

JASTER Instruction (Jason Altimetry Stand-Alone Tool for Enhanced Research)

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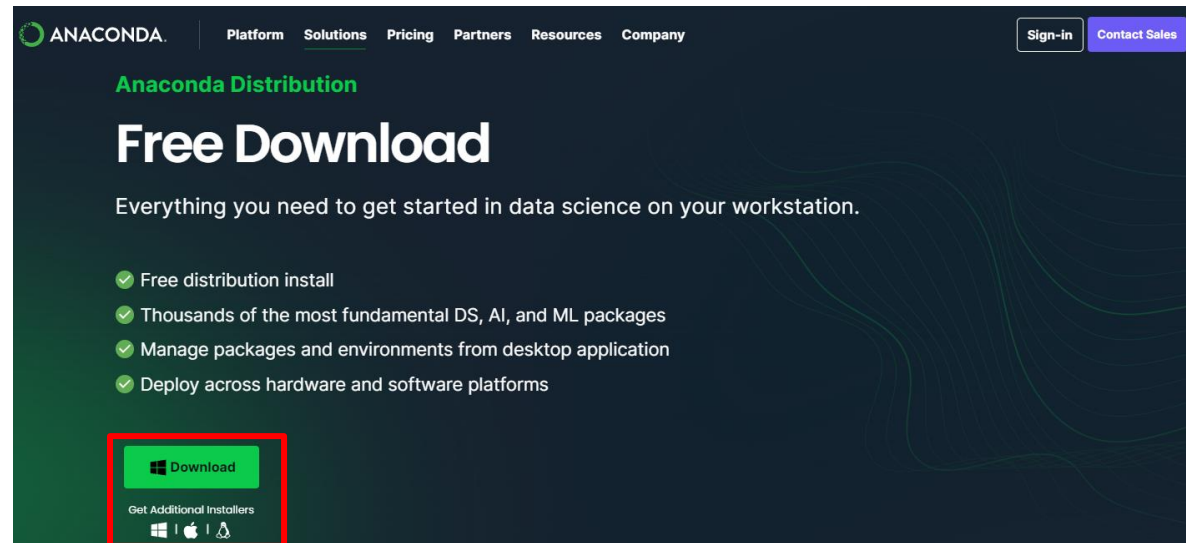
Outline

- Python setup
- Some preparations before running JASTER
- Run JASTER
- Example results

Python Setup

1. Install Anaconda

- **Anaconda**
 - Create virtual environment for better management of python packages
 - Download and install
 - Link: <https://www.anaconda.com/download>



Python Setup

1. Install Anaconda

- **Miniconda**
 - If you do not have anaconda installed, we recommend using Miniconda,
 - Download and install
 - Link: <https://docs.conda.io/projects/miniconda/en/latest/>

Miniconda

Miniconda is a free minimal installer for conda. It is a small bootstrap version of Anaconda that includes only conda, Python, the packages they both depend on, and a small number of other useful packages (like pip, zlib, and a few others). If you need more packages, use the `conda install` command to install from thousands of packages available by default in Anaconda's public repo, or from other channels, like conda-forge or bioconda.

Is Miniconda the right conda install for you? The [Anaconda](#) or [Miniconda](#) page lists some reasons why you might want one installation over the other.

- [System requirements](#)
- [Latest Miniconda installer links by Python version](#)
- [Installing Miniconda](#)
- [Miniconda release notes](#)
- [Other resources](#)

Latest Miniconda installer links

This list of installers is for the latest release of Python: 3.11.5. For installers for older versions of Python, see [Other installer links](#). For an archive of Miniconda versions, see <https://repo.anaconda.com/miniconda/>.


Latest - Conda 23.11.0 Python 3.11.5 released December 20, 2023

Platform	Name	SHA256 hash
Windows	Miniconda3 Windows 64-bit	c9032faa9262828782334b1b0c05b5355e6e38054e5127f5c36c70a7ed43179a
macOS	Miniconda3 macOS Intel x86 64-bit bash	2b7f9e46308c28c26d583a0a3e72121ef63916eaf17b6372305a1f728c3032
	Miniconda3 macOS Intel x86 64-bit pkg	748b9e8c3e903c2fc7c44d710ed9b0d19005d951d013c1284a4eeb0bdf2578
	Miniconda3 macOS Apple M1 64-bit bash	5694c382e695662ed874f2692224c4f53bca22e8135b6f069111e801be07ea
	Miniconda3 macOS Apple M1 64-bit pkg	912c8058e800f2e08d515526a8d3455755e83963d40e70597176540ea2401ca
Linux	Miniconda3 Linux 64-bit	c9a82568e965d1105117b4b1e4999e87d2a920f8eae8f94410e417a0ef1b9c
	Miniconda3 Linux-aarch64 64-bit	decc447fb99db0f5c5004481ec30f3c04f9ba28b35a9292af049cefe400237f
	Miniconda3 Linux-s390x 64-bit	53a9e9eb97c6e218f4f184ad8089436e1a6124cf064bf2d7b067043e50e471

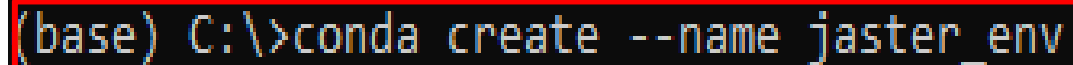
Python Setup

2. Create a virtual environment

- Run “Anaconda Prompt” in Windows or open the terminal (on macOS or Linux)
- In “Anaconda Prompt,” enter:
 - *conda create --name NAME_OF_ENVIRONMENT* (we suggest naming it *jaster_env* for convenience)

A screenshot of an Anaconda Prompt window. The title bar reads "Anaconda Prompt". The command prompt shows the command `conda create --name jaster_env` being entered.

```
Anaconda Prompt - conda create --name jaster_env
```

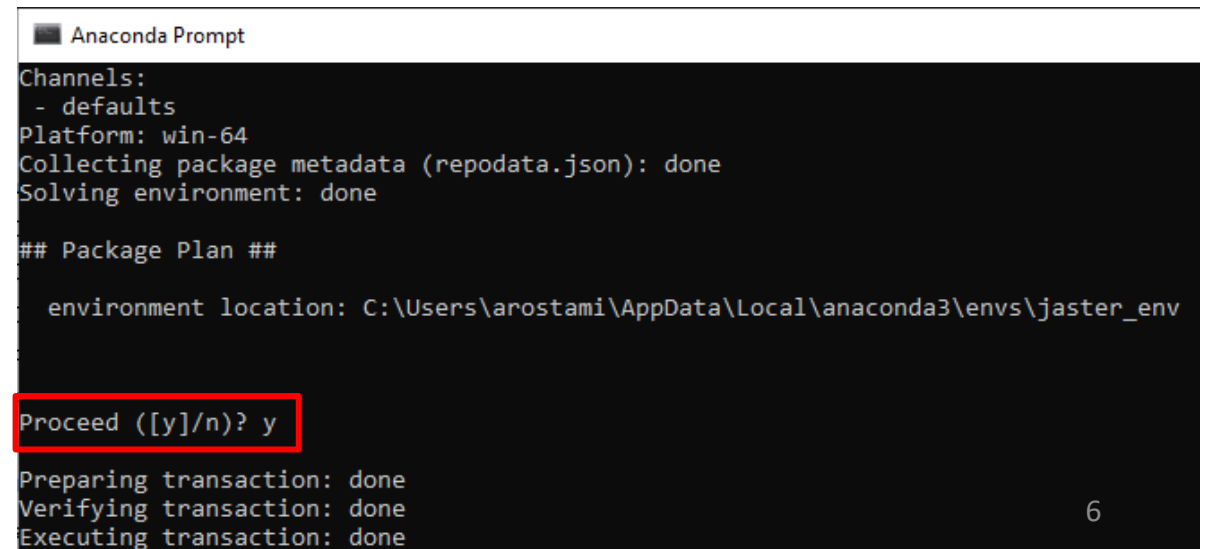
A screenshot of a terminal window with a black background. The command `(base) C:\>conda create --name jaster_env` is entered and highlighted with a red rectangular box.

```
(base) C:\>conda create --name jaster_env
```

Python Setup

2. Create a virtual environment

- Run “Anaconda Prompt” in Windows or open the terminal (on macOS or Linux)
- In “Anaconda Prompt,” enter:
 - *conda create --name NAME_OF_ENVIRONMENT* (we suggest naming it *jaster_env* for convenience)
 - Enter “y” when being asked “Proceed ([y]/n)?”
 - Wait till installation complete



```
Anaconda Prompt
Channels:
- defaults
Platform: win-64
Collecting package metadata (repodata.json): done
Solving environment: done

## Package Plan ##

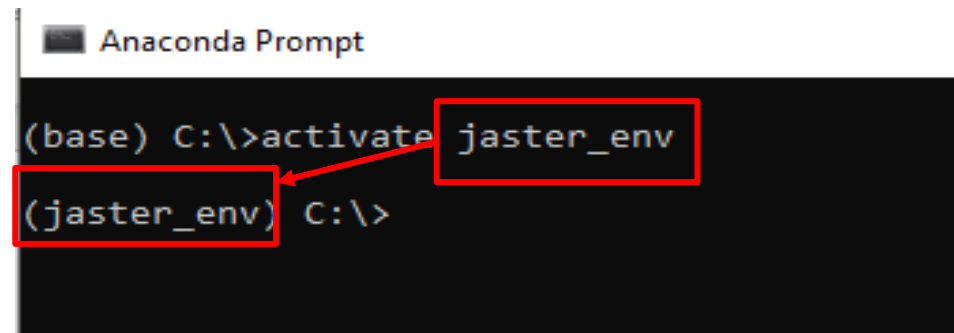
  environment location: C:\Users\arostami\AppData\Local\anaconda3\envs\jaster_env

Proceed ([y]/n)? y
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
```

Python Setup

2. Create a virtual environment

- Run “Anaconda Prompt”
- In “Anaconda Prompt,” enter
 - `conda create --name NAME_OF_ENVIRONMENT` (e.g., `jaster_env`)
 - Enter “y” when being asked “Proceed ([y]/n)?”
 - Wait till installation complete
- **Activate the virtual environment**



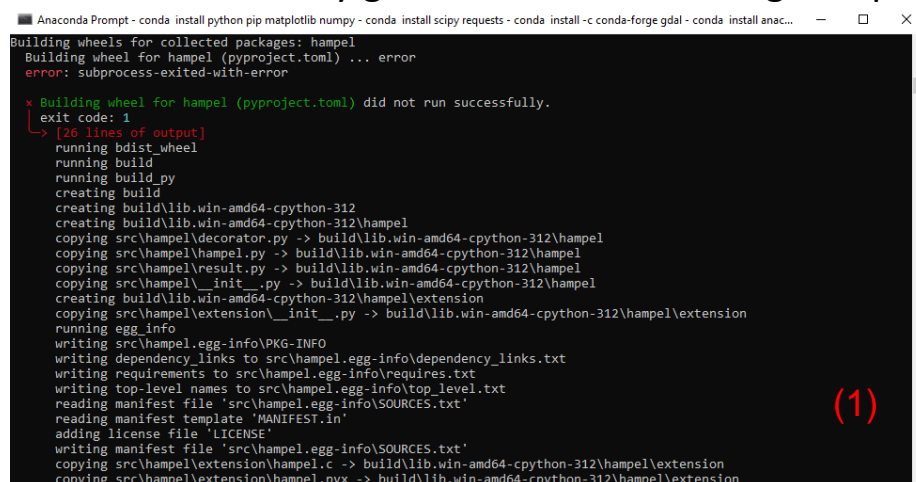
A screenshot of the Anaconda Prompt terminal window. The title bar reads "Anaconda Prompt". The terminal shows the command `(base) C:\>activate jaster_env` being entered. The output is `(jaster_env) C:\>`. Red boxes highlight the command `activate jaster_env` and the resulting prompt `(jaster_env)`. A red arrow points from the `jaster_env` part of the command to the `(jaster_env)` part of the output.

```
(base) C:\>activate jaster_env
(jaster_env) C:\>
```

Python Setup

3. Install required packages

- **Required Python Modules: netcdf4/numpy/matplotlib/scipy/matplotlib/ etc.**
 - Install by typing in (make sure you have activated the virtual environment)
 - `conda install python pip matplotlib numpy scipy requests`
 - `conda install -c conda-forge gdal`
 - `conda install tkinter` (If you get error, then use “*conda install anaconda::tk*”)
 - `pip install netcdf4 rioxarray rasterio screeninfo`
 - `pip install -U scikit-learn`
 - `pip install hampel`
 - You may get error while installing hampel package (It is more likely to happen for Windows users)

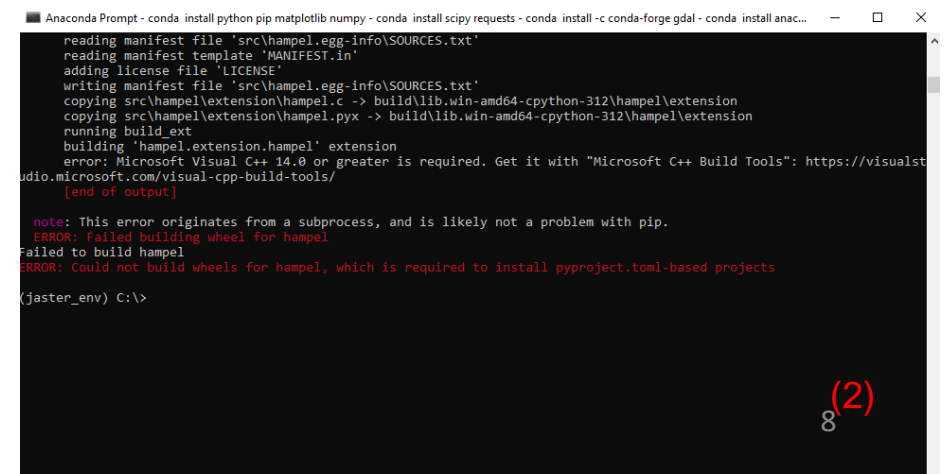


```

Anaconda Prompt - conda install python pip matplotlib numpy - conda install scipy requests - conda install -c conda-forge gdal - conda install anaconda::tk
Building wheels for collected packages: hampel
Building wheel for hampel (pyproject.toml) ... error
error: subprocess-exited-with-error

x Building wheel for hampel (pyproject.toml) did not run successfully.
  exit code: 1
  [26 lines of output]
    running bdist_wheel
    running build
    running build_py
    creating build
    creating build\lib.win-amd64-cpython-312
    creating build\lib.win-amd64-cpython-312\hampel
    copying src\hampel\decorator.py -> build\lib.win-amd64-cpython-312\hampel
    copying src\hampel\hampel.py -> build\lib.win-amd64-cpython-312\hampel
    copying src\hampel\result.py -> build\lib.win-amd64-cpython-312\hampel
    copying src\hampel\_init_.py -> build\lib.win-amd64-cpython-312\hampel
    creating build\lib.win-amd64-cpython-312\hampel\extension
    copying src\hampel\extension\_init_.py -> build\lib.win-amd64-cpython-312\hampel\extension
    running egg_info
    writing src\hampel.egg-info\PKG-INFO
    writing dependency links to src\hampel.egg-info\dependency_links.txt
    writing requirements to src\hampel.egg-info\requires.txt
    writing top-level names to src\hampel.egg-info\top_level.txt
    reading manifest file 'src\hampel.egg-info\SOURCES.txt'
    reading manifest template 'MANIFEST.in'
    adding license file 'LICENSE'
    writing manifest file 'src\hampel.egg-info\SOURCES.txt'
    copying src\hampel\extension\hampel.c -> build\lib.win-amd64-cpython-312\hampel\extension
    copying src\hampel\extension\hampel.pyx -> build\lib.win-amd64-cpython-312\hampel\extension
  
```

(1)



```

Anaconda Prompt - conda install python pip matplotlib numpy - conda install scipy requests - conda install -c conda-forge gdal - conda install anaconda::tk
reading manifest file 'src\hampel.egg-info\SOURCES.txt'
reading manifest template 'MANIFEST.in'
adding license file 'LICENSE'
writing manifest file 'src\hampel.egg-info\SOURCES.txt'
copying src\hampel\extension\hampel.c -> build\lib.win-amd64-cpython-312\hampel\extension
copying src\hampel\extension\hampel.pyx -> build\lib.win-amd64-cpython-312\hampel\extension
running build_ext
building 'hampel.extension.hampel' extension
error: Microsoft Visual C++ 14.0 or greater is required. Get it with "Microsoft C++ Build Tools": https://visualstudio.microsoft.com/visual-cpp-build-tools/
[end of output]

note: This error originates from a subprocess, and is likely not a problem with pip.
ERROR: Failed building wheel for hampel
Failed to build hampel
ERROR: Could not build wheels for hampel, which is required to install pyproject.toml-based projects

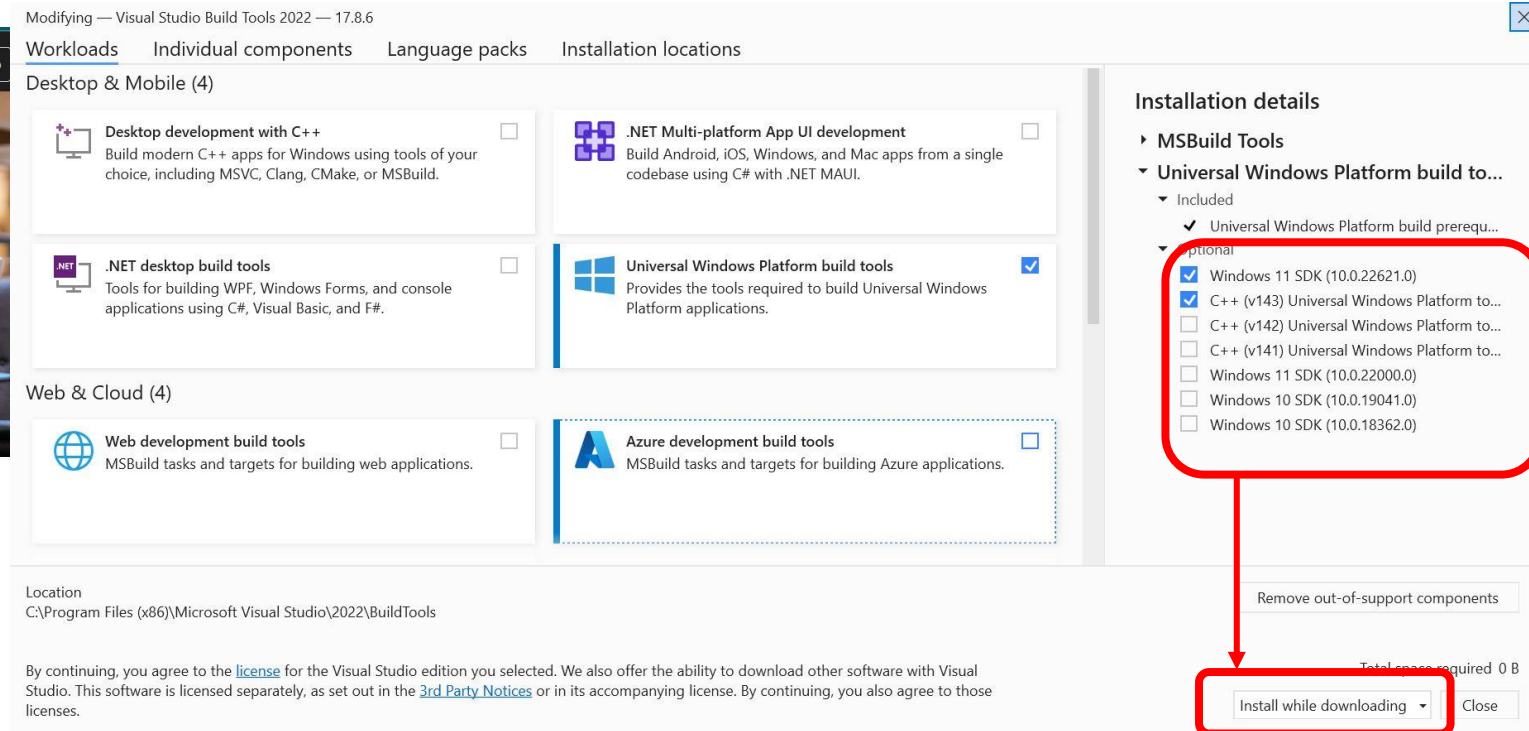
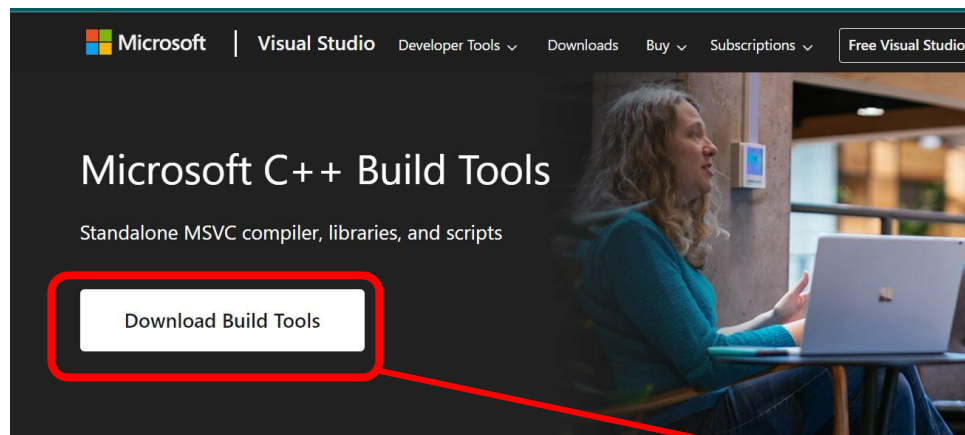
(jaster_env) C:\>
  
```

(2)

Python Setup

3. Install required packages (cont.)

- In this case, If you don't have the Microsoft Visual C++ 14 version or greater,
 - go to the (<https://visualstudio.microsoft.com/visual-cpp-build-tools/>)
 - download Microsoft C++ Build Tools.
 - install Visual Studio (most updated version is preferred) and also Windows SDK (11 or 10 based on user's windows version).



Before Running JASTER

- To download Jason series altimetry data:
- Create Account via AVISO: <https://www.aviso.altimetry.fr/en/my-aviso-plus.html>

The image shows a screenshot of the AVISO+ website, which is a platform for satellite altimetry data. The browser address bar displays the URL <https://www.aviso.altimetry.fr/es/my-aviso-plus.html>. The website features a dark blue header with the AVISO+ logo and a 'Mobile version' button. The main navigation bar includes links for 'MY AVISO+', 'DATA', 'USER CORNER', 'APLICACIONES', 'MISIONES', 'TECHNIQUES', 'NEWS', and 'MULTIMEDIA'. A secondary navigation bar shows a breadcrumb trail: 'AVISO+' > 'DATA' > 'DATAACCESS' > 'REGISTRATION FORM'. The page title is 'SUBSCRIBE TO GET ACCESS TO AVISO+ PRODUCTS'. The main content area is titled 'FORMULAIRE PERSONAL INFORMATION' and contains instructions for registration. A red box highlights the text 'registration page.' with a red arrow pointing to the 'REGISTRATION FORM' link in the breadcrumb trail. The registration form includes fields for 'Family Name*', 'First name*', 'E-mail (in lowercase)*', and 'Company/Organization*'. A yellow box in the bottom right corner contains the text 'Discover AVISO+' and a brief description of the site's features.

AVISO+ Satellite Altimetry Data

Mobile version

MY AVISO+ | DATA | USER CORNER | APLICACIONES | MISIONES | TECHNIQUES | NEWS | MULTIMEDIA

AVISO+ MY AVISO+

You can access to your personal information and Aviso+ products.

If you are not registered, please fill the form on the [registration page.](#)

Please note that the credentials are different for :

- the CNES Data Center. Please register [online](#).
- ODES services are no more available (CNES facility has been decommissioned)

Sorry for any inconvenience it may cause

Please contact AVISO+ help desk for any additional information (aviso@altimetry.fr)

MY AVISO+ | DATA | USER CORNER | APLICACIONES | MISIONES | TECHNIQUES | NEWS | MULTIMEDIA

AVISO+ DATA DATAACCESS REGISTRATION FORM

SUBSCRIBE TO GET ACCESS TO AVISO+ PRODUCTS

FORMULAIRE PERSONAL INFORMATION

In order to get access to Aviso+ products, an identification process is required. Please, fill in the form and read carefully the licence agreement before accepting it.

Please use standard English characters (A to Z), numbers, '.', ',', '_' and spaces only.

Family Name*

First name*

E-mail (in lowercase)*

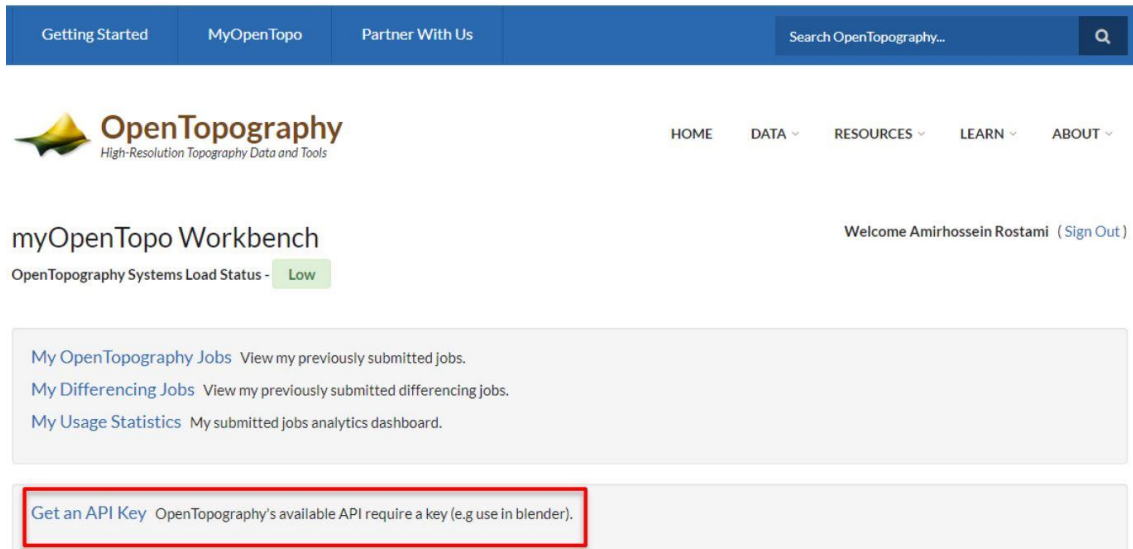
Company/Organization*

Discover AVISO+

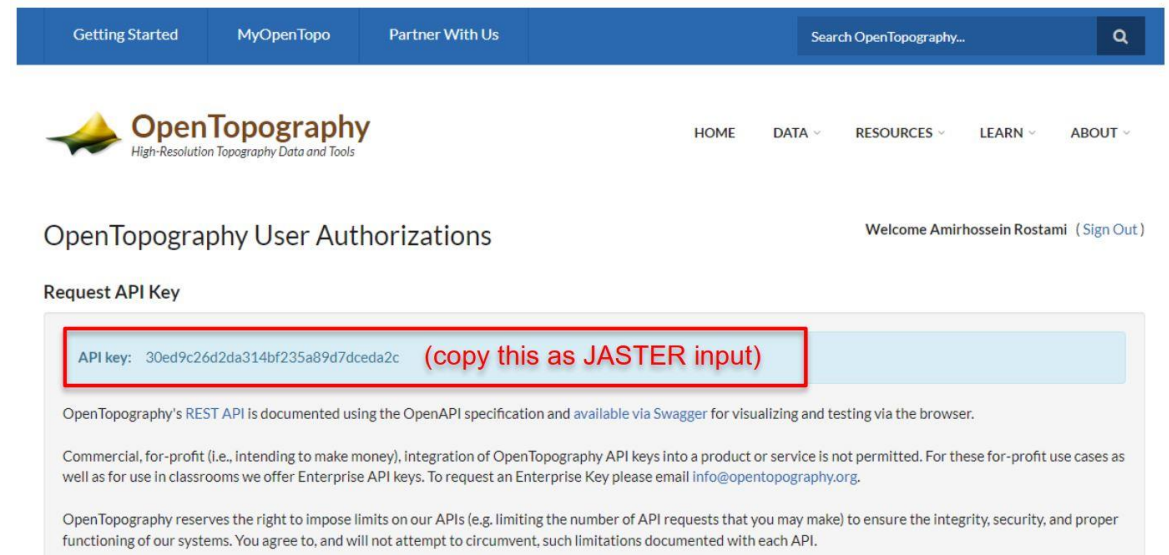
Customizable home, reading tools, products search guide, etc.. Discover step by step the features of the new site AVISO+.

Before Running JASTER

- **OpenTopography API Key**
- To achieve the SRTM DEM API Key,
- go to the <https://portal.opentopography.org/login> and create an account if you do not have:



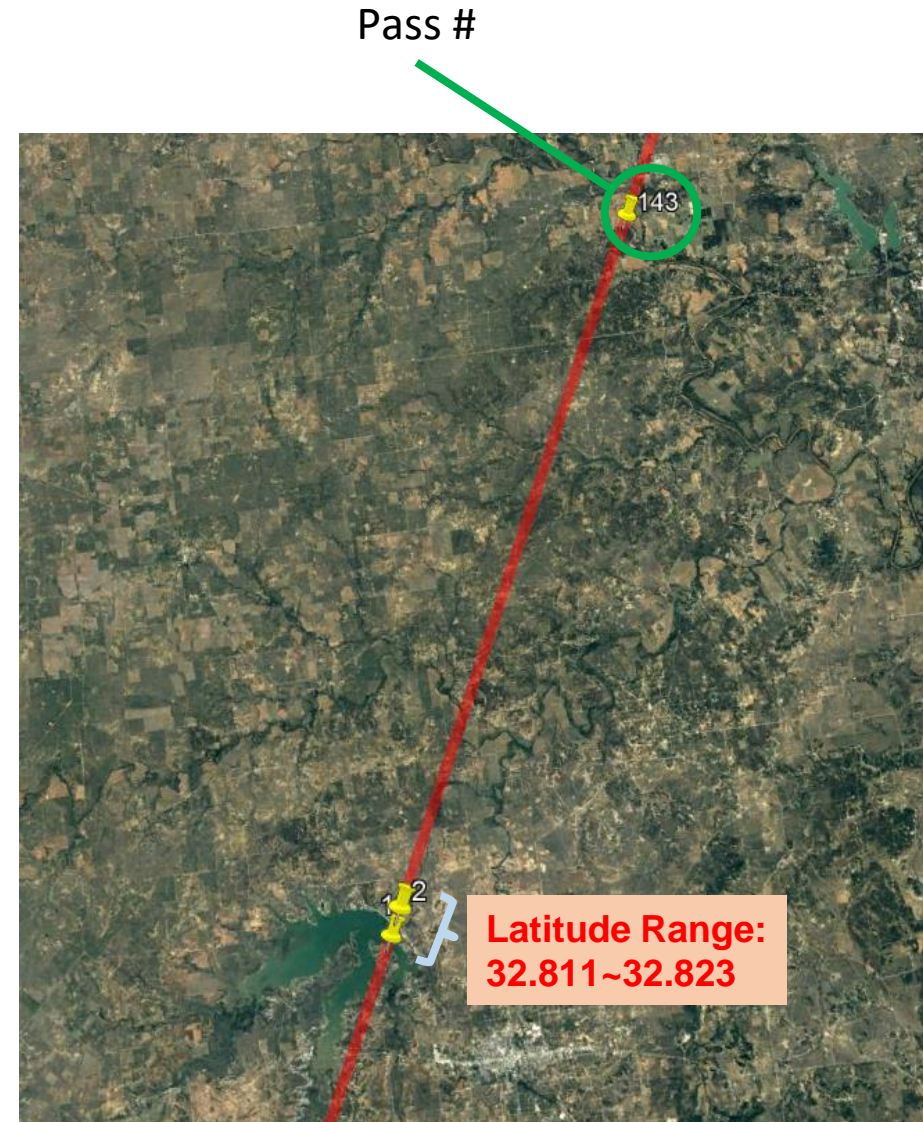
The screenshot shows the 'myOpenTopo Workbench' dashboard. At the top, there is a navigation bar with links: 'Getting Started', 'MyOpenTopo', 'Partner With Us', and a search bar labeled 'Search OpenTopography...'. Below the navigation bar is the OpenTopography logo and a menu with 'HOME', 'DATA', 'RESOURCES', 'LEARN', and 'ABOUT'. The main content area includes a welcome message 'Welcome Amirhossein Rostami (Sign Out)' and a section titled 'myOpenTopo Workbench' with a status indicator 'OpenTopography Systems Load Status - Low'. Below this, there are three links: 'My OpenTopography Jobs', 'My Differencing Jobs', and 'My Usage Statistics'. At the bottom, a red-bordered box highlights the text: 'Get an API Key OpenTopography's available API require a key (e.g use in blender)'.



The screenshot shows the 'OpenTopography User Authorizations' page. It has the same navigation bar as the previous screenshot. The main content area includes a welcome message 'Welcome Amirhossein Rostami (Sign Out)' and a section titled 'OpenTopography User Authorizations'. Below this, there is a 'Request API Key' section. A red-bordered box highlights the text: 'API key: 30ed9c26d2da314bf235a89d7dceda2c (copy this as JASTER input)'. Below this, there is a paragraph of text: 'OpenTopography's REST API is documented using the OpenAPI specification and available via Swagger for visualizing and testing via the browser. Commercial, for-profit (i.e., intending to make money), integration of OpenTopography API keys into a product or service is not permitted. For these for-profit use cases as well as for use in classrooms we offer Enterprise API keys. To request an Enterprise Key please email info@opentopography.org. OpenTopography reserves the right to impose limits on our APIs (e.g. limiting the number of API requests that you may make) to ensure the integrity, security, and proper functioning of our systems. You agree to, and will not attempt to circumvent, such limitations documented with each API.'

Before Running JASTER

- Check pass # using Google Earth and Jason ground track
(Visu_RefOrbit_J3J2J1TP_Tracks_GoogleEarth_V3.kmz)
 - Download kmz via:
<https://www.aviso.altimetry.fr/en/data/tools/pass-locator.html>



Before Running JASTER

- Open Anaconda prompt and change working directory to where the python codes exist:

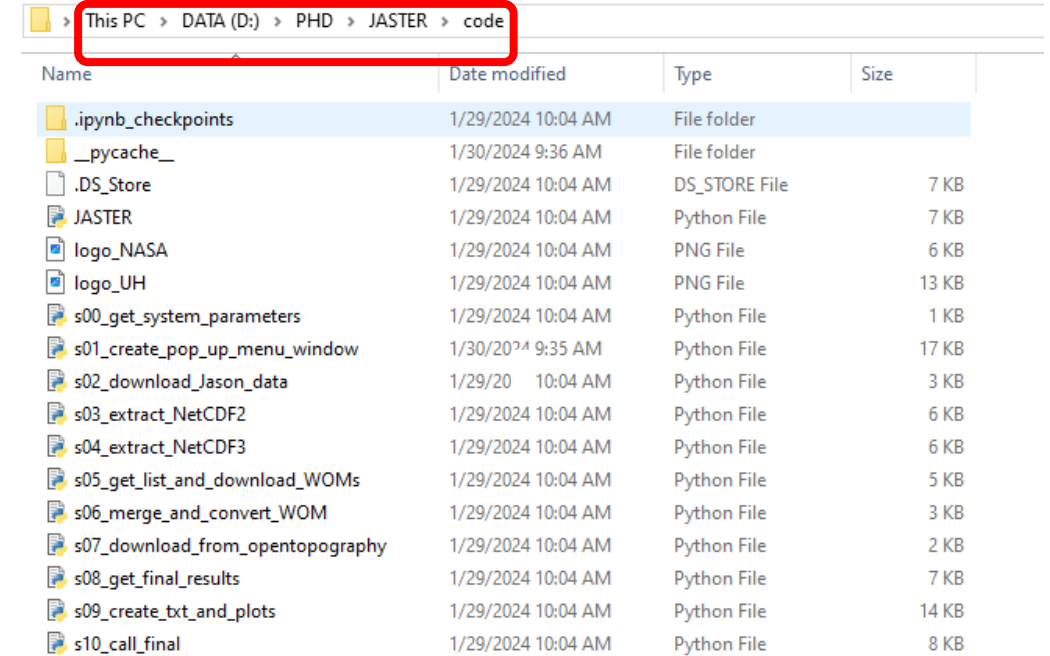
- By default, working directory is in C drive. To switch to other drive:

```
(jaster_env) C:\>D:
```

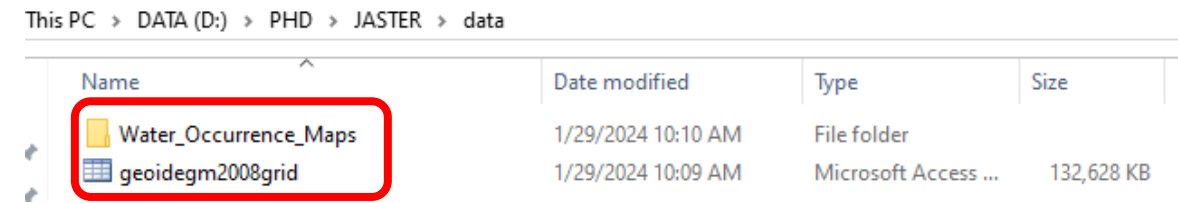
- cd '*PATH_TO_YOUR_PYTHON_CODE*'

```
(jaster_env) D:\>cd PHD\JASTER\code
```

- '*geoidegm2008grid.mat*' and Water Occurrence maps are required for time series plot.
 - Then, execute "*python JASTER.py*" launching JASTER and opens its graphical user interface.



This PC > DATA (D:) > PHD > JASTER > code				
Name	Date modified	Type	Size	
.ipynb_checkpoints	1/29/2024 10:04 AM	File folder		
__pycache__	1/30/2024 9:36 AM	File folder		
.DS_Store	1/29/2024 10:04 AM	DS_STORE File	7 KB	
JASTER	1/29/2024 10:04 AM	Python File	7 KB	
logo_NASA	1/29/2024 10:04 AM	PNG File	6 KB	
logo_UH	1/29/2024 10:04 AM	PNG File	13 KB	
s00_get_system_parameters	1/29/2024 10:04 AM	Python File	1 KB	
s01_create_pop_up_menu_window	1/30/2024 9:35 AM	Python File	17 KB	
s02_download_Jason_data	1/29/2024 10:04 AM	Python File	3 KB	
s03_extract_NetCDF2	1/29/2024 10:04 AM	Python File	6 KB	
s04_extract_NetCDF3	1/29/2024 10:04 AM	Python File	6 KB	
s05_get_list_and_download_WOMs	1/29/2024 10:04 AM	Python File	5 KB	
s06_merge_and_convert_WOM	1/29/2024 10:04 AM	Python File	3 KB	
s07_download_from_opentopography	1/29/2024 10:04 AM	Python File	2 KB	
s08_get_final_results	1/29/2024 10:04 AM	Python File	7 KB	
s09_create_txt_and_plots	1/29/2024 10:04 AM	Python File	14 KB	
s10_call_final	1/29/2024 10:04 AM	Python File	8 KB	



This PC > DATA (D:) > PHD > JASTER > data				
Name	Date modified	Type	Size	
Water_Occurrence_Maps	1/29/2024 10:10 AM	File folder		
geoidegm2008grid	1/29/2024 10:09 AM	Microsoft Access ...	132,628 KB	

Before Running JASTER

- You may encounter some errors before running JASTER such as:
 - No module named “*name of the module*” even though you have already installed it. For example:

```
ModuleNotFoundError: No module named 'screeninfo'
```

- In this case, reinstall modules which give this error in Anaconda Prompt as we described in slide 8
- If it does not work again, reinstall modules through Jupyter Notebook

JASTER Inputs

- Input all required information

- AVISO username & Password (slide 10)
- API Key to download SRTM DEM from OpenTopography (slide 11)
- Jason Series #: select 2 or 3 or both
- Pass #: from 1 to 254
- Start and end cycle #:
 - Jason-2: Cycle ranges from 1 (2008/07) to 303 (2016/09)
 - Jason-3: Cycle ranges from 1 (2016/02) to most recent 226 (2022/03) (Replaced by Sentinel-6 afterward)
- Latitude and Longitude range of the reservoir/lake of interest from Google Earth (slide 12)
- Height and WO threshold for SRTM DEM-WO deoutlier method

1

JASTER

UNIVERSITY OF HOUSTON

Welcome to JASTER
(Jason Altimetry Stand-alone Tool for Enhanced Research)

AVISO Username: AVISO Password:

OpenTopography API Key:

Jason Series: ☐ 2 ☐ 3 ☒ Both

Pass number: (from 1 to 254)

Jason-2 (from 1 to 303)
Start cycle: End cycle:

Jason-3 (from 1 to 226)
Start cycle: End cycle:

Latitude: from 80 to -60 deg (or from 80N to 60S)
Minimum Latitude: Maximum Latitude:

Longitude: from 179 to -180 deg (or from 179E to 180W)
Minimum Longitude: Maximum Longitude:

Output directory*:

Output folder name*:

SRTM DEM-based outlier detection parameters*:
Height threshold* (default 5 m):
Water occurrence threshold* (default 50):

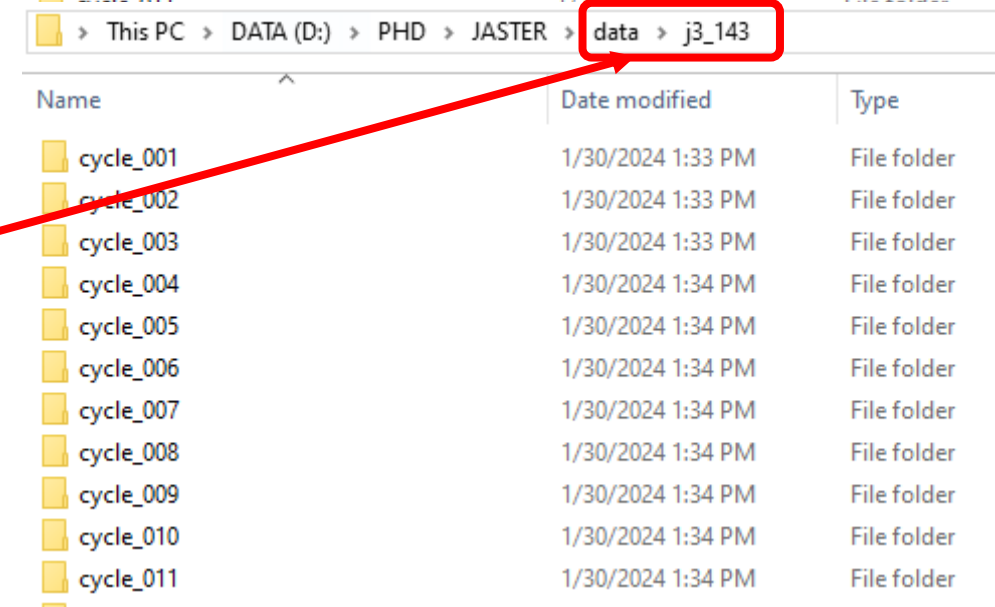
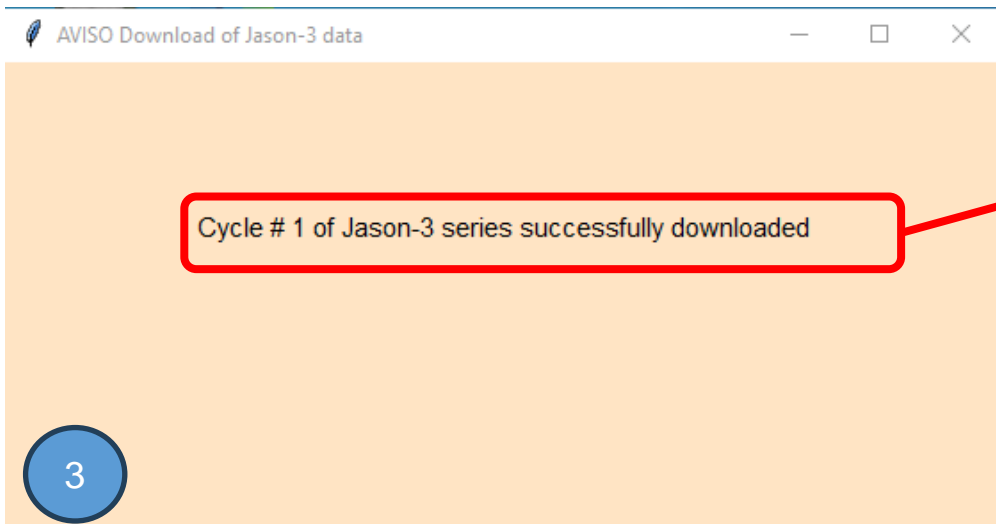
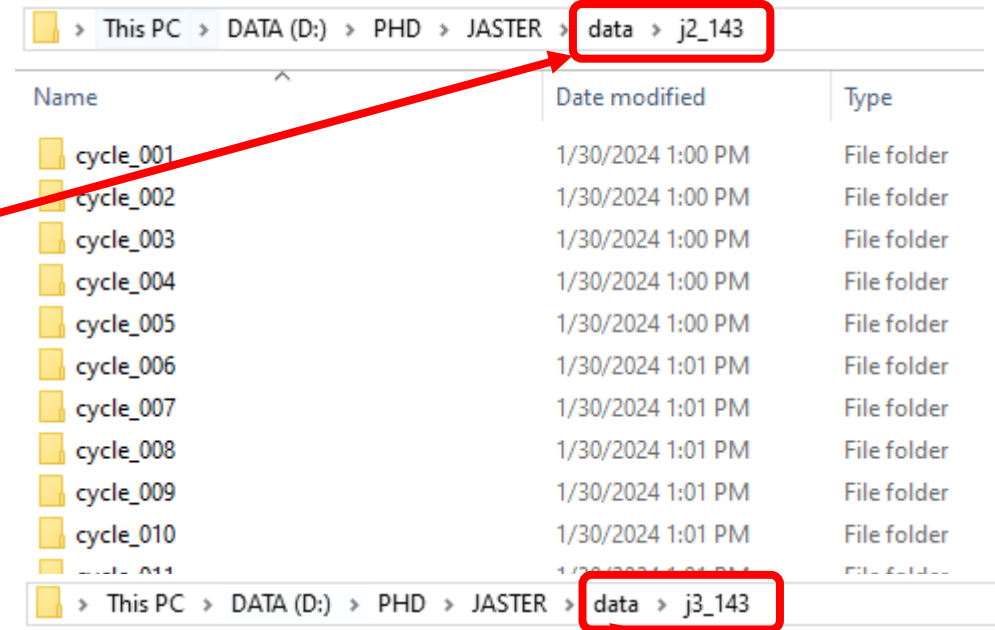
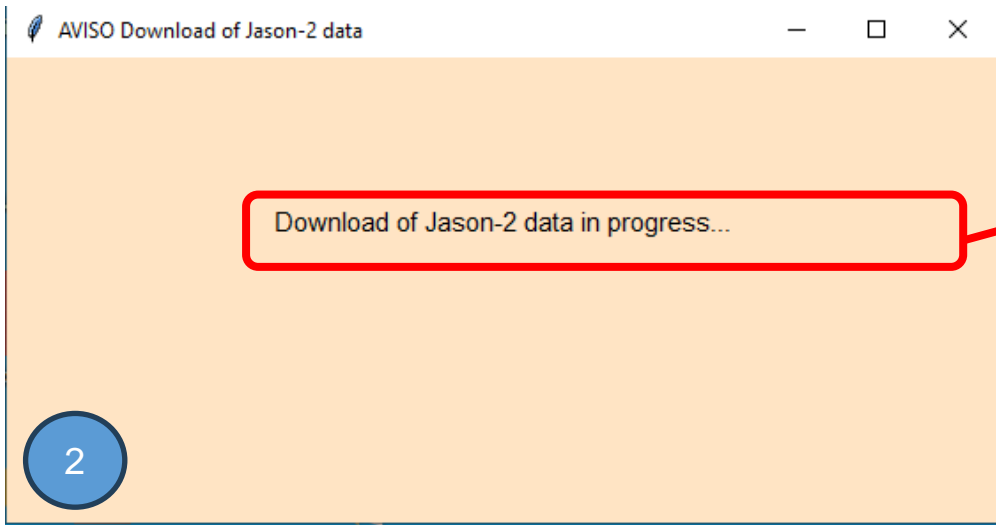
Hampel filter parameters* (set window to 0 to disable):
Window size* 0-20 (default 0):
Sensitivity* 0.1-5.0 (default 3):

* - optional fields

Developed by Natalya Maslennikova (nmaslenn@cougarnet.uh.edu)
Amirhossein Rostami (arostami@cougarnet.uh.edu)
Chi-Hung Chang (chchang37@cougarnet.uh.edu)
Hyongki Lee (hlee45@central.uh.edu)

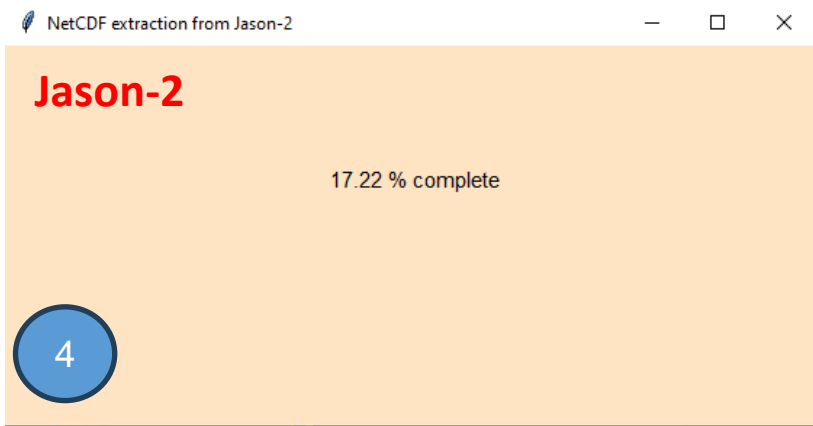
- Directory path to save JASTER output results
- Hampel filter parameters (W, S). If you don't want use Hampel, let Window size = 0

Data Download



- Open "j2_Pass#" or "j3_Pass#" folder after data download complete to confirm the downloaded cycles

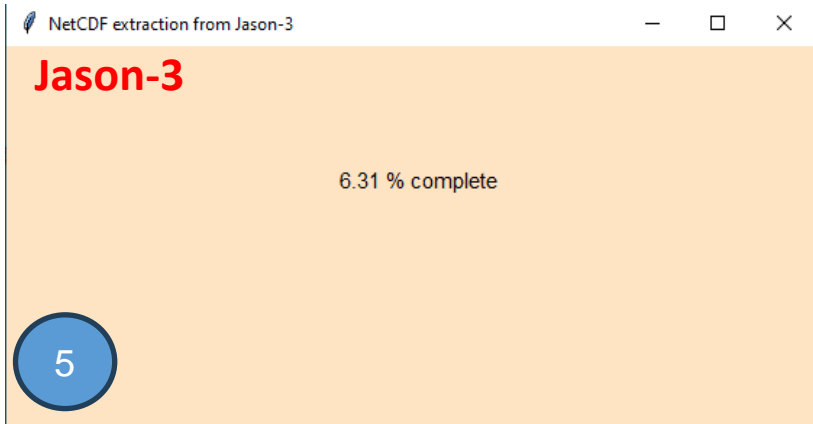
Variable Extraction



Extraction Processing



When it becomes completed

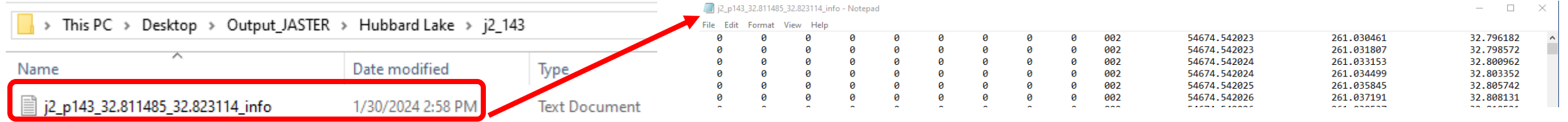


This PC > Desktop > Output_JASTER > Hubbard Lake > j2_143		
Name	Date modified	Type
j2_p143_32.811485_32.823114_info	1/30/2024 2:58 PM	Text Document



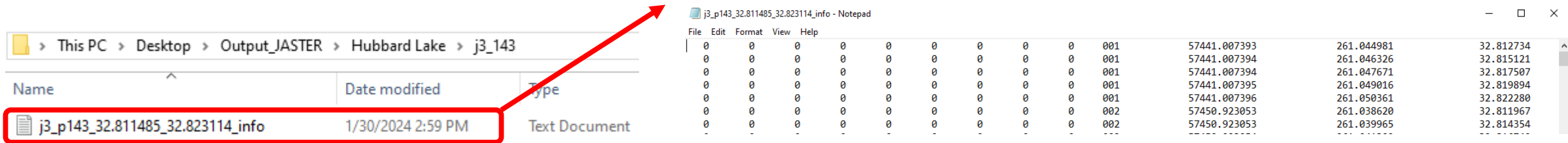
This PC > Desktop > Output_JASTER > Hubbard Lake > j3_143		
Name	Date modified	Type
j3_p143_32.811485_32.823114_info	1/30/2024 2:59 PM	Text Document

Variable Extraction

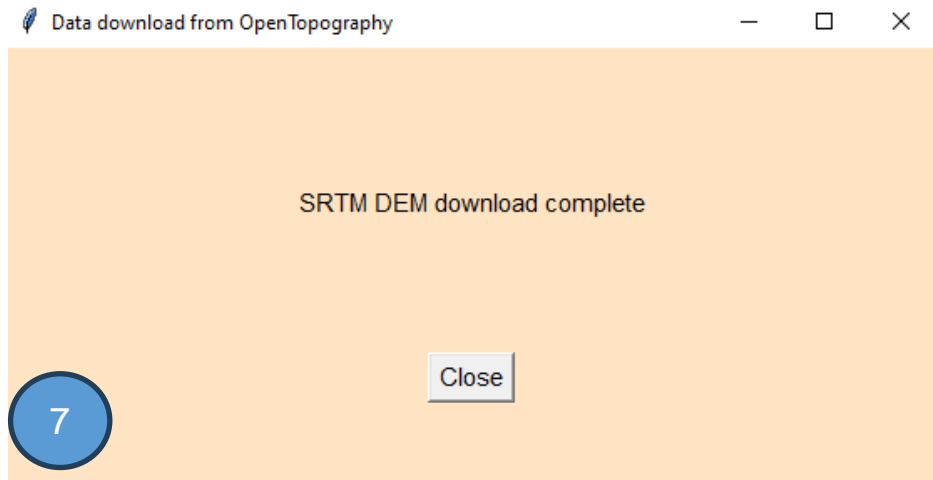


Columns:

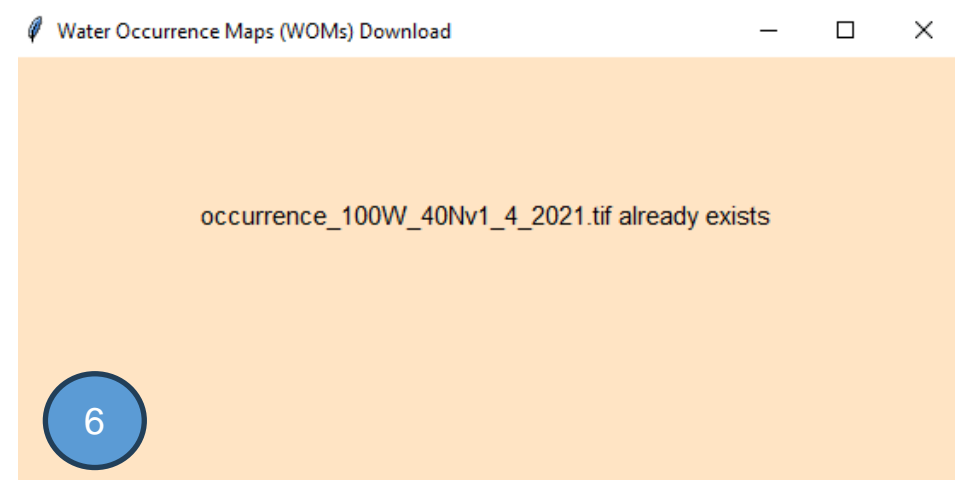
- (10) Jason-2 or 3 Cycle Numbers
- (11) Decimal year
- (12) Longitude
- (13) Latitude
- (14) Height (meter w.r.t. EGM2008 Geoid) **before applying outlier removal methods**
- (15) Uncertainty (meter)



SRTM DEM-Water Occurrence outlier removal

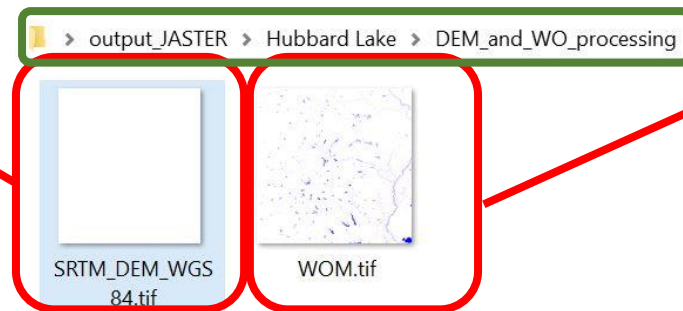


- API key of OpenTopography + (Lat, Long) range.
- SRTM DEM will be downloaded automatically.

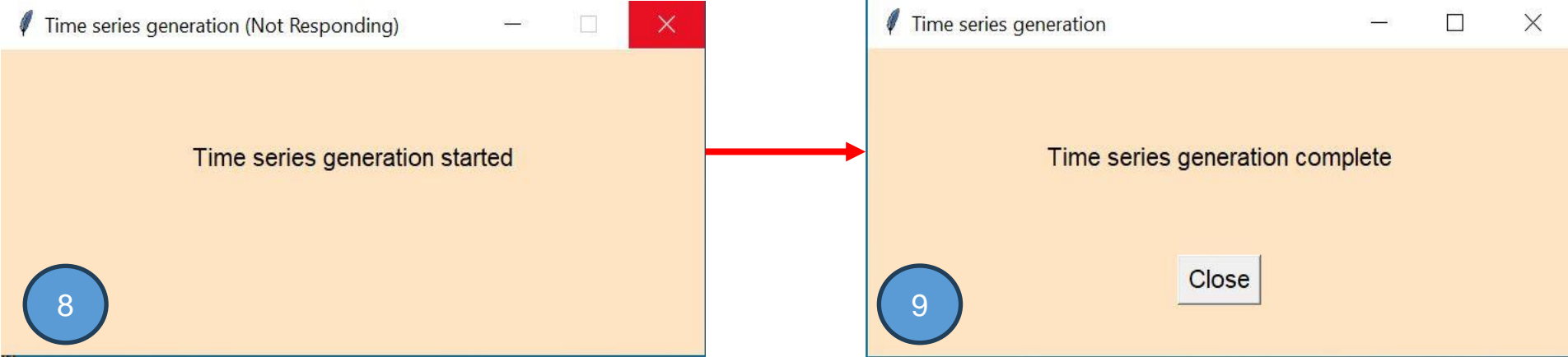


- We have already provided users with WO maps in JASTER data file.
- Users can also download it directly from (<https://global-surface-water.appspot.com/download>)

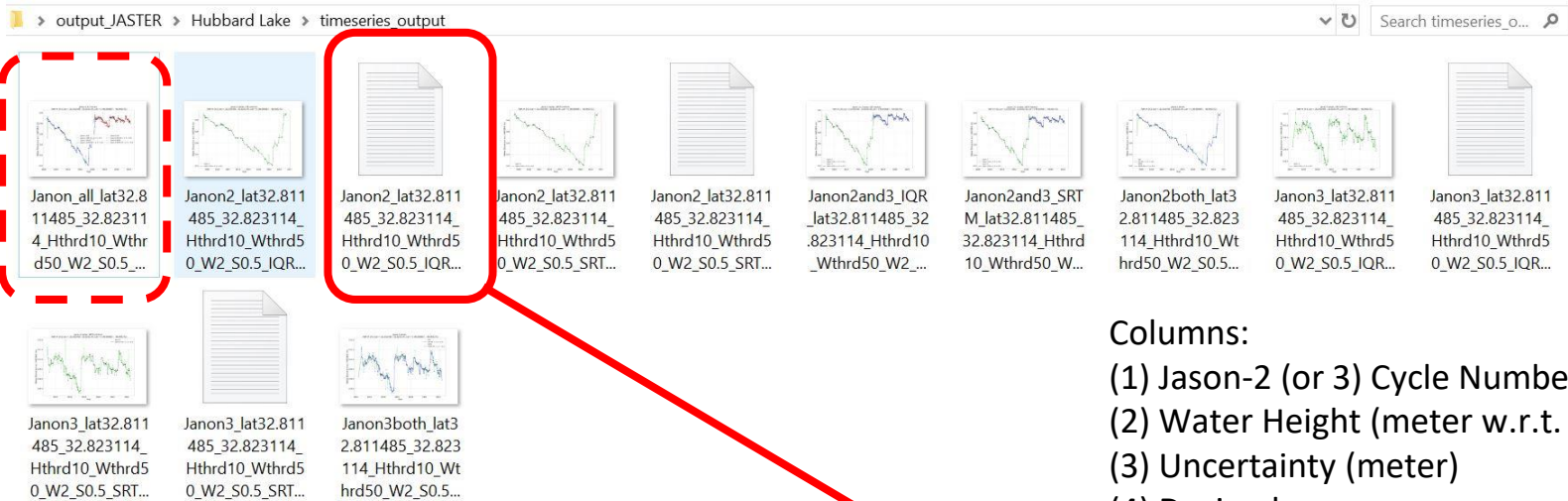
WO map and SRTM DEM are cropped based on Lat and Long range that user defined for the area of interest.



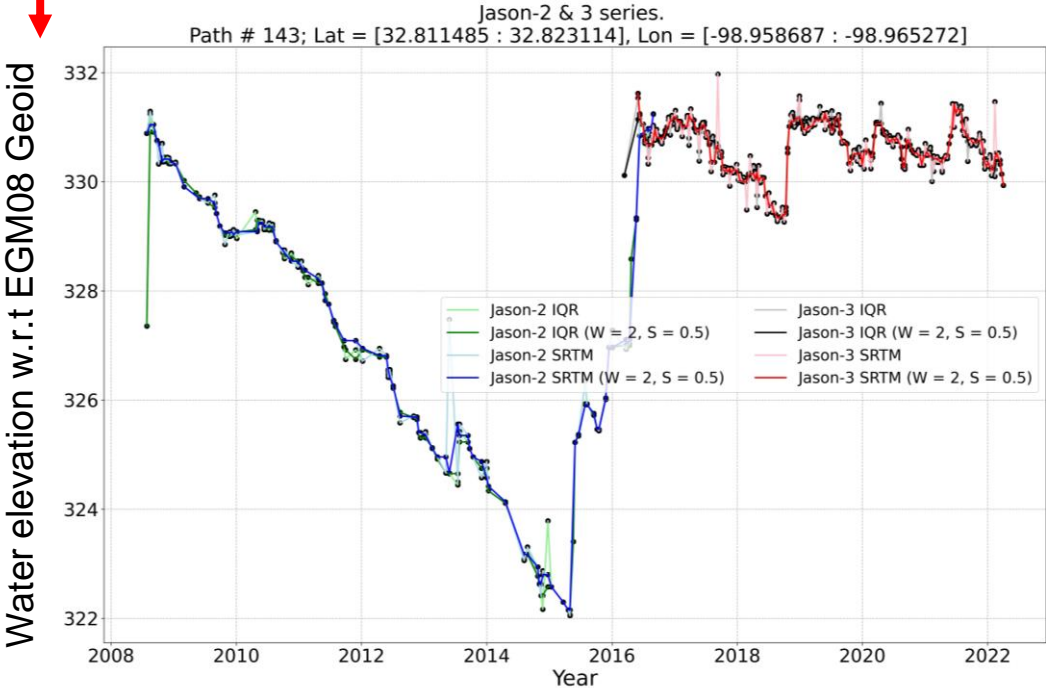
Time Series Plot (Final Outputs)



Time Series Plot (Example: Hubbard Creek Lake, TX)



- Columns:
- (1) Jason-2 (or 3) Cycle Numbers
 - (2) Water Height (meter w.r.t. EGM2008 Geoid) **without** Hampel filter
 - (3) Uncertainty (meter)
 - (4) Decimal year
 - (5) Water Height (meter w.r.t. EGM2008 Geoid) **with** Hampel filter



Janon2_lat32.811485_32.823114_Hthrd10_Wthrd50_W2_S0.5_IQR.txt - Notepad

File	Edit	Format	View	Help
2.0000000000000000e+00	3.273533499999999776e+02	6.78499999999286047e-02	2.008569588029568877e+03	3.273533630371093750e+02
4.0000000000000000e+00	3.312405799999999658e+02	2.828899602318874495e-01	2.008623883128815805e+03	3.309122619628906250e+02
6.0000000000000000e+00	3.309122749999999655e+02	1.678190301336605905e-01	2.008678178240656962e+03	3.309122619628906250e+02
8.0000000000000000e+00	3.307573399999999424e+02	5.982656934840244189e-02	2.008732473376591315e+03	3.307573547363281250e+02
9.0000000000000000e+00	3.303250500000000329e+02	2.521408782803660764e-01	2.008759620938535136e+03	3.307048034667968750e+02
1.1000000000000000e+01	3.307048000000000911e+02	8.747074939658398829e-02	2.008813916060780230e+03	3.303666076660156250e+02
1.2000000000000000e+01	3.303666000000000054e+02	1.830534757932751611e-01	2.008841063613963115e+03	3.304513549804687500e+02
1.4000000000000000e+01	3.304513499999999908e+02	1.144816688382796488e-01	2.008895358698836390e+03	3.303666076660156250e+02
1.5000000000000000e+01	3.303327600000000075e+02	2.564239739181993771e-01	2.008922506234633829e+03	3.303331909179687500e+02
1.6000000000000000e+01	3.3033320000000000335e+02	1.144958165174581877e-01	2.008949653769199131e+03	3.303327636718750000e+02
1.9000000000000000e+01	3.303316599999999994e+02	5.530824893269151166e-02	2.009031096433675657e+03	3.303316650390625000e+02
2.4000000000000000e+01	3.3002192000000000228e+02	1.479309352366875718e-01	2.009166834247228053e+03	3.300219116210937500e+02

All JASTER output results for Hubbard Creek Lake including: Jason-2 and 3, IQR and SRTM DEM-WO, enabled and disabled Hampel filter.

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