Resources and Roman Land-use in Southeast Noricum: a GIS case study

Klaus FREITAG, Austrian Academy of Sciences/Austrian Archaeological Institute, Austria

Keywords: Roman Archaeology, Landscape Analysis, GIS

Introduction

Southeast Noricum counts as one of the best researched archaeological landscapes in Austria. It is especially important to draw attention to the specific topographic position between the resource-rich Alps and the Amber road (fig. 1). Besides the municipium *Flavia Solva*/Wagna 31 Roman settlements in the plains of Graz and Leibnitz (*Grazer, Leibnitzer Feld*) as well as in the river valleys of Laßnitz and lower Mur are documented. Due to excavations and geophysical prospections six of them can be clearly defined as *villae* (rural estates), five as settlements with commercial and trading function (often referred as *vici*).

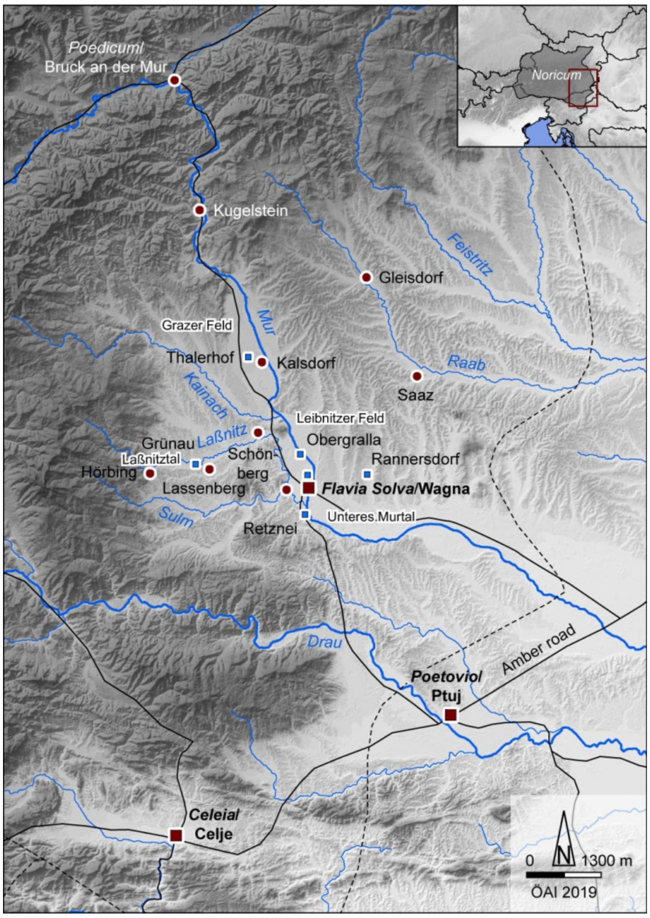

*Fig. 1. Southeast Noricum, main research area in the plains of Graz and Leibnitz (*Grazer, Leibnitzer Feld*) and the river valleys of Laßnitz and lower Mur. Red squares: central places. Red dots: selected settlements. Blue squares:* villae *(© ÖAW/ÖAI, GIS Steiermark).*

The high-resolution Geodata available for this region (including 1 × 1 m Digital Elevation Models, the Austrian soil map 1:10 000[1] or the Franziscean Cadastre from 1820–1825 as WMS-Service[2]) offer a rare opportunity to analyse the ratio behind the Roman utilization of resources and territory in detail.[3] The main research question can be summarized as follows: why are *villae* and settlements situated where they were documented? E. g. do *villae* and settlements continue using prehistoric sites? Or are *villae* preferably located in areas with good soil, settlements at traffic junctions regardless of former land-use?

[1] http://www.bodenkarte.at/ (Accessed: 11 June 2019).
[2] http://www.landesentwicklung.steiermark.at/cms/beitrag/12663682/142970647/ (Accessed: 11 June 2019).
[3] The works are carried out as a Master thesis at the University of Salzburg (UNIGIS MSc, supervisor Dr. Christian Neuwirth).

Methodology

Spatial techniques mainly used to answer research questions concerning resources and territories can be summarized as *least-cost analyses*. For this study *site catchments* and *least-cost paths* were calculated with different parameters (Wheatley and Gillings, 2002, pp. 157-163).

Both analyses are based on raster surfaces representing costs of moving through each cell (*cost surface*). The resolution of *cost surfaces* used in the majority of recent works range from a minimum of 5 × 5 m to a maximum of 90 × 90 m, assuming that raster grids with a coarser resolution provide better representations of the paleogeography (Herzog, 2014, p. 224 tab. 1). While rougher surfaces blur out modern features such as streets, buildings and regulated rivers, they also neglect changes in the terrain like small hills or ridges that could be important for the results of the analysis. This case study generated a 1 × 1 m *cost surface* based on the 1 × 1 m Digital Elevation Model derived from LiDAR-Data (GIS Steiermark) as well as rivers and wetlands mapped in the Franziscean Cadastre (1820–1825). Utilizing land-use data modern features such as streets, buildings and regulated rivers were filtered from the Digital Elevation model (fig. 2).[4]

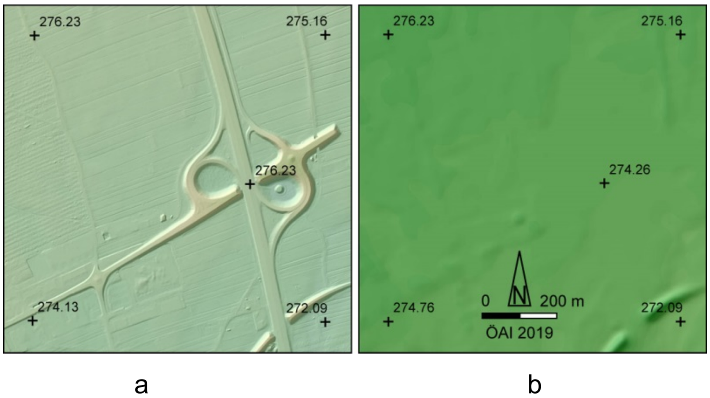

Fig. 2. Leibnitz. Motorway connection Gralla. a) Digital Elevation Model provided by GIS Steiermark. b) Digital Elevation Model cleaned from modern features utilizing land-use data. Still visible features like the road embankment in the south must be deleted manually (© ÖAW/ÖAI, GIS Steiermark).

In the following step different *cost surfaces* were generated; two representing the time it takes for a human and oxen to cross the landscape based on Tobler's hiking function for the *site catchments*[5], another one containing postulated friction costs for the construction of a Roman road for the *least-cost paths.*[6] *Site-catchments* as well as *least-cost paths* were then calculated using the Tools implemented in the Spatial-Analyst-Extension in ArcGIS.

Combined with the high-resolution Geodata the availability and quality of arable and pasture land as well as other resources like water, timber, ore and clay deposits or quarries were examined in the area of one hour walking distance for a human and one to two hours walking distance for oxen. Furthermore it is possible to evaluate the walking distance to other find spots (fig. 3).

In a final step traces of Roman land surveying should be validated and analysed with geostatistics.[7] The good stage of research in South-East-Styria allows asking sophisticated questions, e. g. for the relation between the orientations of parcels mapped in the Franziscean cadastre (1820–1825) to the municipium *Flavia Solva*/Wagna as well as the different settlement sites with known layouts.

The presentation gives an overview over the used data, methods and first results, focusing on the surprising new insights into Roman territorial systems derived from high-resolution geo-information.

[4] For the same approach providing very good results cf. Schmidt et. al., 2018.
[5] Tobler, 1993. The values of a human being were divided through 2/5 to estimate the walking time of oxen.
[6] It is assumed for example that a straight layout is more important than small variations in slope.
[7] Cf. the GIS-based case study concerning the *limiatio* in the hinterland of Carnuntum: Gugl, 2005, p. 109.

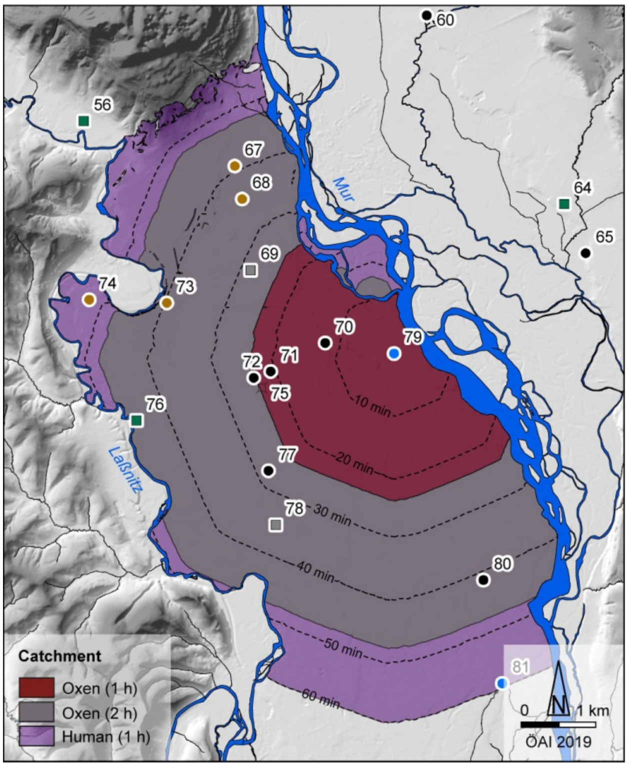

Fig. 3. Leibnitzer Feld. Site catchments of the villa *of Obergralla (79). Dotted line: human walking distance in 10 min.-intervals. Black dots: funeral places. Green squares: settlements/*villae *(?). Grey squares: streets. Orange dots: surface finds (© ÖAW/ÖAI, GIS Steiermark).*

References

Gugl, C. (2005). Limitatio Carnuntina. GIS-Analyse der römischen Zenturiation im Raum Carnuntum (Niederösterreich), Anzeiger der philosophisch-historischen Klasse 140, pp. 61-126.

Herzog, I. (2014). A review of case studies in archaeological least-cost analysis, Archeologia e Calcolatori 25, pp. 223-239.

Schmidt, J., Werther, L. and Zielhofer, C (2018). Shaping pre-modern digital terrain models: The former topography at Charlemagne's canal construction site, PLoS ONE 13(7): e0200167. https://doi.org/10.1371/journal.pone.0200167 (Accessed: 11 June 2019).

Tobler, W. 1993: Three presentations on geographical analysis and modelling. Non-isotropic geographic modelling, National Center for geographic information and analysis. Technical report 93-1. http://www.geodyssey.com/papers/tobler93.html (Accessed: 11 June 2019).

Wheatley, D. and Gillings, M. (2002). Spatial Technology and Archaeology. The archaeological applications of GIS, London, 269 pages.