ISAP NEWS

The newsletter of the International Society for Archaeological Prospection

Issue 47
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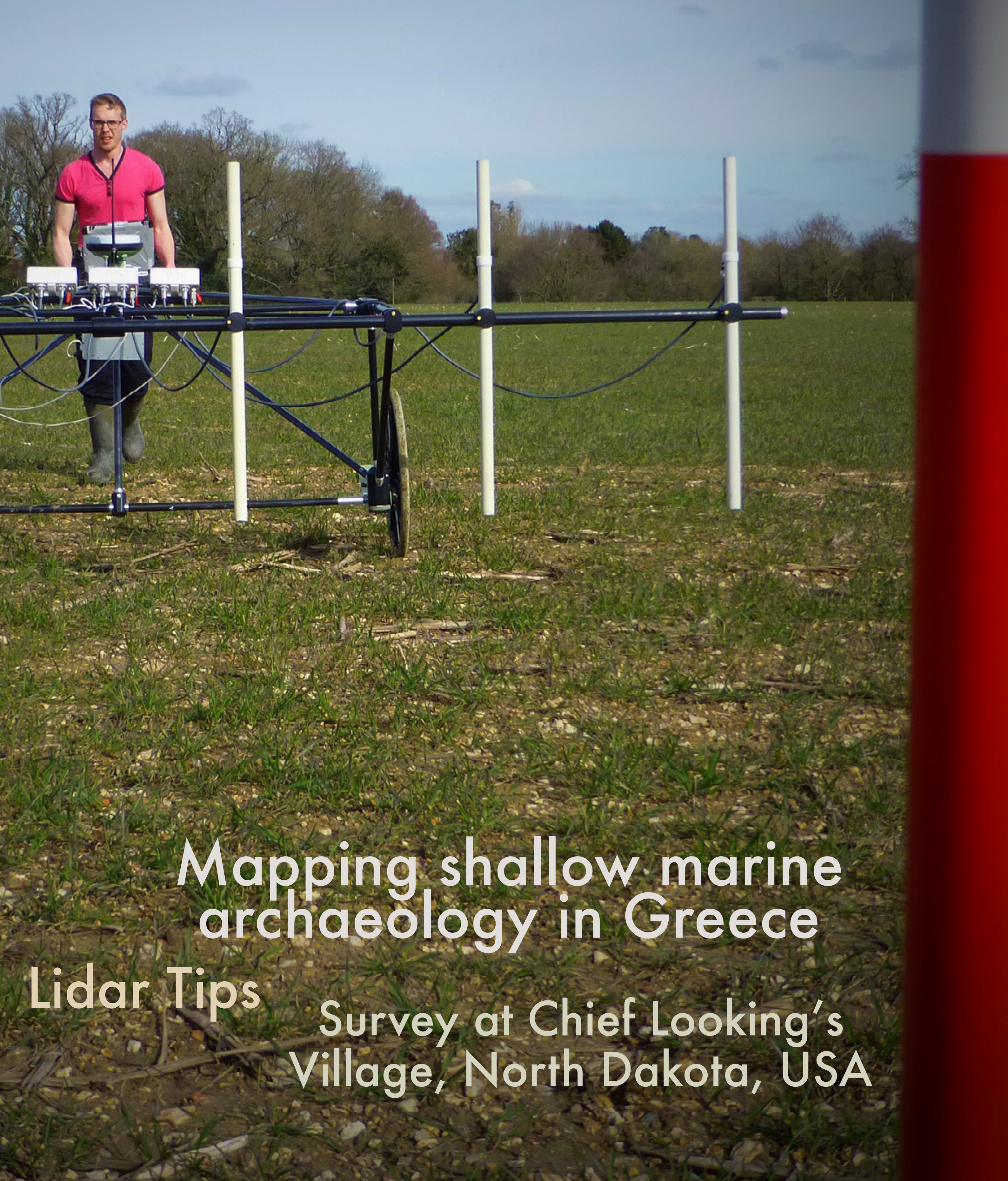

Mapping shallow marine archaeology in Greece

Lidar Tips

Survey at Chief Looking's Village, North Dakota, USA

Welcome to the 47th issue of ISAP News!

Wondering how the ISAP Fund projects are getting on? Well, we have the results of the first one, a survey of the submerged Hellenistic and Byzantine city of Olous using ERT and photogrammetry. We also have the findings of magnetometry and GPR survey at Chief Looking's Village, North Dakota, USA. And some tips and hints that might be useful when it comes to using LiDAR data...

As ever, please send any contributions, notifications, and cover images for the next newsletter (ISAP News 48) to the email address below by the 30th September 2016. All entries are gratefully received!

Hannah Brown & Paul Johnson

editor@archprospection.org

The Cover Photograph shows the Bartington Non-Magnetic Cart surveying over the environs of Silchester Roman town, England. The outer extents of the landscape are now under investigation using geophysics, LiDAR, Aerial Photo analysis, environmental sampling, and excavation to attempt to further understand the Iron Age origins of the Roman town. The Project is led by Prof. Mike Fulford and Dr. Cathie Barnett at the University of Reading. The results of the Silchester Mapping Project (2005-2009), which focussed on the geophysical investigation of the Roman Town itself and immediate hinterland are to be published as a monograph later this year (Creighton & Fry, forthcoming). A new undergraduate course on Archaeological Geophysics will also begin later this year at the University of Reading.

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Mapping the submerged remains of Elounda (Greece) through Geoinformatics
Results of the first ISAP fund

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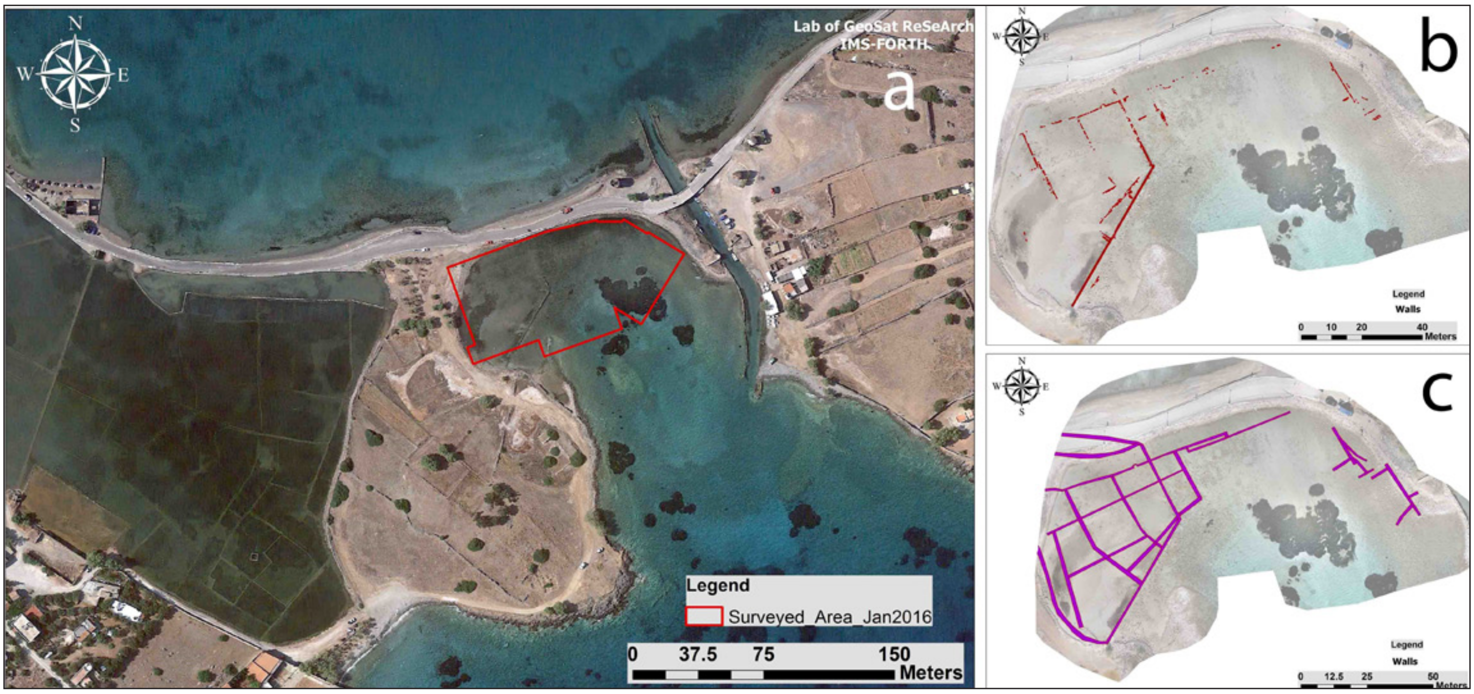
Abstract

The paper aims at presenting the results of the non-invasive investigations undertaken in January 2016 in the framework of the first ISAP Fund awarded to the Authors. The project, titled "Reconstructing the Cultural Dynamics in Shallow Marine Environment through Electrical Resistivity Tomography and Photogrammetry", focused on the use of well-known and commonly used techniques, such as low altitude aerial imagery with Remotely Piloted Aerial Systems (drones) and geophysical imaging techniques like Electrical Resistivity Tomography (ERT), in a context where their application is rare or absent: the shallow marine environment. Indeed, despite the relative frequent employment of these research approaches in the recovery of archaeological relics in the land survey, the specific methods have minimal to non-existent employment for the understanding of the past dynamics in littoral and shallow off-shore environments. The research applied the above survey tools in a comprehensive and integrated way to investigate a part of the archaeological site of Olous, a now submerged Hellenistic to Byzantine aged city, located on the isthmus of Poros on the north-eastern coast of Crete (Greece). The results from this innovative survey will be applicable to archaeological investigations in the littoral zone from similar regions of the world and time periods thus contributing to the best practice of shallow maritime archaeology.

The site

Olous (**Fig. 1a**) was an important centre and a strategic port of the island of Crete (Paus. 9.40.3, Ps. Skylax 47, St. Byz. 326.24, Stadiasmus 360), located on the west side of the gulf of Mirabello (NE coast of Crete, in proximity to the present day town of Elounda). According to the archaeological data the area exhibited continuous occupation from Minoan to Venetian period. The most relevant occupation though refers to the Hellenistic, Roman and Early Byzantine periods. The archaeological evidence suggests that Olous was a flourishing harbour town with a sanctuary, a necropolis and its own coinage since its earlier phases. Moreover, the epigraphic evidence from the area indicates that the Hellenistic Olous had been claimed both from the Ptolemies and the independent state of Rhodes, probably because it represented a strategic entrepôt on the Aegean sea routes. As a result of both the

__Figure 1 (a)__ View of the submerged archaeological site of Olous (Elounda) at the north-eastern part of Crete in Greece. The red polygon outlines the marine area which has been investigated through geoinformatics (aerial imagery with drone, GNSS and Electrical Resistivity Tomography mapping) in the framework of the ISAP fund during January 2016; __(b)__ Visible standing structures (in red) mapped on the photogrammetric orthophoto generated with drone; __(c)__ cumulative outline of wall structures mapped with photogrammetry and examination of historical documents (ancient text, historical maps and archive aerial photographs).



eustatic Sea Level Change and the tectonic depression of the area, most of the remains of the ancient structures that are attributable to the main archaeological occupation of Olous are now either submerged or covered with sand on the sea-floor.

Recently, the Ephorate of Underwater Antiquities in cooperation with IMS (hosting institute in this application) located and mapped part of the currently submerged Hellenistic fortifications of Olous (wall and a probable tower), which seem to indicate also the south limit of the harbour, if we suppose that the latter followed the 'trend' of that period regarding the "limen kleistos" type, namely the walled harbour. Despite the research of the Ephorate and the aforementioned ISAP funded project, we still ignore the dating of the submerged structures. Although previous projects were instrumental for the mapping of man-made features in deep sea, the ISAP fund provided the financial support for a more detailed investigation in the coastal area, laying the foundations for a better dating of identified structures by means of different characterization of artefacts.

Integrated and customized applied methods

Preliminary operations in the bay consisted of the accurate mapping and survey of the site of Olous, via a Real Time Kinematic (RTK) Global Navigation Satellite System (GNSS) with the use of two separate Javad Triumph-1 units (one set up as a base station and the second as rover). The rover moved along the surveyed area to set up the geophysical grids, map the visible submerged walls and relics, outline the coastline and log the bathymetry of the bay with a mean positioning and elevation accuracy over all the 10,000 plus surveyed points of 1.4 cm.

Electrical resistivity tomography (ERT) is a widely applied geophysical method for near surface surveys. Recently, apart from mainland surveys, the method has been extended into the marine environment with promising results. Despite some difficulties concerning the highly conductive seawater layer conditions, it is also used for underwater archaeological prospecting (Passaro, 2010; Papatheodorou et al., 2014). Few field studies can be found in the literature concerning off-shore resistivity archaeological imaging (Simyrdanis et. al., 2015). Furthermore, dynamic data acquisition is suggested when an extended area of interest is needed and there are temporal limitations. The above mentioned specific conditions lead to a floating apparatus construction (named 'Nereid') to carry the ERT equipment on top of the water surface above the relics during the data acquisition (apart from the static data collection which was also implemented for the specific area).

For the aerial photogrammetric documentation of the area under investigation, a Remotely Piloted Aerial System (RPAS, also known as drone) has been used, to assure low flight altitude and therefore higher resolution images.

Figure 2 (a & b) *Custom made apparatus used to carry the resistivity instrumentation for the moving ERT survey mode measurements during January 2016 field campaign;* ***(c & d)*** *custom made remotely controlled sailing device equipped with an underwater photogrammetric camera for mapping the bathymetry, adjusted for the very shallow marine environments.*

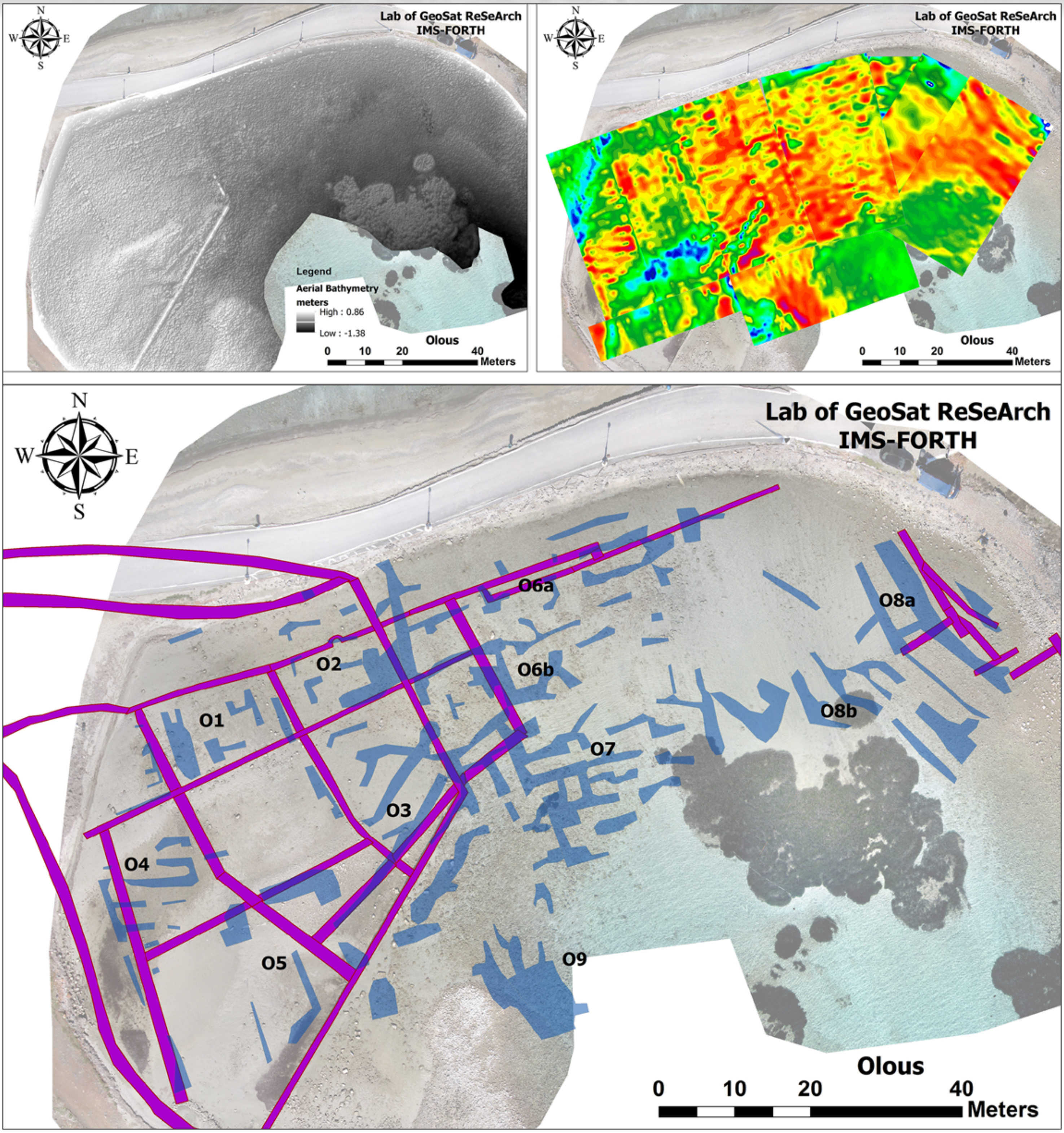


***Figure 3: (a)** Photogrammetric digital model of the investigated area (hill-shade representation of the bathymetry); **(b)** ERT depth slice of 0.0-0.5m below the sea bottom. The color scale ranges from 0.1 to 30 Ohm-m; **(c)** cumulative results of built structures identified in the framework of the project based on photogrammetry and geophysics.*

The specific configuration of the bay makes the planning of aerial survey particularly challenging. Indeed, the optimal solution for such a photographic coverage would have been to make use of polarizing filters on the lens (to minimize water reflections) and plan flights for specific times of the day in consideration of the sun position and the angle between sun-light reflection and aerial camera average position. Unfortunately, the wind regime is such that the ideal time of the day for flights is usually in the afternoon, but the Oxa mountain chains at the West of the bay mask the sun light quite early in the same hours. The overall weather (and sea surface, see Richards 1980) conditions allowed only two flights over the area in two different periods, one of which resulted in good dataset, while the other could not be completed for increasing wind gusts (inducing blurriness in images and water ripple light-reflection). For the georeferencing of the photogrammetric dataset, 29 ground control targets have been measured in randomly distributed locations over the area outside the water body and in the sea. The camera was also equipped with built-in GPS, although its precision was not enough for accurate georeferencing and it was only used for archiving purposes (Cantoro 2015). Given the possibility that targets measured under the water could have been mispositioned in the aerial views (read "water refraction"), priority has been given to targets in the perimeter of the water basin for the purpose of georeferencing, using the in-water targets as checking points.

Mostly during winter time, because of the North wind, the low tide or the very smoothly degrading seafloor (or a concurrence of these factors), the bay is subject to a particular phenomenon of water regression that exposes the sea-floor and part of the man-made structures in open air for some days. As a side effect, this facilitated a quick inspection of usually-submerged structures and allowed the comparative examination of their visibility through and outside the water.

Although the results from the aerial module were satisfactory and did provide an accurate bathymetry model for the investigated area, a parallel approach was experimented with for the bathymetry reconstruction by means of a remotely controlled sailing device. Dasyatis, named after a common stingray which lives along European coasts in direct contact with the seabed, was equipped with an underwater camera and constructed with the use of disposable low cost materials, to facilitate its applicability in similar contexts in the Mediterranean. The configurations and settings of the Dasyatis allowed for very long sailing times: the two available battery sets were sufficient to navigate for a few hours collecting up to four videos of about 30 minutes each. The choice of recording videos was suggested by the variable sea-floor depth and velocity of the device, and the need for overlapping optima (hardly achievable with time-lapse photography). Frames (around 35,000) were then extracted for photogrammetric processing.

Conclusions

The possibility to apply well-known methods to un- (or under-) explored archaeological shallow-water contexts was very important from the methodological point of view and for the obtained results. Indeed, although the adaptation of commonly used tools to depths below 2 meters presented some challenges and required the creation or customization of equipment, the final results support such efforts and provide useful information for the understanding of the complex and pluri-stratified archaeological context of Olous. As often happens, the answers to certain archaeological topics open new questions that will probably lead to new investigation in deeper water south of the investigated area.

A not inconsiderable result, the presentation of preliminary outputs to the local community (undertaken in Elounda on March 10th, 2016) started to increase the awareness and sense of cultural identities that will eventually lead to dedicated politics and better respect and protection of the area. Ideally, the publication of results will generate new attention (and a indirect influx) in a popular touristic place.

Acknowledgements

The fieldwork activities of the project were funded by the International Society for Archaeological Prospection though the ISAP Fund Grant "Reconstruction of the Cultural Dynamics in Shallow Marine Environment through Electrical Resistivity Tomography and Photogrammetry in the Coastal Archaeological Site of Olous, Crete, Greece". The data processing and interpretation was materialized under the basic research program of the Foundation for Research and Technology-Institute for Mediterranean Studies. The authors are grateful to Dr. Theotokis Theodoulou for assisting in the data interpretation and the Ephorate of Underwater Antiquities in Greece for giving the appropriate permissions to access the site of Olous and publish the results.

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Geophysical findings at Chief Looking's Village, North Dakota, USA

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Chief Looking's Village (CLV) is a fortified village on a high bluff overlooking the Missouri River, in central North Dakota. Dating to the mid-sixteenth century, it is an ancestral village of the Mandan, one of the prominent farming tribes of the Northern Great Plains. The site is archaeologically significant because preservation is very good and it was occupied during an important period of transition. The site contains the traditional long rectangular houses characteristic of earlier eras as well as rounded square to circular four-post lodges, commonly referred to as earthlodges, which ultimately came to dominate the region (**Fig. 1**). The transition from rectangular to four-post forms probably reflects new ideas from interaction and a possible in-flux of peoples from further south.

Geophysical investigations have been carried out at Chief Looking's Village (CLV) by the Archeo-Imaging Lab since 1997. Mark Mitchell of the PaleoCultural Research Group of Arvada, Colorado, with support from the State Historical Society of North Dakota, promoted site-wide geophysical investigations over the past several years to guide excavations for material evidence of the cultural transition.

The geophysical results at CLV are significant and unusual for several reasons. At numerous village sites in the Northern Plains

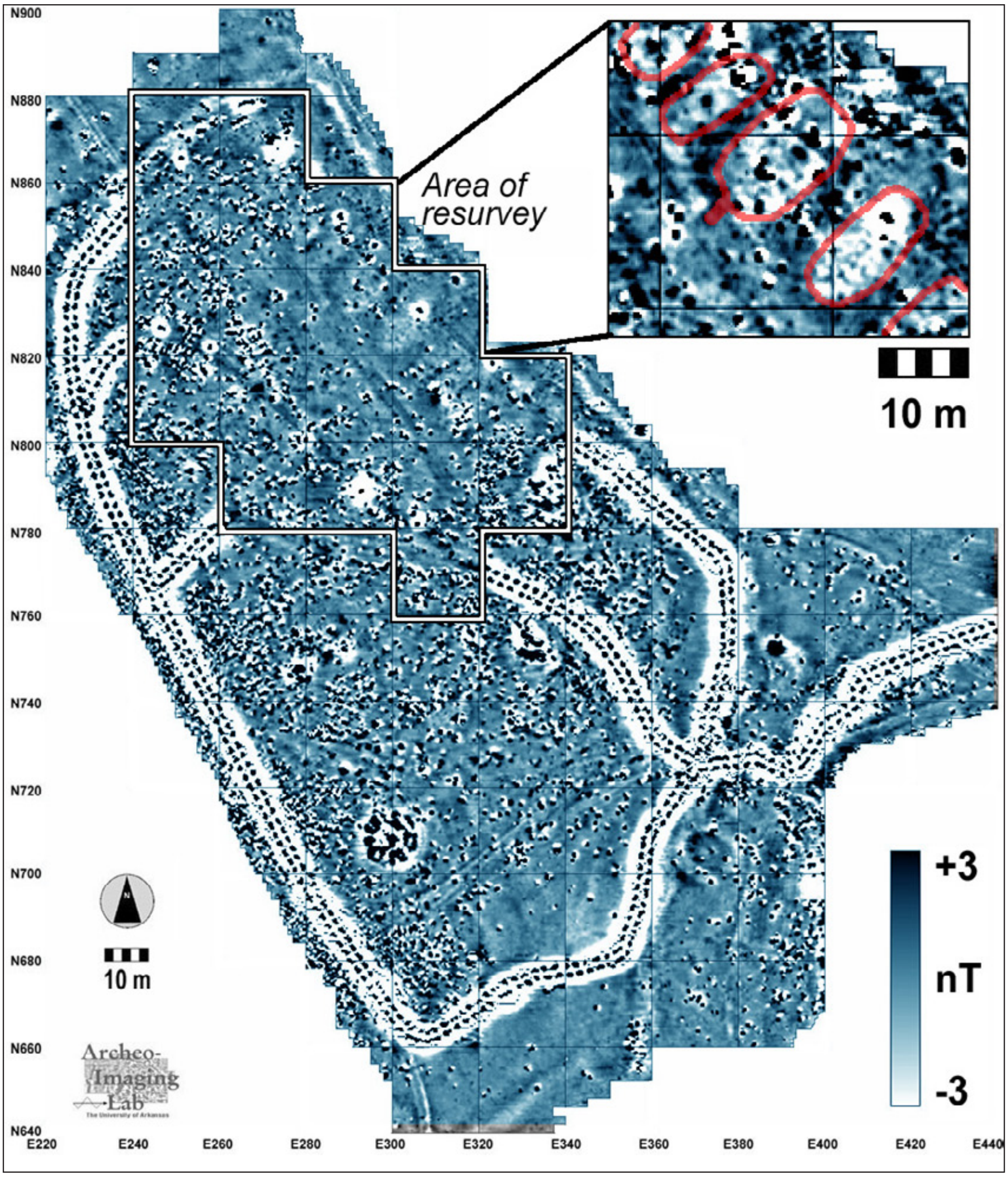

Figure 1 (top right) A reconstruction of an earthlodge, built of a wooden and brush frame supported by four large posts and overlain with a quarter-meter of soil.

Figure 2 (right) Magnetic gradiometry results at CLV obtained with a Bartington 601 dual fluxgate gradiometer. The outlined central resurvey area is after removal of rebar. The inset shows rectangular house outlines with anomalies representing hearths and storage pits.

magnetometry is typically all that is required to reveal principal features of archaeological interest (see Kvamme 2003, 2007). CLV is located within a city park of Bismarck, however, and decades of use have resulted in thousands of discarded steel artifacts (mostly steel beverage cans and bottle tops). Moreover, walkways through the park were lined with wooden rails anchored with steel rebar. The resultant dipolar anomalies almost entirely obscure more subtle ones arising from the prehistoric occupation (**Fig. 2**). Fortunately, the city recently modernized the walkways and removed the rebar. Resurvey of part of the village core produced a much cleaner magnetic data set (central outlined region, **Fig. 2**) that enabled identification of anomalies associated with prehistoric features in a portion of the village core, including hearths, storage pits, and house outlines (**Fig. 2**, inset).

To learn more about content and structure throughout the village required reliance on other geophysical methods. An electrical resistance survey revealed the distribution of houses and house shapes (**Fig. 3**). Smaller archaeological features such as storage pits and hearths were not revealed, however. Focus therefore turned to GPR, but with some reluctance. Nearly two decades of GPR explorations in Northern Plains villages did not recommend it because of the extensive rodent damage that commonly occurs in these sites in the native prairie. The plethora of anomalies caused by their numerous burrows and dens generally make recognition of archaeological patterns and targets difficult to impossible (however, see Kvamme 2003). CLV's location in a manicured city park therefore proved advantageous. Rodent damage is comparatively absent and has been so for decades, permitting some of the cleanest GPR data sets seen in Northern Plains villages (**Fig. 4** - overleaf).

The clarity of GPR results was also due to an unusual circumstance of climate. The Northern Plains are normally dry with an average annual rainfall in Bismarck of only 43 cm. Yet, in the six weeks prior to fieldwork in mid-June of 2015, Bismarck received an unusual 28.5 cm of rainfall compared to a reported average of about 10.2 cm for the same period. Although rainfall and high soil moisture is often viewed as detrimental to GPR because signal is attenuated leading to decreased penetration, the wet conditions led to markedly improved results. Surrounding each house is a raised berm

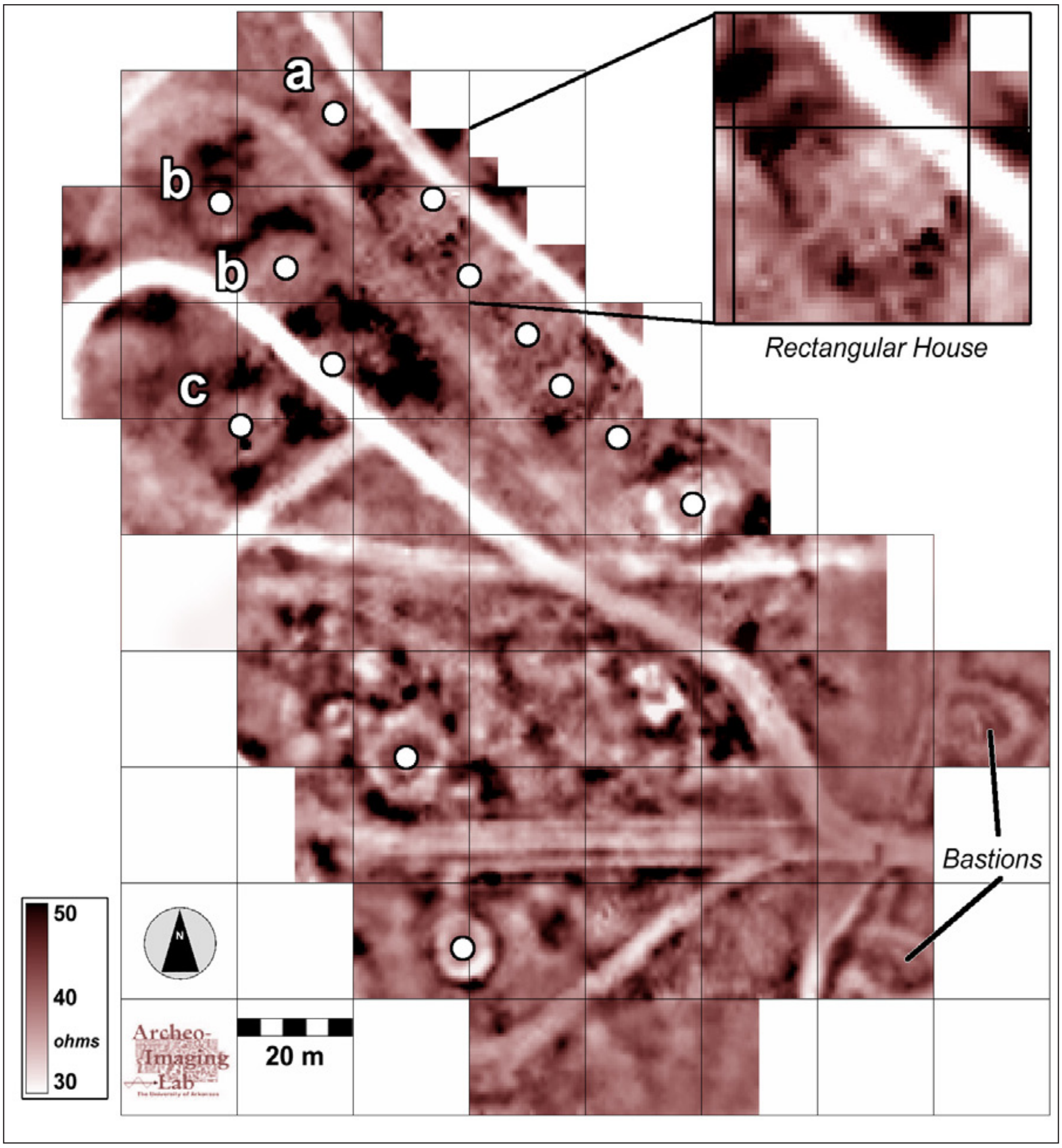

Figure 3
Results of the electrical resistance survey made with a Geoscan Research RM15 using four twin probe arrays in parallel, with 50 cm electrode spacing. Identified houses shown with white circles; letters refer to houses in Figure 4. Trails and former trails of the city park are well indicated.

of sediments eroded from roofs and sides that act much like a mulch in periods of great moisture, increasing GPR reflectivity. The result is a larger contrast between house floors and perimeters, giving excellent definition to house forms particularly in higher depth-slices that enabled the definition of square-to-circular four-post houses as well as rectangular forms (**Fig. 4**). Of particular significance was the determination that several superimposed houses were present in the village, with circular atop rectangular forms (e.g., **Fig. 4c**). Nineteenth century ethnography suggests family "ownership" of parcels with in a village, and this super-positioning may point to a transition of house forms within the same family plots.

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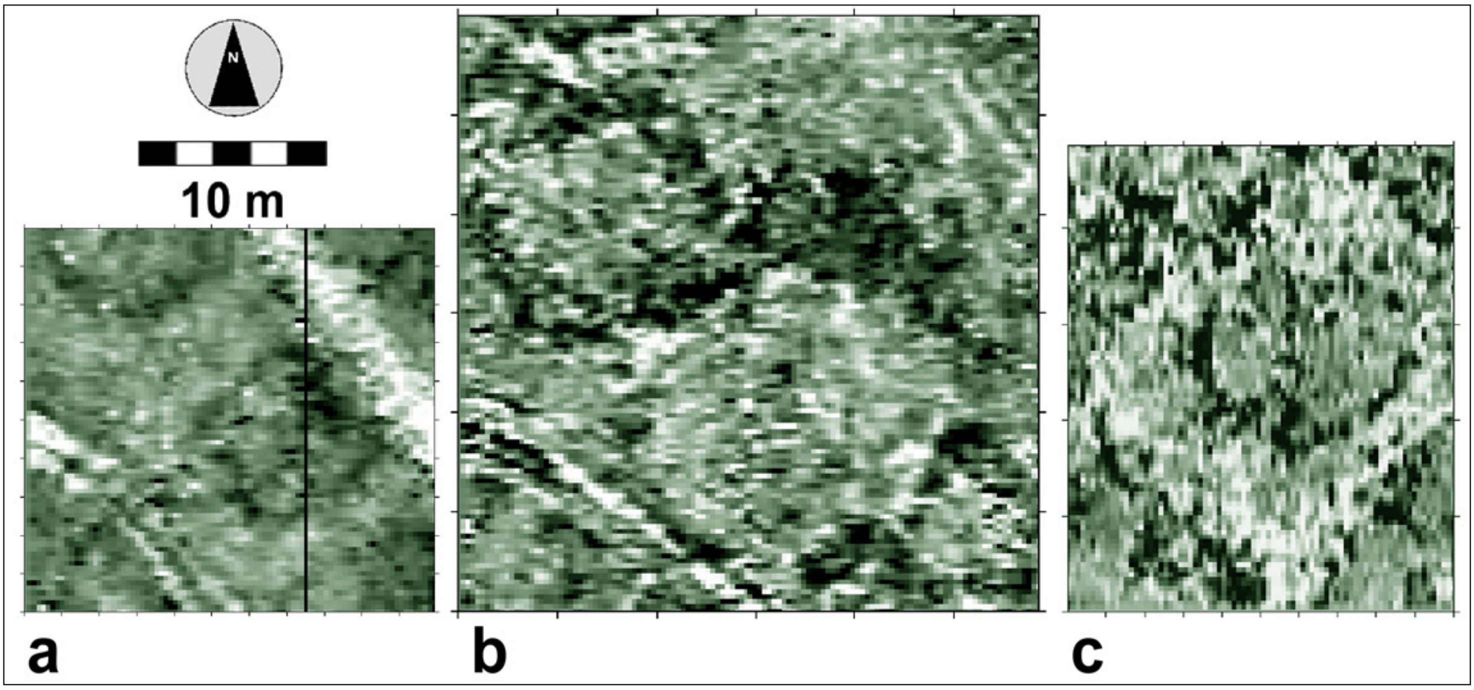
Figure 4 *GPR depth slices 20-50 cm below surface obtained with a Geophysical Survey Systems Inc. SIR-2000 and 400 MHz antenna: a) rectangular house, b) two circular houses, lower one with prominent entryway, c) circular house centered over rectangular house.*



Hillshades and high drama

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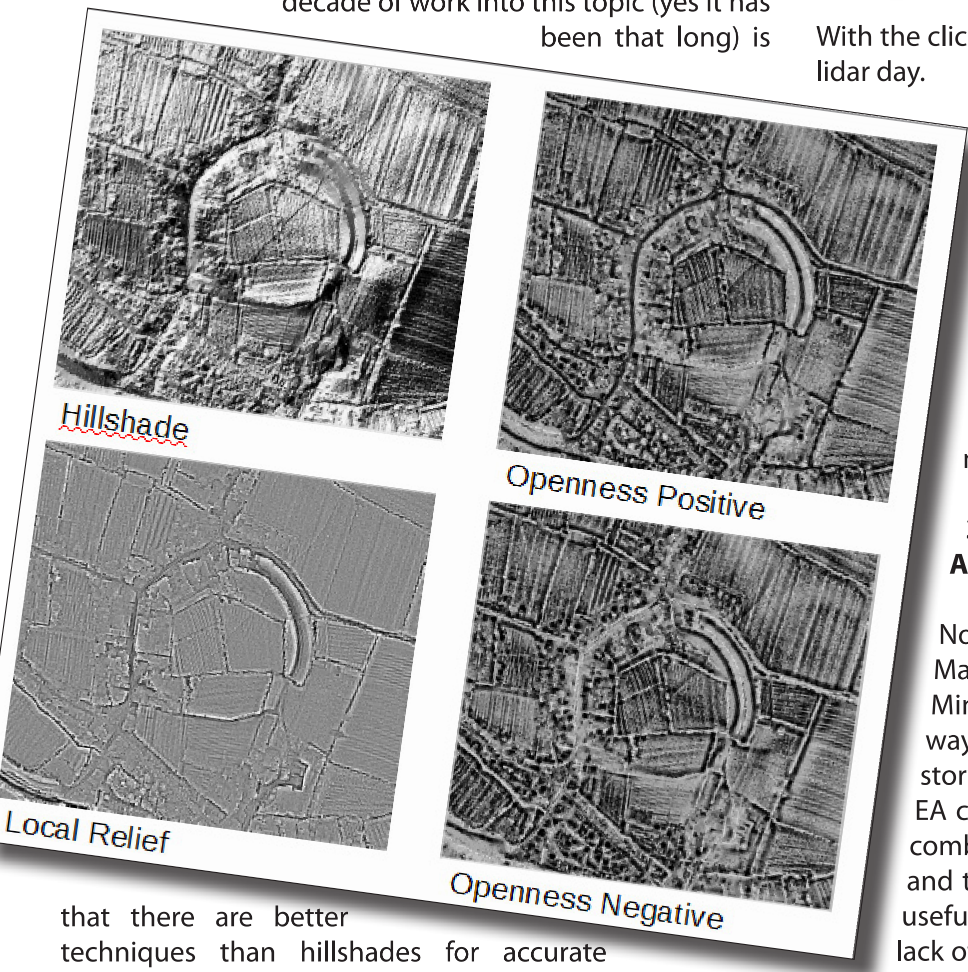
Firstly a confession - I am on a mission, a mission to curb the terrible misuse and abuse of lidar data. It's not a terribly exciting one but it keeps me busy and so to follow on from Roger and Armin's introductory piece on lidar in ISAP News 46 I'd like to share with you my three top tips for getting more out of your data, especially if it comes from the Environment Agency (EA).

1) Everytime you make a single direction hillshade a kitten dies

I know they are everyone's favourite, quick to make, easy on the eye and exactly how you and everyone else expects lidar survey to look. But when it comes to identifying microtopography they have so many problems that I'll run out of words here if I explain them all in detail. We can talk about feature mis-location, mis-representation, inverted topography, shadows, infinite duplication of effort and pointless profiles some other time (or you can check out the references below), but trust me the sum of the last decade of work into this topic (yes it has been that long) is that there are better techniques than hillshades for accurate visualisation and detailed mapping of microtopographic features.



Fortunately people far cleverer than I have published devious ways to get more out of your model without ever making another hillshade. Each visualisation has in common an unappealing name, such as sky-view factor, openness or local relief, and a complex mathematical formula but by Gods do they work wonders on your microtopography. And you don't just have to take my word for it (see refs again), though I have included some darling shots to whet your appetite (**fig. 1, below left**).

Best of all making these visualisations is a doddle thanks to the incredible folks at the Institute of Anthropological and Spatial Studies, ZRCSAZU Slovenia. You can download their stand-alone processing genie, the Relief Visualisation Toolbox, along with a detailed manual and even a powerpoint presentation about the visualisation techniques from this link:

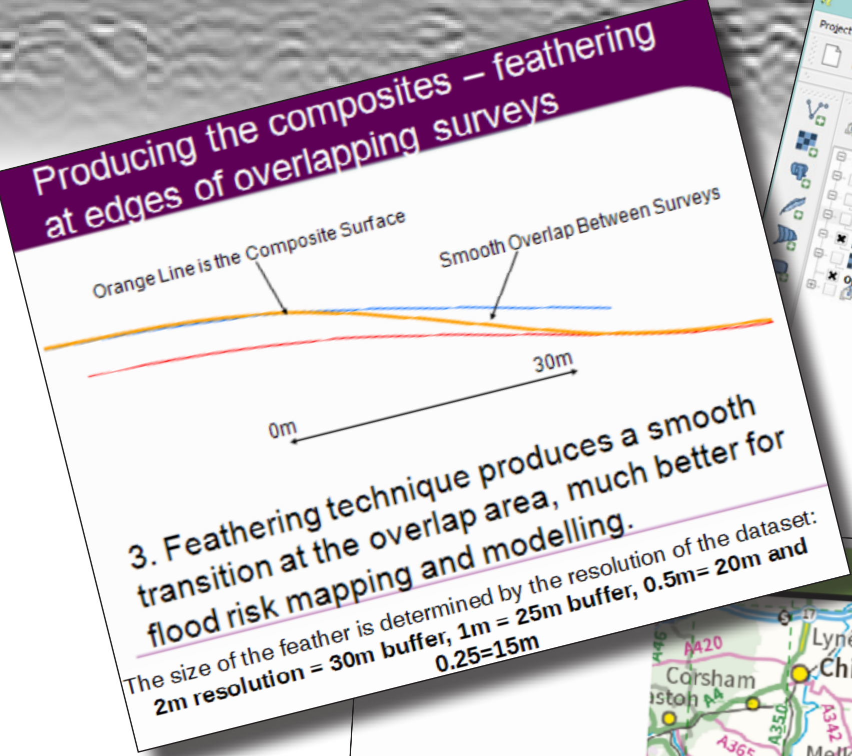
RVT
http://iaps.zrc-sazu.si/en/rvt#v

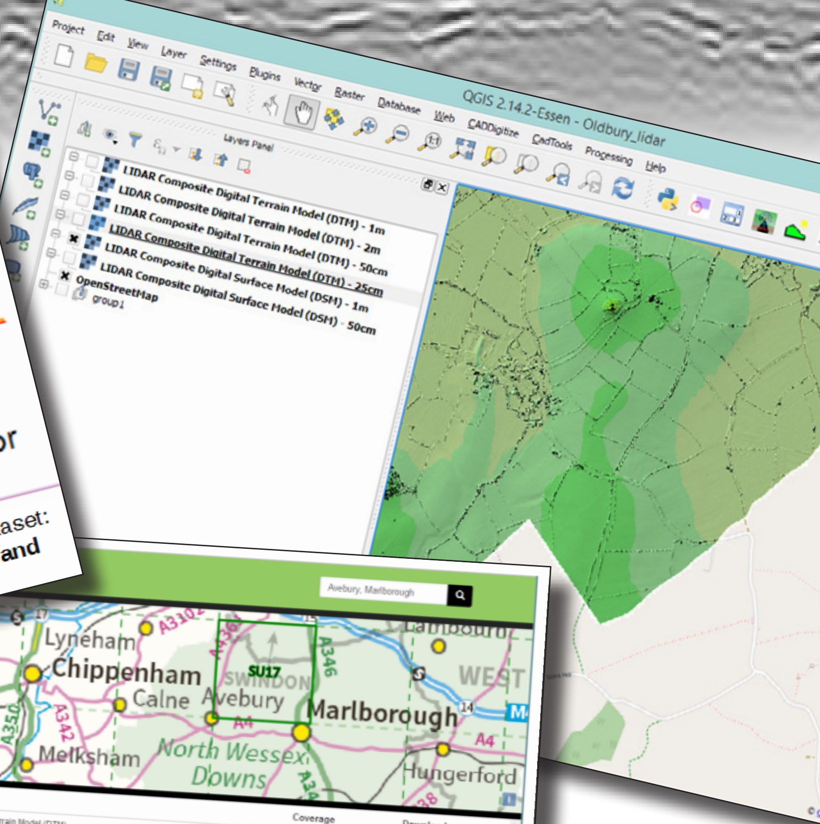
With the click of a button you'll be on your way to a better lidar day.

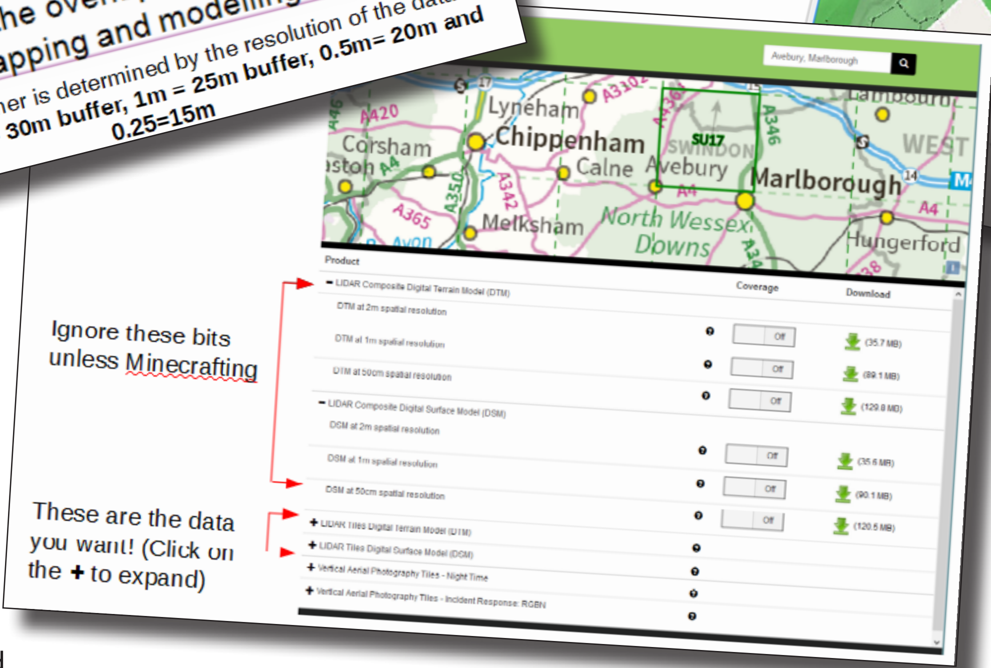
One final and important word of caution: as ever with data processing, an **understanding of the processing** you are doing, along with its **advantages and disadvantages** is a must, otherwise we are just making a selection of pretty pictures! (By the way the title of this section isn't true but if it makes you stop and think twice about your options for visualising lidar then that's OK by me.)

2) Not all the data from the Environment Agency are the same

No doubt you all saw the headlines 'England Makes 3D Data of the Entire Country Free After Minecrafters Ask For It' (entirely untrue by the way but why let that get in the way of a good story?). The data they are referring to here is the EA composite coverage, a neat little product that combines data from multiple surveys into a surface and terrain model for each resolution model. Very useful for minecraft and 3D visualisation but due to lack of date / resolution information and the way in which they must 'blend ' the data from surveys of different dates to account for intersurvey error, this layer is not suitable for prospection of microtopography. I've stolen a diagram from EA's metadata file to demonstrate (**fig. 2 overleaf, top left**).







Don't panic, the single dated surveys that you need are still available but you need to **scroll down** in the downloader to view them as the composite layers are shown first (**fig. 3 above**).

3) Downloading Drama

The EA downloader is rubbish so if you want to try before you 'buy' (or at least spend a while faffing around) why not link in to the highly-underpublicised WMS service in your GIS? You'll need to search for 'lidar' here:

http://environment.data.gov.uk/ds/catalogue/index.jsp#/catalogue

to get the links, then you can check out the coverage of each resolution for your site of interest. Easy like a Sunday morning. (**fig. 4, top right**)

4) Where did the Welsh data go?

I know I said three tips but if you are wondering where the Environment Agency for England and Wales' data for Wales went take a look here:

http://lle.gov.wales/Catalogue/Item/LidarCompositeDataset/?lang=en

5) Got stuck? Ask!

(Sorry I just couldn't help myself – this will be the last point I promise!) As lidar is definitely not a new idea, we have some whizz kids around in the heritage sector who can and will help you if you get stuck or don't understand. Don't feel like you are alone with your model mayhem!

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Summer school

Advanced archaeological prospection, documentation and interpretation for cultural heritage management

Large-scale applications of non-destructive archaeological prospection and digital documentation methods harbour a great potential for time- and cost-efficient, reliable identification, documentation and interpretation of buried cultural heritage, providing the most appropriate solution in order to supply archaeologists and planning authorities with the necessary spatial information for the protection and possible investigation of threatened cultural heritage at the appropriate scales: the archaeological site as well as the surrounding archaeological landscape.

The multidisciplinary summer school 2016 addresses the demands to educate and familiarize students of related fields in universally applicable non-invasive methods and techniques for the detection, documentation and interpretation of the archaeological heritage of complete landscapes. Special focus will be placed on the archaeological interpretation of remote sensing and near-surface geophysical prospection data and the potential of the generated results to facilitate and guide modern cultural heritage management, as well as implications for rescue and exploration archaeology and policy making. Over the course of five days, seminars integrating theory and practice will be given by international experts and national specialists. The invited lecturers are representing a group of internationally respected archaeologists, geophysicists, physicists and architects with teaching skills from universities, national and international research institutions, governmental bodies, cultural heritage foundations and SME´s.

The school combines lectures, discussion and hands-on GIS based practice. A fieldtrip will be organized to Roman Carnuntum, located some 40 km south-east of Vienna, visiting the archaeological park, and finishing with an on-site seminar. A social programme will complement the lectures.

The participation in the summer school will be awarded with 5 ECTS points from the University of Vienna.

Where?
The summer school will be held in English language at the Institute for Prehistory and Historical Archaeology at the University of Vienna, Austria.

When?
September 26th– 30th 2016

How much?
The summer school is free of charge. Travel and lodging costs are to be covered by the participants.

Who can apply?
Master and PhD students in the fields of archaeology, cultural heritage management, architecture, landscape planning, and digital humanities, promising candidates for the prospective use and implementation of archaeological prospection methods. Prerequisite: Basic skills in (Arc)GIS.
The number of participants is limited to 25.

How to apply?
Please submit a letter of motivation and a brief CV (max. 1 page each) with the Subject "Summer school 2016" to LBIArchPro@gmail.com
Deadline for application submission is July 31st 2016. Decisions will be communicated until Sept. 1st 2016.

Organizers
Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology
Vienna Institute for Archaeological Science - The University of Vienna
Central Institute for Meteorology and Geodynamics

This summer school is funded by the Wiener Wissenschafts-, Forschungs- und Technologiefonds.

NSGG Archaeological Geophysics Day Meeting

Geological Society of London, Burlington House, Piccadilly, London
Tuesday 6th December 2016

The Near Surface Geophysics Group of the Geological Society of London (NSGG) is pleased to announce the twelfth in a succession of biennial day meetings devoted to archaeological geophysics. Near surface geophysical techniques have become firmly established in archaeological research and evaluation and are now routinely applied in archaeological investigations. This meeting offers a forum where contributors from the UK and further afield can present and debate the results of recent research and case studies. Suppliers of equipment and software also attend and the meeting represents an invaluable opportunity for both archaeological and geophysical practitioners to exchange information about recent developments.

Unfortunately our colleagues in the Forensic Geosciences Group are otherwise engaged this year and, although we explored other alternatives, it will be a one day archaeological geophysics meeting this time.

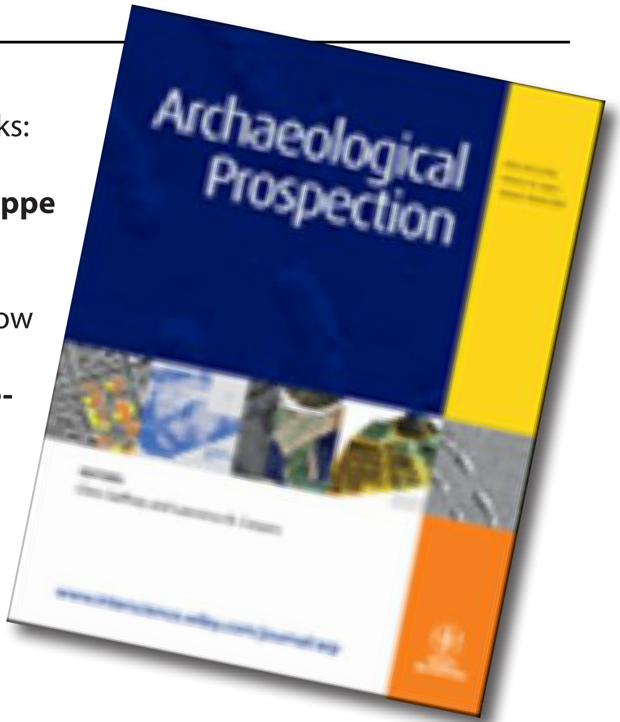
Call for papers
Those interested in contributing a talk or poster are warmly encouraged to contact the convenor. As in past years we'll be seeking abstracts of up to 1000 words in length accompanied by suitable illustrative material (up to 4 images) but we are looking into using an online submission website this time, details to follow. The closing date for submissions will be the **26th September 2016** and provisional session themes include: Technical developments; Assessing Landscapes (including Designed Landscapes); Integrated Approaches; Forensic Geophysics; and Case Studies.

Once plans develop more information and notes for presenters will be available on the NSGG websites: http://www.nsgg.org.uk/meetings/
or http://www.geolsoc.org.uk/NSGG-Archaeological-Geophysics

Convenor: Paul Linford, Historic England, Fort Cumberland, Eastney, Portsmouth, PO4 9LD, UK; Tel: +44 (0)23 9285 6749; email: Paul.Linford@HistoricEngland.org.uk

Journal Notification

Archaeological Prospection 23 (2)



The Use of Geophysical Prospections to Map Ancient Hydraulic Works: The Triglio Underground Aqueduct (Apulia, Southern Italy)
Giovanni Leucci, Mario Parise, Mariangela Sammarco and Giuseppe Scardozzi

Multi-technique Geophysical Survey in and around the Hillfort Lossow – a Bronze and Iron Age Central Site in Brandenburg, Germany
Burkart Ullrich, Ronald Freibothe, Henning Zoellner, Ines Beilke-Voigt, Andreas Mehner and Georg Kaufmann

Slingram EMI Devices for Characterizing Resistive Features Using Apparent Conductivity Measurements: check of the DualEM-421S Instrument and Field Tests
Michel Dabas, Antoine Anest, Julien Thiesson and Alain Tabbagh

Exploring Integrated Geophysics and Geotechnics as a Paleolandscape Reconstruction Tool: Archaeological Prospection of (Prehistoric) Sites Buried Deeply below the Scheldt Polders (NW Belgium)
Jeroen Verhegge, Tine Missiaen and Philippe Crombé

Historical Aerial Photography and Multi-receiver EMI Soil Sensing, Complementing Techniques for the Study of a Great War Conflict Landscape
Wouter Gheyle, Timothy Saey, Yannick Van Hollebeeke, Stephanie Verplaetse, Nicolas Note, Jean Bourgeois, Marc Van Meirvenne, Veerle Van Eetvelde and Birger Stichelbaut

UNIVERSITY of BRADFORD

MSc Archaeological Prospection at the University of Bradford, UK

The course is a highly focused postgraduate degree programme which develops specialist skills in the theory and practice of archaeological prospection, in particular in near-surface geophysics.

It provides students with knowledge and experience of the principal geophysical and geochemical techniques currently available for the detection of buried archaeological features and other near-surface targets. The course provides appropriate background to materials and soil science, together with the relevant mathematical principles.

Other methods of detection such as remote sensing, topographical survey and field-walking are introduced as essential components of an integrated approach to landscape assessment. Sampling procedures and the computer treatment and display of field data from all methods are critically examined with the aid of case studies based on field experience. Skills and knowledge are developed through lectures, seminars, laboratory and fieldwork classes and a substantial individual research dissertation.

Course Syllabus:
- Electrical Methods of Survey
- Magnetic and Electromagnetic Methods of Survey
- Site Evaluation Strategies
- GIS for Practitioners
- The Nature of Matter
- Treatment, Display and Interpretation of Field Data
- Soils and Chemical Prospection
- Dissertation (MSc)

Special Features:
- In-depth specialist training, including hands-on experience in the Division's geophysics and computer laboratories and in the field
- First destination figures indicate that about 85% of postgraduates in Archaeological Sciences achieve work or further studies in the discipline or cognate areas

For more information visit:
http://www.bradford.ac.uk/study/courses/info/archaeological-prospection-msc-full-time
or contact Dr Chris Gaffney: c.gaffney@bradford.ac.uk