

The seasonal cycle of the tropical south Indian Ocean and its impact on intraseasonal and interannual variability

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Scale interactions in the coupled ocean/atmosphere of the tropics play a crucial role in shaping the climate state and its spatial and temporal variability. Here we revisit the mechanisms driving the seasonal cycles of mixed-layer (ML) temperature and salinity in the south tropical Indian Ocean (STIO) and their impact on shorter and longer time scale variability in the region. The seasonal cycle in the region is very much influenced by the basin-scale adjustment in response to monsoon winds in the eastern side of the basin. Our results highlight the prominent role of the zonal advection, which is part of the adjustment process, in bringing fresher/colder waters from the east to the central and western STIO during the austral Spring. This water mass drives a re-stratification of the upper ocean and plays a key role in the shallowing of the ML while maintaining a depressed thermocline. As a consequence, during austral Spring and early Summer, the uppermost STIO becomes decoupled from the thermocline. The water mass is found to arrive in complex pulses, induced by a combination of eddy and wave activity and the history of forcing, mixing and stirring along its trajectory. We further demonstrate that the zonal advection is at the heart of important intraseasonal and interannual variability in SST. At intraseasonal scales, the re-stratification induced by the fresher water mass acts as a positive feedback to the formation of diurnal warm layers by limiting the depth penetration of convection. At the interannual scale it contributes to the development of negative IOD events.