MTG FCI L1 Product User Guide [FCIL1PUG]

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1A Draft	13/05/2015		
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1D Draft	01/06/2016		Added Section 8.10 about special compression Added Section 8.11 about radiance noise and accuracy look up tables Added Section 8.12 about timing information Added Section 1.5 Open Issues and an open issue on look up tables. Added Section 1.5.2 Open issue onthe number of channels in the FDHSI datasets Table 3: Update table of values for reference grid Changed name from Dataset User Guide to product User Guide
1E Draft	25/04/2019		Update to several sections to bring in line with FCI L1 Format Specifications v4A: Add list of acronyms in Section 1.2. Add table with applicable documents Add reference to EUM poster about Meteosat projection grids and to HDF5 filter FCIDECOMP Deleted open issue on Number of Channels in the FDHSI Datasets (previous Section 1.5.2) since it was confirmed that 16 channels are disseminated in FDHSI via EUMETCast Add an open issue on the delivery of the final spectral response function Add an open issue on the delivery of the CharLS decompression algorithm Add an open issue on PyTroll Add an open issue on the NcML description Include a figure showing the LAC regions (Section 3.1) Update SRFs in Section 3.2.2 with information from EUM/RSP/TEN/16/894049 Add text about on-board calibration (Section 3.2.5)

			Explain different data levels (Section 4.1) Create new Section 4.7 as reminder for GSICS information Section 5.2: Restructure text about projection and correct indices of Lambda, Phi and align notations to the formulae in Section 5.3. Correct Figure 8 and Figure 9 Table 3: update with values taken from EUM/RSP/TEN/18/1000370 (sheet CONV) and rename column title 'Resolution' to 'Grid Sampling' Section 5.3: Align with [CONV] and provide only values for equatorial radius, flattening parameter and geostationary radius. Provide text for Section 5.4 and Section 5.7 Update Table 5 Add Table 6 including explanations Update number of chunks (Section 7.3.1) Remove information about quicklooks (Sections 7.4 and 7.11) because they are not provided to the users. Replace text in Section 7.8 with newer information from FCI Format Specifications Update Figure 11, Figure 12 and Figure 13 Simplify Section 7.8.2 and add link to later sections Update Table 9 and Table 10, add Table 11 Provide more information on how reconstruct the reference grid (Section 8.1) Add information to Sections 8.3 and 8.4 Add text to Section 8.6 and 8.12 Include new tables in Appendix A Appendix B.3 updated and shortened Include information about the FCI Decompressor FCIDECOMP in Appendix C.2.3 Add a new section for PyTroll (Appendix C.5)
1F	28/05/2019		Read-only version for review
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			identifying additional reviewers. Section 1.3.2: Add [EURD] as reference document. Section 1.3.2: Add EURD as reference Section 1.4: Include new Section 9 Section 1.5: Remove section on LUT encoding accuracy, update section on final SRF delivery and remove open issues about Pytroll and NcML description Section 3.1: Align description with dissemination baseline. Section 6: remove TBC for UTC time Move section 'Index Mapping', 'Radiance Coding', 'Pixel Quality' and 'Special Compression' one level up. Correction of counts limit for warm scale (Section 7.10) Section: 7.9: add additional parameters and update text about swath direction Update of section 8.4 to indicate the usage of provided wavenumber variable Update of section 8.5 to include the formula to convert radiances to reflectances Removal of section of solar zenith angle calculation Update of sweep_angle_axis default value to "y" (section A.2.2) Section 9: Add section on NRT dissemination of FCI 1C chunks Appendix A: Update format descriptions Appendix C.5: Include Pytroll example code
1J	05/06/2020		Read-only version for signature loop Section 1.3.2: add [MTG-UserTestdataReleases] and [MTGDIS] as references Section 5.7: Remove original text since mask will not be available from the beginning Section 8.5: Add definition of BRF following [Schaepman-Strub] and add paper to list of reference documents

Table of Contents

1 INTRODUCTION

1.1 Scope

This document is a User Guide for MTG FCI Level 1c products.

This release is a preliminary version published to accompany the release of FCI Level 1c test data packages. Although the document represents our current best knowledge of the FCI instrument functionality and characteristics, data processing, and output format, it is likely that there will be evolutions in this knowledge in the years up to the launch of the first MTG Imaging platform which will lead to updates in future releases of this document.

In addition, some areas of the document are currently incomplete and these will be detailed and expanded in subsequent releases.

1.2 Acronyms and Definitions

Abbreviation/Term	Meaning
AU	Astronomical Unit
CDL	Common Data form Language
FCI	Flexible Combined Imager
FD	Full Disc
FDHSI	Full Disc High Spectral Resolution Imagery
FDSS	Full Disc Scanning Service
HDF	Hierarchical Data Format
HR	High Resolution
HRFI	High Spatial Resolution Fast Imagery
IR	Infrared
IRS	Infrared Sounder
LAC	Local Area Coverage
LI	Lightning Imager
MSG	Meteosat Second Generation
MTG	Meteosat Third Generation
NcML	NetCDF Markup Language
NEdT	Noise Equivalent delta Temperature
NetCDF	Network Common Data Format
NIR	Near-Infrared
RC	Repeat Cycle
RSS	Rapid Scanning Service
SEVIRI	Spinning Enhanced Visible and Infrared Imager
SNR	Signal to Noise Ratio
SRF	Spectral Response Function
SSD	Spatial Sample Distance
TAS	Thales Alenia Space
UTC	Coordinated Universal Time
VIS	Visible

VNIR	Visible and Near Infrared
WMO	World Meteorological Organisation
XML	Extensible Markup Language

1.3 Applicable and Reference Documents

1.3.1 Applicable Documents

Acronym	Reference Number	Title
[FCIL1FS]	EUM/MTG/SPE/10/0447	MTG FCI Level 0 & 1 Format Specification, Version 4A
[GFS]	EUM/MTG/SPE/11/0252	MTG Generic Format Specification, Version 4A

1.3.2 Reference Documents

Acronym	Reference Number	Title
[CF]	http://cfconventions.org/	CF Conventions Document
[EURD]	EUM/MTG/SPE/07/0036	MTG End-User Requirements Document
[FCIDECOMP]	https://support.hdfgroup.org/services/contributions.html	HDF5 Registered Third-Party Filters (Compression)
[MTGDIS]	EUM/MTG/DOC/17/946090	MTG Products Distribution Baseline
[Meteosat-Grids]	Poster: EUM/RSP/DOC/18/1013261 Proceedings: https://www.eumetsat.int/website/wcm/idc/idcplg?IdcService=GET_FILE&dDocName=PDF_CONF_2018_S1_MUELLER_P&RevisionSelectionMethod=LatestReleased&Rendition=Web	Geostationary Projection Grids for Three Generations of METEOSAT, Poster and Proceedings, EUMETSAT Meteorological Satellite Conference, 2018
[MTG-UserTestdataReleases]	https://www.eumetsat.int/website/home/Satellites/FutureSatellites/MeteosatThirdGeneration/MTGData/MTGUserTestData/index.html	EUMETSAT website with MTG-related Test Data Releases for Users, and related Support Data/Packages

Acronym	Reference Number	Title
[NACDD]	https://geo-ide.noaa.gov/wiki/index.php?title=NetCDF_Attribute_Convention_for_Dataset_Discovery	NetCDF Attribute Convention for Dataset Discovery
[Schaepman-Strub]	Remote Sensing of Environment 103(2006) 27-42, http://dx.doi.org/10.1016/j.rse.2006.03.002	Schaepman-Strub G., et al. (2006): Reflectance quantities in optical remote sensing – definitions and case studies.
[WMO-386]	http://www.wmo.int/pages/prog/www/ois/Operational_Information/Publications/WMO_386/WMO_386_Vol_I_2009_en.pdf	WMO Manual on the Global Telecommunication System - Volume I. 2009 Edition.

1.4 Document Structure

The sections of this document present the following information:

Section 1 – An overview of the document.

Section 2– A brief introduction to the MTG programme, the MTG platform and the on-board instruments.

Section 3 – The Flexible Combined Imager (FCI) instrument hardware and functionality.

Section 4 – The core algorithms used to process data from the Level 0 data to Level 1c.

Section 5 – The characteristics of the Level 1c data including the use of reference grids, grouping of spectral channels, and use of quality indicators.

Section 6 – The file naming convention.

Section 7 – Characteristics of the netCDF dataset and the division of the product into chunks.

Section 8 – How to read and extract data from the FCI L1c netCDF files.

Section 9 – Information about Near Realtime Product Dissemination

Appendix A – A detailed look at the netCDF formats including complete CDL descriptions.

Appendix B – Discussion of applicable netCDF standards and conventions

Appendix C – Identification of freely available tools for processing, manipulating or displaying these datasets.

1.5 Open Issues

1.5.1 Delivery of final Spectral Response Function

The Spectral Response Functions (SRF) given in Section 3.2.2 capture the best knowledge of the MTG-I1 FCI at the date of December 2016. They were estimated from a combination of theoretical modelling and measurements. The final characterized SRFs are likely to be slightly different from this intermediate delivery. The final SRF measurement will be available in summer 2020 and this document will be updated accordingly.

1.5.2 Delivery of CharLS decompression algorithm

A future version should address how the CharLS decompression algorithm will be provided to the users.

2 METEOSAT THIRD GENERATION (MTG)

2.1 The MTG Programme

The Meteosat Third Generation (MTG) programme provides meteorological imagery over Europe and Africa and maintains continuity of the Meteosat programme, continuing and expanding the service provide by Meteosat Second Generation (MSG).

2.2 The MTG Platform

MTG is a twin satellite concept based on 3-axis stabilised platforms. The twin satellites comprise an imaging satellite, MTG-I, and a sounding satellite, MTG-S. Four imaging and two sounding satellites are planned.

The MTG-I payload comprises:

1. The Flexible Combined Imager (FCI)
2. The Lightning Imager (LI)
3. The Data Collection System (DCS)
4. Search and Rescue (GEOSAR)

The MTG-S payload comprises:

1. The Infrared Sounder (IRS)
2. The Sentinel-4 Ultra-violet, Visible and Near-infrared Sounder (UVN)

3 FLEXIBLE COMBINED IMAGER (FCI)

3.1 The FCI Mission

The FCI will provide follow-on services to the Full Disc Scanning Service (FDSS) and Rapid Scanning Service (RSS) currently provided by the Meteosat Second Generation (MSG) Spinning Enhanced Visible and Infrared Imager (SEVIRI). Two imagery missions are defined that are combined in the FCI instrument design capabilities: The Full Disc Scanning Service (FDSS) provides samples in all of the 16 spectral channels at the nominal spatial resolution (1-2km). The Rapid Scanning Service provides the same 16 channels over the quarter of the disc via EUMETCast Satellite Europe and 4 channels with a better spatial resolution of 0.5-1km via EUMETCast Terrestrial. The nominal operational mode is based on two imager satellites. One MTG-I satellite performs the full Earth-disc scanning in a 10 minutes repeat cycle and the second one covers the northern quarter of the full disc, i.e. LAC4_4 (Figure 1), over Europe in 2.5 minutes.

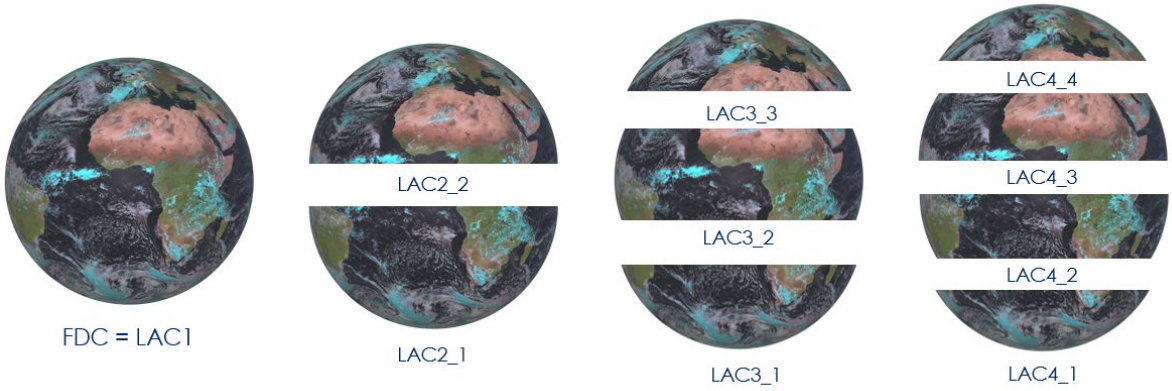


Figure 1 FCI coverage nomenclature for the full disc (FDC) and the different Local Area Coverages (LAC)

3.2 Instrument Characteristics

3.2.1 Spectral Channels

The FCI has channels over 16 spectral ranges covering visible to infrared wavelengths (***Table 1***).

Spectral Channel	Central Wavelength, λ0	Spectral Width, Δλ0	Spatial Sampling Distance (SSD)
VIS 0.4	0.444 µm	0.060 µm	1.0 km
VIS 0.5	0.510 µm	0.040 µm	1.0 km
VIS 0.6	0.640 µm	0.050 µm	1.0 km 0.5 km (HR)
VIS 0.8	0.865 µm	0.050 µm	1.0 km
VIS 0.9	0.914 µm	0.020 µm	1.0 km
NIR 1.3	1.380 µm	0.030 µm	1.0 km
NIR 1.6	1.610 µm	0.050 µm	1.0 km

Spectral Channel	Central Wavelength, λ0	Spectral Width, Δλ0	Spatial Sampling Distance (SSD)
NIR 2.2	2.250 µm	0.050 µm	1.0 km 0.5 km (HR)
IR 3.8	3.800 µm	0.400 µm	2.0 km 1.0 km (HR)
WV 6.3	6.300 µm	1.000 µm	2.0 km
WV 7.3	7.350 µm	0.500 µm	2.0 km
IR 8.7	8.700 µm	0.400 µm	2.0 km
IR 9.7	9.660 µm	0.300 µm	2.0 km
IR 10.5	10.500 µm	0.700 µm	2.0 km 1.0 km (HR)
IR 12.3	12.300 µm	0.500 µm	2.0 km
IR 13.3	13.300 µm	0.600 µm	2.0 km

Table 1 FCI Spectral Channel Spectral and Spatial Requirements.
The spectral channels VIS 0.6, NIR 2.2, IR 3.8 and IR 10.5 are delivered in FDHSI and HRFI spatial sampling configurations. The latter is indicated by (HR) in the table.

The FCI Spectral Channel Radiometric Requirements as defined in the [EURD] are given in Table 2.

Spectral Channel	Min. Signal, α_{min}	Max. Signal, α_{max}	Ref. Signal, α_{ref}	SNR
VIS 0.4	0.01	1.20	0.01	>25
VIS 0.5	0.01	1.20	0.01	>25
VIS 0.6	0.01	1.20	0.01	>30 >12 HR
VIS 0.8	0.01	1.20	0.01	>21
VIS 0.9	0.01	0.80	0.01	>12
NIR 1.3	0.01	0.80	0.01	>40
NIR 1.6	0.01	1.00	0.01	>30
NIR 2.2	0.01	1.00	0.01	>25 >12 HR
Spectral Channel	**Min. Signal, T_{min}**	**Max. Signal, T_{max}**	**Ref. Signal, T_{ref}**	**NEdT**
IR 3.8	200K 350K	350K Fire range#2	300K 350-Fire range#2	<0.1K <0.2K HR <1K FIRE
WV 6.3	165K	270K	250K	<0.3K
WV 7.3	165K	285K	250K	<0.3K
IR 8.7	165K	330K	300K	<0.1K
IR 9.7	165K	310K	250K	<0.3K
IR 10.5	165K	340K	300K	<0.1K <0.2K HR
IR 12.3	165K	340K	300K	<0.2K
IR 13.3	165K	300K	270K	<0.2K

Table 2 FCI Spectral Channel Radiometric Requirements

Notes:

1. The channels VIS 0.6, NIR 2.2, IR 3.8 and IR 10.5 are delivered in FDHSI sampling and HRFI sampling configurations. The radiometric requirements for the HRFI sampling configuration are indicated by the superscript HR in the table.
2. For the IR 3.8 spectral channel the radiometric measurement range has been extended to the "Fire range" with reduced radiometric requirements for active fire monitoring indicated by the superscript FIRE in the table. The fire range is specified to meet the needs for a fire line of temperature 900K, at least 3 km in length and 30m in width on a back ground of 320K.
3. For the FCI, the value α represents the reflectance at the top of atmosphere (TOA) multiplied by the cosine of the solar zenith angle, i.e. $\alpha = \rho.\cos(\theta_s)$ allowing minimum, maximum and reference signals in terms of spectral radiance at the top of atmosphere to be derived for the VNIR spectral channels.
4. Radiometric noise is provided as Signal to Noise Ratio (SNR) for Visible and Near Infrared (VNIR) spectral channels and Noise Equivalent delta Temperature (NEdT) for Infrared spectral channels.

3.2.2 Spectral Response Function (SRF)

Figure 2 shows the SRFs for each of the FCI spectral channels as obtained from a combination of theoretical modelling and measurements by industry. These plots do not represent the final SRFs which are still to be measured.

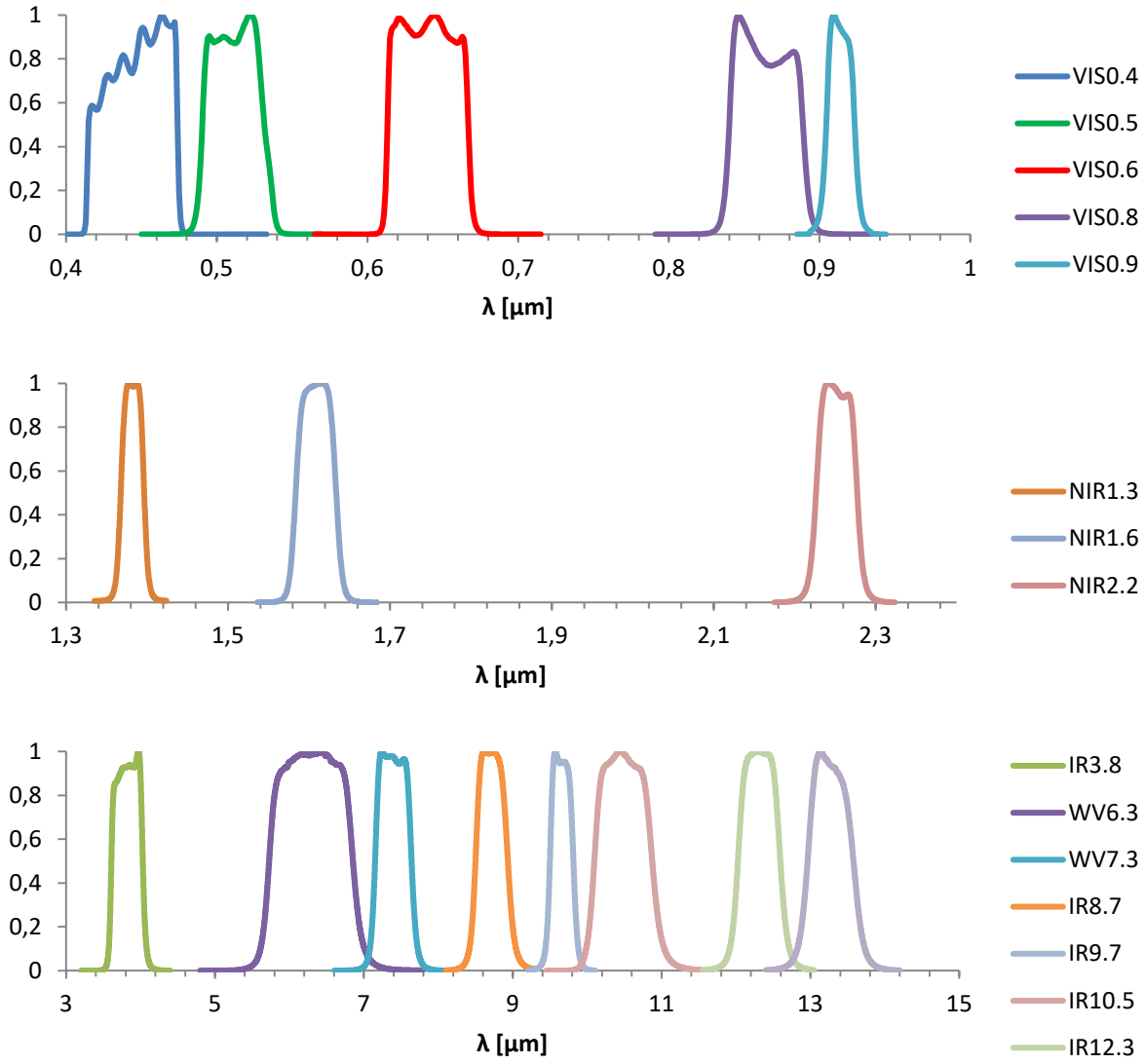


Figure 2 Averaged FCI Spectral Response Functions of each spectral channel as a function of wavelength.

3.2.3 Image Acquisition Principle

The FCI data is acquired by scanning the Earth across the detector arrays in an alternating east to west (E-W) and west to east (W-E) direction, with a south to north (S-N) movement between the alternating scans. The band of data collected in a single scan is referred to as a swath. The swaths are numbered from south to north starting from 1. The Earth full disc is imaged by 70 swaths in approximately 9 minutes and 30 seconds. Subsequently, the scan mirror is

repositioned to the first acquisition position. This movement is called retrace. Due to the nature of the scan the level 1b swaths are inclined with respect to the level 1c grid, see Figure 3.

Each swath is 180 km wide (excluding the required overlap) and the time between points at either side of the swath boundary varies between 0 to 20 seconds maximum at the equator. The duration of a swath is approximately 3 seconds duration at the pole and 10 seconds at the equator. The spacecraft performs a yaw flip between summer and winter observation modes, which reverses the detector, but the scan pattern is programmed to remain almost the same no matter the yaw flip orientation. The yaw flip has no impact on the geographical position of the Level-1c pixels, it only slightly affects the timing of the pixels with respect to the beginning of the repeat cycle.

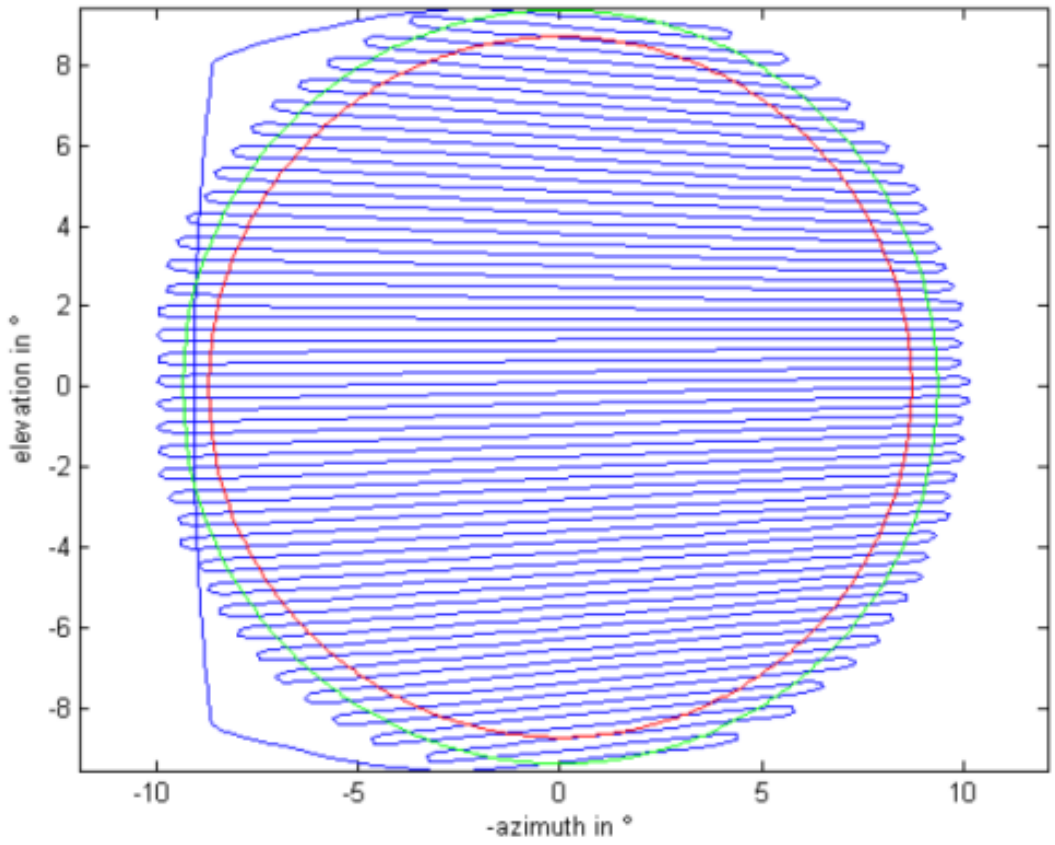


Figure 3 FCI Winter Full Disc Swath Pattern: The swaths are displayed as blue lines. The red circle indicates the Earth radius, i.e. deep space is observed at the beginning/end of each scan line.

In nominal operational use, two coverage missions are defined: the full disc coverage (designated in the dataset name as FD) or quarter disc local area coverage (LAC) for Europe (designated as Q4). Each FD or Q4 dataset corresponds to a single FCI repeat cycle.

As noted previously, two imagery missions are defined that are combined in the FCI instrument design capabilities: the Full Disc High Spectral resolution Imagery (FDHSI) mission, which has all 16 channels at a 1km SSD for visible and near-infrared channels and 2 km SSD for

infrared channels, and the High spatial Resolution Fast Imagery (HRFI) mission, which has 4 channels at high-resolution, namely VIS 0.6 and NIR 2.2 at 0.5km SSD and IR 3.8 and IR 10.5 at 1 km SSD.

3.2.4 Focal Plane Arrangement

[Information to be added in a later issue]

3.2.5 On-board Calibration Principle

Calibration activities are necessary to update some parameters needed for the Level 1 processing. Different methods are used for the VIS and NIR channels on one hand and the IR channels on the other hand. In-flight VIS/NIR calibration is done in two steps. Observations of the deep space at the end of each scan are used to update the offset calibration coefficients. Every six months during the 1.5 months of the equinox period the instrument looks at the sun (through a dedicated filter) to allow an update of the gain coefficients. The determination of the IR offset calibration coefficients is similar to the VIS/NIR ones, i.e. using the deep space measurements during each swath. The IR gain calibration coefficients are determined during the retrace period between two consecutive repeat cycles through the measurement of an internal blackbody with known temperature which is inserted into the instrument's optical path.

3.2.6 Detection Chain

[Information to be added in a later issue]

4 FCI LEVEL 1 PROCESSING ALGORITHMS

4.1 Overview

This section will describe the core processing steps for generating FCI L1c datasets and detail the possible configurations for these steps.

[Information to be added in a later issue]

[Schematic of overall processing to be added in a later issue]

Different data levels names are used to describe the conditions of the science data at various points in the data processing.

Definition	Explanation
Level 0	Raw data
Level 1a	Level 0 science data in counts after removal from the packets, whilst maintaining the spatio-temporal sequencing of the data
Level 1b	Level 1a science data radiometrically calibrated and geolocated
Level 1c	Level 1b science data rectified to a reference grid
Level 2	Level 1b or Level 1c science data converted to geophysical values (temperature, humidity, radiative flux…)

4.2 Level 0 to Level 1a Processing

[Information to be added in a later issue]

4.3 Level 1a to Level 1b Processing

[Information to be added in a later issue]

4.4 Level 1b to Level 1c Processing

[Information to be added in a later issue]

4.5 Stray-Light Correction

[Information to be added in a later issue]

4.6 INR

[Information to be added in a later issue]

4.7 GSICS

[Information to be added in a later issue]

5 CHARACTERISTICS OF THE LEVEL 1C REGISTERED RADIANCE DATASET

5.1 Row and Column Numbering

A row is defined as a line of *spatial samples* or *pixels* running in a (nominal) East to West and West to East direction. The rows are numbered from the south to north starting from 1.

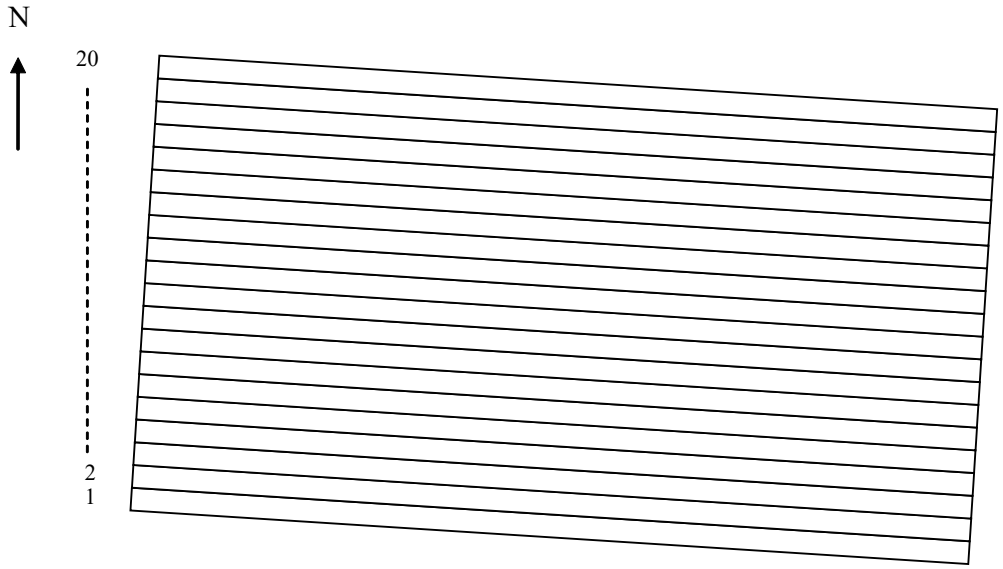


***Figure 4: Illustration of row numbering within a* swath used for Level 1b data.**

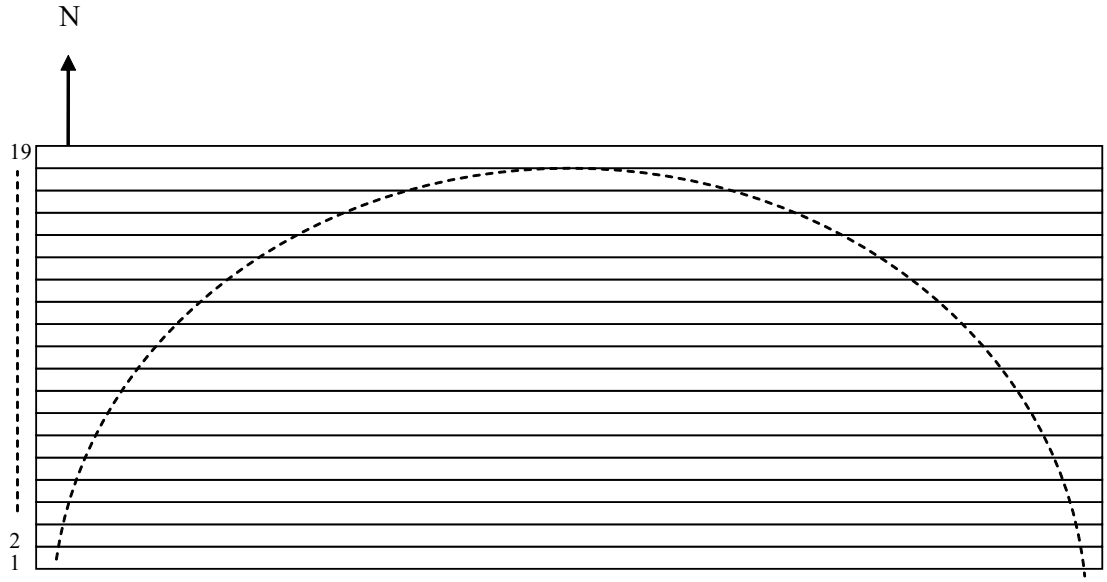


***Figure 5: Illustration of row numbering within a Level 1c rectified* image**

A column is defined as a line of *spatial samples* or *pixels* running in a (nominal) South to North direction. The columns are numbered from the west to east starting from 1.

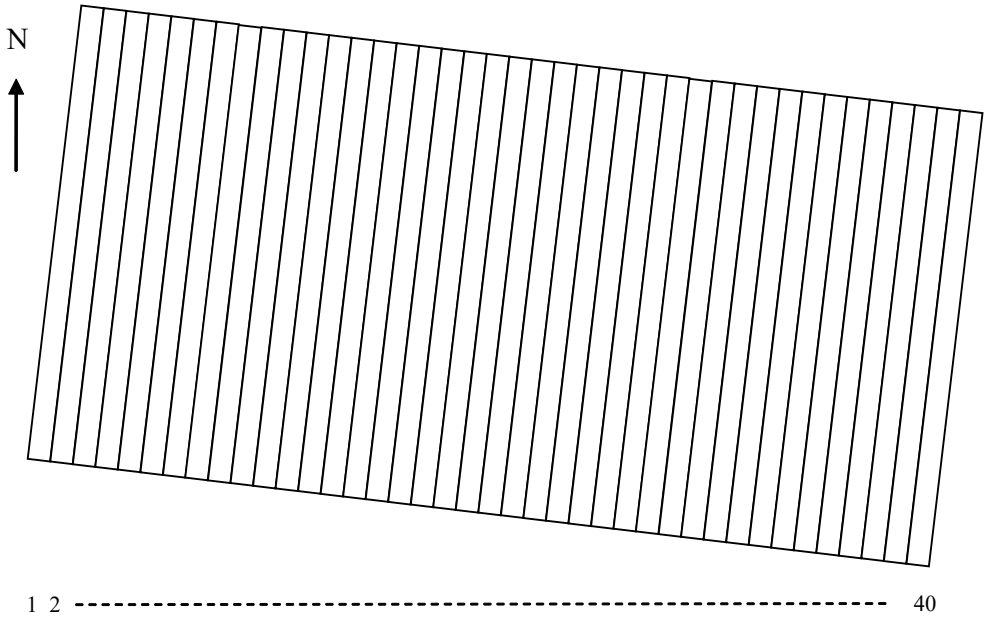


***Figure 6: Illustration of column numbering within a* swath used for Level 1b data.**

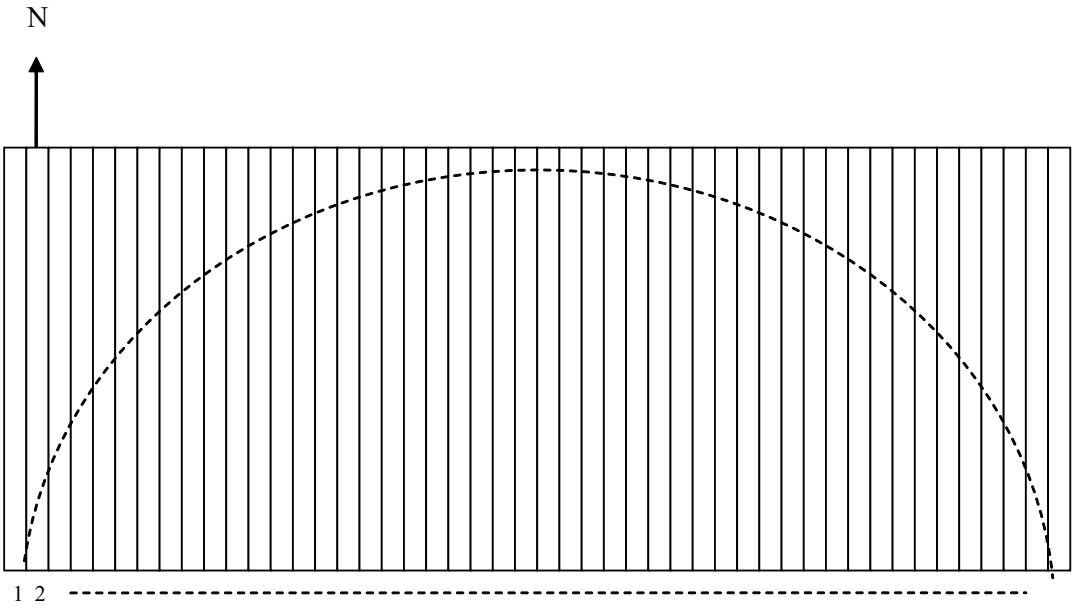


***Figure 7: Illustration of column numbering within a Level 1c rectified* image**

5.2 Level 1c Reference Grid

The reference grid defines the geo-referenced position of the *image pixel centroids* at *level 1c* in a normalized geostationary projection. The normalized geostationary projection describes the view from a virtual satellite to an idealized Earth. The virtual satellite is in a geostationary orbit, perfectly located in the Equator plane at the given longitude, λ_D (normally 0 deg). This point on the equator is the origin of the projection. The distance between virtual satellite and centre of Earth (the geostationary radius) is given by the geostationary altitude above the surface and the equatorial radius of the Earth's reference ellipsoid. The level 1c Reference Grid steps are equiangular both in the virtual satellite azimuth and elevation and equal to the *spatial sampling angle* of the considered channel. The corresponding projected distance at the *sub-satellite point* is the *spatial sampling distance (SSD)*.

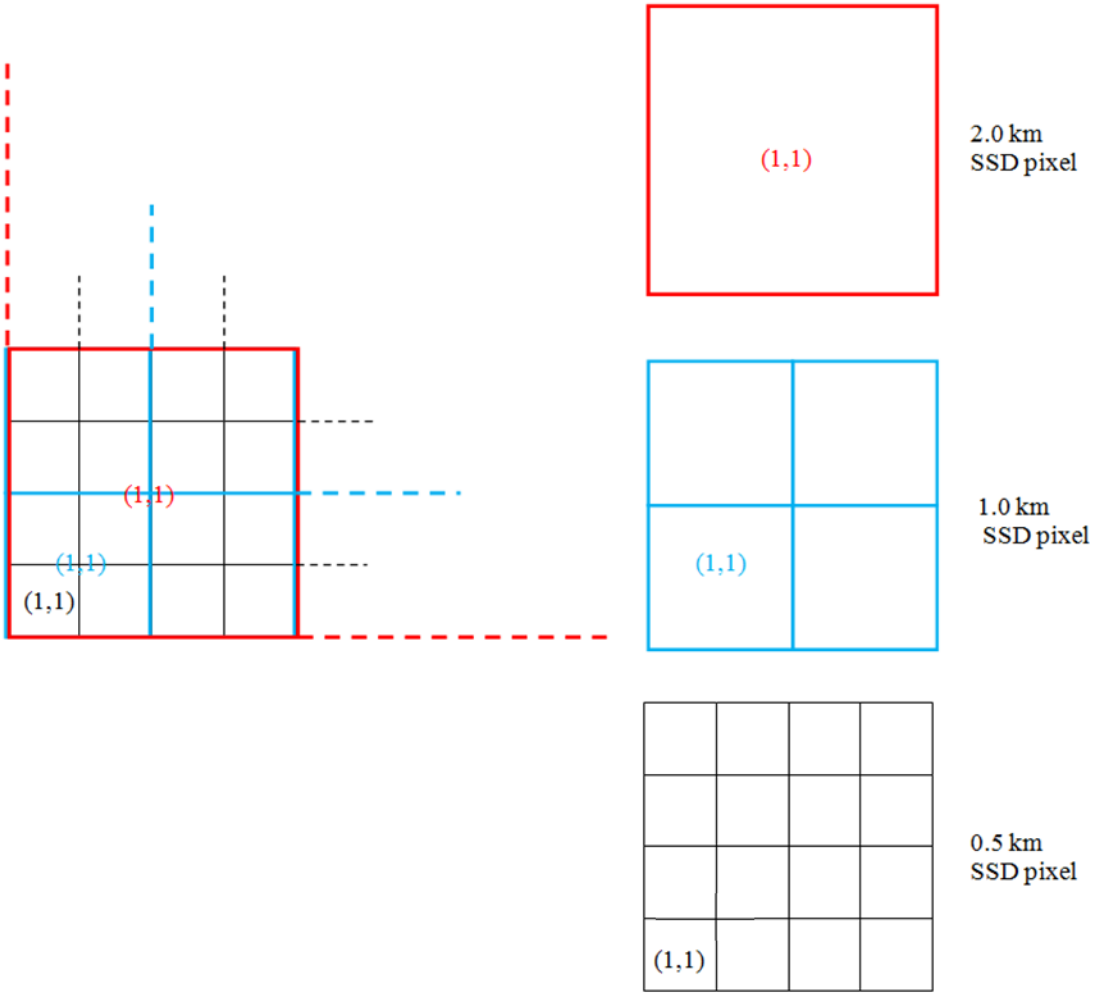


Figure 8: Diagram illustrating the spatial coordination of the three L1c reference grids, starting with the SW corner origin

Figure 8 illustrates how the reference grids for the 3 SSD values are aligned, with the origin pixel at position (1,1) located in the SW corner. Information to generate the FDSS reference grid in the GEOS "Normalized Geostationary Projection" is provided in the dataset. Information on how to use the parameters given in the Level 1c product to reconstruct the reference grid are provided in Section 8.1. Other reduced scans (e.g. for RSS) are defined as fixed subsets of the FDSS grid. Additional information about the Meteosat grids is provided in [Meteosat-Grids].

The normalized geostationary projection defines the line of sight of each pixel centre P as a vector representing the view from the virtual satellite. This vector is expressed as a function of the two angles elevation (ϕ_S) and azimuth (λ_S) and is defined as follows:

$$\lambda_s = \arctan\left(\frac{r_2}{r_1}\right)$$

$$\phi_s = \arcsin\left(\frac{r_3}{\sqrt{r_1^2 + r_2^2 + r_3^2}}\right)$$

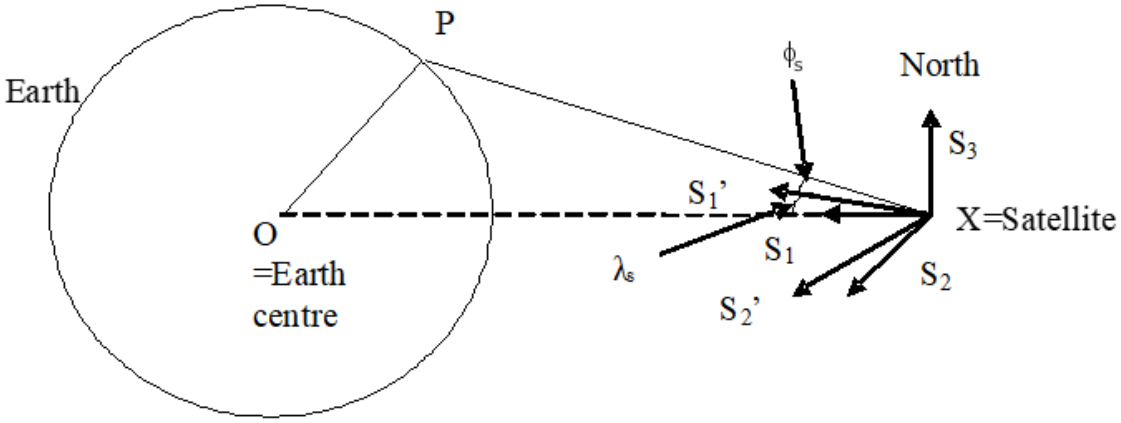


Figure 9: Angular Definition of the Reference Grid

Figure 9 shows the angular definition of the reference grid where:

1. the frame (s1,s2,s3) has its origin at the satellite position, (s3) points northwards, and (s1) directs to the centre of the Earth
2. the vector r of coordinates (r_1, r_2, r_3) in the frame (s1,s2,s3) is a pixel line of sight vector with r = XP/norm(XP)

In order to geolocate the radiances, the user must first calculate the corresponding azimuth, elevation coordinate for each row and column pixel, and then calculate the corresponding latitude, longitude coordinate from the azimuth, elevation information. This is described in the following:

Let (r,c) be the coordinates (row and column) of any pixel of the L1c image. Row and columns are counted increasingly when going from bottom to up (south to north) and left to right (west to east) and beginning at 1. Therefore, the South-West corner of a L1c image has coordinates (1,1). For each channel, the correspondence between the row and column position (r, c) and the azimuth and elevation position (λ, ϕ) of the pixel centre is written:

$$\lambda_s = \lambda_0 - (c\text{-}1) \cdot Azimuth\_Grid\_Sampling$$
$$\phi_s = \phi_0 + (r\text{-}1) \cdot Elevation\_Grid\_Sampling$$

where:

1. *Azimuth_Grid_Sampling* and *Elevation_Grid_Sampling* are the reference grid spatial sampling angles, representing viewing angle increments between pixels in the W-E and S-N directions, respectively. The corresponding values are given in Table 3.
2. λ_0 and ϕ_0 are the angles from the centre of the projection to the centre of the pixel in the first row and first column of the reference grid, respectively. Note that the first row, column of the reference grid is indexed (1,1) (Figure 8). The values correspond to *Azimuth_Grid_Sampling* * (columns –1)/2 or *Elevation_Grid_Sampling* * (rows –1)/2, respectively, and are given in Table 3, too.

Note that the E-W viewing angle (λ_0) does not correspond to the standard definition of azimuth, for an observation from the instrument perspective, which runs from negative to positive from West to East. Instead, it runs from negative to positive from East to West.

The N-S viewing angle corresponds to the standard definition of elevation, for an observation from the instrument perspective.

SSD (km)	λ_0		ϕ_0		Grid Sampling		Columns in Full Disc	Rows in Full Disc
	degrees	radians	degrees	radians	degrees	radians		
0.5	8.9142405037	0.1555828471	-8.9142405037	-0.1555828471	0.000800524494	1.3971788E-05	22272	22272
1	8.9138402398	0.1555758612	-8.9138402398	-0.1555758612	0.001601048988	2.7943576E-05	11136	11136
2	8.9130397083	0.1555618893	-8.9130397083	-0.1555618893	0.003202097973	5.5887153E-05	5568	5568

Table 3 Values per SSD for the three corresponding reference grids used for FCI L1c

With these values, the coordinates of the Earth centre (origin of the projection) in the Full Disc image are (11136.5, 11136.5), (5568.5, 5568.5) and (2784.5, 2784.5) for the 0.5, 1, and 2 km channels, respectively.

The following definitions are currently envisaged (this may evolve in the future) for the L1c LAC products (the row numbers correspond to the full disc row numbering):

LAC type	first row			last row			nb rows in each LAC		
	0,5 km SSD	*1 km SSD*	*2 km SSD*	*0,5 km SSD*	*1 km SSD*	*2 km SSD*	*0,5 km SSD*	*1 km SSD*	*2 km SSD*
LAC 1/2 nb 1	1	1	1	11413	5707	2854	11413	5707	2854
LAC 1/2 nb 2	10869	5434	2717	22272	11136	5568	11404	5703	2852
LAC 1/3 nb 1	1	1	1	8399	4200	2100	8399	4200	2100
LAC 1/3 nb 2	7225	3612	1806	14671	7336	3669	7447	3725	1864
LAC 1/3 nb 3	14192	7096	3548	22272	11136	5568	8081	4041	2021
LAC 1/4 nb 1	1	1	1	6851	3426	1714	6851	3426	1714
LAC 1/4 nb 2	5445	2722	1361	11413	5707	2854	5969	2986	1494
LAC 1/4 nb 3	10869	5434	2717	16482	8241	4121	5614	2808	1405
LAC 1/4 nb 4	15715	7857	3929	22272	11136	5568	6558	3280	1640

Table 4 Offset positions and extents of the 4 LAC coverage areas (cf. Figure 1) in the 3 full disc reference grids

The Level 1c LACs cover the full West-East range, i.e. all of the Full Disc columns.

5.3 Normalized Geostationary Projection

The virtual satellite is in a geostationary orbit, perfectly located in the Equator plane at the given longitude, λ_D (normally 0 deg). The transformation from satellite viewing angles (λ_s, ϕ_s) to geographical coordinates (lon, lat) is given by the inverse projection function:

$$\begin{pmatrix} lon \\ lat \end{pmatrix} = \begin{pmatrix} \arctan\left(\frac{s_2}{s_1}\right) + \lambda_D \\ \arctan\left(s_4 \cdot \frac{s_3}{s_{xy}}\right) \end{pmatrix}$$

where:

$$s_1 = h - s_n \cdot \cos(\lambda_s) \cdot \cos(\phi_s)$$

$$s_2 = -s_n \cdot \sin(\lambda_s) \cdot \cos(\phi_s)$$

$$s_3 = s_n \cdot \sin(\phi_s)$$

$$s_4 = \frac{r_{eq}^2}{r_{pol}^2}$$

$$s_5 = \left(h^2 - r_{eq}^2\right)$$

$$s_{xy} = \sqrt{s_1^2 + s_2^2}$$

$$s_n = \frac{h \cdot \cos(\lambda_s) \cdot \cos(\phi_s) - s_d}{\cos^2(\phi_s) + s_4 \cdot \sin^2(\phi_s)}$$

$$s_d = \sqrt{(h \cdot \cos(\lambda_s) \cdot \cos(\phi_s))^2 - (\cos^2(\phi_s) + s_4 \cdot \sin^2(\phi_s)) \cdot s_5}$$

The shape of the Earth is described by an oblate ellipsoid with a single flattening parameter f

$$f = \frac{r_{eq} - r_{pol}}{r_{eq}}$$

where r_{eq} and r_{pol} denote the equatorial and polar radius of the Earth, respectively. The appropriate values for the Earth are $f = 1/298.257223563$ and $r_{eq} = 6378.137$ km. The parameter h in the equations above refers to the geostationary radius. The geostationary radius is the distance from the Earth's centre to the satellite in geostationary orbit and can be calculated from the sum of the geostationary altitude (35786.4 km) and the equatorial Earth radius r_{eq}.

5.4 Spectral Channels

The FCI instrument consists of 16 imaging spectral channels ranging from 0.4 µm to 13.3 µm plus an additional Fire Application channel at 3.8 µm (FAIR3.8) with an extended dynamic range dedicated to fire monitoring. Section 3.2.1 summaries the main characteristics of the FCI spectral channels.

5.5 Repeat Cycle Coverage and Duration

[Information to be added in a later issue]

5.6 Timeliness and Availability

[Information to be added in a later issue]

5.7 Image Size and Masking

[Information to be added in a later issue]

5.8 Radiometric Quality

[Information to be aded in a later issue]

5.9 Geometric Quality

[Information to be added in a later issue]

5.10 Restricted Operations

Restricted operations do not have any consequences on the product format itself. More details about restricted operations will be added in a later issue.

6 NAMING CONVENTION

All MTG Level 1 products have a WMO-compatible name, following the WMO file naming convention [WMO-386] (cf Attachment II-15 p25 2009 edition)

The filename will consist of the dataset (or product) name with a file_type and a compression field:

(dataset_name) . (file_type) (compression)

Where:

dataset_name is composed of the following fields, separated by underscore symbols, "_":

(pflag)_(productidentifier)_(oflag)_(originator)_(yyyyMMddhhmmss)_(freeformat)

productidentifier is composed of the following fields, separated by commas:

(locationindicator),(datadesignator),(freedescription)

freedescription is composed of the following fields with plus symbol or dash symbol separators:

(spacecraftid)-(data_source)-(processing_level)-(type)-(subtype)-(coverage)-(subsetting)-(component1)-(component2)-(component3)-(purpose)-(format)

freeformat is composed of the following fields, separated by underscore symbols, "_":

(facility_or_tool) _(environment)_(start_time)_(end_time)_
(processing_mode)_(special_compression)_(disposition_mode)_
(repeat_cycle_in_day)_(count_in_repeat_cycle)

The order of the fields is mandatory.

NOTE: If there is no relevant value within the freeformat section, the field is left out. This can lead to the allowable repetition of underscores.

The following table shows the fully expanded set of name fields in the correct order, with values described for FCI L1c datasets. Following the main table, subsequent subsections describes the allowed values for the selected fields in greater detail. Where a field has "no value" as a setting this implies no character is present in the file name.

Name Field	Description	FCI-1C-RAD Values
pflag	WMO mandated	"W"
locationindicator	WMO mandated	"XX-EUMETSAT-Darmstadt"
datadesignator	The type of data with respect to the categories and subcategories defined in [WMO-386],	"IMG+SAT"

Name Field	Description	FCI-1C-RAD Values
spacecraftid	Spacecraft indicator	"MTIn" for MTG Imager n where n = 1, 2, 3 or 4
data_source	Instrument, platform or SAF	"FCI"
processing_level	Processing Level	"1C"
type	Identifies the type of data	"RRAD" for rectified radiances
subtype	Identifies a sub-type for the type.	"FDHSI" for FDHSI data "HRFI" for HRFI data
coverage	Coverage of the full accumulation interval	"FD" for full disc, "Q4" for LAC4
subsetting	Identification of the type of subsetting performed	No value
component1	Identifies a first level component of the product	"CHK" for chunk
component2	Identifies a second level component of the product	"BODY" for a body chunk "TRAIL" for a trailer chunk
component3	Identifies a third level component of the product	No Value
purpose	The intended purpose of the dataset. This normally refers to the intended final recipient.	No Value "DIS" for a dissemination dataset (has CharLS compression)
format	The intended encoding format of the dataset.	"NC4E" for netCDF-4 enhanced model "PNG" for a quick-look PNG image
oflag	WMO mandated	"C"
originator	WMO mandated	"EUMT"
yyyyMMddhhmmss	Is the UTC time of the processing, defined as the time of the formatting of the dataset/product by the processor, formatted in Abbreviated Generalised Time format e.g. yyyy = year MM = month dd = day of month hh = hour of day mm = minute of hour ss = second of minute	
facility_or_tool	Facility or tool producing the dataset	"IDPFI" = Instrument Data Processing Facility for MTG-I "GTT" = Generic Test Tool
environment	Ground Segment Environment producing the dataset	"OPE" - Operational
start_time	UTC Time of start of Sensing Data formatted in Abbreviated Generalised Time format (see above).	For the body chunk, this will be the time of the first measurement in the chunk. For a trailer chunk or a quick-look, this is the start time of the first body chunk in the repeat cycle.
end_time	UTC Time of end of Sensing Data formatted in Abbreviated Generalised Time format (see above).	For the body chunk, this will be the time of the last measurement in the chunk. For a trailer chunk or a quick-look, this is the end time of the last body chunk in the repeat cycle.
processing_mode	Identification of the mode of processing	"N" = nominal

Name Field	Description	FCI-1C-RAD Values
special_compression	This field provides identification of a special compression technique that has been applied to one or more variables in the dataset. Special compression does not include the standard netCDF data compression or "deflation" using in-built zlib support which is transparent to the user.	"JLS" = JPEG-LS. Lossless JPEG compression has been applied internally. blank – no special compression
disposition_mode	Shows disposition of the dataset from the perspective of an end-user"s needs.	"O" = operational "T" = testing
repeat_cycle_in_day	4-digit number (right-justified, zero-filled) indicating the expected current repeat cycle or group accumulation interval in the day for this particular dataset. The counter starts at 0001 for the first repeat cycle at or after midnight and resets for the next repeat cycle at or after the following midnight.	Variable
count_in_repeat_cycle	4-digit number (right-justified, zero-filled) indicating the expected count value of the dataset chunk in the repeat cycle. The counter will have discontinuities when chunks are not produced. The counter starts from 1 and resets when the repeat_cycle_in_day value changes. The counter increments for each chunk in a repeat cycle or accumulation interval (whether header, body or trailer). A value of 0 is used for datasets for which the counter is not applicable (e.g. datasets which are not chunk-able).	Variable
file_type	Indicator of the encoding format of the data, according to WMO conventions.	".nc" – netCDF
compression	Indicator of compression applied to the dataset as a whole according to WMO conventions (as opposed to the internal compression of variable indicated by the "special_compression" name field).	No value

Table 5 Breakdown of the fields in the FCI L1c dataset naming convention

7 STRUCTURE AND PRESENTATION OF THE LEVEL 1C REGISTERED RADIANCE DATASETS

7.1 Overview

An FCI Level 1c rectified radiance dataset consists of a set of files that contain the level 1c science data rectified to a reference grid together with the auxiliary data associated with the processing configuration and the quality assessment of the dataset. The FCI L1c datasets are netCDF-4 files and use the enhanced data model. More details on the netCDF-format are given in Appendix B.

7.2 Coverage Mission and Imagery Mission Datasets

A format ID defined as

<DATA_SOURCE>-<PROCESSING_LEVEL>-<TYPE>-<SUBTYPE>-
<COMPONENT1>-<COMPONENT2>-<FORMAT>

is used to identify the different datasets (Table 6). All datasets will have the same format specification as below.

Format ID	**#/RC**
FCI-1C-RRAD-FDHSI-CHK-BODY-NC4E	multiple
FCI-1C-RRAD-FDHSI-CHK-TRAIL-NC4E	1
FCI-1C-RRAD-HRFI-CHK-BODY-NC4E	multiple
FCI-1C-RRAD-HRFI-CHK-TRAIL-NC4E	1

Table 6 FCI Level 1c datasets for routine operations

7.3 Format

7.3.1 Data Chunks

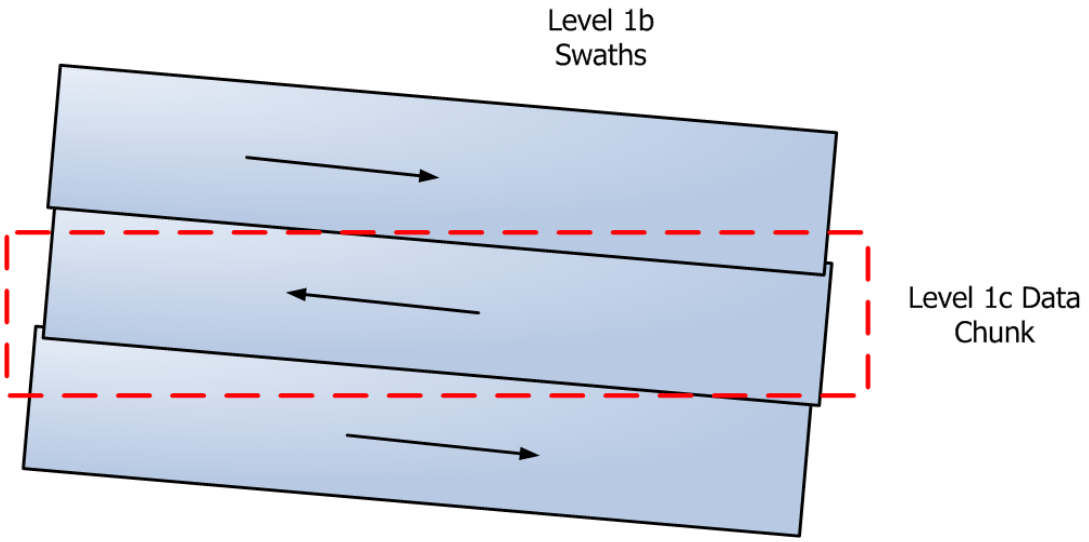
An FCI-1C-RRAD dataset covers the full repeat cycle and is divided into a series of individual files or “chunks” which facilitate dissemination. These same chunks are sent to the Archive for storage and can be retrieved in this form. The main bulk of the dataset are a series of body chunks that contain the observational data for the repeat cycle. There is also a trailer chunk that contains information applicable to or derived from the complete repeat cycle (Table 6).

The division of the dataset in this way provides benefits for timely and efficient transfer rates for near real-time dissemination. It also provides a rapid method for retrieving geographically subsetted data from the archive by returning only those chunks that intersect the region of interest.

Each body chunk will contain about the same number of rows from the reference grid, but the time duration will vary from 10 to 48 seconds in line with the varying duration of the swaths. This will produce circa 40 body chunks for a full disc repeat cycle and up to 13 body chunks

for a LAC4 repeat cycle. The exact numbers may be refined to optimise the ground processing timeliness.

Note: Level 1b swaths appear tilted when projected onto the reference grid due to the fan shaped scan pattern and may contribute to a more than one level 1c body chunk (see Figure 3).



7.4 FCI L1c Rectified Radiance (FCI-1C-RRAD) Dataset

The FCI Level 1c rectified radiance dataset contains the level 1c science data together with the auxiliary data associated with the processing configuration and the quality assessment of the dataset.

The dataset is represented by different format IDs that can be found as a string in the filename as described in Table 5:

FCI-1C-RRAD-FDHSI-CHK-BODY-NC4E
FCI-1C-RRAD-HRFI-CHK-BODY-NC4E
The Level 1c full repeat cycle science data, for the FDHSI or HRFI spectral channels, is divided into a number of L1c body data chunks for dissemination and storage in the data archive. The division of the dataset in this way provides benefits for timely and efficient transfer rates to other environments and for geographically subsetted retrieval from the archive. See Section 7.5 for details.

FCI-1C-RRAD-FDHSI-CHK-TRAIL-NC4E
FCI-1C-RRAD-HRFI-CHK-TRAIL-NC4E
The Level 1c trailer, for the FDHSI or HRFI spectral channels, is used to contain information that is calculated at the end of the repeat cycle, e.g. repeat cycle quality metrics, and information that help in the interpretation of the data but would present too large an overhead if transmitted for every L1c body data chunk, e.g. radiometric noise estimates. See Section 7.13 for details.

7.5 FCI-1C-RRAD Body Chunk

The groups available, to the FDHSI and HRFI subtypes, in the FCI level 1c Body data chunk are given in Table 7, with the nesting applied given in Figure 10.

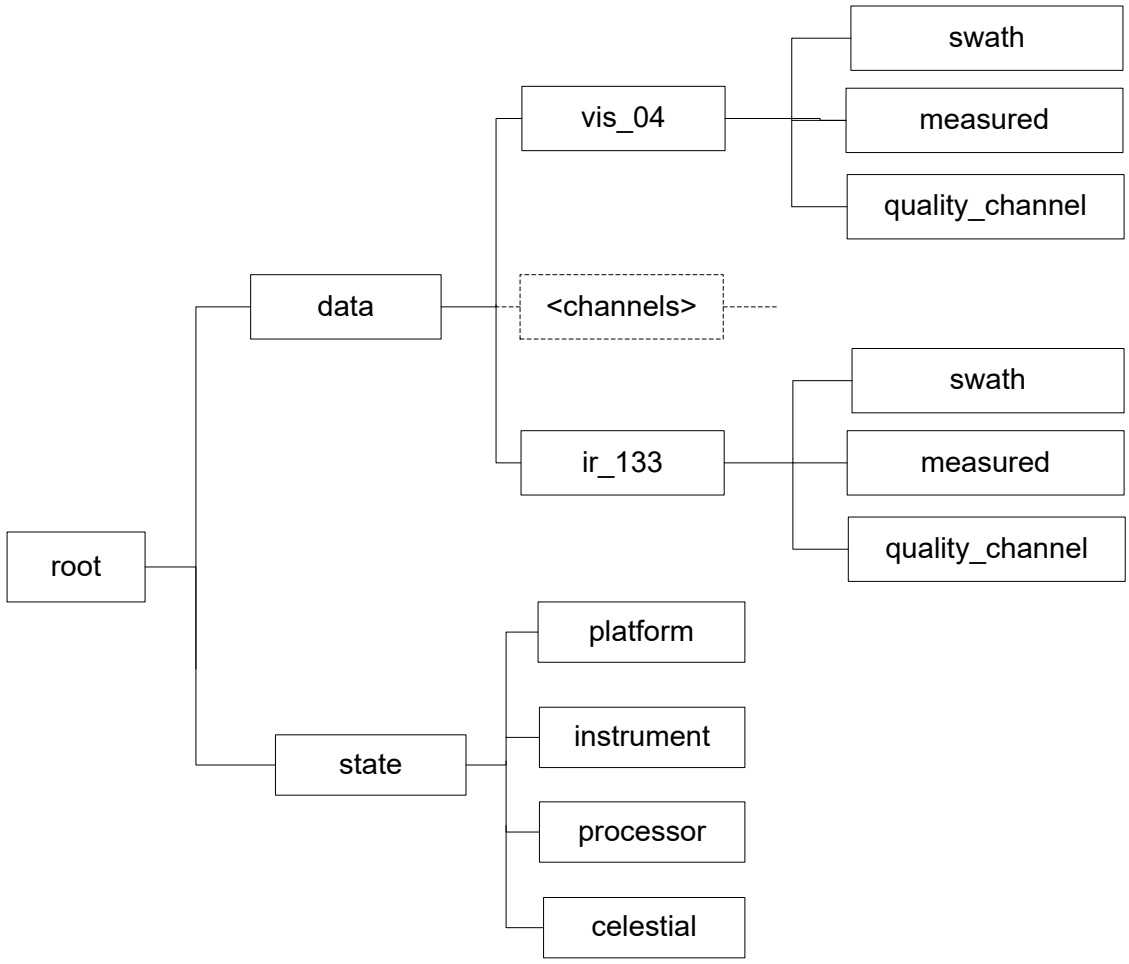


Figure 10 Overview of netCDF groups in the FCI L1c body chunk file for an FDHSI dataset

7.6 Group Overview

Group			Description
Generic Type		netCDF Name	
		root	Root level metadata
		data	Information common to all channels
"channel" groups	FDHSI	vis_04 vis_05 vis_06 vis_08 vis_09 nir_13 nir_16 nir_22 ir_38 wv_63 wv_73 ir_87 ir_97 ir_105 ir_123 ir_133	All "channel" groups share a common generic format and contain information specific to that channel. FDHSI channel groups are found in the FDHSI dataset.
	HRFI	vis_06_hr nir_22_hr ir_38_hr ir_105_hr	HRFI channel groups are found in the HRFI dataset.
		swath	Swath information
		measured	Measured radiances
		quality_channel	Associated quality information specific to a channel
		state	State information
		platform	Satellite state information
		instrument	Instrument state information
		processor	Processor state information
		celestial	Celestial state information

Table 7 Description of the groups in an FCI L1c body chunk

7.7 Channel Subsetting

As each channel group contains only information specific to that channel, they may be removed from the dataset without affecting its integrity. The user can remove channel groups with his own tools and leave only the subset of channels needed. This functionality will be provided for the FCI level 1c products obtained from the EUM archive.

7.8 Swath Information

Dependent upon the rectification method used, a given Level 1c grid pixel may have contributions from a number of Level 1b samples. However, the overlapping nature of the swaths allows the processing to ensure that a given pixel in the Level 1c dataset only has contributions from level 1b samples from a single swath. In order to preserve the information related to the time at which a pixel's data has been derived a "swath" group for each channel providing the ideal location of the swath boundary and the direction in which the swath was scanned is included within the FCI level 1c data. Within the swath group, the variable *swath_boundary* indicates which swath has contributed to a given pixel by recording the northernmost row per column of the last pixel in this chunk to have been created from a particular swath. The column number takes the valid_range of 1 to number_of_columns. In the example in Figure 11 the northernmost pixels in the level 1c data constructed from samples from swaths are indicated by dashed blue boxes, thus the row indexing associated with the *swath_boundary* is as given in Table 8.

The number of the row and column are such that:

1. The column and row refer to the position in the level 1c reference grid, thus the position relative to the data chunk for a swath_boundary value is given by [EQ01].

$$row\_chunk(a,b) = data.\langle channel\rangle.swath.swath\_boundary(a,b) - data.\langle channel\rangle.measured.start\_position\_row + 1 \quad \text{[EQ01]}$$

$$column\_chunk(a,b) = b - data.\langle channel\rangle.measured.start\_position\_column + 1$$

Where

- row_chunk and column_chunk are the indices (not appearing in the dataset) in the chunk data array giving the location of the swath boundary (starting at 1,1)
- a is the swath number
- b is the column number in the swath_boundary array (running from 1 to number_of_columns)

2. For pixels where the swath boundary lies outside of the area of data to be generated given by the mask the swath_boundary is set to _FillValue.
3. For swaths laying completely within the masked out region of the data then no swath boundary information is generated.

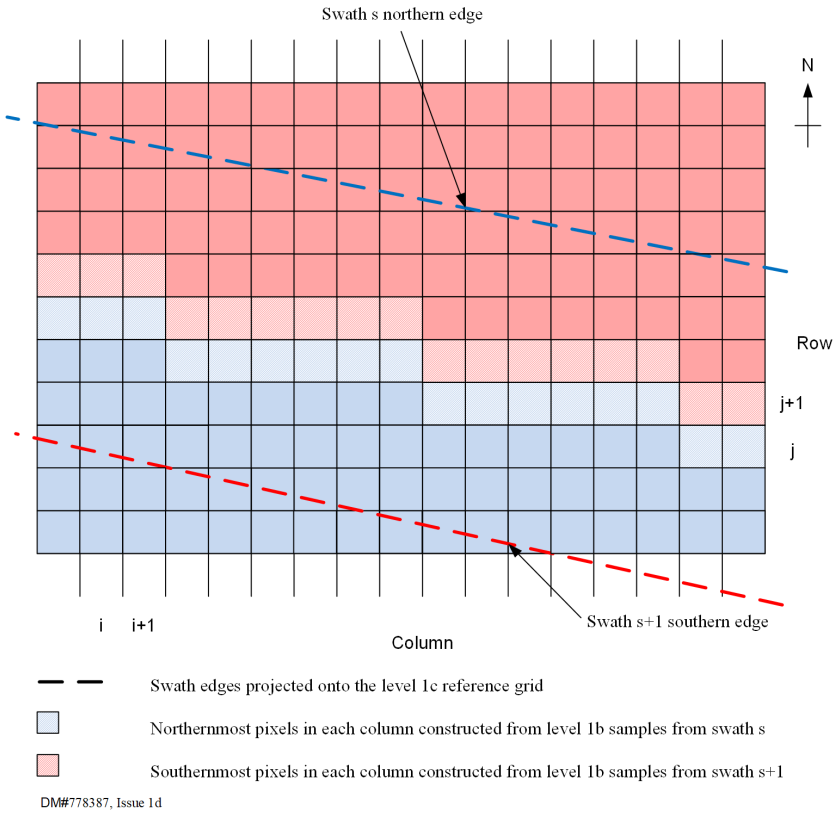


Figure 11 Swath boundary (dashed lines) appearing in the level 1c grid indicated by the horizontal and vertical solid lines. Note that the swath edge can take a positive or negative slope when projected in the level 1c grid.

Column	Row
i	j+3
i+1	j+3
i+2	j+2
i+3	j+2
...	...
i+7	j+2
i+8	j+1
...	...
i+13	j+1
i+14	j
...	...

Table 8 Values of swath_boundary for the example in Figure 11

The *swath_boundary* for the lowermost and uppermost swaths contributing to the FCI level 1c body data chunk may run outside the coverage area contained in the chunk when moving from west to east or east to west. The means of identifying the values for swath_boundary for the upper and lower swath boundaries are illustrated in Figure 12. The following cases are considered:

a) For a given chunk, where a swath_boundary occurs North of the northernmost row in the chunk, its value is ceiled to the index of this northernmost row in the chunk (i.e. data.<channel>.measured.end_position_row). See Figure 12 (top panel).
b) For a given chunk, where a swath_boundary occurs South of the southernmost row in the chunk, its value is set to _FillValue See Figure 12 (centre panel).
c) In the case of the full dataset (all the chunks) the two sets of swath_boundary information given with chunk n and n+1 for the boundary between swaths s to s+1 needs to be combined to create a single set of values. This information is not provided in the trailer and if needed can be reconstructed by the user.

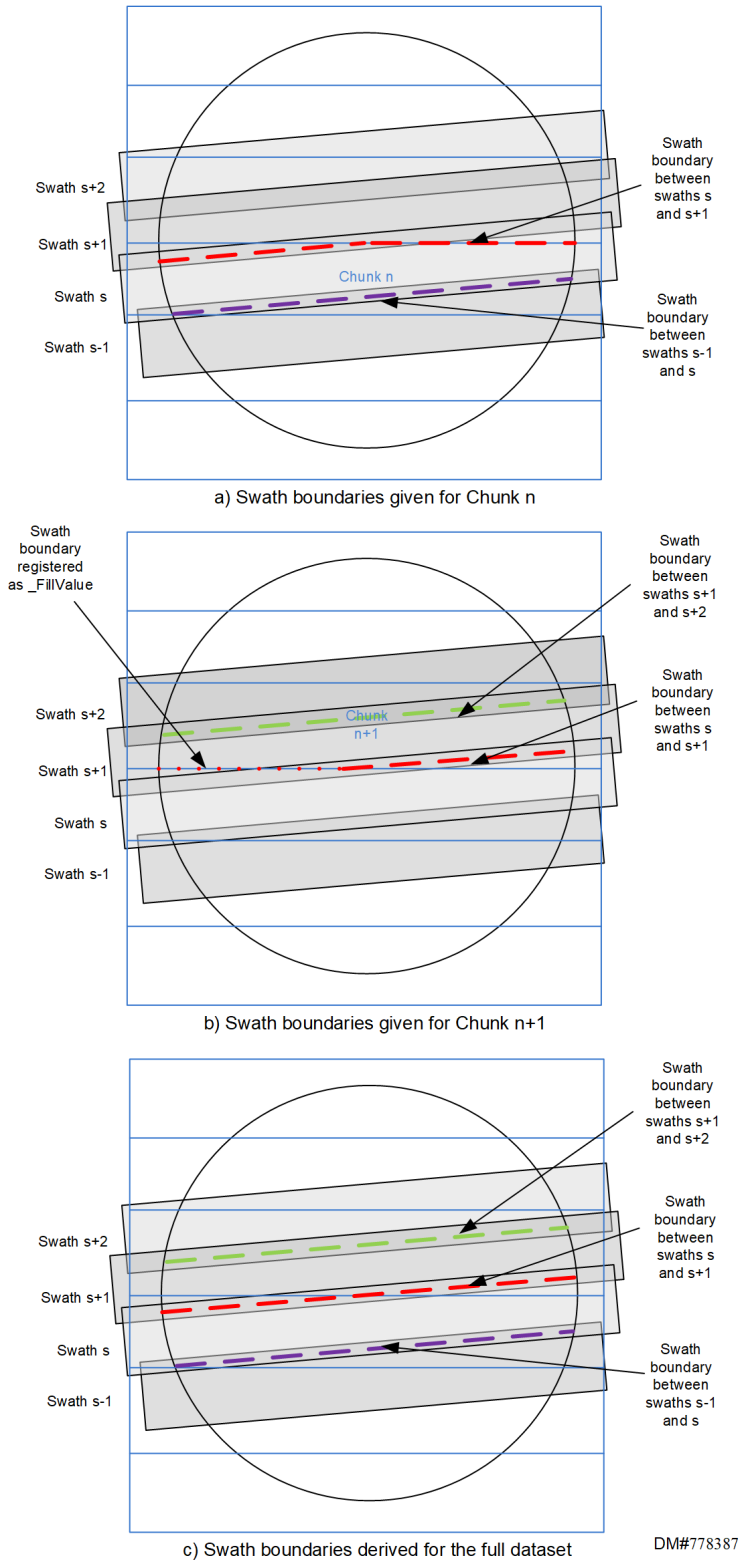


Figure** 12 **Swath boundary for chunks and trailer

In instances where a packet of data is missing from the telemetry downlinked from the satellite an area of effective_radiance values will be generated that are set to the_FillValue. In areas where there is a swath overlap with the next/previous swath, and in case the next/previous

swath data is not missing, the missing data will be replaced with data measured from the next/previous swath, as illustrated in Figure 13.

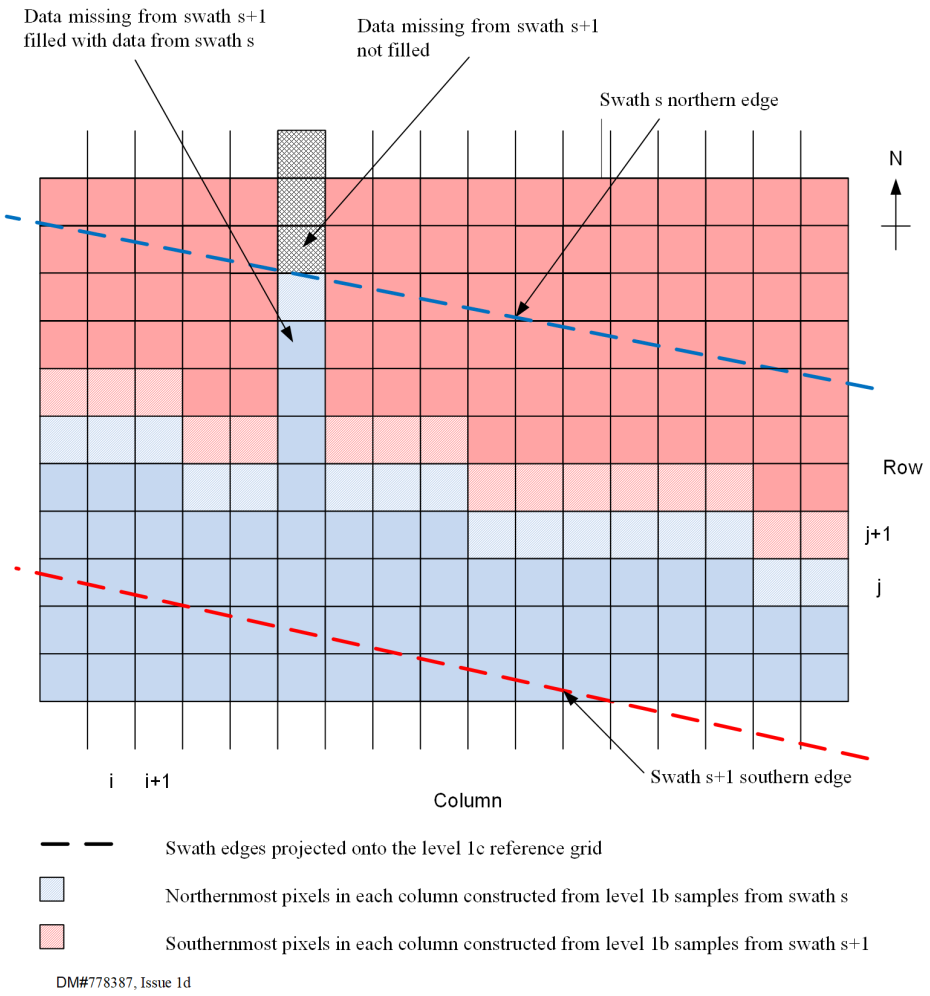


Figure 13 Swath boundary appearing in the level 1c grid including filling of missing data

7.9 Index Mapping

Within the "measurement" group for each channel an array, the *index_map*, is introduced in which an index is recorded per pixel. The index represents an integer number of time intervals from the start of the repeat cycle. The default time interval is 0.1s, but can be modified within the range 0.01 to 1s by the ground processing, if needed.
A collection of geometric parameters is included within the data and is applicable to all channel data groups. The geometric parameters are *data.swath_direction*, *data.swath_number*, *time* (of acquisition), *state.platform.subsatellite_latitude*, *state.platform.subsatellite_longitude*, *state.platform.platform_altitude* (of the satellite), *state.celestial.subsolar_latitude, state.celestial.subsolar_longitude*, *state.celestial.earth_sun_distance,* and *state.celestial.sun_satellite_distance*. They all have the dimension index. The geometric parameters are calculated for each of the time intervals covered during the repeat cycle. Using the index value from the *index_map* for a particular pixel the geometrical parameters applicable at the time of acquisition of that pixel can be established, as indicated in Figure 14. The values

of *data.swath_number* and *data.swath_direction* are taken from the reference scan law. The value of *data.swath_direction* is set to 0 for East-to-West scans, to 1 for West-to-East scans, and 2 during u-turns and retrace.
Attention is paid to ensure no _FillValue index is referenced by an Earth pixel in the *index_map,* except in the case of missing data.

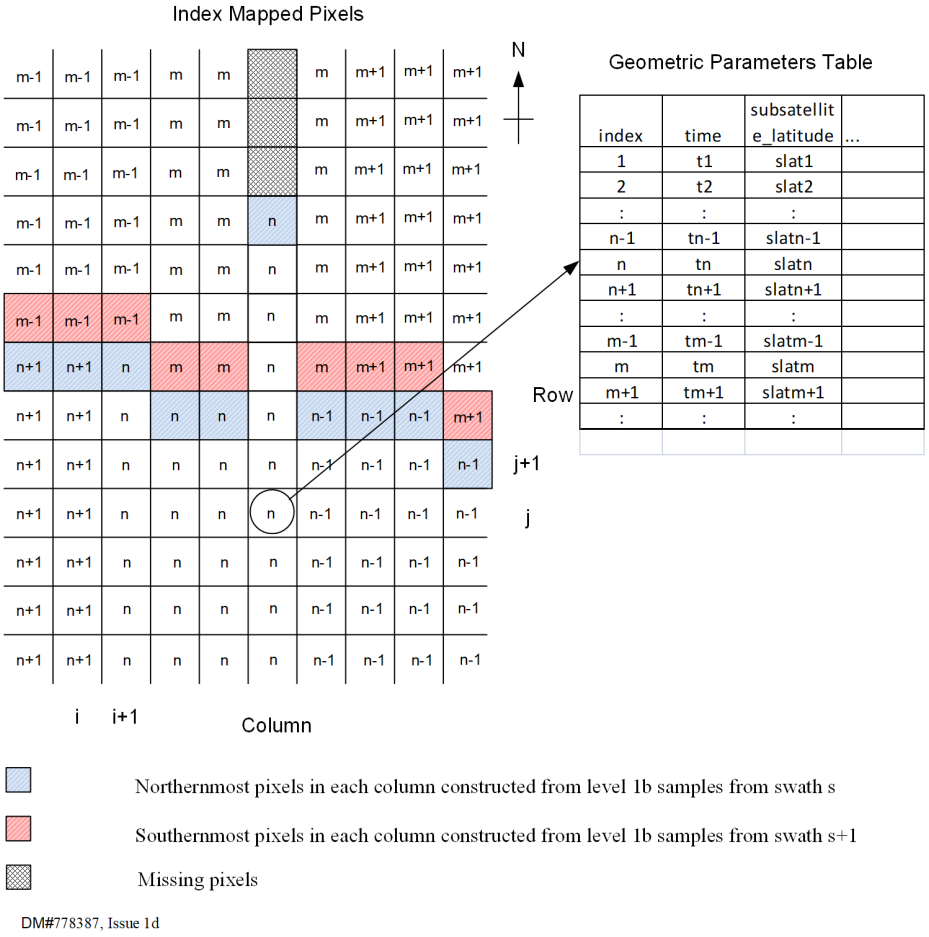


Figure 14 Pixel index mapping relationship to the geometric parameters table

7.10 Radiance Encoding

The "measured" group includes the level 1c science data. The 12 (resp. 13 for IR3.8) bits of the netCDF 16-bit integer are used to encode and compress the effective radiance for all spectral channels except the IR 3.8 channel. Attributes scale_factor and add_offset are used to rescale the 12-bit counts to an effective radiance in units of $mWm^{-2}sr^{-1}(cm^{-1})^{-1}$:

$$radiance = (counts * scale\_factor) + add\_offset$$

The attributes *scale_factor* and *add_offset* are standard for netCDF files. If present for a variable, *add_offset* is to be added to the data after it is read by the application that accesses the data. If both *scale_factor* and *add_offset* attributes are present, the data are first scaled before the offset is added.

The IR 3.8 channel is a special case. Instead of 12 bit as for the other spectral channels, 13 bit are used to store the data. For IR3.8 the additional attributes *valid_cold_range*, *warm_scale_factor* and *warm_add_offset* are used to encode and compress the counts above 2^{12}-1 (4095) to cover the extended radiometric range. For counts below and equal to 4095, the same conversion with *scale_factor* and *add_offset* as for the other channels is used (Figure 15).

radiance = *(counts * scale_factor) + add_offset* for counts below or equal to 4095
radiance = *(counts * warm_scale_factor) + warm_add_offset* for counts above 4095

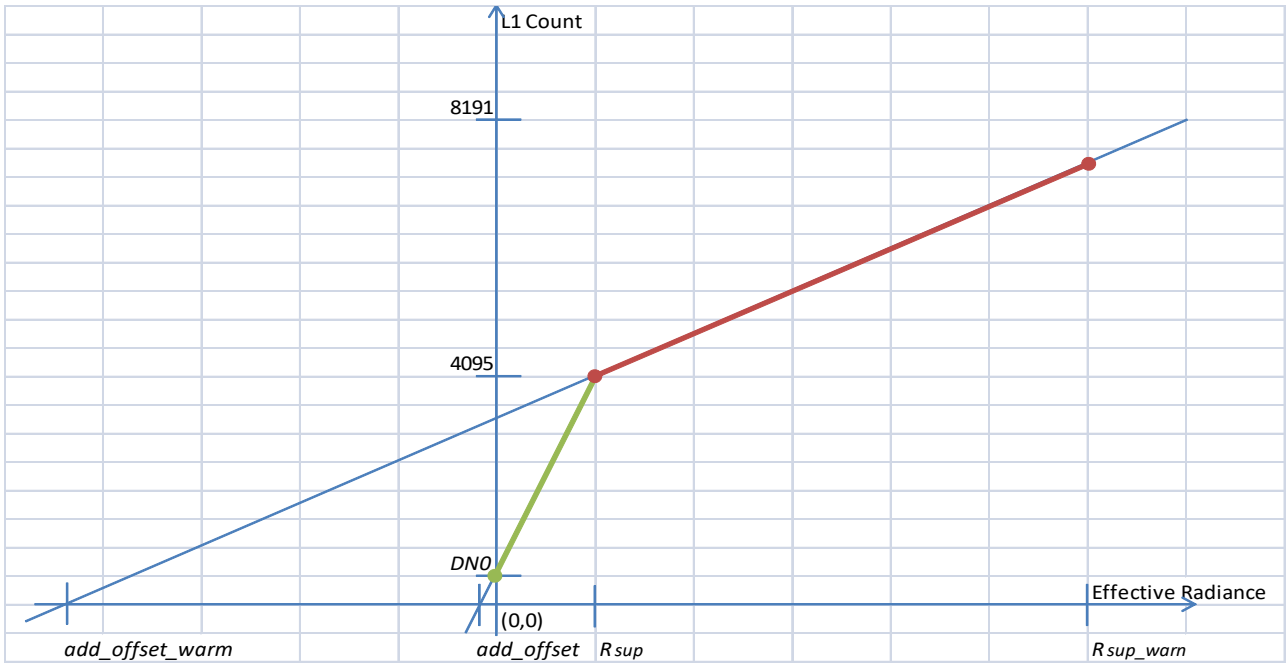


Figure 15 Illustration of the encoding of the combined IR 3.8m channel with offsets and scale factors for the "cold" (green) and "warm" (red) measurements

_FillValue will be used for data that cannot be produced due to missing level 0 data. The conversion from effective radiance into brightness temperatures and reflectances is described in Sections 8.4 and 8.5, respectively.

7.11 Pixel Quality

An 8 bit *pixel_quality* variable, associated with each effective_radiance, is provided in the measurement group. The possible values are given in Table 9.

Bit	***Name***	***Interpretation***
0	missing_warning	Pixel has a contribution from missing samples following rectification.

1	radiometric_warning	Pixel may have radiometric errors due to a contribution from samples with radiometric errors following rectification. Radiometric errors in this sense arise from calibration processes occurring during the repeat cycle that do not impact the calibration of the complete repeat cycle.
2	noise_warning	Pixel may be noisy (have a non-nominal noise level) due to a contribution from noisy samples following rectification.
3	geolocation_warning	Pixel may not have a very accurate geolocation since missing geometric data have been interpolated to compute it.
4	saturation_warning	Pixel has a contribution from saturated samples following rectification.
5	straylight_correction_warning	Pixel has a contribution from samples corrected for solar stray light contamination
6	extended_dynamic_range_warning	For the IR3.8 channel only: Pixel has a contribution from samples selected from the FAIR3.8 detector measurements (cf. Section 5.4)
7	encoding_saturation_warning	Pixel is saturated from the process of encoding into 12-bits (13-bits for FAIR3.8).

Table 9 Description of the quality flags in the pixel_quality variable

7.12 Special Compression

In order to reduce the size of the FCI-1C-RRAD dataset, a compression is applied by default to the variables *effective_radiance*, *pixel_quality* and *index_map*. In order to achieve greater compression than allowed by the default netCDF zipping algorithms, disemminated L1c datasets will use CharLS compression implemented at the HDF layer. Once the releveant decompression module is installed at the user side, decompression will be transparent to the user. See Section 8.10.

7.13 FCI-1C-RRAD Trailer Chunk

The groups available, to the FDHSI and HRFI subtypes, in the FCI level 1c Trailer data chunk are given in Table 10, with the nesting applied given in Figure 16.

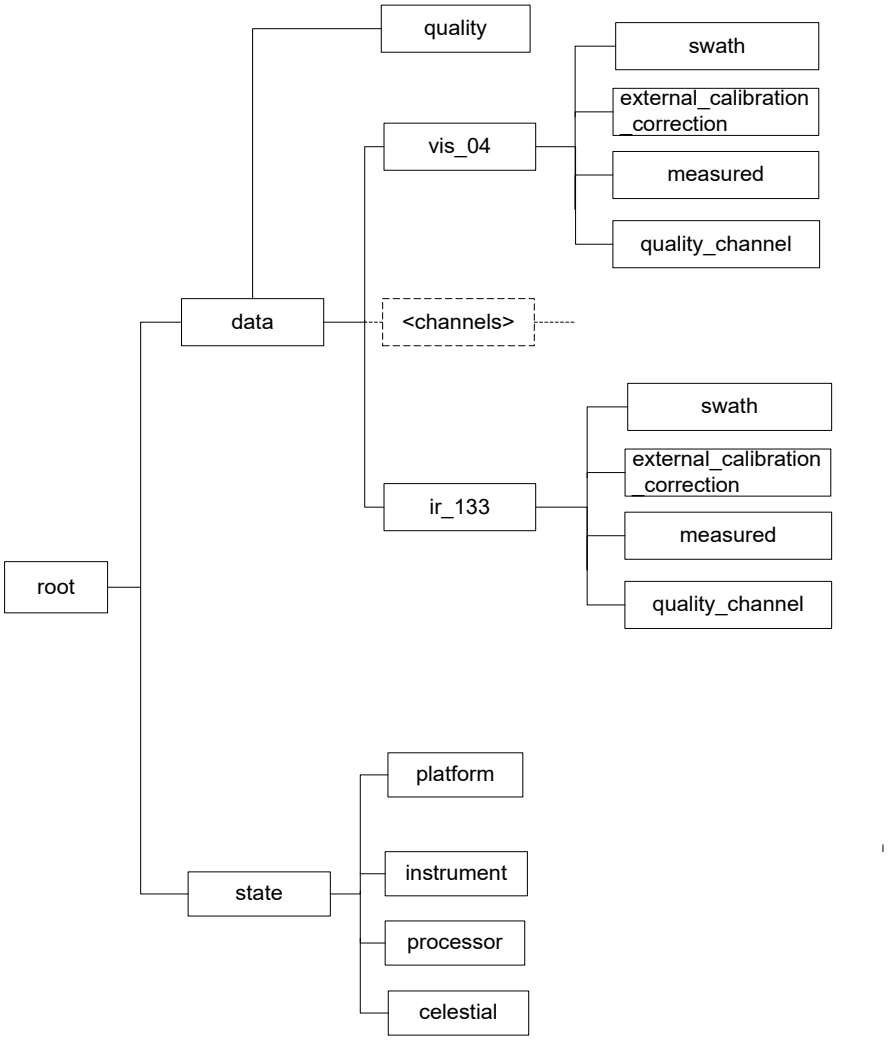


Figure 16 Overview of netCDF groups in the FCI L1c trailer chunk file for an FDHSI dataset

Group			Description
Generic Type		**netCDF Name**	
		root	Root level metadata
		data	Information common to all channels
"channel" groups	FDHSI	vis_04 vis_05 vis_06 vis_08 vis_09 nir_13	All "channel" groups share a common generic format and contain information specific to that channel.

		nir_16 nir_22 ir_38 wv_63 wv_73 ir_87 ir_97 ir_105 ir_123 ir_133	FDHSI channel groups are found in the FDHSI dataset.
	HRFI	vis_06_hr nir_22_hr ir_38_hr ir_105_hr	HRFI channel groups are found in the HRFI dataset.
		swath	Swath information for the repeat cycle
		measured	Metadata about the measured radiances
		quality	Associated repeat cycle quality information common to all channels
		quality_channel	Associated repeat cycle quality information specific to a channel
		external_calibration_ coefficients	GSICS radiance corrections
		state	State information
		platform	Satellite state information
		instrument	Instrument state information
		processor	Processor state information
		celestial	Celestial state information

Table 10 Description of the groups in an FCI L1c trailer chunk

7.14 Example file names

As mentioned above, the FCI-1C-RRAD dataset covers the full repeat cycle and is divided into a series individual files or "chunks" for timely dissemination. Table 11 shows an example of FCI Level 1c RRAD files names for one swath assuming a total number of 40 body chunks. The 40 body chunk files are numbered from 1 to 40 and the single trailer chunk file has the number 41.

W_XX-*IMG+SAT,MTI1+FCI-1C-RRAD-FDHSI-FD--CHK-BODY--*_0001.nc
W_XX-*IMG+SAT,MTI1+FCI-1C-RRAD-FDHSI-FD--CHK-BODY--*_0002.nc
W_XX-*IMG+SAT,MTI1+FCI-1C-RRAD-FDHSI-FD--CHK-BODY--*_0003.nc
……..
W_XX-*IMG+SAT,MTI1+FCI-1C-RRAD-FDHSI-FD--CHK-BODY--*_0040.nc
W_XX-*IMG+SAT,MTI1+FCI-1C-RRAD-FDHSI-FD--CHK-**TRAIL**--*_00**41**.nc

Table 11 Example FCI Level 1c datasets file names

8 FCI L1 DATASET USAGE

8.1 Reconstructing Reference Grids

Pixel-related data (radiances and pixel quality flags) do not have associated geolocation coordinate variables included in the product in order to reduce the size of the product.

NetCDF Climate and Forecast (CF) convention grid_mapping variables for the geostationary projection are included in the product to allow CF-Convention-aware tools to geolocate the grid_mapping associated variables (cf. variable *data.mtg_geos_projection*). In addition, the pixel positions are provided as coordinate variables *data.<channel>.measured.x* (X coordinate in mtg_geos_projection, corresponding to the azimuth direction) and *data.<channel>.measured.y* (Y coordinate in mtg_geos_projection, corresponding to the elevation direction). Their raw counts (packed values) correspond to the column and row numbers, respectively.

Alternatively, the geolocation grids may be calculated and associated to the variables using the equations given in Section 5.2 and the relevant parameters included in the product. The variables *reference_grid_spatial_sampling_angle_ns* and *reference_grid_spatial_sampling_angle_ew* contain the value for *Azimuth_Grid_Sampling and Elevation_Grid_Sampling* in radians units, respectively. Note that the equations in Section 5.2 assume pixel positions start at (1,1) and not (0,0) so the array indexing of the particular programming language used for constructing the grids should be taken into account if the coordinate variable values are not used.

Note that the azimuth and elevation scanning angles for the geostationary projection reference grid can be arbitrarily defined in two ways, depending on which of the two rotation axes is kept to a fixed orientation during the scanning. The geometry selected by EUMETSAT can be recognized in Figure 9. Here, the azimuth scanning (rotation by the angle λ_S) is performed around the fixed axis S3, while the elevation scanning (rotation by the angle ϕ_S) is performed around the rotated axis S2' (S2 rotated by λ_S). The alternative geometry would perform the elevation scanning ϕ_S around the fixed axis S2, and the azimuth scanning λ_S around the rotated axis S3' (S3 rotated by ϕ_S). This ambiguity is adressed in the CF-convention by the sweep angle axis variable (product variable *data.mtg_geos_projection.sweep_angle_axis*). For its geostationary products, EUMETSAT adopts the geometry corresponding to sweep angle axis equal to "y".

8.2 Unpacking Coded Radiances

Radiances are stored in a compressed form as integer values with associated offsets and scale factors as per the standard (see CF conventions [CF]). However, the extended 3.8 channel has an additional set of offset and scale factors that have been used to compress the data into 13 bits. These need to be unpacked as per the explanation in Section 7.10.

8.3 Effective Radiance Unit Conversion

Radiances in the FCI L1c dataset (variable *effective_radiance*) have units of mW.m-2.sr-1.(cm-1)-1. If these radiances are multiplied with the variable *data.<channel>.measured.radiance_unit_conversion_coefficient*, the effective radiances in units W.m-2.sr-1.µm-1 are obtained.

8.4 Converting from Effective Radiance to Brightness Temperature for IR Channels

The effective brightness temperature of a surface is the temperature of a spatially uniform blackbody that emits the equivalent amount of radiant energy as the surface within a spectral band characterized by the spectral response function of the instrument. Given the band-average spectral radiance per wavenumber $\overline{L_v}$, i.e. the effective radiance determined in Section 7.10, the effective brightness temperature T_{eff} can be approximated as follows:

$$T_{eff} = \frac{c_2 \cdot \nu_c}{a \cdot \ln\left(1 + \frac{c_1 \cdot \nu_c^{\,3}}{\overline{L_\nu}}\right)} - \frac{b}{a}$$

The set of coefficients {ν_c, a, b}, corresponding to a given spectral response function, are found by regression over the required range of temperatures. Constants $c_1 = 2hc^2$ and $c_2 = hc/k$ are radiation constants where c, h, and k are the speed of light, Planck, and Boltzmann constant, respectively.

The variable *data.<channel>.measured. radiance_to_bt_conversion_coefficient_wavenumber* contains the wavenumber corresponding to ν_c.

The variables *data.<channel>.measured.radiance_to_bt_conversion_coefficient_a* and *data.<channel>.measured.radiance_to_bt_conversion_coefficient_b* contain the conversion coefficients a and b for IR channels, respectively. They are set to the _FillValue for VNIR channels.

The variables *data.<channel>.measured.radiance_to_bt_conversion_constant_c1* and *data.<channel>.measured.radiance_to_bt_conversion_constant_c2* contain the constants c_1 and c_2 for IR channels. Note that the values given in the dataset are $c_1=2\cdot10^{11}\cdot hc^2$ =1.19104282E-05 and c2=100 hc/k=1.43877513 due to unit conversions. They are set to the _FillValue for visible and near-infrared channels.

8.5 Converting from Effective Radiance to Reflectance for VNIR Channels

The Bidirectional Reflectance Factor (BRF) for the FCI VIS-NIR channels can be calculated as follows:

$$r_{\lambda_i} = \frac{\pi \cdot R_{\lambda_i} \cdot d^2(t)}{I_{\lambda_i} \cdot \cos(\theta(t,x))}$$

Where

- *i* is the channel number

- r_{λ_i} is the Bidirectional Reflectance Factor (BRF) for the channel λ_i
- R_{λ_i} is the measured radiance in $mW \cdot m^{-2} \cdot sr^{-1} \cdot (cm^{-1})^{-1}$, i.e. the effective radiance determined in Section 7.10
- *d(t)* is the Sun-Earth distance in AU at time t
- I_{λ_i} is the channel solar irradiance for the channel λ_i at 1 AU in $mW \cdot m^{-2} \cdot (cm^{-1})^{-1}$
- *θ(t,x)* is the Solar Zenith Angle in Radians at time t and location x

The variable *data.<channel>.measured.channel_effective_solar_irradiance* contains the channel effective solar irradiance at 1 AU to be used in the derivation of the reflectance. The variable is set to _FillValue for IR spectral channels.

The vector variable *state.celestial.earth_sun_distance,* in combination with the index map, can be used to extract the precise Sun-Earth distance in km at the acquisition time of each pixel (see section 7.9).

The definition of BRF follows the nomenclature in [Schaepman-Strub] for a Lambertian surface:

$$BRF = \pi \cdot BRDF = \frac{dL_r}{dE_i}$$

with

$$dL_r = R_{\lambda_i}$$

$$dE_i = \frac{I_{\lambda_i} \cdot cos(\theta(t,x))}{d^2(t)}$$

8.6 Radiometric Noise Assessment

[Information to be added in a later issue]

8.7 Radiometric Accuracy Assessment

[Information to be added in a later issue]

8.8 Recombining Chunks

As noted in Section 7, each FCI Level 1 repeat cycle dataset (either FDHSI or HRFI) is distributed as a set of multiple netCDF files referred to as chunks. There are 2 types of chunks: “body” and “trailer”. Typically, a FDHSI product will consist of 40 body chunks, and a HRFI product up to 13 body chunks. Both products have final trailer chunk containing repeat cycle-based information.

The *start_position_column*, *start_position_row*, *end_position_column* and *end_position_row* variables within the *data.<channel>.measured* group may be used to locate the pixel-based data (radiances, index map and pixel-quality flags) in each chunk with the correct position in the Level 1c reference grid (see Section 5.2 and Figure 17).

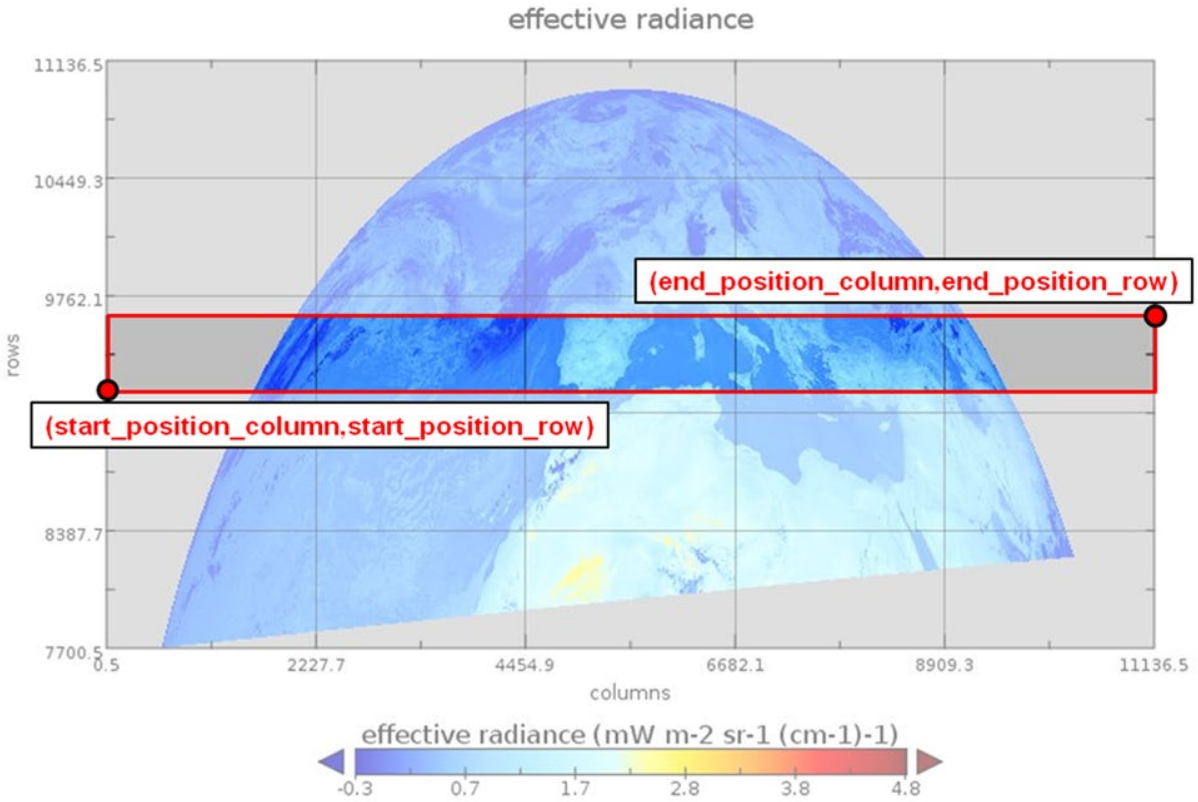


Figure 17 Illustration of the location of a typical body chunk within a LAC 4 repeat cycle dataset. The scan direction is from West to East.

In addition, each of pixel-based variables are linked to row and column 2D coordinate variables (as per the CF conventions [CF]) that contain the position of the pixel in the reference grid. These coordinate variables can also be used to locate the chunk within the reference grid and should allow CF-aware tools to combine the chunks into a complete repeat cycle image. However, at the time of this issue, this functionality appears to be available only for geolocated datasets.

The user currently has three paths to recombine the chunks into a complete repeat cycle image for each channel:

1. Create arrays based on the correct-sized reference grid for each channel and copy the pixel data into the correct area of the grid based upon either the associated corner coordinate variables or the linked 2D coordinate variable in the coordinate attribute.
2. Extend the method of option (1) by also geolocating the reference grid by calculating the relevant latitude and longitude variables, and associating them as 2D coordinate variables with the pixel data. This may require the creation of a new netCDF file on disk or, if supported by the netCDF libraries, a netCDF object in memory.

8.9 Special Compression of Radiances, Index Map and Quality Flags

If the special_compression field in the filename (see Table 5) is set to "JLS", then the *effective_radiance*, *index_map* and *pixel_quality* variables in the dataset have been compressed using the CharLS algorithm, a fast lossless JPEG compression. The user is required to download and install the HDF-5 dynamically loaded filter for CharLS decompression (noting that the netCDF-4 datasets use HDF-5 as their storage layer). This is currently available via the EUMETSAT website ([MTG-UserTestDataReleases]) and comes with an installation guide. More information about the decompression can be found in Appendix C.2.3.

8.10 Radiometric Noise and Accuracy Look-Up Tables

The trailer chunk contains radiometric noise look-up tables for each channel presented as pairs of arrays, where their elements represent (x,y):

1. The estimated noise for a given radiance is represented by the arrays
   data.<channel>.measured.radiometric_noise_lut_radiance (x-axis) and the
   data.<channel>.measured.radiometric_noise_lut_noise (y-axis).

8.11 Timing Information

The Coordinated Universal Time (UTC) associated to each pixel is given by the global variable *time* using the index provided by the variable *index_map* (Section 7.9) provide in the FCI L1c body chunks.

9 NEAR REALTIME PRODUCT DISSEMINATION

EUMETCast is EUMETSAT's primary dissemination mechanism for the near real-time delivery of satellite data and products. It uses commercial telecommunication geostationary satellites using DVB standards and research networks to multi-cast data and products to the user community.

FCI Level 1c FDHSI channels from the FCI-FDSS and FCI-RSS services products will be disseminated via the EUMETCast services. They will be sent as a stream of data chunks in order to achieve better timeliness and efficiency (as described in Section 7.3.1). The stream will consists of a number of body chunks (around 40 for the FDSS) each containing a similar number of grid lines but of varying duration (ranging from about 4 to 10 seconds) and a trailer chunk containing information pertaining to the complete repeat cycle. The dissemination baseline is described in [MTGDIS].

Due to the parallelised nature of the FCI Level 1 processing and the varying duration of the chunks, there is a possibility that chunks may arrive out of order, with later, shorter chunks arriving before earlier, longer chunks. In addition, the trailer chunk may not be the last chunk from the repeat cycle to arrive, and under some circumstances, chunks from repeat cycle N+1 may start to arrive before the last chunk from repeat cycle N has been received.

The FCI L1C format has a number of features to help handle these issues.

1. Each body chunk is a self-contained and independent of the other body chunks
2. The noise look-up-table appropriate for repeat cycle N is sent in the trailer chunk of repeat cycle N-1
3. Each chunk has a counter field in the name and a root metadata attribute called count_in_repeat_cycle that indicates the nominal chunk count. This is a fixed value for a given coverage and increments nominally from 1 to N for the body chunks, with the trailer chunk being assigned the value N+1. Any gaps in this counter indicates missing chunks.
4. Each chunk has root metadata attribute called processed_count_in_repeat_cycle that contains the count of processed chunks. If this is the same as the count_in_repeat_cycle counter, then it indicates that all expected chunks have been processed and that any currently missing chunks should be disseminated. If this counter is less than the count_in_repeat_cycle counter, then it indicates that some chunks have not been processed, most likely due to missing level 0 data, and that a complete repeat cycle will not be disseminated.
5. The trailer chunk contains a list of chunk names of all body chunks comprising the repeat cycle.

APPENDIX A FORMAT DESCRIPTIONS

This Appendix shows the content of the body (A.1) and trailer (A.1) files following the structure of Figure 10 and Figure 16.

A.1 Common Definitions

A.1.1 Enumerated Types

Name	Type	Description	Value	String
manoeuvre_type	ubyte	Indicates type of manoeuvre		
		No manouevre	0	None
		North-South Station Keeping	1	NSSK
		East-West Station Keeping	2	EWSK
		Station Relocation	3	SR
		Momentum Unloading	4	MU
reference_frame_type	ubyte	Reference frame for the manoeuvre parameters		
			0	undefined
			1	GCRF
			2	EME2000
			3	ITRF2008
			4	TDR
			5	TEME
			6	TOD

			7	RTN
boolean	ubyte	boolean type - two states		
			0	false
			1	true
trilean	ubyte	trilean type - three states		
			0	false
			1	true
			2	undefined
auxiliary_dataset_status_type	ubyte	Possible states for an auxiliary dataset used in processing		
		OK	0	OK
		dataset was used but was out of its stated validity time	1	out_of_validity_time
		auxiliary dataset was not available	2	not_available
yaw_flip_type	ubyte	Possible yaw flip states of the platform		
			0	winter
			1	summer
fci_mode_type	ubyte	Mode of FCI instrument		
		Scan Encoder Calibration	18	Scan_Encoder_Calibration
		Refocusing	19	Refocusing
		Observation	41	Observation

		Decontamination	42	Decontamination
		Decontamination – Cool Down	43	Decontamination_Cool_Down
		Decontamination – Wait	44	Decontamination_Wait
resampling_method_type	ubyte	Resampling mehtod		
			0	TruncatedShannon8
			1	TruncatedShannon16
			2	BiCubicSpline
			3	NUFTTiteration
			4	NearestNeighbour
weighting_function_type	ubyte	Weighting Function		
			0	None
			1	Kaiser
			2	Hamming
projection_type	ubyte	Projection		
			0	geostationary
channel_status_type	ubyte	Channel Status		
			0	nominal
			1	non-nominal
filtering_mode_type	ubyte	Filtering mode		
			0	Kalman
			1	Batch
			2	Navig
			3	Navig_Kalman
			4	Navig_Batch
			255	Unknown
inr_mode_type	ubyte	INR mode		
			0	Slave
			1	Cooperative

			2	FCI_only
			3	LI_only
landmark_type_type	ubyte			
			0	none
			1	navigation
			2	verification
		navigation and verification	3	nav_and_verif
illumination_type	ubyte			
			0	day
			1	night
			2	twilight
landmark_rejection_criteria_type	ubyte			
			0	not_rejected
			1	insufficient_uniqueness_ratio
			2	local_cloud_test_failed
			3	unsuccessful_ellipse_ratio_computation
			4	insufficient_maximum_correlation_value
			5	insufficient_ellipse_ratio
			6	insufficient_contrast
			7	insufficient_QM_value
			8	no_valid_relative_error_measurement
			9	measurement_inconsistency_test_failed
star_rejection_criteria_type	ubyte			
			0	not_rejected
			1	out_of_bounds
			2	statistical_rejection
			3	no_available_star
			4	multiple_available_stars
			5	missing_SCI_samples

			6	oversaturated_samples
			7	undersaturated_samples
			8	missing_DefSRD_sample
			9	missing_SAC_or_AOCS_samples
			10	detection_error
			11	insufficient_first_to_second_peak_ratio
			12	other_error
swath_direction_type	ubyte			
			0	East to West
			1	West to East
			2	retrace
ssd_type	ubyte			
			0	0.5km
			1	1km
			2	2km
yaw_flip_type	ubyte			
			0	winter
			1	summer
mnd_type	ubyte			
			0	no MND
			1	nominal MND
			2	reference MND

A.1.2 Bit Masks

Name	Type	Bit	String	Description	Meaning	Range
pixel_quality	byte					255

		0	missing_warning	Pixel has a contribution from missing samples following rectification.	missing_warning missing_warning (L1B) propagated at L1C. At L1B: flag missingSCI_grid in FCI geoloc grid	1
		1	radiometric_warning	Pixel may have radiometric errors due to a contribution from samples with radiometric errors following rectification. Radiometric errors in this sense arise from calibration activities occurring during the repeat cycle that do not impact the calibration of the complete repeat cycle, e.g. offset computation: deep space skipped due to Sun light pollution or Moon intrusion, insufficient number of valid deep space samples.	radiometric_warning: radiometric_warning (L1B) propagated at L1C. At L1B: flag missingRAD_grid in FCI geoloc grid	2
		2	noise_warning	Pixel may be noisy (have a non-nominal noise level) due to a	noise_warning: noise_warning (L1B) propagated at L1C. At L1B: from [IDPFI-FCI-SPS-1.0.3.6] output	4

				contribution from noisy samples following rectification.	FLAG_NOISE_WARNING_L1PROD[i] (same value for all samples acquired with a detector[i]) FCI-1-DPP-RADVNIR Use variable radiometric_noise_lut_flag_detector defined in FCI-1-DPP-RADVNIR (VNIR channels) and FCI-1-DPP-RADIR (IR channels)	
		3	geolocation_warning	Pixel may not have a very accurate geolocation since it has been computed using interpolated data.	geolocation_warning: flag missingGEOLOC in FCI geoloc grid propagated at L1C	8
		4	saturation_warning	Pixel has a contribution from saturated samples following rectification.	saturation_warning: under_saturated_warning (L1B) + over_saturated_warning(L1B) propagated at L1C. At L1B: flags underSaturated_grid and overSaturated_grid in FCI geoloc grid	16
		5	straylight_correction_warning	Pixel has a contribution from samples that have been corrected for solar stray light contamination (above a set threshold).	straylight_correction_warning: straylight_correction_warning (L1B) propagated at L1C At L1B: flag_correct_SSL_L1B in SSL correction algorithm (TAF-FCI-L1PP-CAL-015)	32

		6	extended_dynamic_range_warning	For the IR3.8 channel only: Pixel has a contribution from samples selected from the FAIR3.8 detector measurements	extended_dynamic_range_warning: pixel has a contribution from samples selected from the FAIR3.8 detector measurements (for merged IR3.8 only)	64
		7	encoding_saturation_warning	Pixel is saturated from the process of encoding into 12-bits (13-bits for FAIR3.8).	encoding_saturation_warning: pixel is saturated from the process of encoding into 12-bits (13-bits for FAIR3.8)	128

A.2 FCI-1C-RRAD-BODY

A.2.1 Group:root (/)

Dimensions

Name	Description	Type	Values	Shape
index	Length of geometric data vectors			
number_of_l0_channels	Number of data channels delivered by the FCI instrument used to create the level 1c data [17 if all channels are present, otherwise set at according to the channels available from the instrument]		configured_value	
number_of_l1c_channels	Number of spectral channels present in the originally generated dataset [16 if all FDHSI channels are present, 4 if all HRFI channels are present, otherwise set according to the selected/available channels]		configured_value	
number_of_reference_grids	Number of reference grid used by the		2	

	channels [default 2]. Note although 3 different grid exist for the FCI there are only 2 per mission (FDHSI/HRFI)			

User Types

Name	Description	Type	Values	Shape
boolean	See Enums spreadsheet There is no boolean type in netCDF. This enumerated type at root level can be used by all datasets/products. This user type definition only needs to be present when it is used within the dataset.	enum byte	See Enums table	
trilean	See Enums spreadsheet For situations where an undefined state is also required. This user type definition only needs to be present when it is used within the dataset.	enum byte	See Enums table	
ssd_type	Index based on the SSD size to select SSD-related data from	ubyte enum	see Enums table	

	arrays e.f. reference grid info			
swath_direction_type	Identified the direction of swath acquisition from East to West or West to East.	ubyte enum	see Enums table	

Global Attributes

Name	Description	Type	Values	Shape
Conventions	Conventions that the product conforms to. This could be a future version of the CF Conventions that is applicable to netCDF4.	string	e.g."CF-1.7"	
title	Dataset/product name	string		
summary	As defined in the relevant dataset/product format specification.	string		
keywords	As defined in the relevant dataset/product format specification.	string		
keywords_vocabulary	As defined in the relevant dataset/product format specification.	string		
history	As per [CF]	string	“original generated file”	
institution	This field may be extended with other values should datasets/products be generated in other locations.	string	“EUMETSAT”	
location_indicator	As per the dataset name field” location_indicator” in dataset name	string		
data_designator	As per the dataset name field “data_designator” in dataset name	string		
platform	As per the dataset name field “spacecraft” in dataset name. Renamed in line with Attribute Convention for Dataset Discovery	string		

data_source	As per the dataset name field “data_source” in dataset name	string		
processing_level	As per the dataset name field “level” in dataset name	string		
coverage	As per the dataset name field “coverage” in dataset name	string		
type	As per the dataset name field “type” in dataset name	string		
subtype	As per the dataset name field “subtype” in dataset name	string		
component1	As per the dataset name field “component1” in dataset name	string		
component2	As per the dataset name field “component2” in dataset name	string		
component3	As per the dataset name field “component3” in dataset name	string		
product_id	The identifying product_id as used in the SIP	string		
baseline_version	Baseline version. The baseline version will reference of all other version numbers. Assumes processor_version is not sufficient for this.	string		
release_version	Release version. Used to tag datasets that can be considered to have a contiguous consistency sufficient for example, for consideration as a climate set.	string		
processor_version	Processor version. Currently assumes a single processor version number suffices for the relevant IDPF or L2PP. Currently undefined if processor version also includes configuration of static auxiliary data and processor switch configuration, etc.	string		
algorithm_version	Algorithm version. Currently unclear how this would be used and it may be redundant with processor_version.	string		
format_version	Format version of the dataset/product.	string		

time_coverage_start	As per the dataset name field “start_time” in dataset name. Renamed in line with Attribute Convention for Dataset Discovery	string		
time_coverage_end	As per the dataset name field “end_time” in dataset name. Renamed in line with Attribute Convention for Dataset Discovery	string		
processing_mode	As per the dataset name field “processing_mode” in dataset name	string		
special_compression	As per the dataset name field “special_compression” in dataset name	string		
subsetting	If this field is empty then no further strings follow. If this value is a single specified internal compression method as listed in the “special_compression” field in dataset name then it is followed by two strings: (1) human-readable parameters describing the exact internal compression performed (2) either a URL providing a description of the internal compression method or the words “NO URL”. If the value is “MULTI”, then this is followed by sets of triplets of strings (one per internal compression applied) A triplet consists of: (1) an internal compression code as listed in the “special_compression” field dataset name ; (2) human-readable parameters describing the exact internal compression performed; (3) either a URL providing a description of the internal compression method or the words “NO URL”.	string		
disposition_mode	As per the dataset/product name field “disposition_mode” in dataset name	string		
source	Characterisation of the type of data as per [CF].	string		

runtime_data	Space-separated string array of the SIP names of all nonproduct input datasets used in the creation of the dataset (auxiliary data, configuration file, DPP files, etc.) (Was part of <source> field)	string	<runtime_value>	
parent_data	Space-separated string array of the SIP names of all parent products/datasets used in the creation of the dataset (Was part of <source> field)	string		
linked_data	Space-separated string array of the SIP names of all datasets to be linked with this dataset in the archive (e.g. for a Level 0 dataset this would be all additional datasets required to create the virtual L0+ dataset in the archive). (Was part of <source> field)	string		
facility_or_tool	As per the dataset name field "facility_or_tool" in dataset name	string		
environment	As per the dataset name field "environment" in dataset name	string		
references	"www.eumetsat.int"	string		
comment	Unless otherwise specified in the relevant dataset/product format specification, "None."	string		
date_created	UTC time of processing formatted in Abbreviated Generalised Time format and defined as the time of the formatting of the dataset/product by the processor. Renamed in line with Attribute Convention for Dataset Discovery	string		
group_tag	String that represents a grouping of datasets that allows chunks and quick-looks to be linked together. The string has the format: <platform>_<datsource>_<processing_level>_<type>_<subtype>_YYYY_DDD_NNNN_<release_version> where: <> indicates the same value as the named global metadata field in the brackets (as described in this table) YYYY = the year value of the "repeat_cycle_time_position" field DDD = day in year value derived from the	string		

	"repeat_cycle_time_position " field, left padded with zeroes: 001 = Jan 1st, etc. NNNN = copy of the "repeat_cycle_in_day" field			
repeat_cycle_in_day	4-digit number (right-justified, zero-filled) indicating the expected current repeat cycle or group accumulation interval in the day for this particular dataset. For details on how to determine the expected repeat cycle see [EXPRC]. The counter starts at 0001 for the first repeat cycle at or after midnight (based on the time_position value) and resets for the next repeat cycle at or after the following midnight. Datasets/products that have no repeat cycle or group accumulation interval (e.g. certain DPP files) should use a fixed value of 0000 to indicate the field is not applicable.	strin g		
processed_count_in_repeat _cycle	Cumulative count of the dataset chunk in the repeat cycle or group accumulation interval. Resets when the repeat_cycle_in_day value changes. The counter increments for each created chunk in a repeat cycle or accumulation interval. It does not increment when a chunk is not created due to missing parent data.	strin g		
count_in_repeat_cycle	4-digit number (right-justified, zero-filled) indicating the expected count value of the dataset chunk in the repeat cycle or group accumulation interval based on the scan pattern or equivalent information. The counter will have discontinuties when chunks are not produced. The counter starts from 1 and resets when the repeat_cycle_in_day value changes. The counter increments for each chunk in a repeat cycle or accumulation interval (whether header, body or trailer). A value of 0 is used for datasets for which the counter is not applicble (e.g. datasets which are not chunk-able).	strin g		
instrument_configuration_i d	List of space-separated values of the "instrument configuration identifier" from the level 0 data ICU-I auxiliary data. Each unique ICID/ICID Version combination produces an entry in the list e.g. an ICID 100 that exists in the product with ICID Versions 1 and 2 will produce two "100" entries in the list.	strin g		
instrument_configuration_i d_version	List of space-separated values of the "instrument configuration identifier version" from the level 0 data ICU-I auxiliary data. Each ICID in the	strin g		

	instrument_configuration_id field should have a matching ICID Version entry in the same position in this list.			
subsettable_groups	Space separated list of paths to groups that have the subsettable="yes" group attribute.	string		
subsettable_groups_present	Space separated list of paths to groups that are present in the product. Will be the same as subsettable_groups for unsubsetted products.	string		
mtg_name	String field containing the MTG WMO-convention name for the file	string		
alternative_name	String field containing a possible alternative name for the file (e.g. Sentinel-4 naming convention)	string		
purpose	As per the dataset/product name field “purpose” in dataset name	string		
format	As per the dataset/product name field “format” in dataset name	string		
id	Can contain a DOI for reprocessed climate datasets (configuration file). Otherwise set to an empty string.	string		
naming authority	Will contain the DOI issuing authority for reprocessed climate datasets (configuration file) if id attribute is used. Otherwise set to an empty string.	string		
creator_type	Specifies type of creator with one of the following: 'person', 'group', 'institution', or 'position'.	string		
creator_institution	The institution of the creator; should uniquely identify the creator's institution.	string		
creator_name	The name of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.	string		
creator_email	The email address of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.	string		
creator_url	The URL of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.	string		

license	URL to a standard or specific license, enter "Freely Distributed" or "None", or describe any restrictions to data access and distribution in free text.	string		
standard_name_vocabulary	The name and version of the controlled vocabulary from which variable standard names are taken. (Values for any standard_name attribute must come from the CF Standard Names vocabulary for the data file or product to comply with CF.) Example: 'CF Standard Name Table v27'.	string		
project	The name of the project(s) principally responsible for originating this data. Multiple projects can be separated by commas	string		
time_coverage_duration	Describes the duration of the data set.	string		
time_coverage_resolution	Describes the targeted time period between each value in the data set	string		
cdm_datatype	The data type, as derived from Unidata's Common Data Model Scientific Data types and understood by THREDDS [THREDDS]	string		
comment	Miscellaneous information about the data, not captured elsewhere. (See [CF])	string		
date_time_position	This is the start time of the repeat cycle (accumulation interval) shifted forwards or backwards to the nearest 30 seconds bin counting from 00:00:00. This removes minor variations and offsets in the actual observation start time of the repeat cycle. Repeat cycle Observations starting at 11:59:58, 12:00:00 and 12:00:05 would all have a date_time_position value with a time of 12:00:00. An observation starting at 23:59:45 would have value of 00:00:00 and be the first repeat cycle of the next day.	string		
time_position	This is the time string taken from date/time string in date_time_position.	string		
geospatial_lat_min	Geospatial_lat_min specifies the southernmost latitude covered by the dataset.	double		
geospatial_lat_max	Geospatial_lat_max specifies the northernmost latitude covered by the dataset.	double		
geospatial_lon_min	Geospatial_lon_min specifies the westernmost longitude covered by the dataset.	double		

geospatial_lon_max	Geospatial_lon_max specifies the easternmost longitude covered by the dataset.	double		

Variables

Name	Attribute	Description	Type	Values	Shape
index		Coordindate variable with indices of data vectors segments extracted for chunk from the complete repeat cycle data vectors.	ushort		index
	long_name		*string*	*"Coordinate variable of indices drived from repeat cycle data vectors"*	
index_offset		Offset index of data vectors in this dataset. If not using the cooridnate variable index, then data vector data should be extracted from array position indexed_position - index_offset.	ushort		
	long_name		*string*	*"Offset index for data vectors"*	

time		UTC Time for geometric data vectors i.e. time at which the geometric metadata are calculated.	double		index
	title		*string*	*"UTC Time for geometric data vectors"*	
	long_name		*string*	*"UTC time at which the geometric metadata are calculated."*	
	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
l1c_channels_present		Level 1c spectral channels present in dataset	string		number_of_l1c_channels
	long_name		*string*	*“Level 1c spectral channels present in dataset”*	

A.2.2 Group:/data

Dimensions

Name	Description	Type	Values	Shape
None defined				

User Types

Name	Description	Type	Values	Shape
None defined				

Group Attributes

Name	Description	Type	Values	Shape
None defined				

Variables

Name	Attribute	Description	Type	Values	Shape
mtg_geos_projection		Defines the MTG Geos Projection to use as a grid_mapping variable according to [CF]	int		
	long_name		*string*	*"MTG geostationary projection"*	
	grid_mapping_name		*string*	*"geostationary"*	
	perspective_point_height	*35786400*	*string*	*<configured_value>*	
	semi_major_axis	*6378137*	*string*	*<configured_value>*	

	semi_minor_axis	*6356752*	*string*	*<configured_value>*	
	inverse_flattening		*string*	*<configured_value>*	
	latitude_of_projection_origin		*string*	*<configured_value>*	
	longitude_of_projection_origin		*string*	*<configured_value>*	
	sweep_angle_axis		*string*	*"y"*	
	units		*string*	*m*	
	coordinates		*string*	*y x*	
swath_direction			swath_direction_type	<runtime_value>	index
	long_name		*string*	*"Swath direction"*	
swath_number		Number of the swath	ushort	<runtime_value>	index
	long_name		*string*	*"Swath number"*	

A.2.3 Group:/data/<channel>

Dimensions

Name	Description	Type	Values	Shape
x	The number of columns in the Level 1c Body data chunk this will equal either 5568, 11136 or 22272 data points depending on the channel.		<configured_value>	
y	The number of rows in the Level 1c Body data chunk.		<configured_value>	

User Types

Name	Description	Type	Values	Shape

None defined

Group Attributes

Name	Description	Type	Values	Shape
long_name	A string uniquely identifying the channel wavelength and resolution e.g. “FCI HRFI Visible 0.6 micron channel”	string	<configured_value>	
subsettable	Group can be included or excluded from the dataset according to configured selection	string	"yes"	

Variables

Name	Attribute	Description	Type	Values	Shape
channel_srf_identifier		Identifier for the SRF for this channel.	string	<configured_value>	
	long_name		*string*	*"Channel Spectral Response Function identifier"*	
channel_mtf_identifier		Identifier for the MTF for this channel.	string	<configured_value>	
	long_name		*string*	*"Channel Modulation*	

				Transfer Function identifier"	
channel_srf_version		Version number of the SRF for this channel.	ushort	<configured_value>	
	long_name		*string*	*"Channel Spectral Response Function identifier version"*	
channel_mtf_version		Version number of the MTF for this channel.	ushort	<configured_value>	
	long_name		*string*	*"Channel Modulation Transfer Function identifier version"*	
central_wavelength_specified		Specified central wavelength	float	<configured_value>	
	long_name		*string*	*"Specified central wavelength of channel"*	
	units		*string*	*"um"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	
spectral_width_specified		Specified spectral width	float	<configured_value>	
	long_name		*string*	*"Specified spectral width of channel"*	
	units		*string*	*"um"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	
central_wavelength_actual		Actual (measured) central wavelength	float	<configured_value>	

	long_name		*string*	*"Actual central wavelength of channel"*	
	units		*string*	*"um"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	
spectral_width_actual		Actual (measured) spectral width	float	<configured_value>	
	long_name		*string*	*"Actual spectral width of channel"*	
	units		*string*	*"um"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	
ssd_index		SSD-based index for this channel	ssd_type	<configured_value>	
	long_name		*string*	*"Index selector for this channel based on SSD"*	
ssd		Spatial sampling distance for this channel	float	<configured_value>	
	long_name		*string*	*"Spatial sampling distance for this channel"*	
	units		*string*	*"m"*	

A.2.4 Group:/data/<channel>/measured

Dimensions

Name	Description	Type	Values	Shape
None defined				

User Types

Name	Description	Type	Values	Shape
None defined				

Group Attributes

Name	Description	Type	Values	Shape
None defined				

Variables

Name	Attribute	Description	Type	Values	Shape
start_position_row		Row index of the first position in the reference grid	ushort	<runtime_value>	
	long_name		*string*	*"Row index of the pixel closest to the origin of the reference grid"*	
	_FillValue		*float*	*NC_FILL_USHORT*	
start_position_column		Column index of the first position in the reference grid	ushort	<runtime_value>	
	long_name		*string*	*"Column index of the pixel closest to the origin of the reference grid"*	
	_FillValue		*float*	*NC_FILL_USHORT*	
end_position_row		Row index of the last position	ushort	<runtime_value>	

		in the reference grid			
	long_name		*string*	*"Row index of the pixel farthest from the origin of the reference grid"*	
	_FillValue		*float*	*NC_FILL_USHORT*	
end_position_column		Column index of the last position in the reference grid	ushort	<runtime_value>	
	long_name		*string*	*"Column index of the pixel farthest from the origin of the reference grid"*	
	_FillValue		*float*	*NC_FILL_USHORT*	
x		x coordinate variable for grid_mapping. Content is column value scaled to become radians	short		x
	long_name		*string*	*X coordinate in mtg_geos_projection, the packed value correspond to the column number for each pixel that can be converted into the azimuth angle by using the scale_factor and add_offset of the variable*	
	standard_name	*the content is based on the*	*string*	*projection_x_angular_coordinate*	

		proposed CF 1.8 and should be reviewed when 1.8 is published.			
	unit		*string*	*"radian"*	
	axis		*string*	*"X"*	
	valid_range		*short*	*<configured_value>*	
	scale_factor		*double*	*<configured_value>*	
	add_offset		*double*	*<configured_value>*	
y		y coordinate variable for grid_mapping. Content is row value scaled to become radians	short		y
	long_name		*string*	*Y coordinate in mtg_geos_projection, the packed value correspond to the row number for each pixel that can be converted into the elevation angle by using the scale_factor and add_offset of the variable*	
	standard_name	*the content is based on the proposed CF 1.8 and should be reviewed when 1.8 is published.*	*string*	*projection_y_angular_coordinate*	
	unit		*string*	*"radian"*	
	axis		*string*	*"Y"*	

	valid_range		*short*	*<configured_value>*	
	scale_factor		*double*	*<configured_value>*	
	add_offset		*double*	*<configured_value>*	
effective_radiance		The effective radiance at each pixel. NOTE: For the IR_3.8 and IR_3.8_HR channels, the effective radiance is stored in a 16 bit integer but the merging of the extended radiometric range observations, aimed at fire radiance measurements, requires a different offset and gain to be applied to the data above the upper value in valid_cold_range.	ushort		y, x
	long_name		*string*	*"Effective radiance"*	
	units		*string*	*"mW.m-2.sr-1.(cm-1)-1"*	

	_FillValue		*ushort*	*NC_FILL_USHORT*	
	valid_range		*ushort*	*<configured_value>*	
	valid_cold_range		*ushort*	*<configured_value>*	
	scale_factor		*float*	*<configured_value>*	
	add_offset		*float*	*<configured_value>*	
	warm_scale_factor		*float*	*<configured_value>*	
	warm_add_offset		*float*	*<configured_value>*	
	ancillary_variables		*string*	*"pixel_quality*	
	coordinates		*string*	*"y x"*	
	grid_mapping		*string*	*mtg_geos_projection*	
pixel_quality		Pixel quality flags	bitmask ubyte	See Bitmasks Table	y, x
	long_name		*string*	*"Pixel quality flags"*	
	_FillValue		*ubyte*	*NC_FILL_UBYTE*	
	valid_range		*ushort*	*0b, , 255b;*	*2*
	flag_masks		*ushort*	*1b, 2b, 4b, 8b, 16b, 32b, 64b, 128b;*	*8*
	flag_meanings		*string*	*missing_warning , radiometric_warning, noise_warning , geolocation_warning , saturation_warning , straylight_correction_warning , extended_dynamic_range_warning, encoding_saturation_warning;*	*8*

	coordinates		*string*	*"y x"*	
	grid_mapping		*string*	*mtg_geos_projection*	
radiance_unit_conversion_coefficient		Conversion coefficients to convert radiance units from mW.m-2.sr-1.(cm-1)-1 to W.m-2.sr-1.um-1.	float	<configured_value>	
	long_name		*string*	*"Conversion coefficients to convert radiance units from mW.m^-2.sr^-1.(cm^-1)^-1 to mW.m^-2.sr^-1.mm^-1."*	
	_FillValue		*ushort*	*NC_FILL_FLOAT*	
radiance_to_bt_conversion_constant_c1		Conversion constant C1 (in mW/[m2.sr.(cm-1)4]) to convert radiance to brightness temperature to be used in the calculation of brightness temperature for IR spectral channels. Variable is set to _FillValue for	float	<configured_value>	

		VNIR spectral channels.			
	long_name		*string*	*"Radiance to brightness temperature conversion constant C1"*	
	comment		*string*	*"Only for IR channels. Set to _FillValue for VNIR channels"*	
	units		*string*	*mW/(m^2.sr.(cm^-1)^4)*	
	_FillValue		*ushort*	*NC_FILL_FLOAT*	
radiance_to_bt_conversion_constant_c2		Conversion constant C2 (in cm.K) to convert radiance to brightness temperature to be used in the calculation of brightness temperature for IR spectral channels. Variable is set to _FillVaue for VNIR spectral channels.	float	<configured_value>	
	long_name		*string*	*"Radiance to brightness temperature conversion constant C2"*	
	comment		*string*	*"Only for IR channels. Set to _FillValue for VNIR channels"*	
	units		*string*	*"cm.K"*	

	_FillValue		*ushort*	*NC_FILL_FLOAT*	
radiance_to_bt_conversion_coefficient_a		Conversion coefficient A (unitless) to convert radiance to brightness temperature to be used in the calculation of brightness temperature for IR spectral channels. Variable is set to _FillVaue for VNIR spectral channels.	float	<configured_value>	
	long_name		*string*	*"Radiance to brightness temperature conversion coefficient A"*	
	comment		*string*	*"Only for IR channels. Set to _FillValue for VNIR channels"*	
	units		*string*	*"1"*	
	_FillValue		*ushort*	*NC_FILL_FLOAT*	
radiance_to_bt_conversion_coefficient_b		Conversion coefficient B (in K) to convert radiance to brightness temperature to be used in the	float	<configured_value>	

		calculation of brightness temperature for IR spectral channels. Variable is set to _FillVaue for VNIR spectral channels.			
	long_name		*string*	*"Radiance to brightness temperature conversion coefficient B"*	
	comment		*string*	*"Only for IR channels. Set to _FillValue for VNIR channels"*	
	units		*string*	*"1"*	
	_FillValue		*ushort*	*NC_FILL_FLOAT*	
radiance_to_bt_conversion_coefficient_wavenumber		Conversion coefficient NU (in cm-1) to convert radiance to brightness temperature to be used in the calculation of brightness temperature for IR spectral channels. Variable is set to _FillVaue for	float	<configured_value>	

		VNIR spectral channels.			
	long_name		*string*	*"Radiance to brightness temperature conversion coefficient wavenumber"*	
	comment		*string*	*"Only for IR channels. Set to _FillValue for VNIR channels"*	
	units		*string*	*"cm^-1"*	
	_FillValue		*ushort*	*NC_FILL_FLOAT*	
channel_effective_solar_irradiance		Channel effective solar irradiance at 1 AU (in mW/[m2.(cm-1)]) to be used in the derivation of the reflectance for VNIR spectral channels. Variable is set to _FillVaue for IR spectral channels.	float	<configured_value>	
	long_name		*string*	*Channel effective solar irradiance at 1 AU"*	
	comment		*string*	*"For he derivation of reflectance for VNIR spectral channels. Set to _FillValue for IR channels"*	
	units		*string*	*"mW/(m^2.(cm^-1))"*	
	_FillValue		*ushort*	*NC_FILL_FLOAT*	

index_map		Map associating pixel to indexed geometric parameters	ushort		y, x
	long_name		*string*	*"Map associating pixel to indexed geometric parameters"*	
	_FillValue		*ushort*	*NC_FILL_USHORT*	
	coordinates		*string*	*"y x"*	
	grid_mapping		*string*	*mtg_geos_projection*	

A.2.5 Group:/data/<channel>/swath

Dimensions

Name	Description	Type	Values	Shape
number_of_columns			<configured_value>	
number_of_swath_boundaries	Number of swaths boundaries in the dataset (equal to number_of_swaths – 1)		<runtime_value>	

User Types

Name	Description	Type	Values	Shape
None defined				

Group Attributes

Name	Description	Type	Values	Shape
long_name	Group description " Swath related information"	string	Swath related information	

Variables

Name	Attribute	Description	Type	Values	Shape
swath_boundary		The northern most row per column of the last pixel to have been created from a particular swath.	ushort		number_of_swath_boundaries, number_of_columns
	long_name		*string*	*"Swath northern edge boundary"*	
	comment		*string*	*"The northern most row per column of the last pixel to have been created from a particular swat"*	
	_FillValue		*ushort*	*NC_FILL_USHORT*	
	valid_range	*1 to configured_value for the channel*	*ushort*	*<configured_value>*	

A.2.6 Group:/data/<channel>/quality_channel

Dimensions

Name	Description	Type	Values	Shape
None defined				

User Types

Name	Description	Type	Values	Shape

None defined

Group Attributes

Name	Description	Type	Values	Shape
long_name	Description of group "Quality indicators applicable to a particular channel for the data chunk"	string	Quality indicators applicable to a particular channel for the data chunk	

Variables

Name	Attribute	Description	Type	Values	Shape
number_of_expected_earth_pixels		Number of earth pixels that are expected be in the nominal dataset	uint	<configured_value>	
	long_name		*string*	*Number of expected Earth pixels in nominal chunk"*	
	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
number_of_masked_pixels		Number of space pixels that have been masked.	uint	<configured_value>	
	long_name		*string*	*Number of masked pixels in chunk""*	
	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	

number_of_missing_warning_pixels		Number of Earth pixels with missing_warning flag set	uint	<configured_value>	
	long_name		*string*	*"Number of pixels with missing_warning flag set"*	
	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
number_of_radiometric_warning_pixels		Number of Earth pixels with radiometric_warning flag set	uint	<configured_value>	
	long_name		*string*	*"Number of pixels with radiometric_warning flag set"*	
	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
number_of_noise_warning_pixels		Number of Earth pixels with noise_warning flag set	uint	<configured_value>	
	long_name		*string*	*"Number of pixels with noise_warning flag set"*	
	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
number_of_geolocation_warning_pixels		Number of Earth pixels with geolocation_warning flag set	uint	<configured_value>	
	long_name		*string*	*"Number of pixels with geolocation_warning flag set"*	
	units		*string*	*"pixel"*	

	_FillValue		*ushort*	*NC_FILL_UINT*	
number_of_saturation_warning_pixels		Number of Earth pixels with saturation_warning flag set	uint	<configured_value>	
	long_name		*string*	*"Number of pixels with saturation_warning flag set"*	
	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
number_of_straylight_correction_warning_pixels		Number of Earth pixels with straylight_correction_warning flag set	uint	<configured_value>	
	long_name		*string*	*"Number of pixels with straylight_correction_warning flag set"*	
	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
number_of_extended_dynamic_range_warning_pixels		Number of Earth pixels with extended_dynamic_range_warning flag set	uint	<configured_value>	
	long_name		*string*	*"Number of pixels with extended_dynamic_range_warning flag set"*	
	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	

number_of_encoding_saturation_warning_pixels		Number of Earth pixels with nencoding_saturation_warning flag set	uint	<configured_value>	
	long_name		*string*	*"Number of pixels with encoding_saturation_warning flag set"*	
	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	

A.2.7 Group:/state

Dimensions

Name	Description	Type	Values	Shape
None defined				

User Types

Name	Description	Type	Values	Shape
None defined				

Group Attributes

Name	Description	Type	Values	Shape
None defined				

Variables

Name	Attribute	Description	Type	Values	Shape

None defined

A.2.8 Group:/state/processor

Dimensions

Name	Description	Type	Values	Shape
auxiliary_dataset	Number of auxiliary datasets involved inm processing the dataset		<runtime_value>	

User Types

Name	Description	Type	Values	Shape
auxiliary_dataset_status_type	See Enum types	enum ubyte		
resampling_method_type	Resampling method applied to the level 1b samples to create the level 1c dataset	ubyte enum	see Enums table	
weighting_function_type	Weighting function used with the selected resampling method.	ubyte enum	see Enums table	
projection_type	Projection for the reference grid	ubyte enum	see Enums table	

Group Attributes

Name	Description	Type	Values	Shape
None defined				

Variables

Name	Attribute	Description	Type	Values	Shape

auxiliary_dataset_identifier		Unique identifier for the auxiliary dataset. If available, the filename should be used. If the auxiliary file was not available, the file name template should be stated, with unknown values such as times set to the correct length of lower case x characters.	string		auxiliary_dataset
auxiliary_dataset_status		See Enum types	auxiliary_dataset_status_type		auxiliary_dataset
detector_equalization_enabled		TRUE if detector equalization	boolean	<configured_value>	

		has been applied to the dataset			
	long_name		*string*	*"Detector equalization enabled for the channel"*	
mtf_adaptation_enabled		TRUE if MTF adaption has been applied to the dataset	boolean	<configured_value>	number_of_l0_channels
	long_name		*string*	*"MTF adaptation enabled for the channel"*	
earth_straylight_correction_enabled		TRUE if earth stray light correction has been applied to the dataset	boolean	<configured_value>	
	long_name		*string*	*"Earth straylight correction enabled in this dataset"*	
sun_straylight_correction_enabled		TRUE if sun stray light correction	boolean	<configured_value>	

		has been applied to the dataset			
	long_name		*string*	*"Sun traylight correction enabled in this dataset"*	
resampling_method		Resampling method applied to the level 1b samples to create the level 1c dataset	resampling_method_type	<configured_value>	
	long_name		*string*	*"Selected resampling method"*	
weighting_function		Weighting function used with the selected resampling method".	weighting_function_type	<configured_value>	
	long_name		*string*	*"Weighting method used with the selected resampling method"*	
radiometric_warning		Radiometric calibration	boolean	<runtime_value>	number_of_l0_channels

		in the previous repeat cycles has led to a potential problem in the calibration of the channel data for the complete repeat cycle, e.g. a missing black body calibration			
	long_name		*string*	*"Radiometric calibration warning per channel for the repeat cycle"*	
	comment		*string*	*"Radiometric calibration in the previous repeat cycles has led to a potential problem in the calibration of the channel data for the*	

				complete repeat cycle"	
geometric_warning		The geometric processing in the previous repeat cycles has not allowed the update of the INR state vector the required accuracy to allow current repeat cycle measurements to be guaranteed.	boolean	<runtime_value>	number_of_l1c_channels
	long_name		*string*	*"Geometric calibration warning per channel for the repeat cycle"*	
	comment		*string*	*"Geometric processing in the previous repeat cycles has not allowed the*	

				update of the INR state vector to the required accuracy to allow current repeat cycle measurements to be guaranteed."	
reference_grid		Identifies to which of the three SSD-based grids the parameters are associated.	ssd_type	<configured_value>	number_of_reference_grids
	long_name		*string*	*"Reference grid for the channel"*	
	comment		*string*	*"Reference grid is based on channel SSD"*	
reference_grid_identifier		File name for the reference grid definition file, accessible to the user via the archive.	string	<configured_value>	number_of_reference_grids

	long_name		*string*	*"File name for the reference grid definition file"*	
reference_grid_version		Version number of the set of reference grid parameters. A change in version number between datasets implies the grid must be recalculated.	ushort	<configured_value>	number_of_reference_grids
	long_name		*string*	*"Version of reference grid parameters "*	
	_FillValue		*ushort*	*NC_FILL_USHORT*	
reference_grid_earth_model		Earth model used for reference grid	string	<configured_value>	
	long_name		*string*	*"Earth model used for reference grid"*	

reference_grid_projection		Projection used for reference grid Earth model used for reference grid	projection_type	<configured_value>	
	long_name		*string*	*"Projection used for reference grid"*	
projection_origin_longitude		Longitude of projection origin	double	<configured_value>	
	long_name		*string*	*"Longitude of projection origin"*	
	standard_name		*string*	*"longitude"*	
	units		*string*	*"degrees East"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
projection_origin_latitude		Latitude of projection origin	double	<configured_value>	
	long_name		*string*	*"Latitude of projection origin"*	
	standard_name		*string*	*"latitude"*	
	units		*string*	*"degrees North"*	

	_FillValue		*double*	*NC_FILL_DOUBLE*	
reference_altitude		Satellite reference altitude	double	<configured_value>	
	long_name		*string*	*"Satellite reference altitude"*	
	units		*string*	*"m*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
reference_grid_spatial_sampling_angle_ns		Spatial sampling angle for each reference grid in North-South direction	float	<configured_value>	number_of_reference_grids
	long_name		*string*	*"Spatial sampling angle for each reference grid in North-South direction"*	
	units		*string*	*"radian"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
reference_grid_spatial_sampling_angle_ew		Spatial sampling angle for	float	<configured_value>	number_of_reference_grids

		each reference grid in East-West direction			
	long_name		*string*	*"Spatial sampling angle for each reference grid in East-West direction"*	
	units		*string*	*"radian"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
earth_polar_radius		Earth polar radius	double	<configured_value>	
	long_name		*string*	*"Earth polar radius"*	
	units		*string*	*"m"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
earth_equatorial_radius		Earth equatorial radius	double	<configured_value>	
	long_name		*string*	*"Earth equatorial radius"*	
	units		*string*	*"m"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
reference_grid_number_of_columns		Number of columns in	uint	<configured_value>	number_of_reference_grids

		reference grid			
	long_name		*string*	*"Number of columns in reference grid"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
reference_grid_number_of_rows		Number of rows in reference grid	uint	<configured_value>	number_of_reference_grids
	long_name		*string*	*"Number of rows in reference grid"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
azimuth_angle_at_reference_grid_origin		Azimuth angle from the GEOS projection origin to the centre of the first reference grid column	double	<configured_value>	number_of_reference_grids
	long_name		*string*	*"Azimuth angle from the GEOS projection origin to the centre of the first reference grid column"*	
	units		*string*	*"radian"*	
	_FillValue		*ushort*	*NC_FILL_DOUBLE*	

elevation_angle_at_reference_grid_origin		Elevation angle from the GEOS projection origin to the centre of the first reference grid row	double	<configured_value>	number_of_reference_grids
	long_name		*string*	*"Elevation angle from the GEOS projection origin to the centre of the first reference grid row"*	
	units		*string*	*"radian"*	
	_FillValue		*ushort*	*NC_FILL_DOUBLE*	

A.2.9 Group:/state/platform

Dimensions

Name	Description	Type	Values	Shape
None defined				

User Types

Name	Description	Type	Values	Shape
manoeuvre_type	See Enums worksheet	enum ubyte	See Enums table	
reference_frame_type	See Enums worksheet	enum ubyte	See Enums table	

yaw_flip_type	yaw_flip summer = 1, winter = 0	enum ubyte	See Enums table	

Group Attributes

Name	Description	Type	Values	Shape
None defined				

Variables

Name	Attribute	Description	Type	Values	Shape
yaw_flip		Yaw flip configuration	yaw_flip_type	See Enums table	
in_manoeuvre		A manoeuvre occurs during this dataset	boolean		
	title		*string*	*"Platform manoeuvre occurs in this dataset when set"*	
recent_manoeuvre_time_window		Window of time prior to dataset start that is searched for a recent manoeuvre.	double		
	title		*string*	*"Time window to search for a manoeuvre that starts before or during this dataset"*	

	long_name		*string*	*"Recent manoeuvre time window"*	
	units		*string*	*"seconds"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
recent_maneouvre_found		Boolean to indicate if a recent manoeuvre was found	boolean	true/false	
	long_name		*string*	*"Recent or current manoeuvre found"*	
	title		*string*	*"Recent or current manoeuvre found in the recent manoeuvre time window"*	
recent_manoeuvre_type		See Enums worksheet	manoeuvre_type		
	long_name		*string*	*"Type of recent manoeuvre"*	
recent_manoeuvre_start_time		Start time for manoeuvre	double		
	long_name		*string*	*"Start time in UTC of recent manoeuvre"*	
	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0"*	
	precision		*string*	*"1 millisecond"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	

recent_manoeuvre_end_time		End time for manoeuvre	double		
	long_name		*string*	*"End time in UTC of recent manoeuvre"*	
	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0"*	
	precision		*string*	*"1 millisecond"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
recent_manoeuvre_reference_frame		Reference frame for manoeuvre parameters	reference_frame_type		
	long_name		*string*	*"Reference frame for manoeuvre paramaters"*	
recent_manoeuvre_delta_vx		X component of the velocity increment	double		
	long_name		*string*	*"X component delta v for recent manoeuvre"*	
	units		*string*	*"m/s"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
recent_manoeuvre_delta_vy		Y component of the velocity increment	double		
	long_name		*string*	*"Y component delta v for recent manoeuvre"*	

	units		*string*	*"m/s"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
recent_manoeuvre_delta_vz		Z component of the velocity increment	double		
	long_name		*string*	*"Z component delta v for recent manoeuvre"*	
	units		*string*	*"m/s"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
recent_manoeuvre_spacecraft_delta_mass		Change in spacecraft mass	double		
	long_name		*string*	*"Delta spacecraft mass for recent manoeuvre"*	
	units		*string*	*"g"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
upcoming_manoeuvre_time_window		Window of time that is searched post dataset end for an upcoming manoeuvre.	double		
	title		*string*	*"Time window to search for a manoeuvre that starts after this dataset"*	

	long_name		*string*	*"Upcoming manoeuvre time window"*	
	units		*string*	*"seconds"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
upcoming_maneouvre_found		Boolean to indicate if an upcoming manoeuvre was found	boolean		
	long_name		*string*	*"Upcoming manoeuvre found"*	
	title		*string*	*"Upcoming manoeuvre found in the upcoming manoeuvre time window"*	
upcoming_manoeuvre_type		Type of manoeuvre	manoeuvre_type		
	long_name		*string*	*"Type of upcoming manoeuvre"*	
upcoming_manoeuvre_start_time		Start time for manoeuvre	double		
	long_name		*string*	*"Start time in UTC of upcoming manoeuvre"*	
	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0"*	
	precision		*string*	*"1 millisecond"*	

	_FillValue		*double*	*NC_FILL_DOUBLE*	
upcoming_manoeuvre_end_time		End time for manoeuvre	double		
	long_name		*string*	*"End time in UTC of upcoming manoeuvre"*	
	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0"*	
	precision		*string*	*"1 millisecond"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
upcoming_manoeuvre_reference_frame		See Enums worksheet	reference_frame_type		
	long_name		*string*	*"Reference frame for manoeuvre paramaters"*	
upcoming_manoeuvre_delta_vx		X component of the velocity increment	double		
	long_name		*string*	*"X component delta v for upcoming manoeuvre"*	
	units		*string*	*"m/s"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
upcoming_manoeuvre_delta_vy		Y component of the velocity increment	double		

	long_name		*string*	*"Y component delta v for upcoming manoeuvre"*	
	units		*string*	*"m/s"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
upcoming_manoeuvre_delta_vz		Z component of the velocity increment	double		
	long_name		*string*	*"Z component delta v for upcoming manoeuvre"*	
	units		*string*	*"m/s"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
upcoming_manoeuvre_spacecraft_delta_mass		Change in spacecraft mass	double		
	long_name		*string*	*"Delta spacecraft mass for upcoming manoeuvre"*	
	units		*string*	*"g"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
subsatellite_latitude		Latittude of the sub-satellite point at time(index)	float		index
	long_name		*string*	*"Sub-satellite latitude"*	
	units		*string*	*"degrees_north"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	
	standard_name		*string*	*"latitude"*	

subsatellite_longitude		Longittude of the sub-satellite point at time(index)	float		index
	long_name		*string*	*"Sub-satellite longitude"*	
	units		*string*	*"degrees_east"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	
	standard_name		*string*	*"longitude"*	
platform_altitude		Platform altitude at time(index)	float		index
	long_name		*string*	*"Platform altitude"*	
	units		*string*	*"m"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	
orbit_phase		Orbital phase angle at time(index)	float		index
	long_name		*string*	*"Orbit phase"*	
	units		*string*	*"degrees"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	

A.2.10 Group:/state/celestial

Dimensions

Name	Description	Type	Values	Shape
None defined				

User Types

Name	Description	Type	Values	Shape
None defined				

Group Attributes

Name	Description	Type	Values	Shape
None defined				

Variables

Name	Attribute	Description	Type	Values	Shape
earth_sun_distance		Distance from Earth to Sun at time(index)	float		index
	long_name		*string*	*"Distance between Earth and Sun"*	
	units		*string*	*"km"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	
sun_satellite_distance		Distance from Sun to Satellite at time(index)	float		index
	long_name		*string*	*"Distance between satellite and Sun"*	
	units		*string*	*"km"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	
sun_eclipse_by_earth		If TRUE indicates an eclipse of the sun by the earth, as viewed by the satellite	boolean		index

	long_name		*string*	*"Sun eclipsed by Earth"*	
	titile		*string*	*"If TRUE indicates an eclipse of the Sun by the Earth, as viewed by the satellite"*	
sun_eclipse_by_moon		If TRUE indicates an eclipse of the sun by the moon, as viewed by the satellite	boolean		index
	long_name		*string*	*"Sun eclipsed by Moon"*	
	titile		*string*	*"If TRUE indicates an eclipse of the Sun by the Moon as viewed by the satellite"*	
solar_elevation		Solar angle in instrument frame at time(index)	float		index
	standard_name		*string*	*"solar_elevation_angle"*	
	long_name		*string*	*Solar elevation angle*	
	units		*string*	*"degree"*	
	_FillValue		*string*	*NC_FILL_FLOAT*	
solar_azimuth		Solar angle in instrument frame at time(index)	float		index
	standard_name		*string*	*"solar_azimuth_angle"*	
	long_name		*string*	*"Solar azimuth ange*	
	units		*string*	*"degree"*	
	_FillValue		*string*	*NC_FILL_FLOAT*	

subsolar_latitude		Latittude of the sub-solar point at time(index)	float		index
	long_name		*string*	*"Sub-solar latitude"*	
	units		*string*	*"degrees_north"*	
	_FillValue		*string*	*NC_FILL_FLOAT*	
	standard_name		*string*	*"latitude"*	
subsolar_longitude		Longittude of the sub-solar point at time(index)	float		index
	long_name		*string*	*"Sub-solar longitude"*	
	units		*string*	*"degrees_east"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	
	standard_name		*string*	*"longitude"*	
	valid_range		*float*	*-90, 90*	
moon_shadow_presence		TRUE if the moon shadow on the Earth occurs in this chunk	boolean	<runtime_value>	
	long_name		*string*	*"Moon shadow on the Earth occurs in this dataset"*	
sunglint_presence		TRUE if sunglint is possible within the chunk	boolean	<runtime_value>	
	long_name		*string*	*"Sun glint possible in this dataset"*	
sunglint_extent_latitude_min		Minimum latitude boundary of the rectangular extent	double		

		of the sun glint within the chunk			
	long_name		*string*	*"Minimum latitude of sunglint within chunk"*	
	standard_name		*string*	*"latitude"*	
	units		*string*	*"degrees North"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
sunglint_extent_latitude_max		Maximum latitude boundary of the rectangular extent of the sun glint within the chunk	double		
	long_name		*string*	*"Maximum latitude of sunglint within chunk"*	
	standard_name		*string*	*"latitude"*	
	units		*string*	*"degrees North"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
sunglint_extent_longitude_min		Minimum longitude boundary of the rectangular extent of the sun glint within the chunk	double		
	long_name		*string*	*"Minimum longtitude of sunglint within chunk"*	
	standard_name		*string*	*"longitude"*	
	units		*string*	*"degrees East"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
sunglint_extent_longitude_max		Maximum longitude	double		

		boundary of the rectangular extent of the sun glint within the chunk			
	long_name		*string*	*"Maximum longtitude of sunglint within chunk"*	
	standard_name		*string*	*"longitude"*	
	units		*string*	*"degrees East"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	

A.2.11 Group:/state/instrument

Dimensions

Name	Description	Type	Values	Shape
None defined				

User Types

Name	Description	Type	Values	Shape
fci_mode_type	FCI Mode. Note that in decontamination mode only the Visible channels are generated	byte enum	see Enums table	

Group Attributes

Name	Description	Type	Values	Shape
None defined				

Variables

Name	Attribute	Description	Type	Values	Shape

fci_mode		Copy of the “FCI mode” from the level 0 data ICU-I auxiliary data	fci_mode_type	<runtime_value>	
	long_name		*string*	*"Mode of FCI instrument"*	
level0_channels		Array of strings indicating the FCI data channels delivered in the level 0 data (“FDVIS0.4”, “FDVIS0.5”, “HRVIS0.6”, “FDVIS0.8”, “FDVIS0.9”, “FDNIR1.3”, “FDNIR1.6”, “HRNIR2.2”, “HRIR3.8”, “FAIR3.8”, “FDIR6.3”, “FDIR7.3”,”FDIR8.7”,”FDIR9.7”, “HRIR10.5”, “FDIR12.3”, “FDIR13.3”)	string	<runtime_value>	number_of_l0_channels
	long_name		*string*	*"FCI level 0 data channels"*	
repeat_cycle_start_time		Conversion of the “repeat_cycle_start_time” from the level 0 data ICU-I auxiliary data into UTC	double	<runtime_value>	
	long_name		*string*	*"UTC start time of repeat cycle"*	
	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0";*	
	precision		*string*	*"1 ms"*	

	_FillValue		*double*	*NC_FILL_DOUBLE*	
repeat_sequence_counter		Copy of the “repeat sequence counter” from the level 0 data ICU-I auxiliary data	ushort	<runtime_value>	
	long_time		*string*	*"Repeat sequence counter"*	
	_FillValue		*double*	*NC_FILL_USHORT*	
repeat_cycle_counter		Copy of the “repeat cycle counter since the last transition to operational mode” from the level 0 ICU-I auxiliary data	ushort	<runtime_value>	
	long_time		*string*	*""Repeat cycle counter since the last transition to operational mode"*	
	_FillValue		*double*	*NC_FILL_USHORT*	
repeat_sequence_id		Copy of the “repeat sequence identifier” from the level 0 data ICU-I auxiliary data	ushort	<runtime_value>	
	long_time		*string*	*"Repeat sequence identifier"*	
	_FillValue		*double*	*NC_FILL_USHORT*	

repeat_cycle_counter_in_repeat_sequence		Copy of the “repeat cycle counter in repeat sequence” from the level 0 data ICU-I auxiliary data	ushort	<runtime_value>	
	long_time		*string*	*"Repeat cycle counter in the current repeat sequence"*	
	_FillValue		*double*	*NC_FILL_USHORT*	
repeat_cycle_id		An identifier for the repeat cycle derived from the “Repeat sequence identifier”, “Repeat cycle counter in current repeat sequence” and the "Scan Law" from the level 0 data ICU-I auxiliary data. The repeat_cycle_id is a unique reference to the scan angles commanded to the FCI during a given repeat cycle.	ushort	<runtime_value>	
	long_time		*string*	*"Repeat cycle identifier"*	
	_FillValue		*double*	*NC_FILL_USHORT*	
scan_law_id		Copy of the “Scan law id” from the level 0 ICU-I auxiliary data	ushort	<runtime_value>	
	long_time		*string*	*"Scan law identifier"*	

	_FillValue		*double*	*NC_FILL_USHORT*	
channel_on		TRUE if the spectral channel is switched on and active	boolean	<runtime_value>	number_of_l0_channels
	long_time		*string*	*"Channel active flag"*	
last_decontamination_start_time		Start time in UTC of most recent decontamination	double	<runtime_value>	
	long_name		*string*	*"UTC start time of most recent decontamination"*	
	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0";*	
	precision		*string*	*"1 ms"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
last_decontamination_end_time		End time in UTC of most recent decontamination	double	<runtime_value>	
	long_name		*string*	*"UTC end time of most recent decontamination"*	
	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0";*	

	_FillValue		*double*	*NC_FILL_DOUBLE*	
last_detection_chain_parameter_change_time		Time in UTC of the last change in detection chain parameters, corresponding to the start of the repeat cycle when the parameters were activated	double	<runtime_value>	number_of_l0_channels
	long_name		*string*	*"UTC end time of last change in the detection chain parameters"*	
	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0";*	
	precision		*string*	*"1 ms"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
last_heated_black_body_calibration_time		Time in UTC of the last heated black body calibration for the IR spectral channels, corresponding to the start of the calibration data acquisition	double	<runtime_value>	
	long_name		*string*	*"UTC end time of last heated black body calibration"*	
	standard_name		*string*	*"time"*	

	units		*string*	*"seconds since 2000-01-01 00:00:00.0";*	
	precision		*string*	*"1 ms"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
last_mnd_calibration_time		Time in UTC of the last metallic neutral density calibration for the VNIR spectral channels, corresponding to the start of the calibration data acquisition	double	<runtime_value>	
	long_name		*string*	*"UTC end time of last metallic neutral density calibration"*	
	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0";*	
	precision		*string*	*"1 ms"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	

A.3 FCI-1C-RRAD-TRAIL

A.3.1 Group:root (/)

Dimensions

Name	Description	Type	Values	Shape
body_chunk	Number of body chunks that were produced for the current repeat cycle or equivalent time period.		<runtime_value>	
number_of_l0_channels	Number of data channels delivered by the FCI instrument used to create the level 1c data [17 if all channels are present, otherwise set at according to the channels available from the instrument]		17	
number_of_l1c_channels	Number of spectral channels present in the originally generated dataset [16 if all FDHSI channels are present, 4 if all HRFI channels are present, otherwise set at according to the		16	

	selected/available channels]			
number_of_reference_grids	Number of reference grid used by the channels [default 2]. Note although 3 different grid exist for the FCI there are only 2 per mission (FDHSI/HRFI)		2	

User Types

Name	Description	Type	Values	Shape
boolean	See Enums spreadsheet There is no boolean type in netCDF. This enumerated type at root level can be used by all datasets/products. This user type defininition only needs to be present when it is used within the dataset.	enum byte	See Enums table	
trilean	See Enums spreadsheet For situations where an undefined state is also required. This user type defininition only needs to be present when it is used within the dataset.	enum byte	See Enums table	

ssd_type	Identifies the Spatial Sampling Distance (SSD) at nadir used to sample the data	ubyte enum	see Enums table	
swath_direction_type	Identified the direction of swath acquisition from East to West or West to East.	ubyte enum	see Enums table	

Global Attributes

Name	Description	Type	Values	Shape
Conventions	Conventions that the product conforms to. This could be a future version of the CF Conventions that is applicable to netCDF4.	string	e.g."CF-1.7"	
title	Dataset/product name	string		
summary	As defined in the relevant dataset/product format specification.	string		
keywords	As defined in the relevant dataset/product format specification.	string		
keywords_vocabulary	As defined in the relevant dataset/product format specification.	string		
history	As per [CF]	string	“original generated file”	
institution	This field may be extended with other values should datasets/products be generated in other locations.	string	“EUMETSAT”	
location_indicator	As per the dataset name field” location_indicator” in dataset name	string		
data_designator	As per the dataset name field “data_designator” in dataset name	string		

platform	As per the dataset name field “spacecraft” in dataset name. Renamed in line with Attribute Convention for Dataset Discovery	string		
data_source	As per the dataset name field “data_source” in dataset name	string		
processing_level	As per the dataset name field “level” in dataset name	string		
coverage	As per the dataset name field “coverage” in dataset name	string		
type	As per the dataset name field “type” in dataset name	string		
subtype	As per the dataset name field “subtype” in dataset name	string		
component1	As per the dataset name field “component1” in dataset name	string		
component2	As per the dataset name field “component2” in dataset name	string		
component3	As per the dataset name field “component3” in dataset name	string		
product_id	The identifying product_id as used in the SIP	string		
baseline_version	Baseline version. The baseline version will reference of all other version numbers. Assumes processor_version is not sufficient for this.	string		
release_version	Release version. Used to tag datasets that can be considered to have a contiguous consistency sufficient for example, for consideration as a climate set.	string		
processor_version	Processor version. Currently assumes a single processor version number suffices for the relevant IDPF or L2PP. Currently undefined if processor version also includes configuration of static auxiliary data and processor switch configuration, etc.	string		
algorithm_version	Algorithm version. Currently unclear how this would be used and it may be redundant with processor_version.	string		

format_version	Format version of the dataset/product.	string		
time_coverage_start	As per the dataset name field “start_time” in dataset name. Renamed in line with Attribute Convention for Dataset Discovery	string		
time_coverage_end	As per the dataset name field “end_time” in dataset name. Renamed in line with Attribute Convention for Dataset Discovery	string		
processing_mode	As per the dataset name field “processing_mode” in dataset name	string		
special_compression	As per the dataset name field “special_compression” in dataset name	string		
subsetting	If this field is empty then no further strings follow. If this value is a single specified internal compression method as listed in the “special_compression” field in dataset name then it is followed by two strings: (1) human-readable parameters describing the exact internal compression performed (2) either a URL providing a description of the internal compression method or the words “NO URL”. If the value is “MULTI”, then this is followed by sets of triplets of strings (one per internal compression applied) A triplet consists of: (1) an internal compression code as listed in the “special_compression” field dataset name ; (2) human-readable parameters describing the exact internal compression performed; (3) either a URL providing a description of the internal compression method or the words “NO URL”.	string		
disposition_mode	As per the dataset/product name field “disposition_mode” in dataset name	string		

source	Characterisation of the type of data as per [CF].	string		
runtime_data	Space-separated string array of the SIP names of all nonproduct input datasets used in the creation of the dataset (auxiliary data, configuration file, DPP files, etc.) (Was part of <source> field)	string	<runtime_value>	
parent_data	Space-separated string array of the SIP names of all parent products/datasets used in the creation of the dataset (Was part of <source> field)	string		
linked_data	Space-separated string array of the SIP names of all datasets to be linked with this dataset in the archive (e.g. for a Level 0 dataset this would be all additional datasets required to create the virtual L0+ dataset in the archive). (Was part of <source> field)	string		
facility_or_tool	As per the dataset name field "facility_or_tool" in dataset name	string		
environment	As per the dataset name field "environment" in dataset name	string		
references	"www.eumetsat.int"	string		
comment	Unless otherwise specified in the relevant dataset/product format specification, "None."	string		
date_created	UTC time of processing formatted in Abbreviated Generalised Time format and defined as the time of the formatting of the dataset/product by the processor. Renamed in line with Attribute Convention for Dataset Discovery	string		
group_tag	String that represents a grouping of datasets that allows chunks and quick-looks to be linked together. The string has the format: <platform>_<datsource>_<processing_level>_<type>_<subtype>_YYYY_DDD_NNNN_<release_version> where: <> indicates the same value as the named global metadata field in the brackets (as	string		

	described in this table) YYYY = the year value of the "repeat_cycle_time_position" field DDD = day in year value derived from the "repeat_cycle_time_position " field, left padded with zeroes: 001 = Jan 1st, etc. NNNN = copy of the "repeat_cycle_in_day" field			
repeat_cycle_in_day	4-digit number (right-justified, zero-filled) indicating the expected current repeat cycle or group accumulation interval in the day for this particular dataset. For details on how to determine the expected repeat cycle see [EXPRC]. The counter starts at 0001 for the first repeat cycle at or after midnight (based on the time_position value) and resets for the next repeat cycle at or after the following midnight. Datasets/products that have no repeat cycle or group accumulation interval (e.g. certain DPP files) should use a fixed value of 0000 to indicate the field is not applicable.	strin g		
processed_count_in_repeat _cycle	Cumulative count of the dataset chunk in the repeat cycle or group accumulation interval. Resets when the repeat_cycle_in_day value changes. The counter increments for each created chunk in a repeat cycle or accumulation interval. It does not increment when a chunk is not created due to missing parent data.	strin g		
count_in_repeat_cycle	4-digit number (right-justified, zero-filled) indicating the expected count value of the dataset chunk in the repeat cycle or group accumulation interval based on the scan pattern or equivalent information. The counter will have discontinuities when chunks are not produced. The counter starts from 1 and resets when the repeat_cycle_in_day value changes. The counter increments for each chunk in a repeat cycle or accumulation interval (whether header, body or trailer). A value of 0 is used for datasets for which the counter is not applicable (e.g. datasets which are not chunk-able).	strin g		
instrument_configuration_i d	List of space-separated values of the "instrument configuration identifier" from the level 0 data ICU-I auxiliary data. Each unique ICID/ICID Version combination	strin g		

	produces an entry in the list e.g. an ICID 100 that exists in the product with ICID Versions 1 and 2 will produce two “100” entries in the list.			
instrument_configuration_id_version	List of space-separated values of the “instrument configuration identifier version” from the level 0 data ICU-I auxiliary data. Each ICID in the instrument_configuration_id field should have a matching ICID Version entry in the same position in this list.	string		
subsettable_groups	Space separated list of paths to groups that have the subsettable="yes" group attribute.	string		
subsettable_groups_present	Space separated list of paths to groups that are present in the product. Will be the same as subsettable_groups for unsubsetted products.	string		
mtg_name	String field containing the MTG WMO-convention name for the file	string		
alternative_name	String field containing a possible alternative name for the file (e.g. Sentinel-4 naming convention)	string		
purpose	As per the dataset/product name field “purpose” in dataset name	string		
format	As per the dataset/product name field “format” in dataset name	string		
id	Can contain a DOI for reprocessed climate datasets (configuration file). Otherwise set to an empty string.	string		
naming authority	Will contain the DOI issuing authority for reprocessed climate datasets (configuration file) if id attribute is used. Otherwise set to an empty string.	string		
creator_type	Specifies type of creator with one of the following: 'person', 'group', 'institution', or 'position'.	string		
creator_institution	The institution of the creator; should uniquely identify the creator's institution.	string		
creator_name	The name of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.	string		
creator_email	The email address of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.	string		

creator_url	The URL of the person (or other creator type specified by the creator_type attribute) principally responsible for creating this data.	string		
license	URL to a standard or specific license, enter "Freely Distributed" or "None", or describe any restrictions to data access and distribution in free text.	string		
standard_name_vocabulary	The name and version of the controlled vocabulary from which variable standard names are taken. (Values for any standard_name attribute must come from the CF Standard Names vocabulary for the data file or product to comply with CF.) Example: 'CF Standard Name Table v27'.	string		
project	The name of the project(s) principally responsible for originating this data. Multiple projects can be separated by commas	string		
time_coverage_duration	Describes the duration of the data set.	string		
time_coverage_resolution	Describes the targeted time period between each value in the data set	string		
cdm_datatype	The data type, as derived from Unidata's Common Data Model Scientific Data types and understood by THREDDS [THREDDS]	string		
comment	Miscellaneous information about the data, not captured elsewhere. (See [CF])	string		
date_time_position	This is the start time of the repeat cycle (accumulation interval) shifted forwards or backwards to the nearest 30 seconds bin counting from 00:00:00. This removes minor varinations and offsets in the actual observation start time of the repeat cycle. Repeat cycle Observations starting at 11:59:58, 12:00:00 and 12:00:05 would all have a date_time_position value with a time of 12:00:00. An observation starting at 23:59:45 would have value of 00:00:00 and be the first repeat cycle of the next day.	string		
time_position	This is the time string taken from date/time string in date_time_position.	string		
geospatial_lat_min	Geospatial_lat_min specifies the southernmost latitude covered by the dataset.	double		
geospatial_lat_max	Geospatial_lat_max specifies the northernmost latitude covered by the dataset.	double		

geospatial_lon_min	Geospatial_lon_min specifies the westernmost longitude covered by the dataset.	double		
geospatial_lon_max	Geospatial_lon_max specifies the easternmost longitude covered by the dataset.	double		

Variables

Name	Attribute	Description	Type	Values	Shape
available_body_chunks		Names of all the body chunk files that were produced for the current repeat cycle or equivalent time period.	String		body_chunk
	long_name		*String*	*"Names of body chunk files produced for this product"*	
l1c_channels_present		Level 1c spectral channels present in dataset	string	<configured_value>	number_of_l1c_channels
	long_name		*string*	*"Level 1c spectral channels present in dataset"*	

A.3.2 Group:/data

Dimensions

Name	Description	Type	Values	Shape
None defined				

User Types

Name	Description	Type	Values	Shape
None defined				

Group Attributes

Name	Description	Type	Values	Shape
None defined				

Variables

Name	Attribute	Description	Type	Values	Shape
None defined					

A.3.3 Group:/data/<channel_group>

Dimensions

Name	Description	Type	Values	Shape
None defined				

User Types

Name	Description	Type	Values	Shape
None defined				

Group Attributes

Name	Description	Type	Values	Shape

long_name	A string uniquely identifying the channel wavelength and resolution e.g. “FCI HRFI Visible 0.6 micron channel”	string	<configured_value>	
subsettable	Group can be included or excluded from the dataset according to configured selection	string	"yes"	

Variables

Name	Attribute	Description	Type	Values	Shape
number_of_rows		The number of rows in the Level 1c Body data chunk which will depend on the coverage	ushort	<configured_value>	
	long_name		*string*	*“Number of rows in the current repeat cycle"*	
number_of_columns		The number of columns in the Level 1c Body data chunk this will equal either 5568, 11136 or 22272 data points	ushort	<configured_value>	

		depending on the channel.			
	long_name		*string*	*"Number of columns in the current repeat cycle"*	
start_row_number		Start row number for the configured repeat cycle coverage. 0 for FD but varies for other coverage areas (Q2,Q3,T2, etc.)	ushort	<configured_value>	
	long_name		*string*	*"Start row number for the current repeat cycle"*	
end_row_number		Start row number for the configured repeat cycle coverage. Number_of_rows-1 for FD but varies for other coverage areas	ushort	<configured_value>	
	long_name		*string*	*"End row number for the current repeat cycle"*	
channel_srf_identifier		Identifier for the SRF for this channel.	string		

	long_name		*string*	*"Channel Spectral Response Function identifier"*	
channel_mtf_identifier		Identifier for the MTF for this channel.	string		
	long_name		*string*	*"Channel Modulation Transfer Function identifier"*	
channel_srf_version		Version number of the SRF for this channel.	ushort		
	long_name		*string*	*"Channel Spectral Response Function identifier version"*	
channel_mtf_version		Version number of the MTF for this channel.	ushort		
	long_name		*string*	*"Channel Modulation Transfer Function identifier version"*	
central_wavelength_specified		Specified central wavelength	float	<configured_value>	
	long_name		*string*	*"Specified central wavelength of channel"*	
	units		*string*	*"um"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	

spectral_width_specified		Specified spectral width	float	<configured_value>	
	long_name		*string*	*"Specified spectral width of channel"*	
	units		*string*	*"um"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	
central_wavelength_actual		Actual (measured) central wavelength	float	<configured_value>	
	long_name		*string*	*"Actual central wavelength of channel"*	
	units		*string*	*"um"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	
spectral_width_actual		Actual (measured) spectral width	float	<configured_value>	
	long_name		*string*	*"Actual spectral width of channel"*	
	units		*string*	*"um"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	
ssd_index		SSD-based index for this channel	ssd_type	<configured_value>	
	long_name		*string*	*"Index selector for this channel based on SSD"*	
ssd			float	<configured_value>	
	long_name		*string*	*"Spatial sampling distance for this channel"*	
	units		*string*	*"m"*	

A.3.4 Group:/data/<channel_group>/measured

Dimensions

Name	Description	Type	Values	Shape
number_of_radiometric_noise_lut_steps	Number of steps in the radiometric noise Look Up Table (LUT). Configured value. Default = 1024		<configured_value>	

User Types

Name	Description	Type	Values	Shape
None defined				

Group Attributes

Name	Description	Type	Values	Shape
None defined				

Variables

Name	Attribute	Description	Type	Values	Shape
radiometric_noise_lut_noise		The radiometric noise Look Up Table (LUT) provides the output of a radiometric noise model for each of the effective radiance code words	ushort		number_of_radiometric_noise_lut_steps

		given in the radiometric_noise_lut_radiance variable.			
	long_name		*string*	*Look-up-table for the radiometric noise applicable to the effective radiance - radiometric noise*	
	standard_name		*string*	*effective_radiance_in_wavenumber_standard_error*	
	units		*string*	*mW.m-2.sr-1.(cm-1)-1*	
	valid_range		*ushort*	*0,4095*	
	ancillary_variables		*string*	*radiometric_noise_lut_radiance*	
	scale_factor		*float*	*<configured_value>*	
	add_offset		*float*	*<configured_value>*	
radiometric_noise_lut_radiance		See radiometric_noise_lut_noise description	ushort		number_of_radiometric_noise_lut_steps
	long_name		*string*	*Look-up-table for the radiometric noise applicable to the effective radiance - radiance*	
	units		*string*	*mW.m-2.sr-1.(cm-1)-1*	
	valid_range		*ushort*	*0 4095*	
	valid_cold_range		*ushort*	*0 4095*	

	scale_factor		*float*	*<configured_value>*	
	add_offset		*float*	*<configured_value>*	
	warm_scale_factor		*float*	*<configured_value>*	
	warm_add_offset		*float*	*<configured_value>*	
radiance_unit_conversion_coefficient		Conversion coefficients to convert radiance units. Details of use to be given in User Guide.	float	<configured_value>	
radiance_to_bt_conversion_constant_c1		Conversion constant C1 (in mW/[m2.sr.(cm-1)4]) to convert radiance to brightness temperature to be used in the calculation of brightness temperature for IR spectral channels. Variable is set to _FillVaue for VNIR spectral channels.	float	<configured_value>	

	long_name		*string*		*"Radiance to brightness temperature conversion constant C1"*
	comment		*string*		*"Only for IR channels. Set to _FillValue for VNIR channels"*
	units		*string*		*mW/(m^2.sr.(cm^-1)^4)*
radiance_to_bt_conversion_constant_c2		Conversion constant C2 (in cm.K) to convert radiance to brightness temperature to be used in the calculation of brightness temperature for IR spectral channels. Variable is set to _FillVaue for VNIR spectral channels.	float	<configured_value>	
	long_name		*string*		*"Radiance to brightness temperature conversion constant C2"*
	comment		*string*		*"Only for IR channels. Set to _FillValue for VNIR channels"*
	units		*string*		*"cm.K"*
	_FillValue		*ushort*		*NC_FILL_FLOAT*

radiance_to_bt_conversion_coefficient_a		Conversion coefficient A (unitless) to convert radiance to brightness temperature to be used in the calculation of brightness temperature for IR spectral channels. Variable is set to _FillVaue for VNIR spectral channels.	float	<configured_value>	
	long_name		*string*		*"Radiance to brightness temperature conversion coefficient A"*
	comment		*string*		*"Only for IR channels. Set to _FillValue for VNIR channels"*
	units		*string*		*"1"*
	_FillValue		*ushort*		*NC_FILL_FLOAT*
radiance_to_bt_conversion_coefficient_b		Conversion coefficient B (in K) to convert radiance to brightness temperature to be used in the calculation of	float	<configured_value>	

		brightness temperature for IR spectral channels. Variable is set to _FillVaue for VNIR spectral channels.			
	long_name		*string*		*"Radiance to brightness temperature conversion coefficient B"*
	comment		*string*		*"Only for IR channels. Set to _FillValue for VNIR channels"*
	units		*string*		*"1"*
	_FillValue		*ushort*		*NC_FILL_FLOAT*
radiance_to_bt_conversion_coefficient_wavenumber		Conversion coefficient NU (in cm-1) to convert radiance to brightness temperature to be used in the calculation of brightness temperature for IR spectral channels. Variable is set to _FillVaue for VNIR spectral channels.	float	<configured_value>	

	long_name		*string*		*"Radiance to brightness temperature conversion coefficient wavenumber"*
	comment		*string*		*"Only for IR channels. Set to _FillValue for VNIR channels"*
	units		*string*		*"cm^-1"*
	_FillValue		*ushort*		*NC_FILL_FLOAT*
channel_effective_solar_irradiance		Channel effective solar irradiance at 1 AU to be used in the derivation of the reflectance for VNIR spectral channels. Variable is set to _FillVaue for IR spectral channels.	float	<configured_value>	
	long_name		*string*	*Channel integrated solar irradiance at 1AU*	
	units		*string*	*mW.m-2.(cm-1)-1*	

A.3.5 Group:/data/<channel_group>/swath

Dimensions

Name	Description	Type	Values	Shape

number_of_swaths	Number of swaths in the dataset		<runtime_value>	
number_of_swath_boundaries	Number of swaths boundaries in the dataset		<runtime_value>	

User Types

Name	Description	Type	Values	Shape
None defined				

Group Attributes

Name	Description	Type	Values	Shape
long_name	Group description " Swath related information"	string	Quality indicators applicable to a particular channel for the repeat cycle	

Variables

Name	Attribute	Description	Type	Values	Shape
number_of_earth_samples		Number of Earth samples detected	uint	<runtime_value>	number_of_swaths
	long_name		*string*	*Number of Earth samples detected*	
number_of_missing_samples		Number of samples flagged as missing	uint	<runtime_value>	number_of_swaths

	long_name		*string*	*Number of samples flagged as missing*	
number_of_oversaturated_samples		Number of samples flagged as over-saturated	uint	<runtime_value>	number_of_swaths
	long_name		*string*	*Number of samples flagged as over-saturated*	
number_of_undersaturated_samples		Number of earth samples flagged as under-saturated	uint	<runtime_value>	number_of_swaths
	long_name		*string*	*Number of samples flagged as under-saturated*	
number_of_extended_dynamic_range_samples		Number of earth samples for IR3.8 input level 0 datasets where fire radiometric range samples have replaced those from	uint	<runtime_value>	number_of_swaths

		the normal radiometric range due to saturation of the normal radiometric range. Set to zero for all other spectral channels.			
	long_name		*string*	*Number of extended dynamic range samples*	
swath_coverage_compliance		Compliance to swath coverage requirement [SRD] FCI-05330 for the swath between the current and last repeat cycles. TRUE indicates compliance.	trilean	<runtime_value>	number_of_swaths
	long_name		*string*	*Compliance for Swath coverage*	

swath_overlap_compliance		Compliance to swath overlap requirement [SRD] FCI-05300 for current swath to next swath in the northerly direction. TRUE indicates compliance.	trilean	<runtime_value>	number_of_swath_boundaries
	long_name		*string*		
interswath_navigation_error		Calculated interswath navigation error evaluated at 95.45% confidence level	double	<runtime_value>	number_of_swaths
	long_name		*string*		
interswath_navigation_compliance		Compliance to interswath navigation error requirement [SRD] FCI-06470 for	trilean	<runtime_value>	number_of_swaths

		current swath to next swath in the northerly direction. TRUE indicates compliance.			
	long_name		*string*		

A.3.6 Group:/data/<channel_group>/quality_channel

Dimensions

Name	Description	Type	Values	Shape
None defined				

User Types

Name	Description	Type	Values	Shape
channel_status_type	Status of the channel.	enum ubyte	see Enums table	

Group Attributes

Name	Description	Type	Values	Shape
long_name	Group description "Quality indicators applicable to a particular channel for the repeat cycle"	string	Quality indicators applicable to a particular channel for the repeat cycle	

Variables

Name	Attribute	Description	Type	Values	Shape
channel_status		Status of the channel. Selected from [NOMINAL, NON-NOMINAL]. Defined by the compliance status of the channels to its overall requirements.	channel_status_type		
	long_name		*string*	*"Compliance status of the channel with repect to requirments"*	
number_of_expected_earth_pixels		Number of earth pixels that are expected be in the nominal dataset	uint		
	long_name		*string*	*Number of expected Earth pixels in nominal repeat cycle data set"*	
	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
number_of_masked_pixels		Number of space pixels that have been masked.	uint		
	long_name		*string*	*Number of masked pixels in repeat cycle data set"*	
	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
number_of_missing_warning_pixels		Number of Earth pixels with missing_warning flag set	uint		
	long_name		*string*	*"Number of pixels with missing_warning*	

				flag set in repeat cycle"	
	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
number_of_radiometric_warning_pixels		Number of Earth pixels with radiometric_warning flag set	uint		
	long_name		*string*	*"Number of pixels with radiometric_warning flag set in repeat cycle"*	
	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
number_of_noise_warning_pixels		Number of Earth pixels with noise_warning flag set	uint		
	long_name		*string*	*"Number of pixels with noise_warning flag set in repeat cycle"*	
	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
number_of_geolocation_warning_pixels		Number of Earth pixels with geolocation_warning flag set	uint		
	long_name		*string*	*"Number of pixels with geolocation_warning flag set in repeat cycle"*	

	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
number_of_saturation_warning_pixels		Number of Earth pixels with saturation_warning flag set	uint		
	long_name		*string*	*"Number of pixels with saturation_warning flag set in repeat cycle"*	
	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
number_of_straylight_correction_warning_pixels		Number of Earth pixels with straylight_correction_warning flag set	uint		
	long_name		*string*	*"Number of pixels with straylight_correction_warning flag set in repeat cycle"*	
	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
number_of_extended_dynamic_range_warning_pixels		Number of Earth pixels with extended_dynamic_range_warning flag set	uint		
	long_name		*string*	*"Number of pixels with extended_dynamic_range_warning flag set in repeat cycle"*	
	units		*string*	*"pixel"*	

	_FillValue		*ushort*	*NC_FILL_UINT*	
number_of_encoding_saturation_warning_pixels		Number of Earth pixels with nencoding_saturation_warning flag set	uint		
	long_name		*string*	*"Number of pixels with encoding_saturation_warning flag set in repeat cycle"*	
	units		*string*	*"pixel"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
percentage_expected_pixels_achieved		Percentage of pixels that were expected to be generated that were achieved. As defined by (number_of_expected_earth_pixels - number_of_missing_warning_pixels)/number_of_expected_earth_pixels	float		
	long_name		*string*	*"Percentage of pixels that were expected to be generated that were generated"*	
	units		*string*	*"percentage"*	
	_FillValue		*ushort*	*NC_FILL_FLOAT*	
completeness_compliance		Flag to indicate if image has passed the completeness requirement ([SRD] FCI-05360). TRUE indicates compliance.	trilean	<runtime_value>	
	long_name		*string*	*"Set True when compliant with completeness requirement"*	

accuracy_compliance		Flag to indicate if image has passed the accuracy requirement ([SRD] FCI-05390). TRUE indicates compliance	trilean	<runtime_value>	
	long_name		*string*	*"Set True when compliant with accuracy requirement"*	
coverage_compliance		Status of compliance to the coverage requirement ([SRD] FCI-05060). TRUE indicates compliance.	trilean	<runtime_value>	
	long_name		*string*	*"Set True when compliant with coverage requirement"*	
radiometric_restricted_zone_applied		If TRUE indicates that some of the pixels created during the repeat cycle lie within the radiometric restricted zone around the sun ([SRD] FCI-06650), implying a relaxation in the radiometric requirements for those pixels.	trilean		
	long_name		*string*	*"Radiometric restricted zone requirement relaxations applied"*	
absolute_pixel_position_knowledge_error		Estimate of the absolute pixel position knowledge error for the whole image	float	<runtime_value>	
	long_name		*string*	*"Estimate of the absolute pixel position knowledge error"*	
	units		*string*	*"m"*	
	_FillValue		*ushort*	*NC_FILL_FLOAT*	

absolute_pixel_position_knowledge_error_compliance		Status of compliance to the absolute pixel position knowledge error requirement for the whole image ([SRD] FCI-06380). TRUE indicates compliance.	trilean	<runtime_value>	
	long_name		*string*	*"Set True when compliant with absolute pixel position knowledge error requirement "*	
absolute_pixel_position_knowledge_error_500		Estimate of the absolute pixel position knowledge error within 500 by 500 pixel imagette	float	<runtime_value>	
	long_name		*string*	*"Estimate of the absolute pixel position knowledge error in 500 x 500 pixle vignette"*	
	units		*string*	*"m"*	
	_FillValue		*ushort*	*NC_FILL_FLOAT*	
absolute_pixel_position_knowledge_error_500_compliance		Status of compliance to the absolute pixel position knowledge error requirement within 500 by 500 pixel imagettes ([SRD] FCI-06410). TRUE indicates compliance.	trilean	<runtime_value>	
	long_name		*string*	*"Set True when compliant with absolute pixel position knowledge error in 500 x 500 pixel vignette requirement "*	

relative_pixel_position_knowledge_error		Estimate of the relative pixel position knowledge error relative to last repeat cycle	float	<runtime_value>	
	long_name		*string*	*"Estimate of the relatve pixel position knowledge error"*	
	units		*string*	*"m"*	
	_FillValue		*ushort*	*NC_FILL_FLOAT*	
relative_pixel_position_knowledge_error_compliance		Status of compliance to the relative pixel position knowledge error requirement relative to last repeat cycle requirement ([SRD] FCI-06500). TRUE indicates compliance.	trilean	<runtime_value>	
	long_name		*string*	*"Set True when compliant with relative pixel position knowledge error requirement "*	
radiometric_noise_compliance		Status of compliance to the radiometric noise requirement ([SRD] FCI-05690). TRUE indicates compliance.	trilean	<runtime_value>	
	long_name		*string*	*"Set True when compliant with radiometric noise requirement "*	
noise_power_spectral_density_compliance		Status of compliance to the noise power spectral density requirement ([SRD] FCI-05720). TRUE indicates compliance.	trilean	<runtime_value>	
	long_name		*string*	*"Set True when compliant with noise power spectral density requirement "*	

A.3.7 Group:/data/<channel_group>/external_calibration_coefficients

Dimensions

Name	Description	Type	Values	Shape
number_of_external_calibration_coefficients	Number of polynomial correction coefficients		<configured_value>	
min_max	Dimensions for defining minimum and maximum of a range		<configured_value>	

User Types

Name	Description	Type	Values	Shape
None defined				

Group Attributes

Name	Description	Type	Values	Shape
long_name	Description of group “Calibration coefficients for FCI generated calibration derived from external means”	string	"Calibration coefficients for the FCI generated calibration derived from external means"	
subsettable	Group can be included or excluded from the dataset according to configured selection	string	"yes"	

Variables

Name	Attribute	Description	Type	Values	Shape
external_calibration_coefficients_filename		File name of the file from which External Calibration Coefficients parameters were read	string	<runtime_value>	
	long_name		*string*	*"Name of file from which the External Calibration Coefficients were read."*	
external_calibration_coefficients_update_time		Time in UTC of the last update of External Calibration Coefficients	double	<runtime_value>	

		parameters			
	long_name		*string*	*"UTC time fo the last update of the External Calibration Coefficients"*	
	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0";*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
validity_period		Minimum and maximum times in UTC over which the External Calibration Coefficients are valid	double	<runtime_value>	min_max
	long_name		*string*	*"UTC start and end times between which the External*	

				Calibration Coefficients are valid"	
	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0";*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
external_calibration_coefficients_valid		External calibration coefficients valid for the current repeat cycle. Typo to be corrected in a future version of the Format specification	boolean	<runtime_value>	
	long_name		*string*	*"External Calibration Coefficients are*	

				valid for this repeat cycle"	
external_calibration_coefficients_correction_coefficients		Coefficients for External Calibration Coefficients polynomial correction with first value = 0th order coefficient, second value = 1st order coefficient, etc.	double	<runtime_value>	number_of_external_calibration_coefficients
	long_name		*string*	*External calibration coefficients*	
external_calibration_coefficients_correction_covariance_matrix		Covariance matrix for the External Calibration	double	<runtime_value>	number_of_external_calibration_coefficients, number_of_external_calibration_coefficients

		Coefficients polynomial correction coefficients			
	long_name		*string*	*External calibration covariance_matrix*	
radiance_validity_range		Minimum and maximum radiance for which the External Calibration Correction coefficients are valid	double	<runtime_value>	min_max, number_of_external_calibration_coefficients
	long_name		*string*	*Range of radiance over which external calibration*	

				coefficients are valid	
	units		*string*	*mW.m-2.sr-1.(cm-1)-1*	

A.3.8 Group:/data/quality

Dimensions

Name	Description	Type	Values	Shape
number_of_rppke_channel_pairs	Number of channel pairs evaluated for the Relative Pixel Position Error (RPPKE) between channels (RPPKE)		<configured_value>	
number_of_rppke_outputs	Number of directions for which the Relative Pixel Position Error (RPPKE) output is given [Default: 2 for North-South and East-West]		<configured_value>	
number_of_icra_channel_pairs	Number of channel pairs evaluated for the HRFI Inter-channel co-registration accuracy(ICRA) [FDHSI default = 56, HRFI default = 2]		<configured_value>	

User Types

Name	Description	Type	Values	Shape
None defined				

Group Attributes

Name	Description	Type	Values	Shape
long_name	Group description "Quality indicators at data level"	string	"Quality indicators at data level"	

Variables

Name	Attribute	Description	Type	Values	Shape
geometric_restricted_zone_earth_applicable		TRUE indicates that the sun is in the geometric restricted zone associated to the time around the eclipse of the sun by the Earth when viewed from the satellite, during a portion of the repeat cycle and geometric requirements relaxation applies ([SRD] FCI-06620)	boolean		
	long_name		*string*	*"Geometric restricted operations due to a Sun eclipse by Earth from*	

				satellite during the repeat cycle"	
geometric_restricted_zone_moon_applicable		TRUE indicates that the sun is in the geometric restricted zone associated to the time around the eclipse of the sun by the moon when viewed from the satellite, during a portion of the repeat cycle and geometric requirements relaxation applies ([SRD] FCI-06620)	boolean		
	long_name		*string*	*"Geometric restricted operations due to a Sun eclipse by the Moon from satellite during the repeat cycle"*	
rppke_channel_pairs_id		Identification of channel pairs evaluated for relative pixel position knowledge error (RPPKE). The first dimension corresponds to the same dimension as the dimension for the	ubyte		number_of_rppke_channel_pairs, number_of_rppke_outputs

		variable rppke_between_channels, the second dimension identifies a channel pair corresponding to an index selection from the variable l1c_channels_present			
	long_name		*string*	*"Channel pairs evaluated for RPPKE between channels"*	
rppke_between_channels		Values of relative pixel position knowledge error (RPPKE) between channels of dissimilar sampling distance. NC_FILL_FLOAT indicates an unavailable comparison.	float		number_of_rppke_channel_pairs, number_of_rppke_outputs
	long_name		*string*	*"Relative pixel position knowledge error between channels"*	
	units		*string*	*"m"*	
	_FillValue		*ushort*	*NC_FILL_FLOAT*	
rppke_between_channels_compliance		Overall status of compliance to the	trilean		number_of_rppke_channel_pairs

		relative pixel position knowledge error between channels. TRUE indicates compliance. ([SRD] FCI-06560)			
	long_name		*string*	*"Set True when compliant with relative pixel position knowledge error between channels requirement "*	
icra_channel_pairs_id		Identification of channel pairs evaluated for the interchannel co-registration accuracy (ICRA). The first dimension corresponds to the same dimension as the dimension for the variable hrfi_icra, the second dimension identifies a channel pair corresponding to an index selection from the variable l1c_channels_present	ubyte		

	long_name		*string*	*"Channel pairs evaluated for ICRA"*	
icra		Values of interchannel corregistration accuracy between channels of the same sampling distance. NC_FILL_FLOAT indicates an unavailable comparison	float		
	long_name		*string*	*"Interchannel corregistration accuracy between channels of the same sampling distance"*	
	units		*string*	*"m"*	
	_FillValue		*ushort*	*NC_FILL_FLOAT*	
icra_compliance		Overall status of interchannel corregistration accuracy between channels. TRUE indicates compliance. ([SRD] FCI-06530)	trilean		
	long_name		*string*	*"Set True when compliant with interchannel corregistration*	

				accuracy between channels requirement "	
repeat_cycle_start_compliance		The repeat cycle has started within the allowed margins of the required time. TRUE indicates compliance.([SRD] FCI-05420)	trilean		
	long_name		*string*	*"Set True when compliant with repeat cycle start requirement "*	
	comment		*string*	*"Repeat cycle has started within the allowed margins of the required time"*	
repeat_cycle_duration_compliance		The repeat cycle has the correct duration within the allowed limits. TRUE indicates compliance.	trilean		
	long_name		*string*	*"Set True when compliant with repeat cycle duration requirement "*	

	comment		*string*	*"Repeat cycle has a duration within the allowed limits"*	
repeat_cycle_timing_compliance		The repeat cycle has the correct timing within the allowed limits. TRUE indicates compliance. ([SRD] FCI-05450)	trilean		
	long_name		*string*	*"Set True when compliant with repeat cycle timing requirement "*	
	comment		*string*	*"Repeat cycle has timing within the allowed limits"*	

A.3.9 Group:/state

Dimensions

Name	Description	Type	Values	Shape
None defined				

User Types

Name	Description	Type	Values	Shape

None defined

Group Attributes

Name	Description	Type	Values	Shape
None defined				

Variables

Name	Attribute	Description	Type	Values	Shape
None defined					

A.3.10 Group:/state/platform

Dimensions

Name	Description	Type	Values	Shape
None defined				

User Types

Name	Description	Type	Values	Shape
None defined				

Group Attributes

Name	Description	Type	Values	Shape
None defined				

Variables

Name	Attribute	Description	Type	Values	Shape
subsatellite_minimum_latitude		Minimum value from the subsatellite_latitude vector	float		
	long_name		*string*	*"Minimum sub-satellite latitude"*	
	units		*string*	*"degrees_north"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	
	standard_name		*string*	*"latitude"*	
subsatellite_minimum_longitude		Minimum value from the subsatellite_longitude vector	float		
	long_name		*string*	*"Minimum sub-satellite longitude"*	
	units		*string*	*"degrees_east"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	
	standard_name		*string*	*"longitude"*	
subsatellite_maximum_latitude		Maximum value from the subsatellite_latitude vector	float		
	long_name		*string*	*"Maximum sub-satellite latitude"*	
	units		*string*	*"degrees_north"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	
	standard_name		*string*	*"latitude"*	

subsatellite_maximum_longitude		Maximum value from the subsatellite_longitude vector	float		
	long_name		*string*	*"Maximum sub-satellite longitude"*	
	units		*string*	*"degrees_east"*	
	_FillValue		*float*	*NC_FILL_FLOAT*	
	standard_name		*string*	*"longitude"*	

A.3.11 Group:/state/instrument

Dimensions

Name	Description	Type	Values	Shape
None defined				

User Types

Name	Description	Type	Values	Shape
fci_mode_type		ubyte enum	see Enums table	

Group Attributes

Name	Description	Type	Values	Shape
None defined				

Variables

Name	Attribute	Description	Type	Values	Shape
fci_mode		FCI Mode. Note that in decontamination mode only	fci_mode_type	<runtime_value>	

		the Visible channels are generated. For refocusing mode the level 1c product is generated only if Earth targets are used and the data is not disseminated. VNIR calibration does not generate earth view data during the' blind' LAC the other 4 LACs in the 10 minute cycle are disseminated, but are not expected to meet geometric performance.			
	long_name		*string*	*"Mode of FCI instrument"*	
level0_channels		Array of strings indicating the FCI data channels delivered in the level 0 data ("FDVIS0.4", "FDVIS0.5", "HRVIS0.6", "FDVIS0.8", "FDVIS0.9", "FDNIR1.3", "FDNIR1.6", "HRNIR2.2", "HRIR3.8", "FAIR3.8", "FDIR6.3", "FDIR7.3","FDIR8.7","FDIR9.7", "HRIR10.5", "FDIR12.3", "FDIR13.3")	string	<runtime_value>	number_of_l0_channels
	long_name		*string*	*"FCI level 0 data channels"*	
repeat_cycle_start_time		Conversion of the "repeat_cycle_start_time"	double	<runtime_value>	

		from the level 0 data ICU-I auxiliary data into UTC			
	long_name		*string*	*"UTC start time of repeat cycle"*	
	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0";*	
	precision		*string*	*"1 ms"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
repeat_sequence_counter		Copy of the “repeat sequence counter” from the level 0 data ICU-I auxiliary data	ushort	<runtime_value>	
	long_time		*string*	*"Repeat sequence counter"*	
	_FillValue		*double*	*NC_FILL_USHORT*	
repeat_cycle_counter		Copy of the “repeat cycle counter since the last transition to operational mode” from the level 0 ICU-I auxiliary data	ushort	<runtime_value>	
	long_time		*string*	*""Repeat cycle counter since the last transition to operational mode"*	

	_FillValue		*double*	*NC_FILL_USHORT*	
repeat_sequence_id		Copy of the “repeat sequence identifier” from the level 0 data ICU-I auxiliary data	ushort		
	long_time		*string*	*"Repeat sequence identifier"*	
	_FillValue		*double*	*NC_FILL_USHORT*	
repeat_cycle_counter_in_repeat_sequence		Copy of the “repeat cycle counter in repeat sequence” from the level 0 data ICU-I auxiliary data	ushort		
	long_time		*string*	*"Repeat cycle counter in the current repeat sequence"*	
	_FillValue		*double*	*NC_FILL_USHORT*	
repeat_cycle_id		Copy of the “repeat cycle type” from the level 0 data ICU-I auxiliary data, giving the current repeat cycle type An identifier for the repeat cycle derived from the “Repeat sequence identifier”, “Repeat cycle counter in current repeat sequence” and the "Scan Law" from the level 0 data ICU-I auxiliary	ushort	<runtime_value>	

		data. The repeat_cycle_id is a unique reference to the scan angles commanded to the FCI during a given repeat cycle.			
	long_time		*string*	*"Repeat cycle identifier"*	
	_FillValue		*double*	*NC_FILL_USHORT*	
scan_law_id		Copy of the “Scan law id” from the level 0 ICU-I auxiliary data	ushort	<runtime_value>	
	long_time		*string*	*"Scan law identifier"*	
	_FillValue		*double*	*NC_FILL_USHORT*	
channel_on		TRUE if the spectral channel is switched on and active	boolean		number_of_l0_channels
	long_time		*string*	*"Channel active flag"*	
last_decontamination_start_time		Start time in UTC of most recent decontamination	double	<runtime_value>	
	long_name		*string*	*"UTC start time of most recent decontamination"*	
	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0";*	
	precision		*string*	*"1 ms"*	

	_FillValue		*double*	*NC_FILL_DOUBLE*	
last_decontamination_end_time		End time in UTC of most recent decontamination	double	<runtime_value>	
	long_name		*string*	*"UTC end time of most recent decontamination"*	
	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0";*	
	precision		*string*	*"1 ms"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
last_detection_chain_parameter_change_time		Time in UTC of the last change in detection chain parameters, corresponding to the start of the repeat cycle when the parameters were activated	double	<runtime_value>	number_of_l0_channels
	long_name		*string*	*"UTC end time of last change in the detection chain parameters"*	
	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0";*	

	precision		*string*	*"1 ms"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
last_heated_black_body_calibration_time		Time in UTC of the last heated black body calibration for the IR spectral channels, corresponding to the start of the calibration data acquisition	double	<runtime_value>	
	long_name		*string*	*"UTC end time of last heated black body calibration"*	
	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0";*	
	precision		*string*	*"1 ms"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
last_mnd_calibration_time		Time in UTC of the last metallic neutral density calibration for the VNIR spectral channels, corresponding to the start of the calibration data acquisition	double	<runtime_value>	
	long_name		*string*	*"UTC end time of last metallic neutral density calibration"*	

	standard_name		*string*	*"time"*	
	units		*string*	*"seconds since 2000-01-01 00:00:00.0";*	
	precision		*string*	*"1 ms"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	

A.3.12 Group:/state/processor

Dimensions

Name	Description	Type	Values	Shape
None defined				

User Types

Name	Description	Type	Values	Shape
resampling_method_type	Resampling method applied to the level 1b samples to create the level 1c dataset	ubyte enum	see Enums table	
weighting_function_type	Weighting function used with the selected resampling method.	ubyte enum	see Enums table	
projection_type	Projection for the reference grid	ubyte enum	see Enums table	

Group Attributes

Name	Description	Type	Values	Shape

None defined

Variables

Name	Attribute	Description	Type	Values	Shape
detector_equalization_enabled		TRUE if detector equalization has been applied to the dataset	boolean	<configured_value>	
	long_name		*string*	*"Detector equalization enabled for the channel"*	
mtf_adaptation_enabled		TRUE if MTF adaption has been applied to the dataset	boolean	<configured_value>	number_of_l0_channels
	long_name		*string*	*"MTF adaptation enabled for the channel"*	
earth_straylight_correction_enabled		TRUE if earth stray light correction has been applied to the dataset	boolean	<configured_value>	

	long_name		*string*	*"Earth straylight correction enabled in this dataset"*	
sun_straylight_correction_enabled		TRUE if sun stray light correction has been applied to the dataset	boolean	<configured_value>	
	long_name		*string*	*"Sun traylight correction enabled in this dataset"*	
resampling_method		Resampling method applied to the level 1b samples to create the level 1c dataset	resampling_method_type	<configured_value>	
	long_name		*string*	*"Selected resampling method"*	
weighting_function		Weighting function used with the selected resampling method".	weighting_function_type	<configured_value>	

	long_name		*string*	*"Weighting method used with the selected resampling method"*	
radiometric_warning		Radiometric calibration in the previous repeat cycles has led to a potential problem in the calibration of the channel data for the complete repeat cycle, e.g. a missing black body calibration	boolean	<runtime_value>	number_of_l0_channels
	long_name		*string*	*"Radiometric calibration warning per channel for the repeat cycle"*	

	comment		*string*	*"Radiometric calibration in the previous repeat cycles has led to a potential problem in the calibration of the channel data for the complete repeat cycle"*	
geometric_warning		The geometric processing in the previous repeat cycles has not allowed the update of the INR state vector the required accuracy to allow current repeat cycle measurements to be guaranteed.	boolean	<runtime_value>	number_of_l1c_channels
	long_name		*string*	*"Geometric calibration*	

				warning per channel for the repeat cycle"	
	comment		*string*	*"Geometric processing in the previous repeat cycles has not allowed the update of the INR state vector to the required accuracy to allow current repeat cycle measurements to be guaranteed."*	
reference_grid		Identifies to which of the three SSD-based grids the parameters are associated.	ssd_type	<configured_value>	number_of_reference_grids
	long_name		*string*	*"Reference grid for the channel"*	
	comment		*string*	*"Reference grid is based on channel SSD"*	
reference_grid_identifier		File name for the reference	string	<configured_value>	number_of_reference_grids

		grid definition file, accessible to the user via the archive.			
	long_name		*string*	*"File name for the reference grid definition file"*	
reference_grid_version		Version number of the set of reference grid parameters. A change in version number between datasets implies the grid must be recalculated.	ushort	<configured_value>	number_of_reference_grids
	long_name		*string*	*"Version of reference grid parameters "*	
	_FillValue		*ushort*	*NC_FILL_USHORT*	
reference_grid_earth_model		Earth model used for	string	<configured_value>	

		reference grid			
	long_name		*string*	*"Earth model used for reference grid"*	
reference_grid_projection		Projection used for reference grid Earth model used for reference grid	projection_type	<configured_value>	
	long_name		*string*	*"Projection used for reference grid"*	
projection_origin_longitude		Longitude of projection origin	double	<configured_value>	
	long_name		*string*	*"Longitude of projection origin"*	
	standard_name		*string*	*"longitude"*	
	units		*string*	*"degrees East"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
projection_origin_latitude		Latitude of projection origin	double	<configured_value>	
	long_name		*string*	*"Latitude of projection origin"*	
	standard_name		*string*	*"latitude"*	
	units		*string*	*"degrees North"*	

	_FillValue		*double*	*NC_FILL_DOUBLE*	
reference_altitude		Satellite reference altitude	double	<configured_value>	
	long_name		*string*	*"Satellite reference altitude"*	
	units		*string*	*"m*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
reference_grid_spatial_sampling_angle_ns		Spatial sampling angle for each reference grid in North-South direction	float	<configured_value>	number_of_reference_grids
	long_name		*string*	*"Spatial sampling angle for each reference grid in North-South direction"*	
	units		*string*	*"radian"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
reference_grid_spatial_sampling_angle_ew		Spatial sampling angle for each reference	float	<configured_value>	number_of_reference_grids

		grid in East-West direction			
	long_name		*string*	*"Spatial sampling angle for each reference grid in East-West direction"*	
	units		*string*	*"radian"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
earth_polar_radius		Earth polar radius	double	<configured_value>	
	long_name		*string*	*"Earth polar radius"*	
	units		*string*	*"m"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
earth_equatorial_radius		Earth equatorial radius	double	<configured_value>	
	long_name		*string*	*"Earth equatorial radius"*	
	units		*string*	*"m"*	
	_FillValue		*double*	*NC_FILL_DOUBLE*	
reference_grid_number_of_columns		Number of columns in reference grid	uint	<configured_value>	number_of_reference_grids

	long_name		*string*	*"Number of columns in reference grid"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
reference_grid_number_of_rows		Number of rows in reference grid	uint	<configured_value>	number_of_reference_grids
	long_name		*string*	*"Number of rows in reference grid"*	
	_FillValue		*ushort*	*NC_FILL_UINT*	
azimuth_angle_at_reference_grid_origin		Azimuth angle from the GEOS projection origin to the centre of the first reference grid column	double	<configured_value>	number_of_reference_grids
	long_name		*string*	*"Azimuth angle from the GEOS projection origin to the centre of the first reference grid column"*	
	units		*string*	*"radian"*	
	_FillValue		*ushort*	*NC_FILL_DOUBLE*	
elevation_angle_at_reference_grid_origin		Elevation angle from	double	<configured_value>	number_of_reference_grids

		the GEOS projection origin to the centre of the first reference grid row			
	long_name		*string*	*"Elevation angle from the GEOS projection origin to the centre of the first reference grid row"*	
	units		*string*	*"radian"*	
	_FillValue		*ushort*	*NC_FILL_DOUBLE*	

A.3.13 Group:/state/celestial

Dimensions

Name	Description	Type	Values	Shape
None defined				

User Types

Name	Description	Type	Values	Shape
None defined				

Group Attributes

Name	Description	Type	Values	Shape
None defined				

Variables

Name	Attribute	Description	Type	Values	Shape
moon_shadow_presence		TRUE if the moon shadow on the Earth occurs in this chunk	boolean	<runtime_value>	
	long_name		*string*	*"Moon shadow on the Earth occurs in this dataset"*	
sunglint_presence		TRUE if sunglint is possible within the chunk	boolean	<runtime_value>	
	long_name		*string*	*"Sun glint possible in this dataset"*	

APPENDIX B NETCDF AND APPLICABLE STANDARDS AND CONVENTIONS

B.1 netCDF

The FCI L1c datasets are netCDF-4 files and use the enhanced data model. In addition, they utilise the Hierarchical Data Format version 5 (HDF5) as the storage layer and so can also be read as HDF-5 files.

Use of the enhanced netCDF-4 data model allows groups to be created to aid with the natural collection of various data and the subsetting of channels. In additions, enumerated variable types allow flags to be defined once and used throughout the dataset.

Also, the use of the HDF-5 data layer allows the use of the additional compression functionality as described in Section 7.12.

B.2 CF Conventions

The current Climate and Forecast Conventions (CF 1.7 are applicable to version 3 of the netCDF data model. As such, the FCI L1c datasets cannot conform terms of the conventions although they do try to follow the spirit of the conventions as far as possible. However, there are plans to create a CF-2 document to cover the enhanced netCDF-4 model.

B.3 NetCDF Attribute Convention for Dataset Discovery

The table below shows the conformance of the MTG products to the NetCDF Attribute Convention for Dataset Discovery [NACDD]. The datasets are conformant with all the Highly Recommended attributes and the majority of the recommended attributes that are applicable to the datasets.

ACDD Attribute	Product Compliance
Highly Recommended	
title	Present
summary	Present
keywords	Present
Conventions	Present
Recommended	
id	Present
naming_authority	Present
history	Present
source	Present
processing_level	Present
comment	Present

acknowledgement	Not Present
license	Present
standard_name_vocabulary	Present
date_created	Present
creator_name	Present
creator_email	Present
creator_url	Present
institution	Present
project	Present
publisher_name	Not Present
publisher_email	Not Present
publisher_url	Not Present
geospatial_bounds	Not Present
geospatial_bounds_crs	Not Present
geospatial_bounds_vertical_crs	Not Present
geospatial_lat_min	Present
geospatial_lat_max	Present
geospatial_lon_min	Present
geospatial_lon_max	Present
geospatial_vertical_min	Not Present
geospatial_vertical_max	Not Present
geospatial_vertical_positive	Not Present
time_coverage_start	Present
time_coverage_end	Present
time_coverage_duration	Present
time_coverage_resolution	Present
creator_type	Present
creator_institution	Present
publisher_type	Not Present
publisher_institution	Not Present
program	Not Present
contributor_name	Not Present
contributor_role	Not Present
geospatial_lat_units	Not Present
geospatial_lat_resolution	Not Present
geospatial_lon_units	Not Present
geospatial_lon_resolution	Not Present

geospatial_vertical_units	Not Present
geospatial_vertical_resolution	Not Present
date_modified	Not Present
date_issued	Not Present
date_metadata_modified	Not Present
product_version	Not Present (metadata available across version fields)
keywords_vocabulary	Present
platform	Present
platform_vocabulary	Not Present
instrument	Not Present (metadata available in data_source)
instrument_vocabulary	Not Present
cdm_data_type	Not Present
metadata_link	Not Present
references	Present
Highly Recommended Variable Attributes	
long_name	Usually present
standard_name	Usually present
units	Usually present
coverage_content_type	Not Present

APPENDIX C NETCDF TOOLS

C.1 Overview

The MTG netCDF datasets make use of a number of features of the enhanced netCDF-4 data model, including groups, unsigned integer data types and enumerated data types. FCI products always use the enhanced netCDF-4 format, and therefore their data layer is always HDF-5. Not all netCDF tools are capable of utilizing enhanced netCDF-4 datasets. However, the netCDF-4 files also use HDF-5 as the data layer, and so the datasets may also be examined with HDF-5 tools.

This Appendix lists freely available tools that are known to be compatible with the MTG netCDF-4 datasets.

This is not an exhaustive list as other tools and libraries may also be compatible with the enhanced netCDF-4 model, or may be updated to be so in future.

C.2 netCDF Libraries and Tools

NetCDF libraries are being developed by Unidata, a member of the UCAR Community Programs. Libraries can be downloaded from their webpage:

`http://www.unidata.ucar.edu`

The netCDF distribution provides a number of command line tools for looking at the structure and contents of netCDF datasets.

HDF-5 and gzip need to be installed before netCDF.

C.2.1 gzip

Gzip is used as the internal compression tool for the MTG netCDF-4 datasets. The gzip libraries need to be installed before installing HDF-5. Currently FCI products do not need gzip compression, and therefore the gzip library is not required.

C.2.2 HDF-5

HDF-5 (Hierarchical Data Format, version 5) is used as the storage layer for the MTG netCDF-4 datasets. The HDF-5 libraries need to be compiled before installing netCDF-4.

HDF 5 is being developed by The HDF Group. The latest libraries can be downloaded from their webpage:

`https://www.hdfgroup.org`

C.2.3 FCI Decompressor

NetCDF-4 can implement compression using the filter capabilities of the HDF5 library. These filters are provided by third-party entities, and their code is available in HDF5. The FCIDECOMP filter ("FCI DECOMPressor", ID=32018) is the filter procured by EUMETSAT to decompress FCI level 1c data [FCIDECOMP]. The HDF-5 filter is well integrated into the netCDF-C library. However, other libraries (for example: netCDF-Java) cannot use these filtering capabilities. In this case, a possible workaround is to remove the compression using the netCDF "nccopy" command line.

```
nccopy -F none compressed.nc uncompressed.nc
```

C.3 Panoply

Panoply is a freely available, cross-platform java application that provides as GUI for browsing and plotting geo-gridded and other arrays from netCDF datasets. It can also handle other formats such as GRIB, HDF, etc. It is supported by NASA and is available from:

http://www.giss.nasa.gov/tools/panoply/

As it is implemented in Java, it provides the same GUI in different operating systems and does not require administrative or root privileges to install.

It can display the CDL description as well as images, and makes use of many of the CF conventions. For instance, it converts integer counts from the *effective_radiance* variable to float numbers in the images using the *scale_factor* and *add_offset* variable attributes. Please note that the compressed data needs to be decompressed as described in Section 7.12 or Appendix C.2.3 before it is displayed in Panoply.

C.4 HDFView

HDFView is a freely available, cross-platform java application with a GUI for browsing and editing HDF4 and HDF5 files.

It is available from:

http://www.hdfgroup.org/products/java/hdfview/

C.5 Pytroll

Pytroll is an easy to use, modular, free and open source python framework for the processing of earth observation satellite data. The provided python packages are designed to be used both in R&D environments and in 24/7 operational production. An overview description of all packages and their mutual dependencies, maturity and known operational usage and as well as a complete list of pytroll packages is available on github.com: https://github.com/pytroll.

Satpy is a Python library for reading, manipulating, and writing data from remote-sensing earth-observing meteorological satellite instruments. *Satpy* provides users with readers that convert

geophysical parameters from various file formats to the common *Xarray* DataArray and Dataset classes for easier interoperability with other scientific python libraries. *Satpy* also provides interfaces for creating RGB (Red/Green/Blue) images and other composite types by combining data from multiple instrument bands or products. Various atmospheric corrections and visual enhancements are provided for improving the usefulness and quality of output images. The *Pyresample* package is used to resample data to different uniform areas or grids. The documentation is available at http://satpy.readthedocs.org/.

Satpy also includes a reader of the FCI Level 1c data. The following Python code snippet shows an example on how to use *Satpy* to generate a `natural_color` RGB composite over the European area. A more detailed tutorial is available as part of the Satpy documentation at https://satpy.readthedocs.io/en/latest/examples/fci_l1c_natural_color.html .

```
from satpy.scene import Scene
from satpy import find_files_and_readers

# define path to FCI test data folder
path_to_data = 'your/path/to/FCI/data/folder/'

# find files and assign the FCI reader
files = find_files_and_readers(base_dir=path_to_data, reader='fci_l1c_fdhsi')
# create an FCI scene from the selected files
scn = Scene(filenames=files)

# available dataset names for this scene, e.g., 'vis_04', 'vis_05', ...
print(scn.available_dataset_names())
# available composite names for this scene, e.g.,  'natural_color',
# 'airmass', 'convection', ...
print(scn.available_composite_names())

# load the datasets/composites of interest
scn.load(['natural_color','vis_04'])

# resample the scene to a specified area, e.g., "eurol1" for Europe
# in 1km resolution
scn_resampled = scn.resample("eurol", resampler='nearest',
                radius_of_influence=5000)

# save the resampled dataset/composite to disk
scn_resampled.save_dataset("natural_color",
                           filename='./fci_natural_color_resampled.png')
```

The image file produced by this code is shown in Figure 18.

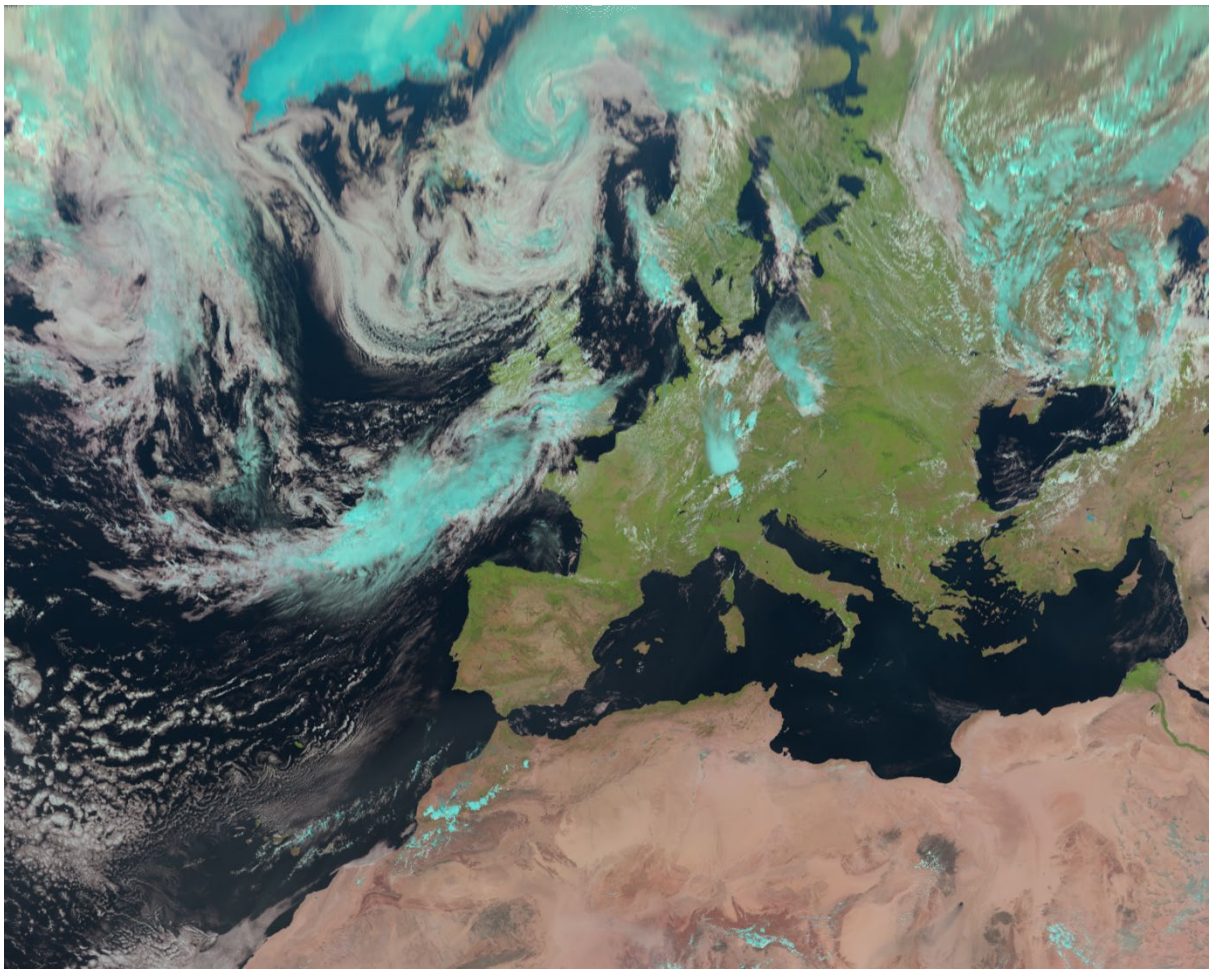


Figure 18 FCI natural colour image

Once a dataset is loaded to a Scene-object, the following code can be used to query the longitude and latitude, and the data values for each pixel in the dataset.

```
# save the dataset AreaDefinition to a variable
adef = scn['natural_color'].attrs['area']
print(adef)

# AreaDefinition-object provides a method for retrieving the longitudes & latitudes
lons, lats = adef.get_lonlats()

# The data values of a dataset can be accessed in form of a common numpy array
using:
dataset_values = scn['vis_04'].values

# NOTE: Datasets are provided by default in the highest available calibration
# level (e.g. reflectances for the VIS/NIR channels and brightness temperatures
# for the IR channels). While the previous commands use so-called lazy code
# executions from the dask library, this line loads the entire dataset into
# memory.
```