The Purpose of research and the abstract of accomplishments:
Main research theme is to investigate an air-sea coupled system on low-frequency timescales; about 10-years (decadal) to 20-years (interdecadal) timescales. It is known that numerous phenomenons have the low-frequency timescales; for instance, sea surface temperature around Japan and a location of axis of the Kuroshio Extension. The Aluation Low (AL) is located in the central North Pacific and also has long-term variations. Therefore, it is expected that the AL causes the low-frequency variations in the upper ocean field.

In this year, I investigated the temporal evolution of the AL in terms of the intensity and the location, and then explored how the AL gave an impact on the upper ocean field, such as sea surface temperature and the Kuroshio transport.

1. The temporal features of the AL are investigated in terms of the intensity and the location. The intensity, latitudinal position, and longitudinal position of AL reveal different temporal variations: the longitudinal shift accompanies intensity variation with an interdecadal timescale and the latitudinal shift does with a decadal timescale. The AL intensity variation and the longitudinal shift are related to activity of the Pacific/North American teleconnection pattern: in a strengthening (weakening) phase of AL, the AL shifts eastward (westward); westerlies strengthen (weaken), and both subtropical and subpolar gyres spin-up (spin-down) simultaneously. The latitudinal shift is associated with activity of the West Pacific teleconnection pattern. It is independent of the intensity variation of AL: when the AL shifts northward (southward), the westerlies correspondingly move northward (southward). Consequently, the gyre boundary, which is defined by the zero line of the Sverdrup stream function, also shifts northward (southward).

2. The role of AL north–south shift on the upper oceanic variations is investigated by using a wind-driven hindcast model. The oceanic Rossby wave formed as a result of the baroclinic response for the AL movement influences the sea surface temperature in the Kuroshio-Oyashio Extension region.

3. Temporal variations of the net Kuroshio transport are explored using long-term hydrographic data from investigation of a repeat section of the 137°E meridian conducted by the Japan Meteorological Agency. The net Kuroshio transport reveals low-frequency timescales: significant signals on decadal and interdecadal timescales. The variations of net Kuroshio transport are predominantly caused by changes in the magnitude of oceanic current velocity fields associated with an upward–downward movement of main pycnocline depth around the southern boundary of the Kuroshio; A deepening of the main pycnocline forms a sharp northern
upward tilting slope of the isopycnal surfaces at the Kuroshio region, and eventually the net Kuroshio transport increases. By using a wind-driven hindcast model, it is found that the main pycnocline depth variation results from the first-order baroclinic response attributable to two types of AL activities: a change in the magnitude of AL and meridional movement of AL.

4. To understand the formation of North Pacific subtropical mode water (STMW) in the Kuroshio recirculation gyre region, the cause of STMW thickness variation is investigated using temperature profiles in a historically archived dataset. The thickness variation is predominantly controlled by the main thermocline depth (MTD). When the main thermocline deepens (shoals), the wintertime mixed layer depth can develop (not develop), and consequently, thicker (thinner) STMW is observed in summer. The large-scale atmospheric forcing controlling the MTD is explored using a wind-driven hindcast ocean model. The MTD variation stems primarily from a baroclinic response in the ocean to the AL activity; especially, the meridional movement of the AL exerts a remarkable influence.

5. Adopting a rotated empirical orthogonal function (REOF) analysis and a maximum covariance analysis (MCA), characteristics of the wintertime wind stress curl (WSC) anomaly field in the North Atlantic are investigated. In terms of both temporal variation and spatial distribution, the first four leading modes of WSC show a one-to-one relation with four atmospheric teleconnection patterns over the North Atlantic sector: the North Atlantic Oscillation (NAO), Eastern Atlantic (EA), Tropical/Northern Hemisphere (TNH), and Pacific/North American (PNA) patterns, respectively. These four patterns characterize the WSC variations over the different regions in the North Atlantic: NAO and EA over the eastern side of the basin, TNH over the central part of the basin, and PNA over the western side of the basin.

Publications:
Journals: