International aerial archaeology conference

AARG 2009 SIENA

Certosa di Pontignano

25 - 27 September 2009

Organised by the University of Siena, Italy, and the Aerial Archaeology Research Group

PROGRAMME AND ABSTRACTS

Thursday, 24 September 2009

19.00 PRE-CONFERENCE DINNER/DRINKS

Friday, 25 September 2009

09.00 - 09.45 REGISTRATION and COFFEE

09.45 - 10.30 AARG AGM – members of AARG only

10.30 - 10.45 CONFERENCE START AND WELCOME

10.45 – 12.30 **AERIAL ARCHAEOLOGY IN ITALY AND THE CENTRAL MEDITERRANEAN**
Chair: Dr Stefano Campana & Prof. Giuseppe Ceraudo

10.45 **Two years of aerial survey along the *via Annia* (Venetian-Friulian plain, Italy)**
A. Ninfo, P. Mozzi, A. Fontana, & F. Ferrarese

11.05 **Photo interpretation in archaeological researches in Sicily: Apolline and Cossyra**
A. Mosca

11.25 **The contribution of historical aerial and satellite photos to archaeological and geo-archaeological researches: cases study in Italy and Turkey**
Giuseppe Scardozzi

11.45 **High resolution satellite ortho-images for archaeological research: different methods and experiences in the Near East**
L. Castrianni, G. Di Giacomo, I. Ditaranto, & G. Scardozzi

12.05 **On the integration of airborne full-waveform laser scanning and optical imagery for archaeological research and the natural resources management**
R. Lasaponara, N. Masini, R.Coluzzi, & A. Guariglia

12.30 - 14.00 LUNCH

14.00 - 16.00 **SEEING LANDSCAPE**
Chair: Darja Grosman

14.00 **Approaching an ancient landscape through the study of aerial photographs: the upland Corvaro plain in the Cicolano region**
Emeri Farinetti & Angela Paolini

14.20 **Upper Tiber Valley aerial photo interpretation for the environmental reconstruction of the ancient landscape.**
Maria Cristina Salvi, Riccardo Salvini & Alice Cartocci

14.40 **Above and Beneath the Sea: aerial imagery and submerged prehistoric landscapes**
Jonathan Benjamin

15.00 **Creating a protocol for mountainous rocky areas: case-studies in Eastern Crete**
Gianluca Cantoro

15.20 **Aerial archaeological topography of the Bronze Age and Iron Age fortified settlements in Hungary**
Zoltán Czajlik

15.40 **Saxony-Anhalt-Mapping Project: Part 1- County of Schönebeck**
Claudia Vattes

16.00 **The Structured Landscape - Late Bronze Age and Early Iron Age Land Use in Saxony-Anhalt, Germany**
Ralf Schwarz

16.15 - 16.45 COFFEE

16.45 - 18.15 **THE DEATH OF CROPMARKS?**
Chair: Wlodek Rączkowski

16.45 **The death of cropmarks**
Kenneth Brophy

17.05 **The effects of changing weather conditions – notes from a concerned surveyor**
René Pelegrin, Luc Corthouts & Marc Lodewijckx

17.25 **Norfolk: Land of Cropmarks!**
Sophie Tremlett

17.45 **Reflexivity; Different Perspectives; Multiple Realities and a Cat: Towards explicit theory**
Dene Wright

18.15 – 19.00	**BEYOND AERIAL ARCHAEOLOGY – AERIAL PHOTOGRAPHY IN THE REAL WORLD** Chair: Dave Cowley
18.15	**Too much? The value of aerial photographs taken for non-archaeological purposes** Sharon Bishop
18.35	**More than just pretty pictures – Art and Aerial photography** Sarah Horlock
19.30	Evening meal
22.00	**Informal evening session** Chair: Dave Macleod

An aerial view of the Past - aerial archaeology in Denmark
Lis Helles Olesen

Would you fly with René?
René Pelegrin

Saturday, 26 September 2009

9.00 - 11.00 **USING ORTHOPHOTOGRAPHS**
Chair: Rog Palmer

9.00 **Low altitude aerial survey, orthophotos and satellite data in archaeological and ancient landscape research - a comparison of their potential (Czech case study)**
Martin Gojda

9.20 **Combining old and new – using orthophotographs in Scotland**
Kevin Macleod

9.40 **The use of digital surface and orthophotographs data to analyse results from the English Heritage National Mapping Programme**
Matthew Oakey

10.00 **Uncovering ancient fishweirs on the Manche coastline: a multiscalar approach to fishing techniques from Bronze Age to Modern Period**
Sophie Quevillon & Cyrille Billard

10.20 **The role of aerial photography as part of a multi-disciplinary study of relict landscapes in County Roscommon, Ireland**
Brian Shanahan

11.00 - 11.30 COFFEE

11.30 - 13.00 **BEYOND-VISIBLE ARCHAEOLOGICAL RECONNAISSANCE**
Chair: Geert Verhoeven

11.30 **Why? Some observations on the limitations of conventional reconnaissance**
Dave Cowley

11.45 **Analysing the information content of airborne remotely sensed data for archaeological prospection: two pilot areas in Wiltshire, UK**
Rebecca Bennett

12.10 **'*Detection of Archaeological residues using Remote sensing Techniques'* a roadmap for archaeological remote sensing in the 21st century?**
Anthony Beck

12.40 **Resolving the Past, reflections and resolutions: West Heslerton re-visited**
Dominic Powlesland

13.15 - 14.45 LUNCH

14.45 - 16.10 **NEW PROJECTS AND LANDSCAPES**
Chair: Lidka Zuk

14.45 **Where have the mounds gone? Photogrammetric restitution of severely altered areas using flights from 1950s – its application in a survey project.**
Enrique Cerrillo Cuenca & José Juan de Sanjosé

15.05 **Reconstructing Iron Age agrarian landscapes in Denmark**
Michael Vinter Jensen

15.25 **Aerial archaeology and settlement development in an Iron Age and Romano-British lowland landscape**
Peter Halkon

15.45 **Recent work on the centuriation around a Pannonian colonia**
András Bödőcs

16.05 - 16.35 COFFEE

16.35 **Exploration of Lothingland with Google Earth - some questions**
John Peterson

16.55 **Southern Romania Danube Plain: What we saw from the sky**
Irina Oberländer-Tarnoveanu, Carmen Bem & Bogdan Sandric

17.15 - 19.00 **CONFLICT AND MILITARY ARCHAEOLOGY**
Chair: Prof. Armando De Guio & Robin Standring

17.15 **The confrontation of aerial photographs with geophysical research to study the conflict landscape of the Great War: the example of Comines-Warneton (Belgium)**
Peter Masters & Birger Stichelbaut

17.35 **The El Alamein Project. A project for the study of the El Alamein Battlefield through remote sensing and GIS (Egypt, 1942)**
Bondesan A., Moretto D., Fabbrucci L., Petrella N., Cinti G., Francese R., Facco L. & Ceccato A.

18.00 **US7GR LOC 349 3041: one Saturday afternoon on the Home Front**
Cathy Stoertz

18.25 **Archaeology at War: a bottom-up perspective**
Armando De Guio & Andrea Betto

19.15 - 20.00 **Informal discussion of AARG Education initiatives**

20.30 **CONFERENCE DINNER**

ABSTRACTS

25/09/09 AERIAL ARCHAEOLOGY IN ITALY AND THE CENTRAL MEDITERRANEAN

Two years of aerial survey along the *via Annia* (Venetian-Friulian plain, Italy)

A. Ninfo, P. Mozzi, A. Fontana, & F. Ferrarese
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The Roman road known as *via Annia* used to cross the Venetian-Friulian alluvial plain, near the Adriatic coast, for an overall length of approximately 180 km. It was built in the 2nd century B.C., in order to link the cities of *Aquileia, Altinum* (Altino), *Concordia*, *Patavium* (Padua) and, probably, *Atria* (Adria). Long stretches of the *via Annia* and related settlements and infrastructures still persist at the surface and can be detected through remote sensing and in the field. Locally, the road is covered by modern roads and buildings, while some sectors are buried under medieval alluvial sediments.

Within the framework of a research programme project financed by ARCUS S.p.A. and supported by Veneto Region and the Municipality of Padova, the *via Annia* is being investigated by means of aerial and satellite remote sensing. The total area of investigation is about 2000 Km^2. Scheduled flights, for the acquisition of oblique aerial photographs, amount to a total of 100 hours; flights started in September 2007 and will finish in fall 2009. The hours are planned to cover two entire years, in order to understand the response of relevant ground features during the cyclicity of the seasons. The availability of daily local climatic data from several meteorological stations (Environmental Protection Agency of Veneto - ARPAV) located in the study area, allows to correlate the ground response to specific meteorological situations. The area is very rich in traces of abandoned river and lagoon channels, relict littoral dunes etc., which show up with particular evidence in the photographs. The integrated analysis of natural and anthropogenic features is providing useful information on the relations between archaeological sites and late Holocene palaeohydrography and coastline. These are fundamental constraining factors for settlements distribution. Spatial data and related attributes are being stored and managed in a GIS, which incorporates both geomorphological and archaeological information along this corridor. Particular attention has been dedicated to the city of *Altinum*, one of the most important Iron Age and Roman cities in the northern Adriatic, located on the margin of the lagoon of Venice. *Altinum* was definitively abandoned in 7th century AD following Barbarian invasions. Its unique spatial setting has allowed the reconstruction of the previously unknown urban structure. The results of the aerial photo survey permit a very precise mapping of the road segments and of other interesting archaeological features.

Photo interpretation in archaeological researches in Sicily: Apolline and Cossyra

A. Mosca

Photo interpretation was useful in archaeological researches along the south west coast of Sicily, between Pozzallo and Capo Pachino, in the identification of the site of *Apolline*. This site is recorded inside the *Itinerarium Antonini* (96.3), between *Hereo* and Siracusa; it is called *plaga*. The Arab writer Edrisi remembered this place like Marsâ al Bwâlis (perhaps the equivalent of *Portus Apollinis*). The ruins were described by Fazello in the 16th century and by Camiliani in the 19th century. The port was important like intermediate call to reach North Africa through Canale di Sicilia in front of Malta island. The maritime route persisted to be used even in later times. The inhabited place was surrounded by boundary wall clearly evident by aerial photography. Archaeological researches and survey ensure the site was important from the Roman period to the VII century a. D. In archaeological surveys in the island of *Cossyra* (Pantelleria) the use of aerial photographs on a side allowed to analyse the peculiar geomorphology so it was possible to clarify the way of housing and the land management, but on the other side was not helpful in understanding the typology of ancient settlement. In fact archeological surveys evidenced a superimposition of ancient and modern sites. Sometimes in modern buildings were even used salvage objects.

The contribution of historical aerial and satellite photos to archaeological and geo-archaeological researches: cases study in Italy and Turkey

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The paper evidences the importance of old aerial and satellite photos for the ancient topography studies, with examples concerning archaeological and geo-archaeological researches conducted in Italy and Turkey, during a

cooperation between the Ancient Topography, Archaeology and Remote Sensing Laboratory of the *Istituto per i Beni Archeologici e Monumentali* of the *Consiglio Nazionale delle Ricerche* (*IBAM-CNR*) and the Ancient Topography and Photogrammetry Laboratory of the Salento University. The historical aerial photos, i.e. those before the big transformations of 1950s and 1960s, represent a fundamental tool for the study of the territory. In many cases, in fact, they document a landscape much different in comparison with the actual one, which has been often modified by urbanization, building of large infrastructures, transformations in the land use and diffusion of agricultural machines; these transformations have often radically changed historical landscapes, modifying the morphology of territories or destroying and covering a lot of ancient evidences. Only thanks the detailed analysis pf these aerial photos is often possible recover, at least partially, a fundamental documentation concerning the existence, the location and the layout of archaeological evidences and paleo-environmental elements otherwise lost.

In detail, the work concerns the contribution to the researches on some ancient sites of south and central Italy provided by aerial photos acquired before the Second World War – such as those of the "Fondo S.A.R.A. - Ala Littoria S.A.", a collection of numerous aerophotogrammetric flights realized in the 1930s by S.A.R.A., *Società Autonoma Rilevamenti Aerofotogrammetrici*, and finalized to the updating the cadastral maps of Viterbo province - or during the war itself - as those of Istituto Geografico Militare and of Royal Air Force of 1943-1945 - or, moreover, in the years immediately after the same war - as the photos taken by IGM in 1947 in some areas of Apulia. These images, sometimes scarcely used in the archaeological researches, constitute a very important documentation about urban contexts and territories that later have been changed or partially destroyed; in them it is therefore possible to detect and examine ancient structures and archaeological traces of buried features now not visible.

Sometimes in these photos are also visible paleo-environmental elements that allow the reconstruction of ancient landscapes; also in these cases the ground check of traces and anomalies visible in the images is very important. Two cases study presented regard similar situations, in the area of the archaic and roman harbor of Torre S. Giovanni (south-western Salento) and in the area of the Yumuk Tepe, a Prehistoric settlement in Mersin (south-eastern Turkey). In the first case a very rich multitemporal air-photos documentation (between 1943 to 2006) allow to reconstruct an ancient lagoon (now reclaim) behind the coastline and the transformation of the last one. In the second case, the analysis and processing of multitemporal satellite photos taken by reconnaissance USA spy satellites (Corona KH-4A, Corona KH-4B, Gambit KH-7, Hexagon KH-9) between 1967 and 1980 allow to reconstruct the ancient landscape around the Yumuk Tepe and the valley of the Kizil Dere, the flows near the settlement; these images also allow the reconstruction of the ancient coastline of the alluvial Adana plain, east of Mersin.

High resolution satellite ortho-images for archaeological research: different methods and experiences in the Near East

L. Castrianni, G. Di Giacomo, I. Ditaranto, & G. Scardozzi

The contribution of the satellite ortho-images to the archaeological research has been significant, since such images have provided constant support for the field work, both excavations and surveys; in fact, the processing, analysis and interpretation of traces and anomalies linked to buried or partly-emerging archaeological and paleo-environmental elements, duly verified on the ground, has enabled the identification and the spatial characterization of archaeological evidences. In the examples presented the satellite ortho-images have different utilizations: in fact they were both used for the creation of space-maps for the field work and as base for the realization and the up-to-date of cartography finalized to the archaeological research or the up-to-date of archaeological maps. In the contexts presented, different uses are often linked to the possibility or not of an accurate ortho-rectification, with the possibility of the collection of Ground Control Point and with the availability of high resolution DEM. In the cases study examined, WorldView-1, QuickBird-2 and Ikonos-2 images, also stereo-pairs, were used. In the case of the archaeological researches in the territory of Hierapolis (Turkey), because of the lack of up-to-date and adequate cartography (the best topographical maps of the area are on a scale of 1:25,000), satellite ortho-images constitute a basic tool for the direct exploration of the territory and for the recording and exact positioning of the ancient evidences. Moreover, these images have provided a large, up-date and detailed documentation of the modern situation of some of the most important ancient cities and settlements of Mesopotamia (from Prehistoric times to the Islamic period) studied and showed in the "Virtual Museum of Iraq" Project of the Italian CNR.

The use of satellite data acquired through second generation VHR (Very High Resolution) sensors for thematic cartography production and update is today a well-established and rapidly executed procedure. However, in the field of archaeology, due to the heterogeneous nature of the entities that form specialized cartographies and the processes binding map production to the unavoidable on-field verification of acquired data, production time is obviously quite extended. The ortho-rectification of satellite imagery can be operated through different methods, with quite varying results according to the reliability of input data such as, for example, orientation parameters of the satellite-sensor group, the number and condition of Ground Control Points acquisition, the detail of the terrain model available, and so on.

Geometric correction of satellite imagery is obtained through the use of mathematical models, today included in most of the widespread data processing software, that can be ascribed to two large groups: the physical-geometric models (or parametric) and the generalized models (not parametric). The first require metadata with the information of the image capture, that is the data regarding the satellite's orbit (ephemerides), the platform's and the sensor's orientation, and the data on optical-geometric conditions of the sensor at the time of the acquisition. These models, generally quite reliable, allow the image straightening through the modeling of geometric distortions and by means of a direct connection between image space and terrain space, using a minimum number of variables. However, such models have been supported and partially substituted by general, not parametric models, thus not bound to one particular type of sensor, mostly due to the fact that not all the companies owning the satellites supply metadata regarding the acquisition. Among the non parametric models, those connected to Polynomial Functions and to Rational Function Models (RFM) were found to be more reliable, in terms of mean squared errors on points surveyed on the ground in relation with the image's pixel dimension). In general, the most functional process for the production of a digital straightening is ortho-photoprojection, for which at least the sensor's internal orientation parameters are needed, as well as a good Digital Terrain Model (DTM).

So, possibilities of cartography production and up-to-date offered by high resolution satellites after an accurate ortho-rectification, in particular in studied contexts where there is no adequate cartography available and it is difficult or impossible to retrieve stereoscopic aero-photos coverage, map thematisms can be extracted for the production and upgrading of maps in scales included between 1:25,000 and 1:5,000, which can thus be specifically aimed for archaeological research. This methodology was applied to a limited portion of the territory located south-east of Hierapolis in Phrygia, between the modern villages of Yeniköy and Küçükdereköy, characterized by a concentration of archaeological evidence dating from the Hellenistic to Ottoman periods.
In the case of the ancient cities of Mesopotamia, multitemporal remote sensing data are a fundamental form of documentation and provided plan views of the archaeological areas, where different monuments are together integrated and correctly localized. So it was possible to upgrade the archaeological plans of the sites and to realize a vectorial documentation utilized for 3D reconstructions of monuments and ancient cities. In some case, instead, the recent satellite images were orthorectified (without Ground Control Points and on DEMs based on SRTM data) and the vectorization of all archaeological remains and traces visible in all multitemporal remote sensing data, allowed the creations of new archaeological maps (ready for the input in a GIS) with new data about ancient layout of sites, monuments and roads; in these maps the contour lines were extracted from DEMs.

On the integration of airborne full-waveform laser scanning and optical imagery for archaeological research and the natural resources management

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Airborne and spaceborne laser scanning is a remote sensing approach recently developed to obtain a high-precision and complete vertical profile of the height of objects by a laser pulse. The applications of ALS are increasing rapidly over the last years. In particular, airborne laser scanner (ALS) with its efficient data sampling capabilities has completely revolutionized the area of bathymetric and topographic surveying. Moreover, ALS data were recently used in land cover classification, forest species classification, estimating forest tree heights and in assessing seasonal canopy differences. Recent studies examined the possibility of using LiDAR in landscape studies and archaeological investigations to depict micro-topographic earthworks.

There are two different types of ASL: (i) conventional scanners based on discrete echo and (ii) full-waveform scanners. The conventional or discrete echo scanners detect a representative trigger signal for each laser beam whereas the full-waveform (FW) laser scanning systems permits one to digitize the complete waveform of each backscattered pulse. FW LiDAR data allows us to have more control in the interpretation process of the physical measurement and this enables the extraction of additional information about the structure and the physical backscattering characteristics of the illuminated surfaces. In this context of landscape studies and archaeological investigations the majority of published studies have been based on conventional ALS, whereas investigations based on FW-ALS are quite rare. The latest generation sensors offer improved capabilities which can enable the detection of micro-topographic relief (low earthworks features) even in dense vegetated areas. An increasing number of ALS-applications in archaeology shows that it can make a special contribution to the study of archaeological landscapes and for the recording of archaeological monuments and landscapes.
This paper analyses the capability of airborne LiDAR derived data for archaeological research and for the management of the natural heritage. In this paper we are focused on the assessment of the benefits achievable from the integration of ALS with aerial photos and very high resolution satellite imagery.
For these two purposes, two test areas were selected in Southern Italy: (i) a medieval village located in Basilicata (not yet excavated) and (ii) a natural park in Apulia.
For the archaeological site, the LiDAR data have been used to detect micro topographic relief linked to ancient structures; whereas for the natural park LiDAR has been employed to provide information for the study of vegetation and the identification of potential palaeo-environmental features under the forest canopy In this paper we are focused on the assessment.

Approaching an ancient landscape through the study of aerial photographs: the upland Corvaro plain in the Cicolano region

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The work presented in this paper constitutes part of a wider research on the historic landscape of the Corvaro plain within the wider Cicolano region (Cicolano Survey project), and aims at offering insights on the diachronical relationship between men and environment through the application of an integrated methodology involving both landscape archaeology and the analysis of aerial photographs.

The investigation, still at its initial stage, focuses on the cultural and geomorphological changes in the area and is based on the reconnaissance on air photographs of human and natural marks that past histories left on the landscape.The interpretation of the visible anomalies was carried out following a multi-temporal approach through a comparison of rectified aerial photographs from different periods (mainly 1954 – 1955, 1970, 2000) in a GIS environment. In particular, a critical change in the landscape is marked by the construction of the highway A24 in the 1960s. Anomalies were checked on the ground and jointly analysed as much as possible with the archaeological data available and with geomorphological and geoarchaeological investigations, giving interesting insights especially on the paleo-hydrography of the karstic area.

In addition, the examination of available historical maps, analysed jointly with the air photographs, gave information on the more recent history of the area and on toponomastic trends. Moreover, the resulting interpretative datasets were analysed jointly with the results from the intensive and systematic artefact surface survey conducted in the area since 2005, offering an heuristic environment for both a critical examination of the archaeological record and a contextualised interpretation of located sites and detected uses of the landscape.

Upper Tiber Valley aerial photo interpretation for the environmental reconstruction of the ancient landscape

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The aim of this paper is to present preliminary results of the EUFAR T-Mapp project, a research work related to the reconstruction of the palaeo-environment of the upper Tiber valley area. Up to now, aerial photos analysis has been conducted to allow the detection of ancient wetlands and palaeo-drainages that, in the study area of Sansepolcro (AR, Italy), constituted a peculiar element of the past territory.

During the XIII sec. the Tiber river flow was diverted, and from the archaeological point of view, it is useful to reconstruct the ancient course in order to better rebuild the ancient territory occupation and to identify hidden archaeological remains.Starting from present and historical geomorphological evidences, several series of multispectral aerial photo and ortophotos (‘70s, ‘90s, 00’s), historical cartography and archive sources have been utilized. The archaeological, geological and geomorphological data, obtained from the processing and the interpretation of aerial photographs has been implemented into a Geographic Information System GIS in order to highlight the spatial and temporal variations of Tiber palaeodrainages.

The analysis of the aerial ortophotos, together with the Digital Elevation Model, has permitted the three-dimensional observation of the landscape favouring the study of the geomorphological evolution of macro and micro relief. The functionalities of the analytical tools of GIS software will be in future opportunely calibrated in relation to the historical-cultural and functional characteristics of the study sites. Moreover, spatial analysis applied to the DEM will allow the morphometric and morpho-hydrological study useful to understand the landscape multitemporal dynamics and relative human uses and exploitations.

Above and Beneath the Sea: aerial imagery and submerged prehistoric landscapes

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This paper discusses the combined application of aerial photography, satellite imagery, and bathymetric data (submarine topography) for underwater archaeological site discovery and interpretation. An emphasis is placed on submerged prehistoric landscapes. Climate change during the final Pleistocene, and subsequent rising sea-levels, impacted cultural landscapes around the world, inundating coastal environments – a process that continued well into the Holocene. Much of the prehistoric coastline of Europe has been submerged and evidence

of human activity now exists underwater at depths accessible to archaeologists. In the central Mediterranean and Adriatic, depths of c.-10 to -25m correspond to shoreline positions of the Final Mesolithic and Early Neolithic, c. 7000–5500 cal BC. Paleoenvironmental reconstruction and identification of specific geographical features are key to the submerged prehistoric site discovery model that will be presented in this paper. This paper aims to demonstrate effective usage of aerial imagery combined with nautical information during both pre-fieldwork and dissemination phases of an underwater project. Specific regional focus is placed on the northeastern Adriatic coastal zone, including results from a pilot study conducted in Istria and a theoretical discussion of future investigations in Dalmatia, Croatia.

Creating a protocol for mountainous rocky areas: case-studies in Eastern Crete

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This paper discussed some challenges arising from the authors PhD research. What to do if there are no cadastral maps, if the 1:5.000 map (the biggest scale available) does not depict hydrography to support the understanding of soil-marks and geological erosion, if crop-marks (or "scrub-marks" of the typical *Mediterranean macchia*) are undistinguishable, if the over-exposure of some military photos hides any shadow-mark (if not more), if oblique photos are not (yet) available, if a road can produce the same mark as a wall in another geological condition few meters away, if the monumentality of some constructions means that scale does not work well as a discriminating factor, …? These are amongst the challenges of creating a specific protocol in photointerpretation of mountainous rocky areas that underlie the prosecution of this PhD research.

A simplified cadastre has been produced according to the photographical evidences with the 4th coordinate of time changes. A particularly rich net of roads, rough tracks and pathways has been digitized, underlining the high potential of areas where some paths were used for long periods. On this generated map, the actual bibliographical information is placed with a particular consideration of the source of the information itself: a data mining analysis is carried out to understand why an archaeological feature was visible from the ground and if the position influenced the recognition itself. The use of symbolic colours in the attribute tables of every single frame and feature was another step for cataloguing the photographic resources and the traces of potentials. At the same time, the description of every single anomaly, via abstraction levels (i.e.: a house is made by walls; walls are made by stones and/or bricks – and/or wood, but this is not the case–… going on inductively for every feature), allows us to group homogeneous elements in a bigger category. On the base of these first subdivisions, the comparison of similar recurrence of symbolic colour allowed the description of dubious cases or the definition of "false-features".

Aerial archaeological topography of the Bronze Age and Iron Age fortified settlements in Hungary

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Commissioned by the Office of Environmental Protection of the Ministry of Environment, in 1997 the Institute of Archaeological Sciences of the Eötvös Loránd University began to assemble the register of prehistoric monuments lying in conservation areas as defined by Act LIII of 1996. We first collected the available archaeological and topographical data on prehistoric kurgans and tumulus burials; this was followed by a register of the two hundred known and topographically identifiable prehistoric hillforts, assembled in collaboration with Gyula Nováki in 1998–99 (Nováki *et al.* 2006).

This work was followed in 2000, with the aerial archaeological documentation of the known hillforts, which resulted in many cases with the identification of new ramparts, terrasses, etc. (Czajlik & Holl 2003). Some cases we have found not only new fortified settlements, but a system of fortification, controlled by field walkings as well (Vicze *et al.* 2005). In the framework of a new grant (OTKA 68824) and supporting by the Bolyai János Award we are collecting all the above mentioned data (cadastre, aerial archaeological and satellite imagery, field walkings, etc.) to present a catalogue for further researches. The results are much more interesting as it was expected; more than hundred new ramparts, hillforts, hillfort-systems, etc. which could complete our knowledge about the Bronze and Iron age settlement systems of Hungary.

Zoltán Czajlik & Balázs Holl, 2003: Die Luftbildprospektion der urzeitlichen Erdburgen Ungarns. Mandulavirágzási tudományos napok, Régészeti műemlékek kutatása és gondozása a 3. évezred küszöbén (szerk.: Visy Zsolt) Pécs-Szekszárd, 2002. március 4-8., kiadta a Pécsi Tudományegyetem Ókortörténeti és Régészeti Tanszék Régészeti Szemináriuma, Pécs, 2003, 67-82.

Gyula Nováki, Zoltán Czajlik & Balázs Holl, 2006: Kataster der prähistorischen Erdburgen Ungarns – Versuch einer umfassenden Datenerfassung zum Schutz des kulturellen, archäologischen und naturräumlichen Erbes In : Alexandra Krenn-Leeb (Hrsg.): Wirtschaft, Macht und Strategie. Höhensiedlungen und ihre Funktionen in der Ur- und Frühgeschichte. Archäologie Österreichs Spezial 1(2006) 125-139.

Vicze Magdolna, Czajlik Zoltán & Tímár Lőrinc, 2005: The archaeological topography of the Northern part of the Benta-valley. In Százhalombatta Archaeological Expedition (SAX), Report 2, Matrica Museum 2005, 251-254.

Saxony-Anhalt-Mapping Project: Part 1- County of Schönebeck

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A landscape is the result of enduring human activity in transforming nature into culture. The result is a more or less structured mosaic of settlements, cemeteries, ceremonial sites, arable land, pastures and woodlands. The arteries of such a landscape are the roads and lanes serving as communication lines and connecting the different parts to a network. All activities involved in the establishment of settlement left their traces in the soil and subsoil and this is why aerial archaeology can contribute to the reconstruction of prehistoric landscapes. Best proof are the studies of D. Riley (1980), R. Palmer (1984), R. Whimster (1989) and C. Stoertz (1997), which are exemplary for further work.

Since relevant studies in Germany do not yet exist, a project seemed to be overdue. A good starting point for aerial archaeological research is the region south of Schönebeck in Saxony-Anhalt, where two important rivers meet: the Saale and the Elbe. In this region aerial reconnaissance is very successful due to the thin layers of sandy loess and Tschernosem soils above Pleistocene gravels. A body of 367 sites documented on more than 5000 aerial photos is available. Furthermore settlement in the Schönebeck region comprises all archaeological periods from the beginning of agriculture to medieval times. A focus will be on the Middle Ages, due to the abundance of deserted Slavic fortified villages.

The initial work is the rectification of selected aerial photos containing sufficient topo-graphical information by means of computer aided programmes, the interpretation of the archaeological content and the digitalization of all relevant structures. Then, the features are compiled in a GIS (ArcGis) and plotted on a topographical background. On the basis of a study by R. Schwarz issued in 2003 the features are morphologically and chronologically determined. Later, all features and sites will be presented according to their date and function in a catalogue. According to their date and shape different GIS-layers were created for further interpretation. By this means and on the basis of topographical and geological maps each feature will be studied either singularly or in a broader context. Finally all components of the settlement (open and fortified settlements, cemeteries, lanes, boundaries etc.) and the mosaic of the prehistoric and medieval landscapes can be evaluated. Examples will be presented in this lecture.

Eventually, this aerial archaeological approach will be flanked by an excavation project focussed on Neolithic and Early Bronze Age circular enclosures in this region benefitting each other.

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The Structured Landscape - Late Bronze Age and Early Iron Age Land Use in Saxony-Anhalt, Germany

Ralf Schwarz

In central Germany the demand for food seems to have increased heavily during the Late Bronze Age (LBA). In particular this is true for the region of the middle Elbe and lower Saale rivers, where the population density increases from 1200 B.C. onwards. This is evident from an overwhelming number of settlement and burial sites, the enlargement of settlement areas and burial grounds and by the expansion of settlement into scarcely or even unsettled areas. Furthermore, the settlements contain numerous large pits for the storage of grain. Also the rising importance of bronze sickles as devices for harvesting, as symbols for fertility and as standardized values in trade additionally highlights the importance of agriculture. There could have been several reasons for the increasing demands of food.

1. After a population weakly scattered over central Germany in the Middle Bronze Age, settlement concentrated alongside the rivers Saale and Elbe and their tributaries in the LBA.
2. The importance of the production of bronze artifacts increased in the LBA. Although it is unknown how many bronze artifacts have been destroyed by fire during the burial rites the huge deposits of bronze artifacts reflect an previously unknown need of valuables. The chain of the production processes from the extraction of ores in the Harz mountain, the melting of copper and tin, to the polishing and decorating of fine artifacts required many labourers and specialist handicraftsmen, who had to be fed.
3. The same is true for the production of salt which became an important economic factor in the LBA and EIA. Different steps in salt production by means of evaporation of water from salt-springs required labourers involved in this processes. They must have been fed und thus agricultural surplus must have been achieved. By means of standardized briquetage salt was cast in cakes which obviously were traded like ingots.

Because of the extensive bronze and salt production the landscape must have been largely unwooded. Thus, for example, the production of salt by means of evaporation was transferred from the salt-springs to remaining woodlands in order to remove the remaining water out of the salt to produce ingot like salt cakes.

To gain agricultural surplus land must had been converted into fields and prepared for cattle grazing. To meet the increasing demands for food it would have been appropriate to structure the landscape and divide it into arable land and pastures and this is what archaeology shows. In the middle Elbe-Saale-region ditches and pit alignments served as boundaries of territories as well as of arable land and pastures. Both are linear features which extend far beyond the limits of areas explored by normal scale rescue excavations so, aerial archaeology is the appropriate method to deliver further information to understand the whole layout and setting in the landscape. In this respect pit alignments are a specific feature of aerial archaeological research which supplement the predominant short rows of excavated pits on the ground. Whereas linear ditches date from the neolithic times onwards pit alignments turned out to be a feature characteristic of LBA and EIA date. This is why pit alignments and associated linear ditches can date a LBA and EIA landscape per se. An aerial photograph of a pit alignment discovered as a crop mark feature shows a series of pits set in a linear row, whereas excavations show the upper layers of such structures almost entirely as shallow continuous ditches where pits had been dug into the bottom.

According to their fillings pit alignments represent three different types of features:
1. Boundaries which are formed by pits with homogeneous fillings of earth without any finds; one or more Adjacent pits may occasionally contain abundant finds.
2. Ceremonial fire pits which contain charcoal and burnt stones; beside single alignments there also exist short parallel rows of pits.
3. Limitations which separate settlements from cemeteries; both the fillings of the ditch and the pits contain numerous finds.

Only the pit alignments of type 1 served as boundaries between fields, communities and territories. By their sizes and combinations ditches and pit alignments can be further categorized into primary and secondary features. Only the secondary type of feature bound fields and pastures, whereas the primary type may have served as frontiers between communities and territories. Regularly the pits of the secondary type of alignments are smaller in size, i.e. shorter or narrower, than their primary counterparts. Both types of pit have a rectangular layout resembling a bath tub. In folklore the primary type of boundary had been consecrated by specific rites to maintain its protective and defensive character, a tradition which endured until the 18th century AD. Finds within such pit alignments may be relics of such ceremonial rites.

The distribution shows that pit alignments are limited to the middle Elbe-Saale-region, which has been inhabited by two archaeological groups: the Saalemündungsgruppe and the Mittelsaalegruppe respectively their EIA successors: the Hausurnenkultur (House Urn Culture) and the Thüringische Kultur. On the other hand the regions inhabited by the Lausitzer Kultur to the east and the Elbe-Havel-Gruppe to the north do not show such boundaries. But, within this region there is a still closer restriction of pit alignments to the river Saale and its tributaries, which reflect the focus of settlement and economic activities in the LBA. There, the very fertile Loess (Tschernosem) soils guaranteed annually good harvests.

An extensive system of linear ditches was first excavated at Zwenkau south of Leipzig in Saxony by large scale rescue excavations at the margins of open-cast mines. There, an H-shaped structure was uncovered and interpreted as settlement precincts by the excavator H. Stäuble in 1998 and 2002. Other components of boundary systems were excavated west of Leipzig during pipeline and motorway construction. There, even earlier aerial reconnaissance led to the discovery of numerous pit alignments and linear ditches since 1992. The frequency of pit alignments and linear ditches increases westwards into Saxony-Anhalt where aerial reconnaissance started in 1991. 120 pit alignments were discovered by aerial archaeology supplemented by discoveries from small scale excavations.

The following considerations concerning the structured landscape are based on a series of rectified aerial photographs from Saxony-Anhalt, a work which was done by Claudia Vattes in 2009. The primary type of alignments show the pits and ditches running several hundred meters over open land without any associated structures. Where plans of rectified aerial photos exist a topographical reference is evident. This is particularly true for pit alignments with associated branches of pits or ditches. In such cases one branch runs parallel to the slope, the other perpendicular to it. Further-more there exist systems of pit alignments and associated ditches which meet at right angles and form a rectangular pattern of fields. Here again a topographical reference is evident. In such cases the sizes of the fields are calculable and these differ from their Late Iron Age successors (0,25 ha) by their larger sizes of about 2,8 ha.
But what were the reasons for enclosing former open land in the LBA?
In the economic sphere the reasons might have been
1. a shortage of free available land, possibly due to population pressure;
2. the establishment of properties;
3. the delimitation of arable land and pastures.
In the political sphere the reasons would have been the establishment of boundaries between
1. settlement precincts

2. clans
3. tribes
4. ceremonial landscapes

Until now the purpose of pit alignments for enclosing land was debatable, lacking, as it does, an explanation for the upper layer of the pits being connected by a shallow ditch. One reason for an interrupted ditch might have been the wish to keep rain water in the pits where it could be available for cattle, sheep etc. The medium annual amount of rain water lies between 450 and 500 mm in the middle Elbe-Saale-region so water was not abundant on higher land above the rivers. With a predominance of cattle in LBA settlements cattle breeding has been of great economic importance. Therefore, the existence of pastures is a postulate. But pastures must be separated from arable land to prevent damage from seed and grain. Cattle hesitate to pass over ditches so these are appropriate boundaries for pastures and arable land. Pits must have been cleaned annually to prevent sedimentation. Thus, no residual sediments are observable by excavation. For construction and cleaning banks between the pits could have served as platforms. Loess is plastic and keeps the shapes of pits very well. Furthermore it holds water very well and prevents it from percolation. In this respect the restricted distribution of pit alignments to loess soils is striking.

This is only one possibility which could explain the construction of pit alignments. Besides it would not be impossible that the fertile earth which accumulated beside the ditches could have served for the plantation of bushes alongside the boundaries.But whatever the reasons for the preference of pit alignments or ditches as boundaries, ultimately there developed a structured landscape where former open land became enclosed and this must have been an integrated component of the LBA and EIA cultures in central Germany.

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25/09/09 **THE DEATH OF CROPMARKS?**

Cropmarks are in crisis! These magical, temporary variations in crop growth have always had a loose grip on any kind of reality, and now they seem to be fading away altogether. They are starting to seem old-fashioned. Technology seems to be superseding them, with new toys and techniques, both aerial and satellite, offering exciting new ways of seeing buried and denuded traces of the past with or without crops. Climate change in some parts of Europe - global warming - seems to be accompanied by global raining, making finding cropmarks more difficult as moisture levels rise. Ongoing development and ever-more invasive and deep-ploughing seems to be gradually eroding the sub-surface traces that make cropmarks. The traditional oblique reconnaissance method of finding and recording cropmarks is under threat in places, both financially and intellectually. Even the occasional excavation is, in essence, destroying the archaeology beneath our feet.

This session will send out a SOS for cropmarks. Can they find salvation in the form of the vast archives of air photos held across Europe? These photos contain millions of cropmarks in the form of negatives or digital images far longer than the real thing. Could research, synthesis, mapping, interpretation and archaeological engagement offer a life-support system? Perhaps government agencies and planning authorities will step in and stop society 'ripping up the past'? Will climatic change offer new opportunities, bringing dryer weather to cropmark-poor areas? Is the silver lining on the cloud of the collapse of the world's financial markets that development slows down and farmers buy smaller tractors? Contributors to the session should come prepared either to help the cropmarks, or write their obituary.

The death of cropmarks

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This paper will form the introduction to a session. The main theme of my paper will be that there seems to be something of a crisis in the discovery, recording, interpretation and treatment of cropmarks in Europe, notably in the British Isles. The paper will take the form of an obituary written in a few decades time, when in all likelihood cropmarks will be a phenomenon of the past, existing only in archival form and the memory of a generation of older archaeologists.

My paper will cover some of the main threats that cropmarks currently face. These include ongoing development and ever-more invasive deep-ploughing that seems to be gradually eroding the sub-surface traces that make cropmarks. Continual ploughing is literally eroding sub-surface archaeology on an annual basis. The impact of 'global warming' and climate change will also be considered; wetter warmer conditions as expected in the British Isles that will make the conditions that allow cropmarking to become rarer. Aside from the physical threats to cropmarks, there are also methodological and financial problems. The traditional oblique reconnaissance method of finding and recording cropmarks is under threat in places, both financially and intellectually. New techniques and technology – LiDAR, satellite imaging and so on – are increasingly being seen as cost-effective tools for flying over the landscape, but such techniques focus on upstanding remains (not features buried beneath short vegetation such as cereal crops). The impression is that cropmarks seem a little old-fashioned, and the methods used to record them anachronistic.

My paper will be a reminder to the aerial archaeological community that in a world of high resolution satellite imagery and expensive laser technology, there is still a role for the cropmark. This may play itself out in the form of new and more efficient reconnaissance, or research, synthesis, mapping, interpretation, excavation – essentially a wider and more reflexive archaeological engagement with the cropmark archive.

The effects of changing weather conditions – notes from a concerned surveyor

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In this paper we want to discuss the consequences of changing weather conditions for the executing of archaeological surveys in Belgium. In the last decade and especially from 2006 on, persistent temperature inversions during winter and early spring have considerably reduced the opportunities to execute aerial surveys and this year especially this depressing wind and smog conditions endured until May. Though, spring is a valuable season for archaeological surveys, particularly for detecting soilmarks in the loess area of Central Belgium. Moreover, unusual layers of fierce turbulences at low altitude have made prospection flights distressing and more difficult.

During the last decades, we have noticed that these long time weather conditions have produced extensive damage to the archaeological features in different landscapes. Frequent ferocious storms and extended periods

of rainfall have set off the horrendous erosion of many archaeological sites in vulnerable areas and major archaeological sites have been completely lost for further research already. Additionally, the inundation of lower areas and historic valuable valleys have caused considerable damage also and these quite extreme weather conditions have, for example, probably set off the collapse of a 14th century keep at Zichem near the river Demer in 2006.

However, more excessive weather conditions have lead to the emergence of more interesting features in certain areas of Belgium, depending on the specific terrain conditions. All the same, these changing weather conditions are to be considered as a threat for the long term preservation of our archaeological sites, especially in agricultural areas where soils are more susceptible to acute conditions and erosion processes emerge. The paper will give some examples of striking case-studies in our areas of activity.

Norfolk: Land of Cropmarks!

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The muted topography of the Norfolk landscape is mirrored by the relatively small size and insubstantial nature of its few surviving earthwork sites. The industrialised agriculture that dominates the county's environment (and that of much of East Anglia) has been unkind to Norfolk's archaeological remains in many respects, but it has at least furnished the landscape with a spectacular array of cropmark sites. This 'hidden' landscape, aspects of which may only be visible on a single photograph or in a single year, is for the first time receiving the attention it rightly deserves, as part of a detailed National Mapping Programme (NMP) survey. By utilising collections of both historic and recent, specialist and non-specialist aerial photography, this thorough and comprehensive survey is endeavouring to exploit to the fullest possible extent the wealth of archaeological information that they contain. As well as recording large numbers of previously unknown sites, the Norfolk NMP often adds valuable new information to sites that have already seen considerable amounts of investigation. Recently, such sites have included the internationally important complex of prehistoric ceremonial and funerary sites surrounding Arminghall Henge (Clarke 1935), parts of which were excavated in advance of the construction of Norwich Southern Bypass (Ashwin and Bates 2000), and also the Roman town of *Venta Icenorum* (Caistor St Edmund), currently the subject of a major research project (http://www.south-norfolk.gov.uk/leisure/1815.asp). Even on specialist oblique photography, which we might expect to have been subjected to years of scrutiny by aerial and non-aerial archaeologists alike, it has been possible to identify unrecorded features, and identify new facets of previously recorded, allegedly 'well-studied', sites.

After several decades of highly-productive work by Derek Edwards, in recent years Norfolk has found itself without a dedicated aerial photographer. Does this signal the death of Norfolk's cropmarks? Or can new, widely accessible resources — specifically Google Earth — sustain them, and even go where others have never gone before?

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Reflexivity; Different Perspectives; Multiple Realities and a Cat: Towards explicit theory

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This paper will consider approaches to reflexivity from the disciplines of psychology and sociology (Bourdieu and Wacquant 1992), and highlight certain criticisms of epistemological methodologies in sociology (Maton 2003). These approaches when considered with Foucault's (1972) concept of discourse demonstrate their importance within interpretive research frameworks which focus on the multi-vocality of interpretation (Hodder and Hutson 1986; Knapp 1996; Hodder 2001; Thomas 2000a). The interpretation of the cropmark record should be ongoing dynamic process. A simple typological classification may hinder alternative interpretations unless the archaeologist incorporates the methodologies of reflexivity and multi-vocality. The numerous routeways to an interpretive research framework requires the consideration of alternative perspectives to create archaeological understanding. An understanding of how different perspectives may be considered can be found in Heisenberg's (1930) *Principle of Uncertainty*, and Schrodinger's (1935) thought experiment to explain the concept of multiple realities. A case study from the SERF project excavations in August 2008 at Forteviot in Perthshire, Scotland will show how the typological classification of a cropmark created a false reality for the monument; the observation and recording by St. Joseph changed the nature of the cropmark.

The inherent biases in all aspects aerial photography and the cropmark record are well understood (Brophy 2005; Hanson 2005). The final section of the paper will consider if reflexive approaches make it possible to measure the immeasurable? A number of questions will be raised, including:

- is it possible through photograph regression to see the destruction of cropmarks?
- will the destruction of known cropmarks through farming practice reveal evidence of earlier occupations?
- how do we record a cropmark without changing the nature of it?

25/09/09 BEYOND AERIAL ARCHAEOLOGY – AERIAL PHOTOGRAPHY IN THE REAL WORLD

Too much? The value of aerial photographs taken for non-archaeological purposes

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English Heritage National Mapping Programme methodology has at its core the philosophy that one should look at all readily available aerial photographs for an area to be surveyed. For most projects the bulk of these photographs come from the English National Monuments Record. This growing archive of aerial photographs includes over 3 million vertical photographs, most taken for non-archaeological purposes, and 680,000 specialist oblique photographs, most taken of archaeological or architectural sites and landscapes. The AARG community are well aware of the tremendous value of aerial photographs taken for non-archaeological purposes and teams carrying out archaeological surveys using NMP methods regularly analyse tens of thousands of these photographs. What percentage of these photographs contain useful information and how do we define "useful"? This paper will use as a case study from the south east coast of England to discuss if, and how, we can maximise our use of "non-archaeological" photographs considering topography, known archaeology, date and scale of photography.

More than just pretty pictures – Art and Aerial photography

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In recent years there has been a multitude of books and exhibitions showing images of the world from above. These often aesthetically pleasing images reveal the potential of the aerial view for perceiving, reappraising and representing the landscape. The development of aerial photography has had an undeniably dramatic effect on the study of archaeological landscapes, but in this paper I would like to explore the less obvious influence of aerial

photography on the Arts. The tendency is for the aerial view to make familiar landscapes and structures appear unusual and abstract, and this has appealed to artists throughout the twentieth century and continues to do so in the present day. The appearance of sometimes ephemeral and transitory tonal patterns within crops and vegetation, revealing hidden dimensions of the landscape, has obvious and immediate appeal for visual and conceptual artists. The current pervasiveness of aerial photographs in books, exhibitions and on TV, and more significantly on the internet in the form of Google Earth and Virtual Earth, means that aerial images are more widely available as a source of interest and inspiration. Often aerial photographic images depicting archaeological sites and structures are used by artists in an indiscriminate and sometimes uninformed way, a trend which is often exacerbated by the fact that these images are frequently accompanied by only limited information in terms of archaeological interpretation, and do little to promote an understanding of the practice of archaeological aerial photography.

This paper will highlight examples of artworks where aerial photography has inspired artists, with particular reference to those artists that have engaged with aerial archaeology as a discipline, rather than simply referring to readily available sources of aerial photography, such as Google Earth. The paper will also briefly explore the potentials of teaching art and photography students about aerial photography as a way of encouraging these sorts of artworks. The paper will aim to encourage the establishment of cross-disciplinary art and archaeology projects and exhibitions that will hopefully reach a new audience beyond normal aerial photographic and archaeological circles. An attempt will be made to look at how these sorts of activities can feed back into the discipline and aid archaeological interpretation, and also how results are presented to the public.

INFORMAL EVENING SESSION

An aerial view of the Past - aerial archaeology in Denmark

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A short presentation of a four years project on aerial archaeology in Denmark with some provisional results. The project comprises different sub-projects. For example there will be basic recording of available series of vertical aerial photographs covering Denmark, together with recording of all types of ancient monuments in the eight chosen areas on a selection of these vertical images. Aerial surveys of these and other areas around national monuments, coastal waters and scheduled ancient monuments. There will be a focus on national and international collaboration and communication with, and education of, the general public.

Would you fly with René?

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A short film of René flying with a friend.

Low altitude aerial survey, orthophotos and satellite data in archaeological and ancient landscape research - a comparison of their potential (Czech case study)

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In Europe of the last 20 years - after the decline of communist regimes in central-eastern Europe - a lot of work has been done in low altitude aerial reconnaissance aimed at the identification and record of buried and ruined archaeological sites, monuments and features performed by archaeologists
from small aircrafts. Recently the possibilities offered by aerial high resolution geo-referenced vertical photographs (orthophotos) available easily on the internet as well as satellite images have been evaluated by archaeologists and ancient landscape historians. Currently a project on the comparison of the potential of both survey methods and data types (oblique photos and remotely sensed images) has been carried out in the Czech Republic by the University of West Bohemia. The paper brings the principal results of this comparative project and evaluates advantages and negative aspects of both methods and data sets.

Combining old and new – using orthophotographs in Scotland

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The 2009 survey of the remote and inaccessible Scottish island of North Rona required the RCAHMS survey team to find a method whereby archaeology visible on high quality b/w verticals could be mapped in detail prior to the survey. This would give the team a head start when landed and facilitate a more rapid survey, leaving time to do other detailed survey, prospection and noting. In the absence of any detailed mapping better than raster 10,000, a successful trial was done using recently acquired georeferenced OS orthophotographs which was used as a photomap, and sections of the verticals were then rectified using Aerial 5 to create an interpreted map, all prior to field survey. On the island the team quickly discovered dozens of other unseen and unidentified structures of importance, and were able to concentrate on mapping these more ephemeral features. They also collected GPS control on a good selection of identifiable archaeology and also natural landscape features to enable a more accurate transcription of the archaeology to be completed post-survey.

The use of digital surface and orthophotographs data to analyse results from the English Heritage National Mapping Programme

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Since 2008 English Heritage has been a member of the Pan Government Agreement (PGA), which gives government agencies in the United Kingdom access to high quality height, aerial photographic and map data. The new data is already proving to be very useful for the Research Department teams, including Aerial Survey.

During the Hadrian's Wall National Mapping Programme (NMP) project a number of linear ditches were noted to the north of the Roman fort at Carvoran. It was suggested that some of these might represent the remains of the aqueduct supplying water to the fort. Previous to the PGA data being available, it was not possible to do any further analysis because of the relative crudeness of the available height data. Fortunately, the fort and its hinterland just fell within an area of 2m Digital Surface Model (DSM) data coverage. The resolution and accuracy of this data is such that even small features such as hedges and buildings are modelled in the DSM. This data was imported into ArcGIS where a 3D model of the landscape was created. The NMP data and PGA orthophotographs were then draped over the model, enabling the features to be viewed in a 3D environment. Spot heights were taken along the course of the linear feature and contours produced along the length of the feature to assess the direction and steepness on incline. This analysis did not entirely rule out the interpretation of the feature as an aqueduct but did indicate the possibility that it may have instead related to a nearby quarry, acting as a trackway or path.

Uncovering ancient fishweirs on the Manche coastline: a multiscalar approach to fishing techniques from Bronze Age to Modern Period

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Discovered in 1970 and located in the northeastern area of the Mont-Saint-Michel bay, Saint-Jean-le-Thomas fishweirs (i.e. any sort of fence or barrier that blocks the passage of fish, but allows the flow of water) were the starting point, in 2002, of a detailed archaeological study including excavation, survey, photography and GIS. Since then many others fishweirs remains have been discovered in the bay and also all along the 350 km of the Manche coastline. In order to understand how those complex systems were built and used by people since early ages, archaeologists decided to gather and compare a large amount of different kind of information in one tool. GIS application was obviously the best solution as it allowed analyzing, sharing and displaying spatial data. Two working scales are now used to answer all kinds of questions about fishing practices:

- a narrow scale used during excavations based on DGPS survey to record visible features like wooden stakes, stone dikes, geomorphological sequences…Surveying and excavating data are compared in GIS application with orthophotos, kite photos and historical air photo coverage provided by the National Geographic Institute (IGN).
- a wide scale used to record fishweirs on the whole coastline and dealing with orthorectified aerial photography to detect fishing remains on the shore during low tides. Those data are displayed in GIS project via a WMS server. All visible features are drawn and historical information are added when sources allow it.

This methodology has been improved for seven years now and three fishweirs sites have been recorded and excavated. The broader extent of the inventory is though at the beginning. Most of the visible features have been detected on orthophotos and drawn on a GIS layer. Names of the fishweirs' owners, dating and interpretation will be added progressively with the help of different sources such as old inventory maps (17^{th} – 18^{th} centuries), archives from public and private collections but also radio-carbon and tree-ring dating made on cut wooden stakes.

Thus, the GIS project on the ancient fishweirs inventory has become a common tool in a multidisciplinary approach gathering archaeological, environmental, technical and chronological information on fishing techniques from Bronze Age to Modern Period on the Manche coastline.

Early Middle Ages and Middle Ages fishweirs in Champeaux (IGN coastline orthophotograph)

The role of aerial photography as part of a multi-disciplinary study of relict landscapes in County Roscommon, Ireland

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This paper will provide an overview of an ongoing research project and will reflect on the role of aerial survey as part of a broader suite of approaches that can be applied to understanding past settlement and landscape change in the west of Ireland. The Discovery Programme, which is Ireland's archaeological research institute is charged with addressing major gaps in our understanding of Ireland's past. One recent aspect of research has been to investigate settlement in Gaelic Ireland, namely, those parts of the island which remained in native control after the English conquest of 1169 AD. These areas, which fragmented into a patchwork of lordships, are poorly understood due to a lack of consistent administrative documentation and few diagnostic secular monuments prior to the fifteenth century. The study area located in County Roscommon was the ancestral territory of the Uí Chonchobhair, or O'Conors, who were kings of the western province of Connacht.

Roscommon is noted for its lush pasture lands and its traditional grazing economy has led to the preservation of earthworks relating to a remarkable range of relict fields, deserted settlements and prehistoric burial sites. Aerial survey has been central to recording and prospecting in this landscape and has been utilised at a variety of scales. Two phases of photography have been flown and processed in PCI Geomatica, covering 140 square km centred on Tulsk, County Roscommon. The resulting product includes high resolution Digital Elevation Models and orthorectified aerial images at a scale of 1:7,500. Subsequently, a low cost photogrammetric system involving a helikite, a digital camera and Topcon Imagemaster software was used to record excavated surfaces. The resulting archive of images covers the level of landscape, sites and their environs and right down to the level of excavation trenches. Relict features were mapped in GIS and correlated with historic maps and other sources to develop relative chronologies of settlement and land use.

The resulting data has led to the discovery and mapping of extensive medieval rural landscapes, sites and their environs. As might be expected, many of the relict features are actually elements of multi-period sites and landscapes. This multi-temporal dimension has been partly addressed by using an extensive collection of oblique images which often highlight features not evident on the vertical images. In some cases, it has been possible to rectify them, using features evident on the orthoimages as a control network. Follow-on micro-studies, selected on the basis of the aerial images, have utilised a combination of geophysical and geochemical surveys, topographic surveys and test excavations. These methodologies have led to a more comprehensive record of the selected sites and this more holistic approach has facilitated an assessment of the qualities and limitations of the aerial survey.

26/09/09 BEYOND-VISIBLE ARCHAEOLOGICAL RECONNAISSANCE

Why? Some observations on the limitations of conventional reconnaissance

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This brief paper will outline some of the challenges to archaeological reconnaissance in areas that are not responsive to traditional techniques such as survey for cropmarks or recording of earthworks.

Analysing the information content of airborne remotely sensed data for archaeological prospection: two pilot areas in Wiltshire, UK

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The use of aerial photographs for identifying archaeological sites has been practised for more than a century in Britain. In more recent times airborne digital remote sensing techniques (including LiDAR) have become available to historic environment professionals. The use of LiDAR elevation data to identify sites of archaeological interest within the landscape is now well attested. The number of applications in the commercial sector within the UK has grown substantially in the last five years with the increased availability of Environment Agency data. Recent studies using LiDAR data can be added to the more established work on multispectral data both in the UK and elsewhere. Familiarity with the remotely sensed datasets available and processing techniques has progressed our

ability to identify possible sites of archaeological interest within LiDAR and multispectral data. But what additional information can airborne remotely sensed data offer us about the sites themselves?

The possibility of extracting further archaeological information content from digital remotely sensed datasets is in its infancy in the UK. Early studies of lidar intensity in combination with elevation data have illustrated their potential, but have also highlighted caveats to their use. Furthermore, while the commercial sector has driven the majority of research undertaken to date in this field in the UK, applications for academic research have been limited. Rarely have multiple airborne remotely sensed datasets been used in combination for a single site.

This research proposes that through systematic, tailored processing and analysis of LiDAR elevation and intensity data in combination with multispectral imaging, it will be possible to improve archaeological feature recognition rates compared with current 'standard' methods. In addition, it is hypothesised that by analysing the full content of the combined datasets, and comparing them to ground-based geophysical data for the same area, it will be possible to make clearer inferences both about the features represented and the broader landscape transformation processes affecting them.

Data will initially be analysed for a number of pilot locations in the Salisbury Plain and Avebury areas of Wiltshire, England. This talk will present the progress in the first year of this research, outlining the methodological approach taken and the preliminary results from the pilot studies.

'*Detection of Archaeological residues using Remote sensing Techniques'* a roadmap for archaeological remote sensing in the 21st century?

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At the time of writing this abstract I am preparing a grant application for the first round of the joint AHRC and EPSRC funded Science and Heritage call. The project is entitled '*Detection of Archaeological residues using Remote sensing Techniques (DART)'.* This presentation will provide an overview of this project.

Recent advances in sensor technology have led to various ground, air and spaceborne imaging instruments that can be applied to heritage. Archaeological remote sensing techniques rely on the ability of a sensor to detect the contrast between an archaeological residue (AR) and its immediate surroundings (or matrix). AR detection is influenced by factors including changes in precipitation, temperature, crop stress, soil type and structure and land management techniques. These factors vary both seasonally and diurnally, meaning that the ability to detect an AR with a specific sensor changes over time. However, the development of detection techniques has evolved independently over time with variable understanding of the physical, chemical, biological and environmental processes that determine whether ARs will be identified in one or any sensor. Consequently detection strategies are poor and biased to 'effective' environmental zones based solely on experience. This has a significant impact on heritage management and development control.

By analysing the physical and environmental factors that influence AR contrast dynamics DART will improve understanding of archaeological visibility. This knowledge will enhance the ability to prospect for features at the site and landscape level. Without understanding the processes that affect the detection of ARs (directly and by proxy), prospection techniques will remain inductive and opportunistic. This is important in environments unresponsive to traditional oblique aerial photography (e.g. those areas dominated by clay soils) and whose significance has only recently been recognised (e.g. the complex landscape revealed by the 1996 Bedfordshire aerial survey).

The project involves 3 stages:
1) Identifying appropriate candidate sites and sampling methodology
2) Field measurements and collecting and analysing field samples from sites under different conditions
3) Physical modelling, feedback, knowledge articulation and evaluation

Gathering relevant data is challenging owing to the complex and varying environmental conditions and AR types. Sites will be chosen on the basis of contrasting ARs, soil and land management conditions etc. Close liason with curatorial agencies (with excavation data) is necessary to ensure a representative range of AR types is identified. To determine contrast factors numerous samples and measurements will be taken on and around the AR at different times of the day and year. Data will be collected throughout the year to ensure that a representative range of seasonal conditions is covered. Field measurements will include electrical resistance, magnetic susceptibility, thermal profiling, soil moisture content and spectral reflectance. The samples will be analysed for variations in geochemistry and particle size. Models will be developed that translate these physical values into spectral, magnetic, electrical and acoustic measures in order to determine contrast parameters.

Understanding how ARs express contrast allows:
1) The identification of suitable sensors

2) Researchers to access data archives more effectively
3) Feedback to improve sensor design
4) Data fusion techniques (physical models, multi-sensor data and domain knowledge) to improve identification
5) Better management and curation

These will improve decisions through a better understanding of what exists, its value and condition. Knowledge led prospection will facilitate large landscape survey and has worldwide application.

The proposed project team is, by necessity, interdisciplinary and is made up of academic and industry professionals from the heritage, remote sensing, knowledge representation and soil science areas.

(Hopefully) Time will be allocated to discuss the merits and implications of this project for AARG and the archaeological remote sensing community in general.

Resolving the Past, reflections and resolutions: West Heslerton re-visited

Dominic Powlesland

26/09/09 **NEW PROJECTS AND LANDSCAPES**

Where have the mounds gone? Photogrammetric restitution of severely altered areas using flights from 1950s – its application in a survey project.

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The integration of aerial photographs in GIS platforms has become during the last decade in one of the most successful tools for landscape analysis. The availability of ortophotos has exponentially increased, providing a valuable tool for archaeological surveying purposes. Nevertheless, the most part of these “ready-to-go” ortophotos have been taken in recent times, and in most of the cases, they don’t supply enough historical perspective to know how diverse elements of landscape have change and have influenced the recognition of archaeological features. Historical photographs have been essential in landscape archaeology for a long time ago, although its integration on GIS platforms has not been as easy as desirable. With the arrival of spatial technologies, digital photogrammetric restitution has facilitated the integration of these flights with less efforts and costs, making possible to analyse historical flights as if they were actual data.

In this paper we discuss how we have incorporated this technique in a survey project focused on analysing the prehistoric landscape of Alconetar, located at one of the fords of Tagus River watershed, west-centre Spain. This is just one of the most transformed territories of Iberian Peninsula, since the building of several damns had flooded large areas of territory as well in Spain as in Portugal. Thus, the area where we are currently working was flooded in 1969, developing then a minimal policy of heritage documentation and rescue. Fortunately, there is enough historical information (photos, manuscripts, drawing sketches, etc.) previous to 1969 that provides rich information about the prehistoric mounds dispersed over the present flooded area.

The most remarkable handicap to locate spatially all this information is that the topographical maps published before that data have not enough detail, so in order to guarantee the success of the project it was necessary to get cartographical products using photogrammetric techniques. To achieve this goal we used the flight made by the USAF during May and April of 1956, whose photogrammes have an optimal balance between scale and accuracy conditions. Nevertheless, during the process several issues were presented. Perhaps, the most important of them was how to get control ground points on field and get them identified on the photogrammes, since most of the buildings represented on the photogrammes are now covered by the reservoir or ruined. Finally, we have obtained two products that will be used in different stages of the project. The first one is a digital elevation model (DEM), which has been useful to a) recover the original topography of the area, b) to analyse some locational aspects of mounds and habitats, and c) to extract some archaeological entities as features. The second one is an orthophoto that has been the support for a) archaeological features recognition and b) survey planning of regularly non-flooded areas.

Both products have been satisfactorily included in a GIS project. Along this paper we will discuss some technical issues on how to restitute these old photogrammes, taking into account that they were taken to be restituted analogically and some useful information was not provided. We will focus on what is the adequate final resolution

of both products and their possibilities in the project. Finally, we will show some partial results and how archaeological data obtained from survey and other geographical features has been integrated over this virtually recovered territorial base.

Reconstructing Iron Age agrarian landscapes in Denmark

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As early as 1882, systems of squared parcels separated by low, broad banks and lynchets, found on marginal heath land in Jutland, were interpreted as prehistoric field systems. In the years between 1927 and 1939, one hundred and twenty of these field systems were visited, recorded and some of them mapped by Gudmund Hatt, a Danish cultural geographer. Similar systems were, during the 1950s, 1960s and 1970s, found in woodlands in different parts of the country, adding approximately 180 to the previously known. Although Hatt knew that Curwen had mapped similar field systems from aerial photographs in England in the 1920s, this method was not put into use in Denmark until the 1970s. Since then, different scholars, mostly non-archaeologists have been able to more than double the number of sites, and enlarging the size of known sites considerably, on the basis of different series of vertical aerial photographs. Sadly enough this data has seldom been put into use. When combining the different verticals series with digitized historical maps, pollen analysis and excavation data from the last 30 years, interesting insights can be gained in the reconstruction of the Iron age landscape, land use and settlement structure.

This paper will present the mapping of Celtic Fields in three micro regions in the northern part of Jutland, which should demonstrate the potential of combining different data sources in landscape studies.

Aerial archaeology and settlement development in an Iron Age and Romano-British lowland landscape

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The aim of this paper is to illustrate the effectiveness of combining aerial archaeology, much undertaken by the presenter, with other techniques in order to develop a “narrative” of landscape development in the Iron Age and Romano-British periods. The case study presented here features the Foulness Valley, East Yorkshire, UK where it has been possible to demonstrate a close association between topographical factors such as drainage, soils and relief and settlement patterns represented by crop marks, supported by geophysical survey and field walking. Three contrasting landscape “zones” were identified within a 30x20km block encompassing the whole catchment of the River Foulness and clear differences in crop mark morphology could be determined between the three zones which provide clues as to differential land use during these eras.
The results of the survey have been published recently:-
P. Halkon (2008) “*Archaeology and Environment in a Changing East Yorkshire Landscape. The Foulness Valley c. 800 BC to c. AD 400*” Archaeopress Oxford (BAR 472 2008 ISBN 978 1 4073 0364 2)
www.ironmasters.hull.ac.uk

Recent work on the centuriation around a Pannonian colonia

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The Colonia Claudia Savaria (CCS) in today’s West-Hungary was a Roman colony founded in the Claudian era. However this colony is one of the most significant Roman settlement of Pannonia, the research has some debt yet about the reconstruction of ancient landscape in this territory. The Roman “centuriatio”-grid around Savaria/Szombathely was not very well researched. Since the publications from the 60’ and 70’ there was no ambition to draw by ancient land surveyors divided territory. This problem would be in turn a significant question, because we do not know yet sure for example, whether the ancient street orientation of the city was deduced from the land division, or was aligned to main roads? In the last decade several Roman roads were excavated around Savaria, which could be assembled in a “big jigsaw puzzle” together in one system. This reconstruction is based on excavation’s data, orthorectified archive and recent vertical aerial photographs and sattelite images (like GoogleEarth and and on the GIS based research, in which the main goal was to point out some connections between the orientations of the ancient roads, and also with the orientation of the today’s road system.

Exploration of Lothingland with Google Earth - some questions

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Lothingland is an ‘island’ in the Broads wetland (UK). A continuing study considers the possibility that it is covered by a Roman centuriated survey, postulated more than 20 years ago in a nearby district. Calculated UK OS coordinates of the centuriation grid intersection points have been converted to WGS84 latitudes and longditudes, by means of an interactive web page. Using these data, Google Earth paths display the grid, easing perception of traces that may be related to it. The reverse conversion has been done to establish the OS coordinates of medieval churches (and church ruins) in order to permit a statistical test of their association with the centuriation grid. Irwin Scollar's software, recently described in AARG News, was not used. Given that the hypothetical grid is defined to a precision of only 10m, is the approach that I have taken almost as good?

Discussion of the significance of features with the orientation of the centuriation raises a further question. The widespread regularity of the mapped landscape is attributed by a Landscape Character Assessment project to enclosure in the early 19th century. Its orientation, similar to that of the centuriation, is thought by some to derive from the eastern (sea) coast. Unmapped image features with this orientation are accordingly described as recent, in most cases. A different approach has been adopted in other parts of the Roman Empire, such as Italy and the Narbonensis. There, uniform orientation of mapped features over a large area is taken to be potentially indicative of regular Roman land planning. Corresponding unmapped features in imagery may be presented as evidence for this, and not always given a recent date. Why is this approach so different from that taken in Britain?

Southern Romania Danube Plain: What we saw from the sky

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During the past three years we started an aerial investigation of the archaeology along the river valleys crossing the Danube Plain in Southern Romania, with the purpose to identify known and unknown sites and the changes in the landscape. Our objectives were to enrich the National Archaeological Record Database for an area less studied and seriously menaced by agricultural works and river exploitation; to compile archaeological maps; and to disseminate archaeological information for a wider audience through our website. With the support of the European Project European Landscape – Past, Present and Future (2004 - 2007) we experienced our first flights on the Mostistea River Valley, south-east of Bucharest, an area with human traces form prehistory to mediaeval times. In 2008 we extended our area of investigation to the west, including Neajlov and Lower Arges valleys. That allowed us to compare the changes of the river courses from antiquity to present and the different landscape in areas so close one to another.

The study of old vertical aerial photos (1872, 1986) and of recent orthophotoplans (2003, scale 1:5000) added new information for the evolution of the landscape in time. The interpretation of the hundreds of digital images we took was not always relevant. Some of the aerial photos were spectacular illustrations of the already known archaeological sites seen from above. Others showed interesting features which might be archaeological in part. We made mistakes and had to learn from them. The balance between taking aerial photos and confronting them with field survey proved to be necessary. After three years, the archaeological map of this part of Southern Romanian is not only richer but much more precise.

26/09/09 CONFLICT AND MILITARY ARCHAEOLOGY

This session examines the varying ways in which air photos and remote sensing are being used to study the material remains from 20th century conflicts. The systematic survey of battlefields undertaken during the First World War and the worldwide reconnaissance images of the following conflict have left a rich resource that can be used by archaeologists and historians for both ‘micro’ and landscape wide studies. The development of high resolution satellite imagery, and techniques of geophysical survey allows for a detailed analysis and comparison of ‘past and present’ in order assess extent and character of the surviving remnants of conflict.

The confrontation of aerial photographs with geophysical research to study the conflict landscape of the Great War: the example of Comines-Warneton (Belgium)

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Millions of aerial photographs of the frontline were taken during the Great War of 1914-18. Aerial photographic evidence shows how extensive these trench systems were but little survives to mark their existence today. Most

of the fields where the action took place have now returned to their pre-war ploughed fields. By using archaeological geophysical techniques in combination with the extensive aerial photographic coverage of the frontline, it has been possible to map accurately the location of these trench systems as well as record the remains of No Man's Land, previously unrecorded by such scientific investigation. With the application of modern digital mapping technology, the conflict landscape can be studied in detail. This paper will focus on a case study researching the former Allied-German frontline near Comines-Warneton (Belgium)

The El Alamein Project. A project for the study of the El Alamein Battlefield through remote sensing and GIS (Egypt, 1942)

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The El Alamein Project is aimed at the documentation of the El Alamein battlefield area by the creation of a geographical database collecting historic, geographic, geological and remote sensed data. The emplacements, trenches, digs and artifacts from WWII were recently discovered through Quickbird observation and correlated with the original Italian reconnaissance taken befor the Alam Halfa Battle.
The desert stretches between El Alamein and the El Qattara Depression, even being today a restricted access military area, have been affected in recent years by an ever increasing tourist presence, due to international resorts development of the El Alamein coastal areas. At the same time, oil prospecting activities have resulted in the spreading of new tracks, trenches and artefacts which have concerned, and in part modified, the most peculiar sites of the El Alamein battlefield (Ruweisat, Mitteriya, Deir El Munassib, Naqb Rala, Haret el Himeimat, Menaquir El Daba), together with the El Alamein built-up area and almost all of the sites along the coast and close to the littoral.As a consequence, there is urgent the need to survey and document these areas before that transformation imposed over the territory shall result in the disappearing of such remarkable historical war remains.

In 1942, between the end of June and the beginning of November, a series of battles and war actions took place in the Egyptian Desert (namely, Western Desert), near the location known as El Alamein. The third, and final, El Alamein battle began at 20.40 on October 23rd when the awaited British offensive started. After 12 days of hard fighting Montgomery's VIII Army broke into Rommel's defences, and the Axis troops began a long and difficult retreat which finally ended-up in Tunisia, in May 1943. During the battle, which lasted until November 4th, and the next few days, about 30,000 Italian and German prisoners were captured, while, as a whole, the Axis had 9,000 men killed or missed and 15,000 wounded. On the British side, Montgomery's VIII Army losses accounted for 13,560 killed, missed, or wounded men.

The project has been implemented setting up a Geographic Information System (GIS) and a cartographic base, as derived from high-precision satellite images. All the available cartographic documentation has been loaded as a background reference. Next, original aerial photographs, as taken from reconnaissance military aircrafts, were over-imposed, allowing comparison of defensive artefacts and man-made positions - recognisable at the time of the El Alamein battle - with today preserved emplacements, still visible on remotely-taken images. Maps and pictures were procured from military museums and documentation centres. Several accurate onsite survey have been performed, with the aim of creating a photographic data bank, which will be integrated by geodetic Gps topographical plotting, by geomorphologic and geologic information, by studies on sedimentation processes, and by prospecting activities which shall help in locating possible artefacts and burial sites. A close collaboration with the National Institute for Oceanography and Geophysics (Trieste's Experimental Geophysics Observatory) will allow for the on-field use of the most advanced geophysics instruments (terrestrial geo-radar and magnetometers) with which to explore ground surface horizons and reveal aeolic fillings of defensive positions.

The Project El Alamein shall allow for the identification of all positions, tracks, digs, trenches and artefacts existing on the battle front. Direct sites inspection suggested by the analysis of aerial photographs and satellite images, and geo-physical researches, shall enable to uncover buried artefacts and military works, and to recover some of countless human remains which are still disseminated under the desert soil. The El Alamein GIS will provide a paramount support for any future planning of the Western Desert cultural and tourist exploitation.

US7GR LOC 349 3041: one Saturday afternoon on the Home Front

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A single frame from a short run of photographs taken by the US Army Air Force on 27 May 1944, centred on Moreton in Marsh, Gloucestershire, evokes scores of stories, ranging from the personal to the international.

At first glance, the photograph provides a plan view of the town as it had existed for generations – orderly, compact, surrounded by fields, linked to the outside world by road and rail. A closer look begins to reveal the extent to which larger events in that outside world have transformed ordinary daily life. There are roadblocks near the railway station and an Emergency Water Supply tank in the High Street; many domestic gardens have been given over to the "Dig for Victory" campaign. Study the photo a bit longer and startling, even shocking, evidence of a military presence can be found on every street corner. This one image encapsulates the impact of the European military conflict on civilian life in an English market town and shows how aerial photographs can open a window on both individual human experience and much broader social and political history.

Archaeology at War: a bottom-up perspective

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The Department of Archaeology – University of Padua and C.I.S.A.S (International Centre for Surface Archaeology Studies) have been involved in warscape analysis since 1994, as a key instance of the wider issue of "Fossil Landscapes" detection, simulation and modelling. A number of North Italian "landscapes of war" (seen as "decision surfaces" from both past and present social actors) have been investigated through Remote Sensing and Air-Photo-Interpretation to GIS, Object/Pattern/Scenery Recognition, Virtual, Enhanced and Mixed Reality, Field-Survey, Geoprospection, Excavation, Forensics, Public Archaeology.

Furthermore, in what we have called an "Archaeology through the War" analytical scenario, we have developed a specific, heuristic approach aimed at extracting from the huge archive of First and Second World War air-photography (the "noisy" component being this time the war "signature" itself) the proper "Archaeological" target "information" (as well as ethno-archaeological and palaeo-environmental), such as the extraordinary network of the Late Bronze Age "metallurgical landscape" (roasting and smelting) of the Veneto-Trentino plateaux. Among the many challenges open to our horizon of expectation is the optimal combined use, through a number of A.I. approaches, of the virtually "de-forested" Lidarcapes (recently acquired) and the really de-forested Ist WW warscape imagery.

POSTER PRESENTATIONS

Applicability of LiDAR in determining spatial relationships between fluted projectile point occurrences and non-lacustrine landforms, Southern Alberta, Canada

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The province of Alberta, Canada was the site of an ice-free corridor during Late Pleistocene glaciation and the debate over its role as a possible human migration route remains hotly contested. The dominant material culture of the province's Early Palaeoindian inhabitants is a surface scatter of 183 fluted projectile points, approximately three-quarters of which have been found in non-lacustrine contexts. The archaeological utility of LiDAR in resolving the depositional contexts of these points is examined in a case study from Southern Alberta. Bare-earth DEM's are used to provide detailed microtopography and enable viewshed analysis. The ability to quantify visibility has led to the generation of suggested refinements for some ambiguous fluted point find locations and offers suggested locations to focus future study. This methodology acts as a starting point in determining the applicability of LiDAR in resolving the spatial relationships between fluted point occurrences and non-lacustrine landforms. A full evaluation of the potential of the methodology will require corroboration through field work and may lead to the discovery of new point occurrences to add to our knowledge base of the human environment of the Southern Alberta ice-free corridor.

Processing of LiDAR and aerial photographic surveys

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LiDAR – The Potential and Utilization by studying Central-European Landscape

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The presentation will be conceived as a contribution into discussion, concerned the application of laser scanning as a part of remote sensing in archeology. The potential of LIDAR will be tested in the process detection, documentation and verification of anthropogenic relicts (earthworks) in the landscape, the degree of effectiveness by dates plotting and their resulting interpretation. This method will be introduced into the context of Central-European district – in a model area of the National Park Bohemian-Saxon Switzerland in the Czech Republic.

Releves Laser et Archeologie Tropicale en Guyane Francaise

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La méthode de relevé laser élaborée par la société française ALTOA (agence laser topographique aéroporté) a été appliquée pour la première fois dans le cadre d'une de nos campagnes de fouilles archéologiques en Guyane, au cours de l'année 2000.
En cette année conclusive d'une longue mission archéologique sur les plantations jésuites installées au cœur de la forêt de Guyane (XVIIe-XVIIIe siècles), nous avions comme objectif la réalisation d'un relevé topographique le plus précis possible, comprenant à la fois les sites et leurs aménagements fluviaux. Le laser aéroporté nous a permis d'acquérir et de traiter rapidement des grandes étendues, et d'obtenir des données altimétriques et planimétriques précises même sous un couvert forestier très dense.

Au cours de nos recherches, les cartes IGN s'étaient en effet montrées peu fiables pour cette région de la planète, tandis que la cartographie d'époque s'est révélée remarquable pour sa précision et pour la profusion de détails de première importance. De la cartographie pédestre des ingénieurs-géographes du roi de France -en passant par le relevé aéroporté traditionnel de l'Institut Géographique National- au laser aéroporté qui traverse la canopée, on est confrontés à autant de façons différentes d'appréhender l'espace, de le mesurer et de le reproduire.

On the detection of adobe buried archaeological structures using multiscale remote sensing techniques: El Templo Naranja in Cahuachi (Peru)

N. Masini, E. Rizzo, R. Lasaponara & G. Orefici

Orthophotomap potential of the earth remote sensing in the Czech Republic

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3D modeling for archeological data archiving in a conflict area: an example

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After a decade of wars in the SW Balkan area, the archaeological heritage, and specifically Orthodox monasteries and churches in Kosovo region, are heavily endangered. So, we need collect, before it is too late, as much information and data as we can, in order to pass to future and more peaceful generations, real possibilities for evaluation, reconstructions and valorization of a great age of local civilization. A GIS system has been developed to help in this task, notwithstanding present unfavorable situation, ethnical and social above all. In this presentation, the work is at the early stage: as will be obvious, 3D topology analysis and management is a powerful but complex tool; however, we have chosen the cardinality of groups of symmetry to make comparatively (when compared to combinatory techniques) easier our task. A case study shows an example of heavy damage, the church of Mušutište.

Surface models from every air-photo in minutes

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A picture is worth a thousand words… but a 3D model is even better! Actually the way to have a surface in three dimensions with the photo draped on it, can be quite time consuming and in many cases the result is not worth the trouble. Digitize the curves of a map and/or rectify on the model the airphoto means not only time consumption, but also the acceptance of some levels of approximation related to the different resolution of the combined elements: i.e., a 1:5.000 map with curves every 4 m (and the 3D model built from this) with a geo-referenced photo with a ground resolution of 10 cm per pixel. The same applies if one combines a LiDAR scan with the still photos of a normal air-photo-survey.

The proposed method is extracting photogrammetric 3D information from a single source and, in a way, inverting the process of LiDAR, to obtain a surface measurable model with a draped photo on it with totally automated or semi-automated systems. The first just consists in sending a selected sequence of air-photos (3 up to 40 photos from the same sorties) to a server with an automated procedure. The second is to use commercial software, normally used for “accurate measurement and 3D models in engineering, architecture, film, forensics”: the challenge is to use it also for DTM from greater distances. Advantages and disadvantages of the two different methods will be presented, and practical examples will demonstrate the great potential of such a tool in PI.

Aerial archaeology in Belgium – continuity and new opportunities

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In Belgium, aerial photographs were first used for archaeological goals by professor Joseph Mertens who, in the sixties of the 20th century, deduced the road network and the allotment and field systems of the Romans by the vertical photographs taken by the Ministry of Defence and the Department of Land Management. Key discoveries were also made by the industrialist and free time archaeologist Charles Léva who carried out numerous aerial surveys in the open landscapes of central Belgium, mainly focusing on Roman remains, such as roads, villa estates and tumuli. When he passed away in 2001, his valuable archives were acquired by the Department of Archaeology of the Walloon Region, mainly because the largest part of his pictures were taken in this region. In the 1980s, pilot and amateur archaeologist Jacky Semey discovered a large number of prehistoric sites, primarily ring ditched burial tombs, in the western parts of Flanders. Later on, he was assisted by Prof. Jean Bourgeois and by Marc Meganck of the University of Ghent. Through his work on the archives of both the University of Ghent and the collection of Charles Léva, Marc Meganck became the Belgian specialist in interpreting aerial photographs. He sadly died in 2007, only 42 years old. Nevertheless, the team of the University of Ghent remained operational and now focuses on new developments in aerial archaeology, like LIDAR, and on specific niches, like battle field archaeology in Flanders Fields.

After many decades of field surveys in the loess region of Central Belgium, the University of Leuven started conducting aerial surveys of eastern Flanders in 1997. Attention was first concentrated to the less prospected area of the Kempen, the sandy region at the north of the provinces of Antwerp and Limburg, but the compartmented landscape did not exhibit many archaeological features. Therefore, the project turned to the loess region of the Hesbaye and its neighbouring areas, such as the Hageland and the Meuse valley. Since the linguistic border between Flanders and Wallonia is not perceptible from the air and since the landscape and archaeological features on both sites are very alike, some Walloon colleagues were contacted, who immediately expressed their interest in organizing aerial surveys in teamwork. As a federal state, the authority on cultural matters in Belgium, including archaeology, belongs to the 3 regions (Flanders, Wallonia and Brussels Capital Region) and to the German Community at the border with Germany. This, however, does not prevent services and organisations from working effectively together for the same goals.

Flights are organized all year round with a four-seat, single-engine, high-wing Cessna 172 Superhawk, with two pilots for safety reasons. All pictures are taken in high resolution with a digital camera. Archaeological features on the photos can easily be located due to the link between the GPS on board the aircraft and digitalised maps. At the start of the partnership between the University of Leuven and the Department of Archaeology of the Walloon Region, we primarily carried out survey flights over the loess area of Central Belgium. However, we swiftly turned to the less familiar landscapes of the Condroz and the Ardennes, where more and pristine discoveries were expected. Despite less favourable weather conditions, we spotted new archaeological sites. This paper presents some of the most outstanding discoveries and a selection of views showing the variety of landscapes of the Walloon region. We hope that this recent evolution will lead to new opportunities for aerial archaeology in Belgium.

Aerial archaeology in Mecklenburg-West Pomerania

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Aerial survey in Mecklenburg-West Pomerania was begun only in the early 1990s and has been pursued intensively by Otto Braasch flying on behalf of the Department for Archaeology of the State Authority for Culture and Preservation of Monuments. Nearly 2300 sites have been discovered through aerial reconnaissance, around 350 of them in coastal waters of the Baltic.

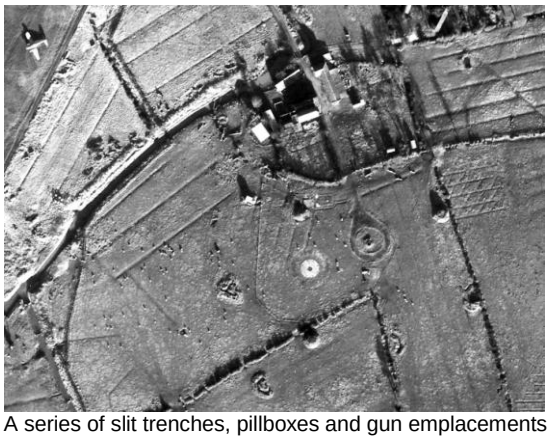
In the past few years, aspects of aerial archaeology at the coast have been looked at through our work in the Culture 2000 project ‘European Landscapes: past, present and future’. This poster gives an impression and overview of regions and regional characteristics of the ‘aerial archaeological landscapes’ in Mecklenburg-West Pomerania, especially inland, but not neglecting coastal regions, and of site types. Some thoughts about our archive will be added.

North-east Scotland cropmark survey
Moira Grieg

The Mendip Hills aerial survey, UK
Russell Priest

The aerial survey of the Mendip Hills Area of Outstanding Natural Beauty (AONB) has been completed as part of a multi-disciplinary study by English Heritage. The Mendip Hills are a limestone upland in Somerset, south-west England. The project will combine documentary research, architectural survey, earthwork survey and aerial survey in order to enhance the archaeological record and contribute to the management of the area. Two interim reports on the aerial survey have been published, and a monograph of the full results will be published in 2010. More information about the project is available at http://www.english-heritage.org.uk/server/show/nav.10577. The aerial survey involved examining several thousand historical and recent aerial photographs, as well as LiDAR which was commissioned for the project. The aerial survey covered an area of 300km² and has added 405 new records, with 465 existing records being amended. Mendip's complex geology has been exploited for minerals since at least the Roman period, and the aerial survey has mapped and recorded tens of thousands of individual extractive pits. Mapping these from the air allowed complex remains to be analysed on a landscape scale; the form, pattern and distribution reflected different phases of extraction. Most archaeological periods are represented in the aerial survey. The Priddy Circles are a series of four Neolithic monuments. A new section of one of these circles was recorded from LiDAR. The LiDAR also revealed that many sites, particularly field systems, which were previously thought to be levelled, survive as earthworks. Medieval and post-medieval field systems were some of the most common earthworks recorded, and give indications about the distributions of pastoral and agrarian landscapes. Historical aerial photographs from the 1940s and 1950s show many sites which have since been destroyed by agricultural processes or development, particularly military sites dating to the Second World War. The landscape scale of the survey has proved useful in understanding the results, and relating them to patterns of change in the use of the landscape over time.

Dolebury Iron Age hill fort and a group of medieval rabbit warrens
NMR ST 4559/1 NMR SF 1462/103 07-MAR-1979 © English Heritage (NMR)



A series of slit trenches, pillboxes and gun emplacements surrounding a barrage balloon site at the edge of an airfield. NMR RAF/3G/TUD/UK/21 5142 13-JAN-1946 © English Heritage (NMR) RAF Photography

The South Cotswolds NMP
Jo Janik

Mapping of the South Cotswolds, Gloucestershire, so far has revealed an interesting wealth of archaeological monuments and features which date from the prehistoric periods to the Second World War. Numerous ring ditches are visible as cropmarks on the aerial photographs and are interpreted as the levelled remains of probable Bronze Age round barrows. Although no settlements have yet been identified dating to this period the presence of the numerous funerary sites and field systems which may be contemporary is indicative of a Bronze Age population. The region continued to be settled during the Iron Age, suggested by the variety of 'banjo' enclosures, rectilinear enclosures, hill forts and unenclosed settlements. More recently the Cotswolds was home to a large number of Second World War military camps, airfields and hospitals. Many of were located within large scale parks and gardens which were requisitioned during the war.

Cirencester Park showing the 188th and 192nd General Hospitals which were largely used by Allied personnel and Axis POWs after the D Day (NMR RAF/CPE/UK/2098 4461 28-MAY-47 © English Heritage RAF(NMR) Photography)

Eastleach Neolithic causwayed enclosure with a later prehistoric or Roman settlement abutting it.
(NMR SP 2104/16 NMR 4611/29 02-JUN-1990 © Crown copyright. NMR)

DECARS: the Dutch Expertise Centre for Archaeological Remote Sensing

Karen Jeneson

From J. Bradford to Google Earth: military airports in Capitanata - from basis to traces for aerial Archaeology

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J. Bradford, an archaeologist, enlisted with the RAF as a photo-interpreter, made his discoveries working from one of the various airports in the province of Foggia, Italy. The area of Capitanata was chosen as the air base for the operations of the Allies against Hitler's German Regime. For some time this air base had been a protagonist in aviation history, thanks to its strategic position in a very important area, lying on a wide plain, with little urbanization and arboreal vegetation, and, above all, with a climate ideal for flying operations. About 30 airports in the province of Foggia took an active part in the Second World War and their strategic importance for controlling the Balkan and Mediterranean area gave them a central and determining role in the Allies' victory.

At the end of the Second World War all airports were dismantled, their structures were partly reused and all pieces of land, previously occupied by those airports, were used again for their former agricultural purpose. These airports had been considered as the starting point for archaeological aerial research and, as time passed, they have become part of that 'landscape of traces', representing another dowel of the buried land of Capitanata.

How we see our sites

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The aerial view is not a new concept in people's perception of landscape and the built heritage. Examples survive from Hellenistic times of modified versions of the bird's eye view, and most maps up until the eighteenth century used a combination of vertical and oblique views. Changes in the eighteenth and nineteenth centuries in the way in which people viewed and conceptualised the landscape around them can be attributed to cultural changes and technical developments. At different periods people use their 'point of view' to shape the world around them and construct their own narratives. In a world where Google Earth is more available than nationally produced maps, will the way in which archaeologists conceive their sites change, or will the aerial view continue primarily as a means for presentation, rather than a means of exploring the landscape of which the site forms a part?