IRS L1B Format Familiarisation Dataset for Users V2.0 - Package Description

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EUMETSAT
Eumetsat-Allee 1, D-64295 Darmstadt, Germany
Tel: +49 6151 807-7
Fax: +49 6151 807 555
http://www.eumetsat.int

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****DCR = Document Change Request***

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1 INTRODUCTION

1.1 Purpose

This is the package description document for the IRS Dwell content being provided to End Users for Format Familiarisation.

1.2 Scope

This document is for the release of the 2019 IRS L1B Format Familiarisation data package that will be made available to the user community. The delivery is not part of a contractual baseline and thus will be identified as *for information*. The datasets have been formatted inline with the latest published baseline for the MTG project with a few minor corrections noted in this description.

1.3 Reference Documents

1.4 Baseline

- MTG Generic Format Specification, version 4A
- MTG IRS Level 0 & 1 Format Specification, version 5

This baseline has been slightly modified to implement minor corrections needed to generate the valid netCDF files. The details of these corrections can be found in Section 2.4.1.

1.5 Terms of Use

The user of Test Data acknowledges that the following limitations apply:

1. Test Data is provided ‘as is’, with EUMETSAT being unable to make any warranty or guarantee as to its properties, quality, or fitness for any specific purpose beyond information for the MTG user community.

2. Test Data shall not be used for operational purposes, nor shall it be cited in scientific publications or disclosed through other publicly available channels and internet platforms.

3. Test Data shall not be transferred, passed on or made available to any third parties without adequately indicating the nature and source of the data.

4. EUMETSAT shall bear no liability for any consequences, whether direct or indirect, arising from any use of Test Data. This includes but is not limited to adaptations carried out to user equipment or software based on the qualities of Test Data. Equally, EUMETSAT cannot be held liable for the interface between such adaptations and the decryption equipment required

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Any dispute, controversy or claim arising out of or relating to the interpretation, application or performance of these Terms of Use shall be settled in accordance with the Rules of Arbitration of the ICC.

2 PACKAGE DESCRIPTION

2.1 Package Contents

The MTG IRS L1B dataset is delivered a compressed tar file: IRS_L1b_Format_Familiarisation_2.0.tar.gz

The unpacked contents are:

- *W_XX-EUMETSAT-Darmstadt,SND+SAT,MTS1+IRS-1B-SSS--Q1--CHK-BODY--DIS-NC4E_C_EUMT_20191112155611_IDPFS_DEV_20160315120800_20160315120810_N__C_0049_0049.nc*: contains the noisy radiances and dwell geometry information encoded in the full L1b spectra format scaled as 2byte integers.
- *W_XX-EUMETSAT-Darmstadt,SND+SAT,MTS1+IRS-1B-PC--Q1--CHK-BODY--DIS-NC4E_C_EUMT_20191112154713_IDPFS_DEV_20160315120800_20160315120810_N__C_0049_0049.*nc: contains the above radiances re-encoded as principle components scaled as 4 byte integers. Using the Eigen vectors and reconstruction operator provided in the following static support file.
- *CM__PCA-USER_MTS1+IRS_20191112180000_static.nc* contains the Eigenvectors and Reconstruction Operator
- *sha256sum.txt* – checksum file (see below)

2.2 Checksum

A checksum file sha256sum.txt is provided in the package to check the integrity of the delivery with the command:

```
sha256sum -c sha256sum.txt
```

2.3 Known Limitations and Issues

2.3.1 Populated data arrays

The full IRS L1b format has many parameters which require a full processing chain in place to populate them all. While the provided datasets contain all the expected parameters to the correct size, many of them are blank or full of dummy values. In the generation of these datasets only the following parameters have been populated:

Common parameters (SSS and PC datasets):

- /data/time
- /data/latitude
- /data/longitude
- /data/land_fraction

- /data/<band>/start_wavenumber
- /data/<band>/end_wavenumber
- /data/<band>/wavenumber_step
- /data/<band>/wavenumber

PC dataset only parameters:

- /data/<band>/compressed/local_pcr_operator
- /data/<band>/compressed/local_eigenvalues
- /data/<band>/compressed/residual_energy
- /data/<band>/compressed/global_pcrs_quality
- /data/<band>/compressed/global_pc_scores
- /data/<band>/compressed/local_pc_scores
- /data/<band>/compressed/global_pcr_scores
- /data/<band>/compressed/local_pcr_scores

SSS dataset only parameters:

- /data/<band>/measured/effective_radiance
- /data/<band>/measured/radiance_scale_factor
- /data/<band>/measured/radiance_offset

2.3.2 Input Data Generation

The IRS L1 spectra and hence derived PC parameters have been generated based on simulated IRS L1b test data which may not be fully representative of L1b data generated by the IRS L1 processing chain. That said it should form a suitable basis for testing the implementation of the algorithm.

2.3.3 Eigenvector Generation

The Eigenvalues and vectors have been generated based on simulated IRS L1b test data which may not be fully representative of L1b data generated by the IRS L1 processing chain. That said it should form a suitable basis for testing the implementation of the algorithm.

2.3.4 L1B Grid

The datasets have been created based on test data defined on the following L1B data grid. This L1b grid may not be the final grid used by the IRS L1 IPC. For the IRS V2 it is expected that this grid will change to match user expectations.

Band	Start WN (cm^{-1})	End WN (cm^{-1})	Grid size	WN step (cm^{-1})
MWIR	1600	2175	921	0.625
LWIR	700	1210	817	0.625

2.3.5 Attributes

Not all attributes and metadata in the radiance datasets and the supporting eignevctor static data files are curtrently set correctly.

2.3.6 Format Evolution

Some aspects of the processing are still evolving, especially relating to the monitoring algorithms and the format of supporting static data. These will be formalised over the next year or so as the procurement of the L1 Data Processing Facility progresses.

2.4 Data Format

The IRS L1B spectra in native and Principle Component form are provided in netCDF format inline with the IRS Level 0 and 1 Format Specification that was released as part of the IDPF-S CDR datapackage. In the construction of the datasets a number of corrections to the format were identified which are outlined below.

2.4.1 Corrections to the L1B Format

The following corrections were applied to the format to allow a successful geeration of the datasets:

- Added to IRS-1B-SSS-BODY and IRS-1B-PC-BODY datasets the missing parameters:
  - *spectral_scale_uncertainty_warning;*
  - *start_number;*
  - *end_number;*
  - *maximum_opd*
- Corrected typos in a few parameter types (*int* instead of *integer*; *float* instead of *flaot*) to allow auto generation of the netCDF skeleton.
- Added some missing *valid_range* values to allow auto generation of the netcdf skeleton
- Swapped the order dimensions in the IRS-1B-PC-BODY*/data/band/compressed/local_pcr_operator* to be consistent with other parameter dimension ordering.
- Corrected *long_name* attribute to '*longitude*' instead of '*latitude*' for IRS-1B-SSS-BODY and IRS-1B-PC-BODY */data/longitude* and */data/subsatellite_longitude* parameters.
- Added to GFS ENUM *reference_frame_type* definition the value: *0 = None* ie. Not used. Otherwise this caused error when running the command '*ncdump*'
- Modified GFS *index* dimension to 1 for IRS.

2.5 Re-scaling the L1B SSS radiances

Due to the large dynamic range of radiance values between channels in the IRS L1b spectra, the *scale_factor* and *add_offset* are provided per channel. The radiances are provided as a data cube with each spectral radiance encoded as an unsigned 2 byte integer. The scaling parameters can then be read separately in the *scale_factor* and *add_offset* arrays.

Below is an example of pseudo code to extract and re-scale the LW radiances from the L1B dataset:

```
SSSFile = "W_XX-EUMETSAT-Darmstadt,SND+SAT,MTS1+IRS-1B-PC--Qx—
CHK-BODY--DIS-
NC4E_C_EUMT_20160315120000_IDPFS_DEV_20160315120800_2016031512
0817_N__C_0048_0049.nc"

# lwir extraction
band=”lwir”
scaled = h5read(SSSFile,
          "/data/$band/measured/effective_radiances")
sf = h5read(SSSFile,
          "/data/$band/measured/scale_factors")
off = h5read(SSSFile,
          "/data/$band/measured/add_offsets")

lw_spectra[i,j,wn] = scaled[i,j,wn] * sf[wn] + off[wn]
```

2.6 Decoding the L1B PC dataset

The IRS L1B PC dataset along with the corresponding Eigenvector support file can be used to reconstruct the original (or near to) radiance values that are provided in the main IRS L1b Spectra dataset. If the users of this data want to test this process then the following pseudo code provides an example of how this can be performed for the LW band.

```
# Read input datasets:
EVFile = "CM__PCA-USER_MTS1+IRS_20190321090000_static.nc"

PCSFile  =  "W_XX-EUMETSAT-Darmstadt,SND+SAT,MTS1+IRS-1B-PC--Qx--
CHK-BODY--DIS-
NC4E_C_EUMT_20160315120000_IDPFS_DEV_20160315120800_20160315120
817_N__C_0048_0049.nc"

band = "lwir"
quantisation = 0.5
n = 150     # No. global PCs
n_local = 5 # No. local PCs.

E = h5read(EVFile, "/$(band)/eigenvectors")
mean = h5read(EVFile, "/$(band)/mean_spectrum")
N = h5read(EVFile, "/$(band)/noise normalisation")
R = N * E
P = quantisation .* h5read(PCSFile,
        "/data/$(band)/compressed/global_pc_scores")
p_local = quantisation .* h5read(PCSFile,
        "/data/$(band)/compressed/local_pc_scores")
R_local = h5read(PCSFile,
        "/data/$(band)/compressed/local_pcr_operator")

# Reconstruction from matrix multiplication of global PCs and
# elementwise addition to the mean spectrum
reconstructed[i,j,:] = mean[:] .+ R[:,:] ⋅ p[i,j,:]

# To include the local PC contribution then also
# apply the following matrix multiplication and elementwise
# addition of local elements to the global reconstruction
reconstructed[i,j,:] = reconstructed[i,j,:]
                        .+ R_local[:,:]⋅ p_local[i,j,:]
```