

## Long-term change and variation of salinity in the western North Pacific subtropical gyre revealed by 50-year long observations along 137°E

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The 137°E repeat hydrographic section for 50 winters during 1967–2016 has been analyzed to examine interannual to interdecadal variations and long-term changes of salinity and temperature in the surface and intermediate layers of the western North Pacific, with a particular focus on freshening in the subtropical gyre. Rapid freshening on both isobars and isopycnals began in mid-1990's and persisted for the last 20 years in the upper main thermocline/halocline in the western subtropical gyre. In addition, significant decadal variability of salinity existed in the Subtropical Mode Water (STMW), as previously reported for the shallower layers. An analysis of the 144°E repeat hydrographic section during 1984–2013 supplemented by Argo profiling float data in 2014 and 2015 revealed that the freshening trend and decadal variability observed at 137°E originated in the winter mixed layer in the Kuroshio Extension (KE) region and was transmitted southwestward to 137°E 1–2 years later in association with the subduction and advection of STMW. The mechanism of these changes and variations in the source region was further investigated. In addition to the surface freshwater flux in the KE region pointed out by previous studies, the decadal KE variability in association with the Pacific Decadal Oscillation likely contributes to the decadal salinity variability through water exchange between the subtropics and the subarctic across the KE. Interdecadal change in both the surface freshwater flux and the KE state, however, failed to explain the rapid freshening for the last 20 years.

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