A global high-resolution analysis of ocean vector wind fields merged from 12 satellite sensors from 1987 onwards has been recently developed by the Objectively Analyzed air-sea Fluxes (OAFlux) project. The 25-year OAFlux vector wind analysis suggests that poleward shift of Southern Hemisphere (SH) westerlies is the most dominant decadal pattern over the global oceans. It is found that the SH westerly band has shifted at a rate of 0.33° per decade, which is comparable to the rate of shift of the Antarctic Circumpolar Current (ACC) fronts derived from satellite altimeters. The coherent displacement in surface westerlies and the ACC fronts raises a question as to whether the shifted ACC fronts are a response to the shift of SH westerlies, or there is a degree of feedback interaction between the ACC fronts and SH westerlies. By using satellite SST and SSH observations, we identified a striking coupling between OAFlux wind stress curl and the gradients of SST and SSH along the ACC fronts. In this study, the mechanism of the coupling between SH westerlies and the ACC fronts is investigated and implications of the feedback interaction are explored.