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Temporal variations of Mascarene High in austral summer and their causes, and influences on the SST field

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Changes in intensity and longitudinal/latitudinal position of Mascarene High (MH) in austral summer (November-January) from 1951 to 2012 are investigated using NCEP-NCAR reanalysis dataset. We define the MH intensity and longitudinal/latitudinal position as sea level pressure (SLP) maximum within a region of [40E-120E, 50S-10S]. The intensity has an interannual variation on a dominant timescale of 3-4 years. The pressure variations associated with the intensity show annular and equivalent barotropic structures throughout the troposphere, which are similar to Southern Annular Mode (SAM). The intensity time series shows a significant correlation with the SAM index. Therefore, it is suggested that the MH intensity variation results from the SAM. The MH longitudinal position also shows an interannual variation on a dominant timescale of 5-6 years and the time series has no significant correlation with the intensity time series. The SLP anomalies associated with the longitudinal variation represent a dipole pattern, whose centers of action are located off the western Australia (WA) and off the south-eastern Madagascar Island (SEMI). The geopotential height anomalies in these regions have different vertical structures; those off the WA are confined from the sea surface to the middle troposphere, while those off the SEMI are distributed throughout the troposphere. In addition, the SLP anomalies averaged within these regions show no significant correlation. It is indicated that the SLP variations off WA are associated with El Nino Southern Oscillation (ENSO). On the other hand, the SLP changes off the SEMI have no relationship with the large-scale atmospheric variations such as SAM and ENSO.

The MH intensity variation forms southwest-northeast dipole pattern of sea surface temperature (SST) field, which resembles the Indian Ocean Subtropical Dipole (IOSD) pattern. In addition, the MH longitudinal changes also show the dipole pattern, which is shifted westward by 10 degrees in longitude compared to the SST pattern associated with the intensity variation. The correlations between the MH variations and IOSD index show significant values (0.39 for intensity and -0.57 for longitudinal position). Therefore, it is suggested that both the changes in the intensity and the longitudinal position cause the IOSD.

Keywords: Mascarene High, Indian Ocean Subtropical Dipole, El Nino Southern Oscillation, Southern Annular Mode