Title: Dataset associated with "El Niño–Southern Oscillation (ENSO) predictability in equilibrated warmer climates"

Abstract: Responses of El Niño-Southern Oscillation (ENSO) to global warming remain uncertain, which challenges ENSO forecasts in a warming climate. We investigate changes in ENSO characteristics and predictability in idealized simulations with quadrupled CO2 forcing from seven general circulation models. Comparing the warmer climate to control simulations, ENSO variability weakens, with the neutral state lasts longer, while active ENSO states last shorter and skew to favor the La Niña state. Six- month persistence-assessed ENSO predictability slightly reduces in five models and increases in two models under the warming condition. While the overall changes in ENSO predictability are insignificant, we find significant relationships between changes in predictability and intensity, duration and skewness of the three individual ENSO states. The maximal contribution to changes in the predictability of El Niño, La Niña and neutral states stems from changes in skewness and events' duration. Our findings show that a robust and significant decrease in ENSO characteristics does not imply a similar change in ENSO predictability in a warmer climate. This could be due to model deficiencies in ENSO dynamics and limitations in persistence model when predicting ENSO.

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Format of data file: .txt and .nc

File Information:

Time series of mean surface air temperature (TAS) in Niño3.4 region, behind Fig.1

Nino_tas /Nino34_tas_CCSM3_abrupt4x_2120.nc
Nino_tas /Nino34_tas_CCSM3_control_1530.nc
Nino_tas/Nino34_tas_CESM104_abrupt4x_5900.nc
Nino_tas/Nino34_tas_CESM104_control_1000.nc
Nino_tas/Nino34_tas_CNRMCM61_abrupt4x_1850.nc
Nino_tas/Nino34_tas_CNRMCM61_control_2000.nc
Nino_tas/Nino34_tas_GISSE2R_abrupt4x_5000.nc
Nino_tas/Nino34_tas_GISSE2R_control_5225.nc
Nino_tas /Nino34_tas_HadCM3L_abrupt4x_1000.nc
Nino_tas /Nino34_tas_HadCM3L_control_1000.nc

Nino_tas /Nino34_tas_IPSLCM5A_abrupt4x_1000.nc
Nino_tas /Nino34_tas_IPSLCM5A_control_1000.nc
Nino_tas/Nino34_tas_MPIESM12_abrupt4x_1000.nc
Nino_tas/Nino34_tas_MPIESM12_control_1237.nc

Niño3.4 index in control simulations and observations, behind Fig.2
Nino_index/Nino34_index_CCSM3_control_1530.nc
Nino_index/Nino34_index_CESM104_control_1000.nc
Nino_index/Nino34_index_CNRMCM61_control_2000.nc
Nino_index/Nino34_index_GISSE2R_control_5225.nc
Nino_index/Nino34_index_HadCM3L_control_1000.nc
Nino_index/Nino34_index_IPSLCM5A_control_1000.nc
Nino_index/Nino34_index_MPIESM12_control_1237.nc
Nino_index/Nino34_index_GISTEMP_obs.nc

Net shortwave flux feedback in control simulations and observations, behind Fig.3
netSWflux/Nino_rsns_mon_CCSM3_control_1530.nc
netSWflux/Nino_rsns_mon_CESM104_control_1000.nc
netSWflux/Nino_rsns_mon_CNRMCM61_control_2000.nc
netSWflux/Nino_rsns_mon_GISSE2R_control_5225.nc
netSWflux/Nino_rsns_mon_HadCM3L_control_1000.nc
netSWflux/Nino_rsns_mon_IPSLCM5A_control_1000.nc
netSWflux/Nino_rsns_mon_MPIESM12_control_1237.nc
Nino.nswrs.sfc.gauss.monthly.nc
values_for_plot.txt

Niño3.4 index in control and abrupt4xCO_2 simulations, behind Fig.4
Nino_index/Nino34_index_CCSM3_abrupt4x_1530.nc
Nino_index/Nino34_index_CCSM3_control_1530.nc
Nino_index/Nino34_index_CESM104_abrupt4x_1000.nc
Nino_index/Nino34_index_CESM104_control_1000.nc
Nino_index/Nino34_index_CNRMCM61_abrupt4x_1850.nc
Nino_index/Nino34_index_CNRMCM61_control_2000.nc
Nino_index/Nino34_index_GISSE2R_abrupt4x_5000.nc
Nino_index/Nino34_index_GISSE2R_control_5225.nc
Nino_index/Nino34_index_HadCM3L_abrupt4x_1000.nc
Nino_index/Nino34_index_HadCM3L_control_1000.nc
Nino_index/Nino34_index_IPSLCM5A_abrupt4x_1000.nc
Nino_index/Nino34_index_IPSLCM5A_control_1000.nc
Nino_index/Nino34_index_MPIESM12_abrupt4x_1000.nc
Nino_index/Nino34_index_MPIESM12_control_1237.nc

ENSO predictability values, behind Fig.5
Predictability/Accuracy_values.txt

Changes in ENSO characteristics, behind Fig.6
changes_bar/characteristics.txt

Changes in ENSO predictability, behind Fig.7
changes_bar/predictability.txt

R-square values and the significance of regressions between ENSO characteristics and predictability in the observations, control simulations, and changes, behind Fig.8
R-square/obs.txt
R-square/obs_sig.txt
R-square/control.txt
R-square/control_sig.txt
R-square/changes.txt
R-square/changes_sig.txt

Calculation:
The Niño 3.4 index in control simulations is done by subtracting the average TAS from the time series, while the index in abrupt4x simulations is done by first subtracting the average TAS from control simulations then subtracting the 30-year base period to remove the warm trend. The net shortwave flux feedback is calculated by regressing TAS anomalies in the Niño3.4 region (netCDF files under directory /Nino_index) onto the net shortwave heat flux anomalies in the combined Niño3 and Niño4 region (netCDF files under directory /netSWflux). The sign of the R-squared values represents the sign of the regression slopes. The regressions are calculated for each 30-year chunk that updates every five years.

Description:
1) The Niño 3.4 index calculated from the LongRunMIP outputs of global and annual TAS in seven models (CCSM3, CESM104, CNRMCM61, GISSE2R, HadCM3L, IPSLCM5A and MPIESM12) with two forcing levels (control and abrupt4x). The LongRunMIP outputs are gained from an archive described in Rugenstein et al. 2019.
2) predictability.txt and characteristics.txt contain the changes of ENSO characteristics (frequency and events' duration) and ENSO predictability (6-month averaged accuracy).
3) The explained variance of ENSO predictability by ENSO characteristics in the observations, control simulations, and changes between control and abrupt4x simulations.

Data source:
Annual TAS data from www.longrunmip.org.

Rugenstein et al. 2019: https://doi.org/10.1175/BAMS-D-19-0068.1