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Investigating stable oxygen and carbon isotopic variability in speleothem records over the last millennium using multiple isotope-enabled climate models

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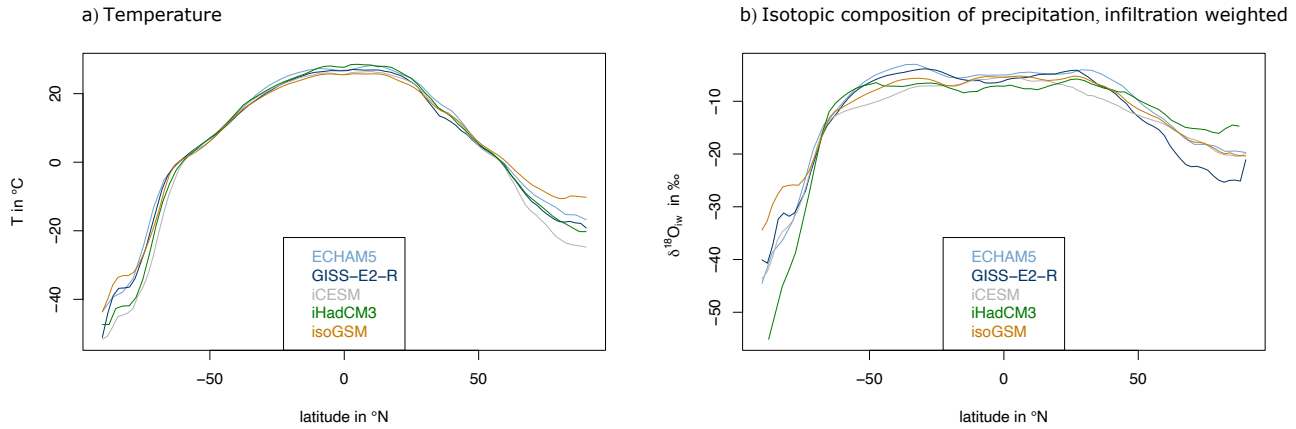

Figure SF1. a) Mean simulated $\delta^{18}O_{iw}$ across latitudes for all simulations in their respective colors. b) Mean simulated temperature as in a).

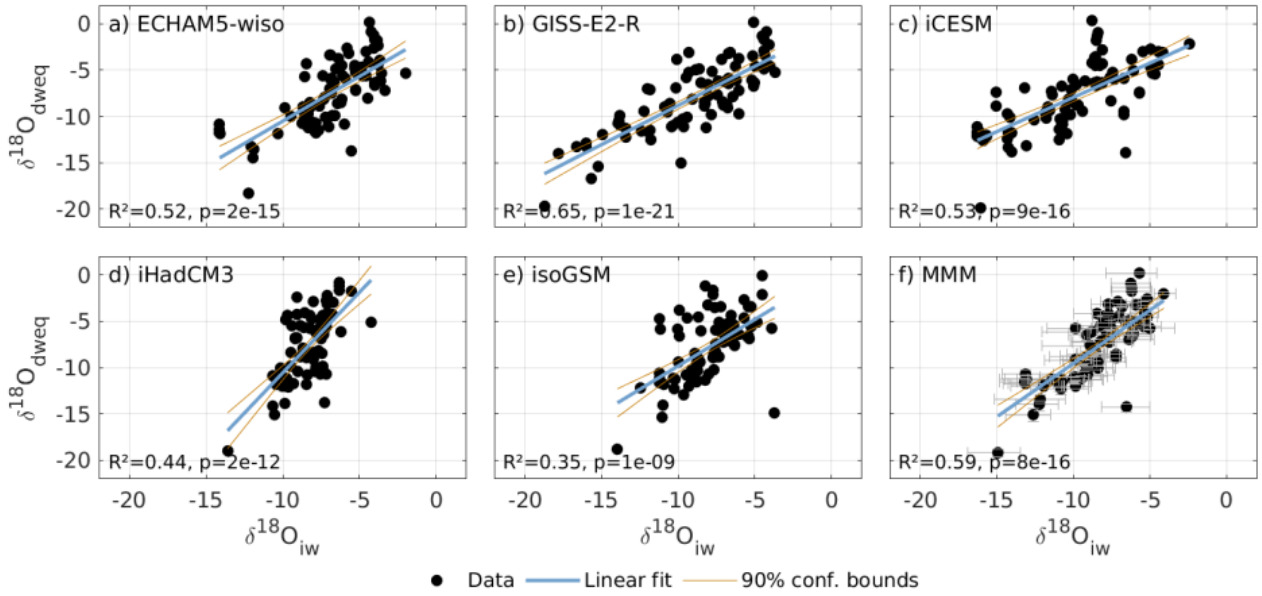

Figure SF2. Speleothem $\delta^{18}O_{dweq}$ and simulated $\delta^{18}O_{iw}$ in a) ECHAM5-wiso, b) GISS-E2-R, c) iCESM, d) iHadCM3, e) isoGSM, and f) multi-model mean. Blue lines are linear regressions with 90% confidence bounds in orange.

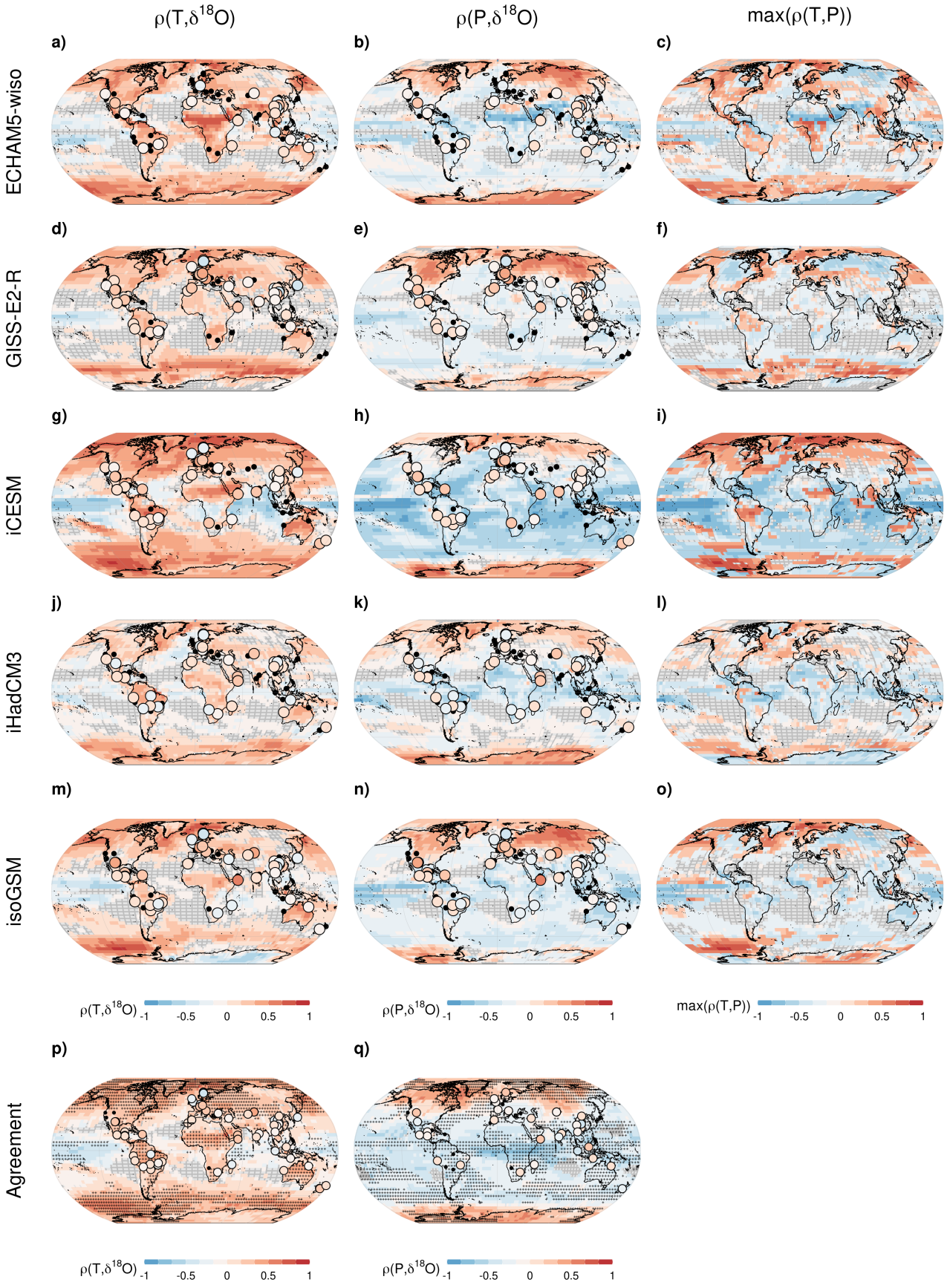

Figure SF3. a-o) shows the correlation between simulated temperature or precipitation to simulated $\delta^{18}O_{iw}$ in the first two columns. The third column shows the areas, where absolute correlation estimated of $\delta^{18}O_{sim}$ are higher to temperature (red colors) or to precipitation (blue colors). Each row shows one simulation (a-c) iCESM, d-f) ECHAM5-wiso, g-i) GISS-E2-R, j-l) iHadCM3, m-o) isoGSM. p-q) show the agreement between the simulations. If a pair of simulations agrees in sign, the score increases by one.

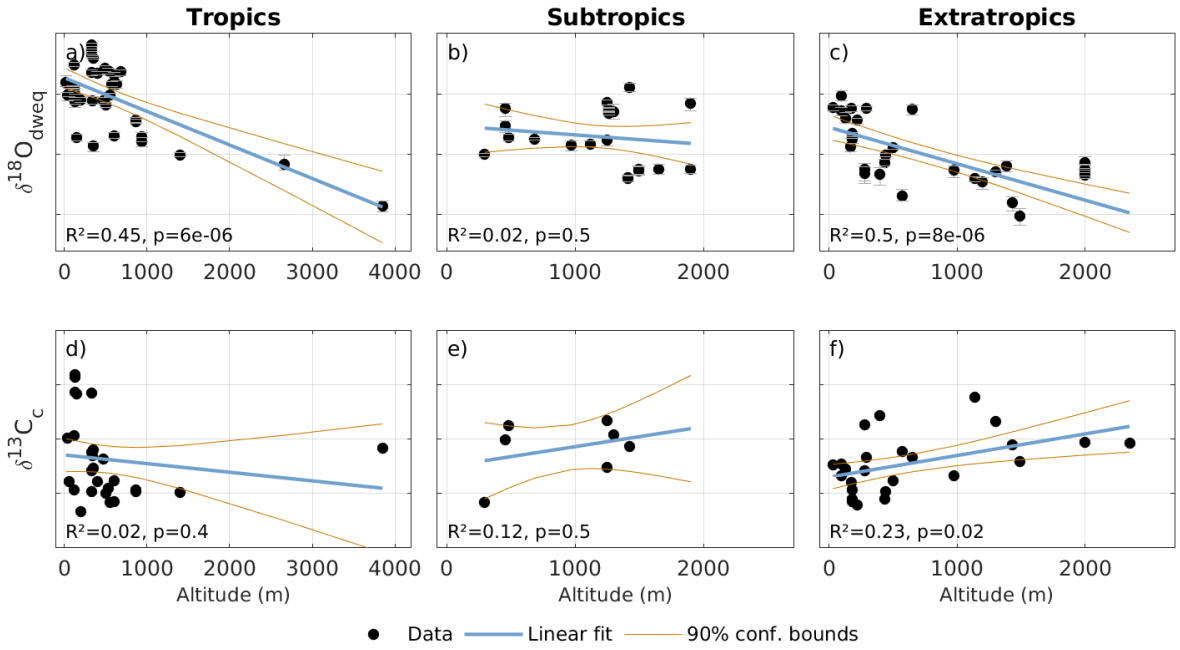

Figure SF4. Speleothem $\delta^{18}O_{dweq}$ and $\delta^{13}C_c$ against altitude as provided by the SISALv2 last millennium subset.

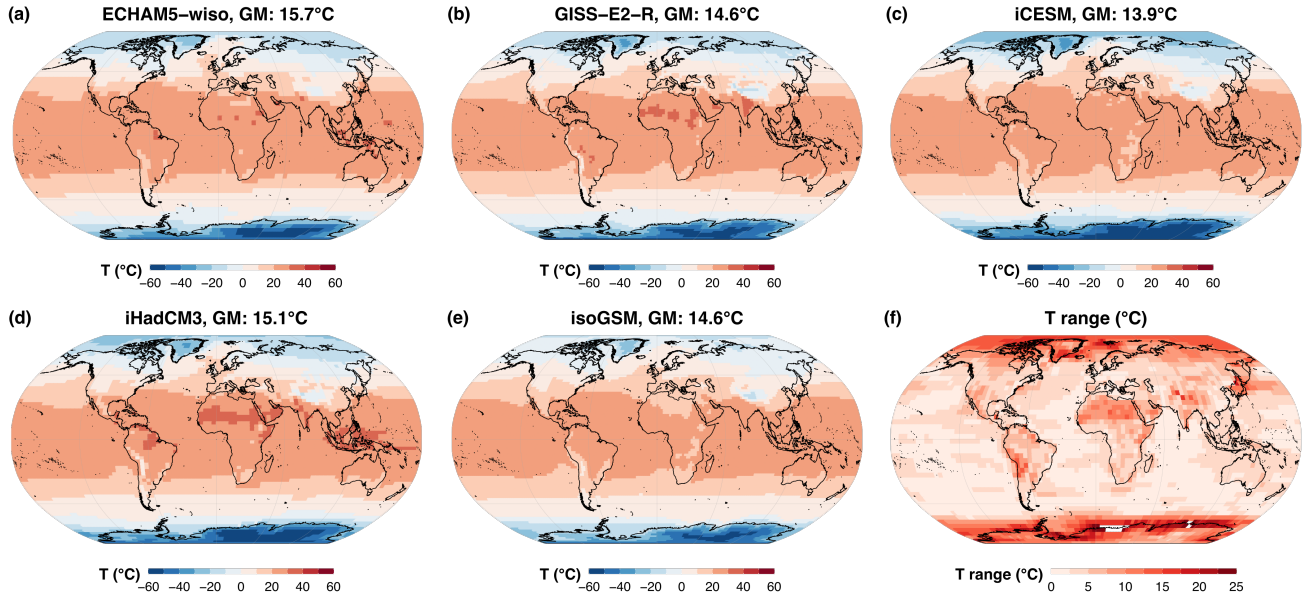

Figure SF5. As Fig. 3 but for surface air temperature.

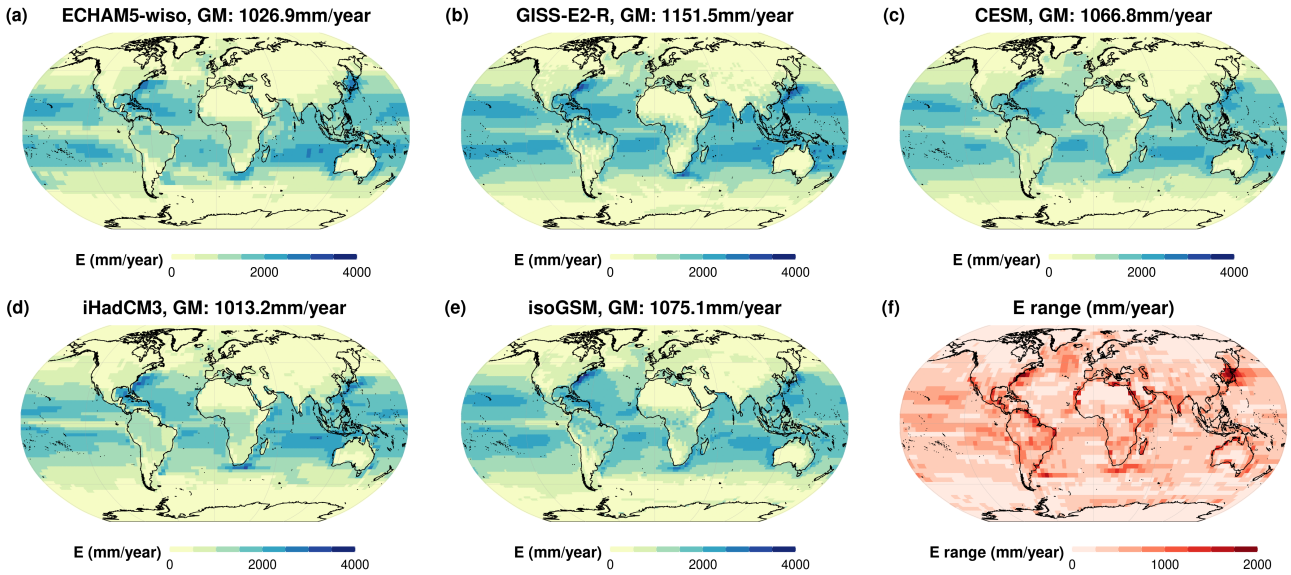

Figure SF6. As Fig. 3 but for evaporation.

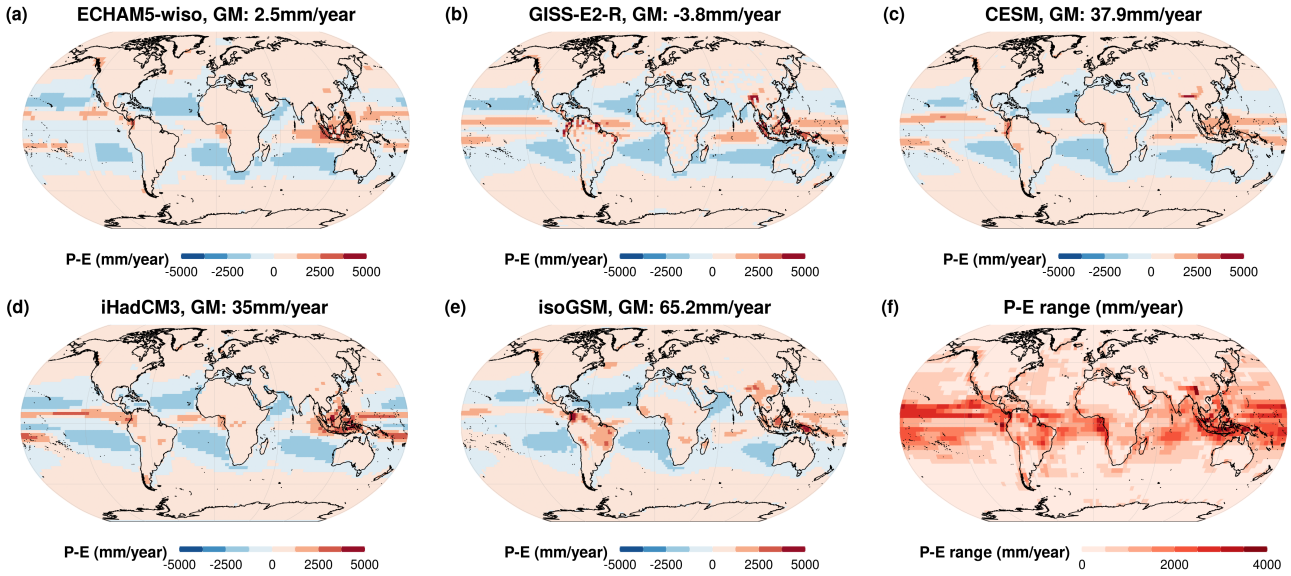

Figure SF7. As Fig. 3 but for precipitation minus evaporation.

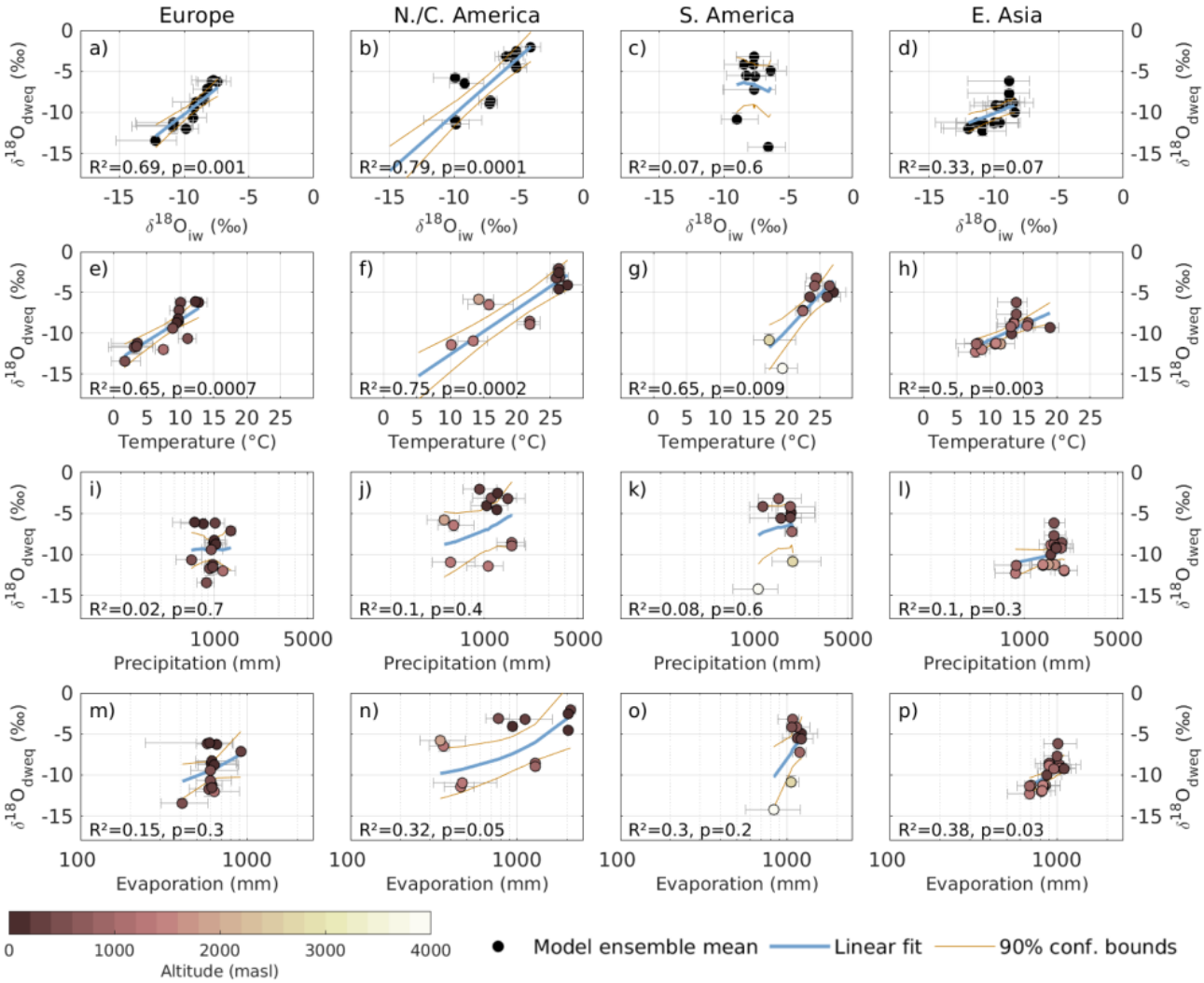

Figure SF8. As Fig. 7 but for different continents. Continents are defined as Europe (36.7-75°N, 30°W-30°E), North and Central America (8.1-60°N, 50-150°W), South America (60°S-8°N, 30-150°W), and East Asia (15-39°N, 100-125°E).

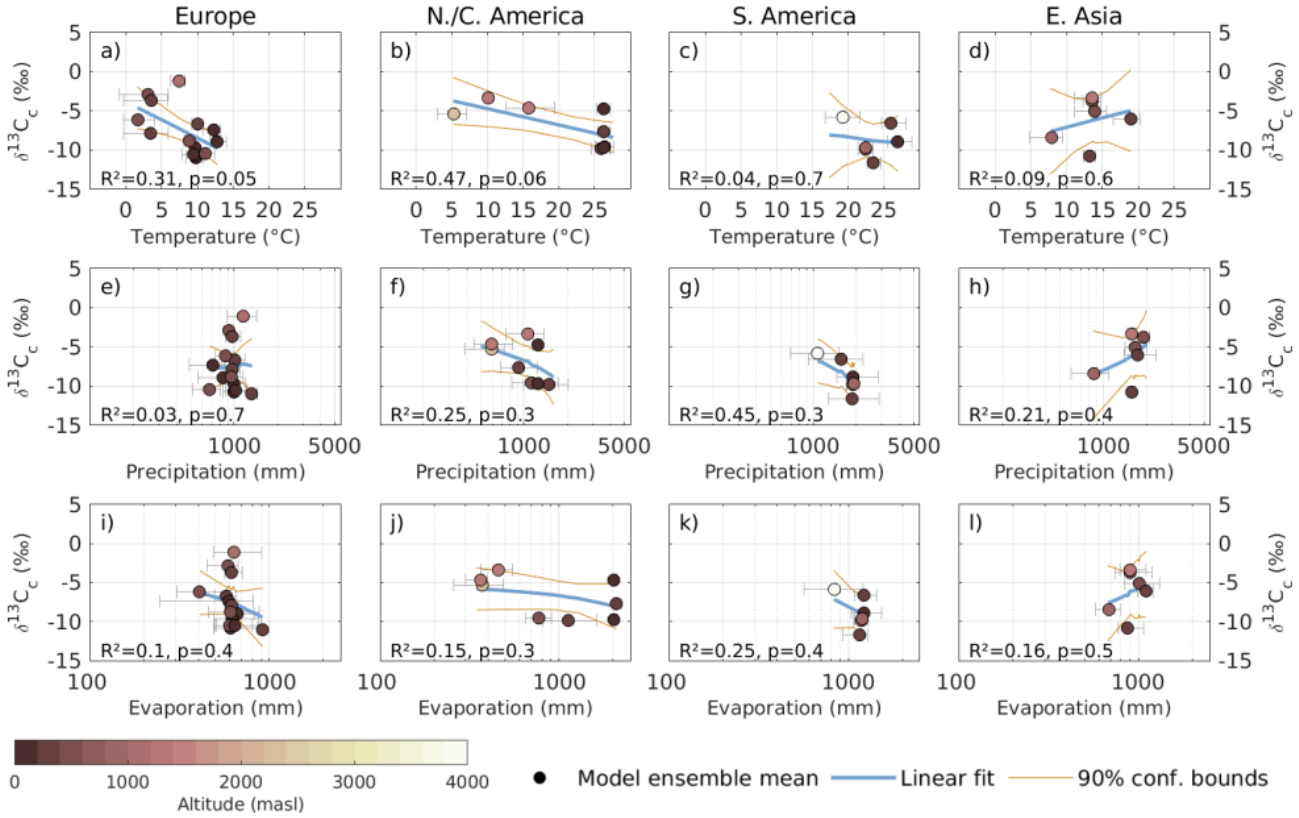

Figure SF9. As Fig. 8 but for different continents.

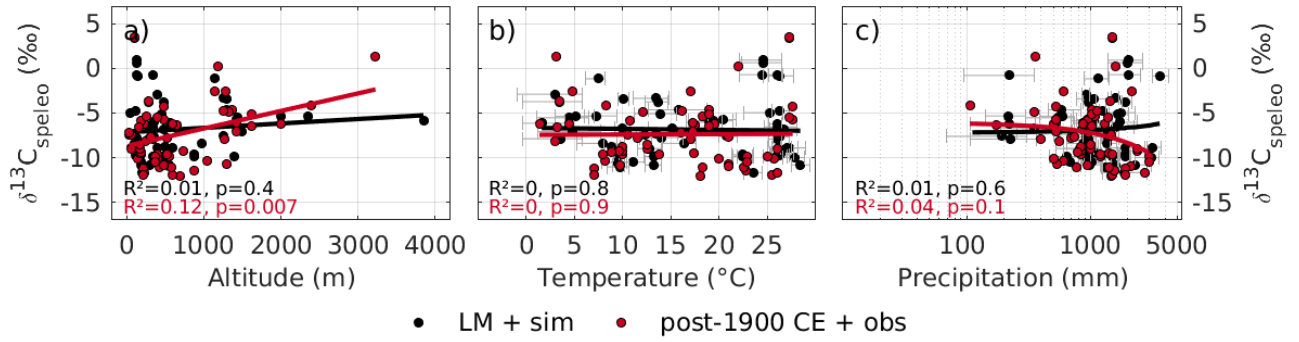

Figure SF10. $\delta^{13}C_{speleo}$, altitude, temperature and precipitation globally with the last century data from Fohlmeister et al. (2020) selection.

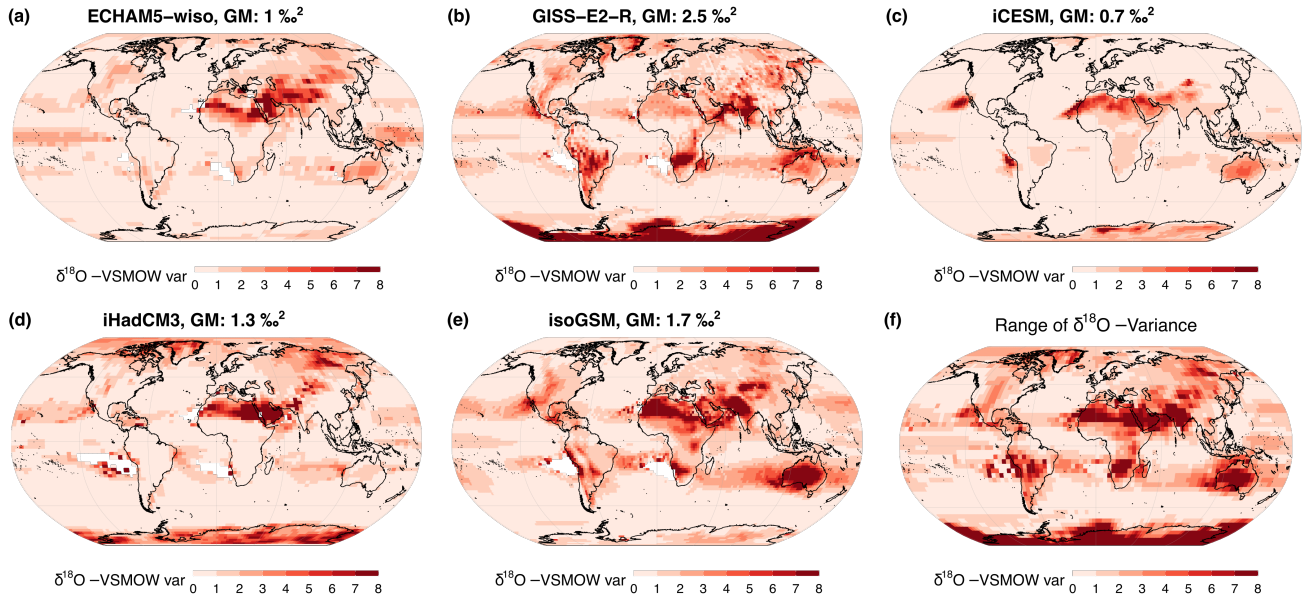

Figure SF11. As Fig. 3 but for the variance over the whole 1000 yr time period per gridbox.

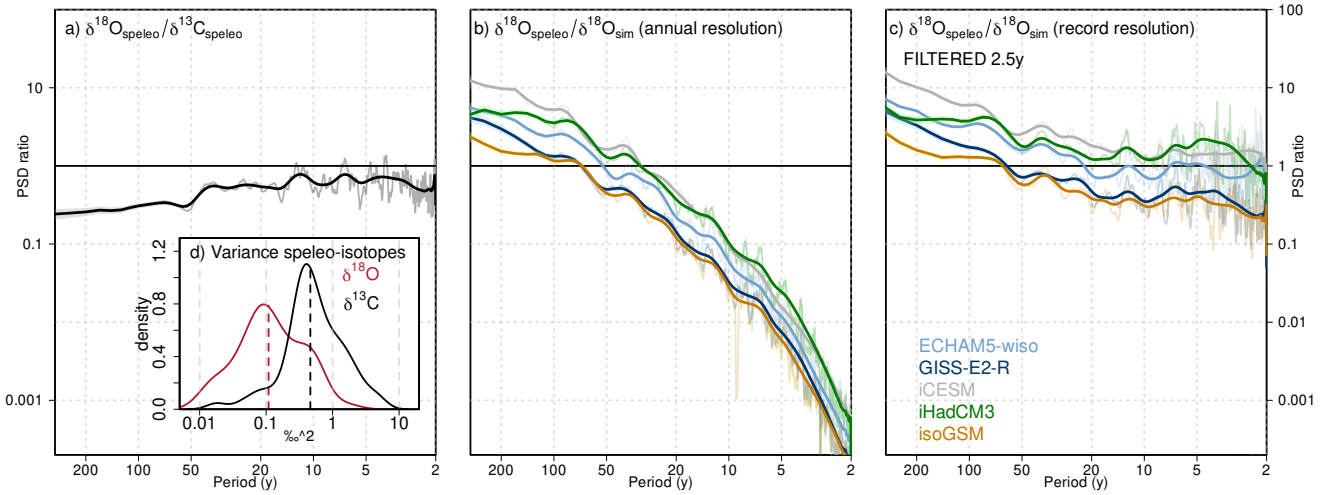

Figure SF12. As Fig. 9 but in b) with a 2.5 yr karst filter applied (as in Bühler et al. (2021) following Dee et al. (2015)) to the annually resolved $\delta^{18}O_{sim}$ which is later down-sampled to the individual records' resolution.

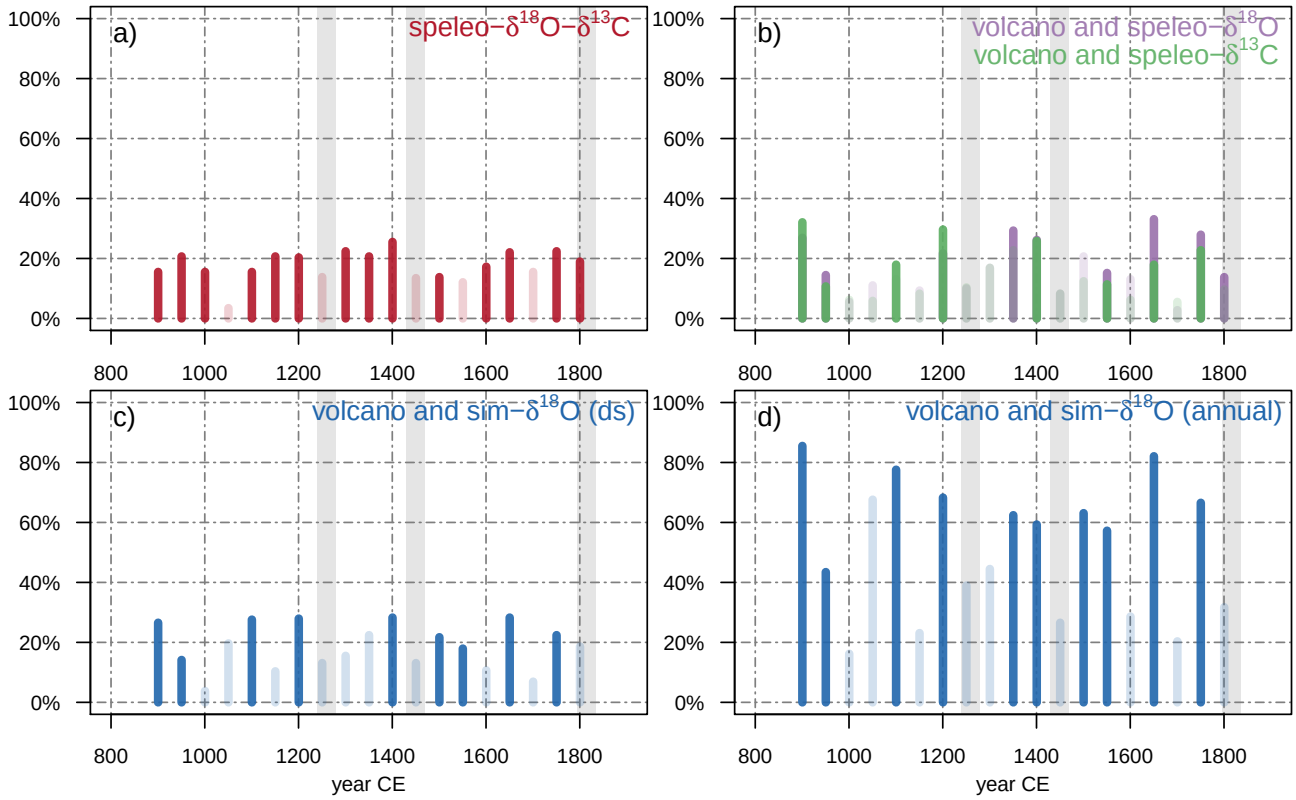

Figure SF13. As Fig. 10 but using bin-sizes of 50 yr which corresponds to the average age-uncertainty in the last millennium sub-sample of the SISALv2 database that we consider here.

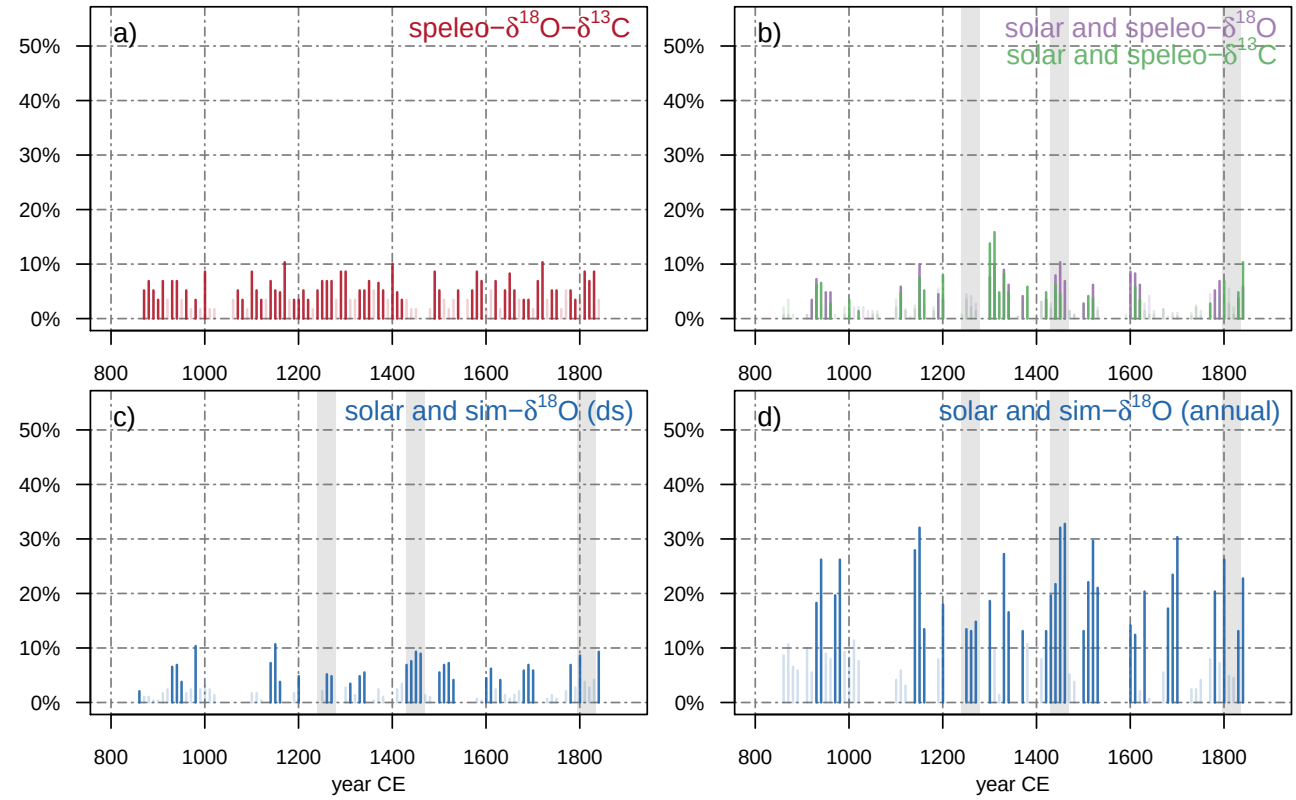

Figure SF14. As Fig. 10 but using the respective solar forcings used in the simulations.

Table ST1. Linear regression between isotopes, simulated climate variables and geographical information with 90% intervals of the distribution for p, R^2, slope and intercept.

		p	R^2	*slope*	*intercept*
$\delta^{18}O_{iw}$-$\delta^{18}O_{dweq}$	Tropics	**0.01** (0.00, 0.03)	0.35 (0.13, 0.39)	1.02 (0.51, 1.54)	1.78 (-1.87, 5.43)
	Subtropics	**0.00** (0.00, 0.01)	0.44 (0.27, 0.61)	0.74 (0.41, 1.07)	-2.02 (-5.01, 0.97)
	Extratropics	**0.00** (0.00, 0.00)	0.67 (0.58, 0.76)	1.03 (0.80, 1.25)	0.07 (-2.24, 2.38)
Temperature-$\delta^{18}O_{dweq}$	Tropics	**0.00** (0.00, 0.00)	0.47 (0.38, 0.54)	0.78 (0.54, 1.02)	-24.67 (-30.64, -18.70)
	Subtropics	**0.00** (0.00, 0.00)	0.71 (0.60, 0.81)	0.51 (0.38, 0.64)	-15.82 (-17.71, -13.94)
	Extratropics	**0.00** (0.00, 0.00)	0.49 (0.39, 0.58)	0.54 (0.36, 0.71)	-15.02 (-16.74, -13.30)
Precipitation-$\delta^{18}O_{dweq}$	Tropics	**0.01** (0.00, 0.02)	0.22 (0.15, 0.30)	-0.00 (-0.00, -0.00)	-2.80 (-4.34, -1.26)
	Subtropics	**0.00** (0.00, 0.00)	0.48 (0.39, 0.57)	-0.00 (-0.00, -0.00)	-5.29 (-6.79, -3.79)
	Extratropics	**0.05** (0.01, 0.12)	0.14 (0.08, 0.20)	0.00 (0.00, 0.00)	-12.48 (-14.54, -10.43)
Evaporation-$\delta^{18}O_{dweq}$	Tropics	0.27 (0.06, 0.56)	0.04 (0.01, 0.10)	0.00 (-0.00, 0.00)	-7.19 (-9.92, -4.45)
	Subtropics	0.08 (0.01, 0.21)	0.18 (0.08, 0.30)	-0.00 (-0.01, -0.00)	-5.58 (-8.24, -2.91)
	Extratropics	**0.04** (0.00, 0.10)	0.17 (0.09, 0.26)	0.00 (0.00, 0.01)	-12.46 (-14.31, -10.60)
Temperature-$\delta^{13}C_c$	Tropics	0.61 (0.25, 0.96)	0.02 (0.00, 0.05)	-0.16 (-0.68, 0.36)	-2.88 (-16.09, 10.32)
	Subtropics	0.77 (0.57, 0.97)	0.02 (0.00, 0.07)	-0.10 (-0.77, 0.57)	-4.29 (-15.20, 6.63)
	Extratropics	**0.04** (0.01, 0.08)	0.18 (0.13, 0.24)	-0.27 (-0.47, -0.06)	-4.86 (-6.86, -2.85)
Precipitation-$\delta^{13}C_c$	Tropics	0.65 (0.31, 0.96)	0.01 (0.00, 0.04)	0.00 (-0.00, 0.00)	-7.47 (-10.01, -4.93)
	Subtropics	0.69 (0.57, 0.82)	0.04 (0.01, 0.07)	0.00 (-0.00, 0.00)	-6.75 (-11.55, -1.96)
	Extratropics	0.60 (0.25, 0.95)	0.02 (0.00, 0.06)	-0.00 (-0.00, 0.00)	-6.44 (-9.16, -3.72)
Evaporation-$\delta^{13}C_c$	Tropics	0.65 (0.31, 0.96)	0.01 (0.00, 0.04)	0.00 (-0.00, 0.00)	-7.90 (-11.92, -3.87)
	Subtropics	0.75 (0.50, 0.97)	0.03 (0.00, 0.10)	0.00 (-0.01, 0.01)	-6.45 (-12.95, 0.05)
	Extratropics	0.15 (0.04, 0.32)	0.10 (0.04, 0.17)	-0.00 (-0.01, 0.00)	-5.31 (-7.58, -3.05)
Latitude-$\delta^{18}O_{dweq}$		**0.00**	0.22	-0.06 (-0.09, -0.04)	-6.46 (-7.16, -5.74)
Altitude-$\delta^{18}O_{dweq}$		**0.00**	0.33	-0.00 (-0.00, -0.00)	-5.41 (-6.20, -4.61)
Latitude-$\delta^{13}C_c$		0.77	0.00	-0.00 (-0.03, 0.02)	-6.83 (-7.68, -5.99)
Altitude-$\delta^{13}C_c$		0.43	0.01	0.00 (-0.00, 0.00)	-7.23 (-8.17, -6.28)

References

Bühler, J. C., Roesch, C., Kirschner, M., Sime, L., Holloway, M. D., and Rehfeld, K.: Comparison of the oxygen isotope signatures in speleothem records and iHadCM3 model simulations for the last millennium, Climate of the Past, 17, 985–1004, 2021.

Dee, S., Emile-Geay, J., Evans, M. N., Allam, A., Steig, E. J., and Thompson, D.: PRYSM: An open-source framework for PRoxY System Modeling, with applications to oxygen-isotope systems, Journal of Advances in Modeling Earth Systems, 7, 1220–1247, https://doi.org/https://doi.org/10.1002/2015MS000447, 2015.

Fohlmeister, J., Voarintsoa, N. R. G., Lechleitner, F. A., Boyd, M., Brandtstätter, S., Jacobson, M. J., and Oster, J. L.: Main controls on the stable carbon isotope composition of speleothems, Geochimica et Cosmochimica Acta, 279, 67–87, 2020.