

Small water mass transport across the Kuroshio Extension region in the thermocline by Seaglider and BGC Argo floats: Hints of integrated ocean observations

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Integrated ocean observations make it possible to realize detailed information of water mass modifications or their exchanges rather than any single observation only. Regarding water mass across the Kuroshio Extension, clarifying not only their physical mechanisms but also their spatial and time scales are crucial to understand heat, freshwater and materials budget. Especially in the northwestern North Pacific Ocean, deep mixed layer is actively formed by strong winter cooling, and major water masses, such as STMW, CMW, and NPIW, are broadly produced. Based on the situation, we observed small water mass characteristics and their changes by autonomous in-situ measurement tools. One was BGC Argo floats and the other was a Seaglider. In 2011-2012, over 30 BGC-Argo floats with dissolved oxygen sensors had been deployed around 30N,145E within a framework of S1-INBOX project in JAMSTEC, which aimed to clarify small scale physical and geochemical processes of a mesoscale eddy. Further, the Seaglider had launched in 2014 around the south of Kuroshio Extension to investigate water mass formation and modification process, continuously operating for 4 months. The Seaglider is able to measure sea water temperature, salinity and dissolved oxygen every 4-6 hours, diving from surface to 1000 dbar. The profiling data were also delivered every 1-10 km of fine horizontal resolution. From these observations, we obtained detailed temperature, salinity and oxygen data with dense spatial and temporal resolutions in the Kuroshio Extension. The analysis of the Seaglider data shows that small water mass with low salinity and/or low dissolved oxygen were observed in the lower thermocline ($26.0\text{-}26.8\sigma_{\theta}$) during middle of April to early May, whose scales were \sim a few ten kilometers for horizontal width and \sim a few ten meters for vertical thickness. Based on apparent oxygen utility (AOU) analysis, the small water mass had characteristics of less amount of oxygen consumption, suggesting that the water mass took shorter time after contacting atmosphere than surrounded water. Also, the water parcels subducted from subpolar northwestern North Pacific region to the north of the Kuroshio Extension. Similar small water parcels with the same characteristics had been observed by the BGC Argo floats operating in the S1-INBOX project. Here we discuss a possibility of integrated ocean observations with BGC- Argo and Seaglider to clarify a detailed oceanic variability more than ever, showing scientific results based on the individual tools and comparing with a high-resolution numerical model.

Keywords: Dissolved oxygen, BGC Argo, Integrated ocean observation