Voronoi Diagrams

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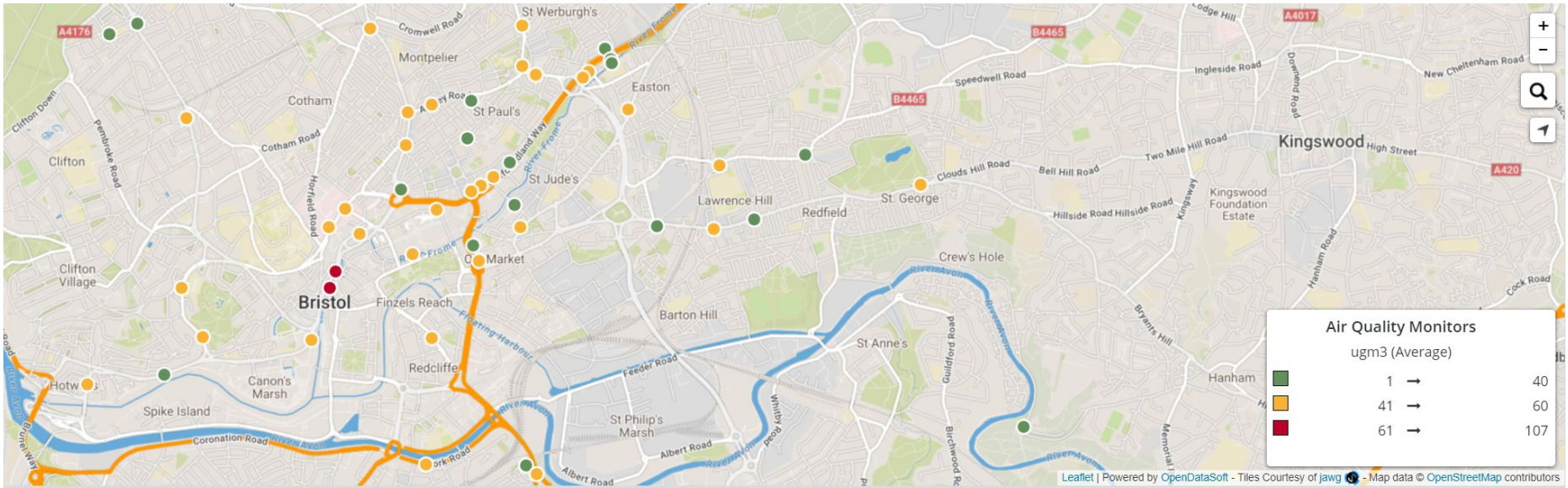
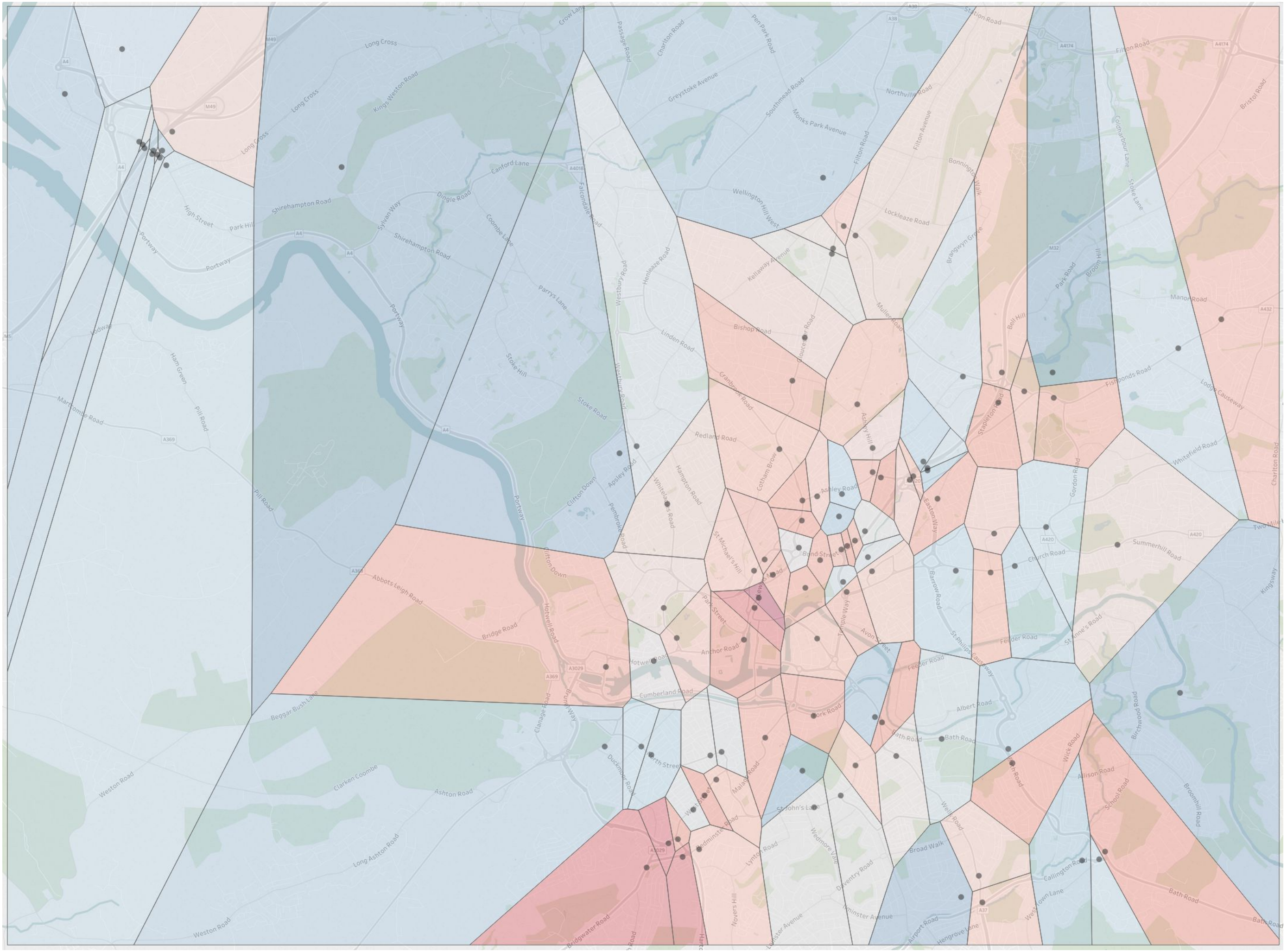
Motivation: Visualising air quality in Bristol

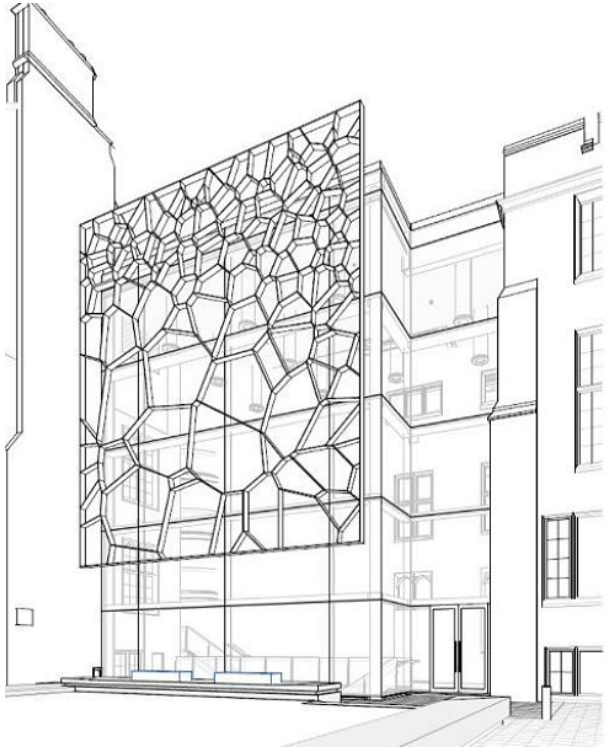


https://opendata.bristol.gov.uk/pages/homepage/



Long Cross
Kings Weston Road
Shirehampton Road
Canford Lane
Dingle Road
Sylvan Way
Coombe Lane
High Street
Park Hill
Portway
Parrys Lane
Stoke Hill
Stoke Road
Ham Green
Pill Road
Martcombe Road
Abbots Leigh Road
Bridge Road
Beggar Bush Lane
Clarken Coombe
Ashton Road
Long Ashton Road
Weston Road
Hotwell Road
Cumberland Road
Anchor Road
Park Street
St Michael's Hill
Redland Road
Hampton Road
Whiteladies Road
Pembroke Road
Apsley Road
Clifton Down
Westbury Road
Henleaze Road
Falcondale Road
Linden Road
Bishop Road
Cranbrook Road
Cotham Brow
Ashley Road
Ashley Hill
Bond Street
Temple Way
Avon Street
Feeder Road
Bath Road
Albert Road
Wells Road
St John's Lane
Wedmore Vale
Daventry Road
Lynton Road
Novers Hill
Bedminster Road
Malago Road
Bridgwater Road
Broad Walk
Airport Road
Hengrove Lane
West Town Lane
Callington Road
School Road
Allison Road
Wick Road
Birchwood Road
Broomhill Road
Bath Road
St Anne's Road
Church Road
Summerhill Road
Whitefield Road
Gordon Road
Barrow Road
Easton Way
Stapleton Road
Fishponds Road
Lodge Causeway
Manor Road
Park Road
Broom Hill
Stoke Lane
Bell Hill
Lockleaze Road
Muller Road
Gloucester Road
Kellaway Avenue
Wellington Hill West
Filton Road
Filton Avenue
Northville Road
Monks Park Avenue
Southmead Road
Greystoke Avenue
Charlton Road
Passage Road
Crow Lane
Pen Park Road
Station Road
Frenchay Road
Bristol Road
Charlton Road
Kingsway
Two Mile Hill
Bonnington Walk
Brangwyn Grove

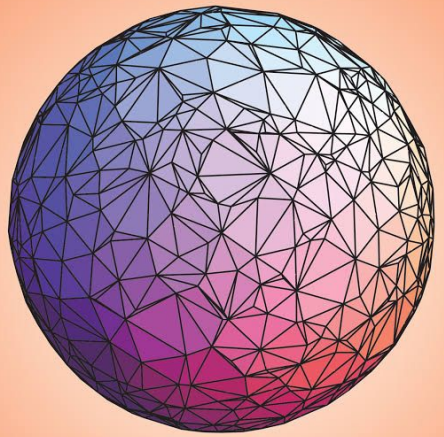
Voronoi diagrams are everywhere!



https://www.flickr.com/photos/bradandkathy/2413154658/

http://www.bristol.ac.uk/maths/fry-building/public-art-strategy/

DISCRETE AND COMPUTATIONAL GEOMETRY

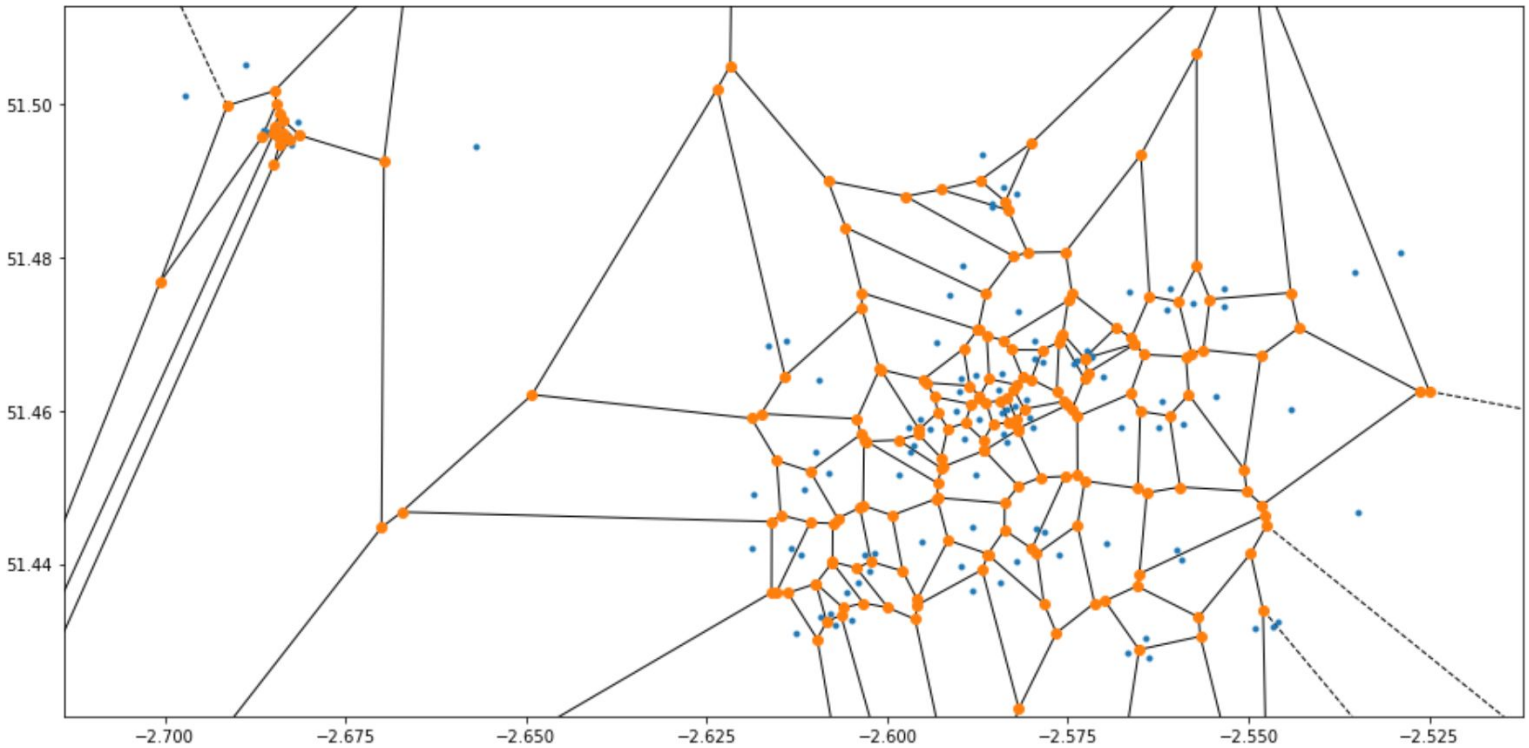


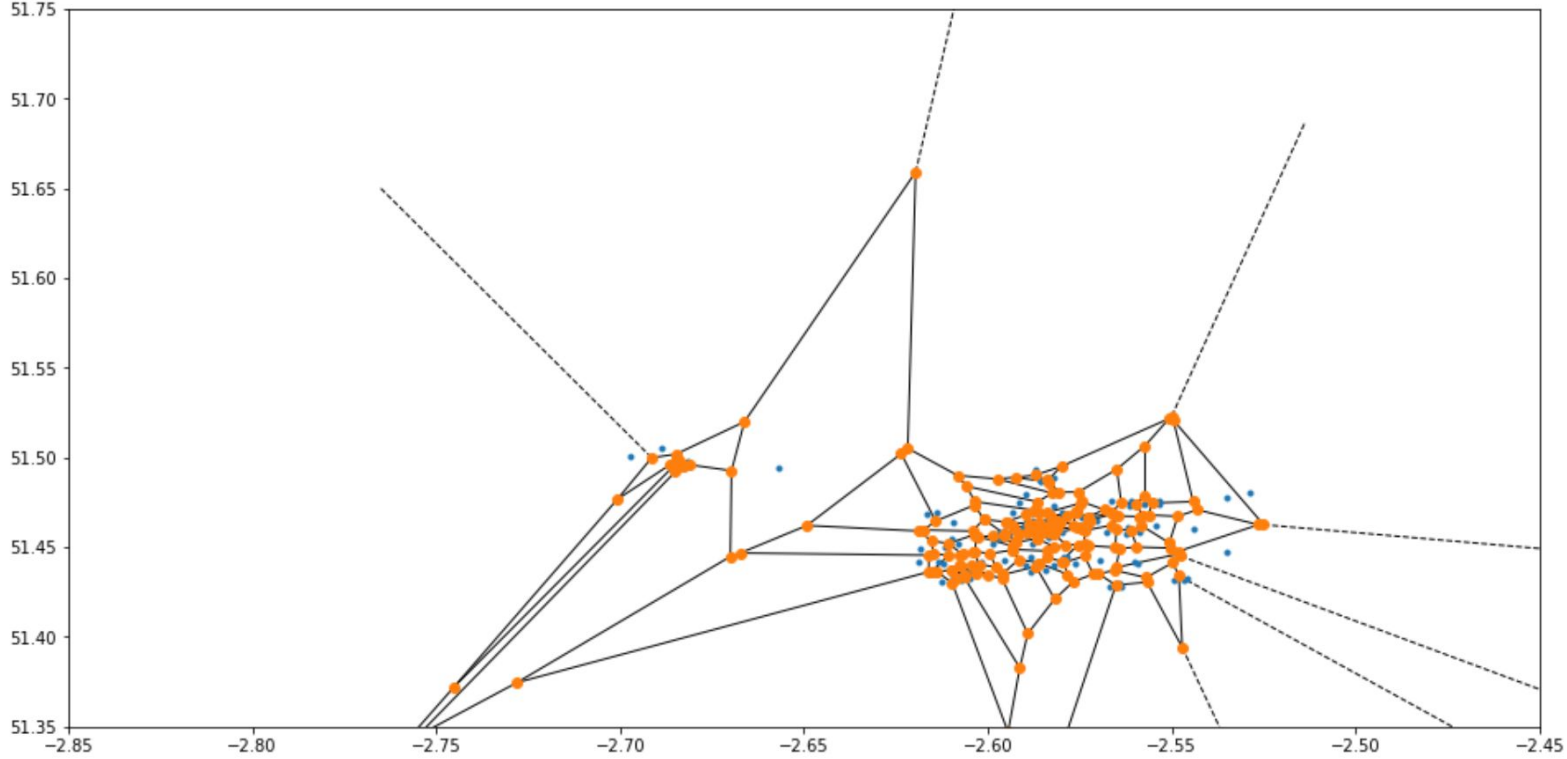
SATYAN L. DEVADOSS
JOSEPH O'ROURKE

The Voronoi Library

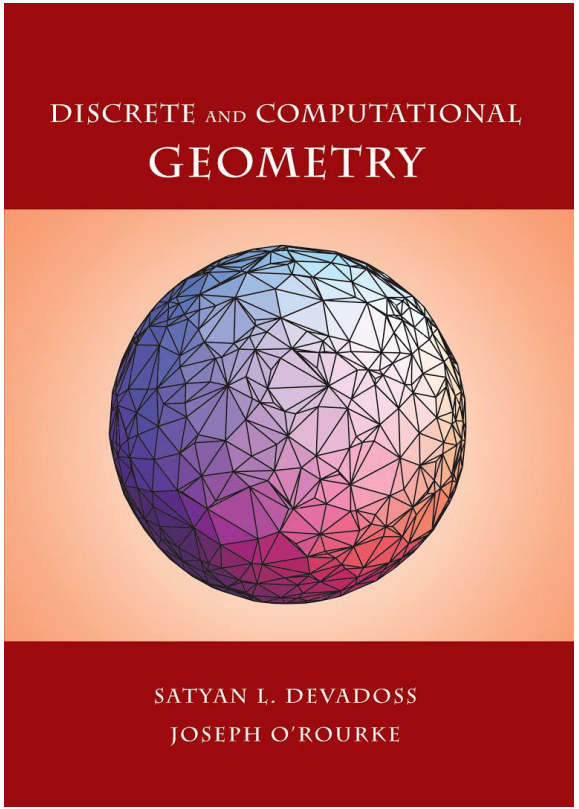
```
from scipy.spatial import Voronoi
```

In [53]:
```
air_quality_locations=np.array([[air_quality_data['long'][k],air_quality_data['lat'][k]] for k in range(len(air_quality_data))])
vor = Voronoi(air_quality_locations)
voronoi_plot_2d(vor)
plt.draw()
```

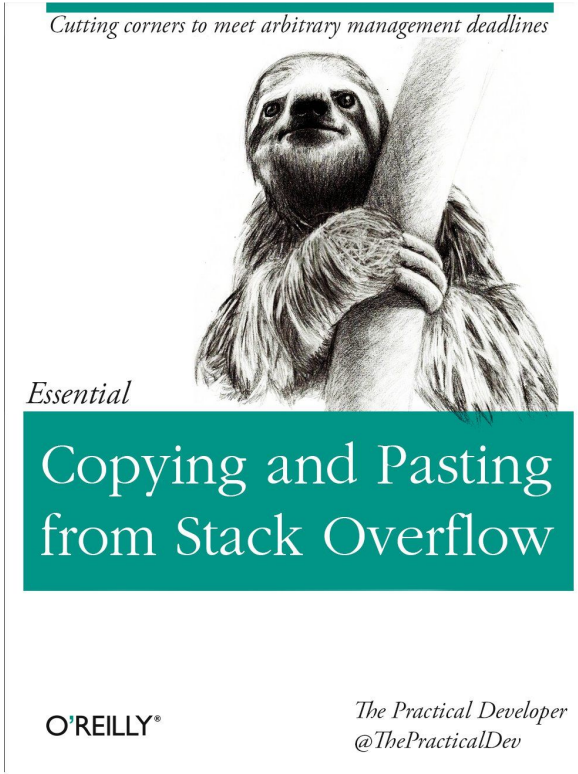



51.75
51.70
51.65
51.60
51.55
51.50
51.45
51.40
51.35
−2.85
−2.80
−2.75
−2.70
−2.65
−2.60
−2.55
−2.50
−2.45

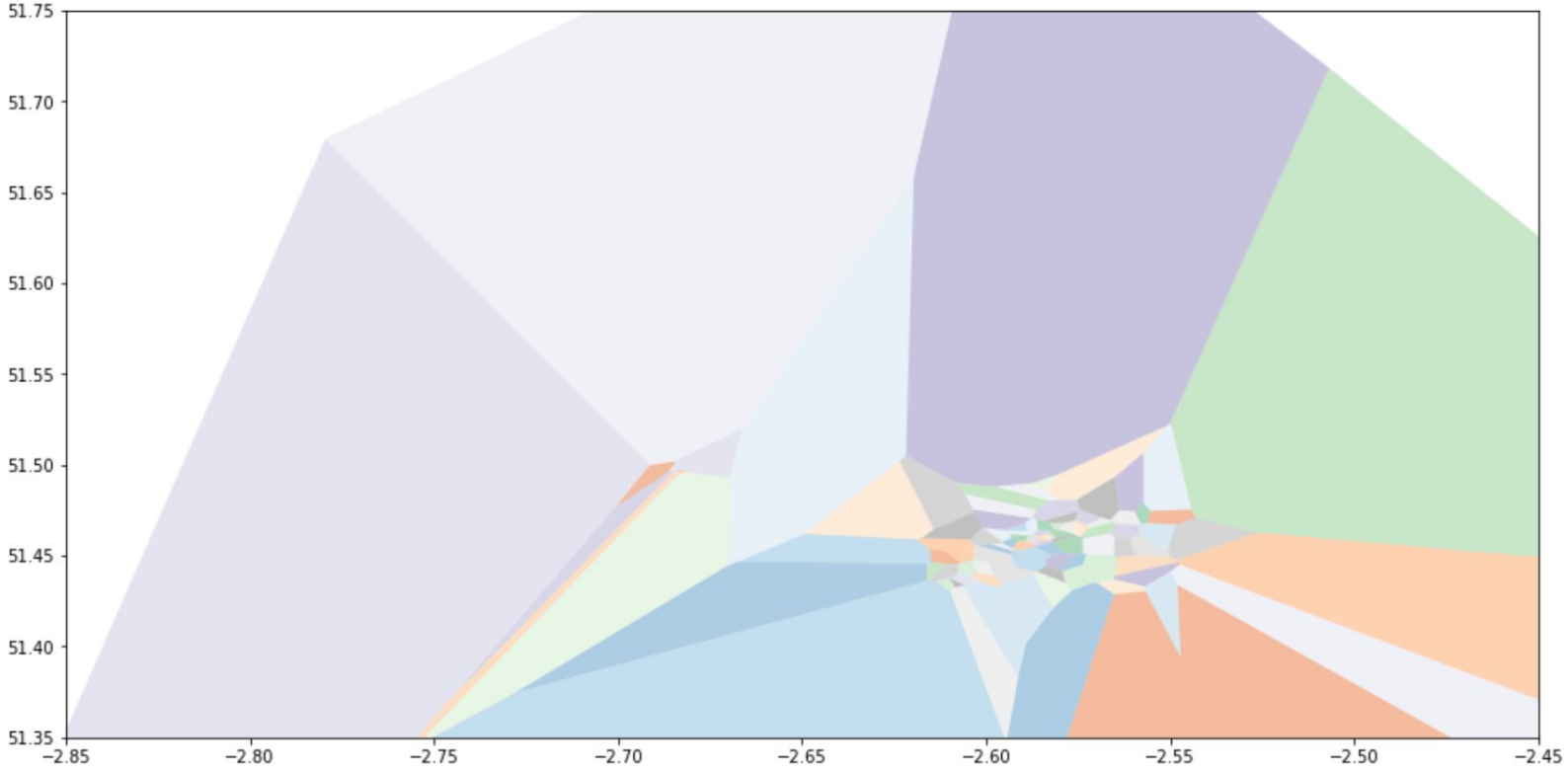
Obtaining finite versions of every cell



Obtaining finite versions of every cell



Obtaining finite versions of every cell



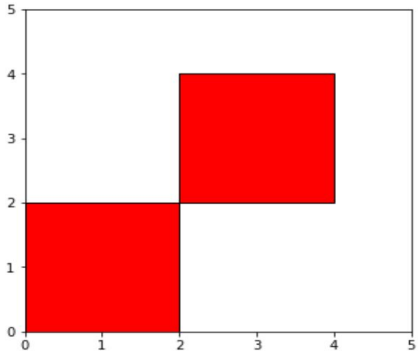
From points to polygons: `shapely` and `geopandas`

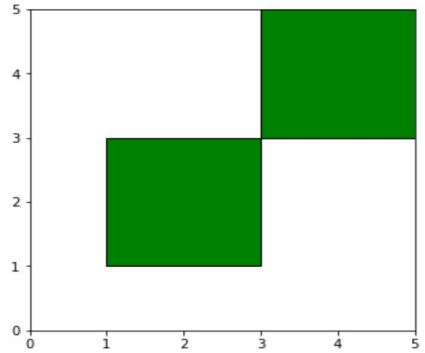
	Shape 1 ID	geometry
0	Lower Red	POLYGON ((0 0, 2 0, 2 2, 0 2, 0 0))
1	Upper Red	POLYGON ((2 2, 4 2, 4 4, 2 4, 2 2))

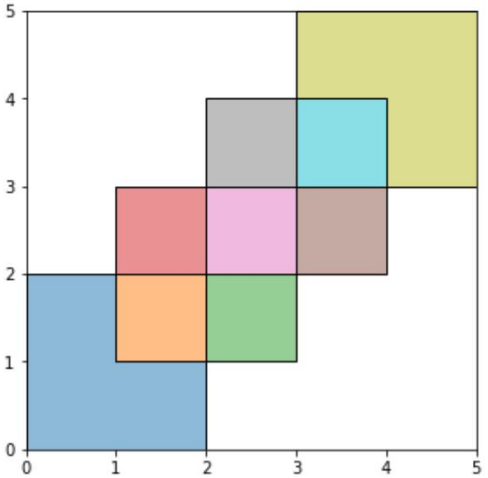
	Shape 2 ID	geometry
0	Lower Green	POLYGON ((1 1, 3 1, 3 3, 1 3, 1 1))
1	Upper Green	POLYGON ((3 3, 5 3, 5 5, 3 5, 3 3))

```
res_union = gpd.overlay(df1, df2, how='union')
res_union
```

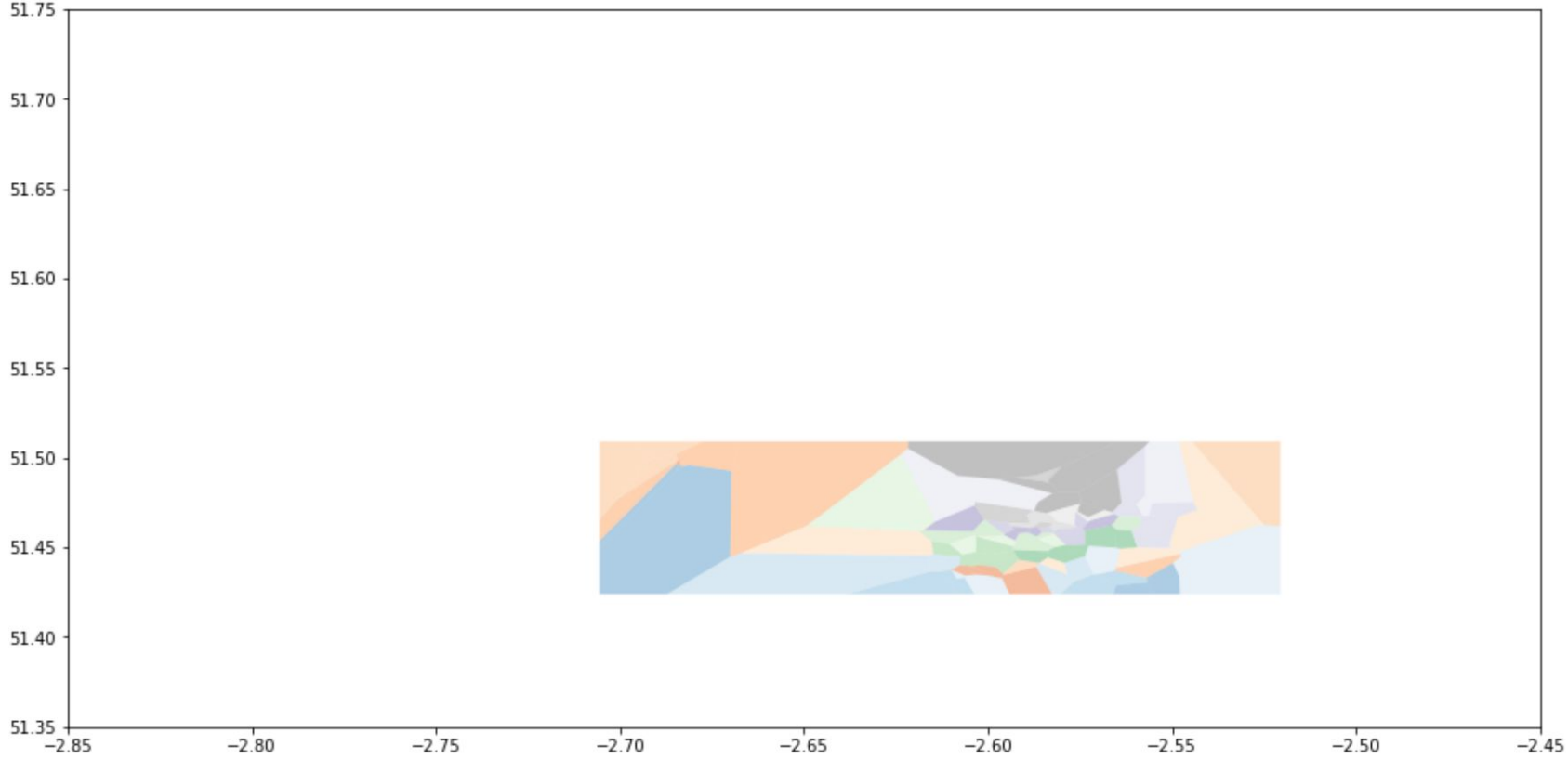
	Shape 1 ID	Shape 2 ID	geometry
0	Lower Red	None	POLYGON ((2 1, 2 0, 0 0, 0 2, 1 2, 1 1, 2 1))
1	Lower Red	Lower Green	POLYGON ((2 1, 1 1, 1 2, 2 2, 2 1))
2	None	Lower Green	POLYGON ((2 1, 2 2, 3 2, 3 1, 2 1))
3	None	Lower Green	POLYGON ((2 2, 1 2, 1 3, 2 3, 2 2))
4	Upper Red	None	POLYGON ((3 2, 3 3, 4 3, 4 2, 3 2))
5	Upper Red	Lower Green	POLYGON ((3 3, 3 2, 2 2, 2 3, 3 3))
6	Upper Red	None	POLYGON ((3 3, 2 3, 2 4, 3 4, 3 3))
7	None	Upper Green	POLYGON ((4 3, 4 4, 3 4, 3 5, 5 5, 5 3, 4 3))
8	Upper Red	Upper Green	POLYGON ((3 4, 4 4, 4 3, 3 3, 3 4))



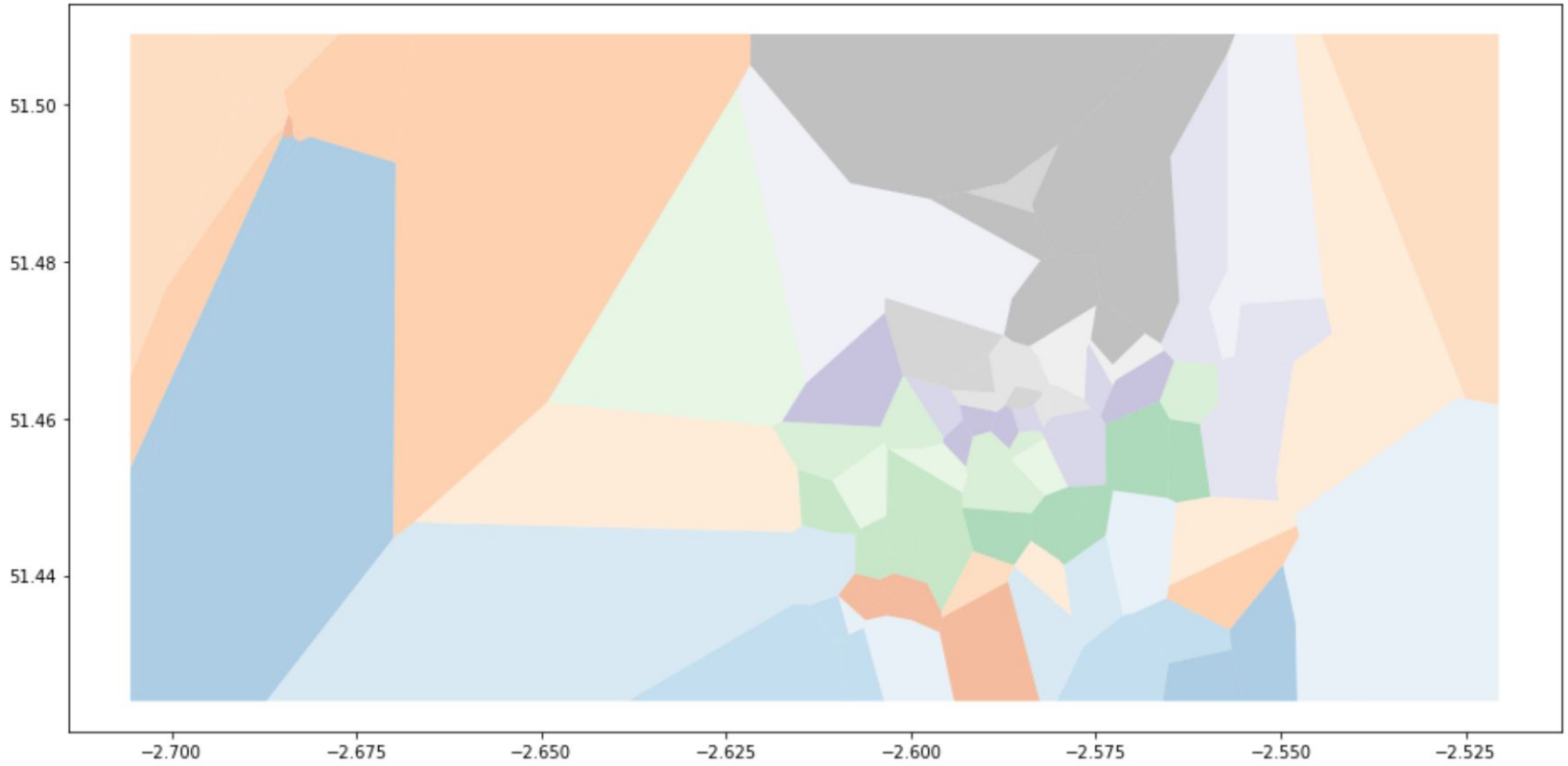




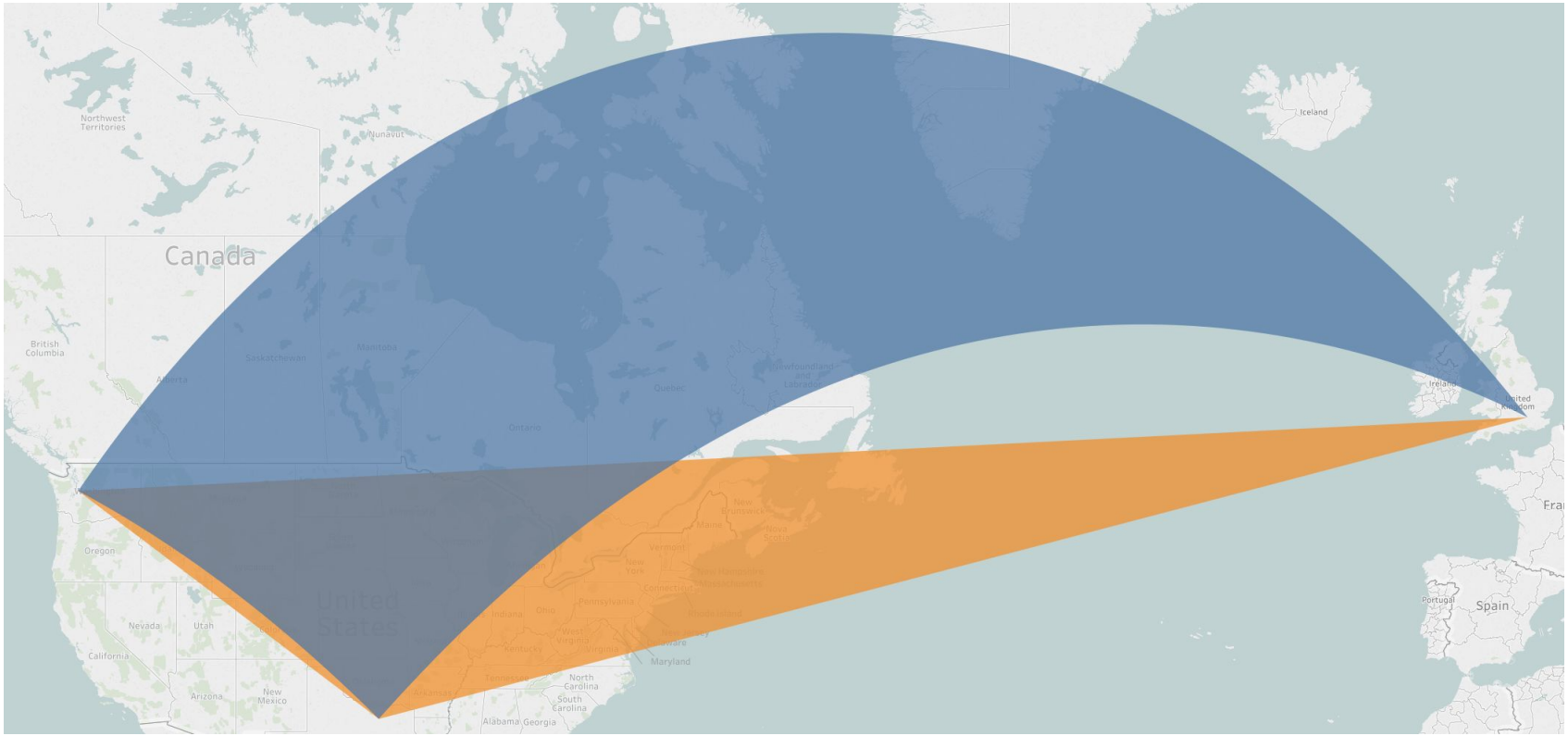
Obtaining bounded cells

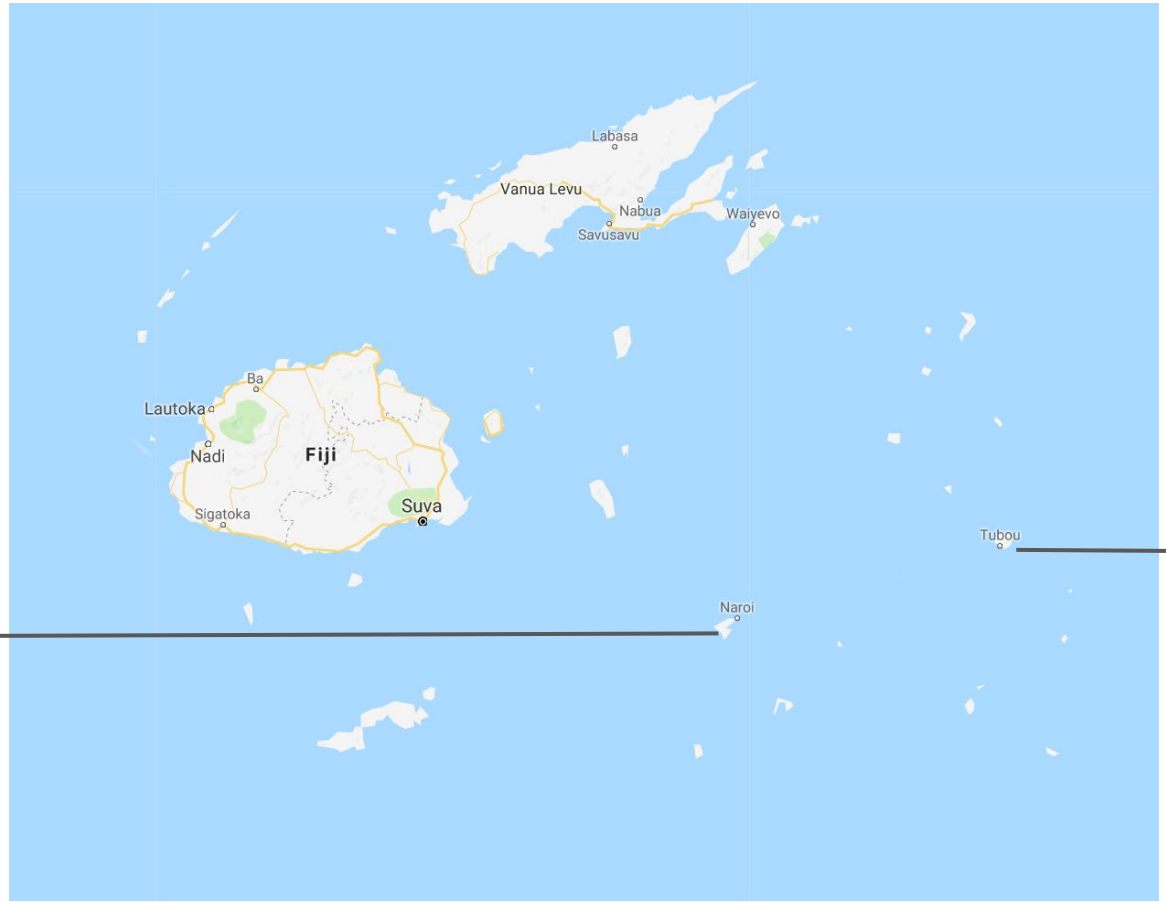


Obtaining bounded cells



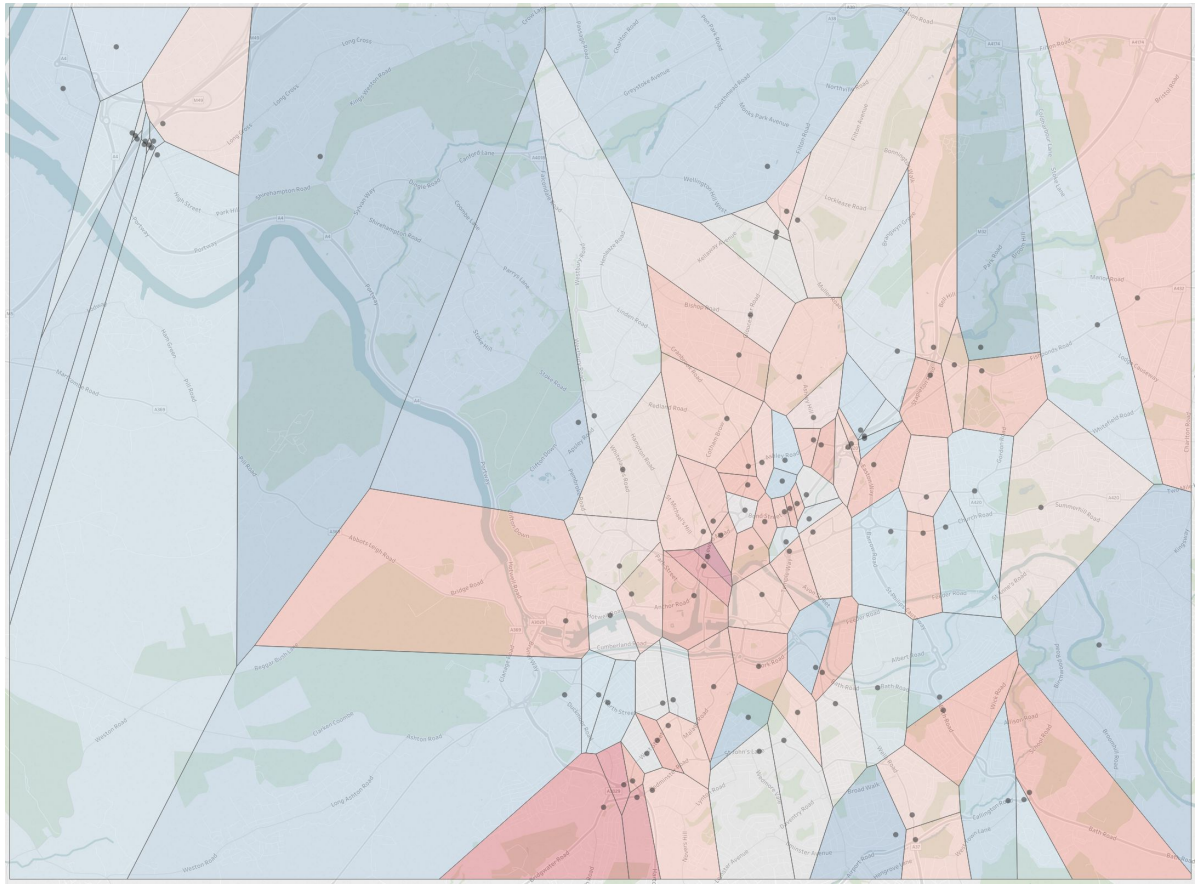
Issue: the world is not flat


Northwest Territories
Nunavut
Canada
Iceland
British Columbia
Saskatchewan
Manitoba
Alberta
Quebec
Ontario
Ireland
United Kingdom
Oregon
Nevada
Utah
California
Arizona
New Mexico
United States
Maine
Vermont
New York
Pennsylvania
Ohio
Indiana
Kentucky
West Virginia
Maryland
North Carolina
South Carolina
Alabama
Georgia
Portugal
Spain



Moala Island
Fiji
-18.592141, 179.886128

Lakeba Island
Fiji
-18.212990, -178.806751



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