

Figure S1. Multi-model ensemble projection of the changes in precipitation by the end of 21st century (2090-2099) relative to present day (2005-2014) under four different anthropogenic emission scenarios. Precipitation data from the five selected climate models (Table 1) are used in the analyses.

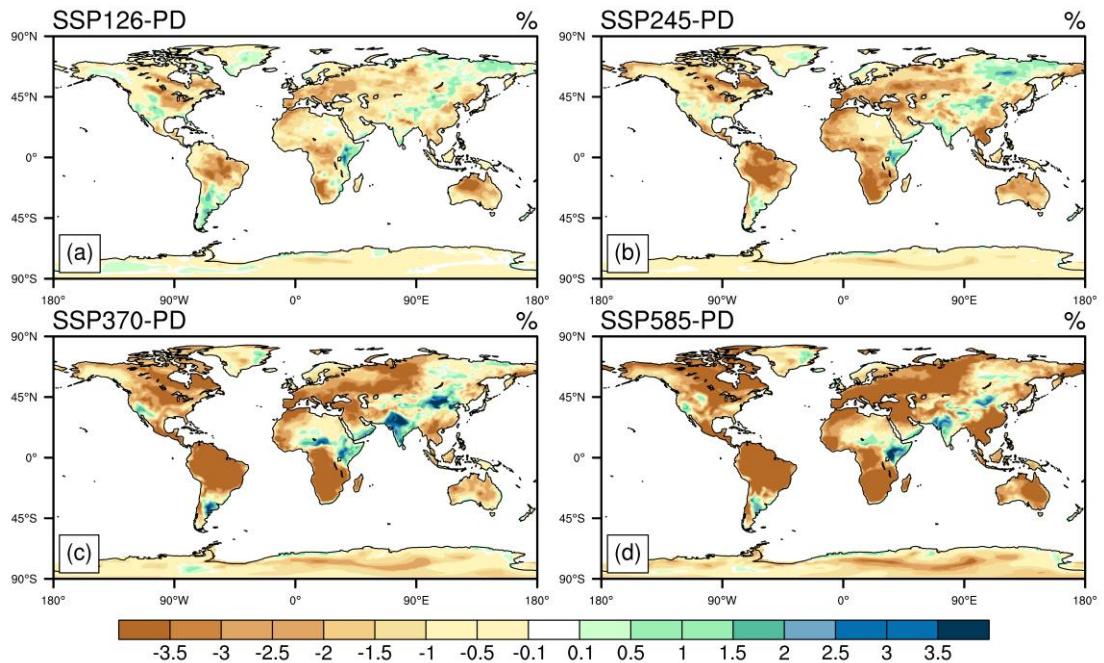


Figure S2. The same as Figure S1 but for changes in relative humidity.

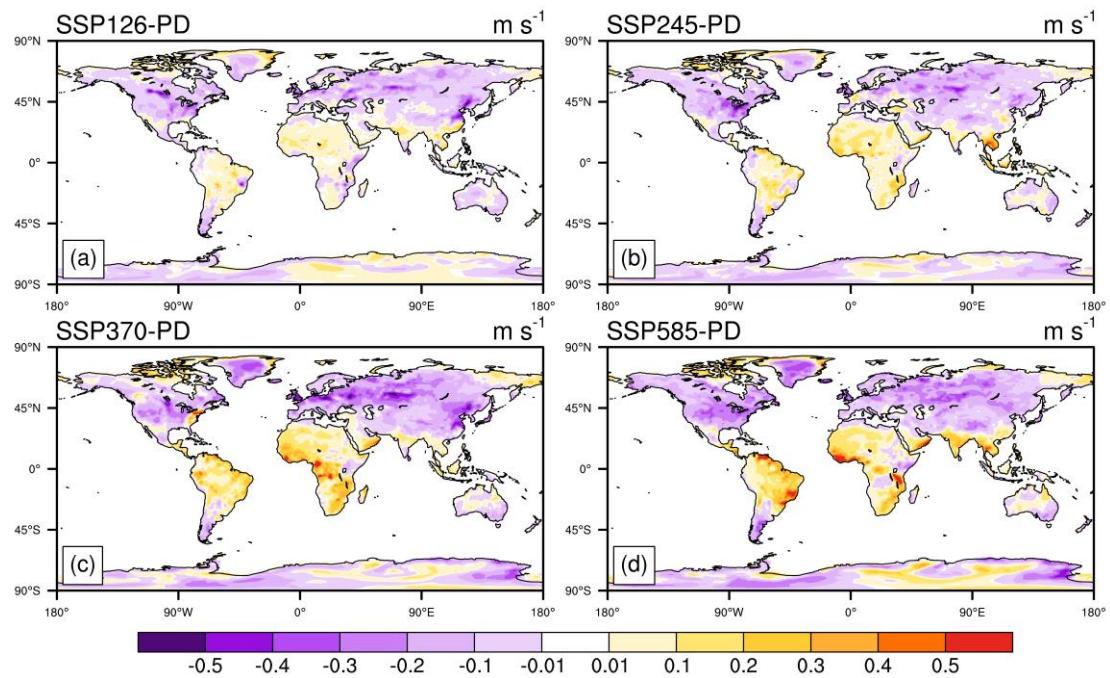


Figure S3. The same as Figure S1 but for changes in surface wind speed.

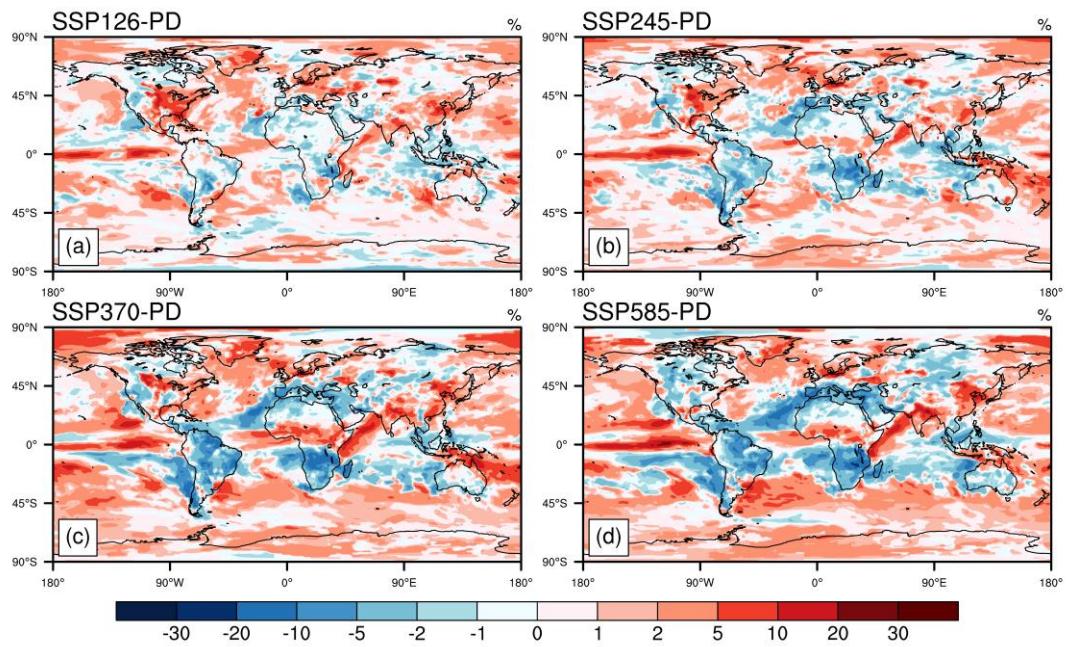


Figure S4. The same as Figure S1 but for changes in the ratio of wet to total deposition.

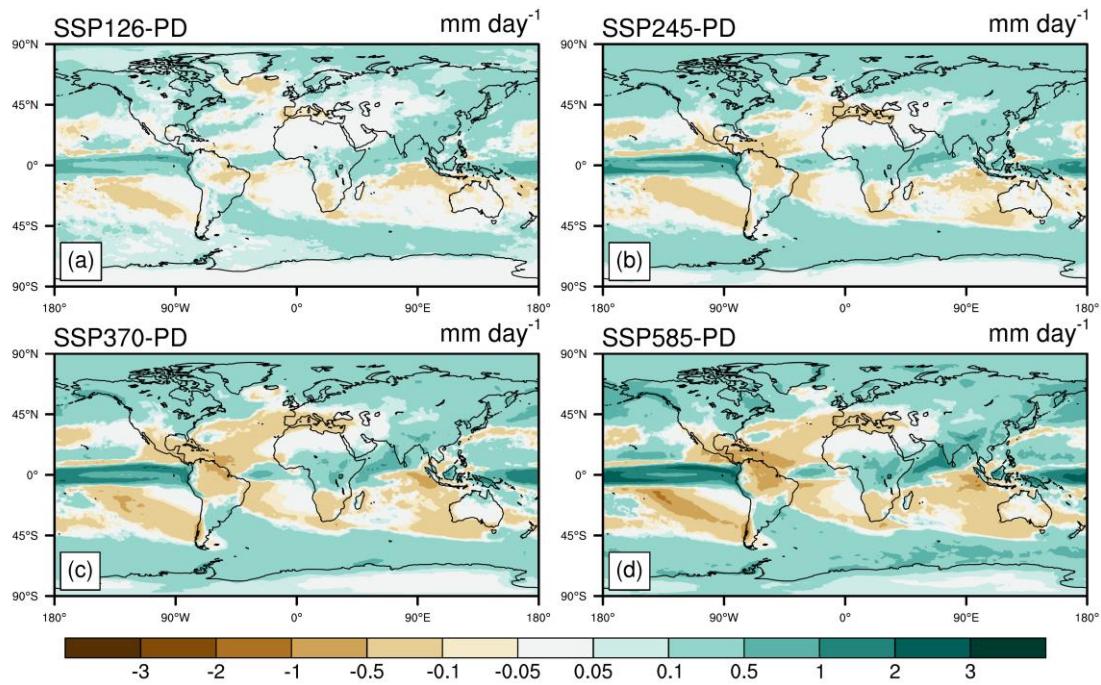


Figure S5. Multi-model ensemble projection of the changes in precipitation by the end of 21st century (2090-2099) relative to present day (2005-2014) under four different anthropogenic emission scenarios using all climate models in Table S2.

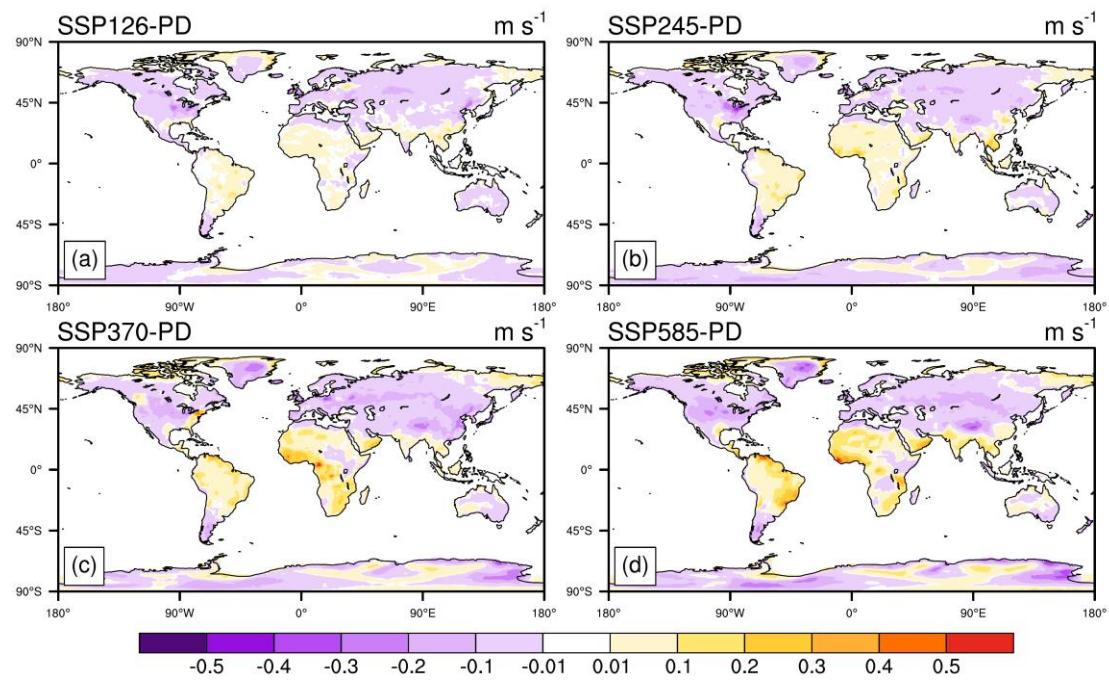


Figure S6. The same as Figure S5 but for changes in surface wind speed.

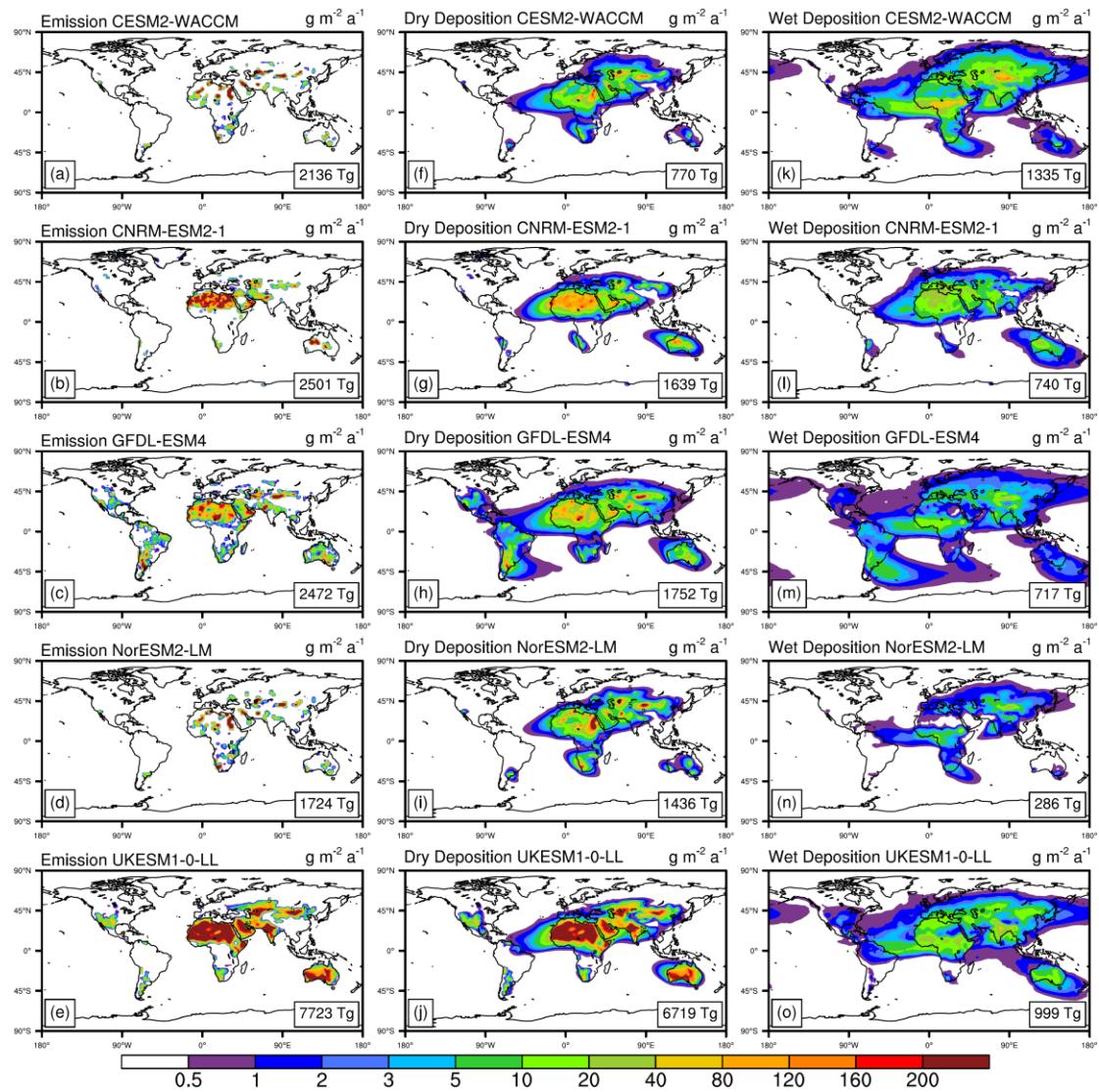


Figure S7. Dust emission and deposition of each selected model used in analyses (Table 1) at present day (2005-2014).

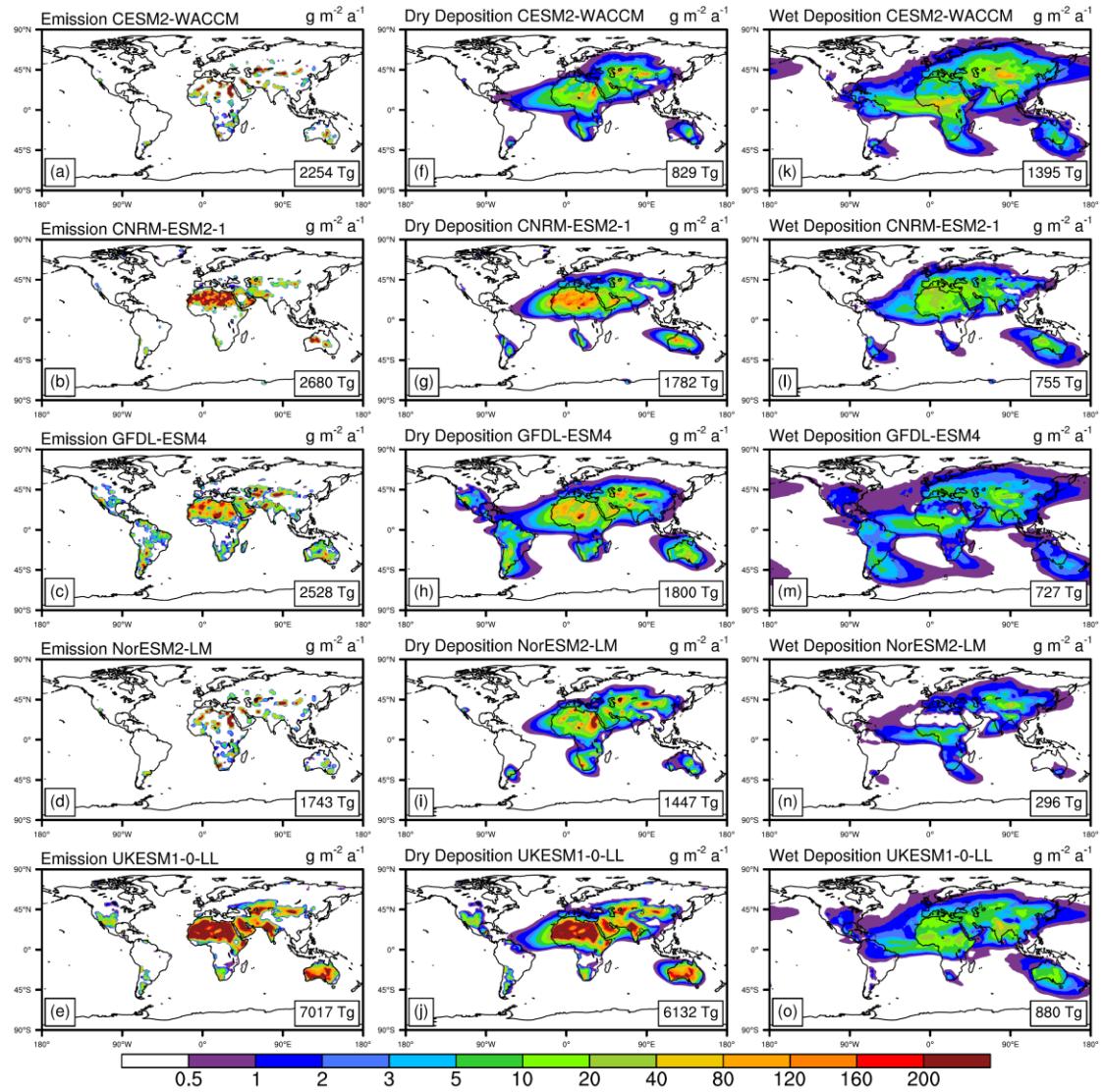


Figure S8. The same as Figure S7 but in SSP1-2.6 scenario (2090-2099).

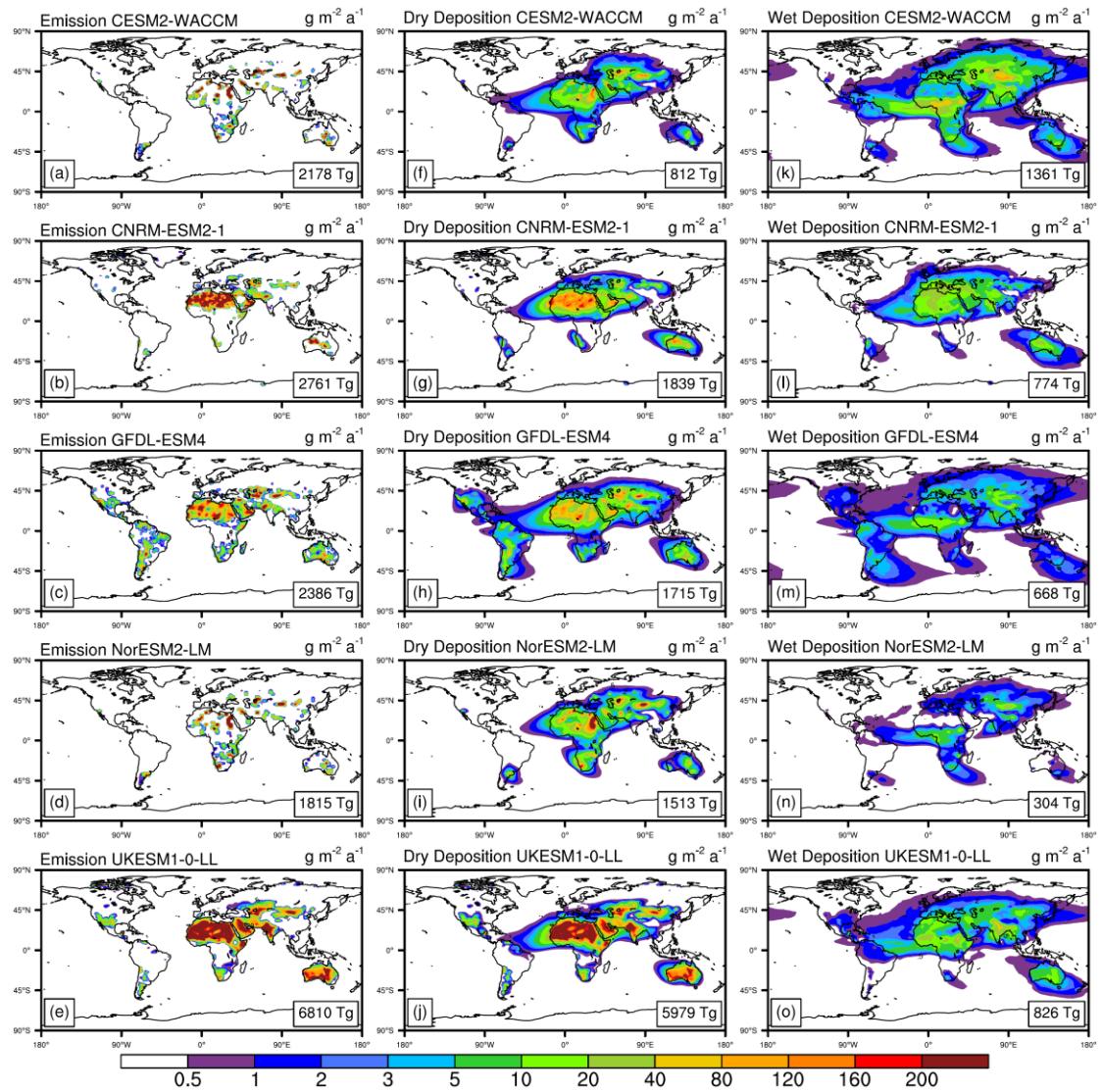


Figure S9. The same as Figure S7 but in SSP2-4.5 scenario (2090-2099).

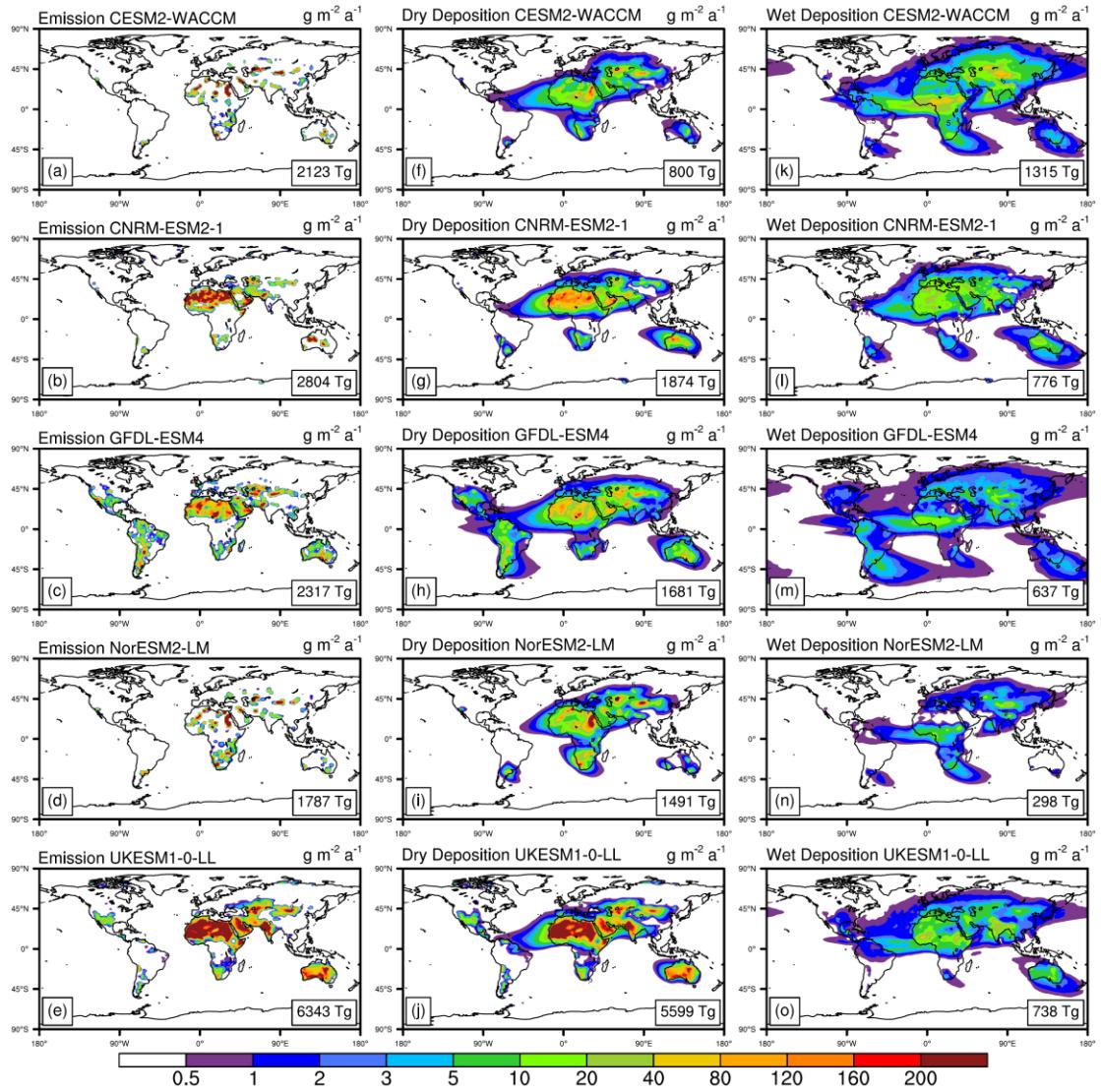


Figure S10. The same as Figure S7 but in SSP3-7.0 scenario (2090-2099).

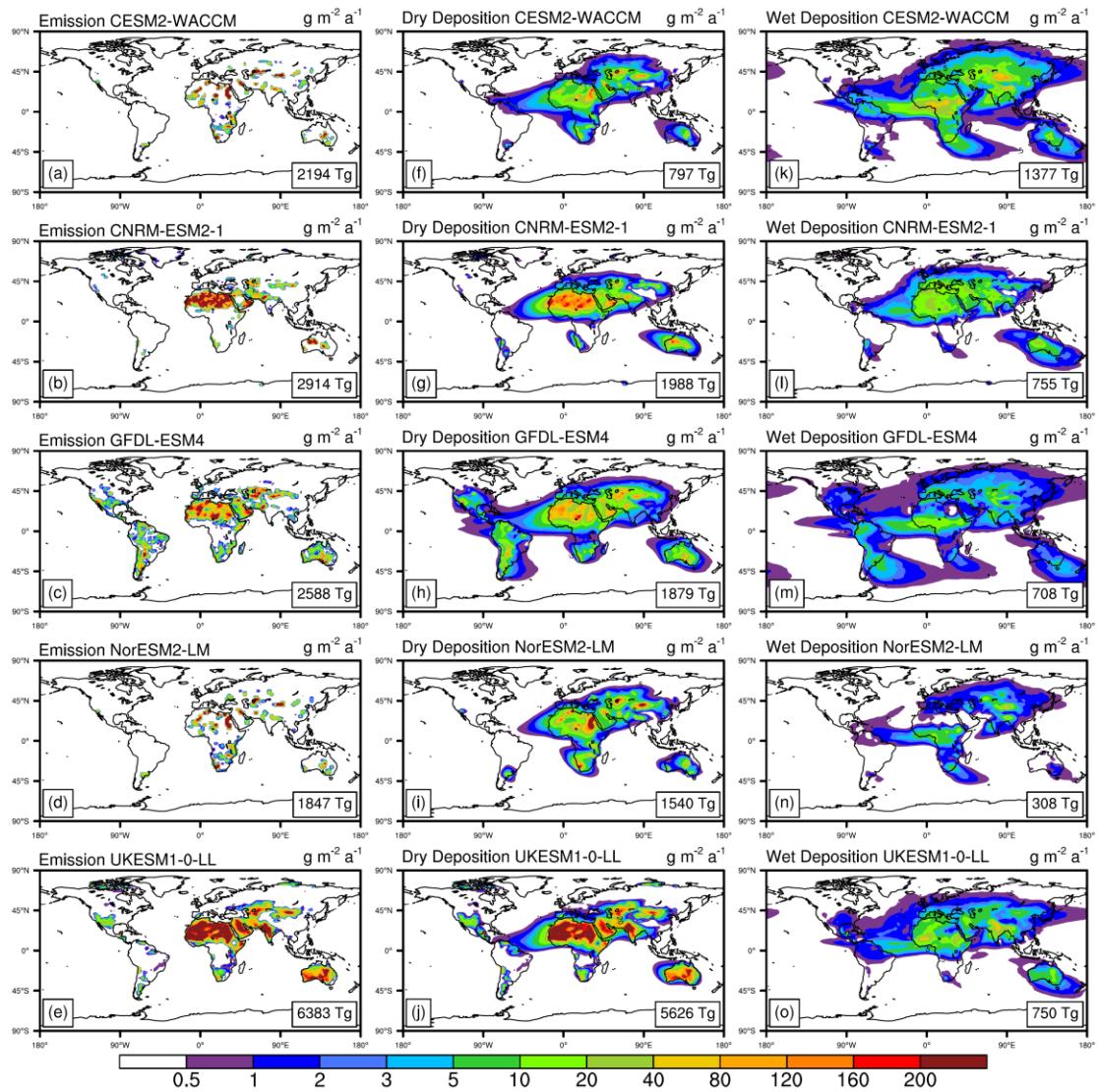


Figure S11. The same as Figure S7 but in SSP5-8.5 scenario (2090-2099).

Table S1. All ensemble runs of each available CMIP6 model for dust projection under different scenarios

Variable	Total Emission Rate of Dust				
Experiments	historical	ssp126	ssp245	ssp370	ssp585
Model	Variant Label	Variant Label	Variant Label	Variant Label	Variant Label
CESM2-WACCM	r[1-3]i1p1f1	r1i1p1f1	r[1-5]i1p1f1	r[1-3]i1p1f1	r[1-5]i1p1f1
CNRM-ESM2-1	r[1-11]i1p1f2	r[1-5]i1p1f2	r[1-10]i1p1f2	r[1-5]i1p1f2	r[1-5]i1p1f2
GFDL-ESM4	r1i1p1f1	r1i1p1f1	r1i1p1f1	r1i1p1f1	r1i1p1f1
NorESM2-LM	r[1-3]i1p1f1	r1i1p1f1	r[1-3]i1p1f1 r[1-10]i1p1f2	r[1-3]i1p1f1	r1i1p1f1
UKESM1-0-LL	r[1-4]i1p1f2 r[5-7]i1p1f3 r[8-19]i1p1f2	r[1-19]i1p1f2	r[1-4]i1p1f2 r8i1p1f2 r[13-15]i1p1f2	r[1-19]i1p1f2	r[1-4]i1p1f2 r8i1p1f2 r[13-15]i1p1f2
Variable	Dry Deposition Rate of Dust				
CESM2-WACCM	r[1-3]i1p1f1	r1i1p1f1	r[1-5]i1p1f1	r[1-3]i1p1f1	r[1-5]i1p1f1
CNRM-ESM2-1	r[1-11]i1p1f2	r[1-5]i1p1f2	r[1-10]i1p1f2	r[1-5]i1p1f2	r[1-5]i1p1f2
GFDL-ESM4	r1i1p1f1	r1i1p1f1	r1i1p1f1	r1i1p1f1	r1i1p1f1
NorESM2-LM	r1i1p1f1	r1i1p1f1	r[1-3]i1p1f1 r[1-10]i1p1f2	r1i1p1f1	r1i1p1f1
UKESM1-0-LL	r[1-3]i1p1f2	r[1-4]i1p1f2 r8i1p1f2	r[1-4]i1p1f2 r8i1p1f2	r[1-3]i1p1f2	r[1-4]i1p1f2
Variable	Wet Deposition Rate of Dust				
CESM2-WACCM	r[1-3]i1p1f1	r1i1p1f1	r[1-5]i1p1f1	r[1-3]i1p1f1	r[1-5]i1p1f1
CNRM-ESM2-1	r[1-11]i1p1f2	r[1-5]i1p1f2	r[1-10]i1p1f2	r[1-5]i1p1f2	r[1-5]i1p1f2
GFDL-ESM4	r1i1p1f1	r1i1p1f1	r1i1p1f1	r1i1p1f1	r1i1p1f1
NorESM2-LM	r1i1p1f1	r1i1p1f1	r[1-3]i1p1f1 r[1-10]i1p1f2	r1i1p1f1	r1i1p1f1
UKESM1-0-LL	r[1-3]i1p1f2	r[1-4]i1p1f2 r8i1p1f2	r[1-4]i1p1f2 r8i1p1f2	r[1-3]i1p1f2	r[1-4]i1p1f2
Variable	Dust Aerosol Mass Mixing Ratio				
CESM2-WACCM	r[1-3]i1p1f1	r1i1p1f1	r[1-5]i1p1f1	r[1-3]i1p1f1	r[1-5]i1p1f1
CNRM-ESM2-1	r[1-3]i1p1f2	r[1-5]i1p1f2	r[1-10]i1p1f2	r[1-5]i1p1f2	r[1-5]i1p1f2
GFDL-ESM4	r1i1p1f1	r1i1p1f1	r1i1p1f1	r1i1p1f1	r1i1p1f1
NorESM2-LM	r[1-3]i1p1f1	r1i1p1f1	r[1-3]i1p1f1 r[1-10]i1p1f2	r[1-3]i1p1f1	r1i1p1f1
UKESM1-0-LL	r[1-19]i1p1f2	r[1-19]i1p1f2	r[1-4]i1p1f2 r8i1p1f2 r[13-15]i1p1f2	r[1-19]i1p1f2	r[1-4]i1p1f2 r8i1p1f2 r[13-15]i1p1f2

Table S2. Multi-model ensemble projection of absolute (Gg) and relative changes (%)
in dust column concentration by the end of 21st century (2090-2099)

Region/ Scenario	SSP126		SSP245		SSP370		SSP585	
	Absolute	Relative	Absolute	Relative	Absolute	Relative	Absolute	Relative
NAF	47.7	1.0	128.1	2.7	119.4	2.5	589.3	12.5
CAT	-7.7	-1.0	-51.2	-6.8	-83.7	-11.2	-91.5	-12.2
MEA	4.7	0.2	-135.7	-6.6	-119.9	-5.8	-32.2	-1.6
AUS	18.2	5.3	52.0	15.1	78.4	22.8	113.9	33.1
NAM	0.2	1.8	-0.1	-0.7	-0.1	-0.5	-0.1	-0.6
SAM	4.6	17.6	9.6	36.5	7.2	27.3	3.8	14.5
SAF	2.8	2.3	18.0	15.0	64.4	53.5	55.6	46.2
SAS	-9.2	-1.8	-25.3	-4.8	-46.2	-8.9	-7.8	-1.5
EAS	-10.7	-3.4	-19.8	-6.3	-37.9	-12.1	-47.7	-15.2

* The scope of each region is shown in Fig. 1a and Fig. 7.

Table S3. The information of all available CMIP6 models for climate projection

Model	Resolution	Model	Resolution	Model	Resolution
ACCESS-CM2	1.875°×1.24°	EC-Earth3-Veg-LR	1.125°×1.125°	MPI-ESM1-2-LR	1.875°×1.875°
ACCESS-ESM1-5	1.875°×1.24°	FGOALS-f3-L	1°×1°	MRI-ESM2-0	1.125°×1.125°
AWI-CM-1-1-MR	0.94°×0.94°	FGOALS-g3	2°×2°	NorESM2-LM	2.5°×1.875°
BCC-CSM2-MR	1.125°×1.125°	GFDL-ESM4	1°×1°	NorESM2-MM	1.91°×0.94°
CAMS-CSM1-0	1.125°×1.125°	IITM-ESM	1.875°×1.91°	TaiESM1	1.25°×0.94°
CAS-ESM2-0	1.4°×1.4°	INM-CM4-8	2°×1.5°	CNRM-CM6-1	0.5°×0.5°
CESM2-WACCM	1.25°×0.94°	INM-CM5-0	2°×1.5°	CNRM-CM6-1-HR	0.5°×0.5°
CMCC-CM2-SR5	1.25°×0.94°	IPSL-CM6A-LR	2.5°×1.26°	CNRM-ESM2-1	1.4°×1.4°
CMCC-ESM2	1.25°×0.94°	KACE-1-0-G	1.875°×1.25°	MIROC-ES2L	2.8°×2.8°
CanESM5	2.8°×2.8°	MIROC6	1.4°×1.4°	UKESM1-0-LL	1.875°×1.25°
EC-Earth3	0.7°×0.7°	MPI-ESM1-2-HR	0.94°×0.94°	/	/