Pacific influences on the meridional temperature transport of the Indian Ocean

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Data and method



Ocean Forecasting Australia Model version 3 (EI_SPINUP_ OFAM3) OFAM3 is based on Modular Ocean Model . OFAM3 we used here is forced by 3-hourly surface heat, freshwater, and momentum fluxes from ERA-Interim.

- ≻Horizontal resolution: 0.1° (75°S-75[°]N)
- ≻ Vertical: 51 vertical levels (from 0 to 5000 m)
 - 5 m vertical resolution in upper 40 m
 - 10 m vertical resolution to 200 m
- ➤ Time range: Jan 1979-Dec 2014



Temperature transport decomposition:

MHT(t) =
$$\iint_{-H}^{0} [v][\theta] dz \, dx + \iint_{-H}^{0} v^* \, \theta^* dz \, dx$$

From Lee and Marotzke (1998) and Hirschi and **Dynamical decomposition** Marotzke (2007) $\psi(z') = \int_{-H}^{z'} dz \int_{x_{w}}^{x_{e}} dx \, \bar{v} + \int_{-H}^{z'} dz \int_{x_{w}}^{x_{e}} dx \, v_{sh} + \int_{-H}^{z'} dz \int_{x_{w}}^{x_{e}} dx \, (v_{ek} - \overline{v_{ek}})$ External mode Vertical shear Ekman mode $= v_{sh} = \tilde{v}(x,z') - \bar{v}_g = -\frac{g}{\rho^* f} \int_{-H}^{z'} \frac{1}{L(z)} (\rho_e - \rho_w) dz - \frac{1}{H(x)} \int_{-H(x)}^{0} \tilde{v}(x,z) dx$



Objective:

1 examine the interannual-decadal variations of the IO meridional temperature transport and their mechanisms

2 explore the link between the IO meridional temperature transport and meridional overturning streamfunction



4

Latitude-time evolution of IO temperature transport anomalies (PW)



Mechanisms of interannual-decadal variability in meridional temperature transport



Variations of temperature dipole and meridional temperature transport



Connection with IO meridional overturning streamfunction



Dynamical decomposition of meridional transport streamfunction



Regression maps at lag 0 on the normalized PC1 of meridional temperature transport

Different processes act together to form this coherent pattern







> The meridional temperature transport is found to be highly influenced by remote **ENSO** forcing

The variability is dominated by the different mechanisms at various latitudinal

- tropical NIO: surface Ekman transport
 - tropical SIO: the geostrophic transport associated with the steric height anomalies off Java and Sumatra
- southern IO: remote ENSO forcing from Pacific through both oceanic and atmospheric waveguides > The meridional temperature transport variability is significantly associated with the leading mode of Indian Ocean meridional overturning streamfunction

Comparison of different models



Overturning streamfunction: 32°S



The overturning strengths and depths in OFAM3 under the
ECMWF forcing have a good agreement with the JRA55 forcing.
The latter two models using the
repeat forcing also show the similar patterns.

Both models with repeat yearforcing (latter two models) showmuch smaller deep MOC than theOFAM3 models



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