5th World Conference on
Climate Change and Global Warming
07 - 09 March 2025 Vienna, Austria

Long-term Changes of Upper Ocean Heat Content and its Dynamical Implications in the Arabian Sea

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ABSTRACT

Over the past few decades, the Arabian Sea has experienced substantial warming, resulting in significant variations in its thermodynamic characteristics. Determining the physical processes underlying these changes requires understanding the relationship between ocean heat content (OHC) and the dynamically active upper ocean regimes such as the mixed layer (ML) and thermocline. ML and thermocline play cardinal roles in driving sea surface height anomalies (SSHAs) and sea surface temperature anomalies (SSTAs). A thorough examination of the spatial patterns of ML, thermocline, SSHA, SSTA, and drivers for their dynamical interactions is necessary because they have significant implications on the Indian monsoon, the Arabian Sea's marine ecosystems, and regional climate variability. Using Argo data from 2005 to 2020 and employing SSHA and SSTA as indicators of the underlying subsurface dynamics, this study explores the correlation between OHC, ML, and thermocline. We used statistical techniques such as correlation analysis, regression models, and cross-spectral analysis. This study highlights critical regions and periods where SSHA and SSTA distributions effectively reflect the Arabian Sea's subsurface variability, offering a better pathway to understanding the coupling between surface anomalies and subsurface dynamics. Moreover, we anticipate that this research enhances the knowledge of the Arabian Sea's thermodynamic structure, contributing to improved climate models, better predictions of regional oceanic phenomena, and a deeper understanding of ocean-atmosphere interactions.

Keywords: Arabian Sea, Ocean Heat Content (OHC), Mixed Layer (ML), Thermocline, Sea Surface Temperature Anomaly (SSTA), Sea Surface Height Anomaly (SSHA)