

Trail 2016 - Chambord
Workshop 4
**LiDAR advanced techniques and automated
detection**

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Mai 2016

This workshop will aim to present two components of advanced processing of LiDAR data :

- Using LiDAR data and geophysical data in order to combine visions of the soil and subsoil vision.
- use of automatic detection process remains on LiDAR data.

LiDAR & Geophysic :

2 different approaches

Information about 2 different types of data

- nature and structures of subsoil
- relief variation

Méthodes de prospection

Paramètres observés et/ou mesurés

Méthode

Concentration de matériaux en surface

Reconnaissance à vue



Couleur, humidité, végétation, topographie

Photographie aérienne



Micro-topographie

LIDAR aéroporté



Surface du sol

Prospections « externes »



Permittivité diélectrique

Radar



Résistivité

Électrique



Susceptibilité magnétique

Electromagnétique



Alimentation

Magnétique



Succession des couches

Sondages

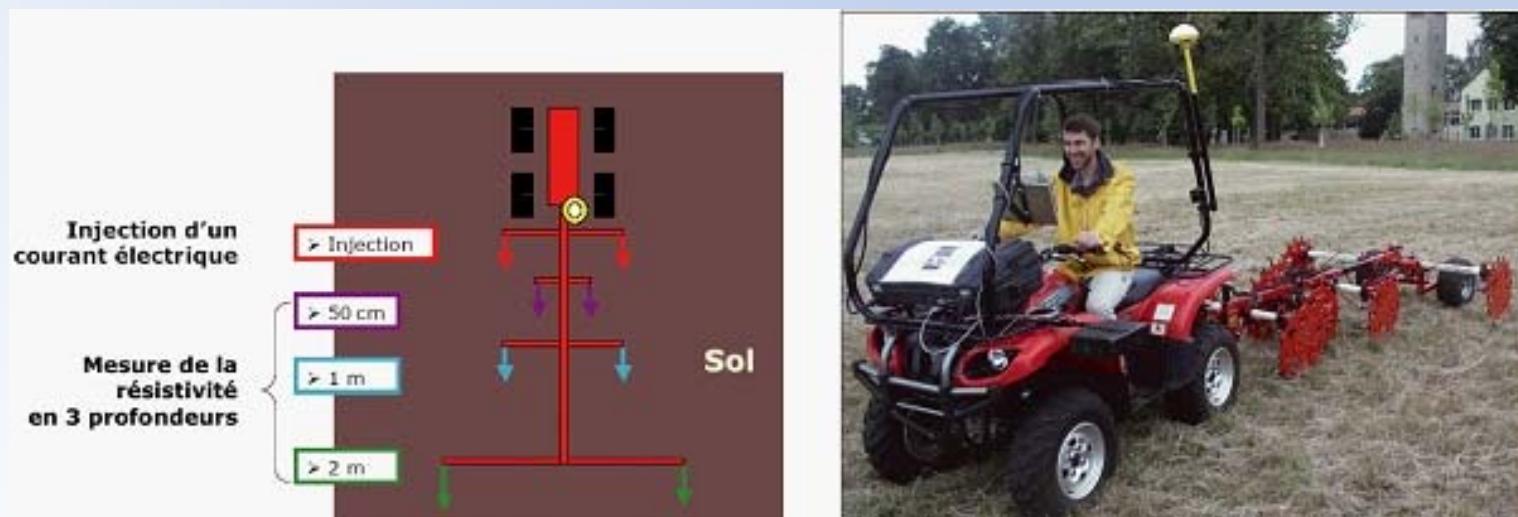
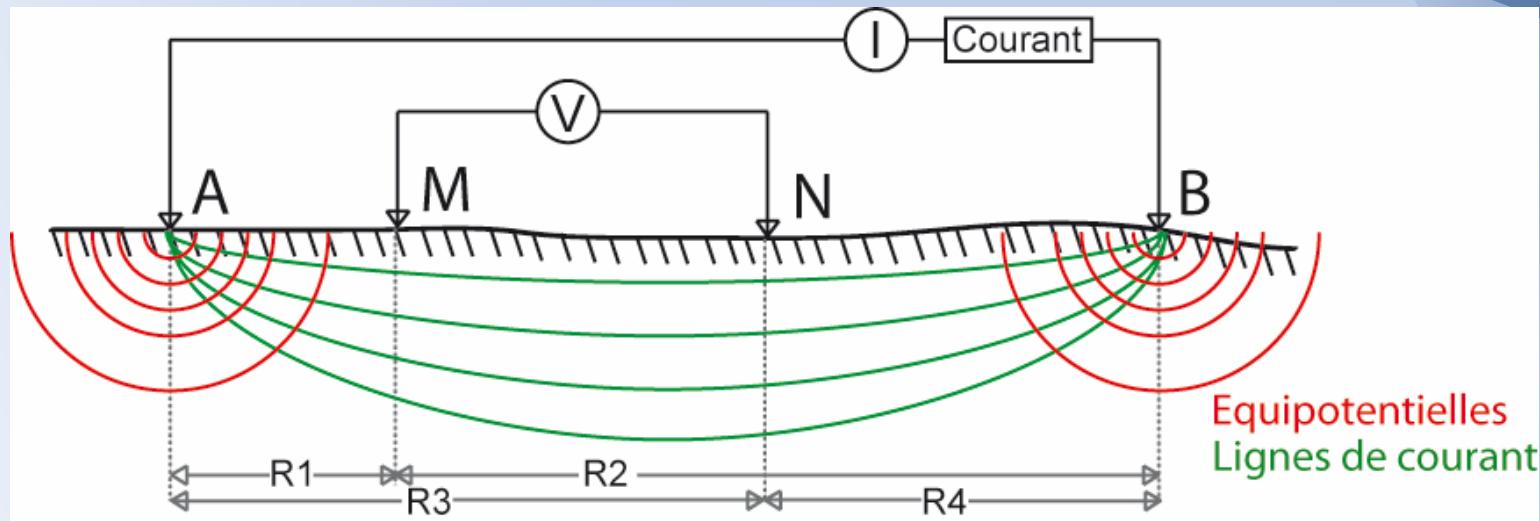


Prospections « internes »

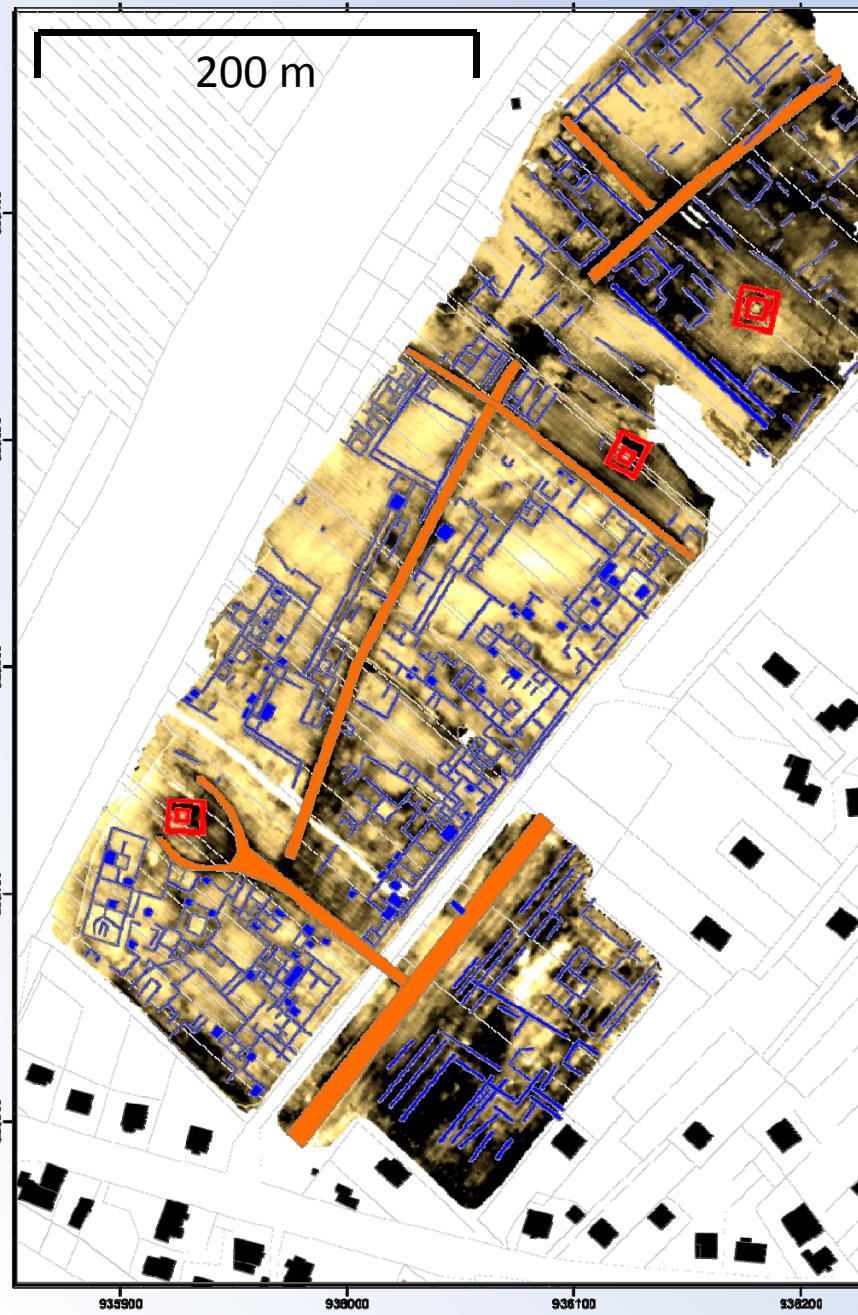
Are there some ways in order to combine these data?
- integration and visualisation of data

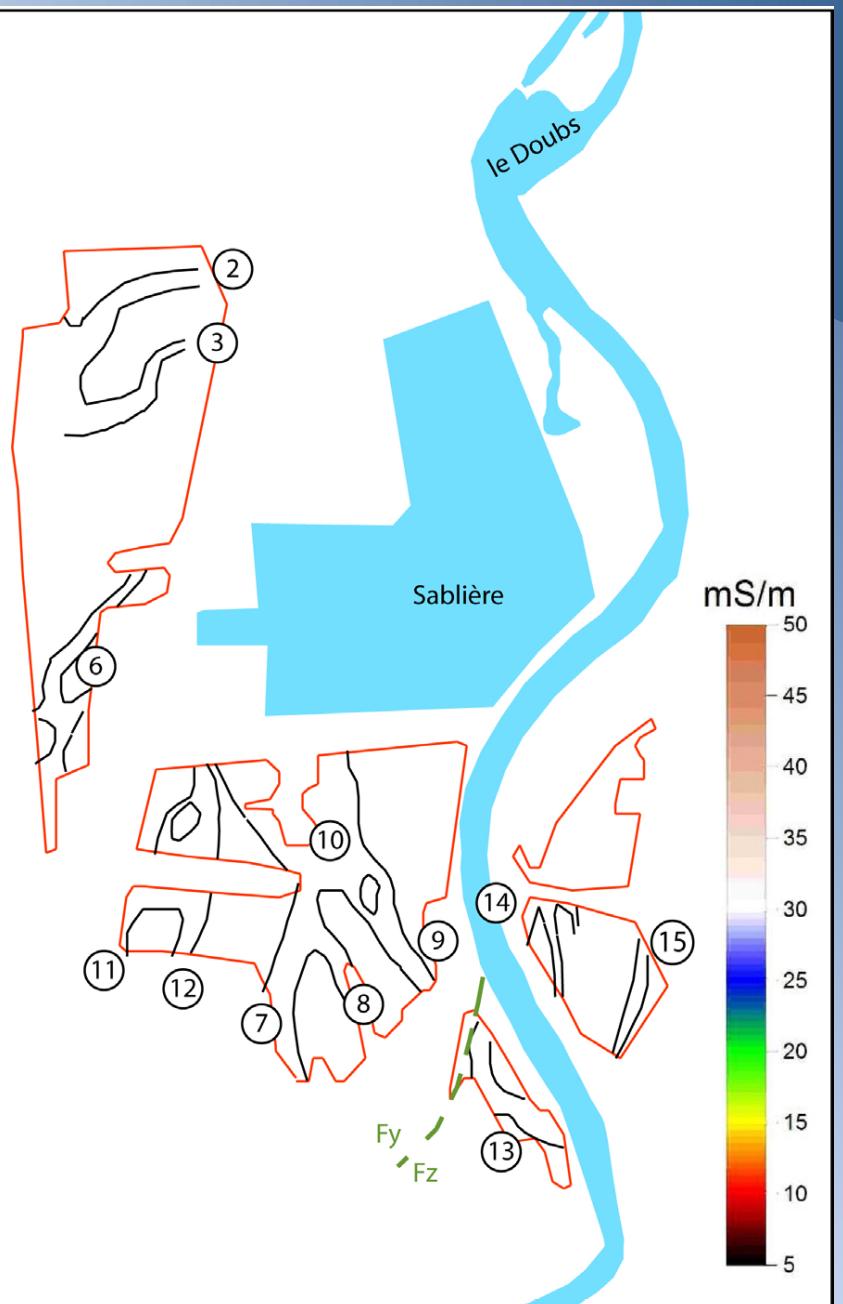
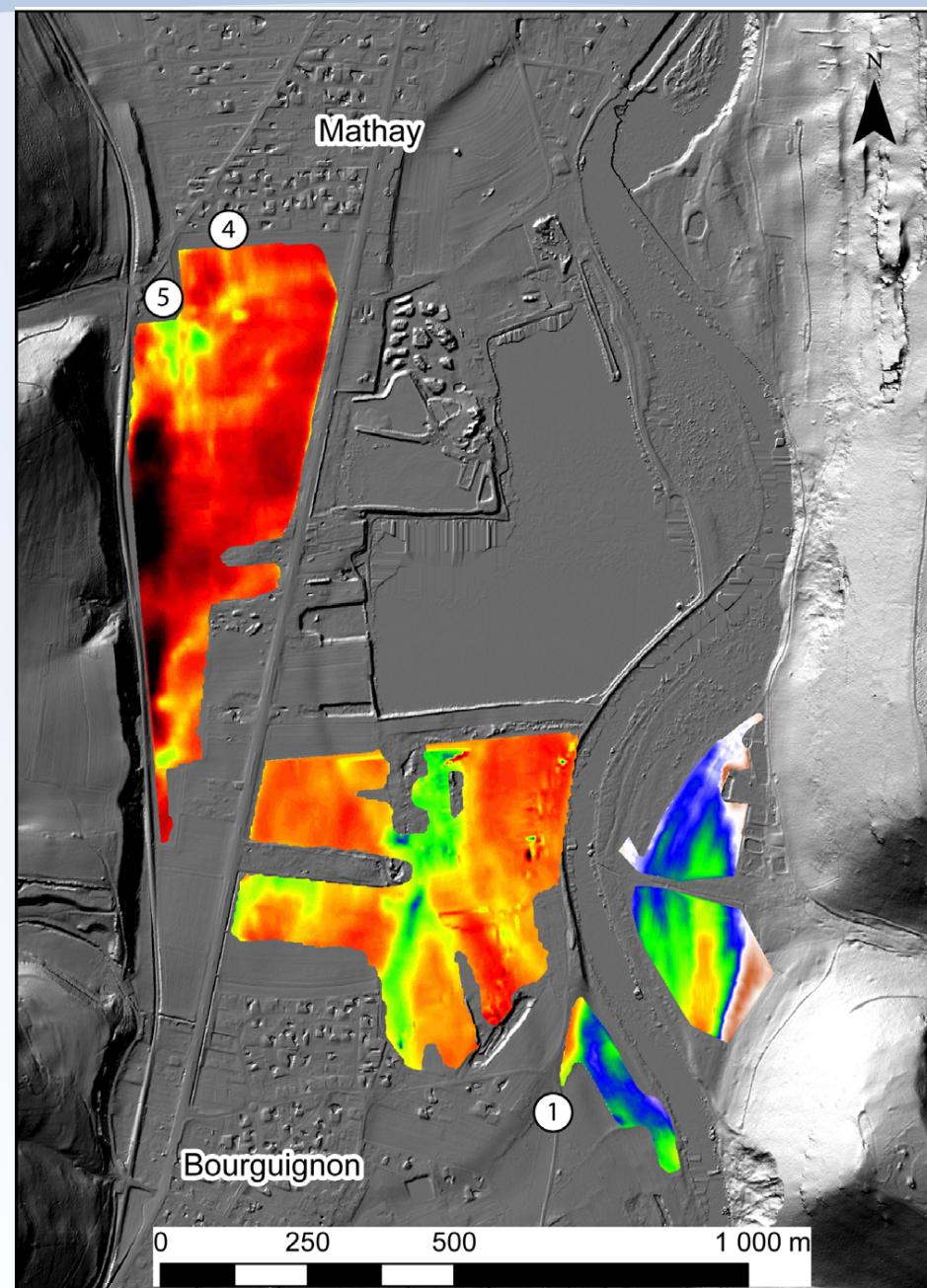
Prospection électrique

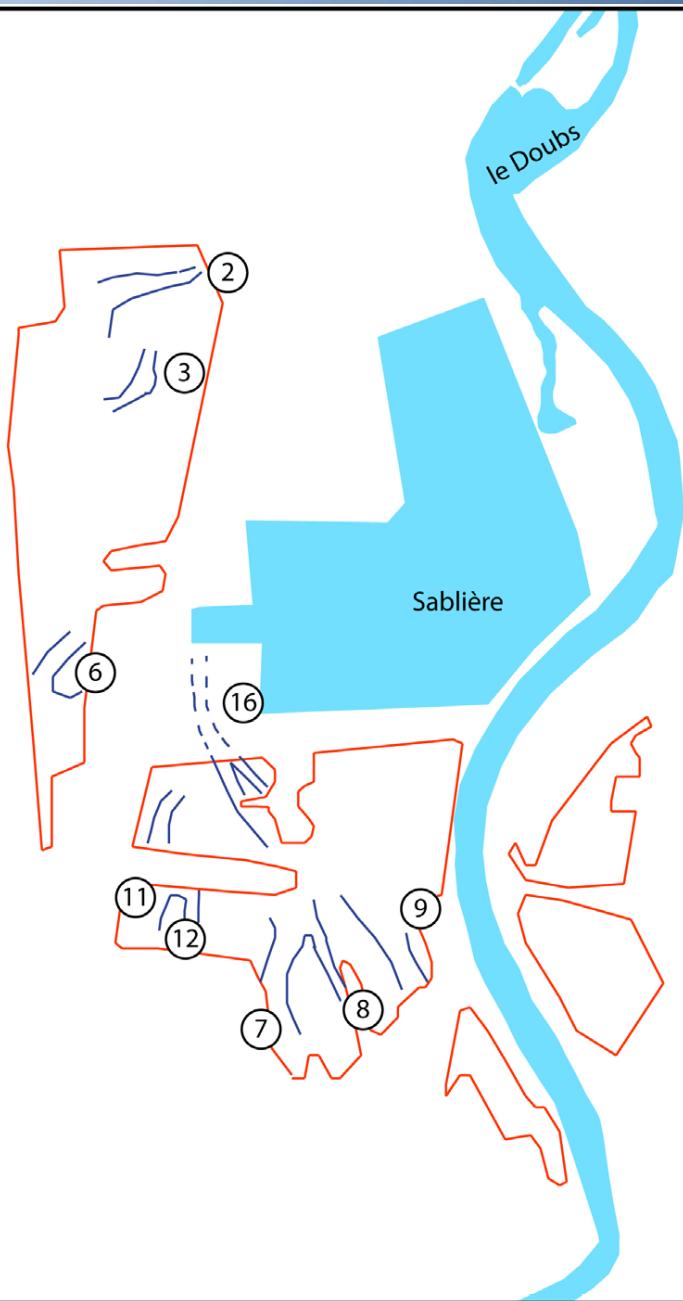
Injection d'un courant électrique dans le sous sol



Prospection électrique







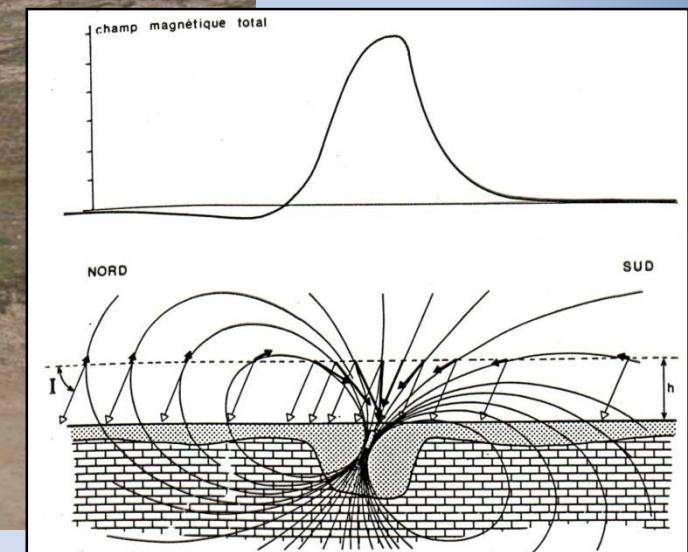


La susceptibilité magnétique K

- $K = J/H$
 - Possible dépendance fréquentielle (viscosité)
 - influence de plusieurs facteurs:
 - Nature des minéraux magnétiques
 - Taille des minéraux magnétiques
 - Concentration en minéraux magnétiques
- 
- Climat
 - Végétation
 - Roche-mère ...

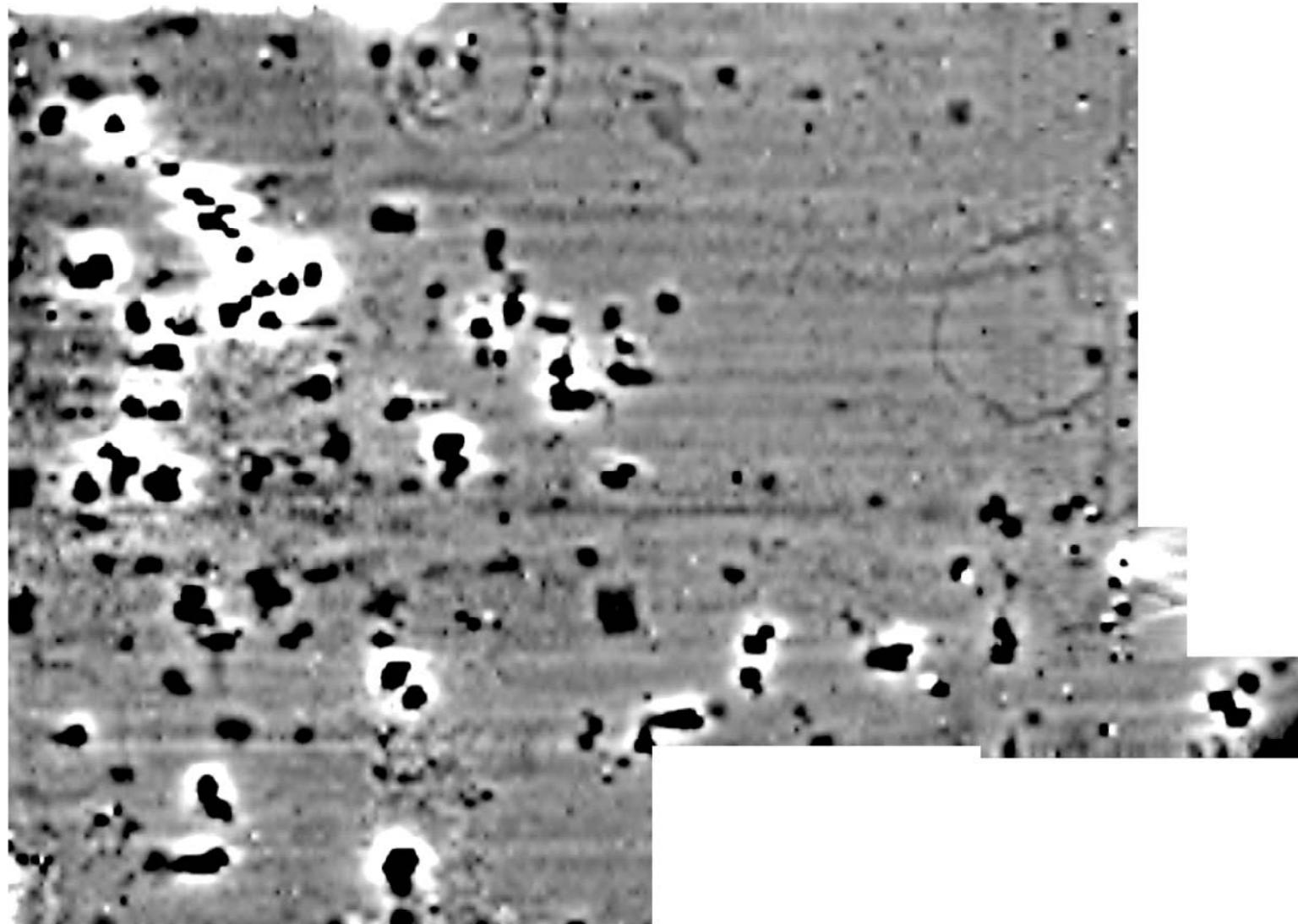
Prospection magnétique

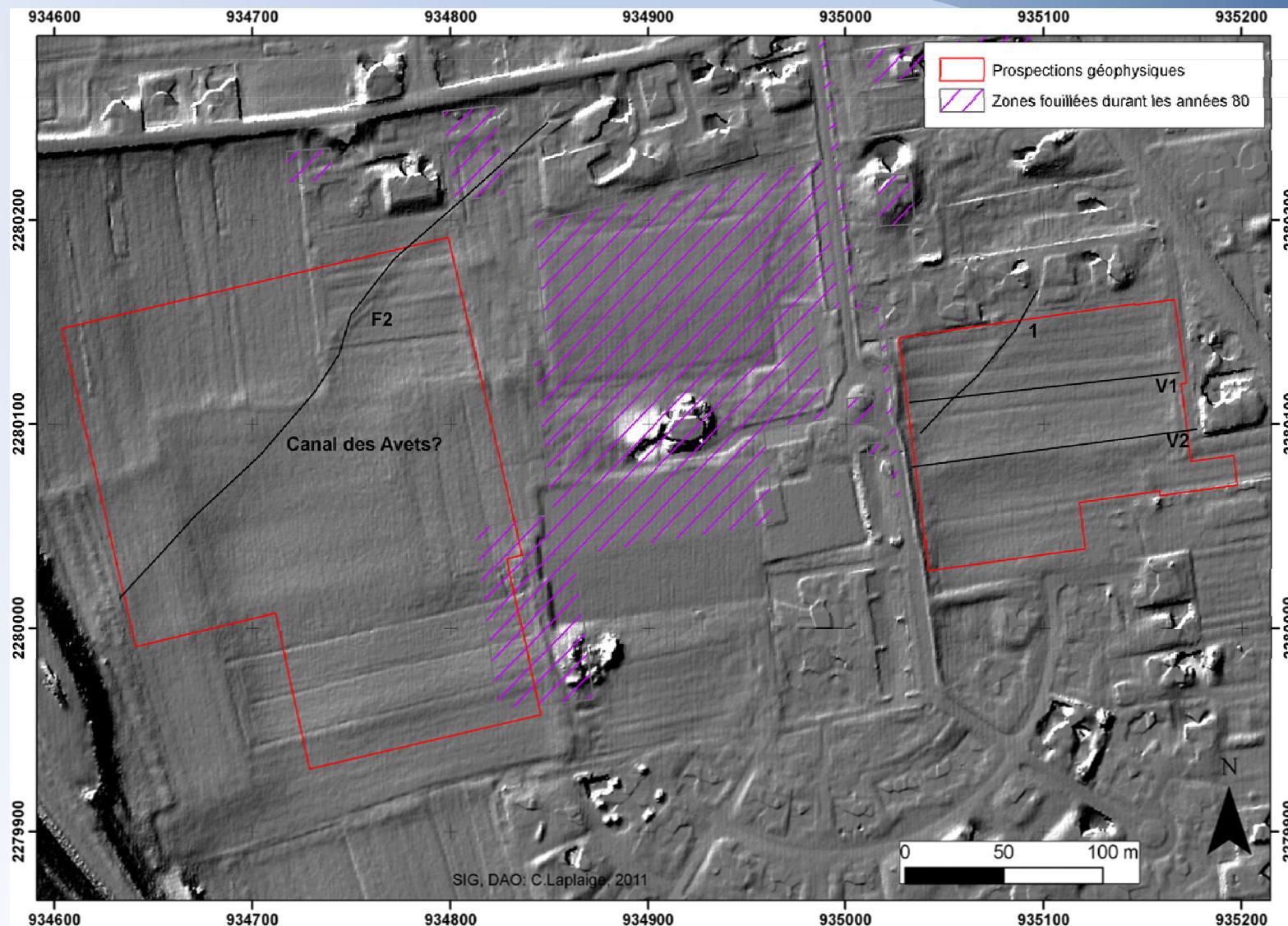
Mesure du champ magnétique terrestre

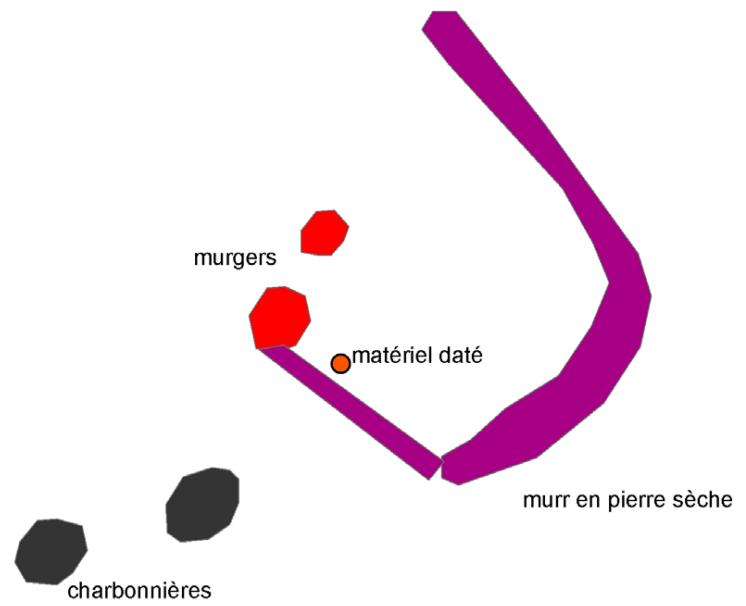
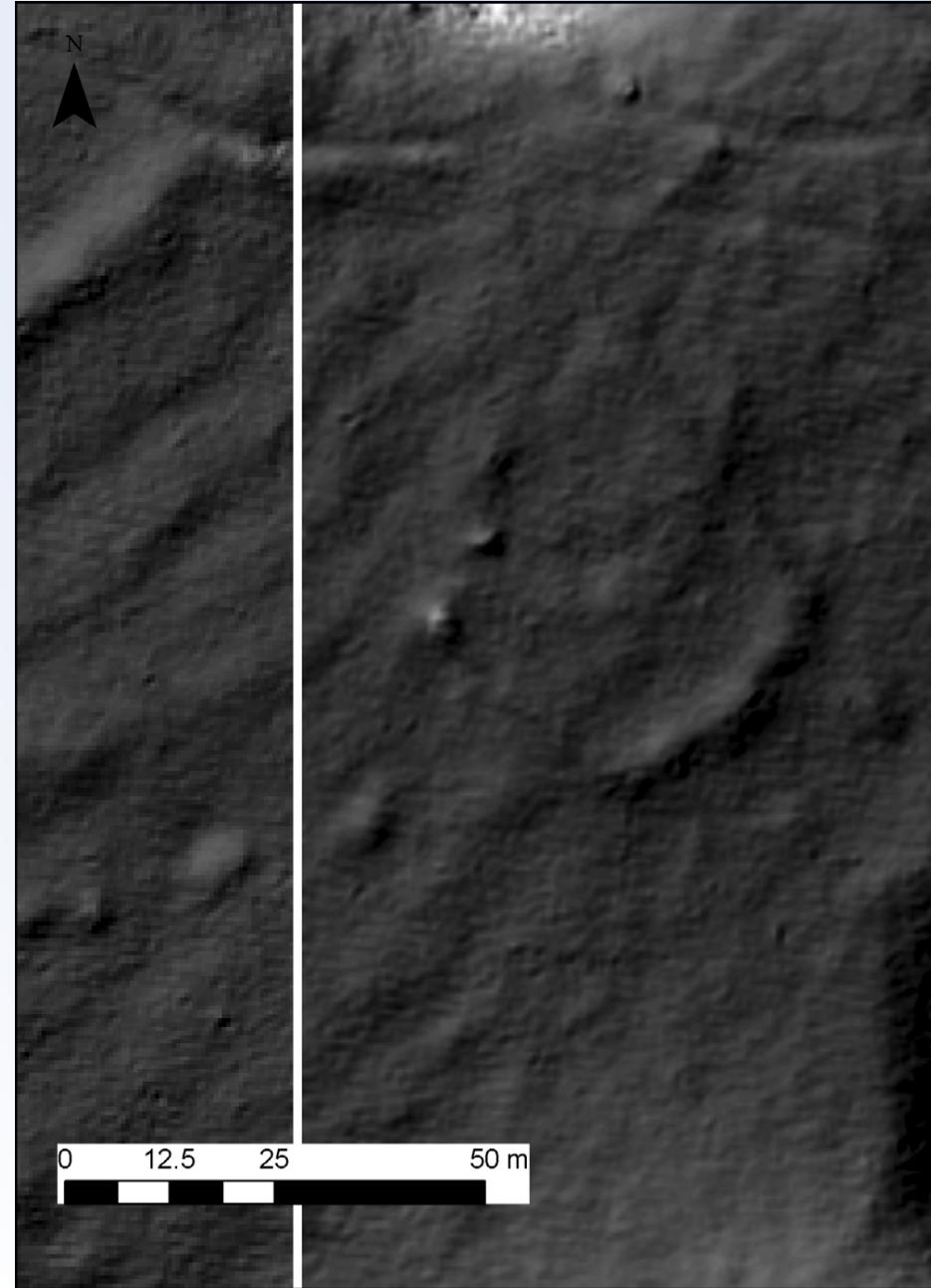


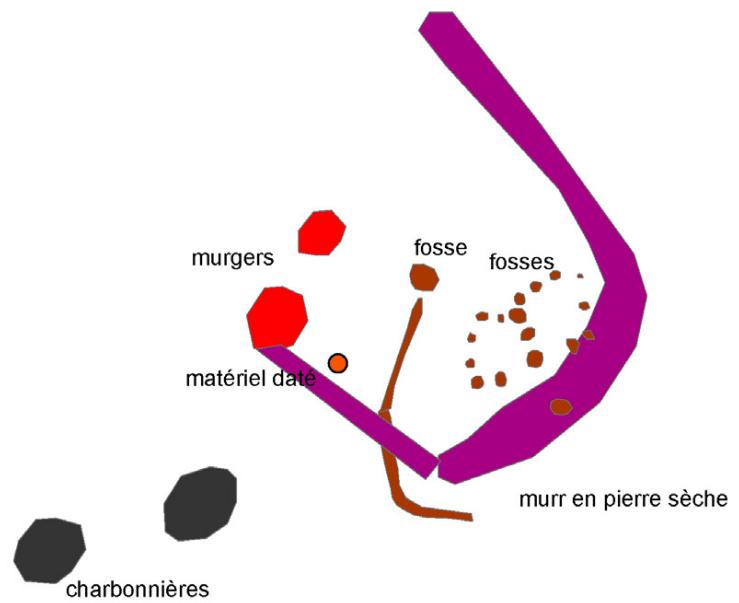
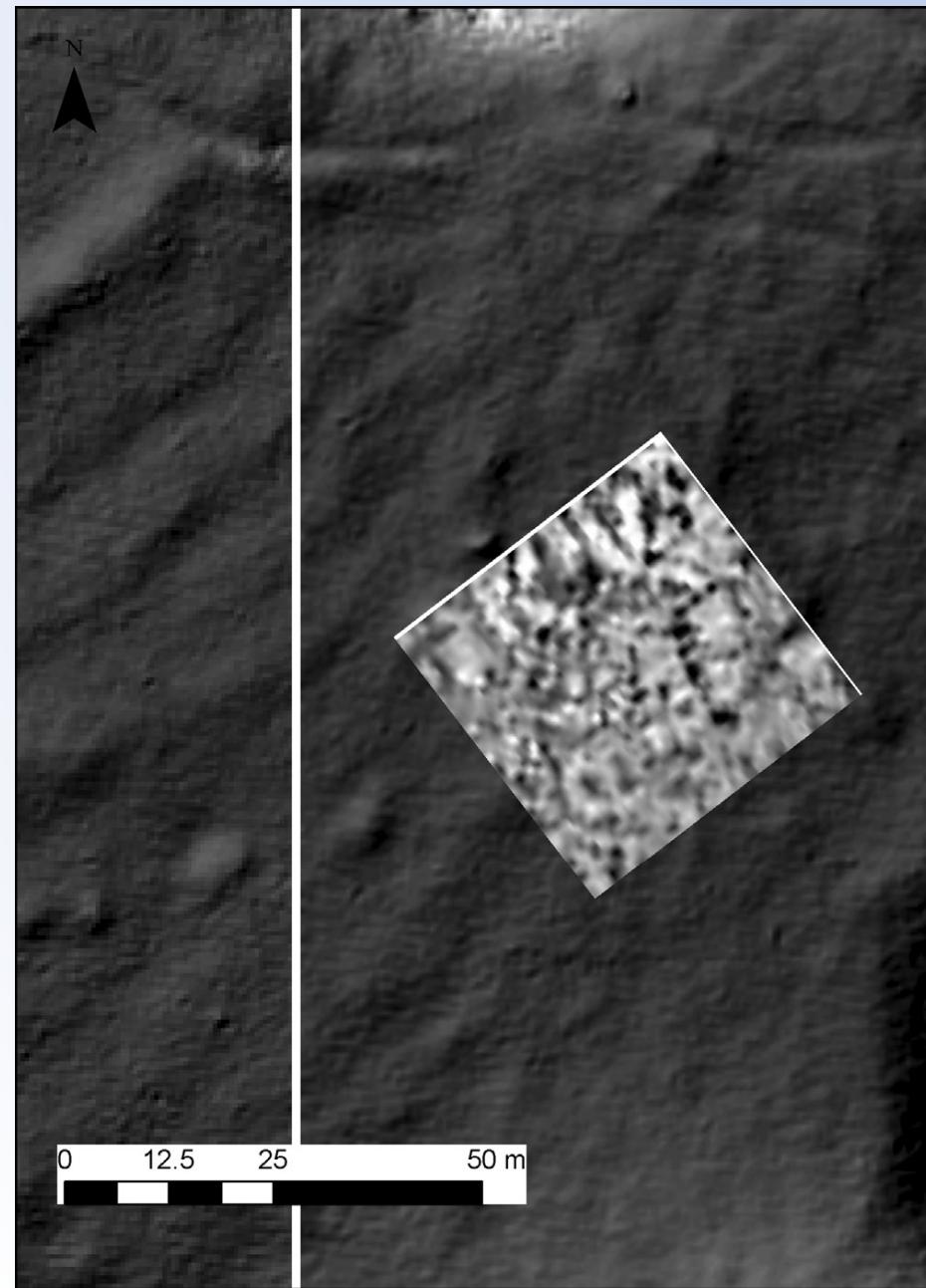
Prospection magnétique

Mesure du champ magnétique terrestre









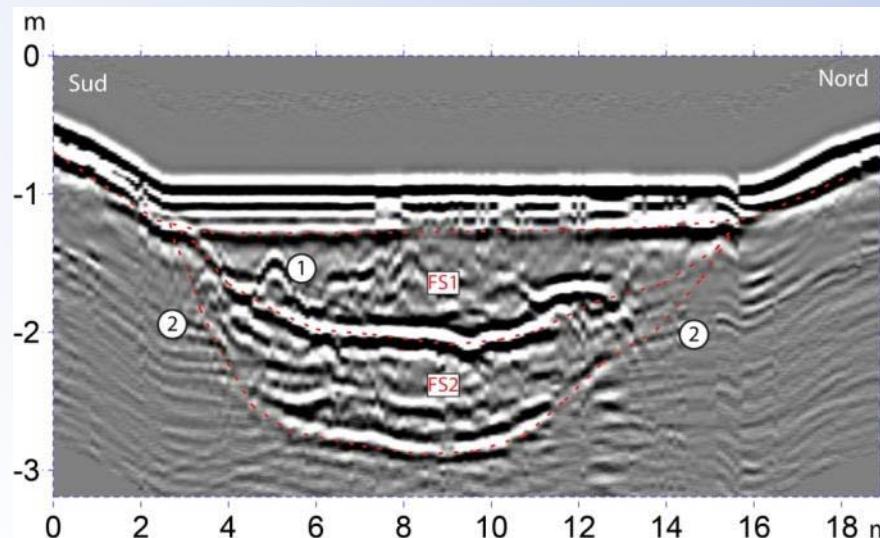
Méthodologie employée : Les prospections géophysiques

Prospection radar : mesure de permittivité électrique du sous sol



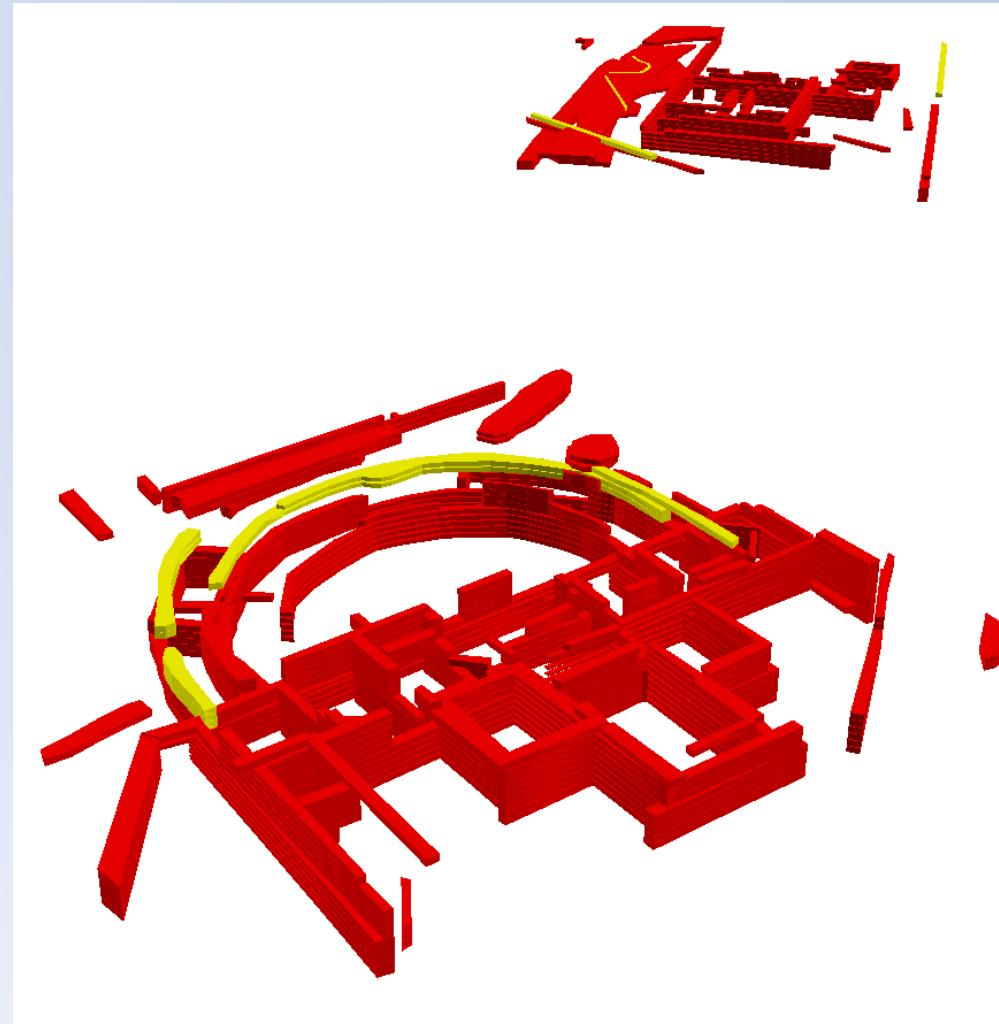
L'appareil émet des ondes à hautes fréquences dans le sol. Celle-ci sont renvoyées par les corps rencontrés.

Cette méthode permet d'obtenir des informations en plan et en coupe.



Méthodologie employée : Les prospections géophysiques

Prospection radar : mesure de permittivité électrique du sous sol



Visualisation des anomalies

De la réception des points bruts à la détection, la caractérisation et la présentation des anomalies microtopographiques



- Ombrages simples
- Ombrages composites
- Puissance de la pente
- Modèles de reliefs locaux (LRM)
- Topographic Position Index
- Sky View Factor

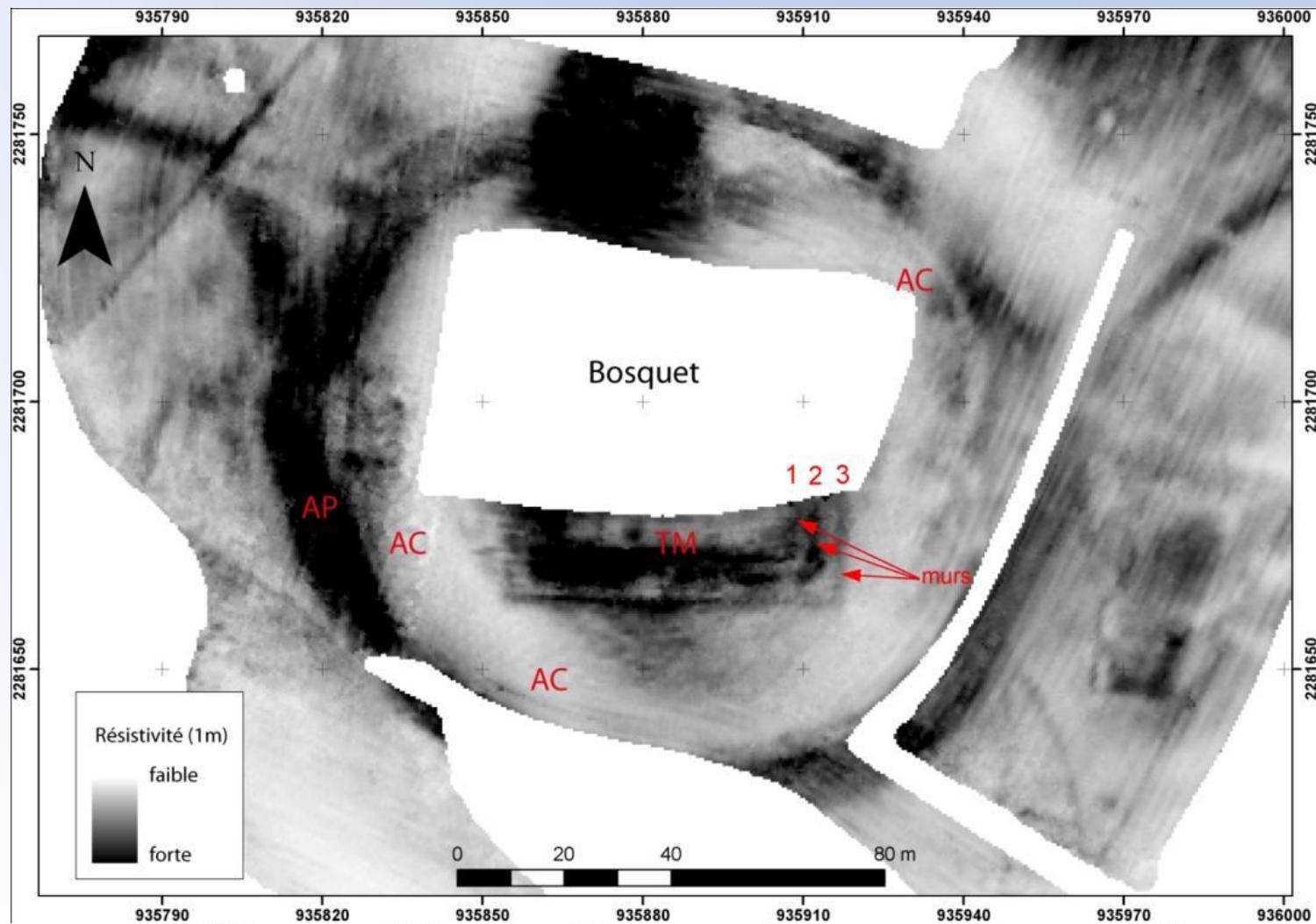
SVF

Efficiency of each method depends on the characteristics of the area

- Taphonomic conditions
- Lidar is more sensitive to erosion
- Geophysical survey is disturbed by woodland

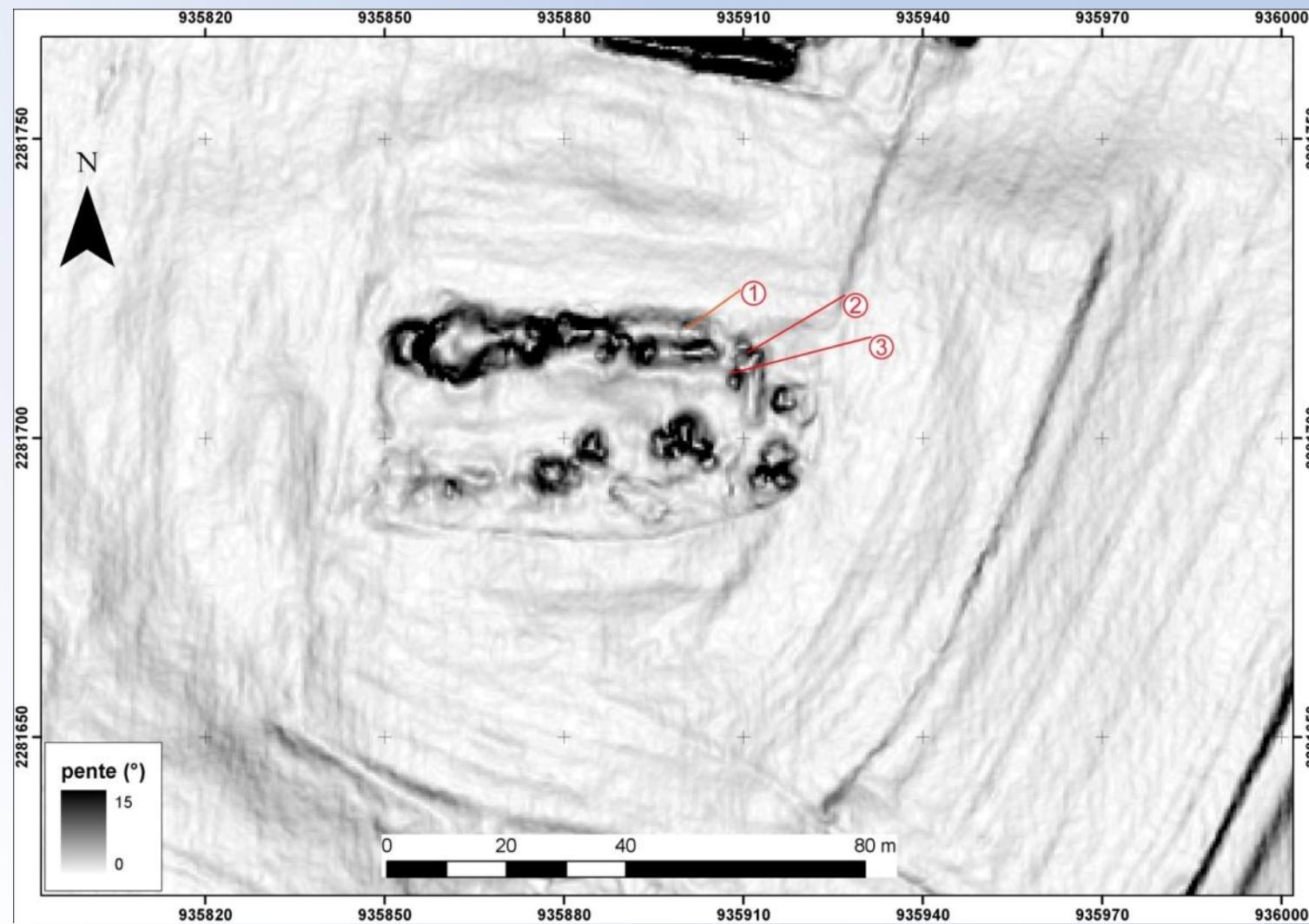
Quelques exemples

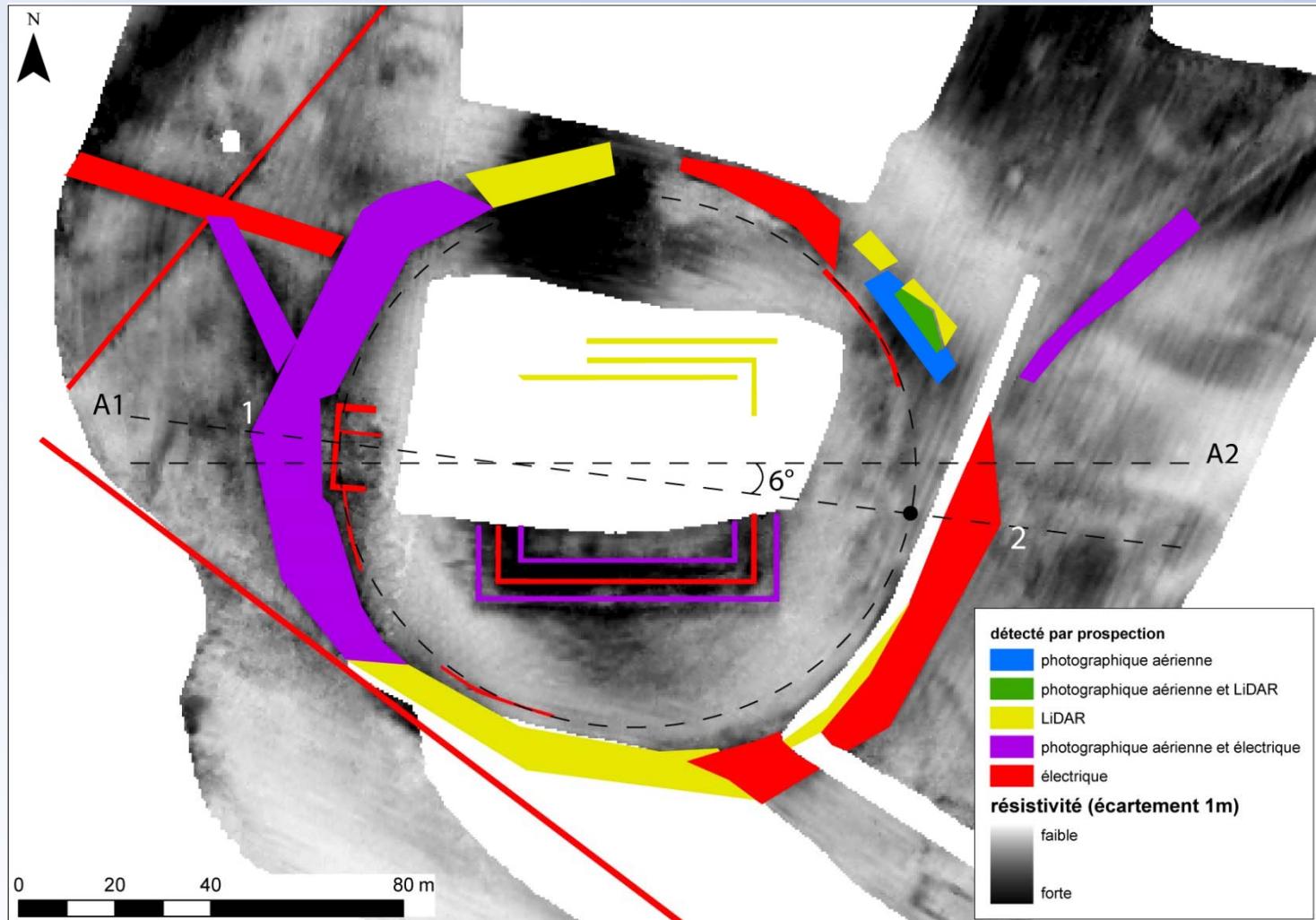
Restitution du plan du grand sanctuaire des « Cloux du Château »



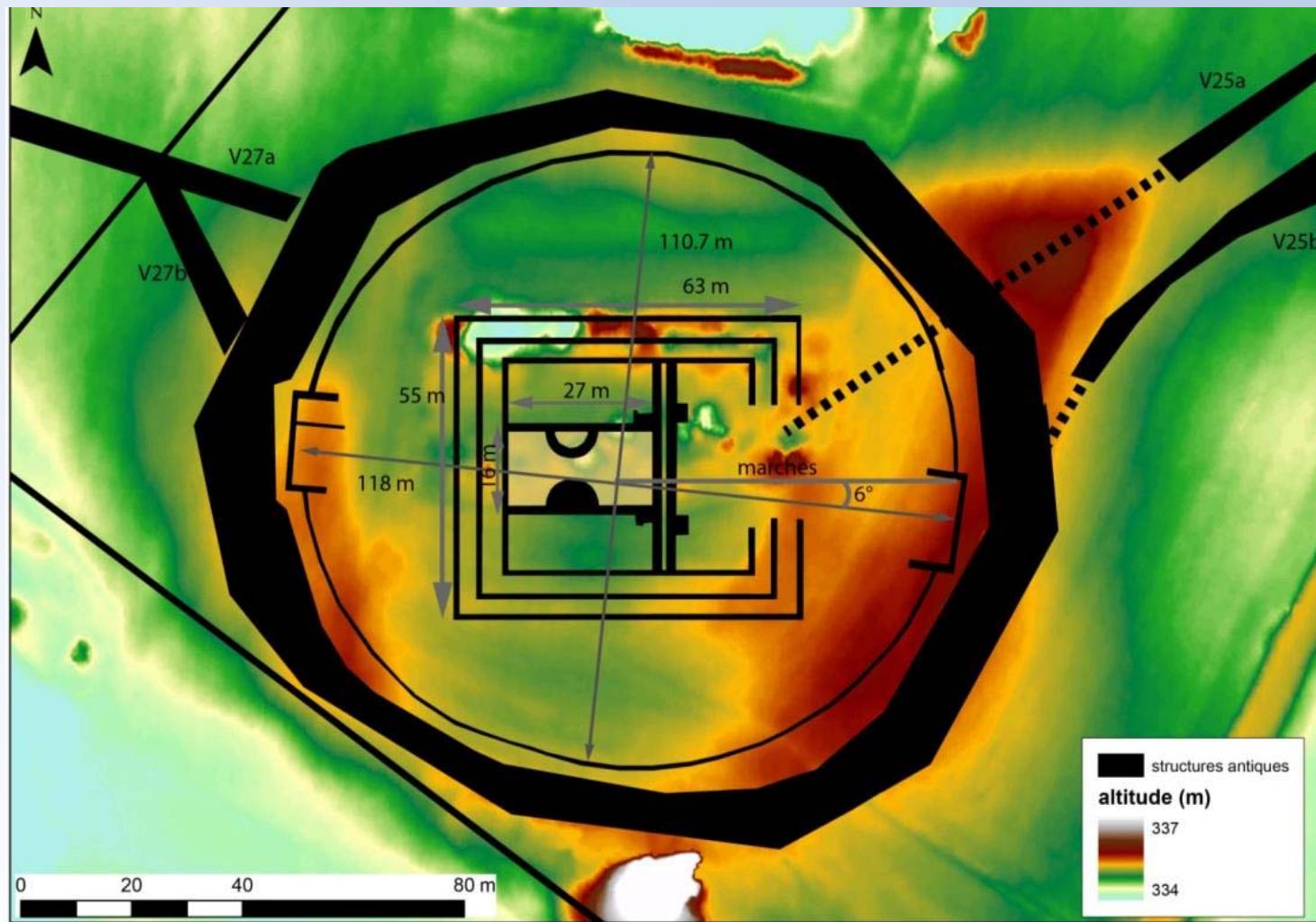


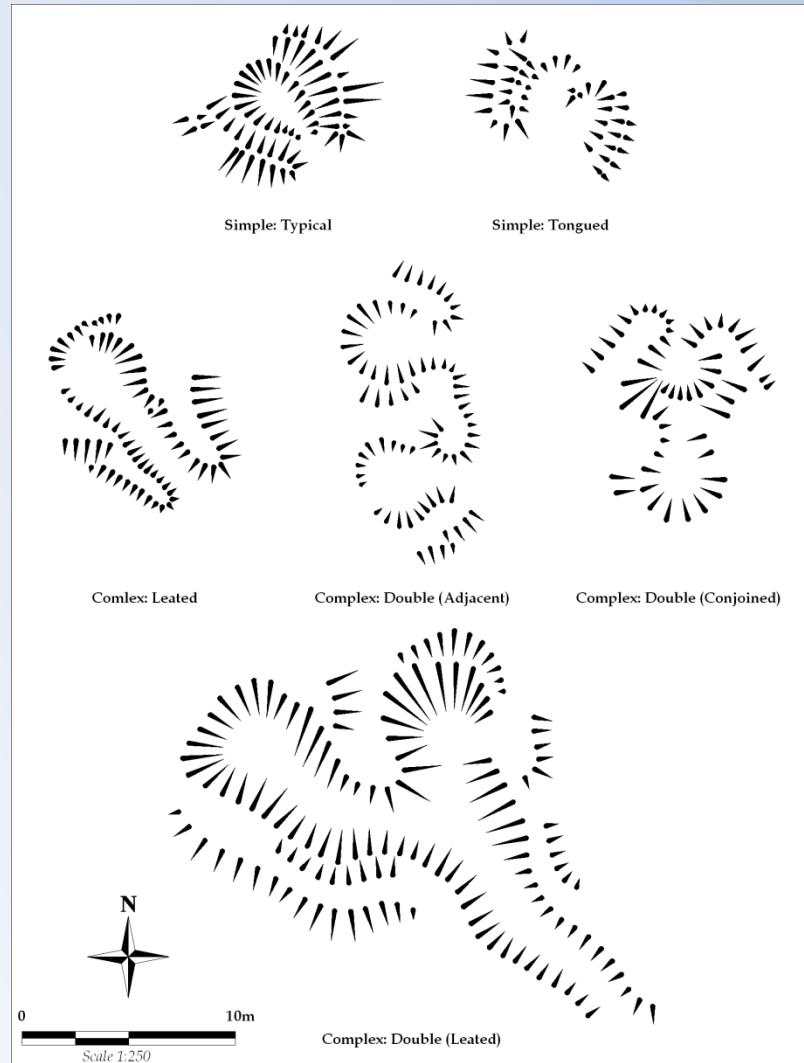
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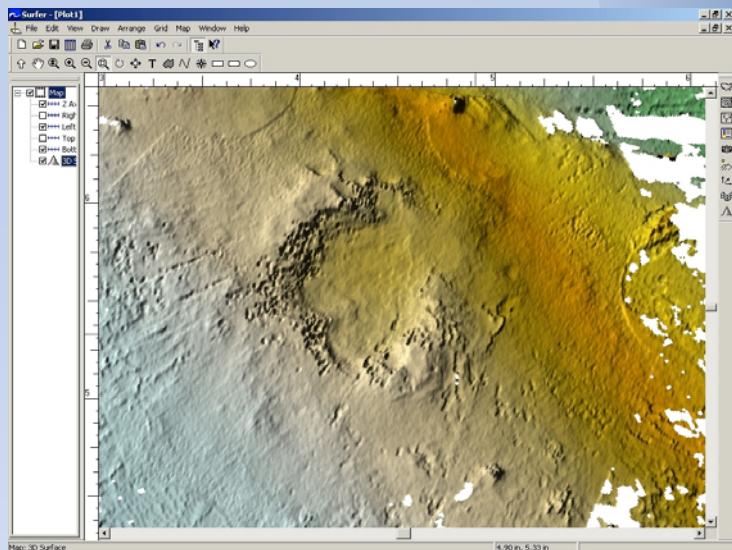
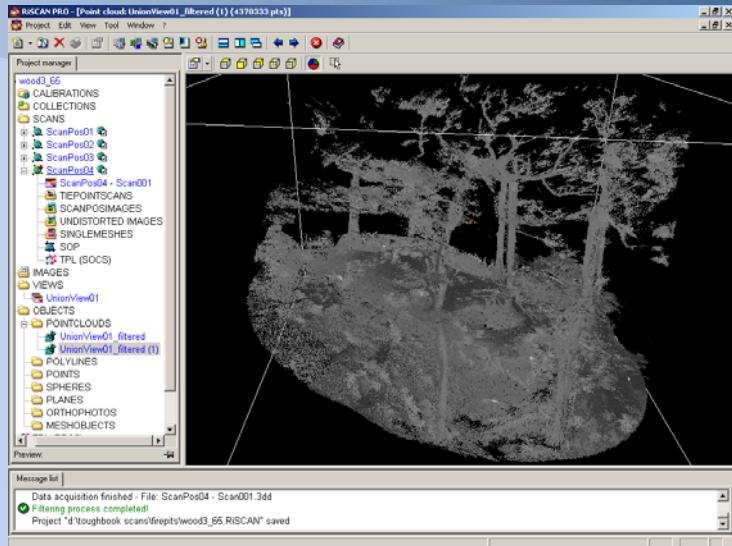


Restitution du plan du grand sanctuaire des « Cloux du Château »



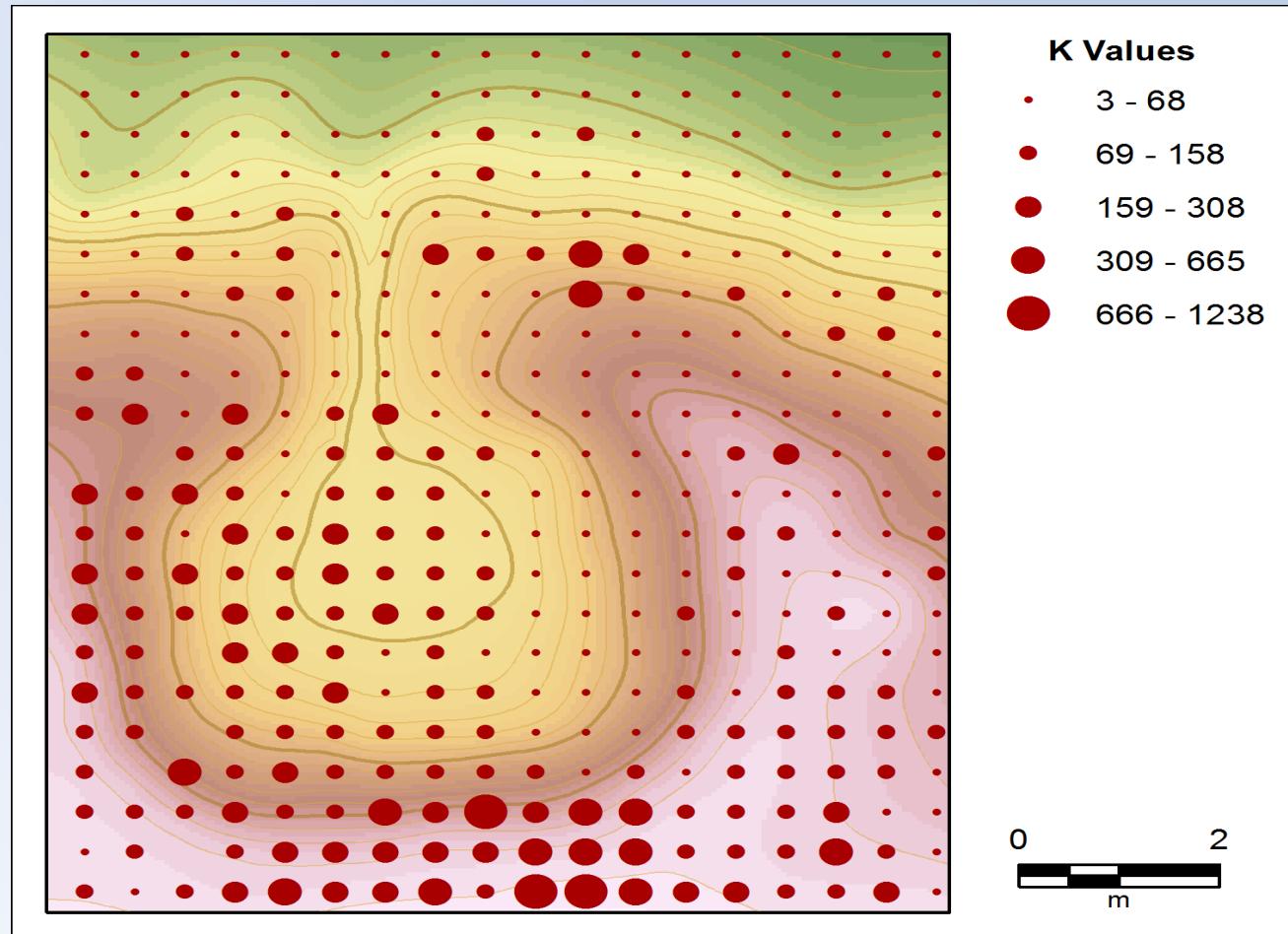


Woodland Industries

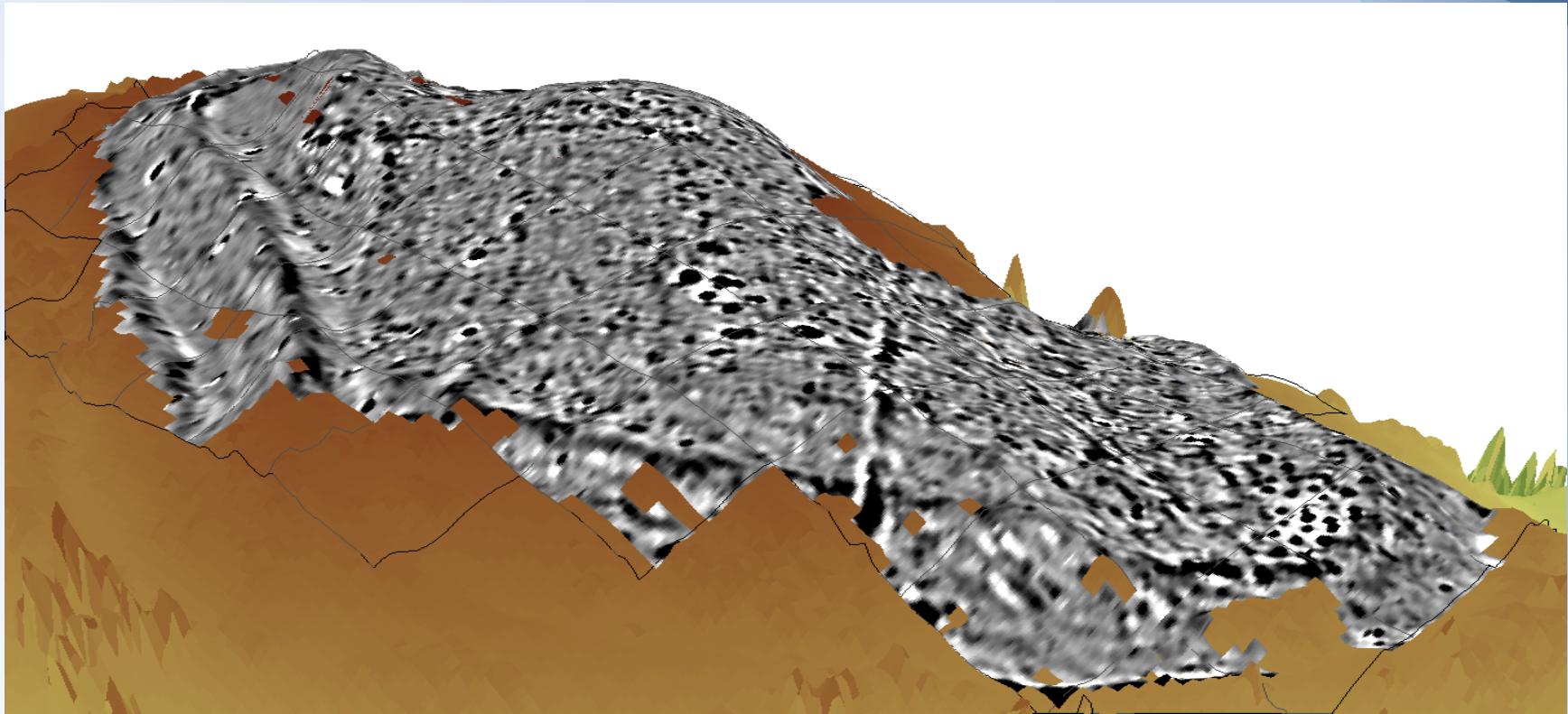


Terrestrial Laser Scanning

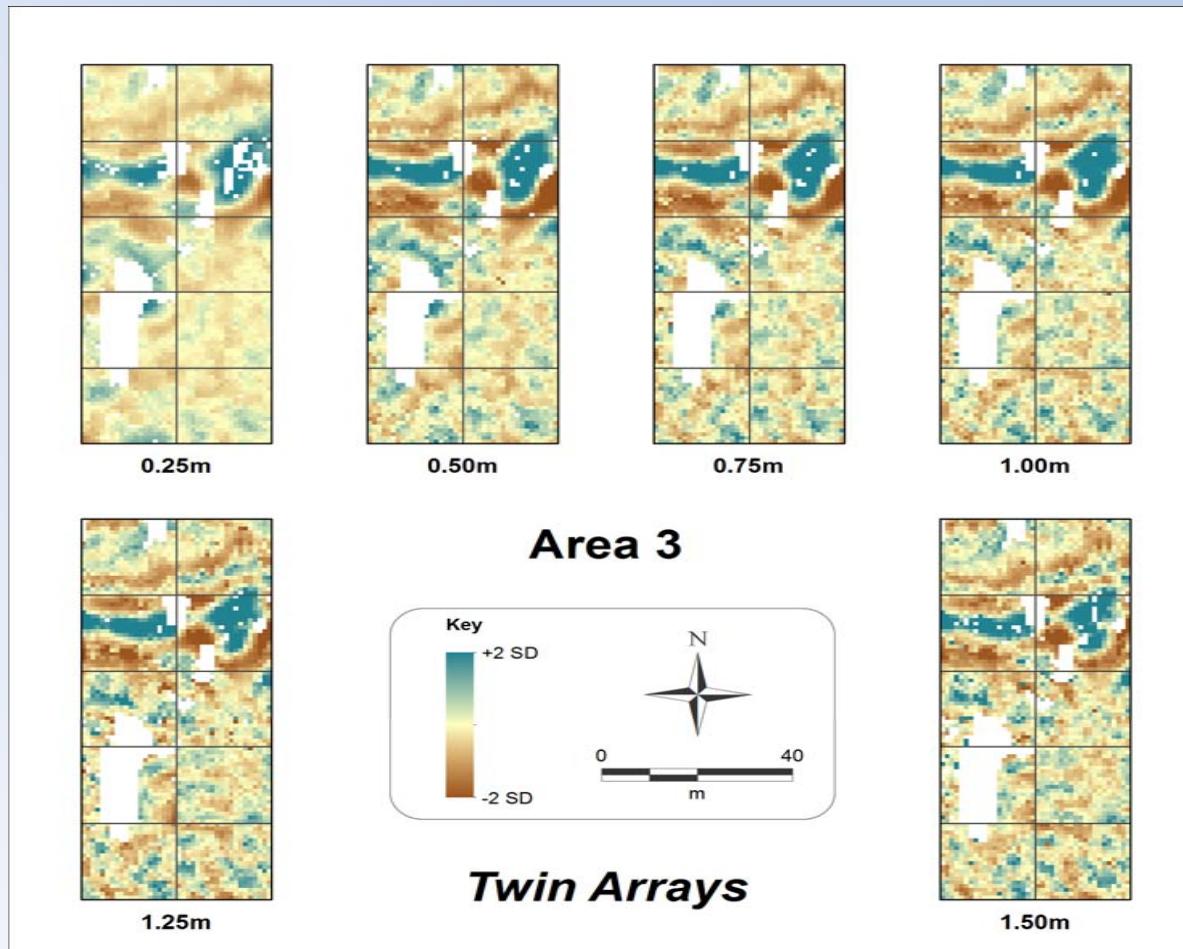
Magnetic Susceptibility

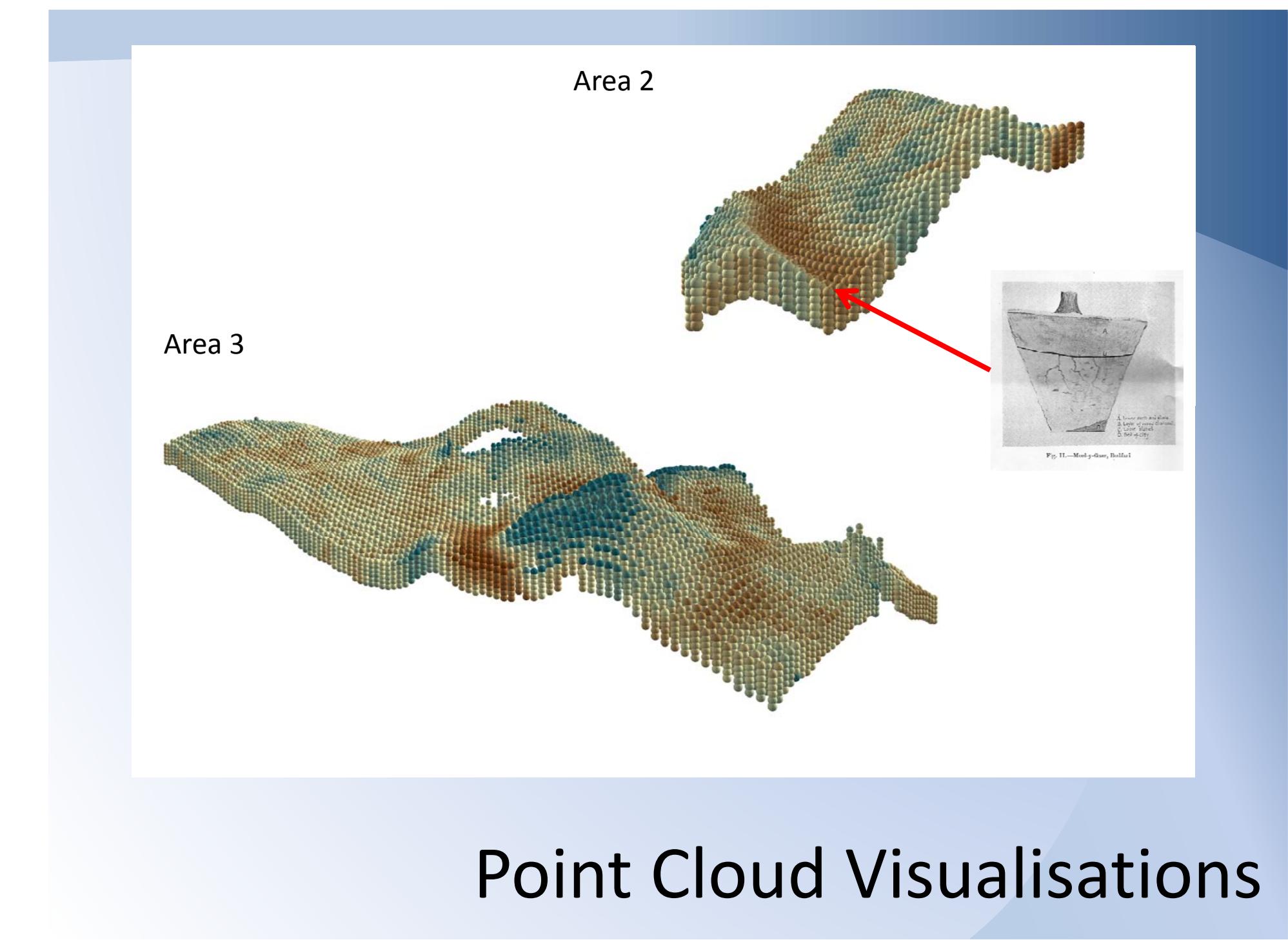


3D Drapes



Multi-Depth Resistance Survey





Exercise 1

ArcMap

Comparison of LiDAR and geophysics

ArcScene

Visualisation of LiDAR and geophysics

(Semi) automated detection:

manual vectorization is really time consuming and subjective

Detection auto : non exhaustive, false positive creation, (objective??)

→ Finally, the same for manual detection.....

It's not a good idea to oppose automated detection of feature and manual interpretation

You only can perform a good automated detection if the objects are defined precisely (and this part is only due to our skill in manual interpretation)

Riley 2012

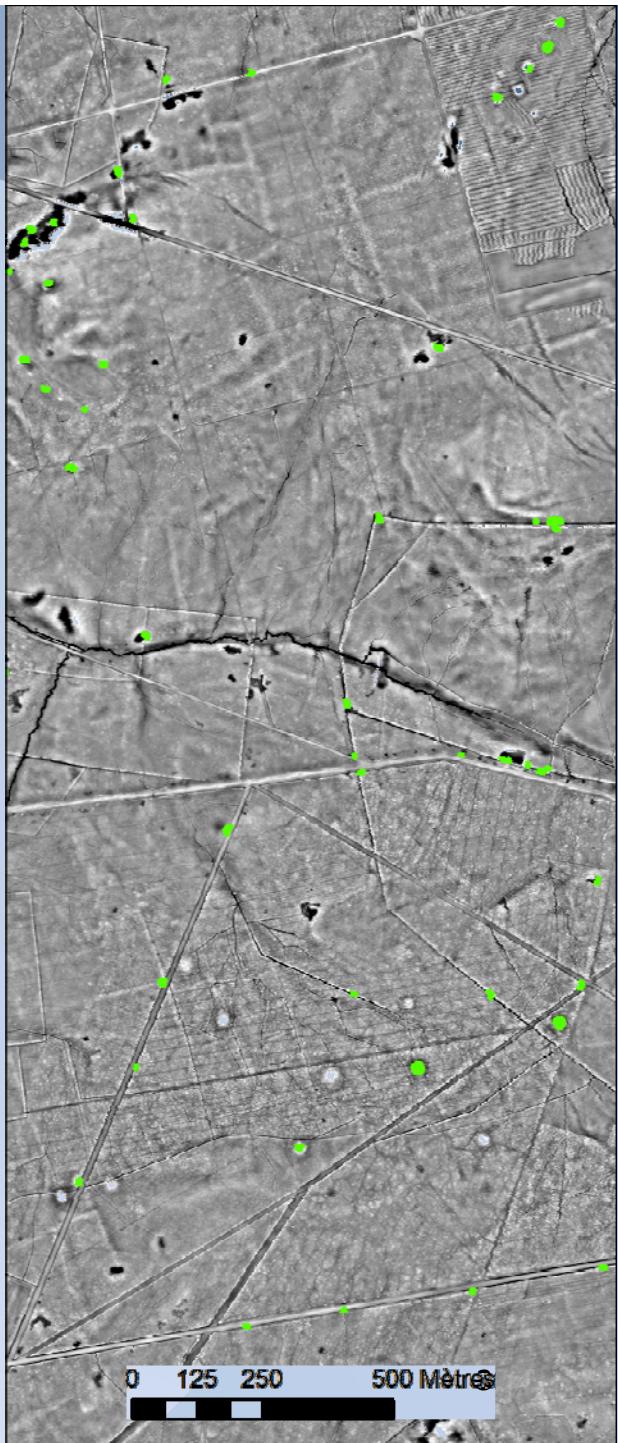
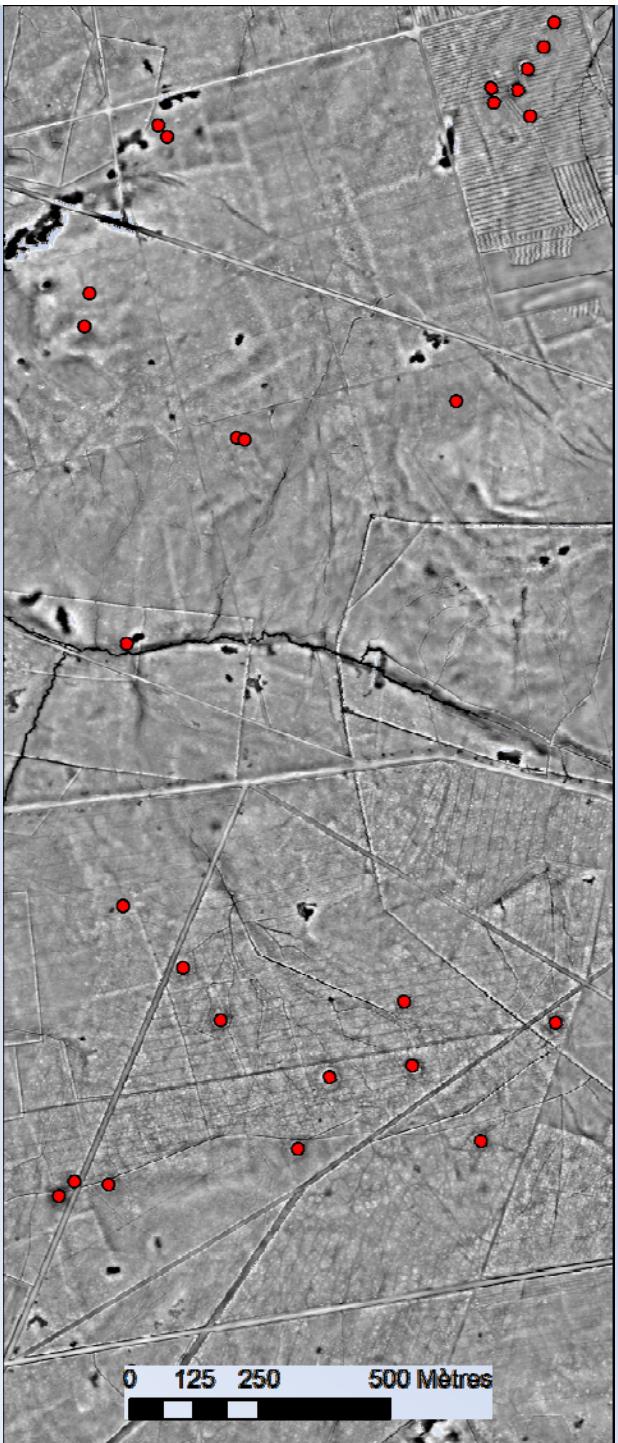
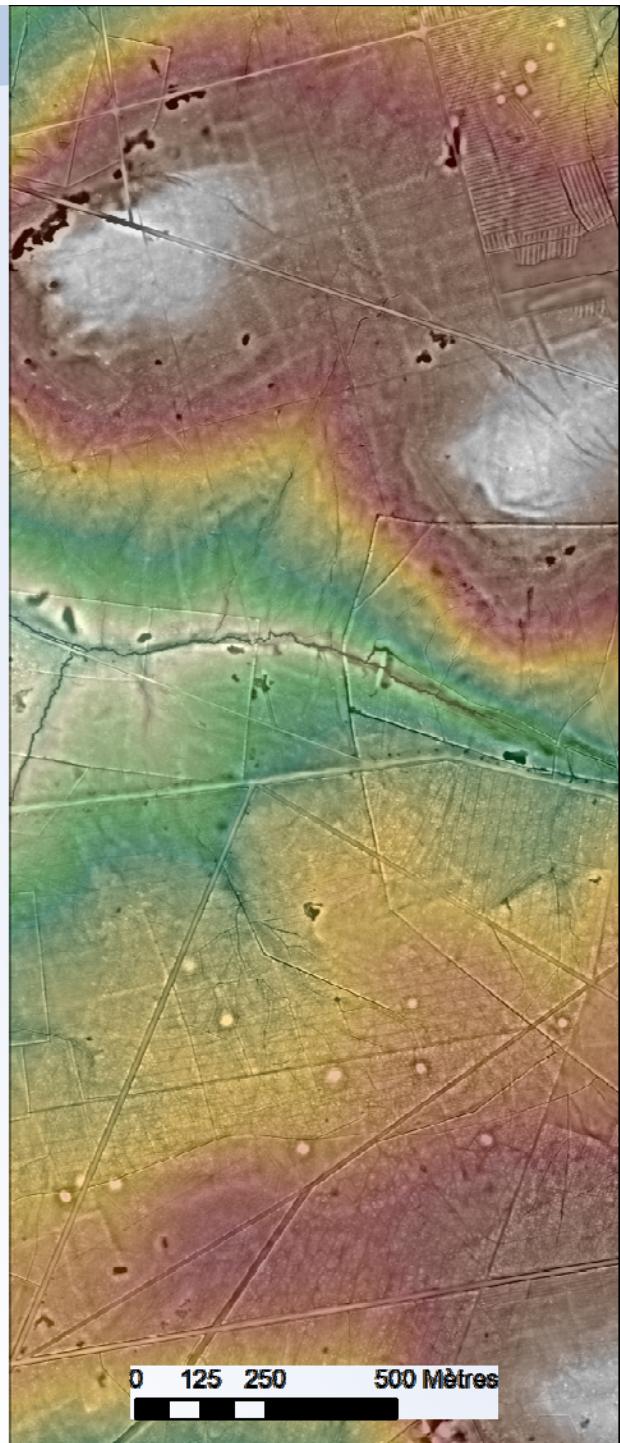
Riley M. " A Tool for Automated Archaeological Feature Extraction from Light Detection and Ranging (LiDAR) Elevation Data, University of Iowa

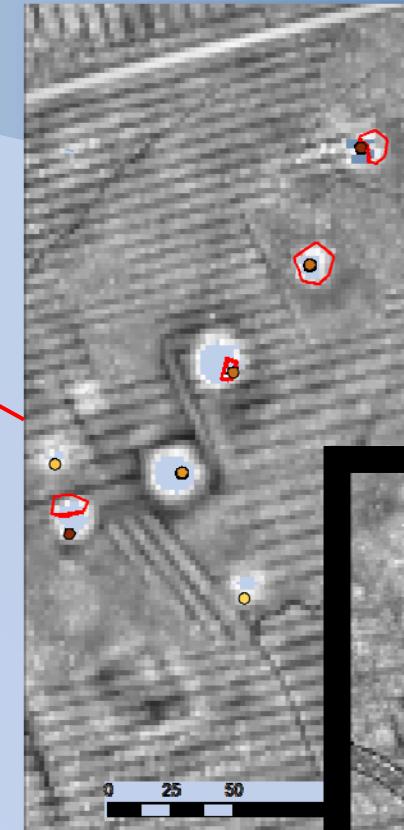
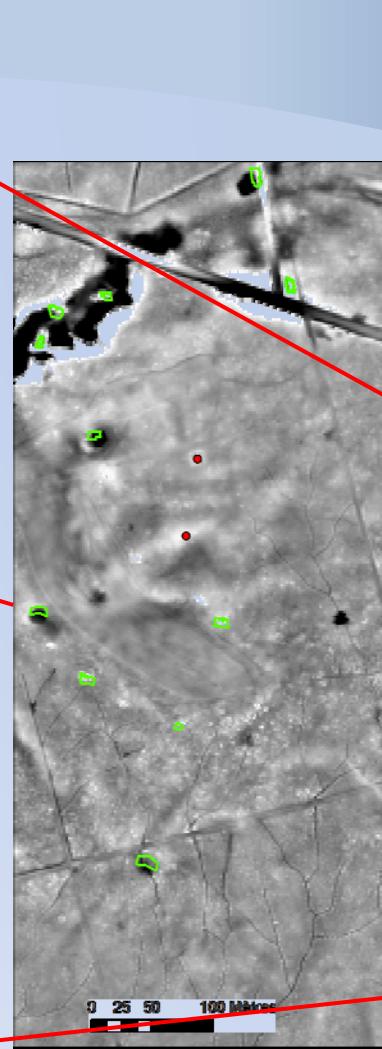
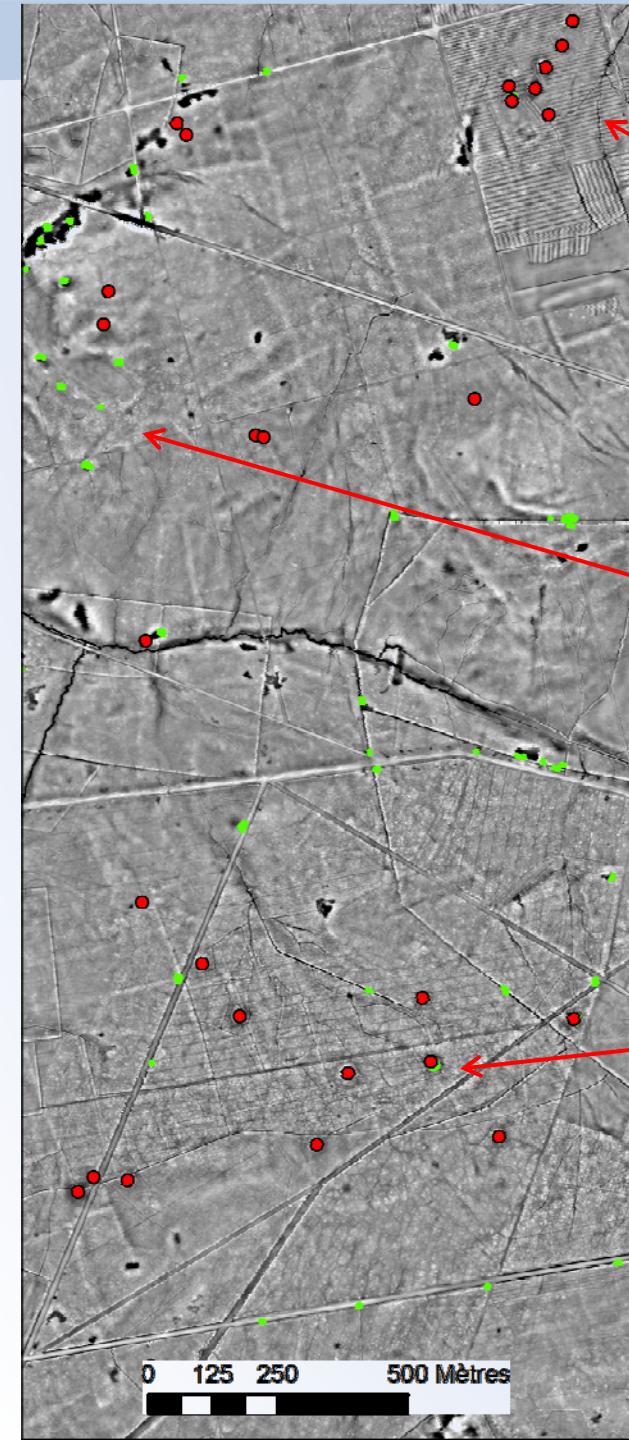
An example : LiDAR Surveyor



Designed for detection of conical
funerar mounds

Analyze the slope power, aspect, and
difference of height

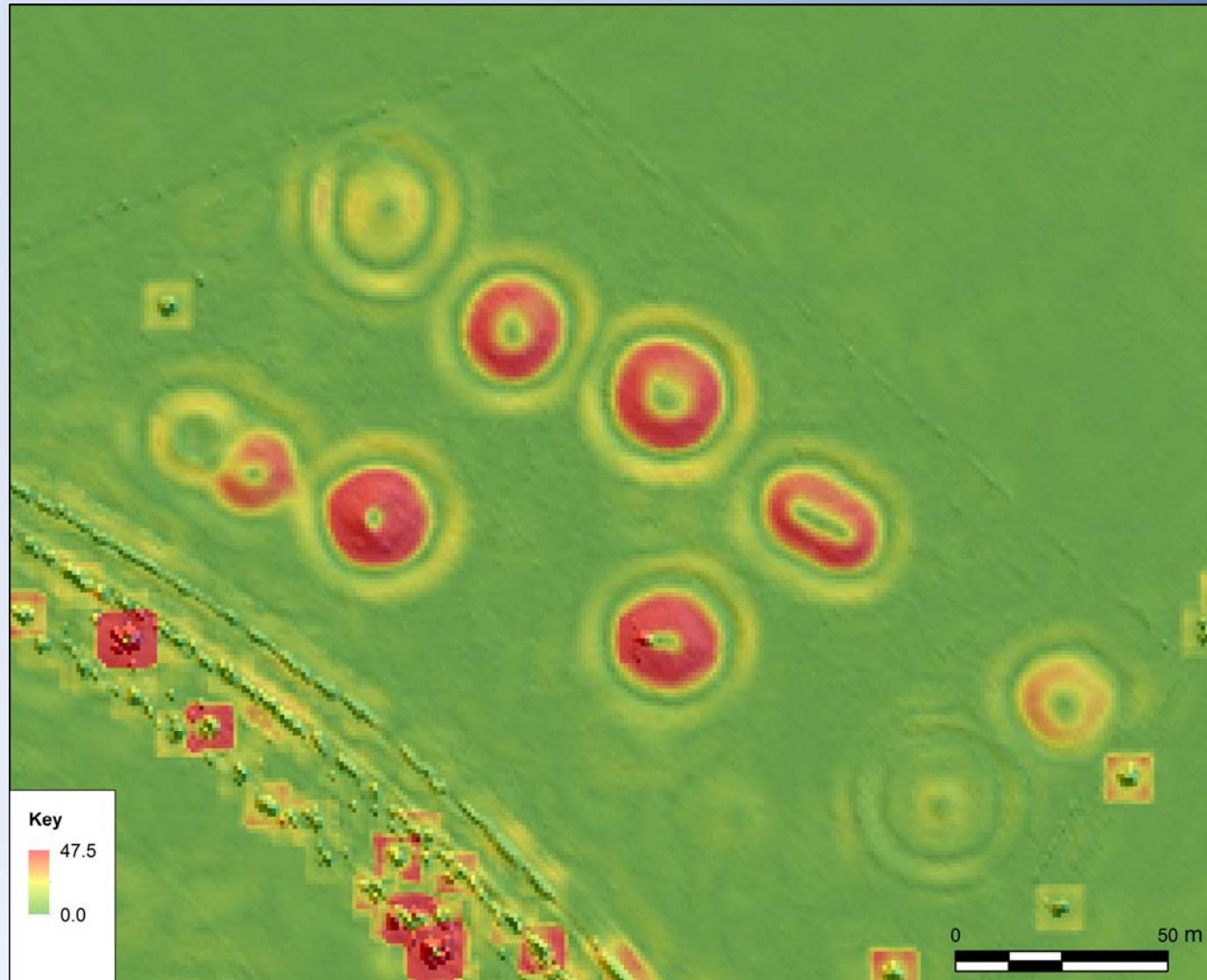




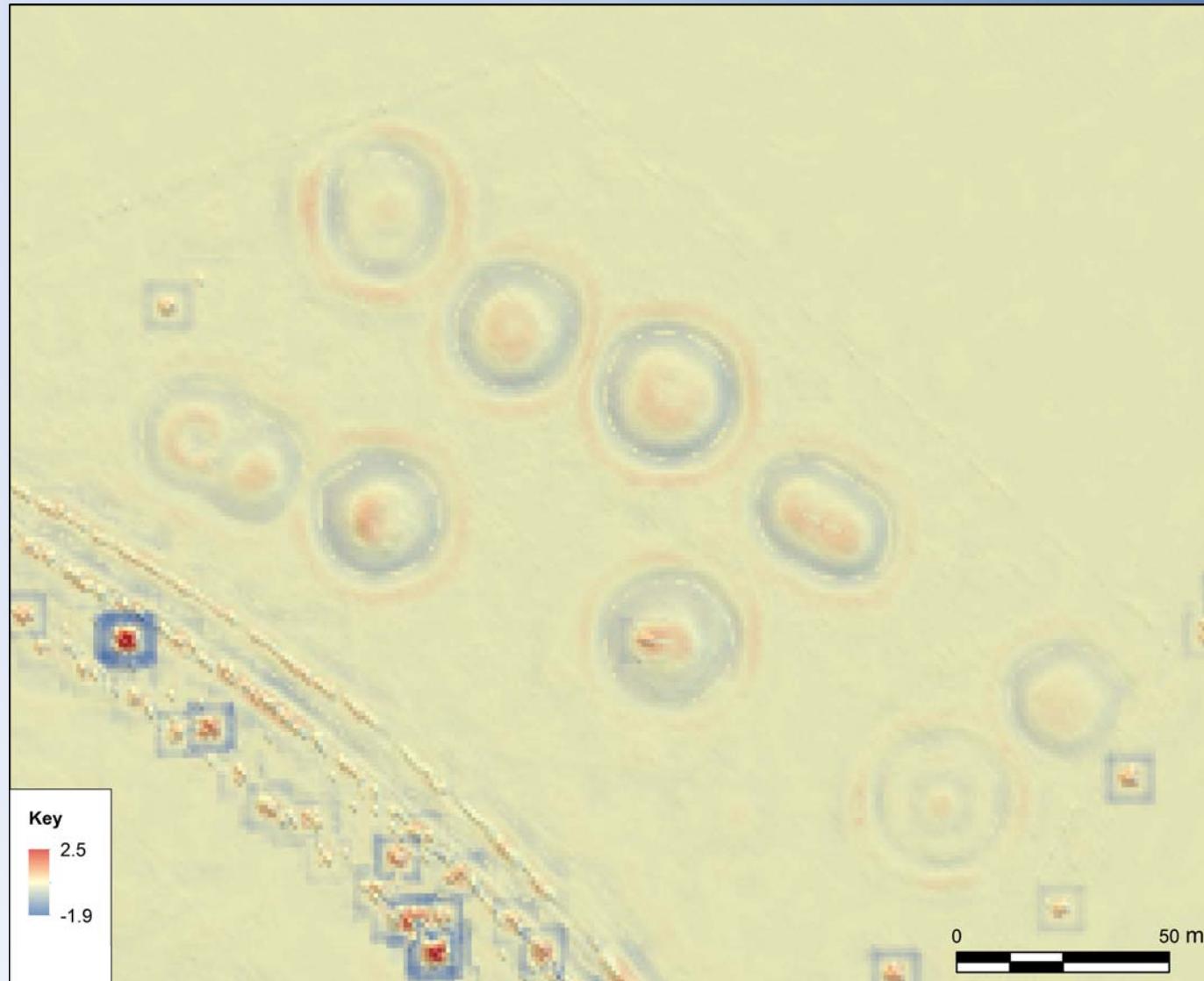
z_1	z_2	z_3
z_4	z_5	z_6
z_7	z_8	z_9

z_1	z_2	z_3
z_4	z_5	z_6
z_7	z_8	z_9

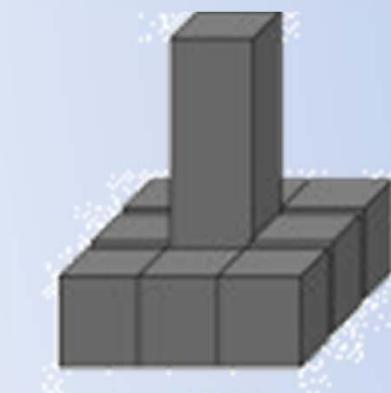
Surface Parameterisation



Slope



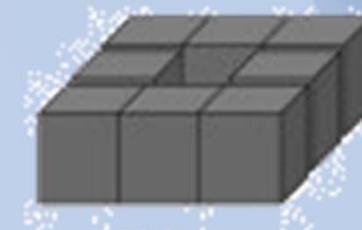
Profile Curvature



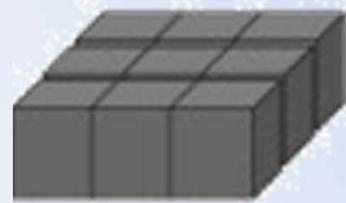
Peak



Pass



Pit



Plain



Ridge

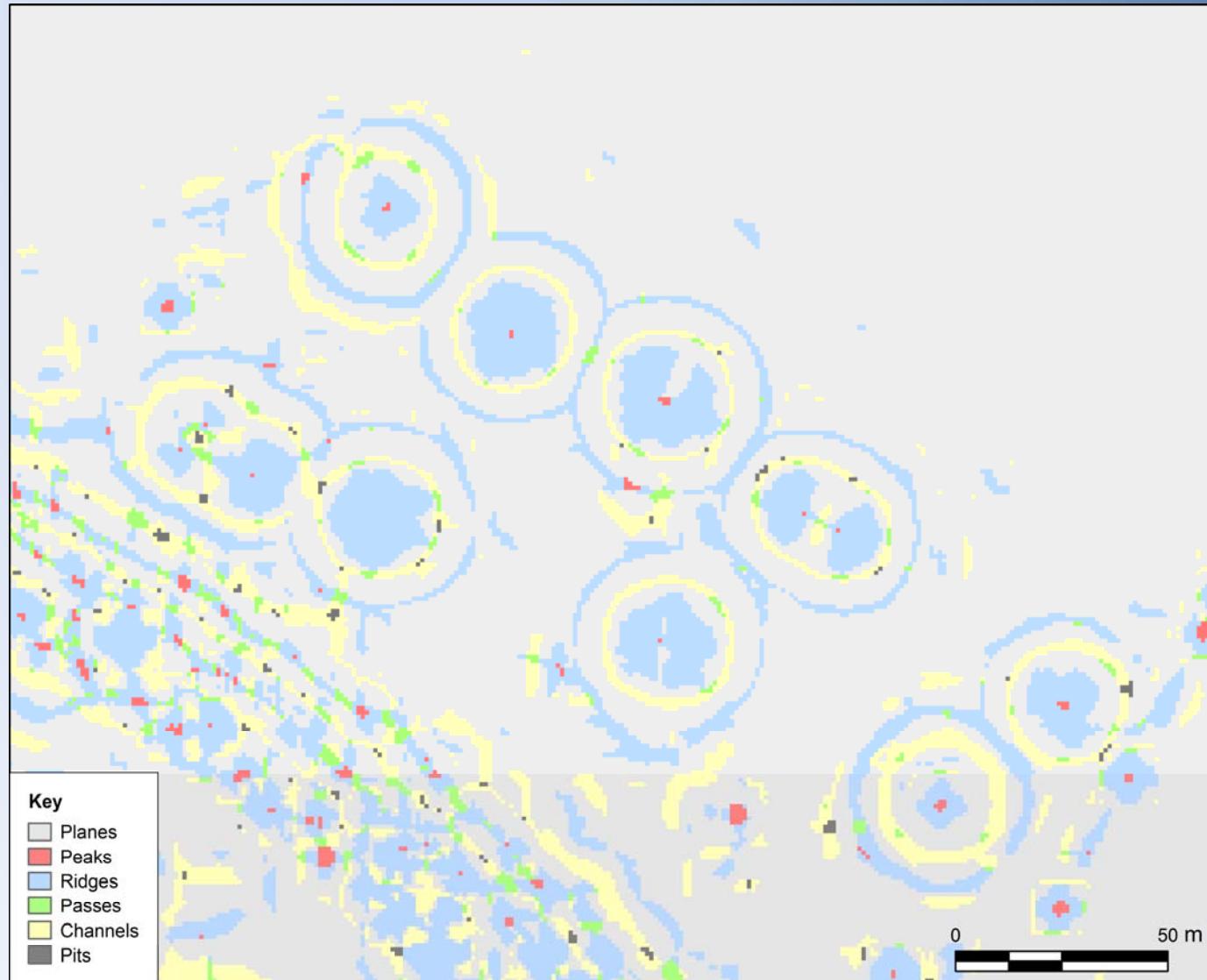


Channel

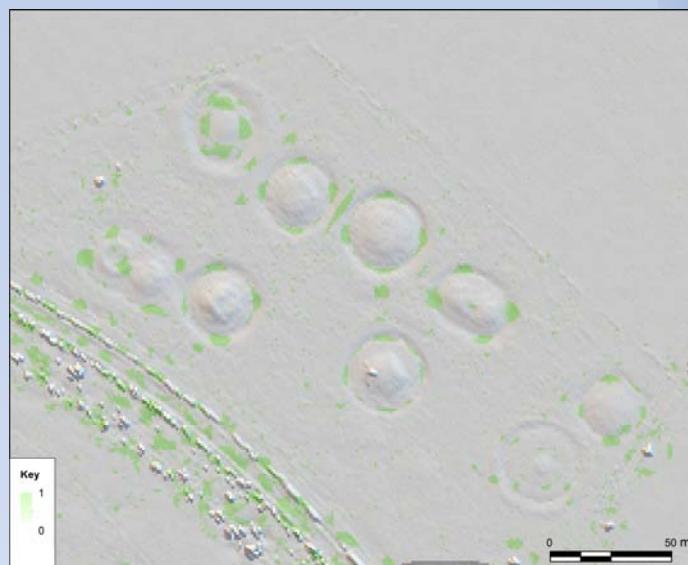
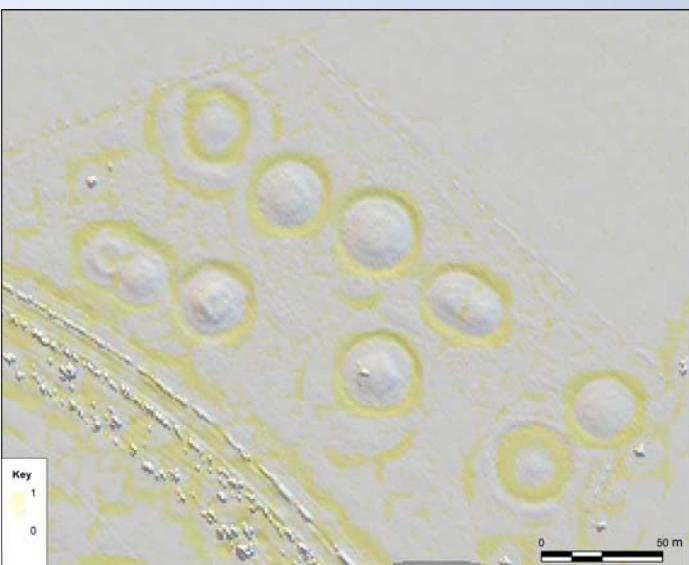
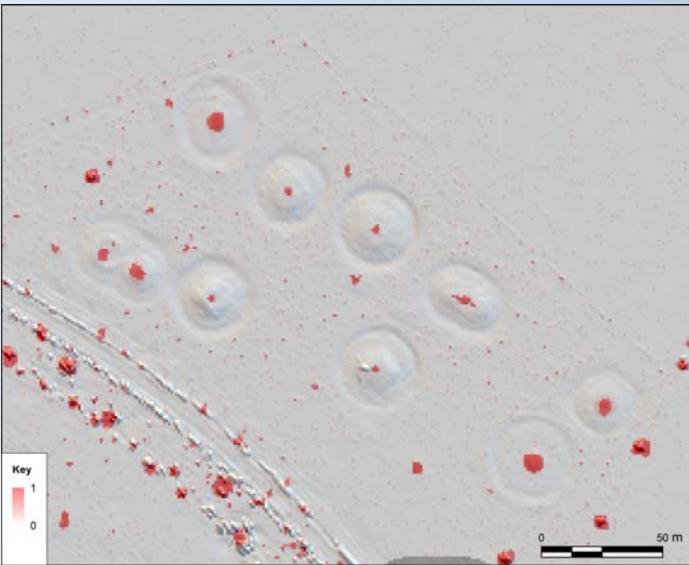
Morphometric Characterisation

Feature	slope	crosc	maxic	minic
Peak	0	-	> 0	> 0
Ridge	0	-	> 0	0
	> 0	> 0	-	-
Pass	0	-	> 0	< 0
Plane	0		0	0
	> 0	0	-	-
Channel	0		0	< 0
	> 0	< 0	-	-
Pit	0	-	< 0	< 0

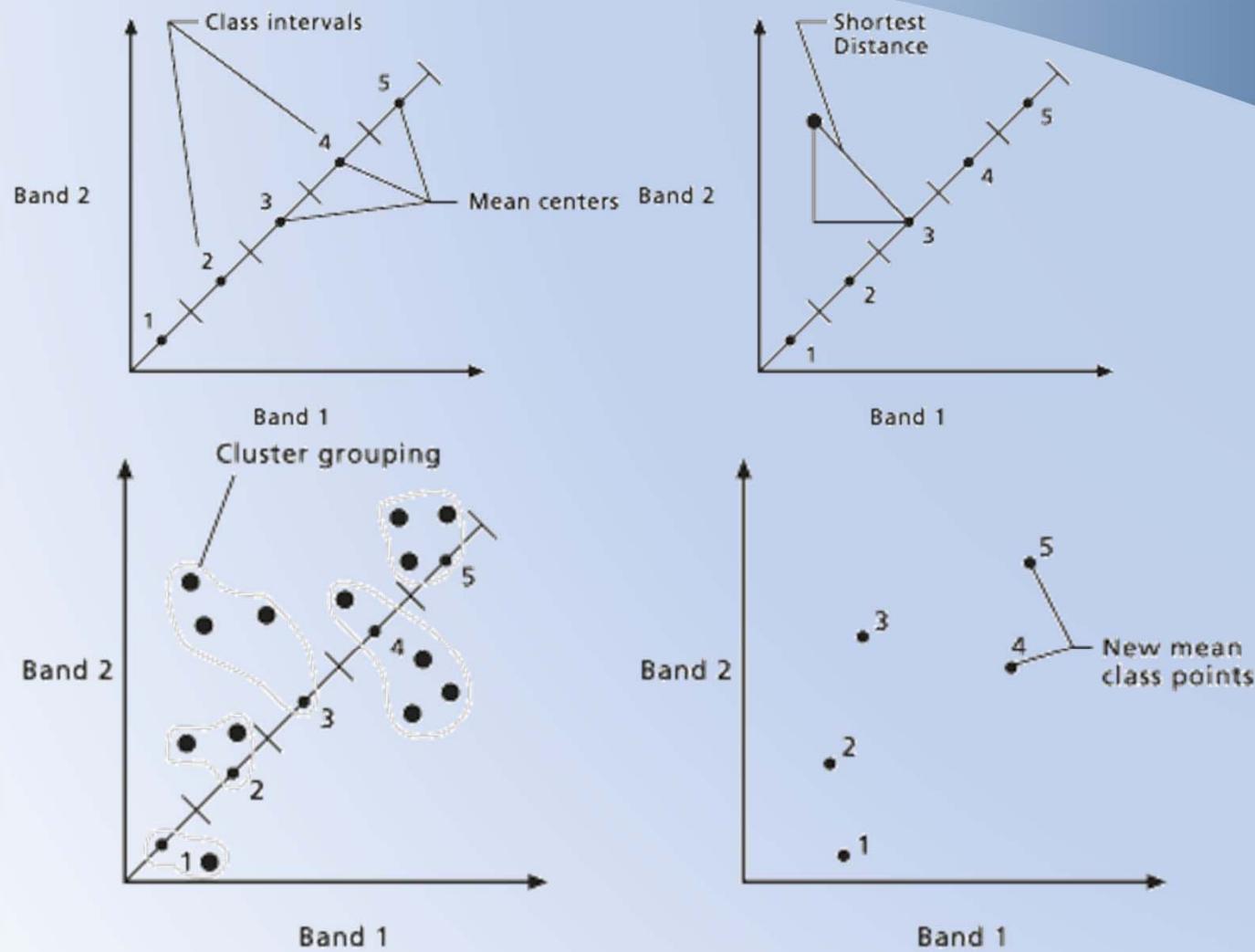
Unique Conditions



Feature Classes



Fuzzy Features



Iterative Self Organising Clustering

Exercise 2

Spatial Analyst > Multivariate
Iso Cluster

Maximum Likelihood Classification
Class Probability

Conversion Tools > From Raster
Raster to Polygon

3D Analyst > 3D Features
Add Z Information

Data Management Tools > Features
Add Geometry Attributes

Riley 2012

Riley M. "A Tool for Automated Archaeological Feature Extraction from Light Detection and Ranging (LiDAR) Elevation Data, University of Iowa

Riley 2009

Riley M. Automated detection of prehistoric burial mounds , phd thesis, Northwest Missouri State University, 124 p.

Hesse 2013

Hesse R. The changing picture of archaeological landscapes: lidar prospection over very large areas as part of a cultural heritage strategy // Opitz R. and owley D. (eds.): Interpreting Archaeological Topography: 3D data, Visualisation and Observation. Oxford. 2013. pp 171–183.

Trier, Pilo 2012

Trier O., Pilo L. Automatic detection of pits in airborne laser scanning data. Archaeological Prospection //Archaeological Prospection № 19 (2). 2012. P. 103–121.

Trier et al. 2015

Trier O., Zortea M., Tonning C. « Automatic detection of mound structures in airborne laser scanning data”, Journal of archaeological science : Reports, 2015 pp. 69-79