UNIVERSITÄT BERN

GIS in Archaeology

05 - Handling Spatial Data

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You can download a pdf of this presentation.

Things to cover

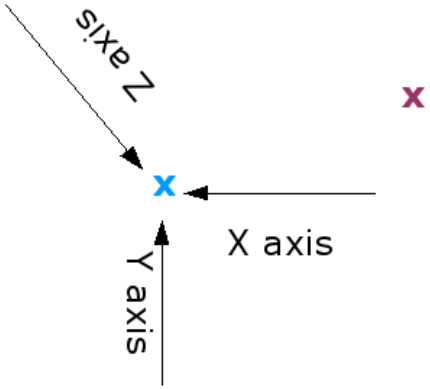
- Manipulation of vector data
- Spatial selection of vector data
- Working with buffers
- Creation of a Thematic Map (Choropleth) by combining vector data

Basic Map Elements

Points

Vector Point Feature

Point Geometry (indicates the x,y and z position of the feature)



Point attributes (describe the feature)

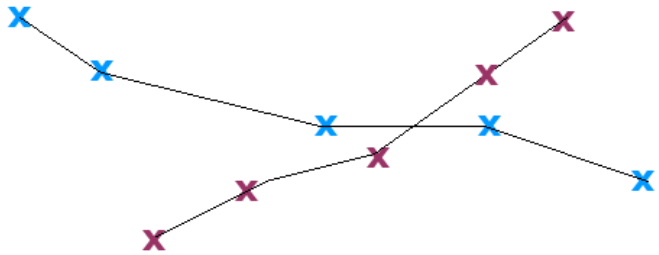
Id, Name, Description
1, Tree, Outside our classroom 2, Light post, At the school entrance

http://docs.qgis.org/2.8/en/docs/gentle_gis_introduction/vector_data.html#overview

Lines

Vector Polyline Feature

Polyline Geometry (a series of connected vertices that do not form an enclosed shape)



Polyline attributes (describe the feature)

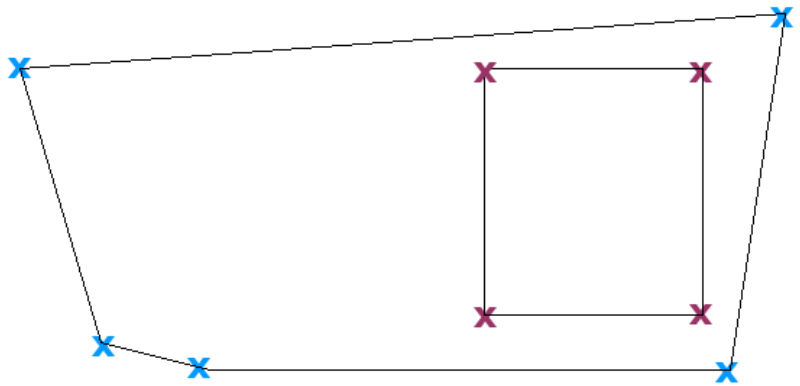
Id, Name, Description
1, Footpath 1, From class to the playground 2, Footpath 2, From the school gate to the hall

http://docs.qgis.org/2.8/en/docs/gentle_gis_introduction/vector_data.html#overview

Polygons

Vector Polygon Feature

Polygon Geometry (a series of connected vertices that do form an enclosed shape)



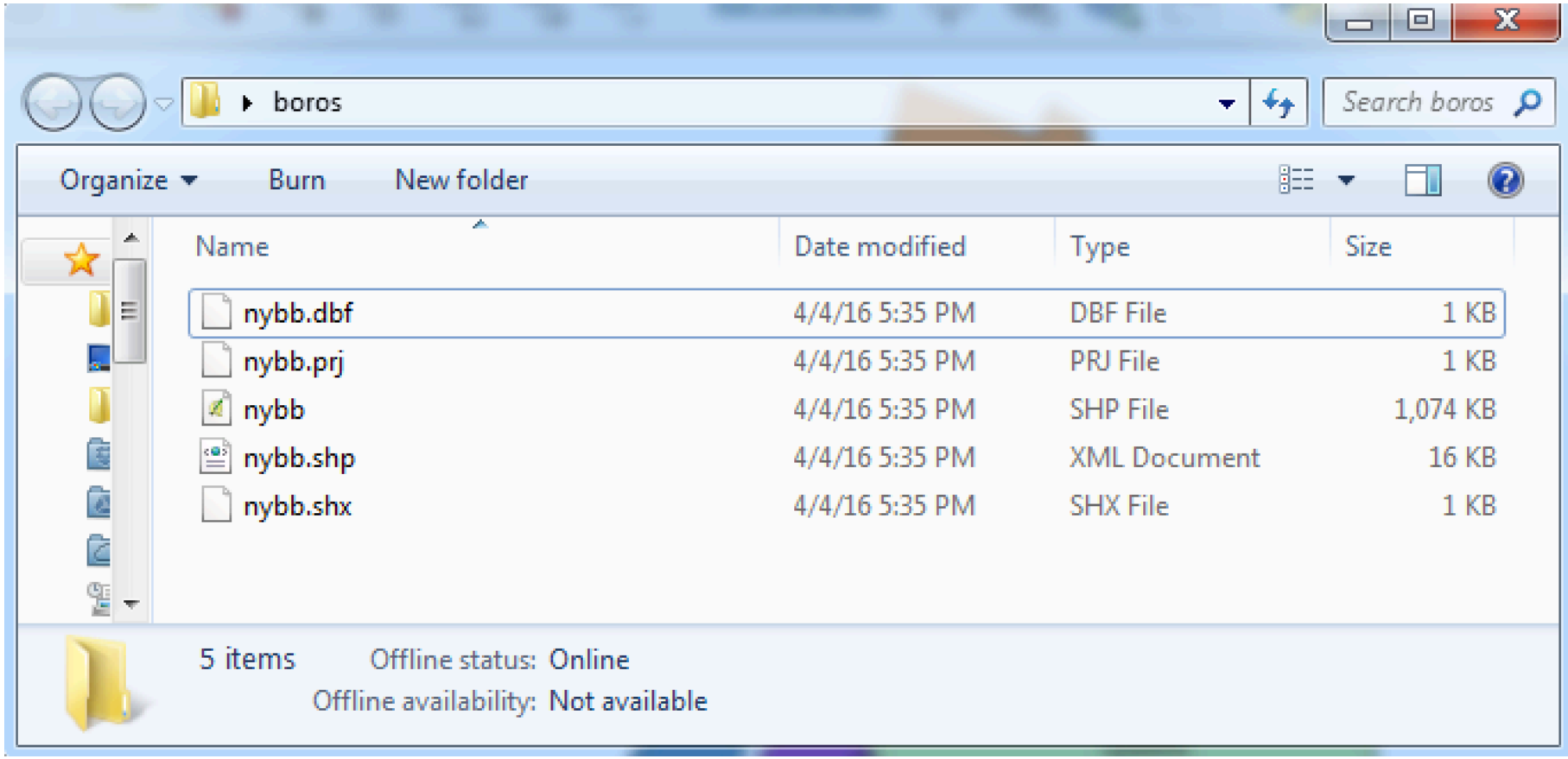
Polygon attributes (describe the feature)

Id, Name, Description
1, School Boundary, Fenceline for the school 2, Sports Field, We play soccer here

http://docs.qgis.org/2.8/en/docs/gentle_gis_introduction/vector_data.html#overview

Shapefiles

- Basic file for storing map elements
- Stores spatial data, like points, lines, and polygons
- Multiple files comprise a "shapefile"



Reworking of Shapefiles

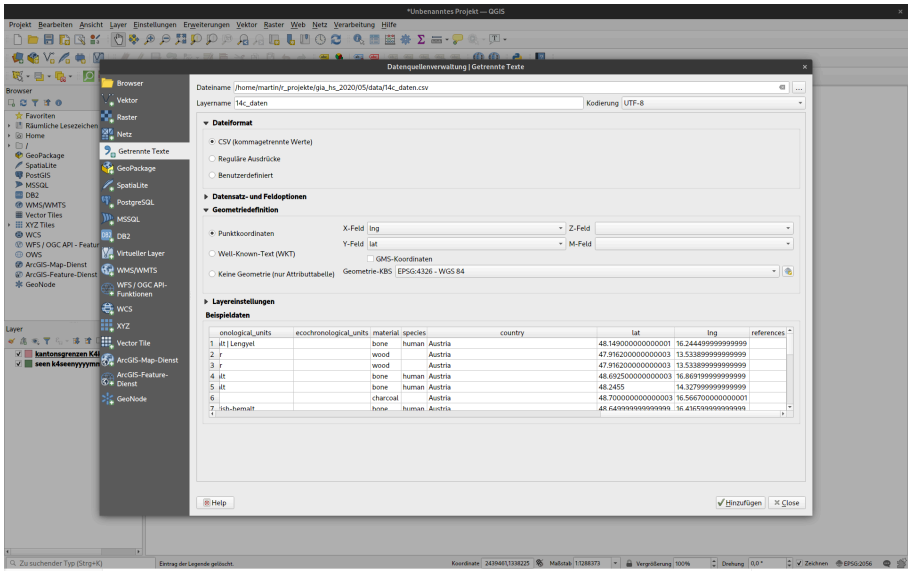
- Spatial (vector) data often can be downloaded, or created using digitalisation of scanned maps (last session)
- Sometimes it is necessary to combine informations (geometries) for the desired result
- for theses tasks there are geometry processing tools

Let's Get Started

1. Click this link and download the cantonal borders of Switzerland (shapefile) to your desktop
2. Click this link and download the lakes of Switzerland (shapefile) to your desktop
3. Click this link and download some 14C data (csv) also to your desktop
4. Open QGIS
5. Start a new project and Add all layers

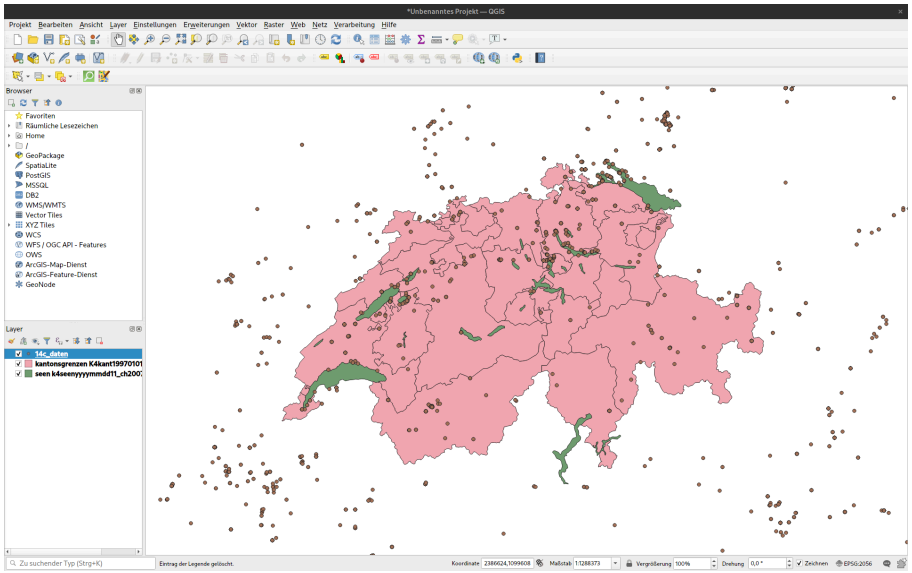
Adding a CSV Layer...Reminder

- csv data are 'delimited text' data, so use the approriate import tool
- the coordinates are store as lat/lng in columns named accordingly
  - lat -> *Latitude:* a geographic coordinate that specifies the **north–south** position of a point on the Earth's surface -> y-coordinate
  - lng -> *Longitude:* a geographic coordinate that specifies the **east–west** position of a point on the Earth's surface -> x-coordinate
- latitude/longitude -> World Geodetic System: WGS 84 -> **EPSG 4326**



Tasks for today

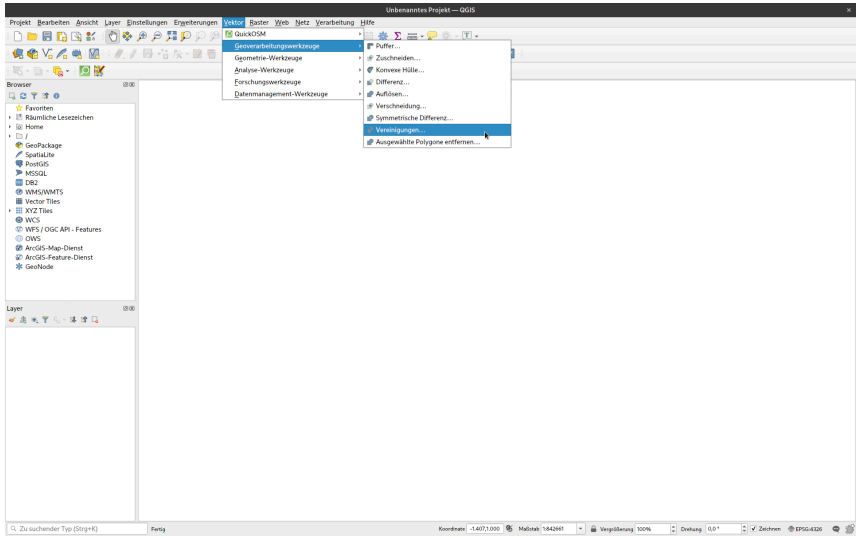
- Extract the 14C data for Switzerland
- Count how many data are in lakes and within 1 km around lakes
- visualise the mean age of 14C dates per canton



- first, we need a polygon of Switzerland (or create one ourself)

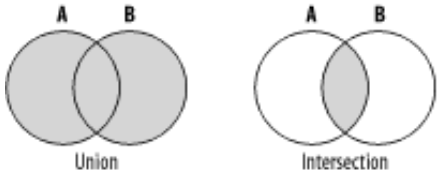
Vector overlay

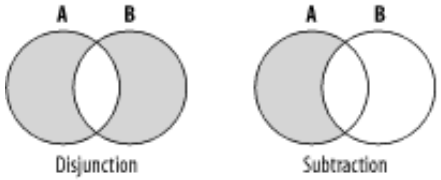
Combine different layers for to produce a combined result



Multiple Options

- Clip (Intersection)
- Difference (Substraction)
- Symmetric Difference (Disjunction)
- Union





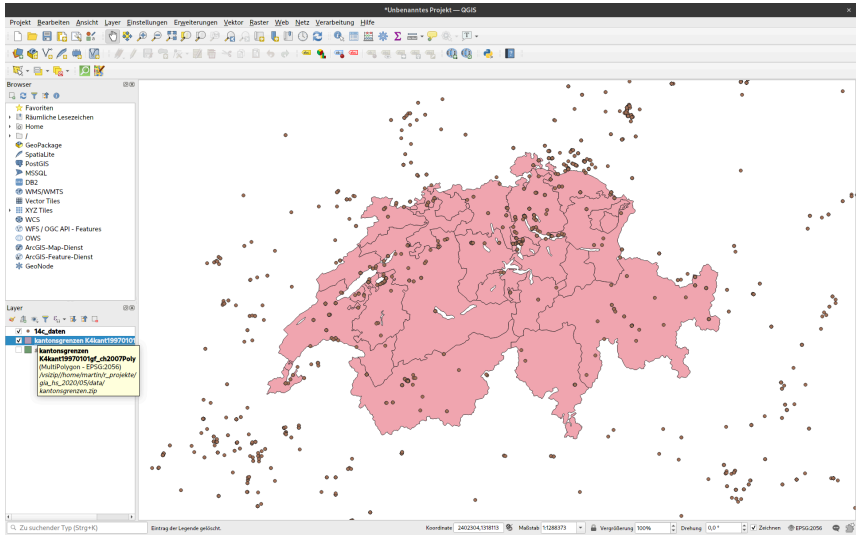
https://moderndilettante.wordpress.com/category/boole/

Combining lakes with cantons

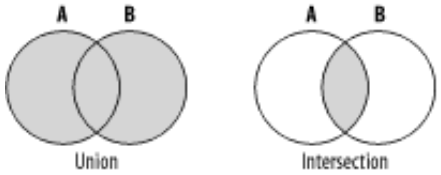
The cantonal borders exclude the lakes!
Check yourself...

We need to combine the lakes with the borders shapefile!

Not strictly necessary for our task at hand, but serves didactic purpose...



Which algorithm to use?



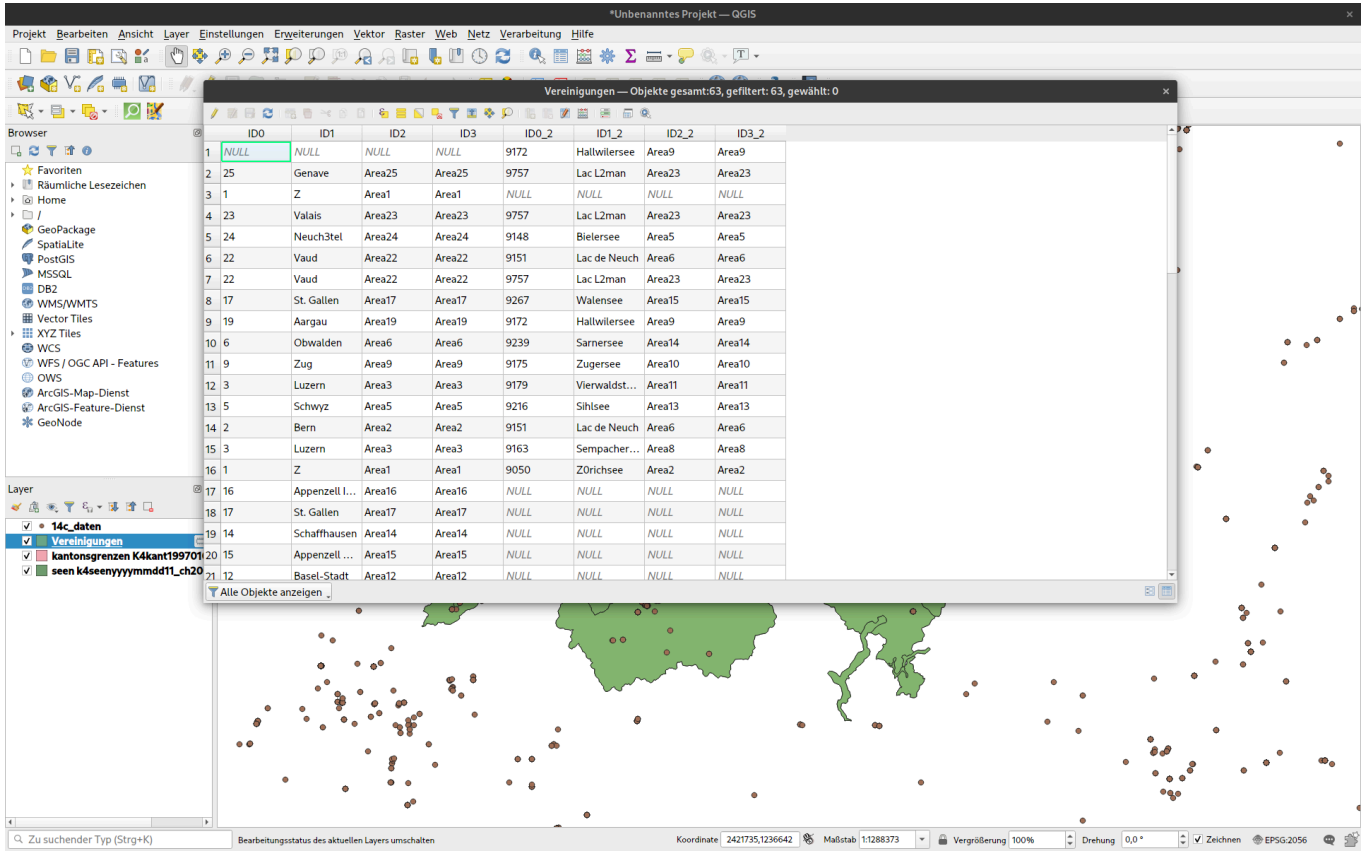
https://moderndilettante.wordpress.com/category/boole/

Union

- Select Union from Vector > Geometry-Processing
- Select the cantonal borders as one layer
- Select the lakes as second layer
- Temporary Layer is fine, so no need to specify storage location
- Check 'Open after success' checkbox
- Click 'Run'

Union Result

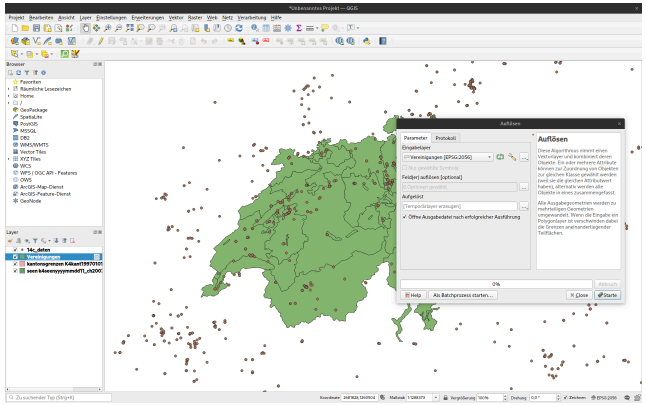
- A layer containing all polygons from both layers
- You can check in the attribute table:

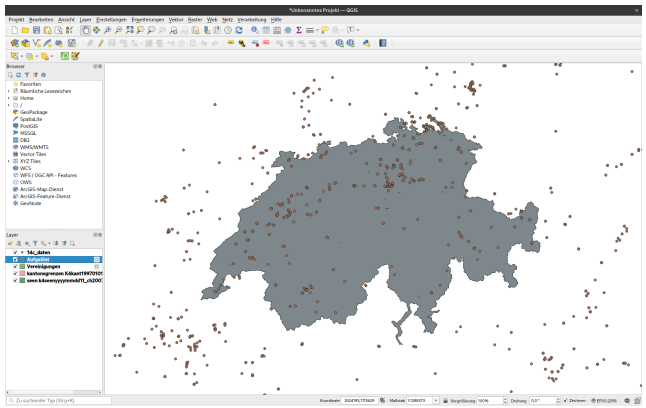


	ID0	ID1	ID2	ID3	ID0_2	ID1_2	ID2_2	ID3_2
1	NULL	NULL	NULL	NULL	9172	Hallwilersee	Area9	Area9
2	25	Genave	Area25	Area25	9757	Lac L2man	Area23	Area23
3	1	Z	Area1	Area1	NULL	NULL	NULL	NULL
4	23	Valais	Area23	Area23	9757	Lac L2man	Area23	Area23
5	24	Neuch3tel	Area24	Area24	9148	Bielersee	Area5	Area5
6	22	Vaud	Area22	Area22	9151	Lac de Neuch	Area6	Area6
7	22	Vaud	Area22	Area22	9757	Lac L2man	Area23	Area23
8	17	St. Gallen	Area17	Area17	9267	Walensee	Area15	Area15
9	19	Aargau	Area19	Area19	9172	Hallwilersee	Area9	Area9
10	6	Obwalden	Area6	Area6	9239	Sarnersee	Area14	Area14
11	9	Zug	Area9	Area9	9175	Zugersee	Area10	Area10
12	3	Luzern	Area3	Area3	9179	Vierwaldst…	Area11	Area11
13	5	Schwyz	Area5	Area5	9216	Sihlsee	Area13	Area13
14	2	Bern	Area2	Area2	9151	Lac de Neuch	Area6	Area6
15	3	Luzern	Area3	Area3	9163	Sempacher…	Area8	Area8
16	1	Z	Area1	Area1	9050	ZOrichsee	Area2	Area2
17	16	Appenzell I…	Area16	Area16	NULL	NULL	NULL	NULL
18	17	St. Gallen	Area17	Area17	NULL	NULL	NULL	NULL
19	14	Schaffhausen	Area14	Area14	NULL	NULL	NULL	NULL
20	15	Appenzell …	Area15	Area15	NULL	NULL	NULL	NULL
21	12	Basel-Stadt	Area12	Area12	NULL	NULL	NULL	NULL

Dissolve

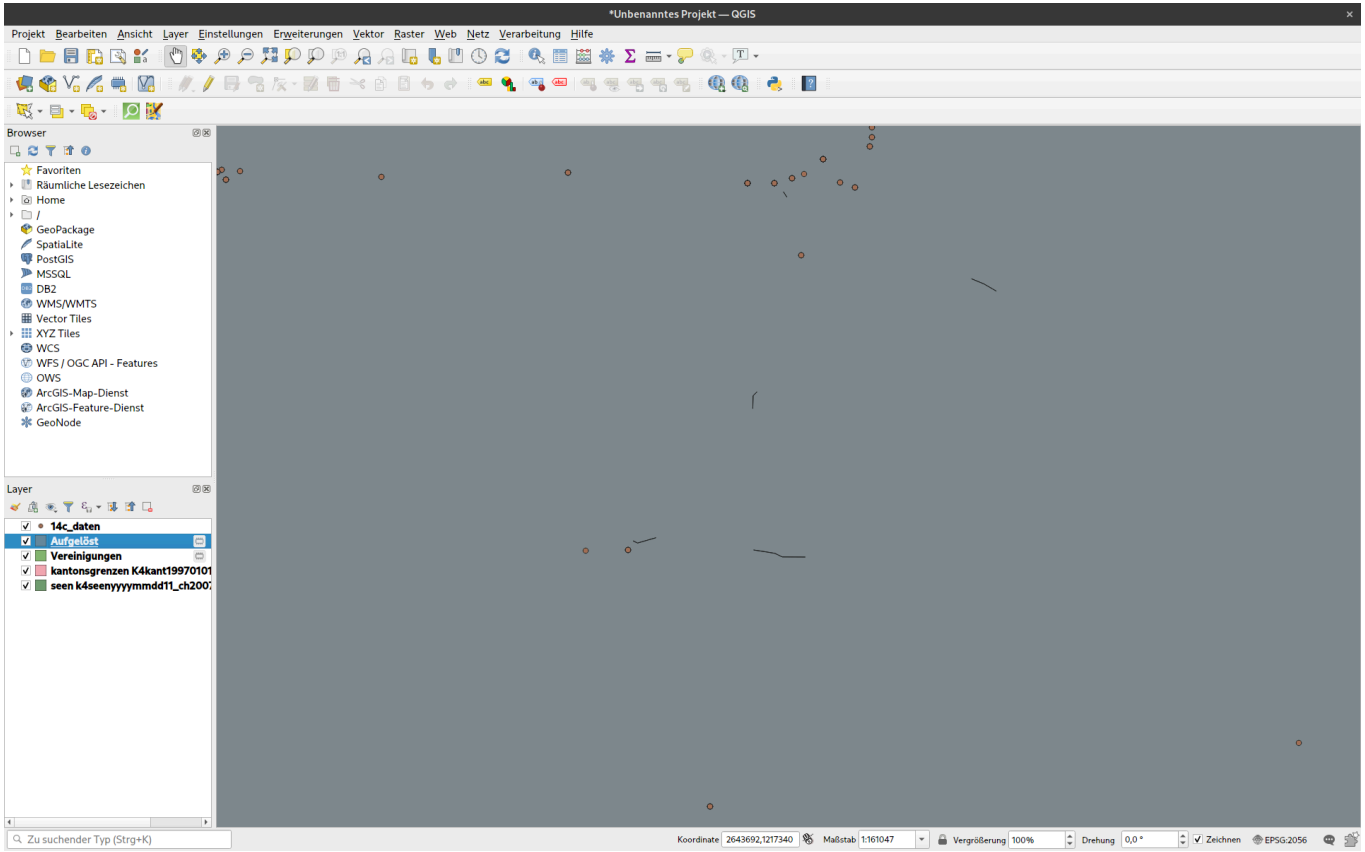
- We need only one polygon -> Combining all polygons to one
- use disolve tool (Vector > Geometry-Processing)
- Select Union Layer as Input Layer
- Temporary Layer as output is fine
- Click 'Run'





Wrong or unnecessary Vertices

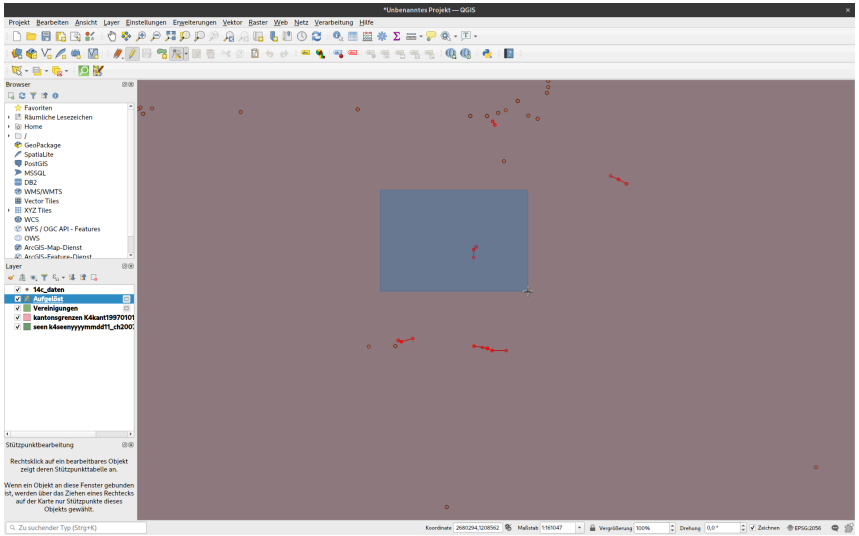
If we zoom in, some Structure within our polygon resulted from non-matching spatial data:



Edit/Remove wrong or unnecessary Vertices

- Click on 'Toggle Edit Mode' 
- Click on Vertices Tool 
- Select unnecessary vertices and remove
- Save by and 'Toggle Edit Mode' 

in the same tool, you also can move points of your polygons to different locations...



Toolbox

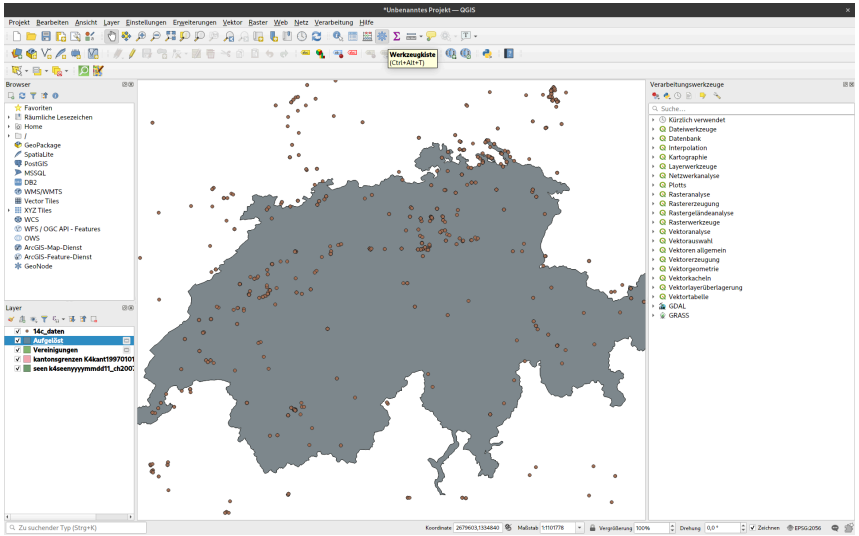
For our next task, we need a tool that is not available from the menu

For this, we activate the toolbox

sidebar/window 

This toolbox contains all menu tools + a lot more

It also features a search bar for fast and easy access



Extract points based on Polygon (1)

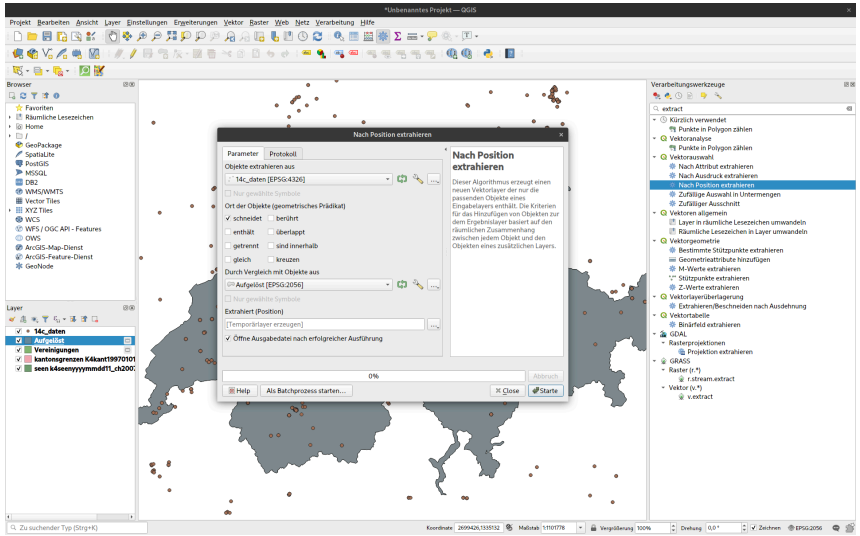
To extract the 14C data contained within the 'Switzerland'-polygon, we access the 'Extract by Position' tool. Start typing in the search field to find it!

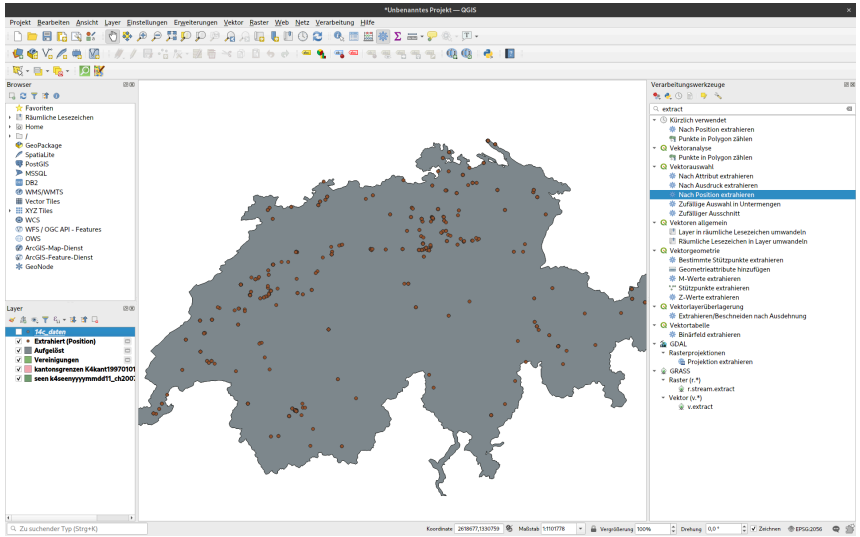
Extract points based on Polygon (2)

- Select the 14c-layer as layer to extract from
- Select 'are contained' as Option
- Select the 'Dissolved' Layer as source
- Temporary Layer might be fine
- Click on 'Run'

- The resulting Layer should only contain the 14C Data within Switzerland

- Finally save your layer as shapefile!



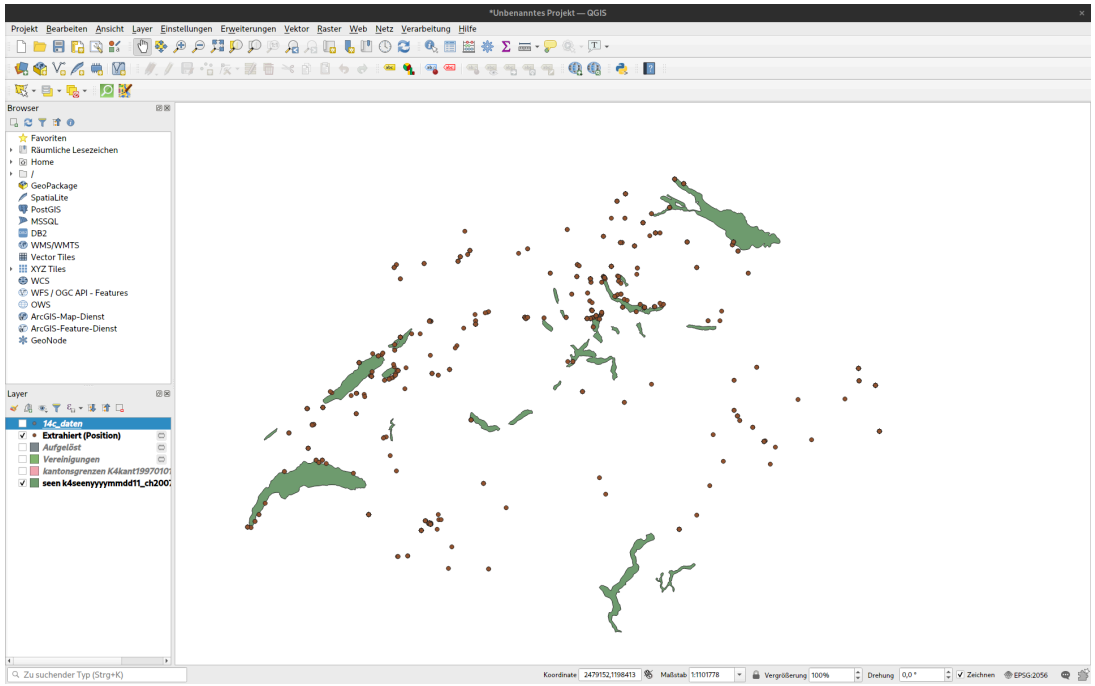


Check the number of 14C Dates within lakes (1)

(Spatial Query)

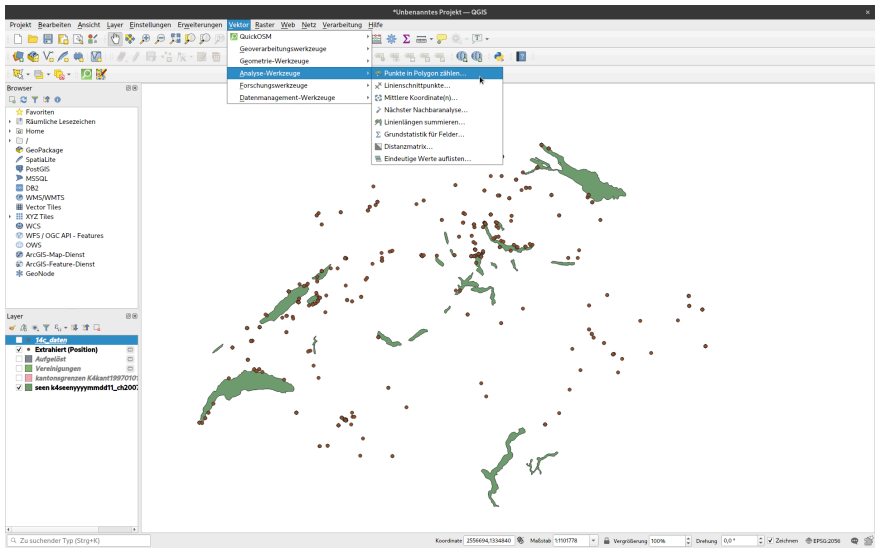
Lets start with our first analytical procedure: How many 14C dates are comming from lakes?

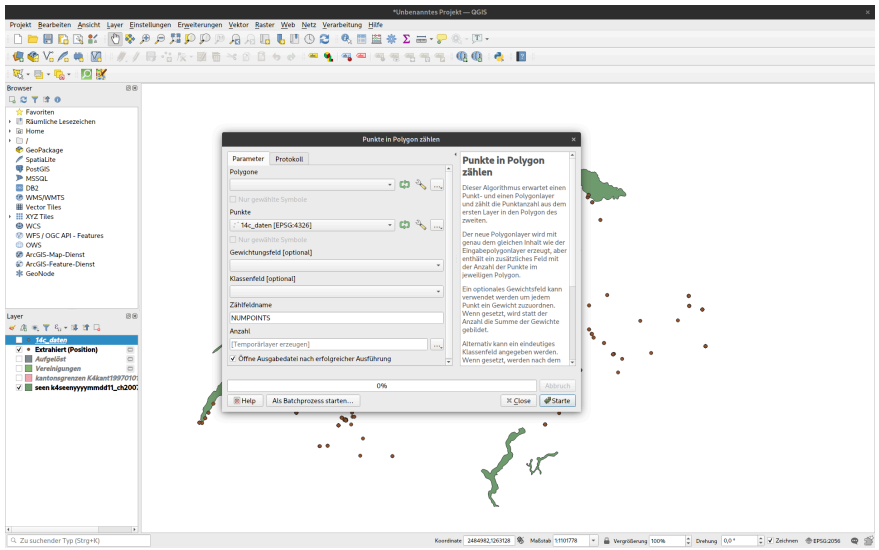
To check this, we need the lakes and the 14C Data:



Check the number of 14C Dates within lakes (2)

This time, the tool is accessible via the menue 'Vector > Analytical tools':





- select the lakes layer as polygon layer
- select the 14C layer as points layer
- (you can specify a weighting and a classification field, too)
- the name of the resulting count column is 'NUMPOINTS', that might be ok for now
- temporary layer might be ok for now
- click on 'Run'

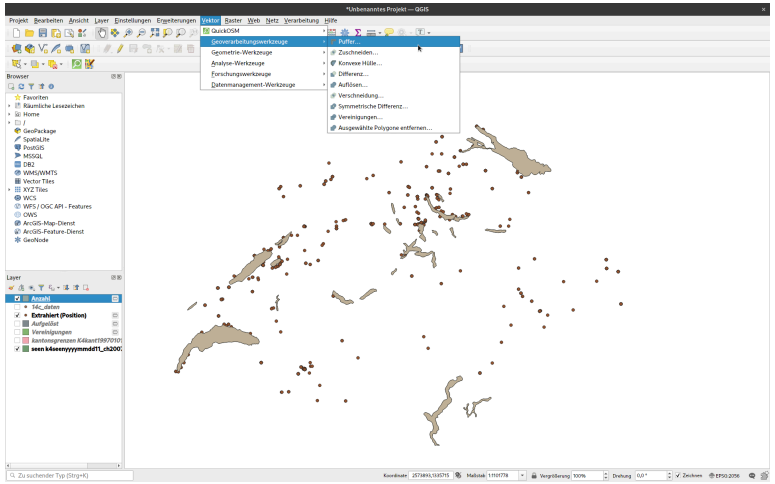
Check the number of 14C Dates within lakes (2)

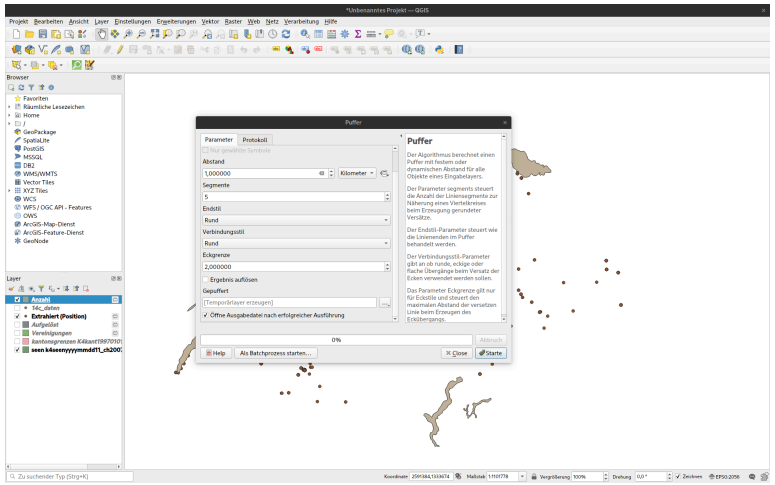
A new layer is created that contains the original information from the lakes layer + the number of 14C data as 'NUMPOINTS'. You can check in the attribute table.

Check the number of 14C Dates within 1km around lakes (1)

To check, how many 14C Data are within a buffer of 1 km around the lakes, we have to create a buffer first.

- Select Buffer from 'Vector > Geometry processing tools'
- Select the lakes layer as input layer
- Select 1km as distance
- most of the other options refer to the shape of the buffer... we can leave them to default now
- the checkbox 'dissolve' merges all connected buffers, we do not want that here
- Click on 'Run'





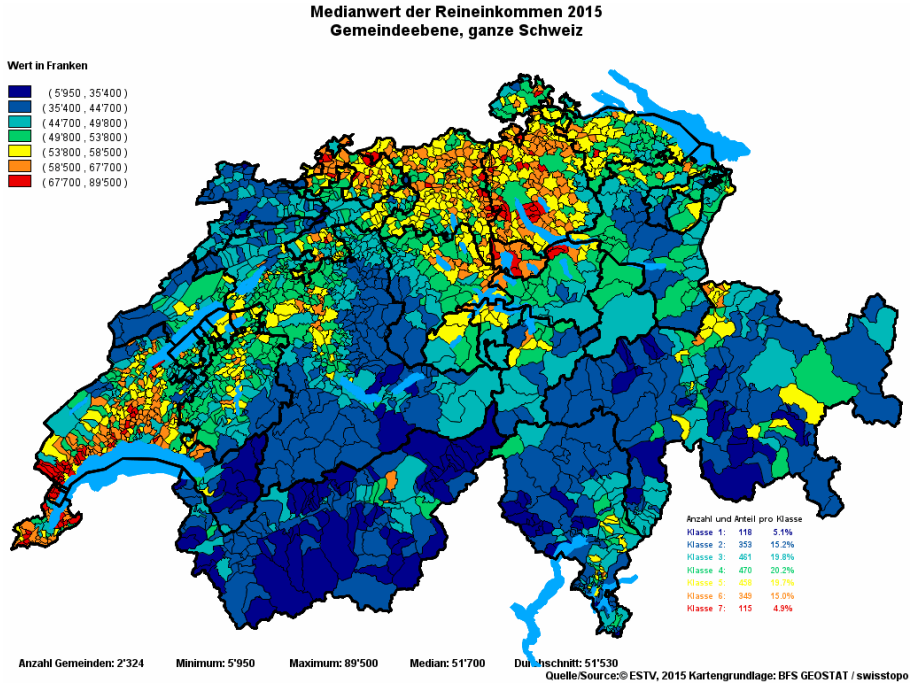
Check the number of 14C Dates within 1km around lakes (2)

- The resulting Vector layer contains all informations of the lakes layer, only that the lakes are 1km enlarged
- You can now count points in polygons like before, but you should select the 'buffered' layer as your input
- The number of 14C dates are now much larger per lake

Calculate mean 14C age per canton (1)

Using GIS, you can excecute statistical procedures and visualise the result in a Choropleth.

(the German term for this is also Choropleth...)



Source: http://www.estv2.admin.ch/

Calculate mean 14C age per canton (2)

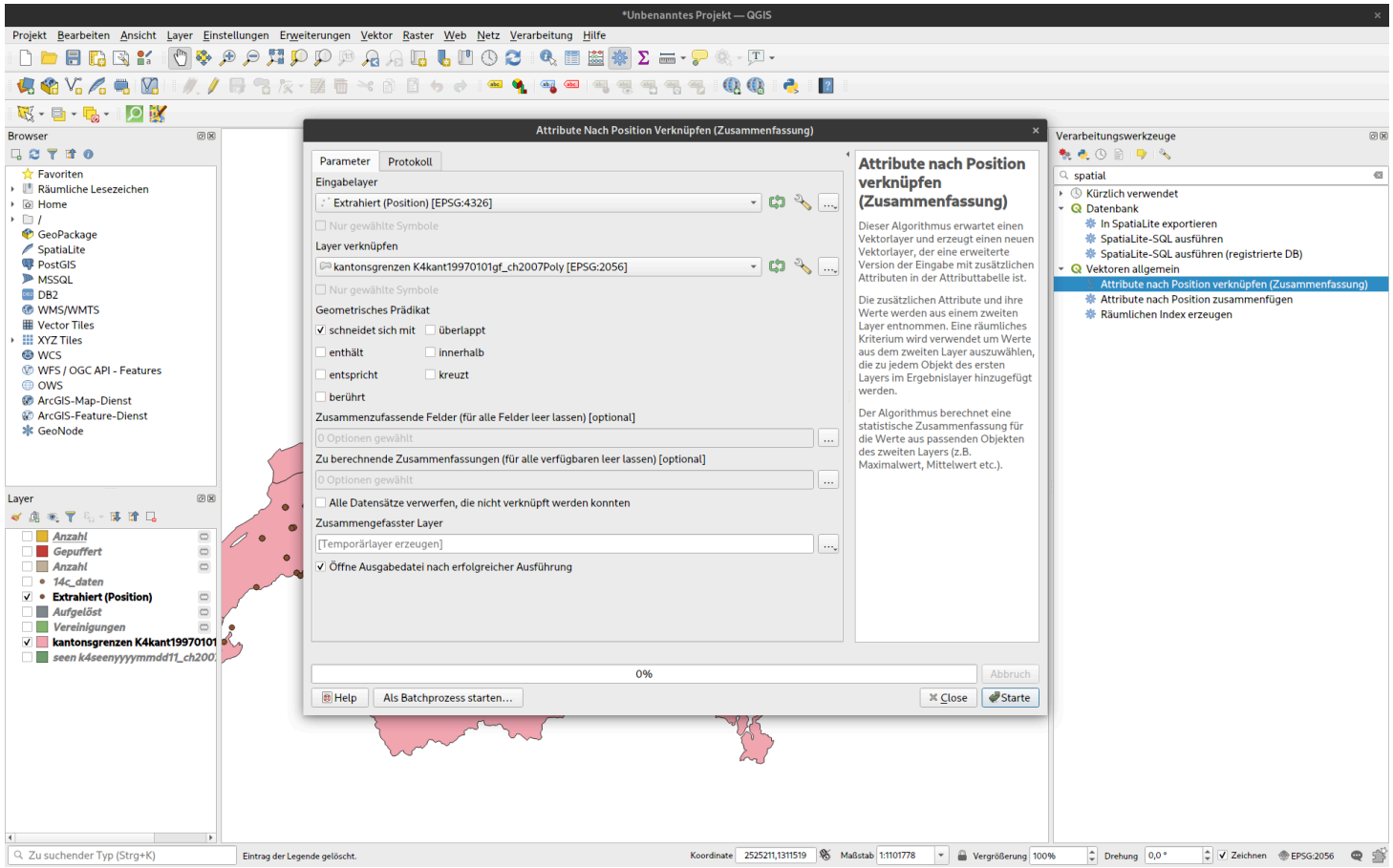
(Spatial Join)

To start, we need the cantonal borders and the 14C data and the Toolbox  .

The command is 'Join attributes by location (summary)'

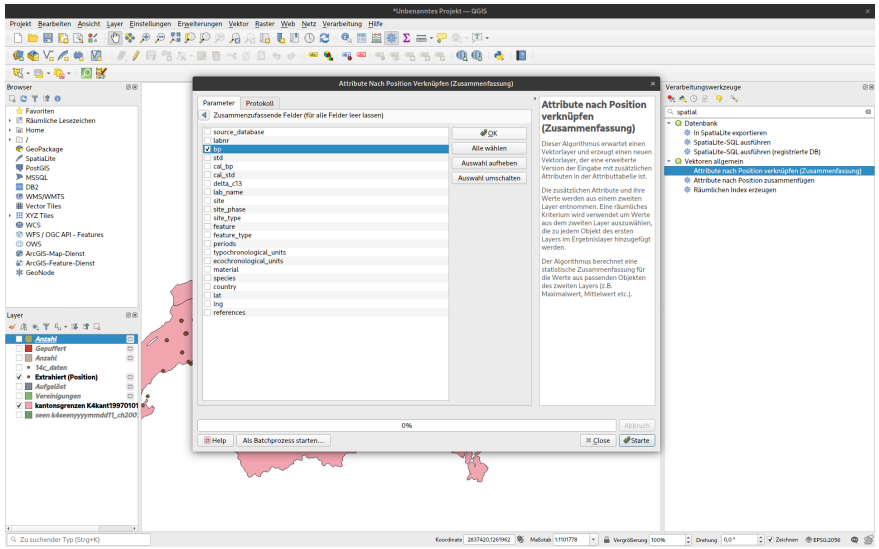
Calculate mean 14C age per canton (3)

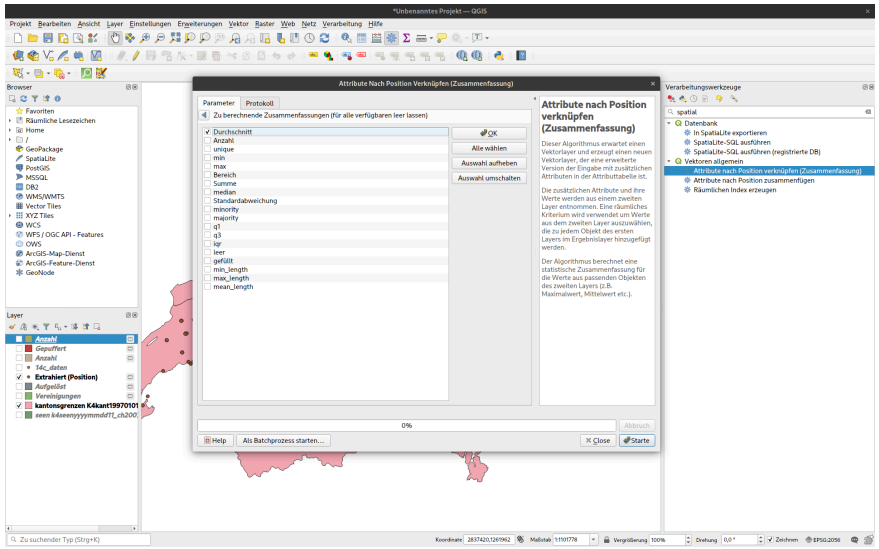
- Select the cantonal borders as input layer
- Select the 14C data as joined layer
- Select intersection as condition



Calculate mean 14C age per canton (4)

- in Summary fields, select bp (uncalibrated 14C date) as field
- in Calculated Summaries, select 'mean' as statistic
- temporary layer might be ok
- press 'Run'





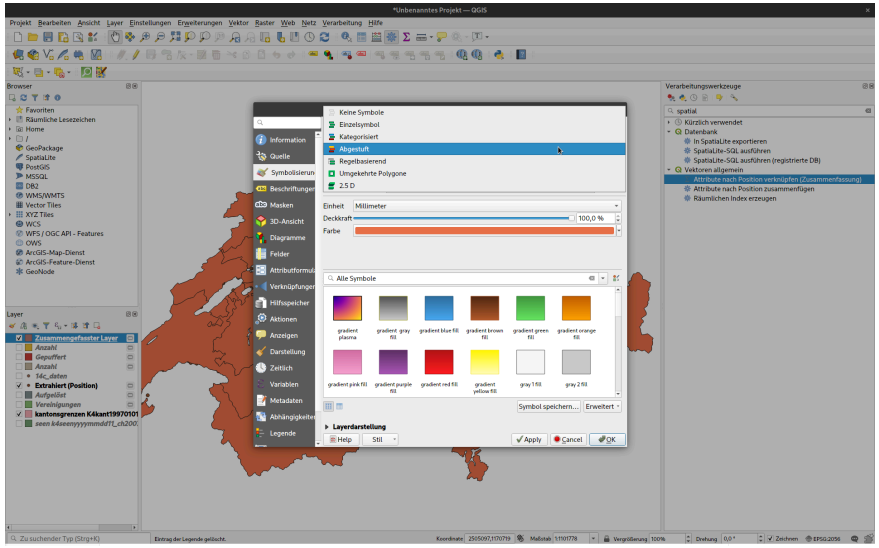
Calculate mean 14C age per canton (5)

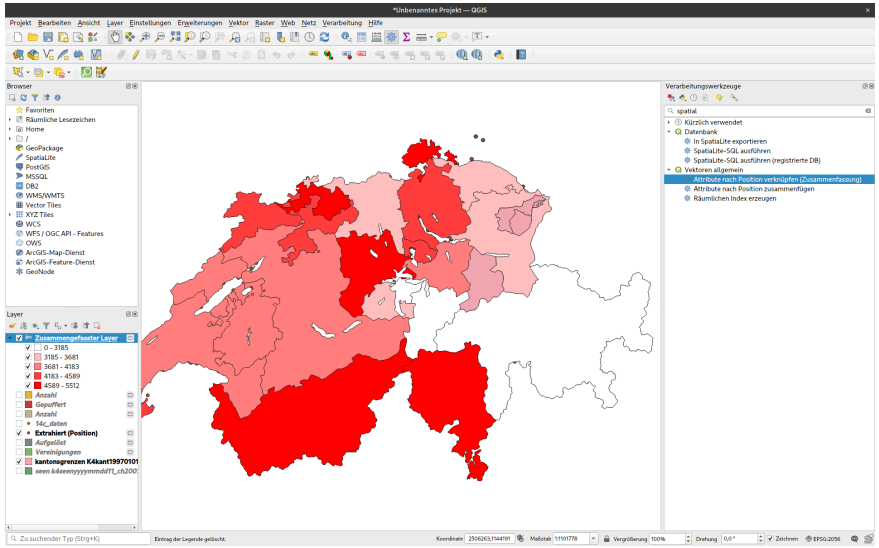
In the Attribute Table, now you can see the mean bp age per canton

Visualise mean 14C age per canton

Now we can color the cantons according to the mean BP age

- Open the **Properties** of the layer (right click on the layer) and Select there the **Symbology** tab
- Select 'Graduated' as symbol and Classify the values
- click on 'OK'
- Now you should be able to see the age by color





What We've Covered

- Editing and joining Geometries
- Extract features based on location in relation to other vector data
- Extract and summarise information based on location in relation to other vector data

Homework

- Get the north and the south part of the Kanton of Bern
- Unite them to get a map of the whole Kanton
- Get the Location of archaeological sites of the Kanton of Bern
- Count the number of sites in each 'Amtsbezirk'
- Make a Map showing the number of sites color coded
- Send me the 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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