



# Impact of Diffusivity Parameterization on Tropical Indian Ocean Heat Content

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## Background & Motivation

Accurate simulation of the upper ocean heat content in OGCMs remains challenging due to excessive downward mixing in widely used KPP schemes. This study evaluates a revised KPP vertical diffusivity formulation in MOM5 to improve upper-ocean mixing over the Tropical Indian Ocean (TIO).

## Methods

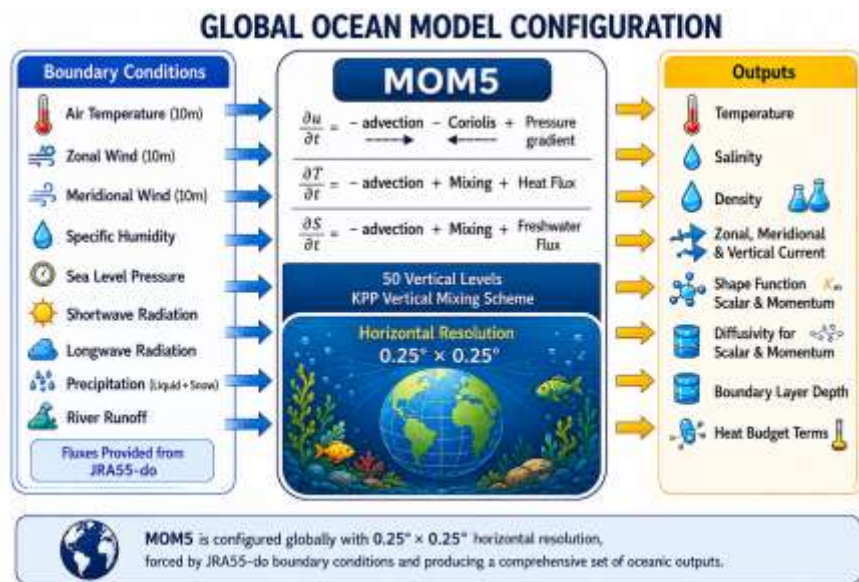
## KPP Scheme:

$$\overline{wx} = -K_x \left( \frac{\partial X}{\partial z} - \gamma_x \right) \quad (1)$$

$$K_x(\sigma) = hw_x(\sigma)G(\sigma) \quad (2)$$

$$\text{For CTRL simulation } G(\sigma) = a_0 + a_1\sigma + a_2\sigma^2 + a_3\sigma^3 \quad (3)$$

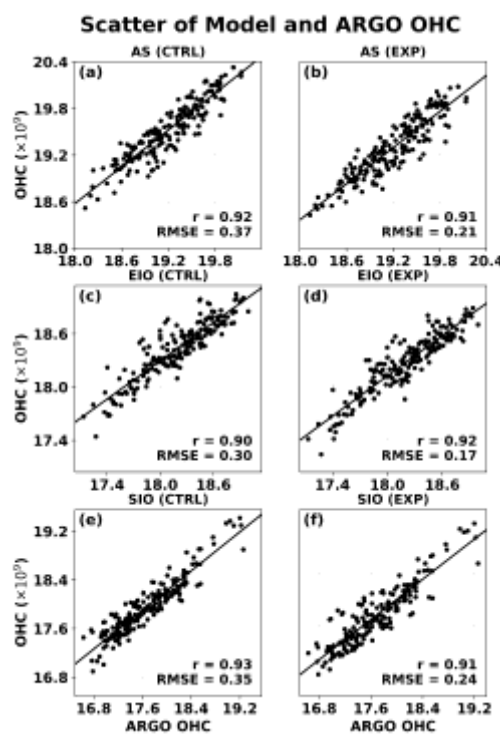
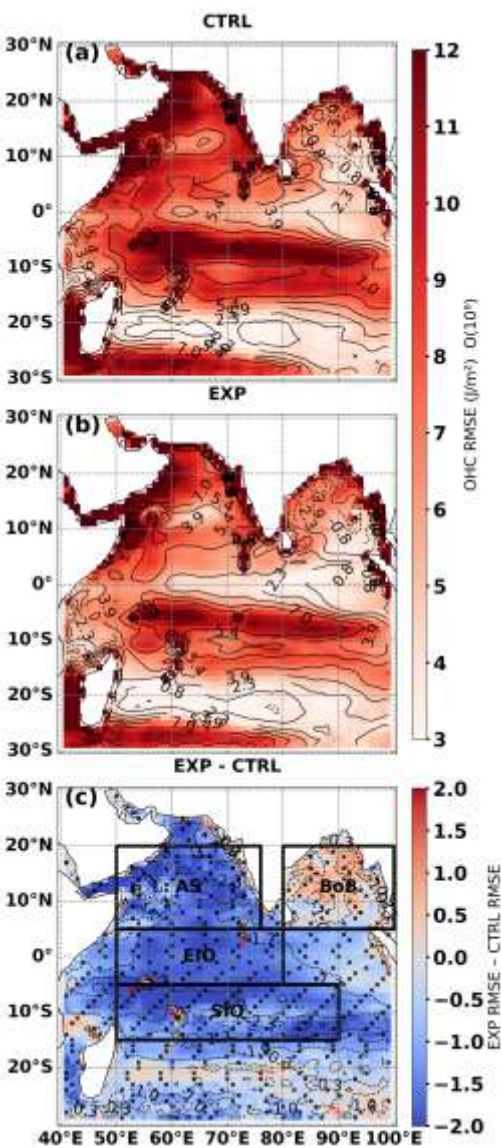
$$\text{For EXP simulation } G(\sigma) = \sigma(1 - \sigma)^2[1 + 45\sigma - 33(\sigma + \sigma^2) + 9(3\sigma + 2\sigma^2 +$$



## Results:

### Spatial distribution of OHC bias

There is reduction of error from  $1.1$  to  $1.6 \times 10^8 \text{ J/m}^2$ .



EXP reduces the subsurface warm bias by  $\sim 39\%$  relative to CTRL.

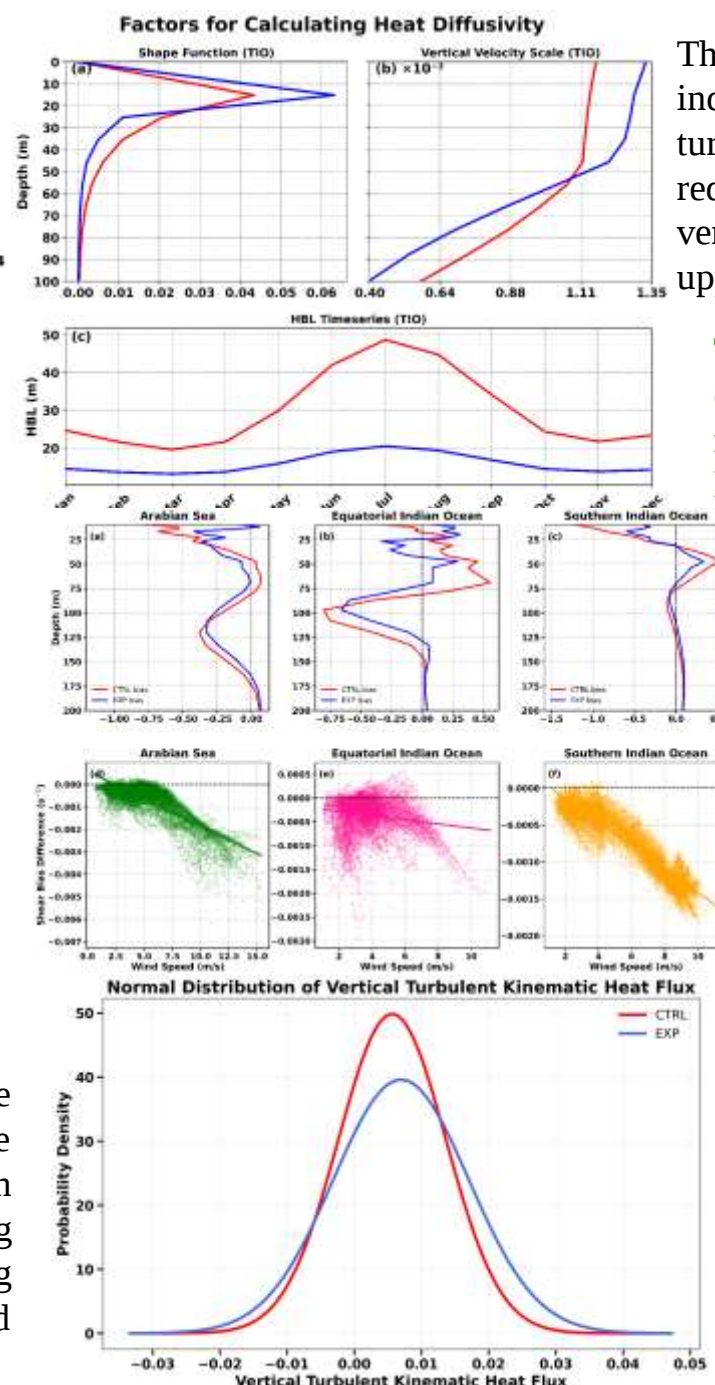
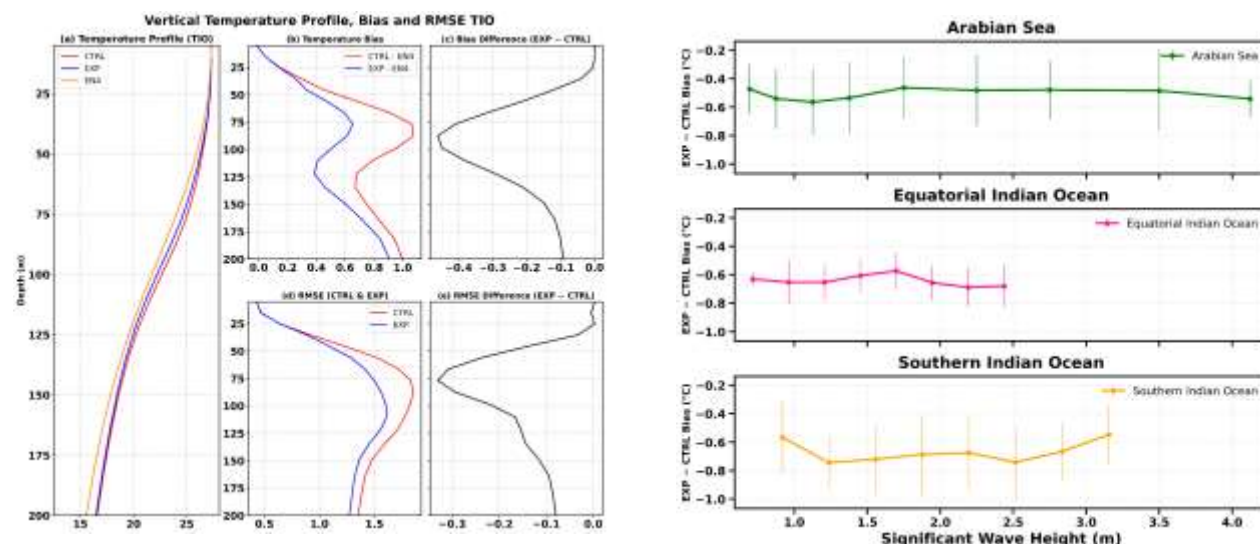
EXP reduces upper-ocean shear bias as well as stratification bias.

EXP-CTRL temperature differences become increasingly negative with wave height before tending toward saturation, indicating enhanced wave-influenced mixing.

## Conclusion:

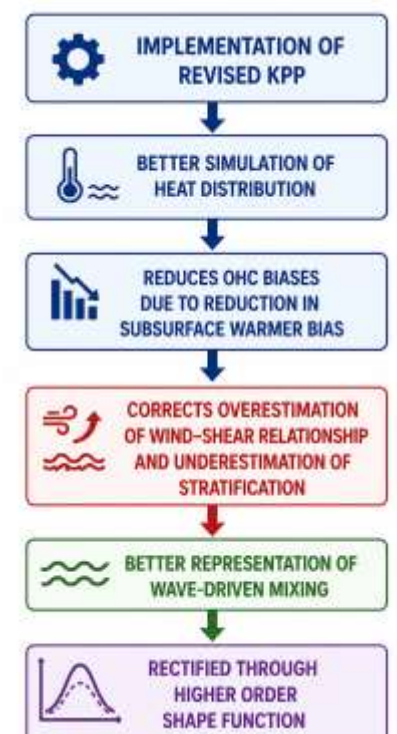
Implement of revised KPP reduces OHC biases due to better simulation of heat distribution leads to reduction in the subsurface warmer bias.

Overestimation of wind-shear relation and underestimation of wave to shear and mixing representation in KPP is rectified through higher order shape function.



The lower-peaked EXP distribution indicates that the excessive turbulent mixing in CTRL has been reduced, yielding more realistic vertical heat redistribution and upper-ocean thermal structure.

Together, these processes determine the final improvement in upper-ocean heat content



References:

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