This document describes how to install Bellhop on a Windows 10 machine. Bellhop is written in Fortran but a python wrapper has been constructed to run python and produce the plots that are the usual outputs of Bellhop. A Jupyter Notebook was created to make that easier for the user. Alternatively, you can call and run Bellhop in python exclusively.

The Bellhop Python Simulation Tools require the following libraries:

- Fortran compiler (optional for win10) – for MACs and Linux implementations
- Acoustic Toolbox
- Windows Binaries
- Arlpy (Bellhop wrapper for python)
- Python3
- Jupyter Notebook unless you want to run Bellhop standalone in Python

The instructions below install everything needed to run Bellhop in python and the Jupyter Notebook.

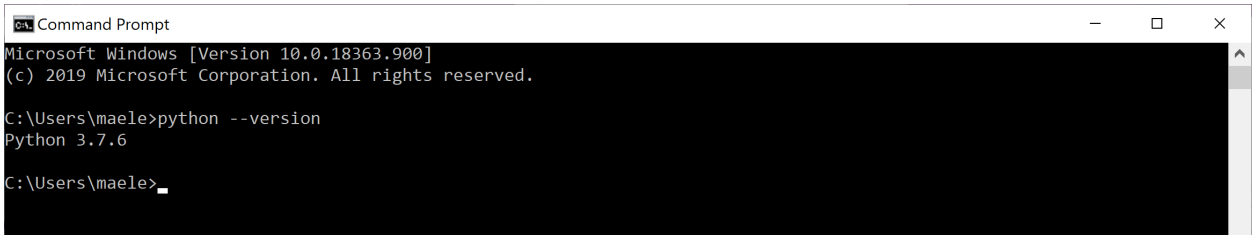
1. Install Python

Please check whether python2 or python3 is already installed on your Windows 10 machine.

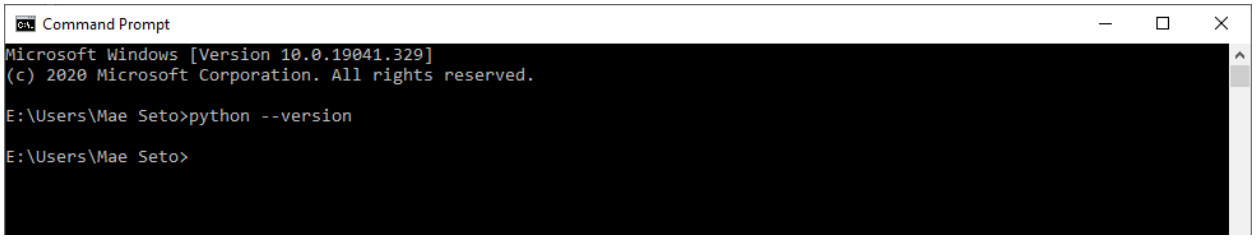
open a Command Prompt and enter:

> *python -- version*

If it is installed, it will reply with the version, i.e.:



If it is not installed, the response is:



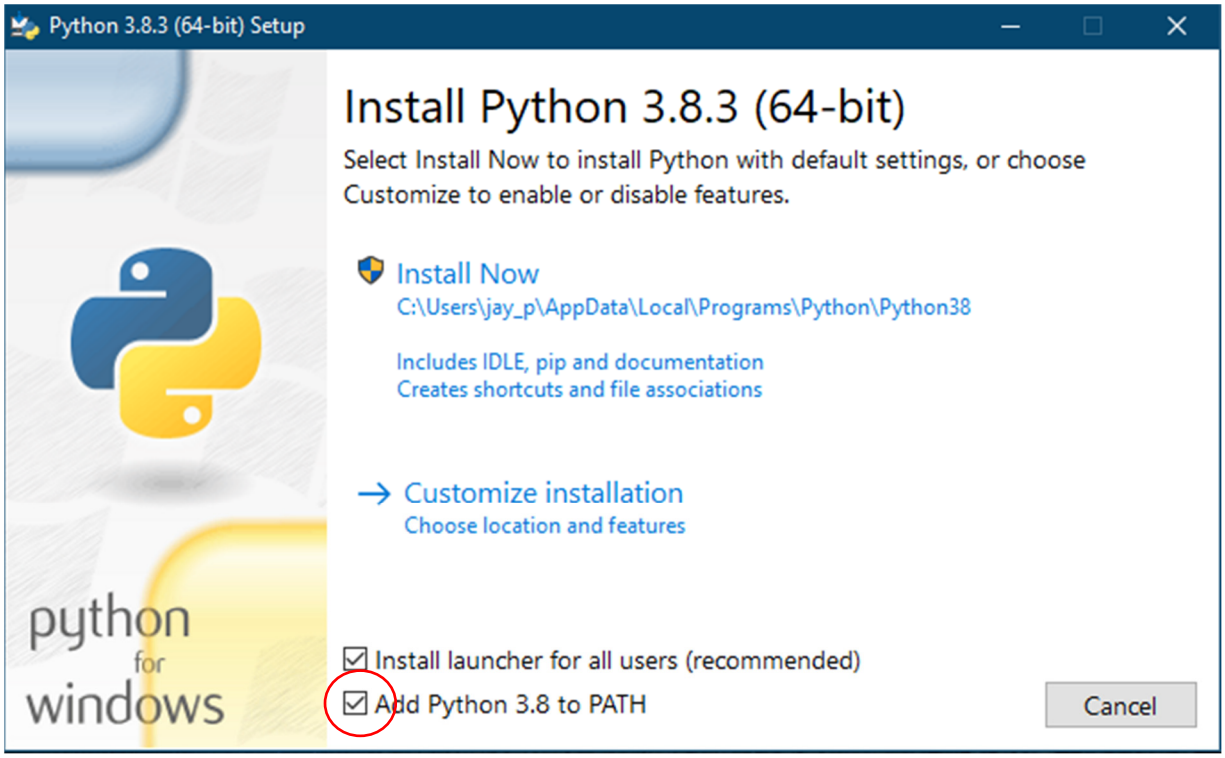
The general site for python downloads is at:

https://www.python.org/downloads/

If you have [Win 10 x86-64 bit], you can download it directly from:

https://www.python.org/ftp/python/3.8.3/python-3.8.3-amd64.exe

During installation it will ask whether to `Add Python 3.8 to PATH`. Select this option to add the path to your windows environment, i.e.



2. Install the Acoustic Toolbox (AT or at)

i. Download the AT Toolbox from this link

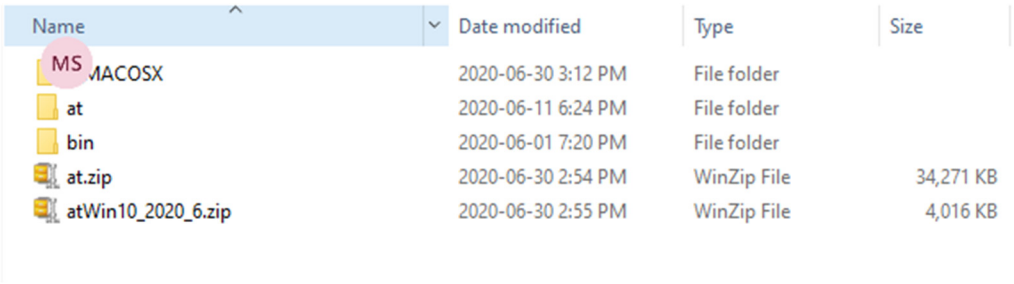
ii. Download the Windows binaries from this link

Both .zip files can be in the same folder

iii. With the at.zip file from (i), use 7-zip or winzip to 'Extract Here'. This should create an 'at' folder with files in it. Ignore the _MACOSX folder which is for a MAC OS implementation.

iv. With the atWin10_2020_6.zip file from (ii), use 7-zip or winzip to 'Extract Here'. Then, rename the folder, *atWin10_2020_*6 to *bin*.

When you are done, your folder that you downloaded the .zip's into should appear as follows.



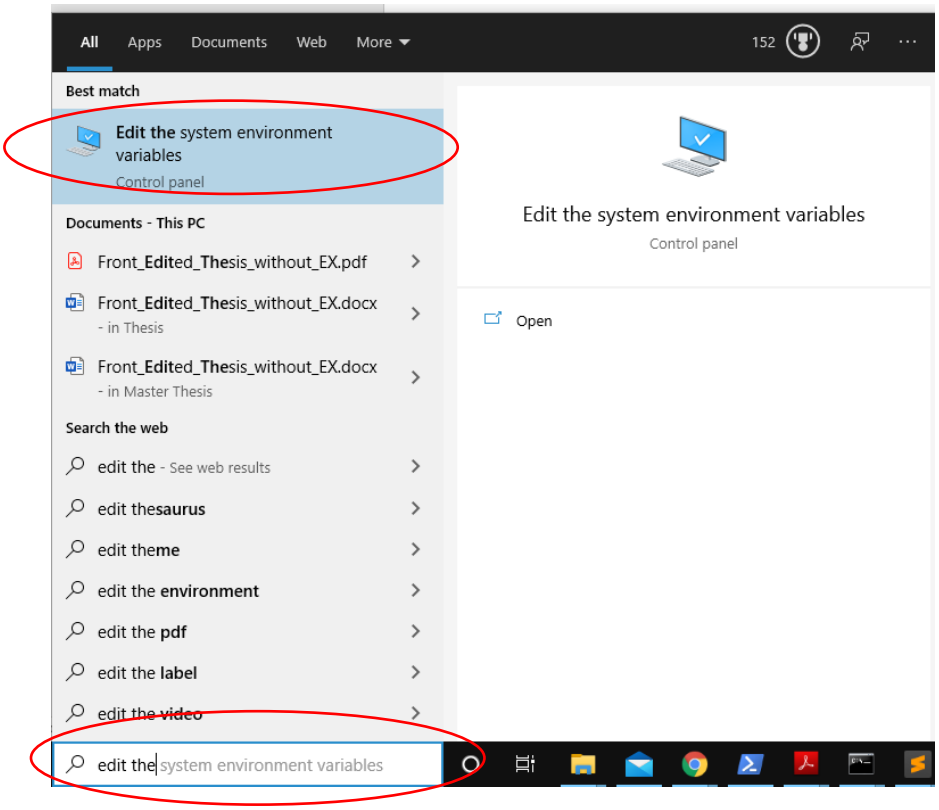
v. Configurations must be made to the Windows System Variables (accessible to ALL user, for e.g. 'Path' must be set to your /at and /bin folders).

Configurations must also be made to the Windows User Variables (accessible to select users, for e.g. 'Path' must be set to your /at and /bin folders for users – like yourself).

System Variables are set before User Variables. The details for this are described next in the event you are unfamiliar with this.

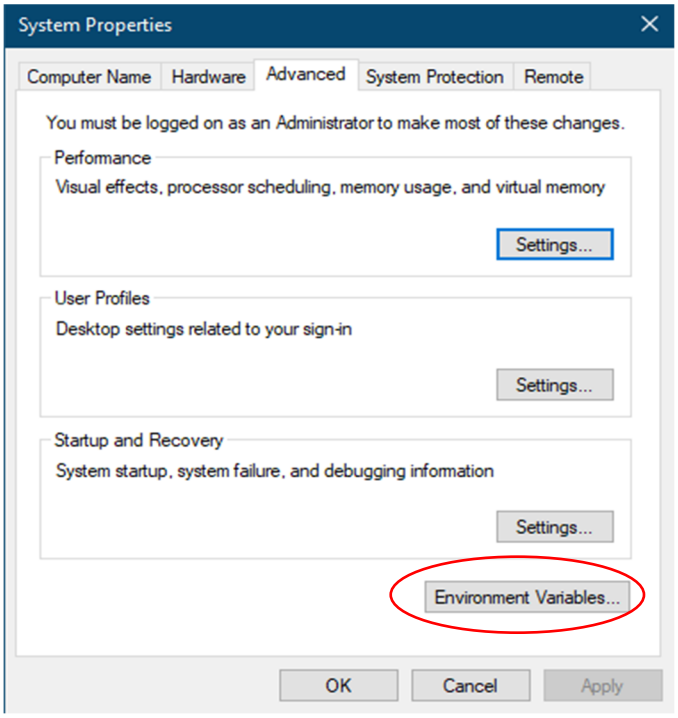
- go to the Windows Start Menu search bar and enter

  edit the system environment variables



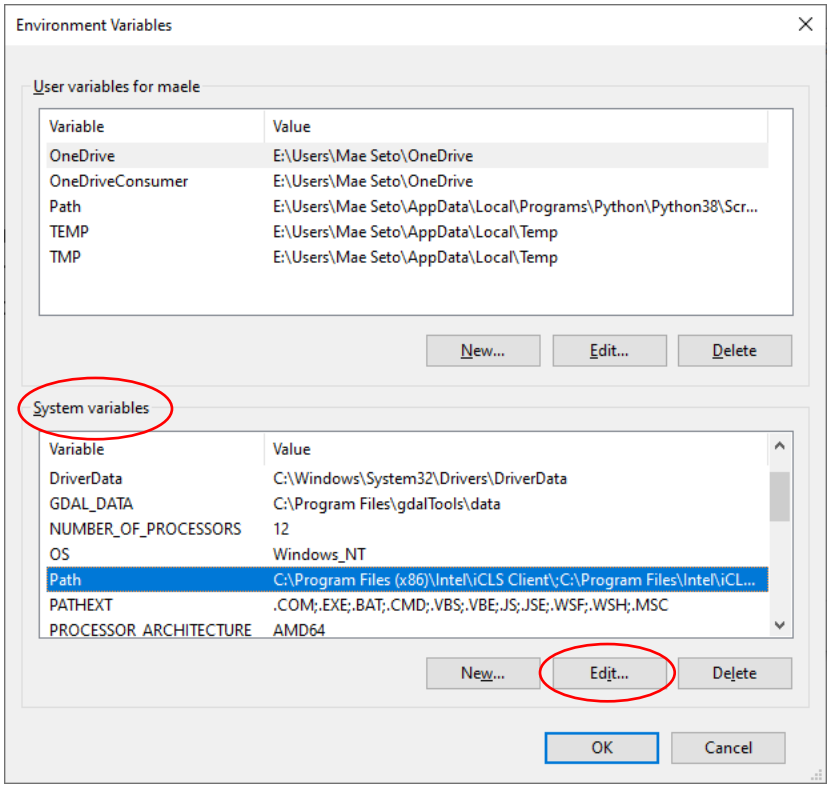
  select 'Edit the system environment variables'

this spawns a box titled **System Properties**



select **Environment Variables**

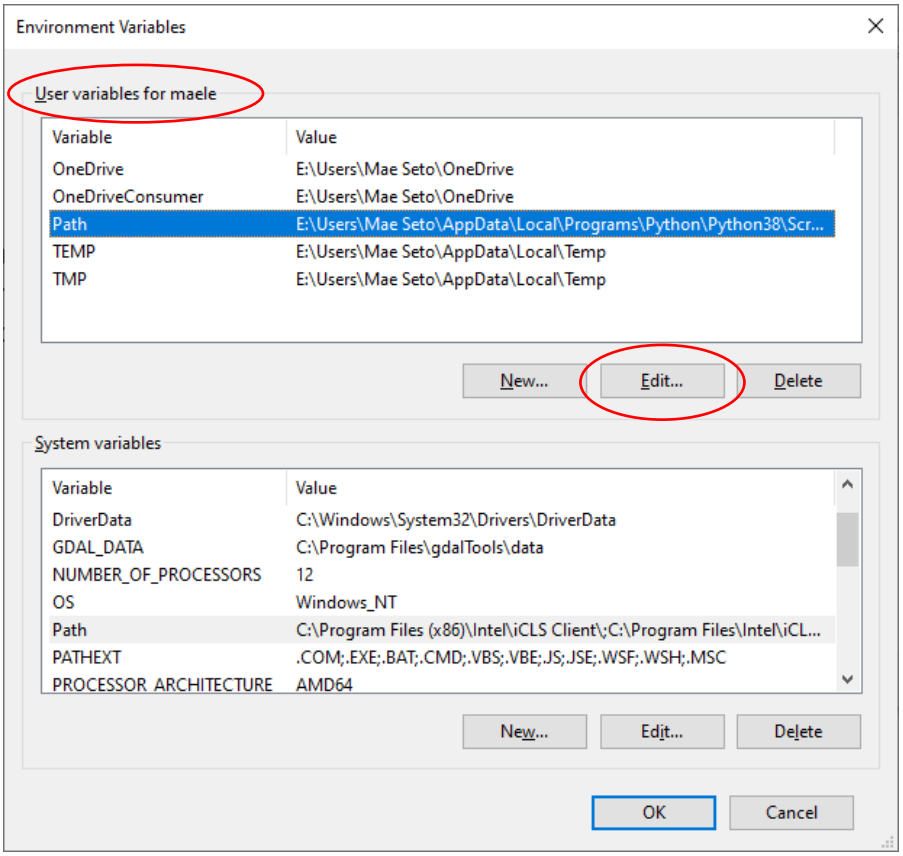
this spawns a box titled **Environment Variables**



go to 'System variables', select 'Path' (as highlighted) and enter 'Edit'

Add the direct paths to both your \bin and \at folders (you can 'Browse' to each folder or copy the path from Explorer and enter it under 'New')

Now, do the same under 'User Variable' in the 'Environment Variables' box, i.e.



Add the direct paths to both your \bin and \at folders (you can 'Browse' to each folder or copy the path from Explorer and enter it under 'New')

The Acoustic Toolbox is now installed.

3. Install Jupyter Notebook

Get a Command Prompt to install the Jupyter notebook

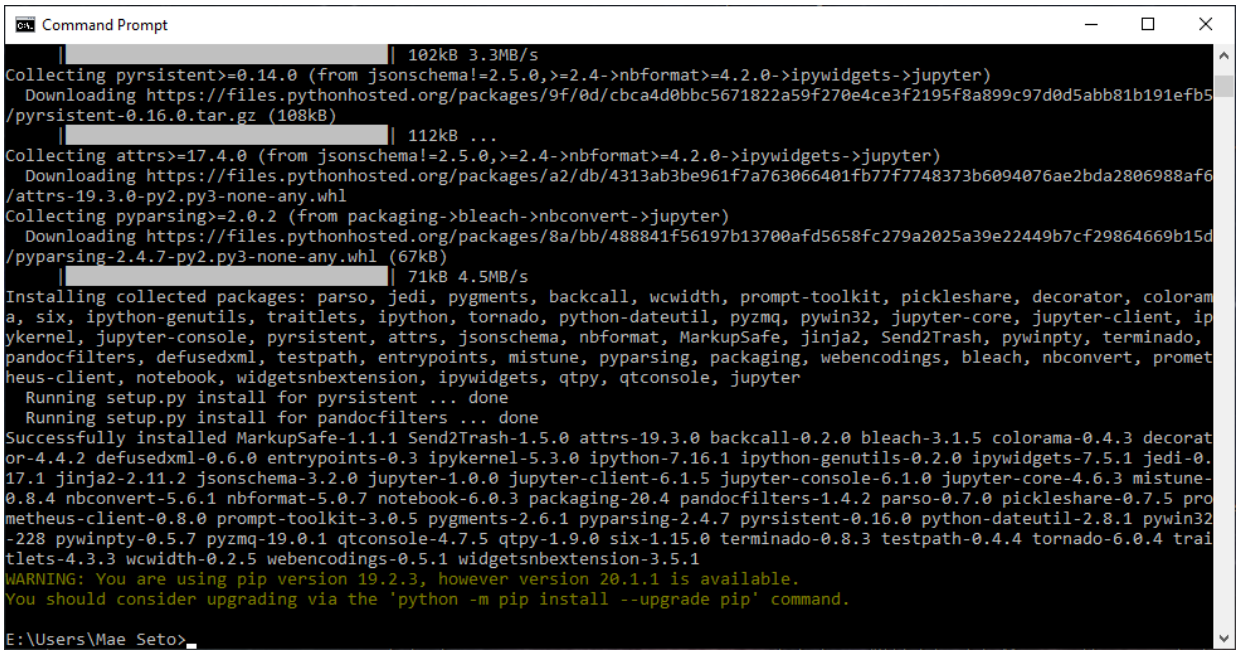
> *pip install jupyter*

[if python has been installed properly then this should work, test with

> *python --version*

]

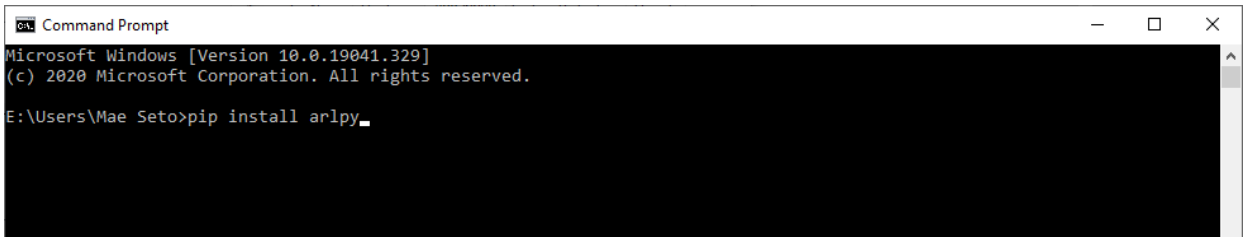
when done it should look like:



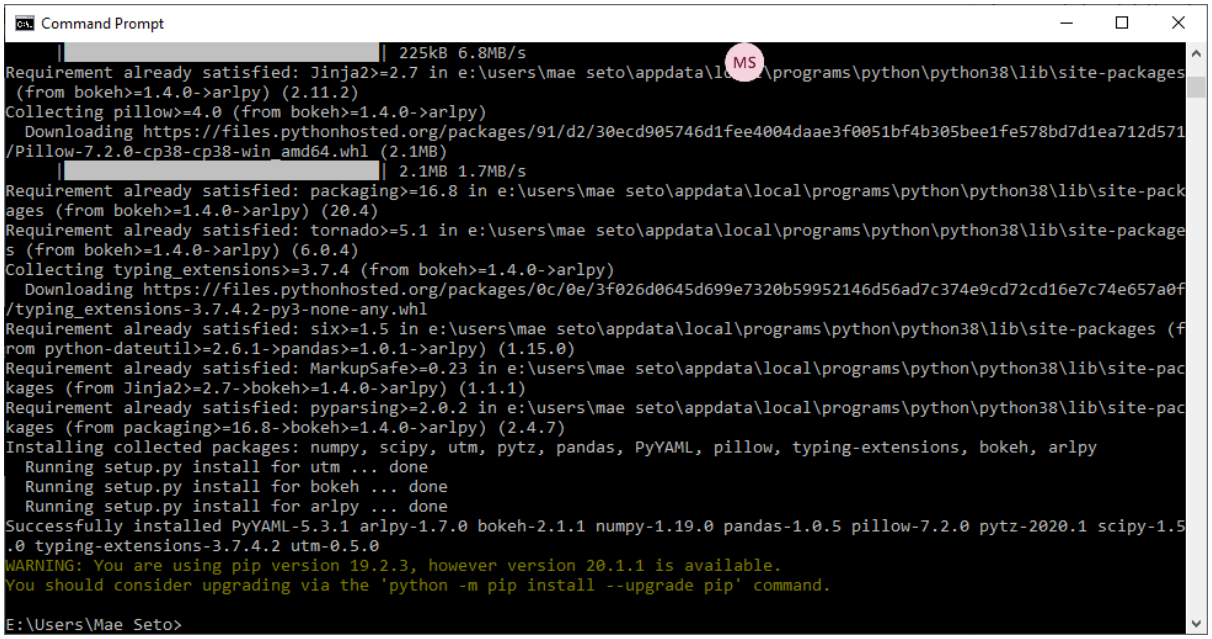
4. Install the arlpy python package

- install using below commands.

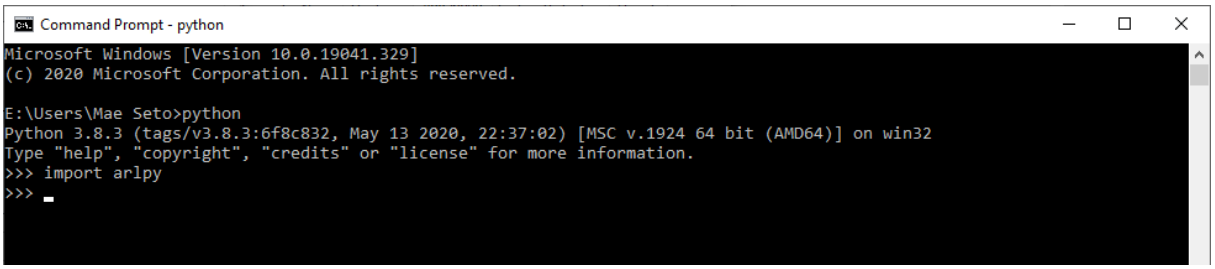
> *pip install arlpy*



when done, it should look like:



Now enter ‘python’ in the command prompt and then, ‘import arlpy’



when you see ‘>>>’ it is correctly done.

The arlpy package has been installed.

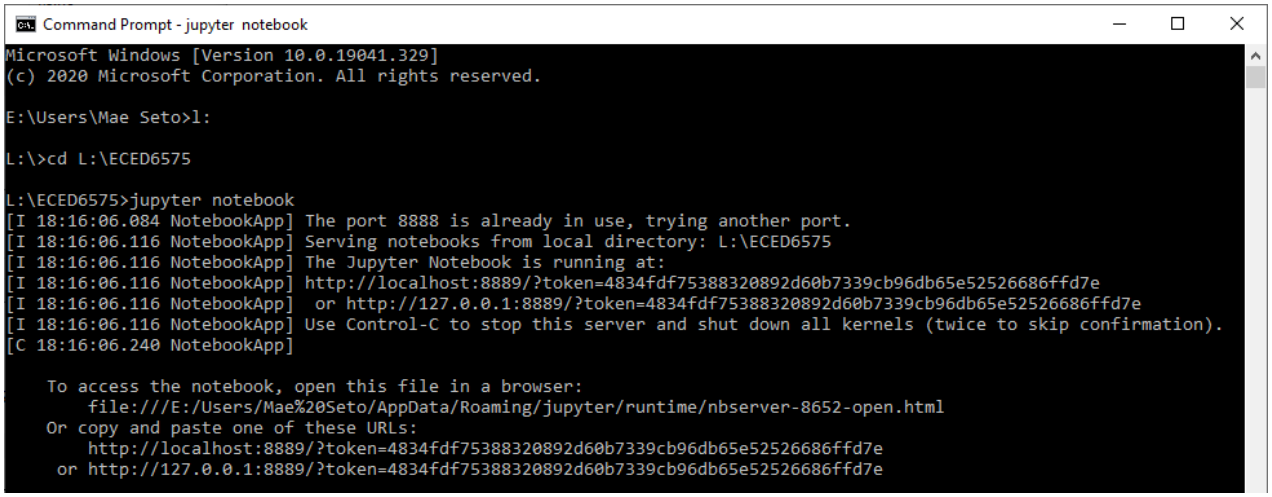
5. Running Bellhop in a Jupyter Notebook

Download the bellhop jupyter notebook, bellhop.ipynb, from the class sharepoint to a convenient location on your local drive.

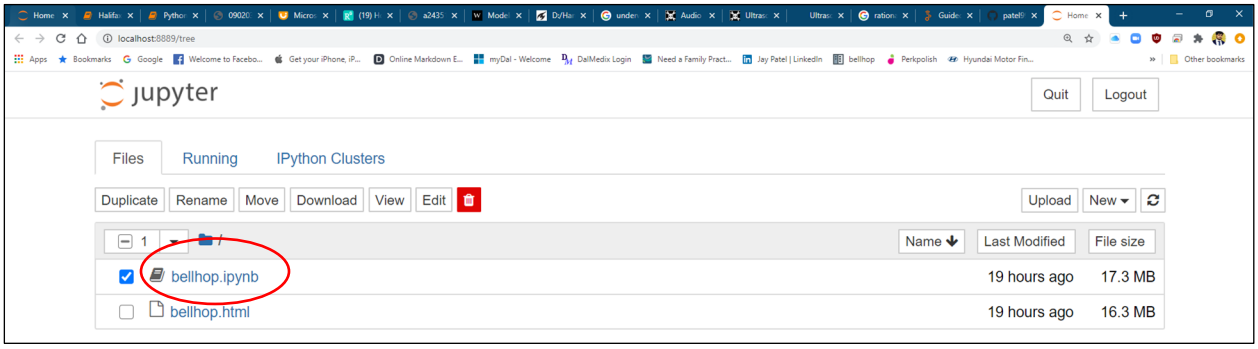
In a Command Prompt window, cd to the directory where you have stored this jupyter notebook. Then launch jupyter notebook as follows:

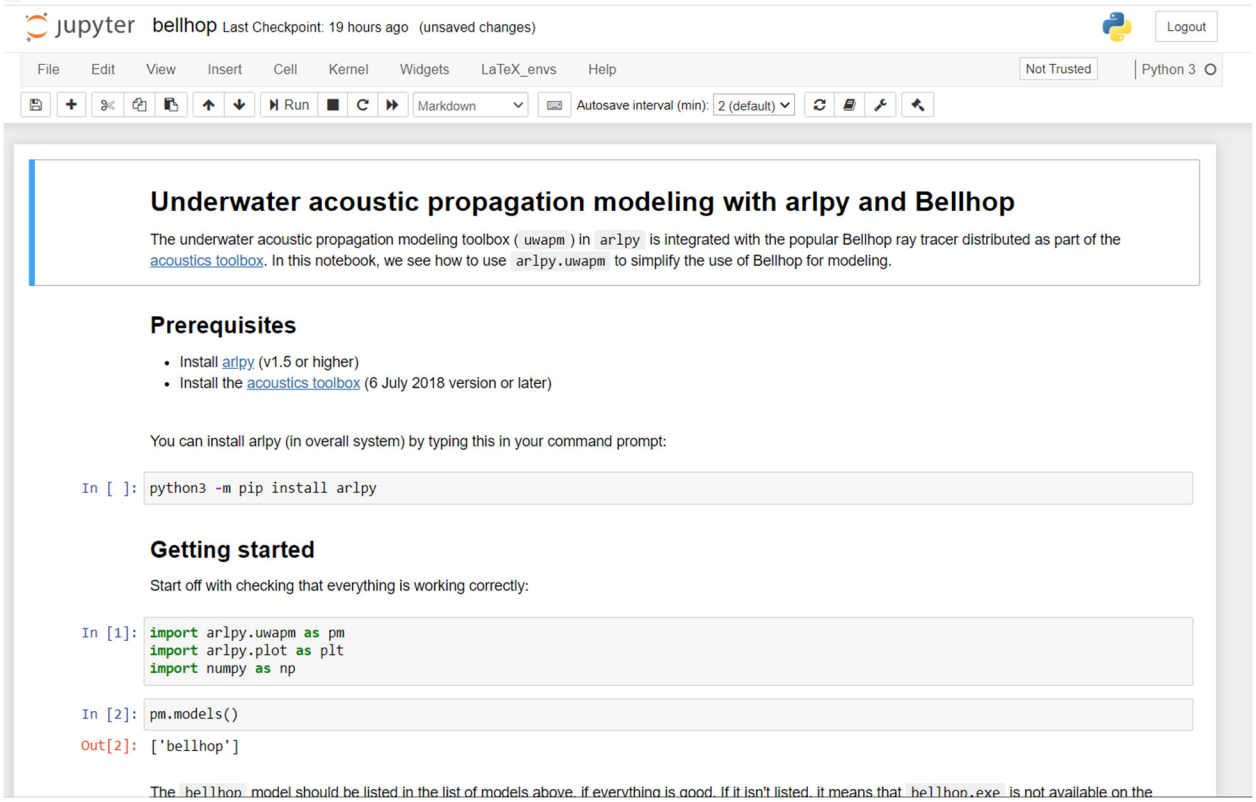
> *jupyter notebook*

It should appear as follows:



This will launch an interactive python notebook in your default browser. Click on the file name `bellhop.ipynb` and it will bring up the sample notebook which facilitates running the basic Bellhop.





Everything works:
You should see the following output upon running 'pm.models()':

```
In [2]: pm.models()
Out[2]: ['bellhop']
```

The `bellhop` model should be listed in the list of models above, if everything is good. If it isn't listed, it means that `bellhop.exe` is not available on the PATH, or it cannot be correctly executed. Ensure that `bellhop.exe` from the acoustics toolbox installation is on your PATH (updated `.profile` or equivalent, if necessary, to add it in).

From here on we assume that the `bellhop` model is available, and proceed...

Trouble-shooting

If you run `pm.models()` and it returns `[]` (empty array), it means your bellhop is not in either the system or user path. Please check this.

The `bellhop` model should be listed in the list of models above when everything works. If it is not listed, it means that `bellhop.exe` is not available on the PATH, or it cannot be correctly executed. Ensure that `bellhop.exe` from the acoustics toolbox installation is on your PATH.
From here on we assume that the `bellhop` model is available, and proceed...

We will go over running Bellhop in class. Please try to install as much as you can.

APPENDIX A: Script to run Bellhop in python

put the following into a .py file to run it:

```
import os
import sys
import arlpy.uwapm as pm
import arlpy.plot as plt
import numpy as np

pm.models()

env = pm.create_env2d()
pm.print_env(env)

pm.plot_env(env, width=900)
```