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BGC-Argo synthetic profile file processing and format on Coriolis GDAC

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ARGO

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BGC-Argo synthetic profile file processing and format for the Coriolis GDAC

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History of the document

Version	Date	Comment
0.1	15/01/2018	JP Rannou : creation of the document
0.3b	15/03/2018	JP Rannou : updated according to "Proposal to produce a simplified synthetic single-cycle profile file for BGC floats" specifications file version '3b' dated 14 March 2018
1.0	18/06/2018 21/06/2018	JP Rannou : initialization of the version describing the first sample files generated by Coriolis GDAC H Bittig: finalization of the version describing the first sample files generated at Coriolis
1.1	17/07/2019	H Bittig: Update following ADMT19, San Diego: Inclusion of full resolution core data and operational production by both GDACs
1.2	02/07/2020	H Bittig: Modify QC flags for gap data points. Better specification on which data are selected when there is more than one N_PROF profile with overlapping pressure range
1.3	04/04/2022	A Wong, H Bittig: Modify QC flags for gap data points in case of QC '0'

Reference documents

Reference#	Title	Link
RD1	Argo user's manual	http://dx.doi.org/10.13155/29825

Color code:

Changes / additions with respect to previous version (if entire section, only the section head is marked)

Content to be validated

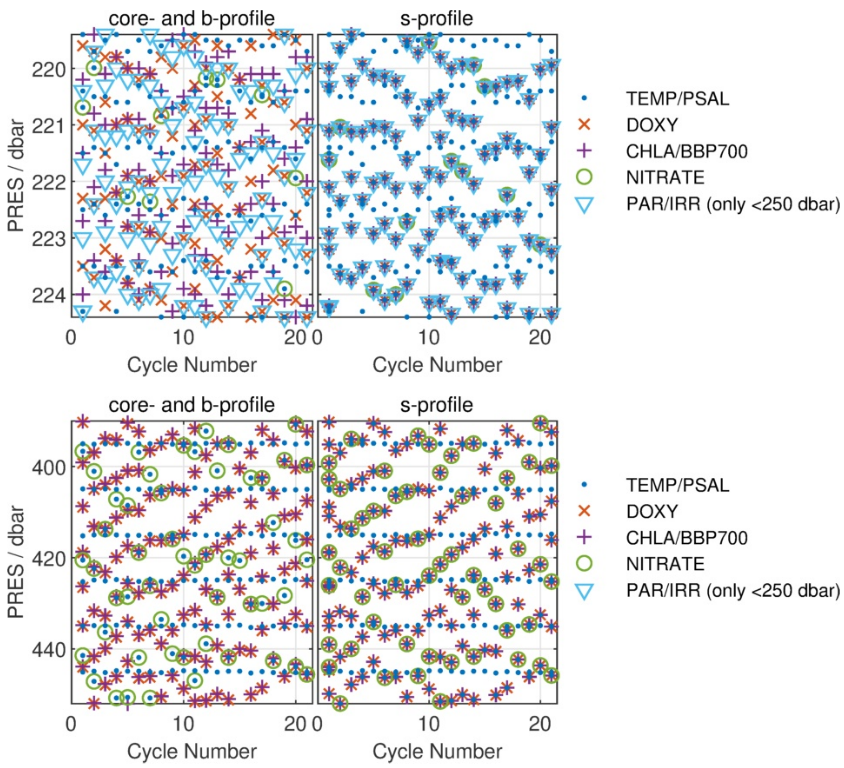
1 Introduction

The current V3.1 Argo netCDF format that produces a pair of core- and b- profile files per cycle, with N_PROF > 1, allows storage of all profile information returned from BGC floats, in a manner that is as close to float output as possible. These can include multiple full-depth profiles with different pressure levels, multiple shallow profiles with different pressure levels, and recording of spatial and/or temporal delays between the CTD and various BGC sensor outputs. The advantage of this data management approach is that float outputs are faithfully recorded, so that any reprocessing demands that require access to the raw data can be met with ease.

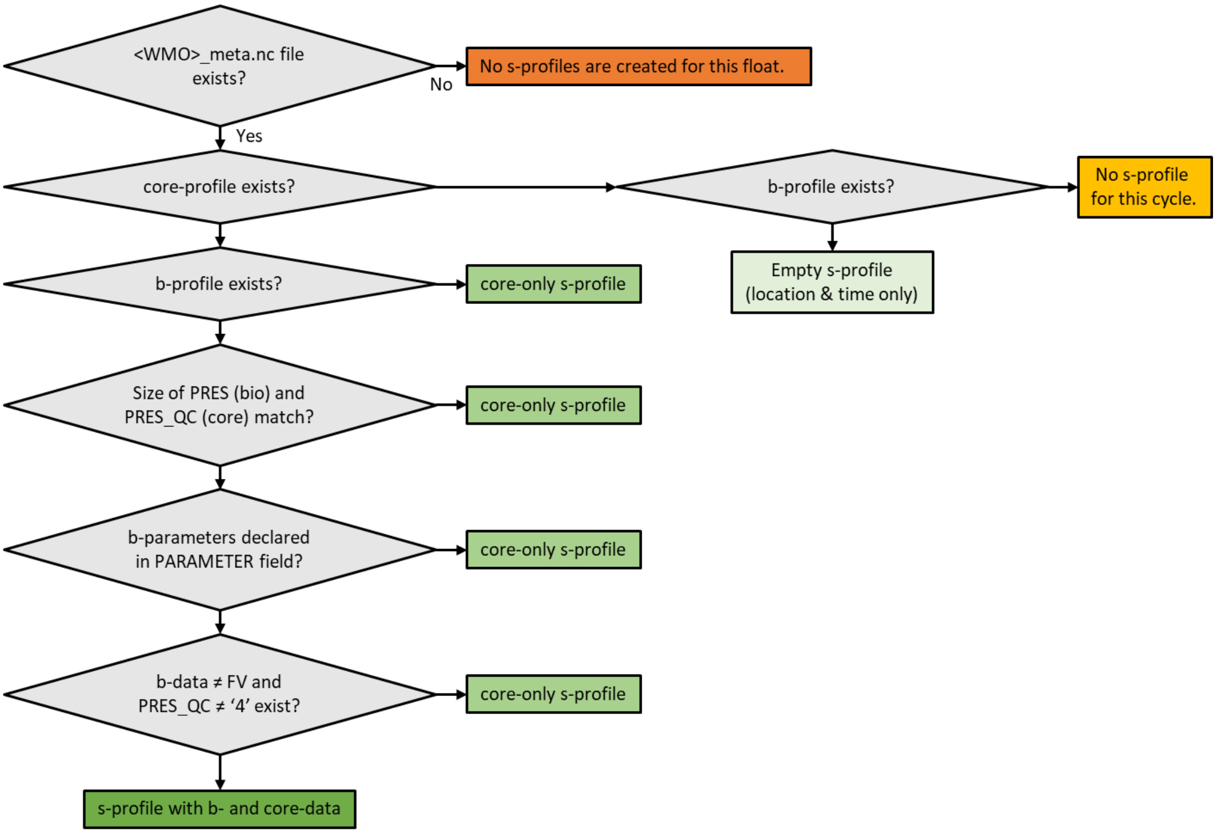
However, when measurements from multiple sensors are not aligned during onboard processing by the floats, they are recorded in their raw pressure locations. This makes it difficult to study these BGC parameters as co-located measurements, since some data manipulation to align them needs to be done before scientific studies can be carried out. Moreover, because the V3.1 format requires that all parameters have dimensions (N_PROF, N_LEVELS), where N_LEVELS = maximum number of vertical levels, the files are large in file size and are mostly filled with white space.

The goal of a simplified, *synthetic profile* is to co-locate as many BGC observations as possible while preserving the character of the sampling pattern, i.e., sample interval, number of samples, and approximate pressure locations. Data come from the single-cycle c- and b-files. Only c- and b-parameters are included (with all subfields), which means no intermediate parameters ("ic" or "ib" params) are included. The synthetic pressure axis is constructed from the BGC sampling levels from each cycle. This means that there is no fixed vertical grid for all floats and all cycles. At the end, each single-cycle synthetic profile will have dimension N_PROF = 1. The co-location takes different vertical attachments of BGC sensors into account by displacing the pressure location (based on the config parameter vertical_pressure_offset), which is not the case in core- or b- profile files. Moreover, the single-cycle synthetic profile contains all primary profile c-parameter observations in their original location and resolution.

For illustration, an example of a float with multiple BGC sensors (WMO 6901472, first 20 cycles) is shown below for two depth ranges. Left panels give the profile information returned from the BGC float, right panels the synthetic profile. No associated QC flags are shown.



The flow scheme below shows the requirements for a simplified synthetic profile to contain both BGC- and core-Argo data, to contain only core-Argo data, only location/time information of the profile, or to not be generated because of insufficient information in the DAC files. A key requirement is the presence of the PRES_QC field (core-profile), without which no synthetic pressure axis can be constructed.



This document details the processing steps used to generate synthetic profile data from Argo profile data. It also describes the format of the NetCDF files produced by the Coriolis GDAC to store the synthetic profile data.

2 Data processing

Input data come from Argo single-cycle core- and b-profile files.

The s-profile files are generated from Coriolis Matlab code.

The synthetic profile data are generated from Matlab code provided and managed by Henry BITTIG (henry.bittig@io - warnemuende.de).

2.1 Processing steps

The profile data are retrieved from the single-cycle c- and b-profile files.

2.1.1 Construction of the synthetic pressure axis

- At present, 'pumped' and 'unpumped' N_PROF parts of the same parameter that have been split at 'CTDPumpStopPressure' are **not** concatenated together and treated as one N_PROF, as such association is not straightforwardly available from the core- and b-profile files. **This may change in a future version**. However, data contained in both such N_PROFs are considered when adding parameter observations on the synthetic pressure axis (see below).
- From all N_PROFs, gather all b-parameter pressure levels from PRES, independent of PRES data mode.
- Leave out all pressure levels that have PRES_QC '4'.
- For each N_PROF and each b-parameter, correct the pressure level for the vertical displacement of the BGC sensor with respect to the pressure sensor using its '<short_sensor_name>VerticalPressureOffset_dbar' from the float config meta information (vertical_offset > 0 when the sensor is situated below the pressure sensor).
- From the remaining pressures, get all unique pressure levels of BGC samples (PRES+vertical_offset) and sort them in a table (bottom: deepest pressure).
- For each N_PROF and each b-parameter, get the pressure difference (dPRES) between subsequent BGC samples and enter the minimum of the two dPRESs (above and below) at the given unique pressure level (rows) and N_PROF (columns) into the table.
- Start at the deepest pressure (at the bottom of the table), and 'jump' towards the surface in the following manner:
  - Add the current level to the synthetic pressure axis
  - Check if within the range of 'current PRES' (included) and 'current PRES – min(dPRES)' (of the current level / row; excluded) any N_PROF has more than 1 observation.
    - Yes: 'Jump' to the deepest 2nd observation of the same N_PROF inside this range.
    - No: 'Jump' to the next (shallower) pressure level outside the range.
  - Continue until you reach the top of the table (i.e., the surface).
- Only the levels identified by the previous step become the synthetic pressure axis (s-PRES).

Note: If TEMP and PSAL were included in the construction of the synthetic pressure axis, the fraction of co-located BGC samples is reduced, which contradicts the goal of a simplified, synthetic profile.

2.1.2 Interspersion of parameter observations on the synthetic pressure axis

2.1.2.1 Creation of a single profile of parameter observations

If there are two or more sets of data of the same core- or b-parameter in different N_PROFs and their pressure range overlaps (e.g., high resolution and low resolution), use the N_PROF with the higher priority (see §2.2 below) for the overlapping portion. For the non-overlapping portion, the different N_PROFs are simply concatenated together (e.g., 'pumped' and 'unpumped' N_PROF parts).

2.1.2.2 Copy of parameter observations that are aligned onto the synthetic pressure axis

Core- and b-parameter observations of the single profile that are aligned with the synthetic pressure levels (s-PRES = PRES+vertical_offset) are recorded without any change/interpolation.

2.1.2.3 Displacement of parameter observations that are not aligned onto the synthetic pressure axis by interpolation

Core- and b-parameters that are not completely aligned with the synthetic pressure levels are interpolated (or extrapolated) as follows:

- Create a synthetic profile by linearly interpolating all parameters to every level on the synthetic pressure axis.
- The QC flag associated with each interpolated value will be the highest order flag amongst the values used in the interpolation. The order of QC flags, from the lowest to the highest, is: '1', '2', '5', '3', and '4' ('good', 'probably good', 'changed', 'probably bad', and 'bad' value).
- End points (and the QC flag) will need extrapolation by nearest neighbor (without limit on the extrapolation).
- **To not artificially upsample data, select from the synthetic profile by keeping only those interpolated (or extrapolated) data nearest to an existing observation.** If there are two samples on the synthetic profile (s-PRES) with the same pressure distance to an existing observation (PRES+vertical_offset), keep both samples.
- For b-parameters, replace other interpolated (or extrapolated) data with unmatched pressure with FillValue, with the exception of 'single gaps in a series of observations' (see below). This will leave some holes in the synthetic profile, but that is a faithful reflection of the b-parameter sample sparsity.
- For b-parameters, a 'single gap in a series of observations' on the synthetic pressure axis is present when for a series of 5 synthetic levels, only the middle one is unmatched (i.e., if the series would become [data, data, FillValue, data, data]). Corresponding boundary condition for the 2^{nd} and 2^{nd} last synthetic level ([(StartOfProfile) data, FillValue, data, data] and [data, data, FillValue, data (EndOfProfile)], respectively) hold. In these cases, the interpolated data are kept. For the 1^{st} and last sample, (extrapolated) values in cases of [(StartOfProfile) FillValue, data, data] or [data, data, FillValue (EndOfProfile)] are kept within a pressure limit on extrapolation of the float length (2 dbar deeper) and of the antenna length (1 dbar shallower), respectively.
  The QC flags of these interpolated/extrapolated gap data are set to '8' ('estimated' value) if the QC flags of the bounding points are '1', '2' or '5' ('good', 'probably good', 'changed'), which are all considered 'good' for the profile quality flag (see Reference table 2a [RD1]). A QC flag '8' allows to keeping them distinct from the 'displaced' data above.
  If any of the bounding points has a QC of '3' or '4' ('probably bad', bad'), the gap data QC is set to the higher QC of the bounding points ('3' or '4'). This ensures that 'bad' data cannot create 'good' data in the s-profile. QC '8' is considered 'good' for the profile quality flag.
  If any of the bounding points have a QC of '0' ('no QC performed'), then the gap data QC is also set to '0'. QC '0' is not counted in the profile quality flag.
- For c-parameters, all unmatched, interpolated data are kept to ensure that all BGC observations have a T&S context. Extrapolated data are kept within a pressure limit on extrapolation of the float length (2 dbar deeper) and of the antenna length (1 dbar shallower), respectively.
  The QC flags for PRES keep the highest order flag from the interpolation/extrapolation step (i.e., no '8' – 'estimated' value are present). The QC flags for c-parameters TEMP and PSAL that are not completely aligned with the synthetic pressure levels follow the same rules as for b-parameter gap data (i.e., the higher of '3' or '4' if the upper/lower parameter observation has a QC of '3' or '4', or '8' otherwise).

2.1.3 Interleaving of c-parameter observations not aligned with the synthetic pressure axis

To preserve the typically high-resolution TEMP and PSAL data for context to the BGC data, the complete single profile of core-parameter observations (§2.1.2.1) is interleaved with the synthetic pressure axis. This may add extra pressure levels that are not part of the synthetic pressure axis. Corresponding b-parameter fields are tapped with FillValue at these interleaved levels.

2.1.4 Add pressure distance between parameter observations on the the synthetic pressure axis and the original profile

For each observation, record the pressure displacement between the nearest sample(s) on the synthetic pressure axis and the original pressure (of the single profile of observations, §2.1.2.1) in the variable <PARAM>_dPRES = (original PRES+vertical_offset) – (synthetic axis PRES). If there are two observations with the same distance to a sample on the synthetic axis, the dPRES with respect to the deeper observations is recorded by convention. For parameter observations that are aligned with the synthetic pressure levels <PARAM>_dPRES = 0.

2.2 N_PROF priority

The primary sampling scheme profile (N_PROF = 1) has highest priority. All other profiles are sorted in alphabetical order of their concatenated, alphabetically ordered <parameter_sensor> names.

E.g., for a profile with

N_PROF	PARAMETER_SENSOR
1	'CTD_PRES' 'CTD_TEMP' 'CTD_PSAL'
2	'CTD_PRES' 'OPTODE_DOXY'
3	'CTD_PRES' 'RADIOMETER_DOWN_IRR380' 'RADIOMETER_DOWN_IRR412' 'RADIOMETER_DOWN_IRR490' 'RADIOMETER_PAR'
4	'BACKSCATTERINGMETER_BBP700' 'CTD_PRES' 'FLUOROMETER_CDOM' 'FLUOROMETER_CHLA'
5	'CTD_PRES' 'TRANSMISSOMETER_CP'

the parameter sensor names would be concatenated to

N_PROF	PARAMETER_SENSOR
1	'CTD_PRES_CTD_TEMP_CTD_PSAL'
2	'CTD_PRES_OPTODE_DOXY'
3	'CTD_PRES_RADIOMETER_DOWN_IRR380_RADIOMETER_DOWN_IRR412_ RADIOMETER_DOWN_IRR490_RADIOMETER_PAR'
4	'BACKSCATTERINGMETER_BBP700_CTD_PRES_FLUOROMETER_CDOM_ FLUOROMETER_CHLA'
5	'CTD_PRES_TRANSMISSOMETER_CP'

which gives the N_PROF priority as 1 > 4 > 2 > 3 > 5.

2.3 Miscellaneous information

2.3.1 Management of SCIENTIFIC_CALIB_* information

SCIENTIFIC_CALIB_EQUATION, SCIENTIFIC_CALIB_COEFFICIENT, SCIENTIFIC_CALIB_ COMMENT and SCIENTIFIC_CALIB_DATE are retrieved from original C and B profile files.

When 'pumped' and 'unpumped' parts of original profiles are available in a file, only the SCIENTIFIC_CALIB_* information of the lower N_PROF index is preserved.

2.3.2 NetCDF format of S-PROF files

The multi-cycle Sprof files are generated in NetCDF4 classic model format. All stored parameters are compressed with a deflation level set to 4.

3 Description of the Synthetic profile format

The synthetic profile data are stored in single-cycle S -profile and multi-cycle Sprof NetCDF files.

The format of the S profile file is based on the Argo B profile file (see Argo user's manual [RD1]).

3.1 Global attributes

global attributes:

:title = "Argo float vertical profile"
:institution = "CORIOLIS"
:source = "Argo float"
:history = "2019-04-22T16:44:07Z creation (software version 1.9 (version 01.04.2022 for ARGO_simplified_profile))"
:references = "http://www.argodatamgt.org/Documentation"
:user_manual_version = "1.0"
:Conventions = "Argo-3.1 CF-1.6"
:featureType = "trajectoryProfile"

Global attribute name	Definition
title	A succinct description of what is in the dataset.
institution	Specifies where the original data was produced.
source	The method of production of the original data. If it was model-generated, source should name the model and its version, as specifically as could be useful. If it is observational, source should characterize it (e.g., "surface observation" or "radiosonde").
history	Provides an audit trail for modifications to the original data. Well-behaved generic NetCDF filters will automatically append their name and the parameters with which they were invoked to the global history attribute of an input NetCDF file. We recommend that each line begin with a timestamp indicating the date and time of day that the program was executed.
references	Published or web-based references that describe the data or methods used to produce it.
comment	Miscellaneous information about the data or methods used to produce it.
user_manual_version	The version number of the user manual
Conventions	The conventions supported by this file, blank separated
featureType	The NetCDF CF feature type.

3.2 Dimensions and definitions

Name	Value	Definition
DATE_TIME	DATE_TIME = 14;	This dimension is the length of an ASCII date and time value. Date_time convention is : YYYYMMDDHHMISS YYYY : year MM : month DD : day HH : hour of the day (as 0 to 23) MI : minutes (as 0 to 59) SS : seconds (as 0 to 59) Date and time values are always in universal time coordinates (UTC). Examples : 20010105172834 : January 5th 2001 17:28:34 19971217000000 : December 17th 1997 00:00:00
STRING256 STRING64 STRING32 STRING8 STRING4 STRING2	STRING256 = 256; STRING64 = 64; STRING32 = 32; STRING8 = 8; STRING4 = 4; STRING2 = 2;	String dimensions from 2 to 256.
N_PROF	N_PROF = <int value>;	Number of profiles contained in the file. It is always 1 in the mono-profile files. In the multi-profile files there is one N_PROF for each descending or ascending profile.
N_PARAM	N_PARAM = <int value>;	Maximum number of parameters measured or calculated for a pressure sample. This dimension depends on the data set. Examples : (pressure, temperature) : N_PARAM = 2 (pressure, temperature, salinity) : N_PARAM = 3 (pressure, temperature, conductivity, salinity) : N_PARAM = 4
N_LEVELS	N_LEVELS = <int value>;	Maximum number of pressure levels contained in a profile. This dimension depends on the data set. Example : N_LEVELS = 100
N_CALIB	N_CALIB = <int value>;	Maximum number of calibrations performed on a profile. This dimension depends on the data set. Example : N_CALIB = 10

3.3 General information on the profile file

This section contains information about the whole file.

Name	Definition	Comment
DATA_TYPE	char DATA_TYPE(STRING32); DATA_TYPE:long_name = "Data type"; DATA_TYPE:conventions = "Argo reference table 1"; DATA_TYPE:_FillValue = " ";	This field contains the type of data contained in the file. The list of acceptable data types is in the reference table 1. Example : Argo synthetic profile
FORMAT_VERSION	char FORMAT_VERSION(STRING4); FORMAT_VERSION:long_name = "File format version"; FORMAT_VERSION:_FillValue = " ";	File format version Example : "3.1"
HANDBOOK_VERSION	char HANDBOOK_VERSION(STRING4); HANDBOOK_VERSION:long_name = "Data handbook version"; HANDBOOK_VERSION:_FillValue = " ";	Version number of the data handbook. This field indicates that the data contained in this file are managed according to the policy described in the Argo data management handbook. Example : "1.0"
REFERENCE_DATE_TIME	char REFERENCE_DATE_TIME(DATE_TIME); REFERENCE_DATE_TIME:long_name = "Date of reference for Julian days"; REFERENCE_DATE_TIME:conventions = "YYYYMMDDHHMISS"; REFERENCE_DATE_TIME:_FillValue = " ";	Date of reference for julian days. The recommended reference date time is "19500101000000" : January 1st 1950 00:00:00
DATE_CREATION	char DATE_CREATION(DATE_TIME); DATE_CREATION:long_name = "Date of file creation"; DATE_CREATION:conventions = "YYYYMMDDHHMISS";	Date and time (UTC) of creation of this file. Format : YYYYMMDDHHMISS

	DATE_CREATION:_FillValue = " ";	Example : 20011229161700 : December 29th 2001 16 :17 :00
DATE_UPDATE	char DATE_UPDATE(DATE_TIME); DATE_UPDATE:long_name = "Date of update of this file"; DATE_UPDATE:conventions = "YYYYMMDDHHMISS"; DATE_UPDATE:_FillValue = " ";	Date and time (UTC) of update of this file. Format : YYYYMMDDHHMISS Example : 20011230090500 : December 30th 2001 09 :05 :00

3.4 General information for each profile

This section contains general information on each profile.

Each item of this section has a N_PROF (number of profiles) dimension. Note that N_PROF=1 in each mono-profile file.

Name	Definition	Comment
PLATFORM_NUMBER	char PLATFORM_NUMBER(N_PROF, STRING8); PLATFORM_NUMBER:long_name = "Float unique identifier"; PLATFORM_NUMBER:conventions = "WMO float identifier : A9IIIII"; PLATFORM_NUMBER:_FillValue = " ";	WMO float identifier. WMO is the World Meteorological Organization. This platform number is unique. Example : 6900045
PROJECT_NAME	char PROJECT_NAME(N_PROF, STRING64); PROJECT_NAME:long_name = "Name of the project"; PROJECT_NAME:_FillValue = " ";	Name of the project which operates the profiling float that performed the profile. Example : "GYROSCOPE" (EU project for ARGO program)
PI_NAME	char PI_NAME (N_PROF, STRING64); PI_NAME:long_name = "Name of the principal investigator"; PI_NAME:_FillValue = " ";	Name of the principal investigator in charge of the profiling float. Example : Yves Desaubies
STATION_PARAMETERS	char STATION_PARAMETERS(N_PROF, N_PARAM, STRING64); STATION_PARAMETERS:long_name = "List of available parameters for the station"; STATION_PARAMETERS:conventions = "Argo reference table 3"; STATION_PARAMETERS:_FillValue = " ";	List of parameters contained in this profile. The parameter names are listed in reference table 3. Examples : TEMP, PSAL, CNDC TEMP : temperature PSAL : practical salinity CNDC : conductvity
CYCLE_NUMBER	int CYCLE_NUMBER(N_PROF); CYCLE_NUMBER:long_name = "Float cycle number"; CYCLE_NUMBER:conventions = "0...N, 0 : launch cycle (if exists), 1 : first complete cycle"; CYCLE_NUMBER:_FillValue = 99999;	Float cycle number. See §1.6 [RD1]: float cycle definition.
DIRECTION	char DIRECTION(N_PROF); DIRECTION:long_name = "Direction of the station profiles"; DIRECTION:conventions = "A: ascending profiles, D: descending profiles"; DIRECTION:_FillValue = " ";	Type of profile on which measurement occurs. A : ascending profile D : descending profile
DATA_CENTRE	char DATA_CENTRE(N_PROF, STRING2); DATA_CENTRE:long_name = "Data centre in charge of float data processing"; DATA_CENTRE:conventions = "Argo reference table 4"; DATA_CENTRE:_FillValue = " ";	Code for the data centre in charge of the float data management. The data centre codes are described in the reference table 4. Example : "ME" for MEDS
PARAMETER_DATA_MODE	char PARAMETER_DATA_MODE(N_ PROF, N_PARAM); PARAMETER_DATA_MODE:long_name = "Delayed mode or real time data"; PARAMETER_DATA_MODE:conventions = "R : real time; D : delayed mode; A : real time with adjustment"; PARAMETER_DATA_MODE:_FillValue = " ";	Describe the data mode of the individual parameter : R : real time data D : delayed mode data A : real time data with adjusted values

PLATFORM_TYPE	char PLATFORM_TYPE(N_PROF, STRING32); PLATFORM_TYPE:long_name = "Type of float"; PLATFORM_TYPE:conventions = "Argo reference table 23"; PLATFORM_TYPE:_FillValue = " ";	Type of float listed in reference table 23. Example: SOLO, APEX, PROVOR, ARVOR, NINJA
FLOAT_SERIAL_NO	char FLOAT_SERIAL_NO(N_PROF, STRING32); FLOAT_SERIAL_NO:long_name = "Serial number of the float"; FLOAT_SERIAL_NO:_FillValue = " ";	Serial number of the float. Example 1679
FIRMWARE_VERSION	char FIRMWARE_VERSION(N_PROF, STRING32); FIRMWARE_VERSION:long_name = "Instrument firmware version"; FIRMWARE_VERSION:_FillValue = " ";	Firmware version of the float. Example : "013108"
WMO_INST_TYPE	char WMO_INST_TYPE(N_PROF, STRING4); WMO_INST_TYPE:long_name = "Coded instrument type"; WMO_INST_TYPE:conventions = "Argo reference table 8"; WMO_INST_TYPE:_FillValue = " ";	Instrument type from WMO code table 1770. A subset of WMO table 1770 is documented in the reference table 8. Example : 846 : Webb Research float, Seabird sensor
JULD	double JULD(N_PROF); JULD:long_name = "Julian day (UTC) of the station relative to REFERENCE_DATE_TIME"; JULD:standard_name = "time"; JULD:units = "days since 1950-01-01 00:00:00 UTC"; JULD:conventions = "Relative julian days with decimal part (as parts of day)"; JULD:resolution = X; JULD:_FillValue = 999999.; JULD:axis = "T";	Julian day of the profile. The integer part represents the day, the decimal part represents the time of the profile. Date and time are in Universal Time. The julian day is relative to REFERENCE_DATE_TIME. Example : 18833.8013889885 : July 25 2001 19:14:00
JULD_QC	char JULD_QC(N_PROF); JULD_QC:long_name = "Quality on date and time"; JULD_QC:conventions = "Argo reference table 2"; JULD_QC:_FillValue = " ";	Quality flag on JULD date and time. The flag scale is described in the reference table 2. Example : 1: the date and time seems correct.
JULD_LOCATION	double JULD_LOCATION(N_PROF); JULD_LOCATION:long_name = "Julian day (UTC) of the location relative to REFERENCE_DATE_TIME"; JULD_LOCATION:units = "days since 1950-01-01 00:00:00 UTC"; JULD_LOCATION:conventions = "Relative julian days with decimal part (as parts of day)"; JULD_LOCATION:resolution = X; JULD_LOCATION:_FillValue = 999999.;	Julian day of the location of the profile. The integer part represents the day, the decimal part represents the time of the profile. Date and time are in Universal Time. The julian day is relative to REFERENCE_DATE_TIME. Example : 18833.8013889885 : July 25 2001 19:14:00
LATITUDE	double LATITUDE(N_PROF); LATITUDE:long_name = "Latitude of the station, best estimate"; LATITUDE:standard_name = "latitude"; LATITUDE:units = "degree_north"; LATITUDE:_FillValue = 99999.; LATITUDE:valid_min = -90.; LATITUDE:valid_max = 90.; LATITUDE:axis = "Y";	Latitude of the profile. Unit : degree north This field contains the best estimated latitude. The latitude value may be improved in delayed mode. The measured locations of the float are located in the trajectory file. Example : 44.4991 : 44° 29′ 56.76″ N
LONGITUDE	double LONGITUDE(N_PROF); LONGITUDE:long_name = "Longitude of the station, best estimate"; LONGITUDE:standard_name = "longitude"; LONGITUDE:units = "degree_east"; LONGITUDE:_FillValue = 99999.; LONGITUDE:valid_min = -180.; LONGITUDE:valid_max = 180.; LONGITUDE:axis = "X";	Longitude of the profile. Unit : degree east This field contains the best estimated longitude. The longitude value may be improved in delayed mode. The measured locations of the float are located in the trajectory file. Example : 16.7222 : 16° 43′ 19.92″ E
POSITION_QC	char POSITION_QC(N_PROF); POSITION_QC:long_name = "Quality on position (latitude and longitude)";	Quality flag on position. The flag on position is set according to (LATITUDE, LONGITUDE) quality.

	POSITION_QC:conventions = "Argo reference table 2"; POSITION_QC:_FillValue = " ";	The flag scale is described in the reference table 2. Example: 1: position seems correct.
POSITIONING_SYSTEM	char POSITIONING_SYSTEM(N_PROF, STRING8); POSITIONING_SYSTEM:long_name = "Positioning system"; POSITIONING_SYSTEM:_FillValue = " ";	Name of the system in charge of positioning the float locations from reference table 9. Examples : ARGOS
PROFILE_<PARAM>_QC	char PROFILE_<PARAM>_QC(N_PROF); PROFILE_<PARAM>_QC:long_name = "Global quality flag of <PARAM> profile"; PROFILE_<PARAM>_QC:conventions = "Argo reference table 2a"; PROFILE_<PARAM>_QC:_FillValue = " ";	Global quality flag on the PARAM profile. PARAM is among the STATION_PARAMETERS. The overall flag is set to indicate the percentage of good data in the profile as described in reference table 2a. Example : PROFILE_TEMP_QC = A : the temperature profile contains only good values PROFILE_PSAL_QC = C : the salinity profile contains 50% to 75% good values
CONFIG_MISSION_NUMBER	int CONFIG_MISSION_NUMBER(N_PROF); CONFIG_MISSION_NUMBER:long_name = " Unique number denoting the missions performed by the float"; CONFIG_MISSION_NUMBER:conventions = "1...N, 1 : first complete mission"; CONFIG_MISSION_NUMBER:_FillValue = 99999;	Unique number of the mission to which this profile belongs. See note on floats with multiple configurations §2.4.6.1 [RD1]. Example : 1

3.5 Measurements for each profile

This section contains information on each level of each profile.
Each variable in this section has a N_PROF (number of profiles), N_LEVELS (number of pressure levels) dimension.

Name	Definition	Comment
<PARAM>	float <PARAM>(N_PROF, N_LEVELS); <PARAM>:long_name = "<X>"; <PARAM>:standard_name = "<X>"; <PARAM>:_FillValue = <X>; <PARAM>:units = "<X>"; <PARAM>:valid_min = <X>; <PARAM>:valid_max = <X>; <PARAM>:C_format = "<X>"; <PARAM>:FORTRAN_format = "<X>"; <PARAM>:resolution = <X>;	<PARAM> contains the original values of a parameter listed in reference table 3. <X> : this field is specified in the reference table 3.
<PARAM>_QC	char <PARAM>_QC(N_PROF, N_LEVELS); <PARAM>_QC:long_name = "quality flag"; <PARAM>_QC:conventions = "Argo reference table 2"; <PARAM>_QC:_FillValue = " ";	Quality flag applied on each <PARAM> values. The flag scale is specified in table 2.
<PARAM>_dPRES	float <PARAM>_dPRES(N_PROF, N_LEVELS); <PARAM>:long_name = "<PARAM> pressure displacement from original sampled value"; <PARAM>:_FillValue = 99999; <PARAM>:units = "decibar";	<PARAM>_dPRES contains the pressure displacement between the <PARAM> measurement provided here and the nearest original sampled value. <PARAM>_dPRES = [original PRES+vertical_offset] – [synthetic axis PRES] where vertical_offset is the offset of the associated sensor with respect to the pressure sensor (vertical_offset > 0 when the sensor is situated below the pressure sensor). If there are two original observations with the same distance to a <PARAM> measurement, <PARAM>_dPRES with respect to the deepest observation (i.e. <PARAM>_dPRES > 0) is recorded by convention. **<PARAM>_dPRES is mandatory for**

		all parameters but PRES.
<PARAM>_ADJUSTED	float <PARAM>_ADJUSTED(N_PROF, N_LEVELS); <PARAM>_ADJUSTED:long_name = "<X>"; <PARAM>_ADJUSTED:standard_name = "<X>"; <PARAM>_ADJUSTED:_FillValue = <X>; <PARAM>_ADJUSTED:units = "<X>"; <PARAM>_ADJUSTED:valid_min = <X>; <PARAM>_ADJUSTED:valid_max = <X>; <PARAM>_ADJUSTED:C_format = "<X>"; <PARAM>_ADJUSTED:FORTRAN_format = "<X>"; <PARAM>_ADJUSTED:resolution= <X>;	<PARAM>_ADJUSTED contains the adjusted values derived from the original values of the parameter. <X> : this field is specified in the reference table 3. **<PARAM>_ADJUSTED is mandatory.** When no adjustment is performed, the FillValue is inserted.
<PARAM>_ADJUSTED_QC	char <PARAM>_ADJUSTED_QC(N_PROF, N_LEVELS); <PARAM>_ADJUSTED_QC:long_name = "quality flag"; <PARAM>_ADJUSTED_QC:conventions = "Argo reference table 2"; <PARAM>_ADJUSTED_QC:_FillValue = " ";	Quality flag applied on each <PARAM>_ADJUSTED values. The flag scale is specified in reference table 2. **<PARAM>_ADJUSTED_QC is mandatory.** When no adjustment is performed, the FillValue is inserted.
<PARAM>_ADJUSTED_ERROR	float <PARAM>_ADJUSTED_ERROR(N_PROF, N_LEVELS); <PARAM>_ADJUSTED_ERROR:long_name = "Contains the error on the adjusted values as determined by the delayed mode QC process"; <PARAM>_ADJUSTED_ERROR:_FillValue = <X>; <PARAM>_ADJUSTED_ERROR:units = "<X>"; <PARAM>_ADJUSTED_ERROR:C_format = "<X>"; <PARAM>_ADJUSTED_ERROR:FORTRAN_format = "<X>"; <PARAM>_ADJUSTED_ERROR:resolution= <X>;	<PARAM>_ADJUSTED_ERROR Contains the error on the adjusted values as determined by the delayed mode QC process. <X> : this field is specified in the reference table 3. **<PARAM>_ADJUSTED_ERROR is mandatory.** When no adjustment is performed, the FillValue is inserted.

Note that <PARAM> could be one of the C or B Argo parameters listed in http://www.argodatamgt.org/content/download/30910/209488/file/argo-parameters-list-core-and-b.xlsx.

3.5.1 Calibration information for each profile

This section contains calibration information for each parameter of each profile.

Each item of this section has a N_PROF (number of profiles), N_CALIB (number of calibrations), N_PARAM (number of parameters) dimension.

Name	Definition	Comment
PARAMETER	char PARAMETER(N_PROF, N_CALIB, N_PARAM, STRING256); PARAMETER:long_name = "List of parameters with calibration information"; PARAMETER:conventions = "Argo reference table 3"; PARAMETER:_FillValue = " ";	Name of the calibrated parameter. The list of parameters is in reference table 3. Example : PSAL
SCIENTIFIC_CALIB_EQUATION	char SCIENTIFIC_CALIB_EQUATION(N_PROF, N_CALIB, N_PARAM, STRING256); SCIENTIFIC_CALIB_EQUATION:long_name = "Calibration equation for this parameter"; SCIENTIFIC_CALIB_EQUATION:_FillValue = " ";	Calibration equation applied to the parameter. Example : Tc = a1 * T + a0
SCIENTIFIC_CALIB_COEFFICIENT	char SCIENTIFIC_CALIB_COEFFICIENT(N_PROF, N_CALIB, N_PARAM, STRING256); SCIENTIFIC_CALIB_COEFFICIENT:long_name = "Calibration coefficients for this equation"; SCIENTIFIC_CALIB_COEFFICIENT:_FillValue = " ";	Calibration coefficients for this equation. Example : a1=0.99997 , a0=0.0021

SCIENTIFIC_CALIB_COMMENT	char SCIENTIFIC_CALIB_COMMENT(N_PROF, N_CALIB, N_PARAM, STRING256); SCIENTIFIC_CALIB_COMMENT:long_name = "Comment applying to this parameter calibration"; SCIENTIFIC_CALIB_COMMENT:_FillValue = " ";	Comment about this calibration Example : The sensor is not stable
SCIENTIFIC_CALIB_DATE	char SCIENTIFIC_CALIB_DATE (N_PROF N_CALIB, N_PARAM, DATE_TIME) SCIENTIFIC_CALIB_DATE:long_name = "Date of calibration"; SCIENTIFIC_CALIB_DATE:conventions = "YYYYMMDDHHMISS"; SCIENTIFIC_CALIB_DATE:_FillValue = " ";	Date of the calibration. Example : 20011217161700

3.6 File localization and naming

3.6.1 GDAC s-profile files localization

The GDAC s-profiles are located at the root of the GDACs' ftp servers.

- ftp://usgodae.org/pub/outgoing/argo/
- ftp://ftp.ifremer.fr/ifremer/argo/

Following the demonstration mode, the creation of the s-profiles is performed on the Coriolis GDAC only, with a daily update and mirroring by the US GDAC.

In the future operational mode, the s-profiles will be continuously created and mirrored on both GDACs.

3.6.2 S-profile files naming convention

The produced synthetic files comply with the following naming conventions.

3.6.2.1 Single-cycle profile files

S<R/D><FloatID>_<XXX><D>.nc

where:

- <FloatID> is the float WMO number,
- <R/D> indicates Real-Time data (R) or Delayed-Mode data (D). D is used if at least one parameter of the file is in delayed mode,
- <XXX> is the cycle number,
- <D> is added for descending profile (default is ascending profile).

Example: SR6901439_001D.nc

3.6.2.2 Multi-cycle profile files

<FloatID>_Sprof.nc

where:

- <FloatID> is the float WMO number.

Example: 6901439_Sprof.nc

3.6.3 GDAC s-profile file index

The s-profile index file describes all individual s-profile files of the GDAC ftp site. Its format is an autodescriptive ASCII with comma separated values.

It is located at the root of the GDACs ftp servers.

- ftp://usgodae.org/pub/outgoing/argo/
- ftp://ftp.ifremer.fr/ifremer/argo/

The directory file contains:

- A header with a list of general informations : title, description, project name, format version, date of update, ftp root addresses, GDAC node
- A table with a description of each file of the GDAC ftp site. This table is a comma separated list.

Index file naming convention

- ./argo_synthetic-profile_index.txt
- ./argo_synthetic-profile_index.txt.gz

S-profile file index format definition : argo_synthetic-profile_index.txt
Title : Synthetic-Profile directory file of the Argo Global Data Assembly Center # Description : The directory file describes all individual synthetic-profile files of the argo GDAC ftp site. # Project : ARGO # Format version : 2.2 # Date of update : YYYYMMDDHHMISS # FTP root number 1 : ftp://ftp.ifremer.fr/ifremer/argo/dac # FTP root number 2 : ftp://usgodae.usgodae.org/pub/outgoing/argo/dac # GDAC node : CORIOLIS file,date,latitude,longitude,ocean,profiler_type,institution,parameters,parameter_data_mode,date_update • file : path and file name on the ftp site. The file name contain the float number and the cycle number. Fill value : none, this field is mandatory • date : date of the profile, YYYYMMDDHHMISS Fill value : " " (blank) • latitude, longitude : location of the profile Fill value : 99999. • ocean : code of the ocean of the profile as described in reference table 13 Fill value : " " (blank) • profiler_type : type of profiling float as described in reference table 8 Fill value : " " (blank) • institution : institution of the profiling float described in reference table 4 Fill value : " " (blank) • parameters : list of c- and b-parameters in the file (space-separated) • parameter_data_mode : list of parameter_data_mode (‘R’, ‘A’, or ‘D’) for the corresponding c- or b-parameter in the file in the same order as in ‘parameters’ (previous column) • date_update : : date of last update of the file, YYYYMMDDHHMISS Fill value : " " (blank) Each line describes a file of the GDAC ftp site.

S-profile file index example
Title : Synthetic-Profile directory file of the Argo Global Data Assembly Center # Description : The directory file describes all individual synthetic-profile files of the argo GDAC ftp site. # Project : ARGO # Format version : 2.2 # Date of update : 20190717101503 # FTP root number 1 : ftp://ftp.ifremer.fr/ifremer/argo/dac # FTP root number 2 : ftp://usgodae.usgodae.org/pub/outgoing/argo/dac # GDAC node : CORIOLIS file,date,latitude,longitude,ocean,profiler_type,institution,parameters,parameter_data_mode,date_update aoml/1900722/profiles/SD1900722_001.nc,20061022021624,-40.316,73.389,I,846,AO,PRES TEMP PSAL DOXY,DDDR,20190425093239 aoml/1900722/profiles/SD1900722_002.nc,20061101064423,-40.390,73.528,I,846,AO,PRES TEMP PSAL DOXY,DDDR,20190425093249 aoml/1900722/profiles/SD1900722_003.nc,20061111101222,-40.455,73.335,I,846,AO,PRES TEMP PSAL DOXY,DDDR,20190425093301 … coriolis/6901486/profiles/SD6901486_071.nc,20140517144300,60.086,-50.156,A,836,IF,PRES TEMP PSAL DOXY DOWN_IRRADIANCE380 DOWN_IRRADIANCE412 DOWN_IRRADIANCE490 DOWNWELLING_PAR CHLA BBP700 CDOM,RRRDRRRRARR,20190715064125 coriolis/6901486/profiles/SD6901486_072.nc,20140522144200,59.872,-50.892,A,836,IF,PRES TEMP PSAL DOXY DOWN_IRRADIANCE380 DOWN_IRRADIANCE412 DOWN_IRRADIANCE490 DOWNWELLING_PAR CHLA BBP700 CDOM,RRRDRRRRARR,20190715064145 …

```
meds/4902481/profiles/SR4902481_003.nc,20190704053600,56.186,-52.387,A,844,ME,PRES TEMP PSAL
DOXY,RRRR,20190712101429
meds/4902481/profiles/SR4902481_004.nc,20190714053200,56.386,-50.992,A,844,ME,PRES TEMP PSAL
DOXY,RRRR,20190716101339
```