Network Theory and Computer Modeling in the Study of Religion

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ABSTRACTS

A Generative Historiography of the Ancient Mediterranean (GEHIR)

Tomáš Hampejs
Sixteen months of generating ancient history: short introduction to project GEHIR

CHRISTROME - Christianization of Roman Empire: Diffusion on a Settlement Network: Modelling Christian Origins in Laboratory of Ancient Mediterranean

Vojtěch Kaše
Historic background and sources
At the beginning of the fourth century, Christians already constituted a substantial proportion of population of the Roman Empire, especially in eastern provinces, but also in Italy, North Africa or Spain. With its origins in 1st century Palestine, Christianity reached some locations earlier than others and blossomed in some places better than others. Using network analysis and computational models of the diffusion of innovations, our research project aims to evaluate several factors which could be responsible for the observed temporal and spatial distributions. We hypothesize that the scarcely evidenced temporal and spatial distribution of Christianity over the Roman Empire can be re-grown in an artificial simulation environment as a diffusion of innovation model on a Roman travelling network of roads and maritime routes, which connects respective settlement sites to one another. We consider only (1) the travel expenses, (2) population sizes and economic importance of reachable destinations and (3) exponential grow of Christian number, while all the other environmental variables can be ignored for the sake of the analysis. In the Graeco-Roman context, an adherence to a religious cult was typically expressed by one's inclusion in a certain social unit (extended family, association etc.), rather than by personal decision and commitment to a set of beliefs. Therefore, Christianisation, too, can be approached on the level of practices of social groups instead than on the level of decisions of individuals. In that respect, by Christianisation we mean a twofold process: 1) by horizontal Christianisation we refer to a process concerning how worldviews and ritual innovations spread from one group to another; 2) by vertical Christianisation we refer to a process, not a moment, of continuous implementation of these innovations into the social practice of certain social group. At the current state of research, we are focusing more attention on the horizontal aspect.

Jan Fousek

Agent-Based Modelling and Simulation for the Geospatial Network Model of the Roman World

Computational models have large potential for enhancing our understanding of human-environment interaction as a factor in various social and historical phenomena. One such an approach are agent-based models that provide useful model paradigm for human behavior. When coupled with geospatial data, such models can be spatially explicit, and have variety of applications in computational social science.

The ORBIS project provides a geospatial network model of travel in the Roman Empire. It combines the road network with maritime transport model derived from historical data, and provides cost and time expense prediction for given routes. The time and cost prediction take into account various influential factors, such as seasonal changes, distinguishes coastal and open sea routes, and onshore means of transport. Currently the online interface enables the researchers to examine routes between given locations, analyze distance from one location to all others, and visualize the importance of paths connecting a given location to the rest of the network.

In our case, we use agents traveling between the cities of the Roman Empire on routes defined by the ORBIS transportation model. As the preferred routes can change depending on season and other external factors, advancing the model from current average estimates to probabilistic distributions derived from the simulation will provide with better understanding and robustness to subsequent analysis. The agent-based approach allows for such probabilistic simulations, and it is a direct extension of the current model.

In this paper we present a computational environment for agent-based modelling on the ORBIS geospatial transport model. We provide web-based interface to specify the agent-based model and visualize the results of the simulation. We also enable the user to specify the parameters of the transportation model to create and visualize a static network, with the possibility to download the network for further analysis. The functionality of the environment is demonstrated on a model of diffusion process on the transport network.

MITHORIG: Generating Origins of Mithraism

Aleš Chalupa

Historic background

The origins of Mithraism remain an unsolved puzzle. Various competing scenarios of Mithraic origins have been presented since the beginning of Mithraic studies, none of these, however, can be unequivocally supported by the oldest archaeological evidence. The papers gives a short overview of this historical problem and a presentation of sources used in the study of Mithraism, with a particular focus on their possible limitations and problems.

Eva Výtvarová

Challenges and future prospects

Based on the presentation of accessible sources, this paper explores the possibility that a quantitative network analysis of the spatial and temporal distribution of the archaeological and epigraphical evidence related to Mithraism might possibly shed some light on the process

of the formation of Mithraism and lead to an identification of a geographic region from where the cult most likely started to spread. Results of such an analysis might thus help scholars to evaluate competing scenarios of Mithraic origins and partly overcome the problem of the lack of relevant evidence.

MARLUK: Mathematical Modeling of the Lukan and Marcionite Christianities
Between Luke and Marcion: Hypothesis Testing in the History of Christian Origins

Dalibor Papoušek
Historic background
The paper reconsiders the dynamics of Jewish and non-Jewish networks in the spread of early Christianity. For the mathematical modeling of complex processes like these it uses the Lukan and Marcionite Christianities as a strictly coded test case. Despite weak historical evidence, it is obvious that these two trends maintained different attitudes to the Jewish heritage and so they probably used different, i.e. Jewish and non-Jewish networks. While the Lukan Christianity, which remained open to the Jewish tradition, might still utilize Jewish Mediterranean networks, the Marcionite Christianity, which rejected the Jewish heritage, probably preferred trade maritime networks which might use the infrastructure provided by its founder's shipping company. The model tests two hypotheses of spreading dynamics based on different historical presuppositions (central role of Jerusalem versus decentralized networks, long-lasting importance of Jewish versus non-Jewish networks, etc.).

Zdeněk Pospíšil
Centralized and Decentralized Networks in the Spread of Early Christianity: Mathematical Modeling of the Lukan and Marcionite Christianities
Inspired by ecological models of metapopulation dynamics (Turchin), there is constructed a mathematical model of spreading the two types of Christianity on networks. The nodes of the hypothesized network are common for the both types – they might interact in ancient Mediterranean sites, but their diffusivities between nodes differ – they might spread on different connections, i.e. Jewish and non-Jewish. The issue is analyzed within the centralized and decentralized networks which might plausibly represent an ambivalent role of Jerusalem during the first two centuries of the spread of Christianity. The model shows a possibility of emergence phenomena that cannot be analyzed by conventional historical methods.

ISISCU: Modelling Isiac Cults between Trade and Politics

Tomáš Glomb
Attracting the Gods: How to Model the Spread of the Egyptian Cults in the Ancient Mediterranean
Early in the Ptolemaic era, the Egyptian cult of Isis and Sarapis spread successfully to ports in the ancient Mediterranean. The reasons standing behind this process are however only partially understood. The main hypotheses in the academic discussion emphasize either the maritime trade network or Ptolemaic political propaganda as key factors in the spread of this cult. Both of these claims are supported by historical evidence. Ptolemaic Egypt was one of

the main exporters of grain, Isis was a patron goddess of sailors and many cities in the ancient Mediterranean had close diplomatic relations with the Ptolemies. In order to clarify which factors could be advantageous for specific locations in the question of the spread of the cult of Isis and Sarapis, this paper introduces a model which based on environmental and political datasets determines the theoretical political and trade attractivity of these specific places for potential Egyptian visitors.

Adam Mertel
Environmental Models for Ancient History
GIS technologies are currently penetrating various fields of science and Religious studies is not an exception. Within this case study GIS methods were used mainly for building an environmental model to be able to estimate agriculture conditions of each relevant island. Combined with the dataset of army bases, temples and trade maritime routes, it was able to correlate the presence of particular cults with particular environmental or demographic factors, like potential starvation, population density, trade network centrality value or army influence.

Secrecy and openness in early modern transconfessional correspondence

Ingeborg van Vugt
This contribution explores the use of multi-layered networks to analyse secrecy and openness in epistolary networks in the dissemination of books that are contested for religious disputes. In particular, it questions how scholars were able to overcome obstacles in the exchange of illegal literature between Catholic Tuscany and the Calvinist Dutch Republic in the early modern period. Scholars between these two contrasting societies had to maintain a balance between, on the one hand, the will to distribute prohibited books and to express controversial ideas and, on the other, social control and the need to avoid the objections of powerful political and religious institutions (Index librorum prohibitorum) and individuals. The representation of epistolary networks, in which both persons and prohibited books constitute the nodes, presents very interesting angles to understand how (and if) scholars were able to break with the oppressive environment that encircled the Republic of Letters.
This study is based on the assumption that full data integration, in particular when dealing with early modern correspondence, is impossible for reasons of incompleteness, complexity and uncertainty in data. Therefore the focus should not be on analytical and statistical methods of network representations alone, but on approaches that allows historians to handle, inquire and interpret these complex historical data. We do not need just networks as static representations, but also networks as interactive interfaces. Those interfaces are created through Nodegoat that enables us to build up epistolary networks by means of data integration from archival research contextualised by various data resources such as the Short Title Catalogue of the Netherlands (STCN).

Simulating ancient audiences

István Czachesz
Tamás Biró

We will present a collaborative research project in the process of formation. The project uses computer modeling to complement cognitive, historical, and philological approaches to textual transmission and textual reception. Network models are used to shed new light on two aspects of textual transmission. First, computer modeling will be used to simulate the cultural knowledge of different ancient audiences. Second, computer modeling will be used to study how readers bring such previous knowledge to the text and how this shapes the meaning of the text.

Word co-occurrence networks are psychologically realistic because they are good approximations of word association networks. An experiment with French school children (Lemaire & Denhi 2004) demonstrated a close correlation between the word association network generated from children's inputs, on one hand, and a word co-occurrence network generated from children's literature, on the other hand. This can be explained by the facts that children learn a great part of their language skills from texts (through listening and reading) and authors who write for children take into consideration the knowledge of their audience. Applying these results to ancient literature, word co-occurrence networks generated from ancient texts should provide good approximations of the word association networks we could create if we could interview ancient audiences. Ancient people learned a great part of their language skills and vocabulary from texts they read or listened to (including oral transmission, secondary orality, and paraphrases) and ancient authors took into account the knowledge of their readers.

The simulated readers will read selected early Christian texts, including narrative and argumentative passages from canonical and non-canonical gospels, letters, and apostolic Acts. The reading process will be simulated by generating a word co-occurrence network of the target text while taking into consideration existing associations with words in the "mind" of the simulated reader.