CURRENT APPROACHES TO ROMAN FRONTIERS

HARRY **VAN ENCKEVORT**, MARK **DRIESSEN**, ERIK **GRAAFSTAL**,
TOM **HAZENBERG**, TATIANA **IVLEVA** AND CAROL **VAN DRIEL-MURRAY** (EDS)

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Digital Limes

Introduction to the session and a discussion of temporary camps in the Netherlands to illustrate the use of modern methods and advanced techniques for a better understanding of the Roman frontier development

Wouter K. Vos, Roeland Emaus,
Jeroen Oosterbaan and Maarten Sepers

A growing number of archaeologists are working in one way or another with what is conveniently called 'digital technology'. LiDAR, aerial photography, GIS, remote sensing, photogrammetry, 3D modelling, big data, machine learning and citizen science are terms and techniques that are emerging and becoming common in the discipline. There are many fine examples of the recent past, however, these digital applications are not completely new and have been around for a couple of decades (Frischer 2008; Cowley 2011; Hesse 2013). The session Digital Limes held at the Limes Congress at Nijmegen was attempted to explore whether these 'new' technologies have really changed the way we study the limes.

Without being a specialist in digital techniques, most Roman archaeologists know that combining different techniques provides important data that was difficult to obtain using the more conventional analogue methods. The techniques promise many opportunities for new research possibilities, but the question is whether we use these methods exhaustively enough to ask the right, and perhaps new research questions. Roman archaeologists and 'digital archaeologists' seem to speak each other's language but is that good enough or are we multiplying the uncertainties of one's own discipline with those of the other? (Sahlins 1972, 47). Searching for answers with these new techniques may follow an old-fashioned way of thinking with − perhaps − blinkers on, but Roman archaeologists should be sufficiently equipped to explore the full possibilities of the 21st century (Verschoof-van der Vaart 2022).

Therefore, three questions have been formulated that are central to the purpose of this session. The first is whether research has changed because of new techniques; in other words, has research taken a different turn with the advent of a new digital toolbox. The second is the question of whether new techniques only answers 'old' questions. In that case, only the methods have changed and nothing new emerges through the application of 21st-century technology. The final question is whether there is enough potential in the combination of using the new techniques, and probably more importantly, what are the opportunities and limitations of using these techniques for a more sophisticated interpretation of life at the Roman imperial frontier.

Wouter K. Vos
Saxion University of Applied Sciences, School of Business, Building & Technology, Education Archaeology, Handelskade 75, 7417 DH, Deventer (the Netherlands), w.k.vos@saxion.nl

Roeland Emaus / Jeroen Oosterbaan / Maarten Sepers
Saxion University of Applied Sciences,
r.emaus@saxion.nl
j.oosterbaan@saxion.nl
m.sepers@saxion.nl

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By new techniques we mean the applications mentioned above with which most Roman archaeologists are more or less familiar. The aim of the papers in this session is thus not to focus on individual sites or methods used to present the limes, but to address the main question of whether using new technology will lead to better knowledge and understanding of the limes in general.

Contributions to Digital Limes

The contributions of the session's participants clearly reflected this aim and showed great diversity, not only in terms of topics, but also in the origins of the various speakers. Contributions covered Germany, the United Kingdom, Italy, Austria and the Netherlands, and doing so were spread across 'Roman' and 'Barbarian' Europe. This indirectly made it clear that applying and implementing the techniques mentioned above has now become commonplace in archaeological communities almost everywhere, and this observation is also seen in several publications from many different countries and institutes (*e.g.* Evans 2016; Kokalj & Hesse 2017). The session Digital Limes started with the introduction paper concerning research aimed at temporary Roman camps in the Netherlands. The subsequent lectures presented in this sessions covered broad and very diverse scopes.

The first topic was presented by Jennifer Schamper on the geophysical, non-destructive research project on the Upper German-Raetian Limes in which *c.* 100 ha have been geomagnetically surveyed. The results were combined with aerial photographs and LiDAR and collectively provided wonderful answers to questions about Roman landscape planning and strategy.

The second paper addressed the question of how to organize a huge data collection that cannot be analyzed by one or two archaeologists alone. This Big Data case on the epigraphic archive of more than 50,000 amphorae from Monte Testaccio in Rome was presented by Arnau Lario Devesa, in which he highlighted the complexity of computer software programs and the tasks of scientists to get the right answers by asking the right questions.

A third contribution to the session was made by Kamil Kopij on acoustic and proxemic analysis of speaking platforms (*pulpitum*) in the headquarters of several Roman fortresses including *Carnuntum*, with the aim of reconstructing the number of soldiers who could actually hear their commander's speech and see the speaker's gestures.

Finally, a fourth paper on the new techniques commonly used in the gaming industry, was presented using a mystery game produced by researchers at *Vindolanda* and Newcastle University. Claire Stocks and Barbara Birley showed that serious gaming tools can be used for archaeological purposes and provide learning opportunities through entertainment ('edutainment') to enhance history education but also contribute to learning literacy, numeracy, and archaeology, even by playing the game at home on the computer during the covid pandemic.

The study of temporary camps in the Netherlands

A fine example of gains to be made when combining different digital techniques is presented here as a case study. The subject is currently being carried out by staff and students of Saxion University of Applied Sciences in Deventer. Our case study deals with a well-known phenomenon within the Roman army, temporary camps. We know of many examples from within the Roman period as stated *e.g.* in Spain (Blanco *et al.* 2020), Wales (Davies & Jones 2006), Scotland (Jones 2009; 2011), Czech Republic and Slovenia (Groh *et al.* 2015), Germany (Bödecker 2015a; 2015b) and recently also in Switzerland (Koch *et al.* 2022).

These camps' functions vary, and their classification is based on marching, practice, siege and construction functions (Jones 2011). Perhaps there is a fifth function that could be a crossover between marching and exercising (personal note in lecture by Rebecca Jones at Saxion University of Applied Sciences, November 2022). Clearly, the structures tell us something about the Roman army on campaign, about the army manoeuvring – inside and outside the Empire – and about the soldiers in training by setting up temporary camps. So, in fact, these are soldiers on the march in the frontier zone for all kinds of reasons, and by studying these particular structures, a better understanding can be gained about the activities of soldiers and the strategy of the Roman army.

Just across the Dutch Border near Xanten and Bonn, dozens of these temporary camps have been recognized using LiDAR, geophysics and aerial photographic surveys. A characteristic of the camps found closest to the Dutch borders, is not only that they are related to fortresses, but also that they were located at short distances of up to 9-10 km from these fortresses. Furthermore, an explanation for the differences in the size of the temporary camps in the areas around Bonn and Xanten has been identified and published by Bödecker (2015b). Drawing on Hyginus, among others, who writes about the layout of temporary camps, as well as the siege camps from Masada (Richmond 1962) where legions bivouacked, Bödecker then calculates the space required for a legion or auxiliary troops in a Roman camp. He concludes that a legionary force would need a minimum of about 4 ha, so the smaller camps could represent auxiliary troops. The smallest category of camps, measuring about 20 by 20 m, are believed to be real training camps, *e.g.* for new recruits, quickly erected to practice the building of entrances and the digging of ditches. All the defensive structures of the temporary camps consist of a V-shaped ditch and a bank or rampart. They all have entrances and usually special features such as *claviculae* and *tituli*.

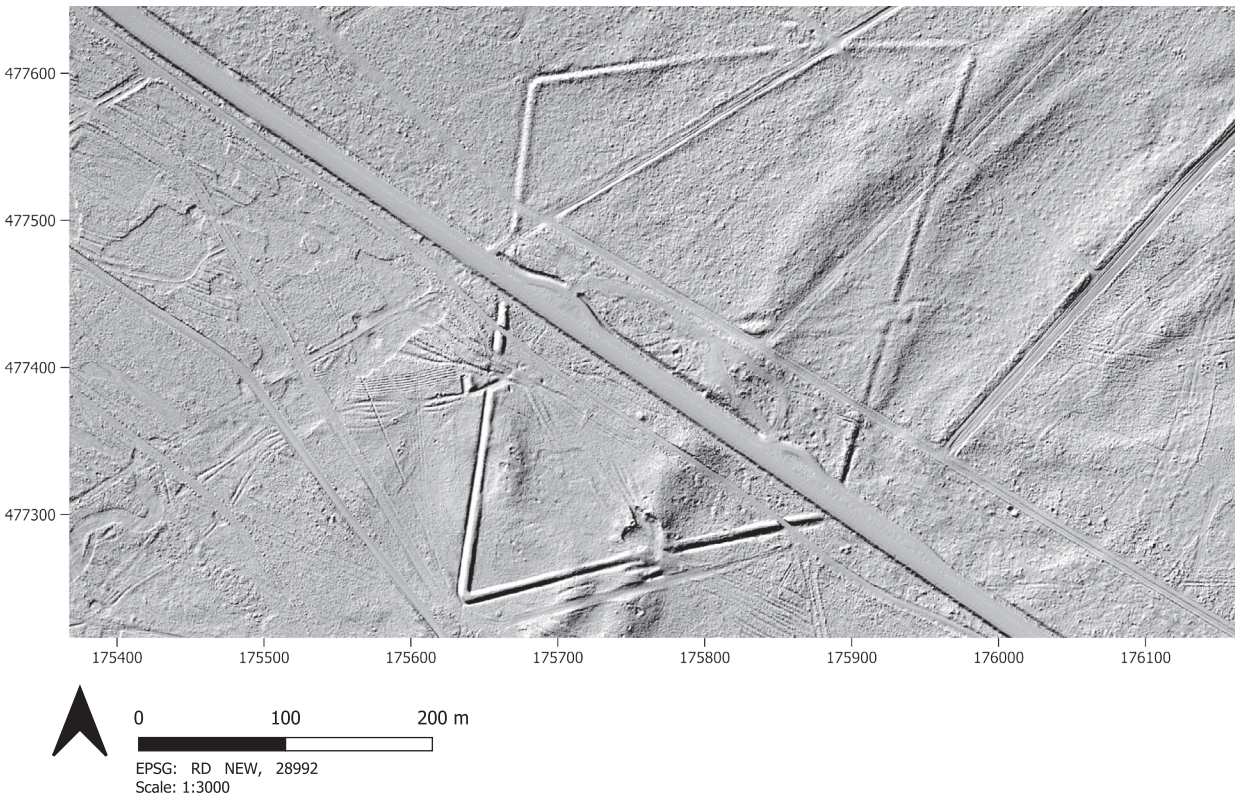

Figure 1. LiDAR image of Ermelo-Leuvenum (www.ahn.nl).

Figure 2. V-shaped ditch of a possible temporary camp at Herwen (Van Renswoude & Van Kampen 2019).

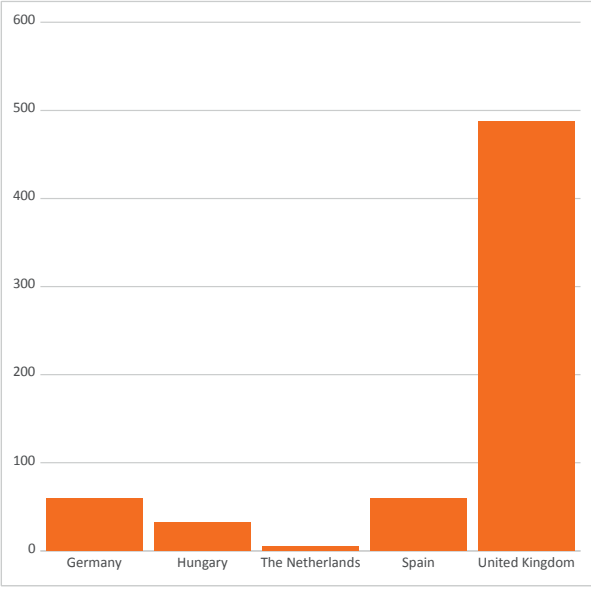

Figure 3. Number of temporary camps in several countries.

The temporary camps are found both inside and outside the Roman frontier zone, but most remarkable is that they are hardly known from the Netherlands. Only one obvious specimen is known (fig. 1), which is Ermelo-Leuvenum (Hulst 2007). However, in the last few years, several potential new sites have been discovered, of which Ermelo-Indianenbos (Verschoof-van de Vaart & Driessen in the fourth volume of thes proceedings), Tiel-Medel (Habermehl *et al.* 2019), The Hague-Ockenburgh (Van Zoolingen 2019) and Herwen (Van Renswoude & Van Kampen 2019) are good candidates to be interpreted as a temporary army camp as well. Occasionally, a temporary camp is found more by chance than by systematic investigations, such as the Roman camp located in Ermelo at Indianenbos was only discovered when the LiDAR imagery of the area was being studied for prehistoric burial mounds.[1] But more often it is found by chance during excavations (Herwen and Medel), when suddenly V-shaped ditches (fig. 2) appear in an otherwise mostly non-military landscape. Be that as it may, it leaves the Netherlands with only five (possible) examples. Given the number of camps identified in all of the surrounding countries, it would be hard to maintain that this reflects the numbers of temporary Roman camps within the present-day Dutch borders (fig. 3).

Dutch researchers have access to the same techniques as the German colleagues in the Rhineland. However, in the hinterlands of Bonn and Xanten, they spring up like mushrooms, while Dutch examples are very sparse indeed. Therefore, the questions are: what causes this big difference in numbers, and how can we possibly mitigate the Dutch situation? To this end, we have formulated some explanations and tried to clarify how it is possible that these camps are largely absent in the Netherlands to this day.

First, it must be said that the temporary camps in Germany are usually found near fortresses. More fortresses are known in Germany than in the Netherlands, where a fortress has only been attested in Nijmegen and Valkenburg. However, temporary camps could occur near auxiliary forts as well, and Bödecker (2015b, 44-46) has argued that precisely the small temporary camps could also be attributed to auxiliaries rather than legionnaires. About 15-20 auxiliary forts of this kind are also known (or suspected) in the Netherlands, but there, too, the temporary training or practice camps of the Roman army are so far missing.

Secondly, soil type may be debit to the absence of the camps in Dutch territory. The dynamics of the mostly Holocene deposits in the river area along the limes have caused significant sedimentation off some sites and erosion of others; both are certainly not conducive to the detection, because of a lack in preservation or surface visibility of temporary camps in the Netherlands. Only the Pleistocene sandy soils near Nijmegen and the Veluwe district seem to be suitable places where ancient features can be traced in the present-day terrain.

The difference in modern land use between Germany and the Netherlands may also be mentioned as a third cause. In the Netherlands, much land has been profoundly worked following the large-scale land consolidation programs from the 1960's onwards. Additionally, nearly all of the Netherlands has been brought under the plow at some point in its history for either agricultural or silvicultural purposes. Because of this, the original Dutch landscapes have not been well preserved, and the (top) soils even less.

A fourth and final reason why temporary army camps have been treated poorly is a lack of scientific interest in the subject. Dutch researchers have focused their attention on the forts, the so-called permanent camps, of which distinct physical features could be found, leaving the remains of the temporary camp Ermelo-Leuvenum as a curiosity in Dutch archaeology for a long time. On top of this, the scientific framework of Dutch archaeologists has been somewhat limited to marching camps; that is, the idea that temporary camps were mainly related to marching routes and expeditions into Barbarian country and not with the notion that this type of camps, albeit in a different form and function, could also be found inside the Roman Empire near the permanent military structures. However, much knowledge has been gained here in recent years, and the attention to these types of military works has significantly increased, partly due to the impressive results in Germany.

1 The complete surface of the Netherlands is periodically mapped with LiDAR and available to the public via Actueel Hoogtebestand Nederland (www.ahn.nl).

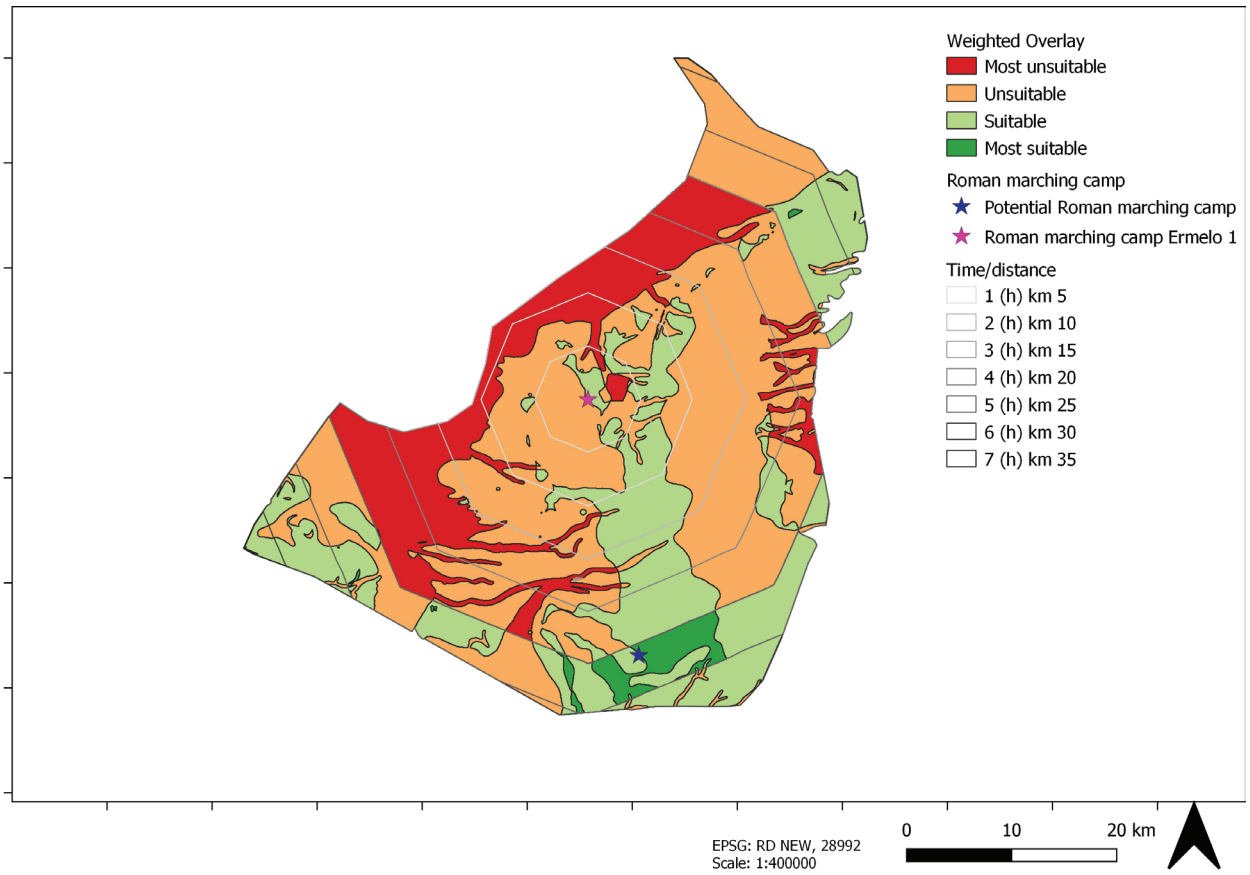

Figure 4. Model with underlying (un)suitable landscape where, based on time and distance a Roman soldier can travel from a known temporary army camp, a possible new next camp can be predicted (Goeree 2023).

From digital logic to analogue proof

Saxion University of Applied Sciences will tackle this subject as part of the overarching research program called 'Constructing the Limes', funded by the Dutch Research Council (www.c-limes.nl). With the list of technical methods quoted above, we plan to discover more temporary camps, and find out by what logic the specific locations of the various types of temporary camps within our country were determined, especially in the Eastern River area near Nijmegen, on the Pleistocene sandy soils of the Veluwe and possibly further north. Using various methods and appropriate techniques is essential, and moreover, the combination of tools and methods. Saxion is, after all, a technical University, so all GIS- and statistical analyses, remote sensing methods (drones, infrared, NDVI, geophysics), will be used and taught to the students, in addition to the more traditional methods like field surveys, coring and trial trenching. We are convinced this is where the advantage lies, in using a broad technical package.

It also remains important to continue combining this technical input with archaeological sources and assumptions to recognize patterns and form predictive models. One aspect has already been illustrated, *i.e.* the presence and relationship between permanent forts and fortresses and temporary camps in the frontier zone. Other parameters are primary and secondary Roman routes as connectivity patterns, combined with the orientation of prehistoric and (early) medieval routes. Next to this are the ancient writers as a source for plotting military activity in *Barbaricum*. In addition to that, there are interesting hypotheses about the possibilities of detecting and predicting a Roman camp by studying the average walking range of a Roman soldier (fig. 4) in combination with the (paleo-)geomorphological opportunities of the landscape (Goeree 2023).

A case study site has been identified in a large nature reserve (Veluwe) between roughly Nijmegen and Ermelo because the chances of finding a temporary camp there are high due to the soil conditions. The aim was to use different digital methods and by combining them to get a more differentiated and well-thought idea about the site. First, satellite-imagery was interpreted, where especially the photographs of the last dry summers provided much information. Second, we used the database with aerial

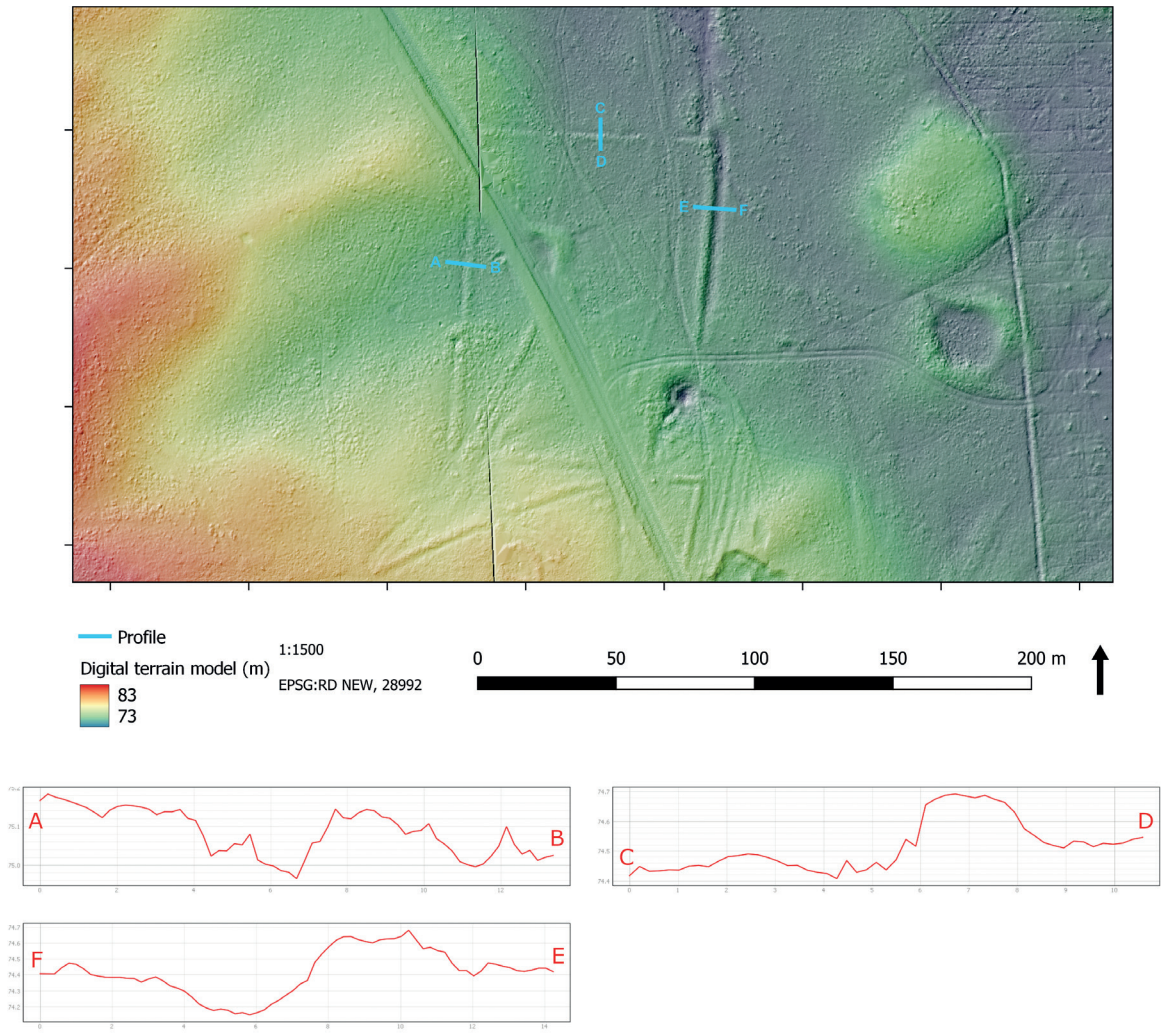

Figure 5. Virtual cross-sections on a local relief model in the case study area on the Veluwe.

images from the Second World War made by the Royal Airforce that show the situation from before the land consolidations of the 1960's and later (https://www.wur.nl/en/library/special-collections/aerial-photographs.htm). Third, the nationally available LiDAR images were studied. The LiDAR data was analyzed using hill-shade tools and other digital visualization techniques. Fourth, an aerial survey was conducted on the site using a drone that was equipped with a standard (RGB-red, green, blue) camera as well as an infrared camera. By using photogrammetry, this resulted in a high-resolution terrain model as well as various false-color image and vegetation indices. The multispectral imaging can be used to recognize patterns in the current vegetation. Disturbances in the soil can influence a plant's health, the color of its leaves, and how light is ultimately reflected differently in the various parts of the electromagnetic spectrum. Using the Normalized Difference Vegetation Index (NDVI), patterns of sub-soil features, otherwise not visible on the surface, can be recognized through differences with the surrounding vegetation. However, the applicability of these techniques depends on the current land use, vegetation type and accessibility of the terrain. In a later stage, the results will be combined with other geophysical data from the ground-penetrating radar (GPR) and electromagnetic (EM) research.

In the case-study area specific data was generated by making virtual cross-sections of the digital terrain model (fig. 5). Clear differences are observed between the supposed rampart and the ditch, and perhaps that could be a positive identifying feature for a temporary camp. When we zoom into where the typical entrances to temporary camps should be present, the so-called *claviculae*, there are indications in the digital cross-section of two elevations, possibly the two rampart sections, and one deeper section that likely can be labelled as an eroded V-shaped ditch.

The advantages of combining the different methods and tools seem obvious for the study of Roman temporary camps; and more results can be expected when the already gathered GPR and EM data are processed and interpreted. Cautiously we may assume that there is a structure here, possibly a temporary camp. The only pressing question is, is it Roman? The next step in the research will be to check this with traditional methods like a fieldwalking survey, metal detecting and trail trenches to draw more definitive conclusions.

In this way, potential locations and areas in the Netherlands are explored, especially near Nijmegen where a fortress was in use between AD 71-104, but also on the sandy soils like the Veluwe. If possible and available, aerial photographs from different seasons are included because these occasionally show different patterns of old traces in the subsurface. The same is true about the study of crop marks in the field.

In addition, when more temporary camps are detected within the Netherlands other techniques can be used to determine area's where more temporary camps could be suspected. One of these methods concerns the walking range of a Roman soldier in different time and distance variables as mentioned above, the idea being that the next suitable spot should be in walking range of the soldier from one camp to another. This is a work in progress for the coming years, and hopefully it will lead to an increasing number of temporary camps in the Netherlands.

Conclusion

Finalizing on this paper, and on this session, we might come to the following general conclusion, and perhaps also a point of caution. The common denominator of the session is not necessarily in the use of new techniques, especially since some have been around for a while as mentioned before, however, in all the papers it was the speed in which the data was processed thanks to better computers and greater accessibility to data. An important consequence of this is that much larger areas or larger datasets can be processed and queried than before. In most cases this yields not only more data (Big Data) but also more complex data that can only be efficiently processed by computers. It is up to archaeologists and historians now to dare to ask new, more complex questions and eventually also to formulate new thoughts on their subject that can provide a more differentiated picture at the end of all kinds of aspects along the limes.

An additional factor in the discussion about digital techniques and improving and expanding datasets is that precisely by combining 'new' techniques, more variation and detail in archaeological data also emerges, which previously could not be observed with a single research technique alone. The gain, therefore, is in the combination of the techniques and a consequently changing and richer archaeological perspective on these data.

As we adopt more methodologies and technologies, we also involve more and more specialists. As we have seen, there is a need for specialists in the field, specifically for questions or adjustments on our 3D-models, our drone-imagery or our statistical analysis. However, perhaps there is a growing separation between the IT-crowd and the domain specialists, between those who are familiar with the complexities of the methodology and those familiar with the complexities of the dataset. The question is how to ensure that occasional assumptions and presuppositions of the data-scientist do not end up somewhere in the conclusions. In some applications this will be more obvious than in others; the misplaced house numbers in 3D game design are obvious for everyone, but what about assumptions in statistical models about march distances, or the effects of the clothes soldiers wore on the acoustics inside a fortress?

Returning to the three questions at the beginning, based on our own experience with the temporary camps, and summarizing what we have heard from the other contributions in this session, we think we can provide at least some partial answers. Has research changed because of the new techniques? We think so, but at the same time not. On the one hand it has, because much more data can be processed simultaneously by, for example, faster, better and bigger computers. On the other hand, it has not, because we still make lists and organize data just like we did long ago in old-fashioned programs like DBASE3+. We still superimpose all kinds of image and map material, only it has all become much faster, more advanced, and detailed.

As to the question of whether we only give modern answers to old issues, the answer is a bit ambiguous. Some questions have not changed, and the answers are given by modern means in terms of technical choices and improved applications. On the other hand, new questions do arise, mainly because of the increased number of possibilities, the larger selection, the larger scope and therefore a greater amount of data from which new questions can arise. This is also the case for our temporary camps, as we can now process more landscape data than ever before.

Thirdly, we can be clear and short about the possibilities of the new techniques. Yes, there are definitely possibilities and certainly in the combination of the use of techniques, but that is probably a bit of an open door. All in all, the conclusion regarding our topic, the absence of temporary camps in the Netherlands, is that through the combined use of different techniques, together with well-considered archaeological principles, much progress can be made; more than we could dream of five or ten years ago, and thus a step towards the final goal has been made: a better understanding of the limes in our country.

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