Modelling terrestrial route networks to understand inter-polity interactions. Two case-studies from the Iron Age.

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During the Bronze Age and the Iron Age, many regions were occupied by small political communities (city-states) whose form of organization could vary widely, from hierarchical to heterarchical systems to purely independent entities. The different developments in similar areas (e.g. state formation or collapse) make their political organization an attractive subject of study from a complex system perspective.

We are interested in the nature of the interactions between these polities, as they reflect how things worked at that regional scale, although it is a challenging task to study those relations in a quantitative manner. However, inter-settlement terrestrial infrastructure networks constitute a great opportunity to achieve this goal. They both shape and were shaped by the societies who created them, and they are suitable to be studied quantitatively when represented as spatial (i.e. geographic) graphs. Here, we present a methodology based on network analysis and modelling to look into the reasons why terrestrial routes were configured the way they were. We devise three models inspired in simple decision-making hypotheses to investigate which mechanism was more likely to be responsible for the topology of the terrestrial infrastructure network.

In particular, we apply this methodology to a paradigmatic case-study (the region of Southern Etruria during the Iron Age) from which we managed to build empirical networks, by means of archaeological and historical sources. We then compare the topological features of the synthetic networks generated by the models against those in the empirical systems. Our results show that a rather simple model (Model 3), combining local decisions with global, integrated information of the system, is a good candidate to the task at hand. It reproduces the features of the empirical systems (see Fig.1 for two relevant examples) while remaining coherent with the historical knowledge about the Etruscan region.

Then, we focus on the evolution of terrestrial route network in the Tyrrhenian region of Latium vetus as it has been hypothesised by scholars from the archaeological evidence. We first attempted to replicate some of its features applying the three models previously elaborated for the neighboring region of Southern Etruria. Since it was not possible to attain entirely satisfactory results, we modified the model that performed better in the Etruscan region by including a tunable amount of rich-get-richer (preferential attachment) bias which improved considerably its performance. In this case, the mechanism implemented by this model implies that places located at favourable positions can build on their initial advantage and get more and more powerful. Once more, this fits very well with the picture elaborated by different scholars on the nature of power balance and dynamics in this region.