Marine Proxies

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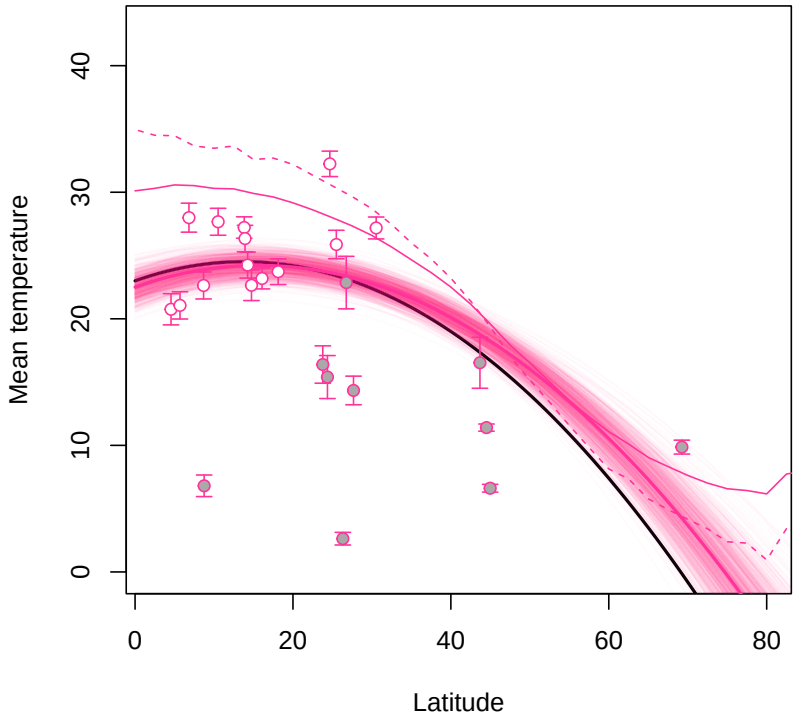
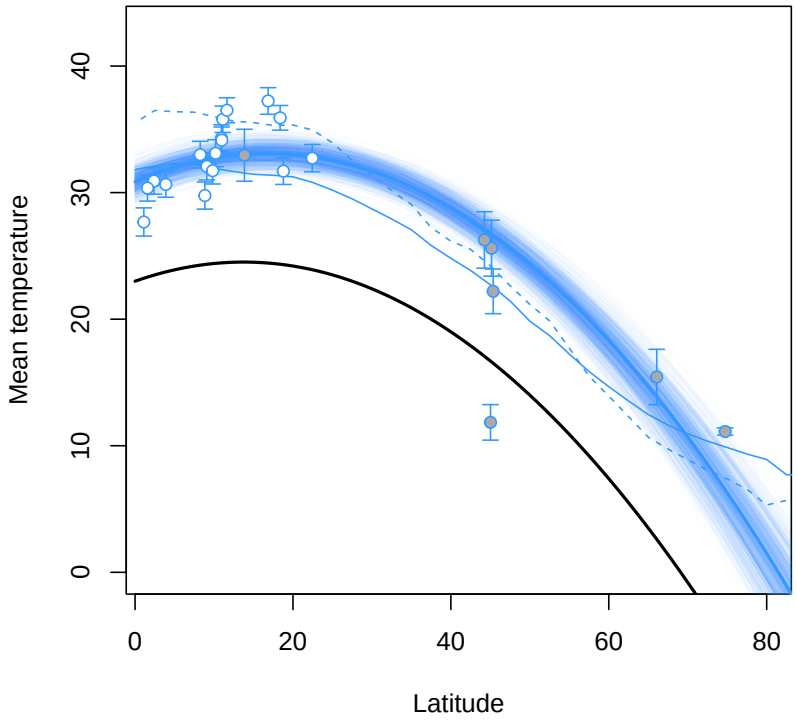
2025-08-20

Let's look at the marine proxy data. The latest run includes ocean average $\delta^{18}O$ value as a free parameter and the high-latitude continental data for both stages.


Mean temperature
0
10
20
30
40
0
20
40
60
80
Latitude


Mean temperature
0
10
20
30
40
0
20
40
60
80
Latitude

Let's review the high-latitude (terrestrial) proxy data and its interpretation. I'll refer to the sites by number for convenience, here's the key:

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[1] "Carnian = pink"
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	Site	lat_mean	lat_min	lat_max
1	Williston_Lake	31.747300	29.564415	34.069320
2	Frederick_Is	28.000000	23.000000	33.000000
3	Maantang_Sichuan	16.039690	13.836185	18.344770
4	Zhuganpo_Sichuan	10.052455	7.828125	12.336815
5	Oman	18.029785	15.843280	20.350800
6	Dolomites	13.616460	11.412840	15.921545
7	Lagonegro	5.954100	3.720405	8.229130
8	Pizzo_Mondello	5.161795	2.924530	7.433245
9	Aghia_Marina	6.201045	3.964600	8.473320
10	Guri_Zi	9.500000	4.500000	14.500000
11	Belvedere_di_Colle	13.792490	11.589545	16.098250
12	Durrnberg-Draxllehen	14.726885	12.526240	17.034900
13	Feuerkogel	14.204060	12.001940	16.510625
14	Guling	25.987755	23.805165	28.310880

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[1] "Anisian = blue"
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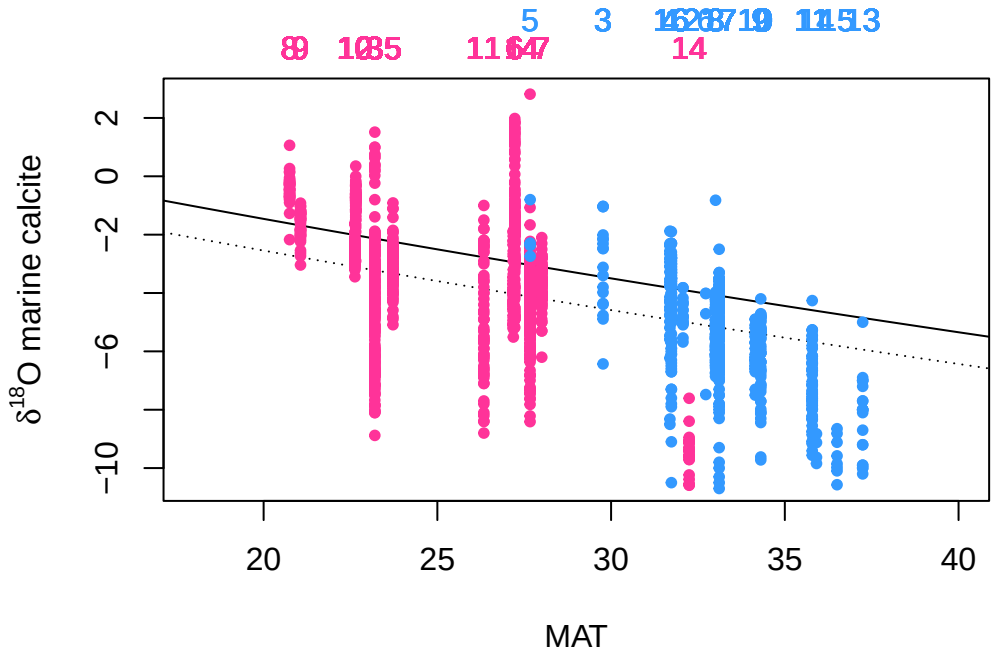
	Site	lat_min	lat_max	lat_mean
1	Lagonegro	0.000000	5.336810	2.5568418
2	Turkey	0.000000	3.590764	0.8224082
3	Hungary	6.874870	12.397296	9.5741582
4	Germany	15.922345	21.443695	18.5893782
5	Palazzo_Adriano	0.000000	4.644485	1.8693109
6	Poland	19.655796	25.176120	22.3170209
7	Nanpanjiang	1.680657	7.203056	4.4080391
8	Yangtze	5.316806	10.839230	8.0229027
9	Ramon	7.801699	13.324113	10.4983673
10	Hamieshar	7.904161	13.426575	10.6003273
11	Nafha	7.664939	13.187353	10.3622791
12	David	6.498835	12.021273	9.2022118
13	Switzerland	14.137560	19.659285	16.8088100
14	Baden-Wurttemberg	15.811126	21.332502	18.4783927
15	Austria	8.113906	13.636300	10.8071727
16	Rio_Sacuz	7.307216	12.829635	10.0044191
17	Palus_San Marco	7.321528	12.843946	10.0186555

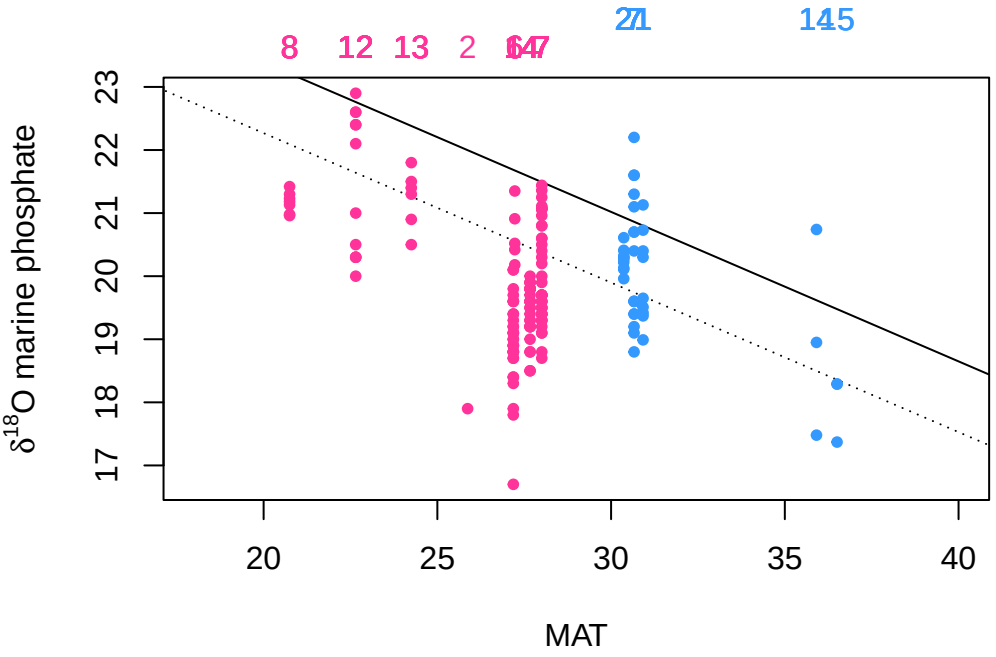
Here are the proxy data for marine calcite:



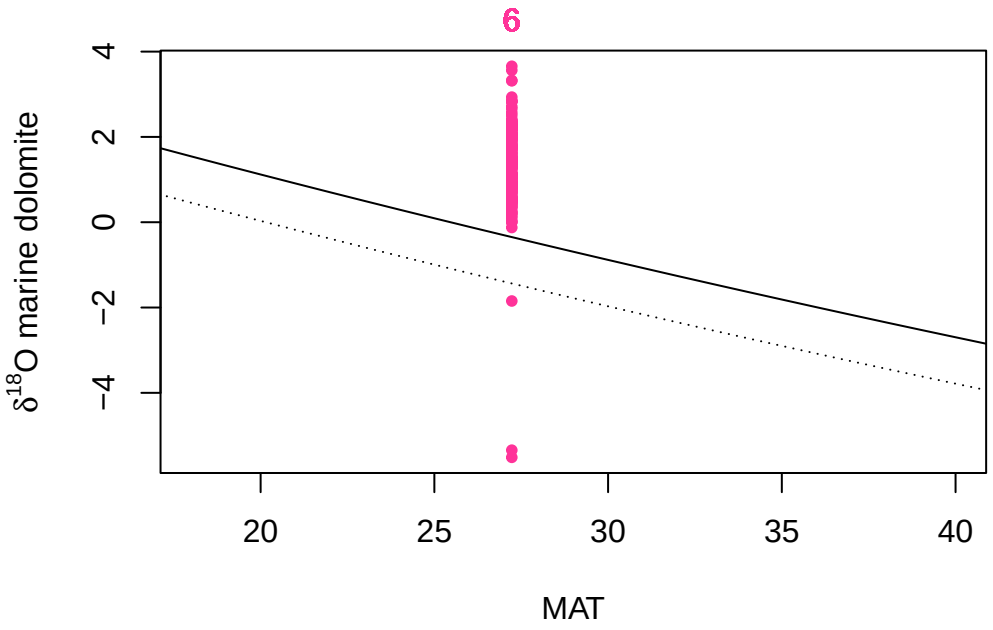
The solid and dashed lines represent the paleotemperature equation using a seawater $\delta^{18}O$ value of zero (solid) or -1.1 per mil (dashed; this is the median value from the JPI posterior). A few observations:

- Comparing the data with the solid line, you can see why the tropics were so hot in our previous analyses: the calcite $\delta^{18}O$ values are very low. Aside from a small number of Carnian samples (pink) that plot nicely on the solid line, most of the data fall well below it. In the analyses that used the fixed seawater value of zero per mil the temperatures at these sites were pulled stongly toward higher values.
- Allowing for lower seawater $\delta^{18}O$ values makes lower MAT values more consistent with these low carbonate $\delta^{18}O$ values. Because most of the continental proxy data are consistent with pretty low MAT (as described in the previous analysis), and because the parameterization of the meridional MAT gradient *prefers* gradients that are not so steep, the tropical marine temperaures decline substantially when we allow this change.
- The distributions of carbonate values for the Carnian and Anisian are offset pretty strongly. I am assuming seawater $\delta^{18}O$ values are the same during both time periods (which I think is appropriate), so this translates to an offset in tropical MATs of ~10 degrees between the two stages.

For comparison here are the same plots for phosphates and dolomites.



The MATs would again be much higher using a seawater $\delta^{18}O$ of zero. Interestingly, the phosphate $\delta^{18}O$ are much more similar for the Anisian and Carnian than the values for calcite are, and if we just used phosphate data the marine tropical temperatures for the two stages would be pretty similar. Because there are a lot more calcite data these end up being more influential, though.



Not so sure about these dolomite data…with the exception of a few low-value outliers they are consistent w/ substantially lower temperatures regardless of what we use for the $\delta^{18}O$ value of seawater. It's only one site, though and in the full analysis they are largley overwhelmed by the other data.