Bancos de Dados Geográficos

PostGIS

Sistemas de coordenadas e projeções
Medições, cálculos de distância e área

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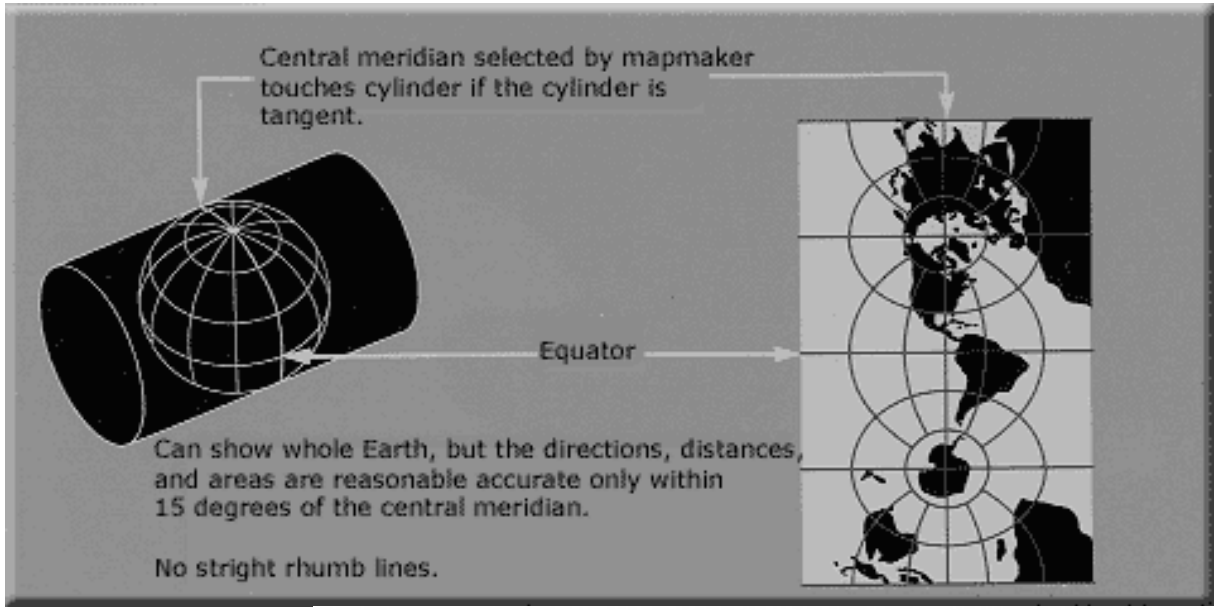
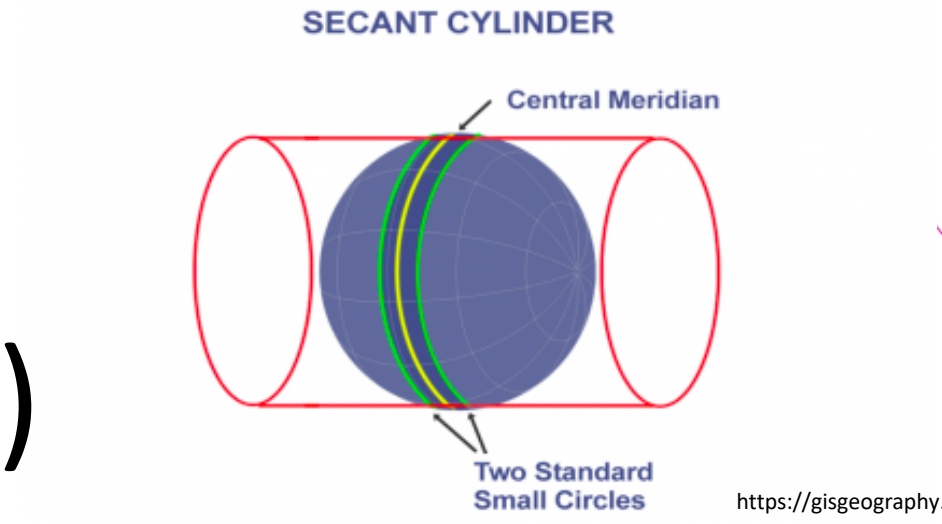
Sistemas de Coordenadas

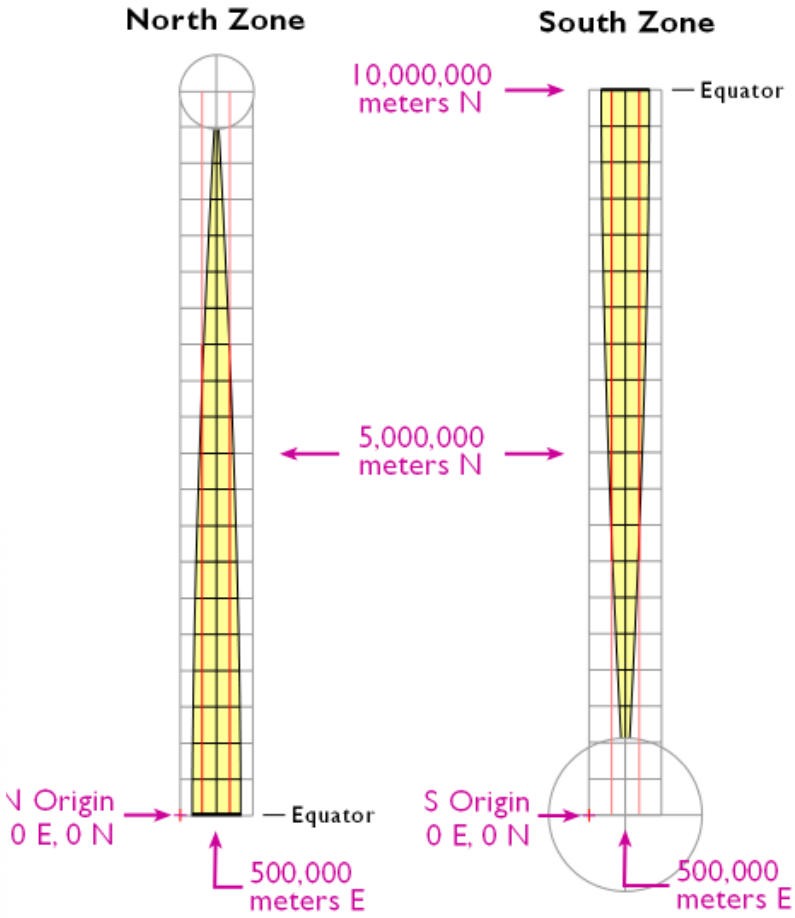
- Dois tipos são os mais usados
  - Coordenadas planas
    - A projeção da superfície da Terra a um plano já foi feita: projeção cartográfica
    - Coordenadas (X, Y) ou (E, N) referidas a um ponto de origem convencionado
    - Mais usado: Universal Transverso de Mercator, UTM
    - Coordenadas expressas em metros
    - Sistema de coordenadas projetadas (PCS – projected coordinate systems)
  - Globais
    - Sistema de coordenadas esféricas: dois ângulos, raio fixo
    - Coordenadas (long, lat), referidas ao Equador e ao Meridiano de Greenwich
    - Mais usados: sistemas geocêntricos, como o WGS-84 e o SIRGAS 2000
    - Coordenadas expressas em graus
    - Sistema de coordenadas geográficas (GCS – global coordinate systems)

Plana (UTM)



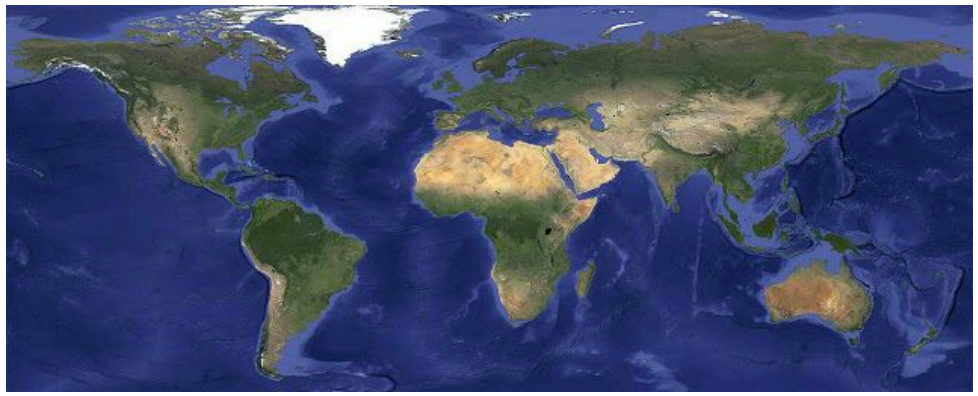
Fonte: Wikipedia



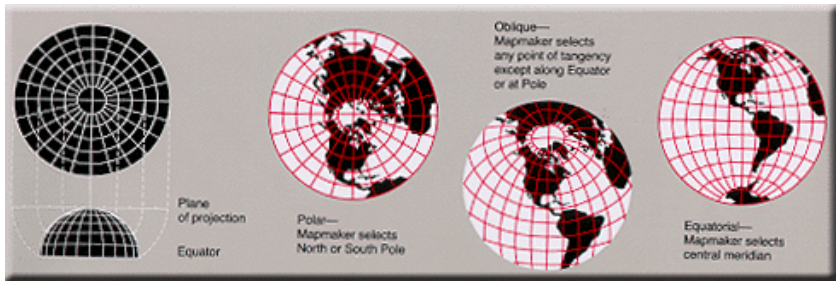


Fonte: Pennsylvania State University

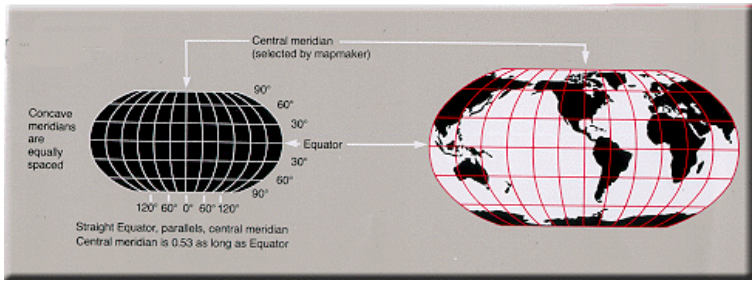
https://gisgeography.com/wp-content/uploads/2017/02/UTM-Secant-Tangent-Cylinder-2-425x278.png



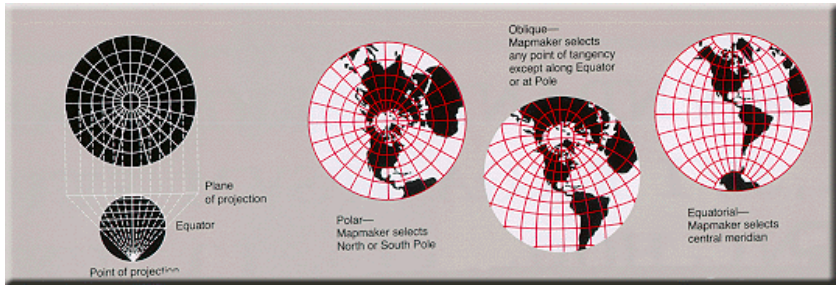
Global



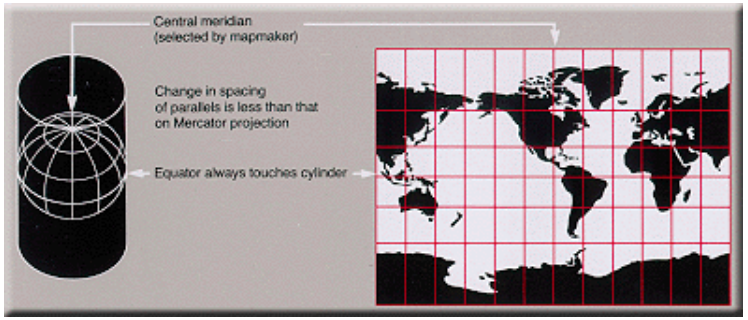
Azimutal



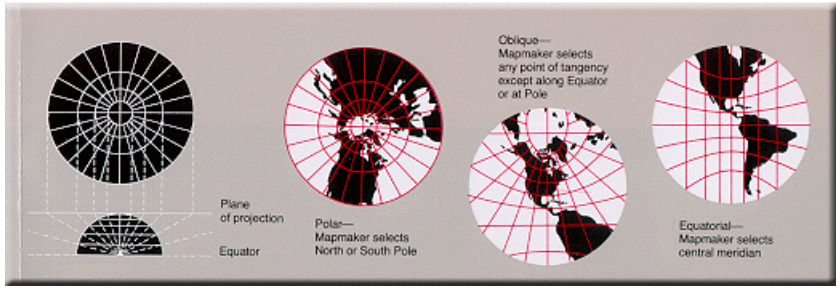
Robinson



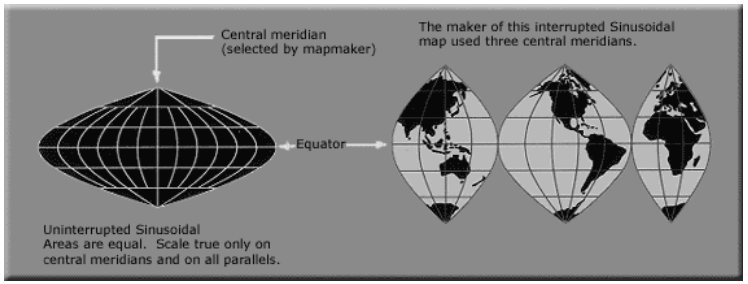
Estereográfica



Miller



Gnomônica



Pseudocilíndrica: senoidal

Global

Fonte: Wikipedia

EPSG:European Petroleum Survey Group

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4	2003	EPSG	2003	PROJCS["Grenada 1953 / British West Indies Grid",GEOGCS["Gren...	+proj=tmerc +lat_0=0 +lon_0=-62 +k=0.9995000000000001 +x_0=40...
5	2004	EPSG	2004	PROJCS["Montserrat 1958 / British West Indies Grid",GEOGCS["M...	+proj=tmerc +lat_0=0 +lon_0=-62 +k=0.9995000000000001 +x_0=40...
6	2005	EPSG	2005	PROJCS["St. Kitts 1955 / British West Indies Grid",GEOGCS["St. Kit...	+proj=tmerc +lat_0=0 +lon_0=-62 +k=0.9995000000000001 +x_0=40...
7	2006	EPSG	2006	PROJCS["St. Lucia 1955 / British West Indies Grid",GEOGCS["St. L...	+proj=tmerc +lat_0=0 +lon_0=-62 +k=0.9995000000000001 +x_0=40...
8	2007	EPSG	2007	PROJCS["St. Vincent 45 / British West Indies Grid",GEOGCS["St. Vi...	+proj=tmerc +lat_0=0 +lon_0=-62 +k=0.9995000000000001 +x_0=40...
9	2008	EPSG	2008	PROJCS["NAD27(CGQ77) / SCoPQ zone 2 (deprecated)",GEOGCS[...	+proj=tmerc +lat_0=0 +lon_0=-55.5 +k=0.9999 +x_0=304800 +y_0=0 ...
10	2009	EPSG	2009	PROJCS["NAD27(CGQ77) / SCoPQ zone 3",GEOGCS["NAD27(CGQ...	+proj=tmerc +lat_0=0 +lon_0=-58.5 +k=0.9999 +x_0=304800 +y_0=0 ...
11	2010	EPSG	2010	PROJCS["NAD27(CGQ77) / SCoPQ zone 4",GEOGCS["NAD27(CGQ...	+proj=tmerc +lat_0=0 +lon_0=-61.5 +k=0.9999 +x_0=304800 +y_0=0 ...
12	2011	EPSG	2011	PROJCS["NAD27(CGQ77) / SCoPQ zone 5",GEOGCS["NAD27(CGQ...	+proj=tmerc +lat_0=0 +lon_0=-64.5 +k=0.9999 +x_0=304800 +y_0=0 ...
13	2012	EPSG	2012	PROJCS["NAD27(CGQ77) / SCoPQ zone 6",GEOGCS["NAD27(CGQ...	+proj=tmerc +lat_0=0 +lon_0=-67.5 +k=0.9999 +x_0=304800 +y_0=0 ...
14	2013	EPSG	2013	PROJCS["NAD27(CGQ77) / SCoPQ zone 7",GEOGCS["NAD27(CGQ...	+proj=tmerc +lat_0=0 +lon_0=-70.5 +k=0.9999 +x_0=304800 +y_0=0 ...
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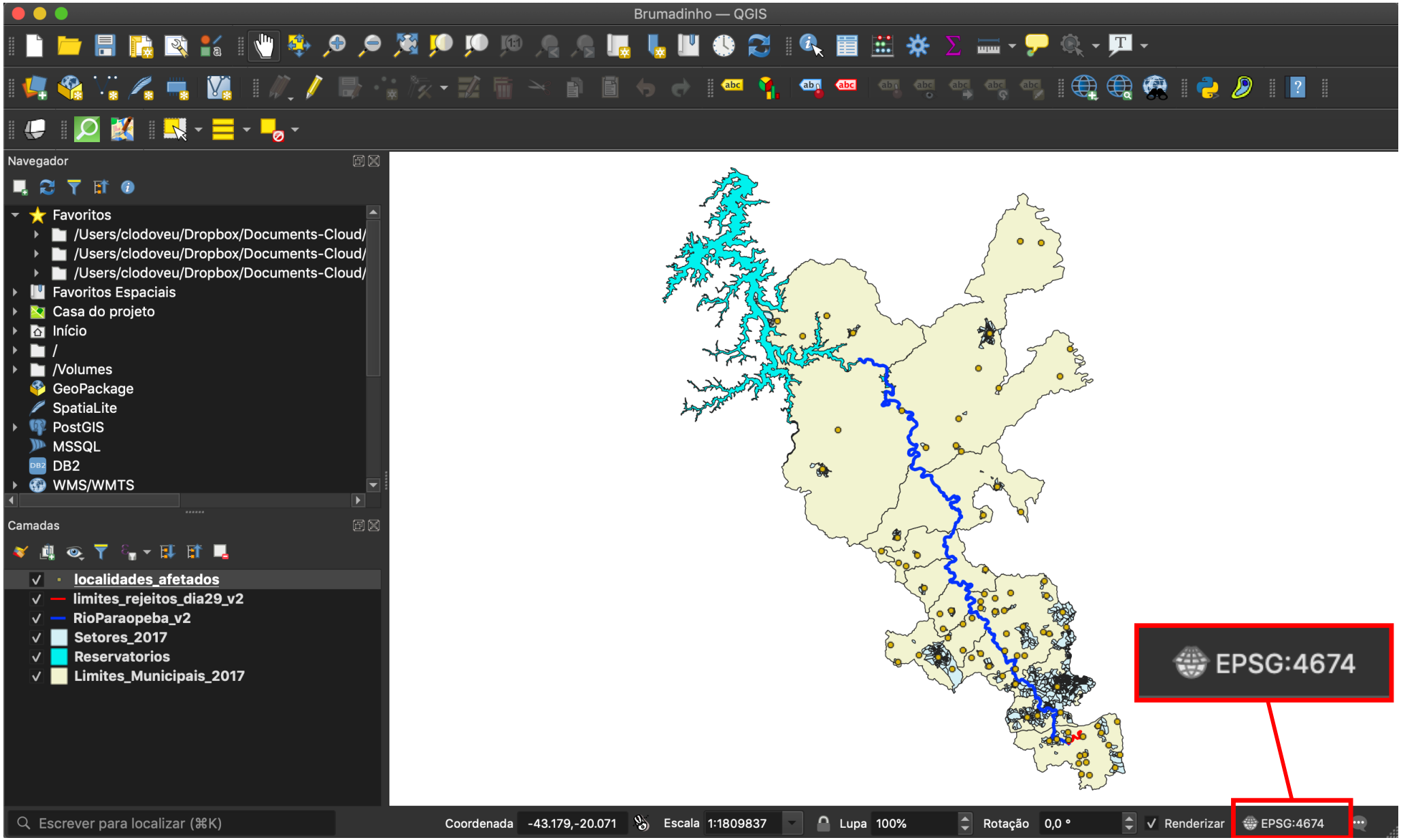

Brumadinho — QGIS
Navegador
Favoritos
/Users/clodoveu/Dropbox/Documents-Cloud/
/Users/clodoveu/Dropbox/Documents-Cloud/
/Users/clodoveu/Dropbox/Documents-Cloud/
Favoritos Espaciais
Casa do projeto
Início
/
/Volumes
GeoPackage
SpatiaLite
PostGIS
MSSQL
DB2
WMS/WMTS
Camadas
localidades_afetados
limites_rejeitos_dia29_v2
RioParaopeba_v2
Setores_2017
Reservatorios
Limites_Municipais_2017
EPSG:4674
Escrever para localizar (⌘K)
Coordenada -43.179,-20.071
Escala 1:1809837
Lupa 100%
Rotação 0,0 °
Renderizar
EPSG:4674

Principais sistemas de coordenadas

SRID	Sistema	proj4
29190-29195	PCS: UTM datum SAD69 zonas 20S a 25S	+proj=utm +zone=23 +south +ellps=aust_SA +towgs84=-66.87,4.37,-38.52,0,0,0,0 +units=m +no_defs [exemplo: 29193]
31980-31985	PCS: UTM datum SIRGAS 2000 zonas 20S a 25S	+proj=utm +zone=23 +south +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs [exemplo: 31983]
4618	GCS: SAD69	+proj=longlat +ellps=aust_SA +towgs84=-66.87,4.37,-38.52,0,0,0,0 +no_defs
4674	GCS: SIRGAS 2000	+proj=longlat +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +no_defs
4326	GCS: WGS84	+proj=longlat +datum=WGS84 +no_defs
900913	Google Earth (authority: spatialreferencing.org)	+proj=merc +a=6378137 +b=6378137 +lat_ts=0.0 +lon_0=0.0 +x_0=0.0 +y_0=0 +k=1.0 +units=m +nadgrids=@null +no_defs

Principais sistemas de coordenadas

SRID	Sistema	srtext
4674	GCS: SIRGAS 2000	GEOGCS["SIRGAS 2000", DATUM["Sistema_de_Referencia_Geocentrico_para_las_AmericaS_2000", SPHEROID["GRS1980",6378137,298.257222101,AUTHORITY["EPSG","7019"]], TOWGS84[0,0,0,0,0,0,0],AUTHORITY["EPSG","6674"]], PRIMEM["Greenwich",0,AUTHORITY["EPSG","8901"]], UNIT["degree",0.0174532925199433,AUTHORITY["EPSG","9122"]], AUTHORITY["EPSG","4674"]]
4326	GCS: WGS84	GEOGCS["WGS 84", DATUM["WGS_1984", SPHEROID["WGS84",6378137,298.257223563,AUTHORITY["EPSG","7030"]], AUTHORITY["EPSG","6326"]], PRIMEM["Greenwich",0,AUTHORITY["EPSG","8901"]], UNIT["degree",0.0174532925199433,AUTHORITY["EPSG","9122"]], AUTHORITY["EPSG","4326"]]

Geometrias e Geografias no PostGIS

- A forma geométrica dos objetos pode ser codificada usando os tipos de dados *geometry* ou *geography*
- GEOMETRY
  - Assume-se que a projeção já foi feita, e os cálculos são planares (cartesianos)
  - Coordenadas: lat/long ou metros (UTM)
  - Unidade de medida: a mesma do sistema de coordenadas
- GEOGRAPHY
  - Assume-se que os cálculos devem ser feitos no esferoide (geodésicos)
  - Coordenadas: sempre lat/long, GCS
  - Unidade de medida: metros

Cálculos de distância e área no PostGIS

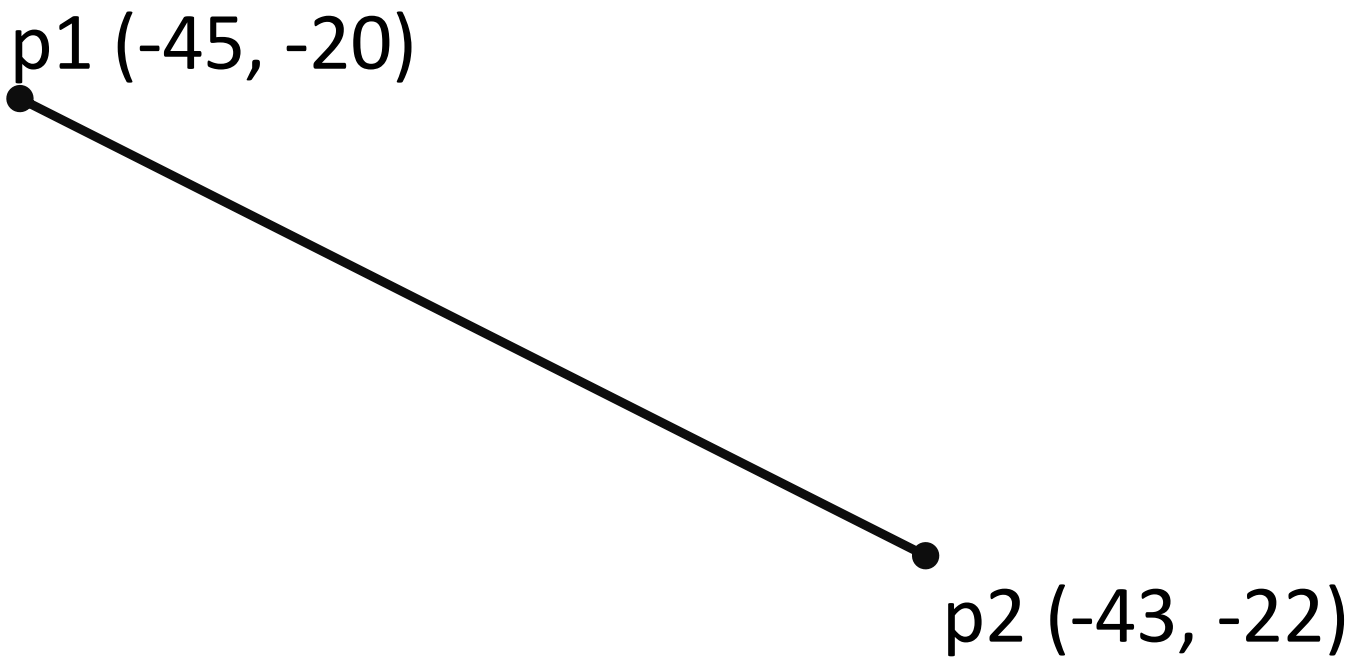
Tipo GEOMETRY

- ST_DISTANCE(geom1, geom2)
- ST_AREA(geom1)

- ST_DWITHIN(geom1, geom2, dist)

- geom1 = ST_POINT(-45, -20)
- geom2 = ST_POINT(-43, -22)

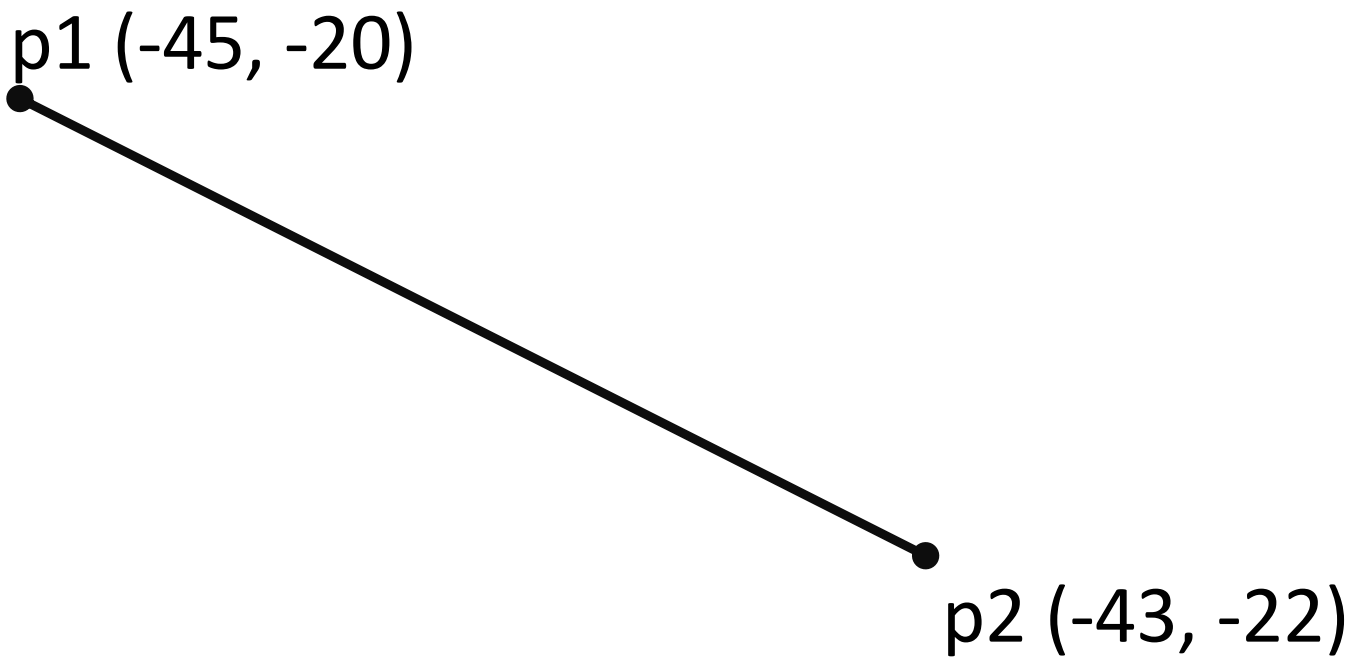
GEOMETRY



select ST_DISTANCE(ST_POINT(-45, -20), ST_POINT(-43,-22))

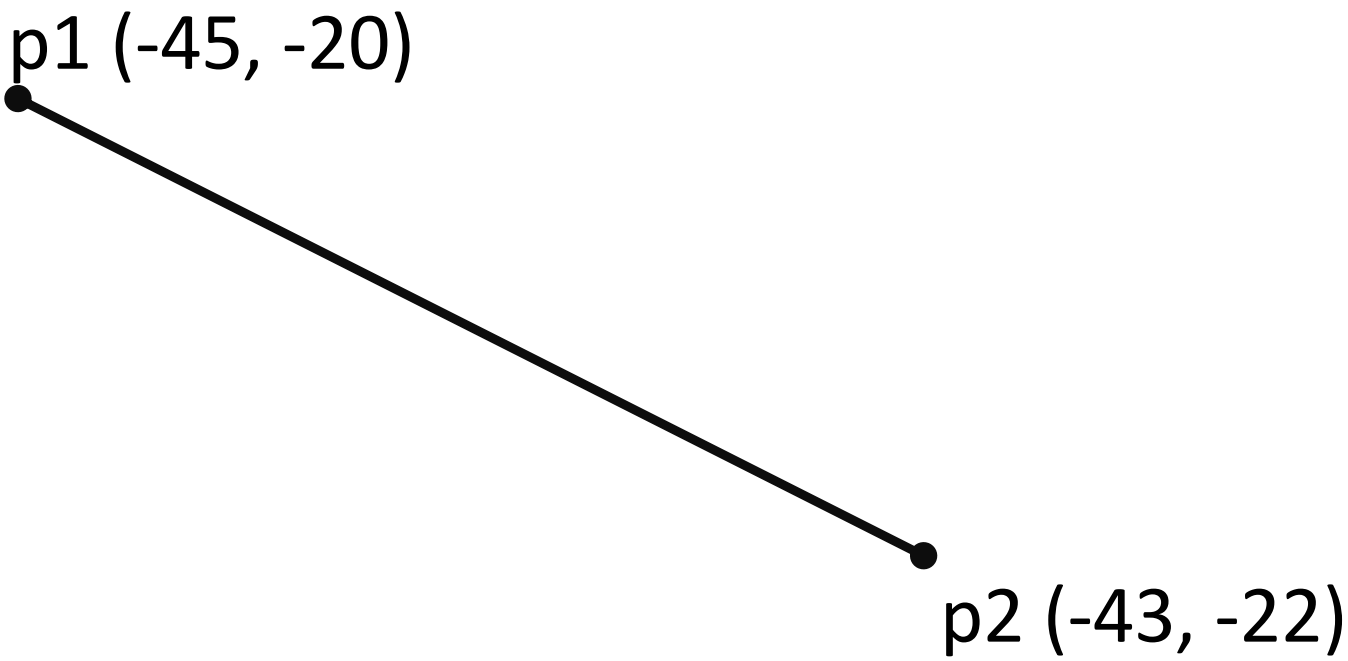
> *2.8284271247461903* GRAUS

GEOMETRY




```
select ST_DISTANCE(ST_SetSRID(ST_POINT(-45, -20), 4326),
                   ST_SetSRID(ST_POINT(-43,-22), 4326))
> 2.8284271247461903
```

GEOMETRY




```
select ST_DISTANCE(ST_SetSRID(ST_POINT(-45, -20), 4674),
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> 2.8284271247461903
```
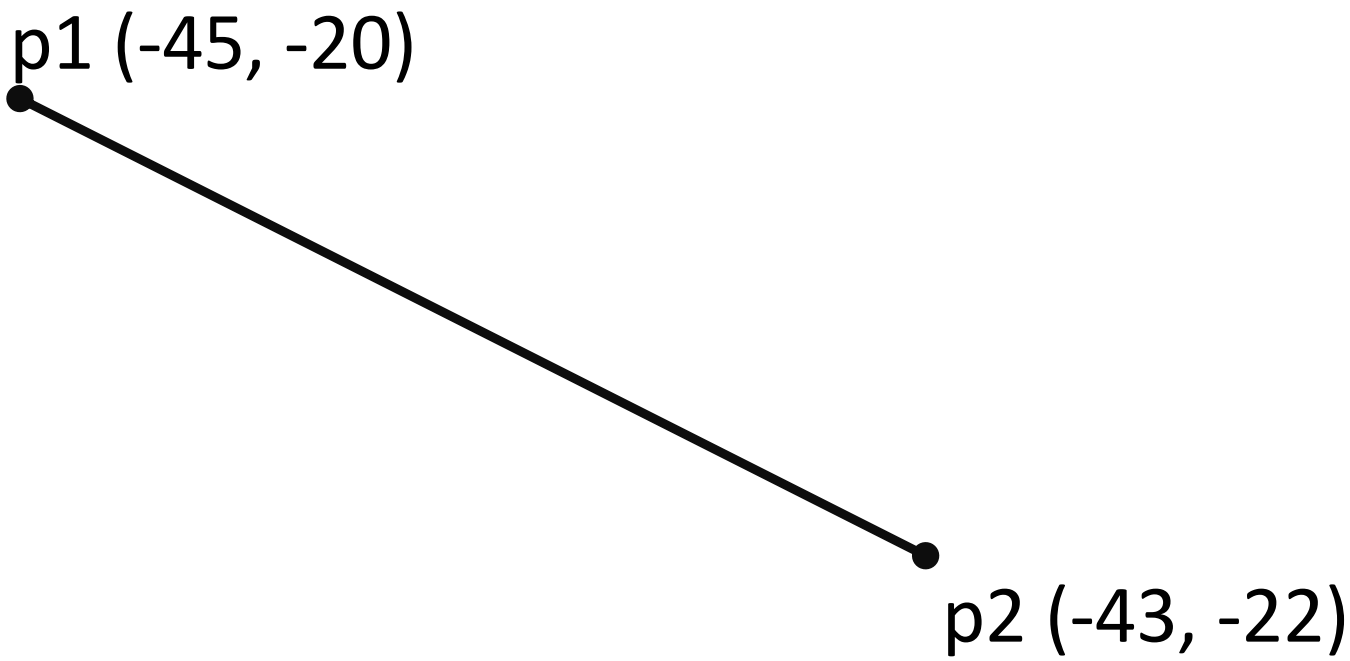
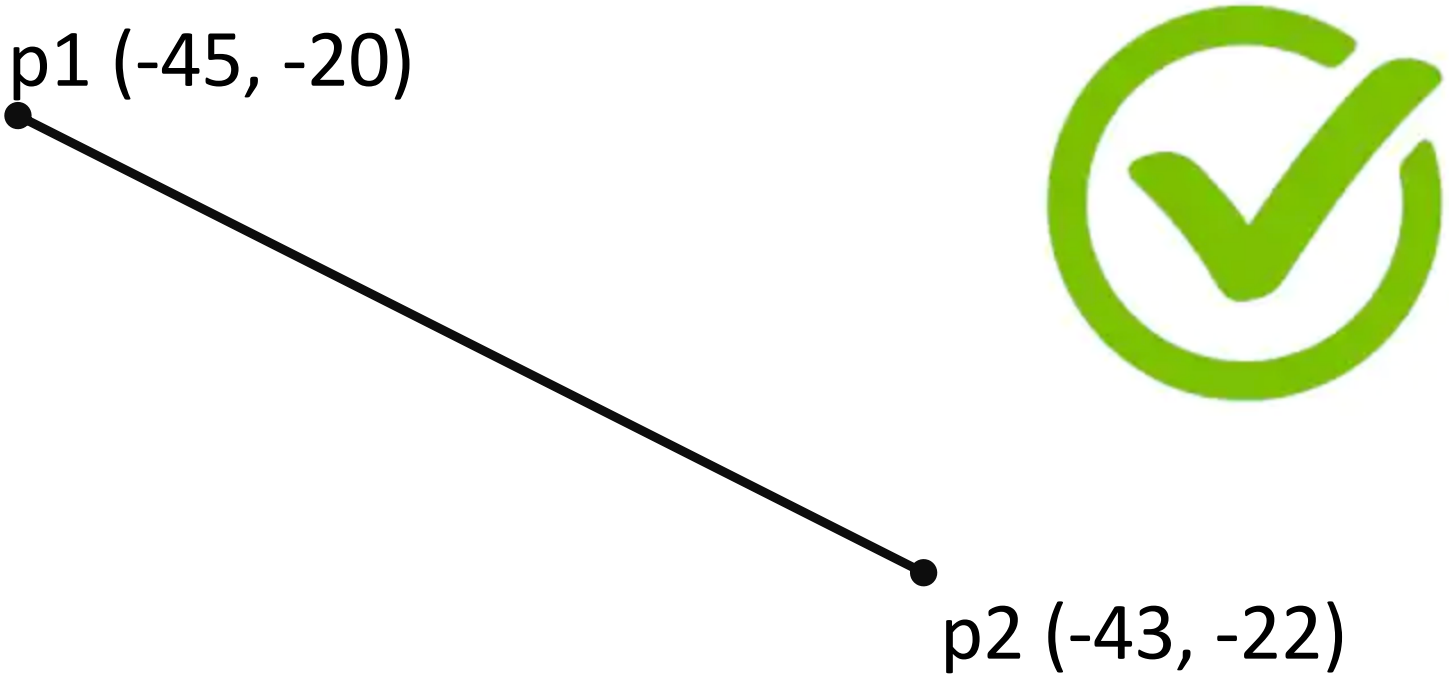

GEOMETRY




```
select ST_DISTANCE(ST_SetSRID(ST_POINT(-45, -20), 4326),
                   ST_SetSRID(ST_POINT(-43,-22), 4674))
```

> ERROR: ST_Distance: Operation on mixed SRID geometries

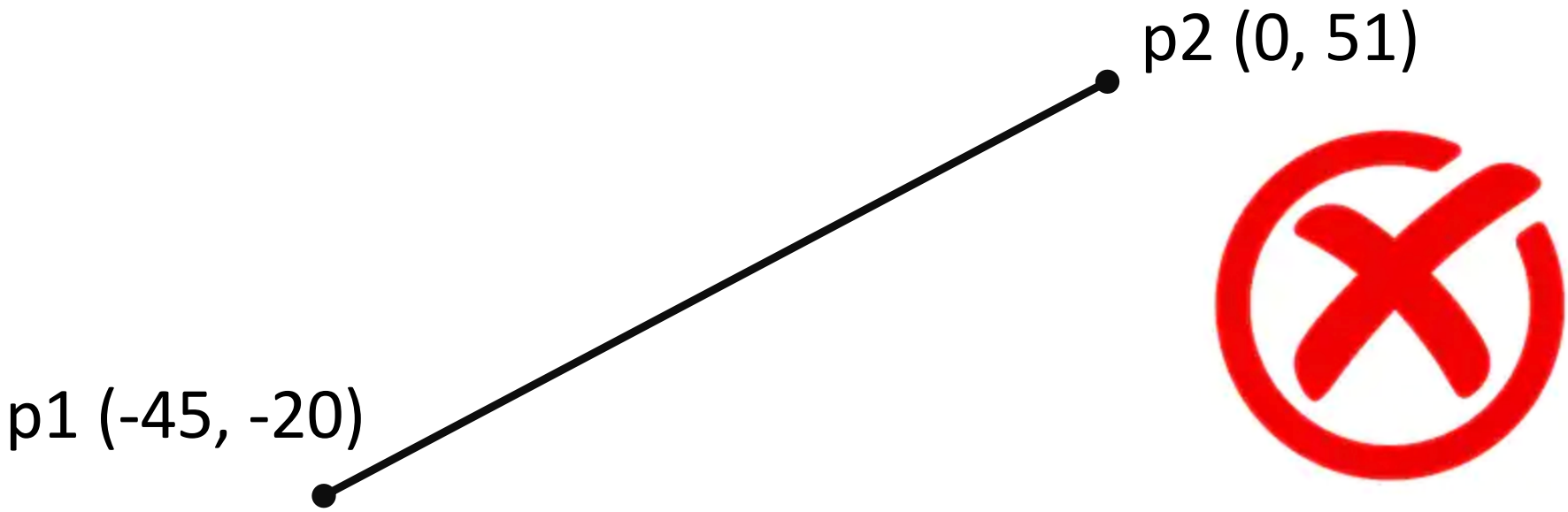
GEOMETRY




```
select ST_DISTANCE(ST_TRANSFORM(ST_SetSRID(ST_POINT(-45, -20), 4674), 31983),
                   ST_TRANSFORM(ST_SetSRID(ST_POINT(-43,-22), 4674), 31983))
```

> *303683.88699569117* METROS

GEOMETRY




```
select ST_DISTANCE(ST_TRANSFORM(ST_SetSRID(ST_POINT(-45, -20), 4326), 31983),
                   ST_TRANSFORM(ST_SetSRID(ST_POINT(0,51), 4326), 31983))
```

> *9398841.321462924* METROS

Cálculos de distância e área no PostGIS

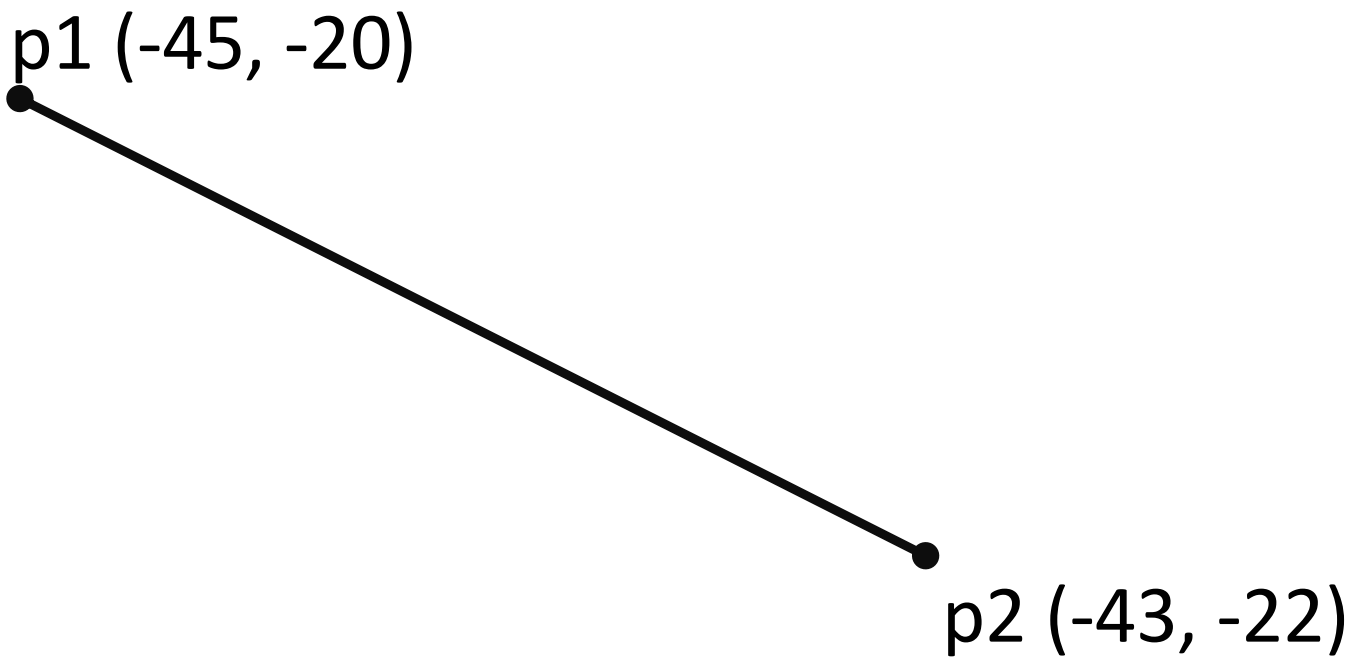
Tipo GEOGRAPHY

- ST_DISTANCE(geog1, geog2)
- ST_AREA(geog1)

- ST_DWITHIN(geog1, geog2, dist)

- geog1 = ST_POINT(-45, -20)::geography
- geog2 = ST_POINT(-43, -22)::geography

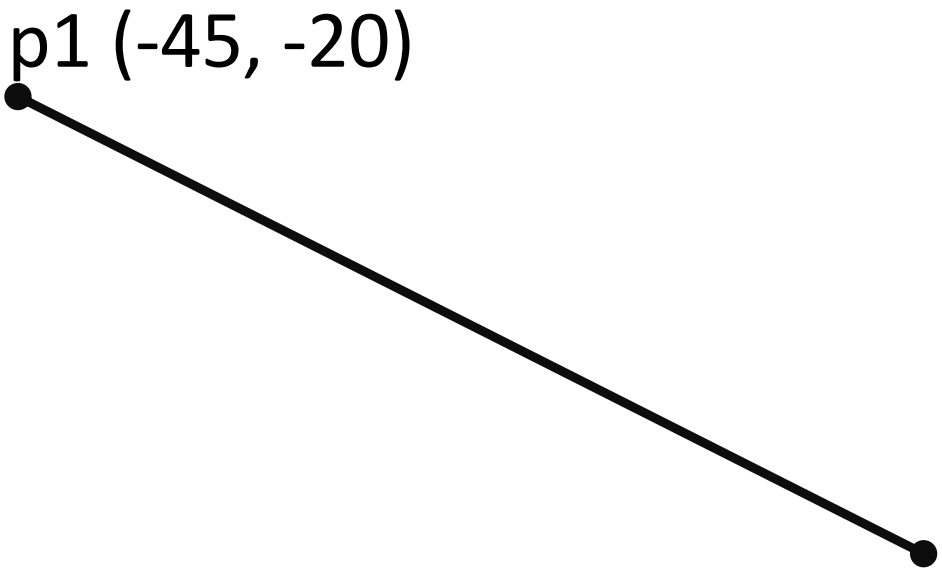
GEOGRAPHY




```
select ST_DISTANCE(ST_POINT(-45, -20)::geography,
                   ST_POINT(-43,-22)::geography)
```

> *303752.54968581* METROS

GEOMETRY



```
select ST_DISTANCE(ST_TRANSFORM(ST_SetSRID(ST_POINT(-45, -20), 4674), 29193),
                   ST_TRANSFORM(ST_SetSRID(ST_POINT(-43,-22), 4674), 29193))
```

> *303683.88699569117* METROS

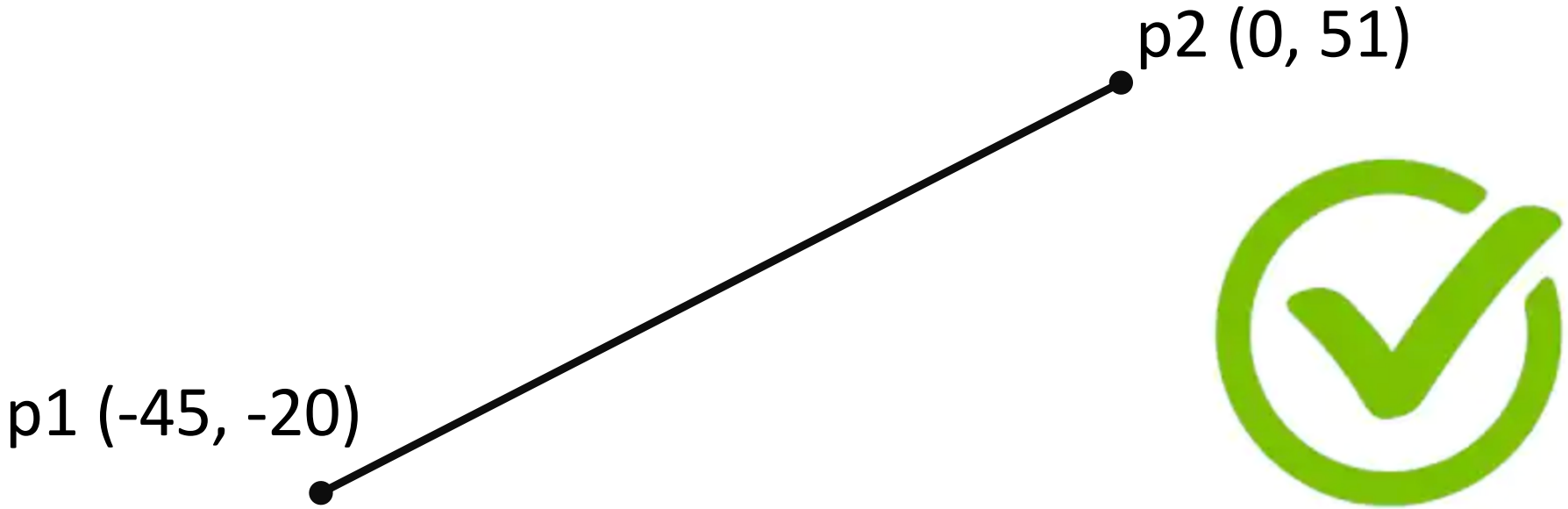
> *303752.54968581 (diferença: 0,02%)*

GEOMETRY


```
select ST_DISTANCE(ST_TRANSFORM(ST_SetSRID(ST_POINT(-45, -20), 4326), 29193),
                   ST_TRANSFORM(ST_SetSRID(ST_POINT(0,51), 4326), 29193))
```

> *9398841.321462924* METROS

GEOGRAPHY




```
select ST_DISTANCE(ST_POINT(-45, -20)::geography,
                   ST_POINT(0,51)::geography)
```

> *9009952.14964749* METROS

> *9398841.321462924 (diferença: 4%)* ⊗

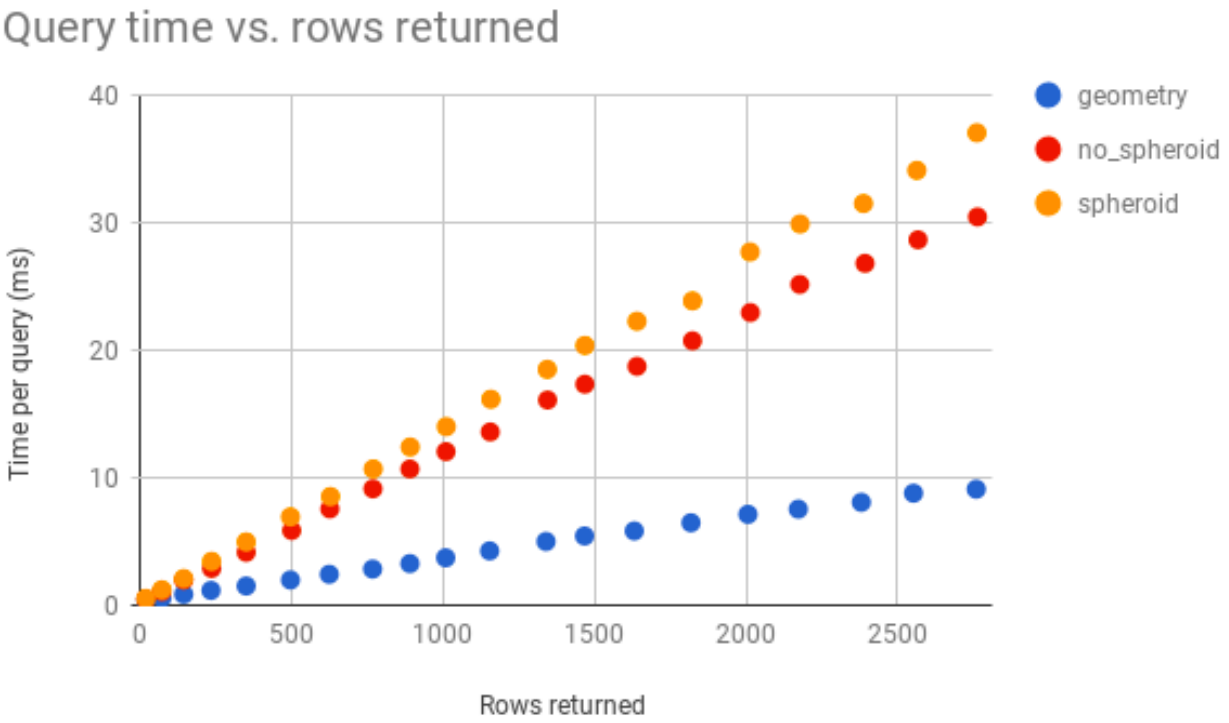
Cálculos de distância e área no PostGIS

- Regras básicas
  - Os SRIDs das geometrias precisam ser iguais na entrada das funções
  - O resultado segue as unidades do SRID utilizado

- Soluções
  - Transformar o SRID de uma das geometrias para se ajustar à outra
  - Fazer typecasting para usar o tipo GEOGRAPHY
  - Usar GEOGRAPHY em vez de GEOMETRY se a aplicação assim exigir

- Observação
  - A variedade de funções que suporta GEOGRAPHY é menor que a que suporta GEOMETRY

Diferenças de desempenho



https://medium.com/coord/postgis-performance-showdown-geometry-vs-geography-ec99967da4f0

clodoveu@dcc.ufmg.br

Links

vCard