

Supplementary Materials for

Projected changes in persistent extreme summer weather events: The role of quasi-resonant amplification

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Supplementary Materials

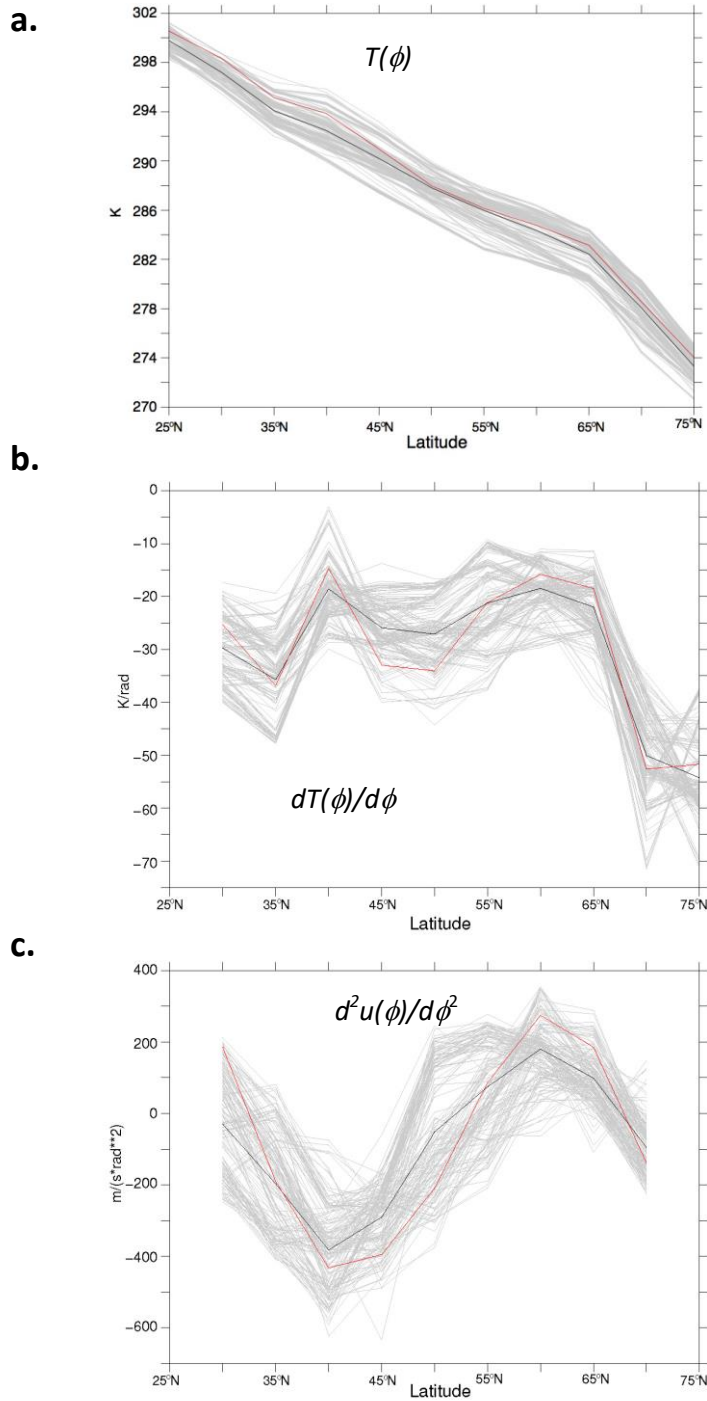


Fig. S1. Latitudinal profiles at 5° resolution. Latitudinal profiles of (a) $T(\phi)$ and (b) $dT(\phi)/d\phi$ and (c) $d^2u(\phi)/d\phi^2$ at 5 degree resolution. Shown in both cases are (grey) the individual realizations of the CMIP5 historical simulations (see “Methods” section of main article) along with the (black) CMIP5 multimodel ensemble mean and (red) ERA reanalysis data (1979-2005). The root-mean-square error of the individual realizations relative to the reanalysis observations is 0.5% in (a) 27% in (b) and 344% in (c).

QRA fingerprint

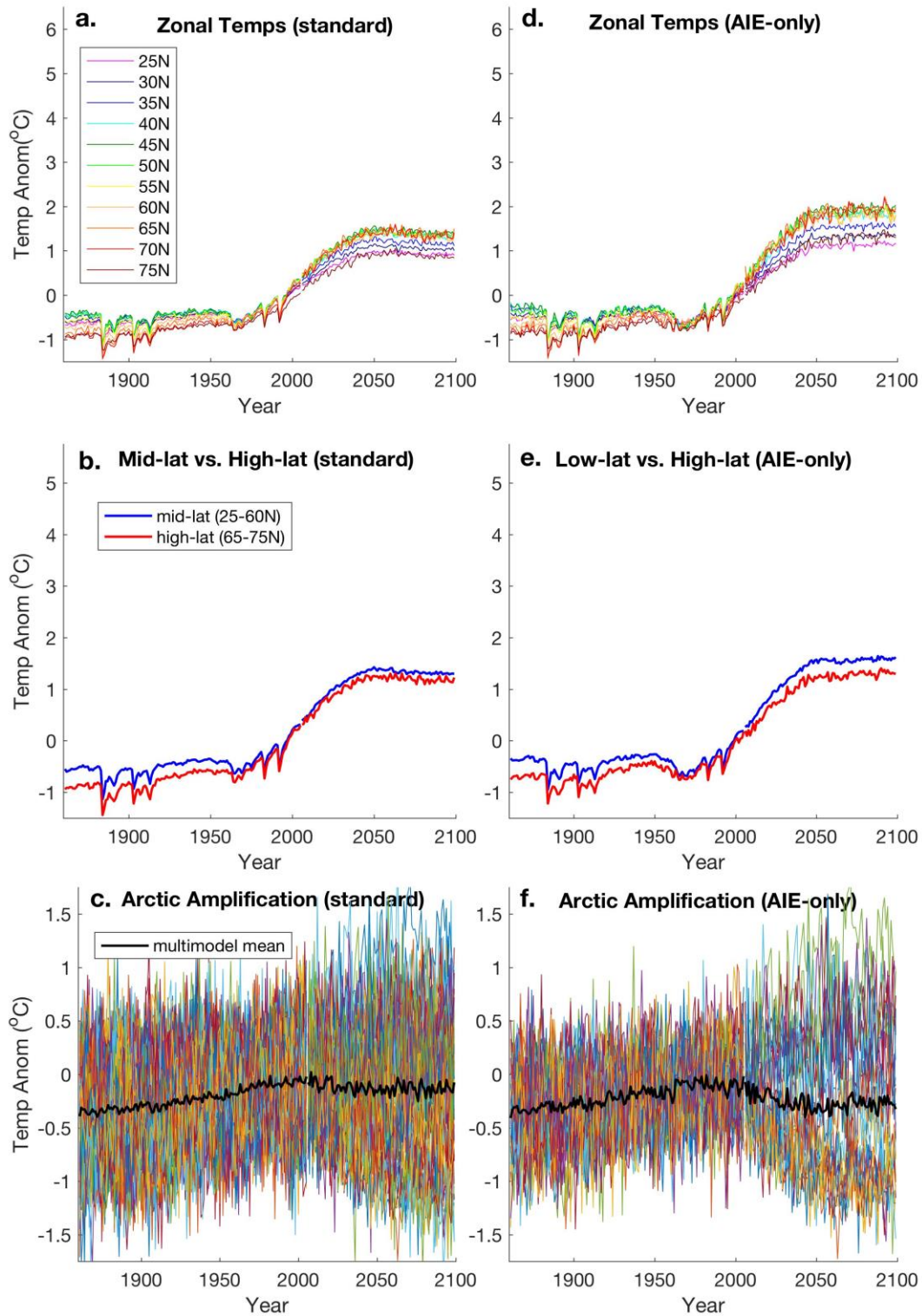


Fig. S2. As Fig. 3 but for RCP 2.6 CMIP5 simulations.

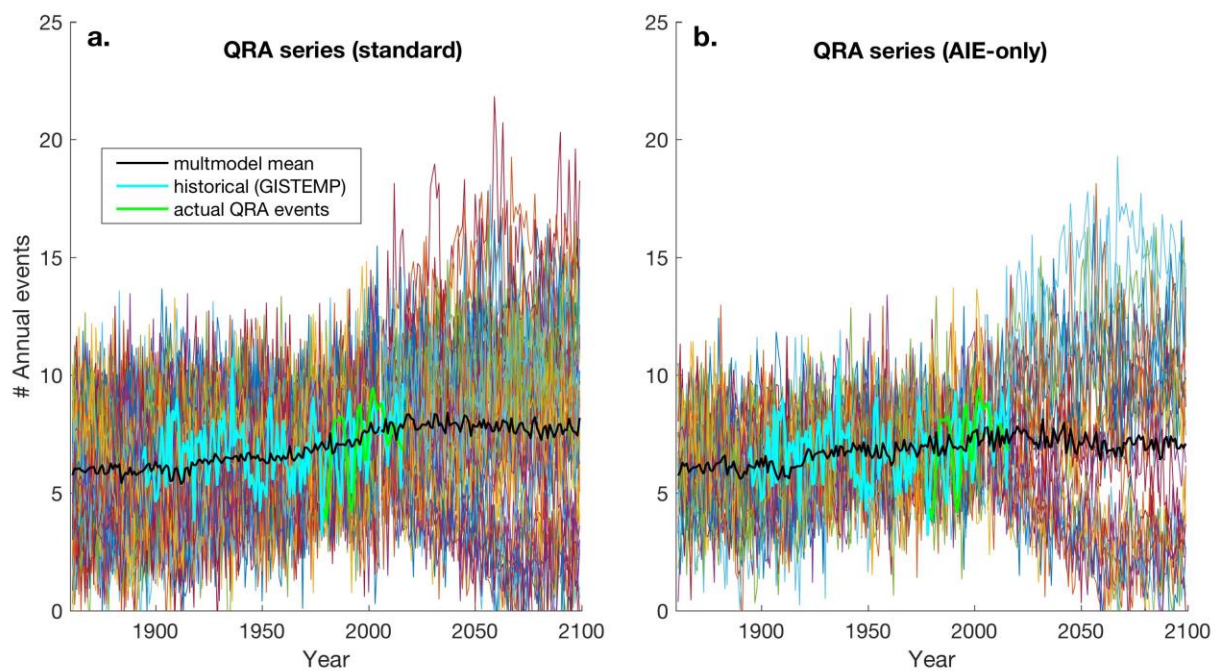


Fig. S3. As Fig. 5 but for RCP 2.6 CMIP5 simulations.

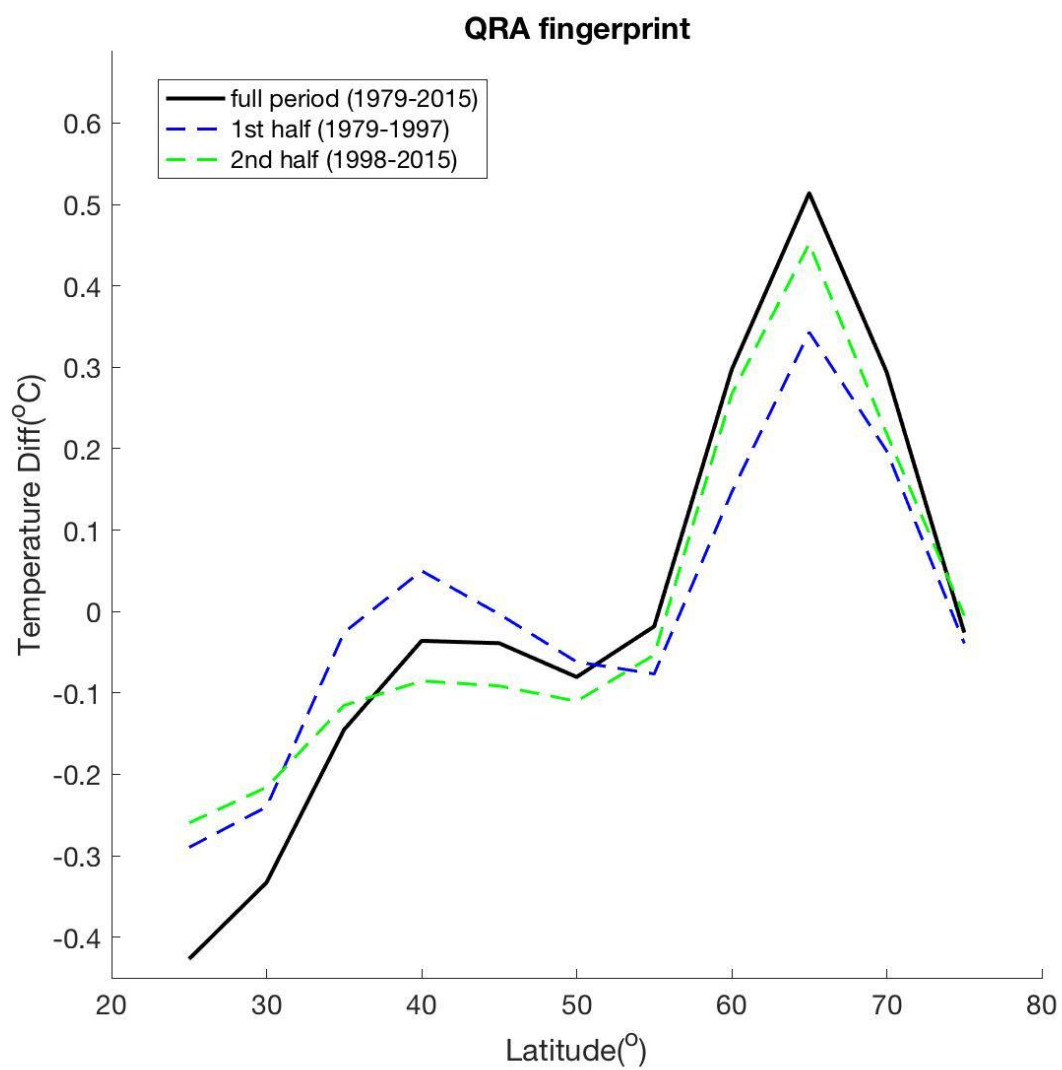


Fig. S4. QRA fingerprint based on first half (1979–1997) and second half (1998–2015) of ERA reanalysis period compared with full period (1979–2015).

Table S1. CMIP5 historical climate model simulations.

Model	Number of Realizations	1 st and 2 nd aerosol indirect effects
ACCESS1-0	1	1
ACCESS1-3	3	1
bcc-csm1-1	3	0
bcc-csm1-1-m	3	0
BNU-ESM	1	0
CanESM2	5	0
CCSM4	6	0
CESM1-BGC	1	0
CESM1-CAM5	3	1
CESM1-FASTCHEM	3	0
CESM1-WACCM	1	0
CMCC-CESM	1	0
CMCC-CM	1	0
CMCC-CMS	1	0
CNRM-CM5	10	0
CNRM-CM5-2	1	0
CSIRO-Mk3-6-0	10	1
FGOALS-g2	4	1
FIO-ESM	3	0
GFDL-CM2.1	10	0
GFDL-CM3	5	1
GFDL-ESM2G	1	0
GFDL-ESM2M	1	0
GISS-E2-H p1	6	0
GISS-E2-H p2	5	0
GISS-E2-H p3	6	0
GISS-E2-H-CC	1	0
GISS-E2-R p1	6	0
GISS-E2-R p2	6	0
GISS-E2-R p3	6	0
GISS-E2-R p100	6	0
GISS-E2-R-CC	1	0
HadCM3	10	0
HadGEM2-AO	1	1
HadGEM2-CC	1	1
HadGEM2-ES	5	1
INMCM4	1	0
IPSL-CM5A-LR	6	0
IPSL-CM5A-MR	3	0
IPSL-CM5B-LR	1	0
MIROC-ESM	3	1
MIROC-ESM-CHEM	1	1
MPI-ESM-LR	2	0
MRI-CGCM3 p1	3	1
MRI-CGCM3 p2	1	1
MRI-ESM1	1	1
NorESM1-M	3	1
NorESM1-ME	1	1
Anthropogenic Only Simulation		
CCSM4 p11	4	–
CESM1-CAM5 p11	3	–
CNRM-CM5	10	–
GFDL-CM3 p2	3	–
GFDL-ESM2M p2	1	–
GISS-E2-H p109	3	–
GISS-E2-H p309	3	–
GISS-E2-R p109	5	–
GISS-E2-R p309	5	–
IPSL-CM5A-LR p2	3	–

Table S2. CMIP5 1%/year CO₂ simulations.

Model	Realizations
ACCESS1-0	1
ACCESS1-3	1
bcc-csm1-1	1
CCSM4	2
CMCC-CM	1
CNRM-CM5-2	3
CSIRO-Mk3-6-0	1
CanESM2	1
GFDL-CM3	1
GFDL-ESM2G	2
GFDL-ESM2M	2
GISS-E2-H	3
GISS-E2-R	3
HadGEM2-ES	1
inmcm4	1
IPSL-CM5A-LR	1
IPSL-CM5A-MR	1
IPSL-CM5B-LR	1
MIROC-ESM	1
MIROC5	1
MPI-ESM-LR	1
MPI-ESM-MR	1
MPI-ESM-P	1
MRI-CGCM3	1
NorESM1-ME	1
NorESM1-M	1

Table S3. CMIP5 RCP 8.5 future projection simulations.

Model	Number of Realizations	1 st and 2 nd aerosol indirect effects
ACCESS1-0	1	1
ACCESS1-3	1	1
bcc-csm1-1-m	1	0
bcc-csm1-1	1	0
BNU-ESM	1	0
CanESM2	5	0
CCSM4	6	0
CESM1-BGC	1	0
CESM1-CAM5	2	1
CMCC-CESM	1	0
CMCC-CM	1	0
CMCC-CMS	1	0
CNRM-CM5	5	0
CSIRO-Mk3-6-0	10	1
FGOALS-g2	1	1
FIO-ESM	3	0
GFDL-CM3	1	1
GFDL-ESM2G	1	0
GFDL-ESM2M	1	0
GISS-E2-H	2	0
GISS-E2-H	1	0
GISS-E2-H	1	0
GISS-E2-R	2	0
GISS-E2-R	1	0
GISS-E2-R	1	0
HadGEM2-AO	1	1
HadGEM2-CC	1	1
HadGEM2-ES	4	1
inmcm4	1	0
IPSL-CM5A-LR	4	0
IPSL-CM5A-MR	1	0
IPSL-CM5B-LR	1	0
MIROC-ESM-CHEM	1	1
MIROC-ESM	1	1
MPI-ESM-LR	2	0
MRI-CGCM3	1	1
MRI-ESM1	1	1
NorESM1-ME	1	1
NorESM1-M	1	1

Table S4. CMIP5 RCP 2.6 future projection simulations.

Model	Number of Realizations	1 st and 2 nd aerosol indirect effects
bcc-csm1-1-m	1	0
bcc-csm1-1	1	0
BNU-ESM	1	0
CanESM2	5	0
CCSM4	6	0
CESM1-CAM5	3	1
CNRM-CM5	1	0
CSIRO-Mk3-6-0	10	1
FGOALS-g2	1	1
FIO-ESM	3	0
GFDL-CM3	1	1
GFDL-ESM2G	1	0
GFDL-ESM2M	1	0
GISS-E2-H	1	0
GISS-E2-H	1	0
GISS-E2-H	1	0
GISS-E2-R	1	0
GISS-E2-R	1	0
GISS-E2-R	1	0
HadGEM2-AO	1	1
HadGEM2-ES	4	1
IPSL-CM5A-LR	4	0
IPSL-CM5A-MR	1	0
MIROC-ESM-CHEM	1	1
MIROC-ESM	1	1
MPI-ESM-LR	2	0
MRI-CGCM3	1	1
NorESM1-ME	1	1
NorESM1-M	1	1