Estimation of changes in salinity and dissolved oxygen based on observational networks

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Changes in temperature and salinity can be captured by Argo float networks more clearly than before the 2000s. For example, the global changes in ocean heat content can be comparable to the ones in sea surface height and net radiative flux into the earth system. Furthermore, various studies have been focusing on the changes in water masses, especially around surface layers. However, quantitative evaluation of regional changes has not been sufficiently clarified. For example, the salinity changes in the deeper layers cannot be easily captured by a float observation due to measurement uncertainty, and the changes in dissolved materials (ex. dissolved oxygen) remained not to be observed sufficiently. In this study, with the combination of autonomous observations and high accurate ship-based observations, we try to examine the possibility to capture and evaluate more accurately long-term changes with observation network.

As the first step, I will present the results based on the monthly salinity (temperature) distributions on the isopycnal surfaces obtained from Argo float observations. Based on the dataset, the long-term mean circulation with the spatial distribution of diffusivity coefficients was estimated, and the budgets for salinity (and temperature) changes in the recent decade were calculated. Especially, in the deeper layer (below 400m), the diapycnal diffusion effects were relatively large to the salinity (and temperature) increases. The salinity (and temperature) increases on the isopycnal surfaces might be consistent with the temperature increased on iso-depths. As the large-scale patterns of the changes revealed by the datasets were similar to the ones detected by twice occupations of the highest accurate observations, the salinity (and temperature) changes in this study were not so much influenced by biases in autonomous measurements (especially of salinity), and the present observation systems might be able to detect such small changes potentially.

The dissolved oxygen budgets were also estimated in the North Pacific with a long-term climatological distribution of the oxygen. The residuals of the budgets seemed to be consistent with the oxygen utilization estimation in previous studies. However, in some regions, temporal changes in oxygen, which included in temporal changes due to the changes in circulations and biological activities, were in the same order of magnitude of the residuals. Thus, spatial and temporal dense (and relatively high accurate) observation network will be needed to clarify the roles of mean biological activities on oxygen circulations as well as the temporal variabilities.

In the presentation, I will show some results of comparisons with assimilation or numerical models, and the other results (regional changes) appearing in the dataset.

Keywords: ocean observations, long-term ocean variability

