

A background image of a mangrove landscape. In the foreground, there are dense mangrove roots (pneumatophores) extending from the water. The water is a light blue-green color. In the background, there are green mangrove trees with thick leaves, and a small white bird is perched on a branch on the right side. The sky is bright blue with some white clouds.

OCN 390: Field Methods

Week 9

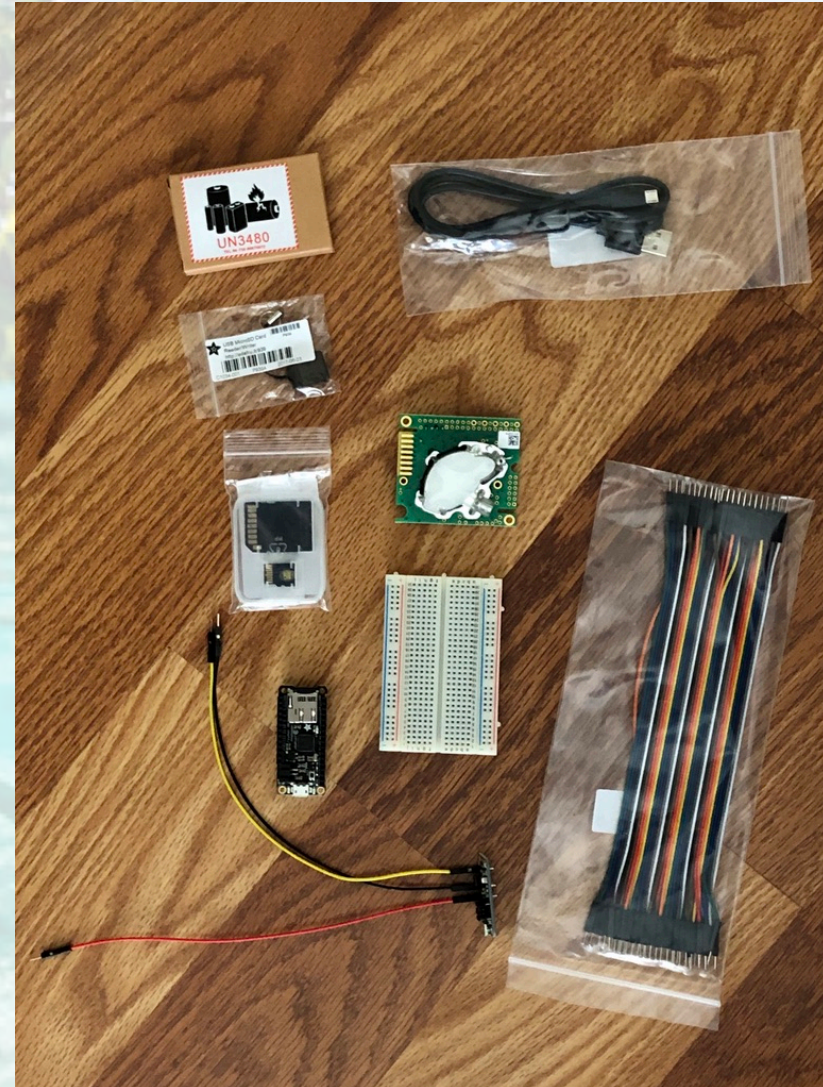
Quick Map-Making Techniques
& Data Interpolation



Note to self: record!

Announcements

- Please take advantage of reaching out to me and Jack as early in the week as possible so that we can offer guidance!
- Rotate who is the keeper of the components
- Rotate who submits the group assignment
- CC your teammates on emails to me or use the Canvas groups for communicating



A photograph of a mangrove forest with green trees and their roots in the water, under a blue sky with clouds. The text "Questions before we get started?" is overlaid in the center.

**Questions before we
get started?**

A tropical mangrove landscape with green trees and turquoise water. The scene is captured from a low angle, showing the intricate root systems of mangrove trees in the foreground and middle ground. The water is a vibrant turquoise color, reflecting the sky and the surrounding foliage. The background features more dense greenery and a clear blue sky with soft, white clouds. The overall atmosphere is serene and natural.

Story Maps for Scientific Storytelling



What you CAN'T see in the Tennessee River



What you CAN'T see in the Tennessee River

A closer look at pollution in the river

Kellie Ward | February 19, 2021

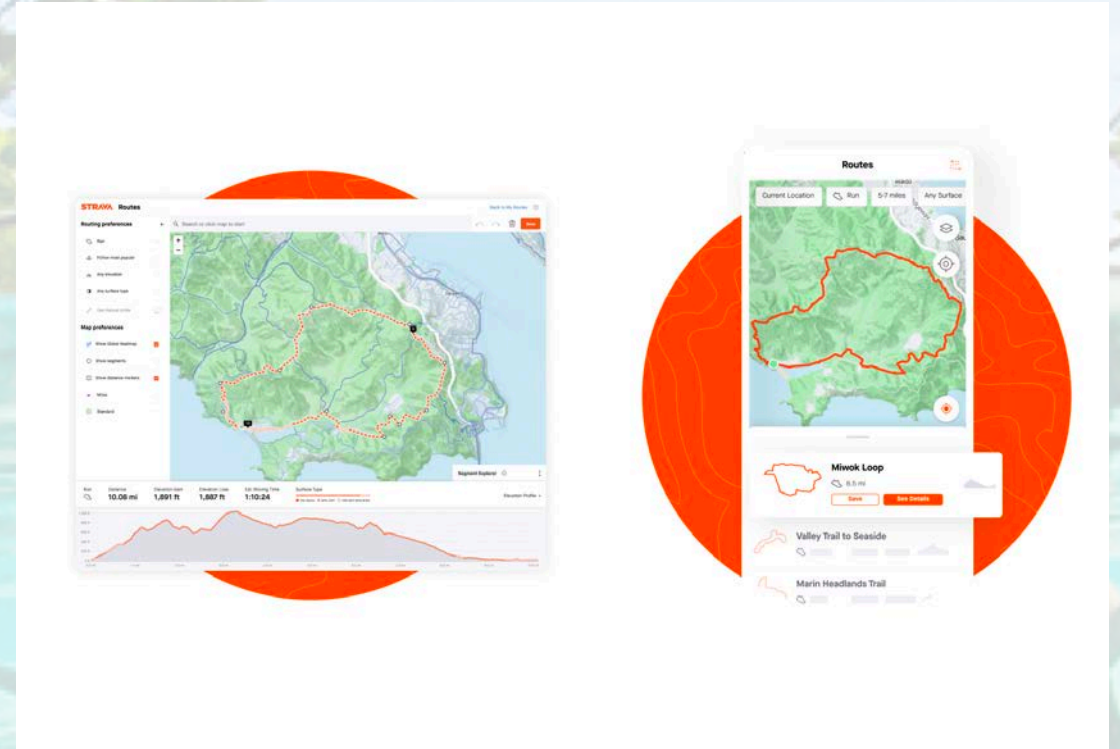


Important Components of Your Story Maps

- Images and/or video of field site. Images of sensor. Other images from web (with citation) if it adds to story.
- Images of field journal, if it adds to the story and provides helpful context
- Image or written out version of your field checklist
- Preliminary data, nicely visualized **(at least 1 interactive map with your data and 1 time-series plot with your data)**
- Text blocks explaining:
 - Why: what was the motivation for your study?
 - How: what were your methods and procedures?
 - What did you learn? Results? Provide both quantitative results and also how they fit into the context of your study.
 - What challenges did you face? How will you make improvements prior to final report? How would you recommend that others overcome those in future semesters? What other data will you collect? What other analysis/analyses will you perform?
 - Hyperlinked citations of peer-reviewed research described in context. Other hyperlinked references as needed.
 - Conclusion: tie it all together.
- Additional paragraph sent via Canvas (not in Story Map) describing your contributions to all aspects of

Last week:

- Collecting indoor/outdoor data with GPS
- One person per team: download Strava app for your phone
- All heading outside
- Each team come talk to me one at a time to talk about proposed field study in greater depth



Today:

Data Processing (GPX)

1. Download GPX file from Strava
2. Process GPX file using https://www.gpsvisualizer.com/convert_input
3. Process GPX file further using Excel
4. Merge unprocessed GPX file with CO2 file using Python

Get GPX from Strava.com (on a computer—not sure this works on mobile device)

The screenshot displays the Strava website interface. At the top, the navigation bar includes the Strava logo, a search icon, and links to Dashboard, Training, Explore, and Challenges. The main content area is divided into two columns. The left column features the profile of Phil Bresnahan, showing a profile picture, name, and statistics: 13 Following, 10 Followers, and 683 Activities. Below this, it lists the latest activity as 'CO2 sensor test walk' from March 8, 2021, and a 'Your Training Log' section with icons for various activities. A promotional banner for staying motivated is also present. The right column shows a detailed view of the 'CO2 sensor test walk' activity, including a map of the route in Wilmington, North Carolina, and activity statistics: 0.61 mi distance, 9 ft elevation gain, and 13m 5s time. The activity has 3 kudos and 1 kudo shown.

STRAVA Search Dashboard Training Explore Challenges

Phil Bresnahan
Following 13 Followers 10 Activities 683

Latest Activity
CO2 sensor test walk · March 8, 2021

Your Training Log

Subscribe to stay motivated with custom progress, segment and power goals. [Upgrade](#)

THIS WEEK
0 mi

M T W T F S S
0h0m 0 ft

Phil Bresnahan
March 8, 2021 at 7:52 AM · Wilmington, North Carolina

CO2 sensor test walk
Distance 0.61 mi Elev Gain 9 ft Time 13m 5s

1 kudos

Export GPX, save to computer

The screenshot shows the Strava website interface for a segment named "an - Walk". The segment details include a distance of 0.61 mi, a moving time of 13:05, and a pace of 21:21/mi. It also shows an elevation of 9ft, an elapsed time of 14:12, and 97 calories. The segment was recorded on Monday, March 8, 2021, in Wilmington, North Carolina. The interface includes a sidebar with options like Overview, Segments, and a main area with a description field and a "Performance Over Time" graph. A "Splits" table is also visible, showing the segment's distance, pace, and elevation. At the bottom, there is a map of the route and a "Create Route" button.

STRAVA Dashboard Training Explore Challenges

Overview Segments

Create Segment an - Walk

Flag Crop Split Delete Create Route Export GPX Export Original Refresh Activity Achievements

CO2 sensor test walk

0.61mi 13:05 21:21/mi

Elevation 9ft Calories 97

Elapsed Time 14:12

Strava iPhone App Shoes: —

Performance Over Time

Splits

Mile	Pace	Elev
0.61	21:21 /mi	0 ft

Create Route Standard Map

Skip this step if using Python (Python is highly recommended)

gpsvisualizer.com/convert_input?units=us

GPS Visualizer

MAKE A MAP
- Leaflet/Google
- Google Earth
- JPG/PNG/SVG

MAKE A PROFILE
CONVERT A FILE
Draw on a map
Calculators

Geocode addresses
Look up elevations
Atlas: Share a map
GPSBabel

Examples
Help/FAQ
About GPSV

QUAKER

Fill Your Morning with Smiles.

SAVE \$2

Convert a GPS file to plain text or GPX

This form reads a tracklog or waypoint file (in a recognized format) or plain-text tabular data, and converts it to an easy-to-read tab-delimited or CSV text file, or to a GPX file.

- Addresses:** If you want to find the coordinates of a list of street addresses, it may be easier to use the [geocoding utilities](#). If, however, you have ZIP codes, postal codes, or cities & states, this form is the right tool to use -- but be sure to include a valid header row! (See the [waypoint tutorial](#) for more info.)
- Google Earth:** If you want to generate a KML or KMZ file for Google Earth, use the [Google Earth mapping form](#).
- Leaflet/Google Maps:** To generate an HTML map, use the [Leaflet](#) or [Google Maps](#) form.
- Non-compatible formats:** If this conversion program cannot read your file, it's possible that [GPSBabel](#) will be able to. (GPSBabel also has a wider range of output formats.)

Output format: ☒ Plain text ☐ GPX ☐ Google Earth KML

Upload your files here: (10 MB max. total size, .zip/.gz is supported)

File #1 No file chosen

File #2 No file chosen

File #3 No file chosen

[Show more file boxes](#)

Or paste your data here:

name,desc,latitude,longitude

Force text data to be this type: default

Or provide the URL of a file on the Web:

Plain text delimiter: tab Plain text output units: U.S.

Add estimated fields: ☐ speed ☐ heading ☐ slope (%) ☐ distance ☐ VMG ☐ pace

Add DEM elevation data: No

[Save these settings](#) • [Load from saved](#)

Donate

Help keep GPS Visualizer free

At the moment, I'm not charging anything for the use of GPS Visualizer; however, if you find it interesting, time-saving, or just plain fun, you can say "thanks" -- and encourage further development -- by clicking the button above and making a contribution via PayPal. Or if you prefer, you could send me something from my Amazon.com wish list.

Process GPS data further in Excel

- Quick demo

CO2 vs. Location

What's wrong with this?

Last week's CO2 data

	A	B	C	D
1	Start Time	3/8/21 07:47		
2	Elapsed Time	CO2 Concentr	Time (absolute)	
3	2	1259	3/8/21 07:47:02	
4	4	1247	3/8/21 07:47:04	
5	6	1231	3/8/21 07:47:06	
6	8	1202	3/8/21 07:47:08	
7	10	1201	3/8/21 07:47:10	
8	12	1197	3/8/21 07:47:12	
9	14	1191	3/8/21 07:47:14	
10	16	1182	3/8/21 07:47:16	
11	18	1174	3/8/21 07:47:18	
12	20	1164	3/8/21 07:47:20	
13	22	1154	3/8/21 07:47:22	
14	24	1144	3/8/21 07:47:24	
15	27	1133	3/8/21 07:47:27	
16	29	1124	3/8/21 07:47:29	
17	31	1102	3/8/21 07:47:31	
18	33	1088	3/8/21 07:47:33	

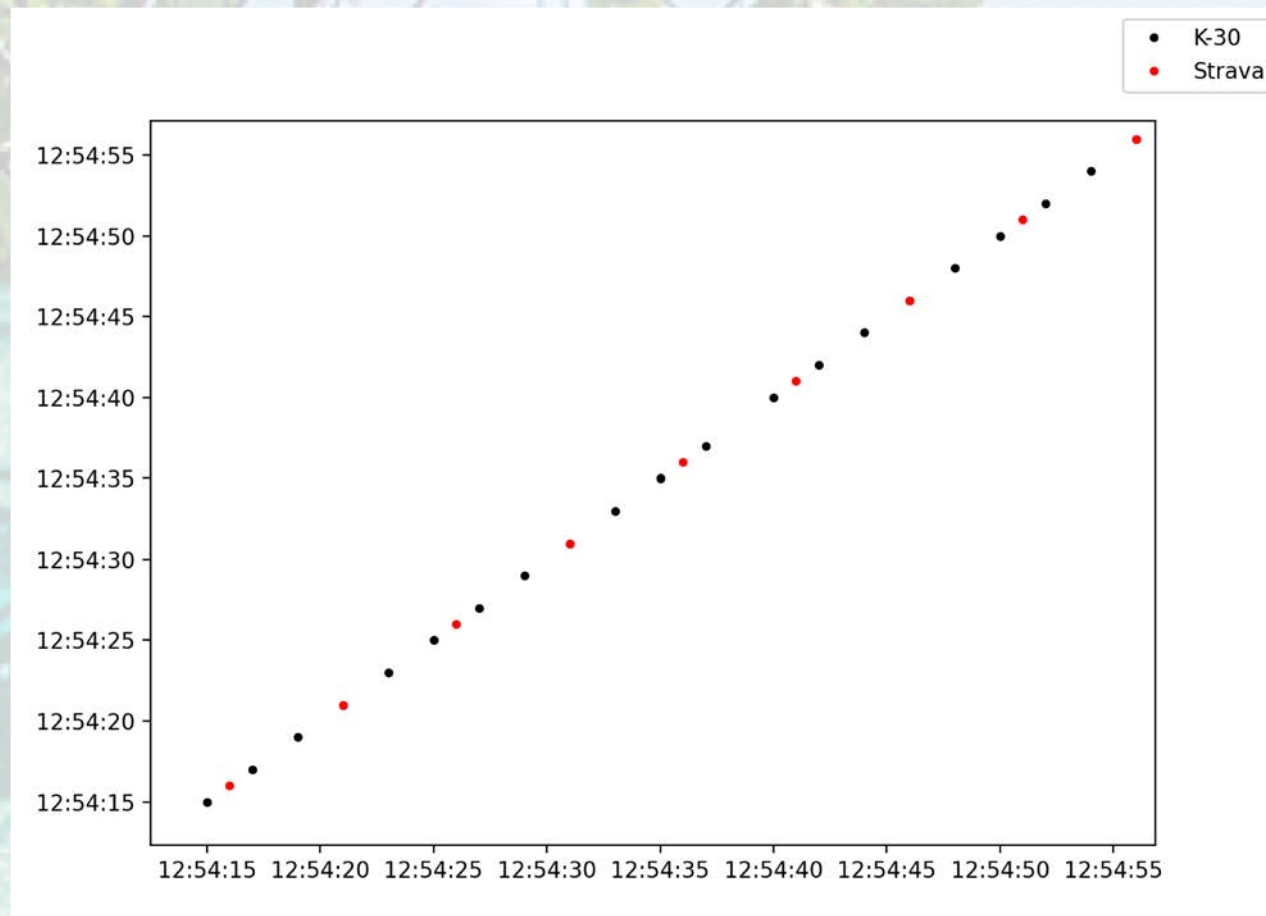
2021-03-08_CO2SensorTestWalk_CO

Last week's GPS data

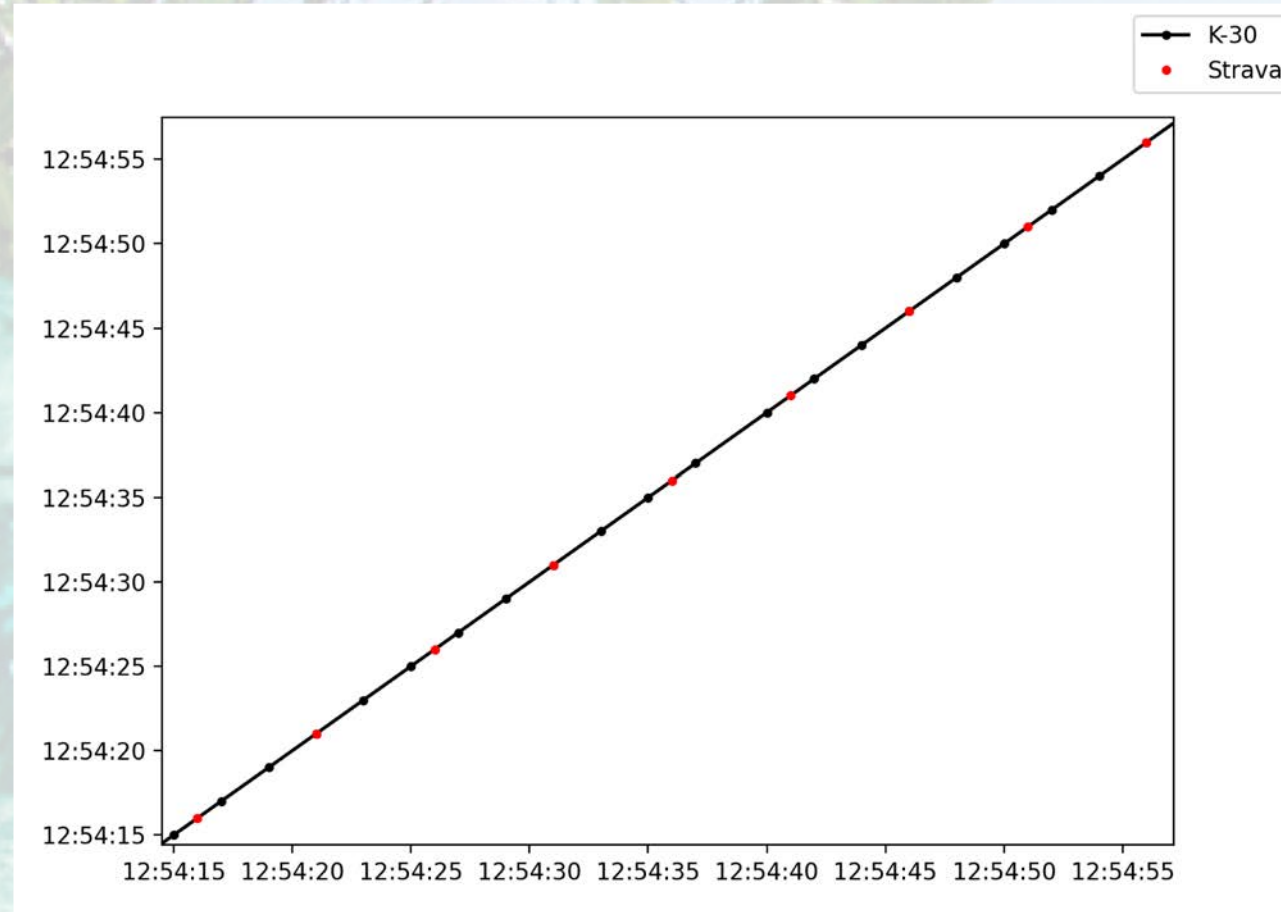
	A	B	C	D	E	F
1	type	date	time (UTC)	latitude	longitude	altitude (ft)
2	T	3/8/21	12:52:36	34.186881	-77.863983	11.2
3	T	3/8/21	12:52:37	34.186888	-77.863942	11.5
4	T	3/8/21	12:52:38	34.186891	-77.863927	11.5
5	T	3/8/21	12:52:39	34.186887	-77.86392	11.5
6	T	3/8/21	12:52:40	34.186884	-77.863922	11.5
7	T	3/8/21	12:52:41	34.18688	-77.863931	11.5
8	T	3/8/21	12:52:42	34.186875	-77.863943	11.5
9	T	3/8/21	12:52:43	34.186871	-77.863952	11.5
10	T	3/8/21	12:52:44	34.186866	-77.86396	11.8
11	T	3/8/21	12:52:45	34.186863	-77.86397	11.8
12	T	3/8/21	12:52:46	34.186861	-77.863979	11.8
13	T	3/8/21	12:52:47	34.186861	-77.863989	11.8
14	T	3/8/21	12:52:48	34.186861	-77.863996	11.8
15	T	3/8/21	12:52:49	34.186861	-77.863996	11.8
16	T	3/8/21	12:52:50	34.186861	-77.863996	11.8
17	T	3/8/21	12:52:51	34.18686	-77.864003	11.8
18	T	3/8/21	12:52:52	34.186856	-77.864013	11.8

Sheet1

What if different devices have different timestamps?



Interpolation



Interpolation

Benefits

- Can help fill in data where we don't have any
- Can help align timestamps in order to combine datasets


Risks

- It's an educated guess, not a true observation
- Can lead to false sense of security

How to merge GPS/CO2 data

A few options:

1. Manually select rows from both spreadsheets that have matching times; make new spreadsheet with time, CO2, and lat/lon data
2. Learn way to do it programmatically with Excel (if you can figure this out, please let me know!)
3. Use scientific data analysis program like **Python**, R, or MATLAB

A tropical beach scene with turquoise water, white sand, and lush green mangrove trees under a bright sky. The text "Python Quickstart" is overlaid in the center.

Python Quickstart

Why use Python

- Free!
- Repeatable coding, you don't have to repeat a whole process with Excel every time you get new data
- Used by top professionals, from YouTube coders to NASA researchers
- Can be applied to any field of science or engineering
- One of the most helpful and lucrative skills in science



Where packages, notebooks, projects and environments are shared.

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Username

Pick a username

Email Address

Your email

Enter Password

SecretPassword



Re-enter Password

SecretPassword



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Register For Free

Anaconda Installers

Windows 

Python 3.8

64-Bit Graphical Installer (457 MB)

32-Bit Graphical Installer (403 MB)

MacOS 

Python 3.8

64-Bit Graphical Installer (435 MB)

64-Bit Command Line Installer (428 MB)

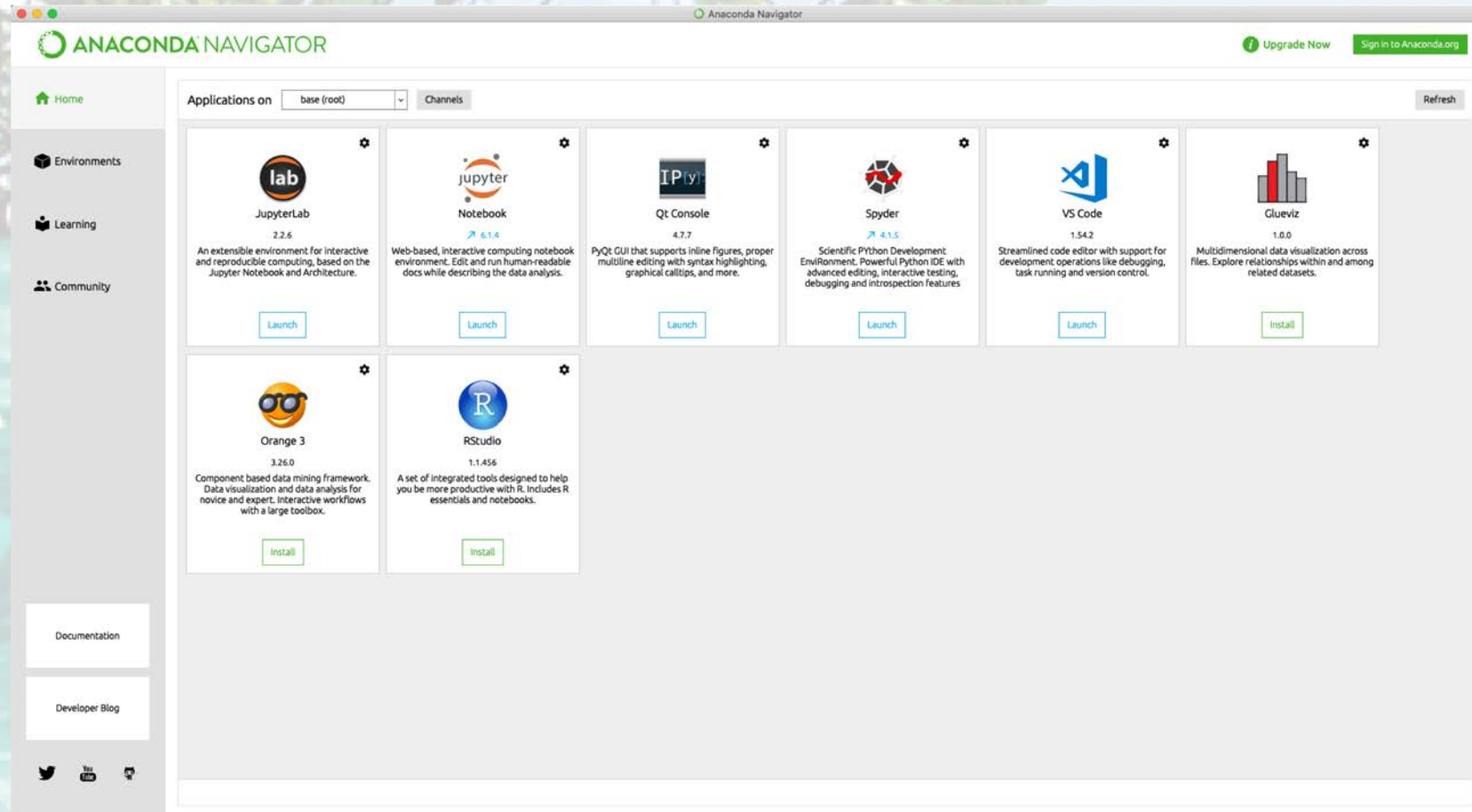
Linux 

Python 3.8

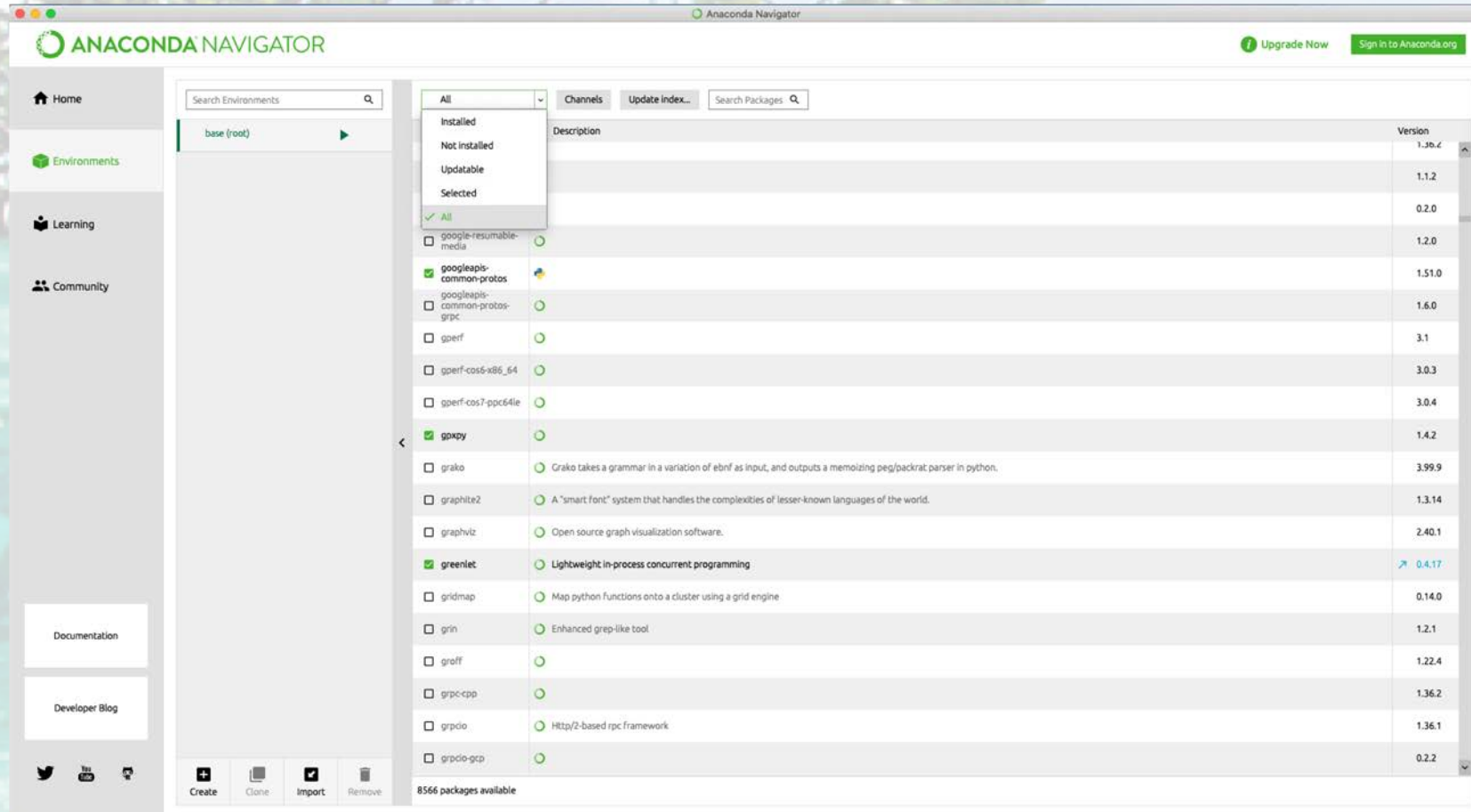
64-Bit (x86) Installer (529 MB)

64-Bit (Power8 and Power9) Installer (279 MB)

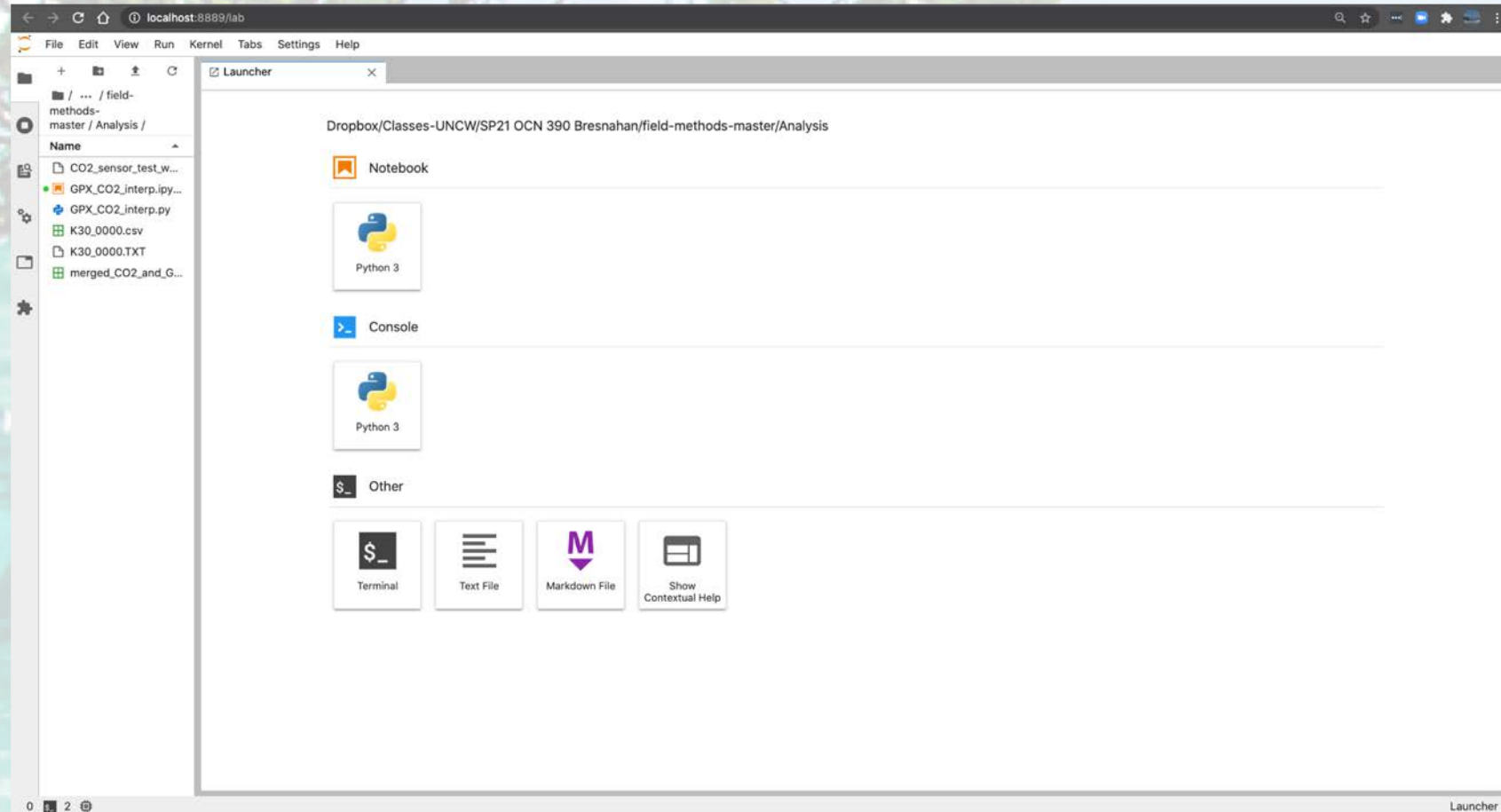
Launch Anaconda Navigator



Go to Environments tab.
Select "All" where it currently says "Installed."
Check box next to gpxpy.

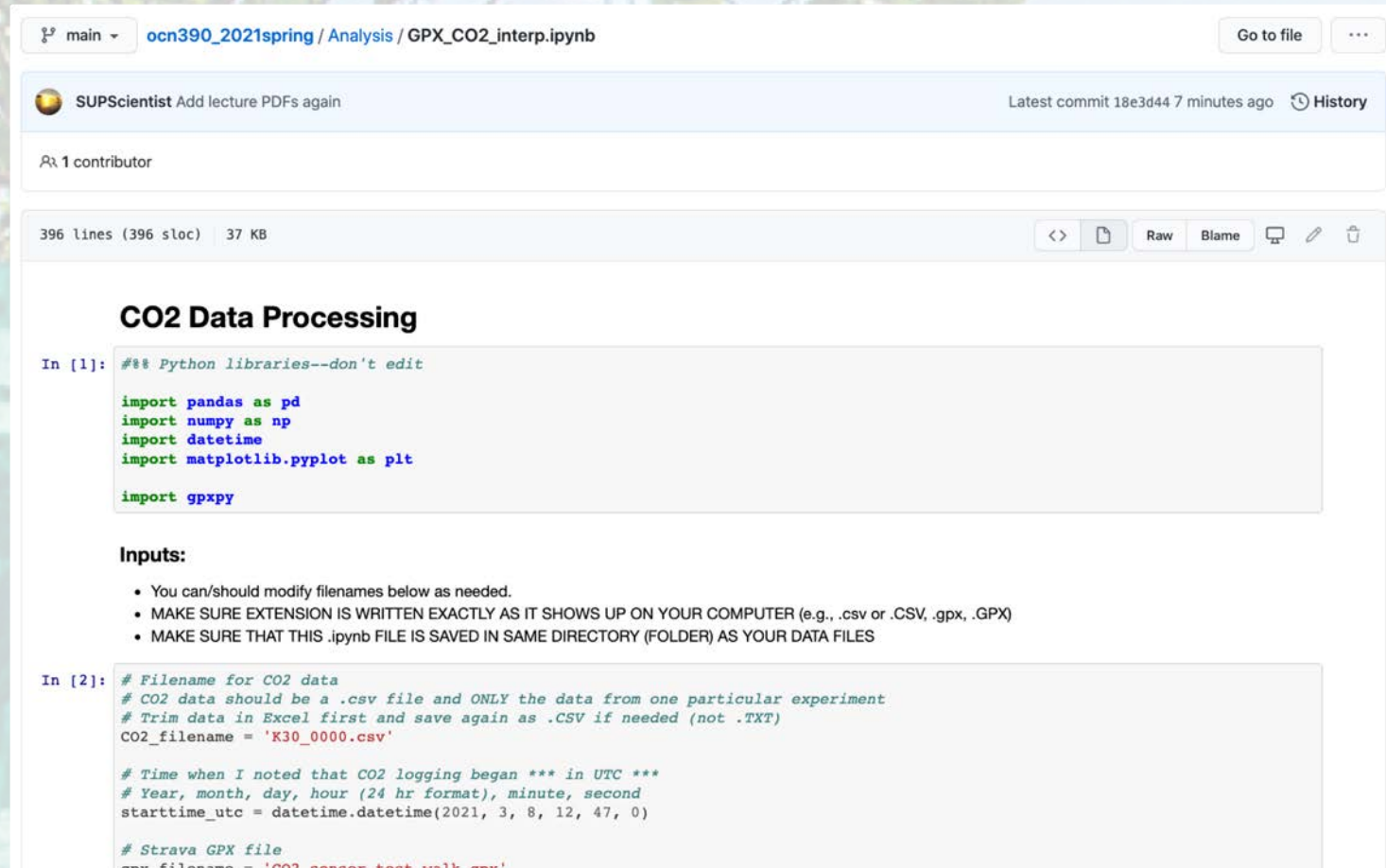


Return to Home tab, Launch JupyterLab



Download Python notebook

(From GitHub or remind me to post to Canvas)



The screenshot shows a GitHub repository page for a Python notebook. The repository is named 'ocn390_2021spring' and is located in the 'Analysis' directory. The file being viewed is 'GPX_CO2_interp.ipynb'. The page shows the notebook's metadata, including the commit hash '18e3d44' and the commit time '7 minutes ago'. The notebook content is displayed in a code editor with a light gray background. The first cell, labeled 'In [1]:', contains Python code for importing libraries: pandas, numpy, datetime, matplotlib.pyplot, and gpxpy. The second cell, labeled 'In [2]:', contains comments and code for setting up CO2 data processing, including file names, start times, and GPX file paths.

```
main ▾ ocn390_2021spring / Analysis / GPX_CO2_interp.ipynb Go to file ...
```

SUPScientist Add lecture PDFs again Latest commit 18e3d44 7 minutes ago History

1 contributor

396 lines (396 sloc) 37 KB <> Raw Blame

CO2 Data Processing

```
In [1]: ### Python libraries--don't edit

import pandas as pd
import numpy as np
import datetime
import matplotlib.pyplot as plt

import gpxpy
```


Inputs:

- You can/should modify filenames below as needed.
- MAKE SURE EXTENSION IS WRITTEN EXACTLY AS IT SHOWS UP ON YOUR COMPUTER (e.g., .csv or .CSV, .gpx, .GPX)
- MAKE SURE THAT THIS .ipynb FILE IS SAVED IN SAME DIRECTORY (FOLDER) AS YOUR DATA FILES

```
In [2]: # Filename for CO2 data
# CO2 data should be a .csv file and ONLY the data from one particular experiment
# Trim data in Excel first and save again as .CSV if needed (not .TXT)
CO2_filename = 'K30_0000.csv'

# Time when I noted that CO2 logging began *** in UTC ***
# Year, month, day, hour (24 hr format), minute, second
starttime_utc = datetime.datetime(2021, 3, 8, 12, 47, 0)

# Strava GPX file
gpx_filename = 'CO2 sensor test walk gpx'
```


A background image of a mangrove forest with green trees and brown roots in shallow water under a blue sky with clouds.

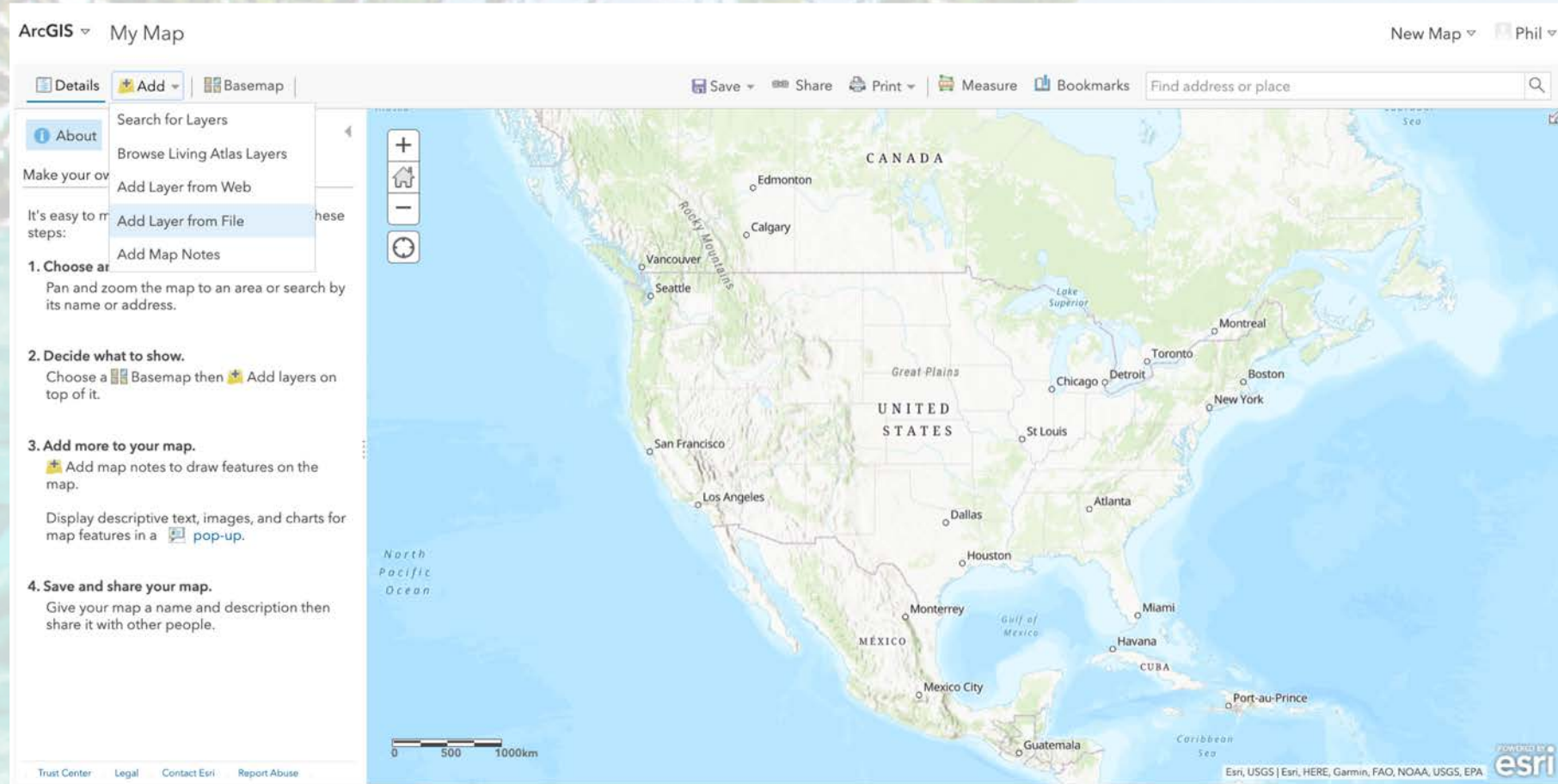
Mapping CO2 data with Lat/Lon

ArcGIS Online

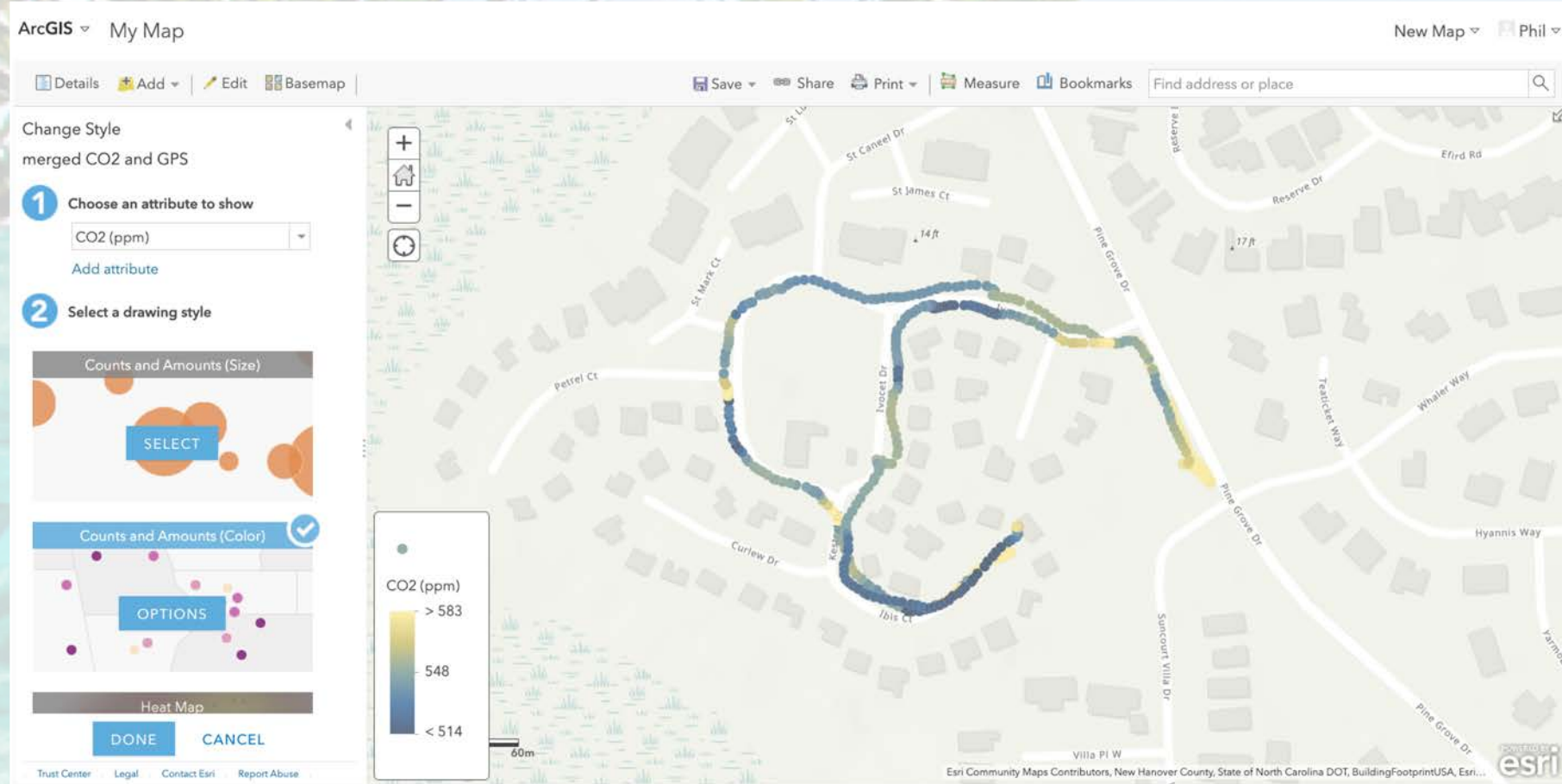
Simple Map-Making

- If you have previously taken a GIS class here or elsewhere, feel free to use other techniques. This is a very basic getting-started guide designed to empower complete beginners to create interactive digital maps of their own data.
- Navigate to <https://www.arcgis.com/home/index.html>
- If you do not already have an ArcGIS account, create one; otherwise, sign in
- Click “Map” in navigation bar

Should see this: now "Add Layer from File" Select your new CSV file



Change style and make sure you are viewing the correct parameter!



Save it

ArcGIS My Map New Map Phil

[Details](#) [Add](#) [Edit](#) [Basemap](#) [Save](#) [Share](#) [Print](#) [Measure](#) [Bookmarks](#)

[About](#) [Content](#) [Legend](#)

Make your own map

It's easy to make your own map. Just follow these steps:

- 1. Choose an area.**
Pan and zoom the map to an area or search by its name or address.
- 2. Decide what to show.**
Choose a [Basemap](#) then [Add layers](#) on top of it.
- 3. Add more to your map.**
[Add map notes](#) to draw features on the map.

Display descriptive text, images, and charts for map features in a [pop-up](#).
- 4. Save and share your map.**
Give your map a name and description then share it with other people.

Save Map

Title:

Tags:

Summary:

Save in folder:

[SAVE MAP](#) [CANCEL](#)

0 30 60m

Villa P1 W
Esri Community Maps Contributors, New Hanover County, State of North Carolina DOT, BuildingFootprintUSA, Esri

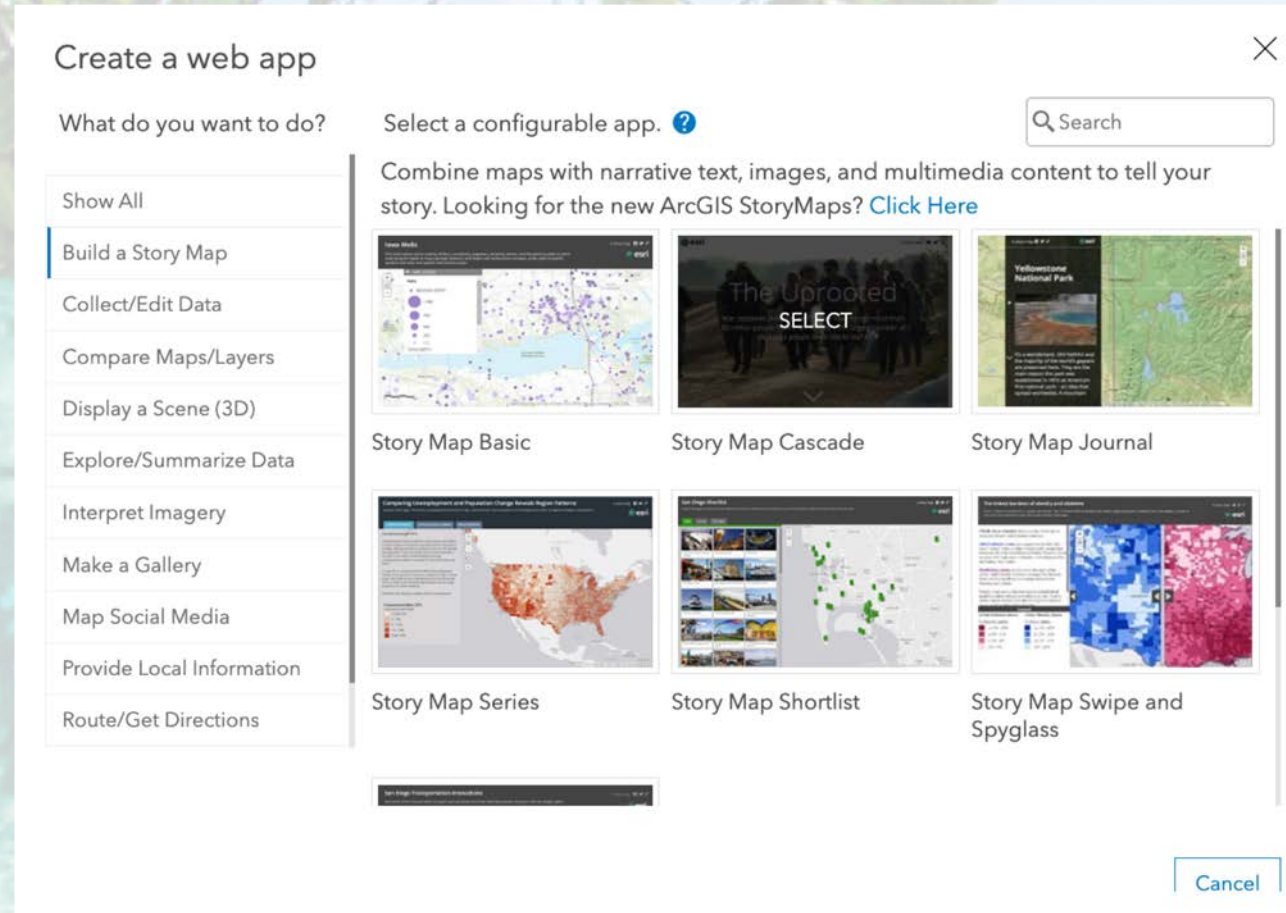
esri

Return to
<https://www.arcgis.com/home/index.html> and click "Content"

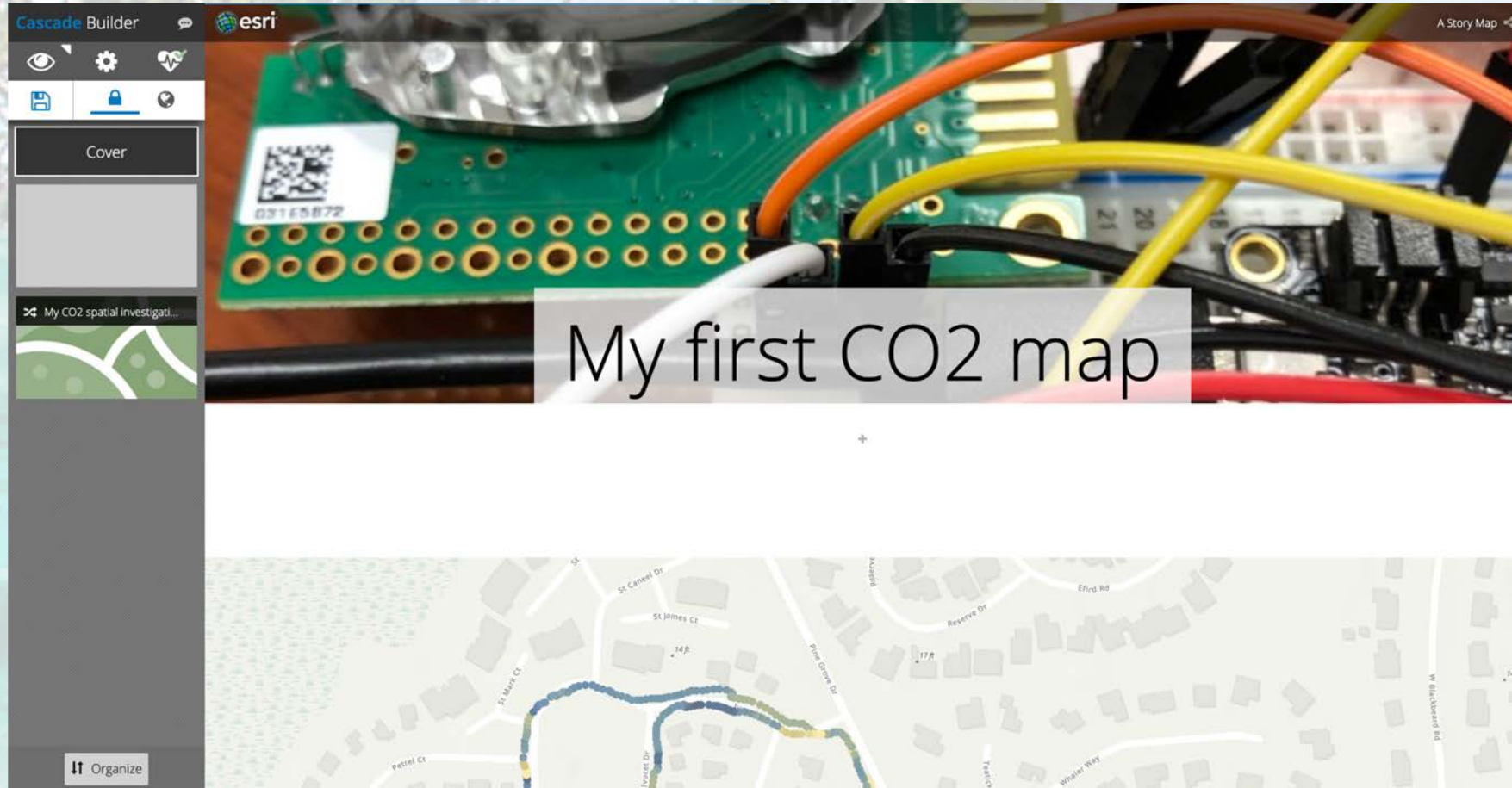
The screenshot shows the ArcGIS Content page. The top navigation bar includes links for ArcGIS, Overview, Pricing, Map, Scene, Groups, and Content. The user is logged in as Phil Bresnahan, SUPScientist. The main header has tabs for Content, My Content, My Favorites, My Groups, and Living Atlas. Below the header, there are buttons for 'Add Item' and 'Create', a search bar for 'Search SUPScientist', and options for 'Table', 'Date Modified', and 'Filter'. A dropdown menu is open from the 'Create' button, showing 'Configurable Apps' with a description: 'Create an app by selecting a focused template and configuring its properties.' The main content area displays a list of items with columns for item name, type, status, and modified date. The left sidebar shows 'Folders' (All My Content, SUPScientist) and 'Filters' (Item Type, Location, Date modified, Date Created).

				Modified
<input type="checkbox"/>	My first CO2 map	Web Mapping Application		☆ ... Mar 14, 2021
<input type="checkbox"/>	CO2 from K-30, 3/8/21	Web Map		☆ ... Mar 14, 2021
<input type="checkbox"/>	CeNCOOS_WaterTemp	CSV		☆ ... Mar 7, 2021
<input type="checkbox"/>	Smartfin All 2018-02-02	Web Map		☆ ... Aug 7, 2018
<input type="checkbox"/>	Surfing for Science and Stewardship	Web Mapping Application		☆ ... Jul 30, 2018
<input type="checkbox"/>	Seagrass and WavepHOx pH	Web Map		☆ ... Feb 5, 2018
<input type="checkbox"/>	World Oceans Day, 2015	Web Map		☆ ... Feb 3, 2018
<input type="checkbox"/>	World Oceans Day test	Web Mapping Application		☆ ... Feb 2, 2018
<input type="checkbox"/>	ODI SUP	Web Map		☆ ... Nov 7, 2017
<input type="checkbox"/>	20150314SurfCove	Web Map		☆ ... Nov 7, 2017

Build a Story Map (Cascade or your preference)



Begin adding content where you want it to tell your story



This Week's Assignments due Mar. 21 @ 11:59 pm

1. Nature journal (last mandatory one)
2. Map of CO₂ with > 300 points (> 600 seconds = 5 minutes of CO₂ logging): final non-project assignment
3. I HIGHLY encourage you to get started on your Story Maps which are due (GROUP ASSIGNMENT) on Sun., Mar. 28 (WITH DATA FROM YOUR PRELIMINARY FIELD WORK) to the class on Mon., Mar. 29.
 - Start writing text and taking photos/videos

Note: I will accept submissions as late as the following Sunday (Sun., Apr. 4) but note that the following weekend is a holiday weekend here.

Summary of data analysis tools

- Microsoft Excel for time-series analysis, graphing
- Excel for averages, standard deviations
- Python for data merging, repeated analyses
- ArcGIS/Esri free online tools for mapping, Story Maps
- That's it—other tools and analyses are up to you

Rest of this semester

- This week's homework
- Story Maps (team assignment)
- Final report (individual assignment)
- Remaining classes to be used for additional topics in data analysis and scientific communication
- Possible re-quiz to correct mistakes from prior quiz (TBD)