Seasonal dependency of air-sea interaction near the Drake Passage

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1. Introduction

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), and it is related to the strength of westerly winds and affect large change of ecological environment in the Antarctic/Southern Ocean during recent decades (Morioka et al., 2015; Naganobu et al., 2014; IPCC, 2013; Rintoul et al., 2016).

The present study focuses on structures of surface layer in the area near the Drake Passage, and clarifies their year-to-year variations and relationships with the DPOI which is a good indication of surface winds across the Passage and has been related to the Krill recruitments by Naganobu et al. (1999, 2008). In addition, we examine what time and space scales year-to-year variations in the surface wind field over the SO characterized by the DPOI have on. One is associated with the meridional shift of the westerly wind area especially in the Pacific sector and with high correlation with the DPOI (Yagi et al., The 6th Symposium on Polar Science 2015). In this study, we focus on air-sea interaction in each parameter (e.g. surface winds and sea surface temperature) each season near the Drake Passage.

2. Results

We find that standard deviation (SD)s in the zonal wind fields have high values in areas near the Drake Passage in austral summer (Dec-Jan-Feb, Fig. 1). The time series of the zonal wind in the high SD areas has a high positive correlation with the DPOI, respectively (0.92, 0.76 Fig. 2). Furthermore, in periods when the DPOI-related signal has high amplitude, largest anomalies cover a zone of 50°-65°S, associated with wavy pattern in the each sector (Indian, Pacific, Atlantic), and the surface winds near the Drake Passage are directed to cross direction of the Passage (Fig. 3). This suggests that the westerly winds over the SO changes with the meridional shifts especially in austral summer.

These mechanisms and air-sea interaction will be examines in further studies.

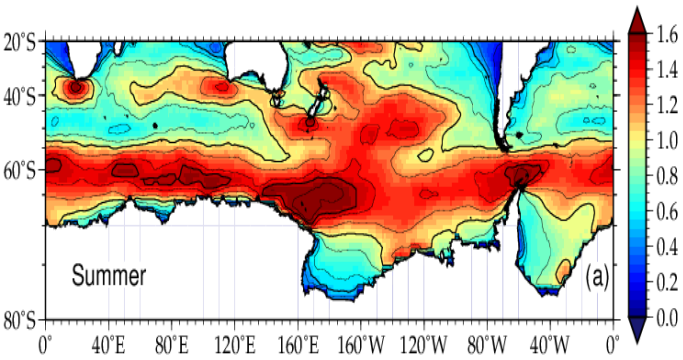

Fig. 1 Standard deviation for zonal wind over the Southern Ocean during 35 years 1981 to 2015 austral summer.

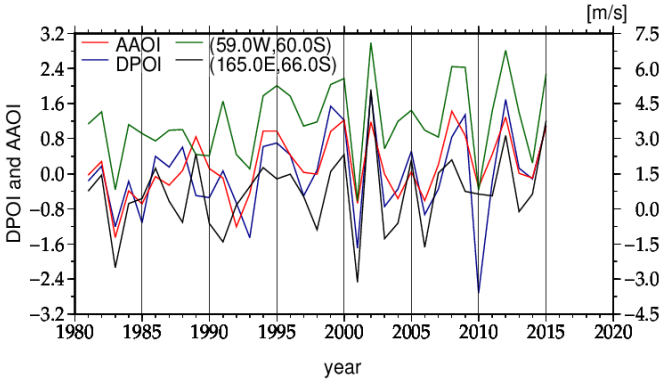

Fig. 2 Time series of DPOI (blue line) and AAOI (red line). Time series of zonal wins in the high SD areas (green and black lines) are overplotted.

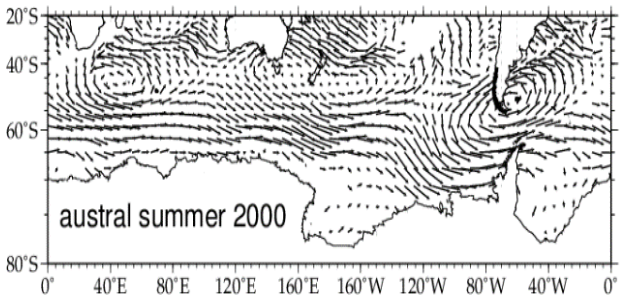

Fig. 3 Anomaly field of the surface wind in 2000 austral summer in which the DPOI have high amplitude over the Southern Ocean.