Supplementary material to Evaluation of Arctic warming in mid-Piacenzian simulations

Table S1: The reconstructions used in this work for the data-model comparison of mean annual surface air temperature anomalies.

Lat (°N)	Lon (°E)	MAT (°C)	Observation (°C)	Age min (Ma)	Age max (Ma)	Methods	Uncertainty	Confidence	Reference
80	-85	-7.1	-14.1	3	4	Fossil Insects Assemblages	>5	4	Elias and Matthews (2002), Elias and Kuzmina (2013), estimates from Ballantyne et al., (2013)
79.85	-99.24	4.3	-2.9	2.6	3.6	CRACLE	>1.1	2	Fletcher et al. (2017)
78.55	-82.33	1.2	-17.2	3	4	CRACLE	>1.1	1	Fletcher et al. (2017) (Age from Rybczynski et al. 2013)
78.3	-80.2	-0.5	-21.0	3	4	Tree ring d18O, CA, Bacterial tetraether composition in paleosols	1.9*	1	Ballantyne et al. (2010)
78.3	-79.2	4	-19.7	3.1	4.8	CRACLE	>1.1	3	Fletcher et al. (2017) (Age from Rybczynski et al. 2013)
72.2	125.97	1.5	-15.3	Late Pliocene	Late Pliocene	QualEst	1	4	Fradkina 1991, estimates from Salzmann et al., 2013
69.5	161.5	2	-8.8	Pliocene, prior to 2.4-2.5 Ma	Pliocene, prior to 2.4-2.5 Ma	CA^	4	4	Fradkina 1991
66.5	14.3	9.5	0.3	3.14	3.6	Pollen Records, CA	5	3	Panitz et al. (2016)
65.5	-144.08	3	-6.3	3	3.6	QualEst	NA	3	Ager, 1994a; Ager et al., 1994b, estimates from Salzmann et al., 2013
64.53	-149.08	3	-3.8	2.8	3.6	QualEst	2	3	Ager, 1994a; Ager et al., 1994b, estimates from Salzmann et al., 2013
64.06	-141.95	7.4	-7.7	2.5	3.3	QualEst	NA	3	Ager, 1994a; Ager et al., 1994b, estimates from Salzmann et al., 2013
64	162	5.3	-13.4	Late Pliocene	Late Pliocene	CA^	>4	3	Popova et al. (2012)
64	-139	6.4	-8.5	2.6	3.3	CA^	5	3	Pound et al. (2015) (age from Westgate et al., 2002)

63	133	7.4	-13.0	Late Pliocene	Late Pliocene	CA^	>4	3	Popova et al. (2012)
60	150.65	2	-5.9	Late Pliocene	Late Pliocene	QualEst	NA	4	Fradkina 1991, estimates from Salzmann et al., 2013

Table S2: Simulated global and Arctic (60-90°N) SAT. SST and SIE anomalies (mPWP minus pre-industrial) for each model and the MMMs. Changes in maximum AMOC strength obtained from Li et al. (in prep.)

Model	Global dSAT (°C)	Arctic dSAT 60–90°N (°C)	Arctic amplification ratio	Global dSST (°C)	Arctic dSST 60–90°N (°C)	Arctic sea ice extent anomaly ($10^6 km^2$)	Change in maximum AMOC strength
CCSM4-NCAR	2.7	6.8	2.6	1.7	1.6	-4.5	
CCSM4-Utrecht	4.8	10.5	2.2	3.4	3.0	-7.2	
CCSM4-UoT	3.8	9.9	2.6	2.7	3.0	-10.4	2.0
CESM1.2	4.1	9.6	2.4	2.8	3.1	-5.9	
CESM2	5.2	10.8	2.1	3.9	3.7	-6.2	
COSMOS	3.4	7.2	2.1	2.1	2.2	-4.4	3.4
EC-Earth 3.3	4.9	11.6	2.4	3.4	4.6	-9.8	
GISS-E2-1-G	2.1	3.7	1.8	1.5	1.3	-5.3	3.2
HadCM3	2.9	5.1	1.8	1.8	1.7	-4.8	5.3
IPSLCM5A	2.3	5.1	2.2	1.6	1.4	-3.4	5.9
IPSLCM5A-2.1	2.2	4.8	2.2	1.6	1.4	-3.1	4.7
IPSL-CM6A-LR	3.2	7.0	2.2	2.4	2.8	-5.2	3.1
MIROC4m	3.1	7.1	2.3	2.1	2.2	-5.9	0.6
MRI-CGCM2.3	2.4	7.4	3.1	1.3	1.4	-4.8	
NorESM-L	2.1	4.9	2.3	1.6	1.3	-3.0	2.0
NorESM1-F	1.7	5.2	3.0	1.3	1.6	-3.4	3.6
PlioMIP2 MMM	3.2	7.2	2.3	2.1	2.4	-6.3	
PlioMIP1 MMM	2.7	6.4	2.4	1.7	1.5	-5.3	

Table S3: Mean absolute deviations (MAD) and median biases for SAT (°C) in the Arctic.

Model	MAD (°C)	Median bias (°C)
CCSM4-NCAR	7.3	-7.4

CCSM4-Utrecht	5.6	-4
CCSM4-UoT	5.5	-5.3
CESM1.2	6.5	-5.0
CESM2	5.0	-2
COSMOS	6.8	-8.1
EC-Earth 3.3	5.7	-4.9
GISS-E2-1-G	11.2	-13.1
HadCM3	8.3	-10.3
IPSLCM5A	9.4	-11.3
IPSLCM5A-2.1	9.8	-11.8
IPSL-CM6A-LR	7.8	-9.3
MIROC4m	7.4	-9.2
MRI-CGCM2.3	8	-9.7
NorESM-L	8.5	-6.9
NorESM1-F	8.1	-6.9
PlioMIP2 MMM	7.3	-8.2
PlioMIP1 MMM	7.8	-8.7

Table S4: Global and Arctic temperature anomalies for different scenarios of future climate change simulated by CMIP5 models (Masson-Delmotte et al., 2013).

Model	Global dSAT (°C)	Arctic (67.5-90°N) dSAT (°C)
RCP2.6	1.0	2.2
RCP4.5	1.8	4.2
RCP6.0	2.2	5.2
RCP8.5	3.7	8.3

References

Li, X., Zhang, Z., Guo, C., Otterå, O. H. and others: Pliocene Atlantic Meridional Overturning Circulation simulated in PlioMIP2, in prep.

Masson-Delmotte, V., Schulz, M., Abe-Ouchi, A., Beer, J., Ganopolski, A., Gonzalez Rouco, J. F., Jansen, E., Lambeck, K., Luterbacher, J., Naish, T., Osborn, T., Otto-Bliesner, B., Quinn, T., Ramesh, R., Rojas, M., Shao, X. and Timmermann, A.: Information from paleoclimate archives, in Climate change 2013: the physical science basis, edited by T. F. Stocker, D. Qin, G.-K. Plattner, M. M. B. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P. M. Midgley, pp. 383–464, Cambridge University Press., 2013.