Australian National University
climate extremes ARC centre of excellence
21st Century Weather ARC Centre of Excellence
CIRES
University of Colorado Boulder
ATOC
nicola.maher@anu.edu.au
https://nicolamaher.weebly.com/

The updated Multi-Model Large Ensemble Archive and the Climate Variability Diagnostics Package: New tools for the study of climate variability and change

Nicola Maher, Adam S. Phillips, Clara Deser, Robert C. Jnglin Wills, Flavio Lehner, John Fasullo, Julie M. Caron, Lukas Brunner, and Urs Beyerle

MMLEAv2 – new regridded archive of large ensembles

Archive to be released in the next week or two on:

https://www.cesm.ucar.edu/community-projects/mmlea/v2

Including a CVDPv6 webpage applied to the data

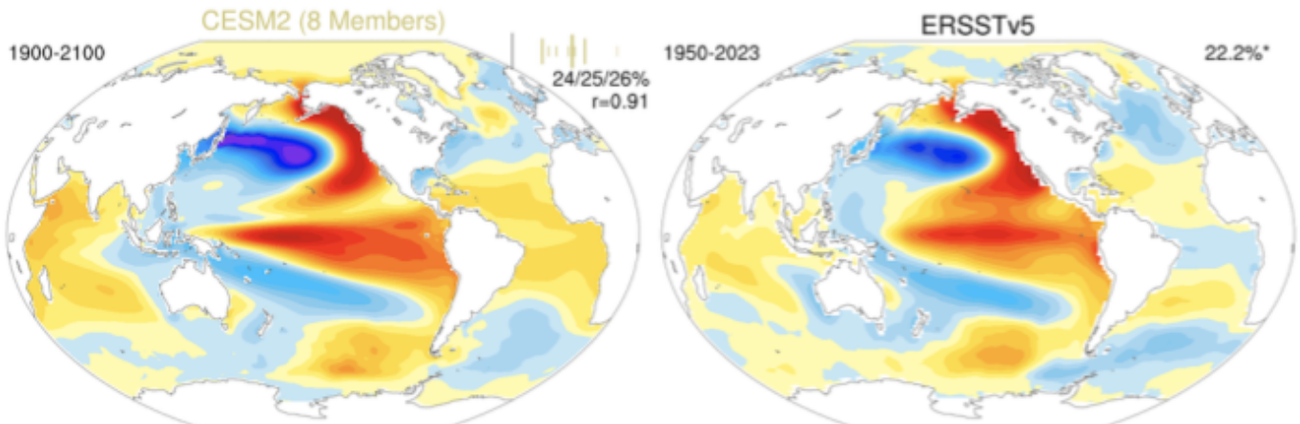
Data already on glade: /glade/campaign/cgd/cas/MMLEAv2

- 18 models & 15 variables (including some extremes (TXx TNn and Rx1day), circulation (taux, tauy z500) and ocean variables (surface salinity, MLD)
- 2.5 x 2.5 degree common grid
- Combination of CMIP5/6 forcing
- Allows for easy initial analysis and inter-model comparison of large ensembles

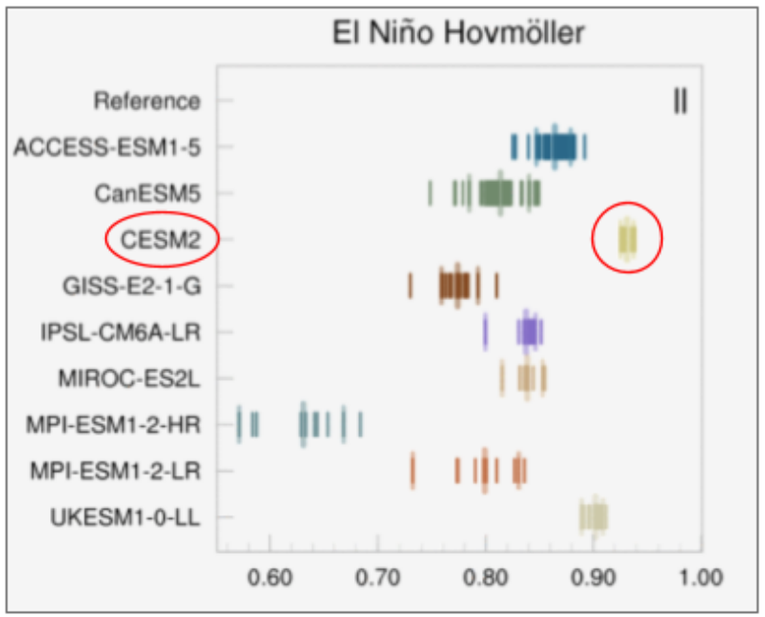
NEW-ish Climate Variability Diagnostics Package (version 6 release)

Automated analysis tool and data repository for assessing modes of variability and trends.

EOF1 Pacific Decadal Variability (quadratic detrending)



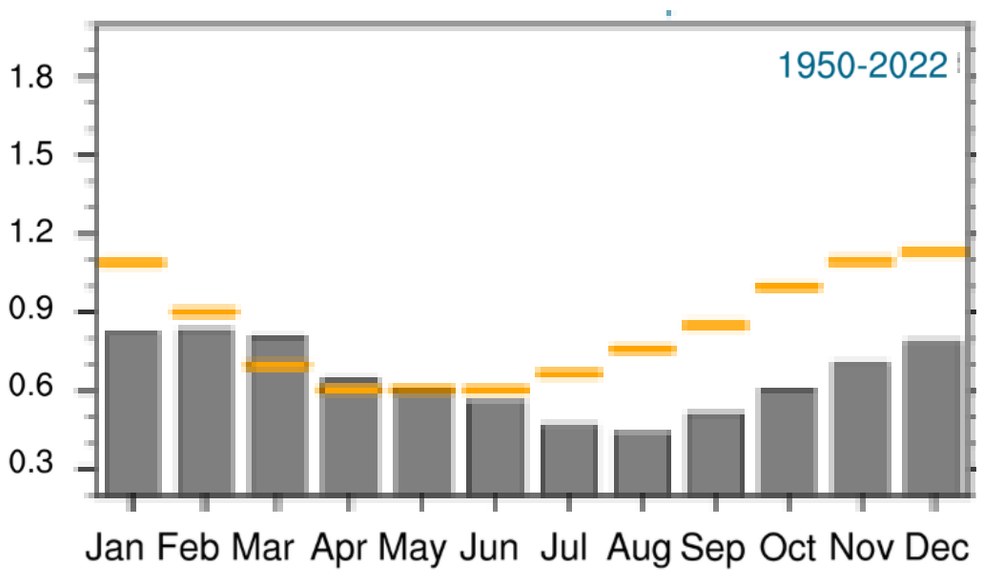
Pattern Correlation w/ Obs

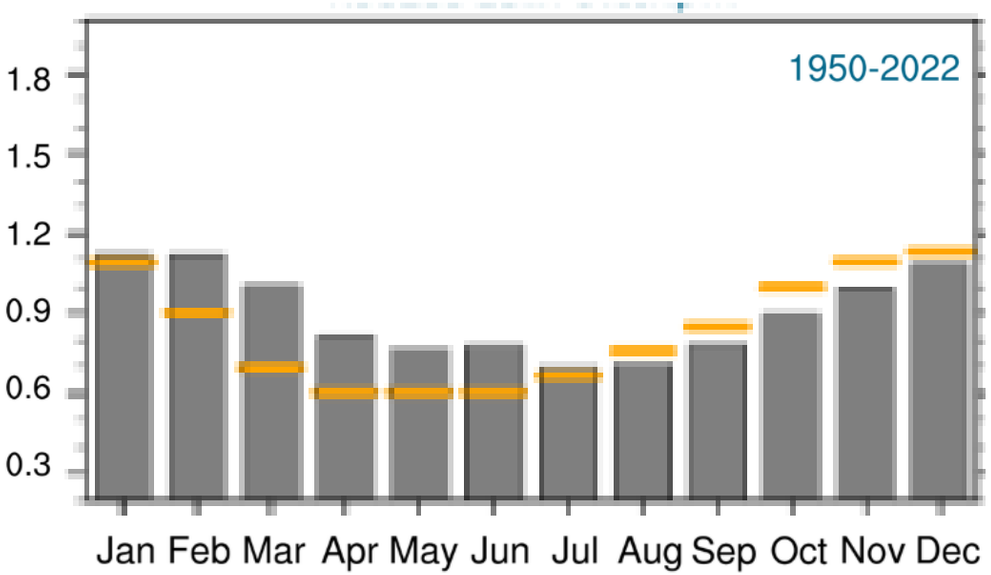


- New detrending options: linear and quadratic, 30-year high-pass filter, remove ensemble mean
- Reference data can be either observations or model simulations.
- CAM-SE data is regridded automatically.
- https://www.cesm.ucar.edu/projects/cvdp
- Aiming for a python version by the end of this year

Contact: Adam Phillips and Clara Deser (Climate Analysis Section)

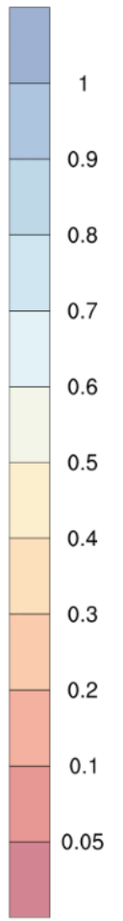
Why use large ensembles for model evaluation?

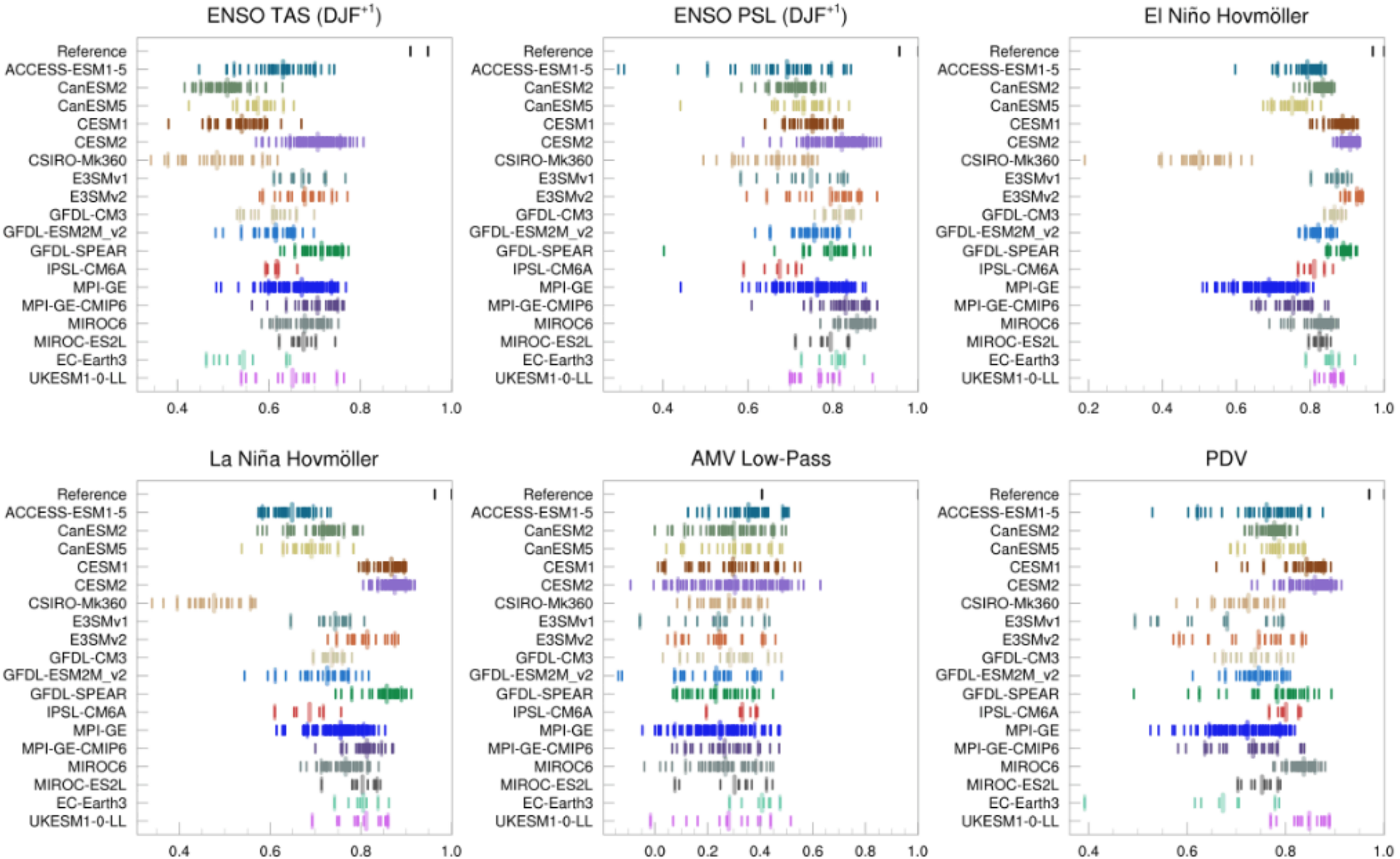


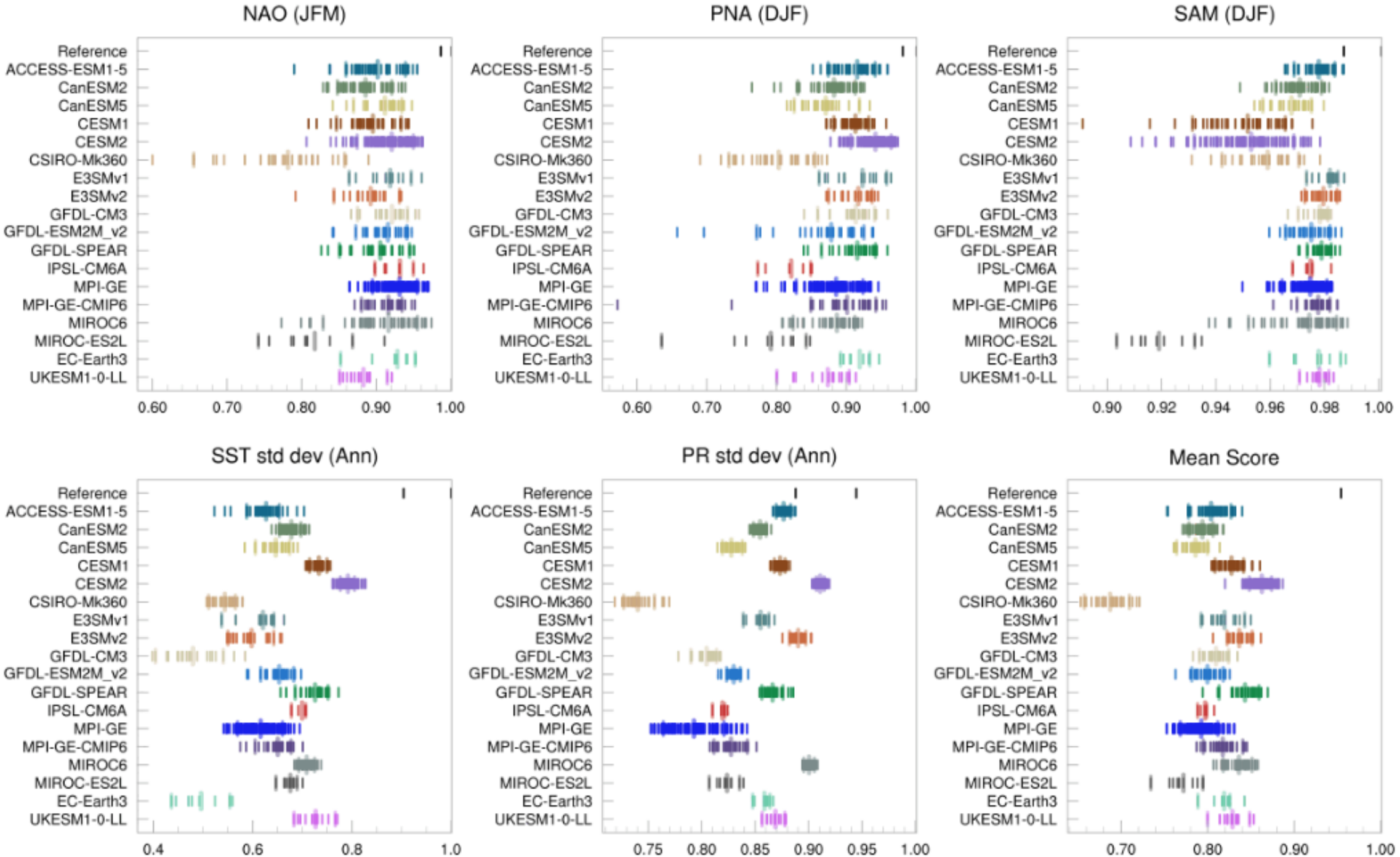


RMS Differences

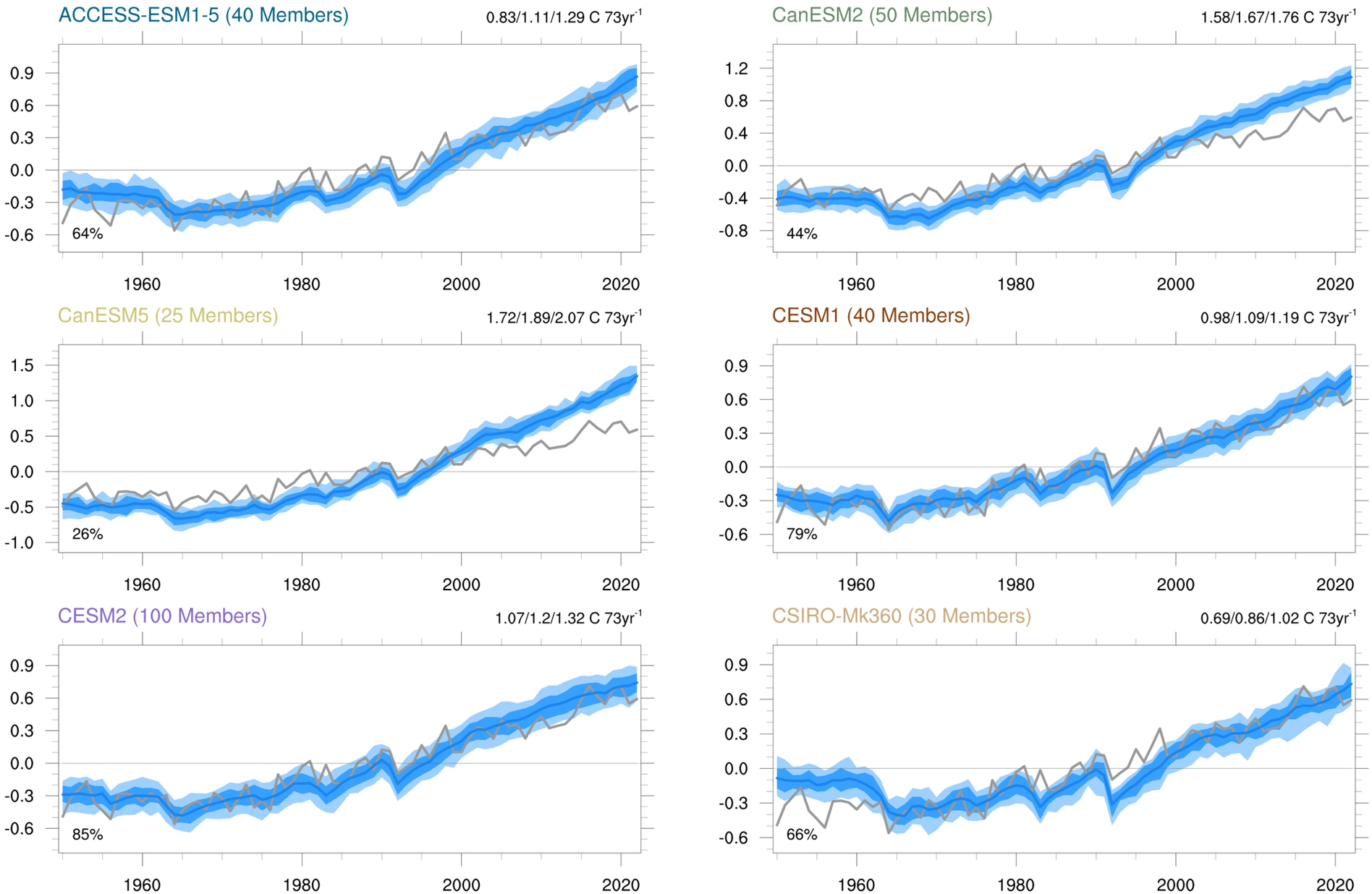
	ENSO TAS (DJF) °C	ENSO PSL (DJF) hPa	El Niño Hovmöller °C	La Niña Hovmöller °C	AMV Low-Pass °C	PDV °C	NAO (JFM) hPa	PNA (DJF) hPa	SAM (DJF) hPa	SST std dev (Ann) °C	PR std dev (Ann) mm day^{-1}	Mean Score
ACCESS-ESM1-5 (10%)	0.58	1.15	0.41	0.46	0.82	0.09	0.58	0.43	0.37	0.15	0.22	0.60
ACCESS-ESM1-5 (Avg)	0.66	1.49	0.48	0.56	1.03	0.11	0.75	0.55	0.51	0.17	0.23	0.66
ACCESS-ESM1-5 (90%)	0.75	1.70	0.54	0.65	1.23	0.13	0.90	0.68	0.68	0.18	0.24	0.70
CanESM2 (10%)	0.84	1.45	0.44	0.55	0.84	0.10	0.71	0.70	0.35	0.12	0.23	0.68
CanESM2 (Avg)	0.94	1.72	0.51	0.66	1.09	0.11	0.91	0.89	0.45	0.12	0.23	0.74
CanESM2 (90%)	1.02	1.96	0.60	0.75	1.35	0.12	1.08	1.07	0.55	0.13	0.24	0.81
CanESM5 (10%)	0.68	1.27	0.45	0.37	0.85	0.09	0.65	0.68	0.33	0.13	0.24	0.60
CanESM5 (Avg)	0.75	1.48	0.50	0.42	1.00	0.10	0.76	0.88	0.38	0.13	0.24	0.65
CanESM5 (90%)	0.82	1.76	0.59	0.48	1.21	0.11	0.91	1.04	0.45	0.14	0.25	0.70
CESM1 (10%)	0.77	1.40	0.43	0.32	0.88	0.09	0.60	0.56	0.36	0.10	0.20	0.61
CESM1 (Avg)	0.87	1.61	0.54	0.42	1.10	0.10	0.80	0.70	0.44	0.12	0.21	0.67
CESM1 (90%)	0.96	1.80	0.63	0.54	1.29	0.11	0.95	0.83	0.49	0.13	0.21	0.74
CESM2 (10%)	0.61	1.19	0.49	0.47	0.80	0.09	0.60	0.52	0.37	0.12	0.22	0.61
CESM2 (Avg)	0.72	1.41	0.63	0.60	1.12	0.10	0.84	0.69	0.45	0.14	0.24	0.70
CESM2 (90%)	0.83	1.74	0.76	0.74	1.48	0.12	1.04	0.89	0.54	0.17	0.27	0.78
CSIRO-Mk360 (10%)	0.69	1.36	0.59	0.55	0.79	0.11	0.88	0.65	0.35	0.14	0.35	0.71
CSIRO-Mk360 (Avg)	0.79	1.55	0.73	0.62	1.04	0.12	1.09	0.79	0.41	0.16	0.37	0.77
CSIRO-Mk360 (90%)	0.91	1.74	0.83	0.71	1.27	0.13	1.28	0.94	0.48	0.17	0.38	0.82
E3SMv1 (10%)	0.56	1.15	0.39	0.42	0.79	0.10	0.45	0.37	0.49	0.17	0.21	0.60
E3SMv1 (Avg)	0.66	1.41	0.46	0.54	1.01	0.13	0.67	0.57	0.67	0.17	0.22	0.67
E3SMv1 (90%)	0.72	1.66	0.58	0.68	1.29	0.15	0.80	0.68	0.84	0.18	0.23	0.71
E3SMv2 (10%)	0.58	1.04	0.31	0.39	0.85	0.09	0.62	0.48	0.49	0.17	0.18	0.61
E3SMv2 (Avg)	0.71	1.35	0.47	0.55	1.05	0.12	0.78	0.58	0.67	0.18	0.19	0.67
E3SMv2 (90%)	0.79	1.64	0.68	0.69	1.28	0.14	0.90	0.72	0.80	0.19	0.20	0.74
GFDL-CM3 (10%)	0.72	1.43	0.52	0.63	0.75	0.10	0.58	0.55	0.48	0.14	0.25	0.72
GFDL-CM3 (Avg)	0.78	2.13	0.67	0.78	1.01	0.11	0.70	0.66	0.66	0.15	0.25	0.77
GFDL-CM3 (90%)	0.83	2.75	0.83	0.88	1.21	0.12	0.82	0.83	0.79	0.17	0.26	0.79
GFDL-ESM2M_v2 (10%)	0.86	1.46	0.57	0.56	1.01	0.11	0.55	0.57	0.40	0.16	0.30	0.75
GFDL-ESM2M_v2 (Avg)	0.95	1.77	0.86	0.77	1.26	0.12	0.71	0.80	0.60	0.18	0.34	0.85
GFDL-ESM2M_v2 (90%)	1.05	1.98	1.07	1.11	1.60	0.13	0.85	1.08	0.82	0.20	0.37	0.96
GFDL-SPEAR (10%)	0.53	1.08	0.33	0.30	0.85	0.08	0.54	0.45	0.29	0.11	0.20	0.54
GFDL-SPEAR (Avg)	0.60	1.26	0.40	0.37	1.15	0.10	0.71	0.55	0.38	0.11	0.21	0.59
GFDL-SPEAR (90%)	0.67	1.41	0.48	0.44	1.35	0.12	0.87	0.66	0.49	0.12	0.22	0.63
IPSL-CM6A (10%)	0.63	1.41	0.43	0.48	0.78	0.09	0.51	0.77	0.42	0.13	0.26	0.63
IPSL-CM6A (Avg)	0.70	1.58	0.48	0.53	0.90	0.10	0.63	0.91	0.57	0.13	0.26	0.66
IPSL-CM6A (90%)	0.71	1.68	0.51	0.58	0.95	0.10	0.69	1.01	0.67	0.14	0.27	0.67
MPI-GE (10%)	0.58	1.18	0.54	0.33	0.86	0.11	0.50	0.56	0.38	0.17	0.24	0.64
MPI-GE (Avg)	0.67	1.38	0.67	0.41	1.10	0.12	0.66	0.74	0.50	0.18	0.26	0.69
MPI-GE (90%)	0.76	1.57	0.82	0.48	1.42	0.14	0.79	0.95	0.64	0.19	0.28	0.74
MPI-GE-CMIP6 (10%)	0.55	1.00	0.44	0.33	0.82	0.11	0.61	0.52	0.40	0.16	0.24	0.60
MPI-GE-CMIP6 (Avg)	0.64	1.20	0.58	0.41	1.01	0.12	0.73	0.73	0.54	0.17	0.25	0.66
MPI-GE-CMIP6 (90%)	0.73	1.45	0.69	0.46	1.13	0.14	0.85	0.93	0.70	0.18	0.26	0.71
MIROC6 (10%)	0.76	1.18	0.67	0.57	0.87	0.12	0.53	0.62	0.27	0.14	0.20	0.67
MIROC6 (Avg)	0.86	1.41	0.82	0.73	1.07	0.15	0.72	0.72	0.38	0.17	0.22	0.77
MIROC6 (90%)	1.01	1.62	0.91	0.90	1.30	0.17	0.91	0.82	0.48	0.19	0.25	0.85
MIROC-ES2L (10%)	0.66	1.25	0.62	0.56	0.92	0.13	0.79	0.71	0.49	0.16	0.24	0.74
MIROC-ES2L (Avg)	0.76	1.39	0.76	0.68	1.13	0.15	0.96	0.80	0.58	0.18	0.25	0.79
MIROC-ES2L (90%)	0.81	1.53	0.85	0.76	1.26	0.16	1.09	0.92	0.62	0.19	0.26	0.88
EC-Earth3 (10%)	0.61	1.00	0.31	0.31	0.72	0.10	0.53	0.43	0.24	0.15	0.22	0.54
EC-Earth3 (Avg)	0.71	1.21	0.42	0.36	0.80	0.13	0.65	0.62	0.31	0.19	0.23	0.59
EC-Earth3 (90%)	0.76	1.31	0.50	0.39	0.88	0.13	0.77	0.76	0.39	0.20	0.24	0.61



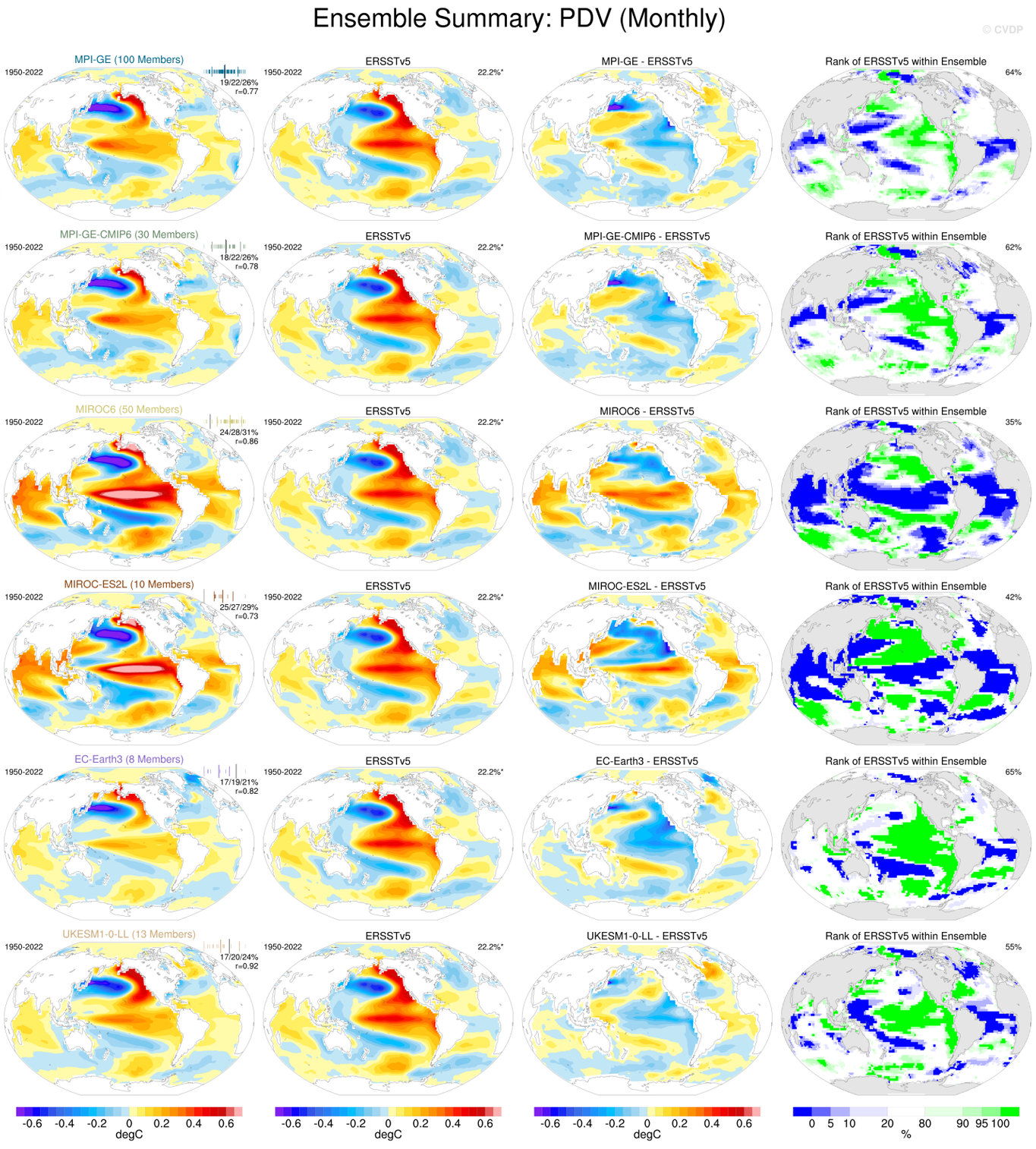

ENSO TAS (DJF+1)
ENSO PSL (DJF+1)
El Niño Hovmöller
La Niña Hovmöller
AMV Low-Pass
PDV
Reference
ACCESS-ESM1-5
CanESM2
CanESM5
CESM1
CESM2
CSIRO-Mk360
E3SMv1
E3SMv2
GFDL-CM3
GFDL-ESM2M_v2
GFDL-SPEAR
IPSL-CM6A
MPI-GE
MPI-GE-CMIP6
MIROC6
MIROC-ES2L
EC-Earth3
UKESM1-0-LL
0.0
0.2
0.4
0.6
0.8
1.0


NAO (JFM)
PNA (DJF)
SAM (DJF)
SST std dev (Ann)
PR std dev (Ann)
Mean Score
Reference
ACCESS-ESM1-5
CanESM2
CanESM5
CESM1
CESM2
CSIRO-Mk360
E3SMv1
E3SMv2
GFDL-CM3
GFDL-ESM2M_v2
GFDL-SPEAR
IPSL-CM6A
MPI-GE
MPI-GE-CMIP6
MIROC6
MIROC-ES2L
EC-Earth3
UKESM1-0-LL
0.60 0.70 0.80 0.90 1.00
0.90 0.92 0.94 0.96 0.98 1.00
0.4 0.6 0.8 1.0
0.75 0.80 0.85 0.90 0.95 1.00
0.70 0.80 0.90 1.00

Global-mean surface temperature



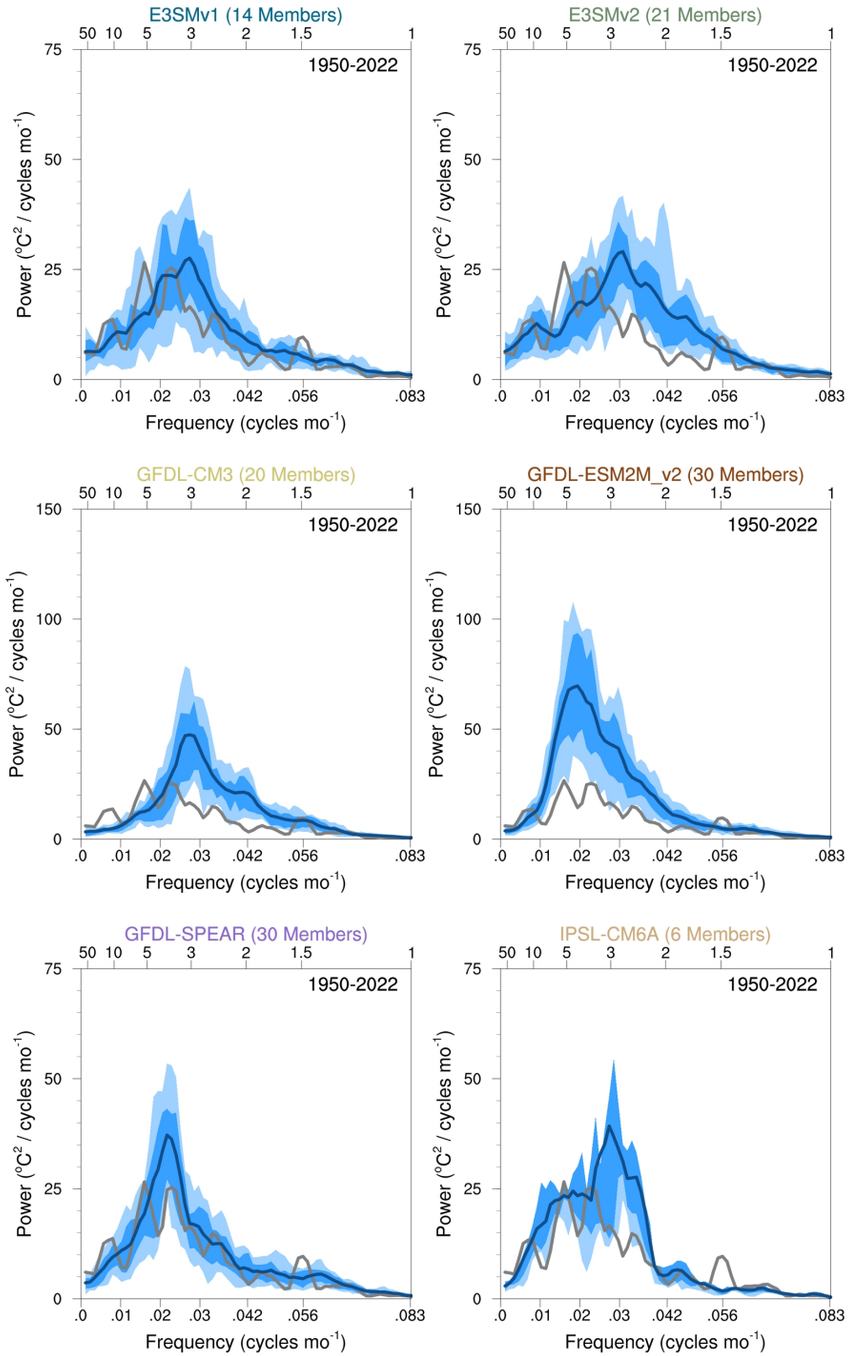
Pacific Decadal Variability



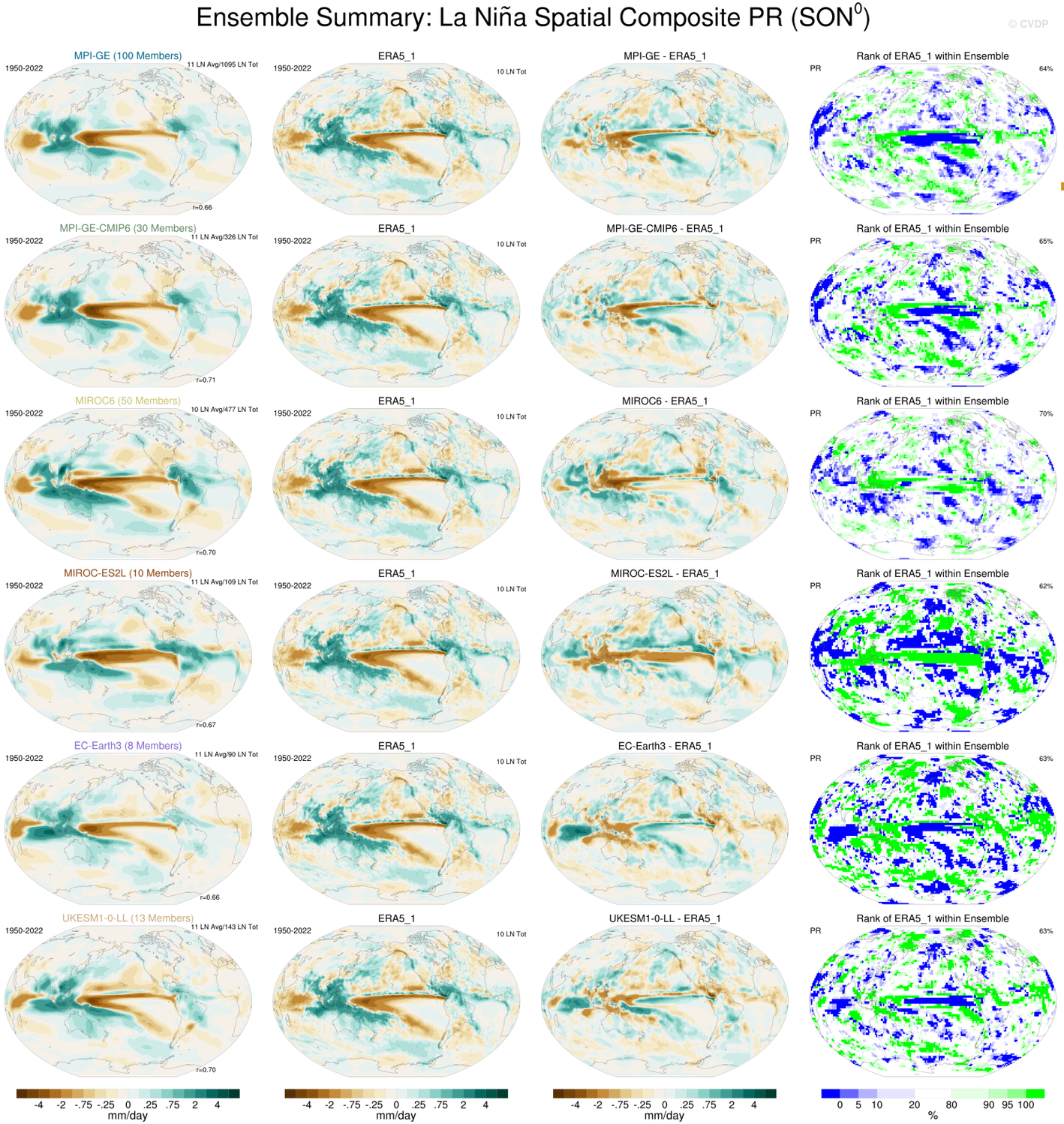
ENSO spectra

Ensemble Summary: Niño3.4 SST Power Spectra (Monthly)

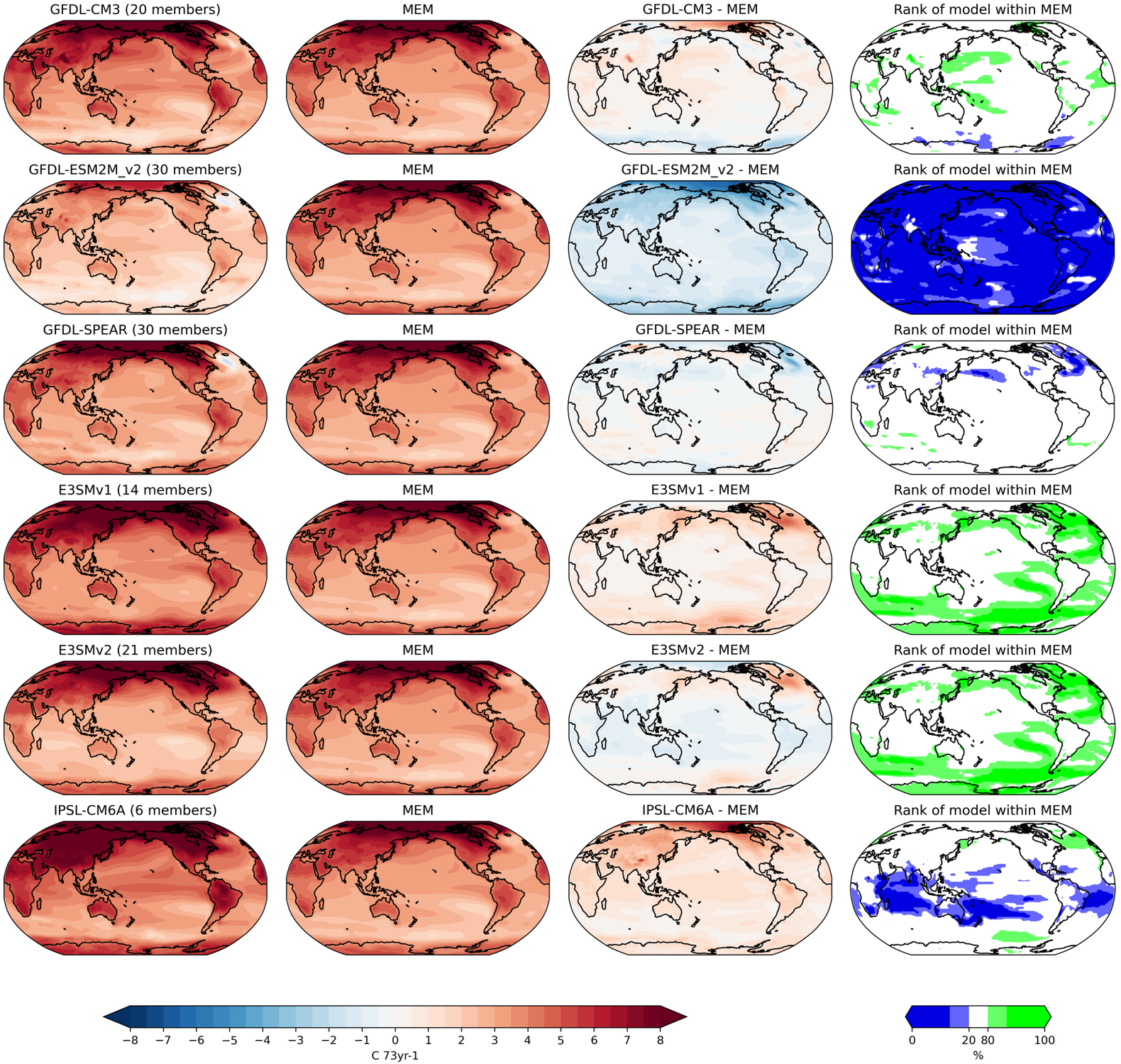
ERSSTv5 1950-2022



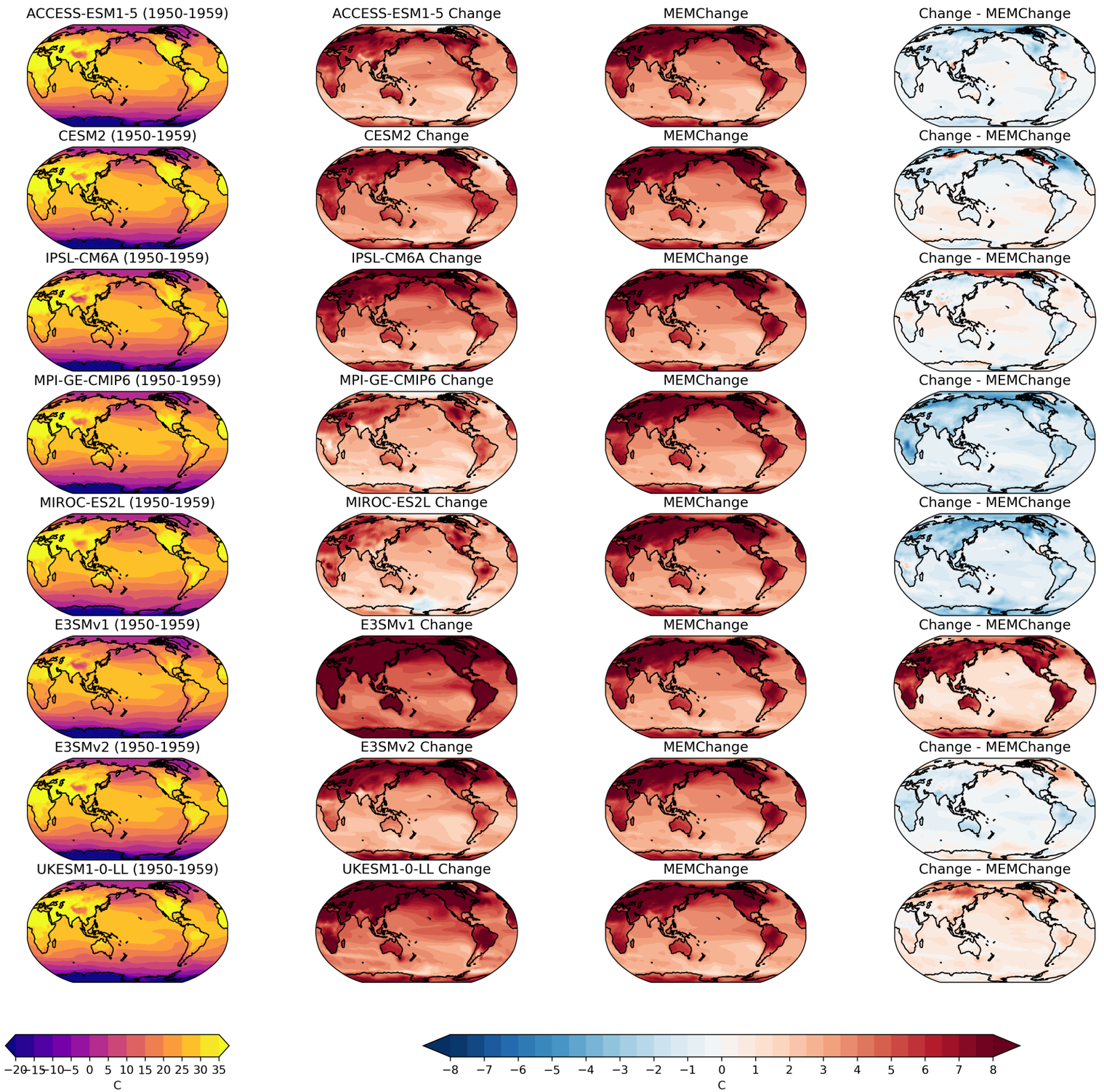
La Nina rainfall



Future warming trends



Daily max temperatures (TXx)



Summary

1. MMLEAv2 is (almost) available!
   - 18models, 15variables
   - https://www.cesm.ucar.edu/community-projects/mmlea/v2
   - Please use it!
2. CVDPv6 has been applied to MMLEAv2
   - Both the detrended and non-detrended version
   - It (and it's output) are available for use
3. Large ensembles are needed for model evaluation as individual members can behave quite differently for variable quantities
4. Archive can be used to compare models to observations
5. Archive can be used to compare models to each other, or the ensemble mean
6. Many scientific questions can be addressed using this archive! So again please utilise it!

Preprint

Website

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CIRES
University of Colorado Boulder
ATOC
nicola.maher@anu.edu.au
https://nicolamaher.weebly.com/