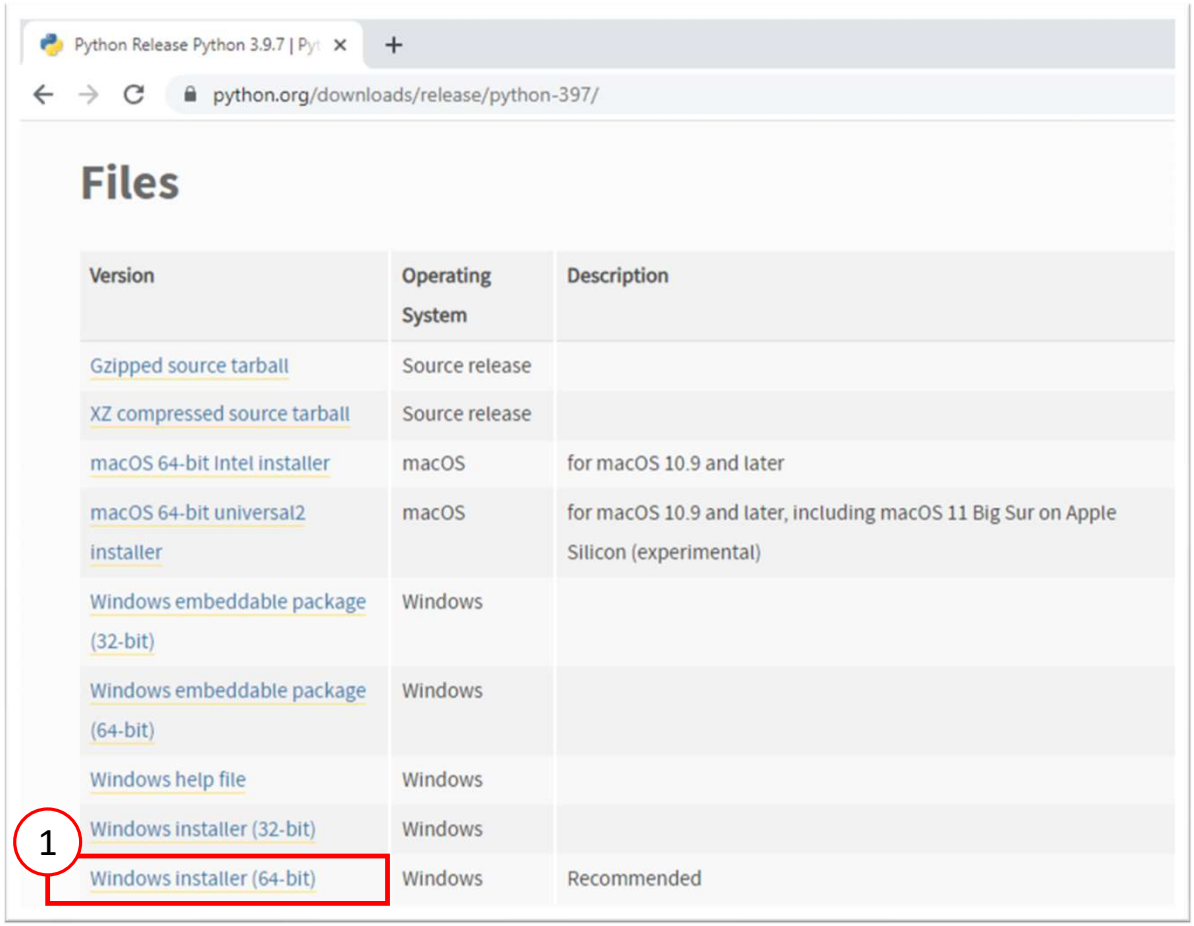
SAETPRO

Shoreline and Analysis Extraction Tool

Installation tutorial (step by step)

1. Install Python versión 3.9.7 from Python.org (https://www.python.org/downloads/release/python-397).

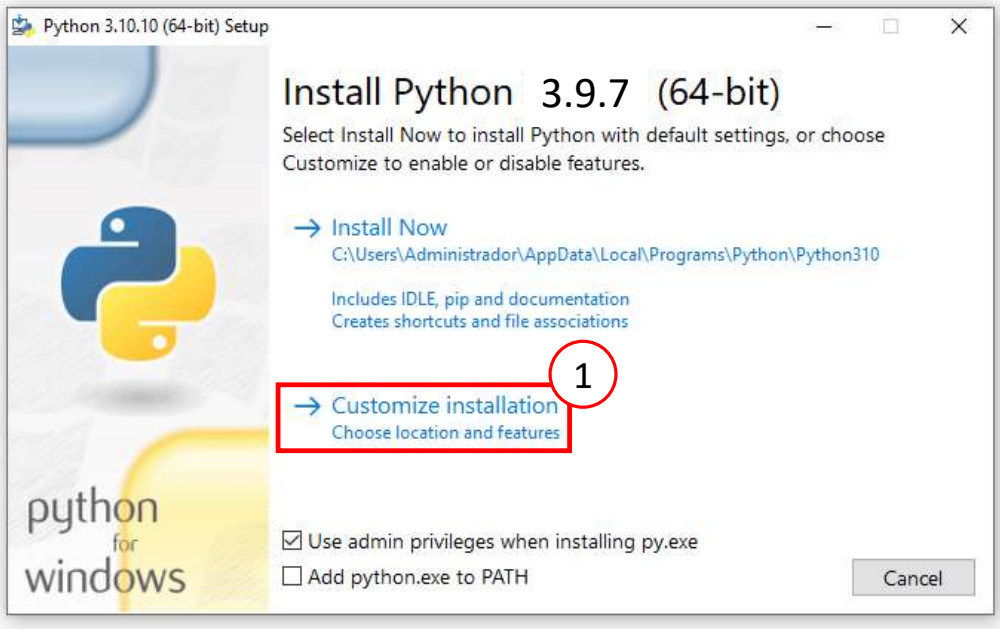
1 Version Windows 64 bits is recommended.

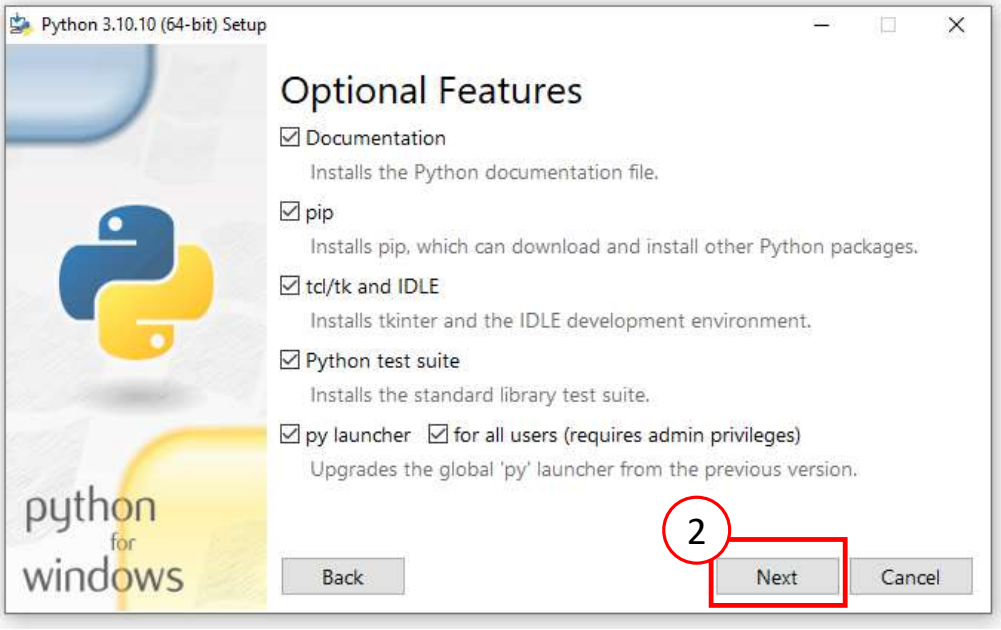


1. Install Python versión 3.9.7. Execute the installation file

1 Choose “Customize installation” to install Python in the folder specified by the user (for example: c:\python397_64.

2 Click on “next”.

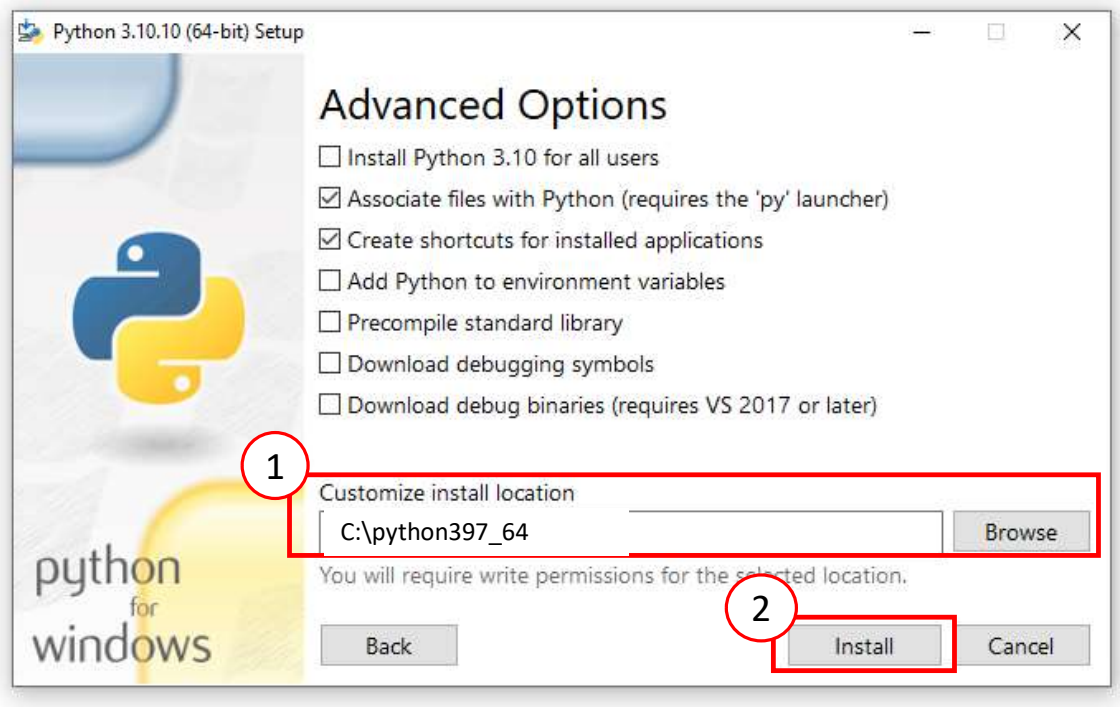




1. Install Python versión 3.9.7.

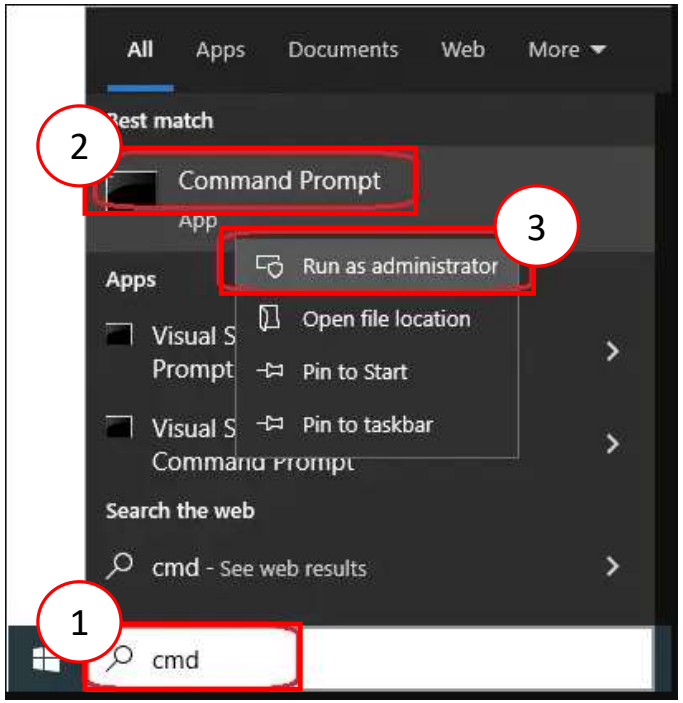
(1) Choose “Customize installation” to install Python in the folder specified by the user (for example: c:\python397_64)

(2) Click on “install”



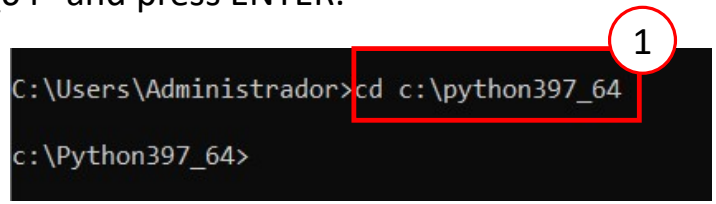
2. Run the command prompt.

1. Type “cmd” in the search bar of Windows
2. Right-click on the “Command prompt” icon
3. Select “Run as administrator”

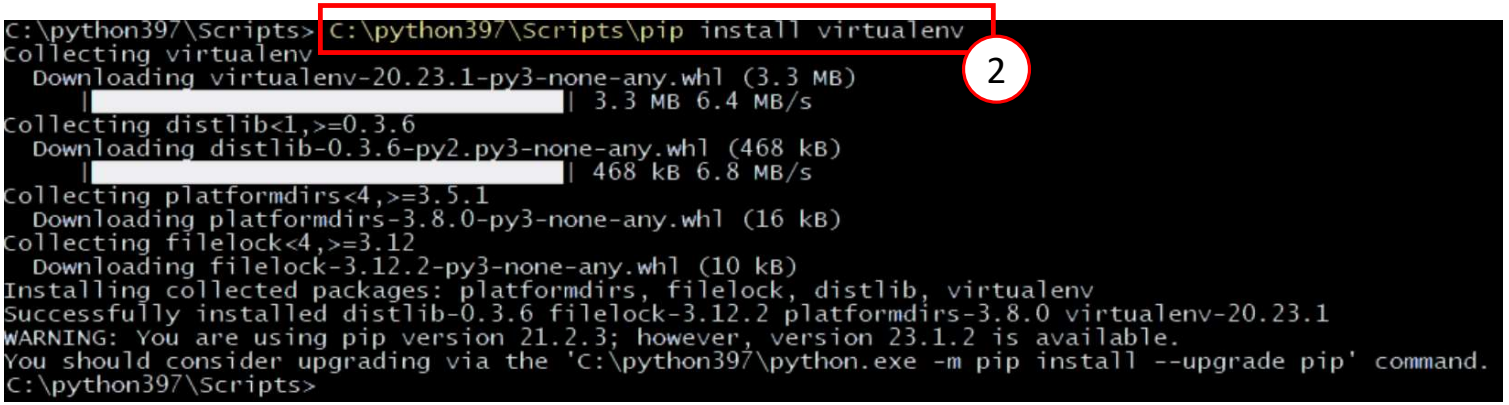


3. Go to the cmd window and change the current folder to the Python installation folder.

1 Type “cd c:\python397_64” and press ENTER.

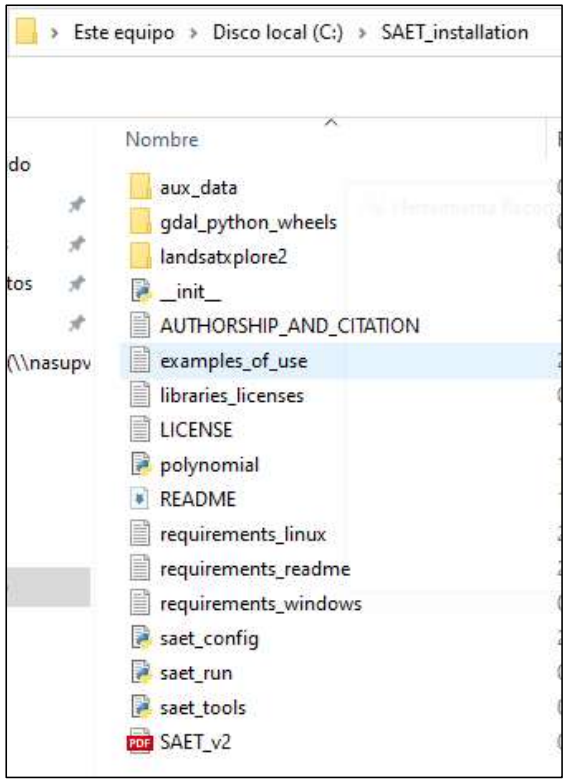


2 Install the library “virtualenv” by typing: “c:\python397_64\Scripts\pip install virtualenv”



5. Create a new folder for SAET (for example SAET_installation) and copy all files to this folder.

6. In the cmd window, change the current folder to the SAET installation folder: type “cd c:\SAET_installation”



7. Create a new virtual environment (VE) called “saet_env”. This will create a new folder called “saet_env” inside the SAET installation folder. Type “c:\python397_64\Scripts\virtualenv saet_env”.

```
C:\SAET_installation>C:\Python397_64\scripts\virtualenv saet_env
created virtual environment CPython3.9.7.final.0-64 in 1283ms
  creator CPython3Windows(dest=C:\SAET_installation\saet_env, clear=False, no_vcs_ignore=False, global=False)
  seeder FromAppData(download=False, pip=bundle, setuptools=bundle, wheel=bundle, via=copy, app_data_dir=C:\Users\[redacted]\AppData\Local\pypa\virtualenv)
    added seed packages: pip==22.3, setuptools==65.5.0, wheel==0.37.1
  activators BashActivator,BatchActivator,FishActivator,NushellActivator,PowerShellActivator,PythonActivator

C:\SAET_installation>
```

8. Check your current versión of Python by typing “python“. Ensure your active versión is 3.9.7 (64 bits). Type “quit()” to close python. Type “saet_env\Scripts\activate” (1) to actívate VE called “saet_env”. The pront will change like that: “(saet_env) c:\SAET_installation”. This “(saet_env)” means that your VE is active. If you want to deactivate your VE, type “saet_env\Scripts\deactivate” (2).

```
C:\SAET_installation>saet_env\scripts\activate

(saet_env) C:\SAET_installation>
```

1

```
(saet_env) C:\SAET_installation>saet_env\scripts\deactivate
C:\SAET_installation>
```

2

Optional but very useful. Batch file creation to open the command prompt window with the virtual environment activated
If you don't want to repeat the step VE activation every time you want to run SAET, do the next:

1. Open a new text file.
2. Type the next sentences and save the file as bat (for example"saet_env_activation.bat"). Be careful to change the name of your SAET installation forlder and the name of your VE if needed.

```
@echo off
start "" cmd /k "cd /d C:\saet_installation && call saet_env\Scripts\activate.bat"
```

3. Run the batch file (saet_env_activation.bat) by double-clicking on it.

9. Install the required libraries for SAET. Being the VE “saet_env” active, type “pip install -r requirements_windows.txt”.

```
(saet_env) C:\SAET_installation>pip install -r requirements_windows.txt
Processing c:\saet_installation\gdal_python_wheels\gdal-3.3.3-cp39-cp39-win_amd64.whl
Collecting python-dateutil==2.8.2
  Using cached python_dateutil-2.8.2-py2.py3-none-any.whl (247 kB)
Collecting numpy==1.21.2
  Using cached numpy-1.21.2-cp39-cp39-win_amd64.whl (14.0 MB)
Collecting matplotlib==3.4.3
  Using cached matplotlib-3.4.3-cp39-cp39-win_amd64.whl (7.1 MB)
Collecting Shapely==1.7.1
  Using cached Shapely-1.7.1-cp39-cp39-win_amd64.whl (978 kB)
Collecting pyshp==2.1.3
  Using cached pyshp-2.1.3.tar.gz (219 kB)
  Preparing metadata (setup.py) ... done
Collecting scikit-image==0.18.3
  Using cached scikit_image-0.18.3-cp39-cp39-win_amd64.whl (12.2 MB)
Collecting scikit-learn==1.0.2
  Using cached scikit_learn-1.0.2-cp39-cp39-win_amd64.whl (7.2 MB)
Collecting scipy==1.7.1
  Using cached scipy-1.7.1-cp39-cp39-win_amd64.whl (33.8 MB)
Collecting networkx==2.6.2
  Using cached networkx-2.6.2-py3-none-any.whl (1.9 MB)
Collecting six>=1.5
  Using cached six-1.16.0-py2.py3-none-any.whl (11 kB)
Collecting pyparsing>=2.2.1
  Downloading pyparsing-3.1.1-py3-none-any.whl (103 kB)
     ---------------------------------------- 103.1/103.1 kB 6.2 MB/s eta 0:00:00
Collecting cycler>=0.10
  Downloading cycler-0.12.1-py3-none-any.whl (8.3 kB)
Collecting kiwisolver>=1.0.1
  Downloading kiwisolver-1.4.5-cp39-cp39-win_amd64.whl (56 kB)
     ---------------------------------------- 56.2/56.2 kB ? eta 0:00:00
Collecting pillow>=6.2.0
  Downloading Pillow-10.1.0-cp39-cp39-win_amd64.whl (2.6 MB)
     ---------------------------------------- 2.6/2.6 MB 16.6 MB/s eta 0:00:00
Collecting tifffile>=2019.7.26
  Downloading tifffile-2023.9.26-py3-none-any.whl (222 kB)
     ---------------------------------------- 222.9/222.9 kB 13.3 MB/s eta 0:00:00
Collecting imageio>=2.3.0
  Downloading imageio-2.31.6-py3-none-any.whl (313 kB)
     ---------------------------------------- 313.2/313.2 kB ? eta 0:00:00
Collecting PyWavelets>=1.1.1
  Using cached PyWavelets-1.4.1-cp39-cp39-win_amd64.whl (4.2 MB)
Collecting threadpoolctl>=2.0.0
  Downloading threadpoolctl-3.2.0-py3-none-any.whl (15 kB)
Collecting joblib>=0.11
  Downloading joblib-1.3.2-py3-none-any.whl (302 kB)
     ---------------------------------------- 302.2/302.2 kB 19.5 MB/s eta 0:00:00
Collecting pillow>=6.2.0
  Downloading Pillow-10.0.1-cp39-cp39-win_amd64.whl (2.5 MB)
```

10. Check SAET by typing “python sp_searching_run.py --h"

```
(saet_env) C:\SAET_installation>python sp_searching_run.py --h
usage: sp_searching_run.py [-h] --fp FP --sd SD --cd CD --ed ED [--mc [0-100]] --lp {landsat_ot_c2_l1,landsat_ot_c2_l2,NONE} --ll LL --sp {S2MSI1C,S2MSI2A,NONE} --sl SL [--so [0-1]]

optional arguments:
  -h, --help            show this help message and exit
  --fp FP               Coordinates long/lat in these formats: (POINT) fp=long,lat; (AOI) fp=min_long,min_lat,max_long,max_lat. Default: NONE
  --sd SD               Start date for searching scenes (YYYYMMDD). --sd=20210101. Default:20200101
  --cd CD               Central date for storm (YYYYMMDD). --sd=20210101. Default:20200102
  --ed ED               End date for searching scenes (YYYYMMDD). --sd=20210101. Default:20200103
  --mc [0-100]          maximum cloud coverture for the whole scene [0-100]. --mc=10. Default 100
  --lp {landsat_ot_c2_l1,landsat_ot_c2_l2,NONE}
                        Landsat 8 product type. landsat_ot_c2_l1 or landsat_ot_c2_l2 or NONE. Default: landsat_ot_c2_l1
  --ll LL               List of scenes for Landsat 8 (number of 6 digits). --ll=198032,199031. Default: NONE
  --sp {S2MSI1C,S2MSI2A,NONE}
                        Sentinel 2 product type (S2MSI1C / S2MSI2A). --s2=S2MSI1C / --s2=S2MSI2A / NONE. Default: S2MSI1C
  --sl SL               List of scenes for Sentinel 2 (string of 5 characters). --sl=31TCF,30TYK. Default: NONE
  --so [0-1]            Exclude images with NO DATA values [0-1]. --so=1. Default: 1

(saet_env) C:\SAET_installation>
```

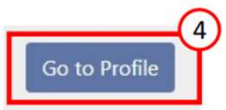
Very important. Before running SAET you must change your credentials (user, password) for the two servers (USGS and ESA-copernicus). Open the file "sp_config.py" and replace the sterisk symbols with your credentials.

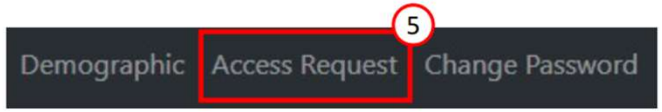
```
os.environ['USER_ESA'] = os.getenv('USER_ESA', '********')
os.environ['PASS_ESA'] = os.getenv('PASS_ESA', '********')
os.environ['USER_USGS'] = os.getenv('USER_USGS', '********')
os.environ['PASS_USGS'] = os.getenv('PASS_USGS', '********')
```

(1) Credentials for Copernicus Space Data Ecosystem: go to the website of Copernicus Space Data Ecosystem and register on the next website: https://dataspace.copernicus.eu/.
Once you have registered correctly, you will be able to access the Copernicus browser https://dataspace.copernicus.eu/browser with your new credentials.

(2) Credentials for USGS Landsat Explorer service: In this case, you need to do two things: register on the Landsat Explorer website and make a request to access the service "machine to machine" (m2m).

For the first requirement, you must register on the website https://ers.cr.usgs.gov/register. Once you have your credentials, access the website https://earthexplorer.usgs.gov, and go to your profile settings. (3) Click on the button "Go to Profile" (4) and finally, on the option "Access Request". (5) There you can make a new request to the m2m service by filling out a form.





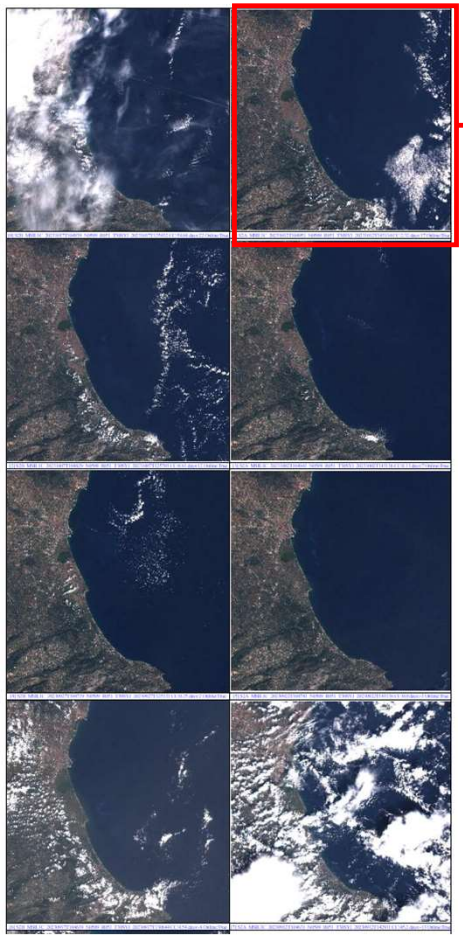
10. In the file “examples_of_use.txt” you can find some examples to test SAET for different proposals. For example, with this sentence

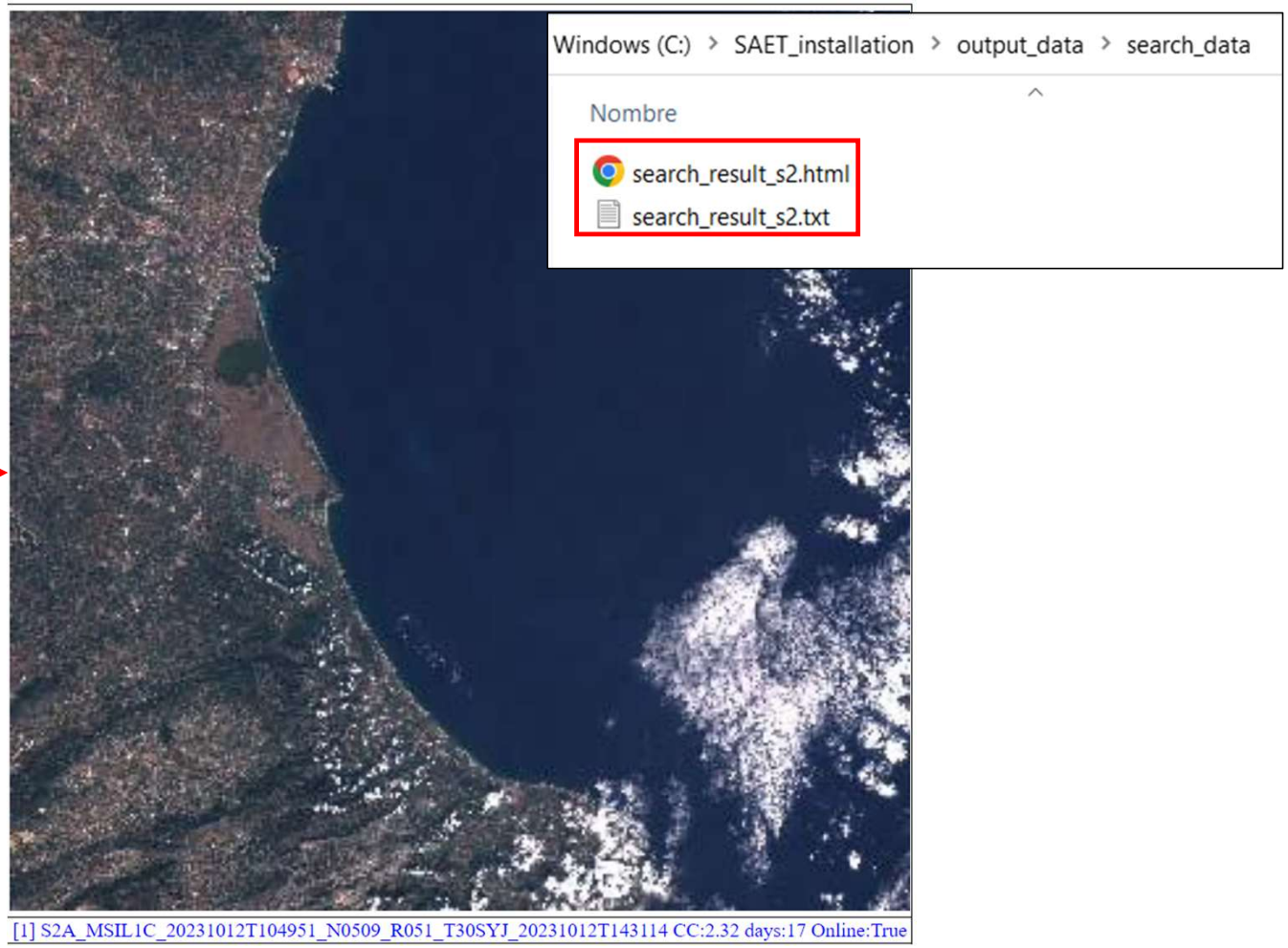
python sp_searching_run.py --fp=NONE --sd=20230901 --cd=20230925 --ed=20231025 --mc=30 --lp=NONE --ll=NONE --sp=S2MSI1C --sl=30SYJ

we are searching for Sentinel-2 (level 1C) images between 2023/09/01 and 2023/10/25 arround the date of análisis (2023/09/25), with les than 70% of cloud coverage. The result offers an ordered-by-date list of images displaying a basic information for each found producto (id, cloud coverage and difference of days between the date of any image and the central date).

```
(saet_env) C:\SAET_installation>python sp_searching_run.py --fp=NONE --sd=20230901 --cd=20230925 --ed=20231025 --mc=70 --lp=NONE --ll=NONE --sp=S2MSI1C --sl=30SYJ
2023-11-02 17:35:00,857 INFO Starting searching SAET_pro algorithm...

[0] Scene: S2B_MSIL1C_20231017T104939_N0509_R051_T30SYJ_20231017T125432 Cloud coverage: 54.04% 22 days
[1] Scene: S2A_MSIL1C_20231012T104951_N0509_R051_T30SYJ_20231012T143114 Cloud coverage: 2.32% 17 days
[2] Scene: S2B_MSIL1C_20231007T104829_N0509_R051_T30SYJ_20231007T125703 Cloud coverage: 0.81% 12 days
[3] Scene: S2A_MSIL1C_20231002T104841_N0509_R051_T30SYJ_20231002T143136 Cloud coverage: 0.13% 7 days
[4] Scene: S2B_MSIL1C_20230927T104719_N0509_R051_T30SYJ_20230927T125131 Cloud coverage: 0.25% 2 days
[*******] Central date:20230925
[5] Scene: S2A_MSIL1C_20230922T104741_N0509_R051_T30SYJ_20230922T143138 Cloud coverage: 0.0% -3 days
[6] Scene: S2B_MSIL1C_20230917T104639_N0509_R051_T30SYJ_20230917T130644 Cloud coverage: 4.54% -8 days
[7] Scene: S2A_MSIL1C_20230912T104631_N0509_R051_T30SYJ_20230912T142911 Cloud coverage: 45.2% -13 days
[8] Scene: S2B_MSIL1C_20230907T104629_N0509_R051_T30SYJ_20230907T143242 Cloud coverage: 17.92% -18 days


2023-11-02 17:35:02,965 INFO SAET_pro searching algorithm have finished successfully.


(saet_env) C:\SAET_installation>
```

10. Along with the results in the terminal, an html file called “search_result.html” is opened automatically, showing the quicklooks for each product. In the same way, an txt file called “search_result_s2.txt” is created. This last file contains the metadata for all found images. This information Will be used in the downloading process.



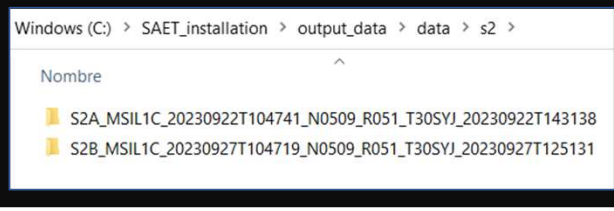


11. Check the downloading parameters by typing “python sp_downloading_run.py --h"

```
(saet_env) C:\SAET_installation>python sp_downloading_run.py --h
usage: sp_downloading_run.py [-h] --sp {s,l}

optional arguments:
  -h, --help  show this help message and exit
  --sp {s,l}  s -> Sentinel-2; l -> Landsat 8-9. Default: s

(saet_env) C:\SAET_installation>
```

12. Download an image. For example, after the step 10, we are going to download the S2 products 4 and 5, the closest products around the central date.

```
(saet_env) C:\SAET_installation>python sp_downloading_run.py --sp=s
2023-11-02 18:03:15,642 INFO Starting downloading SAET_pro algorithm...

[0] Scene: S2B_MSIL1C_20231017T104939_N0509_R051_T30SYJ_20231017T125432.SAFE Cloud coverage: 54.0362507091881 22 days
[1] Scene: S2A_MSIL1C_20231012T104951_N0509_R051_T30SYJ_20231012T143114.SAFE Cloud coverage: 2.32213562662367 17 days
[2] Scene: S2B_MSIL1C_20231007T104829_N0509_R051_T30SYJ_20231007T125703.SAFE Cloud coverage: 0.8123562960972261 12 days
[3] Scene: S2A_MSIL1C_20231002T104841_N0509_R051_T30SYJ_20231002T143136.SAFE Cloud coverage: 0.126250410582579 7 days
[4] Scene: S2B_MSIL1C_20230927T104719_N0509_R051_T30SYJ_20230927T125131.SAFE Cloud coverage: 0.252142494550449 2 days
[5] Scene: S2A_MSIL1C_20230922T104741_N0509_R051_T30SYJ_20230922T143138.SAFE Cloud coverage: 0.0 -3 days
[6] Scene: S2B_MSIL1C_20230917T104639_N0509_R051_T30SYJ_20230917T130644.SAFE Cloud coverage: 4.54155095703067 -8 days
[7] Scene: S2A_MSIL1C_20230912T104631_N0509_R051_T30SYJ_20230912T142911.SAFE Cloud coverage: 45.1963032637583 -13 days
[8] Scene: S2B_MSIL1C_20230907T104629_N0509_R051_T30SYJ_20230907T143242.SAFE Cloud coverage: 17.9243930842963 -18 days

Number of images to be downloaded (* / 0,2,3 / [2-5])?: 4,5
Downloading S2B_MSIL1C_20230927T104719_N0509_R051_T30SYJ_20230927T125131.zip: 100%|
Downloading S2A_MSIL1C_20230922T104741_N0509_R051_T30SYJ_20230922T143138.zip: 100%|


2023-11-02 18:05:33,432 INFO SAET_pro downloading algorithm have finished successfully.


(saet_env) C:\SAET_installation>
```



13. Check the processing parameters by typing “python sp_processing_run.py --h"

```
(saet_env) C:\SAET_installation>python sp_processing_run.py --h
usage: sp_processing_run.py [-h] [--wi {aweish,aweinsh,mndwi,kmeans}] [--th {0,1,2}] [--mm {erosion,dilation}] [--cl {0,1,2}] [--ks {3,5}] [--bc BC]

optional arguments:
  -h, --help            show this help message and exit
  --wi {aweish,aweinsh,mndwi,kmeans}
                        Water index type (aweish, aweinsh,mndwi,kmeans). --wi=aweinsh. Default: aweinsh
  --th {0,1,2}          Thresholding method (0: standard 0 value, 1: Otsu bimodal, 2: Otsu multimodal 3 classes). --th=0. Default: 0
  --mm {erosion,dilation}
                        Morphological method (erosion, dilation). --mm=dilation, Default: dilation
  --cl {0,1,2}          Cloud mask level (0: no masking, 1: only opaque clouds, 2: opaque clouds + cirrus + cloud shadows). Default: 0
  --ks {3,5}            Kernel size for points extraction. Default: 3
  --bc BC               beach code filter list. --bc=520,548 Default: NONE

(saet_env) C:\SAET_installation>
```

14. Processing an image. Now, we are going to process the S2 products 0 and 1, that represents the downloaded products in the step 12. In this case we use the default parameters except the beach code and the water index parameter. Beach code parameter, allow us to control the AOI inside our image. You can find this code in the shapefile “beaches.shp” (folder “aux_data”). Water index parameter allow us to control the segmentation method to separate water from land.

```
(saet_env) C:\SAET_installation>python sp_processing_run.py --bc=2076 --wi=mndwi
2023-11-02 18:24:56,873 INFO Starting downloading SAET_pro algorithm...

List of scenes in the data folder:

[0] S2A_MSIL1C_20230922T104741_N0509_R051_T30SYJ_20230922T143138
[1] S2B_MSIL1C_20230927T104719_N0509_R051_T30SYJ_20230927T125131

Number of images to be reprocessed (* / 0,2,3 / [2-5])?: 0,1

Scenes to be processed:

S2A_MSIL1C_20230922T104741_N0509_R051_T30SYJ_20230922T143138

2023-11-02 18:25:10,796 INFO Processing S2A_MSIL1C_20230922T104741_N0509_R051_T30SYJ_20230922T143138 ...
2023-11-02 18:25:10,796 INFO Computing water index band...
2023-11-02 18:25:10,812 INFO Downscaling T30SYJ_20230922T104741_B03.jp2 ...
2023-11-02 18:25:13,028 INFO Computing cloud mask...
2023-11-02 18:25:13,552 INFO Computing water index mask...
2023-11-02 18:25:56,688 INFO Computing rough pixel line...
2023-11-02 18:25:58,976 INFO Reprojecting shp of beaches...
2023-11-02 18:26:00,187 INFO Computing footprint band...
2023-11-02 18:26:00,195 INFO Clipping shp of beaches by scene footprint...
2023-11-02 18:26:00,431 INFO Rasterizing beaches subset...
2023-11-02 18:26:00,607 INFO Masking rough pixel line with beaches subset...
2023-11-02 18:26:00,831 INFO Extracting points...
100%|                                   | 5470/5470 [01:09<00:00, 79.22it/s]
2023-11-02 18:27:10,408 INFO Computing average points...
2023-11-02 18:27:11,002 INFO Making point shp...
2023-11-02 18:27:11,157 INFO Transfering beaches identifiers...
2023-11-02 18:27:12,360 INFO Cleaning points and making final shoreline in line vector format...
2023-11-02 18:27:12,969 INFO Export final shoreline shapefiles to SDS folder...
```