



## Supplement of

## **Evaluation of global teleconnections in CMIP6 climate projections using complex networks**

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Figure S1: Linearly detrended CERA-20C SST fields over the time period 1901–2010. (a) Global mean SST anomaly (GMSSTa) wrt. base period 1961–1990 (blue), forced component of GMSSTa (black), and residual (red). (b) Seasonal linear-trend patterns (arbitrary units normalized to [-1,1] over all seasons).



Figure S2: Season-reliant trend-EOF of the 20CRv3 SST and Z500 fields over the time period 1901–2010. Global mean SST (a) and global mean Z500 (c) anomaly wrt. base period 1961–1990 (blue), forced component thereof (black), residual (red). (b) and (d) respective seasonal trend-loading patterns in physical space (arbitrary units normalized to [-1,1] over all seasons).



Figure S3: Domains of the 20CRv3 (a) SST and (b) Z500 fields over the time period 1901–2010 (arbitrary colors). Maximum lagged distance correlation links between (c) SST and (e) Z500 domains and (d) cross-links.



Figure S4: Spatially distributed maximum lagged distance correlation links and cross-links between SST and/or Z500 domains in 20CRv3. (a)–(c) ENSO (black) to SST domains; (d)–(f) tropical North Atlantic (AMO, black) to SST domains; (g)–(i) tropical belt (TB, black) to Z500 domains; (j)–(l) ENSO (contoured) to Z500 domains. (a),(d),(g),(j) time period 1901–1955, (b),(e),(h),(k) time period 1901–2010, (c),(f),(i),(l) time period 1951–2010.



Figure S5: Spatially distributed maximum lagged distance correlation links between the ENSO SST domain (black) and all other SST domains over the time period 1951–2010. (a) EC-Earth3, (b) UKESM1-0-LL, (c) MPI-ESM1-2-HR, (d) IPSL-CM6A-LR,(e) CERA-20C, (f) 20CRv3



Figure S6: Spatially distributed maximum lagged distance correlation links between the AMO SST domain (black) and all other SST domains over the time period 1951–2010. (a) EC-Earth3, (b) UKESM1-0-LL, (c) MPI-ESM1-2-HR, (d) IPSL-CM6A-LR,(e) CERA-20C, (f) 20CRv3



Figure S7: Spatially distributed maximum lagged distance correlation links between the TB Z500 domain (black) and all other Z500 domains over the time period 1951–2010. (a) EC-Earth3, (b) UKESM1-0-LL, (c) MPI-ESM1-2-HR, (d) IPSL-CM6A-LR,(e) CERA-20C, (f) 20CRv3



Figure S8: Spatially distributed maximum lagged distance correlation links between a North Polar Z500 domain (black) and all other Z500 domains over the time period 1951–2010. (a) EC-Earth3, (b) UKESM1-0-LL, (c) MPI-ESM1-2-HR, (d) IPSL-CM6A-LR, (e) CERA-20C, (f) 20CRv3



Figure S9: Spatially distributed maximum lagged distance correlation links between the ENSO SST domain (black) and all Z500 domains the time period 1951–2010. (a) EC-Earth3, (b) UKESM1-0-LL, (c) MPI-ESM1-2-HR, (d) IPSL-CM6A-LR,(e) CERA-20C, (f) 20CRv3

	most similar			most similar	
SST domain	SST domain		SST domain	SST domain	
in CERA-20C	in $20$ CRv $3$	NQS	in 20CRv3	in CERA-20C $$	NQS
o1	o13	0.74	o1	o15	0.73
02	o2	0.60	02	o2	0.60
03	03	0.73	03	03	0.73
04	o2	0.43	04	06	0.62
05	07	0.45	05	о9	0.44
06	04	0.62	06	07	0.65
07	08	0.69	07	08	0.65
08	07	0.65	08	07	0.69
09	o10	0.59	09	o11	0.72
o10	08	0.67	o10	о9	0.59
o11	09	0.72	o11	o13	0.68
012	o14	0.62	012	o12	0.50
o13	o11	0.68	o13	o1	0.74
014	o1	0.61	o14	o12	0.62
o15	o1	0.73			
016	o1	0.58			
	, · · · 1				
	most similar			most similar	
Z500 domain	Z500 domain		Z500 domain	Z500 domain	
Z500 domain in CERA-20C	Z500 domain in 20CRv3	NQS	Z500 domain in 20CRv3	Z500 domain in CERA-20C	NQS
Z500 domain in CERA-20C a1	a3	NQS 0.65	Z500 domain in 20CRv3 a1	Z500 domain in CERA-20C a4	NQS 0.55
Z500 domain in CERA-20C a1 a2	most similar Z500 domain in 20CRv3 a3 a3	NQS 0.65 0.46	Z500 domain in 20CRv3 a1 a2	The most similar Z500 domain in CERA-20C a4 a5	NQS 0.55 0.59
Z500 domain in CERA-20C a1 a2 a3	most similar Z500 domain in 20CRv3 a3 a3 a10	NQS 0.65 0.46 0.66	Z500 domain in 20CRv3 a1 a2 a3	most similar Z500 domain in CERA-20C a4 a5 a1	NQS 0.55 0.59 0.65
Z500 domain in CERA-20C a1 a2 a3 a4	most similar Z500 domain in 20CRv3 a3 a3 a10 a1	NQS 0.65 0.46 0.66 0.55	Z500 domain in 20CRv3 a1 a2 a3 a4	most similar Z500 domain in CERA-20C a4 a5 a1 a6	NQS 0.55 0.59 0.65 0.57
Z500 domain in CERA-20C a1 a2 a3 a4 a5	most similar Z500 domain in 20CRv3 a3 a3 a10 a1 a2	NQS 0.65 0.46 0.66 0.55 0.59	Z500 domain in 20CRv3 a1 a2 a3 a4 a5	most similar Z500 domain in CERA-20C a4 a5 a1 a6 a7	NQS 0.55 0.59 0.65 0.57 0.51
Z500 domain in CERA-20C a1 a2 a3 a4 a5 a6	most similar Z500 domain in 20CRv3 a3 a3 a10 a1 a2 a4	NQS 0.65 0.46 0.66 0.55 0.59 0.57	Z500 domain in 20CRv3 a1 a2 a3 a4 a5 a6	most similar Z500 domain in CERA-20C a4 a5 a1 a6 a7 a15	NQS 0.55 0.59 0.65 0.57 0.51 0.64
Z500 domain in CERA-20C a1 a2 a3 a4 a5 a6 a7	most similar Z500 domain in 20CRv3 a3 a3 a10 a1 a2 a4 a9	NQS 0.65 0.46 0.66 0.55 0.59 0.57 0.56	Z500 domain in 20CRv3 a1 a2 a3 a4 a5 a6 a7	most similar Z500 domain in CERA-20C a4 a5 a1 a6 a7 a15 a9	NQS 0.55 0.59 0.65 0.57 0.51 0.64 0.51
Z500 domain in CERA-20C a1 a2 a3 a4 a5 a6 a7 a8	most similar Z500 domain in 20CRv3 a3 a3 a10 a1 a2 a4 a9 a8	$\begin{array}{c} NQS \\ 0.65 \\ 0.46 \\ 0.66 \\ 0.55 \\ 0.59 \\ 0.57 \\ 0.56 \\ 0.47 \end{array}$	Z500 domain in 20CRv3 a1 a2 a3 a4 a5 a6 a7 a8	most similar Z500 domain in CERA-20C a4 a5 a1 a6 a7 a15 a9 a13	NQS 0.55 0.59 0.65 0.57 0.51 0.64 0.51 0.62
Z500 domain in CERA-20C a1 a2 a3 a4 a5 a6 a7 a8 a9	most similar Z500 domain in 20CRv3 a3 a10 a1 a2 a4 a9 a8 a7	NQS 0.65 0.46 0.55 0.59 0.57 0.56 0.47 0.51	Z500 domain in 20CRv3 a1 a2 a3 a4 a5 a6 a7 a8 a9	most similar Z500 domain in CERA-20C a4 a5 a1 a6 a7 a15 a9 a13 a12	NQS 0.55 0.59 0.65 0.57 0.51 0.64 0.51 0.62 0.67
Z500 domain in CERA-20C a1 a2 a3 a4 a5 a6 a7 a8 a9 a10	most similar Z500 domain in 20CRv3 a3 a10 a1 a2 a4 a9 a8 a7 a7	$\begin{array}{c} NQS \\ 0.65 \\ 0.46 \\ 0.55 \\ 0.59 \\ 0.57 \\ 0.56 \\ 0.47 \\ 0.51 \\ 0.50 \end{array}$	Z500 domain in 20CRv3 a1 a2 a3 a4 a5 a6 a7 a8 a9 a10	most similar Z500 domain in CERA-20C a4 a5 a1 a6 a7 a15 a9 a13 a12 a3	NQS 0.55 0.59 0.65 0.57 0.51 0.64 0.51 0.62 0.67 0.66
Z500 domain in CERA-20C a1 a2 a3 a4 a5 a6 a7 a8 a9 a10 a11	most similar Z500 domain in 20CRv3 a3 a3 a10 a1 a2 a4 a9 a8 a7 a7 a11	NQS 0.65 0.46 0.55 0.59 0.57 0.56 0.47 0.51 0.50 0.52	Z500 domain in 20CRv3 a1 a2 a3 a4 a5 a6 a7 a8 a9 a10 a11	most similar Z500 domain in CERA-20C a4 a5 a1 a6 a7 a15 a9 a13 a12 a3 a13	$\begin{array}{c} NQS \\ 0.55 \\ 0.59 \\ 0.65 \\ 0.57 \\ 0.51 \\ 0.64 \\ 0.51 \\ 0.62 \\ 0.67 \\ 0.66 \\ 0.62 \end{array}$
Z500 domain in CERA-20C a1 a2 a3 a4 a5 a6 a7 a8 a9 a10 a11 a12	most similar Z500 domain in 20CRv3 a3 a10 a1 a2 a4 a9 a8 a7 a7 a11 a9	$\begin{array}{c} NQS \\ 0.65 \\ 0.46 \\ 0.55 \\ 0.59 \\ 0.57 \\ 0.56 \\ 0.47 \\ 0.51 \\ 0.50 \\ 0.52 \\ 0.67 \end{array}$	Z500 domain in 20CRv3 a1 a2 a3 a4 a5 a6 a7 a8 a9 a10 a11 a12	most similar Z500 domain in CERA-20C a4 a5 a1 a6 a7 a15 a9 a13 a12 a3 a13 a13 a3 a13 a3	NQS 0.55 0.59 0.65 0.57 0.51 0.64 0.51 0.62 0.67 0.66 0.62 0.39
Z500 domain in CERA-20C a1 a2 a3 a4 a5 a6 a7 a8 a9 a10 a11 a12 a13	most similar Z500 domain in 20CRv3 a3 a10 a1 a2 a4 a9 a8 a7 a7 a11 a9 a3	$\begin{array}{c} NQS \\ 0.65 \\ 0.46 \\ 0.55 \\ 0.59 \\ 0.57 \\ 0.56 \\ 0.47 \\ 0.51 \\ 0.50 \\ 0.52 \\ 0.67 \\ 0.63 \end{array}$	Z500 domain in 20CRv3 a1 a2 a3 a4 a5 a6 a7 a8 a9 a10 a11 a12 a13	most similar Z500 domain in CERA-20C a4 a5 a1 a6 a7 a15 a9 a13 a12 a3 a13 a13 a3 a14	$\begin{array}{c} NQS \\ 0.55 \\ 0.59 \\ 0.65 \\ 0.57 \\ 0.51 \\ 0.64 \\ 0.51 \\ 0.62 \\ 0.67 \\ 0.66 \\ 0.62 \\ 0.39 \\ 0.54 \end{array}$
Z500 domain in CERA-20C a1 a2 a3 a4 a5 a6 a7 a8 a9 a10 a11 a12 a13 a14	most similar Z500 domain in 20CRv3 a3 a10 a1 a2 a4 a9 a8 a7 a7 a11 a9 a3 a13	$\begin{array}{c} NQS \\ \hline 0.65 \\ 0.46 \\ 0.55 \\ 0.59 \\ 0.57 \\ 0.56 \\ 0.47 \\ 0.51 \\ 0.50 \\ 0.52 \\ 0.67 \\ 0.63 \\ 0.54 \end{array}$	Z500 domain in 20CRv3 a1 a2 a3 a4 a5 a6 a7 a8 a9 a10 a11 a12 a13 a14	most similar Z500 domain in CERA-20C a4 a5 a1 a6 a7 a15 a9 a13 a12 a3 a13 a12 a3 a13 a14 a14 a16	$\begin{array}{c} NQS \\ 0.55 \\ 0.59 \\ 0.65 \\ 0.57 \\ 0.51 \\ 0.64 \\ 0.51 \\ 0.62 \\ 0.67 \\ 0.66 \\ 0.62 \\ 0.39 \\ 0.54 \\ 0.49 \end{array}$
Z500 domain in CERA-20C a1 a2 a3 a4 a5 a6 a7 a8 a9 a10 a11 a12 a13 a14 a15	most similar Z500 domain in 20CRv3 a3 a3 a10 a1 a2 a4 a9 a8 a7 a7 a11 a9 a3 a13 a6	$\begin{array}{c} NQS \\ \hline 0.65 \\ 0.46 \\ 0.55 \\ 0.59 \\ 0.57 \\ 0.56 \\ 0.47 \\ 0.51 \\ 0.50 \\ 0.52 \\ 0.67 \\ 0.63 \\ 0.54 \\ 0.64 \end{array}$	Z500 domain in 20CRv3 a1 a2 a3 a4 a5 a6 a7 a8 a9 a10 a11 a12 a13 a14	most similar Z500 domain in CERA-20C a4 a5 a1 a6 a7 a15 a9 a13 a12 a3 a13 a12 a3 a13 a14 a16	$\begin{array}{c} NQS \\ 0.55 \\ 0.59 \\ 0.65 \\ 0.57 \\ 0.51 \\ 0.64 \\ 0.51 \\ 0.62 \\ 0.67 \\ 0.66 \\ 0.62 \\ 0.39 \\ 0.54 \\ 0.49 \end{array}$
Z500 domain in CERA-20C a1 a2 a3 a4 a5 a6 a7 a8 a9 a10 a11 a12 a13 a14 a15 a16	most similar Z500 domain in 20CRv3 a3 a10 a1 a2 a4 a9 a8 a7 a7 a11 a9 a3 a13 a6 a14	$\begin{array}{c} NQS \\ 0.65 \\ 0.46 \\ 0.55 \\ 0.59 \\ 0.57 \\ 0.56 \\ 0.47 \\ 0.51 \\ 0.50 \\ 0.52 \\ 0.67 \\ 0.63 \\ 0.54 \\ 0.64 \\ 0.49 \end{array}$	Z500 domain in 20CRv3 a1 a2 a3 a4 a5 a6 a7 a8 a9 a10 a11 a12 a13 a14	most similar Z500 domain in CERA-20C a4 a5 a1 a6 a7 a15 a9 a13 a12 a3 a13 a13 a13 a14 a16	$\begin{array}{c} NQS \\ 0.55 \\ 0.59 \\ 0.65 \\ 0.57 \\ 0.51 \\ 0.64 \\ 0.51 \\ 0.62 \\ 0.67 \\ 0.66 \\ 0.62 \\ 0.39 \\ 0.54 \\ 0.49 \end{array}$

Table S1: Similarity (in terms of domain-wise NQS) of individual SST and Z500domains between CERA-20C and 20CRv3 over 1901–2010most similarmost similar