

Delta-X Applications Workshop Instructions

Table of Contents

Section 1: Introduction	2
Section 2: Tutorials	4
Section 3: QGIS	6
Installing QGIS	6
Testing QGIS	8
Section 4: Python	10
Installing Anaconda	10
Installing Packages	11
Testing Jupyter Notebook	16
Section 5: ANUGA	19
Installing ANUGA software	19
Section 6: Delft3D	22
Installing Delft3D	22
Section 7: Google Colab	23
Setting up Colab	23
Section 8: Data Access	30
Module Data	35
Field Data	35
AVIRIS-NG	36
AirSWOT	36
UAVSAR	38
ANUGA	40
Delft3D	39

Section 1: Introduction



The Delta-X mission is a 5-year NASA Earth Venture Suborbital-3 mission to study the Mississippi River Delta in the United States, which is growing and sinking in different areas. River deltas and their wetlands are drowning as a result of sea level rise and reduced sediment inputs. The Delta-X mission will determine which parts will survive and continue to grow, and which parts will be lost. Delta-X begins with airborne and in-situ data acquisition and carries through data analysis, model integration, and validation to predict the extent and spatial patterns of future deltaic land loss or gain.

The Applications Workshop Delta-X introduction slides and recordings are linked here:

- [Delta-X Applications Workshop Opening \(Agenda\)](#)
- [Delta-X Overview](#)
- [Delta-X Data Management Plan and Data Access](#)
- [Delta-X Applications Workshop Introduction Recording](#)

You can find more information about the Delta-X mission and datasets here:

- [2021_Delta-X_Open_Data_Workshop_Introduction.pdf](#) (Introduction to Delta-X)
- [2021_Delta-X_Open_Data_Workshop_Datasets.pdf](#) (Info on Delta-X datasets)
- [2021_Delta-X_Open_Data_Workshop_ORNL_DAAC.pdf](#) (Introduction to ORNL archive)
- [2021_Delta-X_Open_Data_Workshop_Website.pdf](#) (Introduction to DeltaX website)

Affiliation: Jet Propulsion Laboratory, California Institute of Technology

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These instructions were provided specifically for participants in the 2-day workshop but may not be relevant beyond that. The ORNL DAAC cannot support the platforms that were specific to the workshop.

Workshop Overview:

This workshop introduces users to Delta-X datasets and steps for analyzing field, airborne, and modeling datasets. These tutorials do not require any previous experience, but if you wish to explore these datasets further, experience with Python, GIS, and remote sensing would be beneficial.

These tutorials are designed to be used in [Google Colab](#), an only version of Jupyter Notebook, that requires no installation or data download. The only requirements are a

Google account and internet access. If you don't wish to install the software on your personal computer, please skip to Section 4: Google Colab.

However, this manual includes steps to install all software needed for the tutorials for participants who want to run the tutorials on their own computers. Installation instructions should work for Mac, PC, and Linux, but specific configuration of your computer may lead to unexpected difficulties. We've done our best to address common issues but can't guarantee that installation will work for every computer.

Software:

QGIS – Open-source GIS software for visualizing and processing geospatial data

Python – Open-source software for installing multiple Python tools

ANUGA – Open-source python-based modeling software

Delft3D – Open-source C and Fortran-based modeling software

Your instructors:

Field Data – Alex Christensen

AVIRIS-NG – Daniel Jensen

AirSWOT – Michael Denbina

UAVSAR – Talib Oliver Cabrera

ANUGA – Kyle Wright

Delft3D – Luca Cortese

To start installing, please download the Installation_Files., which can be downloaded [here](#). Create a new folder on your computer (DeltaX_Workshop), and move everything into DeltaX_Workshop, which will be your working directory.

Installation_Files

- QGIS
 - Test_raster.tif (an example raster file for testing your QGIS installation)
- Python
 - Test_data.ipynb (an example notebook for testing your Python installation)
- ANUGA
 - anuga_core-main.zip (installation file for ANUGA)
- Delft3D
 - Delft3D Hydro-Morphodynamics 4.04.01 Windows.zip (installer)
 - Delft3D_workshop_Delta-X project.lic (license file)
 - Delft3D-Installation_Manual.pdf (additional installation manual)

Section 2: Tutorials

There are 6 tutorials in the workshop, one for each of the data and model components. Each tutorial contains a few modules. You can follow these tutorials directly using the github links or you can watch the recordings for more detailed instructions. You will find links to slides, python notebooks, and recordings for each tutorial below.

All tutorials except Delft3D are designed to run in Google Colab, which can be setup using instructions in **Section 7**. However, for more customizable and in-depth analysis, we recommend installing software and downloading data to run these notebooks on your own computer. Instructions for installing software are described in **Sections 3-6 (QGIS, Python, ANUGA, Delft3D)**, and the data download instructions are described in **Section 8** (the file path in the notebooks must be changed to the appropriate directory on your own computer).

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Tutorial 1: Field Data

Instructor: Alex Christensen

Notebooks:

https://github.com/ornldaac/deltax_workshop_2022/tree/main/tutorials/DeltaXWorkshop_Field

Slides:

https://github.com/ornldaac/deltax_workshop_2022/blob/main/slides/DeltaX_FieldData_Apps_Workshop_Christensen.pdf

Recording: <https://youtu.be/22OaPduBsb8>

Tutorial 2: AVIRIS-NG

Instructor: Daniel Jensen

Notebooks:

https://github.com/ornldaac/deltax_workshop_2022/tree/main/tutorials/DeltaX_Workshop_AVIRIS-NG

Slides:

https://github.com/ornldaac/deltax_workshop_2022/blob/main/slides/DeltaX_AVIRISNG_Apps_Workshop_Jensen.pdf

Recordings:

Part I: <https://youtu.be/Ht9JdXmzKZI>

Part II: <https://youtu.be/Ddkd2B7YG0Q>

Tutorial 3: AirSWOT

Instructor: Michael Denbina

Notebooks:

https://github.com/ornldaac/deltax_workshop_2022/tree/main/tutorials/DeltaX_Applications_Workshop_AirSWOT

Slides: N/A

Recording: <https://youtu.be/PkuNEhInoQo>

Tutorial 4: UAVSAR

Instructor: Talib Oliver Cabrera

Notebooks:

https://github.com/ornldaac/deltax_workshop_2022/tree/main/tutorials/deltax_applications_workshop

Slides: N/A

Recordings:

Part I: <https://youtu.be/WBjDbxfVQKI>

Part II: <https://youtu.be/q6BsX8Bezk>

Tutorial 5: ANUGA Model

Instructor: Kyle Wright

Notebooks:

https://github.com/ornldaac/deltax_workshop_2022/tree/main/tutorials/ANUGA_DXWorkshop

Slides:

https://github.com/ornldaac/deltax_workshop_2022/blob/main/slides/DeltaX_ANUGA_Apps_Workshop_Wright.pdf

Recording: <https://youtu.be/Vee-pPyRefg>

Tutorial 6: Delft3D Model

Instructor: Luca Cortese

Notebooks: https://github.com/ornldaac/deltax_workshop_2022/tree/main/tutorials/Delft3D

Slides:

https://github.com/ornldaac/deltax_workshop_2022/blob/main/slides/DeltaX_Delft3d_Apps_Workshop_Cortese.pdf

Recording: <https://youtu.be/RcGytRMDDIE>

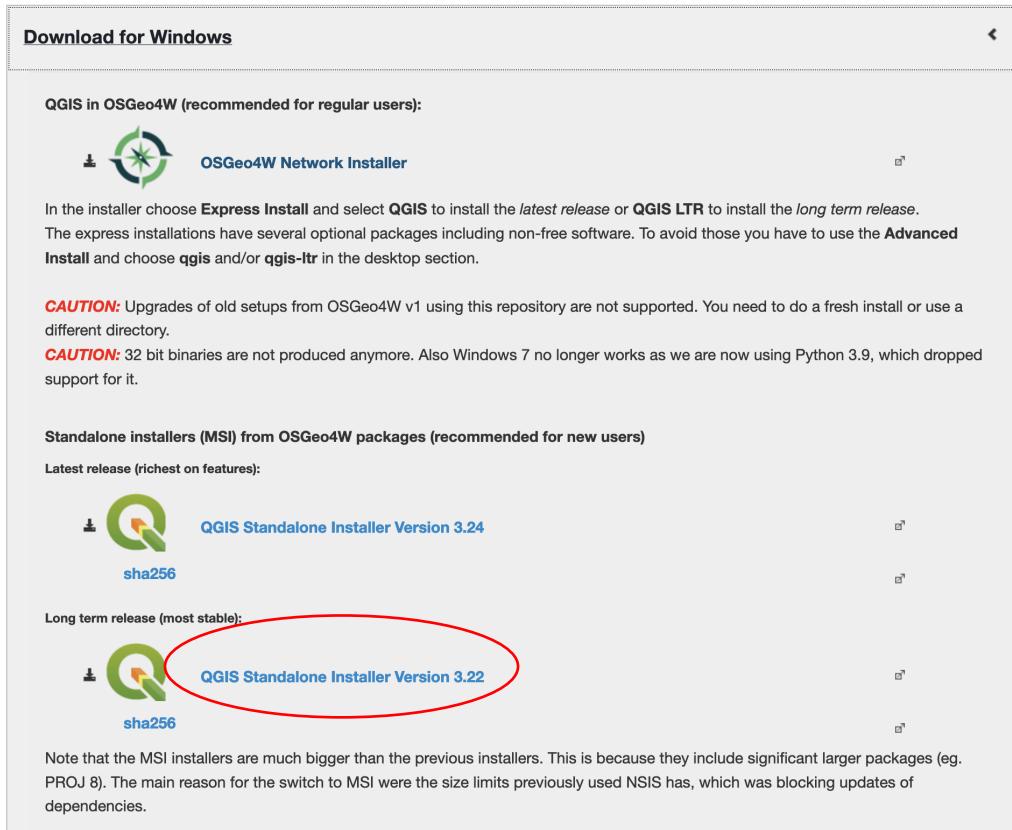
Section 3: QGIS

Installing QGIS

QGIS is a great tool for processing remote sensing data and especially useful for visualizing data quickly and effectively. It is open-source and can be downloaded here:

<https://qgis.org/en/site/forusers/download.html>

For Windows:



Download for Windows

QGIS in OSGeo4W (recommended for regular users):

 **OSGeo4W Network Installer**

In the installer choose **Express Install** and select **QGIS** to install the *latest release* or **QGIS LTR** to install the *long term release*. The express installations have several optional packages including non-free software. To avoid those you have to use the **Advanced Install** and choose **qgis** and/or **qgis-ltr** in the desktop section.

CAUTION: Upgrades of old setups from OSGeo4W v1 using this repository are not supported. You need to do a fresh install or use a different directory.

CAUTION: 32 bit binaries are not produced anymore. Also Windows 7 no longer works as we are now using Python 3.9, which dropped support for it.

Standalone installers (MSI) from OSGeo4W packages (recommended for new users)

Latest release (richest on features):

 **QGIS Standalone Installer Version 3.24**
sha256

Long term release (most stable):

 **QGIS Standalone Installer Version 3.22**
sha256

Note that the MSI installers are much bigger than the previous installers. This is because they include significant larger packages (eg. PROJ 8). The main reason for the switch to MSI were the size limits previously used NSIS has, which was blocking updates of dependencies.

We recommend the standalone installers, specifically Version 3.22

For Mac:

Download for macOS

Official All-in-one, signed installers

Mac Installer Packages for macOS High Sierra (10.13) and newer.

QGIS is not yet notarized as required by macOS Catalina (10.15) security rules. On first launch, please right-click on the QGIS app icon, hold down the Option key, then choose Open.

Latest release (richest on features):

 **QGIS macOS Installer Version 3.24**

Long term release (most stable):

 **QGIS macOS Installer Version 3.22**

Alternative build

 **macOS Installers**

Mac Installer Packages for macOS High Sierra (10.13) and newer.

Installation instructions are in the Read Me on the disk image. GDAL and Python (both included on the disk image) are installed separately and outside the QGIS app so they are usable on their own. These packages use the python.org Python 3 - other distributions are not supported.

We recommend Version 3.22

For Linux:

Download for Linux

For many flavors of GNU/Linux binary packages (rpm and deb) or software repositories (to add to your installation manager) are available. Please select your choice of distro below:

- [Debian/Ubuntu](#)
- [Fedora](#)
- [openSUSE](#)
- [RHEL, CentOS, Scientific Linux, ...](#)
- [Mandriva](#)
- [Slackware](#)
- [Arch Linux](#)
- [Flatpak](#)

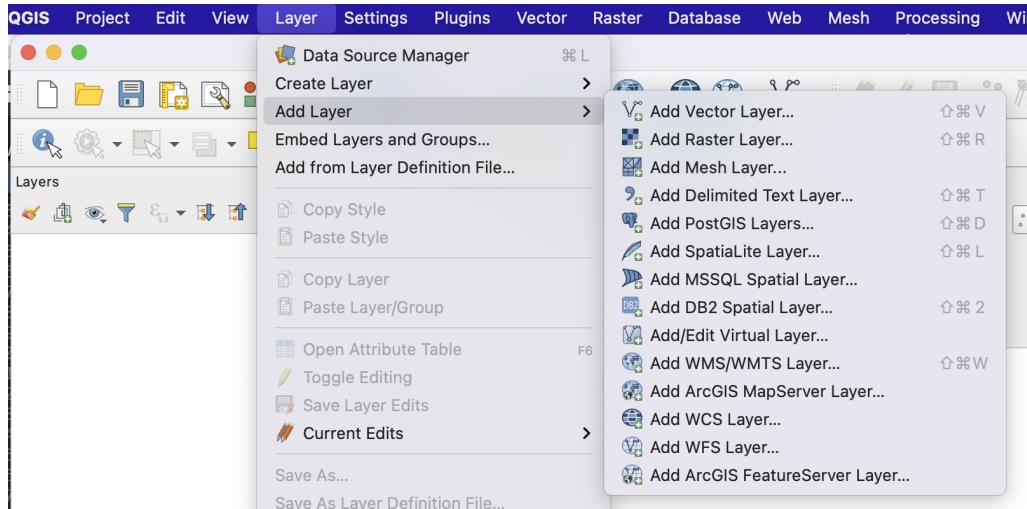
[Linux Installation Instructions](#)

Common issues:

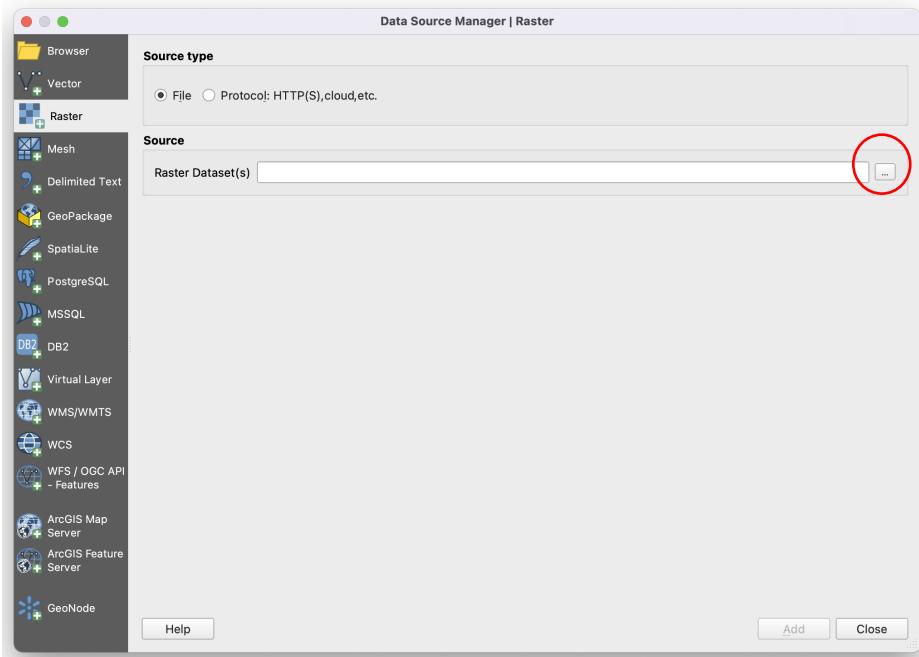
- If you're using a PC and get error 2503 or 2503, you need to set permissions on C:\\WINDOWS\\TEMP to Authenticated users = Full Control
 - More info [here](#)

Testing QGIS

Once you have installed QGIS, run the application. Find the **Layer** tab, select **Add Layer**, and then select **Add Raster Layer ...**



When the Data Source Manager window opens, browse through your files (click the button with three small dots) to find the DeltaX_Workshop/Installation_Files/QGIS/Test_Raster.tif file and click **Open**. Then click **Add** at the bottom of the Data Source Manager window.



If you have no issues visualizing the file and it looks similar to the image below (but maybe different colors), then QGIS is ready to go.



Section 4: Python

Python will be the most important tool for this workshop. It's easy to use, open-source, and has many packages that are great for geospatial analysis.

The combination of your operating system and the Python version you install will change your experience with installing packages. Several issues and solutions are discussed below, but remember you can always run the workshop tutorials through Google Colab (Section 4).

Installing Anaconda

Follow the installation instructions for your operating system:

For Windows:

<https://docs.anaconda.com/anaconda/install/windows/>

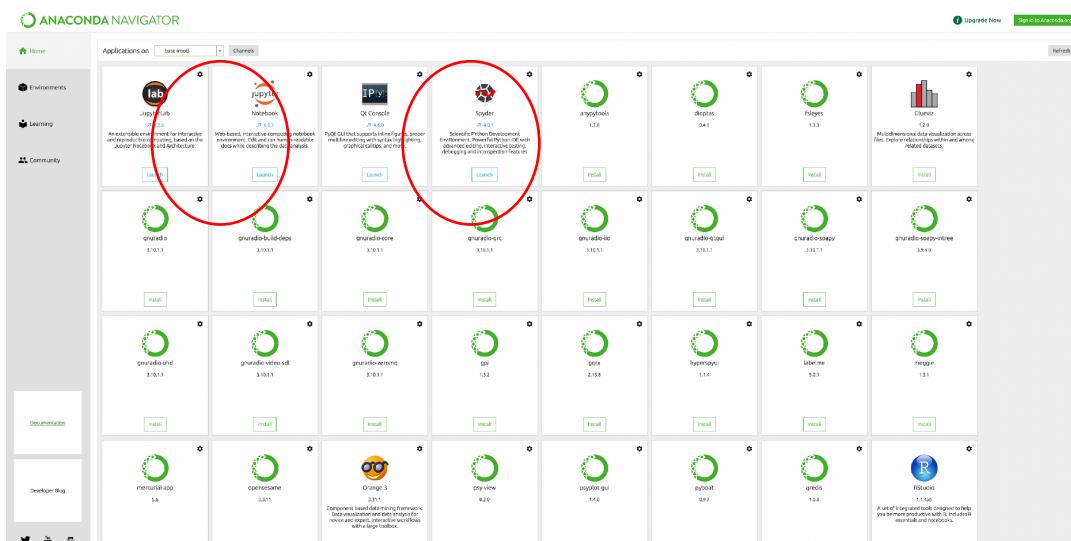
For Mac:

<https://docs.anaconda.com/anaconda/install/mac-os/>

For Linux:

<https://docs.anaconda.com/anaconda/install/linux/>

Once you have Anaconda installed, please test it by launching the application. You should see a window that looks similar to this (you should see Spyder and Jupyter Notebooks):

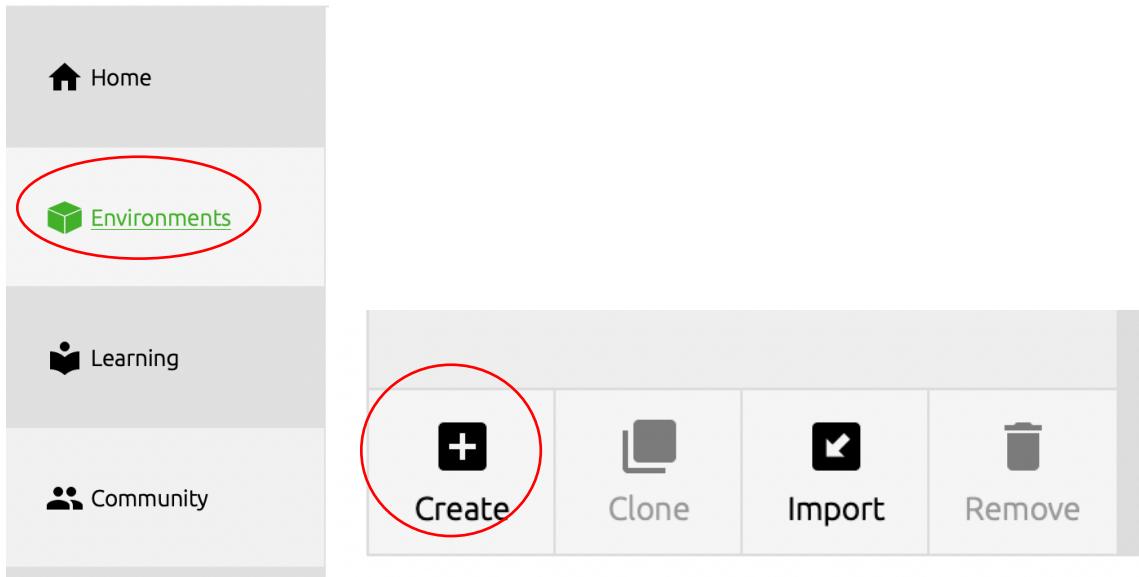


Installing Packages

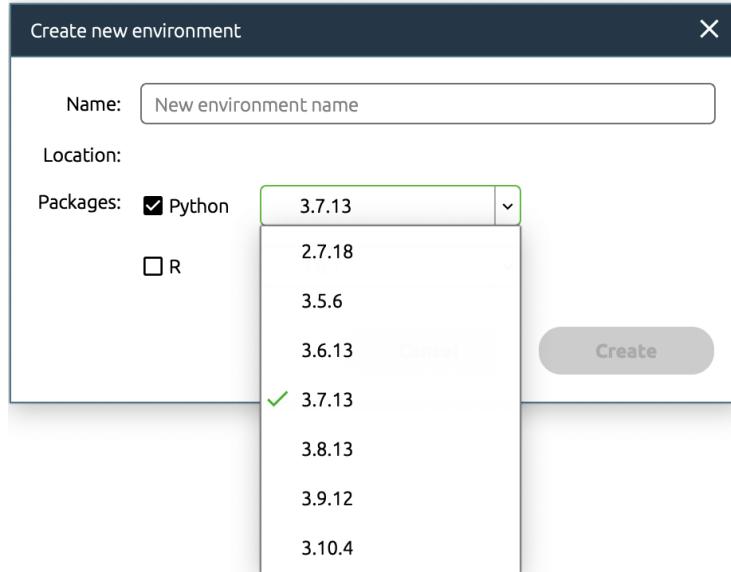
You will need several packages for the workshop, which can easily be installed via Anaconda or the command line. If you're comfortable with the command line, see instructions below. Either way, please try Python version 3.7 - this has the highest success rate so far. We'll discuss further below.

Install via Anaconda Navigator

First, start by creating a new environment. In Anaconda Navigator, you do this by going to the Environments tab and clicking Create.

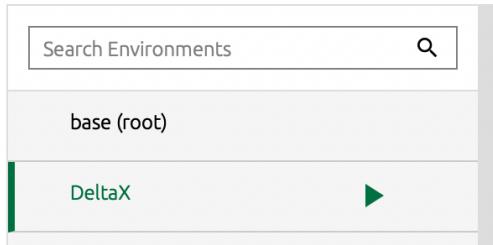


Give the new environment the name DeltaX.



Once you click Create, a new environment will be created (this may take some time).

You will now see the DeltaX environment list on the left. Select this environment and begin installing packages.



To install a package, select “Not installed” and search for each package.



Check the box next to the desired package and continue until you've selected of the following packages:

Numpy
Matplotlib
Gdal
Pandas
Geopandas
Scikit-learn
Scikit-image
Scipy

Cython
Netcdf4
Nose
Dill
Future
Gitpython
Jupyter
Rasterio

If you choose ‘Selected’ from the drop-down menu, you should see all of the packages selected for installation. Make sure to clear the search box to see all the selected packages. You can now click Apply at the bottom of the window and the packages will be installed.

Selected		Channels	Update index...	Search Packages 	
Name	Description				Version
 cython	The cython compiler for writing c extensions for the python language				0.29.9
 dill	Serialize all of python (almost)				0.3.4
 future	Clean single-source support for python 3 and 2				0.18.2
 gdal	Gdal is a translator library for raster and vector geospatial data formats that is released under an x/mit style open source license by the open source geospatial foundation.				3.4.2
 geopandas	Geographic pandas extensions.				0.9.0
 gitpython	Python git library				3.1.9
 google-colab					1.0.0
 jupyter	Jupyter metapackage. install all the jupyter components in one go.				1.0.0
 matplotlib	Publication quality figures in python				3.5.1
 netcdf4	Provides an object-oriented python interface to the netcdf version 4 library.				1.5.8
 nose	Nose extends unittest to make testing easier				1.3.7
 numpy	Array processing for numbers, strings, records, and objects.				1.9.3
 pandas	High-performance, easy-to-use data structures and data analysis tools.				1.4.2
 rasterio	Rasterio reads and writes geospatial raster datasets.				1.2.9
 scikit-image	Image processing routines for scipy.				0.19.2
 scikit-learn	A set of python modules for machine learning and data mining				1.0.2
 scipy	Scientific library for python				1.8.0

17 packages available 17 packages selected  

Install Via Command Line

You can also create a new environment and install the packages in the command line.

The biggest difference between MAC and PC command lines are the symbols / and \. For MAC, you use /. For PC, you use \ in the command line or \\ within python or jupyter notebook.

****Red font represents text to enter into the command line**

For Windows:

Open the command prompt (Start menu → search for ANACONDA prompt)

Within the window that opens, navigate to your working folder. For example:

`cd \PATH_TO_FOLDER\DeltaX_Workshop\Installation_Files\ANUGA\anuga_core-main`

You will need to change “PATH_TO_FOLDER” to be your own path for your working direction

For Mac:

Open a new terminal (Finder → Applications/Utilities/Terminal.app)

Within the window that opens, navigate to your working folder. For example:

`cd /PATH_TO_FOLDER/DeltaX_Workshop/Installation_Files/ANUGA/anuga_core-main`

You will need to change “PATH_TO_FOLDER” to be your own path for your working direction

```
Last login: Thu Apr 7 15:46:30 on ttys001
(base) Alchrist@iMac ~ % cd /users/alchrist/documents/DeltaX_Workshop/DeltaX_Prep %
(base) Alchrist@iMac DeltaX_Prep %
```

For Mac or Windows:

Once you have navigated to your working directory, type the following in the command window

`conda create --name DeltaX python=3.7 numpy matplotlib gdal pandas scikit-learn scikit-image cython scipy netcdf4 nose dill future gitpython jupyter rasterio`

When prompted with proceed ([y/n]?) type y

Some common issues:

- rasterio gives an error or hangs at “solving environment”
 - solution: remove rasterio from the list. If you successfully install the other packages, then you can try to “pip install rasterio”

When the new environment is created type:

`conda activate DeltaX`

If you need to add packages in the future, you can do this by running the following:

`conda install -c conda-forge XX` (where XX is the name of your package)

**If you have unresolvable issues with installing Python,
please go to the end of this document to find an alternative,
which uses Google Colab and doesn't require installing
Python.**

Testing Jupyter Notebook

Jupyter Notebook is a great tool for learning Python and testing code. Each training session in this workshop will have a notebook with pre-written code that you can run, modify, and take home for further study. Each segment of code is explained with text. Please take some time to test this notebook. Through this example, you'll learn how to install packages, get access to data on the Google Drive folder we've shared with you, and plot data. If you run into any errors, please let us know immediately so we can work out issues before you come to the workshop. We won't have time to work out Python issues during the workshop, so please be prepared to participate by asking questions before May 1st.

We will be using Jupyter Notebooks for these exercises. Please try launching Jupyter Notebook with the example file (Test_data.ipynb). To launch Jupyter, open your command line.

For Windows:

Open the command prompt (Start menu → search for ANACONDA prompt)

For Mac:

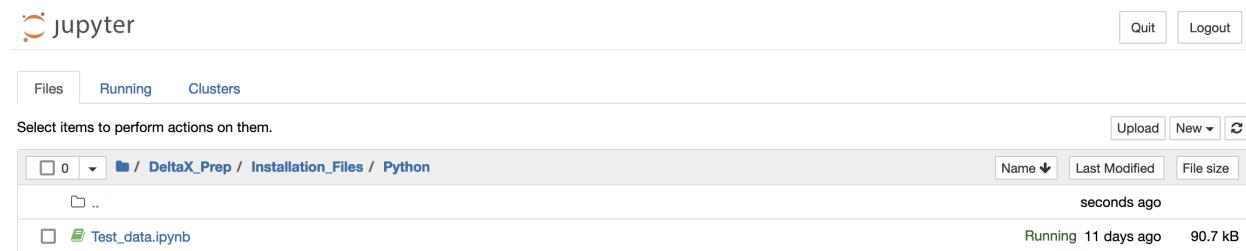
Open a new terminal (Finder → Applications/Utilities/Terminal.app)

For Windows and Mac:

Type this into your command line:

jupyter notebook

This should pull up a new tab in your web browser showing your home directory. Within this tab, please navigate to the folder 'DeltaX_Workshop/Installation_Files/Python' within the new folder you created earlier. Your window should look similar to this, with a different directory:



If you click on the Test_data.ipynb file, Jupyter Notebook will open in a new tab:

Delta-X Applications Workshop

Get familiar with Jupyter Notebook using the toolbox at the top.

First we must import packages

```
In [24]: import numpy as np
from osgeo import gdal
import pandas as pd
import rasterio
import matplotlib.pyplot as plt
```

You will need to change input_dir to the path where you QGIS files are stored

If you launch Jupyter Notebook through Anaconda, there are a few additional steps you need to take.

First, check if nb_conda_kernels is an installed package within your **base environment**. If not, please install it there.

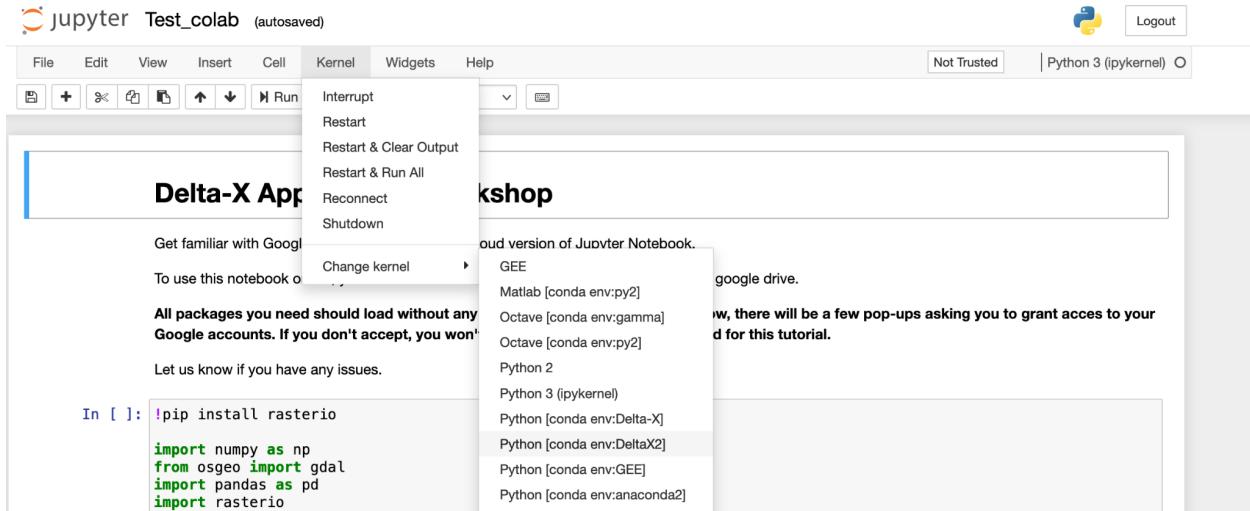
Name	Description	Version
nb_conda_kernels	Launch jupyter kernels for any installed conda environment	2.3.1

Second, check if ipykernel is installed in your **DeltaX environment**. If not, please install it there.

ipykernel	ipython kernel for jupyter	6.13.0
-----------	----------------------------	--------

Third, when you launch Jupyter Notebook through Anaconda, click on Kernel → Change kernel → and select the environment you created.

This should make all of your packages available within the Jupyter Notebook.



Section 5: ANUGA

Installing ANUGA software

ANUGA is an open-source hydrodynamic modeling software we will be using for one training session. It requires a few more steps for installation, building off of the DeltaX environment we installed earlier.

You can find more information about ANUGA here (https://github.com/GeoscienceAustralia/anuga_core), but instructions for a simple installation are detailed below.

You will find the anuga_core-main.zip file in the DeltaX_Prep/ANUGA folder included with these instructions. Please unzip this file, creating a folder called anuga_core-main

Please avoid using spaces in your folder names.

Before installing this software, you will need to install a few additional packages. This must be done from the command line.

The biggest difference between MAC and PC command line are the symbols / and \. For MAC, you use /. For PC, you use \ in the command line or \\ within python or jupyter notebook

For Windows:

Open the command prompt (Start menu → search for ANACONDA prompt)

Within the window that opens, navigate to your working folder. For example:

cd \PATH_TO_FOLDER\DeltaX_Workshop\Installation_Files\ANUGA\anuga_core-main

You will need to change “PATH_TO_FOLDER” to be your own path for your working direction

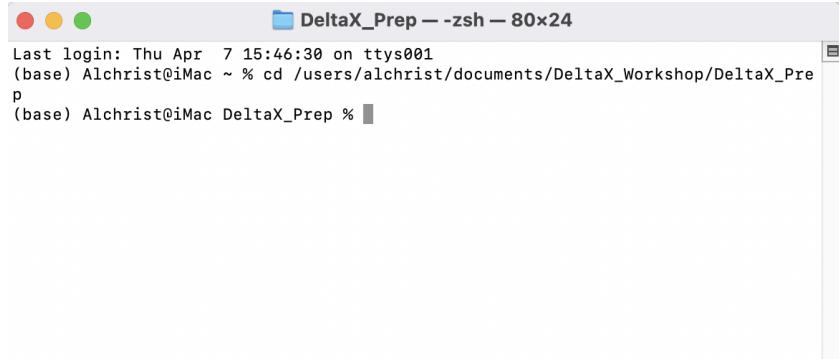
For Mac:

Open a new terminal (Finder → Applications/Utilities/Terminal.app)

Within the window that opens, navigate to your working folder. For example:

cd /PATH_TO_FOLDER/ΔελταX_Workshop/Installation_Files/ANUGA/anuga_core-main

You will need to change “PATH_TO_FOLDER” to be your own path for your working direction



```
Last login: Thu Apr  7 15:46:30 on ttys001
(base) Alchrist@iMac ~ % cd /users/alchrist/documents/DeltaX_Workshop/DeltaX_Prep
(base) Alchrist@iMac DeltaX_Prep %
```

For Windows and Mac:

Then you need to activate the python environment you created above. If you skipped that step, please go back and do it now.

Copy the following text into the Terminal and hit return:
conda activate DeltaX

We will now install a few additional packages.

Copy the following text into the Terminal and hit return:
pip install mpi4py triangle Pmw pymetis

If you are using a Mac with a newer installation, you may get an error installing mpi4py and pymetis with pip. If so, please try to conda install these two packages:

conda install -c conda-forge mpi4py pymetis
pip install triangle Pmw

If you are using a PC, you should also install a few additional packages, especially if you have issues:

conda install -c msys2 m2w64-toolchain
conda install -c msys2 libpython

Once completed, we will install ANUGA.

Copy the following text into the Terminal and hit return:
python setup.py install --user

Once completed, we will run some tests.

Copy the following text into the Terminal and hit return:

`python runtests.py`

If everything runs successfully, this command should finish with ‘OK’ and you are ready to use ANUGA for the workshop. If not, please reach out for assistance.

Section 6: Delft3D

Installing Delft3D

Delft3D is another open-source hydrodynamic modeling software that we will be using for the second training session. Unfortunately, Delft3D can only be used on Windows computers, so Mac/Linux users won't be able to install, but can follow along during the demonstration. In addition, we cannot provide executable or license files. For users interested in compiling Delft3D, please find more information to get started [here](#).

Section 7: Google Colab

Setting up Colab

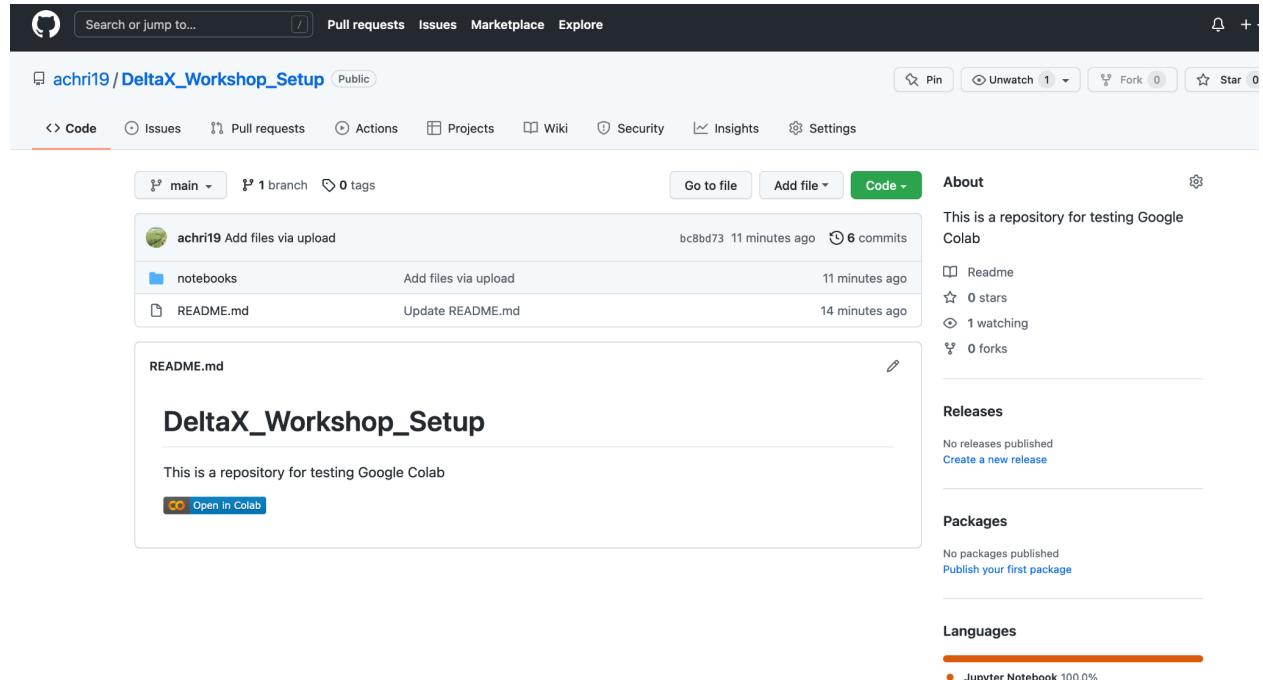
If you have any issues installing python packages, don't worry. We have a cloud version of the Python Notebooks that can be run online, using Google Colaboratory.

If you successfully installed Python and can run the test Jupyter Notebook, you can skip the steps below.

Google Colab is similar to Jupyter Notebooks, but is run on the Google cloud and comes with many packages already installed. Therefore, it's a great way to teach tutorials for this workshop. The only requirement will be allowing Colab access to your Google Drive. Unfortunately, Colab cannot access the files on your computer, so we will be accessing data through the shared Google Drive.

Please go through the following steps to practice using Colab.

- 1) Go to https://github.com/achri19/DeltaX_Workshop_Setup to find the Github site where we are hosting the test notebook.



You should not need a Github account to access this repository.

- 2) Click on the “Open in Colab” button within the README section.



- 3) This will open a new window and a beautiful test notebook.

```

Test_colab.ipynb
File Edit View Insert Runtime Tools Help
+ Code + Text Copy to Drive Share
RAM Disk Editing
Delta-X Applications Workshop
Get familiar with Google Colab, but it basically a cloud version of Jupyter Notebook.
To use this notebook online, you will need to Colab accres to your google account and google drive.
All packages you need should load without any issues. When you run the cell below, there will be a few pop-ups asking you to grant acces to your Google accounts. If you don't accept, you won't be able to access the files needed for this tutorial.
Let us know if you have any issues.

[2] !pip install rasterio
import numpy as np
from osgeo import gdal
import pandas as pd
import rasterio
import matplotlib.pyplot as plt
import os

```

- 4) Read the instructions

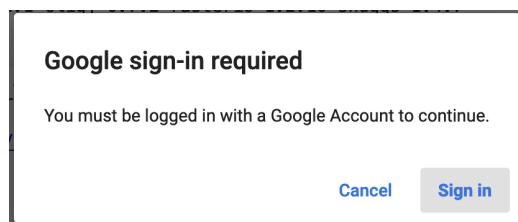
- 5) When you hover over the first gray box, you will see a “play” button in the upper left corner. **Click it** to run the first cell. You can also use a command to run this cell, often it's SHIFT + ENTER or CTRL+ENTER, depending on your system. If you hover over the “play” button, it will tell you what the command is.

```

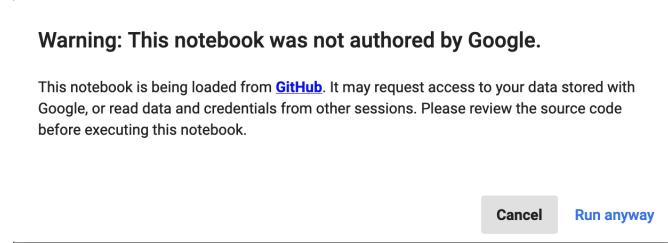
!pip install rasterio
import numpy as np
from osgeo import gdal
import pandas as pd
import rasterio

```

- 6) If you aren't currently signed into your Google Account, it will now ask you to sign in.



- 7) You will also be notified that this notebook is not built by Google. Please click “Run Anyway”

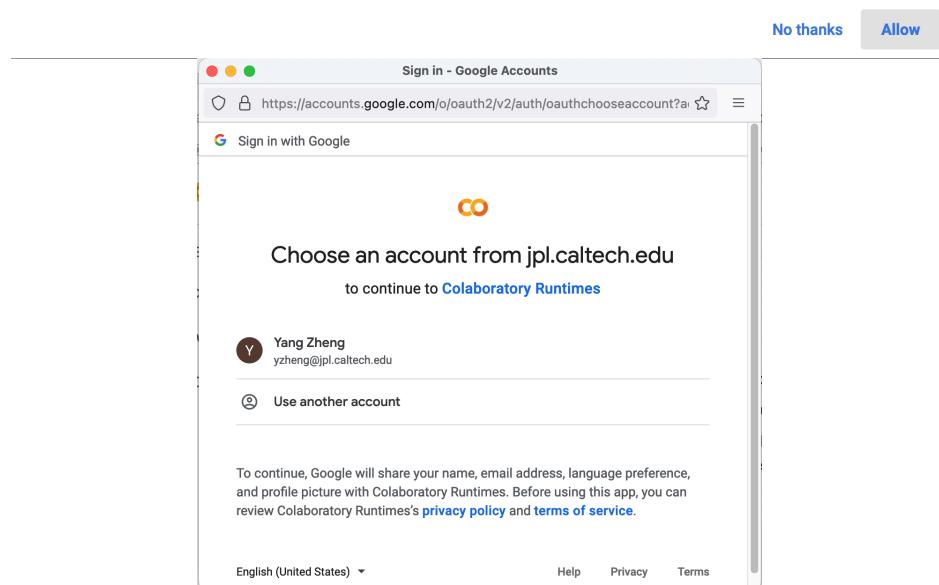


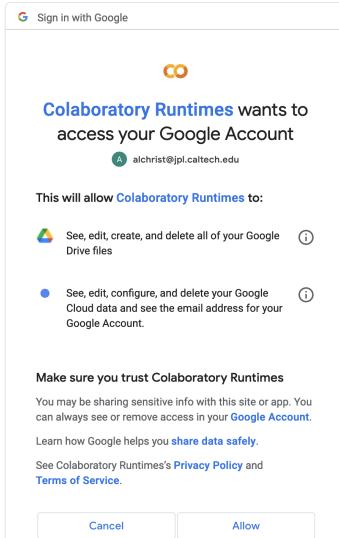
- 8) You will also be asked for 2 permissions to get access to your Google Credentials and Google Drive. If you don't allow it, you won't be able to access the files needed for the tutorial. You may be prompted to do this multiple times throughout the workshop.

First permission

Allow this notebook to access your Google credentials?

This will allow code executed in this notebook to access your Google Drive and Google Cloud data. Review the code in this notebook prior to allowing access.



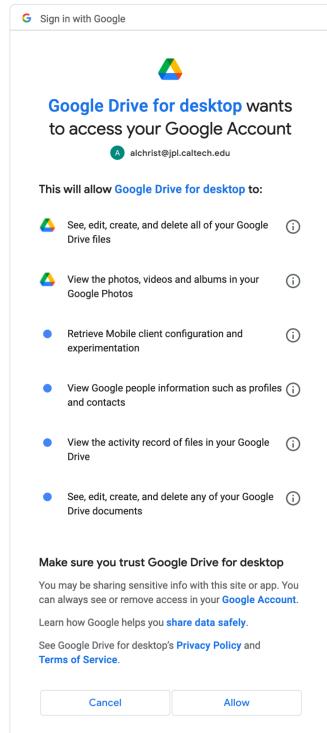


Second permission

Permit this notebook to access your Google Drive files?

This notebook is requesting access to your Google Drive files. Granting access to Google Drive will permit code executed in the notebook to modify files in your Google Drive. Make sure to review notebook code prior to allowing this access.

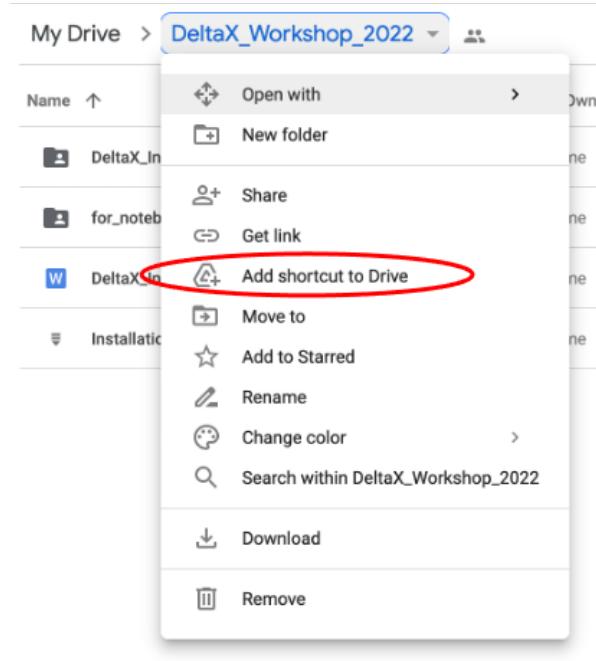
[No thanks](#) [Connect to Google Drive](#)



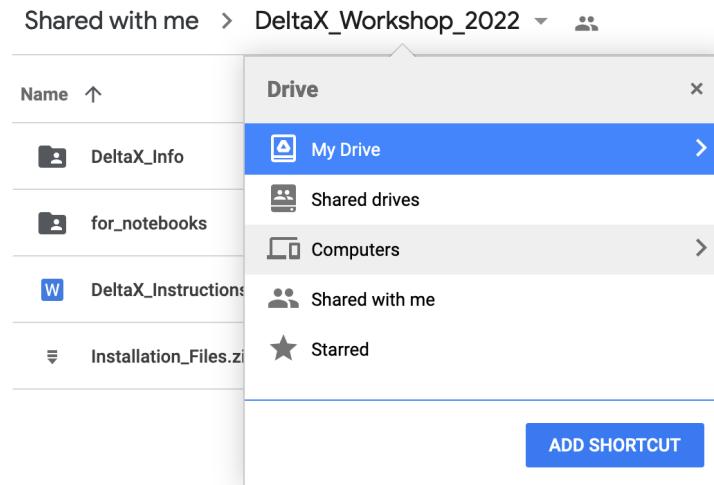
- 9) If the first cell runs smoothly, the packages should install and Colab should now have access to your Drive folders. You should see a small green check mark on the upper left corner if the cell ran successfully.

```
✓ [1] !pip in
      import
```

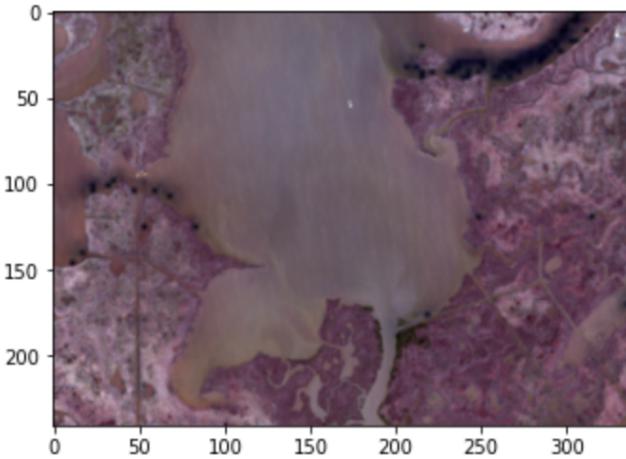
- 10) Next you will see instructions for linking the shared Google Drive (DeltaX_Workshop) to your Colab notebook. This is done by going to <https://drive.google.com/drive/folders/1KQIQPNowinFYQGd7SvpUE2sHPS0ALueV?usp=sharing> and adding a shortcut to your drive.



Make sure “My Drive” is highlighted, then click “ADD SHORTCUT”.



- 11) Then you can proceed to run the 2nd and 3rd cells in the notebook. If everything is connected properly, this should run without any problem and plot a map that looks like this:



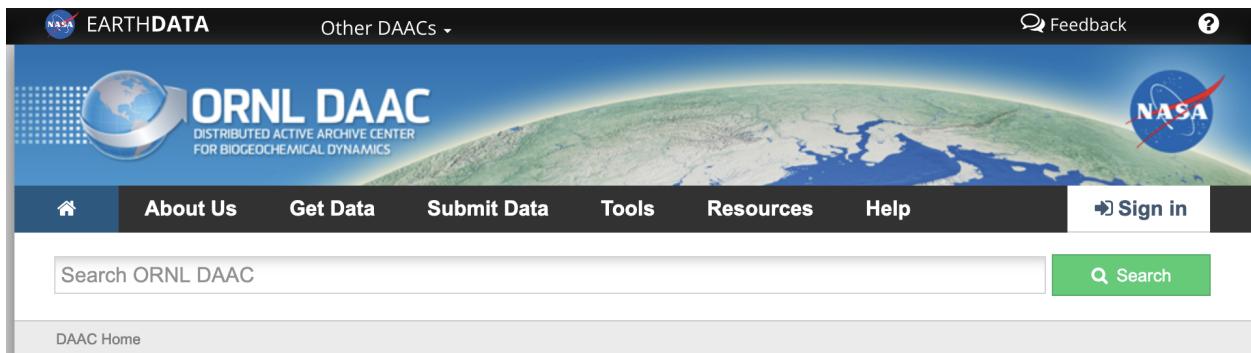
If you run into any problems with this process, please reach out to
alexandra.l.christensen@jpl.nasa.gov

Section 8: Data Access

Data collected as part of Delta-X are processed and quality assessed by the science team. Once this process is complete, data are curated and made publicly available through the Oak Ridge National Laboratory Distributed Active Archive Center. At this time, several datasets are available through the ORNL website (<https://daac.ornl.gov/>) and can be found by searching for “Delta-X”. However, most datasets are still in preprint form and await final approval before release. As part of this workshop, you will be given direct access to these data with the understanding that these data are preliminary and not yet approved for final release.

In order to access data through the ORNL DAAC, you will need to create a NASA Earth Data account.

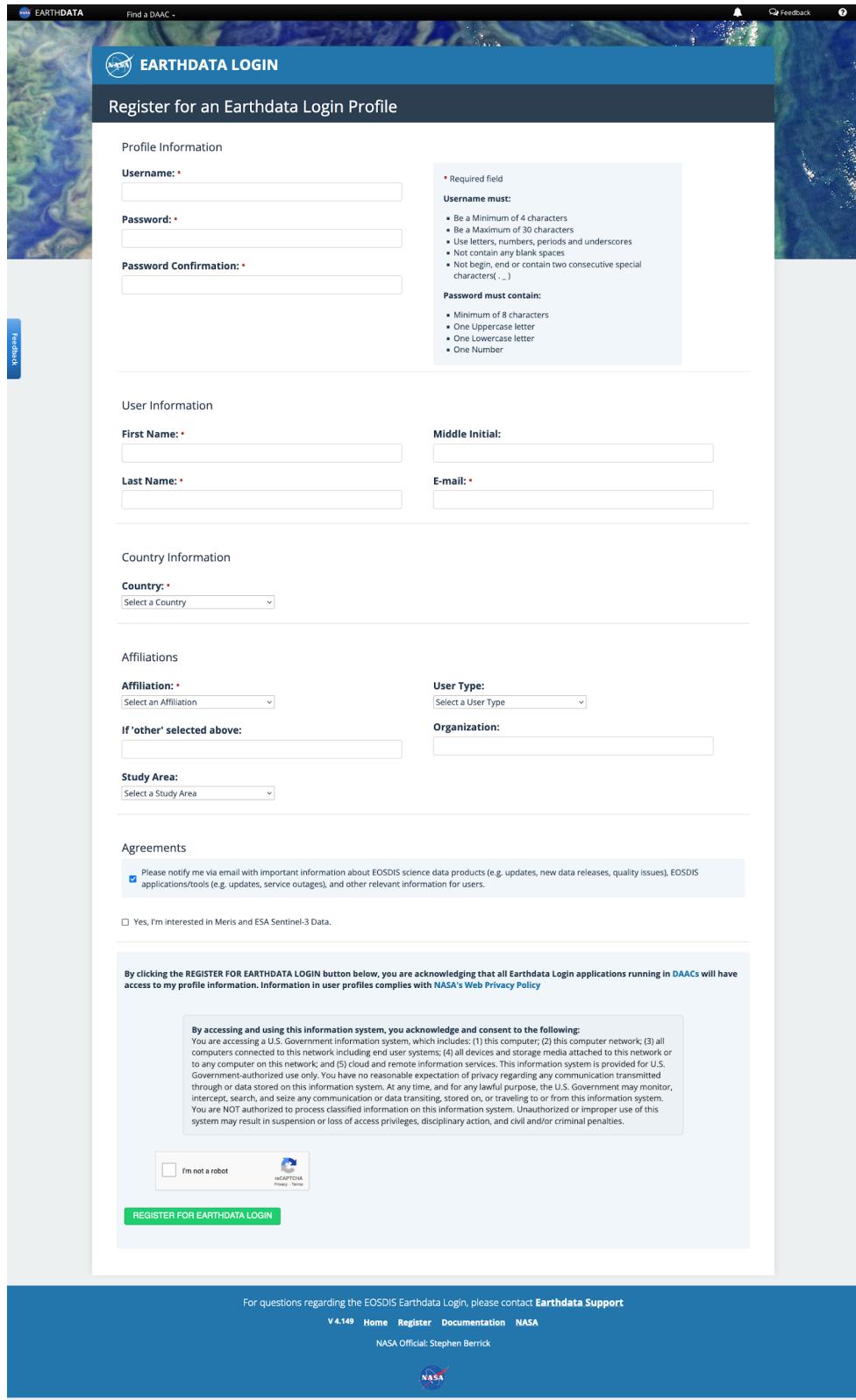
When you reach the ORNL website (<https://daac.ornl.gov/>), you will see a **Sign in** button.



Clicking this takes you to a login page, where you can register for a Earth Data account (if you don't already have one)

 A screenshot of the Earthdata Login page. The top navigation bar includes the NASA Earthdata logo and the text "EARTHDATA LOGIN". The main content area has a blue header with the ORNL DAAC logo. Below the header, a message states: "You are logging on to the Oak Ridge National Laboratory Distributed Active Archive Center (ORNL DAAC)". The login form contains fields for "Username" and "Password", both with placeholder text. There is a checked checkbox for "Stay signed in (this is a private workstation)". Below the form are two buttons: "LOG IN" (green) and "REGISTER" (blue). To the right of the form is a sidebar with the title "Why must I register?". It explains that the Earthdata Login provides a single mechanism for user registration and profile management for all EOSDIS system components (DAACs, Tools, Services). It also mentions that the login helps the EOSDIS program better understand user usage through customization of tools and improvement of services. The sidebar notes that EOSDIS data are openly available to all and free of charge except where governed by international agreements.

To create your account, click on the blue REGISTER button then fill out the registration form.

The screenshot shows the 'Register for an Earthdata Login Profile' page. It has a blue header with the NASA Earthdata logo and a search bar. The main form is divided into sections: 'Profile Information' (Username, Password, Password Confirmation), 'User Information' (First Name, Middle Initial, Last Name, E-mail), 'Country Information' (Country dropdown), 'Affiliations' (Affiliation and User Type dropdowns, plus fields for 'If 'other' selected above' and 'Study Area'), 'Agreements' (checkboxes for email notifications and interest in Meris and ESA Sentinel-3 Data), and 'By clicking the REGISTER FOR EARTHDATA LOGIN button below, you are acknowledging that all Earthdata Login applications running in DAACs will have access to my profile information. Information in user profiles complies with NASA's Web Privacy Policy'. At the bottom, there's a reCAPTCHA field, a 'REGISTER FOR EARTHDATA LOGIN' button, and a footer with links to Earthdata Support, version information, and NASA.

Once you have registered and logged in, you can begin by searching the archive using the search box near the top. The spring ADCP dataset will be used as an example.

Delta-X ADCP

Data **Website**

Found 2 results

Delta-X: Acoustic Doppler Current Profiler Channel Surveys, Coastal Louisiana, 2021
<https://doi.org/10.3334/ORNLDaac/1939>

This dataset provides river discharge measurements collected at selected locations in the Atchafalaya and Terrebonne Basins within the Mississippi River...

Pre-Delta-X: River Discharge Channel Surveys across Atchafalaya Basin, LA, USA, 2016
<https://doi.org/10.3334/ORNLDaac/1806>

This dataset provides river discharge measurements collected at selected locations across the Atchafalaya River Basin, within the Mississippi River Delta...

Earthdata Search

Page 1

You'll notice 2 datasets appear. The first is the one you will download. The second is a dataset from the Pre-Delta-X campaign in 2016.

By clicking on the first entry, you will be taken to the page for the ADCP dataset. This will show a brief description, dates of publication, a citation, and the data files available. If you see the banner "A newer version exists" please click on the DOI link provided:

DAAC Home > Get Data > NASA Projects > Delta-X > Landing page

Delta-X: Acoustic Doppler Current Profiler Channel Surveys, Coastal Louisiana, 2021

A newer version exists.

Click the DOI link in the following citation for the latest version (as of 0000-00-00):

Christensen, A.L., J.M. Mallard, J. Nghiem, M. Simard, T.M. Pavelsky, and M.P. Lamb. 2022. Delta-X: Acoustic Doppler Current Profiler Channel Surveys, MRD, Louisiana, 2021. ORNL DAAC, Oak Ridge, Tennessee, USA.
<https://doi.org/10.3334/ORNLDaac/2081>

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DAAC Home > Get Data > NASA Projects > Delta-X > Landing page

Delta-X: Acoustic Doppler Current Profiler Channel Surveys, MRD, Louisiana, 2021

Preprint This dataset is released as a preprint. The data are provisional. Read more [About Preprint Datasets](#)

Overview

DOI	https://doi.org/10.3334/ORNLDAAC/2981
Version	2
Project	Delta-X
Published	08/09/2021
Updated	2022-04-29
Usage	1 download

[Download Data \(73.9 MB\)](#) [User Guide](#)



[Keyhole Markup Language \(KML\) | Max Date | Terms of Use](#)

Description

This dataset provides river discharge measurements collected at selected locations in the Atchafalaya River Terminus Basin within the Mississippi River delta (MRD) region in coastal Louisiana, USA. The measurements were made during Delta-X surveys, which took place from 2021-03-26 to 2021-04-11 (spring) and 2021-08-17 to 2021-09-24 (fall). Channel surveys were conducted with a Teledyne RitePro acoustic doppler current profiler (ADCP) on selected wide channels (>100 m wide) and a few selected narrow channels (approximately 10 m wide) near the Delta-X intensive study sites. The data is provided in comma separated values (CSV) and Keyhole Markup Language (KML) formats.

Data Use and Citation

Christensen, A.L., J.M. Mallard, J. Nghiem, M. Simard, T.M. Pavelsky, and M.P. Lamb. 2022. Delta-X Acoustic Doppler Current Profiler Channel Surveys, MRD, Louisiana, 2021. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2981>

This dataset is openly shared, without restriction, in accordance with the [EO/SDS Data Use Policy](#). See our [Data Use and Citation Policy](#) for more information.

Data Files

Check the box next to the files you want to order and then click the 'Add Checked Items' button to order files. Click on the file link to see the file or save it. Click the 'Add Dataset' button to order the complete dataset.

36.9 MB in 773 files

Show 25	entries	Filter					
✓ Data File (Granule)	Size	Start Date	End Date	N Lat	S Lat	E Lon	W Lon
ADCP_20210325-154526_VLD_VP_MW_center_1_Rept1_Bathy.csv	58.2 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210325-154526_VLD_VP_MW_center_1_Rept1_Velocity.csv	1.1 MB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210325-155819_VLD_VP_MW_center_2_Rept2_Bathy.csv	45.6 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-134429_ATCHICWW_ICWW_A_000_Rept1_Bathy.csv	846.1 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-134429_ATCHICWW_ICWW_A_000_Rept1_Velocity.csv	18.9 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-134756_ATCHICWW_ICWW_A_000_Rept2_Bathy.csv	19.0 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-135242_ATCHICWW_ICWW_A_001_Rept1_Bathy.csv	13.4 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-135903_ATCHICWW_ICWW_A_001_Rept2_Bathy.csv	14.5 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-141120_ATCHICWW_ICWW_B_002_Rept1_Bathy.csv	15.9 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-141423_ATCHICWW_ICWW_B_002_Rept2_Bathy.csv	15.6 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-143117_ATCHICWW_ICWW_C_003_Rept1_Bathy.csv	9.1 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-143324_ATCHICWW_ICWW_C_003_Rept2_Bathy.csv	13.8 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-144146_ATCHICWW_Arch_A_004_Rept1_Bathy.csv	21.6 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-144736_ATCHICWW_Arch_A_004_Rept2_Bathy.csv	22.0 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-151639_ATCHICWW_Arch_B_005_Rept1_Bathy.csv	32.1 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-151616_ATCHICWW_Arch_B_005_Rept2_Bathy.csv	45.3 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-153754_ATCHICWW_Arch_C_006_Rept1_Bathy.csv	23.4 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-154391_ATCHICWW_Arch_C_006_Rept2_Bathy.csv	18.8 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-161645_ATCHICWW_Arch_D_007_Rept1_Bathy.csv	19.6 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-161651_ATCHICWW_Arch_D_008_Rept1_Bathy.csv	13.2 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-161746_ATCHICWW_Arch_D_008_Rept2_Bathy.csv	9.7 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-164116_ATCHICWW_Arch_E_019_Rept1_Bathy.csv	27.9 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-165436_ATCHICWW_Arch_E_019_Rept2_Bathy.csv	27.2 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-181493_ATCHICWW_ICWW_A_011_Rept1_Bathy.csv	9.9 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45
ADCP_20210326-181629_ATCHICWW_ICWW_A_011_Rept2_Bathy.csv	11.2 KB	2021-03-26	2021-09-24	29.66	29.16	-96.82	-91.45

Showing 1 to 25 of 773 entries

[Previous](#) [1](#) [2](#) [3](#) [4](#) [5](#) ... [31](#) [Next](#)

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Companion Files

Dataset has 1 companion files.

- [DeltaX_ADCP_Measurements_V2.pdf](#)

Version History

Version	Dataset Title	Published
1	Delta-X: Acoustic Doppler Current Profiler Channel Surveys, Coastal Louisiana, 2021	2021-10-29
2	Delta-X: Acoustic Doppler Current Profiler Channel Surveys, MRD, Louisiana, 2021	0905-06-40

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[NASA Projects](#) [All Datasets](#) [Data Scope and Acceptance Criteria](#) [Data Management](#) [News](#)

[Data Use and Citation Policy](#) [Acceptance Criteria](#) [Data Submission Policy](#) [Earthdata Forum](#) [CF](#)

[User Training Group](#) [Partners](#) [Data Submission Timeline](#) [Archive Data Visualizer](#) [Soil Moisture Visualizer](#) [Land + Water Checker](#)

[Guidelines](#)

You can download all of the data and the user guide using the green and blue buttons at the top of the page.



Or you can download individual files at the bottom of the page. You can use the filter search box to find specific files, then use the download button  to download individual files.

Data Files

Check the box next to the files you want to order and then click the 'Add Checked Items' button to order files. Click on the file link to see the file or save it. Click the 'Add Dataset' button to order the complete dataset.

305.9 MB in 773 Files

Show 25 entries

Filter:

		Size	Start Date	End Date	N Lat
<input type="checkbox"/>	ADCP_20210325-154526_WLO_VP_MW_center_1_Rep1_Bathy.csv	58.2 KB	2021-03-26	2021-09-24	29.60
<input type="checkbox"/>	ADCP_20210325-154526_WLO_VP_MW_center_1_Rep1_Velocity.csv	1.1 MB	2021-03-26	2021-09-24	29.60
<input type="checkbox"/>	ADCP_20210325-155519_WLO_VP_MW_center_2_Rep2_Bathy.csv	45.8 KB	2021-03-26	2021-09-24	29.60
<input type="checkbox"/>	ADCP_20210325-155519_WLO_VP_MW_center_2_Rep2_Velocity.csv	840.1 KB	2021-03-26	2021-09-24	29.60

Showing 1 to 4 of 4 entries (filtered from 773 total entries)

< Previous 1 Next >

This is an example of a preprint dataset that is also searchable. However, most of the datasets are only available as preprints that are not searchable on the ORNL website. Instead, we have provided direct links for participants in the Delta-X workshop. See below for more instructions.

Module Data

The datasets needed to run the modules in each tutorial using software installed on your own computer (not Google Colab) are listed below. Total file size will be larger than 15GB so make sure you have sufficient space on your device.

Data that are searchable on ORNL will be listed as such. Those that are available as preprints will have a direct link. The remaining datasets are hosted on Google Drive.

Each dataset has a user guide with detailed information about collection, processing, and data format.

Field Data

Please save each of these files into a folder in your working directory (FIELD).

- **Module 1: Biomass**

- The aboveground and belowground biomass datasets are searchable through ORNL DAAC. Please download both datasets.

The screenshot shows the Earthdata Search interface. A search bar at the top contains the text "deltax biomass". Below the search bar are two tabs: "Data" (which is selected) and "Website". A green button labeled "Search" is to the right of the search bar. The main area displays a search result for "Delta-X: Aboveground Biomass and Necromass across Wetlands in the MRD, LA, USA, 2021". Below the title is the DOI: <https://doi.org/10.3334/ORNLDaac/2000>. A thumbnail image of a grass sample is shown, along with a brief description: "This dataset contains total carbon, total nitrogen, and total phosphorus content of aboveground biomass (AGB) and necromass (AGN) samples collected from...". To the right of the description are two download icons: a blue document icon and a blue downward arrow icon. Below this result is another entry for "Delta-X: Belowground Biomass and Necromass across Wetlands in the MRD, LA, USA, 2021" with the DOI: <https://doi.org/10.3334/ORNLDaac/1999>. It also includes a thumbnail image of a soil sample and a brief description: "This dataset contains total carbon, total nitrogen, and total phosphorus content of belowground biomass (BGB) and necromass (BGN) samples collected from...". To its right are two download icons: a blue document icon and a blue downward arrow icon.

- **Module 2: Sediment Accretion**

- Feldspar Sediment Accretion Measurements: https://daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=2079

- **Module 3: ADCP**

- This dataset is searchable through ORNL DAAC. Please download the entire dataset.
- https://daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=2081

- **Module 4: Gauges**

- This dataset is not available through ORNL yet. You can find a subset of these data on the Google Drive >> 40DeltaX_Workshop_2022/Tutorials/0_Field/Module4_Gauges)

https://drive.google.com/drive/folders/1oADB57znBUkJr0lTx1rVN_Kz2GBFNxBU?usp=sharing

- **Module 5: Water Quality and Total Suspended Solids**
 - In Situ Water Quality Indicators: https://daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=2080
 - Total Suspended Solids Concentration across MRD, LA, USA, 2021: https://daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=2075
- **Module 6: Sediment Grain Size**
 - Bed and Suspended Sediment Grain Size, Wax Lake Delta: <https://doi.org/10.3334/ORNLDAAAC/2061>

AVIRIS-NG

Please save each of these files into a folder in your working directory (AVIRISNG).

- AVIRIS-NG L2 Surface Reflectance Products across the MRD:
<https://doi.org/10.3334/ORNLDAAAC/1988>. Please download these files:
 - ang20210401t150456_rfl
 - ang20210401t150456_rfl.hdr
- PreDeltaX_WaterReflectance+TSS_Atchafalaya_Fall2016
 - You can find a subset of these data on the Google Drive >> DeltaX_Workshop_2022/Tutorials/1_AVIRIS-NG)
https://drive.google.com/drive/folders/1x2daBncvJvsPXfuteaCpzTpoqa5D_OtFW
 - Download the file “PreDeltaX_WaterReflectance+TSS_Atchafalaya_Fall2016.csv” by right-clicking on the file name then clicking on the “Download” from the pop-up menu.

AirSWOT

Please save each of these files into a folder in your working directory (AIRSWOT).

- AirSWOT L2 Geocoded Water Surface Elevation, LA, USA, 2021:
<https://doi.org/10.3334/ORNLDAAAC/2070>
 - utm_m0m_20210326171437.err.tif
 - utm_m0m_20210326171437.hgt.tif
 - utm_m0m_20210326171437.inc.tif
 - utm_m0m_20210326194454.err.tif
 - utm_m0m_20210326194454.hgt.tif
 - utm_m0m_20210326194454.inc.tif
 - utm_m0m_20210327142430.err.tif
 - utm_m0m_20210327142430.hgt.tif

- utm_m0m_20210327142430.inc.tif
- utm_m0m_20210327164503.err.tif
- utm_m0m_20210327164503.hgt.tif
- utm_m0m_20210327164503.inc.tif
- utm_m0m_20210401124406.err.tif
- utm_m0m_20210401124406.hgt.tif
- utm_m0m_20210401124406.inc.tif
- utm_m0m_20210401152540.corr.tif
- utm_m0m_20210401152540.dhdphi.tif
- utm_m0m_20210401152540.err.tif
- utm_m0m_20210401152540.hgt.tif
- utm_m0m_20210401152540.inc.tif
- utm_m0m_20210401152540.mag_ns.tif
- utm_m0m_20210401152540.mag.tif
- utm_m0m_20210412191209.hgt.tif
- utm_m0m_20210412224621.hgt.tif
- utm_m0m_20210416005432.hgt.tif
- utm_m0m_20210416041720.hgt.tif
- utm_m0m_20210418164312.hgt.tif
- utm_m0m_20210418202023.hgt.tif

- Pre-Delta-X: L3 AirSWOT-derived Water Level Profiles
 - Search the ORNL DAAC for “pre-deltax airswot L3” data and download the entire package from the first link (the Feb 18, 2021 dataset).

pre-deltax airswot L3

[Data](#) [Website](#)

Found 12 results

Pre-Delta-X: L3 AirSWOT-derived Water Level Profiles, Wax Lake ...
https://daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=1819
 Feb 18, 2021 ... ORNL DAAC: This dataset contains water level profiles generated from the AirSWOT data collected in the Atchafalaya Basin in Southern ...

Daac Home > Get Data > NASA Projects > Delta-X > Landing page

Pre-Delta-X: L3 AirSWOT-derived Water Level Profiles, Wax Lake Outlet, LA, USA, 2015

Overview

DOI	https://doi.org/10.3334/ORNLDaac/1819
Version	1
Project	Delta-X
Published	2021-02-18
Updated	2021-04-03
Usage	137 downloads
Citations	1 publication cited this dataset

[Download Data](#) 4.7 MB [User Guide](#)

Spatial Coverage

Bounding rectangle
 N: 29.73 S: 29.45 E: -91.36 W: -91.51

- A water mask file (stored on the Google Drive >> DeltaX_Workshop_2022/Tutorials/2_AirSWOT)
 - <https://drive.google.com/drive/folders/1windaRWzje3oDFlo6nD89yawFKjG7sY?usp=sharing>

- Water level gauges data (stored on the Google Drive >> DeltaX_Workshop_2022/Tutorials/2_AirSWOT)
 - https://drive.google.com/drive/folders/1wX_LJdyuuAzaFsdKQ5MaYWpyO_OmFAhTP?usp=sharing

UAVSAR

Please save each of these files into a folder in your working directory (UAVSAR).

- UAVSAR Level 3 Geocoded InSAR Derived Water Level Changes, LA, USA, 2021: <https://doi.org/10.3334/ORNLDAAAC/2058> Please download these files (you can find all 14 files by searching for “wterre_34202_210406” using the “Filter” text box):
 - wterre_34202_2104061728_2104061728_01_waterlevelchange.grd.dat
 - wterre_34202_2104061728_2104061728_01_waterlevelchange.grd.dat.hdr
 - wterre_34202_2104061728_2104061800_01_waterlevelchange.grd.dat
 - wterre_34202_2104061728_2104061800_01_waterlevelchange.grd.dat.hdr
 - wterre_34202_2104061728_2104061831_01_waterlevelchange.grd.dat
 - wterre_34202_2104061728_2104061831_01_waterlevelchange.grd.dat.hdr
 - wterre_34202_2104061728_2104061902_01_waterlevelchange.grd.dat
 - wterre_34202_2104061728_2104061902_01_waterlevelchange.grd.dat.hdr
 - wterre_34202_2104061728_2104062032_01_waterlevelchange.grd.dat
 - wterre_34202_2104061728_2104062032_01_waterlevelchange.grd.dat.hdr
 - wterre_34202_2104061728_2104062102_01_waterlevelchange.grd.dat
 - wterre_34202_2104061728_2104062102_01_waterlevelchange.grd.dat.hdr
 - wterre_34202_210406_01_temporalcoherence.grd.dat
 - wterre_34202_210406_01_temporalcoherence.grd.dat.hdr
- UAVSAR Level 2 Geocoded Interferometric Products, LA, USA, 2021: <https://doi.org/10.3334/ORNLDAAAC/2057> Please download these files (you can find all 8 files by searching for “wterre_34202_2104061800_2104062032” using the “Filter” text box):
 - wterre_34202_2104061800_2104062032_01_coh.grd.dat
 - wterre_34202_2104061800_2104062032_01_coh.grd.dat.hdr
 - wterre_34202_2104061800_2104062032_01_intamp.grd.dat
 - wterre_34202_2104061800_2104062032_01_intamp.grd.dat.hdr
 - wterre_34202_2104061800_2104062032_01_intphase.grd.dat
 - wterre_34202_2104061800_2104062032_01_intphase.grd.dat.hdr
 - wterre_34202_2104061800_2104062032_02_unwphase.grd.dat
 - wterre_34202_2104061800_2104062032_02_unwphase.grd.dat.hdr

- UAVSAR Level 1B: This is available in final form through ORNL. Search for “Delta-X UAVSAR L1B”. Please download these files:

DAAC Home > Get Data > NASA Projects > Delta-X > Landing page

Delta-X: UAVSAR L1B Interferometric Products, MRD, Louisiana, 2021

Overview

DOI	https://doi.org/10.3334/ORNLDaac/1979
Version	1.1
Project	Delta-X
Published	2022-04-21
Updated	2022-04-28
Usage	4 downloads

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Yattee

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Search for “wterre_34202_2104061800_2104062032_01” using the “Filter” search box, then download and unzip the 4 resulting files. You should end up with the following 8 files:

- wterre_34202_2104061800_2104062032_01_coh.dat
- wterre_34202_2104061800_2104062032_01_coh.hdr
- wterre_34202_2104061800_2104062032_01_intamp.dat
- wterre_34202_2104061800_2104062032_01_intamp.hdr
- wterre_34202_2104061800_2104062032_01_intphase.dat
- wterre_34202_2104061800_2104062032_01_intphase.hdr
- wterre_34202_2104061800_2104062032_01_unwphase.dat
- wterre_34202_2104061800_2104062032_01_unwphase.hdr

ANUGA

You don't need to download any files for this tutorial.

Delft3D

If you are using a PC, you can run Delft3D. If you are using a Mac, you won't be able to run Delft3D, but you can follow along with the instructor. Please save the folder “Simulation” into your working directory (Delft3D) by right clicking the folder then clicking “Download”. Google Drive will take some time to generate a zip file for you to download. Make sure to unzip it.

These files are available on the Google Drive >>

DeltaX_Workshop_2022/Tutorials/5_Delft3D)

<https://drive.google.com/drive/folders/1ZARCu82vQFZ0rvb6JukINjtnrEB6ZKM?usp=sharing>