

Indonesian Throughflow in an OGCM and CGCM

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- **Motivation**
- **Model Description**
- **ITF Simulated by an OGCM**
- **ITF Simulated by a CGCM**

Motivation

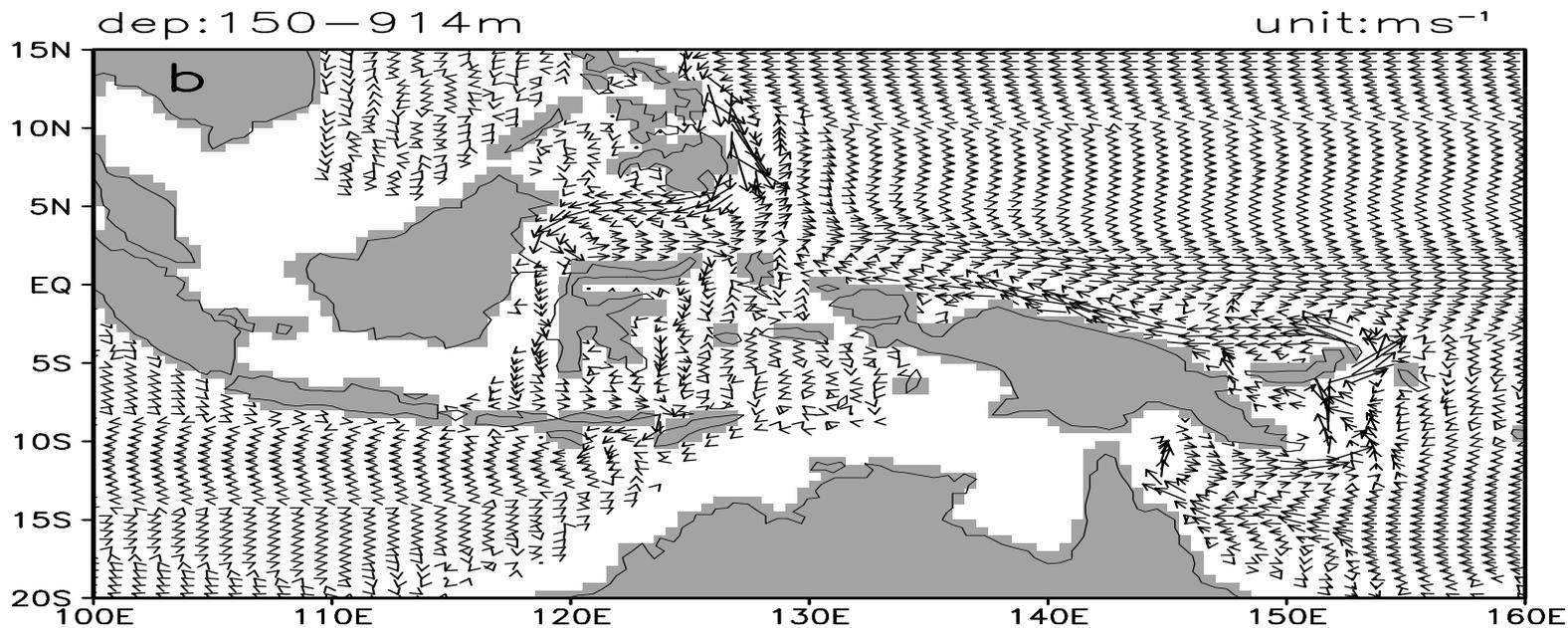
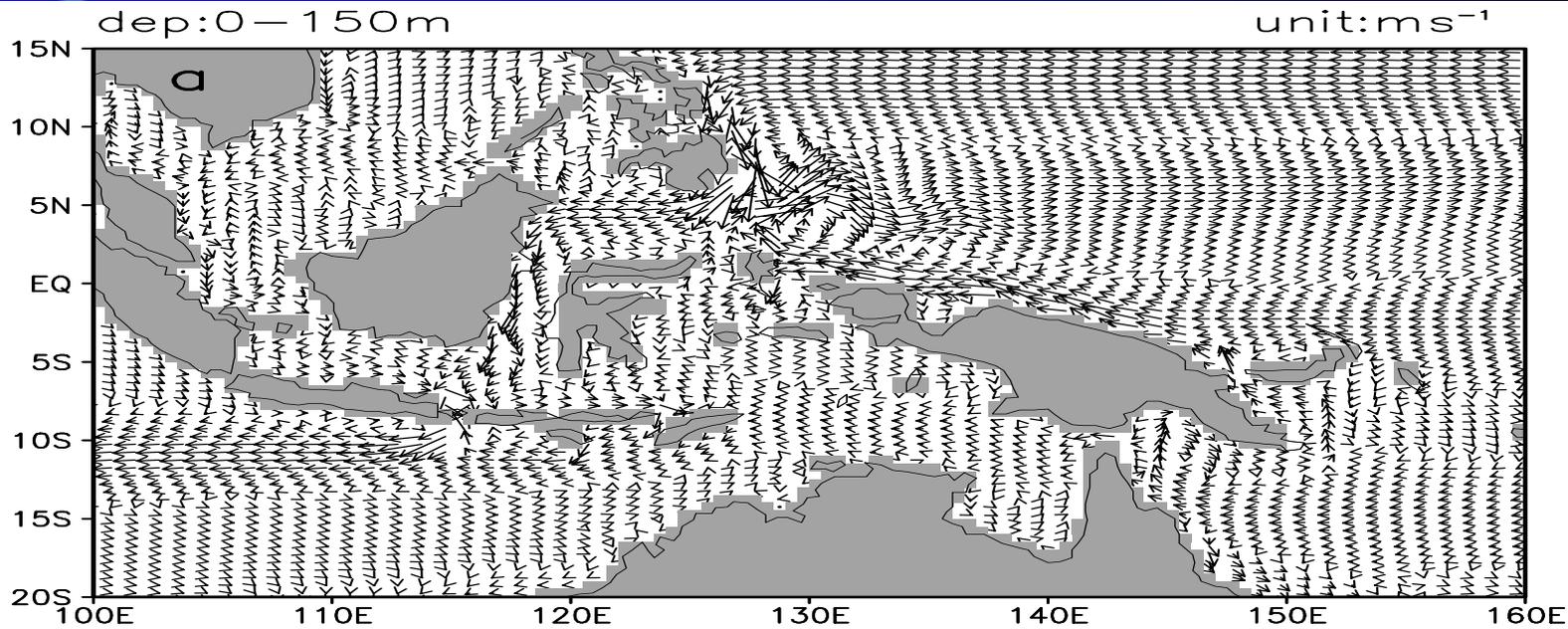
- ITF is only link between the tropical Pacific and Indian Oceans, and which is closely associated with tropical atmospheric and oceanic circulations.
- Development of a global eddy-permitting OGCM make it possible to describe its detailed structure.

Model Description

- **LASG/IAP Climate Ocean Model (LICOM) is near-global eddy-permitting OGCM (78S-65N) except for Arctic Ocean.**
- **FGCM-1.0 is a coupled GCM without flux correction, including four component models (LICOM, CAM2, CLM2, and CSIM4).**

Experiment Design for OGCM

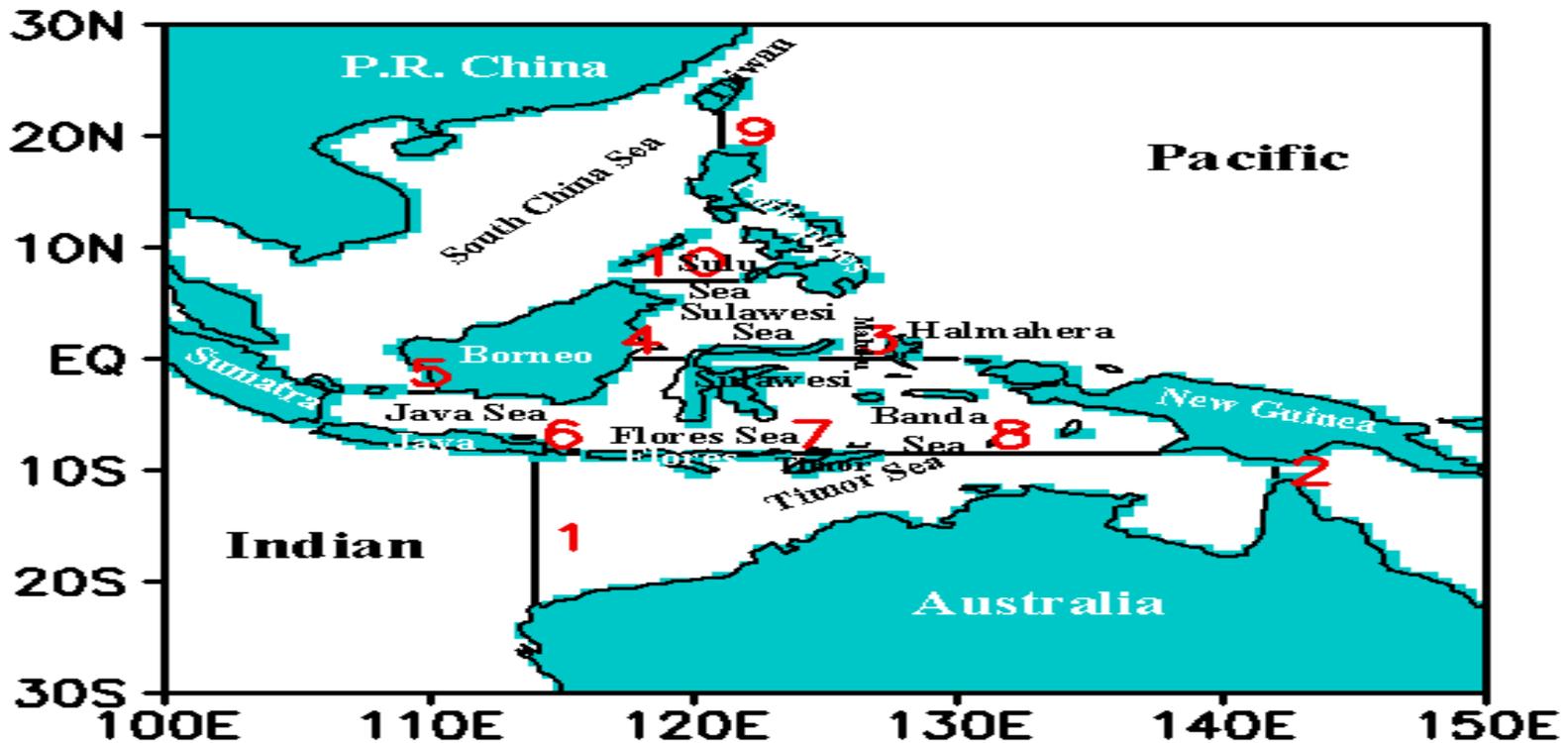
- 1000 year spin-up
- ECMWF Reanalysis daily mean wind stress (1979-1993)
- Climatology mean heat flux from COADS data
- Restoring boundary condition for salinity
- TOP5 topography.



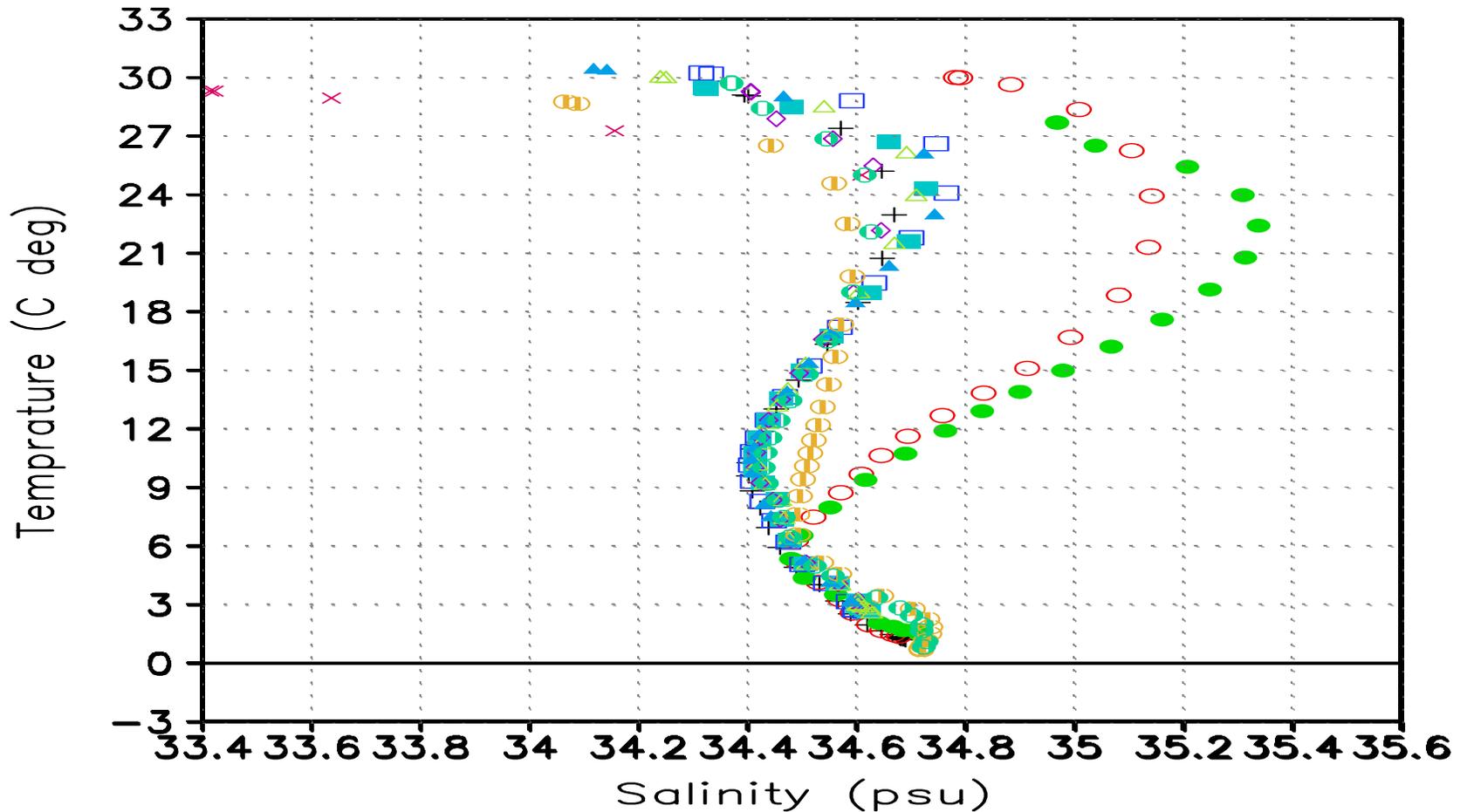
Observed and Simulated ITF

	Mass 1	Makassar 4	Torres 2	Karimata 5	Lombok 6	Ombai 7	Timor 8
Model	-12.2	-6.5	-1.1	0.5	-5.1	-5.9	-0.02
OBS	-12 ¹	-9.3 ²	0.1	-	-1.7 ³	-5 ⁴	-4.5 ⁵

Straits around Indonesian Seas

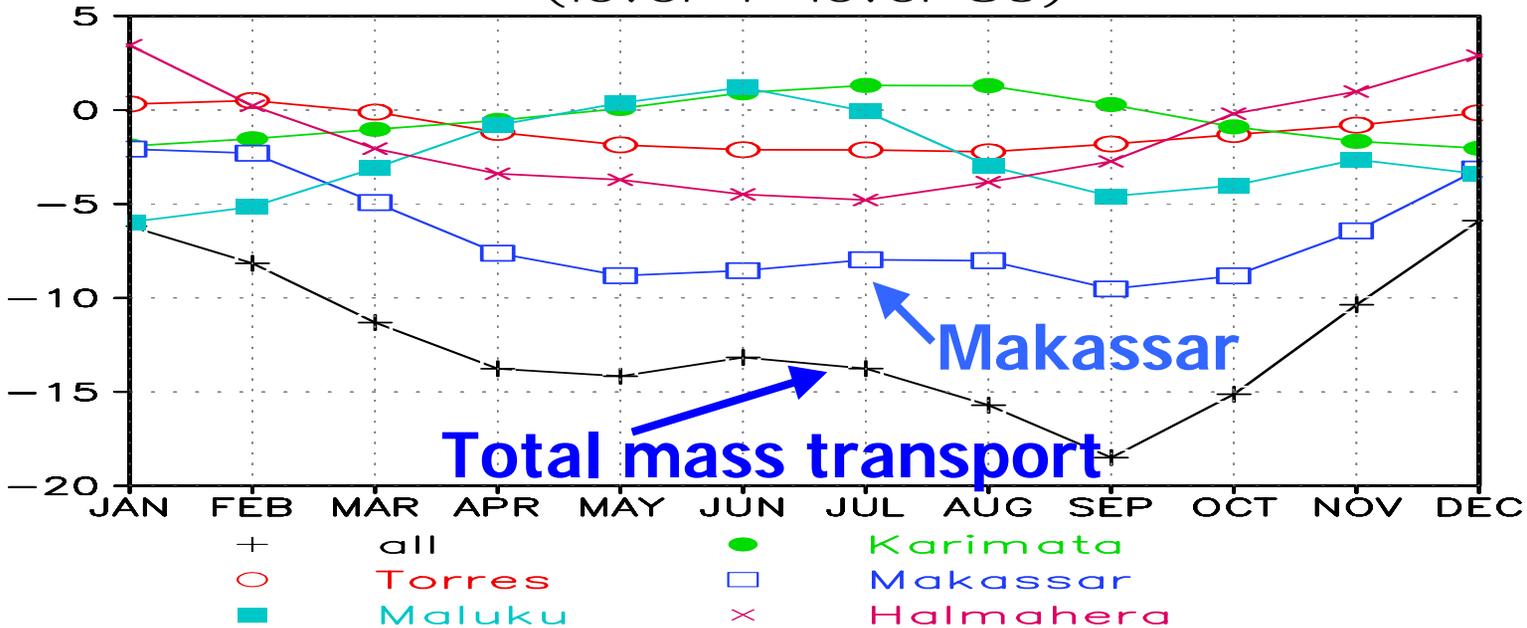


Temperature-Salinity structure in Indonesian Sea

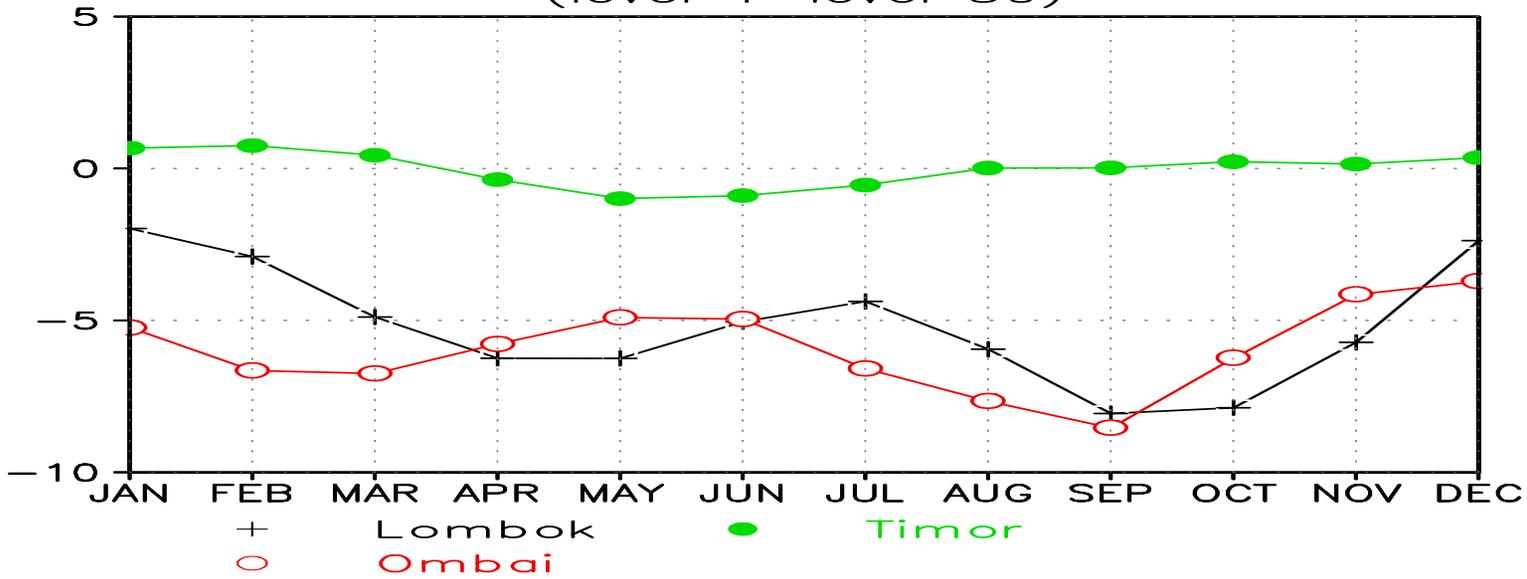


- | | | | | | | | |
|---|----|---|----------|---|----------|---|---------------|
| + | NP | □ | Sulawesi | ◇ | Timor | ⊖ | Lombok |
| ○ | EP | ■ | Banda | △ | Flores | ◐ | Timor & Ombai |
| ● | SP | × | Java | ▲ | Makassar | | |

Mass Transport (Sv)
(level 1~level 30)



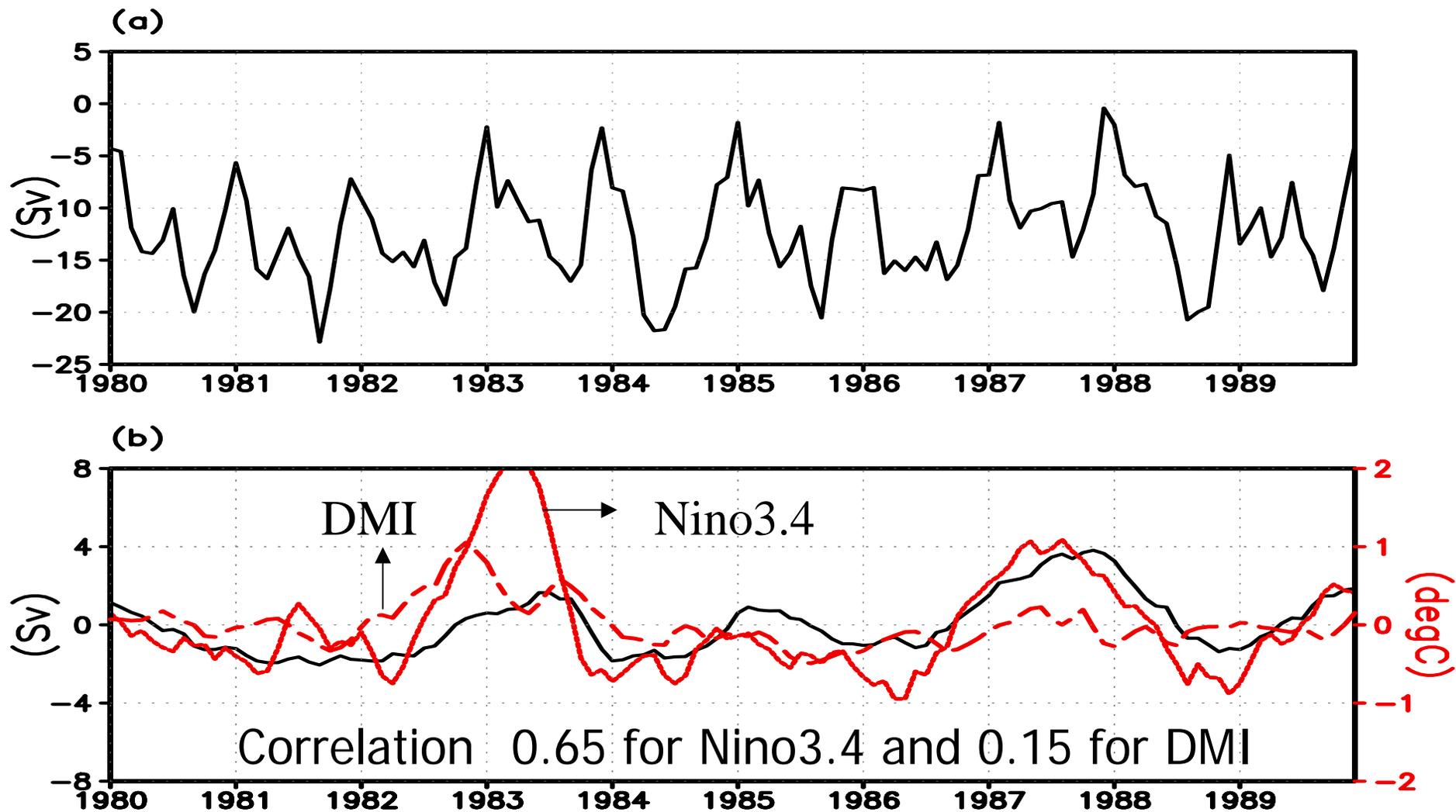
Mass Transport (Sv)
(level 1~level 30)



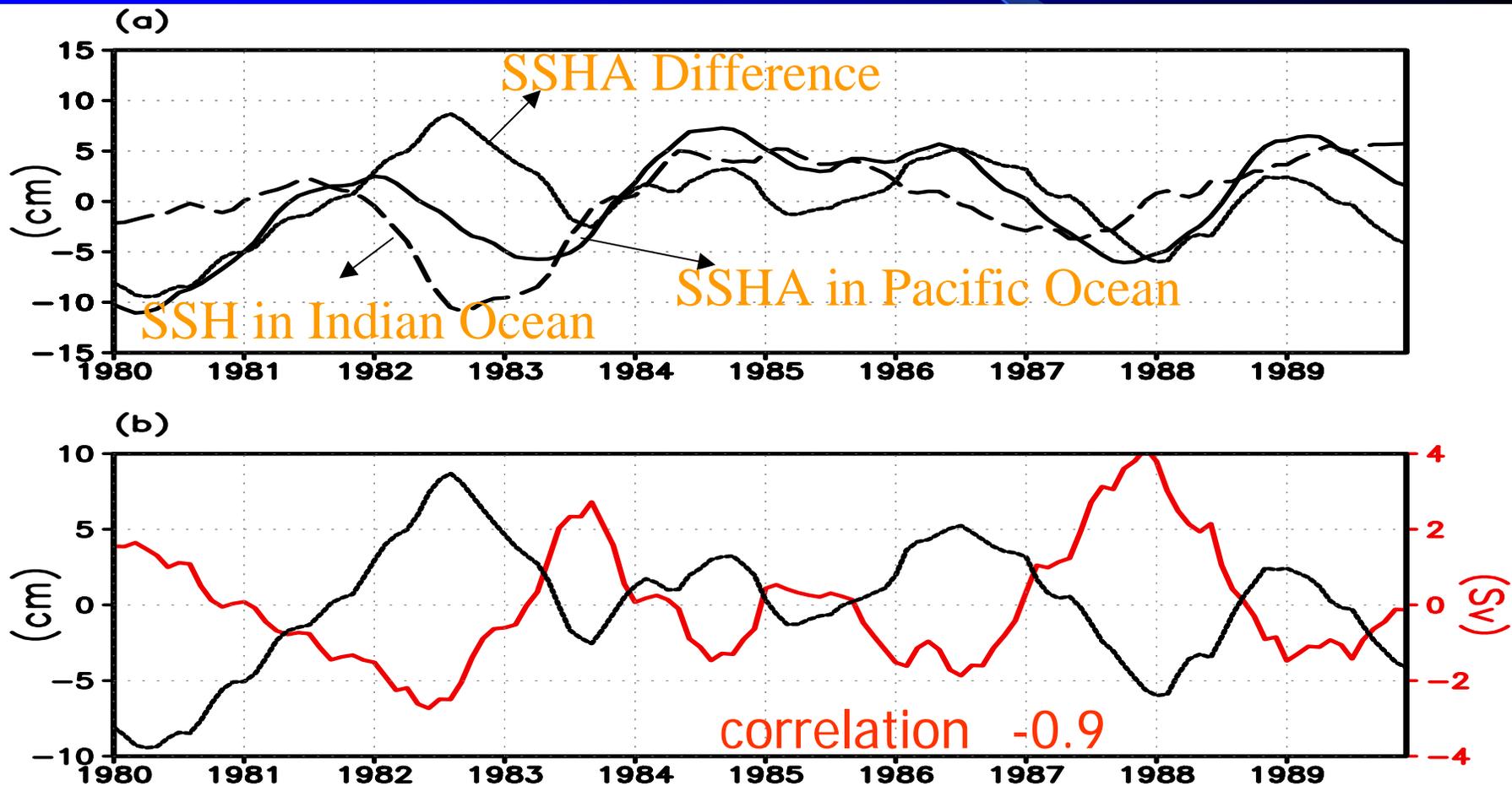
Mass Transport (Sv)

a Mass transport along 114°E (Unit Sv) b Mass transport anomaly (solid line), Nino3 dotted line DMI dashed line

ITF Transport vs Nino3 Index & DMI



SSH anomaly in Pacific 131°E 133°E 5°N 8°N
 solid line and Indian Ocean 111°E 113°E 10°S
 8°S dashed line and the difference dotted line
 (unit cm) b SSH difference dashed line cm
 and ITF mass transport anomaly unit:Sv

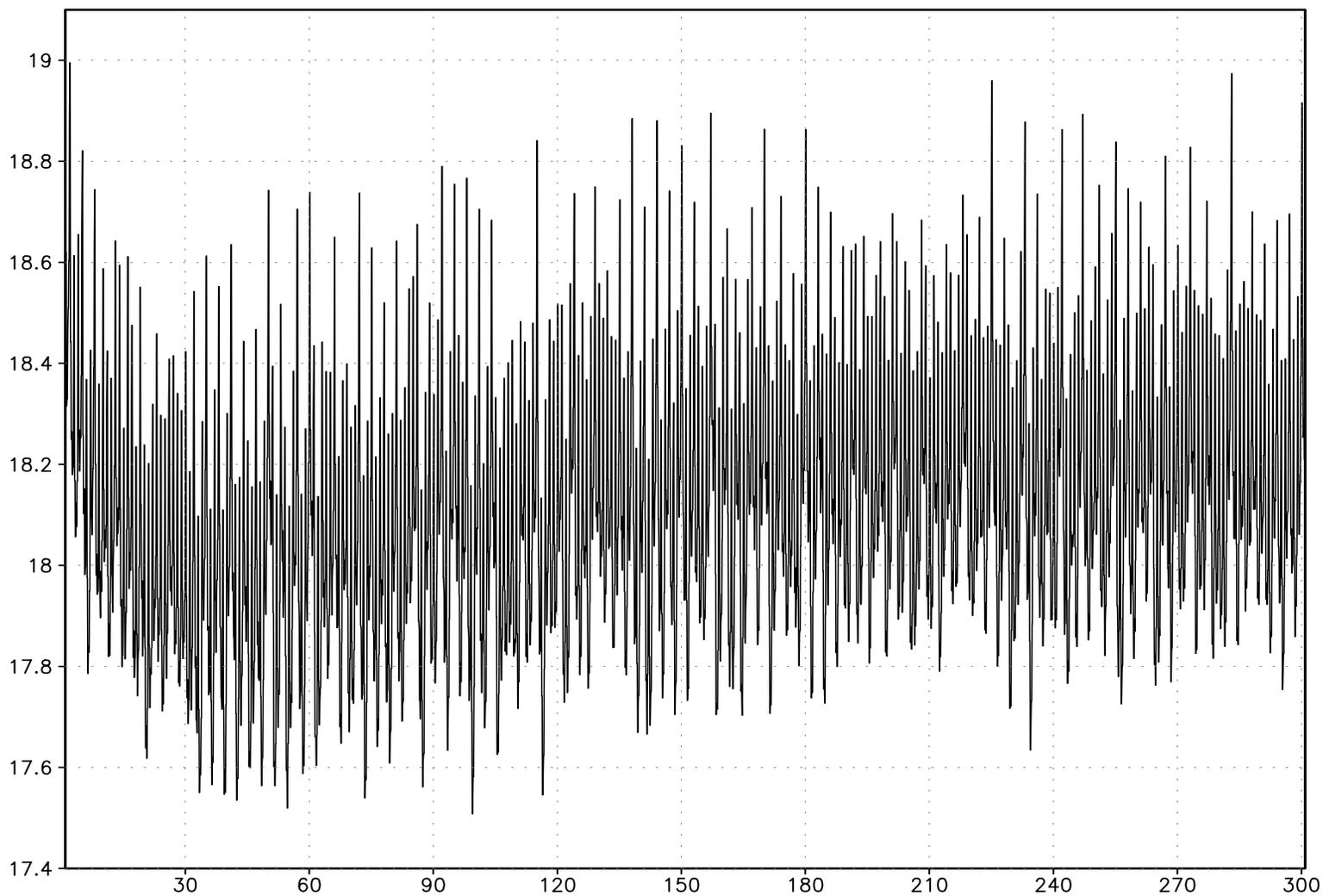


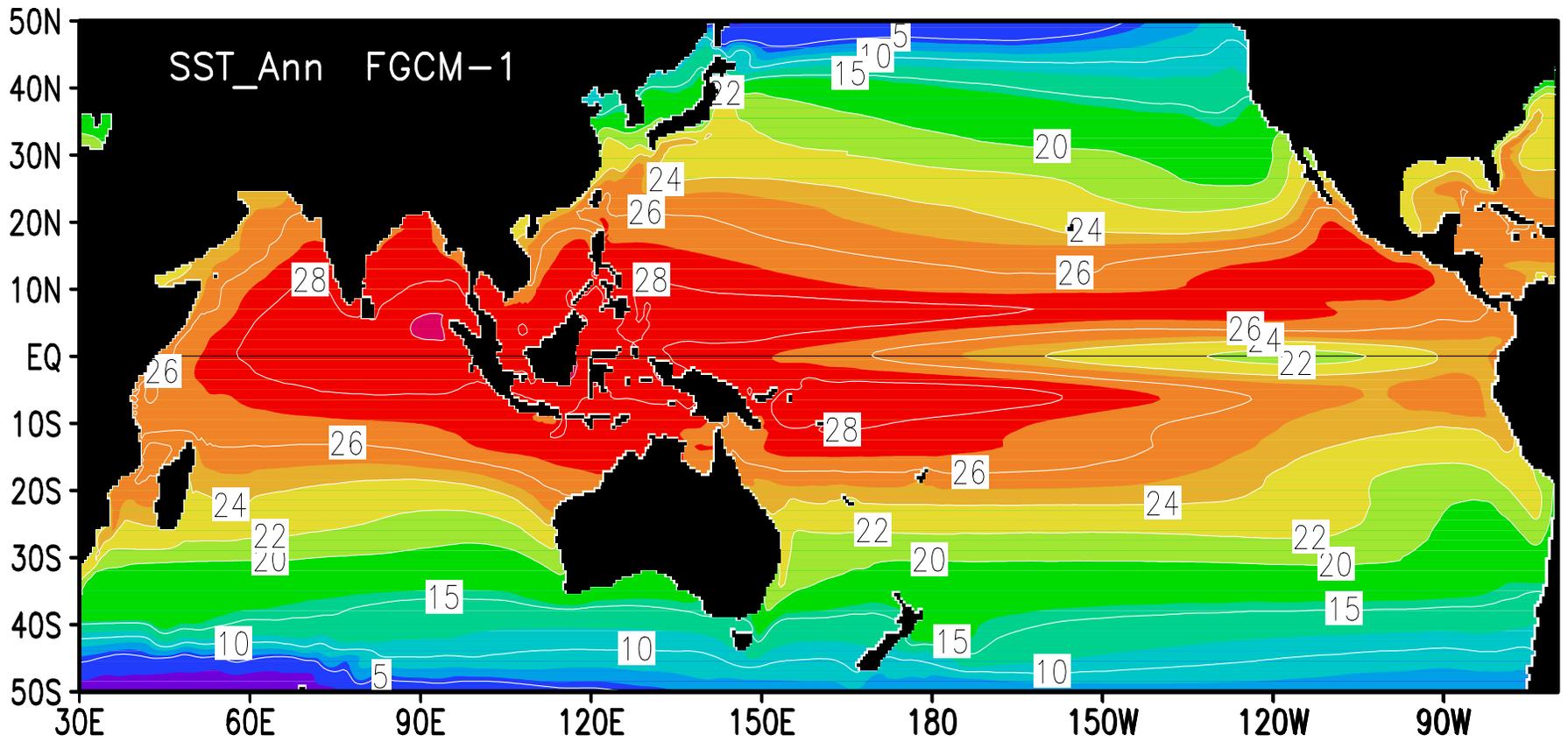
The uncoupled OGCM reproduces the basic features of ITF, including pathway, seasonal cycle, and interannual variability. Especially, the model shows a significant correlation between the ITF mass transport and ENSO as observed. How about in the coupled GCM ?

Experiment Design for Coupled GCM

- Atmospheric, oceanic, sea ice and land component models are coupled with NCAR flux coupler version 5.
- Heat, momentum, and fresh water fluxes are exchanged at model interface without any flux correction.
- A 300-year-integration was carried out.

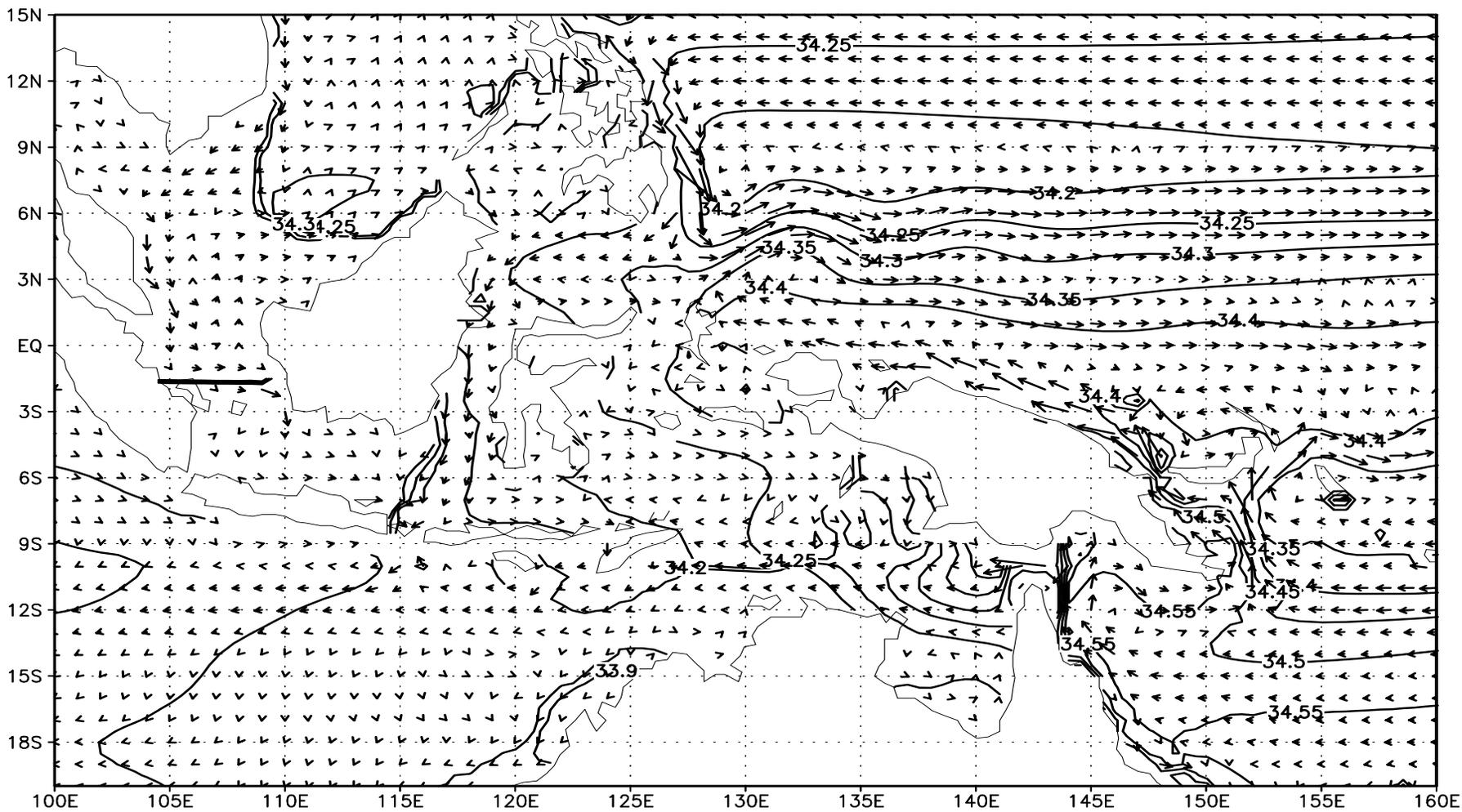
Global Monthly Mean SST from the Coupled GCM





Annual mean SST simulated by FGCM-1

100-year mean Salinity and Current in the upper 150 M



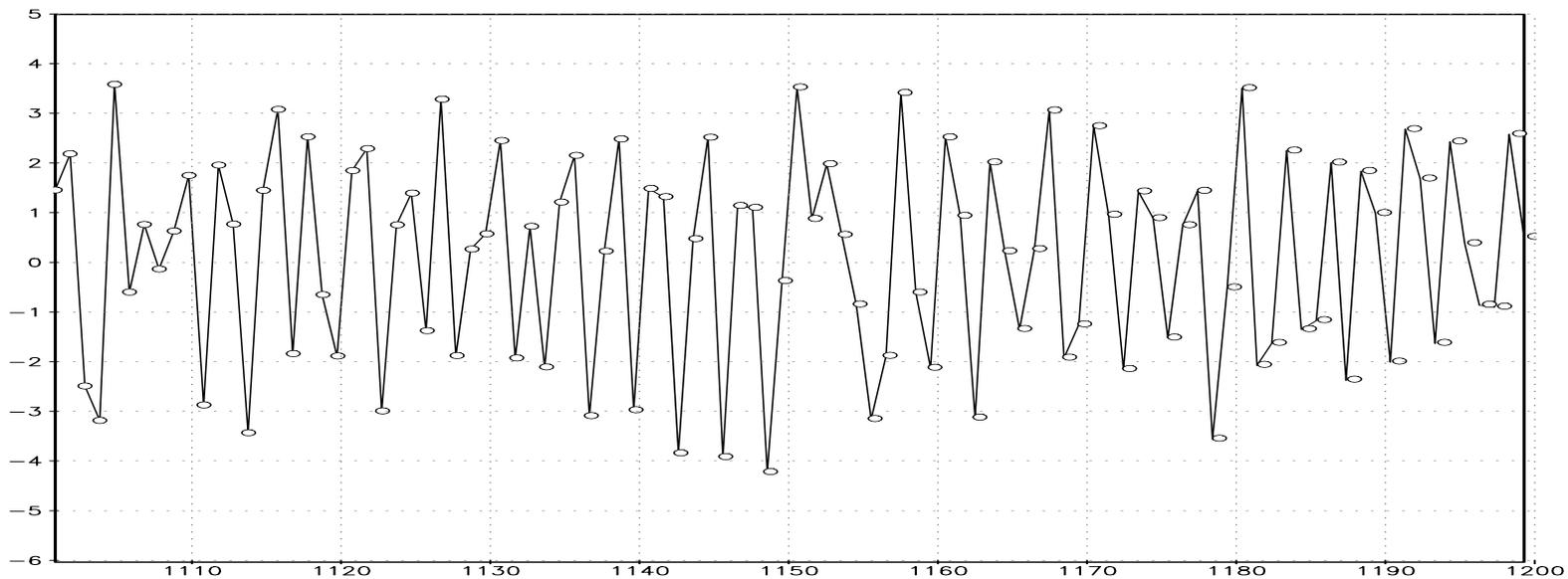
Mass Transport in OGCM and CGCM

	Mass 1	Makassar 4	Torres 2	Karimata 3	Lombok 6	Ombai 7	Timor 8
LICOM	-12.2	-6.5	-1.1	0.5	-5.1	-5.9	-0.02
FGCM	-17.6	-6.5	-2.2	-1.0	-4.8	-9.7	-0.9
OBS	-12 ¹	-9.3 ²	0.1	-	-1.7 ³	-5 ⁴	-4.5 ⁵

100-year mean ITF mass transport (Sv)



ITF

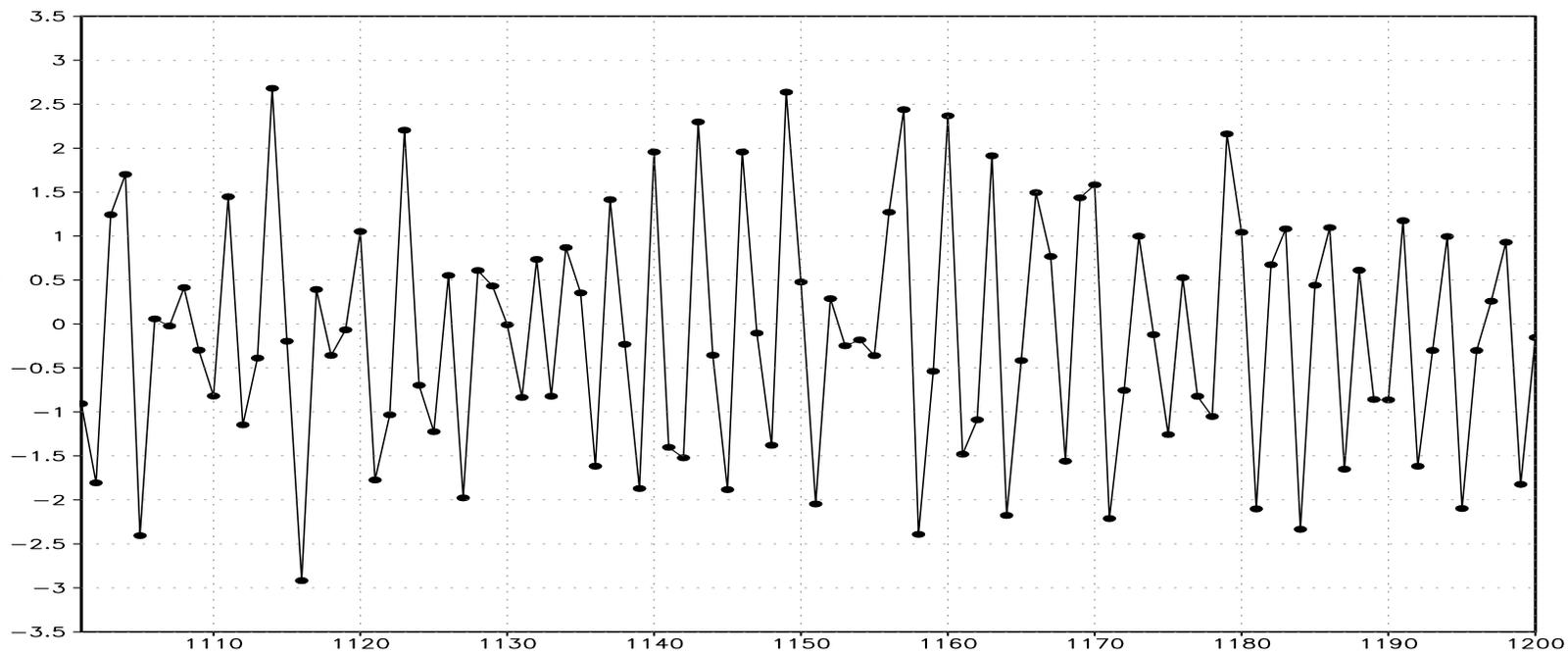


GrADS: COLA/IGES

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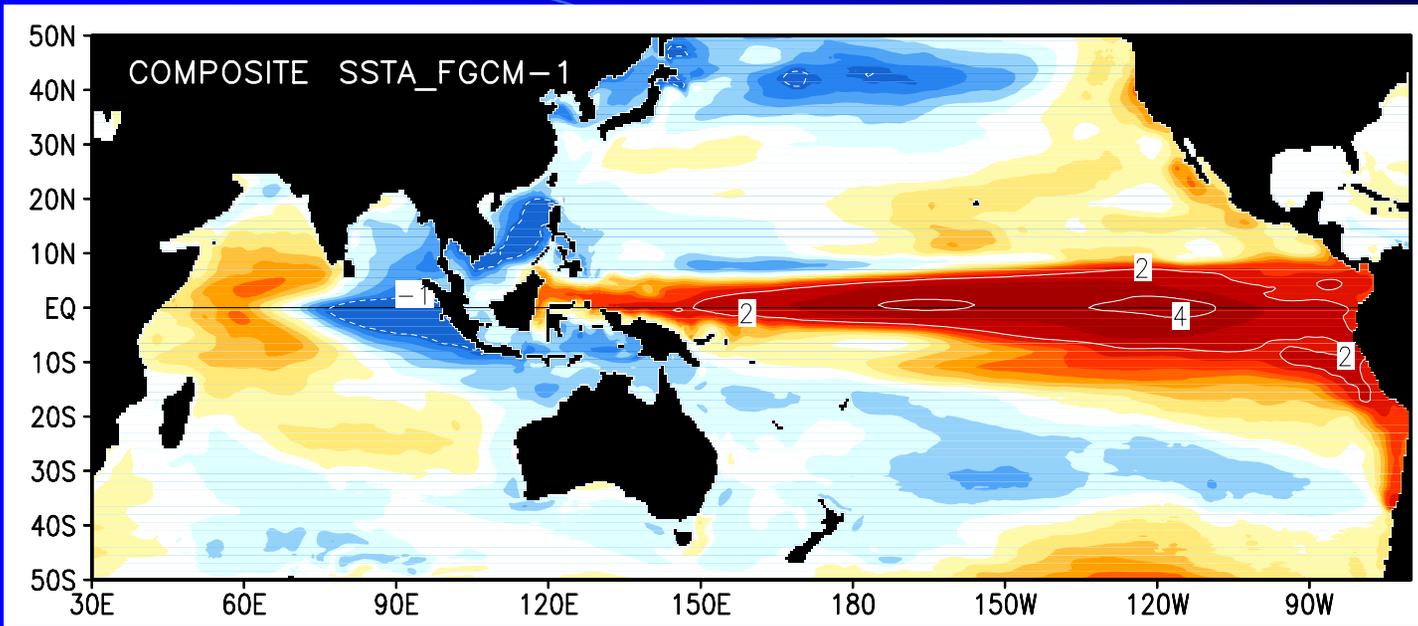
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Nino3.4

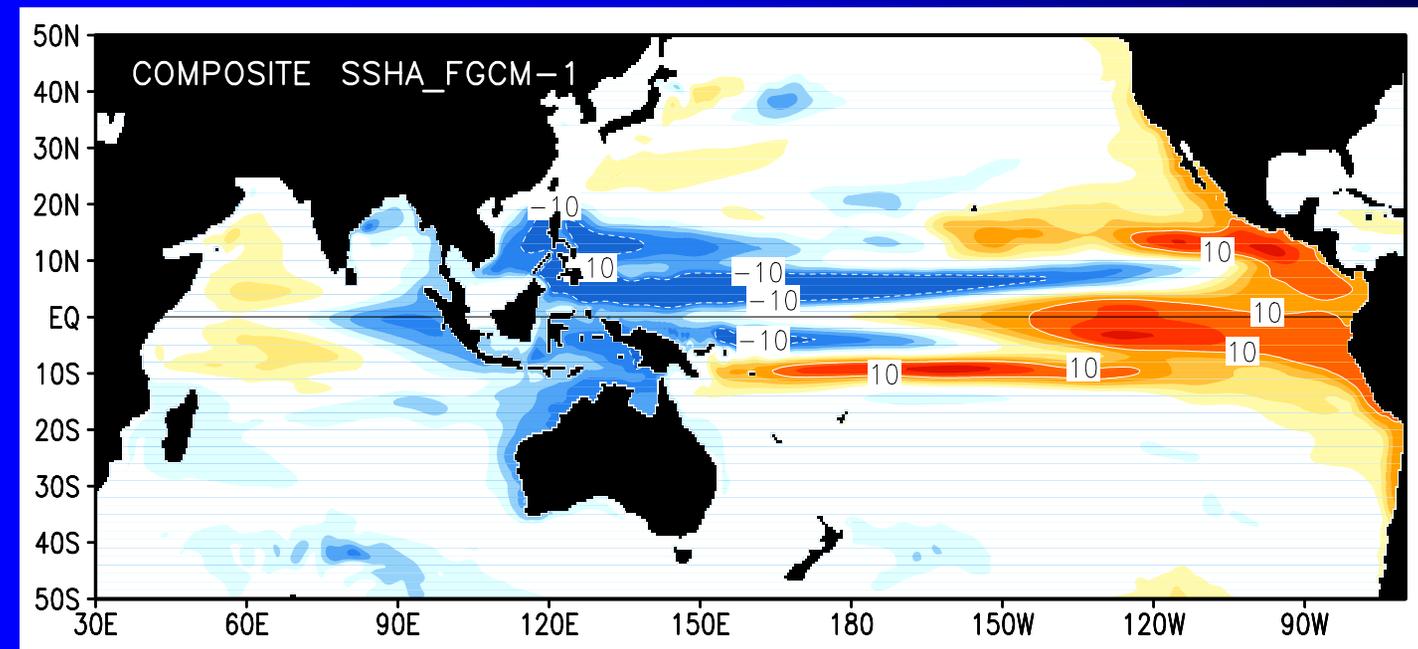


GrADS: COLA/IGES

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SSTA



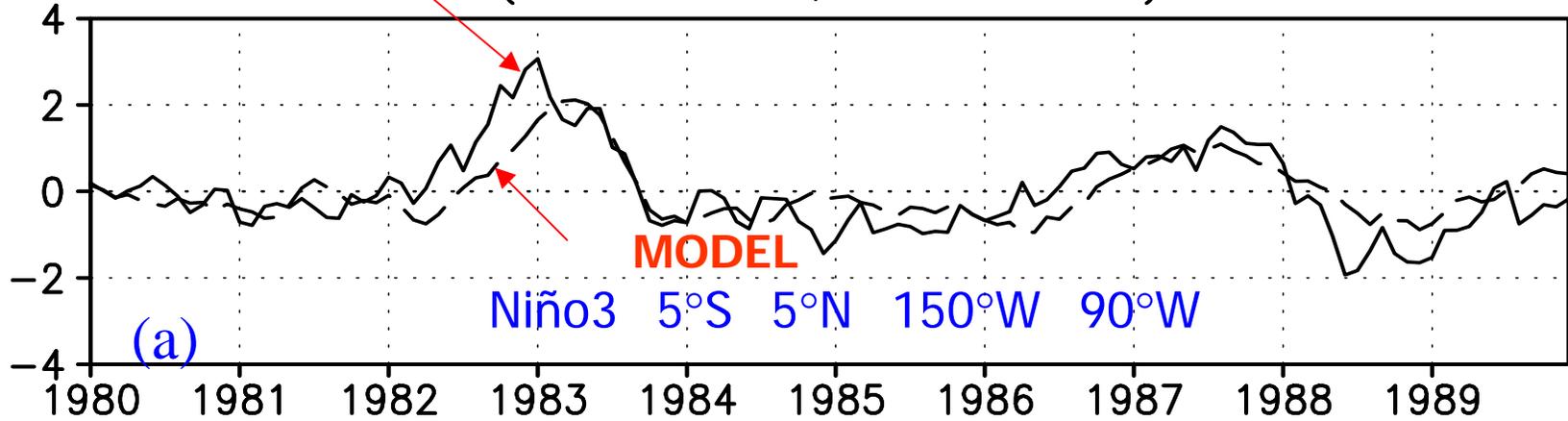
SSHA

Summary

- Both OGCM and the corresponding CGCM can reproduce some basic features of ITF, including pathway, seasonal cycle, interannual variation, etc.
- The systematic biases in CGCM results in a enhanced ITF mass transport, and more significant correlation between ENSO and ITF than uncoupled OGCM.

NINO3 Index (C deg)

GISST (solid: GISST; dash: EXP5)



MODEL DMI (C deg)
(solid: GISST; dash: EXP5)

