

Toward further understanding of central mode water formation and circulation

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The North Pacific has several mode waters, which are water masses characterized by low vorticity. Among them, central mode water (CMW) was first reported as pycnostad at $\sigma_\theta = 26.0\text{--}26.5 \text{ kg m}^{-3}$ (Nakamura, 1996) or thernostad at $10^\circ\text{--}13^\circ\text{C}$ (Suga et al. 1997). Subsequently, Oka and Suga, (2005) showed that CMW can be divided into two types: lighter variety of modal water (L-CMW) with $\sigma_\theta = 25.8\text{--}26.2 \text{ kg m}^{-3}$ and denser variety type of modal water (D-CMW) with $\sigma_\theta = 26.3\text{--}26.4 \text{ kg m}^{-3}$. While climatological data (Suga et al., 2004, 2008) have shown that the distribution of the CMW is largely consistent with ventilation temperature dynamic layer theory (Oka et al., 2009), ship-based synoptic observations suggest that mesoscale subduction is occurring across the Kuroshio Extension in a southerly direction. Suga et al. (2013) suggested, based on a comparison of synoptic XCTD observation cross sections and climatological value data that traverse the formation and distribution regions of transition region mode water (TRMW) and D-CMW, suggested that some of the low eddy level water that forms and sinks in and around the subarctic front region is transported south across the mean flow by the mesoscale-eddy. The way radionuclides from the Fukushima Daiichi nuclear accident spread inside the ocean (Aoyama et al., 2016) also suggests transport of CMWs in the direction across the mean flow streamline by mesoscale processes below the medium-scale eddy. Nakano et al. (2021) used Lagrangian particles in an eddy-resolving OGCM and suggested that a part of L-CMW crosses the Kuroshio Extension when cyclonic eddies are pinched off from the troughs of the Kuroshio Extension, reaching the 137°E section within 2 years. Our knowledge of the process by which CMWs formed in the northern margin of the subtropical circulation spread into the interior of the circulation system is fragmentary, and a unified picture has not been established. In this presentation, we will review previous studies related to this issue, summarize the issues, and discuss approaches to solving them.

Keywords: Central mode water, North Pacific, mesoscale-eddy