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Recent trends in the upper ocean salinity for the tropical Indo-Pacific and decadal shift in mid-1990s

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As an indicator of the global hydrological cycle, ocean salinity is an essential factor in the large scale climate variability (Schmitt, 2008, Oceanography). The sea surface salinity (SSS) in the global ocean can be well reflected in the pattern of air-sea freshwater flux, the evaporation and precipitation (Yu et al., 2007, JC). Previous studies revealed that the western tropical Pacific (WTP) was freshening since 1950s, as the most significant salinity change over the global ocean (e.g. Boyer et al., 2005, GRL; Cravatte et al., 2009, CD). It resulted from an increase of global hydrological cycle in a global warming scenario, constrained by the Clausius-Clapeyron relationship (Held and Soden, 2006, JC). However, a remarkable hiatus of the global warming has occurred since the beginning of the 21th century (Meehl et al., 2011, Nature Climate Change), which is tied to a strengthening Pacific trade winds and sea surface temperature (SST) cooling in the eastern equatorial Pacific (e.g. Tokinaga et al., 2012, Nature; Kosaka and Xie, 2013, Nature; England et al., 2014, NCC).

Argo profiles provide unprecedented salinity observations in global coverage. Robust SSS trends are found in the tropical Indo-Pacific, recorded in Argo since 2004 but started from mid-1990s in reconstructed salinity dataset. The analysis of atmospheric fields reveal that the intensification of the Walker Circulation is the cause of SSS trends. It enhances the precipitation over the Marinetime Continent and adjacent ocean and reduces precipitation over the central tropical Pacific, resulting in WTP salty and SCS-SETIO fresh. From a view of longer time scale, the present salinity trends start a few years before the Global Warming Hiatus, which terminate the trends since 1970s, and implying a dominated decadal shift in the tropical Indo-Pacific in mid-1990s

Keywords: salinity, decadal shift, tropical Indo-Pacific, Global Warming Hiatus, Argo float, Walker Circulation