

Interannual Variation of Surface Wind Field over the Southern Ocean

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The Southern Ocean (SO) is a single oceanic domain encircling the globe, and covered by the strong eastward flowing Antarctic Circumpolar Current (ACC). Previous studies have pointed out that there are some dominant atmospheric variabilities over the SO such as the Southern Annular Mode (SAM; Thompson and Wallace, 2000), Antarctic Oscillation Index (AAOI; Gong and Wang, 1999) and Pacific South American (PSA; Mo and Ghil, 1987), and they are related to the strength of westerly winds and affect large change of ecological environment in the Antarctic/Southern Ocean during recent decades (Boyd and Roberts, 1993; Thompson and Solomon, 2002; Turner et al., 2009; Naganobu et al., 2014; IPCC, 2001, 2007, 2013; Hogg et al., 2015).

The Antarctic krill (*Euphausia super ba*) is a key species in the Antarctic Ocean, so understanding of its relationships with climate and oceanic condition is considered to be a fundamental issue. Naganobu et al. (1999) and Kondo (2008) found significant correlations between the krill recruitment and DPOI (Drake Passage Oscillation Index) which is a climate index defined by the sea-level pressure differences between Rio Gallegos at the southern edge of the South America and Esperanza at the northern edge of the Antarctic Peninsula. The strength of the westerlies affects krill recruitment, such as the strong (weak) westerlies resulting high (low) krill recruitment.

In this study, we focus on spatial features in wind variations over the southern ocean which are related to the DPOI. Correlation analyses are made between time series of DPOI (regional scale), AAOI (global-scale) and surface winds.

In order to investigate the spatial structures of zonal wind variations, we perform empirical orthogonal function (EOF) analysis. The spatial feature of the 1st EOF mode for the zonal wind, having contribution ratio of 23.8%, is similar to that of the AAOI pattern derived from the 1st mode of the 850-hPa height in the NCEP reanalysis (Fig.1a). The score of this mode has a high correlation with the AAOI (0.71), (Fig.2a). Thus, the leading EOF mode of the zonal wind is related to the Atmospheric SAM pattern. The spatial distribution of the 2nd EOF mode, having contribution ratio of 17.6% reveals a dominant pattern in the Atlantic and Indian sectors (Fig.1b) with maxima, poleward of that for the 1st EOF mode. The score of this mode has high correlation with DPOI (0.72), (Fig.2b).

These suggest that the DPOI-related variations are characterized by spatial features in the 2nd EOF mode of the zonal wind. These mechanisms will be examined in further studies.

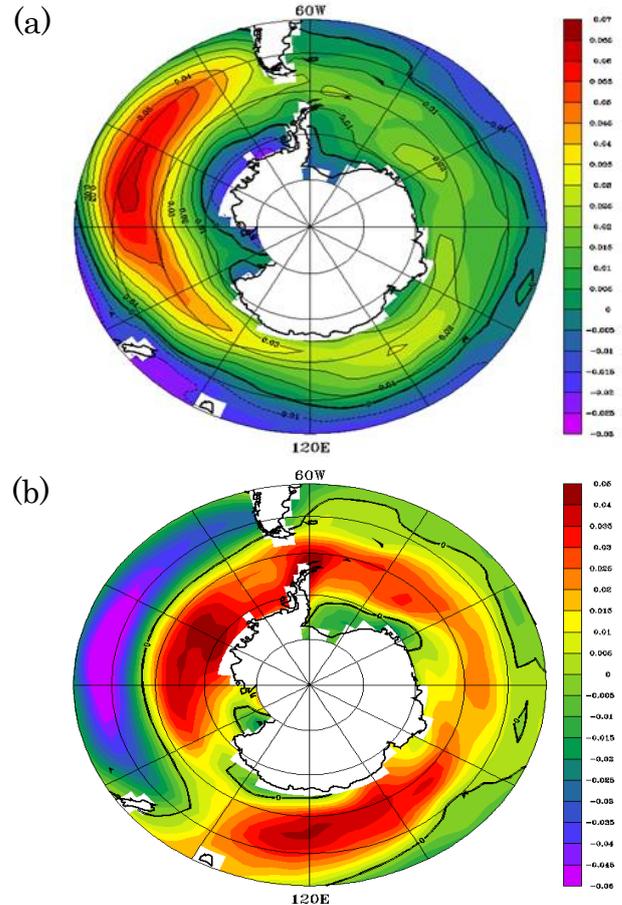


Fig1. Spatial pattern of the 1st (a) and 2nd (b) EOF modes for the zonal wind. These are calculated by 12-month running mean time series from 1975 to 2014.

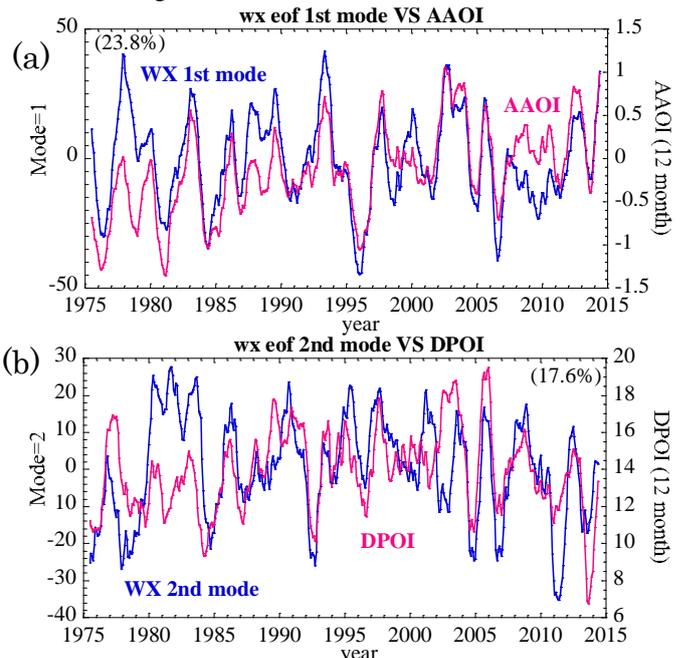


Fig2. Time series of scores of the 1st (a) and 2nd (b) EOF modes of the zonal wind. Time series of AAOI (a) and DPOI (b) are overplotted.