P08
International Workshop of Hotspot3 (Jul.16,2025)

Observation-based seasonal change in decorrelation length of the physical parameters and corrected dataset of MOAA GPV

*Shigeki Hosoda[1,2]
[1] Japan Marine-Earth Science and Technology, [2] WPI AIMEC
E-mail: hosodas@jamstec.go.jp

Keywords: Argo, Gridded dataset, Mixed layer, optimal interpolation

Introduction

The monthly gridded dataset of oceanic temperature and salinity with horizontal 1 x 1 degree grid, MOAA GPV, which is estimated by Argo's global observational data, is available via JAMSTEC's website, and a 10-day vertical high-resolution gridded dataset has been made (MOAA ver2). From 2024, two types of data sets are available using Argo float profiles:

- NRT: quasi-real-time using AQC data set,
- DM: delayed mode quality control using dmQC data.

These data sets are interpolated by optimal interpolation in two horizontal dimensions (OI), and the statistics of the decorrelation radius and signal-to-noise ratio are given a priori as a function of latitudinal depth dependence based on historical observations as a few degrees ~ 10 degrees in meridional direction and several degrees ~ 20 degrees in zonal direction.
Although the OI for the horizontal direction is conducted over a wide area, no OI is performed in the vertical direction, calculating values on vertical layer independently. This potentially causes density inversion layers in the surface layers. Such “artificial” density inversions near the surface is actually existed, mainly appearing in the frontal region such as the Kuroshio Extension and high latitude areas. The density inversion also makes estimate mixed layer depth to be shallower or deeper.
In this study, we consider an idea that a time-varying decorrelation radius is applied to the existing horizontal decorrelation radius as a weight function. The procedure makes the gridded data set correct with the decorrelation radius seasonally. By this procedure, it is expected that the vertical profiles at each grid point are appropriately corrected.
Here we describe appearance of density inversion and influence to MLD. Then we provide decorrelation radius in seasonal temperature changes.

Argo gridded dataset: MOAA GPV ver2

Argo gridded data set MOAA GPV (Grid Point Value of the Monthly Objective Analysis using the Argo data) published by JAMSTEC (Hosoda et al., 2008) is created using 2-dimensional optimal interpolation method. This dataset has been used to analyze temperature and salinity up to 2000 dbar depth since January 2001, and is available on the Web site (https://www.jamstec.go.jp/argo_research/dataset/moaagpv/moaa_en.html). In addition, the potential density, dynamic height are calculated based on these data and are provided.

1) Differences between MOAA GPV v2.0 and v1.3
Table 1: MOAA GPV V2.x settings and usage data and differences from V1.3.

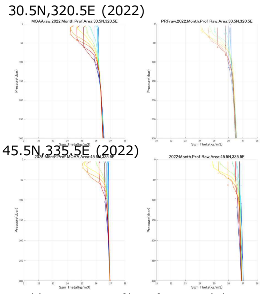
	MOAA GPV V1.3	MOAA GPV V2.0
Method	2-D Optimal interpolation (Lat x Lon)	3-D optimal interpolation (Lat x Lon x Time)
Analysis	Temperature and salinity on pressure surface	
Products	Temperature, salinity, potential density, dynamic height	
Area and depth	70.5N-60.5S, 179.5W-179.5 ° E, 10~2000dbar, Excluding marginal seas	70.5N-70.5S, 179.5W-179.5E, 5~2000dbar, Including marginal seas
Resolution	1°×1° Horizontally, 25 levels vertically (10,20,30,50,75,100,125,150,200,250,300,400,500,600,700,800,900,1000,1100,1200,1300,1400,1500,1750,2000 dbar)	1°×1°Horizontally, 66 levels vertically (Every 5 dbar in 5-100dbar, 25 dbar in 125-500dbar, 50 dbar in 550-2000dbar)
Period and time	Jan. 2001, monthly	Jan. 1st, 2001, every 10 days Jan. 2001 monthly
Climatollogy for 1st guess	WOA01 (World Ocean Atlas 2001): Monthly climatology above 1500dbar, Seasonal climatology below 1500 dbar	WOA13 (World Ocean Atlas 2013)): Monthly climatology above 1500dbar, Seasonal climatology below 1500 dbar
Standard deviation	Annual mean standard deviation from WOA01	Annual mean standard deviation from WOA13
Used params for OI	Temperature and salinity anomaly calculated from climatology on pressure surface	
Decorrelation radius	Lat x Lon x Depth from White (1995)	Lat x Lon x Depth from White (1995), 15 days or 30 days for time window
Estimation error	The estimated error variance is the variance of the water temperature and salinity fields minus the weight of the data. At an estimated point with zero data, the error variance is 1 and the estimated value is the climate value itself.	

The following temperature and salinity profile data are used with quality controll.
Argo data provided by GDAC: The AQC ver1.2 dataset provided by JAMSTEC which is corrected rQC data to create the dataset in quasi-real time. (https://www.jamstec.go.jp/argo_research/dataset/aqc/aqc_ja.html, Argo DOI: Argo (2019). Argo float data and metadata from Global Data Assembly Centre (Argo GDAC). SEANOE. https://doi.org/10.17882/42182) The data will be reanalyzed after 1 or 2 years to incorporate dQC-corrected Argo data. Each profile will be interpolated into the standard layer using the Akima method (Akima, 1970).

2) Format and usage of public data
The format of the gridded data set is Network Common Data Form (NetCDF) based on the COARDS convention. Detailed information is found in the web site. The data set can be downloaded from the following site.
[Download site URL] https://www.jamstec.go.jp/argo_research/....(i) Delayed Mode (update frequency: once a year, updated for:) Calculated using the latest Argo profile data at the time of update (ii) Near Real Time (creation frequency: once a month) Calculated using the latest Argo profile data for the last month at the time of creation

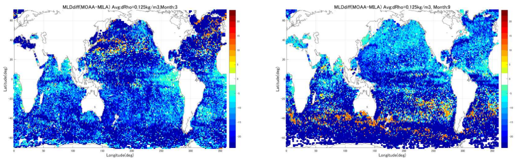
Seasonality of MLD

1) Existence of density inversion in surface mixed layer
Because the MOAA GPV has a wide radius of influence, it is affected by temperature and salinity in other latitude areas depending on seasonal variability. In mid- and high- latitude, surface density decrease appears in the fall and early winter profiles. This allows for a too much deepening of ML.

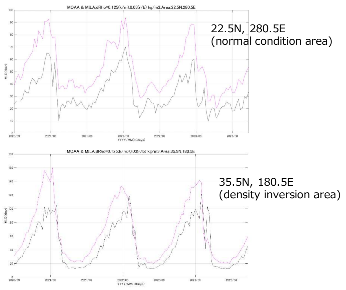


Monthly average profiles of potential density in MOAA GPV(left) and Argo profile (right).

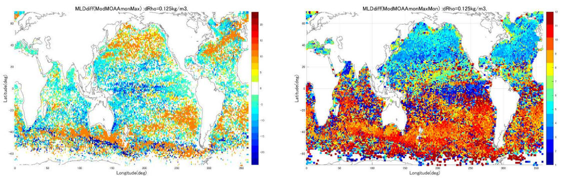
2) Distribution of inversion layer near the surface mixed layer
Comparison of monthly average of MLD(MOAA)-MLD(MILA) shows to what extent mission MLD estimation associated with density inversion occurs in which area of the ocean. During the seasonal transition period, the difference of MLD increases in the mid- and high latitude region.


Monthly average of MLD(MOAA)-MLD(MILA) in March (left) and September (right). Mainly MLD in MOAA GPV is shallower, while deeper MLD appears in transition season.

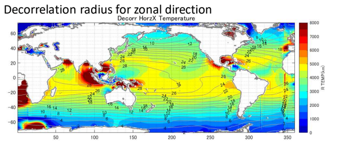
3) Characteristics of seasonal changes in MLD
Seasonal MLD generally changes in phase, amplitude is smaller in MOAA GPV (upper panel). In some area phase of seasonal change in MLD (MOAA GPV) tends to delay and to be larger amplitude. This effect is basically based on surface temperature variability.

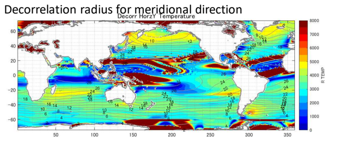
MLD in MOAA(Blk) and MILA(purple)


4) Max. MLD differences between MOAA GPV and MILA GPV difference values and its appeared months
The maximum MLD differences are larger for MILA GPV at mid- and high-latitudes, with values ranging into the tens of meters. The months when the max. difference appears are in spring and summer season. On the other hand, MLD in MOAA GPV is larger in tropical regions. This might be due to deepening MLD affected by surrounding region, and are more likely to be expressed in MOAA GPV because of its smaller seasonal variation and greater smoothing.


Max MLD difference (m) between MOAA and MILA GPV(left). Month of Max MLD difference (right)

5) Decorrelation radius on seasonal variability
Since MLD is mainly affected by the seasonal variability of temperature, it is necessary to take into account the regional seasonal variability of temperature when a gridded data set with more accurate ML is made. Therefore, we attempted to calculate the decorrelation radius on seasonal temperature variability.
Here, spatial correlations were made separately for meridional and zonal directions. Although there were some processing problems, we were able to determine the decorrelation radius on seasonal temperature variability in the two directions.

Decorrelation radius for zonal direction


Decorrelation radius for meridional direction


Summary and future plans

1. New gridded dataset MOAAGPV ver2 has been created and will be available soon. Expanding the area to the polar regions and providing data sets for each month and each 10 days (NRT and DM)
2. Confirmation and characterization of the existence of density inversion layer, which is a problem in the calculation of mixed layer in the gridded data set-> Delayed mixed layer development occurs in the MOAAGPV, especially in mid and high latitude regions.
3. In order to improve this situation, we considered applying an influence radius that takes seasonal variability into account to the surface water temperature data in the gridded dataset, and estimated the influence radius.
4. We will apply this radius of influence to the MOAA GPV to check the development process of the mixed layer. We will also calculate the OHC and consider the quantitative impact of this modification.