Archeologia e Calcolatori
34.1, 2023, 321-328
doi 10.19282/ac.34.1.2023.34

SHAPING A JURIDICAL DISTRICT: A POSTDICTIVE APPROACH

1. Introduction

This paper focuses on a GIS-based procedure to draw juridical boundaries of a given central place. Our case studies are a castle and a town in the Early Middle Ages. However, the procedure can be reproduced for any site, whose role as central place within a district is proven. This is not a brand new idea. Several attempts have been made over time, starting from the application of the Voronoi maps. This approach is helpful to get a rough idea, as I have shown for the late medieval Tuscan bishoprics (Citter 2012, 92-101). But it is deterministic and it does not consider natural as well as human agents that could have played a key role in shaping the historical boundary. Ten years ago we tried to calibrate this odd by redrawing the district according to slopes and hydrography. Now we can go further and try to link the simulation to more accurate morphological and hydrological models.

In particular, we aim to move to a postdictive approach. Sometimes, we already know the district's shape in a given period. But this is not always the case. In fact, sometimes we have no idea of its extension. The two case studies we provide here fall within both the former and the latter category. In the case of the town of Lucca we know the extension of its district in the 11th century CE, while the jurisdiction of the castle of Selvena is unknown. In the first case our procedure will aim to find the best approximation, such as a polygon, whose shape fits well with that of the historical boundary recorded by the sources.

On the contrary, in the case of Selvena we don't know the district. However, we can get some hints with a regressive approach. It has been hypothesised that the communities' districts drawn in the historical cadastre of 1823-1835 (also known as Lorena's cadastre: http://www502.regione.toscana.it/castoreapp/) are the outcome of the union of medieval castles' territories (Farinelli 2007, 23). We assume that this is true and we get the cadastre as a hint to compare the evaluation's outcome, though the precision's degree won't be the same as for Lucca.

A juridical district is influenced by several natural and human agents that reshape it over time. It is the result of a complex and long lasting process of political and economic negotiations, conflict, adaptation among neighbouring communities. Castles can be abandoned and their territory can be distributed among the neighbouring communities. A town normally started with a small district that became a regional state like for instance

Florence and Siena. The site catchment area is, thus, a different concept. This procedure is not intended to search for it. The expansion of Lucca beyond its town's walls was not welcomed by the surrounding lords and communities. The making of a castle district, as in the case of Selvena, is part of a wider process of seigneurial power. In this case the local community had little chance to influence the lord's decision. But, as we recently suggested (Citter 2021), it is likely that the community of Selvena used to live in small villages around the castle, rather than within its walls. The postdictive approach seems to be a wise choice to avoid both determinism and generic assumptions. It points out the potential agents that returned the district recorded by the sources.

We used to apply this approach to the connectivity network (Citter, Patacchini 2018), to the settlement location (Citter 2021) and, recently, to the symbolic landscapes (Citter, Paciotti 2023). Though the study of the movement has played a crucial role in the development and test of this approach, the last test and the present proposal open a methodological reflection toward a wider scenario and allow the GIS-based modelling to make significant step forward. In fact, in these last two cases the "traditional" topic of spatial analyses is less relevant from an historical perspective. The GIS is, thus, a laboratory where we can set new links to anthropology, law sciences, as we already did with earth sciences. The outcome of this paper, mainly in the case of Selvena, is not assumed to be the truth, but it is the best approximation we can draw today. If we will extend this approach to a large number of neighbouring castles, the aberration factors will be calibrated one another, due to the greater amount of data concerning boundaries that literary sources provide. Therefore, the single case study could find a more proper and a more accurate description.

C.C.

2. The two case studies: the procedure and the outcomes

As mentioned in the previous paragraph the study addressed two areas, the first one concerns the city of Lucca, in the North of Tuscany, while the second one refers to the castle of Selvena, in the southern part of the region. The study of these two areas involved a procedure that in a first phase is common to both to obtain possible districts. Once the possible jurisdictions were obtained, they were compared with the available data. To obtain the basins for the two areas we used DEM, Digital Elevation Model made available by Tinitaly (Tarquini *et al.* 2007), to which it was applied the SAGA algorithm TPI Landform Classification. It classifies the DEM's cells according to a list of 10 morphological positions (Brogiolo,

Citter 2018). Thus, a morphologically accurate raster is obtained. We also applied the algorithm SAGA Wetness Index to the DEM. It evaluates the slope in a given point and the catchment area that passes through that point (Llobera, Fábrega-Álvarez, Parcero-Oubiña 2011; Brogiolo, Citter 2018).

Both rasters were reclassified in order to answer our question: how much do these characteristics impact in the formation of a jurisdiction? To reclassify the TPI we used the following rules: 1 thru 1 = 50; 2 thru 2 = 20; 3 thru 3 = 30; 4 thru 4 = 20; 5 thru 5 = 10; 6 thru 6 = 0; 7 thru 8 = 30; 9 thru 9 = 20; 10 thru 10 = 10. While the TWI was reclassified according to these rules: 1 thru 4 = 0; 4 thru 10 = 10; 10 thru 13 = 40 (Citter 2019). Then, we based on the reclassified TPI and the TWI to evaluate the least cost path. This is a raster in which each cell represents the energy needed to pass through it (Cross 2012; Verhagen, Jeneson 2012). The raster calculator is the mandatory step to get it. We need to assign a value to the characteristics that we want to take into consideration, in our case the morphology and the hydrology, represented by the reclassified TPI and the TWI. The weight assigned to the rasters must return a value 1 (Citter, Patacchini 2018). In our case we gave the morphology a weight of 0.6 while the hydrology 0.4. Thus, the raster calculator formula is:

TPI reclassified * 0.6 + TWI reclassified * 0.4

To this raster the algorithm r.walk.points was applied, to get a cumulative cost surface. Then, we run the GRASS algorithm Channel network and drainage basins to get the hypothetical districts.

To obtain the cumulative cost surface, the first case study used a vector file with the castles that are located within a radius of 20 km from the city of Lucca. We opted to consider the development of the city related to the control of the surrounding castles and in their districts. Concerning the case of Lucca, Voronoi maps have been made centred on the castles mentioned above. They show the potential catchment area, which does not take into account the geographic, political and institutional features of a territory. Thus, they are an abstract evaluation (Citter, Arnoldus-Huyzendveld 2011; Citter 2012). These polygons were overlapped to the basins obtained through the Channel network and drainage basins algorithm. The two layers closely overlay one another. In addition to this, the overlap with a vectorial layer of the jurisdiction of Lucca was also made. It was drawn by J.A. Quiros Castillo from a document dated to 1081 AD. In this chart it is said that the emperor granted to the city a territory of six miles around it (Quiros Castillo 1999). It seems clear that in a first phase Lucca's jurisdiction was based on the natural characteristics of the

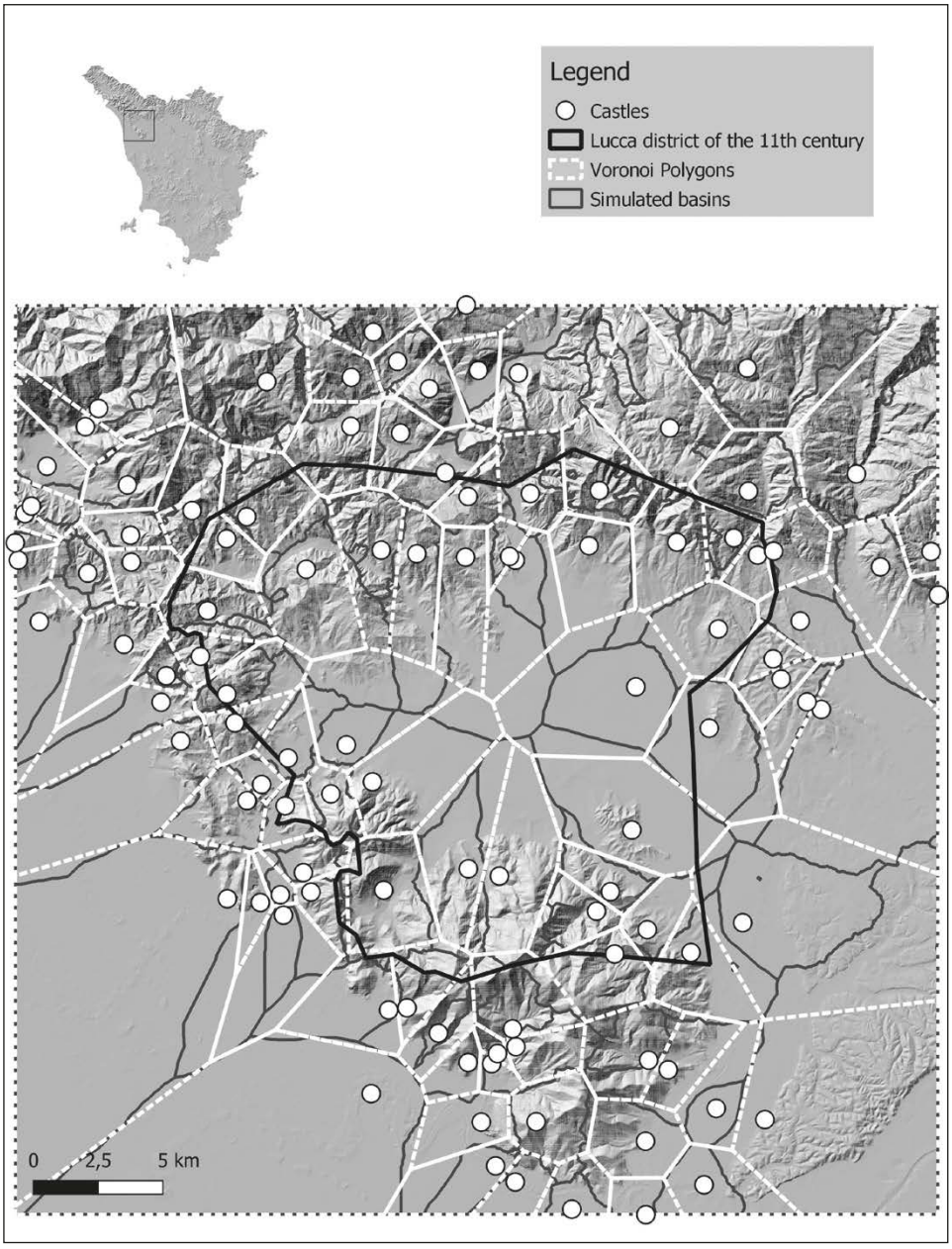

Fig. 1 – The case study of Lucca. In this image there is the overlap between the simulated basins (grey lines), the Voronoi polygons (white lines) and the Lucca district of the 11th century (black lines).

landscape, controlled by the castles and their districts, which we obtained with the QGIS simulations (Fig. 1).

The other case study took into consideration the area of the castle of Selvena, in Southern Tuscany. This area was important during the Middle Ages, for the presence of ore, especially cinnabar. To obtain the basins we applied the same method used for Lucca. We assigned to the TPI and the TWI reclassified a weight of 0.6 and 0.4. We assigned a higher value to the morphology, due to the landscape, which is predominantly a mountainous area. To the least cost path was applied the GRASS algorithm r.walk.points, but we included the castles located in the area we considered. Finally, GRASS algorithm Channel network and drainage basins has been applied to the cumulative cost raster, with that we obtained the hypothetical basins of the castles.

This raster has been overlain with a layer, that shows the boundaries of the community recorded in the historic cadastre of 1835, which Tuscan region made available through a WMS service. Before making an assumption, we must consider that the algorithm assigns to all the castles the same value, but it was not like that. We noticed that there is a high degree of overlap between the two layers and it makes us think that the nineteenth-century jurisdictions were a sum of the district of medieval castles. This theory has been hypothesized but never proved. At the end of the process we redesigned the district of the Selvena's castle, including the modern inhabited centre and the ore that were part of it but the algorithm inserted them in another castle district, which, we know, did not have the same importance as Selvena. To draw the district we followed the boundaries of the cadastre, including the aforementioned mines and the inhabited centre. The result is the best approximation ever made for a district of a castle, apart from cases where the boundaries were well known from the written documents (Fig. 2).

Y.P.

3. Conclusions

In this study we used the postdictive method, thus we run several simulations until we get the best overlay with the available data. Our case studies were focused on the city of Lucca and the castle of Selvena. The procedure we used took into account the use of natural parameters as morphology and hydrology, which returned good outcomes. Thus, we can say that the natural characteristics of these territories were important for the making of their jurisdictions. But we must take in consideration that where there is no overlay, it is obvious that there are other factors which influenced the formation of the boundaries. They can be either political or economic.

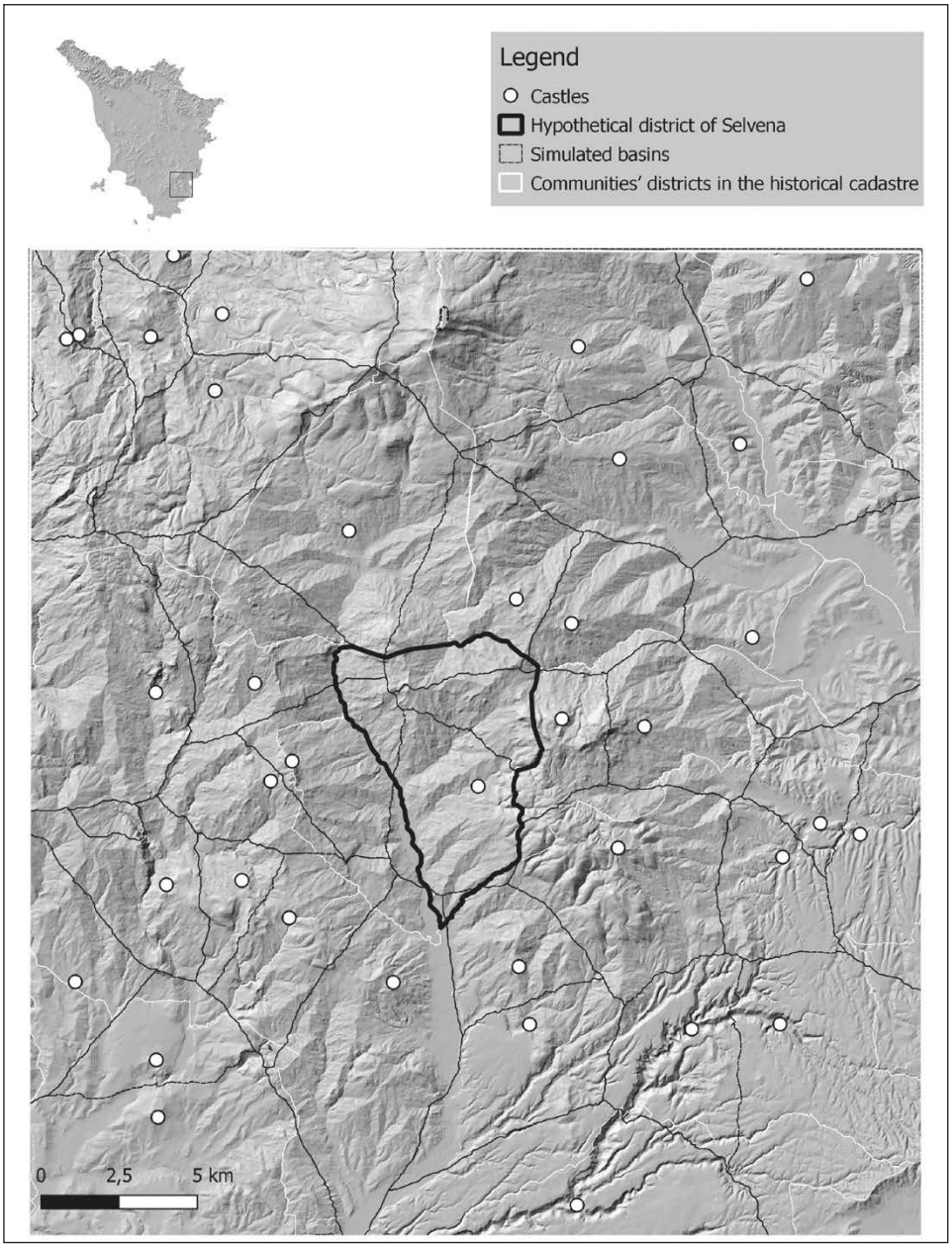

Fig. 2 – The case study of Selvena. In this image there is the overlap between the simulated basins (grey lines), the community districts in the historical cadastre (white lines) and the hypothetical district of Selvena.

Obviously, we will never have a perfect overlay between the simulations and the known data. There are many combinations of factors that could influence and we can only try to find some of them.

Carlo Citter
Università degli Studi di Siena
carlo.citter@unisi.it

Ylenia Paciotti
Università degli Studi di Genova
yleniapaciotti9@gmail.com

REFERENCES

Brogiolo G.P., Citter C. 2018, *Paesaggi e sistemazioni agrarie nel basso corso dell'Adige da Montagnana al mare*, in G. Volpe (ed.), *Storia e archeologia globale dei paesaggi rurali in Italia fra Tardoantico e Medioevo*, Bari, Edipuglia, 599-621.

Citter C. 2012, *Archeologi delle città toscane nel Medioevo (V-XV secolo). Fotogrammi di una complessità*, Documenti di archeologia, Mantova, SAP, Società archeologica s.r.l.

Citter C. 2019, *From roads to mobility. A theoretical framework and a case study to investigate the medieval connections network*, «PCA Post-Classical Archaeologies», 9, 325-342.

Citter C. 2021, *Établissements monastiques, environnement et exploitation des ressources dans le haut Moyen Âge: analyses spatiales et postdictives*, in M. Lauwers (ed.), *Labeur, production et économie monastique dans l'Occident medieval. De la Règle de saint Benoît aux Cisterciens*, Collection d'études médiévales de Nice, Turnhout, Brepols Publishers (https://doi.org/10.1484/M.CEM-EB.5.121870).

Citter C., Arnoldus-Huyzendveld A. 2011, *Uso del suolo e sfruttamento delle risorse nella pianura grossetana nel Medioevo*, Roma, Artemide.

Citter C., Paciotti Y. 2023, *La modellazione di paesaggi simbolici su piattaforma GIS: una proposta*, in M. Nucciotti, E. Pruno, *Studi in onore di Guido Vannini*, Firenze, Fup Press.

Citter C., Patacchini A. 2018, *Postdittività e viabilità: il caso della direttrice tirrenica*, in C. Citter, S. Nardi Combescure, F.R. Stasolla (eds.), *Entre la terre et la mer: la Via Aurelia et la topographie du littoral du Latium et de la Toscane. Colloque international (Paris 2014)*, Roma, Edizioni Quasar, 31-54.

Cross K. 2012, *Least resistance? Cost-path analysis and hunter-gatherer mobility in the Virginia Blue Ridge*, «Journal of Middle Atlantic Archaeology», 28, 1-10.

Farinelli R. 2007, *I castelli nella Toscana delle "città deboli": dinamiche del popolamento e del potere rurale nella Toscana meridionale (secoli VII-XIV)*, Firenze, All'Insegna del Giglio.

Llobera M., Fábrega-Álvarez P., Parcero-Oubiña C. 2011, *Order in movement: A GIS approach to accessibility*, «Journal of Archaeological Science», 38, 843-851.

Quiros Castillo J.A. 1999, *El incastellamento en el territorio de la ciudad de Luca (Toscana). Poder i territorio entre la Alta Edad Media y el siglo XII*, Oxford, Archaeopress.

Tarquini S., Isola I., Favalli M., Mazzarini F., Bisson M., Pareschi M.T., Boschi E. 2007, *TINITALY/01: A new Triangular Irregular Network of Italy*, «Annals of Geophysics», 50, 407-425.

Verhagen P., Jeneson K. 2012, *A Roman puzzle. Trying to find the Via Belgica with GIS*, in A. Chrysanthi, P. Murrieta-Flores, C. Papadopoulos (eds.), *Thinking Beyond the Tool. Archaeological Computing and the Interpretive Process*, BAR International Series 2344, Oxford, Archaeopress, 123-130.

ABSTRACT

How can we study the making of a medieval juridical space? Which were the agents that affected more? We try to answer to these questions thanks to a postdictive approach. We applied the QGIS algorithms to model the potential political space. We used several agents to get different outcomes. We tried both environmental and human agents to avoid the more deterministic side of this approach. We focused on the plain of Lucca in Northern Tuscany to study the making and development of its bishopric. Then we turned to the southern side of this region to study the district of a castle already excavated and whose territory is known quite well: Selvena. In this last example, we applied a regressive procedure, starting from the 19th century communities boundaries and making hypotheses about the relationship with medieval districts. This procedure can be applied to any context where a certain amount of data is available.