Plotting with GeoJSON

VISUALIZING GEOSPATIAL DATA IN PYTHON

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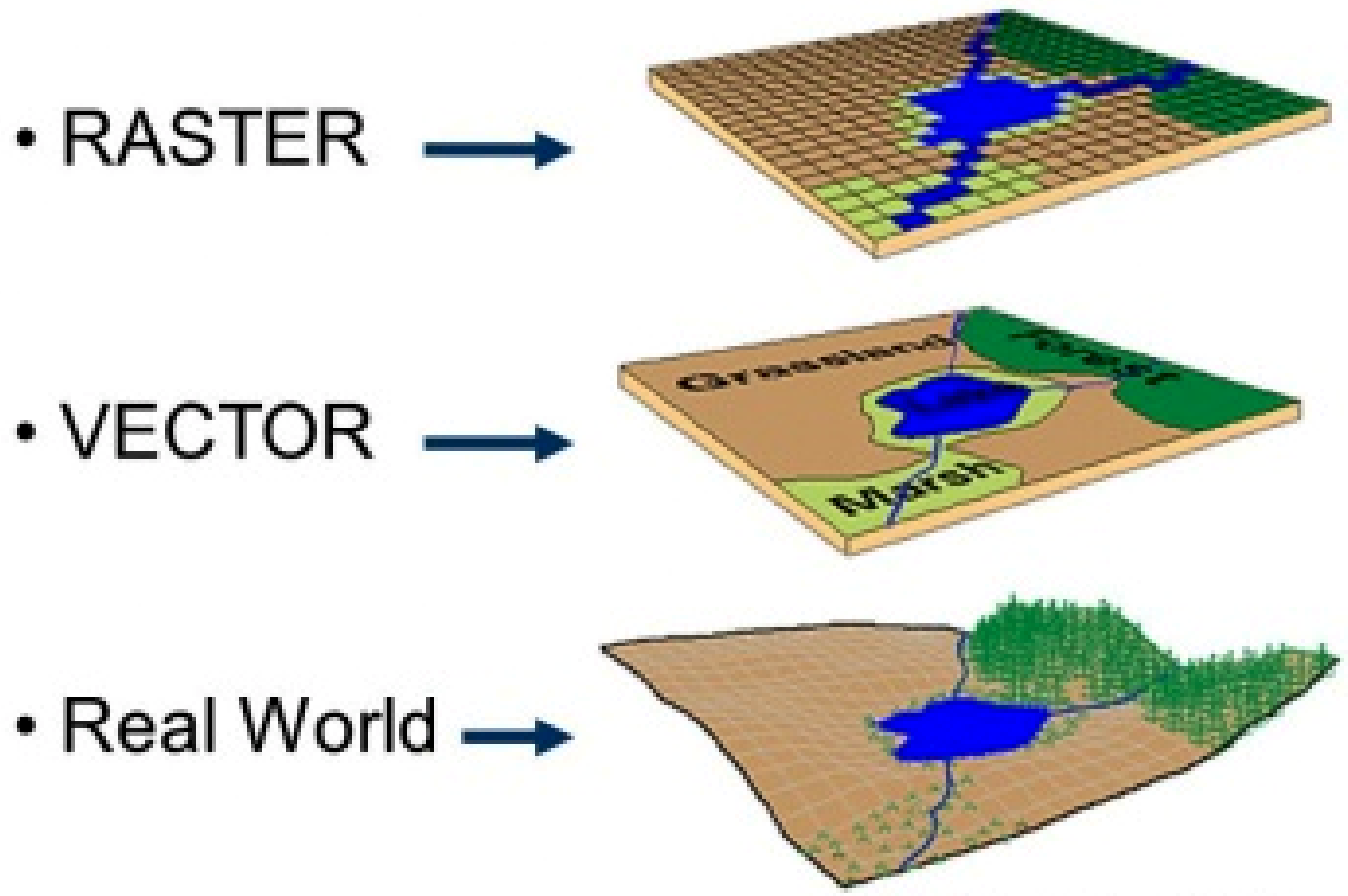
Neighborhoods GeoJSON

```
{ "type": "FeatureCollection",
  "features": [
    { "type":"Feature",
      "properties":{
    "name":"Historic Buena Vista"
    },"geometry":{
        "type":"MultiPolygon","coordinates":[[[[-86.79511056795417,36.17575....
```

```
neighborhoods = gpd.read_file('./data/neighborhood_boundaries.geojson')
neighborhoods.head(1)
```

```
        name                 geometry
Historic Buena Vista    (POLYGON ((-86.79511056795417 36.17575964963348...)))
```

Geopandas dependencies

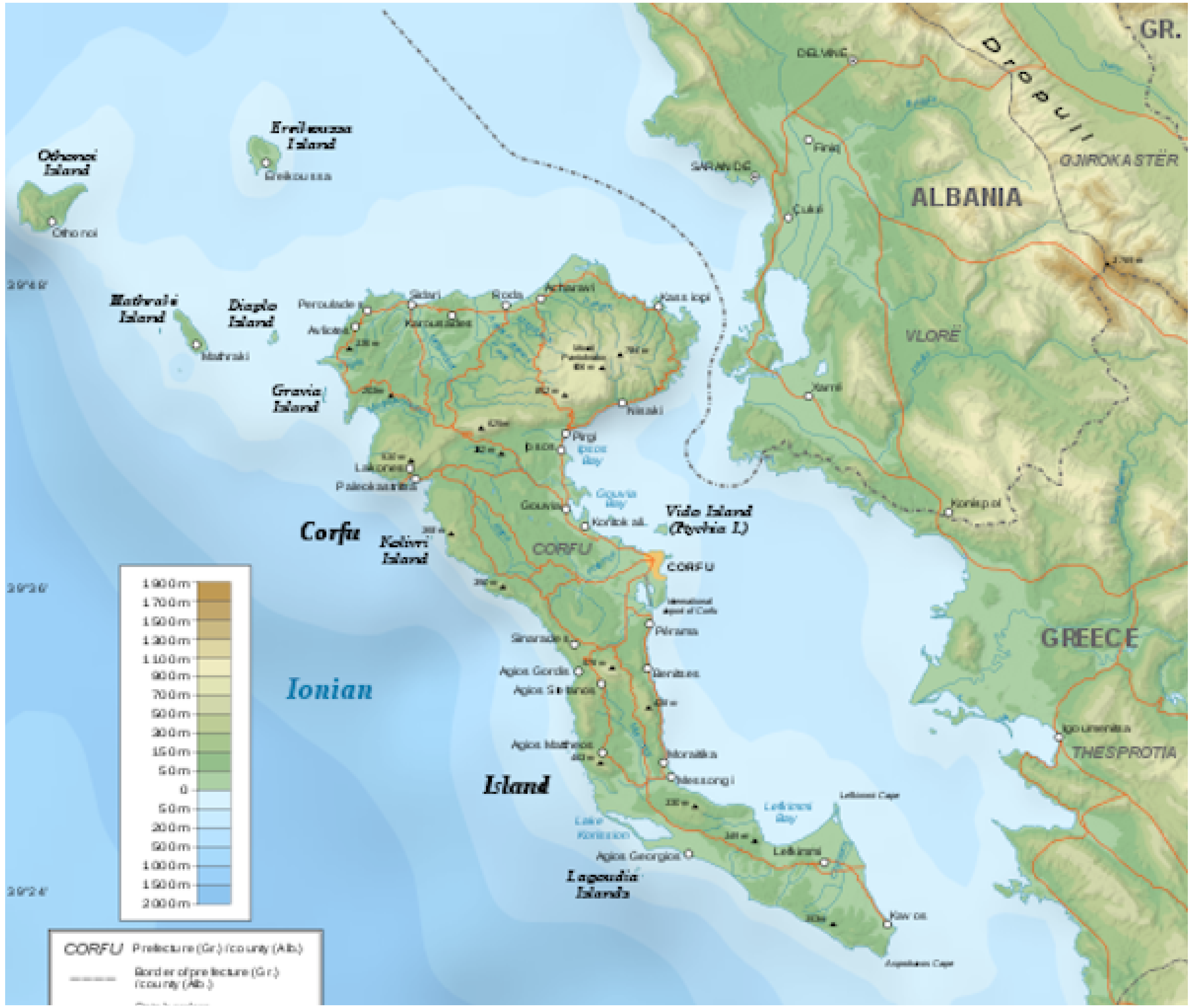


Source: Defense Mapping School
National Imagery and Mapping Agency

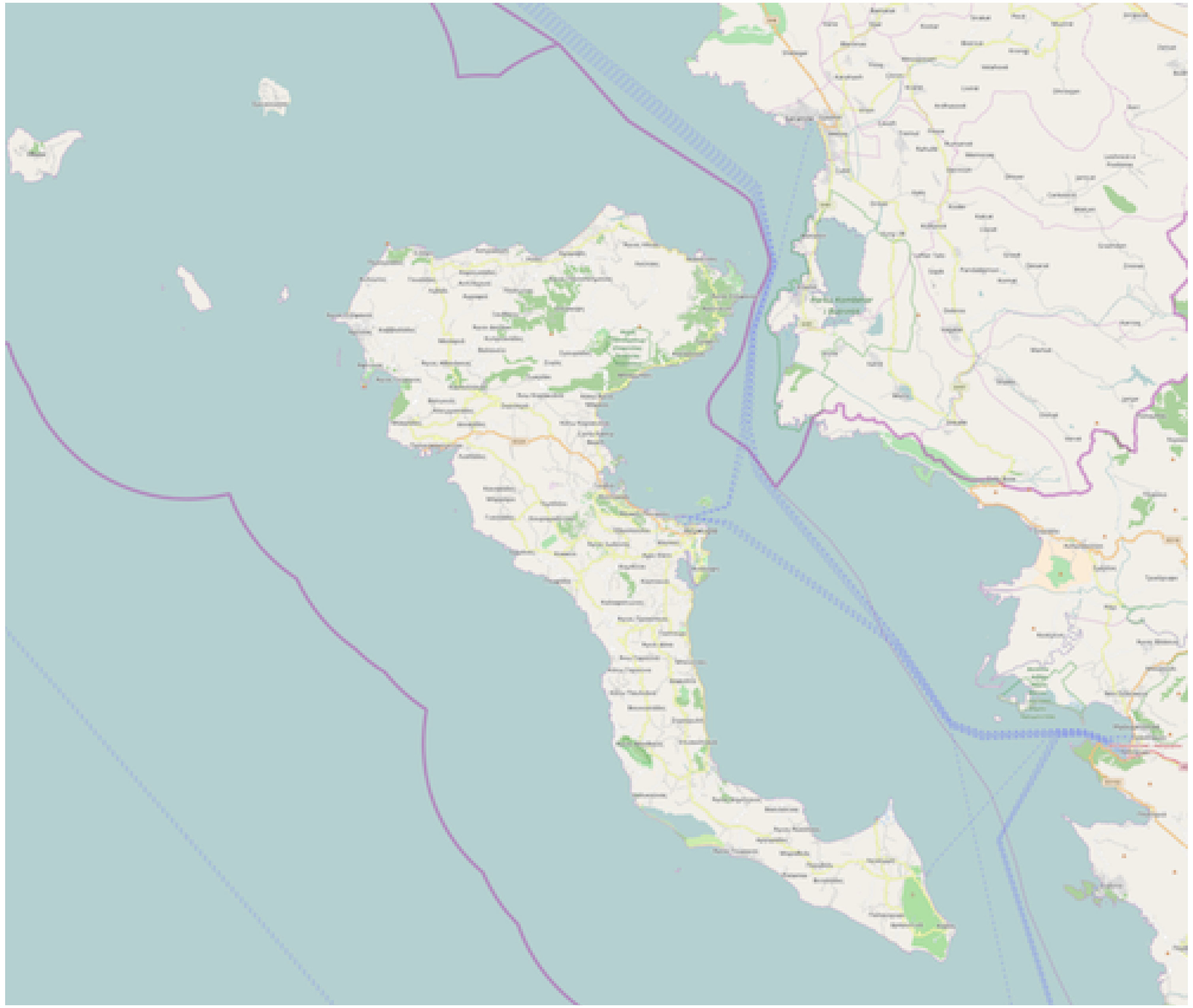
- Fiona
  - provides an python API for OGR
- GDAL/OGR
  - GDAL for translating raster data
  - OGR for translating vector data

Comparing raster and vector graphics

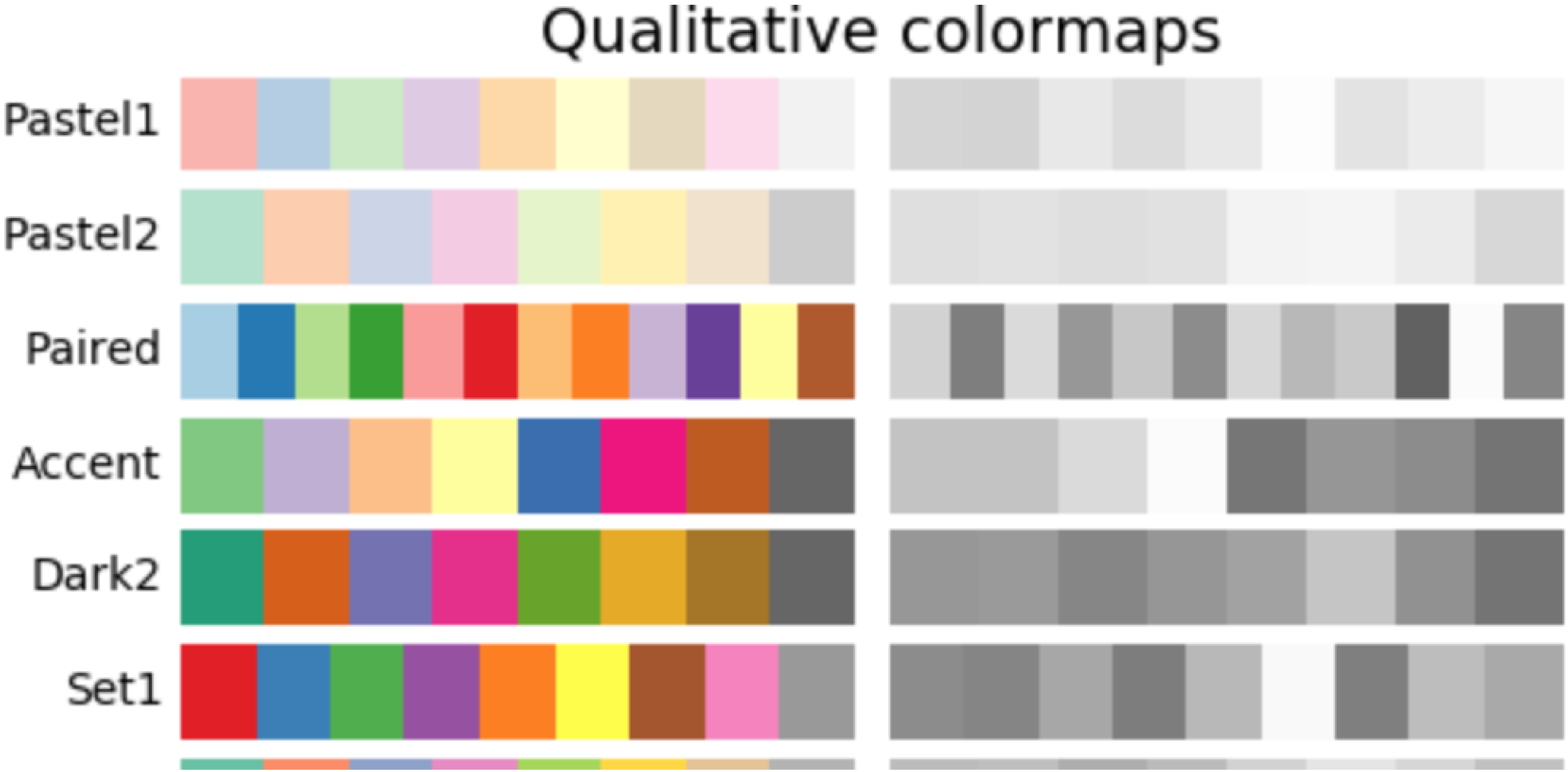
raster image of Corfu



vector image of Corfu



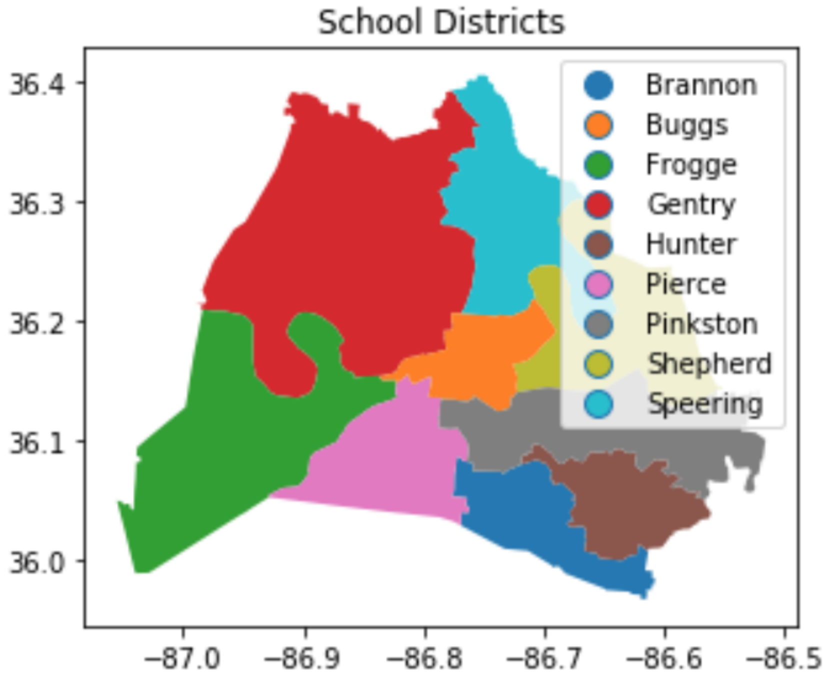
Colormaps


Qualitative colormaps
Pastel1
Pastel2
Paired
Accent
Dark2
Set1

Plotting with color

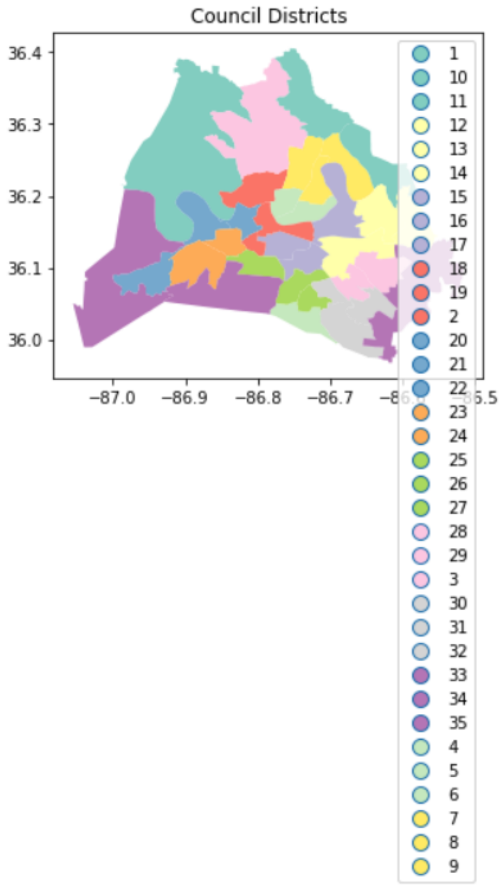
```
school_districts.head(3)
```

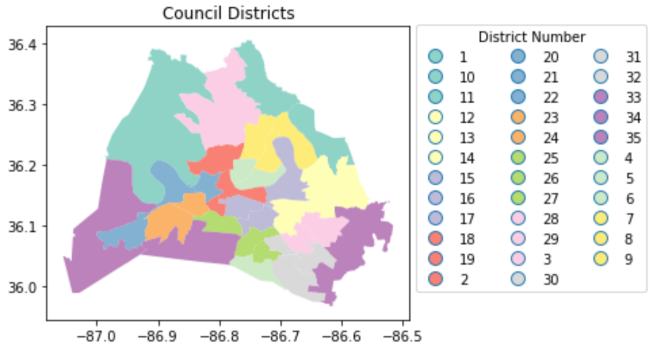
```
first_name     last_name    position    district      geometry
Sharon         Gentry       Member       1      (POLYGON ((-86.771 36.383)...))
Jill           Speering     Vice-Chair   3      (POLYGON ((-86.753 36.404)...))
Jo Ann         Brannon      Member       2      (POLYGON ((-86.766 36.083)...))
```



```
council_dists.plot(
                   column='district',
                   cmap='Set3',
                   legend=True)
plt.title('Council Districts')
plt.show();
```

```
leg_kwds={'title':'District Number',
          'loc': 'upper left',
          'bbox_to_anchor':(1, 1.03),
          'ncol':3}
council_dists.plot(column='district',
                   cmap='Set3',
                   legend=True,
             legend_kwds=leg_kwds)
plt.title('Council Districts')
plt.show();
```





Let's practice!

VISUALIZING GEOSPATIAL DATA IN PYTHON

Projections and Coordinate Reference Systems

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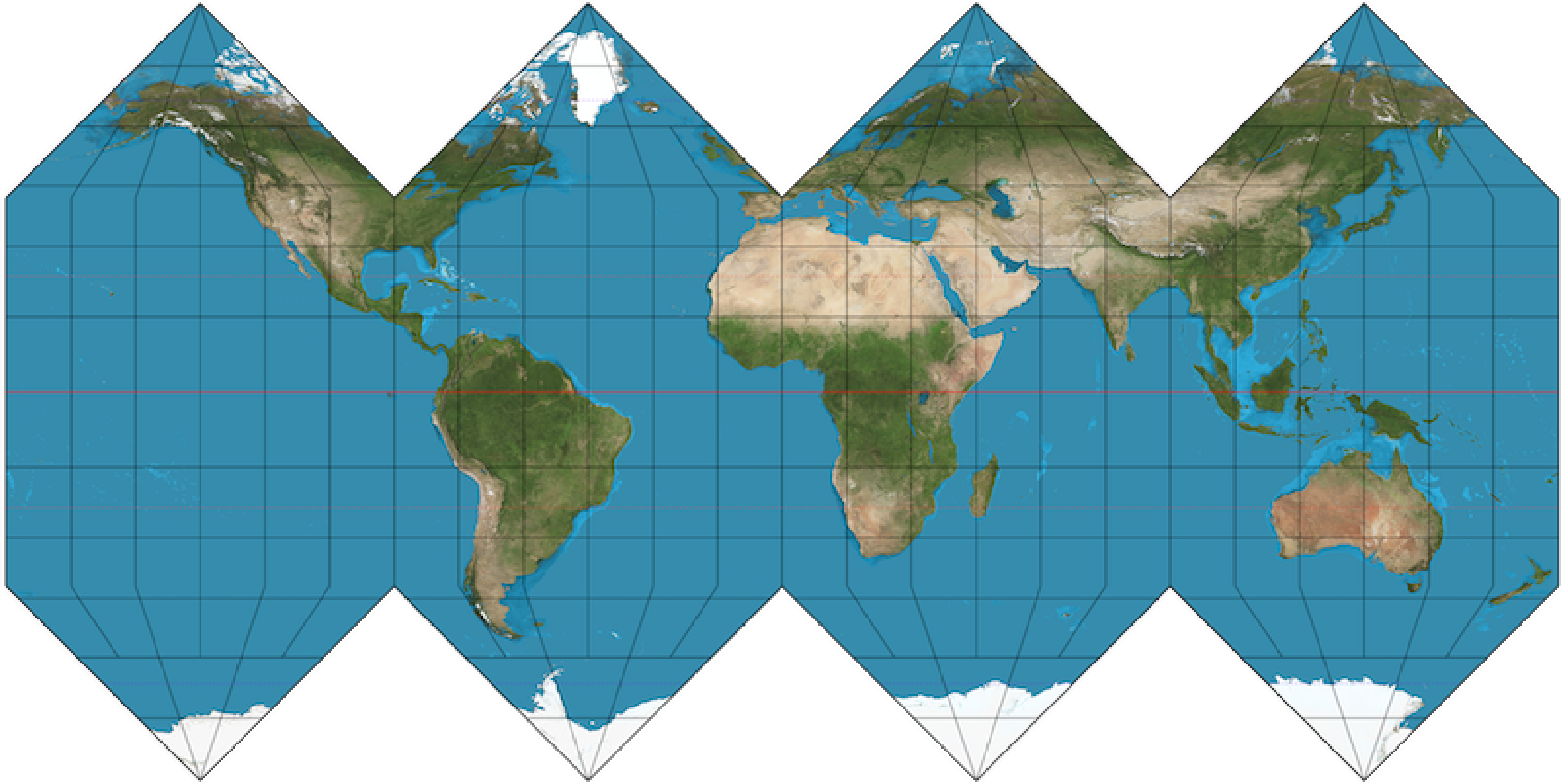
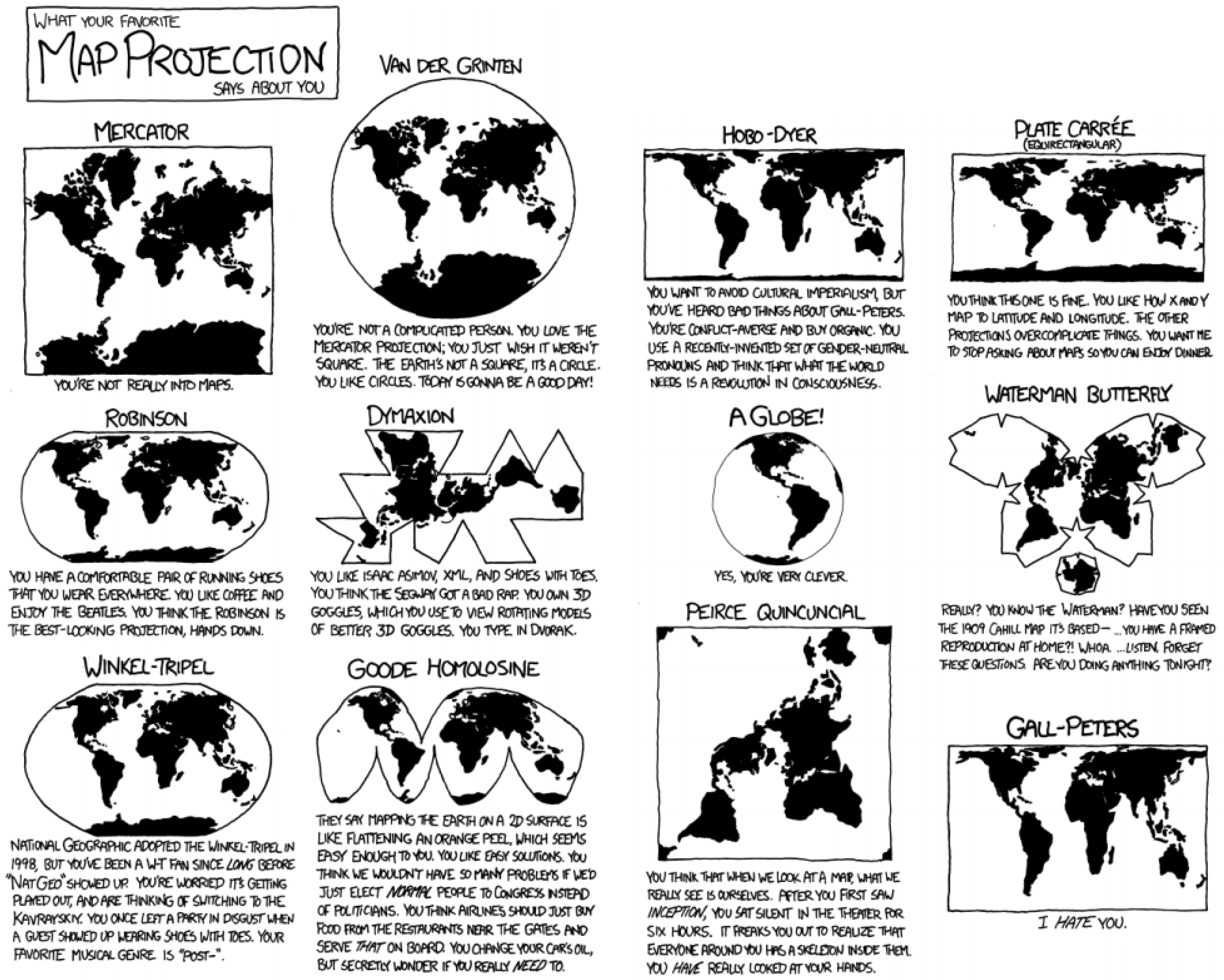
Projections



Many approaches to map projection


WHAT YOUR FAVORITE
MAP PROJECTION
SAYS ABOUT YOU
MERCATOR
YOU'RE NOT REALLY INTO MAPS.
ROBINSON
YOU HAVE A COMFORTABLE PAIR OF RUNNING SHOES THAT YOU WEAR EVERYWHERE. YOU LIKE COFFEE AND ENJOY THE BEATLES. YOU THINK THE ROBINSON IS THE BEST-LOOKING PROJECTION, HANDS DOWN.
WINKEL-TRIPEL
NATIONAL GEOGRAPHIC ADOPTED THE WINKEL-TRIPEL IN 1998, BUT YOU'VE BEEN A W-T FAN SINCE LONG BEFORE "NAT GEO" SHOWED UP. YOU'RE WORRIED IT'S GETTING PLAYED OUT, AND ARE THINKING OF SWITCHING TO THE KAVRAYSKIY. YOU ONCE LEFT A PARTY IN DISGUST WHEN A GUEST SHOWED UP WEARING SHOES WITH TOES. YOUR FAVORITE MUSICAL GENRE IS "POST-".
VAN DER GRINTEN
YOU'RE NOT A COMPLICATED PERSON. YOU LOVE THE MERCATOR PROJECTION; YOU JUST WISH IT WEREN'T SQUARE. THE EARTH'S NOT A SQUARE, IT'S A CIRCLE. YOU LIKE CIRCLES. TODAY IS GONNA BE A GOOD DAY!
DYMAXION
YOU LIKE ISAAC ASIMOV, XML, AND SHOES WITH TOES. YOU THINK THE SEGWAY GOT A BAD RAP. YOU OWN 3D GOGGLES, WHICH YOU USE TO VIEW ROTATING MODELS OF BETTER 3D GOGGLES. YOU TYPE IN DVORAK.
GOODE HOMOLOSINE
THEY SAY MAPPING THE EARTH ON A 2D SURFACE IS LIKE FLATTENING AN ORANGE PEEL, WHICH SEEMS EASY ENOUGH TO YOU. YOU LIKE EASY SOLUTIONS. YOU THINK WE WOULDN'T HAVE SO MANY PROBLEMS IF WE'D JUST ELECT NORMAL PEOPLE TO CONGRESS INSTEAD OF POLITICIANS. YOU THINK AIRLINES SHOULD JUST BUY FOOD FROM THE RESTAURANTS NEAR THE GATES AND SERVE THAT ON BOARD. YOU CHANGE YOUR CAR'S OIL, BUT SECRETLY WONDER IF YOU REALLY NEED TO.
HOBO-DYER
YOU WANT TO AVOID CULTURAL IMPERIALISM, BUT YOU'VE HEARD BAD THINGS ABOUT GALL-PETERS. YOU'RE CONFLICT-AVERSE AND BUY ORGANIC. YOU USE A RECENTLY-INVENTED SET OF GENDER-NEUTRAL PRONOUNS AND THINK THAT WHAT THE WORLD NEEDS IS A REVOLUTION IN CONSCIOUSNESS.
A GLOBE!
YES, YOU'RE VERY CLEVER.
PEIRCE QUINCUNCIAL
YOU THINK THAT WHEN WE LOOK AT A MAP, WHAT WE REALLY SEE IS OURSELVES. AFTER YOU FIRST SAW INCEPTION, YOU SAT SILENT IN THE THEATER FOR SIX HOURS. IT FREAKS YOU OUT TO REALIZE THAT EVERYONE AROUND YOU HAS A SKELETON INSIDE THEM. YOU HAVE REALLY LOOKED AT YOUR HANDS.
PLATE CARRÉE
(EQUIRECTANGULAR)
YOU THINK THIS ONE IS FINE. YOU LIKE HOW X AND Y MAP TO LATITUDE AND LONGITUDE. THE OTHER PROJECTIONS OVERCOMPLICATE THINGS. YOU WANT ME TO STOP ASKING ABOUT MAPS SO YOU CAN ENJOY DINNER.
WATERMAN BUTTERFLY
REALLY? YOU KNOW THE WATERMAN? HAVE YOU SEEN THE 1909 CAHILL MAP IT'S BASED— ...YOU HAVE A FRAMED REPRODUCTION AT HOME?! WHOA. ...LISTEN, FORGET THESE QUESTIONS. ARE YOU DOING ANYTHING TONIGHT?
GALL-PETERS
I HATE YOU.

*What's that? You think I don't like the Peters map because I'm uncomfortable with having my cultural assumptions challenged? Are you sure you're not... ::puts on sunglasses:: ... **projecting**?* http://xkcd.com/977/ - http://bit.ly/explainxkcd-977

Coordinate Reference Systems

EPSG:4326

- used by Google Earth
- units are decimal degrees

EPSG:3857

- used by Google Maps, Bing Maps, Open Street Maps
- units are meters

```
School Name                Latitude     Longitude
A. Z. Kelley Elementary    36.021       -86.658
Alex Green Elementary      36.252       -86.832
Amqui Elementary           36.273       -86.703
```

```python
# create a point geometry column
from shapely.geometry import Point
schools['geometry'] = schools.apply(lambda x: Point((x.Longitude, x.Latitude)),
                                              axis = 1)
schools.head(3)
```

```
School Name                Latitude     Longitude     geometry
A. Z. Kelley Elementary    36.021    -86.658       POINT (-86.658 36.021)
Alex Green Elementary      36.252    -86.832       POINT (-86.832 36.252)
Amqui Elementary           36.273    -86.703       POINT (-86.703 36.273)
```

Creating a GeoDataFrame from a DataFrame

```
import geopandas as gpd

schools_crs = {'init':  'epsg:4326'}
schools_geo = gpd.GeoDataFrame(schools,
                               crs = schools_crs,
                               geometry = schools.geometry)
```

```
schools_geo.head(3)
```

```
School Name                Latitude     Longitude     geometry
A. Z. Kelley Elementary    36.021    -86.658       POINT (-86.658 36.021)
Alex Green Elementary      36.252    -86.832       POINT (-86.832 36.252)
Amqui Elementary           36.273    -86.703       POINT (-86.703 36.273)
```

Changing from one CRS to another

```
schools_geo.head(2)
```

```
School Name                Latitude     Longitude     geometry
A. Z. Kelley Elementary    36.021    -86.658       POINT (-86.658 36.021)
Alex Green Elementary      36.252    -86.832       POINT (-86.832 36.252)
```

```
# convert geometry from decimal degrees to meters
schools_geo.geometry = schools_geo.geometry.to_crs(epsg = 3857)
schools_geo.head(2)
```

```
School Name                Latitude    Longitude    geometry
A. Z. Kelley Elementary    36.021    -86.658    POINT (-9646818.8 4303623.8)
Alex Green Elementary      36.252    -86.832    POINT (-9666119.5 4335484.4)
```

Let's practice!

Spatial joins

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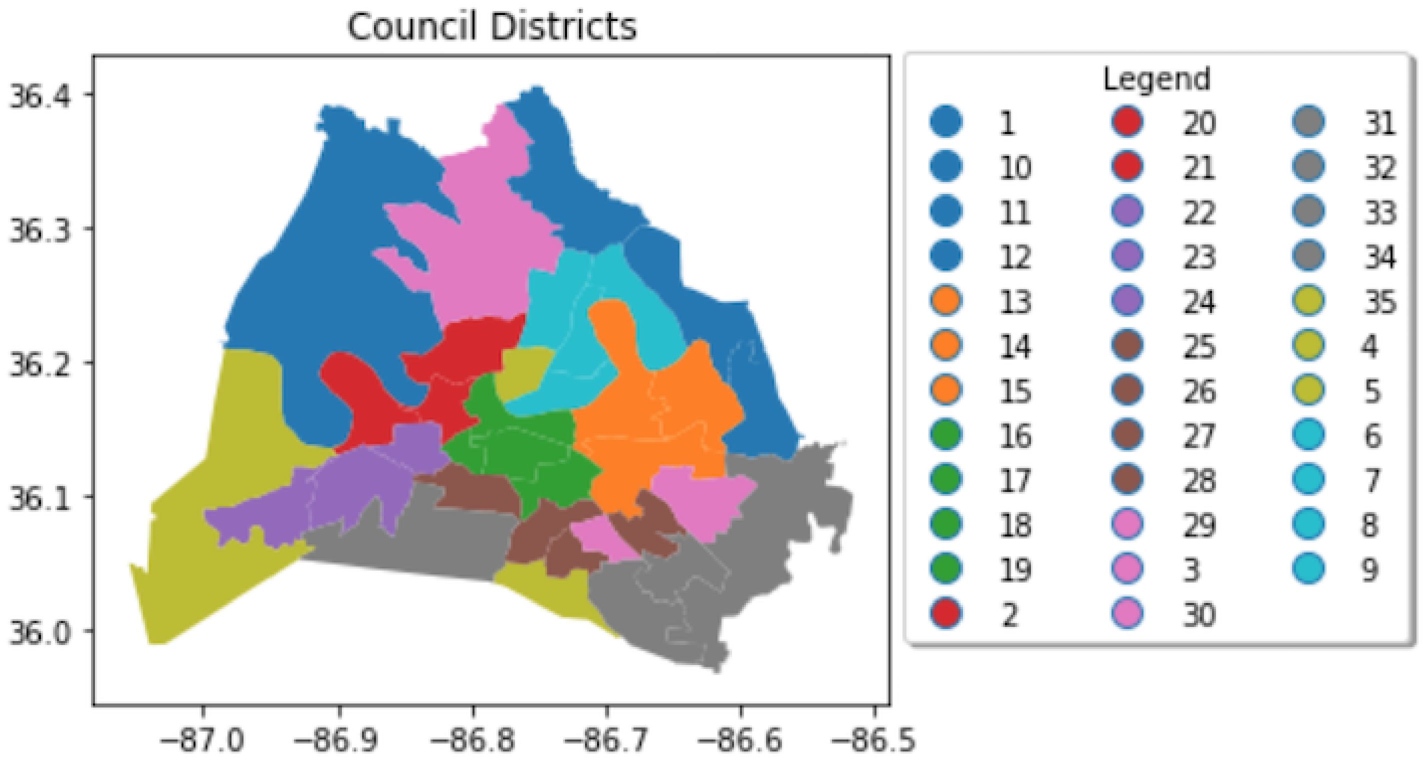
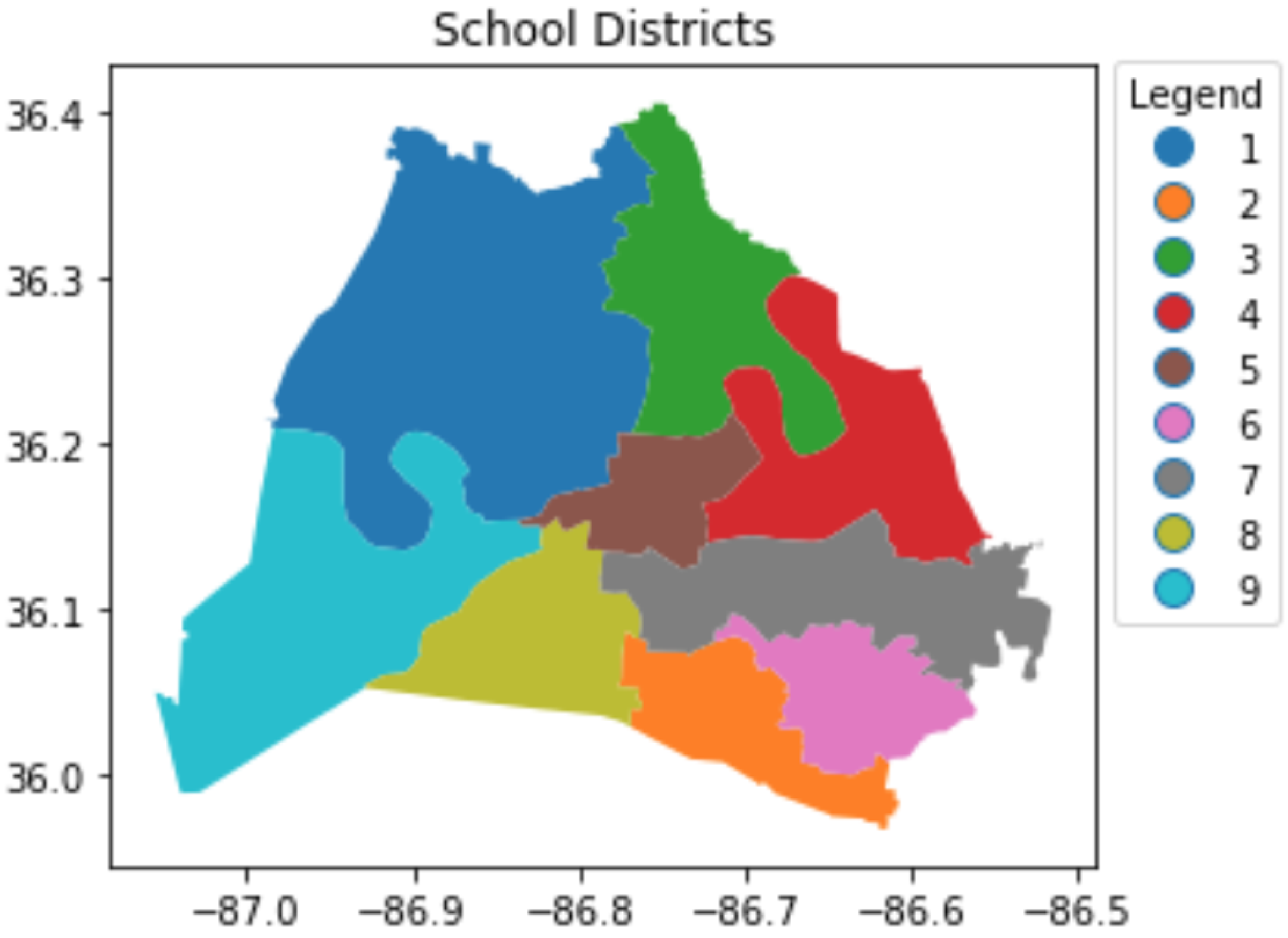
Council districts and school districts





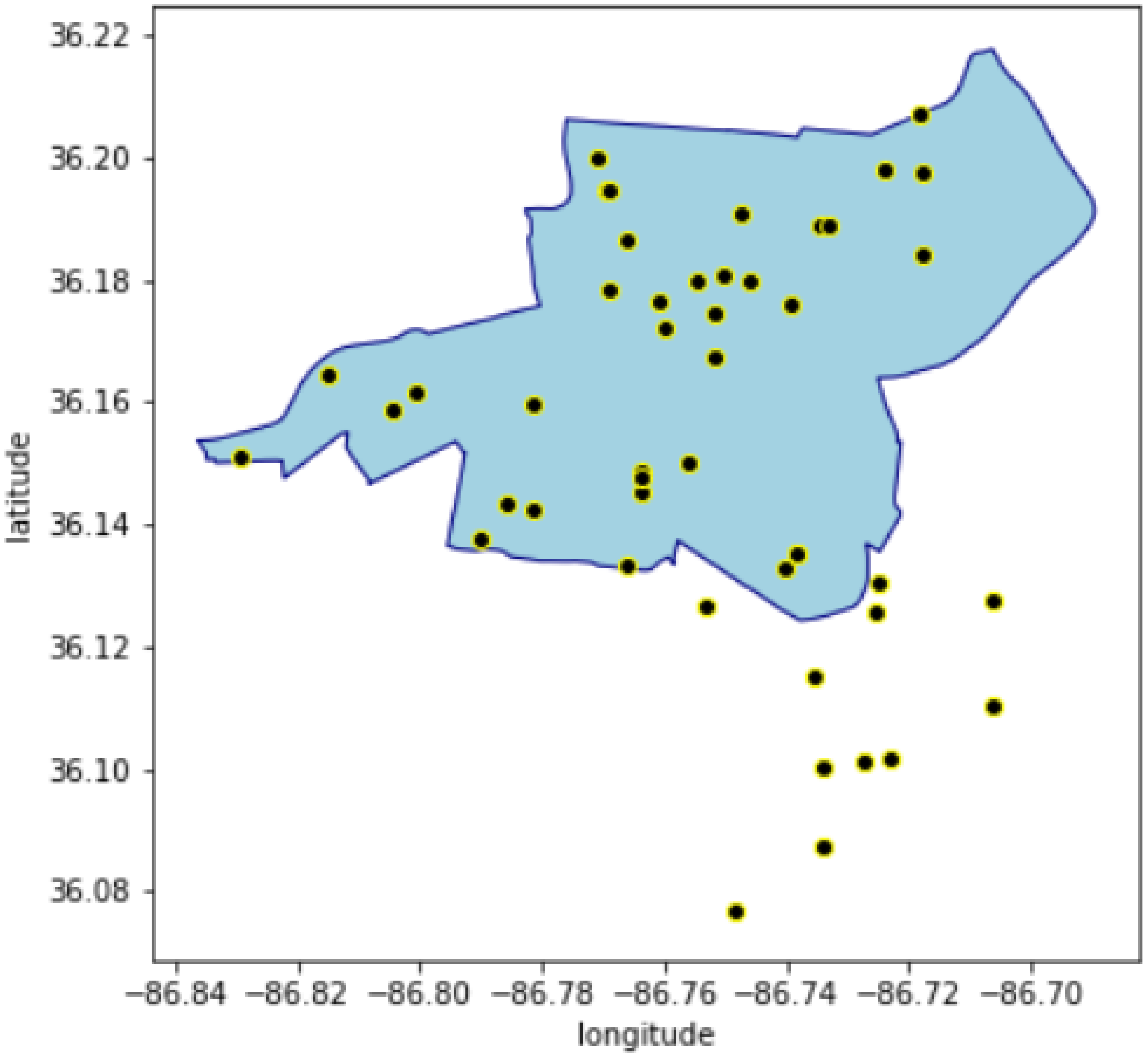
The .sjoin() op argument

```
import geopandas as gpd


gpd.sjoin(blue_region_gdf, black_point_gdf, op = <operation>)
```

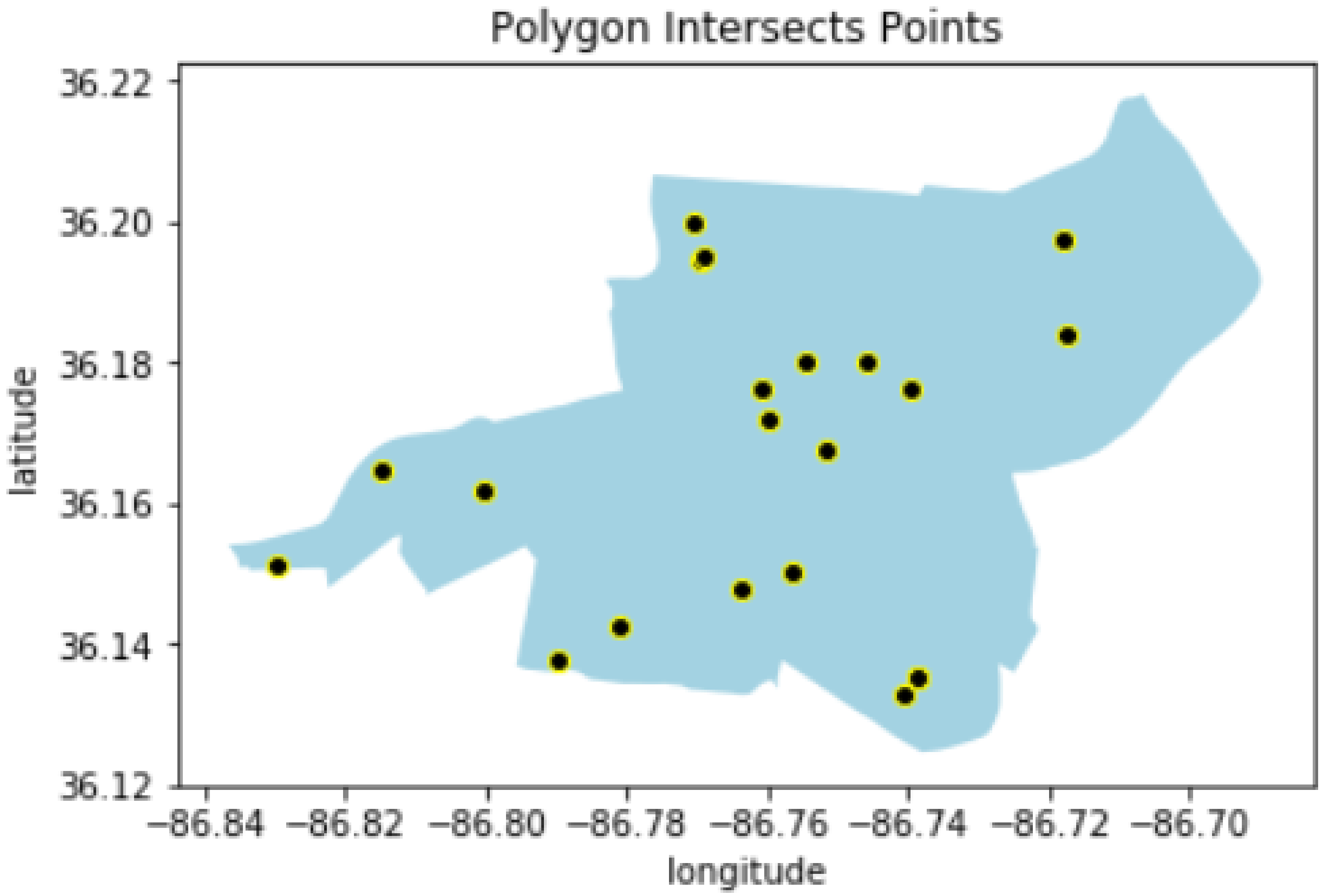
operation can be ***intersects***, ***contains***, or ***within***

Using .sjoin()


36.22
36.20
36.18
36.16
36.14
36.12
36.10
36.08
latitude
−86.84
−86.82
−86.80
−86.78
−86.76
−86.74
−86.72
−86.70
longitude

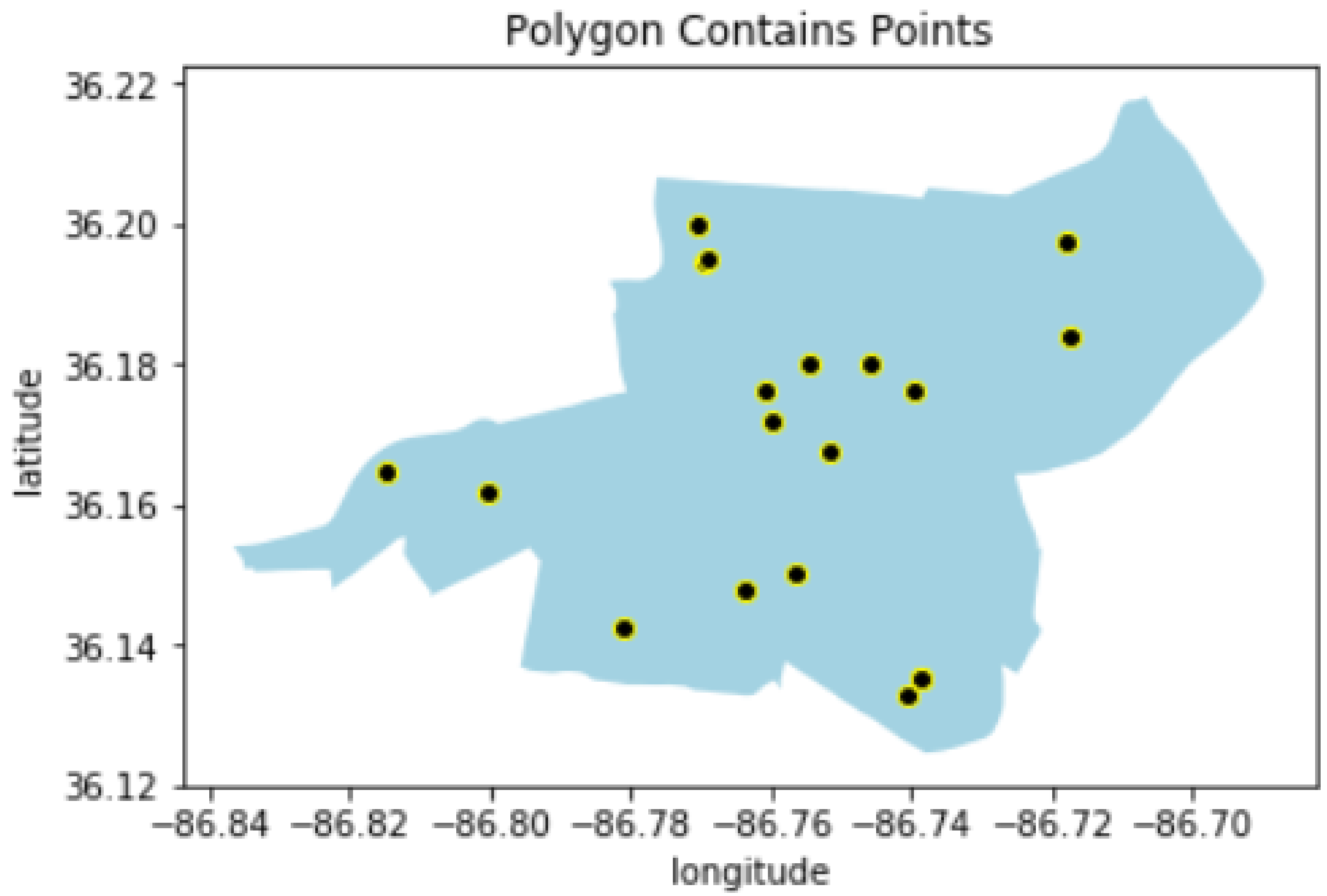
op = 'intersects'

```
gpd.sjoin(blue_region_gdf, black_point_gdf, op = 'intersects')
```



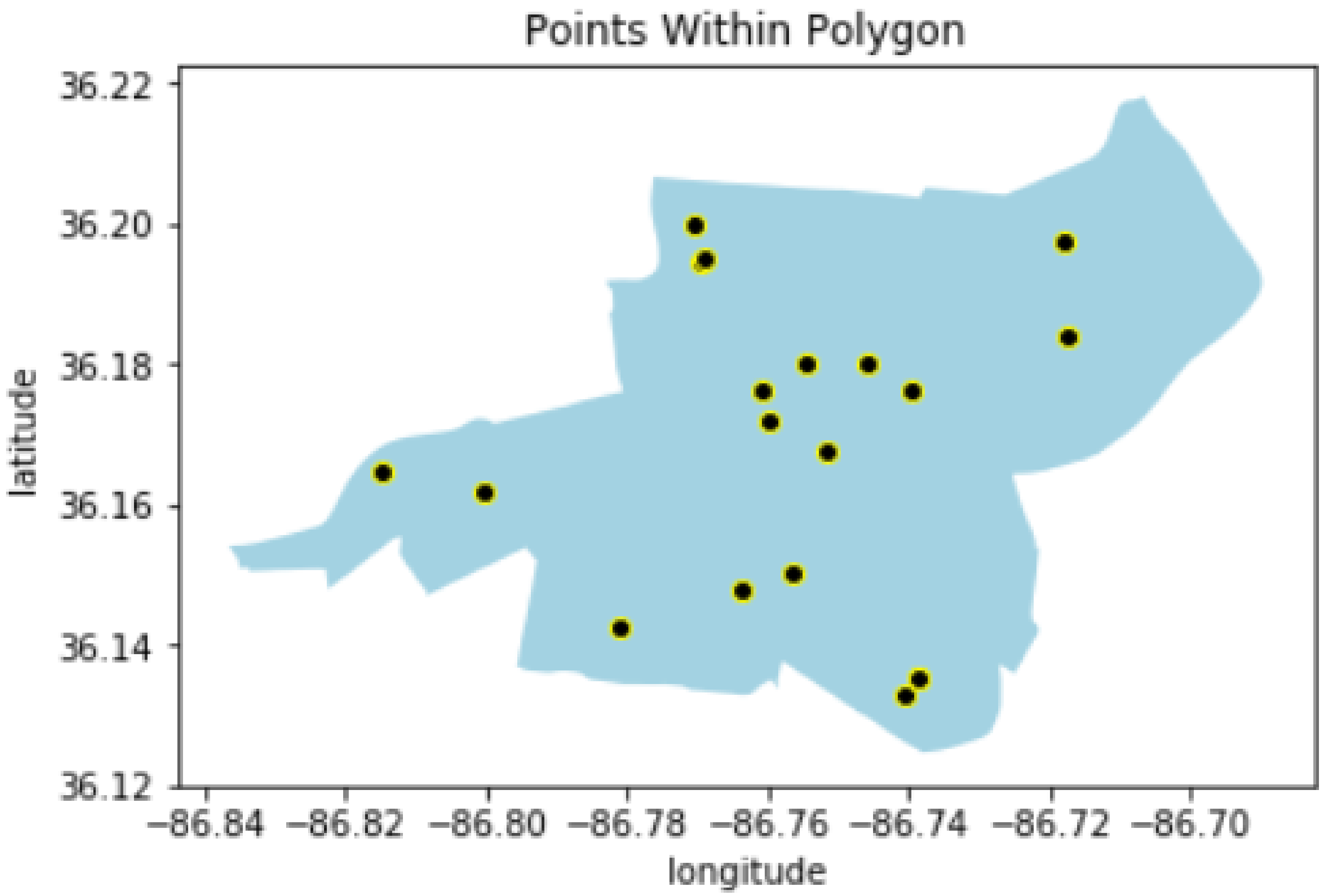
op = 'contains'

```
gpd.sjoin(blue_region_gdf, black_point_gdf, op = 'contains')
```



op = 'within'

```
gpd.sjoin(black_point_gdf, blue_region_gdf, op = 'within')
```



The sjoin.() op argument - within

```python
# find council districts within school districts

within_gdf =gpd.sjoin(council_districts, school_districts, op='within')
print('council districts within school districts: ', within_gdf.shape[0])
```

```
council districts within school districts:  11
```

The sjoin.() op argument - contains

```
# find school districts that contain council districts

contains_gdf=pd.sjoin(school_districts, council_districts, op='contains')
print('school districts contain council districts: ', contains_gdf.shape[0])
```

```
school districts contain council districts:  11
```

The sjoin.() op argument - intersects

```python
# find council districts that intersect with school districts


intersect_gdf=gpd.sjoin(council_districts, school_districts, op='intersects')
print('council districts intersect school districts: ', intersect.shape[0])
```

```
council districts intersect school districts:  100
```

Columns in a spatially joined GeoDataFrame

```
within_gdf=gpd.sjoin(council_districts, school_districts, op = 'within')
within_gdf.head()
```

```
  first_name_left  last_name_left district_left  index_right
0 Nick             Leonardo                   1            0
1 DeCosta          Hastings                   2            0
2 Nancy            VanReece                   8            1
3 Bill             Pridemore                  9            1
9 Doug             Pardue                    10            1
```

```python
# Aggregate council districts by school district - first rename district_left and district_right
within_gdf.district_left = council_district
within_gdf.district_right = school_district
within_gdf[['council_district', 'school_district']
          ].groupby('school_district'
                   ).agg('count'
                        ).sort_values('council_district', ascending = False)
```

```
                   council_district
school_district
       3                   3
       1                   2
       9                   2
       2                   1
       5                   1
       6                   1
       8                   1
```

Let's Practice!

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