ABSTRACT

Present study explores the role of three primary atmospheric phenomena, viz., El Niño Southern Oscillation (ENSO), mid-latitude atmospheric wavetrain and Southern Annular Mode (SAM) in controlling the sea ice area (SIA) over the Indian Ocean Sector of the Southern Ocean (IOS) using both observation and model studies. Our study finds an asymmetric response of ENSO to the sea ice cover in the east- and the west- IOS. A significant reduction in SIA is observed in the eastern IOS during summer as well as the winter following El Niño Modoki. The El Niño and El Niño Modoki years show contrasting signals in SIA in the east IOS. Apart from ENSO, SIA over the IOS is affected by mid-latitude atmospheric wavetrain with wavenumber -3 and -4 pattern having intra-seasonal (20 – 90 days) variability (ISV). The ISV is also observed in SIA. SIA extremes on intra-seasonal timescales lag the ISV in wavetrain by ~5 days. ISV (at 16-48 days period) in SIA over the west IOS shows significant increase in persistence of positive extremes during 1995-2010. These changes after 1994 are consistent with the positive trend in SIA over the west IOS. Another atmospheric phenomenon which affects the sea ice cover over the IOS is SAM. It is found that SAM contributes more to sea ice variability over the IOS than ENSO. An ocean-sea ice coupled model (ORCA2-LIM) is used to study the effects of SAM. The model simulates the sea surface temperature (SST), surface salinity and the annual cycle of SIA with reasonable accuracy in the control run. However, SIA is seen to be underestimated closer to the Weddell Sea (at 20°E), and overestimated over the easternmost part of the IOS. This could be due to the model inefficiency in resolving the isothermal layer, density mixed layer and barrier layer properly. A separate study is conducted to examine the effect of fresh water influx on the barrier layer in the Chun Spur region due to the variation in the local current using the observational data sets. Forcing ORCA2-LIM model with surface wind for the positive and negative SAM period reveals opposite sea ice anomalies over the west and east IOS. It may be attributed to a non-annular response in sea ice drift and surface air temperature.

Key words: Sea ice over Indian Ocean sector, ENSO, mid-latitude atmospheric wavetrain, Southern Annular Mode, sea ice model