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Decadal variations in the southern tropical Indian Ocean: A case study for 1990s

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Decadal variations in the southern tropical Indian Ocean and their relation to variations of Southern Cell, a part of shallow meridional overturning circulations in the Indian Ocean, during 1990s are investigated, using outputs of a high-resolution OGCM, called OFES, and a simple reduced-gravity model. OFES reproduces mean conditions and interannual to decadal variations of the Southern Cell, which consists of southward surface Ekman flow and northward subsurface geostrophic currents. During 1990s, the Ekman flow is weakened in a northern part of the cell associated with weakening of the southeasterly Trade Winds, while it is strengthened south of 10S. The subsurface meridional currents at the depth of the thermocline show the flows opposite to the surface in a region north of 20S. These results suggest that the Southern Cell weakened/strengthened during this particular period only partly and not the whole cell. Mechanisms responsible for this weakening in the northern part of the cell are related to a dipole structure in sea surface height and the thermocline depth anomalies, which are generated by wind stress curl over the southeastern tropical Indian Ocean and subsequently propagate westward as downwelling and upwelling Rossby waves. The simple reduced-gravity model well reproduces the thermocline depth anomalies during this period, supporting the importance of the baroclinic Rossby waves in the decadal variations there.

Keywords: Indian Ocean, Decadal variations, Shallow meridional circulation cell