

Introduction to PostGIS

Relational databases & GIS

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AG Landscape Ecology

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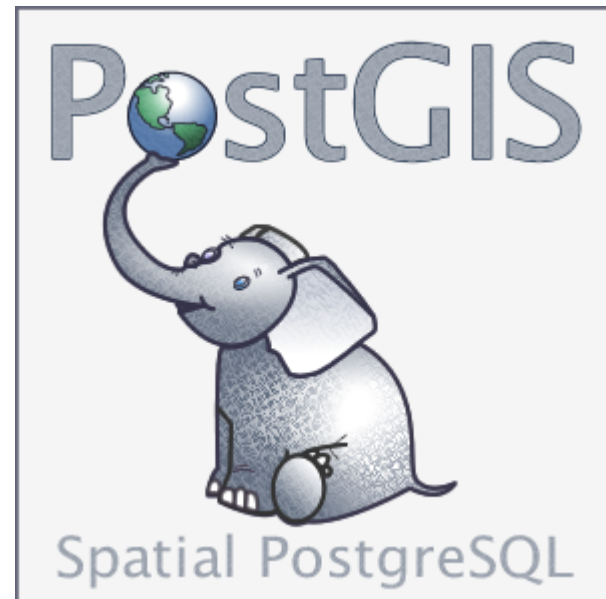
What is PostGIS ?

- It's FOSS!
- Spatial extension for the relational database PostgreSQL
- Compliant with the Open Geospatial Consortium (OGC) standards
<https://www.ogc.org>
- Simple Feature Access
https://en.wikipedia.org/wiki/Simple_Features
 - ST_Area()
 - ST_Length()
 - ST_Intersection()
 - ST_Intersects()
 - ...



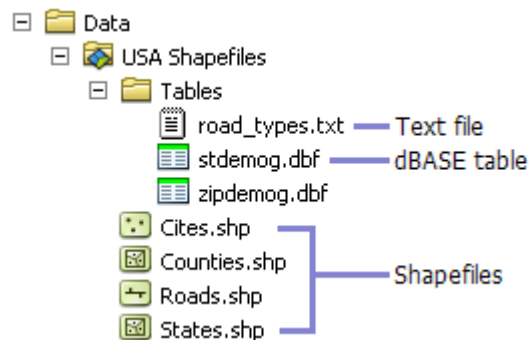
What is PostGIS ?

- Spatial extension for the relational database PostgreSQL
 - Geospatial Data Type
 - Point
 - Line
 - Polygon
 - Geometry Collection
 - Raster
 - (Spatial) Indices



Why not use a Shapefile?

ArcGIS (proprietary)



```
## cities.dbf
## cities.prj
## cities.shp
## cities.shx
```

PostGIS

city text	lon numeric	lat numeric	geom geometry
Lagos	3.3840	6.4550	0101000020E6100000DF4F8D976E120B4052B81E85EBD11940
Vienna	16.3666	48.2	0101000020E6100000AEB6627FD95D30409A99999999194840
Taipei	121.5166	25.0666	0101000020E6100000454772F90F615E40E2E995B20C113940
Brasilia	-47.8827	-15.7938	0101000020E6100000F0164850FCF047C02D211FF46C962FC0
Boston	-71.1043	42.3150	0101000020E6100000423EE8D9ACC651C0B81E85EB51284540

- Geo-Information

- **One table**
- **One Column**

Why not use a Shapefile?

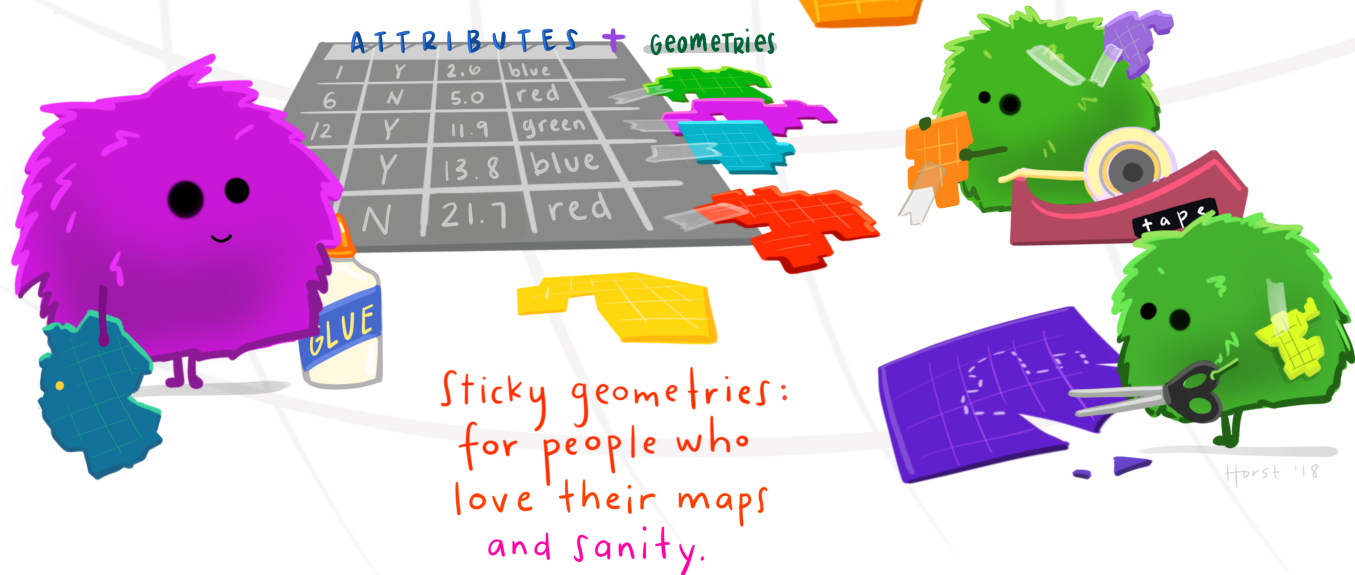
- Easy data storage (compared on standard GIS software)
- Standard simple feature formatting allows spatial data to be accessed by other software
- Automation of processes
- Handling of large data-sets

PostGIS

city text	lon numeric	lat numeric	geom geometry
Lagos	3.3840	6.4550	0101000020E6100000DF4F8D976E120B4052B81E85EBD11940
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- Geo-Information
 - **One table**
 - **One Column**

sf: SPATIAL DATA ... SIMPLIFIED.



Geo Libraries

- GDAL - Geo Data Abstraction Library



- GEOS - Geometry Engine, Open Source



- PROJ



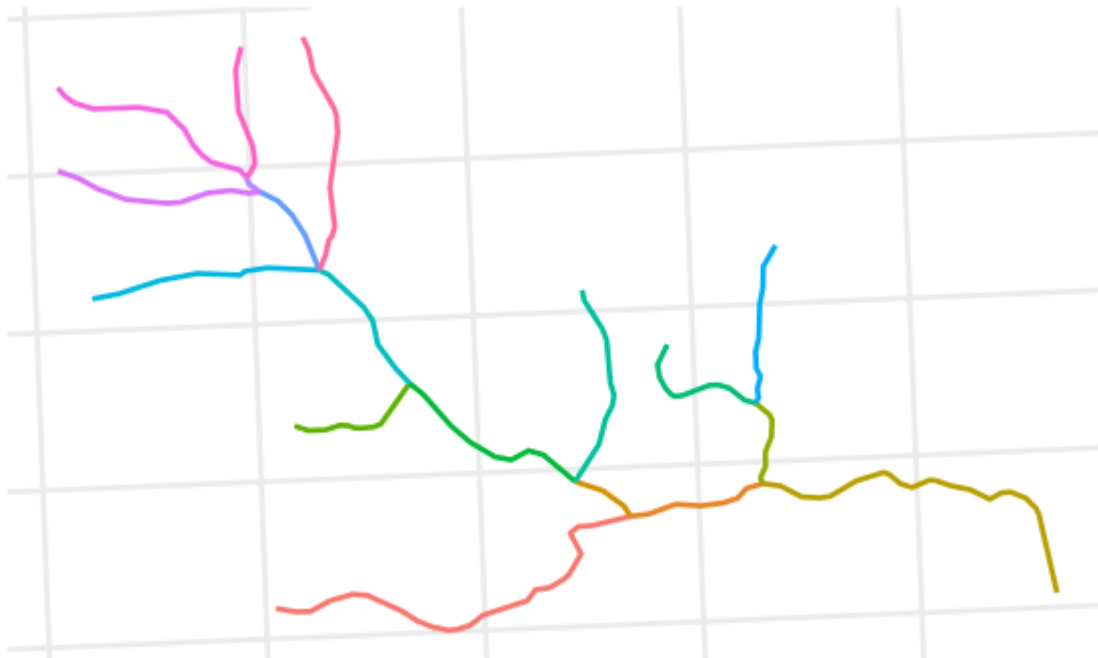
PostGIS functions

Palar River Example



Palar River Example

length	pente	strahler	fid	geom
3053.50	20.366169	1	1194653	LINESTRING (4550796 2582247...
986.99	5.996377	2	1194668	LINESTRING (4553302 2582898...
476.30	11.744198	2	1194670	LINESTRING (4552910 2583143...



Union

```
SELECT ST_Union(geom) AS geom  
FROM palar
```

```
palar |>  
  st_union()
```



Length

```
SELECT ST_Length(ST_Union(geom)) geom  
FROM palar
```

```
palar |>  
  st_union() |>  
  st_length()
```

```
## 23289.93 [m]
```

Buffer - 100m

```
SELECT ST_Buffer(ST_Union(geom), 100) AS geom_buf  
FROM palar
```

```
palar |>  
  st_union() |>  
  st_buffer(100)
```

Area

```
SELECT ST_Area(ST_Buffer(ST_Union(geom), 100)) AS area
FROM palar
```

```
palar |>
  st_union() |>
  st_buffer(100) |>
  st_area()
```

```
## 4615553 [m^2]
```

Convex Hull

```
SELECT ST_ConvexHull(geom) AS geom  
FROM palar
```

```
palar |>  
  st_union() |>  
  st_convex_hull()
```

Projections

```
SELECT ST_SRID(geom)
FROM palar
LIMIT 1
```

```
st_crs(palar) # 3035
```

Transform

```
CREATE TABLE palar2 AS
  SELECT fid, ST_Transform(geom, 4326) geom -- EPSG for WGS84
  FROM palar
```

<https://epsg.io/4326>

Intersection

- Aim: Intersect 500m River Buffer with CORINE - LULC data

Intersection

```
SELECT
    cor.label, cor.label,
    ST_Intersection(ST_Buffer(riv.geom, 500), cor.geom) geom
FROM
    palar riv,
    corine cor
WHERE ST_DWithin(tbl1.geom, tbl2.geom, 500)
```

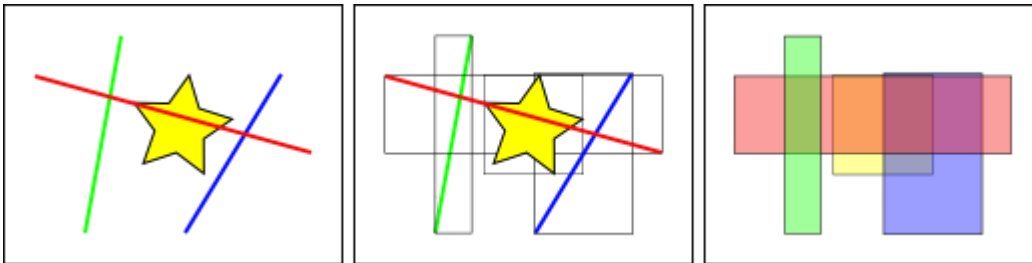
Intersection

```
st_intersection(st_buffer(st_union(palar), 500), corine)
```

Idexing

Index

- Extremely important for performance!
- Different Indices for different data types
 - PRIMARY KEY
 - BTREE
 - **GIST** - Geographic Data



<http://postgis.net/workshops/postgis-intro/indexing.html>

Index

```
CREATE INDEX corine_label_btree_idx ON corine USING BTREE (label);  
CREATE INDEX palmar_geom_gist_idx ON palmar USING GIST (geom);
```

Resources

- R sf cheatsheet

<https://raw.githubusercontent.com/rstudio/cheatsheets/main/sf.pdf>

- Gentle Introduction to PostGIS

<https://medium.com/innovation-and-technology/part-1-postgis-at-the-city-of-boston-9476293d71c2>

<https://medium.com/@paylakatel/part-2-postgis-at-the-city-of-boston-711cf30cf1f3>

<https://medium.com/@paylakatel/part-3-postgis-at-the-city-of-boston-98b83b0d1503>

Slides

- OLAT
- <https://andschar.github.io/teaching/PostGIS-intro.html>

Made with

- <https://github.com/rstudio/rmarkdown>
- <https://github.com/yihui/knitr>
- <https://github.com/yihui/xaringan>

Introduction to Git & GitHub

Thank you for your attention!

Material: <https://andschar.github.io/teaching>

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