Interannual Indian Ocean Variability in the GFDL Coupled Model

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GFDL/NOAA

GFDL CM2.1 Ocean-Atmos-Land-Ice fully coupled model

- Ocean
  - MOM4
  - 50 vertical levels (10m uniform spacing in upper 200m), 1°x1° horizontal resolution reducing to 1/3° in the tropics.
- Atmosphere
  - AM2p13, finite volume dynamical core
  - 24 vertical levels, 2.5°x2° horizontal spacing

Experiment

- 1990 control run with 1990 values of tracer gases, insolation, aerosols and land cover. (Control run for IPCC)
  - Delworth et al. (2005), Wittenberg et al., (2005), Gnanadesikan et al. (2005)
- 300 years integration, outputs from year 50-300 are analyzed.

Focus

- Tropical IO variability (IODZM), and its relation with ENSO

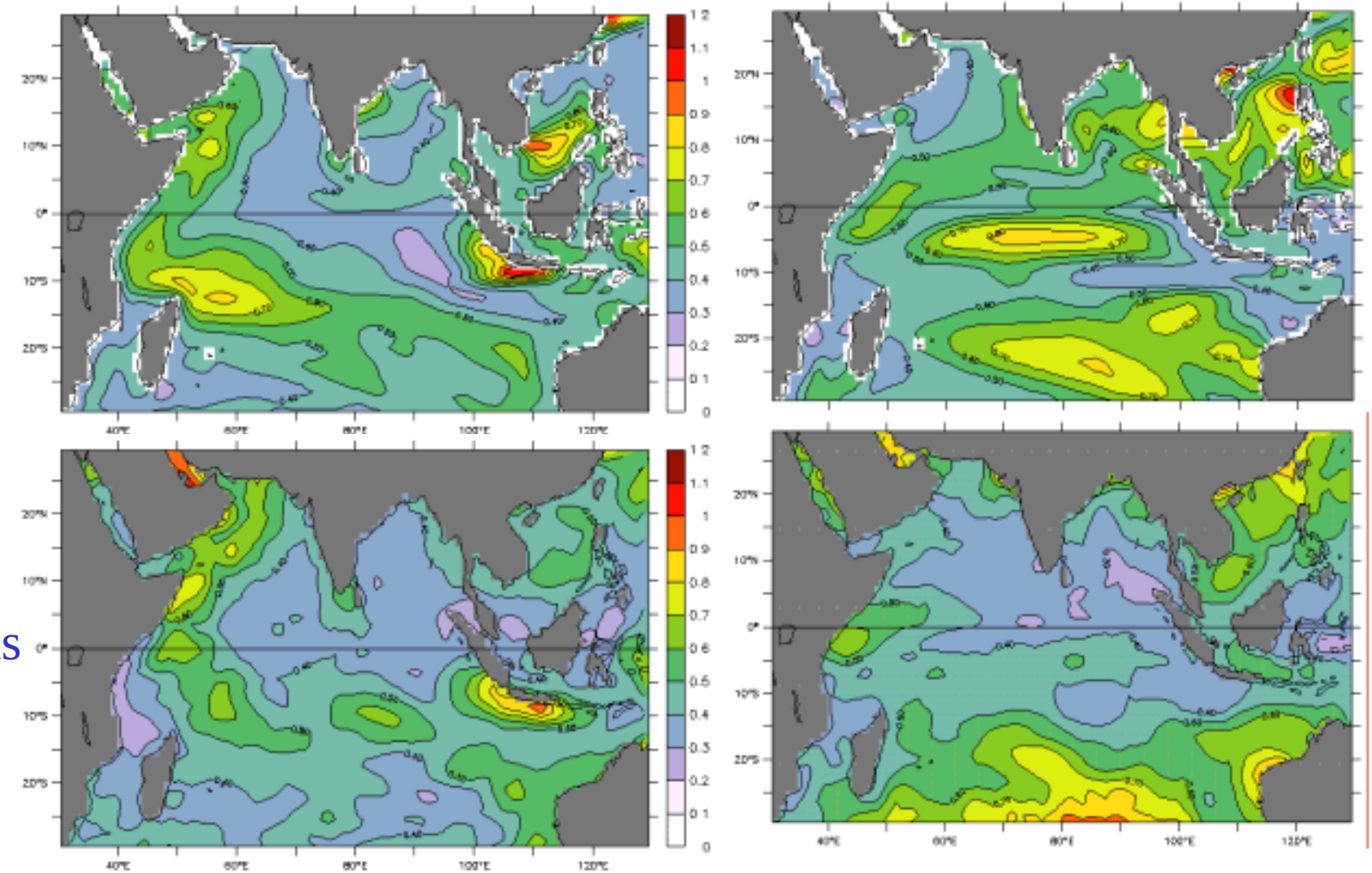
Interannual SST Std.

JJA

DJF

Model

Reynolds

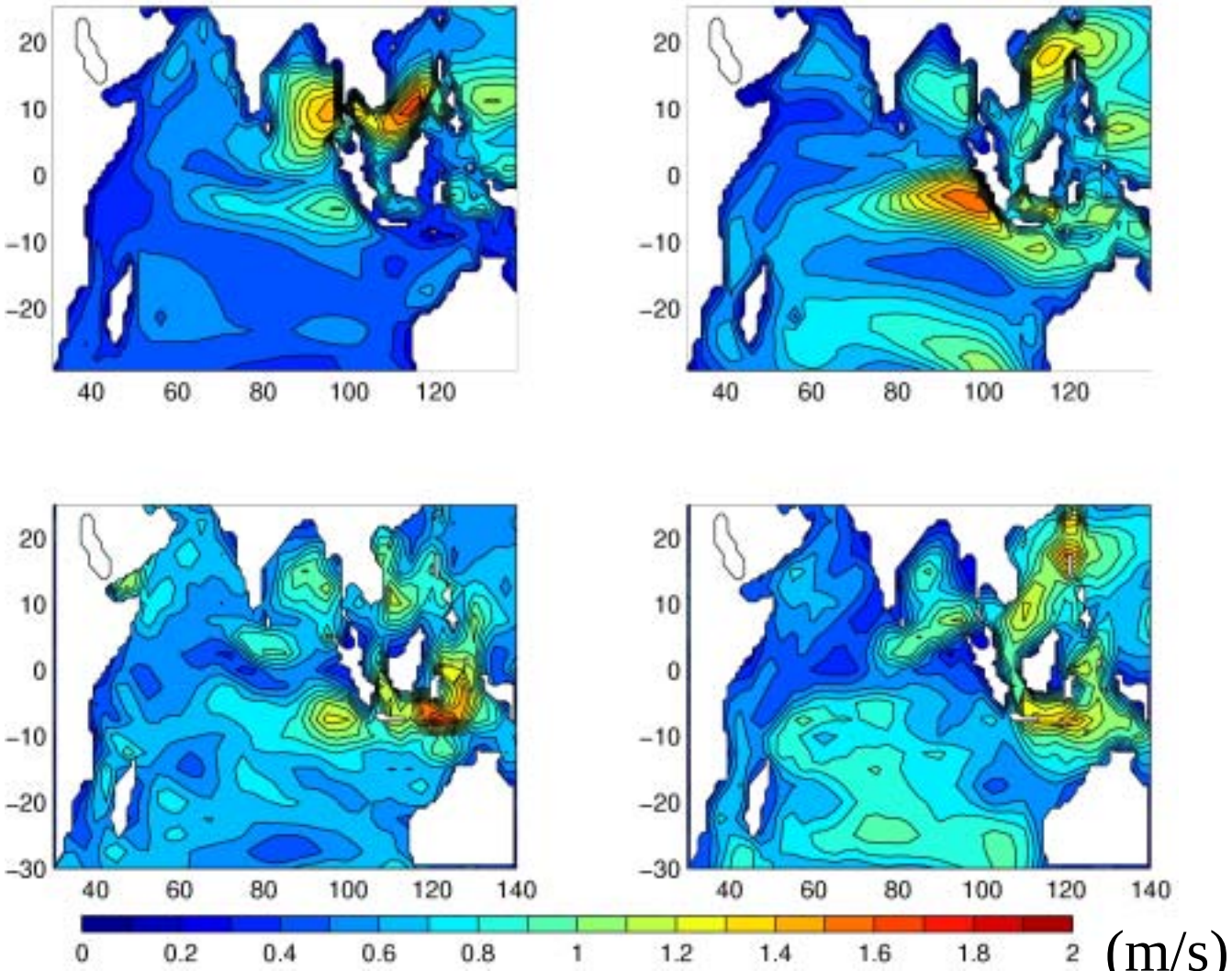


Interannual Surface Wind Speed Std.

JJA DJF

Model

NCEP



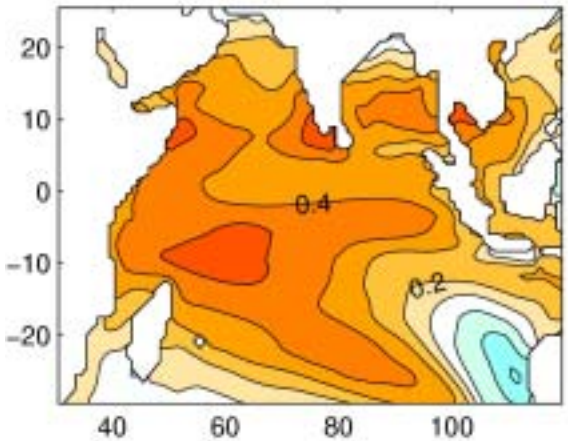
SST EOF

Model

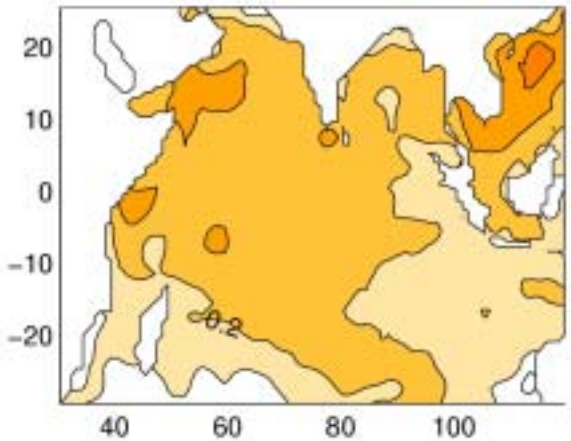
Reynolds

EOF1

31%

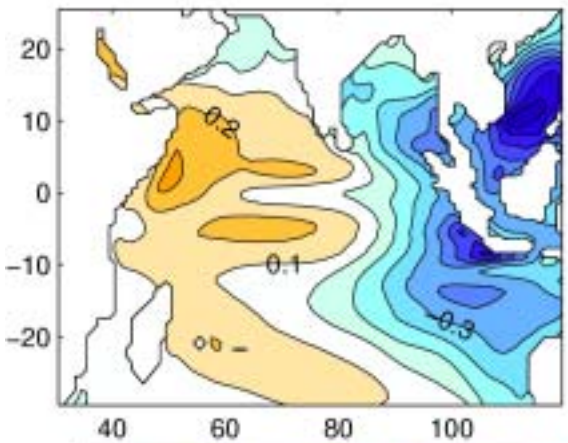


23%

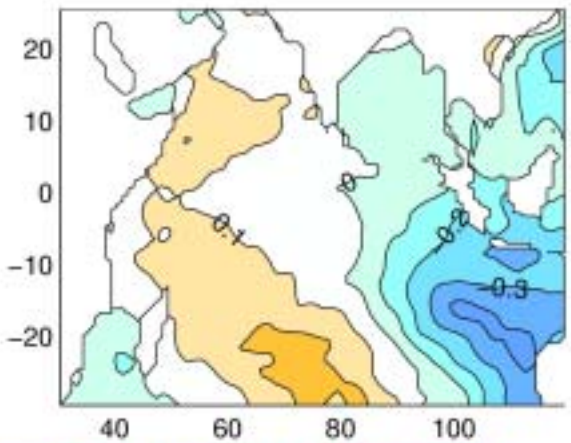


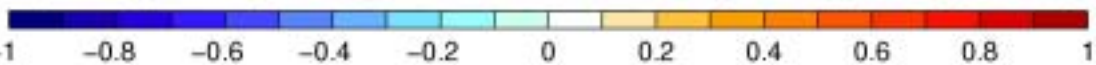
EOF2

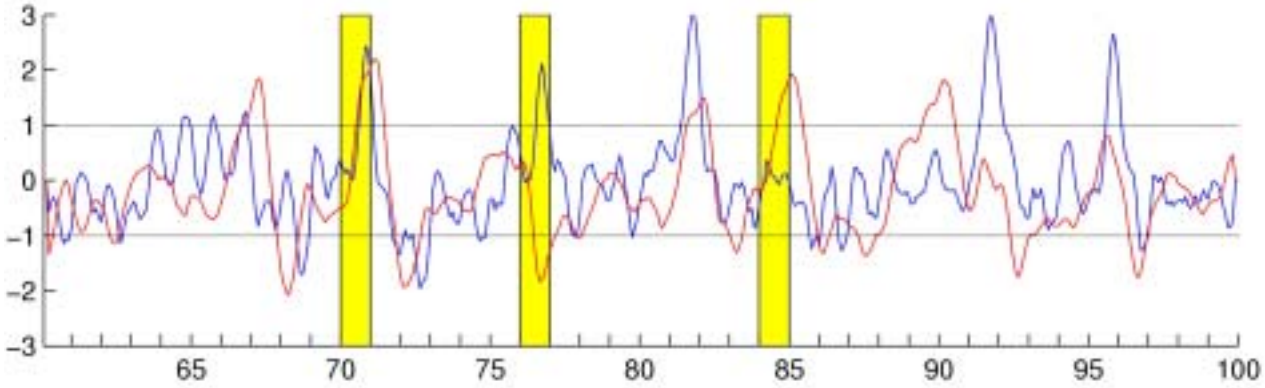
15%



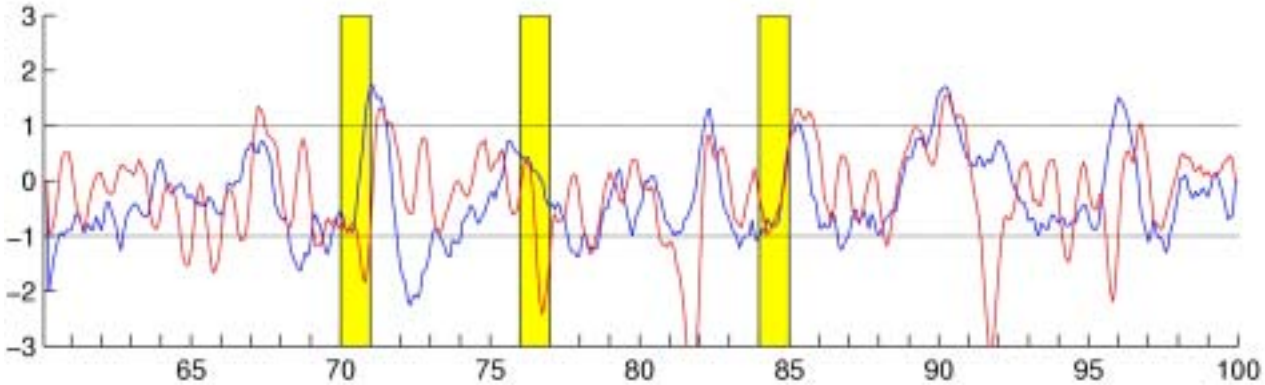
10%







IODZM index
(std=0.73°C)
NINO3 index
(std=1.40°C)



WTIO (10S-10N,50-70E)
(std=0.50°C)
ETIO (10S-0,90-110E)
(std=0.63°C)

	Model (250 yr)		Reynolds (1950-2003)	
	Full Year	SON only	Full Year	SON only
Nino3,IODZM	0.41	0.56	0.25	0.56
Nino3,ETIO	0.10	-0.38	0.22	-0.14
Nino3,WTIO	0.66	0.65	0.52	0.58
WTIO,ETIO	0.26	-0.43	0.46	-0.21

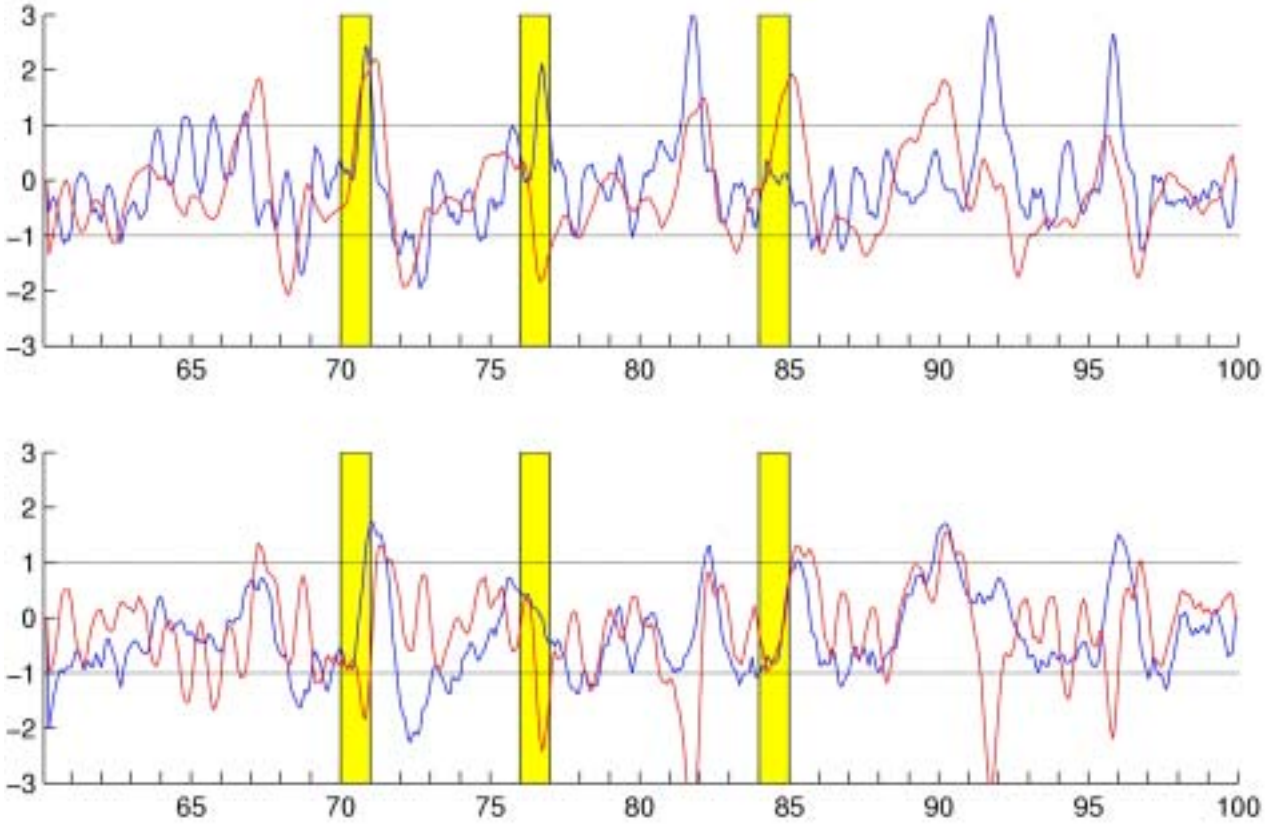
Correlation calculated for five 50-yr segments

Full Year Monthly

	Model					Reynolds
Nino3,IODZM	0.21	0.30	0.33	0.41	0.25	0.25
Nino3,ETIO	0.15	0.17	0.06	0.02	0.09	0.22
Nino3,WTIO	0.55	0.58	0.56	0.66	0.49	0.52
WTIO,ETIO	0.12	0.27	0.15	0.13	0.16	0.46

SON only

	Model					Reynolds
Nino3,IODZM	0.39	0.57	0.60	0.66	0.43	0.56
Nino3,ETIO	-0.28	-0.44	-0.51	-0.55	-0.31	-0.14
Nino3,WTIO	0.50	0.63	0.64	0.71	0.52	0.58
WTIO,ETIO	-0.53	-0.59	-0.70	-0.57	-0.50	-0.21



IOZM index
(std=0.73°C)
NINO3 index
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WTIO (10S-10N,50-70E)
(std=0.50°C)
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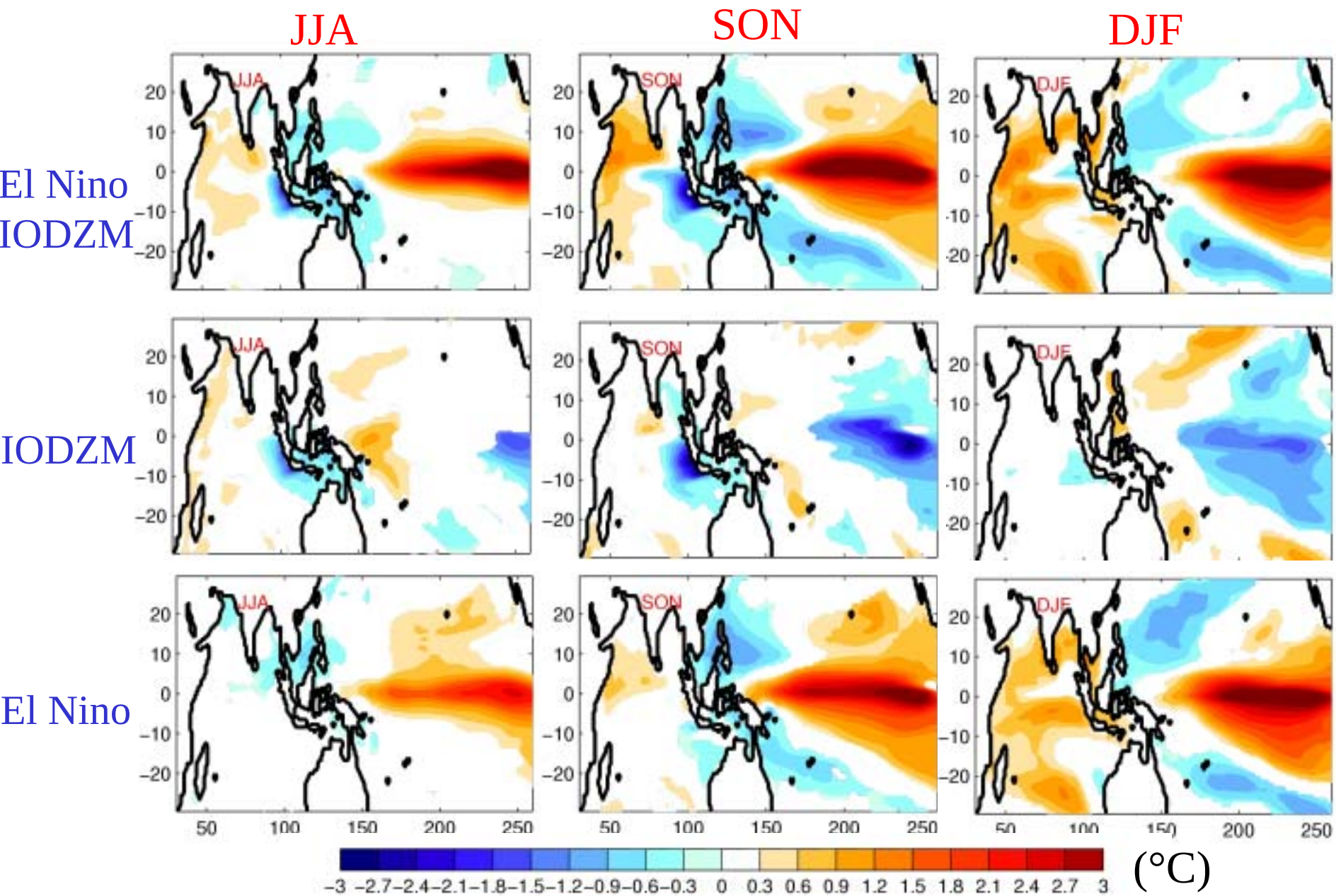
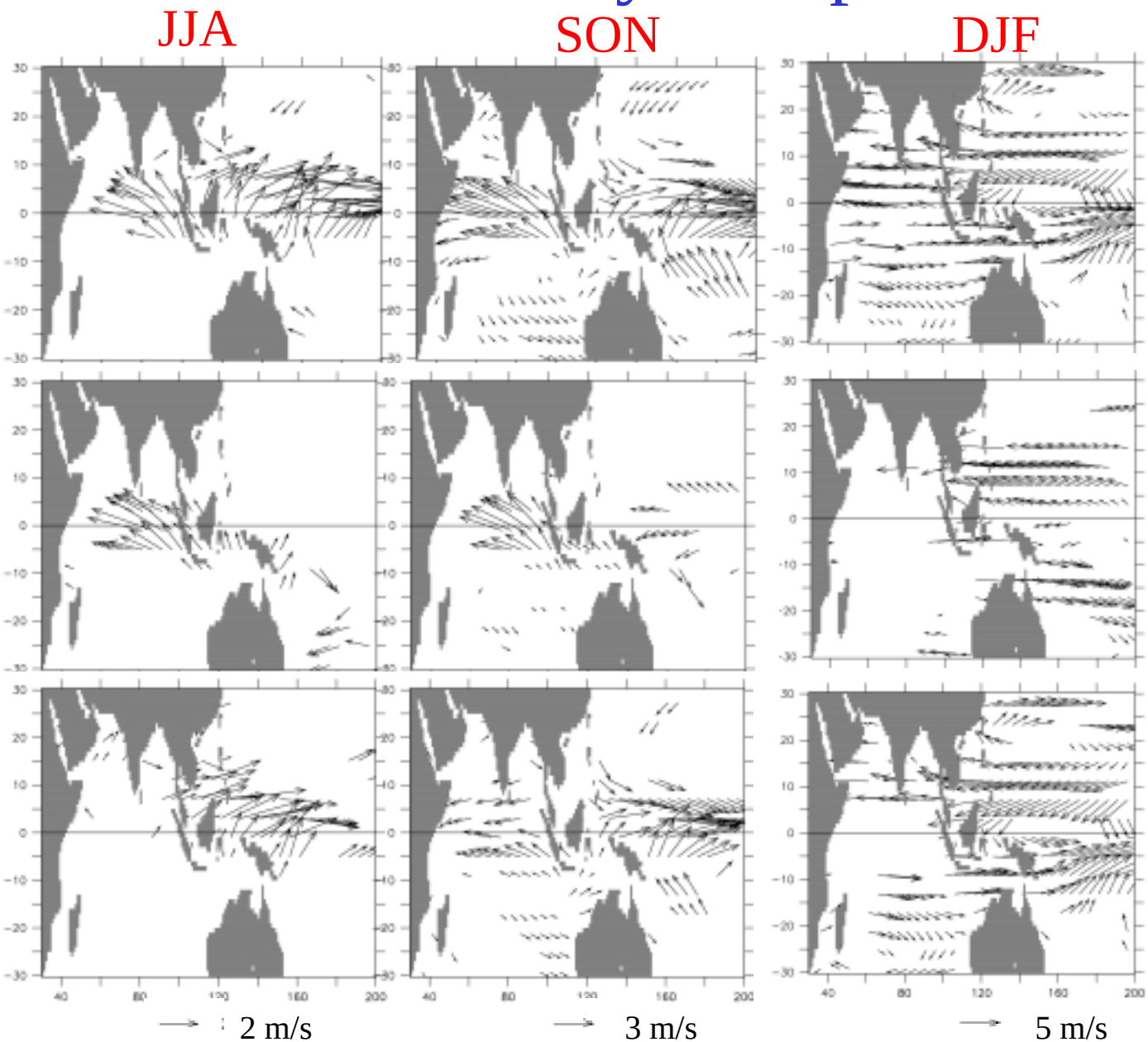
(std=0.63°C)

Composite 1(15): IOZM and NINO3 index > 1 std. for 5 months
Composite 2(8) : IOZM > 1 std. for 5 months; NINO3 < 0.5 std.
Composite 3(10): IOZM < 0.5 std; NINO3 > 1 std. for 5 months

SSTA Composites



Surface Wind Anomaly Composites

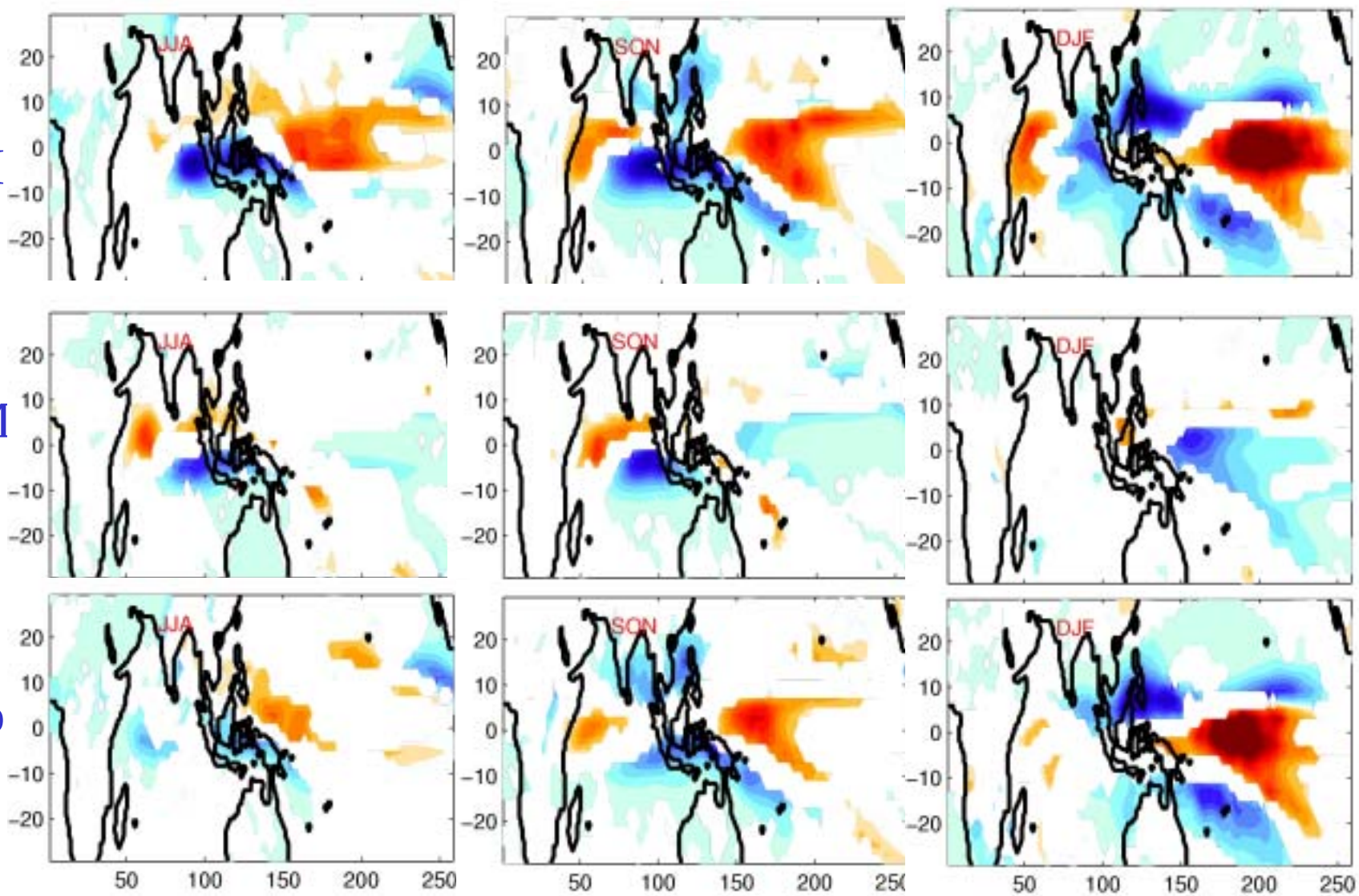


Precipitation Anomaly Composites

El Nino
IODZM

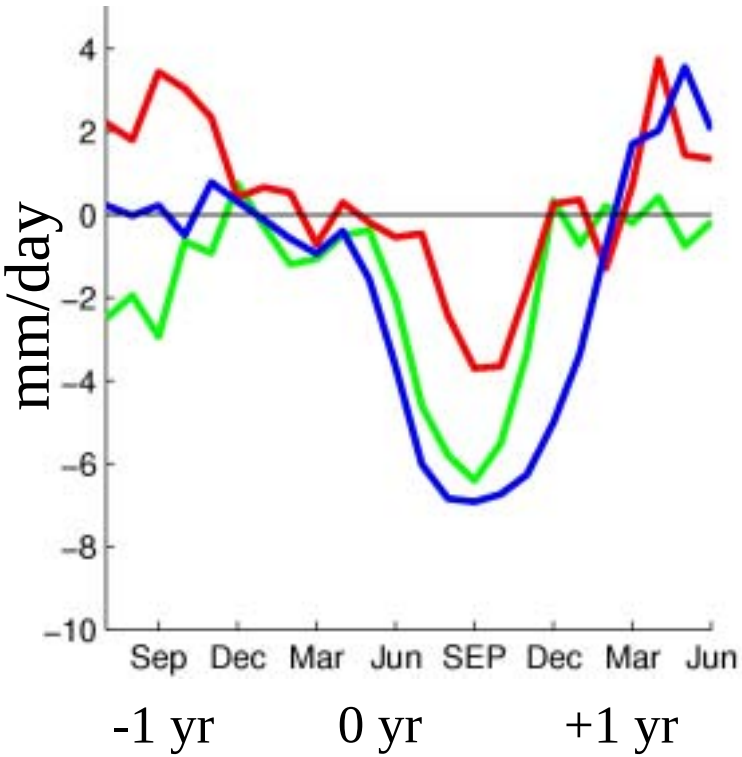
IODZM

El Nino



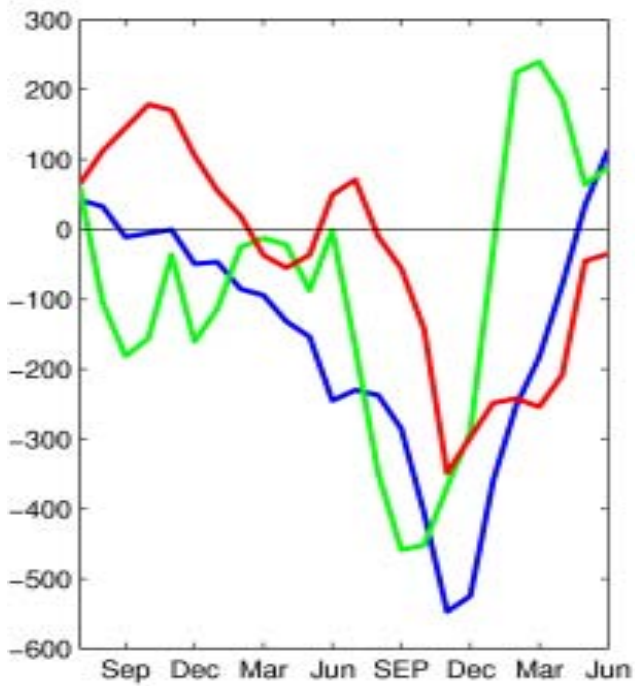
ETIO **(90-100E,10S-0)**

Precip Anomaly



-1 yr 0 yr +1 yr

Heat Content (0-200m) Anomaly



-1 yr 0 yr +1 yr

El Nino & IODZM

IODZM

El Nino

Summary

- The GFDL CM2.1 coupled model reasonably simulates IO variability, in particular, the IO Dipole/Zonal Mode, its connection with ENSO.
- Ongoing work:
  - Exploring the mechanisms for the tropical IO variability and its interaction with ENSO
  - Indian Ocean variability in climate change scenarios