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Upper ocean salinity variabilities in the Southern Ocean responding to the recent surface salting in perspective of climate changes

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Water cycle have prevailed on upper ocean salinity acting as the climate change fingerprint in the numerous observation and simulation works. Water mass in the Southern Ocean accounted for the increasing importance associated with the heat and salt exchanges between Subantarctic basins and tropical oceans. The circumpolar deep water (CDW), the most extensive water mass in the Southern Ocean, plays an indispensable role in the formation of Antarctic Bottom Water. In our study, the observed CTDs and reanalysis datasets are examined to figure out the recent salinity changes in the three basins around the Antarctica. Significant surface salinity anomalies occurred in the South Indian/Pacific sectors south of 60°S since 2008, which are connected with the enhanced CDW incursion onto the Antarctic continental shelf. Saltier shelf water was found to expand northward from the Antarctica coast. Meanwhile, the freshening of Upper Circumpolar Deep Water(UCDW), salting and submergence of Subantarctic Mode Water(SAMW) were also clearly observed. The modified vertical salinity structures contributed to the deepen mixed layer and enhanced intermediate stratification between SAMW and UCDW. Their transport of salinity flux attributed to the upper ocean processes responding to the recent atmospheric circulation anomalies, such as the Antarctic Oscillation and Indian Ocean Dipole. The phenomena of SAMW and UCDW salinity anomalies illustrated the contemporaneous changes of the subtropical and polar oceans, which reflected the meridional circulation fluctuation. Salinity changes in upper southern ocean (< 2000m) revealed the influence of global water cycle changes, from the Antarctic to the tropical ocean, by delivering anomalies from high- and middle-latitudes to low-latitudes oceans.