iCOR Landsat-8 and Sentinel-2 plugin for SNAP toolbox

Software User Manual

Version 3.1: 20/05/2025

VITO Remote Sensing Unit

Boeretang 200 | 2400 Mol | Belgium

Contents

1. Introduction

1.1. Scope

This document describes the installation and handling of the iCOR plugin for the Sentinel-2 SNAP toolbox.

1.2. Objectives

The plugin allows users to test and perform an iCOR atmospheric correction for

- Landsat-8 and Sentinel2 data
- Land, inland and coastal waters

1.3. Background

iCOR (De Keukelaere et al., 2018, Sterckx et al., 2015) is a scene and sensor generic atmospheric correction algorithm that can handle land and water targets (Pahlevan et al., 2021) and is adaptable with minimal efforts to other hyper- or multi-spectral sensors. All input data required for the atmospheric correction are derived from the image itself or delivered through pre-calculated look-up-tables. Through the use of a single atmospheric correction implementation, discontinuities in the reflectance between land and the highly dynamic water areas are reduced. The workflow of iCOR is depicted in Figure 1. In short following steps are run through: (i) land and water pixels are identified (ii) land pixels are used to derive Aerosol Optical Thickness (AOT) based on an adapted version of the method developed by (Guanter, 2007) (iii) an adjacency correction is performed using SIMEC (Sterckx et al., 2014) over water and fixed background ranges over land targets, and (iv) the radiative transfer equation is solved. iCOR uses MODTRAN 5 (Berk et al., 2006) Look Up Tables (LUT) to perform the atmospheric correction and needs information about the solar and viewing angles (Sun Zenith Angle (SZA), View Zenith Angle (VZA) and Relative Azimuth Angle (RAA)) and a digital elevation model (DEM).

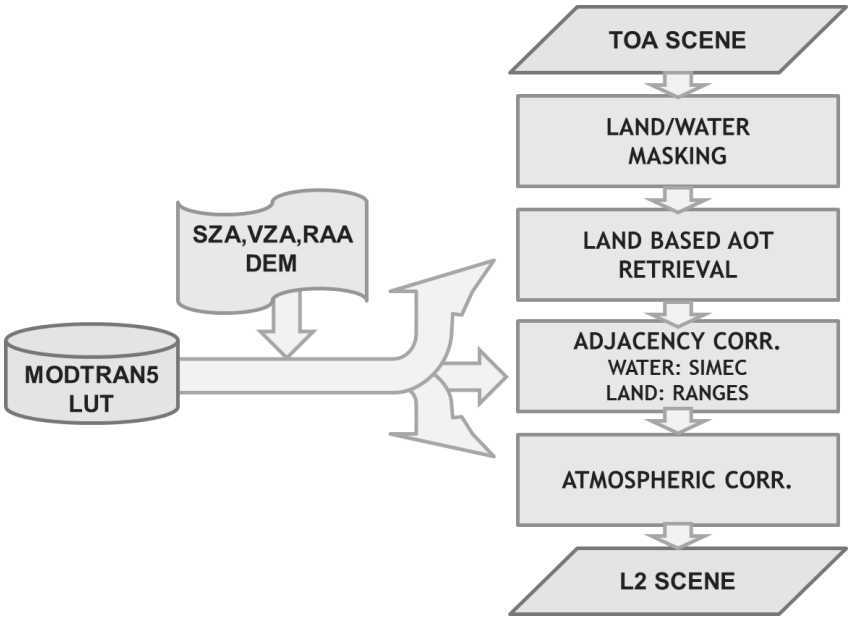


Figure 1 Workflow of iCOR atmospheric correction. LUT = Look-up-Table, SZA = Solar Zenith Angle, VZA = View zenith anhle, RAA = relative azimuth angle, DEM = Digital Elevation Model, TOA = Top-Of-Atmopshere, AOT = Aerosol Optical Thickness, SIMEC = Similarity Environment Correction (Sterckx et al., 2014), L2 = Level 2 atmospherically corrected.

1.4. Version 3.1 updates

We find it important to keep improving the performance of iCOR and to expand the embedded functionalities. The iCOR SNAP Version 3.1 plug-in is made compatible with latest SNAP 12.0 version and latest Sentinel-2 L1C processing baselines include the following improvements:

- Update to support SNAP 12
- Python upgraded to version 3.12
- Installation as user without administrative privileges under Windows
- Sentinel-2C support
- Sentinel-2 L1C latest processing baselines which includes a radiometric_offset (i.e. processing baselines 04.00 and higher)

1.5. Reader level

This document is written for SNAP Toolbox users. The document assumes that the reader is familiar with the basic concepts in the SNAP software and its integrated processors.

1.6. Notion

The iCOR plugin for the SNAP toolbox is provided as an experimental tool for research purposes. The use of the tool is at own discretion and risk.

1.7. Acronyms

AOT Aerosol Optical Thickness

BOA Bottom-of-Atmopshere

DEM Digital Elevation Model

iCOR Image Correction (De Keukelaere et al., 2018)

SIMEC Similarity Environment correction (Sterckx et al., 2014)

TOA Top-Of-Atmosphere

VITO Vlaams Instituut voor Technologisch Onderzoek

1.8. References

Bassani, C.; Sterckx, S. Calibration of Satellite Low Radiance by AERONET-OC Products and 6SV Model. Remote Sens. 2021, 13, 781. https://doi.org/10.3390/rs13040781

De Keukelaere, L., Sterckx, S., Adriaensen, S., Knaeps, E., Reusen, I., Giardino, C., Bresciani, M., Hunter, P., Neil, C., Van der Zande, D., Vaiciute, D. (2018) Atmospheric correction of Landsat-8/OLI and Sentinel-2/MSI data using iCOR algorithm: validation for coastal and inland waters, European Journal of Remote Sensing, 51:1, 525-542, DOI: 10.1080/22797254.2018.1457937

Guanter, L., 2007. New algorithms for atmospheric correction and retrieval of biophysical parameters in earth observation. Application to ENVISAT/MERIS data.

Guanter, L., Alonso, L., Moreno, J., Member, A., 2005. A Method for the Surface Reflectance Retrieval From PROBA / CHRIS Data Over Land : Application to ESA SPARC Campaigns 43, 2908–2917.

Pahlevan, N., A. Mangin, S. V. Balasubramanian, et al. 2021. "ACIX-Aqua: A global assessment of atmospheric correction methods for Landsat-8 and Sentinel-2 over lakes, rivers, and coastal waters." Remote Sensing of Environment, 258: 112366 [10.1016/j.rse.2021.112366]

Richter, R., Schläpfer, D., Müller, A., 2006. An automatic atmospheric correction algorithm for visible/NIR imagery. Int. J. Remote Sens. 27, 2077–2085. doi:10.1080/01431160500486690

Sterckx, S., Knaeps, E., Adriaensen, S., Reusen, I., Keukelaere, L. De, Hunter, P., 2015. Opera : an Atmospheric Correction for Land and Water. Proc. Sentin. Sci. Work. 3–6.

Sterckx, S., Knaeps, S., Kratzer, S., Ruddick, K., 2014. SIMilarity Environment Correction (SIMEC) applied to MERIS data over inland and coastal waters. Remote Sens. Environ. doi:10.1016/j.rse.2014.06.017

Sterckx, S.; Wolters, E. Radiometric Top-of-Atmosphere Reflectance Consistency Assessment for Landsat 8/OLI, Sentinel-2/MSI, PROBA-V, and DEIMOS-1 over Libya-4 and RadCalNet Calibration Sites. Remote Sens. 2019, 11, 2253. https://doi.org/10.3390/rs11192253

Vermote, E.F., Tanré, D., Deuzé, J.L., Herman, M., Morcrette, J.J., 1997. Second simulation of the satellite signal in the solar spectrum, 6s: an overview. IEEE Trans. Geosci. Remote Sens. 35, 675–686. doi:10.1109/36.581987

2. Software installation

2.1. Hardware requirements

20 GB of free disk space of which:

- 1.2 GB for ESA-SNAP Toolbox installation
- 7 GB for iCOR installation
- Extra space for intermediate files during processing

2.2. Software requirements

OS :

- Window 8 or higher (64bit)
- Linux: Ubuntu 24.04 (LTS)

General :

- SNAP 12.0.0 – https://step.esa.int/main/download/snap-download/

Windows:

- Windows redistributables (2022) https://aka.ms/vs/17/release/vc_redist.x64.exe
- When installing ESA-SNAP make sure the option “Extend my PATH environment variable” is selected

Ubuntu:

- Installation of python packages:

```
sudo apt install python3-rasterio
sudo apt install python3-pyproj
```

```
sudo apt install python3-gdal
sudo apt install gdal-bin
```

- Make esa-snap gpt available on PATH
  Assuming esa-snap is installed in /opt/esa-snap
  this can be done by adding these lines to ~/.bashrc

```
if [ -d "/opt/esa-snap/bin" ] ; then
  PATH="/opt/esa-snap/bin:$PATH"
fi
```

2.3. Download and installation

!! Important note: If you have already previous version of SNAP and/or ICOR installed, it is important to fully uninstall and remove these older SNAP and ICOR versions before starting the installations.

Installation on WINDOWS

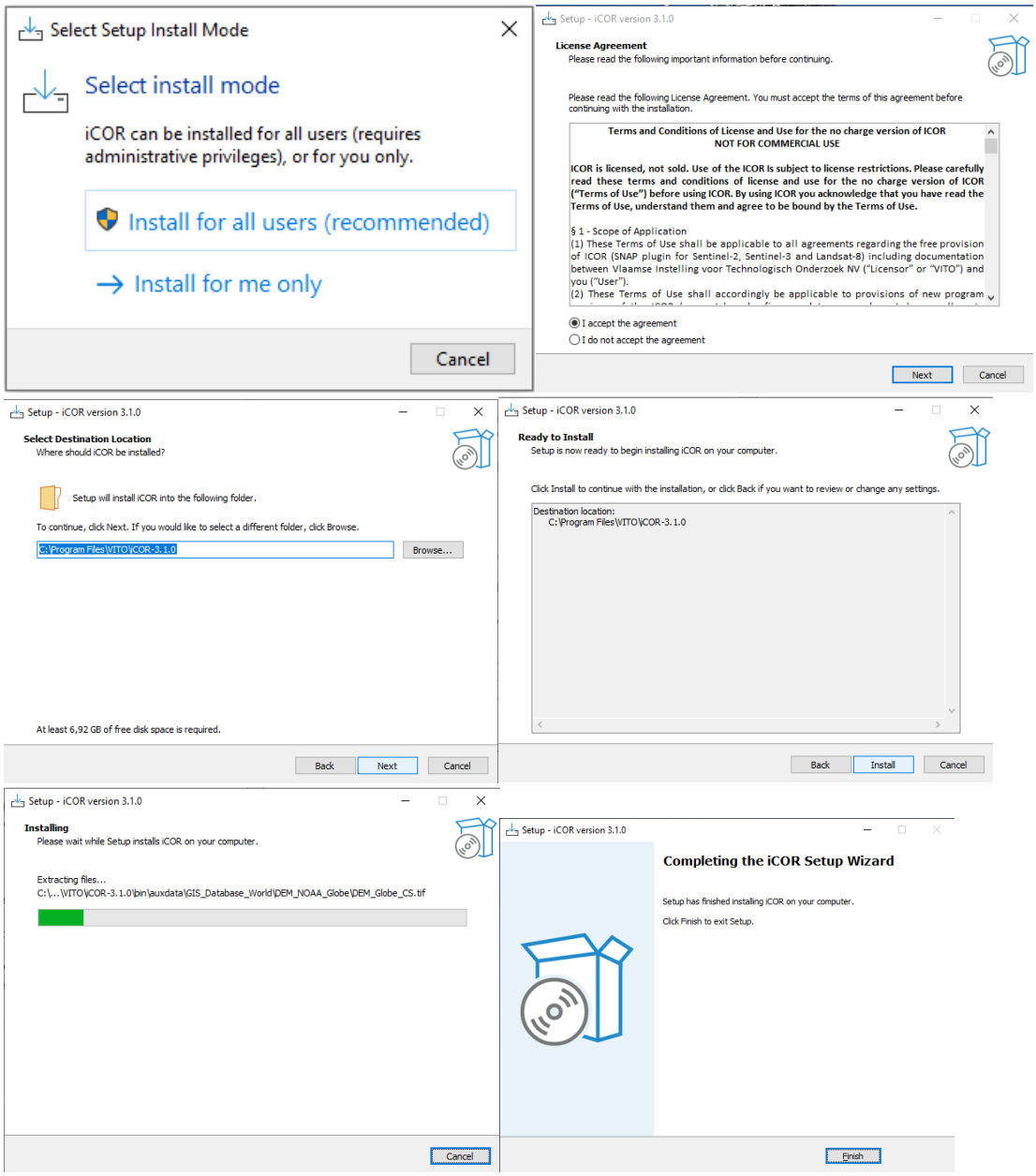
Run `iCOR_Setup_3.1.0.exe`

Please note that it can take a few minutes before the installation process starts.

A new window will pop-up with the iCOR Setup installation wizard.

If you have no administrative privileges some steps are skipped, also see "Non default installation path" further below in this document for needed changes.

- ➔ "Select install mode" → "Install for all users (recommended)"
- ➔ "Do you want to allow this app from an unknown publisher to make changes to your device" → "Yes"
- ➔ Go through the installation by selecting "`I accept the agreement`"
- ➔ Choose the installation folder (by default: '`C:\Program Files\VITO\iCOR-3.1.0`')
  If you change this see "Non default installation path" further below in this document for needed changes.
  → "Next" → "Install"
- ➔ "Finish"



Installation on LINUX Ubuntu

Run icor_install_ubuntu_24_04_x64_3.1.0.bin with a user that has permissions to write to /opt or by using sudo

Please note that it can take a few minutes before the installation process starts.

```
sudo ./icor_install_ubuntu_24_04_x64_3.1.0.bin
```

This should result in the following output:

```
[sudo] password for <username>:

Verifying archive integrity...  100%   MD5 checksums are OK. All good.

Uncompressing iCOR installer Ubuntu 24.04 x64 3.1.0  100%

Copying iCOR files into the installation folder : /opt/vito/icor-3.1.0

Done

iCOR installation for SNAP finished
```

Opening the plugin in SNAP

If the tool is successfully installed, you need to provide the installation path to SNAP. Therefore, in the SNAP toolbox go to Tools → Plugins → Downloaded → Add Plugins. Browse to the directory where the iCOR files where installed, under the subdir 'sta' and select the file → click on Open. For Windows:

- ***iCOR-landsat8-sta-3.1.0-WINDOWS.nbm***
- ***iCOR-sentinel2-sta-3.1.0-WINDOWS.nbm***
- *iCOR-sentinel3-sta-3.1.0-WINDOWS.nbm*

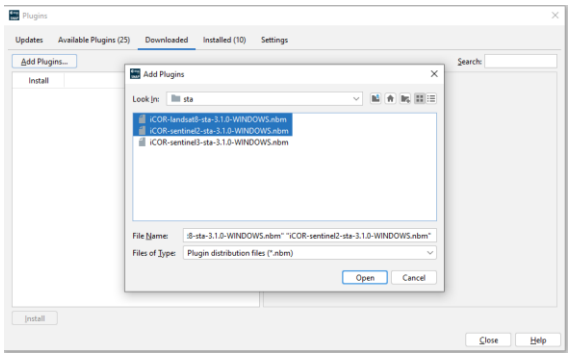
The default directory for these files is: `C:\Program Files\VITO\iCOR-3.1.0\sta` or C:\Users\<username>\AppData\Local\Programs\VITO\iCOR-3.1.0

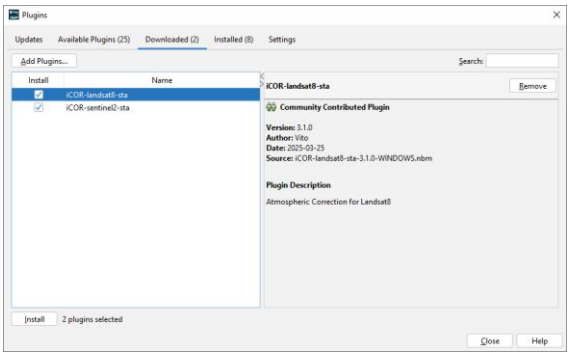
For Linux:

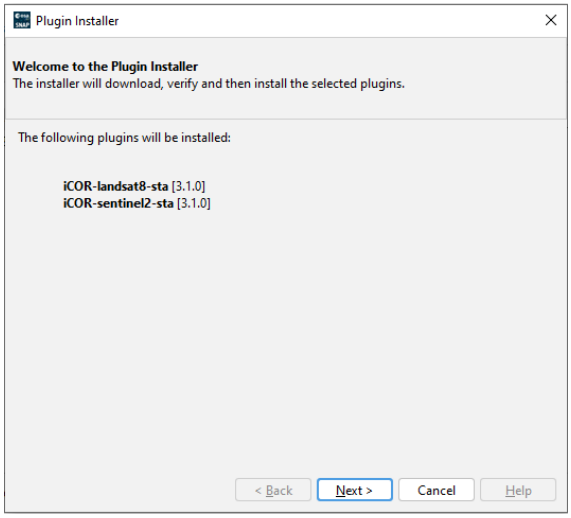
- ***iCOR-landsat8-sta-3.1.0-LINUX.nbm***
- ***iCOR-sentinel2-sta-3.1.0-LINUX.nbm***
- *iCOR-sentinel3-sta-3.1.0-LINUX.nbm*

The default directory for these files is: `/opt/vito/icor-3.1.0.sta`

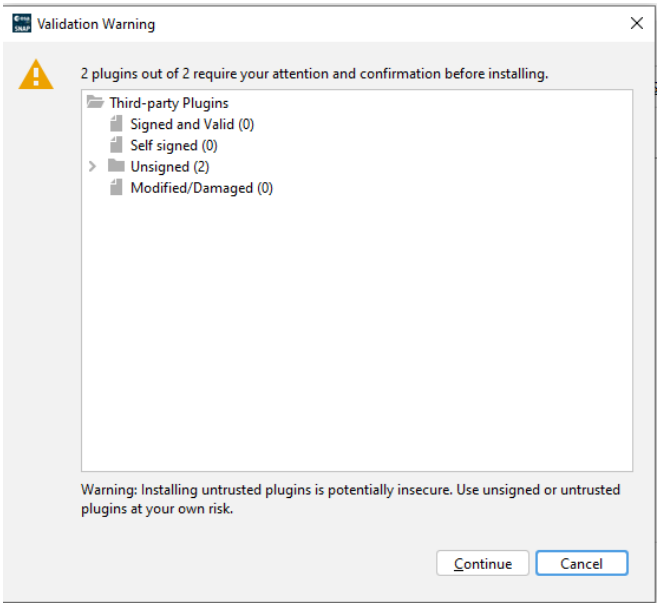
Select both plugins (iCOR-landsat8-sta and iCOR-sentinel2-sta) and press on Install → Next → Select '*I accept the terms in the License Agreement*' → Install.



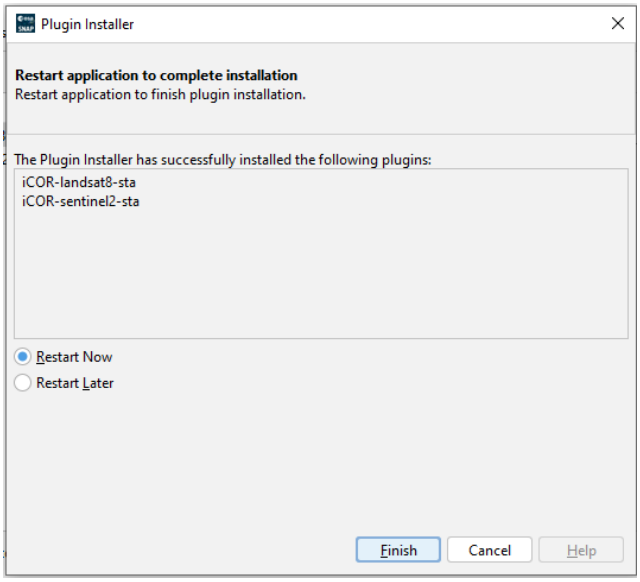




A validation Warning might pop-up:



Press Continue to continue the installation procedure.



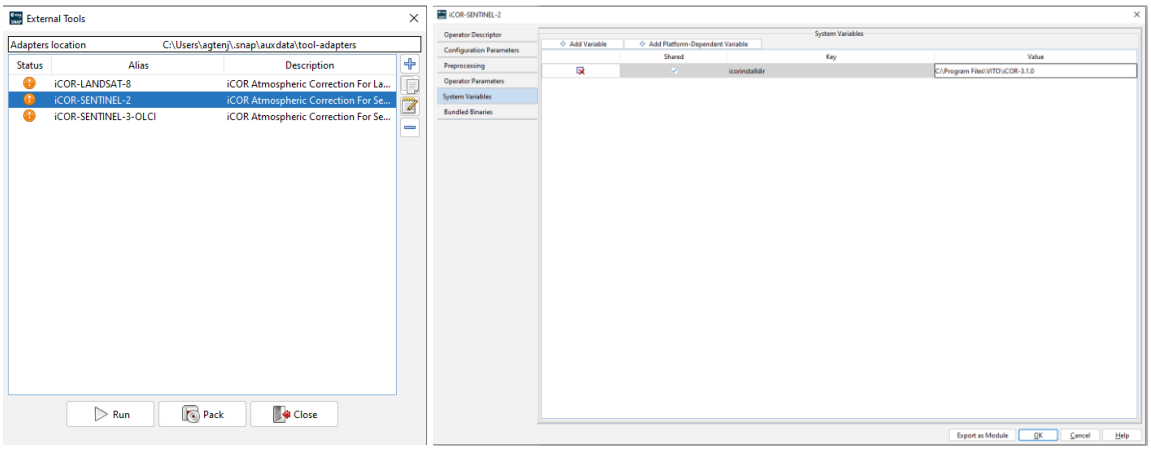
To complete the installation, restart SNAP.

Non default installation path

If you made adaptations to the installation path of one of the software tools (iCOR on Windows by default: C:\Program Files\VITO\iCOR-3.1.0\ non privileged user install by default: C:\Users\<username>\AppData\Local\Programs\VITO\iCOR-3.1.0, on Linux by default: /opt/vito/icor-3.1.0), you will need to adapt the settings through Tools → Manage External Tools. A new window will pop-up where you can highlight which tool you'd like to edit.

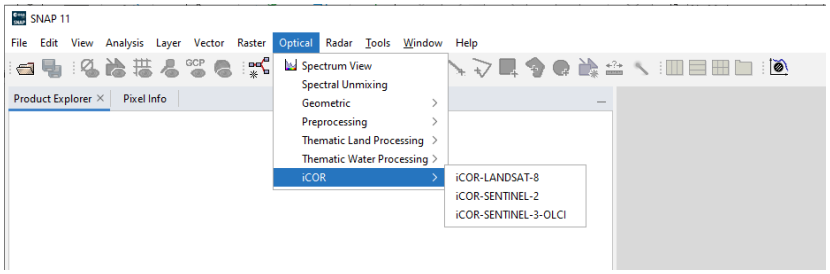
Select "iCOR-SENTINEL-2" and click on the "edit the selected operator" button.

Navigate to System Variables and adapt the value of "icorinstalldir".



3. Processors

When the plugin is loaded in SNAP, the tool can be accessed through Optical → iCOR. There are two versions: one for processing Landsat-8 (iCOR-L8) and one for Sentinel-2 (iCOR-S2) data. The set-up of both versions is similar, therefore they will be handled simultaneously in the next paragraphs.



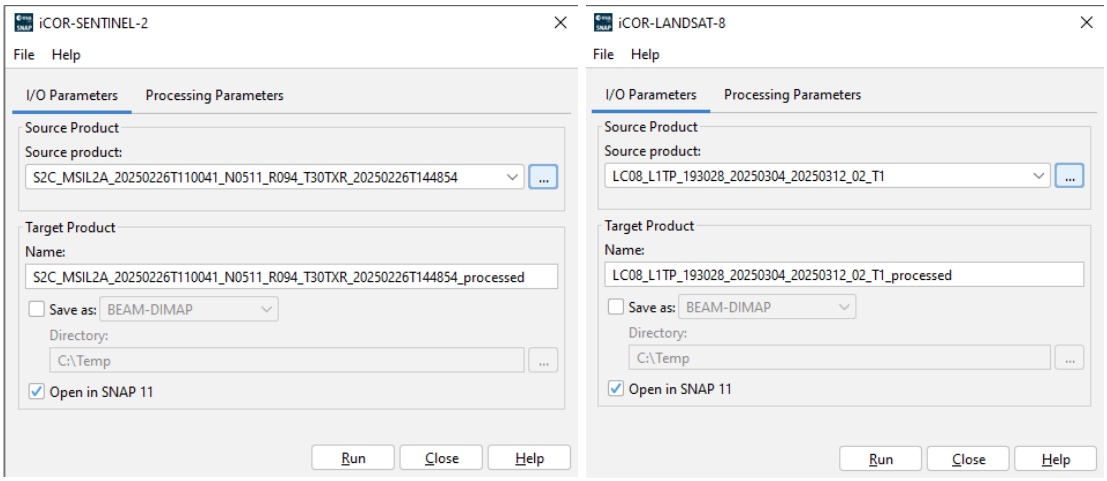
3.1. I/O parameters

The **source product** refers to the file containing the metadata of the in the **unzipped** satellite data (Please note that iCOR doesn't work with zipped files) i.e. :

- Landsat-8: *_MTL.txt
- Sentinel-2 : MTD_MSIL1C found in the *.SAFE folder

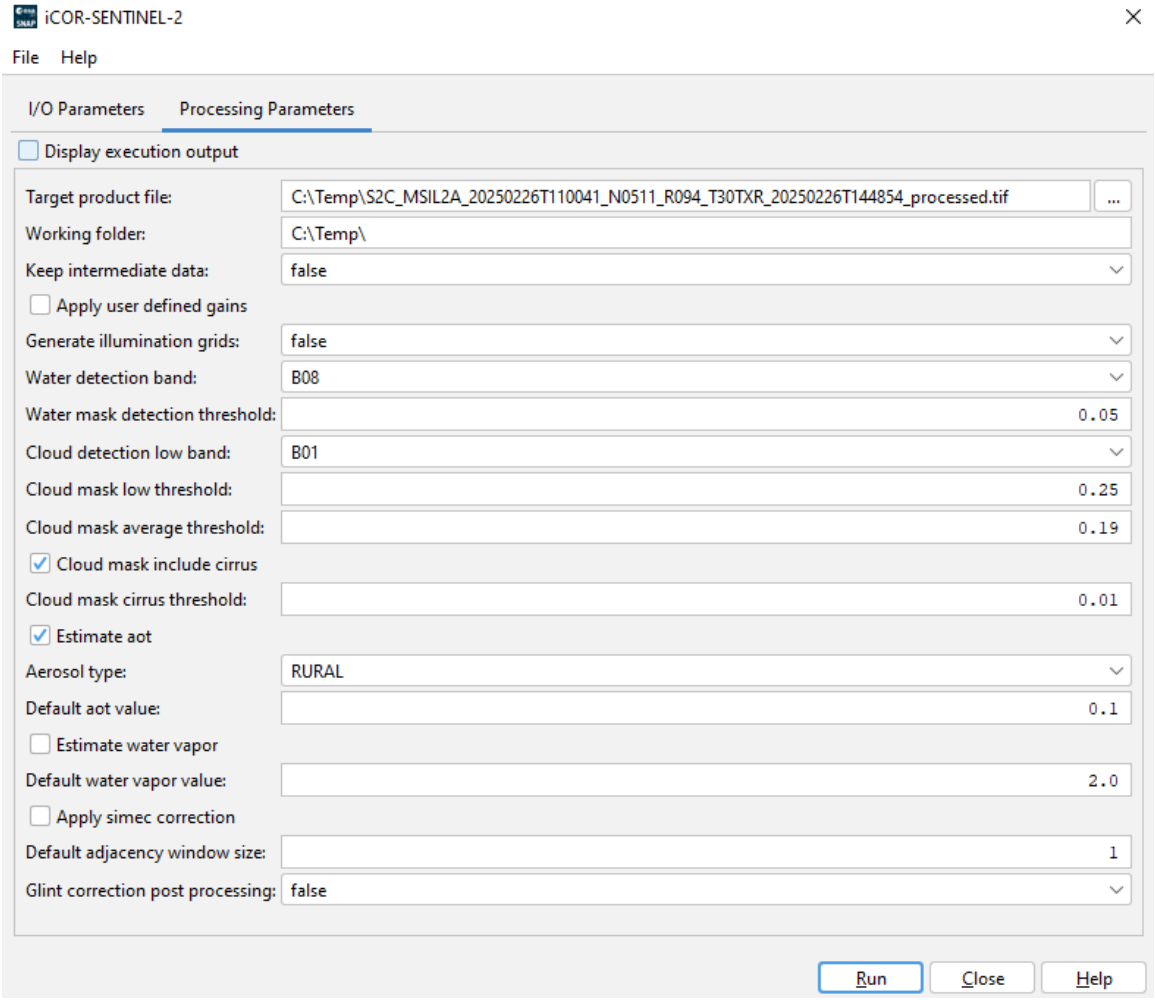
Target product refers to the name of the output product as it will appear in SNAP. You can also choose to save the output file as a BEAM-DIMAP format as well , and to open the result immediately in SNAP or not.

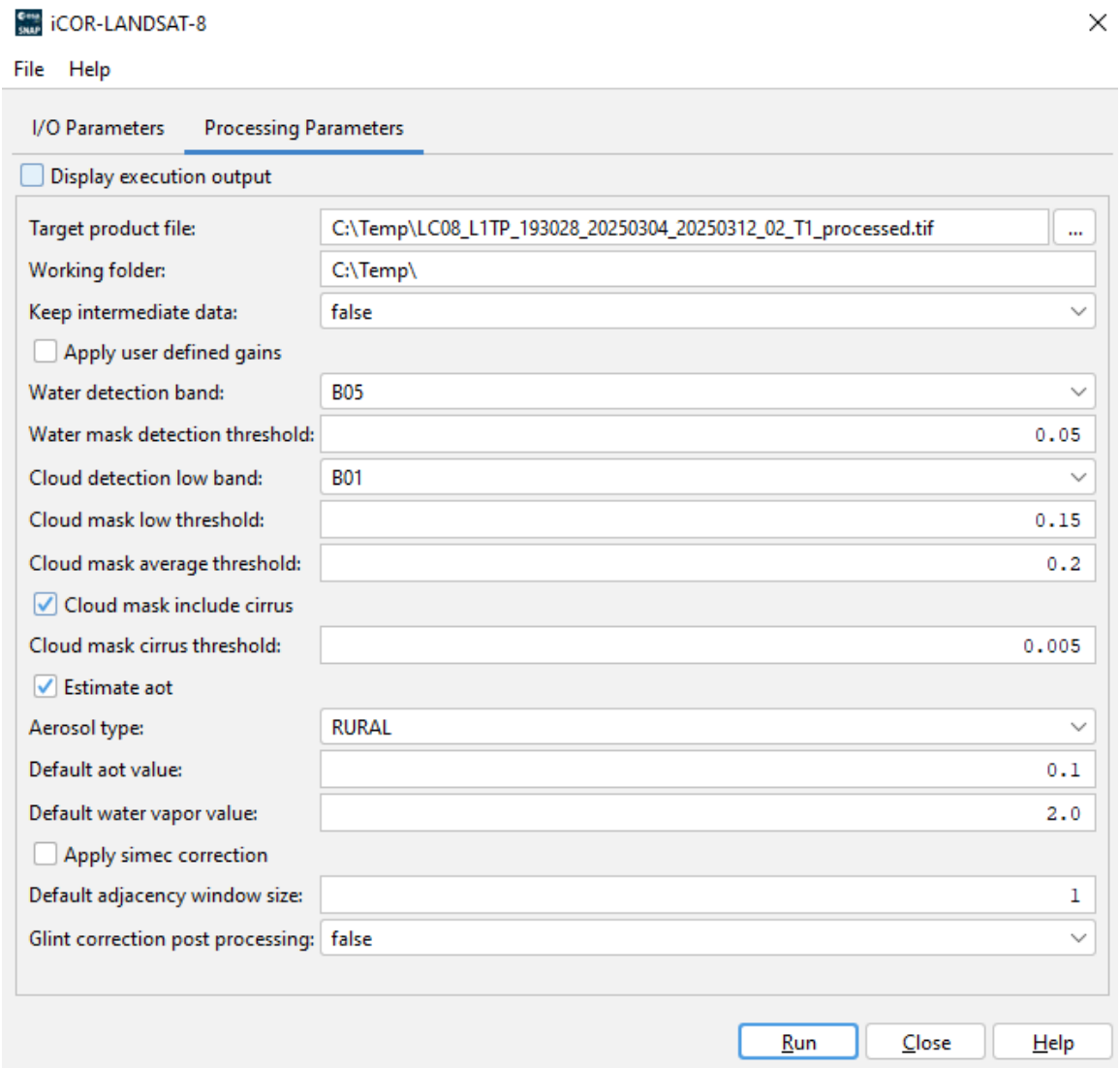
Note for Sentinel-2 the DIMAP output is only provided for the 60 m output i.e. the reflectance of all bands (except B9 and B10) at 60 m resolution.



3.2. Processing parameters

In the second tab Processing Parameters, you can play and adapt the default parameters.


iCOR-SENTINEL-2
File
Help
I/O Parameters
Processing Parameters
Display execution output
Target product file:
C:\Temp\S2C_MSIL2A_20250226T110041_N0511_R094_T30TXR_20250226T144854_processed.tif
...
Working folder:
C:\Temp\
Keep intermediate data:
false
Apply user defined gains
Generate illumination grids:
false
Water detection band:
B08
Water mask detection threshold:
0.05
Cloud detection low band:
B01
Cloud mask low threshold:
0.25
Cloud mask average threshold:
0.19
Cloud mask include cirrus
Cloud mask cirrus threshold:
0.01
Estimate aot
Aerosol type:
RURAL
Default aot value:
0.1
Estimate water vapor
Default water vapor value:
2.0
Apply simec correction
Default adjacency window size:
1
Glint correction post processing:
false
Run
Close
Help


iCOR-LANDSAT-8
File
Help
I/O Parameters
Processing Parameters
Display execution output
Target product file:
C:\Temp\LC08_L1TP_193028_20250304_20250312_02_T1_processed.tif
...
Working folder:
C:\Temp\
Keep intermediate data:
false
Apply user defined gains
Water detection band:
B05
Water mask detection threshold:
0.05
Cloud detection low band:
B01
Cloud mask low threshold:
0.15
Cloud mask average threshold:
0.2
Cloud mask include cirrus
Cloud mask cirrus threshold:
0.005
Estimate aot
Aerosol type:
RURAL
Default aot value:
0.1
Default water vapor value:
2.0
Apply simec correction
Default adjacency window size:
1
Glint correction post processing:
false
Run
Close
Help

3.3. Default processing parameters

This table lists the default processing parameters. Users need to update these parameters depending on their needs. For example for water application it is highly recommended to select SIMEC adjacency correction and the glint correction.

ID	Parameter	Landsat-8	Sentinel-2
1	Display execution output	unchecked	unchecked
2	Target product file	C:\Temp\LC8*processed.tif	C:\TEMP\S2A*_processed.tif
3	Working folder	C:\Temp\	C:\Temp\
4	Keep Intermediate Data	false	false
5	Apply user defined gains	unchecked	unchecked
6	Generate illumination grids	NA	false
7.1	Water detection band	B05	B08
7.2	Water mask detection threshold	0.05	0.05
8.1	Cloud detection low band	B01	B01
8.2	Cloud mask low threshold	0.15	0.25
8.3	Cloud mask average threshold	0.2	0.19
8.4	Cloud mask include cirrus	Checked	checked
8.5	Cloud mask cirrus threshold	0.005	0.01
9.1	Estimate AOT	checked	checked
9.2	Aerosol type	Rural	rural
9.3	Default AOT value	0.1	0.1
9.4	Estimate water vapor	NA	unchecked
9.5	Default water vapor value	2	2
10.1	Apply simec correction	unchecked	unchecked

10.2	Default Adjacency window size	1	1
11	Glint correction post processing	unchecked	unchecked

3.4. Explanation Processing parameters

1. **Display execution output** It is advised to check this box. When this box is checked, the different steps run through by iCOR are displayed. This helps to check if there was no failure in one of the processing steps. A failure might for instance occur when the image based AOT retrieval was not able to retrieve AOT values from the scene.

2. **Target product file –** Directory & Name of the Geotiff output file

   By clicking on "…" the user can change the output directory and output file name.

   Comment: To deal with the different tiles within a Sentinel-2 image, the final output name for Sentinel-2 will consist of 3 Geotiff products

   Example:

   Target product file = C/TEMP/S2A_MSIL1C_*_processed.tif

   Generated output files:

   - *S2A_MSIL1C_*_processed.tif : includes the reflectance of all bands (except B9 and B10) at 60m resolution*
   - *S2A_MSIL1C_*_processed_10M.tif : includes the reflectance of B02, B03, B04 and B08 at 10m resolution*
   - *S2A_MSIL1C_*_processed_20M.tif : includes the reflectance of B02,B03,B04,B08 at 20m resolution*
   - *S2A_MSIL1C_*_processed_AOT.tif : image retieved AOT values*
   - *S2A_MSIL1C_*_processed_watermask.tif: generated water mask*
   - *S2A_MSIL1C_*_processed_cloudmask.tif: generated cloud mask*

3. **Working folder**

   Folder where the intermediate files are stored. These files are removed when the process has finished unless the "Keep Intermediate Data" box is checked.

4. **Keep Intermediate Data**

By checking this option the intermediate files will not be automatically removed when the process has finished.

Please note that the intermediate data size can exceed 10 GB.

5. Apply user defined gains

When this box is checked the user defined radiometric gains are applied to the at-sensor radiance data prior to the atmospheric correction.

Users can define the gains by modifying the following files:

"C:\Program Files\VITO\iCOR\bin\Sensor_LANDSAT8\l8_svc\L8.csv"

"C:\Program Files\VITO\iCOR\bin\Sensor_Sentinel2\s2_svc\S2A.csv"

"C:\Program Files\VITO\iCOR\bin\Sensor_Sentinel2\s2_svc\S2B.csv"

"C:\Program Files\VITO\iCOR\bin\Sensor_Sentinel2\s2_svc\S2C.csv"

In Sterckx and Wolters (2019) and Bassani and Sterckx (2021) radiometric gains have been derived for respectively land and water scenes.

6. Generate illumination grids

When this option is set to “True” sun-view angle information at pixel level is generated for Sentinel-2 and used in the atmospheric correction. If set to “false” the image averaged sun-view angles are used.
Please note that setting the option to “True” will significantly increase the processing time.

7. Water detection

The water pixels are detected using a threshold value on a single band.

7.1. **Water detection band**– Defies the id of the band used to create a land/water mask.

7.2. **Water detection threshold**– Defines the threshold value. If the value is below the threshold, the pixel is identified as a water pixel, otherwise it is a land pixel.

8. Cloud mask

The cloud mask is created using multiple threshold levels. A pixel is identified as a cloud if it fulfils following requirements:

$$TOAreflectance_{\text{Cloud Low BAND ID}} > Threshold_{\text{Cloud Mask Low}} \quad AND$$

$$Average\_TOAreflectance_{VNIRbands} > Threshold_{Cloud\ Mask\ Average}$$

OR if the pixel contains cirrus clouds:

$$TOAreflectance_{cirrusband} > Threshold_{Cloud\ Mask\ Cirrus}$$

As such, the parameters stand for

8.1. **Cloud detection low band** – Band ID used to check the Cloud Mask Low Threshold value.
8.2. **Cloud mask low threshold** Threshold value for the cloud low ID band. If this value is exceeded, one of the requirements of defining a cloud pixel is fulfilled.
8.3. **Cloud mask average threshold** – Threshold value for the average reflectance in the VIS region (0.4 – 0.8 micron, Bands B01 – B04 for Landsat-8 and Bands B01 – B08A for Sentinel-2). If this value is exceeded, one of the requirements of defining a cloud pixel is fulfilled.
8.4. **Cloud mask include cirrus** – If checked, iCOR includes the cirrus band to optimise the cloud mask.
8.5. **Cloud mask cirrus threshold** – This threshold defines a pixel as cirrus cloud when the threshold value is exceeded

9. Aerosol Optical Thickness

In iCOR an adapted version of the land based AOT retrieval technique described by Guanter et al. (2005b) is implemented. This AOT retrieval algorithm makes use of the spectral variability of the land pixels within the image.

9.1. Estimate AOT – Checking this box enables the image based AOT retrieval

9.2. Aerosol type – you can choose between rural and desert aerosol

9.3. Default AOT value – If you know the AOT value, you can choose to uncheck the Estimate Aerosol Optical Thickness retrieval and insert the value.

WARNING: The image based AOT retrieval requires the presence of land pixel and sufficient spectral variability in the scene. The image-based AOT retrieval might fail if scene is dominated by for instance water, clouds, deserts or snow. In this case a failure message is given in the execution window when the “display execution output” is checked. In this case the user has to uncheck the “Estimate AOT” (by unchecking the box) and insert of fixed value in “Default AOT value” box.

10. Water vapor

10.1. **Estimate water vapor** This option is only available for Sentinel-2. If this option is checked ICOR retrieves the water vapor per pixel from the image itself

10.2. **Default water vapor value** The Columnar Water Vapour content of the atmosphere, currently only the default value of 2 is available

11. Adjacency correction

The spectra of a target pixel can be contaminated by light originating from surrounding pixels and atmospherically scattered into the target-sensor path, called adjacency effect (R. Richter et al., 2006; Vermote et al., 1997). As a consequence, the overall apparent surface contrast decreases as bright pixels will be darkened and dark pixels brightened. iCOR contains a module which can correct for these artefacts. For land, adjacency corrections will be applied over a fixed range, while over water SIMEC is implemented (SIMilarity Environmental Correction (SIMEC), Sterckx et al., 2014)**.**

11.1. **Apply Simec correction** – If checked the SIMEC adjacency correction will be applied over water bodies.

11.2. **Default Adjacency window size** – Over land, instead of SIMEC, adjacency effects will be corrected using a fixed range. The extent of this range is given by the value defined in this default adjacency window. The units are number of pixels (N). The weighted average within the NxN box is considered for the adjacency correction. When N is set to 1, no adjacency correction is applied over land.

12. **Glint correction post processing** It is highly recommended to check this box if you are using the images for water-related applications**.**

To deal with uncertainties in the Fresnel correction, mainly related to glint and haze effects, the minimum value of the water leaving reflectance within bands [B04,B05,B06,B07] of Landsat-8 and bands [B04,B05,B06,B07,B08,B8A,B11,B12] of Sentinel-2 is calculated for each water pixel, this value is subtracted from the retrieved water leaving reflectance values of all spectral bands.

3.5. Output

The generated output contains Bottom-Of-Atmospheric (BOA) reflectance, which are above water water-leaving-reflectance.

For Landsat-8 one output file is created with a spatial resolution of 30 m.

Band 1 = Coastal aerosol	0.43 to 0.45
Band 2 = Blue	0.45 to 0.51
Band 3 = Green	0.53 to 0.59
Band 4 = Red	0.64 to 0.67
Band 5 = Near Infrared (NIR)	0.85 to 0.88
Band 6 = SWIR 1	1.57 to 1.65
Band 7 = SWIR 2	2.11 to 2.29

For Sentinel-2, three output files are created for each tile:

- *.tif – containing the reflectance of all bands (except B9 and B10) at 60 m spatial resolution

(0) BAND1 - Aerosols	0.443	60
(1) BAND2 - Blue	0.490	10
(2) BAND3 - Green	0.560	10
(3) BAND4 - Red	0.665	10
(4) BAND5 - narrow1 (red-edge)	0.705	20
(5) BAND6 - narrow2 (red-edge)	0.740	20
(6) BAND7 - narrow3 (red-edge)	0.783	20
(7) BAND8 - NIR	0.842	10
(8) BAND8b- narrow4 (red-edge)	0.865	20
(11)BAND11- SWIR1	1.610	20
(12)BAND12- SWIR2	2.190	20

- *_20M.tif – only bands with original spatial resolution of 20 m

(0)1	B05	705	15	20
(1)2	B06	740	15	20
(2)3	B07	783	20	20
(3)4	B8A	865	20	20
(4)5	B11	1610	90	20
(5)6	B12	2190	180	20

- *_10M.tif – only bands with original spatial resolution of 10 m

(0)1	B02	490	65	10	
(1)2	B03	560	35	10	
(2)3	B04	665	30	10	
(3)4	B08	842	115	10	

3.6. Command line processing

The best way for running iCOR in batch mode is to first run iCOR through the nominal GUI interface with the settings you want to use and to select 'display execution output'.

In the beginning of the output window you get something like:

```
"C:\Program Files\VITO\iCOR-3.1.0\bin\ python-3.12.10-embed-
amd64\python.exe" "C:\Program Files\VITO\iCOR-3.1.0\src\icor.py" --
sensor S2 --generate_viewing_grids_s2 false --glint_cor false --
keep_intermediate false --apply_gains false --cloud_average_threshold
0.19 --cloud_low_band B01 --cloud_low_threshold 0.25 --cirrus true --
aot false --aerosol_type RURAL --aot_window_size 100 --simec false --
watervapor false --bg_window 1 --cirrus_threshold 0.01 --aot_override
0.1 --ozone_override 0.33 --wv_override 2.0 --water_band B08 --
water_threshold 0.05 --working_folder C:\Temp\ --output_file
C:\Temp\S2C_MSIL1C_20250226T110041_N0511_R094_T30TXR_20250226T130034_pr
ocessed.tif
C:\dev\vito\S2C_MSIL1C_20250226T110041_N0511_R094_T30TXR_20250226T13003
4.SAFE\MTD_MSIL1C.xml
```

You can reuse this line and change the input and output files to run iCOR in batch mode.

Windows:

```
[icor_dir]\icor.bat --sensor S2 --generate_viewing_grids_s2 false --
glint_cor false --keep_intermediate false --apply_gains false --
cloud_average_threshold 0.19 --cloud_low_band B01 --cloud_low_threshold
0.25 --cirrus true --aot false --aerosol_type RURAL --aot_window_size
100 --simec false --watervapor false --bg_window 1 --cirrus_threshold
0.01 --aot_override 0.1 --ozone_override 0.33 --wv_override 2.0 --
water_band B08 --water_threshold 0.05 --working_folder C:\Temp\ --
output_file
C:\Temp\S2C_MSIL1C_20250226T110041_N0511_R094_T30TXR_20250226T130034_pr
ocessed.tif
C:\dev\vito\S2C_MSIL1C_20250226T110041_N0511_R094_T30TXR_20250226T13003
4.SAFE\MTD_MSIL1C.xml
```

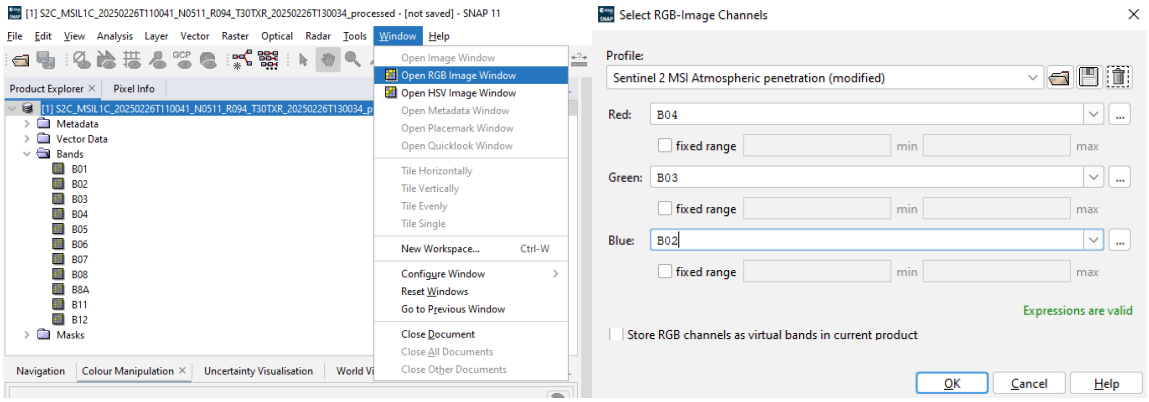
Linux :

```
[icor_dir]/icor.sh --sensor S2 --generate_viewing_grids_s2 false --
glint_cor false --keep_intermediate false --apply_gains false --
cloud_average_threshold 0.19 --cloud_low_band B01 --cloud_low_threshold
```

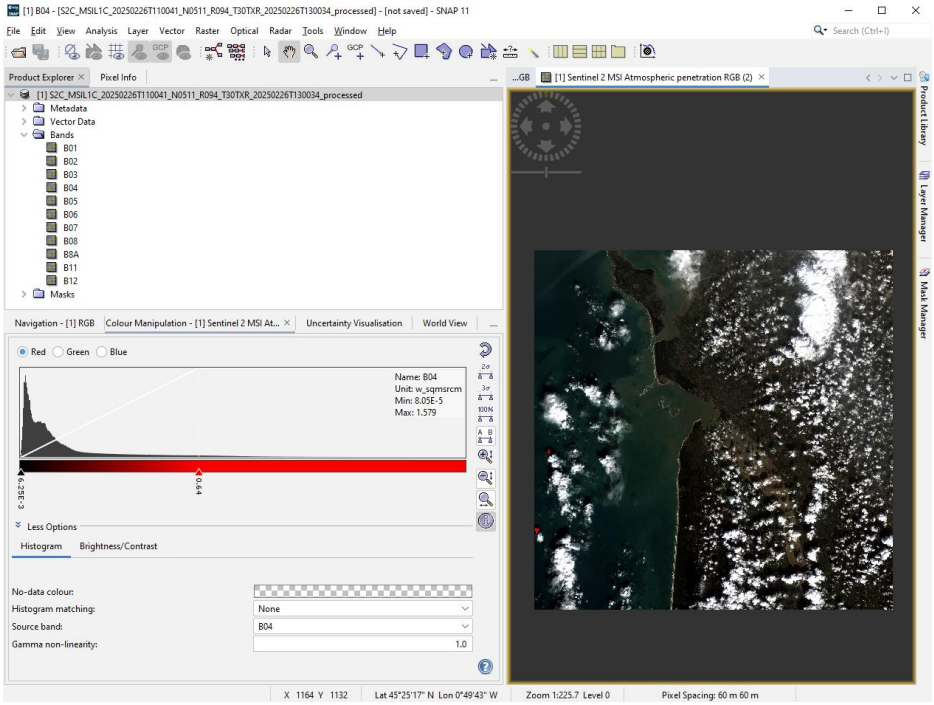
```
0.25 --cirrus true --aot false --aerosol_type RURAL --aot_window_size
100 --simec false --watervapor false --bg_window 1 --cirrus_threshold
0.01 --aot_override 0.1 --ozone_override 0.33 --wv_override 2.0 --
water_band B08 --water_threshold 0.05 --working_folder /tmp/ --
output_file
/tmp/S2C_MSIL1C_20250226T110041_N0511_R094_T30TXR_20250226T130034_proce
ssed.tif
/data/vito/S2C_MSIL1C_20250226T110041_N0511_R094_T30TXR_20250226T130034
.SAFE\MTD_MSIL1C.xml
```

3.7. Visualisation

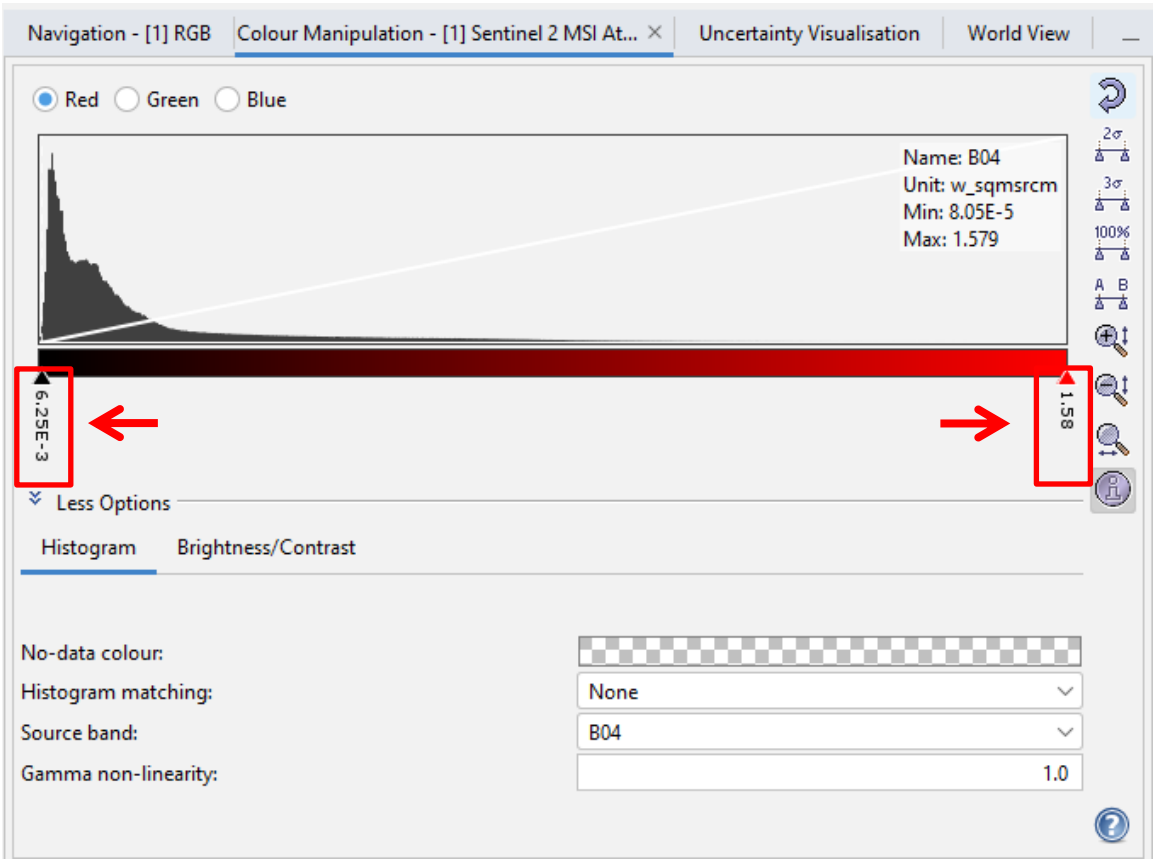
You can now play with the data in SNAP to improve the visualisation: Select the image of interest in the Product explorer, go to the Window tab and select *Open RGB Image window*. A new window will pop-up where you can select the appropriate band settings (A good choice for Landsat-8 and Sentinel-2 is: Red – band_4, Green – band_3, Blue – band_2).

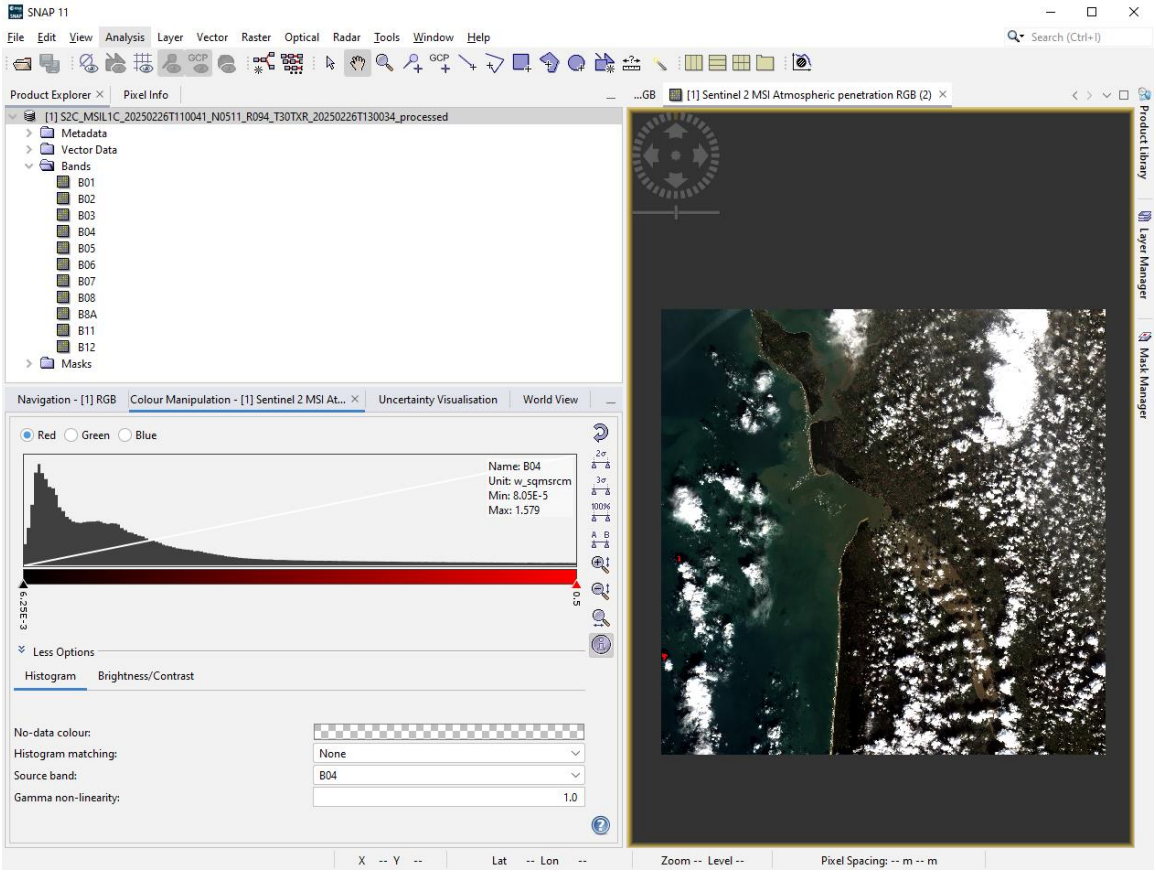


In first instance you might get an image with only black and white colours, since iCOR sets invalid pixels at max float.



To change this, go to the Colour Manipulation window (View → Tools Windows → Colour Manipulation) and change the range of values for the different colour bands (red, green and blue). Double click on the value at the end of the colour bar (highlighted in red in the following figure) and change to more appropriate values (eg. 0 – 0.5). Press enter.




SNAP 11
File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Product Explorer
Pixel Info
[1] S2C_MSIL1C_20250226T110041_N0511_R094_T30TXR_20250226T130034_processed
Metadata
Vector Data
Bands
B01
B02
B03
B04
B05
B06
B07
B08
B8A
B11
B12
Masks
[1] Sentinel 2 MSI Atmospheric penetration RGB (2)
Product Library
Layer Manager
Mask Manager
Navigation - [1] RGB
Colour Manipulation - [1] Sentinel 2 MSI At...
Uncertainty Visualisation
World View
Red
Green
Blue
Name: B04
Unit: w_sqmsrcm
Min: 8.05E-5
Max: 1.579
6.23E-3
0.5
Less Options
Histogram
Brightness/Contrast
No-data colour:
Histogram matching:
None
Source band:
B04
Gamma non-linearity:
1.0
X -- Y --
Lat -- Lon --
Zoom -- Level --
Pixel Spacing: -- m -- m

3.1. Important remarks

The masks generated in iCOR are solely developed to optimize the atmospheric correction and do not guarantee optimal performance in different conditions. iCOR does not mask bad pixels, and it is advised to look at other sources if a proper mask is needed or wanted.

iCOR makes use of spectral diversity in land pixels to derive the AOT and to conduct the atmospheric corrections. As such, there are situations for which iCOR will not perform well, eg. deserts, open oceans (or tiles not including land pixels) or regions fully covered by snow.

3.2. Processing time

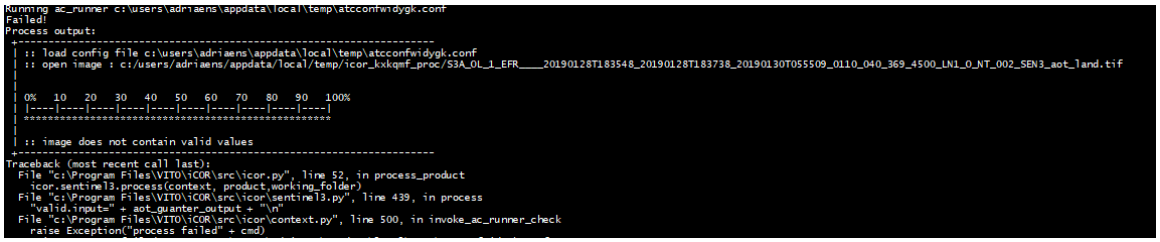
iCOR is a computational intensive tool. Consequently, other programmes might run slow meanwhile and the required time needed to process one image, depending on the size and number of granules, can take a while. For example: one Sentinel-2 granule, without SIMEC adjacency correction, might take half an hour. With SIMEC, the whole process will run even slower.

4. Frequently Asked Questions

4.1. iCOR fails to run

iCOR failure can occur due to different reasons:

- The image-based AOT retrieval might fail if scene is dominated by only water, clouds, deserts or snow. In this case a failure message is given in the execution window when the display execution output is checked. In this case the user has to disable “Estimate AOT from image” (by unchecking the box) and insert of fixed value in ‘AOT override value’ box.

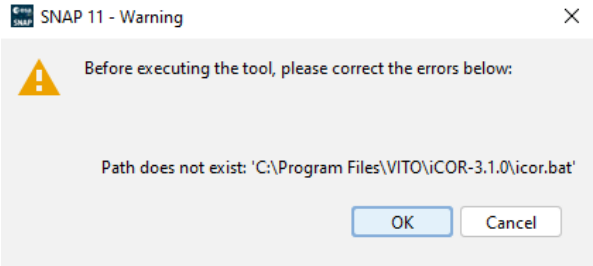


- Paths are not properly defined (See download and installation)

- Not enough disk space available for processing. iCOR generates during processing a lot of intermediate data. It is therefore recommended to have about 20 GB of free disk space for running iCOR.
- When failure has occurred, useful information can be derived. when the 'keep_intermediate' option is selected, it is advisable to clean these temp folders frequently. Intermediate files are stored into the working folder.

4.2. Path does not exist

You get a Warning "Path does not exist".

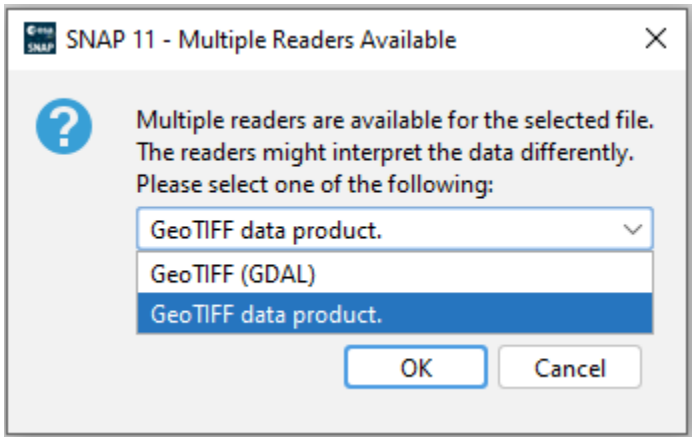


Check Download and Installation especially Non default installation path.

4.3. Seemingly corrupt output in SNAP

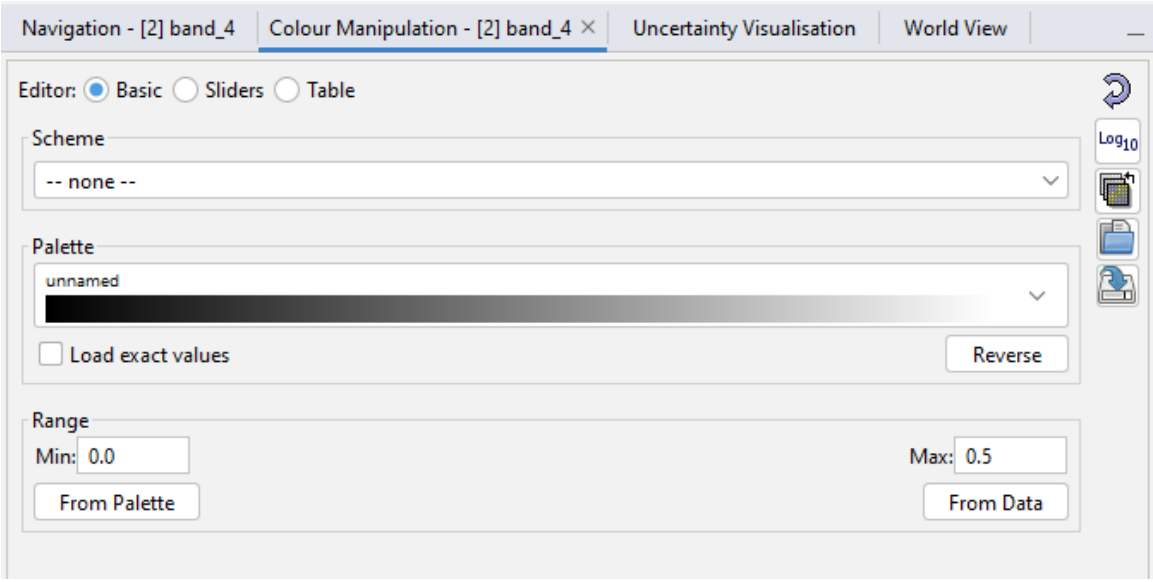
When opening (automatically after processing or manually) the S2*_processed.tif, this can sometimes result in SNAP opening the S2*_processed.tif file with the wrong reader if multiple readers are available.

In that case, close the product and reopen it selecting the "GeoTIFF data product." reader.



4.4. The result image band is all black

In first instance you might get an image with only black and white colours, since iCOR sets invalid pixels at max float. To change this, go to the Colour Manipulation window (View → Tools Windows → Colour Manipulation) and change the range of values. In the Colour Manipulation Window → click on “From Data” → change Max: to a more appropriate value (eg. 0.5) and press ENTER to confirm.



Acknowledgement

The research leading to the development of the iCOR atmospheric correction tool has received funding from the Belgian Science policy through two Stereo projects under contract n° SR/00/003 (BELCOLOUR) and SR/00/104 (BELCOLOUR II), and has been validated in the European Community's Seventh Framework Programme ([FP7/2007-2013]) under grant agreement n° 606865 (INFORM) and n° 606797 (HIGHROC).

The distribution of the iCOR software as a plugin in the SNAP toolbox received funding from the Belgian Science Policy under grant agreement n° SR/67/342 (INOPS-2) and grant contract SR/67/399 (SNAPPI).