Japan Geoscience Union Meeting 2012
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BPT24-01 Room:203 Time:May 24 15:45-16:00

PREDICTIVE MODELLING OF ARCHAEOLOGICAL SITE LOCATION: PROSPECTS AND CHALLENGES

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Archaeological predictive modelling has been used for over twenty years as a decision-making tool in cultural resources management. It is a technique to predict the location of archaeological materials in the landscape, by finding or hypothesizing correlations between existing archaeological data and various features of the natural landscape, like slope, soil type, geology or distance to water. These correlations can then be extrapolated to areas where no archaeological information is available.

Predictive models can be useful as tools for cultural resources management. They indicate the zones where archaeological remains are most likely to be found, and this can serve to guide planning decisions and to decide on archaeological research intensity during development plans. But they can also be used for establishing the validity of archaeological theories concerning the behaviour of prehistoric people. The models can be tested by fieldwork, and the test results will then tell us something about their predictive power, and if the assumptions used for setting up the models were correct.

Various procedures can be used to produce predictive models, ranging from multi-criteria analysis and standard statistical procedures like logistic regression to more advanced methods such as Bayesian statistics. However, the main factors determining the success of predictive modelling are the availability of reliable archaeological data, the reconstruction of the palaeo-environment, and the theoretical concepts used by archaeologists.

In this paper, I will present an overview of the state of the art in predictive modelling, and present case studies from Europe that illustrate the potential and problems of the methods used. I will argue that a good theoretical basis should be the starting point for creating a modelling structure that will allow for developing and adapting models to different regional cultural and environmental characteristics. Palaeo-environmental information is crucial to this: if we want to understand settlement location choices of prehistoric people, we need to know what the natural environment was like in the period under consideration, and what possibilities and constraints it offered to the people concerned.

Furthermore, it is crucial that predictive models are not seen as a single answer to the question of where people settled in the past; in most cases, the available archaeological data and archaeological theories are simply too uncertain for that. A good predictive model should produce the best possible prediction with the available information. Uncertainties should be made explicit, and it is only through field testing that we will be able to improve the models, and to understand better what theories of settlement location choice are the most plausible for a particular archaeological setting. The dialogue between model, data and interpretation is therefore an important aspect of the modelling exercise.

Keywords: archaeological predictive modelling, statistics, archaeological theory, palaeo-environment, model testing

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BPT24-02 Room:203 Time:May 24 16:00-16:15

"Replacement of Neanderthals by Modern Humans" archaeological database and its potential for interdisciplinary research

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Research Team A01 "Archaeological Research of the Learning Behaviors of the Neanderthals and Early Modern Humans", directed by Yoshihiro Nishiaki, is part of the multidisciplinary project of "Replacement of Neanderthals by Modern Humans" (http://www.koutaigeki.org/), and is collecting the information on paleoanthropological sites and lithic industries in Africa and Eurasia between 200 k.a. and 20 k.a. towards a better understanding of the progression of the replacement of Neanderthals by anatomically modern humans. By February 15, 2012, we have recorded 1,264 sites, 3,177 cultural layers, and 4,896 radiometric samples to our client-server relational database system named *Neander DB*, which is featured by updates of recently discovered sites in Africa, Arabian Peninsula, Central Asia, and Siberia, as well as integration of the European databases published by the preceding projects.

The data gathering process described above targets so extensive regions that it has revealed some important issues that regional archaeologists have conventionally overlooked. Firstly, lithic industries sometimes have different regional terminology. For instance, Mousterian was originally defined in Europe and is thought to belong to Neanderthals, while the similar industry is called "Nubian Complex" in Eastern Africa and Eastern Arabian Peninsula. Secondly, the concept of cultural layers was originally developed under the assumption that paleoanthropological sites were likely to be located in caves and shelters in which anthropogenic deposits were usually layered, while it is difficult to apply the same concept to open sites in Siberia and other regions. Thirdly, it has also been revealed that different fields of research may apply different time scales, which could be a problem when comparing archaeological time periods with the paleoclimatic proxies that Research Team B02 is developing.

In order to give a solution to these issues, we flexibly changes the specification and structure of *Neander DB* on demand. For example, a table of correspondence was inserted to explicitly define the relationship between lithic industries and time periods. Our network-based database works well without any troubles in versioning because we are editing the single master database.

The information of paleoanthropological sites recorded in *Neander DB* will be an infrastructure to carry out interdisciplinary research in the "Replacement of Neanderthals by Modern Humans" project. In particular, it is expected that a GIS-based integration of radiometric dates, paleoclimate, and paleogeomorphological information may contribute to visualizing the spatio-temporal correlation between human evolution and climate change. We would like to have an active interaction with geoscientists attending the session with regard to the information sharing and integrated analyses.

Keywords: Replacement of Neanderthals by Modern Humans, archaeology, site, database, data mining, interdisciplinary research

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BPT24-03 Room:203 Time:May 24 16:15-16:30

Reconstructing Plant Functional Types in the Levant

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Compared to the Western Mediterranean region, there are relatively few paleoclimatic reconstructions from the Levant region during the early last glacial period. In addition, the proxy data available are often influenced by more than one parameter, which is problematic when separate reconstructions for temperature and precipitation are desired. Given these limitations, palynological data is most likely to provide the best information regarding habitat changes in the Levant region. To overcome the sparsity of observational proxy data, the MIROC atmosphere-ocean-land general circulation model will be used to produce climate simulations. The results are then converted to plant functional types (PFT) using the BIOME3 algorithms. This approach can calculate a total of 18 PFTs, which is sufficient to describe vegetation changes in the regions of interest. Simulations will be validated by comparing with available proxy data from Both the Levant and greater Europe. This will allow calculation of habitat changes based on model results at spatial and temporal scales higher than the available proxy data.

Keywords: Neanderthal

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BPT24-04 Room:203 Time:May 24 16:30-16:45

Modeling the climate of the past 130,000 years to understand the evolution of humans

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Climate change, characterized by the glacial-interglacial cycle of the past 130,000 years, has shaped the environment in which homo sapiens have evolved. An important feature during this period is the climate fluctuations known as the Dansgaard-Oeschger events which brought about rapid warming episodes, followed by cooling over longer periods. In order to understand how this global climate change affected both the landscape and local climate over Africa and Eurasia and also how these factors in turn may have influenced the migratory patterns of homo sapiens and neanderthals, general circulation models (GCM) can be used to produce numerical simulations of the past climate.

To perform such simulations, certain conditions which vary according to the period of interest are specified in the models. These conditions include the orbital parameters (Milankovitch forcing) which control the insolation, the atmospheric concentration of greenhouse gases such as carbon dioxide, and ice sheet extent. Meltwater from ice sheets can also induce abrupt climate changes by affecting the global ocean circulation and these can be modeled by so-called water-hosing experiments.

Modeling experiments have been run using the MIROC atmosphere-ocean-land GCM at various intervals of the past glacial-interglacial cycle, for example, the mid-Holocene (6ka before present) and the Last Glacial Maximum. Simulations can be validated by comparing in detail with proxy data, where available. We will discuss the various types of models available and how they can be used to give a complete picture across the various climatic states. How the climate evolves to affect human migration in terms of seasonal precipitation and changes in forests and deserts will also be discussed.

Keywords: paleoclimate, climate model, glacial-interglacial cycle

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BPT24-05 Room:203 Time:May 24 16:45-17:00

Upper Paleolithic Radiocarbon Chronology in Levant and Europe

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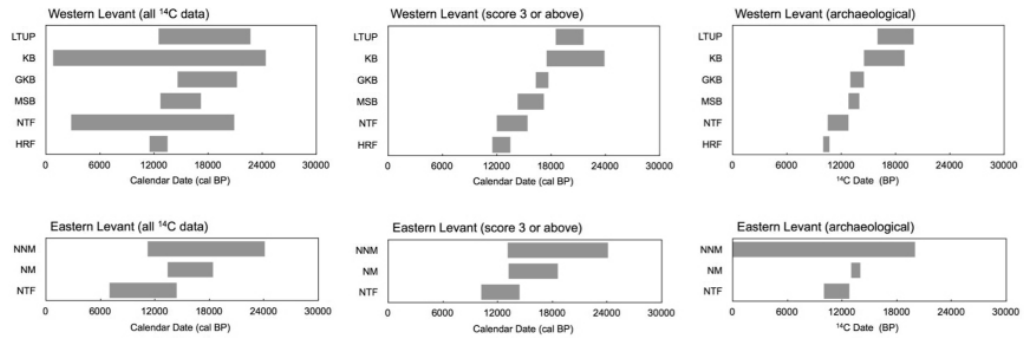
In our own research project for chronological reevaluation, we began to evaluate reliability assessment of radiocarbon dates from the Levantine Upper Paleolithic industries. A series of reviews of chronological data has been reported by leading archaeologists (e.g., Bar-Yosef et al. 2006); however, the qualification of absolute data was not counted in previous works and the integrity of stratigraphic layers was assumed. In terms of technical confidence in the measurements and adequacy of material types and archaeological provenance, the data reliability is rated on a scale of one to five. All of the ^{14}C data with its reliability and cited reference have been managed on the Neandat database run by project B02. To discuss the detail duration of an archaeological site and lithic industry, we have calibrated the ^{14}C age to the calendar date, and estimated likelihood time-span on the basis of cumulating of the calibrated dates.

Tables present the estimated durations of upper Paleolithic and Epipaleolithic industries. They were calculated from all of the ^{14}C data, the highly reliable ^{14}C data and archaeological chronology respectably. The estimation from the reliable ^{14}C data provided relatively agreement with archaeological chronology. It is important to notice that this estimation is derived from only scientific assessment without archaeological data screening and represented as calendar dates. To validate this approach, we are investigating the ^{14}C data from not only Levant but also Europe in which chronological works have already been developed in the Stage 3 project (Van Andel and Davies 2003).



Estimated durations of the lithic industries. Late/Terminal Upper Paleolithic (LTUP); Kebaran (KB); Geometric Kebaran (GKB); Mushabian and Related Industries (MSB); Natufian (NTF); Harifian (HRF); Non Natufian Microlithic (NNM); Non Microlithic (NM); Natufian and Related Industries (NTF).