EGU23-595, updated on 15 Apr 2024
https://doi.org/10.5194/egusphere-egu23-595
EGU General Assembly 2023
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Intra-decadal variability of the Indian Ocean shallow meridional overturning circulation during boreal winter

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The variability of Indian Ocean shallow meridional overturning circulation (SMOC) is studied using the century-long ocean reanalysis simple ocean data assimilation (SODA) data. Though SMOC exhibits stronger southward transport during boreal summer, it displays stronger variability during boreal winter. The spectrum analysis of the winter SMOC index reveals the presence of the highest amplitude between 5 to 7 years at 95% confidence level, suggesting the dominance of intra-decadal SMOC variability. The robustness of intra-decadal SMOC variability is also confirmed in different ocean reanalysis data sets. Composite analysis of filtered upper Ocean Heat Content, sea level, thermocline depth, and Sea Surface Temperature anomalies for strong (weak) SMOC years show negative (positive) anomalies over north and East of Madagascar. Correlation analysis, of filtered SMOC index and sea level pressure (zonal winds) over the Indian Ocean, found a significant negative (positive) correlation coefficient north of 40 °S (around 10 °S) and a significantly positive (negative) correlation coefficient over the 45 °S to 70 °S (20 °S to 50 °S and north of 5 °S). This meridional pattern of the correlation coefficient for sea level pressure, manifesting the out-of-phase relationship between sub-tropics and high latitude mean sea level pressure, resembles Southern Annular Mode (SAM). We conclude that the intra-decadal variability of mean sea level pressure leads to zonal wind variation around 10 °S modulating SMOC, which in turn affects the upper ocean thermal properties in the east and north of Madagascar. This study for the first time brought out coherent intra-decadal evolution of SAM and SMOC during boreal winter.