QGIS Tutorial

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Introduction and Welcome

- Welcome!
- Basic GIS concepts
- Data Acquisition
- Exploring the interface
- Data Manipulation

Before Starting

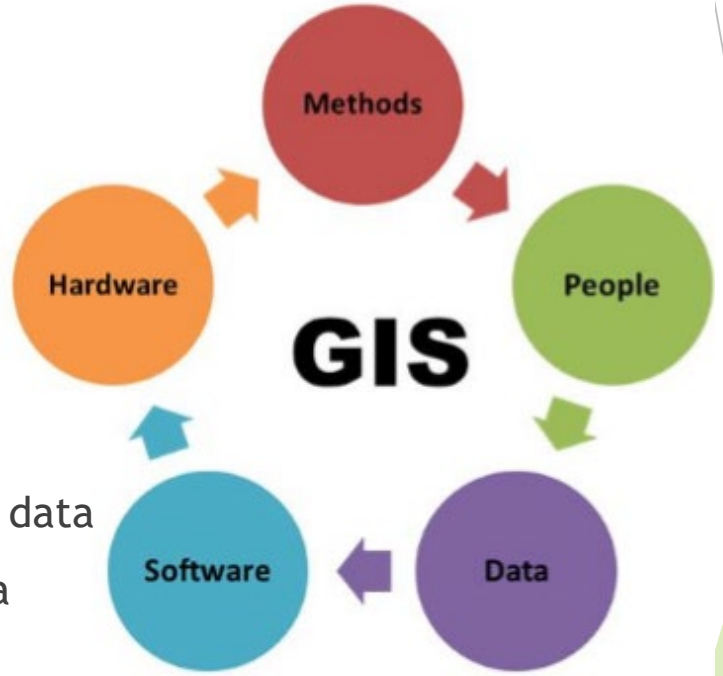
- Go to “qgis.org”
- Click on Download now
- QGIS version 3.4 (64 bit) standalone
- Install with Default config
- Create a folder for the tutorial

Tutorial Objectives

- Identify other GIS topics (tools and techniques for analysis), data formats (raster, vector), and software (open source and ArcGIS) to pursue for future study
- Locate GIS data on the web and consider the merits of different data sources
- Add data to GIS software and navigate a GIS interface
- Perform basic geoprocessing operations for preparing vector GIS data
- Convert text-based data to a GIS data format
- Conduct geographic analyses using standard GIS tools and vector data

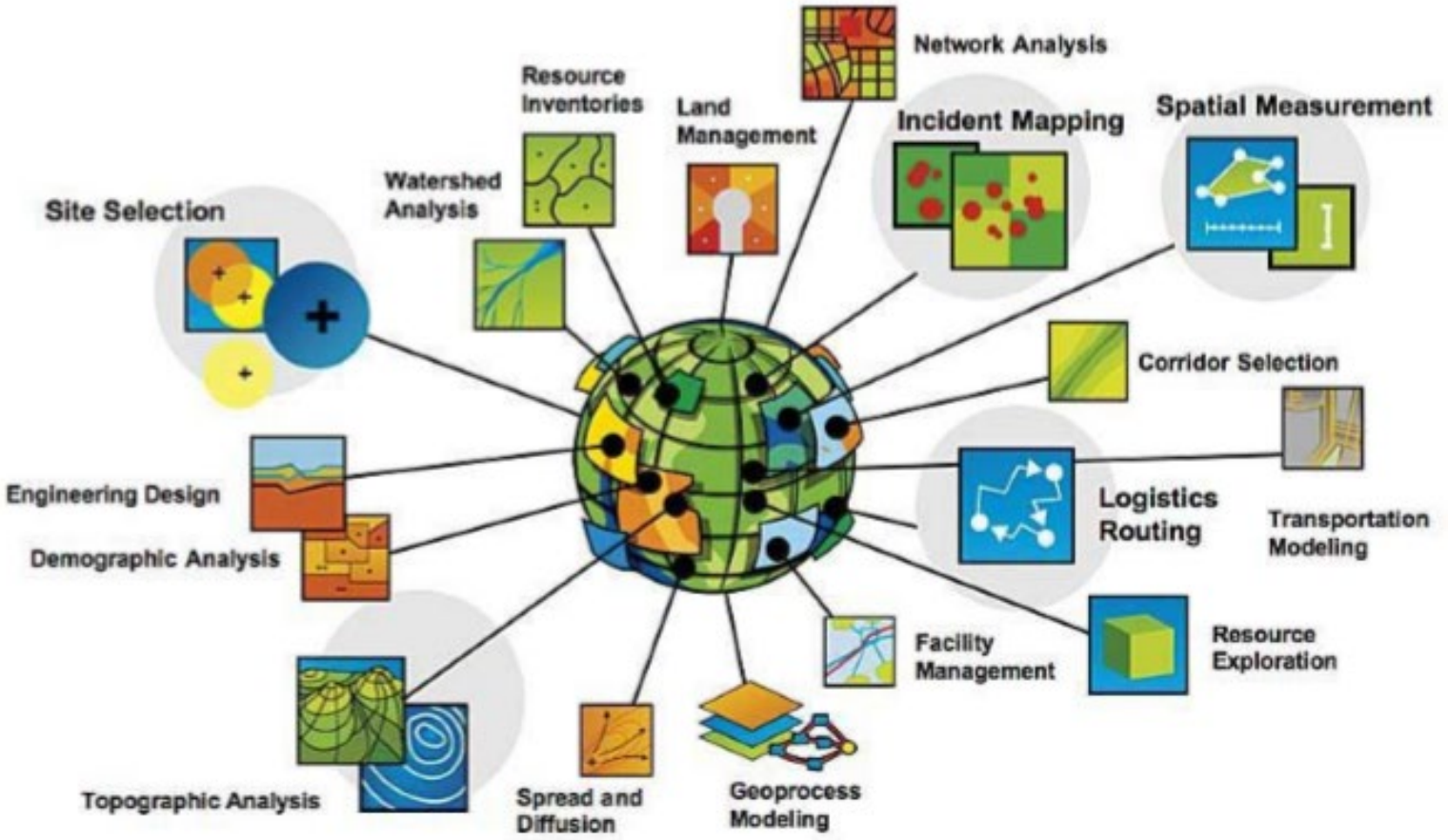
Basic GIS Concepts

- GIS stands for Geographic Information System
- Uses spatial information to provide visual output
- With modern GIS you can:
  - Capture and prepare data
  - Manage, store and maintain data
  - Manipulate and analyse data
  - Present data



GIS Is Being Applied Around the World

Across Many Disciplines, Professions, and Organizations

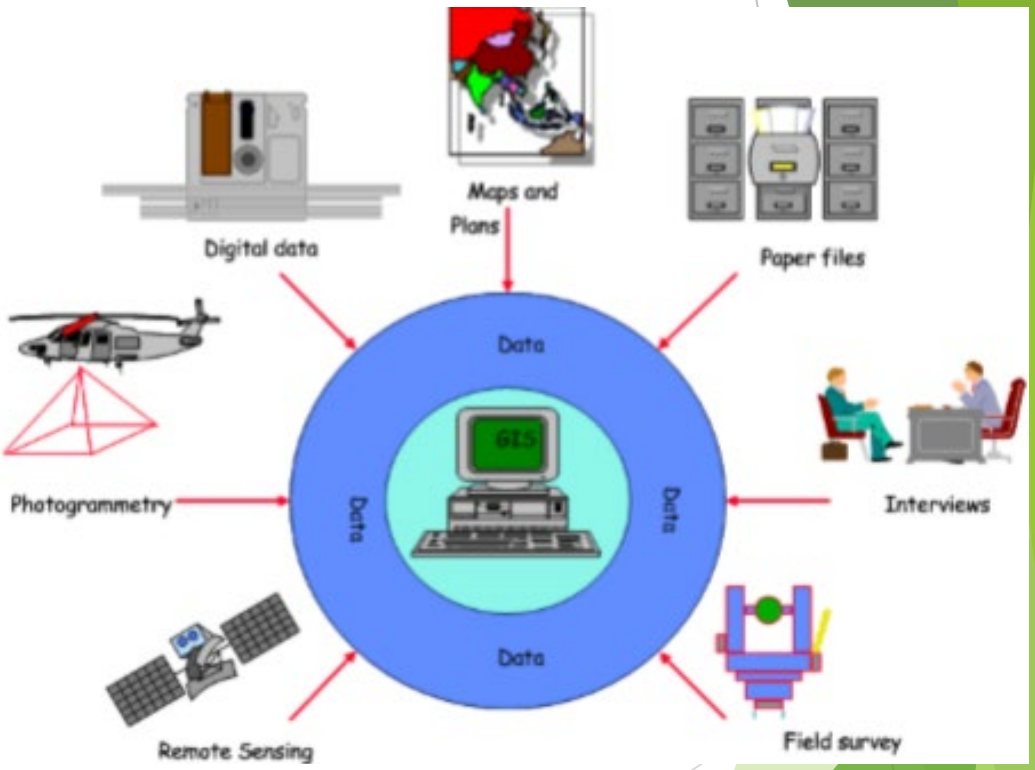


How does GIS analysis work?

- GIS is often used as a tool for decision making
- Steps for GIS analysis:
  - Data acquisition
  - Data entry
  - Analysis and interpretation
  - Presentation

Data Acquisition

- Digital format and georeferenced
- Types and sources of data depend on application
- Data can be created or taken from pre-existing sources and then modified for a specific task
  - E.G. Historical census data, satellite aerial imagery, old physical maps.



Data Acquisition

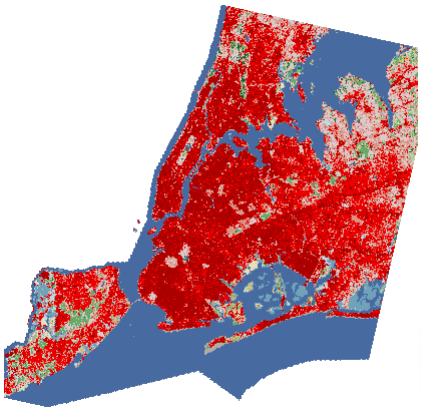
Colombia	Others
IDEAM (Instituto de Hidrología, Meteorología y Estudios Ambientales)	Natural Earth Data
CAR (Corporación Autónoma Regional de Cundinamarca)	ESRI Open Data
Datos Abiertos (Gov.co)	Sentinel Satellite Data
Geoportal IGAC	USGS Earth Explorer

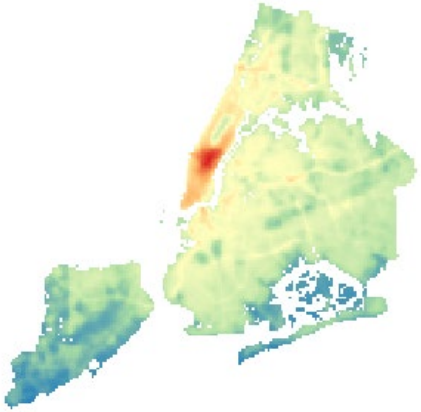
Data Entry

- GIS Files are features
- Features are represented by files or layers that are added to a map (Raw material for maps)
- Every layer is georeferenced
- All datasets require metadata
- GIS datasets contain attribute information
- Data file formats: Raster, Vector or Attribute Table
- Geodatabases and Web Services

Data Entry: Raster

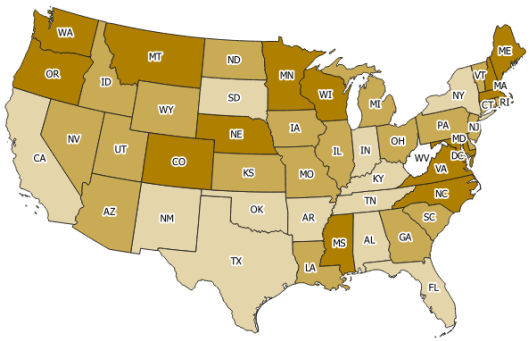
- Continuous surface divided into grids of equal sizes
- Each cell has a value, colour
- Common formats “.tif” or “.jpg”
- Georeferenced!!!

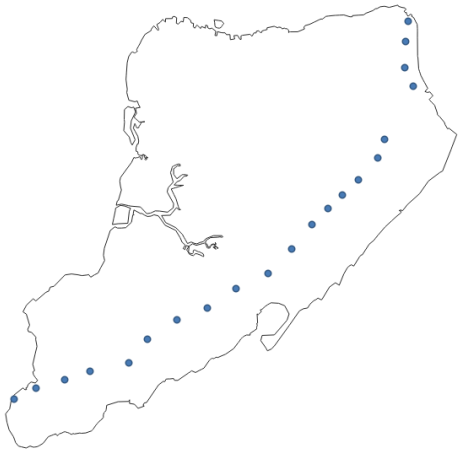




Data Entry: Vector

- Discrete coordinates and surfaces represented as individual points, lines or polygons
- Appear more “map-like”
- They are abstractions (boundaries, points like cities)
- They have descriptors associate to them
- Common formats: “.shp” or “.json”





Data Entry: Tables

- Data tables with records can be mapped in several ways
- Lon and Lat are part of the attributes → Vector
- Contains single ID codes for each file → Join features in GIS file
- Common formats: “.txt”, “.csv”, “.dbf”
- Standardized IDs to join tables:
  - ANSI/FIPS (within US / codes for countries)
  - ISO (Countries and Subdivisions)

	A	B	C	D	E	F	G
1	id	geography	totpop	fem18_49	per_fem	medinc	moe_med
2	36005000100	Census Tract 1, Bronx County, New York city, New York	11091	787	7.1		
3	36005000200	Census Tract 2, Bronx County, New York city, New York	4334	1042	24.0	72034	13991
4	36005000400	Census Tract 4, Bronx County, New York city, New York	5503	1404	25.5	74836	8407
5	36005001600	Census Tract 16, Bronx County, New York city, New York	5643	1351	23.9	32312	6859
6	36005001900	Census Tract 19, Bronx County, New York city, New York	1917	476	24.8	37936	3771
7	36005002000	Census Tract 20, Bronx County, New York city, New York	8731	2193	25.1	18086	3694
8	36005002300	Census Tract 23, Bronx County, New York city, New York	4933	1231	25.0	14479	1901
9	36005002400	Census Tract 24, Bronx County, New York city, New York	4	1	25.0		

Data Entry: Containers

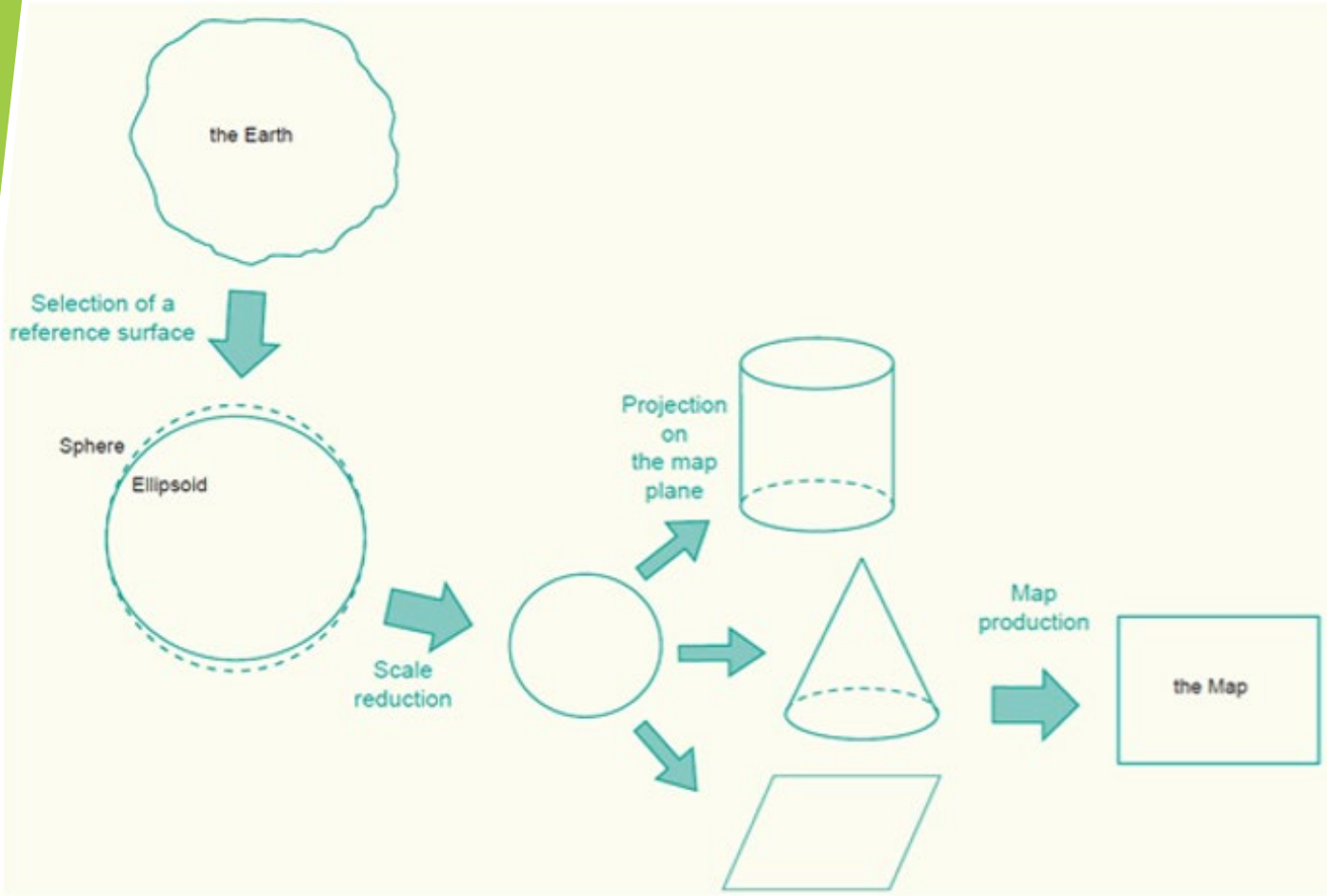
- Geodatabases: Containers that can hold raster, vector and tabular data. Good for organizing data and can be used for spatial query analysis
  - ".mdb", ".gdb", ".sqlite" and ".gpkg"
- WebServices: GIS files stored in the web. The user can connect and render them directly in GIS
  - WMS, WFS, XYZ tiles

Data Analysis

- Analysis is based on data models
- Models represent some real-world phenomenon
- Models are simpler representation of complex ideas
- Models can be maps, databases or processing chains
- Often have a strong temporal component

Data Representation

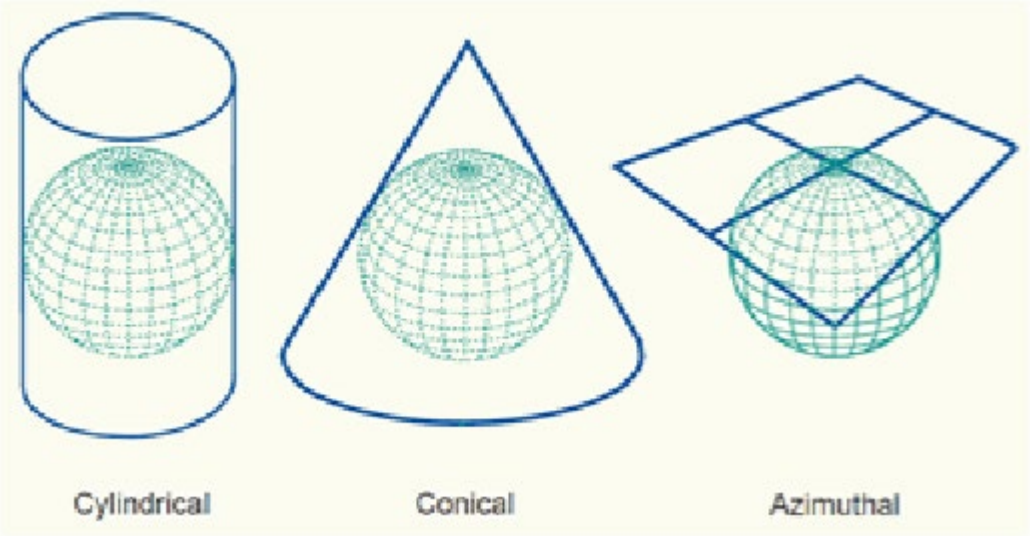
- Usually graphical representation of the outputs of a model
- Maps are commonly used as a form of representation
- GIS results are also represented as scientific reports
- Other representations: complete models, web mapping, posters, presentations…



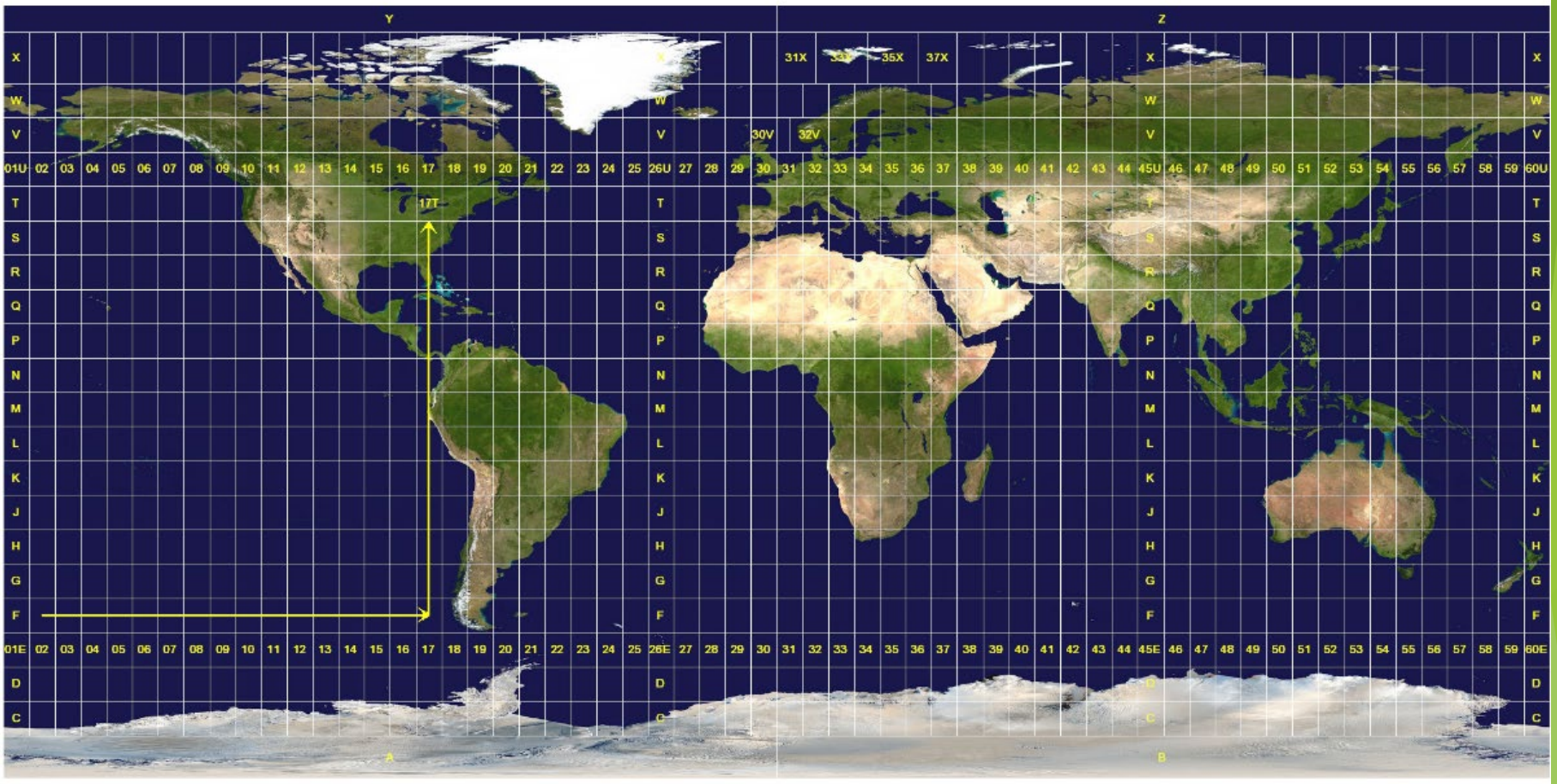
Understanding Reference Systems

Map Projections

- Geographical Coordinates Vs. Cartesian Coordinates
- Mostly optimized locally!!!
- http://metrocosm.com/compare-map-projections.html



Universal Transverse Mercator (UTM): Conformal Projection



https://en.wikipedia.org/wiki/Universal_Transverse_Mercator_coordinate_system

Nordrhein-Westfalen: ETRS89 / UTM

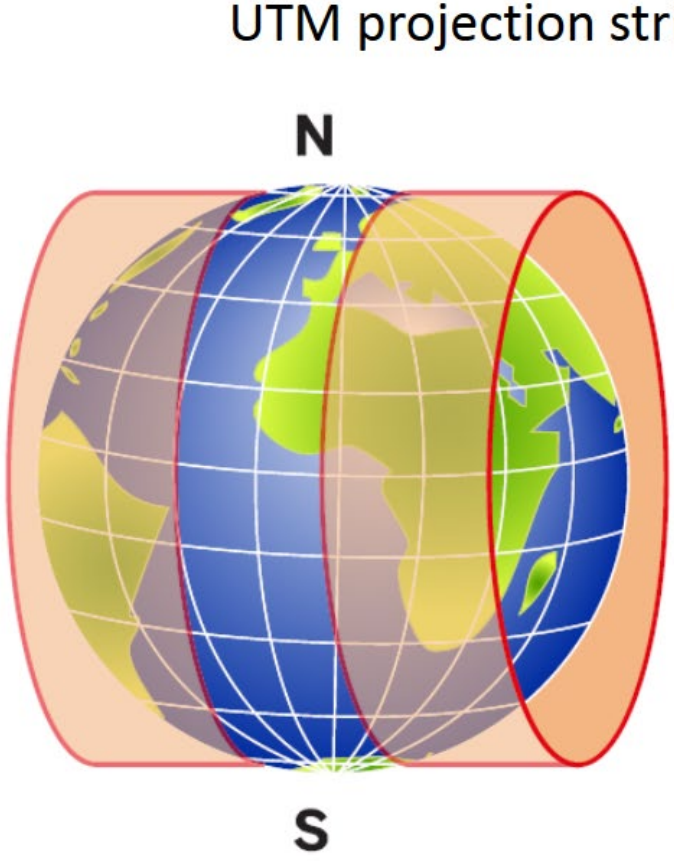


Abb. 2: Schnittzylinder der UTM-Abbildung

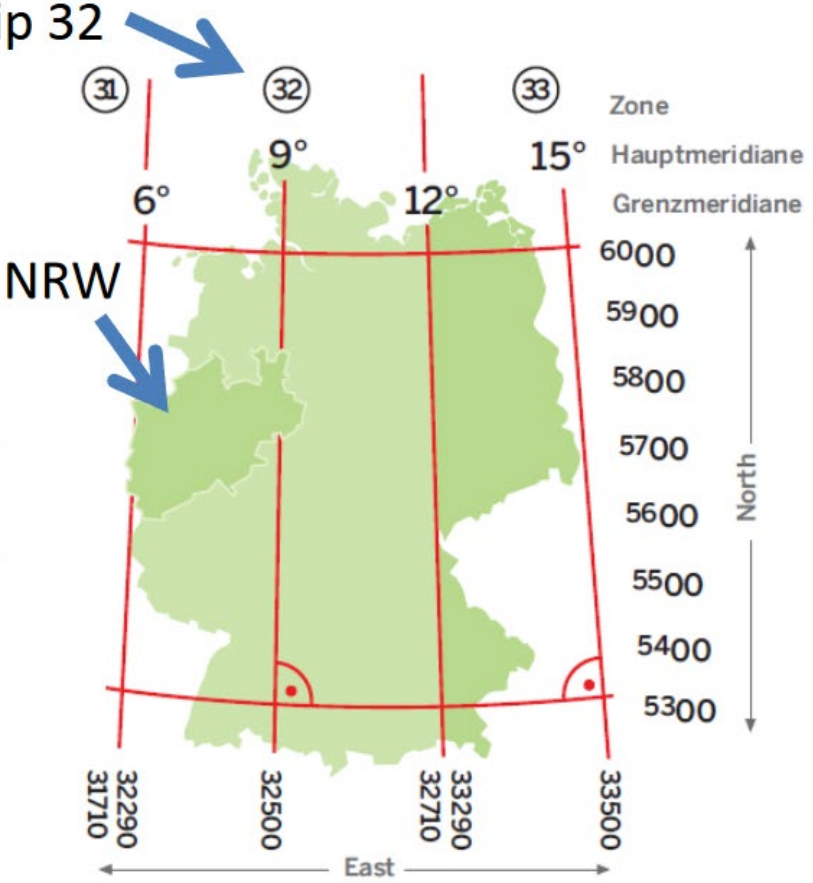
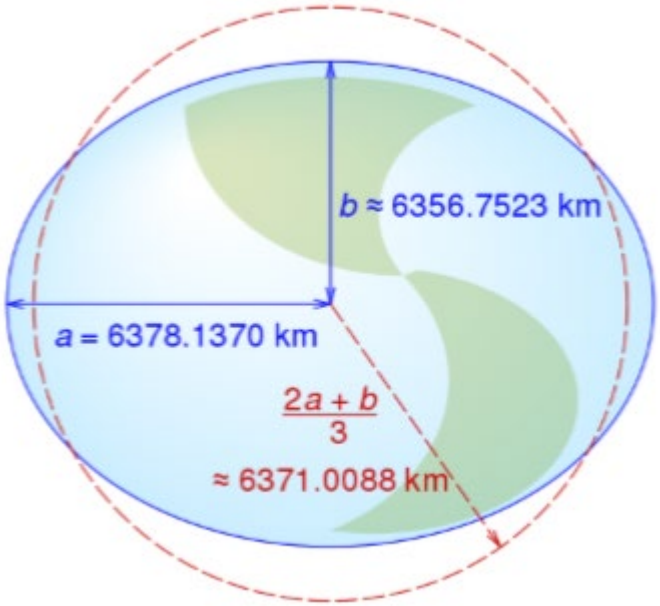


Abb. 3: Die Lage von NRW in der UTM-Zone 32

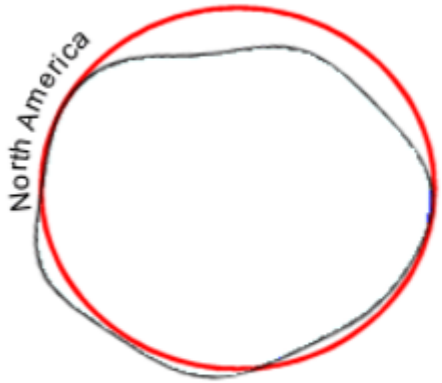
https://www.bezreg-koeln.nrw.de/brk_internet/publikationen/abteilung07/pub_geobasis_etrs89.pdf

World Geodetic System WGS84

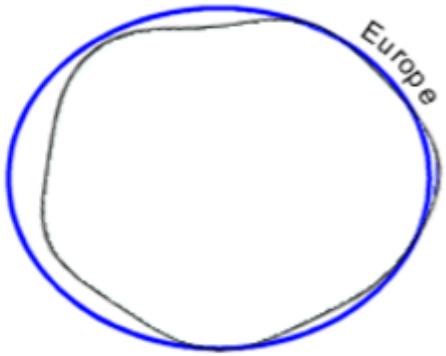
- Origin Located in Earths centre of mass
- Defined in 1984
- Prime Meridian (PM) approx. at Greenwich
- Latitude (Breite) φ, φ : measured from equator, North +, South –
- Longitude (Länge) λ : measured from PM, East + , West -



Ellipsoid Approximates Geoid Locally

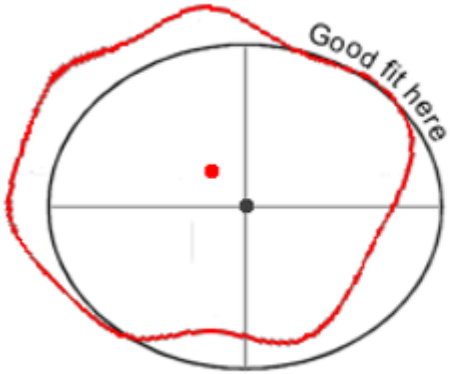


The red ellipsoid fits the geoid well in North America.

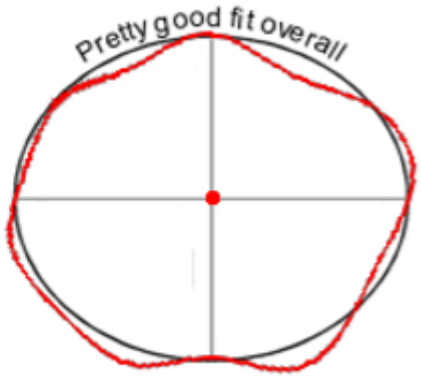


The blue ellipsoid fits the geoid well in Europe.

- center of mass of geoid
- center of ellipsoid



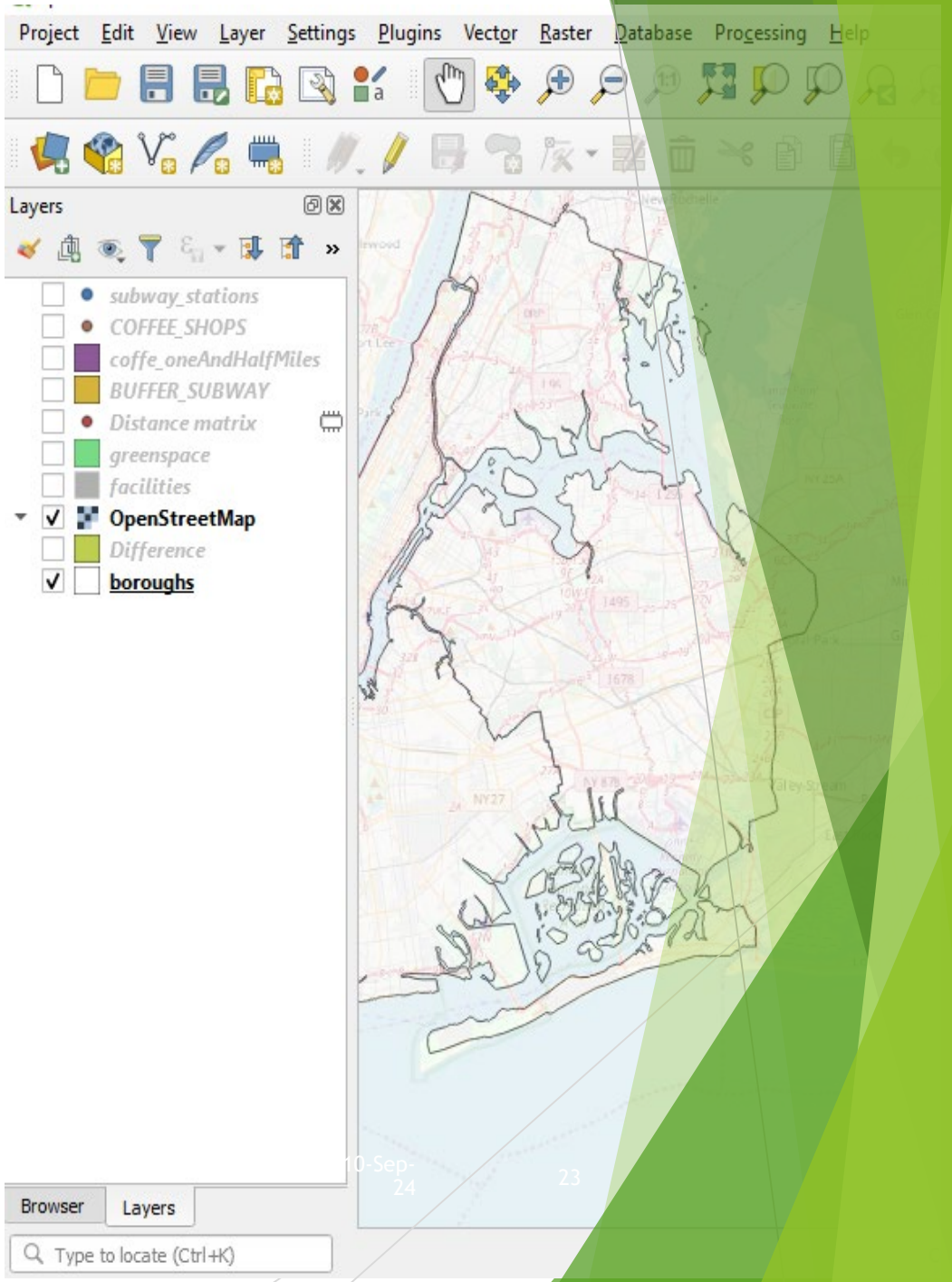
Local datum



Earth-centered datum

Introduction to the GIS Software

- Data view: table of content
- Data window: displays the GIS files
- Change order of layers
- Toolbars and menus
  - Zoom
  - Attribute table visualizer
  - Highlight features
  - Queries
  - Modify geometry
  - Print Layout



Introduction to the GIS Software

- Project file relates the layers of the project
- GIS files are NOT stored directly in your project
- Project file saves data view, symbols, layer classification, layouts
- If you move the project files the link might break
- You cant change the data
  - Except: Edit mode or new GIS file

Exploring the Interface

Shape File Contents

- .shp → Geometry
- .shx → Index of the geometry
- .dbf → Attributes for features
- .prj → Plain text with projection and coordinate system
- .sbn and .sbx → spatial index of features
- .shp.xml → metadata

- Renaming is an issue!!!
  - Solution: batch renaming
  - Geopackages “gpkg”

Exploring the Map View

- Check status bar
  - Experiment with the scale
  - Check coordinate reference system (CRS) and projected reference system (PRS)
- Zoom to layer

Exploring Features

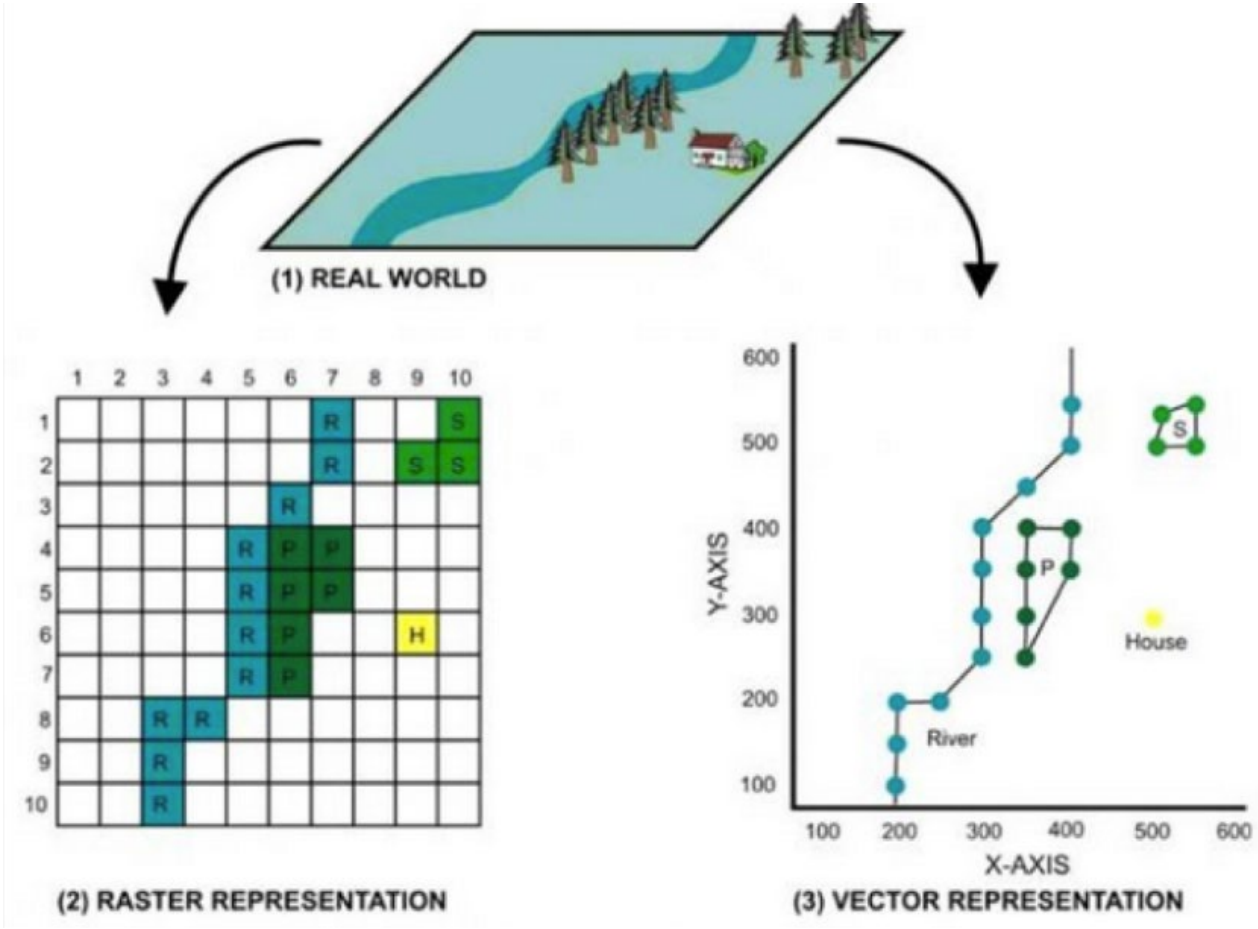
- Identify features using 
- Open attribute table of the subways
- Sort the features
- Select a feature from the map
- Select by attribute
- Clear selected Features
- Explore labels
- Deactivate labels

Adding Raster Data

- Add raster data: Admin1
- Change colour
  - Parameters: Single-band pseudo colour, spectral, inverted Change colour
- Zoom in the raster map (notice the accuracy)
- Add topographic map
- Zoom to native resolution

Saving your project

- Ensure saving with relative paths
- Save project and close
- Project file links the layers!!!



Raster VS Vector

Raster VS Vector

- Pixels - Coordinates
- Map scale
- File size
- Aesthetics
- Network analysis
- Proximity operators
- Processing time

Geographic Analysis

- create a new project from an existing one
- create a subset of a layer and process it to create land boundaries
- join an attribute table to a shapefile
- map the attributes of a shapefile
- take a list of coordinates and convert it to a shapefile
- draw buffers around a set of features
- select features based on their attributes and their spatial relationship to other features
- connect to a Web Mapping Service.

Exercise

- Areas in NYC for a neighborhood coffee shop
- Assumption: women 18-49
- High percentage of women
- Median household income not too high
- High-traffic commercial areas (near to subway stations)
- Avoid a lot of competition

What kind of data do we need?

- Neighbourhood areas of NYC
- Demographic information (Age, gender and house income)
- Location of train stations
- Location of pre-existent coffee shops

Geoprocessing shapefiles

- Add the shapefile limite_catastral_de_commun.shp to your project
- Organize the layers
  - Tracts in last position
- Deactivate layers
  - Except boundary and tracts
- Save selection as new layer: TRACTS_NYC

Preparing your data

- Use the previous project
- Save your layers
- Remove the raster files
- Zoom to fit and save

Thank you for your attention!