Numerical Investigation of Tropical Indian Ocean Barrier Layer Variability : A dynamic thermodynamic perspective

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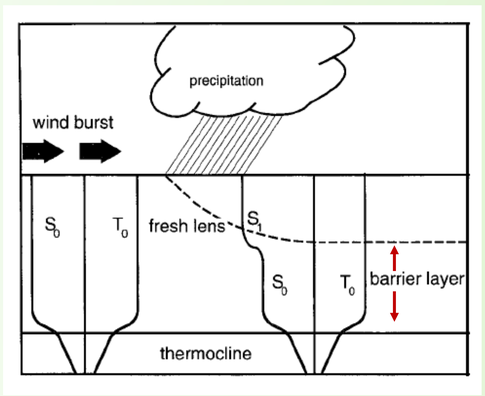
Objective

What is the individual role of major forcing mechanisms of Barrier Layer-IOD coupling in Indian Ocean?

Forcings: Domain salinity**(S)**, Vertical velocity**(W)**, Net outward heat flux**(Q)**, Domain temperature**(T)**, Precipitation-Evaporation**(F)**

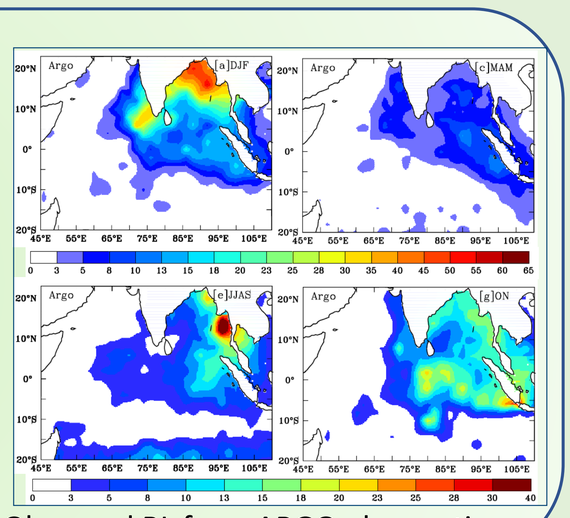
Background



Barrier Layer – Layer between Isothermal Layer and Mixed Layer.

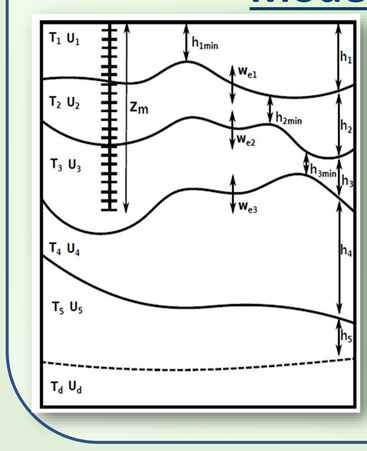
BL is often a heat storage beneath MLD.

During a positive IOD year, BL in East Indian Ocean thins.



Observed BL from ARGO observation

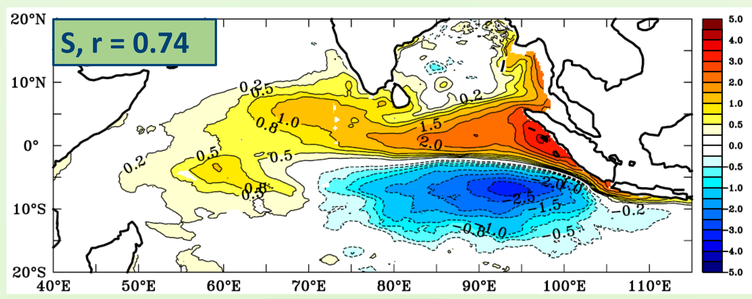
Ocean Dynamic Thermodynamic Model (ODTM)



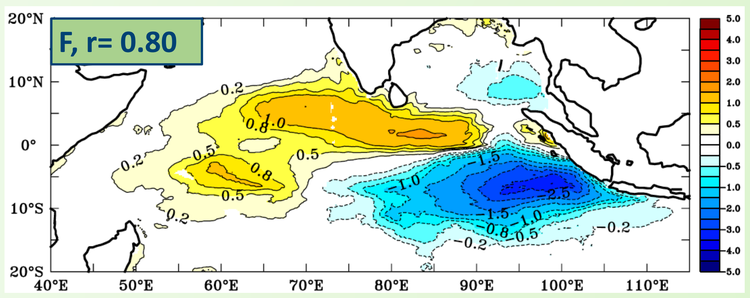
Domain : 30°E-120°E, 30°S-30°N
Resolution : 0.2° x 0.2°, 5m in Mixed layer model
Duration : 1980-2009
Forcing : winds, humidity, rainfall, air temperature, solar radiation, river run-off & chlorophyll (CORE)

Model Simulations
**CTRL – interannual forcings*
**SENS –a forcing (S/W/Q/T/F) replaced with its seasonal mean*
**Difference(SENS-CTRL) of EOF1 of BLT shown to highlight effect of forcing during IOD.*
** r - correlation between CTRL and SENS*

Results

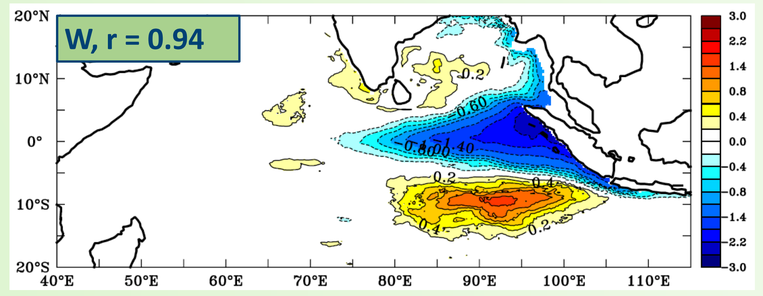


- Thickens BLT in Tropical IO, thins in SEIO during +ve IOD
- Local impact – mixing
- Non-local impact- dynamic height

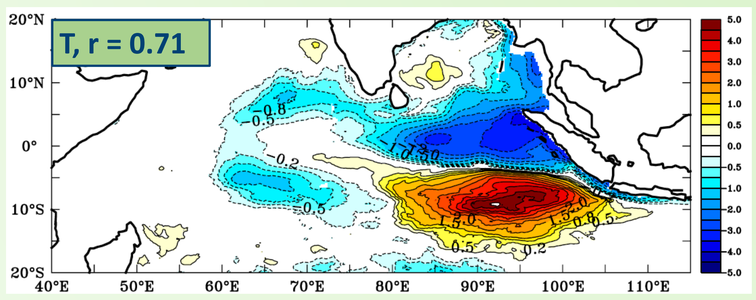


- P-E thins BLT in EIO, thickens in CIO during +ve IOD
- Thinning due to increased evaporation

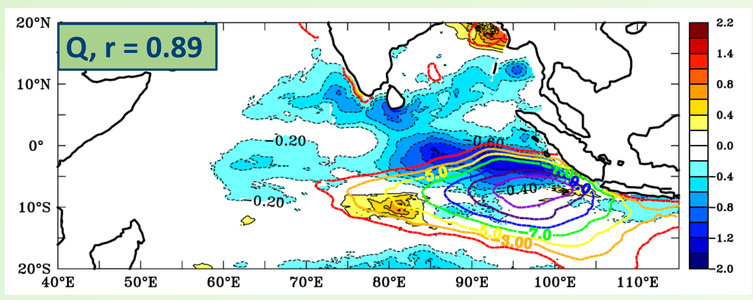
Forcing mechanisms of Barrier Layer Thickness



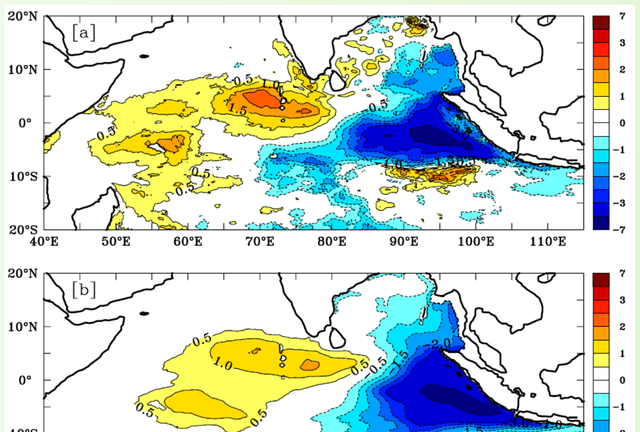
- Vertical Velocity thins BLT in equatorial region, slightly thickens in SEIO in +ve IOD
- Strong linear relationship between Thermocline and BLT



- Temperature thins BLT in +ve IOD (Opposite effect of salinity)
- Anomalous cooling and mixing during IOD thins BL
- Temperature has both 'local' & 'non-local' effects like Salinity



- Heat flux thins BL in +ve IOD
- Heat flux has local impacts
- ↑Net outward heat flux →↑TKE→↑mixing →↓BL



Q+W+S+T+F EOF1 compared to CTRL EOF1 (BLT)

Conclusion

- Thermocline heaving results in most localized variability of BLT.
- Freshwater forcing (P-E) influences variability in larger areas.
- Net surface heat flux has influence more on eastern equatorial IO.
- Salinity has local and non local impacts.
- Temperature and Salinity have impacts in the far western region- due to dynamic height effect.

- Net effect of buoyancy forcing, thermocline heaving, temperature and salinity during IOD = total variability in BLT.

Scan for more details