FACULTY OF ARTS AND PHILOSOPHY

GHENT CENTRE FOR DIGITAL HUMANITIES

# WORKSHOP QGIS

Hans Blomme | 14-11-2024

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# GEOGRAPHICAL INFORMATION SYSTEMS

- Structuring, storing, editing, managing, querying, analyzing, and visualizing (geographical) information
- Non-spatial information can be linked to spatial entities
- Various software packages, e.g. ArcGIS, QGIS...

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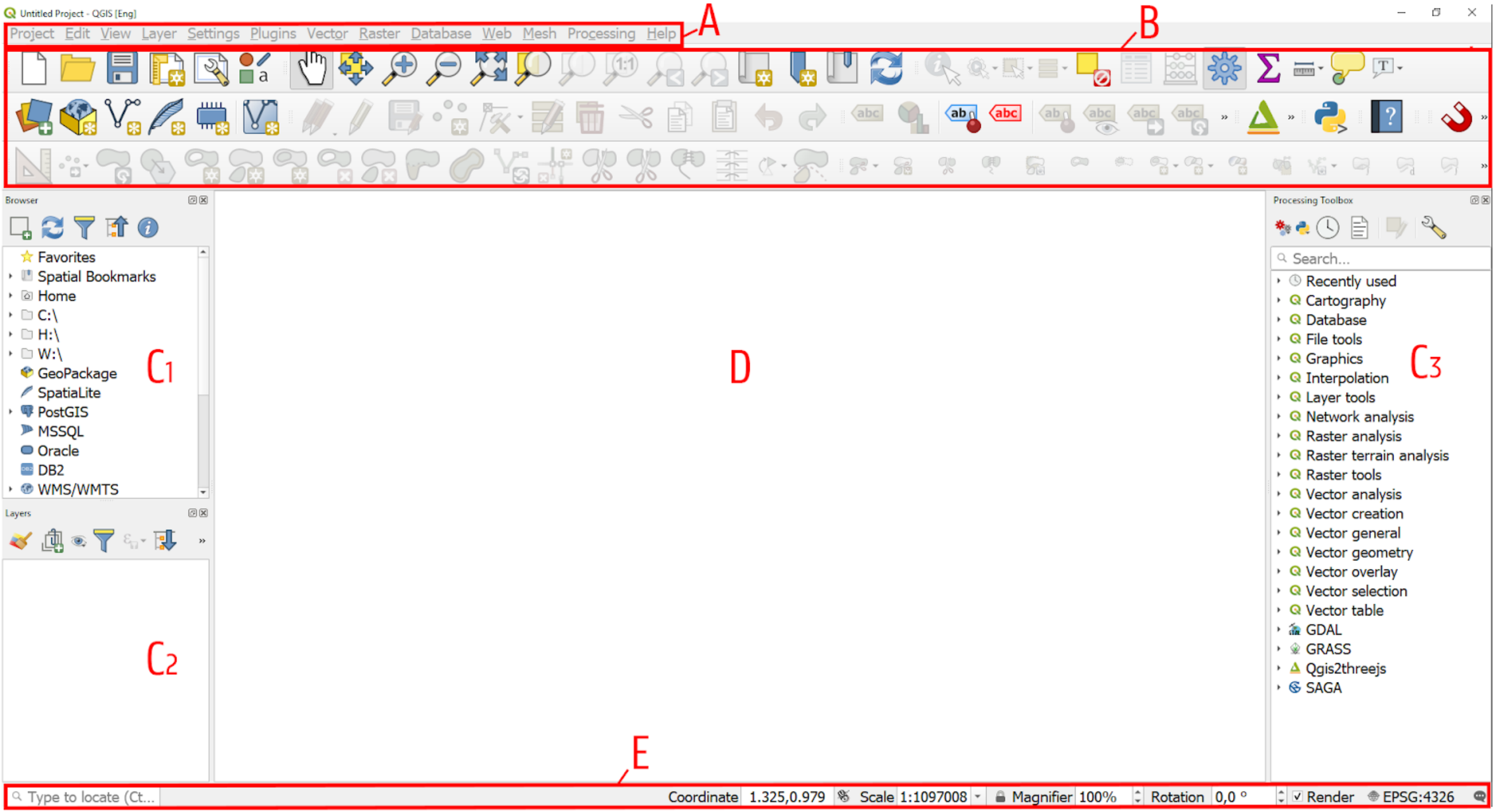
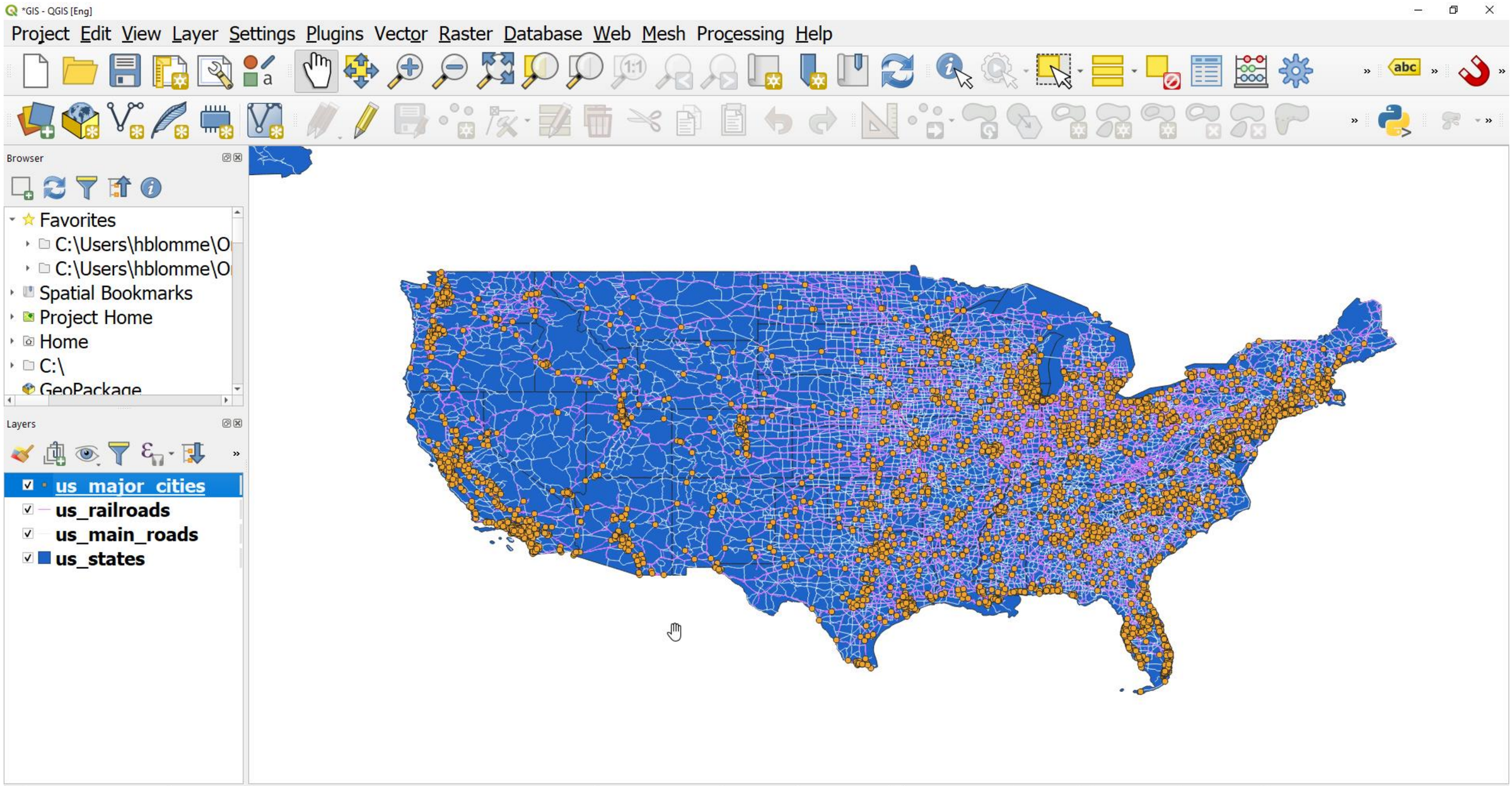
# QGIS INTERFACE

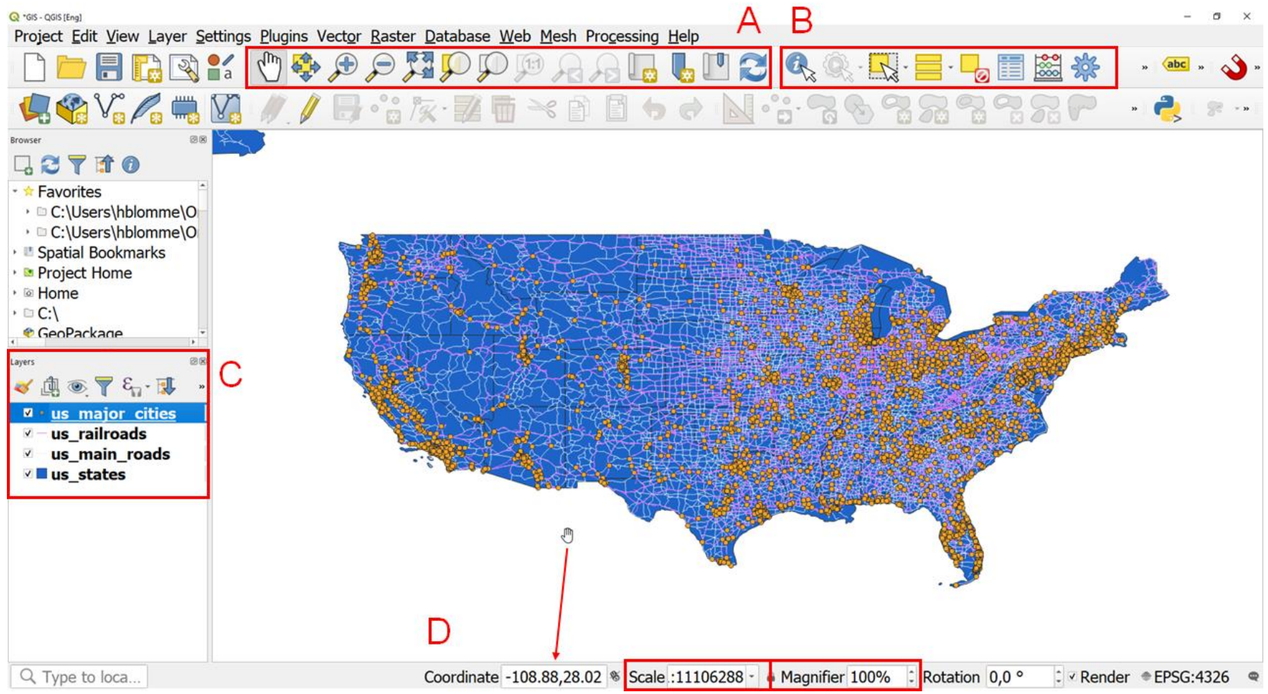


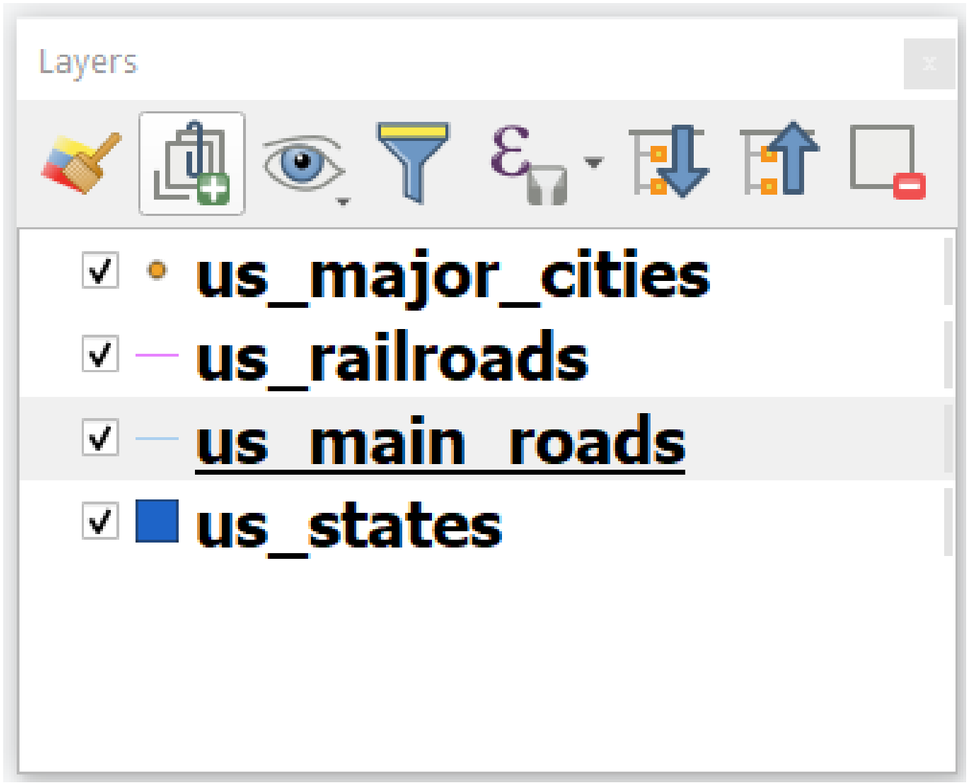
# GEOGRAPHICAL DATA IN QGIS



# MAP LAYERS

- Multiple (thematic) layers with geographical information
- Geodata = data with a spatial component =coordinates
  - Spatial data models (raster vs vector)
  - Different data sources

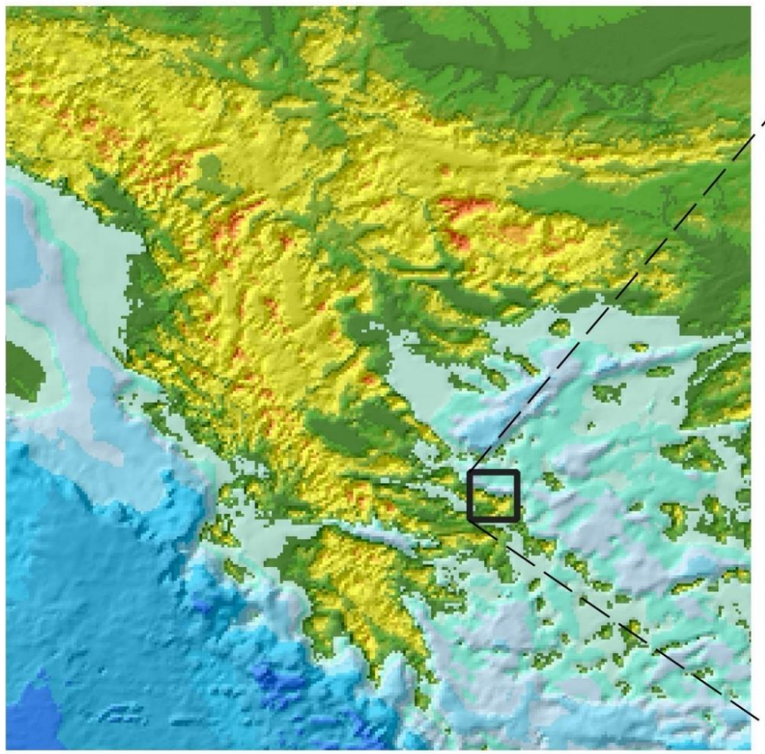


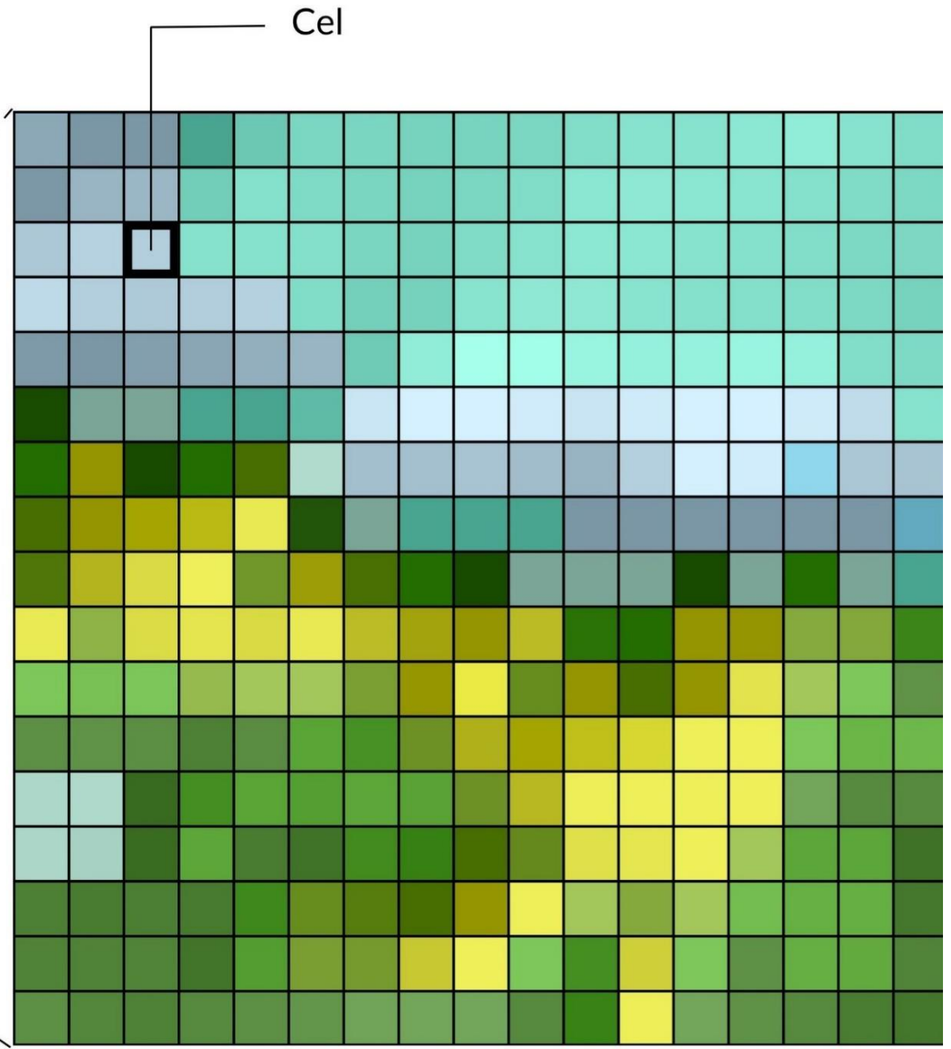




C

# RASTER DATA (1/3)

- Regular grid of pixels/cells
- Spatial resolution
- TIF(F), JP(E)G, PNG…



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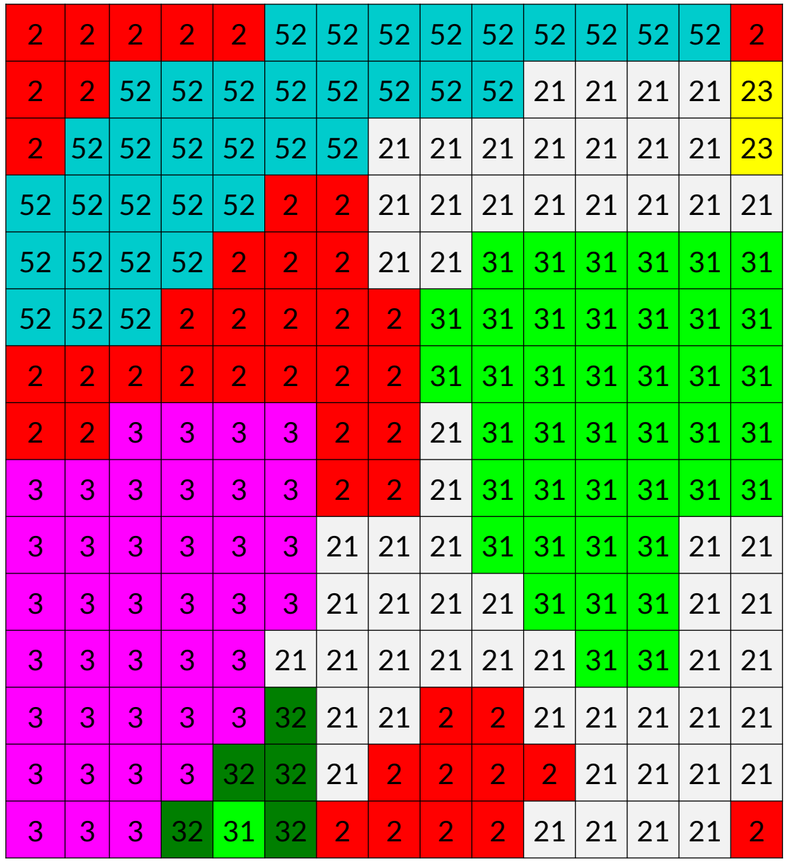
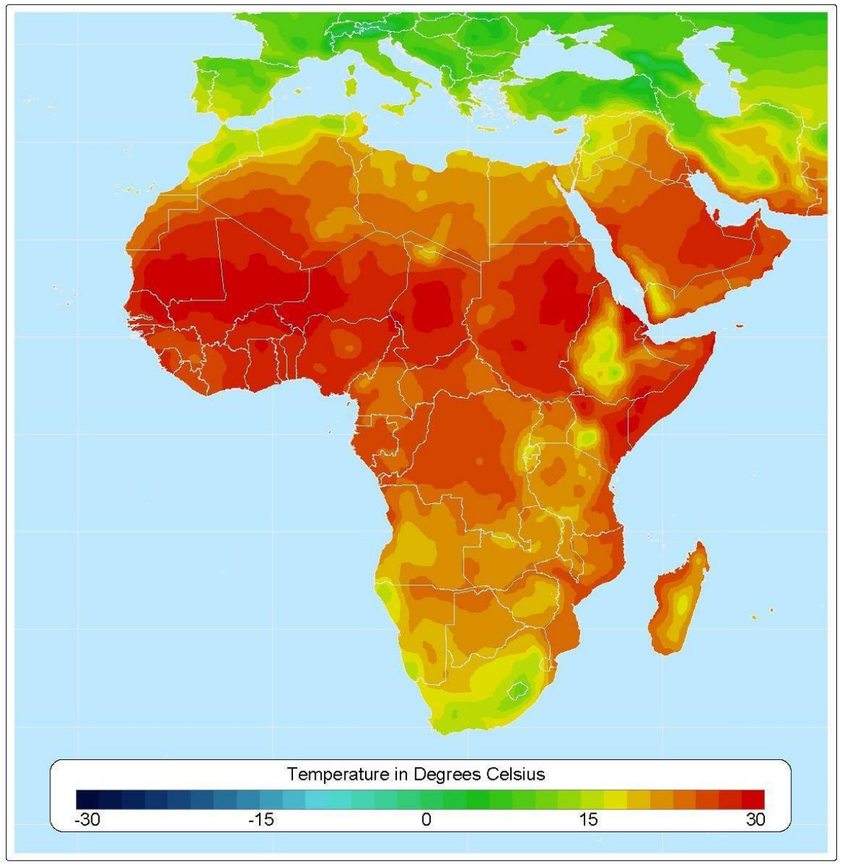
# RASTER DATA (2/3)

– 1 numeric value / image band

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 2 | 2 | 2 | 2 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 2 |
| 2 | 2 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 21 | 21 | 21 | 21 | 23 |
| 2 | 52 | 52 | 52 | 52 | 52 | 52 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 23 |
| 52 | 52 | 52 | 52 | 52 | 2 | 2 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 |
| 52 | 52 | 52 | 52 | 2 | 2 | 2 | 21 | 21 | 31 | 31 | 31 | 31 | 31 | 31 |
| 52 | 52 | 52 | 2 | 2 | 2 | 2 | 2 | 31 | 31 | 31 | 31 | 31 | 31 | 31 |
| 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 31 | 31 | 31 | 31 | 31 | 31 | 31 |
| 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 21 | 31 | 31 | 31 | 31 | 31 | 31 |
| 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 21 | 31 | 31 | 31 | 31 | 31 | 31 |
| 3 | 3 | 3 | 3 | 3 | 3 | 21 | 21 | 21 | 31 | 31 | 31 | 31 | 21 | 21 |
| 3 | 3 | 3 | 3 | 3 | 3 | 21 | 21 | 21 | 21 | 31 | 31 | 31 | 21 | 21 |
| 3 | 3 | 3 | 3 | 3 | 21 | 21 | 21 | 21 | 21 | 21 | 31 | 31 | 21 | 21 |
| 3 | 3 | 3 | 3 | 3 | 32 | 21 | 21 | 2 | 2 | 21 | 21 | 21 | 21 | 21 |
| 3 | 3 | 3 | 3 | 32 | 32 | 21 | 2 | 2 | 2 | 2 | 21 | 21 | 21 | 21 |
| 3 | 3 | 3 | 32 | 31 | 32 | 2 | 2 | 2 | 2 | 21 | 21 | 21 | 21 | 2 |

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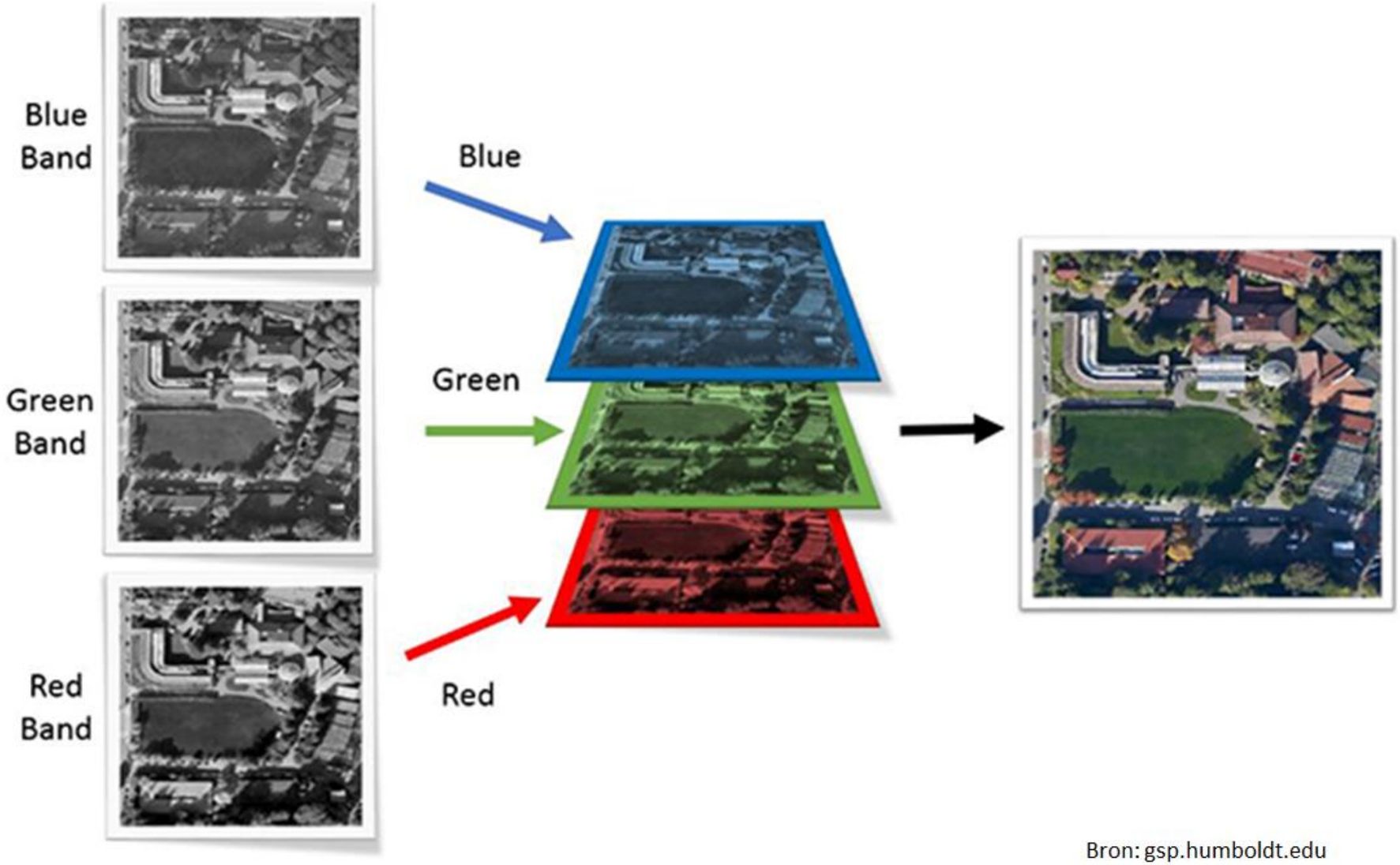
# RASTER DATA (3/3)

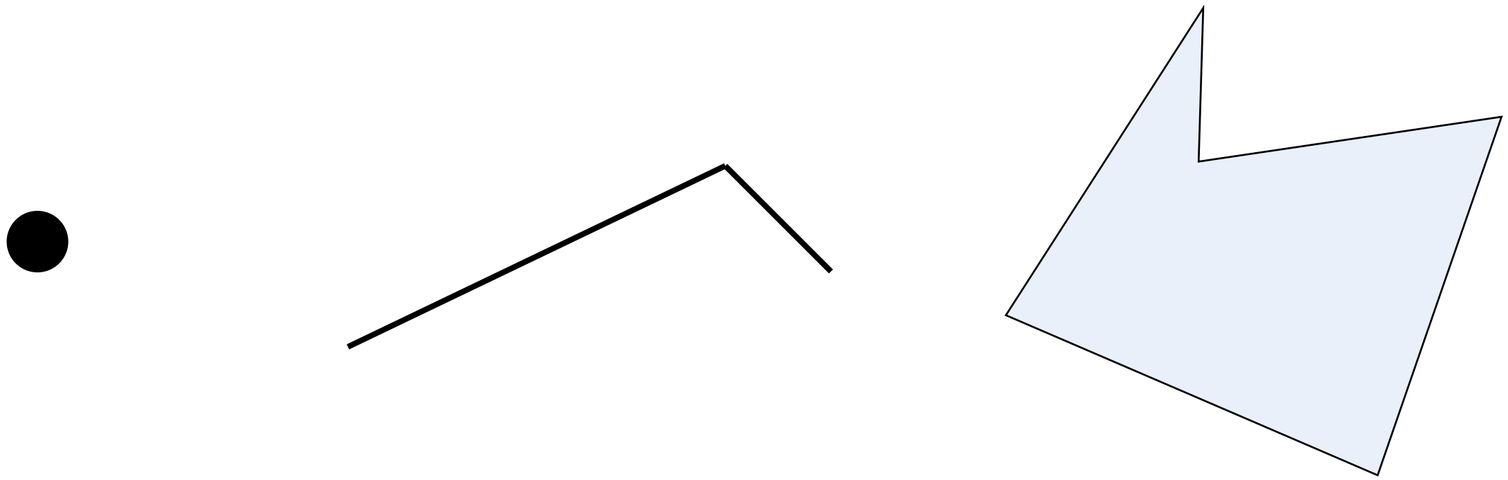
– Single band vs multiband




Bron: gsp.humboldt.edu

# VECTOR DATA (1/4)

- Data are mathematical objects:
  - Points
  - Lines
  - Polygons



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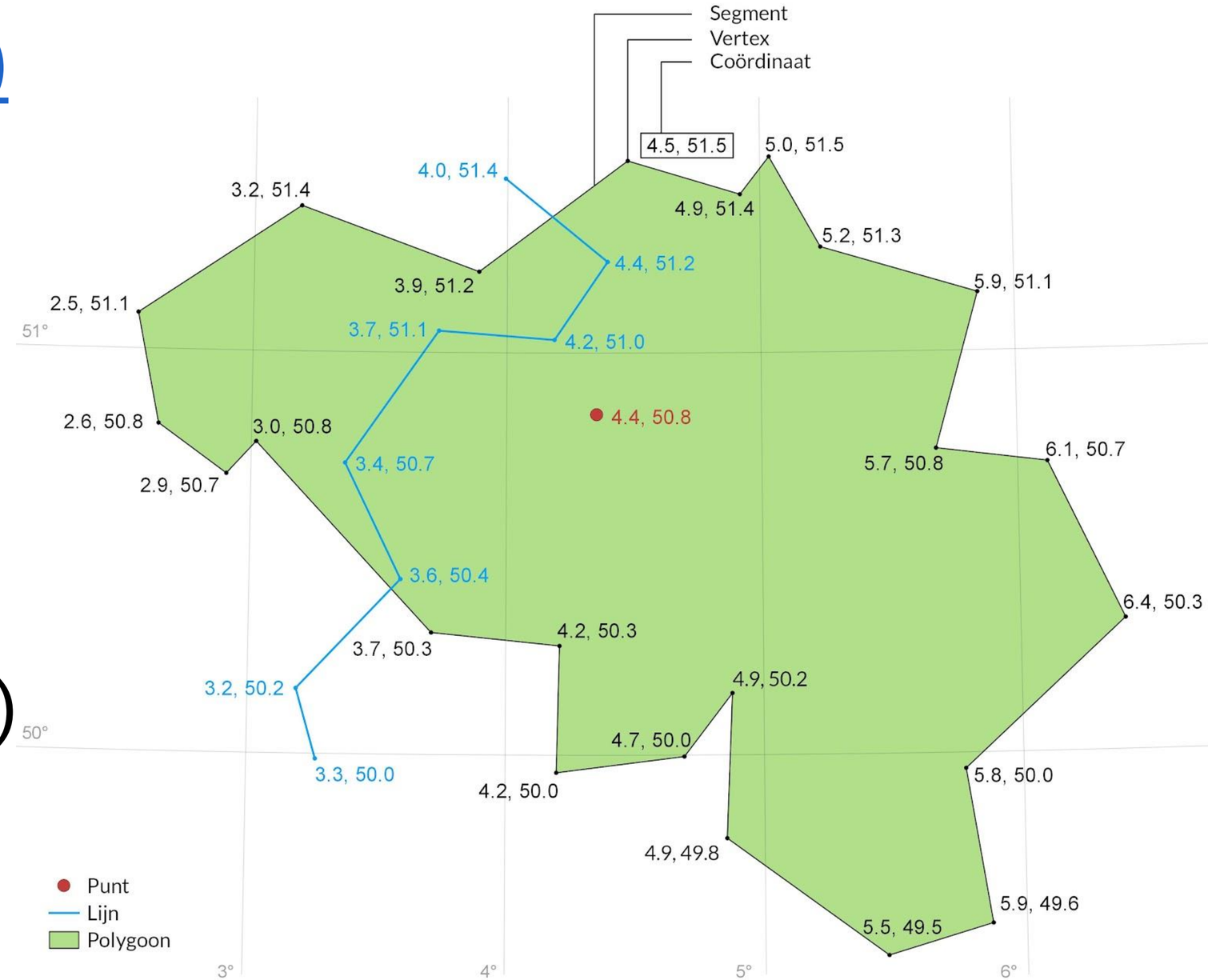
# VECTOR DATA (2/4)

- These objects are spatially defined by coordinates
- These coordinates consist of 2 values:
  - Longitude (x-value)
  - Latitude (y-value)

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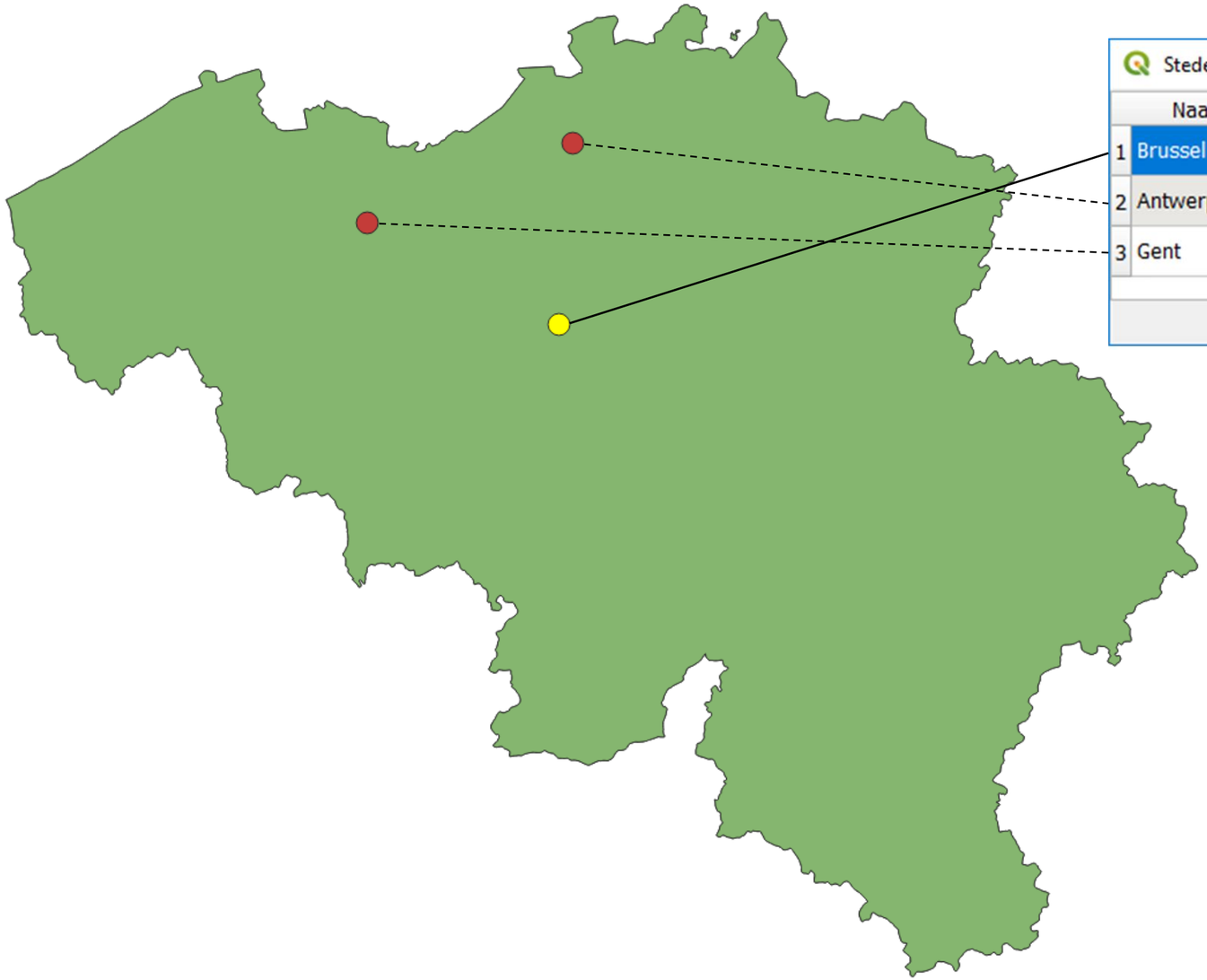
# VECTOR DATA (3/4)

– Multiple attributes possible for each object



Steden :: Features Total: 3, Filtered: 3, Selected: 1

| | Naam | Inwoners | Opp in km2 | Gewest |
|---|---|---|---|---|
| 1 | Brussel | 182000 | 32,6099... | Brussels Hoofdstedelijk Gewest |
| 2 | Antwerpen | 526000 | 204,509... | Vlaams gewest |
| 3 | Gent | 262000 | 156,180... | Vlaams gewest |

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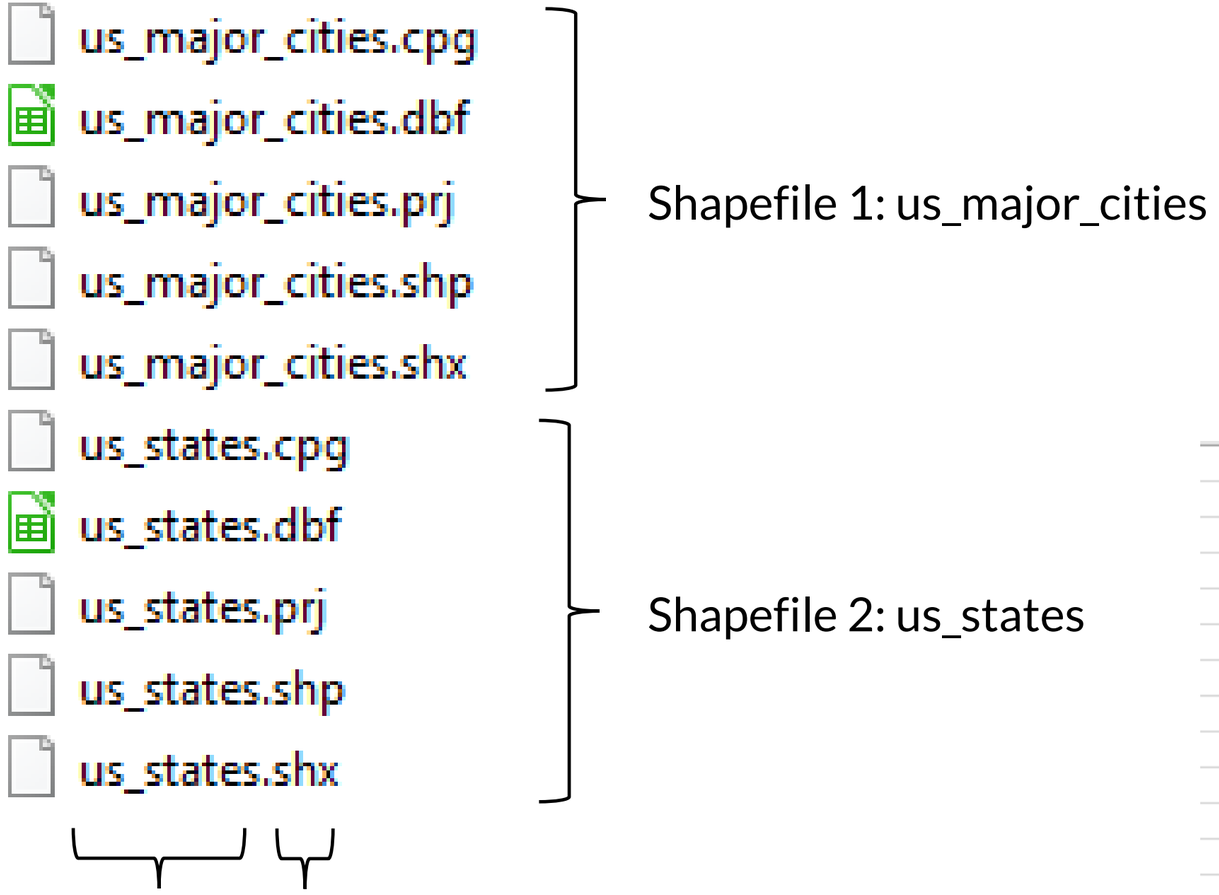
# VECTOR DATA (4/4)

- Multiple formats
- Shapefile




```geojson
{
  "type": "Feature",
  "properties": {
    "name": "Flemish Diamond",
    "area": 2947
  },
  "geometry": {
    "type": "Polygon",
    "coordinates": [
      [
        [3.55, 51.08],
        [4.36, 50.73],
        [4.84, 50.85],
        [4.45, 51.30],
        [3.55, 51.08]
      ]
    ]
  }
}
```

| SpatialLocation |
| --- |
| POINT (1871427.98982823 5715934.85121039), POINT (1871398.87774672 571 |
| POLYGON ((1867375.0352999996 5713908.8962, 1867336.0141000003 5713899 |
| POLYGON ((1870308.8731000004 5713538.1421, 1870284.051 5713516.3827, 18 |
| POINT (1869943 5712928), POLYGON ((1869942.58385879 5712942.2441537, 1 |
| POLYGON ((1838476.84789884 5687993.76778652, 1838469.14305032 5687961 |
| POLYGON ((1845296.0232999995 5743338.0379, 1845265.1827999996 5743295 |
| POINT (1885584.04019775 5725586.80404679), POLYGON ((1885668.32589827 |
| POLYGON ((1839594.57062493 5682788.03998412, 1839583.98204807 5682797 |
| POLYGON ((1837020.29948424 5685696.94562652, 1837033.9053094 5685663.6 |
| POLYGON ((1869833.36958009 5713280.6899985, 1869809.27094626 5713249.5 |
| POINT (1871185.29368715 5716530.21168081), POLYGON ((1871270.5658 5716 |
| POLYGON ((1867201.54716832 5713978.94739066, 1867207.71753994 5713954 |
| POINT (1870097.50248512 5712954.59715977), POLYGON ((1870046.70215557 |
| POINT (1870111.58999994 5713302), POLYGON ((1870101.3407238 5713308.93 |

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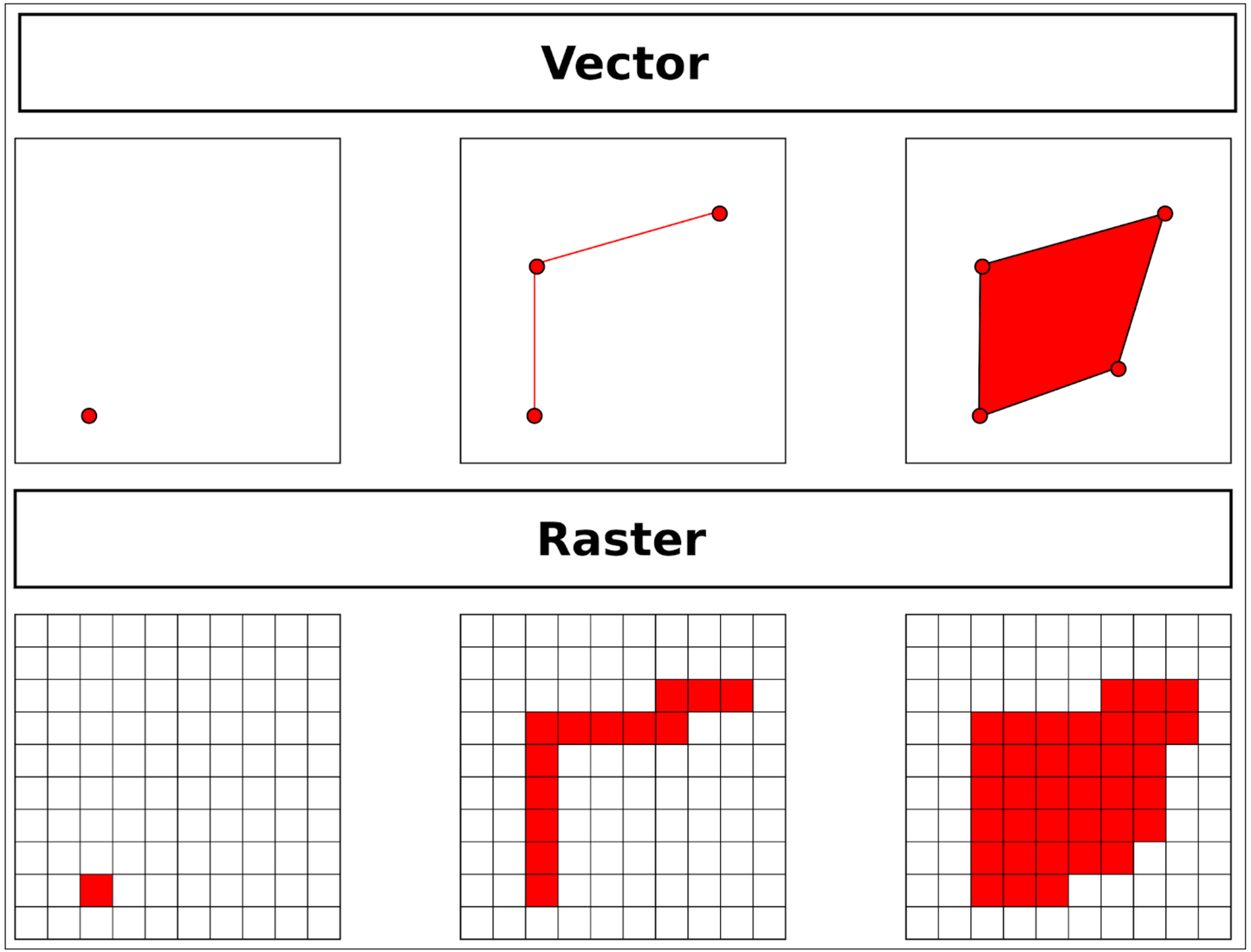
# RASTERS AND VECTORS: DIFFERENCES

- Model
- Spatial definition
- File size
- Accuracy
- Practical application
- Attributes
- Analysis

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# EXERCISE | DATASET 2

- Display only the boundaries of the dioceses. Their colors depend on the archdiocese they belong to. (Reims: orange; Cologne: purple; Trier: red)
- For each location, a pie chart is displayed to show the types of donations present in the sources. The more donations, the larger the chart.
- Provinces are colored green. The larger the province, the darker the green. They are also labeled with their name.

# QGIS PROJECT

- QGZ-file
- Contains all configurations (which data sources are loaded, how they are styled...)
- Does NOT contain the data itself

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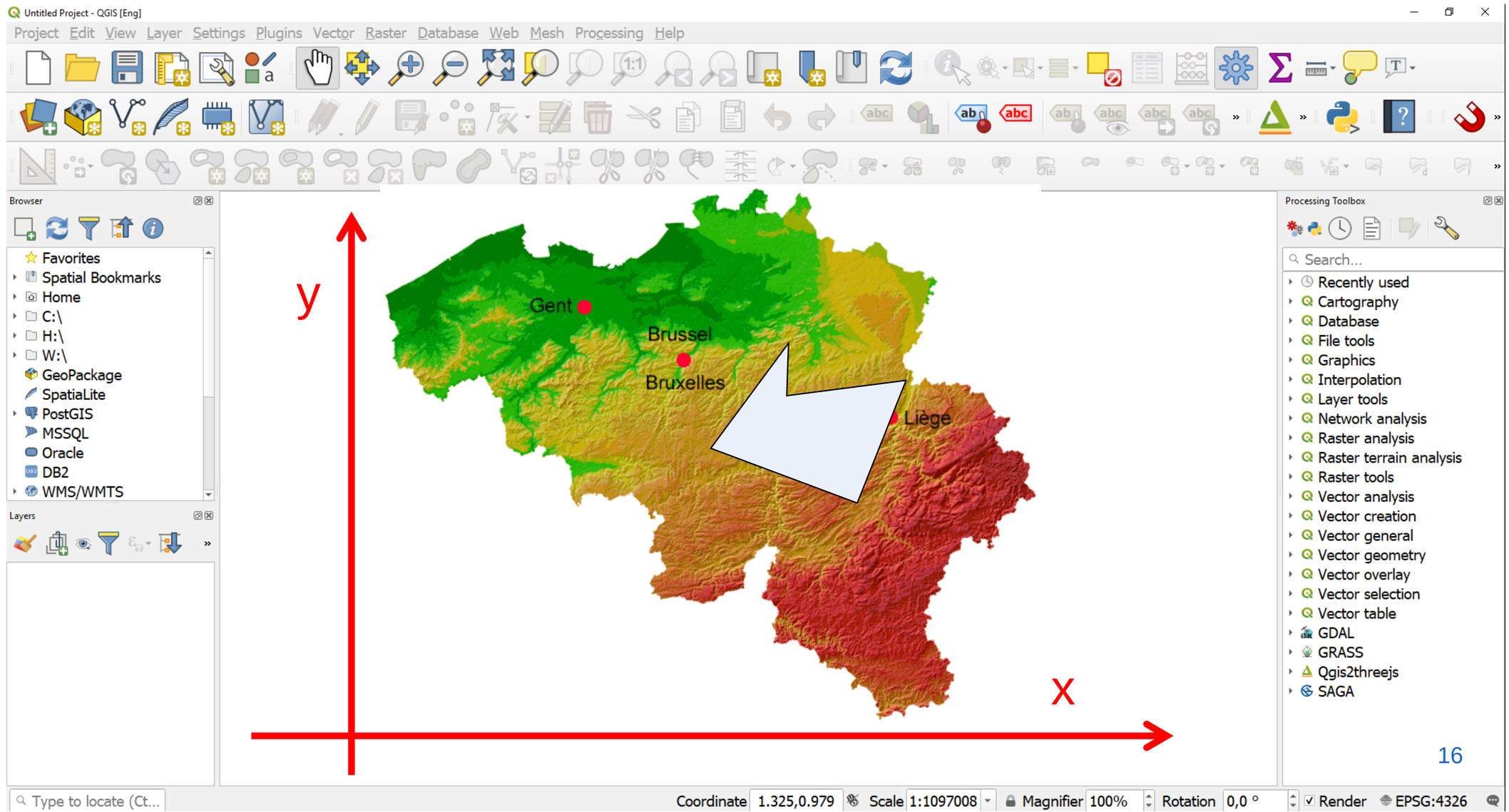
# QGIS MAP VIEWER

– Coordinate system with an (invisible) x- and y-axis.

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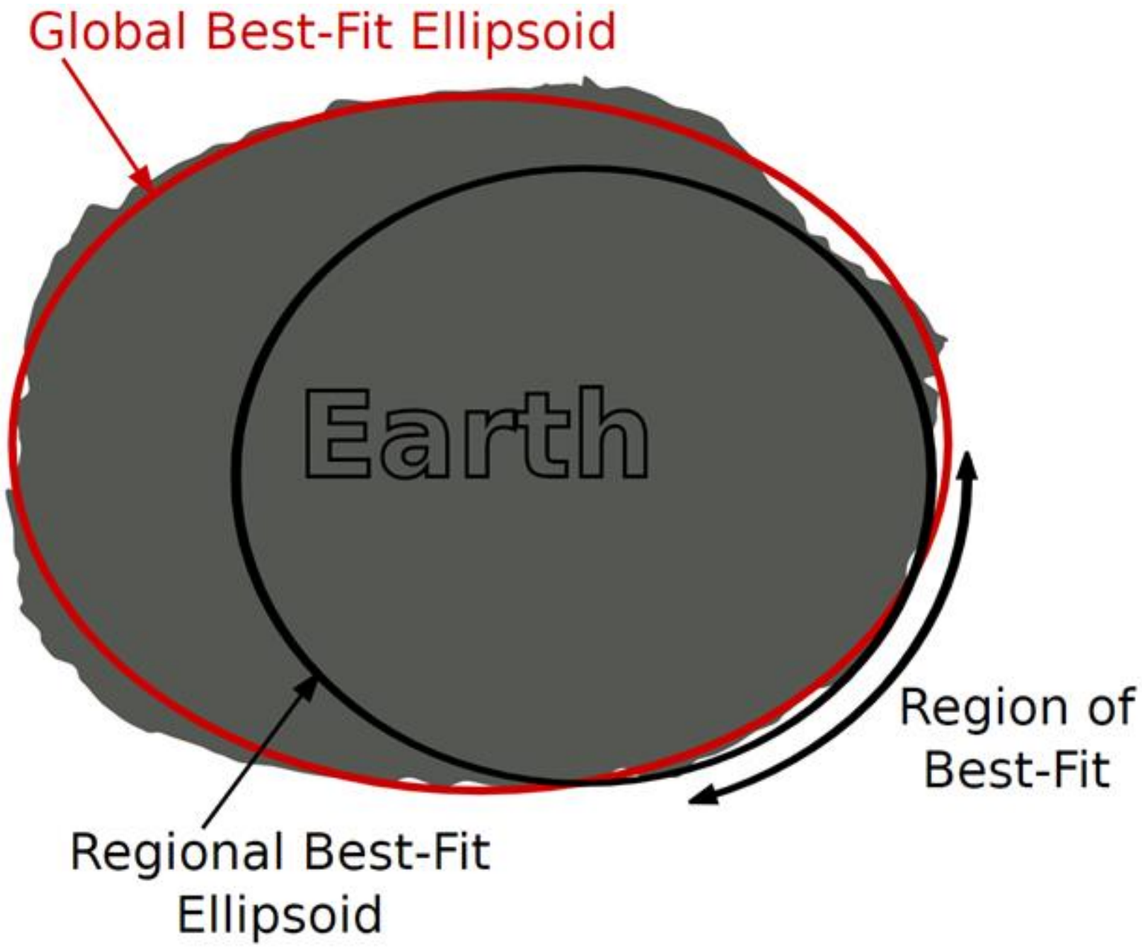
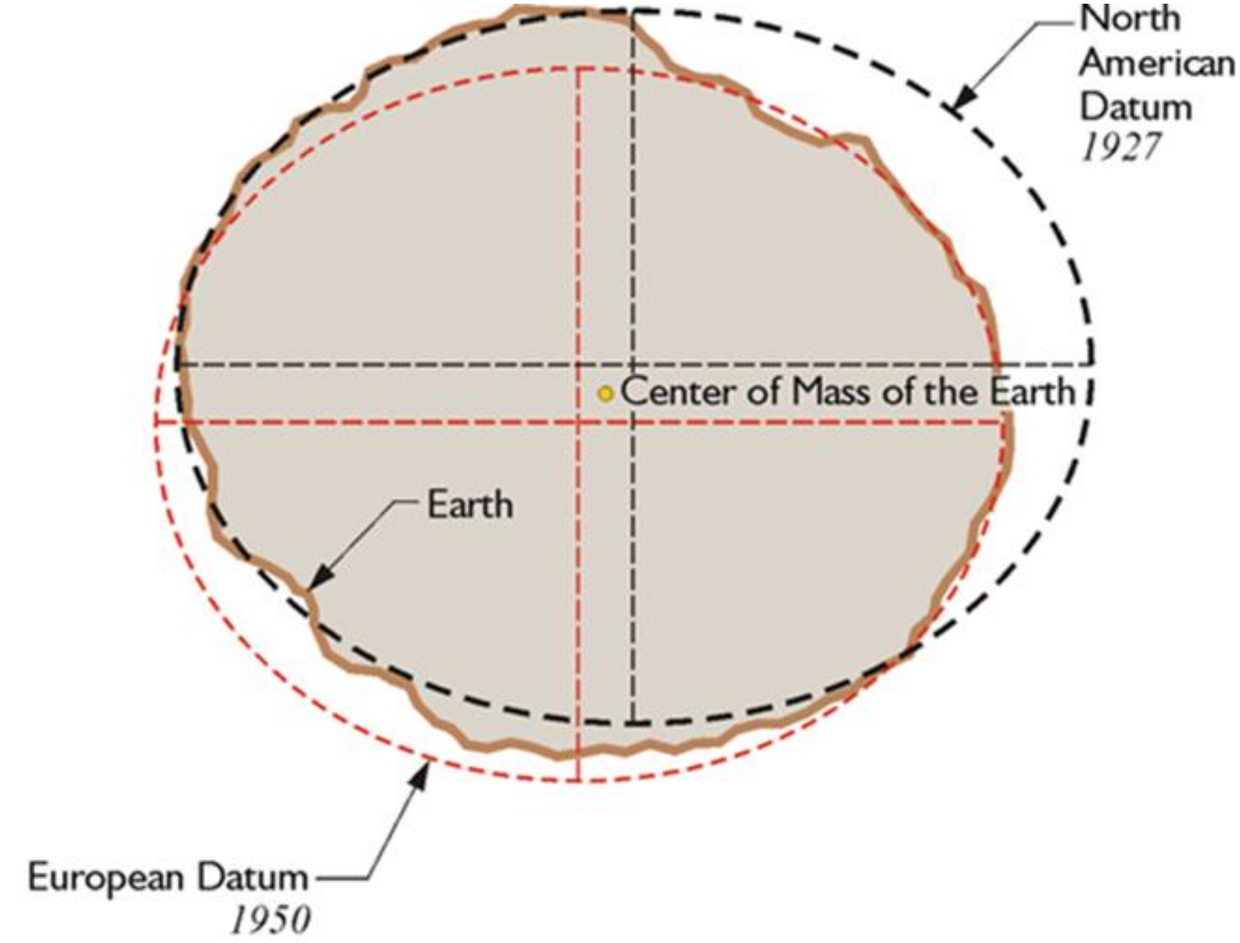
# GEOGRAPHICAL COORDINATE SYSTEMS (1/2)

- Geodetic datums

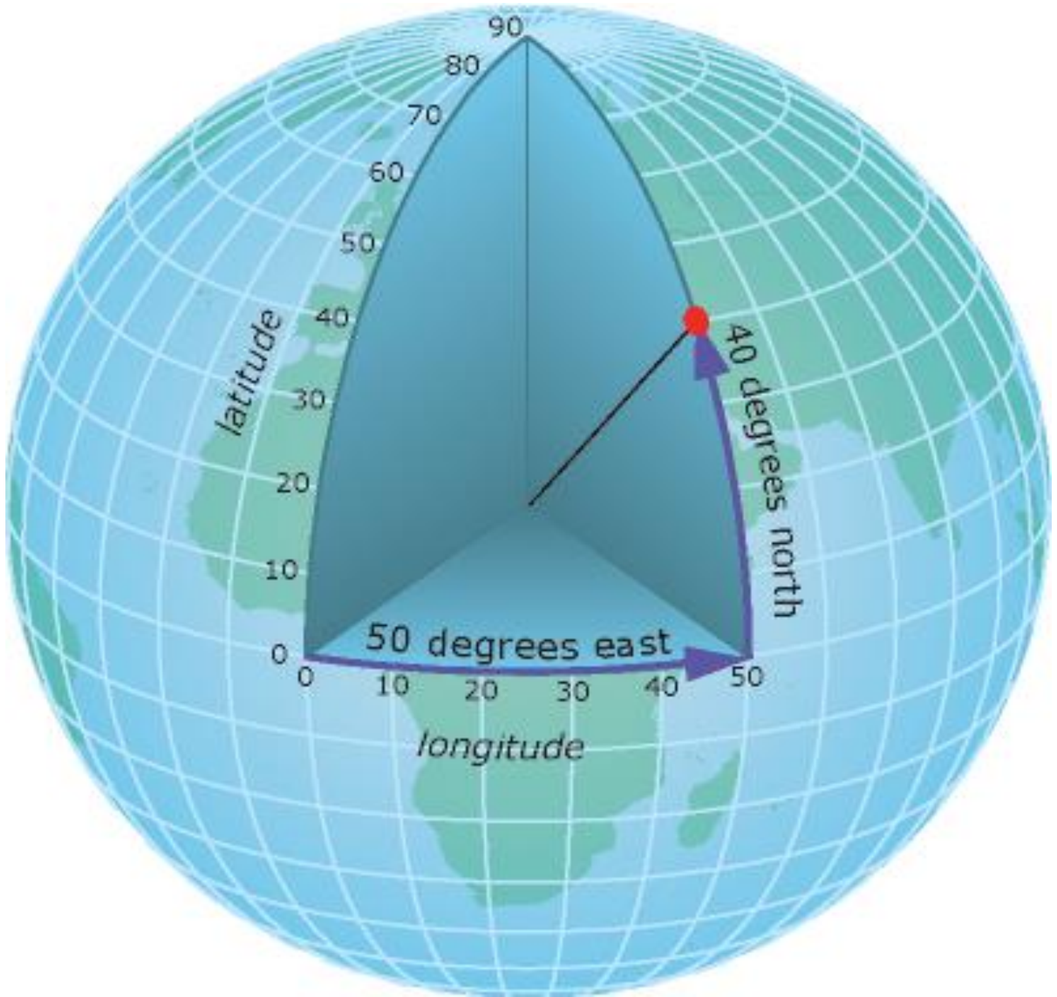



Bron: www.e-education.psu.edu

# GEOGRAPHICAL COORDINATE SYSTEMS (2/2)

- Degrees and Minutes
- E.g. Ghent: 51° 3' NB, 3° 42' OL

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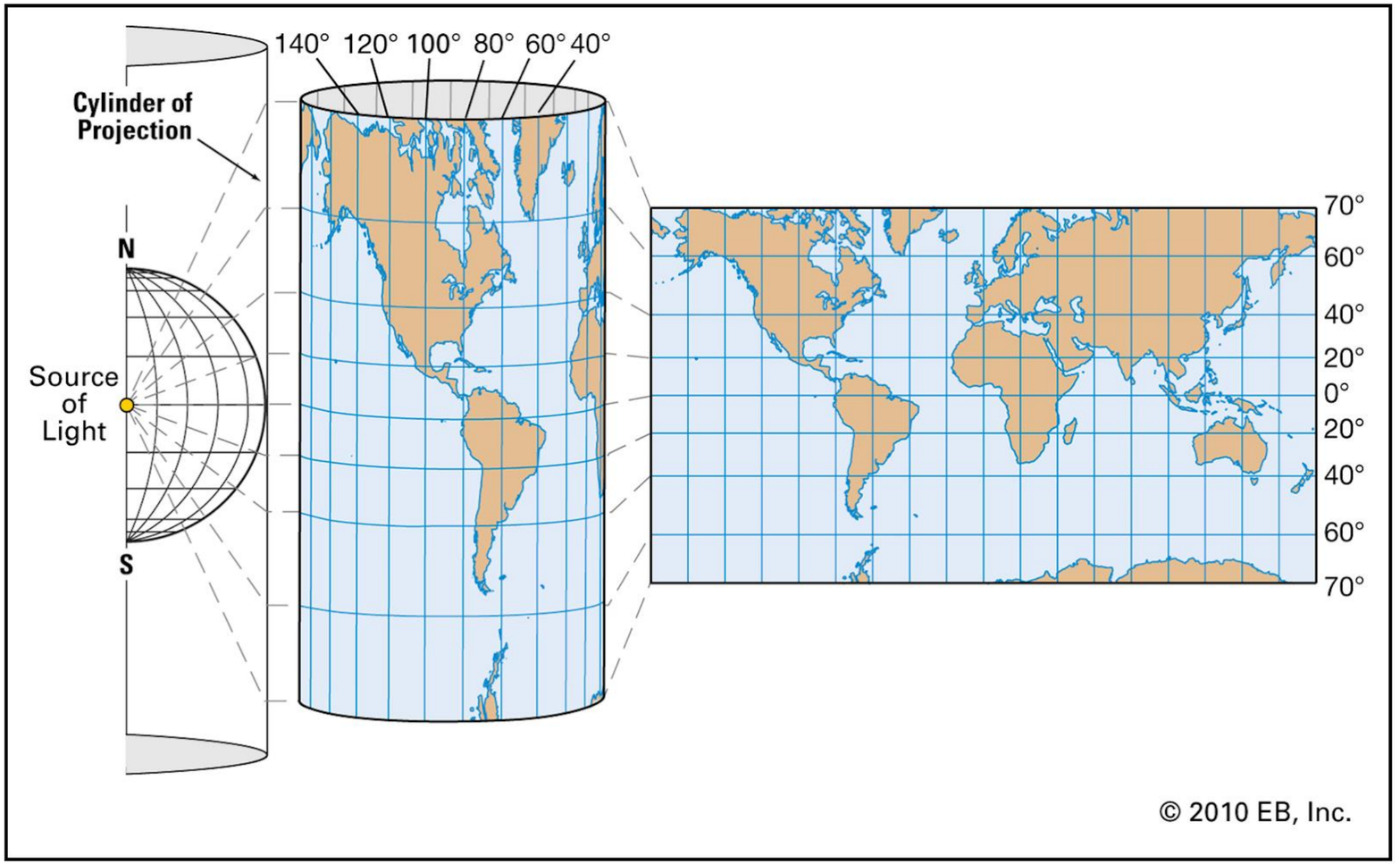
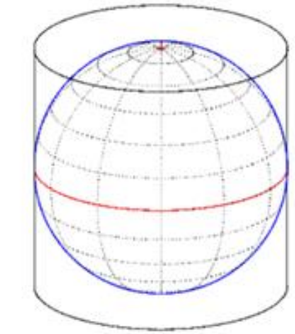
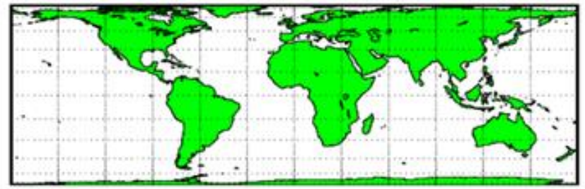
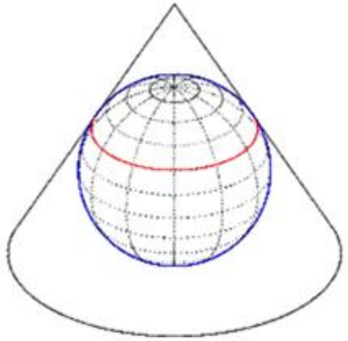
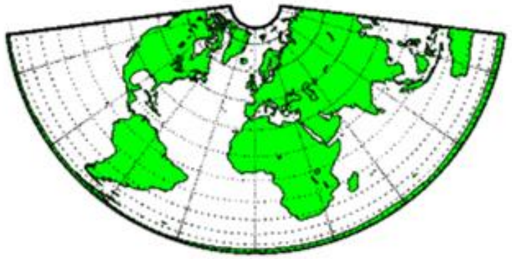
# PROJECTED COORDINATE SYSTEMS (1/5)

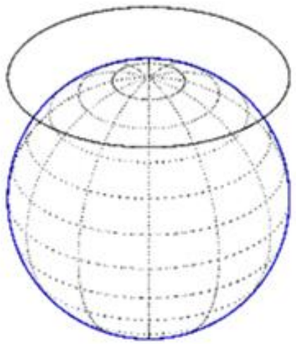


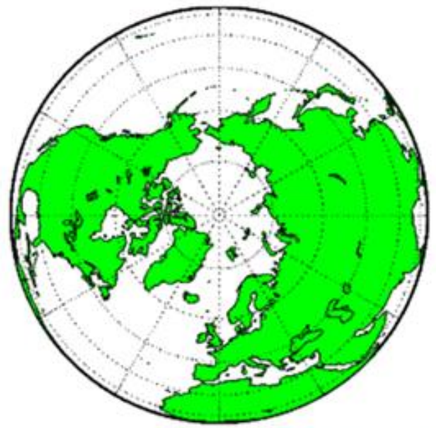













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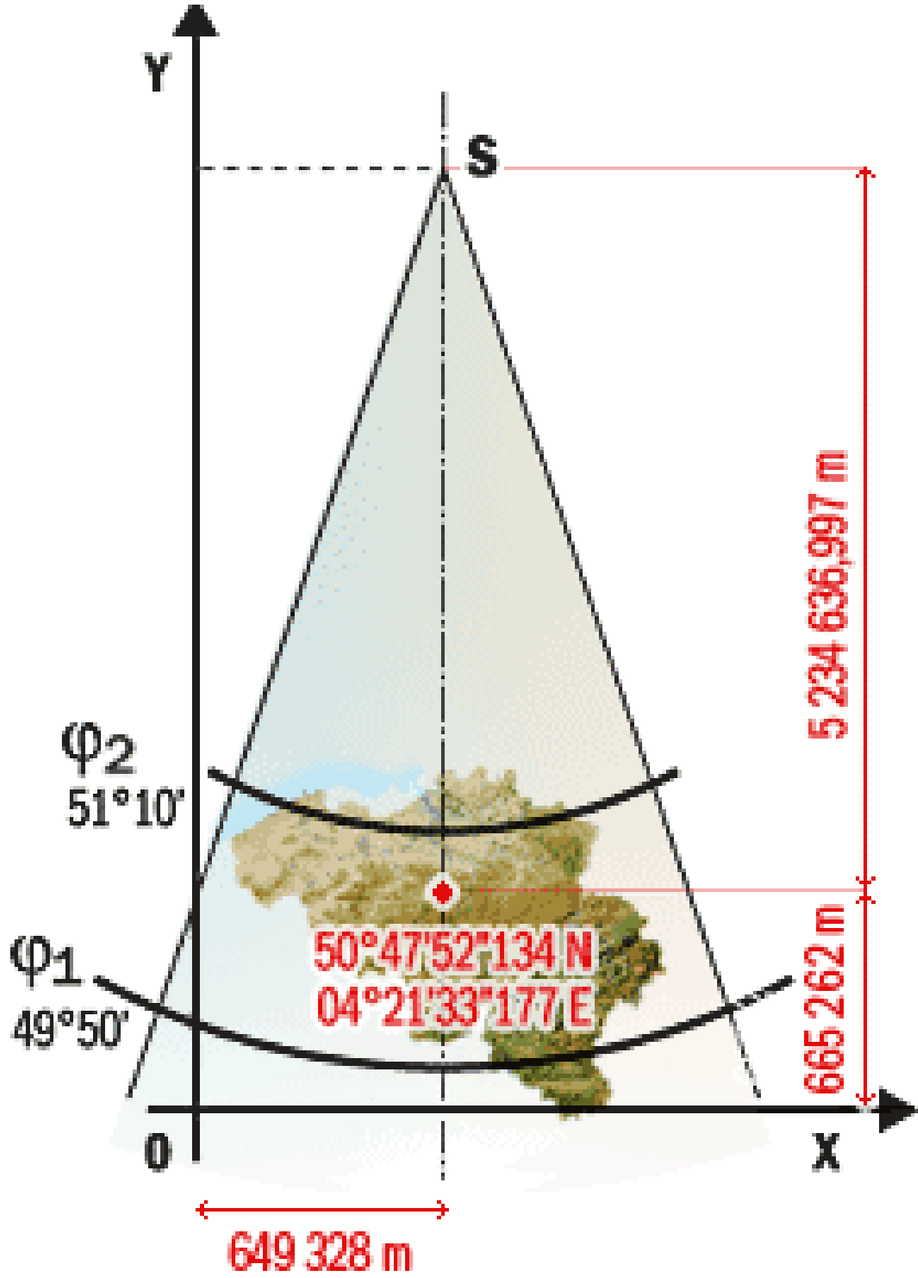
Bron: www.mathworks.com

# PROJECTED COORDINATE SYSTEMS (2/5)

- Projected units (e.g. meter)
- E.g. Ghent: 104600 m, 194000 m

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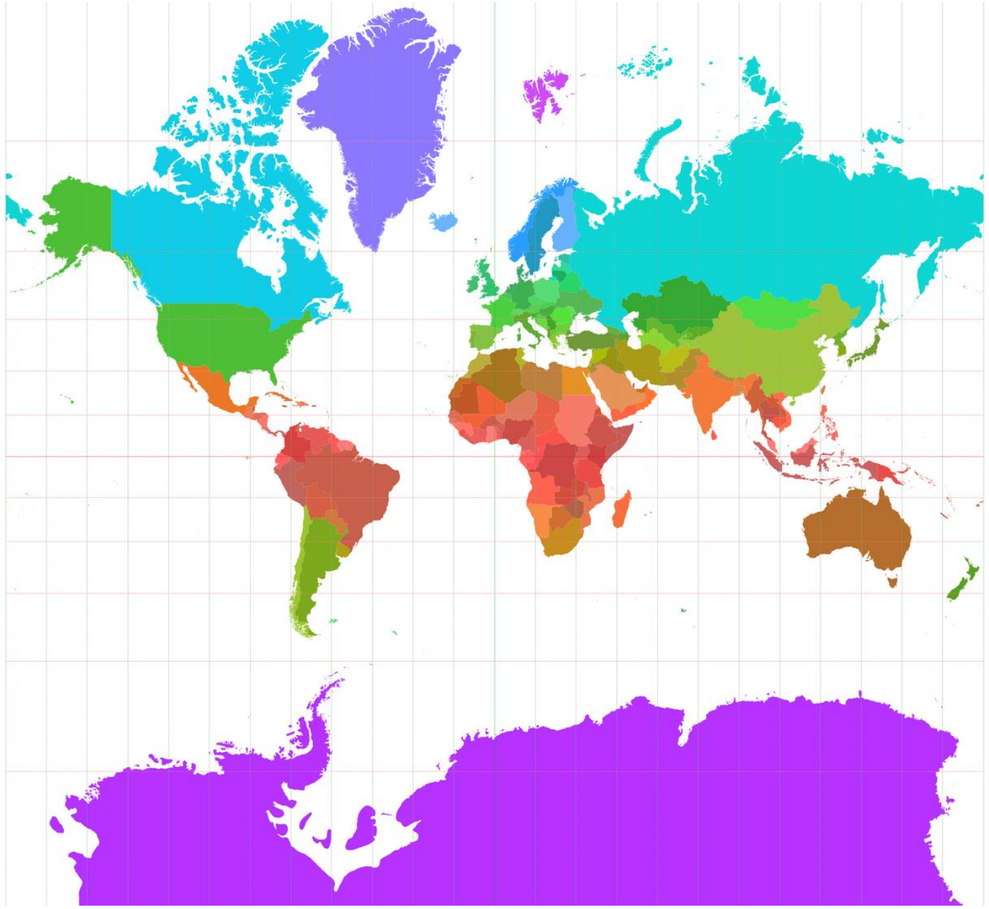
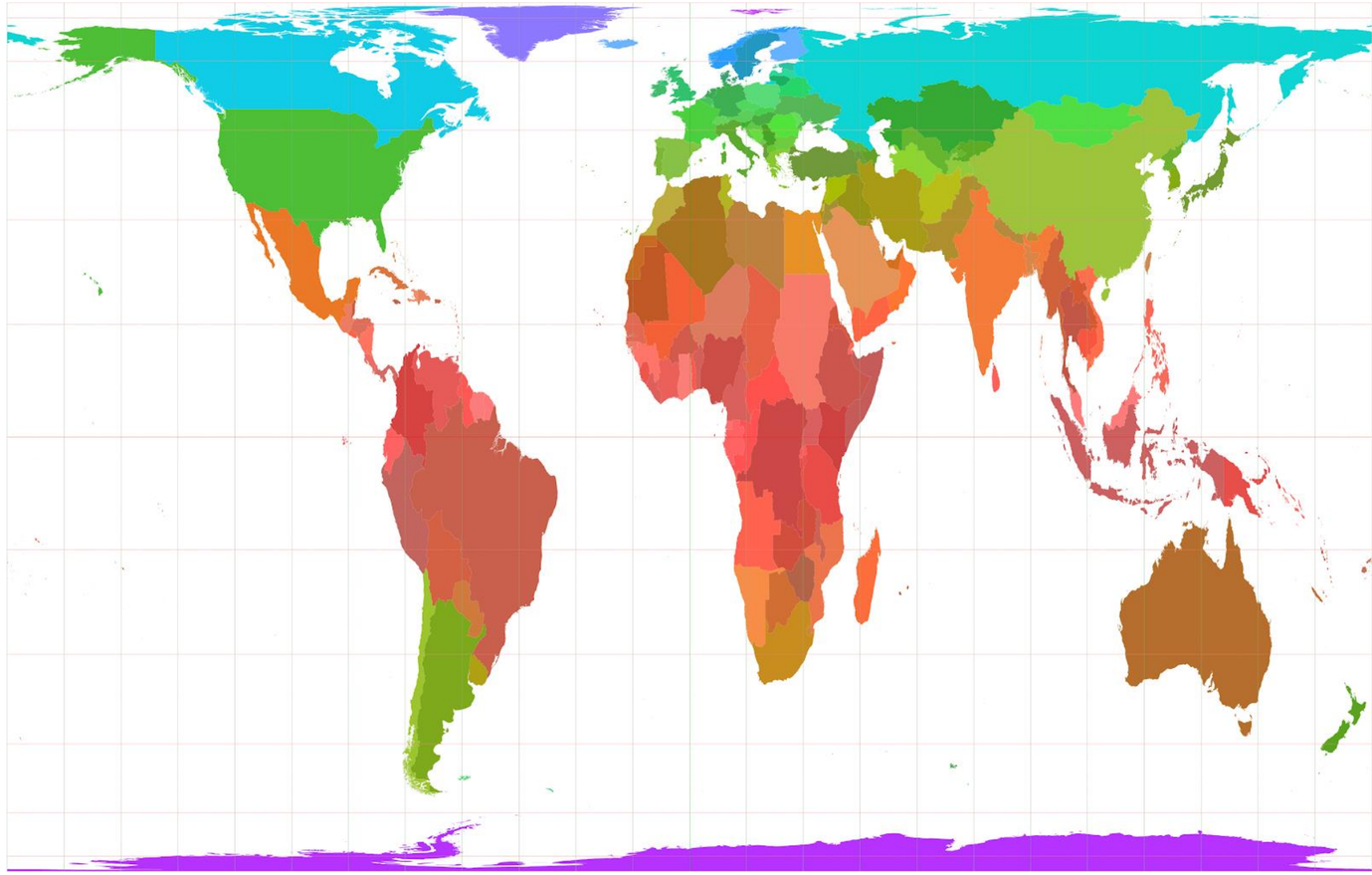
# PROJECTED COORDINATE SYSTEMS (3/5)

- Distortions



*Conformal*



*Equivalent*

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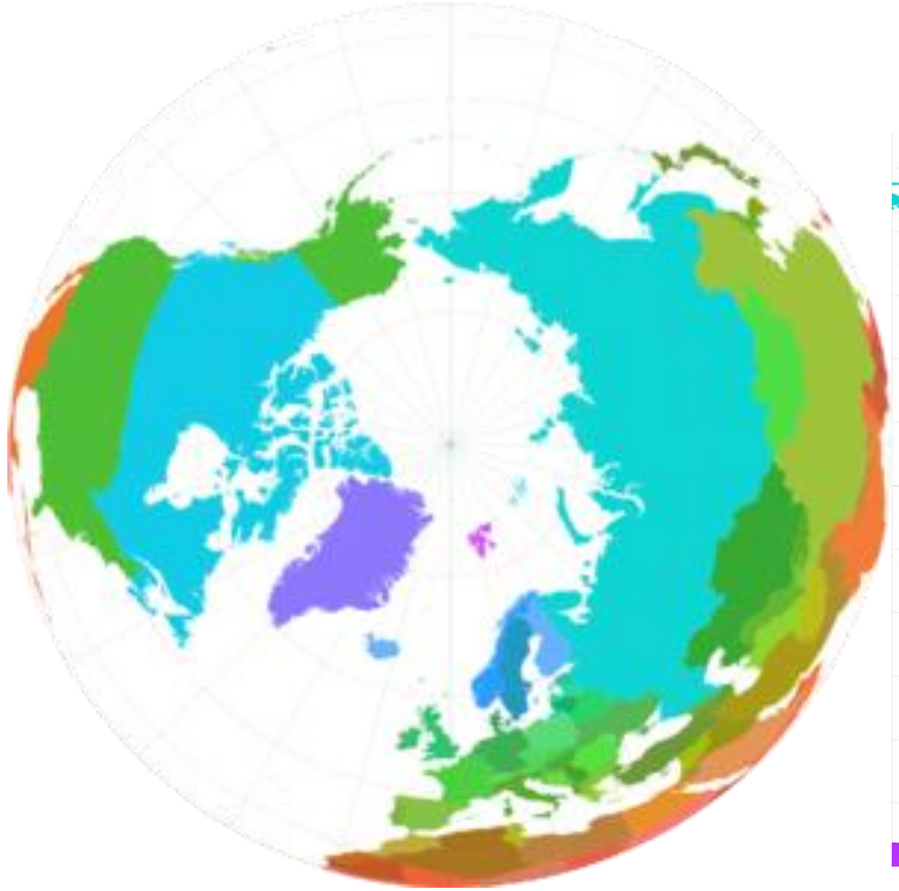
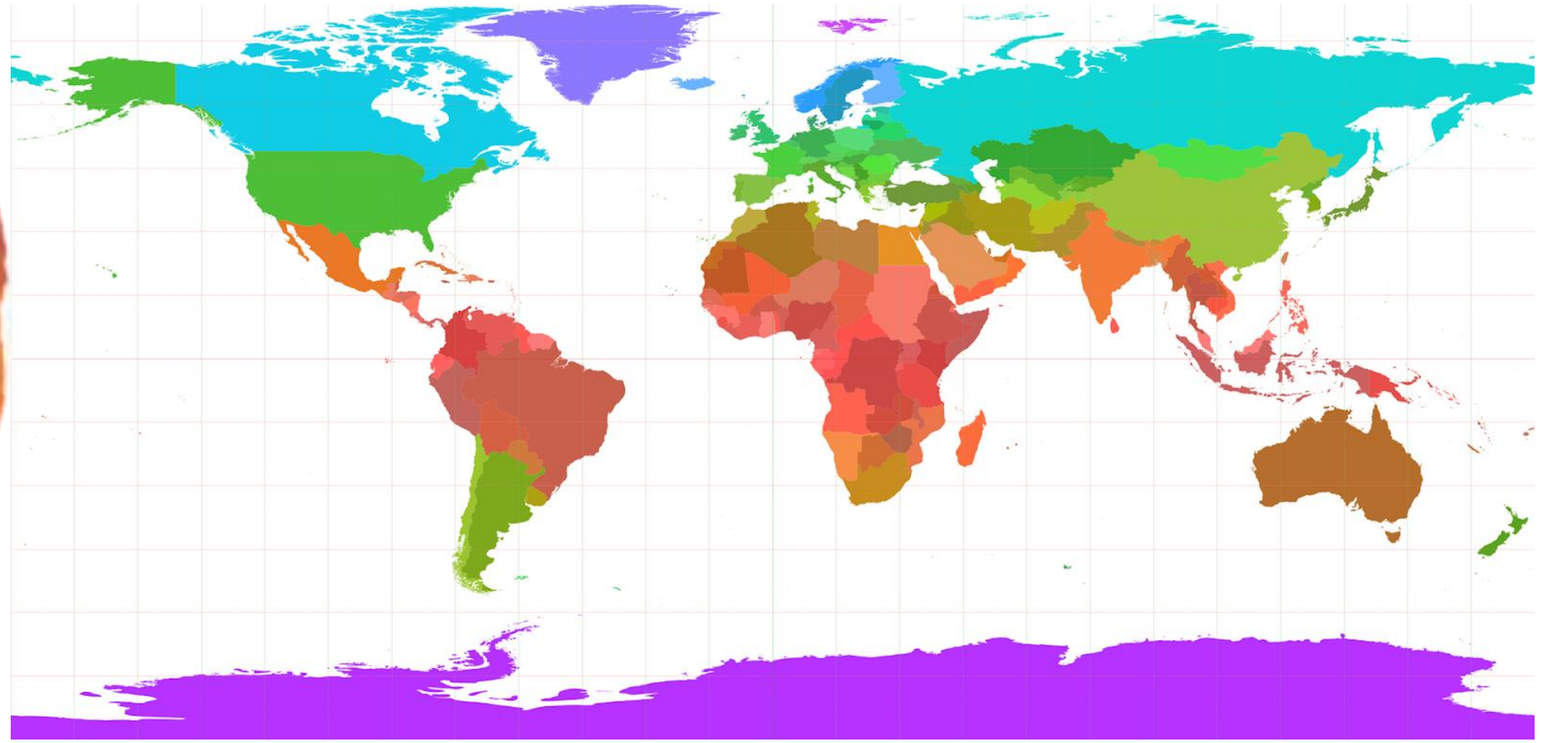
# PROJECTED COORDINATE SYSTEMS (4/5)

– Distortions



*Azimuthal*



*Equidistant*

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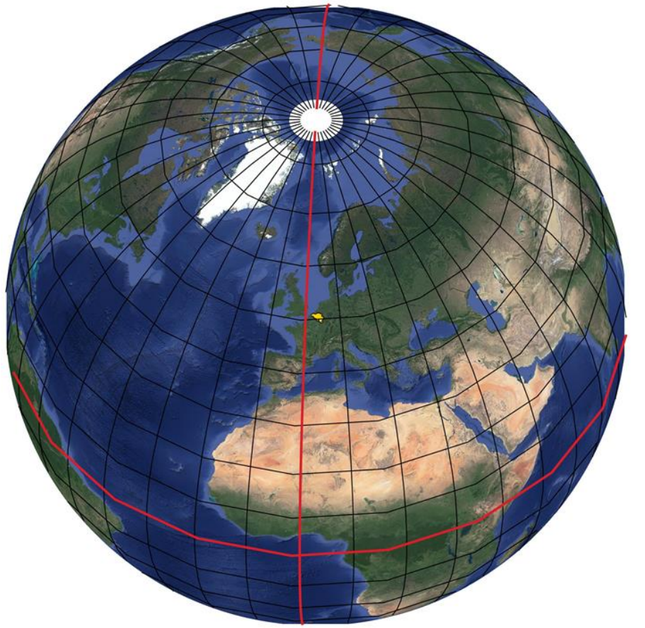
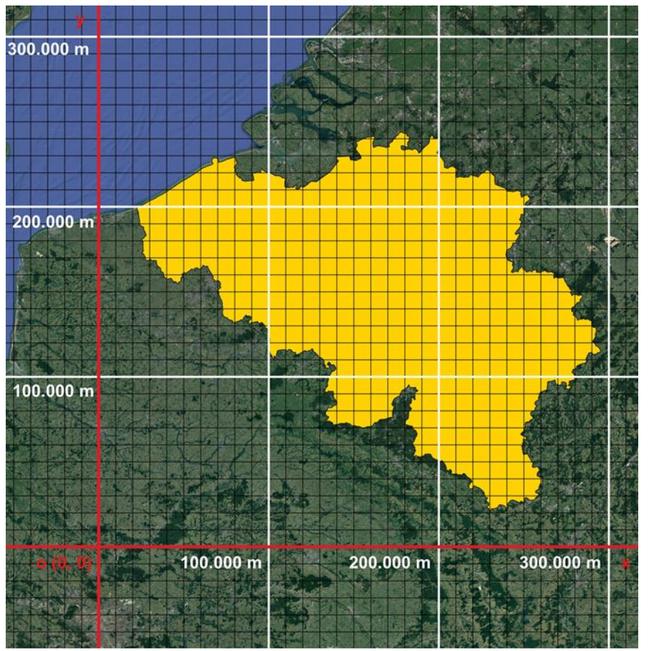
# COMMONLY USED COORDINATE SYSTEMS

- Globe
  - Geographical: WGS 84 [4326]
  - Projected: Pseudomercator [3857]
- Europe
  - Projected: ETRS89 [3035]
- Belgium:
  - Lambert 72 [31370]

➔ Depending on region and goal

(Cf. https://epsg.io/)



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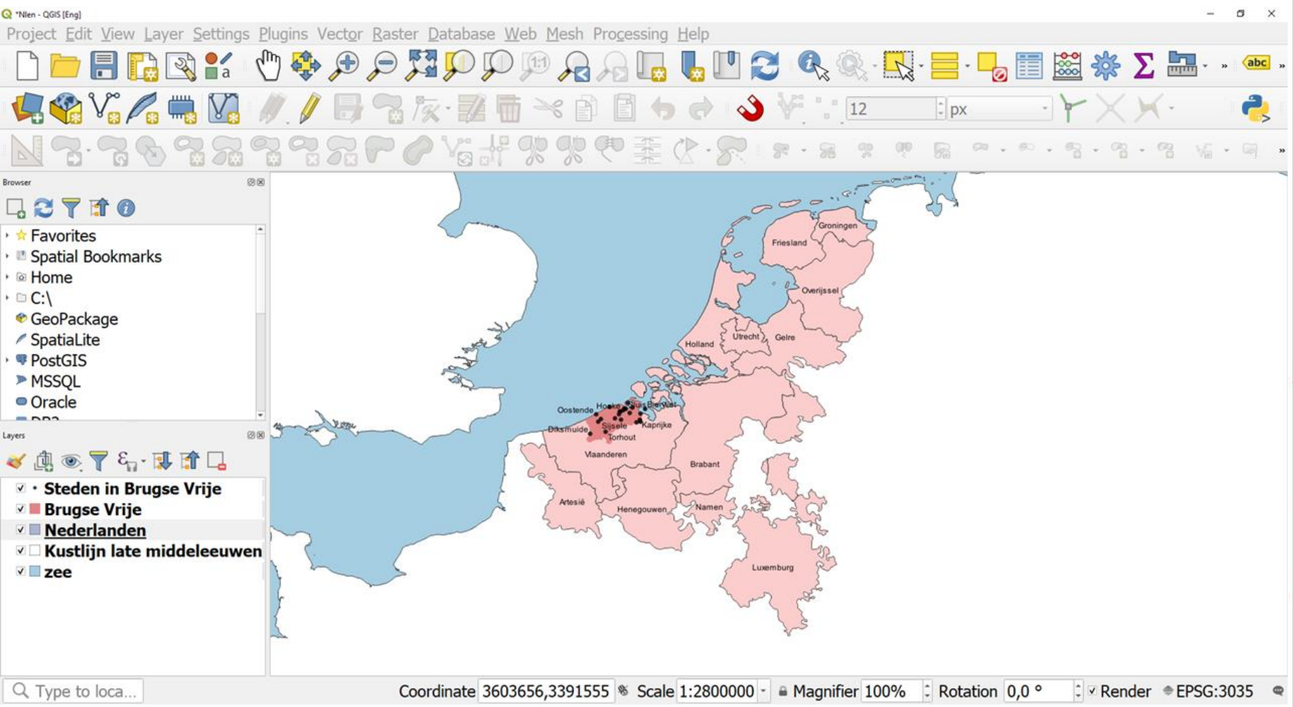
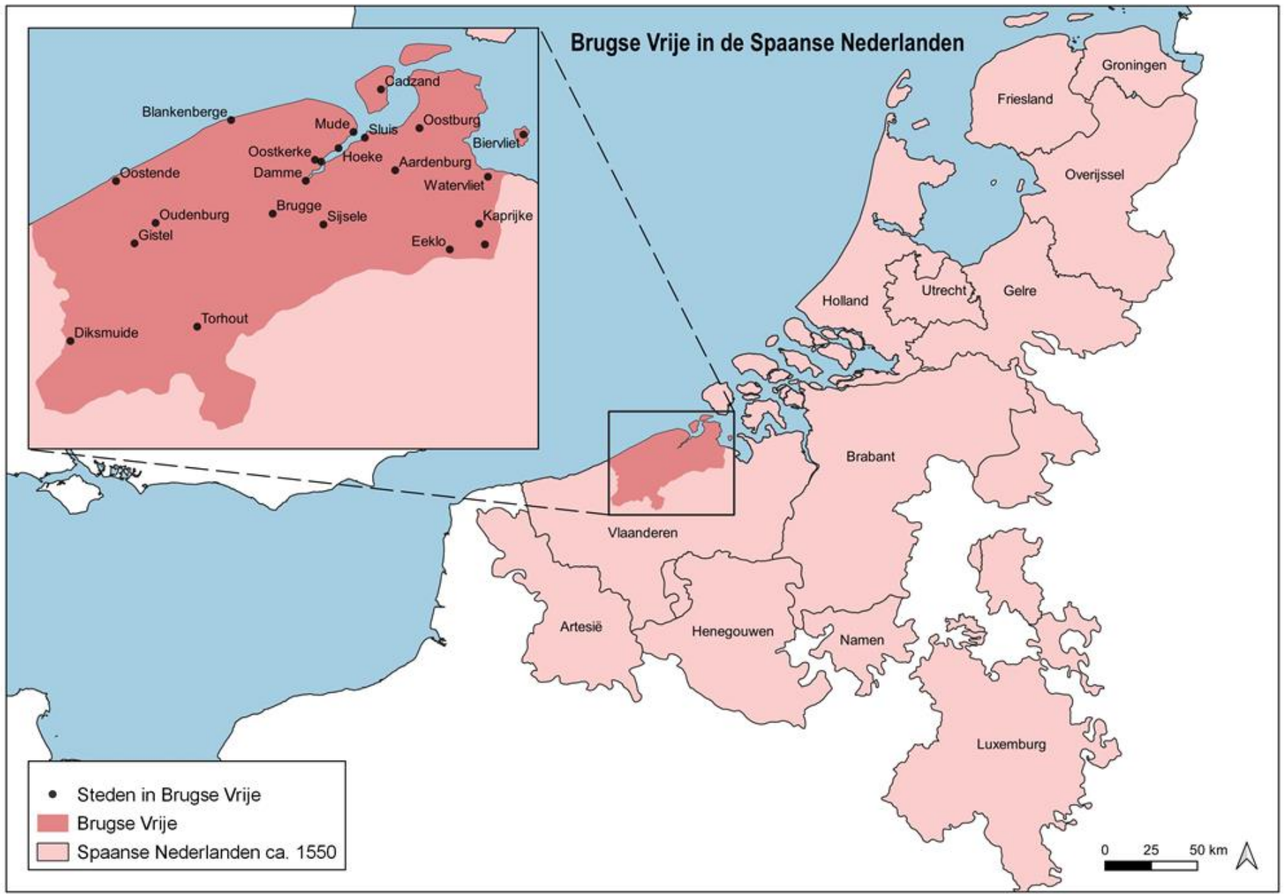
# LAYOUTS (1/2)

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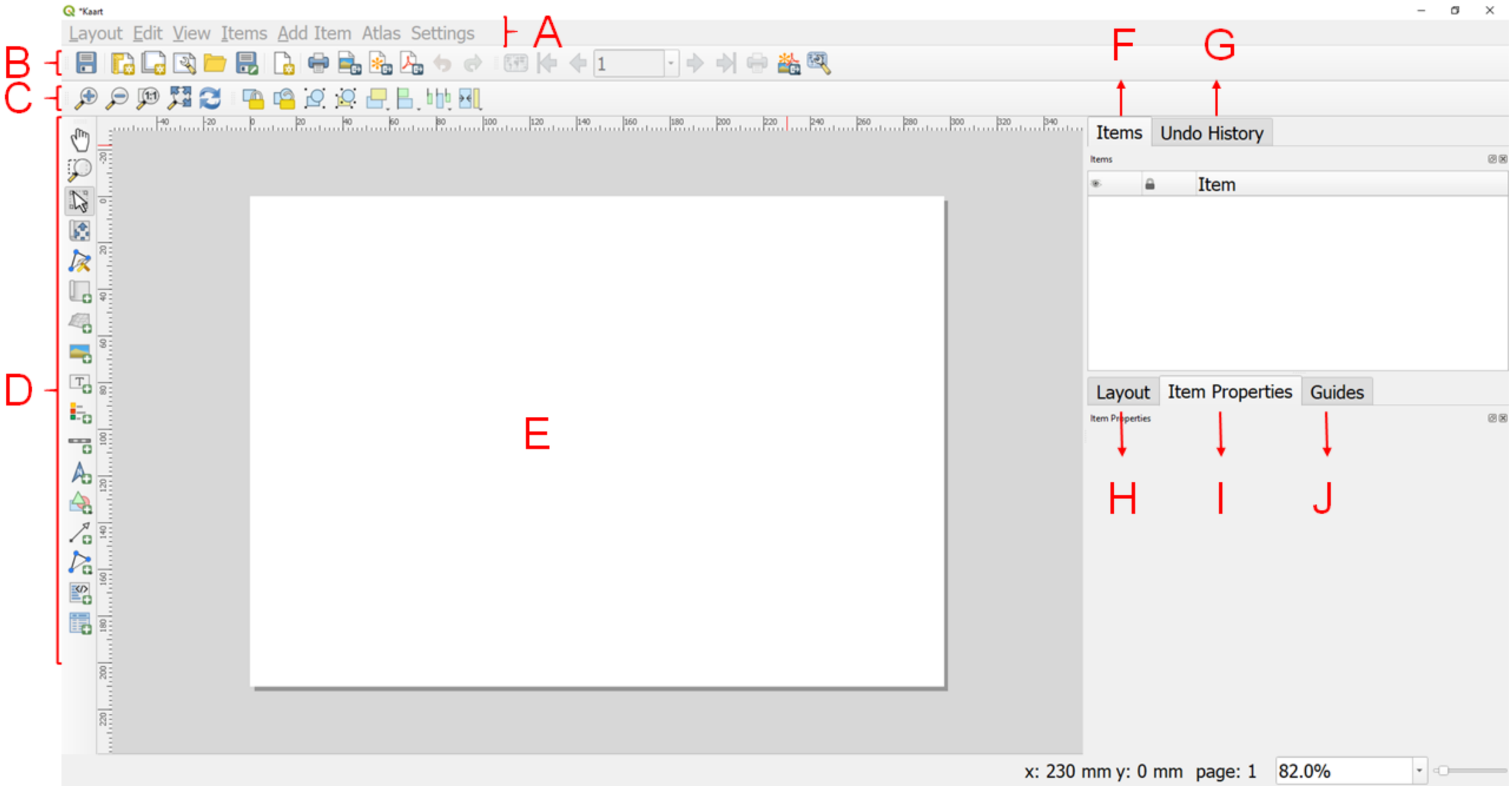
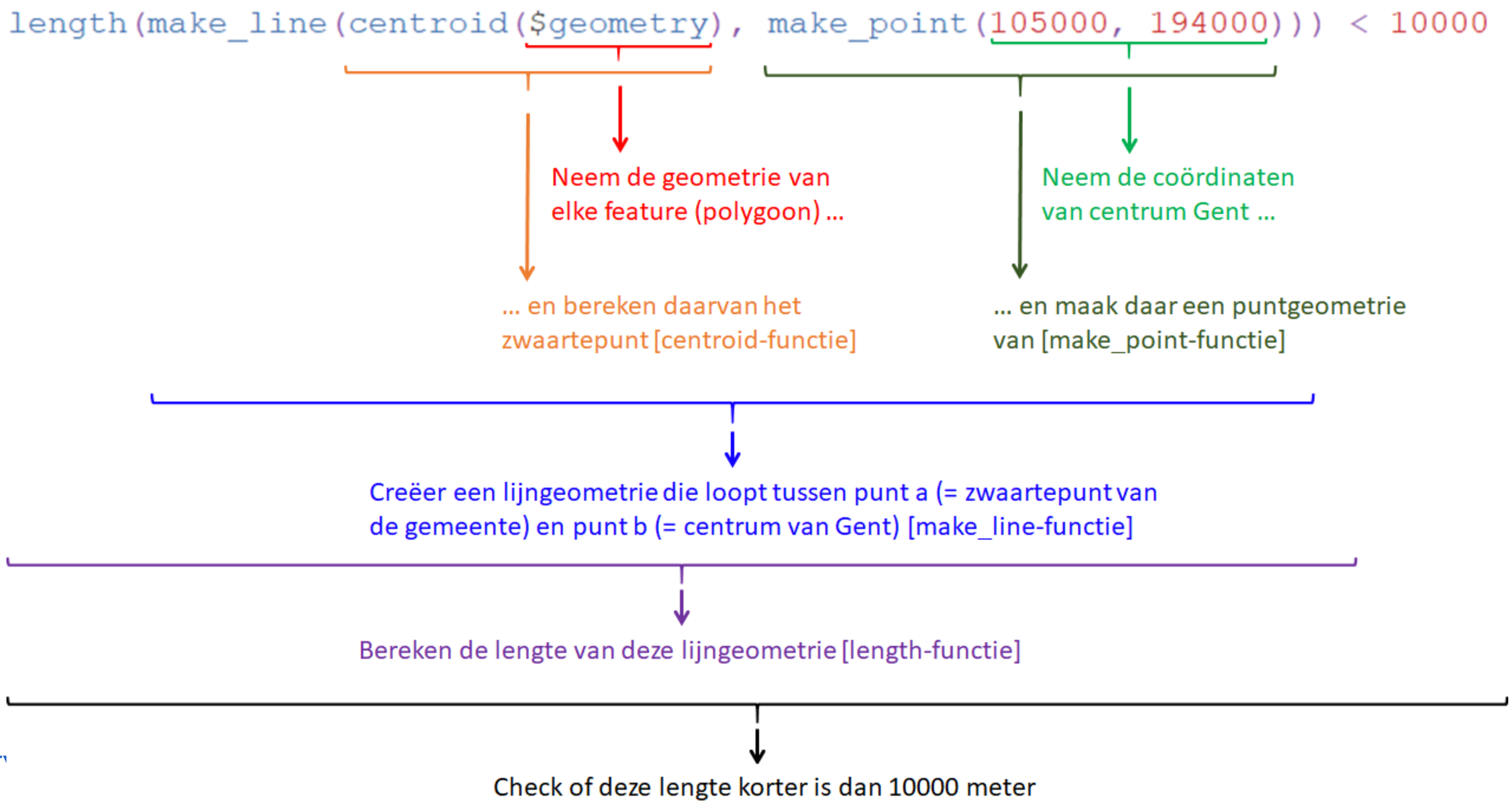
# LAYOUTS (2/2)


*Kaart
Layout Edit View Items Add Item Atlas Settings
A
B
C
D
E
F
G
Items
Undo History
Item
Layout
Item Properties
Guides
H
I
J
x: 230 mm y: 0 mm page: 1
82.0%

# EXPRESSIONS

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# EXERCISE | DATASET 6

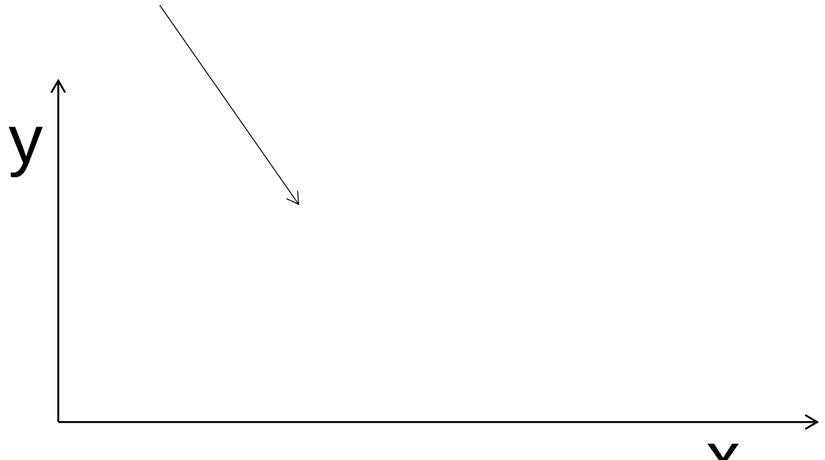
- Color all countries whose second letter is an "a" in red. The 5 countries with the highest population density on the African continent should be colored green.
- In the attribute table, Belgium has not been assigned an area. Calculate this yourself. Does it match what Wikipedia states, i.e., 30,528 km²?
- Assign a different symbol to all "Amsterdams" in the world based on the type of place they represent. The "Amsterdams" in the United States should be colored purple, and the others orange.

# EXERCISE | DATASET 7

- Create a map using an appropriate coordinate system for Belgium. If necessary, transform all layers to this system.
- Visualise the difference between 'cities,' 'towns,' and 'hamlets' using not only different colors but also at least two different shapes.
- Calculate the percentage of children under 4 years old (cf. ‘z__0_4_JA’) relative to the total population (cf. ‘ALGEMEEN_T’) for East Flanders and visualize this (gradually) on the map.
- Label each municipality in East Flanders with its name.
- Calculate the average area of a municipality in Flemish Brabant.

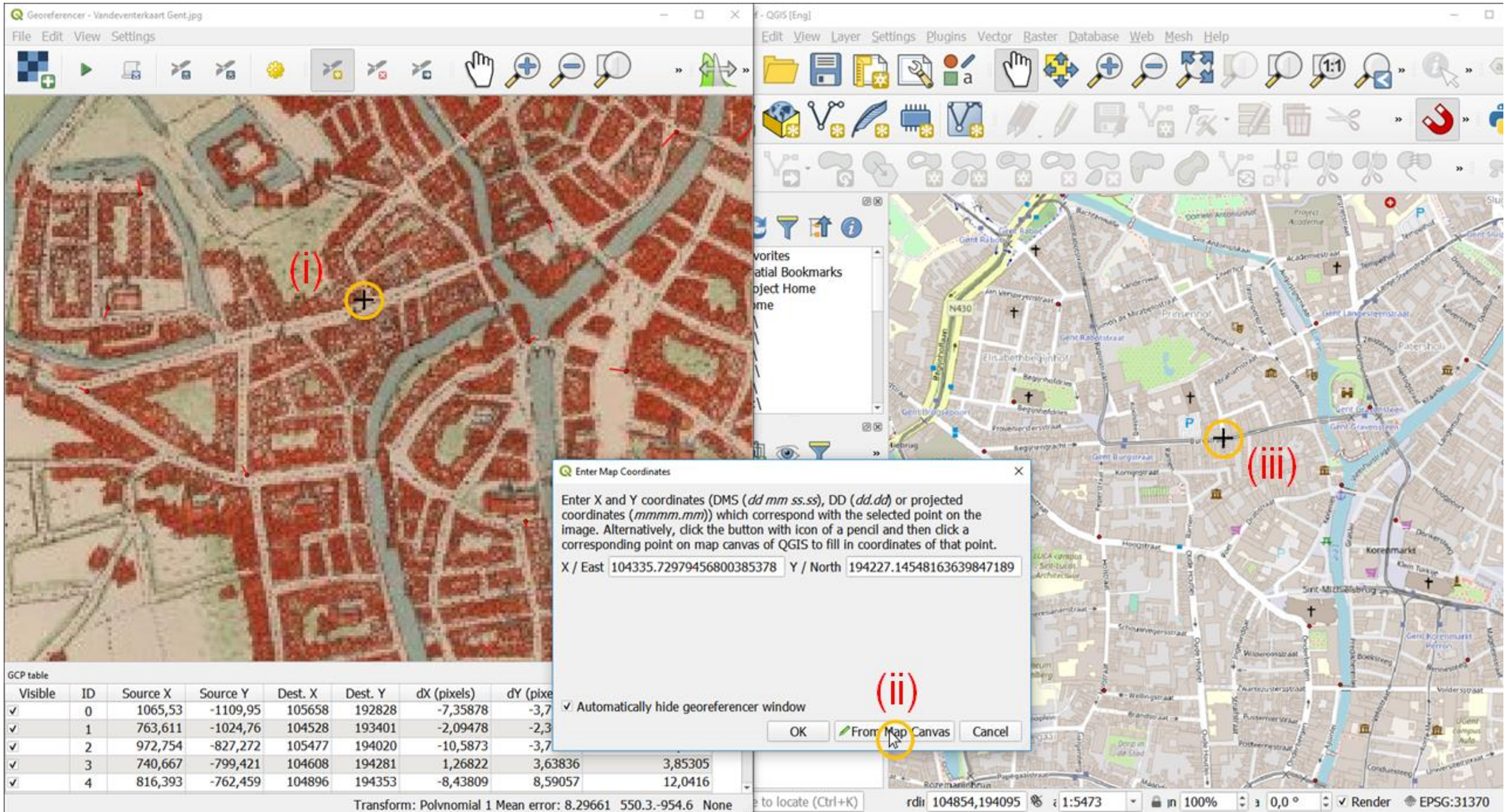
# GEOREFERENCING (1/8)

- Assigning coordinates to data
- Ground control points

# GEOREFERENCING (2/8)

– In practice: homologous points

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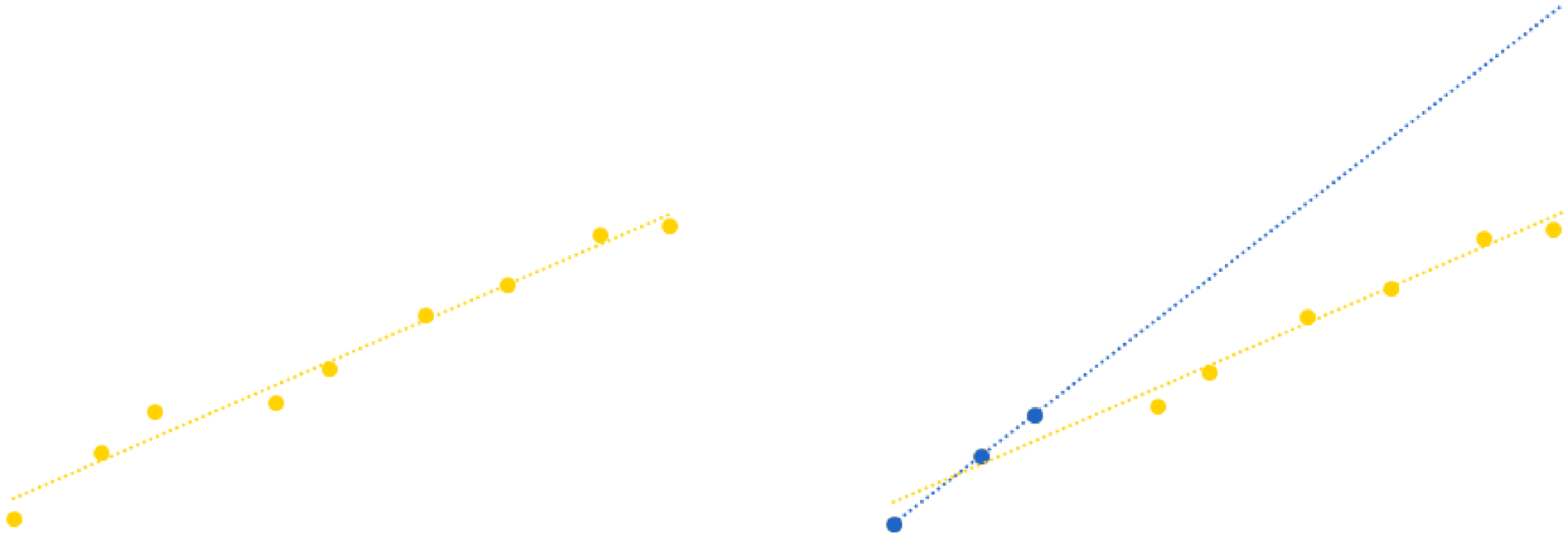
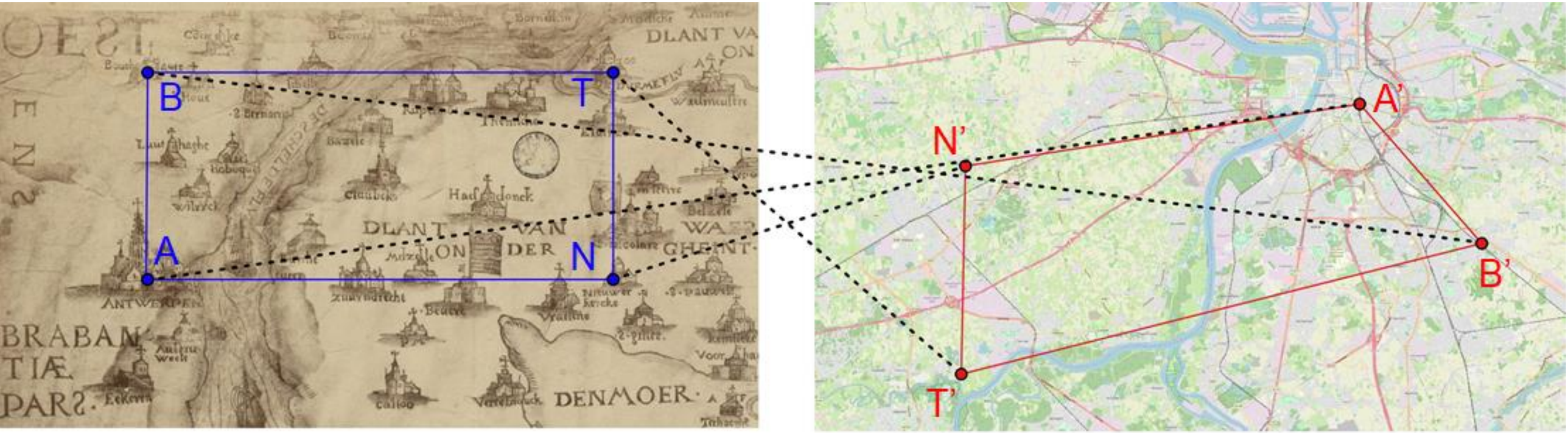
# GEOREFERENCING (3/8)

- Homologous points
  - Evenly distributed
  - Homologous?
  - Sufficient!



# GEOREFERENCING (4/8)

– Transformation type

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# GEOREFERENCING (5/8)

– Transformation type

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# GEOREFERENCING (6/8)

– Transformation type

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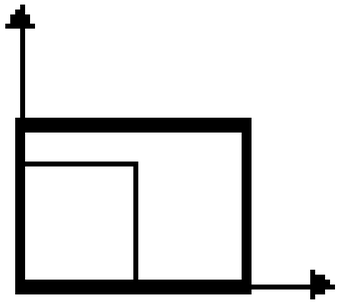
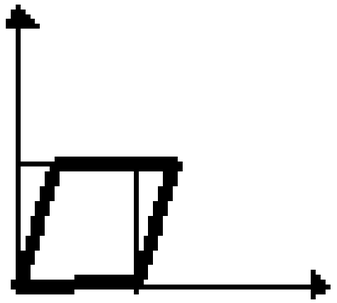
# GEOREFERENCING (7/8)

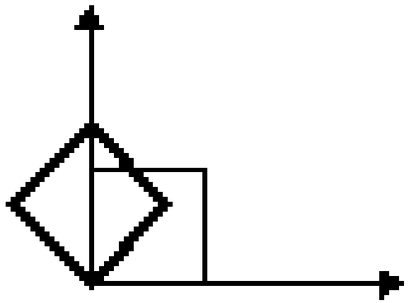
- Transformation type
  - Linear
  - Helmert
  - Polynomyal (1, 2 and 3)
  - Thin plate spline
  - Projective



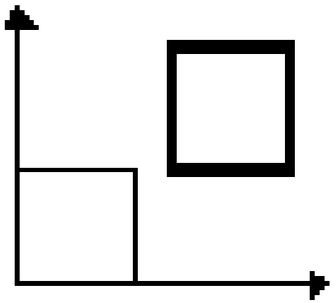
Differential Scaling



Skew



Rotation



Translation

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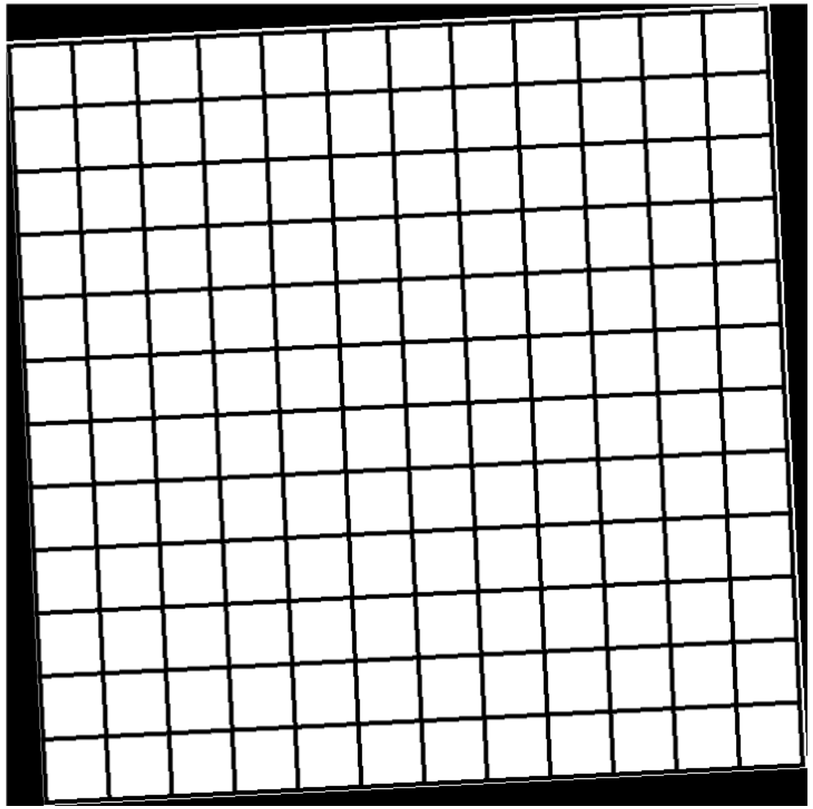
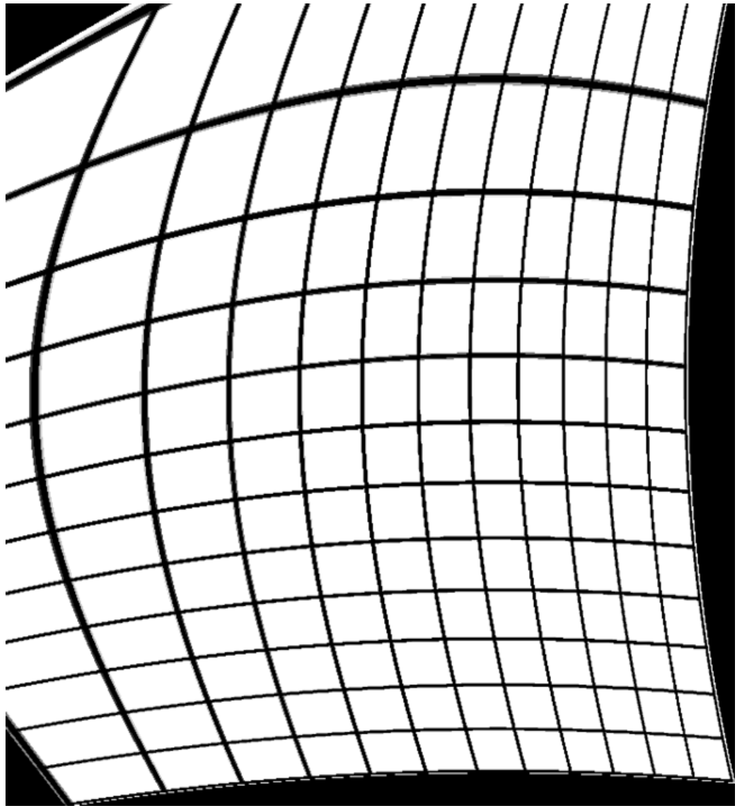
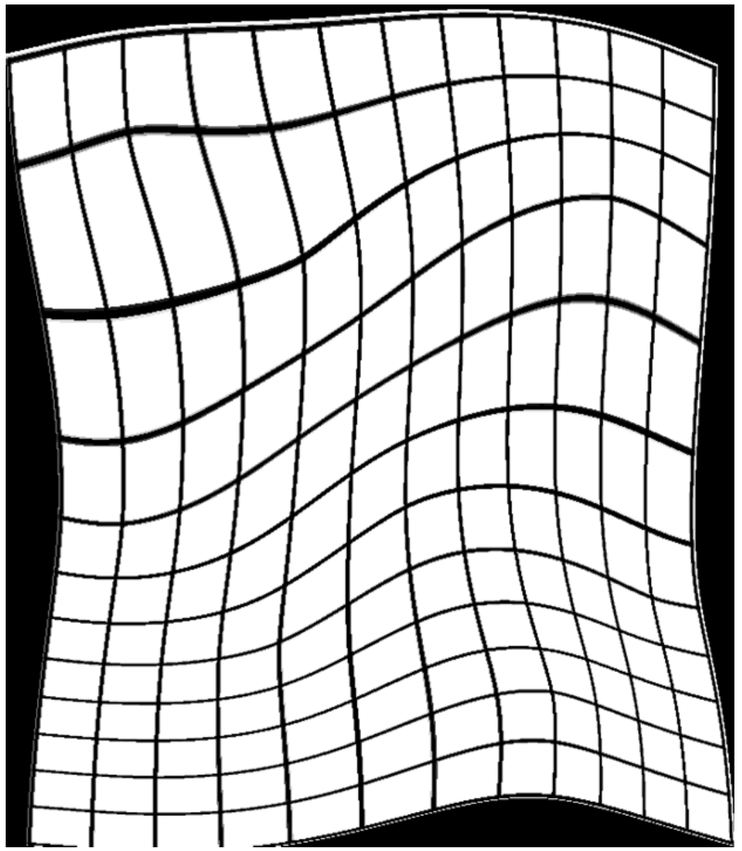
# GEOREFERENCING (8/8)



*Helmert*



*Polynomial 2*



*Thin plate spline*

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# EXERCISE | DATASET 9

- Geo-reference the 17th-century Vandeventer map. Save the homologous points.
- Vectorise the “Spanish Castle” (Spaans Kasteel) as on the Vandeventer map

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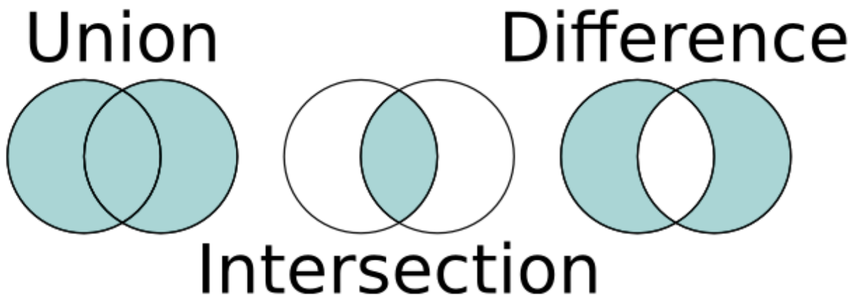
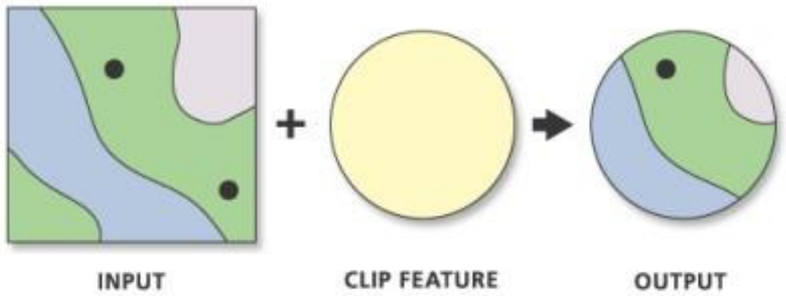
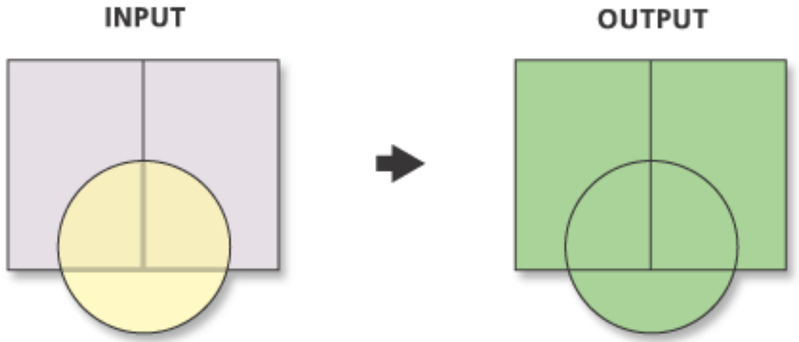
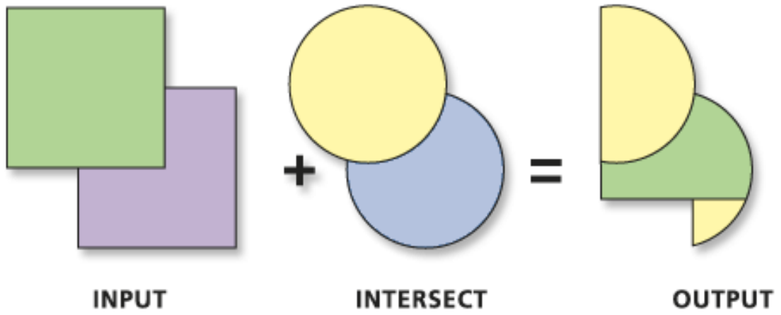
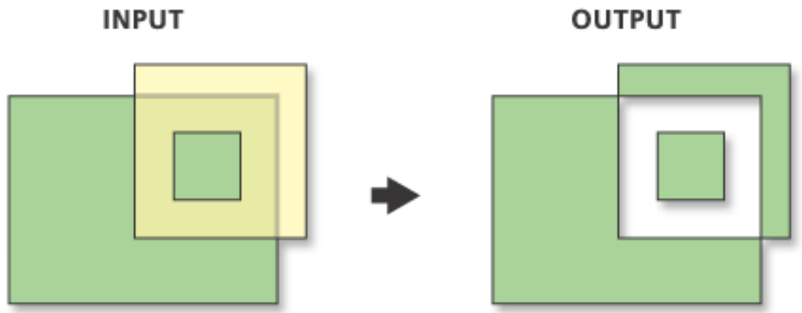
# OVERLAY TOOLS

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# EXERCISE | DATASET 11

- Create a single shapefile of the German Confederation (circa 1850).
- Combine the individual features that together formed one state (see the field 'LAND') into one large feature.
- Link the name of each country to the appropriate geometry. You can find the necessary data in **LandNames.csv**.
- For each modern-day location (see shapefile 'contemporary-populatedPlaces'), write to the attribute table which political entity it belonged to in 1850.
- Create a new layer where the waterways are represented as polygons with a width as indicated in the field 'a_WIDTH'. (Note: the number you provide for the buffer is a radius, not a diameter!)

# EXERCISE | DATASET 12

- Color the countries of the European Union from light to dark according to the chronology of their accession.
- The capitals of the countries where the euro is used should be visualized differently from the others.
- Create a shapefile of the entire area of the European Union. This shapefile should contain only 1. Then, split this layer into multiple features so that each feature consists of exactly one polygon.
- If the European Union were to expand 500 km in all directions, how many countries would then belong (a) if only countries that are fully within this perimeter are counted, and (b) if all countries that are partially within this perimeter are counted?
- Visualise the conflict areas in the world according to these guidelines: conflict areas that are within 250 km of a capital should be shown in red, and the others in orange. The attribute table should include the type of conflict area and (if applicable) the name of the neighboring capital.

# EXERCISE | DATASET 13

- Ensure that there is only one layer with highways. Roads with the same name should consist of only one feature.
- If the Sambre, Meuse, and Scheldt were to flood by two kilometers each, how much Belgian territory would be underwater?
- Create one map layer that covers the entire territory of Belgium and correctly indicates in the attribute table which region and community each area belongs to.
- Create a map with a legend, scale bar, and north arrow!

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# EXERCISE | DATASET 14

- Merge the provided soil maps into one large map. Then, cut out from this large map only the portion that overlaps with the elevation maps of the Blandijnberg.
- Visualize the DTM (Digital Terrain Model) so that the elevation differences around the Blandijnberg are clearly visible. (Clarification: the DTM contains the elevation model of the Earth's surface, while the DSM (Digital Surface Model) includes the surface elevation plus vegetation and buildings.)
- Create a raster layer that stores the heights of the buildings and vegetation.
- Write the information related to building heights (see point 3) to the correct buildings in the vector layer.