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Session S35: Mapping and modelling movement in archaeology: From least cost analysis to diffusion pathways.

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Introduction

Understanding the mobility of past human populations in and around the landscapes they occupied is an enduring challenge that has been addressed at many perspectives and scales. Some approaches, like the wave of advance model (Ammerman and Cavalli-Sforza 1979) or the site catchment modelling approaches of Vita-Finzi et al (1970) predate the application of quantitative methods using modern computers. Others are closely allied to the emergence of geographical information systems (GIS) desktop software in the 1980s and 1990s. For example, there is a large body of work around the concept of "cost", which concerns the relative difficulty of transit across regions, resource locations or occupation sites, on the basis of physical characteristics like terrain slope, vegetation cover or ocean currents. Least Cost Analysis (LCA), as this is known, is one of the oldest applications of geographical information systems in archaeology and has evolved to become a standard operation undertaken in many contexts and chronological periods. These include exploring the location of Roman roads (Güimil-Fariña and Parcero-Oubiña 2015), understanding connections and tribal territoriality associated with agriculture (Howey 2007), mapping the distribution of Palaeolithic symbolic objects (Gravel Miguel and Wren 2018), or reconstructing historical journeys (Seifried and Gardner 2019), among many others.

Agent-based models (ABMs) have been developed that approach the problem through simulation of autonomous decisions around movement under different conditions. For example, Hölzchen et al (2016) propose to evaluate "Out of Africa" hypotheses by modelling the behaviour of individual agents with particular characteristics, e.g. group size, typical interaction range, resource demand, allowing the potential for different hominin species to disperse into different regions to be tested. Some classic models, like the STEPPINGOUT model of Mithen and Reed (2002), approach this question using cellular automata (CA) theory. These authors model population dispersal by dividing the globe into gridded cells and simulating colonization between adjacent cell neighbours. The importance of ease of communication between regions as well as the suitability of the destination territory, included in the

concept of “affordances” (Verhagen et al 2019), makes the link between LCA and dispersion models very clear.

However, as yet, no coherent “archaeology of movement”, at least in the sense proposed by LLobera (2000), has emerged to unify these different threads. Rather, the range of applications and approaches has expanded within each different knowledge domain, and the boundaries have become increasingly blurred. For example, Lewis (2021) addresses the problem of error in the source elevation data through a Monte Carlo simulation approach that identifies the most probable Least Cost pathways within the stated margin of error. In this sense, Lewis’ probabilistic simulation-based approach links traditional LCA in GIS with least cost models. At the same time, empirical work is becoming more broadly integrative. Bilotti et al’s (2024) highly innovative approach to understanding trade networks in the Western Mediterranean moves beyond state-of-the-art by combining both marine and land-based communication networks in a single model.

At the same time clear gaps remain, and many problems that have been long exposed remain insufficiently explored or addressed. Classical approaches to LCA based on physical landscape variables may be problematically environmentally deterministic, yet they remain widely used. Some ABM approaches often seem to make little progress beyond the conceptual realm. Human and animal interaction in archaeological models of movement remains under-explored. Finally, artificial Intelligence (AI) is currently receiving enormous attention in every corner of society, yet it’s not clear to what extent it is likely to be useful in archaeological modelling of movement.

This session proposes to critically examine quantitative approaches to the archaeology of movement in a broad and integrative way, looking to integrate further these diverse threads and, in so doing, identify differences and commonalities that allow cross-fertilization of ideas beyond domain boundaries. The main objective of the session is to build bridges between case-focussed GIS-based analyses of movement within landscapes and population diffusion models more broadly.

In this sense we particularly welcome contributions in the following areas:

1. Explorations of the limits and frontiers of conventional LCA approaches. At what distance and at what scale do ordinary assumptions of cost-based rational decision-making begin to break down?

2. Hybrid modelling approaches which combine GIS-based cost analyses with agent-based, cellular automata or other simulation approaches for modelling diffusion, colonization and dispersal.

3. Time-cost studies, that seek to understand and incorporate the role of travel time in movement-based studies. Which agents could arrive at which times, and how does this affect our interpretation of past population dynamics?

4. Studies that specifically address the question of scale. Can the same methods and techniques applied to global studies of population dispersal also be applied to micro-scale studies of movement around site habitation areas? If not, why not?

5. Critical examinations of particular concepts, approaches, or methods.

6. Artificial Intelligence in the archaeology of movement. Despite breathless enthusiasm in every discipline, one of the greatest limitations of AI, its lack of explanatory power, seems to pose an

enormous challenge to archaeological applications, where exact pattern replication would seem to be secondary to understanding how and why such patterns emerge.

7. New directions extending the theoretical reach of cost and diffusion pathways beyond just movement across the physical landscape, into theoretical domain of innovation diffusion (Hägerstrand 1967)

8. Any other approach to the analysis of past populations movement in time and space that would seem to be relevant to the integrative objectives of the session.

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