CVIIRS - Software User Manual
## Document Change Record

<table>
<thead>
<tr>
<th>Issue / Revision</th>
<th>Date</th>
<th>DCN. No</th>
<th>Changed Pages / Paragraphs</th>
</tr>
</thead>
<tbody>
<tr>
<td>v1</td>
<td>03/12/2014</td>
<td></td>
<td>First version</td>
</tr>
<tr>
<td>v1A</td>
<td>07/07/2015</td>
<td></td>
<td>Updated for release 1.1.7</td>
</tr>
<tr>
<td>v1B</td>
<td>19/08/2016</td>
<td></td>
<td>Updated for release 1.2.7 &amp; 1.2.8</td>
</tr>
<tr>
<td>v1C</td>
<td>13/09/2017</td>
<td></td>
<td>Updated for release 1.2.10</td>
</tr>
<tr>
<td>v1D</td>
<td>25/01/2018</td>
<td></td>
<td>Updated for CVIIRS release 2.0.0. Prepared by Fabio De Santis of CS GmbH on behalf of EUMETSAT with contributions from Stephan Zinke.</td>
</tr>
</tbody>
</table>
Table of Contents

1 Introduction .................................................................................................................. 7
  1.1 Purpose ..................................................................................................................... 7
  1.2 Scope ......................................................................................................................... 7
  1.3 Applicable Documents ............................................................................................... 7
  1.4 Reference Documents ............................................................................................... 7
  1.5 Document Structure ................................................................................................... 7

2 System overview .......................................................................................................... 8
  2.1 Global architecture .................................................................................................... 8
  2.2 Operational environment ........................................................................................... 8

3 Installation for users .................................................................................................... 9
  3.1 Environment Set-Up .................................................................................................. 9
    3.1.1 Minimum Hardware Requirements .................................................................... 9
    3.1.2 Configuring the Launching Script for Windows 32 bit .................................. 9
    3.1.3 Software Requirements .................................................................................... 10
  3.2 Software Deployment ................................................................................................ 10
  3.3 Directory Structure ................................................................................................... 10

4 Operator Reference ..................................................................................................... 12
  4.1 Configuration of CVIIRS ......................................................................................... 12
    4.1.1 Logging Configuration ....................................................................................... 12
    4.1.2 Properties Configuration .................................................................................. 12
  4.2 Running the CVIIRS Tool ........................................................................................ 12
  4.3 --of (--originalFileName) ...................................................................................... 15
  4.4 -p (--policy) option .................................................................................................. 16
  4.5 -g option (handle multi-granule aggregations) ....................................................... 20
  4.6 File Creation order and Temp Filename .................................................................. 21
  4.7 Geolocation Information in the Compact Format .................................................. 22
  4.8 Fill Values for Dropped Geolocation Information .................................................. 22
  4.9 Configuration ........................................................................................................... 26
    4.9.1 Compaction ......................................................................................................... 26
    4.9.2 Expansion ........................................................................................................... 27
  4.10 Startup Script (cviirs.sh, cviirs.bat) and JAVA_HOME .......................................... 27
  4.11 Reading the Compact VIIRS format created by version 0.9.7 and 1.2.4 .............. 27
  4.12 Additional Attributes for CVIIRS version and Compact VIIRS SDR Version .... 28
  4.13 Mission and Satellite Name ..................................................................................... 28
    4.13.1 Filtering by Platform_Short_Name ................................................................. 29
    4.13.2 Mapping “Platform_Short_Name” to “satellite identifier” in the Compact Format 29
  4.14 Command Line Arguments validation ..................................................................... 29

Appendix A Properties configuration .................................................................................. 30
Appendix B Log4j configuration ........................................................................................ 35
Appendix C Folders structure ............................................................................................ 36
Appendix D Statistic report format ..................................................................................... 38
List of Tables

Table 1: Hardware Requirements ........................................................................................................................... 9  
Table 2: directory structure of the installation folder ................................................................................................. 10  
Table 3: Option --of / --originalFilename .................................................................................................................. 15  
Table 4: Option -p / --policy ......................................................................................................................................... 16  
Table 5: Attribute fill or default values for -p=lax ........................................................................................................ 18  
Table 6: Dataset fill or default values for -p=lax .......................................................................................................... 19  
Table 7: File Creation Sequences .................................................................................................................................. 21  
Table 8: Geolocation Information with fill values ....................................................................................................... 22  
Table 9: Configuration run-time parameters ................................................................................................................ 26  
Table 10: lib folder files description .......................................................................................................................... 36  
Table 11: config folder files description ..................................................................................................................... 36  
Table 12: scripts folder files description ..................................................................................................................... 37  
Table 13: Array Element Counts .................................................................................................................................... 38  
Table 14: Array Element Statistics .................................................................................................................................. 38

List of Figures

Figure 1 - The General Software Architecture ............................................................................................................ 8  
Figure 2 - The filter mechanism. .................................................................................................................................. 14  
Figure 3: DDS Aggregation Methodology ................................................................................................................ 20  
Figure 4: Aggregation Methodology for missing Granules ............................................................................................ 20  
Figure 5: Complete Examples for Aggregation Methodology ..................................................................................... 21
Acronyms

API  Application Programming Interface
CPU  Central Processing Unit
CS   CS Communication & Systems Germany GmbH
CVIIRS  Compact VIIRS Format
EARS  EUMETSAT Advanced Retransmission Service
EUMETSAT  European Organisation for the Exploitation of Meteorological Satellites
GB   Gigabyte
GHz  Gigahertz
HDF  Hierarchical Data Format
JRE7 Java Runtime Environment 7
JVM  Java Virtual Machine
SDR  Sensor Data Records
TAI  International Atomic Time
VIIRS  Visible Infrared Imaging Radiometer Suite
1 INTRODUCTION

1.1 Purpose

This document describes the Software User Manual of the ‘Compact VIIRS SDR Product format’ conversion tool (from now on, simply ‘CVIIRS’ conversion tool).

The intended readers of this document are the CVIIRS users who have a minimum background knowledge of the VIIRS SDR and EUMETSAT Compact VIIRS SDR product formats (see [AD.1]).

1.2 Scope

The purpose of this document is to provide the software user manual of the CVIIRS tool from a user point of view.

1.3 Applicable Documents


1.4 Reference Documents


474-00001-01-B0200, August 23, 2016, 0200C

1.5 Document Structure

The structure of the document is as follows:

- Chapter 1 – This introduction.
- Chapter 2 – The system overview.
- Chapter 3 – The software installation procedure for normal users.
- Chapter 4 – The software reference for users.
2 SYSTEM OVERVIEW

2.1 Global architecture

The purpose of the CVIIRS tool is to convert both ways, between the VIIRS SDR Product format (from now on, also “Classic format”) and the Compact VIIRS SDR Product format (from now on, also “Compact format”).

In the context of the EUMETSAT Advanced Retransmission Service (EARS), EUMETSAT has developed a service for providing VIIRS SDR (L1) M-Band data in near real time to European Users via its satellite based dissemination system EUMETCast. EUMETCast has an established base of around 3000 Users. Considering the cost of the satellite data bandwidth, EUMETSAT identified a need to develop a more compact product format for the distribution of the VIIRS data.

The Compact VIIRS product format follows the structure and conventions of the original VIIRS SDR product format closely. However, the observations are reduced to 16 bit radiances only and the geolocation and angular data are contained only at a set of tie points (the corners of square areas forming a grid over the granule). The resulting product size is around a third of the original product size, while maintaining a very high accuracy of the observations and geolocation and angular data.

Having small granules is convenient for distributing the data as soon as they are available from the satellite, reducing the processing time and distributing them earlier.

2.2 Operational environment

The functionalities of the CVIIRS tool can be accessed through the following interfaces (see also Figure 1):

- the command-line interface from which it is possible to access most of the CVIIRS tool functionalities, and
- the API, to be directly linked to the CVIIRS tool internal classes.
3 INSTALLATION FOR USERS

3.1 Environment Set-Up

3.1.1 Minimum Hardware Requirements

The minimum hardware requirements refer to the machine the CVIIRS tool is intended to be installed on:

Table 1: Hardware Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Minimum</th>
<th>Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free Memory</td>
<td>4 GB</td>
<td>6 GB</td>
</tr>
<tr>
<td>Free Disk Space¹</td>
<td>10 MB</td>
<td>20 MB</td>
</tr>
<tr>
<td>CPU</td>
<td>2 GHz (multi-core)</td>
<td>2 GHz (multi-core)</td>
</tr>
</tbody>
</table>

The memory requirements should be seen as the memory constraints of the underneath machine and not of the Java Virtual Machine running the tool.

3.1.2 Configuring the Launching Script for Windows 32 bit

In order to run the tool on a Windows 32 bit machine, the launching script is modified to be compliant with the Oracle Java Virtual Machine memory constraints². The parameter changed from -Xmx2048m to –Xmx1536m (from 2GB to 1.5GB), only for a Windows 32-bit machine. In order to further customize the memory limit for the JVM, edit the following section of the cviirs.bat script:

```bash
:: Set the max JVM memory depending on the architecture
::
set JVM_MAX_MEM=1536m
if "%ARCH%" == "i386" goto memarch32
set JVM_MAX_MEM=2048m
:memarch32
```

Modify the number in red (i.e.1536) according to the desired heap limit. The value must be expressed in megabytes.

¹ It does not include the space required for the data.

² For further details, see http://www.oracle.com/technetwork/java/hotspotfaq-138619.html#gc_heap_32bit.
3.1.3 Software Requirements

Only the Java Runtime Environment 7 is required.

Both the Windows and Linux versions can be downloaded from:


3.2 Software Deployment

The CVIIRS tool comes either as a compressed archive (zip for Windows and tar.gz for Linux) or as an rpm package (only for the Linux version).

When it is available as a compressed package, the only action required is to extract it and run it using the provided script inside the root folder, that is either cviirs.bat (for Windows) or cviirs.sh (for Linux).

When the release is available as an rpm package, to install it, run the following command as root:

```
rpm -i cviirs-x.y.z-w.arch.rpm
```

Where:

- x, y and z represents the version of CVIIRS tool;
- w is the package release number;
- arch is the architecture, can be i386 or x86_64 (respectively for 32 bits and 64 bits).

If succeeded, the command cviirs will be immediately available in the PATH.

3.3 Directory Structure

Table 2 shows the directory structure of the installation folder.

<table>
<thead>
<tr>
<th>File or Directory</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cviirs.bat</td>
<td>The main script for launching the CVIIRS tool.</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>cviirs.sh</td>
<td></td>
</tr>
<tr>
<td>cviirs.jar</td>
<td>The main jar file packaging the CVIIRS tool Java classes.</td>
</tr>
<tr>
<td>File</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>license.txt</td>
<td>The description of the licences included in the folder licences.</td>
</tr>
<tr>
<td>config</td>
<td>The folder containing the logger and the CVIIRS tool configuration files.</td>
</tr>
<tr>
<td>lib</td>
<td>The directory containing all the third-party libraries (jar files and the system-depended dynamic libraries).</td>
</tr>
<tr>
<td>licences</td>
<td>The folder containing all the licences for the CVIIRS tool and the third-party libraries.</td>
</tr>
</tbody>
</table>

Further details about the folders **lib** and **config** can be found in Appendix C. Note that inside the **lib** folder, as regards the specific HDF5 dynamic libraries (system-depended), there is only one directory for the particular architecture the tool is installed. For instance, for the Windows 64 bit installation, the lib directory will have the following structure (only the folder `hdf-win-x86_64`):

```
lib
│   │   jhdf.jar
│   │   jhdf4obj.jar
│   │   jhdf5.jar
│   │   jhdf5obj.jar
│   │   jhdfobj.jar
│   │   jopt-simple-5.0.3.jar
│   │   junit-4.10.jar
│   │   log4j-1.2.17.jar
│   │   hdf-win-x86_64
│   │       jhdf.dll
│   │       jhdf5.dll
```

In bold what is specific for the architecture the CVIIRS tool is installed on. The rest is common to all the available architectures.
4 OPERATOR REFERENCE

4.1 Configuration of CVIIRS

The CVIIRS tool offers the possibility to customise several constants which are used internally and that rule many of the aspects related to the data processing (compaction and expansion). Such a tuning can influence both the physical aspect (e.g. brightness temperature conversion constants) and the processing algorithm (e.g. number of scans per sections).

Please observe that changing the constants might result in unforeseen behaviour of the tool.

4.1.1 Logging Configuration

It is possible to configure the format and the minimum reported severity for the log messages the CVIIRS tool reports to the user.

The CVIIRS tool uses a logging third-party library called log4j which can be configured by editing the standard configuration file already provided and called log4j.properties (see Appendix B). After the installation, this file will be located under the folder config.

For further information about the log4j.properties file, please refer to http://wiki.apache.org/logging-log4j.

4.1.2 Properties Configuration

To configure the internal aspect, related to the file processing, the configuration file called config.properties is provided (see Appendix A). After the installation, this file will be located under the folder config.

Its structure is of the type property=value whose meaning can be easily understood by reading the comment above each single property. Below is reported an example.

```
# Number of threads handled by the pool (maximum number of threads the tool # is allowed to use).
NumWorkingThreads=20
```

A typical customisation includes the following properties tuning:

- LeapDates;
- NumWorkingThreads;
- DefaultNumberOfGranules.

4.2 Running the CVIIRS Tool

To run the CVIIRS tool run the script cviirs.sh in Linux or cviirs.bat in Windows. If CVIIRS was installed from an rpm package, run the command cviirs from anywhere within the system (the script should be already in the PATH).
This script will setup the environment and run the CVIIRS tool inside the default Java Virtual Machine. If it cannot find it, an error is reported and the script is aborted (in this case, check your environment that java is defined in the PATH).

When running the script (or the command) it is possible to pass to the JVM extra parameters (See the available java command line options for more information) by using as first option --jvmo followed by the JVM parameters within quotes. For instance:

```bash
cviirs --jvmo "<JVM parameters>" <cviirs arguments>
```

The CVIIRS tool has a command-line help which describes all the parameters that can be used and their meaning. The output shown below can be obtained by running the tool with the --help option.

```
Usage :
cviirs -<sc|c|x><M|I|MI|N> -i <input dir> -o <output dir> [-f <filter>] 
[-g <number of granules>] [-p <strict|lax|mixed>] 
[-from <dd/MM/yyyy HH:mm:ss>] [-to <dd/MM/yyyy HH:mm:ss>]

Option                                Description
------                                -----------
-?, -h, --help                        show help
-I                                    convert I-Band channels
-M                                    convert M-Band channels
-N                                    convert DN-Band channels
-a, --accuracy <Accuracy>            the interpolation accuracy level
                                     (HIGH|STANDARD) - (default: HIGH)
-c                                    compact the SDR product
-f <String>                           an inclusive filter for the file names
--from <dd/MM/yyyy HH:mm:ss>          product start time interval
-g <Integer>                          maximum number of granules per aggregation (default: 1)
-i, --input-dir <Path>                input directory
-m <Satellite Identifier>            Only consider the aggregations from a specific satellite (i.e. Satellite Identifier) (default: All)
-o, --output-dir <Path>              output directory
--of, --originalFileName             use the original file name when reconstructing the channels
-p, --policy <Policy>                the policy in case of corrupted channels (strict|lax|mixed) (default: 'strict' with option 'c', 'lax' with option 'x')
-s                                     calculate statistics (compaction only)
-t, --threads <Integer>               specify the number of working threads (default: 20)
--to <dd/MM/yyyy HH:mm:ss>            product end time interval
-x                                     expand the Compact SDR product

Examples:

1) Filter the aggregations by Satellite Id (e.g. 'npp') using the attribute '/Platform_Short_Name' (e.g. 'NPP') mapped in the 'config.properties' file
```
Further details about the statistics report format (i.e. the option \texttt{--s}) can be found in Appendix D.

The options \texttt{--from} and \texttt{--to} define the lower and upper bound of the range within which the individual aggregations should entirely be contained in order to be selected.

\begin{verbatim}
cviirs -cMI -i <input-dir> -o <output-dir> -m 'NPP'
\end{verbatim}

Figure 2 - The filter mechanism.

Figure 2 shows an example. The filter is set to be from \texttt{10:02:00.0} to \texttt{10:10:00.0}. Only the second aggregation (i.e. \texttt{d20150204_t1003305_e1009109}) is entirely contained in the selected range (from \texttt{10:03:30.5} to \texttt{10:09:10.9}) and therefore eventually either compacted or expanded. The first one (i.e. \texttt{d20150204_t0957489_e1003293}) is only partially included (from \texttt{09:57:48.9} to \texttt{10:03:29.3}), hence excluded.

The dates format must comply to the following syntax (see also the usage description above):

\texttt{dd/MM/yyyy HH:mm:ss}

where:

- \texttt{dd} – day of the months (two digits, zero-padded – from 00 to 31)
- \texttt{MM} – month of the year (two digits, zero-padded – from 01 to 12)
- \texttt{yyyy} – year (four digits – e.g. 1995 and 2017)
- \texttt{HH} – hours of the day (two digits, zero-padded – from 00 to 23)
- \texttt{mm} – minutes of the hour (two digits, zero-padded – from 00 to 59)
- \texttt{ss} – seconds of the minute (two digits, zero-padded – from 00 to 59)

Always specify the dates between quotes and separate the day from the time using a space.

Note that the option \texttt{--p} (i.e. \texttt{--policy}) produces different software behaviours in the event of a missing channel. In particular:

1) \texttt{strict} immediately terminates the program,
2) \texttt{lax} simply ignores the channel (the channel will be not present in the target aggregation) and
3) \texttt{mixed} will recreate the channel empty (using specific default values whenever possible).
When no policy is specified the *strict* strategy is applied in case of compaction and the *mixed* one in case of expansion.

In all cases (both compaction and expansion), if the geolocation data is missing, the option *strict* is applied (i.e. the program aborts immediately).

Below are a few examples of execution:

*Expand all the aggregations (only I-band) in the folder called “input” and save the outcome in the directory called “output”. Select only aggregations between 07/07/2014 07:45 and 07/08/2014 00:15”.*

```
cviirs -xI -i input -o output --from "07/07/2014 07:45:00" --to "07/08/2014 00:15:00"
```

*Compact all the aggregations (both M-band and I-band) in the folder called “input” and save the outcome in the directory called “output”. If there is any channel missing, skip it.*

```
cviirs -cMI -i input -o output -p lax
```

### 4.3 --of (--originalFileName)

CVIIRS offers the capability to re-create the original filename of the files which were used during the compaction process, when expanding them.

**Table 3: Option --of / --originalFilename**

<table>
<thead>
<tr>
<th>Option</th>
<th>Option parameters</th>
<th>Behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>--originalFileName</td>
<td>none</td>
<td>This option is only valid when using the -x option. If this option is used, the CVIIRS tool will recreate the original filenames. If this option is not used, the CVIIRS tool will use as the creation time part of the filename the current system time. See section 3.4.1 “File Naming Convention for NPP/NPOESS Data Products” in the JPSS Common Data Format Control Book – External Volume I, p. 22 for more information [RD-1].</td>
</tr>
</tbody>
</table>
4.4 -p (--policy) option

CVIIRS offers with the -p command line option (--policy) a possibility to compact and expand VIIRS products even if some channel files are missing or are corrupted in their structure.

In general, if any of the input geolocation data is either:
- fully missing;
- missing expected HDF5 groups, datasets or attributes; or
- containing expected datasets or attributes with incorrect data type or dimension,

the CVIIRS tool will stop processing and no output product will be created. A Log4J error message is generated stating the affected granule as well as the nature of the encountered problem.

In the paragraph above and in the table below, expected HDF5 attributes refer to those attributes that are defined explicitly in [AD-1], and are needed by the CVIIRS tool for the conversion of the product. All other attributes are transferred as is without checking missing attributes, incorrect data type or dimension.

<table>
<thead>
<tr>
<th>Option</th>
<th>Option parameters</th>
<th>Behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>-p policy</td>
<td></td>
<td>In the following a channel refers to the full HDF5 file containing that channel in the case of an original VIIRS SDR product and to the full HDF5 group containing that channel in the case of a Compact VIIRS SDR product.</td>
</tr>
<tr>
<td></td>
<td>strict</td>
<td>A corrupted channel is defined as channel that is either:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- fully missing;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- missing expected HDF5 groups, datasets or attributes; or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- containing expected datasets or attributes with incorrect data type or dimension.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For each corrupted channel a Log4J error or warning message, as defined below, is generated, stating the affected granule and channel as well as the nature of the corruption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If this option is set, the CVIIRS tool will stop processing if it encounters a corrupted channel. No output product will be created in this case. A Log4J error message is generated.</td>
</tr>
</tbody>
</table>


Table 4: Option -p / --policy
<table>
<thead>
<tr>
<th>lax</th>
<th>If this option is set, the CVIIRS tool will continue processing if it encounters a corrupted channel. In the generated output the corrupted channel will be included, but all values will be set to fill values or default values. For each corrupted channel a Log4J warning message is generated.</th>
</tr>
</thead>
<tbody>
<tr>
<td>mixed</td>
<td>If this option is set, the CVIIRS tool will continue processing if it encounters a corrupted channel. In the generated output the corrupted channel will be excluded. For each corrupted channel a Log4J warning message is generated.</td>
</tr>
</tbody>
</table>
To create a fill value channel, the condition is that at least one valid M- or I-Band file is present.

**Table 5: Attribute fill or default values for \(-p=lax\)**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Fill or Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>/root: @N_HDF_Creation_Date</td>
<td>Set to system date</td>
</tr>
<tr>
<td>/root: @N_HDF_Creation_Time</td>
<td>Set to system time</td>
</tr>
<tr>
<td>/VIIRS-[M][I]xx-SDR: @N_Collection_SHORT_Name</td>
<td>Set to value according to the band, i.e. VIIRS-M1-SDR, ..., VIIRS-M16-SDR, VIIRS-I1-SDR, ...</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB][xx-[SDR][GEO][Gran_y@Band_ID</td>
<td>N/A</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
<tr>
<td>VIIRS-[M][I]DNB</td>
<td>MOD</td>
</tr>
</tbody>
</table>
### Table 6: Dataset fill or default values for \(-p=lax\)

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Fill or Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NumberOfBadChecksums</td>
<td>All set to -998</td>
</tr>
<tr>
<td>NumberOfDiscardedPkts</td>
<td>All set to -998</td>
</tr>
<tr>
<td>NumberOfMissingPkts</td>
<td>All set to -998</td>
</tr>
<tr>
<td>PadByte1</td>
<td>254, 254, 254</td>
</tr>
<tr>
<td>QF1_VIIRSMBANDSDR</td>
<td>All set to 254</td>
</tr>
<tr>
<td>QF2_SCAN_SDR</td>
<td>All set to 254</td>
</tr>
<tr>
<td>QF3_SCAN_RDR</td>
<td>All set to 254</td>
</tr>
<tr>
<td>QF4_SCAN_SDR</td>
<td>All set to 254</td>
</tr>
<tr>
<td>QF5_GRAN_BADDETECTOR</td>
<td>All set to 254</td>
</tr>
<tr>
<td>Radiance</td>
<td>All set to 65534 (for UINT16 datatype channels) or -999.8 (for FLOAT32 datatype channels)</td>
</tr>
<tr>
<td>Reflectance or BrightnessTemperature</td>
<td>All set to 65534 (for UINT16 datatype channels) or -999.8 (for FLOAT32 datatype channels)</td>
</tr>
<tr>
<td>ReflectanceFactors or BrightnessTemperatureFactors</td>
<td>-999.8, -999.8</td>
</tr>
</tbody>
</table>
4.5 -g option (handle multi-granule aggregations)

The -g option of CVIIRS is used to handle multi-granule aggregations within the same files, both on the input and output side, for both the standard VIIRS format as well as for the Compact VIIRS format.

The handling of multi-granule aggregations is described in detail in [RD-1] section 3.5.12. This section here defines additional behaviour applied by CVIIRS.

![Figure 3: DDS Aggregation Methodology](image)

**Figure 3: DDS Aggregation Methodology**

As can be seen in Figure 3, the DDS Aggregation Methodology defines that the first and last Aggregation Buckets may contain less than the specified number of granules per file (via the -g option, in the example in Figure 3 - g=5).

[RD-1] fails, though, to describe how the Aggregation Buckets are to be filled when the sequence of granules is not contiguous, see Figure 4 below.

![Figure 4: Aggregation Methodology for missing Granules](image)

**Figure 4: Aggregation Methodology for missing Granules**

CVIIRS behaves in the following way:

- If the first 1..m<n granules making up the first Aggregation bucket are not present, CVIIRS will ignore those and will make up an Aggregation bucket which has less granules than specified via the -g option; cf. Aggregation Bucket #1 in Figure 2 and 3.

- If the last 1..m<n granules making up the last Aggregation bucket are not present, CVIIRS will ignore those and will make up an Aggregation bucket which has less granules than specified via the -g option; cf. Aggregation Bucket #6 in Figure 2 and 3.
If granules are missing at any position in the middle of the stream of granules currently processed, but other granules exist for the Aggregation Bucket currently treated by CVIIRS, those granules will be created as “fill” granules, i.e. the data for those granules will be filled with fill values as defined in section 4.4 for \(-p=lax\); cf. Aggregation Buckets 1, 3 and 5 in Figure 4 and 3.

If all granules are missing in the middle of the stream of granules currently processed which would make up an Aggregation Bucket, then this Aggregation Bucket will not be created; cf. Aggregation Bucket 4 in Figure 4 and 3.

Figure 5 below shows all possible scenarios and the output of CVIIRS:

- Fill Granules are granules where the data for those granules will be filled with fill values as defined in section 4.4 for \(-p=lax\).

When expanding a multi-granule aggregation which contains Fill Granules to single granule files, CVIIRS does not create those Fill Granules in the expanded format.

A Fill Granule in the compact format is identified by the attribute \texttt{VIIRS-[MOD|IMG|DNB]_GEO_Gran_y@N\_Reference\_ID} having the value \texttt{N/A}.

### 4.6 File Creation order and Temp Filename

When compacting and extracting the files to and from a Compact Format, CVIIRS is creating the filenames with a .\texttt{tmp} extension first. Only when each file is complete it will remove the .\texttt{tmp} extension from the filename.

The order of files appearing on the filesystem when extracting a Compact Format is as follows:

<table>
<thead>
<tr>
<th>File type</th>
<th>File creation sequence</th>
</tr>
</thead>
</table>
| SVMC      | 1. All M-Band SDR files in any order  
            2. GMODO file is created last |
| SVIC      | 3. All I-Band SDR files in any order  
            4. GIMGO file is created last |
| SVIMC     | 1. All M- or I-Band SDR files in any order  
            2. GIMGO  
            3. GMODO |
| SVDNBC    | 1. SVDNB  
            2. GDNBO file is created last |
4.7 Geolocation Information in the Compact Format

The Compact VIIRS Format stores the all bands and the geolocation information in the same file and identifies them by the appropriate Groups, e.g., **VIIRS-M1-SDR**, **VIIRS-MOD-GEO**, **VIIRS-I1-SDR**, **VIIRS-IMG-GEO**, etc.

If both M- and I-Band are stored in the same Compact VIIRS Format (**SVIMC** files), only one set of geolocation information is stored, namely the one from the I-Band: **VIIRS-IMG-GEO**.

4.8 Fill Values for Dropped Geolocation Information

As described in the Compact VIIRS SDR Product Format User Guide [AD-1], some information from the geolocation data is not carried forward into the Compact VIIRS Format and thus cannot be recreated during the expansion process.

However, the structure and datasets are recreated in the expanded files, and the content is assigned with fill values as specified below in Table 8.

Table 8 specifies as well the content of all the datasets for fill granules (cf. section 4.5). The column “Dropped Geolocation” identifies which columns are filled with fill values during the expansion process.

**Table 8: Geolocation Information with fill values**

<table>
<thead>
<tr>
<th>Band</th>
<th>Element</th>
<th>Dropped Geolocation</th>
<th>Fill Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>Height</td>
<td>X</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
</tr>
<tr>
<td>M</td>
<td>Latitude</td>
<td></td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
</tr>
<tr>
<td>M</td>
<td>Longitude</td>
<td></td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
</tr>
<tr>
<td>M</td>
<td>MidTime</td>
<td></td>
<td>MISS_INT64_FILL (-998)</td>
</tr>
<tr>
<td>M</td>
<td>(ModeGran)</td>
<td></td>
<td>MISS_UINT8_FILL (254)</td>
</tr>
<tr>
<td>M</td>
<td>(ModeScan)</td>
<td></td>
<td>MISS_UINT8_FILL (254)</td>
</tr>
<tr>
<td>M</td>
<td>NumberOfScans</td>
<td></td>
<td>MISS_INT32_FILL (-998)</td>
</tr>
<tr>
<td>M</td>
<td>PadByte1</td>
<td></td>
<td>MISS_UINT8_FILL (254), MISS_UINT8_FILL (254), MISS_UINT8_FILL (254)</td>
</tr>
<tr>
<td>M</td>
<td>QF1_SCAN_VIIRSSDRGEO</td>
<td></td>
<td>MISS_UINT8_FILL (254)</td>
</tr>
<tr>
<td>M</td>
<td>QF2_SCAN_VIIRSSDRGEO</td>
<td>MISS_UINT8_FILL (254)</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>QF2_VIIRSSDRGEO</td>
<td>X</td>
<td>MISS_UINT8_FILL (254)</td>
</tr>
<tr>
<td>M</td>
<td>SCAttitude</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>SCPosition</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>SCSolarAzimuthAngle</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>SCSolarZenithAngle</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>SCVelocity</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>SatelliteAzimuthAngle</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>SatelliteRange</td>
<td>X</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
</tr>
<tr>
<td>M</td>
<td>SatelliteZenithAngle</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>SolarAzimuthAngle</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>SolarZenithAngle</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>StartTime</td>
<td>MISS_INT64_FILL (-998)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Height</td>
<td>X</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
</tr>
<tr>
<td>I</td>
<td>Latitude</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Longitude</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>MidTime</td>
<td>MISS_INT64_FILL (-998)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>(ModeGran)</td>
<td>MISS_UINT8_FILL (254)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>(ModeScan)</td>
<td>MISS_UINT8_FILL (254)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>NumberOfScans</td>
<td>MISS_INT32_FILL (-998)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Field Name</td>
<td>Value</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------</td>
<td>------------------------------</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>PadByte1</td>
<td>MISS_UINT8_FILL (254), MISS_UINT8_FILL (254), MISS_UINT8_FILL (254)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>QF1_SCAN_VIIRSSDRGEO</td>
<td>MISS_UINT8_FILL (254)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>QF2_SCAN_VIIRSSDRGEO</td>
<td>MISS_UINT8_FILL (254)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>QF2_VIIRSSDRGEO</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>QF2_VIIRSSDRGEO</td>
<td>MISS_UINT8_FILL (254)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>SCAAttitude</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>SCPPosition</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>SCSolarAzimuthAngle</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>SCSolarZenithAngle</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>SCVelocity</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>SatelliteAzimuthAngle</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>SatelliteRange</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>SatelliteZenithAngle</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>SolarAzimuthAngle</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>SolarZenithAngle</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>StartTime</td>
<td>MISS_INT64_FILL (-998)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>Height</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>Height_TC</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>Latitude</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>Field Description</td>
<td>Value</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------</td>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>Latitude_TC</td>
<td>X MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>Longitude</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>Longitude_TC</td>
<td>X MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>MidTime</td>
<td>MISS_INT64_FILL (-998)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>(ModeGran)</td>
<td>MISS_UINT8_FILL (254)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>(ModeScan)</td>
<td>MISS_UINT8_FILL (254)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>NumberOfScans</td>
<td>MISS_INT32_FILL (-998)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>PadByte1</td>
<td>MISS_UINT8_FILL (254), MISS_UINT8_FILL (254), MISS_UINT8_FILL (254)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>QF1_SCAN_VIIRSSDRGEO</td>
<td>MISS_UINT8_FILL (254)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>QF2_SCAN_VIIRSSDRGEO</td>
<td>MISS_UINT8_FILL (254)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>QF2_VIIRSSDRGEO</td>
<td>X MISS_UINT8_FILL (254)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>QF2_VIIRSSDRGEO_TC</td>
<td>X MISS_UINT8_FILL (254)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>SCAttitude</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>SCPosition</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>SCSolarAzimuthAngle</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>SCSolarZenithAngle</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>SCVelocity</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>SatelliteAzimuthAngle</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>SatelliteRange</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>SatelliteZenithAngle</td>
<td>MISS_FLOAT32_FILL (-999.8)</td>
<td></td>
</tr>
</tbody>
</table>
4.9 Configuration

The compact format is fully self-contained, i.e. any software tool (CVIIRS and others) shall not need additional information (i.e. configuration) to expand the product.

However, to define certain execution behaviour of CVIIRS, a couple of parameters are defined, Table 9. Those are set as default in the source-code, can be defined through the configuration file (config.properties) for the compaction process, or through command line parameters (both for compaction and expansion).

The following parameters are defined and can be overwritten as follows:

a. They are hardwired in the code and thus provide the default value if not specified otherwise.

b. They are defined in the configuration file (config.properties) and overwrite the hardwired default values. If the configuration file is present but the parameters are not present in the configuration file, the hardwired values will be used. This one applies only for the compaction.

c. They are defined through command line parameters, and if present will overwrite the values set through the configuration file or the hardwired values.

Table 9: Configuration run-time parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Default in source-code</th>
<th>Default in config file</th>
<th>Command line parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>NumWorkingThreads</td>
<td>20</td>
<td>20</td>
<td>-t, --threads</td>
</tr>
<tr>
<td>DefaultNumberOfGranules</td>
<td>1</td>
<td>1</td>
<td>-g, --aggregation</td>
</tr>
<tr>
<td>AccuracyLevel</td>
<td>HIGH</td>
<td>HIGH</td>
<td>-a, --accuracy</td>
</tr>
</tbody>
</table>

4.9.1 Compaction

CVIIRS needs a configuration file for the compaction process. This file defines several parameters needed for the compaction process. No further details are given in this document as the parameters are fully defined and described in the configuration file (config.properties), e.g. cf. Appendix A.

To enable the compact format to be self-contained, parameters which are needed for expansion are written as datasets or attributes into the compact format, e.g. the parameters for converting radiances into reflectances or brightness temperatures. For more details refer to [AD-1].
Additionally, the following parameters are stored as attributes in the compact format:

- **MissionStartTime** = 1698019234000000
  - Attribute of **/All_Data**
  - where **MissionStartTime** is defined in the configuration file.

- **LeapSecondsGranuleStart** = m
  - Attribute of **/Data_Products/VIIRS-<band/channel>-GEO/VIIRS-<band/channel>-GEO_Gran_<n>**
  - Where m is the number of leap-seconds applicable for the granule start, i.e. it is calculated from the **BaseLeapSeconds** and all **LeapSeconds** from **LeapDates** which are applicable for the first pixel in this granule, band/channel is one of **MOD, IMG, DNB** and n is the granule number in this aggregation.
  - Note that **LeapSecondsGranuleStart** is added to the compact product for each band/channel and for each granule.

### 4.9.2 Expansion

As said before, for the expansion no additional information is needed. All parameters needed are either stored as datasets or attributes in the compact format, or can be specified through command line parameters (see Table 9 above or section 4.2 above). That is, even if present, a configuration file for CVIIRS will not be used.

### 4.10 Startup Script (cviirs.sh, cviirs.bat) and JAVA_HOME

CVIIRS is not directly invoked via a call to the java environment, but a startup script (cviirs.sh, cviirs.bat) is provided and should be used.

To enable users to use different java environments, the startup script is using the value of the environment variable **JAVA_HOME** to identify the java version to be used.

If **JAVA_HOME** is set, it is checked if $JAVA_HOME/bin/java exists. If it doesn’t exist, an error is returned ("Java RE pointed to by JAVA_HOME not found.").

If **JAVA_HOME** is not set externally to calling the script, the startup script will assume the default java installation of the machine it is executed on, e.g. by checking if Java exists in the **PATH**. If it doesn’t exist, an error is returned ("Java RE not found.").

If the Java runtime environment is found, the Java version is checked with java -version. If the version is lower than 1.7, an error is returned ("CVIIRS needs Java RE >=1.7.")

### 4.11 Reading the Compact VIIRS format created by version 0.9.7 and 1.2.4

Currently, EUMETSAT disseminates the VIIRS M-Band data in the Compact VIIRS format created by CVIIRS version 0.9.7. This version of CVIIRS doesn’t have the concept, yet, of variable tie point zones and Tie Point Zone Groups.
CVIIRS versions > 1.2.4 are able to read the Compact VIIRS format for M-Band created by CVIIRS version 0.9.7 and use the following default values, if not present in the Compact VIIRS format:

- $\text{NumberOfTiePointZoneGroupsTrack} = 1,$
- $\text{NumberOfTiePointZoneGroupsScan} = 1,$
- $\text{TiePointZoneGroupLocationTrackCompact} = 0,$
- $\text{TiePointZoneGroupLocationScanCompact} = 0,$
- $\text{TiePointZoneGroupLocationTrack} = 0,$
- $\text{TiePointZoneGroupLocationScan} = 0.$
- $\text{MissionStartTime} = 1698019234000000$
- $\text{LeapSecondsGranuleStart} = \text{<calculated for the first pixel in this granule>}$

CVIIRS versions > 1.2.4 are able to read the Compact VIIRS format for DNB created by CVIIRS version 1.2.4 and use the following default values, if not present in the Compact VIIRS format:

- $\text{MissionStartTime} = 1698019234000000$
- $\text{LeapSecondsGranuleStart} = \text{<calculated for the first pixel in this granule>}$

### 4.12 Additional Attributes for CVIIRS version and Compact VIIRS SDR Version

To be able to keep track of version changes of the CVIIRS tool as well as possible version changes of the product format content for the Compact VIIRS SDR, CVIIRS adds two non-standard attributes to the root of the product:

- $\text{CVIIRS\_Version} = \text{<version of CVIIRS, e.g. 2.0.1, which was used to create the compact SDR>}$
- $\text{Compact\_VIIRS\_SDR\_Version} = \text{<version of the Compact VIIRS SDR as provided through the configuration file, currently 3.1>}$

### 4.13 Mission and Satellite Name

The satellite name is tuneable via the configuration property $\text{PlatformShortSatelliteId}$. The configuration file includes a mapping between values of the root attribute “Mission Name” and the “satellite identifier” $\text{[Mission\_Name:sat\_id]}$ in the filename.

Examples:
- $\text{[NPP:npp]}$
- $\text{[JPSS-1:j01]}$
- $\text{[JPSS-2:j02]}$

CVIIRS does not mix data from two or more different missions in one aggregation.
4.13.1 Filtering by Platform_Short_Name
There is the possibility of using CVIIRS by filtering according to the Platform_Short_Name (i.e. satellite). This filtering allows selecting only the files of the same Platform_Short_Name. A this is possible via the “-m” option:

% cviirs [-m Platform_Short_Name]

If the option “-m” is not specified, CVIIRS aggregates the granules according to their Platform_Short_Name. Different aggregations are created when the Platform_Short_Name is different.

4.13.2 Mapping “Platform_Short_Name” to “satellite identifier” in the Compact Format
A new attribute is specified in the compact format “Satellite_Id_Filename” to save the current mapping between “Platform_Short_Name” and the “satellite identifier” for the expansion process.

4.14 Command Line Arguments validation
Command Line Arguments are identified and verified before starting the processing of the granules. The software ends with an error under the following conditions:

- Using non-existing parameters or invalid values associated to existing parameters when a finite number of values exist.
- Using the option “-s” (statistical analysis) when the option “-x” is specified.
- The option “-N” (Day Night Band) is specified besides other types of bands (M-Band, I-Band or both M- and I-Band).
APPENDIX A  PROPERTIES CONFIGURATION

Original content of the config.properties file.

# Version of CVIIRS
CVIIRSVersion = 2.0.1

# Version of the Compact VIIRS SDR
CompactVIIRS_SDR_version = 3.1

# The mission start time (TAI - atomic time)
MissionStartTime = 1698019234000000

# The number of leap seconds as at 1972-06-30.
BaseLeapSeconds = 10

# The dates at which the total number of leap seconds changed.
# The dates need to be comma-separated and the format should be
# of type yyy-MM-dd (y=year, M=month, d=day of month)

# Number of threads handled by the pool (maximum number of threads the tool
# is allowed to use). During the conversion (compaction or expansion), each
# group is assigned to a single thread.
NumWorkingThreads = 20

# Default number of granules assigned to each aggregation
DefaultNumberOfGranules = 1

# This can be either HIGH or STANDARD.
# If HIGH, the vector interpolation will always be used.
# If STANDARD, the direct interpolation will be used whenever possible,
# otherwise the vector interpolation will be used.
# Vector interpolation is more accurate but also more demanding
# in terms of computational resources.
AccuracyLevel = HIGH

# Number of Tie Point Zones in each Group in the Track direction (Day-Night Band
# Ntrack)
DayNightBand_NumberOfTiePointZonesTrack = 1

# Number of Tie Point Zones in each Group in the Scan direction (Day-Night Band
# Nscan)
DayNightBand_NumberOfTiePointZonesScan = 5, 1, 4, 4, 4, 2, 1, 3, 2, 4, 2, 3, 2, 3, 3, 3, 5, 4, 5, 4, 4, 4, 4, 3, 3, 4, 3, 23, 23, 3, 4, 3, 5, 3, 4, 4, 4, 4, 4, 5, 4, 5, 3, 3, 3, 3, 2, 3, 2, 3, 2, 3, 2, 4, 2, 3, 1, 2, 4, 4, 4, 1, 5

# Size in the expanded data set of the Tie-Point Zone in each Group in the Track
direction (Day-Night Band Ztrack)
DayNightBand_TiePointZoneSizeTrack = 16
# Size in the expanded data set of the Tie-Point Zone in each Group in the Scan direction (Day-Night Band Zscan)


# Number of Tie Point Zones in each Group in the Track direction (Imagery Band Ntrack)

ImageryBand_NumberOfTiePointZonesTrack = 1

# Number of Tie Point Zones in each Group in the Scan direction (Imagery Band Nscan)

ImageryBand_NumberOfTiePointZonesScan = 200

# Size in the expanded data set of the Tie-Point Zone in each Group in the Track direction (Imagery Band Ztrack)

ImageryBand_TiePointZoneSizeTrack = 32

# Size in the expanded data set of the Tie-Point Zone in each Group in the Scan direction (Imagery Band Zscan)

ImageryBand_TiePointZoneSizeScan = 32

# Number of Tie Point Zones in each Group in the Track direction (Moderate Band Ntrack)

ModerateBand_NumberOfTiePointZonesTrack = 1

# Number of Tie Point Zones in each Group in the Scan direction (Moderate Band Nscan)

ModerateBand_NumberOfTiePointZonesScan = 200

# Size in the expanded data set of the Tie-Point Zone in each Group in the Track direction (Moderate Band Ztrack)

ModerateBand_TiePointZoneSizeTrack = 16

# Size in the expanded data set of the Tie-Point Zone in each Group in the Scan direction (Moderate Band Zscan)

ModerateBand_TiePointZoneSizeScan = 16

# The mantissa size in bit for the compacted floating-point type

MantissaSize = 8

# Use the shuffle technique during the writing of the compacted datasets

UseShuffle = true

# The GZIP level of compression for the datasets. Zero means the compression will not be performed

CompressionLevel = 5

# Platform_Short_Name/Satellite_Id_Filename

PlatformShortSatelliteId = NPP:npp, J01:j01
# ---------------------
# Radiance Coefficients
# ---------------------
# <Channel> should be replaced with the real channel name (M3, M4, M5, M7, M13)
#
# RadianceOffsetLow_<Channel>
# RadianceScaleLow_<Channel>
# RadianceOffsetHigh_<Channel>
# RadianceScaleHigh_<Channel>
# Threshold_<Channel>
#

RadianceOffsetLow_M3 = -0.253273210035
RadianceScaleLow_M3 = 0.003273210035
RadianceOffsetHigh_M3 = -686.169444444444
RadianceScaleHigh_M3 = 0.024206349206
Threshold_M3 = 107

RadianceOffsetLow_M4 = -0.202386620277
RadianceScaleLow_M4 = 0.002386620277
RadianceOffsetHigh_M4 = -694.164957264957
RadianceScaleHigh_M4 = 0.023565323565
Threshold_M4 = 78

RadianceOffsetLow_M5 = -0.201806750900
RadianceScaleLow_M5 = 0.001806750900
RadianceOffsetHigh_M5 = -712.164743589744
RadianceScaleHigh_M5 = 0.023534798535
Threshold_M5 = 59

RadianceOffsetLow_M7 = -0.100888115730
RadianceScaleLow_M7 = 0.000888115730
RadianceOffsetHigh_M7 = -402.092094017094
RadianceScaleHigh_M7 = 0.013156288156
Threshold_M7 = 29

RadianceOffsetLow_M13 = -0.020108557651
RadianceScaleLow_M13 = 0.000108557651
RadianceOffsetHigh_M13 = -653.066269871795
RadianceScaleHigh_M13 = 0.020038553114
Threshold_M13 = 3.537

# ---------------------
# Reflectance Coefficients
# ---------------------
# <Channel> should be replaced with the real channel name (from M1 to M11)
#
# EquivalentWidth_<Channel>
# IntegratedSolarIrradiance_<Channel>
#

EquivalentWidth_M1 = 0.01979783550
IntegratedSolarIrradiance_M1 = 33.83940249
EquivalentWidth_M2 = 0.01430752221
IntegratedSolarIrradiance_M2 = 26.66728877

EquivalentWidth_M3 = 0.01900157705
IntegratedSolarIrradiance_M3 = 37.98883065

EquivalentWidth_M4 = 0.02093922533
IntegratedSolarIrradiance_M4 = 39.14834573

EquivalentWidth_M5 = 0.01996985823
IntegratedSolarIrradiance_M5 = 30.56515889

EquivalentWidth_M6 = 0.01459505595
IntegratedSolarIrradiance_M6 = 18.69858623

EquivalentWidth_M7 = 0.03869968280
IntegratedSolarIrradiance_M7 = 37.24469424

EquivalentWidth_M8 = 0.02712116949
IntegratedSolarIrradiance_M8 = 12.38904874

EquivalentWidth_M9 = 0.01500406861
IntegratedSolarIrradiance_M9 = 5.398250081

EquivalentWidth_M10 = 0.05875030532
IntegratedSolarIrradiance_M10 = 14.41161119

EquivalentWidth_M11 = 0.04669837281
IntegratedSolarIrradiance_M11 = 3.506045974

EquivalentWidth_I1 = 0.080
IntegratedSolarIrradiance_I1 = 130.4500003

EquivalentWidth_I2 = 0.039
IntegratedSolarIrradiance_I2 = 37.57360035

EquivalentWidth_I3 = 0.060
IntegratedSolarIrradiance_I3 = 14.73727253

# --------------------------
# Brightness Coefficients
# --------------------------
#
# <Channel> should be replaced with the real channel name (from M12 to M16)
#
# CentralWaveLength_<Channel>
# BandCorrectionCoefficientA_<Channel>
# BandCorrectionCoefficientB_<Channel>
#

CentralWaveLength_M12 = 0.000003692118094
BandCorrectionCoefficientA_M12 = 1.0000000000000000
BandCorrectionCoefficientB_M12 = -0.0000000000000000

CentralWaveLength_M13 = 0.000004063950468
BandCorrectionCoefficientA_M13 = 1.0000000000000000
BandCorrectionCoefficientB_M13 = -0.637890868
BandCorrectionCoefficientB_M13 = -0.338046119

CentralWaveLength_M14 = 0.000008574690139
BandCorrectionCoefficientA_M14 = 1.000666830
BandCorrectionCoefficientB_M14 = -0.201236951

CentralWaveLength_M15 = 0.000001068610341
BandCorrectionCoefficientA_M15 = 1.004393762
BandCorrectionCoefficientB_M15 = -1.049491534

CentralWaveLength_M16 = 0.000001181466532
BandCorrectionCoefficientA_M16 = 1.003041012
BandCorrectionCoefficientB_M16 = -0.649809876

CentralWaveLength_I4 = 0.000003740000
BandCorrectionCoefficientA_I4 = 1.003471
BandCorrectionCoefficientB_I4 = -1.923757

CentralWaveLength_I5 = 0.000011450000
BandCorrectionCoefficientA_I5 = 1.003843
BandCorrectionCoefficientB_I5 = -0.655337
APPENDIX B  LOG4J CONFIGURATION

Below is reported the original Log4j.properties file.

```properties
log4j.rootLogger=INFO,default
log4j.appender.default=org.apache.log4j.ConsoleAppender
log4j.appender.default.layout=org.apache.log4j.PatternLayout
log4j.appender.default.layout.ConversionPattern=%p %d{yyyy-MM-dd HH:mm:ss.SSS} - %m%n

log4j.logger.eumetsat.viirs.data.Hdf5AggregationView=INFO,developer
log4j.additivity.eumetsat.viirs.data.Hdf5AggregationView=false
log4j.appender.developer=org.apache.log4j.ConsoleAppender
log4j.appender.developer.layout=org.apache.log4j.PatternLayout
log4j.appender.developer.layout.ConversionPattern=%p %d{yyyy-MM-dd HH:mm:ss.SSS} - (%F:%L) %m%n
```
APPENDIX C  FOLDERS STRUCTURE

Below the detailed description of the single files inside the project folders is reported.

The **lib** folder

The left column reproduces the folder hierarchy inside the **lib** folder. In bold are marked the directories.

**Table 10: lib folder files description**

<table>
<thead>
<tr>
<th>Folder tree</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>jhdf.jar</td>
<td>The JHI5 library files.</td>
</tr>
<tr>
<td>jhdf4obj.jar</td>
<td></td>
</tr>
<tr>
<td>jhdf5.jar</td>
<td></td>
</tr>
<tr>
<td>jhdf5obj.jar</td>
<td></td>
</tr>
<tr>
<td>jhdfobj.jar</td>
<td></td>
</tr>
<tr>
<td>jopt-simple-5.0.3.jar</td>
<td>The JOpt library</td>
</tr>
<tr>
<td>junit-4.10.jar</td>
<td>The JUnit library</td>
</tr>
<tr>
<td>log4j-1.2.17.jar</td>
<td>The Log4J library file.</td>
</tr>
<tr>
<td>hdf-linux-i386</td>
<td>The HDF5 C library files (dynamic libraries for Linux 32 bit).</td>
</tr>
<tr>
<td>libjhdf.so</td>
<td></td>
</tr>
<tr>
<td>libjhdf5.so</td>
<td></td>
</tr>
<tr>
<td>hdf-linux-x86_64</td>
<td>The HDF5 C library files (dynamic libraries for Linux 64 bit).</td>
</tr>
<tr>
<td>libjhdf.so</td>
<td></td>
</tr>
<tr>
<td>libjhdf5.so</td>
<td></td>
</tr>
<tr>
<td>hdf-win-186</td>
<td>The HDF5 C library files (dynamic libraries for Windows 64 bit).</td>
</tr>
<tr>
<td>jhdf.dll</td>
<td></td>
</tr>
<tr>
<td>jhdf5.dll</td>
<td></td>
</tr>
<tr>
<td>hdf-win-x86_64</td>
<td>The HDF5 C library files (dynamic libraries for Windows 64 bit).</td>
</tr>
<tr>
<td>jhdf.dll</td>
<td></td>
</tr>
<tr>
<td>jhdf5.dll</td>
<td></td>
</tr>
</tbody>
</table>

The **config** folder

**Table 11: config folder files description**

<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>config.properties</td>
<td>Contains some constants used inside the tool.</td>
</tr>
<tr>
<td>log4j.properties</td>
<td>The configurations file of the logger.</td>
</tr>
</tbody>
</table>
The scripts folder

*Table 12: scripts folder files description*

<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>config.bat</td>
<td>The batch script for running the Java application in Windows.</td>
</tr>
<tr>
<td>cviirs.sh</td>
<td>The shell script for running the Java application in Linux.</td>
</tr>
</tbody>
</table>
## APPENDIX D  
**STATISTIC REPORT FORMAT**

### Table 13: Array Element Counts

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>n(array)</td>
<td>Total number of elements in the array. For a VIIRS M-Band array of dimension [768, 3200] the number of elements is n = 2,457,600. n(array) = n + n(fill-eq-fill) + n(fill-ne-fill) + n(num-to-fill) + n(fill-to-num)</td>
</tr>
<tr>
<td>n</td>
<td>Number of elements where a non-fill value in the original array maps to a non-fill value at the corresponding index position in the reconstructed array.</td>
</tr>
<tr>
<td>n(fill-eq-fill)</td>
<td>Number of elements where a fill value in the original array maps to a fill value at the corresponding index position in the reconstructed array and the two fill values are equal.</td>
</tr>
<tr>
<td>n(fill-ne-fill)</td>
<td>Number of elements where a fill value in the original array maps to a fill value at the corresponding index position in the reconstructed array and the two fill values are not equal.</td>
</tr>
<tr>
<td>n(num-to-fill)</td>
<td>Number of elements where a non-fill value in the original array maps to a fill value at the corresponding index position in the reconstructed array.</td>
</tr>
<tr>
<td>n(fill-to-num)</td>
<td>Number of elements where a fill value in the original array maps to a non-fill value at the corresponding index position in the reconstructed array.</td>
</tr>
</tbody>
</table>

### Table 14: Array Element Statistics

To be applied to all n array elements where a non-fill value \( v_1 \) in the original array maps to a non-fill value \( v_2 \) at the corresponding index position in the reconstructed array.

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>min</td>
<td>Minimum difference of array elements:</td>
</tr>
<tr>
<td></td>
<td>[ min = \min (v_{i_2} - v_{i_1}); i \in {1; n} ]</td>
</tr>
<tr>
<td>max</td>
<td>Maximum difference of array elements:</td>
</tr>
<tr>
<td></td>
<td>[ max = \max (v_{i_2} - v_{i_1}); i \in {1; n} ]</td>
</tr>
<tr>
<td>avg</td>
<td>Average difference of array elements:</td>
</tr>
<tr>
<td></td>
<td>[ avg = \frac{1}{n} \sum_{i=1}^{n} (v_{i_2} - v_{i_1}) ]</td>
</tr>
<tr>
<td>stddev</td>
<td>Standard deviation of difference of array elements:</td>
</tr>
<tr>
<td></td>
<td>[ stddev = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} \left( (v_{i_2} - v_{i_1}) - avg \right)^2} ]</td>
</tr>
</tbody>
</table>
Root mean square error of difference of array elements:

\[ \text{rmse} = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (v_{i2} - v_{i1})^2} \]