UNIVERSITÄT BERN

GIS in Archaeology

04 - Georeferencing

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You can download a pdf of this presentation.

Why georeferencing information is necessary?

- Many spatial informations are already available in digital form
- Archaeology often deals with legacy data (before the 1990s)
- Vital information about site distribution or excavations are available only as printed maps ins books
- Even for later publications, most of the time no digital data are available
- For reevaluation, analysis or combining with other information, it is necessary to bring them to a GIS

Things to consider

- Every map comes with its own projection. Sometimes known, more often not
- Every mapping results in errors or imprecision. Every digitalisation adds errors up to that.
- Scale matters: digitised information on large scale might be precise enough, on small scale not. It is necessary to keep meta-data to know how the data were digitised (on what scale) to be able to understand on what scale they might be used.

Projections

- Every projection distorts some part of your map

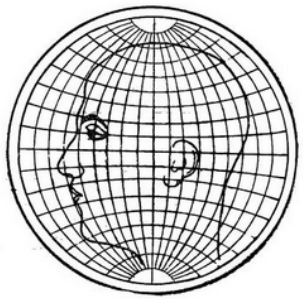


Fig. 42.—Man's head drawn on globular projection.

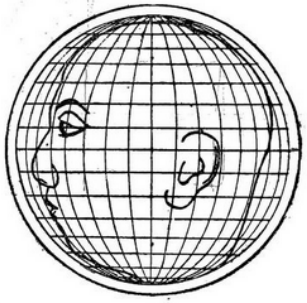


Fig. 43.—Man's head plotted on orthographic projection.

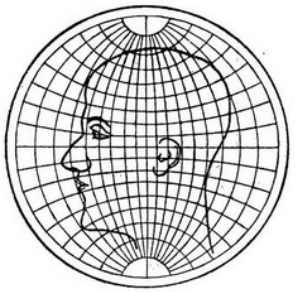


Fig. 44.—Man's head plotted on stereographic projection.

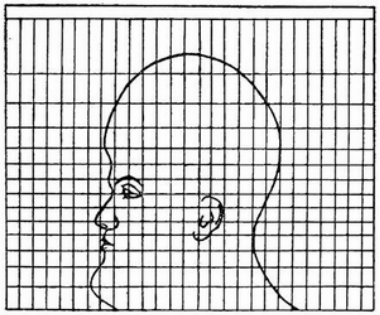


Fig. 45.—Man's head plotted on Mercator projection.

FlowingData

Things we will do today

- Georeference a map
- Digitise the information on a map

Georeference a map

We use the example of the Early Bronze Age burial ground of Miskovice in the Czech Republic.
General location:

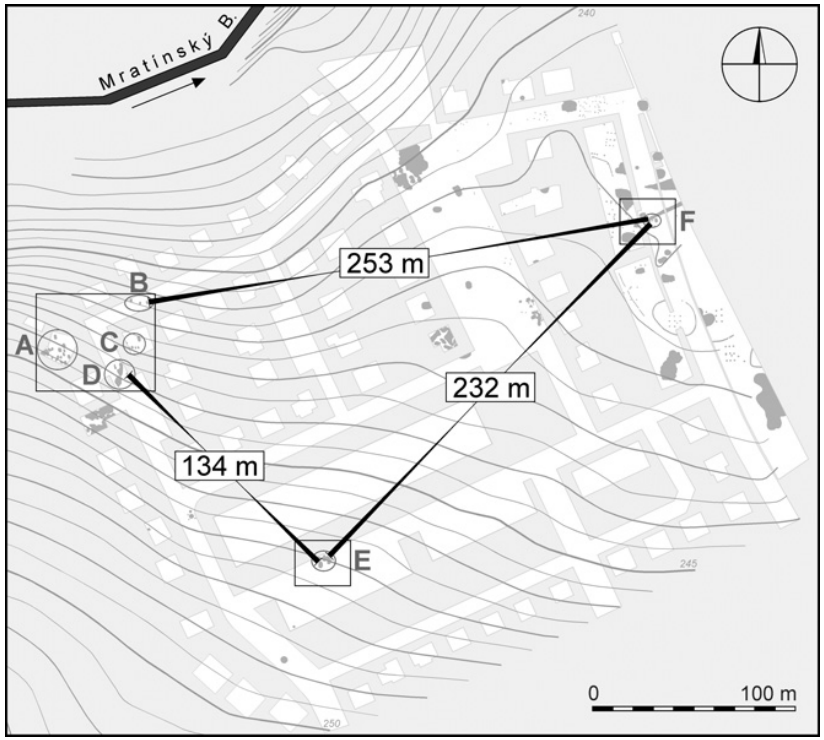
50°09'26.0"N 14°32'30.0"E (Degree, Minutes, Seconds)

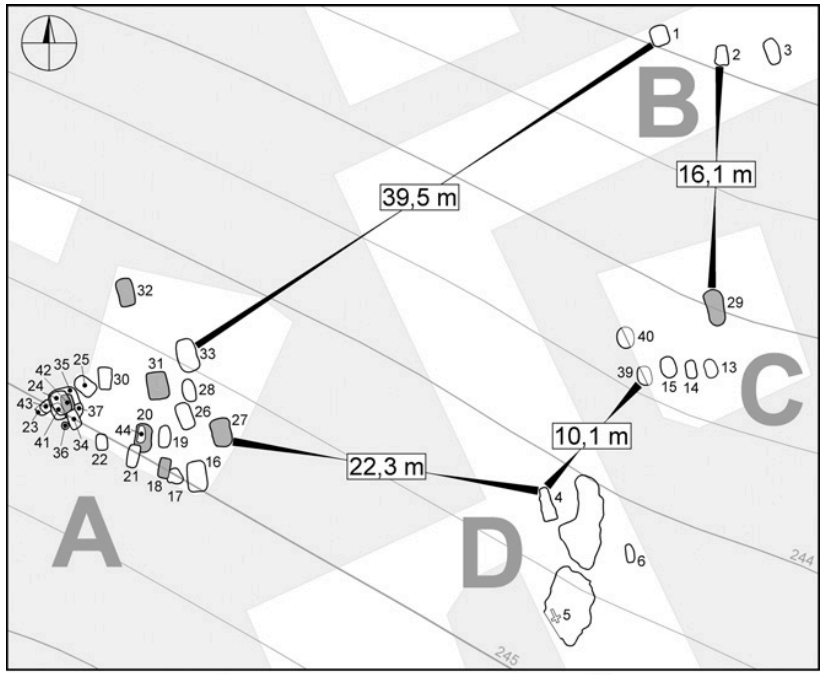
50.157222, 14.541667 (Decimal Degree)

https://goo.gl/maps/ZRNGjJZVchzGwbHS6

How the spatial information come in the publication

- an overview map + more detailed map of the burials
- no information on CRS are available
- no reference coordinates are given





Let's Get Started

1. Click this link and download the 'Overview' map
2. Click this link and download the detailed map
3. Open QGIS
4. Start a new project
5. Add a background layer with 'manmade features', eg. positron

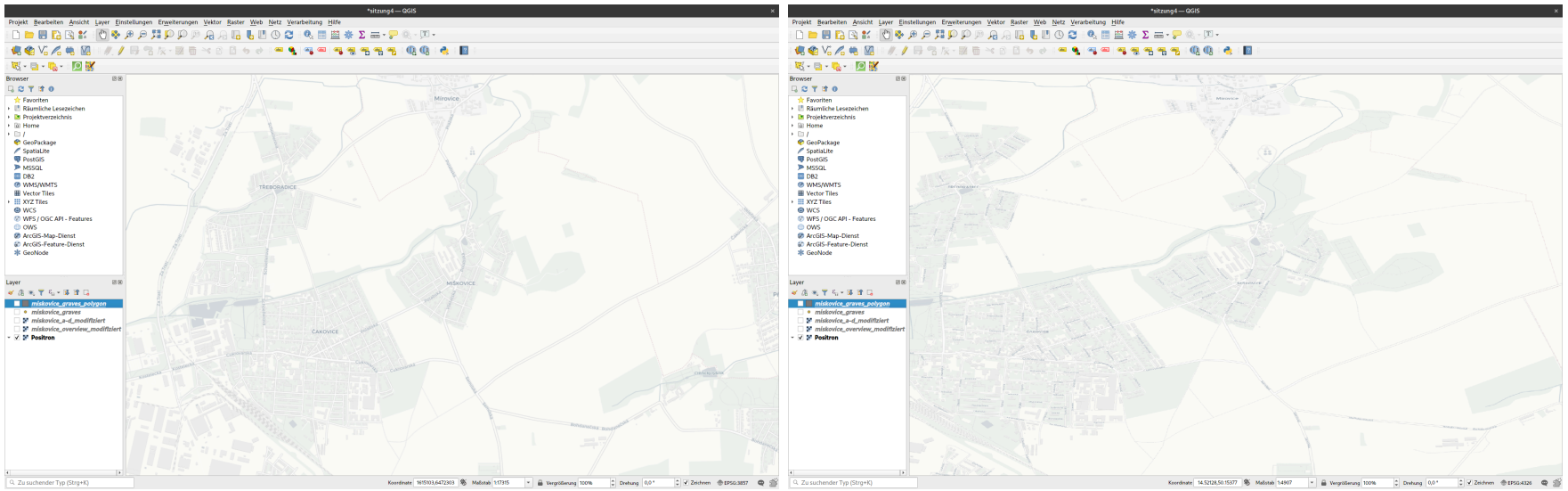
Locate the general area

North-West of Prag

- 50.157222, 14.541667 (Decimal Degree) EPSG 4326
- 1618620.5, 6472956.1 (EPSG 3857)

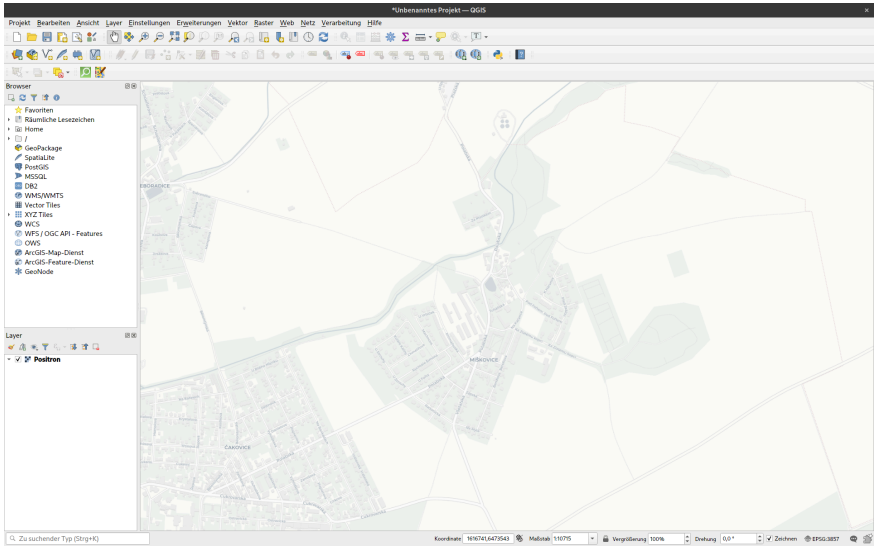
Check your Project CRS!

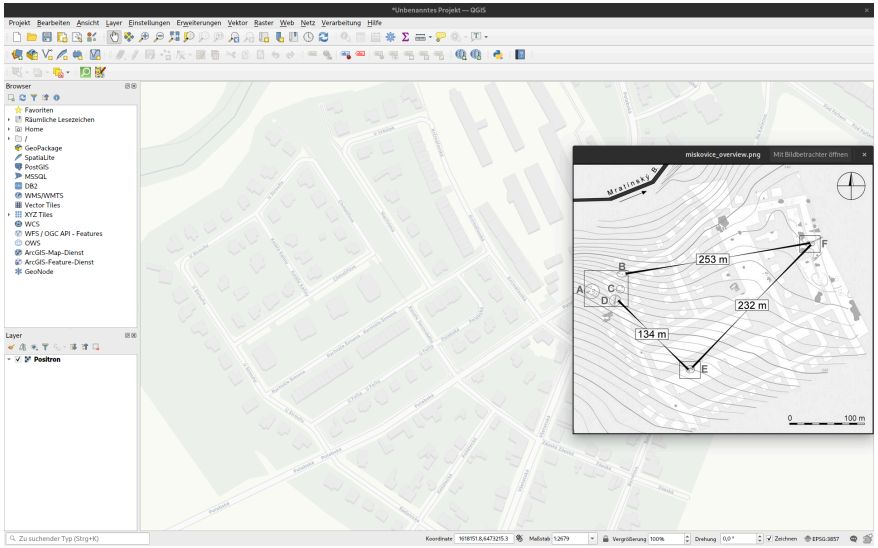
Use EPSG 3857, as this is the native projection for our background reference map (Positron).



Locate the specific mapped area

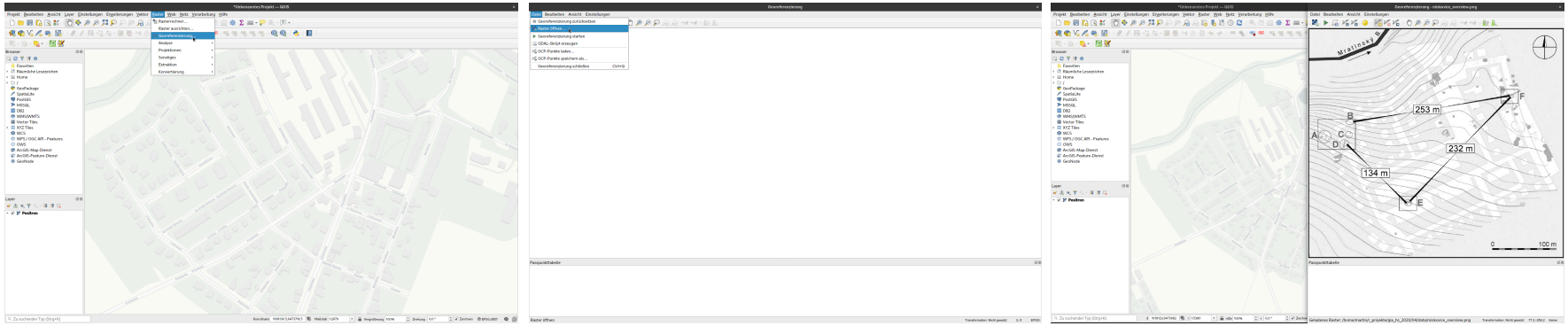
- compare the overview map with the background reference map





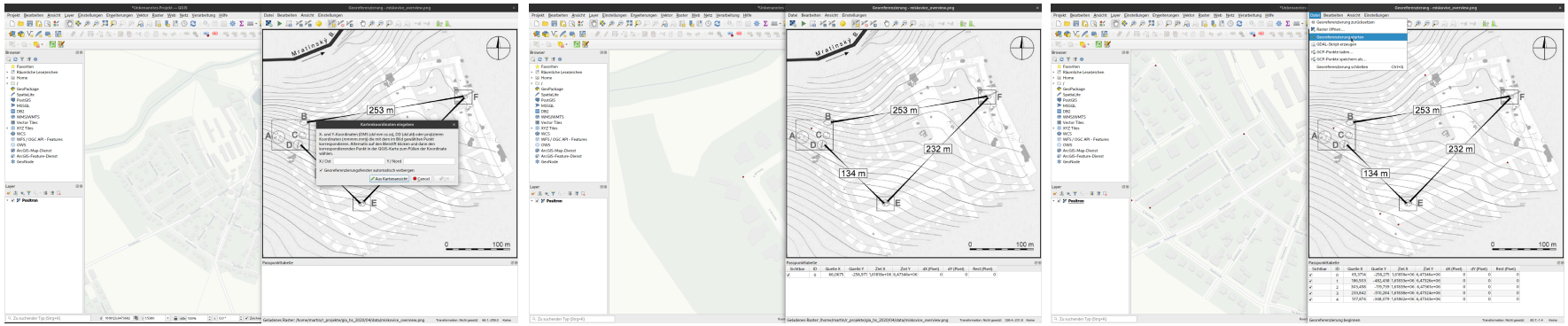
Start georeferencing

- Open the Georeferencing Tool
- In there, Open the raster image



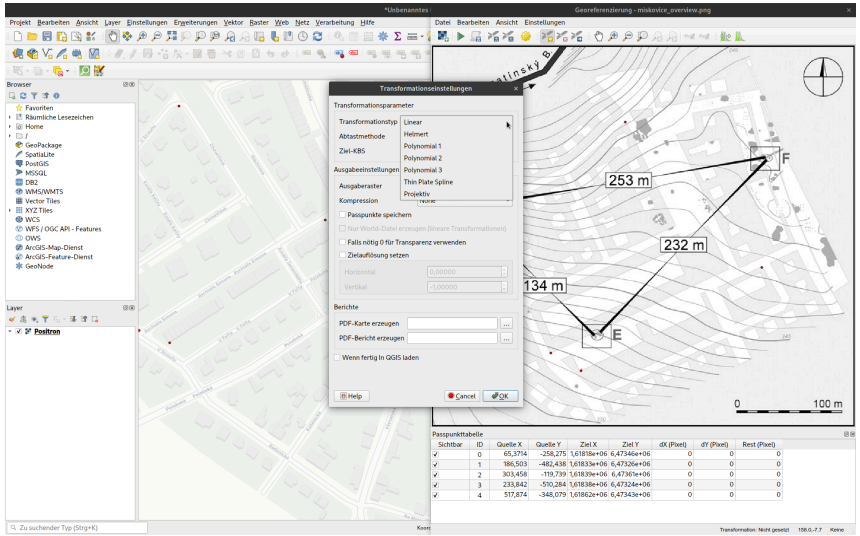
Identify and mark congruent points

- Click on 'Add Point' in the Georeferencing tool
- Identify in both maps points that represent the same feature
- Click on that point in the raster image
- In the dialog, either add known coordinates, or click on 'From map view'
- Click in 'map view' on the corresponding point
- Click on 'OK'
- Repeat, until you have at least 5 points
- **Try to spread the points over the whole image!**



Start the transformation (1)

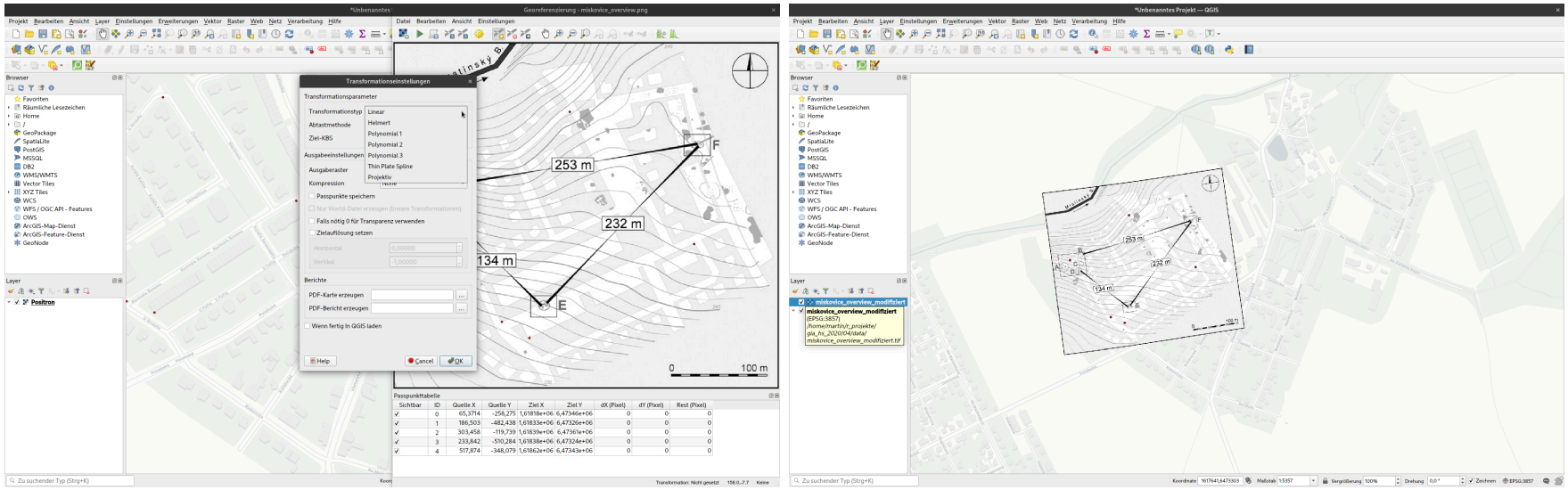
- Click on 'Transfomation Settings' (the cogwheel icon)
- Transformation types:
  - The *Linear algorithm* does not actually transform the raster. This algorithm likely won't be sufficient if you are dealing with scanned material.
  - The *Helmert transformation* performs simple scaling and rotation transformations.
  - The *Polynomial algorithms 1-3* are among the most widely used algorithms.
  - The *Thin Plate Spline (TPS) algorithm* is useful when very low quality originals are being georeferenced.
  - The *Projective transformation* is a linear rotation and translation of coordinates.



We use either Thin Plate Spline or Projective Transformation.

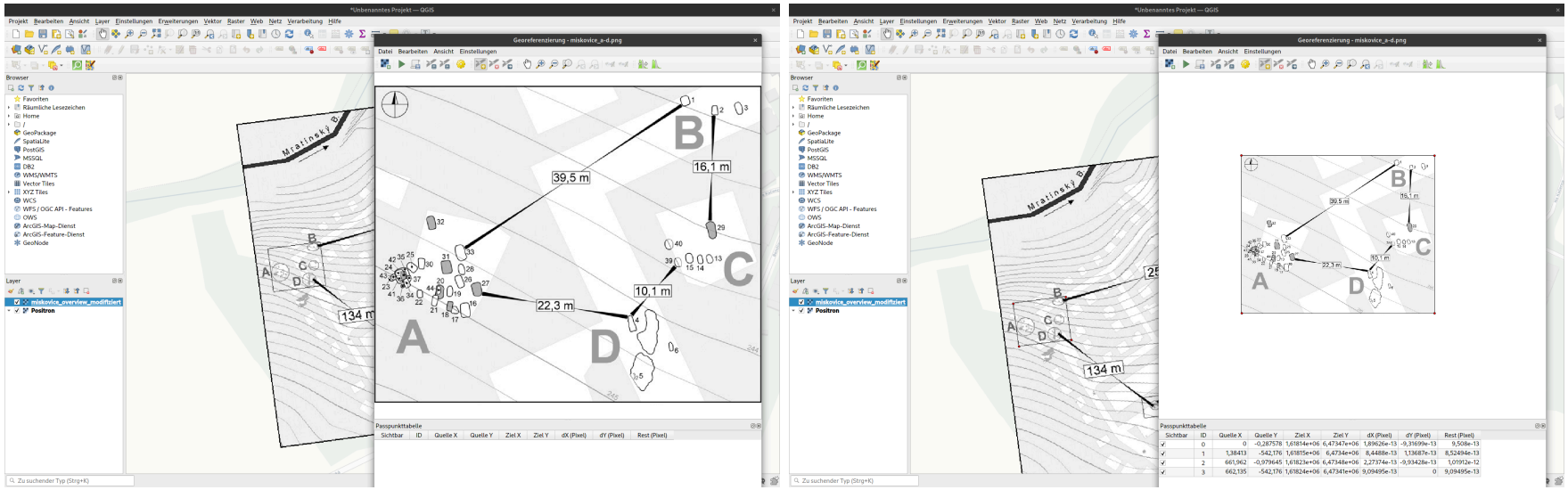
Start the transformation (2)

- Define the Target CSR matching our input CSR (EPSG 3857).
- Select the output raster file to create
- Select 'Add to QGIS when ready'
- Click on 'OK'
- Test different Transformation algorithms



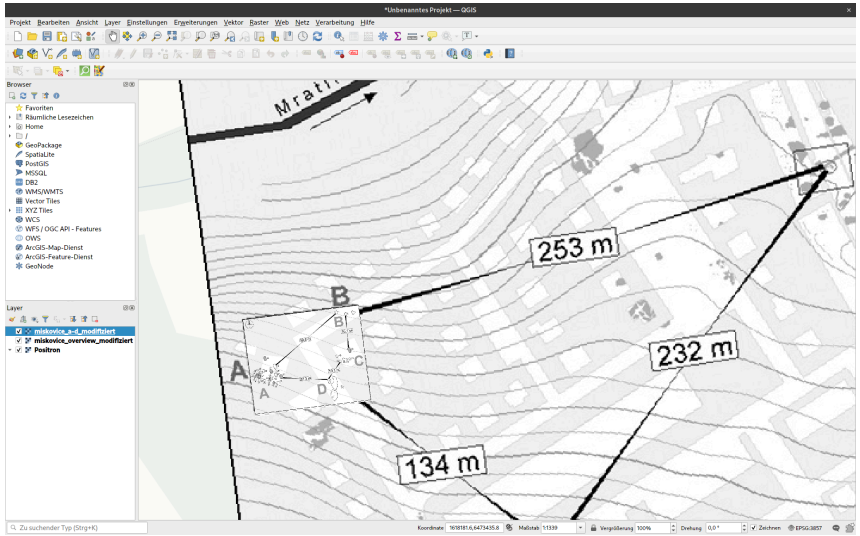
Georeferencing the detailed map

- Your turn:
  - Open the detailed map in the georeferencing tool
  - Georeference it based on the already georeferenced overview map
  - *Tip:* You can use the corners of the map...



Result

- Now you should have the maps georeferenced, i.e. their orientation and extend are aligned with the reference map.
- You can activate and deactivate the layer to compare
- Every pixel in the map should be placed in space as best as possible
- You can start digitising features of the map into spatial data (eg. as shapefile)



Digitising Points

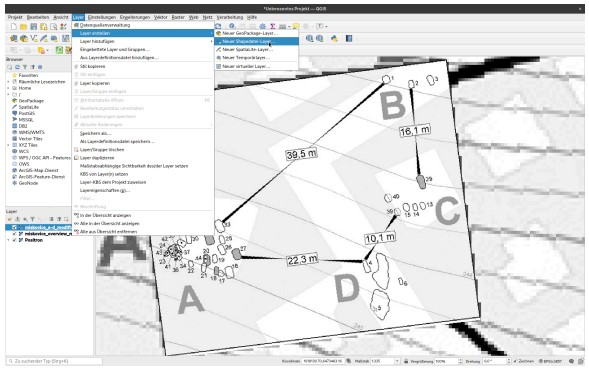
Now we can start recording the position of map features as spatial data. Remember the types of vector data:

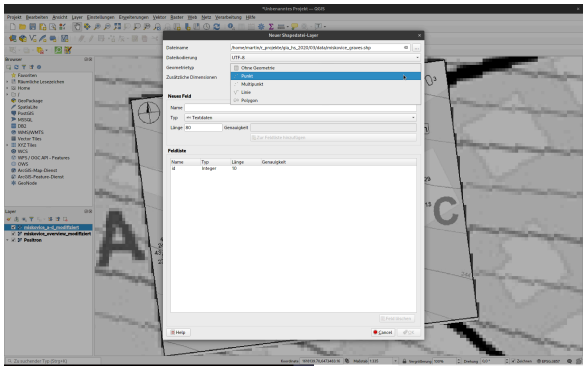
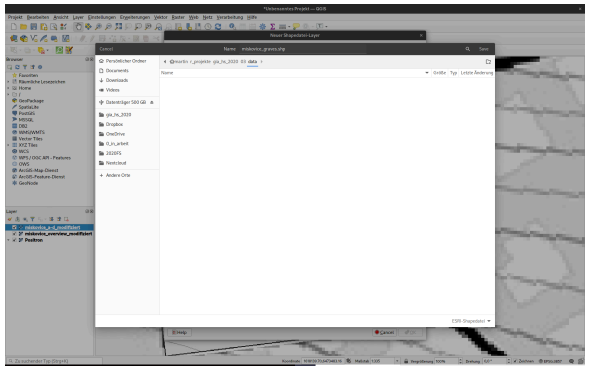
- Point
- Line
- Polygon

At first, we digitise the burials as points. To do so, we add a new Shapefile layer.

Adding a point layer

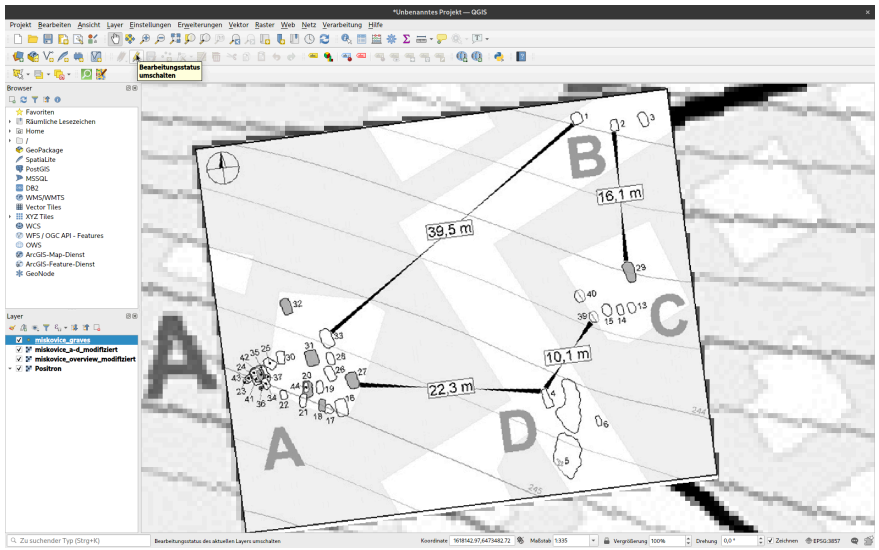
- Click on 'Layer > Create Layer > New Shapefile Layer'
- As geometry type, you can select 'Point'
- Select the storage location and name of your new layer
- You can add more fields (of different data tye) to the shapefile layer as needed.
- (We stick to the ID field as only field for now)
- Click on 'OK'.

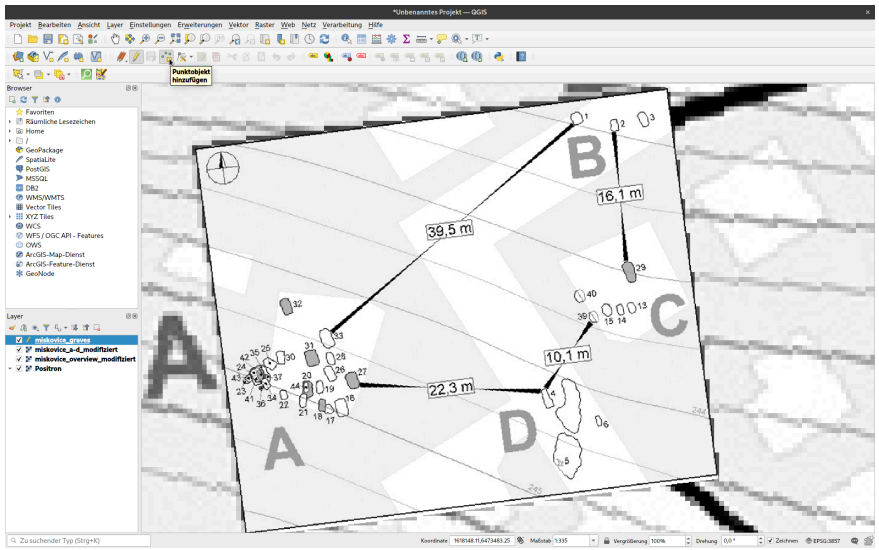


Adding point features to a shapefile layer (1)

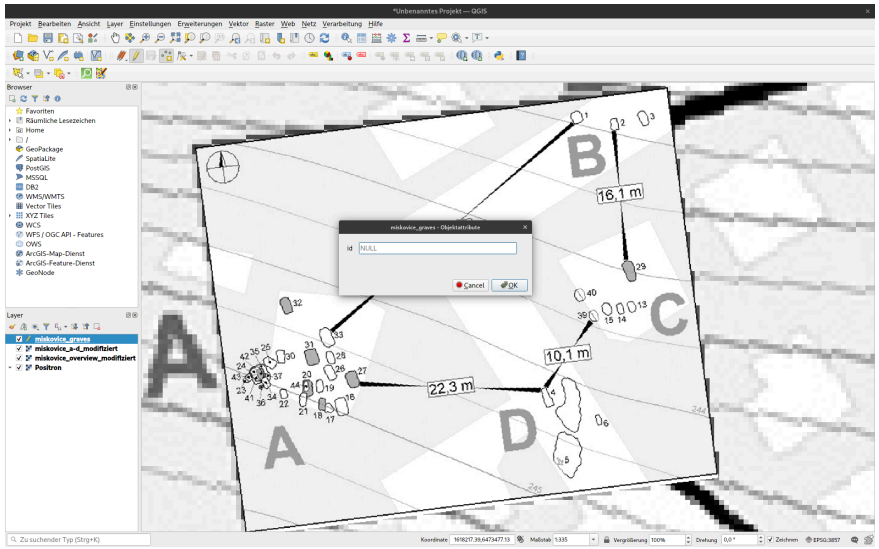
- First, enable Editing Mode
- Than, select 'Add Point Object'

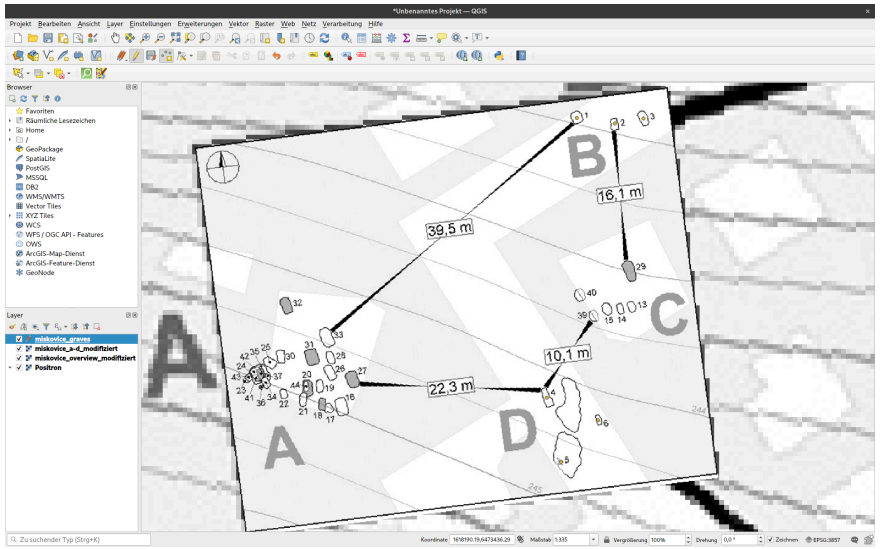




Adding point features to a shapefile layer (2)

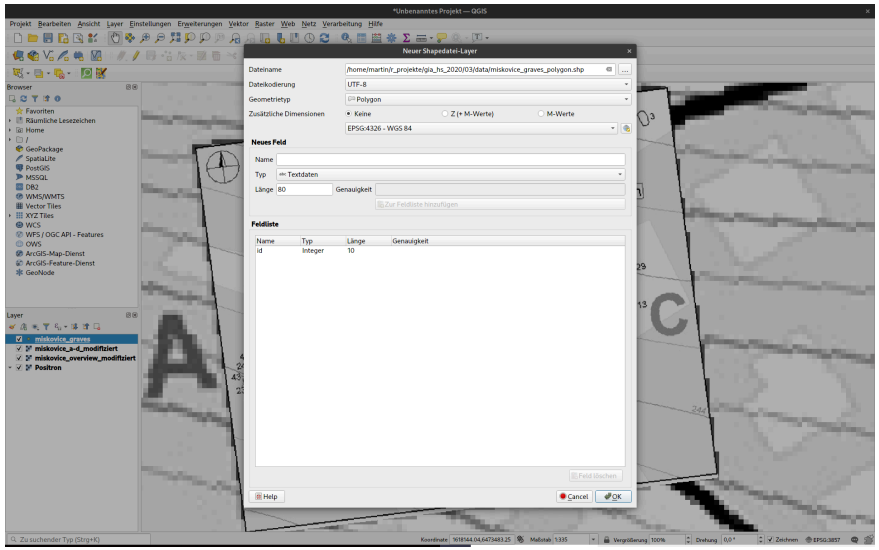
- Click in the center of a burial
- In the dialog, add the burial number as id
- Repeat for all burials...
- Click on 'Save Changes' and on 'Switch Edit Mode' to store your changes in the file.

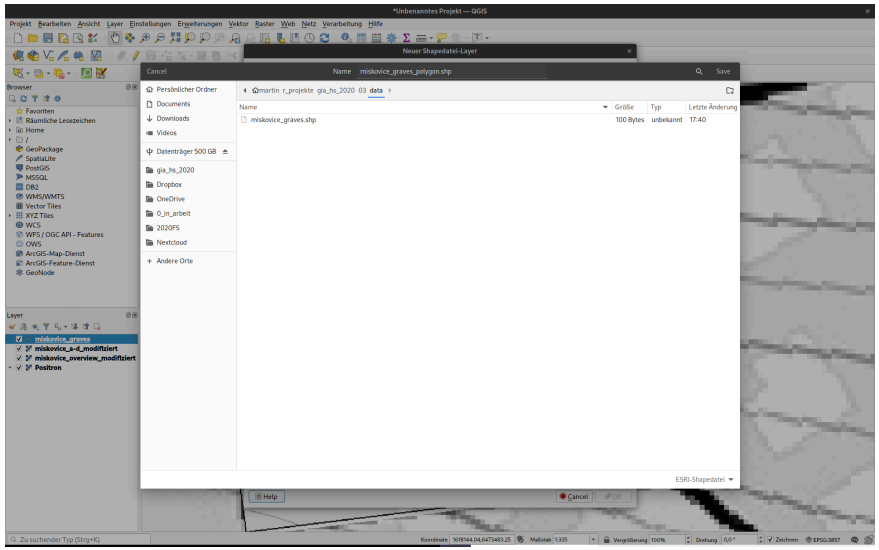




Adding polygon features to a shapefile layer (1)

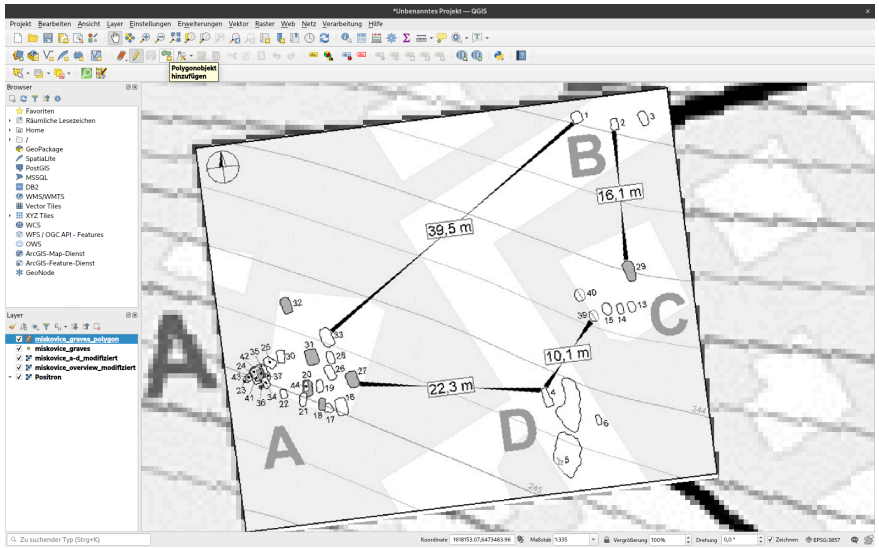
- If you need to record the extend of objects, you might like to consider digitising them as polygon
- Add new layer, select 'Polygon' as Geometry type
- Add fields as needed, select storage location, mark name with '_polyon' or similar to know later the geometry type of that layer.

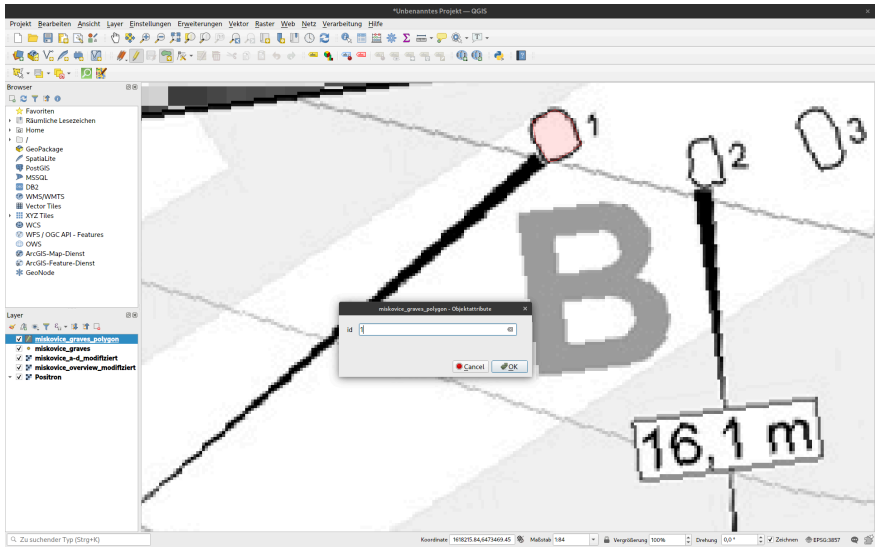




Adding polygon features to a shapefile layer (2)

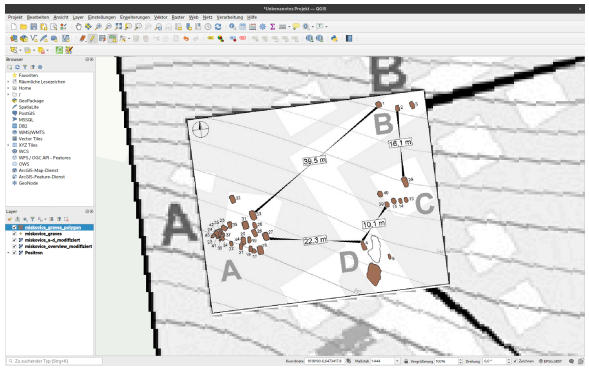
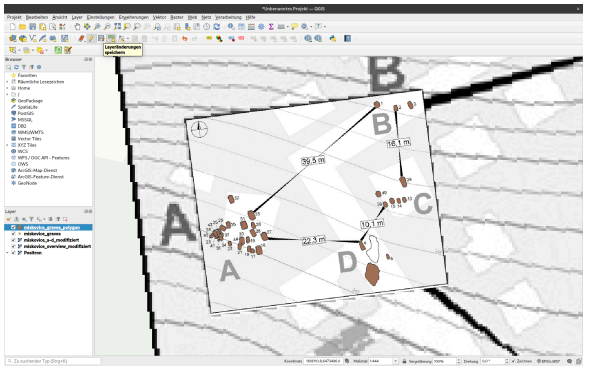
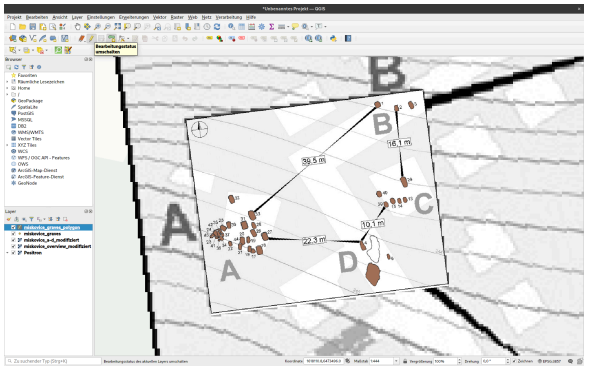
- First, enable Editing Mode
- Than, select 'Add Polygon Object'
- Left click on a point of the burial border
- Add more nodes of the polygon by left clicking on further points of the burial border
- Right click to finish adding points





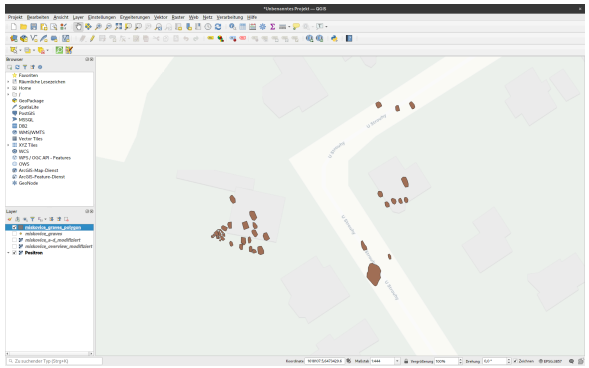
Adding polygon features to a shapefile layer (3)

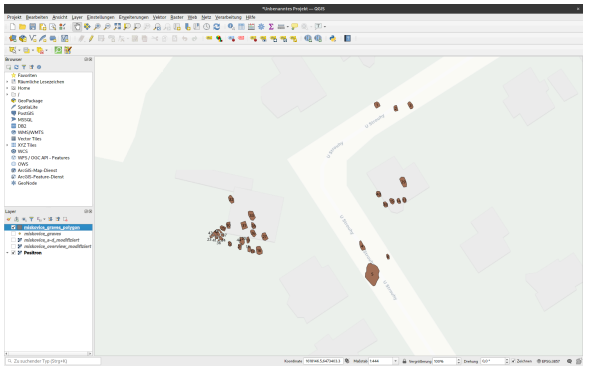
- Repeat for all burials
- Click on 'Save changes' and 'Switch Edit Mode'
- Your new layer contains now the spatial information for all burials

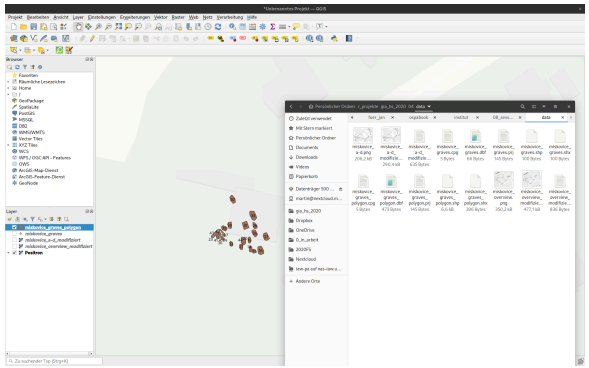




Inspect the final result

- You now can deactivate the georeferenced map to inspect the result on the background reference map
- You can also turn on labeling to see the burial numbers
- Now, you will have many different files in your output folder...







Finally

- Now you can use your data for mapping and for further analysis
- Keep in Mind:
  - Every mapping results in errors or imprecision. Every digitalisation adds errors up to that.
  - Scale matters: digitised information on large scale might be precise enough, on small scale not. It is necessary to keep meta-data to know how the data were digitised (on what scale) to be able to understand on what scale they might be used.
  - **Be as accurate as possible and neccesary**

Homework

- Select an arbitrary map from archaeological literature (individual burial ground to europe wide mapping).
- Digitise the information (point or polygon)
- Send me the resulting shapefile and the (georeferenced) original map.

Any questions?

Source: https://www.instagram.com/sadtopographies

You might find the course material (including the presentations) at

https://github.com/BernCoDALab/gia

You can see the rendered presentations at

https://berncodalab.github.io/gia

You can contact me at

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