Synergy and Interaction: The Value of Using Historical Sources in Archaeological Landscape Studies

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Abstract

The paper discusses a few theoretical issues related to the use of historical sources in landscape archaeology studies. The core of the contribution is dedicated to various procedures adopted to exploit the informative content of each source in a GIS environment. From this study perspective the importance of an approach which is orientated towards the analysis of the sources in all their complexity emerges. The integration of data and the interaction between the analytical results leads to a synergy which is highly effective in terms of landscape interpretation. The combination of sources exploited at a local or sub-regional scale provides valuable and improved results with regard to the informative content of each single data. These procedures are illustrated with case studies in southern Tuscany (Italy) intended to provide practical examples of this synergic approach.

1. Introduction

The paper focuses on the precious informative contents that derive from the analysis of historical cartography and ancient documents and in particular on the problems and potentialities related to the integration of historical sources in a GIS environment. Furthermore, a historical approach to the study of landscape enables us to recognize the role of natural events as well as human intervention in the transformation processes that constitute the matrix of the present territorial setting.

The historical sources represent a set of key elements for our understanding of the various changes which dynamically shaped and characterized the landscape of the past. This resulted in regional studies which allow for a fuller comprehension of both continuity and changes by means of spatial comparison.

From this perspective, the study of landscape archaeology can take full advantage of the use of different types of historical sources (namely geometric cadastres, geodetic and pre-geodetic cartographies, geographical descriptions, thematic maps, agrarian technical reports etc.) stored in the Tuscan historical archives.

Different procedures have been adopted to input these data into a GIS in order to solve different kinds of problems, such as the methodology of geo-referencing historical cartography (De Silva in press, 2006; De Silva and Pizziolo 2003) especially in the absence of documents with geometrical characteristics.

Moreover, crucial information can be gleaned from the contextualization of descriptive archive documents and through the comparison of different sources related to different historical phases, thus confirming the validity of an integrated approach. Integration of different sources in a GIS environment, indeed, may reveal latent features and information otherwise not clearly identifiable through single visualizations. As a consequence, data integration has led to the synergy and interaction between historical sources and other types of data.

This paper initially gives an overview of the different sources and then goes on to outline a few specific ones which are considered useful for landscape archaeology studies, dwelling on the informative content of the sources and their characteristics. The core of the paper is to explore the synergy of source integration and it concludes with a critical approach towards historical sources, considered as 'historic' documents exemplified by two cases studies.

2. Study area and research background

The study area is located in southern Tuscany and it is part of the Maremma regional park (*Fig. 1*).

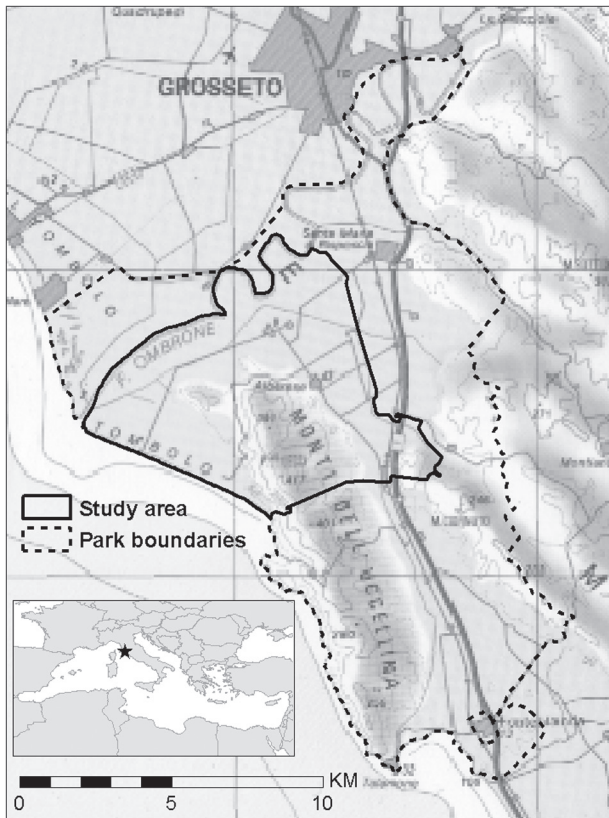The general framework of the research is orientated towards the analysis of ancient landscape

Fig. 1. The study area in the Maremma Regional Park.

and transformation processes through the integration of different sources in a GIS environment.

The topic presented in this paper derives from various research projects carried out in recent years by different institutions, namely Siena University – Department of Archaeology and History of Arts, Laboratory of Informatics applied to Medieval Archaeology, Department of History, and Laboratory of Informatics in Geography; and Florence University – Department of Science of Antiquities and Laboratory of Landscape Archaeology and GIS. Furthermore, the National Historical archives of Grosseto and Florence have been involved in the projects as well as the Council of Tuscany.

The projects related to the main issues of this paper are the following:
–   The historical cartography for landscape archaeology in a GIS environment. The Grosseto area case study (PhD thesis, University of Siena)
–   *MEDCORE* (Mediterranean Coast-River Eco-systems), EU project (ICA3-2002-10003, 5° FP, INCO-MED Programme)
–   *CaStoRe* (Historical Regional Cadastres – Tuscan Council)

3. Theoretical issues

The general aims of this research is to explore the problems and potentialities in integrating different kinds of sources in a GIS environment and to 'squeeze' the available sources for maximum informative content and meaning throughout the synergy of the interaction. In our theoretical framework, landscape should not be considered in a synchronic way, but as the dynamic result of an historical sedimentation process, whereby different events have left an overlay of traces resulting in the formation of a complex whole. The reverse research method of analysis, in other words regressive analysis progressing from the present to the past, permits the separate layers of historical sedimentation to be revealed. (De Silva and Pizziolo 2004, 2005, 2005a; De Silva 2006). In order to identify the various phases of this sedimentation different kinds of sources need to be used. In the study of landscape these generally derive from field activities such as archaeological investigation, or may derive from geographical or historical analyses which involve textual historical documents, modern and historical cartography and iconography, remote sensing as well as sources originating from an oral tradition. Different sources offer different kinds of information related to evidences, remains, artefacts, toponymy, chronological references and so on. In historical geographical studies the sources may be used on different scales and for different themes (Gambi 1973; Rombai 2002), whereas landscape archaeological studies may take advantage of the availability of all these sources (Sereno 1981; Cambi and Terrenato 1994).

Let us highlight that the advantage of using different kinds of sources is not to simply obtain as much data as possible for investigative purposes, but to enhance the quality and significance of the information through correct integration in a GIS environment. In order to fully appreciate this approach it is necessary to bear in mind that there are no absolute levels of information, whether high or low, that have been provided by the different sources, but that the informative content is related to three different parameters, namely, 'what', 'when' and 'where' something happened.

Archaeologists and historians are also interested in "how" and "why" something happened, although this belongs to the field of historical interpretation.

The table below (*Table. 1*) schematically illustrates the information resulting from different sources in

	WHAT	WHEN	WHERE
Old cadastres	High	Low	High
Historical maps	Medium	Low-Medium	Low-High
Historical documents	High	High	Low
Aerial photographs	Medium	Low	High
Field Surveys	Medium	Low	High
Excavations	Medium-High	High	High

Table 1. Level of informative content for some classes of sources in relation to identification, chronology and location of archaeological elements.

terms of identification (what), chronology (when) and position or location (where) of archaeological elements used in landscape archaeology.

To clarify this scheme and in order to illustrate its contribution to the synergic integration of data let us give a hypothetical example of the analysis and integration of sources.

Let us consider, for the sake of argument, that in the course of our research we have come across a textual historical document testifying the foundation of a castle. This kind of source generally provides a well defined chronological reference and gives us some details about the owner, the toponymy as well as other information concerning its identity but provides meagre and rather generic information about its territorial location.

Let us say that we have identified traces of this feature on aerial photographs. In this case there are no chronological or typological hints despite its accurate location. These two different sources provide different levels of information and consequently acquire different positions within our conceptual scheme structured along the three main axes of "what", "where" and "when" (*Fig. 2*).
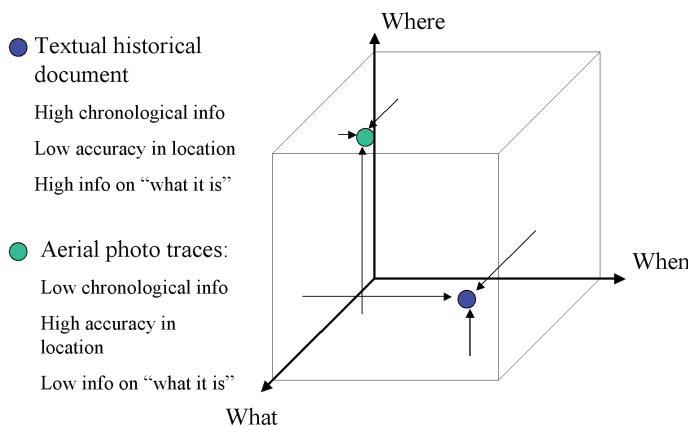
In synthesis, a textual historical document provides us with highly accurate chronological information, low accuracy as to its location but a high level of information regarding its identity or "what it is". On the other hand, traces on the aerial photograph are characterised by a low level of chronological information, high accuracy concerning location and poor or a low level of information about its identity.

If, however, we hypothetically are able to relate both sources to the same feature through analysis of the toponymy, shape, or similar territorial location, then it is possible to exponentially improve upon the quality of information. Thus, data deriving from different sources interact with each other generating synergy. In this process the historical evidence
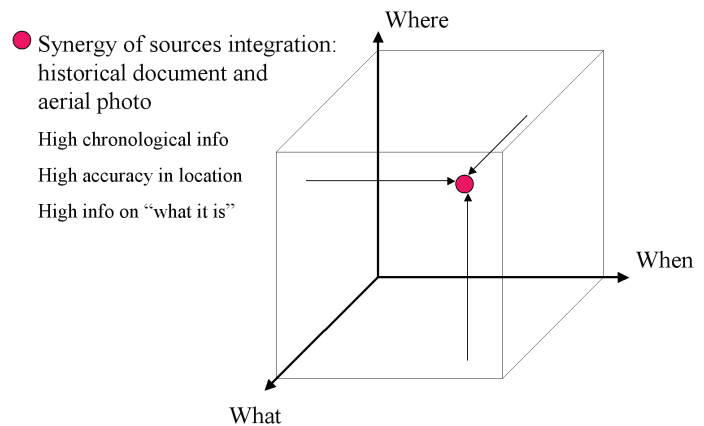

Fig. 3. Conceptual scheme showing the synergy of the integration of sources.

acquires a topographical connotation and becomes archaeological evidence whereas, on the other hand, the topographical traces acquire an historical meaning. Our hypothetical feature has now reached a high level of accuracy with regard to its chronology, location as well as its characteristics. (*Fig. 3*).

As we have already pointed out in the previous paragraphs, in order to perform this synergy our sources must be analysed in detail and each source must be placed within its derived context. A certain amount of uncertainty is often attached to historical data. Indeed, accuracy and reliability of the sources depend on the historical context in which they have been produced and

Fig. 2. Conceptual scheme of different levels of information structured along the three main axes.

the meaning of a sign or conventional representation can easily change in relation to its context. It is therefore necessary to undertake a philological interpretation of what the writer or cartographer wanted to point out or communicate in his document. It is necessary to remember that data from historical sources are not necessarily as they seem but are as those who produced them perceived them and how they subsequently decided to communicate them. This procedure is fundamental since it leads to the understanding of how to cross-reference sources.

4. Case studies

Two case studies related to the Maremma Regional Park in Southern Tuscany will be presented here as examples of the synergy of interaction between different kind of sources.

The first case study concerns the path of the ancient *Aurelia Vetus* Roman road in the proximity of the Ombrone river in relation to the position of the ruins of what is presumed to be a Roman bridge (the *Ponte del Diavolo*) and the position of the last meander of the river.

A part of the track of the Aurelia Vetus, crossing the area of the park near Alberese, which has completely disappeared by today, has been reconstructed through the GIS integration of data derived from the Leopoldino Cadastre (1817–1834) and from old aerial photographs (GAI flight, 1954). The methodology and results have already been presented on other occasions (De Silva and Pizziolo 2004, 2005, 2005a; De Silva in press, 2006).

The Northern portion of the Roman road in the vicinity of the Ombrone river is neither visible in any present-day or historical aerial photograph nor in the historical Leopoldino cadastre. This lack of evidence is due to the formation of alluvial deposits as a result of repeated past flooding of the Ombrone river from the 19th century onwards. From a regressive analysis of the historical sources it is worth noting that in the historical map, the *Pianta dimostrativa della Tenuta dell'Alberese* (conserved on the Alberese Farm) drawn by Giuseppe Baccani in 1805, the Roman road was represented in a schematic way but complete right up to the river where the ruins of the Roman bridge are marked on the map (*Fig. 4*). The cartographer indicated a series of floods from the meander and classified the neighbouring areas as marshes. We do not know if Baccani wanted to represent contemporary or earlier floods.

However, the comparison with an older map, the *Pianta della Tenuta dell'Albarese* (Archivio di Stato di Firenze, *Piante delle Regie Possessioni*, Piante sciolte, n. 606) drawn by Ansano Ruini in 1719, testifies that during the XVIII century the Roman
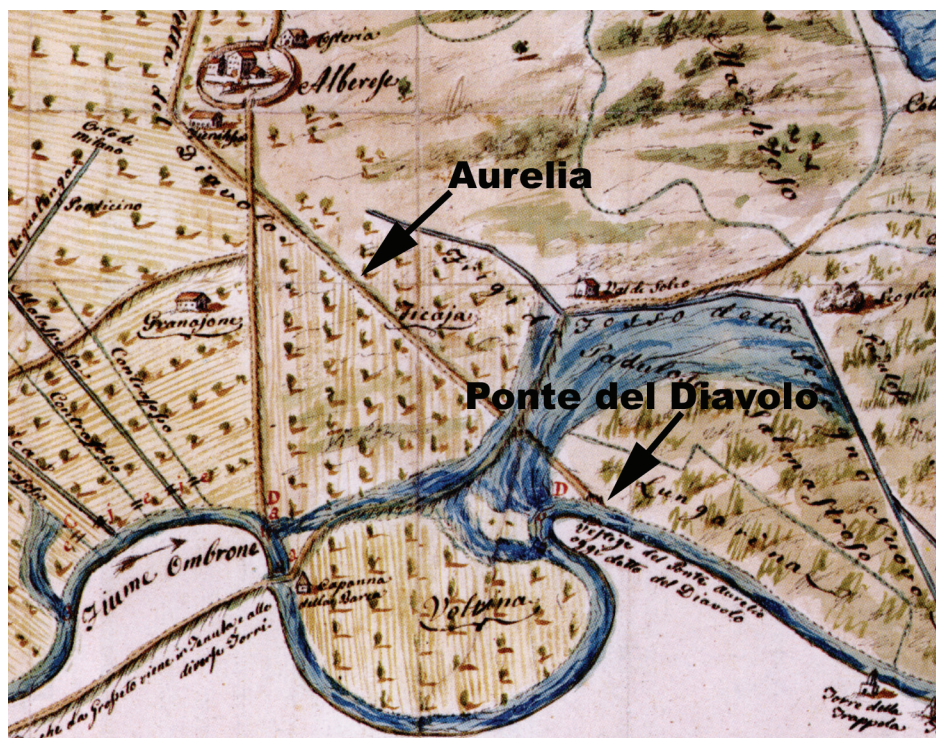

Fig. 4. The Aurelia Roman road and the ruins of the Ponte del Diavolo *in the map (oriented to West-Southwest) by G. Baccani (1805).*
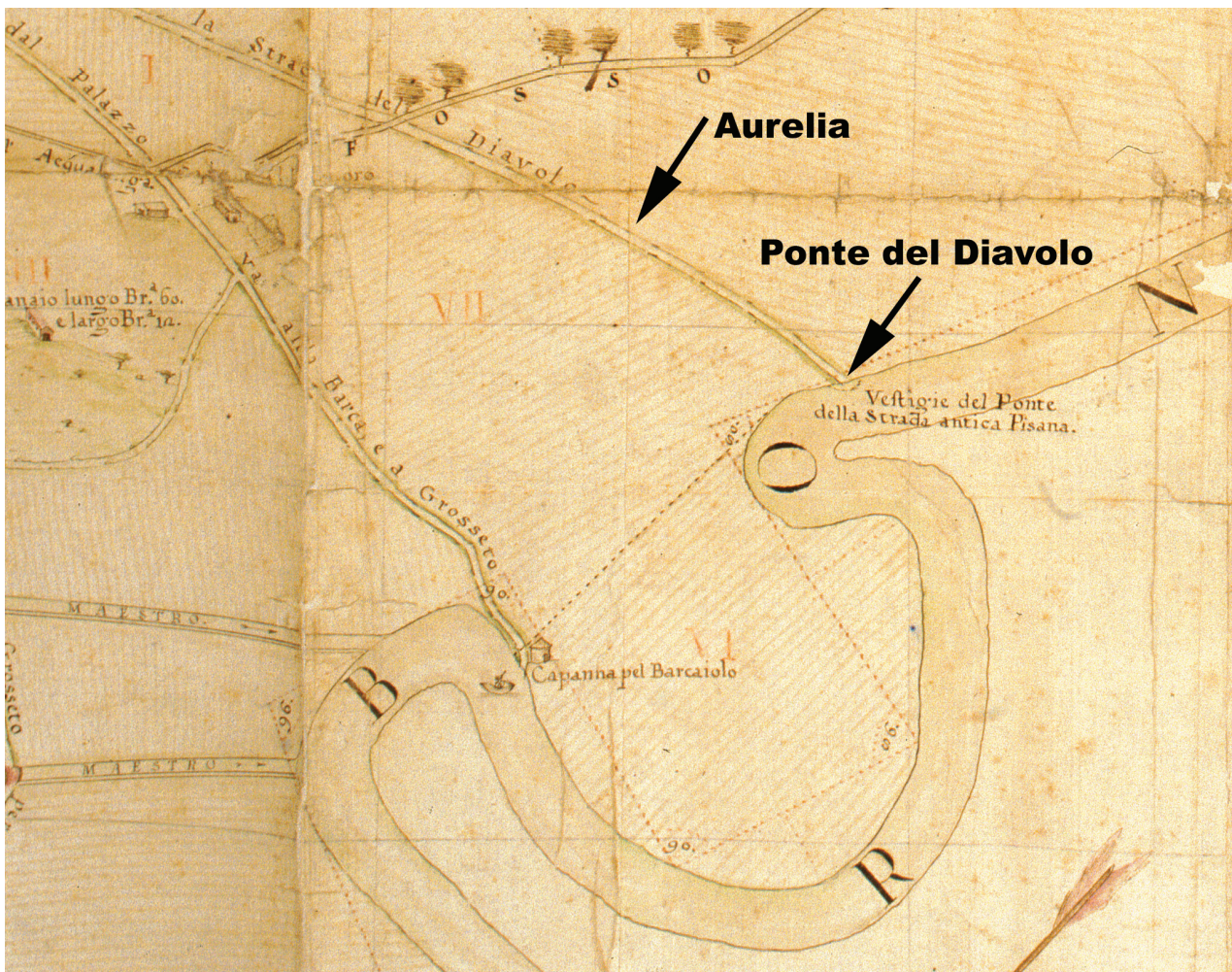
Fig. 5. The Aurelia Roman road and the ruins of the Ponte del Diavolo *in the map (oriented to Southwest) by A. Ruini (1719).*

road was still visible (*Fig. 5*). Ruini, in fact, described it as a very ancient road paved with stone slabs which connected Rome to Pisa and called it the *Strada del Diavolo* or the "Road of the Devil".

It was not possible to georeference both these historical maps in the GIS as they are not geometrical. Thus the way in which the road is presented by both cartographers does not enable us to consider this information as topographically accurate and it is impossible to simply vectorialise the data. Nevertheless, it is important to observe that on both maps the road continues along a straight line until it reaches the Ombrone. Even more interestingly, the road track diagonally meets the course of the river slightly downstream from the meander. How are we to deal with this historical information? How can we input this data in the GIS? The Ruini and Baccani maps suggest that the Roman road follows a straight course and that it is connected to the *Ponte del Diavolo*. One possible hypothesis is to link the *Aurelia Vetus* with the bridge by drawing a line from the last remaining traces of the road to

the bridge, the position of which can be identified on the geometrical Leopoldino cadastral map. Another possibility is to continue a straight line from the traces of the *Aurelia Vetus* which then meets the river Ombrone in a south-western point with respect to the *Ponte del Diavolo* (*Fig. 6*). In this way it is possible to use two kinds of sources: the above mentioned archaeological evidence and the topographical information provided by an historical cadastral map – the Leopoldino Cadastre – after it has been accurately georeferenced in the GIS.

The analysis of the first hypothesis highlights some inconsistencies in relation to the Ruini and Baccani maps: the line is not perfectly aligned with the attested traces of the Aurelia and it orthogonally meets the river at the centre of the present day meander (different from the historical maps).The second hypothesis is similarly contradictory since the path does not reach the bridge.

These inconsistencies could either signify that the position of the bridge in the cadastral map is wrong or, on the contrary, that the meander has changed its
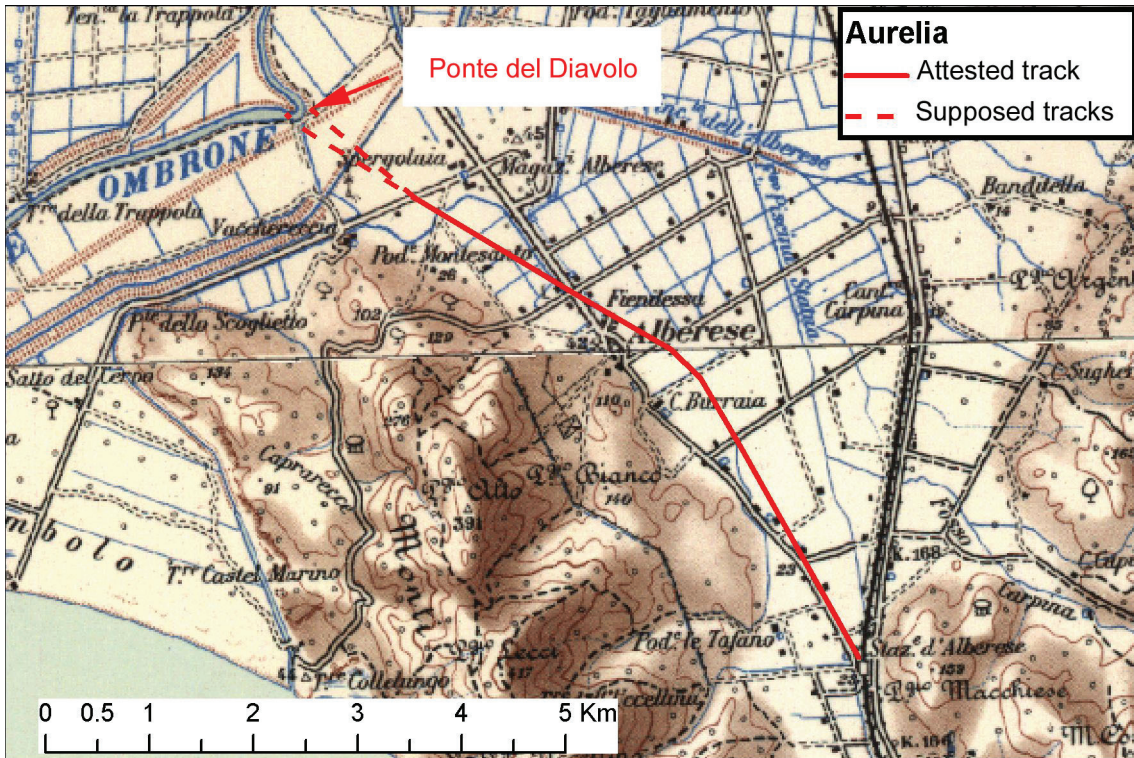
Fig. 6. Attested and supposed tracks of the Aurelia Roman road.

position in more recent times. A further comparison between the georeferenced Leopoldino cadastre and the present day maps undertaken in the GIS shows that the meander has shifted approximately 200 meters south-west over the last two centuries (*Fig. 7*).

Moreover, this information is confirmed by another source which shows that the Leopoldino
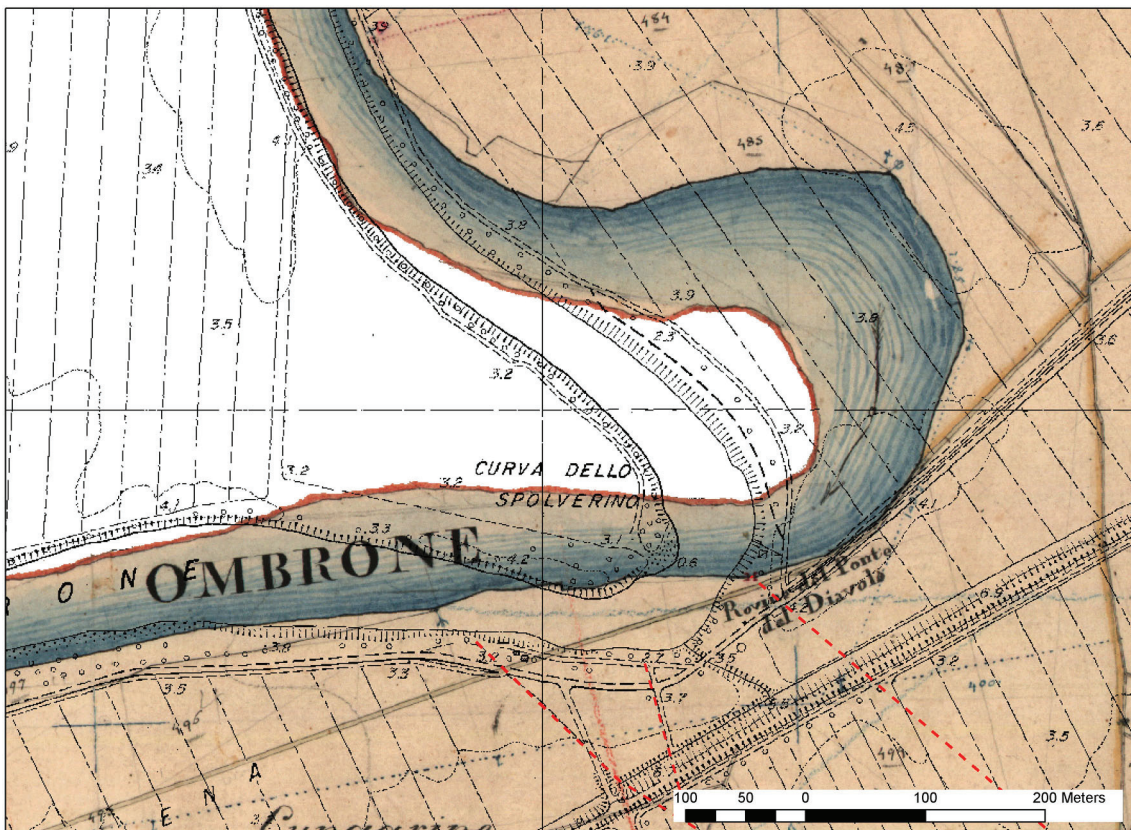

Fig. 7. The meander of the Ombrone in the georeferenced Leopoldino cadastre and in the present day maps.
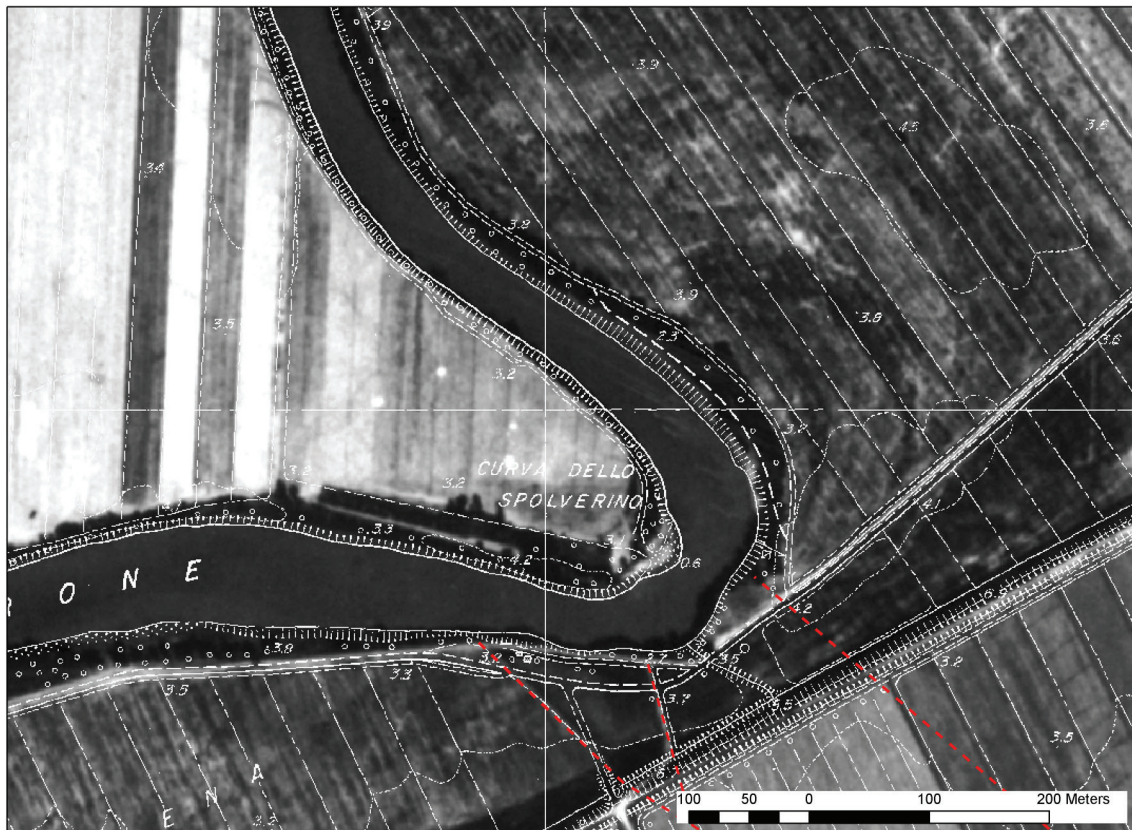
*Fig 8. Anomalies related to the meander at the beginning of the 19th century
in the aerial photograph of 1954 (GAI flight).*

cadastre was correctly georeferenced. In fact, the interpretation of the 1954 aerial photographs (GAI flight) highlights anomalies which correspond accurately with highlights of the Ombrone meander in the 19th-century map (*Fig. 8*).

This case study bears witness to the importance of a critical approach to the analysis of historical sources performed in a GIS environment.

Our second case study deals with the evolution of the coastline in the Grosseto area in relation to the archaeological data. Through the integration of geomorphological data, interpretation of historical aerial photographs and some historical sources and cartographies we were able to identify different phases of the evolution of the delta of the Ombrone river over the last two centuries (Ciampi 2004; De Silva and Pizziolo 2004, 2005a). Let us point out that the historical sources with good geometrical accuracy, enabling us to reconstruct the coastline, are available only from the beginning of the 19th century. However, from observation of archaeological evidences and of numerous historical 16th-century maps we can suppose that the coastline has undergone multiple transformations.

As an example of the synergy of integration of sources let us present an application of this

methodology. As we have already mentioned in the previous case study, the map drawn by Ansano Ruini in 1719 is an interesting document representing the territorial settings of the area, but the characteristics of this historical map do not allow us to properly georeference it in a GIS. Despite this problem, the Leopoldino Cadastre – drawn a century after the Ruini map – allows us to recognize and accurately locate some elements which are marked in the 18th-century Ruini map. In particular the ruins of the *Ponte del Diavolo* and the *Castel Marino* tower have been accurately pinpointed. Observing the Ruini map we may note that two red lines link these two points to the Ombrone mouth. The legend and the textual annotation on the map inform us that the drawing was executed on the basis of direct measurements taken in the field, thus the red lines represent the measured lines. Due to these conditions we were able to calculate directly on the historical document the relative distances and subsequently position the Ombrone mouth, related to the beginning of the 18th century, by means of triangulation (*Fig. 9*). In this way we have been able to correctly represent the two coastline limits in the GIS.

From observation of the Ruini map we can note that the coastline links the river mouth to the
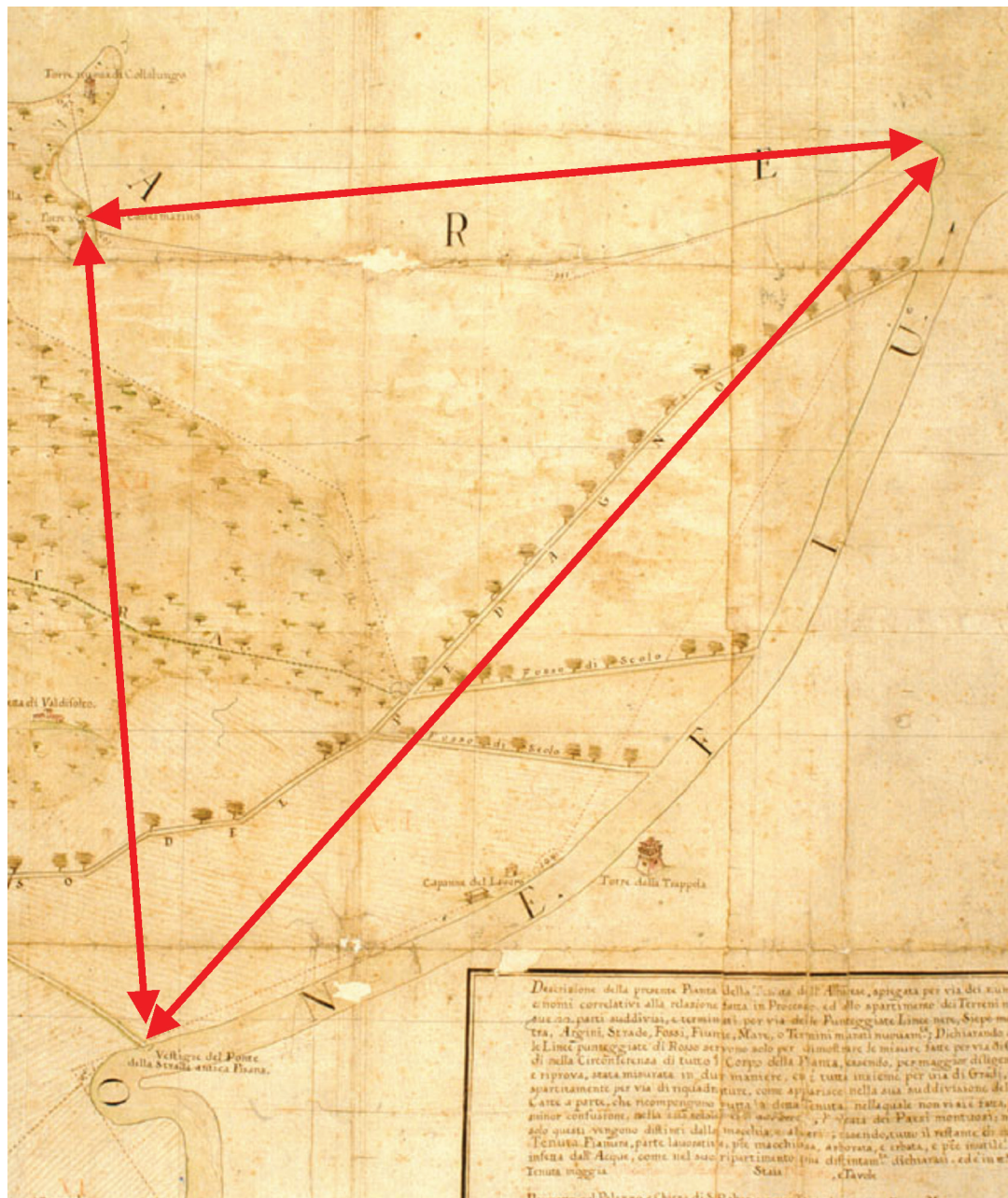
Fig. 9. The triangulation of the Ombrone mouth (in 1719) by measurements from 2 identified control points.

Castel Marino tower in a concave route. In order to topographically reconstruct the historical coastline we used the 1954 aerial photographs to recognize the shape of the coastal dunes in the proximity of the two limits. The coastline should be located between the two coastal dunes. We consequently traced a line joining these two points by following the contour of the dunes. The geomorphological data (Bellotti et al. 1999) shows that the coastal dune located slightly inland of our coastline (1719) dates to the 18th century (*Fig. 10*). In other words comparison with the geomorphological data confirms our initial interpretation providing a logical reasoning behind our integration of data.

5. Conclusion

The theoretical issues and the brief case studies presented in this paper have attempted to underline how the use of different kinds of sources may be advantageous in landscape studies, especially the historical sources which provide fundamental information in our understanding of landscape transformation. From a research perspective, however, attention must be paid in the use of historical sources, especially when intending to make comparisons and undertake spatial analyses deriving from sources of a different nature, since the 'informative content' of these sources does not have an absolute value but on
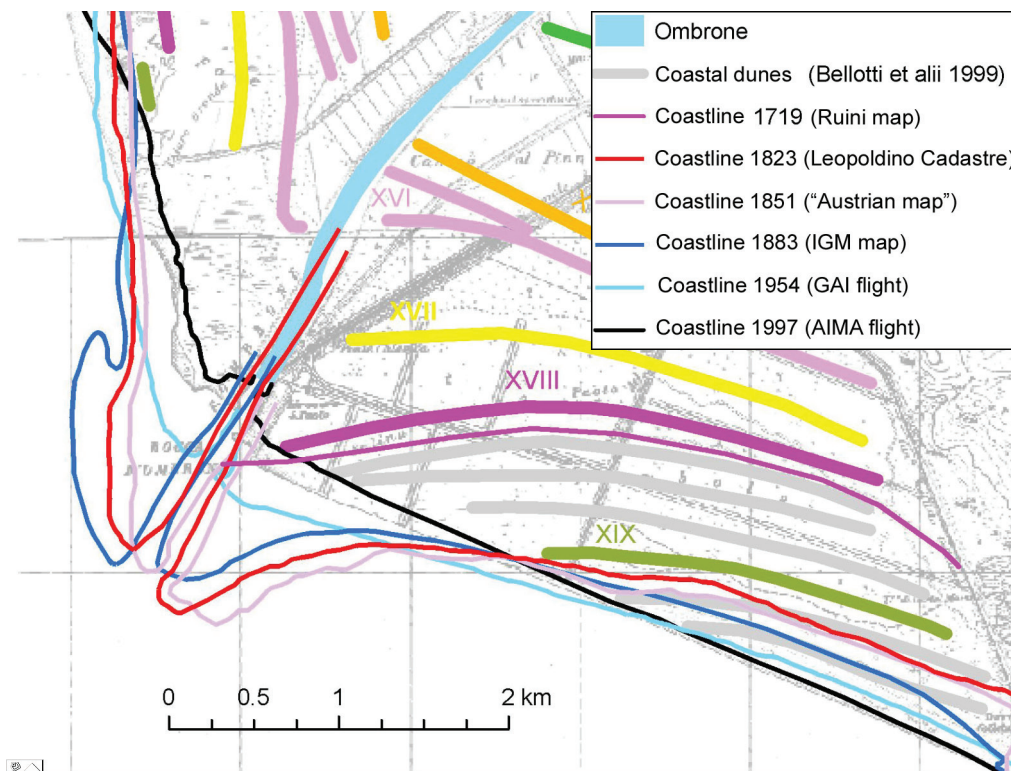
Fig. 10. Integration of data for analysis of coastal changes 1719–1997.

the contrary, may range from high to low levels in the characterization, positioning and chronology of the testified features. Moreover, every source has a different level of accuracy calling for a rigorous critical approach of evaluation. For this reason philological analysis should provide the historical framework for the document and the correct meaning of the elements represented. The uncertainty implicit in the historical sources (but also in other kinds of data i.e. those deriving from an oral tradition and so on) could be dealt with and resolved by integrating different data utilising a synergic approach. In conclusion the GIS environment should be considered an elective space for the interaction of various data whereby quality and reliability of spatially related information may be duly enhanced.

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