

ENSO Prediction and Interactive Ensemble Using CCSM3

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Two COLA Projects Using CCSM3

- ENSO prediction using CCSM3.0
 - Description
 - Results of retrospective forecast ensembles
- Interactive ensemble version of CCSM3.0 using flux coupler
 - Description
 - Preliminary results

History of ENSO Forecast Experiment with CCSM

- Tribbia
 - (1982-83) event case studies using various version of CCM
- Schneider, DeWitt, Rosati, Kirtman, Ji, and Tribbia (MWR, 2003)
 - CCM3 (CAM1) coupled to MOM3 retrospective forecasts
- Kirtman and Min (2007)
 - These results
 - First set of retrospective forecasts using an official version of CCSM (including flux coupler)

Technical Details

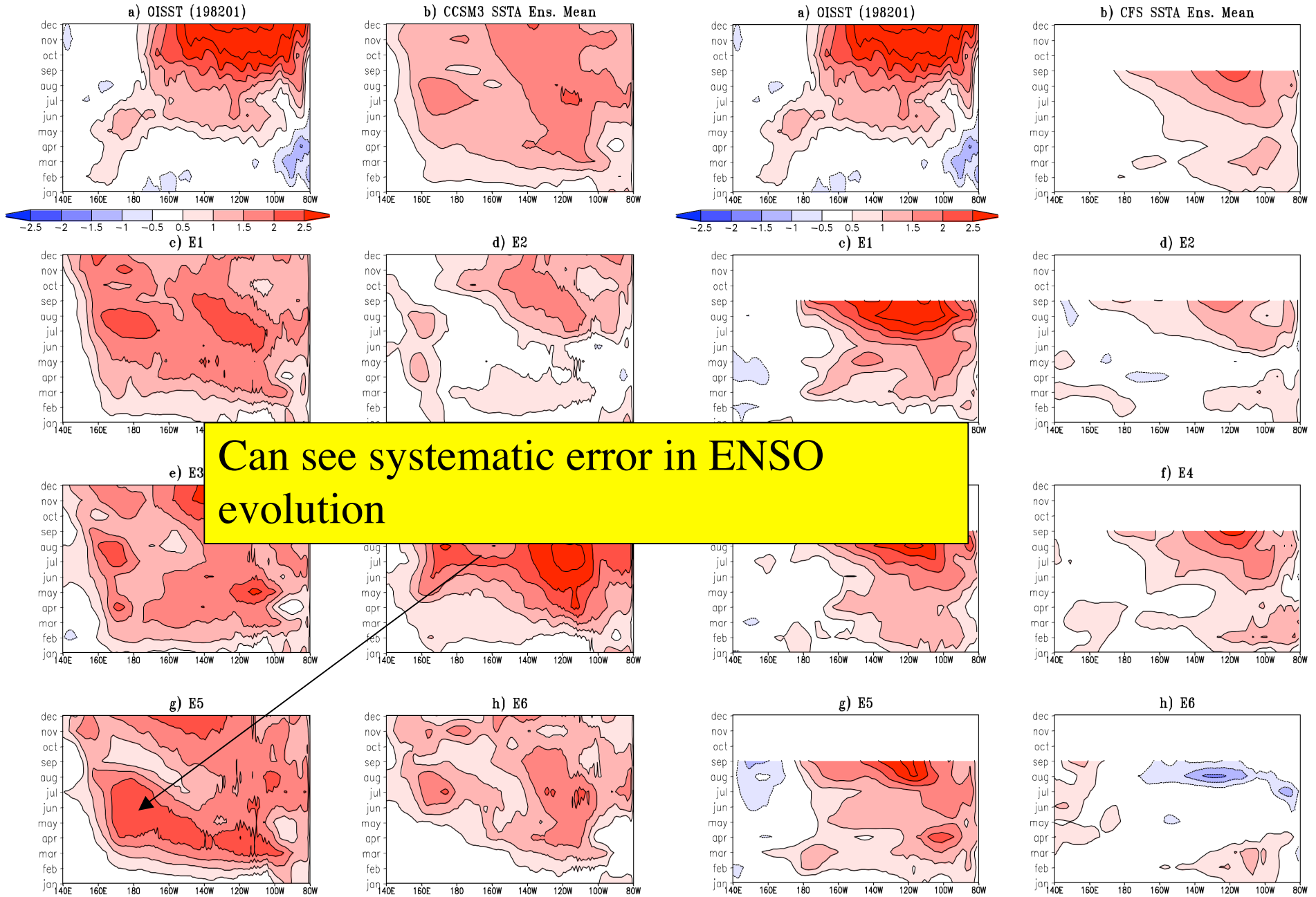
- Model
 - CCSM3.0 T85
- Initial Conditions (1982-1998)
 - Ocean: provided by GFDL (Rosati) and interpolated to CCSM3 ocean grid
 - Atmosphere: from archived 20th century SST forced simulation
- 6 member ensembles for Jan. 1 and Jul. 1 initial conditions 1982-1998
 - Ensemble members from perturbed atmospheric initial conditions

Results

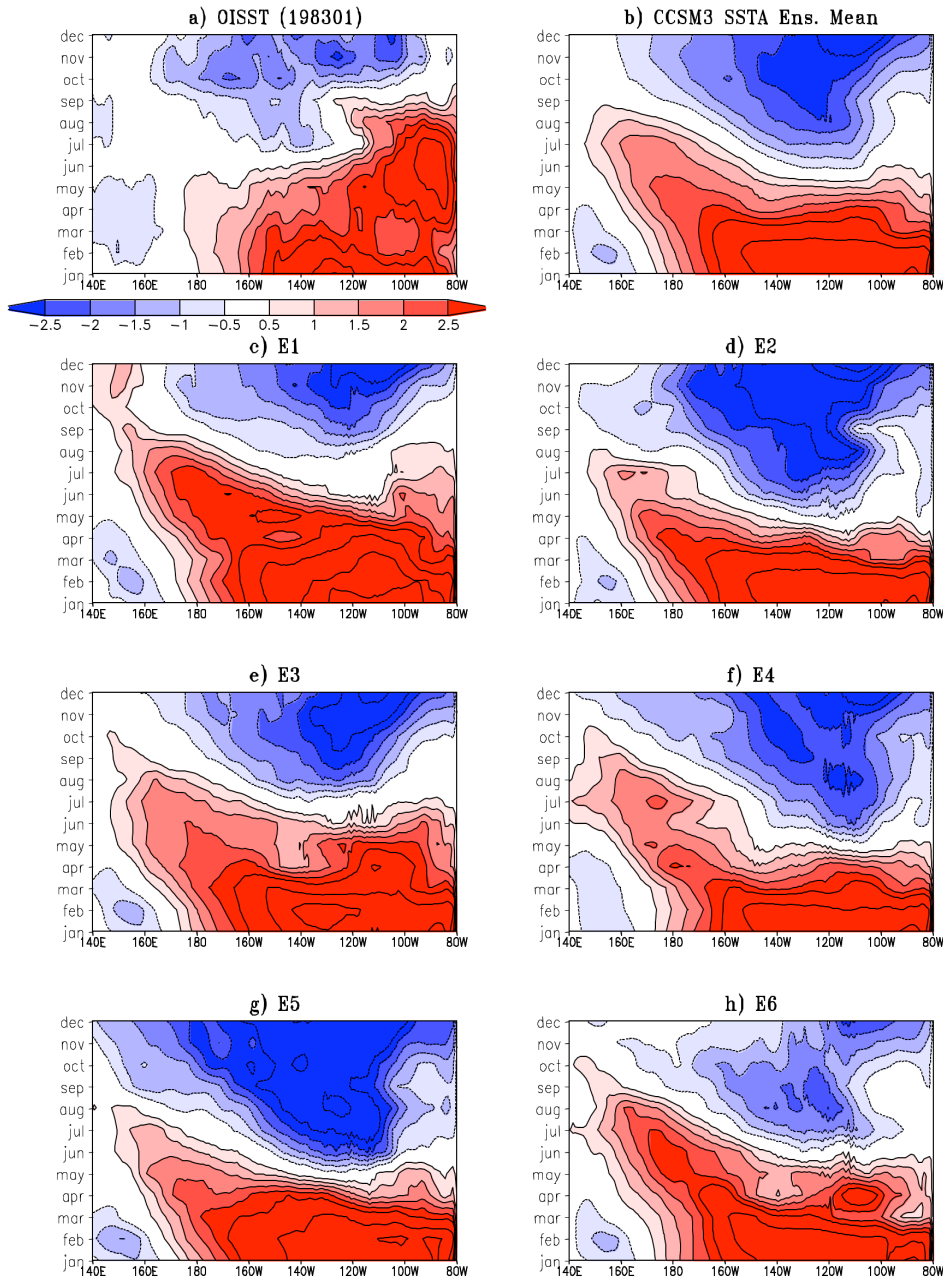
- 6 case ensembles CCSM3
- 15 case ensembles CFS (T62L64)
 - CCSM equatorial cold bias, double ITCZ, semiannual annual cycle, biennial ENSO
 - CFS little equatorial cold bias, realistic ENSO period
- Comparison and ensembling of the two sets of forecasts (mean bias removed)

CCSM3.0 Jan 1982 IC

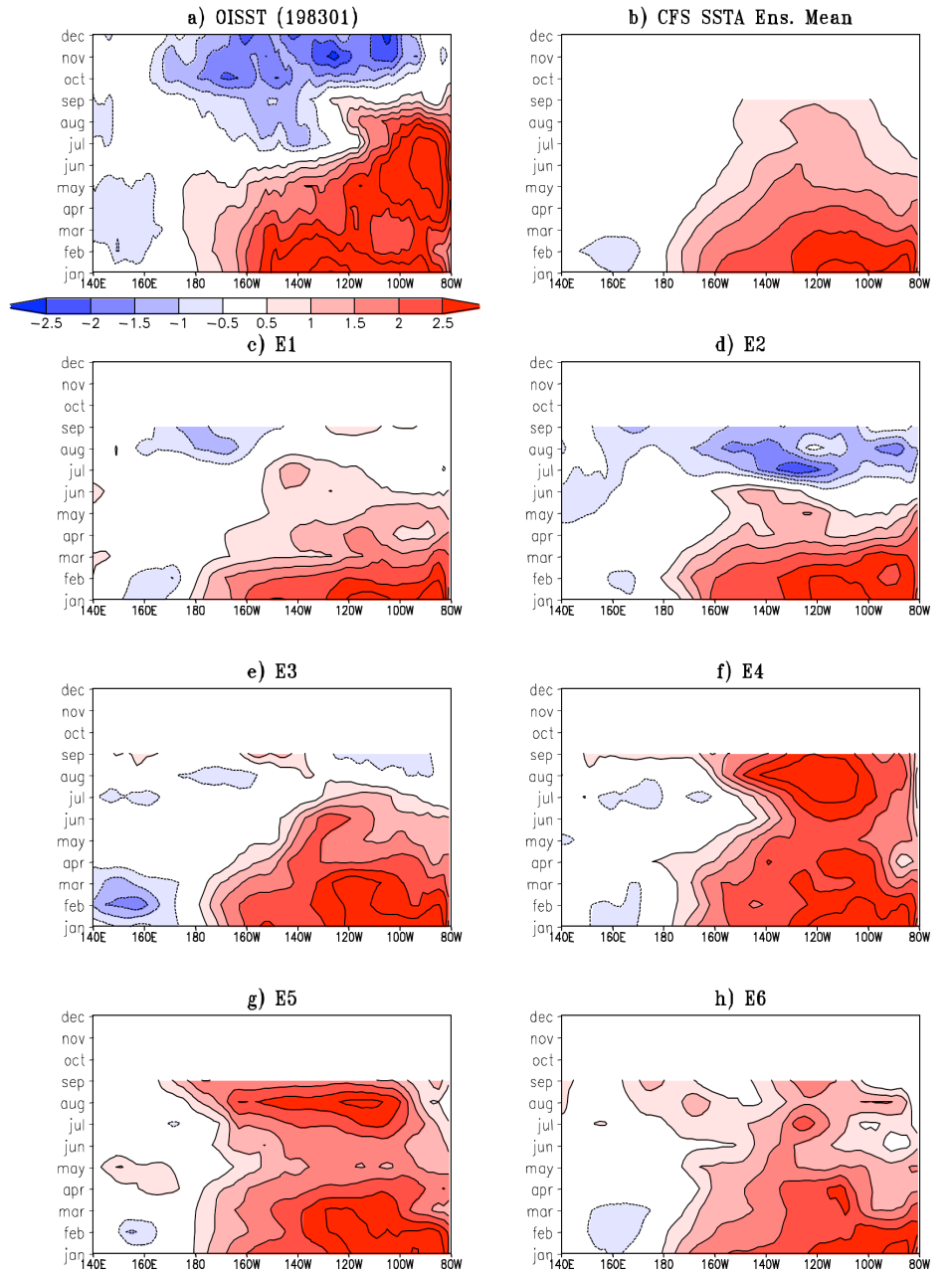
CFS Jan 1982 IC



CCSM3.0 Jan 1983 IC

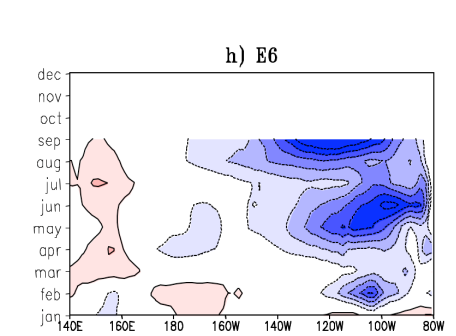
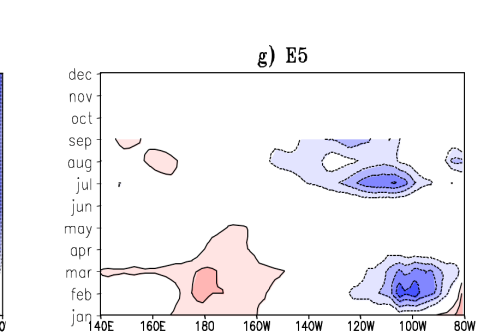
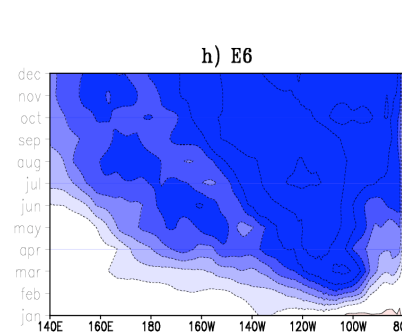
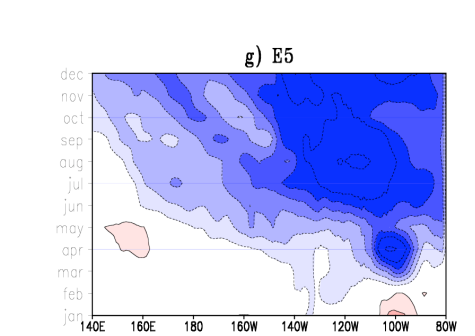
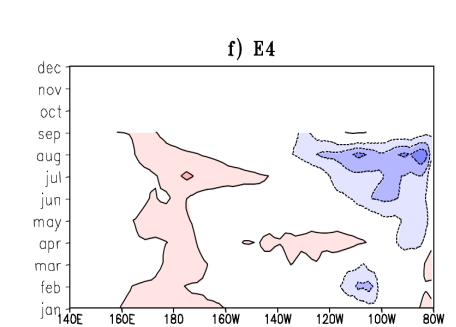
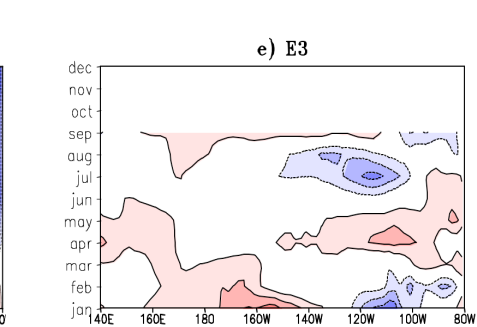
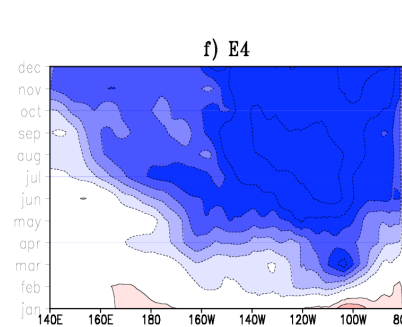
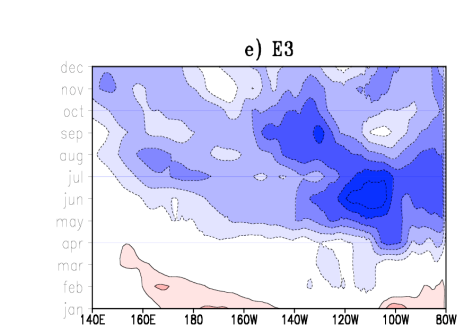
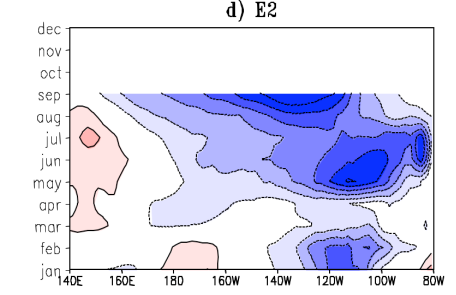
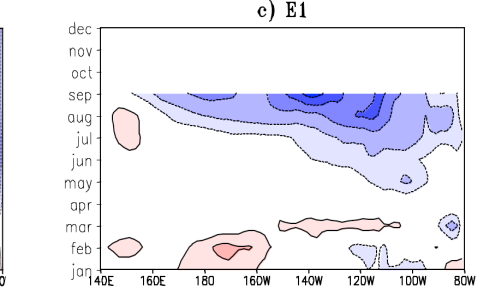
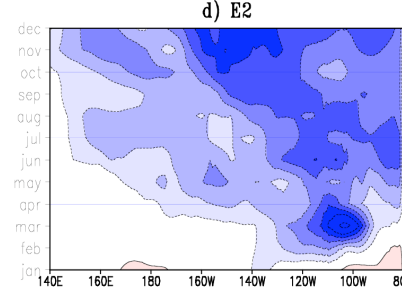
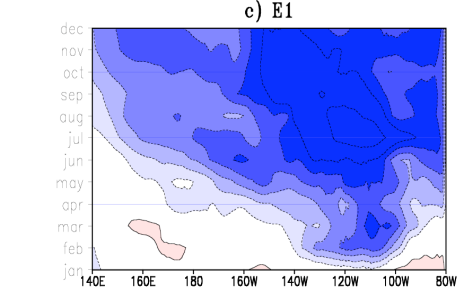
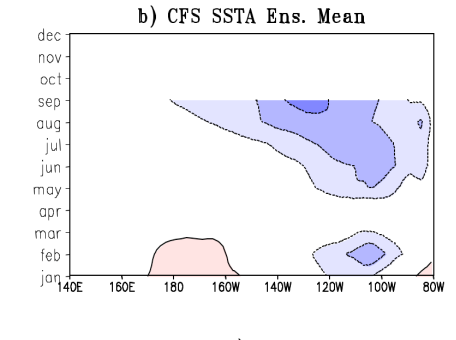
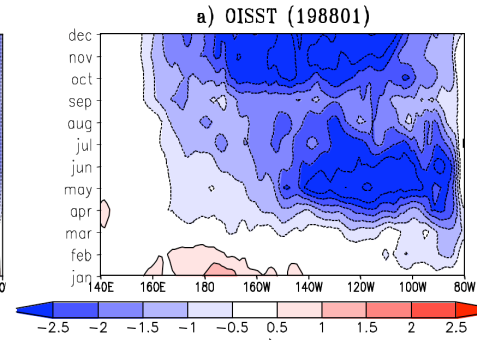
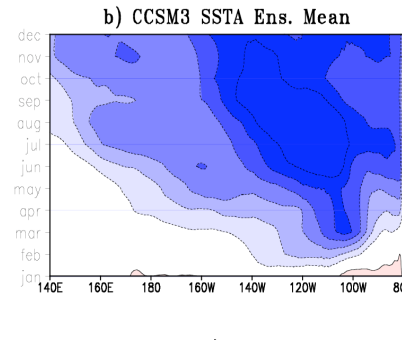
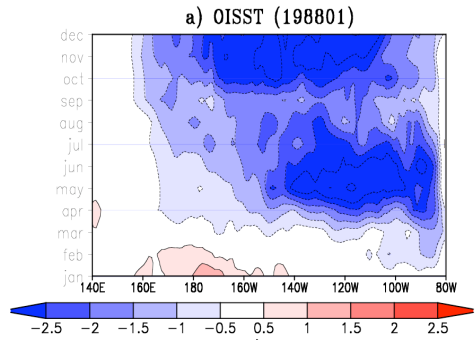


CFS Jan 1983 IC



CCSM3.0 Jan 1988 IC

CFS Jan 1988 IC

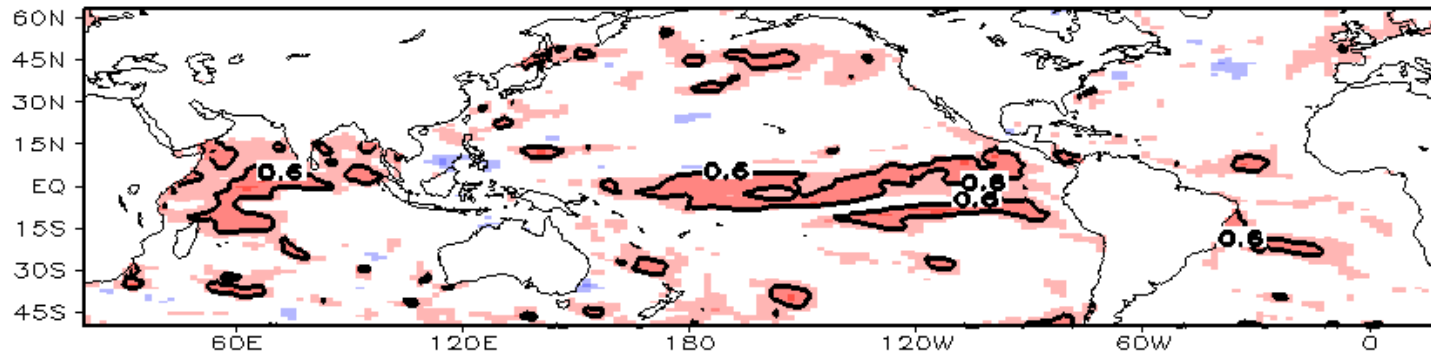


Comparison

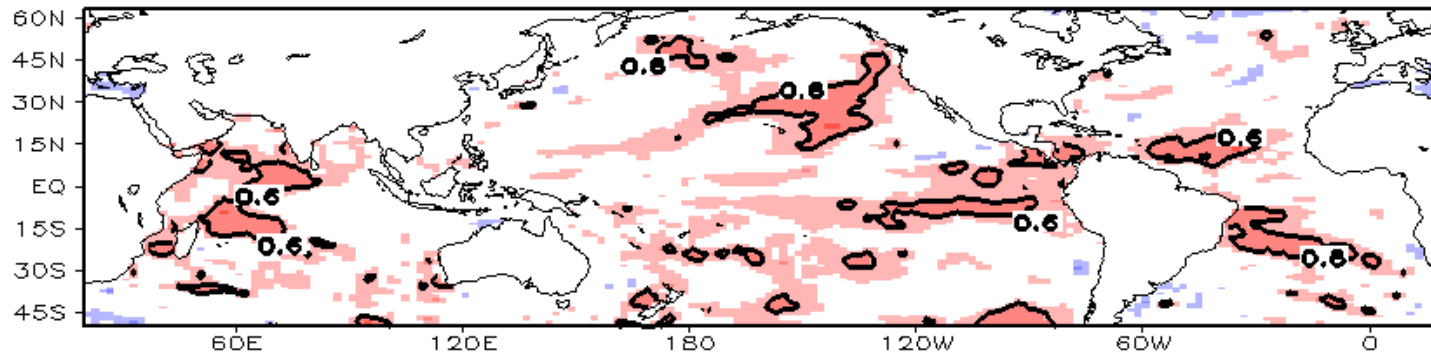
- Systematic errors in ENSO from coupled simulations carry over to predictions
- CFS hangs on to warm events too long
- CCSM does a good job on predicting cold events

Correlation (Jan IC 6 Month Lead Time)

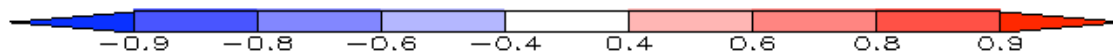
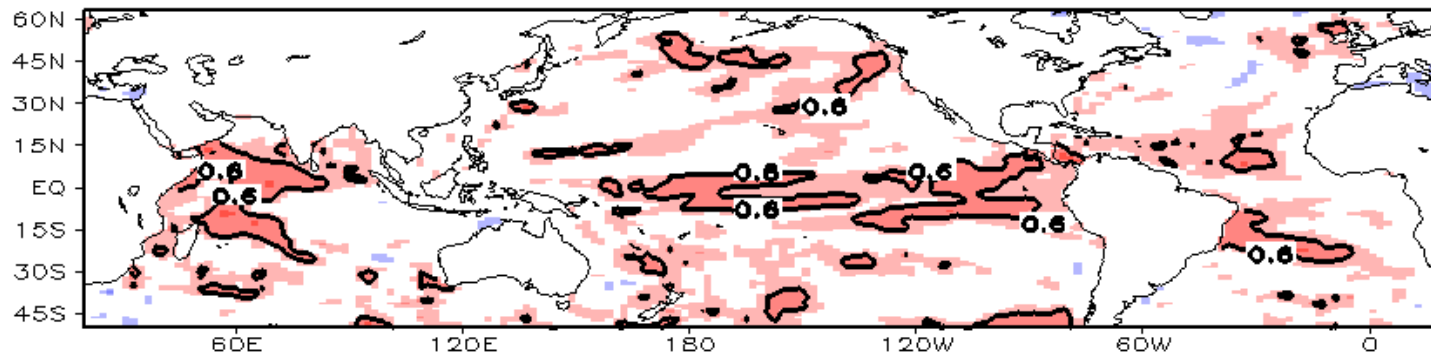
CCSM(6)



CFS(6)

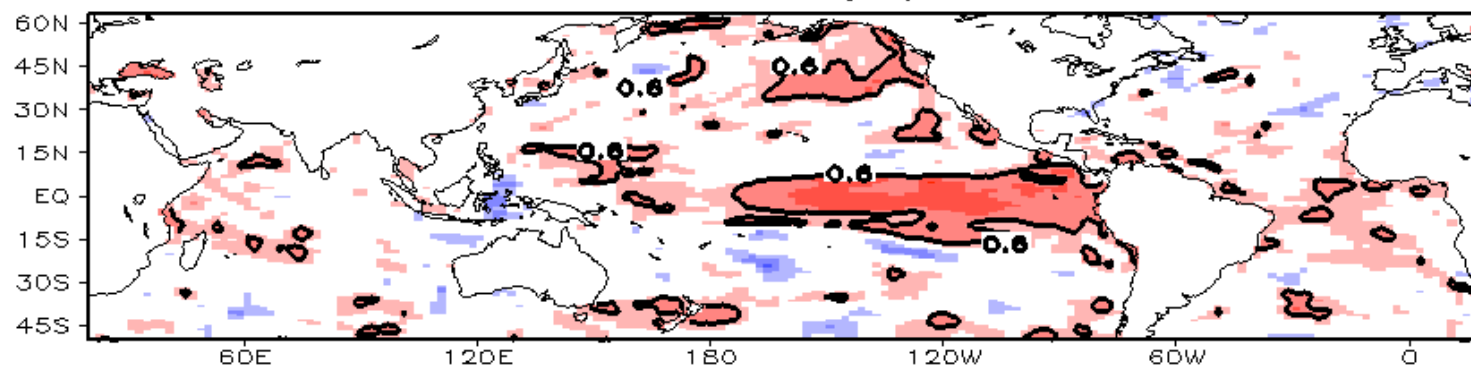


CCSM(6)+CFS(6)

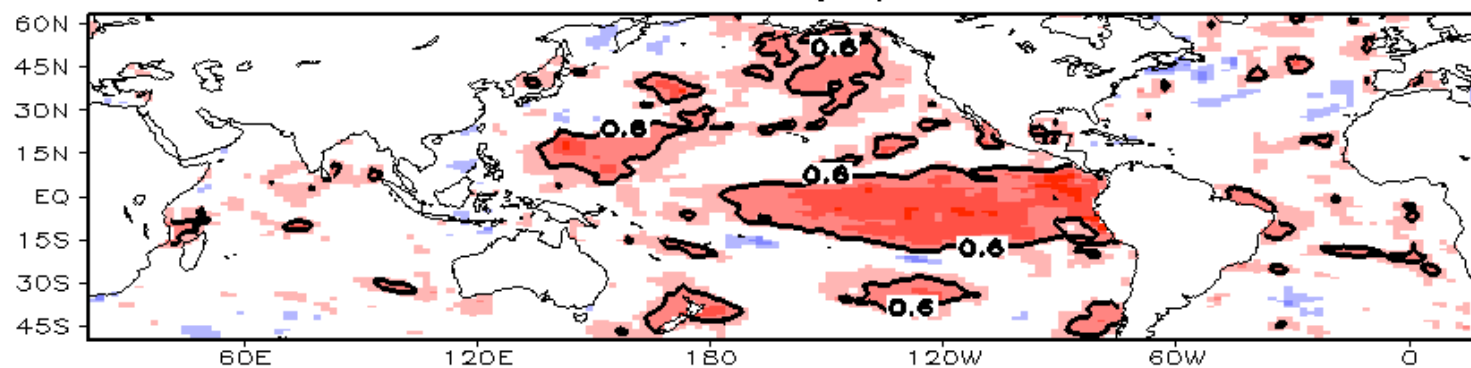


Correlation (Jul IC 6 Month Lead)

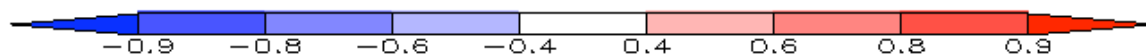
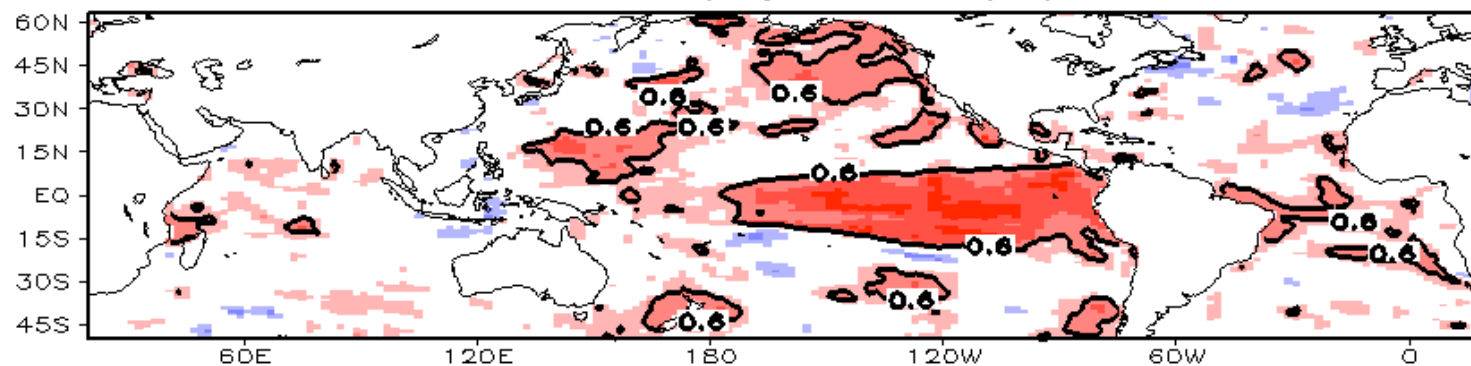
CCSM(6)



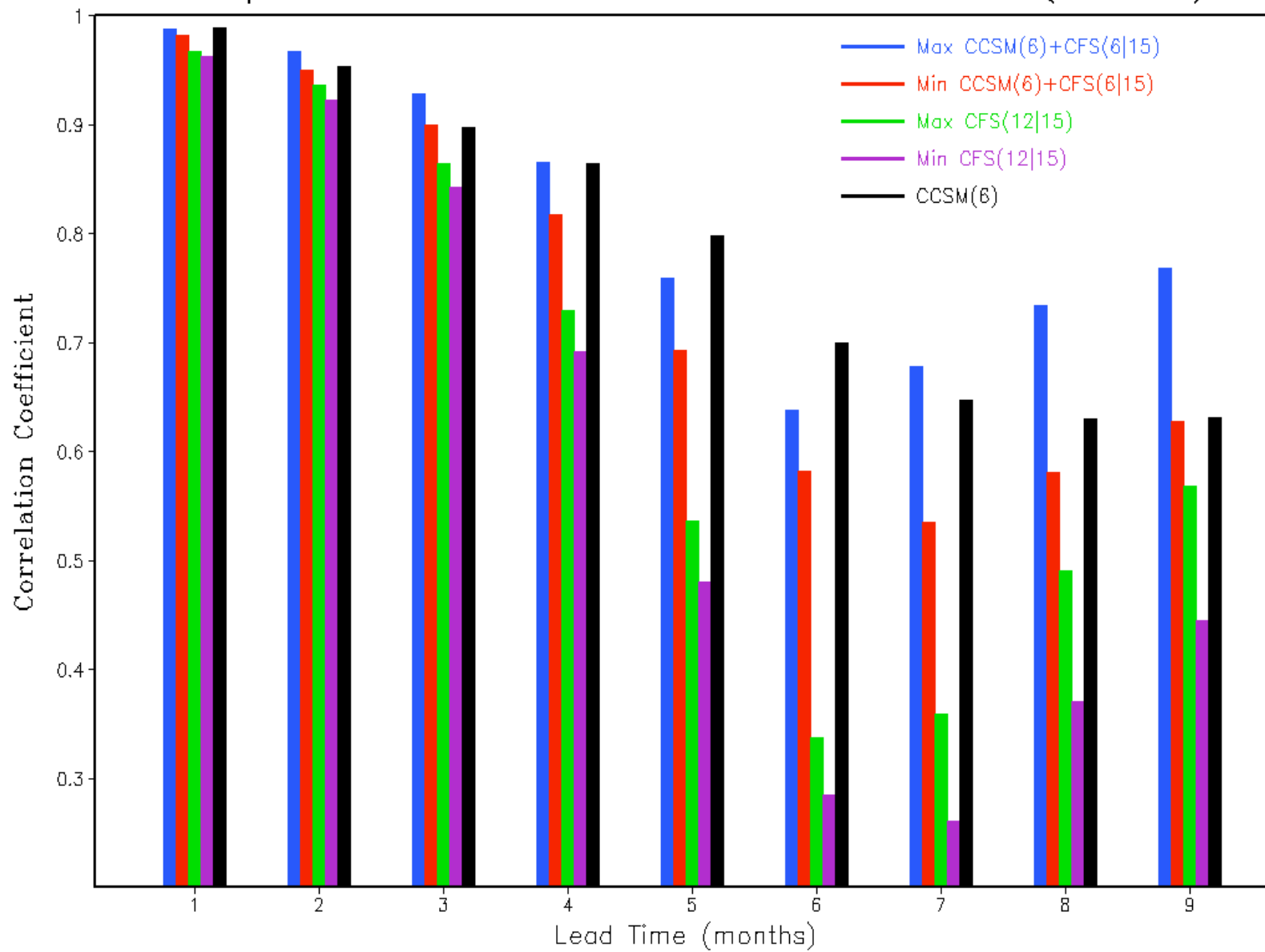
CFS(6)



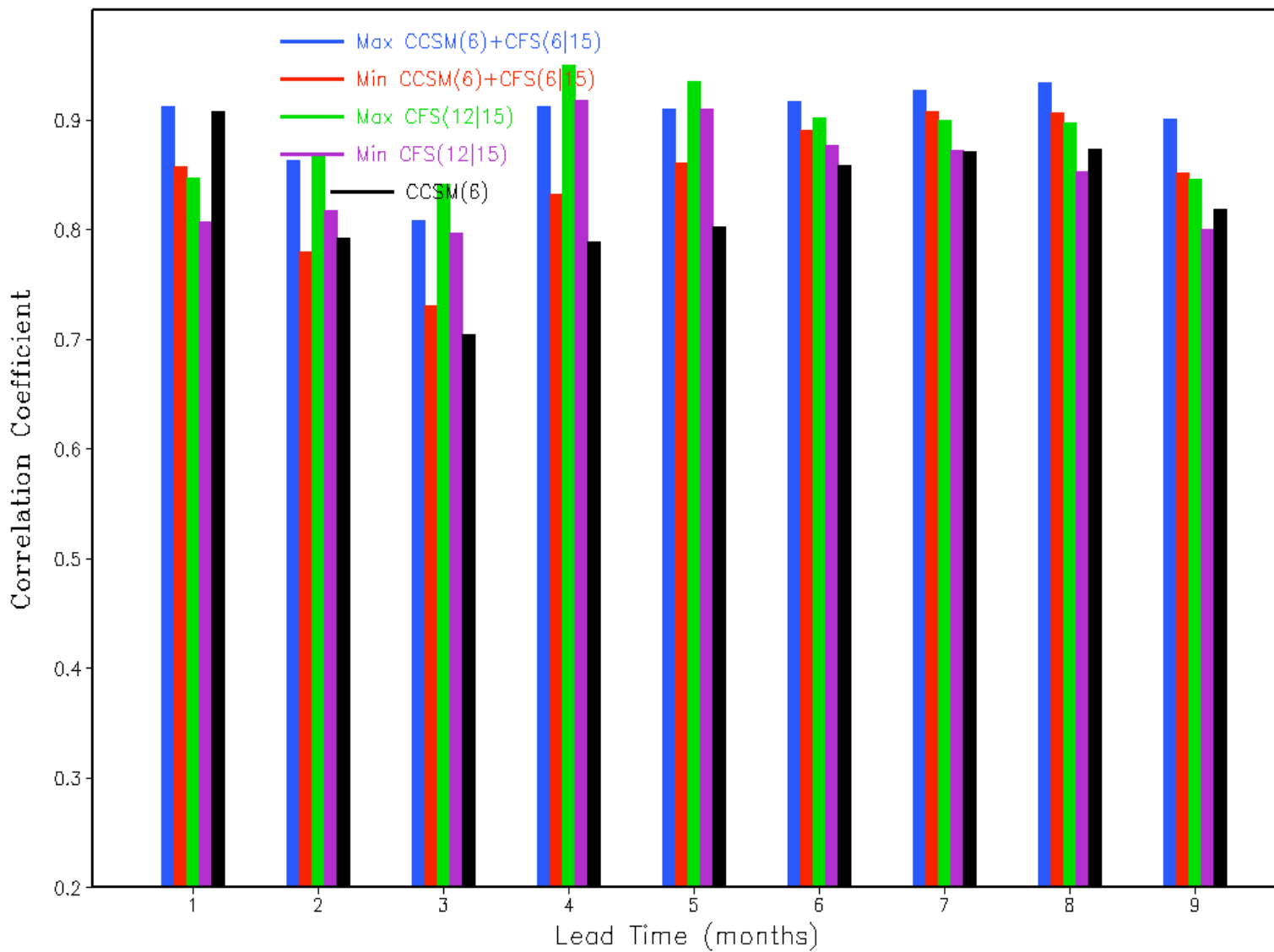
CCSM(6)+CFS(6)



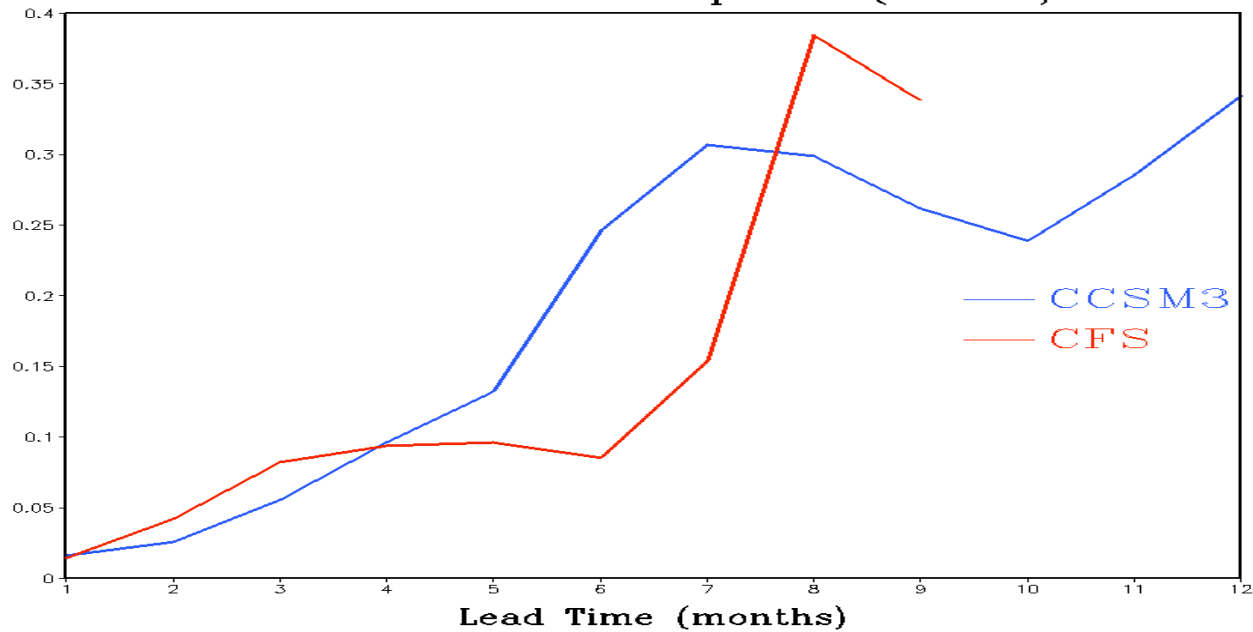
Max|Min Nino3.4 Correlation Coefficient (Jan IC)



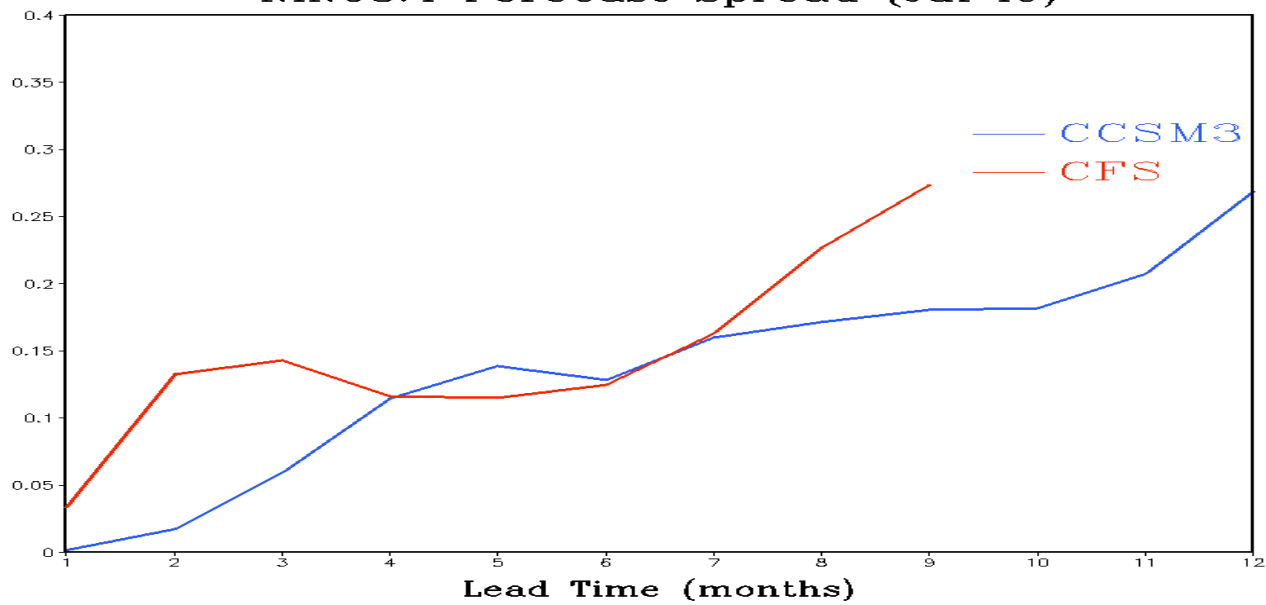
Max|Min Nino3.4 Correlation Coefficient (Jul IC)



NINO3.4 Forecast Spread (Jan IC)



NINO3.4 Forecast Spread (Jul IC)

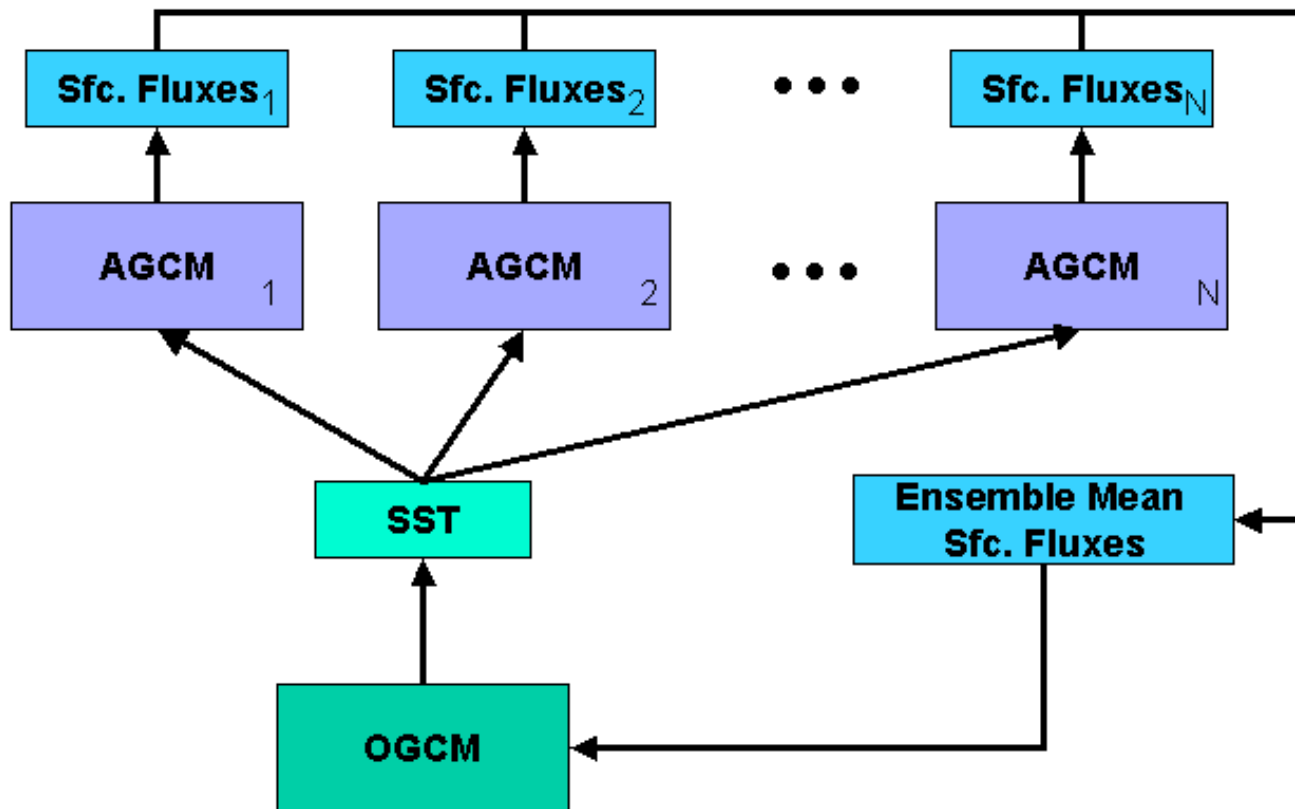


**Please see poster by
Min and Kirtman for
more details**

Interactive Ensemble Version of CCSM3

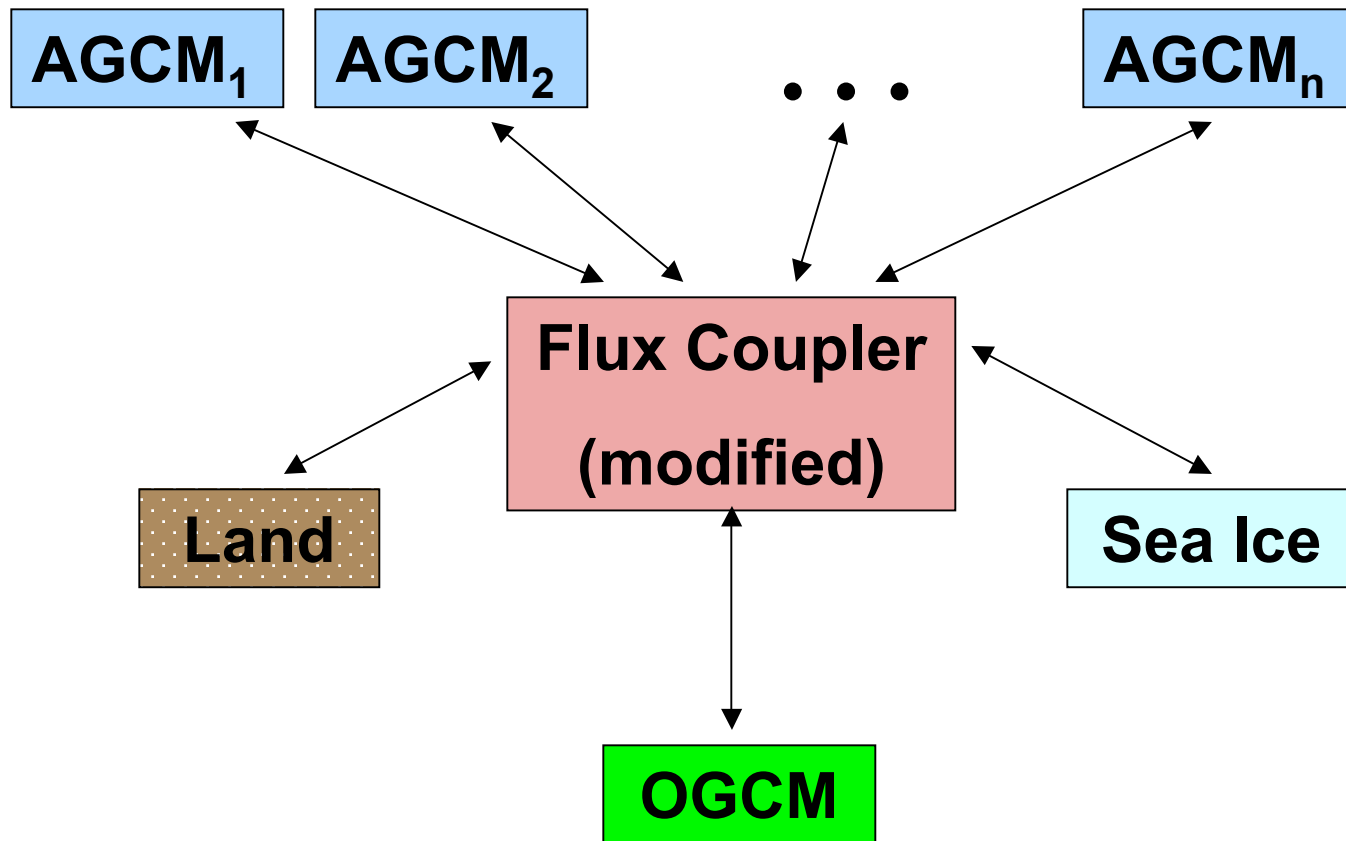
- A new tool being developed for the CCSM community
- Couple ensemble mean of AGCMs (CAM3) to the other components through the flux coupler
 - Each AGCM started from different initial conditions, so weather noise uncorrelated
 - Ensemble mean filters out weather noise (variance $1/N$ for N atmospheres)
 - Reduces variability forced by weather noise but leaves unstable coupled variability (if there is any)
 - Response to specified forcing will be deterministic

Interactive Ensemble CGCM (in COLA CGCM)



Interactive Ensemble Approach

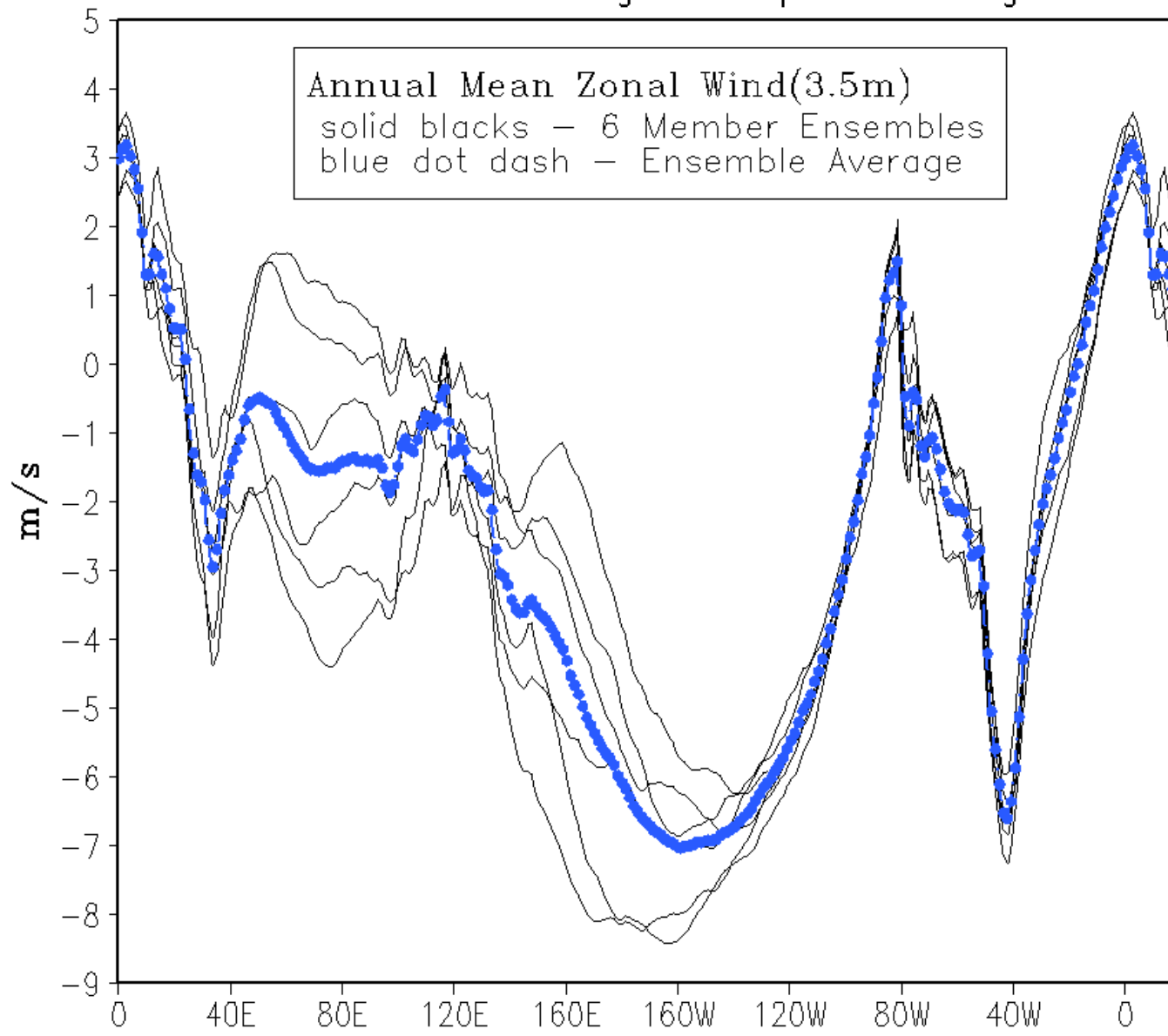
Interactive Ensemble CCSM3



Configuration

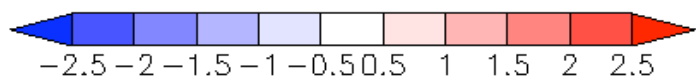
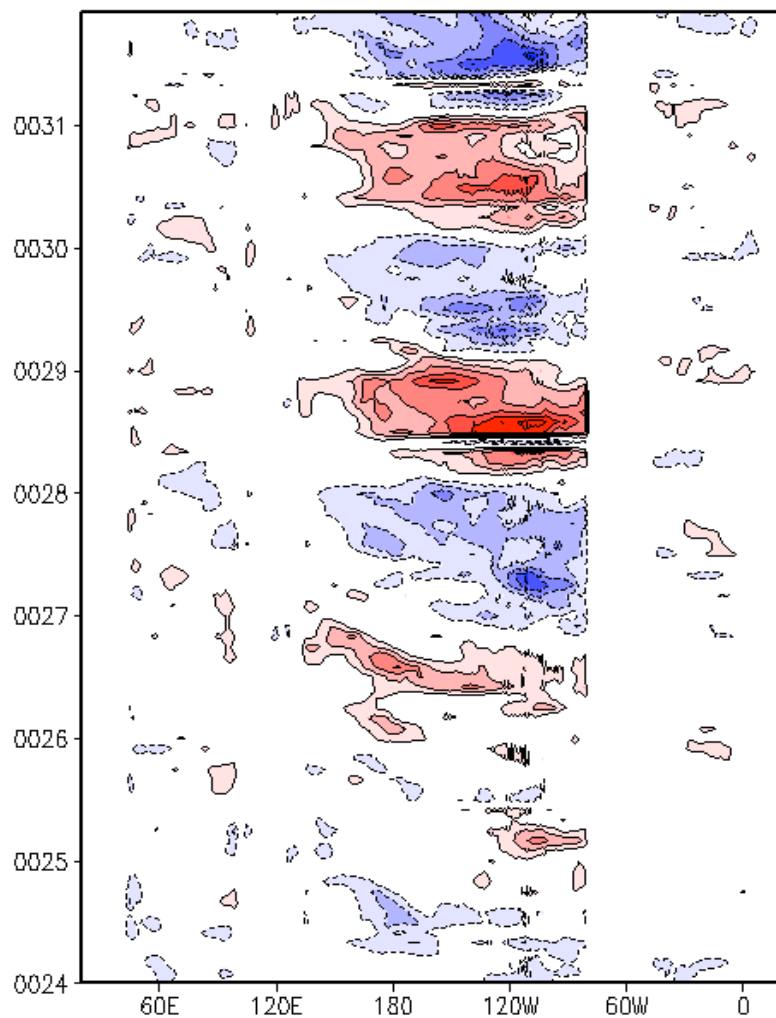
- 6 copies of CAM3
- Embarrassingly parallel (wall clock ~ that for CCSM3)

CCSM3 IE Run along the Equatorial region

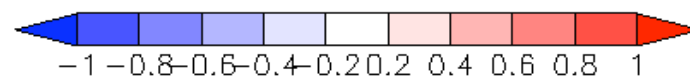
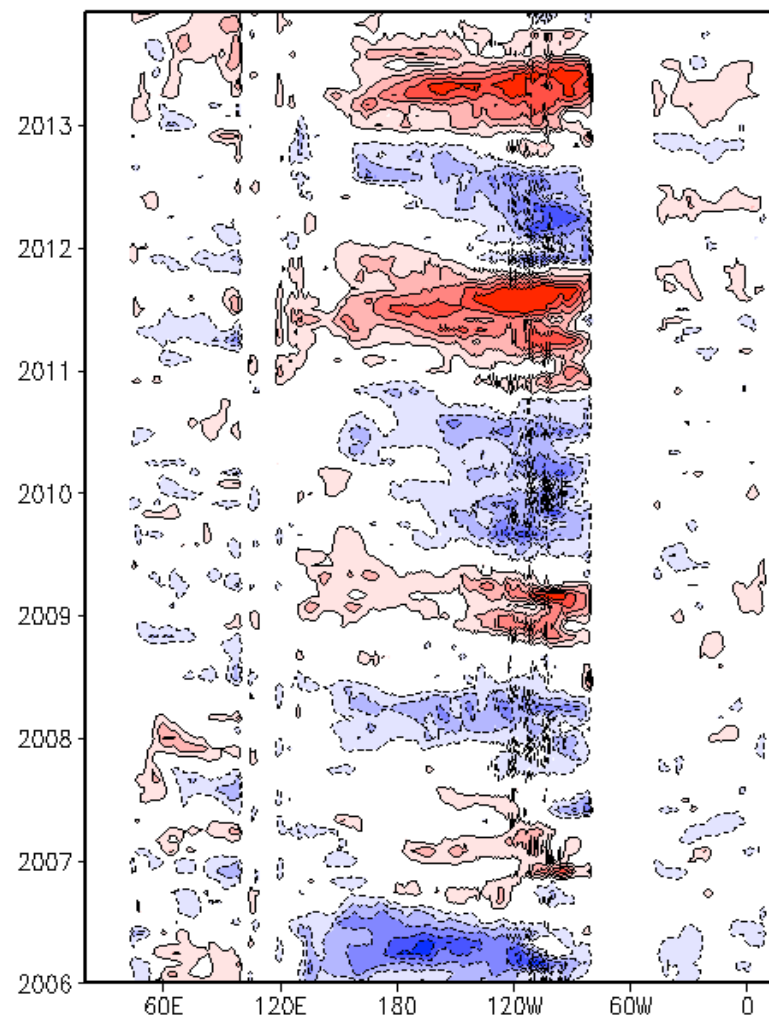


CCSM SSTA along the equator

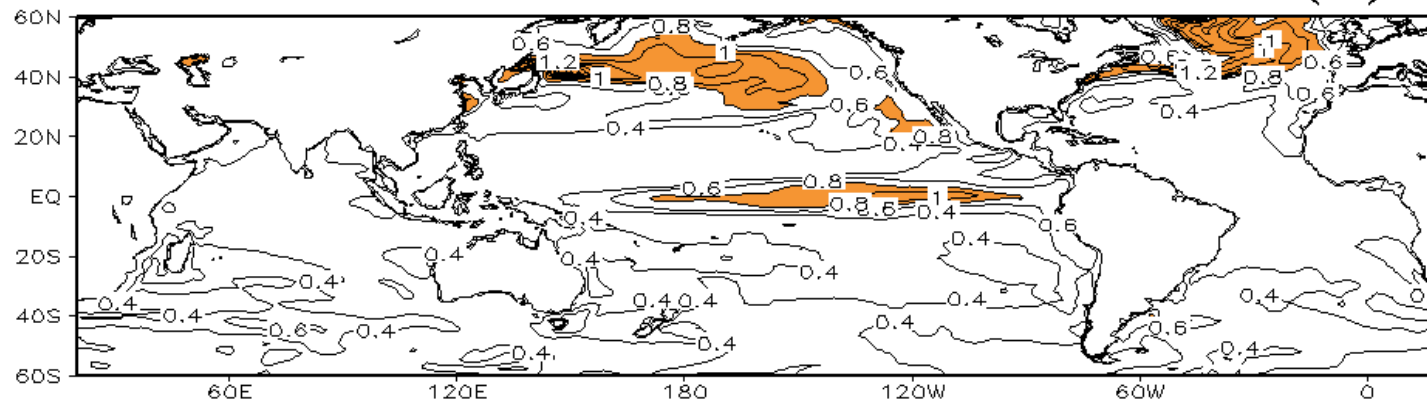
Ctrl (a)



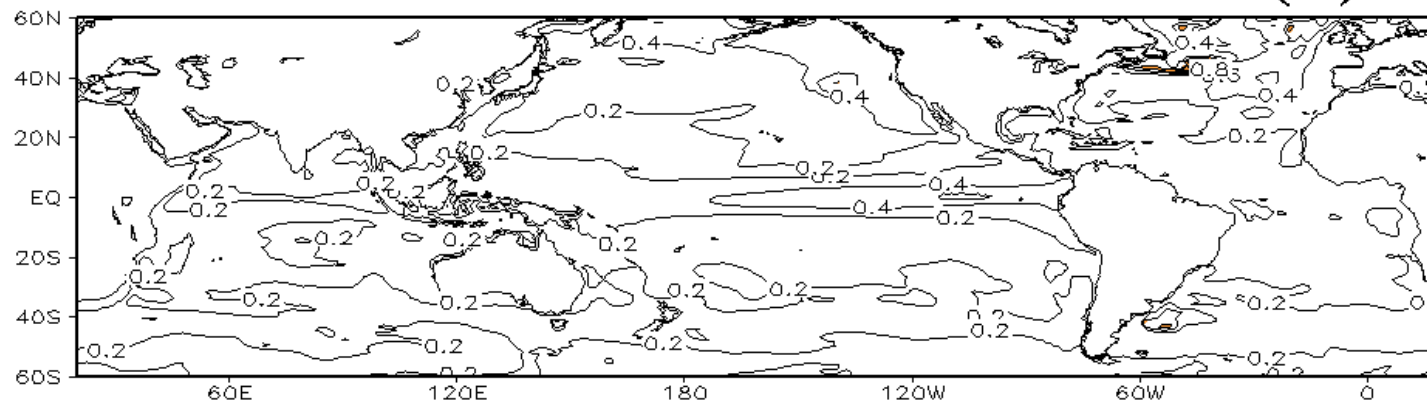
IE (b)



SSTA Standard Deviation CCSM Ctrl (a)



SSTA Standard Deviation CCSM IE (b)



Conclusions

- CCSM3 has been tested for seasonal-to-interannual prediction and should be a useful tool.
- An interactive ensemble version of CCSM3 has been constructed and is being tested.