Critical GIS

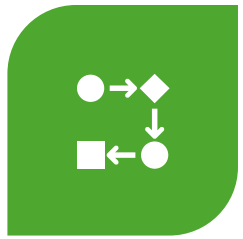
WHAT IS GIS?

CAPTURE

STORE

QUERY

ANALYSE



VISUALIZE

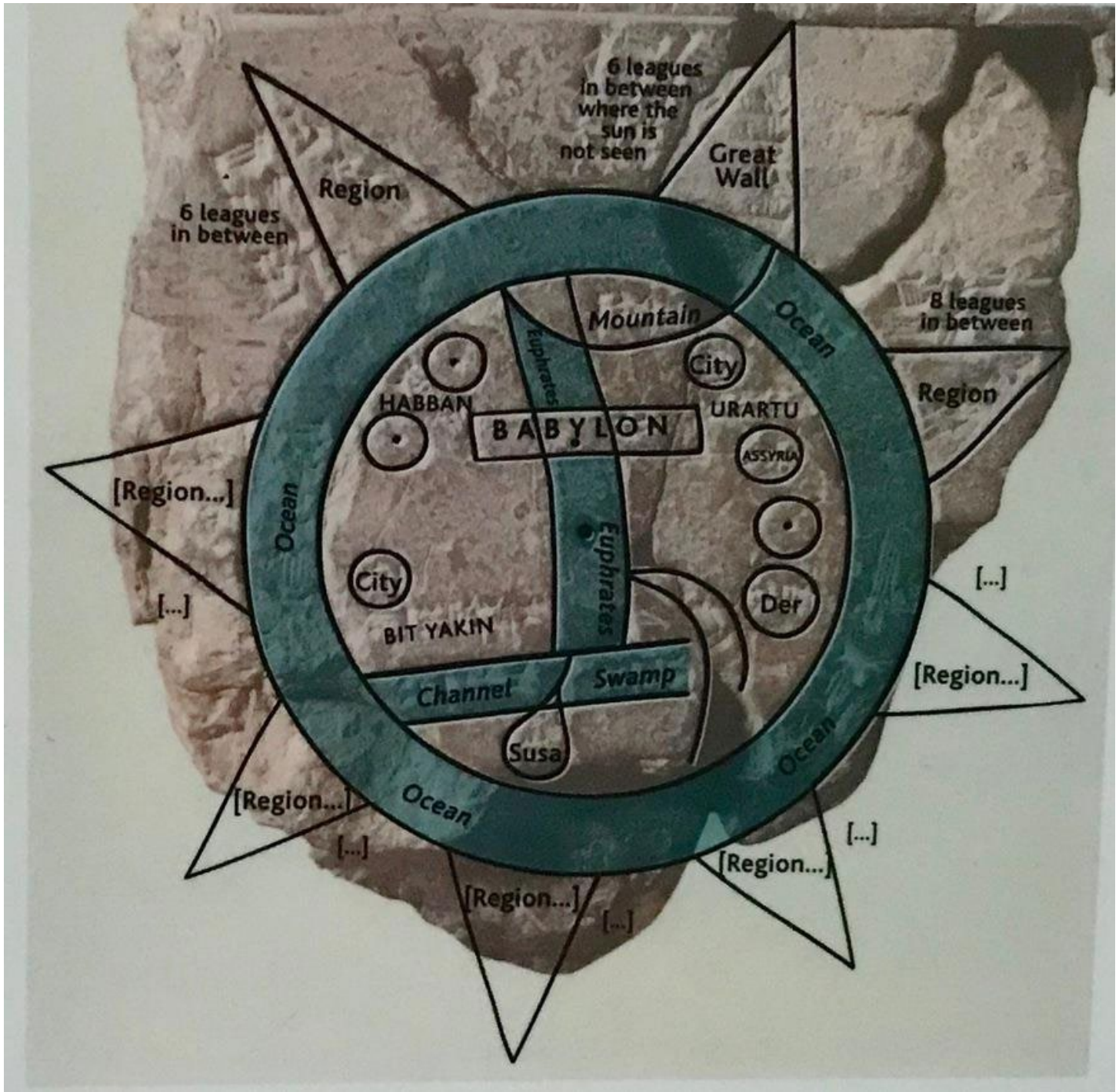
WHAT WE WILL LEARN

Data Collection, Manipulation & Management

Cartography & Visualization

Spatial Analysis

Statistical & Modeling



GEOGRAPHICAL REPRESENTATION

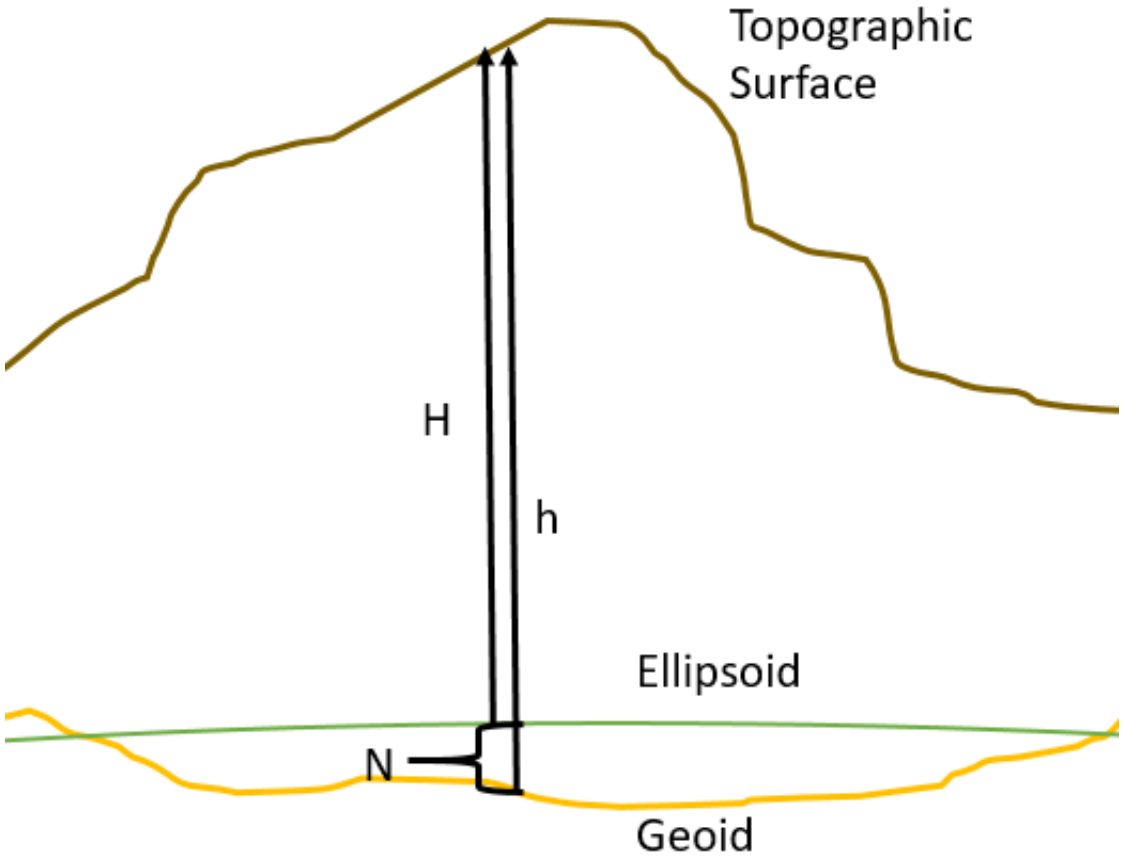
COGNITIVE MAPPING AND MENTAL MODEL

CARTOGRAPHY IS A SOCIAL CONSTRUCT

THEMATIC MAPPING

Measuring the Earth

- Geodesy
- The Earth has an oblate spheroid shape, which is complex to model accurately.
- Simplifications
- We use an ellipsoid as a more practical and manageable representation of the Earth's surface.



Plotemy - Geographia

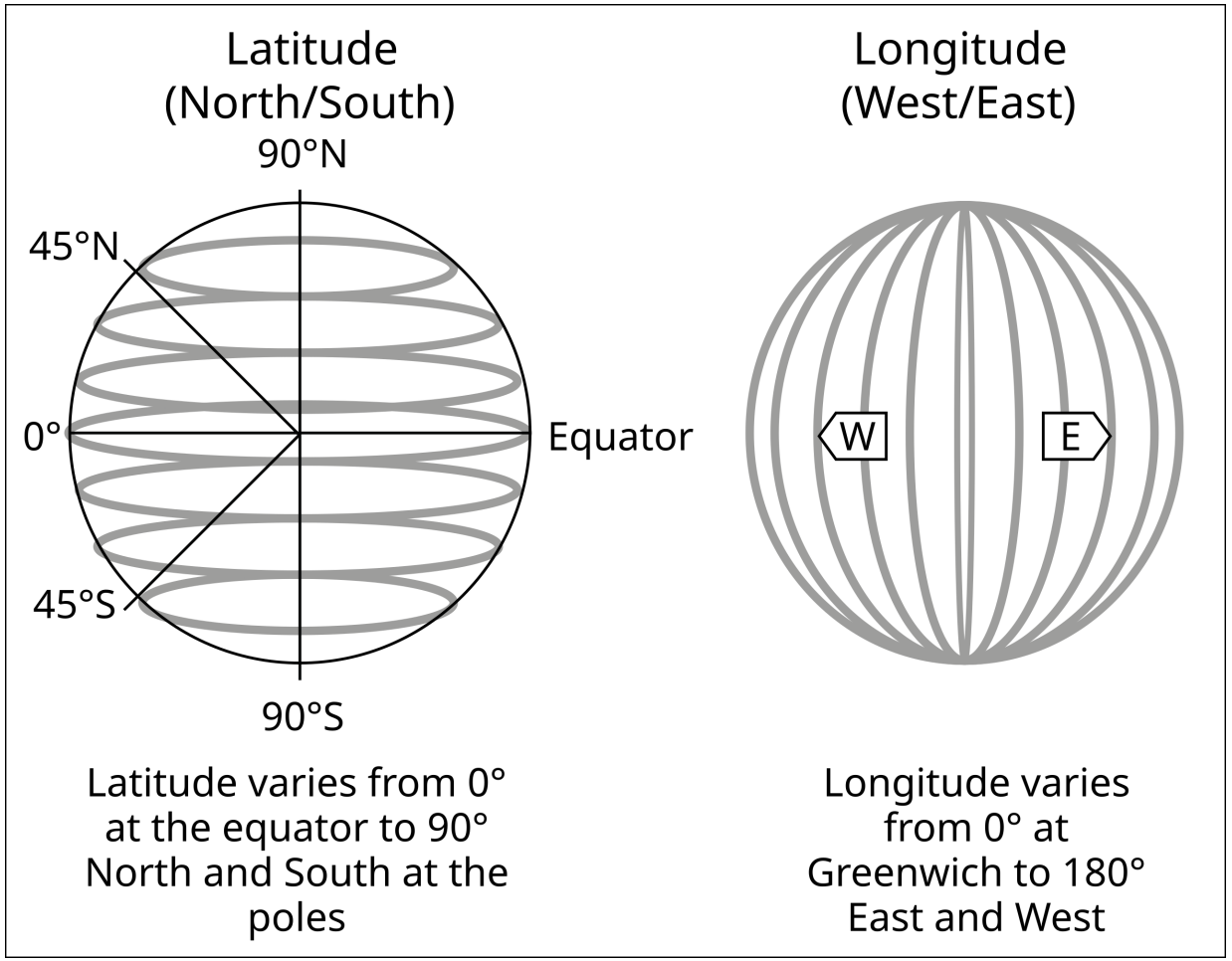
Latitude and Longitude

Latitude (Parallels)

- Measures north to south
- 90°in each hemisphere
- Increases as you go north in the northern hemisphere
- Increases as you go south in the southern hemisphere
- Zero is Equator

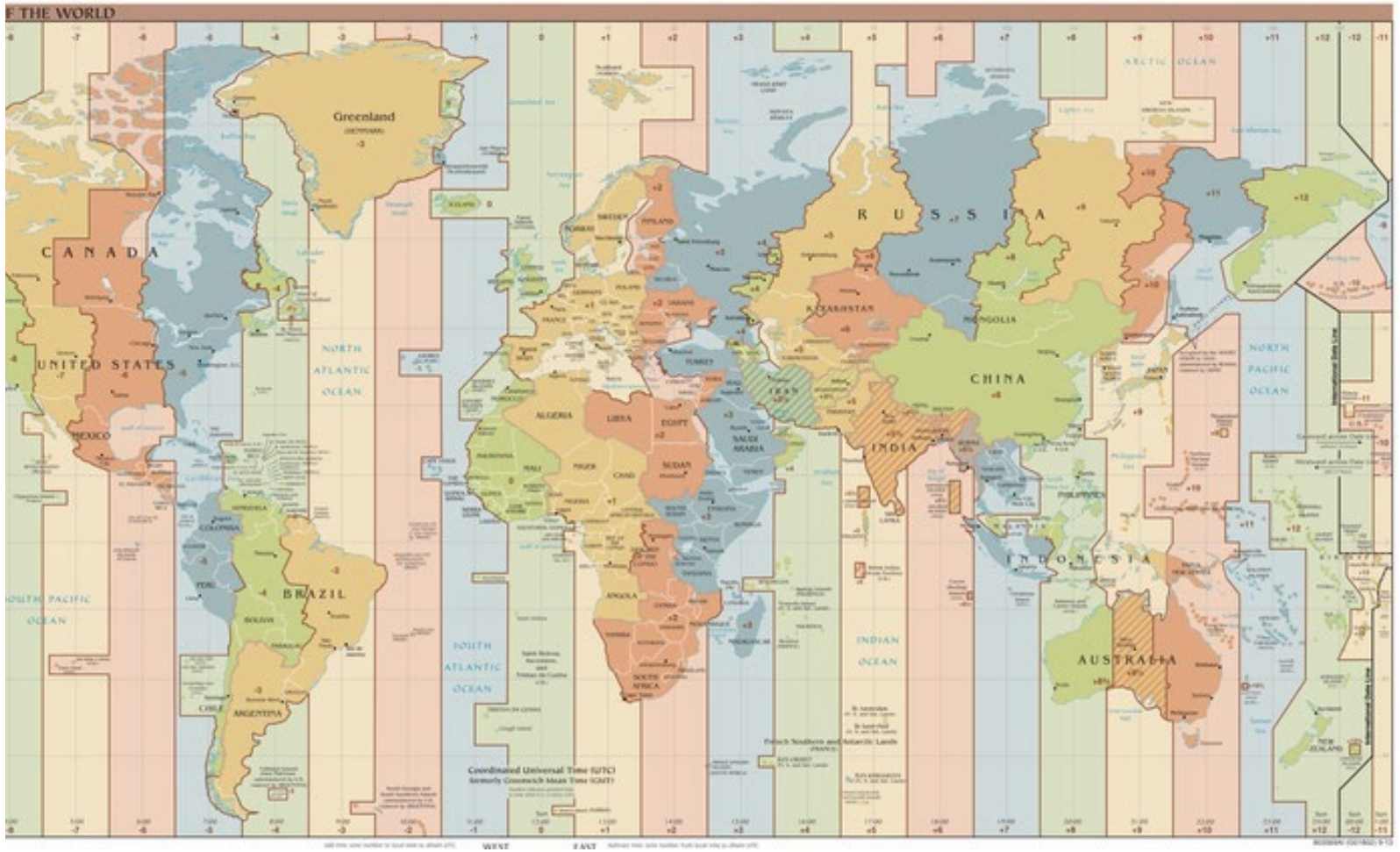
Longitude(Meridians)

- Measures east to west
- 180°in each hemisphere
- Increases as you go east in the eastern hemisphere
- Increases as you go west in the western hemisphere
- Zero is Prime Meridian



1 ° Degree = 60 Minutes = 3,600 Seconds

Time Zones


Greenland
CANADA
UNITED STATES
MEXICO
BRAZIL
ARGENTINA
CHILE
RUSSIA
KAZAKHSTAN
MONGOLIA
CHINA
INDIA
INDONESIA
AUSTRALIA
NEW ZEALAND
NORTH ATLANTIC OCEAN
SOUTH ATLANTIC OCEAN
INDIAN OCEAN
NORTH PACIFIC OCEAN
SOUTH PACIFIC OCEAN
ARCTIC OCEAN
Coordinated Universal Time (UTC)
formerly Greenwich Mean Time (GMT)
WEST
EAST

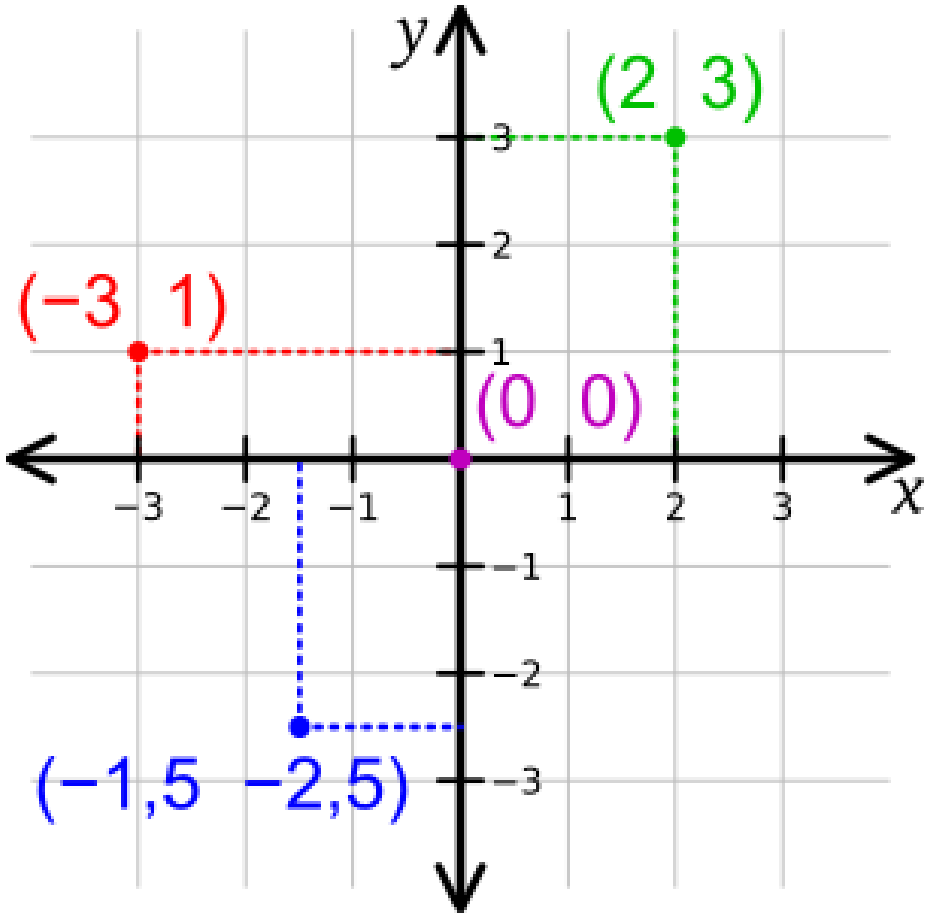

RUSSIA
MONGOLIA
CHINA
INDIA

Islamic Medieval Cartography

Al-Idrisi

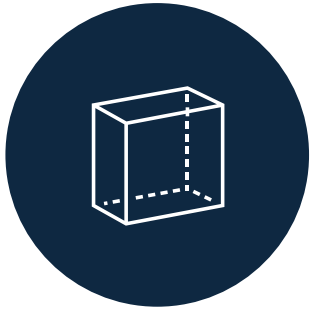
MAP PROJECTIONS

- Map projections allow us to view the 3D Earth on a 2D surface
- Earth is mathematically projected to a surface that can be made flat
- We now make measurements in distance or length units as opposed to degrees
- A Cartesian coordinate system
- We call these surfaces Map Projections



Geographic vs. Projected Coordinate Systems

MAP DISTORSIONS

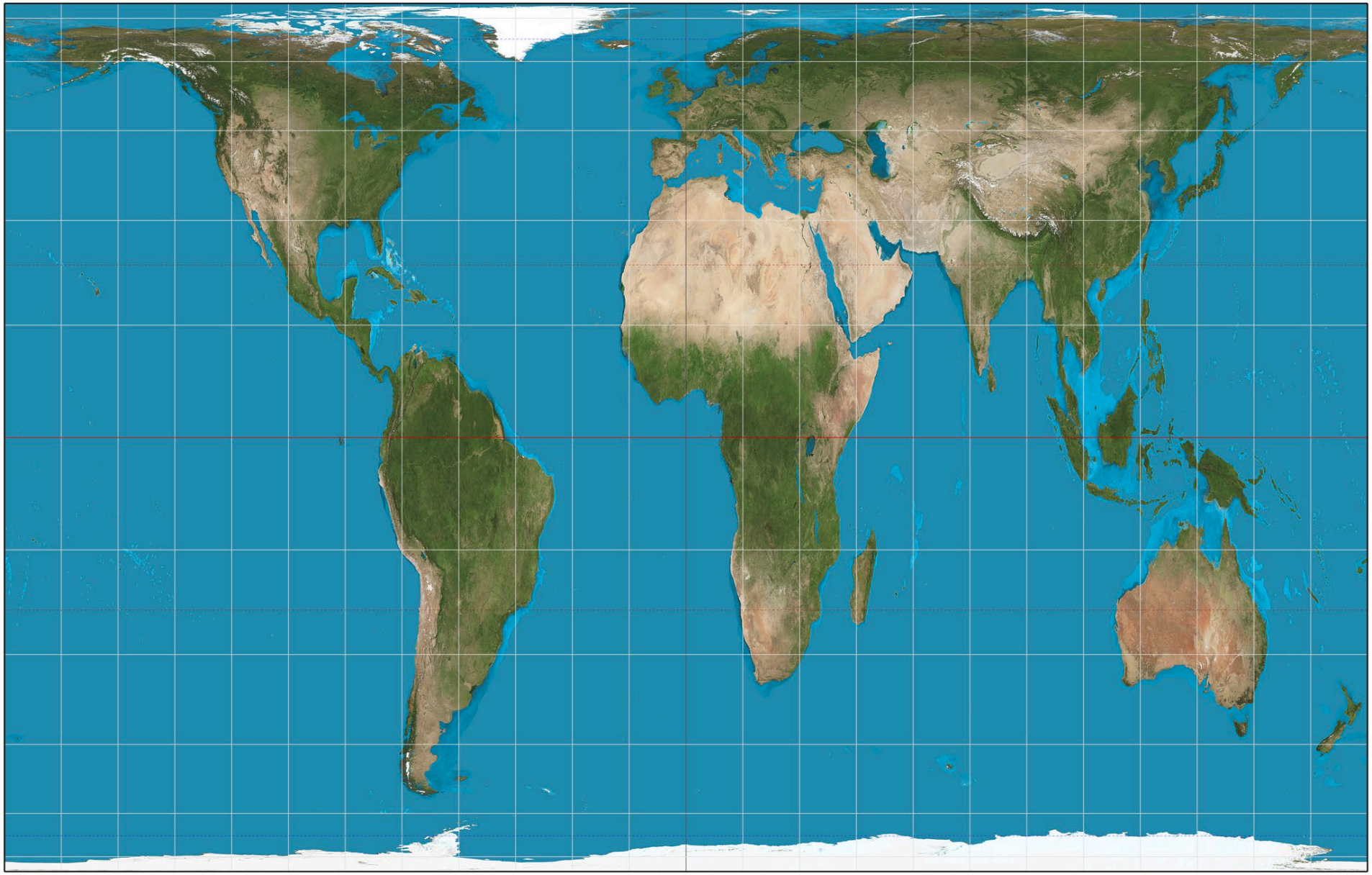


SHAPE

AREA

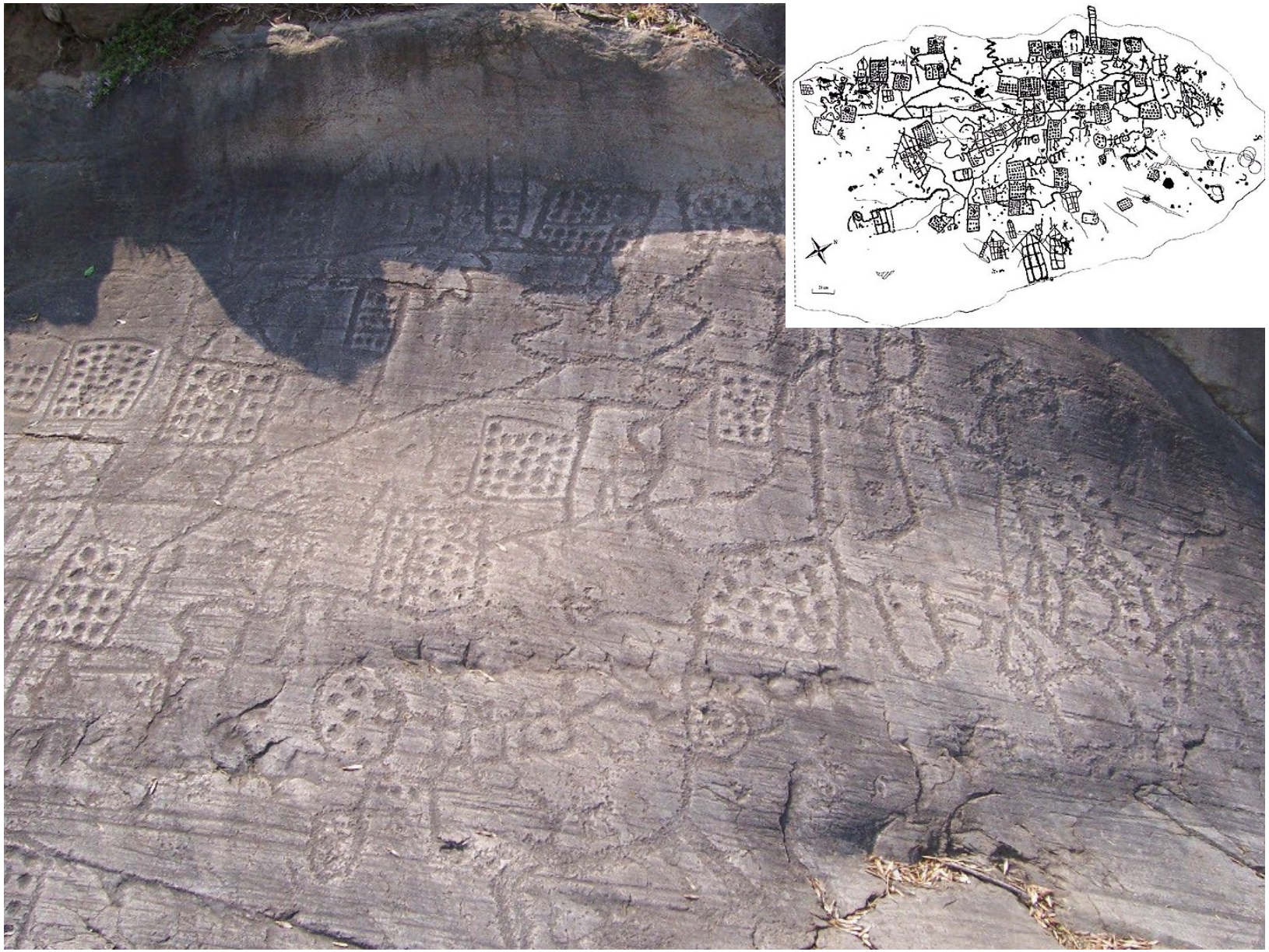
DISTANCE

DIRECTION



- https://www.thetruesize.com/

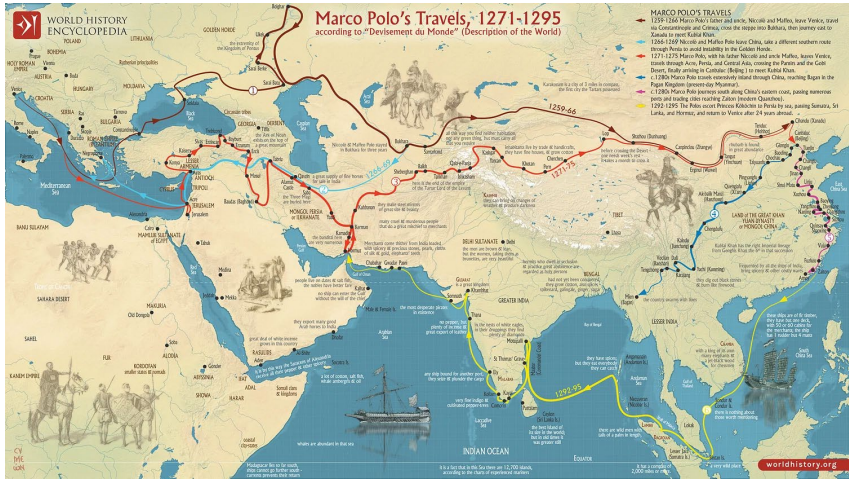
DATA?

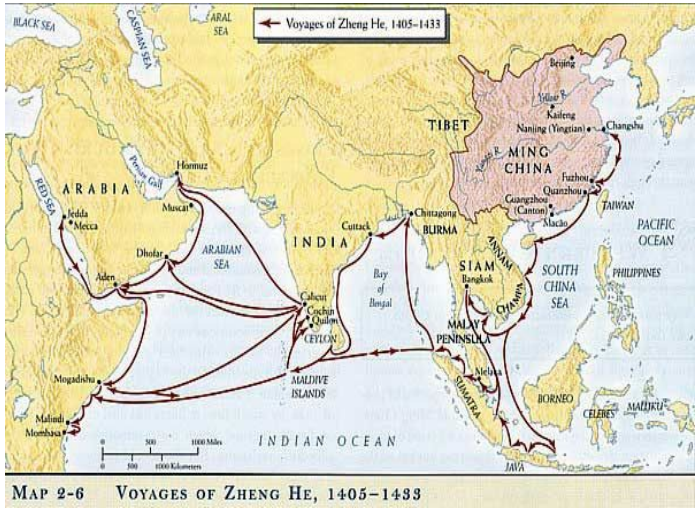


Marco Polo, 24 years (1271–1295)
24,000 km

Ibn Battuta, 29 years (1325–1354)
117,000 km

Zheng He, 28 years (1405–1433), 50,000 km





What count as Data?

Non-Spatial Data in GIS

Categorical

Attributes = non-spatial characteristics associated with spatial data

Nominal = A unique identifier or unique types

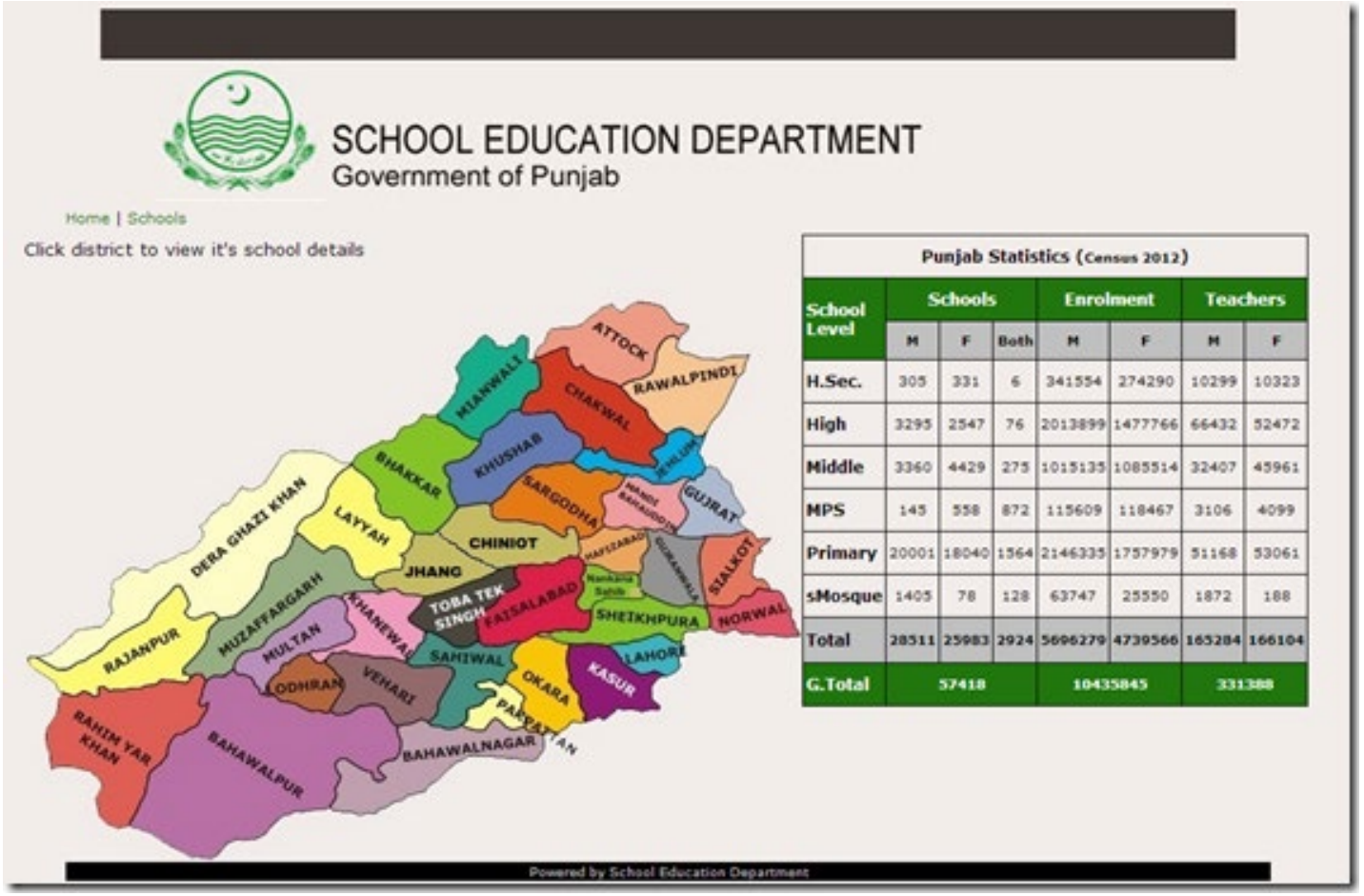
Ordinal = Ranked data

Numeric

Interval = Difference between numbers is significant, but no fixed non-arbitrary zero point

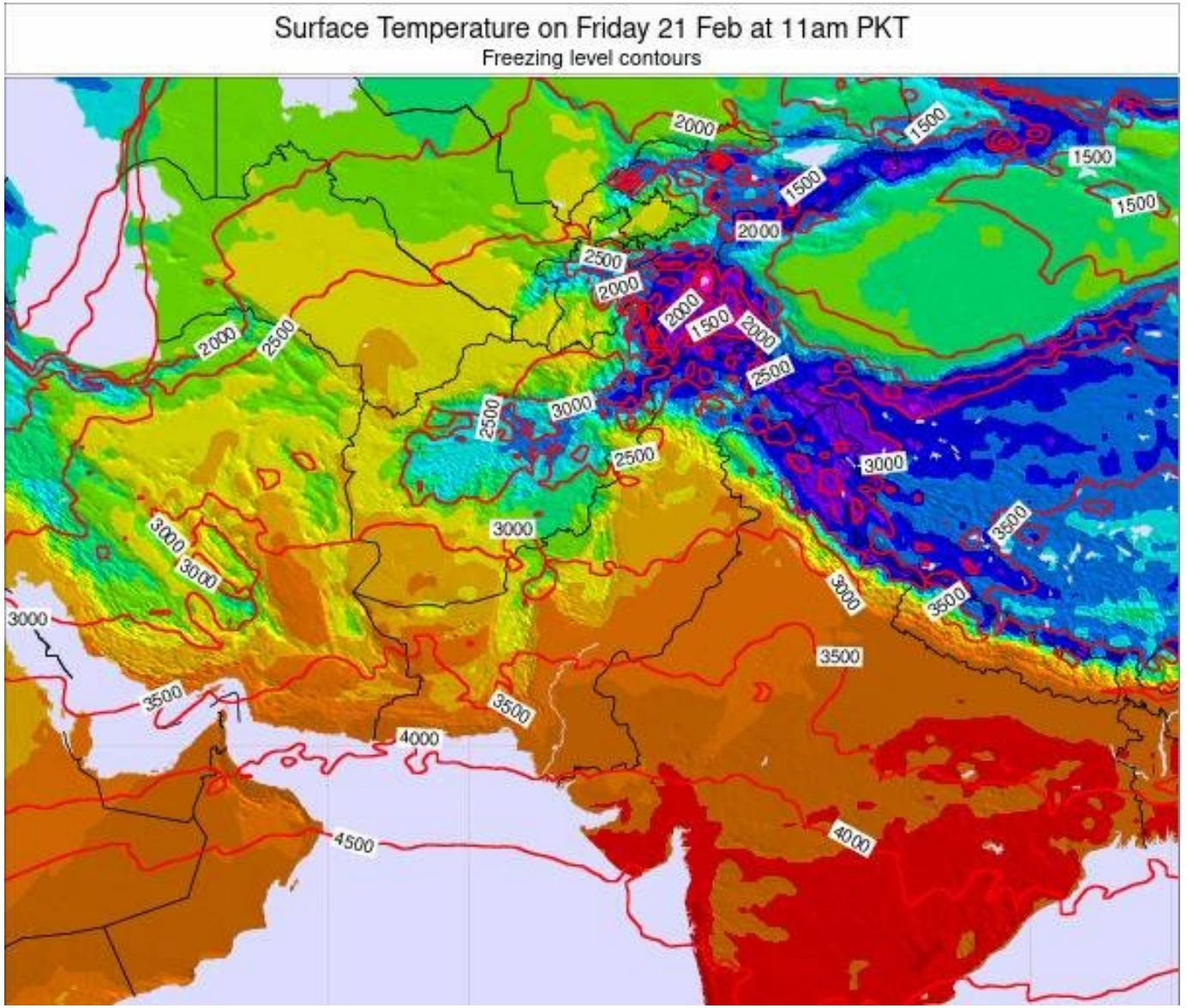
Ratio = Difference between numbers is significant, and there is a fixed non-arbitrary zero value

Nominal Data



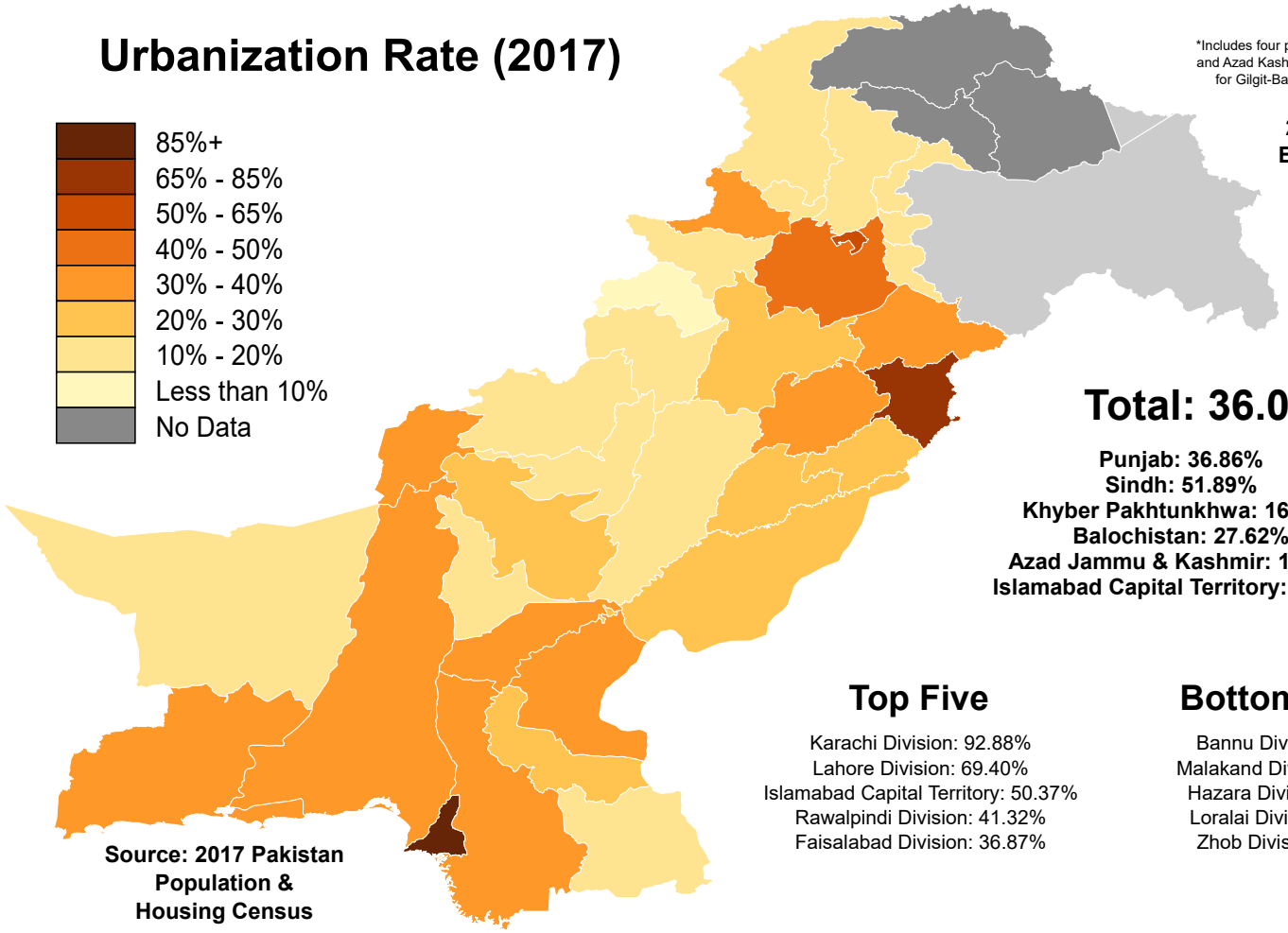
Punjab Statistics (Census 2012)							
School Level	Schools			Enrolment		Teachers	
	M	F	Both	M	F	M	F
H.Sec.	305	331	6	341554	274290	10299	10323
High	3295	2547	76	2013899	1477766	66432	52472
Middle	3360	4429	275	1015135	1085514	32407	45961
MPS	145	558	872	115609	118467	3106	4099
Primary	20001	18040	1364	2146335	1757979	51168	53061
sMosque	1405	78	128	63747	25550	1872	188
Total	28511	25983	2924	5696279	4739566	165284	166104
G.Total	57418			10435845		331388	

Interval Data



Ratio Data

Urbanization Rate (2017)



*Includes four provinces, federal capital, and Azad Kashmir. Data is not available for Gilgit-Baltistan as of July 2021

2021 Division Borders in use

Total: 36.07%*

Punjab: 36.86%
Sindh: 51.89%
Khyber Pakhtunkhwa: 16.55%
Balochistan: 27.62%
Azad Jammu & Kashmir: 17.37%
Islamabad Capital Territory: 50.37%

Source: 2017 Pakistan Population & Housing Census

Top Five

Karachi Division: 92.88%
Lahore Division: 69.40%
Islamabad Capital Territory: 50.37%
Rawalpindi Division: 41.32%
Faisalabad Division: 36.87%

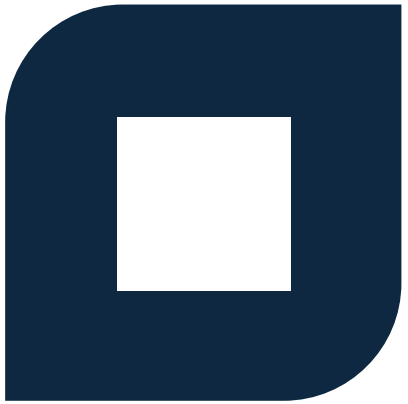
Bottom Five

Bannu Division: 5.41%
Malakand Division: 10.43%
Hazara Division: 10.75%
Loralai Division: 12.40%
Zhob Division: 13.58%

VECTOR DATA?

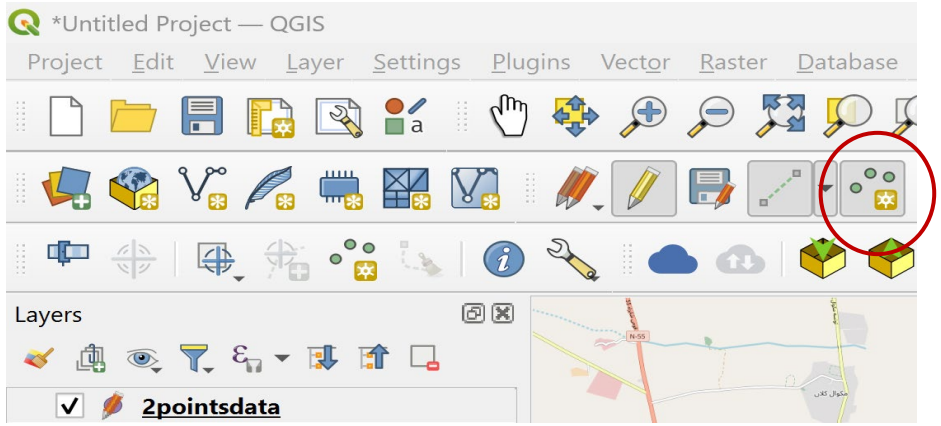
POINT

LINE



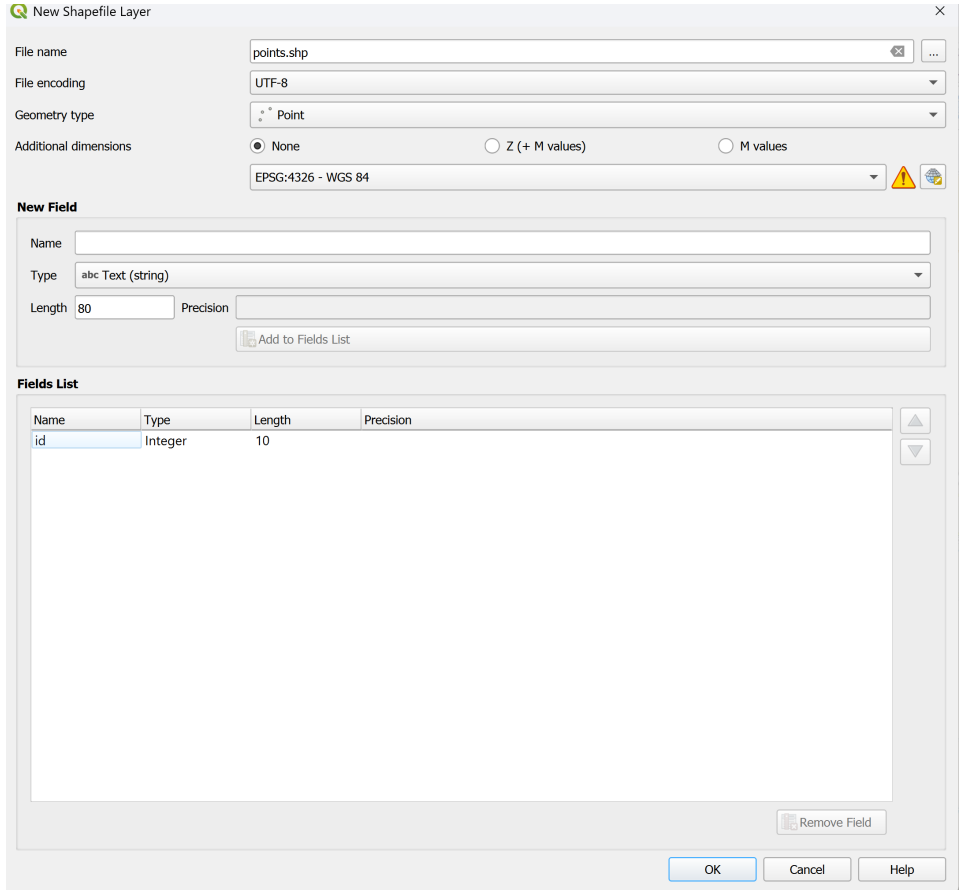
POLYGON

1. Manually Adding Points from QGis



Create a New Point Layer

1. **Open QGIS** and go to **Layer** > **Create Layer** > **New Shapefile Layer**.
2. In the dialog:
    1. Set **File Name** and **Save** location.
    2. Choose **Geometry Type** as **Point**.
    3. Set **CRS** (Coordinate Reference System) (e.g., **WGS 84 / EPSG:4326**).
    4. Add any necessary **attributes** (e.g., "Name", "ID").
    5. Click **OK**.



Start Editing the Layer

1. In the **Layers Panel**, select your new point layer.
2. Click on the **Toggle Editing** button (pencil icon) in the **Toolbar**.
3. Click on the **Add Point Feature** tool (looks like a point).
4. Click anywhere on the map where you want to add a point.
5. Click **Save Edits** and **Toggle Editing** off.

Export as CSV

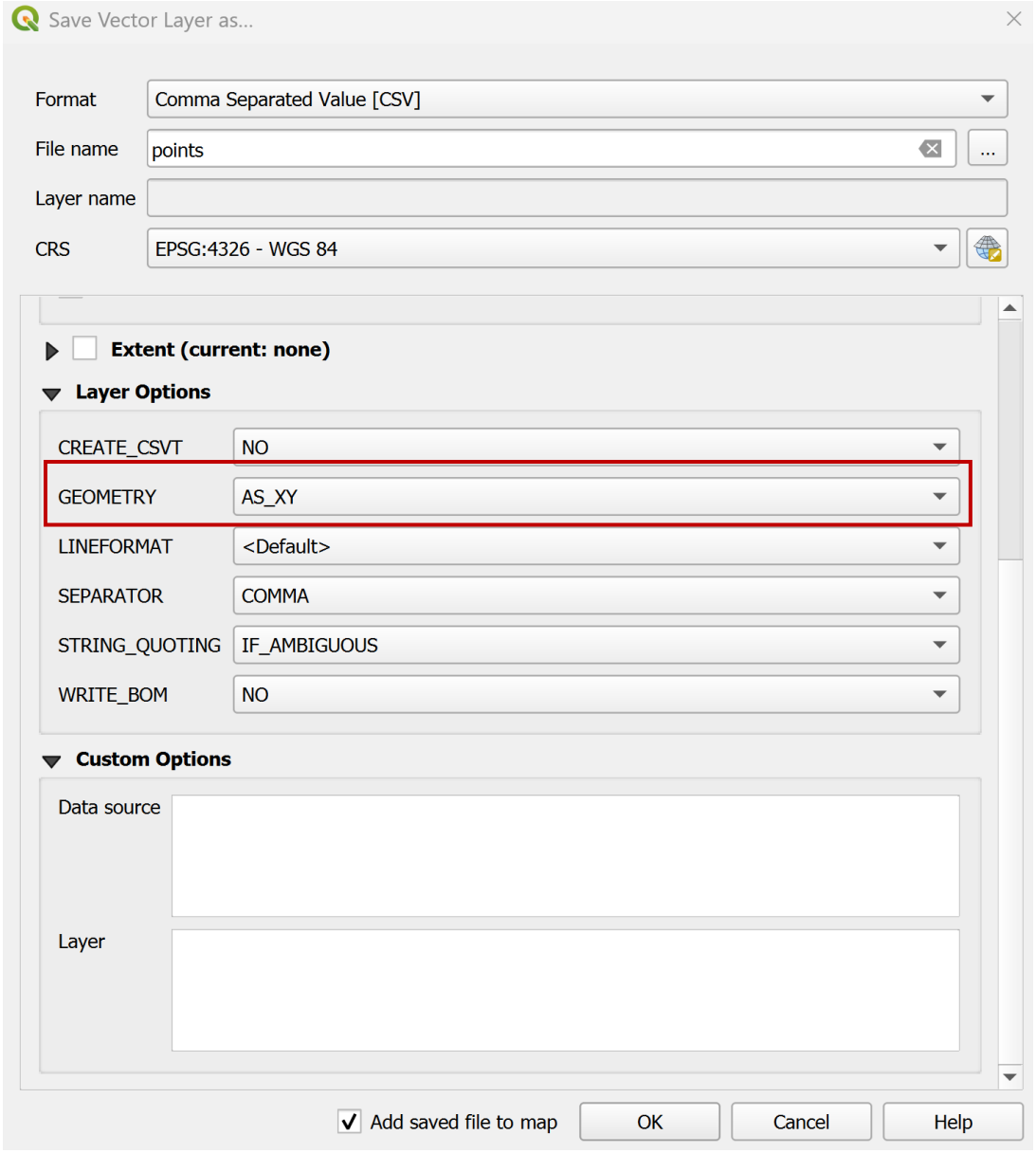
Select Your Layer In the Layers Panel

- right-click your point layer.
- Click Export > Save Features As....

Configure Export Settings In the Save Vector Layer

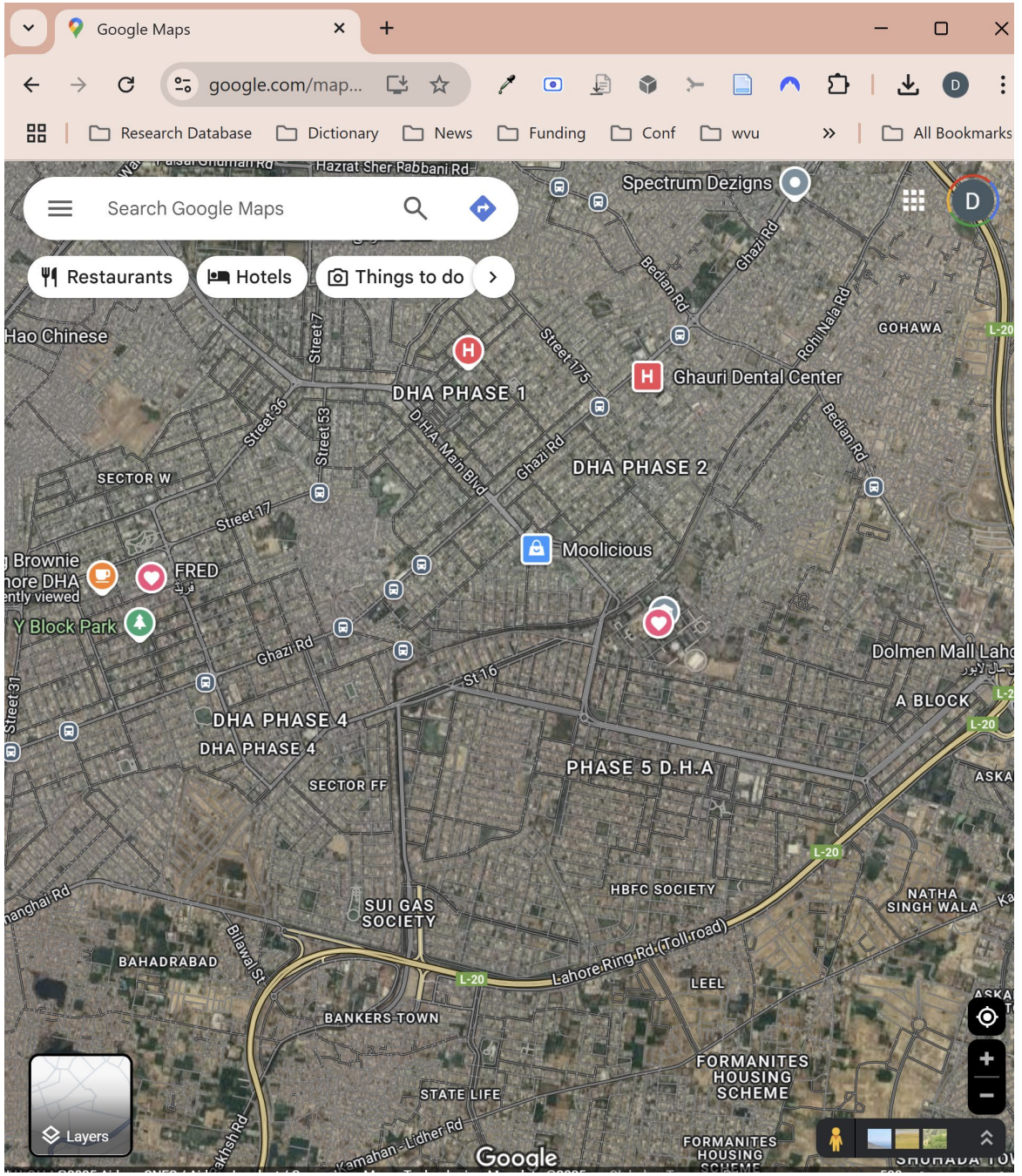
- Format: Choose Comma Separated Value (CSV).
- File Name: Click Browse and choose a location to save your CSV.
- Layer Options:
  - Geometry: Choose Point coordinates.
  - Make sure Geometry is set to "AS_XY" (this ensures latitude/longitude are included).
  - CRS: Select WGS 84 (EPSG:4326) for standard lat/lon coordinates.
  - Encoding: Keep as UTF-8 (to avoid character issues).

Why = Easier to deal with CSV than shapefile + remote sensing imagery



2. Data from Google Maps

- Open Google Maps
- Right Click
- Careful Google maps is lat long
- Paste in csv file
- Clean up



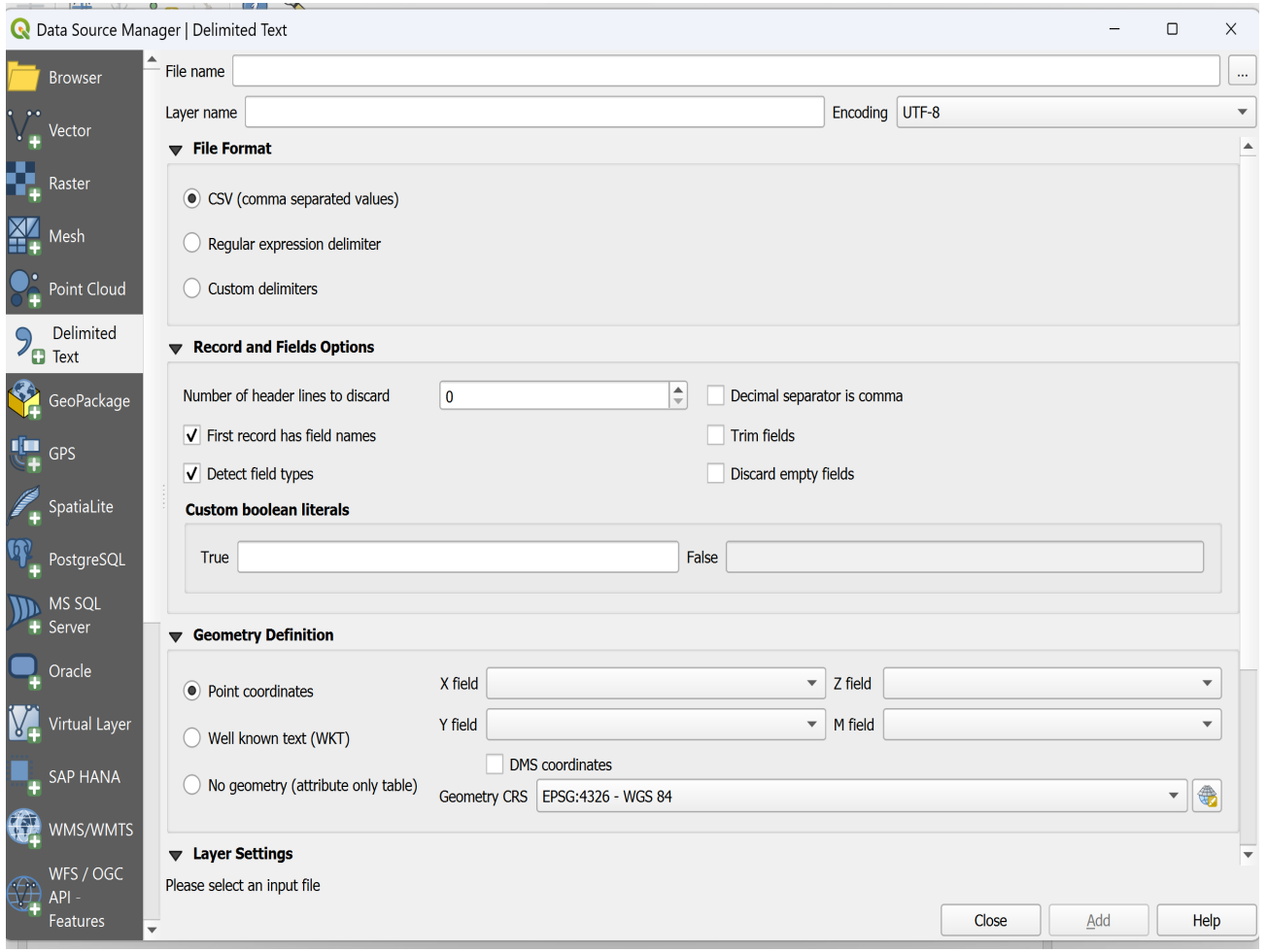
Load CSV into QGIS

1. **Open QGIS** and go to **Layer → Add Layer → Add Delimited Text Layer...**
2. Click **"..."** next to **File Name** and select your CSV file.
3. In the **File Format** section, select:
    1. **CSV (comma-separated)** (or adjust if using another delimiter).
4. In **Geometry Definition**:
    1. Select **Point Coordinates**.
    2. Set **X Field** to long (Longitude).
    3. Set **Y Field** to lat (Latitude).
5. Choose the **Coordinate Reference System (CRS)**:
    1. If coordinates are in **WGS 84**, select **EPSG:4326**.
    2. If using another CRS, choose accordingly.
6. Click **Add → Close**.

Save as a Shapefile

1. Right-click the CSV layer in **Layers Panel**.
2. Click **Export → Save Features As....**
3. Choose **ESRI Shapefile** (or another format).
4. Select the appropriate **CRS** and location, then save.

ADD DELIMITED TEXT LAYER



Geolocated Photos

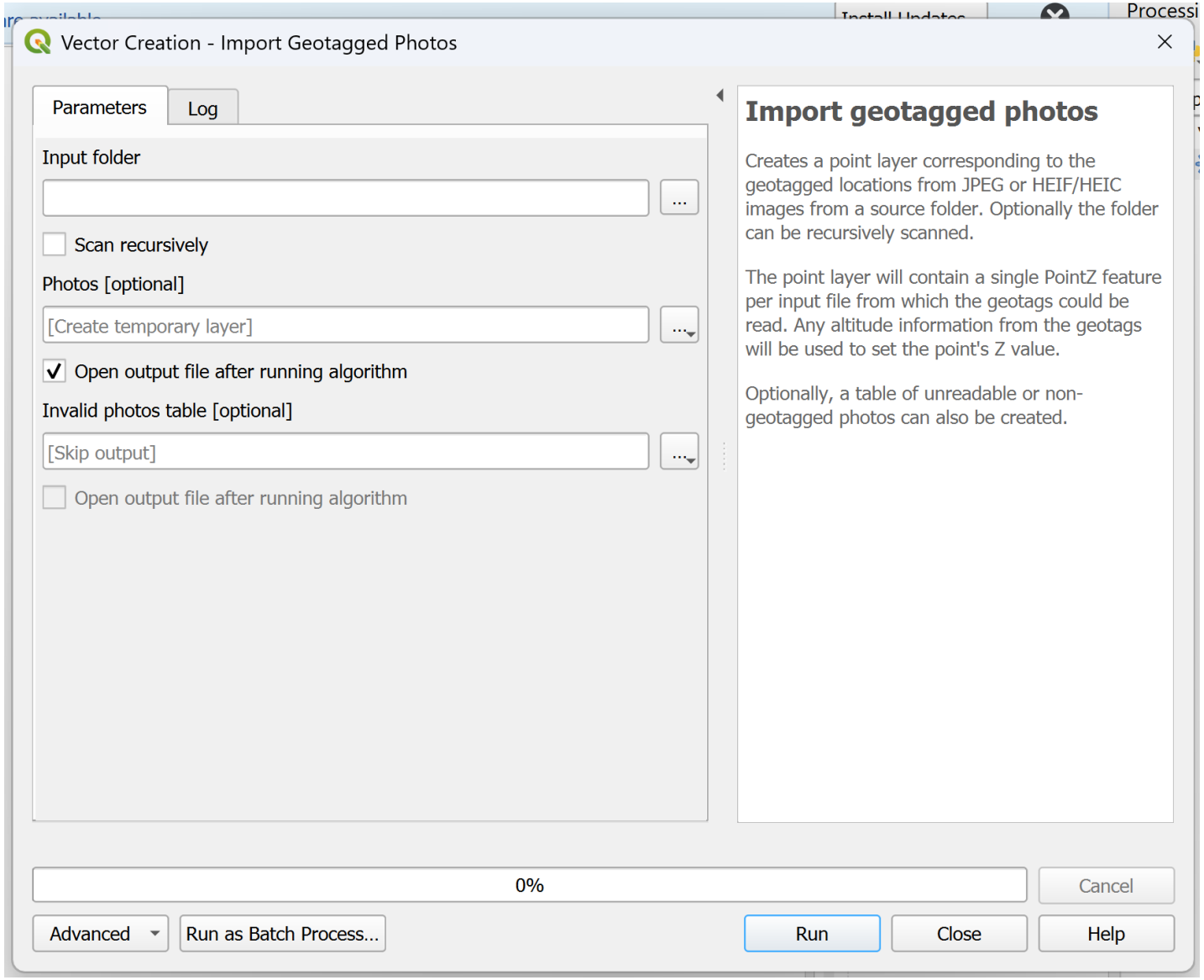
Apple

1. **Enable Location Services for Camera**
    1. Go to **Settings** → **Privacy & Security** → **Location Services**
    2. Ensure **Location Services** is **ON**
    3. Scroll down and select **Camera**
    4. Choose **While Using the App** or **Always**
2. **Verify Geotagging in Photos**
    1. Open **Camera** and take a picture
    2. Open **Photos app**, select the image, and swipe up
    3. If **location appears**, geotagging is active
3. **Troubleshooting**
    1. If no location is saved, restart the phone and retake the photo
    2. Ensure **Airplane Mode is OFF** (GPS needs connectivity)

Android

1. **Enable Location Services**
    1. Go to **Settings** → **Location**
    2. Toggle **Use Location ON**
2. **Enable Location for Camera**
    1. Open the **Camera app**
    2. Go to **Settings (Gear Icon)**
    3. Look for **Save Location / Location Tags / Geotagging** (varies by brand)
    4. Turn it **ON**
3. **Verify Geotagging in Photos**
    1. Take a picture
    2. Open **Google Photos** or **Gallery**
    3. Swipe up on the photo and check if a **map/location** appear

3. Geolocated Photos



How to preserve geolocation data?

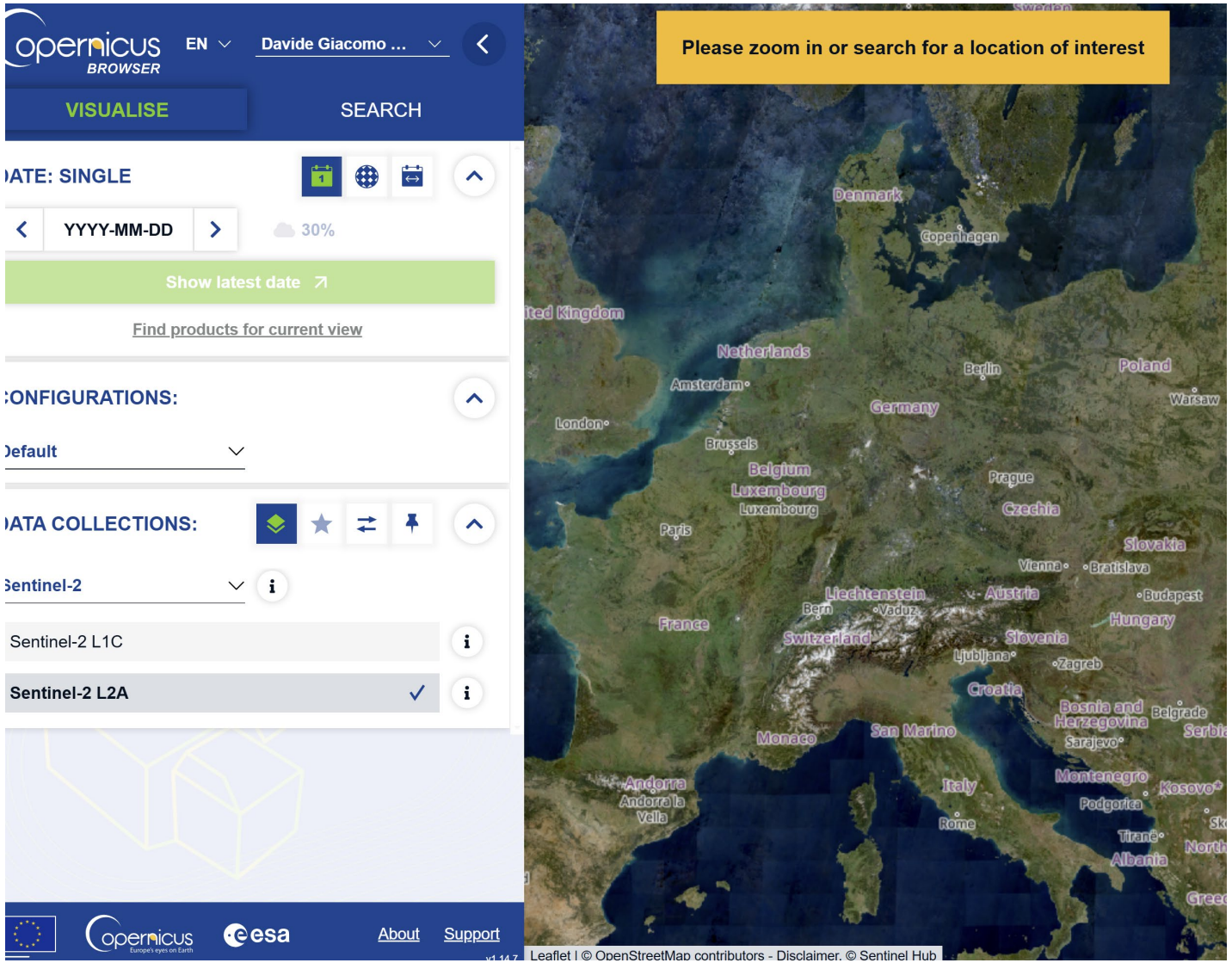
- WhatsApp/Telegram etc **removes EXIF metadata.**
- You can still share geolocated images using these methods:
- **Method 1: Send as a "Document" (Keeps GPS Data)**

1. Open **WhatsApp** and go to the chat.
2. Tap the **paperclip (Android) or "+" icon (iPhone)**.
3. Select **Document** → **Browse Other Docs**.
4. Navigate to your **photo folder** and select the image.
5. Send the photo **without compression**—the metadata, including location, remains intact.

4. Satellite Imagery

- How to Get an API Key?

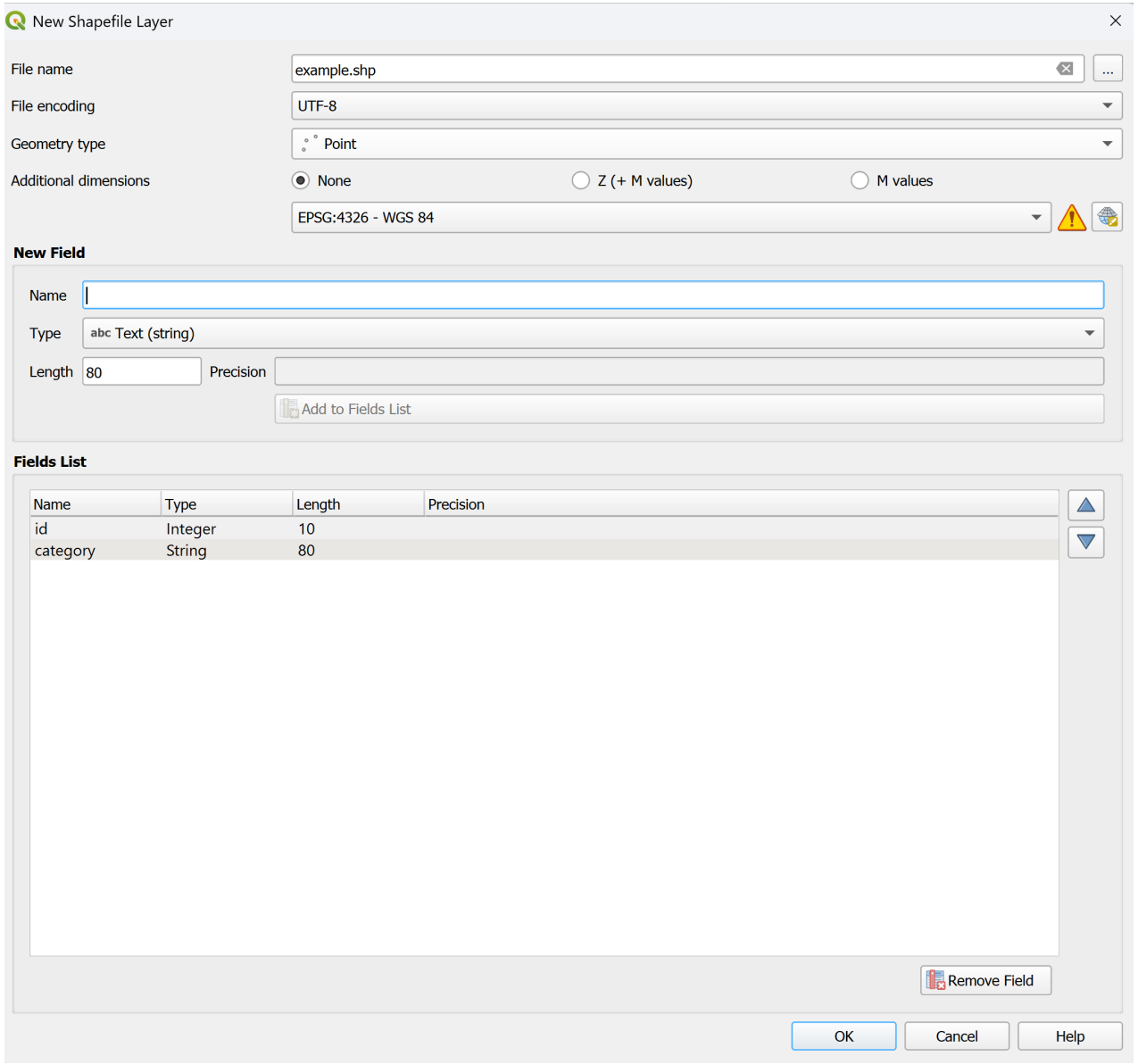
1. Sign up at https://browser.dataspace.copernicus.eu/
2. Navigate to Dashboard → Access & Authentication.
3. Create a new API Key under OAuth Clients.
4. Use the key in your API requests or applications.



Adding Fields

- Create layer and add fields
- Make sure to define the correct type

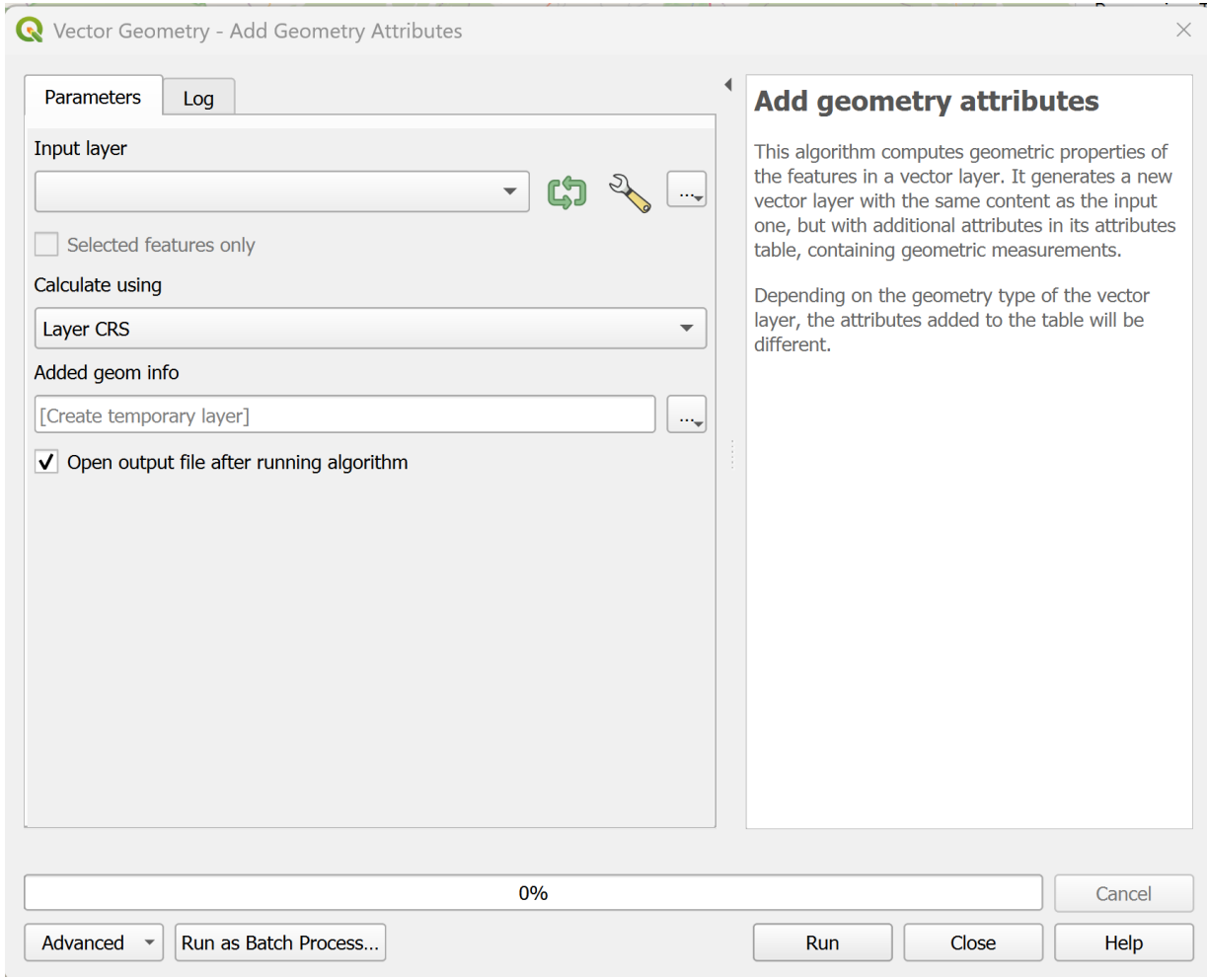
Data Type	Description
Short Integer	Integer values between -32,768 and 32,767
Long Integer	Integer values between -2,147,483,648 and 2,147,483,647
Float	Decimal values with 1-6 decimal places
Double	Decimal values with more the 6 decimal places
Text	Text strings
Date	Data info (mm/dd/yyyy)



Add Geometric Fields

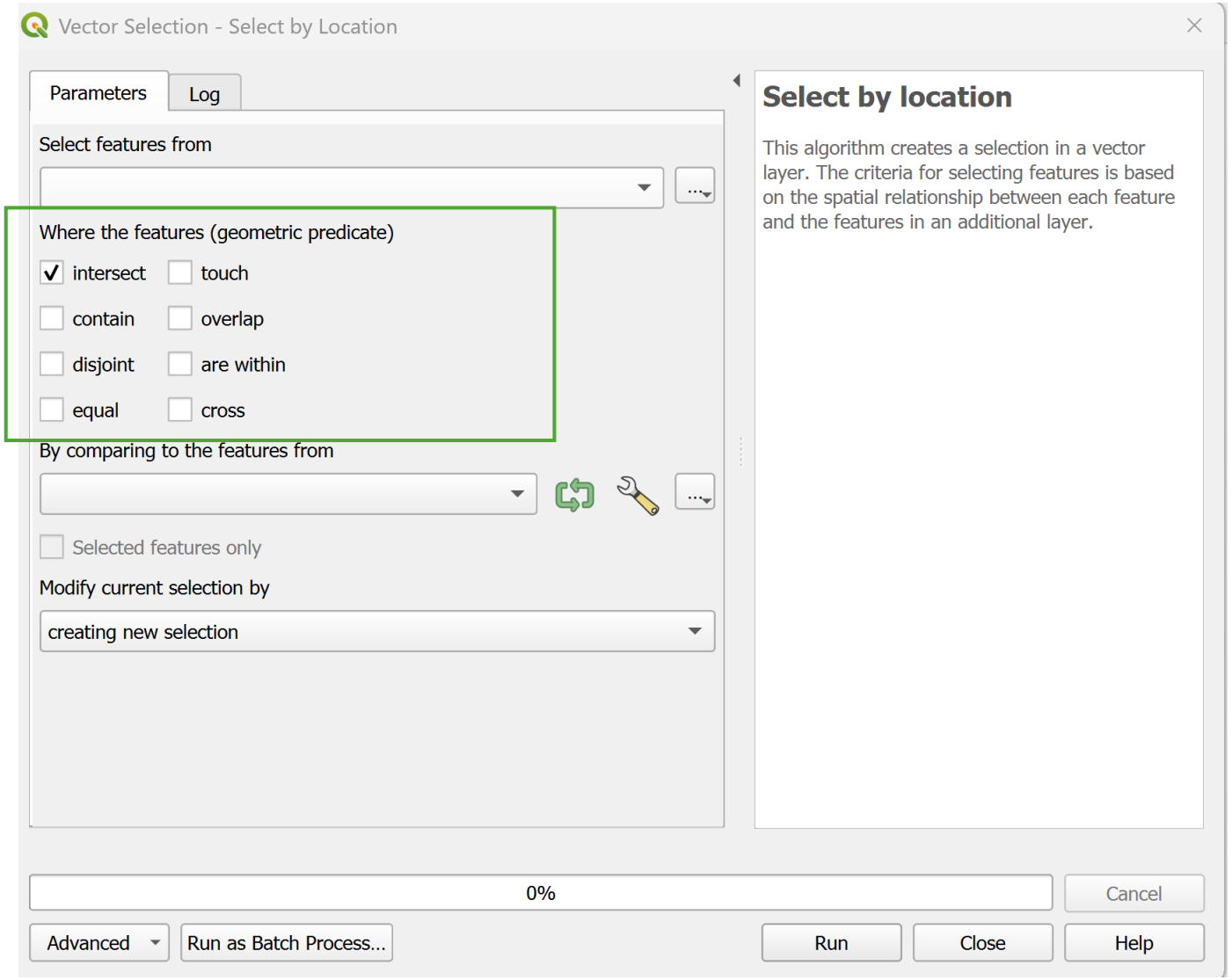
- Use Add Geometry Attributes Tool

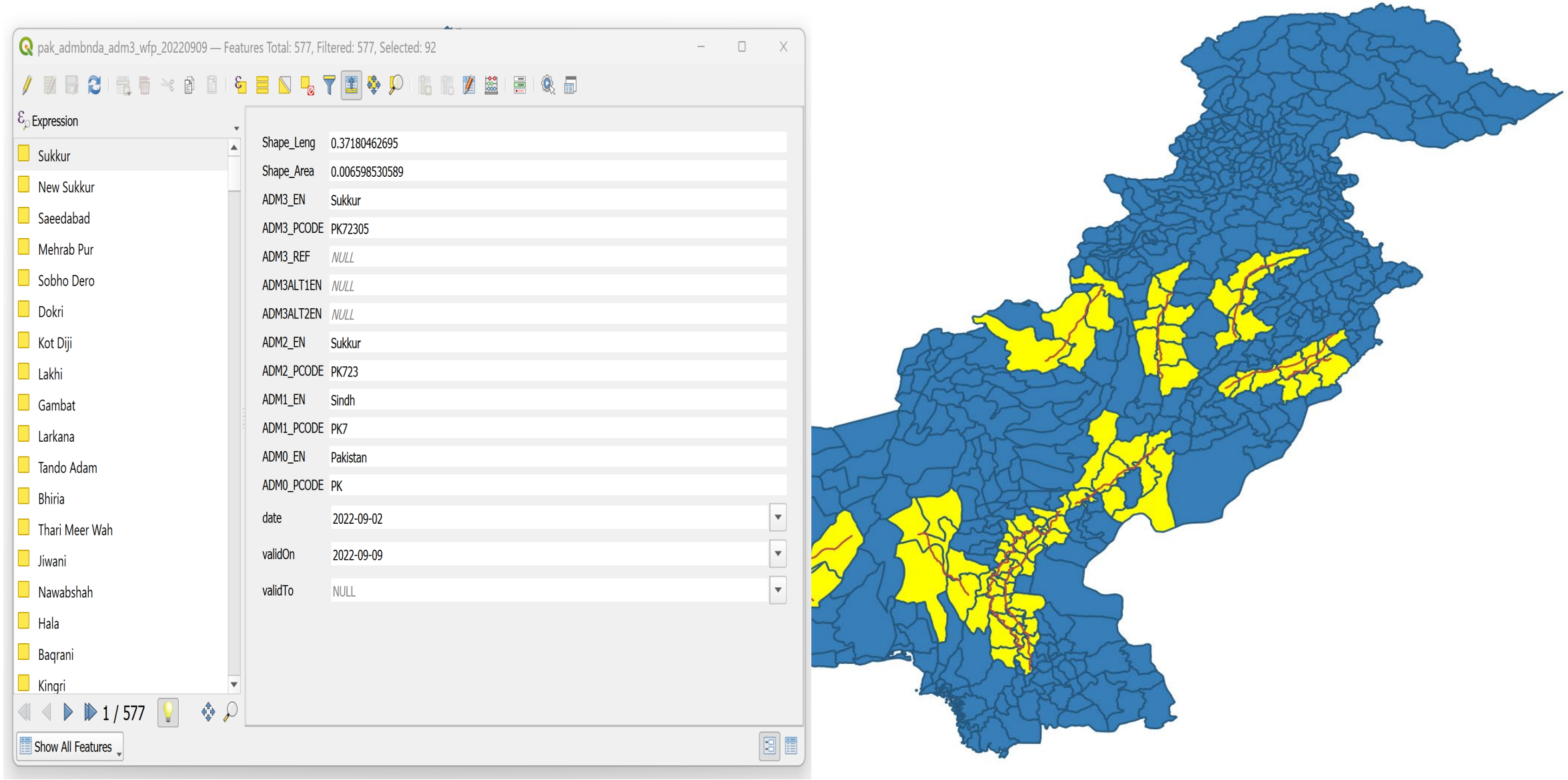
Spatial Data Type	Geometry?
points	X y coordinates
lines	Length bearing
polygons	Area/perimeter/centroid



Select by Location

- Select based on spatial relationships to other geographic features




pak_admbnda_adm3_wfp_20220909 — Features Total: 577, Filtered: 577, Selected: 92
Expression
Sukkur
New Sukkur
Saeedabad
Mehrab Pur
Sobho Dero
Dokri
Kot Diji
Lakhi
Gambat
Larkana
Tando Adam
Bhiria
Thari Meer Wah
Jiwani
Nawabshah
Hala
Baqrani
Kingri
1 / 577
Show All Features
Shape_Leng 0.37180462695
Shape_Area 0.006598530589
ADM3_EN Sukkur
ADM3_PCODE PK72305
ADM3_REF NULL
ADM3ALT1EN NULL
ADM3ALT2EN NULL
ADM2_EN Sukkur
ADM2_PCODE PK723
ADM1_EN Sindh
ADM1_PCODE PK7
ADM0_EN Pakistan
ADM0_PCODE PK
date 2022-09-02
validOn 2022-09-09
validTo NULL

OF SYMBOLS AND REPRESENTATIONS

Outline of Hereford Mappa Mundi c. 1285, showing modern countries