Contents

Editorial

Chairman’s piece: by Steve Davis

AARG Conference 2019 – venue, dates and call for papers

AARG’s new website: https://a-a-r-g.eu by Agnes Schneider

AARG notices: Derrick Riley Bursary

iSAP Fund

Information for contributors

Cultural landscape as palimpsest revisited by Mikolaj Kostyrko and Grzegorz Kiarasz

LiDAR for Italian archaeology. High-resolution elevation data to enrich our understanding of the defensive circuits of a protohistoric site in Southern Italy by Jitte Waagen

AARG Conversation No 4(1): Darja Grosman and Rog Palmer: 12 September 2018

Searching for remains of the Great War – prisoner of war camps in Poland in perspective of aerial prospection by Mikolaj Kostyrko and Dawid Kobiałka

Drones + images = archives? by Rog Palmer

Cropmarks


Books and papers of interest?

AARG: general information, membership, addresses, student scholarships

More posters from AARG 2018:

Felice Perciante, Landscape archeology: the Swedish Geodatabase example of multistratified monitoring

Felice Perciante, The threat of intensive agriculture on the ancient landscape: Ager Picentinus
AARGnews is the newsletter of the Aerial Archaeology Research Group

Published twice yearly in April and October

Edited by Rog Palmer
rog.palmer@ntlworld.com

Cover photo:
Not the Roman town you may hope it to be but a WW2 military depot (although I can no longer find the reference/link to that) by Abbotsley Bridge, Cambridgeshire. Photo: Rog Palmer: 10 July 2018.
Editorial

Thoughts on auto-detection

At times during the past several months my thoughts have returned to automatic detection methods and their use for identifying objects on aerial images of any kind. The first airing of automation of any kind in AARGnews was by Sam Redfern in 1997 and 1998 who was using automated computer techniques to classify mapped enclosures, but not to detect them. Eleven years later we had a paper by Øivind Due Trier and others who were using auto detection to identify solid circular marks on QuickBird images. There followed various projects using automated detection and these were brought together in a reading list compiled by Karsten Lambers and Arianna Traviglia in 2016. Since then, Dave Cowley and Adara López-López summarised their work on Arran, part of which is to find a way of automating the new National Mapping Programme for Scotland. Most recently (to me), there is a paper by Verschoof-van der Vaart and Lambers (see ‘Books and papers of interest?’ in this issue) that has been using a new technique to detect round barrows and Celtic fields.

After my initial lack of conviction in automated detection I was won over during a conversation with Dave Cowley whose thoughts at the time were well in advance of anything that auto-detection has since produced. Now I’m losing my belief in its effectiveness to find anything other than very simple shapes. I cannot claim to have read, even glanced at, much of the literature because I’m not interested in the technical aspects, just the results. And the results seem to have given us project after project that has used a range of (apparently) improving techniques to find spots (solid circles) or spots or spots with the occasional square thrown in. My hopes were raised slightly by the inclusion of Celtic fields (hollow rectangles, I suppose) in the most recent paper but the illustrations in the report were uninformative and most of the text was about round things. I conclude two things: one, that most of the recent work has concentrated on methods of detection rather than on detection of some of the range of shapes in the archaeological compendium; and two, that the data used for detection has changed from aerial images in general to ALS in particular. I may be showing my ignorance or just causing trouble, but I’ve got fed up with waiting for auto-detection to progress from its finding spots phase. Objects on aerial images range from the simple to the horribly complex and can be mixed in with cultivation patterns and a range of natural features. To find the complex may never be possible, but surely after at least ten years of spots there are some auto-detection methods that will be able to find something as simple as that illustrated (right). If not – where is it going?

1 rog.palmer@ntlworld.com

There seems to be a move among various of us old farts to make digital copies of our old slides and, sometimes, negatives. In August last year, I was asked by David Hall for advice on scanners that could be used to make digital copies from 35mm and 60 x 70mm film stock and also from glass negatives that he had inherited from his father. We settled on an Epson flat-bed scanner with a light box. Around the end of the year I was thinking of copying some of my old 35mm slides (with an option for negatives) for which I bought a 60mm macro lens and a little device that could be screwed on the lens and held a slide or negative carrier at the optimum distance. And a week or so ago I bumped into Gwil Owen who said he was using a Nikon Coolscan to copy his old family pictures. So there are several ways of doing the same job and we each seemed pleased with our results. For all of us, the lengthiest time-component of the job is indexing the material so that it can be copied in the order it comes but found by a search range that includes (for me) original date, coordinates, UK county name, site name, person name – each as relevant. It ought to work for anyone else, but that has yet to be tested.

I didn’t use colour much in the days of film because my darkroom was set up for black and white and I couldn’t be bothered to learn to make colour prints. For aerial photography I would take a 35mm camera with an 85mm lens on and take colour slides for lectures. Control points were unnecessary because they were on the 645 format black and whites that would be used for interpretation and mapping. For fun pics I also preferred black and white although my slide collection includes colour excavation shots and a little tourist material. It has been interesting to look back on my past, try to remember names, try to read my miniscule writing of those times (there isn’t much writing space on a 35m slide mount), but perhaps most interesting have been some of the illicit copies of aerial photos that just happened to fall under my camera when I had borrowed them. After many recent years with my head in the fenland and Cambridge local, I had forgotten quite how contrasty sites could be on the Wessex chalk at certain times of year. When I was working through the CUCAP material in the 1970s I remember noticing a time of year when there seemed to be a mixture of soil colours (on the chalk this would be a black ditch against a white background) with the black enhanced by young cereal growth. In the farming regime of the time (probably mid 1960s-early 1970s) the dates for this enhanced effect seemed to be from March to May – but things may have changed by now and the effect may not be as startling in colour digital as in well-printed black and whites from film. Looking at some of the copies I was making I was aware of the ‘wow effect’ that some aerial photographers have mentioned although, of course, they would be seeing it in colour.

Ought we to be slightly embarrassed that the first, or only, review of some of the papers given at AARG, Venice, has been in *isapnews* 55 (published January 2019)? It’s available to members of ISAP.

Armin Schmidt, who is ISAP, asked members for birthday wishes for Irwin Scollar, who reached 90 last November. Irwin is also one of AARG’s Honorary Members. The same issue of *isapnews* includes the collected birthday wishes and has two links to interviews with Irwin made in 2011 and 2013 of which [https://youtu.be/fTQjttmDf0](https://youtu.be/fTQjttmDf0) worked when I tried it (January 2019). I have occasional talks with Irwin via Skype and know that he is already looking forward to reaching 91.
AARG website
Our thanks go to Michael Doneus who created and ‘mastered’ our website from its inception until he handed over in 2018. During that time, it became the platform from which subscriptions and conference fees can be paid, all issues of AARGnews can be downloaded as well as providing reading lists and samples/case studies of aerial photography and its uses. Our new ‘web-mistress’, Agnes Schneider (or AARGnes to me) has completely redesigned the website and has added new text and information and introduces it to on page 10 of this issue along with a call for more aerial images. Agnes is also managing AARG’s Facebook page and (new) Twitter account, for those of you who twit.

This issue (not necessarily in order of appearance)
Mikolaj Kostyrko has been busy. Not only has he co-produced two joint papers for us, but he has been jointly organising a session for CAA and successfully defending his PhD thesis at Poznań. His paper with Grzegorz Kiarszys continues the Poznań tradition by giving us something to think about while the other, with Dawid Kobiałka, includes all the good components of an inquisitive survey as they seek surviving evidence of WW1 POW camps in Poland. Their project also makes good use of a drone to capture up-to-date images at a chosen ‘good time’ in a way that we could not afford to do using a light aircraft. A long-term research project in Italy provides the target site for Jitte Waagen’s manipulation of ALS data to formulate (and answer) questions at the fortified town of Muro Tenente. Those of you who use ALS may enjoy the DOI link he gives on p22. Jitte also sees the potential of future drone surveys to add detail and seek information on some of his questions. We also include a further two posters from AARG Venice showing projects by Felice Perciante. The addition of posters in AARGnews gives us all a chance to properly read these contributions.

After the ‘drone summer’ of 2018 there have been talks within and without AARG about drone users and their images. Steve Davis’s ‘Chairpiece’ discusses some of this while a longer note of mine details some questions, answers and thoughts regarding long-term archiving of this potentially valuable source of information. Finally, there is part of a conversation with Darja Grosman that shows what we were doing by not going to Venice last September. Read it with some beer.

References
Chairman’s Piece

Steve Davis

Once again ‘Sumner is icumin in’, and with it we will not only hear the sound of the cuckoo, but increasingly also the buzzing of drones. Summer 2019 promises to be an interesting one: in 2018 the amateur enthusiast (the airborne antiquarian?) woke up to the fact that not only could they use these remarkable little gadgets to take photographs of their favourite archaeological site, but they could use them to make archaeological discoveries of genuine international importance. This has in turn created some interesting ‘gaps’ and possibilities. Firstly, while there are many people flying drones and taking excellent pictures, the number of hobby fliers who actually understand what makes an archaeologically useful image is rather fewer. This has created a pressing need for better training in aerial photography, both in helping amateurs understand when and why to fly and also how to interpret the images they capture. It is likely that for every screamingly obvious site that is being identified other, less obvious sites are being overlooked.

Secondly, the sheer quantity of data being generated by these devices has already become unmanageable in any practical sense – leaving us with the important question: do we even try to manage it or do we leave it to ‘self-regulate’ (or not as the case may be)? Taking the training element: while some flyers are already well-informed and understand at least the basics of when and why to fly, there are many who have limited understanding of the processes of crop-mark formation and the practice of aerial archaeology. This, I would suggest, could and probably should be one objective of AARG going forwards: if aerial archaeology is to be democratized then we should make sure that amateur enthusiasts are trained to understand some first principles and perhaps to even work systematically together as groups and with professionals. At the moment there is a lack of co-operation between the amateurs and professionals: what we would like to see is the ‘droners’ to work with the professionals, rather than team up with the detectorists and leave the academy and state bodies on the sidelines. In particular an understanding of context is critical: a large number of beautiful but difficult to rectify site shots appeared last year, and it would be wonderful if we could see some orthophoto creation if this continues in 2019, or at least an awareness of landmarks that can help us in georeferencing and rectification.

As regards the second issue, the sheer quantity of images that can be generated by even a single drone flight is enormous. This is not aerial photography as it used to be – the digital photographic revolution saw to that – but it is likely that the majority of photographs or videos captured today are deleted following quite a cursory analysis, usually by a non-specialist. This represents potentially a massive loss of archaeological data, not only from any less obvious sites that an expert might have pointed the observer in the direction of, but also as regards the potential for photogrammetric terrain model reconstructions. How can this be resolved? It seems unlikely at the moment that there is any way of sustaining a repository capable of dealing with the vast quantities of data involved, let alone actually analysing it. There has to be an aspiration to at least go beyond cherry-picking the best images of the best sites if we are to use these data to help us better understand archaeological landscapes. One

1 stephen.davis@ucd.ie
easy fix would be to significantly improve the reporting mechanisms for potential new features. In Ireland reporting a new monument in theory still requires submission of a paper form, although this is changing; however, given the choice between actual official reporting as opposed to ‘putting it up on the internet’, it is understandable that many people opt for the latter…

I realise I am writing yet again about drones. Droning on (a phrase that was clearly ahead of its time!). This is because I believe that in 2018 we saw them exceed what we as a community had felt they were capable of in the hands of the general public. This caught a number of people on the hop, but this year we are (more) ready – which of course will probably mean we have a terrible summer.

I should also draw your attention to a few additional pieces of news/information. The AARG website has been entirely revamped and rebuilt by our new webmistress Agnes Schneider. The committee would like to thank Agnes for a wonderful job on this. Do check it out!  https://a-a-r-g.eu

We are grateful to Moira Greig for stepping back into the role of treasurer following Willem Vletter’s tenure in the position. We are inviting applications from interested parties to take this on long-term and work with Moira in the meantime so as to learn the ropes.

I sent out two SurveyMonkey surveys last year, one on the idea of moving the conference to a move convenient time of year (especially given the usual slew of conferences in early September) and the other regarding a proposal to move AARG to a biannual event, alternating with ICAP. These will be discussed more at the AGM and relatively few answers were received. Early indications are that the membership are generally in favour of moving the conference away from the September slot. As regards the biannual conference poll, opinion was evenly split for and against the motion.

The 2019 AARG conference will take place in Constanta, Romania from 11-14th September. Key themes will be a local session on eastern Romania and the Black Sea area, infrastructural development and aerial archaeology, aerial archaeology and communities (see above!) and ‘revisiting the gaps’, invoking the excellent ‘Mind the Gap’ conference held in Siena a few years back. Rather than the ‘debate’ session we will have a series of invited presentations on AARG: The Next Generation as a final session this year. We hope to see you there.
AARG CONFERENCE 2019
Constanţa, Black Sea Coast, Romania
September 11-14


The event is hosted by the Museum of National History and Archaeology Constanta.

Welcome reception: September 11, evening.
Papers, posters, etc: September 12 and 13.

Field trip to the ancient ruins of Tropaeum Traiani: September 14.

The Museum of National History and Archaeology Constanta was founded by the Romanian administration of Dobroudja in 1878. It is one of the richest museums in Romania, with a vast number of archaeological treasures exhibited, ranging from the Neolithic to the Byzantine era. Our meeting will be held in the museum and its galleries are open to participants.
AARG 2019: CALL FOR PAPERS

Oral Papers (20 minutes) and posters (A1 portrait) are invited on the themes of:

1. **Local session: Aerial Archaeology in Romania and the Black Sea region**
   This session features papers on aerial archaeology in Romania and especially in the area of the Black Sea. Contributions are welcome on recent research and historical applications of aerial archaeology, including case studies and more theoretical contributions.

2. **Aerial Archaeology in the commercial sector**
   Increasingly, aerial archaeology is (or perhaps should be?) an indispensable part of the planning process, and aerial methods are integral to infrastructural development worldwide. This session invites papers on any aspect of such collaborations, from successful collaborations and innovative approaches to abject failures and cautionary tales.

3. **Aerial archaeology and the public**
   The last decade has seen the rapid democratisation of aerial archaeology, from Google Earth and Bing, to digitisation of historic collections and the development of ever cheaper and more effective drone technology. These developments have seen the ever-increasing involvement of the public with airborne and spaceborne archaeological prospection. This session invites contributions that explore the intersection between aerial archaeology and public archaeology, including case studies and critical reflections on such interactions, both successful and less successful.

4. **Revisiting the gaps: Empty spaces in the theory and practice of aerial archaeology**
   In 2013 the University of Siena held an international seminar on ‘Emptiness, Visibility, Ambiguity and Absence in Archaeology’ - Mind the Gap. This thought-provoking meeting focused on ideas of emptiness in archaeological landscapes and asked: how do we begin to address apparent gaps in various landscapes? Do these gaps reflect real patterns of past activity, or are they methodological artefacts? How do we understand the character of the patterns of archaeological evidence derived from aerial survey? Has progress been made in addressing these gaps in theory and practice? Contributions are invited on methodological or theoretical aspects of understanding patterns of (relative) emptiness, on the character of patterns and distributions of archaeological materials in the landscape, or on methodological voids within the field of aerial archaeology.

5. **Aerial Archaeology: The Next Generation**
   In this plenary session we will hear from diverse voices from the next generation of aerial archaeologists: What does the future of aerial archaeology look like? What are the key developments in method, theory and application likely to be within the next decade? What training and skills will be needed to succeed? Will aerial archaeology remain an independent specialism, or become part of the general archaeological toolkit? Are opportunities and challenges shared across the community or regionally varied? What are the most exciting emerging research areas? What does the community need to prioritise to attract the next generation of researchers and professionals?

Please direct all conference paper and poster offers (max 800 characters) to:
Stephen Davis, UCD School of Archaeology, Dublin  aargchair@gmail.com
Closing date for all proposals with title and abstract is 31st May 2019.
AARG’s new website: [https://a-a-r-g.eu/](https://a-a-r-g.eu/)

Agnes Schneider¹

I am deeply honoured to take on the job of Webmaster of the Aerial Archaeology Research Group from Michael Doneus, who managed the AARG website for so long. It is a pleasure to contribute in any way to the AARG Community, with such a history, visible throughout the website and in *AARGnews*.

Please contact me if you would like to have your pictures featured on the website.

---

¹ [euboia@gmail.com](mailto:euboia@gmail.com)
AARG notices

The Derrick Riley Bursary

The Derrick Riley Bursary still exists. It is £500 a year, usually a single award, but sometimes is split and given to two people.

There should be an application form on the Sheffield Archaeology Department website and a Riley Bursary page on the Sheffield website where potential applicants will be able to find information and download the application form.

Finding the relevant page represents the first challenge, but if you can’t please contact Bob Johnston (r.johnston@sheffield.ac.uk) who administers the bursary.

Please apply for this even though it is not used only for conference attendance. AARG has limited funding and access to the Riley Bursary extends this amount to something more useful. No whinging about lack of money if you don’t apply.

ISAP Fund

ISAP have a fund to provide support of up to £1000 to assist with members’ projects [membership costs less per year than AARG does] that ‘further the objectives of the Society’.

Guidelines and application form from the ISAP web site: http://www.archprospection.org/isap-fund

Information for AARGnews contributors

AARGnews is published at six-monthly intervals. Copy for AARGnews 59 (October 2019) needs to be with me no later than September 20, 2019. Editorial policy (for want of a better word) tends to be that if I am sent interesting contributions they go in unless there’s a danger of an issue overflowing. Instructions for contributors are no longer on the AARG website, but this issue may serve as a guide or more information can be sent on request.

Please do not use any ‘clever’ formatting and avoid footnotes.

Good-quality jpegs are suitable for illustrations. Tiffs are for archives.

Address for contributions: rog.palmer@ntlworld.com
Cultural landscape as palimpsest revisited

Mikołaj Kostyrko1 and Grzegorz Kiarszys

At the end of last year, while visiting one of archaeological conferences devoted to remote sensing methods, we heard some of the researchers addressing the matter of landscape and palimpsest using expressions such as “a palimpsest compressed into an image” (in reference to an aerial photograph) or “palimpsest that LiDAR data shows”. It is highly possible that the speakers used those particular expressions as rhetorical figures, in order to raise the dramatic tension during their presentations. It is important to state that by doing so, they were referring to our prior knowledge or our familiarity with the expression of palimpsest in the context of landscape interpretation. We believe that, through having a closer look at different ‘mental shortcuts’ or in other cases little ‘mistakes’ that are often ignored, one can also formulate questions regarding a bigger picture of our archaeological understanding of the past.

One can be quite certain that archaeologists are aware that the palimpsest refers to an analytical (hermeneutic) concept and that it is impossible for it to be shown by anything other than us (people/researchers). It can’t be compressed in anything as it is a means of deconstructing things. One could say that an archaeologist reading the landscape ‘through the lens’ of remote sensing data while interpreting and untangling a palimpsest is doing nothing other than reverse engineering. The outcome of such a process is translated into words or a drawn descriptive interpretation of remote sensing data – in other words a representation of our thoughts (narration). It is through these steps that we compress and reduce landscape of its animate, and quite often intimate, components regarded as meaningless to archaeological narrativization of the world we live in. We must keep in mind that at the same time this reductionist step is creative. Not only new meaning arises, but new entities as well, i.e. in a form of spatial data bases – palimpsests of our own creation (Johnson & Ouimet, 2018).

Ambiguity of the cultural landscape idea

The idea of landscape’s palimpsest has been used by archaeologists studying remote sensing data since at least the second half of 20th c. (Crawford, 1953). This term is used in references to spaces where material traces of past human activities overlap each other and form a specific assemblage. This meshwork is later disentangled by an archaeologist in a process of interpretation. It is possible, and often encountered, that a sophisticated mosaic of diverse human traces could be observed in a limited area, later represented by only one image. It can reveal a fascinating coincidence of long centuries of human history ‘compressed’ into one limited space. No surprise then, that one of the pioneers of aerial archeology, O. G. S. Crawford, had reached for a metaphor of palimpsest - the writing material so precious, that it was alternately overwritten and erased many times. In this parallel the surface of earth is compared to such writing material and archaeological landforms symbolize the text. And is there any better way to persuasively illustrate such situation than through aerial photography of historical landscape?

Archaeological palimpsest was defined within the traditional paradigm. It was, therefore, perceived as something that was to be discovered in the archaeological record and objectively observed. Together with introduction of post-processual approaches in landscape

---

1 mikolaj.kostyrko@uni-bamberg.de
archaeology, the cultural landscape started to be seen as a theoretical construct that required specific types of preliminary knowledge along with a critical approach and empirical evidence (Barford, 2005, 2005; Casey, 2008; Johnston, 1998; Tilley, 1994; Wylie, 2009). Therefore, landscape palimpsest ceased to exist as something that could be objectively ‘discovered’ and became a tool of narrating and understanding of material relics of past human acts. It means that palimpsest is created by an archaeologist in the process of critical interpretation of the archaeological record (Johnson & Ouimet 2018). Such a conclusion also leads to the notion that the idea of cultural landscape itself cannot be simply reduced to its physical surrounding but is tightly connected to our engagement with it as well as our prior knowledge.

Archaeologists working with spatial information quite often feel that more data constitutes better research and that this situation leads to a richer and more complete reconstruction of the past (Opitz & Herrmann, 2018: 26–30). Isn’t that the main reason standing behind an ever-growing focus of archaeologists on computer vision and algorithm-based interpretation of remote sensing data? This subconscious state deriving from inductive reasoning appears to be very tempting. However, we can be somewhat sure that higher quantity of data does not guarantee qualitative shift (or improvement) in archaeological narration and understanding of the past.

Archaeological narrations predominantly depend on inductive reasoning and commonly shared belief in the objectivity of material sources. Such convictions are not usually directly declared (or even realized) by the scholars, but they can be found concealed between the lines of their works. It can be observed, for example, in the descriptive nature of archaeological papers, or in a focus on quantitative analysis, without later use of their results in the process of interpretation. It is one of the reasons why most of the narrations about the past have very similar structures and conclusions. Archaeologists repeat, in fact, the same old stories over and over again, and the only difference between them are the locations of each case study.

Computer processing of the collected data allows us to create aesthetic and very persuasive presentations of the results obtained. However, the qualitative change in archaeological narrations cannot be achieved by simple growth in collected datasets and improvement of their precision, but through the introduction of new theoretical perspectives.

An analogous comment can be observed through the continuously growing number of ‘messy landscapes’ (Mlekuž, 2011) mentioned in archaeological narrations. Like the palimpsest it became a thing, one feels should be referred to during a presentation or while writing a paper. Sadly, it is quite often a closing remark on the nature of landscape rather than becoming a focal point (a hermeneutic-deconstructionist tool) leading to the creation of new reflections.

Which way should we proceed in order to break the loop of this ‘hermeneutic circle’ which binds the way archaeologist think (Zuk, 2005)? The answer to this question is neither easy nor new. We argue that scholars should stress a stronger emphasis in presenting the development of their interpretation and to reveal different biases that take part in this process (Brophy, 2005a, 2005b; Cowley & Gilmour, 2005; Hauser, 2007; Millican, 2012; Rączkowski, 1999; Wickstead & Barber, 2012). In other words, we should denude our doubts and share the challenges we encounter while working with remote sensing data and constantly
reflect upon the goal of our work. Those thoughts should not be a single focus of the work but rather they should be embedded within ‘scientific’ articles.

References
LiDAR for Italian archaeology. High-resolution elevation data to enrich our understanding of the defensive circuits of a protohistoric site in Southern Italy

Jitte Waagen

Abstract
This paper presents a case study in which LiDAR data has been studied to provide information on the defensive wall-circuits of a protohistoric site in Southern Italy: Muro Tenente. By applying various approaches of relief visualization, in combination with blending techniques, the high-resolution elevation data is used to shed light on the overgrown and partly lost inner and outer walls of the ancient city. In addition to the application of various analytical representations, a more dynamic approach is proposed using 3D modelling software for real-time visualisations using a realistic shading render engine. The results present new insights into the morphology and preservation of the city walls, as well as providing a new hypothesis regarding their layout.

Keywords
LiDAR, Italy, Muro Tenente, Defensive Circuits, Relief Visualisation Techniques, Blending Techniques, Blender, 3D

1. Introduction
Airborne Laser Scanning, or LiDAR (Light detection and Ranging) has become a well-established source for studying archaeology in the last decade. Although its general value as an archaeological resource is widely recognized, methods for analysing and visualising the extremely detailed point clouds, and their potential for identifying specific archaeological features, are still a field of continuous exploration. This entails all kinds of techniques of manual modeling and terrain analysis, such as lighting, morphometry, image fusion, etc. that improve our perception of that data (cf. Costa-García and Fonte 2017; Doneus 2013; Forte & Campana 2017; Kokalj and Hesse 2017; Kokalj and Somrak 2019; Opitz & Cowley 2013), as well as (semi-) automated feature recognition to aid the archaeologist in tracing important features (cf. Lambers and Traviglia 2016).

These developments are fuelled, among other things, by the increasing availability of LiDAR data for regions in which aerial remote sensing has not been part of structural research agendas for studying archaeology. Italy is a case in point, where LiDAR data has been collected as a publicly available service from 2008 onwards, initially aimed at monitoring coast line and main rivers (2008-2009), later at areas with a high hydrogeological risk (2010-2011), and finally coverage has been enlarged by including secondary fluvial networks and areas with a high probability of landslide activity (2013-2015). Although the Italian territory is not yet fully covered (see García Sánchez 2018, García Sánchez & Waagen, forthcoming), data is now available for considerable parts of mainland Italy. A range of projects have since successfully applied LiDAR studies, using both private and public LiDAR datsets for tracing, documenting and monitoring archaeological remains (cf. Cifani et al. 2007a, 2007b; De Cazanove, 2016;
Lasaponara et al. 2010b; Campana et al 2012; García Sánchez and Fontana 2016, García Sánchez 2018).

The study of LiDAR data is not a means to itself; it is a resource providing clues on the archaeology under study, and should be well-integrated into the broader set of archaeological techniques and strategies. This short case study aims to demonstrate the value of LiDAR data as an additional layer of information for the analyses of the archaeological site of Muro Tenente. By applying various techniques of LiDAR data visualisation the data provides new archaeological insights, gives a picture of the state of preservational aspects of the site, and provides clues for new hypothesis that will be integrated into future field expeditions.

2. The site of Muro Tenente
Muro Tenente is an archaeological site in the Apulia region, a complex protohistoric settlement dating from the first millennium BC (FIG. 1). The 52 ha large ancient fortified town is an important site for the archaeology of Southern Italy, with well-preserved remains giving evidence of domestic, burial and ritual practices. The VU University of Amsterdam has been conducting research on Muro Tenente for almost 30 years up to now, ranging from surveys, test-pits, coring and open area excavations, shedding light on key processes such as Greek colonisation and Roman expansion in southern Italy (e.g. Burgers 1998; Burgers & Napolitano 2010; Vermeulen, Burgers, et al. 2012).

3. Analysis of the LiDAR data
The recently available LiDAR data provide an excellent opportunity to explore yet another layer of evidence on the ancient town, hopefully shedding light on features that are otherwise difficult to observe or analyse. It must be kept in mind of course that there are methodological limitations to LiDAR data and archaeological features on the ground may dodge a clear expression in the collected datasets. In the case of Muro Tenente, one can expect subtle features to escape notice due to thick low vegetation through which the LiDAR pulses only moderately penetrate and are

FIG. 1. Satellite image (ESRI Satellite (ArcGIS/World Imagery) 2019), with some of its most conspicuous topological features: the defensive inner and outer wall circuits, as well as an excavated ancient road.
difficult to filter (Holata et al. 2018: 2). On the other hand, the general morphology of the terrain should be well visible, as well as the still standing but overgrown parts of the defensive wall circuits. The latter provide indeed a nice example of the application of LiDAR analysis. In the following paragraphs, a couple of striking features of the LiDAR data on the defensive circuits of the site will be highlighted, using various methods for visualisation optimized for the specific archaeological features under study. Finding the optimal visualisation technique has been a rather experimental undertaking, informed by knowledge on the various representation methods (Kokalj and Hesse 2017; Kokalj and Somrak 2019); after all, no single method outperforms all others when it comes to archaeological feature recognition (cf. Roman 2016; Costa-García and Fonte 2017). In addition to relief visualisation techniques, image fusion (blending modes), i.e. pixels ascribed new values by an equation between overlapping cells of two or more raster layers, have been applied to enhance representations (cf. Kokalj and Somrak 2019: 10).

4. From pulse to DTM
From the LiDAR data provided by the Ministero dell’Ambiente e della Tutela del Territorio e del Mare, the .xyz points have been converted to the .las format and projected to the WGS84 UTM33N CRS using lastools. Subsequently, the measurements in the .las file have been classified using the lasground algorithm from the lastools to generate bare-earth classified points. Then, the resulting points have been imported into SAGA where they have been gridded using an Inverse Distance Weighting (IDW) interpolation, search radius 10 mt, max. number of points 20 and IDW power 2, as well as cellsize, i.e. resolution, 20 cm. The resulting Digital Terrain Model (DTM) has been used for all further analyses.

5. Inner city walls, trajectory
The original layout of the site as drawn in the early phases of the survey of the site shows the trajectory of the inner wall circuit that has been based on the general topography and a general notion of higher densities of archaeological finds. It generally follows the course of an old dirt road that ran in a circle in the centre of the site. It has been excavated in various parts, showing indeed archaeological evidence of wall structures with towers, built in various phases from the late 4th to the beginning of the 3rd C. BC. Looking at various visualisations of the LiDAR data, it is possible to assess the exact course of the wall in a bit more detail. Examining the simple digital terrain model (DTM) of the ground classified points, resolution 20 cm, a slight circular elevated area can be detected in the eastern central part of the site.

The elevation difference amounts to ca. 20-30 cm height difference, that, due to a gradual transition, is nigh undetectable in the field. The circular elevation is especially crisp on a rendering of the DTM blended with an optimized colour ramp blended with a local dominance model (FIG. 2). A local dominance model calculates the relative dominance, i.e. angle between an 'observer' looking down at surrounding pixels, and is optimized for very subtle positive and negative features (Kokalj and Hesse 2017: 25). It has been calculated here using a search radius of 20 mt and an observer height of 1.7 mt. The multiply blending mode literally multiplies pixel values from the DTM and local dominance, resulting in a strengthening of the visibility of the elevation difference.

To get a good view at the general morphology of the terrain, a resampling filter made with SAGA GIS software (Conrad et al. 2015, see Costa-García and Fonte 2017 on its application)
on an exaggerated hillshade (3x) blended with the DTM provides a very useful image (FIG. 3). The resampling filter acts as a trend-removal technique that emphasizes local small-scale differences, which multiplied with the general image of the hillshade does a great job at representing both local and global morphology. A soft light blend with the DTM then subtly
emphasizes the lighter and darker areas, resulting in a smooth but very clear representation. Not only does this visualisation provide a good view of the eastern course of the inner wall circuit, but it also nicely shows the complete trajectory with exception from the southwestern part.

The exact nature of the elevation is hard to determine, but it may be a result of a local strong luting of sand and sand-lime bricks (Burgers 1998: 57), that defines a tough layer that gave shape to the central walled area and impeded a complete flattening of the terrain in subrecent times. A further clue is provided by projecting the Hellenistic pottery densities from the archaeological fields surveys that shows a nice spatial correlation (Burgers 1998: 53-94). The orientation of the most prominent features found in the Italian and Dutch excavation trenches appear to confirm the spatial arrangement as well; the trajectory indicated by the DTM is consistent with the Soprintendenza excavations from the 70s, that show an ancient road in roughly the same orientation (FIG. 1). We can safely redraw the central wall circuit according to the trajectory visible on the LiDAR data as it can consistently argued to be an accurate representation.

6. Outer city walls, morphology and preservation
The site of Muro Tenente is surrounded by the outer city walls. Although parts are preserved, they are not visible because they are covered by rubble and are heavily overgrown. Some small sections of it have been laid bare, which have shown an emplectrum wall building with various phases and probably towers, dating from the late 4th to the beginning 2nd c. BC. The major part of the trajectory has not been studied, and we had no clear picture of the degree of preservation of all of the probably partly upstanding structures. The canopy penetrating capacities of the LiDAR pulses however allow a rather sharp image, even enabling precise measurements of the actual structures. They are effectively visualised with a sky view factor (SVF) rendering of the LiDAR data, that shows the degree to which a location has an

FIG. 4. Sky View factor rendering of the LiDAR data (generated with SAGA). Preserved parts of inner and outer emplectrum walls in the eastern area (A), plateau ridge in the northeastern area (B).
unobstructed hemisphere above it. The advantage of such a model is that it provides a sharp image of local differences in elevation. Where a hillshade shows the effect of directional sunlight over a terrain as modeled shadows, a SVF resembles the shadow effect in case of diffuse illumination, i.e. an overcast sky (Kokalj and Hesse 2017: 22). Although less subtle than the local dominance, the SVF has the advantage of the 'plasticity' of hillshade models and features are comprehensible to perceive (Kokalj and Hesse 2017: 22). It has here been produced with SAGA, settings default with the maximum search radius (FIG. 4).

Using this visualisation, we are able to assess the walls' general state of preservation, and locally study its construction. E.g. the eastern trajectory of the outer wall circuit is almost completely removed (mechanically), but it is still possible to follow its course, along which line there are still pieces left of the inner and outer empłectrum construction. In areas where the wall is completely gone, such as in the northeastern part of the outer wall circuit, we still find clues about the trajectory. For the original reconstruction of the wall trajectory the subrecent road has been followed, which is now corroborated through the LiDAR analysis. The SVF presents a sharp contrast on the outer side of the road, showing that the road lies on the edge of a slightly elevated platform, which is the geological stratum known as the 'Gallipoli formation' (Burgers 1998: 57). The known wall structures make use of the elevation drop at the edge of this geological formation, to abut the wall. It is very plausible to suggest that the elevation drop indicated on the edge of the plateau is indeed the outer wall trajectory.

Of the northwestern preserved trajectory, a section of about 125 mt in the northwestern outer city wall is fairly conspicuous; parallel to the remains of the empłectrum structure runs a stretch of about 5 m wide, demarcated by an apparent drop in elevation, which appears to be a 3 m wide, 1 m deep ditch, clearly visible on the DTM, with a local histogram stretch applied, stretching the colour ramp over the range of values visible in the extent of the map (FIG. 5A). Although the general shape is discernible on the SVF, a high pass over the resampling filter on the hillshade gives a slightly sharper image (its usefulness mentioned by Costa-García, personal communication). The high pass emphasizes the local small-scale differences, showing what is very likely the outer wall of the empłectrum construction (FIG. 5B).

Yet another rendering, this time a multiplication of a multiple hillshade and a Sobel edge detection provides the best overall image (FIG. 6). A multiple hillshade solves the problem of linearity (features lying parallel to the cast shadows) and loss of detail in areas with shadows cast over them (Kokalj and Hesse 2017: 16) by combining the results of 16 hillshade projections from different azimuths on a regular interval. The combination with a Sobel edge detection,
which is basically an image segmentation technique, emphasizes the edges without the effect of darkening adjacent pixels as with a SVF.

![Image of Sobel edge detection](image.png)

**FIG. 6.** Sobel edge detection (generated with Orfeo Toolbox, Monteverdi) combined with a multiple hillshade (generated with SAGA), rendering created using the blending mode 'multiply' in QGIS. Indicated are the ditch (A) and the inner emplectrum wall (B).

The resulting image clearly shows the inner wall of the emplectrum structure, the outer edge of the fortification, and the parallel stretch of terrain that rises from north to south to about 1 mt in relation to the fields to the west of the walls (FIG. 6). The interpretation is however difficult; if this is the difference between the Gallipoli formation and the surrounding geological formation, why was that boundary not followed here? Is this ditch excavated purposely to make the approach to the wall more difficult at this location? If it is modern, and the 'elevated' stretch parallel to the walls consisting of rolled down rubble from the walls, what is it, since such a broad and deep ditch is not found elsewhere? In any case, the ditch and its particular context has gone unnoticed so far in the research and warrants some further investigation. Obviously, observations made on the basis of an inductive study of the LiDAR data must be checked on the ground, by means of a thorough inspection of the locations, as far as possible, i.e. ground-truthing. This has not yet been part of a dedicated fieldwork effort.

7. **Towards a dynamic 3D analysis of LiDAR data**

A large part of this case-study into the value of the LiDAR data for understanding the walls of Muro Tenente has actually been a continuous production and recombination of various analytical renderings. Whereas informed by their particular qualities, the actual effect for the identification of interesting features is still often one of experimentation. Standardised visualisation workflows have recently been proposed (Kokalj and Hesse 2017; Kokalj and Somrak 2019). A supplementary approach that could make this process more dynamic, is to insert the generated elevation models into 3D modeling software. In applications such as Blender, various types of shaders can be cast over the projected data realtime. Instead of generating a multitude of hillshade models, or using multivariate modeling with a range of hillshades, such as the PCA method, it is possible in this way to directly change the position of the light source and examine the effects. As a trial in this study, in collaboration with the 4D
Research Lab at the University of Amsterdam (help and advice from T. Lanjouw), the Muro Tenente data were reworked into a mesh in Blender (with the plugin BlenderGIS). With the visualisation of the LiDAR data in Blender, it was possible to add a light source of which we could determine the position, type and intensity and move it around the model to see the effects for identifying archaeological features. It is these visualisation possibilities of 3D software with, for example, very realistic shadows, or multiple light sources for multiscalar visualisation, in combination the real-time dynamics of changing lighting conditions that made this a very powerful tool.

![FIG. 7. Render of the DTM in a Blender scene with one sunlight at a small angle using the cycles physically based rendering engine.](image)

Of course, that process of real-time lighting cannot be shown in a single illustration, but hopefully a render can already give a good impression of the advanced dynamics in shadow modelling (FIG. 7). To give an impression, an animation of the sunlight rotating around its central axis can be found here https://doi.org/10.21942/uva.7996022 (made by T. Lanjouw).

The representation in Blender was made by adding the DTM produced with lastools as a texture in Blender, after which the values of the DTM in the texture are interpreted by Blender’s ‘displacement modifier’ as elevations. By adding ‘subdivision modifiers’, it is possible to increase detail up to the original DTM resolution. The data has subsequently been visualised by adding a sun casting sharp shadows over the DTM with a modified colour ramp, and rendered using the cycles physically based render engine.
Detailed renders of parts of the DTM cast more light over the conspicuous wall arrangement of the northwestern part of outer city walls (Fig. 8AB). Studying these visualisations, the inner emplotrum wall is well visible, but more importantly, the direct continuation of the terrace formed by the Gallipoli formation into the ditch, is evident. This strengthens the idea that the ditch has locally been dug as part of the fortification system, where for some unknown reason the emplotrum wall structure was built a bit more towards the inside then elsewhere.

8. Conclusions
The study of the LiDAR data by means of various types of visualisations has brought to light several interesting features of the inner and outer wall circuits of the site of Muro Tenente. In case of the trajectory of the inner wall circuit, this has concretely led to an important new archaeological insight into the spatial organisation of the site. The areas in between the walls have not been explicit part of this investigation, since the expectation of observing traces of archaeology is very low due to the intensive agricultural development of the area combined with the problem that low vegetation poses for LiDAR measurements. This problem could potentially be mitigated by a dedicated campaign of Low Altitude Aerial Photogrammetry, i.e. drone missions. These could be performed flexibly in seasons where the ground is mostly bare and, due to the close range collect photos for subsequent Image Based Modelling, resulting in much higher resolution 3D data than LiDAR (García Sánchez and Waagen, forthcoming). Furthermore, drone flights could also be planned to collect high resolution aerial pictures in various stages through the year for a study of cropmarks, which may very well show up on a site like this. Surely, incorporating 3D rendering software into a LiDAR analyses is well worth the effort, and holds promise for future LiDAR data exploration.

Acknowledgements
I would like to thank Prof. dr. Gert-Jan Burgers, who kindly allowed me to perform the LiDAR analyses on the site that he has been investigating since the last decade of the previous millennium. My gratitude goes as well to Tijm Lanjouw, 4D Research Lab of the University of Amsterdam, who enthusiastically assisted with the Blender visualisations, dr. Jesus García Sánchez, for reading and commenting on the first draft and dr. José Manuel Costa-García, who pointed out the resampling technique in SAGA. Finally, the interpretations were discussed with the late Raphaëlle-Anne Kok-Merlino, my very dear friend and colleague with whom I participated in many archaeological projects in Southern Italy.
Conflicts of Interest: The author declares no conflict of interest.

References


AARG Conversation No 4(1): Darja Grosman and Rog Palmer:
12 September 2018

Instead of going to AARG in 2018, I stayed with Darja for a week and we talked a lot about many things. She showed me Social Realism (a train journey from Ljubljana to Pula to see Sara Popovic who had just returned from AARG, bursting with ideas) and we recorded two evenings of conversation that diverted over many themes. This is from the first evening from which I have edited the conversations to follow two main and interlinked themes: the future of AARG and education. Darja and I have taught together several times and tend to think similarly, even if we arrive at the conclusion from different directions.

DG – I thought that an important bit of AARG work was educating.

RP – I’m not sure if that’s in the constitution.

DG – Today, you can still say that? … Well, OK, maybe it should be in the constitution because today you have to bring certain things back. It’s not all in terms of using aerial photographs and things like that, because people are just saying, “Oh, that’s something that’s already been done.”. Do we accept that? Is it acceptable to say it’s over? Because there are other possibilities. I still believe that they’re just part of all this junk called ‘remote sensing’.

RP – It’s broadening things out, because we realise that there are more than photographs that are useful to us.

DG – Yes OK, but as I said it before, I have no problems with seeing these things diversifying in different directions, and we can call it ‘imagery’, we can call it ‘scanning’, we can call it whatever you want to. The problem is that I think that a group like that [AARG], a specialist group, has an obligation to carry on education apart from universities, and specially because the universities don’t have the time, don’t have the inclination, don’t have the knowledge to do it.

RP – Yes, schools are one thing and …

DG – It’s not everything AARG is about …

RP – We [AARG] could afford to do it, now …

DG – But it shouldn’t be just that, “OK we’ve done it twenty years and we’ve got these stupid Easterns to do it.”. And of course, we don’t do it, because we don’t know how to organise ourselves on a different systematic level apart from single people doing it.

RP – It’s still going to be single people starting to do it.

DG – Never mind! It’s bringing it to groups that want to learn these things. It’s also bringing fresh blood into AARG.

RP – Which is what we need.
DG – Yes. We’re dying out.

RP – The money that we’ve got in AARG is perhaps enough for one, maybe two, schools with no flying. Because, all right, there may be twenty-odd thousand in the box but all of the treasurers were told by Wilson that we need to keep ten thousand back for emergencies – if, a conference goes wrong and we need to pay back… what? Hire of rooms, everything. It may come to ten … I don’t know, I don’t often look at the accounts. So, if we’ve got ten thousand, how many schools could we run?

DG – But the moment you’re going into the direction of an actual result for a certain area, you can get co-financing, I’m convinced.

RP – Do you think we can find the …

DG – Even if it is not in cash, if it is having …

RP – A space?

DG – Yes, things like that, that we don’t have to pay for. Or be sponsored …

RP – It depends what you mean by ‘results’, doesn’t it. And results, realistically …? Zadar [an Arcland workshop that we ran in 2013 with selected students]– was it just a week or was it ten days?

DG – Ten days.

RP – And there was flying, so that was a diversion. So that knocked out … two days, one day?

DG – No, two days. It was two days flying.

RP – Yes, but they weren’t all flying at the same time were they. That achieved … I was really proud of what they’d done, which was why I wanted it in AARGnews [48, 38-50]. You know, two little projects. How possible is that in other places?

DG – The bottom line for Zadar is, if we’re talking about it, is that these people had a different approach even if they’re going out to different types of archaeology. Now that they’ve produced a result in a school, you know, now that they’ve …

RP – They know what’s possible, yes?

DG – Yes. They actually saw the thing from a different perspective. And that’s the first step. Now, we never got to the second step, that some of the people would actually push for staying into this work with aerial photography. There were no professionals in there. If there were young professionals there might have been more possibilities for them to go into a special field.

RP – It doesn’t need to be a ‘special field’, if the awareness of what aerial photos can add to ‘conventional archaeology’ is known.
DG – Of course, it is not. I’m not saying that you are making specialists – you can’t do it in ten days. You just try to bring them towards the different perspective that they can have. And they might eventually go also in that direction, but unless they know the ... possibilities that are there... They are never going to suggest, or try to get, some job that is close to this topic and things and way that it works... Which means that most of the countries where the 20 schools got the people from haven’t made the next step. Not in organisation, or in institutional level, and not in individual level. Not even on a project level in most of the places. So that next step is necessary in order to get a better archaeological grounding to the data and to the possibilities to work with them.

RP – The next step being something that they do or with a higher school? Because you and Michael [Doneus] used to do the higher schools didn’t you? You were working with people who had been there before.

DG – Yes, yes. You won’t necessarily get people that were there before, because nowadays people just chose it once. And if this is not going to be their profession, they don’t go to the next one. The Italians have something that is called ‘scoala de specialisation’ or ‘scoala de professionamento’ – perfectionist, you know – and they can pick them, as many as they want to, specially the people who don’t have jobs. They go into that because the state pays for it. But it is something that means, ‘I have done this one and I go into the next one’. That’s why we had these two stages in [most of our Italian workshops] … you would probably have a problem getting this today.

RP – I wasn’t thinking of that as something that we could do now. But let’s put it in an ideal situation, if you like. If there were to be another school with that aim – to produce an archaeological result – to produce an archaeological result – is there anywhere you would choose to do it, and would you involve the small amount of flying that we did before? [At Zadar there were eight flights, each of about one-hour duration, for the ten students.] Because that’s going to affect when you do the school.

DG – I know, but I must say that one is a political decision, and that is I would involve flying on a really small scale in order to give most of the people the experience of what it means when you’re up there moving around looking for things. Because people say, OK, I have the drone, I see down there what it is. It’s completely different. Apart from its lower height, you don’t experience it. I don’t believe that anybody who’s been just looking at the monitor has the same experience as somebody who’s been flying.

RP – Yes, agreed, and you’ve got a wider area to look at from a higher aircraft.

DG – And b) I still believe that flying shouldn’t be at the beginning, flying is after you’ve already put some effort into understanding it, using the [existing] photographs, having archaeological information, having environmental knowledge, and everything. And then you give them the opportunity to look at this perspective in vivo.

RP – Yes, and the Zadar people, I think, planned where they wanted to go.

DG – Yes, yes, it was their choice. Their preparation trajected them into that area. We just said, we can’t go beyond it because it’s too far away, because it’s too expensive, because we don’t have the time for you when we make both groups moving. There were some
limitations, but it was them deciding, within this region we’re going to take this and this and this direction. They prepared for it and then they executed that thing and eventually they got to some results.

RP – What did that cost?

DG – All together was €10,000, including flying. If I look at the Balkans; flying is expensive in Croatia, it’s 50% of that in Serbia, in Montenegro, in areas like that. Specially if I look at Serbia who has all the diversities from lowlands, from Pannonian zone like Banat, Bačka, to Danube and Tisze, for instance, Pusta down to valleys that are completely different set of landscapes. Flying would be €150, sometimes even below that, for an hour. Maybe it’s slightly more now, I don’t know, but it’s certainly more expensive in Croatia and Slovenia.

RP – I think that a reason, one reason that Zadar worked was because all the sites they were looking at were upstanding sites, weren’t they.

DG – Yes, on karst.

RP - So you could do it at almost any time of year. If you’re doing it in an area where you’re looking for crop marks, the timing is … more risky. As we found out …

DG – Yes, you’ve seen it in Požarevac [Serbia. An Arcland school organised by Darja in 2011]. But, for instance, in that context an interreg between the Romanian side and the Serbian side, if I think about what we’re doing there on the Romanian border. That would bring us – you have slight differences, slight change in times. On this side, it’s usually three weeks, four weeks, before; and on the other side you have it later. For instance, in terms of climatic change and things like that. It’s not just the weather, it’s the crops that are problematic because these are things that are subsidised. They go into mono-cultures like this yellow stuff for fuel and things like that. Sunflowers, for instance. And it’s maize. As I say, this industrial maize even showing details. Hard to say which … I would probably chunk out a bit in the north on the triangle between Hungary … I’m talking now of concrete areas … Hungary, Serbia and Romania, because they’re using the land in a different way. If we don’t have it on this side, we’d have it on the other side.

RP – Is there a convenient airport there? Airfield.

DG – You have four airports. At least on this side … there’s no shortage of airports there. I don’t know for other areas, I’m just talking from my own experience, what I know, but I would go for this archaeological thing. Definitely. And rather take locals from, let’s say three countries, than go into the other workshops from all over the world who have no idea in terms of environment, and historical landscape, what we’re talking about.

RP – If we take them from three different countries, you have three different chances of sponsorship, as well, haven’t you.

DG – Yes, definitely.

RP – So what I would like to do is to actually try and get this written out in some way so that we… Because you will remember, or I will certainly remember because I’ve spent years
kicking AARG to do it, that because we’ve got so much money we are open to ideas for projects. … produce a project design of some sort for this. Just to send off and say …

DG – Yes, but I would … in a project design I would go for … co-financing rather than an AARG project. AARG projects would be the school, but the co-financing should cover, or could cover, part of the expenses there. But it gives it the bottom line, or the beginning, the raw data for working on later on.

RP – That item would fit how AARG would like to spend its money – I’m only guessing now – rather than spending all the spare money on one project in an obscure part of the world. Yes, if they could contribute, if they’re up for half of it…

DG – And as I say, at the same time you could ask for an interreg, in that sense. They are short-term things.

RP – What about the idea of students paying towards this? Because we haven’t done that in the past, have we?

DG – Yes, we were … €120 was for Zadar. Yes, they’ve always paid something. It wasn’t much but it was always paid. Maybe the first schools, not, but later on they always paid. We were trying to keep it low, especially going east was an attempt to keep it at about €100. The travelling costs were the first thing that we never covered. People coming to and going from.

RP – Which is often a higher cost than accommodation, isn’t it.

DG – That’s why it makes sense that you also take the people from a certain area, so they don’t have this enormous travel cost, and being plunged into something they don’t understand.

RP – So is there, in the area you proposed, is there that catchment of people? Or people studying that area? They don’t need to come from there, do they?

DG – No, but in this sense it would probably be an … upgrade from what we had in Zadar version, or for the people that were that were in Požarevac. I’m talking about Szilamér [Pánczél], Sándor [Berecki] – both attended the school in Serbia in 2011], people from Hungary …

RP – Yes, selected people from there.

DG – Yes, you know they would probably bring, or at least, if they wouldn't want to come they would probably let someone else participate. We never targeted Timişoara University [SW Romania] which is closer to the area where we were, for instance. The Danube part, and things like that. Because in this context, the next question is, what do you want to do with Gabor [Bertók, from Pécs, Hungary]? He has a real knowledge of this southern area. He could come in as a teacher, as someone invited to present their results …

RP – Guest lecturers. Like we did with Uroš [Stepišnik, a geologist who guested at Zadar].
DG – Yes. And it makes sense because if you are going for some sort of basic results, it’s for the locals as well. It’s for them to appreciate it, to maybe find that it was something they would want to proceed working on if it’s a base for all their field people. I did it with people from Kikinda [Serbia]. They had this bronze age thing, this early bronze age thing and they did a site and monuments record and they published it in a book. And they have an iron age settlement on top of it and Neolithic one on a lower terrace. And they said, “Here are the finds, and here are the finds, and here are the finds, and here are the finds, and here are the finds.”, and I said, “Why didn’t you see that you have a settlement that is exactly the same as most of the bronze age settlements around it?” It is just partly destroyed with an old sand quarry but you can see it actually. It’s a complex that goes from Neolithic to iron age and it’s all around. They did fieldwalking and numbered it, ‘location 1’, ‘location 2’, and three locations were one … if you looked at the Google [Earth] and the Geoserbia thing [geoportal] … one settlement, and we knew because of the comparative things that it was bronze age.

RP – That’s a good example of not looking at what you should do.

DG – They were doing geophysics on the top of it. You have from the late 40s and beginning of 50s, three or four trenches on this iron age thing. So it’s just piling up. Just looking at it from a different perspective. And I said, “You’ve published the book. Now, the four locations that you had down there, you put an aerial photograph next to it and you say, ‘this is this type of settlement from the early bronze age’.”.

RP – Have they really published a book without saying that?

DG – No, they couldn’t say it because they looked at aerial photographs that were taken at a time when the ramparts of the iron age things were visible. You know?

RP – Ah, and covered the other stuff?

DG – Yes. No, no, they didn’t cover it, the bronze age is underneath. These ones [that show the bronze age site] are soil marks, that one [showing the iron age features] has … oop, oop, oop, oop .. humps and bumps.

RP – So it was pure chance that the quarrying had got down to that depth? That makes it clearer.

DG – Things like that. And of course when you have this … people that are so interested and that are doing this detailed work in their regional area and you suddenly show them that even though they found things here, and things here, and things here. Just step away for a few moments, and try to look for better, more appropriate, photographs. And if you don’t know how to find them, or when they were supposed to be taken, ask.

RP – Well, yes, if they know who to ask.

---

1 The idea that leads from Darja’s comment above is that on the last day of the school we have the project presentations in front of an invited audience of local archaeologists. Some of whom may have provided field data for the aerial projects to enhance.
DG – Yes, yes, of course. So, these are the possibilities that you have, and it gives the locals – the local museum, the local heritage office, because most of the people are in the heritage office, they are inspectors. But the inspectors published this book. Let’s go from there.

DG – Flying would be just a bonus, if the time is right. But it must not necessarily be there. There’s a lot of pictures available in Digital Globe, Terraserver, things like that, and in Geoserbia. And one could get back to the museum, the war museum in Belgrade, to get the old pictures that are stored there.

RP – I haven’t heard if the Romanian vertical surveys have been put somewhere.

DG – Yes, they have a geoportal.

RP – OK, I thought there was a separate site.

DG – No, there are two sites: the geoportal with bla, bla, bla, and then you have the aerial photography which is regional. You have, for this year we do this bit, and in that year we do that chunk. Exactly the same as we [Slovenia] do. We need three years to cover all the country in verticals.

RP – There’s older stuff as well. I think it is available somewhere, maybe not in the geoportal, I’d need to ask either Carmen [Miu] or Ionut [Sandric].

DG – It certainly is. I would probably ask the people from Timișoara because they are the regional centre.

RP – Because this is stuff, when I first went to cIMeC to do things, it may have been 2005, APs were still secret and we weren’t supposed to be shown them …

DG – But these are not things that are in Bucharest. These are things that are local.

RP – OK, the Bucharest collection I think is on the internet somewhere.

DG – Yes, yes, as I say, there is a geoportal. I don’t know, for a few years …

RP – Beyond the geoportal.

DG – I’ve never looked for that.

RP – I think Carmen spoke about it but, yes, it may be regional.

DG (getting up) – Let me go there and fetch this. I think I have some pictures on my little tablet.

RP – Do you want half a can of beer?

DG – OK.
Searching for remains of the Great War – prisoner of war camps in Poland in perspective of aerial prospection

Mikołaj Kostyrko¹ and Dawid Kobiałka

Introduction

This article discusses and presents the recent outcomes of aerial prospection conducted with different platforms over former prisoner of war (POW) camps dated to the First World War that are located at the territory of contemporary Poland.

For a few years now our interest has been focused on former POW camps constructed during the First World War by the German Army. The sites were built in order to imprison the Triple Entente soldiers. It is calculated that over 2.4 million people were held as prisoners of war in Germany between 1914 and 1919 (Jones 2008). A special system of camps was scattered all over the German Empire. From over 175 of such facilities at least 32 were functioning within the borders of contemporary Poland (Bączyk 2015). These were within the scope of our studies. It has to be pointed out that there is a poor archaeological knowledge concerning the state of preservation of such kind of sites. Although we are not the first to conduct archaeological research on this subject in Europe (e.g. Corkill 2013; Demuth 2009; Griessel 2016; Newell, Winser 2011), none of the previous studies seriously assessed the potential of aerial prospection for recording and analyzing Great War POW camps. With one exception (Demuth 2009), remote sensing data never had any significance in studies of these archaeological sites. In contrast, this kind of data were crucial for our research. For example, the analysis and interpretation of Airborne Laser Scanning (ALS) derivatives, historical and recent aerial photos allowed us to discover and map over 450 archaeological structures related to a camp near Czersk. Indeed, the former Kriegsgefangenenlager Czersk (Kobiałka, Kostyrko, Kajda, 2017a, 2017b) occupied most of our attention and became a founding stone for the development of our interest in an archaeology of the Great War (see also Kobiałka 2018).

Not all of the former POW camps now survive in a state that allows application of remote sensing data with success. Oflags (Offizerslager) often reused older buildings (i.e. castles or fortresses) whereas camps for other ranks had to be constructed from scratch. These camps, in contrast to Oflags, were usually planned to detain a larger number of prisoners and became the focus of our study. Furthermore, it was not unusual to adapt military barracks or military training grounds to imprison soldiers of the Triple Entente. Most of the camps were swiftly dismantled after the Great War and their parts were often reused by local communities or by the army. In rare cases, some of the buildings were also used during the next military conflicts. For example, the Polish Army interned Russian and Ukrainian soldiers between 1919 and 1921 in Tuchola and Strzalkowo – former German camps from the First World War. Similarly, some also served as POW camps during the Second World War – e.g. Kriegsgefangenen Stammlager der Luftwaffe 3, Sagan well known form ‘The Great Escape’ movie.

The majority of the Great War POW camps in contemporary Poland have been reshaped by different events in which the changes were so great that the use of archaeological non-invasive techniques seems to be impractical. Just a few of them now survive in forms that give the possibility of successful identification on remote sensed data. Furthermore, only a

¹ mikolaj.kostyrko@uni-bamberg.de
handful of them is covered with vegetation that potentially could be helpful in indicating underground archaeological features that may be recorded on aerial photographs. Nonetheless, while studying historical aerial photographs, we have identified numerous cropmarks which we have connected with buried relicts of former POW camps in Czersk, Tuchola, Czarne, and Strzałkowo (Łężec). For contemporary aerial prospection we had to exclude the site in Czarne from our group as it is still a military protected area and most of it is covered by the forest (Error! Reference source not found.). Archaeological features from Czarne have also a different history than those from the other sites. An impressive state of preservation of the camp’s dugouts seems to suggest that the structures were not deliberately dismantled and erased to the ground after the war. Remains of the dugouts (in German *Erdbarracke*) – a kind of wooden barracks that were dug for 1.5 m into the ground – are still clearly visible on ALS-derivatives (Error! Reference source not found.). Concerning Czersk, Tuchola and Strzałkowo camps, the infrastructure was removed at the beginning of the 1920s when the last of these facilities finally closed. Most of the ground in the camps at Tuchola and Czersk was deliberately levelled and was soon reforested, agriculturally cultivated or slowly overbuilt by houses.

In the next part of this paper, we will analyze data gathered during aerial surveys conducted in 2017 and 2018 over former POW camp sites at Strzałkowo, Czersk, and Tuchola. The same research question was raised apropos of the camps – do relicts of POW camps used during the Great War still survive despite different acts of human pressure on them?

![Figure 1. Czarne (Hammerstein) – on the top left, photo numerous cropmarks can be spotted (blue arrows). It is easier to acknowledge their existence once we examine the DTM (SVF) on the right. Worth noticing is the fact that the pattern of dugout relicts is visible under the forest canopy (blue arrows indicate one of the features, data source: CODGiK). Left bottom prisoners standing on top of dugouts (after: Doegen 1921, 38), right bottom a virtual reconstruction of a dugout based on remote sensing data, photos depicting Kriegsgefangenenlager Czersk and Tuchel (Doegen 1921, table 9).](image)
Case studies and aerial prospection

Gefangenenlager Stralkowo/ Obóz Jeńców i Internowanych nr 1 w Strzałkowie

The site of Stralkowo lies in an agricultural area near the small village of Łężec in Wielkopolska province. Łężec was located at the very state boundary between Germany and Russian Empire. Shortly after the war began, right by the customs office which once stood here, a POW camp was erected at the site, known as Gefangenenlager Stralkowo. A detailed plan of the facility was drawn in 1920 when the Polish Army was reconstructing its water management system, by that time it was named Obóz Jeńców i Internowanych nr 1 w Strząłkowie (Figure 2, right). A few postcards depicting prisoners as well as the camp’s infrastructure survived and helped guide our search of remote sensing data. The outline of the camp is not visible in the landscape anymore but fortunately, a cemetery where dead prisoners were buried still exists. Its location became a trustworthy reference point for our research. The research was carried out to find whether the traces of the camp’s facilities have survived over the years, as its infrastructure itself did not seem to be durable or resistant to change over time. One has to bear in mind that the life of a POW camp in this place was only a short hiatus in agricultural cultivation of the local landscape (Figures 2-3).

Figure 2. Łężec. Aerial photo taken in 1941 (left, source: NARA) – blue arrows indicate an outline of the former camp; white arrows indicate selected archaeological features registered as positive cropmarks. Plan of the camp drawn in 1920 (right, source: Head Office of the State Archives) – rectangles indicate areas where cropmarks were identified during the 2018 prospection, green rectangle – a former hospital area, red rectangle – living quarters (ward VII A).

On the 1941 aerial photo, we have found some cropmarks which might indicate the outline of the camp as well as some of its internal structures (Figure 2, left). We then searched for additional data to validate this interpretation. We inspected other historical aerial photographs in various Polish national archives that had been taken in the second half of the 20th century or more recently. Unluckily most of them were not taken in favourable conditions for archaeological prospection. There was a possibility that, due to human pressure
on the camp’s traces, all of them had been erased from this landscape, although from 2015 we have been monitoring this location from an airplane or using a UAV in the hope of documenting any archaeological features related to the camp. Aerial prospection conducted in 2018 finally brought expected results and we have documented numerous positive cropmarks relate to the camp’s structure (Figures 4-6). We were able to recognize the same pattern of traces known from the 1941 photo in the south-western corner of the area where the camp once stood. Equally of note, a different part of the former POW camp infrastructure can be seen on Google Earth satellite imagery taken at the end of May 2018 (Figure 7). These cropmarks pinpoint camp’s zone where the dugouts were placed. Additionally, new features were identified in the northern part of the inspected area (Figures 2,4,5). Unfortunately, we are not sure what kind of buildings stood in this area. One possible interpretation is that they belonged to the hospital ward. Although we are familiar with the plan from 1920 (Figure 2, right), one has to remember that changes might have been made within the camp’s internal infrastructure during its functioning. A preliminary conclusion of our research is that traces of the former camp’s infrastructure still exist and the aerial perspective can be a useful way to document them.
Figure 4. Łężec. Areas indicated by rectangles refer to the previous figure. White arrows indicate positive cropmarks – traces of POW camp’s structures. (Photo: W. Rączkowski, 9 July 2018)

Figure 5. Łężec. Close up of the former hospital area outlined by a green rectangle in Figure 4. Numerous positive cropmarks can be identified in the photo (white arrows), but only few of them seem to resemble the outlines of buildings. (Photo: W. Rączkowski, 9 July 2018)

Figure 6. Łężec. Close up of the area indicated by the red rectangle in Figures 3 and 4. White arrows indicate positive cropmarks – probably the remains of dugouts. (Photo: W. Rączkowski, 9 July 2018)
Figure 7. Łężec. Positive cropmarks seen on the satellite imagery taken on 23 May 2018. The blue rectangle refers to fig. 6, white arrows indicate selected archaeological features – relicts of dugouts and part of a road. (Source: Google Earth)

Gefangenenlager Tuchel/ Obóz Jeńców i Internowanych nr 7 w Tucholi

Our study of the former POW camp at Tuchola was helped by maps that had been prepared in 1916 and 1920. Today most of its area is covered with houses. However, the northern part of the camp is forested which is the reason why remains of more than 200 of the camp’s structures are still preserved (see more in Kobiałka, Kostyrko, Kajda 2017b). Until recently only the very south-eastern corner had not been overbuilt and retained features of the POW camp – traces of square-shaped dugouts – which fortunately, had been recorded during an ALS data collection in 2012 (Figure 8, left). A few years later in the same place, newly built houses with their small lawn (garden) areas can be observed.

Figure 8. Tuchola. On the left is a DTM (superposition of Multi‐Scale Integral Invariants over Hill‐Shade model, data gathered in 2012), on the right a contemporary aerial photo (2016) of the overbuilt POW camp on which is shown our interpretation of the DTM in orange. The red rectangle indicates our study area in 2017‐18 (Source of data: CODGiK, geoportal.gov.pl).
In this case we had a high level of certainty of what we were seeing on remote sensing data. While inspecting historical aerial photographs, we did not notice any indications or possibility of the former POW camp's ‘layer’ to survive this change within the landscape. Based on this experience, we were expecting that archaeological features survived only in the digital world as a point-cloud data. A short prospection conducted in the middle of August 2017 with a UAV proved our first assumptions to be wrong (Figures 9-10). We were able to document three features that we previously identified while interpreting the DTM while others were obscured by the change in land development. Some of the dugouts’ remains were most probably completely destroyed. However, two new possible structures were spotted through positive cropmarks. We carried out our next research in the middle of July 2018. Unfortunately, lawns were too dry for any cropmarks to appear with only one or two exceptions, where one of the features was newly mapped the year before (Figure 11). Although we are not able to validate this feature, as it is not visible to us on other types of data, we can state that there is some kind of sub-surface anomaly which impacts the state of plants that grow above it. Interpretation of the contemporary camp landscape was a challenge to us and we have to keep in mind that these small modern plots of land are being maintained in different ways and they have also a different recent history (house building phase). Both of these processes had affected what we interpreted as positive cropmarks on lawns in this area.

Figure 9. Tuchola. LAAP taken with a UAV on 14 August 2017. For the wider context see Figure 8 (Source: authors).

Figure 10. Tuchola. White shapes indicate positive cropmarks visible on Figure 9, black shapes are derivatives of DTM interpretation (Source: authors).
Gefangenenlager Czersk

In the middle of June 2018, a UAV was deployed to photograph part of the former Gefangenenlager Czersk. The idea behind the research was to take new aerial photographs to compare with others taken in 1964 (Figure 12, left). Analysis of the historical photographs showed a regular group of rectangular features in the south-east compound that documents showed to be Lager 6. The historical documents collected at the National Archive in Bydgoszcz, Poland confirm that the camp consisted of several separate compounds (Lager 1-6, Lazarette 1-2, cemetery) of which four are recorded on a simple plan of the camp which outlines its middle parts.

Today the former camp’s area is either forested, overbuilt or serves as meadow and only the south-eastern corner is cultivated (Figure 12, right). We were hoping that the last 50 years of land use had not erased all traces of the camp in this area and we were expecting that the dry summer of 2018 would enable us to acquire new data that would enable us to corroborate the conclusions we made from the 1964 photo. Unfortunately, we were not lucky with what we found in the Lager 6 research area. The northern part was an unkempt meadow and the southern part was partly overgrown with a plant that was strongly affected by the drought (possibly lupin or a red clover) on the local sandy soil. Only the middle part seemed to have potential for cropmarks that may indicate possible archaeological features (Figures 13,14). The results of this low altitude aerial prospection were ambiguous. We were not able to identify any distinct patterns of anomalies that could be interpreted as caused by archaeological features although comparison with our interpretation of the 1964 photo showed that in some parts greener patches of crops were place in the similar place.
Figure 12. Czersk. On the left, a historical aerial photo from 1964 (source: CODGIK) and its interpretation. On the right that interpretations overlain on contemporary photography (2016). The red rectangle indicates the research area in Lager 6 (source: geoportal.gov.pl).

Figure 13. Czersk. Orthophotomap of the research area derived from UAV prospection conducted on the 13th of July 2018 (Poland CS92, source: authors)
Summary

This article discussed and presented the recent outcomes of aerial prospection of former POW camps in Strzalkowo, Tuchola, and Czersk. A century has passed since the camps were closed, dismantled and razed to the ground. It seemed that such facts as the short life of the camps, the use of a local soil to backfill the dugouts, and the reversion to agriculture or other land use make it impossible to successfully apply aerial prospection. Each of the discussed camps has a different history of using and later re-using of the local landscape. However, the use of aerial prospection enabled to identify cropmarks which can be interpreted as the camps’ heritage.

Figure 14. Czersk. Interpretation of cropmarks seen on the orthophotomap. Blue arrows indicate where cropmarks appeared on the 1964 aerial photo. White arrows indicate cropmarks not connected with archaeological features. Red arrows indicate places where potentially archeological features could be placed (Poland CS92, source: authors).

The 2018 year will be remembered in most parts of the Europe as a dry one, bringing good conditions for archaeological aerial prospection (Figure 15). This has not proven to be
true for two case studies presented in this paper. The drought was so strong that the plants overgrowing our research areas in Tuchola and Czersk had dried to a point where they were no longer effective indicators of buried relicts. Interestingly, the first prospection with the use of UAV in Tuchola (Figures 9, 10) was made during seemingly not preferable conditions on 16 August 2017 (Figure 15 – middle image). We can suspect that the cropmarks were either caused by the previous dryer months or, what seems even more likely, specific local conditions.

Acknowledgments
Work conducted by Dawid Kobialka is a part of his research financed by the National Science Centre, Poland on the basis of decision no. DEC-2016/20/S/HS3/00001.

Bibliography
Drones + images = archives?

Rog Palmer

For at least the past ten years, AARGnews has included articles and comments about drones/UAVs and their uses in archaeological work (e.g., from Collie, et al, 2009 to Hickie 2018). Most of these articles concerned taking or processing images or using the results. But what happens to the images once those results have been achieved? Are we in danger of losing aerial images that may hold unique information and how should we make efforts to ensure curation of these in accessible archives?

In the summer of 2018, dry conditions that occurred over much of the UK and mainland Europe led to a surfeit of crop-marked information and, in cases, calls for help to drone operators to help record them (AARGnews 57, passim). The focus of those calls for help concerned image capture and there seemed to have been no (published) thought given to image storage other than a germ of an idea in AARGnews 57 (5). It would be nice to think that possibilities for future access were included as part of some requests but, as ever, the excitement of discovery outweighed the tedium of archiving the results. During the February committee meeting, drones and image storage was an item on the agenda, discussed then and at other times during our stay in Constanţa and by follow-up emails after our return. It was suggested, rather grandly, that AARG should coordinate standardisation of image storing and that led to additional contacts being made after that meeting. (See also ‘Chairman’s piece’ in this issue.)

Independently of AARG, the Welsh Commission had already published its policy for accepting images from drone operators which included the requirement that they needed to hold a valid Permission for Commercial Operations (PfCO) and provide evidence of permissions and insurance (RCAHMW 2019). Historic Environment Scotland (HES 2019) publish advice on requirements for requests to use UAVs at ‘our sites’ and that links to a longer guidance note (HES 2019a; b). Neither of the HES notes mention archiving of still or moving images. Historic England’s website includes a note about drones, including a link to the relevant CAA regulations, but says nothing about archiving the resulting images (HE 2019). Northern Ireland’s Historic Environment Division is similar, discussing the official requirements for flying but making no mention of any resulting images (HED 2019).

That was more-or-less all I could find written in English and seems to show that only RCAHMW is ready to accept a specific and restricted selection of drone images. Although one could suppose that if these had been taken by commercially licensed operators the task would have been done for a reason that was not necessarily to be given away to the local heritage organisation. To deposit images with RCAHMW, it is necessary to register and accept conditions laid down by the host organisation. I glanced at these and saw no mention of copyright, whether this was retained by the photographer or stolen by the host. HES have a ‘My Canmore’ part of their archive through which registered people can deposit images. This already includes a small number of images and photo-mosaics taken using a drone whose metadata suggests that copyright has been assigned to the host.

---

1 rog.palmer@ntlworld.com
2 Thanks to Dave Cowley for talking me though this during a phone conversation.
If other heritage bodies follow the Welsh lead, are we beginning to dig ourselves into a hole from which a useful source of aerial information is being excluded? Better, I would suggest, would be to lighten the ‘PfCO only’ regulation to consider anything acceptable that had been taken within CAA rules and with any other necessary permissions as that opens the potential sources to include the amateur operators who may themselves be more amenable to collaborating with archaeologists without the expense of commercial licensing. In future, as happened occasionally during summer 2018, target sites and areas may be proposed to drone operators by professional archaeological organisations who, presumably, will be given copies of any resulting images. Professionals could also engage further by suggesting research projects as, for example, may be pursued through frequent repeat flying that would not be affordable using light aircraft (e.g., Hickie 2018). With any such schemes, the idea should also be planted that a selection of images captured would be offered to heritage archives for use by others. If these are taken under CAA and other relevant regulations and permissions, I see no reason why they should not be welcomed as a source of information by archaeologist-users.

A further question is to ask which images should be offered to archives? A drone mission may produce several hundred localised images which software can combine into one composite orthophoto that may (must?) also include control information to allow geolocation. If I were an archive, I think I’d go for the single finished image rather than the bits that made it, in much the same way that most current GIS users of vertical photographs include the combined orthophoto rather than the individual image tiles.

In preparation for writing this note, I contacted several others to ask if they knew if anything was being done or was planned about archiving images from drone operators. One organisation, The Council for British Archaeology, had already been thinking about it initially thought that local HERs may be the right place – but they are overworked and understaffed. Their second thought was that perhaps the ADS (Archaeology Data Service) may be a good place for drone images. I thought that ADS may be a good choice because they archive a lot of grey material and drone images may fit that description. However, contact with Katie Green, ADS Collections Development Manager, made it clear that there would be huge costs associated with this and that they would expect the bureaucracy involved to be done by an outside party before images were submitted. If this did become a last resort, the good news is that images held by ADS can be seen immediately and are free to download, which is quite a contrast to using UK’s national archives.

I emailed Carenza Lewis, the person who called for mass drone cover in Britain last summer, but had no reply. Perhaps she has already explained everything on her blog or facebook page? Also in Britain, I had no reply from Historic England archives. Out of Britain, collections of APs tend to be kept by the persons who took them, or their organisation, so we have aerial photographs but no drone photographs. Perhaps more than in the UK, drone operators have their own agenda and do things for themselves or at the request of other individuals and, once done, the job is considered to be complete. However, more than one person I contacted was aware that information may be lost because of the lack of contact.

---

3 Emails with Mike Heyworth, CBA, November 2018-February 2019.
5 Email, 25 February 2019.
As we learned with conventional archaeological aerial photography, discovery and photography are the first steps in the sequence of understanding what has been found. With drone photography, we have had (in Britain) Carenza Lewis asking all drone operators to go out and discover sites, Channel 4 making a hour-long programme on discoveries from summer 2018 (see AARGnews 57, 24-5) but with little interest in what happens to the photographs/images of those discoveries. With archaeological obliques, it was the Royal Commissions who became curators for photographs taken by ‘private fliers’, with drone images there seems to be little thought given to their curation.

Obviously, AARG cannot tell national organisations or individuals what to collect but we may be able to propose means of doing this that will open eyes to the potential loss of information if they do not encompass use of drones as a valuable source of aerial information. This note may open that discussion.

Acknowledgements
Thanks to the following for answering email queries: Toby Driver (RCAHMW), Dave Cowley (HES), Mike Heyworth (CBA), Katie Green (ADS), Lenka Starkova, Moira Greig, Włodek Rączkowski, Mikolaj Kostrko.
For completeness, those who did not answer my enquiries included Carenza Lewis, Michael Doneus, Darja Grosman and Historic England (archives).

References (web links accessed early March 2019)
HES, 2019a. UAVs (Drones). https://www.historicenvironment.scot/visit-a-place/filming/uavs/
Cropmarks

Harvested by Rog Palmer

(web links were accessed on various dates between mid-October 2018 and mid-April 2019)

Use of sequential images
One of the key factors in the identification of ‘re-education camps’ in western China has been comparison of open source satellite images taken on different dates by GMV company. When you have a spare moment, you can try it for yourself using place names in Google Earth and then comparing the location on Sentinel images.
https://www.bbc.co.uk/news/resources/idt-sh/China_hidden_camps

Free ALS data (continued)
Supposed sources of free ALS data. The link is possibly up to date for USA (where the author lives) but may not be too complete for the rest of the world.
https://www.geospatialworld.net/blogs/did-you-know-the-sources-for-free-lidar-data/

Photo interpretation in France
This, it is/was a French PI magazine in 1980s that includes a series by A S Stefan on Romanian sites in 1986. I remember seeing a good quality AP with an opposite page of explanation but cannot now (October 2018) find any useful web link to it.

Photo Interprétation: images aériennes et spatiales
Published by: Éditions Technip, 27 rue Ginoux, 75737 Paris Cédex 15, France

Digital image archive
The HEIR (Historic Environment Image Resource) Project is based at the Institute of Archaeology, Oxford and, by late 2018, contains 19,000+ images taken between the 1870s and the early 21st century. It includes some 500 aerial photographs from a range of sources but seems to be a mishmash of stuff that was lurking in the Institute and has recently been scanned. The HEIR collection can be searched in several ways including basic single word, detailed querying, geographical. However, the geographical search seems to be on the nearest place name – so two of Bradford’s collected images in Apulia have a centre point in the middle of Foggia. Closer to home, geographical searches at Windmill Hill and West Kennet long barrow produced no results even though photographs of those two sites exist in Stuart Piggott’s scanned images and can be found by name search. I’m not sure what this collection is trying to achieve although it includes a lot of old images of stuff that may no longer be extant – if you can find them.
http://heir.arch.ox.ac.uk

rog.palmer@ntlworld.com
Call for writers
Currently seeking contributions is the Special Issue 2nd Edition Advances in Remote Sensing for Archaeological Heritage for the journal Remote Sensing, one of MDPI’s peer-reviewed, open access journals. The blurb from the editors seeks papers before 30 September 2019 that assess the status of remote sensing applications in archaeology and explore how their use could have a significant impact on archaeological research and cultural heritage protection in the future. Info, contact details of the editors, plus papers so far published, from:
https://www.mdpi.com/journal/remotesensing/special_issues/2ndarchaeology_RS

Professional drone
Big and expensive-looking range of drones that can carry various payloads (to 14.8kg) for up to 25-minute flights. Offers a range of sensors including camera, ALS, thermal plus software to plan flights and process data afterwards.
https://www.microdrones.com/en/

Drone art
Perhaps if hiring aircraft cost less, there would be more aerial artists among conventional aerial photographers. Having a (cheaper) drone certainly seems to bring out the vision in some operators. The link is to the 2018 entries in Skypixel’s annual competition.

Old drones
A recent news bulletin from the Imperial War Museum, London, noted that unmanned aircraft are nothing new, having been first developed in WW1 and continued afterwards. In 1935, the RAF used radio-controlled aircraft (such as the DH 82B) as targets for training. Further use of UAVs was made during the Vietnam War either as controlled missiles or for dropping leaflets. Their use as weapons continues today but their main military use is for surveillance.
[source: IMW e-news, 10 January 2019, copyright 2017]

Thermal imaging – 1
John Wells, renowned advocate of kite survey, has a facebook page devoted to his use of thermography and NIR photography. It includes examples of kit used plus results and weather information.
https://www.facebook.com/KARSensing/
[thanks to Dave Cowley]

Thermal imaging – 2
Nothing to do with archaeology, but we use similar kit for our own work. It reminds me of when CUCAP were paid by Cambs City Council to fly something thermal over the city at night to identify houses with poor roof insulation. There seems to be nothing like that in Copenhagen although we can wonder of the origin of the hot rectangles on some roofs.
https://thermalcapture.com/thermal-mapping-inspection-of-district-heating/
**Multispectral imaging**
Among the products by MicaSense is Altum, a tiny drone-sized multispectral and thermal sensor which has some potential for archaeological use. I picked up this link from the Cherish Project facebook page – they have just acquired one – and the MicaSense website includes an archaeological case study of work for a PhD being done by Henry Webber. Cost is in the region of $10,000.
https://www.micasense.com/

**Iceland pics**
Dutch photographer, Albert Dros, recently published a series of ‘top down’ photos of parts of Iceland, that can be seen in the first link below. Pretty stuff. The second link is to his website on which there are other landscape pics mixed in with the aerials.
https://petapixel.com/2019/02/14/paintings-from-the-sky-aerial-photos-of-iceland/
https://www.albertdros.com/

**Ancient settlement in Poland**
Examination of ALS in an area of the Tuchola Forest revealed a 2000-year old settlement complete with houses, roads and fields that extend over 170 ha. Some excavation has taken place, more is threatened.
http://scienceinpoland.pap.pl/en/news/news,32802,archaeologists-trail-completely-preserved-almost-2000-years-old-settlement.html?fbclid=IwAR0GwZvYFE63hTNYVFku7WfISEdSHtxtwIk_f4nWJIFmbRZbk4zZ7RW9g

**CUCAP begins(?) to surface**
An item in BBC news with learned comments by Martin Millett (prof of classical archaeology) and ‘world authority’ Robert Bewley – both of whom quote false history – makes a lot of fuss because Cambridge University Library now has a handful (1500) of photos from CUCAP on line. These include some early colour shots that Alan Martin, their last librarian, suggested to me may be the first, or one of the first, uses of colour to take obliques from the air. Correspondence shows that Kodak gave St Joseph a few films and he made them last a long time. Links below are to the BBC news item and the images at Cambridge UL. This present publicity is an attempt to attract funding to enable CUCAP to make digital copies of the remaining 498,500 (or so) photographs.
https://www.bbc.co.uk/news/uk-england-cambridgeshire-47319251
http://cudl.lib.cam.ac.uk/collections/landscapehistories/1

**Old vertical photographs of Egypt**
The EAMENA project has added a selection of RAF vertical photographs, taken in 1938 and covering land in the vicinity of Mersa Matruh, to its digital archive where they can be examined by registered users.
http://eamena.arch.ox.ac.uk/opening-up-historic-aerial-photograph-datasets-to-support-endangered-heritage-documentation-in-egypt/?fbclid=IwAR3h6VUxYQKMHHeE5FkAg1SlHIikShMc63xdvBhRzOQ1HwznFZxfF8H2c7E

**Declassified U2 photographs**
These can be of very good resolution but the U2’s cameras covered a lot less ground than the succeeding Corona film strips. Of course, the header image in this piece is upside down. See also Hammer and Ur in ‘Books and papers of interest?’
Review note

Aerial investigation and mapping of the Newgrange landscape, Brú na Bóinne, Co. Meath: The Archaeology of the Brú na Bóinne World Heritage Site Interim Report, December 2018


Following the discovery and photography of ‘dronehenge’ last summer (see AARGnews 57, 7-8, 24-25), Irish archaeologists have been active in the area and released a 138-page interim report on features within the WHS area. Their report presents details of ‘archaeological discoveries that were made in the course of aerial survey … in July and August 2018.’

The report is in four parts, giving first the background to the Brú na Bóinne area, the floodplain area and its past archaeological investigations. Illustrations show some of the results of the pre-2018 surveys. This first part also includes a brief history of aerial survey in the area together with a note on how buried archaeological features may become visible. Following the discoveries by drone, the National Monuments Service carried out a number of aerial surveys with the assistance of the Irish Air Corps. Bluesky International had taken vertical photographs the Brú na Bóinne landscape in late June 2018 which were helpful with the georeferencing oblique images as was open-source ALS data.

‘The cropmarks field’, the second part of the report, is a detailed feature-by-feature analysis of objects identified in this single 16ha field. This is illustrated with many aerial images, some annotated, some with superimposed interpretations, some naked, that show the wealth of information that was recorded and identified in a single season. ‘Dronehenge’ has also been renamed as ‘The Geometric Henge’.

Part three examines the central and eastern floodplain in the light of the new discoveries and recent geophysical surveys and excavation. Figure 72 in this part, makes the area look like a training school for henge builders as there are so many and so many variations on the theme which range from a plain boring bank-and-ditch henge to the geometrical designs.

Finally, there is a discussion and summary of the Newgrange ritual landscape that ties together the range of sites on the floodplain and includes consideration of the natural features and hence the choice of the location in the past. Illustrations add interpretative plans to topographical surface models and the text provides a 2018 interpretation of the use and role of Brú na Bóinne. This report shows what can be achieved in a few months following an unexpected discovery. A full report will follow.

Rog Palmer, 31 January 2019
Books and papers of interest?

Rog Palmer¹


Maybe Google Earth is new in China as the first part of this paper rambles on about what it is, its history, and how it works. All examples are images – not a map in sight – and the authors insist that every discovery from RS must be ‘ground truthed’. Bah!


ALS data at about 25 points/sq m was processed and visualised in various ways. Some were then further processed/enhanced using mathematical methods devised by Geary to achieve more obvious images. These (I think) provided images for subjective interpretation. For comparison, automatic feature extraction was applied to the ALS models. Then, just to be certain, things were checked on the ground and the results displayed in a map showing the four kinds of feature identified.


From the summary:
Results of aerial photography from 2000 to 2017 constitute the backbone of this study, which presents the aerial archaeological research of the late Celtic fortified settlements identified in Transdanubia, the western part of Hungary. Previously unknown fortification traces were identified, and small-scale excavation helped to differentiate more precisely between the oppida and other, smaller fortified settlements.


¹ rog.palmer@ntlworld.com
A UAV survey was conducted on 16 and 17 September 2016 in two modern fields close to the ancient city of Metsamor and its cemetery. Crop types are not mentioned, but one field appears to be grass, the other stubble. Examination of the resulting orthophoto and various processing enhancements to led to the detection of several promising anomalies within and beyond the known limits of the excavated kurgans in the burial ground. Some of these can also be identified on satellite images [dates not given, other than ‘earlier’] and so gain more credibility and are suggested as possible burials and may be checked on the ground in future seasons.


Integration of free ALS data with ground-based photography to produce SfM models of a deserted medieval settlement resulted in a new survey of a that will help management and presentation to the public. The method, about which much detail is provided, is both cheap and easy for those with access to accurate ground survey kit and the required computer power and software.


This project has been undertaken in collaboration with the American Schools of Oriental Research and the US Department of State, to monitor war-related damage (2010-2017) to archaeological sites in Syria, northern Iraq, and southern Turkey using high-resolution satellite imagery. Rather than detailing damage to key sites (e.g., Nimrud and Palmyra) the report details findings of a study to survey systematically thousands of sites across the region that have damage resulting from looting, military activity, earthmoving, construction, etc. and to do this by examining and comparing pre-war and series of recent images. A background database of the location of sites came from the previous research and atlases and resulted in about 4200 sites within the study area.

Illustrations (with north to the top) show examples of looting damage, that caused by the military, other earthmoving and new construction – usually shown as a ‘before and after’ pair or sequence. Analysis shows what we know, that looters are archaeologically aware and target sites that are likely to make their efforts worthwhile. There are lots of statistics, maps and details, plus a little discussion on use of auto-detection to find looting and this seems to have been successful where it has been applied but has its limitations when damage is of forms other than looters’ pits.

These are brief (3-4 page) items in an encyclopaedia with some cross linking to other items in the volume and with each having a short reference list. As such, they may seem slightly discontinuous as single ‘papers’. Both are unillustrated and in the first item there is space for a description of wavelengths, etc and some applications are noted. It ends with a tantalising glimpse into the future (it seems to have been written in 2016, so perhaps that future is ‘now’) and the prospect of multi-wavelength ALS. The satellite entry is useful for its comments on ground sampling distance and the effect this has on archaeological uses.

There are several other contributions in the book(s) that summarise aerial aspects at the time of publication. Make friends and ask for pdf copies as this four-volume Encyclopedia costs £527 from Amazon and Oxbow. You can browse by topic (for example: aerial photography; airborne remote sensing; airborne laser scanning and lidar) and find those friends at: https://onlinelibrary.wiley.com/doi/book/10.1002/9781119188230


Use of satellite images to reconstruct systems of water management in Northern Mesopotamia. The stereoscopic facility of declassified Corona photographs was especially useful to reconstruct high-resolution DEMs to show the form of the terrain. Many of the hydraulic systems identified had been lost or damaged by more recent agricultural modifications to the land.


Google translates the title as Past: The History of Air Archeology and the book only exists in Hungarian. A list of contents can be read in the link below.

https://www.academia.edu/37923423/Rep%C3%BCl%C3%A9s_a_m%C3%BAltba_A_l%C3%A9gir%C3%A9g%C3%A9szet_t%C3%B6rt%C3%A9nete


The authors’ abstract tells us that the paper focuses on the exclusive use of free remote sensing data by the Western Harra Survey to investigate the arid “Black Desert” of north-eastern Jordan. Systematic analysis of such data prior to the commencement of fieldwork allowed for the precise planning of ground surveys, with advanced knowledge of which sites were vehicle-accessible and how to efficiently visit a sample of different site types. By subsequently correlating ground data with this analysis, it was possible to create a typological seriation of the site forms known as ‘wheels’, determine that at least two-thirds of sites are within 500 m of valleys or mudflats (highlighting these features’ roles as access routes and resource clusters) and identify numerous anthropogenic paths cleared through the basalt for site access and long-distance travel. These results offer new insights into this region and allow
for supra-regional comparisons with better-investigated areas by a method that is rapid and cost-effective.


The authors’ abstract tells us that satellite images can be used to document sites in areas that are distant, dangerous, or expensive to visit, and they can be used instead of basic fieldwork although their resolution of 35–50 cm can be limiting. This project used very high resolution satellite data and super resolution data from drone in an area near Palpa, Peru. Use of a drone to capture high resolution images has provided new details including previously-unknown geoglyphs of a bird, a guinea pig, and other small drawings. The new data shows many other details, unseen from the surface or from the satellite imagery, and provides the basis for updating current knowledge and theories about the use and construction of geoglyphs.

It’s worth looking at Figure 9 of a childlike geoglyph of a guinea pig, poorly digitised by the authors, but you’ll get the idea.


This is nothing directly to do with archaeology but the paper examines the potential of cube satellite (eg [www.planet.com](http://www.planet.com)) observations (3m resolution) to estimate evapotranspiration in arid-landscape farming and for the results to be used to control watering from the central pivot of individual fields. It raises the possibility that farming of the future may be able to eliminate crop-marked information – or perhaps to enhance it if we ask nicely.


The authors used this as a test case for evaluating the effectiveness of open source Sentinel-2 images to identify a Roman road and anything possibly archaeological in its vicinity. Evaluation of different bands, singly and in combination, plus use of algorithms identified NIR + Red as good [no surprise there] as was use of an adapted orthogonal equation called Crop Coefficient 3. Roman roads are big linear things and so ought to be readily visible, in the right conditions, on lowish-resolution images – and this was the case. Other crop-marked sites were identified and the whole lot was checked on the ground.

The two sentences below, taken from the second of two pages numbered as ‘2 of 18’, highlight problems of using aerial sources from a range of collections, as was initially intended for this project. They should be waved at the possessive, security-mad, money-grabbing people who currently curate some of this stuff in ways that make it impossible to undertake effective uses of them:
The itinerary, extended on an overall distance of 650 km, crossed five different countries: Italy, Slovenia, Croatia, Bosnia Herzegovina, and Serbia. Providing an exhaustive documentation of aerial images has raised, on its own, several issues in terms of delivery time of the materials and of their availability to the public, together with the problem of the dispersion of the documentation in different institutes and countries with different policies for the use and publication of the data.


This article includes a lot of beginners’ stuff about ALS in a summary of surveys undertaken in the last decade that are helping establish population numbers in the former Maya lowlands. In this case, ALS surveys have allowed some archaeologists to climb down from their little excavations of hierarchical sites and see and count the number of peasant structures (and so on to population) that were necessary to keep the upper classes alive.


Aerial images provided the background on to which the 1-inch to 1-mile maps resulting from the Survey of India were geolocated. The paper goes into details about the survey, its conventions and what was and was not mapped and the documentation (manual for surveyors) telling how to depict things. Thus, it came about that the maps show many mounds, some now destroyed or damaged, that could be checked on the ground for archaeological potential (see following article).


Use of historical sources, including old maps (see above article), and remote sensing to examine riverine dynamics and their influence on human settlement. I’ve included these two articles as a way of showing that archaeological uses of aerial images/remote sensing go far beyond photographing the odd crop mark.


Use of classified modelling to identify former water features. The methods and thinking may be of interest to those trying to develop auto-detection methods for things other than circles.

Secrecy, especially that of the military, means that some facilities were ‘hidden from view’ during their active life but whose surviving material remains may now be examined. This research project combines historical cartography, archived aerial photographs, declassified satellite imagery and ALS to investigate three Cold War nuclear storage sites in western Poland. Greg’s investigations included documentary searches to discover why the stores were established where they were and how they were built; what happened after abandonment; use of ALS visualisations and Corona images to examine phases of activity; and ground visits to see what is left now. Altogether it makes an excellent story of detection and understanding and may lead to the sites becoming protected if national mentality will allow that.


Although it is two years old, I think this is new to *AARGnews* and shows what can be done if you have the ideas, money and resources to match old images to specially captured ALS data. The project is in Western Sicily and includes the comparison of a series of historic DEMs generated from old aerial images (1941, 1955, 1975, 1992, 2016) with that from recent results include evaluation of the landscape – both natural and anthropogenic – and the authors’ identification of topographic change provides a demonstration relevant to anyone working in active countryside. Effects of topographic change are also noted with regard to the preservation/destruction of archaeological contexts using illustrated case studies that examine changes over the last 70 years.

The paper includes content on some of the technical aspects involved, problems with using old images and matching these to a modern ALS base, and detailed notes for each case study. Discussion identifies some of the technical issues and cost (time, equipment and processing power) then moves to the value of understanding how perception of geomorphological changes can help our understanding of archaeological contexts. This kind of approach has potential in areas where significant and rapid change occurred during the period of available historical aerial photography.


Australia discovers archaeological uses of UAVs, concluding: “Drone technology has the potential to make substantial contributions to cultural heritage management outputs and outcomes, and the capabilities of most commercially available models are well-suited to the dynamic working environments associated with archaeological fieldwork.”

A muddily theoretical review of what I take to be a theoretical, possibly muddy, book: Caren Kaplan, 2018. *Aerial aftermaths: wartime from above*. Duke University Press, 312 pp, $27.95 (paperback), ISBN: 978-0-8223-7017-8. It may be of interest to one or two AARG members who may then like to submit a clear(er) review.


A short autobiography of Bewley and a longer part about the EAMENA project and what it has achieved to date with a focus on medieval period sites and some examples of recent destruction by war and looting.


Examination of ALS data (with some field checking) showed a prehistoric landscape comprising enclosures, tracks, field systems (both brickwork and irregular) and cairn fields in an area of the Slovenian Karst where previously hillforts had been studied in isolation. This case study … ‘proves a vivid example that prehistoric landscapes were not empty spaces between settlements, but full of features and evidence of daily activities.’


This paper is in two parts with the first describing characteristic of cameras and film used and the missions that are currently available at NARA. Plus ways of finding the pics you want, as geographical finding aids are still classified and matching flight tracks to images is a separate problem (p.6). However, the authors include a table listing 11 missions with comments and a link to an ArcGIS index which gives a good idea of locations that may have been photographed. This seems a very helpful guide for potential users and it ends with a page (10) showing how NARA, a friendly helpful archive, lets its users copy material – UK archives take note please. Case studies look at prehistoric kites in Jordan, first millennium BC water management in Iraq and spatial ethnohistory of marsh communities in S Iraq.

U2 images are of higher resolution than Corona (although they cover much smaller areas) and can be up to a decade earlier.

An assessment of the ability of the LDAS-Monde platform’s (a land data assimilation system developed by Météo-France) sequential assimilation of satellite-derived surface soil moisture and leaf area index to represent the impact of the summer 2018 heatwave in Europe on vegetation. This is a fairly-technical paper and, in parts, uses more acronyms than words, but it may be of interest to those of us who rely on vegetation to indicate the presence of buried archaeology. I’m not sure if information from this satellite can be used in conjunction with that from Sentinel 2 to help short-term predictions of when to fly.


Examining ways in which flight planning, angle of view, number of GCPs and other things can affect the accuracy of surface models generated from UAV surveys. Maybe of interest to any of you needing centimetric accuracy.

Verschoof-van der Vaart, W.B. and Lambers, K., 2019. Learning to Look at LiDAR: The Use of R-CNN in the Automated Detection of Archaeological Objects in LiDAR Data from the Netherlands. *Journal of Computer Applications in Archaeology*, 2(1), 31–40. DOI: [https://doi.org/10.5334/jcaa.32](https://doi.org/10.5334/jcaa.32)

The paper is based on results of the first year of a PhD project by the first author that has used a technique based on R-CNNs (Regions-based Convolutional Neural Networks) for automated detection of round barrows and Celtic fields on ALS data covering part of the central Netherlands.


More work developing methods for multi-class archaeological object detection (round barrows, charcoal kilns, Celtic fields) in LiDAR data based on convolutional neural networks.


The authors provide a ‘recipe’ and tool to mix visualization techniques and blend modes to compute a visualization for archaeological topography that meets all the criteria of a good visualization.
The Aerial Archaeology Research Group

AARG sees the aerial perspective as integral to the pursuit of key questions in archaeology and heritage, including landscape character, long term landscape change, human ecodynamics, and the experience of place. We are a community of heritage professionals, researchers, students and independent scholars dedicated to education, research and outreach initiatives involving the acquisition and application of data from airborne platforms. AARG provides opportunities for networking, mentorship, and exchanges of ideas on theories, methods and technologies related to aerial archaeology. The organization supports an annual conference, workshops, training schools, and publications.

Membership is open to all who have an interest or practical involvement in aerial archaeology, remote sensing and landscape studies.

AARG is a registered charity: number SC 023162.

AARG homepage.  http://aarg.univie.ac.at/

Membership/subscription rates:

<table>
<thead>
<tr>
<th>Category</th>
<th>Individual</th>
<th>17.00 Euro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual</td>
<td>£15.00</td>
<td>17.00 Euro</td>
</tr>
<tr>
<td>Students</td>
<td>£10.00</td>
<td>12.00 Euro</td>
</tr>
<tr>
<td>Institutional</td>
<td>£25.00</td>
<td>29.00 Euro</td>
</tr>
</tbody>
</table>

Subscription reminders may be sent out on January 1

Methods of payment:
- Standing Order mandate /Electronic funds transfer
- PayPal
- Sterling or Euro bank notes

Bank details are available on request for direct payment from overseas.
Please contact the Secretary: aarg.secretary@googlemail.com

Copyright. Copyright © in AARGnews rests with the individual authors.

Student scholarships. AARG has a limited number of student scholarships for attendance at its annual meeting. These are aimed at supporting bona fide students and young researchers who are interested in aerial topics and may wish to attend.

Anyone wishing to apply should write to AARG’s Chairman (aargchair@gmail.com) with information about their interests in archaeology and aerial archaeology, as well as their place of study. The annual closing date for applications to the annual AARG conference is mid-May. Other meetings for which scholarships may be available will be advertised on an ad hoc basis. Support for conference attendance may also come from the Riley Fund (see elsewhere, this issue).
Landscape Archaeology: The Swedish Geodatabase Example of Multi-stratified Monitoring

Felice Perciante

Department of Archaeology and Ancient History, Lund University, Helgonavägen 3, LUX - Hus A, Lund 221 00, Sweden

feliceperciante@gmail.com

INTRODUCTION
The anthropic evolution and the use of new technologies both in agriculture and engineering in the last thirty years has implicated many continuous transformations of the contemporary landscape. Today even the large estates are threatened by heavy mechanization interventions that endanger the already fragile traces of hidden archaeological evidences. In some cases, in fact, aerial and satellite supports are the only sources of proof and reading of anthropic and natural historical signs. This contribution offers an example of a study developed in Sweden and based on geodata made available by public administration on an accessible platform for scholars engaged in various research sectors. In detail, a work of archaeological photoreading and photointerpretation about three different historical contexts relevant to the Blekinge and Skåne regions of the southern Sweden was carried out, affected by future anthropic interventions (new construction and agricultural divisions). The investigation, conducted using multi-spectral supports and SAR data, followed initially the classical methodology of aerial archeology with optical and stereoscopic reading. Then, the capacities offered by the supports for automatic and semi-automatic identification of traces were evaluated. The aim is to implement the informative system derived from published data or commercial archeology interventions in order to characterize the territories where these works are going to be realized. The results, although uncertain, are not yet subject to ground surveys and are very interesting because they describe a much more complex framework than what has been known until now.

ARCHAEOLOGICAL CONTEXT

The Scandinavian cultural historical context was analyzed, in particular Blekinge and Skåne regions in the southern Sweden. The archaeological sites of Uppåkra in Skåne, Näsrum and Vång in Bleking were examined, all belonging to settlements close to rivers or natural landing places.

FIRST RESULTS

Overall about 100,000 km² were analyzed on eight different media among thematic maps and historical maps and it was decided to use GIS software for the individualization, stand out and above all the geo-referencing of the anomalies. In this way each trace has been recorded in an expressly created database and displayed on the supports by means of coloured vectorial elements. During the reading it was possible to recognize even false traces caused by problems throughout the scanning stages of the supports, of the human actions in the agricultural fields or climatic conditions.

ACKNOWLEDGEMENTS

This project, financed with the Lerici grant, was developed in different operative phases between September – December 2017 at the Institute of Archeology and Ancient History of the Lund University in Sweden. This period was organized following a timeline in continuous development and transformation. For this reason I thank the Lerici foundation for the opportunity given to me through the scholarship and the lecturers Niccolò Dell’Unto and Giacomo Landeschi of the University of Lund for the hospitality in their laboratories and for the precious support to the activities of research.

TOOLS AND METHODOLOGY

In order to facilitate the reading and deconstruction of the landscape, a study about the human settlement shapes and soil utilization was realized for having indicative profiles to compare in the contemporary panorama, characterized mainly by traces of canalsization or pole lakes.

The research is based on different steps typical of classical archaeology photoreading and of the new automatic and semi-automatique research systems. All of the supports (cartographies, historical photos, TIN) were downloaded with the references of Lund University from ministerial platform (©Lantmäteriet).

The aerogeographical investigation is structured upon more levels.

The main supports examined are:
- Historical aerial photographs (1966)
- Historical cartography
- Soil type Maps of 05/02/2014
- Rgb support (colour composite) - 2015
- IR support (colour composite) - 2015
- Laser data to TIN and DEM - 2009
- World imagine by ESRI - 2016
- NDVI map

The study of remote sensing supports is aimed to the identification and classification of the features due to possible buried archaeological elements. Through especially designed cards, all the anomalies were recorded and archived in a geographical database. The latter allows to compare and connect the anomalies recognized on single supports.

PERSPECTIVES

The project, financed with the Lerici grant, was developed in different operative phases between September – December 2017 at the Institute of Archeology and Ancient History of the Lund University in Sweden. This period was organized following a timeline in continuous development and transformation. For this reason I thank the Lerici foundation for the opportunity given to me through the scholarship and the lecturers Niccolò Dell’Unto and Giacomo Landeschi of the University of Lund for the hospitality in their laboratories and for the precious support to the activities of research.
The threat of intensive agriculture on the ancient landscape: Ager Picentinus

Felice Perciante
Department of Cultural Heritage Sciences, University of Salerno, Giovanni Paolo II street, Fisciano (SA) - Italy
feliceperciante@gmail.com

INTRODUCTION

The computer and mechanical evolution in all sectors but especially in agriculture, is making the man a passive spectator of the destruction of the historical memory of our ancient landscapes that coexist in latent forms in the contemporary gaze. The increasing demand of food and consequently the intensive exploitation of the soil is leading to the use of more refined, but at the same time, highly destructive agricultural techniques. The aerial supports before and the satellite after have been for many years the main sources of research and above all of monitoring by the authorities responsible for the protection and enhancement of Cultural Heritage. The advert in many places of our country (Italy) of roofing systems (greenhouses) if on the one side they help to protect buried evidence (through superficial workings, on the other one they hide them to the syoptic view guaranteed by aerial visions. In fact, greenhouses are often a favorable environment for bee activities such as clandestine excavation. This contribution show the results of a study conducted by the writer in the area of the Ager Picentinus, today strongly influenced by new productive sites. Here, thanks to aerial and satellite support, it has been possible to discover hidden traces of the past that are slowly disappearing.

ARCHAEOLOGICAL CONTEXT

Some abridgements regarding the territorial and topographic dynamics of sites of Salerno, Pontecagnano and Paestum have been already published. Some of the used supports (© Google).

INSTRUMENTS AND METHODOLOGIES

The exum has been executed starting from an accurate analysis of written and cartographic fonts and then with the reading of aerial and historical satellite photographs (stereoscoppy and software for automatic and semi-automatic recognition of features). All photos have been orthorectified and georeferenced by means of GIS platform. In this way it was possible to compare the tracks on different supports. Furthermore thematic, geological and geomorphologic maps were examined and realized DTM. The traces were compared with theoretical grids of centennial form found, verified and dated in the areas of Pontecagnano and Paestum. The hidden or visible traces discovered and mediated with crop-marks, soil-marks, damp-marks, grass-marks, and shade-marks were verified with surveys on the ground.

OBSERVATIONS

Despite the difficulties, due to the comparison of data with several origin, the identification of numerous interesting zones and three agricultural division systems has occurred (Fig. 4). These are the proof of human action in line with land divisions and organizations. Some anomalies have answered positively to surface surveys, giving back copious archaeological materials pertinent to inhabited places or cemeteries of different ages that go from prehistorical one to medieval one. Some areas have been investigated by geophysical survey (georadar and magnetometry) permitting to define the shape of possible buildings dated to the Imperial age thanks to the surface materials. The tracks of agricultural division systems, nowadays hidden in the contemporary landscape, still illustrate degeneration types of ancient cadastres or movement of road areas over time.

In conclusion, the study in continuous processing and in publication phase, aims to add a further small lessona to the complex framework of ancient poisoning in the Gulf of Salerno and to reaffirm the importance of aerial photography as an extraordinary instrument of monitoring for risks of Cultural Heritage loss in locations now continually disturbed by antropic interventions.

The immediate offer of new elements of knowledge acquired and mapped in a three-dimensional geographic platform, besides to support the scientific research, can be a good tool of tutelage for the Superintendence and a basis for a better scheduling and development for local authorities responsible of territorial planning, in order to be faithful with own past.