

AARGnews

Number 62: April 2021

The newsletter of the Aerial Archaeology Research Group

Edited by Rog Palmer



Contents:

Editorial <i>by</i> Rog Palmer	2	Wazzat? Number 3 <i>by</i> Rog Palmer	26
Chair's piece: <i>by</i> Sara Popović	5	Aerial archaeological time window in 2020: 12 days in June. Report from Hungary <i>by</i> Zoltán Czajlik	27
AARG 2021: Strange times – strange call for papers	7	Aerial Archaeology in Oman 2018 and 2019 <i>by</i> Robert Bewley and Sufyan Al Karaimah	38
AARG notices:	8	Aerial images and instant gratification (figure 1) <i>by</i> Rog Palmer	51
AARG's news and information in other formats		Cropmarks	53
Derrick Riley Bursary		Books and papers of interest?	55
ISAP Fund		AARG: general information, membership, addresses, student scholarships	70
Information for contributors			
AARG's Sentinel 2 working group – background and first report <i>by</i> Rog Palmer	9		
Drone archaeology as an amateur <i>by</i> Julian Ravest	11		
GeoNadir: mobilising Mother Earth's paparazzi <i>by</i> Karen Joyce	24		

(cover picture: Prehistoric enclosure on Veli Školj (Pakoštane), Croatia,
Photo: Darja Grosman, 22 May 2011)

Editorial ¹

Is my history your history?

The previous issue of *AARGnews* included a French perspective of aerial archaeology in which it had been invented by Antoine Poidebard (Bliez 2020, 32) and that prompted a sentence in my Editorial asking if each country ought to have its own history rather than the shared one that we often use (Palmer 2020, 7). This communal history has been echoed, perhaps even enlarged, in the new book by Martin Gojda (2020, 23-116 – see *Books and papers of interest?* this issue) that takes it back to the beginnings of aviation (kites in China and Leonardo da Vinci) and photography and then notes all the usual personnel. Martin's history is mainly about collectors of data, the aerial photographers, with a nod to those who made archaeological use of aerial information among the last few pages. In a talk I've been preparing I identified two different threads of 'history': one of takers of aerial images, another of their users. A few individuals are interchangeable (Allen and Riley, for example) but most belong to one thread or the other and as a lifelong user of aerial photographs I know which history I slot into. Furthermore, I could divide the other history into those who produced useful photographs and the aviators (as they liked to call themselves) whose output either cannot be used or is difficult to use.

Tracing histories also raises the question of what is relevant history. Is it at all relevant to the history of archaeological aerial survey that a bloke went up in a balloon and took a picture of an archaeological site (e.g., Rome's forum or Stonehenge or Biscupin)? I could argue that it was more relevant that Crawford made a map from RAF photographs he was given than that he (with Keiller) and Poidebard photographed known and upstanding sites in Wessex and Syria. In my version of history I would put Allen as a first: the first to extensively photograph crop-marked landscapes and the first to wonder why they were not visible all the time and make maps to join together the fragments. But that is *my* history and not explicitly-relevant to the history of archaeological aerial survey in Czechia, Poland, Italy or the Balkans – each of which should identify its national or regional history with a minimum of outside interference. From this comes the question of how global or centralised is our small aerial community? We adopt and adapt methods to suit our local environments and, although we talk to one another, there has never been just one beginning, one direction, or one present situation – if that makes sense.

Is AI the right way to recognise objects on aerial sources?

There is a paper in this issue's *Books and papers of interest?* that is the result of an experiment comparing 'subjective' human visual use of Munsell colour charts with 'objective' instruments designed to make the job simpler. The result of those experiments was a 'win' for the humans although the instrument was consistent and may just need a tweak to set it right. However, it reminded of those among us who claim that we need AI as a means of scouring aerial images for archaeological content – or one reason at least – because new methods of aerial collection will flood us with more data than humans can deal with. But there is no need for humans to deal with all of that heap because years of experience – not only our personal experience, but experience of knowing which wavelengths record which phenomena – mean that we can, with a high confidence level, ignore data that is unlikely to serve our purposes. So, for example, a hyperspectral survey that some claim will threaten to

¹ rog.palmer@ntlworld.com

engulf us with many tens of layers of image can be culled to the few that we know are going to be usefully informative. It seems rather stupid to ignore that past decades of knowledge gain and, if they are really needed, tests on obscure layers and combinations of them can be left as puzzles for PhD students as can developing uses of AI for finding ‘our’ shapes of object.

We may miss occasional bits of information, but so what? Examination of aerial sources provides archaeological survey of an extent of land that is unachievable by any other means and this should be our principal selling point, rather than using it to show occasional great detail. Neither human interpreters or developing AI systems are ever going to find and record everything from the air but we can rationalise our aims and methods to optimise our use of those ways of examining aerial data that we know produce useful results.

Using eyes and brain

After discussion within the Committee we gathered a trial group for an evening of photo reading through an advert in our Google Group page. That resulted in interest from 12 members (of whom three didn’t link up on the night) which provided a small and relaxed group for free and easy discussion and we decided to advertise future events to the whole membership and start with the idea of monthly sessions. Those of you who have attended any past AARG workshops, or other teaching by those familiar with using aerial images, will have been introduced to photo reading as an excellent way to become familiar with the information that can be identified on images. Members of all levels are welcome and archaeological knowledge is not necessary as discussion at the first meeting was more about soils, crops, landform and time of year than about archaeology. There were some things that our combined brain-power couldn’t decide and we were all learning. Photo reading helps us understand that aerial images can be used to provide context for sites and that there is so much more on them that we ought to appreciate and use than just archaeology.

This issue

Under its new leadership, AARG established several working groups of which one was *Visual Identity* with tasks that included designing a new look for *AARGnews*. The working group was fairly active until the end of 2020, after which it vanished into silence, leaving me with a few ideas of which the new-look cover is one. Another was a change of fonts – undecided fonts – but the concept led to a change in appearance in *Books and papers of interest?* which may make it easier to find what you are looking for. Elsewhere I have used (mostly) fonts as submitted by contributors.

The drone content in this issue led to thoughts about ways in which the aerial world has changed since AARG began in the 1980s and whether as a group, as a committee, we are likely to embrace or ignore these differences in approach. If the end result is to achieve archaeological understanding aided by uses of aerial sources (where aerial means anything more than a few metres above the ground) then anything goes and AARG ought to take interest. As with earlier new technology, we tended to get overdosed with technical information and inundated with uninterpreted products so it was something of a surprise to discover something different in the videos of Julian Ravest on You Tube. Here, to me at least, was something different which I can only describe as a 21st century version of *Wessex from the Air* produced by someone using a drone to illustrate well-researched archaeological interpretations. I contacted him and he agreed to write a piece for this issue – but I urge you

also to watch the videos identified in his contribution. At about the same time, Steve Davis sent me a link to GeoNadir which is a first step towards creating an archive of drone images – something discussed within AARG but which got no further. Karen Joyce, founder of the web site, outlines the aims and potential of the site and we would be pleased if archaeological droners were able to fill in some of the gaps on the world map. A permanent archive for drone images is a serious need as you have only to think how impossible our work would be if there were not major and minor collections of aerial photographs dotted around to provide source material for our work.

Those of you who enjoy aerial images should be happy with this issue. The contribution by Zoltán Czajlik includes photographs of some really small features (tractor marks give a scale) and suggests, to me at least, the role played in ‘discovery’ by colours and crop changes caused by natural differences. Zoltán is one of the few people I know of who was able to fly in 2020 and that gives a little hope for those of us who hope to get airborne this coming summer. A completely different landscape is offered by Robert Bewley and Sufyan Al Karaimah in a report on their work in Oman which includes some spectacular photographs as an appetiser for a pending book that they hope to compile if flying is possible this year. It is good to see how the aerial world is able to cope with restrictions arising from Covid-19.

I have added two short contributions of which the first revives the old *Wazzat?* series (if a few pages in early issues of *AARGnews* makes a series) of things on aerial photographs that we were unable to interpret. Please do chip in with any ideas you may have about these. My second is a small rant about ‘remote sensing’ and how its teaching and practice seems to fit in with the instancy of modern times. I may be wrong, but I feel better.

References

- Bliez, A., 2020 Aerial research in Nord Isère (France - Rhône Alpes region) Panossas "les buissières". *AARGnews* 61, 32-37.
- Gojda, M., 2020. *Air Survey and Remote Sensing in Archaeology*. University of Cardinal Stefan Wyszyński (UKSW) Press: Warsaw.
- Palmer, R., 2020. Editorial. *AARGnews* 61, 7.

Chair's piece

Sara Popović

Time moves slowly

After being elected at the AARG 2020 AGM, our half new - half old committee started its mandate with great enthusiasm. Big plans were made and presented in the last Chair's piece. We started strong with few meetings held within the committee and some with all members invited to participate. Our first open meeting had great turnout and lasted almost 3 hours which we were not prepared for, having to generate links for next session after each expired in 40 minutes. Yes, it was a great laugh, and yes, we bought a proper Zoom account after it. But then 2021 happened, its start not being any different than the already too long and difficult 2020, and not giving us any hope that things regarding the Covid situation will change any time soon. This makes some of our planned activities, like organisation of international workshops, impossible to carry out for now. On the other hand, three Working Groups have taken off and are properly working. The largest group which meets every month is *Sentinel 2* WG. It has been proposed and led by Rog and you can read his report on its progress in this issue. The *Visual identity* WG is putting its effort into creating a new web page and is making a great progress. Our web-mistress Agnes Schneider has the help of our member Andrea Devlahović and the ladies are doing this voluntarily. Spoiler alert – it looks great. Darja Grosman is tackling the work on our *Archives* WG and has found some volunteers outside our group to help with updating Arcland's database.

All communication within AARG remained online, which makes it hard for all of us who were hoping that meeting face-to-face will be possible this year. Unfortunately, our Trondheim meeting still has to wait for a time when we can safely travel and socialize. Fortunately, we are grateful that Ole Risbøl, even after two years of putting in the work and having to postpone the meeting, did not give up and will try again when circumstances change.

ALI is forming ALIS

When ArchaeoLandscapes International (ALI) was set up as a successor to ArchaeoLandscapes Europe, ISAP and AARG took on the patronage of ALI and became the two permanent members of its General Management Board (GMB). As AARG Chair I took on the responsibility of being our representative on that Board and to inform our group about the developments within the network. It was news to me, and also to the rest of the committee, that ALI was taking serious steps to be registered as a legal entity in order to formalise its activities and was in the final stages of setting this up.

ALI has decided that this formal setup shall take the form of a Dutch foundation 'Stichting' that will be created alongside ALI and eventually governed by the same Board as the ALI GMB so that its activities are aligned with ALI as closely as possible. The name of this new entity shall be ArchaeoLandscapes International Stichting (ALIS).

After many meetings with ALI but also with our trustees, the committee has decided that AARG will become a Patron of ALIS (equal to ISAP) and eventually send representatives to its Board. In order to establish ALIS and allow its operation the Patrons have committed to

limited financial support (a one-off sum of £800 shall be provided as well as £120 for running costs in the first year) until ALIS becomes financially self-sufficient.

Treasurer's Piece (Rebecca Bennett)

During the first quarter of 2021 the Treasurer spent a good deal of time working to iron out legacy issues with both the AARG Paypal and HSBC accounts. Without boring the membership with details, there were administrative loose ends that had occurred over a number of years that needed to be resolved with the change of Treasurer and Trustees. Although the processes took a lot of time and back-and-forth with the relevant organisations the admin is now 95% completed. Given the last 5% still remains to be finalised with HSBC four months on and despite the efforts of all AARG Treasurers and Trustees past and present, the Treasurer may recommend a change of banking provider to one that better understands the needs of charitable groups once she has recovered her stamina!

AARG 2021: STRANGE TIMES – STRANGE CALL FOR PAPERS

Unfortunately, due to reasons well known to us all, this is the second year that we are not able to meet in person. We all still hope that the Trondheim meeting will be possible as a face-to-face conference in 2022.

The AARG committee has decided that we are not going to have ‘standard’ online conference this year because we are aware that we are all a bit tired of that format and from sitting all day at our computers. Instead, we propose to have a few shorter online meetings in September and October.

The proposed dates for these are: Fridays: **September 3rd and 17th, October 15th**
There are going to be a few dates reserved for invited talks, and these will be announced in advance. We hope you all will join us.

Sessions

1. Open call

Instead of standard thematic sessions we are inviting you to submit proposals for presentations which can encompass a wide range of archaeological questions and different research approaches. This is sort of an open call after which all accepted proposals will be grouped by theme.

2. Technical session

There has always been an interest within AARG in new technical developments which can be applied in our work. We would like to invite proposals from all who want to show how technical solutions have assisted solving archaeological questions.

3. Discussion sessions

A. Special time calls for modified research approach?

We invite short 10-minute presentations on how covid has affected your research. Have you been able to do aerial reconnaissance has was your research been more focused on interpretation of historical APs, ALS data or satellite imagery?

B. Talk to a colleague!

This session is open to all who would like to discuss a certain topic with a group. You are invited to prepare a short 5-minute presentation with your idea as a conversation starter.

Young/starting researchers are also encouraged to participate if you would like to discuss your research ideas, get ‘a second opinion’ on data interpretation or would benefit from the help of more experienced members.

Proposals are to be sent to aargchair@gmail.com by 1st of June 2021.

Conference fee will be symbolic 10 euros per day which can amount to staggering 30 euros if you attend all 3 days.

AARG notices

AARG's news and information in other formats

Twitter account: @AerialArchRG

Facebook page: <https://www.facebook.com/aerialarchaeologyresearchgroup/>

AARG's Google Group is here: <https://groups.google.com/forum/#!forum/aarg-group>. This is for AARG members only and all requests to join will be approved (or not) by the administrator of the Google Group. After having joined the group you are free to start new topics about anything you want to ask or discuss with AARG members!

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 is an application form at the link below 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.

<https://www.sheffield.ac.uk/archaeology/derrick-riley-fund>

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* 63 (October 2021) needs to be with me no later than **September 15, 2021**. 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

AARG's Sentinel 2 working group – background and first report

Rog Palmer¹

Sentinel 2 captures scenes at 2-3 day intervals at a resolution of about 10m and has been operating since July 2015. The working group aims to use its frequent cover to monitor changes in crop and soil colour that occur over different soils. On past experience, those changes should indicate promising times to photograph archaeological targets by any means (drones, light aircraft, vertical area cover or high-resolution satellite). These possibilities are relatively easy to check retrospectively by examining a time span of Sentinel 2 images at known crop-marked sites. Hopefully, our observations can then be tested by image capture in 2021. There is no intention to use Sentinel 2 to identify archaeological targets although some coarse-level information may be recorded by default.

Invitations to join the Sentinel 2 working group were circulated to AARG members at the end of November and resulted in interest from 18 potentially active members plus two advisors. Since then, the number has reduced by four who either didn't have time or didn't make further contact. We have a reasonably broad span of locations and soil types – Austria, Belgium, Denmark, Germany, Ireland, Poland, Romania, Serbia, plus several members from UK.

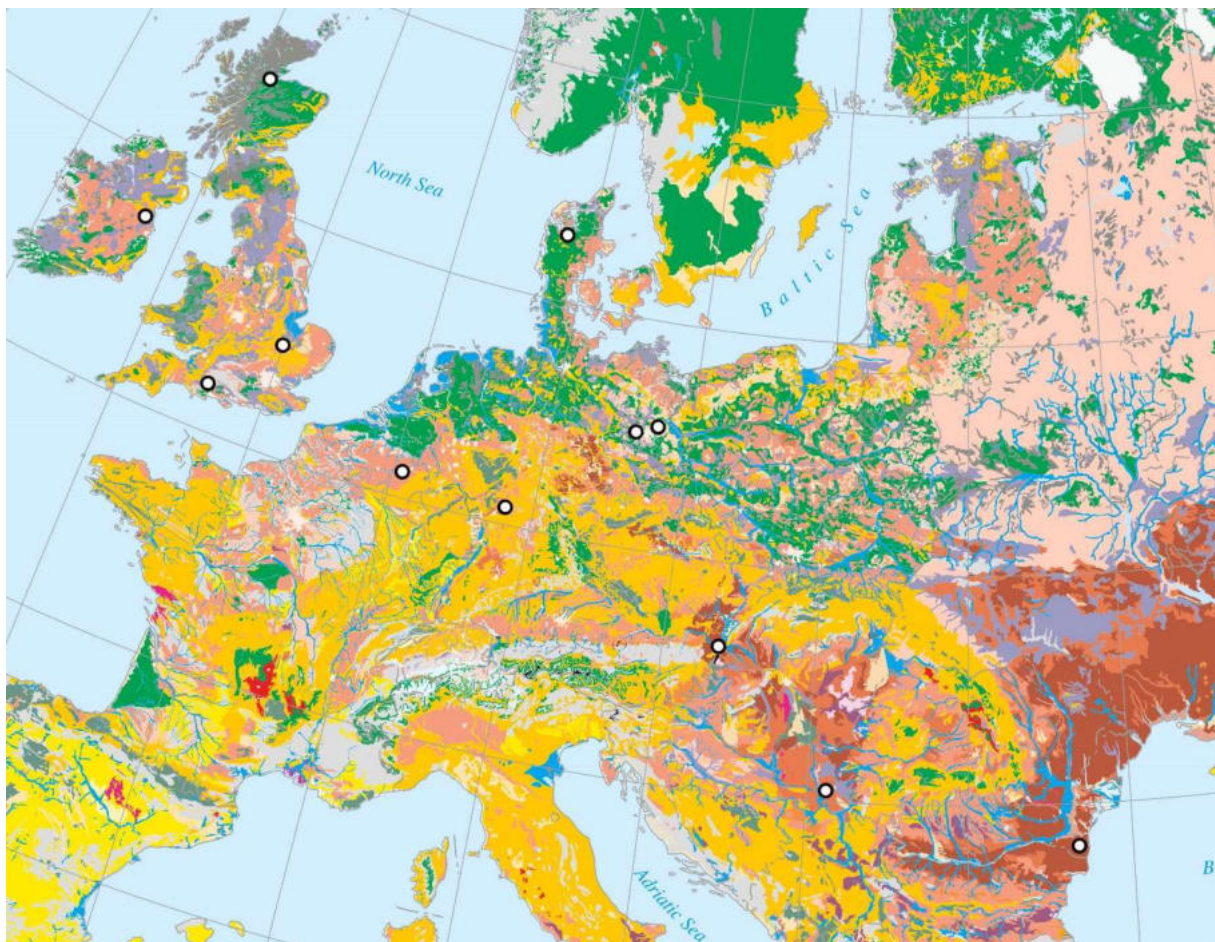
The group first met via Zoom on 17 December 2020 and has fallen into a sequence of monthly meetings since then. We have discussed and demonstrated methods of collecting series of Sentinel 2 data for our target sites and are deciding how best to use these to record the visible changes that can be seen in various wavebands. Most members have identified their targets (see map on following page) and these range from individual fields to wider areas that include different soils. Those of us who have appropriate old aerial images have begun to do retrospective collection and analysis of past Sentinel 2 images. 'Appropriate' means those taken in the operating life of Sentinel 2 which, from an archaeological point of view, means those taken since summer 2016.

We are testing two methods to analyse (by eye and brain) the Sentinel data and indicate colour/contrast change in crops. Following retrospective work using his own aerial photographs, Andreas Ziegler devised an Excel table on which he showed crop colour change at set intervals at individual locations/sites. Some other members have begun to apply this at their targets using Sentinel 2 data and all noted that cloud cover is much higher than expected and this breaks the flow of diagrams of changing crop colours. We also are unsure that we will be able to agree on standardised colour descriptions – or even if there are such things across the span of our test sites. A second proposed method has been tested on a 6 x 6 km area in Cambridgeshire. The idea there is to mark a letter or symbol in each modern field where colour change was identified within a field and make a chronological stack of those images to see if we can trace back to the earliest date on which changes can be identified with confidence. This may provide a guide as to how early we can begin planning to obtain photographs that include archaeological content – although obviously this forward date may change each year.

¹ rog.palmer@ntlworld.com

We have become wary of using internet crop monitoring sites which are AI based and claim to identify crop types and moisture content among other relevant criteria². However, where these have been checked it has been noted that they are not always right so the decision, supported by Bob Evans one of our advisors, has been to look at them but not to rely on them.

There has been some debate about the usefulness of this project compared with the usual ways that we decide to fly – SMD figures, circulated reports of observations. However, those of us with limited funding may find it a method that enables them to decide on a date for a flight that ought to be productive without wasting resources on that first flight to see if crops are yet indicating archaeological features.



Dots indicate locations of test sites and areas against a background from *Soil Atlas of Europe*, plate 1. This omits any location(s?) still to be decided by Historic England.

By the time of publication of this issue all working group members ought to be noting their field or areas on images from this year. Retrospective work suggests that we should expect to see changes in crop colours in May – depending on local weather, of course – so it remains to be seen if cloud cover will let us make predictions for flying times this year, and whether Covid-19 allows us to do any flying other than those members who are pilots of light aircraft or drones.

² For example: <https://map.onesoil.ai> and <https://eos.com>

Drone Archaeology as an Amateur

Julian Ravest¹

Background

In this article I want to share my personal experience as an amateur “drone archaeologist”. I hope to demonstrate that this can not only be a deeply satisfying activity, but can also contribute to the discovery, understanding, and consequent management, of archaeological sites and their landscape context. Fig. 1 is a map showing sites, selected from many others, referred to below.

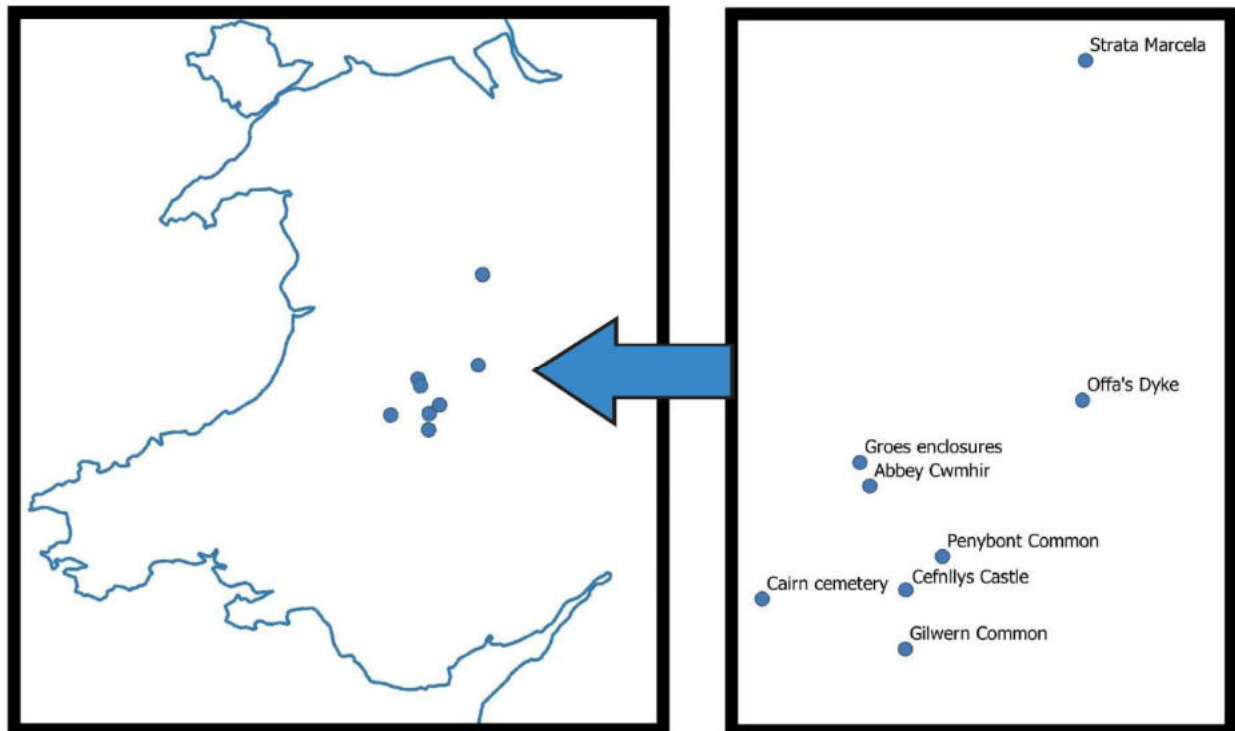


Fig.1. Map showing location of sites mentioned.

When I moved to Mid Wales some 5 years ago I had very little knowledge of the richness of its archaeology. I had been attracted by its landscapes and the possibility of being able to indulge my interest in hill-walking and photography. An interest in archaeology had been kindled by books in my local library when I was at school and, later, by television programmes. However, my working career had rarely brought me into direct contact with archaeology so it remained a passive interest.

As I became more aware of my new surrounding in Wales, I volunteered for work with the Clwyd Powys Archaeological Trust, CPAT, for whom I initially spent a lot of time washing pottery shards. During this time, I obtained a copy of Chris Musson’s book *Radnorshire from Above*. This was inspirational. Good quality drones were just coming on the market at an affordable price and I saw the opportunity of using them for photographing sites from the air.

I discovered that one of CPAT’s archaeologists, Mark Walters, used a drone and he confirmed that the one I had my eye on, a DJI Phantom 4, was a good choice and encouraged me.

¹ julian.ravest@gmail.com



Fig.2. Gilwern Common, Glascwm, viewed from the west.

To say I was thrilled by my early results would be an understatement. I was hooked. One of my first photographs, taken in October 2016, was of Gilwern Common near my home, (Fig 2). There is an abundance of archaeological features visible in this single photograph: two deserted farmsteads, one with a field system the other with a field used as a stop-over by cattle drovers, three bronze age cairns, part of a boundary bank which once encircled the common, the sites of two standing stones, and an iron age fort on a hill in the distance looming out of the early morning mist. I was to return later to explore these features in more detail.

Where I can be self-indulgent is in choosing what I photograph. Importantly, this does not mean that I necessarily work independently of professional and academic archaeologists, indeed, I greatly value that collaborative aspect of my work. Not only have I learnt a tremendous amount from such contacts, it has also informed much of what I do. I can only marvel at their patience in dealing with me. This was especially evident in my early work with the Historic Environment Record, HER, managed by CPAT, and to which I contributed images and comments, plus created some new records.

That early work focused on taking oblique photographs, using the drone as a highly mobile tripod in the sky to frame informative images. The ideal conditions for this meant taking photographs with low angle sun light, early or late in the day. The consequent narrow windows were a limitation. I was therefore delighted to be introduced by CPAT to the possibilities of photogrammetry. This not only widened that window, but also opened up a whole new role for my drone photography. The metadata of every drone photograph includes the GPS location of where it is taken. This is very useful, particularly when using Adobe Lightroom to manage and map each photograph. However, it is the combination of, say, a hundred such photographs taken when automatically flying a pre-defined grid path that enables the creation of photogrammetric visualisations.

As can be seen in the following section, a wide variety of images can be produced using programmes and internet services readily available to the non-professional. These enable the creation of a georeferenced digital models of an area, enabling locations of features to be determined and providing the immediate context for any particular feature.

Examples of sites recorded

In this section I want to provide some examples from my own experience of the range of features and sites that an amateur can now tackle.

Bronze age cairns



Fig. 3. Orthophoto of part of a cairn cemetery with identified cairns circled.

There are numerous bronze age burial cairns in the unenclosed uplands of Mid Wales. Surveying and recording them using conventional techniques is challenging and time consuming.

In contrast, photogrammetry enables the rapid surveying of large areas, Fig. 3 is part of a much larger survey.. This is also more likely to be complete since it is often easy to miss cairns from ground level because of vegetation, and it provides objective evidence that can be reviewed later by others.



Fig.4. Close up of largest cairn from Fig. 3 showing stone piles from when it was dismantled.

The wide area survey can be augmented by close-ups of the cairns, for example Fig. 4. As in so many other instances, the photography defines the cairn unambiguously and is a clear record of the current state of a feature. This provided a reference point against which future photos can be compared to assess any erosion or other damage.

Deserted farmstead and enclosures

Deserted Farmsteads fringe many of the unenclosed uplands of Wales and, on the uplands themselves, are enclosures and platforms that may have had seasonal use associated with cattle or, more likely in this area, sheep management. Groes, Fig. 5, is an example of such an abandoned farmstead.

Photogrammetry allows accurate mapping of, not only the abandoned farmstead, but also the complex pattern of relict field boundaries and sunken trackways which form the context for this feature. A previously unrecorded feature of Groes itself is the atypically large platform at its centre.

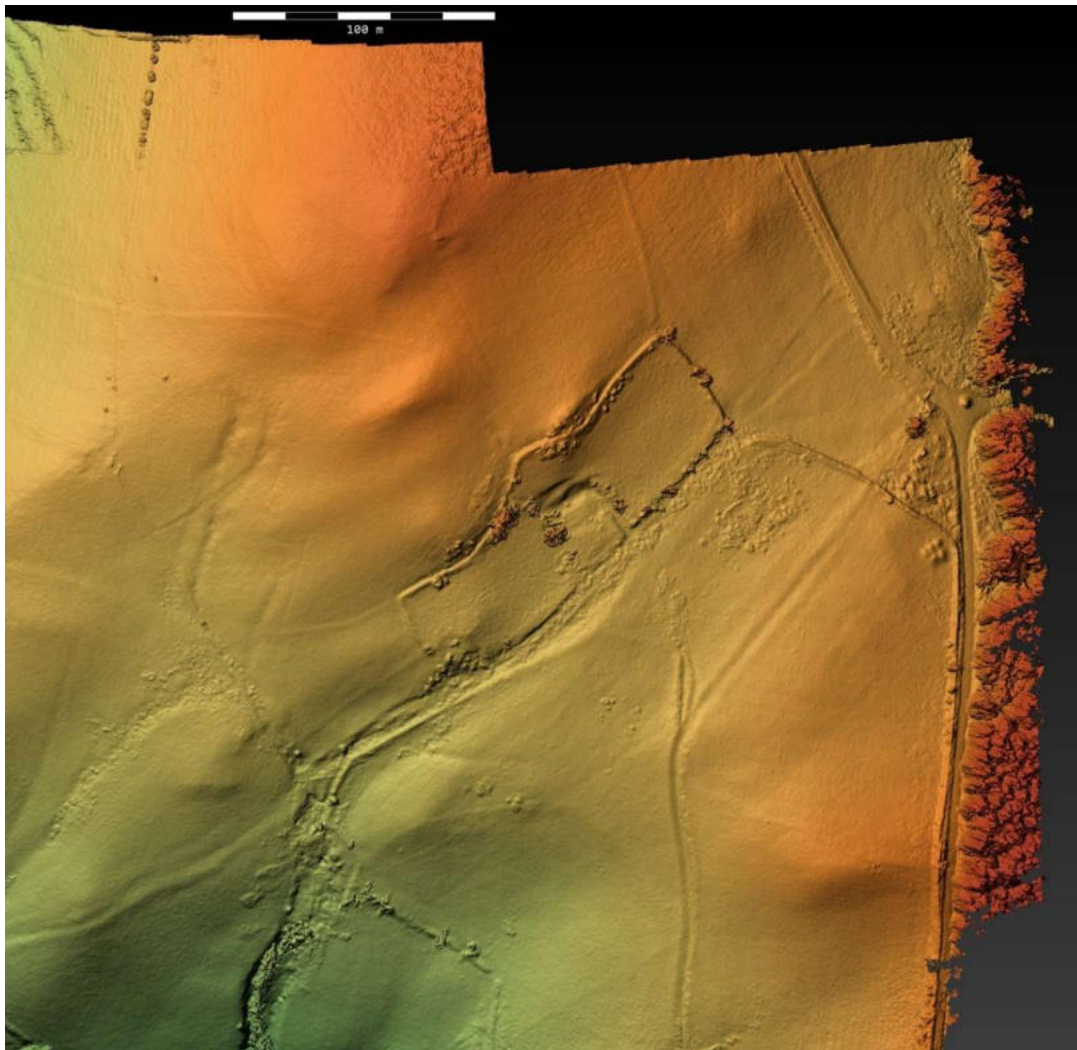


Fig. 5. Groes: an abandoned farmstead encroaching onto an upland sheepwalk.

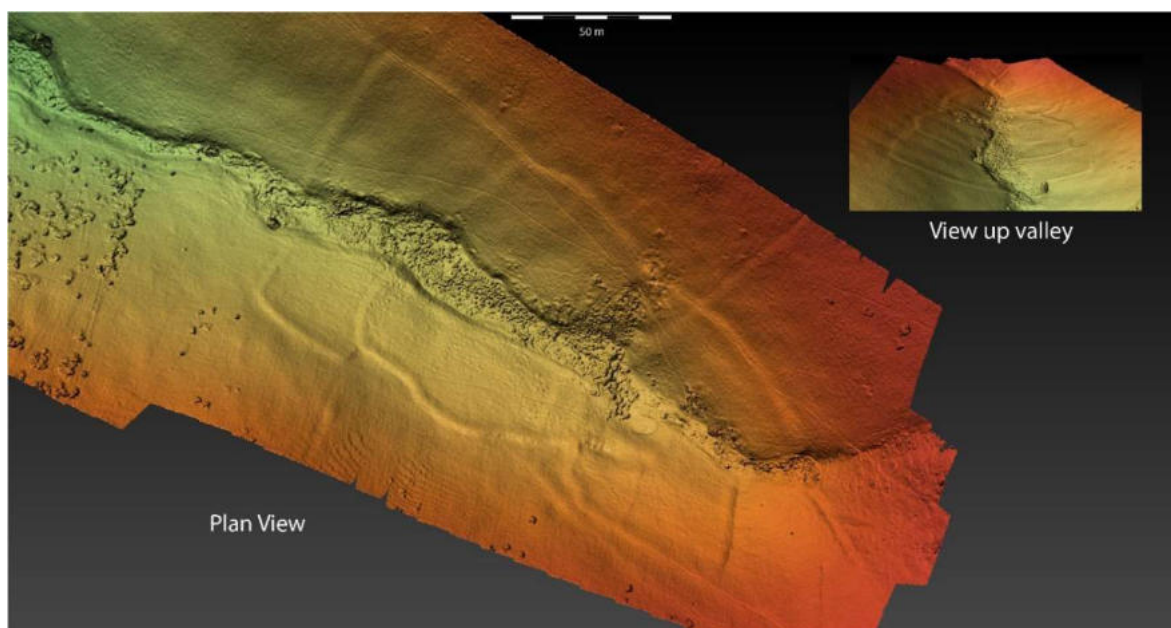


Fig. 6. A set of enclosures, with a platform, on either side of a valley near Groes.

While surveying Groes, a nearby set of enclosures, with a possible platform in a steep sided valley on the Cefn Dyrys sheep walks was observed, Fig. 6. This entire area was once held by the Cistercian Abbey Cwmhir and the enclosures may stem from that period – an ideally sheltered location for seasonal gathering of sheep. While these low earthen field banks show up clearly in the photogrammetry, they are all but impossible to trace on the ground and have never been previously mapped or, apart from a passing note, even noticed.

Offa's Dyke

Offa's Dyke is a good example of what I like to photograph. So far, I have made a photogrammetric survey of only 16 miles of the Dyke – still a long way to go! Eventually this will form a permanent record of the Dyke which will be a reference dataset by which to assess future erosion. It has also thrown up some previously undetected archaeological features.

The oblique image, Fig. 7, draws attention to sunken ridgeways which pass under the Dyke possibly pointing to an earlier long-distance ridgeway.

A previously unrecorded rectangular earthwork *under* a much-visited section of the Dyke, Fig. 8, is an example of a discovery revealed by photogrammetry. The two prominent dark lines in the image represent the slope on either side of the dyke. It is, of course, not possible from the images alone to determine with any certainty the function or period of this earthwork, (apart from pre-Dyke). One suggestion is that it was a Roman signal station - its position makes this a possibility. Another suggestion is that it had a role during the construction of the Dyke.



Fig. 7. Oblique photograph of Offa's Dyke showing braided sunken ridgeway passing under the Dyke.

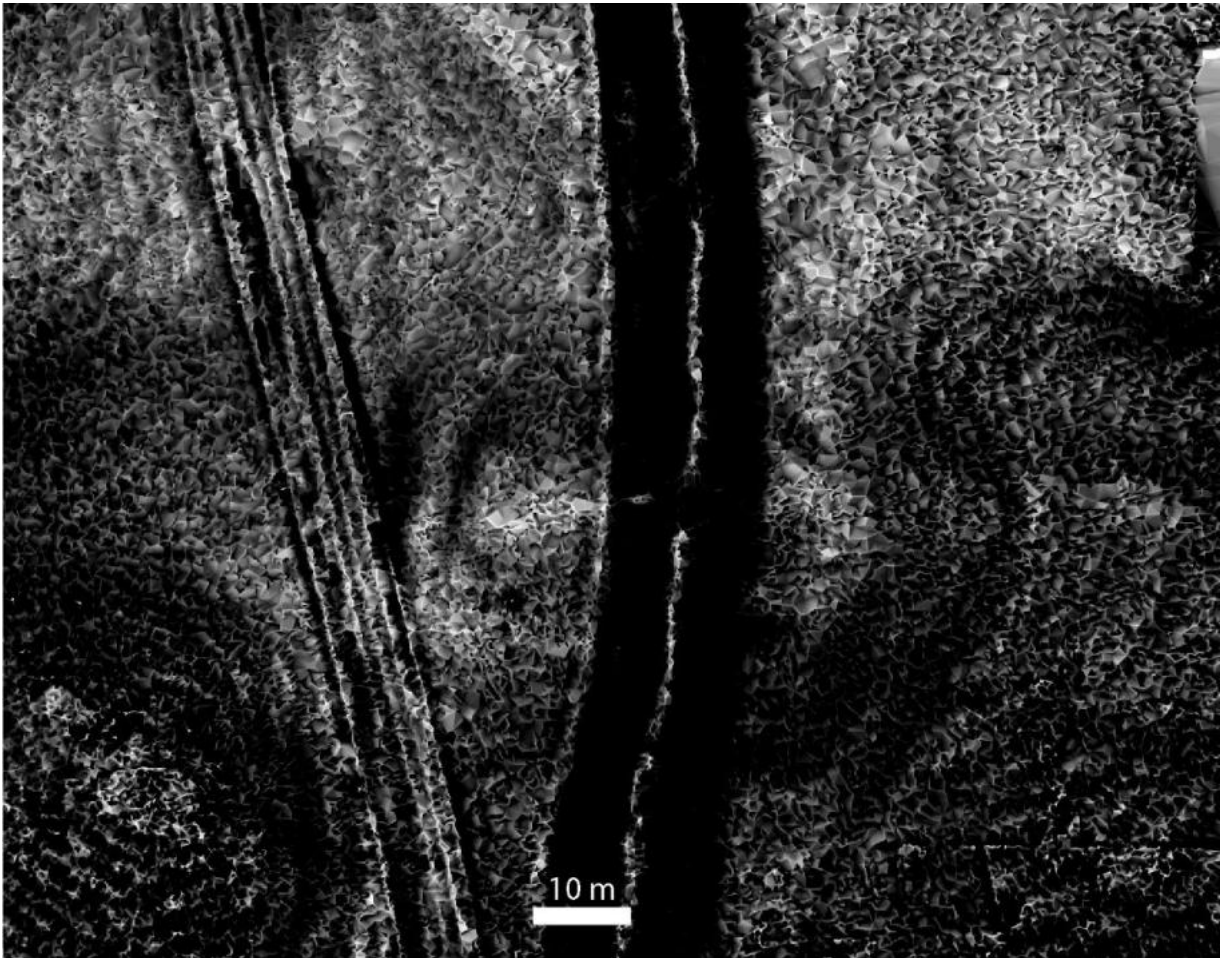


Fig. 8. Rectangular earthwork under Offa's Dyke.

Medieval fields, Penybont

Penybont Common covers approximately 260 hectares and now provides rough grazing for stock. An abandoned medieval field system had previously been identified on a small part of it. Some initial drone photography showed that the system extended beyond that part. A major project developed in which the whole of the Common was photogrammetrically surveyed. This revealed a generally intact field system that encompassed the sides of the common and much of the interior. The original field banks, and the ploughing strips within, had never been subject to later ploughing and improvement, and so remain clearly visible from the air. The area covered in Fig. 9 is around 3-4 % of the Common. Using the freely available QGIS, this section has been placed together with some 40 other georeferenced tiles to form a single, continuous and zoomable map of the entire Common.

The appearance is of an area abandoned at one time. The cause of the abandonment must be speculative but some combination of black death, climate or economic causes seems likely. Evidence of the field system extending beyond the present common can be seen in some of the adjoining modern, albeit heavily ploughed, fields.



Fig. 9. Part of the 1 sq mile Penybont Common showing abandoned medieval field system. (The irregular marks at the bottom of the image are due to a stream.)

Abbey Cwmhir

Fig. 10. The existing walls of the Abbey church.

Abbey Cwmhir was a Cistercian Abbey founded on its present site in 1176. Most of the previous research on the Abbey has focussed on the immediate area of the only extant ruins, that of the Abbey church which had the longest nave in Wales, Fig. 10. By invitation of the Abbeycwmhir Heritage Trust, a photogrammetric survey was undertaken of the entire Abbey precinct and surrounding areas, Fig. 11. A small part had previously been surveyed by geophysical techniques but had produced no conclusive evidence of structures outside the ruined walls. By contrast, the photogrammetry of the much larger precinct area produced evidence of a previously unsuspected building at the east end of the ruins as well as multiple earthworks from the site's later history. A video account of the Abbey survey has been loaded to YouTube: <https://youtu.be/0IN-YOT82uc>

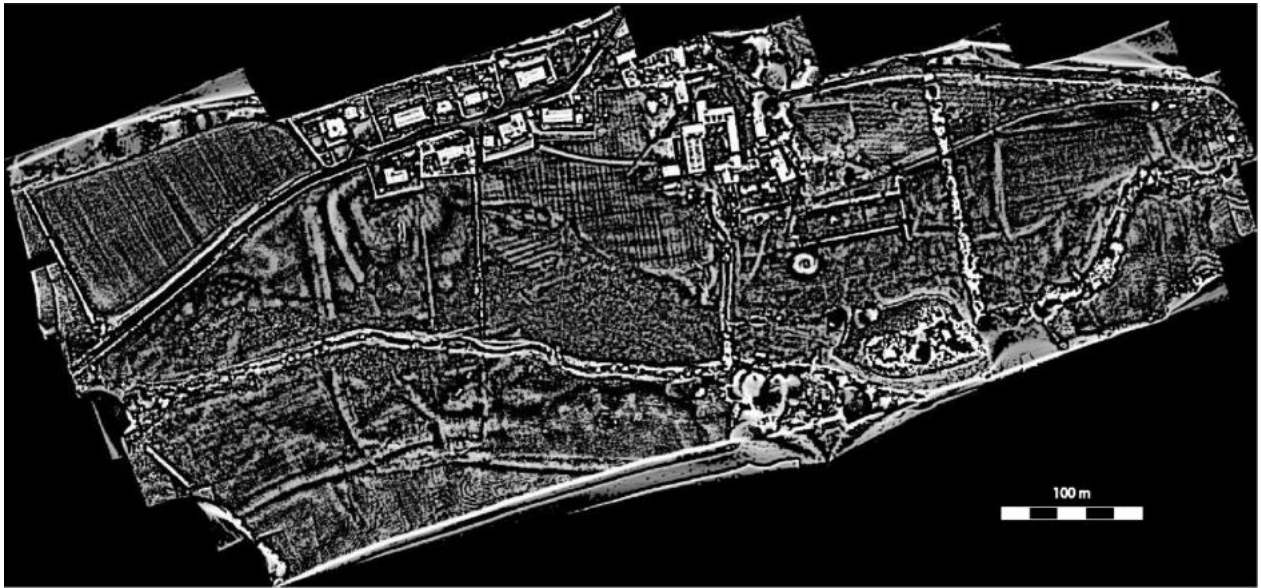


Fig. 11. Photogrammetric view of Abbey Cwmhir precinct.

A surprising discovery at the west end of the precinct was a square earthwork. Documentary research led to the view that this was probably a military fortification constructed during the English Civil War, 1644. At that time the already ruined Abbey had been turned into a stronghold of the Royalist army. This outwork was probably designed to cover the approach along the steep-sided valley from the west. However, following a short engagement, the Parliamentarians captured the Abbey and slighted any remaining church walls.

River erosion, Strata Marcella

While drones, with other forms of aerial imaging, have been used very effectively to record and measure coastal erosion, river erosion can also present risks to the historic environment. In this case, the River Severn was encroaching on the remains of the Cistercian Abbey of Strata Marcella. Using a drone to fly along the river photographing the bank profile, together with photogrammetry of the whole site, has provided a definitive record of the current position. The new imagery, Fig. 12, of the freshly exposed banks was compared to earlier photographs to assess the speed of erosion and the risks to the historic, below ground features, as well as recording some interesting profiles within the steep river banks. This work was done at the invitation of CPAT.



Fig. 12. Erosion of bank of River Severn at Strata Marcella

Cefnlllys Castle

The mid-wales border area was much fought over as the Welsh Princes and the English Marcher Lords contested for power. This has left a rich legacy of castles ranging from simple motte-and-bailey types to larger scale masonry castles. One of the most spectacular sites is Cefnlllys Castle, Fig. 13. This is actually two castles built successively by the Marcher Lord Roger Mortimer, one at either end of a dramatic ridge. The first may have been on the site of an earlier Welsh castle, all within what is widely believed to be an iron age hillfort. While much researched and photographed, photogrammetry and oblique photographs show a level of detail not previously recorded.

This is a complex site most clearly revealed in a short YouTube video: <https://youtu.be/YvVE9Nnalpw>

This video is aimed at the general interested public as part of an effort to communicate the history and archaeology of the area as widely as possible.



Fig. 13. Cefnlllys Castle ridge from the east, with ruined castles at either end and fields and platforms between.

Conclusions

Since starting photographing sites with a drone, I have taken nearly 40,000 photographs, contributed to more than 400 HER records and created around 100 new records. These few examples outlined here, are taken from this large dataset to show how the availability of drones at an affordable price, plus the developments in the software for processing images, has placed a powerful tool for aerial archaeology in the hands of an amateur.

Aerial photography was once an expensive activity only affordable to professional archaeological organisations. – this is changing and will continue do so. For example, Lidar hardware and software is being developed at an astonishing rate as an off-shoot of the development of autonomously driven cars. High resolution Lidar equipment carried by a consumer level drone at a reasonable price may be the next step in the democratisation of aerial archaeology for the amateur.

A comparable example is that of the role played by amateur astronomers. From at least the 18th century to the present day, amateurs have seized upon advances in equipment technologies and used them to augment the work undertaken by professional, (ie paid), astronomers with their more expensive, tightly focused equipment. Similarly, unpaid amateur aerial archaeologists can undertake work that no professional archaeologist would be paid for, the more-eyes-on-the-ground equivalent of the astronomers needing more eyes on the sky. Alert networks, formal and informal, exist for amateur astronomers to be made aware of ephemeral events such as comets, and the need to co-ordinate responses. Maybe the time is ripe for a similar network of amateur aerial archaeologists to focus on ephemeral subjects such as parch marks, or sites in imminent danger.

While using drones to photograph sites can give great personal satisfaction, be it from an aesthetic or an informative view point, the amateur-professional partnership is important for a number of reasons, for example:

- Communication of archaeological knowledge by discussion ensuring that better informed photographs can be made
- Establishment of a permanent record, especially through archiving of images with professional bodies
- Improving existing records by the addition of aerial images and other information to, say, the HER
- Ensuring discovery of new sites is properly recorded and the information disseminated
- Informal direction regarding priorities so that drone images can be incorporated into archaeological projects.
- Bringing local knowledge into a wider informed context

The amateur-community relationship is an equally important role in engaging public interest by increasing awareness of archaeology in general and local sites in particular. This can take the form of, for example:

- Participation with local societies and communities in projects
- Talks and Zoom meetings
- Local and local society publications
- Creation of videos, use of social media to reach wider audience

All of these roles are undertaken by professional archaeologists but there are not enough of them with the necessary time. The amateur plays a special role in the promotion of a greater awareness and appreciation of archaeology within their own local area. This can also reflect back into political awareness and project funding for the professional.

Nurture the amateur - the benefits are mutual.

Technical points

Drone used	DJI Phantom 4 with 12 Mp camera
Oblique photography	Flight controlled by DJI-Go
Grid flying for photogrammetry	Flight controlled by Dronedeploy
Initial photogrammetric processing	Internet service: mapsmadeeasy.com
Plan visualisations	Relief Visualisation Toolbox, RVT
3D visualisations, analysis and videos	Planlauf/TERRAIN
Photo management	Adobe Lightroom

GeoNadir: mobilising Mother Earth's paparazzi

Karen Joyce¹

Firstly, a confession. I am not an archaeologist, and I feel somewhat of an imposter contributing to this newsletter! However after working a very small amount with archaeologists in recent years, I think perhaps that I know just enough to be dangerous... So I contribute this piece as a geospatial scientist, and one who has worked with remote sensing technology for over 20 years.

I consider myself to be a biographer for Mother Earth. I tell stories of her beauty, challenge, and change, using drones and satellites as my scientific illustrators. Over the years I have amassed many 'photo albums' of Mother Earth; seen the progression from expensive and siloed, to open satellite data archives; and now particularly enjoy the autonomy of earth observation using my own drones. Though most recently I have started wondering – what if we could set free our drone data like the US Government did for Landsat in 2008?

There are hundreds of thousands of registered drone pilots around the world. What if we all contributed to a common goal of creating the most highly detailed map ever possible for Mother Earth? What if local communities were able to capture the stories of their land and sea country from their drones, and make a difference on a global scale? What could we learn from observing imagery around the world, outside our own bubble? And what if these valuable snapshots in time and *through* time were part of a central library to which anyone could contribute, and anyone could view?

I've sat with these questions for several years now and am convinced that to write the ultimate biography for Mother Earth, we need all hands on deck. Or all drones in the sky as the case may be! I've created the library to keep secure our albums and named it GeoNadir – literally meaning the earth viewed from directly above. Now it's time for Mother Earth's Paparazzi to get to work.

I know that drones are not a new technology for many within AARG, and I'm sure many of you know their benefits for your research more than I do! So rather than write about what drones can do for archaeology, I'll share with you a little more about GeoNadir and our development plan that I hope you might find useful now and into the future.

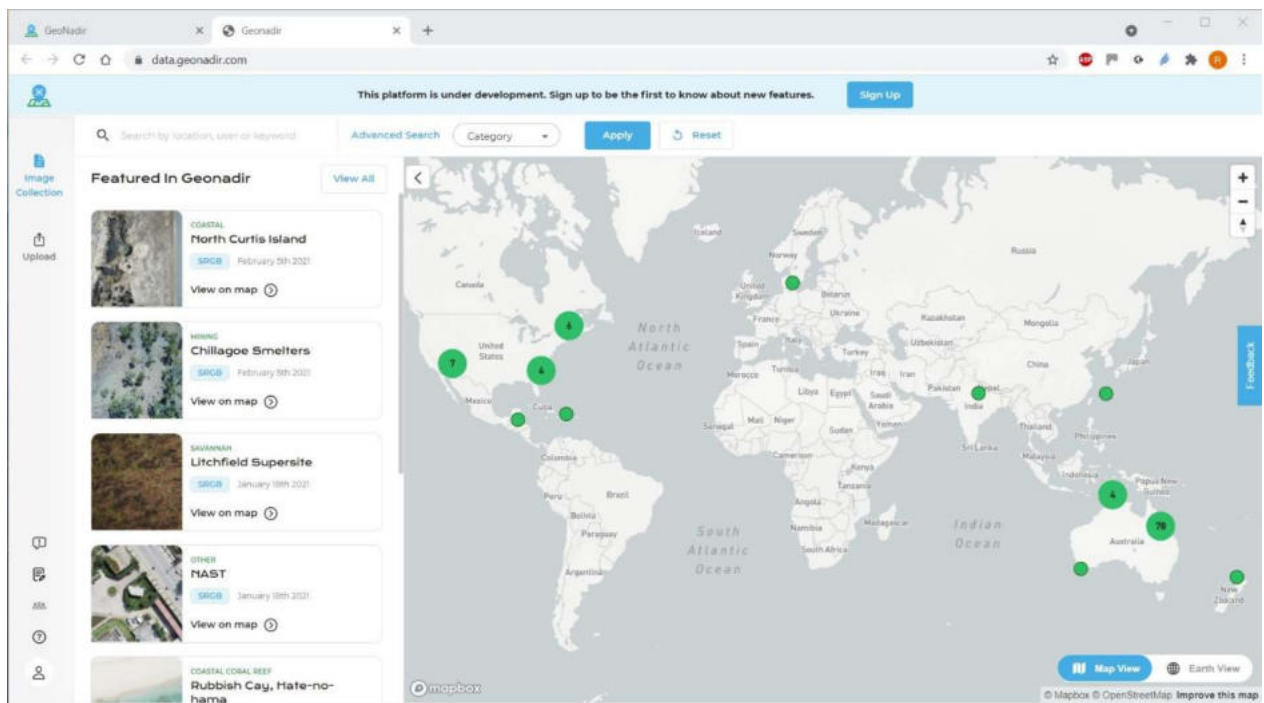
GeoNadir helps people organise their drone data and easily share it all over the world. We are currently hosting raw, geotagged nadir images, arranged into image collections uploaded by pilots. An image collection is effectively a drone mission that represents a single location on a set date and time. Pilots provide a description of the data and their mission; credit other people / funding bodies etc; assign a general category to the collection (e.g. ecosystem type); and add tags to identify features contained in the collection (e.g. hearths, stone arrangement, fish traps...). Other metadata components are extracted directly from the photographs where available (e.g. drone type, camera specifications, altitude, location, etc.). Those wishing to view or use the data are then able to search GeoNadir based on location or other aspects from the tagging and metadata. Because images are attributed with their date and time of collection, it facilitates time series analysis and can be used to document change in environmental and

¹ karen@geonadir.com www.geonadir.com

cultural features. We hope in the future it can provide a platform with evidence to support communities to protect their local ecosystems.

Granted, GeoNadir is in its infancy (launched March 2021). It's my passion project though I am very ably supported by my husband, Paul Mead (strategy); Joan Li (data scientist); Jules Blundell (vision amplifier); Stefan Maier (technical advisor); and Nishon Tandukar (NAXA – platform development). As a team we share a common commitment to the environment and sense of responsibility to make the world a better place for future generations to continue to enjoy. We made the decision very early to undertake 'agile development'. This means that we released our dream to public uptake and scrutiny with a continual development plan where we adjust, modify, and co-create with our user community. In the coming weeks, users will already start to see some of these exciting changes, including our much anticipated integrated orthomosaic and 3D model module. Users will be able to push these georeferenced products to GIS platforms through web mapping services. We are building additional search and filter features (including date of capture, date uploaded, pixel resolution), and the ability for users to create their own 'showcases' to combine image collections thematically just like a Spotify or YouTube playlist. And through machine learning we are growing feature recognition tools that will help automatically tag data upon upload, aiding data discovery downstream. What's more, we are listening – to you.

We are all biographers for Mother Earth in our own way, and we want to hear how GeoNadir can help you tell your stories. So please fly into GeoNadir, set free your data, and discover sites around the world contributed by other members of Mother Earth's Paparazzi (www.geonadir.com).



Join Mother Earth's Paparazzi on GeoNadir and add more 'dots' or datasets to this map.

Wazzat? Number 3

Rog Palmer¹

Two examples of similar features, both in Cambridgeshire, UK.

The upper figure is a crop from a photograph taken on 3 July 2017. North is roughly to the top. Its location is TL395991 (or for GE users: 52.571567°N, 0.056922°E). The Soil Survey map shows the land to the west is marine alluvium and fen peat and the lighter colour on the oblique shows the March island deposit of clay with associated drift. Side ditches of the Fen Causeway – a Roman road – can be seen curving into the field from the middle car and the RR continued north to the Roman small town of Grandford, some 600 m north of this picture.



Photograph taken of a curiosity. North is approximately to the top.
Photo: Rog Palmer 20170703-445-2.

More recently I was looking at a newish layer in Google Earth dated 28 May 2020 which was, as some may remember, a very dry month, and the layer includes a high number of archaeological sites on lighter soils. This location is TL471679 (or 52.290316°N, 0.155746°E) and the soil is river terrace and chalky drift. Again there is the apparently circular formation, this time adjacent to or abutting rectangular blocks that I would usually associate with hand dug quarries.



Cropped from Google Earth. No source given, but ©2021 Google [it says].
Image date: 28 May 2020. North to the top.

Do any readers know of similar features, or what these may be. Answers may be published in future issues of *AARGnews*.

¹ rog.palmer@ntlworld.com

Aerial archaeological time-window in 2020: 12 days in June. Report from Hungary

Zoltán Czajlik¹

Introduction

In preparation for our aerial photography, we mainly concentrated on the northern part of Transdanubia, since several Roman, Iron Age and possibly future medieval landscape archaeological projects focus on these areas. It would have been particularly important to take advantage of the late winter and especially the vegetation-free spring period, primarily for the detailed observation of soil-signs, but the lockdown declared in Hungary in March 2020 made this impossible. However, the epidemic situation improved significantly by June, allowing us to complete a severely limited program, following the safety measures. (To protect everyone involved, we bought our first head-set after 27 years of flying, and Gábor Petrovszki was the pilot for all flights.)

General remarks

The late winter – spring – summer weather also influenced the exact period of the time window. After a long period of relatively dry weather, heavy rains hit Hungary in May and especially in early June, thus we could start the prospections only in the second half of the month. Altogether, we had four flight days from 19th to 30th June. We were in the air for 9.5 hours for gradually longer periods. However, the number of both the days for flying and the flight hours is only a third of the usual annual total.

In Hungary, the early summer period is ideal mainly for the prospection of cropmarks, and 2020 did not disappoint in that regard. We located almost 90, mostly previously unknown or only partially known aerial archaeological sites (Fig. 1). We observed the vast majority of the cropmarks in winter wheat and barley. Their maturity varied depending on the area and of course, the date, since at the beginning the colours light green / yellow were dominant, but later light yellow / brown prevailed. In general, there was no or only little difference in height, and the differences in colour revealed the archaeological phenomena. Within the entire research area, a 160 x 70 x 140km triangle, we found large zones with no cropmarks at all, while elsewhere (e.g. along Danube) there were a few and in certain micro-regions (Százhalombatta, Tárkány, Tokod and the Celldömölk area) relatively many and high-quality cropmarks were documented. In addition to this variety, we should note that more than 30% of the aerial photo sites identified in 2020 are in the Rába interfluvial area.

As usual, we observed mainly positive cropmarks in 2020. The larger, longer archaeological features (roads, ditches, fortifications, successive archaeological sites) were not typical, except for the Rába interfluvial area. At the same time, most of the prospected phenomena are finely drawn and relatively easy to interpret. Based on our experience this is not typical in the late spring/early summer period of very wet years (e.g. 2019), when the cropmark lines become more difficult to notice.

¹ czajlik.zoltan@btk.elte.hu

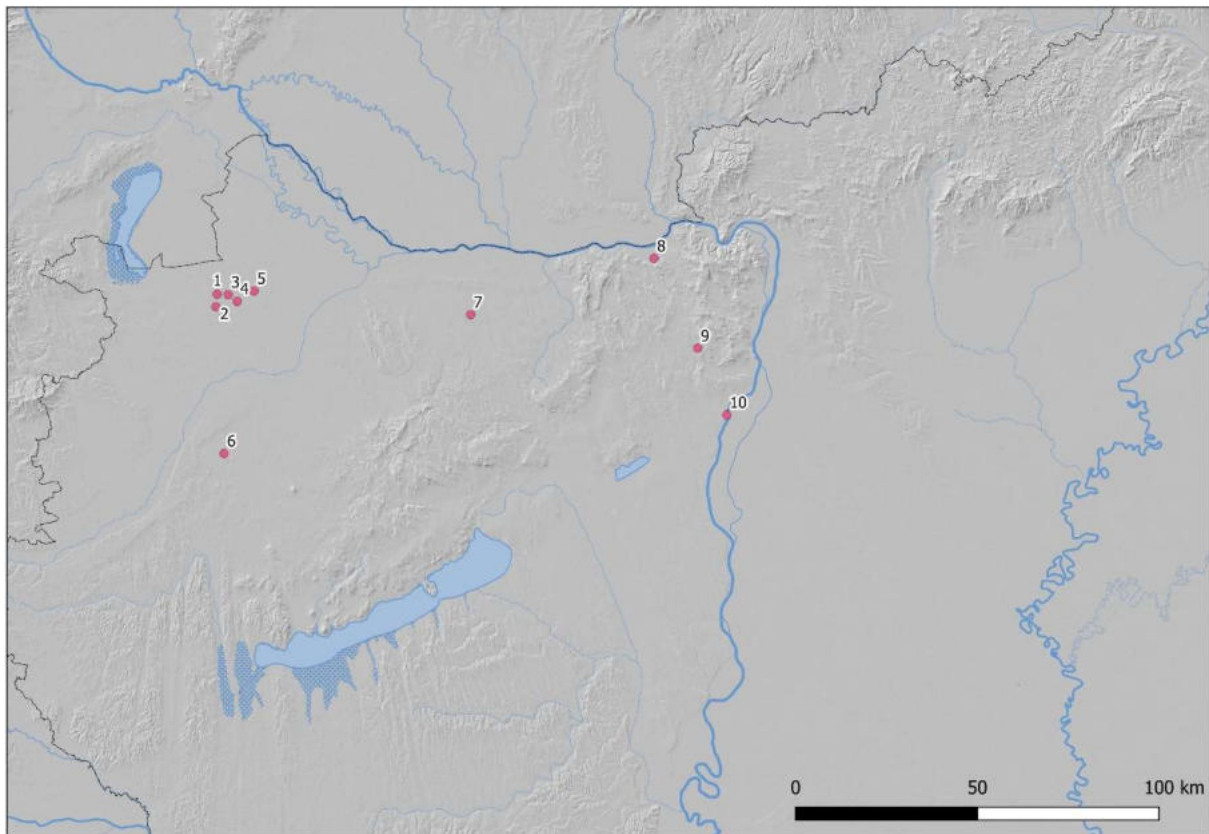


Figure 1. Location of the aerial archaeological sites, presented in the article. Close to: Osli – 1, Veszvény – 2, Szárföld – 3, Rábatamási – 4, Farád – 5 (all Rába interfluve, Győr-Moson-Sopron County), Celldömök-Sághegy – 6 (Vas County), Tárkány – 7, Tokod – 8 (both Komárom-Esztergom County), Páty – 9, Százhalombatta – 10 (both Pest County) (mapping: Balázs Holl)

Important sites

Despite taking photographs of the Érd/Százhalombatta tumulus cemetery (Pest County) for exactly two decades under various vegetation conditions, we managed to prospect high-quality cropmarks for the first time at the neighbouring Early Iron Age / Bronze Age settlement (Cf. Czajlik et al. 2019, 173). Besides the pits, we can also see the traces of smaller, pit houses on the photographs (Fig. 2).

Close to Tárkány (Komárom-Esztergom County) we photographed the traces of larger, rectangular pit houses with rounded corners. Interestingly, they were located in a large area but mostly rather far apart from each other, forming a loosely-built settlement. We discovered a cemetery of at least 100 inhumation graves, in superposition(?) with the settlement phenomena. Most likely, it was used later as the settlement (Fig. 3).

The result of the prospection along Danube is the detailed examination of a *villa* (Fig. 4) next to the fort of Tokod (Komárom-Esztergom County), both late Roman. The photographs confirm the earlier interpretation of Máté Szabó (Szabó 2011, 158-162), based on his own aerial photos. It is important to mention that a magnetometer survey of the site was completed in the meantime (Nagy – Stibrányi 2020, 24-27).



Figure 2. Traces of pits and pit houses at Százhalombatta (19th June 2020)

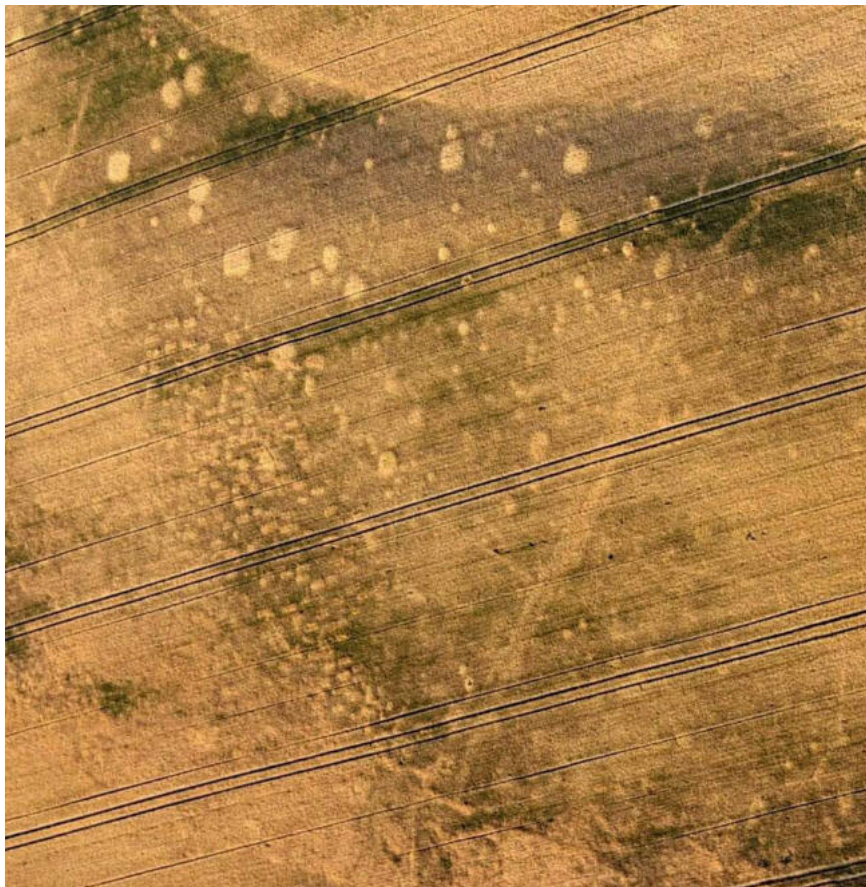


Figure 3 Traces of pits, pit houses and inhumation graves at Tárkány (27th June 2020)



Figure 4. Traces of a Late Roman *villa* at Tokod (24th June 2020)



Figure 5. Traces of a Roman *villa* at Celldömölk-Sághegy (30th June 2020)

We discovered a part of a different Roman *villa* at Celldömök – Sándorháza major (Vas County) in the winter grains. Although some details are perhaps more distinct than in the previous one (Szabó 2020, fig 16.12), we were unable to draw the complete floor plan, due to the lodged crops and the cultivation marks. However, the rich detail of the existing elements is likely to depict the condition of the walls correctly (Fig. 5).

The rotunda close to Páty (Pest County) has also been identified earlier (Czajlik 2005, 124). However, only the flight in 2020 revealed the eastern orientation of the first round church with a semi-circular sanctuary (Fig. 6) and some pit houses of the settlement mentioned as Paagh already in a charter from 1286.

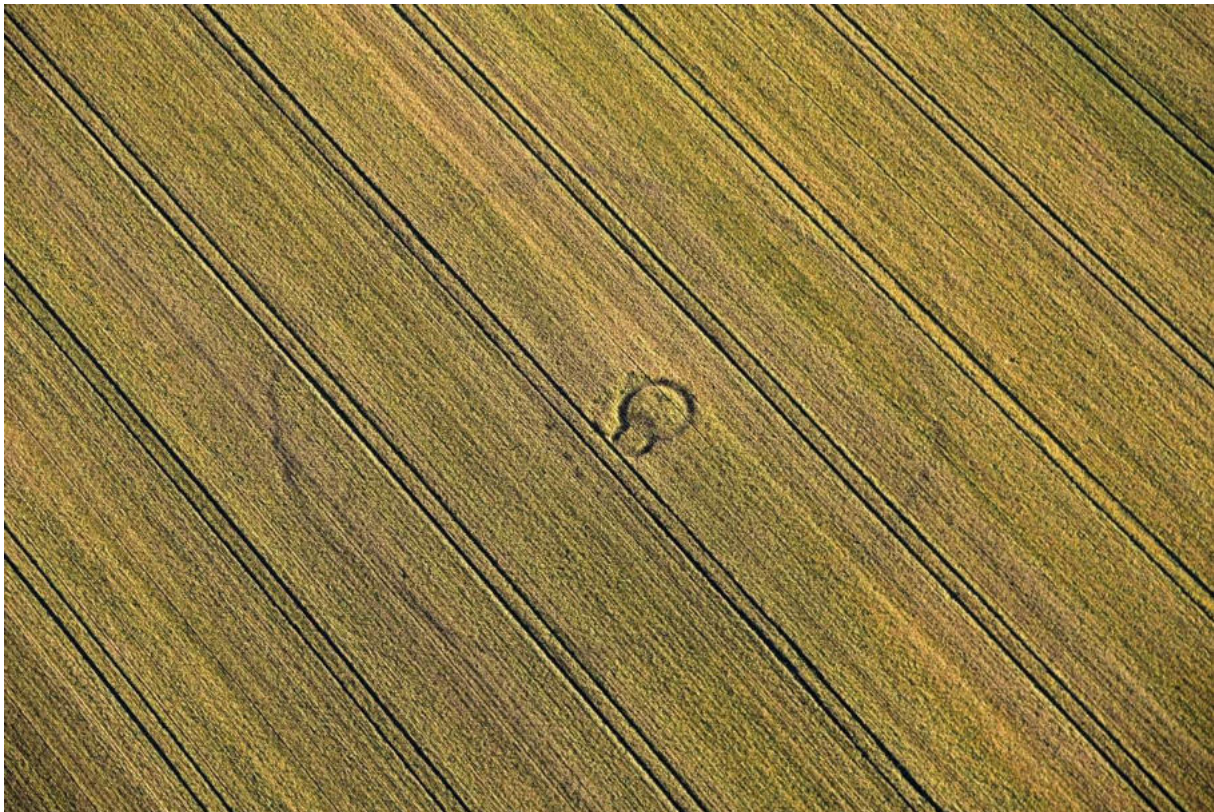


Figure 6. Traces of a rotunda at Páty (24th June 2020)

Rába interfluve

As discussed in a recently published paper (Czajlik et al. 2021), the systematic investigation of the Rába interfluve provides an exceptional opportunity to study the relationship between alluvial areas and cropmarks. The constant prospection of the area is important not only for the continuity of the data sets, but also for finding out the reason of the striking difference in the success of different aerial photography seasons in this area.

The alluvial fans of the section of the paleo-Danube entering the Carpathian Basin and of the watercourses (e.g. Rába) coming from the eastern edge of the Alps developed into one of the sub-basins of the Carpathian Basin - in the direction of the Győr Basin. The gravel-dominated alluvial fans were superimposed on top of each other in this lowland depression. Their floodplain sedimentary cover also significantly thickened during the Holocene, covering the

lower layers of the alluvial fan. As the result of this alluvial procedure, which can be detected even in historical times, a remarkably flat area has emerged, with only minimal differences in height. However, in the archaeological periods and especially in prehistoric times it is likely that the alluviation was less advanced, and countless mounds, large or small, could emerge from the frequent floods.

Szárföld – Átaljáró is one of the important Copper Age settlements in the region with a lot of buildings, partly surrounded by fortification ditches / palisades, and is located on a gentle hill, still noticeable today (Czajlik et al. 2011, fig. 19.5). In other cases, however, only the cropmark, that is the faster ripening of grains indicates the inhabited hills (Veszkény – Keleti csapásra dűlő, Czajlik et al. 2011, fig.19.4). Most of the buildings documented in 2020 may have stood on such an ‘old’ hill (at Rábatamási (Fig. 7), Szárföld (Fig. 8) and Osli (Fig. 9). On the former lands, the winter grains turned dark brown, making it easy to distinguish from the surrounding alluvial areas. Depending on the size of the inhabited hills, even more buildings (Szárföld, Osli) can be observed, but there was also a small pebble surface where we could only capture a part of a building (Farád, Fig. 10).



Figure 7. Aerial archaeological site located on a small “hill” at Rábatamási (30th June 2020)



Figure 8. Aerial archaeological site located on a small "hill" at Szárföld (30th June 2020)



Figure 9. Aerial archaeological site located on a small "hill" at Osli (30th June 2020)



Figure 10. Aerial archaeological site located on a small “hill” at Farád (30th June 2020)

In a previous publication (Czajlik et al. 2011, 238-239) we highlighted that Neolithic long houses and especially Copper Age buildings with bedding trenches are quite common in Tóköz, which is part of the Rába interfluvium. Meanwhile, we have documented the traces of several similar prehistoric buildings in the entire Rába interfluvium, and the number of new aerial archaeological sites increased by 11 also in 2020. Traces of a rectangular post-hole building at Rábatamási (Győr-Moson-Sopron County, Fig. 11) belong to the older, Neolithic types. We documented simple Copper Age buildings with bedding trench at Farád (Győr-Moson-Sopron County, Fig. 12) and a large building with bedding trench and central post-holes at Szárföld (Győr-Moson-Sopron County, Fig. 13).

Results

Despite the pandemic, we fortunately managed to open the time window in the most important aerial archaeological prospection period in 2020. The simple effectiveness also confirms this, as we discovered 10 new archaeological sites or new archaeological features of a known site per hour. The direct cost per site remained below €15, which is slightly better than the average of recent years. The most important result, however, was that no flights were cancelled, thus long-term data sets were not or only partially damaged. In some cases (Százhalombatta, Páty), for a long time open issues have been resolved, and the detailed processing and complex evaluation of the Rába interfluvium can help in understanding the landscape archaeological processes of alluvial plains with providing important information.



Figure 11. Traces of a Neolithic(?) building at Rábatamási (30th June 2020)



Figure 12. Traces of Copper Age buildings at Farád (30th June 2020)



Figure 13. Traces of a Copper Age building at Szárföld (30th June 2020)

Funding

This research was funded by National Research Development and Innovation Office (Hungary), grant numbers K-119520, K-134522 and SNN-134635, and by the Higher Educational Institutional Excellence Program / the Thematic Excellence Program of the Eötvös Loránd University.

References

- Czajlik, Zoltán: Légirégészeti kutatások Magyarországon 2004-ben (Rövid beszámoló az ELTE Régészettudományi Intézetének Térinformatikai Kutatólaboratóriumában végzett munkáról) - Aerial archaeological investigations in Hungary in 2004 (A short report of the activity of the 3D Research Laboratory of the ELTE Archaeological Institute). In: *Régészeti Kutatások Magyarországon – Archaeological Investigations in Hungary*, 2004, KÖH, Budapest, 2005, 121-142.
- Zoltán Czajlik, Eszter Fejér, Katalin Novinszki-Groma, László Rupnik, András Bödőcs, Rebeka Gergác, Balázs Holl, András Jáky, Géza Király, Gabriella T. Németh, Sándor Pusztai and Bence Soós: Before and after: investigations of prehistoric land use in relation to the Early Iron Age settlement and tumulus necropolis on the Érd/Százhalombatta-plateau. In: Matija Črešnar – Marko Mele (eds.): *Early Iron Age Landscapes of the Danube Region*. Graz – Budapest, 2019, 161-184.
- Zoltán Czajlik, László Rupnik, Máté Losonczi and Lőrinc Timár: Aerial archaeological survey of a buried landscape: The Tóköz project. In: David C. Cowley (ed.): *Remote Sensing for Archaeological Heritage Management. Proceedings of the 11th EAC Heritage Management Symposium, Reykjavik, Iceland, 25-27 March 2010*. Bruxelles, 2011, 235-241.

- Zoltán Czajlik, Mátyás Árvai, János Mészáros, Balázs Nagy, László Rupnik and László Pásztor: Cropmarks in aerial archaeology: New lessons from an old story. *Remote Sens.* 2021, 13, 1126. <https://doi.org/10.3390/rs13061126>
- Nagy, László and Stibrányi, Máté: Ditches along the road. In: Gergő István Farkas – Máté Szabó (eds.): *The Danube Limes in Hungary. Archaeological Research conducted in 2015-2020.* Pécs, 2020, 13-37.
- Szabó, Máté: Régészeti kutatások a *Ripa Pannonica* polgári településein – Archaeological research on the civilian settlements of the *Ripa Pannonica*. In: Visy, Zsolt – Szabó, Máté – Priskin, Anna – Lóki, Róbert (eds.): *A Danube Limes program régészeti kutatásai 2008-2011 között – The Danube Limes Project archaeological research between 2008-2011.* Pécs 2011, 147-162.
- Szabó Máté: Római kori villagazdaságok légitérészeti kutatása Magyarországon (Aerial survey of Roman *villa* sites in Hungary). *Archaeologiai Értesítő* 145 (2020) 207–235.

Aerial Archaeology in Oman 2018 and 2019

Robert Bewley and Sufyan Al Karaimeh

Introduction to the pilot phase

The Aerial Archaeology in Jordan project (AAJ) has been running for over 20 years (Bewley et al. 2012, Kennedy and Bewley 2004) and there had always been the intention to expand into other countries if this ever became possible. The desire to visit, and perhaps one day work in Oman, had always been there, but the opportunity to undertake aerial reconnaissance had never arisen, until 2017.

At a chance meeting between the two authors at a conference in Leiden in 2017 on Landscapes of Survival (Akkermans 2021), the pilot project for the Oman aerial archaeology project was formulated. Once the various permissions had been achieved and with enough funds to cover travel and accommodation expenses, the first flight took place on 15th February 2018 in a Royal Air Force of Oman's (RAFO) Puma helicopter from the Musanah airbase, near Rustaq, north of Muscat. As this was a familiarisation flight there were nine on board (the authors, and staff from the Ministry of Heritage and Culture - Amira Darwish al Balushi, Nasser al Hosni and Waleed Hamad al Gafari) - plus two pilots and two crewmen (to ensure safety and operating the door for our photography).

Figure 1 – Sufyan and Puma

The timing of the flight, in February, was deliberate – to assess the optimum time of year for aerial reconnaissance for archaeology. We flew for most of the day (undertaking nearly 5 hours), and the light in the middle of the day was just acceptable for photographing earthwork and stonework structures. In 2019 we were a month earlier, having been granted permission for three days of flying – 14th to 16th January - and the light was even better. The window of opportunity for aerial reconnaissance for archaeology is therefore from mid-November to mid-February, for optimum light conditions, as the targets are all upstanding archaeological sites, earthworks, stoneworks or buildings. We did experience some cloud cover (morning of 14th January 2019) but the conditions were still suitable for photographing buildings.



Figure 1. Sufyan and the Puma. We have used three different helicopters, the Puma, Lynx and the NH-90 (used by NATO countries). The most suitable was the NH-90 in terms of space – especially if we are to train Omani archaeologists – but also speed and duration. The Lynx was restricted to just under 2 hours, and 3 crew whereas the NH-90 can do 3.5 hours or more, thus making for more efficient sorties without having to refuel.

Flying on (three) consecutive days is not ideal in the ‘digital’ world when having to download all the imagery, GPS tracklogs and reload the next day’s routes in rapid time. However, the opportunity to fly with the RAFO was a generous offer and, possibly, the last chance to operate in this region.

Pilot phase results

The aim of these initial flights was to cover as much of northern Oman’s different landscapes to assess the efficacy and usefulness of aerial reconnaissance, with a view to writing a book on *Ancient Oman from the Air* (cf. Kennedy and Bewley 2004). Oman lies on the south-eastern edge of the Arabian peninsula, bordered by the UAE, Yemen and Saudi Arabia, covering 309,500 sq. kms., making it 25% larger than the United Kingdom. It is also relatively sparsely populated – with just over 5 million people, its major city being the capital Muscat. Oman has a variety of landscapes zones, with over 1,700 kms of coastline, fertile coastal plains, high mountains, especially the Al Hajar Mountains, in the north of Oman, from the Musandam Peninsula in the north to Ras Al Hadd in the south-east (as well as the Dhofar mountains in the far south and west). On the first day of flying we reached an altitude of over 7,000 ft to cross the Al Hajar mountain range. The southern coast, and especially the major settlement there, Salalah, has its own micro-climate (with a June monsoon). By contrast the large low-lying central area is an arid desert, and as one moves west, becomes part of the Empty Quarter or Rub’ al Khali. Oman is mainly very hot and dry: its average annual rainfall is 80-100mm (or 3 to 4 inches), by comparison the range in England is 1,000 to 1,800 mm (or 40 to 75 inches) with an average rainfall from of c 1400 mm.

In the first flight (2018) we targeted c. 21 sites to explore the potential of the technique for recording existing sites, as well as reconnoitring for new discoveries. It was successful on both counts. The selection of the target sites was undertaken by colleagues in the Ministry for Culture and Heritage (MHC) as we wanted to ensure that any reconnaissance and photography we undertook, would be useful in terms of recording and monitoring their archaeology. We continued this approach in 2019 as well as linking with field survey projects being undertaken in the Universities of Durham and Leiden.

Figure 2. Tracklogs 2018 and 2019

There was one small hiccup a few minutes before we took off on the first day in 2018, we discovered that the Ministry’s permission was to work in only one of the governorates (Batinah); this came as quite a surprise – it would be the equivalent of trying to undertake reconnaissance in England but being restricted by a county boundary. Luckily the pilots understood the mission and they had the authority to fly wherever we asked them.

To show that we are still in the pilot phase of this project a few numbers may help:

- Flights undertaken: 4 (one in 2018 and three in 2019)
- Hours flown: 14.2
- Photographs taken: 4,730
- Sites recorded: c 250

Secure copies of all the photographs have been made, so there are archives of the photographs in the Ministry of Heritage and Culture, Oman; in Leiden University and the University of Oxford. All the imagery was assessed after the flight by a senior representative of the National Survey Authority (NSA). All the photographs have been catalogued, that is each has a name and geolocated as a first step to further recording and analysis.

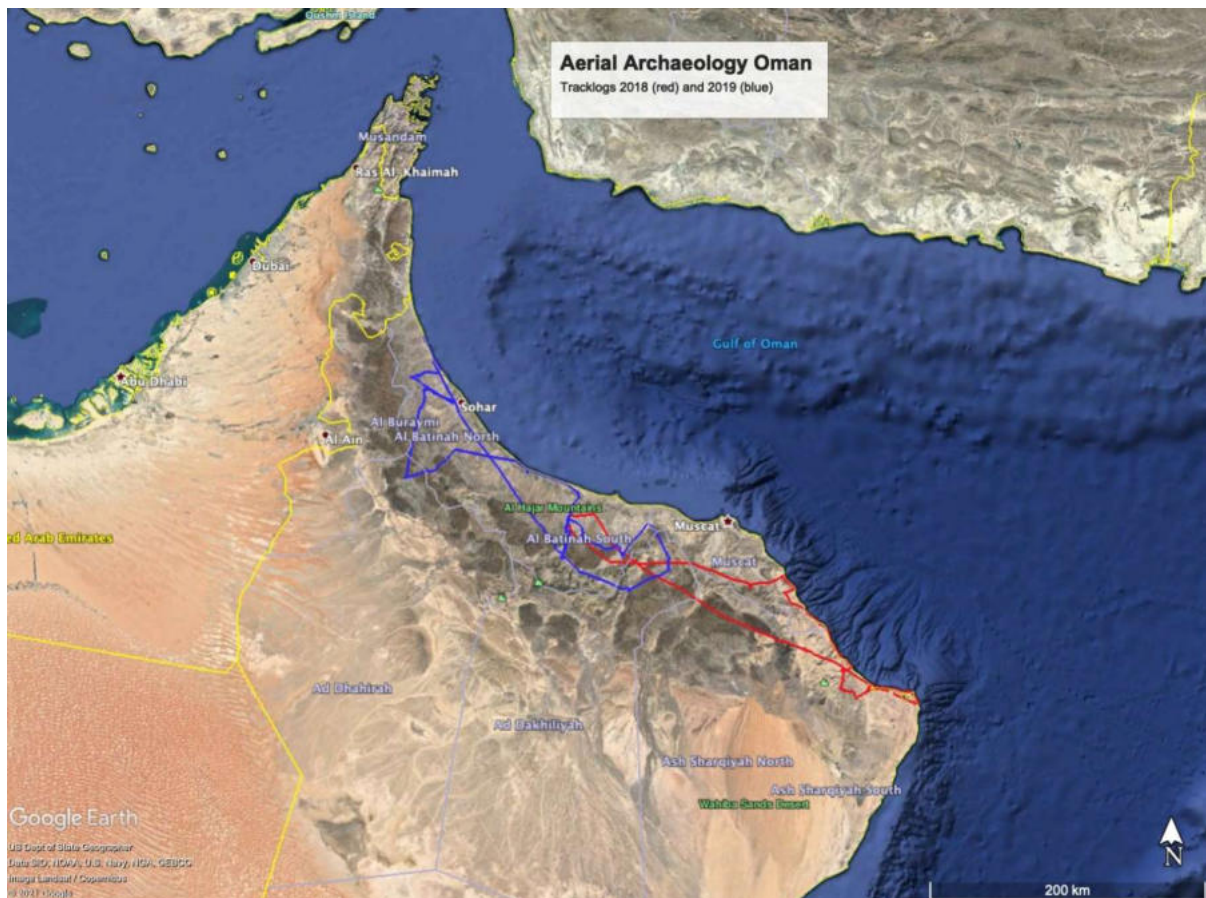


Figure 2. Tracklogs of the 2018 and 2019 flights.

Not surprisingly Oman has a wide diversity of archaeological sites, including five World Heritage Sites. The sites range from the prehistoric period, especially stone-built tombs in the Bronze Age and later, settlements from the first millennium BCE and ACE, Islamic period villages and cities, but the most prominent, ubiquitous and visible features are the many towers and small castles (Dinteman 1993). One estimate is that there are 3,000 castles and over 5,000 round towers in Oman. The majority of the older and smaller mud-brick ones are crumbling, as modern buildings (made of concrete and breeze block) are built around them. There is therefore an urgency to try to record these important elements of Oman's history before they disappear forever. This is not to say that the Omani authorities have not also invested hugely in the renovation and maintenance of many of the towers and castles; we saw many examples of these too. It is clear though that not all of them can be saved. The reason the towers, forts and castles are important is that they represent at least a thousand years of Oman's position on the main maritime trading route between Africa and Asia, and especially to and from India. This passing trade meant that the local (Omani) populations were either having to defend themselves from attack, by possible occupying forces (mainly the Portuguese and British), or, as is true in most countries, settlements were being defended from attacks by internal, tribal conflict.

The following images highlight the character of the sites we have so far been able to photograph, but is, as yet, not representative of the archaeology of the country, as we have only covered less than 20% of Oman, so this is very much the 'starter'; we hope the 'main course' can be served up in a couple of years.



Figure 3. Prehistoric rectangular defended enclosure in the Wadi Fizh, dating from the Iron Age II period, with a smaller, late Islamic phase (Leiden site reference: WAJAP-S47. Costa and Wilkinson 1987, 100). Photo: R. Bewley. APAAME_20190115_RHB-0272.



Figure 4. Prehistoric tombs, in the Sahlat area of northern Oman, known as 'honeycomb' or 'cell' graves. Stone-built burials, which can be dated to the Iron Age (1600 BC - 400 AD). Photo: S. Al Karaimeh. APAAME_20190116_SaLK-0412.



Figure 5. A hilltop settlement with many enclosures, late Islamic (19th century), in the Wadi al Jizzi. There is a defensive wall with 3 (now collapsed) towers on each of the spurs, see Costa and Wilkinson 1987, Figure 109, Plate 118 pp. 215-218 and 223. Photo: R. Bewley. APAAME_20190115_RHB-0179.



Figures 6a & 6b (next page). Living on the Edge. Rock-cut feature on a narrow escarpment. Presumably an important location, and presumably a temple or place of worship. Wadi Bani Jabir. Photos by R Bewley. APAAME_20180215_RHB-0378, APAAME_20180215_RHB-0367.



Figures 6a & 6b (previous page). Living on the Edge. Rock-cut feature on a narrow escarpment. Presumably an important location, and presumably a temple or place of worship. Wadi Bani Jabir. Photos by R Bewley. APAAME_20180215_RHB-0378, APAAME_20180215_RHB-0367.



Figures 7a and 7b. Medieval city of Qalhat, an important trading port, visited by Marco Polo in the 13th century, and by Ibn Battuta who noted its "fine bazaars and one of the most beautiful mosques" in the 15th century. One of the five World Heritage Sites in Oman.
Photo: R Bewley APAAME_20180215_RHB-0226.



7b. The Bibi Maryam Mausoleum: Bibi Maryam ruled Qalhat after the death of her husband Ayaz, in 1311 or 1312 ACE. Photo: R Bewley. APAAME_20180215_RHB-0273.



Figure 8. Mazahit Fort. Defended hilltop castle, with three round towers and one square one, presumably medieval in date. Photo: R Bewley. APAAME_20190114_RHB-0106.

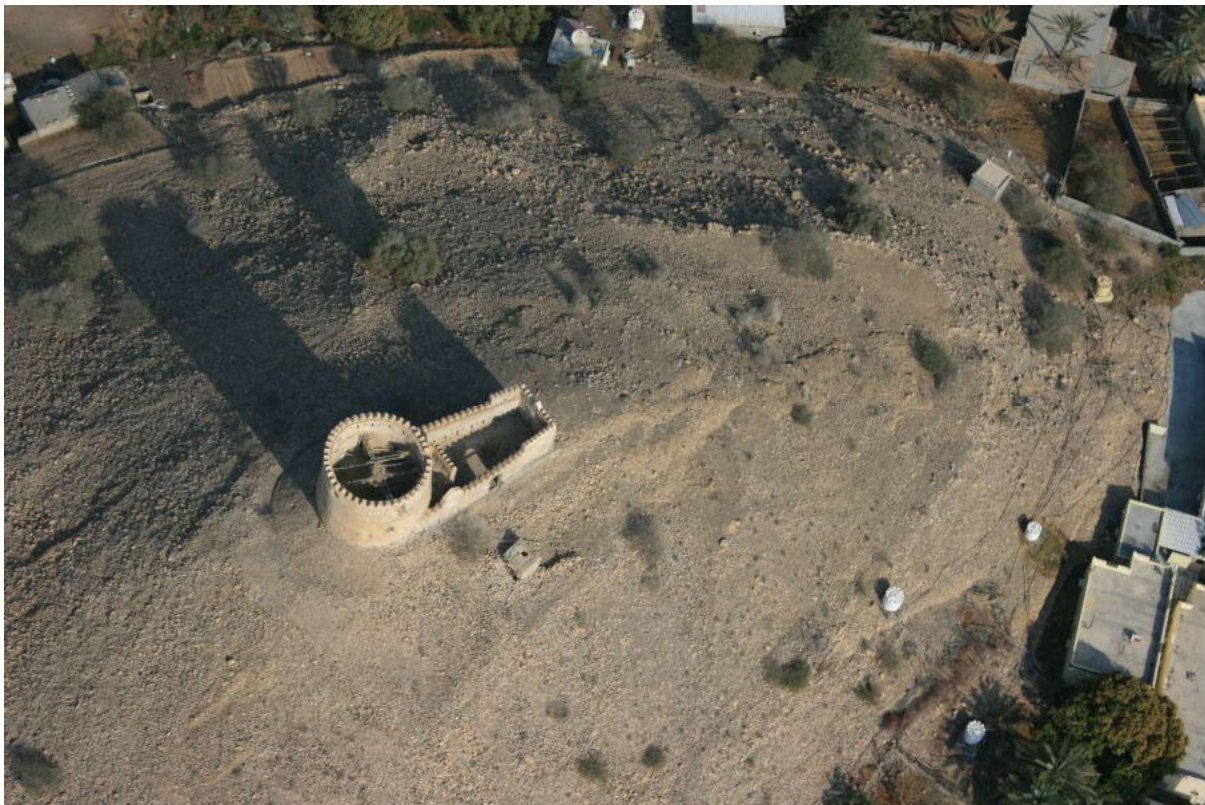


Figure 9. Daghmar Castle. Tower and keep. Photo: S Al Karaimeh. APAAME_20180215_SaLK-0084.



Figure 10. Rabi Round Tower. One of c. 5,000 such sites across Oman.
Photo: S Al Karaimeh. APAAME_20190116_SaLK-0068.



Figure 11. Suhayla, a medieval settlement defended by a small castle and two round towers, which have been restored. Photo: R. Bewley. APAAME_20190116_RHB-0608.



Figure 12. Nakhal Castle, surmounting a rocky outcrop overlooking the entrance of the wadi Wilayt Nakha. Originally defended by the Sassanids, from Arab incursions. Rebuilt in the 17th century by the Portuguese defending an important oasis and trading station. Photo: S Al Karaimeh. APAAME_20190114_SAIK-0354.



Figure 13. Sama'il Fort with 5 towers (4 having been recently restored) connected by a wall, defending the Sama'il Gap on the important frankincense trade route from Muscat to Nizwa. Sa'mail is also the location of Oman's oldest mosque. Photo R Bewley. APAAME_20190114_RHB-0286.



Figure 14. Sahlat Qanats. The tell-tale remnants of a medieval water management system, known as qanats; they are the air (and access) vents to allow the water below ground to flow in underground channels from natural water springs to drier (low-lying) areas for irrigation and human consumption. Photo: S Al Karaimah APAAME_20190116_SaLK-0559.



Figure 15. Oman's long coastal line has many examples of fishing activities, many of the smaller enterprises now disappearing fast. The individual huts and boats represent the small-scale (and presumably sustainable) fishing industry on the east coast. The fisherman are just visible tending their nets. Photo: R Bewley. APAAME_20190115_RHB-0046.

Conclusions and Next steps

In 2019 we finished the season off with a workshop on aerial archaeology for the MHC staff who were interested and wanted to discuss the next steps. One reason we had been given permission to operate in Oman was to raise awareness of the diversity of the country's heritage and attract tourists.

However, another reason for the project is the opportunity to train local archaeologists in the techniques of aerial archaeology, so that they can continue this work. The aim in the future is therefore threefold:

- i) to focus on the discovery of previously unrecorded sites, made much easier through initial identification from satellite imagery – see the EAMENA project <https://eamena.org/>;
- ii) to monitor the condition of sites from the air, an important and efficient use of aerial survey – as sites in the Middle East are under the greatest threat they have ever been;
- iii) to create records in a national (digital) inventory of all the sites in Oman, comparable to what Jordan has developed, <http://www.megajordan.org/>, using the experience gained in the EAMENA and Cultural Protection Fund projects.

All the 2018 and 2019 imagery has been catalogued and uploaded to the APAAME website:

<https://www.flickr.com/photos/apaame/collections/72157717396764638/>

This means that all the sites have been geolocated and the next stage will be to assign a specific number for each site using the national system in Oman.

To help achieve these goals we have been fortunate to obtain grants for 2021, 2022 and 2023 from the British Academy and the Beatrice de Cardi Fund (through the Society of Antiquaries of London), as well as a grant from the Augustus Foundation.

The COVID pandemic is the main stumbling block, as we do not know if travel to Oman from the UK will be possible in 2021; at the time of writing (April 2021) there are no direct flights from the UK to Oman and travel is only permitted if you have a residency permit. However if these restrictions are lifted we hope to be flying and training in November to December 2021. The plan for the third season of aerial reconnaissance is to operate for c. 30 hours to be able to produce enough imagery for the proposed book *Ancient Oman from the Air*. This will require covering all the governorates of Oman (preferably in the NH-90 helicopter), and especially to cover the south coast and islands.

Acknowledgements

We are very grateful to His Majesty Sayyid Haitham Bin Tarq Al Said, His Excellency Sayyid Badr bin Saud bin Harib al-Busaidi Minister of Defence Affairs, and to the Royal Air Force of Oman (RAFO) for allowing these reconnaissance flights to happen. We are also grateful to His Excellency Salem bin Mohammed Al Mahrouqi, Minister of Heritage and Culture for the support of the Ministry and the staff there: Salim Mohamed Al Hajri, Amira Darwish Al-Balushi, in the GIS Department, and Waleed al Gafari. For the everyday logistics we could not have managed without the help of Mr Nasser Al Hosni, who not only kept us safe on the roads but also well fed and watered. The National Survey Authority, Oman checked the photography and helped us with maps and information. The Augustus Foundation for funding. We are grateful to Dr W. Deadman for his knowledge of Omani prehistory and archaeology (Deadman et al. 2015 and pers. comm.).

References

- Akkermans P.M.M.G. 2021 (ed.). *Landscapes of Survival. The Archaeology and Epigraphy of Jordan's North-Eastern Desert and Beyond*.
- Bewley R, Kennedy D, Dalton M. and Banks R. 2012 Aerial Archaeology in Jordan 2010-2012. *AARGnews* 43. September 2012.
- Costa, P. M, Wilkinson, T. J., 1987. *The Journal of Oman Studies. The Hinterland of Sohar, Archaeological Surveys and Excavations within the Region of an Omani Seafaring City*. Vol. 9.
- Deadman W.M., Kennet D. and Khamis al Aufi. 2015. Hafit tombs and social heirarchy in al-Batinah, Oman. *Proceedings of the Seminar for Arabian Studies*. Vol. 45. 205: 49-56.
- Dinteman W. 1993. *Forts of Oman*. Motivate Publishing, London.
- Kennedy D. and Bewley R. 2004. *Ancient Jordan from the Air*. CBRL. London.

Aerial images and instant gratification (figure 1)

Rog Palmer¹



During the past decade, perhaps for longer, there has been some concern expressed about why AARG, or ‘aerial archaeology’ as we know it does not attract the younger students. Conversations didn’t really resolve anything other than the proposal that contemporary work with images came under the heading ‘remote sensing’. The theme cropped up again a few days ago in an email from Agnes Schneider, AARG’s webmistress, in which she wondered if it may help current students if AARG members were able to talk to CAA members. My reply was fairly negative. Yes, it may be a good thing to do, but is there likely to be any connection between AARG’s traditional ways and the button pressing students of today?

Working with aerial images to interpret and map a single site or a larger area can be a lengthy process taking a few hours or a few years. Neither is immediate but the time taken allows the interpreter to think about what is being mapped, to see and maybe overcome problems and perhaps to form an opinion about what the photographs show. Nothing immediate, but enjoyable work and an act that can claim to produce an ‘interpretation’. This is something we’ve been doing since John Hampton (re)introduced it as an essential thing to do with aerial photographs in the late 1960s. Technology has changed the way we transform and map images, but the essential tools for interpretation remain the same – human eyes and brain.

I thought that the main reason there has been little interest in working with aerial photos (from student research to getting a job – should they exist) is that it is rarely taught at university because to teach it effectively requires a teacher who has had active experience of things aerial. There are very few of those, therefore any aerial teaching has to come from books – which will not provide the same level of intimacy with the topic.

gratification

noun [U]

UK  /græt.ɪ.ˈfɪ.ker.ɪˈʃn/ US  /græt.ə.ˈfe.ker.ɪˈʃn/

pleasure or satisfaction, or something which provides this:

- sexual gratification
- Some people expect *instant gratification* (= to get what they want immediately).

See
gratify

— More examples

- Sales of chocolate-covered snacks are up as people seek immediate gratification.
- The children who were best at delaying gratification had better academic and social skills.
- Our culture is geared towards short-term gratification.

Figure 1. Source: <https://dictionary.cambridge.org/> (accessed 22 February 2021)

Once we move away from our own use of aerial sources to ‘remote sensing’ in a GIS we encounter teachers who have familiarity with that tool and are competent button pushers and can demonstrate ways to achieve a visual result in a few clicks. When images are involved they inevitably will be ‘enhanced’ in some way because remote sensing people seem to think this is an essential part of using them.

Enhancement has been a photographic technique since (probably) soon after its invention and was part of aerial photography in the days of film when a suitable grade of paper was chosen for making a print, and dodging and burning were accepted techniques of hand and machine printing. There were experiments that could lead to obvious overprocessing (sorry, no references, but I know that I and others tried this) but usually the images as originally printed were the ones we used. Enhancing can induce clarity but a skilled interpreter is able to see that information on the original print much as they can with most recent demonstrations of digital image processing. Information needs to be part of the image before it can be enhanced.

¹ rog.palmer@ntlworld.com

GIS people take it as a basic premise that images need to be manipulated before they can be used, and books and papers abound with demonstrations (e.g. Masini and Lasaponara 2017). These results can be achieved by anyone via a few clicks and produce visible changes that are able to deliver the instant gratification of my title. I do not recall seeing mention of the danger that over-enhancing may introduce artefacts that may later be claimed to be objects of relevance. This is one of the dangers of leaving your brain in its box and believing that computers are able to do your thinking.

This difference in approaches to using images came to a head recently – and is the main reason for this little rant – when Maurizio Forte promoted his 2021 ‘virtual field school’ on Facebook and I made the mistake of looking at what was on offer (Forte 2021). One of the course objectives was ‘Airborne and satellite imaging interpretation’ so I looked further to see what was to be taught. On day 8, after previously ‘adding and georeferencing raster data in QGIS’, there is a one hour workshop titled ‘Multispectral image processing in QGIS Raster Calculator’ followed by an hour lecture on the use (*sic*) of satellite imagery in archaeology plus a reference to a paper by Galiatzatos (2014). And that seems to be it – nothing about photo reading, nothing about problems of distinguishing archaeological from non-archaeological features, nothing about the archaeological use of this image, nothing really about anything. But this multispectral image processing will bring an immediately gratifying result and students will believe, and probably be told, they have achieved something useful.

This approach is typical of the promotion of use of satellite sources which include a lot of image manipulation and virtually no archaeology (e.g. Lasaponara and Masini 2012). In practical terms, this is the opposite way that archaeology should be done in which we first think of a problem and find a technique to help solve it rather than finding a technique whose use may help solve an unidentified problem.

This is the level of teaching that we more traditional users of images are competing with, and I’m not sure if we can. The present-day way of living seems to require an immediacy that cannot be provided from hours of looking at images through a stereoscope (or on screen) and carefully picking out features of interest that will be mapped and deciphered – the interwoven levels of photo interpretation and archaeological interpretation that I believe are at the root of our work.

If we are to attract students and young researchers to our work we need to find those whose gratification comes from the pleasure of slowly and thoughtfully teasing the information from image sources and combining that with their archaeological knowledge to make a narrative about a small piece of the past. It is the archaeological results that are important – this is why we do this work – not the product of a few clicks that can be used to brighten an array of pixels.

Acknowledgements

I thank Agnes Schneider for seeding the original idea and Darja Grosman for a few hours joint ranting about this topic

References

- Forte, M., 2021. Virtual Introduction to Digital and Cyber Archaeology: syllabus. https://ifrglobal.org/wp-content/uploads/2021/02/Syllabus_Virtual_Digital_and_Cyber_Archaeology_2021.pdf (accessed 22 Feb 2021)
- Galiatzatos, N., 2014. Exploring archaeological landscapes with satellite imagery. In Remondino, F., & Campana, S (eds) *3D Recording and Modelling in Archaeology and Cultural Heritage: BAR International Series*, 2598, 91-102.
- Lasaponara, R and Masini, N., 2012. *Satellite Remote Sensing: A New Tool for Archaeology*. Springer International.
- Masini, N. and Lasaponara, R., 2017. Sensing the past from space. In Nicloa Masini and Francesco Soldovieri (eds) *Sensing the Past: from artifact to historical site*. Springer: Switzerland, 23-60.

Cropmarks

Harvested by Rog Palmer¹

(web links were accessed on various dates between mid-October 2020 and April 2021)

GeoNadir – an archive for drone images

This may be a step towards archiving drone surveys that otherwise would be lost or too local to be found in 50 years. See also the contribution by Karen Joyce in this issue.

<https://www.geonadir.com>

AI, satellite images and archaeology

From the press release, 26 March 2021: The ‘Cultural Landscapes Scanner’ (CLS) project has born from the collaboration between Istituto Italiano di Tecnologia (IIT) and the European Space Agency (ESA) in order to detect archaeological sites from above by analyzing satellite images through artificial intelligence (AI). IIT’s researchers of the Centre of Cultural Heritage Technology in Venice, led by Arianna Traviglia, will introduce AI to help archaeologists trace back the ancient presence of humans by revealing hidden traces in the soil. The AI will be able to recognize even minimal or imperceptible variations in vegetation or other particular signs of the surface that may indicate the presence of remains not yet discovered. The project will last three years and may have as immediate outcome an improved capacity of identifying cultural heritage sites at risk of looting.

https://www.eurekalert.org/pub_releases/2021-03/iidt-aas032621.php

ALS survey at National Trust's Wallington Estate in Northumberland, England

A 16 pt/m survey has been commissioned by NT and we must hope that someone competent is given the job of analysing it. That bit wasn’t mentioned in the note below.

<https://www.gim-international.com/content/news/airborne-lidar-survey-to-help-find-lost-village>

Cameras on Mars

Not really aerial photography but I know that some members are interested in cameras as cameras. The link is to a fairly journalistic article and more details can be found (not easily) on NASA’s web site. Nice to see they know the importance of stereo photography.

<https://petapixel.com/2021/03/01/a-closer-look-at-the-mars-perseverance-rovers-incredible-cameras/>

A success for AI

A case study about use of AI to count elephants in Addo Elephant National Park, South Africa. Maybe our auto-archaeologists could learn something from this or perhaps elephant shapes are too basic for our stuff? It also was picked up by the BBC (second link).

https://www.euspaceimaging.com/heeding-the-herd-detecting-elephants-from-above/?mc_cid=565524a9fa&mc_eid=96bf24f871
<https://www.bbc.co.uk/news/science-environment-55737086>

¹ rog.palmer@ntlworld.com

A success for eyeballs

A news item noting a new cursus monument identified by Dave Cowley while examining ALS of the island. It appears to have been designed to ‘fit’ into the natural landscape.

<https://www.scotsman.com/heritage-and-retro/heritage/new-stone-age-discovery-massive-island-ritual-site-3105420?fbclid=IwAR2FPxUSeaFitPpoxVjhhPkeJCL0MjxabKs-27IyaFw9zXnu9ZxEtowR864Q>

High resolution SAR satellites

Capella have the first operation SAR satellite in what they intend to become a constellation that can offer a one-hour revisit time. Quality in the demo images looks good enough for identification of archaeological objects – and radar can see through clouds.

<https://www.capellaspace.com/>

CREODIAS

... is a seamless environment that brings processing to Earth Observation data (EODATA - EO DATA Free Archive). The platform contains online most of Copernicus Sentinel satellites data and Services, Envisat and ESA/Landsat data and other EODATA. Its design allows Third Party Users to prototype and build their own value-added services and products [see Malinowski, et al, *Books and papers of Interest*].

CREODIAS provides:

- Big-data enabled OpenStack cloud platform for processing,
- Over 18 PB of Earth Observation data (Copernicus Sentinels, Landsat, Envisat and [others](#)) available with instant and local access,
- Access to array of Platform as a Service appliances.

<https://creodias.eu/>

Advances in AI

An AI camera used at a football match in Scotland, programmed to track ‘ball’, sometimes followed a linesman’s bald or blonde head instead. I’ve said before that AI has amply demonstrated its skill in finding circles and here is further proof of that.

<https://petapixel.com/2020/11/02/ai-tracking-camera-mistakes-referees-bald-head-for-a-soccer-ball/>

Arty aerial photos

Winning pics from Aerial Photography Awards 2020.

<https://www.aerialphotoawards.com/>

Ancient books as good-quality scans

Poidebard, A., 1934. *La trace de Rome dans le désert de Syrie...*

<http://digital.library.stonybrook.edu/cdm/ref/collection/amar/id/155083>

Schmidt, E.F., 1940. *Flights over Ancient Cities of Iran.*

https://oi.uchicago.edu/sites/oi.uchicago.edu/files/uploads/shared/docs/flights_over_iran.pdf

Books and papers of interest?

Rog Palmer¹

There is so much relevant or vaguely-relevant stuff being churned out now that the following are usually little more than titles, links, and bits of the published abstracts.

US Defense Mapping Agency, 1995. *Photo Interpretation Student Handbook: photo interpretation principles.*

All the things we, as archaeologists, don't need to know about but may find interesting. A guide to buildings, transportation, industries, communications and electronics, and cultural areas (these include missile sites). There is a chunk missing between pages 456 and 774 but plenty of other pages that offer distraction. [Discovered by Lidka Žuk]

<https://sites.miiis.edu/geospatialtools2012/files/2012/07/Photo-Interpretation-Student-Handbook.-Photo-Interpretation-Principles.pdf>

Dave Cowley, Geert Verhoeven and Arianna Traviglia, 2021. Editorial for Special Issue: “Archaeological Remote Sensing in the 21st Century: (Re)Defining Practice and Theory” *Remote Sens.* 2021, 13, 1431. <https://doi.org/10.3390/rs13081431>

Nine papers noted in this and the last few issues of *AARGnews* were part of a special issue of *Remote Sensing* edited by the above trio. This Editorial gives the aims and aspirations for so doing and shows the way they hope aerial work may develop in future. References provide links to those papers.

Karen E. Joyce 1, Karen Anderson and Renee E. Bartolo, 2021. Of Course We Fly Unmanned—We're Women! *Drones* 2021, 5, 21. <https://doi.org/10.3390/drones5010021>

The Editorial from of *Drones: She Maps Special Issue* that calls for use of terms that help to ‘achieve a diverse and inclusive workplace’ by not using gender-specific words such as ‘unmanned’. Something to think about next time you write anything.

Luigi Magnini 1 and Cinzia Bettineschi, 2021. Object-Based Predictive Modeling (OBPM) for Archaeology: Finding Control Places in Mountainous Environments. *Remote Sens.* 2021, 13, 1197. <https://doi.org/10.3390/rs13061197>

From the abstract: ...examines the potential of object-based image analysis (OBIA) for archaeological predictive modeling starting from elevation data, by testing a ruleset for the location of “control places” on two test areas in the Alpine environment (northern Italy). ... Subsequently, the same model was applied to the Isarco Valley to verify the replicability of the method. The procedure resulted in 36 potential control places which find good correspondence with the archaeological sites discovered in the area. Previously unknown contexts were further controlled

¹ rog.palmer@ntlworld.com

using very high-resolution (VHR) aerial images and digital terrain model (DTM) data, which often suggested a possible (pre-proto)historic human frequentation.

Andrzej Giza 1, Paweł Terefenko, Tomasz Komorowski and Paweł Czapliński, 2021. Determining Long-Term Land Cover Dynamics in the South Baltic Coastal Zone from Historical Aerial Photographs. *Remote Sens.* 2021, 13, 1068. <https://doi.org/10.3390/rs13061068>

Not archaeological, but some of us map coastal change as part of our archaeological investigations. This paper examines ‘... spatial and temporal variations in the dune areas of the Pomeranian Bay coast (South Baltic Sea) were quantified using remote sensing data from the years 1938–2017, supervised classification, and a geographic information system post-classification change detection technique.’

Zoltán Czajlik, Mátyás Árvai, János Mészáros, Balázs Nagy, László Rupnik and László Pásztor, 2021. Cropmarks in Aerial Archaeology: New Lessons from an Old Story. *Remote Sens.* 2021, 13, 1126. <https://doi.org/10.3390/rs13061126>

From the abstract: ... the essential analyses [of cropmarks] belong mostly to the predigital period, while the significant growth of datasets in the last 30 years could open a new chapter. This is especially true in the case of Hungary ... [where] characteristics of soil formed of Late Quaternary alluvial sediments are intimately connected to the young geological/geomorphological background. The predictive soil maps elaborated within the framework of renewed data on Hungarian soil spatial infrastructure use legacy, together with recent remote sensing imagery. Based on the results from three study areas investigated, analyses using statistical methods (the Kolmogorov–Smirnov and Random Forest tests) showed a different relative predominance of pedological variables in each study area. The geomorphological differences between the study areas explain these variations satisfactorily.

Demetrios Athanasoulis, Alex R. Knodell, Žarko Tankosić, Zozi Papadopoulou, Maria Sigala, Charikleia Diamanti, Yannis Kourayos and Apostolos Papadimitriou, 2021. The Small Cycladic Islands Project (2019–2020): a comparative survey of uninhabited landscapes near Paros and Antiparos, Greece. *Antiquity* online 26 February 2021. <https://doi.org/10.15184/aqy.2021.15>

Noted because in its method statement there is no mention of examining available images in this survey of a group of small islands. They had a drone, but that seems to have been used to record what they found – for example, Byzantine fortifications on Vriokastro which, I think, show more clearly on GE. Who, other than these authors, undertakes a survey without using aerial images? Rant over.

Andrea Titolo , 2021. Use of Time-Series NDWI to Monitor Emerging Archaeological Sites: Case Studies from Iraqi Artificial Reservoirs. *Remote Sens.* 2021, 13, 786.
<https://doi.org/10.3390/rs13040786>

Use of Landsat and Sentinel-2 NDWI values to document how much of an archaeological site is submerged following dam construction in Iraq. Use of 3m Planetscope images has allowed some visual evaluation.

Javier Fernández-Lozano and Enoc Sanz-Ablanedo, 2021, Unraveling the Morphological Constraints on Roman Gold Mining Hydraulic Infrastructure in NW Spain. A UAV-Derived Photogrammetric and Multispectral Approach. *Remote Sens.* 2021, 13, 291.
<https://doi.org/10.3390/rs13020291>

Not written by archaeologists. Use RGB and multispectral sensors collected by UAV that may be of interest to those who enjoy manipulating images and/or are studying Roman mines and mining. See also the first author and others 2018, below.

From the abstract: ... a unique hydraulic infrastructure 1200 km-long, used for the exploitation of auriferous deposits in Roman times ... represents the most extensive waterworks in Europe and is one of the best-preserved examples of mining heritage in Antiquity. In this work, three mining exploitation sectors ... characterized by channels and least developed in different geological materials were examined.... A multi-approach based on a comparison of photogrammetric and multispectral data improved the identification and description of the hydraulic network. Comparison with traditional orthoimages and LiDAR data suggests that UAV-derived multispectral images are of great interest in areas where these sets of data have low resolution or areas that are densely covered by vegetation. ... these inferences might help researchers develop new strategies for mapping the Roman mining infrastructure and establishing the importance of geological inheritance on the construction of the hydraulic system that led the Romans to the accomplishment of the largest mining infrastructure ever known in Europe.

Lindsay C. Bloch, Jacob D. Hosen, Emily C. Kracht, Michelle J. LeFebvre, Claudette J. Lopez, Rachel Woodcock, and William F. Keegan, 2021. Is It Better to Be Objectively Wrong or Subjectively Right? Testing the Accuracy and Consistency of the Munsell Capsure Spectrocolorimeter for Archaeological Applications. *Advances in Archaeological Practice*, 2021, 1–13. DOI:[10.1017/aap.2020.53](https://doi.org/10.1017/aap.2020.53)

While this is nothing at all to do with aerial matters it does raise interesting questions about the effectiveness of AI methods in general.

From the abstract: ... a field-ready digital colormatching instrument is marketed to archaeologists as a replacement for MSCC [Munsell Soil Color Charts], but the accuracy and overall suitability of this device for archaeological research has not been demonstrated. Through three separate field and laboratory trials, we found systematic mismatches in the results obtained via device, including variable accuracy against standardized MSCC chips, which should represent ideal samples. At the same time, the instrument was consistent in its readings. This leads us to question whether using the “subjective” human eye or the “objective” digital eye is preferable for data recording of color.

Nada Mzid, Stefano Pignatti, Wenjiang Huang and Raffaele Casa, 2021. An Analysis of Bare Soil Occurrence in Arable Croplands for Remote Sensing Topsoil Applications. *Remote Sens.* 2021, 13, 474. <https://doi.org/10.3390/rs13030474>

Nothing directly to do with archaeology but maybe of interest to those of you seeking information in bare soil?

From the abstract: This research investigated the usage of multispectral (Sentinel-2 MSI) satellite data at the farm/regional level, for the identification of agronomic bare soil presence, utilizing bands of the spectral range from visible to shortwave infrared. The research purpose was to assess the frequency of cloud-free bare soil time-series images available during the year in typical agricultural areas, ... Two main results were obtained: (i) bare soil frequency, indicating where and when a pixel (or an agricultural field) was detected as bare surface in three representative agricultural areas of Italy, and (ii) a temporal sensitivity analysis, providing the acquisition frequency of useful bare soil images applicable for the retrieval of soil variables of interest. It was shown that, in order to provide for an effective agricultural soil monitoring capability, a revisit frequency in the range of five to seven days is required

Marco Balsi, Salvatore Esposito, Paolo Fallavollita, Maria Grazia Melis and Marco Milane, 2021. Preliminary Archeological Site Survey by UAV-Borne Lidar: A Case Study. *Remote Sens.* 2021, 13, 332. <https://doi.org/10.3390/rs13030332>

From the abstract: ... we present a case study of a detailed topographic survey based on a ... LiDAR sensor carried by an unmanned aerial vehicle.... The high-resolution digital terrain model ... was searched exhaustively by an expert operator looking for entrances to prehistoric hypogea. The study documents the usefulness of such a technique to reveal anthropogenic structures hidden by vegetation and perform fast topographic documentation of the ground surface.

Edisa Lozić 1 and Benjamin Štular, 2021. Documentation of Archaeology-Specific Workflow for Airborne LiDAR Data Processing. *Geosciences* 2021, 11, 26. <https://doi.org/10.3390/geosciences11010026>

Maybe of interest for those of you finding ways of dealing with ALS data?

From the abstract: ... this paper provides a critical review of existing archaeology-specific workflows for airborne LiDAR-derived topographic data processing, resulting in an 18-step workflow with consistent terminology.

Dave Cowley and Piers Dixon, 2020. New light on medieval settlement in lowland Scotland. *Medieval Archaeology: Newsletter of the Society for Medieval Archaeology*, 3-4. https://www.academia.edu/login?post_login_redirect_url=https%3A%2F%2Fwww.academia.edu%2F%2FuAHs-PkDAbSP-bxqJa0%2Fresource%2Fwork%2F44878294%2FNew_light_on_medieval_settlement_in_lowland_Scotland%3Femail_work_card%3Dview-paper

Reminiscent of the series in *Antiquity* by St Joseph, *Air reconnaissance: recent results*, this single page of text describes a DMV which is illustrated by an uninterpreted ALS visualisation which leaves the reader to try and work out what can and cannot be seen.

Ioana A. Oltean and João Fonte, 2021. GIS Analysis and Spatial Networking Patterns in Upland Ancient Warfare: The Roman Conquest of Dacia. *Geosciences* 2021, 11, 17. <https://doi.org/10.3390/geosciences11010017>

From the abstract: ... Based on LiDAR and satellite-generated high- and mid-resolution topographic data, our paper employs an innovative combination of GIS spatial analysis tools to examine the spatial relationships between Roman military bases, Dacian targets, and the wider landscape This helped us formulate and test spatial and historical hypotheses, according to which all known and potential Roman military bases in the study area functioned as part of a system where each contributed individual advantages in securing their domination across the landscape. Our research highlighted the advantages and challenges for Comarnicelu as one of the key Roman logistical nodes, and for the attackers at Şesului and Muncelu working in tandem to besiege and subdue Sarmizegetusa Regia. Our study raises doubts with respect of the fall and destruction of the hillfort at Vârfu lui Hulpe as a result of a Roman siege, making space for alternative political narratives. Ultimately, our findings help build a better understanding of this iconic world heritage landscape and its Roman conquest.

Jesse Casana , Elise Jakoby Laugier, Austin Chad Hill, and Donald Blakeslee, 2020. A Council Circle at Etzanoa? Multi-sensor Drone Survey at an Ancestral Wichita Settlement in Southeastern Kansas. *American Antiquity* 85(4), 2020, pp. 761–780. [doi:10.1017/aaq.2020.49](https://doi.org/10.1017/aaq.2020.49)

From the abstract: ... results of a multi-sensor drone survey at an ancestral Wichita archaeological site in southeastern Kansas, originally recorded in the 1930s and believed by some scholars to be the location of historical “Etzanoa,” a major settlement reportedly encountered by Spanish conquistador Juan de Oñate in 1601. We used high-resolution, drone-acquired thermal and multispectral (color and near-infrared) imagery, alongside publicly available lidar data and satellite imagery, to prospect for archaeological features across a relatively undisturbed 18 ha area of the site. Results reveal a feature that is best interpreted as the remains of a large, circular earthwork, similar to so-called council circles documented at five other contemporary sites of the Great Bend aspect cultural assemblage. We also located several features that may be remains of house basins, the size and configuration of which conform with historical evidence. These findings point to major investment in the construction of largescale ritual, elite, or defensive structures, lending support to the interpretation of the cluster of Great Bend aspect sites in the lower Walnut River as a single, sprawling population center, as well as demonstrating the potential for thermal and multispectral surveys to reveal archaeological landscape features in the Great Plains and beyond.

Andrés Menéndez Blanco, Jesús García Sánchez, José Manuel Costa-García, João Fonte, David González-Álvarez and Víctor Vicente García, 2020. Following the Roman Army between the Southern Foothills of the Cantabrian Mountains and the Northern Plains of Castile and León (North of Spain): Archaeological Applications of Remote Sensing and Geospatial Tools. *Geosciences* 2020, 10(12), 485; [doi:10.3390/geosciences10120485](https://doi.org/10.3390/geosciences10120485)

They’ve done some interpretation and mapping too.

From the abstract: Sixty-six new archaeological sites have been discovered thanks to the combined use of different remote sensing techniques and open access geospatial datasets (mainly aerial photography, satellite imagery, and airborne LiDAR). These sites enhance the footprint of the Roman military presence in the northern fringe of the River Duero basin (León, Palencia, Burgos and

Cantabria provinces, Spain). This paper provides a detailed morphological description of 66 Roman military camps in northwestern Iberia that date to the late Republic or early Imperial eras. ... Finally, it stresses out the relevance of these novel data to delve into the rationale behind the Roman army movements between the northern Duero valley and the southern foothills of the Cantabrian Mountains. We conclude that methodological approaches stimulated by open-access geospatial datasets and enriched by geoscientific techniques are fundamental to understand the expansion of the Roman state in northwestern Iberia during the 1st c. BC properly. This renewed context set up a challenging scenario to overcome traditional archaeological perspectives still influenced by the cultural-historical paradigm and the pre-eminence of classical written sources.

Diego Ronchi, Marco Limongiello and Salvatore Barba, 2020. Correlation among Earthwork and Cropmark Anomalies within Archaeological Landscape Investigation by Using LiDAR and Multispectral Technologies from UAV. *Drones* 2020, 4(4), 72; [doi:10.3390/drones4040072](https://doi.org/10.3390/drones4040072)

All authors come from the Dept of Civil Engineering at Salerno and have produced a good example of everything a paper on this topic ought not to be. Figure 3 gives readers a good idea of their comprehension of how things may be visible from above. They had a drone, they found some anomalies but they are not sure what they mean. And it got published...

Their abstract claims: ... this contribution investigates particularly the correlation among the presence of cropmarks, identifiable with the processing of multispectral maps and vegetation indices from RGB images, and earthwork anomalies identified in a Digital Terrain Model (DTM) built, by utilizing a light detection and ranging (LiDAR) flight from an Unmanned Aerial Vehicle (UAV). The study demonstrates how the use of vegetation maps—calculated starting from RGB and multispectral aerial photos—can provide a more expeditious preliminary analysis on the position and extension of areas characterized by the presence of buried structures, but also that, in order to investigate in-depth a context in similar conditions, the most effective approach remains the one based on LiDAR technology. The integration between the two techniques may prove fruitful in limiting the extension of the areas to be investigated with terrestrial survey techniques.

Ciara N. McGrath, Charlie Scott, Dave Cowley and Malcolm Macdonald, 2020. Towards a Satellite System for Archaeology? Simulation of an Optical Satellite Mission with Ideal Spatial and Temporal Resolution, Illustrated by a Case Study in Scotland. *Remote Sens.* 2020, 12, 4100; [doi:10.3390/rs12244100](https://doi.org/10.3390/rs12244100)

From the abstract: Applications of remote sensing data for archaeology rely heavily on repurposed data, which carry inherent limitations in their suitability to help address archaeological questions. Through a case study framed around archaeological imperatives in a Scottish context, this work ... conclude[s] that the availability of [existing] commercial data is currently insufficient. ... Following an analysis of existing systems, this paper presents a high-level mission architecture for a bespoke satellite system designed from an archaeological specification. This study focuses on orbit design and the number of spacecraft needed to meet the spatial and temporal resolution requirements for archaeological site detection and monitoring in a case study of Scotland, using existing imaging technology. ... [and] specifies a satellite constellation design on that basis. High-level design suggests that a system of eight 100 kg spacecraft in a 581 km altitude orbit could provide coverage at a desired temporal and spatial resolution of two-weekly revisit and <1 m ground sampling distance, respectively. The potential for such a system to be more widely applied in regions of similar latitude and climate is discussed.

Martti Pärssinen, William Balée, Alceu Ranzi and Antonia Barbosa, 2020. The geoglyph sites of Acre, Brazil: 10 000-year-old land-use practices and climate change in Amazonia. *Antiquity* 2020 Vol. 94 (378): 1538–1556. <https://doi.org/10.15184/aqy.2020.208>

A note about recent research into various aspects – climatic, landuse, dating and excavation – from investigations into some of the earthwork 450+ enclosures that include many identified on aerial sources.

Iriarte, J, et al. 2020. Geometry by Design: Contribution of Lidar to the Understanding of Settlement Patterns of the Mound Villages in SW Amazonia. *Journal of Computer Applications in Archaeology*, 3(1), pp. 151–169. DOI: <https://doi.org/10.5334/jcaa.45>

From the abstract: ... we carried out the first Lidar survey with a RIEGL VUX-1 UAV Lidar sensor integrated into an MD 500 helicopter ... results documented distinctive architectural features of Circular Mound Villages such as the presence of ranked, paired, cardinally oriented, sunken roads interconnecting villages, the occurrence of a diversity of mound shapes within sites, as well as the exposure the superimposition of villages. Site size distribution analysis showed no apparent signs of settlement hierarchy. At the same time, it revealed that some small groups of villages positioned along streams exhibit regular distances of 2.5–3 km and 5–6 km between sites. Our data show that after the cessation of Geoglyph construction (~AD 950), this region of SW Amazonia was not abandoned, but occupied by a flourishing regional system of Mound Villages. The results continue to call into question traditional views that portray interfluvial areas and the western sector of Amazonia as sparsely inhabited. A brief discussion of our findings in the context with pre-Columbian settlement patterns across other regions of Amazonia is conducted.

[The things they call ‘geoglyphs’ would be normal ditch-and-bank enclosures in temperate Europe and beyond with construction sometimes showing more than one phase.]

Gergő István Farkas, Réka Neményi and Máté Szabó (eds), 2020. *The Danube Limes in Hungary: Archaeological research conducted in 2015–2020*. Kontraszt Plusz Ltd.: Pécs. ISBN 978-963-429-597-6 (print)
ISBN 978-963-429-598-3 (digital)
[DOI: 10.15170/CLIR.2020](https://doi.org/10.15170/CLIR.2020)

A collection of 11 papers that include geophysical survey, excavation reports and analyses of finds with occasional reference to, and illustrations from, aerial sources. I was pleased to note that many of the geophysical surveys had been interpreted and begin to wonder – as with aerial evidence when we do not publish all or any of the photographs – if we need to be shown the raw data in contributions such as these rather than just the results and analyses? Raw data, along with its meanings and confusions, has a place in teaching and understanding geophysical results, but not in ‘we found yet another Roman fort’ type of papers. Discuss.

Students of the Roman empire may be pleased to have a freely downloadable copy of this book but, as a non-Romanist, I kept thinking of the waste of effort researching the well known in order to make minute tweaks to knowledge.

Dave Cowley, Richard Jones, Giles Carey and Juliette Mitchell, 2020. Barwhill revisited: rethinking old interpretations through integrated survey datasets. *Transactions of the Dumfriesshire and Galloway Natural History and Antiquarian Society*, Volume 93 (2019), 9–26.

https://www.academia.edu/44629568/Barwhill_Revisited_Rethinking_old_interpretations_through_integrated_survey_datasets?email_work_card=view-paper

A theme of this article is discussion of individual aerial photographs (and other means of survey) to produce a single coherent result so it is pleasing to note that the quality of the illustrations in my PDF copy is sufficiently good to follow the arguments presented.

From the abstract: A suite of archaeological remains, including a group of barrows, a later Iron Age settlement and a stretch of Roman road at Barwhill, just north of Gatehouse of Fleet [Scotland], are explored using aerial photographic records, geophysical survey and Airborne Laser Scanning data. These have provided new insights into the remains which were first recorded in 1949. Of note is the revision of an earlier identification of a square example amongst the barrows. This paper highlights the importance of systematic review of the survey evidence and the benefits of complementary datasets. The wider context for the group of barrows is discussed, identifying the need for excavation to provide dating evidence for a poorly understood corpus of burial sites that may span the Iron Age, Roman and early medieval periods.

Louise Rayne, Maria Carmela Gatto, Lamin Abdulaati, Muftah Al-Haddad, Martin Sterry, Nichole Sheldrick and David Mattingly, 2020. Detecting Change at Archaeological Sites in North Africa Using Open-Source Satellite Imagery. *Remote Sens.* 2020, 12, 3694;

doi:[10.3390/rs12223694](https://doi.org/10.3390/rs12223694)

From the abstract: ... a remote sensing workflow for identifying modern activities that threaten archaeological sites, developed as part of the work of the Endangered Archaeology of the Middle East and North Africa (EAMENA) project. We use open-source Sentinel-2 satellite imagery and the free tool Google Earth Engine to run a per-pixel change detection to make the methods and data as accessible as possible for heritage professionals. We apply this and perform validation at two case studies, the Aswan and Kom-Ombo area in Egypt, and the Jufra oases in Libya, with an overall accuracy of the results ranging from 85–91%. Human activities, such as construction, agriculture, rubbish dumping and natural processes were successfully detected at archaeological sites by the algorithm, allowing these sites to be prioritised for recording. A few instances of change too small to be detected by Sentinel-2 were missed, and false positives were caused by registration errors, shadow and movements of sand. This paper shows that the expansion of agricultural and urban areas particularly threatens the survival of archaeological sites, but our extensive online database of archaeological sites and programme of training courses places us in a unique position to make our methods widely available.

Marek Bundzel, Miroslav Jaščur, Milan Kováč, Tibor Lieskovský, Peter Sinčák and Tomáš Tkáčik, 2020. Semantic Segmentation of Airborne LiDAR Data in Maya Archaeology.

Remote Sens. 2020, 12, 3685; doi:[10.3390/rs12223685](https://doi.org/10.3390/rs12223685)

Use of AI to identify types of Mayan structures recorded using ALS.

From the abstract: Labeling this type [ALS] of archaeological data is a tedious process. We used a data set from Pacunam LiDAR Initiative survey of lowland Maya region in Guatemala [that] contains ancient Maya structures that were manually labeled, and ground verified to a large extent. We have built and compared two deep learning-based models, U-Net and Mask R-CNN, for semantic segmentation. The segmentation models were used in two tasks: identification of areas of ancient construction activity, and identification of the remnants of ancient Maya buildings. The U-Net based model performed better in both tasks and was capable of correctly identifying 60–66% of all objects, and 74–81% of medium sized objects. The quality of the resulting prediction was evaluated using a variety of quantifiers. Furthermore, we discuss the problems of re-purposing the archaeological style labeling for production of valid machine learning training sets. Ultimately, we outline the value of these models for archaeological research and present the road map to produce a useful decision support system for recognition of ancient objects in LiDAR data.

Stefan L. Smith, 2020. Drones over the “Black Desert”: The Advantages of Rotary-Wing UAVs for Complementing Archaeological Fieldwork in the Hard-to-Access Landscapes of Preservation of North-Eastern Jordan. *Geosciences* 2020, 10, 426; doi:[10.3390/geosciences10110426](https://doi.org/10.3390/geosciences10110426)

I thought this was going to be yet another ‘I’ve got a drone, here are some 3D images’ but it seems to be more useful than that and expands David Kennedy’s work in Jordan.

From the abstract: ... recent use of a rotary-wing drone by the Western Harra Survey in the “Black Desert”, or Harra, of north-eastern Jordan, showcases these advantages [digital elevation models and three-dimensional models] in the context of a landscape that (a) is subject to negligible transformation processes and (b) is difficult to access, both by vehicle and on foot. By using processed drone imagery to record in detail prehistoric basalt structures visible on the surface and their surroundings, morphological site typologies hypothesised from satellite imagery were confirmed, relative dating within sites ascertained, structural features and damage documented, spatial relationships to natural resources established, offsite features traced, modern threats to heritage catalogued, and practically inaccessible sites investigated. Together, these results, most of which were only obtainable and all of which were obtained more rapidly by using a drone, represent significant insights into this underrepresented region, and provide a case-study for the benefits of these devices in other landscapes of a similar nature.

José Ángel Salgado Carmona, Elia Quirós, Victorino Mayoral and Cristina Charro, 2020. Assessing the potential of multispectral and thermal UAV imagery from archaeological sites. A case study from the Iron Age hillfort of Villasviejasdel Tamuja (Cáceres, Spain). *Journal of Archaeological Science: Reports* 31. DOI: [10.1016/j.jasrep.2020.102312](https://doi.org/10.1016/j.jasrep.2020.102312)

From the abstract: ... This work explores the potential of low altitude [UAV] remote sensing (multispectral and thermal infrared imaging) for the study of complex archaeological zones through the study case of an Iron Age hillfort in the southwest of the Iberian Peninsula. We describe the methodology developed in order to maximize and objectively quantify the detection of buried structures. On the one hand, we evaluate the capacity to categorize the response to varying depths of the overlying sediments, exploring the limits of the statistically significant separability between noise and signal. On the other hand, thermal IR images taken at different times of the day are compared to assess the optimal conditions for the identification of archaeological features. The results reveal that although we can only approach meaningful separability values, it was possible to identify a large number of buried structures. These results were finally validated by comparison with the data obtained by geophysical survey and excavation.

Roland Filzwieser and Stefan Eichert, 2020. Towards an Online Database for Archaeological Landscapes. Using the Web Based, Open Source Software OpenAtlas for the Acquisition, Analysis and Dissemination of Archaeological and Historical Data on a Landscape Basis *Heritage* 2020, 3, 1385–1401; <https://doi:10.3390/herita>

From the abstract: In this paper, we present the web-based, open source software OpenAtlas, which uses the International Council of Museums' Conceptual Reference Model (CIDOC CRM), and its possible future potential for the acquisition, analysis and dissemination of a wide range of archaeological and historical data on a landscape basis. To this end, we will first introduce {a case study} ... Subsequently, the article will then discuss the possible extension of this database ... with regard to the integration of further archaeological structures ... and other data, such as historical maps, aerial photographs and airborne laser scanning data. Finally, the paper will conclude with the general added value for future research projects by such a collaborative and web-based approach.

Possibly of interest to those of you in heritage organisations or those undertaking large landscape projects. With any of these intended large, open access, collections of data there is a worry that future research projects may use only those sources and not pursue minor collections that may hold useful data but are overlooked because they have not been transferred into the 'big' source. We've seen the same in the aerial world in which some research is based solely on Google Earth.

Radek Malinowski, Stanisław Lewiński, Marcin Rybicki, Ewa Gromny, Małgorzata Jenerowicz, Michał Krupiński, Artur Nowakowski, Cezary Wojtkowski, Marcin Krupiński, Elke Krätzschmar and Peter Schauer, 2020. Automated Production of a Land Cover/Use Map of Europe Based on Sentinel-2 Imagery. *Remote Sens.* 2020, 12, 3523; <https://doi:10.3390/rs12213523>

Reporting the process of making a land cover map and its classifications that is available for the year 2017 as an open access layer on <https://browser.creodias.eu/> The classification is fairly crude for aerial use (it's better on <https://map.onesoil.ai/> – see *AARGnews* 61, 57) but may help people understand new areas where they may be working, running schools, etc.

Ole Risbøl, Daniel Langhammer, Esben Schlosser Mauritsen and Oula Seitsonen, 2020. Employment, Utilization, and Development of Airborne Laser Scanning in Fenno-Scandinavian Archaeology—a Review. *Remote Sens.* 2020, 12, 1411; doi:10.3390/rs12091411

A thoughtful and informative review of uses of ALS 'in the North' between 2005 and 2019 that, after an introduction, starts by showing the availability and resolution of data for each country (Norway, Sweden, Finland, Denmark) and the reason(s) why it was taken. It also identifies the archaeological uses made of it. Given the amount of forested land in the first three countries, ALS was put to use to identify what archaeological evidence may remain below the trees and case studies show examples of the range of features identified. There is discussion throughout the paper and it includes notes on different resolutions (where these are available), results and effectiveness of using semi-automated algorithms (see, for example, work on Danish ringforts on p20) and comments that ALS is one of several forms of aerial remote sensing that are often best used together.

This paper is more than the ‘review’ of the title. The discussion and case studies make it a useful introduction for anyone wanting to learn about uses of ALS in archaeology.

Nicodemo Abate, Abdelaziz Elfadaly, Nicola Masini and Rosa Lasaponara, 2020. Multitemporal 2016-2018 Sentinel-2 Data Enhancement for Landscape Archaeology: The Case Study of the Foggia Province, Southern Italy. *Remote Sens.* 2020, 12, 1309; doi:10.3390/rs12081309

Why would anyone want to use 10m resolution images to identify archaeological features when there is higher-resolution stuff easily available? Why would anyone fund research like this and why would anyone publish it? Read all about it here. I’ve never understood why people need to bash images with technology with the aim of producing the ‘best’ picture of an archaeological site and, having done that, do nothing archaeological with it. In a way it reminds me of the aviators’ philosophy that was akin to she who discovers the most sites is the best aerial archaeologist (for this in action see *AARGnews* 9, 28-29).

From the abstract: This paper is focused on the use of satellite Sentinel-2 data for assessing their capability in the identification of archaeological buried remains. ... investigations were performed using multi-temporal Sentinel-2 data and spectral indices, commonly used in satellite-based archaeology, and herein analyzed in known archaeological areas to capture the spectral signatures of soil and crop marks and characterize their temporal behavior using Time Series Analysis and Spectral Un-mixing. Tasseled Cap Transformation and Principal Component Analysis have been also adopted to enhance archaeological features. Results from investigations were compared with independent data sources and enabled us to (i) characterize the spectral signatures of soil and crop marks, (ii) assess the performance of the diverse spectral channels and indices, and (iii) identify the best period of the year to capture the archaeological proxy indicators. Additional very important results of our investigations were (i) the discovery of unknown archaeological areas and (ii) the setup of a database of archaeological features devised ad hoc to characterize and categorize the diverse typologies of archaeological remains detected using Sentinel-2 Data.

Martin Gojda, 2020. *Air Survey and Remote Sensing in Archaeology*. University of Cardinal Stefan Wyszyński (UKSW) Press: Warsaw. ISBN: 978-83-8090-674-7, paperback, 288 pages.

Price seems to vary between a promotion of 30.00 zł² (c £7.50) and €45.00³ so it’s worth potential buyers browsing the web.

This introduction to archaeological remote sensing compacts the author’s 25 years of aerial experience into a book of three parts – History, Methods and Data. Each of these sections has entries under series of sub-headings which makes it easy, in lieu of an index, to flick through and find topics. The part dealing with *History* is the longest, perhaps because of its unusually generous time span, going back to the emergence of photography and flying machines through the expected gallery of aerial photographers to brief mention of uses of satellite sources and ALS. *Methods* deals with what I would call ‘data collection’ and, after noting how archaeological features may be seen, is weighed towards oblique aerial photography but includes notes about other sources such as ALS, satellites, and various non-visible wavelength

² https://www.ksiegarniaonline.pl/s/s.list_cat_id,288.html (both links accessed October 2020)

³ <http://www.creatorph.pl/Air-Survey-and-Remote-Sensing-d239.htm>

sensors. The final *Data* part begins with a survey of analogue and digital archives and then runs through an illustrated chronological list of feature types that are mainly from Czechia.

The author concluded that we would each write this book differently – and I agree. This book, especially if it really does cost less than £10, provides a useful guide to beginners who need a fairly traditional outline of aerial survey. However, for a book published in 2020 it presents what seems a fairly old fashioned way of dealing with the topic.

Volkmar Schmidt, Michael Becken and Jörg Schmalz, 2020. A UAV-borne magnetic survey for archaeological prospection of a Celtic burial site. *First Break* 38, 61-66

Noted here because of the worrying direction to which geophysical survey has now been elevated. Carried by UAV... does this mean that ISAP now has to become a subset within AARG?

Doneus, M., Mandlbürger, G. and Doneus, N., 2020. Archaeological Ground Point Filtering of Airborne Laser Scan Derived Point-Clouds in a Difficult Mediterranean Environment. *Journal of Computer Applications in Archaeology*, 3(1), pp. 92–108. <https://doi.org/10.5334/jcaa.44>

From the abstract: Digital terrain models (DTM) based on airborne laser scanning (ALS) are an important source for identifying and monitoring archaeological sites and landscapes. ... Its accuracy and quality must conform to its purpose and are a result of several considerations and decisions along the processing chain. One of the most important factors of ALS-based DTM generation is ground point filtering, i.e., the classification of the acquired point-cloud into terrain and off-terrain points. Filtering is not straightforward. The resulting DTM is usually a compromise that might show the surface below very dense vegetation while losing detail in other areas. In this paper, we show that in very complex situations (e.g., strongly varying vegetation cover), an optimal compromise is difficult to achieve, and more than one filter with different settings adapted to the varying degree of vegetation cover is necessary. For practical reasons, the results need to be combined into a single DTM. This is demonstrated using the case study of a Mediterranean landscape in Croatia, which consists of open areas (agricultural and grassland), olive plantations, as well as extremely dense and evergreen macchia vegetation. The results are the first step toward an adaptive ground point filtering strategy that might be useful far beyond the field of archaeology.

Łukasz Banaszek, 2019. *The Past amidst the Woods: The Post-Medieval Landscape of Polanów*. Poznań. ISBN: 978-83-916342-6-4. <https://www.researchgate.net/publication/335570339> *The Past amidst the Woods The Post-Medieval Landscape of Polanow*

Includes use of ALS, aerial photos, old maps and field survey and is based on his PhD although the present version ‘... has drifted away from the theory-oriented investigations which characterized previous works, towards archaeological landscape survey.’ (p10).

From the abstract: This publication explores a complex landscape south of Polanów, and its transformations over the last few centuries. The area is rich in early and late modern earthworks which have been investigated through various archaeological prospection methods. Recognising that the forest is a dynamic and complex entity, the impacts on archaeological discovery strategies are

discussed. Thus, while the work identifies the role that the longevity of forest has had on the survival of archaeological monuments, at the same time, this volume aims to demystify the omnipresent woodland of West Pomerania. While increasing awareness of earthworks in the forest, that otherwise have rarely attracted the attention of inhabitants of the area, this volume also draws attention to other actors in the landscape, including archaeologists.

Anjali Phukan, Todd J. Braje, Thomas K. Rockwell, and Isaac Ullah, 2019. Shorelines in the Desert: Mapping Fish Trap Features along the Southwest Coast of Ancient Lake Cahuilla, California. *Advances in Archaeological Practice* 7(4), 2019, pp. 325–336

DOI:10.1017/aap.2019.31

Use of UAV to survey a series of stone-built fish traps in a former lake in California.

Timothy M. Murtha, Eben N. Broadbent, Charles Golden, Andrew Scherer, Whittaker Schroder, Ben Wilkinson, and Angélica Almeyda Zambrano, 2019. Drone-Mounted Lidar Survey of Maya Settlement and Landscape. *Latin American Antiquity* 30(3), 2019, pp. 630–636. doi:10.1017/laq.2019.51

From the abstract: ... unmanned aerial vehicle lidar missions in the Maya Lowlands using Phoenix Lidar Systems. Piedras Negras, Guatemala, was tested in 2017, and Budsilha and El Infiernito, both in Mexico, were tested in 2018. These sites represent a range of natural and cultural contexts, which make them ideal to evaluate the usefulness of the technology in the field. Results from standard digital elevation and surface models demonstrate the utility of deploying drone lidar in the Maya Lowlands and throughout Latin America.

Gianluca Cantoro, 2019. Handling Hundreds of Aerial Images without Ground References: Archaeological Photointerpretation in the Era of Digital Photogrammetry. *Archeologia Aerea* 11/2017, pp. 23 – 29.

The paper introduces the author's AutoGR-Toolkit⁴ and demonstrates its use and usefulness using case studies in different topographical environments – Crete, Rome and the Foggia plain.

From the abstract: ... Whether one prefers (or is allowed) ... exclusive or complementary use of manned aircraft, remotely piloted aerial systems or historical archives, the management of the acquired dataset (or the new data generated from its processing) is not trivial and may even generate pitfalls, if not properly handled. Examples in this paper, presented with the goal to highlight potential issues and the proposed solution in different contexts, are synthesized as follows: high resolution RPAS photogrammetric model of mountainous and mostly inaccessible landscapes without the possibility to employ or measure ground control points (because of the bushy/forested nature of the area, the difficulty of carrying bulky GNSS or EDM devices); georeferencing of historical photographs in a quickly changing environment; mosaicking hundreds of single frames of buried archaeological features where no reference items (i.e. buildings, cross-roads, field boundaries, ...) could be identified.

⁴ Download available at <http://www.ims.forth.gr/autogr>

Christopher Sevara, Michael Doneus, Erich Draganits, Roderick B. Salisbury, Cipriano Frazzetta, Doris Jetzinger, Sheba-Celina Schilk, Sebastiano Tusa, 2019. Innovating Archaeological Investigations in Mediterranean Landscapes: Contributions from the Prospecting Boundaries Project. In Bonsall, J (ed), *New Global Perspectives on Archaeological Prospection: 13th International Conference on Archaeological Prospection 28 August - 1 September 2019 Sligo – Ireland*. Archaeopress: Oxford, 107-110. ISBN 978-1-78969-306-5, ISBN 978-1-78969-307-2 (e-Pdf)

A project that includes use of orthophotos and ALS to investigate land use and social change in western Sicily. This is one of several publications on the project, some noted in previous issues of *AARGnews* by the compendium of authors.

Javier Fernández-Lozano, Alberto González-Díez, Gabriel Gutiérrez-Alonso, Rosa M. Carrasco, Javier Pedraza, Jacinta García-Talegón, Gaspar Alonso-Gavilán, Juan Remondo, Jaime Bonachea and Mario Morellón, 2018. New Perspectives for UAV-Based Modelling the Roman Gold Mining Infrastructure in NW Spain. *Minerals* 2018, 8, 518; doi:10.3390/min8110518

Not written by archaeologists. Use of a mixture of ALS and UAV data that may be of interest to those studying Roman mines and mining. See also the first author and others, 2021.

From the abstract: ... the potential of UAV-assisted photogrammetry for the study and preservation of mining heritage sites using the example of Roman gold mining infrastructure in northwestern Spain. The study area represents the largest gold area in Roman times and comprises 7 mining elements of interest that characterize the most representative examples of such ancient works. [Our approach] ... is based on a combination of data provided by aerial orthoimage and LiDAR to improve the accuracy of UAV derived data. The results ... providing high-resolution digital information that improves the identification, description and interpretation of mining elements such as the hydraulic infrastructure, the presence of open-cast mines which exemplifies the different exploitation methods, and settlements. ...

Anamaria Roman, Tudor-Mihai Ursu, Vlad-Andrei Lăzărescu and Coriolan Horațiu Opreanu, 2016. Multi-sensor surveys for the interdisciplinary landscape analysis and archaeological feature detection at Porolissum, in Coriolan Horațiu Opreanu and Vlad-Andrei Lăzărescu (eds), *Landscape archaeology on the Northern Frontier of the Roman Empire at Porolissum: An interdisciplinary research project*. Mega Publishing House: Cluj-Napoca. ISBN 978-606-543-787-6.

https://www.academia.edu/keypass/UGd3VUFRWkt1SGI1Y2dtcFk2alc5WjNhT2l6bFhBNVV3bHVLNGewT1IvUT0tLVVtYjNpc0YzMHgwN0QrenV3OE01cmc9PQ==--e26bba2f2252e8ade94a20143a1cecd0d1e91df/tfR0Qd-PfMfgDf-7mDvK/resource/work/36161489/Multi_sensor_surveys_for_the_interdisciplinary_landscape_analysis_and_archaeological_feature_detection_at_Porolissum?email_work_card=view-paper

This is oldish, but its illustrations may provide good teaching examples to show results of chucking every technique at WorldView 2 images and ALS in search of an answer. There is also a 40-page bibliography that covers the whole book.

Piotr Wroniecki, Roman Brejcha and Jerzy Sikora, 2017. Knowing Without Digging? Non-invasive Research of the Krzczonów Earthwork and its Surroundings. *Analecta Archaeologica Ressoiviensia* 12, 177–198.

https://www.academia.edu/37080668/Wroniecki_P_Sikora_J_Brejcha_R_2017_LINK_to_PDF

A useful example of chucking everything at a site and its local landscape and coming up with an archaeological result. See also next paper for a wider view of the project.

From the abstract: ... a non-invasive research case study of a protected monument mound in Krzczonów, Świętokrzyskie voivodeship in Lesser Poland. It explores the possibilities of non-invasive methodological approaches in the recognition of archaeological sources by asking whether it is possible to procure relevant information without conducting excavations. A new interpretation of the mound's function and chronology is based on data derived from multi-method field surveys including remote sensing (satellite imagery, UAV, light aircraft, ALS), geophysical (magnetic gradiometry, earth resistance), total station measurements and analytical field walking prospection along with comparison of archival field-walking data. We would like to hypothesize that, contrary to the protected monument list, the Krzczonów earthwork is not a prehistoric feature but could be related to the end of 14th up to the beginning of the 16th century. In this case it could be understood as a remnant of a motte-type castle.

Piotr Wroniecki, 2016. Hidden cultural landscapes of the Western Lesser Poland upland. Project overview and preliminary results, in Piotr Kołodziejczyk Beata Kwiatkowska-Kopka (eds) *Cracow Landscape Monographs, vol. 2*, Institute of Archeology, Jagiellonian University in Kraków: Kraków, 21-32.

An oldish paper but new to me from a volume (unseen) that includes other papers on aerial and landscape themes. This paper introduces a project that expands knowledge derived from the AZP field walking programme through additional research that includes aerial and geophysical survey in a study area of 2500 sq km. From the aerial viewpoint, the paper includes comments on ground conditions, flying and results (popularised in a short film released on the Creative Commons license and may be viewed at <http://archeolot.pl>) and at least one enclosure system was partly surveyed by magnetic gradiometry. Conclusions include the plea for aerial and geophysical remote sensing to be accepted by conventional archaeologists (in Poland, if nowhere else) as fully-fledged research tools.

Web Aviation – A range of somewhere from the air books

The Web Aviation web page includes 18,736 photos of Britain from above, including some archaeological targets. There are also several picture books, mostly towns in Britain and Germany or local areas, and one of railway stations. There are no book publication dates on the website but the brief text about each book suggests they may be 10 years old or more, which may also account for the reasonable prices (£10 for c170 pages in hardback). Contact details, etc on the website:

<https://www.webbaviation.co.uk/books/books.htm>

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. <https://a-a-r-g.eu/>

Membership/subscription rates:	Individual	£15.00	17.00 Euro
	Students	£10.00	12.00 Euro
	Institutional	£25.00	29.00 Euro

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).