

Southern Ocean: the key factor of climate change

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Ocean keeps a lot of heat, oxygen, CO₂, and nutrients, and transports these to the world ocean by the global ocean circulation. Polar oceans having sea ice is "Canary of Climate", and are very sensitive to the climate change, e.g., the global warming. Antarctic Bottom Water (AABW) formed in the Southern Ocean is the main actor for these two mechanisms, however, it is still difficult to clarify the whole image of AABW only by the in-situ observation. Our purpose is the estimation of AABW formation, sinking process, and its spread in the bottom layer by the numerical modeling, by using the following three different methods; monitoring of sea ice production by the satellite remote sensing, high-resolution mapping of water temperature and salinity by in-situ observation, and numerical modeling by high-resolution model. This study is challenging to the final and most difficult blank area for the global climate system, and could contribute to the prediction of future climate change.

By our recent results, we got the following two progresses; (1) hemispheric-scale and long-term monitoring of sea ice production which directly links to the AABW formation becomes possible by the accumulation of satellite data and the development and improvement of the algorithms (Tamura et al., 2008) and (2) the result from the numerical modeling could compare to the in-situ results directly by the improvement of the numerical model (Matsumura and Hasumi, 2011). Under these our past works, it is possible to detect the actual dynamics of AABW by the following three independent methods; (a) monitoring of sea ice production by the satellite remote sensing, (b) high-resolution mapping of water temperature and salinity based on the in-situ observation data, and (c) high-resolution ocean modeling.

This study try to clarify the process of AABW formation quantitatively by using our dataset, algorithm, and numerical model. Specifically, our purpose is to estimate the AABW formation, its sinking process, and its expansion in the bottom layer. By using the latest in-situ and satellite data and numerical modeling, we try to clarify the following three questions; Where and how much does the dense water (the origin of the AABW) generate?, How much does the dense water mix with the surrounding water during the process of sinking around the shelf break?, and Where and how much does the AABW exist in the bottom of the world ocean and how does AABW spread?

In our talk, we will introduce updated results for our three ongoing projects; (I) mapping of sea ice production by the satellite remote sensing, (II) improvement of in-situ ocean observation data set, (III) ice shelf-sea ice-ocean coupled modeling, and (IV) micro-scale modeling.

Keywords: Southern Ocean, Antarctic Bottom Water, Sea Ice Production, In-situ Ocean Observation Data Set, Ice shelf - Sea ice - Ocean Interaction, Micro-scale Modeling