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.
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.
<table>
<thead>
<tr>
<th>Model</th>
<th>Mass 1</th>
<th>Makassar 4</th>
<th>Torres 2</th>
<th>Karimata 5</th>
<th>Lombok 6</th>
<th>Ombai 7</th>
<th>Timor 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBS</td>
<td>-12 ¹</td>
<td>-9.3 ²</td>
<td>0.1</td>
<td>-</td>
<td>-1.7 ³</td>
<td>-5 ⁴</td>
<td>-4.5 ⁵</td>
</tr>
</tbody>
</table>

### Observed and Simulated ITF

#### Straits around Indonesian Seas

- P.R. China
- South China Sea
- Java Sea
- Flores Sea
- Banda Sea
- Timor Sea
- New Guinea

**Indian Ocean**

**Pacific Ocean**
Temperature-Salinity structure in Indonesian Sea

[Graph showing temperature-salinity relationship with various markers for different locations such as Sulawesi, Timor, Lombok, EP, Banda, Flores, Timor & Ombai, SP, Java, Makassar.]
Total mass transport

Makassar

Mass Transport (Sv)
( level 1~level 30 )
a Mass transport along 114°E (Unit: Sv)  

Mass transport anomaly (solid line), Nino3 (dotted line), DMI (dashed line)

**ITF Transport vs Nino3 Index & DMI**

(a) 

![Graph showing ITF Transport vs Nino3 Index & DMI](image)

(b) 

Correlation 0.65 for Nino3.4 and 0.15 for DMI

![Graph showing correlation](image)
SSH anomaly in Pacific  $131^\circ E\ 133^\circ E\ 5^\circ N\ 8^\circ N$ solid line and Indian Ocean $111^\circ E\ 113^\circ E\ 10^\circ S\ 8^\circ S$ dashed line and the difference dotted line (unit cm) b SSH difference dashed line cm and ITF mass transport anomaly unit: Sv

(a)

SSH in Indian Ocean  
SSHA in Pacific Ocean

SSHA Difference

(b)
correlation -0.9
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

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<td>-1.0</td>
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<tr>
<td>OBS</td>
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¹, ², ³, ⁴, ⁵: Notes or references for the respective values.
100-year mean ITF mass transport (Sv)
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)
(solid: GISST; dash: EXP5)

(a) Niños 5°S 5°N 150°W 90°W

DMI (°C)
(solid: GISST; dash: EXP5)

(b) GISST

MODEL