

User manual for the *GroupSelect* Excel macro

SPATIAL QUERYING IN THE DATABASE OF THE IHARKÚTI BONEBED FINDINGS

Gáspár Albert 2017. 06.08.
albert@ludens.elte.hu

THE EXCEL DATABASE

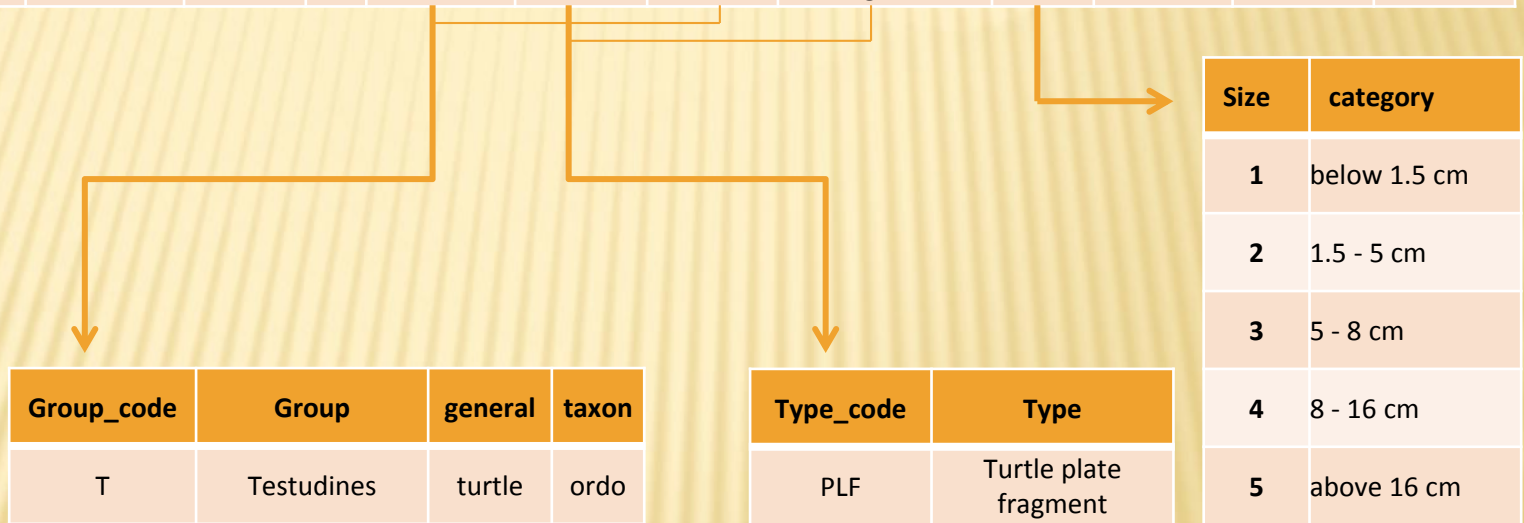
- ✗ The Excel database contains 5 tables and 2 sub-routines (macros).
 - + GroupSelect – to run the spatial query
 - + selGroupCoordList – for internal calculations
- ✗ Data tables (worksheets):
 - + findings – records of all findings with measured coordinates
 - + group – identified taxonomical groups
 - + type – list of determined anatomical types
 - + size – list of size categories
 - + geometry – measurements of the bonebed geometry

ATTENTION! Names and inner structure (column names) of the tables should not be modified! Otherwise the macro scripts will not work! The „geometry” worksheet is not involved in the spatial query.

THE STRUCTURE OF THE DATABASE

Columns of the „findings” data table:

X	Y	Z	Code	Area	Group_code	Type_code	Group	Type	Size	Orientation	Note	Year
544376.3304	210661.6355	2956387	2013_1_4	1	T	PLF	Testudines	turtle plate fragment	2			2013



The „group” data table

The „type” data table

Size table

Arrows indicate the connections between data tables via the indicated column content. Elements of the *Group_code* column in the „group” table are the base of the spatial analysis. The analysis is done by sub-routines (macros) with the coordination of the user.

INITIALIZATION OF THE SPATIAL ANALYSIS

The screenshot shows the Microsoft Excel interface with the 'View' tab selected in the ribbon. The 'Macros' button in the 'View' tab is circled in red. A red arrow points from this button to the 'Macro' dialog box, which is open. In the dialog box, 'GroupSelect' is selected in the list of macro modules. The 'Macro name' field is empty, and the 'Macros in' dropdown is set to 'All Open Workbooks'.

Group	Group	csoport	taxon	records	unit
A	Albanerpeton	salamander		0	amphibia
AJ	Ajkaceratops	ankylosaur		0	dinosaur
AL	Allodaposuchus	crocodile	genus	121	crocodile
AN	Anura	frog	ordo	4	amphibia
AR	Archosauria	dinosaurs and crocodiles	group	29	else
AT	Atractosteus	lepisosteid fish	genus	7	fish
B	Bakonydraco galaczi	pterosaur	species	6	pterosauria
D	Doratodon	crocodiles (mainly teeth)		61	crocodile
DI	Dinosauria	dinosaurs		7	dinosaur
DO	Dortokidae	turtles (mainly plate fragments)		20	turtle
E	Eusuchia	crocodile (mainly vertebrae)		41	crocodile
F	Foxemys trabanti	turtle	species	2	turtle
I	Iharkutosuchus makadii	crocodiles (mainly skulls)	species	58	crocodile
L	Lepisosteiformes	lepisosteid fish		89	fish
LA	Lacertilia	lizards		5	lizzard
M	Mesoeucrocodylia	crocodiles		109	crocodile
MO	Mochlodon vorosi	iguanodontid	species	51	dinosaur
N	Nodosauridae	ankylosaur		825	dinosaur
P	Pisces	fishes		10	fish
PA	Pannoniasaurus inexpectatus	mosasaur		164	lizzard
PT	Pterosauria	pterosaur		37	pterosauria
PY	Pycnodontiformes	fishes		33	fish
S	Sauropsida	sauropsids		798	else
T	Testudines	turtles	ordo	632	turtle

The initialization of the analyzer program is accessed through the Excel's „View” menu's „Macros” submenu. In the popup window a list of executable macro modules is shown. Select the „GroupSelect” to start the analyzer.

THE ANALYZER PROGRAM

The list on the top left contains the taxonomical groups short codes from the „Group_code” column of the database, while above the list the complete name of the group is displayed.

The screenshot shows the 'Spatial Analyser Form' window. At the top left, it says 'Searching for those points that lies close to:' followed by 'Allodaposuchus'. Below this is a dropdown menu with 'AL' selected and highlighted by a red rectangle. To the right of the dropdown are 'Add to list' and 'Clear' buttons. Further right is a 'List of interest:' label and an empty text box. Below the dropdown are three buttons: 'Select as base', 'Add to base', and 'Open base file'. To the right of these is a 'Types to examine:' dropdown set to 'all', and two radio buttons: 'in metric system (z=elevation)' and 'in cm system (z=depth)'. A 'Reset' button is to the right of the radio buttons. Below these are three input fields for 'False Easting (m):' (544300), 'False Northing (m):' (210600), and 'False Z (m):' (350). Below these are three more input fields for 'X (Easting)', 'Y (Northing)', and 'Tvss (depth)'. To the right of these is a 'Results:' section with two checkboxes: 'Convert back to metric coordinates' (checked) and 'Export only full matches' (unchecked). At the bottom right are 'Export', 'Exit', and 'Export line-plot' buttons. At the bottom left is a label 'Number of grid coordinates:'.

Two types of spatial query can be executed:

- I.) The **geometric base of the analysis is defined from the selectable list**. This way, the search is done around all the findings, which has the defined group code.
- II.) The search is done around **points defined in an external file** (e.g. nodes of a regular grid, or locations of specific interest).

TYPE I. SPATIAL QUERY – BASE POINTS

A group code is selected as the geometric base of the search.

The base points can also be filtered by their anatomical types.

False coordinates, to redefine the origin of the Cartesian system.

Number and code of the base points

The screenshot shows the 'Spatial Analyser Form' window. It includes a search criteria section with a dropdown for 'Allodaposuchus' and a 'Select as base' button highlighted with a red box. A 'List of interest' list is empty. The 'Search radius (cm)' is set to 50. The 'Types to examine' dropdown is set to 'all'. The 'in metric system (z=elevation)' and 'in cm system (z=depth)' radio buttons are present, with the latter selected. A 'Reset' button is also visible. The 'False Easting (m)', 'False Northing (m)', and 'False Z (m)' fields are highlighted with a red box and contain the values 544300, 210600, and 350 respectively. Below these are three listboxes for 'X (Easting)', 'Y (Northing)', and 'Tvss (depth)' containing numerical values. The 'No. of base coordinates: 121 pcs (AL)' is displayed at the bottom. On the right, there are checkboxes for 'Convert back to metric coordinates' (checked) and 'Export only full matches' (unchecked), along with 'Export', 'Exit', and 'Export line-plot' buttons. Two orange callout boxes provide additional information: one about filtering by anatomical types and another about the search radius and the 'Reset' button's function.

Spatial Analyser Form

Searching for those points that lies close to: Allodaposuchus

List of interest:

Search radius (cm): 50 Calculate

AL Add to list Clear

Select as base Add to base Open base file

Types to examine: all

in metric system (z=elevation) in cm system (z=depth) Reset

False Easting (m): 544300 False Northing (m): 210600 False Z (m): 350

X (Easting) Y (Northing) Tvss (depth)

7078.891452 5848.806644 -444.14277
7709.805696 6035.403825 -534.37491
7554.547315 5987.199825 -501.88562

No. of base coordinates: 121 pcs (AL)

Results:

☒ Convert back to metric coordinates
☐ Export only full matches

Export Exit

Export line-plot

Pressing the „Select as base” button the program searches the database for all the records that have the defined code, and lists their coordinates in the lower left listboxes.

ATTENTION! The coordinates can be loaded into the listboxes in meters, or in cm-s, according to the selected options. The latter is preferred if the exported data should be used in the 3D modelling program (JewelSuite). After selecting a group as the base of the search, the option buttons are no longer available!

TYPE I. SPATIAL QUERY – ADD POINTS

Adding the selected group code to the geometric base coordinates

Spatial Analyser Form

Searching for those points that lies close to: Anura

List of interest:

Search radius (cm): 50 Calculate

AN Add to list Clear

Select as base Add to base Open base file

Types to examine: all

☐ in metric system (z=elevation)
☒ in cm system (z=depth) Reset

False Easting (m): 544300 False Northing (m): 210600 False Z (m): 350

X (Easting): 7078.891452, 7709.805696, 7554.547315 Y (Northing): 5848.806644, 6035.403825, 5987.199825 Tvss (depth): -444.14277, -534.37491, -501.88562

No. of base coordinates: 125 pcs (AL; AN)

Results:
☒ Convert back to metric coordinates
☐ Export only full matches

Export Exit Export line-plot

The number of base point coordinates increases and the group codes are listed

While the database file's Cartesian coordinate system is the meter-based EOVS (Hungarian National Grid – on the HD72 geodesic datum), the calculations can also be done in a local centimeter-based coordinate system.

Both the *Select as base* and the *Add to base* commands initiate the *selGroupCoordList* script which updates the content of the X,Y,Z listboxes. If the coordinates here are in centimeters, the Z-values are switched to depth to assist the subsequent 3D modeling with JewelSuite.

TYPE I. SPATIAL QUERY – ANALYSIS

From the group code list, one or more items can be selected for the list of interest by pressing the „Add to list” button. The „Clear” command will empty the list.

Spatial Analyser Form

Searching for those points that lies close to: Doratodon

List of interest: B
D

Search radius (cm): 50 **Calculate**

D **Add to list** **Clear**

Select as base
Add to base
Open base file

Types to examine: all
in metric system (z=...)
in cm system (z=de...)

False Easting (m): 544300
False Northing (m): 210600
False Z (m): 350

X (Easting): 7078.891452
Y (Northing): 5848.806644
Tvss (depth): -444.14277

No. of base coordinates: 125 pcs (AL; AN)

Results:
☒ Convert back to metric coordinates
☐ Export only full matches

Export **Exit**
Export line-plot

We can filter the anatomical types before initiating the query. This will not affect the type selection of the base points.

The program will look for those findings which are within the spherical search radius around the base point coordinates and have a taxonomical group code which is in the list of interest. The search radius is indicated in cm-s. To start the analysis press the „Calculate” button!

TYPE II. SPATIAL QUERY – BASE POINTS

The base points are from an external text-type file. The file structure must follow strictly the tab-delimited X,Y,Z sequence row-by row.

Spatial Analyser Form

Searching for those points that lies close to: Allodaposuchus

AL [dropdown] [Add to list] [Clear] [List of interest:]

[Select as base] [Add to base] [Open base file]

Types to examine: all [dropdown]

☐ in metric system (z=elevation) ☒ in cm system (z=depth) [Reset]

Search radius (cm): 50 [Calculate]

False Easting (m): 544300 False Northing (m): 210600 False Z (m): 350

X (Easting) Y (Northing) Tvss (depth)

6566.649254	4969.795958	-349.97374
6566.648460	4969.796279	-335.62743
6566.647485	4969.796673	-321.28109

Number of base coordinates: 9210 pcs

Results: ☒ Convert back to metric coordinates ☐ Export only full matches

[Export] [Exit]

In the case of lagre point numbers the calculations could take several minutes!

The coordinates in the external file must be in the same coordinate system as the collected findings. Since this option is used to work with grid-like point files exported from the 3D modeling program (JewelSuite), the option to switch to cm-based coordinates can also be used.

RESULTS OF THE SPATIAL QUERY

Spatial Analyser Form

Searching for those points that lies close to:
Doratodon

List of interest: B
D

Search radius (cm): 50 Calculate

D Add to list Clear

Select as base Add to base Open base file

Types to examine: all

☐ in metric system (z=elevation)
☒ in cm system (z=depth) Reset

False Easting (m): 544300
False Northing (m): 210600
False Z (m): 350

X (Easting) 7078.891452
7709.805696
7554.547315
Y (Northing) 5848.806644
6035.403825
5987.199825
Tvss (depth) -444.14277
-534.37491
-501.88562

No. of base coordinates: 125 pcs (AL; AN)

Result: 4 full and 54 partial matches

☒ Convert back to metric coordinates
☐ Export only full matches

Export Exit Export line-plot

0	E	0	7078.89145290246	5848.80
0	E	0	7709.80569688836	6035.40
0	E	0	7554.5473151491	5987.19
0	E	0	7477.64922886854	5971.30
0	E	0	7130.60341624077	5763.97
0	E	0	6603.75308861258	5528.05
1	P	(D)	7249.08999999752	5692.53
0	E	0	7240.07999999449	5754.88

In the list of the results, the number of rows are the same as the number of base points. Below the listbox a text is displayed mentioning the number of full and partial matches.

The results exported into a txt file.

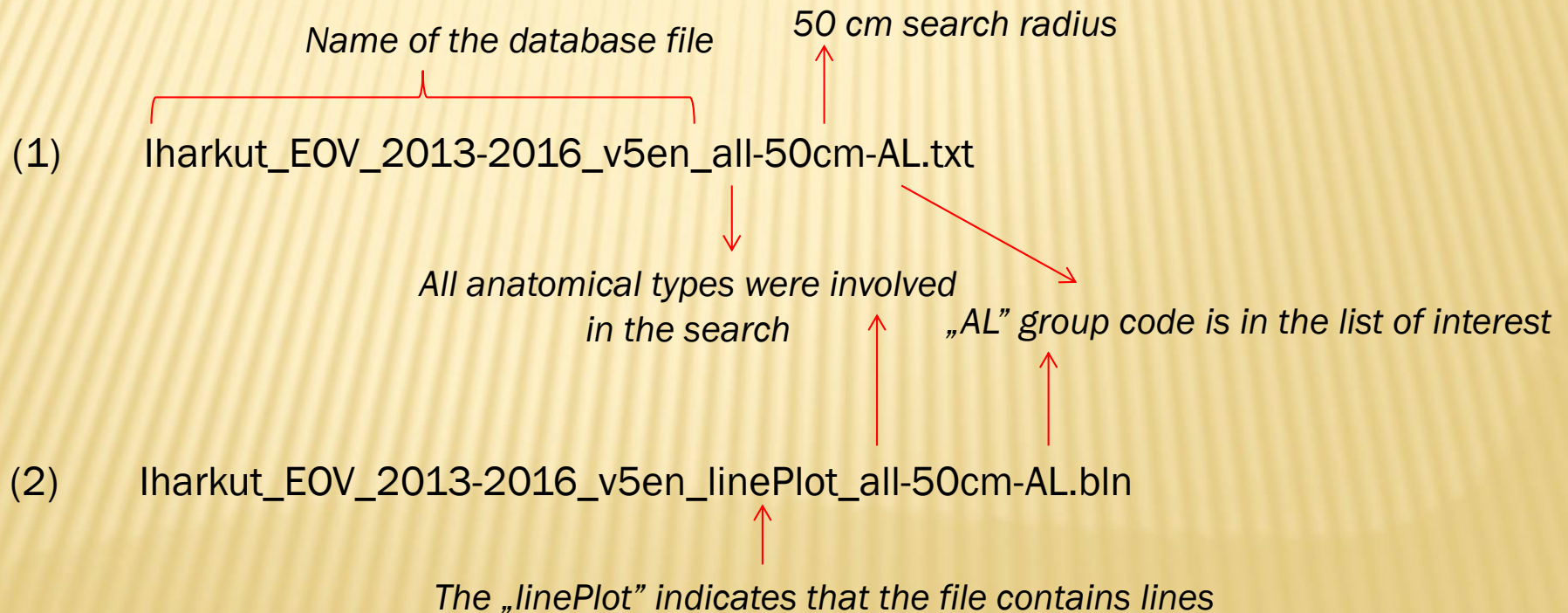
The identified full and partial matches exported as a line-plot graphic indicating the connections

At the beginning of the rows a number shows how many of the taxonomical groups from the list of interest were found within the search radius around the given base point. The second column's letter refer to the type of the match case: E (empty); P (partial); T (total). The third column lists the group code of the elements around the base point in parenthesis. Furthermore, the coordinates of the base point, and the identifiers (Code-column) of the matching findings are indicated.

NAMES OF THE EXPORTED FILES

The name of the exported txt file:

The file extension is .txt in the case of database export (1), and .bln in the case of line-plot export (2). The path and the name of the exported file is based on the original database file's path and name. Additionally the parameters of the spatial query completes the name. For example:



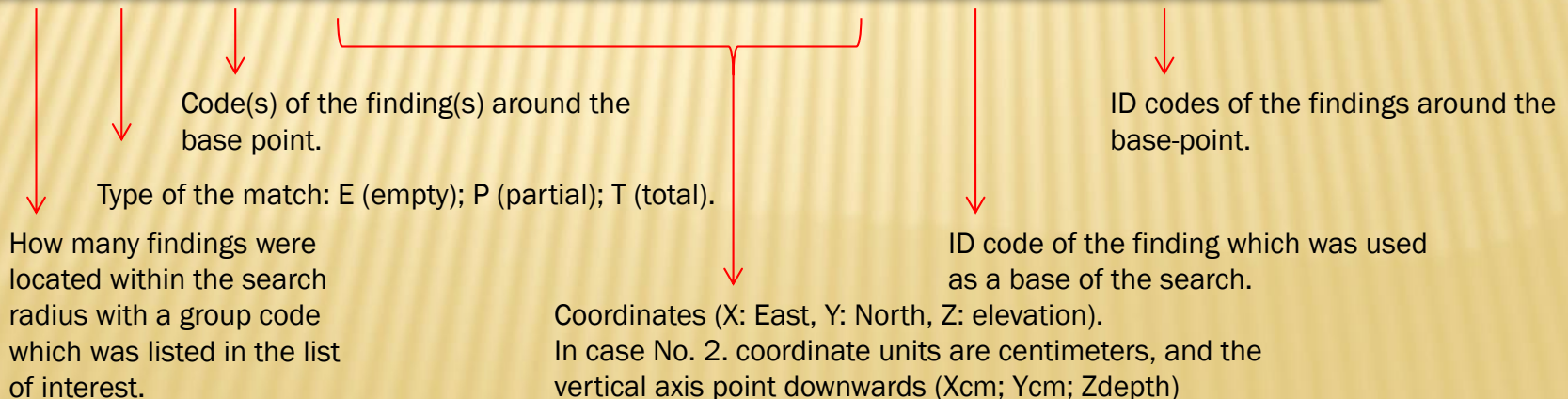
THE STRUCTURE OF THE DATABASE FILE

The structure of the file is a tab-delimited text-type data table. The header line of the file has two variations according to the export settings:

1. The units are meters and the vertical axis is elevation.
2. The units are centimeters and the vertical axis is depth.

The file structure in the case No. 1.:

finds	findType	Code_list	Xm	Ym	Zelev	Code(base)	Code(find)
1	T	(UIG)	544378.2223	210659.5095	355.662909	2014_47_k19	2014_47_k19
3	T	(UIG)	544375.9577	210658.7962	355.031535	2014_49_k3	2014_49_k3 2014
1	T	(UIG)	544376.7564	210659.0701	355.278368	2014_49_k4	2014_49_k4
12	T	(UIG)	544375.6589	210658.3156	354.888766	2014_50_k39	2014_50_k39 201
1	T	(UIG)	544374.9489	210658.5688	354.897087	2014_50_k2	2014_50_k2



ERROR HANDLING

The macro is equipped with error handling within the code, but – as the script was written for a special scientific use-case, and not for commercial use – occasional unhandled errors may occur during executing the script.

Known errors which are unhandled:

- The Excel and the operating system handles the numerical formats differently (e.g. decimal point vs. comma). This can be corrected within the regional settings of Excel, and the PC.
- The base point file contains the coordinates in an incorrect sequence, has header row, or the content does not corresponds with the metric/centimetric settings of the program. The file should contain the x,y,z coordinates in tab-delimited format and without header!
- The worksheets or the column headers are renamed in the database.

The macro runs very slowly in the case of many (hundreds, thousands) base points! It is usual that during such events the Excel sends „Not responding” message; in this case it is recommended to wait patiently for the macro to finish the calculations! In the case of several thousands point it may take 10-30 minutes!

If it is not possible then pressing the Ctrl+Break will stop the macro, or using the Ctrl+Alt+Del combination the Excel can also be stopped.