



## Urban and landscape changes through historical maps: The Real Sitio of Aranjuez (1775–2005), a case study



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### ABSTRACT

When determining the evolution of a territory or town over time, comparing historical maps with contemporary maps is indispensable. In this study, we applied the methodology of georectification to compare historical maps with current orthophotos from 2005. We propose colour and lines code as useful tools for the analysis of the urban and landscape changes that the town has undergone since the 18th century, and we graphically reconstruct certain former heritage items that no longer exist. For example, these techniques are applied to the Real Sitio de Aranjuez (Spain) using the two most important historical maps: the 1775 *Domingo de Aguirre* map, which shows the full extent of the royal site for the first time, and the 1835 *General Town Plan*, which is the most characteristic of available 19th-century maps, as it displays the consolidated historical town. Next, using two rectified rasters and the orthophoto, we overlay a grid of nine 1 × 1 km squares, allowing us to “see the town and its territory” at three moments in history: 1775, 1835 and 2005. Thus, we obtain formal and dimensional information allowing analysis of the evolution of the territory, urban area and historic buildings. Among the many applications of this methodology in the fields of urban development and monumental-heritage conservation, we propose the graphical reconstruction of three urban elements that no longer exist. We determined that graphical reconstruction, in conjunction with traditional historical research, provides the greatest benefits for recreating a historical landscape. These methodologies will aid in the development of long-range management strategies and facilitate the assessment of threats posed by anthropogenic activities and environmental change to preserve the landscape heritage.

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### 1. Introduction

Urbanisation can be defined as the changes that occur in the territorial and socioeconomic progress of an area, including the general transformation of land cover/use categories from being non-developed to developed (Weber, 2001). Urbanisation is a worldwide phenomenon that has increased significantly in the last century (Aguilera, Valenzuela, & Botequilha-Leitão, 2011). Landscapes are characterised by dynamic and continuous change, which may be expressed by quantitative changes in landscape structural characteristics (Skaloš, 2006).

Although photographic techniques are highly accurate, they are unable to provide measurements of the landscape prior to the 1950s (Bromberg & Bertness, 2005). Thus, when graphically reconstructing the landscape, we must resort to historical cartography. Historical cartography all over the world is a fundamental part of cultural heritage (Bitelli, Cremonini, & Gatta, in press), and such

maps are a potential source of information for historical studies (Jenny & Hurni, 2011). Large map collections are available in many countries, representing great potential for describing and understanding the development of landscapes through time (Vuorela & Toivonen, 2003). In landscape studies, maps have been used for a variety of purposes, such as analysing changes in land use or reconstructing landscape and vegetation transitions over time (Simpson et al., 1994). For example, Tucci, Giordano, and Ronza (2010) used historical maps dating back to the eighteenth century and a 2005 official city map, and they applied methods of spatial analysis and geovisualisation techniques to determine which parts of the city (Milan) changed the most in the time interval considered.

Technically speaking, it is possible to digitise all historic sources and integrate these seamlessly into new reconstructions. Historical maps have their own limitations, which can lead to unreliable virtual reconstructions (Benavides, 2004). Most of historical maps were created before standardised map projections were being used. It is almost impossible to perfectly align an old map to modern coordinate systems (Rumsey & Williams, 2002). Thus, transformation has been the only option for transforming unprojected historical maps to compare them with projected GIS data layers.

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