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Wind forced variability of the Antarctic Circumpolar Current south of Africa between 1993 and 2010

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Abstract

The variability of the Antarctic Circumpolar Current (ACC) system is largely linked to atmospheric forcing. The objective of this work is to assess the link between local wind forcing mechanisms and the variability of the upper-ocean temperature and the dynamics of the different fronts in the ACC region south of South Africa. To accomplish this, in situ and satellite-derived observations are used between 1993 and 2010. The main finding of this work is that meridional changes in the westerlies linked with the Southern Annular Mode (SAM) drive temperature anomalies in the Ekman layer and changes in the Subantarctic Front (SAF) and Antarctic Polar Front (APF) transports through Ekman dynamics. The development of easterly anomalies between 35_S and 45_S during positive SAM is linked to reduced (increased) SAF (APF) transports and a warmer mixed layer in the ACC. The link between the changes in the wind stress and the SAF and APF transport variations occurs through the development of Ekman pumping anomalies near the frontal boundaries, driving an opposite response on the SAF and APF transports. The observed wind-driven changes in the frontal transports suggest small changes to the net ACC transport. In addition, observations indicate that the SAF and APF locations in this region are not linked to the local wind forcing, emphasizing the importance of other factors (e.g., baroclinic instabilities generated by bottom topography) to changes in the frontal location. Results obtained here highlight the importance of repeat XBT temperature sections and their combined analysis with other in situ and remote sensing observations.