Temporal and spatial variability of atmosphere and ocean in the Southern Ocean

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The variability of atmospheric circulation in the Southern Ocean (SO) is dominated by a zonally symmetric pattern, that is the Southern Annular Mode (SAM) (Thompson and Wallace, 2000), which is characterized by a dipole in the westerly winds with opposing centers between mid- and high-latitudes. Especially, the westerly winds prevail in the Drake Passage, suggesting key area of oceanic and atmospheric variations. Our previous study focusing on structures in surface oceanic layer near the Drake Passage clarified that their year-to-year variations have relationships with the DPOI which is a good indication of surface winds across the Passage and related to the Krill recruitments (Naganobu et al., 1999, 2008). In addition, we examine year-to-year variations in the surface wind field over the SO characterized by the DPOI, and detected another variation associated with the meridional shift of the westerly wind area over the Southern Ocean (Indian-Pacific-Atlantic sector) and having high correlation with the DPOI (Yagi et al., 2017). However, the influence of DPOI-related variation in the surface winds on the oceanic field still remains unclear. In this study, we investigate relationships between the sea-surface-temperature (SST) and surface wind variations over the SO.

The leading mode, derived from the empirical orthogonal function (EOF) analysis for the monthly-mean zonal wind field, has a contribution of 55.5% with maxima on the Drake Passage. The score of this mode has a high correlation with the DPOI (0.94), so is related to the DPOI. Its spectrum has significant peaks at the periods of 6-month and 12-months, and another peak at the periods of 30-months. We focus on variabilities with time scales of about 3 years. To examine relationship between the DPOI-related surface wind and SST over the SO, we derive time series of the score of the 1st EOF mode for the zonal wind which are band-pass filtered for periods around 3 years, and examine its spatial correlations with the SST field. Results reveal that high correlations are found over the entire SO region. Spatial correlations indicate that there are negative areas to the west of the Drake Passage and positive ones to the east of it, and maxima in the Ross and Weddell seas. Relationships will be examined between surface wind and SST fields in these regions in detail.

Keywords: Westerly Wind, DPOI, Air-Sea interaction

