EUMETSAT Data Centre Archive netCDF Formats

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Document Change Record

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1.0	9 December 2008		1st Version Beta.
2.0	30 September 2009		Updates to finalise version 1.0 of the EUMETSAT Data Centre Archive netCDF formats. Addition of MSGCLMK netCDF format.
4	7 Dec 2009		Minor editorial updates resulting from the ORR.
4A	24 Jan 2017		updates to reflect the upgrade to netCDF4
4B	10 Nov. 2020		Update to reflect the current state of the netCDF formats available from the Data Centre.

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1 INTRODUCTION

1.1 Purpose and Scope

The purpose of this document is to present the netCDF formats offered as a delivery formats for many of the products stored in the EUMETSAT Data Centre Archive.

1.2 Document Structure

Section 1	Introduction
Section 2	Overview
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Section 4	Tools

1.3 Reference Documents

[1] netCDF Climate and Forecast Metadata Conventions version 1.3. 7 Nov, 2008.
[2] WMO Publication No. 386 (Manual on the Global Telecommunication System), pp A.II-15/31 to 36.
[3] OGC 06-122 Draft CF-netCDF Candidate Standard

2 OVERVIEW

This section provides an overview of the netCDF format, reasons for introducing netCDF as a delivery format in the EUMETSAT Data Centre Archive, the version and conventions used, and the current set of Archive data sets orderable in netCDF.

2.1 Introduction to netCDF

netCDF (Network Common Data Form) is a set of software libraries and self-describing, machine-independent data formats that support the creation, access, and sharing of array-oriented scientific data[1]. Access to the data encapsulated within the format (stored as arrays) is done though Application Programming Interfaces (APIs) defined in various computer languages[2]. Using these APIs means data can be access without the need to understand the underlying structure of the data. Other advantages of netCDF are:

- *Self-Describing*. A netCDF file includes information about the data it contains.
- *Portable*. A netCDF file can be accessed by computers with different ways of storing integers, characters, and floating-point numbers.
- *Direct-access*. A small subset of a large dataset may be accessed efficiently, without first reading through all the preceding data.
- *Appendable*. Data may be appended to a properly structured netCDF file without copying the dataset or redefining its structure.
- *Sharable*. One writer and multiple readers may simultaneously access the same netCDF file.
- *Archivable*. Access to all earlier forms of netCDF data will be supported by current and future versions of the software.

NetCDF format provides APIs to create meta data information within its contents. Various user groups and organisations have proposed meta data conventions for the netCDF format to promote its use for data exchange as users and applications can relay on these conventions to work with and operate.

Many international organisations have adopted the netCDF format as a standard way to represent their scientific data; NOAA, NASA, ECMWF, EUMETSAT (Jason), etc.

netCDF is developed and maintained by Unidata. Unidata is funded primarily by the National Science Foundation, is part of the University Corporation for Atmospheric Research (UCAR) Office of Programs (UOP). For 20 years, this organisation has been vested in the

[1] Completely free format means that no need to define bits/bytes offsets for locations of data. Data is stored in arrays access by software APIs.
[2] API are available in C/C++, Fortan, Java, Perl etc. See http://www.unidata.ucar.edu/software/netCDF/ for more details.

common goal of sharing atmospheric and climate data, and tools to access and visualising this data.

The netCDF format is flexible and offers many different possibilities of presenting the same data products. Several standards exist with the goal of standardising the representation of data products in netCDF. The most widely adopted and general-purpose of these is set forth in the CF Conventions. The most current version of these Conventions is found at http://cfconventions.org/. The CF Conventions are adopted by the Open Geospatial Consortium (OGC 10-091r3, http://portal.opengeospatial.org/files/?artifact_id=43733) and ongoing work in the WMO INFCOM ET-Data is being pursued with the aim of anchoring the use of CF-netCDF in WMO systems.

2.2 Introducing netCDF as a EUMETSAT Data Centre Archive Delivery Format

The EUMETSAT Data Centre Archive receives and permanently stores images and meteorological products (collectively referred to as Archive data sets) from EUMETSAT satellites 24 hours a day, for every day of the year. It provides a comprehensive data retrieval service for the Archive data sets in full, sub-sampled, sub-area form, and in a variety of formats.

To facilitate co-operation with EUMETSAT's international partners, the introduction of the netCDF format as an orderable Archive delivery format is necessary to utilise the advantages the format offers as well as come to a common format that is recognisable and used in the international community.

In addition to this, various freeware tools are available to query, extract and visualise data defined in this format.

2.2.1 EUMETSAT Data Centre Archive netCDF Version

The Data Centre offers netCDF 4 as a delivery format for many of its products stored in its Archive. netCDF 4 offers new format types, complex data structures, data compression, no file size restrictions and data access performance enhancements such as chunking. Please consult the Unidata website[3] for more information.

2.2.2 EUMETSAT Data Centre Archive netCDF Conventions

While netCDF is intended for "self-documenting data", it is necessary for data writers and readers to agree upon attribute conventions and representations for discipline-specific data structures. Unidata recommends several netCDF conventions[4] and the one adopted by the EUMETSAT Data Centre Archive is the conventions for Climate and Forecast[5] (CF [1]).

The CF conventions are increasingly gaining acceptance and have been adopted by a number projects and organisations as the primary standard for netCDF meta-data definition. The

[3] Documentation for netCDF can be found here: https://www.unidata.ucar.edu/software/netcdf/docs/.
[4] Unidata recommended netCDF conventions: http://www.unidata.ucar.edu/software/netCDF/conventions.html.
[5] CF conventions can be found at https://cfconventions.org/.

conventions define metadata that provide a definitive description of what the data in each variable represents, and the spatial and temporal properties of the data. This enables users of data from different sources to decide which quantities are comparable, and facilitates building applications with powerful extraction, re-gridding, and display capabilities. It is also the convention recommended by Unidata for meta-data stored in the netCDF format.
The Data Centre's netCDF data sets delivered to the users follows the CF conventions as closely as possible. CF standard names and units are used as meta-data in the products if available. Otherwise they are defined according to the expectation of the target user community for the products.

In addition to meta-data conventions, all Archive netCDF filenames defined for Archive data sets shall adopt the WMO filename convention[6] [2]. This convention provides the important file attributes in the filename without the need to open the file.

2.2.3 Examples of netCDF formats for the Data Centre Archived Products

The Data Centre has developed netCDF formats generation plug-ins for many of the products stored in its Archive. Examples of these products and their netCDF versions can be found under the following URL:

http://gsics.eumetsat.int/thredds/netcdf-4-classic-model-format-v2.html

The structure of a product can be accessed by selecting the product of interest e.g.

http://gsics.eumetsat.int/thredds/catalog/Demc4v2MSGLevel15/catalog.html?dataset=demc4v2MsgLevel15/W_XX-EUMETSAT-Darmstadt,VIS%2BIR%2BHRV%2BIMAGERY,MSG4%2BSEVIRI_C_EUMG_20181203103009.nc

From this product's meta-data page, its structure is shown by selecting the **OPENDAP** service under the **Access** section of the page e.g.

http://gsics.eumetsat.int/thredds/dodsC/Demc4v2MSGLevel15/W_XX-EUMETSAT-Darmstadt,VIS+IR+HRV+IMAGERY,MSG4+SEVIRI_C_EUMG_20181203103009.nc.html

2.3 netCDF Tools

The netCDF format can be visualised using the following tools.

- Unidata IDV[7] & ToolsUI[8].
- ncgen[9], ncdump[10] & ncBrowse[11].

[6] WMO Publication No. 386 (Manual on the Global Telecommunication System), pp A.II-15/31 to 36.
[7] http://www.unidata.ucar.edu/software/idv/
[8] http://www.unidata.ucar.edu/software/netCDF-java/
[9] http://www.unidata.ucar.edu/software/netCDF/docs/ncgen-man-1.html
[10] http://www.unidata.ucar.edu/software/netCDF/docs/ncdump-man-1.html
[11] http://www.epic.noaa.gov/java/ncBrowse/