Dutch Military Landscapes

Heritage and Archaeology on WWII conflict sites

Max VAN DER SCHRIEK

Vrije Universiteit Amsterdam

Abstract: In the Netherlands, archaeological research concerning World War II (WWII) is not very well explored compared with the neighboring countries. Its key methodologies were developed already in the 1980s in the United States, where both specialized field techniques (such as advanced metal detectors) and methods for analysis like Geographical Information Systems (GIS) were administered to locate specific artefacts and to map and reconstruct military strategies and other war events. Dutch (conflict) archaeologists still need to develop, practice and reflect international developments in the subject area to learn from the experiences of colleagues abroad.

Individual archaeologists participated in the research out of personal interest and/or a particular personal commitment to the features and artefacts they came across during excavations. However, there are still large differences in the approach to the archaeology of WWII between the various commercial excavation companies, provincial administration and municipalities. Even when recording has been systematically undertaken, there have sometimes been administrative, conservation, and legal difficulties in dealing with WWII conflict sites in the Netherlands.

Modern Conflict Archaeology plays a vital role with regard to the preservation of these sites and relics. There are several non-invasive approaches and techniques which we can use without any juridical problems, for example KOCOA (**K**ey terrain, **O**bstacles, **C**over and concealment, **O**bservation and fields of fire, **A**venues of approach), an established approach to military analysis, and the application of LiDAR (**Li**ght **D**etection **A**nd **R**anging), a remote sensing technology which can provide a detailed digital elevation model of a landscape. Both can be useful tools for landscape studies and to map and better understand conflict sites. This paper will show the benefits and drawbacks of such research conducted in the Netherlands.

Keywords: KOCOA, LiDAR, Modern Conflict Archaeology, the Netherlands, World War II.

Introduction

In countries such as the United Kingdom, France, Belgium and even Germany the archaeology of conflict has been widely accepted as a field of research and can count on a growing interest of both community-based and academic groups (VAN DER SCHRIEK and VAN DER SCHRIEK 2014, 228). Wars are etched on the memories of nations, communities and individuals. The way and what people remember changes with time, especially now historic events pass out of living memory. Modern Conflict Archaeology contributes to the knowledge of war and the reality of violence and it renews our understanding of war from prehistoric times to the contemporary era (http://www.inrap.fr). The American Civil War (1861-1865) is generally considered as the first 'Modern' war which means mass-conscripted armies, rapid transportation (first on railroads, then by sea and air), telegraph and wireless communications and industrial produced weapons.

Although both World War I (WWI) and WWII appealed strongly in the popular imagination, many scholars, at least in the Netherlands, are still sceptic for excavating and archiving the 'modern.' This attitude has resulted that for long the remains of the twentieth century was not considered as archaeology. A good balance is needed between the micro- and macro-scale by putting individual stories in context as a form of 'historical archaeology.'

The impact of conflict archaeological research should not be underestimated; it can even change political attitudes. During the Spanish Civil War (1936-1939) at least 50,000 people were killed by the Socialists and approximately 100,000 by the Falangist's. After the victory of Franco, most victims were deliberately 'forgotten.' From this era, 88,000 persons are still missing. Only Cambodia has more missing persons. The general opinion was that 'it was not all that bad' during Franco's regime. After some recent archaeological excavations, this opinion shifted as it proved many horrors were conducted during 1936-1975 (GONZÁLEZ-RUIBAL 2007; FERRÁNDIZ 2013).

Both macro-scale approaches (for instance degree of devastation of settlement pattern) as micro-scale approaches (individual sites, impacts of war) can be used. For most (modern) conflict archaeological investigations historical documents, oral history and the archaeological record can be consulted. Methods such as topographic surveys, aerial photographs, metal detecting surveys, field surveys, excavations and documentary evidence are needed for a good interpretation of the features.

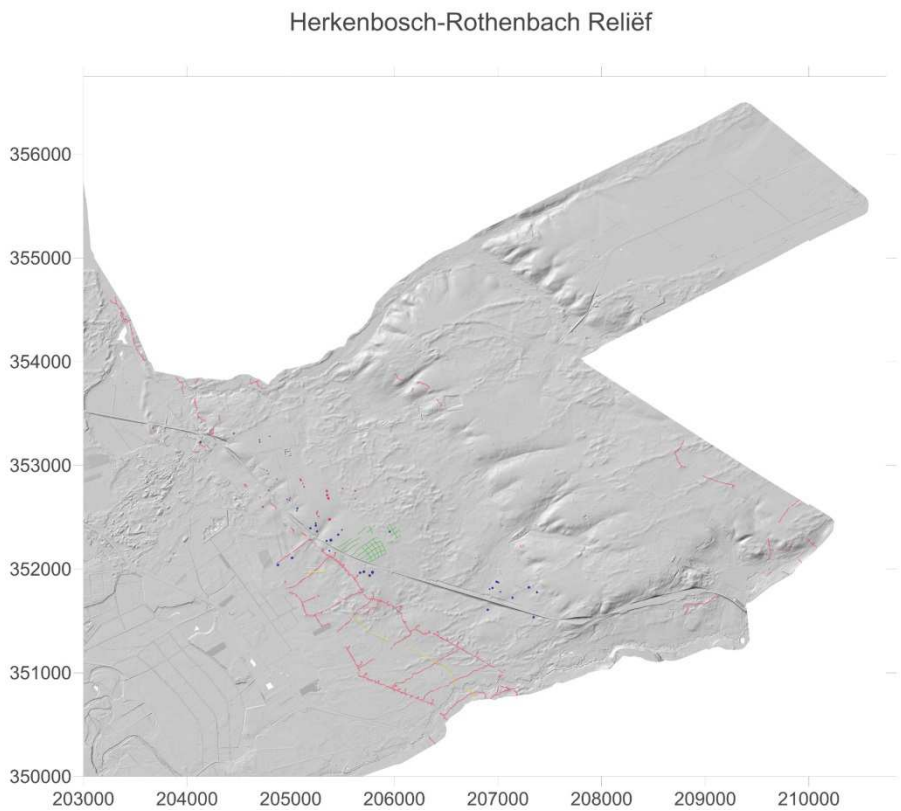

Fig. 1 – A DEM of the Herkenbosch-Rothenbach relief at the border of Germany. The LiDAR data in this country is not freely available hence the white parts. See also figure 10 for the inclusive legend (Copyright: AHN2/Willem Beex/Max van der Schriek).

Twentieth century warfare literally changed the landscape. WWI can also be considered as the first 'industrial', 'modern' or Total War. A 'Total War' is unrestricted in terms of the weapons used, the territory or combatants involved (SCHOFIELD *et al.* 2002, p. 2; STRACHAN and HERBERG-ROTHE 2007). The word 'total' does not refer to the extent of destruction but to the range of targets and means.

Obviously, the 'event' of a battle leaves physical marks on a landscape, while war has major psychological and physical impacts on the people themselves. Conquerors erect monuments that may alter the landscape, having a far-reaching effect on both landscape and perception of that landscape. However, the meaning of these monuments can also change over time (VAN DER SCHRIEK and VAN DER SCHRIEK 2011, p. 146).

In Western Europe, the focus on battle scars is mainly on concrete fortifications. However, these form only a relatively small part of a conflict landscape. Forests and heathlands can conceal well preserved landscapes of earthwork field fortifications, military support structures and craters. By studying and mapping these landscapes systematically, they can contribute a great deal to wider research agendas especially those focused on heritage and memory, military geography and historical accounts and narratives of conflict (PASSMORE and HARRISON 2008), but also complementing studies of the environmental impact of combat (PASSMORE *et al.* 2014, p. 1288).

This paper consist of three main parts. First, I will describe shortly Modern Conflict Archaeology as conducted in the Netherlands. Secondly I will summarize some non-invasive techniques which are being used during conflict archaeological research abroad. Finally I will describe the use of LiDAR-based Digital Elevation Models (DEM's) in the Netherlands (Fig. 1). What are the opportunities and problems of this new tool for Modern Conflict Archaeology?

Modern Conflict Archaeology

Numerous objects from both WWI and WWII are still hidden below the surface in most European countries. One can think of human remains, ammunition, weapons, tools, personal belongings but also wreckages of aircrafts and land vehicles. Many landscapes also conceal more physical evidence of warfare like trenches, concrete bunkers, craters and tank traps. All these remains should be considered as the material remains of war (SAUNDERS 2007; VAN DER SCHRIEK and VAN DER SCHRIEK 2014, p. 229).

Modern Conflict Archaeology provides snapshots of often a brief moment in time. Archaeology can play an important role in the contemporary experience of a former battlefield, for instance where the events and individual experiences of people engaged or caught up in war can be demonstrated on a detailed, recognizable and most significantly, on a human scale (VAN DER SCHRIEK and VAN DER SCHRIEK 2014). Now living memory fades, the material heritage takes on more significance (MOSHENSKA 2012).

In 2011 a start has been made with the systematic recording of features, findings and records of WWII in the Netherlands with the 'Buried Past of War' project. The data located in archaeological archives was as diverse as the amount and method of research of WWII over the past decades. The objective of this project can be outlined as follows: to determine the academic potential and the cultural-historical value of features and cultural material of WWII, which has been discovered during excavations in the Netherlands. The principle emphasis of the research was on the features and artefacts discovered during excavations by archaeologists

between 1970 and 2000. This included chance finds and the more designed and directed excavations of the period 2000–10 (KOK and WIJNEN 2012; VAN DER SCHRIEK and VAN DER SCHRIEK 2014, p. 229).
One of the most striking outcomes of this research was that there are large differences in the approach of conflict archaeology, especially with regard to the WWII era, between the various commercial excavation companies, provincial administration and municipalities. For instance, the province of Zuid-Holland does not accept or register any material or features from WWII, although other provinces and municipalities do make records of such finds. These objects and features vary from incidental discoveries of human remains to the professional excavation of the remains of major and complex defensive structures. These finds were seldom recorded in official excavation reports and publications before the year 2000. Research-focused excavations have hardly been carried out, in almost every case they were incidental discoveries (VAN DER SCHRIEK and VAN DER SCHRIEK 2013a; 2014, p. 230).
That said, even when recording has been systematically undertaken, there have sometimes been administrative, conservation, and legal difficulties in dealing with twentieth century conflict archives. As stated in the Monuments Law of 1988, which was revised in 2012, Dutch archaeologists are not granted permission to excavate, store and preserve materials such as firearms and ammunition (VAN DER SCHRIEK and VAN DER SCHRIEK 2014, pp. 230-231).

Fig. 2 – The remains of a 19 year old German soldier discovered at Arnhem-Schuytgraaf in 2008 (Copyright: BIDKL).

Belgium is in particular ‘famous’ for its WWI excavations. However, also WWII conflict sites are being archaeologically investigated. In 2014 an excavation had been carried out at Vroenhoven (Riemst, Belgium).

At this spot next to the Albert canal, WWII started for Belgium at 10 may 1940. It turned out that this research had a great additional value to the known historical sources. Around 120 objects were unearthed. Also four bombs from a Junkers Ju 87 (a.k.a. 'Stuka', *Sturzkampfflugzeug*) were found. Due to the distribution pattern the approach route of the airplane and the angle of attack was reconstructed (VERDEGEM and LOOPIK 2014). Human remains were also present at the site. Remarkably, no military equipment or shoes were found to identify this individual or at least be able to establish the nationality. Most likely this person was a wounded soldier, for his remains were discovered at an 'island' between the trenches, the perfect spot for a dressing station. A military scissor was found near the remains (VERDEGEM and LOOPIK 2014). A research-focused excavation like this is still not possible in the Netherlands.

In France however, bomb disposal squads are recovering 500 tons of live ammunition each year. Archaeologists of the *Institut National de Recherches Archeologiques Préventives* (INRAP) are now taking courses to recognize the different types of ammunition and, more important, to be able to judge if it is responsible or too dangerous to carry on with the excavation. In Flanders, it is common to request a digging permit (Federal Law of 30 June 1993, Article 9, revised at 28 February 2003) to work on sites where it is likely that ammunition will be found. When archaeologists recover unexploded shells the *Dienst voor Opruiming en Vernietiging van Oorlogstuig* (DOVO, Flemish Explosive Ordnance Disposal Squad) has to be informed which will remove the ammunition from the site (VAN DER SCHRIEK and VAN DER SCHRIEK 2013b; 2014, p. 232).

Professional archaeology insists on a painstaking forensic approach to the recovery of battlefield casualties, aimed at maximizing the research potential and, most importantly, the possibility of identifying the casualty to allow official and personal closure to relatives (POLLARD 2008). It is estimated that the remains of 200,000 missing soldiers are still hidden below the surface in the relatively small area of the former WWI Ypres Salient in Belgium (DE MEYER 2006, 53). Similarly, it is estimated that approximately 100,000 soldiers of the Commonwealth are still to be discovered on the old battlefields at the Somme (SAUNDERS 2007, p. 98). Of course it is in the nature of modern warfare that not all such remains will be articulated but it is essential nonetheless that robust technical and ethical practice founded on respect for the local law and appropriate archaeological methods are in place and understood (VAN DER SCHRIEK and VAN DER SCHRIEK 2014, p. 238).

Each year approximately ten soldiers are recovered, mostly on the former battlefields of WWI. In France and Flanders it is common to investigate these deaths archaeologically. Unfortunately this type of effective and practical working practice is currently impossible in the Netherlands because under Dutch legislation it is strictly forbidden to excavate human remains believed to be of recent origin. In the Netherlands, human remains are to be recovered by a specialized team of the Dutch Army, the *Bergings- en Identificatiedienst van de Koninklijke Landmacht* (BIDKL), which do not work according to archaeological protocols concerning the recordings of features and context (Fig. 2) (VAN DER SCHRIEK and VAN DER SCHRIEK 2013a; 2014, pp. 232-233).

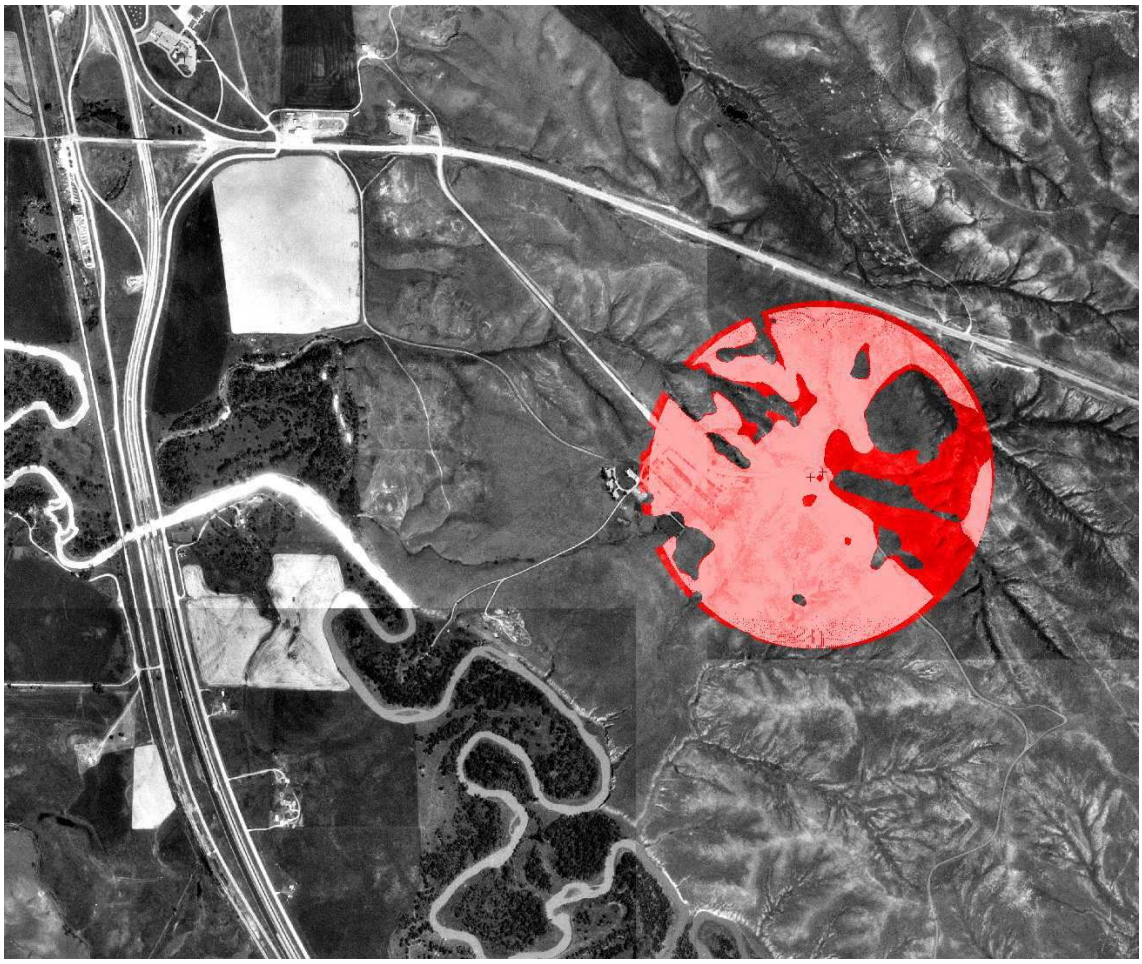

Fig. 3 – The visibility of the U.S. soldiers at battlefield of Little Big Horn (1876), Montana, was mapped by means of GIS (Copyright: Douglas D. Scott).

Despite the fact that Dutch archaeologists are not allowed to excavate remains of individuals of WWII there are still possibilities for this branch of research. Landscapes are of main importance in defense structures. By means of non-invasive techniques, Dutch archaeologists can map for instance parts of the Atlantic Wall, not only the bunkers but also the trenches to get a better understanding of the defense system in a particular area. On an academic level, Modern Conflict Archaeology is still a pioneering job in the Netherlands.

The use of non-invasive techniques outside of the Netherlands

One must bear in mind that a landscape has an effect on every conflict. If we look at a conflict zone it has to be taken into account that each landscape needs different strategies and different tactics which will influence the archaeological record. At the famous Little Big Horn battlefield (1876) for instance the identification of individual rifles led to tracing movements of those firearms about the field of battle. Different landscapes imply different strategies which follow different tactics. It turned out that the Native American warriors used the terrain more effectively which was later also proven by a GIS research (Fig. 3) (GEIER *et al.* 2014, p. 6). Such research can (relatively) easily be conducted in the Netherlands as well.

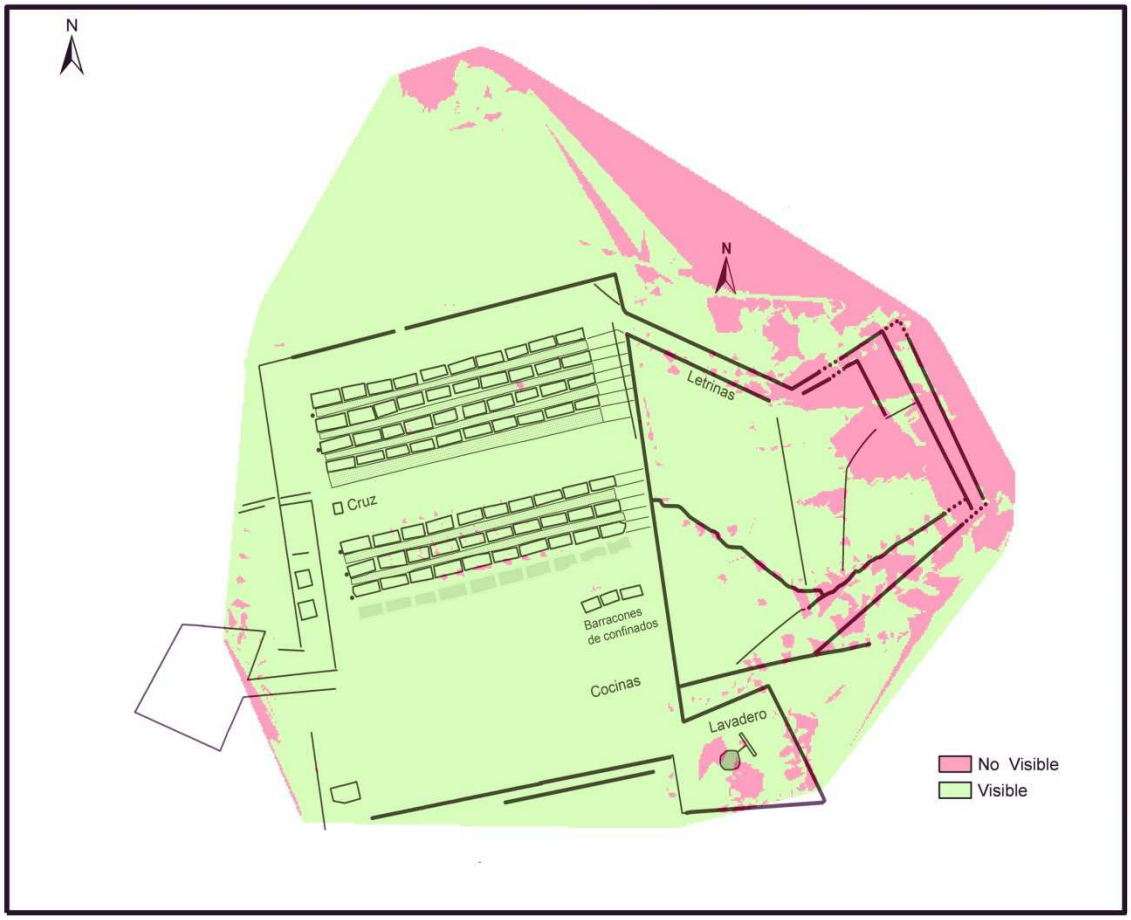

Fig. 4 – A Falangist's concentration camp was researched in Spain (Copyright: Alfredo González-Ruibal).

Another used perspective in both the United States and Scotland is KOCOA: Key terrain, Obstacles, Cover and concealment, Observation and fields of fire, Avenues of approach (U.S. Army 2001, p. 133; GEIER *et al.* 2014, p. 6). This approach is still used by the present-day U.S. Army to make best effort of a landscape in a conflict situation. KOCOA is an acronym for identifying key terrain aspects of a conflict site. According to Geier and his colleagues (2014, p. 6) it forms a framework together with the principles of war:

> *"[...] a key for understanding behavior during battle and provide researchers with a better junction of military practice with the historical and archaeological record."*

Is it possible to find a battlefield by predictive modelling? For Scotland this is an imminent concern, as locating battlefields on modern maps is a key requirement for inclusion on the Scottish Inventory of Battlefields, and thus for planning consideration. Ryan McNutt developed an applied theoretical framework, allowing for a conscious agency of choice in the selection of terrain through a mental 'grammar' of conflict and tactical knowledge: a military lifeway distinct from, yet intertwining with, the overarching culture. His model can be utilized for battlefields with unknown or uncertain locations, as modelling prioritizes high probability areas within potential conflict sites, which can be targeted with archaeological fieldwork (MCNUTT 2014, pp. 2 and 38).

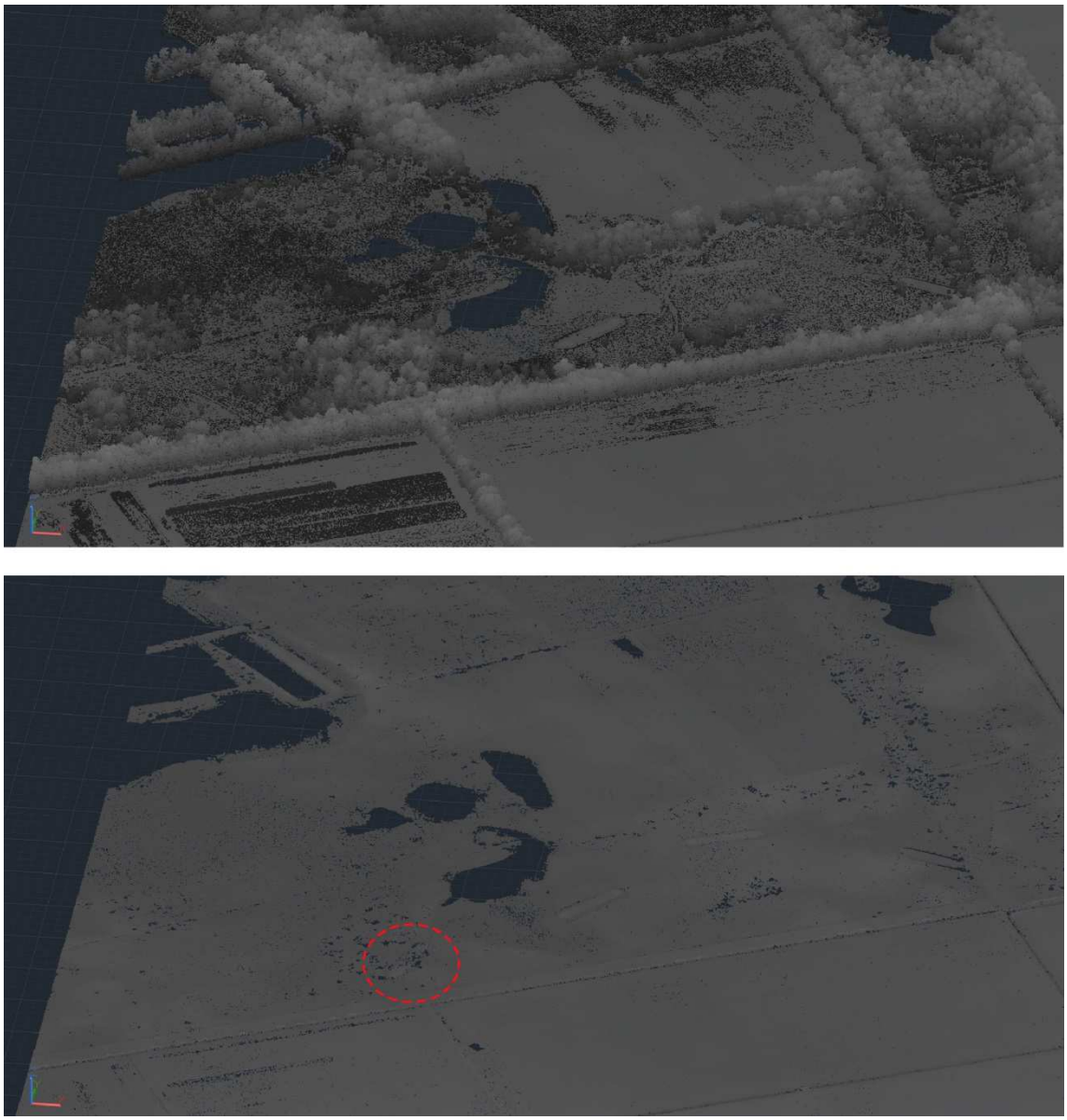

Fig. 5 – A Digital Surface Model (DSM) (above) and a Digital Terrain Model (DTM) (below) of the Landschotse Heide (Copyright: AHN2/Willem Beex/Bert Brouwenstijn).

In Spain GIS was used to map a Falangist's concentration camp. The visibility of the prisoners and the campsite itself was mapped. By doing so the humiliation of the prisoners was demonstrated surprisingly well. According to guidelines commissioned by General Francisco Franco (*1892 - †1975) himself the lavatories should be at least 250 meters away from the campsite and minimal 2 meters in depth. However, the lavatories were less than 30 meters away and only 20 centimeters in depth. Above all, the prisoners were visible from all sides while using the lavatories: from the living area, the working area and also for outsiders. Looking at the campsite as a whole, it turned out that the camp was visible but inaccessible for people outside which had an odious effect (Fig. 4). One knew horrible things happened 'over there' but not exactly what (GONZÁLEZ-RUIBAL 2007; FERRÁNDIZ 2013).

As part of an interdisciplinary research the WWI battlefield near the *Chemin du Mont de la Hutte* at Ploegsteert, Belgium, was researched by an archaeological team by means of aerial photographs, ground

penetrating radar and historical landscape analyses. In this way it was possible to map trenches without excavating. The magnetometer penetrated the surface about 0.5 meters, just beneath the plough soil. After analyses of the radar and comparing research with the known historical aerial photographs it turned out that about 80% of the trenches where still present in the investigated area. This can be significant information for later spatial developments and/or preservation of these specific remains (SAEY *et al.* 2014).

Another important non-invasive technique which is much used in Flanders is known as 'image warping.' Aerial photography was developed during WWI and since 1915 applied on a large scale by all participants on the Western Front. These photographs not only have a historical value, they also form the cradle of present-day archaeological aerial reconnaissance. In the (re)search of features and findings of WWI these pictures are of great informational value (STICHELBAUT 2005, p. 235; 2006).

These aerial reconnaissance images are the first, truly reliable source of information by which it is possible to form an accurate image of the landscape at the beginning of the twentieth century. For instance, on most early maps of Flanders errors occur with regularity and often these errors are copied on newer maps. This kind of inaccuracy is not possible on aerial photographs. It is also possible to precisely locate the sites seen on the photographs (STICHELBAUT 2005, p. 238).

To use these images properly vertical records are needed which are geo-referred with GIS. The old aerial photographs are distorted and projected on recent maps and present-day aerial photographs (JANSSENS and DE MEYER 2004, p. 32). In potential these images give three sorts of vital information, namely 1) natural and topographical phenomena, 2) structures and relicts from WWI and last 3), 'traditional' archaeological sites and (pre)historic features in the landscape.

In total 1,128 WWI aerial images where put into a database. Of 1,039 the exact location was found. A database like this was necessary to be able to make a proper selection of images which could be of importance for archaeology, history and/or geography. Obvious, the old photographs were of different quality. However, 2,130 structures were identified on the base of these images. Mainly trenches where identified but also a total of 373 previously unknown dugouts (DE MEYER 2006, p. 61; STICHELBAUT 2006).

The application of LiDAR-based DEM's in the Netherlands

As discussed above, the impact of 'industrial', 'modern' or 'total' warfare on a landscape is far larger than previous wars. What is the potential of a landscape-archaeological approach in this field of research? Part of the solution for the difficulties conflict archaeologists are dealing with in the Netherlands can be the use of non-invasive techniques to map conflict sites like LiDAR-based DEM's. The use of this technique is quite new for archaeologists. 'Airborne Laser Scanning' or 'LiDAR' is a remote sensing technology, based on emitting active laser beams to the ground surface from an aircraft. It produces enormous quantities of very accurate three-dimensional measurements of the ground surface, thus providing a detailed digital elevation model of a landscape (Cf. CREEMERS *et al.* 2011).

As outlined in this paper, compared with other countries dealing with Modern Conflict Archaeology, there are some specific 'Dutch' obstacles in the archaeological research of WWII. As mentioned before, WWII victims are not to be recovered by archaeologists but only by a specialized team of the Dutch Army. Obviously, they do not work according to archaeological protocols concerning the recordings of features and context.

Furthermore, there are no clear (national) guidelines on how to deal with the remains of this era. This is quite an obstacle for Dutch (conflict) archaeologists, because war is fundamentally about the killing and wounding of people and, unlike 'traditional' archaeologists, conflict archaeologists are almost certain to discover human remains and ammunition (VAN DER SCHRIEK and VAN DER SCHRIEK 2014, pp. 232-233).
By means of LiDAR data it is possible to make an indication of the archaeological and/or heritage value of a conflict site. Furthermore, this is Open Data of the *Actueel Hoogtebestand Nederland* (Actual Height Model of the Netherlands, AHN) and therefore freely available in the original point-data maps to anyone (BEEX 2003). With the appropriate software (*MapInfo* or *Surfer* for instance) it is possible to make highly accurate DEM's of a particular site. The 'raw data' will show all measured points (i.e. all the highest points) generated by the first return of the laser pulse, including trees, bushes and even people and is called a Digital Surface Model (DSM) (Fig. 5, above). When subsequently all features above the natural surface are removed a Digital Terrain Model (DTM) is created. Usually a DTM is not showing the features very well (Fig. 5, below) and still needs adaption to highlight the features on the ground. It is necessary to filter out the 'noise', like a ploughed field when looking for ditches and walls (BEEX 2003). Once this has been done a Digital Elevation Model (DEM) is produced (English Heritage 2010, p. 41).

Fig. 6 – A Digital Elevation Model (DEM) of the Landschotse Heide (Copyright: AHN2/Willem Beex).

The resulting DEM can be visually interpreted using a shaded relief image at different illumination angles. Linear features are not visible if they are aligned with the direction of the illumination. The visibility and detection of the features often depends on the chosen illumination, a time-consuming process. However, for the archaeological interpretation the relative elevation of such small-scale features is vital (HESSE 2010, p. 68).

For the creation of the DEM's in this paper the original *AHN2* point-cloud has been used. This point-cloud is available for download in two parts. One file with all the actual surface-points and one file containing all the other reflection-points from buildings, vegetation and other objects. In this case of course, only the surface-points were needed (WILLEM BEEX, pers. comm.).

Except for open water, the files with the surface-points contain an average number of eight observations per square metre. According to basic sampling-strategies, this allows for a grid of 0.5 by 0.5 metres to be created. The size of such a grid is also perfect for detecting the features mentioned in this paper (BEEX 2003).

For all DEM's the gridding-method used was *Kriging* as available in the application *Surfer* by Golden Software (ISAAKS and SRIVASTAVA 1989; ABRAMOWITZ and STEGUN 1972). This method is ideal for irregularly spaced data as the surface-points. *Kriging* is named after the South-African mining-engineer Danie Gerhardus Krige (*1919 - †2013) and this algorithm is very useful in detecting trends as suggested in the data. For instance when looking for a trench-system (Willem BEEX, pers. comm.).

The particular site as depicted in Figures 5 and 6, the 'Landschotse Heide', can be considered as part of the international heritage of WWII. During the Second World War the German *Luftwaffe* built a harbor and five boats on the heathland for aerial bombing practices. It was a training area for the preparation of 'Operation Seelöwe' (See-lion), the planned invasion of the United Kingdom. Made of sand, these 'boats' were approximately 50 meters in length and about seven meters in width and encircled by a ditch. Because life ammunition was too expensive to use during training, the German airplanes dropped concrete bombs on the site. These bombs contained glass tubes filled with phosphor. The tubes would break on impact and thus creating smoke. This smoke could then be observed from both the airplane as well as from the observation bunker on the ground (www.tracesofwar.com).

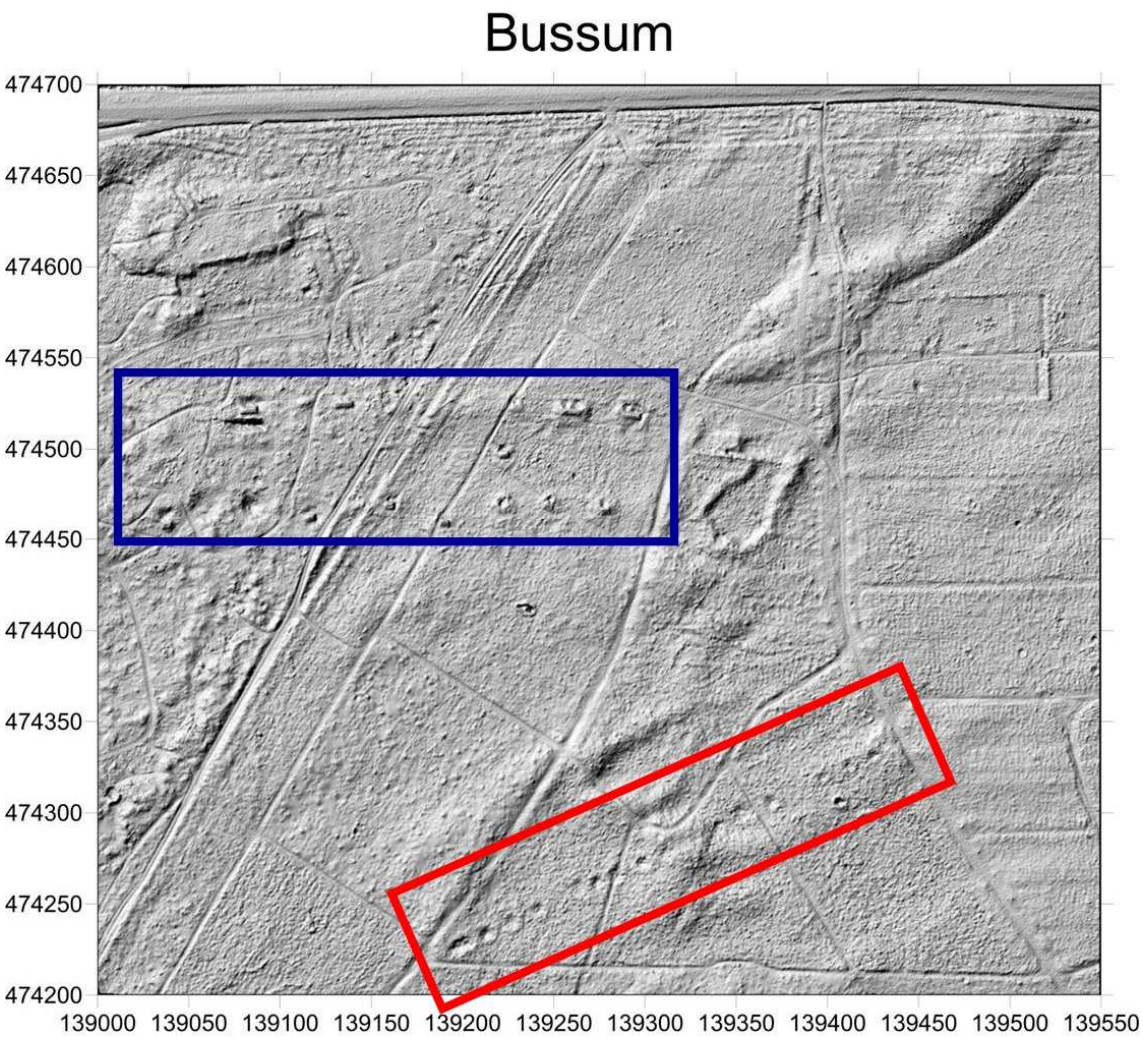

Fig. 7 – Bussum. In the blue rectangle bunkers of the 'Nieuwe Hollandse Waterlinie' can be distinguished. In the red rectangle a military camp site of Napoleon Bonaparte is clearly visible (Copyright: AHN2/Willem Beex/Menne Kosian).

After the war the 'harbor' disappeared. Nowadays three boats remain visible in the landscape. However, on the DEM of this site clearly a fourth boat can be detected in the left corner below of the image (Fig. 6). From this particular site we have hardly any historical data as it was a secret operation. Now we can get some idea of what remains on or just below the surface.

Just as is the case with image warping, the features detected on DEM's are not restricted to one era. Elevations and features from all times can be detected by using DEM's. It is striking that in some areas in different times a site was used for the same military purposes. Near Bussum (Fig. 7) several features can be observed. The forested area is nowadays a nature reserve and used for recreation. The small squares in the blue rectangle are bunkers of the *'Nieuwe Hollandse Waterlinie'*, a Dutch defense line used between 1815 and 1940. These bunkers date back to WWI. The pitches visible in the red rectangle are much older. A metal detecting survey confirmed that this was a French military camp site of Louis Napoléon Bonaparte (*1778 - †1846) which could be precisely dated to 1809, the year of The War of the Fifth Coalition, a coalition of the Austrian Empire and the United Kingdom against Napoleon's French Empire and Bavaria. In order to stop a possible British invasion Napoleon needed a force of a significant size on a strategic location: Bussum (Jos BAZELMANS, pers. comm.).

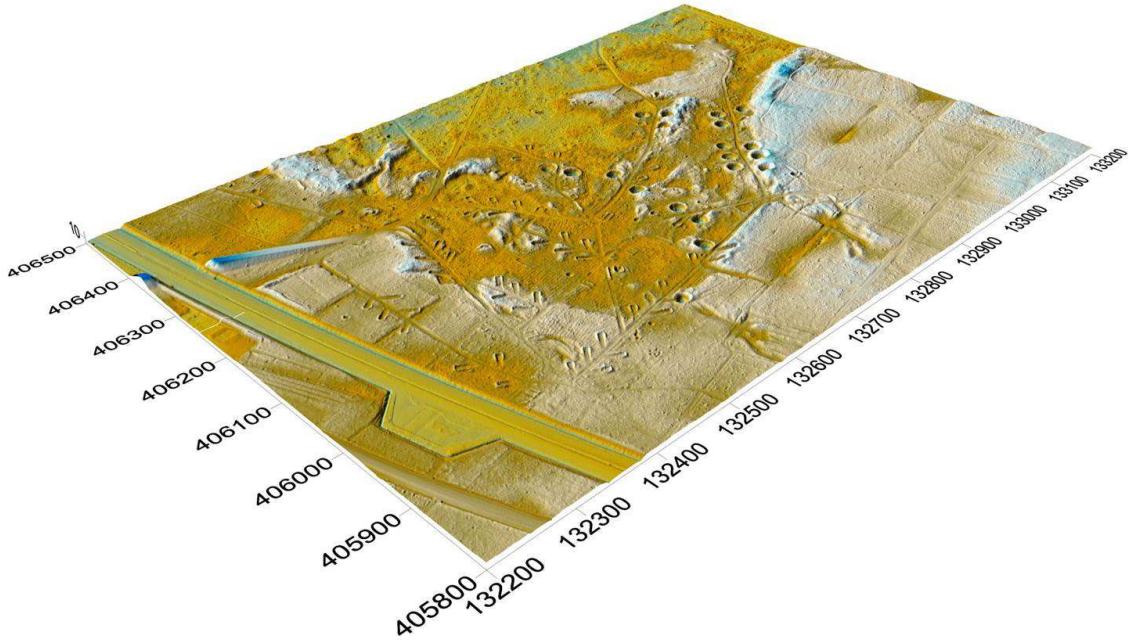

Fig. 8 – A DEM in bird's eye view of the 'Munitions Ausgabe Stelle 8/VI' at Loon op Zand (Copyright: AHN2/Willem Beex).

In the Netherlands there are also several German WWII military support structures. The difficulties in the supply of munitions and fuel have been widely acknowledged as being a significant factor in the German defeat. However, the supply depots themselves have hardly ever been subject to detailed historical analysis or archaeological evaluation although these sites can be considered as a primary source of information (PASSMORE *et al.* 2014, p. 1281). Secondly, an archaeological analysis can contribute to an evaluation of the strategy, effectiveness and landscape impact of the Allied bombing campaign during WWII (PASSMORE *et al.* 2014, p. 1288).

Near Loon op Zand the Germans build a large ammunition depot, the *'Munitions Ausgabe Stelle (M.A.St.) 8/VI'.* In a forested area of 10 hectares buildings, bunkers, storages, covered parking lots and even a pool was constructed. When the Allies approached, the ammunition was partially relocated but the larger part was destroyed on the spot, creating huge craters in the landscape (http://www.tracesofwar.com). By using a bird's eye view on the LiDAR data, the elevation of the landscape can be made visible very well (Fig. 8).

Once one know what to look for it is easy to recognize the same featherlike structures elsewhere. Although much more affected, a German military supply structure is very simple to distinguish at the 'Hoorneboegse Heide' (Fig. 9). According to the typology of logistic depot features by CAPPS-TUNWELL, PASSMORE and HARRISON (2015, pp. 239-247), six types can be distinguished, namely: 1) munitions bunkers, 2) fuel bunkers, 3) rations/stores bunkers, 4) vehicle shelters, 5) control, security and personnel shelter features and 6) miscellaneous.

During WWII several defense structures were built, also in the Netherlands. After the Battle of Arnhem (17-25 September 1944) the *Oberkommando der Wehrmacht* (OKW, 'Supreme Command of the Armed Forces') realized it needed a better protection of the important industrial Ruhr-area. The trench system at Herkenbosch-Rothenbach (Fig. 10) was part of the *'Maas-Rur-Steilhang-Elmpter-Wald-Stellung'* which was mainly built by force laborers. German defensive structures are commonly characterized by bunkers, mainly 'Tobruks', interconnected with communication trenches (ROTTMAN 2004; PASSMORE *et al.* 2014, p. 1280).

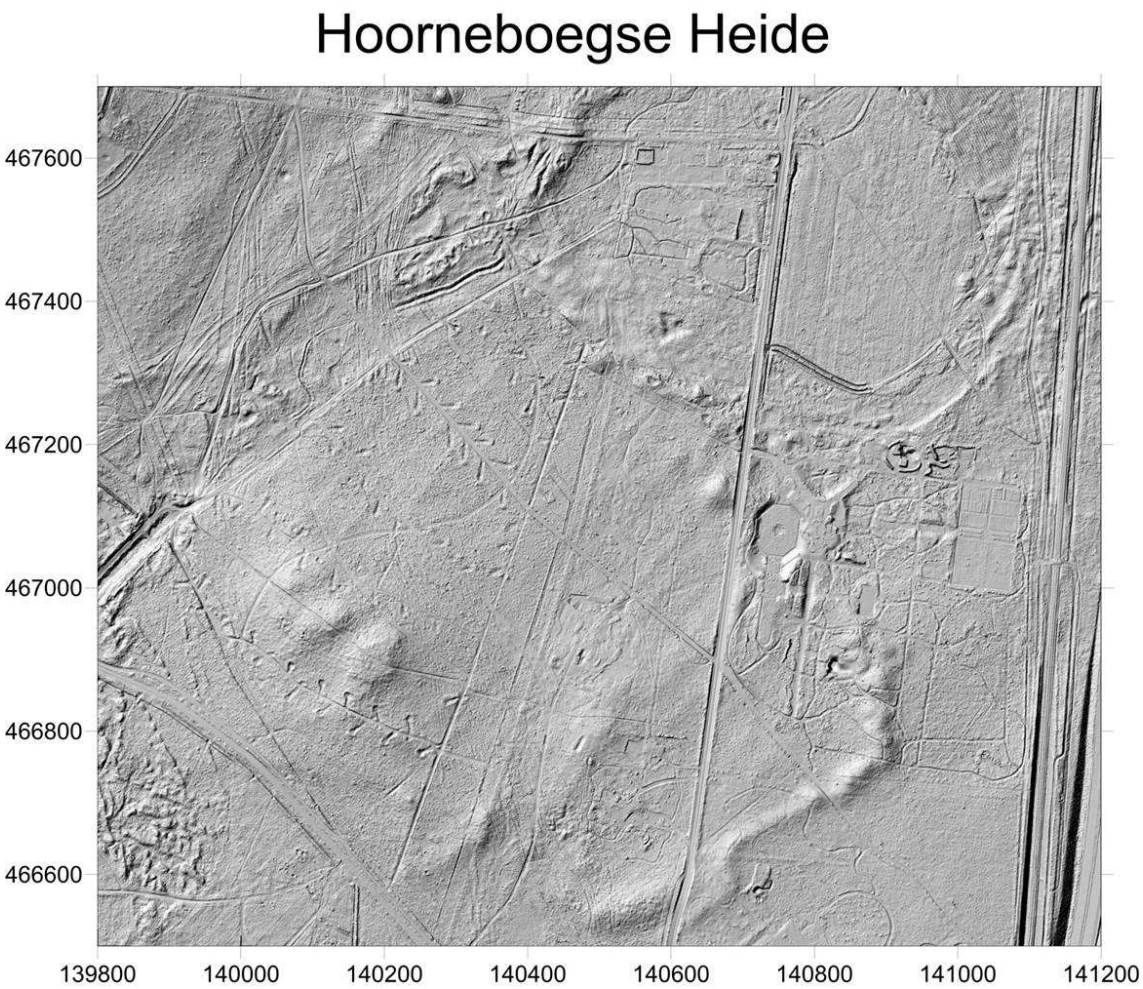

Fig. 9 – The remains of a German military supply structure at the 'Hoorneboegse Heide' (Copyright: AHN2/Willem Beex).

Due to the dense vegetation, LiDAR-based DEM's are perfect to map this trench system. Again, features from all eras are visible and one has to know what to look for. I spoke to an archaeologist who excavated a Celtic Field at this site. He did not note the trench system and craters at the spot but I completely missed the clearly visible Celtic Field on the DEM (Jan-Willem DE KORT, pers. comm.).

The pioneering work of geo-archaeologist David Passmore and his colleagues already proved that most forests of north-west Europe often conceal preserved landscapes of earthwork field fortifications, military support structures and craters. Archaeological surveys in these wooded landscapes demonstrated that further research can significantly enhance our understanding of ground combat (PASSMORE *et al.* 2014, p. 1275).

It is very important to secure the status of regional forests which is also the case at Herkenbosch-Rothenbach. They often host some of the richest but yet least well-documented archaeological resources of WWII (CAPPS-TUNWELL *et al.* 2015, p. 256; PASSMORE *et al.* 2014). As clearly visible on the DEM of the site the trench system completely disappeared at the edge of the forest were the land is used agriculturally. These landscapes have much to contribute to wider research agendas, including those focused on heritage and memory (PASSMORE *et al.* 2014, p. 1288).

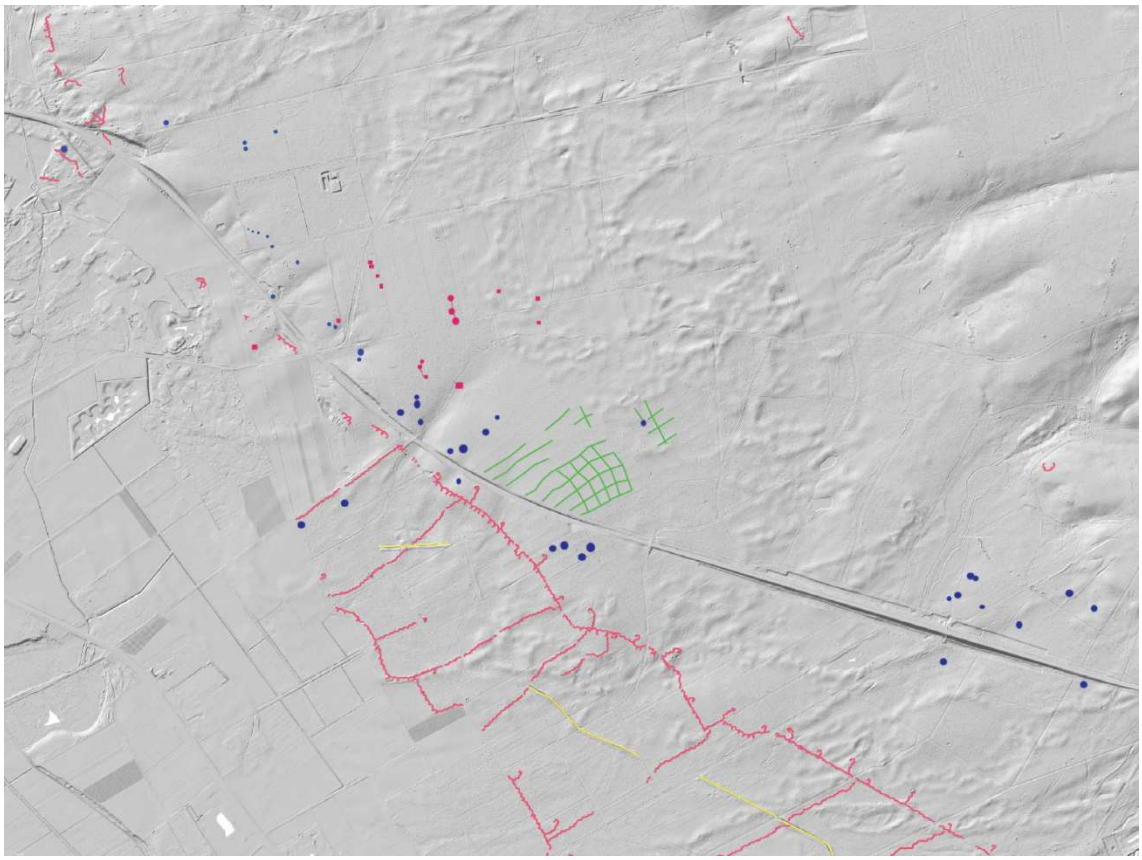

Fig. 10 – Herkenbosch-Rothenbach. Several archaeological features can be distinguished at the DEM. Red: German defense line. Yellow: (German) tank traps. Blue: Shell craters. Green: Celtic Field (Copyright: AHN2/Willem Beex/Max van der Schriek).

WWII sites like Herkenbosch-Rothenbach are usually locally known but not on a national level and there heritage value has hardly been investigated. In order to know what is left and which sites should be considered to protect and/or excavate and research further, it is very well worth mapping conflict sites by means of LiDAR-based DEM's. Obvious, if the material traces of WWII in the Netherlands are of value and significance today, then we should also be concerned with preserving them for future generations (MOSHENSKA 2012; VAN DER SCHRIEK and VAn DER SCHRIEK 2014, p. 229).

Conclusion

With regard to valorization and reaching the wider public one has to bear in mind that one can 'popularize' the main theme on a limited scale, without distorting or sensationalizing the research. This is also the case in many conflict archaeological investigations. However, it remains important to raise public awareness. Public interest in this field of research remains vital to the profile, impact and value of Modern Conflict Archaeology. Often WWII conflict sites in the Netherlands are not recognized as (archaeological) (inter)national heritage that should be protected and preserved. Modern Conflict Archaeology has a vital role with regard to the preservation of WWII sites and relics which has been inadequate up until now. Living memory is fading away; instead the material heritage will be of increasing importance (MOSHENSKA 2012; VAN DER SCHRIEK and VAN dEr SCHRIEK 2014, p. 229).

Conflict archaeology provides a broader perspective and analysis of military activities and their impact on landscapes, combatants and non-combatants (CAPPS-TUNWELL *et al.* 2015, pp. 233-234). Compared with neighboring countries, there are some more specific juridical problems concerning the archaeology of conflict in the Netherlands, especially those concerning the recovery of human remains. Like all other disciplines concerned with the past the main goal of archaeology is to reconstruct and analyze human behavior. As such, one should also look at warfare. In my opinion, Modern Conflict Archaeology should be using a multi-dimensional approach with an historical-anthropological perspective (by putting individual stories in context on both a micro- and macro-scale) in which new technologies like LiDAR-based DEM's should be regarded as a complementary tool for further research. Archaeology can demonstrate its academic value as a mechanism to edit and supplement traditionally gathered historical data where objective information is lacking (VAN DER SCHRIEK and VAN DER SCHRIEK 2014, p. 232).

Given the historic indifference of professional archaeologists, and the fact that little is done to protect this vulnerable heritage formally, Dutch legislation should be adjusted to permit properly framed conflict archaeology research (VAN DER SCHRIEK and VAN DER SCHRIEK 2014, pp. 240-241). However, in the meantime it is possible to map conflict sites with non-invasive techniques. Since the LiDAR data is freely available in the Netherlands in its original point-data maps, this technique can be of high supplementary value. However, although DEM's are often easily created, they usually tend to be just 'nice images' instead of a true scientific basis for (further) research (BEEX 2003). In contrary to image-warping, which can show the same site in different periods, DEM's provide a 'frozen' image of the site at the moment the data is collected. Moreover, one always has to bear in mind that DEM's can only show a potential archaeological site. The collected and interpreted data should always be checked at the location itself. DEM's are best administered on forests and heathlands, usually the sort of sites 'classical' archaeologists tend to avoid. DEM's have emerged as a valuable new data source for the prospection, mapping and monitoring of archaeological sites. The visibility of potential archaeological features depends to a large degree on the chosen illumination angles (HESSE 2010, p. 67).

By using this relatively new technique, it is possible to map conflict sites in the Netherlands without any juridical problems. In this paper, I discussed WWII training sites (Landschotse Heide), military supply structures (Loon op Zand) and defense structures (Bussum and Herkenbosch-Rothenbach). All are to be considered conflict sites with their own specific dataset. Their archaeological potential can be mapped by means of LiDAR-based DEM's whereupon it can be placed in its historical context. This has never been conducted systematically on an academic level in the Netherlands. For instance, WWII military supply depots in the Netherlands can be mapped to detect their distribution pattern. Extracting DEM's from the original point-data maps has the ability to greatly improve the potential of such data for the prospection, mapping and monitoring of archaeological sites (HESSE 2010, p. 71).

Non-hardened conflict sites are usually not very well documented. According to conflict archaeologist David CAPPS-TUNWELL and his colleagues (2015, p. 235):

> *"The archaeological and landscape legacy of this activity is likely to be elusive and has certainly not been the focus of published academic enquiry."*

WWII conflict sites has been widely investigated in urban sites and landscapes with regard to heritage, memory and commemoration, especially those focused on the civilian experience of modern warfare (MOSHENSKA 2009; 2012; CAPPS-TUNWELL *et al.* 2015, p. 258). In contrast, much less attention has been paid to the conflict sites in non-urban landscapes, not least because the targets themselves and associated cratered terrain has rarely survived post-war landscape rehabilitation (CAPPS-TUNWELL *et al.* 2015, p. 258). As David PASSMORE and his colleagues argue (2014, p. 1281):

> *"[…] there is a considerable scope for further battlefield survey and analysis in the forests of western Europe and no doubt also in the wooded battlefields of the* [former] *Eastern Front."*

LiDAR-based DEM's can be very useful to map conflict sites in order to know better what is left and how these remains should be protected. One has to take heritage tourism and changing cultural heritage value(s) into account and be aware of the long term cultural awareness of the WWII era. Further research will stimulate a new perspective on WWII heritage inventory in the Netherlands that encompasses a wider range of monument types and their associated landscapes (CAPPS-TUNWELL *et al.* 2015, p. 259).
However, to conclude, Dutch archaeologist should not consider the use of LiDAR-based DEM's as some sort of 'God particle' in conflict archaeological research. One always has to bear in mind that technology should be at the service of archaeology, not the other way around.

Acknowledgments

I would not have been able to conduct this part of my research without the help of (in alphabetical order) Jos Bazelmans, Willem Beex, Bert Brouwenstijn, Rita Hermans, Jan-Willem de Kort and Menne Kosian.

References

ABRAMOWITZ, M., and I. STEGUN. (1972). *Handbook of Mathematical Functions.* New York: Dover Publications.

BEEX, W. (2003). Use and Abuse of Digital Terrain/Elevation Models. *Enter the Past. The E-way into the four Dimensions of Cultural Heritage. CAA 2003. Computer Applications and Quantitative Methods in Archaeology:* BAR International Series 1227.

CAPPS-TUNWELL, D., D.G. PASSMORE and S. HARRISON. (2015). 'Landscape Archaeology of World War Two German Logistics Depots in the Forêt domaniale des Andaines, Normandy, France.' *International Journal of Historical Archaeology* 19: 233-261.

CREEMERS, G., E. MEYLEMANS, J. PAESEN and M. DE BIE. (2011). Laseraltimetrie en de kartering van Celtic Fields in de Belgische Kempen: mogelijkheden en toekomstperspectieven. *Relicta 7*: 11-36.

English Heritage. (2010). *The Light Fantastic. Using airborne lidar in archaeological survey.* Swindon: English Heritage.

FERRÁNDIZ, F. (2013) 'Exhuming the Defeated: Civil War Mass Graves in 21st-Century Spain', *American Ethnologist*, vol. 40 (1): 38-54.

GEIER, C.R., D.D. SCOTT and L.E. BABITS (Eds). (2014) *From These Honored Dead: Historical Archaeology of the American Civil War.* University Press of Florida, Gainesville.

GONZÁLEZ-RUIBAL, A. (2007). 'Making Things Public: Archaeologies of the Spanish Civil War.' *Public Archaeology*, vol. 6 (4), 203-226.

HESSE, R. (2010). LiDAR-derived Local Relief Models – a new tool for archaeological prospection. *Archaeological Prospection 17:* 67-72.

ISAAKS, E.H. and R.M. SRIVASTAVA. (1989). *An Introduction to Applied Geostatistics*. New York: Oxford University Press.

JANSSENS, L. and M. DE MEYER. (2004). Het begin van het A19-project en het GIS onderzoek, in E. Raemen, V. Hendriks and J. Problome (Ed.), *Loop!graven. Een archeologische zoektocht naar de Eerste Wereldoorlog,* Universitaire Pers Leuven: Leuven: 30-33.

KOK, R.S. and J.A.T. WIJNEN. (2012). *Oorlog op de plank: inventarisatie en potentie van oude archeologische opgravingen met sporen en vondsten uit de Tweede Wereldoorlog.* RAAP-rapport 2546: Raap Archeologisch Adviesbureau, Weesp.

MCNUTT, R.K. (2014). Finding Forgotten Fields: A Theoretical and Methodological Framework for Historic Landscape Reconstruction and Predictive Modelling of Battlefield Locations in Scotland, 1296-1650. PhD Dissertation, Centre for Battlefield Archaeology: University of Glasgow. http://www.academia.edu/11305071/Finding_forgotten_fields_a_theoretical_and_methodological_framework_for_historic_landscape_reconstruction_and_predictive_modelling_of_battlefield_locations_in_Scotland_1296-1650

MEYER, M. de. (2006). Inventarisatie van archeologische resten uit de Eerste Wereldoorlog en de mogelijkheden voor onderzoek naar sporen van andere conflicten: Battlefield Archaeology in West-Vlaanderen. M. de Meyer (Ed.) De opbouw van een archeologisch beleidsinstrument. Brussel:CAI 2 (VIOE-Rapporten).

MOSHENSKA, G. (2009). Resonant materiality and violent remembering: archaeology, memory and bombing. *International Journal of Heritage Studies* 15: 44-56.

MOSHENSKA, G. (2012). *The Archaeology of the Second World War. Uncovering Britain's Wartime Heritage.* South-Yorkshire: Pen and Sword Archaeology.

PASSMORE, D.G. and S. HARRISON. (2008). 'Landscapes of the Battle of the Bulge: WW2 Field Fortifications in the Ardennes Forests of Belgium.' *Journal of Conflict Archaeology* 4.1: 87-107.

PASSMORE, D.G., S. HARRISON and D. CAPPS-TUNWELL. (2014). Second World War conflict archaeology in the forests of north-west Europe. *Antiquity 88* (342): 1275-1290.

POLLARD, T. (2008). ''A View from the Trenches: An Introduction to the Archaeology of the Western Front.'' In M. Howard (Ed.) A Part of History. Aspects of the British Experience of the First World War. London: Continuum: 198-208.

ROTTMAN, G.I. (2004). *German field fortifications 1939-45.* Oxford: Osprey.

SAUNDERS, N.J. (2007). *Killing Time. Archaeology and the First World War.* Gloucestershire: Sutton Publishing.

SAEY, T., W. GHEYLE, M. VAN MEIRVENNE, J. BOURGOIS, S. VERPLAETSE, V. VAN EETVELDE and B. STICHELBAUT. (2014). Elektromagnetische inductie op een slagveld van de Groote Oorlog: Chemin du Mont de la Hutte, Ploegsteert. In: M. Bracke (Ed.), *Conflict in Contact II*. CO7 Archeo: 62-63.

SCHOFIELD, J.A., W.G. JOHNSON and C.M. BECK. (2002). *Matériel Culture: The Archaeology of 20th Century Conflict.* London.

SCHRIEK, J. VAN DER and M. VAN DER SCHRIEK. (2011). ''Up ewig Ungedeelt!' Schleswig-Holstein 1864-1920.' *Journal of Conflict Archaeology* 6.2: 146-172.

SCHRIEK, J. VAN DER and M. VAN DER SCHRIEK. (2013a). *"Begraven oorlogsverleden." De wetenschappelijke potentie en cultuurhistorische waarde van archeologische sporen en vondsten uit de Tweede Wereldoorlog.* Literatuuronderzoek. VU Amsterdam: CLUE.

SCHRIEK, J. VAN DER and M. VAN DER SCHRIEK. (2013b). 'Slagveldarcheologie in Nederland.' *Vitruvius 23* (4): 16-20.

SCHRIEK, J. VAN DER and M. VAN DER SCHRIEK. (2014). 'Metal Detecting: Friend or Foe of Conflict Archaeology? Investigation, Preservation and Destruction on WWII sites in The Netherlands.' *Journal of Community Archaeology and Heritage*, vol. 1 (3), 228-244.

STICHELBAUT, B. (2005). 'The application of Great War aerial photography in battlefield archaeology: the example of Flanders.' *Journal of Conflict Archaeology 1.1:* 235-243.

STICHELBAUT, B. (2006). 'The application of First World War aerial photography to archaeology: the Belgian images.' *Antiquity 80:* 161-172.

STRACHAN, H. and A. Herberg-Rothe. (2007). *Clausewitz in the twenty-first century.* Oxford University Press.

U.S. Army. (2001). *FM 3-0: Operations.* Department of the Army, Washington, D.C.

VERDEGEM, S. and J. LOOPIK. (2014). Een stille aanval met grote gevolgen: De Duitse inval in België en de strijd om de brug van Vroenhoven (Riemst, Lim.), in: M. Bracke (Ed.), *Conflict in Contact II*. CO7 Archeo: 84-89.

Internet sources

http://nl.tracesofwar.com/artikel/13083/Duits-Oefenterrein-%91Schijnboten-Westelbeers.htm Last accessed on 23-12-2015.

http://www.inrap.fr/archeologie-preventive/Ressources/p-17800-Archeologie-de-la-violence-violence-de-guerre-violence-de-masse.htm Last accessed on 14-10-2015.

Imprint:

Proceedings of the 20th International Conference on Cultural Heritage and New Technologies 2015 (CHNT 20, 2015)

Vienna 2016

http://www.chnt.at/proceedings-chnt-20/

ISBN 978-3-200-04698-6

Editor/Publisher**:** Museen der Stadt Wien – Stadtarchäologie

Editorial Team: Wolfgang Börner, Susanne Uhlirz

The editor's office is not responsible for the linguistic correctness of the manuscripts.

Authors are responsible for the contents and copyrights of the illustrations/photographs.