Marinet NetCDF format reference manual

NetCDF conventions

Version 1.0

April 2019

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Table of contents

History

Version	Date	Comment
1.0	02/04/2019	TC: initialization of the document based on Copernicus and SeaDataNet NetCDF format manuals

1 Marinet data-management principles

1.1 About Marinet

Marinet data managemement harmonizes data and metadata originating from EU Marine tests infrastructures federated by Marinet2 EU project.

1.2 About this document

This document specifies the NetCDF file format of Marinet, used to distribute Marine test sites data and metadata. It documents the standards used herein; this includes naming conventions as well as metadata content.

It was initiated in March 2019, based on Copernicus Marine in situ and SeaDataNet NetCDF manuals.

1.3 Marinet data management structure and data access

The data flow within Marinet is carried out by distributed centres.

A Marinet data centre aggregates data and metadata within Marinet NetCDF files. The NetCDF files are CF compliant, they follow the prescription of this manual, the use the Marinet standard vocabulary, an extension of SeaDataNet vocabularies, specific for Marinet test sites.

The best version of these files is published on a data publisher service (such as Seanoe or Zenodo) that insure the long-term preservation. The publisher service provides a DOI to properly cite and access the file (usually a simple a one click download).

A Marinet data centre is also responsible for pushing its files on **Marinet E-infrastructure**, where they are made publicly available, ready to be used directly on the E-infrastructure from Jupyter Notebooks (data, metadata and the codes to plot, combine, process).

1.4 User Obligations

A user of Marinet data is expected to read and understand this manual and the documentation about the data contained in the “attributes” of the NetCDF data files which contain essential information about data quality.

A user of Marinet 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 Marinet 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 EU Marinet infrastructure and the programs that contribute to it.”

1.5 Disclaimer

Marinet data are published without any warranty, express or implied.

The user assumes all risk arising from his/her use of Marinet data.

Marinet data are intended to be research-quality, but it is possible that these data 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.

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

1.6 Further Information Sources and Contact Information

- Marinet website: www.marinet.eu

1.7 Useful links, tools

Marinet file format checker

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

NetCDF file format checker for Marinet TAC https://doi.org/10.17882/45538

2 Marinet NetCDF data format version 1.0

Marinet uses 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.

Marinet layers 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 Data Centres to aggregate data from multiple sites, and to ensure that the data can be created and understood by the basic NetCDF utilities.

- Marinet includes standard terms for the short name of both coordinate and data variables (measurements).
- File names are created using a standard, described in section 5.1.

A Marinet data file contains measurements such as temperature and salinity, continuously performed at different levels on a marine platform with x, y, z, t coordinates (3D location and time).

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 NetCDF, UDUNITS, COARDS, CF and ISO8601 see:

- NetCDF: http://www.unidata.ucar.edu/software/netcdf/docs/BestPractices.html
- CF: http://cfconventions.org
- UDUNITS: http://www.unidata.ucar.edu/software/udunits/
- COARDS: http://www.ferret.noaa.gov/noaa_coop/coop_cdf_profile.html
- ISO8601: http://en.wikipedia.org/wiki/ISO_8601

Note on format version

Since May 2019, the Marinet valid data format version is **1.0**.

The NetCDF format manual may be updated with clarifications, recommendations, additional optional attributes without changing the data format version.

2.1 Dimensions

NetCDF dimensions provide information on the size of the data variables, and additionally tie coordinate variables to data. CF recommends that if any or all of the dimensions of a variable have the interpretations of "date or time" (T), "height or depth" (Z), "latitude" (Y), or "longitude" (X) then those dimensions should appear in the relative order T, Z, Y, X in the variable's definition (in the CDL).

Name	Example	Comment
TIME	TIME=365	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. The TIME dimension is fixed (for a more efficient compression than with unlimited dimension).
DEPTH	DEPTH=5	Number of depth levels. Example: for a mooring with measurements at nominal depths of 0.25, 10, 50, 100 and 200 meters, DEPTH=5.
LATITUDE	LATITUDE= 365	Dimension of the LATITUDE coordinate variable.
LONGITUDE	LONGITUDE=365	Dimension of the LONGITUDE coordinate variable.

2.2 Global attributes

The global attribute section of a NetCDF file describes the contents of the file overall, and allows for data discovery. All fields should be human-readable and use units that are easy to understand (e.g. time_coverage_duration should be in days, for a file that spans more than a month). Marinet recommends that all of these attributes be used and contain meaningful information, unless there are technical reasons rendering this impossible. Attributes used by our data inventory system are required, and are listed in **bold type**.

Global attribute names are case sensitive.

Attributes are organized by function: Discovery and identification, Geo-spatial-temporal, Conventions used, Publication information, and Provenance.

Discovery and identification		
site_code	site_code = "Brest"	The test site code. The list of valid site codes is reference table 1. **Mandatory**
platform_code	platform_code="44087"	The unique platform code within Marinet **Mandatory**
~~**data_mode**~~	~~data_mode="R"~~	~~Indicates if the file contains real-time, provisional or delayed-mode data. See §3.1.12~~
title	title="Round Robin exercise …"	Free-format text describing the dataset, for use by human readers. Use the file name if in doubt.
summary	summary="A compléter."	Longer free-format text describing the dataset. This attribute should allow data discovery for a human reader. A paragraph of up to 100 words is appropriate.
naming_ authority	naming_authority="Marinet"	The organization that manages data set names.

id	id="GL_LATEST_TS_MO_44087_20190409"	The "id" and "naming_authority" attributes are intended to provide a globally unique identification for each dataset. The id may be the file name without .nc suffix, which is designed to be unique.
~~wmo_platform_code~~	~~wmo_platform_code="44087"~~	~~WMO (World Meteorological Organization) identifier for the platform~~
source	source="moored surface buoy"	SeaVoX-SeaDataNet platform categories L06 reports platform categories, as a code and a label
source_platform_category_code	source_platform_category_code ="41"	SeaVoX-SeaDataNet platform categories L06 reports platform categories, as a code and a label
institution_edmo_code	institution_edmo_code = "3511"	SeaDataNet EDMO code of the platform's institution
institution	institution="Ifremer"	Name of the platform's institution owner
institution_references	institution_references = "http://www.euskalmet.euskadi.eus/"	The references of the platform's institution (blank separated if many)
comment	comment="Provisional data"	Miscellaneous information about the data or methods used to produce it. Any free-format text is appropriate.
Geo-spatial-temporal		
area	area="Baltic sea"	Geographical coverage. Try to compose of the following: North/Tropical/South Atlantic/Pacific/Indian Ocean, Southern Ocean, Arctic Ocean.
geospatial_lat_min	geospatial_lat_min="59.8"	The southernmost latitude, a value between -90 and 90 degrees; may be string or numeric.
geospatial_lat_max	geospatial_lat_max="59.8"	The northernmost latitude, a value between -90 and 90 degrees.
geospatial_lon_min	geospatial_lon_min="-41.2"	The westernmost longitude, a value between -180 and 180 degrees.
geospatial_lon_max	geospatial_lon_max="-41.2"	The easternmost longitude, a value between -180 and 180 degrees. (ACDD, GDAC)
geospatial_vertical_min	geospatial_vertical_min="10.0"	Minimum depth or height of measurements.
geospatial_vertical_max	geospatial_vertical_max="43"	Maximum depth or height of measurements.
time_coverage_start	time_coverage_start="2006-03-01T00:00:00Z"	Start date of the data in UTC. See note on time format below.
time_coverage_end	time_coverage_end="2006-03-05T23:59:29Z"	Final date of the data in UTC. See note on time format below.
cdm_data_type	cdm_data_type="Station"	The Unidata CDM (common data model) data type used by THREDDS. e.g. point, profile, section, station, station_profile, trajectory, grid, radial, swath, image; use Station for mooring data.
data_type	data_type="Marinet time-series data"	A vocabulary driven type of data. See §3.1.1
Conventions used		
format_version	format_version="1.0"	Marinet NetCDF format version
Conventions	Conventions=" CF-1.6 Cpernicus-Manual-1.0 Marinet-InSituTAC-SRD-1.4 Marinet-InSituTAC-ParametersList-3.1.0"	Name of the conventions followed by the dataset (a blank separated list).

netcdf_version	netcdf_version=”netCDF-4 classic model”	NetCDF version of this file, from ncdump –k command
Publication information		
references	references=”http://marine.Marinet.eu http://www.ifremer.fr”	Published or web-based references that describe the data or methods used to produce it (blank separated list)
data_center	data_centre=” Ifremer”	Data centre in charge of this data file.
update_interval	update_interval=”daily”	Update interval for the file. It may use ISO 8601 Interval format: PnYnMnDTnHnM where elements that are 0 may be omitted. Use “void” for data that are not updated on a schedule.
citation	citation=” These data were collected and made freely available by the Marinet project and the programs that contribute to it”	The citation to be used in publications using the dataset; should include a reference to Marinet TAC but may contain any other text deemed appropriate by the PI and DAC.
doi	doi=”10.17882/54023 10.17882/54024 10.17882/54025“	A blank separated list of DOIs (Digital Object Identier) related to data aggregated in this file.
Provenance		
date_update	date_ update=”2019-04-09T04:34:14Z”	The date on which this file was last updated.
history	history= “2019-04-09T04:34:14Z Creation”	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.
last_date_observation	last_date_observation = "2019-04-09T03:00:00Z"	The last valid observation date and position.
last_latitude_observation	last_latitude_observation = "37.02600"	The last valid observation date and position.
last_longitude_observation	last_longitude_observation = "-76.15100"	The last valid observation date and position.

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

2.3 Variables

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. Each variable has a specific set of attributes, some of which are mandatory.

The mandatory variables or attributes are in **bold characters in the following tables**.

2.3.1 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.

Default values are not allowed in coordinate variables.

All attributes in this section except the "comment" are mandatory.

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
double **TIME**(TIME); TIME:long_name = "Time" ; TIME:standard_name = "time" ; TIME:_FillValue = 999999. ; TIME:units = "days since 1950-01-01T00:00:00Z" ; TIME:valid_min = -90000. ; TIME:valid_max = 90000. ; TIME:QC_indicator = 1 ; TIME:QC_procedure = 1 ; TIME:uncertainty = " " ; TIME:comment = " " ; TIME:axis = "T" ;	Time of the measurement in days since noon, 1950-01-01.
double **LATITUDE**(TIME); LATITUDE:long_name = "Latitude of each location" ; LATITUDE:standard_name = "latitude" ; LATITUDE:_FillValue = 99999.f ; LATITUDE:units = "degree_north" ; LATITUDE:valid_min = -90. ; LATITUDE:valid_max = 90. ; LATITUDE:QC_indicator = 1 ; LATITUDE:QC_procedure = 1 ; LATITUDE:uncertainty = " " ; LATITUDE:comment = " " ; LATITUDE:axis = "Y" ;	Latitude of the measurements. Units: degrees north; southern latitudes are negative.
double **LONGITUDE**(TIME); LONGITUDE:long_name = "Longitude of each location" ; LONGITUDE:standard_name = "longitude" ; LONGITUDE:_FillValue = 99999.f ; LONGITUDE:units = "degree_east" ; LONGITUDE:valid_min = -180. ; LONGITUDE:valid_max = 180. ; LONGITUDE:QC_indicator = 1 ; LONGITUDE:QC_procedure = 1 ; LONGITUDE:uncertainty = " " ; LONGITUDE:comment = " " ; LONGITUDE:axis = "X" ;	Longitude of the measurements. Unit: degrees east; western latitudes are negative.

Note on latitude and longitude WGS84 datum

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

Marinet uses the EPSG coordinate reference system to describe geographical positions; the coordinate reference frame corresponding to WGS84 is : "urn:ogc:crs:EPSG::4326".

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

Note on TIME

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

2.3.2 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); TIME_QC:long_name = "quality flag" ; TIME_QC:conventions = "Marinet reference table 2" ; TIME_QC:_FillValue = -128b ; TIME_QC:valid_min = 0b ; TIME_QC:valid_max = 9b ; TIME_QC:flag_values = 0b, 1b, 2b, 3b, 4b, 5b, 6b, 7b, 8b, 9b ; TIME_QC:flag_meanings = "no_qc_performed good_data probably_good_data bad_data_that_are_potentially_correctable bad_data value_changed not_used nominal_value interpolated_value missing_value" ;	Quality flag for each TIME value.
byte **POSITION_QC**(TIME) POSITION_QC:long_name = "quality flag" ; POSITION_QC:conventions = "Marinet reference table 2" ; POSITION_QC:_FillValue = -128b ; POSITION_QC:valid_min = 0b ; POSITION_QC:valid_max = 9b ; POSITION_QC:flag_values = 0b, 1b, 2b, 3b, 4b, 5b, 6b, 7b, 8b, 9b ; POSITION_QC:flag_meanings = "no_qc_performed good_data probably_good_data bad_data_that_are_potentially_correctable bad_data value_changed not_used nominal_value interpolated_value missing_value" ;	Quality flag for each LATITUDE and LONGITUDE value.

2.3.3 Data variables, physical parameters

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 physical parameters variables are standardized in *"Marinet TAC - physical parameters list. https://doi.org/10.13155/53381"*

See §3.9 "in situ TAC parameters".

Type, name, dimension, attributes	Comment
int **<PARAM>(**TIME); <PARAM>:**standard_name** = <X>; <PARAM>:**units** = <X>; <PARAM>:**_FillValue** = <X>; <PARAM>:**add_offset** = <X> ; <PARAM>:**_FillValue** = <X> ; <PARAM>:long_name = <X>; <PARAM>:valid_min = <X>; <PARAM>:valid_max = <X>; <PARAM>:comment = <X>; <PARAM>:ancillary_variables = <X>; <PARAM>:accuracy = <X>; <PARAM>:precision = <X>; <PARAM>:resolution = <X>; <PARAM>:cell_methods = <X>; <PARAM>:coordinates = "TIME LATITUDE LONGITUDE <X>";	<PARAM> names are defined in https://doi.org/10.13155/53381. Examples: PRES, TEMP, PSAL, DOXY.
byte **<PARAM>_QC**(TIME); <PARAM>_QC:**long_name** = "Quality flag"; <PARAM>_QC:**conventions** = "Marinet reference table 2"; <PARAM>_QC:**_FillValue** = -128; <PARAM>_QC:**valid_min** = 0; <PARAM>_QC:**valid_max**= 9; <PARAM>_QC:**flag_values** = 0, 1, 2, 3b, 4, 5, 8, 9; <PARAM>_QC:**flag_meanings** = "no_qc_performed good_data probably_good_data bad_data_that_are_potentially_correctable bad_data value_changed interpolated_value missing_value";	Quality flags for values of associated <PARAM>. The flag scale is specified in reference table 2, and is included in the flag_meanings attribute.

Note on _FillValue variable attribute

The _FillValue variable attribute is mandatory; it is set to the default value of the variable type.

See https://www.unidata.ucar.edu/software/netcdf/docs/netcdf_8h.html

Note on add_offset and scale_factor

Marinet TAC parameters are signed integers with add offset and scale factor.

- signed integer
- "0" offset
- "0.001" scale factor (except for Beaufort wind with scale_factor =1).

Following CF recommendation, the coordinate variables have no offset and scale_factor : time, latitude, longitude, pressure, depth.

Example for sea temperature measurements and associated quality flags

```
int TEMP(TIME, DEPTH) ;
        TEMP:units = "degrees_C" ;
        TEMP:long_name = "Sea temperature" ;
        TEMP:standard_name = "sea_water_temperature" ;
        TEMP:scale_factor = 0.001f ;
        TEMP:add_offset = 0.f ;
        TEMP:_FillValue = -2147483647 ;
byte TEMP_QC(TIME, DEPTH) ;
        TEMP_QC:long_name = "quality flag" ;
        TEMP_QC:conventions = "Marinet reference table 2" ;
        TEMP_QC:_FillValue = -128b ;
        TEMP_QC:valid_min = 0b ;
        TEMP_QC:valid_max = 9b ;
        TEMP_QC:flag_values = 0b, 1b, 2b, 3b, 4b, 5b, 6b, 7b, 8b, 9b ;
        TEMP_QC:flag_meanings = "no_qc_performed good_data probably_good_data
bad_data_that_are_potentially_correctable bad_data value_changed not_used nominal_value interpolated_value missing_value"
;
```

3 Marinet TAC implementation of NetCDF4 CF1.6 convention

Marinet distributes data and metadata following the NetCDF4 CF1.6 conventions, this chapter describes its detailed implementation.

3.1 NetCDF global attributes

The following global attributes are mandatory, unless explicitly described as “not mandatory”.

3.1.1 NetCDF data_type family global attributes

Marinet NetCDF files handle 4 families of data, reported in the global attribute “data_type” of NetCDF files:

- :data_type = "vertical profile" ;
- :data_type = "time-series" ;
- :data_type = "trajectory" ;
- :data_type = "trajectoryProfile" ;
- :data_type = "spectral data" ;
- :data_type = "radial data" ;

3.1.2 Citation, distribution statement

In the global attribute section of NetCDF files, the citation and distribution statement should be reported as follow:

- distribution_statement=”These data follow Marinet standards; they are public and 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.”
- citation=" These data were collected and made freely available by the Marinet project and the programs that contribute to it"

An additional citation statement can be appended to the “citation” attribute.

Example: citation=" These data were collected and made freely available by the Marinet project and the programs that contribute to it. The data were collected at the Brest Ifremer test site."

3.1.3 Site code

This attribute is not mandatory.

The site code identified a defined area where observations are performed.

On a moving platform (drifting buoy, ship, float) the site_code global attribute is irrelevant; it does not appear in the global attributes.

3.1.4 Platform institution code

The institution where the original data is produced is described with the 2 global attributes:

- institution
- institution_edmo_code

The Edmo codes are managed by the SeaDataNet project; they are available at:

- http://seadatanet.maris2.nl/edmo/

Example:

- institution = "Puertos del Estado (Spain) "
- institution_edmo_code = "2751"

3.1.5 Platform codes

An individual platform may have different identification codes. The NetCDF global attributes provide this information.

Global attribute "platform_code"

It is unique within all Marinet Distribution Units.This attribute is mandatory.

Global attribute "platform_name"

The human readable name of the platform.This attribute is **not** mandatory.

Global attribute "wmo_platform_code"

It contains the Call Sign assigned by WMO (World Meteorological Organization).

This attribute is not mandatory. If it does not exist (example: sea-level stations do not have Call Signs), the attribute is not inserted in the NetCDF file.

Global attribute "ices_platform_code"

It contains the platform code assigned by ICES (International Council for the Exploration of the Sea) for vessels.

This attribute is not mandatory. If it does not exist (example: drifting buoys do not have ICES codes), the attribute is not inserted in the NetCDF file.

3.1.6 Format version, convention

In the global attribute section of NetCDF files, the format version and conventions should be reported as follow:

- format_version = “1.0”
- Conventions = "CF-1.6 Marinet-NetCDF-Format-1.0 Marinet-InSituTAC-ParametersList-1.0.0" ;
- netcdf_version = "netCDF-4 classic model"
  (output from ncdump -k filename)

3.1.7 WMO instrument type

This global attribute is not mandatory.

If available, the WMO instrument type is recorded in the global attribute section of the NetCDF file. The WMO code is available only for vertical profiles.

Example: wmo_inst_type = "830";

3.1.8 Platform category

The SeaDataNet vocabulary L06 (SeaVoX) reports platform categories, as a code and a label.

Global attributes: source, source_platform_category_code

Example of a fixed surface buoy:

- source = “moored surface buoy”
- source_platform_category_code = “41”

3.1.9 Sea level datum

This attribute is not mandatory; it is mandatory for file having sealevel data. It does not appear otherwise.

For tide gauge, the sea level reference is recorded in the global attribute section of the NetCDF file.

Example: sea_level_datum = "Chart Datum";

3.1.10 Last observation global attribute

The 3 “last observation” attributes are not mandatory.

The last valid observation date and position is recorded in the NetCDF global attributes:

- last_latitude_observation,
- last_longitude_observation
- last_date_observation

The date and position quality code is set to 1, 2, 5, 7 or 8 (good, probably good, value changed, nominal, interpolated).

A file with no valid time and position is not distributed on Marinet.

3.1.11 Data centre global attribute

The global attribute “data_centre” is the institution name of the Distribution Unit in charge of the aggregation and distribution of data.

Distribution Unit	data_assembly_centre
ARC – Arctic	IMR
BAL – Baltic	SMHI
BS - Black sea	IOBAS
GLO – Global	Ifremer

IBI - Iberia Biscay Ireland	Puertos del Estado
MED - Mediterranean	HCMR
NWS - North West Shelf	BSH

3.1.12 Data mode: real-time, delayed mode data

The global attribute data mode is used to discriminate files containing real-time data, delayed mode data or both.

- data_mode
  - R: data with real-time quality control
  - D: data with delayed mode quality control
  - M: data with mixed real-time and delayed mode quality control

3.1.13 Update interval of the file

“update_interval”: update interval for the file, one of the following:

- “hourly”, “daily” ”, “monthly”, “yearly”, “void”

Use “void” for delayed-mode or archive data that do not need continuous updating.

3.1.14 Bottom depth

“bottom_depth” : an optional human readable string value.

Example : “37 meters”.

On moorings or fixed buoys, this information is provided by the platform operator. If that information is not available, the default value is “unknown”.

3.2 Reference to DOI for data traceability

List of Data Object Identifiers (DOI) related to this data file (blank separated). The DOIs are minted by data providers.

doi=”10.17882/51141”

3.3 Time sampling description

“time_sampling” : an optional variable attribute with a float type.

For sea level SLEV variable, time_sampling value is mandatory. The unit is “minute”.

Example :

float SLEV(TIME, DEPTH) ;
SLEV:long_name = "Water surface height above a specific datum" ;
SLEV:standard_name = "water_surface_height_above_reference_datum" ;
SLEV:units = "m" ;

SLEV:_FillValue = 9.96921e+36f ;
SLEV:time_sampling = 10f ;
SLEV:sea_level_datum = "chart datum" ;
SLEV:processing_method = "filtered values" ;

3.4 SeaDataNet station identifier

SeaDataNet is the European project that federates the network of EU national oceanographic data centres. SeaDataNet is a data provider for Marinet. Each SeaDataNet station distributed in Marinet NetCDF data file have the following additional variables:

- sdn_cruise: the SeaDataNet cruise ID
  A text string identifying the grouping label for the data object to which the data row belongs. This will obviously be the cruise name for data types such as CTD and bottle data, but could be something like a mooring name for current meter data.
- sdn_station
  A text string identifying the data object to which the data row belongs. This will be the station name for some types of data, but could also be an instrument deployment identifier.
- sdn_local_cdi_id
  The local identifier of the Common Data Index record associated with the data row. The maximum size allowed for this parameter is 80 bytes.
- sdn_edmo_code
  The key identifying the organisation responsible for assigning the local CDI given in the European Directory of Marine Organisations (EDMO).e for some types of data, but could also be an instrument deployment identifier.

```
char SDN_CRUISE(TIME, STRING80) ;
        SDN_CRUISE:long_name = "SeaDataNet cruise ID";
        SDN_CRUISE:conventions = "SeaDataNet convention";
        SDN_CRUISE:_FillValue = " ";

char SDN_STATION (TIME, STRING80) ;
        SDN_STATION:long_name = "SeaDataNet station ID";
        SDN_STATION:conventions = "SeaDataNet convention";
        SDN_STATION:_FillValue = " ";

char SDN_LOCAL_CDI_ID(TIME, STRING80) ;
        SDN_LOCAL_CDI_ID:long_name = "SeaDataNet common data index";
        SDN_LOCAL_CDI_ID:conventions = "SeaDataNet convention";
        SDN_LOCAL_CDI_ID:_FillValue = " ";

int SDN_EDMO_CODE (TIME) ;
        SDN_EDMO_CODE:long_name = "SeaDataNet European Directory of Marine
Organisations code";
        SDN_EDMO_CODE:conventions = "SeaDataNet convention";
        SDN_EDMO_CODE:_FillValue = " ";
```

3.5 Data center reference

When possible, the Distribution Unit should provide a unique id on observation, useful for feedbacks. Each observation is identified in the following variable:

```
char DC_REFERENCE(TIME, STRING32) ;
        DC_REFERENCE:long_name = "Station/Location unique identifier in data centre" ;
        DC_REFERENCE:conventions = "Data centre convention" ;
        DC_REFERENCE:_FillValue = " " ;
```

3.6 Direction of the profiles

The direction of the profiles is recorded in the variable DIRECTION. Therefore, we can store the profiles data, up and down casts, in a single netCDF file.

```
char DIRECTION(TIME);
    DIRECTION:long_name = "Direction of the profiles";
    DIRECTION:conventions = "A: ascending profile, D: descending profile";
    DIRECTION:FillValue = " ";
```

- For an ascending profile (up cast) : DIRECTION = “A”
- For a descending profile (down cast) : DIRECTION = “D”

3.7 Data file with no valid or missing time or position

A file with no valid or missing time or position is not distributed on Marinet TAC.

A valid time has a TIME_QC variable set to 1, 2, 5, 7 or 8 (good, probably good, value changed, nominal, interpolated).

A valid position has a POSITION_QC variable set to 1, 2, 5, 7 or 8 (good, probably good, value changed, nominal, interpolated).

3.8 Coordinate variables : time, latitude, longitude, vertical dimensions

Each observation is located in time, latitude, longitude and Z (vertical dimensions, e.g. immersion, sea water pressure).

The TIME, LATITUDE, LONGITUDE dimensions have the same value.

The In Situ parameters variables have a (TIME, DEPTH) dimension.

Management of vertical axis: DEPH or PRES

There is a unique vertical axis within each file, either DEPH (ex. drifting buoys), or PRES (ex: floats). The vertical axis variable have the attribute axis=”Z” and positive=”down”.

Platforms such as mooring may have both DEPH and PRES variables. The vertical axis is DEPH, the pressure present on some levels is a standard parameter, not a vertical axis. Example: a mooring line with 15 depths levels, with one pressure sensor clipped at 100 meter depth.

When no direct pressure or depth observation is performed, the depth estimation can be a nominal value or a convention. The estimated depth is stored in the DEPH variable, its associated QC flag is set to 7 (nominal value).

Examples of estimated depths

- The depth of a thermosalinograph fitted at 5 meters deep on a vessel: DEPH = 5 DEPH_QC=7

- The depth of a thermistor fitted at 50 meters deep on a mooring cable: DEPH=50 DEPH_QC=7
- The depth of a sealevel station set to 0 meter deep by convention: DEPH = 0 DEPH_QC=7

Example of coordinate variables

```
double TIME(TIME) ;
        TIME:long_name = "Time" ;
        TIME:standard_name = "time" ;
        TIME:units = "days since 1950-01-01T00:00:00Z" ;
        TIME:axis = "T" ;
float LATITUDE(LATITUDE) ;
        LATITUDE:long_name = "Latitude of each location" ;
        LATITUDE:standard_name = "latitude" ;
        LATITUDE:units = "degree_north" ;
        LATITUDE:axis = "Y" ;
float LONGITUDE(LONGITUDE) ;
        LONGITUDE:long_name = "Longitude of each location" ;
        LONGITUDE:standard_name = "longitude" ;
        LONGITUDE:units = "degree_east" ;
        LONGITUDE:axis = "X" ;
float DEPH(TIME, DEPTH) ;
        DEPH:long_name = "Depth" ;
        DEPH:standard_name = "depth" ;
        DEPH:units = "m" ;
        DEPH:axis = "Z" ;
        DEPH:positive = "down" ;
```

3.9 Marinet parameters list

The valid parameters are listed in the Excel spreadsheet “Marinet parameters list” available on the landing page of this document: http://doi.org/10.13155/xxx

Each parameter has a variable name, a long_name, a unit. When available, the CF standard name is set.

Each parameter <PARAM> may have an associated variable <PARAM>_AJUSTED, <PARAM>_AJUSTED_QC, <PARAM>_ADJUSTED_ERROR.

- <PARAM>_AJUSTED: the adjusted value of the parameter, usually the delayed mode adjustment.
- <PARAM>_AJUSTED_QC : the QC flag associated to the adjusted parameter
- <PARAM>_ADJUSTED_ERROR : the error associated to the adjusted parameter

The Marinet standard names come from the CF standard names, available at:

- http://cfconventions.org/standard-names.html

The parameter names are based on SeaDataNet-BODC parameter discovery vocabulary available at:

- http://seadatanet.maris2.nl/v_bodc_vocab/welcome.aspx
  Select P021, “ BODC Parameter Discovery Vocabulary”

The units are compliant with UDUNITS, as implemented by the CF standard; definitions are available at:

- http://www.unidata.ucar.edu/software/udunits

4 Marinet reference tables and vocabularies

4.1 Reference table 1: Marinet test sites code

Brest

BoulogneSurMer

Lorient

…

4.2 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, TIME_QC, POSITION_QC variables to describe the quality of each measurement.

Code	Meaning	Comment
0	No QC was performed	-
1	Good data	All real-time QC tests passed.
2	Probably good data	These data should be used with caution
3	Bad data that are potentially correctable	These data are not to be used without scientific correction.
4	Bad data	Data have failed one or more of the 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 neighbouring data in space or time.
9	Missing value	The value is missing, is not reported, is not applicable…

5 Marinet files distribution organization

Marinet Marine NetCDF files are published with a DOI.

When relevant, they are directly available on Marinet E-infrastructure. This chapter proposes the files organization on Marinet E-infrastructure.

5.1 File naming convention

The Marinet data centre file naming convention is:

- marinet/YY/RR_XX_YY_CODE<_ZZZZ>.nc
    - RR: site bigram (see table 2)
    - XX: file type
    - YY: data type
    - CODE: platform code[1]
    - <_ZZZ>: optional information
    - .nc: NetCDF file name suffix

ZZZ field is generally absent; it is used in specific cases such as a platform having data with multiple time-sampling.

Example: marinet/RR/BL_RR_RoundRobinTidalTest20181209.nc

5.2 Index of Marinet files

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

The index file is updated to describe all the files available in the E-infrastructure directories.

Each index file contains one line per latest, monthly, history or reference_data file:

- product_id
  MA-XX-YY
    - MA: Marinet bigram
    - XX: region bigram (see table 2)
    - YY: product version
      Example: COP-NO-01
- file_name
- geospatial_lat_min
- geospatial_lat_max
- geospatial_lon_min
- geospatial_lon_max
- time_coverage_start
- time_coverage_end
- provider
- date_update
- data_mode

u

[1] This platform code appears in the netCDF file as the global attribute "platform_code"

  - R: real-time data
  - D: delayed-mode data
  - M: mixed real-time and delayed mode data
- parameters (separator : blank)

Index names

- index_latest.txt
- index_monthly.txt
- index_history.txt
- index_reference_data.txt

Index lines order

The index lines are sorted by file name and time coverage start.

Separator character ","

The fields separator character is "," (comma).
In the "provider" field, each "," (comma) character is replaced by "-" (minus). The "," comma character must not appear within a field.

Date format

ISO8601 format: YYYY-MM-DDThh:mm:ssZ

Marinet data file index example
Title : In Situ observations catalog # Description : catalog of available In Situ observations per platform. # Project : Marinet # Format version : 1.0 # Date of update : 20191105194820 # product_id,file_name,geospatial_lat_min,geospatial_lat_max,geospatial_lon_min,geospatial_lon_max,time_coverage_start,time_coverage_end,provider,date_update,data_mode,parameters BL-01,ftp://ftp.ifremer.fr/ifremer/boulogne/drifter/IR_200910_PR_BA_10007.nc,54.17,54.17,7.43,7.43,2009-10-01T00:40:00Z,2009-10-25T12:40:00Z,BSH,2009-11-05T17:01:51Z,DEPH TEMP … … BL-01,ftp://ftp.ifremer.fr/ifremer/ boulogne /vessel/IR_200911_TS_TS_SHIP.nc,37.7667,38.3333,-24.8333,-23.1,2009-11-02T00:00:00Z,2009-11-02T23:00:00Z,Ifremer,2009-11-05T16:32:58Z,TEMP

6 Glossary, definitions

This chapter gives a definition for the Marinet items described in this manual.

6.1 Observatory

An observatory is a facility that manages a series of ocean in situ platforms.

6.2 Deployment

The deployment is the period between the launch and recovery or loss of an autonomous platform.

6.3 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: Transmissiometer, Fluorometer, Oxygen sensor.

Parameter measured by the sensor

What was measured.

Calibration of the parameter measured by the sensor

Verification of Any operation measurement against independent measurements to derive a corrected value or a new parameter.