

## **Modelling regional dynamics and Roman pottery supply using network analysis and GIS: the sanctuary of Kalapodi in central Greece as a case study**

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Kalapodi in central Greece is home to one of the most spectacular Greek sanctuaries, mentioned in numerous ancient textual sources, which is now identified as the oracle of Apollo of Abai. The sanctuary has yielded evidence of cult activity from the Late Bronze Age (13 c. BC) to Late Antiquity and has been the focus of long-standing excavations by the German Archaeological Institute, Athens department. This paper offers an integrated approach to modelling commodity flows and transport routes to the sanctuary in the Roman period by analyzing pottery distribution data from the entire region and exploring Kalapodi within regional and global distribution and infrastructural networks of the Roman period. Based upon the preliminary results of the ongoing finds analysis and by integrating published and reported evidence from other sites in the wider region as well as unpublished data available to us, we investigate first the role of the sanctuary as a central place in the distribution network of pottery imports from close-regional and more distant sources. Pottery distributions are analyzed as a weighted (non-directed) unimodal network, in which the sites appear as nodes and the pottery wares attested as edges, in three different datasets for the Early Roman (1st c. BC – 2nd c. AD) Middle Roman (2nd – 4th c. AD) and Late Roman period (5th – 7th c. AD). The analysis reveals several key issues of historical interpretation, highlighting amongst others the shifting significance of the sanctuary as a destination/ place of consumption of imported pottery wares and bringing forward questions regarding the site's access efficiency, directionality of imports and transport routes. The above questions derived from network analysis provide the backbone of a GIS-based simulation of the sanctuary's pottery supply. This involved the creation of a huge dataset which allowed for a detailed GIS-based simulation of the sanctuary's pottery supply, utilizing and experimenting with the results of the network analysis. By analyzing the network of potential trade routes and shipping lanes, the study was able to simulate the transportation of pottery imports to Kalapodi. The incorporation of shipwreck evidence and experimentation with alternative scenarios added depth and complexity to the research. The findings shed light on the patterns of trade and exchange in the region, providing valuable insights into the economic and cultural dynamics of maritime trade networks in Kalapodi. This multidisciplinary approach contributes to the understanding of ancient trade patterns and offers a robust framework for future studies in the archaeology of the area and network analysis suggesting alternative routes in ancient trade, considering factors such as navigational features, wind patterns, and other variables. By incorporating this information, network analysis in combination with GIS approaches can offer new insights into how goods were exchanged and distributed in the past, going beyond traditional methods of analysis and providing a deeper understanding of ancient trade and transportation dynamics.