Product Information Document (PIDoc)

SeaDataCloud Brunt–Väisälä Frequency profiles for the Atlantic and Pacific Oceans

SDC_GLO_CLIM_N2

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Product Name

SDC_GLO_CLIM_N2

Extended name

SeaDataCloud Brunt–Väisälä frequency profiles for the Atlantic and Pacific Oceans

Product DOI

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Short description

The SDC_GLO_CLIM_N2 contains seasonally averaged Brunt–Väisälä frequency squared (N2) profiles for Atlantic and Pacific oceans for time period 2003 to 2017. The N2 profiles were computed using data from the World Ocean Database (2018).

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Dissemination	Copyright terms
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How to Cite

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History

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1	Kanwal Shahzadi	November 7, 2020	First version
2	Nadia Pinardi	December 5, 2020	Revision
3	Kanwal Shahzadi	December 10, 2020	Revision
4	Volodymyr Myroshnychenko	December 21, 2020	Revision
5	Kanwal Shahzadi	January 14, 2021	Final Revision
6	Simona Simoncelli	February 10, 2021	Final check

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Abstract

The SDC_GLO_CLIM_N2 product contains seasonally averaged Brunt–Väisälä squared frequency profiles using the density profiles computed in Global Ocean In-situ Density climatology (SDC_GLO_CLIM_Dens). The SDC_GLO_CLIM_Dens uses the Profiling Floats (PFL) from 2003 to 2017 checked with a Nonlinear Quality procedure. Computed BVF profiles have been averaged seasonally into 5x5 degree boxes for the Atlantic and Pacific Oceans. The resultant profiles are compared with the reference literature Emery et al. (1984) and the results appear consistent.

1. General description of the input data sets

The input data used for averaged Brunt–Väisälä Frequency (BVF) are profiling Floats (PFL) from the WOD 2018 [1], spanning the time period 2003 to 2017. In this product, only collecated Temperature and Salinity profiles are considered. Table 1 reports the number of stations and observations used for the Atlantic and Pacific domains.

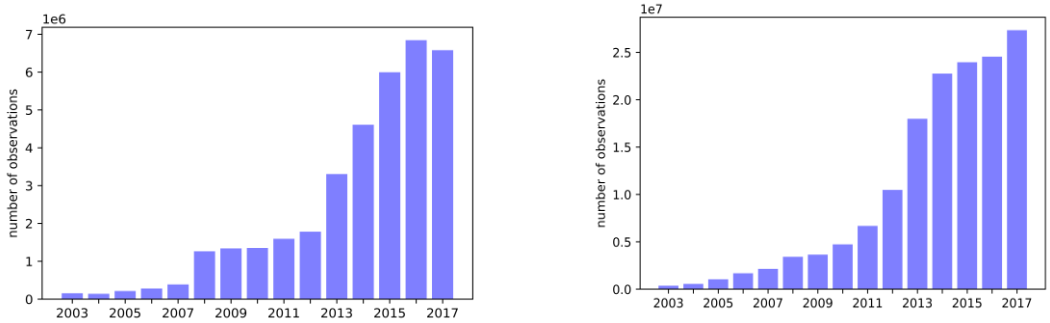
Domain	Number of Stations T & S together	Total number of vertical measurements T & S together
Atlantic	127,895	35,830,940
Pacific	518,937	151,263,414

Table 1 Statistics of the data used for the Atlantic and Pacific Ocean

1.1. Profiling Floats

The PFL dataset is a collection of data from different PFL platforms: Profiling Autonomous Langrangian Circulation Explorer (PACE), PROVOR (free drifting hydrographic profiler), SOLO (Sounding Oceanographic Langrangian Observer) and APEX (Autonomous Profiling Explorer) [1]. Most of the data in the PFL dataset come from the Argo project. PFL stations are well distributed on the global scale, the number of PFL casts used is 646,832 and the number of observations is 187,094,354.

Annual distribution of data in Figure 1(a and b) represents a gradual increase of data from 2003 to 2017 in both Pacific and Atlantic Oceans.



a) **b)**

Figure 1 Total observations year wise: (a) Atlantic and (b) Pacific Oceans.

2. Methodology

2.1. Data Quality Control

Quality control (QC) is an essential step to exclude anomalous data before doing the analysis. In this product, first the basic WOD quality flags (QF) have been considered. There are three types of QFs in the WOD:

1- Orginator Flag (Oflag)
2- World Ocean database observed value flag (WODf)
3- World Ocean database profile flag (WODpf)

Only the observations with WODf value **"0" (Accepted)** and WODpf value **"0" (Accepted)** have been used in further analysis.

An additional the nonlinear quality control developed by Shahzadi (2020) has been implemented with the following assumptions:

1- The domain is divided into 5x5 degree boxes, where mean and standard deviations(std) are computed for each layer for each month.
2- Data is eliminated outside 2 std in each box and procedure is repeated.

2.2. Procedure

The density profiles used for SDC_GLO_CLIM_Dens [6] product not having any missing values for more than 40m in the first 500m of the water column were selected. Then the resulting density profiles were interpolated vertically with step 1 m from the surface to 2000m. The Brunt–Väisälä frequency squared profiles (N2) were computed using:

$$N^2 = -\frac{g}{\rho}\frac{d\rho}{dz} \qquad (1)$$

Where g is gravitational constant, 9.8 m/s^2, ρ is the density, z is depth in meter. The mean N2 profiles are computed from the single N2 profiles in each 5 x 5-degree boxes illustrated in Figure 2 and Figure 3.

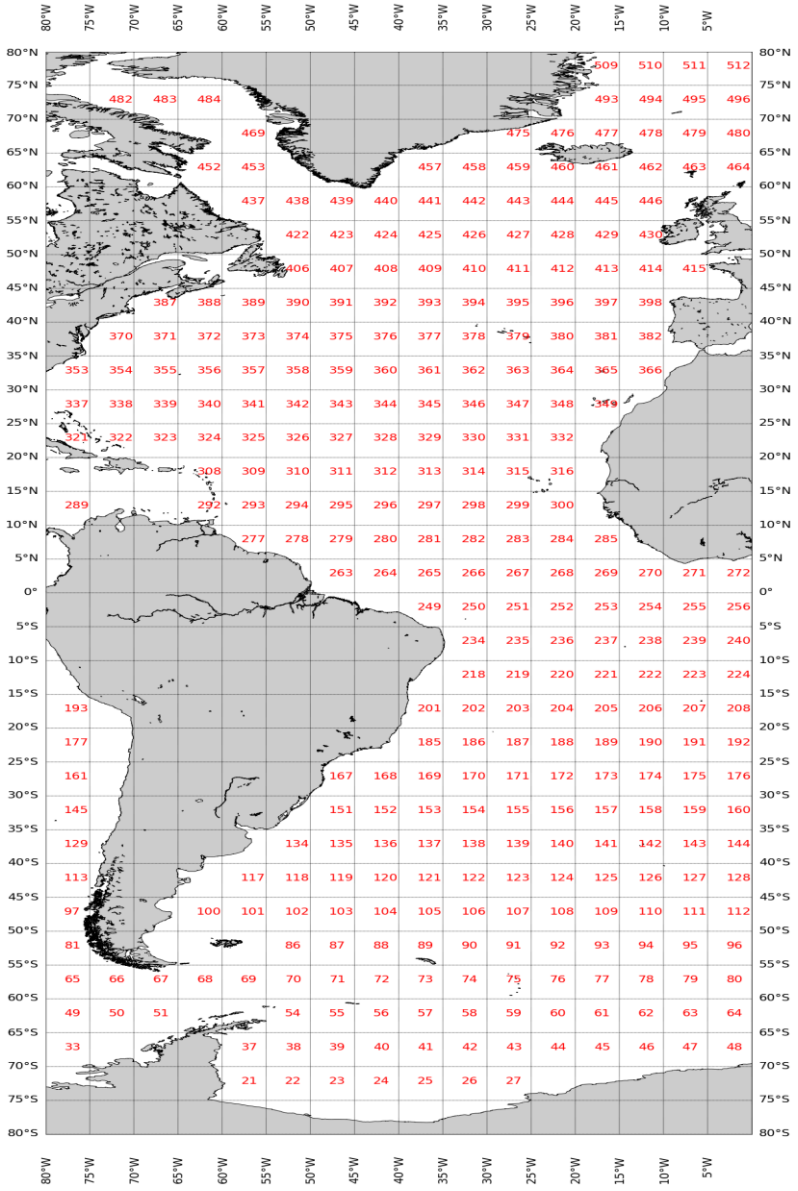


Figure 2 5x5 degree boxes: Atlantic Ocean

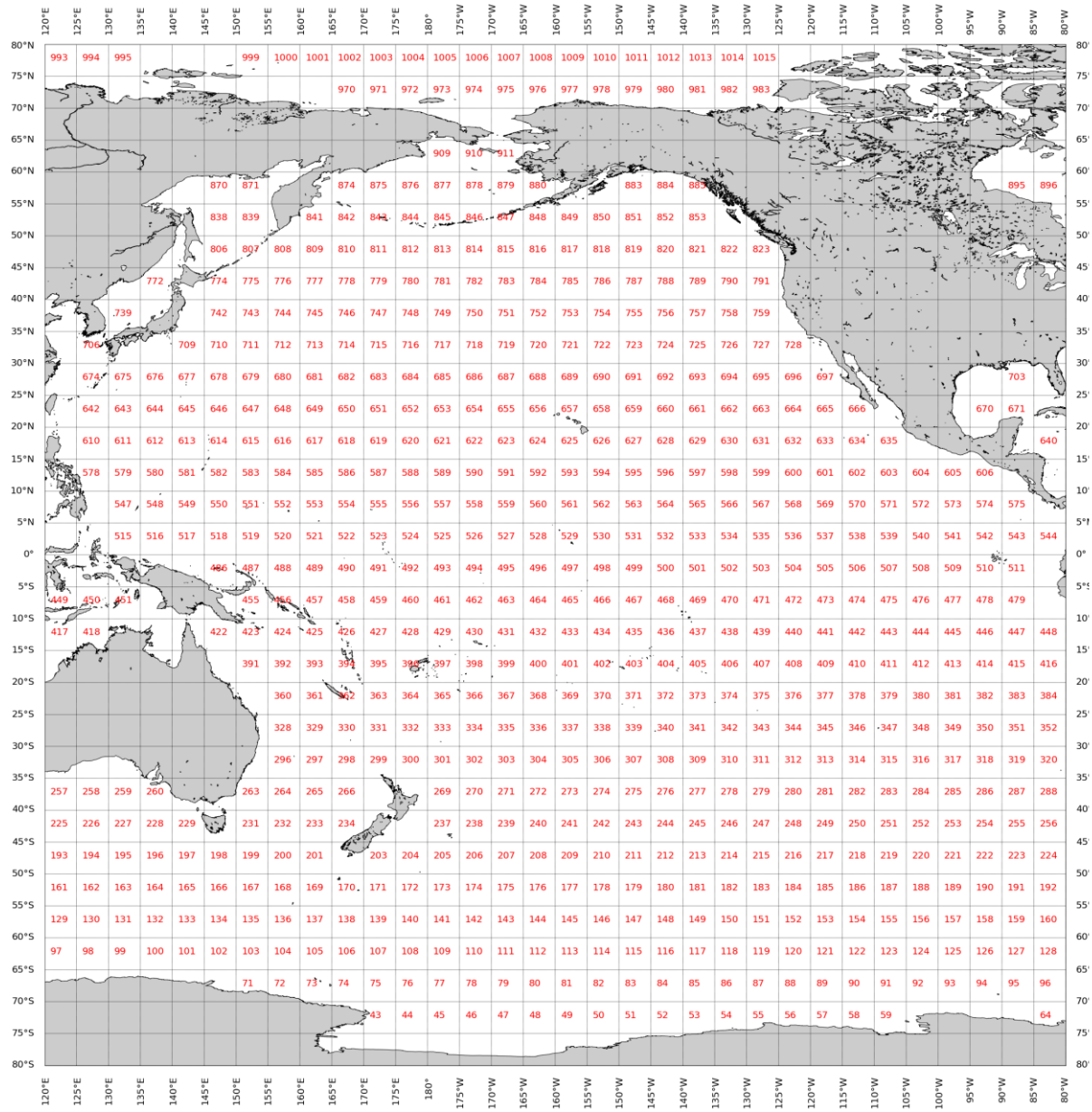


Figure 3 5 x 5-degree boxes: Pacific Ocean

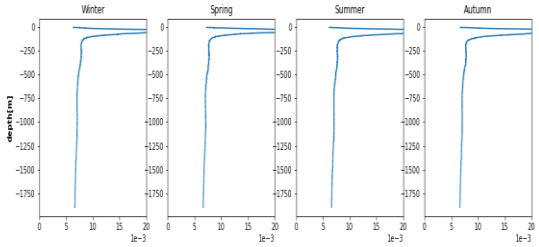
3. Consistency Analysis

The resulting seasonal N[sec-1] fields are shown instead of N^2 in order to make the comparison with reference BVF profiles from Emery et al. (1984) [2].

Figure 4, Figure 5, Figure 6, Figure 7, and Figure 8 display the maps for equatorial, north and south Atlantic and Pacific respectively.

Seasons are defined as: winter for Jan-Feb-Mar, spring for Apr-May-June, summer for Jul-Aug-Sept and autumn for Oct-Nov-Dec.

Overall, the comparison of profiles is consistent except the difference in deepest part of the water column due to the potential density used in [2].



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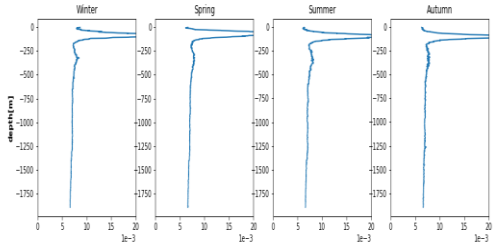

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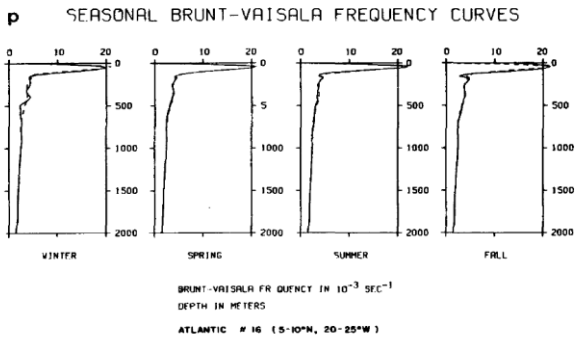

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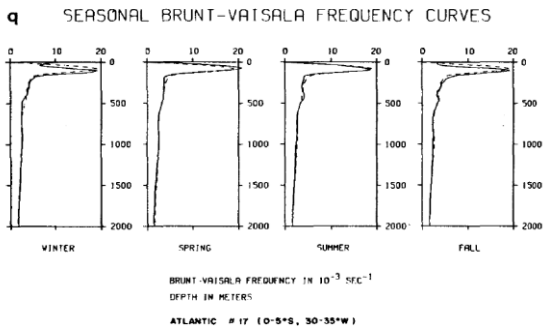
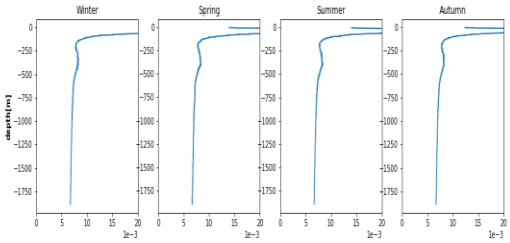


d).

Figure 4 Averaged BVF (s-1) profiles for the Equatorial Atlantic: box no. 284 (a) and box no. 250 (b) from Figure 2 and corresponding profiles from Emery et al. (1984) in (c) & (d).



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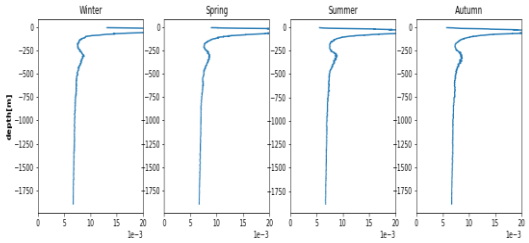

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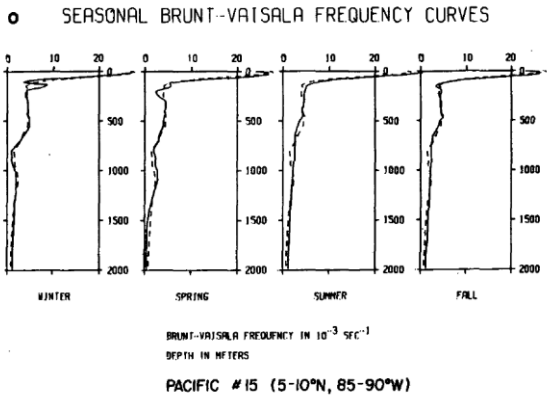

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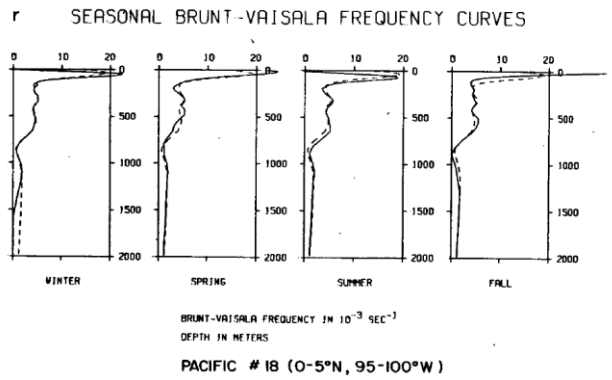
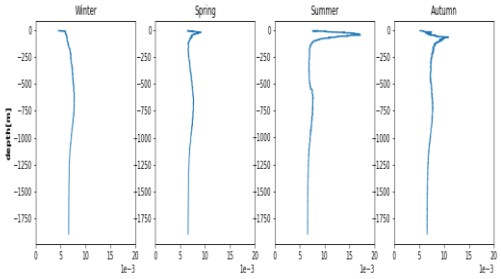


d)

Figure 5 Averaged BVF (s-1) profiles for the Equatorial Pacific: box no. 575 (a) and box no. 541 (b) from Figure 2 and corresponding profiles from Emery et al. (1984) in (c) & (d).

The resulting seasonal N profiles are shown in Figure 6, Figure. 7 and Figure 8 for Equatorial, North and South Pacific.



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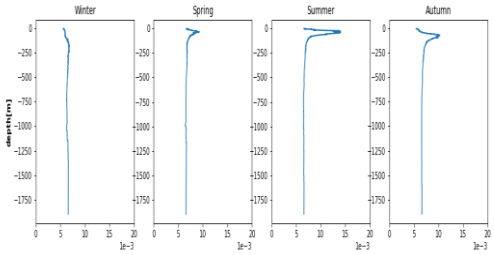

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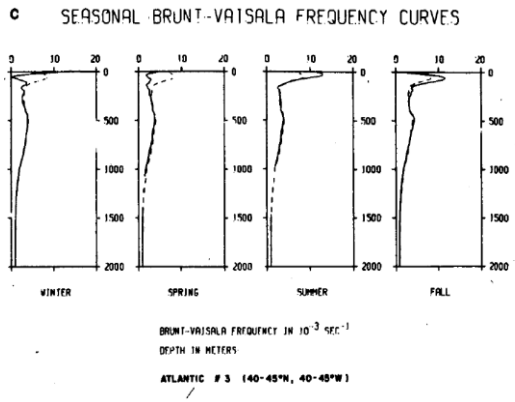

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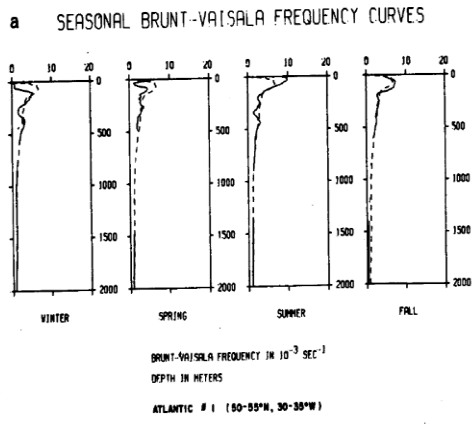
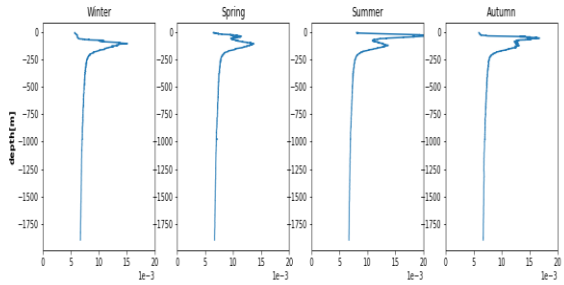


d)

Figure 6 Averaged BVF (s-1) profiles for the North Atlantic: box no. 575 (a) and box no. 541 (b) from Figure 2 and corresponding profiles from Emery et al. (1984) in (c) & (d).



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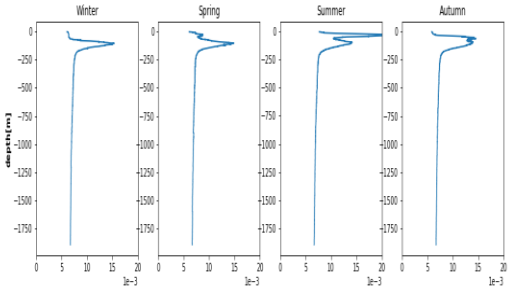

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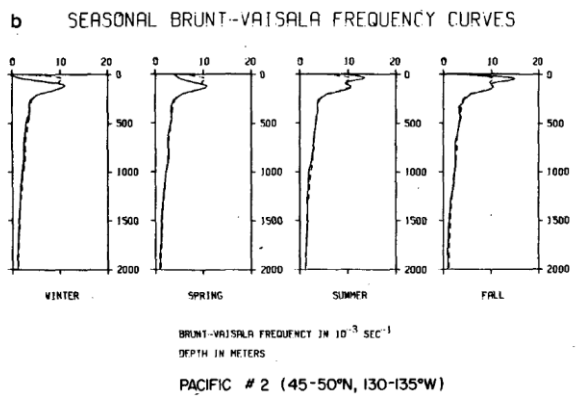

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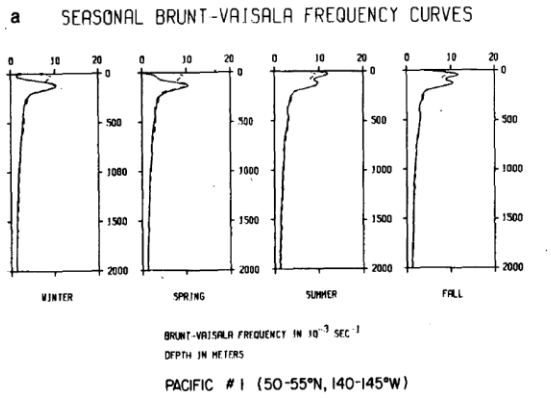
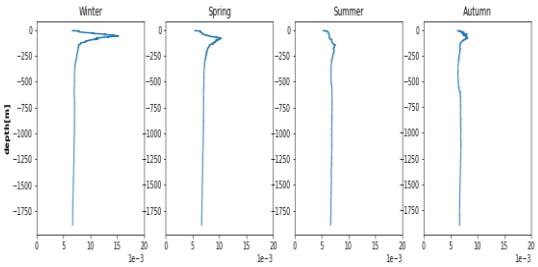


d)

Figure 7 Averaged BVF (s-1) profiles for the North Pacific: box no. 822 (a) and box no. 852 (b) from Figure 3 and corresponding profiles from Emery et al. (1984) in (c) & (d).



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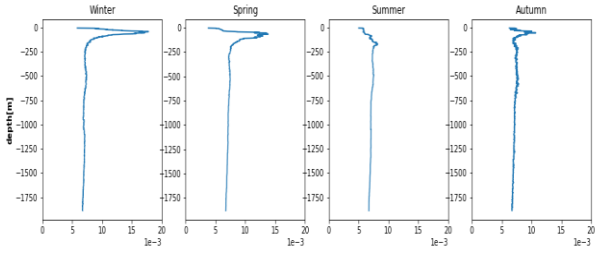

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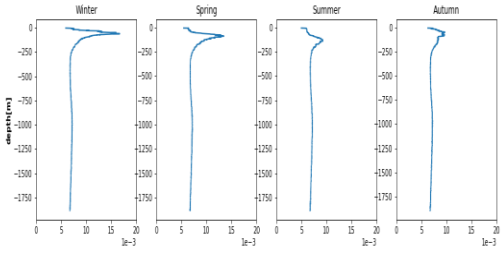

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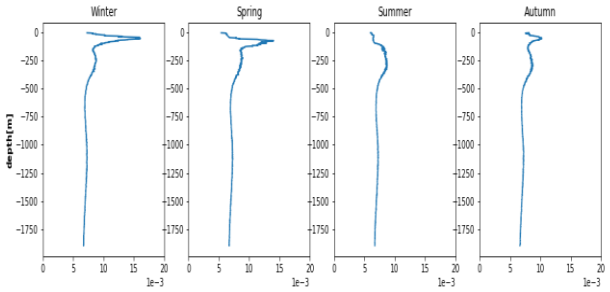

d)

Figure 8 Averaged BVF (s-1) profile: South Atlantic: box no. 122 (a) and 156(b), South Pacific: box no. 246(c) and 306(d).

4. Technical Specifications

The product is delivered in NetCDF format for each box. Each file contains a 1d array of BVF as function (depth), and the season is fixed for each file. The longitude and latitude are chosen as a center of that box. Parameters of the file are named as follow:

BVF (Brunt–Vaisala Frequency) – 1d array (depth)

lon(lon) - Longitude

lat(lat) - Latituide

Density(m): Density as a function of depth

The naming convention for NetCDF files for Atlantic and Pacific is as follows:

SDC_ATL_N2_Box_number_Winter.nc

SDC_ATL_N2_Box_number_Spring.nc

SDC_ATL_N2_Box_number_Summer.nc

SDC_ATL_N2_Box_number_Autumn.nc

The box_number for Atlantic are given in Figure 2.

SDC_PAC_N2_Box_number_Winter.nc

SDC_PAC_N2_Box_number_Spring.nc

SDC_PAC_N2_Box_number_Summer.nc

SDC_PAC_N2_Box_number_Autumn.nc

The box_number for Pacific are given in Figure 3.

5. Product Usability

Seasonally averaged N2 profiles are computed in 5x5 degree boxes for Atlantic and Pacific Oceans. The product is useful to determine the stratification of the water column which is associated with health of the ocean issues and related to primary productivity. The profiles are averaged within 5x5 degree boxes therefore it is advisable to consult the producer before using this product for a specific application.

References

1- Boyer, T. P., et al. "World Ocean Database 2018. AV Mishonov, Technical Editor." *NOAA Atlas NESDIS* 87 (2019).

2- Barth, A, et al. "divand-1.0: n-dimensional variational data analysis for ocean observations." *Geoscientific Model Development* 7 (2014): 225-241.

3- Emery, W. J., et al. "Geographic and seasonal distributions of Brunt–Väisälä frequency and Rossby radii in the North Pacific and North Atlantic." *Journal of Physical Oceanography* 14.2 (1984): 294-317.

4- Fofonoff, "Algorithms for the computation of fundamental properties of seawater." (1983).

5- Shahzadi, K. 2020. “A new global ocean climatologies”, PhD Thesis, Alma Mater Studiorium University of Bologna.

6- Shahzadi, K. and Pinardi, N. “A Global Ocean In-situ Density climatology” (2020).