How to Use the Spatial Access Live App

https://access.readthedocs.io/en/latest/app.html

The Live App, which you can access here, offers a point-and-click interface to the spatial access package developed at the University of Chicago's Center for Spatial Data Science. We created it to make it easy to map and download spatial access results without having to install the package (the Live App runs on Amazon Web Services). The app allows you to quickly generate spatial access results for data aggregated to Census tracts in the United States. This document explains how the app works and how to prepare your own data for use with the app.

The app allows you to calculate the following spatial access metrics:

- Traditional **floating catchment area** (FCA) measures: FCA, 2-stage FCA (2SFCA), Enhanced 2SFCA (E2SFCA), 3-stage FCA (3SFCA);
- **Rational Agent Access Model** (RAAM);
- **Catchment**: This is a measure of normalized supply, specifically the weighted sum of providers within the catchment area of a provider's location (here, the tract centroid), normalized by the total area average. In an example with two providers in a catchment area, where one is further away, the more distant one will get a smaller weight.

A summary of each model (except for catchment), numeric examples and references can be found here.[1]

Three of the LiveApp's access metrics depend on the selection of a distance decay function, as outlined in the original papers:

(1) **Catchment** uses a step function, partitioning the catchment area into six even time zones, based on the time scale selected. The weights assigned to each zone by the step function are {Zone 1: 1, Zone 2: 0.83, Zone 3: 0.67, Zone 4: 0.5, Zone 5:0.33, Zone 6:0.17}.

(2) **E2SFCA** uses a discretized Gaussian function (step function)[2], dividing the catchment area into three zones {Zone 1: [0-20min), Zone 2: (20-40min], Zone 3: (20-60min]}. The step function that associates each zone with a weight is defined by {Zone 1: 1, Zone 2: 0.68, Zone 3:0.22}.

(3) **3SFCA** also uses a discretized Gaussian function (step function). It divides the catchment area into four zones, namely {Zone 1: (0-10min], Zone 2: (10-20min], Zone 3: (20-30min], Zone 4: (30-60min]}. The step function is defined by {Zone 1: 0.962, Zone 2: 0.704, Zone 3: 0.377, Zone 4: 0.042}.

[1] https://geoda.s3.amazonaws.com/docs/PySALAccess+Package_Documentation.pdf

[2] Both metrics, E2SFCA and 3SFCA, use a Gaussian function of the form: $f(d_{ij}) = e^{-d_{ij}^2/\beta}$, as defined in the original papers.

(4) **RAAM:** the tau parameter τ used by RAAM corresponds to the specified time scale chosen in the LiveApp, which ranges from 15 to 60 minutes.

This guide walks you through the two required steps to get spatial access results with the Live App:

1. Input Data
2. Download Results

To illustrate the two steps, we are using data of primary care physicians in Illinois (source: HRSA/Dartmouth Primary Care Service Area (PCSA) data). You can use the app to get results for your data at the Census tract level in the US (including Alaska and Hawaii but excluding Puerto Rico). For both the sample data and your data, the 2010 population count from the US Census will be used as a proxy for demand.

Part 1: Input Data

1. Create your input file

To calculate your own results, first prepare a csv file with two columns: (1) 2010 Census tracts FIPS codes, and (2) the amount of a resource supplied (e.g. the number of doctors in our example). The two columns should be labeled "geoid" (first column) and "supply" (second column). The input format is illustrated with the il_doctors.csv data below. Note that the csv file format automatically converts the geoid field to numeric format. If this field was formatted in string/text format before with leading zeros, those zeros will be dropped in the numeric format.

	A	B	C
1	geoid	supply	
2	17001000100	0	
3	17001000201	0	
4	17001000202	0	
5	17001000400	3	
6	17001000500	10	
7	17001000600	3	
8	17001000700	42	
9	17001000800	0	
10	17001000900	0	

2. Getting geoids (2010 Census tracts FIPS codes)

The app matches 2010 Census tract FIPS codes that are used in the app with those in the csv file you provide. If you add your data to this tract-level GeoJSON file,[3] your FIPS codes will match those used in the app.

We explain how to do this below with free software (QGIS and R) for a common use case where you have XY coordinates for your providers and need to aggregate them to Census tracts. If you are starting with addresses, you first need to convert those to XY coordinates (a process called geocoding).[4] Once you have the coordinates, you can map them and spatially join them to the Census tracts.

Step 1: Make sure you have a file with XY coordinates and a count of providers as in the example below.

	A	B	C	D
1	x	y	supply	
2	-87.61981	41.8950305	243	
3	-87.619361	41.8906144	5	
4	-87.626229	41.8925605	4	
5	-87.761041	41.9261643	4	
6	-87.734114	41.9234822	1	
7	-87.737541	41.9198315	0	
8	-87.729676	41.9196338	1	
9	-87.733955	41.9117263	0	
10	-87.675312	41.906024	3	

Step 2: Find a tract map layer with 2010 FIPS codes. The app uses this national GeoJSON file, which you can download here to make sure your FIPS codes match those of the app.[5]

If you prefer to work with smaller tract files, you can download files for individual states from the Census Bureau website here: US-Tracts. The structure of the files is as follows: tl_2010_**XXXXX**_tract10.zip, where XXXXX represents the FIP codes. Files with two digits represent states, while files with five digits represent counties (2-digit state code, followed by 3-digit county code). You can locate the relevant code of your state or county of interest here: FIP-codes. The data in our example uses information for the state of Illinois (17), which is: tl_2010_17_tract10.zip. Unzip this file before opening it in QGIS.

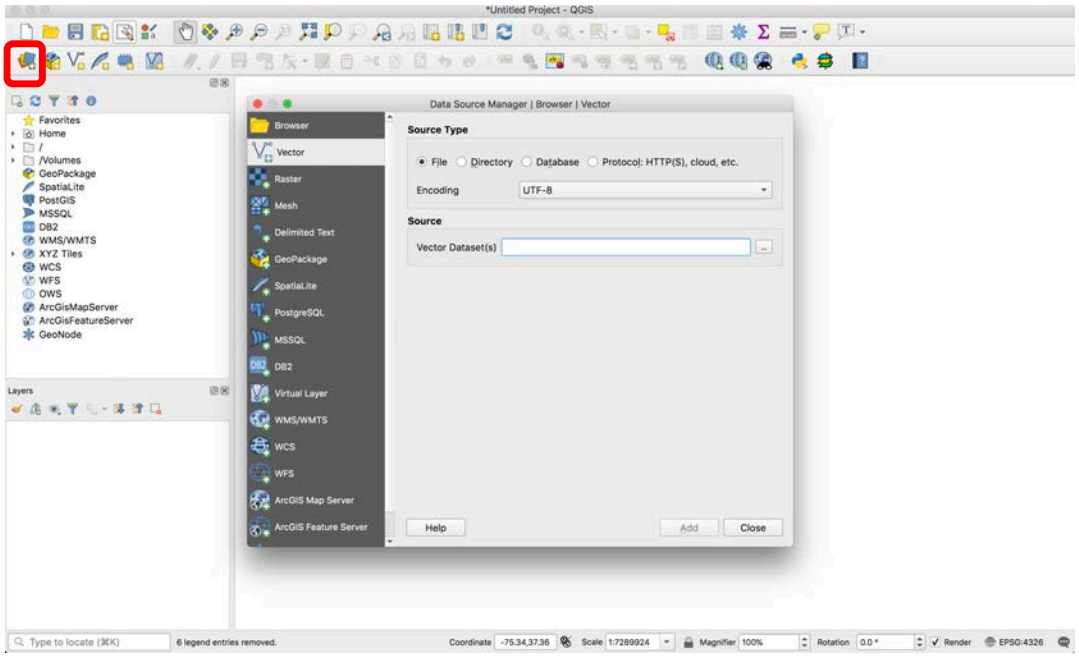
[3] https://uchicago.box.com/shared/static/l50awntbv9qjtheixgltax2oy6pq8ekq.bz2

[4] You can use a GIS to geocode your address or an online geocoder. E.g., the Census Bureau's online geocoding API is available at: https://geocoding.geo.census.gov/geocoder/ Documentation to use the geocoder helper: https://www2.census.gov/geo/pdfs/maps-data/data/FAQ_for_Census_Bureau_Public_Geocoder.pdf. General documentation: https://www.census.gov/programs-surveys/geography/technical-documentation/complete-technical-documentation/census-geocoder.html

[5] https://uchicago.box.com/shared/static/l50awntbv9qjtheixgltax2oy6pq8ekq.bz2

Step 3: Add the tract layer in a Geographic Information System (in our case, in the free QGIS program).[6]

- Click on the "Data Source Manager" icon in the upper left  (highlighted in red). You will see the following window:

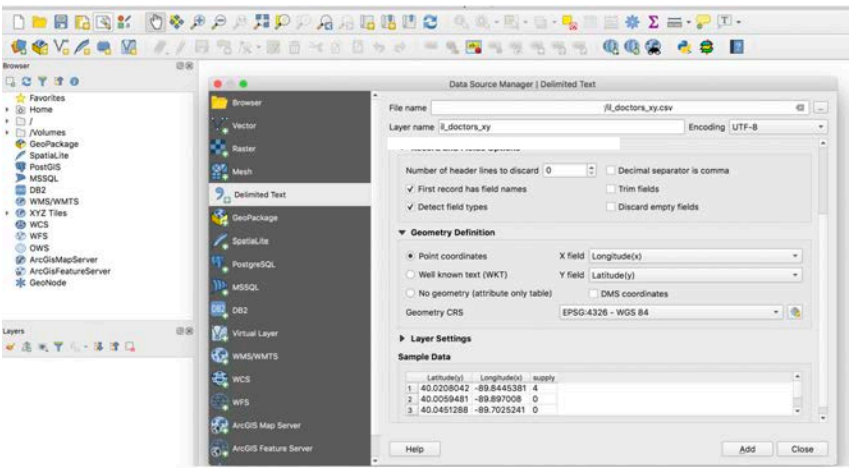


- Select Vector and the tract file from the (…) icon. In our example, load the file national-origins-TRACT.geojson or the Illinois_shapefile_tl_2010_17_tract10.shp. Alternatively, you can drag and drop files into the platform.

- **Next, add the .cvs file to this map:** as before, click "Data Source Manager".

- Select "Delimited Text". Choose the relevant file and select the column names corresponding to each coordinate. Make sure that the "X field" corresponds to longitude and "Y field" to latitude. Also, select the appropriate Coordinate Reference System (CRS). In our example, the "X field" is x and "Y field" is y. Finally, click add.

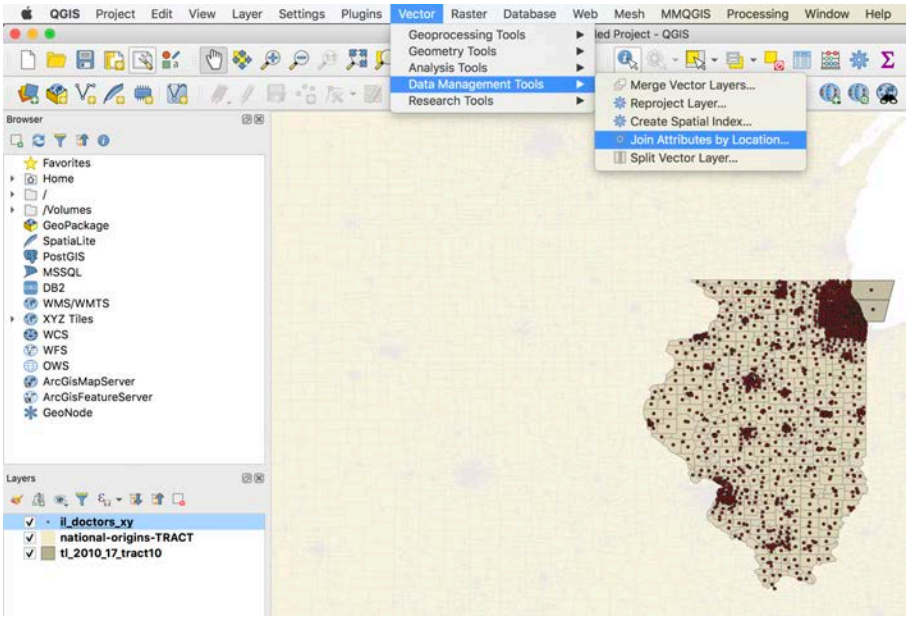
[6] You can download the latest stable version of QGIS here: https://qgis.org/en/site/forusers/download.html



- **Warning:** make sure that both files (your points and the shapefiles) have the same CSR projection. The national county file as well as the coordinates csv file use EPSG:4326 - WGS 84 while the shapefiles provided by the Census Bureau uses EPSG:4269 – NAD83.[7]

Step 5: Join FIPS codes to each point.

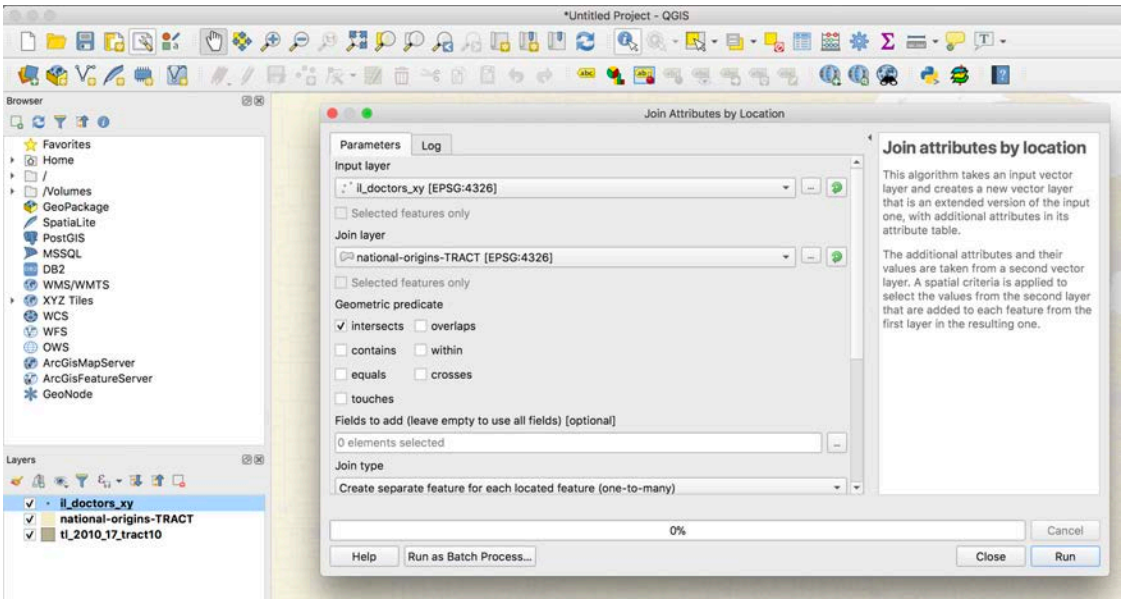
- From the tool menu, select Vector>> Data Management Tools >> Join attributes by Location …



- Select "Input layer": il_doctors_xy in our example.

[7] See this tutorial for reprojection in QGIS: https://docs.qgis.org/2.8/en/docs/training_manual/vector_analysis/reproject_transform.html

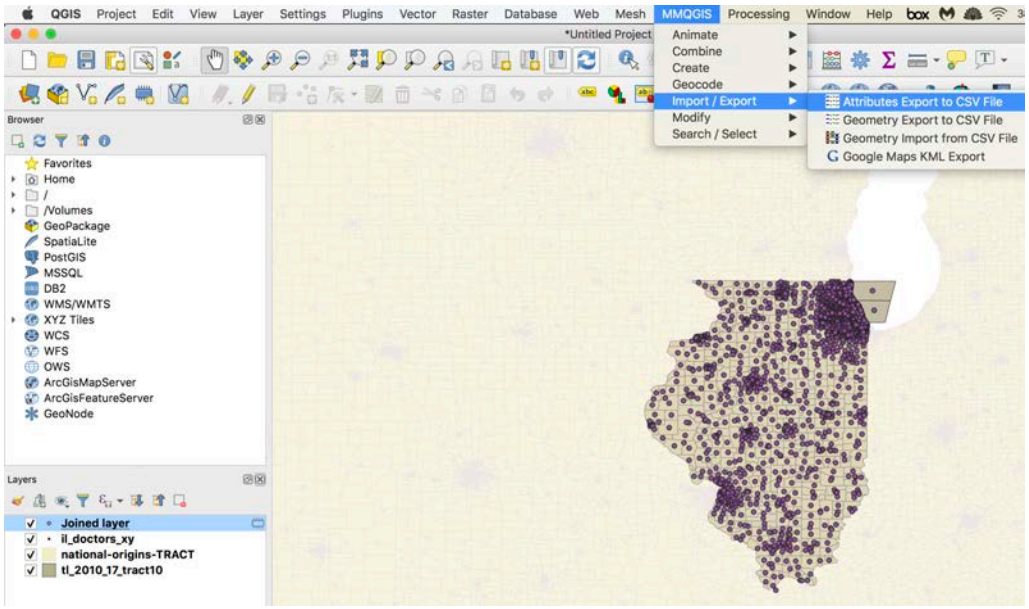
- Select “Join layer”: it corresponds to the National GeoJSON file provided or the shapefile downloaded from the Census Bureau website.
- Choose the field desired at “Fields to add”. Given that our purpose is to add the FIPS codes, select that unique field (geoid) from the National GeoJSON file. If using the Census Bureau shapefiles, choose the field “GEOID10”.
- Select “Join type”: (one-to-many).
- Optional: Assign a name and location to the layer that is going to be created at “Joined layer”.
- Lastly, press “Run”.



Note: if using the GeoJSON file, the process might take longer than using specific state shapefiles, due to the larger size of the national file.

Step 6: Export the joined file with FIPS codes.

- Use the plugin MMQGIS. If not installed, click Plugins>> Manage and Install Plugins… >> type MMQGIS and install.
- Select the layer that was created from the previous step. If a name is not assigned, a layer called “Joined layer” is going to be generated.
- From the toolbar, select MMQGIS>> Import/Export>> Attributes Export to CSV file.
- Select a folder (…) from your computer and click “Apply”.



- This is what the .csv output file looks like:

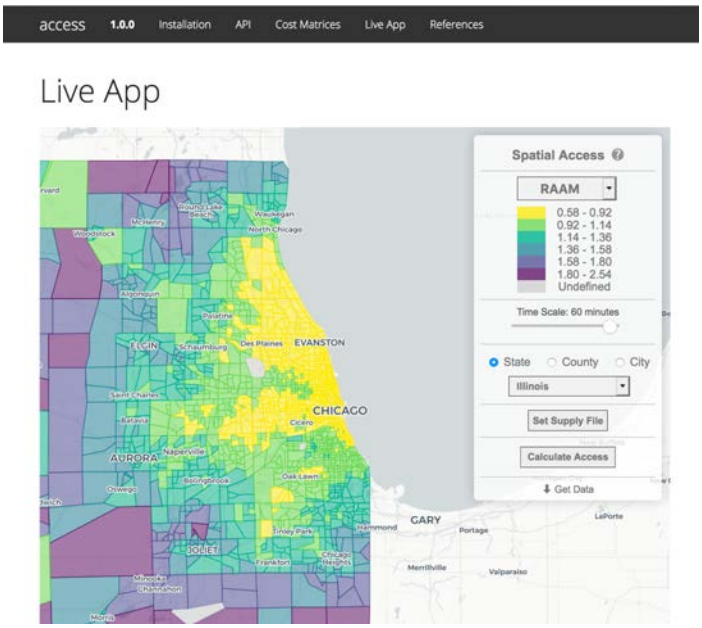
	A	B	C	D	E
1	x	y	supply	geoid	
2	-87.619533	41.7437381	5	17031440300	
3	-87.619158	41.7326849	1	17031440600	
4	-87.60963	41.7347516	0	17031440700	
5	-87.547021	41.7413848	2	17031460200	
6	-87.559516	41.7356312	0	17031460600	
7	-87.575606	41.7352501	0	17031480100	
8	-87.619156	41.7253754	0	17031490300	
9	-87.628364	41.7107046	0	17031490700	
10	-87.637441	41.6887752	0	17031491200	

- Remove coordinates columns and keep csv with the format explained before. Sort columns such that column A is “geoid” and column B is “supply”.

Option 3 if you have coordinates information: latitude/altitude, the folder called **LiveAPP** steps will guide you to obtain the geocodes using the open source application R

Part 2: Download Results

Step 1: load your supply file (e.g. il_doctors.csv) to the website Live App, selecting “Set Supply File”.



Step 2: Use the drop-down for the state/county/city option to select your location

Step 3: press "Calculate Access". The legend is an interactive drop-down: you can change the access method.

Step 4: click "Get Data". You will get data from the selected model. If results from different models are desired, you will need to download different files for each model.