Computer Applications and
Quantitative Methods in Archaeology

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CAA 2013 PERTH

ACROSS SPACE AND TIME

CALL FOR PAPERS AND POSTERS

PROPOSED SESSIONS AND WORKSHOPS

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SESSIONS

The accepted sessions have been grouped for consultation ease into seven main themes, including:

- Field and laboratory data recording
- Data management, analysis and the semantic web
- 3D modelling, visualisation and simulations
- Spatio-temporal modelling and GIS
- Remote sensing (long and short range)
- Users and interfaces: multimedia, museums and education
- Cultural heritage management.

Field and laboratory data recording

S1. 3D Recording of Rock Art

Chair: G. Avern
Format: Roundtable

The purpose of this roundtable is to bring together international experts in 3D recording technologies who are visiting Perth for CAA-2013 and Australian experts on Rock Art in order to share and learn from each other's expertise and experiences, and to forge new links for future collaborations, as concerns the issues of 3D documentation of this hugely important, yet vulnerable, sector of Australia's indigenous heritage and artistic treasures. We hope that this roundtable will be a timely contribution given, on the one hand, the attention this heritage has attracted across Australia in last few years due to perceived threats from the activities of mineral, oil and gas industries, from erosion (whether natural or at potentially accelerated rates attributable to climate change) and from vandalism, and on the other hand, in light of the increasing interest and activity in 3D recording of Rock Art in many parts of the world.
The roundtable will take the form of short (~10 minute) presentations, each followed by an open discussion. Each presentation will be chosen to highlight an issue, to elucidate some poorly-understood aspect, or to preview current activities in 3D recording of Rock Art. Invited speakers will include Rock Art experts from around Australia, researchers and engineers with practical experience of recording rock art around the world, and representatives of companies who produce 3D recording instruments.
Topics to be addressed will include:
- Review of the threats to Australian Rock Art
- Examples of recording Rock Art in Australia and Overseas
- Review of the wide range of available 3D recording technologies
- Accuracy in surface modelling – issues of resolution and accuracy
- Accuracy in colour data – what data is actually captured?
- Multi-scalar modelling and visualising data sets of different resolution
- Archiving, access and dissemination.

S2. Federating Archaeological Information Systems - Have Your Say!

Chairs: S. Ross, A. Sobotkova
Format: Roundtable

This is an interactive session fleshing out key aspects of FAIMS (Federated Archaeological information Management Systems), a project funded by National eResearch Collaborative Tools and Resources (NeCTAR) to create infrastructure for the collection, analysis, and dissemination of digital archaeological data. Through community engagement we aim to develop flexible, robust and extensible data standards, and employ those standards to federate a range of new and existing components for acquiring, analysing, and archiving archaeological data.
The information management resources envisioned by this project will consist of four broad categories of components, corresponding to the major stages in the life-cycle of archaeological data:
1) mobile and desktop applications for the digital acquisition of archaeological data;
2) operational databases optimised for input and editing for the manipulation of data;
3) online repositories optimised for storage and dissemination of data;
4) statistical, analytical, and visualisation tools for knowledge discovery.
These components will allow data from archaeological field and laboratory work to be born digital using mobile devices, processed in local databases, published online through cultural heritage registries and data repositories (including cloud-based implementations), shared as open linked data, and extracted to online workspaces for reconciliation and analysis. We want to use existing standards and components wherever possible, and welcome proposals of new ones for development where necessary.
After a fifteen-minute orientation to the project, this session will follow the "focus" format, with a series of five-minute papers. Several of these papers will be presented by researchers or developers affiliated with the project, highlighting its most innovative or powerful aspects. Topics will span the theoretical and the practical, and examples might include: philosophies of data in archaeology, data standards and

semantic interoperability, building interoperability amongst existing data repositories, integrating mobile applications into a comprehensive information management system, etc. The bulk of the papers, however, will be solicited from the archaeological community, and may consist of proposals for new components, critiques and criticisms, examples of potential uses of FAIMS outputs, or other suggestions or ideas. All presenters, whether affiliated with the project or not, will be encouraged to produce posters that will serve as the focus of discussion after the short papers have been presented. Prototypes of selected FAIMS e-research tools will be available for hands-on demonstrations. Ideas generated during this session will feed back into the FAIMS development process (which continues through 2013). This session also represents a networking opportunity for archaeologists who are interested in joining the FAIMS initiative.

S3. When time is all: fast and efficient site recording in underwater archaeology.

Chair: J. Green
Format: Paper presentation (LP)

Underwater archaeological mapping has always been a challenging task particularly when considering the difficulties in mapping and monitoring dynamically transforming environments. Since working underwater time is at a premium, any technique that speeds recording provides enormous cost benefit. Techniques employed in underwater surveys have been largely related to photography and the application of computer methods to extract information from the photographic records (photogrammetry), integrated by other methodologies such as sonar to measure and record distances and programs that assist and simplify surveying techniques. This session will deal with these three main topics, together with other associated systems that are related to underwater archaeology.

S38. Mobile Applications in Cultural Heritage and Archaeology

Chair: J. Scriffignano
Format: Paper presentation (LP)

Since the introduction of commercially available laptops in the Late 1980's, researchers and consultants have endeavoured to utilise the advantages that are associated with field based data capture and recording. Leap forward 20 years and that large, heavy laptop with extremely short battery life has evolved into something that fits into the palm of your hand, is many time more powerful, makes phone calls, takes high resolution photos and tells you where you are in the world. The latest mobile devices are extremely powerful and able to operate most desktop software applications or derivatives that, most times, seamlessly integrate. Apps can be downloaded from the WWW or easily created using proprietary or open source frameworks. Utilising the latest incarnation of mobile devices and applications, archaeologists can combine the laborious data entry process with the field recording process, control and standardise the data that is entered, create mixed media data utilising a single multi function device or from paired devices and upload to servers all while in the field.
This session welcomes presentations that elaborate on the mobile applications now being used in archaeology and cultural heritage. Papers which explore what data is captured and recorded, the data entry/capture process of the mobile application, how the data is managed within the mobile application, how the mobile application data is integrated within the broader information gathering and management paradigm, the benefits that are afforded by the mobile application's use and what challenges they have created are of interest.

Data management, analysis and the semantic web

S4. Archaeological information modelling

Chairs: C. Gonzalez-Perez, P. Martín-Rodilla
Format: Paper presentation (LP)

The information that we use to represent the elements in the archaeological record is not neutral; its shape, depth and quality affects the descriptive and interpretive processes that we are later capable to produce. For this reason, attention must be paid to the ways in which we construct information models and the ways in which we employ them.
Data modelling has been used in archaeology for decades (e.g. CIDOC CRM, Harris matrices). However, there is much more to information modelling than merely thinking of data. Issues such as abstraction, semantics, scoping and intentionality must be considered if a valuable information model is to be obtained. In addition, some "soft" aspects of information modelling in archaeology are still poorly addressed, such as subjectivity, multivocality, temporality and uncertainty.
This session aims to address all these issues by questioning the state of the art about the theories and methods that are commonly employed to create and use information models in archaeology.
Major research areas that are welcome in the session include (but are not limited to) the following:
- Do we, as archaeologists, actually create information models as an a priori step? Or is information described without pre-existing models in mind?

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- How can we document and communicate information models to colleagues, partners and other organisations?
- How can we record the processes that are carried out on archaeological data, together with the data?
- How can we capture subjective points of view and multivocality within information models and data sets?
- How can time be represented in information models and data sets, especially when temporal uncertainty is considered?
- What mechanisms can we use to express ontological (imprecision) and epistemic (vagueness) uncertainty with regard to archaeological data?
- Is it appropriate or feasible to extend or adapt industry-standard modelling languages and/or best practices (such as those in engineering, i.e. UML, or ontologies) to archaeology?

Please bear in mind that the session is intended to focus on the theory and methods of information modelling in archaeology, rather than on specific case studies of particular archaeological problems.
The session will be of interest to people who:
- Are concerned about conceptualisation and/or terminology issues in archaeology
- Are involved in the development of policies, processes or standards for the management of, or research on, archaeological collections, artefacts or monuments
- Have an inclination to theorise about the world that surrounds us, but are not happy with the existing representational approaches
- Are having problems to conceptualise, express or communicate a particular area of inquiry in archaeology
- Find that imprecision and vagueness must be acknowledged and expressed as part of archaeological data
- Design forms, templates and tables to record archaeological information
- Need to integrate or otherwise inter-relate two or more repositories or data sets of archaeological information
- Create databases or other software-intensive archaeological tools.

The workshop “Hands-on Archaeological Conceptual Modelling”, to be held during the Pre-conference Workshop session, co-chaired by Cesar Gonzalez-Perez and Charlotte Hug, will introduce the discipline of conceptual modelling to archaeologists and related professionals, and constitutes an applied counterpart to this session.

S5. *E pluribus unum*? The pleasures and pitfalls of working together

Chair: L. Isaksen
Format: Paper presentation (LP)

This session, one of a series on the potential and practicalities of producing and re-using Open Data in Archaeology, addresses the benefits and challenges of a communal research agendas. Although all research is decentralized to some extent, building upon the prior results of others in the field, here we specifically address working practices that actively facilitate collaborative partnerships and data reuse. Such collaborations may be those established at the outset of a programme of work, or which arise serendipitously through awareness raising, academic dissemination or educational and public outreach. They may also include collaborations and collectives within the academic, governmental, charitable and commercial spheres. Papers are invited which consider the social, technical and legal aspects of this process based on real-world examples, including (but not limited to) the following topics:
- Early-stage publishing
- Open Data and licensing
- Attribution paradigms
- Establishing virtuous research feedback loops
- Open vs. closed collaborations
- Cautionary tales (with lessons learned)

All papers are expected to draw out general themes from their experiences, rather than focus on issues solely relevant to their own projects. Especially welcome are joint papers that explore the issues from two (or more) sides of a collaboration, as well as those that bridge traditional boundaries in the discipline of archaeology.

S6. Potentiality, prediction and perception for digital documentation in Archaeology

Chairs: A. Ippolito, L.J. Senatore
Discussants: C. Bianchini, B. Belelli
Format: Paper presentation (LP)

Since the early 1990s, researchers aimed at the elaboration of numerical models to represent ideas, surfaces and architectures. The research and practice for Cultural Heritage yields a large amount of data and information which imply complex relationships and categorization phenomena. The quality of the conceptual and real models that are selected to gather, organise and process this information affects to a large extent the quality of the final results. As the archaeological research is concerned, detailed and accurate 3D numeric models are becoming widely available thanks to the diffusion of several new technologies for automatic 3D acquisition, digitalization and utilization in real time.

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The new technologies are substantially changing the approach to the workflow:
1) Creating interactive and dynamic graphical models for the analysis and understanding of the products made on-time with the excavation;
2) New possibilities for data sharing, with the creation of GIS platforms and visual databases, including digital models;
3) Development of detailed analysis of the artefacts and the architectural monuments for the interpretation of archaeological sites, carried out with interactive models (2d and 3d) which can be easily web-shared.
The session will focus on different approaches, techniques and methodologies based on the non-contact 3D acquisition of data and their following elaboration into 2D-3D digital models at a large and small scale, from archaeological sites to small objects.
Contributions to this session will discuss the use of integrated and multidisciplinary approaches in archaeological research, highlight their benefits during both the acquisition and the interpretation of data from the fieldwork, and examine the potential problems associated/not associated with their application.
The session aims at outlining theoretical foundations, as a starting point for further debate about the changing approach to Cultural Heritage.

S7. Standardising thesauri for the re-use of information using SKOS

Chairs: G. Lange, M. Lang
Format: Roundtable

Institutions worldwide are aware of the need to standardise their vocabularies in order to make their data re-usable in the long term by a wider audience. The Semantic Web and Linked Data sessions at earlier CAA conferences were seminal in introducing the new challenge with the accompanying new methodologies and techniques to archaeologists.
Several central Cultural Heritage agencies and archaeological departments have taken up the challenge and are translating their thesauri in SKOS-XML, which offers a way to structure vocabularies in a standardised format. SKOS stands for Simple Knowledge Organisation System. We expect that many of the more locally (in space or specialisation) oriented institutes will follow this initiative.
SKOSifying thesauri is neither a self-explanatory nor a common-sense type of activity. Making decisions on the design of the structure and filling that structure with content are continuous processes that require both technical and theoretical domain knowledge.
A Thesaurus consists often of several subdivisions and may interlink with others. Recent developments indicate that a dedicated infrastructure is needed to use the potential of thesauri to the full.
This Round Table will be focussed on discussing recent and future developments and will provide as a context to the discussion at least the following topics
1) an introductory presentation explaining what SKOS and the infrastructure is all about;
2) papers on SKOSIfied thesauri and their use;
3) discussion on how to proceed to ensure compatibility of approaches by the several initiatives.
The ultimate objective is to try to standardise the standardisation process in such a way that use of each other's solutions and content (thesauri) will be facilitated.

3D modelling, visualisation and simulations

S8. Beyond 3D modelling: virtual GIS, immersion, and virtual experiential environments

Chairs: T. Harris, S. Dunn
Format: Paper presentation (FS)

Computing technology is evolving at a pace that threatens to outstrip our ability to meaningfully embrace and coordinate research-driven questions and theory with technological opportunities. Arguably, this risk could be applied to the role of Virtual Reality (VR) in archaeology. During the past decade, for example, technological and software advances have enabled impressive and aesthetically very attractive 3D models to be constructed, only to be followed by a debate as to their significance in addressing archaeological research questions. Similarly, while texture rendering has become more accurate, and the ability to incorporate 3D models into GIS and virtual globes has been demonstrated, the question remains as to the value and appropriate contribution of these technical advances in furthering deeper insight into archaeological understanding.
This session will invite papers that critically examine the role of 3D modelling and virtual reality in archaeology. In particular, we have a strong preference for papers that step beyond the now well established realms of model building and consider the practical and theoretical constructs surrounding phenomenology in virtual environments and the role of immersive and experiential environments in 3D archaeological reconstruction. We seek papers that address:
- Identifying trends in next-generation 3D models and modelling environments
- Evaluations of 3D modelling applications in archaeology
- The functional integration of 3D reconstructions within multi-scalar GIS environments
- The handling of uncertainty in 3D model reconstructions
- Phenomenological approaches in 3D modelling and virtual GIS
- Exploring experiential immersion in virtual reality and virtual GIS environments

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- Mobile applications of augmented reality in archaeology
- The impact of 3D modelling on cultural heritage and visitor experience.

S9. Complex systems simulation in archaeology

Chairs: I. Romanowska, T. Brughmans
Discussants: E. Ch'ng, C. Vegvari
Format: Paper presentation (LP)

A complex system is “a system in which large networks of components with no central control and simple rules of operation give rise to complex collective behaviour, sophisticated information processing, and adaptation via learning or evolution.” Mitchell 2009: 14.
Complexity has been proclaimed as a new paradigm shift in science almost half a century ago. It developed as a response to the reductionist approach of René Descartes and the idea of a ‘clockwork universe’ that dominated past thinking for many centuries. Complexity brings a fresh alternative to this mechanistic approach. Complex Systems exist in every hierarchy of our world, from the molecular, to individual organisms, and from community to the global environment. This is why researchers in many disciplines, including archaeology, found particularly appealing the idea that global patterns can emerge in the absence of central control through interaction between local elements governed by simple rules (Kohler 2012). As a result, the unifying phrase ‘the whole is greater than the sum of its parts’ (Aristotle, Metaphysica 10f-1045a) became the common ground for scholars in many disciplines.
Due to the complex nature of interactions, the study of complex systems requires computational tools such as equation-based modelling, agent-based modelling (ABM) and complex network analysis. In recent years the number of archaeological applications of complex systems simulation has increased significantly, not in the least due to a wider availability of computing power and user-friendly software alternatives. The real strength of these tools lies in their ability to explore hypothetical processes that give rise to archaeologically attested structures. They require archaeological assumptions to be made explicit and very often force researchers to present them in quantifiable form. For example, vague concepts such as ‘social coherence’, ‘connectivity’ or even seemingly explicit ‘dispersal rates’, often have to be given numeric values if they are to be integrated into computational models. Computational tools also allow for testing alternative hypotheses by creating ‘virtual labs’ in which archaeologists can test and eliminate models which, although superficially logical, are not plausible.
The main contribution that complexity science perspectives have to offer archaeology is the wide set of modelling and analytical approaches which recognise the actions of individual agents who collectively and continually create new cultural properties. Indeed, it has been argued that a complexity science perspective incorporates the advantages of culture historical, processual and post-processual paradigms in archaeology (Bentley and Maschner 2003; Bintliff 2008). Quantifiable complex systems simulations and mathematical modelling can provide a way to bridge the gap between the reductionist approach and the constructionist study of the related whole (Bentley and Maschner 2003).
This session aims to reflect upon and build on the recent surge of complex systems simulation applications in archaeology. Innovative and critical applications in analytical modelling, ABM, network analysis and other methods performed in a complexity science approach are welcomed. We hope this session will spark creative and insightful discussion on the potential and limitations of complexity science, possible applications, tools as well as its theoretical implications.

S10. Immersive digital Archaeology? Emerging technologies to envision the Past

Chairs: A.R. Flaten, J. Case
Format: Paper presentation (LP)

Envisioning the past is not new. We are transported to ancient cultures and periods through prose and poetry, through paintings, sculpture, ceramics, and architectural ruins. The past two decades have witnessed a veritable flood of digital applications to heighten the sense of immersion in our collective past: museum kiosks, metaverses such as Second Life or Unity, portable lecture devices, computer reconstructions of ancient monuments and topographies, first person shooter video games, GPS enabled smart phones and other location-aware software and hardware, web apps, and so on.
The playing board is constantly in flux, with new technologies supplementing or replacing existing ones. Custom-designed “caves” and portable 3D projection systems allow users to experience datasystems in three dimensions. Similar technologies can project holographic images of scanned or built objects (eg. reconstructed vases) to be rotated and viewed from any number of angles. Similarly, Microsoft’s Kinect software for Xbox and PC platforms can be adapted for interaction with archaeological models with imbedded metadata. This session focuses on new and emerging approaches to bridge the divide between our present and various pasts, between perception and reception, between audience/user and programmer, between experience and reality (however broadly the terms are defined or applied).

S11. Photogrammetric models in action

Chairs: R. Opitz, K. Simon
Discussant: C. Walker
Format: Paper presentation (FS)

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Close range, convergent photogrammetry is revolutionizing documentation on excavations, surveys and in museums. With recent improvements in software, the creation of the models themselves is now relatively simple. As an increasing number and variety of projects adopt this technique, developing workflows and strategies which suit their project's particular problems, new challenges are appearing. The capture, generation, management and distribution of large collections of 3D models involves developing new technical and semantic strategies, and innovative work in this area is essential to making 3d modelling a standard part of the archaeologist's toolkit. The integration of the data collected through photogrammetric modelling with the larger pool of archaeological information and the analysis of these models presents equally great semantic and technical difficulties, and at the same time, the potential for the development of exciting new modes of studying and discussing archaeology and heritage.
This session invites short presentations on successful, unsuccessful, in development and potential future modes for meeting the challenges of the explosion of 3D photogrammetric modelling in archaeology. We particularly encourage presentations focused on semantic, analytical and interpretive topics. Presentations should be supplemented by a (possibly digital) poster or a live demo of another form for an interactive, breakout session in which ad hoc groups will work with and discuss different modes of using photogrammetric models. Presentations and the breakout session will be followed by a moderated discussion to tie together key themes resulting from the papers and breakout session.

S12. Three-dimensional computational analysis and simulation in archaeological research

Chairs: E. Paliou, C. Papadopoulos
Format: Paper presentation (LP)

In the last decade advances in three-dimensional technologies have increasingly offered more opportunities for the recording, documentation and visualisation of archaeological environments and artefacts in three dimensions. Nonetheless, 3D technologies are still used mainly for qualitative descriptions of spaces and objects, while the possibilities for interpretations based upon explicitly quantitative 3D analyses remain still untapped.
Three-dimensional computational simulation and analysis have relatively recently begun to be developed and utilised to research on the relationship of people with their environment both in large and smaller spatial scales. Methodologies such as formal visibility and lighting analysis have enabled the investigation of aspects of human perception in simulated prehistoric and historical 3D digital spaces, which more closely resemble real-world environments. Furthermore, in recent years GIS research in the fields of landscape and urban studies has been equipped with new tools for 3D visualisation and analysis. The latest versions of ArcGIS software, for example, are not only able to represent 3D cityscapes, but they can also perform some basic visual analysis (calculation of sight lines) on building facades, while they offer more possibilities for exploratory data analysis in three dimensional space. In a similar vein, open source software solutions (e.g. ParaView) have developed procedures for effectively post-processing and analysing 3D simulation data.
This session welcomes scholars with an interest in archaeology, architecture, material culture, cultural heritage and computer graphics, who utilise three-dimensional computational tools. The focus is mainly upon approaches that seek to analyse archaeological spaces and artefacts in a formal quantitative way, rather than merely record and describe them qualitatively. Lighting simulation and analysis, visibility simulation and analysis, simulation of movement and structural analysis, volumetric and statistical analysis of 3D data, procedural modelling are only a few of the applications that fall into the scope of this session. Participants are expected apart from presenting their work on 3D simulation and analysis, to critically evaluate any methodological and theoretical issues posed by these approaches.

Spatio-temporal modelling and GIS

S13. Advanced exploration of spatial patterns in archaeological site assemblages using GIS applications and data mining technologies

Chairs: M. Märker, P. Verhagen
Format: Paper presentation (LP)

Site location analysis and archaeological predictive modelling often combine data mining techniques such as multi-variate statistics with spatially continuous environmental datasets, in particular digital elevation models and remote sensing data. From these data, a number of potentially useful derivatives can be extracted. For example, topographic indices can be derived from digital elevation data that describe processes or characteristics of a geomorphological, geological, climatic, hydrological, vegetational or strategic nature. A huge variety of open source and commercial tools is available to extract and delineate meaningful derivatives from the original environmental data. However, the quality of site location analysis and prediction largely depends on the pre-processing and quality of the original data as well on the chosen data mining method. For this session, we invite papers that focus on both aspects that are closely related:
i) GIS methodologies for data preparation, as well as the extraction and selection of meaningful derivatives for specific site location assessments, and
ii) data mining techniques for site location analysis and their validation.

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In particular we want to discuss problems related to spatial scales of data and the processes or characteristics that they should reflect (e.g. what scales should be used to describe specific processes? or what happens if no data is available at the correct scales?). Moreover we would like to focus on the selection of data mining technologies for a given archaeological site assemblage and methods to validate directly and/or indirectly these techniques.

S14. Beyond Virtual Reality: documentation, interpretation and understanding of ancient cities

Chairs: H. Stöger, U. Lieberwirth
Format: Paper presentation (LP)

Since the 1990s archaeologists have been employing computer-based quantitative analysis tools to reconstruct not only cultural landscapes and rural settlements, but also urban built environments. These analysis tools and software solutions have been improved over the last decades, allowing us to advance our knowledge of the 'Ancient City' beyond descriptive digital models.
This session seeks to stimulate the discussion between different analytical approaches to the 'Ancient City', ranging from macro-scale analysis (including the exterior peripheral environment) to the micro-scale analysis of individual houses and interior spaces. How do we find ways of recapturing not only the physical form and fabric of the city, but also the daily activities which took place within the past urban space? Exceptional buildings and activities threaten to dominate the archaeological record because of their visibility; archaeology, on the other hand, has resorted to analytical tools such as GIS and Space Syntax which often reduce complex human interaction to deterministic models. How can we reach beyond these conceptual and methodological limits? How do we confront the spatial and temporal challenges posed by past urban environments? What techniques, approaches, or bodies of evidence prove most fruitful for detecting and reconstructing past urban life.
The session seeks to engage with broader debates on past urban space and its 'social logic' and wishes to invite participation which shows interdisciplinary dynamics, incorporating ideas from urban planning, thermal-modelling, geography, logistics, as well as spatial and movement analysis (accessibility, visibility) into urban computer-based archaeology. The aim of this session is to push the boundaries of current applications to open up new ways of studying and understanding Ancient Cities, and to work towards a shared set of analysis techniques and interpretative frameworks that can be applied to most past built environments across most time-scales.
Paper proposals should demonstrate a critical awareness of the theoretical issues involved in computerised study of the built environment; the proposed papers should clearly state the methodologies applied, the methods of analysis and software solutions used.

S15. Databases on cultural heritage and their geographic visualization

Chairs: M. Märker, E.Uleberg
Discussants: V. Hochschild
Format: Paper presentation (LP)

In this session we would like to bring together scientists working on different issues of visualization of data stored in Databases that are related to archaeology and cultural heritage. This comprises the technical prerequisites of DB-systems such as interface solutions that pass geographic, geodetic, and 3D data to visualization tools (e.g. Postgis) as well as tools and interfaces that allow the visualization of these data like web based portrayal services, GIS systems, etc.. On the other hand, we want to discuss visualization issues related to the data formats and metadata like, vector, raster and voxel formats and geographic data projections.
Part of the session will be devoted to a review of a range of visualisations by the session chairs, with a focus on open source solutions. Finally the session will also discuss how user requirements can be already considered in the design of these systems to guarantee sustainability and acceptability of the targeted user. Here questions of visualization versus interaction might be focused.

S16. Early humans in space and time: how to get from DB assemblages to spatial distributions

Chairs: M. Märker, Y. Kondo
Format: Paper presentation (LP)

Recently, several large-scale multidisciplinary projects such as ROCEEH, RNMH, NESPOS, or AHOB, were launched by national and international initiatives to carry out research on early humans like Ardipithecus, Australopithecus, Homo erectus, Homo heidelbergensis, the Neandertals (Homo neanderthalensis), and early modern humans (Homo sapiens). These projects are focusing not only on anatomical evolution of early humans but also on their geospatial characteristics such as spatio-temporal distribution, migration, cultural behaviour, and environmental niches. Consequently, an increasing number of papers have recently been published to discuss the spatio-temporal distribution and migration of early humans taking into account different types of environmental information such as paleoclimate, paleotopography, stratigraphy, lithology, paleofauna and -flora, and/or ecological niches. However, there are some problems to apply spatio-temporal analyses to early human archaeology. Firstly, in general, the older type of human species the fewer the archaeological assemblages. Thus, spatial and temporal resolutions of the data are often too coarse to extract any significant patterns at a reliable standard. Secondly, since early humans are truly interdisciplinary research topics, a great

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variety of approaches are employed. Therefore, data and results of projects are often managed and stored in large database systems of different origin and different technical background. It requires a common working platform (such as a common metadata format).
In this session we would like to discuss techniques and methodologies to understand the spatio-temporal distribution of early humans, taking into account the current technical problems and constraints. Major topics of our session will include (but not limited to) i) the provision of spatial data in large-scale databases, ii) techniques to assess the spatial distribution of early humans, iii) techniques to deal with small statistical samples, and iv) theories and methods to generate meaningful information for spatio-temporal modelling by means of GIS, Remote Sensing and statistical modelling. We welcome a wide variety of papers relevant to any of the above mentioned topics and are looking forward to fruitful further discussions on the technical issues of early human research.

S17. GIS based solution for underwater archaeological sites and coastal landscape analyses

Chairs: M. Lorenzini, P.G. Spanu
Format: Paper presentation (LP)

The study of historical and archaeological sites requires the analysis of different kind of archaeological and historical data to allow reconstruction of the original context. This broadly applied approach brings together the interpretation of archaeological evidence with the social, economical, geographical and geological context. In this way, we can achieve a higher degree of understanding of an historical/archaeological context and differentiate the factors that contributed to the formation and definition of a particular terrestrial landscapes.
The use of GIS in analyzing landscapes is, nowadays, standard practice that allows the management of geographic, social and economic aspects and the development of predictive models of past settlements.
Maritime and underwater archaeology are, both conceptually and methodologically, part of “landscape archaeology”. In marine contexts, we can observe the same or similar interactions between the environment and numerous agents that also participate in the formation of terrestrial archaeological landscapes.
In spite of the dramatic improvements and achievements in recent years, GIS is still not quite a standard application in underwater, maritime and coastal archaeology. The goal of this session is to discuss the manifold aspects of the use of GIS in underwater and maritime archaeology, and in coastal and submerged landscapes. We invite papers on:
- GIS applied to the study of coastal landscapes
- GIS applied to inter and intra site analysis of underwater archaeological sites.
More generally, we are also interested in new methods for managing and processing archaeological data, such as the development of underwater 3D DTM, and the use of metadata and open formats for the description and categorization of underwater archaeological evidence.

S18. GIS in Cultural Heritage consultancy work

Chair: C. Reeler
Format: Paper presentation (FS)

The cultural heritage consultancy field represents a large body of practising archaeologists and other cultural heritage experts who every day face challenges in applying the precepts of their fields in a real-world environment. The constraints of the consultancy environment mean that there is often not time for elaborate project design. However, high standards can be maintained and often innovations within the field are born out of meeting the challenges and constraints in real-world applications.
Consulting archaeologists have not been slow to use any tool that provides a competitive advantage and also leads to improved results for all parties. The consulting world is the place that meaningful results for communities and cultural heritage are achieved. GIS is an extremely valuable tool in assisting in the provision of the best results.
In Australia in particular there is something of an artificial separation between the academic and consulting environments and consultants rarely get the chance to discuss the tools of their trade in a forum environment. Similarly, academic archaeologists can be out of touch with the techniques used by consultants ‘on the ground’.
This focus session invites papers on the use of GIS (and related spatial technologies, including mobile technologies) in the consulting environment worldwide. Australia is an especially appropriate place to host such a discussion, since the consulting environment here covers such a broad range of disciplines within archaeology, as well the necessity to work in such a wide range of environments and across huge sweeps of time.

S19. Is there time for archaeology? Understanding time through modelling and representation

Chairs: X. Rodier, J.-Y. Blaise, L. Kaddouri
Format: Paper presentation (LP)

The session’s objective is to question the way we model and represent time when studying heritage artefacts basing on archaeological remains, pieces of architecture, written sources, old maps, etc.
Indeed, from dating raw material (historical sources, artefacts...) to monitoring ongoing continuous changes (erosion, degradations…), time is at the heart of many concerns & analyses inside the so-

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called spatial dynamics field. Yet time remains rather poorly supported, both at concept and implementation levels. A number of open challenges are therefore clearly before us: handling robustly heterogeneous granularities, supporting ill-defined time points or open time intervals, etc. Furthermore, time is still often used to basically order observations chronologically. But rhythms or densities sometimes mean more than dates or order. Accordingly, understanding, modelling and representing the time parameter itself does appear as one of today's hottest research topics in and around historic sciences.
Founded three years ago under the auspices of CNRS (French National body for scientific research), the MoDyS research group investigates challenges raised by the modelling and representation of time, though interdisciplinary contributions encompassing various scientific communities (archaeology, but also architecture, geography and geosciences, computer science). With this session the group proposes to cross-examine ground-breaking epistemological and methodological approaches and experiments, by bringing together, at international level, researchers from the scientific communities concerned.
In this way, this session wishes to contribute to the emergence of a similar interdisciplinary effort, but on the time parameter – an effort aimed at integrating methods, tools, formalisms developed over the years (inside or outside of archaeology as a discipline) in order to foster more efficient reasoning on temporal aspects.
The session will be an opportunity for scientists to discuss how different legacies and scientific practises can help coping with the parameter time. Its ambition is to encourage fruitful and in-depth discussions on time-oriented, innovative and/or interdisciplinary research, and to promote networking and scientific exchanges.
Contributions can cover various scales of the archaeological analysis: stratigraphy, furniture, architecture, urban spaces, and territories. Research results encompassing different scientific profiles and approaches are welcome.
Accordingly contributions should address one of the following questions:
- What instrumentation do we base on, or design?
- What is its cost in terms of biases introduced at interpretation time?
- Is it reliable, and adapted to our needs?
- How do we evaluate the distance between the changes we wish to perceive (identification, resolution, meaning), and the results the instrumentation provides?
- In what way does time influence the object or phenomenon under scrutiny?
- How is time modelled and in what does this effort serve the analysis?
- How is time represented?
- In what way do computer formalisms and tools help processing temporal information?
- Can innovative HCI (Human Computer Interaction) solutions or graphics help better underlining temporal patterns?

S20. Modelling space and time as rooms of possibilities

Chairs: Ø. Eide, J. Holmen, C.-H. Ore
Format: Paper presentation (LP)

During the last two decades, large collections of cultural heritage material have become available in digital format, including historical source texts, museum catalogues, and excavation reports. Although a number of advanced methods already exist for searching and integrating such resources, they are still under-utilised in storytelling and advanced reasoning. It is still the case that many scholarly users only access such resources through free text or simple metadata searches, if they use them at all.
On the other hand, there are several well defined standards and methods for data integration at various levels, including, e.g., CIDOC-CRM, Linked Data and RDF/OWL. But such methods are only applied to limited data sets. Although no uncontested history is known or even knowable based on available source materials, the sources can still be interpreted as representing a series of events happening in time and space, involving actors and objects. Even if these events do not give themselves to the researcher as a well ordered series steered by causality, they are still related.
We envisage systems which should be able to handle questions in the form of more or less developed hypotheses. This may imply that a tool can build up a scenario based on interpretation of available source material and also be used to scrutinise the plausibility of such scenarios, including likely connections between events in time and space. This will, of course, include speculations about causality.
For the session, we invite papers presenting ways to integrate historical events as they can be read from historical documents. Our experience leads us to believe that hybrid human-computer methods are better suited for solving such problems than fully algorithmic or fully manual approaches, but we are looking forward to being challenged by papers seeing this differently.
We are looking for well developed plans and prototypes for how such data integration can be done in practice, ideally based on real life examples. Rather than providing answers, we would like a focus on organising the information for the researchers so that they can use the systems for developing new questions; but again, we are happy to be challenged by proposed papers. Questions we would like to see addressed in paper proposals include, but are not restricted to:
- How to use various sources to verify co-references within one source material as well as across collections. Co-referring items could, e.g., refer to events, artefacts, places, or actors.

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- If and how inferred information can be separated from «basic» information, at all levels from theory to the level of implementation.
- Can rules be established for how events and actors are distributed in time and space, e.g., based on maximum travel speed at a certain time and place?
- Can rules be established for how to use causality and other relationships between events to decide on and reduce uncertainty in their possible time spans and locations?
- Which tools are already available, and what would be needed in order to move forward in this area? Can existing tools be used in better ways?

S21. New approaches in predictive modelling

Chairs: A. Lodoen, N. Dubbini
Format: Roundtable

Archaeologists have been developing predictive modelling approaches since the 1970s. The methods and the data have continuously been improving since then. A number of interesting methodological and theoretical developments have occurred in the field in the last decade, including tentative attempts to include cultural (i.e. non-environmental) variables. Despite this, the maximum 'gain' of most models (as defined by Kvamme) seems to be limited to c.70%. Is there now a need to rethink the way that predictive models are constructed? Should we build on and improve the traditional methods, or is a more comprehensive rethink necessary? Can pure and applied sciences methods (statistics, engineering, mathematics) improve the quality of the predictions? This roundtable discussion will focus on new and innovative approaches within the field of archaeological predictive modelling. Contributions are invited from academics and practitioners working in any part of the world.

S22. Quantifying Patterns in Landscape

Chair: J. Peterson
Format: Paper presentation (LP)

Patterns in landscape may arise through human acts of land surveying, allocation and division. They include patterns in boundaries, such as consistency of orientation and modular spacing, patterns in distribution of sites with respect to visible or virtual grids, and patterns in angular relationships.
This session intends to focus upon the innovative application of computational and statistical methods that aid the interpretation of these patterns, such as numerical modelling, the use of transforms (Fourier, Radon), measurement of association (Kolmogorov-Smirnov) and simulation. We also wish to see reports of comparative studies that indicate the validity of these approaches in this context, including their ability to distinguish between patterns generated by human action and regularities induced by nature.
Research in this area has, until now, concentrated mainly on the partially degraded Greek and Roman systems of ancient Europe and the Jori systems of Japan, but future work could make more use of computational approaches and be extended in space and time to include, for example, the modern colonial land allocation systems visible in North America and Australia.

S23. Studying the built environment across space and time: conceptualisation and spatial analysis of morphological and topological structure and development

Chair: B. Vis
Format: Paper presentation (FS)

This focus session is aimed at bringing together the widespread, but often isolated, research interests in studying the built environment, its spatial structure and its transformational development. Although such research tends to share the common purpose of interpreting analytical outcomes in case specific contexts, this session will concentrate on the methodological challenges involved from the bottom-up. Its point of departure is formed by the theoretical premises and conceptualisations that require the designation of appropriate analytical units which determine the (re)organisation and preparation of spatio-temporal datasets leading to suitable analytical techniques. Within developing analytical techniques, the conceptualisations restrict the scope for interpretation of built-up space. Questions to ask are: how is the technique pertinent to the interpretation of selected aspects of the built environment and what can be learnt from it?
It is hoped the structure of the session will reveal and steer the structural connections between theoretical concepts, methodological and data driven challenges, and analytical techniques devised for interpreting and understanding the broad notion of the built environment complex and its development. By focusing on the research aims, concepts and process an emphasis on the comparative potential of various approaches is stimulated. Considering the focus on structure and transformation the built environment theme here refers particularly, though not exclusively, to processes of settling and urbanisation.
It is requested that presentations taking a case study perspective will highlight their contribution towards the wider bearings of their concepts and research methods used instead of focusing on time-space specific findings. This intends to stimulate debate on our conduct and applied techniques, revealing common interests that make an approach appropriate for a broad diversity of spatial contexts. Therefore contributions and attendants are welcomed who share this field, ranging from abstraction to data

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preparation and computational analyses pursuing interpretive outcomes. In this way, the extent of the potential of a disentanglement of research premises and processes from time-space contingencies (e.g. cultural and historical specificities) will be explored as an undercurrent.
Since theory and methodology are notoriously demanding to present, this session will employ a 'focus' format. The focus session format will be used to establish the common tenets between researchers working on their own approaches or significant improvements to existing methodologies for studying built environment structure and transformation. The brief bullet point presentations stimulate each presenter to capture the core aims or challenges, purposively devised concepts and (technological) operationalisation in a few sharp statements on their work. This will pave the way for an extensive structured debate on emerging themes in which the participation of attendees is encouraged. It is expected that recognition of shared challenges will maximise productivity during the free networking and discussion time that follows. Here people get the opportunity to demonstrate and/or distribute some research information (handouts/posters) amongst attendees and participants. All attendees are urged to come prepared for this exchange of ideas.

S24. The importance of spatial scale

Chairs: G. Lock, J. Pouncett
Format: Paper presentation (LP)

Scale is fundamental to any spatial analysis and yet it is a concept that is often taken for granted, used implicitly and not mentioned or justified. In this session we want papers that place considerations of scale at the core of their thinking and analysis: work that is explicit about scale, why it is important and how we can move between scales and integrate different scales into spatial analysis and interpretation.
Whether you situate your work within local, regional or national scales, we would like to explore the two main elements of scalar thinking, namely analytical scale and philosophical scale. Analytical scale is how we represent and analyse a measured reality, i.e. ratios and distances, while philosophical scale is concerned with humanised scales of perception. How important, for example, is distance in modelling visibility and/or movement or the implications of different interpolation methods, and the use of different search radii. Of interest to us are topics such as the scales of data collection (for example sampling methodologies), innovative applications of spatial statistics using points and grids, global and local test statistics (Moran's I v Anselin's local Moran's I), LISA (local indicators of spatial association), Ripley's k and geographically weighted regression.
We are interested in papers that explore the emergence of new techniques which take into account the scale at which patterns exist and the spatial variation in patterns. For example, what are the issues when moving between scales and the problem of ecological fallacy (and/or MAUP and methods of aggregation) and the opportunities and/or constraints of spatial software when trying to operationalise these problems. Crucial to all of these aspects of scale are the archaeological questions being asked (and answered?), are these uni-scalar or multi-scalar and how have spatial technologies helped or hindered your writing of the past?

Remote sensing (long and short range)

S25. Geophysical prospection and remote sensing for archaeology. "State-of-the-art" and the road ahead

Chair: J. Fassbinder
Format: Paper presentation (LP)

Large-scale high-resolution archaeological prospection harbours great potential for the efficient mapping of buried cultural heritage worldwide. The application of remote sensing and non-invasive geophysical measurement methods has on many occasions been proven to have resulted in considerable new archaeological knowledge about the layout, organisation and extent of archaeological sites ranging from the oldest era of mankind to present day. This includes more simple items like Palaeolithic fire places but even such things as urban constructions, rural settlements, grave yards and defensive fortifications.
The recent development and application of innovative measurement techniques and fast survey methods enables the generation of detailed images of archaeological structures hidden beneath the surface with unprecedented quality, redefining "state-of-the-art". Combinations of airborne and terrestrial laser scanning, hyper-spectral scanning and aerial photography with high-definition ground penetrating radar measurements, large scale magnetic surveys or resistivity measurements permit the detection and investigation of individual sites and their surrounding archaeological landscapes. Amongst all the geophysical prospection methods, only the magnetometer survey results are highly dependent upon the geographical latitude of archaeological sites. This may be one of the reasons why these methods in general are still rarely applied near to the magnetic equator or in the southern hemisphere.
Integrative GIS based archaeological interpretation of the prospection data can be used for the generation of maps and, in some cases, even for the creation of digital models of ancient buildings and constructions, forming the basis of the understanding of the site and its archaeological analysis.
The purpose of the session is the communication and presentation of latest methodological and technological developments and concepts in the field of archaeological geophysics and prospecting, describing the "state-of-the-art" as well as outlining the road ahead.

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S26. Geophysics and remote sensing for underwater archaeology: data recording, analysis and visualisation

Chairs: M. Pipan, E. Forte
Format: Paper presentation (LP)

Acoustic remote sensing and geophysical methods are widely used to study submerged sites of potential archaeological interest to provide images and maps of submerged and buried targets. Several methods can be employed, such as side--scan sonar, multi--beam sonar, acoustic sub--bottom profiling, magnetic measurement and resistivity measurement. The elusive nature of archaeological targets, often of unknown dimensions, shapes and materials, require dedicated data processing and analysis strategies to extract useful pre--excavation information from the remarkably large amount of data that can be rapidly obtained by such methods. Data integration and joint interpretation/inversion offer promising solutions to map targets of interest and to analyse their physical characteristics in order to provide useful pre--excavation information to the archaeological teams.
This session wishes to provide a showcase for methods and case histories in the field of remote sensing and geophysics in underwater archaeology. We invite integrated studies, which combine technology with integrated archaeological/ geophysical data interpretation. The key point for this session is the sharing of recording, analysis and visualisation/interpretation techniques that can be used within various aspects of underwater archaeological studies.
Papers are invited on, but not limited to, the following topics:
- Data recording, analysis and visualization in:
    - underwater acoustics/high resolution seismic
    - resistivity
    - magnetics
    - electromagnetic
- Data processing
- Data integration and visualization
- Joint inversion
- Archaeo-geophysical case histories.

S27. More than meets the eye - New techniques for analysing and interpreting LiDAR data

Chairs: A. Posluschny, R. Opitz
In collaboration with: ArchaeoLandscapes (http://www.archaeolandscapes.eu/)
Format: Roundtable

Over the past decade Airborne Laserscanning (LiDAR) has proved an important addition to the collection of archaeological surveying methods, useful for the rapid detection of new sites and features across large and varied landscape areas. To date most interpretation of lidar data has been visual, in the tradition of aerial photographic survey, but the potential uses of LiDAR data are far more varied than visual interpretations of shaded relief representations or point cloud data. This session is intended to present and discuss uses of LiDAR data beyond visualization and interpretation, e.g. the use of LiDAR data in modeling and simulations, intensity data analysis, semi-automated approaches to feature identification, and data fusion. This session will highlight the potential and problems of these methods for archaeological research and cultural heritage management. In recognition that much work in these areas is in early stages and remains exploratory, this session will be organized as a collection of presentations and round table discussions. Papers may be either 10 or 20 minutes in length, and will be grouped by sub-topic. Each sub-topic will be followed by a moderated discussion, and a general, open discussion will end the round table session. The aim of this format is to encourage open discussion of emerging techniques in lidar analysis and processing.

S28. The contribution of space technologies from site discovery to risk management

Chairs: R. Lasaponara, N. Masini
In collaboration with: EARSeL ReSeArCH (http://www.ibam.cnr.it/earsel/)
Format: Paper presentation (LP)

In the last decades, space technologies have triggered improvements in the study of human past and developments of new tools of investigation, for site discovery, monitoring, documentation, and preservation of cultural resources.
Nevertheless, still today specific methodologies need to be developed ad hoc for archaeology in order to optimize the extraction and understanding of the information content from the numerous active and passive satellite data sets.
This session, jointly proposed with SIG of EARSEL “ReSeArCH”, aims at providing an overview on qualitative and quantitative data analyses from visual interpretation to digital manipulation.
The SIG ReSeArCH organized dedicated conferences (Rome 2008, Poznan 2011) and yearly sessions within EARSEL Symposia (Chania 2009, Paris 2010, Prague 2011, Mykonos 2012) this contributing to enlarge and increase the interest of scientific community for Remote Sensing in Archaeology.

In detail, the session articulate according the following main topics:

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- From visual data interpretation to semiautomatic and automatic procedures in an archaeological perspective
- Geographic Information and Earth observation technologies for risk monitoring and management of cultural heritage
- New perspectives from space radar data
- Integration of space/air borne and ground remote sensing in Archaeogeophysics
- Study of landscape over time by means of declassified satellite images
- Tools and ideas for creating a platform to share knowledge and data.

Fields of application
Detection of archaeological sites; documentation; landscape modelling; palaeoenvironment; preventive archaeology; risk monitoring of cultural heritage.

Space Technologies and data sources
Very high and high spatial resolution satellite data; SAR; Declassified Intelligence Satellite Photographs; Spaceborne Hypespectral data.

Methods and procedures
Change detection; Classification; Data fusion / Data integration; Data mining; photo interpretation; Geostatistics and Spatial statistics; Image processing; Image interpretation; Linear and on linear statistical analysis; Segmentation; Pattern recognition and edge detection; Time series analysis; Time space modelling.

Users and interfaces: multimedia, museums and education

S29. Authenticity and meaning in Cultural Heritage interpretation

Chair: R. E. Brayley
Format: Paper presentation (LP)

This session includes papers that address the challenge of interpreting the past using digital resources while maintaining a sense of authenticity in the absence of true artifacts, dynamic human representation, and deeply spiritual contexts. Culture, sacred experience, social affinity, and intimate interpersonal relationships are difficult to portray in museum displays or interpretive facilities and media, yet they are as essential to understanding cultural heritage as the tangible products of daily life, industry, war, and ceremony. Papers in this session will explore computer applications in understanding and presenting the intangible artifacts of meaning, emotion, devotion, and cultural heritage. Papers will also consider ethical, moral, and practical concerns about interpreting sacred history through multimedia and other digital forms.

S30. Computational approaches towards artefacts studies

Chair: E. Kotoula
Format: Paper presentation (FS)

This Focus session examines computer applications in the study of artefacts from archaeological sites and museum collections. Understanding the intellectual meaning and the values of artefacts, which have reached us covered in a highly distorted and incomplete matter, is a prerequisite in order to serve their double post-excavation function, as displayable objects and as sources of archaeological information. Archaeological computing can contribute significantly using various methodological directions, including computational photography, RTI, algorithmic rendering, multispectral imaging, three-dimensional modelling, replication, rapid prototyping and 3d printing and fragments matching. Advanced digital analogues overcome problematic aspects of traditional methodologies and meet the technological needs of contemporary museum practice, regarding materials and artefact analysis, conservation, documentation and interpretation.

S31. Data capture and visualisation technologies for Rock Art

Chairs: J. McDonald, A. Paterson
Discussant: P. Bourke
Format: Paper presentation (LP)

The use of data capture and visualisation technologies has grown dramatically, embracing the needs of researchers, stakeholder communities, cultural resource managers, and tourists. We invite papers on the topic of visualisation of rock art using photographic techniques, 3D reconstruction, laser scanning and other methods.
We are particularly interested in (1) the ways that these methods are mobilised by researchers both to enhance recording and to facilitate research methodologies; and (2) the relationship between these types of technologies and the opportunities for these to communicate research results and the visual records of sites to groups outside the research community: to cultural resource managers, Aboriginal

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communities managing their heritage in a range of contexts and to tourists in interpretive displays and other virtual media.

S32. New approaches in Digital Libraries

Chairs: H. Sorin, F. Niccolucci
Discussants: V. Vassallo, P. Ronzino
Format: Roundtable

The huge number of digital heritage resources has brought in the cultural institutions the necessity to evaluate and operate solutions and policies in the preservation of this content for the next generations. Digital libraries are therefore born to meet the need of conservation of these digital resources and to facilitate their wide fruition with the necessity to structure the information following standards and ontologies.
So far digital libraries are huge containers of the resources available on line, both in private repositories and in portals created by Digital Libraries projects, that in some cases allows the users to only consult the contents without contributing to the creation of new knowledge.
From our perspective, users interaction with the structured content, is considered to be an important contribution for data enrichment and for the creation of new knowledge.
The next step in the exploitation of the digital library is to find solutions and new approaches in this research field trying to answer the following questions:
- How can we create new knowledge from existing content structured in digital libraries?
- How can users contribute in creating new knowledge?
This roundtable wants to be an opportunity to both showcase experiences facing the issue of passive consultation, through the development of new tools and new methodologies, and both to brainstorm and contribute on the investigation of new approaches and advancements in digital libraries.

S33. Open source methods and practices in heritage and archaeology

Chair: A. K. Hodgkinson, I.D. Santos
Format: Paper presentation (FS)

Open Source software and hardware alternatives are being deployed and developed by archaeologists around the world in order to replace the frequently very costly proprietary tools. From individuals to commercial companies and institutions, the discipline of archaeology has embraced the use and philosophy of open source communities. In Europe, the use of and contribution to open source projects from the discipline of archaeology is widespread. Institutions such as University College London use open source software stacks in their teaching and research. The commercial company Oxford Archaeology is moving the entire company's infrastructure over to open source alternatives. Operating systems, web browsers, GIS applications, web and server software, network visualisation, statistics software, total station download, data collectors, digital globes and more all have thriving open source communities.
In this session we would like to hear from individual researchers, project leaders and developers, academic and governmental institutions as well as commercial companies about their motives and experience of using open source alternatives in heritage. We are interested in how the software was approached, applied, whether any alterations were made to codes, and in the user experience in general. Furthermore, we would like to hear about the reception of the product, by fellow researchers or clients, or the users themselves. Support and community are vital factors when it comes to software in general, both open source and proprietary. Papers outlining experience with support, such as user and expert forums and mailing-lists would be welcome, as well as those from users who opted to pay for support while using open source tools.
Using the focus session format we would like to hear short presentations on the use of open source in various situations, experience with support and open source communities online, training and education using open source, projects which have adopted open data policies to foster collaboration. Posters detailing projects are invited as are live demonstrations and training sessions which we hope to work around the course of the conference. During the breakout session we will be welcoming demonstrations and basic instruction sessions by users in order to encourage the sharing of knowledge and use of open source software.

S39. Archaeology and the Social Web

Chair: N.Beale
Format: Paper presentation (LP)

The social web is increasingly dominant in our daily experiences of the internet. In Archaeology, there is a need to explore the extent to which resources and spaces such as social networking platforms and social media tools can contribute to our practice.
This session aims to review the approaches that we as archaeologists have been developing to appropriate web tools and resources to improve all aspects of our work.
Projects such as utilising social media for public engagement for excavations, adopting social web approaches to the creation of user generated content for Archaeology, using social network accounts to raise profiles of archaeological organisations both commercial and academic, are welcome. Topics

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covering theoretical approaches to understanding the impact that the Web more generally is having on the development and delivery of Archaeology are also encouraged.
Whilst it is difficult to predict how the web, and indeed the technologies with which we access it, will develop over the next five to ten years, it is clear with the increase in mobile device use and improvements in access to the Internet infrastructures, that the social web experience is here to stay. Archaeology must continue to find its way in the social web, and indeed to contribute to the development of this aspect of the online world.

S40. Archaeology got game?

Chair: Luke Benbow
Format: Paper presentation (LP)

Archaeology has been featured in literally hundreds of films and computer games over the past fifty years or so. The manner in which Archaeology has been utilized/portrayed through these different mediums varies greatly, and has, to some extent, shaped the way modern audiences view the field of archaeology. While the communication of archaeological themes and topics through computer games is not an original concept, the development of increasingly complex graphics and physics engines has allowed archaeologists, curators, and educators more broadly, to communicate about archaeology in increasingly sophisticated ways. The purpose of this session is thus to a) explore the manner in which Archaeology has been utilized/portrayed in computer games in the past, b) identify the issues associated with communicating archaeological themes through such mediums, b) extrapolate how archaeological themes may be integrated into the games of the future, with particular focus on the use of computer games in education.

Cultural heritage management and interpretation

S34. Digital Cities and archaeologies of the past

Chair: F. Morel-EdnieBrown
Format: Roundtable

As the world becomes more globalised, and urbanisation swallows the landscape, what role can the past play in determining our future?
This session explores both the physical archaeologies of the urban environment and the psychological archaeologies of interpretation and seeks to discover the interface of authentic interpretation in digital cities and their representation. The session seeks to be interdisciplinary and multi-disciplinary and can explore the integration of digital techniques with other more traditional methodologies.
Proposed papers can focus on both theoretical and practical aspects of this work but must clearly show how understanding the past is an integral aspect of the commutation of knowledge to the future and extend the conceptual and digital discourse for doing so.

S35. Enriching 3D visualization: linking supplemental materials to 3D models of cultural heritage sites

Chair: L. Fischer
Format: Paper presentation (FS)

A 3D virtual reconstruction of a cultural heritage site can be an effective visualization tool, but its educational and research value can be enriched through the connection of related data, text, and media to the model. This additional content can serve a variety of purposes and may be aimed at different audiences. If a model is designed to educate the public, the additional information may be intended to provide general historical context or specific information about individual buildings or objects within the scene. For models designed for scholars and researchers, the supplementary information may be the archaeological data on which the model is based or a record of the modeling decisions, to make the visualization process transparent. Determining how to link and present these additional materials, whether text, image, or structured data, however, can be much more complicated within a 3D environment as opposed to 2D. 3D GIS software works well for some types of visualization and analysis, but it does not necessarily meet the needs of all 3D virtual heritage reconstruction projects. Some projects make use of gaming engines, customizing the interface to present the supplemental materials, using techniques, such as creating hotlinks within the model or returning information based on the user proximity to objects within the space.
This Focus Session will bring together projects embedding and linking information to 3D models of cultural heritage sites to enrich their educational and research value. What technical approaches are being used to connect the data, text, and other media to the models? How is this additional content being managed and presented? What types of information and formats are being connected and how is the overall narrative constructed? What is the level of detail on which the end user can query: can a user learn about a general space as well as individual objects, features within that space, or is there some other unit on which the information is based? Can users explore a model freely to access the information, or is the path predetermined to follow a prescribed tour through the virtual world? Is it

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possible to add too much information, thereby decreasing the effectiveness of the user interface? What are the challenges in linking information to 3D models?
In this new Focus Session format, presenters will each give a 5 minute overview of their project. Then they will present a poster or demo their model(s), allowing session attendees to engage more closely with individual projects and explore the different approaches more closely.

S36. Preservation of Industrial Heritage

Chair: T. Morrison
Format: Paper presentation (LP)

Preservation of industrial heritage has presented challenges which are becoming increasingly relevant with the demise of some industries, the need of continuous modernisation of the sites and the spread of the outer suburbs of cities into land that was traditional industrial. The massive scale of the industrial sites makes them difficult to preserve and/or re-use. Generally their preservation is reserved for cultural purposes such as museums and concert halls. For example Tate Modern, London originally the Bankside Power station designed by Giles Gilbert Scott and completed in 1949 and Zollverein industrial complex in Land Nordrhein-Westfalen, Essen, Germany consists of the complete infrastructure of a historical coal-mining site, this site was listed as a UNESCO world heritage site and in 2010 Ruhrland Museum, a regional-history museum located in the colliery's coal-washing plant opened. These preservations are dependent on the industrial sites being no longer economically or environmentally viable. This raises the question, how is the heritage of industrial sites that are economic and viable being preserved? In the past has been the role of museums to represent lost heritage. However, with the increasing use of information technologies such as virtual reality, augmented reality, computational analysis, social network and mobile devices a new concept of preservation is merging. This section is open to papers that use emerging technologies to 'preserve' both lost and current industrial heritage.

S37. General session

Format: Paper presentation (FS)

This session is for any papers which do not obviously fit in another session. They may be reassigned as appropriate by the Review Committee.

WORKSHOPS

The conference will include a number of half and full day pre-conference workshops to be held on campus on March 25th. Workshops will generally include practical work or other active participation of attendees.
Detailed information about participation requirements and enrolment details will be provided in a separate communication.

W1. Complex Systems and Agent-Based Modelling in Archaeology

Chairs: E. Ch'ng, C. Vegvari
Discussants: I. Romanowska, T. Brughmans

Modelling in various forms has always been an integral part of archaeology. In the broadest sense, archaeology is the study of human activities in the past, and a model is a simplified representation of reality. As a map is a useful abstract of the physical world that allows us to see aspects of the world we chose to, so a computational model distils reality into a few key features, leaving out unnecessary details so as to let us see connections. Human societies in their environmental context can be considered as complex systems. Complex systems are systems with many interacting parts, they are found in every hierarchy of the universe, from the molecular level to large planetary systems within which life and humanity with its cultural developments occur. Formal modelling can help archaeologists to identify the relationships between elements within a complex socio-environmental system in that particular hierarchy. Simulating large populations and non-linear interactions are computationally expensive. In recent years, however, the introduction of new mathematical techniques, rapid advances in computation, and modelling tools has greatly enhanced the potential of complex systems analysis in archaeology. Agent-Based Modelling (ABM) is one of these new methods and has become highly popular with archaeologists. In Agent-Based Modelling, human individuals in ancient societies are modelled as individual agents. The interaction of agents with each other and with their environment can give rise to emergent properties and self-organisation at the macro level – the distribution of wealth within a society, the forming of cohesive groups, population movements in climate change, the development of culture, and the evolution of landscape use are among the examples. Thus, the application of Agent-Based Models to hypothesis testing in archaeology becomes part of the question. The ability to construct various models and run hundreds of simulation in order to see the general developmental trend can provide us with new knowledge impossible in traditional approaches. Another advantage of agent-based models over other mathematical methods is that they can easily model, or capture heterogeneity within these systems, such as the different characteristics (personalities, gender,

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age, size, etc.), preferences (coastal, in-land, food, fashion), and dynamics (microstates of position and orientation).
We would like to invite archaeologists new to complex systems and Agent-Based Modelling for an introductory workshop on Complex Systems and Agent-Based Modelling in archaeology. The workshop introduces the concept of Complexity in archaeology, drawing relationships between Information, Computation and Complexity. The practicality of the workshop leads beginners in building simple agent-based models and provides a means to build more complex simulations after. Participants knowledgeable in Complexity wishing to gain insights on real-world applications of Complexity will benefit from this workshop. Participants will get the opportunity to experiment with simple models and draw conclusions from analysis of simulations of those models. Programming experience is not required as the workshop leads beginners from the ground up in modelling tools.

W2. ECAI Workshop: CAA 2013 Perth, Australia
Chair: L. Lancaster

The ECAI Workshop has been a part of CAA meetings in Vienna and Fargo. This one is a follow-up to our 2012 meeting at University of California, Berkeley, 2011 in Taipei, Taiwan and the 2010 one in Chennai, India.
The workshop will have two parts:

(1) Consortium of Cultural Atlases (morning session). We will have reports from groups that are actively working on specific atlases:
(a) Atlas of Maritime Buddhism
Dr Dayalan, Senior Director of Archaeological Survey of India (South Indian States)
"The GIS mapping of all Buddhist Archaeological Sites in Tamil Nadu"
(b) Atlas of Asian Religions
Jeanette Zerneke, ECAI Berkeley
"Technical Features of Mapping Multiple Sites with Metadata"
(c) Technical Report and training for Consortium of Cultural Atlas at Academia Sinica, Taiwan
Professor I-chun Fan, Director of GIS Center for Historical GIS

(2) Annotated Analytics for Archaeological data (Afternoon session)
(a) New Publication Digital Content and Format
Professor Lewis Lancaster, ECAI
(b) Production of Annotations for Cultural Analytics
Howie Lan, ECAI.

The workshop will be open to those who only wish to hear the presentations but are not involved in creating datasets. Our participants are expected to come from India, Malaysia, China, Taiwan, Mongolia, Kalmyk Republic, Australia, Singapore, Hong Kong, USA, Vietnam and tentatively from Germany and Russia.

W3. Federated Archaeological Information Management Systems (FAIMS): a hands-on demonstration of prototype mobile device applications and online services
Chairs: Ross Shawn, A. Sobotkova. P. Crook, B. Ballsun-Stanton

FAIMS (Federated Archaeological information Management Systems) is a project funded by National eResearch Collaborative Tools and Resources (NeCTAR) to create infrastructure for the collection, analysis, and dissemination of digital archaeological data. It includes participants from 41 organizations, including professional or academic researchers from 16 Australian universities, seven Australian archaeological consultancies, 10 foreign organizations, the Australian Society for Historical Archaeology, the Australian Institute of Maritime Archaeology, and the Australian Archaeological Association. The goal of the project is to produce a comprehensive information management system for archaeology. Through community engagement it will develop flexible, robust and extensible data standards, and employ those standards to federate a range of new and existing components for acquiring, analysing, and archiving archaeological data. It will allow data from archaeological field and laboratory work to be born digital using mobile devices, processed in local databases, published online through cultural heritage registries and data repositories (including cloud-based implementations), shared as open linked data, and extracted to online workspaces for reconciliation and analysis. Existing standards and components are used wherever possible; new ones are proposed for development only where necessary. Documentation and developer kits will be produced to facilitate the federation of new components. Since the needs of archaeological fieldwork and research vary, the project hopes to develop the core of a federated, open-source system, encouraging the growth of a wide and expanding range of options at each stage of data processing.
More specifically, the information management resources envisioned by this project will consist of four broad categories of components, corresponding to the major stages in the life-cycle of archaeological data: (1) mobile and desktop applications for the digital acquisition of archaeological data; (2) operational databases optimised for input and editing for the manipulation of data; (3) online repositories optimised for storage and dissemination of data; (4) statistical, analytical, and visualisation

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tools for knowledge discovery. Many components of this system already exist, particularly online repositories for various types of archaeological data. Categories (1) and (4) above are currently the least developed, and will require the construction of new mobile applications and analytical tools. This workshop will evaluate early versions of these mobile device applications and analytical tools.

Participants in this workshop will engage in a hands-on demonstration of prototypes developed by the project, providing feedback on various elements of design and performance. These newly developed prototypes (released between October 2012 and March 2013) will include both mobile device applications for data capture, and online analytical tools. Participants will have the opportunity to handle mobile devices loaded with early releases of the applications, and access demonstration versions of online tools for combining and analysing data from multiple datasets. Feedback received during this workshop will be used to inform future development of these tools and resources (through the remainder of 2013).

We will have specific questions for workshop participants, but also encourage free responses and suggestions. Further details about the applications and services being demonstrated for feedback will be made available in early 2013.

Participants should bring their own laptops to access online resources. Mobile devices will be provided. No prior knowledge or skills are required; the purpose of this workshop is to solicit feedback from as wide a range of archaeologists as possible – we look forward to hearing from users with previous experience of mobile device applications or archaeological databases and encourage their participation, but such experience is not a prerequisite. At least two facilitators will be present, and we can provide at least three mobile devices. We want to give participants plenty of time to play with the applications and then provide their impressions.

W4. Generating georeferenced 3D models from overlapping images using free software

Chair: B. Ducke

Computer Vision is the computationally intense field of research into methods for extracting 3D information from overlapping digital images. This is an applied science that aims to produce robust, scale free and fully automatic tools for use in autonomous systems. The methods demonstrated in this workshop work with minimal assumptions regarding the input data, low cost hardware and free software. Archaeological applications are plentiful, including 3D artefact models and architectural recordings, image rectification and production of digital elevation models. Participants of the workshop will be provided with an introduction to key concepts of computer vision (such as Feature Tracking and Structure from Motion), basic guidelines for good practice and a hands-on tutorial to the generation of 3D models from digital images.

The software used in this workshop is freely distributable and runs on Windows, Mac OS X and Linux operating systems. Participants are welcome to bring their own laptops, but available PCs in the seminar room can also be used. The software requires no installation or administrator rights. Participants bringing their own laptops should contact the workshop lecturer in advance, to obtain the software and install it on their machines.

W5. Hands-On Archaeological Conceptual Modelling

Chair: C. Gonzalez-Perez, C. Hug

Research and practice in archaeology often generates, and needs to manage, a large amount of information, which exhibits complex relationships and categorisation phenomena. The quality of the conceptual models that we use when gathering, organising, processing and reporting this information determines, to a large extent, the quality of our work. Creating explicit, high-quality conceptual models is a crucial task in any information-intensive endeavour, and especially in those where the complexity of the information means that intuition alone is not sufficient.

This workshop aims to introduce the discipline of conceptual modelling, often seen as pertaining to the engineering world, to archaeologists and related professionals. This introduction will be achieved by hands-on work, i.e. doing and experimenting rather than through theoretical explanations. The organisers have extensive experience in using conceptual modelling in archaeological domains for over 15 years, and will use ConML (www.conml.org) as a vehicle. ConML is a simple, high-level, affordable, powerful modelling language specifically designed with the humanities and social sciences in mind. In addition to supporting most of the object-oriented structural modelling constructs, ConML extends them with concerns that are rarely seen in industry-standard approaches but which are extremely important in archaeology, such as the ability to express temporality and subjectivity in conceptual models. The workshop will assume no previous knowledge of conceptual modelling, although it will assume familiarity with archaeological concepts and practice. It will begin by teaching the basic tenets of object-oriented structural modelling, followed by more advanced concepts and situations. Participants will be asked to undertake an extensive array of exercises and practical cases in the archaeological domain, either individually or in small groups, throughout the workshop. The maximum number of participants is estimated at 20.

Similar experiences have been carried out internally at Incipit, in the form of postgraduate courses at CSIC, and as workshops at various editions of the CAA conference, with excellent results in all cases; archaeologists, historians and architects with no previous exposure to conceptual modelling were capable of creating good-quality models after a few hours of practice.

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W6. LiDAR processing in Archaeology using LAStools

Chair: M. Isenburg

Low flying aircrafts equipped with modern laser-range scanning technology (LiDAR) can collect precise elevation information for entire counties or even states. By shooting 200,000 or more laser pulses per second onto the earth's surface they take measurements at ever increasing resolutions. Because the laser beam can penetrate even dense forest canopy it is possible to subsequently compute detailed digital terrain maps from the acquired LiDAR points. The new capability to literally "look through the canopy" has proven useful to aid archaeological discoveries. The figures on the next page illustrate this nicely with an example from geology where the same technique is able to visualize hidden volcanic structures. However, the sheer amount of LiDAR data poses a significant challenge as not millions but billions of elevation samples need to be acquired, stored, processed, and analyzed.

In this workshop, I will give a hands-on introduction on efficient processing of large amounts of airborne LiDAR using the LAStools software suite. Starting with how to find sources from which public LiDAR data can readily be acquired, over simple tricks for efficient downloading and management of these massive point data sets, I will present the entire processing pipeline. Initial understanding and basic quality checking of the downloaded data, preparing the data for processing, extracting the bare earth points, generating Digital Terrain Models (DTMs) and Digital Surface Models (DSMs), computing the height of the canopy, and finally visualizing the generated rasters as hillshaded terrains under different lighting conditions to aid visual discovery of structures beneath the canopy.

During the hands-on part of the work shop I will only use a rather small LiDAR file which will allow us to work in real-time and give the audience the chance to follow along on their own laptops (software and example data will be made available for download) or conference computers (Windows only). At the end I will explain how to scale up these very same computations to run across the Gigabytes or the Terabytes of LiDAR data that they are either already working with or can expect to be soon. For this last part I explain the use of simple example batch scripts that attendees should only have to slightly modify to meet their own particular needs when running on their data back home.

The attendees should be familiar with basic computer skills. Computer participation will be optional as all steps will be demonstrated on the projector screen.

W7. Modelling, linking and publishing data: a rapid introduction to managing data in Heurist 3

Chairs: S. Hayes, S. White

H3 is a sophisticated information management tool with the ability (among other things) to rapidly create new collaborative databases and define and evolve their structure through a web interface, annotate text and images, build and visualise relationships and interactive maps, handle maps, images and multimedia, and publish data selectively to web sites and to repositories. It is used by a number of major projects including the Dictionary of Sydney (dictionaryofsydney.org) and Zagora 3 (legacy data publication and new excavations at the major site of Zagora in Greece).

Heurist is a mature system now at version 3 ('H3'). The 2012 version is a significant upgrade on previous versions, allowing local installation as well as web access. It includes better support for linked open data; photography stored in image sharing services can for instance now be referenced directly rather than stored locally; improved mapping and timeline functions; improved workflows and documentation. Advanced users can add their own publishing formats and custom applications. H3 is now available on Virtual Servers and is being migrated to the NeCTAR Research Cloud as part of the recently funded Humanities Networked Infrastructure project (HuNI). It will also be available as part of the Fieldwork Archaeological Information Management System (FAIMS) infrastructure project.

In this workshop we will focus on modelling and linking research objects (sites, phases, layers, deposits, structures, artefacts, maps, photos, type specimens etc.). H3 presents an innovative and compelling approach to understanding and managing a web of distributed research objects and we expect the small group of participants to enjoy a lively afternoon.

The workshop is limited to 8 participants and will be run by Steven Hayes and Steve White from The University of Sydney's Arts eResearch Unit. Participants are encouraged to bring their own laptop with the latest version of Chrome or Firefox and to bring examples of research data that is of interest. We recommend sending a general description of your data to Steven Hayes/Steve White at least a week prior to the workshop - the small size of the group and the inherent flexibility of H3 will allow the team to customise the workshop to the specific needs of participants.

Participants will set-up a working Heurist H3 environment that they can continue to use with confidence after the workshop. Participants will leave with a full H3 installation package, the database they create and extensive documentation. The team will also provide participants with up to two hours of post workshop Heurist support.

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W8. Semantic Vocabularies and Linked Data Workshop

Chairs: G. Lange, C. Binding, M. Lang, K. May

The purpose of this workshop is to explore the use of semantic vocabularies in archaeology and their expression as Linked Data. Topics will include participants' experience with SKOS thesauri, gazetteers and associated Web Services. The relationship between SKOS thesauri and ontologies will be explored. We will experiment with existing tools and techniques for creating and using vocabularies. Techniques for publishing vocabularies as Linked Data will be demonstrated and discussed, together with methods for making use of this Linked Data. We will also collaboratively discuss and develop use cases in post excavation analysis and publication of excavation data and interpretations. The workshop builds on experience with national research council funded projects and ongoing European projects, together with workshops at previous CAA conferences.

W9. Archaeological Interpretation and Airborne Laserscanning

Chair: R. Opitz

This workshop focuses on the theory and practice of the archaeological interpretation of ALS data. Over the past decade Airborne Laserscanning (ALS or lidar) has proved an important addition to the collection of archaeological surveying methods, useful for the rapid detection of new sites and features across large and varied landscape areas. Archaeological projects employing ALS for base mapping, prospection, and analysis are increasingly common. While archaeologically driven ALS surveys remain exceptional, substantial archival data sets are available for public use in some areas, national collect programmes are being established, and data can be acquired at a lower cost through collaboration with agencies and organizations collecting data for forestry, hydrology etc., bringing it within reach for many projects. In addition to a strong understanding of the fundamentals of the tools and techniques used in the processing and manipulation of ALS data, good interpretive skills are essential. ALS interpretation combines aspects of traditional aerial photographic interpretation with a variety of data visualization techniques geared towards identifying patterns and wrangling big data, and often integrates manual and semi-automated tasks. This workshop will provide an overview of approaches to interpretation and information extraction developed by organizations working to integrate large ALS surveys into their cultural heritage management and research practices.

The workshop is organized into four modules:

1. Visualization tools and techniques (open source software solutions)
2. Aerial Imagery reading skills
3. Point Cloud reading skills
4. Integration with field data