
CD-OCO

Csv & Netcdf OCO user's manual :

- Csv OCO in-situ
- Netcdf OCO straight grid 1.4
- Netcdf OCO oriented grid 1.3.1
- Netcdf OCO spectra 1D 1.1
- Netcdf OCO spectra 2D 1.1

CD-OCO

Csv & Netcdf OCO user's manual

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Title :

Csv & Netcdf OCO user's manual

Titre traduit :

Référence : COR-DO/DTI-MUT/07.159

Date : 23/03/2012

Version : 1.3.1

Diffusion : libre restreinte interdite

nombre de pages
31
bibliographie
(Oui / Non)
illustration(s)
(Oui / Non)
langue du rapport

Nom	Date	Signature	Diffusion	
			Attribution	Nb ex.
Préparé par : Stéphane Tarot Wenceslas Duros				
Vérifié par :				

Résumé :

Ce document décrit les formats des fichiers Csv et Netcdf produits par le centre de données OCO. Il fournit les informations nécessaires aux utilisateurs pour manipuler les données contenues dans ces différents types de fichiers :

- Csv In-Situ,
- Netcdf maillés droits,
- Netcdf maillés orientés,
- Netcdf spectres.

Abstract :**Mots-clés :****Keywords :****Commentaire :**

History of the document

Version	Date	Comments
0.9	17/09/2007	ST : création du document (basé sur le DIE Coriolis)
1.0	30/06/2008	ST : première version diffusable (sans le format <i>in-situ</i>)
1.1	25/11/2008	ST : formats 1.2, ajout du format Csv
1.1.1	09/12/2008	ST : correction du nom de l'attribut station_name:conventions dans le format NetCDF OCO spectre.
1.2	13/10/2010	WD : update format Netcdf OCO straight grid 1.2 en 1.3
1.3	07/09/2011	WD : update formats : - Netcdf OCO straight grid 1.3 to 1.4 - Netcdf OCO oriented grid 1.2 to 1.3 Adding formats : - Netcdf Spectra file format 1D 1.1 - Netcdf Spectra file format 2D 1.1 Deletion format : - Netcdf Spectra file format 1.2
1.3.1	23/03/2012	WD : update § 2.2.2 NetCDF OCO : - adding to the wishes of NetCDF format file
1.3.2	11/07/2012	WD : update formats : - Netcdf OCO oriented grid 1.3 to 1.3.1

Table of contents

1. INTRODUCTION	8
2. FORMATS DESCRIPTION	9
2.1. CSV OCO IN-SITU	9
2.1.1. GENERAL DESCRIPTION	9
2.1.2. COLUMNS DESCRIPTION	9
2.1.3. EXAMPLES	10
2.2. OVERVIEW OF THE NETCDF FORMATS	11
2.2.1. WHAT IS NETCDF ?	11
2.2.2. NETCDF OCO	11
2.2.3. FILE STRUCTURE	12
2.3. NETCDF OCO STRAIGHT GRID 1.4	14
2.3.1. DIMENSIONS AND DEFINITIONS	14
2.3.2. GENERAL ATTRIBUTES, META-DATA INFORMATION	14
2.3.3. COORDINATE VARIABLES	15
2.3.4. DATA VARIABLES	16
2.4. ORIENTED GRID FILE FORMAT 1.3	18
2.4.1. DIMENSIONS AND DEFINITIONS	18
2.4.2. GENERAL ATTRIBUTES, META-DATA INFORMATION	18
2.4.3. COORDINATE VARIABLES	19
2.4.4. DATA VARIABLES	20
2.5. SPECTRA FILE FORMAT 1D 1.1	22
2.5.1. DIMENSIONS AND DEFINITIONS	22
2.5.2. GENERAL ATTRIBUTES, META-DATA INFORMATION	22
2.5.3. COORDINATE VARIABLES	23
2.5.4. DATA VARIABLES	24
2.6. SPECTRA FILE FORMAT 2D 1.1	25
2.6.1. DIMENSIONS AND DEFINITIONS	25
2.6.2. GENERAL ATTRIBUTES, META-DATA INFORMATION	25
2.6.3. COORDINATE VARIABLES	26
2.6.4. DATA VARIABLES	27
3. REFERENCE TABLES	29
3.1. REFERENCE TABLE 1 : QUALITY CONTROL FLAG SCALE	29
3.2. REFERENCE TABLE 2 : DATA TYPE	29
3.3. REFERENCE TABLE 3 : PROPOSAL OF FILL VALUES	29
3.4. REFERENCE TABLE 4 : CELL METHODS	29
3.5. REFERENCE TABLE 5 : STANDARD NAME MODIFIERS	30
3.6. REFERENCE TABLE 6 : EXAMPLES OF VARIABLES DEFINITION	30

4. APPENDIX	31
4.1. APPENDIX A: WHAT'S NEW IN NETCDF OCO STRAIGHT GRID 1.3	31
4.2. APPENDIX B: WHAT'S NEW IN NETCDF OCO STRAIGHT GRID 1.4	31
4.3. APPENDIX C: WHAT'S NEW IN NETCDF OCO ORIENTED GRID 1.3	31
4.4. APPENDIX D: WHAT'S NEW IN NETCDF SPECTRA FILE FORMAT 1D 1.1	31
4.5. APPENDIX E: WHAT'S NEW IN NETCDF SPECTRA FILE FORMAT 2D 1.1	31

1. Introduction

This document is the Csv & NetCDF OCO user's manual.

It contains the description of the formats of the files produced by the CD-OCO :

- Csv OCO In-situ,
- Netcdf OCO straight grid 1.4,
- Netcdf OCO oriented grid 1.3,
- Netcdf Spectra file format 1D 1.1,
- Netcdf Spectra file format 2D 1.1.

2. Formats description

2.1. Csv OCO in-situ

2.1.1. General description

CSV is the short for “Comma Separated Values”.

The OCO Csv files contain an header line and many record lines.

The field separator is the comma (`,`). The decimal separator is the dot (`. `).

The filename extension is “.csv”.

The record lines are ordered by platform, by date, and by level (pressure or depth) for the vertical profiles.

2.1.2. Columns description

Column header	Comment
PLATFORM	The platform code. If it exists, it is the WMO code, otherwise it is an internal code.
ARGOS_ID	The beacon code of the platform. This column is optional. If one or more of the platforms of the file has a beacon code, the column is present.
DATE (yyyy-mm-ddThh:mi:ssZ)	The date/time of the observation. The date and times are given in UTC time, using the ISO 8601 international standard representation (yyyy-mm-ddThh:mi:ssZ).
LATITUDE (degree_north)	The latitude of the observation.
LONGITUDE (degree_east)	The longitude of the observation.
CODE (Unit) or CODE LEVELn (Unit)	The physical observations (e.g. : temperature, salinity, river flow, ...). CODE is a code describing the physical parameter observed. The list of codes is available at http://www.ifremer.fr/sismer/program/formats_phy/htql/liste_param_UK.htql . A level may be associated to the observation. It is mainly used when a platform records observations at different level at the same time. Generally the level 0 is for atmospherical observations and the level 1..N are for oceanographic observations. In some case those columns are omitted, for example for some drifting buoys which only records a position.
QC	This field concatenates the quality flag of each of the previous fields. Flag scale is specified in reference table 1. If a field has no quality flag (e.g. : PLATFORM) the default quality flag 0 is used.
TECH_CODE	The technical observations (e.g. : battery voltage) associated to the physical observations. There is no codification for TECH_CODE. Those columns are optional.

2.1.3. Examples

Vertical profile

```

PLATFORM,ARGOS_ID,DATE      (YYYY-MM-DDTHH:MI:SSZ),LATITUDE      (degree_north),LONGITUDE      (degree_east),PRES
(decibar=10000 pascals),TEMP (Celsius degree),QC
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,0,21.241,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,6,21.264,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,16,21.364,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,26,21.412,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,36,21.426,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,48,21.285,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,56,18.124,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,67,16.959,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,76,16.195,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,86,15.693,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,96,15.362,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,106,14.981,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,117,14.593,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,126,14.363,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,136,14.12,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,146,13.932,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,156,13.821,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,166,13.802,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,176,13.727,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,186,13.654,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,196,13.583,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,206,13.591,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,216,13.575,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,226,13.573,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,237,13.57,00111111
6900664,78656,2008-11-02T01:14:00Z,38.7440,6.3060,246,13.578,00111111

```

Time serie

```

PLATFORM,DATE      (yyyy-mm-ddThh:mi:ssZ),LATITUDE      (degree_north),LONGITUDE      (degree_east),SLEV      LEVEL0
(meter),TEMP LEVEL1 (Celsius degree),PSAL LEVEL1 (P.S.U.),DOX1 LEVEL1 (ml/l),PHPH LEVEL1 (pH unit),TUR4 LE
VEL1 (N.T.U Nephelo Turb. Unit),FLU3 LEVEL1 (FFU),QC,MAREL_DATASTATE
62444,2008-11-12T14:35:46Z,49.3821,-1.0986,0.11,12.29,0.11,7.66981,56.3,4,-8.4,01111111411,0.5
62444,2008-11-12T14:58:05Z,49.3821,-1.0986,0.11,12.36,0.11,7.57883,60.94,3.8,-7.4,01111111411,0.5
62444,2008-11-12T15:02:05Z,49.3821,-1.0986,0.11,12.37,0.1,7.55784,61.97,4.1,6.2,01111111411,0.5
62444,2008-11-12T15:06:06Z,49.3821,-1.0986,0.11,12.37,0.1,7.55084,59.12,4.6,0.2,01111111411,0.5
62444,2008-11-12T15:10:07Z,49.3821,-1.0986,0.11,12.39,0.1,7.55084,59.48,3.8,-6,01111111411,0.5
62444,2008-11-12T15:14:10Z,49.3821,-1.0986,0.11,12.44,0.1,7.52985,59.85,4.4,-4.5,01111111411,0.5
62444,2008-11-12T15:18:10Z,49.3821,-1.0986,0.11,12.41,0.1,7.53685,59.88,4.6,-4.3,01111111411,0.5
62444,2008-11-12T15:22:10Z,49.3821,-1.0986,0.11,12.34,0.1,7.55084,59.89,4.6,-2.9,01111111411,0.5
62444,2008-11-12T15:26:11Z,49.3821,-1.0986,0.11,12.35,0.1,7.53685,60.76,4.7,1,01111111411,0.5
62444,2008-11-12T15:30:13Z,49.3821,-1.0986,0.11,12.36,0.1,7.53685,61.15,4.3,-7.3,01111111411,0.5
62444,2008-11-12T15:34:12Z,49.3821,-1.0986,0.11,12.4,0.1,7.52285,61.41,4.9,5.2,01111111411,0.5
62444,2008-11-12T15:38:19Z,49.3821,-1.0986,0.11,12.31,0.1,7.53685,61.4,4.5,5.7,01111111411,0.5
62444,2008-11-12T15:42:14Z,49.3821,-1.0986,0.11,12.25,0.1,7.54384,61.76,4.2,3.5,01111111411,0.5
62444,2008-11-12T15:46:14Z,49.3821,-1.0986,0.11,12.18,0.1,7.55784,61.81,4.3,3.8,01111111411,0.5
62444,2008-11-12T15:50:14Z,49.3821,-1.0986,0.11,12.14,0.1,7.57184,62.45,4,-3.9,01111111411,0.5
62444,2008-11-12T15:54:15Z,49.3821,-1.0986,0.11,12.11,0.1,7.57184,62.79,4.7,0.2,01111111411,0.5
62444,2008-11-12T15:58:16Z,49.3821,-1.0986,0.11,12.06,0.1,7.57883,63.08,4,0.2,01111111411,0.5
62444,2008-11-12T16:02:17Z,49.3821,-1.0986,0.11,11.99,0.1,7.59283,63.7,4.7,4.3,01111111411,0.5
62444,2008-11-12T16:06:31Z,49.3821,-1.0986,0.11,11.87,0.1,7.60683,63.76,4.5,5.1,01111111411,0.5
62444,2008-11-12T16:10:18Z,49.3821,-1.0986,0.11,11.79,0.1,7.59283,63.62,4.1,2.1,01111111411,0.5

```

2.2. Overview of the Netcdf formats

2.2.1. What is NetCDF ?

NetCDF OCO uses the NetCDF (Network Common Data Form) system, a set of software libraries and machine-independent data formats.

NetCDF (Network Common Data Form) is an interface for array-oriented data access and a library that provides an implementation of the interface. The NetCDF library also defines a machine-independent format for representing scientific data. Together, the interface, library, and format support the creation, access, and sharing of scientific data. The NetCDF software was developed at the Unidata Program Centre in Boulder, Colorado. The [freely available](#) source can be obtained as [a compressed tar file](#) or [a zip file](#) from Unidata or from other [mirror sites](#).

- Ucar web site address : <http://www.ucar.edu/ucar>
- NetCDF documentation : <http://www.unidata.ucar.edu/packages/netcdf/index.html>

2.2.2. NetCDF OCO

Our implementation of NetCDF is based on the community-supported Climate and Forecast (CF) specification, which supplies a standard vocabulary and some metadata conventions.

NetCDF has several more restrictions than the CF standard. These are intended to make it easier to share data, to make it simpler to aggregate data from multiple sites, and to ensure that data can be created and understood by the basic NetCDF utilities.

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

- Units are compliant with CF/COARDS/Udunits ;
- The time variable 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 international standard representation is used : yyyy-mm-ddThh:mi:ssZ (i.e. year – month – day T hour : minute : second Z).

Other requirements are:

- All the date and time are given in UTC time, universal time coordinates.
- The `_FillValue` associated to each variable is not prescribed. However it must be a value out of the span defined by `valid_min`, `valid_max`. The reference table 3 suggests a fill value for each type.
- The NetCDF file format should be (in order of preference):
 - NetCDF4 (“netCDF-4” or “netCDF-4 classic model”)
 - NetCDF3 (“classic” or “64 bits”).

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

2.2.3. File structure

NetCDF OCO formats are divided in 4 sections:

- Dimensions and definitions,
- General attributes, meta-data information,
- Coordinate variables,
- Data section as variables.

General attributes, meta-data information

The general attributes 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. It is recommended that all of these attributes be used and contain meaningful information (even “n/a” – not applicable or not available) unless there are technical reasons rendering this impossible.

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.

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.

Each coordinate variable must be strictly monotonic and must not have any missing data (thus it has no _FillValue attribute).

The <vertical> variable (depth, height, level or layer) may be positive in either upward or downward direction, which is defined in its "positive" attribute.

The level variable's standard_name could be “ocean_sigma_coordinate” or “ocean_s_coordinate”.

The level variable defines an **ocean sigma coordinate** as :

- $z(n, k, j, i) = \text{eta}(n, j, i) + \text{sigma}(k) * (\text{depth}(j, i) + \text{eta}(n, j, i))$

where $z(n, k, j, i)$ is height, positive upwards, relative to ocean datum (e.g. mean sea level) at gridpoint (n, k, j, i); $\text{eta}(n, j, i)$ is the height of the ocean surface, positive upwards, relative to ocean datum at gridpoint (n, j, i); $\text{sigma}(k)$ is the dimensionless coordinate at vertical gridpoint(k); and $\text{depth}(j, i)$ is the distance from ocean datum to sea floor (positive value) at horizontal gridpoint (j, i).

The level variable defines an **ocean s coordinate** as :

- $z(n,k,j,i) = \text{eta}(n,j,i)*(1+s(k)) + \text{depth}_c*s(k) + (\text{depth}(j,i)-\text{depth}_c)*C(k)$
- $C(k) = (1-b)*\sinh(a*s(k))/\sinh(a) + b*[\tanh(a*(s(k)+0.5))/(2*\tanh(0.5*a)) - 0.5]$

where $z(n,k,j,i)$ is height, positive upwards, relative to ocean datum (e.g. mean sea level) at gridpoint (n,k,j,i) , $\eta(n,j,i)$ is the height of the ocean surface, positive upwards, relative to ocean datum at gridpoint (n,j,i) , $s(k)$ is the dimensionless coordinate at vertical gridpoint (k) , and $\text{depth}(j,i)$ is the distance from ocean datum to sea floor (positive value) at horizontal gridpoint (j,i) . The constants a , b , and depth_c control the stretching.

In the OCO spectra file format theta and frequency are used as pseudo-coordinate variables.

Data variables

Data variables contain the actual data. The variable names are not standardized, but the `standard_name` attribute of each variable is.

The standard name table is located at <http://cf-pcmdi.llnl.gov/documents/cf-standard-names/standard-name-table/current/cf-standard-name-table.html>. Standard names by themselves are not always sufficient to describe a quantity. For example, a variable may contain data to which spatial or temporal operations have been applied. Or the data may represent an uncertainty in the measurement of a quantity. These quantity attributes are expressed as modifiers of the standard name. Modifications due to common statistical operations are expressed via the `cell_methods` attribute (see reference table 4). Other types of quantity modifiers are expressed using the optional modifier part of the `standard_name` attribute (see reference table 5).

Variable attributes

The attributes “`scale_factor`” and “`add_offset`” are optional.

At the current time, the OCO format does not provide for packing data, however a simple packing may be achieved through the use of the optional attributes `scale_factor` and `add_offset`.

The aim of this packing is to store data with a type which is smaller than the original type. For example, a Netcdf file containing float values stored with short type (by using `scale_factor` and `add_offset` attributes) will be smaller than another file storing the same float values with float type.

A simple way to

$$\text{real_value} = \text{stored_value} * \text{scale_factor} + \text{add_offset}$$

If both “`scale_factor`” and “`add_offset`” are presents, they should not be equal to, respectively, 1 and 0.

When data to be packed contains missing values the attributes that indicate missing values (“`_FillValue`”, “`valid_min`”, “`valid_max`”) must be of the same data type as the packed data.

The missing values (“`_FillValue`”, “`valid_min`”, “`valid_max`”) of a variable with “`scale_factor`” and/or “`add_offset`” attributes are interpreted relative to the values stored in the netCDF file.

2.3. Netcdf OCO straight grid 1.4

The OCO straight grid file format is in compliance with the "Mersea IP guidelines for Mersea Data Provider – Gridded Data Product Format" ref MERSEA-WP06-CLS-UMAN-001B_gridded_data_format.doc.

2.3.1. Dimensions and definitions

Name	Value	Comment
time	Unlimited	Number of time steps. This dimension must be set to unlimited.
depth ^(*)	e.g. : 1	If applicable, for oceanographic data Number of steps along vertical axis.
height ^(*)	e.g. : 1	If applicable, for meteorological data Number of steps along vertical axis
level ^(*)	e.g. : 1	If applicable, for oceanographic data with sigma levels Number of steps along vertical axis
layer ^(*)	e.g. : 32	If applicable, for oceanographic data Number of layers along vertical axis.
latitude	e.g. : 251	Number of latitude steps of the grids
longitude	e.g. : 201	Number of longitude steps of the grids

(*): If the Netcdf file contains only 2D data (along latitude and longitude), none of the vertical dimension (depth, height, level or layer) is required. If the Netcdf file contains at least one 3D data (along latitude, longitude and vertical), one and only one of the vertical dimension (depth, height, level or layer) is required.

2.3.2. General attributes, meta-data information

Name	Value	Comment
WHAT		
data_type	"OCO straight grid"	Type of data contained in the file (reference table 2).
format_version	"1.3"	File format version
title	e.g. : "Meteo-France Aladin analysis and forecast"	A descriptive title for the dataset i.e. a product short name or original product name (habitual reference for users, succinct description of what is in the dataset)
Conventions	"CF-1.5"	Name of the conventions followed by the dataset. <i>Please note the first capital letter for COARDS compatibility.</i>
netcdf_version	e.g. : "3.6"	Netcdf version used for the data set
product_name	e.g. : "ww3.2008082011.nc"	Product name for data provider
creation_date	e.g. : "2006-04-11T08:35:00Z"	File creation date (UT)
product_version	e.g. : "1.0"	Release number of the data file
software_version	e.g. : "MFS analysis and forecasting system v5"	Software version (i.e. the software used for the production of the data)
references	e.g. : "http://www.previmer.org/"	Web-based reference that describe the data or methods used to produce it.
history	e.g. : "2006-04-11T08:35:00Z : Creation\n 2008-03-23T11:56:12Z : Merging variable : poc"	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 modification name and optional modification arguments.
source	e.g. : "MARS V5.14"	The method of production of the original data. If it was model-generated, source should name the model and its version, as specifically as could be useful. If it is observational, source should characterize it (e.g., "surface observation" or "radiosonde")
comment	e.g. : "Any free-format text is appropriate."	Miscellaneous information about the data or methods used to produce it. Any free-format text is appropriate.
WHERE		
area	e.g. : "Western Europe"	Geographical coverage
easting	"longitude"	
northing	"latitude"	
grid_projection	e.g. : "Mercator"	Describe the grid use to store the data
southernmost_latitude	e.g. : "35.5°"	Value between -90° and 90°
northernmost_latitude	e.g. : "53.8°"	Value between -90° and 90°
latitude_resolution	e.g. : "0.1°"	Latitude step between two consecutive latitude values
westernmost_longitude	e.g. : "-11°"	Value between -180° and 180°

Name	Value	Comment
easternmost_longitude	e.g. : "14°"	Value between -180° and 180°
longitude_resolution	e.g. : "0.1°"	Longitude step between two consecutive longitude values
minimum_altitude (*)	e.g. : "-5 m"	Negative value for depth (Zmin= Zmax if no variation)
maximum_altitude (*)	e.g. : "-5 m"	Negative value for depth (Zmin= Zmax if no variation)
altitude_resolution (*)	e.g. : "n/a"	If applicable, vertical distance between two consecutive altitude values
WHEN		
start_date	e.g. : "2006-03-01T00:00:00Z"	Start date of the data (UT)
stop_date	e.g. : "2006-03-05T23:59:29Z"	Final date of the data (UT)
field_type	e.g. : "6-hourly"	If applicable, describe the period between two consecutive timestamp hourly/daily/weekly/monthly/yearly n-hourly/n-daily/n-weekly monthly climatology permanent
run_time	e.g. : "2006-03-01T00:00:00Z"	If applicable, date of the model run when the data were calculated.
forecast_range	e.g. : "2-days forecast"	If applicable, time range of forecast
forecast_type	e.g. : "forecast"	If applicable, "hindcast" or "nowcast" or "forecast"
WHO		
institution	e.g. : "Meteo-France"	Data provider name
institution_references	e.g. : "http://www.meteo.fr/"	Web-based reference for data provider, the place to find all information upon the data set
data_centre	"IFREMER OCO DATA CENTER"	Data centre in charge of this data file
data_centre_references	"http://www.previmer.org/"	Web-based reference for data centre
contact	e.g. : "cdoco-exploit@ifremer.fr"	User desk e-mail
HOW		
distribution_statement	e.g. : "Data restrictions: for registered users only"	Text like "Approved for public release. Distribution unlimited" or "Data restrictions: for registered users only" or link to the place where the rule is described
operational_status	e.g. : "operational"	Statement like : "under development" or "operational" or "experimental"
quality_index	e.g. : "1"	A code value: 0 unknown quality 1 excellent (no known problems, regular quality checking) 2 probably good (occasional problems, validation phase) 3 extremely suspect (frequent problems)

(*) : This attribute is mandatory only if one of the vertical dimension (depth, height, level or layer) is present. If not, the attribute is optional.

2.3.3. Coordinate variables

Type Name(Dimensions), Attributes	Comment
double time(time) long_name = <X ₁ > standard_name = "time" units = <X ₂ > conventions = <X ₃ > axis = "T"	Time stamps of the grid which can be expressed as : <ul style="list-style-type: none"> seconds since a reference date <X₁> = "time in seconds (UT)" <X₂> = "seconds since 1900-01-01T00:00:00Z" <X₃> = "relative number of seconds with no decimal part" e.g. : 320577240.0 : July 25 2001 19:14:00 julian days since a reference date (the integer part represents the day, the decimal part represents the time of the day) <X₁> = "julian day (UT)" <X₂> = "days since 1900-01-01T00:00:00Z" <X₃> = "relative julian days with decimal part (as parts of the day)" e.g. : 37095.801388 : July 25 2001 19:14:00 Date and time are in universal time. It is allowed to use another date as the reference date.
<type> latitude(latitude) long_name = "latitude" standard_name = "latitude" units = "degree_north" valid_min = <X ₁ > valid_max = <X ₂ > axis="Y"	Latitudes (degree north) of the grid. <type> : double, float <X ₁ > : depends on <type> (-90. for double, -90.f for float) <X ₂ > : depends on <type> (90. for double, 90.f for float) e.g. : 44.4991 for 44° 29' 56.76" N

Type Name(Dimensions), Attributes	Comment
<type> longitude(longitude) long_name = "longitude" standard_name = "longitude" units = "degree_east" valid_min = <X ₁ > valid_max = <X ₂ > axis="X"	Longitudes (degree east) of the grid. <type> : double, float <X ₁ > : depends on <type> (-90. for double, -90.f for float) <X ₂ > : depends on <type> (90. for double, 90.f for float) e.g. : 16.7222 for 16° 43' 19.92" E
float depth(depth) long_name = "depth" standard_name = "depth" units = "m" axis="Z" positive="down"	If applicable, for oceanographic data. If and only if depth dimension is defined.
float height(height) long_name = "height" standard_name = "height" units = "m" axis="Z" positive="up"	If applicable, for meteorological data. If and only if height dimension is defined.
float level(level) long_name = "sigma level" standard_name = "ocean_sigma_coordinate" or "ocean_s_coordinate" formula_terms = <X ₁ > axis="Z" positive="up"	If applicable, for oceanographic data with sigma levels. If and only if level dimension is defined. For "ocean_sigma_coordinate" <X ₁ > : "sigma: var1 eta: var2 depth: var3" var1, var2, var3 are the names of the variables matching respectively sigma, eta, depth in the equation $z = \text{eta} + \text{sigma}(\text{depth} + \text{eta})$ For "ocean_s_coordinate" <X ₁ > : "s: var1 eta: var2 depth: var3 a: var4 b: var5 depth_c: var6" var1, var2, var3, var4, var5, var6 are the names of the variables matching respectively s, eta, depth, a, b, depth_c in the equations : $z(n,k,j,i) = \text{eta}(n,j,i) * (1 + s(k)) + \text{depth_c} * s(k) + (\text{depth}(j,i) - \text{depth_c}) * C(k)$ $C(k) = (1 - b) * \sinh(a * s(k)) / \sinh(a) + b * [\tanh(a * (s(k) + 0.5)) / (2 * \tanh(0.5 * a)) - 0.5]$
int layer(layer) long_name = "layer" standard_name = "model_level_number" units = "layer" axis="Z" positive="down"	If applicable, for oceanographic data. If and only if layer dimension is defined.

2.3.4. Data variables

Some examples of grid variables are listed in reference table 6.

Type Name(Dimensions), Attributes	Comment
<type> <var2d>(latitude,longitude) long_name = <X ₁ > standard_name = <X ₂ > units = <X ₃ > _FillValue = <Y> valid_min = <X ₄ > valid_max = <X ₅ > scale_factor = <X ₆ > add_offset = <X ₇ >	<var2d> contains the values of a (lat, lon) parameter <type> : double, float, int, short, byte <X ₁ > : a free text which describes <var2d> <X ₂ > : a CF-1 standard text which describes <var2d> <X ₃ > : the CF-1 standard unit of <var2d> <Y> : Appropriate chosen value <X ₄ ><X ₅ > : the min and max valid bounds for <var2d> <X ₆ > : an <u>optional</u> factor to apply on data <X ₇ > : an <u>optional</u> offset to add to data
<type> <var3d>(time,latitude,longitude) long_name = <X ₁ > standard_name = <X ₂ > units = <X ₃ > _FillValue = <Y> valid_min = <X ₄ > valid_max = <X ₅ > scale_factor = <X ₆ > add_offset = <X ₇ >	<var3d> contains the values of a (t, lat, lon) parameter <type> : double, float, int, short, byte <X ₁ > : a free text which describes <var3d> <X ₂ > : a CF-1 standard text which describes <var3d> <X ₃ > : the CF-1 standard unit of <var3d> <Y> : Appropriate chosen value <X ₄ ><X ₅ > : the min and max valid bounds for <var3d> <X ₆ > : an <u>optional</u> factor to apply on data <X ₇ > : an <u>optional</u> offset to add to data

Type Name(Dimensions), Attributes	Comment
<type> <var4d>(time,<vertical>,latitude,longitude) long_name = <X ₁ > standard_name = <X ₂ > units = <X ₃ > _FillValue = <Y> valid_min = <X ₄ > valid_max = <X ₅ > scale_factor = <X ₆ > add_offset = <X ₇ >	<var4d> contains the values of a (t, z, lat, lon) parameter <type> : double, float, int, short, byte <vertical> : depth, height, level <X ₁ > : a free text which describes <var4d> <X ₂ > : a CF-1 standard text which describes <var4d> <X ₃ > : the CF-1 standard unit of <var4d> <Y> : Appropriate chosen value <X ₄ ><X ₅ > : the min and max valid bounds for <var4d> <X ₆ > : an <u>optional</u> factor to apply on data <X ₇ > : an <u>optional</u> offset to add to data

2.4. Oriented grid file format 1.3.1

The OCO oriented grid file format is in compliance with the "Mersea IP guidelines for Mersea Data Provider – Gridded Data Product Format" ref MERSEA-WP06-CLS-UMAN-001B_gridded_data_format.doc.

2.4.1. Dimensions and definitions

Name	Value	Comment
time	Unlimited	Number of time steps. This dimension must be set to unlimited.
depth ^(*)	e.g. : 1	If applicable, for oceanographic data Number of steps along vertical axis.
height ^(*)	e.g. : 1	If applicable, for meteorological data Number of steps along vertical axis
level ^(*)	e.g. : 1	If applicable, for oceanographic data with sigma levels Number of steps along vertical axis
layer ^(*)	e.g. : 32	If applicable, for oceanographic data Number of layers along vertical axis.
ni	e.g. : 64	X dimension of the grids
nj	e.g. : 95	Y dimension of the grids

(*): If the Netcdf file contains only 2D data (along latitude and longitude), none of the vertical dimension (depth, height, level or layer) is required. If the Netcdf file contains at least one 3D data (along latitude, longitude and vertical), one and only one of the vertical dimension (depth, height, level or layer) is required.

2.4.2. General attributes, meta-data information

Name	Value	Comment
WHAT		
data_type	"OCO oriented grid"	Type of data contained in the file (reference table 2).
format_version	"1.3.1"	File format version
title	e.g. : "Meteo-France Aladin analysis and forecast"	A descriptive title for the dataset i.e. a product short name or original product name (habitual reference for users, succinct description of what is in the dataset)
Conventions	e.g. : "CF-1.5 xxxx" or "CF-1.6 xxxx"	Name of the conventions followed by the dataset. <i>Please note the first capital letter for COARDS compatibility.</i>
netcdf_version	e.g. : "4.1.2"	Netcdf version used for the data set
product_name	e.g. : "ww3.2008082011.nc"	Product name for data provider
creation_date	e.g. : "2006-04-11T08:35:00Z"	File creation date (UT)
product_version	e.g. : "1.0"	Release number of the data file
software_version	e.g. : "MFS analysis and forecasting system v5"	Software version (i.e. the software used for the production of the data)
references	e.g. : "http://www.previmer.org/"	Web-based reference that describe the data or methods used to produce it.
history	e.g. : "2006-04-11T08:35:00Z : Creation\n 2008-03-23T11:56:12Z : Merging variable : poc"	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 modification name and optional modification arguments.
source	e.g. : "MARS V5.14"	The method of production of the original data. If it was model-generated, source should name the model and its version, as specifically as could be useful. If it is observational, source should characterize it (e.g., "surface observation" or "radiosonde")
comment	e.g. : "Any free-format text is appropriate."	Miscellaneous information about the data or methods used to produce it. Any free-format text is appropriate.
WHERE		
area	e.g. : "Western Europe"	Geographical coverage
easting	"longitude"	
northing	"latitude"	
grid_projection	e.g. : "Mercator"	Describe the grid use to store the data
southernmost_latitude	e.g. : "35.5°"	Value between -90° and 90°
northernmost_latitude	e.g. : "53.8°"	Value between -90° and 90°
latitude_resolution	e.g. : "0.1°"	Latitude step between two consecutive latitude values
westernmost_longitude	e.g. : "-11°"	Value between -180° and 180°

Name	Value	Comment
easternmost_longitude	e.g. : "14°"	Value between -180° and 180°
longitude_resolution	e.g. : "0.1°"	Longitude step between two consecutive longitude values
minimum_altitude (*)	e.g. : "-5 m"	Negative value for depth (Zmin= Zmax if no variation)
maximum_altitude (*)	e.g. : "-5 m"	Negative value for depth (Zmin= Zmax if no variation)
altitude_resolution (*)	e.g. : "n/a"	If applicable, vertical distance between two consecutive altitude values
WHEN		
start_date	e.g. : "2006-03-01T00:00:00Z"	Start date of the data (UT)
stop_date	e.g. : "2006-03-05T23:59:29Z"	Final date of the data (UT)
field_type	e.g. : "6-hourly"	If applicable, describe the period between two consecutive timestamp hourly/daily/weekly/monthly/yearly n-hourly/n-daily/n-weekly monthly climatology permanent
run_time	e.g. : "2006-03-01T00:00:00Z"	If applicable, date of the model run when the data were calculated.
forecast_range	e.g. : "2-days forecast"	If applicable, time range of forecast
forecast_type	e.g. : "forecast"	If applicable, "hindcast" or "nowcast" or "forecast"
WHO		
institution	e.g. : "Meteo-France"	Data provider name
institution_references	e.g. : "http://www.meteo.fr/"	Web-based reference for data provider, the place to find all information upon the data set
data_centre	"IFREMER OCO DATA CENTER" or "DYNECO/PHYSED"	Data centre in charge of this data file
data_centre_references	"http://www.previmer.org/" or "http://(.)*.ifremer.fr(.)*"	Web-based reference for data centre
contact	e.g. : "cdoco-exploit@ifremer.fr"	User desk e-mail
HOW		
distribution_statement	e.g. : "Data restrictions: for registered users only"	Text like "Approved for public release. Distribution unlimited" or "Data restrictions: for registered users only" or link to the place where the rule is described
operational_status	e.g. : "operational"	Statement like : "under development" or "operational" or "experimental"
quality_index	e.g. : "1"	A code value: 0 unknown quality 1 excellent (no known problems, regular quality checking) 2 probably good (occasional problems, validation phase) 3 extremely suspect (frequent problems)

(*) : This attribute is mandatory only if one of the vertical dimension (depth, height, level or layer) is present. If not, the attribute is optional.

2.4.3. Coordinate variables

Type Name(Dimensions), Attributes	Comment
double time(time) long_name = <X ₁ > standard_name = "time" units = <X ₂ > conventions = <X ₃ > axis = "T"	Time stamps of the grid which can be expressed as : <ul style="list-style-type: none"> seconds since a reference date <X₁> = "time in seconds (UT)" <X₂> = "seconds since 1900-01-01T00:00:00Z" <X₃> = "relative number of seconds with no decimal part" e.g. : 320577240.0 : July 25 2001 19:14:00 julian days since a reference date (the integer part represents the day, the decimal part represents the time of the day) <X₁> = "julian day (UT)" <X₂> = "days since 1900-01-01T00:00:00Z" <X₃> = "relative julian days with decimal part (as parts of the day)" e.g. : 37095.801388 : July 25 2001 19:14:00 Date and time are in universal time. It is allowed to use another date as the reference date.
<type> latitude(nj, ni) long_name = "latitude" standard_name = "latitude" units = "degree_north" or "degrees_north" valid_min = <X ₁ > valid_max = <X ₂ >	Latitudes (degree north) of the grid. <type> : double, float <X ₁ > : depends on <type> (-90. for double, -90.f for float) <X ₂ > : depends on <type> (90. for double, 90.f for float) e.g. : 44.4991 for 44° 29' 56.76" N

Type Name(Dimensions), Attributes	Comment
<type> longitude(nj, ni) long_name = "longitude" standard_name = "longitude" units = "degree_east" or "degrees_east" valid_min = <X ₁ > valid_max = <X ₂ >	Longitudes (degree east) of the grid. <type> : double, float <X ₁ > : depends on <type> (-90. for double, -90.f for float) <X ₂ > : depends on <type> (90. for double, 90.f for float) e.g. : 16.7222 for 16° 43' 19.92" E
float depth(depth) long_name = "depth" standard_name = "depth" units = "m" axis="Z" positive="down"	If applicable, for oceanographic data. If and only if depth dimension is defined.
float height(height) long_name = "height" standard_name = "height" units = "m" axis="Z" positive="up"	If applicable, for meteorological data. If and only if height dimension is defined.
float level(level) long_name = "sigma level" standard_name = "ocean_sigma_coordinate" or "ocean_s_coordinate" formula_terms = <X ₁ > axis="Z" positive="up"	If applicable, for oceanographic data with sigma levels. If and only if level dimension is defined. For "ocean_sigma_coordinate" <X ₁ > : "sigma: var1 eta: var2 depth: var3" var1, var2, var3 are the names of the variables matching respectively sigma, eta, depth in the equation $z = \text{eta} + \text{sigma}(\text{depth} + \text{eta})$ For "ocean_s_coordinate" <X ₁ > : "s: var1 eta: var2 depth: var3 a: var4 b: var5 depth_c: var6" var1, var2, var3, var4, var5, var6 are the names of the variables matching respectively s, eta, depth, a, b, depth_c in the equations : $z(n,k,j,i) = \text{eta}(n,j,i) * (1 + s(k)) + \text{depth_c} * s(k) + (\text{depth}(j,i) - \text{depth_c}) * C(k)$ $C(k) = (1 - b) * \sinh(a * s(k)) / \sinh(a) + b * [\tanh(a * (s(k) + 0.5)) / (2 * \tanh(0.5 * a)) - 0.5]$
int layer(layer) long_name = "layer" standard_name = "model_level_number" units = "layer" axis="Z" positive="down"	If applicable, for oceanographic data. If and only if layer dimension is defined.
float ni(ni) long_name = "x-dimension of the grid" standard_name = "x_grid_index" axis="X"	X dimension of the grid.
float nj(nj) long_name = "y-dimension of the grid" standard_name = "y_grid_index" axis="Y"	Y dimension of the grid.

2.4.4. Data variables

Some examples of grid variables are listed in reference table 6.

Type Name(Dimensions), Attributes	Comment
<type> <var2d>(nj,ni) long_name = <X ₁ > standard_name = <X ₂ > units = <X ₃ > _FillValue = <Y> valid_min = <X ₄ > valid_max = <X ₅ > scale_factor = <X ₆ > add_offset = <X ₇ > coordinates = "latitude longitude"	<var2d> contains the values of a (lat, lon) parameter <type> : double, float, int, short, byte <X ₁ > : a free text which describes <var2d> <X ₂ > : a CF-1 standard text which describes <var2d> <X ₃ > : the CF-1 standard unit of <var2d> <Y> : Appropriate chosen value <X ₄ ><X ₅ > : the min and max valid bounds for <var2d> <X ₆ > : an <u>optional</u> factor to apply on data <X ₇ > : an <u>optional</u> offset to add to data
<type> <var3d>(time,nj,ni) long_name = <X ₁ > standard_name = <X ₂ > units = <X ₃ > _FillValue = <Y> valid_min = <X ₄ > valid_max = <X ₅ > scale_factor = <X ₆ > add_offset = <X ₇ > coordinates = "latitude longitude"	<var3d> contains the values of a (t, lat, lon) parameter <type> : double, float, int, short, byte <X ₁ > : a free text which describes <var3d> <X ₂ > : a CF-1 standard text which describes <var3d> <X ₃ > : the CF-1 standard unit of <var3d> <Y> : Appropriate chosen value <X ₄ ><X ₅ > : the min and max valid bounds for <var3d> <X ₆ > : an <u>optional</u> factor to apply on data <X ₇ > : an <u>optional</u> offset to add to data

Type Name(Dimensions), Attributes	Comment
<type> <var4d>(time,<vertical>,nj,ni) long_name = <X ₁ > standard_name = <X ₂ > units = <X ₃ > _FillValue = <Y> valid_min = <X ₄ > valid_max = <X ₅ > scale_factor = <X ₆ > add_offset = <X ₇ > coordinates = "latitude longitude"	<var4d> contains the values of a (t, z, lat, lon) parameter <type> : double, float, int, short, byte <vertical> : depth, height, level <X ₁ > : a free text which describes <var4d> <X ₂ > : a CF-1 standard text which describes <var4d> <X ₃ > : the CF-1 standard unit of <var4d> <Y> : Appropriate chosen value <X ₄ ><X ₅ > : the min and max valid bounds for <var4d> <X ₆ > : an <u>optional</u> factor to apply on data <X ₇ > : an <u>optional</u> offset to add to data

2.5. Spectra file format 1D 1.1

2.5.1. Dimensions and definitions

Name	Value	Comment
time	Unlimited	Number of time steps. This dimension must be set to unlimited.
station	e.g. : 1	Number of stations.
string16	16	character strings dimension
frequency	e.g. : 32	Number of frequencies in the spectra

2.5.2. General attributes, meta-data information

Name	Value	Comment
WHAT		
data_type	"OCO spectra 1D"	Type of data contained in the file (reference table 2).
format_version	"1.1"	File format version
title	e.g. : "WAVEWATCH-III FORECAST"	A descriptive title for the dataset i.e. a product short name or original product name (habitual reference for users, succinct description of what is in the dataset)
Conventions	"CF-1.5"	Name of the conventions followed by the dataset. <i>Please note the first capital letter for COARDS compatibility.</i>
netcdf_version	e.g. : "4.11"	Netcdf version used for the data set
product_name	e.g. : "ww3.2008082011.nc"	Product name for data provider
creation_date	e.g. : "2006-04-11T08:35:00Z"	File creation date (UT)
software_version	e.g. : "3.14-Ifremer-SHOM_rev65"	Software version (i.e. the software used for the production of the data)
references	e.g. : "http://wwz.ifremer.fr/iowa ga/"	Web-based reference that describe the data or methods used to produce it.
history	e.g. : "2006-04-11T08:35:00Z : Creation\n 2008-03-23T11:56:12Z : Merging variable : poc"	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 modification name and optional modification arguments.
source	e.g. : "NORGASUG WAVEWATCH III (R) NORGAS-UG"	The method of production of the original data. If it was model-generated, source should name the model and its version, as specifically as could be useful. If it is observational, source should characterize it (e.g., "surface observation" or "radiosonde")
comment	e.g. : "Any free-format text is appropriate."	Miscellaneous information about the data or methods used to produce it. Any free-format text is appropriate.
WHERE		
area	e.g. : "Western Europe"	Geographical coverage
easting	"longitude"	
northing	"latitude"	
grid_projection	"n/a"	Describe the grid use to store the data
southernmost_latitude	e.g. : "35.5°"	Value between -90° and 90°
northernmost_latitude	e.g. : "35.5°"	Value between -90° and 90°
latitude_resolution	"n/a"	Latitude step between two consecutive latitude values
westernmost_longitude	e.g. : "-11°"	Value between -180° and 180°
easternmost_longitude	e.g. : "-11°"	Value between -180° and 180°
longitude_resolution	"n/a"	Longitude step between two consecutive longitude values
minimum_altitude	"n/a"	Negative value for depth (Zmin= Zmax if no variation)
maximum_altitude	"n/a"	Negative value for depth (Zmin= Zmax if no variation)
altitude_resolution	"n/a"	vertical distance between two consecutive altitude values
WHEN		
start_date	e.g. : "2006-03-01T00:00:00Z"	Start date of the data (UT)
stop_date	e.g. : "2006-03-05T23:59:29Z"	Final date of the data (UT)
field_type	e.g. : "6-hourly"	If applicable, describe the period between two consecutive timestamp hourly/daily/weekly/monthly/yearly n-hourly/n-daily/n-weekly

Name	Value	Comment
		monthly climatology permanent
run_time	e.g. : "2006-03-01T00:00:00Z"	If applicable, date of the model run when the data were calculated.
forecast_range	e.g. : "2-days forecast"	If applicable, time range of forecast
forecast_type	e.g. : "forecast"	If applicable, "hindcast" or "nowcast" or "forecast"
WHO		
institution	e.g. : "SHOM and Ifremer"	Data provider name
institution_references	e.g. : "http://www.previmer.org/"	Web-based reference for data provider, the place to find all information upon the data set
data_centre	"IFREMER OCO DATA CENTER"	Data centre in charge of this data file
data_centre_references	"http://www.previmer.org/"	Web-based reference for data centre
contact	e.g. : "cdoco-exploit@ifremer.fr"	User desk e-mail
HOW		
distribution_statement	e.g. : "Data restrictions: for registered users only"	Text like "Approved for public release. Distribution unlimited" or "Data restrictions: for registered users only" or link to the place where the rule is described
operational_status	e.g. : "operational"	Statement like : "under development" or "operational" or "experimental"
quality_index	e.g. : "1"	A code value: 0 unknown quality 1 excellent (no known problems, regular quality checking) 2 probably good (occasional problems, validation phase) 3 extremely suspect (frequent problems)
SPECIFIC VARIABLES		
<variable_name>	"a value"	Some variables specify model options used to generate this spectra. e.g. : :grid = "points"; :SWELLF = "0.1";

2.5.3. Coordinate variables

Type Name(Dimensions), Attributes	Comment
double time(time) long_name = <X ₁ > standard_name = "time" units = <X ₂ > conventions = <X ₃ > axis = "T"	Time stamps of the grid which can be expressed as : <ul style="list-style-type: none"> seconds since a reference date <X₁> = "time in seconds (UT)" <X₂> = "seconds since 1900-01-01T00:00:00Z" <X₃> = "relative number of seconds with no decimal part" e.g. : 320577240.0 : July 25 2001 19:14:00 julian days since a reference date (the integer part represents the day, the decimal part represents the time of the day) <X₁> = "julian day (UT)" <X₂> = "days since 1900-01-01T00:00:00Z" <X₃> = "relative julian days with decimal part (as parts of the day)" e.g. : 37095.801388 : July 25 2001 19:14:00 Date and time are in universal time. It is allowed to use another date as the reference date.
<type> frequency(frequency) long_name = "frequency of center band" standard_name = "sea_surface_wave_frequency" units = "hertz" or "s-1" valid_min = <X ₁ > valid_max = <X ₂ > axis = "Y"	Frequencies of the spectra <type> : double, float <X ₁ ><X ₂ > : the min and max valid bounds for frequencies
int station(station) long_name = "station id" axis = "X"	Station identifier
int string16(string16) long_name = "station id" axis = "Z"	The aim of this dimension is to bind axis "Z" with the name "string16".

2.5.4. Data variables

Type Name(Dimensions), Attributes	Comment
<type> <var1d>(frequency) long_name = <X ₁ > standard_name = <X ₂ > units = <X ₃ > _FillValue = <Y> valid_min = <X ₄ > valid_max = <X ₅ > scale_factor = <X ₆ > add_offset = <X ₇ > content = "Y" associates = "frequency"	<var1d> contains the values of a (freq) parameter <type> : double, float, int, short, byte <X ₁ > : a free text which describes <var1d> <X ₂ > : a CF-1 standard text which describes <var1d> <X ₃ > : the CF-1 standard unit of <var1d> <Y> : Appropriate chosen value <X ₄ ><X ₅ > : the min and max valid bounds for <var1d> <X ₆ > : an <u>optional</u> factor to apply on data <X ₇ > : an <u>optional</u> offset to add to data content : axis used by this variable associates : axis' variable names used by this variable
<type> <var2d>(time,station) long_name = <X ₁ > standard_name = <X ₂ > units = <X ₃ > _FillValue = <Y> valid_min = <X ₄ > valid_max = <X ₅ > scale_factor = <X ₆ > add_offset = <X ₇ > content = "TX" associates = "time station"	<var2d> contains the values of a parameter associated to each spectra <type> : double, float, int, short, byte <X ₁ > : a free text which describes <var2d> <X ₂ > : a CF-1 standard text which describes <var2d> <X ₃ > : the CF-1 standard unit of <var2d> <Y> : Appropriate chosen value <X ₄ ><X ₅ > : the min and max valid bounds for <var2d> <X ₆ > : an <u>optional</u> factor to apply on data <X ₇ > : an <u>optional</u> offset to add to data content : axis used by this variable associates : axis' variable names used by this variable
<type> <var3d>(time, station, frequency) long_name = <X ₁ > standard_name = <X ₂ > units = <X ₃ > _FillValue = <Y> valid_min = <X ₄ > valid_max = <X ₅ > scale_factor = <X ₆ > add_offset = <X ₇ > content = "TXY" associates = "time station frequency"	<var3d> contains the values of a (t, station, freq) parameter <type> : double, float, int, short, byte <X ₁ > : a free text which describes <var3d> <X ₂ > : a CF-1 standard text which describes <var3d> <X ₃ > : the CF-1 standard unit of <var3d> <Y> : Appropriate chosen value <X ₄ ><X ₅ > : the min and max valid bounds for <var3d> <X ₆ > : an <u>optional</u> factor to apply on data <X ₇ > : an <u>optional</u> offset to add to data content : axis used by this variable associates : axis' variable names used by this variable
char station_name(station, string16) long_name = "station name" content = "XZ" associates = "station string16"	Name of the stations content : axis used by this variable associates : axis' variable names used by this variable
<type> latitude(time, station) long_name = "latitude" standard_name = "latitude" units = "degree_north" _FillValue = <Y> valid_min = <X ₁ > valid_max = <X ₂ > scale_factor = <X ₃ > add_offset = <X ₄ > content = "TX" associates = "time station"	Latitudes (degree north) of the stations. <type> : double, float <Y> : Appropriate chosen value <X ₁ > : depends on <type> (-90. for double, -90.f for float) <X ₂ > : depends on <type> (90. for double, 90.f for float) e.g. : 44.4991 for 44° 29' 56.76" N <X ₃ > : an <u>optional</u> factor to apply on data <X ₄ > : an <u>optional</u> offset to add to data content : axis used by this variable associates : axis' variable names used by this variable
<type> longitude(time, station) long_name = "longitude" standard_name = "longitude" units = "degree_east" _FillValue = <Y> valid_min = <X ₁ > valid_max = <X ₂ > scale_factor = <X ₃ > add_offset = <X ₄ > content = "TX" associates = "time station"	Longitudes (degree east) of the stations. <type> : double, float <Y> : Appropriate chosen value <X ₁ > : depends on <type> (-90. for double, -90.f for float) <X ₂ > : depends on <type> (90. for double, 90.f for float) e.g. : 16.7222 for 16° 43' 19.92" E <X ₃ > : an <u>optional</u> factor to apply on data <X ₄ > : an <u>optional</u> offset to add to data content : axis used by this variable associates : axis' variable names used by this variable

2.6. Spectra file format 2D 1.1

2.6.1. Dimensions and definitions

Name	Value	Comment
time	Unlimited	Number of time steps. This dimension must be set to unlimited.
station	e.g. : 1	Number of stations.
string16	16	character strings dimension
frequency	e.g. : 32	Number of frequencies in the spectra
direction	e.g. : 24	Sea surface wave from direction

2.6.2. General attributes, meta-data information

Name	Value	Comment
WHAT		
data_type	"OCO spectra 2D"	Type of data contained in the file (reference table 2).
format_version	"1.1"	File format version
title	e.g. : "WAVEWATCH-III FORECAST"	A descriptive title for the dataset i.e. a product short name or original product name (habitual reference for users, succinct description of what is in the dataset)
Conventions	"CF-1.5"	Name of the conventions followed by the dataset. <i>Please note the first capital letter for COARDS compatibility.</i>
netcdf_version	e.g. : "4.11"	Netcdf version used for the data set
product_name	e.g. : "ww3.2008082011.nc"	Product name for data provider
creation_date	e.g. : "2006-04-11T08:35:00Z"	File creation date (UT)
software_version	e.g. : "MFS analysis and forecasting system v5"	Software version (i.e. the software used for the production of the data)
references	e.g. : "http://wwz.ifremer.fr/iowa ga/"	Web-based reference that describes the data or methods used to produce it.
history	e.g. : "2006-04-11T08:35:00Z : Creation 2008-03-23T11:56:12Z : Merging variable : poc"	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 modification name and optional modification arguments.
source	e.g. : "NORGASUG WAVEWATCH III (R) NORGAS-UG"	The method of production of the original data. If it was model-generated, source should name the model and its version, as specifically as could be useful. If it is observational, source should characterize it (e.g., "surface observation" or "radiosonde")
comment	e.g. : "Any free-format text is appropriate."	Miscellaneous information about the data or methods used to produce it. Any free-format text is appropriate.
WHERE		
area	e.g. : "NORGAS-200m-UNST"	Geographical coverage
easting	"longitude"	
northing	"latitude"	
grid_projection	"n/a"	Describe the grid use to store the data
southernmost_latitude	e.g. : "35.5°"	Value between -90° and 90°
northernmost_latitude	e.g. : "35.5°"	Value between -90° and 90°
latitude_resolution	"n/a"	Latitude step between two consecutive latitude values
westernmost_longitude	e.g. : "-11°"	Value between -180° and 180°
easternmost_longitude	e.g. : "-11°"	Value between -180° and 180°
longitude_resolution	"n/a"	Longitude step between two consecutive longitude values
minimum_altitude	"n/a"	Negative value for depth (Zmin= Zmax if no variation)
maximum_altitude	"n/a"	Negative value for depth (Zmin= Zmax if no variation)
altitude_resolution	"n/a"	vertical distance between two consecutive altitude values
WHEN		
start_date	e.g. : "2006-03-01T00:00:00Z"	Start date of the data (UT)
stop_date	e.g. :	Final date of the data (UT)

Name	Value	Comment
	"2006-03-05T23:59:29Z"	
field_type	e.g. : "6-hourly"	If applicable, describe the period between two consecutive timestamp hourly/daily/weekly/monthly/yearly n-hourly/n-daily/n-weekly monthly climatology permanent
run_time	e.g. : "2006-03-01T00:00:00Z"	If applicable, date of the model run when the data were calculated.
forecast_range	e.g. : "2-days forecast"	If applicable, time range of forecast
forecast_type	e.g. : "forecast"	If applicable, "hindcast" or "nowcast" or "forecast"
WHO		
institution	e.g. : "SHOM and Ifremer"	Data provider name
institution_references	e.g. : "http://www.previmer.org/"	Web-based reference for data provider, the place to find all information upon the data set
data_centre	"IFREMER OCO DATA CENTER"	Data centre in charge of this data file
data_centre_references	"http://www.previmer.org/"	Web-based reference for data centre
contact	e.g. : "cdoco-exploit@ifremer.fr"	User desk e-mail
HOW		
distribution_statement	e.g. : "Data restrictions: for registered users only"	Text like "Approved for public release. Distribution unlimited" or "Data restrictions: for registered users only" or link to the place where the rule is described
operational_status	e.g. : "operational"	Statement like : "under development" or "operational" or "experimental"
quality_index	e.g. : "1"	A code value: 0 unknown quality 1 excellent (no known problems, regular quality checking) 2 probably good (occasional problems, validation phase) 3 extremely suspect (frequent problems)
SPECIFIC VARIABLES		
<variable_name>	"a value"	Some variables specify model options used to generate this spectra. e.g. : :grid = "points"; :SWELLF = "0.1";

2.6.3. Coordinate variables

Type Name(Dimensions), Attributes	Comment
double time(time) long_name = <X ₁ > standard_name = "time" units = <X ₂ > conventions = <X ₃ > axis = "T"	Time stamps of the grid which can be expressed as : <ul style="list-style-type: none"> seconds since a reference date <X₁> = "time in seconds (UT)" <X₂> = "seconds since 1900-01-01T00:00:00Z" <X₃> = "relative number of seconds with no decimal part" e.g. : 320577240.0 : July 25 2001 19:14:00 julian days since a reference date (the integer part represents the day, the decimal part represents the time of the day) <X₁> = "julian day (UT)" <X₂> = "days since 1900-01-01T00:00:00Z" <X₃> = "relative julian days with decimal part (as parts of the day)" e.g. : 37095.801388 : July 25 2001 19:14:00 Date and time are in universal time. It is allowed to use another date as the reference date.
float<type> frequency(frequency) long_name = "frequency of center band" standard_name = "sea_surface_wave_frequency" units = "hertz" or "s-1" valid_min = <X ₁ > valid_max = <X ₂ > axis = "Y"	Frequencies of the spectra <type> : double, float <X ₁ ><X ₂ > : the min and max valid bounds for frequencies

Type Name(Dimensions), Attributes	Comment
<pre><type> direction(direction) long_name = "sea surface wave to direction" standard_name = "sea_surface_wave_to_direction" units = "degree" or "angular_degree" valid_min = <X1> valid_max = <X2> axis = "Z"</pre>	<p>Sea surface wave from direction of the spectra</p> <pre><type> : double, float <X1> : depends on <type> (0. for double, 0.f for float) <X2> : depends on <type> (360. for double, 360.f for float)</pre>
<pre>int station(station) long_name = "station id" axis = "X"</pre>	Station identifier
<pre>int string16(string16) long_name = "station id" axis = "W"</pre>	The aim of this dimension is to bind axis "W" with the name "string16".

2.6.4. Data variables

Type Name(Dimensions), Attributes	Comment
<pre><type> <var1d>(frequency) long_name = <X1> standard_name = <X2> units = <X3> _FillValue = <Y> valid_min = <X4> valid_max = <X5> scale_factor = <X6> add_offset = <X7> content = "Y" associates = "frequency"</pre>	<p><var1d> contains the values of a (freq) parameter</p> <pre><type> : double, float, int, short, byte <X1> : a free text which describes <var1d> <X2> : a CF-1 standard text which describes <var1d> <X3> : the CF-1 standard unit of <var1d> <Y> : Appropriate chosen value <X4><X5> : the min and max valid bounds for <var1d> <X6> : an <u>optional</u> factor to apply on data <X7> : an <u>optional</u> offset to add to data content : axis used by this variable associates : axis' variable names used by this variable</pre>
<pre><type> <var2d>(time,station) long_name = <X1> standard_name = <X2> units = <X3> _FillValue = <Y> valid_min = <X4> valid_max = <X5> scale_factor = <X6> add_offset = <X7> content = "TX" associates = "time station"</pre>	<p><var2d> contains the values of a parameter associated to each spectra</p> <pre><type> : double, float, int, short, byte <X1> : a free text which describes <var2d> <X2> : a CF-1 standard text which describes <var2d> <X3> : the CF-1 standard unit of <var2d> <Y> : Appropriate chosen value <X4><X5> : the min and max valid bounds for <var2d> <X6> : an <u>optional</u> factor to apply on data <X7> : an <u>optional</u> offset to add to data content : axis used by this variable associates : axis' variable names used by this variable</pre>
<pre><type> <var3d>(time, station, frequency) long_name = <X1> standard_name = <X2> units = <X3> _FillValue = <Y> valid_min = <X4> valid_max = <X5> scale_factor = <X6> add_offset = <X7> content = "TXY" associates = "time station frequency"</pre>	<p><var3d> contains the values of a (t, station, freq) parameter</p> <pre><type> : double, float, int, short, byte <X1> : a free text which describes <var3d> <X2> : a CF-1 standard text which describes <var3d> <X3> : the CF-1 standard unit of <var3d> <Y> : Appropriate chosen value <X4><X5> : the min and max valid bounds for <var3d> <X6> : an <u>optional</u> factor to apply on data <X7> : an <u>optional</u> offset to add to data content : axis used by this variable associates : axis' variable names used by this variable</pre>
<pre><type> <var4d>(time, station, frequency, direction) long_name = <X1> standard_name = <X2> units = <X3> _FillValue = <Y> valid_min = <X4> valid_max = <X5> scale_factor = <X6> add_offset = <X7> content = "TXYZ" associates = "time station frequency direction"</pre>	<p><var4d> contains the values of a (t, station, freq, direction) parameter</p> <pre><type> : double, float, int, short, byte <X1> : a free text which describes <var4d> <X2> : a CF-1 standard text which describes <var4d> <X3> : the CF-1 standard unit of <var4d> <Y> : Appropriate chosen value <X4><X5> : the min and max valid bounds for <var4d> <X6> : an <u>optional</u> factor to apply on data <X7> : an <u>optional</u> offset to add to data content : axis used by this variable associates : axis' variable names used by this variable</pre>
<pre>char station_name(station, string16) long_name = "station name" content = "XW" associates = "station string16"</pre>	<p>Name of the stations</p> <pre>content : axis used by this variable associates : axis' variable names used by this variable</pre>

Type Name(Dimensions), Attributes	Comment
<type> latitude(time, station) long_name = "latitude" standard_name = "latitude" units = "degree_north" _FillValue = <Y> valid_min = <X ₁ > valid_max = <X ₂ > scale_factor = <X ₃ > add_offset = <X ₄ > content = "TX" associates = "time station"	Latitudes (degree north) of the stations. <type> : double, float <Y> : Appropriate chosen value <X ₁ > : depends on <type> (-90. for double, -90.f for float) <X ₂ > : depends on <type> (90. for double, 90.f for float) e.g. : 44.4991 for 44° 29' 56.76" N <X ₃ > : an <u>optional</u> factor to apply on data <X ₄ > : an <u>optional</u> offset to add to data content : axis used by this variable associates : axis' variable names used by this variable
<type> longitude(time, station) long_name = "longitude" standard_name = "longitude" units = "degree_east" _FillValue = <Y> valid_min = <X ₁ > valid_max = <X ₂ > scale_factor = <X ₃ > add_offset = <X ₄ > content = "TX" associates = "time station"	Longitudes (degree east) of the stations. <type> : double, float <Y> : Appropriate chosen value <X ₁ > : depends on <type> (-90. for double, -90.f for float) <X ₂ > : depends on <type> (90. for double, 90.f for float) e.g. : 16.7222 for 16° 43' 19.92" E <X ₃ > : an <u>optional</u> factor to apply on data <X ₄ > : an <u>optional</u> offset to add to data content : axis used by this variable associates : axis' variable names used by this variable

3. Reference tables

3.1. Reference table 1 : quality control flag scale

n	Meaning
0	No QC was performed
1	Good data
2	Probably good data
3	Probably bad data
4	Bad data
5	Value changed
6	Not used
7	Not used
8	Interpolated value
9	Missing value

3.2. Reference table 2 : data type

The following table contains the list of acceptable contents for data_type attribute.

Name
OCO straight grid
OCO oriented grid
OCO spectra

3.3. Reference table 3 : proposal of fill values

The fill values are not prescribed. The following table suggests a fill value for each type.

Type	Fill value
double	-1.7+308
float	-3.4+38
int	-2147483648
short	-32768
byte	-128
char (for strings)	' ' (space)

3.4. Reference table 4 : cell methods

In the “Units” column, u indicates the units of the physical quantity before the method is applied.

cell_method	Units	Comment
point	u	The data value are representative of points in space or time (instantaneous).
sum	u	The data value are representative of a sum or accumulation over the cell
maximum	u	Maximum
minimum	u	Minimum
median	u	Median
mid_range	u	Average of maximum and minimum
mean	u	Mean (average value)
mode	u	Mode (most common value)
standard_deviation	u	Standard deviation
variance	u ²	Variance

3.5. Reference table 5 : standard name modifiers

In the "Units" column, u indicates the units of the physical quantity before the method is applied.

Modifier	Units	Comment
detection_minimum	u	The smallest data value which is regarded as a detectable signal
number_of_observations	1	The number of discrete observations or measurements from which a data value has been derived
standard_error	u	The uncertainty of the data value.
status_flag		Flag values indicating the quality or other status of the data values. The variable should have flag_values or flag_masks (or both) and flag_meanings attributes to show and it should be interpreted. An explanation for the way to use this modifier can be found directly in the CF Metadata convention.

3.6. Reference table 6 : examples of variables definition

Variable	type	long name	standard_name	units	valid min	valid max
Arpege, Aladin						
flat	float	Flux de chaleur latente	surface_upward_latent_heat_flux	W m-2	-10800000.f	10800000.f
fisen	float	Flux de chaleur sensible	surface_upward_sensible_heat_flux	W m-2	-6480000.f	6480000.f
flsolaire	float	Bilan du rayonnement de courtes longueurs d'onde	surface_net_upward_shortwave_flux	W m-2	-43200000.f	43200000.f
fltherm	float	Bilan du rayonnement de grandes longueurs d'onde	surface_net_upward_longwave_flux	W m-2	-10800000.f	10800000.f
hu2m	float	Humidite relative fraction a 2m.	relative_humidity		0.f	1.f
nebul	float	Nebulosite totale fraction	cloud_area_fraction		0.f	1.f
prige	float	Precipitations liquide a grande echelle	large_scale_precipitation_amount	kg m-2	0.f	64800000.f
pmer	float	Pression au niveau de la mer	air_pressure_at_sea_level	Pa	80000.f	120000.f
t2m	float	Temperature de l'air a 2m.	air_temperature	K	220.f	330.f
u10m	float	Composante U du vent horizontal a 10m.	eastward_wind	m s-1	-100.f	100.f
v10m	float	Composante V du vent horizontal a 10m.	northward_wind	m s-1	-100.f	100.f
ustress	float	Première composante tension sol intégrée	surface_downward_eastward_stress	Pa	-21600.f	21600.f
vstress	float	Deuxième composante tension sol intégrée	surface_downward_northward_stress	Pa	-21600.f	21600.f
Radar HF Vigicote						
hcdt	float	Direction de projection du courant	direction_of_sea_water_velocity	degree	0.f	360.f
hcsp	float	Vitesse du courant radial	sea_water_speed	m s-1	-100.f	100.f
hcdt_error	float	Precision de la mesure radiale	error_on_sea_water_speed	m s-1	-100.f	100.f
ewct	float	Composante U du courant	eastward_sea_water_velocity	m s-1	-100.f	100.f
nsct	float	Composante V du courant	northward_sea_water_velocity	m s-1	-100.f	100.f
ewct_error	float	Precision de la composante U du courant	error_on_eastward_sea_water_velocity	m s-1	-100.f	100.f
nsct_error	float	Precision de la composante V du courant	error_on_northward_sea_water_velocity	m s-1	-100.f	100.f

"Unitless" quantities such as fraction are left empty (units="").

4. Appendix

4.1. Appendix A: What's new in Netcdf OCO Straight Grid 1.3

- Manage an alternate sigma vertical coordinate (ocean s coordinate) through the use of dimension “level” and variable “level”.
- The variable could have the attributes “scale_factor” and “add_offset” for packing data.
- The use of one of the depth, height or level coordinate variables is no more mandatory.
- The value of the format_version global attribute is “1.3”.
- The value of the Conventions global attribute is “CF-1.5”.
- The value of the data_center global attribute is “IFREMER OCO DATA CENTER”.

4.2. Appendix B: What's new in Netcdf OCO Straight Grid 1.4

- Manage an alternate vertical dimension (layer) through the use of dimension “layer” and variable “layer”.
- The value of the format_version global attribute is “1.4”.

4.3. Appendix C: What's new in Netcdf OCO Oriented Grid 1.3

- Manage an alternate sigma vertical coordinate (ocean s coordinate) through the use of dimension “level” and variable “level”.
- The variable could have the attributes “scale_factor” and “add_offset” for packing data.
- The use of one of the depth, height or level coordinate variables is no more mandatory.
- The value of the format_version global attribute is “1.3”.
- The value of the Conventions global attribute is “CF-1.5”.
- The value of the data_center global attribute is “IFREMER OCO DATA CENTER”.
- Manage an alternate vertical dimension (layer) through the use of dimension “layer” and variable “layer”.

4.4. Appendix D: What's new in Netcdf Spectra file format 1D 1.1

New format definition for Netdf spectra files.

4.5. Appendix E: What's new in Netcdf Spectra file format 2D 1.1

New format definition for Netdf spectra files.

4.6. Appendix F: What's new in Netcdf OCO Oriented Grid 1.3.1

- Minor modifications.