**GCOM-C SGLI**

**RSP Path Detection in L2 Tile**

**Tool**

# User's Manual

Version 1.0

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JAXA
GCOM-C project

# User's Manual
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# 1. Introduction

This user's manual explains how to use the tool for "RSP Path Detection in L2 Tile of GCOM-C/SGLI HDF5 products". This tool detects the number of RSP-path for raster data in the L2-tiles on a daily basis (01D) based on the observing time and attaches it to the original filename. If the tile includes multiple RSP paths, the tool separates the tile for each of the paths and outputs their corresponding multiple HDF5 files. The type of tool is CUI (Character User Interface) so that users can install it into their system or scripts for mass processing.

# 2. System Requirements

**Hardware Requirements**
- CPU          Intel Xeon/Core-i7 or higher
- Memory       1GByte or higher.

**Operating Systems**
- Linux        Kernel 2.6 or higher (64bit)
               The operation test has been done on RHEL7/CentOS7.
- Windows      Windows 10 (64bit)

# 3. Input Products / Available Datasets

Available input SGLI HDF5 products for this tool are L2-tiles on a daily basis (01D) as follows:

LTOA, RSRF, VGI, LAI, AGB, LST, CLFG, CLPR, ARNP, ARPL, SICE, SIPR

The tool uses the following dataset, which indicates the observing time of all raster data in the tile, for detecting the number of RSP-path.

Geometry_data/Obs_time

The following products do not include the above dataset; therefore, the tool needs an additional input of the LTOA or RSRF product that has the same Granule ID as a reference.

VGI, LAI, AGB, SICE, SIPR

If the target tile has the resolution of 250 m (Q), the reference LTOA/RSRF should be the same resolution.

If the tile includes multiple RSP paths, the tool separates the data for each of the paths. The target data for the separation are all raster datasets, which the size is 4800 x 4800 or 1200 x 1200, in the HDF Group of the Image_data and the Geometry_data.

The details of the datasets in the L2-tile products can be found at:

https://suzaku.eorc.jaxa.jp/GCOM_C/data/product_std.html

# 4．Operation

Put the downloaded .exe file at any folder/directory in your file system. No installation is required. Run the .exe file at a command prompt (a terminal for Linux).

> SGLI_t2p_linux(win).exe [hdf_filename(*.h5)] [OPTIONS]

OPTIONS:

| Option&Parameter | Description |
|---|---|
| -r HDF_FILE | Set the reference LTOA or RSRF product(*.h5) at HDF_FILE. The Granule-ID should be the same as the target L2-tile product. This is mandatory for target L2-tile products that has no Obs_time dataset in the Geometry_data group (i.e., VGI, LAI, AGB, SICE, SIPR). |
| -o OUTPUTDIR | Set a directory for output files to OUTPUTDIR. If this was not specified, the tool outputs files to a current directory. |
| -h | Print a usage message and exit. |
| -v | Print version and license information and exit. |

Examples:

1) Process L2/LTOAQ product, the output directory is "./output"

> SGLI_t2p_linux.exe [L2/LTOAQ].h5 -o ./output

2) Process L2/LAI

> SGLI_t2p_linux.exe [L2/LAI_Q].h5 -r [L2/LTOAQ]

# 5. Output Files

The output file is the HDF5 with the number of RSP path attached in the filename. If the tile includes multiple RSP paths, the multiple files for each of the paths are separately output.

## 5.1 File naming

The rules of naming for output files are as follows:

GID_PPP.h5

where,

GID is the Granule ID of an input HDF product,

PPP is the number of the RSP paths (001~485).

Example:

GC1SG1_20220627D01D_T0427_L2SG_LTOAQ_2012_039.h5

GC1SG1_20220627D01D_T0427_L2SG_LTOAQ_2012_073.h5

# 6.  License information

The tool includes the open-source libraries for the file interface of the HDF5. The license information is as follows:

# 7. Appendix

## 7.1 The detection of the number of RSP-path

This section briefly explains the algorithm for the detection of the number of RSP-path.

The number of RSP-path is detected from the dataset of Geometry_data/Obs_time, which gives the time from the epoch of UT00:00 at the date of the Granule ID, by using the nominal parameters of the satellite orbit.

Let the $t_d$ be the time in the above dataset and $t_{d0}$ is the epoch time of the Granule ID, the number of RSP-path P is given as the following formula,

$$P = mod\left(P_0 + int\left(\frac{t_d + (t_{d0} - t_{REF})}{t_{ORB}}\right) \cdot N - 1, X\right) + 1$$

where, mod(a,b) is the remainder of a division of a by b, int() is a conversion to an integer with rounding-down, $P_0$ is the reference number of RSP-path, $t_{REF}$ is the passing time of the ascending node of $P_0$, N is the recurrent period, X is the total number of RSP-paths, and $t_{ORB}$ is the period of orbit cycle. The setting of these nominal orbital parameters are as follows:

$$P_0 = 196$$
$$t_{REF} = 2018\text{-}01\text{-}16\ 07\text{:}57\text{:}14\ (UT)$$
$$N = 34$$
$$X = 485$$
$$t_{ORB} = N/X*86400$$

The actual satellite orbit has errors in the passing time of the ascending node from the nominal, hence, it may cause a miss-detection of the RSP-path number in ascending tiles around the equator. To detect and correct the miss-detection, a relative time difference $t_{d\text{-}AN}$ between the observation and the ascending node is calculated as

$$t_{d-AN} = t_d + t_{d0} - t_{AN}$$

where, $t_{AN}$ is the nominal passing time of the ascending node and is calculated as

$$t_{AN} = int\left(\frac{t_d + (t_{d0} - t_{REF})}{t_{ORB}}\right) \cdot t_{ORB} + t_{REF}$$

The $t_{d\text{-}AN}$ is used to check the miss-detection, where it implies the relative position from the equator, while the tile ID indicates the hemisphere of north or south. For tiles of the northern hemisphere in ascending tiles (i.e., tile ID = T00**~T08**), if the $t_{d\text{-}AN}$ is greater than a threshold $T_N$, the number of RSP-path is detected being shifted backward and is added by N. For tiles of the southern hemisphere (i.e., tile ID = T09**~T17**), if the $t_{d\text{-}AN}$ is less than a threshold $T_S$, the number of RSP-path is detected being shifted forward and is subtracted by N. Both of $T_N$ and $T_S$ are set to 3000 seconds as approx. the half of the period of orbit cycle.

Note that this algorithm does not support the "RSP shifts" that temporarily occurred because of non-routine orbital maneuvers. In that period, the number of RSP-path has the error of +1. The details of the "RSP shift" can be found at:

https://shikisai.jaxa.jp/docs/event_information.pdf
See records that the Comments = "RSP is 1 more than nominal" at Table 1.

## 7.2    GeoTIFF conversion with the external tool

The output HDF5 files of this tool can be converted into GeoTIFF format files with the external tool "Map projection & GeoTIFF conversion Tool."

A sample shell script in the Bash at Linux OS that implements the procedure is as follows:

```
#-----------------------------------------------------------
#!/bin/bash

#set the input file and output directory
file="GC1SG1_20220627D01D_T0427_L2SG_LTOAQ_2012.h5"
outdir="./output"

#run the "RSP Path Detection in L2 Tile Tool"
/(exedir)/SGLI_t2p_linux.exe $file -o $outdir

#omit the extension of the input filename
file1=`basename $file .h5`

#run the "Map projection & GeoTIFF conversion Tool"
#for all output files from the "RSP Path Detection in L2 Tile Tool"
for f in ${outdir}/${file1}_???.h5; do
   /(exedir)/SGLI_geo_map_linux.exe $f -d "Image_data/Lt_VN01" -o $outdir
done
#-----------------------------------------------------------
```

For Windows OS, the procedure can be implemented in the standard scripting language such as the PowerShell.