Relationships between Indo-Pacific SSTs and Asian-Austrailian monsoon in NCEP models

[1,2]Soo-Hyun Yoo , [2]Song Yang, and [1]Chang-Hoi Ho

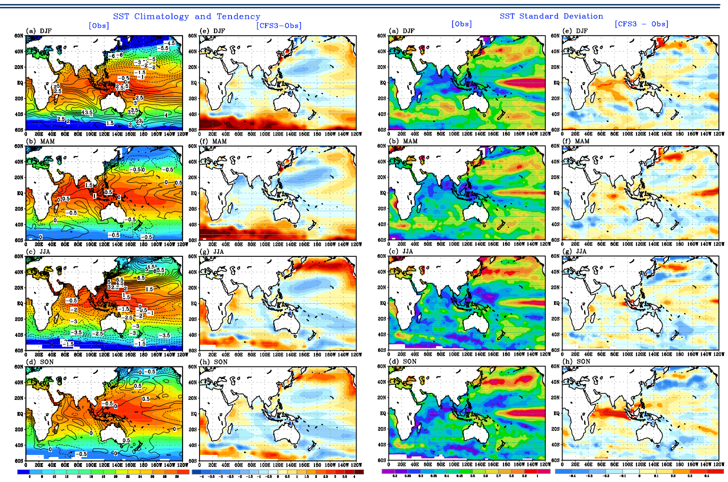
[1]School of Earth and Environmental Sciences, Seoul National University, Seoul 151-742, Korea
[2]Climate Prediction Center, NCEP/NWS/NOAA, Camp Springs, Maryland 20746, USA

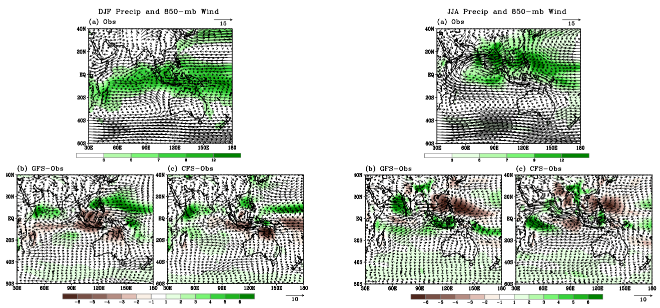
Objective

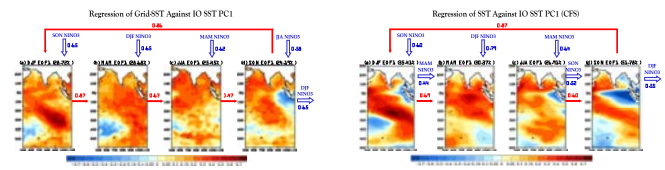
To assess the model performance in generating the characteristics of the mean climatology, seasonal cycle, and interannual variability of IO SST and the relationship between Indo-Pacific SSTs and Asian-Australian monsoon system in the NCEP CFS and GFS models.

Data and Models

- **SST:** Reynolds/NCEP version 2 monthly 1ºx1º optimally interpolated SST (OISST) product from 1982 to 2004 (Reynolds and Smith 1994)
- **Winds:** NCEP/NCAR reanalysis data (Kalnay et al. 1996)
- **Precipitation:** pentad and monthly CPC Merged Analysis of Precipitation (CMAP) data on a global 2.5 ºx2.5º grid (Xie and Arkin 1997)
- **Indices:**
  - NINO3 SST index (5ºS-5ºN, 90º-150ºW; Bjerkness 1969)
  - IOD (Indian Ocean Dipole, Saji et. al 1999)
  - SDP (Subtropical Dipole Pattern, Behera and Yamagata 2001)
  - AIMR (All-India monsoon rainfall index; Parthasarathy et al. 1995)
  - WY (large-scale Asian monsoon, Webster and Yang 1992)
  - SEAM (southeast Asian monsoon; DU2, Wang and Fan 1999)
  - SAM & EAM (south & east Asian monsoon; RM1 & RM2, Lau et al. 2000)
  - AuM (Austrailan monsoon, Meehl and Arblaster 2002)
- **Models:**
  - NCEP Atmospheric Global Forecast system (GFS): T62L64
  - NCEP Coupled atmosphere-ocean Forecast system (CFS):
    - a. Atmospheric component - NCEP GFS03, T62L64
    - b. Oceanic component - GFDL MOM3, 1/3˚x1º in tropics; 1ºx1º in extratropics; 40 layers
    - c. Coupled model – Once a day coupling, Observed climatological sea-ice data







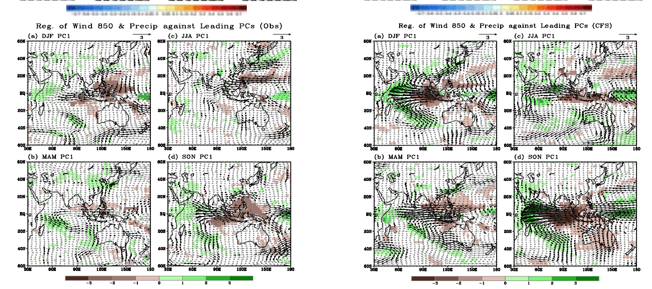
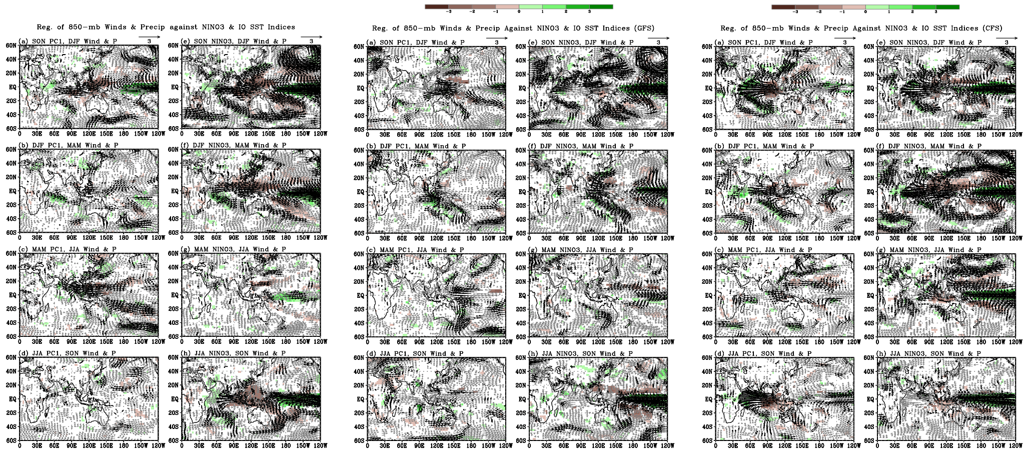


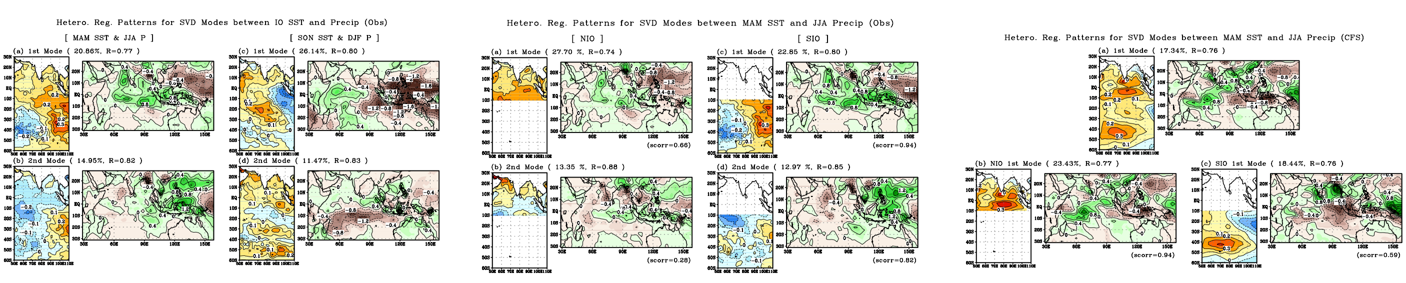
Table 1. Simultaneous correlation between the principle components of the first EOF modes of IO SST and climate indices including Nino3 SST, WY monsoon, AIMR, SAM, SEAM, EAM, AuM, IOD, and SDP. Only the values exceeding the 95% confidence level are shown.

	EOF PC1		
	Obs	GFS	CFS
DJF	Nino3 SST (0.55) IOD (0.41) SDP (-0.59) AuM (-0.40)	Nino3 SST (0.50) SDP (-0.65)	Nino3 SST (0.69) IOD (0.86) SDP (-0.83) AuM (-0.53)
MAM	SDP (-0.60)	IOD (-0.51) SDP (-0.73)	Nino3 SST (0.60) SDP (-0.42)
JJA	WY (-0.52) SEAM (-0.57)		Nino3 SST (0.56) IOD (0.87) WY (0.50) SEAM (-0.42) EAM (-0.43)
SON	Nino3 SST (0.70) IOD (0.78)	Nino3 SST (0.54) IOD (0.65) SDP (-0.43)	IOD (0.96) SDP (-0.53)

Table 2. Lagged correlation between the JJA Asian monsoon and the EOF of previous MAM IO SST, and between the DJF AuM and the EOF of previous SON IO SST. Values exceeding significantly the 95% confidence level are highlighted.

	JJA						DJF
	AIMR	WY	SAM	EAM	SEAM		AuM
MAM PC1 (Obs)	0.40	-0.34	0.47	0.02	-0.64	SON PC1 (Obs)	-0.49
MAM PC1 (GFS)		-0.09	-0.36	0.06	0.06	SON PC1 (GFS)	-0.12
MAM PC1 (CFS)		0.01	-0.29	0.05	-0.46	SON PC1 (CFS)	0.46





Summary

- The CFS performs better than the GFS in simulating the variability of the monsoons, implying the importance of ocean-atmosphere coupling.
- Both models produce weaker climatological anticyclonic circulation over the southern IO and summer monsoon flow over the northern IO compared to observations.
- In CFS, the annual evolution of IO SST, the feedback of monsoon flow, and the expratropical southern IO SST have not been simulated realistically.
- The relationship between IO SST and the Asian-Australian monsoons appear relatively more realistic in the CFS than in the GFS.