Spatial and temporal variability of temperature and salinity in the global ocean from Argo float data

*Shigeki Hosoda[1], Kanako Sato[1]

1. Japan Marine-Earth Science and Technology

Statistical analysis for spatial and temporal variability of oceanic temperature and salinity, especially focusing on decorrelation length and signal/noise ratio, is carried out using long-term accumulated Argo float data.
It has been passed 16 years since International Argo program started. The number of active Argo float exceeded 3000 in late 2007, which is the first target in the Argo program, and then the number of accumulated profile data got to 1,000,000 in 2011. As the global Argo observation array is producing real-time oceanic data each horizontally 3x3 degrees every 10 days, we are able to have a huge amount of temperature and salinity data from sea surface to 2000 dbar in the global ocean. The long-term huge Argo data enable us get statistical information of spatial and temporal variability accurately.
Previously such kind of statistical information were estimated for mainly temperature field using eXpendable BathyThermograph (XBT) data (e.g., White, 1995; Meyer et al., 1982). However, sampling area of XBT data is temporally and spatially biased because of limited observational or voluntary ship courses. Recently statistical analyses were carried out using a huge amount of Argo float data to investigate statistical structure of longer term spatial variability on oceanic fields of not only temperature but also salinity. For example, Resnyanskii et al. (2010) showed spatial covariance and signal/noise ratio for separated temperature and salinity fields into 12 areas using Argo data for 2005-2007, and discussed the characteristics of statistical structures depending on areas, temperature/salinity and depth qualitatively. However, they directly analyzed only spatial covariance, indirectly guessed temporal one by global average current velocity.
Using 16-year Argo float data, here we show 4-D statistical structures of accurate decorrelation length and signal/noise ratio, referring the analytical method of Resinyanskii et al. (2010).
Used Argo profiling data are delayed mode quality controlled temperature and salinity in Jan. 2001 - Dec. 2016 obtained from the Argo Global Data Assembly Centers (GDACs) and the Advanced Quality Controlled data (AQC), which is well quality controlled dataset for real-time QC Argo data. Anomalies are calculated from monthly climatology of World Ocean Atlas 2013 (WOA2013: Locarnini et al.,2013; Zweng et al., 2013) to remove seasonal variability. Here we separate the global ocean into 25 areas, which is finer than in the previous study. After sorting all profiling data for each areas, the profiling data are interpolated on 23 levels from 10 to 2000 dbar (Akima, 1970). Then covariance of anomalies are calculated for temperature and salinity fields, sorting into 20km bins of zonal and meridional distances between observations from 0 - 3000km, respectively. Temporal covariance is also calculated from sorted profiling data into 5-day bins from Jan. 2001 to Dec. 2016, referring spatial covariance estimated above. Based on these temporal and spatial covariance maps, we then estimate decorrelation lengths for time, horizontal and vertical directions every areas.
The temporal and spatial covariance exponentially decrease with distances in all area, which are qualitatively similar to the previous study except for temporal covariance that is the first time to analyze in this study. However, some differences of spatial structures on decorrelation length and signal/noise ratio in the previous study are detected in the spatial covariance of temperature and salinity, especially in the difference between temperature and salinity, surface and deeper layers. These results are obtained because of sorting finer area separation into 25 areas and using long-term Argo float data.
The basic statistical information in this study is estimated based only on the purely observational data

from the global Argo array. Therefore, this information is expected to be useful for not only applications for objective analyses and optimal interpolation mapping but also improvement and validation of data assimilation and numerical simulation models.

Keywords: Decorrelation length of oceanic variability, Argo, Global ocean

