Figure S1. SST anomalies over the MC from individual models in the pre-industrial (E280) relative to HadISST1 reanalysed SSTs. Numbers in brackets indicate the RMSE between HadISST1 SSTs and model SSTs over the MC for each model.

Table S1. The discrepancy values between individual model and data. Unit:°C

Model name	Eoi400 discrepancy	E280 discrepancy	E280 discrepancy (bias adjusted)
CESM2	2.28	0.82	0.63
IPSL-CM6A-LR	1.58	0.94	0.56
COSMOS	1.73	0.94	0.91
EC-Earth3.3	2.17	0.84	0.53
CESM1.2	1.77	0.44	0.35
IPSLCM5A	1.52	1.29	0.62
MIROC4m	1.62	1.27	0.92
IPSLCM5A2	1.58	0.66	0.65
HadCM3	1.52	1.29	1.14
GISS-E2-1-G	1.52	0.68	0.64
CCSM4	1.58	0.39	0.39
CCSM4-Utr	1.93	0.58	0.52
CCSM4-UoT	1.62	0.51	0.50
NorESM-L	1.62	1.06	0.96
MRI-CGCM2.3	1.58	0.81	0.81
NorESM1-F	1.62	0.56	0.54
HadGEM3	2.08	0.50	0.50
MMM	1.58	0.51	0.50
cluster 1	2.28	0.82	0.63
cluster 2	2.28	1.03	1.03
cluster 3	1.58	0.45	0.44
cluster 4	1.58	0.64	0.55
cluster 5	1.58	0.81	0.81
MCM	1.62	0.56	0.56
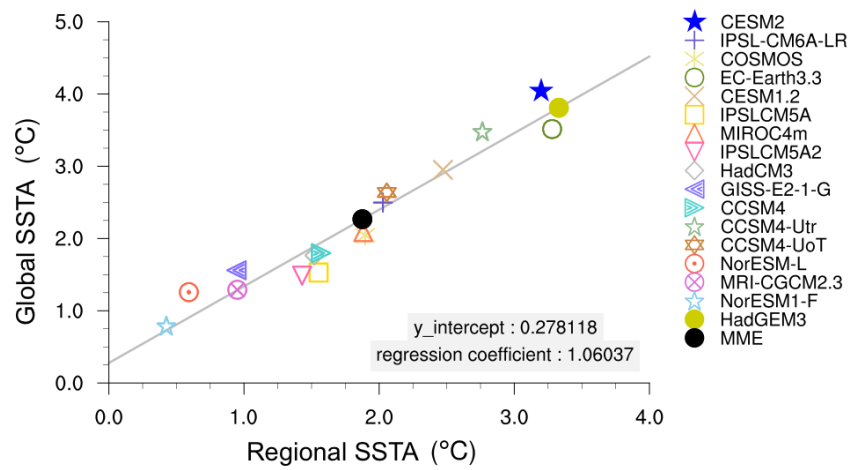
Figure S2. The comparison of the global SSTAs and the mean SSTAs over the MC.
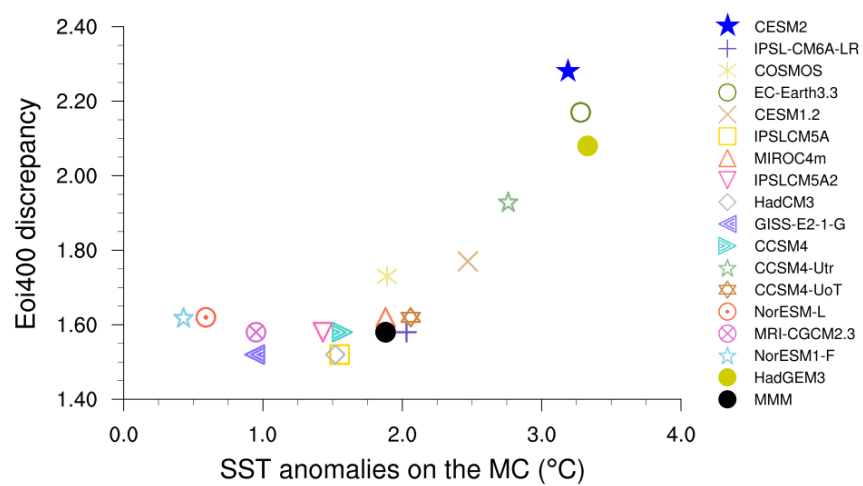
Figure S3. The comparison of the SSTAs averaged over the MC and the Eoi400 discrepancy with proxy.
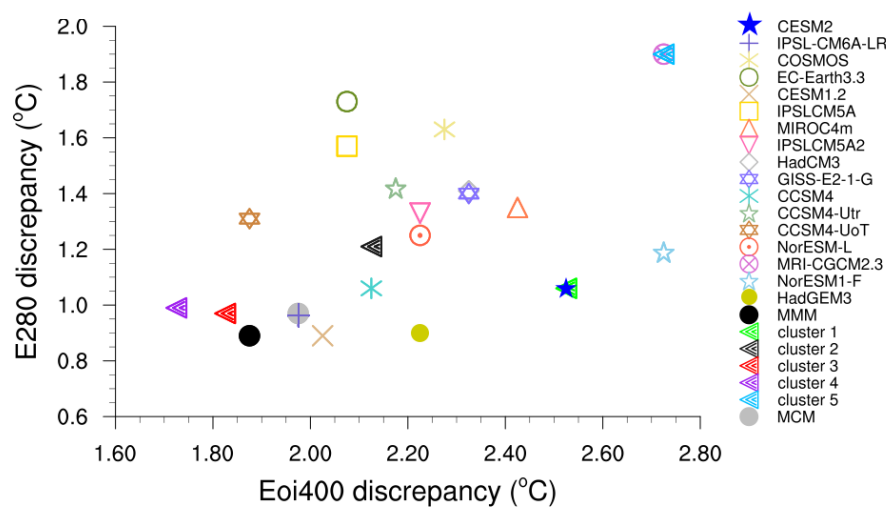
Figure S4. Comparison of the model and data discrepancies at the global scale between the E280 and Eoi400 simulations.
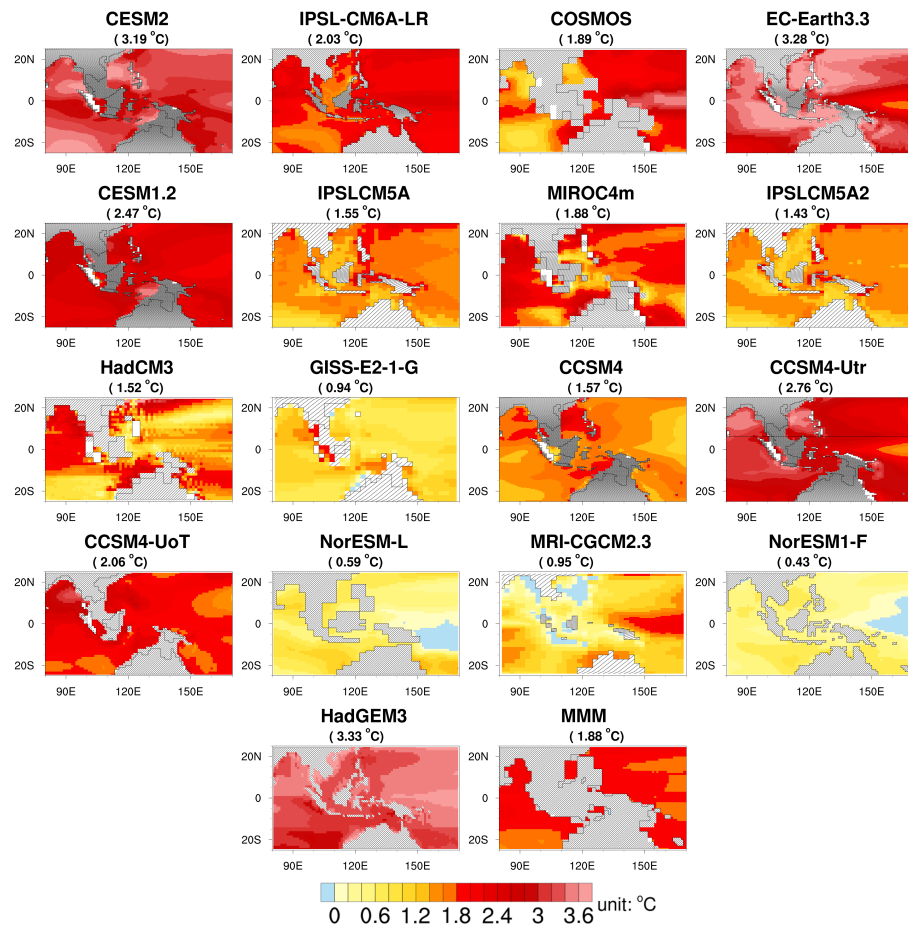
Figure S5. SSTA over the MC from individual models in the mid-Pliocene simulation (Eoi400) relative to the preindustrial simulation (E280). Numbers in brackets indicate the regional mean SST anomalies for each model.
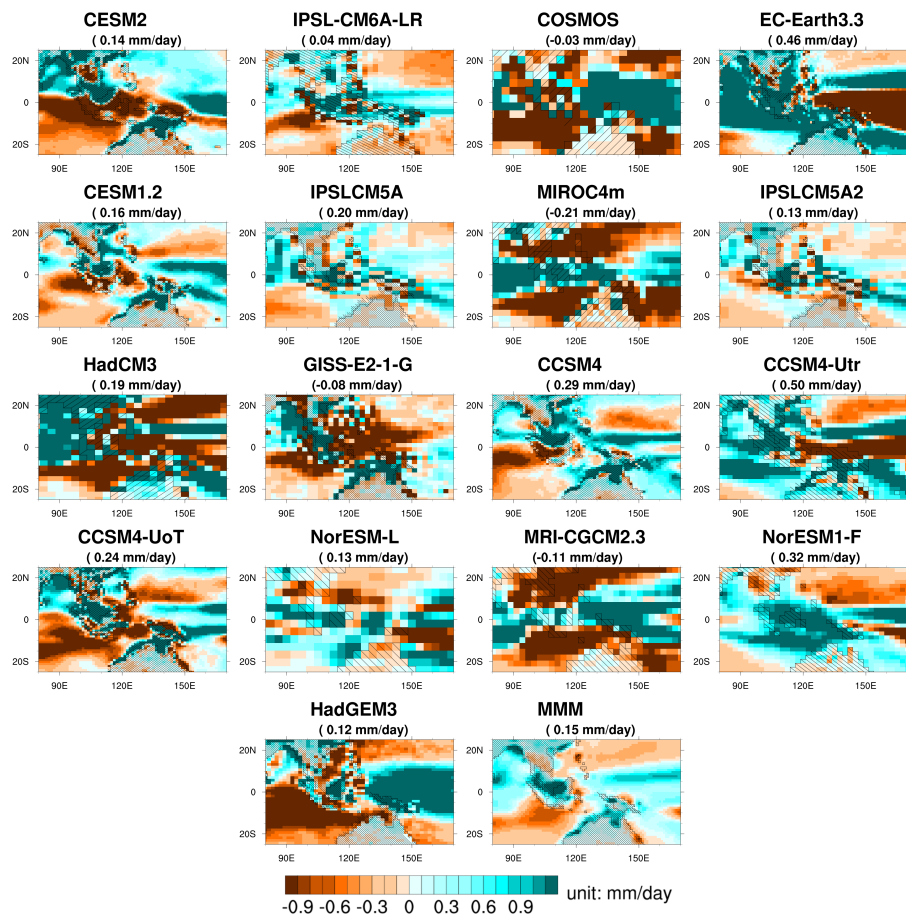
Figure S6. Same as Figure S5 but for precipitation minus evaporation (P-E).
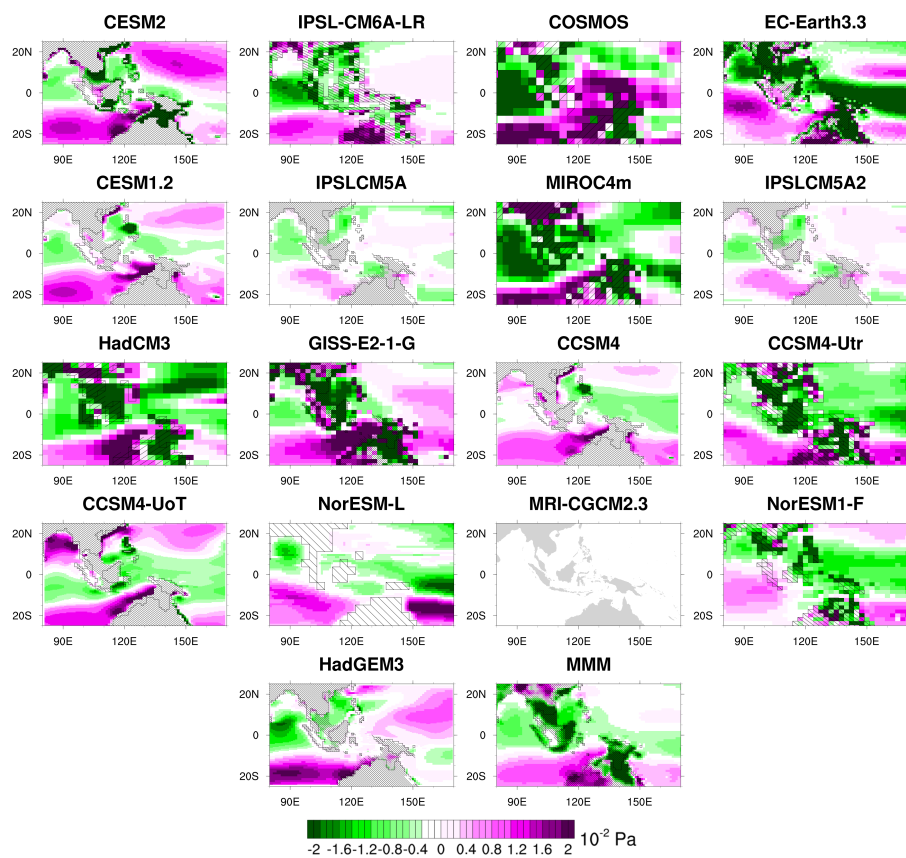
Figure S7. Same as Figure S5 but for zonal wind stress. Green shading indicates westward tendency and yellow shading indicates eastward tendency. Unit: Pa.
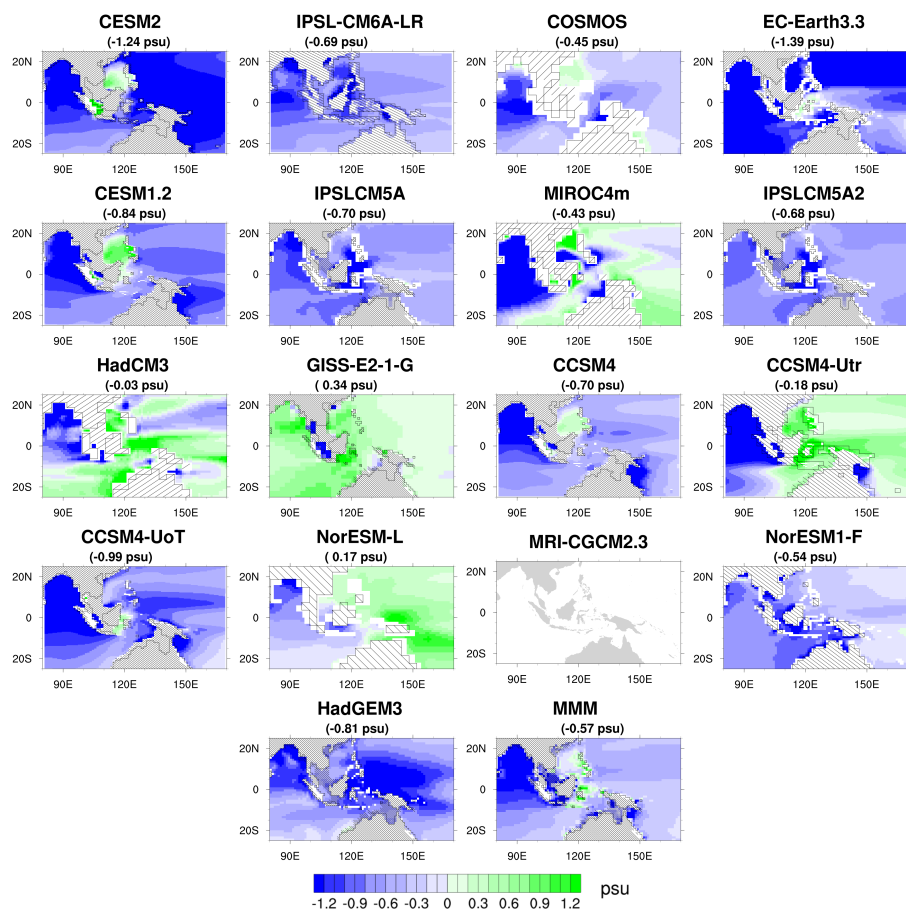
Figure S8. Same as Figure S5 but for SOS.
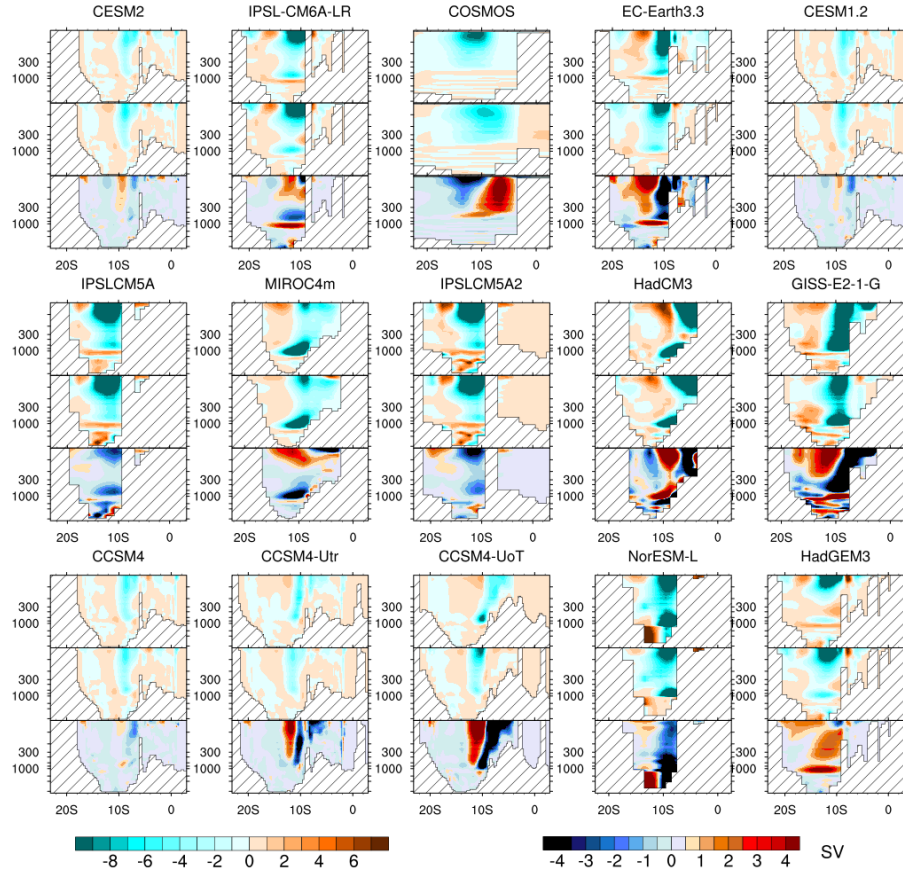
Figure S9. The profiles of the ocean current through the MC in the mid-Pliocene (top panel for each model), in the preindustrial (middle panel for each model) and the anomalies of the mid-Pliocene relative to preindustrial (bottom panel for each model). Warm shading indicates direction from west to east. Cold shading indicates direction from east to west.