Ocean heat content variability in the Bay of Bengal: a CMIP6 model analysis with implications on the Indian Ocean Dipole

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The present study evaluates the performance of CMIP6 models in capturing ocean heat content (OHC) variations in the Bay of Bengal. The seawater potential temperature of the six best-performing models up to a depth of 500 m from the sea surface was chosen for the study on a 1° × 1° horizontal resolution and monthly temporal scale, compared with RAMA buoy and North Indian Ocean Atlas data. Performance indices such as root mean square error (RMSE), average error, absolute average error (AAE) and Willmott score were used. The GISS-E2-1-G model performed better with lower RMSE and AAE values, while the IPSL-CM6A-LR model performed poorly. Monthly climatology variations showed increased temperature and OHC during the summer. Annual trends in OHC revealed negative trends for some models, indicating a net loss of heat, while others showed positive trends, indicating heat accumulation. Comparison with RAMA buoy data consistently showed lower heat content than the models, indicating overestimation. The study emphasizes the importance of incorporating observational data to improve accuracy. The findings highlight variations in model performance, and the need for understanding uncertainties and biases in climate models for reliable projections. Additionally, the study suggests that the interaction between the North and South Bay of Bengal can affect the Indian Ocean Dipole phenomenon, influencing temperature gradients and hence OHC.

Keywords: *Annual trends, climate prediction, ocean heat content, performance indices, seawater potential temperature.*

effects. Monitoring changes in ocean heat content (OHC) and the Earth's energy imbalance is vital for comprehending and predicting the impacts of climate change[2].

Climate modelling is central to climate change studies and has become an expanding field within climate research. The advancements in general circulation models now allow for studying historical climate variations and future climate projections. The international climate modelling community collaborates every few years to employ the latest versions of their climate models in a coordinated set of simulations[3]. Through this model intercomparison, the climate science community can assess the performance of models in comparison to older versions and newer models. Moreover, the ensemble of model results supports a range of climate change impact and adaptation studies, as well as public outreach and education. Utilizing an ensemble of models within a standard experimental framework enables scientists to compute ensemble statistics, enhancing the accuracy of projections and allowing for quantification of the associated confidence or uncertainty. This successful global collaboration is known as the Coupled Model Intercomparison Project (CMIP)[4].

The latest phase of the Coupled Model Intercomparison Project, viz. CMIP6, under the World Climate Research Programme (WCRP), presents an opportunity to examine several simulated global ocean general circulation models (OGCMs)[5]. This study aims to develop a suite of models that can more accurately replicate the oceans and climate. The CMIP6 models, incorporating both natural and anthropogenic forcing, provide historical simulations from 1850 to 2014, along with prospective scenarios of tiers 1