

Structure of Meridional Circulation in Southern Ocean captured by long term Mooring

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The deep Global circulation is a large-scale thermohaline circulation over the Earth and plays an important role in maintaining a stable climate. In recent years, as freshening of Antarctic bottom water is being observed in various places and it is expected to be related with Southern Ocean meridional circulation (S-MOC), to clarify its mechanism and quantify the S-MOC, we deployed mooring (January 2017 - January 2018) at 61S-110E by TR/V Umitaka-Maru.

The annual mean current velocity [u, v (cm / s)] obtained with 5 current meters are [2.15, -1.26] at 429db, [1.46, -0.88] at 859db, [0.26, -1.26] at 1918db, [-1.32, -0.78] at 3366db, and [-1.65, -1.77] at 4080db. In northward component v , it is slightly larger at the lowest layer, but in other depths it shows southward flow of about 1 cm/s. The annual averages of current velocity showed the southward velocity of about 1cm/s with almost barotropic structure, whereas baroclinic structure in the eastward component. Magnitude of the southward current almost agreed with the Pena-Molino et al. (2016)'s result. Furthermore, the annually averaged southward velocity almost agreed with estimated magnitude of Sverdrup transport.

Although annual mean southward flow suggests southward advection of temperature and salinity structure, the gradient of temperature and salinity in the meridional section is maintained and being at the steady state. Thus, it is thought that the horizontal advection balances with the horizontal diffusion in the first order approximation, conservation equation for temperature θ in steady state is given by $v\partial\theta/\partial y = K_h(\partial^2\theta)/(\partial y^2)$, where v is meridional current velocity, and K_h is the horizontal diffusivity coefficient induced by mesoscale eddy. From temperature and salinity section data, horizontal diffusive coefficient was estimated to be $K_h \approx 500 \text{ m}^2/\text{s}$.