

Relating CMIP5 model biases to seasonal forecast skill in the tropical Pacific

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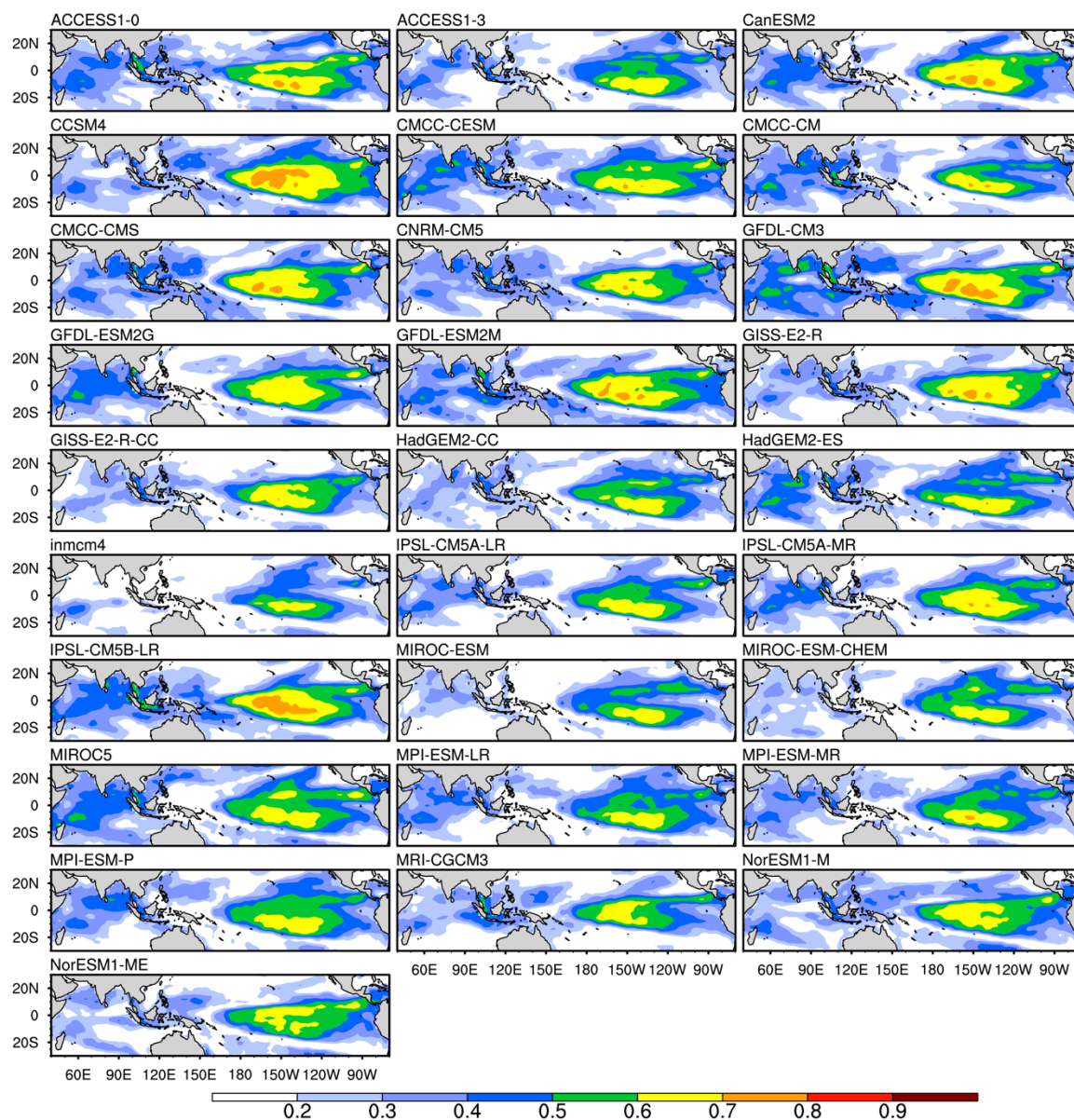


Figure S1. Model-analog hindcast skill of observed SST variations (1961-2015) at 6-month lead, for each individual CMIP5 model, calculated as an anomaly correlation between observations and the hindcast ensemble mean.

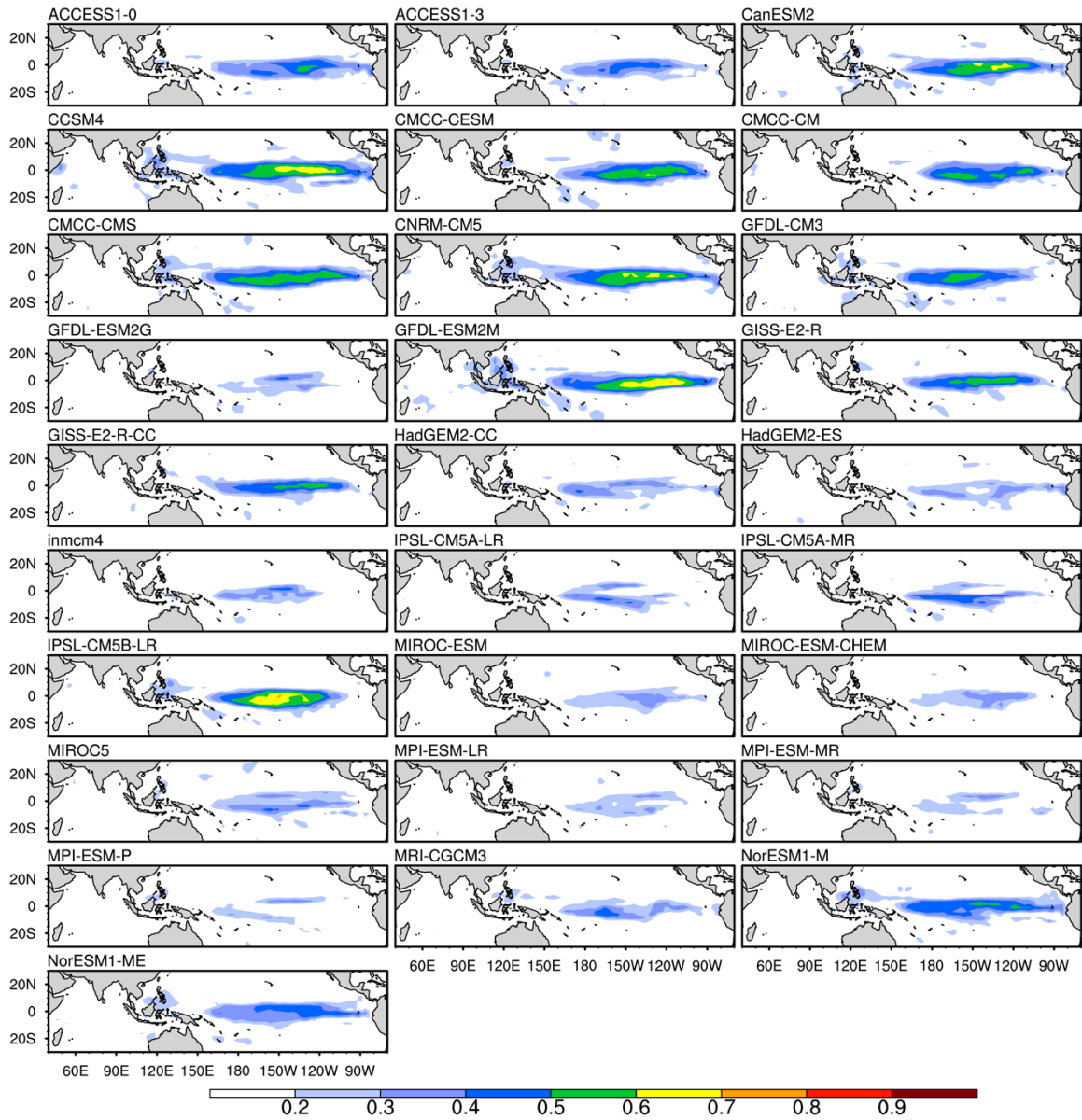


Figure S2. As in Fig. S2, but for precipitation (1979-2015).

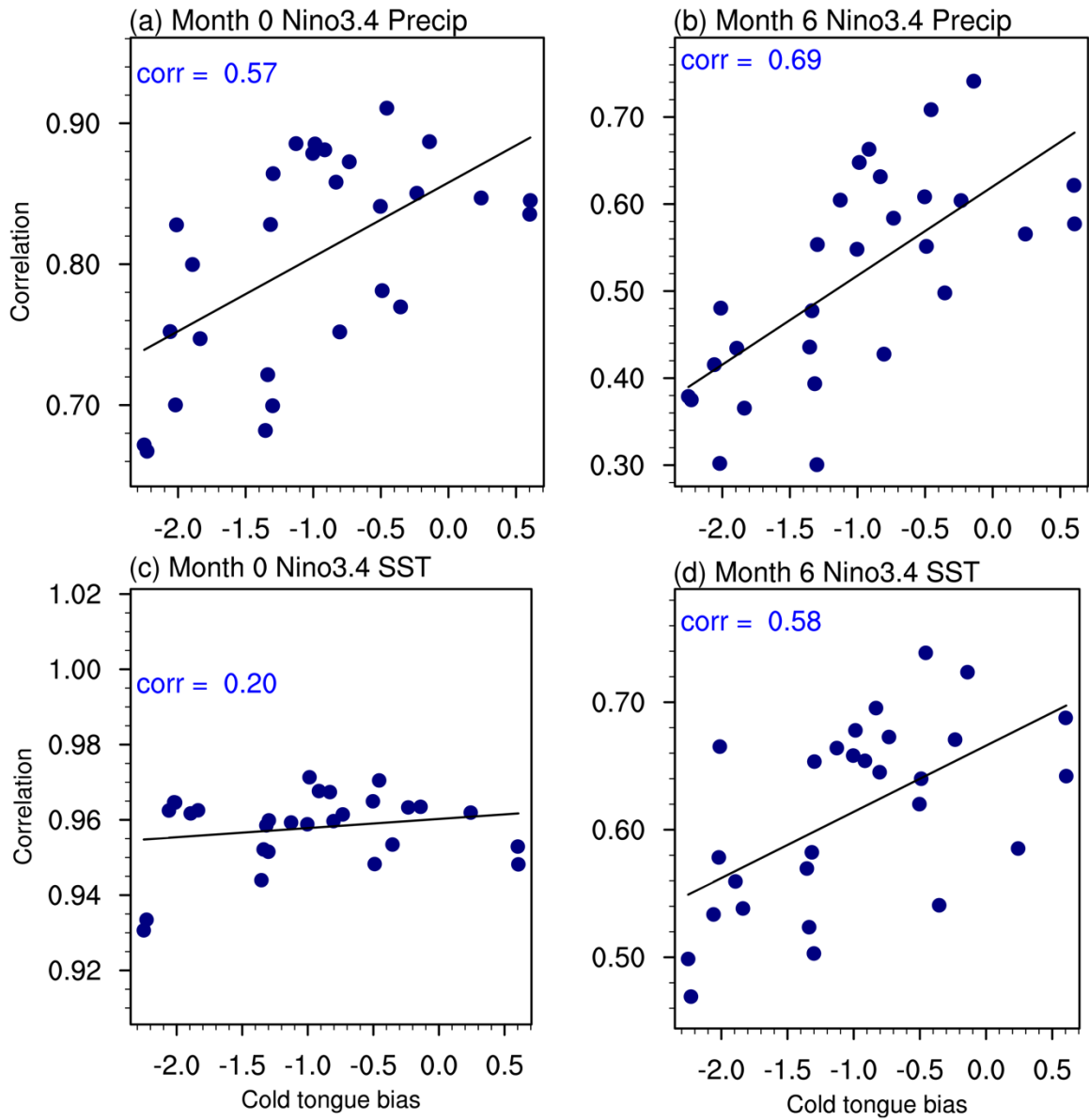


Figure S3. As in Fig. 2, but for model-analog anomaly correlation on the ordinate.

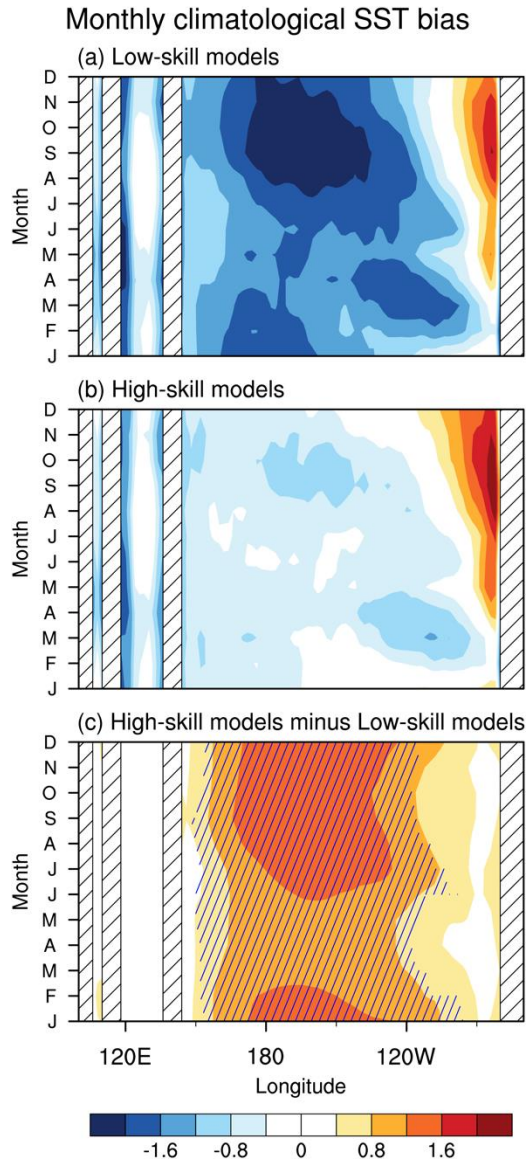


Figure S4. Multi-model monthly climatological equatorial (5°S-5°N) SST biases, calculated from the pre-industrial control simulations of the 12 models with the (a) worst and (b) best initial model-analog reconstruction error (SRMSE) for Niño3.4 precipitation and (c) the difference between the two groups of models. Differences in SST are hatched when they exceed 95% significance. The unit is Celsius.

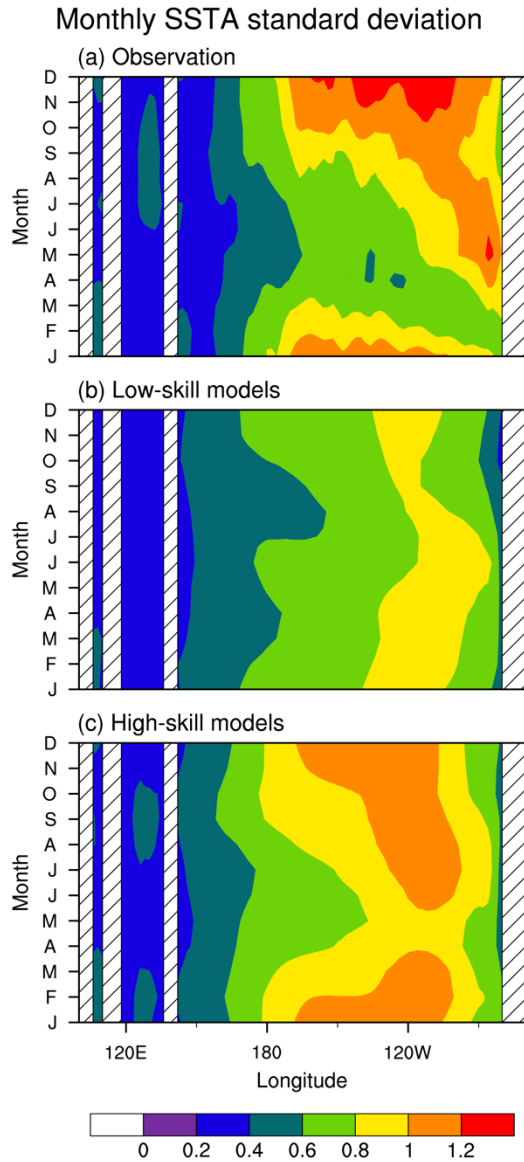


Figure S5. Monthly equatorial (5°S-5°N) SSTA standard deviation, calculated from (a) observations and the pre-industrial control simulations of the 12 models with the (b) worst and (c) best initial model-analog reconstruction error (SRMSE) for Niño3.4 precipitation. The unit is Celsius.

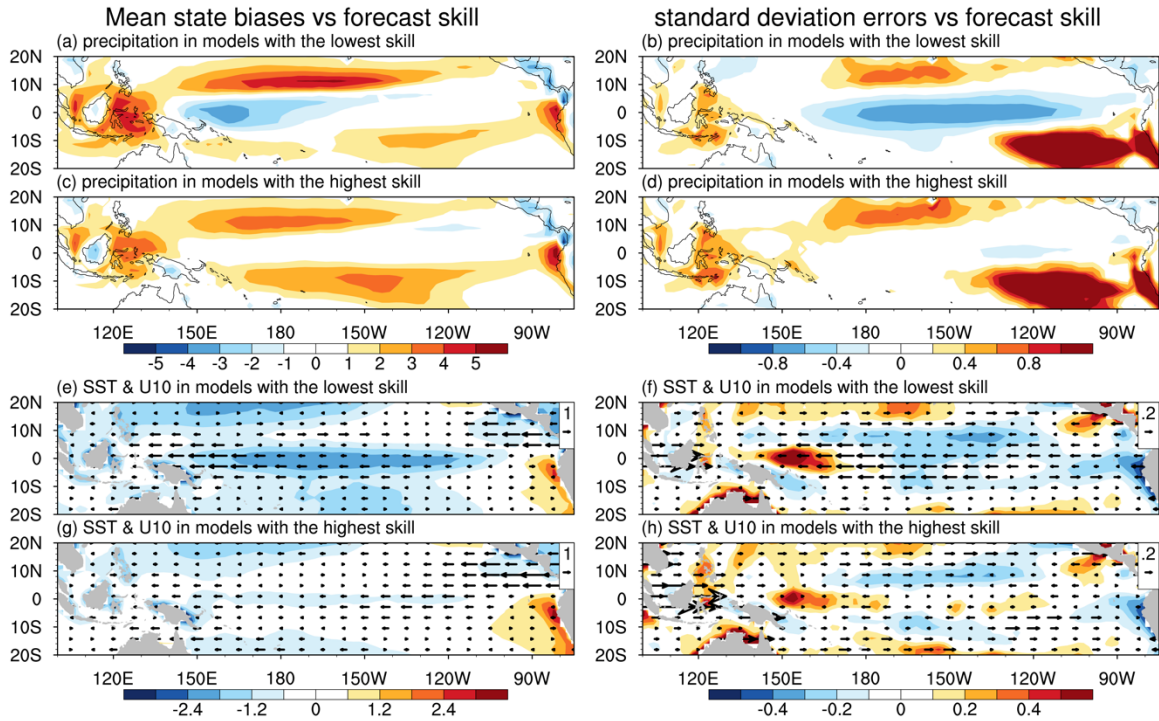


Figure S6. As in Fig. 3, but for the 12 models selected according to model-analog forecast accuracy of Niño3.4 precipitation at 6-month lead.

Model name	Expanded model name	Length of run (yr)
ACCESS1-0	Australian Community Climate and Earth System Simulator Coupled Model	500
ACCESS1-3	Australian Community Climate and Earth System Simulator Coupled Model	500
CanESM2	Second Generation Canadian Earth System Model	995
CCSM4	Community Climate System Model, version 4	1050
CMCC-CESM	CMCC Carbon Earth System Model	277
CMCC-CM	CMCC Climate Model	330
CMCC-CMS	CMCC Climate Model with a resolved Stratosphere	500
CNRM-CM5	Centre National de Recherches Meteorologiques Coupled Global Climate Model, version 5	850
GFDL-CM3	Geophysical Fluid Dynamics Laboratory, Climate Model versions 3.0	500
GFDL-ESM2G	Geophysical Fluid Dynamics Laboratory Earth System Model with Generalized Ocean Layer Dynamics (GOLD) component	500
GFDL-ESM2M	Geophysical Fluid Dynamics Laboratory Earth System Model with Modular Ocean Model 4 (MOM4) component	500
GISS-E2-R	Goddard Institute for Space Studies Model E2, coupled with the Russell ocean model	550
GISS-E2-R-CC	Goddard Institute for Space Studies Model E2, coupled with the Russell ocean model, Interactive Carbon Cycle	251
HadGEM2-CC	Hadley Centre Global Environment Model, version 2–Carbon Cycle	240
HadGEM2-ES	Hadley Centre Global Environment Model, version 2-Earth System	575
INMCM4	Institute of Numerical Mathematics Coupled Model, version 4.0	500
IPSL-CM5A-LR	L’Institut Pierre-Simon Laplace Coupled Model, version 5, coupled with Nucleus for European Modelling of the Ocean (NEMO), low resolution	1000
IPSL-CM5A-MR	L’Institut Pierre-Simon Laplace Coupled Model, version 5, coupled with NEMO, mid resolution	300
IPSL-CM5B-LR	L’Institut Pierre-Simon Laplace Coupled Model, version 5, coupled with NEMO, new atmospheric physics low resolution	300

MIROC-ESM	Model for Interdisciplinary Research on Climate, Earth System Model	630
MIROC-ESM-CHEM	Model for Interdisciplinary Research on Climate, Earth System Model, an atmospheric chemistry coupled version	255
MIROC5	Model for Interdisciplinary Research on Climate, version 5	670
MPI-ESM-LR	Max Planck Institute Earth System Model, low resolution	1000
MPI-ESM-MR	Max Planck Institute Earth System Model, medium resolution	1000
MPI-ESM-P	Max Planck Institute Earth System Model, low resolution, and paleo mode	1155
MRI-CGCM3	Meteorological Research Institute Coupled Atmosphere–Ocean General Circulation Model, version 3	500
NorESM1-M	Norwegian Earth System Model 1, medium resolution	500
NorESM1-ME	Norwegian Earth System Model 1, medium resolution with capability to be fully emission driven	252

Table S1. The 28 CMIP5 models whose preindustrial control simulations served as the data library for selection of model-analogs.