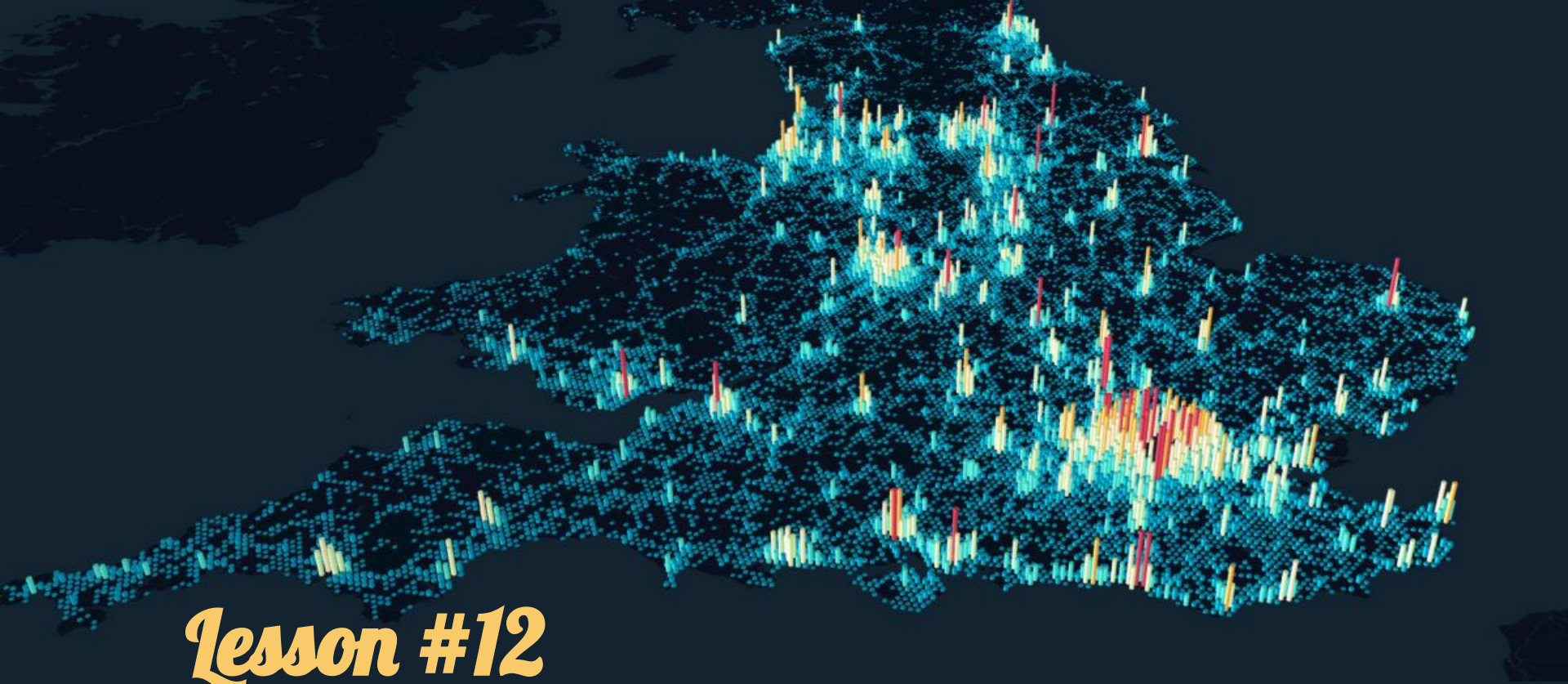


Lesson #12
Storytelling from geographic data

April 2019

Update from repository

```
git clone https://github.com/ivanovitchm/datascience_one_2019_1
```

Or ....

```
git pull
```

motivation

Cholera Outbreak 1854

DEATH'S DISPENSARY.

OPEN TO THE POOR, GRATIS, BY PERMISSION OF THE PARISH.

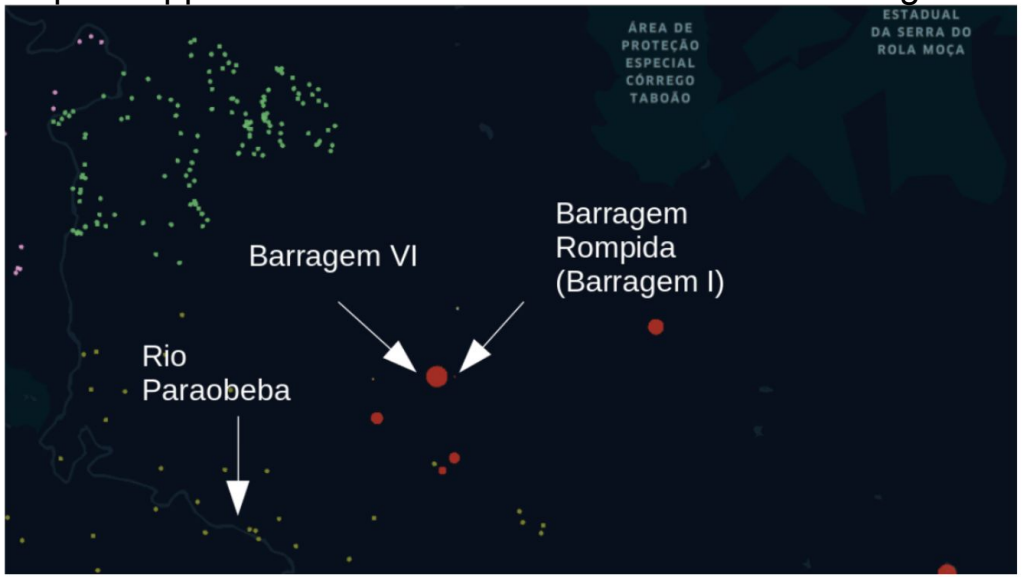
Maps Save Lives

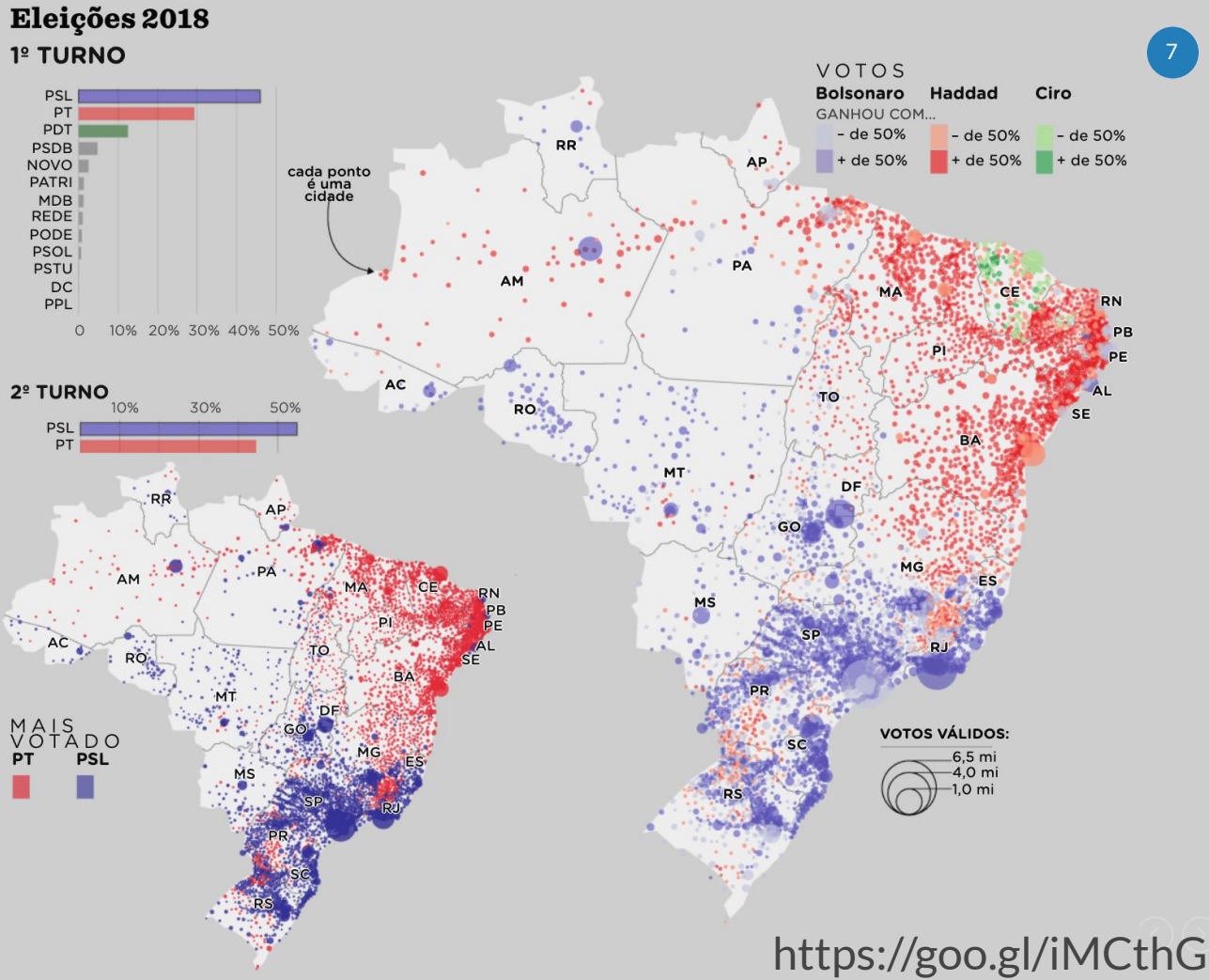
Tejuco

#data4good: Ciência de dados vs Riscos das barragens 🇧🇷

RICARDO CAPPRA

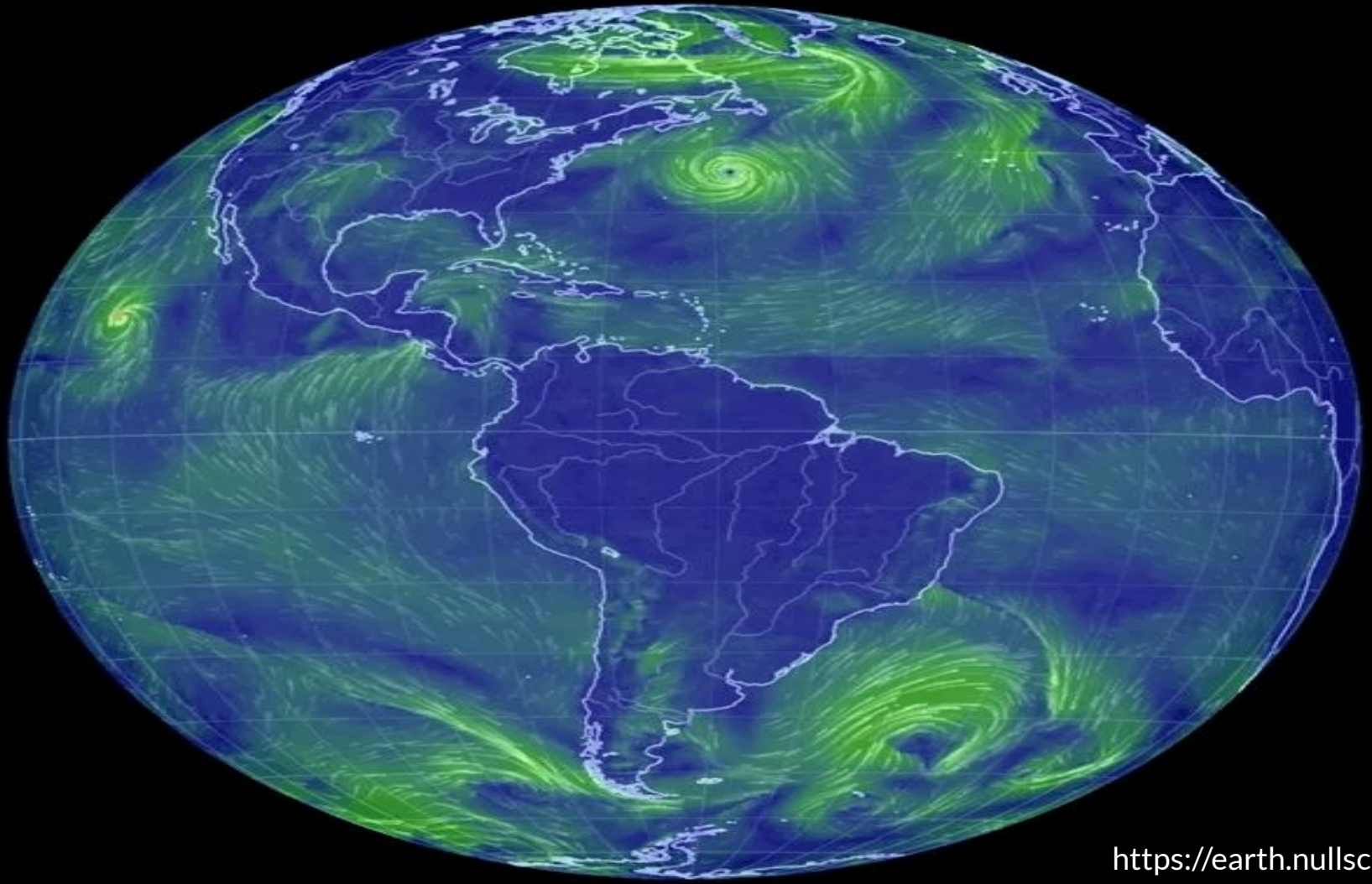
https://cappra.com.br/2019/02/19/ciencia-dados-barragens/



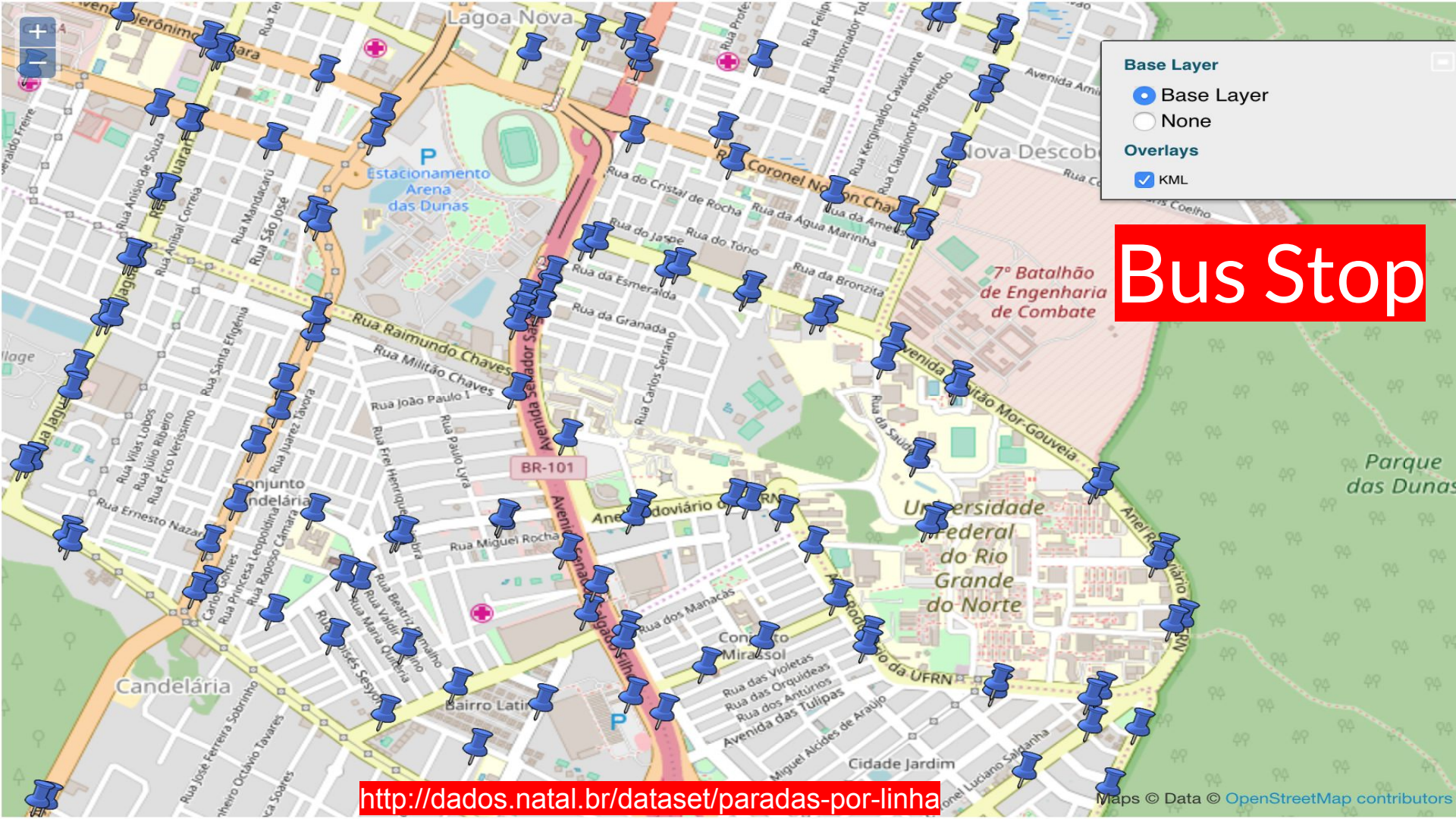


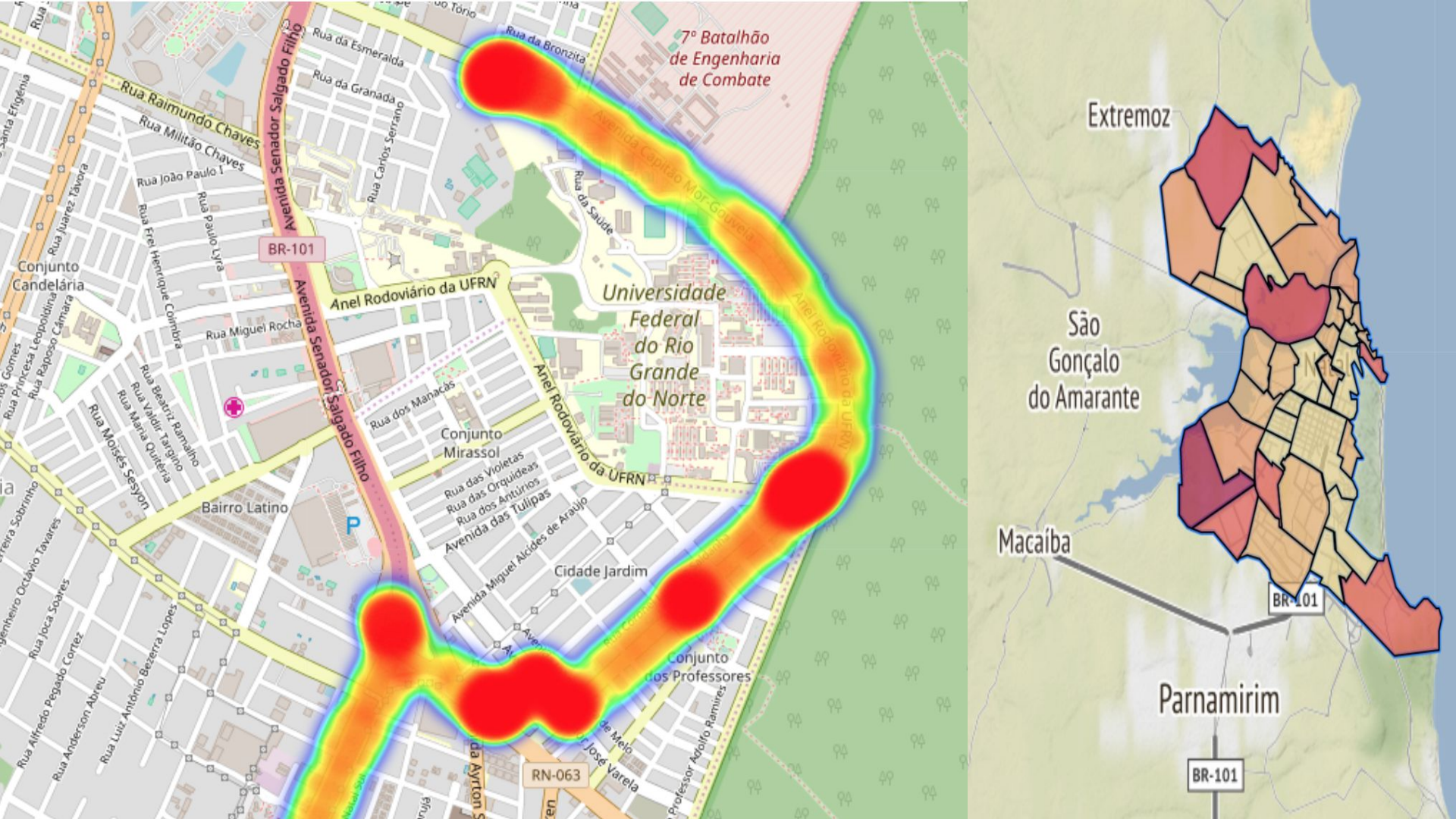
Geographic data is always present in our everyday lives

https://goo.gl/iMCthG



https://earth.nullschool.net/


Base Layer
Base Layer
None
Overlays
KML
Bus Stop
http://dados.natal.br/dataset/paradas-por-linha
Maps © Data © OpenStreetMap contributors
Lagoa Nova
Candelária
Cidade Jardim
Bairro Lagoa Nova
Estacionamento Arena das Dunas
7º Batalhão de Engenharia de Combate
Universidade Federal do Rio Grande do Norte
Parque das Dunas
BR-101
Avenida Senador Salgado Filho
Rua Raimundo Chaves
Rua Coronel Nonato Chaves
Rua Militão Chaves
Rua Miguel Rocha
Rua dos Manacás
Rua das Violetas
Rua das Orquídeas
Rua dos Antúrios
Avenida das Tulipas
Rua do Cristal de Rocha
Rua da Água Marinha
Rua do Jaspe
Rua do Topázio
Rua da Esmeralda
Rua da Granada
Rua da Bronzita
Rua Carlos Serrano
Rua João Paulo I
Rua Frei Henrique Soares
Rua Paulo Lyra
Rua Ernesto Nazaré
Rua Vilas Lobos
Rua Júlio Ribeiro
Rua Érico Veríssimo
Rua Juarez Távora
Rua Santa Efigênia
Rua Aníbal Correia
Rua São José
Rua Mandacaru
Rua Princesa Leopoldina
Rua Raposo Câmara
Rua Beatriz Fonseca Ramalho
Rua Valdir Ramalho
Rua Maria Queiroz
Rua Luísa Sesyom
Rua José Ferreira Sobrinho
Rua Heleno Octávio Tavares
Rua Miguel Alcides de Araújo
Rua Coronel Luciano Saldanha
Rua da Saúde
Avenida Capitão Mor Gouveia
Anel Rodoviário da UFRN
Conjunto Mirassol


7º Batalhão de Engenharia de Combate
Rua da Bronzita
Rua da Esmeralda
Rua da Granada
Rua Raimundo Chaves
Rua Militão Chaves
Rua João Paulo I
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BR-101
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Rua dos Antúrios
Avenida das Tulipas
Avenida Miguel Alcides de Araújo
Cidade Jardim
Bairro Latino
Rua Moisés Seyon
Rua Beatriz Ramalho
Rua Valdir Targino
Rua Maria Quitéria
Conjunto dos Professores
RN-063
Extremoz
São Gonçalo do Amarante
Macaíba
Parnamirim
BR-101
BR-101

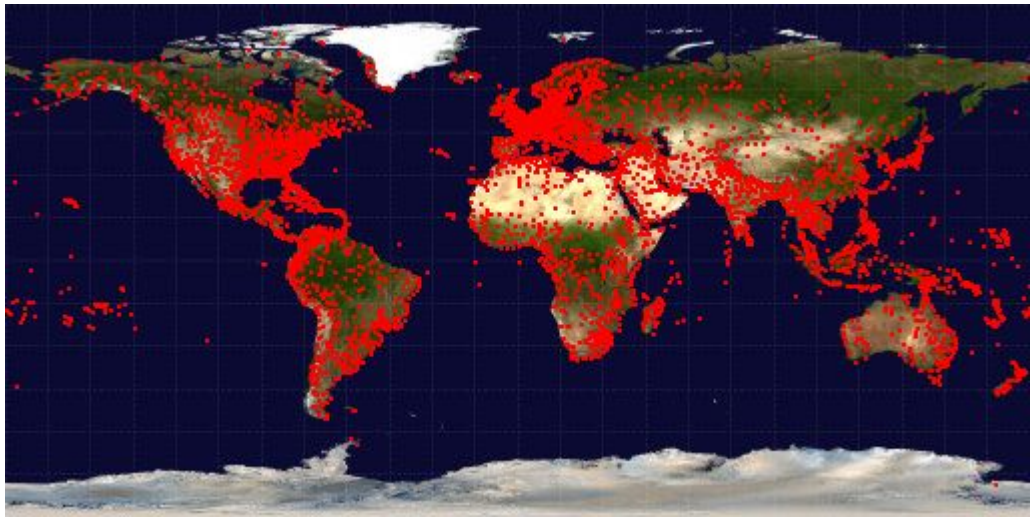
Raw geographic data like latitudes and longitudes are difficult to understand using the data charts and plots we've discussed so far

- Case study: open flights
- Geographic coordinate system: problems
- Basemap toolkit

Geographic dataset

Airport, airline and route data

- airlines.csv - data on each airline.
  - country - where the airline is headquartered.
  - active - if the airline is still active.
- airports.csv - data on each airport.
  - name - name of the airport.
  - city - the airport is located.
  - country - country the airport is located.
  - code - unique airport code.
  - latitude - latitude value.
  - longitude - longitude value.
- routes.csv - data on each flight route.
  - airline - airline for the route.
  - source - starting city for the route.
  - dest - destination city for the route.



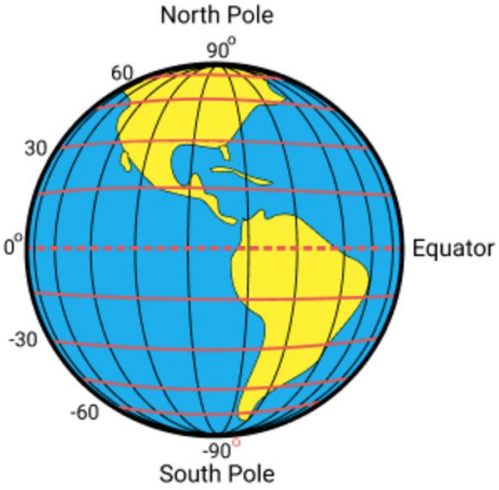
https://openflights.org/data.html

Geographic coordinate system

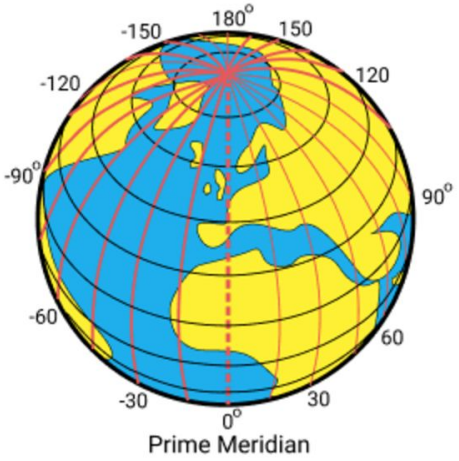
Latitude

Describes the North-South position

Ranges from -90 to 90 degrees



Longitude



Describes the East-West position

Ranges from -180 to 180 degrees

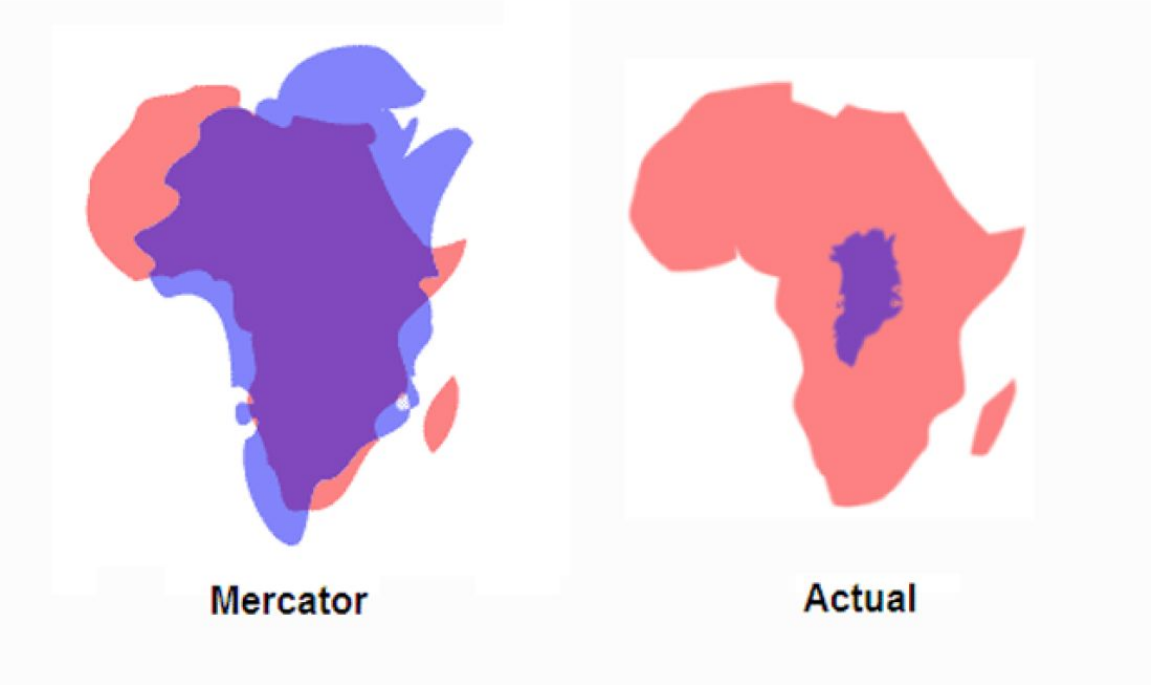
Geographic coordinate system

Name	City	State	Latitude	Longitude
White House	Washington	DC	38.898166	-77.036441
Alcatraz Island	San Francisco	CA	37.827122	-122.422934
Instituto Metrópole Digital	Natal	RN	-5.831997	-35.205415

the problem with maps

The world as we know it
https://goo.gl/ckFKh6

Greenland is no Africa



The true size of Africa

http://kai.sub.blue/en/africa.html

Map Projections

Two types of maps:

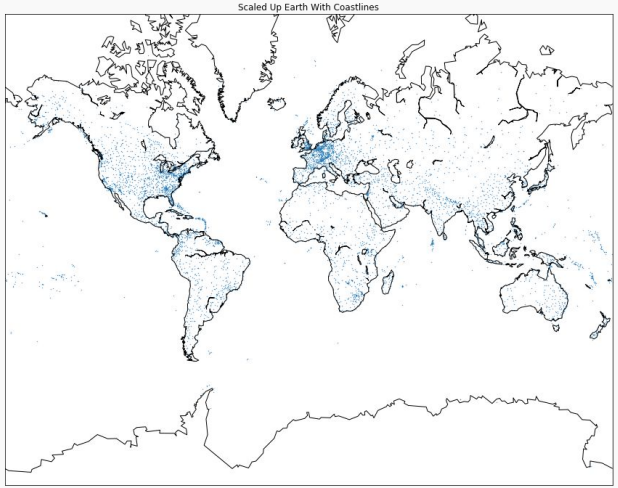
- Reference: accuracy is the most important
- Thematic: the data, i.e., getting the story right is the most important

Basemap Toolkit

Basemap is an extension to Matplotlib that makes it easier to work with geographic data

matplotlib

Basemap

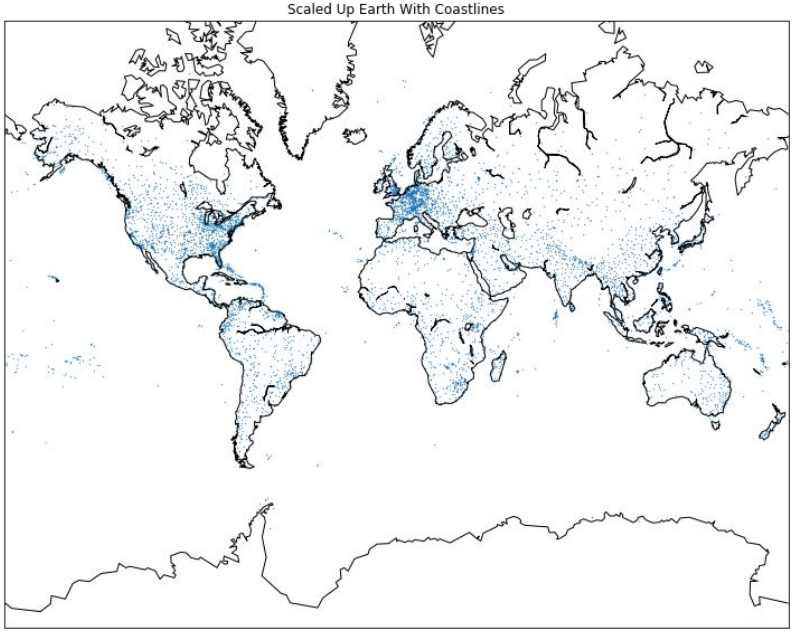


Workflow with basemap

```
import matplotlib.pyplot as plt
from mpl_toolkits.basemap import Basemap

m = Basemap(projection='merc',
            llcrnrlat=-80,
            urcrnrlat=80,
            llcrnrlon=-180,
            urcrnrlon=180)
```

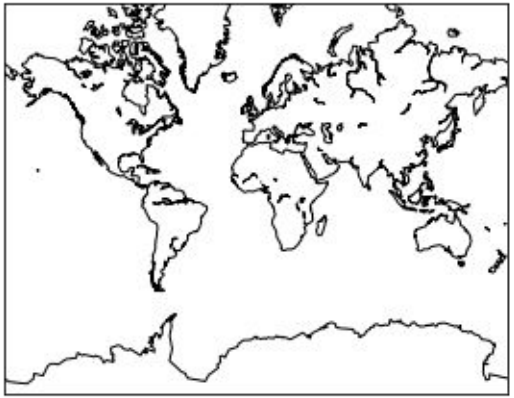
Converting from spherical to cartesian coordinates

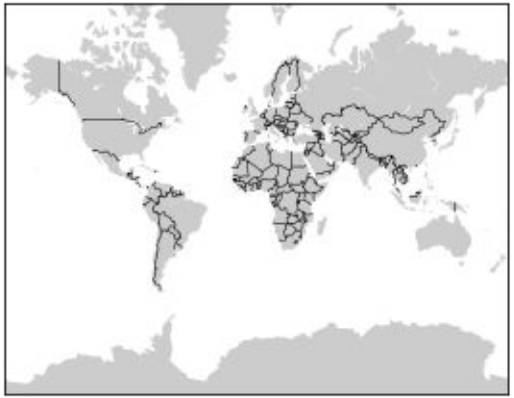



```
longitudes = airports["longitude"].tolist()
latitudes = airports["latitude"].tolist()
x, y = m(longitudes, latitudes)

fig, ax = plt.subplots(figsize=(20,10))
plt.title("Scaled Up Earth With Coastlines")
m.scatter(x,y,s=0.1)
m.drawcoastlines()
plt.show()
```

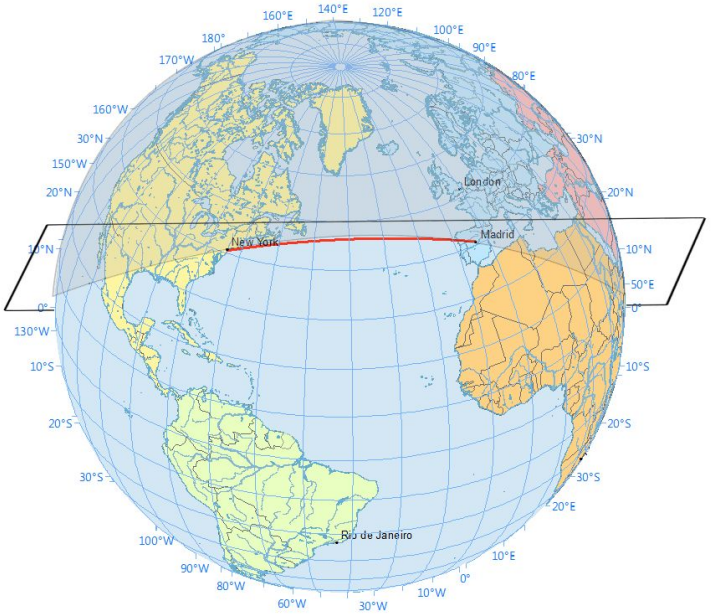
Customizing the plot using Basemap





```
fig, ax = plt.subplots(ncols=3, nrows=1, figsize=(16,6))
m.drawcoastlines(ax=ax[0])
m.fillcontinents(ax=ax[1])
m.drawcountries(ax=ax[1])
m.scatter(x,y,s=1,ax=ax[2])
```

Introduction to great circles

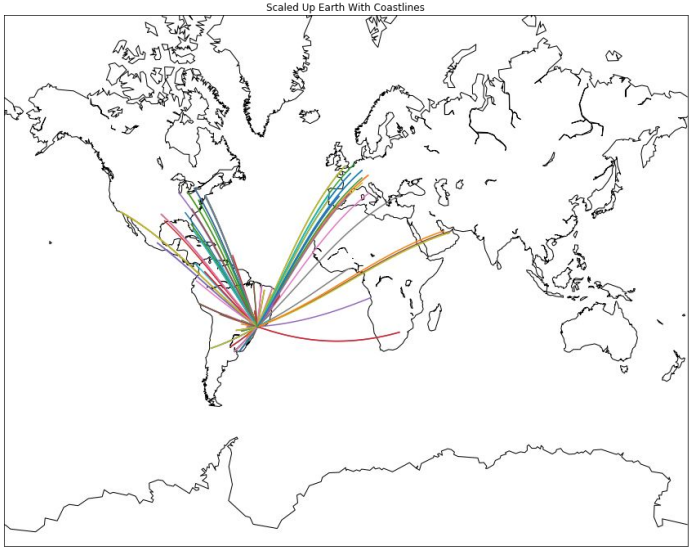


Displaying great circles

lon1 - longitude of the starting point.
lat1 - latitude of the starting point.
lon2 - longitude of the ending point.
lat2 - latitude of the ending point.

```
m.drawgreatcircle(39.956589, 43.449928, 49.278728, 55.606186)
m.drawgreatcircle(48.006278, 46.283333, 49.278728, 55.606186)
m.drawgreatcircle(39.956589, 43.449928, 43.081889 , 44.225072)
```

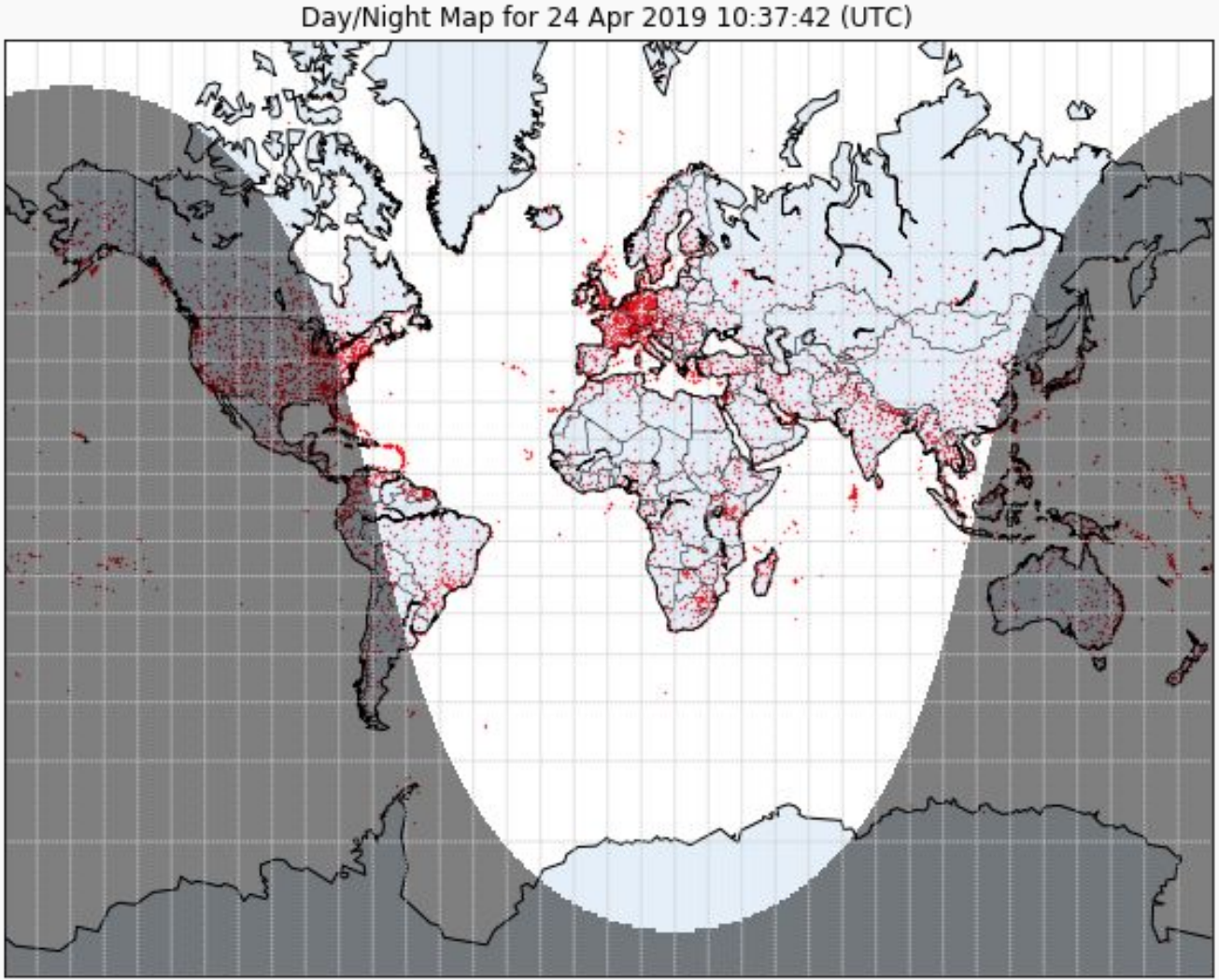
Great circles: case study

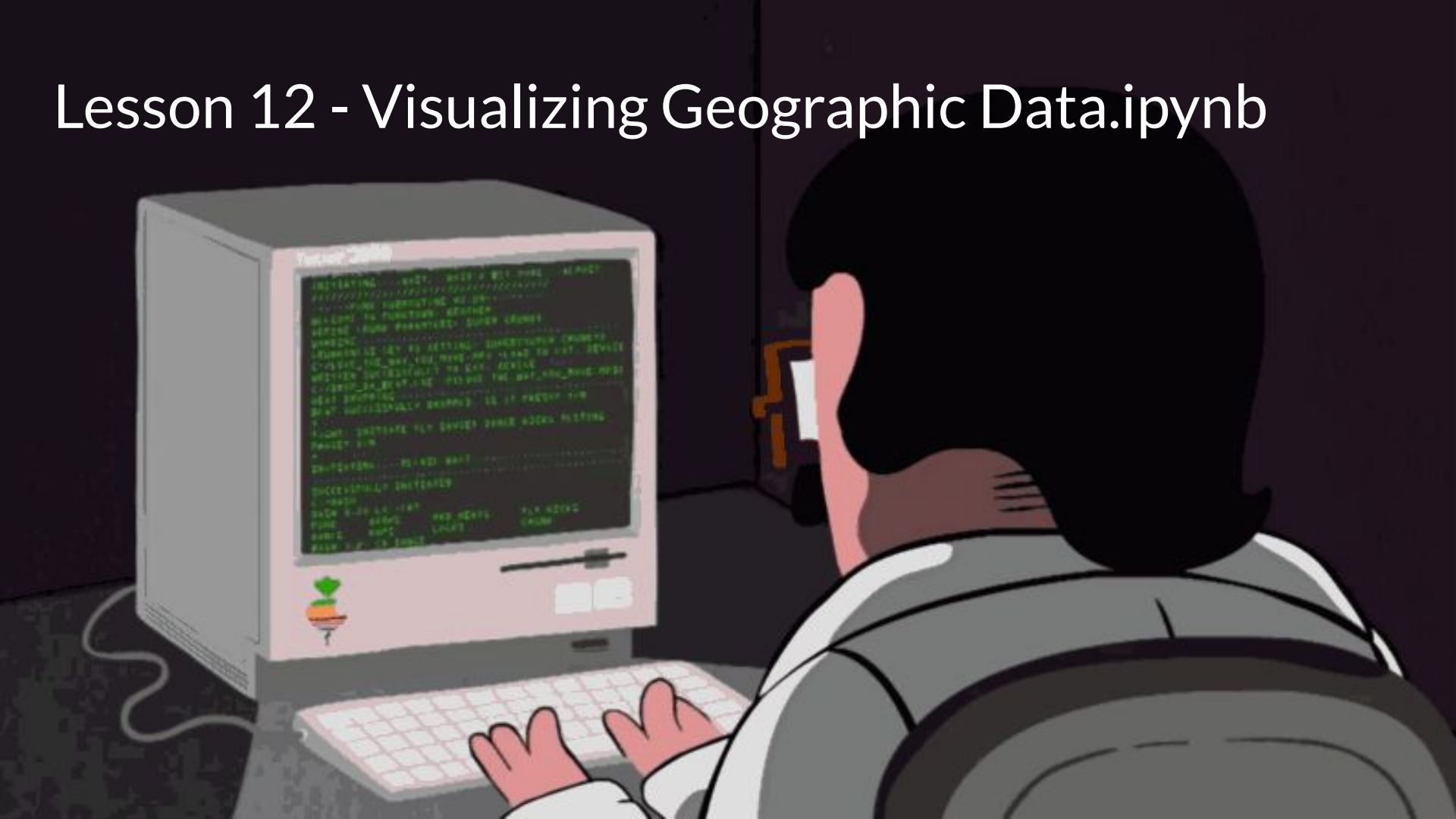



```
def create_greate_circles(df):
  for index,row in df.iterrows():
    end_lat,start_lat = row["end_lat"],row["start_lat"]
    end_lon,start_lon = row["end_lon"],row["start_lon"]

    if (abs(end_lat-start_lat) < 180):
      if (abs(end_lon-start_lon) < 180):
        m.drawgreatcircle(start_lon,start_lat,end_lon,end_lat)

gru = geo_routes[geo_routes["source"] == "GRU"]
create_greate_circles(gru)
m.drawcoastlines()
plt.show()
```



Day-night terminator on map

Lesson 12 - Visualizing Geographic Data.ipynb