Prostorska in krajinska arheologija vaje I

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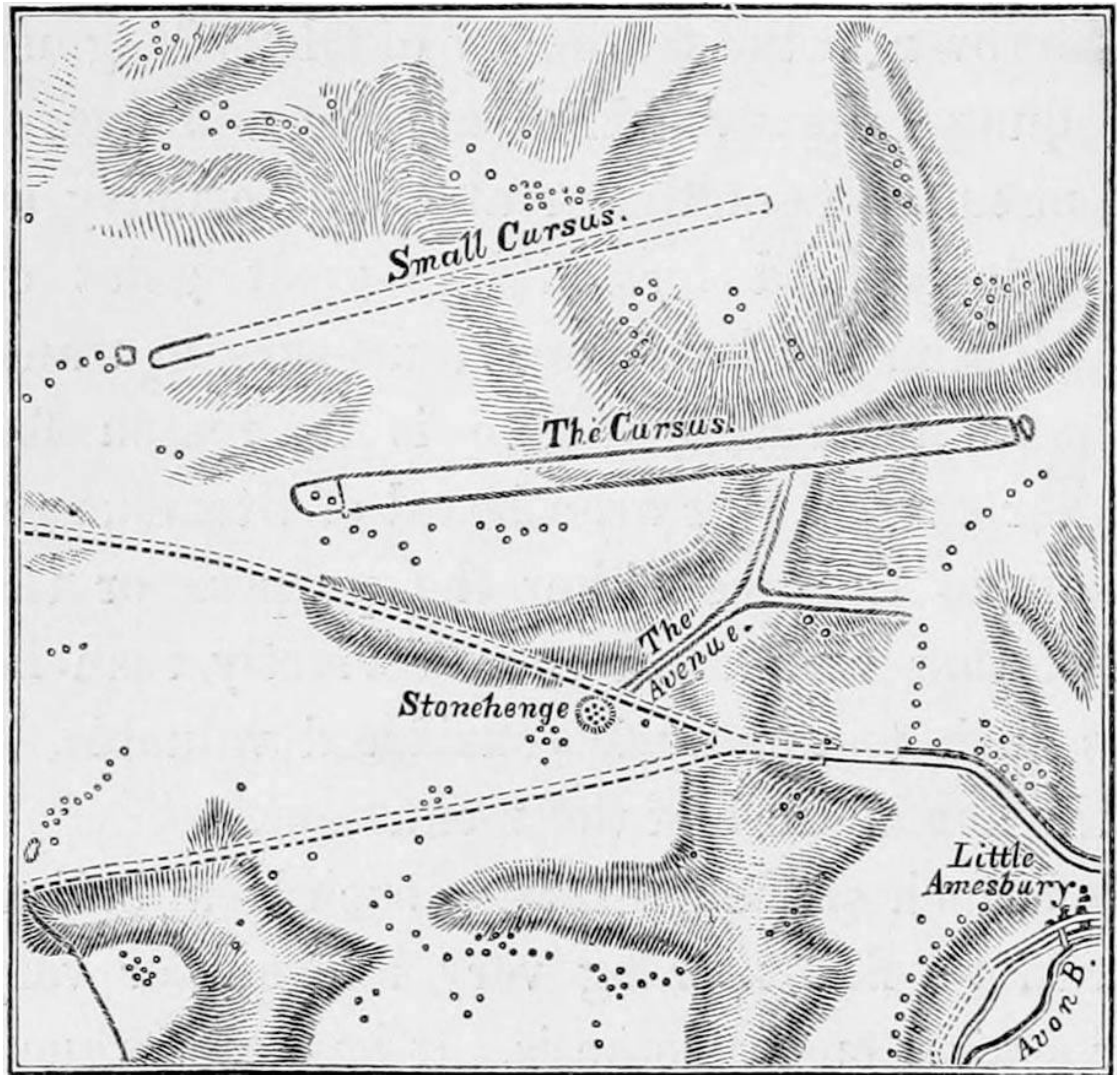
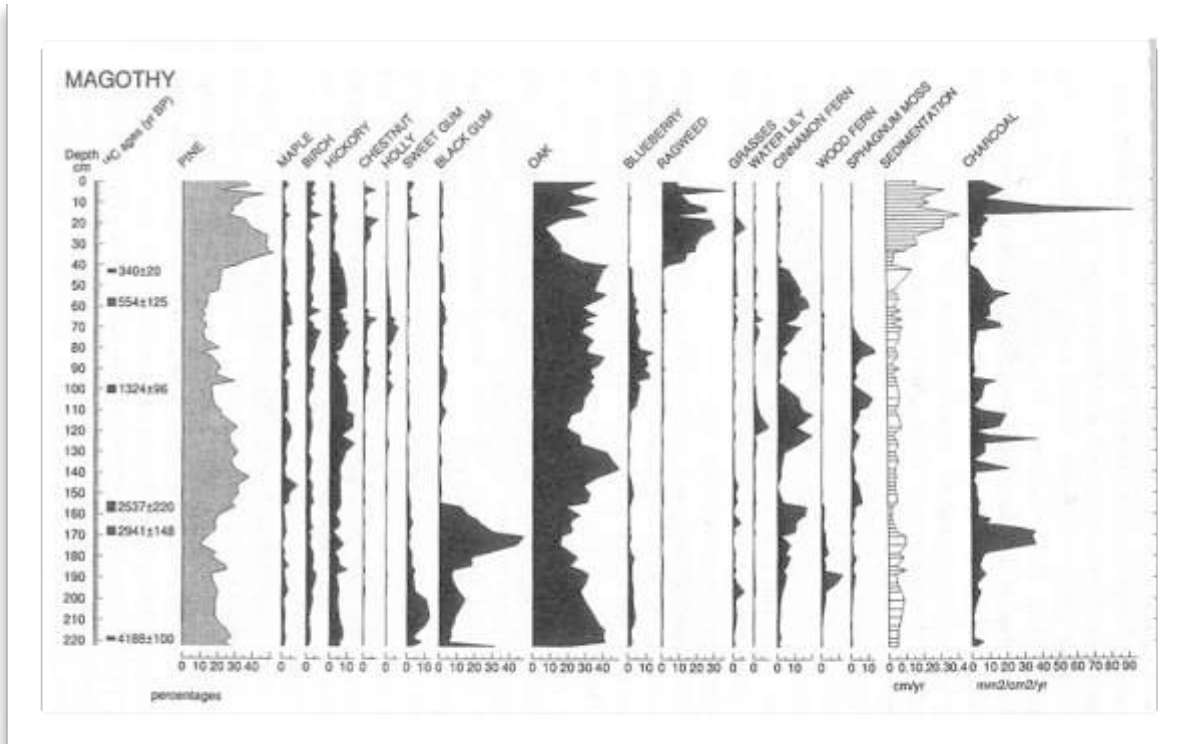
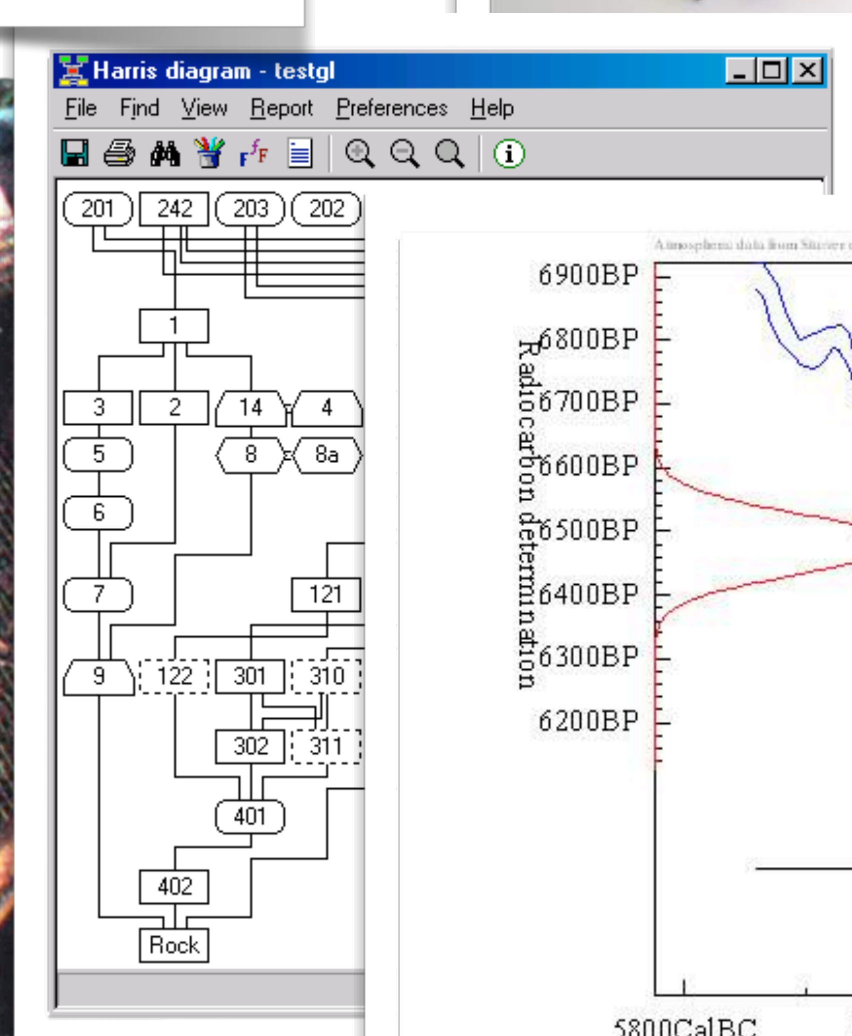
dmlekuz@gmail.com

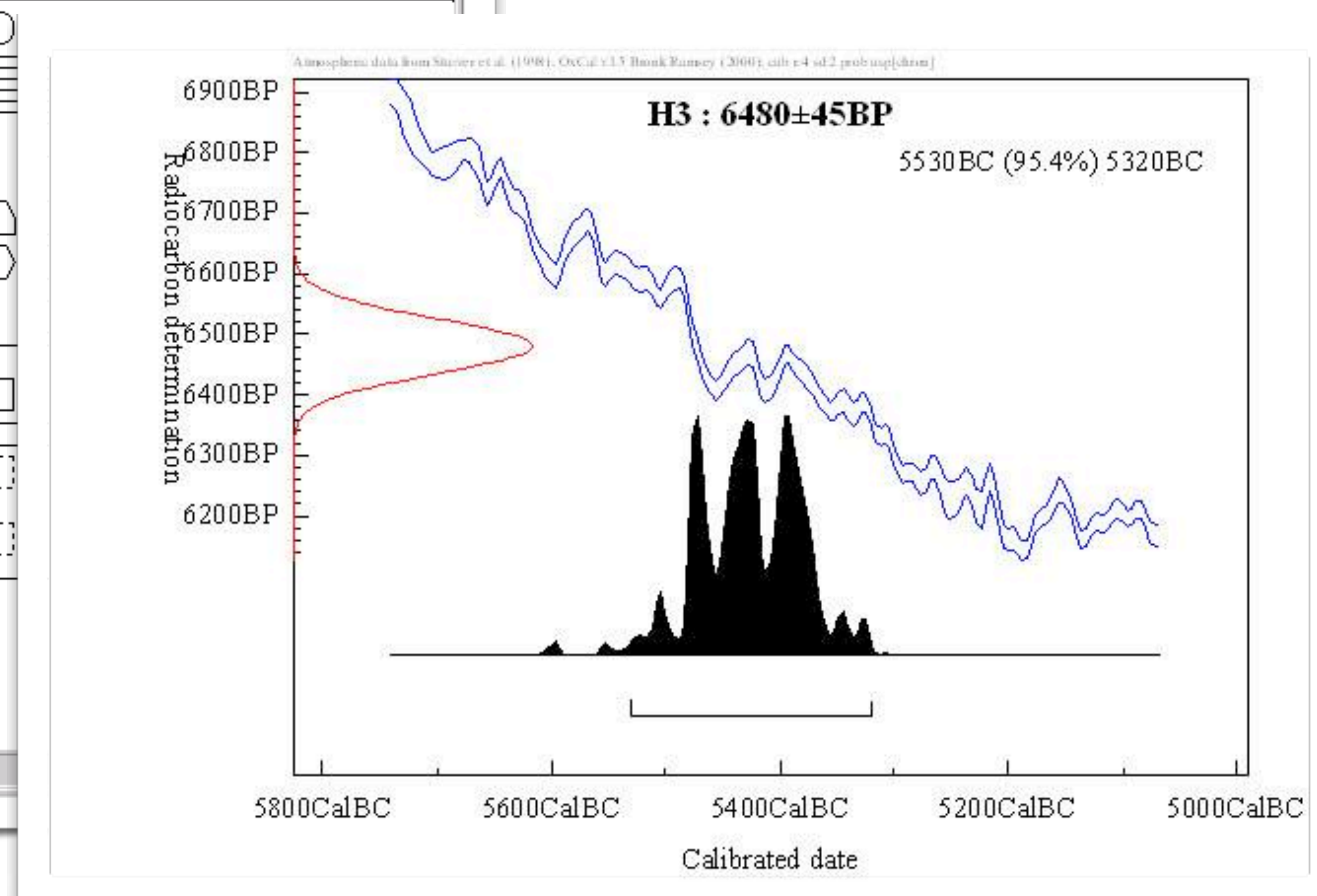


Archaeology is
and
has always
been
a spatial
discipline

... but works with other kinds of data as well

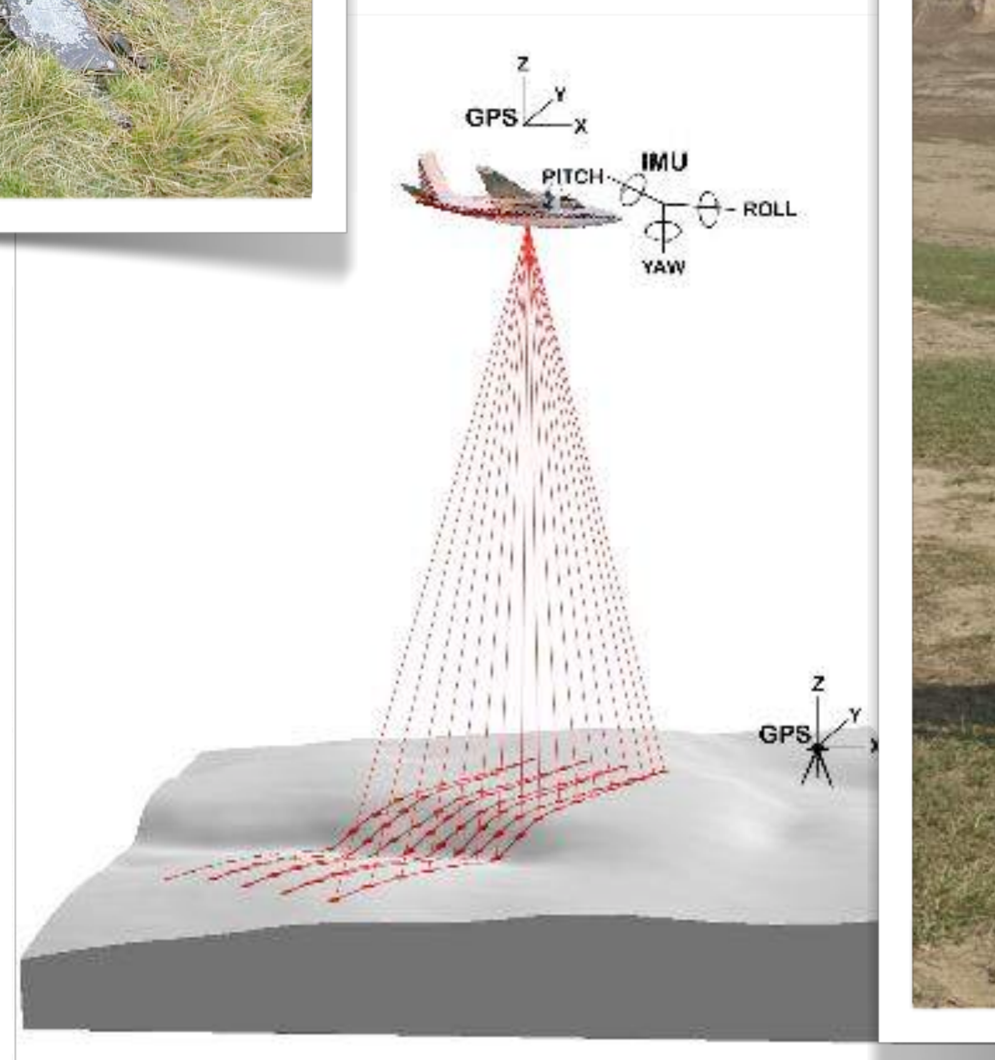






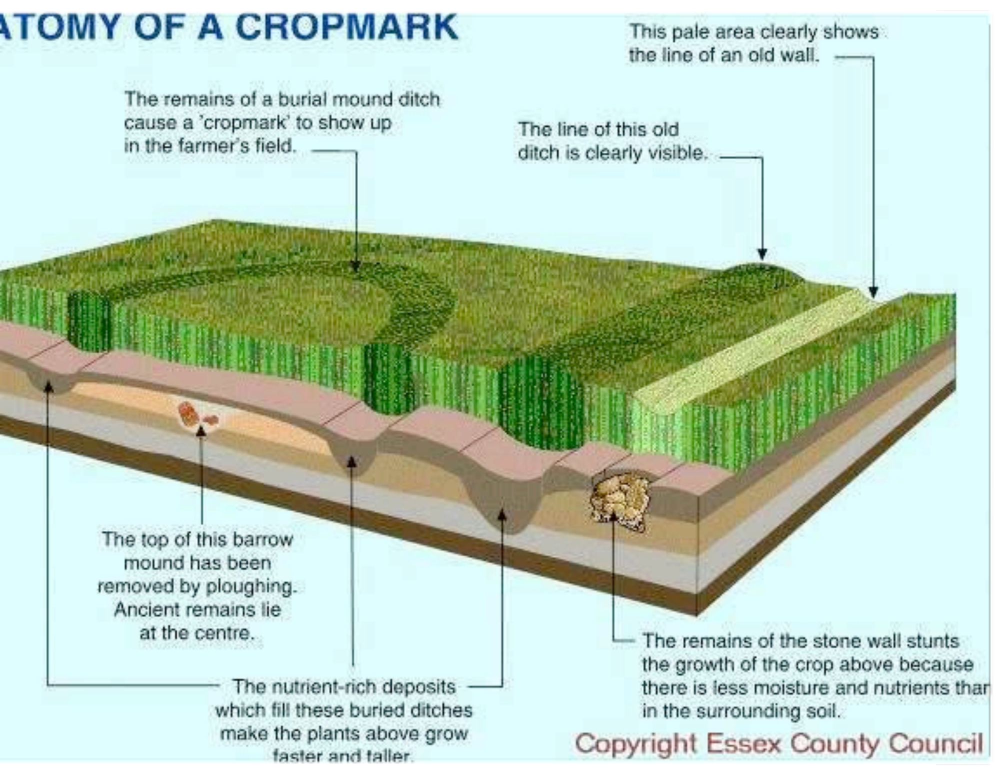
Landscape perspective

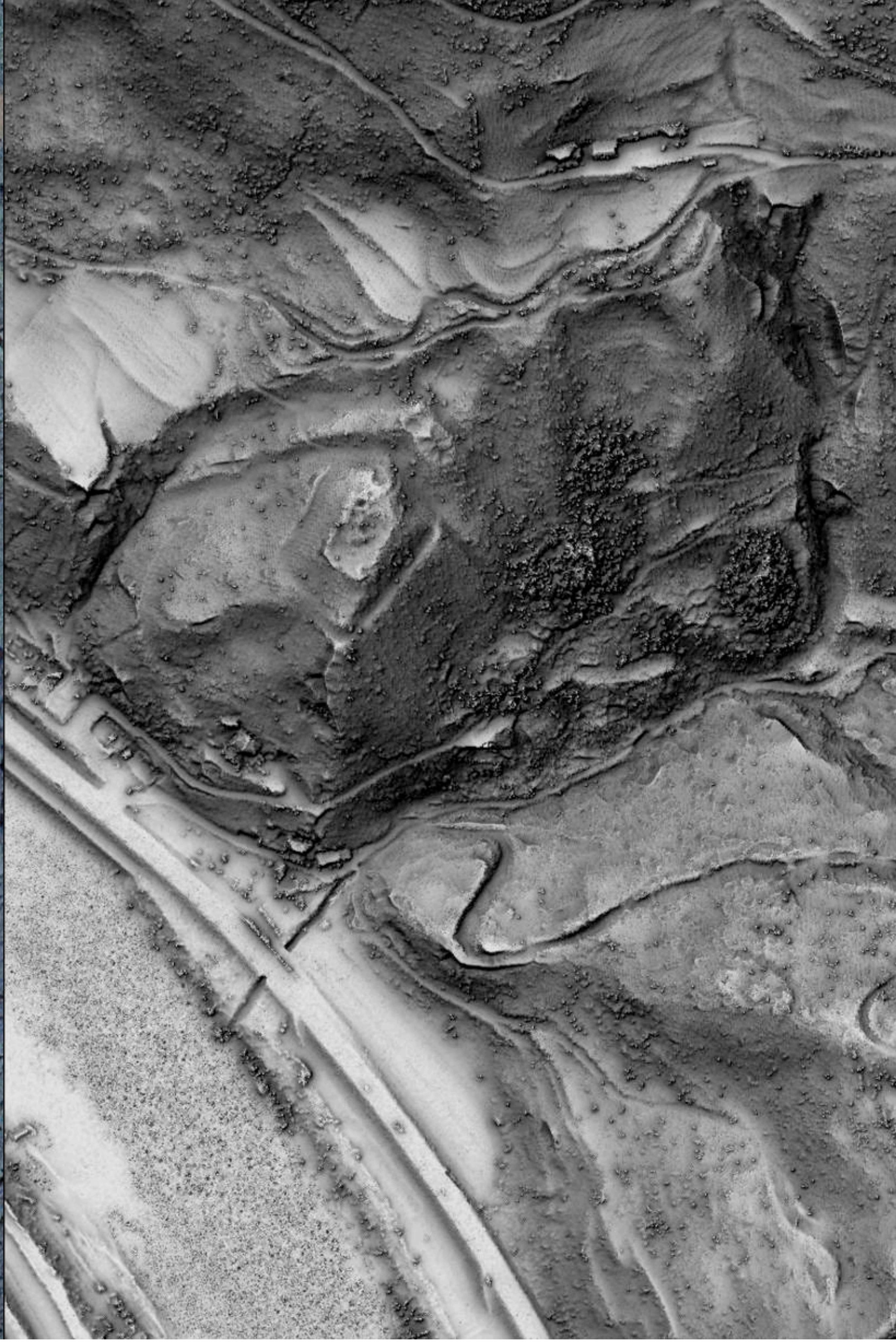
Archaeological survey



Satellite imaging

Aerophotography



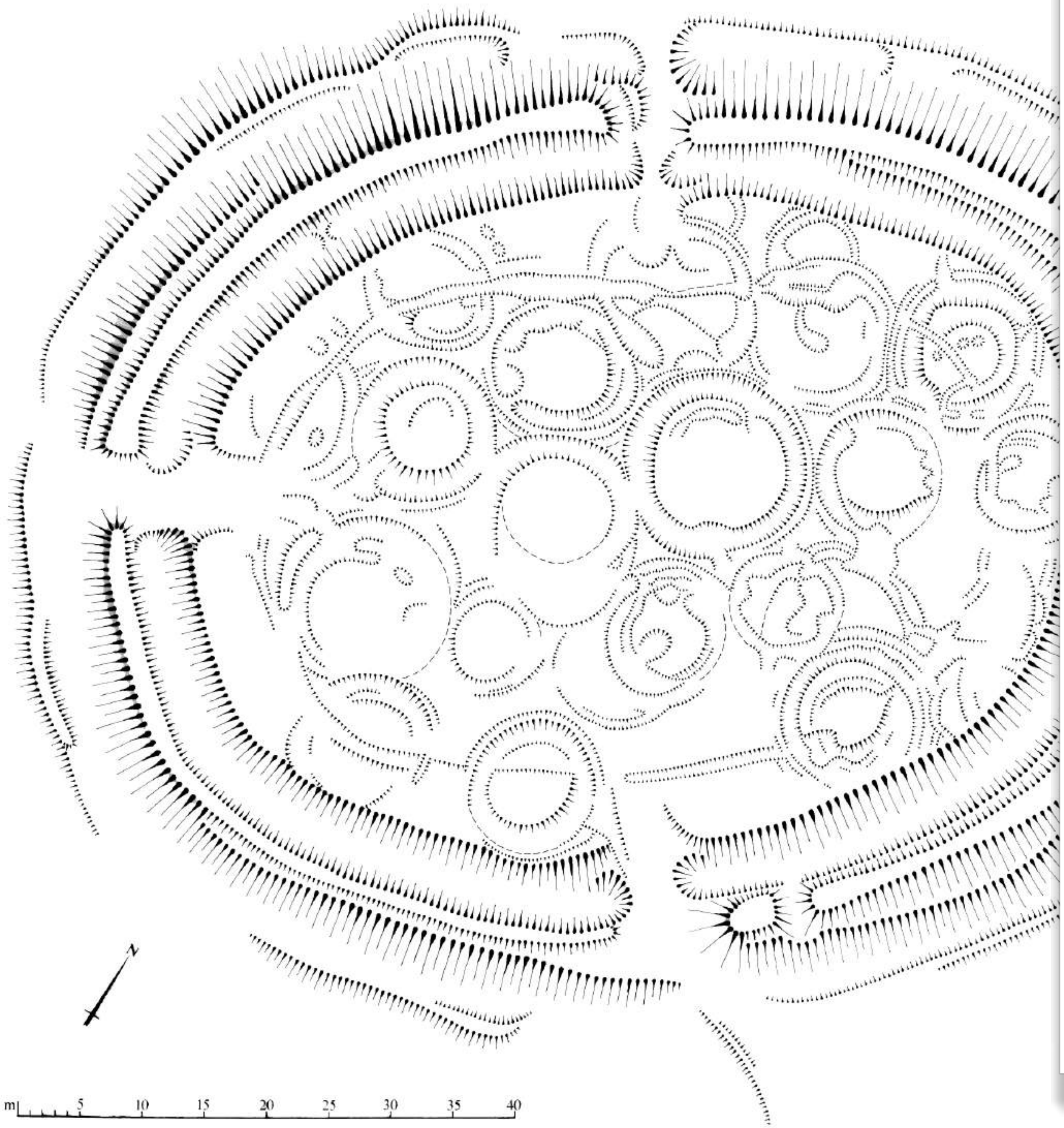



Systematic surface survey

Shovelpits

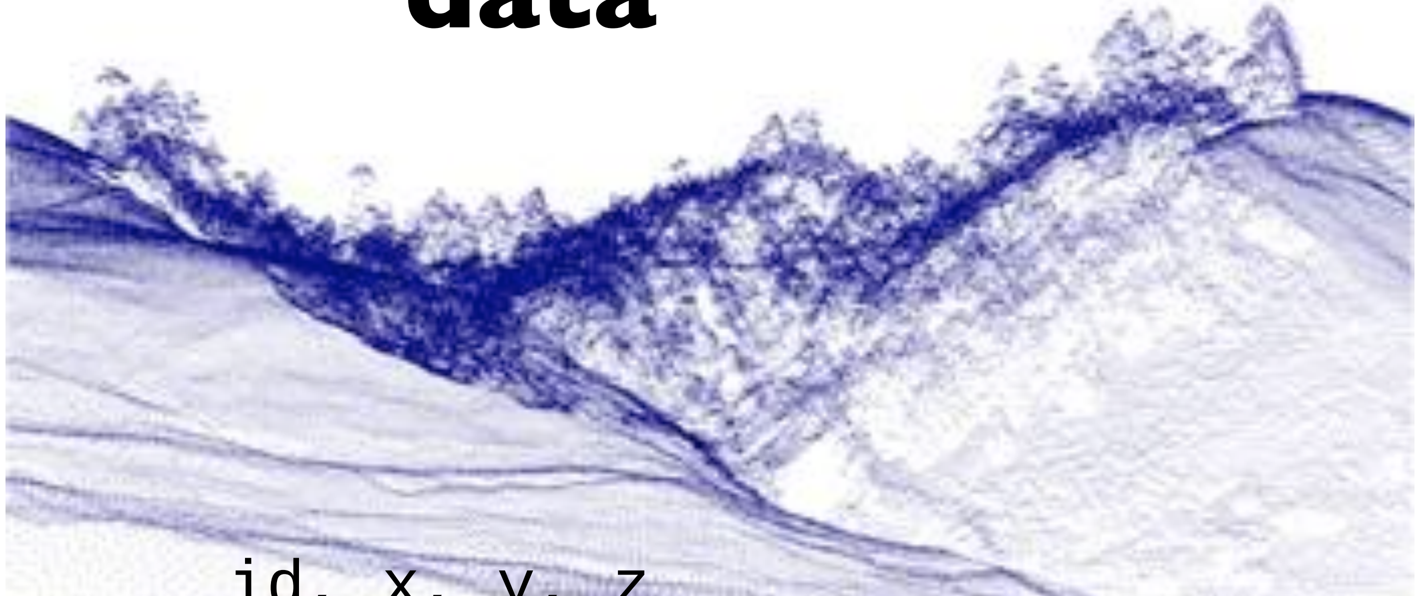
Coring

Topographic survey

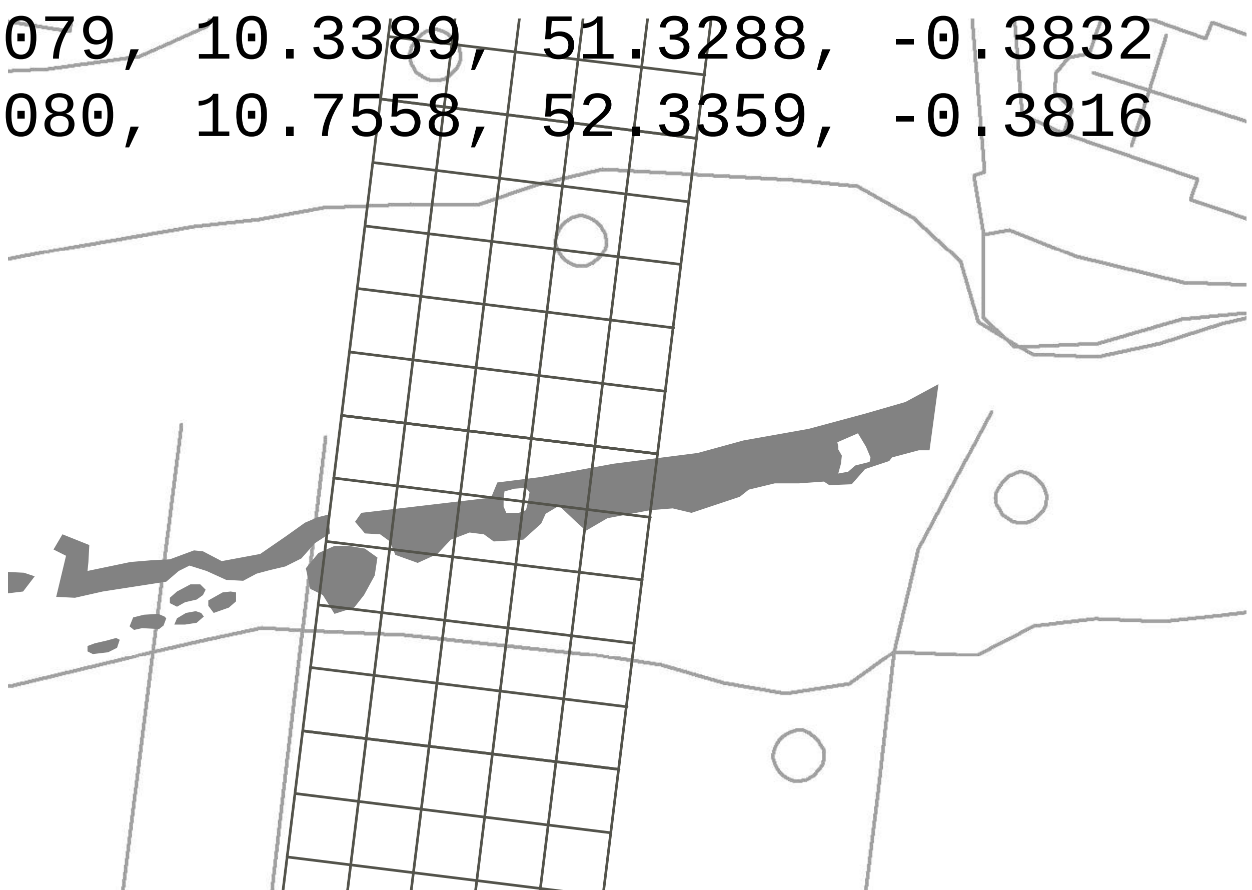


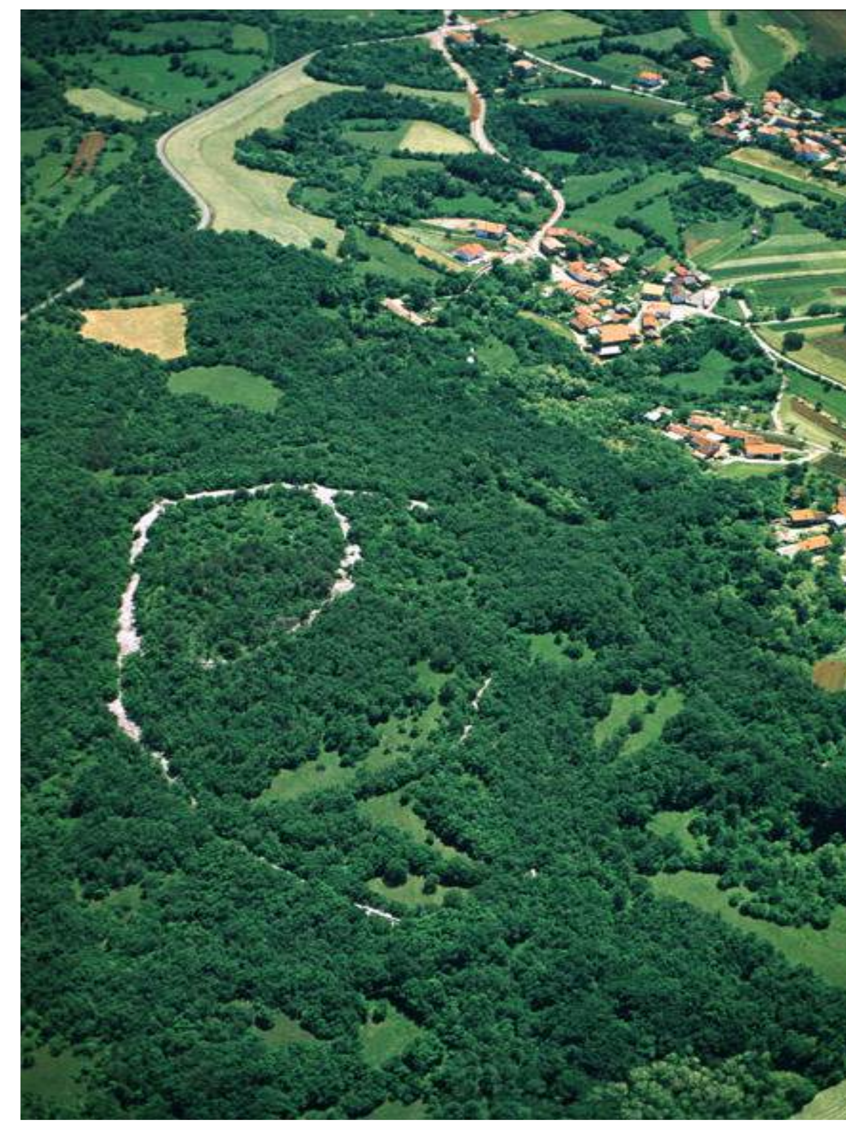
Geophysics

Different kinds of data

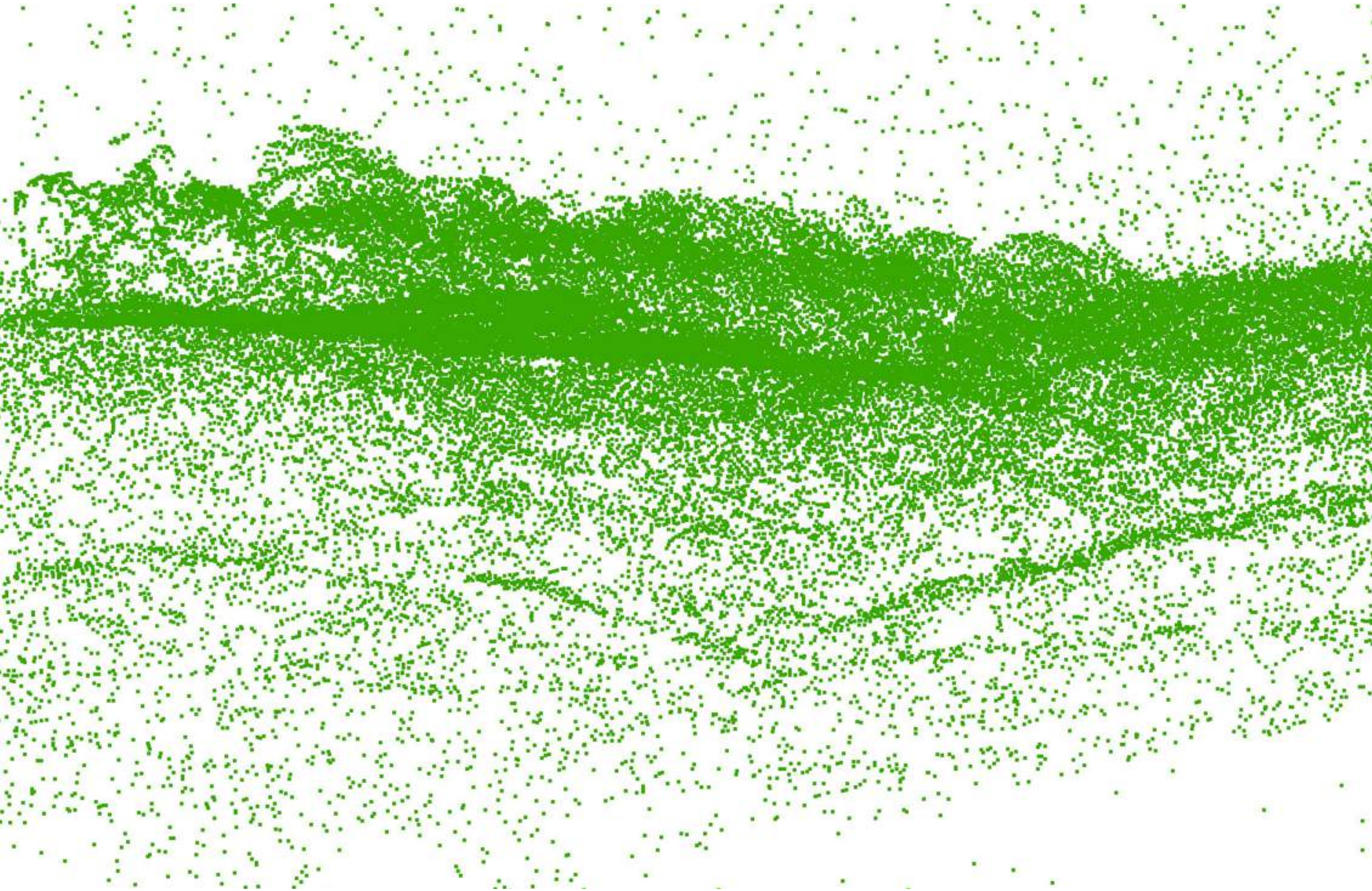


```
      id, x, y, z
1076, 9.7191,   52.7416, -0.4004
1077, 9.2562,   51.4537, -0.4082
1078, 10.3386, 51.3085, -0.3831
1079, 10.3389, 51.3288, -0.3832
1080, 10.7558, 52.3359, -0.3816
```

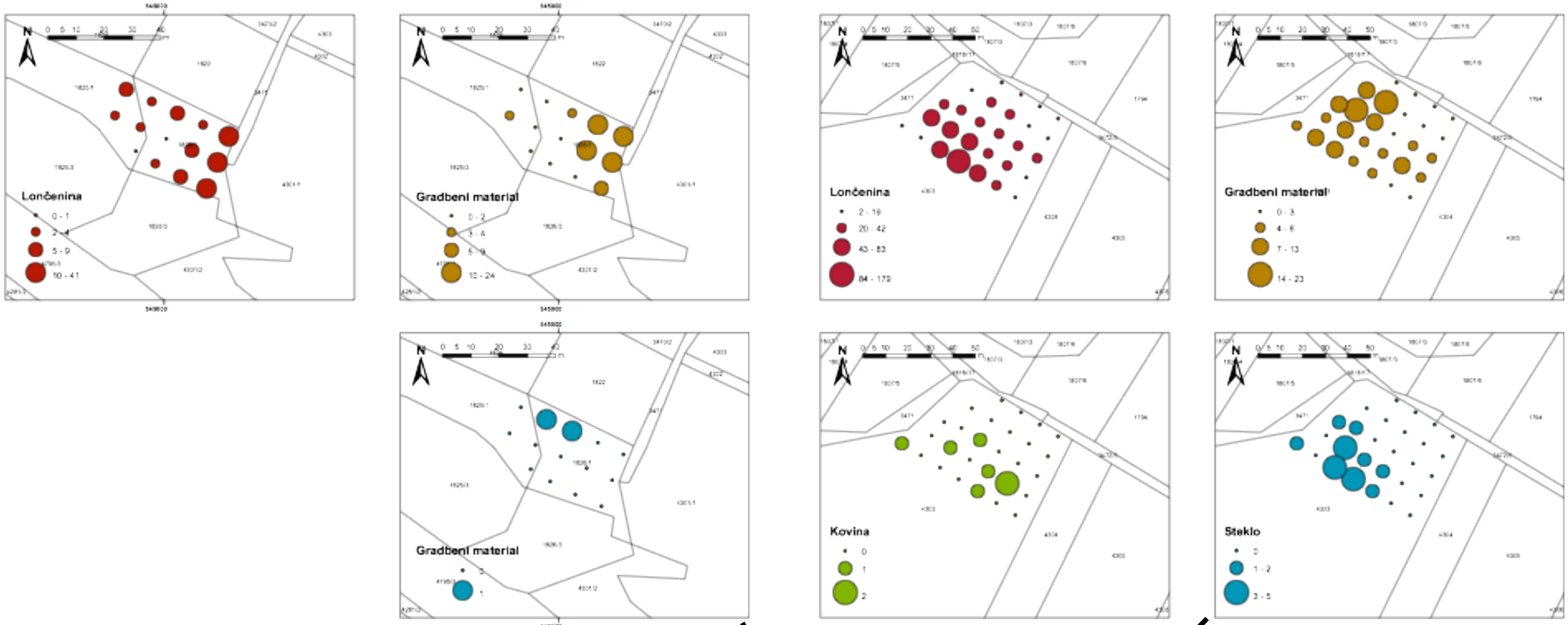




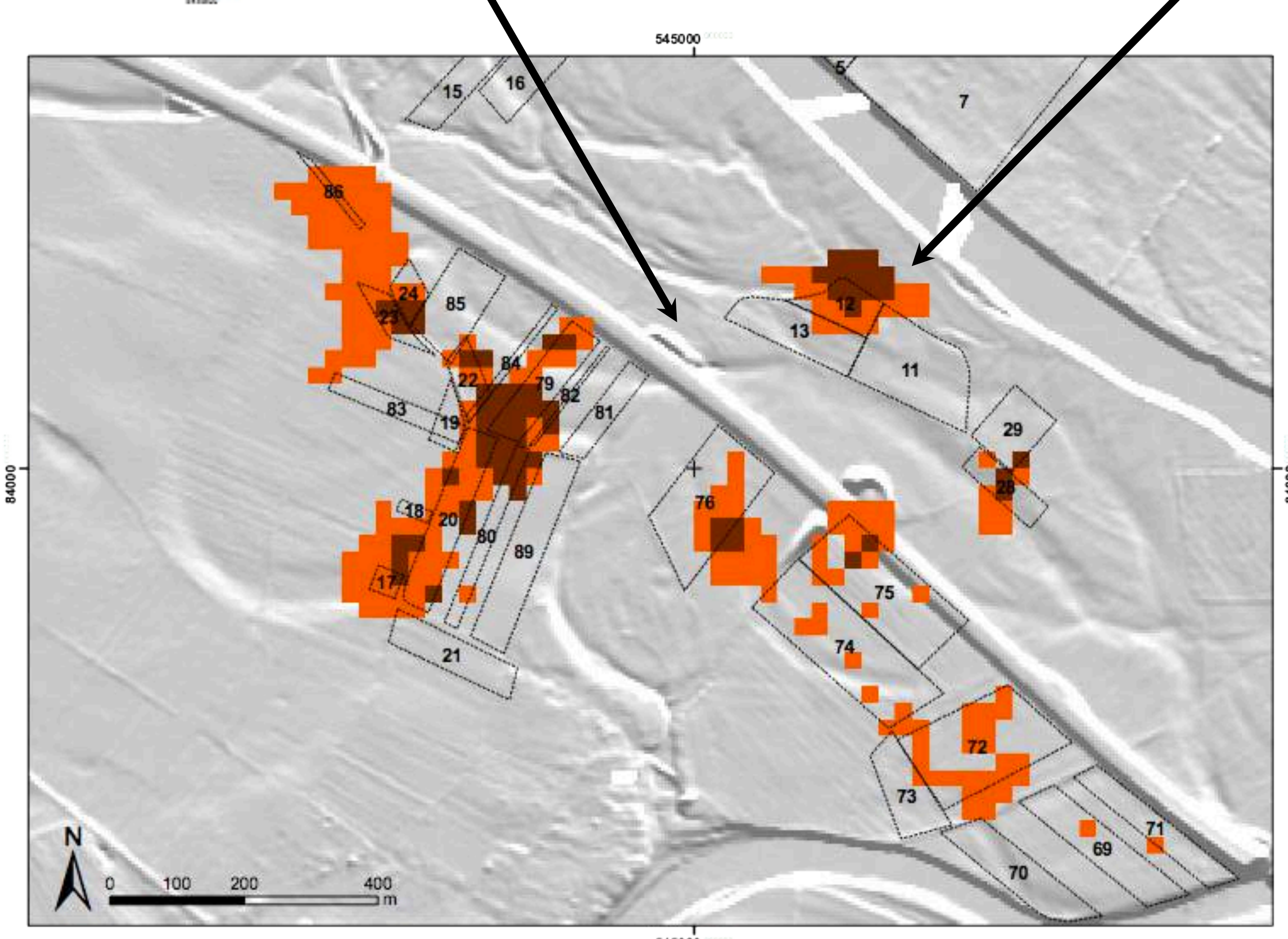
Large volumes of data



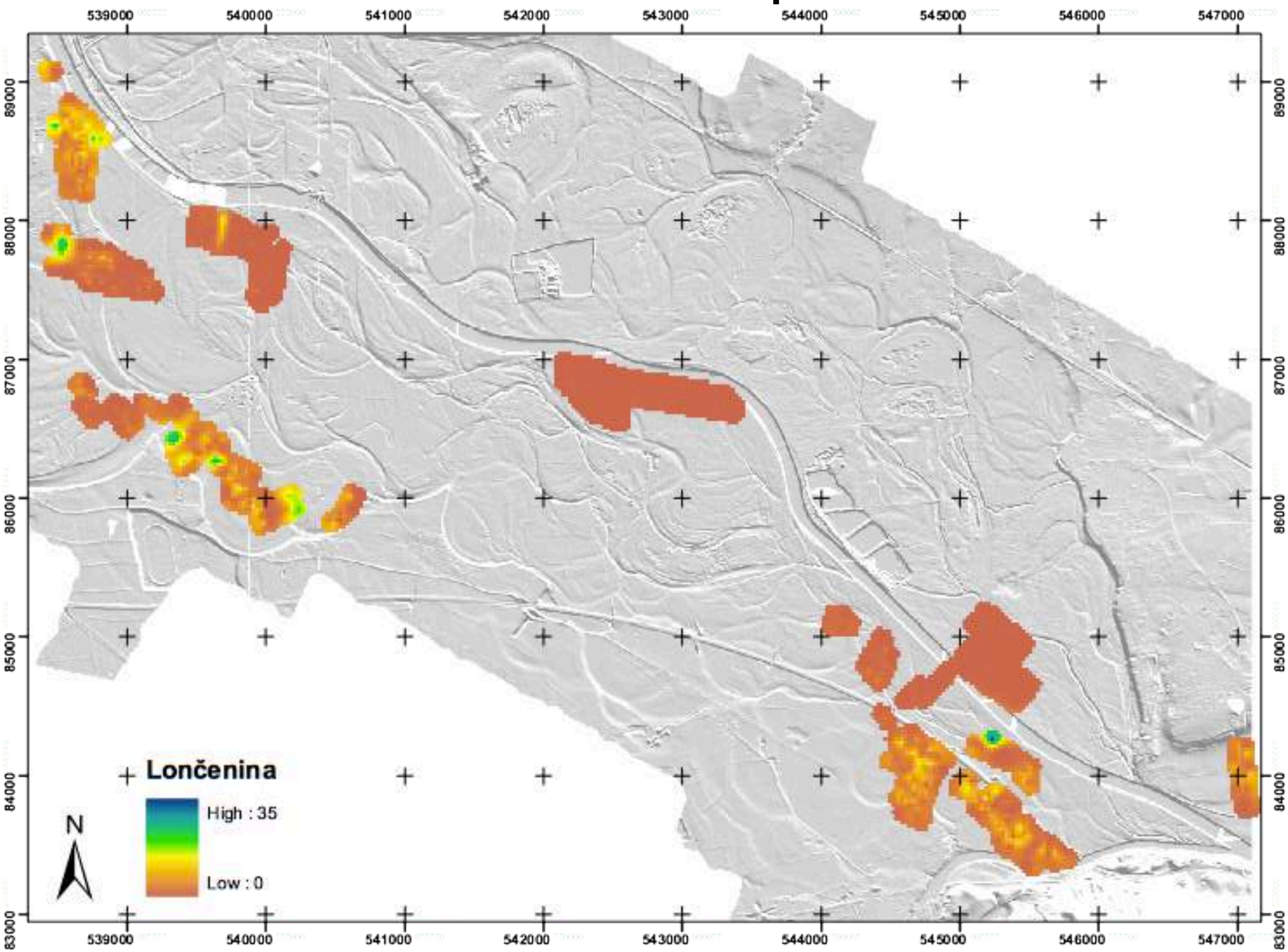
Acquired in a very different ways

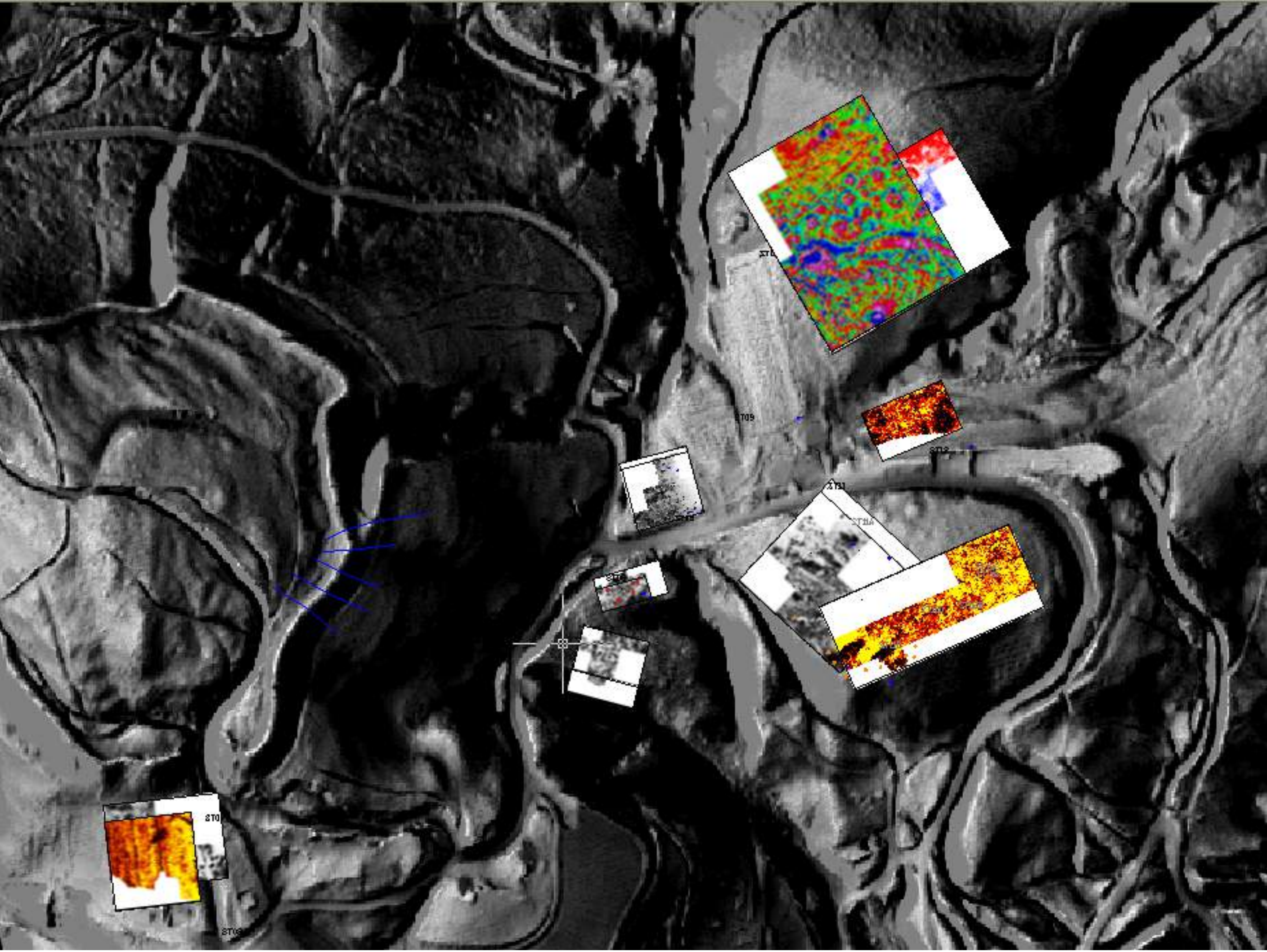


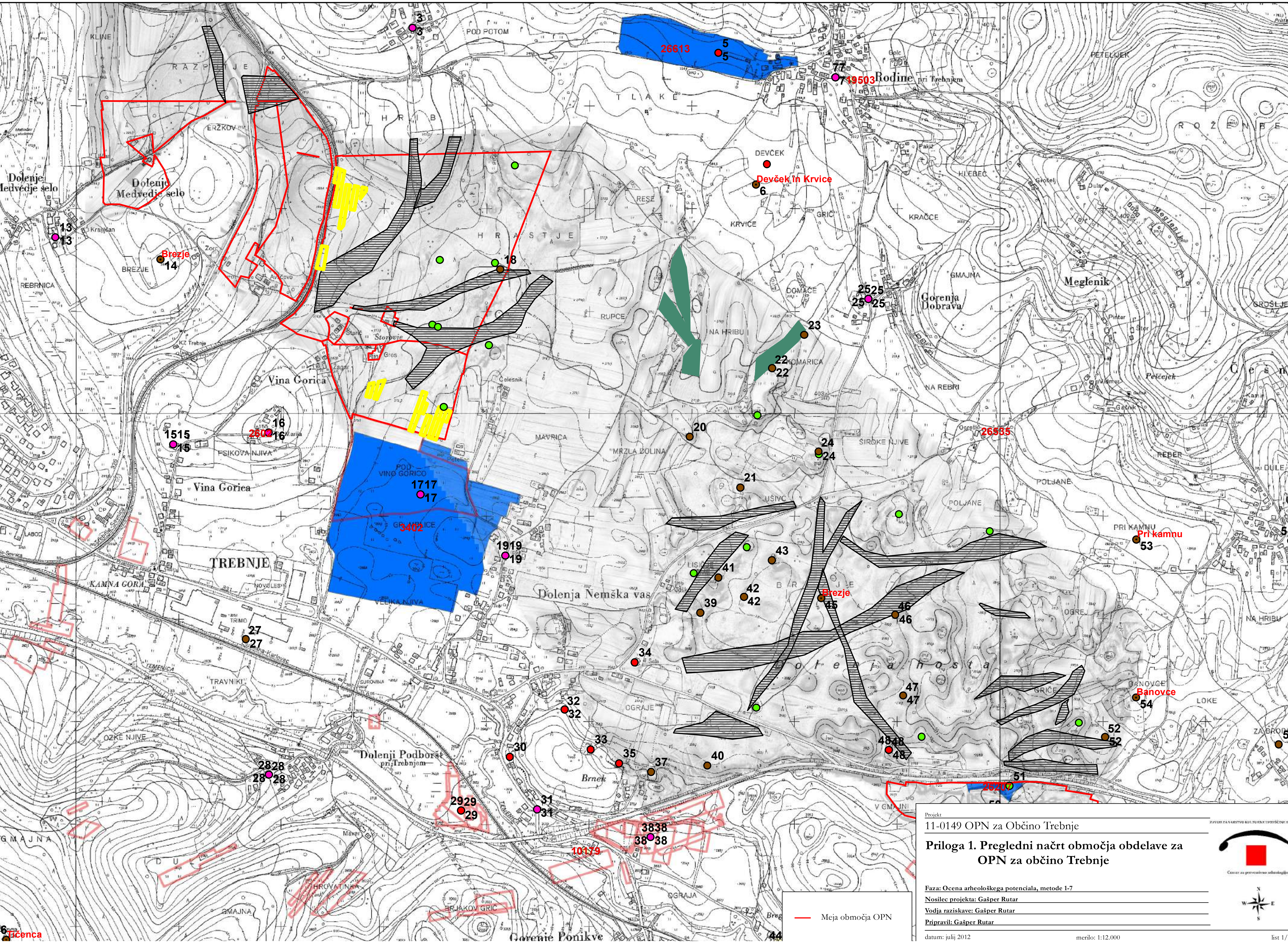
Has to be stored,processed, analysed, integrated, interpreted and disseminated



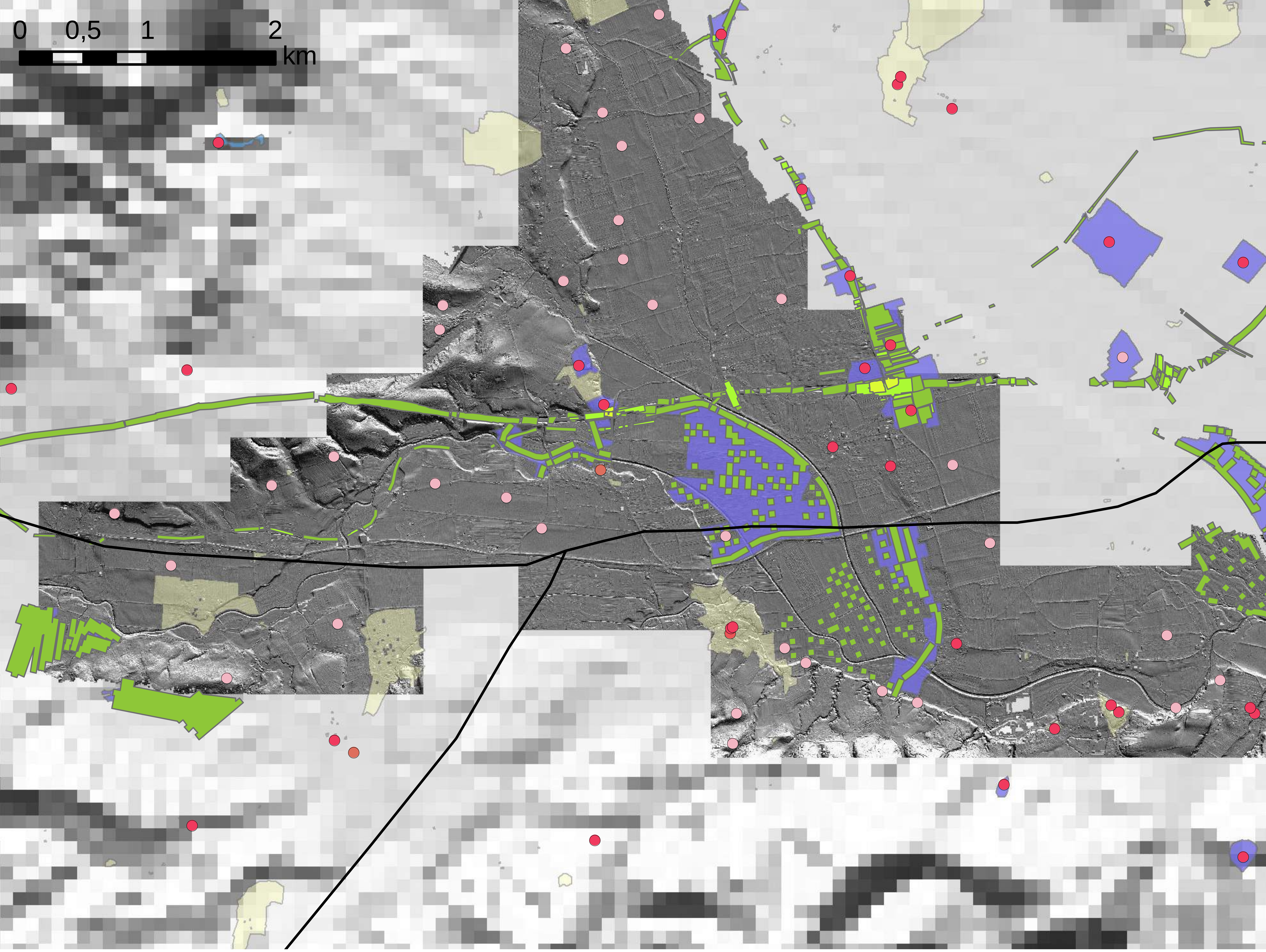
To help us understand what was going on in the landscape in the past




ST09



Monday, October 8, 12



Monday, October 8, 12

Large volumes of heterogenous data gathered in a number of ways, which have to be stored, manipulated, processed, integrated, visualized, interpreted and disseminated...

?

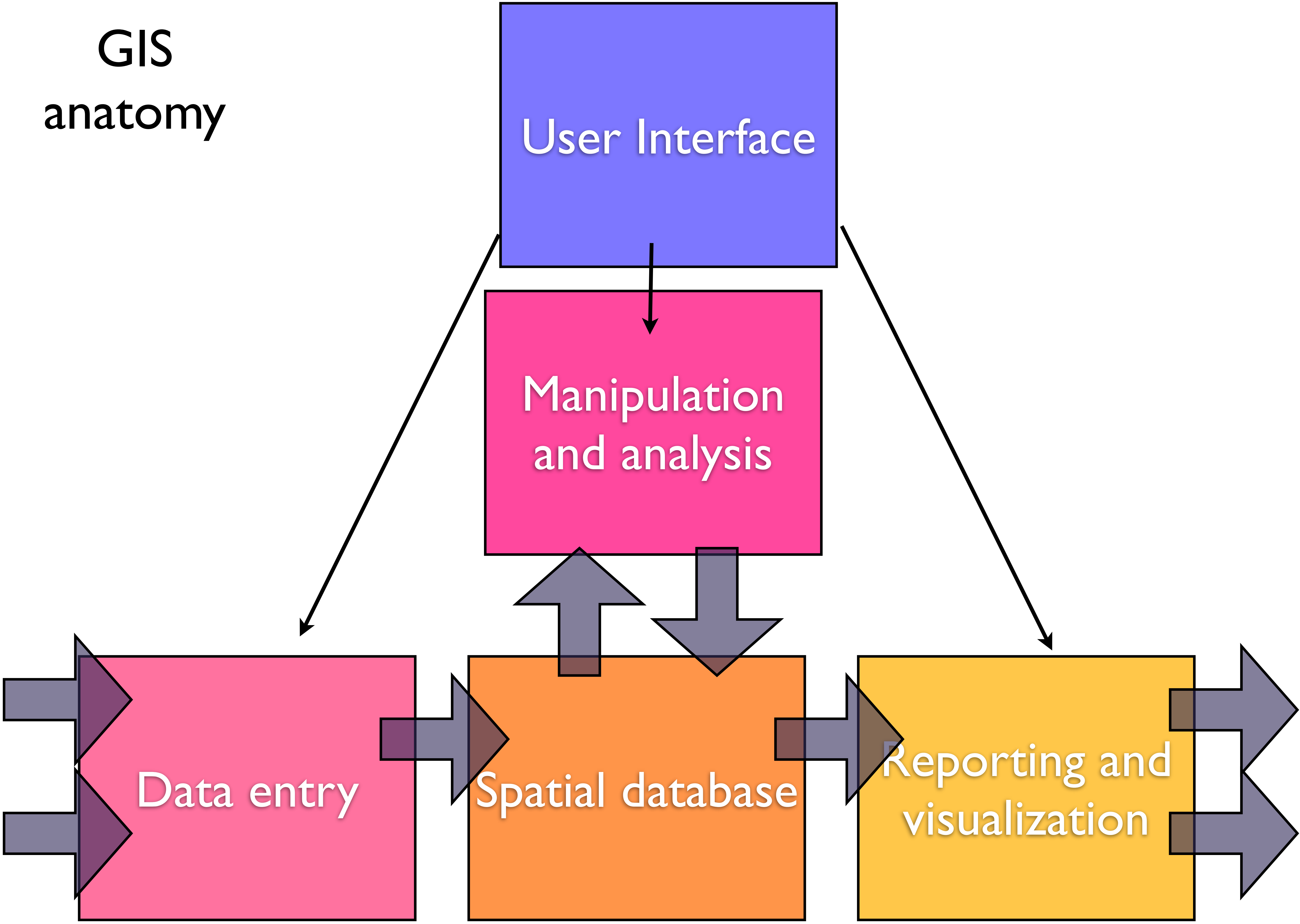
GIS

GIS

"...a powerful set of tools for collecting, storing, retrieving at will, transforming, and displaying spatial data from the real world for a particular set of purposes." (Burrough 1986) "

"An information system that is designed to work with data referenced by spatial or geographic coordinates. In other words a GIS is both a database system with specific capabilities for spatially-referenced data as well as a set of operations for working (analysis) with the data." (Star and Estes 1990)

GIS anatomy


User Interface
Manipulation and analysis
Data entry
Spatial database
Reporting and visualization

It is not a piece of software ...

http://www.esri.com/software/arcgis/index.html

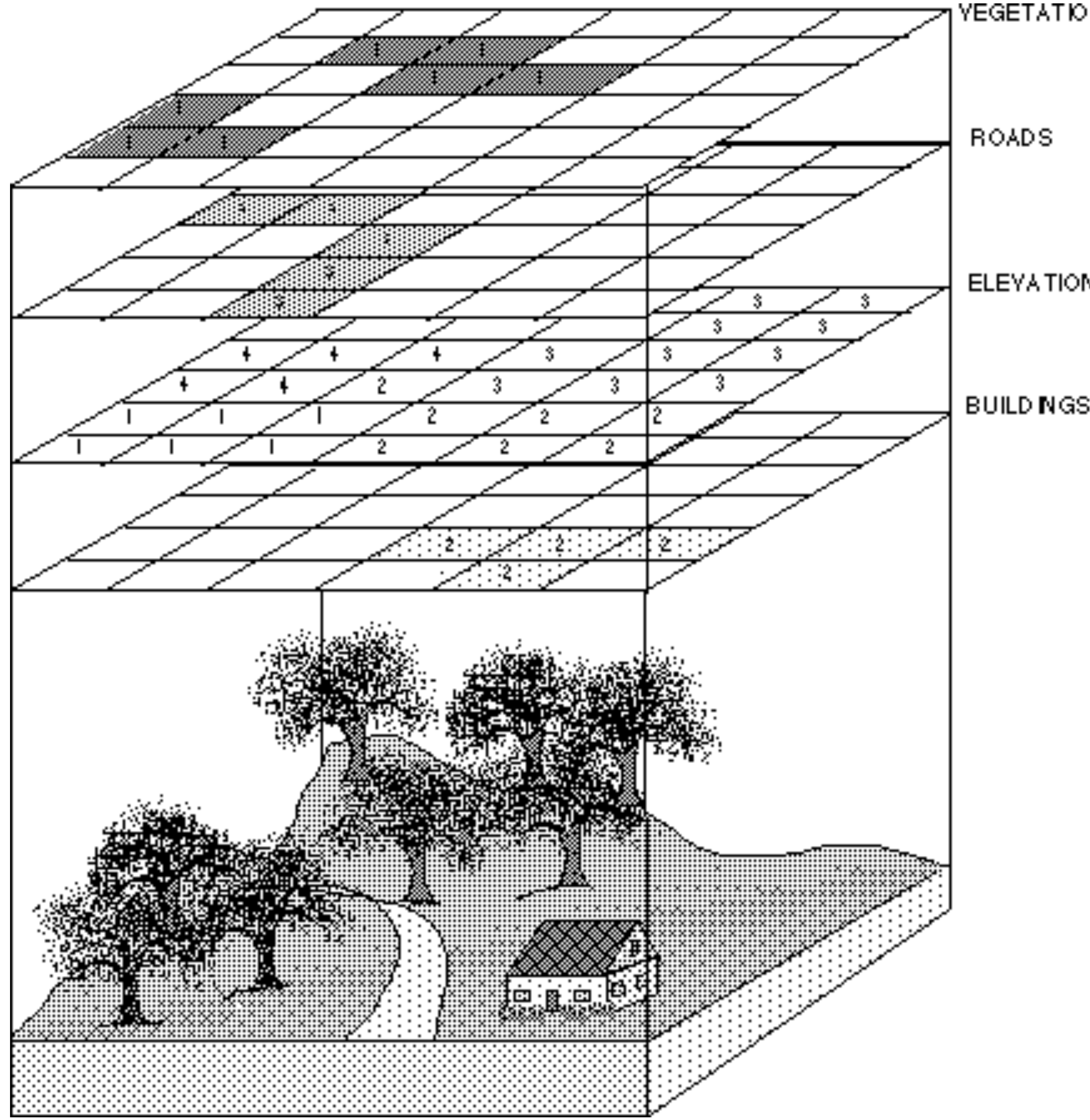
http://www.clarklabs.org/

http://grass.itc.it/

http://www.qgis.org/

Model of spatial phenomena

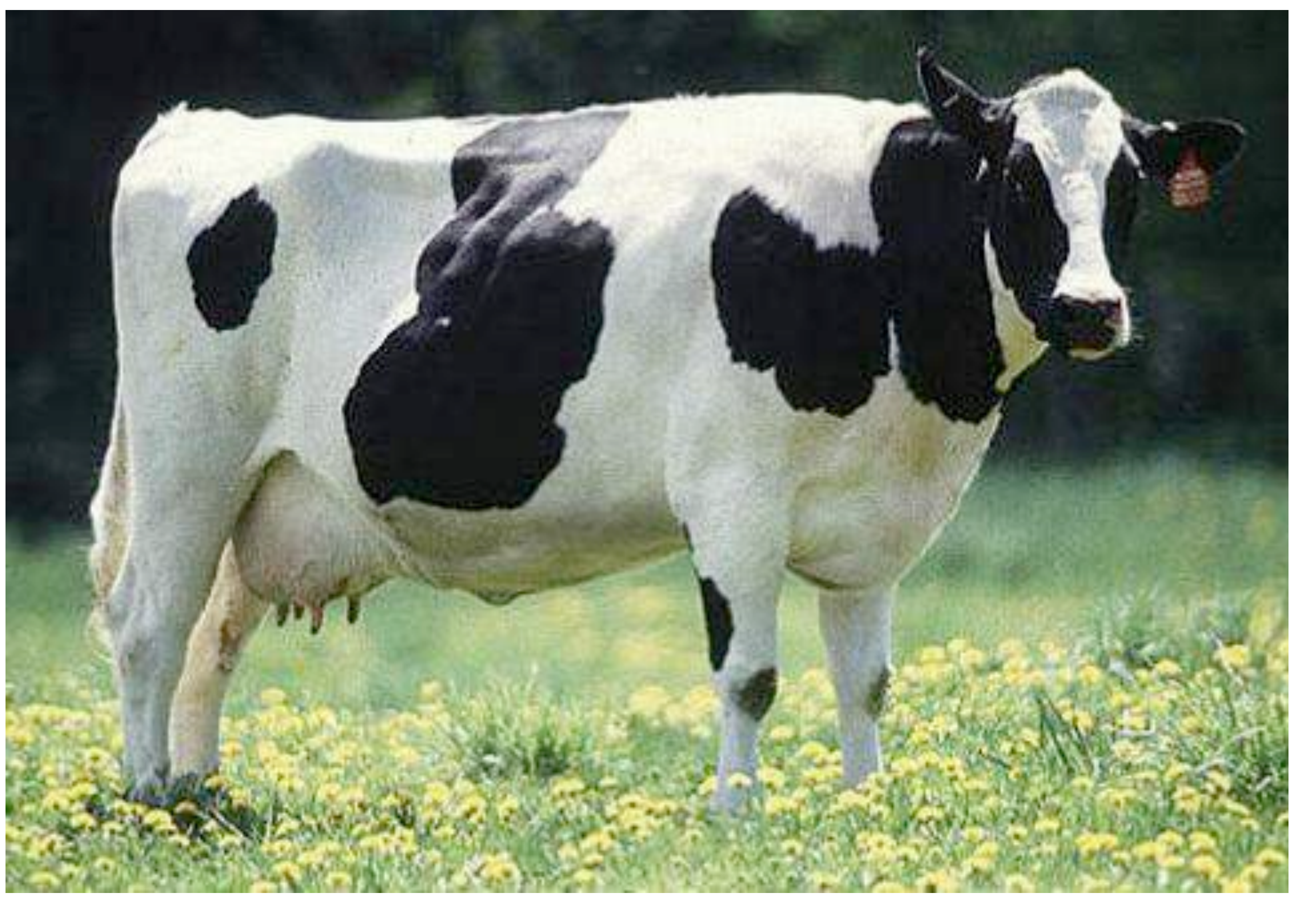
Model



Spatial phenomna

Modelling

Phenomenon



Model

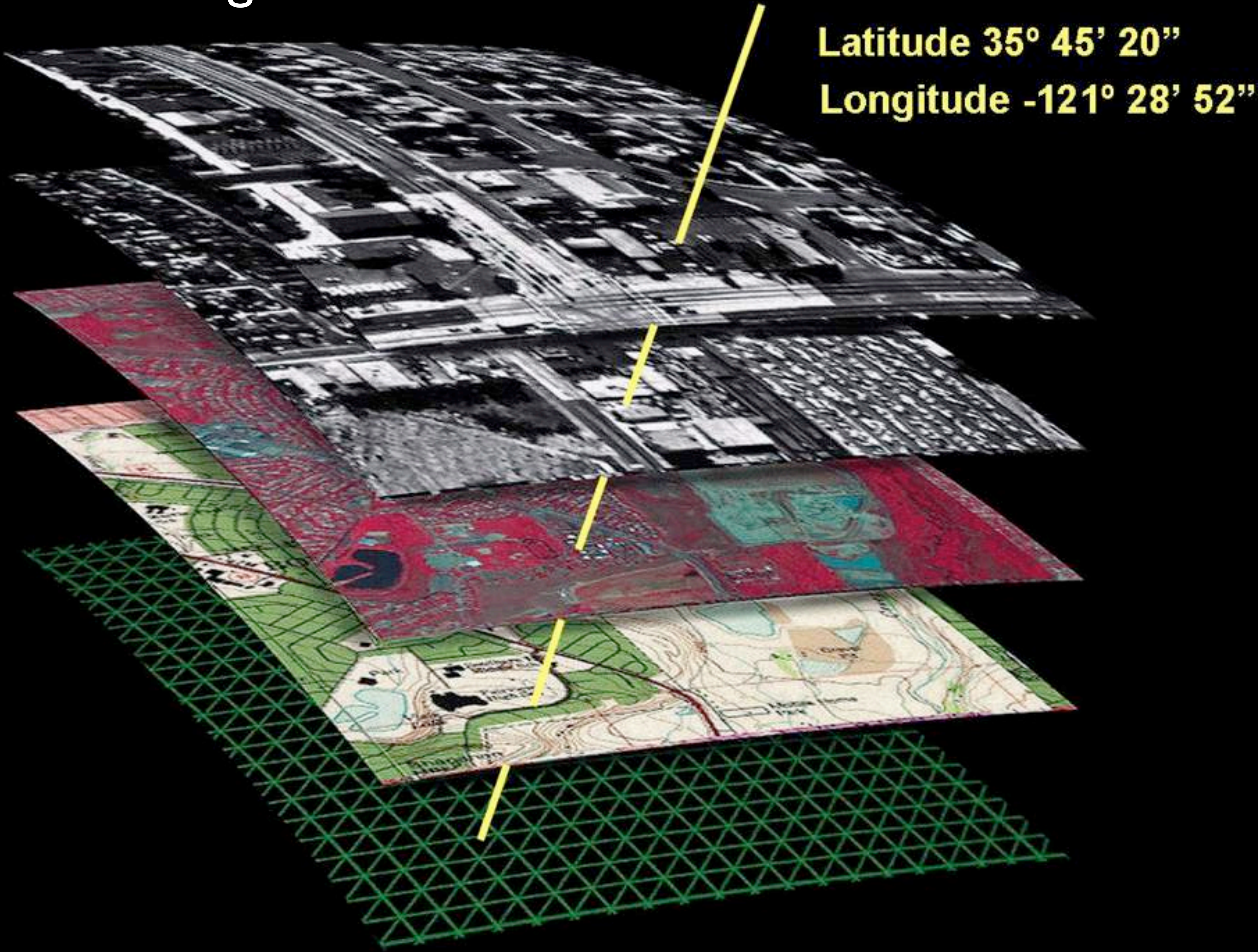
Model

mapping feature A model is based on an original.

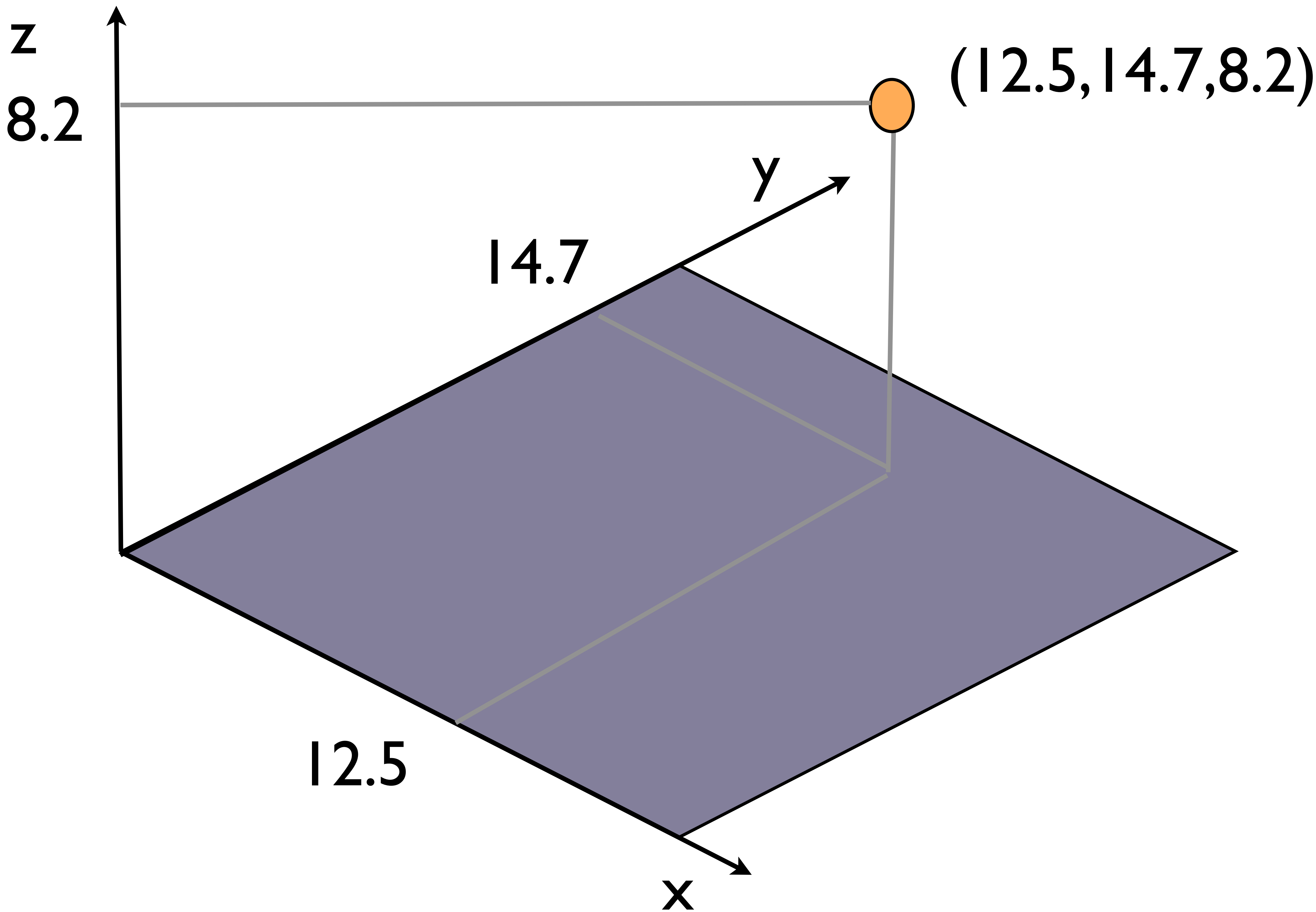
reduction feature A model only reflects a (relevant) selection of the original's properties.

pragmatic feature A model needs to usable in place of the original with respect to some purpose.

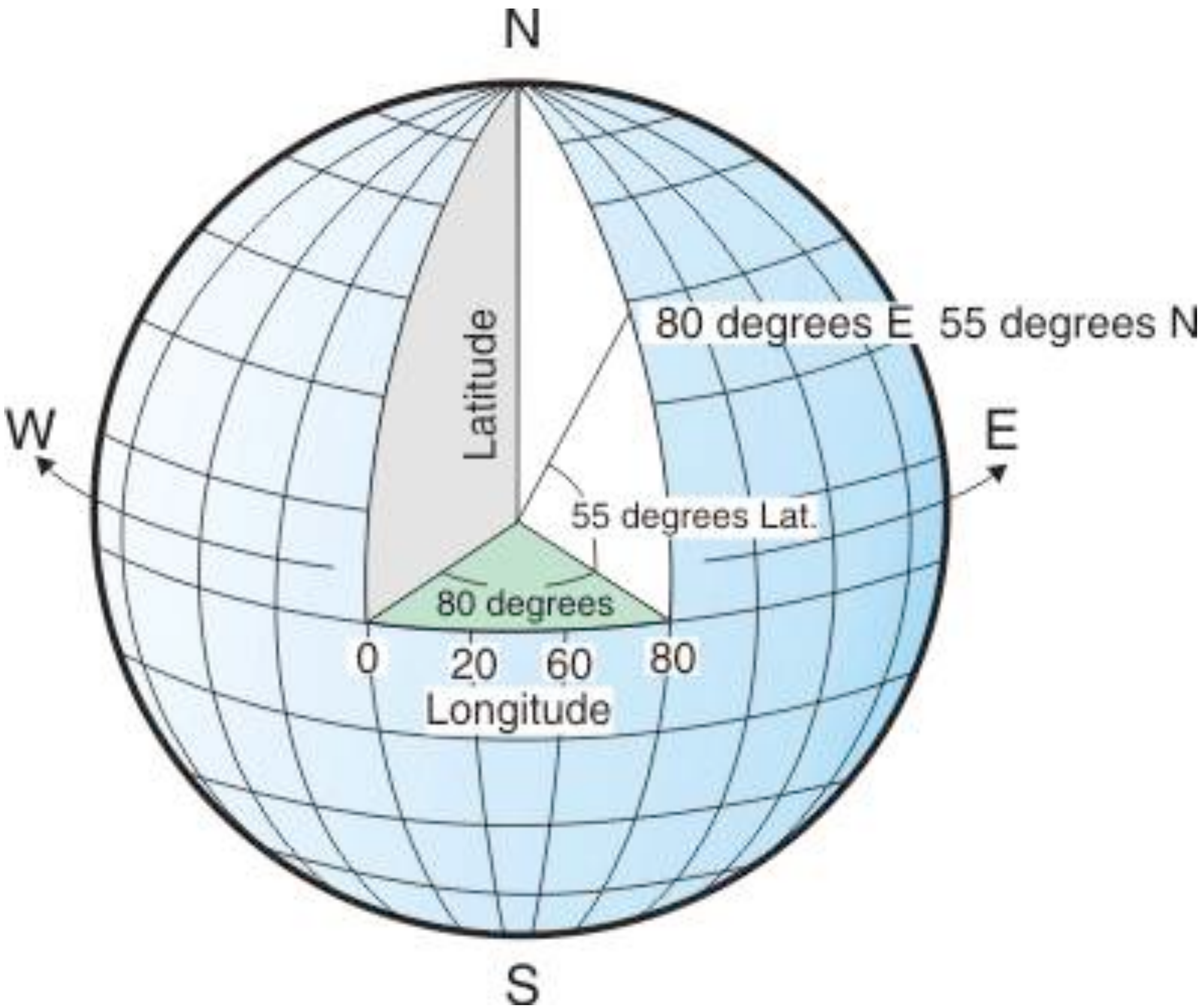
Georeferencing



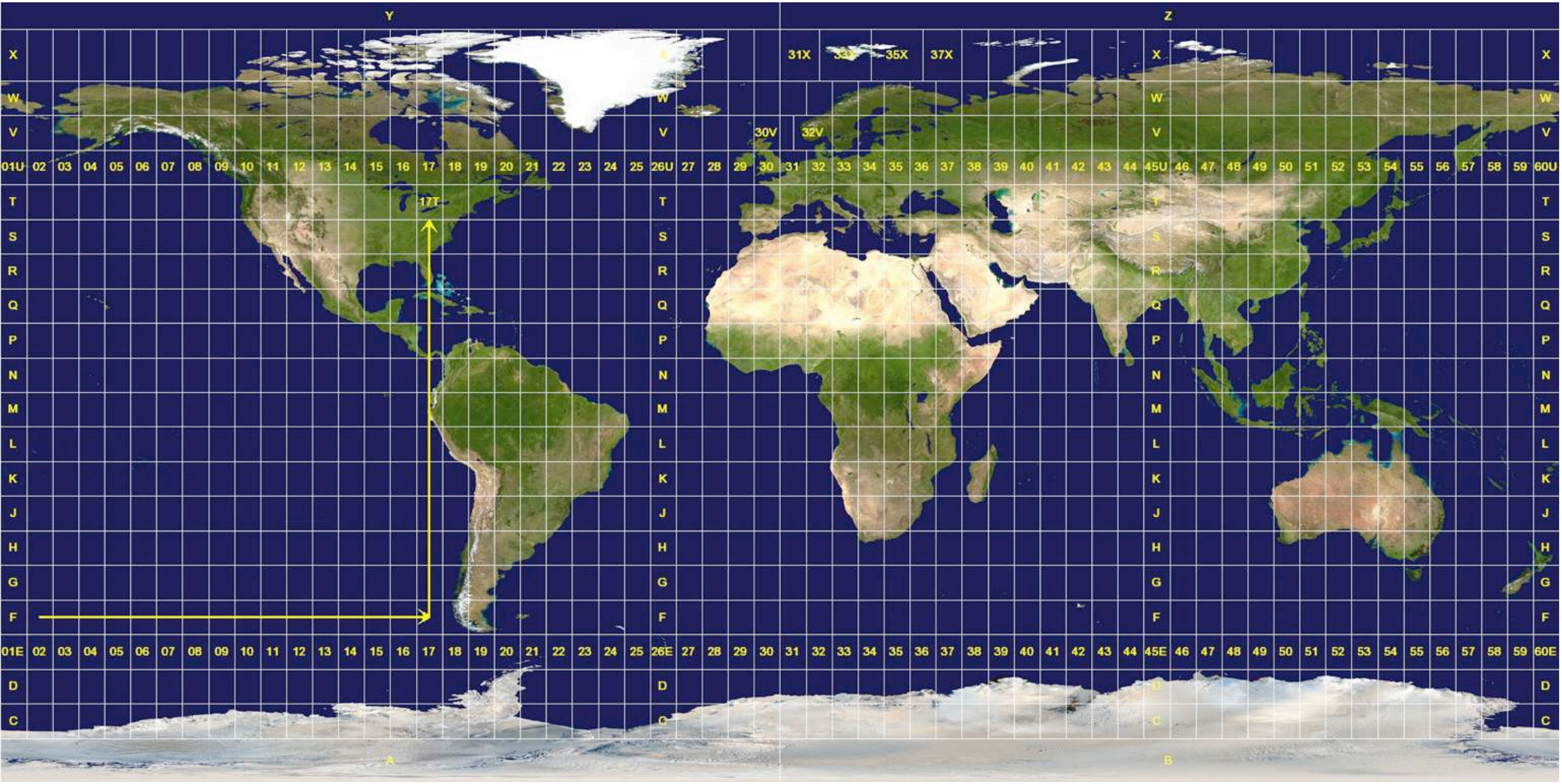
Coordinate system



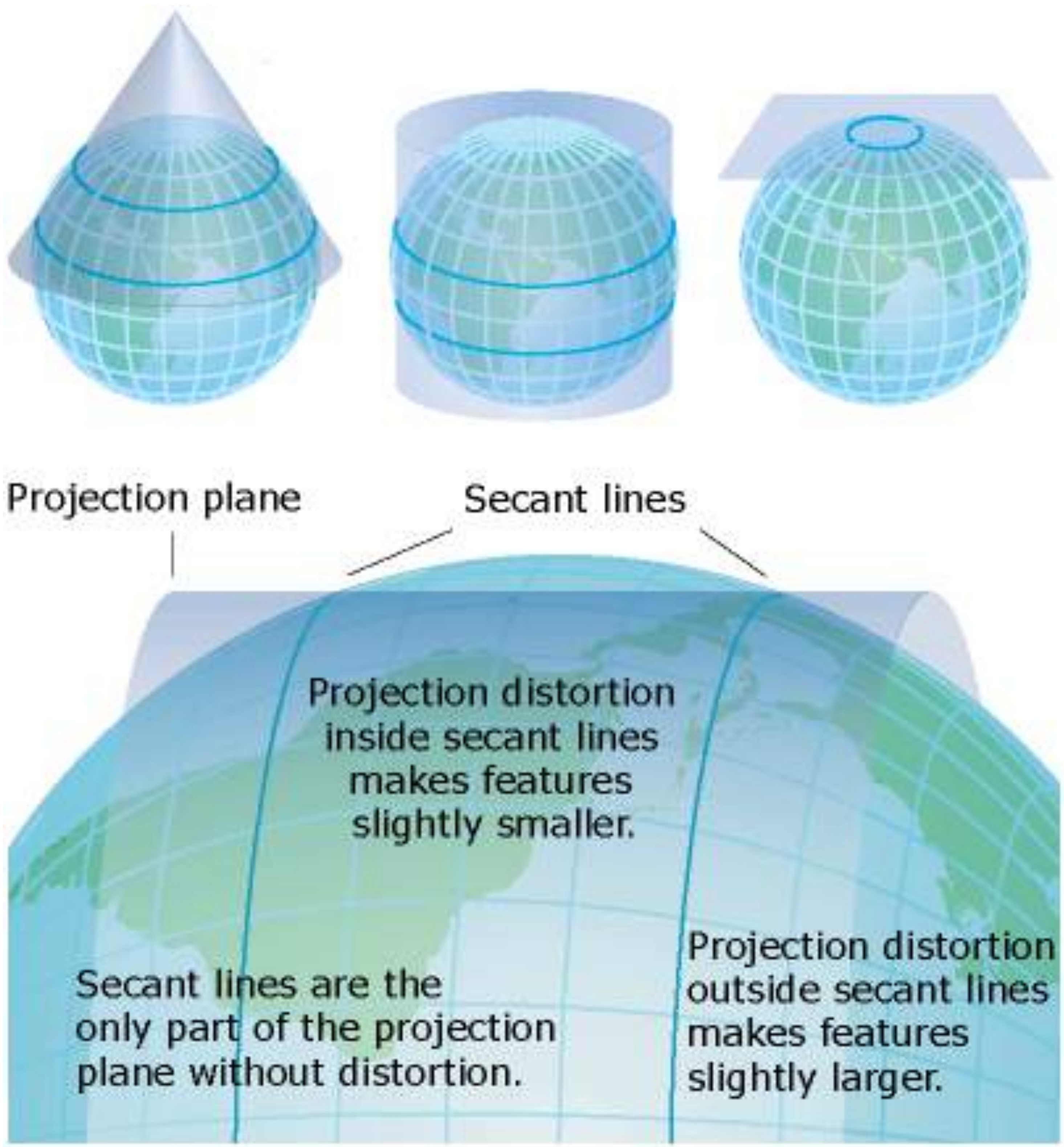
Geographic coordinate system



Projected coordinate system



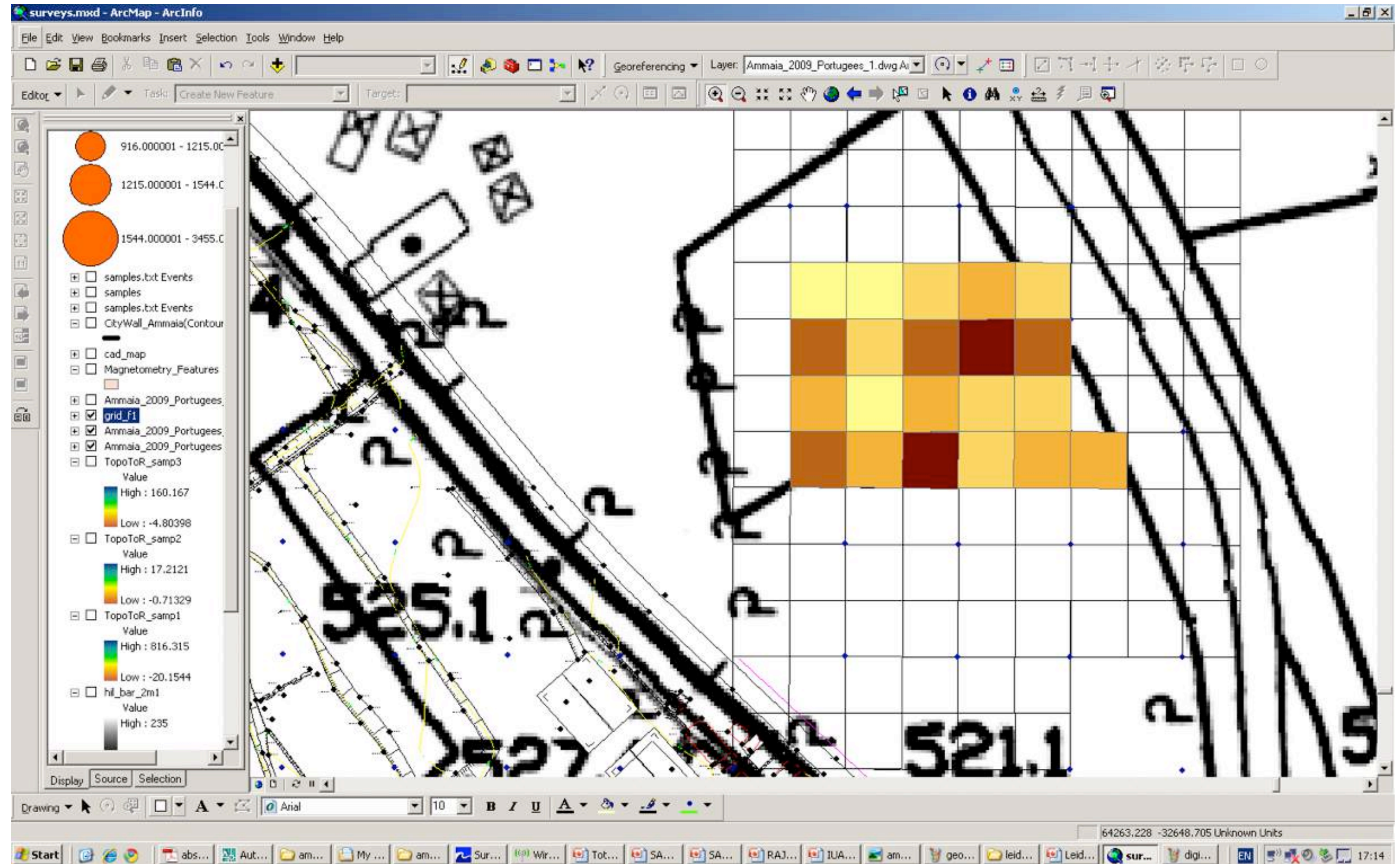
Projections

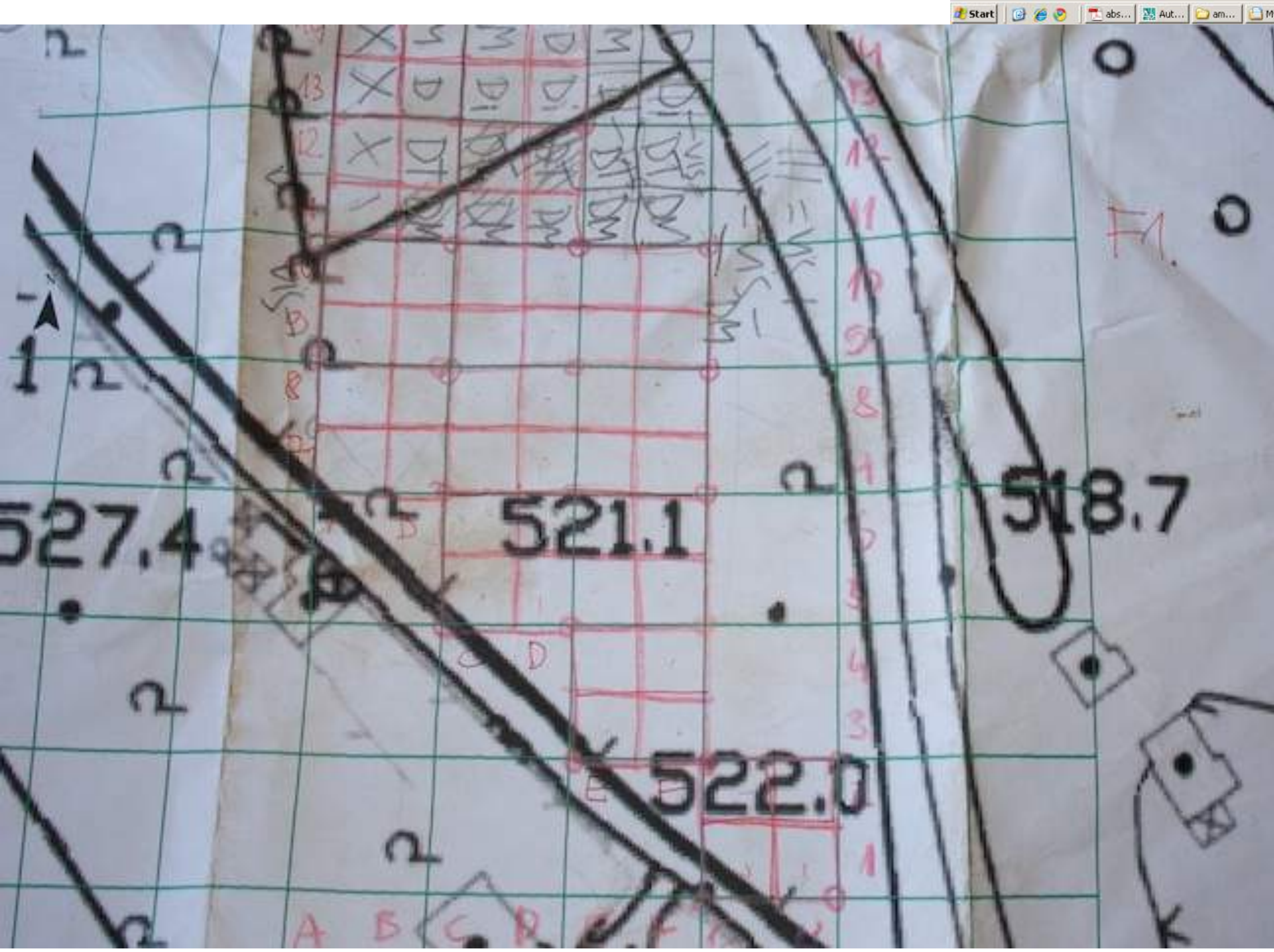


Getting data into gis: total station

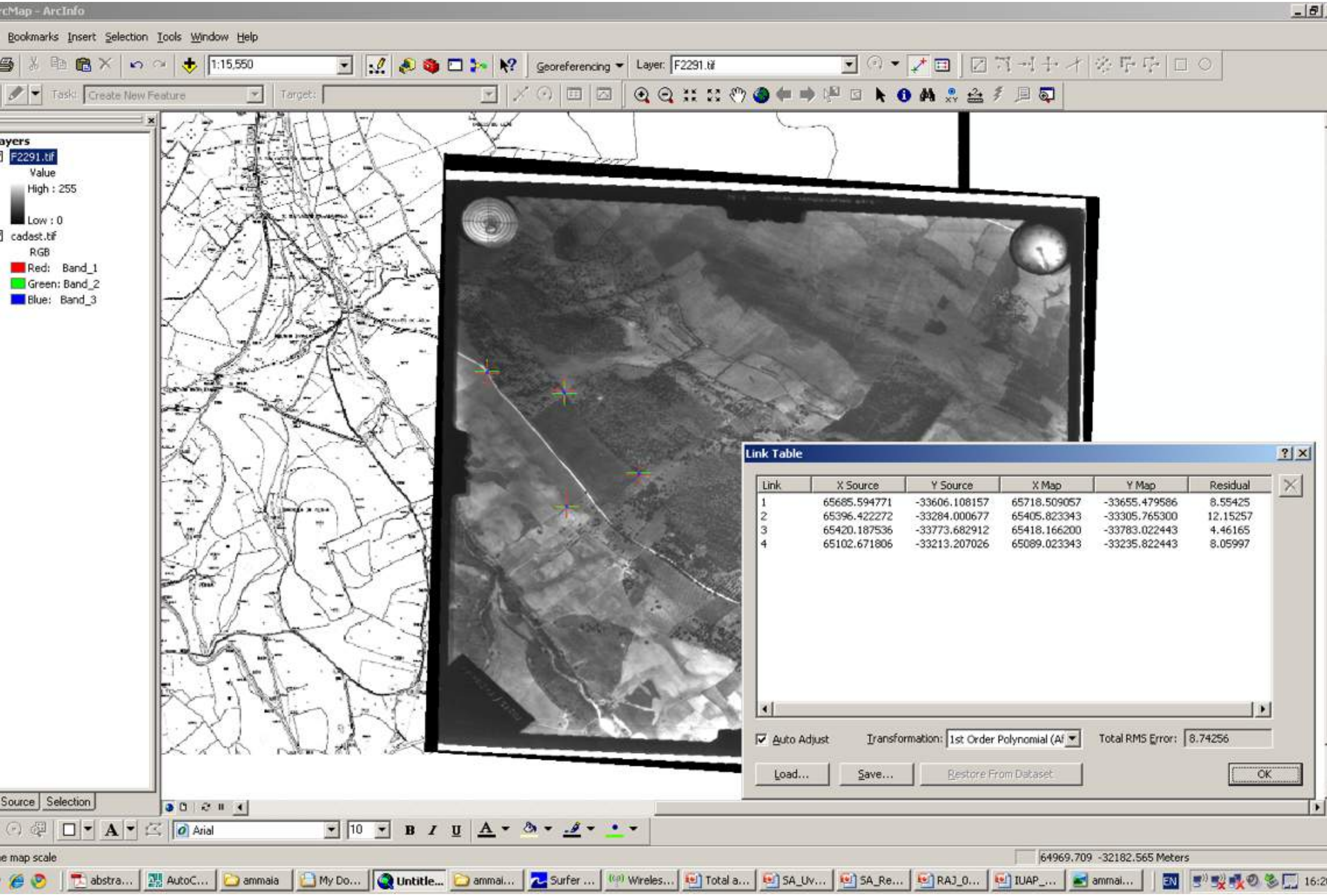
```
      id, x, y, z
1076, 9.7191,   52.7416, -0.4004
1077, 9.2562,   51.4537, -0.4082
1078, 10.3386, 51.3085, -0.3831
1079, 10.3389, 51.3288, -0.3832
1080, 10.7558, 52.3359, -0.3816
```

Gridded data



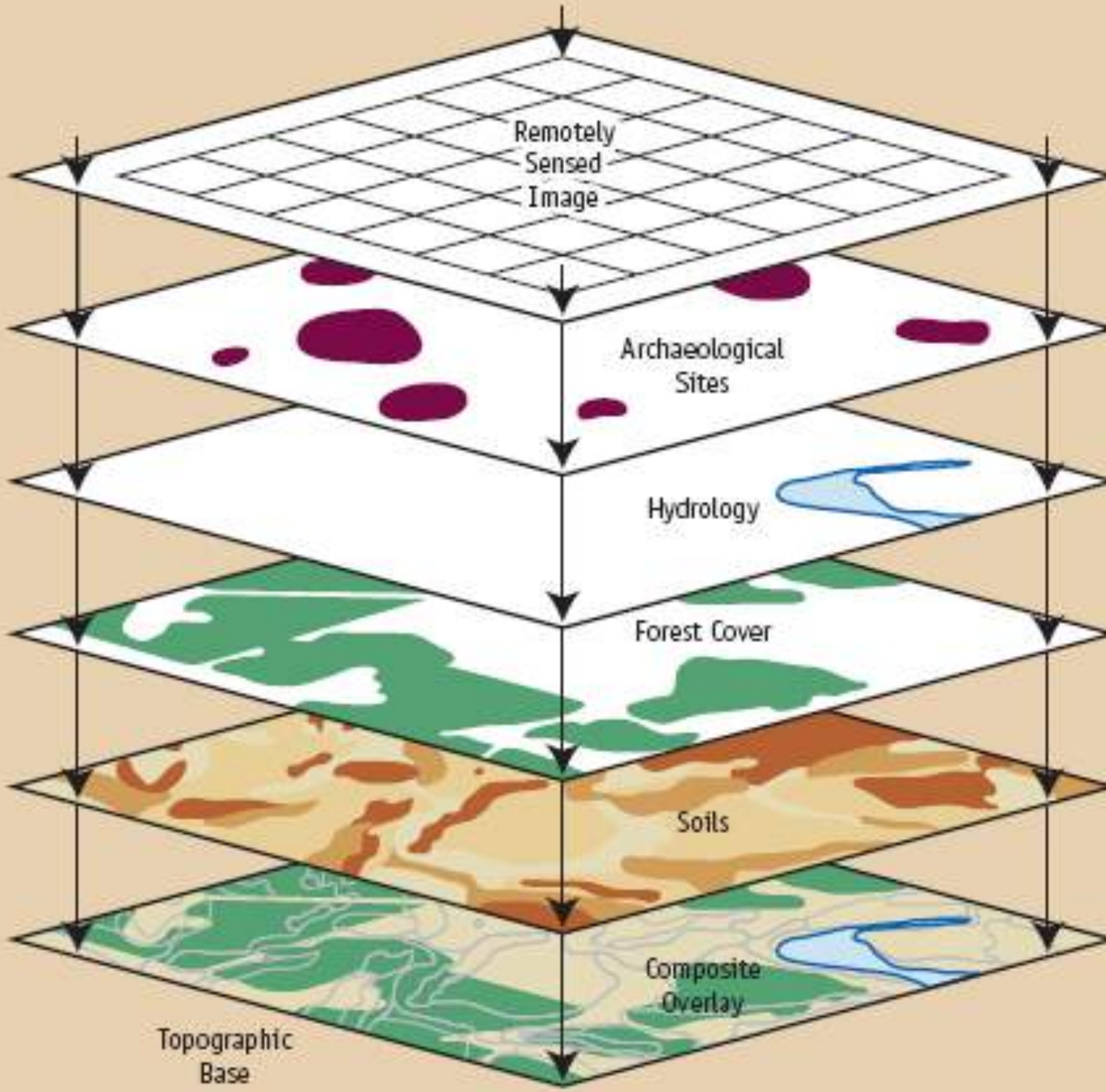


Georeferencing

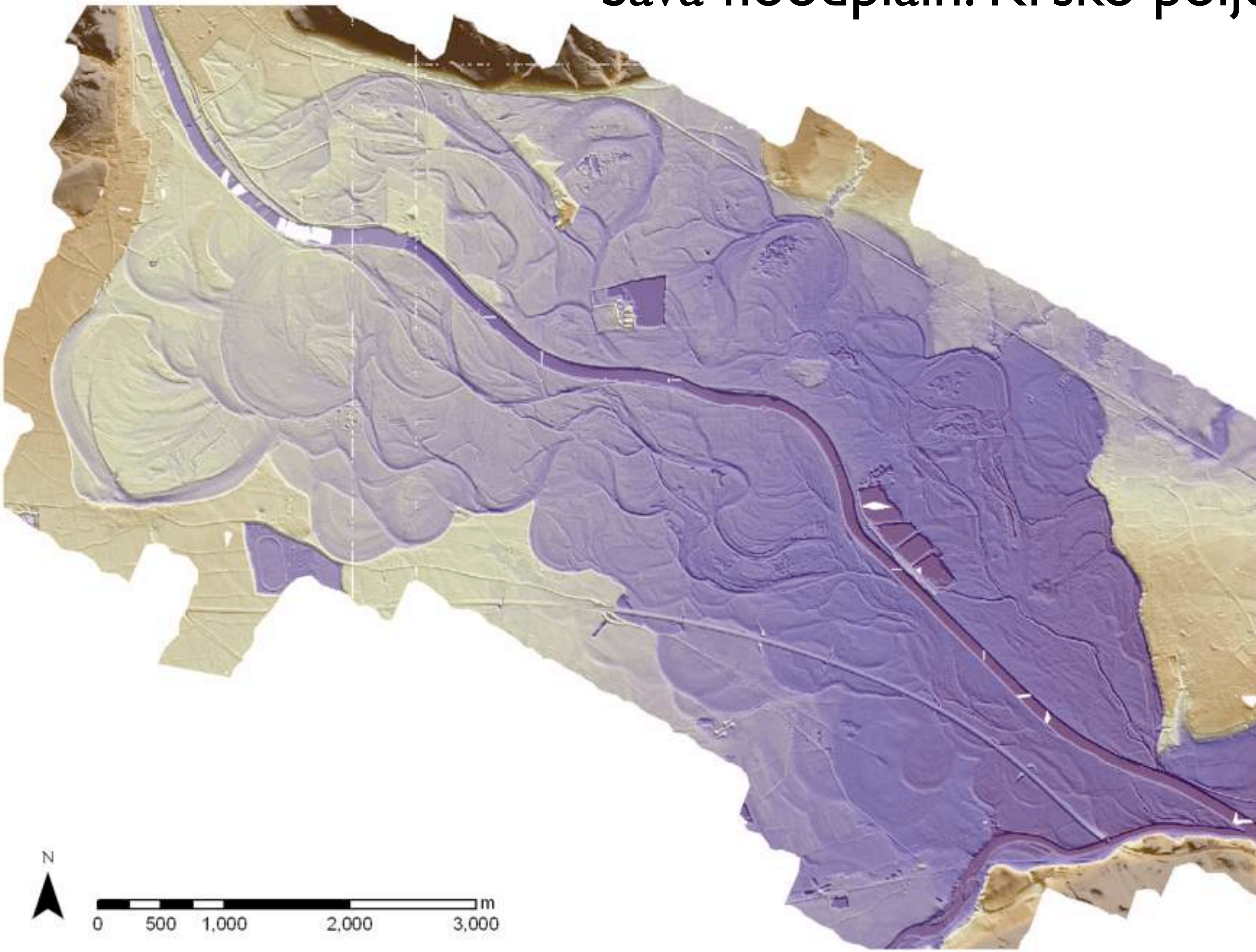


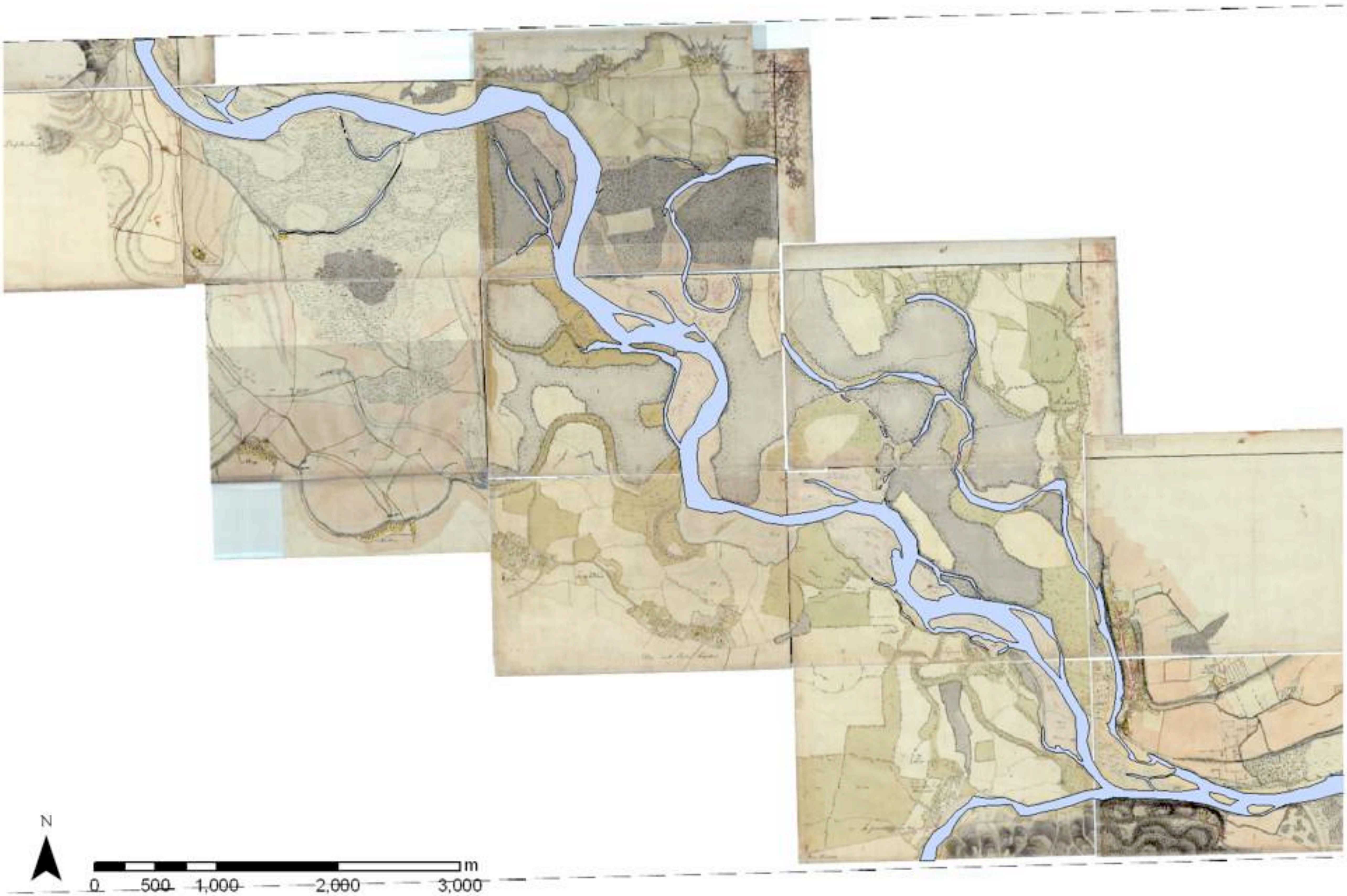
Thematic layers

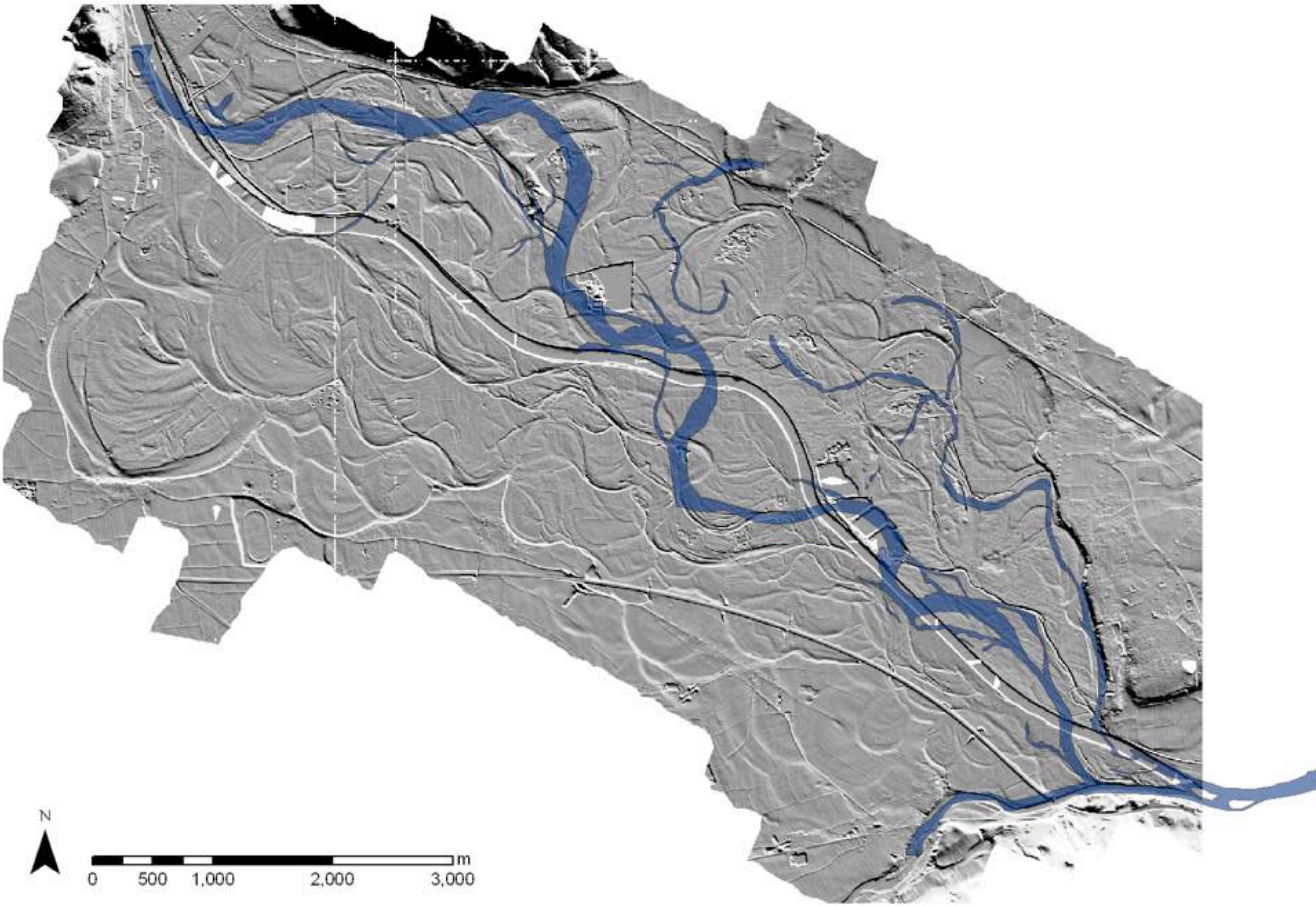
Geographical information system (GIS) works by creating a series of georeferenced overlays.

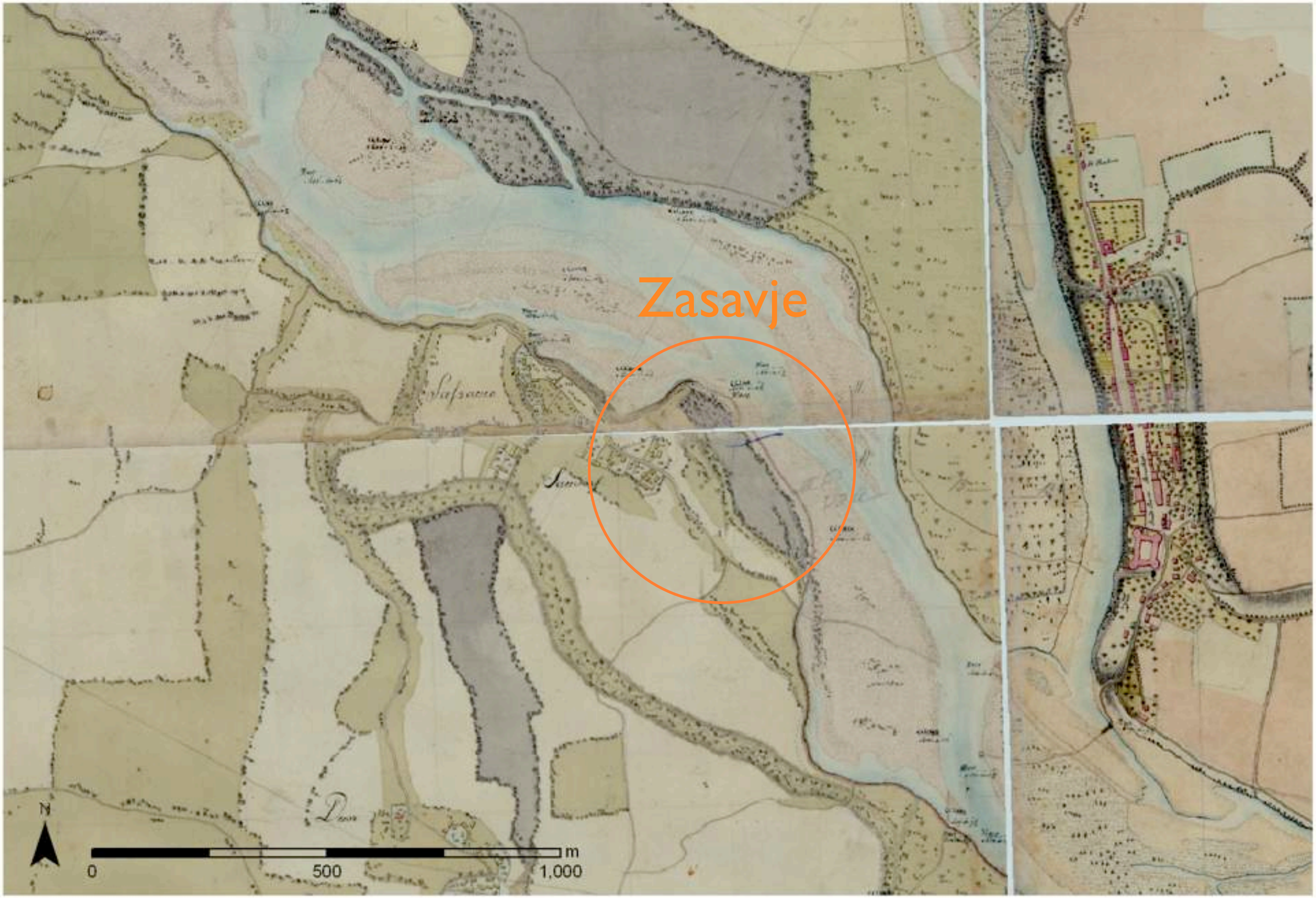


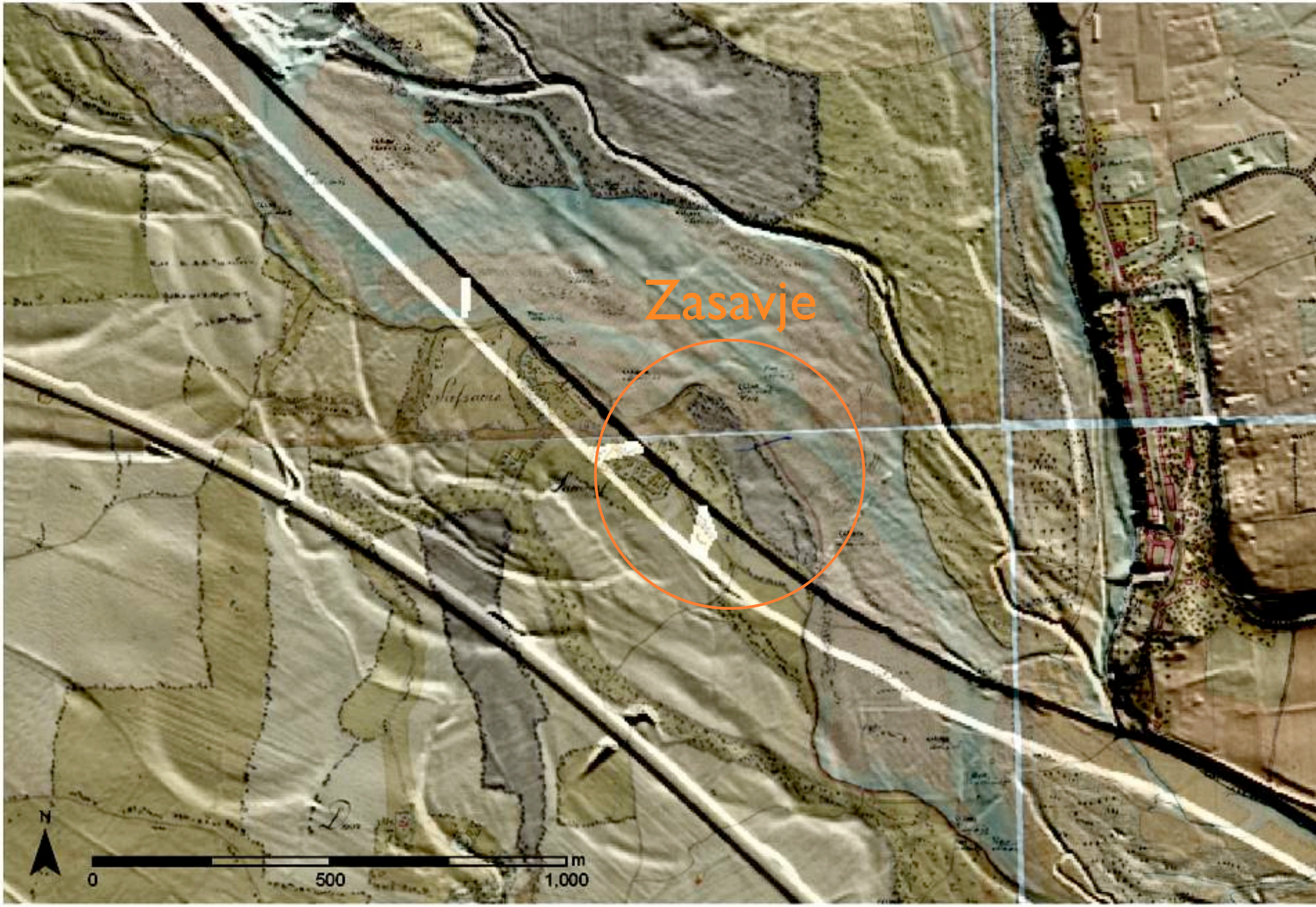
Sava floodplain: Krško polje

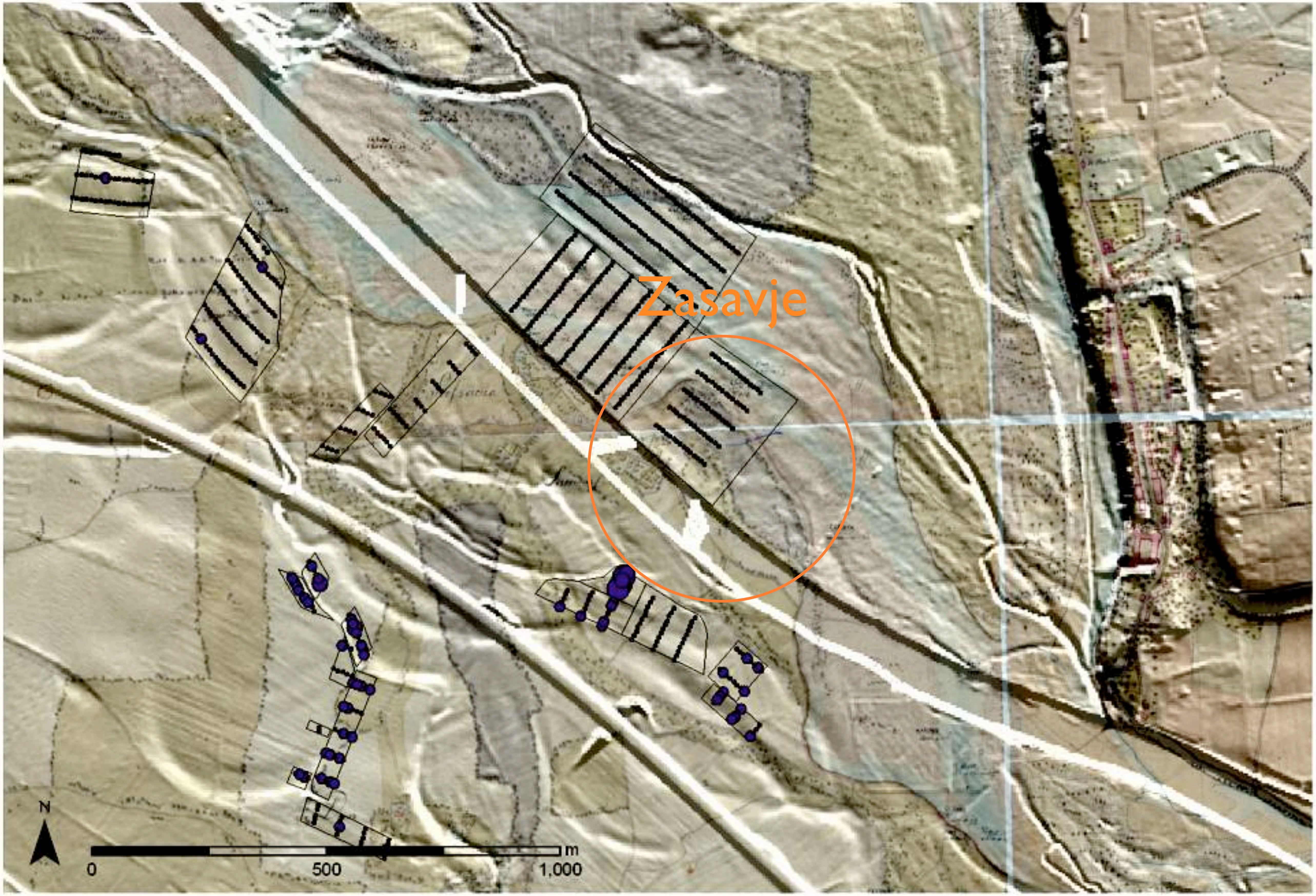



N
m
0
500
1,000
2,000
3,000

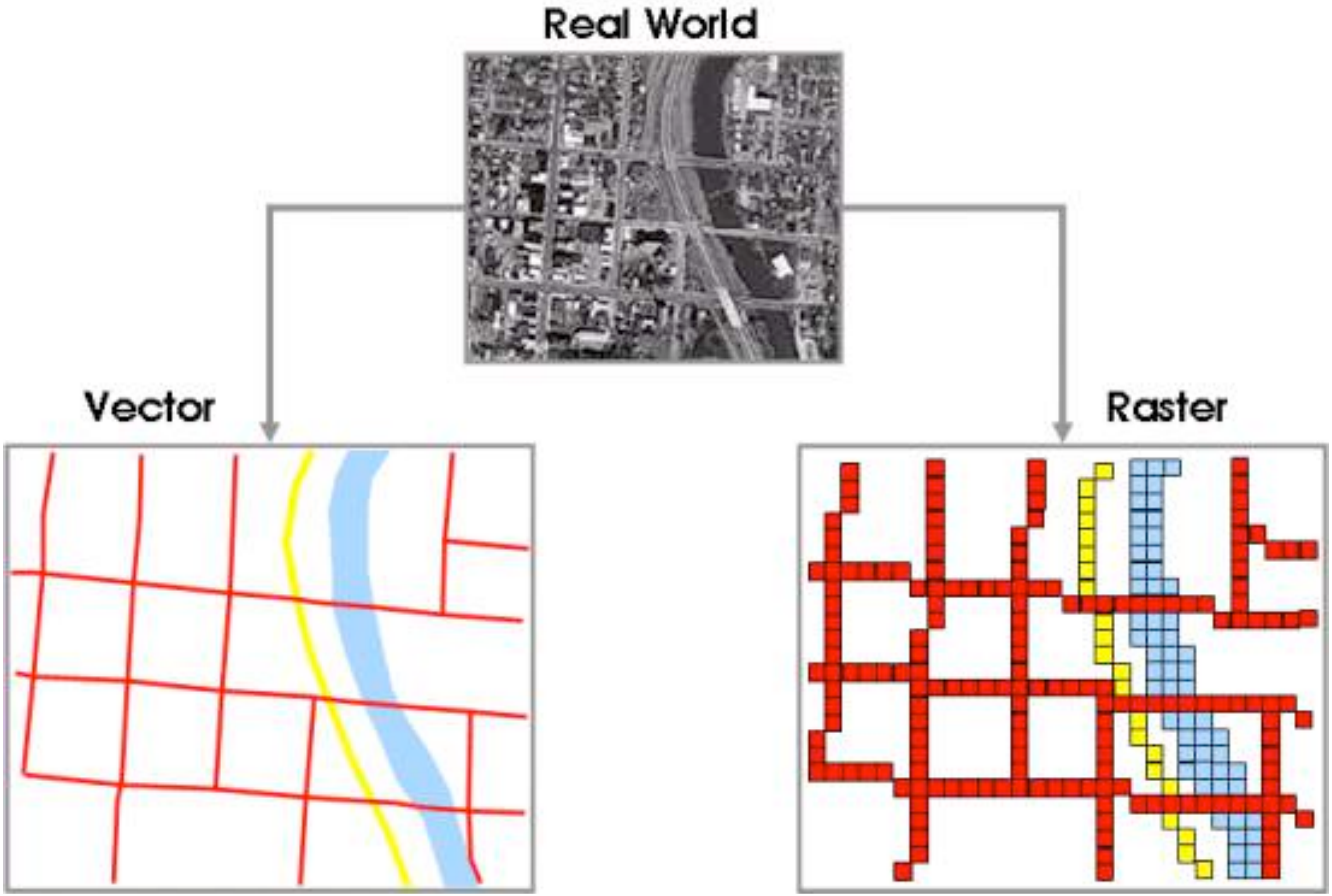

N
0
500
1,000
2,000
3,000
m


Zasavje
N
0
500
1,000
m


Zasavje
N
0
500
1,000
m


Zasavje
N
0
500
1,000
m

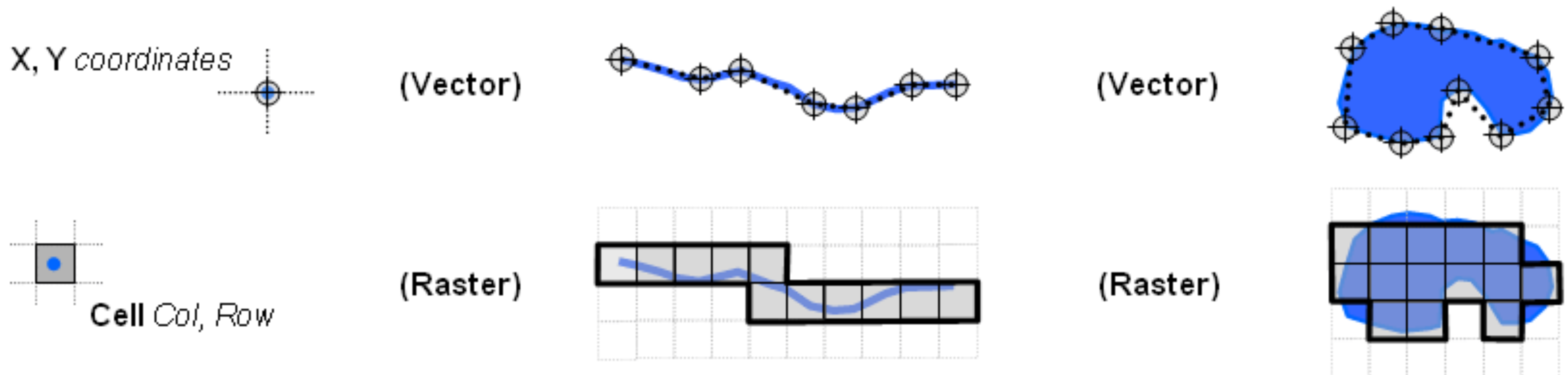
Raster vs vector data model



The "Paper Map World" *(analog)*

POINTS	*LINES*	*AREAS*

The "GIS Map World" *(digital)*

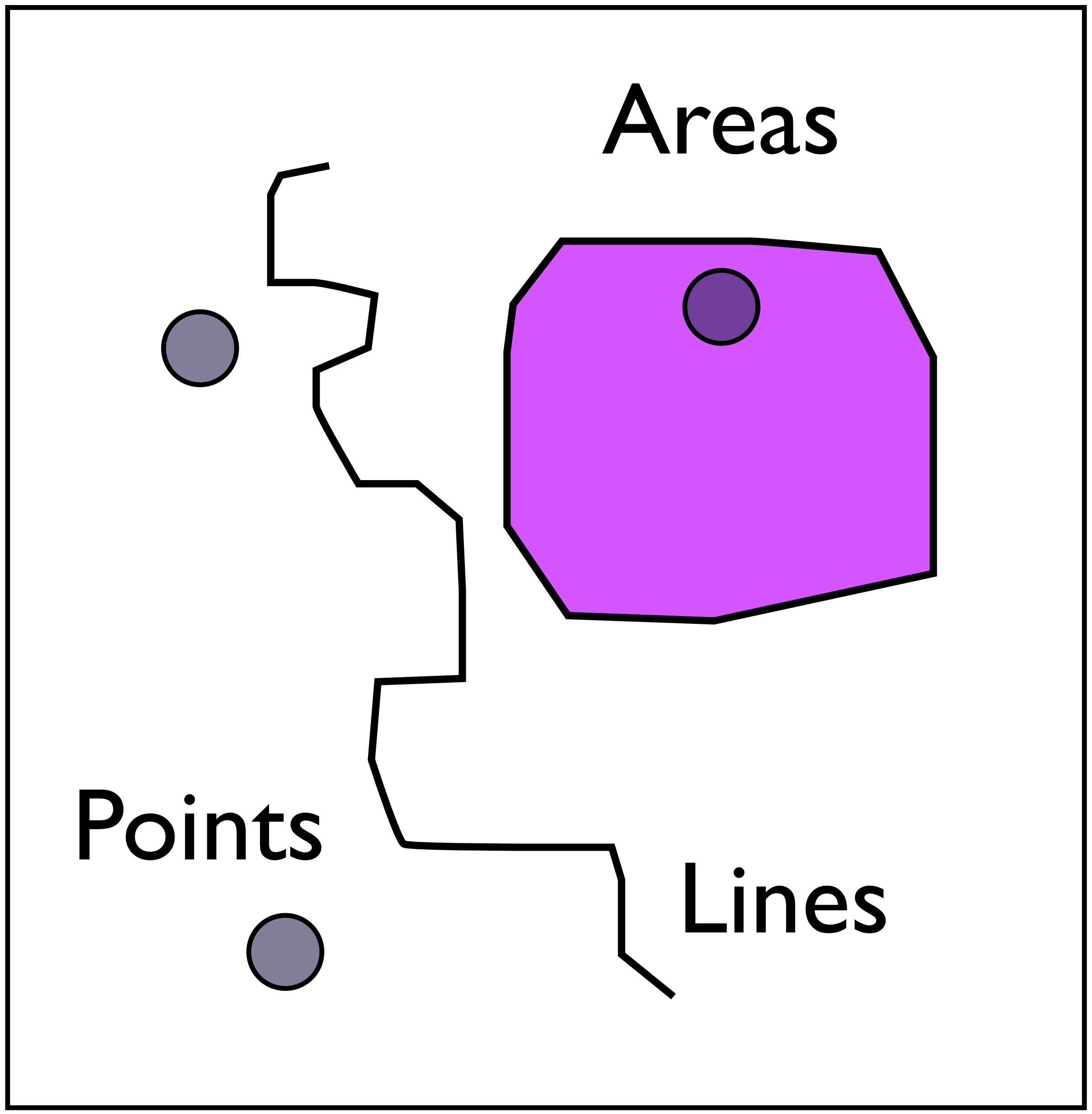


POINTS **are stored as individual X, Y coordinates (Vector) or as individual Column, Row cell entries in a grid (Raster)**

LINES **are stored as a set of mathematically connected X, Y coordinates (Vector) or as a set of connected grid cells (Raster)**

AREAS **are stored as a set of mathematically connected X, Y coordinates defining the boundary (Vector) or as a set of contiguous cells defining the interior (Raster)**

Vectors



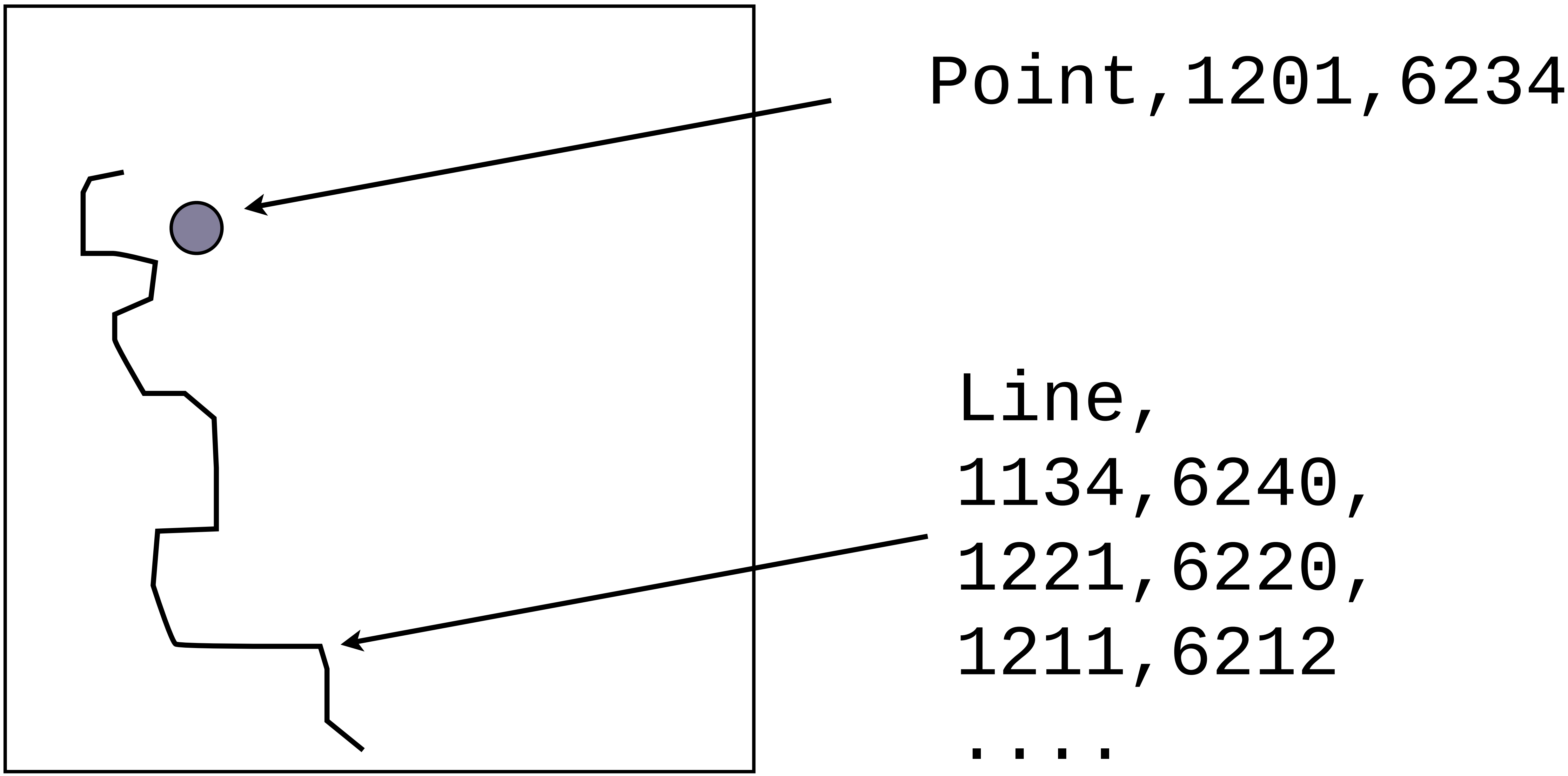
Locational component

Topological component

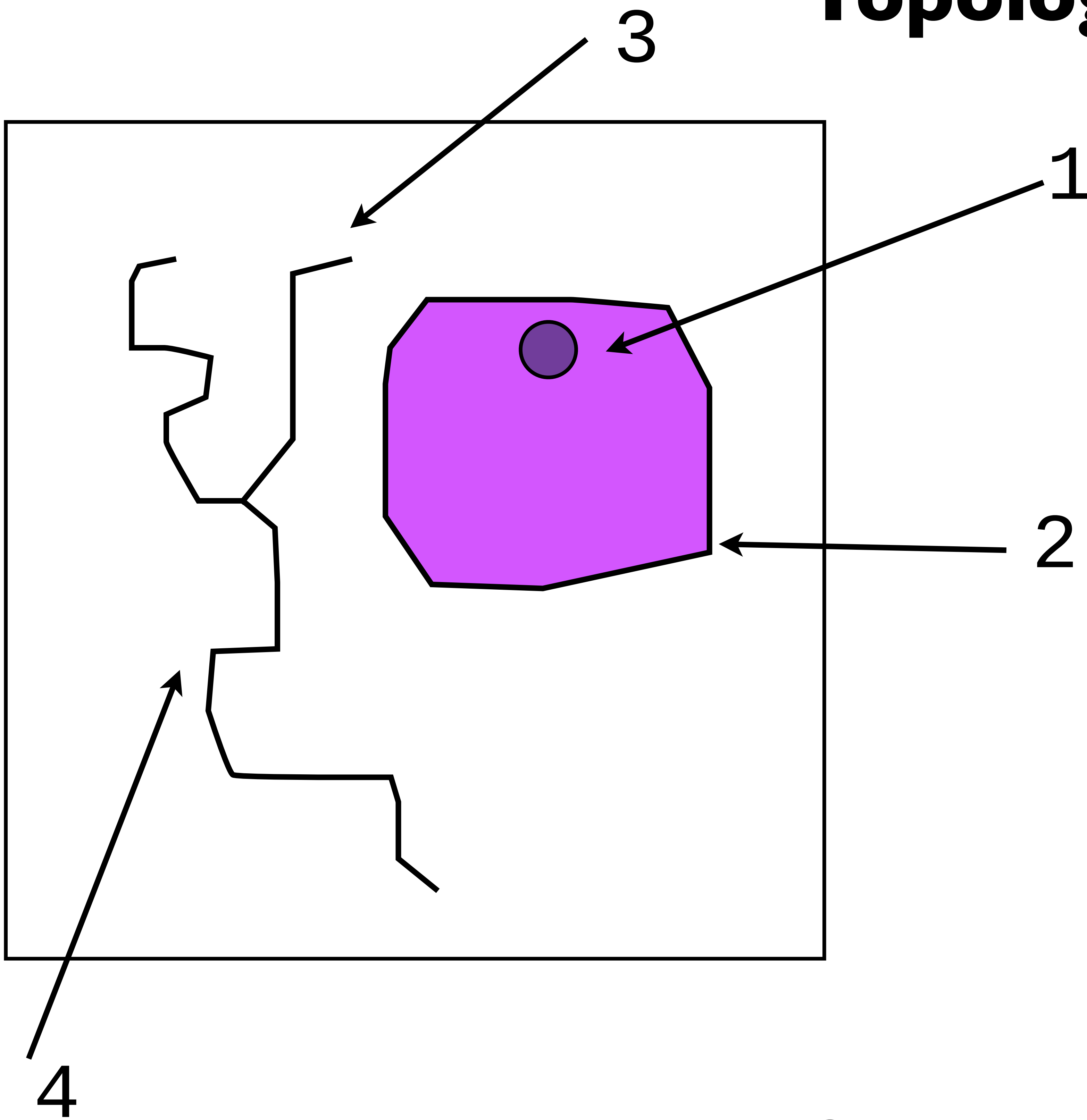
Attribute component

Metadata component

Locational component



Topological component

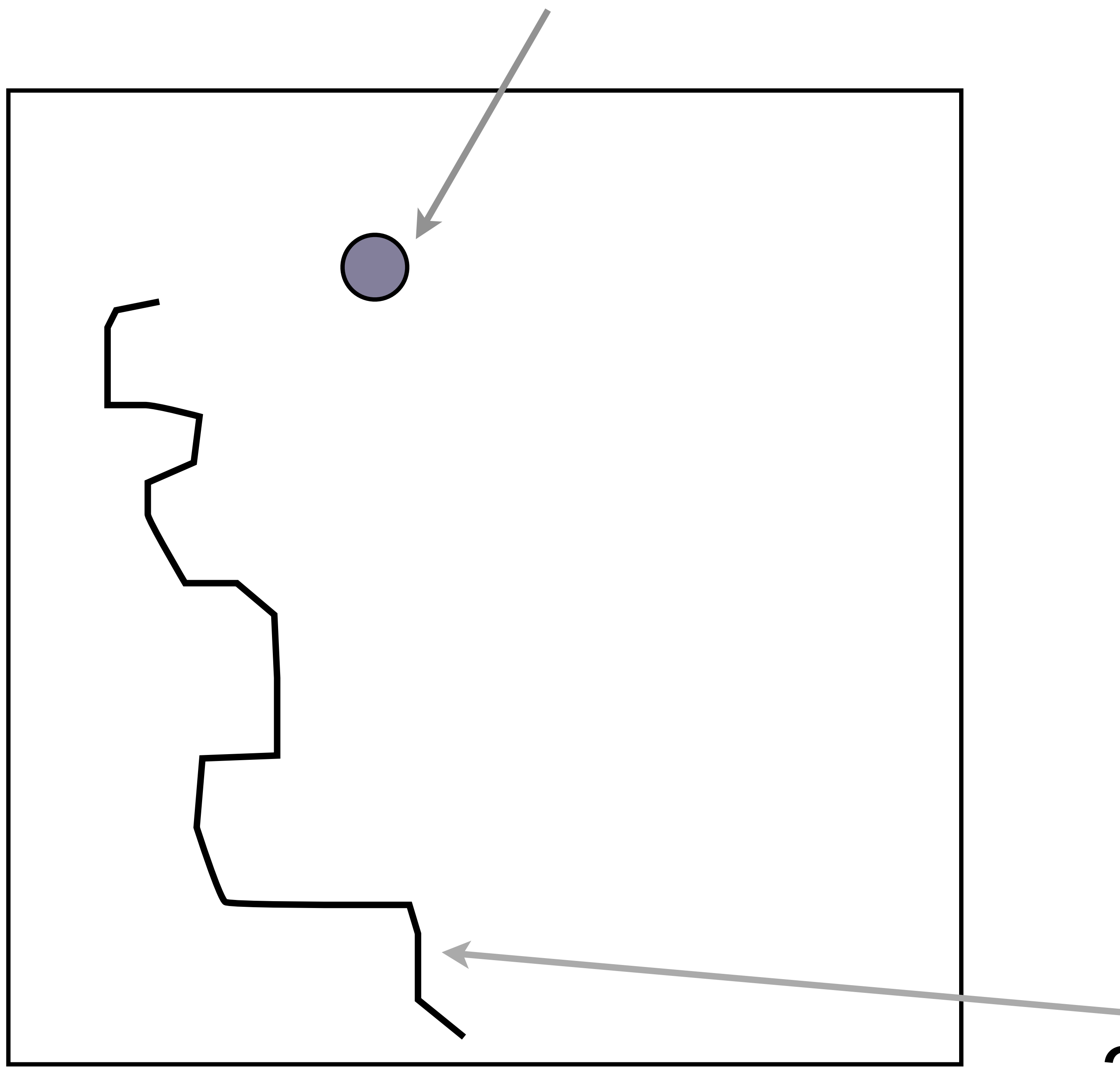


1 is inside 2

3 is connected to 4

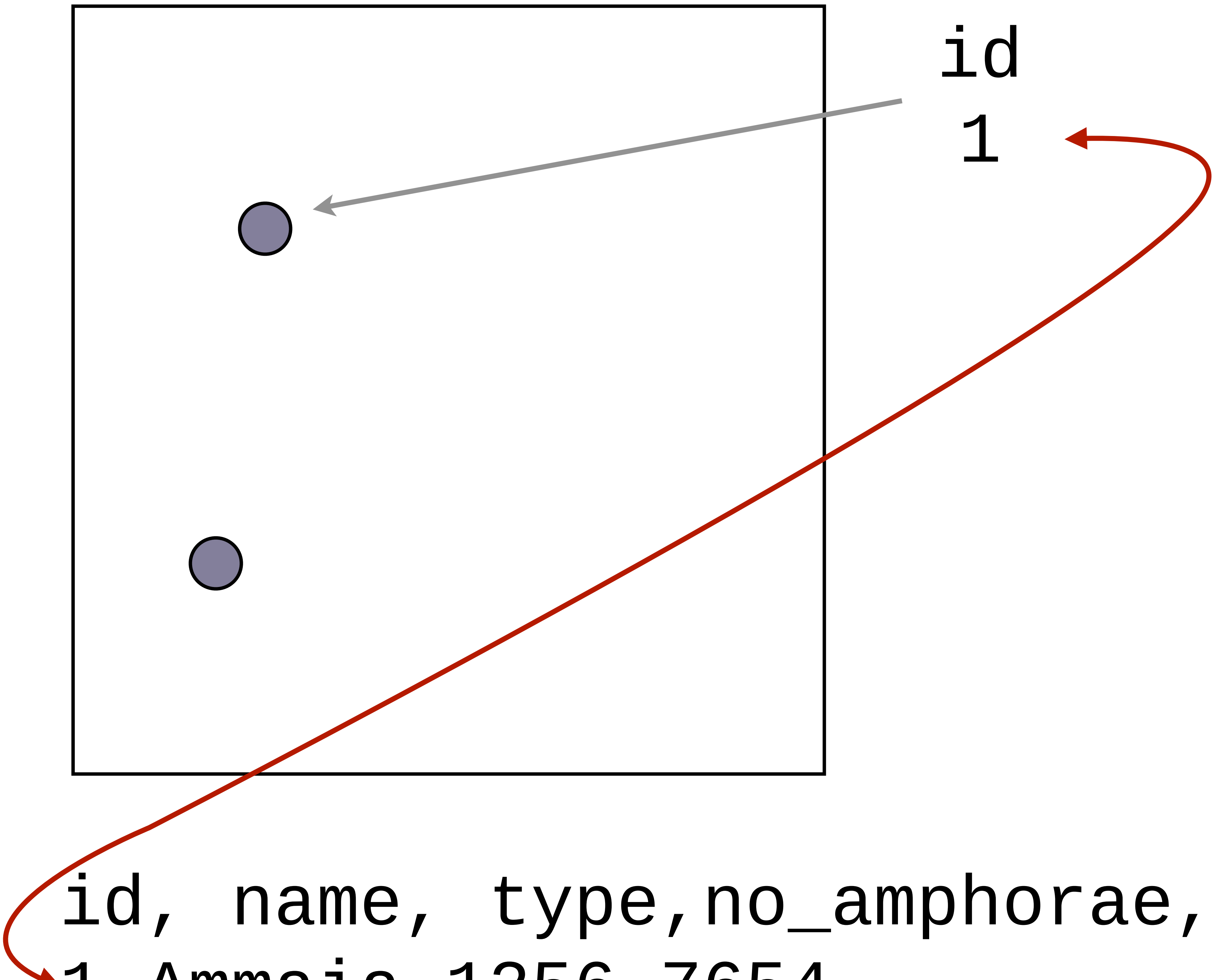
Attribute component

id,type,date,name
1, archaeological site, Roman, Ammaia



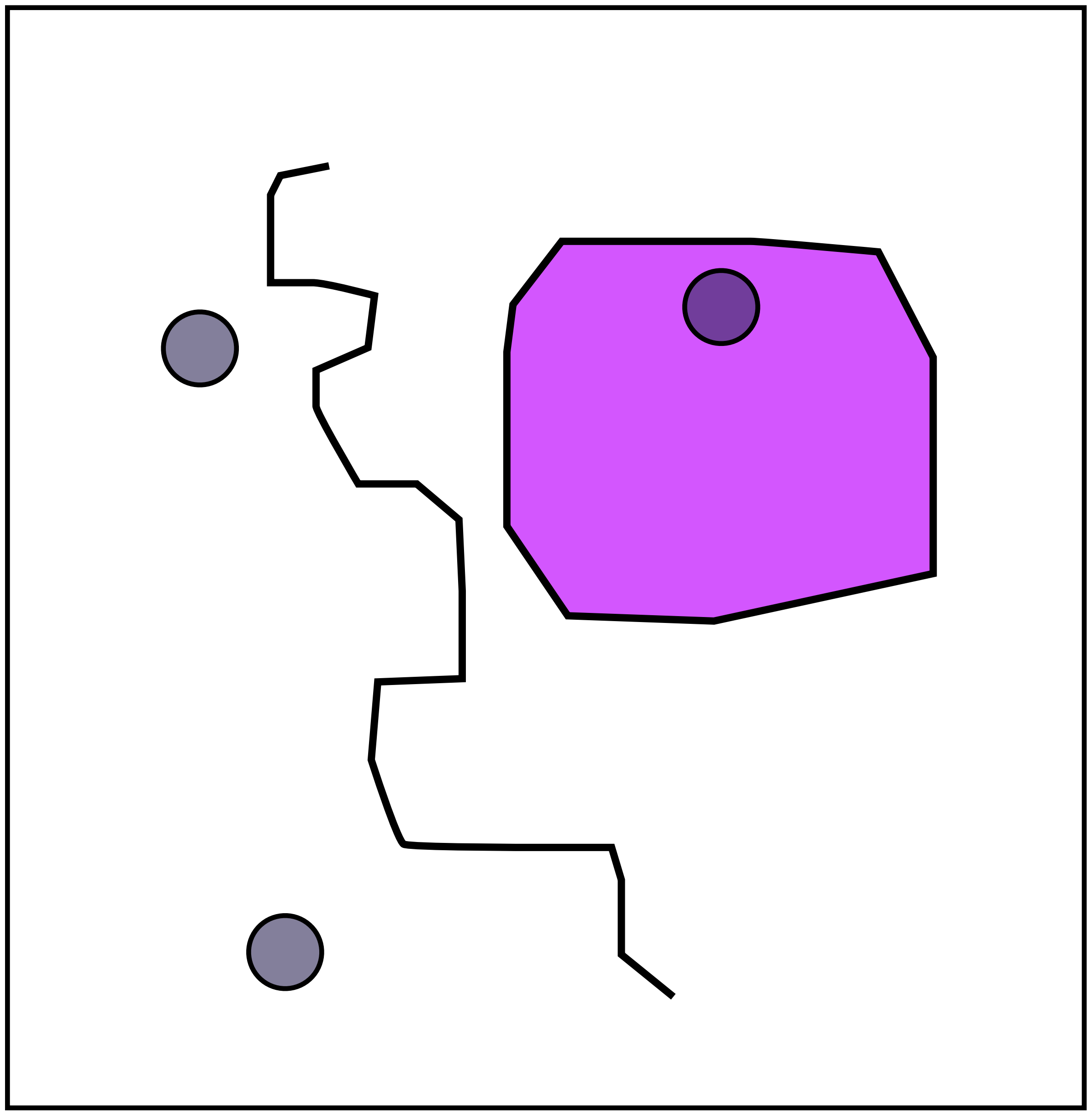
id,type,name
2, river,Rio Sever

Linking with external databases




```
id, name, type,no_amphorae,no_coarsewar
1,Ammaia,1256,7654
```

Metadata



Projection

Source

Legend

Errors

Copyright

...

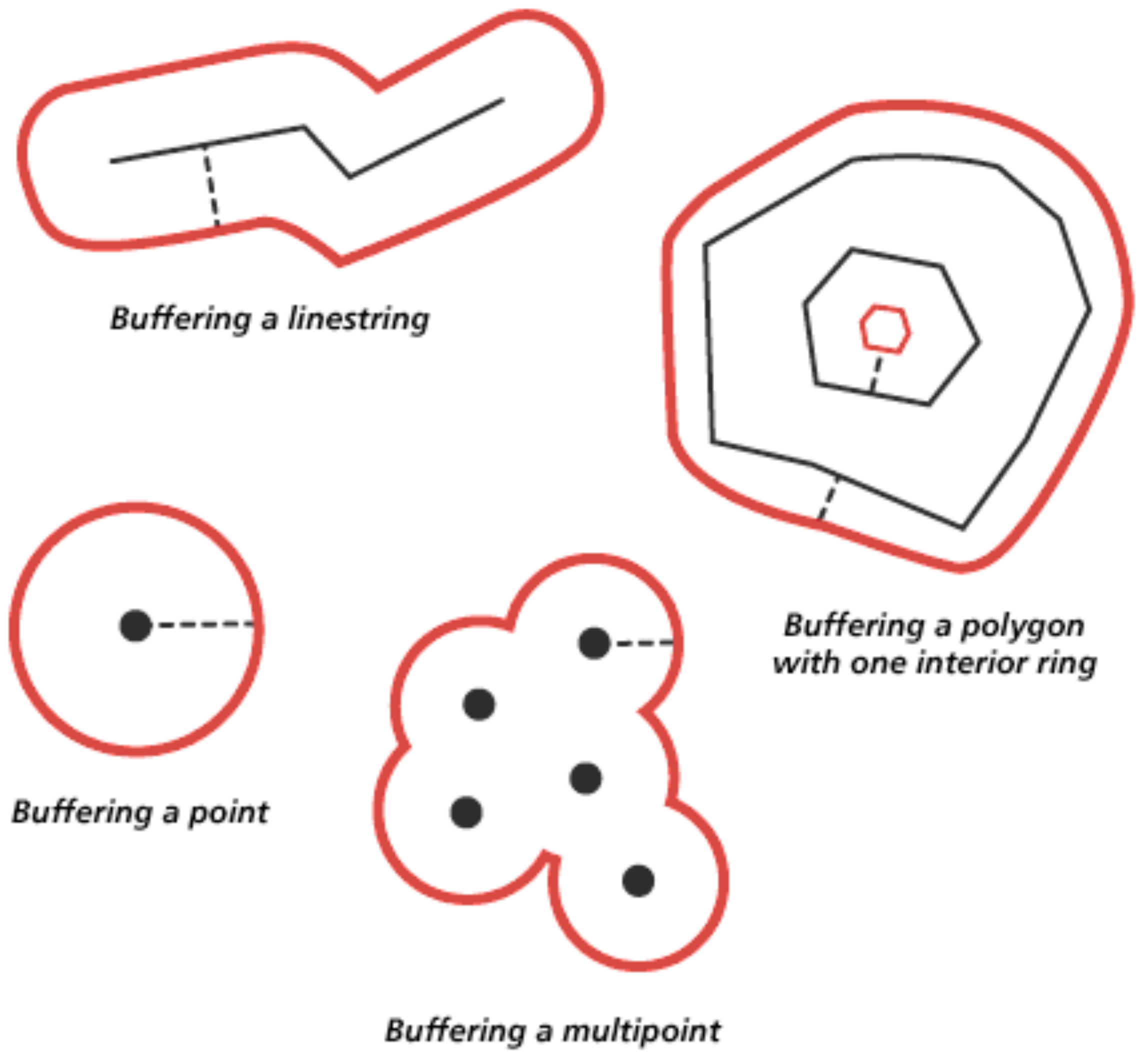
Metadata

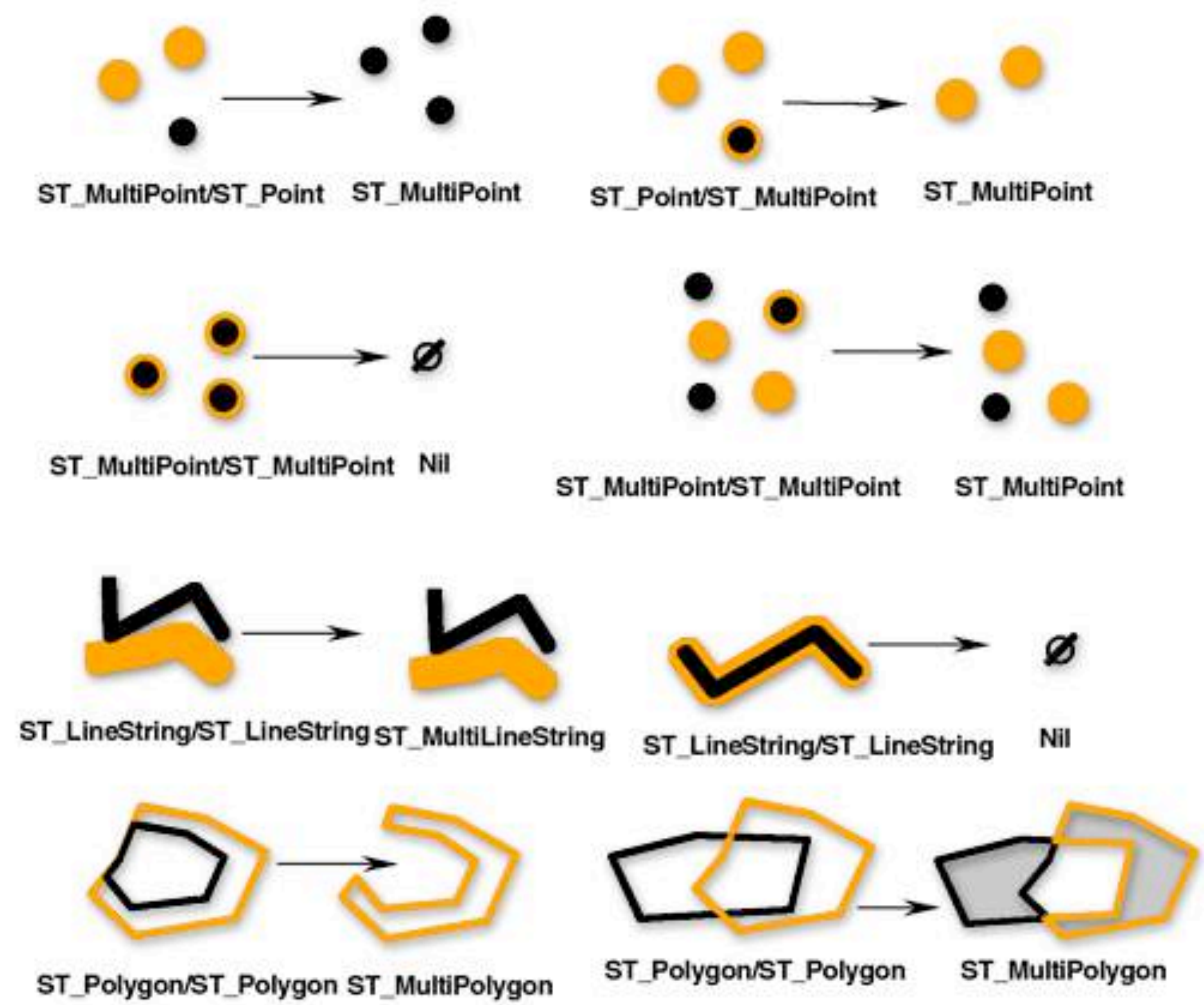
Table 3.6 A list of the metadata you would need to record when digitising a layer of thematic information from a map sheet.

Metadata	Why is it needed?
The projection system used to generate the map	So that you can ensure the spatial integrity of the overall spatial database by ensuring that all of the layers are derived from the same projection. Where projections do differ you can undertake the required re-projection of the data layers
The scale of the source map	Given the ability of the GIS to work at any scale the user selects, to ensure that data collected at a specific scale is not used at any scale larger. This is a procedure that would at best produce distorted results and at worst meaningless ones.
The medium and integrity of the map sheet	To help account for any RMS errors encountered
The map publisher and copyright details	There may well be restrictions imposed upon the digital copying and subsequent use and distribution of any map sheets. As a result it is important to record this information.
The RMS error encountered on digitising the layer	To provide a record of the errors associated with the data layer —there is little point undertaking an analysis to centimetre precision if a given layer has associated errors of 2.5 metres! As errors can become compounded during the course of the various analytical possibilities offered by the GIS it is crucial that all error sources and assessments are carefully monitored.
The control points utilised and their real-world co-ordinates	To provide a record of the georeferencing information employed.
The coding and legend schemes used to name layers and label features within layers	To provide a simple reference to the various codes utilised, codes that may well seem obvious when designated but in a years time may not be so readily apparent!

From Wheatley and Gillings 2002

Operations

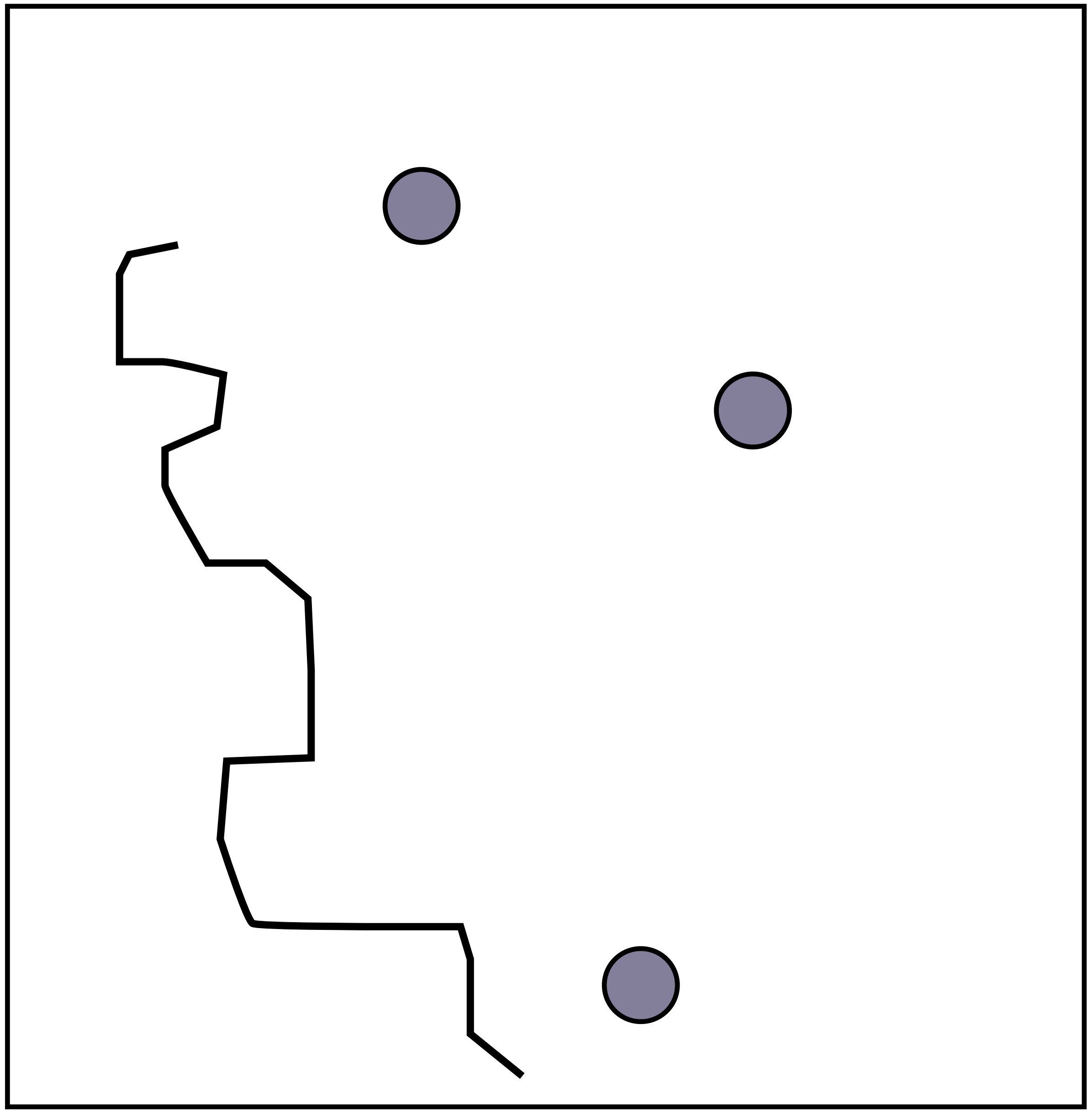




Buffering

Algebra: union, intersection, exclusion

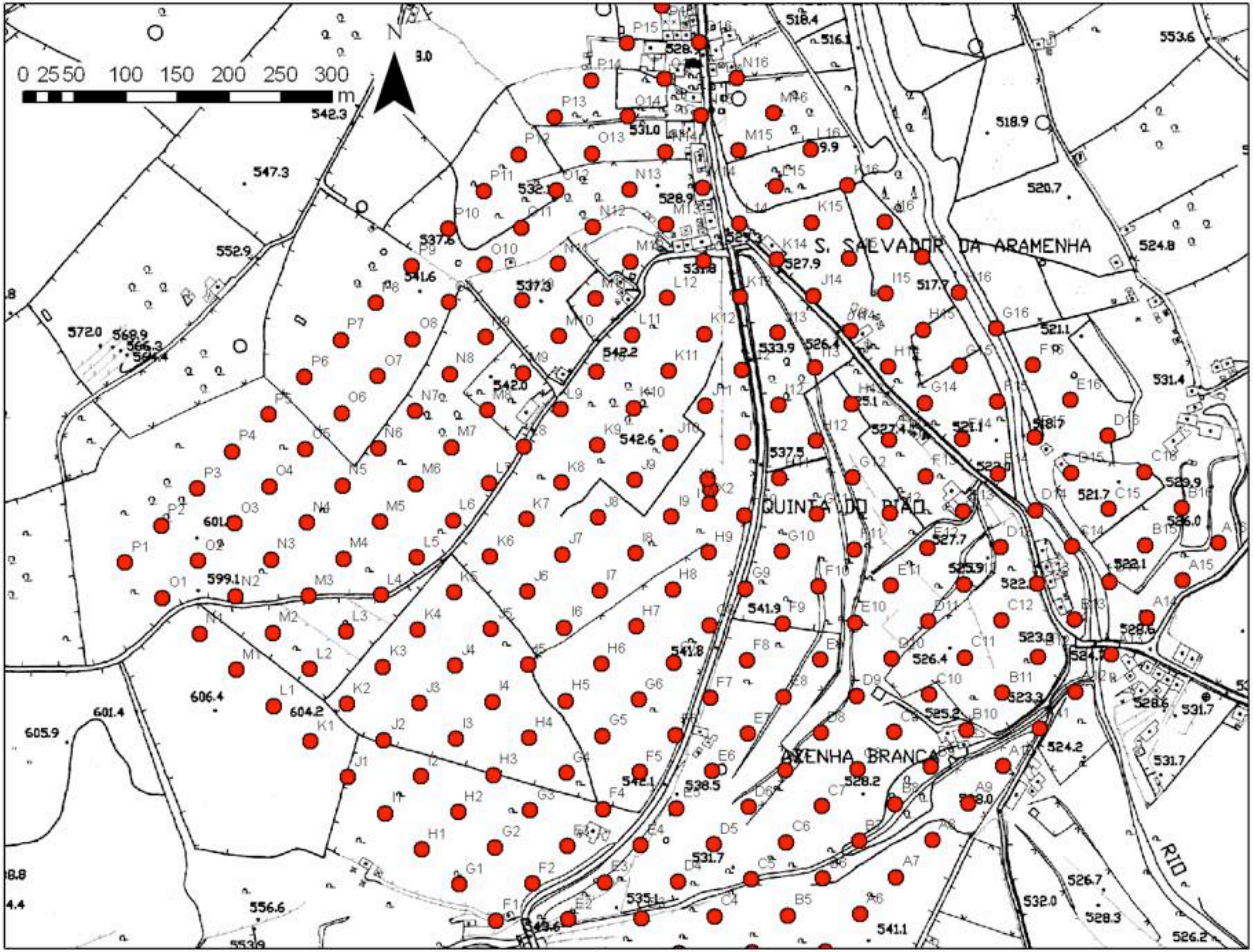
Queries



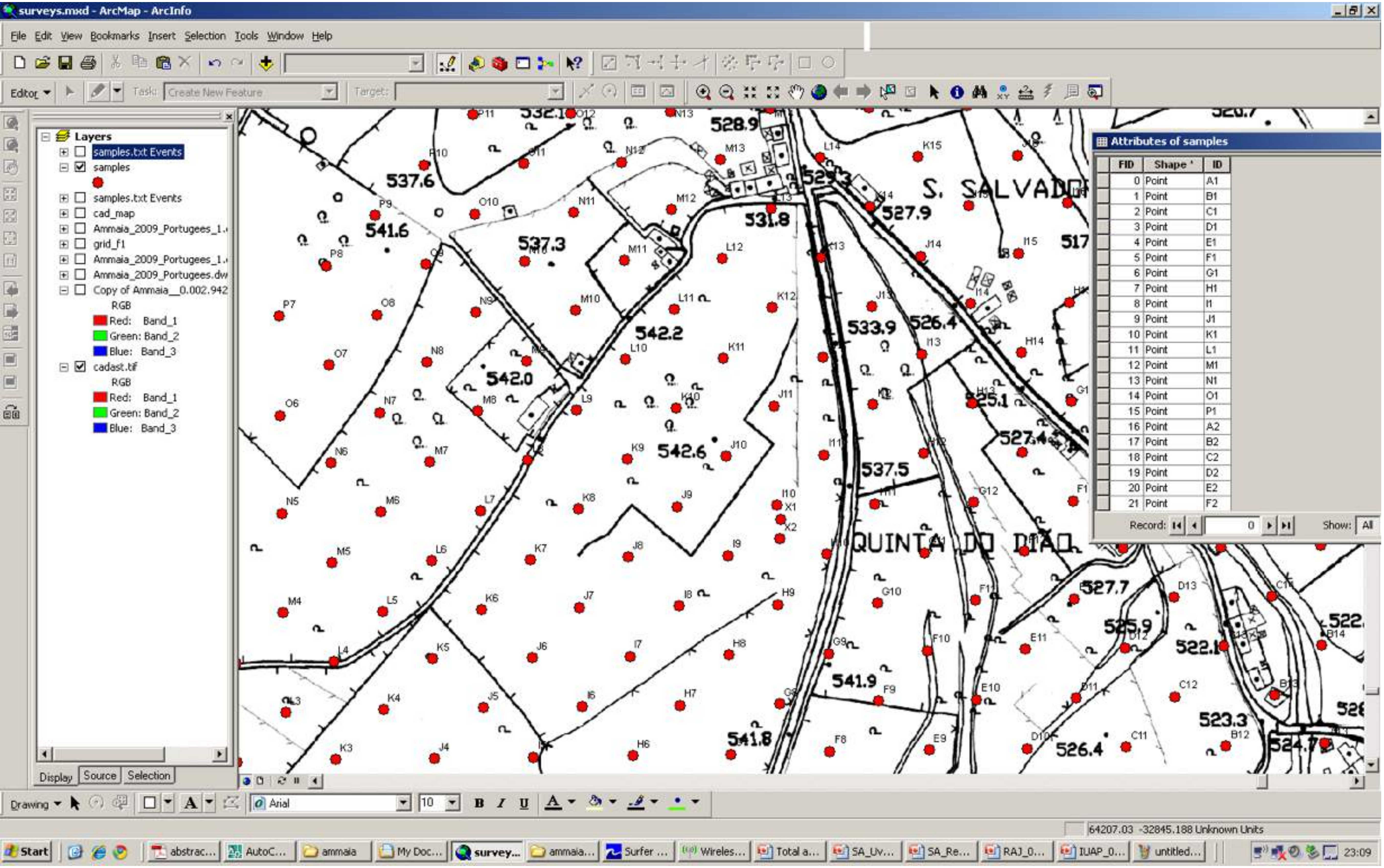
list the sites within 500 m of a river;

list the roman sites within 500 m of a river with less than 80% of coarse pottery;

Planed systematic sampling



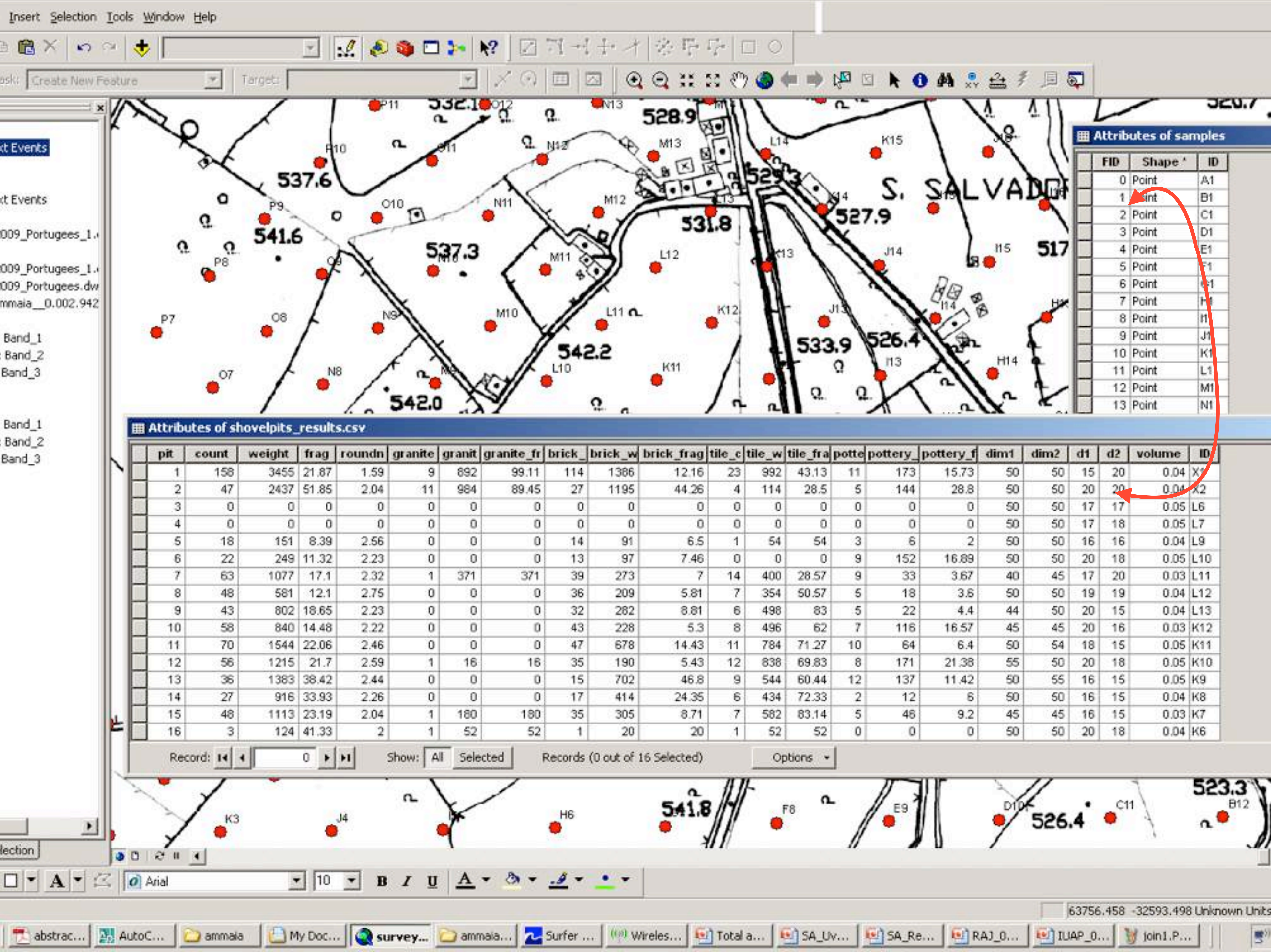
Location of shovel pits




2

External database

pit	count	weight	roundness	granitec	granitew	tilec	tilew	potc	potw	volume	grid
1	158	3455	1.59	9	892	23	992	11	173	0.04	X1
2	47	2437	2.04	11	984	4	114	5	144	0.04	X2
3	0	0	0	0	0	0	0	0	0	0.05	L6
4	0	0	0	0	0	0	0	0	0	0.05	L7
5	18	151	2.56	0	0	1	54	3	6	0.04	L9
6	22	249	2.23	0	0	0	0	9	152	0.05	L10
7	63	1077	2.32	1	371	14	400	9	33	0.03	L11
8	48	581	2.75	0	0	7	354	5	18	0.04	L12
9	43	802	2.23	0	0	6	498	5	22	0.04	L13
10	58	840	2.22	0	0	8	496	7	116	0.03	K12
11	70	1544	2.46	0	0	11	784	10	64	0.05	K11
12	56	1215	2.59	1	16	12	838	8	171	0.05	K10
13	36	1383	2.44	0	0	9	544	12	137	0.05	K9
14	27	916	2.26	0	0	6	434	2	12	0.04	K8
15	48	1113	2.04	1	180	7	582	5	46	0.03	K7
16	3	124	2	1	52	1	52	0	0	0.04	K6
17	6	78	2.67	0	0	0	0	2	22	0.05	J6
18	25	859	2.04	0	0	7	288	0	0	0.04	J7
19	19	1127	2.53	0	0	17	1095	2	32	0.05	J8
20	47	2388	2.23	0	0	11	1852	1	44	0.06	J9
21	43	1188	2.4	1	8	18	932	1	18	0.06	J10
22	39	1465	2.64	3	548	7	382	5	79	0.04	J11



Attributes of samples

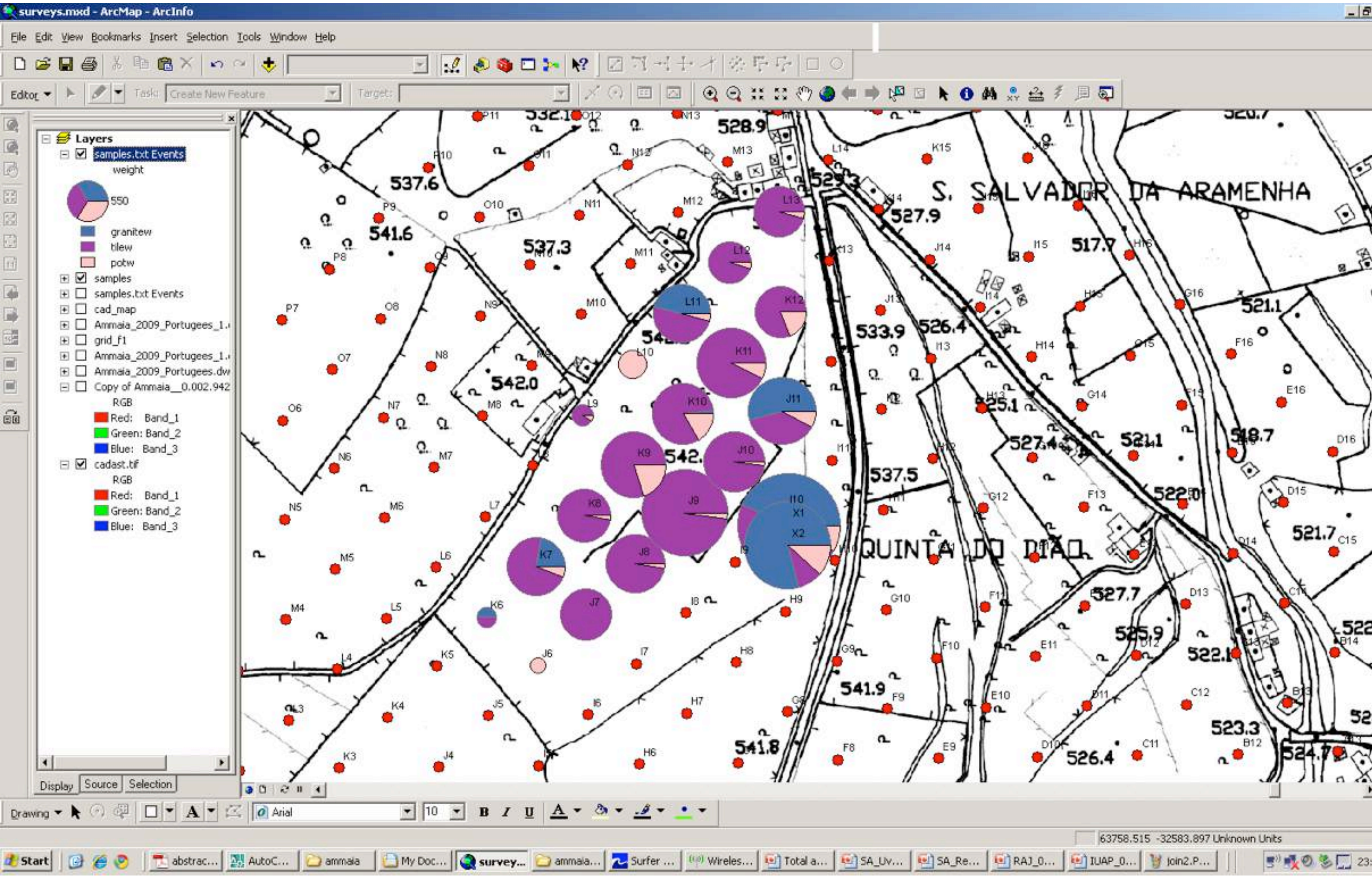
FID	Shape *	ID
0	Point	A1
1	Point	B1
2	Point	C1
3	Point	D1
4	Point	E1
5	Point	[illegible]
6	Point	[illegible]
7	Point	[illegible]
8	Point	I1
9	Point	J1
10	Point	K1
11	Point	L1
12	Point	M1
13	Point	N1

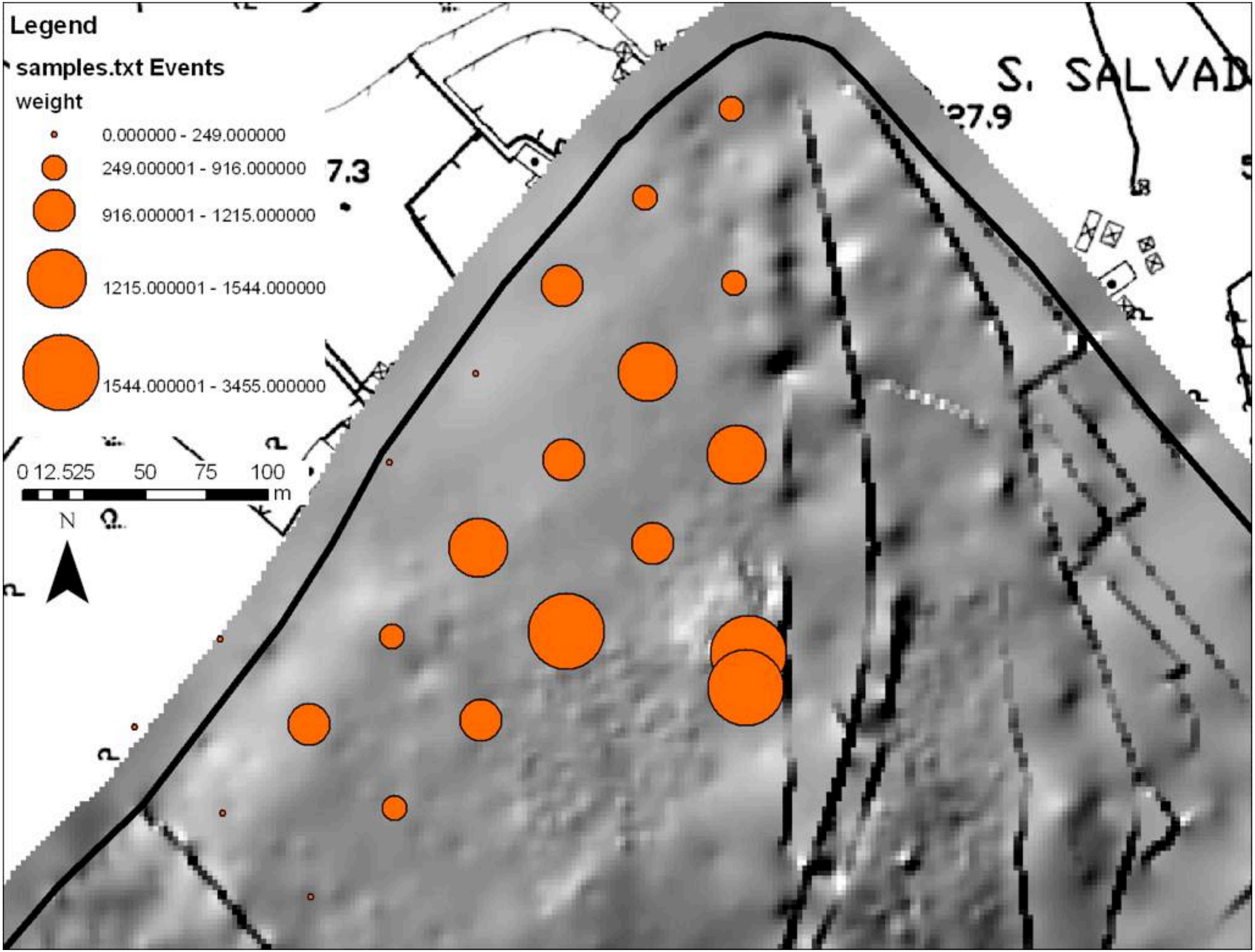
Attributes of shovelpits_results.csv

pit	count	weight	frag	roundn	granite	granit	granite_fr	brick_	brick_w	brick_frag	tile_c	tile_w	tile_fra	potte	pottery_	pottery_f	dim1	dim2	d1	d2	volume	ID
1	158	3455	21.87	1.59	9	892	99.11	114	1386	12.16	23	992	43.13	11	173	15.73	50	50	15	20	0.04	X1
2	47	2437	51.85	2.04	11	984	89.45	27	1195	44.26	4	114	28.5	5	144	28.8	50	50	20	20	0.04	X2
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	50	17	17	0.05	L6
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	50	17	18	0.05	L7
5	18	151	8.39	2.56	0	0	0	14	91	6.5	1	54	54	3	6	2	50	50	16	16	0.04	L9
6	22	249	11.32	2.23	0	0	0	13	97	7.46	0	0	0	9	152	16.89	50	50	20	18	0.05	L10
7	63	1077	17.1	2.32	1	371	371	39	273	7	14	400	28.57	9	33	3.67	40	45	17	20	0.03	L11
8	48	581	12.1	2.75	0	0	0	36	209	5.81	7	354	50.57	5	18	3.6	50	50	19	19	0.04	L12
9	43	802	18.65	2.23	0	0	0	32	282	8.81	6	498	83	5	22	4.4	44	50	20	15	0.04	L13
10	58	840	14.48	2.22	0	0	0	43	228	5.3	8	496	62	7	116	16.57	45	45	20	16	0.03	K12
11	70	1544	22.06	2.46	0	0	0	47	678	14.43	11	784	71.27	10	64	6.4	50	54	18	15	0.05	K11
12	56	1215	21.7	2.59	1	16	16	35	190	5.43	12	838	69.83	8	171	21.38	55	50	20	18	0.05	K10
13	36	1383	38.42	2.44	0	0	0	15	702	46.8	9	544	60.44	12	137	11.42	50	55	16	15	0.05	K9
14	27	916	33.93	2.26	0	0	0	17	414	24.35	6	434	72.33	2	12	6	50	50	16	15	0.04	K8
15	48	1113	23.19	2.04	1	180	180	35	305	8.71	7	582	83.14	5	46	9.2	45	45	16	15	0.03	K7
16	3	124	41.33	2	1	52	52	1	20	20	1	52	52	0	0	0	50	50	20	18	0.04	K6

Record: 0 Show: All Selected Records (0 out of 16 Selected) Options

Database join





Legend
samples.txt Events
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249.000001 - 916.000000
916.000001 - 1215.000000
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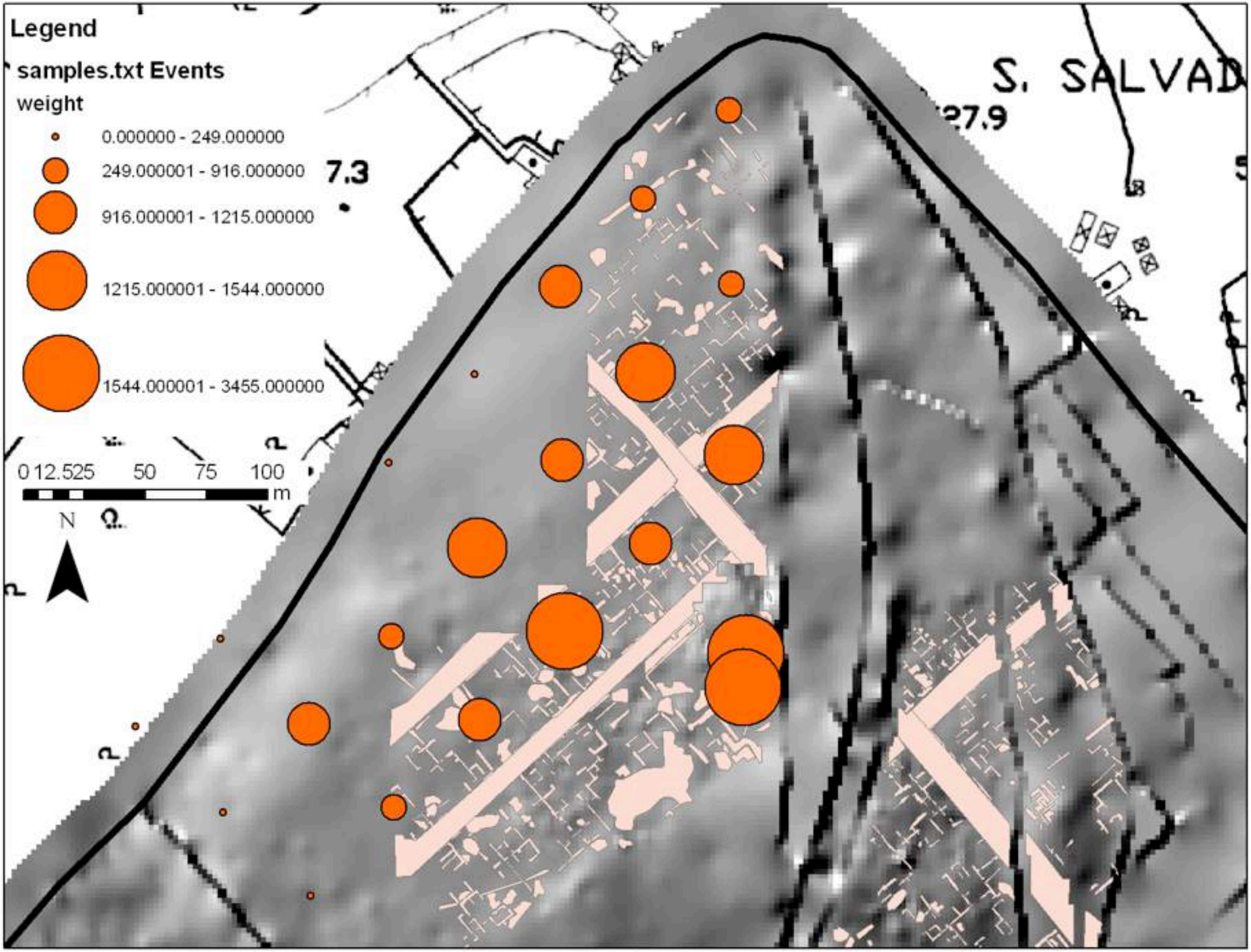
1544.000001 - 3455.000000
0 12.525 50 75 100
m
N
S. SALVAD
7.3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samples.txt Events
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1544.000001 - 3455.000000
0 12.5 25 50 75 100
m
N
S. SALVAD
7.3
27.9

Rasters

Pixel

1	1	1	1	1	1	1	3	3	3
1	1	1	1	1	1	1	3	3	3
1	1	1	1	1	1	3	3	3	3
1	1	1	2	2	2	2	3	3	3
1	1	1	2	2	2	2	3	3	3
1	1	1	2	2	2	2	3	3	3
1	1	1	1	2	2	2	3	3	3
1	1	1	1	1	1	3	3	3	3
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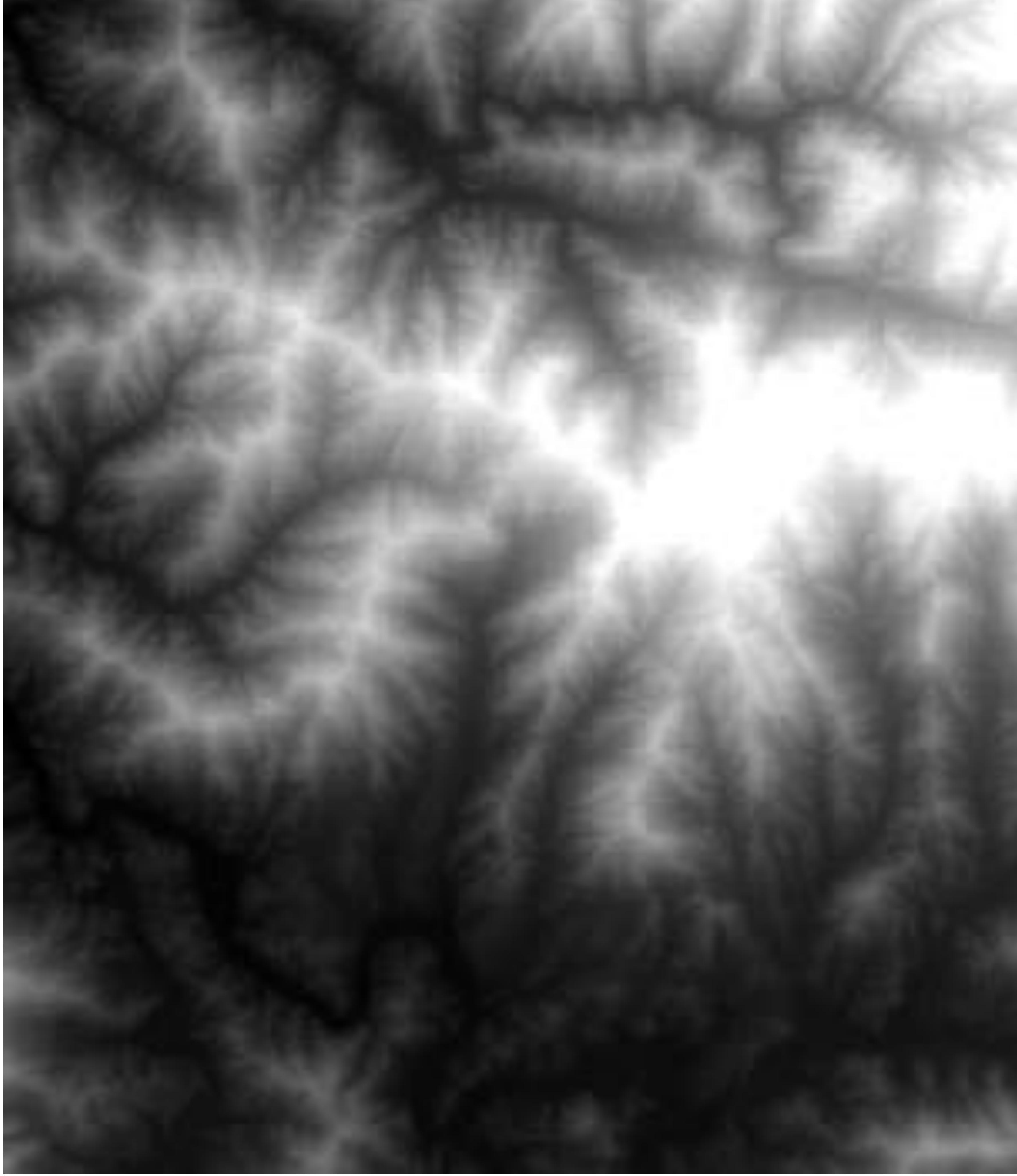
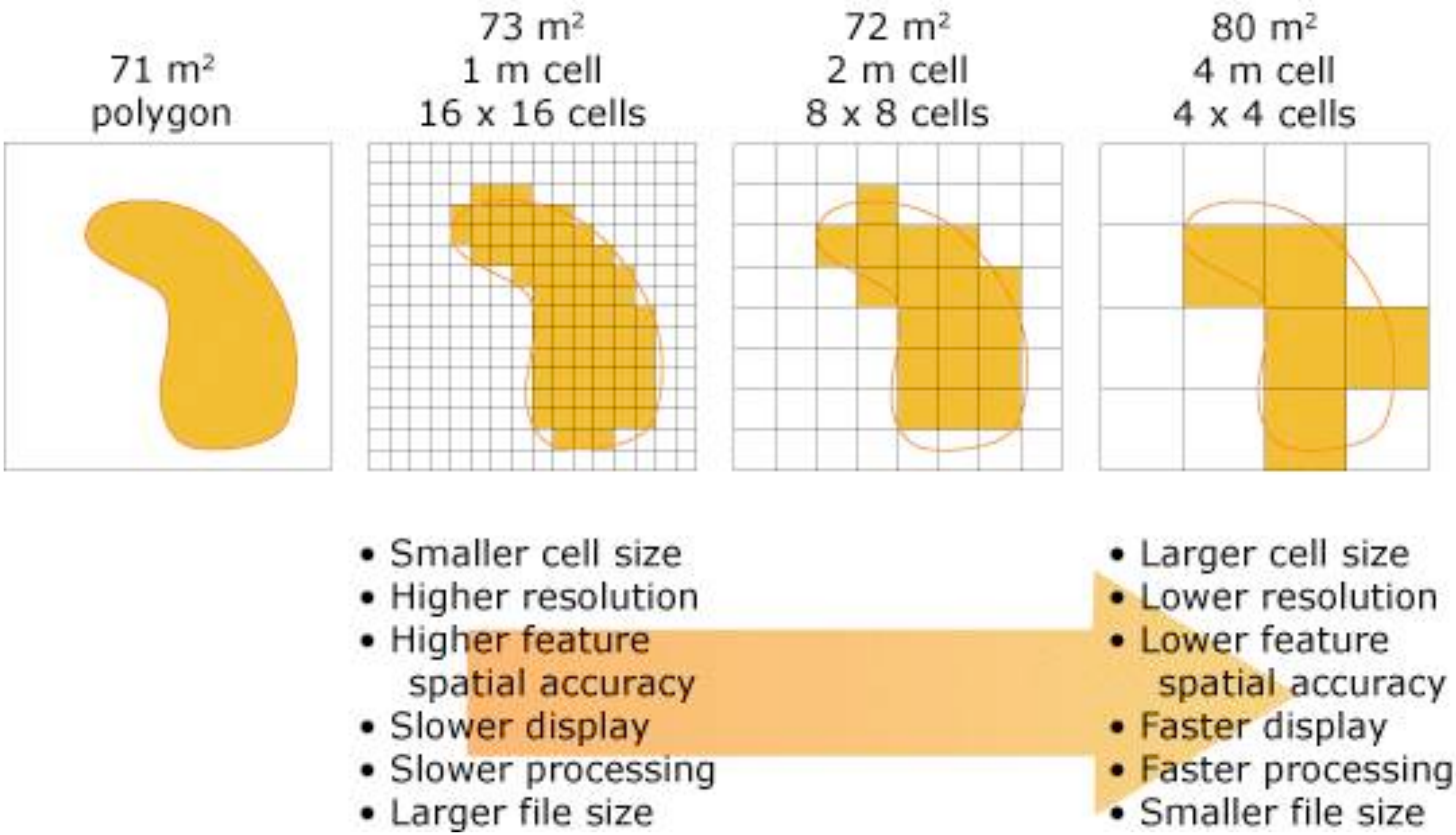
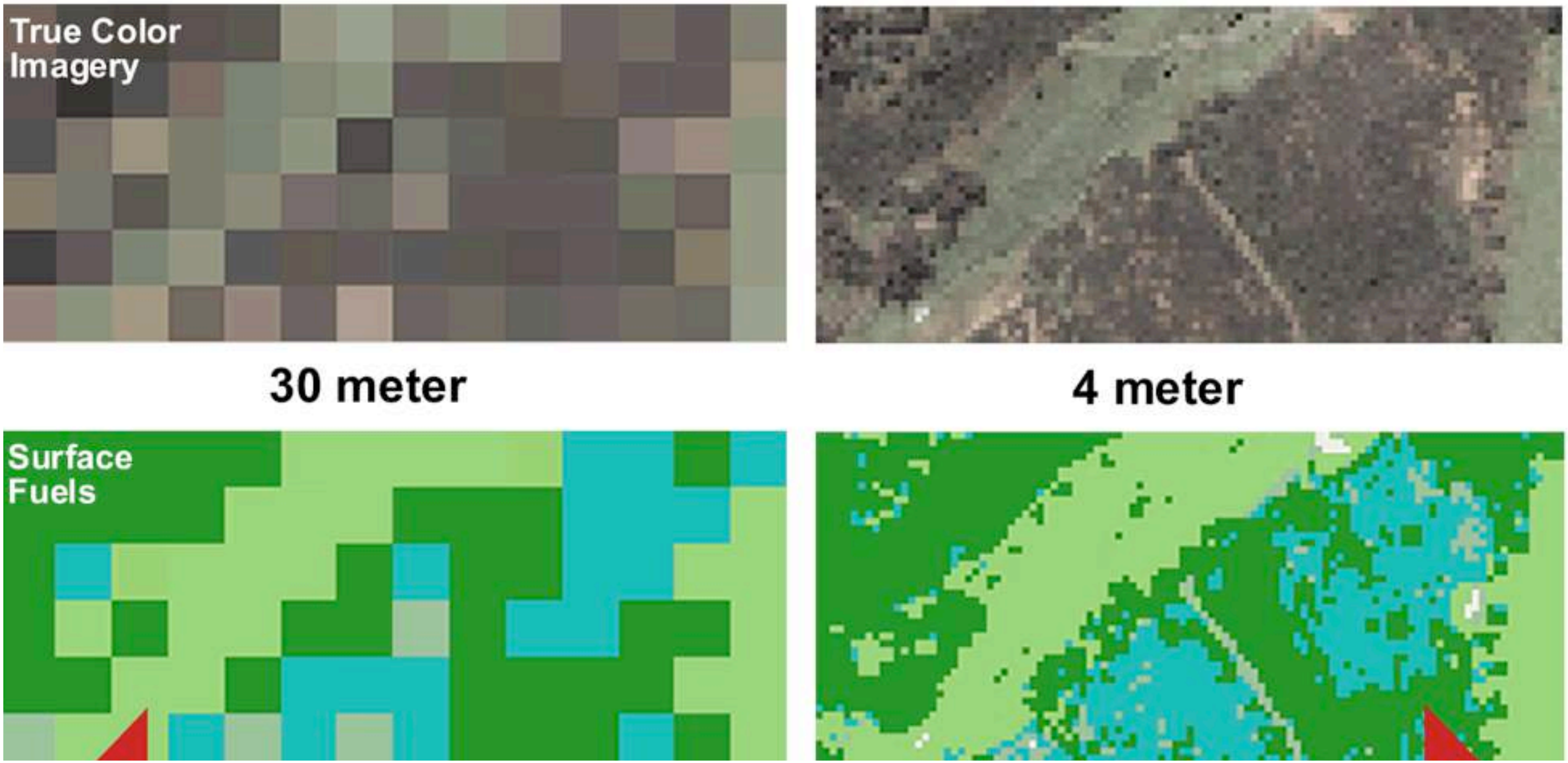
1	1	1	1	1	1	1	1	3	3

Rasters

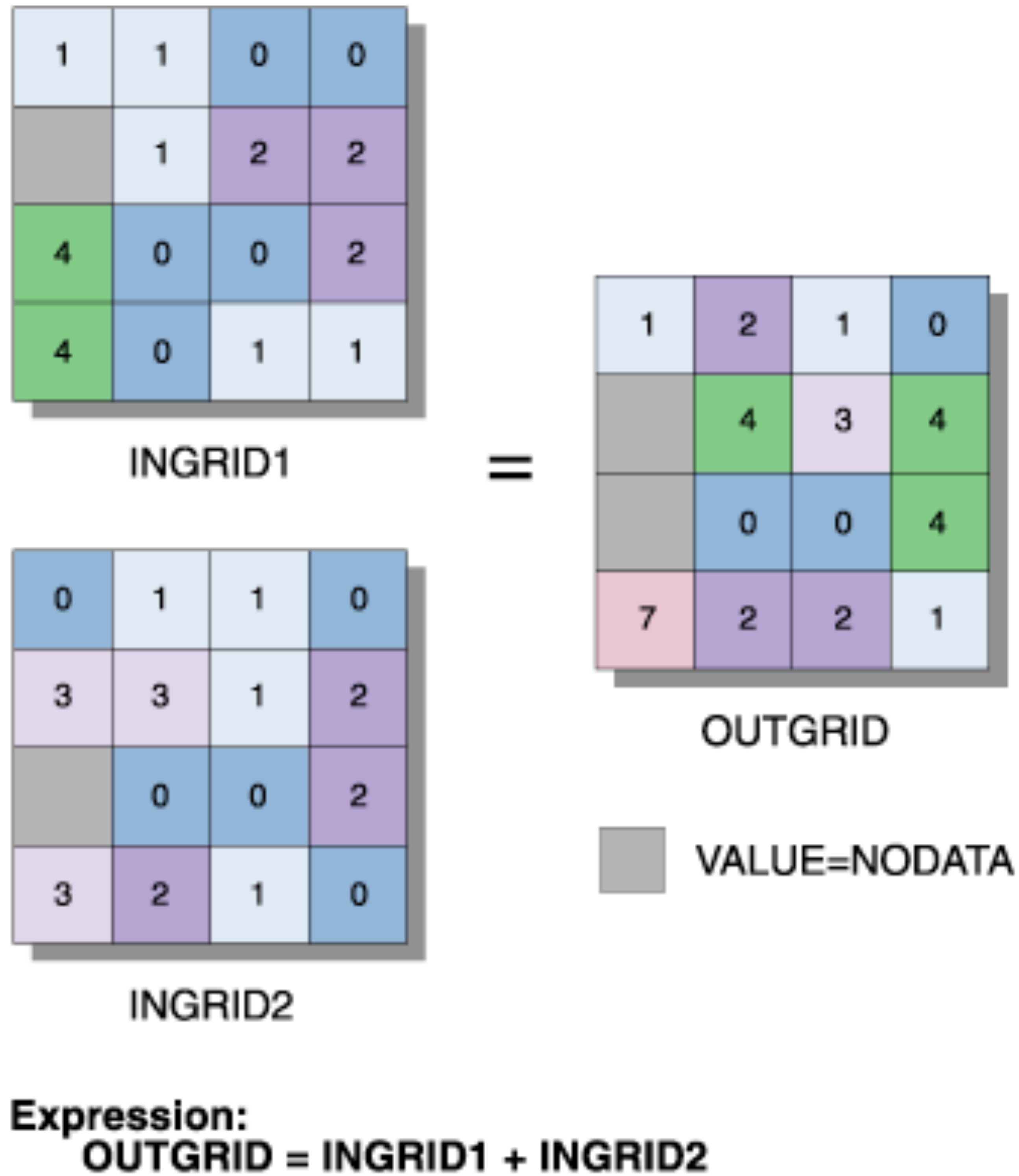


Resolution


71 m²
polygon
73 m²
1 m cell
16 x 16 cells
72 m²
2 m cell
8 x 8 cells
80 m²
4 m cell
4 x 4 cells
• Smaller cell size
• Higher resolution
• Higher feature spatial accuracy
• Slower display
• Slower processing
• Larger file size
• Larger cell size
• Lower resolution
• Lower feature spatial accuracy
• Faster display
• Faster processing
• Smaller file size

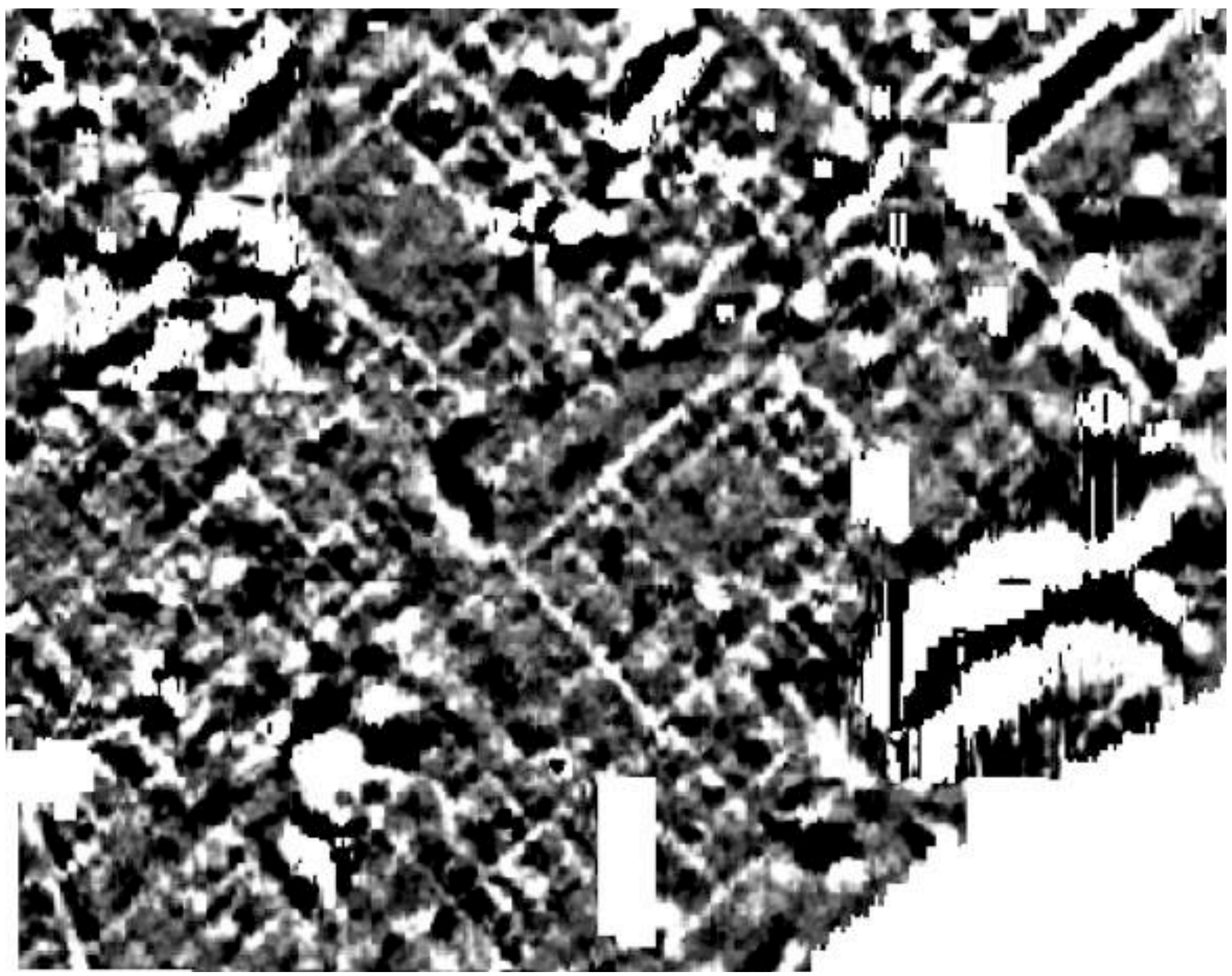

True Color
Imagery
30 meter
4 meter
Surface
Fuels

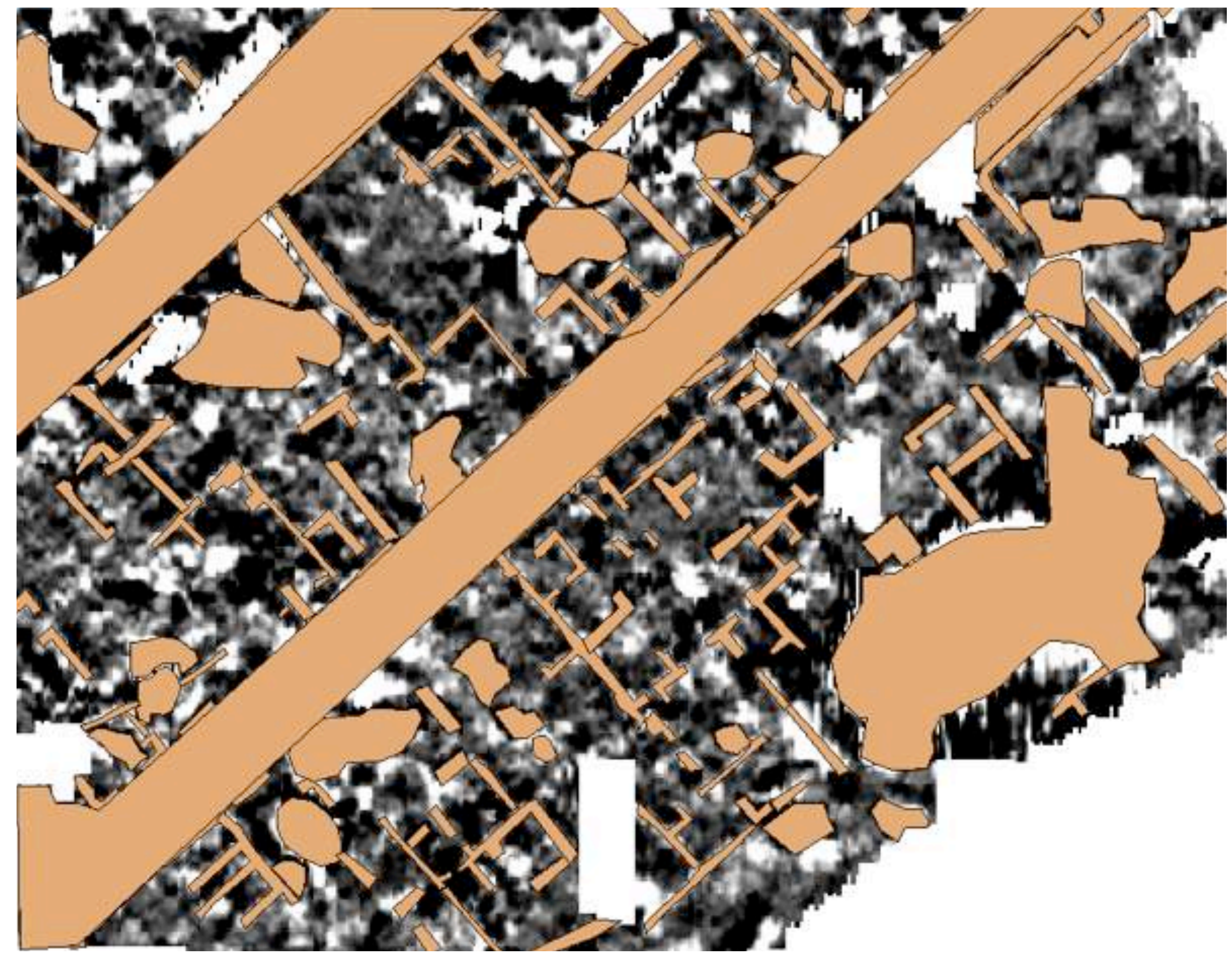
Map algebra



1 1 0 0
1 2 2
4 0 0 2
4 0 1 1
INGRID1
=
1 2 1 0
4 3 4
0 0 4
7 2 2 1
OUTGRID
0 1 1 0
3 3 1 2
0 0 2
3 2 1 0
INGRID2
VALUE=NODATA
Expression:
OUTGRID = INGRID1 + INGRID2

Vectorisation

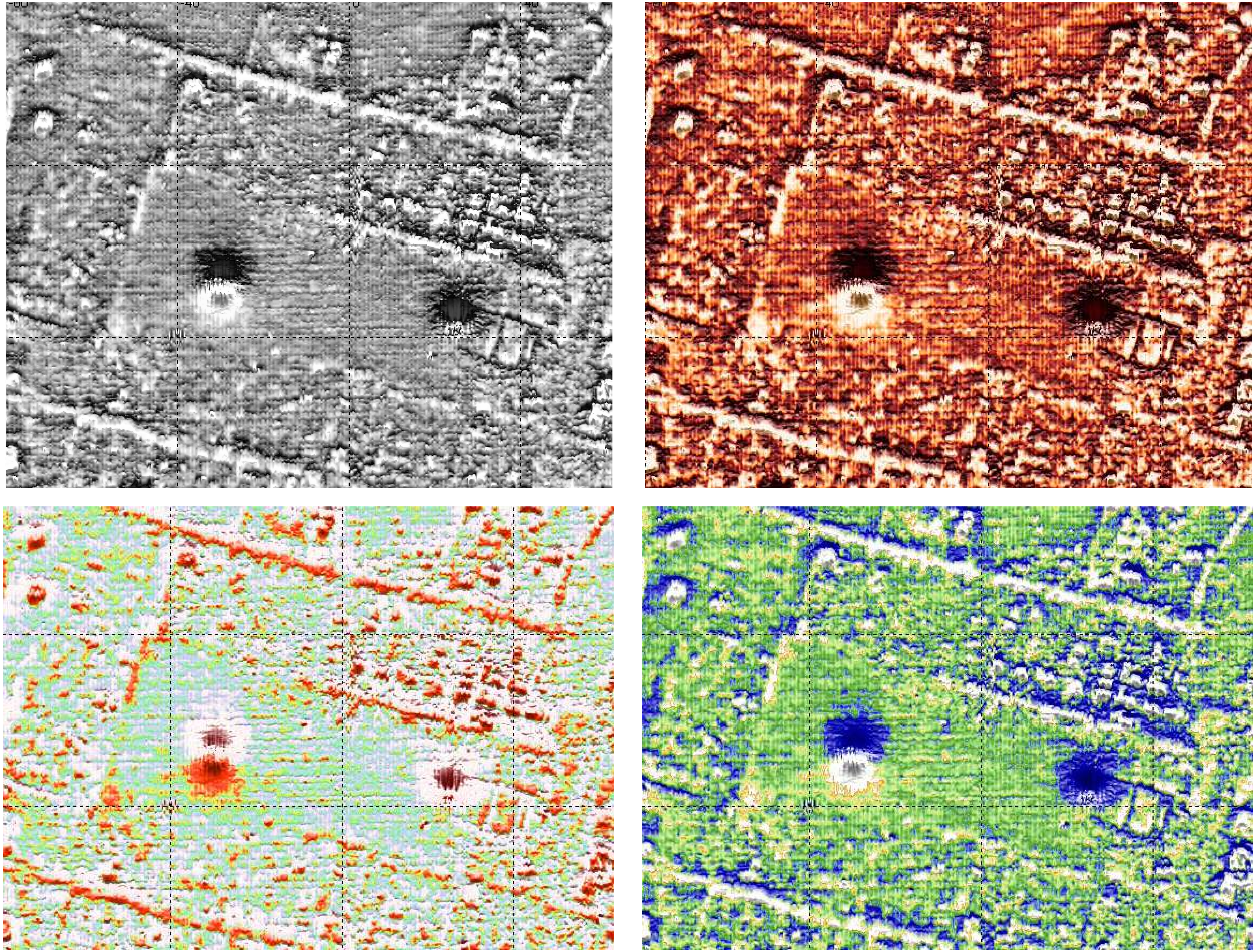




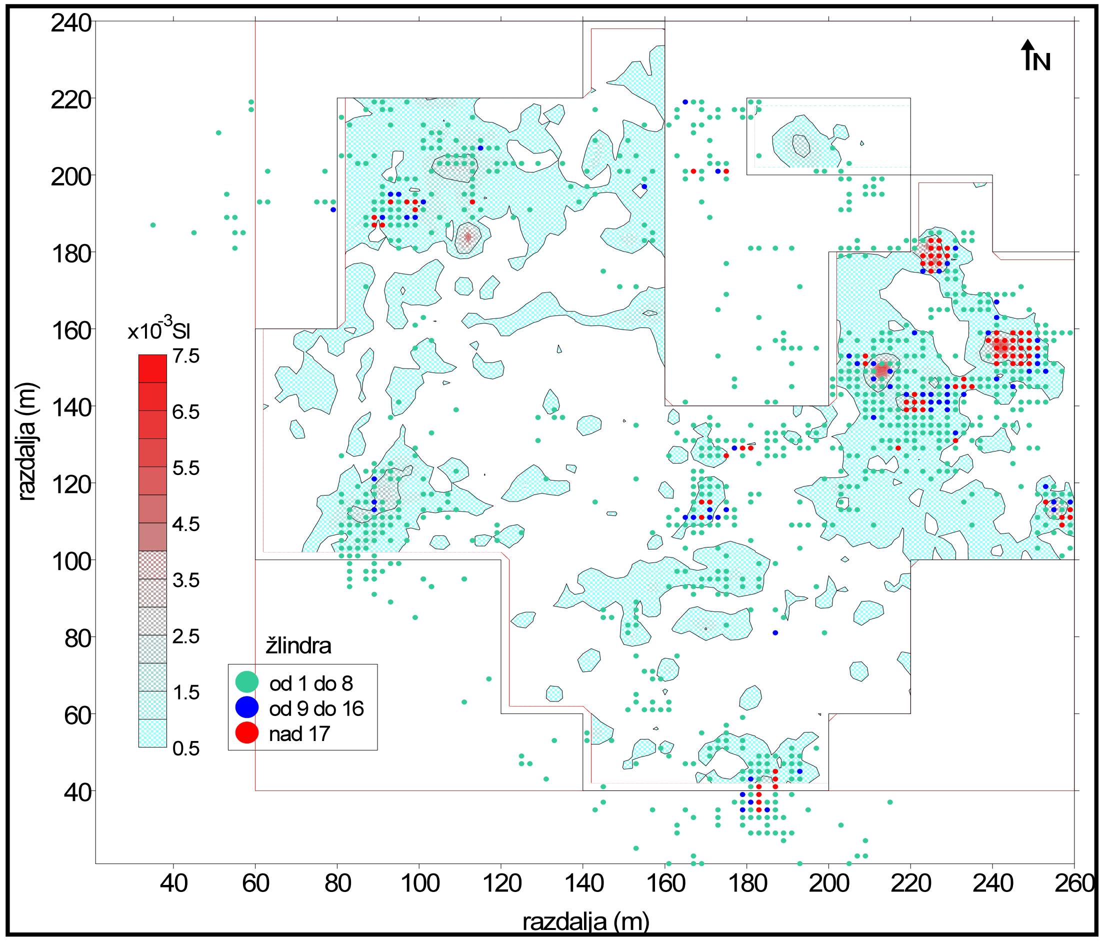
Changing numbers into images: Maps, diagrams, visualizations

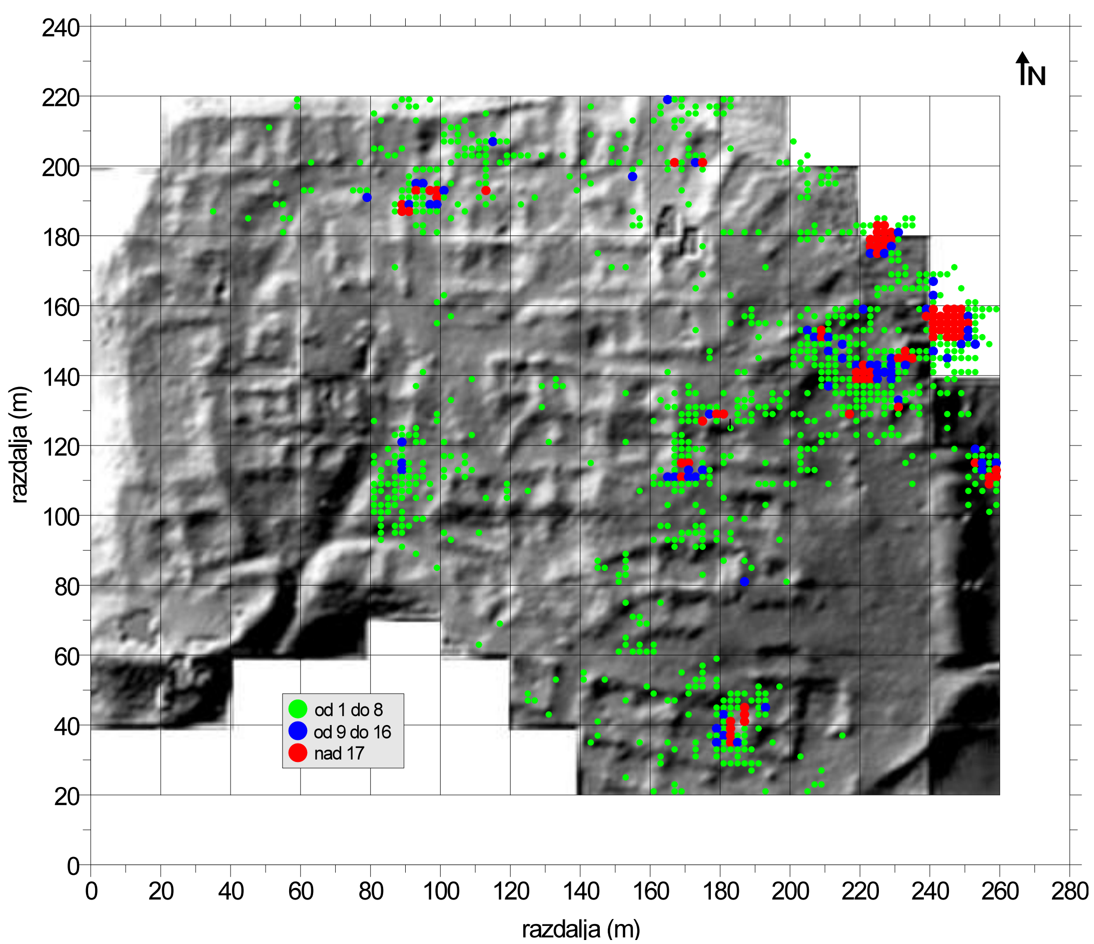
"'Pictures that emphasize what we already know—'security blankets' to reassure us—are frequently not worth the space they take. Pictures that have to be gone over with a reading glass to see the main point are wasteful of time and inadequate of effect. The greatest value of a picture is when it forces us to notice what we never expected to see." (Tukey 1977)

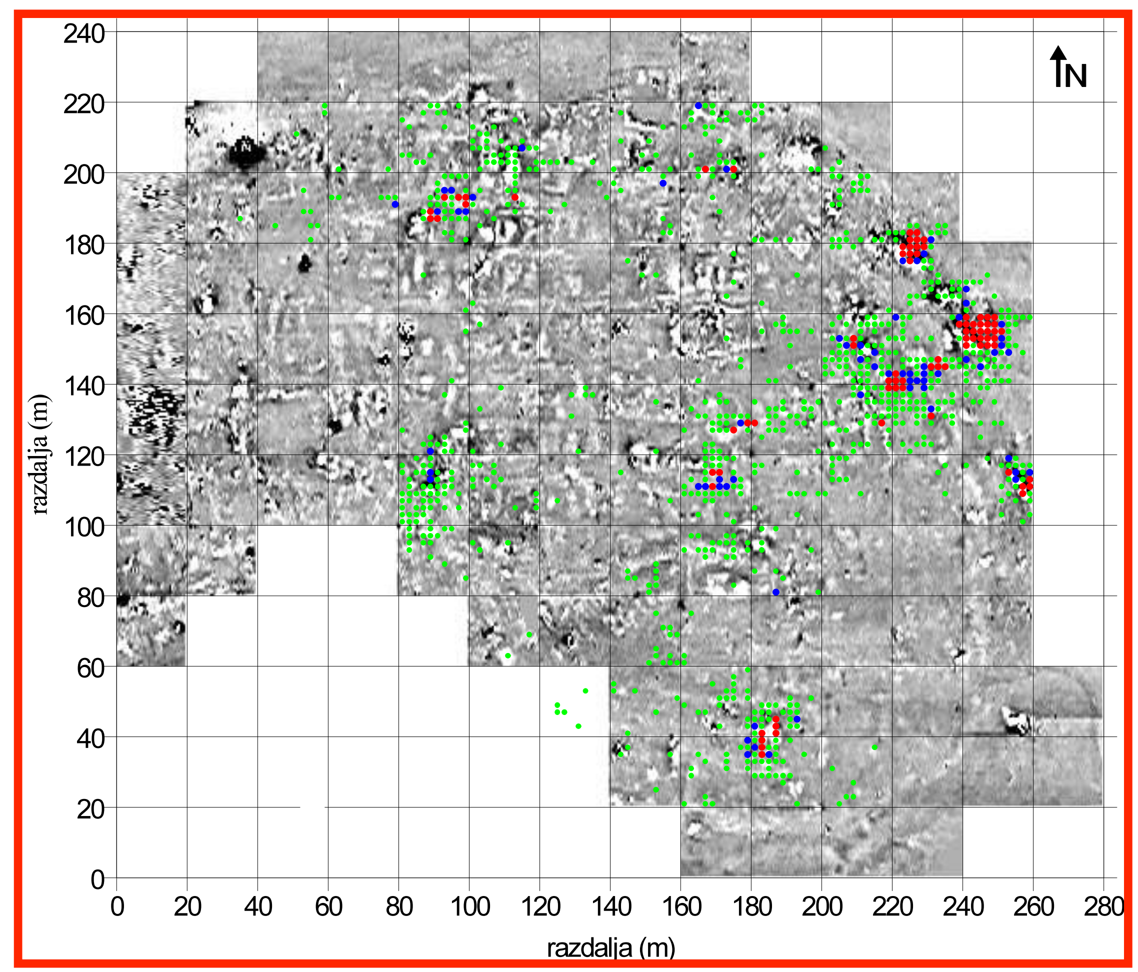
Changing numbers into images: Maps, diagrams, visualizations



Exploring data: Maps, diagrams, visualizations







Future

3D GIS (Volumes)

Object oriented GIS

Problems

Representation of Time

Long term data storage and curation