Let's make our own spatial ABM

Overview of Model Process

- Scope topic

- Identify what you need

- Getting/Organizing/Reviewing/Cleaning Data

- Importing data and building a Netlogo model

- Trouble-shooting and test throughout the process

- Validation

- Sharing your model

Scoping the Model

Scoping the Model

- **Topic**: Ebola

Scoping the Model

- **Topic**: Ebola

- **What is being modeled**: spread of ebola, rate of spread

- **Experiments**: Identify impacts on rate of spread, if restrict travel

Scoping the Model

- Topic: Ebola

- What is being modeled: spread of ebola, rate of spread

- Experiments: Identify impacts on rate of spread, if restrict travel

- **Spatial Scope:** Africa>Sierra Leone>district level

- **Temporal Scope:** Variable

- **Agents:** People (categories based on SEIR model)

- **Environment:** (layers we want to show such as with GIS) Admin districts, treatment facilities, roads, cities, airports

Note about our model

For this exercise we are only focusing on a sample model to bring in the GIS and CSV data into Netlogo, based on these themes above. We will not actually model the spread of the disease or be able to support the experiments with this base model. However, I encourage you to build upon the model to do this.

What data do we need?
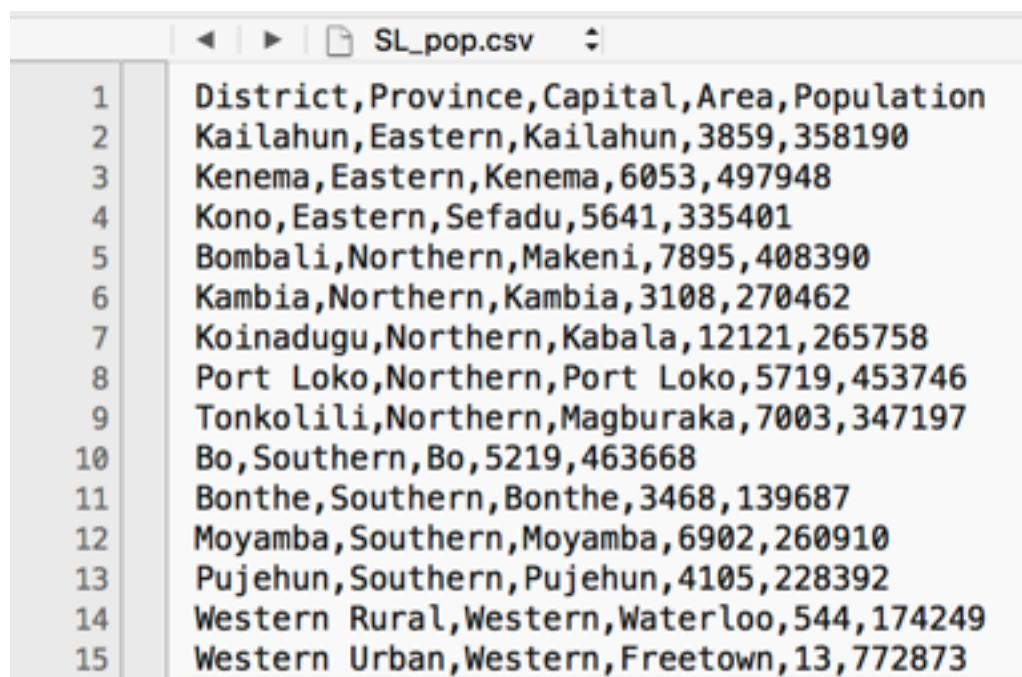
- map data

- Demographic

- Ebola counts

Let's get some data

- Types of data CSV, GIS
  - csv
  - shp

- Download, rename, save data

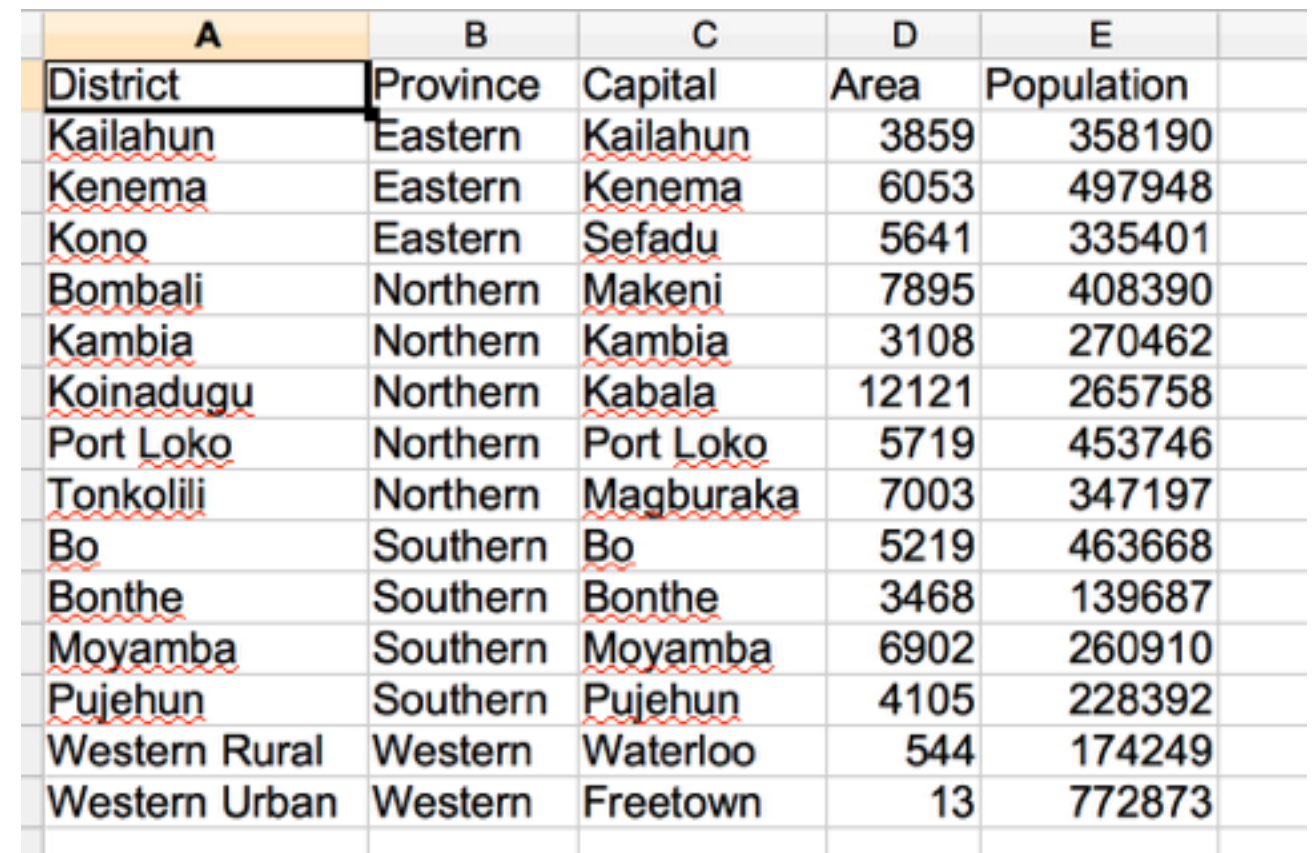- Review data

CSV

Data: Structured data in text format separated by commas

.csv data viewed in text

.csv data viewed in excel

		SL_pop.csv		
1	District,Province,Capital,Area,Population
2	Kailahun,Eastern,Kailahun,3859,358190
3	Kenema,Eastern,Kenema,6053,497948
4	Kono,Eastern,Sefadu,5641,335401
5	Bombali,Northern,Makeni,7895,408390
6	Kambia,Northern,Kambia,3108,270462
7	Koinadugu,Northern,Kabala,12121,265758
8	Port Loko,Northern,Port Loko,5719,453746
9	Tonkolili,Northern,Magburaka,7003,347197
10	Bo,Southern,Bo,5219,463668
11	Bonthe,Southern,Bonthe,3468,139687
12	Moyamba,Southern,Moyamba,6902,260910
13	Pujehun,Southern,Pujehun,4105,228392
14	Western Rural,Western,Waterloo,544,174249
15	Western Urban,Western,Freetown,13,772873

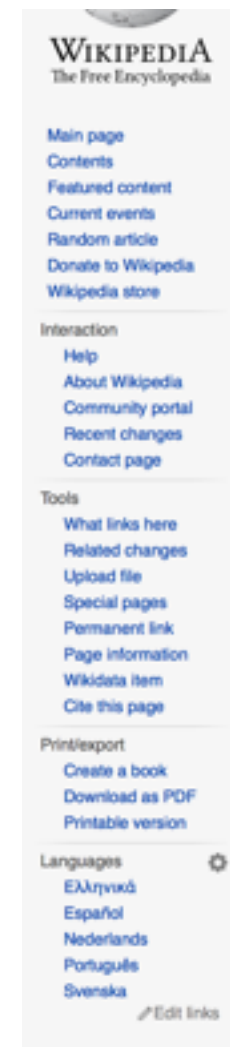|	A	B	C	D	E
	District	Province	Capital	Area	Population
	Kailahun	Eastern	Kailahun	3859	358190
	Kenema	Eastern	Kenema	6053	497948
	Kono	Eastern	Sefadu	5641	335401
	Bombali	Northern	Makeni	7895	408390
	Kambia	Northern	Kambia	3108	270462
	Koinadugu	Northern	Kabala	12121	265758
	Port Loko	Northern	Port Loko	5719	453746
	Tonkolili	Northern	Magburaka	7003	347197
	Bo	Southern	Bo	5219	463668
	Bonthe	Southern	Bonthe	3468	139687
	Moyamba	Southern	Moyamba	6902	260910
	Pujehun	Southern	Pujehun	4105	228392
	Western Rural	Western	Waterloo	544	174249
	Western Urban	Western	Freetown	13	772873

Where do you get data

Data: Tablular data in csv format

- US Census data: https://www.census.gov/geo/maps-data/data/tiger-data.html

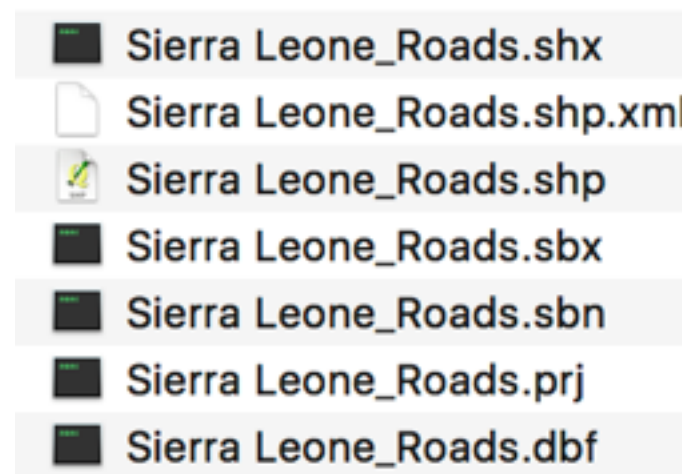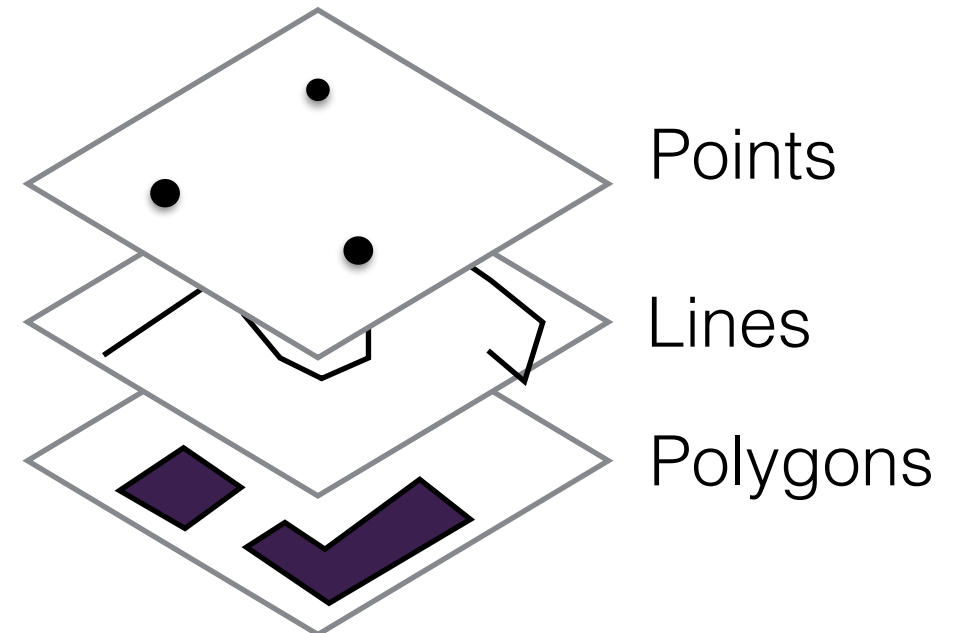- Global humanitarian datasets: https://data.hdx.rwlabs.org

- Wikipedia

GIS

Data: GIS data (shapefile)

Using the GIS extension, you can use geographic data that is vector format as shapefiles or raster data as ASCII and .tif

Vector datasets (shapefiles): For example, cities as points, roads as lines, buildings as polygons

Raster datasets (ASCII, .tif): For example, elevation data or imagery

Points

Lines

Polygons

A **shapefile** is actually a set of files with these different extensions for one type of feature layer

Sierra Leone_Roads.shx
Sierra Leone_Roads.shp.xml
Sierra Leone_Roads.shp
Sierra Leone_Roads.sbx
Sierra Leone_Roads.sbn
Sierra Leone_Roads.prj
Sierra Leone_Roads.dbf

Note that "**Shapefiles**" are not a single file. They are made up of minimum of 4 and up to 8 files that end in the following: **.shp, .dbf, .shx, .prj**, .sbn,.sbx, .cpg, .xml

Where do you get data

Where to find GIS data in shapefile format (.shp)

- Various US datasets: http://catalog.data.gov/dataset

- Base level GIS global: https://lib.stanford.edu/GIS/data

- List of sources: http://gisgeography.com/best-free-gis-data-sources-raster-vector/

- US Census data: https://www.census.gov/geo/maps-data/data/tiger-data.html

- Global humanitarian datasets: https://data.hdx.rwlabs.org

- Open Street Map and other datasets:

  WeoGeo Market - Trimble Data Marketplace
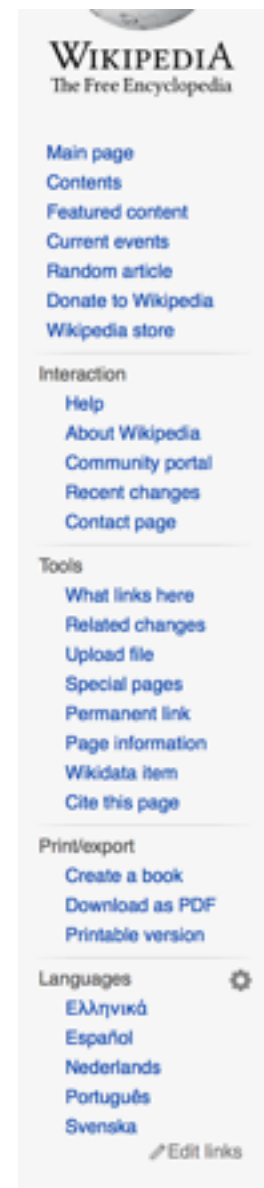 market.weogeo.com/ ▼
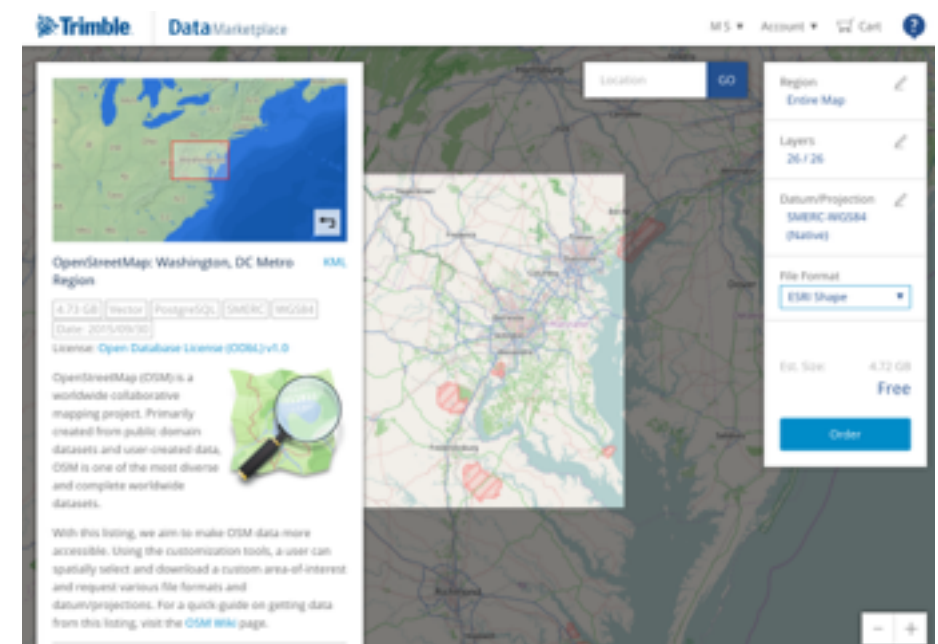
Let's get organized

- Make a folder for this project called: GIS_ebola

- Inside the ebola_model folder, make two folders, one called source_data and one called data

Let's get some data

Data: Tablular data in csv format

- Wikipedia search on Districts of Sierra Leone

- Copy table to a spreadsheet

Let's get data for population

Sources of data - let's go to the Internet and search on Districts of Sierra Leone

- **Go to Wikipedia:** Districts of Sierra Leone

- **Highlight** the table contents including headers, **copy** it, **paste** it in a spreadsheet, **rename text** for Area and Population by removing text in parenthesis and notes, **Save as SL_pop.csv** inside the data folder with your GIS data.

Districts of Sierra Leone

From Wikipedia, the free encyclopedia

The provinces of Sierra Leone are divided into 14 districts. The Western Area is divided into two districts. Sierra Leone's capital Freetown is located in the Western Area of the country and its makes up the Western Area Urban District. One traditional leader from each district occupies a seat in Sierra Leone's parliament. Each one of Sierra Leone's fourteen administrative districts (with the exception of the Western Area Urban District) is governed by a directly elected district council headed by a council chairman. The national capital Freetown, which makes up the Western Area Urban District, is governed by a directly elected city council headed by a mayor.

The districts are further divided into a total of 149 chiefdoms, whose elected leaders provided most of local government from 1896 to 2004, when they were supplemented by elected local councils.

1 - Western Area Urban
2 - Western Area Rural

District	Province	Capital	Area (km²)[1]	Population (2004 census)
Kailahun	Eastern	Kailahun	3,859	358,190
Kenema	Eastern	Kenema	6,053	497,948
Kono	Eastern	Sefadu	5,641	335,401
Bombali	Northern	Makeni	7,895	408,390
Kambia	Northern	Kambia	3,108	270,462
Koinadugu	Northern	Kabala	12,121	265,758
Port Loko	Northern	Port Loko	5,719	453,746
Tonkolili	Northern	Magburaka	7,003	347,197

Review your SL_pop.csv

	A	B	C	D	E
	District	Province	Capital	Area	Population
	Kailahun	Eastern	Kailahun	3859	358190
	Kenema	Eastern	Kenema	6053	497948
	Kono	Eastern	Sefadu	5641	335401
	Bombali	Northern	Makeni	7895	408390
	Kambia	Northern	Kambia	3108	270462
	Koinadugu	Northern	Kabala	12121	265758
	Port Loko	Northern	Port Loko	5719	453746
	Tonkolili	Northern	Magburaka	7003	347197
	Bo	Southern	Bo	5219	463668
	Bonthe	Southern	Bonthe	3468	139687
	Moyamba	Southern	Moyamba	6902	260910
	Pujehun	Southern	Pujehun	4105	228392
	Western Rural	Western	Waterloo	544	174249
	Western Urban	Western	Freetown	13	772873

Note columns of interest are column 0 (District, for name of district) and column 4 (Population). Note text formatting is mixed case. Note values for population are very large so we will create agents in Netlogo that is a representative population where 1 agent = 10,000 people.

Additional resources

OpenOffice: To view/process csv data

I prefer Open Office because I have more control over handling CSV formatted data than I do with other software.

Also with OpenOffice you can edit attributes of GIS datasets without having GIS software - you can't do this with Excel 2010 and newer.

Let's get some GIS data

- Use the internet and **Google search:** Ebola open data

- In search results Click on: **Ebola Response Open Data Sharing**

- or Go directly to **website**: http:// home.ebolaresponse. opendata.arcgis.com

Ebola Response Open Data Sharing — Mapping Portal / Map Gallery

Search for open data ☐ SEARCH WITHIN MAP — My Activity

MAP | SATELLITE

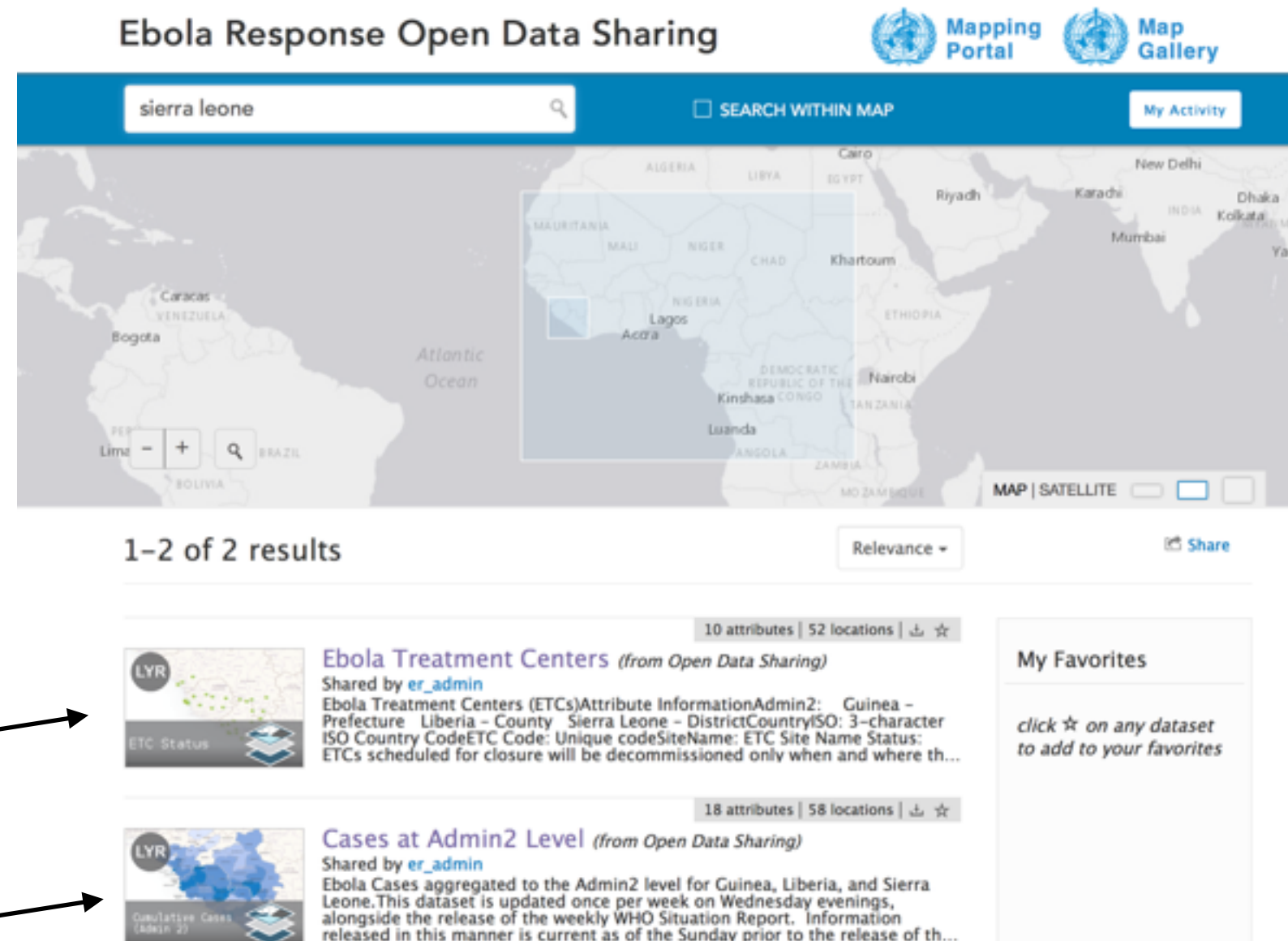Open Geospatial Data for World Health Organization (WHO) Ebola Response

This site highlights open data products from WHO-related epidemiological and operational data pertaining to the United Nations Mission for Ebola Emergency Response (UNMEER). Data is provided freely and in multiple formats, updated when new content is available.

Let's get some data

Website: http://home.ebolaresponse.opendata.arcgis.com

In the search bar for the Ebola Response Open Data Sharing website:

- **Search on Sierra Leone**

Ebola Response Open Data Sharing — Mapping Portal — Map Gallery

sierra leone — ☐ SEARCH WITHIN MAP — My Activity

1–2 of 2 results — Relevance ▾ — Share

10 attributes | 52 locations

Ebola Treatment Centers *(from Open Data Sharing)*
Shared by er_admin
Ebola Treatment Centers (ETCs)Attribute InformationAdmin2: Guinea – Prefecture Liberia – County Sierra Leone – DistrictCountryISO: 3–character ISO Country CodeETC Code: Unique codeSiteName: ETC Site Name Status: ETCs scheduled for closure will be decommissioned only when and where th...

Points of treatment centers

18 attributes | 58 locations

Cases at Admin2 Level *(from Open Data Sharing)*
Shared by er_admin
Ebola Cases aggregated to the Admin2 level for Guinea, Liberia, and Sierra Leone.This dataset is updated once per week on Wednesday evenings, alongside the release of the weekly WHO Situation Report. Information released in this manner is current as of the Sunday prior to the release of th...

Polygons with number of ebola cases per district

My Favorites

click ☆ on any dataset to add to your favorites

Download Sierra Leone districts polygons

Let's get polygons of admin district level and ebola

- **Click on** "Cases at Admin2 Level"

- **Review info** on tabs: Source, Date, Attributes

- Click on **Download Dataset** and choose **shapefile** save the zip to your source_data folder

Download Sierra Leone points

Let's get points of treatment centers

- **Go back and Click on** "Ebola Treatment Centers"

- **Review info** on tabs: Source, Date, Attributes (note no lat and long in attributes)

- **Click on Download Dataset** as **shapefile** save zip to your source_data folder

Download Sierra Leone lines

Let's get lines for roads and also country boundary

- **Google search** gis roads sierra leone

- Find the ArcGIS site like those shown to right

- On the arcgis.com site, **Review info** about data

- **Click on Open>Download as shapefile**

- **Repeat for** Sierra Leone Boundary to get the country boundary
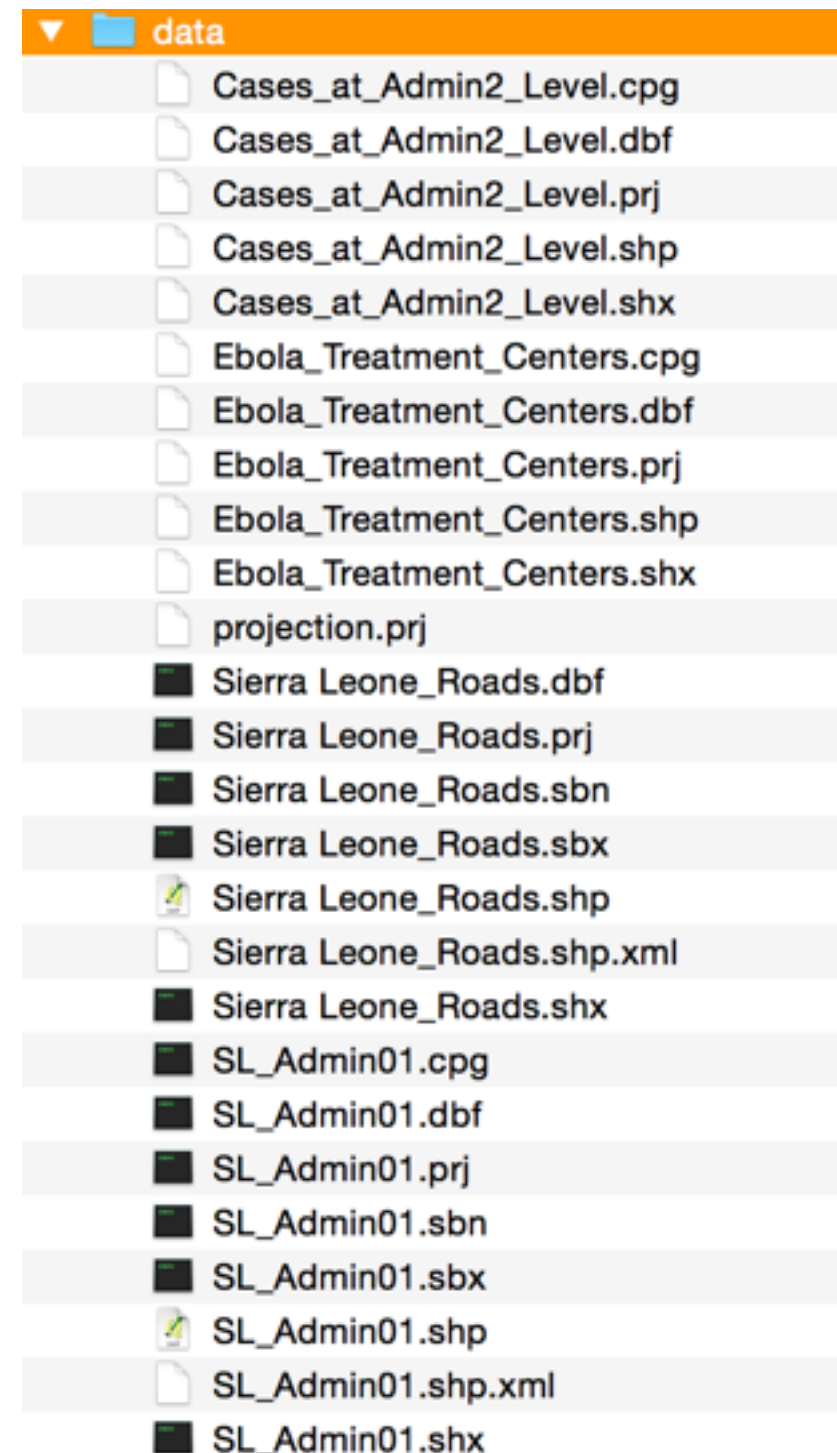
Organize Data

- In your source_data folder, **unzip** the zip files, and look in each folder

- What do you notice about the file extensions and size? Note that "**Shapefiles**" are not a single file. They are made up of minimum of 4 and up to 8 files that end in the following: .**shp, .dbf, .shx, .prj**, .sbn,. sbx, .cpg, .xml

- **copy shape files into the data folder** - should have results like shown to right

Having all your shapefiles in one place makes it easier to load data into Netlogo

▼ 📁 data
　　📄 Cases_at_Admin2_Level.cpg
　　📄 Cases_at_Admin2_Level.dbf
　　📄 Cases_at_Admin2_Level.prj
　　📄 Cases_at_Admin2_Level.shp
　　📄 Cases_at_Admin2_Level.shx
　　📄 Ebola_Treatment_Centers.cpg
　　📄 Ebola_Treatment_Centers.dbf
　　📄 Ebola_Treatment_Centers.prj
　　📄 Ebola_Treatment_Centers.shp
　　📄 Ebola_Treatment_Centers.shx
　　📄 projection.prj
　　⬛ Sierra Leone_Roads.dbf
　　⬛ Sierra Leone_Roads.prj
　　⬛ Sierra Leone_Roads.sbn
　　⬛ Sierra Leone_Roads.sbx
　　📄 Sierra Leone_Roads.shp
　　📄 Sierra Leone_Roads.shp.xml
　　⬛ Sierra Leone_Roads.shx
　　⬛ SL_Admin01.cpg
　　⬛ SL_Admin01.dbf
　　⬛ SL_Admin01.prj
　　⬛ SL_Admin01.sbn
　　⬛ SL_Admin01.sbx
　　📄 SL_Admin01.shp
　　📄 SL_Admin01.shp.xml
　　⬛ SL_Admin01.shx

Review Data

- Your data folder should have the following:

Having all your shapefiles in one place makes it easier to load data into Netlogo
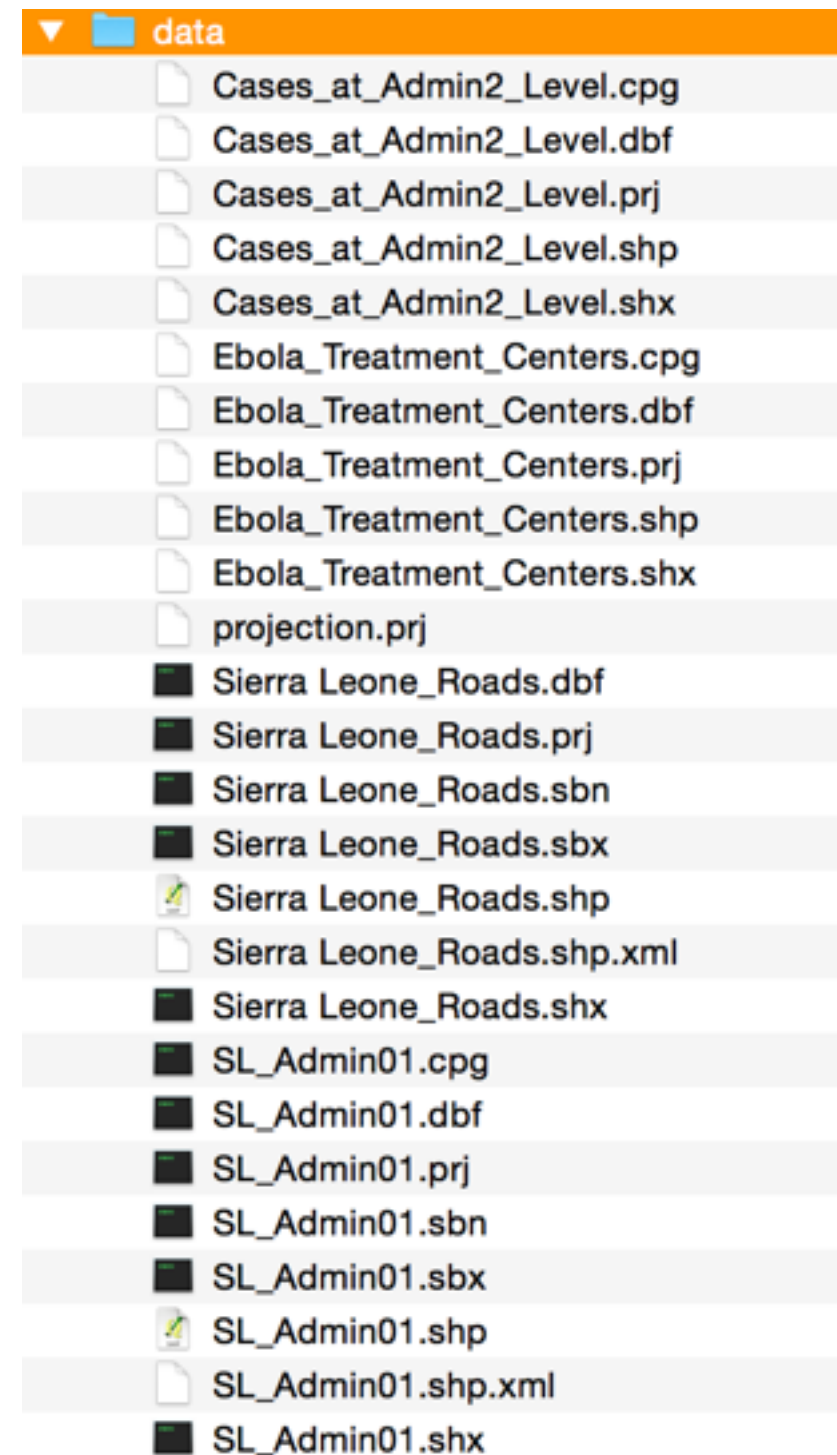
Review Data

Review data attributes: The dbf file contains the GIS data attributes that you will use in Netlogo.

- **Open the .dbf file for Cases_at_Admin2** in excel or open office (do not save).

- **Note the column names** of interest for the model (district name, country name, number of confirmed cases), and then close the file but do not save.

Note: may have to refer back to data source to know what column names mean

District name (GLOBAL_A_1), country name (GLOBAL_A_3), and the number of confirmed ebola cases to date (V_ADM2_C3)

Attributes stored in .dbf

|	A	B	C							K	L
1	GLO	GLOBAL_A_1,C,F	GLOBAL_A_2,C,80	GLOBAL_A	v	v_A	v_AD	v_AD	v_AD	v_ADM2_C	v_ADM2_
2	1637 COMMUNE IV	BAMAKO	MALI	2	0	0	4	56	297	2014-09-29	2014-11-2
3	1638 COMMUNE V	BAMAKO	MALI	2	0	0	2	57	299	2014-09-27	2014-11-2
4	1670 KAYES	KAYES	MALI	2	0	0	1	87	359	2014-07-29	2014-10-2
5	1785 BOFFA	BOKE	GUINEA	2	0	0	36	90	184	2015-01-20	2015-04-2
6	1786 BOKE	BOKE	GUINEA	2	0	6	32	18	40	2015-06-13	2015-07-0
7	1787 CONAKRY	CONAKRY	GUINEA	2	15	25	558	1	6	2015-07-17	2015-07-1
8	1788 COYAH	KINDIA	GUINEA	2	3	3	236	2	8	2015-07-15	2015-07-1
9	1789 DABOLA	FARANAH	GUINEA	2	0	0	8	207	418	2014-05-31	2014-12-2
10	1790 DUBREKA	KINDIA	GUINEA	2	0	0	147	30	64	2015-05-20	2015-06-1
11	1791 DALABA	MAMOU	GUINEA	2	0	0	9	286	576	2013-12-24	2014-10-0
12	1793 FARANAH	FARANAH	GUINEA	2	0	0	46	172	348	2014-08-09	2015-01-2
13	1794 FORECARIAH	KINDIA	GUINEA	2	7	21	421	4	12	2015-07-11	2015-07-1
14	1795 MALI	LABE	GUINEA	2	0	0	5	150	304	2014-09-22	2015-02-1
15	1796 BEYLA	NZEREKORE	GUINEA	2	0	0	46	209	422	2014-05-27	2014-12-2
16	1797 FRIA	BOKE	GUINEA	2	0	1	12	8	20	2015-07-03	2015-07-1

Review Data

Review projection: The .prj file tells us the spatial reference information and projection of the shapefile. Ideally we want all our data in same projection, and lucky for us it is for this exercise.

- **Open .prj file** in a text editor, review, close, do not save.

- **COPY any** one of the **.prj file** and **name it projection.prj** to make it easy for Netlogo and to have a separate prj file for the model.

- **Review spatial extent** of data in QGIS, optional.

Projection info in .prj

```
GEOGCS["GCS_WGS_1984",DATUM["D_WGS_1984",
SPHEROID["WGS_1984",6378137.0,298.257223563]],
PRIMEM["Greenwich",0.0],UNIT["Degree",0.0174532925199433]]
```
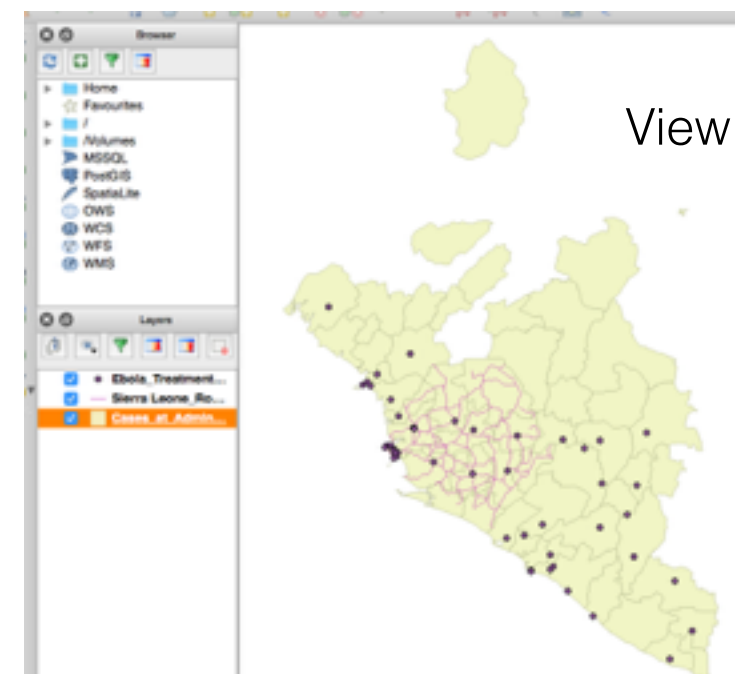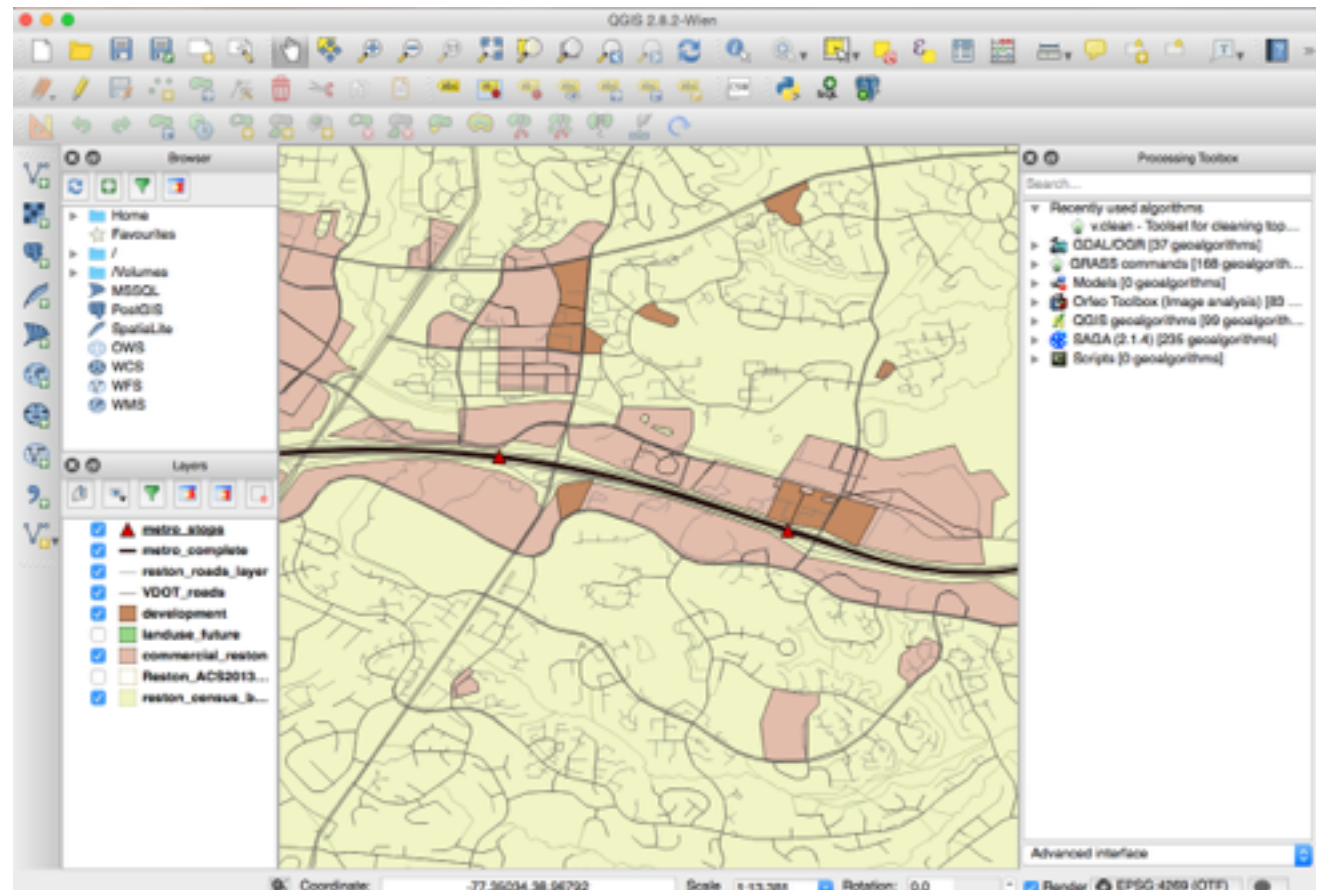

View of data in QGIS

QGIS to process data

- Intro to QGIS

- Review data

- Reproject, filter, simplify, clean data

- Save to data folder

QGIS to View Process GIS

QGIS: to view/process GIS data

https://www.qgis.org/en/site/forusers/download.html

QGIS is a free open source GIS software for manipulating and creating geographic data. Most often I use it to view the GIS data before I load it into a model. Sometimes I use it to *reproject*, *edit*, *trim*, *simplify*, and *clean* datasets for a model. I also use it to create additional GIS data layers if needed for the model. QGIS is not needed for this exercise.