DHQ: Digital Humanities Quarterly

Preview
2023
Volume 17 Number 2

An Integral Web-map for the Analysis of Spatial Change over Time in a Complex Built Environment: Digital Samos

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Abstract

The paper focuses on a prototype interactive web-map developed for the presentation and dissemination of architectural transformations at the monastic site of San Julián de Samos in north-western Spain. The paper’s central argument offers a response to questions regarding why and how to create an interactive web-map in the field of architectural history through a particular case study. The paper is organized into three main parts. It first presents the project focus on spatiotemporal analysis of a centuries-old Spanish monastic site. Second part is devoted to the specific domain of web-mapping tools and why they can help us to better make sense of complex built environments that humans have formed and re-formed over time. After that, we explain how we faced the process of creating an integral scientific web-map that goes beyond static 2D representations of a multi-layered past physical realm in a definitive publication, the challenges we faced, and the proposed future developments. The prototype web-map of Digital Samos integrates the graphic features of spatial objects with source data in a web publication platform where the reader is granted accessed to fully uncover, interact with, and learn about a historically rich monastic palimpsest.

Introduction

The project Digital Samos is devoted to study the monastic site of San Julián de Samos, which is one of the most ancient and largest monasteries in Spain. We examine the evolving nature of the monastic architecture along with its surrounding environment, the sacred precinct, and the nearby village. This monastic compound has been written and re-written through continuous spatial changes over the course of centuries. As a consequence, Samos is currently a palimpsest, that is, a complex built environment defined by multiple historical layers. 1

Despite the monastery as a single entity has been largely examined by scholars since the late 19th century onwards,[1] the monastic site as a totality of the religious buildings and their agricultural plots, the nearby urban tissue, the geographical setting, and the surrounding landscape, was not previously addressed when the present project began. This is probably due to the difficulties that spatiotemporal analysis involves in the case of built environments defined by layers that cross millennia. 2

To uncover and reconstruct those historical layers in spatial and temporal terms, we utilize a multidisciplinary approach that combines historical sources, evidence-based investigation, and digital technologies. Historical sources related to monastic architecture and landscape at Samos are diverse and, sometimes, scarce, incomplete, or uncertain. The extant fragments of past monastic compounds may appear currently decontextualized, dispersed, hidden, or even lost. As a consequence, to investigate and reconstruct those multiple layers poses a set of challenges that concerns both urban history and architectural history. Digital tools can help us to overcome those challenges. 3

Through computer-aided design (CAD) tools we created a series of phased 2D maps and 3D models that visualize the main stages of the monastic site evolution from the High Middle Ages to the early 21st century. These digital 4 visualizations help us, as scholars, to gain a better understanding of the processes by which the monastic site of San Julián de Samos was designed, understood, changed, and experienced over time as a totality of topography, architecture, and human history.[2] A number of initiatives has also demonstrated in recent decades that the communication of knowledge with digital methods in academia can promote the understanding of cultural heritage and spread awareness of the importance of preserving and protecting historical architecture along with its context outside academia.[3]

In June 2018, we began a new in-process work for the project with the creation of an interactive web-map, hosted by Universidade da Coruña at https://digitalsamos.udc.es/interactive_map.html.[4] This new stage emerged from our participation in the Getty Summer Institute "Advanced Topics in Digital Art History: 3D (Geo)Spatial Networks" [Duke University 2018], where instructors and participants illustrated how web-based platforms have become essential vehicles for presentation and dissemination of research about architectural heritage. They can be also thought and designed as tools to ensure the intellectual integrity of computer-based visualization outcomes in research and communication of urban and architectural history [Jaskot et al. 2018]. 5

In addition, an issue of major concern in the architectural community and virtual heritage domain at large is how we can publish graphic materials such as vector plans, 3D models, or geospatial historical maps in such a way that their rigor is clear to their full consideration as research arguments. Print and online publications not only put a limit on the number of figures or illustrations to be published per article, but they also establish specific types of image file formats, which are generally raster graphics. The first issue — number — gives priority to prose in scientific publications. This fact usually leads to the consideration of graphic materials or multimedia outputs as an accompaniment to the text, but not the research arguments themselves [Chattopadhyay 2012] [Staley 2015, p. 123–127] [Sullivan et al. 2017]. 6

As Freddolini recently pointed out, "… the activity of writing involves diverse aspects that include the possible ways to visualize and disseminate my research… Tools for data visualization, to cite only one example, are not only a corollary – or a demonstration– of what I 'write', but essential components of the arguments I aim to create…" [Helmreich 2021, p. 176]. However, the use of common image file formats force researchers in those fields to convert their original vector CAD architectural plans, graphic 3D models reconstructions, or geospatial GIS historical maps into fixed images when they aim to publish their work. As a consequence, historical data and the different types of thinking and interpretation that were made and integrated in the computer-aided design visual materials, through layers, categories, or attributes, are generally lost. 7

This is a common challenge we faced when we tried to communicate the results of our research about the monastic site of San Julián de Samos. The interactive web-map of Digital Samos is created to overcome that challenge through the use of web-mapping tools, while it also promotes the understanding of the historical site among scholars and public. It displays the extensive knowledge we acquired about this complex built environment through on-site and archival research into a digital publication, in which the "reader" is granted access to the evolution of the historical site. In addition to cartographic display showing detailed information about the setting topography and the compound of the monastic site (buildings, precinct, and village), the web-map aims to become a more scientific successor to the phased CAD maps we previously created. By taking advantage of the potentials of the digital domain, we try to overcome the limitations of the traditional series of fixed images in which we converted the CAD maps for prior dissemination of our research. Instead of static phased maps that revealed the complexity of spatiotemporal changes by means of time fragmentation or color coding design, the prototype web-map we present in this paper walks toward a more integral and effective online interface, where the final user is able to interact with space, time, scale, layers, and sources. All spatial entities are displayed in the form of web graphic features with attributes with historical data and interpretation within one single digital output. 8

The paper is organized into three main parts. First, we present the project focus on the spatiotemporal analysis of a centuries-old Spanish monastic site and its main outcomes so far. Second part is devoted to the specific domain of web-mapping tools. Based on related works and projects in the field, we show how web-mapping can help us to better make sense of complex built environments that humans have formed and re-formed over time. As this point we also connect our project to existing literature in Spatial Humanities on deep mapping, thereby contextualizing the present case study. 9

Then, we explain how we faced the process of creating an integral scientific web-map for Digital Samos that goes beyond static 2D representations of a multi-layered past physical realm in a definitive publication. We present the workflow, its potential, and pitfalls. Finally, we discussed the challenges, the present limitations, and the future developments of what we consider a functional prototype web-map for spatiotemporal analysis, presentation, and dissemination in the field of digital art and architectural history, while we also summarize why this project is valuable as a case study. The web-map is here conceived as a means for public outreach, a self-explanatory visual product, in which accessibility, transparency, legibility, and integrity of visual and textual spatial data in a digital environment aims to promote a fuller understanding of the process that defined the past monastic site(s).[5]

San Julián de Samos beyond historical practice

The main art historical question in the project San Julián de Samos is spatial change over time of a historical monastic 10
site that includes the monastic buildings, the sacred precinct, the nearby village, and the surrounding rural area (Figure 1). The monastery was founded before the 7th century and, like most religious houses, it changed across its long life through constant constructions and re-constructions. Studying the question of spatial change over time is crucial to analyze how the site was conceived, understood and experienced, as a sum of different pieces (monastic buildings, topography, urban tissue, geographical features) instead of as a single artifact (Figure 2).

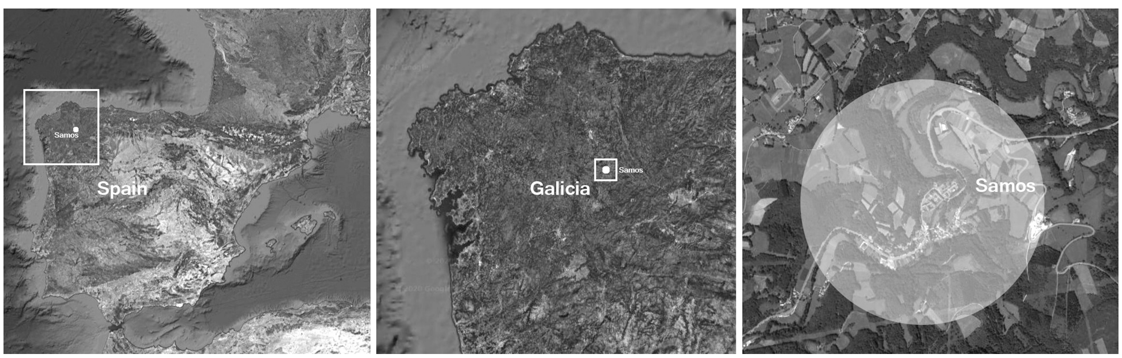


Figure 1. Google Satellite maps showing the location of the monastery of San Julián de Samos in progressive closeness to the country (Spain), the province (Galicia) and the place (Samos).

Figure 2. The monastery of San Julián de Samos and its present context. Photograph: June 2011, the author.

The first part of our research process comprised the collection of historical and contemporary sources. Historical ones are very disparate from each other, such as building contracts, rental agreements, books of demarcations, cadasters, historical photographs, old maps, expropriation records, and civil engineering projects. Contemporary sources collected are images, plans, on-site investigation, measure surveys, remains, testimonies, scientific papers, book chapters, etc. 11

The second part of the research process was focused on generating 2D maps and 3D models with Computer-Aided Design programs, that is digital tools, to recreate the multiples phases of spatial change of this monastic site over time. The monastic site was re-created and then visualized through static images of plans/maps and renderings, one per each main phase of transformation (Figures 3 and 4). We used a code for 2D map drawing that is comprised of different colored lines. Each colored line has a different meaning about the knowledge it represents. For example, dark and grey lines visualize buildings that are extant nowadays, that is evidence. On the contrary, brown and orange lines are used to draw hypothetical parts of the monastic site. We also used a different color to represent those monastic proposals that were planned but not built (Figure 5). 12

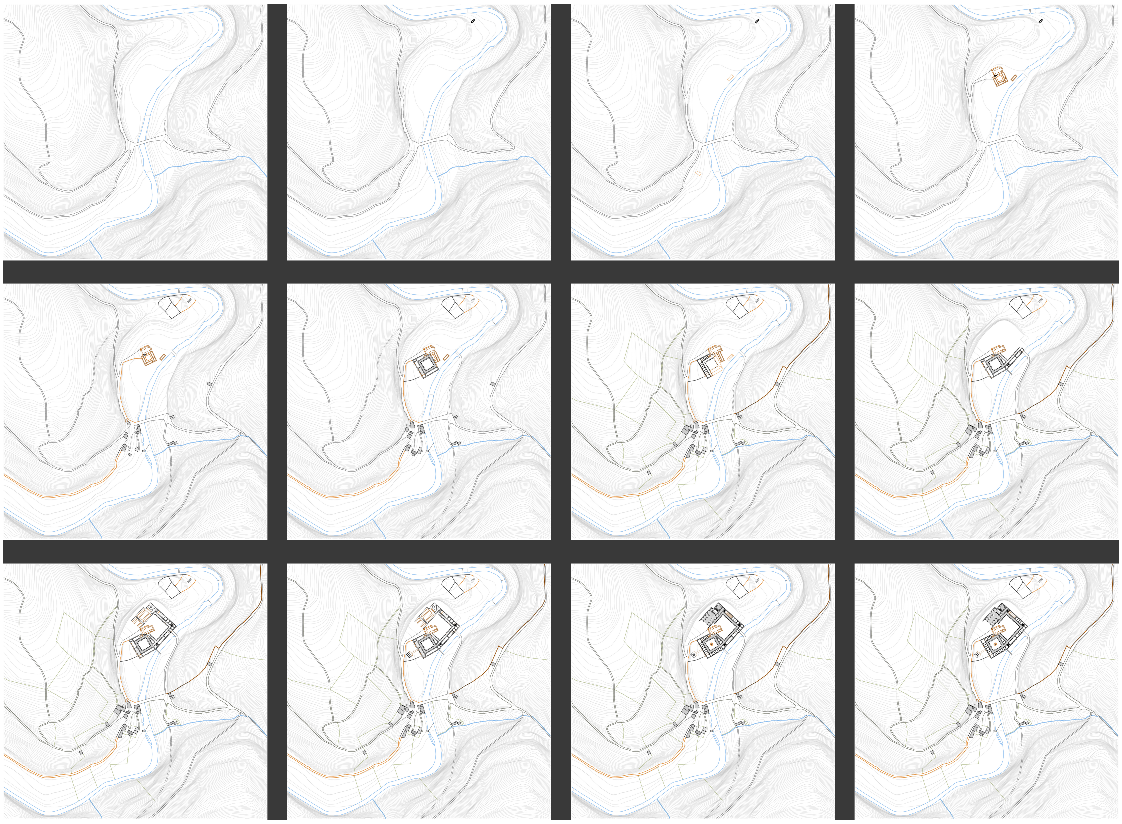


Figure 3. A selection of phased computer-aided design 2D maps of the monastic site of San Julián de Samos from Middles Ages to early 18th century. Images: the author.

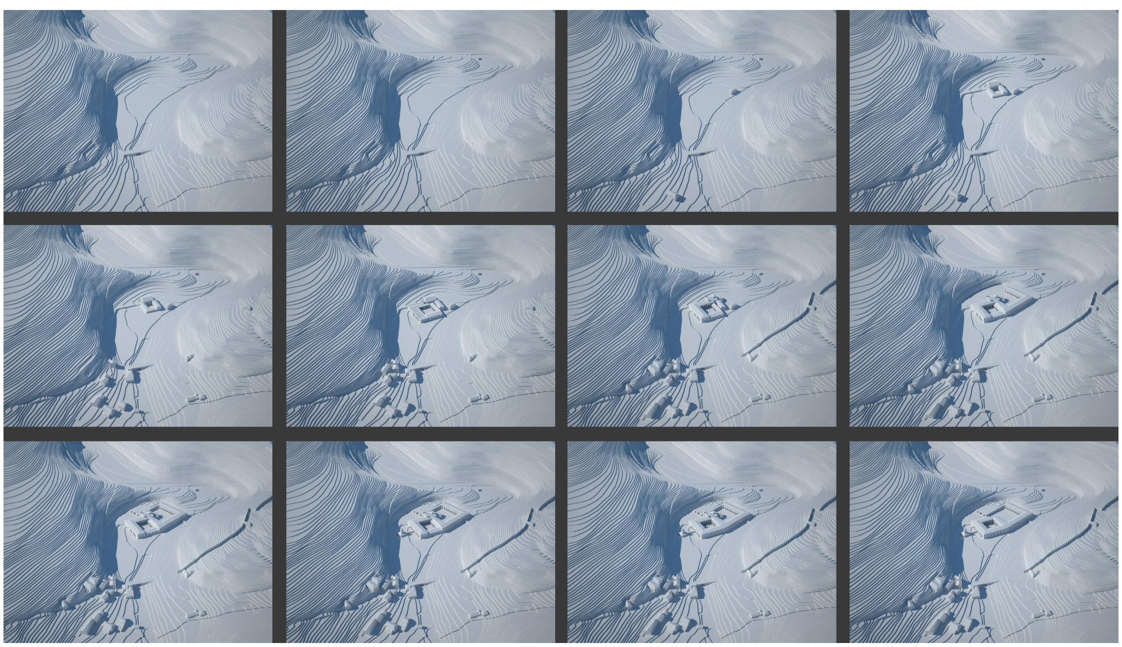


Figure 4. A selection of phased 3D reconstructions of the monastic site of San Julián de Samos from Middles Ages to early 18th century. Images: the author.

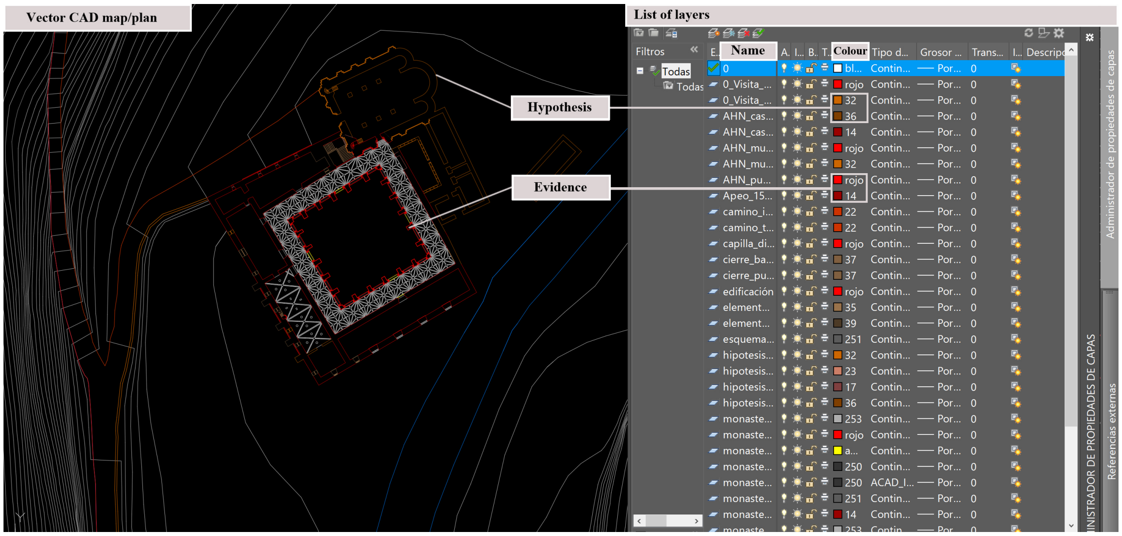


Figure 5. Vector map/plan generated with AutoCAD of the monastic site at Samos in the second half of the 16th century along with the associated layers of entities and colors classified in accordance with the status of the knowledge that they represent (evidence vs hypothesis). Images: the author.

Through this methodology we were able to recover the lost monastic compound of the Late Middle Ages from which 13
only some remains are extant currently [López Salas 2013]. We could analyze the reasons behind the architectural reform that took place in the late 15th century and its consequences on the definition of a new monastic site [López Salas 2017a]. We discovered the role of monks in the creation and evolution of the sacred precinct and the immediate village of Samos, as urban planners [López Salas 2017b] [López Salas 2017c]. We came to understand the multiple processes that surrounded the replacement of the Romanesque church and cloister by bigger buildings, and the role that context, topography, and geographical features played in the monastic design of the 18th century. We also analyzed through digital representation how a proposed but unbuilt fourth cloister would have changed completely the historical monastic realm, as well as the losses that secularization brought to architecture and monastic landscape in the 19th century [López Salas 2017d] [López Salas 2017e] [López Salas 2017f].

The new knowledge was acquired in the process of making the maps and models due to the reasoning that was applied 14
to create them from sources and interpretations while also filling the gaps caused by ambiguity, uncertainty, or absence of data. This is what Elena Svalduz called “a new form of intellectual reasoning through modeling” or representation of past spaces by means of digital visualization tools [Svalduz 2018, p. 36]. We also consider that most of this new knowledge in the form of visual products must be communicated from scholars to the scientific community and general public without losing the potential of the visual sense. However, scientific publications prioritize textual analysis as it also happens in the evaluation of knowledge production within academia, where images, videos, maps, or models that results from serious research are rarely considered as rigorous as texts. The inclusion of visual data in publications is usually restricted to a specific number of figures and its presentation is also limited by widely used raster image formats instead of vector graphics.

In our case, the project outcomes reveal the potential of digital visualization for art-historical academic research as we 15
have largely published in paper conferences, journal articles, and book chapters.[6] However, the lack of funds and the high cost of print publication prevented us from presenting the project along with its sources and results in any complete fashion so far. The creation of a web presence could provide, we think, an ideal solution to not only make the research outcomes about Samos accessible and better known in and outside academia, but also to test a new form of publication beyond the limits of scientific journals in what refers to the dissemination of visual-centered projects, where drawings, maps, images, and digital graphic outputs are not a complement of the text, but a new form of scholarly production to be recognized as rigorous as textual research [Chattopadhyay 2012] [Staley 2015, p. 123–127] [Sullivan et al. 2017]. In addition, we should not forget that each form of communication can do something that the other cannot and, for that reason, both should be considered complementary, and neither superior, as Ethington and Toyosawa point out in their comparison of cartography, which operates by simultaneity and juxtaposition, and semantic text, which is syntactically

linear and narratological [Ethington and Toyosawa 2015, p. 75]. In this way the idea of creating an interactive web-map of the spatiotemporal changes at the monastery of San Julián de Samos was born.

References and goals for Digital Samos web-map

Working with 2D maps and 3D models poses a set of challenges in publication. The main one is the file format. While maps and models that reconstruct past spaces are usually created with computer-aided design or 3D computer graphics software toolsets, print and online scientific journals mainly display these types of digital products in the form of images, that is, fixed visual representations of real or imagined past spaces. None of the data on which the generation of the digital product was based on, or the interpretations the scholars made through various types of thinking, are usually published along with the images. They may be explained in the prose narrative that the images accompany, but as two entities separately [McClure and Worthey 2019]. 16

This fact leads to a main difference between the map or model made by the scholar with the final map or model to be published in what refers to information and interpretation. It also shows another difference, which is not always visible, between the way we display and read text and images in scientific publications. While we are able to quote any excerpt of the text to cite the source or sources in which our argument is based, such quotation is not possible in the case of spatial features that define the image of a 2D map or a 3D model. As a consequence, the connection between our visual arguments and their evidence is lost [McClure and Worthey 2019], although it is fundamental to guarantee the rigor and transparency of scholarly publication. 17

This is an issue of major concern in the computer-based visualization of cultural heritage research community that both the London Chapter (2009) and the Principles of Seville (2011) highlight [London Chapter 2009] [Seville Principles 2011] [Lanjouw and Waagen 2021]. Sufficient information to document and disseminate computer-aided visualization outcomes is needed to enable the understanding of the relationship between research sources, implicit knowledge, explicit reasoning, and visualization-based outcomes, but also to facilitate the recognition of accuracy in the field. 18

The London Chapter (2009) points out that a first way to accomplish this challenge is through the publication of a two-dimensional record of the computer-based visualization outputs along with the methods used, and the interpretations made [London Chapter 2009]. However, in this paper we propose to create a web-map were data and interpretations embedded during the generation of phased CAD maps for spatiotemporal analysis at Samos are also displayed when the online publication is faced. 19

This challenge has already been accomplished by a number of research teams in historical studies about complex built environments with different purposes and results. Such is the case of the “Digitally Encoded Census Information and Mapping Archive” (DECIMA), which was designed as a research tool for historians interested in early modern Florence.[7] DECIMA website is an open-access platform. In the so-called mapping tool, users can interact with mapped data from three censuses of 1551, 1561, and 1563. These are displayed on a historical map of the city from 1584 georeferenced onto a contemporary one [Pecile 2018]. The design of DECIMA database and web platform enables users to display one census data layer or a group of them. As we zoom in the map, it is also possible to click on projected points with a cursor and a data table with associated census information about residents and properties will be displayed. In addition to that, DECIMA offers a data query tool for interactive analysis about ownership, shops, occupation, property values, or gender. It has already proved to be a powerful analytical tool that, even from simple questions, leads to new interpretations and knowledge about the modern Florence, its social conditions and relations [Terpstra and Rose 2018]. However, spatial features are simplified in the form of dots which is enough for the analysis of human movement or economic activity in the past city, but not for the study of the built environment in spatial terms. 20

In this sense, another relevant example is the project “Visualizing the Mountain Estate: Landscape, Architecture and Experience in Chengde.” Their authors are developing an interactive web platform thought and designed as a tool for evolving research and discovery in a historical environment.[8] The project is devoted to study an important Qing Dynasty Imperial Park in Chengde (China) that was built in multiple phases over the most part the eighteenth century and then deconstructed and reconstructed in the following two centuries. To approach how this imperial park was 21 conceived, understood and experienced, the web-map of this project visualizes the whole built park environment along with its topography and hydrology over a current orthophotograph. The platform provides users with a layer control to select the type of landscape feature to visualize (buildings, walls, rivers, islands, lakes...). Moreover, data can be filtered by structure type, construction data and reign for selected display. As we interact with the map, it is also possible to click on each building and a pop-up with associated data is opened. Each pop-up shows organized relevant information as well as a link to extended textual data and non-textual outputs about the selected building to explore the spatial environment at will. This is a work in progress and its results are still to come, but the main aim is to enable researchers and users to query the database in the future and, by doing so, to address new questions of the historical environment through computational analysis and interactive presentation [Whiteman et al. 2018].

In the particular field of monastic architecture, Wulfman, Mylonas, Loyer, Bonde, and Maines developed the MonArch Project website to explore the ways in which complex relationships among textual, architectural, and archaeological evidence can be represented in non-traditional formats to create a new form of scholarly expression for their work about the Abbey of Saint-Jean-des-Vignes in Soissons (France) [Wulfman et al. 2007]. They realized that archaeological evidence supports and illustrates the textual narrative at the same time that the latter contextualizes the archaeology and monastic architecture, so they proposed a web infrastructure that allows authors to present their arguments and also users of the website to develop their own interpretations around monasticism, the abbey's structures, place, community, and economy based on an interactive interface.[9] 22

This project demonstrates the potential of digital representation in a web-context to publish detailed corpora of material findings, to present the spatial dimensions of social relationships, and to recover the human actions performed in the past [Bonde et al. 2009]. However, in what refers to the presentation and dissemination of the past architectural spaces the results are limited. They created an interactive site plan of the Romanesque abbey with a time slider and clickable phases showing some evidence options for that period, but the user is not able to directly interact with each spatial element or to have access to historical or excavated data from the visual argument, so the exploratory possibilities are somehow restricted as well as the provision of information to understand the nature of evidence and hypothesis. 23

Another promising project is an in-process collaborative platform, called SIG 4D, presented by Rollier-Hanselmann, Petty, Mazuir, Faucher, and Coulais for the case study of Cluny Abbey (France), considered the greatest building of European Christendom in the 12th century [Rollier-Hanselmann et al. 2014]. By using the TerraExplorer Pro software, they try to integrate 2D maps and 3D models created from historical data and archaeological excavations into one single GIS database and research system. Their aim is to offer scholars a digital tool for research analysis, where the access to disparate data is possible as well as its comparison to better understand the Cluniac site. The project is focused on studying the relationship between the abbey and the surrounding landscape through the hybrid nature of the archaeological artefacts. For this purpose, they argue that it is essential the collaboration and the combination of data coming from different disciplines. In the digital realm, the authors also recognize that the diversity of data and its integration in a single geographic system bring technical difficulties they still have to solve. Web-mapping and online dissemination of the SIG 4D seem to be additional aims as they presented in the project workflow [Rollier-Hanselmann et al. 2014, p. 174], but no access to the system is accessible yet. 24

The third and last case study that this state of the art comprises is the Sera project, led by José Ignacio Cabezón [Budapesti 2019, p. 28–29].[10] It is focused on Sera, one of the largest and most important monasteries in the Tibetan world. Cabezón created a multimedia, interactive database that allows users to explore different aspects of Sera: its physical layout, history, material culture, educational system, and ritual life that, on the whole, defined what he called the richness and complexity of Tibetan monastic life.[11] The project includes a section devoted to the physical space of the monastery. Sera buildings are classified according to their form into: compounds, complexes, or freestanding structures.[12] A compound is said to be an enclosure, that is, a single building or a group of adjoining buildings with an interior courtyard, such as the main regional houses, apartments, or lama residences. A complex is a group of buildings that share some kind of association, but no necessarily adjoining and enclosed. Freestanding buildings are single structures with no association to nearby ones and with no perimeter wall. 25

The architecture of Sera is represented in an interactive web-map.[13] They gathered data of mayor structures within the monastery, images, GPS readings, and field notes during a field trip that, later on, were the foundation to develop an image catalogue and the narrative descriptions of each building, compound, and complex of the monastery. Then, they created a digital map of the monastic site using a GIS software that was finally converted into a web-deliverable, flash map of the monastic architecture. The map is said to integrated the narrative descriptions and the image database, however it is no longer working after Adobe Flash Player was retired in 2020. This is also what happened with the MonArch Project website.[14] 26

The previous examples demonstrate the potentials of a web-map, not only as a means to access and showcase a project, but also as a research tool that allows public to explore, interpret, and analyze data in the wholeness of each case study, to pose novel questions, and to create new ways to engage with and gain knowledge about historical built environments. They also illustrate different ways to address the representation of architectural space and spatiotemporal analysis in a web context mainly from archaeological excavations and historical data. Different software tools were used in each case study in accordance with data and purposes of analysis, but also depending on funding. Moreover, while web-maps of DECIMA and Mountain Estate are fully functional, the MonArch and Sera Projects are deprecated and the SIG 4D for Cluny Abbey seems to be a desktop system on the way to being transformed into a web-map. A common concern in these projects is looking for new forms of publication in what refers to 2D maps that, first, enables interaction with different source of data, and secondly, aims to open new paths for query and exploration (Figure 6). 27

The four examples are efforts to build increasingly more complex maps of visible and invisible aspects of a place. They aspire to be more-than-representational and they put emphasis on one particular user interaction: exploration. Anyone who approaches these maps is given various possible paths to “dive within” them and explore different questions. We argue that they are attempts to move towards more integrated spatial frameworks for research while they also illustrate some challenges and potentials of what has recently emerged as deep mapping practices in the field of Spatial Humanities [Bodenhamer 2010] [Bodenhamer et al. 2013] [Bodenhamer et al. 2015] [Murrieta-Flores and Martins 2019] [Roberts 2016].[15] 28

Although there is no scholarly consensus on what deep mapping entails as a practice or what a deep map is as a product [Earley-Spadoni 2016, p. 96] [Roberts 2016], the four previous examples do aim to “record and represent the grain and patina of place through juxtapositions and interpretations of the historical and the contemporary… the conflation of oral testimony, anthology, memoir, biography, natural history and everything (their authors) might ever want to say about a place” [Pearson and Shanks 2001, p. 64–65]. They are not simply digital maps, but “subtle and multilayered views of small area(s) of the earth” [Bodenhamer 2010, p. 27] [Bodenhamer et al. 2013, p. 174] that take advantage of the digital tools to comprise layers of meaning and process and to develop routes for new forms of spatial narratives. They are also “shaped by a particular scholarly vision but offering an open-ended, exploratory environment” that is only limited by available data, framework design, query tools, and the end user’s critical eye, knowledge, and imagination [Ridge 2013, p. 177]. 29

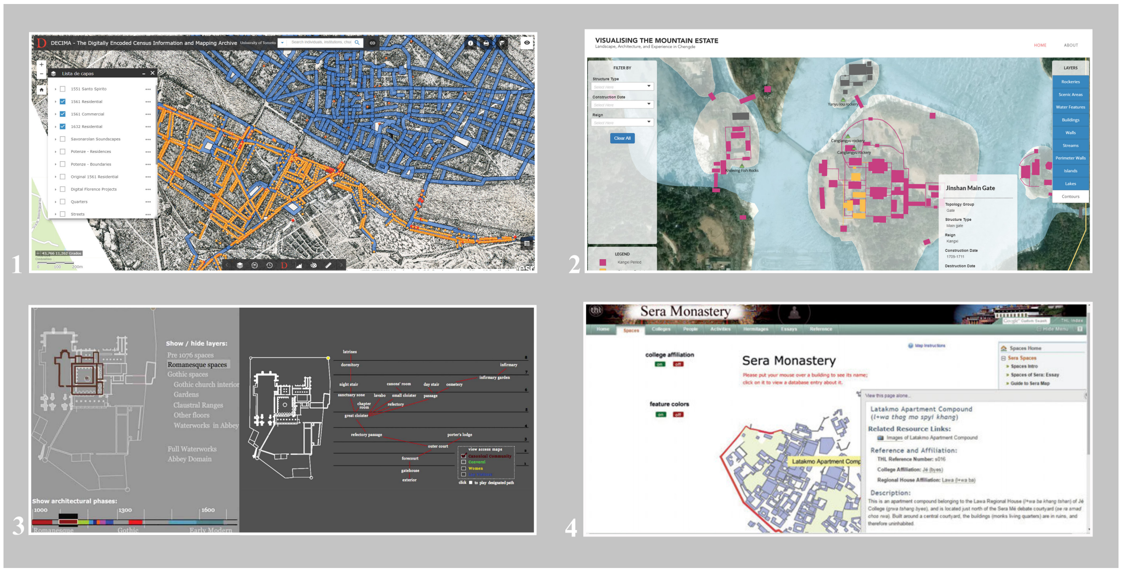


Figure 6. Four examples of scientific web-maps for research and dissemination in Art and Architectural History: 1. DECIMA WebGIS (https://utoronto.maps.arcgis.com/apps/webappviewer/index.html?id=d9692905ff41436d99cf7c398552ca39); 2. Visualizing the Mountain Estate. Landscape, Architecture, and Experience in Chengde (https://blogs.ntu.edu.sg/bssz/); 3. The MonArch Project – The site of Saint-Jean-des-Vignes (Figures 3 and 7 published by [Bonde et al. 2009], http://monarch.brown.edu/); 4. Sera Interactive Map – Sera Project (Figure 2 published by [Budapesti 2019, p. 29]).

They allow us to set the goals of the interactive web-map for our Digital Samos project in accordance with our research 30
questions. First, through the web-map we aimed to make the spatiotemporal analysis of the monastic site at Samos accessible to a broader audience. Besides, we considered important to allow interaction between the user and the platform, not only as a way to engage new audiences, but also to enable them to learn about this historical site at its own pace. Another goal was to make readable the relations between sources upon which the research was built and any project output in order to create a reliable web environment, where intellectual integrity is guaranteed. In addition, we prioritized a fully functional result in what refers to the final representation of change over time in the web context. To achieve a detailed web-display of spatial features was considered a high issue along with their embedded data and topographical context, instead of a simplification of the original geometries into points, or ideal shapes. This implies a series of difficulties from a technical perspective, as we will explain in the following section.

Digital Samos is in conversation with many concerns in literature about deep mapping, as not only aspires to delineate 31
and give shape to the locational properties of a particular monastic place. It also tries to go deep in the horizontal surface and to embrace the verticality of spatiotemporal analysis along with multimedial navigability for critical reflection and open-ended exploration [Bodenhamer 2010, p. 26–29]] [Ridge 2013, p. 178] [Roberts 2016, p. 3]. By going deeper there are more layers we discover and Digital Samos aims to give an answer to how we can hold them all together, that is, how we can frame them as a map, as deep mappers seek [Roberts 2016, 3]. All in all, the web-map of Digital Samos aims to renew the interest in the monastic past realm through accessibility and dissemination, interaction and public engagement, transparency and rigorousness, all of which is inside an integral platform, a new research tool to further our knowledge about this site in its intactness by means of interactive visual presentation and interpretation.

From fixed CAD to an integral web-map

The next step of the process was to deal with how to make all these goals possible. This was not only a technical 32
challenge and an experiment in a new way of communicating this project about monastic architecture, urban history and landscape, but it was also an iterative process of thinking and learning through web development in an intellectual way. This is what we aim to explain next.

To understand the process of making the integral web-map demands, first, to remind that the project has a conceptual 33
focus on space and on its dynamic transformation over time. Therefore, space and time are two key factors to be

represented in our web-based environment. All maps and models previously generated in the project visualize spatiotemporal changes by using computer-aided design (CAD) technologies. Therefore, the first step was to explore how it might be possible to turn the existing visualizations of past spaces into a web-map that meets all the goals set before.

A first way to approach this challenge could be to generate one image per each phase of the evolving monastic complex and to display all of them in a website created with a content management system (CMS), even in relation with a timeline. When a map or plan is displayed in a website as a fixed image or as a series of images showed in chronological order, they do not usually have associated data to each feature represented, beyond the one we may add manually through embedded external hyperlinks, for instance. In addition to that, if we showed maps or architectural plans in this way, they would not be georeferenced either. As a result, the historical site would not dialogue with current physical realm. We would not enable audience to interpret and understand the relations between present and past monastic compounds by looking at both at the same time. These were some of the limits that early attempts in the sphere of website representation of urban history projects dealt with, lack of geo-referencing and accuracy of dependency relationships between documentation and visualizations, weak user interaction options, and short-term sustainability [Cardesín Díaz 2018]. 34

Our aim is to push the concept of CAD maps that revealed the complexity of spatial changes over time by means of phased representations much further, toward a more integral and effective interface (Figure 7). We considered creating a digital and interactive two-dimensional map to portray spatial changes over time in permanent relationship with: previous and following realms, the present monastic complex, research sources, and extant physical remains. For the first attempt, we left the incorporation of the existing three-dimensional models pending for a future scale-up of the project. Although the sense of space provided by a two-dimensional map is limited, it is generally best to start simple and expand the project in following developments. As for time, the aforementioned two-dimensional web-map in the singular was conceived, actually, as many maps overlapped. Each one will represent a main phase of the process of changes at San Julián de Samos over time. We aimed that the multiple maps might be displayed or hidden by the user at will as a way to explore and discover spatial changes and relations between them in the interaction. In order to simplify the process of making, we also selected the most relevant stages to be represented. For that reason, each stage would be an abstraction that does not visualized changes on a short-term time basis. Although we are aware that the analytical nature of the project showed is reduced with this decision, to increase the number of stages will be possible and easier in future developments of the web-map, after learning how to face the whole process for a lower number of them. 35

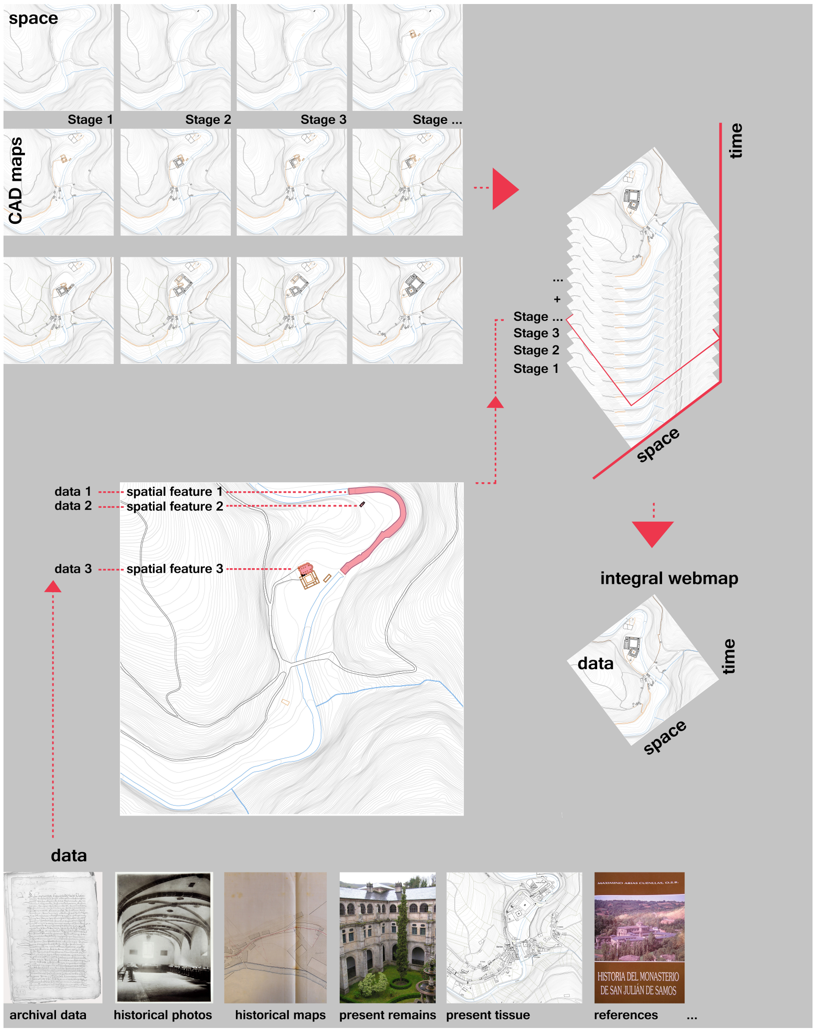


Figure 7. First conceptual model for an integral web-map showing spatiotemporal changes in the historical site of San Julián de Samos. Image: the author.

Each single spatial feature in our existing phased maps and models shapes a building, a property, a road, or any other part of the monastic built environment in the past according to historical sources and current physical remains. We always try to show how it actually was. When sources or remains are scarce, ambiguous or even non-extant, hypotheses had to be developed by forcing a dialogue between available evidence. The hypothetical parts of our maps were made visible by means of color-coded lines. However, connections between spatial features and historical documentation or physical remains that supported the reconstruction were missing in the definite maps and models. The reason was that the software application used to generate them, AutoCAD. When this project started, this CAD program did not offer the possibility to associate non-spatial information to each spatial feature. In other words, there were no attributes appended to features displayed in our maps and models, although all of them were classified in layers according to their type, the level of knowledge and the source. However, historical data that supported the reconstructions was not readable within the 2D or 3D graphic outputs, unlike text-based research findings where we can quote any reference to a book or an archival document, for instance, by embedding its text directly in our written argument [McClure and Worthey 2019]. This sort of quotation would be fundamental to create a transparent and rigorous visual output, where integrity is ensured, as we previously pointed [Hatchwell et al. 2019]. It would also end up in the creation of self-explanatory digital maps and models about historical sites opened to scientific evaluation, again like research scholarship in the form of text [Münster et al. 2018]. 36

With all this in mind, the next step towards the web-map was to resort to a geographic information system (GIS). They are designed to store, manage, analyze, and display spatial data, either past or present. In research about historical built environments and urban history, GIS has already been proved as a powerful tool to track and analyze changes in 37 time. Historical maps created with GIS have many potentials: to define shapes, to create layers, to assign attributes to those shapes and layers, to represent the passage of time to some extent, and to use visualization as a means of inquiry, both in desktop and online applications [Camerlenghi and Schelbert 2018]. In particular, we decided to use QGIS, a free and open source geographic information system.

38 At this point, the following question could arise: why not simply use a GIS system since the very beginning? This is a question that often appears in the discussions about the best approach to historical 2D/3D drawing, mapping and modelling of past architectural spaces. The short answer is that computer-aided design (CAD) and drafting applications (e.g. AutoCAD) and 3D computer graphics software (e.g. Blender, 3D max) offers much more degree of freedom with regards to freehand design and 3D modelling that is not possible in GIS or in HBIM [Lanjouw 2021] [Boeykens 2018, p. 72–75]. CAD tools and 3D graphics software better allow the process of reasoning or intellectual representation that is needed for the understanding and rigor reconstruction of complex past architectures. For instance, they enable the scholar to properly describe the actual irregularities of historical complex built environments, which are much more difficult to be represented with GIS or HBIM applications [Lanjouw 2021] [Boeykens 2018, p. 72–75]. On the contrary, GIS, as well as HBIM software, do integrate various types of data, so vector features may have associated datasheets with historical information that can be finally turned into web-maps.

39 To move the project from AutoCAD to QGIS was not an immediate process. We had to adapt the existing CAD files to a new program and way of working within it, along with continuous thoughts regarding how to improve the representation of spatiotemporal changes in a new web-based context as well as how to manage and structure textual data and spatial features in accordance with the proposed aims (Figure 8).

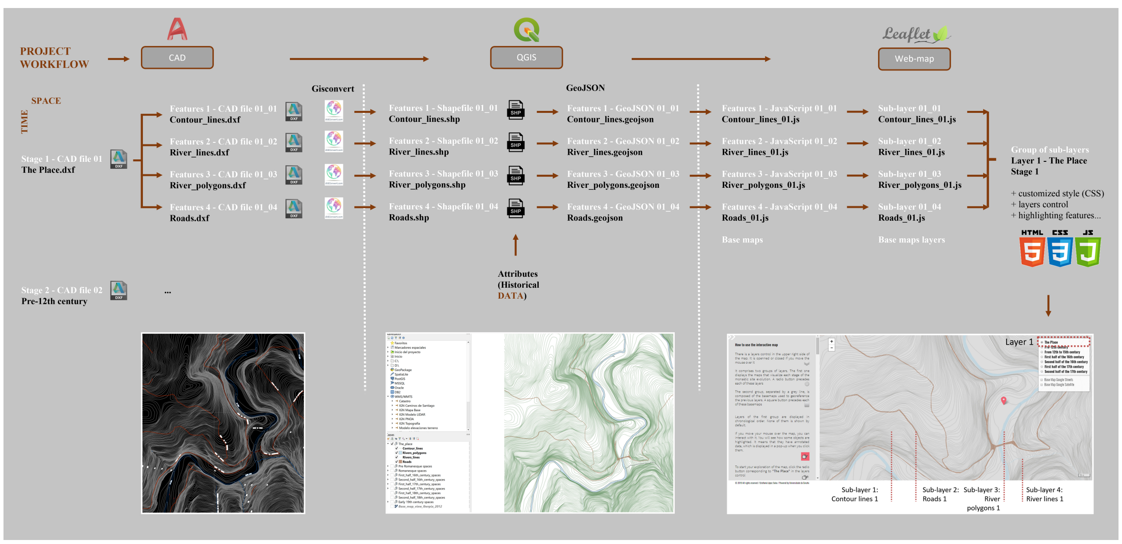


Figure 8. Project workflow from 2D CAD maps of the monastic site to the web-map of Digital Samos. Image: the author.

40 The first step was to geo-reference the CAD files so in the web output they will be displayed in relation with present cartography. The following step was to turn CAD files into shapefiles (SHP) to be readable by QGIS.[16] This was not a direct step. Each map generated with CAD represents one phase of the monastic site's biography through multiple overlapped layers. Each layer comprises diverse types of geometries: lines, circles, polylines, points... and each geometry might represent a single spatial feature or just one part of it. This is an important issue to clearly distinguished, for instance, between remains and hypothesis by using CAD tools. In QGIS each SHP file or layer of the project is only able to comprised one type of geometry: points, lines, or polygons. This difference between both programs forced the creation of a series of individual CAD files to later represent each stage of the monastic site at a distinct moment in time within QGIS. Each of them only comprises one type of geometry readable in QGIS. For instance, in the case of the CAD map that represented the monastic site from the twelfth century to the fifteenth century, we generated nine CAD files that were converted into SHP files in a following step: "contour_lines" (lines), "guest_house" (polygons),

“Romanesque_church” (polygons), “Romanesque_cloister” (polygons), “Chapel_of_the_Cypress” (polygons), “hospital” (polygons), “roads” (polygons), “rivers_1” (polygons), “rivers_2” (lines).

However, this initial division of each phased CAD map into multiple layers prior to their conversion into SHP files was not only due to one technical reason. It also resulted from thinking about: what type of historical information supported each graphic reconstruction; how we aimed to structure it; and in which way spatial features should be visualized to ensure a clear and friendly understanding, interpretation, and evaluation of the final interface by users. To find a proper answer to all these questions was the result of an iterative process of thinking, making, checking the results and moving the process forwards or backwards to test other ways of making through all of which we learnt and advanced the project. 41

For instance, the files called “contour_lines” and “rivers_2” in the group of SHP files of the monastic site from the twelve to the fifteenth centuries only comprise one type of geometry: lines. Therefore, the initial thought could be to merge them in a single file if we only consider it as a technical issue. However, if we also reflect about how they should be displayed for an easy visual understanding by means of color-coded lines and fills, the separation between the two files is needed. 42

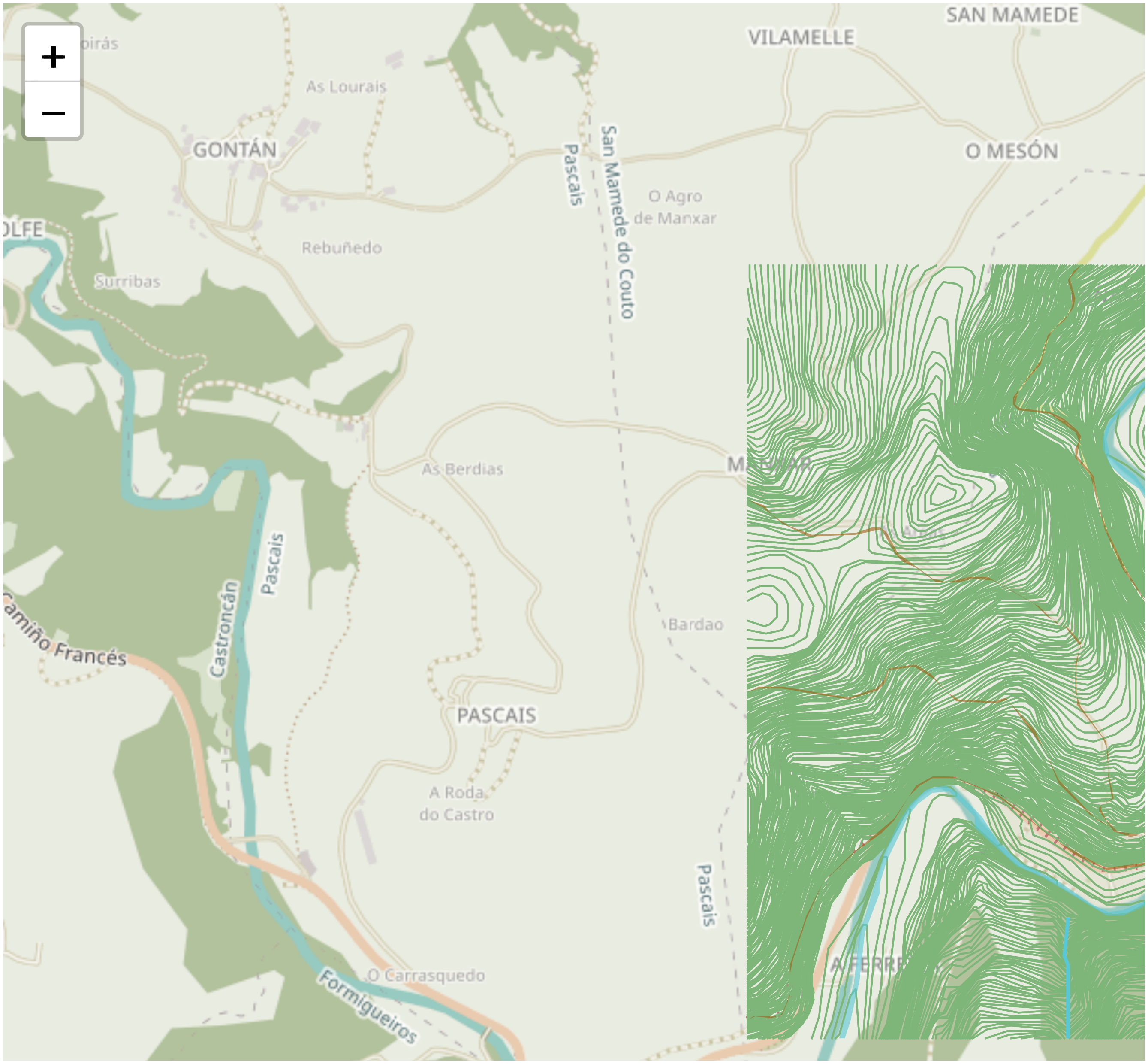
The layers called “Romanesque_church” and “Romanesque_cloister” could also perfectly be within a single SHP file called “monastic_buildings” along with the QGIS layers of “guest_house”, “Chapel_of_the_Cypress” and “hospital”. All of them just comprise one type of geometry (polygons). Besides, the attribute table with information on spatial features of the layer can be organized with the same structure, as they are all under the consideration of monastic buildings. However, if we think about how to display the question of change over time in the web-based map without forgetting the diverse evolving nature of each monastic building, we come to the conclusion that their separation is also needed for an integral and legible visual reading and understanding of the resulting interface. Although it is possible to assign diverse attributes to each spatial feature within the same layer, we cannot follow the same path in what refers to their visualization yet, as the styling options (color, fill, type of line...) of a vector layer will be applied to all its spatial features. 43

To go in depth in this issue, the next example is a reflection about how to best represent a historical fact with spatial consequences, which is the fire of 1534 in the Romanesque cloister, in the web-map. It affected one part of the monastic complex and monks decided to rebuild it immediately. Based on sources, the shape of the spatial feature was not altered. So to visualize it by means of changes of shape in a two-dimensional representation is not possible. To make easier the legibility of this change in the period corresponding to the monastic site in the first half of the sixteenth century beyond the addition of a textual annotation, the cloister is represented by a different line-coded polygon. As a result, one historical fact with architectural consequences is somehow made visible to the observer (Figure 9). 44

Figure 9. From left to right: 1. the monastery in the Late Middle Ages with the cloister represented with a contour line and a fill color; 2. the monastery in the first half of the 16th century after the fire of 1534, with the cloister represented with a contour line but without a fill color to graphically display the historical fact; 3. the monastery in the first half of the 16th century after the fire of 1534 with displayed historical data in a pop-up. Image: the author.

After the first four groups of layers called “The Place,” “Pre-twelve century,” “From twelve to fifteenth centuries,” and “First half of the sixteenth century” were created and georeferenced onto a contemporary cartography in QGIS,[17] the following step was to learn how this simple GIS map could be turned into a web-map. For this purpose, we made some trials with two QGIS plug-ins: QGIS Cloud Free and QGIS2WEB. The first plug-in was tested in QGIS 3.4. The free 45 application is presented as a web-GIS platform for publishing unlimited public maps and data on the internet for non-commercial and non-government uses, but with storage for their databases limited up to 50Mb.[18] The process to create and publish a QGIS project is quite easy by taking just a few steps.[19] However, the trials made with our databases were not fulfilling as the plug-in worked unstable in the latest release of QGIS, as the QGIS Cloud Support Team confirmed. Besides, we soon realized that the storage limit of 50Mb to upload the local database of our maps in QGIS Cloud Free would not be enough once we have created the missing groups of layers.

In regards to QGIS2WEB, it also enables users to create an OpenLayers/Leaflet web-map from a QGIS project, but this 46
is not automatically published in an online platform, as it happens with QGIS Cloud. In other words, we can generate the HTML, CSS and JavaScript files that defined the web-map with QGIS2WEB, but then we need a web hosting to release it. Trials carried out with this plug-in allowed us to create a simple interactive map in a quick way. It is possible to set what layers or group of layers will be visible or hidden in the web-map as well as to select the base-map onto which they will be georeferenced. We can also add a series of tools for user’s interactivity, such a scale and zoom, an address search for locations, a layers list, a measure tool, the option to highlight features, and to show pop-ups when mouse hovers over features.[20] However, we also checked that QGIS2WEB did not represent all the spatial features defined in our QGIS project and, above all, it has many limitations to control and customize the resulting web-map according to the project requirements, unless we manually enhance the basic template generated by the plug-in (Figure 10).



View embedded content above in its own browser window at: http://digitalhumanities.org/dhq-annex/000652/figure10/#15/42.7327/-7.3294.

Figure 10. Result of the second trial to create a web-map with the QGIS2WEB plug-in. Webmap: the author. Interface controls may be hidden depending on the size of your browser window. Navigate using map scroll bars or open the map in a new window to access interface controls.

In any case, the exploration of these two ways to create a web-map from a QGIS project led us to learn about Leaflet. Leaflet is one of the two powerful web-mapping libraries used by QGIS2WEB developers. It is an open-source JavaScript library designed to create friendly interactive maps that work efficiently in all major desktop and mobile platforms.[21] Leaflet API is said to be simple to read and easy to use even for beginner JavaScript developers. It is well-documented in its website, where we also found tutorials to get started with Leaflet basics as well as lots of plug-ins to extend its functionalities. 47

Another relevant feature of Leaflet is that we can create a web-map from map vectors defined by GeoJSON objects.[22] 48
GeoJSON is a JSON format that encodes a geometry (one geographical feature) or a collection of geometries by defining their coordinates along with their non-spatial attributes [Crickard 2014, p. 41–44]. The features include points,

line strings, polygons, and multipart collections of these types (multi-points, multi-line strings, and multi-polygons). The non-spatial attributes are similar to the attribute table with textual information associated to a layer in QGIS.

For several months, the in-process work of Digital Samos was focused on learning how to use Leaflet and what 49
potentials it offers for the interactive map of the monastic site at Samos. In addition to that, the in-process work revealed that if we aimed to meet all the aforementioned goals for free, we would need to design a custom-built platform; that is, a manually coded web-map (Figure 11). Otherwise, its future capabilities would be limited. However, making the decision of custom-designing the website to display our research involves dealing with a series of challenges that we also discovered in the in-process work.

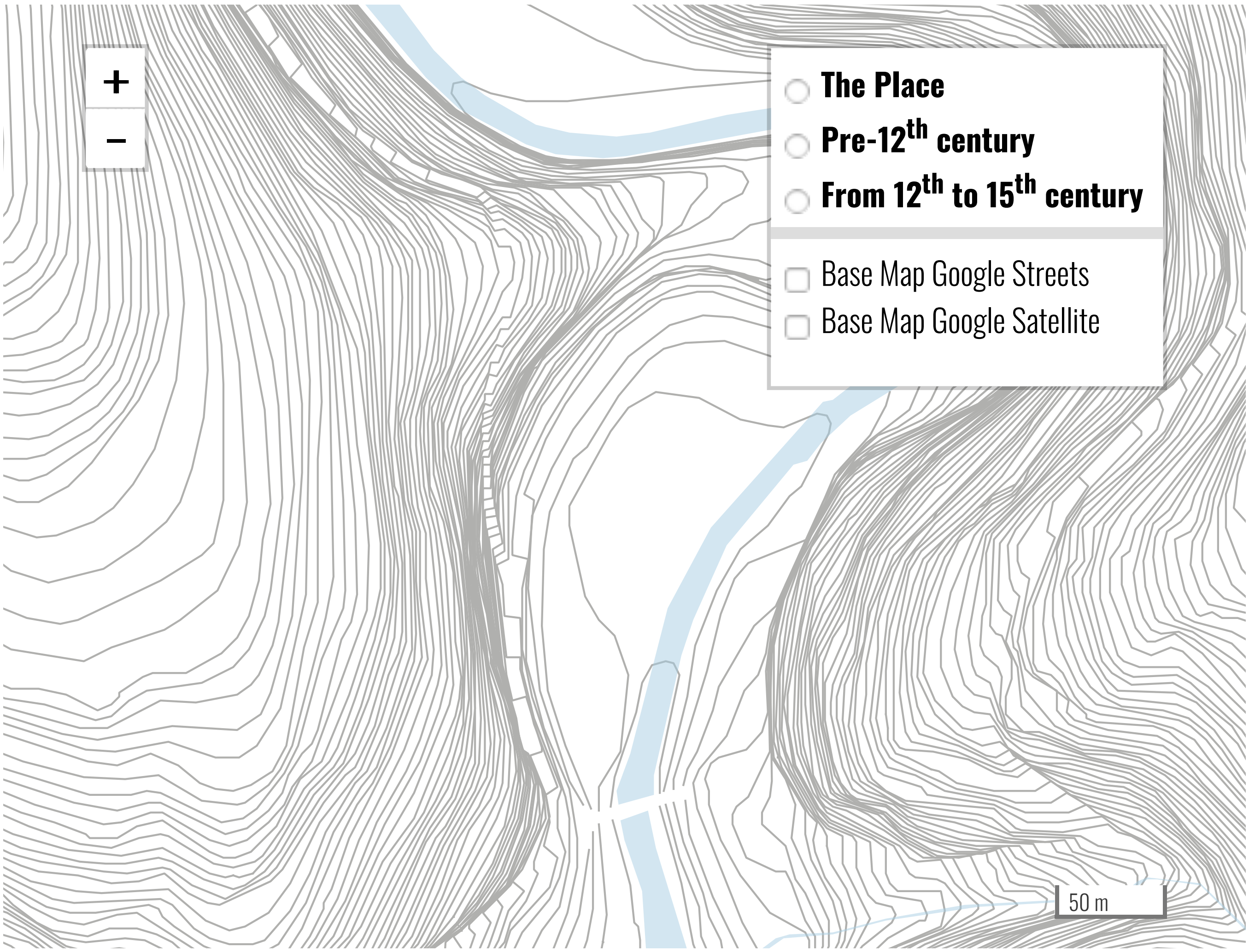


Figure 11. Manually coded interactive web-map showing the basics of Digital Samos spatial framework: visual, multilayered, multi-scalar, time-based and structurally open-ended. Web-map: the author.

View embedded content above in its own browser window at: http://digitalhumanities.org/dhq-annex/000652/figure11/.

Figure 11. Manually coded interactive web-map showing the basics of Digital Samos spatial framework: visual, multilayered, multi-scalar, time-based and structurally open-ended. Webmap: the author. Interface controls may be hidden depending on the size of your browser window. Navigate using map scroll bars or open the map in a new window to access interface controls.

Struggling with integrity of visual and textual data in web-mapping: challenges and opportunities

The web-map of Digital Samos is hosted by the Universidade da Coruña, as a way to guarantee its future sustainability in addition to a custom-design solution (Figure 12). Its code is written with three programming languages: HTML, CSS and JavaScript. HTML provides a means to create the structure of the website: the main sections and their content. The interactive web-map was created with Leaflet, which is a JavaScript mapping library, as we previously said. CSS was used for describing the presentation of the HTML structure and the interactive map; that is, its layout or graphic design (format, fonts, style, colors...). 50

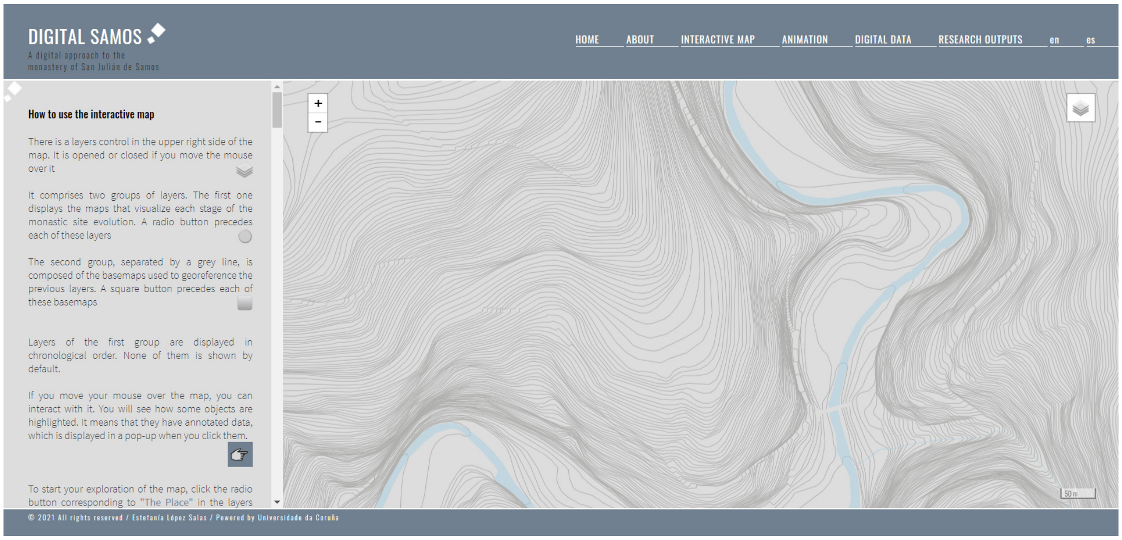


Figure 12. Image of the interactive web-map of the Digital Samos project, https://digitalsamos.udc.es/interactive_map.html. Image: the author.

In the present article, we are not going to explain how we developed the code for the interactive web-map, but we will reflect about the functionalities implemented in the web-based map to meet our goals, some of the problems we faced in the process, a critical evaluation of the current solutions and some thoughts about what things we had left out in this first cut of the web presence and how we aim to move it forward in the future. 51

The interactive web-map layout is divided into two main parts. The left one is devoted to long-form textual narrative. The spatial data is showcased in the right container. The latter is much wider as a way to visually highlight the focus of the project on spatiotemporal changes by using digital representation. When we open the interactive map we find a short, but needed explanation about how to use it in the left side, and the empty topography and hydrology of the place we study is shown on the right part. 52

The very first functionality of the map is the layers control in its upper right side (Figure 13). It is opened or closed if we move the mouse over it. It comprises two groups of layers. The first one displays the sub-web-maps that visualize each stage of the monastic site evolution in chronological order. The second group, separated by a grey line, is composed of the base-maps used to geo-reference the previous layers. None of the layers are displayed by default, so if we want to start our exploration of the map, we have to click the radio button corresponding to one of them. In brief, this is explained in the non-textual left container of the map, where we recommend beginning the exploration by clicking on the first layer called “The Place.” If we do so, the area where the monastery was built is visualized in a two-dimensional representation in the website. We can learn about it if we scroll the textual narrative to the section with the same title. The platform always tries to make it easy, but subtle, to follow the recommended exploration by representing the same structure in the layers control and in the sections of the narrative left trail. These first features give user freedom to explore the web-based spatial environment at will, but it also provides a clear and simple path through the spatial and data content by the addition of an accompanying textual narrative. In a future development, we aim to create one-to-one 53 connections between the name of each layer within the layers control and the narrative section by the same name, so whether you click on one or the other, both textual and non-textual parts of the web-map will be displayed at the same time. This way integrity and legibility will be enhanced.

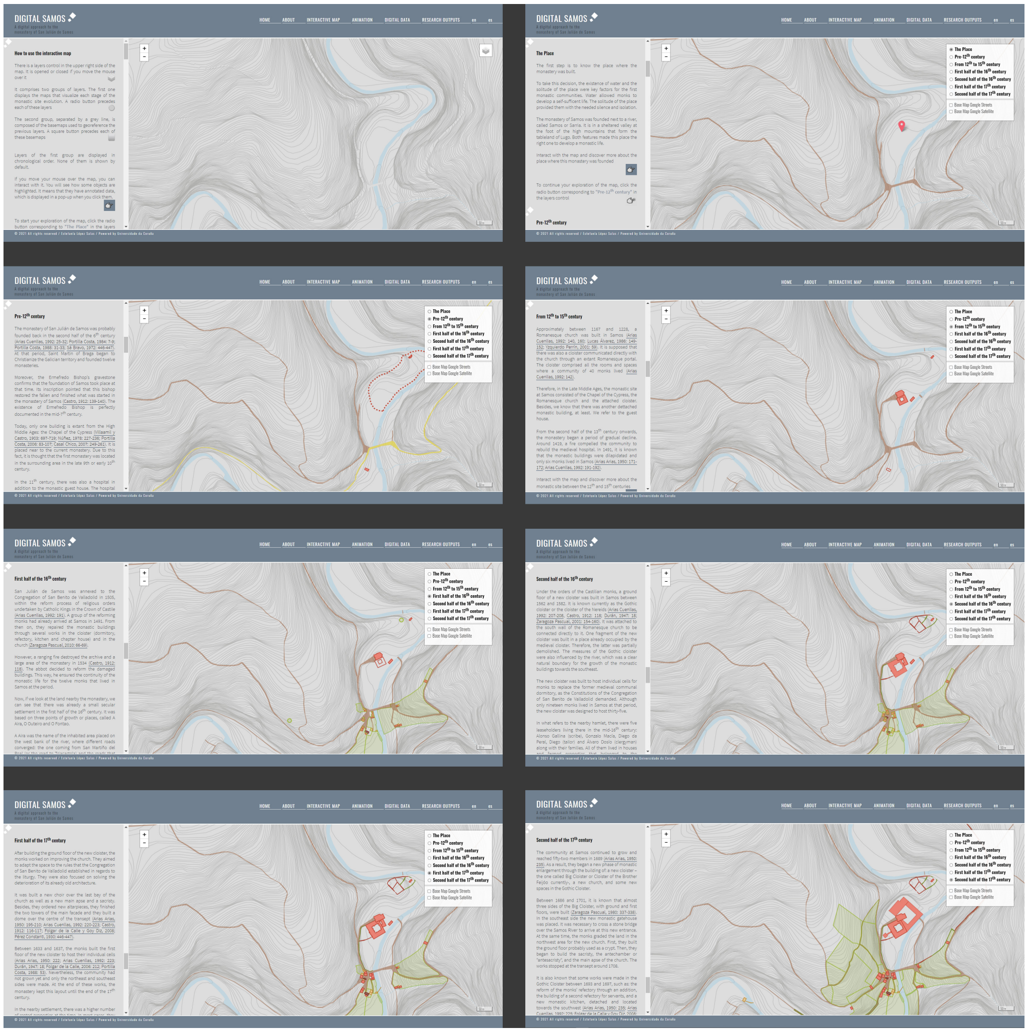


Figure 13. Sequence of eight screenshots of the interactive web-map of Digital Samos Project, https://digitalsamos.udc.es/interactive_map.html, showing: the sub-web-map by default, the first layer "The Place," the second layer "Pre-twelfth century," the third layer "From twelfth to fifteenth century," the fourth layer "First half of the sixteenth century," the fifth layer "Second half of the sixteenth century," the sixth layer "First half of the seventeenth century," and the seventh layer "Second half of the seventeenth century" in the present version, November 2021. Image: the author.

Another functionality of the present platform is that we can always display a phased map of the monastic site onto the current cartography due to the addition of two base-maps: Google Satellite and Google Street View. This way, the website enables users to visualize any re-created past realm of the monastery, the village and their context in relation with the present built environment (Figure 14). We can discover what artefacts are preserved, altered or lost, for instance, by means of visual comparison. We think it would be also an effective tool to better understand the spatial changes between consecutive time periods if we could visualize two or more phased web-maps at the same time. However, the basic layers control of Leaflet just comprises two groups of layers: layers within the first group are displayed one by one, but layers of the second group can be showed all together or even along with one layer of the first group.[23] However, the ability to display a number of phased web-maps would of course be essential to make clearer the spatial change over time to human eye. This could be done by means of a multi-mode viewer that allows user to study overlapped transparent layers or synchronized multiple side-by-side maps [Henel 2019].[24]

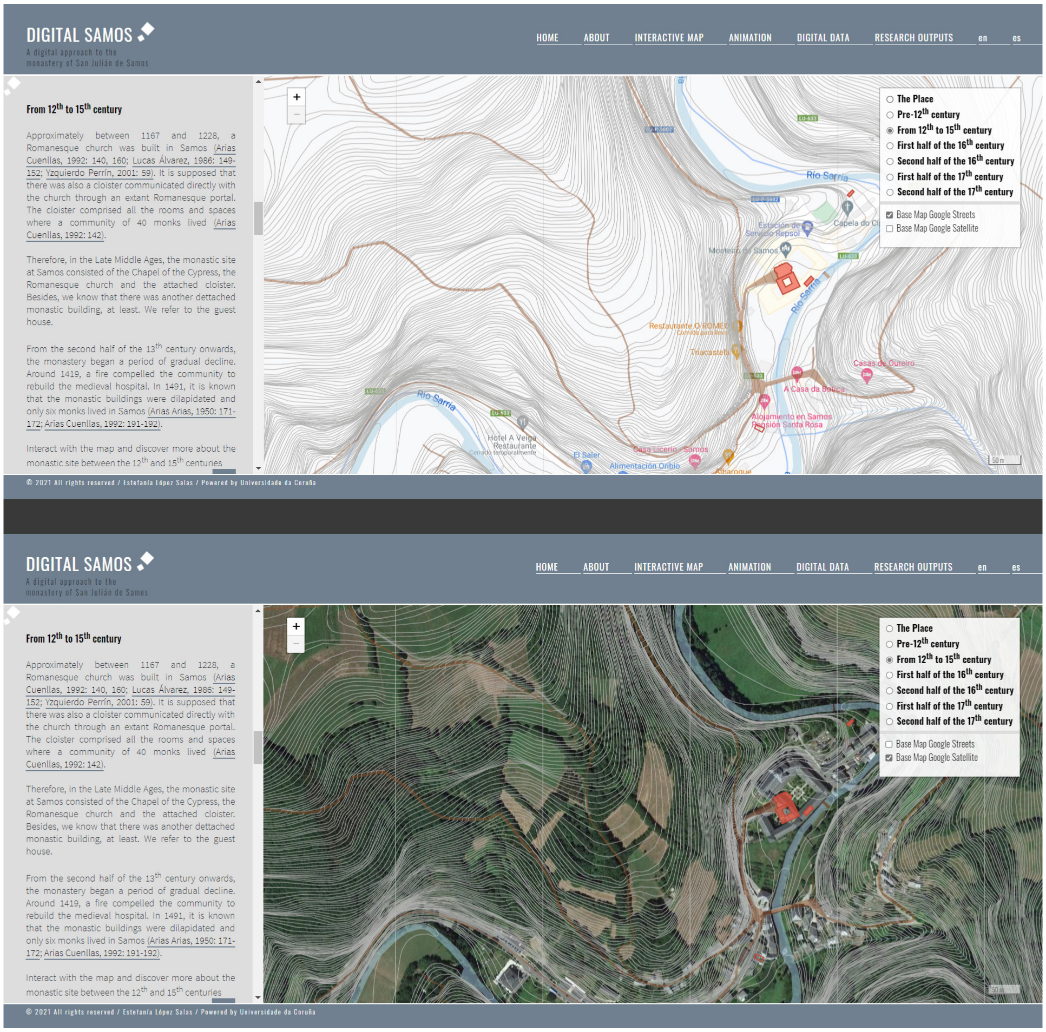


Figure 14. Screenshots of the interactive web-map of Digital Samos Project, https://digitalsamos.udc.es/interactive_map.html, showing the phase called “From twelfth to fifteenth century” onto two current base-maps: Google Satellite and Google Streets. Image: the author.

All previous features give an answer to how to represent space and time in a web-based environment, by starting simple with a two-dimensional map that we aim to expand to a three-dimensional model integrated in the platform somehow in the future. For now, we show what was where and when. This is the basic spatiotemporal knowledge for any historical exploration of the past monastic site. Each layer of the web-map is defined by discrete, measurable elements that represent the space, the answer to what was where and how the different elements were related to each other. However, we also pointed out previously that we aimed to create a self-explanatory web-map through the integration of historical non-textual data within the two-dimensional context in order to ensure transparency, legibility and evaluation. 55

For this purpose, we implemented functionalities of highlighting features and pop-up windows. When the user hovers the cursor on the map, most of its spatial features change their color. It means that they have assigned attributes with embedded historical data to display and explore by clicking on a particular highlighted object. These one-to-one connections aim to extend the interaction between user and the map as well as to create an integrated platform. Pop-up windows were designed to not obscure the visibility of the underlying map by means of transparent backgrounds when they are opened. This way, not only do they favor the integration of textual data within the map with immediacy, but they also ensure a permanent vision of the spatial feature within its context. 56

In this part of the in-process work, we ruminated on what textual information should be showed and how to structure it at length. So far we have created three main different types of pop-ups. The first type is used in the case of spatial features such as roads, rivers, bridges, dams and the hypothetical area of the first monastic settlement (Figure 15). 57

Historical data about them is scarce, so the pop-up window is designed to only display the name of the feature.

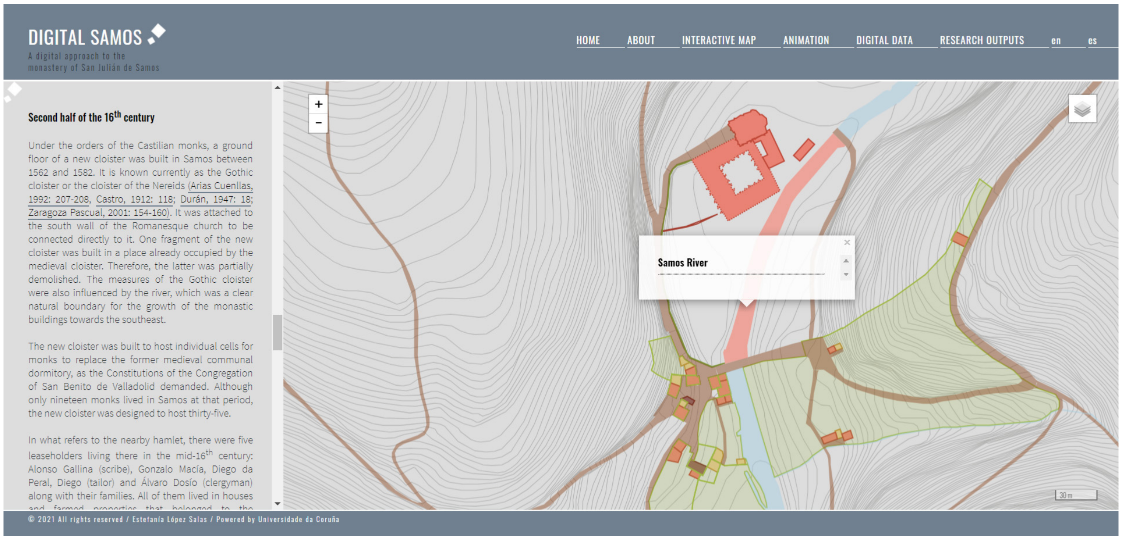


Figure 15. Screenshot displaying the first type of pop-up windows created for spatial features with scarce historical data. Interactive web-map of Digital Samos Project, https://digitalsamos.udc.es/interactive_map.html. Image: the author.

The second type of pop-up window was defined for monastic buildings (Figure 16). In their current layout, data is displayed starting with the name of the building. Next we show the main art history style period and the construction date, if known. We also indicate whether the selected entity is extant or not currently. We gathered references to events that caused spatial changes in the period visualized, such as a fire, an ongoing reconstruction... As the present layers embrace long-term time periods, we considered it relevant to highlight what spatial changes were taking place at the moment and why, beyond the knowledge we gain through the spatial feature that recreates them. Finally, there is a hyperlink called "View more." The creation of this linked information is still a work in progress, but the idea is, when clicked, user could extend their knowledge through: detailed maps of the selected building, three-dimensional models to be able to experience the space, access to historical and contemporary photographs, brief historical descriptions... all of which expand the understanding and analysis of the question of change over time. 58

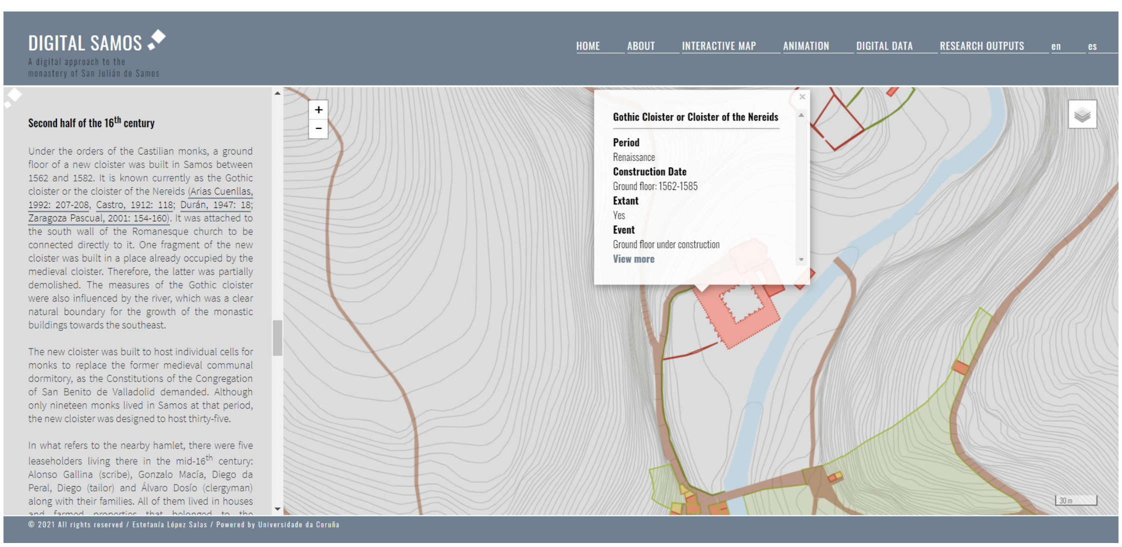


Figure 16. Screenshot displaying the second type of pop-up windows created for the monastic buildings. Interactive web-map of Digital Samos Project, https://digitalsamos.udc.es/interactive_map.html. Image: the author.

The third main type of pop-up window was created for the spatial features that represent farming properties and 59 residential plots located in the surroundings of the monastery and in the village (Figure 17). It is the most complex pop-up as data come from very disparate sources in each time period, among which we find or not the name of the property, the name of the owner, the name of the tenant or subtenant, their jobs, the location, the tenancy year, the holding type, etc. As for now, the third type of pop-up is actually designed with four possible displays that better structure and show data related to farming and residential plots in accordance with the most relevant historical documents in four of the seven phases already represented in the platform. Each pop-up is a rich subset of data that comes mainly from two types of archival documentation: rental agreements and books of demarcations from the sixteenth and seventeenth centuries. We can find up to twenty different variables displayed in the third type of pop-ups. We tried to structure historical information in a similar order to enable the integration of web tools for spatial data query and analysis within the platform in the future. For instance, simple questions regarding the names of tenants or the rents of their properties face with tools that read multiple data sets at a time might reveal new insights into the evolving nature of the monastic site and its human and socioeconomic history.

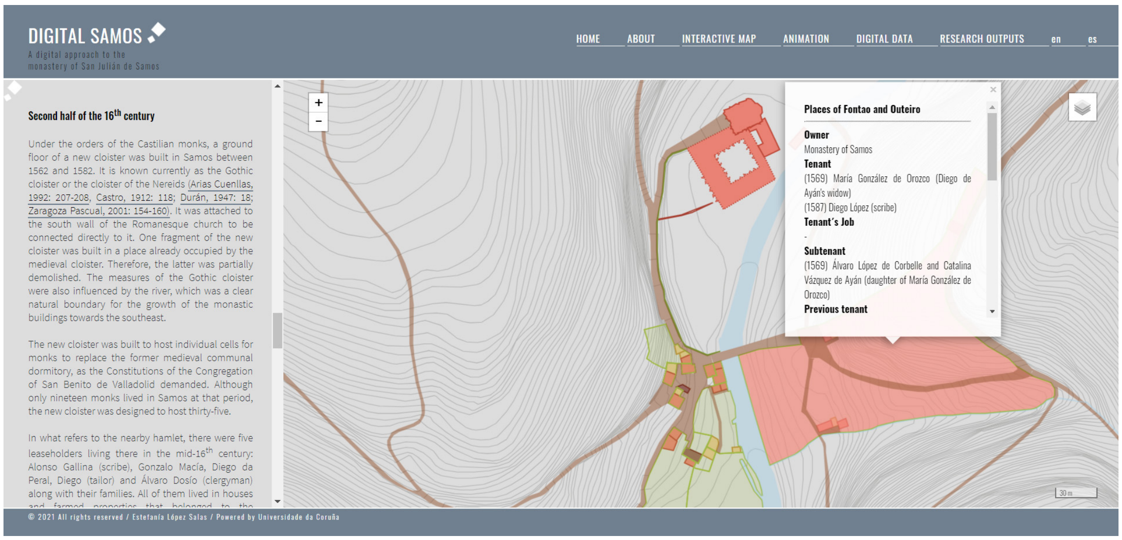


Figure 17. Screenshot displaying one sub-type of pop-up windows created for residential and farming plots in the second half of the sixteenth century. Interactive web-map of Digital Samos Project, https://digitalsamos.udc.es/interactive_map.html. Image: the author.

Last but not least, although we can learn about what artefacts in the historical site/s are extant today through the 60
information gathered in the pop-ups, the web-map in its current form does not provide, we admit, a clear but needed graphic distinction between evidence and hypothesis, or even between different levels of probability regarding the recreation of lost built entities or plot tissues. To overcome this weak point in terms of an accurate communication of the visual outcome, one solution would be to use color-coded lines as we previously created for the CAD maps. In the present form of our web-based environment, graphic design already contributes to convey conceptual issues regarding spatial changes, for instance, through different types of lines to distinguish between ended monastic buildings (solid lines) and works in progress (dash lines) within each phase. In future developments, we will go on working in the map layer styling as it impacts visual analysis and, therefore, it is an essential and constant consideration for producing web-maps both for individual and public viewing.

Conclusions

This article introduced the Digital Samos interactive web-map, an online 2D representation of spatiotemporal changes 61
implemented for one of the largest and most ancient monastic sites in Spain, San Julián de Samos. Digital Samos web-map was first released in late April 2019 and it offers fully functional access to six main stages of the site's biography: the empty place prior to the foundation of the monastery; the monastic settlement before the 12th century; the monastery of the Late Middle Age; the transformations of the monastic site in the first half of the 16th century along with the formation of the nearby Samos village; the spatial changes that took place in the second half of the same century; and its ending in the early 17th century. In November 2019 we added a new spatiotemporal layer, the one

corresponding to the first steps towards the mayor transformation of the monastic site from the late 17th century that were not completed until the 18th century. The latter is still pending to be added to the interactive map, as well as the complex monastic compound of the early 19th century prior to secularization.

Unlike existing web-map displays for monastic architecture, the Digital Samos prototype addresses an open representation of past compounds without compromising interaction with each feature, the accuracy of geometries and the integration of historical data in the web output. We offer a practical solution to create a self-explanatory or "self-speaking" virtual product due to the integration of both visual (graphic) and textual (written) data that complement each other in a novel and friendly digital environment. We show a way to overcome some limitations of fixed images for the interpretation and presentation of research outcomes in urban and architectural historical studies in and outside academia. We make use of the potentials of digital vectorised maps that may inspire others to dream big by working gradually with spatial and temporal data in the study of built environments that, like this web-map, were not built in a day. 62

The present article documents the project workflow, pitfalls and challenges to convert two separate initial research outputs (vector maps/plans) and historical data into one integral virtual product for presentation and dissemination of our spatiotemporal analysis in the field of architectural history where not only buildings, but also topography, geographical features and monasticism history play a role that is visualized in the web context. 63

The process reveals some technical challenges for non-technical backgrounds as well as some needed improvements to be implemented in future development. We tried to communicate both effectively from the particular subdomain of architectural history research in and through web technology. We situated our argument within a broader context of research and we included explanations of the significance of our web-map in a way that could be easily applied in other case studies. We also offer a cost-effective and sustainable solution to overcome limitations caused by the lack of funding or the use of specific commercial software that may affect the continuation of digital projects over time, its evolution towards new stages, or the possibility to involve specialists with technical backgrounds. 64

Digital Samos is woven with some common threads and complex requirements that are under consideration in the wider discussions and debates around deep maps. It develops a multilayer and multi-scalar spatial structure for a view of a particular monastic area that is meant to be "visual, time-based and open-ended" [Bodenhamer et al. 2013, p. 174]. It is designed as an exploratory environment where scholars and public alike might gain knowledge through the exploration of a particular place or pursue their own questions [Ridge 2013, p. 177]. It has a capacity for thick expert description that might be unstable and changing in response to new data or insights [Bodenhamer 2010, p. 27] [Roberts 2016, p. 5]. It also embraces the spatiotemporal contingent to incorporate time into analyses that are spatially contextualized [Bodenhamer et al. 2013, p. 172] [Roberts 2016, p. 5]. It calls into the question the primacy of texts as the foundation of knowledge by taking advantage of the potential of technology and it walks towards an alternative construction of spatial narratives that embraces complexity, multiplicity, and simultaneity [Bodenhamer 2010, p. 28–29]. During the process of constructing this prototype, we can learn and understand what works best in this new arena and make the most of thinking through making. The case study offered identifies a gap in the way spatial change over time in complex built environments is approached and disseminated in academia, and it proposes a solution that might help unravelling or getting at least a better understanding of a complex monastic site. With this approach we are able to integrate the complexity of the spatial transformations over time at San Julián de Samos, allowing us to present and make readable the large variety of information and interpretation the research contained, through explorable layers of meaning and process that lead to new forms of spatial narratives in a web context. In sum, it is another effort to move forward a more integrated spatial framework for humanities research as literature about deep mapping demands [Bodenhamer et al. 2013, p. 175]. 65

Through the work we present in this article, its open-ended results, the challenges we posed and the opportunities we approach, we hope to contribute, both conceptually and technically, to move forward the application of web-mapping tools in urban history and architectural history for a better understanding, presentation and dissemination of complex built environments. We expect this web-map to favor the engagement of a broader audience in and out academia through its attractive, clear and integrated appearance that, undoubtedly, makes visible to the observer eyes the 66 complexity of one monastic built environment while it changed over time. We think it opens new possibilities for publication of visual research beyond traditional raster graphics that, on the whole, aims to no longer be considered just a visual demonstration or end visual product, but essential pieces of the research arguments themselves.

Acknowledgements

The author would like to thank the instructors and participants in the Visualizing Venice Summer Institute “Advanced Topics in Digital Art History: 3D (Geo)Spatial Networks” 2018-2019 for their theoretical and technical visions and feedback upon which this new adventure was born and owes a lot. 67

Notes

[1] For the history of the monastery of San Julián de Samos see: [Arias Arias 1950], [Arias Cuenllas 1992], [Castro 1912], [Durán 1947], [Folgar de la Calle 2006], [Folgar de la Calle and Goy Diz 2008], [López Peláez 1894], [Portilla Costa 1978], [Portilla Costa 2003].

[2] The research project was started in: [López Salas 2015].

[3] See, for example: [Borin 2016] [Calabi 2009] [Harris 2015] [King et al. 2016] [Monteleone et al. 2016] [Svalduz 2013].

[4] The Digital Samos project is accessible at: https://digitalsamos.udc.es/index.html. In August 2018, it was selected by the Getty Foundation to feature its Digital Art History Initiative page, https://www.getty.edu/foundation/initiatives/current/dah/index.html. In February 2020, it was awarded with a special mention in the second edition of the Hispanic Digital Humanities Prizes, HDH 2020.

[5] By following the principles of the: [London Chapter 2009] and [Seville Principles 2011].

[6] A comprehensive list of publications and communications related to the research carried out in Digital Samos is available at the project website: “Articles and Book Chapters,” https://digitalsamos.udc.es/research_publications.html, “Congresses, Workshops, Seminars and Conferences,” https://digitalsamos.udc.es/research_congresses.html.

[7] University of Toronto, DECIMA, https://decima-map.net/.

[8] Office of Information, Knowledge and Library Services (OIKLS), NTU Singapore. Visualizing the Mountain Estate. Landscape, Architecture, and Experience in Chengde, https://blogs.ntu.edu.sg/bssz/.

[9] Brown University, The MonArch Project, http://monarch.brown.edu/.

[10] The Tibetan & Himalayan Library, Sera Monastery, https://www.thlib.org/places/monasteries/sera/

[11] Cabezón, J. I., “Sera Monastery Project Overview,” https://www.thlib.org/places/monasteries/sera/about/wiki/sera%20monastery%20project%20overview.html

[12] Cabezón, J. I., “The Space of Sera (Se ra’i khor yug),” https://www.thlib.org/places/monasteries/sera/spaces/#!essay=/cabezon/sera/spaces/s/b4

[13] The Tibetan & Himalayan Library, Sera Interactive Map, https://www.thlib.org/places/monasteries/sera/spaces/map/

[14] Brown University, The MonArch Project, http://monarch.brown.edu/site.

[15] This brief historiographic context related to deep mapping was added to the paper based on the suggestions provided by reviewers to which we want to express our gratitude for their constructive thoughts. Deep maps or deep mapping are not terms we have found ourselves using to any great extent in Digital Samos work to date, but we have certainly identified some common threads in recommended literature to which our web-map is in conversation with.

[16] GISConvert, https://www.gisconvert.com/. There are also QGIS plug-ins to insert topographic lines from CAD to QGIS, as well as information related to natural resources as rivers. Both topography and natural resources at each stage of the monastic site evolution represent the historical compound that is not exactly the same as the present one.

[17] National Air Orthophotography Programme (PNOA). Spanish National Geographic Institute (IGN), https://www.ign.es/iberpix2/visor/.

[18] QGIS Cloud Plans, https://qgiscloud.com/en/pages/plans.

[19] Sourcepole AG, QGIS Cloud, https://qgiscloud.com/en/pages/quickstart.

[20] Morales A. “Publica tus mapas en la web con qgis2web,” https://mappinggis.com/2016/03/crea-aplicaciones-webmapping-con-qgis/.

[21] Agafonkin V. “Leaflet: an open-source JavaScript library for mobile-friendly interactive maps,” https://leafletjs.com/.

[22] Leaflet. “Using GeoJSON with Leaflet,” https://leafletjs.com/examples/geojson/.

[23] Leaflet, “Leaflet Plugins,” https://leafletjs.com/plugins.html.

[24] See, for example: Institut Cartogràfic i Geològic de Catalunya. “Changes in the territory,” https://www.icgc.cat/es/Aplicaciones/Visores/Cambios-en-el-territorio.

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