S16 Networking the past: Towards best practice in archaeological network science

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The full diversity of network perspectives has only been introduced in our discipline relatively recently. As a result we are still in the long-term process of evaluating which theories and methods are available, the 'fit' between particular network perspectives and particular research questions, and how to apply these critically. How can network science usefully contribute to archaeological research by enabling archaeologists to answer important questions they could not have answered through other approaches? In what circumstances is the use of network science techniques appropriate? There is a need to address these questions by working towards guidelines to best practice in archaeological network science. This is a goal that should be achieved by a community of scholars in collaboration, drawing on the lessons learned from applying network science critically and creatively in a diversity of archaeological research contexts.

This session aims to build on the growing interest in and maturity of archaeological networks science to lay the foundations of guidelines for best practice in archaeological network science. It invites papers debating best practice in archaeological network science, addressing methodological and theoretical challenges posed by the archaeological application of network science, or presenting archaeological case studies applying network science techniques. It particularly welcomes papers presenting work in which the use of network science techniques was necessary and well theoretically motivated, and papers applying network science to exploring 'oceans of data'.

S16-01 A guide to good practice for archaeological network science

Tom Brughmans

The use of network science techniques for the study of the past shows great potential and has recently become more common practice. However, this increased use of network science techniques has also led to the identification of particular challenges posed by their archaeological application, which deserve more critical attention. In order to overcome all these challenges and uncover new and useful archaeological uses of network science it is important that archaeological network science should be considered more than just a hype: archaeological network scientists should be cautious to make grand claims about the novelty of their methods and instead enable a larger body of archaeologists to critique their approaches.

In this talk I will argue there is a need for best practice guidelines for archaeological network science. I consider this a task that should be performed in collaboration with more mathematically- and computer-literate archaeologists, who should work towards a 'guide to good practice' accessible to all archaeologists, and provide critical applied case studies as examples. By doing so, archaeologists will be provided with the means to evaluate how and whether network science is a tool that can lead to innovative insights in their own research contexts, as well as enable a larger group of archaeologists to critique the ever increasing number of archaeological network science studies.

S16-02 Exploring formal SNA approaches to funerary contexts in Early Iron Age Italy

Lieve Donnellan

This paper explores various possible ways to analyse evidence from funerary contexts with formal SNA methods. Despite the availability of large datasets from grave yards of the Early Iron Age in the Mediterranean, formal SNA has hardly ever been applied to this type of data. Research of funerary contexts has traditionally focussed on typologies of objects and tombs, and the religious meanings of death, but a formal SNA has the potential to contribute

significantly to the scholarly understanding of a number of aspects, going from trends in the overall population, the evolution of such trends through time, to social stratification strategies, such as social distance through ritual performance, and intercultural interaction. The paper presents a summary of the analysis from two case-studies from Campania (the sites of Pithekoussai and Pontecagnano), whose funerary data sets have been digitised and subsequently analysed with SNA software. Various analytic tools, offered by standard SNA software packages, allow to ask and reassess several questions pertaining to the social make-up and interaction of the populations in question. The paper focusses especially on methodological questions and problems in translating conventionally-published excavation data, deriving from funerary contexts, to digital datasets that can be analysed with formal, quantitative methods. It also elaborates on some tools, available in standard SNA packages, that can be used to study social and cultural interaction in past populations.

S16-03 Wine trade from Roman Crete: Onomastic─geographic network analysis

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We present a case study developed within the EPNet Project (ERC-2013-ADG 340828), whose main goal is to characterize the dynamics of the commercial trade system during the Roman Empire.
We analyse a subset of archaeological data found in Pompeii, namely, the greek epigraphy (tituli picti) on the cretese amphorae. It represents a promising dataset, given that greek names can be crossed with the Lexicon of Greek Personal Names (LGPN) and linked to geographical data. Since we deal with two different kinds of entities, names and places, we represent the relations between them through a weighted bipartite network.
The bipartite network is built considering that the epigraphic data is incomplete and ambiguous, and foremost, that there are a few onomastic aspects to be taken into account. On the one hand, there are some very common names (homonimy) that don't provide significant information. On the other, there exist highly similar names that are likely to belong to the same families. Therefore, we introduce a set of probabilistic rules to weigh the links of our network that, together with the reference of the whole LGPN, allow us to: Include the ambiguity of the data with very few assumptions. Identify homonimy cases and remove its effect. Check for family names grouping.
With the aim of detecting relevant trade-related information, we extract the community structure of the bipartite system. It is an appropriate baseline to detect different types of nodes according to their function in the network [1]. The goal is to identify possible roles for the names and places as a function of two topological variables in two-mode networks [2], by means of a functional cartography of families and places of different types (ports, production and consumption places, etc.).
[1] Guimer├á & Nunes Amaral (2005) [2] Saavedra et al.(2009)

S16-04 Least-Cost Networks and Network Analysis: Modelling trade relations in early medieval East Central Europe

Donat Wehner
 Medieval trade relations can be considered from many different angles. One can attend to the actors, their identities, motivations, manners and perception as well as the circumstances of travelling and equipment or one can deal with types and amount of traded goods, to name just a few of the possible aspects. The concern of this contribution is to reveal the structures, intensities and directions of commodity flows on different spatial and temporal scales in East Central Europe in the Early Middle Ages. Networks of nodes and edges serve as visualizations of the economic relations. Sites with an increased density of interaction function as nodes, economic flows on transportation routes between these nodes serve as

edges. The commodity flows can be weighted asymmetrically as well as differentially. Starting from networks created from least cost path routes and graph theoretical models network analysis and space syntax are used to obtain additional information on the structural characteristics and mechanisms of the networks. One issue is the network density. Are there many trade relations or rather few? Bridges and structural gaps are of interest as well. Do sites exist which connect economically densely entangled areas and where are such areas not connected? The importance of different sites in the exchange-networks is also relevant. It can be defined e.g. by the amount of relations (degree centrality), the closeness to other interaction hubs (closeness centrality) or in its strategical position between other interaction hubs (betweenness centrality). In order to achieve a dynamic and differentiated result, multiplex multimodal network analysis is used. Different artifact- groups like coins, so called imports, scales and weights as well as geographical distances and written sources of trade relations in diverse place-time-configurations are included as representatives and parts of trade. By combining various relevant models, data records, spatial layers (local, regional, supra-regional) and time slices, dynamic networks can be created and interpreted in a comparative and complementary way. This approach provides an opportunity for understanding the significance of relationships within and between past material culture, individuals, and groups. The alternating relation between physical distance, commodity distribution and contemporary perception of commodity flows can for example be identified by using affiliation-networks of Least-Cost Path relations, artifact-relations and trade relations known from written sources. One gets an idea of different types of linking in the context of trade activities, what they are good for and how they are related to each other. Thereby, connections in the network can be favored, created or handicapped and impeded by space. Complex feedback-loops between the creation of space through networks and the creation of networks through space can be observed. By doing so, mediation between physical and social space is created similarly.

S16-05 Geometrical and planar graphs in ancient iconography studies, a heuristic tool
Thomas Huet

By definition, Prehistory's symbolic systems are not readable; one of the main attributes of the writing - the syntactical axe- is lacking in almost all of ancient iconographical compositions (painted caves, engraved rocks, ceramic decorations, etc.). In those compositions, graphical units (GU) are commonly displayed with what Chippindale called a "weak tendency of avoidance" between each other. Therefore, despite the chrono-cultural attribution work (by comparison, study of superimpositions, seriation, etc.) of GU, recognition of associations and recurrent compositions (patterns) remains difficult. Furthermore, in almost all statistical analysis on ancient iconography, GU are quotes in term of presence/absence in data table and their proximity links are lost during the analysis process. We will present different cases studies showing how geometric and planar graphs, belonging to network analysis, are heuristic tools to manage "weak organised" compositions of graphical units.

S16-P1 Artificial Neural Networks to estimate Paleotemperatures in North Patagonia (Argentina) based on micromammals sequences
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Small mammal's assemblages from archaeological sites were employed worldwide as proxy data to reconstruct paleoenvironments. However, the scope of these researches allow indirect paleoclimate inferences. The aim of this work is based on the use of neural networks (NN) to predict paleotemperatures during Middle and Late Holocene in northern Patagonia based on the presence/absence of rodent species from stratigraphical sequences. The study area is the Natural Protected Area of Somuncura, a massive volcanic plateau located in the Extra-Andean

Patagonia, in which successive basaltic flows, step-like landform, set an elevational gradient between 600 and 1800 m a.s.l. At present, the annual average temperature decreases with the altitude (linear model, r=-0.96376, m= -0.0061, b= 15.456) but the annual average precipitation remains slow and constant (187 mm). This steep altitudinal gradient configures the assemblage composition of small mammals and plants along the gradient. Small mammals contained in diverse samples stem from owls' regurgitate balls and recovered along this gradient, and the temperature estimated at each locality by the regression model were employed as the actual correlate of the network. NN allowed discriminating species that distribute in colder environments (and upper levels) and those from wormer environments (and lower levels). The temperature parameters used to build the network were inferred from the sequence of micromammals with a predicted limit temperature of 9.5 ºC. Results show that during colder periods micromammals from the current upper levels would have occupied lower levels, while the opposite would have happened in warmer times, micromammals from lower levels have occupied the upper plateau. The model reproduce well the temporal correlation of the observed data and indicates that the spatio- temporal informations and an accurate classification of micromammals is essential for NN predictive time series with incomplete data bases.