

Marine-mammals data management
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Marine-mammals NetCDF formats and conventions

Version 1.0
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History

Version	Date	Comment
0.9	29/03/2013	BP, TC: creation of the document
1.0	15/12/2014	TC, FR: general update Addition of profile format, GDAC file naming convention

1 Marine-mammals data-management principles

1.1 About Marine-mammals

The instrumented sea-mammals program is the global network of open-ocean in-situ observations, being implemented by an international partnership of researchers. Instrumented sea-mammals provide trajectories and vertical profiles of various physical, biogeochemical variables in different regions around the globe.

The program's objective is to build and maintain a multidisciplinary global network for a broad range of research and operational applications including biology, climate and ecosystem variability and forecasting and ocean state validation.

Sea-mammals data are publicly available. More information about the project is available at:

- <http://www.coriolis.eu.org/Observing-the-Ocean/Marine-Mammals>

1.2 About this document

The main purpose of this document is to specify the format of the files that are used to distribute Sea-mammals data, and to document the standards used therein. This includes naming conventions, or taxonomy, as well as metadata content.

This document is derived from the “Argo NetCDF user’s manual”, adapted and specialized to Sea-mammals in-situ observations (whereas Argo is specialized in floats ocean observations).

1.3 Sea-mammals data management structure and data access

The data flow within Sea-mammals is carried out through three organizational units: PIs, DACs, GDACs.

The **Principal Investigator (PI)**, typically a scientist at a research institution, organize the sea-mammals instrumentation with sensors that deliver the data. He or she is responsible for providing the data and all auxiliary information to a **Data Assembly Center (DAC)**.

The **DAC** assembles Sea-mammals-compliant files from this information and delivers these to a **Global Data Assembly Centers (GDAC)**, where they are made publicly available.

The **GDAC** distributes the best copy of the data files. When a higher quality data file (e.g. adjusted data) is available, it replaces the previous version of the data file.

The user can access the data at either GDAC, cf. section “GDAC organization”.

1.4 User Obligations

A user of Sea-mammals data is expected to read and understand this manual and the documentation about the data as contained in the “attributes” of the NetCDF data files, as these contain essential information about data quality and accuracy.

A user of Sea-mammals data must comply with the requirements set forth in the attributes “distribution_statement” and “citation” of the NetCDF data files.

Unless stated otherwise, a user must acknowledge use of Sea-mammals data in all publications and products where such data are used, preferably with the following standard sentence:

“These data were collected and made freely available by the international Sea-mammals project and the national programs that contribute to it.”

1.5 Disclaimer

Sea-mammals data are published without any warranty, express or implied.

The user assumes all risk arising from his/her use of Sea-mammals data.

Sea-mammals data are intended to be research-quality and include estimates of data quality and accuracy, but it is possible that these estimates or the data themselves contain errors.

It is the sole responsibility of the user to assess if the data are appropriate for his/her use, and to interpret the data, data quality, and data accuracy accordingly.

Sea-mammals project welcomes users to ask questions and report problems to the contact addresses listed in the data files or on the Sea-mammals internet page.

1.6 Further Information Sources and Contact Information

Note 15/12/2014: these links and email address are not yet activated

- Sea-mammals website: <http://www.sea-mammals.org>
- For further information about the benefits and distributing data onto the GTS, please refer to: <http://www.jcommops.org/dbcp/gts> or contact the Sea-mammals Project Office on projectoffice@sea-mammals.org.
- For information about unique numbering of Sea-mammals Moorings and Gliders on the GTS see: <http://www.wmo.int/pages/prog/amp/mmop/wmo-number-rules.html>

1.7 Useful links, tools

1.7.1 Sea-mammals file format checker

The OceansSITES file format checker is a java software freely available at:

- <http://www.coriolis.eu.org/Data-Products/Tools>

2 Sea-mammals NetCDF data format version 1.0

Sea-mammals use the NetCDF (network Common Data Form) system, a set of software libraries and machine-independent data formats. Our implementation of NetCDF is based on the community-supported Climate and Forecast (CF) specification, which supplies a standard vocabulary and some metadata conventions.

Sea-mammals layer several more conventions above the CF standard.. These are intended to make it easier to share in-situ data, to make it simpler for the GDACs to aggregate data from multiple sites, and to ensure that the data can be created and understood by the basic NetCDF utilities.

- Sea-mammals include standard terms for the short name of both coordinate and data variables (measurements).
- File names are created using a standard, described in section §4.1.

A Sea-mammals data file contains measurements such as temperature and salinity, continuously performed at different levels on a platform (e.g. elephant seal).

The requirements are drawn almost exclusively from the NetCDF Style Guide:

- Units are compliant with CF/COARDS/Udunits ;
- The time parameter is encoded as recommended by COARDS and CF.
- Parameters are given standard names from the CF table
- Where time is specified as an attribute, the ISO8601 standard is used.

For more information on CF, COARDS, NetCDF, Udunits, and ISO8601 see:

- NetCDF: <http://www.unidata.ucar.edu/software/netcdf/docs/BestPractices.html>
- Udunits: <http://www.unidata.ucar.edu/software/udunits/>
- CF: <http://cf-pcmdi.llnl.gov/>
- COARDS: http://www.ferret.noaa.gov/noaa_coop/coop_cdf_profile.html
- ISO8601: http://en.wikipedia.org/wiki/ISO_8601

2.1 Global attributes

The global attribute section of a NetCDF file contains metadata that describes the contents of the file overall, and allows for data discovery. All fields should be human-readable, and should be of character type, not numeric, even if the information content is a number. Sea-mammals recommends that all of these attributes be used and contain meaningful information unless there are technical reasons rendering this impossible. However, files that do not at least contain the attributes listed as “mandatory” will not be considered Sea-mammals-compliant. In Sea-mammals, global attribute names are in lower-case letters.

Global attributes can be thought of as conveying five kinds of information:

- What: what are the data in this dataset;
- Where: the spatial coverage of the data;
- When: the temporal coverage of the data;
- Who: who produced the data;
- How: how were the data produced and made available.

The global attributes specification follows the recommendations of Unidata NetCDF Attribute Convention for Dataset Discovery, at:

<http://www.unidata.ucar.edu/software/netcdf-java/formats/DataDiscoveryAttConvention.html>

Name	Example	Definition
WHAT		
data_type	data_type="Sea mammals time-series data"	This field contains the type of data contained in the file. The list of acceptable data types is in reference table 1. Example: "Sea-mammals time-series data". This attribute is mandatory.
format_version	format_version="1.1"	Sea-mammals format version Example: "1.1". This attribute is mandatory.
date_update	date_update="2014-04-11T08:35:00Z"	File update or creation date (UTC). See note on time format below. This attribute is mandatory.
platform_code	platform_code="ct96-01-13"	Platform unique code within Sea-mammals project. When available, the WMO platform code should be used as platform code. This attribute is mandatory.
wmo_platform_code	wmo_platform_code="9900172"	WMO (World Meteorological Organization) identifier. This platform number is unique within the Sea-mammals project. Example: "48409" for CIS-1 mooring.
smru_platform_code	smru_platform_code = "ct96-01-13"	Code assigned by SMRU
deployment_code	deployment_code = "ct96K1"	A deployment is performed when one or several sea-mammals are equipped with sensors.

species	species = "Elephant"	Species of the sea-mammal
institution	institution="Museum national d'histoire naturelle"	Specifies the institution where the original data was produced.
number_of_ts_profiles	number_of_ts_profiles=364	Number of profiles with temperature and salinity
number_of_t_profiles	number_of_t_profiles=364	Number of profiles with temperature only
source	source="Sea mammal observation"	The method of production of the original data. For Sea-mammals data, use one of the following: "Shipborne observation", "Mooring observation"
history	history= "2012-04-11T08:35:00Z data collected, C. Guinet. 2012-04-12T10:11:00Z file with provisional data compiled and sent to DAC, A. Meyer."	Provides an audit trail for modifications to the original data. It should contain a separate line for each modification, with each line beginning with a timestamp, and including user name, modification name, and modification arguments. The time stamp should follow the format outlined in the note on time formats below.
data_mode	data_mode="D"	Indicates if the file contains real-time, provisional or delayed-mode data. The list of valid data modes is in reference table 5. This attribute is mandatory.
quality_index	quality_index="A"	A code value valid for the whole dataset: 0 unknown quality A excellent (no known problems, regular quality checking) B probably good (occasional problems, validation phase) C extremely suspect, frequent problems
references	references="http://www.cebc.cnrs.fr/ecom m/En_ecomm/ecomm_con.html"	Published or web-based references that describe the data or methods used to produce it. Include a reference to Sea-mammals and a project-specific reference if appropriate.
comment	comment="..."	Miscellaneous information about the data or methods used to produce it. Any free-format text is appropriate.
Conventions	Conventions="CF-1.6 Sea-mammals-1.1"	Name of the conventions followed by the dataset. "convention" starting in lower case 'c' is still valid but will become obsolete.
Netcdf_version	netcdf_version="3.6"	Netcdf version used for the data set
title summary	title="Sea mammal observations" summary="Sea mammal observations from sensors deployed by Museum/CEBC in Kerguelen Islands."	Free-format text describing the dataset. The display of these two attributes together should allow data discovery for a human reader. "title": title of the dataset. Use the file name if in doubt. "summary": a longer description of the dataset. A paragraph of up to 100 words is appropriate.
naming_authority	Naming_authority="Sea mammal international project"	The "id" and "naming_authority" attributes are intended to provide a globally unique identification for each dataset. For Sea-mammals data, use: naming_authority="Sea-mammals"

cdm_data_type	cdm_data_type="time-series"	The "cdm_data_type" attribute gives the Unidata CDM (common data model) data type used by THREDDS. E.g. "Point", "Trajectory", "Station", "Radial", "Grid", "Swath". Use "Station" for Sea-mammals mooring data. More: http://www.unidata.ucar.edu/projects/THREDD_S/CDM/CDM-TDS.htm
WHERE		
area	area="Southern Indian Ocean"	Geographical coverage. Try to compose of the following: North/Tropical/South Atlantic/Pacific/Indian Ocean, Southern Ocean, Arctic Ocean. For specific sea area, use the International Hydrographic Bureau sea areas available at : http://vocab.ndg.nerc.ac.uk/client/vocabServer.jsp .
geospatial_lat_min	geospatial_lat_min="59.8"	The southernmost latitude, a value between -90 and 90 degrees. This attribute is mandatory.
geospatial_lat_max	geospatial_lat_max="59.8"	The northernmost latitude, a value between -90 and 90 degrees. This attribute is mandatory.
geospatial_lon_min	geospatial_lon_min="-41.2"	The westernmost longitude, a value between -180 and 180 degrees. This attribute is mandatory.
geospatial_lon_max	geospatial_lon_max="-41.2"	The easternmost longitude, a value between -180 and 180 degrees. This attribute is mandatory.
geospatial_vertical_min	geospatial_vertical_min="10.0"	Minimum depth for measurements.
geospatial_vertical_max	geospatial_vertical_max="2000"	Maximum depth for measurements
WHEN		
time_coverage_start	time_coverage_start="2011-10-01T00:00:00Z"	Start date of the data in UTC. See note on time format below.
time_coverage_end	time_coverage_end="2012-02-05T23:59:29Z"	Final date of the data in UTC. See note on time format below.
WHO		
institution_references	institution_references="http://www.cebc.cnrs.fr"	References to data provider institution, the place to find all information on the dataset (web-based, i.e. give URLs).
contact	contact="guinet@cebc.cnrs.fr"	Contact person's e-mail.
author	author="Christophe Guinet"	Name of the person responsible for the creation of the dataset.
data_assembly_center	data_assembly_center="Coriolis"	Data Assembly Center (DAC) in charge of this data file. The data_assembly_center are listed in reference table 4.

pi_name	pi_name="Christophe Guinet"	Name of the principal investigator in charge of the platform.
HOW		
distribution_statement	distribution_statement="Follows Coriolis data policy standards, cf. http://www.coriolis.eu.org/data_policy . Data available free of charge. User assumes all risk for use of data. User must display citation in any publication or product using data. User must contact PI prior to any commercial use of data."	Statement describing data distribution policy.
citation	citation="These data were collected and made freely available by the Sea Mammals International project and the national programs that contribute to it."	The citation to be used in publications using the dataset.
qc_manual	qc_manual="http://www.coriolis.eu.org/data/quality_control_manual.pdf"	This field contains the name of the manual that describes the quality control procedure.
positioning_system	positioning_system = "argos"	Name of the system used to derive the float locations, see reference table 9. Use blank as a separator to discriminate multiple positioning systems. Examples : SEA-MAMMALS, GPS

Note on time formats

Whenever time information is given in the global attributes, it ought to be a string of the format:

"YYYY-MM-DDThh:mm:ssZ" (i.e. year - month - day T hour : minute : second Z)

If higher resolution than seconds is needed, any number of decimal digits (".s") for the seconds is acceptable:

"YYYY-MM-DDThh:mm:ss.sZ"

In any case, the time must be in UTC. A capital "T" separates the date and the hour information. The string must end with a capital "Z", an old indication of UTC. These formats are two (of many) described by ISO8601.

Examples:

- 2005-10-24T08:00:00Z
- 2008-01-01T22:50:02.031Z

2.2 Vertical profile file

The current version of the profile file format is 1.0. It is derived from Argo NetCDF vertical profile file format.

1.1.1 Dimensions

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 5 th 2001 17:28:34 19971217000000 : December 17 th 1997 00:00:00
STRING256 STRING64 STRING32 STRING16 STRING8 STRING4 STRING2	STRING256 = 256; STRING64 = 64; STRING32 = 32; STRING16 = 16; 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. This dimension depends on the data set. A file contains at least one profile. There is no defined limit on the maximum number of profiles in a file. Example : N_PROF = 100
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
N_HISTORY	N_HISTORY = UNLIMITED;	Number of history records.

1.1.2 General information on the profile file

This section contains information about the whole file.

Name	Definition	Comment
DATA_TYPE	char DATA_TYPE(String16); DATA_TYPE:long_name = "Data type"; DATA_TYPE:conventions = "Sea-mammal 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 : Sea-mammal profile
FORMAT_VERSION	char FORMAT_VERSION(String4); FORMAT_VERSION:long_name = "File format version"; FORMAT_VERSION:_FillValue = " ";	File format version Example : "1.0"
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 Sea-mammal 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 1 st 1950 00:00:00
DATE_CREATION	char DATE_CREATION(Date_Time); DATE_CREATION:long_name = "Date of file creation"; DATE_CREATION:conventions = "YYYYMMDDHHMISS"; DATE_CREATION:_FillValue = " ";	Date and time (UTC) of creation of this file. Format : YYYYMMDDHHMISS Example : 20011229161700 : December 29 th 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 30 th 2001 09 :05 :00

1.1.3 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.

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 SEA-MAMMAL program)
PI_NAME	char PI_NAME (N_PROF, String64); PI_NAME:long_name = "Name of the	Name of the principal investigator in charge of the profiling float.

	principal investigator"; PI_NAME: FillValue = " ";	Example : Fabien Roquet
STATION_PARAMETER S	char STATION_PARAMETERS(N_PROF, N_PARAM, STRING16); STATION_PARAMETERS:long_name = "List of available parameters for the station"; STATION_PARAMETERS:conventions = "Sea-mammal 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 : conductivity
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 § Error! Reference source not found. : 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 = "Sea- mammal 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
DC_REFERENCE	char DC_REFERENCE(N_PROF, STRING32); DC_REFERENCE:long_name = "Station unique identifier in data centre"; DC_REFERENCE:conventions = "Data centre convention"; DC_REFERENCE: FillValue = " ";	Unique identifier of the profile in the data centre. Data centres may have different identifier schemes. DC_REFERENCE is therefore not unique across data centres.
DATA_STATE_INDICAT OR	char DATA_STATE_INDICATOR(N_PROF, STRING4); DATA_STATE_INDICATOR:long_name = "Degree of processing the data have passed through"; DATA_STATE_INDICATOR:conventions = "Sea-mammal reference table 6"; DATA_STATE_INDICATOR: FillValue = " ";	Degree of processing the data has passed through. The data state indicator is described in the reference table 6.
DATA_MODE	char DATA_MODE(N_PROF); DATA_MODE:long_name = "Delayed mode or real time data"; DATA_MODE:conventions = "R : real time; D : delayed mode; A : real time with adjustment"; DATA_MODE: FillValue = " ";	Indicates if the profile contains real time, delayed mode or adjusted data. 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 = "Sea- mammal 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,	Firmware version of the float.

	<p>STRING32); FIRMWARE_VERSION:long_name = "Instrument firmware version"; FIRMWARE_VERSION:_FillValue = " ";</p>	<p>Example : "013108"</p>
WMO_INST_TYPE	<p>char WMO_INST_TYPE(N_PROF, STRING4); WMO_INST_TYPE:long_name = "Coded instrument type"; WMO_INST_TYPE:conventions = "Sea-mammal reference table 8"; WMO_INST_TYPE:_FillValue = " ";</p>	<p>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</p>
JULD	<p>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";</p>	<p>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</p>
JULD_QC	<p>char JULD_QC(N_PROF); JULD_QC:long_name = "Quality on date and time"; JULD_QC:conventions = "Sea-mammal reference table 2"; JULD_QC:_FillValue = " ";</p>	<p>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.</p>
JULD_LOCATION	<p>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.;</p>	<p>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</p>
LATITUDE	<p>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";</p>	<p>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</p>
LONGITUDE	<p>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";</p>	<p>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</p>
POSITION_QC	<p>char POSITION_QC(N_PROF); POSITION_QC:long_name = "Quality on position (latitude and longitude)"; POSITION_QC:conventions = "Sea-mammal reference table 2"; POSITION_QC:_FillValue = " ";</p>	<p>Quality flag on position. The flag on position is set according to (LATITUDE, LONGITUDE) quality. The flag scale is described in the reference table 2. Example: 1: position seems correct.</p>
POSITIONING_SYSTEM	<p>char POSITIONING_SYSTEM(N_PROF,</p>	<p>Name of the system in charge of</p>

	STRING8); POSITIONING_SYSTEM:long_name = "Positioning system"; POSITIONING_SYSTEM:_FillValue = " ";	positioning the float locations from reference table 9. Examples : SEA-MAMMALS
PROFILE_<PARAM>_QC	char PROFILE_<PARAM>_QC(N_PROF); PROFILE_<PARAM>_QC:long_name = "Global quality flag of <PARAM> profile"; PROFILE_<PARAM>_QC:conventions = "Sea-mammal 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

Note: how to sort STATION_PARAMETERS variable

The parameters listed in STATION_PARAMETERS should be sorted in the same order within a given data file.

1.1.4 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.

<PARAM> contains the raw values telemetered from the floats.

The values in <PARAM> should never be altered. <PARAM>_QC contains QC flags that pertain to the values in <PARAM>. Values in <PARAM>_QC are set initially in 'R' and 'A' modes by the automatic real-time tests.

They are later modified in 'D' mode at levels where the QC flags are set incorrectly by the real-time procedures, and where erroneous data are not detected by the real-time procedures.

Each parameter can be adjusted (in delayed-mode, but also in real-time if appropriate). In that case, <PARAM>_ADJUSTED contains the adjusted values, <PARAM>_ADJUSTED_QC contains the QC flags set by the adjustment process, and <PARAM>_ADJUSTED_ERROR contains the adjustment uncertainties.

A real-time data file with no adjusted data has an adjusted section with fill values (<PARAM>_ADJUSTED, <PARAM>_ADJUSTED_QC and <PARAM>_ADJUSTED_ERROR).

The Sea mammal profile delayed mode QC is described in "Sea mammal quality control manual" (see <http://www.sea-mammaldata.mgt.org/Documentation>).

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> contains the original values of a parameter listed in reference table 3. <X> : this field is specified in the reference table 3.

	<PARAM>:resolution = <X>;	
<PARAM>_QC	char <PARAM>_QC(N_PROF, N_LEVELS); <PARAM>_QC:long_name = "quality flag"; <PARAM>_QC:conventions = "Sea-mammal reference table 2"; <PARAM>_QC:_FillValue = " ";	Quality flag applied on each <PARAM> values. The flag scale is specified in table 2.
<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: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 = "Sea-mammal 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 = "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: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 on vertical axis associated to PRES

The variable PRES (pressure) is the vertical axis. The PRES declaration contains the variable attribute.

```
PRES:axis = "Z";
```

Example of a profiling float performing temperature measurements with adjusted values of temperature

Parameter definition : PRES, TEMP, TEMP_ADJUSTED

```
float TEMP(N_PROF, N_LEVELS);
TEMP:long_name = "sea temperature in-situ ITS-90 scale";
TEMP:standard_name = "sea_water_temperature";
TEMP:_FillValue = 99999.f;
TEMP:units = "degree_Celsius";
TEMP:valid_min = -2.f;
TEMP:valid_max = 40.f;
TEMP:resolution = 0.001f;

char TEMP_QC(N_PROF, N_LEVELS);
TEMP_QC:long_name = "quality flag";
TEMP_QC:conventions = "Sea-mammal reference table 2";
TEMP_QC:_FillValue = " ";

float TEMP_ADJUSTED(N_PROF, N_LEVELS);
TEMP_ADJUSTED:long_name = "adjusted sea temperature in-situ ITS-90 scale";
```

```

TEMP:standard_name = "sea_water_temperature";
TEMP_ADJUSTED:_FillValue = 99999.f;
TEMP_ADJUSTED:units = "degree_Celsius";
TEMP_ADJUSTED:valid_min = -2.f;
TEMP_ADJUSTED:valid_max = 40.f;
TEMP_ADJUSTED:resolution= 0.001f;

char TEMP_ADJUSTED_QC(N_PROF, N_LEVELS);
TEMP_ADJUSTED_QC:long_name = "quality flag";
TEMP_ADJUSTED_QC:conventions = "Sea-mammal reference table 2";
TEMP_ADJUSTED_QC:_FillValue = " ";

float TEMP_ADJUSTED_ERROR(N_PROF, N_LEVELS);
TEMP_ADJUSTED_ERROR:long_name = "error on sea temperature in-situ
ITS-90 scale ";
TEMP_ADJUSTED_ERROR:_FillValue = 99999.f;
TEMP_ADJUSTED_ERROR:units = "degree_Celsius";
TEMP_ADJUSTED_ERROR:resolution= 0.001f;

```

1.1.5 Calibration information for each profile

Calibrations are applied to parameters to create adjusted parameters. Different calibration methods will be used by groups processing Sea-mammal data. When a method is applied, its description is stored in the following fields.

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.

If no calibration is available, N_CALIB is set to 1, PARAMETER is filled with the list of parameter names, and all values of calibration section are set to fill values.

Name	Definition	Comment
PARAMETER	char PARAMETER(N_PROF, N_CALIB, N_PARAM, STRING16); PARAMETER:long_name = "List of parameters with calibration information"; PARAMETER:conventions = "Sea-mammal 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 : $T_c = a_1 * T + a_0$
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 : $a_1=0.99997$, $a_0=0.0021$
SCIENTIFIC_CALIB_COMMENT	char SCIENTIFIC_CALIB_COMMENT(N_PROF, N_CALIB, N_PARAM, STRING256);	Comment about this calibration Example :

	OF, N_CALIB, N_PARAM, STRING256); SCIENTIFIC_CALIB_COMMENT:long_name = "Comment applying to this parameter calibration"; SCIENTIFIC_CALIB_COMMENT:_FillValue = " ";	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

1.1.6 History information for each profile

This section contains history information for each action performed on each profile by a data centre.

Each item of this section has a N_HISTORY (number of history records), N_PROF (number of profiles) dimension.

A history record is created whenever an action is performed on a profile.

The recorded actions are coded and described in the history code table from the reference table 7.

On the GDAC, multi-profile history section is empty to reduce the size of the file. History section is available on mono-profile files, or in multi-profile files distributed from the web data selection.

Name	Definition	Comment
HISTORY_INSTITUTION	char HISTORY_INSTITUTION(N_HISTORY, N_PROF, STRING4); HISTORY_INSTITUTION:long_name = "Institution which performed action"; HISTORY_INSTITUTION:conventions = "Sea-mammal reference table 4"; HISTORY_INSTITUTION:_FillValue = " ";	Institution that performed the action. Institution codes are described in reference table 4. Example : ME for MEDS
HISTORY_STEP	char HISTORY_STEP(N_HISTORY, N_PROF, STRING4); HISTORY_STEP:long_name = "Step in data processing"; HISTORY_STEP:conventions = "Sea-mammal reference table 12"; HISTORY_STEP:_FillValue = " ";	Code of the step in data processing for this history record. The step codes are described in reference table 12. Example : ARGQ : Automatic QC of data reported in real-time has been performed
HISTORY_SOFTWARE	char HISTORY_SOFTWARE (N_HISTORY, N_PROF, STRING4); HISTORY_SOFTWARE:long_name = "Name of software which performed action"; HISTORY_SOFTWARE:conventions = "Institution dependent";	Name of the software that performed the action. This code is institution dependent. Example : WJO

	HISTORY_SOFTWARE:_FillValue = " ";	
HISTORY_SOFTWARE_RELEASE	char HISTORY_SOFTWARE_RELEASE (N_HISTORY, N_PROF, STRING4); HISTORY_SOFTWARE_RELEASE :long_name = "Version/release of software which performed action"; HISTORY_SOFTWARE_RELEASE :conventions = "Institution dependent"; HISTORY_SOFTWARE_RELEASE :_FillValue = " ";	Version of the software. This name is institution dependent. Example : «1.0»
HISTORY_REFERENCE	char HISTORY_REFERENCE (N_HISTORY, N_PROF, STRING64); HISTORY_REFERENCE:long_name = "Reference of database"; HISTORY_REFERENCE:conventions = "Institution dependent"; HISTORY_REFERENCE:_FillValue = " ";	Code of the reference database used for quality control in conjunction with the software. This code is institution dependent. Example : WOD2001
HISTORY_DATE	char HISTORY_DATE(N_HISTORY, N_PROF, DATE_TIME); HISTORY_DATE:long_name = "Date the history record was created"; HISTORY_DATE:conventions = "YYYYMMDDHHMISS"; HISTORY_DATE:_FillValue = " ";	Date of the action. Example : 20011217160057
HISTORY_ACTION	char HISTORY_ACTION(N_HISTORY, N_PROF, STRING4); HISTORY_ACTION:long_name = "Action performed on data"; HISTORY_ACTION:conventions = "Sea-mammal reference table 7"; HISTORY_ACTION:_FillValue = " ";	Name of the action. The action codes are described in reference table 7. Example : QCF\$ for QC failed
HISTORY_PARAMETER	char HISTORY_PARAMETER(N_HISTORY, N_PROF, STRING16); HISTORY_PARAMETER:long_name = "Station parameter action is performed on"; HISTORY_PARAMETER:conventions = "Sea-mammal reference table 3"; HISTORY_PARAMETER:_FillValue = " ";	Name of the parameter on which the action is performed. Example : PSAL
HISTORY_START_PRES	float HISTORY_START_PRES(N_HISTORY, N_PROF); HISTORY_START_PRES:long_name = "Start pressure action applied on"; HISTORY_START_PRES:_FillValue = 99999.f; HISTORY_START_PRES:units = "decibar";	Start pressure the action is applied to. Example : 1500.0
HISTORY_STOP_PRES	float HISTORY_STOP_PRES(N_HISTORY, N_PROF);	Stop pressure the action is applied to. This should be greater than

	RY, N_PROF); HISTORY_STOP_PRES:long_name = "Stop pressure action applied on"; HISTORY_STOP_PRES:_FillValue = 99999.f; HISTORY_STOP_PRES:units = "decibar";	START_PRES. Example : 1757.0
HISTORY_PREVIOUS_VALUE	float HISTORY_PREVIOUS_VALUE(N_HISTORY, N_PROF); HISTORY_PREVIOUS_VALUE:long_name = "Parameter/Flag previous value before action"; HISTORY_PREVIOUS_VALUE:_FillValue = 99999.f;	Parameter or flag of the previous value before action. Example : 2 (probably good) for a flag that was changed to 1 (good)
HISTORY_QCTEST	char HISTORY_QCTEST(N_HISTORY, N_PROF, STRING16); HISTORY_QCTEST:long_name = "Documentation of tests performed, tests failed (in hex form)"; HISTORY_QCTEST:conventions = "Write tests performed when ACTION=QCP\$; tests failed when ACTION=QCF\$"; HISTORY_QCTEST:_FillValue = " ";	This field records the tests performed when ACTION is set to QCP\$ (QC performed), the test failed when ACTION is set to QCF\$ (QC failed). The QCTEST codes are describe in reference table 11. Example : 0A (in hexadecimal form)

The usage of the History section is described in §**Error! Reference source not found.**
"Using the History section of the Sea-mammal netCDF Structure".

2.3 Trajectory file

NetCDF variables include data measured by instruments, parameters derived from the primary measurements, and coordinate variables, which may be nominal values, such as values for depth for instruments that do not directly record depth. The variable names are written in CAPITALIZED letters. Each variable has a specific set of attributes, some of which are mandatory.

2.3.1 Data file dimensions

NetCDF dimensions provide information on the size of the data variables. OceanSITES allows a single parameter for each of the data dimensions, i.e. time, depth, latitude and longitude. Requirements are described further in the section on coordinate variables. Standard names for OceanSITES dimensions should be in upper case.

Name	Example	Comment
TIME	TIME=unlimited	Number of time steps. Example: for a mooring with one value per day and a mission length of one year, TIME contains 365 time steps.
DEPTH	DEPTH=5	Number of depth levels. Example: for a mooring with measurements at 0.25, 10, 50, 100 and 200 meters, DEPTH=5.
LATITUDE	LATITUDE=1	Dimension of the LATITUDE coordinate variable.
LONGITUDE	LONGITUDE=1	Dimension of the LONGITUDE coordinate variable.
POSITION	POSITION=1	Dimension of the POSITION_QC variable.

2.3.2 Coordinate variables

The coordinate variables orient the data in time and space. For this purpose, they have an “axis” attribute defining that they point in X, Y, Z, and T dimensions. The DEPTH variable may be positive in either upward or downward direction, which is defined in its “positive” attribute.

Default values are not allowed in coordinate variables.

All attributes in this section except the “comment” are mandatory; however “QC_indicator” may be omitted for any parameter if there is a separate QC variable for that parameter.

The Z axis may be represented as pressure, if, for example pressure is recorded directly by an instrument and the calculation of depth from pressure would cause a loss of information. Depth is strongly preferred, since it allows data to be used more directly.

Type, name, dimension, attributes	Comment
-----------------------------------	---------

<pre> Double TIME(TIME); TIME:long_name = "time"; TIME:standard_name = "time"; TIME:units = "days since 1950-01-01T00:00:00Z"; TIME:valid_min = 0.0; TIME:valid_max = 90000.0; TIME:QC_indicator = <X>; TIME:QC_procedure = <Y>; TIME:uncertainty = <Z>; TIME:comment = "Optional comment..." TIME:axis = "T"; </pre>	<p>Date and time (UTC) of the measurement in days since midnight, 1950-01-01.</p> <p>Example: Noon, Jan 2, 1950 is stored as 1.5. July 25, 2001, 19:14:00 is stored as 18833.8013889885.</p> <p><X>: Replaces TIME_QC if constant. Cf. note on quality control in data variable section, value from reference table 2. <Y>: Cf. note on quality control in data variable section, value from reference table 2.1. <Z>: Choose appropriate value.</p>
<pre> Float LATITUDE(TIME); LATITUDE:long_name = "Latitude of each location"; LATITUDE:standard_name = "latitude"; LATITUDE:units = "degrees_north"; LATITUDE:valid_min = -90.0; LATITUDE:valid_max = 90.0; LATITUDE:QC_indicator = <X>; LATITUDE:QC_procedure = <Y>; LATITUDE:uncertainty = <Z>; LATITUDE:comment = "Optional comment..." LATITUDE:axis="Y"; LATITUDE:reference="WGS84"; LATITUDE:coordinate_reference_frame="urn:ogc:crs:EPSG::4326"; </pre>	<p>Latitude of the measurements. Units: degrees north; southern latitudes are negative.</p> <p>Example: 44.4991 for 44° 29' 56.76" N</p> <p><X>: Replaces POSITION_QC if constant. Cf. note on quality control in data variable section, value from reference table 2. <Y>: Cf. note on quality control in data variable section, value from reference table 2.1. <Z>: Choose appropriate value.</p>
<pre> Float LONGITUDE(TIME); LONGITUDE:long_name = "Longitude of each location"; LONGITUDE:standard_name = "longitude"; LONGITUDE:units = "degrees_east"; LONGITUDE:valid_min = -180.0; LONGITUDE:valid_max = 180.0; LONGITUDE:QC_indicator = <X>; LONGITUDE:QC_procedure = <Y>; LONGITUDE:uncertainty = <Z>; LONGITUDE:comment = "Optional comment..." LONGITUDE:axis="X"; LONGITUDE:reference="WGS84"; LONGITUDE:coordinate_reference_frame="urn:ogc:crs:EPSG::4326"; </pre>	<p>Longitude of the measurements. Unit: degrees east; western latitudes are negative.</p> <p>Example: 16.7222 for 16° 43' 19.92" E</p> <p><X>: Replaces POSITION_QC if constant. Cf. note on quality control in data variable section, value from reference table 2. <Y>: Cf. note on quality control in data variable section, value from reference table 2.1. <Z>: Choose appropriate value.</p>
<pre> Float PRES(PRES); PRES:long_name = "PRES of each measurement"; PRES:standard_name = "PRES"; PRES:units = "meters"; PRES:positive = "down"; PRES:_FillValue = -99999.0; PRES:valid_min = 0.0; PRES:valid_max = 12000.0; PRES:QC_indicator = <X>; PRES:QC_procedure = <Y>; PRES:uncertainty = <Z>; PRES:comment = "Optional comment..." PRES:axis="Z"; PRES:reference=<R>; PRES:coordinate_reference_frame="urn:ogc:crs:EPSG::5113" </pre>	<p>PRES of each measurement.</p> <p>Example: 513 for a measurement 513 meters below sea surface.</p> <p><X>: Replaces PRES_QC if constant. Cf. note on quality control in data variable section, value from reference table 2. <Y>: Cf. note on quality control in data variable section, value from reference table 2.1. <Z>: Choose appropriate value.</p> <p><R> : The PRES reference default value is "sea_level". Other possible values are : "mean_sea_level", "mean_lower_low_water", "wgs84_geoid"</p>

Note on latitude and longitude WGS84 datum

The latitude and longitude datum is WGS84. This is the default output of GPS systems.

Sea-mammals uses the EPSG coordinate reference system to describe geographical positions; the coordinate reference frame corresponding to WGS84 is : "urn:ogc:crs:EPSG::5113".

More on EPSG : <http://www.epsg.org/>

Note on DEPTH reference

The default depth reference is "sea_level" (free sea surface).

In EPSG coordinate reference system, this default reference is: "urn:ogc:crs:EPSG::5113"

Note on handling observations in multiple locations

An Sea-mammals files may contain observations performed in different locations. In that case, the TIME, LATITUDE and LONGITUDE dimensions have the same value.

For example: two CTD casts performed in different locations.

- TIME, LATITUDE and LONGITUDE dimensions are set to 2
- TIME(1) is the time of the first CTD cast, TIME(2) is the time of the second CTD cast
- LATITUDE(1) is the latitude of the first CTD cast, LATITUDE(2) is the latitude of the second CTD cast
- LONGITUDE(1) is the longitude of the first CTD cast, LONGITUDE(2) is the longitude of the second CTD cast

Note on TIME

By default, the time word represents the center of the data sample or averaging period.

2.3.3 Coordinate quality control variables

The coordinate variables have the same quality control variables as the data variables. If the quality control values are constant, the information is given in attributes of the coordinate variables. For details, see <PARAM>_QC in the section on data variables, and the note on quality control therein.

Type, name, dimension, attributes	Comment
Byte TIME_QC(TIME);	Quality flag for each TIME value.
Byte POSITION_QC(POSITION);	Quality flag for each LATITUDE and LONGITUDE value.
Byte DEPTH_QC(DEPTH);	Quality flag for each DEPTH value.

2.3.4 Data variables

Data variables contain the actual measurements and indicators about their quality, uncertainty, and mode through which they were obtained. There are different options as to how the indicators are specified, whether in attributes or separate variables, which are outlined in the notes below the table. The variable names are standardized in reference table 3; replace <PARAM> with any of the names indicated there. Mandatory attributes are marked as such, however, Sea-mammals requests that all other attributes be used and contain meaningful information unless technical reasons make this impossible.

Type, name, dimension, attributes	Comment
Float <PARAM>(TIME); <PARAM>: standard_name = "<X>"; <PARAM>: units = "<Y>"; <PARAM>: _FillValue = <Y>; <PARAM>:long_name = "Y"; <PARAM>:QC_indicator = <X>; <PARAM>:QC_procedure = <X>; <PARAM>:valid_min = <Y>; <PARAM>:valid_max = <Y>; <PARAM>:comment = "<Y>"; <PARAM>:sensor_depth = <Y>; <PARAM>:sensor_mount = <X>; <PARAM>:sensor_orientation = <X>; <PARAM>:sensor_name = <Y>; <PARAM>:sensor_serial_number = <Y>; <PARAM>:ancillary_variables = "<Y>"; <PARAM>:uncertainty = <Y>; <PARAM>:accuracy = <Y>; <PARAM>:precision = <Y>; <PARAM>:resolution = <Y>; <PARAM>:cell_methods = "<X>"; <PARAM>:DM_indicator = "<X>"; <PARAM>:reference_scale = "<Y>"	<PARAM> names are defined in reference table 3. Examples: TEMP, PSAL, DOXY. These 3 attributes are mandatory: standard_name, units and _FillValue. These 11 attributes are highly desirables : QC_indicator, QC_procedure, valid_min, valid_max, sensor_name, uncertainty, sensor_serial_number, accuracy, precision, resolution, DM_indicator. The other attributes are optional. <X> : standardized attributes listed in reference tables <Y> : attributes whose value is set by the PI (Principal Investigator) standard_name : type char, see reference. table 3 units : type char, see reference table 3 _FillValue : type float, see reference table 3 long_name : type char, free text QC_indicator : type byte, see reference table 2 and note on quality control below QC_procedure type byte, see reference table 2.1 and note on quality control below valid_min : type float. Minimum value for valid data valid_max : type float. Maximum value for valid data comment . type char. Any free-format text with comments as appropriate. sensor_depth . type float. Nominal sensor depth(s) in meters, counting positive as per DEPTH:positive. sensor_mount type char. See reference table 7 for sensor mounting characteristics. sensor_orientation type char. See reference table 8 for sensor orientation characteristics. sensor_name type char (if the data all come from a single sensor). sensor_serial_number type char (if the data all come from a single sensor). ancillary_variables . type char. Other variables associated with <PARAM>, e.g. <PARAM>_QC. List as space-separated string. Example: TEMP:ancillary_variables="TEMP_QC TEMP_DM TEMP_UNCERTAINTY"

	<p>uncertainty: type float. Overall measurement uncertainty, if constant. Cf. note on uncertainty below.</p> <p>accuracy: type float. Nominal sensor accuracy. Cf. note on uncertainty below.</p> <p>precision: type float. Nominal sensor precision. Cf. note on uncertainty below.</p> <p>resolution: type float. Nominal resolution of this data parameter.</p> <p>cell_methods: type char. Specifies cell method as per CF convention. Example: TEMP:cell_methods="TIME: point DEPTH: point LATITUDE: point LONGITUDE: point" Values are listed in table 2.2</p> <p>DM_indicator: Type char. Data mode, if constant, as per reference table 5. Cf. note on data modes below.</p> <p>reference_scale: type char. For some measurements that are provided according to a standard reference scale specify the the reference scale with this optional attribute. Example: ITS-90, PSS-78</p>
<p>Byte <PARAM>_QC(TIME, DEPTH); <PARAM>_QC:long_name = "quality flag"; <PARAM>_QC:conventions = "Sea-mammals reference table 2"; <PARAM>_QC:_FillValue = -128; <PARAM>_QC:valid_min = 0; <PARAM>_QC:valid_max= 9; <PARAM>_QC:flag_values = 0, 1, 2, 3, 4, 5, 7, 8, 9; <PARAM>_QC:flag_meanings = "no_qc_performed good_data probably_good_data bad_data_that_are_potentially_correctable bad_data_value_changed nominal_value_interpolated_value missing_value"</p>	<p>Quality flags for values of associated <PARAM>. The flag scale is specified in reference table 2, and is included in the flag_meanings attribute.</p> <p>long_name: type char. fixed value</p> <p>conventions. type char. Required; fixed value</p> <p>_FillValue. type byte. Required; fixed value</p> <p>valid_min. type byte. Required; fixed value</p> <p>valid_max: type byte. Required; fixed value</p> <p>flag_values: type byte. Required; fixed value</p> <p>flag_meanings: type char. Required; fixed value</p>
<p>Char <PARAM>_DM(TIME, DEPTH); <PARAM>_DM:long_name = "method of data processing"; <PARAM>_DM:conventions = " Sea-mammals reference table 5"; <PARAM>_DM:flag_values = "R", "P", "D", "M"; <PARAM>_DM:flag_meanings = "real-time provisional delayed-mode mixed"; <PARAM>_DM:_FillValue = " ";</p>	<p>This is the data mode.</p> <p>Indicates if the data point is real-time, delayed-mode or provisional mode. It is included when the dataset mixes modes for a single variable.</p> <p>See note on data modes below, and reference table 5.</p> <p>long_name: type char. Required; fixed value</p> <p>conventions: type char. Required; fixed value</p> <p>flag_values: type char. Required; fixed value</p> <p>flag_meanings: type char. Required; fixed value</p> <p>_FillValue: type char. Required; fixed value</p>
<p>Float <PARAM>_UNCERTAINTY(TIME, DEPTH); <PARAM>_UNCERTAINTY:long_name = "uncertainty" <PARAM>_UNCERTAINTY:_FillValue=<Y> <PARAM>:units = "<Y>";</p>	<p>Overall uncertainty of the data given in <PARAM>. See note on uncertainty below.</p> <p>long_name: type char. Required; fixed value</p> <p>_FillValue: type float. Required.</p> <p>units: type char. Required. Must be the same as <PARAM>:units.</p>

Note on quality control (QC)

The quality of the data in a variable <PARAM> is described by the attribute <PARAM>:QC_procedure, and one of the following: the attribute <PARAM>:QC_indicator or the variable <PARAM_QC>.

<PARAM>:QC_procedure is mandatory and contains values from reference table 2.1, which

describe what kind of quality control procedure has been applied.

It is mandatory to define one of <PARAM>:QC_indicator or <PARAM_QC>, both of which would contain values describing the data quality as per reference table 2. If the quality is the same for all <PARAM>, use <PARAM>:QC_indicator. Else, use <PARAM_QC>.

Note on uncertainty

If the overall measurement uncertainty for a variable <PARAM> is reasonably well-known, it must be provided in the attribute <PARAM>:uncertainty if it is constant, or in a variable of its own, <PARAM>_UNCERTAINTY, if it is not constant. If uncertainty is given in either way, the attribute <PARAM>:accuracy is optional.

If it is impossible to estimate the overall measurement uncertainty, it is required to define at least the attribute <PARAM>:accuracy with the nominal sensor accuracy.

The attributes <PARAM>:precision and <PARAM>:resolution are optional; they contain the sensor precision and resolution if defined.

Note on data modes (DM)

Data mode may be represented as a global attribute “data_mode” if all data is a single mode, or as an attribute to a variable <PARAM>:DM_indicator if all data for <PARAM> is in a single mode. If a parameter contains a mixture of modes, these attributes should be set to “M” and the actual data modes should be represented by an extra variable, <PARAM>_DM. The values for the data modes are explained in reference table 5.

Example for sea temperature measurements and associated quality flags

```
Float TEMP(TIME, DEPTH);
TEMP:standard_name = "sea_water_temperature";
TEMP:units = "degree_Celsius";
TEMP:_FillValue = 99999.f;
TEMP:long_name = "sea water temperature in-situ ITS-90 scale";
TEMP:QC_indicator = 1;
TEMP:QC_procedure = 5;
TEMP:valid_min = -2.0f;
TEMP:valid_max = 40.f;
TEMP:comment = "";
TEMP:sensor_depth = 1;
TEMP:sensor_mount = "mounted_on_surface_buoy";
TEMP:sensor_name = "SBE41";
TEMP:sensor_serial_number = "3263";
TEMP:ancillary_variables = "TEMP_QC" ;
TEMP:uncertainty = 0.01f;
TEMP:accuracy = 0.01f;
TEMP:precision = 0.01f;
TEMP:resolution = 0.001f;
TEMP:cell_methods="median";
TEMP:DM_indicator="P";
TEMP:reference_scale = "ITS-90";

TEMP_QC:long_name = "quality flag";
TEMP_QC:conventions = "Sea-mammals reference table 2";
TEMP_QC:_FillValue = -128;
TEMP_QC:flag_values = 0, 1, 2, 3, 4, 5, 7, 8, 9;
TEMP_QC:flag_meanings = "no_qc_performed good_data probably_good_data
bad_data_that_are_potentially_correctable bad_data_value_changed nominal_value interpolated_value
missing_value"
```

3 Reference tables

3.1 Reference tables 1: data type and data code

3.1.1 Reference table 1: Data type

The data_type global attribute should have one of the valid values listed here.

Data type
Sea-mammals profile data
Sea-mammals time-series data
Sea-mammals trajectory data

3.2 Reference table 2: Variable quality control flag scale

The quality control flags indicate the data quality of the data values in a file, and are normally assigned after quality control procedures have been performed. These codes are used in the <PARAM>_QC variables to describe the quality of each measurement, or in the attribute <PARAM>:QC_indicator to describe the overall quality of the parameter.

Code	Meaning	Comment
0	No QC was performed	-
1	Good data	All QC tests passed.
2	Probably good data	-
3	Bad data that are potentially correctable	These data are not to be used without scientific correction or re-calibration.
4	Bad data	Data have failed one or more tests.
5	Value changed	Data may be recovered after transmission error.
6	-	Not used.
7	Nominal value	Data were not observed but reported. Example: an instrument target depth.
8	Interpolated value	Missing data may be interpolated from neighboring data in space or time.
9	Missing value	-

3.2.1 Reference table 2.2: cell methods

From NetCDF Climate and Forecast (CF) Metadata Conventions, Version 1.0, 4 May, 2008. In the Units column, *u* indicates the units of the physical quantity before the method is applied.

Cell method	units	description
point	u	The data values are representative of points in space or time (instantaneous).
sum	u	The data values are representative of a sum or accumulation over the cell.
maximum	u	Maximum
median	u	Median
mid_range	u	Average of maximum and minimum
minimum	u	Minimum
mean	u	Mean (average value)
mode	u	Mode (most common value)
standard_deviation	u	Standard deviation
variance	u2	Variance

3.3 Reference table 3: Sea-mammals parameter dictionary

3.3.1 Convention for parameter names, standard names and units

The parameters list used for sea-mammals is a subset of Argo floats project parameters list.

parameter name	long_name	cf standard_name	unit	valid_min	valid_max
CNDC	Electrical conductivity	sea_water_electrical_conductivity	mhos/m	0.f	8.5f
PRES	Sea water pressure, equals 0 at sea-level	sea_water_pressure	decibar	0.f	12000.f
PSAL	Practical salinity	sea_water_salinity	psu	2.f	41.f
TEMP	Sea temperature in-situ ITS-90 scale	sea_water_temperature	degree_Celsius	-2.5f	40.f
DOXY	Dissolved oxygen	moles_of_oxygen_per_unit_mass_in_sea_water	micromole/kg	0.f	600.f
CHLA	Chlorophyll-A	mass_concentration_of_chlorophyll_a_in_sea_water	mg/m3		

3.4 Reference table 4: Data Assembly Center Codes

Data Assembly Centers and institutions	
SMRU	Sea-Mammals Research Unit, university of Saint-Andrews, UK
Coriolis	Coriolis data centre, France

3.5 Reference table 5: data mode

The values for the variables “<PARAM>_DM”, the global attribute “data_mode”, and variable attributes “<PARAM>:DM_indicator” are defined as follows:

Value	Meaning
R	Real-time data. Data coming from the (typically remote) platform through a communication channel without physical access to the instruments, disassembly or recovery of the platform. Example: for a mooring with a radio communication, this would be data obtained through the radio.
P	Provisional data. Data obtained after the instruments or the platform have been recovered or serviced. Example: for instruments on a mooring, this would be data downloaded directly from the instruments after the mooring has been recovered on a ship.
D	Delayed-mode data. Data published after all calibrations and quality control procedures have been applied on the internally recorded or best available original data. This is the best possible version of processed data.
M	Mixed. This value is only allowed in the global attribute “data_mode” or in attributes to variables in the form “<PARAM>:DM_indicator”. It indicates that the file contains data in more than one of the above states. In this case, the variable(s) <PARAM>_DM specify which data is in which data mode.

3.6 Reference table 6: data state indicators

Level	Descriptor
0	Data are the raw output from instruments, without calibration, and not necessarily converted to engineering units. These data are rarely exchanged
1	Data have been converted to values independent of detailed instrument knowledge. Automated calibrations may have been done. Data may not have full geospatial and temporal referencing, but have sufficient information to uniquely reference the data to the point of measurement.
2	Data have complete geospatial and temporal references. Information may have been compressed (e.g. subsampled, averaged, etc.) but no assumptions of scales of variability or thermodynamic relationships have been used in the processing.
3	The data have been processed with assumptions about the scales of variability or thermodynamic relationships. The data are normally reduced to regular space, time intervals with enhanced signal to noise.

Class	Descriptor	Subclass
A	No scrutiny, value judgements or intercomparisons are performed on the data. The records are derived directly from the input with no filtering, or subsampling.	- Some reductions or subsampling has been performed, but the original record is available. + Geospatial and temporal properties are checked. Geophysical values are validated. If not validated, this is clearly indicated.
B	Data have been scrutinized and evaluated against a defined and documented set of measures. The process is often automated (i.e. has no human intervention) and the measures are published and widely available.	- Measures are completely automated, or documentation is not widely available. + The measures have been tested on independent data sets for completeness and robustness and are widely accepted.
C	Data have been scrutinized fully including intra-record and intra-dataset comparison and consistency checks. Scientists have been involved in the evaluation and brought latest knowledge to bear. The procedures are published, widely available and widely accepted.	- Procedures are not published or widely available. Procedures have not undergone full scrutiny and testing. + Data are fully quality controlled, peer reviewed and are widely accepted as valid. Documentation is complete and widely available.

Data state indicator recommended use

The following table describes the processing stage of data and the value to be assigned the data state indicator (DS Indicator). It is the concatenation of level and class described above.

Processing Stage	DS Indicator
1. Data pass through a communications system and arrive at a processing centre. The data resolution is the highest permitted by the technical constraints of the floats and communications system.	0A (note 1)
2. The national centre assembles all of the raw information into a complete profile located in space and time.	1A (note 2)
3. The national centre passes the data through automated QC procedures and prepares the data for distribution on the GTS, to global servers and to PIs.	2B
4. Real-time data are received at global data centres that apply QC including visual inspection of the data. These are then distributed to users in near real-time	2B+ (note 3)
5. Data are reviewed by PIs and returned to processing centres. The processing centres forward the data to the global Argo servers.	2C
6. Scientists accept data from various sources, combine them as they see fit with other data and generate a product. Results of the scientific analysis may be returned to regional centres or global servers. Incorporation of these results improves the quality of the data.	2C+
7. Scientists working as part of GODAE generate fields of gridded products delivered in near real-time for distribution from the global servers. Generally, these products mostly will be based on	3B (note 4)

data having passed through automated QC procedures.	
8. Scientists working as part of GODAE generate fields of gridded products delivered with some time delay for distribution from the global servers. Generally, these products mostly will be based on data having passed through manual or more sophisticated QC procedures than employed on the real-time data.	3C

Notes

1. We need to have a pragmatic approach to what constitutes "original" or "raw" data. Despite the fact that an instrument may be capable of high sampling rates, what is reported from the instrument defines what is considered "raw". For example, Argo floats can certainly sample at finer scales than every 10 db, but because of communications, all we see for now is data at that (or worse) vertical resolution. Therefore the data "coming from the instrument" is "raw" output at 10db resolution.
2. The conversion of the raw data stream from the communications system into profiles of variables causes the data state indicator to switch from level 0 to 1.
3. Even though the data at global data centres use manual or semi-automated QC procedures, there is often not the intercomparisons to larger data collections and fields that would qualify the data state indicator to be set to class C. This is generally only provided by scientific scrutiny of the data.
4. The transition from class 2 to 3 occurs when assumptions of scales of variability are applied. During the course of normal data processing it is common to carry out some averaging and subsampling. This is usually done to exploit oversampling by the instrument, and to ensure good measurements are achieved. These are considered to be part of the geospatial and temporal referencing process.

3.7 Reference table 7: history action codes

Code	Meaning
CF	Change a quality flag
CR	Create record
CV	Change value
DC	Station was checked by duplicate checking software
ED	Edit a parameter value
IP	This history group operates on the complete input record
NG	No good trace
PE	Position error. Profile position has been erroneously encoded. Corrected if possible.
QC	Quality Control
QCF\$	Tests failed
QCP\$	Test performed
SV	Set a value
TE	Time error. Profile date/time has been erroneously encoded. Corrected if possible.
UP	Station passed through the update program

3.8 Reference table 8: instrument types

The instrument type codes come from WMO table 1770.

Note : this table should be updated with additional instrument codes specifics to sea-mammals.

Code number	Instrument
-------------	------------

831	P-Alace float
837	Arvor-C float
838	Arvor-D float
839	Provor-II float
840	Provor, no conductivity
841	Provor, Seabird conductivity sensor
842	Provor, FSI conductivity sensor
843	POPS ice Buoy/Float
844	Arvor, Seabird conductivity sensor
845	Webb Research, no conductivity
846	Webb Research, Seabird sensor
847	Webb Research, FSI sensor
848	Apex-EM float
849	Apex-D deep float
850	Solo, no conductivity
851	Solo, Seabird conductivity sensor
852	Solo, FSI conductivity sensor
853	Solo2, Seabird conductivity sensor
854	S2A float
855	Ninja, no conductivity sensor
856	Ninja, SBE conductivity sensor
857	Ninja, FSI conductivity sensor
858	Ninja, TSK conductivity sensor
859	Profiling Float, NEMO, no conductivity
860	Profiling Float, NEMO, SBE conductivity sensor
861	Profiling Float, NEMO, FSI conductivity sensor
862	Solo-D deep float
863	Navis-A Float
864	Ninja-D deep float
865	Nova float

3.9 Reference table 9: location classes

SEA-MAMMALS location classes	
Value	Estimated accuracy in latitude and longitude
0	Sea-mammals accuracy estimation over 1500m radius
1	Sea-mammals accuracy estimation better than 1500m radius
2	Sea-mammals accuracy estimation better than 500 m radius
3	Sea-mammals accuracy estimation better than 250 m radius
G	GPS positioning accuracy
I	Iridium accuracy

4 GDAC organization

The Global Data Assembly Centre (GDAC) handles Sea-mammals data and index files on ftp servers. The servers at both GDACs are synchronized at least daily to provide the same Sea-mammals data.

The user can access the data at either GDAC's ftp site:

- ftp://ftp.ifremer.fr/ifremer/sea_mammal

From this root directory of the GDAs downward, the organization of the directories and files is:

- data/platform_code/FileName.nc
platform_code: sea-mammals unique code

The sites codes will be listed in the “Sea-mammals catalogue” document at either GDAC's root directory.

4.1 File naming convention

The Sea-mammals file names use the following naming convention for data and metadata files.

4.1.1 Data file naming convention

SM_XXX_ZZZ.nc

- SM - Sea-mammals prefix
- XXX - Platform code from the Sea-mammals catalogue
- ZZZ : _prof for profile files, _traj for trajectory file

Example

- SM_ct96-01-13_prof.nc

This file contains temperature and salinity data from the sea-mammals ct96-01-13.

4.2 Index file for data files

To allow for data discovery without downloading the data files themselves, an index file is created at the GDAC level, which lists all available data files and the location and time ranges of their data contents:

- The data index file is located at the root directory of the GDAC.
- The index file contains the list and a description of all data files available on the

GDAC.

- There is a header section, lines of which start with # characters.
- The information sections are comma-separated values.
- Each line contains the following information:
- file: the file name, beginning from the GDAC root directory
- date_update: the update date of the file, YYYY-MM-DDTHH:MI:SSZ
- start_date: first date for observations, YYYY-MM-DDTHH:MI:SSZ
- end_date: last date for observations, YYYY-MM-DDTHH:MI:SSZ
- southern_most_latitude
- northern_most_latitude
- western_most_longitude
- eastern_most_longitude
- geospatial_vertical_min
- geospatial_vertical_max
- update_interval: M monthly, D daily, Y yearly, V void
- size: the size of the file in megabytes
- gdac_creation_date: date of creation of the file on the GDAC
- gdac_update_date: date of update of the file on the GDAC.
- data_mode: R, P, D, M (real-time, provisional, delayed mode, mixed; see reference table 5)
- parameters: list of parameters (standard_name) available in the file separated with blank

The fill value is empty: ",,".

GDAC data files index: Sea-mammals_files_index.txt

```
# Sea-mammals FTP GLOBAL INDEX
# FTP://FTP.IFREMER.FR/IFREMER/SEA-MAMMALS
# Contact: HTTP://WWW.SEA-MAMMALS.ORG
# Index update date YYYY-MM-DDTHH:MI:SSZ: 2008-03-30T18:37:46Z
#
#file,date_update,start_date,end_date,
southern_most_latitude,northern_most_latitude,western_most_longitude,eastern_most_longitude,
geospatial_vertical_min,geospatial_vertical_max,update_interval,size,gdac_creation_date,gdac_update_date,d
ata_mode,parameters
TAO/0n170w/OS_0n170w_SW_LW_2m.nc,2008-04-12T08:05:00Z,2007-03-17T18:07:00Z,2008-04-
12T08:05:00Z,0,0,-170,-170,M,16.7,0,550,2008-04-12T08:05:00Z,2008-04-
12T08:05:00Z,R,sea_water_pressure sea_water_temperature sea_water_salinity
```

5 Glossary, definitions

This chapter gives a definition for the Sea-mammals items described in this manual.

5.1 Deployment

A Sea-mammals deployment is an instrumented individual animal performing observations for a period of time.

5.2 Sensor

A device that measures environmental parameter but does not digitize data for transmission, it needs to be connected to an instrument to produce a data stream that a computer can read.
Examples: CTD, Fluorometer, Oxygen sensor.