Copernicus Marine In Situ TAC NetCDF Format Manual

Version 2.0.0

June 2023

https://doi.org/10.13155/59938

HISTORY OF THE DOCUMENT

Version	Date	Comment
1.0	02/04/2019	TC: initialization of the document based on OceanSITES Marine In Situ user's manual
1.4	31/03/2020	Manual and Copernicus In Situ NetCDF format use the same version: 1.4 §1.2 about this document: add "note on versions", "notes on version updates" §1.2 about this document: add "note on format validity" §2 data format: add "Note on format version" §2 data format: add "Note on format validity" §2.2 global attributes: document site_code (OceanSITES specific) §2.2 global attributes: document « contact » §2.2 global attributes: update Conventions §2.2 global attributes: use ISO8601 update intervals §2.2 global attributes: doi syntax: use URI §2.2 global attributes: document Distribution statement §2.2 global attributes: document pi_name §2.2 global attributes: document wmo_inst_type §2.2 global attributes: All global attributes are mandatory §2.3.1 coordinate variables: Z may be non monotonic §2.3.1 coordinate variables: position dimension may be 1 for fixed platforms §2.3.1 coordinate variables: no fill_value for time, latitude, longitude §2.3.1 coordinate variables: qc_indicator is deprecated (valid but will disappear) §2.3.1 coordinate variables: add ancillary_variables attribute §2.3.1 coordinate variables: add calendar attribute §2.3.2 coordinate variables: typo on conventions and FillValue attributes §2.3.3 data variables: add DEPTH missing dimension §2.3.3 data variables: document sensor_depth, sensor_mount, sensor_orientation, data_mode §2.3.4 data variables: "Fill values conventions" new chapter §3.1.10 global attributes: Last observation global attribute exception for HF-radar §3.1.13 global attributes: "Update interval of the file" new chapter §3.1.4 global attributes: institution and institution_edmo_code separators §3.1.6 global attributes: Conventions update §3.2 data mode: "Data mode: real-time, delayed mode data" new chapter §3.3 SeaDataNet: "SeaDataNet station identifier" chapter removed §3.6 parameters: "In Situ parameters" typo corrections §3.8 reference tables: Update variable data mode §4.1 hf radar: "Conventions for HF radar" new chapter §4.2 wave spectra: "Convention for wave spectral data" new chapter §4.3 vessel ADCP: "Conventions for ADCP observations" new chapter §5.3 reference tables: add "conversion methods" tables §5.3 reference tables: add cdm_data_type reference table §7 abbreviations: "Abbreviations" new chapter
1.41	20/10/2020	§2.2 Conventions manual 1.41 and parameters list 3.2.0 §2.3 *_QC:long_name : add the variable name in the long name §2.3.2 Coordinate quality control variables : all attributes are mandatory §4.1.1 add REFMAX dimension for HF radar §5.1 add "A" real time data with adjusted values in reference table 1 §5.3 additional conversion method codes §5.5 add CO and TX data types in reference table 5
1.42	31/03/2021	§2.2 the attributes not listed in bold may have an empty fill value ("") §2.2 revisit "title" global attribute description §2.3.1 "uncertainty" coordinate variable attribute is not mandatory. §4.2.5 §5.2 update flag 6 from "not used" to "value below detection" (EMODnet chemistry) §2.3.3 If the value of an attribute is not known, then the attribute is omitted (no fill value) §3.1.5 Conventions global attribute updated "Copernicus-InSituTAC-FormatManual-1.42" §3.2 TEMP_DM example flag_meanings typo correction §5.5 add "MBT profiles" to XB data type
1.43	11/04/2023	§2.2 changes in "license", "citation" and "distribution_statement"
2.0.0	14/06/2023	New version of the document (redesign and sections restructuring): - Scope limited to exclusively pure format - Attributes externalised to a new document - Content restriction and internal rules externalised

TABLE OF CONTENTS

History of the document 2

Table of contents 3

GLOSSARY AND ABBREVIATIONS 5

I. COPERNICUS MARINE IN SITU PRINCIPLES 6

- I.1. About Copernicus Marine In Situ 6
- I.2. About this document 6
- I.3. Format validation 6
- I.4. Content validation 6

II. NETCDF SYSTEM 7

- II.1. Dimensions 7
- II.2. Global attributes 8
- II.3. Coordinate variables 8
  - II.3.1. Quality control variables 9
- II.4. Data variables, physical parameters 10
- II.5. Other variables 11
  - II.5.1. Data centre reference 11
  - II.5.2. Direction of the profiles 12
- II.6. Discrete Sampling Geometries 12
  - II.6.1. Timeseries 13
  - II.6.2. Trajectory 14
  - II.6.3. TrajectoryProfile 15

III. CONVENTIONS FOR HF RADARS 18

- III.1. Dimensions 18
- III.2. Global attributes 18
- III.3. Coordinate variables 18
- III.4. SDN namespace variables and attributes 18
  - III.4.1. SDN variables 18
  - III.4.2. SDN attributes 19

IV. CONVENTIONS FOR WAVE SPECTRAL DATA 20

- IV.1. Dimensions 20
- IV.2. Global Attributes 20
- IV.3. Coordinates variables 20
- IV.4. Coordinates quality control variables 20
- IV.5. Data variables 20
  - IV.5.1. Specific attributes for directional variables 21

V. CONVENTIONS FOR VESSEL MOUNTED ADCP OBSERVATIONS 22

VI. REFERENCES 23

ANNEX A: REFERENCE TABLES 24

- Reference table 1: variable quality control flag scale 24
- Reference table 2: production unit (PU) bigrams 24
- Reference table 3: file type bigrams 25
- Reference table 4: data type bigrams 25
- Reference table 5: data mode 26

Reference table 6: In Situ TAC and SeaDataNet equivalences 27

GLOSSARY AND ABBREVIATIONS

Argo , Euro-Argo	International profiling float network (https://argo.ucsd.edu) and its European component (http://www.euro-argo.eu)
OCEANSITES	OceanSITES is a worldwide system of long-term, open-ocean reference stations(OceanSITES is a worldwide system of long-term, open-ocean reference stations) and its European component (http://www.emso-eu.org)
SeaDataNet	European Network of National Oceanographic Data Centres (NODCs) (http://www.seadatanet.org)
TAC	CMEMS Thematic Assembly Centre
NetCDF	Network Common Data Form
CDL	Common Data Language
CF	Climate and Forecast convention for NetCDF formats
DSG	Discrete Sampling Geometries
PU	Production Unit
URN	Universal Resource Name
HFR	High Frequency Radar
WMO	World Meteorological Organization

I. COPERNICUS MARINE IN SITU PRINCIPLES

I.1. About Copernicus Marine In Situ

Copernicus Marine In Situ aggregates operational oceanography data and metadata for EU Copernicus service and the broader scientific community.

I.2. About this document

This document specifies the NetCDF file format of Copernicus Marine In Situ used to distribute ocean in situ 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 OceanSITES and Argo user's manuals.

This document is meant to be understood as purely format oriented; the scope is limited to just the syntax. Content, rules and relevant information is supported by VI. REFERENCES.

Note on versions

It is used Semantic Versioning (https://semver.org/) given a version number MAJOR.MINOR.PATCH, increment the:

- MAJOR version when you make incompatible API changes
- MINOR version when you add functionality in a backwards compatible manner
- PATCH version when you make backwards compatible bug fixes

Additional labels for pre-release and build metadata are available as extensions to the MAJOR.MINOR.PATCH format.

Note on updates

In order to assure the stability of the format version, a maximum of one new minor version will be released every 6 months and a major version every 2 years, only when required.

I.3. Format validation

Copernicus Marine In Situ format files are validated by the file format checker: RD[3] NetCDF file format checker for Argo floats, Copernicus In Situ TAC, EGO gliders, OceanSITES

I.4. Content validation

Copernicus Marine In Situ files content are validated by the file content checker: RD[4] Copernicus Marine in situ NetCDF file content checker

II. NETCDF SYSTEM

Copernicus Marine In Situ uses the NetCDF (Network Common Data Form) system, a set of software libraries and machine-independent data formats to generate the files. Our implementation of NetCDF is based on the community-supported Climate and Forecast (CF) specification, which supplies a standard vocabulary and some metadata conventions.

Data in NetCDF format is self-describing, portable, scalable, appendable, shareable, and archivable.

Copernicus Marine In Situ 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 aggregating data from multiple sites, and to ensure that the data can be created and understood by the basic NetCDF utilities and other tools.

A Copernicus Marine In Situ data file contains measurements continuously performed at different levels with x, y, z, t coordinates (that is, 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: https://www.unidata.ucar.edu/software/netcdf/docs/index.html
- CF: http://cfconventions.org
- UDUNITS: http://www.unidata.ucar.edu/software/udunits/
- COARDS: https://ferret.pmel.noaa.gov/Ferret/documentation/coards-netcdf-conventions
- ISO8601: http://en.wikipedia.org/wiki/ISO_8601

II.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).

There is no "unlimited" dimension in the Copernicus In Situ NetCDF Format Manual.

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.
DEPTH	DEPTH=5	Number of depth levels. Example: for a mooring with measurements at nominal depths

		of 0.25, 10, 50, 100 and 200 metres, DEPTH=5.
DEPLOYMENT	DEPLOYMENT = 3	Aggregated number of deployments for stations Deployment position of a station can change after maintenance or repositioning after it drifts. (Used for timeseries feature when available)
STRLEN	STRLEN = 64	String length for variables containing the cf_role attribute

II.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. Attributes are listed by function in: RD [2] Copernicus Marine In Situ Attributes List.

Copernicus Marine In Situ recommends the usage of all the attributes included in the aforementioned document, as they should contain meaningful information, unless there are technical reasons rendering this impossible.

Global attribute names are case sensitive.

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 or 2008-01-01T22:50:02.031Z

Note on lists separators in global attributes

The default separator is blank “ “

Exception: use the semicolon “;” for strings having possible blank letters content (ex: institution). If the content also contains semicolons they will be replaced by dash “-”.

II.3. Coordinate variables

The coordinate variables guide data in time and space. For this purpose, they have an “axis” attribute defining that they point in X, Y, Z, and T dimensions.

Note on monotony

The time and vertical axis variables are strictly monotonic.

- Example for timeSeries data with measures at different level:

  DEPH(DEPTH) = 0, 15, 32, 36, 47, 50, 62, 64, 76, 77, 91

- Example for profile or trajectoryProfile:

  PRES(TIME, DEPTH) =

  5.11, 5.21, 5.31, 5.39, 5.48, 5.58, 5.65, 5.74, 5.84, 5.92, 6, 6.08, 6.16, …,

  0.981, 1.875, 2.879, 3.886, 5.002, 6.002, 6.94, 7.994, 8.99, 9.909, 10.991, …,

  …

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

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.

Note on LATITUDE and LONGITUDE WGS84 datum

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

Copernicus Marine In Situ 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 DEPH and PRES

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

Note on coordinate variable with the attribute cf_role

As recommended by CF convention for Discrete Sampling Geometries (see II.6 Discrete Sampling Geometries), a coordinate variable with the attribute cf_role should be included.

FeatureType	Coordinate variable
timeSeries **timeSeriesProfile**	char STATION(STRLEN) ; STATION:long_name = "station" ; STATION:cf_role = "timeseries_id";
trajectory **trajectoryProfile**	char TRAJECTORY(STRLEN); TRAJECTORY:long_name = "trajectory" ; TRAJECTORY:cf_role = "trajectory_id";
profile	char PROFILE (STRLEN); PROFILE:long_name = "profile" ; PROFILE:cf_role = "profile_id";

II.3.1. 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.

All attributes described in this section are mandatory (exception for timeseries *)

Type, name, dimension, attributes	Comment
byte **TIME_QC**(TIME); TIME_QC:long_name = "Time quality flag" ; TIME_QC:_FillValue = -127b ; 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 value_below_detection nominal_value interpolated_value missing_value" ;	Time quality flags
byte **POSITION_QC**(TIME) POSITION_QC:long_name = "Position quality flag" ; POSITION_QC:_FillValue = -127b ; 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 value_below_detection nominal_value interpolated_value missing_value" ;	Quality flag for each LATITUDE and LONGITUDE value. (*) In timeseries this variable is referred to the precise position when available. When PRECISE_LATITUDE and PRECISE_LONGITUDE are provided, POSITION_QC is given See II.6 Discrete Sampling Geometries
byte **DEPH_QC**(TIME, DEPTH) ; DEPH_QC:long_name = "Depth quality flag" ; DEPH_QC:_FillValue = -127b ; DEPH_QC:valid_min = 0b ; DEPH_QC:valid_max = 9b ; DEPH_QC:flag_values = 0b, 1b, 2b, 3b, 4b, 5b, 6b, 7b, 8b, 9b ; DEPH_QC:flag_meanings = "no_qc_performed good_data probably_good_data bad_data_that_are_potentially_correctable bad_data value_changed value_below_detection nominal_value interpolated_value missing_value" ;	Depth quality flags
byte **PRES_QC**(TIME, DEPTH) ; PRES_QC:long_name = "Sea pressure quality flag" ; PRES_QC:_FillValue = -127b ; PRES_QC:valid_min = 0b ; PRES_QC:valid_max = 9b ; PRES_QC:flag_values = 0b, 1b, 2b, 3b, 4b, 5b, 6b, 7b, 8b, 9b ; PRES_QC:flag_meanings = "no_qc_performed good_data probably_good_data bad_data_that_are_potentially_correctable bad_data value_changed value_below_detection nominal_value interpolated_value missing_value" ;	Pressure quality flags

II.4. 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 standardised in RD [1] Copernicus Marine In Situ TAC - physical parameters list

Each parameter has a variable name, a long_name, a unit, a CF standard name.

Each parameter may have a type of analysis, a valid_min and a valid_max attribute.

Each variable <PARAM> may have a related variable <PARAM>_QC, <PARAM>_DM, <PARAM>_ADJUSTED, <PARAM>_ADJUSTED_QC and <PARAM>_ADJUSTED_ERROR.

- PARAM_QC: the quality control flags on PARAM values
- PARAM_DM: the data mode of PARAM values
- <PARAM>_ADJUSTED: the adjusted value of the parameter, usually the delayed-mode adjustment.
- <PARAM>_ADJUSTED_QC : the QC flag associated to the adjusted parameter
- <PARAM>_ADJUSTED_ERROR : the error associated to the adjusted parameter

The attributes in **bold font** are mandatory; the others are optional.

If the value of an attribute is not known, then the attribute is omitted (no fill value for attribute).

Type, name, dimension, attributes	Comment
int <PARAM>(TIME, [DEPTH]); <PARAM>:**standard_name** = <X>; <PARAM>:**units** = <X>; <PARAM>:**_FillValue** = <X>; <PARAM>:**long_name** = <X>; <PARAM>:valid_min = <X>; <PARAM>:valid_max = <X>; <PARAM>:comment = <X>; <PARAM>:uncertainty = <X>; <PARAM>:accuracy = <X>; <PARAM>:precision = <X>; <PARAM>:resolution = <X>; <PARAM>:cell_methods = <X>; <PARAM>:**coordinates** = "TIME LATITUDE LONGITUDE [STATION|TRAJECTORY|PROFILE]<X>"; <PARAM>:type_of_analysis = <X>; <PARAM>:sensor_depth = <X>; <PARAM>:sensor_mount = <X>; <PARAM>:sensor_orientation = <X>; <PARAM>:**data_mode** = <X>; <PARAM>:ancillary_variables = "<PARAM>_QC <PARAM>_DM";	<PARAM> names and attributes are documented in RD[1] Copernicus Marine In Situ TAC - physical parameters list Examples: PRES, TEMP, PSAL, DOXY.
byte **<PARAM>_QC**(TIME, [DEPTH]); <PARAM>_QC:**long_name** = "<PARAM:long_name> quality flag"; <PARAM>_QC:**_FillValue** = -127b; <PARAM>_QC:**valid_min** = 0b; <PARAM>_QC:**valid_max**= 9b; <PARAM>_QC:**flag_values** = 0b, 1b, 2b, 3b, 4b, 5b, 6b, 7b, 8b, 9b; <PARAM>_QC:**flag_meanings** = "no_qc_performed good_data probably_good_data bad_data_that_are_potentially_correctable bad_data value_changed value_below_detection nominal_value interpolated_value missing_value"; <PARAM>_QC:**coordinates** = "TIME LATITUDE LONGITUDE [STATION|TRAJECTORY|PROFILE]<X>";	Quality flags for values of associated <PARAM>. The flag scale is specified in Annex A: Reference table 1 variable quality control flag scale, and is included in the flag_meanings attribute.
char <PARAM>_DM(TIME, [DEPTH]); <PARAM>_DM:**long_name** = "<PARAM:long_name> method of data processing" ; <PARAM>_DM:**_FillValue** = " " ; <PARAM>_DM:**flag_values** = "R, A, D" ; <PARAM>_DM:**flag_meanings** = "real-time adjusted-in-real-time delayed-mode" ; <PARAM>_DM:**coordinates** = "TIME LATITUDE LONGITUDE [STATION|TRAJECTORY|PROFILE]<X>";	Data mode for values of associated <PARAM> This is the data mode. Mandatory when there are different values of data mode mixed 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 See Annex A: Reference table 5 data mode

II.5. Other variables

II.5.1. Data centre reference

When possible, the Distribution Unit should provide a unique id on observation, useful for feedback. 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 = " " ;
```

II.5.2. 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”

II.6. Discrete Sampling Geometries

Apart from Radar HF which are gridded files, Copernicus Marine In Situ files adopt Discrete Sampling Geometries introduced by cf convention.

Discrete sampling geometry datasets are characterised by a dimensionality that is lower than that of the space-time region that is sampled. Discrete sampling geometries are typically “paths” through space-time: each type of discrete sampling geometry (point, time series, profile or trajectory) is defined by the relationships among its spatiotemporal coordinates. The type of discrete sampling geometry is the featureType . The term “feature” refers herein to a single instance of the discrete sampling geometry (such as a single time series).

Note: Currently i = 1. In the future more than one timeseries/trajectory per file will be allowed.

featureType (CF Conventions)	**Description** of a single feature with this DSG		**Data type** See Annex A: Reference table 4 data type bigrams	**File type** See Annex A: Reference table 3 file type bigrams
	Form of a data variable containing values defined on a collection of these features	Mandatory **space-time coordinates** for a collection of these features		
timeSeries	a series of data points at the same spatial location with monotonically increasing times		MO, TG, RF	TS, WS
	data(i,o)	x(i) y(i) t(i,o)		
trajectory	a series of data points along a path through space with monotonically increasing times		DB, DC, FB, TS	TS, WS
	data(i,o)	x(i,o) y(i,o) t(i,o)		
profile	an ordered set of data points along a vertical line at a fixed horizontal position and fixed time		BO, CT, XB, MO* *special cases	PR
	data(i,o)	x(i) y(i) z(i,o) t(i)		
timeSeriesProfile	a series of profile features at the same horizontal position with monotonically increasing times		BO, CT	PR
	data(i,p,o)	x(i) y(i) z(i,p,o) t(i,p)		
trajectoryProfile	a series of profile features located at points ordered along a trajectory		BO*, CT, GL, ML, PF, SM, TX, VA, XB	PR
	data(i,p,o)	x(i,p) y(i,p) z(i,p,o) t(i,p)		

List of different featureType used in Copernicus Marine In Situ

** Note that bottles can be both trajectory or trajectoryProfile*

In the above table the spatial coordinates x and y refer to longitude and latitude. The spatial coordinate z refers to vertical position. The time coordinate is indicated as t. The space-time coordinates that are indicated for each feature are mandatory.

II.6.1. Timeseries

A time series is a series of data points at the same spatial location with monotonically increasing times. Time series data is taken over periods of time at a set of discrete points or spatial locations.

Here is a list of data types that can be timeseries: MO, TG, RF. See Annex A: Reference table 4 data type bigrams

Different cases can occurs:

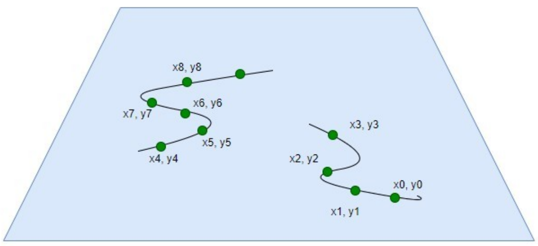
a) Only nominal positions   b) Nominal positions + GPS positions   c) Only GPS positions

Type, name, dimension, attributes	Comment
double **TIME**(TIME); TIME:long_name = "Time" ; TIME:standard_name= "time" ; TIME:units = "days since 1950-01-01T00:00:00Z" ; TIME:valid_min = -90000. ; TIME:valid_max = 90000. ; TIME:uncertainty = " " ; TIME:comment = " " ; TIME:axis = "T" ; TIME:ancillary_variables = "TIME_QC"; TIME:calendar= "standard";	Time of the measurement in days since noon, 1950-01-01 By default, the time represents the centre of the data sample or averaging period calendar: standard →Mixed Gregorian/Julian calendar as defined by UDUNITS (see http://cfconventions.org/cf-conventions/cf-conventions.html#calendar)
float **LATITUDE**; LATITUDE:long_name = "Latitude of each location" ; LATITUDE:standard_name = "latitude" ; LATITUDE:units = "degree_north" ; LATITUDE:valid_min = -90. ; LATITUDE:valid_max = 90. ; LATITUDE:uncertainty = " " ; LATITUDE:comment = " " ; LATITUDE:axis = "Y" ;	Nominal latitude of the fixed station This information could be : 1. Defined by the provider 2. Last valid position 3. Computed position (median filter)
float **LONGITUDE**; LONGITUDE:long_name = "Longitude of each location" ; LONGITUDE:standard_name = "longitude" ; LONGITUDE:units = "degree_east" ; LONGITUDE:valid_min = -180. ; LONGITUDE:valid_max = 180. ; LONGITUDE:uncertainty = " " ; LONGITUDE:comment = " " ; LONGITUDE:axis = "X" ;	Nominal longitude of the fixed station (see above for more information)
float **DEPLOY_LATITUDE (DEPLOYMENT)**; DEPLOY_LATITUDE:long_name = "Latitude of each deployment" ; DEPLOY_LATITUDE:standard_name = "deployment_latitude" ; DEPLOY_LATITUDE:units = "degree_north" ; DEPLOY_LATITUDE:valid_min = -90. ; DEPLOY_LATITUDE:valid_max = 90. ; DEPLOY_LATITUDE:uncertainty = " " ; DEPLOY_LATITUDE:comment = " " ;	(Optional) In the case of known deployment positions, the auxiliary coordinate variable deploy_latitude is used.
float **DEPLOY_LONGITUDE(DEPLOYMENT)**; DEPLOY_LONGITUDE:long_name = "Longitude of each deployment" ; DEPLOY_LONGITUDE:standard_name = "deployment_longitude" ; DEPLOY_LONGITUDE:units = "degree_east" ; DEPLOY_LONGITUDE:valid_min = -180. ;	(Optional) (see above for more information)

DEPLOY_LONGITUDE:valid_max = 180. ; DEPLOY_LONGITUDE:uncertainty = " " ; DEPLOY_LONGITUDE:comment = " " ;	
int **DEPLOYMENT**(**DEPLOYMENT**) ; DEPLOYMENT:long_name = "index of the first time after (re)deployment" ; DEPLOYMENT:compress="TIME";	(Optional) Deployment times expressed as compression of TIME variable. Each value corresponds with an index of the TIME variable, when the (re)deployment took place
float **PRECISE_LATITUDE (TIME)**; PRECISE_LATITUDE:long_name = "Latitude of each location" ; PRECISE_LATITUDE:standard_name = "latitude" ; PRECISE_LATITUDE:_FillValue = NC_FILL_FLOAT ; PRECISE_LATITUDE:units = "degree_north" ; PRECISE_LATITUDE:valid_min = -90. ; PRECISE_LATITUDE:valid_max = 90. ; PRECISE_LATITUDE:uncertainty = " " ; PRECISE_LATITUDE:comment = " " ; PRECISE_LATITUDE:ancillary_variables = "POSITION_QC";	(Optional) In the case of known position depending on TIME, the auxiliary coordinate variable precise_latitude is used
float **PRECISE_LONGITUDE(TIME)**; PRECISE_LONGITUDE:long_name = "Longitude of each location" ; PRECISE_LONGITUDE:standard_name = "longitude" ; PRECISE_LONGITUDE:_FillValue = NC_FILL_FLOAT ; PRECISE_LONGITUDE:units = "degree_east" ; PRECISE_LONGITUDE:valid_min = -180. ; PRECISE_LONGITUDE:valid_max = 180. ; PRECISE_LONGITUDE:uncertainty = " " ; PRECISE_LONGITUDE:comment = " " ; PRECISE_LONGITUDE:ancillary_variables = "POSITION_QC";	(Optional) (see above for more information)
float **DEPH**(DEPTH); DEPH:long_name = "Depth" ; DEPH:standard_name = "depth" ; DEPH:_FillValue = NC_FILL_FLOAT ; DEPH:units = "m" ; DEPH:positive = "down" ; DEPH:valid_min = -12000. ; DEPH:valid_max = 12000. ; DEPH:uncertainty = " " ; DEPH:comment = " " ; DEPH:axis = "Z" ; DEPH:reference = "sea_level" ; DEPH:data_mode = <X>;	Depth of the measurements
char **STATION**(STRLEN) ; STATION:long_name = "station" ; STATION:cf_role = "timeseries_id";	Timeseries id. This variable contains the mandatory attribute cf_role. Only one timeseries per file is allowed. This variable is included because of compatibility reasons with CF Conventions.

II.6.2. Trajectory

Data may be taken over periods of time at a set of discrete point, spatial locations called stations . The set of elements at a particular station is referred to as a timeSeries feature.



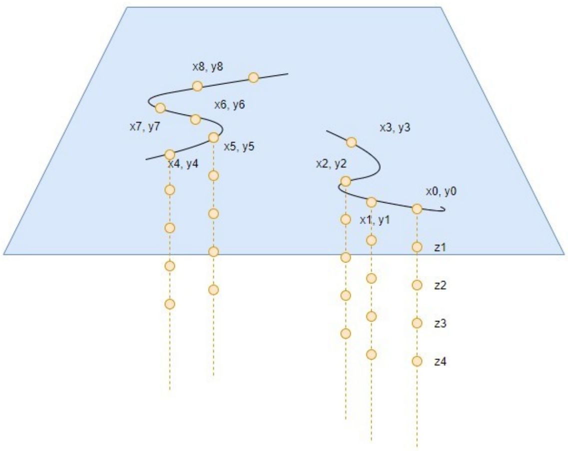
Here is a list of data types that can be trajectory: BO, DB, DC, TS. See Annex A: Reference table 4 data type bigrams

Type, name, dimension, attributes	Comment

double **TIME**(TIME); TIME:long_name = "Time" ; TIME:standard_name= "time" ; TIME:units = "days since 1950-01-01T00:00:00Z" ; TIME:valid_min = -90000. ; TIME:valid_max = 90000. ; TIME:uncertainty = " " ; TIME:comment = " " ; TIME:axis = "T" ; TIME:ancillary_variables = “TIME_QC”; TIME:calendar= “standard”;	Time of the measurement in days since noon, 1950-01-01 By default, the time represents the centre of the data sample or averaging period calendar: standard →Mixed Gregorian/Julian calendar as defined by UDUNITS (see http://cfconventions.org/cf-conventions/cf-conventions.html#calendar)
float **LATITUDE (TIME)**; LATITUDE:long_name = "Latitude of each location" ; LATITUDE:standard_name = "latitude" ; LATITUDE:units = "degree_north" ; LATITUDE:valid_min = -90. ; LATITUDE:valid_max = 90. ; LATITUDE:uncertainty = " " ; LATITUDE:comment = " " ; LATITUDE:ancillary_variables = “POSITION_QC”;	
float **LONGITUDE(TIME)**; LONGITUDE:long_name = "Longitude of each location" ; LONGITUDE:standard_name = "longitude" ; LONGITUDE:units = "degree_east" ; LONGITUDE:valid_min = -180. ; LONGITUDE:valid_max = 180. ; LONGITUDE:uncertainty = " " ; LONGITUDE:comment = " " ; LONGITUDE:ancillary_variables = “POSITION_QC”;	
float **DEPH**(DEPTH); DEPH:long_name = "Depth" ; DEPH:standard_name = "depth" ; DEPH:_FillValue = NC_FILL_FLOAT ; DEPH:units = "m" ; DEPH:positive = "down" ; DEPH:valid_min = -12000. ; DEPH:valid_max = 12000. ; DEPH:uncertainty = " " ; DEPH:comment = " " ; DEPH:axis = "Z" ; DEPH:reference = "sea_level" ; DEPH:data_mode = <X>;	Depth of the measurements.
char **TRAJECTORY**(STRLEN); TRAJECTORY:long_name = "trajectory" ; TRAJECTORY:cf_role = "trajectory_id";	Trajectory id. This variable contains the mandatory attribute cf_role.. This variable is included because of compatibility reasons with CF Conventions.

II.6.3. TrajectoryProfile

A series of connected observations along a vertical line, like an ocean sounding, is called a profile. For each profile, there is a single time, latitude and longitude.



Here is a list of data types that can be trajectoryProfile: BO, CT, GL, ML, PF, SM, TX, VA, XB. See Annex

A: Reference table 4 data type bigrams

Type, name, dimension, attributes	Comment
double **TIME**(TIME); TIME:long_name = "Time" ; TIME:standard_name= "time" ; TIME:units = "days since 1950-01-01T00:00:00Z" ; TIME:valid_min = -90000. ; TIME:valid_max = 90000. ; TIME:uncertainty = " " ; TIME:comment = " " ; TIME:axis = "T" ; TIME:ancillary_variables = “TIME_QC”; TIME:calendar= “standard”;	Time of the measurement in days since noon, 1950-01-01 By default, the time represents the centre of the data sample or averaging period calendar: standard →Mixed Gregorian/Julian calendar as defined by UDUNITS (see http://cfconventions.org/cf-conventions/cf-conventions.html#calendar)
float **LATITUDE (TIME)**; LATITUDE:long_name = "Latitude of each location" ; LATITUDE:standard_name = "latitude" ; LATITUDE:units = "degree_north" ; LATITUDE:valid_min = -90. ; LATITUDE:valid_max = 90. ; LATITUDE:uncertainty = " " ; LATITUDE:comment = " " ; LATITUDE:ancillary_variables = “POSITION_QC”;	
float **LONGITUDE(TIME)**; LONGITUDE:long_name = "Longitude of each location" ; LONGITUDE:standard_name = "longitude" ; LONGITUDE:units = "degree_east" ; LONGITUDE:valid_min = -180. ; LONGITUDE:valid_max = 180. ; LONGITUDE:uncertainty = " " ; LONGITUDE:comment = " " ; LONGITUDE:ancillary_variables = “POSITION_QC”;	
float **DEPH**(TIME, DEPTH); DEPH:long_name = "Depth" ; DEPH:standard_name = "depth" ; DEPH:_FillValue = NC_FILL_FLOAT ; DEPH:units = "m" ; DEPH:positive = "down" ; DEPH:valid_min = -12000. ; DEPH:valid_max = 12000. ; DEPH:uncertainty = " " ; DEPH:comment = " " ; DEPH:axis = "Z" ; DEPH:reference = "sea_level" ; DEPH:data_mode = <X>;	Depth of the measurements. Mandatory when PRES as z axis is not defined.
float **PRES**(TIME, DEPTH); PRES:long_name = "Sea pressure" ; PRES:standard_name = "sea_water_pressure" ; PRES:_FillValue = NC_FILL_FLOAT ; PRES:units = "dbar" ; PRES:uncertainty = " " ; PRES:comment = " " ; PRES:axis = "Z" ; PRES:positive = “down” ; PRES:data_mode = <X>; PRES:ancillary_variables = “PRES_QC”;	Sea water pressure of the measurements. Mandatory when DEPH as Z axis is not defined (profiles).
char **TRAJECTORY**(STRLEN); TRAJECTORY:long_name = "trajectory" ; TRAJECTORY:cf_role = "trajectory_id";	Trajectory id. This variable contains the mandatory attribute cf_role. This variable is included because of compatibility reasons with CF Conventions.

III. CONVENTIONS FOR HF RADARS

High Frequency radar (HF radar) NetCDF file format mostly follows the rules described in this document. Due to the specific nature of this land-based remote sensing technology, some exceptions and differences with respect to the main rules are necessary and are listed in the following.

III.1. Dimensions

For HFR radial data measured on a polar geometry the true dimensions are bearing (BEAR) and range (RNGE). In this case LATITUDE and LONGITUDE are evaluated from bearing and range, so they have no dimensions but they are geophysical variables.

Name	Example	Comment
BEAR	BEAR=72	Dimension of the BEAR coordinate variable.
RNGE	RNGE=51	Dimension of the RNGE coordinate variable.
REFMAX	REFMAX=1	Dimension of the REFMAX coordinate variable.

III.2. Global attributes

Attributes are listed by function in: List Attributes document. There is a specific section for HF radars.

III.3. Coordinate variables

The LATITUDE, LONGITUDE, BEAR and RNGE variables are monotonic (HFR data are provided on a fixed geographical grid).

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

Variables of HFR total data and of HFR radial data measured on a cartesian grid have a (TIME, DEPTH, LATITUDE, LONGITUDE) dimension.

Variables of HFR radial data measured on a polar grid have a (TIME, DEPH, BEAR, RNGE) dimension.

BEAR (bearing) and RNGE (range) are the coordinate variables for radial velocity data measured on a polar geometry (e.g. Codar .ruv files). In this case, LATITUDE and LONGITUDE are data variables since they are evaluated starting from bearing and range. Thus, the coordinates of data and QC variables for radials measured on a polar geometry shall be (TIME, DEPH, BEAR, RNGE) and RNGE dimension shall have the 'axis' attribute set to 'X' and BEAR dimension shall have the 'axis' attribute set to 'Y';.

The coordinates of data and QC variables for radials measured on a cartesian grid shall be (TIME, DEPH, LATITUDE, LONGITUDE) and LONGITUDE dimension shall have the 'axis' attribute set to 'X' and LATITUDE dimension shall have the 'axis' attribute set to 'Y'.

III.4. SDN namespace variables and attributes

III.4.1. SDN variables

SeaDataNet (SDN) is the European project that federates the network of EU national oceanographic data centres. SDN is a data provider for Copernicus. Each HF radar station distributed in Copernicus NetCDF data file includes the following additional variables:

Name	Comment
SDN_CRUISE	Text string identifying the grouping label for the data object to which the data row belongs. For HFR data it is set equal to the site_code attribute, that is the EDIOS Series id of the HFR network.
SDN_STATION	Text string identifying the data object to which the data row belongs. For HFR data it is set equal to the platform_code attribute.
SDN_LOCAL_CDI_ID	The local identifier of the Common Data Index record associated with the data row.
SDN_EDMO_CODE	The key identifying the organisation responsible for assigning the local CDI given in the European Directory of Marine Organizations (EDMO).
SDN_XLINK	Text strings containing a URI (URN or URL) pointing to a web resource such as a usage metadata document for the data object to which the array element belongs.

III.4.2. SDN attributes

Attributes for coordinate variables and data variables required in the SDN extension to CF are included in the HFR data format. In particular, the SDN extensions to CF were concerned with providing storage for standardised semantics and metadata included in the SDN profiles format. The standardised semantics are included as four mandatory parameter attributes for each data or coordinate variable, which are: sdn_parameter_urn, sdn_parameter_name, sdn_uom_urn and sdn_uom_name. More details in RD [2] Copernicus Marine in situ NetCDF Attributes list.

IV. CONVENTIONS FOR WAVE SPECTRAL DATA

IV.1. Dimensions

Name	Example	Comment
FREQUENCY	FREQUENCY=14	Number of frequencies in the spectra.
nv	nv=2	Number of vertices for the bounds variables.

IV.2. Global Attributes

See RD [2] Copernicus Marine in situ NetCDF Attributes list

:data_type value is “wave-spectra data”;

:cdm_data_type value is “timeSeries”;

IV.3. Coordinates variables

Type, name, dimension, attributes	Comment
float **FREQUENCY**(TIME, FREQUENCY); FREQUENCY:long_name = “Central frequency of the band" ; FREQUENCY:standard_name = “wave_frequency" ; FREQUENCY:units = "s-1" ; FREQUENCY:_FillValue = NC_FILL_FLOAT ; FREQUENCY:bounds = “FREQUENCY_BOUNDS" ; FREQUENCY:uncertainty = " " ; FREQUENCY:comment = " " ; FREQUENCY:ancillary_variables = "FREQUENCY_QC" ;	FREQUENCY contains the central frequency of the bands. The lower and upper frequency bounds of each band are in FREQUENCY_BOUNDS. The frequencies can vary over time.
float **FREQUENCY_BOUNDS**(TIME, FREQUENCY, nv) ;	

IV.4. Coordinates quality control variables

Type, name, dimension, attributes	Comment
byte **FREQUENCY_QC**(TIME, FREQUENCY) POSITION_QC:long_name = "quality flag" ; POSITION_QC:_FillValue = NC_FILL_BYTE ; 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 value_below_detection nominal_value interpolated_value missing_value" ;	Quality flag for each FREQUENCY value

IV.5. Data variables

The data variables for spectral data are VSPEC1D, THETA1, THETA2, STHETA1 and STHETA2.

Type, name, dimension, attributes	Comment
int <PARAM>(TIME, FREQUENCY); <PARAM>:**standard_name** = <X>; <PARAM>:**units** = <X>; <PARAM>:**_FillValue** = <X>; <PARAM>:**add_offset** = <X> ; <PARAM>:**scale_factor** = <X> ;	<PARAM> names and attributes are documented in RD[1] Copernicus Marine In Situ TAC - physical parameters list. Examples:VSPEC1D, THETA1.

<PARAM>:**long_name** = <X>; <PARAM>:valid_min = <X>; <PARAM>:valid_max = <X>; <PARAM>:comment = <X>; <PARAM>:uncertainty = <X>; <PARAM>:accuracy = <X>; <PARAM>:precision = <X>; <PARAM>:resolution = <X>; <PARAM>:cell_methods = <X>; <PARAM>:coordinates = <X>; <PARAM>:**type_of_analysis** = <X>; <PARAM>:**data_mode** = <X>; <PARAM>:sensor_depth = <X>; <PARAM>:sensor_mount = <X>; <PARAM>:sensor_orientation = <X>; <PARAM>:ancillary_variables = “<PARAM>_QC <PARAM>_DM”;	
byte **<PARAM>_QC**(TIME, FREQUENCY); <PARAM>_QC:**long_name** = “quality flag”; <PARAM>_QC:**_FillValue** = -127; <PARAM>_QC:**valid_min** = 0; <PARAM>_QC:**valid_max**= 9; <PARAM>_QC:**flag_values** = 0b, 1b, 2b, 3b, 4b, 5b, 6b, 7b, 8b, 9b; <PARAM>_QC:**flag_meanings** = “no_qc_performed good_data probably_good_data bad_data_that_are_potentially_correctable bad_data value_changed value_below_detection nominal_value interpolated_value missing_value”;	Quality flags for values of associated <PARAM>. The flag scale is specified in Annex A: Reference table 1 variable quality control flag scale, and is included in the flag_meanings attribute.
Char <PARAM>_DM(TIME, FREQUENCY);	Data mode for values of associated <PARAM> Same as the general section.
int <PARAM>_UNCERTAINTY(TIME, FREQUENCY):	It is not mandatory. Overall uncertainty of the data given in <PARAM>. It should apply scale_factor and add_offset in the same way as the related variable. Same as the general section.

IV.5.1. Specific attributes for directional variables

Type, name, dimension, attributes	Comment
<PARAM>:direction_reference = <X>; <PARAM>:direction_convention = <X>;	direction_references: type char. Example: “True North” direction_convention: type char. Example: ”clockwise from North”

V. CONVENTIONS FOR VESSEL MOUNTED ADCP OBSERVATIONS

The Acoustic Doppler Current Profiler (ADCP) reports trajectories of vertical profiles of seawater currents. This sensor is fitted on moving platforms such as vessels, auv, saildrones or gliders. It can also be fitted on a fixed buoy or mooring to report time series.

The file type is time series: “TS”

A specific data type “VA” is used for vessel mounted ADCP.

ADCP data variables:

- EWCT West-east current component m s-1 eastward_sea_water_velocity
- NSCT South-north current component m s-1 northward_sea_water_velocity
- VCSP Bottom-top current component m s-1 upward_sea_water_velocity

VI. REFERENCES

Copernicus Marine In Situ distributes data and metadata following the NetCDF4 CF Conventions, this chapter describes its detailed implementation.

[1] Copernicus Marine in situ TAC - Physical Parameters List https://doi.org/10.13155/53381

[2] Copernicus Marine in situ NetCDF Attributes list https://doi.org/10.13155/95044

[3] NetCDF file format checker for Argo floats, Copernicus In Situ TAC, EGO gliders, OceanSITES https://doi.org/10.17882/45538

[4] Copernicus Marine in situ NetCDF file content checker https://doi.org/10.17882/95058

ANNEX A: REFERENCE TABLES

The codes used in Copernicus In Situ TAC are documented in the reference tables. They are part of in situ TAC vocabularies.

Reference table 1: 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	Value below detection / quantification	The level of the measured phenomenon was too small to be quantified/detected by the technique employed to measure it. The accompanying value is the quantification/detection limit for the technique or zero if that value is unknown.
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.

Reference table 2: production unit (PU) bigrams

For file and directory naming conventions, a bigram is used to identify the Production Unit that generates the data file.

Code	Meaning
AR	Arctic (Arctic ROOS)
BO	Baltic Sea (BOOS)
BS	Black Sea (Black Sea GOOS)
GL	Global Ocean
IR	Iberia Biscay Ireland (IBI-ROOS)
MO	Mediterranean Sea (MONGOOS)
NO	North West Shelf (NOOS)

Reference table 3: file type bigrams

The file type is a bigram used in file names for a quick identification of the content of the file regarding data geometry.

Code	Meaning
TS	timeseries, trajectories
PR	profiles
TV	total velocity (for HF radars)
RV	radial velocity (for HF radars)
WS	wave spectra

Reference table 4: data type bigrams

The data type is a bigram used in file names for a quick identification of the major source of the data.

Code	Meaning
BO	botte samples

CT	vessel CTDs
DB	drifting buoys
DC	drifting buoy reporting calculated sea water current
FB	ferrybox
GL	glider
HF	HF radar
ML	mini loggers for fishery observing system
MO	fixed buoys, mooring time series, fixed observations
PF	profiling floats
RF	river flows
SD	saildrone
SF	scanfish (towed CTDs)
SM	animal borne sensor data
TG	tide gauges
TS	ship underway data, thermosalinograph, fluorometer…
TX	thermistor chain data
VA	vessel mounted ADCPs
XB	XBT, XCTD or MBT profiles
XX*	not yet identified

** The use of code XX is discouraged and should be used only as an interim solution until the appropriate code is identified.*

Reference table 5: data mode

The data mode flag indicates the quality control level of the data values in a file and are assigned after quality control procedures have been performed.

Code	Meaning
R	Real-time data. Observations checked with automated quality control
D	Delayed-mode data. Observations checked by a scientist or a specialist
A	Real time data with adjusted values
M	Mixed. This value is only allowed in the global or variable attribute “data_mode”. It indicates that the file or variable contains data in more than one of the above modes

Reference table 6: In Situ TAC and SeaDataNet equivalences

Copernicus in situ TAC quality control flags definitions and values are slightly different from SeaDataNet QC flags. The main differences concern flag B and flags 6, 7,A, Q specific in SeaDataNet for chemistry data.

The following table provides the equivalences used when data provided with SeaDataNet QC flags are redistributed in Copernicus in situ TAC NetCDF files.

Copernicus in situ and SeaDataNet QC equivalences				
SeaDataNet L20 (measure and qualifier flags)			Copernicus in situ quality control flag scale	
conceptid	preflabel	Definition	qc flag	meaning
0	no quality control	No quality control procedures have been applied to the data value. This is the initial status for all data values entering the working archive.	0	No QC was performed

1	good value	Good quality data value that is not part of any identified malfunction and has been verified as consistent with real phenomena during the quality control process.	1	Good data
2	probably good value	Data value that is probably consistent with real phenomena but this is unconfirmed or data value forming part of a malfunction that is considered too small to affect the overall quality of the data object of which it is a part.	2	Probably good data
3	probably bad value	Data value recognised as unusual during quality control that forms part of a feature that is probably inconsistent with real phenomena.	3	Bad data that are potentially correctable
4	bad value	An obviously erroneous data value.	4	Bad data
5	changed value	Data value adjusted during quality control. Best practice strongly recommends that the value before the change be preserved in the data or its accompanying metadata.	5	Value changed
6	value below detection	The level of the measured phenomenon was too small to be quantified by the technique employed to measure it. The accompanying value is the detection limit for the technique or zero if that value is unknown.	6	Value below detection/quantification

7	value in excess	The level of the measured phenomenon was too large to be quantified by the technique employed to measure it. The accompanying value is the measurement limit for the technique.	4	Bad data
8	interpolated value	This value has been derived by interpolation from other values in the data object.	8	Interpolated value
9	missing value	The data value is missing. Any accompanying value will be a magic number representing absent data.	9	Missing value
A	value phenomenon uncertain	There is uncertainty in the description of the measured phenomenon associated with the value such as chemical species or biological entity.	3	Bad data that are potentially correctable
B	nominal value	The data value is a numerical data value that was the intended or targeted value rather than the measured value (e.g. instrument target depth).	7	Nominal value
Q	value below limit of quantification	The level of the measured phenomenon was less than the limit of quantification (LoQ). The accompanying value is the limit of quantification for the analytical method.	6	Value below detection/quantification