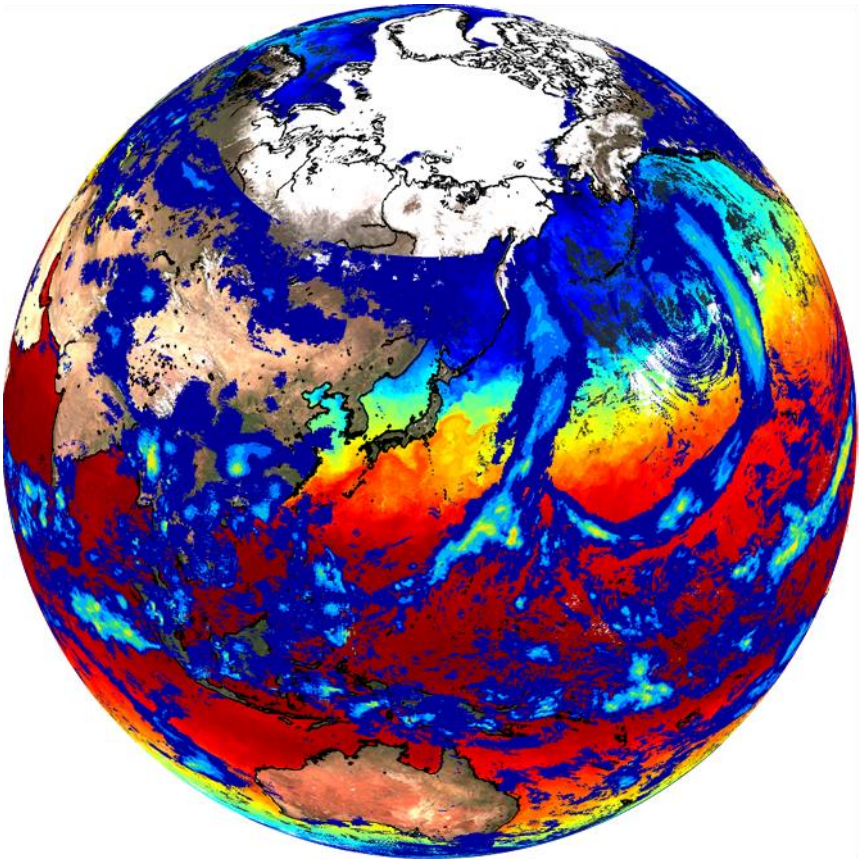
JAXA Earth Tools : ASIST

(Automated Satellite Image Stacking Tool)

User Manual



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Revision history

date	location	revision
2021/7/21	-	-

Contents

1. Purpose of this document

Earth observation satellite data is generally in special formats (HDF: Hierarchical Data Format, netCDF, CEOS format, binary, etc.) and projection grids (sinusoidal projection, satellite scene, etc.) and its specification is different depend on each distribution site and satellite sensor. Researching and understanding all of these data processing and visualization from the beginning and developing processing scripts are burdensome task.

Therefore, this tool has been developed for researchers in other fields and programmers who are not familiar with satellite data processing to support research and consider the utilization of satellite data. By using this tool, you can easily process, visualize, and use satellite data regardless of the sensor type, even when using a large number of images.

In particular, the tool automatically identifies, downloads, and pre-processes source data to generate image products on PC by just specifying the interested date, time, latitude, longitude, and product then executing the tool in the user configuration file.

The generated images are in formats that are easy to display and use, such as KML/PNG files (which can be displayed and superimposed on google earth, etc.), npz files (which can be used with numpy in python), geotiff, etc.

This document describes the tool specification and instruction etc. By using this tool, we hope that researchers in other fields and programmers will be able to reduce the effort required to examine the use value of satellite data and find new use values.

2. Tool Specification

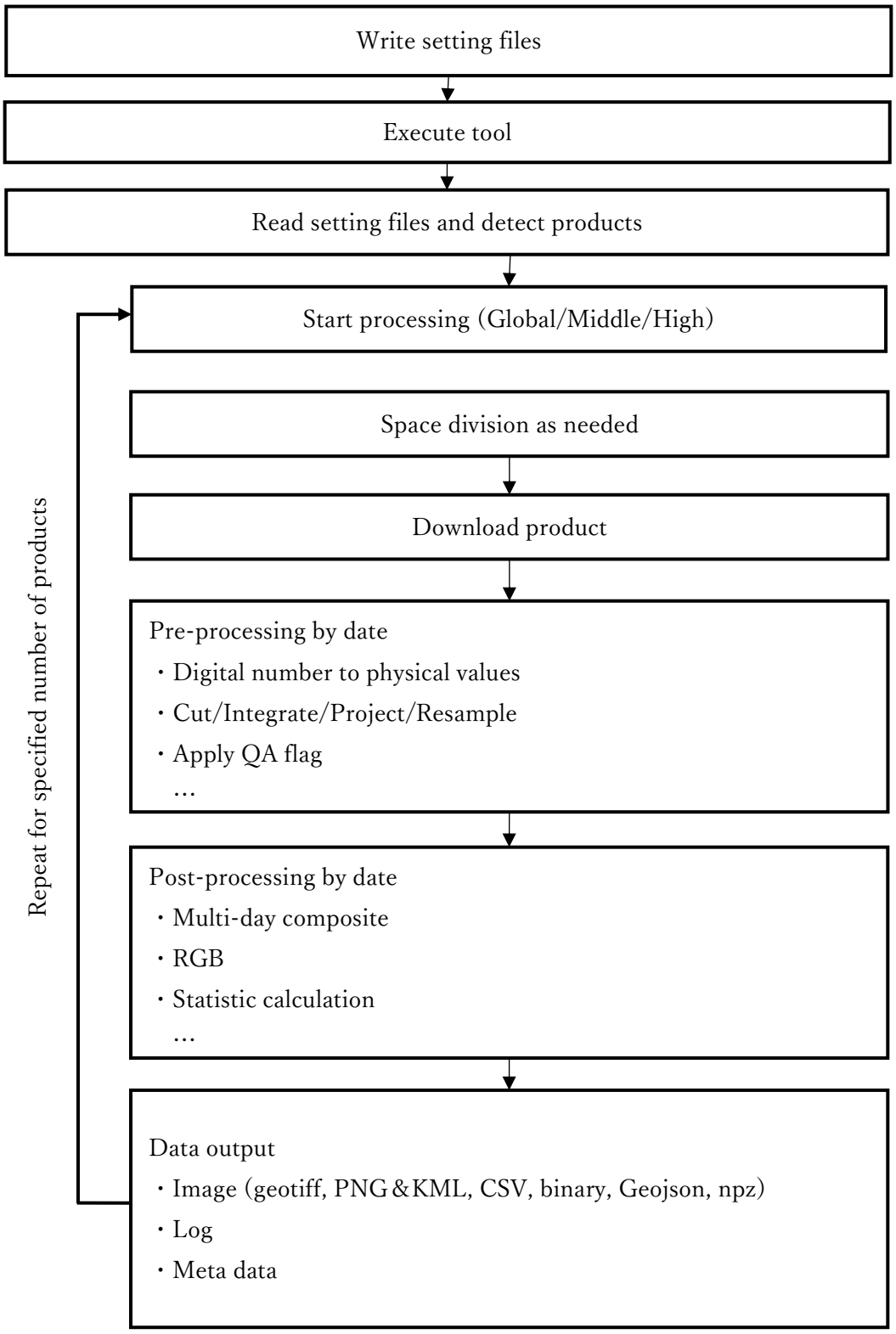
2.1. Main Functionality

Following table shows the main tool functionality list. Please note that some functions are not supported, or unique processing functions are needed depend on the types of satellite products. (Example: ALOS-2 product cannot download automatically with interference processing function (unique function))

Table. Tool Functionality List

ID	Category	Functionality
1	Automatic product identification & Download	(1) Setting lat, lon by KML (arbitrarily) (2) Dividing lat, lon area to saving memory (3) Specify resolution (arbitrarily) (4) Search custom day, area product list (5) FTP connection, saving products (6) Availability of FTP connection /offline processing
2	Pre-Processing	(1) Product reading /change of physical quantity (2) Extract/integrate/mozaiking/data, and apply QA flag (3) Dfferential interferometric SAR processing (only ALOS-2) (4) EQuiRectangular (EQR) Projection or Mercator projection for image
3	Post-Processing	(1) User specified image/color range, map/file output (geotiff, PNG＆KML, CSV, binary, Geojson, npz) (2) RGB composition・output (3) Image composite (8 days, 16 days, one month) function (4) Output function of time-series animation (GIF) (5) Space statistics data output by KML, Administrative data (6) Output function of coastline/sea depth (-200m) image (7) Processing log, meta files output

2.2. Processing flow



2.3. Required PC specification and Network

Following spec PC is operable. It takes a long analysis time depending on the specified date range, latitude and longitude range. Therefore, we recommend changing the power settings not to sleep on operating systems if necessary.

Also, it's better to start from small range(※1) , because there is a possibility to stop the tool due to the lack of memory depending on the specified latitude and longitude range.

Table. Required PC specification and Network

ID	Item	Value
1	Operating system	Windows 10 (64bit) Ubuntu 20.04 LTS (64bit)
2	Recommended CPU speed	Equiv. Intel or AMD x86-64 processor (recommended over 4 core)
3	Recommended Memory	More than 4GB※1 (recommended over 8GB)
4	Drive	More than 5-8 GB as a free space (for tool install only) More than 100 GB as a free space (recommended condition for data usage) ※2
5	Network	More than 10 Mbps ※3

※1 Rough indication for medium resolution, latitude and longitude range; ±1.5deg, about three type designations

※2 High-capacity HDD (external one, etc.) is recommended in order to download data and save the output image

※3 Stable network environment is necessary for data download.

2.4. Available Product

2.4.1. Available satellite name and sensor list

Following table shows the available satellites name and product list. Please refer to SetProduct.csv for the types of products that can be obtained for each sensor. Please note that this tool does not cover all the products distributed for the relevant sensor. Also, if you want to know the details of the source product or if you apply the flag using SetType.csv, please refer to each website described in Chapter 7. 7.

Table. Product List

ID	Satellite/Sensor Product	Start of observation, End of observation	Data Interval	Note
1	Terra MODIS	Feb. 2000 ～ Under observation	1 day	Data Interval depends on product type
2	Aqua MODIS	July 2002 ～ Under observation	1 day	Data Interval depends on product type
3	GCOM-C SGLI	Jan. 2018 ～ Under observation	1 day	Data Interval depends on product type
4	GCOM-W AMSR-2	July 2012 ～ Under observation	1 day	Data Interval depends on product type
5	AW3D	-	-	Use AW3D (30m Resolution ver.) as the input data. Output data is resampled and averaged to 250m resolution. Outputted its average inclination angle in the pixel as well.
6	ALOS-2 PSR MOS/FNF	2015 ～ Under observation	1 year	Use PSR MOS/FNF (25m resolution ver.) as input data. Output data is resampled and averaged to 250m resolution. FNF data is calculated and outputted as 250m resolution in pixel as a forest rate.
7	ALOS-2	May 2014 ～ Under observation	-	Refer to 2.4.3
8	GSMaP	Mar. 2000 ～ Under observation	1 year	
9	JASMES	-	Depends on product	

2.4.2. Product classification

For the convenience of processing, this tool categorizes the product types into the following three types. If the resolution of the product is high, please note that the tool may stop due to insufficient memory in case the latitude/longitude range is too large.

- High (high resolution product : 1m-100m)
- Middle (medium resolution product : 100m-1km)
- Global (global product : 1km-)

In addition, there is also the "Multi_M" classification, which combines two or more Middle products. There is "Multi_G" classification, as well.

2.4.3. Specific settings for ALOS-2 product

(1) Available product

The tool is available for ALOS-2 product shown in the table down below. Data format is only available for CEOS format.

Table. ALOS-2 processing levels and observation modes that can be processed by the tool

LN	Processing levels	Observation modes	Note
1	L1.1	SM1/SM3	phase /possible to output coherence
2	L2.1	SM1/SM3/WD1	phase / impossible to output coherence

(1) Obtain and locate product

Since ALOS-2 product cannot be downloaded automatically by the tool, it is necessary for users to obtain it manually. Please utilize free sample data on EORC website or the paid data that can be purchased from data providers.

Obtained product is needed to locate the folder "ALOS-2.PALSAR-2/L1.1" or "ALOS-2.PALSAR-2/L2.1" which will be created in the folder described DaraFolder of SetParameter.txt.

(2) Location of elevation data that can be used

Elevation data (AW3D) is used to perform the differential interferometric processing. DEM is needed to be located in the parameter “Params_00_DEM_Folder” (AW3D30/DSM_030.v2003 by default) in SetType.csv in advance. AW3D, the souse data downloaded by the function of this tool can be used directly.

(3) Data that can be output

By default, intensity and phase (differential phase for non-master images) are output. By setting “Read” of “SetType.csv” as “1”, coherence output is possible.

(4) Parameter that can be set

Currently, following three kinds of parameter settings are available in SetType.csv.

Table. parameter settings

LN	Parameter name	Default settings	explanation
1	Params_00_DEM_Folder	AW3D30/DSM_030.v2003	DEM reference folder
2	Params_01_WindowPix_Phase	1	Average window size of phase
3	Params_02_WindowPix_Coh	3	Window size of coherence

2.5. Specification of output tool

(1) Category of output data and naming rules

This tool outputs following categories of files. Physical quantity data (ID 1) is saved in the folder " Tool execution folder/satellite(sensor) name/physical quantity/orbit(A/D) ". Projection of output image is EQuiRectangular (EQR) projection. Fine names are registered, date (20190523 etc.), orbit (Ascending/Descending/X), resolution (0250, 0500, 1000, 04K6 (same as 4600), 09K2 (same as 9200), 11K0), range of latitude and longitude range, accordingly.

Processing log is saved in "tool execution folder/satellite(sensor) name/LOG". In case that error happens during tool execution, "_error" will be added to the file name.

Table. Category of output data and names

ID	Contents	Extension	Example of file name
1	Physical quantity data (Image)	tif, png (+ kml) csv, bin, npz	20190523D_0250_N33.00_N38.00_E137.50_E142.50
2	Composite Image	tif, png (+ kml) csv, bin, npz	/CMP.08D/20190523D_0250_N33.00_ … _E142.50 /CMP.16D/20190523D_0250_N33.00_ … _E142.50 /CMP.01M/20190523D_0250_N33.00_ … _E142.50
3	Tile image	png,tif	/20190523D_0250_N33.00_ … _E142.50/ 3-6-2.png, 3-6-3.png…
4	Coastline Image Sea depth Image	png (+kml)	XXXXXXXXX_0250_N26.00_N46.00_E127.00_E147.00_01_Coastline
5	Spatial Statistics Data	csv	20190523A_20190524A_LST_Statistics_Ave 20190523A_20190524A_LST_Statistics_Max 20190523A_20190524A_LST_Statistics_Min 20190523A_20190524A_LST_Statistics_Std
6	Time-Series animation	gif	20190523A_20190524A_LST
7	Metafile	json	20190523A_1000_N33.00_N38.00_E137.50_E142.50
8	Processing log	txt	LOG_Middle_SGLI_GCOM-C_20200106_092828

(2) File capacity of output images as a guide

For a single physical quantity data image (tif, uncompressed), the data amount per pixel is 4 bytes (for single-precision floating point). For a 250m resolution image with a latitude and longitude range of 20deg, the number of pixels is 9600×9600, and the storage capacity is 4*9600^2 ≒ 369MB. In fact, the data will be about 20-30% of the actual size due to compression, but a reasonable amount of data space will be required. So please pay attention to the available space.

3. Procedure of tool usage

3.1. Obtain the accounts for satellite data usage (required)

Obtain the accounts following to the website in reference 1. [1] (G-portal, NASA HP, etc). In case of using NASA's earth data, to get the app key is also needed. The minimum number of accounts is fine to acquire.

3.2. Install of MATLAB runtime file (required)

Decompress the runtime file and install it to the PC. The runtime file is available on the website of Mathworks as follows.

https://jp.mathworks.com/products/compiler/matlab-runtime.html

Please select the version “2021a (9.10)” and OS (64bit) you will use.

3.3. Install of Decompression software (arbitrarily: windows only)

When utilizing AW3D, PSR MOS/FNF and GSMaP, decompression process would be faster by installing decompression software(7zip). In case of installing 7zip, please install executive file in the following folder

C:¥Program Files¥7-Zip¥7z.exe

3.4. Migration of the tool and the related files (required)

Arrange the folder "for_redistribution_files_only" (including the tool main unit) on an arbitrary place in PC. Then, arrange "SetParameter.txt", "SetAccount.txt", "SetProduct.csv" and "SetType.csv" on an arbitrary place in PC. Although it is fine to arrange the folder on same location as "for_redistribution_files_only", separate location is convenient.

Please note that it is necessary to arrange "SetParameter.txt", "SetAccount.txt" "SetProduct.csv" and "SetType.csv" all in the same folder.

The Output folder (each sensor) and the file are generated and saved at the same location as these four kinds of files.

3.5. Modification of SetAccount.txt (required)

Put your account information obtained by 3.1 in "ID" and "Pass"(part of XXXX). Enter ID, password and key information (if necessary) accordingly. Just enter the information for the service you would like to use.

```
%%% Data provider Account information (Service(Don't change),ID,Pass,Key(if any))
Account, G-portal, XXXX, XXXX, XXXX
Account, MODIS   , XXXX, XXXX, XXXX
Account, GSMaP   , XXXX, XXXX, XXXX
Account, JASMES  , XXXX, XXXX, XXXX
```

Fig. Example of setting up satellite data account information

3.6. Modification of SetParameter.txt (required)

(1) Modification of "range(date range, latitude and longitude range)" (Range Setting) (required)

Configure the date range, latitude and longitude range. As for latitude and longitude range, minimum values should be -90, -180deg and maximum values should be +90, +180deg. If the tool seems to be stopped due to memory shortage, try to minimize the latitude and longitude range.

```
%%% Range Setting %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
DateRange, 2019/09/15, 2019/09/15, % Date Range (YYYY/MM/DD)
LatRange ,       33.0,       38.0, % Latitude   Min, Max (-90 ~ +90 deg)
LonRange ,      137.5,      142.5, % Longtitude Min, Max (-90 ~ +90 deg)
```

Fig. Example of range designation

(2) Modification of "tool process settings" (Process Setting) (arbitrarily)

Tool settings are modified as needed. Following table shows each functionality.

Fig. Setting Parameter List

LN	Name	Value	Description	Default
1	KML	ON/OFF	In case of ON and kml file exists in parameter file, its range of lat/long is the target for analytical processing. In case of OFF, no processing will be done.	OFF
2	HLLR	1～5	In case a large area is specified as the analysis range for a High category product, the analysis range will be processing segmental according to the numbers (latitude and longitude range) listed here. Adjust depend on the PC memory and your analysis purpose.	1
3	MLLR	5～30	In case a large area is specified as the analysis range for a Middle category product, the analysis range will be processing segmental according to the numbers (latitude and longitude range) listed here. Adjust depend on the PC memory and your analysis purpose.	30
4	FTP	ON/OFF	In case of ON, connect to product distribution site. In case of OFF, search for the data in local folder with no connection to the site.	ON
5	EXE	ON/OFF	In case of ON, run processing downloaded product. As for OFF case, no product processing is done.	ON
6	DEL	ON/OFF	In case of ON, delete downloaded source product. In case of OFF, downloaded product is saved in the local folder.	OFF
7	OVW	ON/OFF	In case of ON, the product will be processed, and the file will be overwritten even if there is a geotifff file that has been completed analytical processing, In case of OFF, skip the process if the geotiff file is found in a folder.	ON
8	DSP	ON	In case of ON, image of processing result is shown during tool processing.	ON

```
%%% Process Setting %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
Process, KML ,   OF ,% ON,OFF : Area from KML     (ON :Detect ROI from KML)
Process, HLLR,  3.0 ,% 0.5~ 5 : High   Lat-Lon Area Maximum Range [deg]
Process, MLLR, 30.0 ,%  5~ 30 : Middle Lat-Lon Area Maximum Range [deg]
Process, FTP ,   ON ,% ON,OFF : FTP Connection    (OFF:Search from Dfolder)
Process, EXE ,   ON ,% ON,OFF : Image processing  (OFF:No image processing)
Process, DEL ,   OF ,% ON,OFF : Delete DL Data    (OFF:Saved in DFolder   )
Process, OVW ,   ON ,% ON,OFF : Overwrite or Skip (OFF:TIF Found and skip )
Process, DSP ,   ON ,% ON,OFF : Disp Process Image(OFF:Dont show image    )
```

Fig. Example of tool processing settings

(3) **Modification of "tool output settings" (Output Setting) (arbitrarily)**

Tool output settings are modified. Following table shows each functionality.

Fig. Setting parameter list

LN	Name	Value	Description	Default
1	HRES	OFF, 0003, 0010, 0030, 0050, 0100	For the High category product, fix the resolution[m] of output image. In case of OFF, the image has product's own resolution.	OFF
2	MRES	OFF 0250, 0500, 1000, 1200, 4600	For the Middle category product, specify the resolution[m] of output image. In case of OFF, the image has product's own resolution.	OFF
3	GRES	OFF 04K6, 05K6 09K2, 11K0	For the Global category product, specify the resolution[m] of output image. In case of OFF, the image has product's own resolution. (K means "10^3" Ex: 11K0 indicates 11km resolution)	OFF
4	PPD	Integer	Number of pixels per degree of latitude and longitude (Not specified for NaN)	NaN
5	VPRT	0 ~ 1	Specify effective pixel rate when specified by HRES, MRES and GRES. Pixel rate "1" means there's no defective data in the resampling pixel.	0.5
6	ROIC	ON/OFF	In case of ON, cut the user specified lat/long	ON

			range for Global category product.	
7	GTIF	ON/OFF	In case of ON, Geotiff files are saved.	ON
8	COG	ON/OFF	In case of ON, output COG (Cloud Optimized Geotiff) format	OFF
9	CMLN	1~	Maximum number of internal COG layers	3
10	TDT	float, uint, int	Saves the TIF data values in the selected format. When selecting a data type other than float, the data type will be the same as the source data (uint, int, etc.).	float
11	NPZ	ON/OFF	Output Numpy format (.npz) data.	OFF
12	BIN	ON/OFF	In case of ON, output data as binary data.	OFF
13	CSV	ON/OFF	In case of ON, output data as csv.	OFF
14	GJSN	ON/OFF	In case of ON, output data as geojson data.	OFF
15	NDXI	ON/OFF	In case of ON, calculate normalized index using 1st and 4th type when physical quantity types are included more than four. Calculating formula is as follows. NDXI = (V4-V1)/(V4+V1)	OFF
16	IC08	ON/OFF	In case of ON, output 8-day composite for the data as daily one. The standard day is January 1st. Note that data is proceeded even though the number is less than 8 days.	OFF
17	IC16	ON/OFF	In case of ON, output 16-day composite for the data as daily one. The standard day is January 1st. Note that data is proceeded even though the number is less than 8 days.	OFF
18	IC1M	ON/OFF	If case of ON, monthly composite data will be output for the data output as Daily data. Note that even if the number of data does not include all of the data for a month, it will be processed as well.	OFF
19	PNG1	ON/OFF	In case of ON, output PNG file (8 bit color) of each physical quantity. The KML file for display will be output as well.	OFF
20	PNG3	ON/OFF	In case of ON, save PNG file (24bit) of PRG image assigned R, G, B as physical quantity. The	OFF

			KML file for display will be output as well.	
21	CMP3	ON/OFF	In case of ON, compress for 8bit color about above PNG3.	OFF
22	GAM	0 ~ 3	Proceed γ correction based on the specified value about above PNG3.	1.5
23	SPH1	ON/OFF	In case of ON, output spherical image centered by user specified lat/long for Global category product (each physical quantity).	OFF
24	SPH3	ON/OFF	In case of ON, output spherical image centered by user specified lat/long for Global category product (assigned R, G, B as 3 physical quantities).	OFF
25	GIF1	ON/OFF	In case of ON, output time-series GIF file based on each physical quantity.	OFF
26	GIF3	ON/OFF	In case of ON, output time-series GIF file using image which applies three physical quantities to R, G, B.	OFF
27	MIMG	ON/OFF	In case of ON, output projection image (PNG) from output image to Mercator projection.	OFF
28	MTIL	ON/OFF	In case of ON, project output image from equal lat/long to Mercator projection, then output segmented processing tile image (PNG).	OFF
29	ETIL	ON/OFF	In case of ON, output segmented processing file on tile image with equal lat/long.	OFF
30	CLIN	ON/OFF	In case of ON, output PNG file of coastline data in analysis range.	OFF
31	OCDM	ON/OFF	In case of ON, output mask data of sea depth (-200m). Sea area less than 200m looks black color.	OFF
32	META	ON/OFF	In case of ON, output meta data. (.json)	OFF

```
%%% Output Setting %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
Output, HRES,   OF ,% String : High   Fix Res (OF,0003,0010,0030,0050)
Output, MRES, 0250 ,% String : Middle Fix Res (OF,0100,0250,0500,1000,1200)
Output, GRES,   OF ,% String : Global Fix Res (OF,04K6,05K6,09K2,11K0)
Output, VPRT, 0.50 ,% Value  : Valid Pixel Rate Threshold in resizing (0~1)
Output, ROIC,   ON ,% ON,OFF : Region Of Interest Cut (Global only)
Output, GTIF,   ON ,% ON,OFF : Geotiff output (deflate compressed)
Output, COG ,   ON ,% ON,OFF : Cloud Optimized Geotiff output
Output, TDT , float,% String : TIF Data Type (float,uint or int(original))
Output, NPZ ,   OF ,% ON,OFF : numpy(.npz) data output
Output, BIN ,   OF ,% ON,OFF : Binary data output
Output, CSV ,   OF ,% ON,OFF : CSV data output
Output, GJSN,   OF ,% ON,OFF : Geojson data output
Output, NDXI,   OF ,% ON,OFF : Normalized Index (No.1,4 value) GTIF output
Output, IC08,   OF ,% ON,OFF : Image Composite ( 08day) GTIF,PNG,KML output
Output, IC16,   OF ,% ON,OFF : Image Composite ( 16day) GTIF,PNG,KML output
Output, IC1M,   OF ,% ON,OFF : Image Composite (1Month) GTIF,PNG,KML output
Output, PNG1,   ON ,% ON,OFF : PNG,KML output (individual values)
Output, PNG3,   ON ,% ON,OFF : PNG,KML output (upper 3 values comp RGB)
Output, CMP3,   OF ,% ON,OFF : PNG RGB Image's Compression to 8 bit color
Output, GAM , 1.50 ,% Value  : PNG RGB Image's Gamma
Output, SPH1,   OF ,% ON,OFF : Sphere png output (Global only, individual)
Output, SPH3,   OF ,% ON,OFF : Sphere png output (Global only, upper 3   )
Output, GIF1,   OF ,% ON,OFF : Time series GIF output (individual values)
Output, GIF3,   OF ,% ON,OFF : Time series GIF output (upper 3 values comp)
Output, MIMG,   OF ,% ON,OFF : Mercator IMG saving (PNG)
Output, MTIL,   OF ,% ON,OFF : Mercator Web Map Tile output (PNG1,PNG3)
Output, ETIL,   OF ,% ON,OFF : EQR      Web Map Tile output (GTIF)
Output, CLIN,   OF ,% ON,OFF : Coast line PNG,KML output
Output, OCDM,   OF ,% ON,OFF : Ocean Deepness(<-200m) Mask output
Output, META,   ON ,% ON,OFF : Meta data (.json) output
```

Fig. Example of tool output settings

(4) Modification of “Satellite data saving folder” (required)

The satellite data, which will be the source file, will be downloaded to the folder you are setting here. Please make the folder in advance or specify existing folder. If you reuse the file once downloaded, tool will search the file in this folder.

```
%%% Downloaded & Input Datasets Archive Folder Setting %%%%%%%%%%%%%%%%%%%%%%
DataFolder, X:/01_DataSets
```

Fig. Example of satellite data folder settings

3.7. Modification of SetProduct.csv (required)

As for the product you would like to run, set product initial name “Execute” as value 1. It is possible to select multiple products and set “Execute” as value 1. Product has five categories depend on its resolution, “High” (High resolution), “Multi-Middle” (Multiple data of medium resolution), ”Multi-Global” (Multiple global data) , “Middle” (Medium resolution) and “Global” (Global resolution) .

By format conversion this csv data to excel etc. and save it the name such as “SetProduct.xlsx/SetProduct.xls”, it is possible to make the data reading on a priority basis. Since data filtering is easily added for xls or xlsx, please utilize as you needed.

For some products, the observation period of the distributed data is different depend on each version. In that case, please change the value of "Version" as necessary.

Execute	Resolutior	Sensor	ID	Version	Area	Resolution_deg	Resolution_m
1	High	AW3D30	DSM_030	2003	Global	1/3600 deg	30 m
1	High	ALOS-2.PALSAR-2	SM1.UB.L1.1	NaN	Global	1/36000 deg	3m
0	High	ALOS-2.PALSAR-2	SM3.FB.L1.1	NaN	Global	1/12000 deg	10m
0	High	ALOS-2.PALSAR-2	SM1.UB.L2.1	NaN	Global	1/36000 deg	3m
0	High	ALOS-2.PALSAR-2	SM3.FB.L2.1	NaN	Global	1/12000 deg	10m
0	High	ALOS-2.PALSAR-2	WD1.WW.L2.1	NaN	Global	1/1200 deg	100m
0	High	ALOS-2.PALSAR-2	WD1.WB.L2.1	NaN	Global	1/1200 deg	100m
0	High	GSI	GEONET_F3	NaN	Japan	Points	Points
0	High	GSI	GEONET_R3	NaN	Japan	Points	Points
0	Multi_M	GCOM-C.SGLI	RGB___08D	1	Global	1/480 deg	250 m
0	Multi_M	GCOM-C.SGLI	RGB___01M	1	Global	1/480 deg	250 m
0	Multi_M	GCOM-C.SGLI	BNVI__08D	1	Global	1/480 deg	250 m
0	Multi_M	GCOM-C.SGLI	BNVI__01M	1	Global	1/480 deg	250 m

Fig. Example of product specification (when executing AW3D30 and ALOS-2 product)

3.8. Modification of SetType.csv（arbitrarily）

When user side wants to control the product output type/QA flag settings/RGB allocation/control PNG output detailed settings, modify SetType.csv. Setting is available for the following four kinds of parameters.

In case you want to apply multiple QA flags to a physical quantity, it is necessary to set the Read of the target QA flag to all “1” and manually process the output data after running the tool.

Table: List of setting parameters

ID	Parameter	Input	Explanation
1	Flag	QA flag name	Specify “QA flag” and use it as mask. Not applicable in case of “NaN”. Only one mask can be specified as a QA flag.
2	Read	0/1	0：not readable 1 ：readable
3	Cmin	NaN or real	If setting NaN, Automatic value (average—1 σ). By using "log10(XX)", the color bar can be logarithmically scaled.
4	Cmax	NaN or real	If setting NaN, Automatic value (average＋1 σ). By using "log10(XX)", the color bar can be logarithmically scaled.
5	Cmap	See below table	Matlab-compliant color map (below table)

Table: List of color map

Name	Color map
parula	
jet	
hsv	
hot	
cool	
spring	
summer	
autumn	
winter	
gray	
bone	
copper	
pink	

3.9. Location of TIF and KML files (arbitrarily)

It is possible to locate TIF files and kml files which users make arbitrarily in the same tree where various parameter files are located. Following figure shows both required specification of file and conducted processing in the case. Kml file can save the data made by software like Google Earth and GADM (administrative area) data.

Table. Operation processing list for each located file

LN	File Category	Specification	Processing
1	.tif	Projection: same lat/long stored value: 0 or 1	Apply to the product to be analyzed and performs mask processing to make the 0 portion missing and only the 1 portion valid. When using this function, take care that the user-specified latitude and longitude ranges are included in the spatial range of the mask file.
2	.kml	Category: dot, line, polygon data	Processing spatial statistics for designated area, and output four types of csv data (Average, maximum, minimum, abmodality)

3.10. Execution of the tool and output file

After installing the runtime, execute the tool with command. This section explains the way of execution according to OS.

3.10.1. Execution of the tool and output file

(1) Windows 64bit

Firstly, run the command prompt. Move the current directory to the directory where the tool executable is located using the cd command, and enter “IMG_Stack[Space][Absolute path of the folder where parameter file is located] ” as a command. Parameter file contains four files - “SetParameter.txt”, “SetAccount.txt”, “SetProduct.csv” and “SetType.csv”. For example, in case of the following condition:

・Storage location of tool：C:¥IMG_Stack_folder

・Storage location of Parameter file：C:¥Output

Enter the following commands.

```
cd C:¥IMG_Stack_folder
IMG_Stack C:¥Output
```

Above script can be a batch file. So, execution of the tool is available just by double clicking the batch file. Also, it makes it easier to reprocess after parameter adjustment based on regular processing and output result.

Sometimes, it takes a few minutes before processing since MATLAB is boot and set up in the background. The screen appearing during the process is the confirmation screen of projection graphics and processing status.

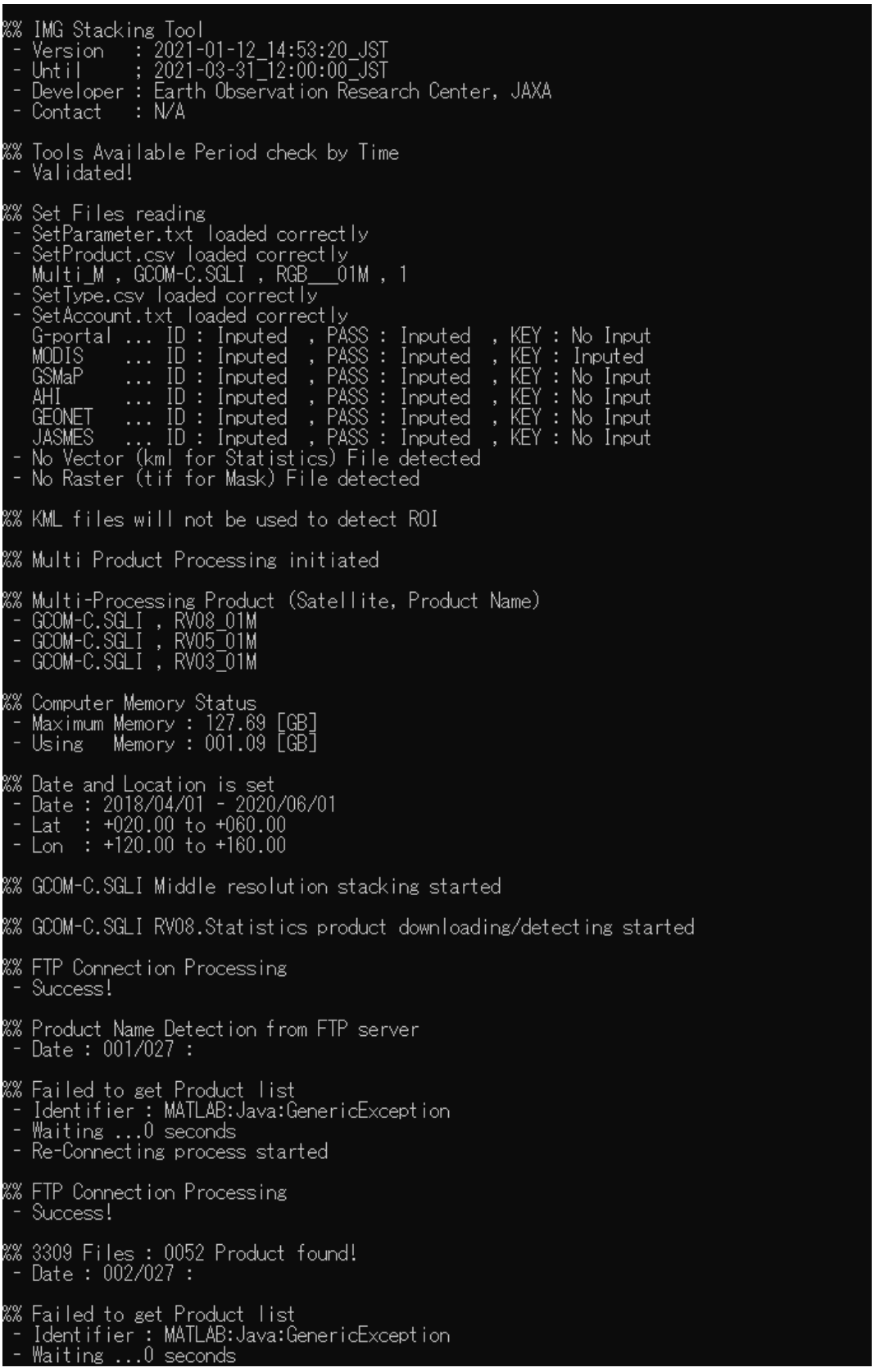


Fig. Example of Command Prompt screen after tool execution (windows)

(2) Ubuntu 20.04 LTS (64bit)

Boot the terminal, then move the current directory to the location where tool is located and enter the command "./run_IMG_Stack.sh[Space][Absolute path of MATLAB runtime][Space][Absolute path of parameter file]". Parameter file contains four files - "SetParameter.txt", "SetAccount.txt" , "SetProduct.csv"and "SetType.csv".

For example, in case of the following condition:

・Storage location of tool：/home/IMG_Stack

・Location of MATLAB runtime：/usr/local/MATLAB/MATLAB_Runtime/v96

・Storage location of parameter file：/home/hoge/Output

Enter the following commands.

```
cd /home/IMG_Stack
./run_IMG_Stack.sh /usr/local/MATLAB/MATLAB_Runtime/v96 /home/hoge/Output
```

Same as Windows, highly convenient usage is possible by making a shell script.

3.10.2. Example of output file

When the tool has installed successfully, user designated file will be generated. The file will be displayable on google earth and GIS soft etc. by using KML file.

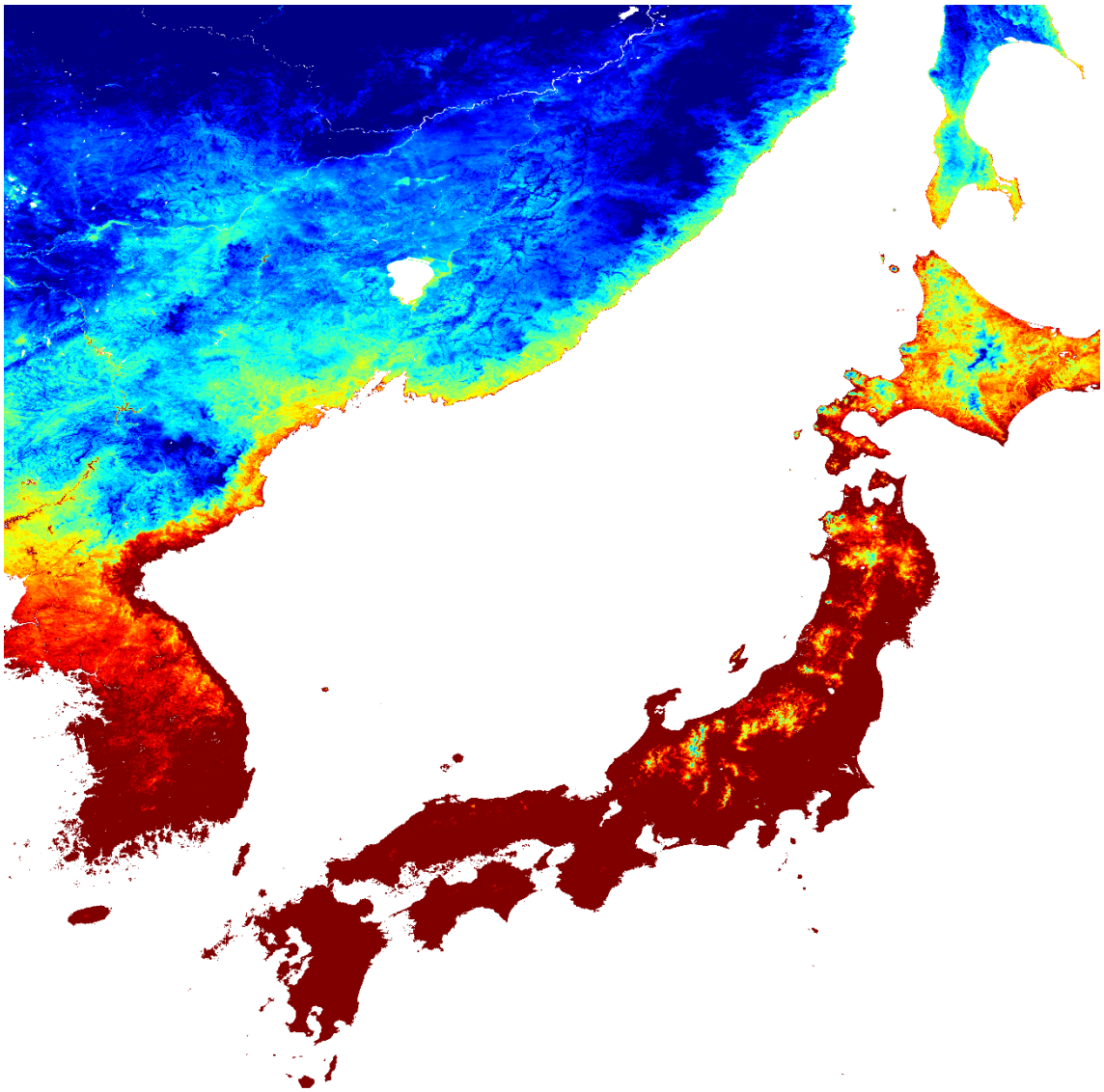


Fig. Example of output file (GCOM-C LST one-month average; December 2018)

3.10.3. About log file

Analyzed log is automatically recorded in “LOG” folder inside the satellite folder from the folder which SetParameter.txt is located. This happens even in the error case. Please note that the data may not be recorded properly when the tool is stopped due to insufficient memory.

4. Caution and supplementary note for tool usage

4.1. Adjustment of set up file

(1) Specified range of date when using statistical data (SetParameter.txt)

When utilizing statistical product (one-month, 8 days average, etc.), pay attention to specify the date. For example, one-month statistical product of GCOM-C is all saved in "1st day" of the month.

4.2. Tool usage

(1) Firewall warning

Following warning is shown at start-up on Windows. However, there is no problem because it is for processing request by parallel computation.

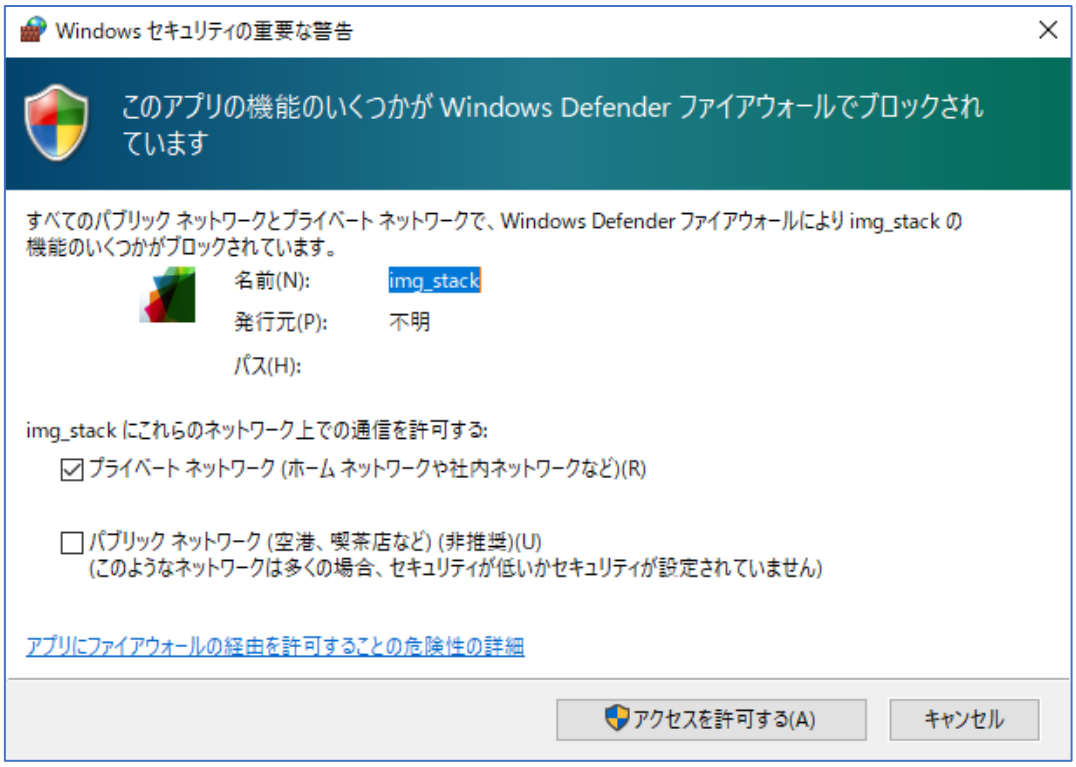


Fig-4. Firewall Warning Screen

(2) Error caused by creating intermediate file when product download is interrupted

There is a case that intermediate file is created when product download is interrupted due to some sort of reason. In this case, remove the intermediate file. Otherwise, product cannot be read right way.

(3) Data output of only missing value

Although data is created per day, there is a case of outputting only missing value data due to cloud loss, range of satellite observation and so on. So, this is not a trouble of the tool. In this case, file output in PNG format will not be executed.

(4) Download failure due to the problem of product distribution site

Due to a problem with the product distribution site, you cannot obtain the target satellite images in some cases. In this case, please wait for a while and try again to conduct the process or contact the support of each product distribution site.

(5) Product cannot be found/processed in tool processing

There are cases that the observation period of the data provided is different depending on the version of the product. For example, version 1 product of SHIKISAI has no data after July 2020. Instead, version 2 has been available since July 2020. Please change "Version" of SetProduct.csv and try again.

5. About tool specification and quality

- This tool can be used without any charge, but limited for a non-commercial purpose such as education, research and so on.
- If you plan to publish the outcome of using this tool in a paper etc., please include a description to that effect in the main text. (example: "We use JAXA ASIST in preprocessing of the data shown in this paper") If possible, it would be appreciated if you could contact us about it in advance.
- Please confirm the product format or distribution policy of each product on its own distribution site as necessary.
- The specification/service of this tool subjects to change without notice. Also, this tool is in prototype stage for satellite image utilization, so JAXA cannot ensure the quality and accuracy regarding the performance.
- We cannot guarantee any problem caused by or possibly caused by using the tool. Redistribution is prohibited.

6. Contact

If you have any questions about this tool, or if you would like to present your results, please send an email to the following address.

Z-ASIST@ml.jaxa.jp (Automated Satellite Image Stacking Tool Secretariat)

If an unexplained error occurs and the problem cannot be solved by checking the analysis log or the contents of Chapter 4, please contact us with "SetParameter.txt", "SetType.csv", and "SetProduct.csv". We will use your notice as a reference for future upgrade.

Please note that it may take some time for us to respond to your inquiries.

7. References

7.1. Terra, Aqua MODIS

[1] MODIS User registration (NASA website)：land data
https://urs.earthdata.nasa.gov/users/new

[2] MODIS Data Pool (NASA website)：Land data
https://lpdaac.usgs.gov/tools/data-pool/

7.2. GCOM-C SGLI

[1] G-portal User registration
https://gportal.jaxa.jp/gpr/user/regist1?lang=en

[2] G-portal FTP website
ftp.gportal.jaxa.jp

[3] GCOM-C FAQ (G-portal)
https://gportal.jaxa.jp/gpr/information/support#common

[4] GCOM-C FAQ 025 GCOM-C Guidance for Product utilization Introduction (G-portal)
https://suzaku.eorc.jaxa.jp/GCOM_C/users_portal/faq/faq0025_j.html

[3] Standard Products and Algorithms (GCOM-C HP)
htmlhttps://suzaku.eorc.jaxa.jp/GCOM_C/data/Product_std.html

[4] SGC-180025 GCOM-C “SHIKISAI” Data Users Handbook
https://gportal.jaxa.jp/gpr/assets/mng_upload/GCOM-C/GCOM-C_SHIKISAI_Data_Users_Handbook_jp.pdf

[5] SGC-180021 SGLI Level 1 Product Format Description
https://gportal.jaxa.jp/gpr/assets/mng_upload/GCOM-C/SGLI_Level1_Product_Format_Description_jp.pdf

[6] SGC-180023 SGLI Higher Level Product Format Description
https://gportal.jaxa.jp/gpr/assets/mng_upload/GCOMC/SGLI_Higher_Level_Product_Format_Description_en.pdf

7.3. GCOM-W AMSR-2

[1] Standard Product (GCOM-W HP)
https://suzaku.eorc.jaxa.jp/GCOM_W/data/data_w_product-2.html

[2] Format specification, Users handbook, and Toolkit (GCOM-W HP)
https://suzaku.eorc.jaxa.jp/GCOM_W/data/data_w_use.html

7.4. AW3D, ALOS-2 PSR MOS/FNF

[1] Precise Global Digital 3D Map "ALOS World 3D" Homepage
https://www.eorc.jaxa.jp/ALOS/en/aw3d/index_e.htm

[2] ALOS World 3D-30m（AW3D30）Version 2.2 Product Instruction
https://www.eorc.jaxa.jp/ALOS/aw3d30/aw3d30v22_product_j.pdf

[3] Global PALSAR-2/PALSAR/JERS-1 Mosaic and Forest/Non-Forest map
https://www.eorc.jaxa.jp/ALOS/en/palsar_fnf/fnf_index.htm
[4] Global 25m resolution PALSAR-2/PALSAR Mosaic and Forest/Non-Forest map instruction
https://www.eorc.jaxa.jp/ALOS/palsar_fnf/DatasetDescription_PALSAR2_Mosaic_FNF_ja_revH.pdf

7.5. ALOS-2

[1] ALOS-2/ALOS User Interface Gateway (AUIG2)
https://auig2.jaxa.jp/ips/home
[2] ALOS-2 Product format instruction
https://www.eorc.jaxa.jp/ALOS-2/doc/jformat.htm
[3] ALOS-2 Sample product
https://www.eorc.jaxa.jp/ALOS-2/doc/sam_jindex.htm

7.6. GSMaP

[1] GSMaP User registration
https://sharaku.eorc.jaxa.jp/GSMaP/registration_j.html
[2] GSMaP User guide
https://sharaku.eorc.jaxa.jp/GSMaP/guide_j.html

7.7. JASMES

[1] JASMES Portal Top
https://kuroshio.eorc.jaxa.jp/JASMES/index.html

7.8. Others

[1] Global Administrative Areas (Database of country administrative areas)
https://gadm.org/
[2] GSHHG (A Global Self-consistent, Hierarchical, High-resolution Geography Database)
http://www.soest.hawaii.edu/pwessel/gshhg/
[3] Natural Earth bathymetry (Sea depth 200m) Data
https://www.naturalearthdata.com/downloads/10m-physical-vectors/