**CODC-v1**

**Temperature Format Description (monthly\_NetCDF)**

CODC-v1 (CAS-Ocean Data Center, Global Ocean Science Database) provides quality-controlled and bias-corrected ocean temperature profile data. The original data source is WOD18 and local observations in China. The instruments include 14 different types such as XBT, MBT, CTD, Argo, Glider, mooring buoys, Bottle etc.

The quality-controlled (QC) was implemented by CODC-QC (CAS Ocean Data Center - Quality Control), a climatology-range based automatic quality control system developed by IAP/CAS and IOCAS group (Tan et al., 2023). We used Cheng et al. 2014 XBT bias correction scheme, Gouretski & Cheng 2020 MBT correction scheme and Gouretski & Cheng 2022 Bottle correction scheme to correct the ocean temperature systematic bias.

This README file provides the variable information for the monthly NetCDF files (1,009 files in total, from January 1940 to December 2023, including a file containing all Chinese Institute data) for temperature *in-situ* observations.

More details and scientific evaluations could be found in Zhang et al., 2024[1]

**VARIABLES**

**[1] N\_PROF**: total number of profiles in the file.

**[2] WOD\_unique\_cast**：Profile ID provided by NOAA/NECI (WOD).

**[3] CAS\_unique\_cast**：Profile ID provided by CODC-GOSD.

**[4] Depth**: depth records after CODC-QC quality control and XBT/MBT bias corrections

**[5] Temperature**: temperature records after CODC-QC quality control and XBT/MBT bias corrections

**[6] Temp\_origin**: original temperature records without preforming any quality control procedures and bias corrections

**[7] Depth\_origin**: original depth records without preforming any quality control procedures and bias corrections

**[8] Temp\_BiasCor, Depth\_BiasCor**: Temperature and depth records after CH14 (Cheng et al., 2014) bias correction method for XBT, GC20 bias correction methods (Gourestki and Cheng, 2020) for MBT, GC22 bias correction method (Gourestki and Cheng, 2022) for Bottle data, and IAP-APB bias correction method for APB data. The index of the column where the bias corrected profile is located can be obtained from Varibles <Data\_type>. The column where the profile is not observed by the XBT/MBT/Bottle/APB is represented by missing value

**[9] Temperature\_CODCflag**: The temperature QC flag provided by CODC-QC (Tan et al., 2023) system (based on observed levels). ‘0’ represents good quality data (passed all 14 QC checks), ‘1’ represents bad data (at least flagged by 1 QC check). The dimension is corresponding to the variable <Temp\_origin>.

**[10] Temperature\_CODCflag\_checks**: The temperature quality flag for each distinct check provided by CODC-QC (Tan et al., 2023) system (based on observed levels). ‘0’ represents good quality data, ‘1’ represents bad data (outliers), and ‘-99’ represents missing value. The third dimension (N\_PROFILE) indicates the number of distinct checks. There are 14 distinct checks in total (From 1 to 14 are the basic information check, the increasing depth check, the instrument depth check, the local maximum bottom depth check, the global crude range check, the freezing point check, the local climatological range check, the constant value check, the spike check, the density inversion check, the temperature extreme value check, the global gradient check, the local gradient climatological range check, and the XBT Instrument specific check).

**[11] Temperature\_WODflag**: The temperature quality flag provided by WOD18 (NOAA-NCEI) (based on observed levels). ‘0’ represents good quality data, non-zero represents bad data (outliers). The dimension is corresponding to the variable <Temp\_origin>. More information can be referenced from <https://www.ncei.noaa.gov/access/world-ocean-database/CODES/definition-quality-flags.html> (Dimension: 2000\* N\_PROF).

**[12] Depth\_WODflag**：The depth quality flag provided by WOD18 (NOAA-NCEI) (based on observed levels). ‘0’ represents good quality data, non-zero represents bad data (outliers). The dimension is corresponding to the variable <Depth\_origin>. More information can be referenced from <https://www.ncei.noaa.gov/access/world-ocean-database/CODES/definition-quality-flags.html>

**[13] Temperature\_ORIGINALflag**: The depth quality flag provided by original data center.

**[14] Temperature\_WODprofileflag**：the temperature quality flag provided by WOD18 (NOAA-NCEI) (based on observed profile). ‘0’ represents good quality profile, non-zero represents bad profile. More information can be referenced from <https://www.ncei.noaa.gov/data/oceans/woa/WOD/CODES/PDF/DefinitionQualityFlags.pdf> (Dimension: 1\* N\_PROF).

**[15] access\_num**：accession number provided by NODC

**[16] country**：country name of the profile

**[17] Data\_type**：the index for temperature instrument type (1=OSD; 2=CTD; 3=MBT; 4=XBT; 5=SUR; 6=APB; 7=MRB; 8=PFL; 9=DRB; 10=UOR; 11=GLD; 12=DBT; 13=STD; 14=microBT; -999=Unknown).

**[18] Date**: observation date.

**[19] dbase\_orig**：original database of the profile.

**[20] GMT\_time**：observation time zone (GMT).

**[21] Institute**：institute name of the profile.

**[22] Latitude**：observation latitude.

**[23] Longitude**：observation longitude.

**[24] Ocean\_Vehicle**：cruise name.

**[25] org\_stat\_num**：original station number.

**[26] platform**: platform name.

**[27] Project**: project name.

**[28] real\_time**: The flag index of whether the Argo data is real-time data or not (real-time; real-time adjusted; delayed-mode).

**[29] Temp\_instrument**：the probe type of the temperature measurement.

**[30] Recorder**: the recording system type of temperature measurement.

**[31] time**: observation time since: 1770-01-01 00:00:00.

**[32] WMO\_id**: ID provided by the World Meteorology Organization.

**[33] WOD\_cruise\_identifier**: Cruise ID provided by NOAA/NCEI.

**[34] launch\_height**: the launch height above the sea surface level (only in XBT data).

**[35] need\_depth\_fix\_instrument**: index of whether the XBT depth bias correction is needed (only in XBT data).

**[36] XBT\_depth\_eq**: The type of equation used for XBT depth bias correction (only in XBT data).

**NOTES:**

**[1]** Each column represents the observations and its corresponding metadata information for each profile. For example, the method for extracting the 1001st profile is:

* Depth records: Depth(1:1001)
* Temperature records: Temperature(:,1:1001)
* Metadata information:

Latitude (1001)

**[2] We recommended to directly use the variables <Temperature> and <Depth>,** which has been applied the XBT/MBT/Bottle bias correction and CODC-QC quality control, because the rest of the observational variables are initial variables or intermediate process variables.

**[3]** For a detailed description of each variable (such as unit, dimension, default value definition, long\_name, etc.), please see the comments of the variables in the netCDF file.

**[4]** We applied the CODC-QC system (CAS Ocean Data Center - Quality Control) for the temperature quality control. **For more information about the CODC-QC, please refers to Tan et al., 2023.**

**[5]** We applied the CH14 method for XBT bias corrections, GC20 method for MBT bias correction, and GC22 method for Bottle bias correction. For more information about the bias correction method, please refers: <http://www.ocean.iap.ac.cn/>

**DATA CITATIONS:**

[1] Zhang B., L. Cheng, Z. Tan, V. Gouretski, F. Li, Y. Pan, H. Yuan, H. Ren, F. Reseghetti, J. Zhu, and F. Wang, 2024: CODC-v1: a quality-controlled and bias-corrected ocean temperature profile dataset from 1940-2023. *Scientific Data*

[2] Tan Z., Cheng L., Gouretski V., Zhang B., Wang Y., Li F., Liu Z., Zhu J., 2023:  A new automatic quality control system for ocean in-situ temperature observations and impact on ocean warming estimate. Deep Sea Research Part I, 103961, <https://doi.org/10.1016/j.dsr.2022.103961>

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