

Temporal variations of Kuroshio transport based on a repeated hydrographic section along 137E

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Kuroshio is the western boundary current in the North Pacific subtropical gyre. It flows northeastward along the south coast of Japan. The Kuroshio has its origin in tropical region, and plays an important role for heat transport from low-latitude to mid-latitude North Pacific. Through its heat transport, the Kuroshio has a significant impact on basin-scale climate in the North Pacific. Therefore, in order to understand climate variability in the North Pacific, it is important to monitor and understand a temporal variation of the Kuroshio transport.

Past works reported that the Kuroshio transport fluctuates on decadal (about 10 years) and bi-decadal (about 20 years) timescales, responding to changes in the winter atmospheric field which reflects Aleutian Low activities. However, the length of Kuroshio transport time series used in the previous studies is about 35 years at most, and it cannot be said that low-frequency variations like decadal and bi-decadal timescale variations are detected robustly. The Japan Meteorological Agency has repeated ship-board observations along 137E across the Kuroshio since 1967 in winter and 1972 in summer. This long-term observational data is powerful tool to investigate the Kuroshio transport variation. In this study, we examine the Kuroshio transport variation based on the repeated hydrographic sections along 137E.

We estimate the Kuroshio transport by vertical and meridional integration of zonal geostrophic velocity. In this study, we focus on net eastward transport across the 137E section (hereafter, referred as net Kuroshio transport). The net Kuroshio transport is calculated by subtracting westward transports associated with the cold-core eddy and Kuroshio Counter current in the north and south of the Kuroshio from eastward Kuroshio transport.

The net Kuroshio transport fluctuates on inter-annual, decadal, and bi-decadal timescales. The inter-annual variation is detected before 1985 and after 2000, and the decadal variation is dominant before 2000. The bi-decadal timescale is detectable throughout the analysis period. As shown by previous studies, the net Kuroshio transport variation is caused by changes of the winter atmospheric forcing. We confirmed that the net Kuroshio transport responds to changes of winter wind stress curl (WSC) in the central North Pacific with a lag of two years.

To examine temporal variations of winter WSC field in the North Pacific subtropical gyre, we next performed an EOF analysis. As a result, the mode-1 is linked to a meridional movement of the Aleutian Low which has an inter-annual timescale before 1980 and after 1995, and the mode-2 reflects an Aleutian Low intensity fluctuation with a decadal timescale before 2000 and bi-decadal timescale throughout the analysis period. A correlation analysis shows that the winter WSC in the central North Pacific resulting in the net Kuroshio transport variation well reflects mode-2, especially before 2000 when the Aleutian Low intensity fluctuation has a decadal timescale. In addition, the winter WSC in the central North Pacific relatively well correlates to also mode-1 after 1985 and before 2000 when the meridional Aleutian Low movement has an inter-annual timescale. These results suggest that the winter WSC in the central North Pacific is determined by the Aleutian Low intensity fluctuation on decadal and bi-decadal timescales whereas influenced by the meridional movement of the Aleutian Low on an inter-annual

timescale.

From the above results, we concluded that the net Kuroshio transport variation on an inter-annual timescale is caused by the meridional Aleutian Low movement, and that on decadal and bi-decadal timescale results from the Aleutian Low intensity fluctuation. It can be also pointed out that temporal changes of timescales in the net Kuroshio transport derives from changes of timescales in the Aleutian Low activities.

Keywords: Kuroshio transport, Repeated hydrographic section along 137E, Aleutian Low