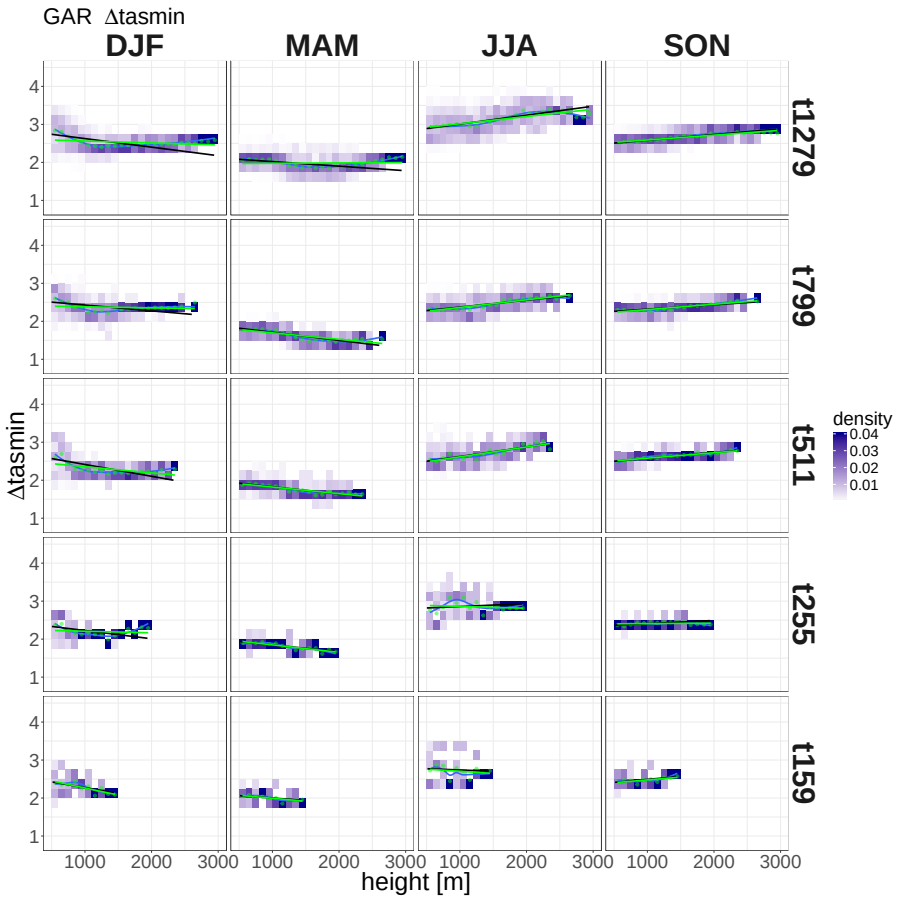

Fig. S3 The same as Fig. S1, for *tasmin* in the Greater Alpine Region.

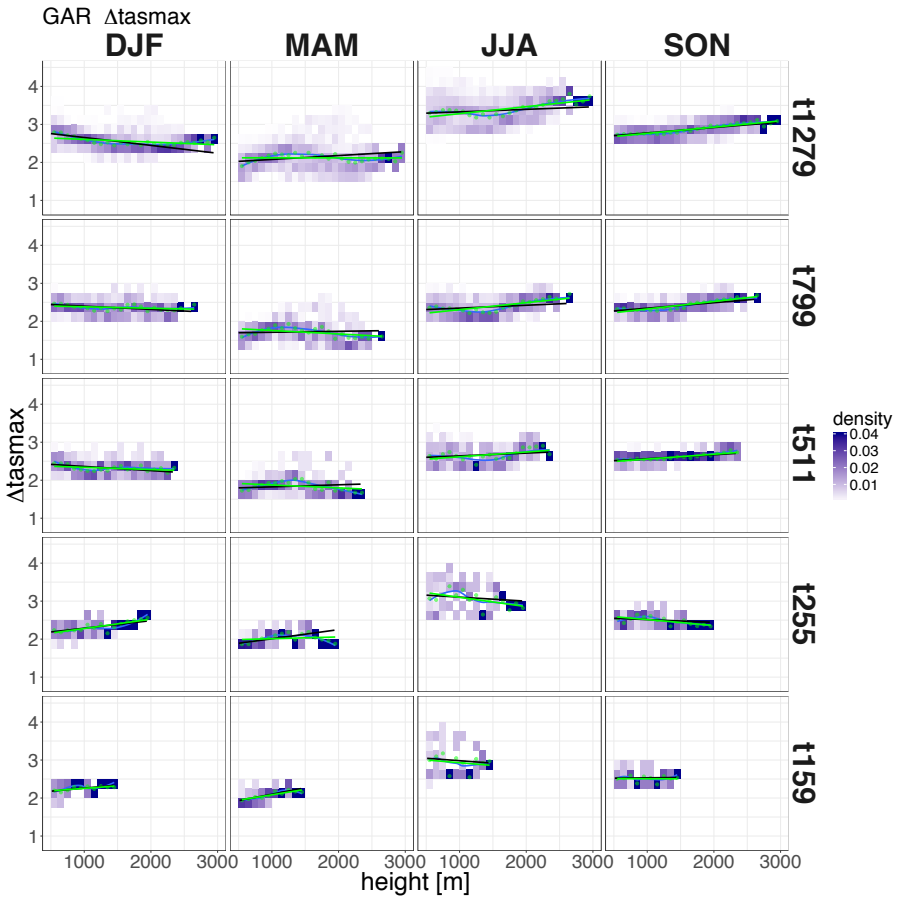

Fig. S4 The same as Fig. S1, for *tasmax* in the Greater Alpine Region.

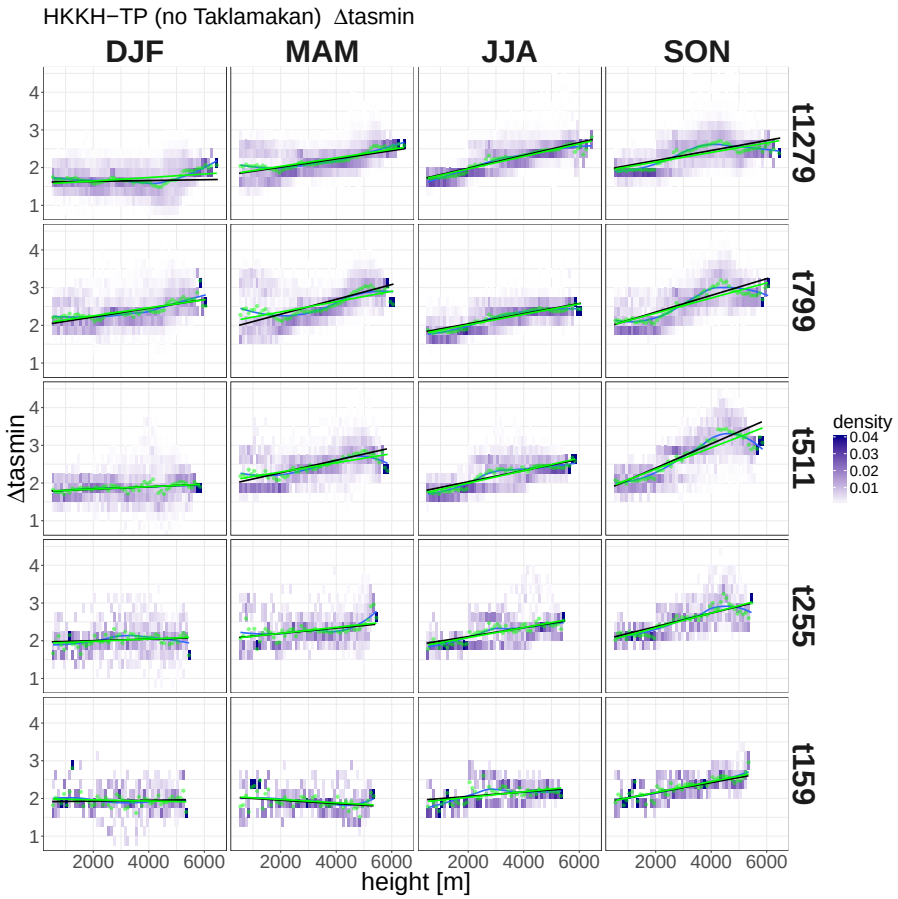

Fig. S5 The same as Fig. S1, for *tasmin* in the HKKH-TP region.

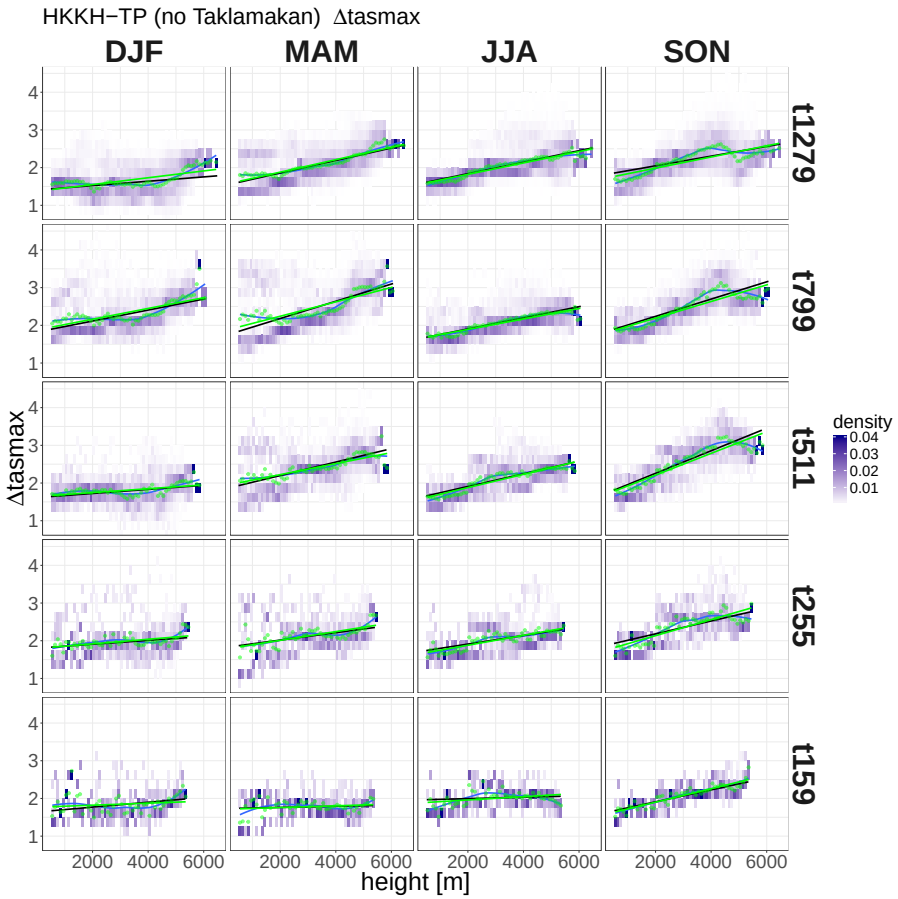

Fig. S6 The same as Fig. S1, for *tasmax* in the HKKH-TP region.

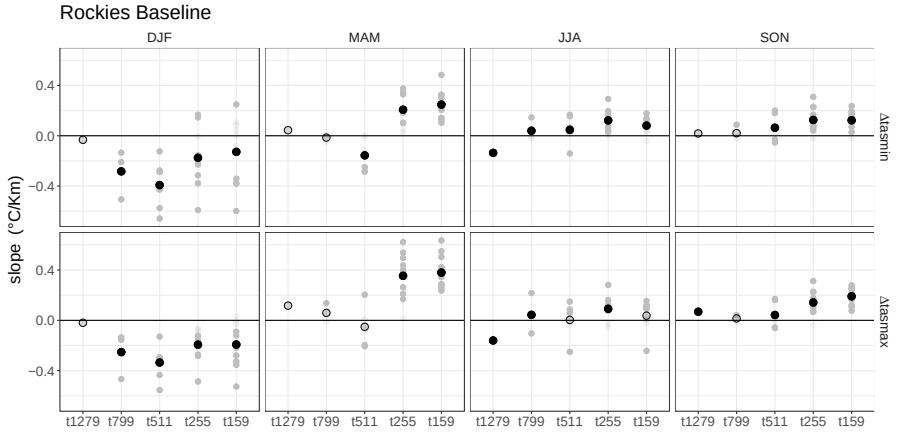

Fig. S7 Elevational gradients of the seasonal temperature change in the Rocky Mountains, for only the ensemble members run with base physics at different model resolutions. The minimum and maximum temperature changes are shown in the top and bottom panels, respectively, while different seasons are organized in the different columns. Each gray circle is the output of one individual model ensemble member at each resolution, while the black circle denotes the multi-member mean. The open symbols represent statistically non-significant elevational gradients of warming rates. To be compared to Fig. 3 of the main text.

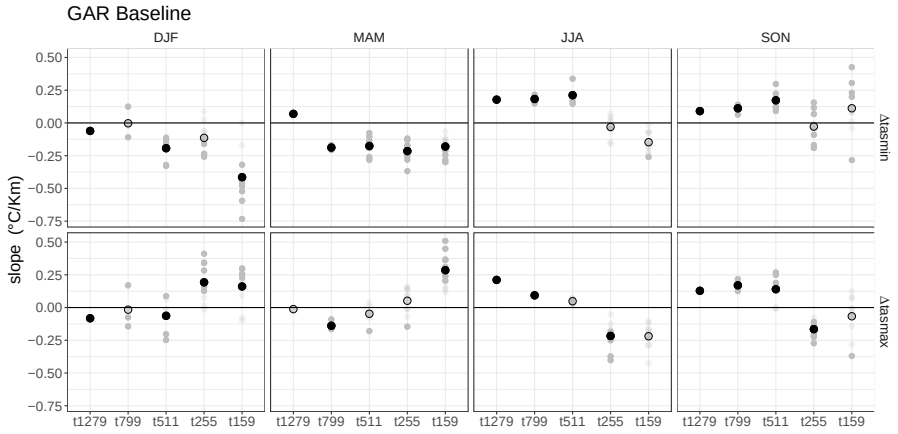

Fig. S8 The same as Fig. S7, for the GAR. To be compared to Fig. 4 of the main text.

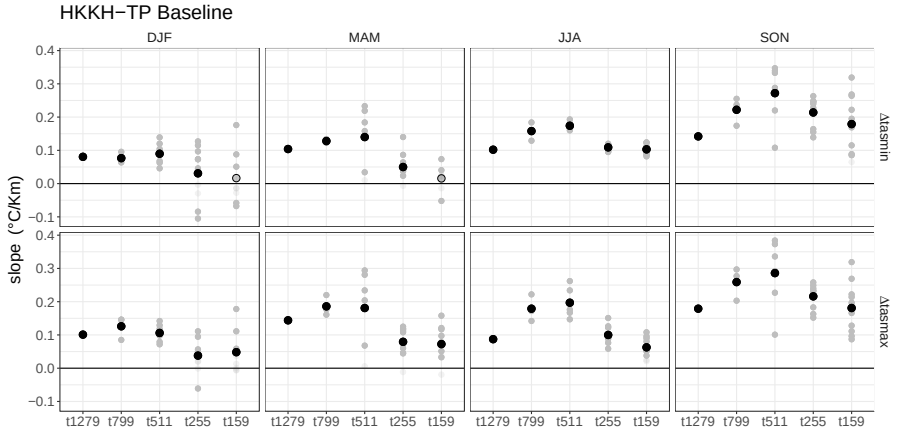

Fig. S9 The same as Fig. S7, for the HKKH-TP. To be compared to Fig. 5 of the main text.