atmosphere

Supplementary materials

Table S1. The 44 models used to calculate the total response and the 12 models used to calculate the fast response in Figure S1.

Models used in the total response				
ACCESS-CM2	ACCESS-ESM1-5	AWI-CM-1-1-MR	BCC-CSM2-MR	BCC-ESM1
CAMS-CSM1-0	CanESM5	CAS-ESM2-0	CESM2	CESM2-FV2
CESM2-WACCM	CESM2-WACCM-FV2	CIESM	CMCC-CM2-SR5	CMCC-ESM2
E3SM-1-0	EC-Earth3-Aer-Chem	EC-Earth3-CC	EC-Earth3-Veg	FGOALS-f3-L
FGOALS-g3	FIO-ESM-2-0	GISS-E2-1-G	GISS-E2-1-H	GISS-E2-2-G
GISS-E2-2-H	ICON-ESM-LR	IITM-ESM	INM-CM4-8	INM-CM5-0
IPSL-CM6A-LR	KACE-1-0-G	KIOST-ESM	MIROC6	MPI-ESM-1-2-HAM
MPI-ESM1-2-HR	MPI-ESM1-2-LR	MRI-ESM2-0	NESM3	NorCPM1
NorESM2-LM	NorESM2-MM	SAM0-UNICON	TaiESM1	
Models used in the fast response				
ACCESS-CM2	ACCESS-ESM1-5	CESM2	EC-Earth3	GFDL-ESM4
GISS-E2-1-G	IPSL-CM6A-LR	MIROC6	MPI-ESM1-2-LR	MRI-ESM2-0
NorESM2-LM	NorESM2-MM			

Table S2. The 9 models used to calculate the convective cloud cover in Figure S2.

Modle name	Institution	Nation	Resolution (longitude × latitude)
CESM2	NCAR	USA	1.25° × 0.9375°
CESM-FV2	NCAR	USA	2.5° ×1.875°
CESM-WACCM-FV2	NCAR	USA	2.5° ×1.875°
EC-Earth3-AerChem	EC-Earth-Consortium	European Community	~0.7° ×0.7°
GISS-E2-1-G	NASA-GISS	USA	2.5° × 2°
GISS-E2-1-H	NASA-GISS	USA	2.5° × 2°
GISS-E2-2-G	NASA-GISS	USA	2.5° × 2°
GISS-E2-2-H	NASA-GISS	USA	2.5° × 2°

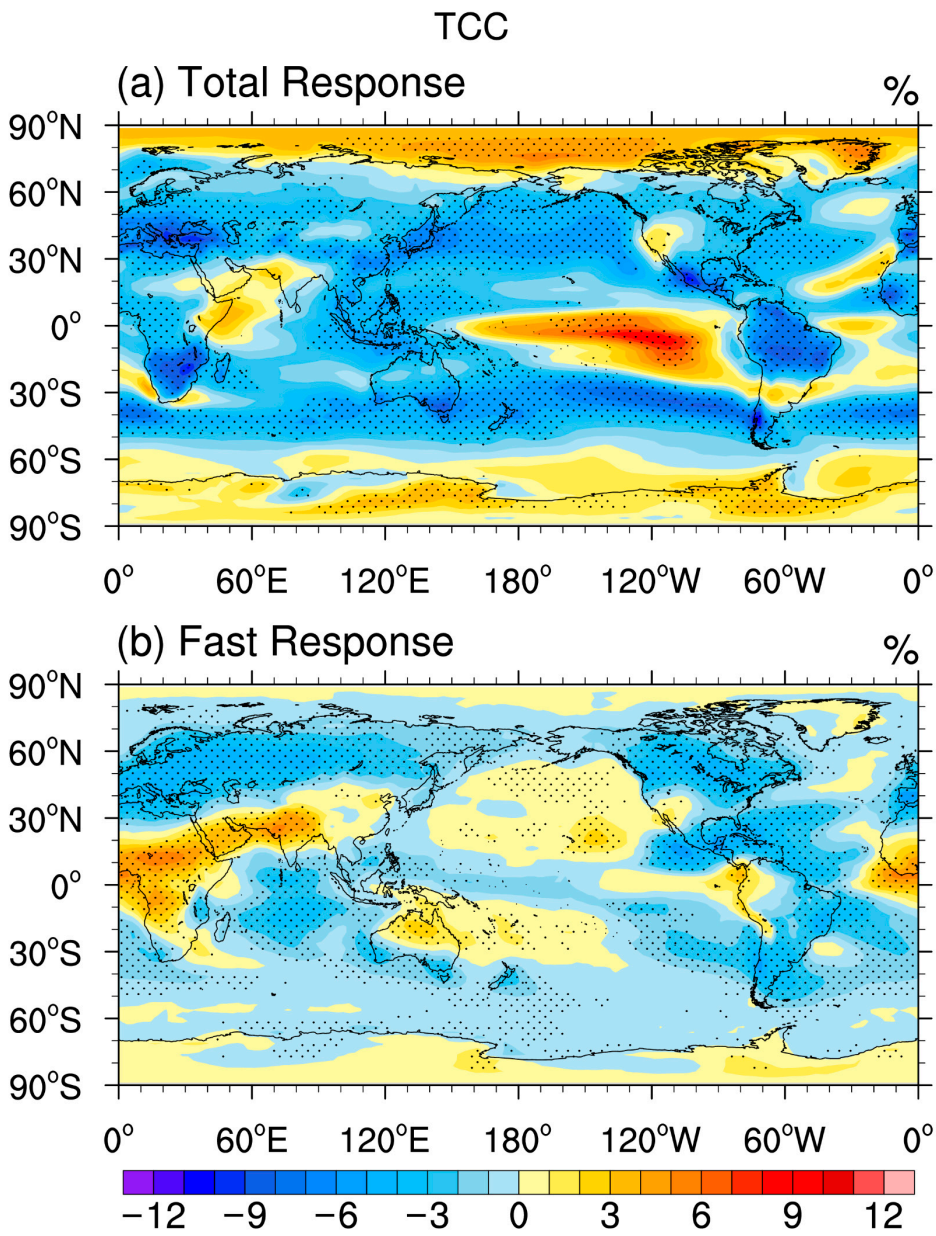

Figure S1. (**a**) The total response of TCC from 44 available models and (**b**) the fast response from 12 available models (unit: %). Black dot represents more than 80% models agree with the sign of changes.

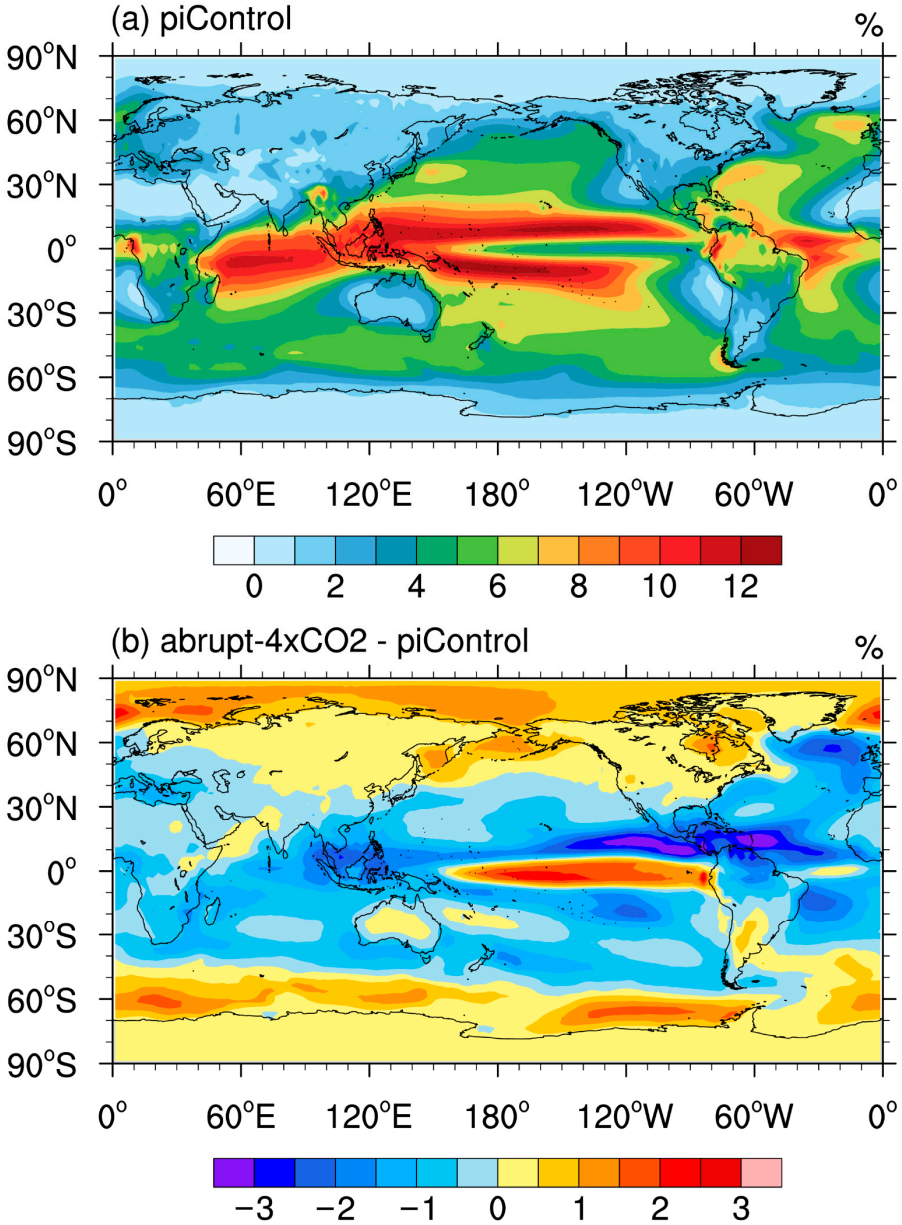

Figure S2. (**a**) The distribution of convective cloud cover provided by 9 available models in piControl, and (**b**) the difference between abrupt-4xCO2 and piControl (unit: %).

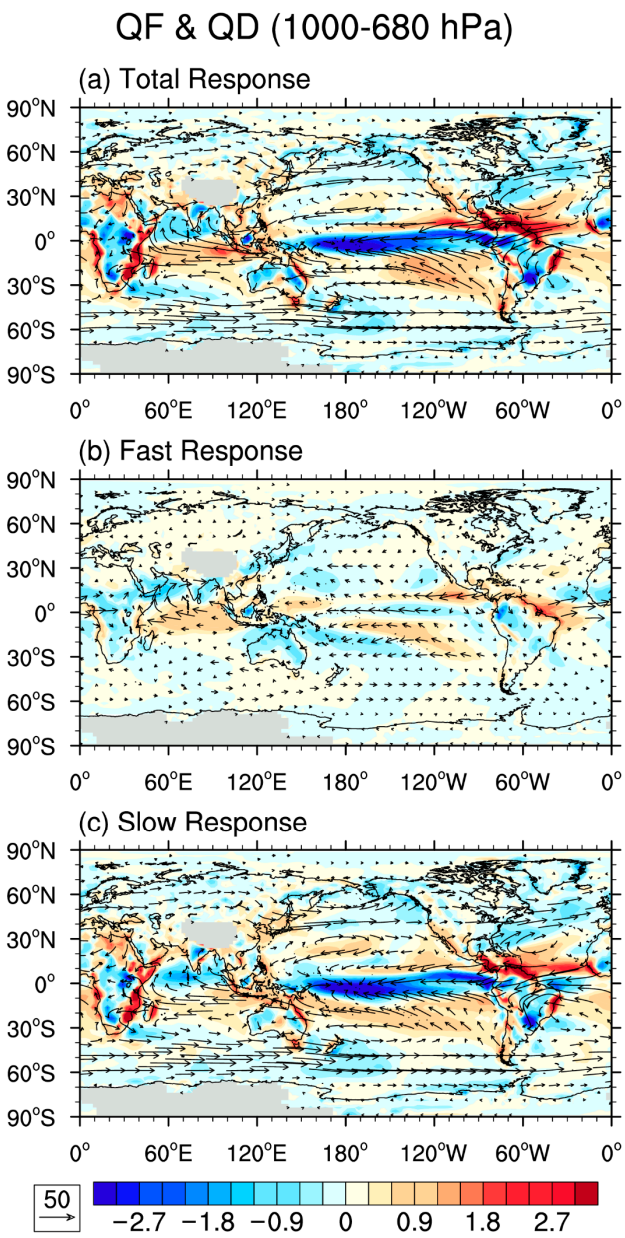

Figure S3. (**a**) Total, (**b**) fast, and (**c**) slow responses of global vertical integrated column horizontal water vapor flux (QF, vector, units: kg m^{-1} s^{-1}) and divergence (QD, color shading, units: 10^{-5} kg m^{-2} s^{-1}, positive values represent water vapor diffusion) from 1000 hPa to 680 hPa.

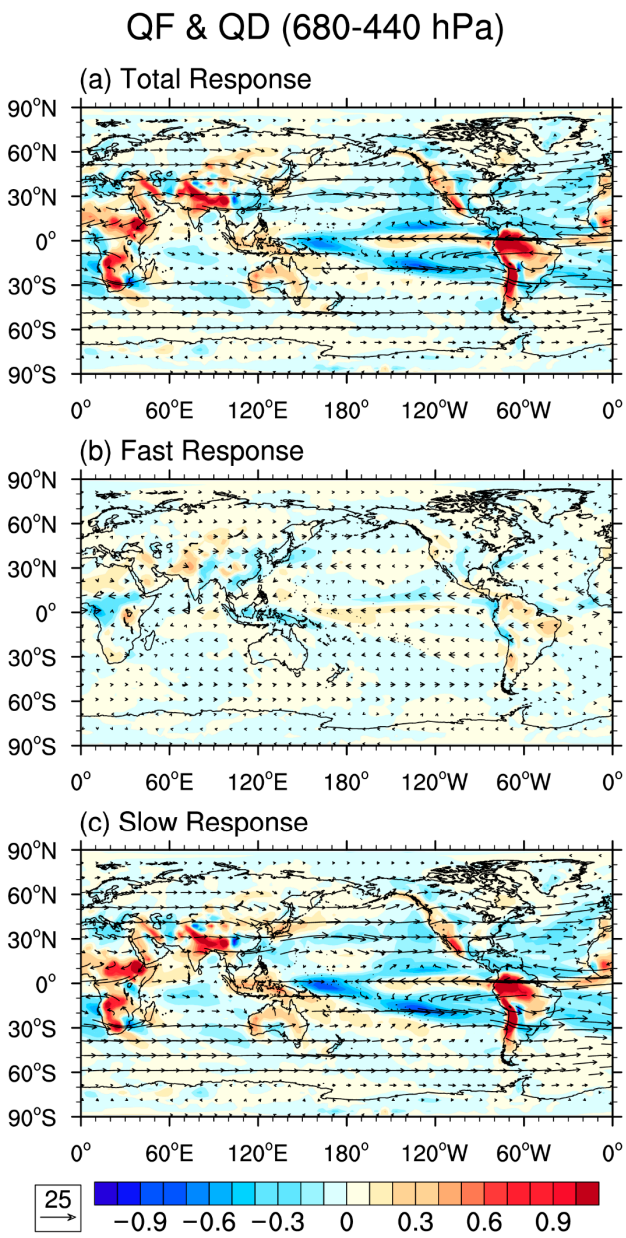

Figure S4. Same as Figure S3, but from 680 hPa to 440 hPa.

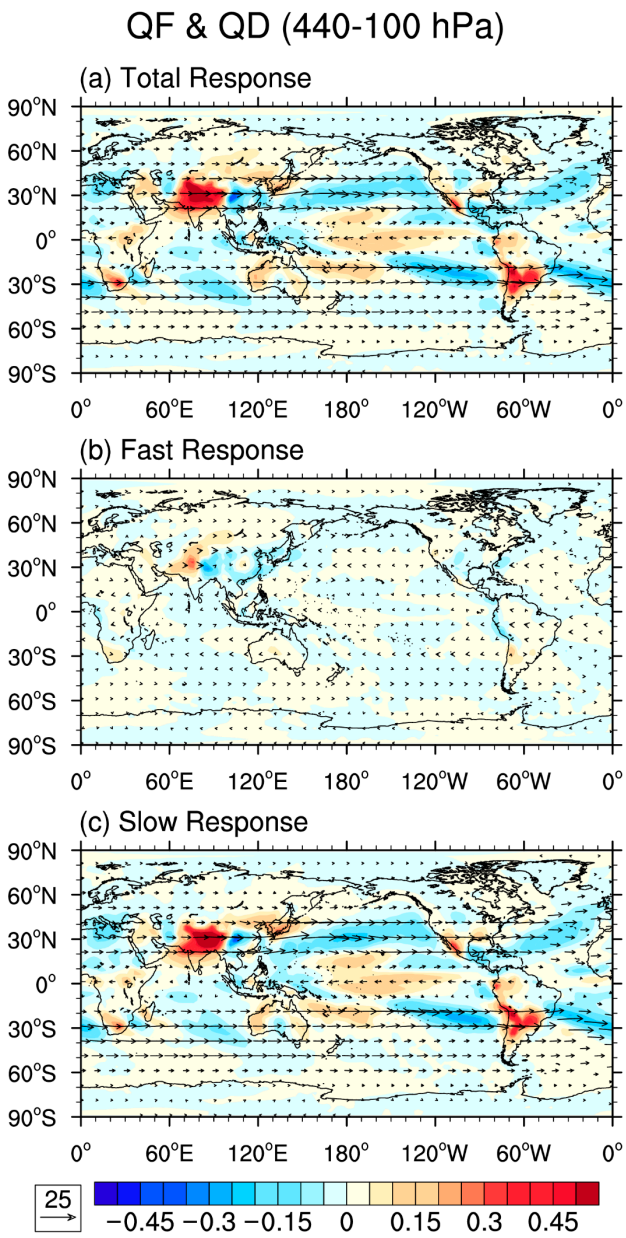

Figure S5. Same as Figure S3, but from 440 hPa to 100 hPa.

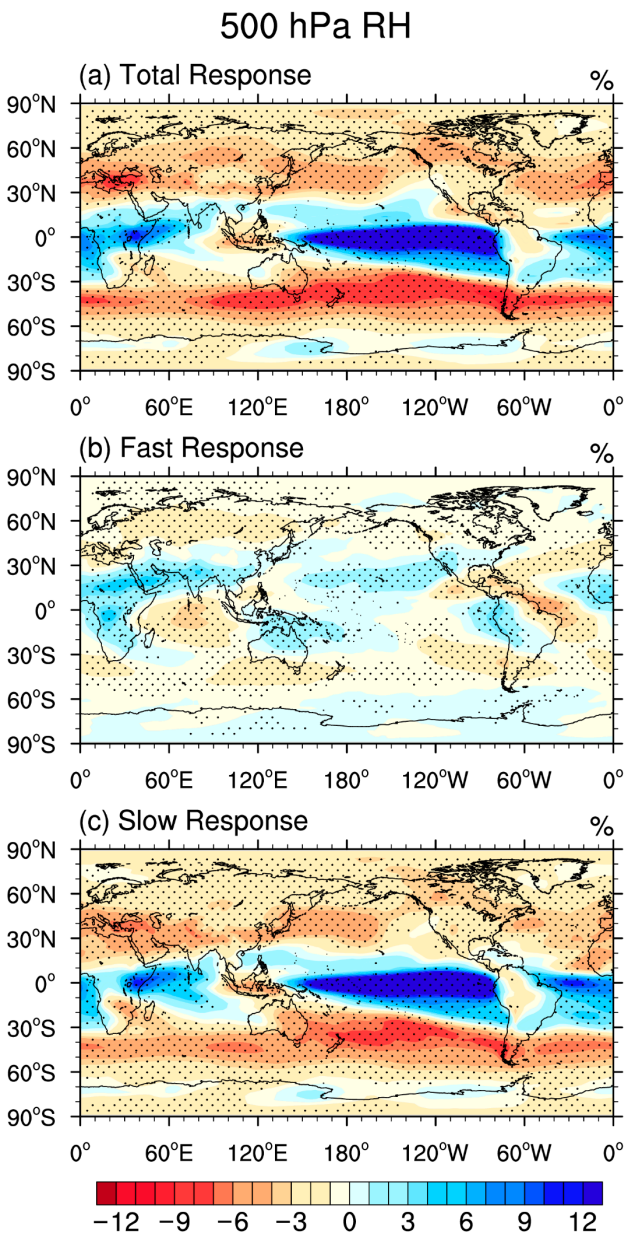

Figure S6. (**a**) Total, (**b**) fast, and (**c**) slow responses of 500 hPa relative humidity (units: %). Black dot represents that at least 8 models agree with the sign of changes.