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Influences of Pacific Climate Variability on Decadal Subsurface Ocean Heat Content Variations in the Indian Ocean

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Decadal variabilities in Indian Ocean subsurface ocean heat content (OHC, 50-300m) since the 1950s are examined using ocean reanalyses. This study elaborates on how Pacific variability modulates the Indian Ocean on decadal timescales through both oceanic and atmospheric pathways. High correlations between OHC and thermocline depth variations across the entire Indian Ocean basin suggest that OHC variability is primarily driven by thermocline fluctuations. The spatial pattern of the leading mode of decadal Indian Ocean OHC variability closely matches the regression pattern of OHC on the Interdecadal Pacific Oscillation (IPO), emphasizing the role of the Pacific Ocean in determining Indian Ocean OHC decadal variability. Further analyses identify different mechanisms by which the Pacific influences the eastern and western Indian Ocean. IPO-related anomalies from the Pacific propagate mainly through oceanic pathways in the maritime continent to impact the eastern Indian Ocean. By contrast, in the western Indian Ocean, the IPO induces wind-driven Ekman pumping in the central Indian Ocean via the atmospheric bridge, which in turn modifies conditions in the southwestern Indian Ocean via westward-propagating Rossby waves. To confirm this understanding, a linear Rossby wave model is forced with wind stresses and eastern boundary conditions based on reanalyses. This linear model skillfully reproduces observed sea surface height anomalies and highlights both the oceanic connection in the eastern Indian Ocean and the role of wind-driven Ekman pumping in the west. These findings are also reproduced by ocean general circulation model hindcast experiments forced by interannual atmospheric boundary conditions applied only over the Pacific and Indian Oceans, respectively.