Generic metadata guidelines on atmospheric and oceanographic datasets for the Envisat Calibration and Validation Project

Version 01R001 *pre-print*

April 23, 2002

Bojan R. Bojkov*, (SSAI) NASA-GSFC, USA
bojkov@ventus.gsfc.nasa.gov
Martine De Mazière, BIRA-IASB, Belgium
Martine.deMaziere@bira-iasb.oma.be
Rob M. Koopman, ESA-ESRIN, Italy
Rob.Koopman@esa.int

* formerly NILU, Kjeller, Norway,

Contents

Preface

This document contains the definitions of metadata and file structure that have been developed to optimise correlative dataset accessibility and portability for the validation of satellite-borne instruments for atmospheric and oceanographic research. These guidelines are generic and may be applied to any campaign aimed at validation of such satellite instruments or where data are to be exchanged.

The objective of this document is to define specific metadata guidelines for the Validation Campaign of the European Space Agency's Envisat earth observation mission, in particular for the validation of the AATSR, GOMOS, MERIS, MIPAS and SCIAMACHY sensors. For that reason, a number of more restrictive rules within the generic guidelines have been formulated for use by the Envisat Principal Investigators (PIs) Data Originators (DOs) and Data Submitters (DSs). These Envisat-specific guidelines, constraints and implementation-related issues are clearly highlighted in the text.

Generic metadata guidelines on atmospheric and oceanographic datasets for the Envisat Calibration and Validation Project

1 INTRODUCTION

The Envisat-1 satellite, launched on March 1, 2002, carries ten instruments, three of which are aimed at atmospheric research, MIPAS, GOMOS and SCIAMACHY, and two aimed at observing land surface and oceans, MERIS and AATSR (ESA, 2001a). For the geophysical validation, independent observations are performed by a large number of in-situ, remote sensing, and satellite instruments for comparison with the geophysical Envisat data products In order to make these correlative data available to all scientists and engineers involved in the Envisat calibration and validation campaign, these data will be stored centrally at NILU's Atmospheric Database for Interactive Retrieval (NADIR), a Norwegian atmospheric data centre successfully used for the GOME validation campaign and several large-scale European Stratospheric campaigns (EASOE, SESAME and THESEO/THESEO2000).

To enhance the usability of the diverse datasets collected for Envisat, a metadata standard, covering a broad range of instrument types and geophysical parameters has been established for the correlative data. In support of these data, a relational database index has been designed to store the metadata and to allow extensive quality assurance and quality control of the submitted files, while enabling easy data mining and retrieval of selected datasets (Bojkov *et al.*, 2001). This development was initiated in 1998 through the European Commission (EC) project COSE, Compilation of atmospheric Observations in support of Satellite measurements over Europe (De Mazière, 2001), and further developed in cooperation with ESA, NASA and the principal investigators of the Envisat validation campaign for the implementation of the Envisat Cal/Val database. The metadata definition presented here is so broad that it describes datasets from many different instruments observing the atmosphere and marine environments

These guidelines describe the metadata standard developed for the Envisat Cal/Val database at NADIR hosting the correlative data and numerical model output data acquired and generated for Envisat Calibration and Validation. The definitions have been carefully chosen to allow applicability to other validation campaigns. The few exceptions that are specific to Envisat validation are outlined in the text. This document has undergone significant changes since the second validation rehearsal, as many Principal Investigators provided feedback. In view of the general applicability to future campaigns, this is a living document, and modification should be expected to both data definitions, reporting routines and file formats.

2 CONCEPTS

The multidisciplinary exchange of data in a project like the Envisat calibration and validation depends heavily on *good* definitions for data. Freedom of choice would let different end-users describe identical dataset in very different terms, thus hindering their application to effective validation. To avoid this, we define a small set of entities (the structure of our data), and allowed values for each of these entities (the metadata). The central structural data-definitions are briefly discussed in the following paragraphs.

2.1 TERMINOLOGY

metadata Data about data. Parameters that describe, characterize and index the data.

parameter A physical or chemical entity that is measured or computed (often pertaining to data), or predefined (often pertaining to metadata).

dataset A set of one or more parameters reported in coincident time and space.

variable A data parameter to be reported in a dataset. Characterized by variable name, variable mode, and variable descriptor (see detailed descriptions later in this document).

variable name The primary variable identifier. The name of the physical quantity observed or estimated by the measurement or model calculation

variable mode The mode generally describes how the variable was measured.

variable descriptor The descriptor will shift the focus from the normal value of the variable to some other aspect, like its uncertainty, its minimum, a flag, etc.

data source An instrument or a model. Data from the source is normally quality controlled, calibrated and scaled before it is formatted into a data file and submitted to the data centre. Some instruments gather samples that must be analysed in a laboratory before results are reported. The sampler is then considered to be the source.

data location The position of the sampled or modelled site (this may be a mobile entity such as a plane or ship).

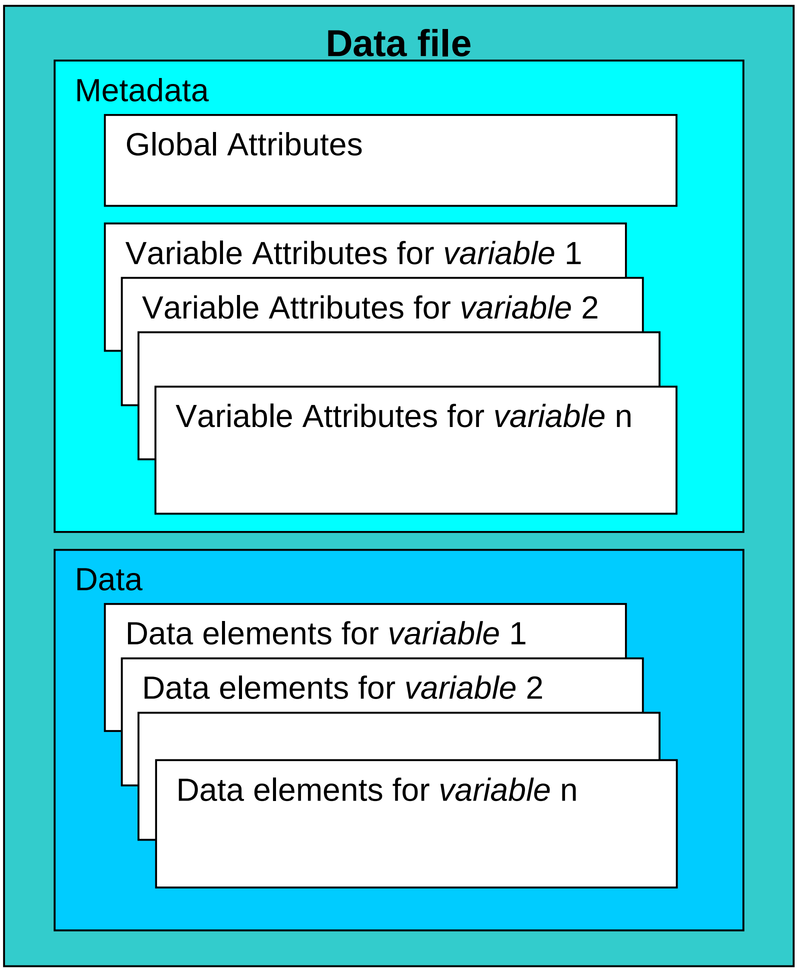
depend Parameters that are provided as a function of another parameter (for example temperature as a function of time) are considered dependent parameters. The parameter on which the parameter depends (time in the example) is an independent parameter. The number of independent parameters determines the dimensionality of the grid on which the dependent data are provided.

2.2 DATA STRUCTURE

Data and associated metadata are packed in files and transferred from data originators to the data centre. Sufficient metadata must be available in the header of each file (as specified in Sections 4 and 5). This is required both for proper indexing, and to make the data useful to the end user that retrieves the file. The user will expect to be able to use the data properly without searching for metadata in other sources.

Metadata parameters are divided into Global Attributes (pertaining to an entire dataset contained in one single file), and Variable Attributes (pertaining to one single variable within a dataset). A variable is a chemical component or physical parameter that is reported in a file (the main content of the file). Several variables are normally included in a dataset. The term parameter is in our context normally used for a metadata element (a piece of information about a variable or an entire dataset). The term field is often used for a subdivision of the content of a parameter (for example, a person name parameter consists of both family name and first name). In many cases, a field may be subdivided into sub fields with dot separators.

Figure 2: *Simplified view of the file data structure.*



For the purposes described here, a dataset normally consists of all data from one single instrument, auxiliary data (such as related meteorological data), and metadata that describe the data. The main data (measurements or calculations) are often referred to as primary data.

The auxiliary data are often referred to as secondary data. One particular class of auxiliary data are time and position information. These variables are often independent variables. The primary data and other secondary data parameters are normally dependent variables.

2.3 CONSIDERATIONS

In the context of effective data exchange and efficient data management various considerations must be given to the following:

1. The identification of the parameter is of great importance for application to validation. The description (consisting of **variable name**, **variable mode**, **variable descriptor**) should allow to identify parameters in various datasets with a similar physical basis. For that reason the **variable name** should contain a basic description in physical terms of the physical quantity estimated and of the geophysical or chemical target that is subject of the measurement, for example TEMPERATURE.AIR. The **variable mode** on the other hand, should emphasise those aspects of the measurement method that prevent simple direct comparison with other estimations: the measurement is an estimate of the underlying physical quantity, but when comparing estimations obtained with different methods, the differences in variable mode inform the user that differences between the results may actually be due to the estimation method. The third entry, the **variable descriptor**, can be used to construct a related variable that contains additional information (for example: error, uncertainty) on the original variable.

2. The **variable mode** or **variable descriptor** should not be used to distinguish measurement methods that are characterised by the use of specific but potentially different input values of a physical quantity. Typical examples are reference wavelength or pre-defined depths. Instead, these quantities should be provided as independent variables if several values are applicable to the measurements, or otherwise as constants. In practice this means that numeric values will generally not appear in the **variable mode** or **variable descriptor**.

3. A minimal set of time and position variables is mandatory: geolocation must be specified in terms of date, time (in the variable DATETIME), latitude, longitude and altitude or depth. If at all possible this geolocation must describe the effective location of the 'object' that is subject of measurement.

4. Pressure (PRESSURE) or geopotential height (ALTITUDE.GPH) is acceptable as alternative if altitude cannot be provided. If this is not possible, the geolocation of the instrument and relevant auxiliary parameters must be provided. In this case the geolocation is expressed as LATITUDE.INSTRUMENT, LONGITUDE.INSTRUMENT, ALTITUDE.INSTRUMENT

5. Data will be reported over several different time scales, such as daily, monthly or seasonal in length, depending on need. One dataset may be divided into several data files, as this facilitates its application to satellite data validation. Since satellite data files typically contain much less than one day of data, correlative data files should generally not contain more than one day of data.

6. There is always a possibility that someone can submit an erroneous dataset that appears to be legal in normal integrity checks. Some types of errors are difficult to detect even with

stringent quality control routines. For example, the height above ground for a dataset is specified as “2m” one year and as “2-metre” the next year, these could be indexed as two different datasets. Also misprints or careless renaming of methods or instruments may cause similar identification errors. Data originators must therefore use consistent wording in all free text fields.

7. The metadata guidelines may appear complex. However, the guidelines serve to reduce the complexity inherent in the data exchange problem. The majority of typical errors will be detected before the file is indexed and added to a file tree. This constitutes a major improvement in the management efficiency compared to a file tree that is not supported by such an index database. The resulting metadata index will facilitate both project management and scientific use of the collected data.

3 FORMATTING ISSUES

3.1 CHARACTER SET:

- All metadata entries should be given with characters contained in the US ASCII character set.
- No special national characters are allowed (Å, ñ, ô, ö, etc.).
- Underscore characters "_" are used to separate metadata elements from each other, and cannot be part of a metadata element.
- The period symbol "." is used to separate sub fields from each other inside a metadata element.
- Other special characters ?, #, !, &, %, etc.) should not occur, except in comment text strings.
- Hyphens and apostrophes may occur in names of people, locations or institutions. In other contexts such special characters are not allowed.

3.2 CAPITALISATION

- All metadata entries are generally all capitals.
- Variable names and measurement units are defined with specific capitalisation, and the input routines are case sensitive for such elements.
- File names are always set in lower case.
- Names of persons and addresses should be submitted with natural capitalisation.

3.3 NUMERIC TYPE:

The currently implemented numerical types are found in Table 3.3. These have been chosen carefully for compatibility in FORTRAN, C, IDL and HDF.

Table3.3: *Allowed numeric types implemented for the Envisat Cal/Val project.*

Numeric Type	Comment
REAL	*HDF: 32 bit floating point numbers (FORTRAN: *4real)*
DOUBLE	*HDF 64-bit floating point numbers (FORTRAN: *8real)*
INTEGER	*HDF: 16-bit signed integers (FORTRAN: *2integer)*
LONG	*HDF: 32-bit signed integers (FORTRAN: *4integer)*
STRING	*character string (Note that the maximum string length is software/tool dependent)*

3.4 FILL VALUE:

Data elements and metadata parameters cannot be left empty. A missing code (also called fill value) is normally used to fill an element when data is not available, but a measurement has been performed.

3.4.1 NUMERIC FILL VALUES

For numbers, the fill value is negative and consists of nines. In absolute value it must be 2 orders of magnitude larger than the absolute value of the real data. If the **VAR_DATA_TYPE** is of type floating point, then the fractional data of the fill value must be zeroes to the same number of digits as the measurement data.

ATTENTION

Special care must be given to the data format to prevent that the larger fill values exceed the number of positions reserved in the data format.

Example: *General*

Data is of the order **0.1** *the fill value must be:* **-99.0**

Data is of the order **10000** *the fill value must be:* **-9999999**

Example: *Exponentials*

Data is of the order **2.dddE-6** *the fill value is:* **-9.000E-4**

Data is of the order **2.ddE+6** *the fill value is:* **-9.00E+8**

3.4.2 STRING FILL VALUES

For string variables – the fill value is always “ZZZZZZZZZZ” (10”Z’s”).

Example: *Strings*

The datum is a string *the fill value is:* **ZZZZZZZZZZ**

3.5 DATE FORMATS

There are two date formats used in these guidelines: a numerical format (MJD2000) for data reporting and a string format (ISO 8106) used in the file name construction. The MJD2000 format is used for data records to facilitate calculations and plots.

For the Envisat project, conversion tools are available

3.5.1 MJD2000

The Modified Julian Date (MJD2000) used throughout this document is defined as follows:

```
MJD2000 is 0.000000 on January 1, 2000 at 00:00:00 UTC.
```

3.5.2 MJD2000 ALGORITHM

The general algorithm to calculate MJD2000 is as follows:

For a given YYYY, MM, DD, hh, mm, ss:

STEP 1: Calculate the Julian date:

```
IF ( MM GT 2 ) THEN
     y = DOUBLE(YYYY)
     m = DOUBLE(MM - 3)
     d = DOUBLE(DD)
ELSE BEGIN
     y = DOUBLE(YYYY - 1)
     m = DOUBLE(MM + 9)
     d = DOUBLE(DD)
ENDELSE

j =  INTEGER( 365.25*( y+4712.0 ) ) +
INTEGER( 30.6*m+0.5 )+ 59.0 + d - 0.5
```

Check for Julian or Gregorian calendar:

```
IF ( j LT 2299159.5D0 ) THEN; If Julian calendar.
    jd = j
ELSE                        ; If Gregorian calendar.
    gn = 38.0 - INTEGER( 3.0*INTEGER( 49.0+y/100.0 )/4.0
)
    jd = j + gn
ENDELSE
```

STEP 2: Calculate day fraction

```
df = ( hh*3600.0 + mm*60.0 + ss ) / 86400.0
```
… *for second resolution*

or

```
df = ( hh*3.6E+6 + mm*6.0E+4 + ss*1.0E+3 + ms ) / 8.64E+7
```
… *for milli-second resolution*

STEP 3: Calculate MJD2000

```
mjd2000 = jd + df – 2451544.5
```

Example: *for* 2002/04/20 at 11:29:23 UTC `mjd2000 = 840.478738`

ATTENTION

Special care must be given to the formatting of MJD2000 by reporting the appropriate number of significant figures to represent the actual time resolution.

3.5.3 DATETIME (ISO-8106)

The UTC DATETIME representation in ISO-8106 long format is (ISO, 1988):

`YYYYMMDDThhmmssZ`

where	`YYYY`	is the numeric year
	`MM`	is the numeric month
	`DD`	is the numeric day
	`hh`	is the numeric hour
	`mm`	is the numeric minute
	`ss`	is the numeric second
	`T`	is the *time* delimiter
	`Z`	represents the Universal Time (UTC).

ATTENTION

When appropriate, `MM`, `DD`, `hh`, `mm`, `ss` may require a leading zero.

For example `20010101T060501Z`.

4 GLOBAL ATTRIBUTES

To facilitate the understanding of the Global Attributes, three categories have been defined, namely **Originator Attributes** (Section 4.1), **Dataset Attributes** (Section 4.2) and **File Attributes** (Section 4.3). Each metadata parameter in these 3 groups is specified once for each data file. All these attributes (with some very few exceptions) need to be filled in.

Table 4: *Overview of required Global Attributes for the Envisat Cal/Val project. 'X' indicate entries and 'O' indicate optional entries.*

Originator Attributes	Section	Entry	Entry type	Req
PI_NAME	4.1.1	Family name; Given Name	2 semi-colon separated	X
PI_AFFILIATION	4.1.2	Affiliation name, Affiliation Acronym	2 semi-colon separated	X
PI_ADDRESS	4.1.3	Address; Postal code; Country name	3 semi-colon separated	X
PI_EMAIL	4.1.4	E-mail address	Single entry	X
DO_NAME	4.1.5	Family name; Given Name	2 semi-colon separated	X
DO_AFFILIATION	4.1.6	Affiliation name, Affiliation Acronym	2 semi-colon separated	X
DO_ADDRESS	4.1.7	Address; Postal code; Country name	3 semi-colon separated	X
DO_EMAIL	4.1.8	E-mail address	Single entry	X
DS_NAME	4.1.9	Family name; Given Name	2 semi-colon separated	X
DS_AFFILIATION	4.1.10	Affiliation name, Affiliation Acronym	2 semi-colon separated	X
DS_ADDRESS	4.1.11	Address; Postal code; Country name	3 semi-colon separated	X
DS_EMAIL	4.1.12	E-mail address	Single entry	X
Dataset Attributes	**Section**	**Entry**	**Entry type**	**Req**
DATA_DESCRIPTION	4.2.1	Data description	Single entry	X
DATA_DISCIPLINE	4.2.2	Field; Class; Subclass	3 semi-colon separated	X
DATA_GROUP	4.2.3	Type; Subtype	2 semi-colon separated	X
DATA_LOCATION	4.2.4	Location code name	Single entry	X
DATA_SOURCE	4.2.5	Concatenated:DATA_SOURCE Type + Institute acronym + 3-digit identifier	Concatenated entry	X
DATA_TYPE	4.2.6	Concatenated:Time scale code + Data level code	Single entry	X
DATA_VARIABLES	4.2.7	List of variables in the file	n semi-colon separated	X
DATA_START_DATE	4.2.8	MJD2000	Single entry	X
DATA_FILE_VERSION	4.2.9	3 digit integer	Single entry (ddd)	X
DATA_MODIFICATIONS	4.2.10	Description of the data modifications	Single entry	X
DATA_CAVEATS	4.2.11	Description of the data caveats	Single entry	O
DATA_RULES_OF_USE	4.2.12	Description of the data rules of use	Single entry	O
DATA_ACKNOWLEDGEMENT	4.2.13	Data acknowledgement	Single entry	O
File Attributes	**Section**	**Entry**	**Entry type**	**Req**
FILE_NAME	4.3.1	Concatenated and underscore separated	Concatenated entry	X
FILE_GENERATION_DATE	4.3.2	MJD2000	Single entry	X
FILE_ACCESS	4.3.3	File project association	Semi-colon separated	X
FILE_PROJECT_ID	4.3.4	Custom project identification related to 4.3.3	Single entry	X
FILE_ASSOCIATION	4.3.5	File "other" project association	Semi-colon separated	O
FILE_META_VERSION	4.3.6	Meta data version used	2 semi-colon separated (ddRddd; free format)	X

4.1 Originator Attributes

The Originator Attribute metadata entries describe the ownership of the data found in a given file as well as the guidelines for the use and/or publication of these data.

4.1.1 PI_NAME

The Global Attribute **PI_NAME** is the data's Principal Investigator's (PI) Name. The PI has the main scientific and/or institutional responsibility for the given data.

ATTENTION

If there is no instrument PI for the reported data in the file (as is the case for some operational satellite instruments) – then the Data Submitter (DS) must substitute the PI information with the instrument's affiliation coordinates and institute's information.

The PI of the Envisat AO proposal is derived from the FILE_PROJECT_ID (section 4.3.4), the metadata PI field holds the name of the actual instrument PI.

Type: STRING
Format: Family name; Given names
Entry: The entry consists of two fields separated by a semicolon.
Example: PI_NAME = Bojkov; Bojan R.

4.1.2 PI_AFFILIATION

The Global Attribute **PI_AFFILIATION** is the Principal Investigator's **official** affiliation name and affiliation acronym.

Type: STRING
Format: Affiliation name; Affiliation acronym
Entry: The entry consists of two fields separated by a semicolon.
Example: PI_AFFILIATION = Norwegian Institute for Air Research; NILU

Table 4.1.2: *Allowed affiliation names and affiliation acronyms of the agencies and institutes participating in the Envisat Cal/Val project.*

AFFILIATION NAME	AFFILIATION ACRONYM
ACRI	ACRI
Alfred-Wegener-Institut fuer Polar und Meeresforschung	AWI
Australian Institute of Marine Science	AIMS
Belgian Institute for Space Aeronomy	BIRA.IASB
British Antarctic Survey	BAS
Centre National d\'Etudes Spatiales	CNES

AFFILIATION NAME	AFFILIATION ACRONYM
Chalmers University of Technology	CTH
Commonwealth Scientific and Industrial Research Organisation	CSIRO
Danish Meteorological Institute	DMI
Department of Meteorology Stockholm University	MISU
Deutscher Wetterdienst	DWD
Deutsches Zentrum fuer Luft- und Raumfahrt	DLR
European Centre for Medium-Range Weather Forecasts	ECMWF
European Commission - Joint Research Centre	JRC
European Space Agency	ESA
Finnish Meteorological Institute	FMI
Forschungszentrum Juelich	FZJ
Forschungszentrum Karlsruhe	FZK
Fraunhofer-Institut fuer Atmosphaerische Umweltforschung	IFU
Free University of Berlin	FUB
GKSS Forschungszentrum Geesthacht	GKSS
Hadley Centre	HADCEN
Institut fuer Ostseeforschung	IOW
Institut National de la Recherche Agronomique	INRA
Institute for Environmental Studies - Vrije Universiteit - Amsterdam	IVM
Institute of Ocean Sciences	IOS
Instituto de Astrofisica de Andalucia	IAA
Instituto Nacional de Meteorologia	INM
Instituto Nacional de Tecnica Aerospacial	INTA
Istituto di Fisica dell Atmosfera del CNR	CNR.IFA
Istituto di Metodologie Avanzate di Analisi Ambientale del CNR	CNR.IMAAA
Istituto per la Ricerca sulle Onde Elettromagnetiche del CNR	CNR.IROE
Laboratoire de Meteorologie Dynamique du CNRS	CNRS.LMD
Laboratoire de Physique et Chimie de l\'Environnement du CNRS	CNRS.LPCE
Laboratoire de Physique et Chimie Marines du CNRS	CNRS.LPCM
Laboratoire de Physique Moleculaire et Applications du CNRS	CNRS.LPMA
Leibniz Institut fuer Atmosphaerenphysik	IAP
Management Unit of the North Sea Mathematical Models	MUMM
Meteorological Service of Canada	MSC
NASA\'s Goddard Space Flight Centre	NASA.GSFC
NASA\'s Jet Propulsion Laboratory	NASA.JPL
NASA\'s Jet Propulsion Laboratory - Table Mountain Facility	NASA.JPL.TMF
NASA\'s Langley Research Centre	NASA.LRC
National Center for Atmospheric Research	NCAR
National Institute of Public Health and the Environment	RIVM
National Institute of Water and Atmospheric Research	NIWA
National Oceanic and Atmospheric Administration	NOAA
National Physical Laboratory	NPL
National Taras Shevchenko University of Kyiv	KTSU
NOAA National Environmental Satellite Data and Information Service	NOAA.NESDIS
Norwegian Institute for Air Research	NILU
Norwegian Institute for Water Research	NIVA
Observatoire de Bordeaux (INSU/CNRS)	OBORDEAUX
Royal Meteorological Institute of Belgium	RMI
Royal Netherlands Meteorological Institute	KNMI
Russian Central Aerological Observatory	CAO
Rutherford Appleton Laboratory	RAL
Service Central d\'Exploitation Meteorologique	SCEM

AFFILIATION NAME	AFFILIATION ACRONYM
Service d\'Aeronomie du CNRS	CNRS.SA
Smithsonian Astrophysical Observatory	SAO
Stockholm University	SU
Swedish Environmental Research Institute	IVL
Swedish Institute of Space Physics	IRF
Swiss Federal Institute of Technology - Zurich	ETHZ
Swiss Meteorological Institute	SMI
United Kingdom Meteorological Office	UKMO
Universite de la Reunion Laboratoire de Physique de l\'Atmosphere	UREUNION.LPA
University of Bern	UBERN
University of Bonn	UBONN
University of Bremen	UBREMEN
University of Cambridge, Department of Chemistry	UCAMB.CHEM
University of Denver	DU
University of Heidelberg	UHEIDELBERG
University of l\'Aquila	UNIVAQ
University of Leicester	ULEICESTER
University of Liege	ULG
University of Miami	UMIAMI
University of Nagoya	UNAGOYA
University of Reading Data Assimilation Research Centre	UREADING.DARC
University of Reims	UREIMS
University of Sao Paulo	UNESP
University of Southampton	USOUTHAMPTON
University of Toronto	UT
University of Wales Aberystwyth	UWA
University of Wollongong	UOW

4.1.3 PI_ADDRESS

The Global Attribute **PI_ADDRESS** is the Principal Investigator's official mailing address. The country name must be the English entry in ISO 3166-1:1997 (ISO, 1997).

Type: STRING
Format: Address; Postal code; Country name
Entry: Three fields separated by semicolons
Example: PI_ADDRESS = P.O. Box 100; N-2027 Kjeller; Norway

4.1.4 PI_EMAIL

The Global Attribute **PI_EMAIL** is the Principal Investigator's e-mail address.

Type: STRING
Format: Free format
Entry: Single field
Example: PI_EMAIL = bojan.bojkov@nilu.no

4.1.5 DO_NAME

The Global Attribute **DO_NAME** is the Data Originator's (DO) Name. The DO may or may not be the same person as the PI. It is often important to distinguish the DO from the PI, since the person that has performed the measurements, computed and quality controlled the results, may know details of which the PI is not aware.

Type;	STRING
Format:	Family name; Given names
Entry:	The entry consists of two fields separated by a semicolon.
Example:	DO_NAME = Krognes; Terje

4.1.6 DO_AFFILIATION

The Global Attribute **DO_AFFILIATION** is the Data Originator's **official** affiliation (the DO_AFFILIATION may differ from the PI_AFFILIATION).

Type:	STRING
Format:	Affiliation name; Affiliation acronym
Entry:	The entry consists of two fields separated by a semicolon.
Example:	DO_AFFILIATION = Norwegian Institute for Air Research; NILU

4.1.7 DO_ADDRESS

The Global Attribute DO_ADDRESS is the Data Originator's mailing address (the DO_ADDRESS may differ from the PI_ADDRESS). The country name must be the English entry in ISO 3166-1:1997 (ISO, 1997).

Type:	STRING
Format:	Address; Postal code; Country name
Entry:	Three fields separated by semicolons
Example:	DO_ADDRESS = P.O. Box 100; N-2027 Kjeller; Norway

4.1.8 DO_EMAIL

The Global Attribute **DO_EMAIL** is the Data Originator's e-mail address (the DO_EMAIL may differ from the PI_EMAIL).

Type:	STRING
Format:	Free format
Entry:	Single field
Example:	DO_EMAIL = terje.krognes@nilu.no

4.1.9 DS_NAME

The Global Attribute **DS_NAME** is the Data Submitter's (DS) Name (the DS may or may not be the same person as the PI or the DO). Sometimes data are processed by and forwarded to the data centre by an additional person or institution. An institution that extracts a subset of the original dataset, may be named a Data Submitter.

For the Envisat Cal/Val project the Data Submitter must be a registered user of the database, either as Principal Investigator or as Co-Investigator.

Type; STRING
Format: Family name; Given names
Entry: The entry consists of two fields separated by a semicolon.
Example: DS_NAME = De Maziere; Martine

4.1.10 DS_AFFILIATION

The Global Attribute **DS_AFFILIATION** is the Data Submitter's **official** affiliation (he DS_AFFILIATION may differ from the PI_AFFILIATION and DO_AFFILIATION).

Type: STRING
Format: Affiliation name; Affiliation acronym
Entry: The entry consists of two fields separated by a semicolon.
Example: DS_AFFILIATION = Belgian Institute for Space Aeronomy; BIRA.IASB

4.1.11 DS_ADDRESS

The Global Attribute DS_ADDRESS is the Data Submitter's mailing address (the DS_ADDRESS may differ from the PI_ADDRESS and DO_ADDRESS). The country name must be the English entry in ISO 3166-1:1997 (ISO, 1997).

Type: STRING
Format: Address; Postal code; Country name
Entry: Three fields separated by semicolons
Example: DS_ADDRESS = Ringlaan 3; B-1180 Brussels; Belgium

4.1.12 DS_EMAIL

The Global Attribute **DS_EMAIL** is the Data Submitter's e-mail address (the DO_EMAIL may differ from the PI_EMAIL and the DO_EMAIL).

Type: STRING
Format: Free format
Entry: Single field
Example: DS_EMAIL = Martine.deMaziere@bira-iasb.oma.be

4.2 DATASET ATTRIBUTES

The global **Dataset Attributes** provide detailed description of the data contained in the given file. These attributes include the type and identity of the instrument or model, the discipline of the data, a list of the variables included in the file, etc.

4.2.1 DATA_DESCRIPTION

The Global Attribute **DATA_DESCRIPTION** is a brief sentence describing the data content.

Type: STRING
Format: Descriptive text, free format
Entry: Single field
Example: DATA_DESCRIPTION= Weekly NILU ozonesonde launch from Orland, Norway.

4.2.2 DATA_DISCIPLINE

The Global Attribute **DATA_DISCIPLINE** is a character string describing the field of research to which the data in the file belongs. The string refers to the research field and area of the data.

Type: STRING
Format: Field; Class; Subclass
Entry: 3 semicolon-separated fields
Example: DATA_DISCIPLINE = ATMOSPHERIC.CHEMISTRY; INSITU; BALLOON

Table 4.2.2a: *Allowed **DATA_DISCIPLINE Field** attribute entries. An entry consists of the combination of one of each Field, Class, and Subclass.*

DATA_DISCIPLINE (*Discipline Field*)	*Comment*
ATMOSPHERIC.CHEMISTRY	*Entire atmosphere, chemistry only*
ATMOSPHERIC.DYNAMICS	*Entire atmosphere, dynamics only*
ATMOSPHERIC.PHYSICS	*Entire atmosphere, chemistry & dynamics*
LAND.SURFACE.GEOPHYSICS	
LUNAR.PHYSICS	
OCEANOGRAPHIC.BIOLOGY	*Ocean, biology only*
OCEANOGRAPHIC.CHEMISTRY	*Ocean, chemistry only*
OCEANOGRAPHIC.DYNAMICS	*Ocean, dynamics only*
OCEANOGRAPHIC.PHYSICS	*Ocean, chemistry and dynamics*
SOLAR.PHYSICS	
STELLAR.PHYSICS	

Table 4.2.2b: *Allowed **DATA_DISCIPLINE Class** attribute entries. An entry consists of the combination of one of each Field, Class, and Subclass.*

DATA_DISCIPLINE (*Discipline Class*)	*Comment*
INSITU	
NUMERICAL.SIMULATION	
REMOTE.SENSING	
SAMPLE	

Table 4.2.2c: *Allowed* ***DATA_DISCIPLINE Subclass*** *attribute entries. An entry consists of the combination of one of each Field, Class, and Subclass.*

DATA_DISCIPLINE (*Discipline Subclass*)	***Comment***
AIRCRAFT	
ASSIMILATION	*data assimilation = combined use of model and experimental data*
BALLOON	
BUOY	
GROUNDBASED	
MODEL	
MOORING	
PLATFORM	*For marine use only*
ROCKET	
SATELLITE	*includes the space shuttle platform*
SHIP	

4.2.3 DATA_GROUP

The Global Attribute DATA_GROUP is a 2-fields entry, specifying (1) the origin of the data (experimental or model or a combination of both), and (2), the spatial characteristics of the data. The spatial characteristics include the dimensionality of the spatial grid of the dataset for a single data element, in addition to the information whether the ‘footprint’ of the spatial grid varies in space with time, i.e., over the successive data elements.

These concepts are best explained by considering the example of a travelling LIDAR system: At a given point in time, this LIDAR system provides measurements at a single latitude and longitude location but for multiple altitudes. With time, this 1-dimensional spatial grid (fixed latitude and longitude, vector of altitudes), is moving in latitude and longitude. The 2 field entry for this example thus becomes EXPERIMENTAL; PROFILE.MOVING.

NOTE

The dimensionality that is expressed in DATA_GROUP by SCALAR (0D), PROFILE (1D) and FIELD (2D or more) only refers to the spatial dimensionality.

Format: Type; Subtype
Entry: 2 semicolon-separated fields
Example 1: *A timeseries of column measurements from a ground-based instrument will have …*
DATA_GROUP = EXPERIMENTAL; SCALAR.STATIONARY.
Example 2: *A 3D model output on a fixed spatial grid will have …*
DATA_GROUP = MODEL; FIELD.STATIONARY.

__Table 4.2.3a__: Allowed __DATA_GROUP Type__ entries. An entry consists of a combination of a Type and Subtype.

DATA_GROUP (Group Type)	Comment
EXPERIMENTAL	*Measurements*
MIXED	*I.e. assimilation analyses*
MODEL	

__Table 4.2.3b:__ Allowed __DATA_GROUP Subtype__ entries. An entry consists of a combination of a Type and Subtype.

DATA_GROUP (Group Subtype)	Comment
SCALAR.MOVING	
SCALAR.STATIONARY	
PROFILE.MOVING	
PROFILE.STATIONARY	
FIELD.MOVING	
FIELD.STATIONARY	

4.2.4 DATA_LOCATION

The Global Attribute **DATA_LOCATION** is the code of the location, normally based on a fixed location (i.e. a station) or a moving platform name (i.e. a plane, a ship, a buoy, etc.), that the data originates from.

NOTE

Depending on specific campaign policy, the data location for a moving platform (ship or plane) may be named after the air strip (where the aircraft is based for the duration of the campaign) or the body of water that the ship is cruising through.

ATTENTION

If the name consists of two or more words, they are separated with periods (.), blanks (space characters) should not occur in the names.

Type: STRING
Format: Refer to Table DATA_LOCATION
Entry: Single field
Example: DATA_LOCATION = ORLAND

Table 4.2.4: *Allowed DATA_LOCATION entry for the Envisat Cal/Val.*

DATA_LOCATION (*Location*)	*Comment*	*Longitude*	*Latitude*	*Elevation*
ABERYSTWYTH		*-004.1*	*+052.4*	
ADEOS2				
ADRIATIC.SEA				
AIRE.SUR.L.ADOUR	*Aire sur l\'Adour*			
ALOMAR	*Alomar, Andøya*	*+016.0*	*+069.3*	*385*
ALPILLES				
AMBURLA.SITE1				
ANDENES	*Airport, Andøya*	*+016.2*	*+069.3*	*14*
ARHANGELSK		*+040.5*	*+068.6*	
AROSA		*+009.7*	*+046.8*	*1840*
ARRIVAL.HEIGHTS	*Arrival Heights*	*+166.7*	*-077.8*	*190*
ATLANTIC				
AUSTRALIAN.SEA				
BALTIC.SEA				
BAUCE				
BAURU		*-049.0*	*-022.4*	*300*
BERN		*+007.5*	*+047.0*	*550*
BILTHOVEN				
BLANES				
BRASIL				
BREMEN				
CARIBBEAN				
DE.BILT	*De Bilt*			
DESERT.ALGERIA.SITE1				
DESERT.ALGERIA.SITE2				
DESERT.ALGERIA.SITE3				
DESERT.ALGERIA.SITE4				
DESERT.ALGERIA.SITE5				
DESERT.ARABIA.SITE1				
DESERT.ARABIA.SITE2				
DESERT.ARABIA.SITE3				
DESERT.EGYPT.SITE1				
DESERT.LIBYA.SITE1				
DESERT.LIBYA.SITE2				
DESERT.LIBYA.SITE3				
DESERT.LIBYA.SITE4				
DESERT.MALI.SITE1				
DESERT.MAURITANIA.SITE1				
DESERT.MAURITANIA.SITE2				
DESERT.NIGER.SITE1				
DESERT.NIGER.SITE2				
DESERT.NIGER.SITE3				
DESERT.SUDAN.SITE1				
DUMONT.D.URVILLE	*Dumont d\'Urville*	*+140.0*	*-066.7*	*20*
DUNHUANG.SITE1				
DYFAMED	*Buoy*			
EKRAFANE				
ENGLISH.CHANNEL				

DATA_LOCATION (*Location*)	*Comment*	*Longitude*	*Latitude*	*Elevation*
EOS.AQUA	*EOS-AQUA Satellite*			
EOS.AURA	*EOS-AURA Satellite*			
EOS.TERRA	*EOS-TERRA Satellite*			
EP	*Earth Probe satellite*			
ERBS	*Earth Radiation Budget Satellite*			
ERS2	*ESA ERS-2 satellite*			
ESRANGE	*Radar Hill*	*+021.1*	*+067.9*	*485*
EUREKA		*-086.4*	*+080.1*	*610*
FALCON	*DLR Falcon Aircraft*			
FORLI				
FORT.SUMNER	*Fort Sumner*			
GAP				
GARDERMOEN				
GARMISCH	*Garmisch-Partenkirchen*			
GEOPHYSICA	*M-55*			
GERMAN.BIGHT				
GLOBAL	*Model or satellite global coverage only*			
GOTLAND				
GREENLAND.SITE1				
GSFC	*NASA-GSFC*			
HALLEY.BAY	*Halley Bay*	*-026.8*	*-075.6*	
HARESTUA		*+010.8*	*+060.2*	*580*
HAY.SITE1				
HOBART				
HOHENPEISSENBERG		*+011.0*	*+047.5*	*980*
INDIAN.OCEAN				
IRSP3	*Indian Satellite IRS-P3*			
IZANA		*-016.5*	*+028.3*	*2367*
JOKIOINEN				
JUNGFRAUJOCH	*International Scientific Station of the Jungfraujoch*	*+008.0*	*+046.6*	*3580*
KARLSRUHE				
KERGUELEN.ISLANDS	*Kerguelen Islands*	*+070.3*	*-049.4*	*10*
KIRUNA		*+020.4*	*+067.8*	*419*
KISLOVODSK		*+042.7*	*+043.7*	
KITT.PEAK		*-111.5*	*+032.0*	*2090*
L.AQUILA	*L\'Aquila*			
LA.REUNION	*Saint-Denis de La Reunion*	*+055.5*	*-020.9*	*10*
LAUDER		*+169.7*	*-045.1*	*370*
LEON				
LULEA	*Radiosonde*	*+022.1*	*+065.6*	
MACQUARIE.ISLAND	*Macquarie Island*	*+159.0*	*-054.8*	
MALEDIVES				
MARAMBIO				
MAUNA.LOA	*Mauna Loa*	*-155.6*	*+019.5*	*3397*
MEDITERRANEAN				
MERIDA				
METEOR.3M	*sattelite*			
METOP1	*sattelite*			

DATA_LOCATION (*Location*)	***Comment***	***Longitude***	***Latitude***	***Elevation***
MONKS.WOOD				
MORETON.BAY	*Moreton Bay*			
MOSCOW		*+037.6*	*+055.8*	
MURMANSK		*+033.1*	*+069.0*	
NEUMAYER	*Neumayer Station*	*+008.4*	*-070.6*	
NH	*Northern Hemisphere (model or satellite use only)*			
NH.HIGH.LATITUDE				
NH.LOW.LATITUDE				
NH.MID.LATITUDE				
NOAA14	*Satellite in NOAA TIROS-N program*			
NOAA16	*Satellite in NOAA TIROS-N program*			
NORTH.ATLANTIC				
NORTH.SEA				
NY.ALESUND	*Ny-Ålesund*	*+011.9*	*+078.9*	*15*
OBERPFAFFENHOFEN				
O.BORDEAUX	*Observatoire de Bordeaux*	*-000.5*	*+044.8*	*73*
ODIN	*sattelite*			
OHP	*Observatoire de Haute Provence*	*+005.7*	*+043.9*	*679*
OMSK		*+073.4*	*+054.9*	
ORLAND	*Ørland*			
OSLO				
PARACOU				
PARAMARIBO				
PAYERN		*+007.0*	*+046.8*	*491*
PECHORA		*+057.1*	*+065.1*	
PENCK	*Ship "Professor Albrecht Penck"*			
PERTH				
PERUGIA				
PLATEAU.DE.BURE	*Plateau de Bure*	*+005.9*	*+044.6*	*2550*
POTENZA		*+015.7*	*+040.6*	*820*
PUNTA.ARENAS	*Punta Arenas*			
ROME				
ROTHERA		*-068.1*	*-067.6*	
SALEKHARD		*+066.7*	*+066.5*	*419*
SCORESBYSUND		*-022.0*	*+070.5*	*10*
SH	*Southern Hemisphere (model or satellite use only)*			
SH.HIGH.LATITUDE				
SH.LOW.LATITUDE				
SH.MID.LATITUDE				
SIDERADOUGOU				
SODANKYLA	*Sodankÿla*	*+026.7*	*+067.4*	*100*
SONDRESTROMFJORD		*-050.7*	*+067.0*	*180*
SONORASITE1				
SOUTHAMPTON				

DATA_LOCATION (*Location*)	*Comment*	*Longitude*	*Latitude*	*Elevation*
SPOT4	*sattelite*			
TABLE.MOUNTAIN	*Table Mountain Facility*	*-117.7*	*+034.4*	*2300*
TARAWA		*+172.9*	*+001.4*	*0*
THANGOO.SITE1				
THULE		*-068.7*	*+076.5*	*30*
TINGATINGANA				
TOGO				
TORONTO		*-079.5*	*+043.8*	*150*
TOWNSVILLE				
TRAPANI				
TROMSO	*EISCAT*	*+019.2*	*+069.6*	
UARS	*UARS satellite*			
UCCLE				
VERNADSKY		*-064.3*	*-065.3*	
WMO?????	*TAO Buoy*			
WMO13008	*TAO Buoy*	*-038.0*	*+015.0*	
WMO13009	*TAO Buoy*	*-038.0*	*+008.0*	
WMO13010	*TAO Buoy*	*+000.0*	*+000.0*	
WMO13011	*TAO Buoy*	*-010.0*	*+002.0*	
WMO15001	*TAO Buoy*	*-010.0*	*-010.0*	
WMO15002	*TAO Buoy*	*-010.0*	*+000.0*	
WMO15003	*TAO Buoy*	*-010.0*	*-005.0*	
WMO15005	*TAO Buoy*	*-010.0*	*-002.0*	
WMO31001	*TAO Buoy*	*-035.0*	*+000.0*	
WMO31002	*TAO Buoy*	*-038.0*	*+004.0*	
WMO32303	*TAO Buoy*	*-095.0*	*+005.0*	
WMO32304	*TAO Buoy*	*-095.0*	*-005.0*	
WMO32305	*TAO Buoy*	*-095.0*	*-008.0*	
WMO32315	*TAO Buoy*	*-110.0*	*+005.0*	
WMO32316	*TAO Buoy*	*-110.0*	*+002.0*	
WMO32317	*TAO Buoy*	*-110.0*	*-002.0*	
WMO32318	*TAO Buoy*	*-110.0*	*-005.0*	
WMO32319	*TAO Buoy*	*-110.0*	*-008.0*	
WMO32320	*TAO Buoy*	*-095.0*	*+002.0*	
WMO32321	*TAO Buoy*	*-095.0*	*+000.0*	
WMO32322	*TAO Buoy*	*-095.0*	*-002.0*	
WMO32323	*TAO Buoy*	*-110.0*	*+000.0*	
WMO41026	*TAO Buoy*	*-038.0*	*+012.0*	
WMO43001	*TAO Buoy*	*-110.0*	*+008.0*	
WMO43301	*TAO Buoy*	*-095.0*	*+008.0*	
WMO46134	*TAO Buoy*			
WMO46146	*TAO Buoy*	*-123.7*	*+049.3*	
WMO51006	*TAO Buoy*	*-140.0*	*+009.0*	
WMO51007	*TAO Buoy*	*-140.0*	*+005.0*	
WMO51008	*TAO Buoy*	*-140.0*	*+002.0*	
WMO51009	*TAO Buoy*	*-140.0*	*-002.0*	
WMO51010	*TAO Buoy*	*-170.0*	*+000.0*	
WMO51011	*TAO Buoy*	*-125.0*	*+000.0*	
WMO51014	*TAO Buoy*	*-140.0*	*-005.0*	
WMO51015	*TAO Buoy*	*-125.0*	*+005.0*	

DATA_LOCATION (*Location*)	*Comment*	*Longitude*	*Latitude*	*Elevation*
WMO51016	*TAO Buoy*	*-125.0*	*+002.0*	
WMO51017	*TAO Buoy*	*-125.0*	*-002.0*	
WMO51018	*TAO Buoy*	*-125.0*	*-005.0*	
WMO51019	*TAO Buoy*	*-155.0*	*-005.0*	
WMO51020	*TAO Buoy*	*-155.0*	*+005.0*	
WMO51021	*TAO Buoy*	*-155.0*	*+002.0*	
WMO51022	*TAO Buoy*	*-155.0*	*-002.0*	
WMO51023	*TAO Buoy*	*-155.0*	*+000.0*	
WMO51301	*TAO Buoy*	*-155.0*	*+008.0*	
WMO51302	*TAO Buoy*	*-155.0*	*-008.0*	
WMO51303	*TAO Buoy*	*-170.0*	*+005.0*	
WMO51304	*TAO Buoy*	*-170.0*	*-005.0*	
WMO51305	*TAO Buoy*	*-170.0*	*+002.0*	
WMO51306	*TAO Buoy*	*-170.0*	*-002.0*	
WMO51307	*TAO Buoy*	*-125.0*	*+008.0*	
WMO51308	*TAO Buoy*	*-125.0*	*-008.0*	
WMO51309	*TAO Buoy*	*-170.0*	*+008.0*	
WMO51310	*TAO Buoy*	*-170.0*	*-008.0*	
WMO51311	*TAO Buoy*	*-140.0*	*+000.0*	
WMO52001	*TAO Buoy*	*+165.0*	*+002.0*	
WMO52002	*TAO Buoy*	*+165.0*	*-002.0*	
WMO52003	*TAO Buoy*	*+165.0*	*+005.0*	
WMO52004	*TAO Buoy*	*+165.0*	*-005.0*	
WMO52006	*TAO Buoy*	*+165.0*	*+008.0*	
WMO52007	*TAO Buoy*	*+165.0*	*-008.0*	
WMO52008	*TAO Buoy*	*+156.0*	*+005.0*	
WMO52010	*TAO Buoy*	*+156.0*	*-005.0*	
WMO52011	*TAO Buoy*	*+156.0*	*+002.0*	
WMO52012	*TAO Buoy*	*+156.0*	*-002.0*	
WMO52302	*TAO Buoy*	*+147.0*	*+005.0*	
WMO52307	*TAO Buoy*	*+137.0*	*+002.0*	
WMO52309	*TAO Buoy*	*-180.0*	*+005.0*	
WMO52310	*TAO Buoy*	*-180.0*	*+002.0*	
WMO52311	*TAO Buoy*	*-180.0*	*+000.0*	
WMO52312	*TAO Buoy*	*-180.0*	*-002.0*	
WMO52313	*TAO Buoy*	*-180.0*	*-005.0*	
WMO52315	*TAO Buoy*	*-180.0*	*+008.0*	
WMO52316	*TAO Buoy*	*-180.0*	*-008.0*	
WMO52317	*TAO Buoy*	*+156.0*	*+000.0*	
WMO52318	*TAO Buoy*	*+147.0*	*+000.0*	
WMO52319	*TAO Buoy*	*+156.0*	*+008.0*	
WMO52321	*TAO Buoy*	*+165.0*	*+000.0*	
WMO53001	*TAO Buoy*	*+116.0*	*+018.0*	
WMO53002	*TAO Buoy*	*+114.0*	*+013.0*	
WMO53003	*TAO Buoy*	*+115.0*	*+015.0*	
WOLLONGONG		*+150.9*	*-034.4*	*30*
YAKUTSK		*+129.6*	*+062.0*	
ZHIGANSK		*+123.4*	*+067.7*	*50*
ZUGSPITZE		*+011.2*	*+047.4*	*2964*
ZVENIGOROD		*+035.8*	*+055.7*	

4.2.5 DATA_SOURCE

The Global Attribute **DATA_SOURCE** consists of three elements. These are the type of instrument or numeric model that created the data (the type may consist of several dot-separated words), the organisation that owns the instrument/model (which may differ from the organisations of the PI, the DO and the DS), and a unique numeric identifier concatenated to the organisation acronym (refer to the Affiliation acronyms in **Table 4.1.2** above).

Each laboratory must assure that no two instruments of the same type have the same identifier, even if they are operated in different locations (a simple number is a sufficient identifier). For example, if NILU acquired a second SAOZ instrument, the entire attribute for NILU's second instrument would become: UVVIS.SAOZ_NILU002

This instrument identification system allows each laboratory to create a worldwide unique identifier for each instrument, without conflict with other laboratories. Any laboratory may operate several instruments of the same type at the same location without identification errors. The instruments may be re-used at different locations, while the instrument history remains traceable. The instruments may be brought to national or international inter-calibration experiments at some common location without naming conflicts. In this particular case, a name is required for each instrument, even if each laboratory has only one. Therefore the naming system must be enforced even for single instruments.

ATTENTION

Instrument names should in general not contain the parameters that it measures. Other metadata entries will ensure that this information is available to the data file users.

RECOMMENDATION

When an instrument is taken out of service, the identifier must not be reused for another instrument.

NOTE

A particular case exists for instruments that are used as "consumables" (for example weather sondes that are often lost after the balloon flight). In such cases a unique identifier may be useless. The identifier 000 is therefore reserved for the NON-UNIQUE case. A laboratory may re-use this particular identifier any number of times.

Type:	STRING
Format:	Type (from **Table 4.2.5**) and Institute acronym (from **Table 4.1.2**) **concatenated** with a unique 3-digit identifier (for example 001, 007 or 111)
Entry:	2 fields concatenated by an underscore

Example 1: DATA_SOURCE = FTIR_NILU001
Example 2: DATA_SOURCE = UVVIS.SAOZ_NILU002

Table 4.2.5: *Allowed entry for **DATA_SOURCE Type** in the COSE and Envisat Cal/Val projects.*

DATA_SOURCE (*Instrument Type*)	***Comment***
AATSR	*only to be used for non-measurement data like for example the averaging kernels that are derived from theoretical analysis*
AC9	
AIRMISR	
ALIS	
AMON	
AMSR	
AMSU	
ANAIS	
APEX	
ASUR	
ATMOINSPECTOR	
ATSR2	
AUTOCHEM	*Chemical data assimilation by UCAMB.CHEM*
AVHRR	
BB4	
BMP	*Biospherical Multiband Profiler for Subsurface Ed/Lu and R measurements*
BUOY.SST.DRIFTER	*Sea Surface temperature buoy, drifting*
BUOY.SST.FIXED	*Sea Surface temperature buoy, fixed position*
BUOY.TAO	*Tropical Atmosphere Ocean Buoy*
CAESR	
CASI	
CEILOMETER	
CH4TDL	
CHLOROPHYLL.FLUORESCENCE.PROFILER	*Chlorophyll Fluorescence Profiler*
CIMEL	
CTD	*CTD*
CYCLOMETER	
CYTOMETERS	
DESCARTES	
ECMWFMODEL.GOMOS	
ECMWFMODEL.MIPAS	
ECMWFMODEL.SCIAMACHY	
ECOC	
ELHYSA	
FAR.IR.INTERFEROMETER	*Far Infrared Interferometer*
FILTRATION	
FIRS2	
FISH	*Airborne alpha-Lyman Hygrometer (balloon)*
FLUORIMETER	
FOZAN	
FTIR	*Infrared Fourier Transform Spectrometer*
FTS	*Fourier Transform Spectrometer (UV + IR)*

DATA_SOURCE (*Instrument Type*)	*Comment*
GASCOD	
GOME	*ESA ERS-2 satellite instrument*
GOME2	
GOMOS	*only to be used for non-measurement data like for example the averaging kernels that are derived from theoretical analysis*
GPS	
HAGAR	
HALOE	
HALOX	
HIRDLS	
HPLC	
HUMIDITY.SENSOR	
HY2TH	*NILU ECMWF T106 Analysis extraction data on isentropic model levels*
HYDROSCAT	*Backscattering measurements*
HYGROMETER	
IRRADIANCE.SENSOR	
IRTDL	
ISAMS	*Improved Strat. And Mesos. Sounder aboard UARS*
ISAR	*Infrared Sea surface temperature Autonomous Radiometer*
IUE	
LABS	
LAI	
LICOR1800UW	*Spectroradiometer for Subsurface Ed and Eu Measurements*
LIDAR.BACKSCATTER	
LIDAR.DIAL	
LIDAR.OLEX	*Airborne LIDAR (DLR Falcon)*
LIDAR.RMR	*Rayleigh-Mie-Raman Lidar*
LPMA	*Balloon-borne experiment operated by LPMA*
MACSIMS	
MAERI	
MERIS	*only to be used for non-measurement data like for example the averaging kernels that are derived from theoretical analysis*
METEOSAT	
MICROWAVE.RADIOMETER	
MIPAS	*only to be used for non-measurement data like for example the averaging kernels that are derived from theoretical analysis*
MIPAS.B	*MIPAS on balloon*
MIPAS.STR	*MIPAS on ?*
MISR	
MLS	
MODIS	
MOPITT	*EOS-TERRA Satellite Instrument*
MOS	*Modular Optoelectronic Scanner (on IRS-P3)*
MSDOL	*ACRI model*
MSDOL.ATMOS	

DATA_SOURCE (*Instrument Type*)	***Comment***
MSDOL.GOMOS	
MSDOL.MIPAS	
MSDOL.SCIAMACHY	
MSDOL.SMR	
MSX	
MVIRI	
OMI	*Ozone satellite instrument*
OPC	
OPER	
OSIRIS	
OVID	
PARABOLA	
PHOTOMETER	
PHOTOMETER.CIMEL	
PHOTOMETER.PERKINELMER	
PHOTOMETER.SUN	
PLANKTONNET	
POAM3	
POLDER	
PSICAM	
PYGIOMETER	
PYRANOMETER	
RADAR	*Rain radar*
RADAR.PROFILER	*Windprofiler, MST radar*
RADIANCE.SENSOR.UPWELLING	
RADIOMETER.SATLANTIC	
RADIOMETER.TRIOS	
RAMSES	*Hyperspectral Profiler for Subsurface Ed/Lu and R measurements*
SABER	
SAFIREA	
SAGE2	
SAGE3	
SALOMON	
SAMPLE.GAS	
SAMPLE.LIQUID	
SATLANTICSENSOR	
SAW	
SBUV2	
SCIAMACHY	*only to be used for non-measurement data like for example the averaging kernels that are derived from theoretical analysis*
SDLA	*Tunable Diode Laser Spectrometer*
SEA.ATM.STATE	*placeholder for MAVT aux info*
SECCHIDISC	
SIMBAD	
SISTER	
SMR	
SMSR	*SeaWiFS Multichannel Surface Reference*
SOAP	
SODAR	*Windprofiler, sonar principle*
SOLSPEC	

DATA_SOURCE (*Instrument Type*)	*Comment*
SOLSTICE2	
SONDE.BACKSCATTER	
SONDE.O3	
SONDE.PTU	*ptu sonde (also drop sonde)*
SPAD	
SPECTROMETER	
SPECTROPHOTOMETER	
SPECTRORADIOMETER	
SPEXTUBE	
SPIRALE	
SPMR	*SeaWiFS Profiling Multichannel Radiometer*
SSBUV	
SSC	
SSM	
SUSIM	
TES	
TOMS	
TOVS	
TRIOS	*Radiance-Irradiance Spectrometer*
TRIPLE	
TYCHO	
UNIFIEDMODEL.GOMOS	*UK Met Office Unified Model*
UNIFIEDMODEL.MIPAS	*UK Met Office Unified Model*
UNIFIEDMODEL.SCIAMACHY	*UK Met Office Unified Model*
UVVIS	*UV-visible spectrometer*
UVVIS.AMAXDOAS	*Airborne DOAS, Cooperation between Universities of Bremen and Heidelberg*
UVVIS.BREWER	
UVVIS.DOAS	
UVVIS.DOBSON	
UVVIS.GUV	
UVVIS.NILUV	
UVVIS.OFFAXIS	
UVVIS.SAOZ	
VEGETATION	

4.2.6 DATA_TYPE

The Global Attribute **DATA_TYPE** specifies the data time resolution and the data product level. The identifiers are **concatenated into one field**.

The Envisat data products subject to validation are grouped into files. These files contain one entire orbit of data, or subsets of the data acquired during an orbit. To facilitate collocation, the correlative data should be grouped also in files not too different from the Envisat grouping. In continuation of earlier validation campaigns, correlative data are to be grouped in one file per day or subset of a day, although specific datasets may require different grouping of data (in particular correlative satellite and model datasets)."

Type: STRING, maximum 2 characters
Format: Time Scale Code + Data Level Code
Entry: Single concatenated entry
Example: DATA_TYPE = H2 … *is hourly level 2 data*

Table 4.2.6a: *Time Scale Codes to construct the DATA_TYPE attribute entry. The attribute entry is built by concatenating the Time Scale Code with a Data Level Code.*

DATA_TYPE (*Time Scale Code*)	*Comment*
D	*Daily*
H	*Hourly*
M	*Minutes*
S	*Seconds*
O	*Other*

Table 4.2.6b: *Data Level Codes to construct the DATA_TYPE attribute entry. The attribute entry is built by concatenating the Time Scale Code with a Data Level Code.*

DATA_TYPE (*Data Level Code*)	*Comment*
0	*Reformatted, time-ordered instrument data*
1	*Geolocated, radiometrically and/or spectrally calibrated instrument data*
2	*Extracted geolocated geophysical data*
3	*Added-value/derived geophysical data, typically gridded data*
4	*Assimilated geophysical data*

4.2.7 DATA_VARIABLES

The Global Attribute **DATA_VARIABLES** lists the variables, such as the chemical compounds or physical parameters, found in the current data file. This entry contains one field for each variable. Each field consists of the variable name, the variable mode and the variable descriptor (underscore separated). Only DATETIME, ALTITUDE, LATITUDE and LONGITUDE variables are always modeless. All other parameters always must have a mode. The descriptor is used only when required. The last part of the variable entry field is therefore optional. Some entries may be subdivided by dots where required (but only in the exact manner stated in the Table 4.2.7 a, b, or c below).

The variable **name** is a basic declaration of the measurable described in the dataset, i.e. the physical property of the measurement subject that is measured or computed by a model. The name includes the chemical or physical identification of the measurement subject. A typical example of a variable name is the concentration of ozone:

```
O3.CONCENTRATION
```

Stringent naming criteria apply to those **independent variables that specify geolocation**. Every datafile must contain a specification of geolocation in four dimensions. In addition to the DATETIME variable, latitude, longitude and a vertical geolocation parameter are mandatory.

- The vertical geolocation should be expressed as ALTITUDE or DEPTH.
- If ALTITUDE is not available, acceptable substitutes are PRESSURE and ALTITUDE.GPH (Geo-Potential Height).

The geolocation provided should specify the location where the measurement variables are sampled (when possible). Only in the event that this information cannot be provided is it acceptable to provide the instrument location with auxiliary information that allows to derive the location of the sampling. In this case the label ".INSTRUMENT" is to be appended to the geolocation parameters. For example:

`LATITUDE.INSTRUMENT; LONGITUDE.INSTRUMENT; ALTITUDE.INSTRUMENT.`

ATTENTION

The mode and the descriptor parts discussed below do not apply to the geolocation variables.

ACCEPTABLE COMBINATIONS OF MANDATORY DATA

1. **DATETIME; ALTITUDE; LATITUDE; LONGITUDE**
2. **DATETIME; ALTITUDE.GPH; LATITUDE; LONGITUDE**
3. **DATETIME; PRESSURE; LATITUDE; LONGITUDE**
4. **DATETIME; DEPTH; LATITUDE; LONGITUDE**
5. **DATETIME; ALTITUDE.INSTRUMENT; LATITUDE.INSTRUMENT; LONGITUDE.INSTRUMENT**
   (Please provide relevant auxiliary parameters)
6. **DATETIME; DEPTH.INSTRUMENT; LATITUDE.INSTRUMENT; LONGITUDE.INSTRUMENT**
   (Please provide relevant auxiliary parameters)

The **mode** is the context in which the entity is described **and is a mandatory entry**. The mode should contain the information on the measurement method that can lead to differences when comparing to other methods to observe the same quantity. Exceptions are those categories of differences that are already present elsewhere in the metadata, for example the REMOTE.SENSING data are already distinguished from SAMPLE or INSITU in the entry DATA_DISCIPLINE.. We may construct several examples compliant with tables 4.2.7a and 4.2.7b where we add typical modes to the ozone variable name:

```
O3.COLUMN_SLANT.SOLAR
O3.COLUMN_VERTICAL.SOLAR
```

Descriptors are needed only when a property is variable over the dataset. As an example, the descriptor DETECTIONLIMIT is used to construct a variable that contains the changing detection limits for a series of measurements. A constant detection limit (or any other static, descriptive information) should be specified in a comment (see sections VAR_DESCRIPTION and VAR_NOTES), and not as a descriptor variable. The descriptor is added only to construct auxiliary variables that describe some particular property of a primary variable (such as the last variable entry H2O_COLUMN_ERROR in the example below). We can create additional examples using the ozone + mode examples above:

```
O3.COLUMN_ SLANT.SOLAR_ UNCERTAINTY.STDEV
O3.COLUMN_ VERTICAL.SOLAR_UNCERTAINTY.STDEV
```

NOTE

The descriptor is not intended to distinguish subsets of a dataset. Such distinctions should be made by providing additional dependent or independent parameters, as outlined in the following examples.

1. ***The ozone column obtained by SAOZ measurements are traditionally distinguished in two subsets: measurements at dawn and measurements at dusk. The solar azimuth angle is the parameter is the relevant basis for distinction of these measurements and should be provided together with every measurement of the ozone column.***
2. ***Irradiance measurements are often performed at specific wavelengths. Wavelength should therefore be an independent parameter if values at more than one wavelength are reported***
3. ***Water samples are often performed at three depths with optical thickness parameter (DEPTH.SECCHI) 0, 0.5 and 1.0 respectively. Parameters retrieved from these samples and the optical thickness parameter should all be reported as functions of the independent parameter DEPTH.***

Variable names, modes, descriptors and units are case sensitive. Please observe the exact capitalisation given in the tables below.

ATTENTION

The combination of a variable name, mode and descriptor must be unique. If the exact combination you need is not yet listed in the table, please contact the authors of this metadata document to declare the combination and assign an appropriate default measurement unit.

Type:	STRING
Format:	Variable name_Variable mode_Variable descriptor
Entry:	Multiple semicolon separated fields (each field constructed according to the format above)
Example:	DATA_VARIABLES = DATETIME; LATITUDE; LONGITUDE; ALTITUDE; O3.CONCENTRATION_VERTICAL.SOLAR;

H2O.COLUMN_VERTICAL.SOLAR;
H2O.COLUMN_VERTICAL.SOLAR_ERROR

Table 4.2.7a: *Allowed DATA_VARIABLES (combinations of Variable Name, Variable Mode and Variable Descriptor).*

DATA_VARIABLES (*Variable Name*)	***Comment***
ABSORPTION.COEFFICIENT	
AEROSOL.BACKSCATTER.COEFFICIENT	*Aerosol/cloud backscatter coefficient*
AEROSOL.BACKSCATTER.RATIO	*Aerosol/cloud Backscatter Ratio*
AEROSOL.COLOUR.A188.RATIO	
AEROSOL.COLUMN	
AEROSOL.CONCENTRATION	*Aerosol/cloud*
AEROSOL.DEPOLARIZATION.RATIO	*Aerosol/cloud Depolarization Ratio*
AEROSOL.EPSILON	
AEROSOL.EXTINCTION.COEFFICIENT	*Aerosol/cloud Extinction Coefficient*
AEROSOL.EXTINCTION.RATIO	*Aerosol/cloud Extinction Ratio*
AEROSOL.LIDAR.RATIO	*Aerosol/cloud extinction coefficient over backscatter coefficient*
AEROSOL.OPTICAL.DEPTH	*Aerosol/cloud Optical Depth*
AEROSOL.OPTICAL.DEPTH	
AIR.CONCENTRATION	*Air density*
AIR.MASS.FACTOR	
ALBEDO	
ALTITUDE	*(Modeless)*
ALTITUDE.GPH	*Geopotential height*
ALTITUDE.INSTRUMENT	*Altitude of the instrument (Modeless)*
ALTITUDE.SURFACE	*Altitude of Lake Surface*
ANGLE	
ANGLE.ALA	*Average Leave Inclination Angle in degrees*
ANGLE.LUNAR	
ANGLE.SOLAR	
ANGLE.STELLAR	
ANGLE.VIEW	*View Angle, Line of Sight Angle*
ATMOSPHERIC.TRANSMISSION	
ATMOSPHERIC.TRANSMISSION	
B.PHASE.FUNCTION	
BACKSCATTERING.COEFFICIENT	
BAROMETRIC.PRESSURE	
BEAM.ATTENUATION.COEFFICIENT	
BPA	*Bleached particle absorption*
Br.COLUMN	
Br.CONCENTRATION	
Br2.COLUMN	
Br2.CONCENTRATION	
BrCl.COLUMN	
BrCl.CONCENTRATION	
BrO.COLUMN	
BrO.CONCENTRATION	
BrONO.COLUMN	

DATA_VARIABLES (*Variable Name*)	*Comment*
BrONO.CONCENTRATION	
BrONO2.COLUMN	
BrONO2.CONCENTRATION	
C2H2.COLUMN	
C2H2.CONCENTRATION	*Acetylene*
C2H6.COLUMN	
C2H6.CONCENTRATION	*Ethane*
CFC11.COLUMN	
CFC11.CONCENTRATION	*CFC11 == CFCl3*
CFC12.COLUMN	
CFC12.CONCENTRATION	*CFC12==CF2Cl2*
CH3.COLUMN	
CH3.CONCENTRATION	
CH3Br.COLUMN	
CH3Br.CONCENTRATION	
CH4.COLUMN	
CH4.COLUMN.AMF	*air-mass factor*
CH4.CONCENTRATION	*Methane*
CH4.CONCENTRATION.AMF	*air mass factor*
CH4.CONCENTRATION.AVK	*averaging kernel*
CHL.1.CONCENTRATION	
CHL.1.INDEX	*Algal pigment index valid in Case 1 waters*
CHL.2.CONCENTRATION	
CHL.2.INDEX	*Algal pigment index valid in Case 2 waters*
CHL.A.CONCENTRATION	*Chlorophyll*
CHL.A.INDEX	*Chlorophyll*
CHL.FLUORESCENCE	*Chlorophyll-Fluorescence*
Cl.COLUMN	
Cl.CONCENTRATION	*Chlorine*
Cl2.COLUMN	
Cl2.CONCENTRATION	
Cl2O2.COLUMN	
Cl2O2.CONCENTRATION	
ClO.COLUMN	
ClO.CONCENTRATION	*(Do not confuse the small l with a capital I)*
ClONO.COLUMN	
ClONO.CONCENTRATION	
ClONO2.COLUMN	
ClONO2.CONCENTRATION	
ClOO.COLUMN	
ClOO.CONCENTRATION	
CLOUD.BOTTOM.HEIGHT	*Cloud Bottom Height*
CLOUD.BOTTOM.PRESSURE	*Cloud Base Pressure*
CLOUD.CONDITION	*Text entries only*
CLOUD.COVER	*Cloud Cover*
CLOUD.DROPLET.EFFECTIVE.RADIUS	*Cloud droplet effective radius (ref)*
CLOUD.DROPLET.NUMBER.CONCENTRATION	*Cloud droplet number concentration*
CLOUD.LAYER.HEIGHT	
CLOUD.LAYER.THICKNESS	
CLOUD.LAYER.TRANSMISSION	

DATA_VARIABLES (*Variable Name*)	*Comment*
CLOUD.OPTICAL.THICKNESS	*Cloud Optical Thickness*
CLOUD.TOP.HEIGHT	*Cloud Top Height*
CLOUD.TOP.PRESSURE	*Cloud Top Pressure*
CLOUD.TYPE	*WMO codes*
CN.COLUMN	
CN.CONCENTRATION	
CO.COLUMN	
CO.COLUMN.AMF	*air-mass factor*
CO.CONCENTRATION	*Carbon monoxide*
CO.CONCENTRATION.AMF	*air mass factor*
CO.CONCENTRATION.AVK	*averaging kernel*
CO2.COLUMN	
CO2.CONCENTRATION	*Carbon dioxide*
COF2.COLUMN	
COF2.CONCENTRATION	
COLOUR.INDEX	*Colour index f550/f350 after molecular absorption correction*
COLOUR.RATIO	
CONDUCTIVITY	
DATETIME	*ENVISAT day in MJD2000, meaning that Jan. 1, 2000 at 00:00 hrs = DATETIME 0.00*
DAY.MISSION.ELAPSED	*Mission start (e.g., launch) = day 0.00*
DAY.OF.YEAR	*Day 1 is January 1st.at 24hrs.*
DEPTH	*Water depth*
DEPTH.KD	
DEPTH.SEA.FLOOR	*Depth of the Sea Floor*
DEPTH.SEA.OPT	*OPT depth of samples*
DEPTH.SECCHI	*Can be dependent or independent. As independent variable it has values 0, 0.5 and 1*
DISCOLOUR.CODE	*possible values according to MAVT definition*
DISTANCE	
EMISSIVITY	
FLAG.ABSOA.CONT	
FLAG.ABSOA.DUST	
FLAG.CASE2.ANOM	
FLAG.CASE2.S	
FLAG.CASE2.Y	
FLUORESCENCE	
FOAM	*Text entrie only, description of Foam and other Sea Surface Conditions*
H.COLUMN	
H.CONCENTRATION	
H2.COLUMN	
H2.CONCENTRATION	
H2CO.COLUMN	
H2CO.COLUMN.AMF	*air-mass factor*
H2CO.CONCENTRATION	*Formaldehyde*
H2CO.CONCENTRATION.AMF	*air mass factor*
H2CO.CONCENTRATION.AVK	*averaging kernel*
H2O.ABOVE.CLOUD	*Water vapour content above clouds*
H2O.COLUMN	

DATA_VARIABLES (*Variable Name*)	*Comment*
H2O.COLUMN.AMF	*air-mass factor*
H2O.CONCENTRATION	*Water Vapour*
H2O.CONCENTRATION.AMF	*air mass factor*
H2O.CONCENTRATION.AVK	*averaging kernel*
H2O.LIQUID.COLUMN	
H2O.LIQUID.CONCENTRATION	*Liquid Water Content*
H2O.LIQUID.PATH	*Liquid Water Path*
H2O2.COLUMN	
H2O2.CONCENTRATION	
HBr.COLUMN	
HBr.CONCENTRATION	
HCFC22.COLUMN	
HCFC22.CONCENTRATION	
HCHO.COLUMN	
HCHO.CONCENTRATION	
HCl.COLUMN	
HCl.CONCENTRATION	*(Do not confuse the small L with a capital I)*
HCN.COLUMN	
HCN.CONCENTRATION	*Hydrogen cyanide*
HCO.COLUMN	
HCO.CONCENTRATION	
HDO.COLUMN	
HDO.CONCENTRATION	
HEADING	*Compass heading*
HEAVE	
HF.COLUMN	
HF.CONCENTRATION	
HNO3.COLUMN	
HNO3.COLUMN.AMF	*air-mass factor*
HNO3.CONCENTRATION	
HNO3.CONCENTRATION.AMF	*air mass factor*
HNO3.CONCENTRATION.AVK	*averaging kernel*
HO2.COLUMN	
HO2.CONCENTRATION	
HO2NO2.COLUMN	
HO2NO2.CONCENTRATION	
HOBr.COLUMN	
HOBr.CONCENTRATION	
HOCl.COLUMN	
HOCl.CONCENTRATION	
HONO.COLUMN	
HONO.CONCENTRATION	
HUMIDITY	
HUMIDITY.RELATIVE	*Relative humidity*
IO.COLUMN	
IO.CONCENTRATION	
IRRADIANCE.DOWNWELLED	*Downwelling irradiance*
IRRADIANCE.DOWNWELLED	
IRRADIANCE.DOWNWELLED.SURFACE	
IRRADIANCE.SURFACE	*Surface irradiance*

DATA_VARIABLES (*Variable Name*)	*Comment*
IRRADIANCE.UPWELLED	*Upwelling irradiance*
IRRADIANCE.UPWELLED	
LAI	*Leaf Area Index, DIMENSIONLESS*
LATITUDE	*(Modeless), Latitude North*
LATITUDE.EQUIVALENT.PV	
LATITUDE.INSTRUMENT	*(Modeless), Latitude of the Instrument (North)*
LAYER	
LEVEL	
LONGITUDE	*(Modeless) Longitude East*
LONGITUDE.INSTRUMENT	*(Modeless) Longitude (East) of the Instrument*
MeO.COLUMN	
MeO.CONCENTRATION	
MeOCl.COLUMN	
MeOCl.CONCENTRATION	
MeOH.COLUMN	
MeOH.CONCENTRATION	
MeONO2.COLUMN	
MeONO2.CONCENTRATION	
MeOO.COLUMN	
MeOO.CONCENTRATION	
MeOOH.COLUMN	
MeOOH.CONCENTRATION	
N.COLUMN	
N.CONCENTRATION	
N2.COLUMN	
N2.CONCENTRATION	
N2O.COLUMN	
N2O.COLUMN.AMF	*air-mass factor*
N2O.CONCENTRATION	
N2O.CONCENTRATION.AMF	*air mass factor*
N2O.CONCENTRATION.AVK	*averaging kernel*
N2O5.COLUMN	
N2O5.CONCENTRATION	*dinitrogenpentoxide*
NCO.COLUMN	
NCO.CONCENTRATION	
NH3.COLUMN	
NH3.CONCENTRATION	
NLC.BOTTOM.HEIGHT	*Noctilucent Cloud (NLC)*
NLC.BOTTOM.PRESSURE	
NLC.LAYER.HEIGHT	
NLC.LAYER.THICKNESS	
NLC.LAYER.TRANSMISSION	
NLC.OPTICAL.THICKNESS	
NLC.TOP.HEIGHT	
NLC.TOP.PRESSURE	
NO.COLUMN	
NO.CONCENTRATION	
NO2.COLUMN	
NO2.COLUMN.AMF	*air-mass factor*
NO2.CONCENTRATION	*nitrogen dioxide*

DATA_VARIABLES (*Variable Name*)	*Comment*
NO2.CONCENTRATION.AMF	*air mass factor*
NO2.CONCENTRATION.AVK	*averaging kernel*
NO3.COLUMN	
NO3.COLUMN.AMF	*air-mass factor*
NO3.CONCENTRATION	
NO3.CONCENTRATION.AMF	*air mass factor*
NO3.CONCENTRATION.AVK	*averaging kernel*
O.1D.COLUMN	
O.1D.CONCENTRATION	
O.3P.COLUMN	
O.3P.CONCENTRATION	
O2.COLUMN	
O2.COLUMN.AMF	*air-mass factor*
O2.CONCENTRATION	
O2.CONCENTRATION.AMF	*air mass factor*
O2.CONCENTRATION.AVK	*averaging kernel*
O3.COLUMN	
O3.COLUMN.AMF	*air-mass factor*
O3.CONCENTRATION	*Ozone*
O3.CONCENTRATION.AMF	*air mass factor*
O3.CONCENTRATION.AVK	*averaging kernel*
O4.COLUMN	
O4.CONCENTRATION	
OClO.COLUMN	
OClO.COLUMN.AMF	*air-mass factor*
OClO.CONCENTRATION	*(Do not confuse the small L with a capital I)*
OClO.CONCENTRATION.AMF	*air mass factor*
OClO.CONCENTRATION.AVK	*averaging kernel*
OCS.COLUMN	
OCS.CONCENTRATION	*Carbonyl sulfide*
OH.COLUMN	
OH.CONCENTRATION	
OIO.COLUMN	
OIO.CONCENTRATION	
PAR	*Photosyntetically available radiation*
PATH.DIFFERENCE	
PHYTOPLANKTON.PIGMENTS	
PITCH	
PMC.BOTTOM.HEIGHT	*Polar Mesospheric Cloud (PMC)*
PMC.BOTTOM.PRESSURE	
PMC.LAYER.HEIGHT	
PMC.LAYER.THICKNESS	
PMC.LAYER.TRANSMISSION	
PMC.OPTICAL.THICKNESS	
PMC.TOP.HEIGHT	
PMC.TOP.PRESSURE	
PRESSURE	*Pressure*
PSC.BOTTOM.HEIGHT	*Polar Stratospheric Cloud (PSC)*
PSC.BOTTOM.PRESSURE	
PSC.LAYER.HEIGHT	

DATA_VARIABLES (*Variable Name*)	*Comment*
PSC.LAYER.THICKNESS	
PSC.LAYER.TRANSMISSION	
PSC.OPTICAL.THICKNESS	
PSC.TOP.HEIGHT	
PSC.TOP.PRESSURE	
RADIANCE.DOWNWELLED	*Downwelled radiance*
RADIANCE.DOWNWELLED.SKY	
RADIANCE.SQUARED	
RADIANCE.UPWELLED	*Upwelling radiance*
RADIANCE.UPWELLED	
RANGE	*distance for e.g. radar, not [min-max]*
REFLECTANCE	
REFLECTANCE.RHOW	
RELAZ	*Relative Azimuth Transmittance*
RHOW	*p\'w – water-leaving reflectance*
ROLL	
SALINITY	*Salinity*
SF6.COLUMN	
SF6.CONCENTRATION	
SIGNAL	
SIGNAL.NOISE.RATIO	*Signal to noise ratio*
SIGNIFICANT.WAVE.HEIGHT	
SKY.CODE	*possible values according to MAVT definition*
SKY.RADIANCE.DISTRIBUTION	
SM	*Suspended matter (marine use)*
SO2.COLUMN	
SO2.COLUMN.AMF	*air-mass factor*
SO2.CONCENTRATION	
SO2.CONCENTRATION.AMF	*air mass factor*
SO2.CONCENTRATION.AVK	*averaging kernel*
SPECTRAL.ABSORPTION.COEFFICIENT	*Spectral absorption coefficient*
SPECTRAL.BACKSCATTER.COEFFICIENT	*Spectral backscattering coefficient*
SPECTRAL.BEAM.ATTENUATION.COEFFICIENT	*Spectral beam attenuation coefficient*
SPEED	*Velocity*
SPM	*Suspended particulate matter (atmospheric use)*
SURFACE.CODE	*possible values according to MAVT definition*
SURFACE.CONDITION	*Text entries only*
SWELL.DIRECTION	
SWELL.HEIGHT	
TEMPERATURE	*Temperature*
TEMPERATURE.AIR	
TEMPERATURE.BRIGHTNESS	*Brightness Temperature*
TEMPERATURE.BUCKET	*Bucket Temperature (Ship use)*
TEMPERATURE.INTERNAL.BOX	
TEMPERATURE.INTERNAL.INSTRUMENT	
TEMPERATURE.LAND.SURFACE	
TEMPERATURE.SEA.SUBSURFACE	
TEMPERATURE.SEA.SURFACE	
TEMPERATURE.WATER	
THETA	*Potential Temperature*

DATA_VARIABLES (*Variable Name*)	*Comment*
TSM.CONCENTRATION	*Total suspended matter (combine with DRYW,B442)*
UV.INDEX	*UV Index*
VEGETATION.INDEX	
VISIBILITY	*WMO codes*
VMG	
WAVE.DIRECTION	
WAVE.HEIGHT	
WAVE.PERIOD	
WAVE.TYPE	
WAVELENGTH	
WAVENUMBER	
WIND.DIRECTION	*Wind direction*
WIND.SPEED	
YS	*Yellow substance absorption*
YSBPA	*Yellow substance and bleached particle absorption*

Table 4.2.7b: *DATA_VARIABLES Variable mode (not used for DATETIME, ALTITUDE, LATITUDE AND LONGITUDE).*

DATA_VARIABLES (*Variable Mode*)	*Comments*
A442	*optical method for determination of Chl.2.Index*
ABSORPTION	
ALONG.TRACK	
APRIORY	
ASSIMILATION	*Chemical data assimilation*
AZIMUTH	
B442	*optical method for determination of TSM*
BBC??	*Black Body Cavity, where ?? is 00 to 99*
BULK	*Use with TEMPERATURE to get Bulk Sea Surface temperature (SST)*
COLLOCATED	
DECLINATION	
DIFFSLANT	
DIFFSLANT.EMISSION	
DIFFSLANT.LIMB	
DIFFSLANT.LUNAR	
DIFFSLANT.SOLAR	
DIFFSLANT.STELLAR	
DRYW	*method for determination of TSM*
ELEVATION	
EMISSION	
INSITU	
HPLC	*method for determination of Chl.2.Index*
LIMB	
LUNAR	*with reference to the moon*
LUNAR.OCCULTATION	*With reference to the moon\'s occultation*
NADIR	

DATA_VARIABLES (*Variable Mode*)	*Comments*
OFFAXIS	*Off-axis*
PARALLEL	*Reference to parallel polarisation*
PERPENDICULAR	*Reference to perpendicular polarisation*
SAMPLE	
SKIN	*Use with TEMPERATURE to get Skin Sea Surface temperature (SST)*
SLANT	
SLANT.EMISSION	
SLANT.LIMB	
SLANT.LUNAR	
SLANT.SOLAR	
SLANT.STELLAR	
SOLAR	*With reference to the sun*
SOLAR.OCCULTATION	*With reference to the solar occultation*
SP	*spectrophotometic method for determination of Chl.2.Index*
STELLAR	*With reference to a star*
STELLAR.OCCULTATION	*With reference to a star occultation*
TILT	
TOA	*Top Of Atmosphere*
U	*velocity component*
UMKEHR	*Dobson/Brewer specific profiling technique*
V	*velocity component*
VERTICAL	
VERTICAL.EMISSION	
VERTICAL.LIMB	*vertical column retrieved from limb data*
VERTICAL.LUNAR	
VERTICAL.NADIR	
VERTICAL.SOLAR	
VERTICAL.STELLAR	
VERTICAL.ZENITH	
W	*velocity component*
X	
Y	
Z	
ZENITH	

Table 4.2.7c: *Variable descriptor (optional).*

DATA_VARIABLES (*Variable Descriptor*)	*Comment*
APPARENT	
ASTRONOMICAL	
BEGIN	
DETECTIONLIMIT	
DIFF.MODEL.OBS	*Difference Model - Observed*
DIFF.SAT.BUOY	*Difference Satellite - Observed by buoy*
DIFF.SAT.OBS	*Difference Satellite - Observed by other instrument*
END	
FLAG	
LIMIT	
MAX	*Maximum value of a set of variables*
MEAN	*Average*
MEASUREMENT.SPACING	*space between grid points (note the difference with resolution).*
MEDIAN	*Median*
MIN	*Minimum value of a set of variables*
REGISTRATION.ACCURACY	*use with e.g. ALTITUDE for absolute accuracy of altitude values*
RESOLUTION	*closest distance between points that can be distinguished.*
RESOLUTION.ALTITUDE	
RESOLUTION.TIME	
RESOLUTION.X	
RESOLUTION.Y	
SATURATION	
START	
STOP	
UNCERTAINTY.RANDOM	*Random uncertainty*
UNCERTAINTY.RELATIVE	*Relative uncertainty*
UNCERTAINTY.RMS	*Root mean square uncertainty*

4.2.8 DATA_START_DATE

The Global Attribute **DATA_START_DATE** specifies the earliest/first measurement date found in the current data file. The date/time format to be used is MJD2000 with fractional days. For resolution in seconds, MJD is to be reported with 6 digits behind the decimal point, for milliseconds 9 decimals should be used

ATTENTION

An appropriate number of digits after the decimal must be reported to properly represent the desired time resolution

Type: DOUBLE
Format: MJD2000 date time specification
Entry: Single field
Example: DATA_START_DATE = 800.348678

4.2.9 DATA_FILE_VERSION

The Global Attribute **DATA_FILE_VERSION** specifies the version of the file submitted to the database.

ATTENTION

DATA_VERSION begins with 001 (leading zeroes), each new version should by incremented by 1.

Type:	INTEGER
Format:	DDD with leading zeroes.
Entry:	Single field
Example:	DATA_FILE_VERSION = 003

4.2.10 DATA_MODIFICATIONS

The Global Attribute **DATA_MODIFICATIONS** describes the data modification history of **DATA_VERSION** found in the data file. Detail of the information is up to the discretion of the data originator.

Type:	STRING
Format:	Free format
Entry:	Single field
Example:	DATA_MODIFICATIONS = Version 002, uses the pump correction table of Komhyr (1986).

4.2.11 DATA_CAVEATS

The Global Attribute **DATA_CAVEATS** refers to potential caveats with the data in the current data file.

Type:	STRING
Format:	Free format
Entry:	Single field
Example:	DATA_CAVEATS = This is near real-time data, final revised data will be available within 3 months.

4.2.12 DATA_RULES_OF_USE

The Global Attribute **DATA_RULES_OF_USE** entry is the PI's (the data owner) guidelines for the data usage.

NOTE

This entry is usually guided through a specific project data protocol.

Type: STRING
Format: Free format
Entry: Single field
Example: DATA_RULES_OF_USE = Refer to Envisat Cal/Val data protocol, for more information contact nadirteam@nilu.no.

4.2.13 DATA_ACKNOWLEDGEMENT

The Global Attribute **DATA_ACKNOWLEDGEMENT** is the PI's 'desired' acknowledgement of the data when used in publications, presentations, etc.

Type: STRING
Format: Free format
Entry: Single field
Example: DATA_ACKNOWLEDGEMENT = We thank B. Bojkov (NILU) for providing us with the revised ozonesonde data from Orland.

4.3 FILE ATTRIBUTES

The global **File Attributes** provide detailed description of the data file. These attributes include the file name and generation date, the names of projects that have access to the file, and the version of the metadata used in the given file.

4.3.1 FILE_NAME

The Global Attribute **FILE_NAME** is the current data file name. The file should always have the same official name at the NADIR data centre as that used by the DO (to prevent errors when updating files). The name must therefore be generated by the PI, DO or DS according to the following rules:

ATTENTION

The file name is always set in lower case, even if the fields it contains are capitalised.

Type: STRING
Format: **FILE_NAME must be constructed using 6 underscore separated Global Attributes + the correct file extension:**

The **DATA_DISCIPLINE** subclass entry from Table 4.2.2c
The **DATA_SOURCE** entry from Section 4.2.5
The **DATA_LOCATION** entry from Table 4.2.4
The **DATA_TYPE** entry from Section 4.2.6
The **DATA_STARTDATE** entry from Section 4.2.8, **but converted to ISO format.**

The **DATA_VERSION** entry from Section 4.2.9
The **.hdf** file extension (referring in this case to the HDF file format).

Entry: Lower case, underscore separated + ".hdf"
Example: FILE_NAME = groundbased_uvvis.saoz_nilu002_issj_h2_19990301t110000z_001.hdf

… illustrating how a NILU instrument can operate at Jungfraujoch without creating identification problems in the metadata or the file naming.

4.3.2 FILE_GENERATION_DATE

The Global Attribute **FILE_GENERATION_DATE** is the date of generation of the current file and is to be reported in MJD2000.

Type: DOUBLE
Format: MJD2000 date/time specification
Entry: Single field
Example: FILE_GENERATION_DATE = 890.857575

4.3.3 FILE_ACCESS

The Global Attribute **FILE_ACCESS** is a multi-field character string referring to the file project association at the NADIR data centre. FILE_ACCESS is used to define the file's UNIX grouping and access rights on the database.

For the Envisat project, access rights are exclusively determined by the Envisat Validation Protocol.

Type: STRING
Format: project_1; project_2, project_3, …, project_n
Entry: Multiple fields separated by semicolons
Example: FILE_ACCESS = CALVAL; COSE; THESEO

Table 4.3.3: *Allowable project names and equivalent FILE_ACCESS currently active at NADIR data centre.*

FILE_ACCESS (Group Access Rights)	*Comment*
ARCHIVE	*Pseudo project with files removed from main data directory*
CALVAL	*ENVISAT Cal/Val Data Centre*
COSE	*COSE - Compilation of Atmospheric Observations in Support of Satellite Measurements over Europe*
PUBLIC	*Unrestricted access to the data*

4.3.4 *FILE_PROJECT_ID*

The Global Attribute **FILE_PROJECT_ID** is a multi-field string defining the custom projects that have access to the file. The Envisat Cal/Val project requires the AOID responsible for providing the file to be given here, other projects may leave this metadata entry blank.

For Envisat only one Envisat Cal/Val FILE_PROJECT_ID is allowed.

Type:	STRING
Format:	id_1; id_2; id_3; …; id_n
Entry:	Multiple fields separated by semicolons, but a single entry in the Envisat Cal/Val project
Example:	FILE_PROJECT_ID = AOID126

4.3.5 *FILE_ASSOCIATION*

The Global Attribute **FILE_ASSOCIATION** is a multi-field character string defining the file's other associations such as National Programs, special campaigns, or funding programs.

Type:	STRING
Format:	project_1; project_2; project_3; …; project_n
Entry:	Multiple fields separated by semicolons
Example:	FILE_ASSOCIATION = …

4.3.6 *FILE_META_VERSION*

The Global Attribute **FILE_META_VERSION** is a single field character string defining the version of the metadata definitions used in the given file and the name of the tool used to generate the file.

Type:	STRING
Format:	ddRddd; tool name (free format)
Entry:	Two fields
Example:	FILE_METAVERSION = 02R001; `ASC2HDF ver. 001R032`

5 VARIABLE ATTRIBUTES

Unlike the global attributes, the variable attributes refer specifically to one single variable. For each variable listed under DATA_VARIABLES in section 4.2.7, there must be one section containing the metadata parameters described under Sections 5.1 and 5.2 below.

Table 5: *Overview of the Variable Attributes.*
'X' indicate entries and 'O' indicate optional entries.

Variable Description Attributes	Section	Entry	Entry type	Req
VAR_NAME	5.1.1	Concatenated, underscore separated	Single entry	X
VAR_DESCRIPTION	5.1.2	Variable description	Single entry	X
VAR_NOTES	5.1.3	Variable notes/warnings	Single entry	O
VAR_DIMENSION	5.1.4	Number of dimensions that the dependent variables depend on	Single entry	X
VAR_SIZE	5.1.5	Number of nodes in each dimension	n semi-colon separated	X
VAR_DEPEND	5.1.6	List of variables that the dimensions depend on	n semi-colon separated	X
VAR_DATA_TYPE	5.1.7	Primary or Secondary (support variable)	Single entry	X
VAR_UNITS	5.1.8	Variable units	Single entry	X
VAR_SI_CONVERSION	5.1.9	Conversion factor; SI unit	3 semi-colon separated	X
VAR_VALID_MIN	5.1.10	Valid minimum or detection limit	Single entry	X
VAR_VALID_MAX	5.1.11	Valid maximum or saturation limit	Single entry	X
VAR_AVG_TYPE	5.1.12	Variable averaging technique used	Single entry	X
VAR_FILL_VALUE	5.1.13	See section description	Single entry	X
Variable Visualisation Attributes	**Section**	**Entry**	**Entry type**	**Req**
VIS_LABEL	5.2.1	Short string to facilitate the identification of the variable	Single entry	X
VIS_FORMAT	5.2.2	FORTRAN like format of the data	Single entry	X
VIS_PLOT_TYPE	5.2.3	Plot type to display the variable	Single entry	X
VIS_SCALE_TYPE	5.2.4	Plot scale type used to display the variable: scale type code; scale order code	2 semi-colon separated	X
VIS_SCALE_MIN	5.2.5	Scale display minimum	Single entry	X
VIS_SCALE_MAX	5.2.6	Scale display maximum	Single entry	X

5.1 VARIABLE DESCRIPTION ATTRIBUTES

5.1.1 VAR_NAME

The **VAR_NAME** must be identical to one of the entries in section 4.2.7: **DATA_VARIABLES**.

This entry consists of the variable identifier constructed using a variable name, the variable mode and the variable descriptor (not always relevant). See detailed description in section 4.2.7

Type: STRING
Format: Refer to section DATA_VARIABLES
Entry: Up to 3 fields concatenated with an underscore character
Example: VAR_NAME = O3.COLUMN_VERTICAL.SOLAR

5.1.2 VAR_DESCRIPTION

The Variable Attribute **VAR_DESCRIPTION** is a verbose description of the variable. This is a free format string that must be provided by the data originator to clearly identify the variable's meaning (preferably inline, or by reference to some easily available document), thus making the data file self-explanatory.

Type: STRING
Format: Free format
Entry: Single field
Example: VAR_DESCRIPTION = In-situ ozone partial pressure measured by ECC ozonesondes.

5.1.3 VAR_NOTES

The optional Variable Attribute **VAR_NOTES** is character string containing specific comments about the variable's data elements. Used by the data originator to convey any additional information pertinent to the variable.

Type: STRING
Format: Free format
Entry: Single
Example: VAR_NOTES = ...

5.1.4 VAR_DIMENSION

The Variable Attribute **VAR_DIMENSION** is the rank of the variable, defined as the number of independent dimensions required to identify one element of the data variable. If the dimension is given as 3, the VAR_SIZE (see Section 5.1.5) requires 3 elements.

Type: INTEGER between 1 and 8
Format: Integer
Entry: Single
Example: VAR_DIMENSION = 3

5.1.5 *VAR_SIZE*

The Variable Attribute **VAR_SIZE** is a semicolon separated character string containing the specific dimensionalities of the variable. In the following example, the dependent variable is reported for four independent dimensions (time, x, y, z) in a grid of 10*2*3*4 nodes. For a computed field, the VAR_SIZE specifies the number of nodes in the 4D time-space. For a set of measured data and for space coordinates that depend on the time, the VAR_SIZE is the number of data elements in the series. The total number of entries in VAR_SIZE must be equal to VAR_DIMENSION.

Type:	INTEGER(s)
Format:	Integer
Entry:	Semicolon separated, one number per dimension
Example:	VAR_SIZE= 10; 2; 3; 4

5.1.6 *VAR_DEPEND*

The Variable Attribute **VAR_DEPEND** is a list of semicolon-separated character strings that describes all independent variables on which the current variable depends. The number of independent variables listed must correspond to VAR_DIMENSION, and the order in which the variables are listed must correspond exactly to the order in which their sizes are given in VAR_SIZE.

ATTENTION

Independent variables must have: VAR_DEPEND = INDEPENDENT,
Constants must have: VAR_DEPEND = CONSTANT

Type:	STRING
Format:	Free format
Entry:	Semicolon separated, one name per dimension
Example:	VAR_DEPEND = DATETIME; LONGITUDE; LATITUDE; ALTITUDE

5.1.7 *VAR_DATA_TYPE*

The Variable Attribute **VAR_DATA_TYPE** specifies the type of the variable.

Type:	STRING
Options:	Refer to Table 5.1.7
Entry:	Single
Example:	VAR_DATA_TYPE = INTEGER

Table 5.1.7: *Variable type options.*

DATA_VARIABLE_TYPE	*Comment*
REAL	*16 bit floating point*
DOUBLE	*32 bit floating point*
INTEGER	*16bit integers*
LONG	*32 bit integers*
STRING	*character string*

5.1.8 VAR_UNITS

The Variable Attribute **VAR_UNITS** specifies the units in which the data elements are stored in the current data file. The prefix is optional (not needed when reporting in a base unit). While the prefix is concatenated with the unit, multiple units are separated by spaces. Powers of units (signed integer) are concatenated with the unit. No brackets are to be used.

ATTENTION

Units are case sensitive.

The list of accepted units for VAR_SI_CONVERSION has been slightly expanded with respect to SI.

NOTE

Project protocols/templates may restrict this to only one allowed unit and scale for each variable.

Type:	STRING	
Options:	Combination of Tables 5.1.8a and b	
Entry:	Case sensitive, single field	
Example 1:	VAR_UNITS = mPa …	*for milli Pascal*
Example 2:	VAR_UNITS = nm m-2	*for nanometre per square metre*

Table 5.1.8a: *Allowed SI prefix to be used in VAR_UNITS in conjunction with the* ***Units*** *in Table 5.1.8b.*

VAR_UNITS (*Base Unit Prefix*)	*Comment*
Y	*yotta*
Z	*zetta*
E	*exa*
P	*peta*
T	*tera*
G	*giga*
M	*mega*
k	*kilo*
h	*hecto*
da	*deka*
d	*deci*
c	*centi*
m	*milli*
u	*micro (u is used as a substitute for the greek letter \'mu\')*
n	*nano*
p	*pico*
f	*femto*
a	*atto*
z	*zepto*
y	*yocto*

Table 5.1.8b: *Allowed base units to be used in VAR_UNITS.*

VAR_UNITS (*Base Unit*)	*Comment*	VAR_SI_CONVERSION	Flag
%	*Percent or Relative Humidity*	0; 0.01; DIMENSIONLESS	
A	*ampere*		*base*
C	*coulomb*	0;1; s A	*base*
cd	*candela*		*base*
d	*day*	0; 86400; s	*base*
deg	*angular degree*	0; 1.74533E-2; rad	*base*
degC	*degree Celsius*	273.15 ; 1 ; K	
DIMENSIONLESS	*If dimensionless or no specific unit*	0;1;DIMENSIONLESS	*base*
DU	*dobson unit*	0; 2.69E16; molec cm-2	
g	*gram*		*base*
h	*hour*	0; 3600; s	*base*
Hz	*hertz*	0; 1; s-1	base
J	*joule*	0; 1; m2 kg s-2	*base*
K	*kelvin*		*base*
L	*liter*	0; 10-3; m3	*base*
lm	*lumen*	0; 1; cd sr	*base*
lx	*lux*	0; 1; cd sr m-2	*base*
m	*metre*		*base*
min	*minute*	0; 60; s	*base*
MJD2000	*Modified Julian Day 2000*	0; 86400; s	*base*
mol	*mole*		*base*
molec	*molecule*	0; 1; molec	*base*
N	*newton*	0; 1; m kg s-2	*base*
NONE	*Text entries only, otherwise use DIMENSIONLESS*	NONE	
Pa	*pascal*	0; 1; kg m-1 s-2	base
photons		0; 1; photons	*base*
ppbv	*parts per billion (volume)*	0; 10-9; ppv	
ppmv	*parts per million (volume)*	0; 10-6; ppv	
pptv	*parts per trillion (volume)*	0; 10-12; ppv	
ppv	*parts per volume*	0; 1; ppv	*base*
psu	*practical salinity unit*	??	*base*
rad	*radian*	0; 1; DIMENSIONLESS	base
s	*second*		*base*
sr	*steradian*	0; 1; DIMENSIONLESS	base
V	*volt*	0; 1; m2 kg s-3 A-1	*base*
W	*watt*	0; 1; m2 kg s-3	*base*

5.1.9 VAR_SI_CONVERSION

The Variable Attribute **VAR_SI_CONVERSION** is the conversion factor between the units used for the given data element and the corresponding SI unit. If the measurement unit is identical to the SI unit, the conversion factor is 1 and the constant offset is 0.

In VAR_SI_CONVERION, unit divisions should be factored out to have the shortest possible units string. This means that VAR_UNIT = nm m-2 shall have VAR_SI_CONVERSION = 0; 1.0E-9 m-1 This parameter is intended to facilitate calculations by automated tools, using different data files as input. For plot axis labelling, please refer to the VIS_LABEL metadata variables in section 5.2.1.

ATTENTION

For consistency in the prefixes in VAR_UNITS, kilogram (kg) has been replaced by the gram (g) for consistency with the prefixes in VAR_UNITS.

Type:	STRING	
Format:	Offset; Conversion factor; SI unit	
Entry:	Single field with 3 semi-colon separated entries	
Example:	VAR_SI_CONVERSION = 0; 1.0E-3; Pa	*for mPa*

5.1.10 VAR_VALID_MIN

The Variable Attribute **VAR_VALID_MIN** indicates the valid minimum or detection limit of the data element.

ATTENTION

The number must be specified in the appropriate VAR_UNITS reported in section 5.1.8.

Type:	REAL/DOUBLE/INTEGER/LONG
Format:	Number
Entry:	Single
Example:	VALID_MIN = 10.0

5.1.11 VAR_VALID_MAX

The Variable Attribute **VAR_VALID_MAX** indicates the valid maximum or saturation limit of the data element.

ATTENTION

The number must be specified in the appropriate VAR_UNITS reported in section 5.1.8.

Type:	REAL/DOUBLE/INTEGER/LONG
Format:	Number
Entry:	Single
Example:	VAR_VALID_MAX = 100

5.1.12 VAR_AVG_TYPE

The Variable Attribute **VAR_AVG_TYPE** is the averaging 'technique' used in generating the given data element.

Type: STRING
Format: Refer to Table 5.1.12
Entry: Single
Example: VAR_AVG_TYPE = STANDARD

Table 5.1.12: *VAR_AVG_TYPE Averaging techniques.*

VAR_AVG_TYPE (*Applied Averaging Method*)	***Comment***
ANGLE.COSINE	*Cosine of the average of the arc-cosines of the values*
ANGLE.DEGREES	*Direction average over 360 deg (i.e., average of 5 and 355 is 0 instead of 180)*
ANGLE.HOUR	*Direction average over local times (hours) (i.e., average of 2 and 22 is 0 instead of 12)*
ANGLE.RADIANS	*Direction average over 2 pi*
CLEAN	*Procedure for computing the mean after eliminating all data above or below a certain standard deviation*
DECIBEL	*10 times the logarithm of the average of the anti-logarithms of the (values/10)*
LOG	*Logarithm of the average of the anti-logarithms of the values*
NONE	*No averaging used*
RMS	*Square root of the average of the squares of the values*
STANDARD	*Simple arithmetic mean*

5.1.13 VAR_FILL_VALUE

The Variable Attribute **VAR_FILL_VALUE** is the number or string inserted if the element is known to be '*erroneous*' or missing. The VAR_FILL_VALUE may be different for each variable in a file, but must be constant for all occurrences within a given variable. For variables with numeric **VAR_DATA_TYPE** the **VAR_FILL_VALUE** is negative and consists of nines**.** In absolute value it must be 2 orders of magnitude larger than the largest absolute value in the real data. If the **VAR_DATA_TYPE** is of type floating point, then the fractional data of the fill value must be zeroes to the same number of digits as the measurement data. For string variables the VAR_FILL_VALUE is "ZZZZZZZZZZ" (i.e.10 times a "Z").

ATTENTION

Consideration must be given to the actual format of the VAR_FILL_VALUE to avoid erroneous formatting in section 5.2.2

Type: REAL/DOUBLE/INTEGER/LONG/STRING
Format: Fixed entry
Entry: Single field
Example1: *for a dataset range* [-82.5428 : 4.2396]…
… *the* `VAR_FILL_VALUE = -9999.0000`
Example2: *for a dataset range* [-1.4E-1 : 2.6E1]…
… *the* `VAR_FILL VALUE = -9.0E3`

5.2 VARIABLE VISUALISATION ATTRIBUTES

The following metadata entries are defined to facilitate the visualisation of the data content in tables or figures.

5.2.1 VIS_LABEL

The Variable Attribute **VIS_LABEL** is a short (and concise) character string containing the variable name and unit used to label an axis or a table column.

ATTENTION

The unit must correspond to the appropriate VAR_UNITS reported in section 5.1.8.

Type: STRING
Format: Free format text
Entry: Single field
Example: VIS_LABEL = O3 (ppm)

5.2.2 VIS_FORMAT

The Variable Attribute **VIS_FORMAT** defines the output format of the data elements to the screen and/or to tables. The values must be chosen to ensure that the specification does not result in truncation of fill values (please refer to VAR_FILL_VALUE in section 5.1.13).

Type: STRING
Format: FORTRAN-*like* format (refer to Table 5.2.2).
Entry: Single field
Example: VIS_FORMAT = F8.3

Table 5.2.2: *Allowed FORTRAN like format types for VIS_FORMAT.*

VIS_FORMAT (*Format Type Code*)	*Comment*
A*d*	*Strings (STRING)*
F*d.d*	*Floating point (REAL/DOUBLE)*
E*d.d*	*Exponentials (REAL/DOUBLE/INTEGER/LONG)*
I*d*	*Integer (INTEGER/LONG)*
I*d.d*	*Integer with leading zeroes (INTEGER/LONG)*

5.2.3 VIS_PLOT_TYPE

The Variable Attribute **VIS_PLOT_TYPE** defines the type of graph to be displayed when plotting the given variable.

Type: STRING
Format: Refer to Table 5.2.3
Entry: Single
Example: VIS_PLOT_TYPE = TIMESERIES

Table 5.2.3: Available plot types for VIS_PLOT_TYPE.

VIS_PLOT_TYPE (*Plot Type Code*)	*Comment*
XY	*2D*
XY.PROFILE	*profile*
XY.TIMESERIES	*timeseries*
XYZ	*3D*
XYZ.COLOUR	
XYZ.CONTOUR	
FALSE	*None*

5.2.4 VIS_SCALE_TYPE

The Variable Attribute **VIS_SCALE_TYPE** indicates the default scale type when plotting the data element.

Type: STRING
Options: Scale type code; scale order code (refer to Tables 5.2.4a and b)
Entry: 2 semicolon separated fields
Example 1: VIS_SCALE_TYPE = LOG; INCREASE

Example 2: VIS-SCALE_TYPE = FALSE; FALSE *if no suitable scale is available*

Table5.2.4a: *Available scale type code options for plotting.*

VIS_SCALE_TYPE (*Scale Type Code*)	*Comment*
LINEAR	*Linear*
LOG	*Logarithm*
FALSE	

Table5.2.4b: *Available scale order code options for plotting.*

VIS_SCALE_TYPE (*Scale Order Code*)	*Scale Order*
INCREASE	*Ascending order*
DECREASE	*Descending order*
FALSE	

5.2.5 VIS_SCALE_MIN

The Variable Attribute **VIS_SCALE_MIN** indicates the default scale minimum when plotting the data element. The number must be specified in the appropriate VAR_UNITS.

Type: REAL/DOUBLE/INTEGER/LONG
Format: *Number*
Entry: Single field
Example: VIS_SCALE_MIN = 0

5.2.6 VIS_SCALE_MAX

The Variable Attribute **VIS_SCALE_MAX** indicates the default scale maximum when plotting the data element. The number must be specified in the appropriate VAR_UNITS.

Type: REAL/DOUBLE/INTEGER/LONG
Format: *Number*
Entry: Single field
Example: VIS_SCALE_MAX = 100

6 ACKNOWLEDGEMENTS

Acknowledgements go to Mr. Bart Quaghebeur and Dr. Daniel Heynderickx (BIRA-IASB) for demonstrating the usefulness of a modern data format; to Ms. Françoise Pinsard and Dr. Phillippe Keckut of CNRS/SA, Dr. K.-H. Fricke of the Bonn University, Drs. H. Siegel and T. Ohde of the Institut fur Ostseeforschung Warnemunde, and Mr. T. Krognes of NILU for their patience and valuable contributions to these guidelines.

The community participating in the first and second Envisat Cal/Val rehearsals has provided very valuable feedback on a multitude of technical and scientific matters, without which this document could not have been completed..

Funding has been provided by EC COSE (ENV4-CT98-0750.), the ESA Envisat Cal/Val database project (ESTEC Contract 14419/00/NL/SF) and by the NASA contract NAS5-01008.

7 REFERENCES

Bojkov, B.R., Koopman, R.M. and De Mazière, M, "The Envisat Cal/Val Data Centre", presented at the *NDSC 2001 Symposium – Celebrating 10 years of atmospheric research.* September 24-27, 2001, Arcachon, France.

De Mazière, M., "Final Report of the EC-COSE Project (contract ENV4-CT98-0750)", BIRA-IASB, Brussels, Belgium, (2001).

ESA, "Envisat - Caring for the Earth", European Space Agency, Paris, France, (2001a).

ESA, *European Space Agency - Envisat Calibration and Validation Plan home page:* http://envisat.esa.int/support-docs/index.html#calval

ESA, "Second Envisat Rehearsal Campaign Guidelines – Version 1.1", European Space Agency, Noordwijk, The Netherlands, (2001b).

ISO, "Representation of Dates and Ti`mes", ISO 8106:1988, International Organization for Standardization (ISO), Geneva, Switzerland, (1988).

ISO, "Codes for the representation of names of countries and their subdivisions -- Part 1: Country codes", ISO 3166-1:1997, International Organization for Standardization (ISO), Geneva, Switzerland, (1997).

NCSA, National Center for Supercomputing Applications – *HDF 4 home page*: http://hdf.ncsa.uiuc.edu/hdf4.html

Page intentionally left blank