DIGITAL TECHNOLOGIES FOR THE KNOWLEDGE AND VALORISATION OF INACCESSIBLE ARCHAEOLOGICAL SITES IN PHLAGRAEAN FIELDS

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ABSTRACT

The paper proposes a project for the knowledge and the valorisation of the archaeological heritage in urban and natural areas characterized by a fragility high degree due to the urbanization's pressures. The research proposes an infoscape for the Archaeological Park of Phlegraean Fields, i.e. an integrated project that aims, on the one hand, at surveying the heritage at risk of disappearance and, on the other, at using the 3d model obtained by digital photogrammetry to configure new spatial relationships between physically distant places (through theme-based tours), among lost spaces and archaeological remains, between real and digital spaces, in order to generate a new model of a widespread and more inclusive museum, in which digital information are not only related to the single monument, but recombined, remixed and recontextualized, so determining new physical and semantic geographies.

KEYWORDS: ICT, Augmented reality, Virtual reality, archaeology, landscape

INTRODUCTION

The Phlegraean Fields are a singular mixture of urbanised areas, impressive archaeological ruins, and fascinating landscape, with a close and sometimes inseparable connection among archaeological sites and modern constructions. The numerous widespread remains from the Greco-Roman period, often still partially buried, require an integrated cultural approach particularly focussed on the area's specific features. In fact, it is difficult to valorise the huge archaeological heritage of the Phlegraean fields due to the impossibility of expropriating private buildings to excavate still buried remains. It's also impossible to coherently organise the accessibility system. Archaeological remains in the Phlegraean area have frequently been concealed by private owners afraid that their property could be classified as unbuildable. Culture must therefore be the strategic factor, responding to the inability of the inhabitants to give a proper value to their sites, which instead should be assumed by the local communities first, and then by tourists, as a symbol of the collective memory in those territories. It is therefore necessary to identify the sense of their presence within the contemporary city, to enhance the value of today's inseparable connection, through the redefinition of their mutual relations. ICTs increase our ability to access data, information and thus knowledge, conditioning new forms of interactive experience not only in terms of knowledge but also in urban performance.

DIGITAL TECHNOLOGIES AFTER COVID

The current historical moment and the not yet overcome pandemic is making us re-acquaint with digital technologies: although we created and founded them, we began to mistrust very early because they have been considered responsible for numerous and dangerous cultural and social transformations.

The Covid 19 emergency led us to grow in trust and gratitude towards digital tools, recently free from the widespread previous sense of fear and suspicion even in the young generations. This acceptance will certainly remain in common feeling afterwards because, thanks to Information and Communication Technologies (ICT), we have been able to stay in touch instead of being totally separated. The enforced quarantine also showed us new ways of experiencing the beauty of our cultural heritage, according to a widespread and free system of virtual fruition. Prior to the pandemic, few museums were equipped with digital tools to show their assets when closed, but all the others understood very early in the pandemic the urgent need for it, to be ready to face all the present and future uncertainties regarding the global health situation.

This research thus aims to structure a new relationship among new information technologies and the Phlegraean Archaeological Park, strongly characterized by a peculiar archaeological heritage. The primary purpose of this project is enhancing those precious but poorly exploited assets, in order to make these testimonies of the past to talk about their own value to local communities, even before the tourists.

NEW ARCHAEOLOGICAL TRANSECTS IN THE PHLEGREAN FIELDS

Archaeology in the Phlegraean area should be understood as the valuable history of the territory, of the environment, and of the present landscape, in an integrated process of enhancement with the aim of bringing the archaeological areas back into the life of the contemporary city, giving the ancient heritage dignity and value through a conscious enjoyment of these assets, assisted by ICT that enhance an active and emotional experience of the archaeological heritage.

«When we experience territories, we create stories. We model these stories using mental maps. A mental map refers to one person's point of view perception of their own world […] In this, our mental maps—the personal representations of the city which we build in our minds to navigate them to fulfil our needs and desires—live a complex life as our perception joins into the great performance of the city» (Iaconesi, Persico, 2017).

The first step is to overcome the fragmentation of the numerous archaeological sites and to exploit the identity of the Phlegraean heritage by means of the construction of thematic maps (free and accessible by Google my maps), which could be easily explored and questioned; each map contains recognisable thematic paths of knowledge, connecting archaeological sites with a common identity. The thematic routes in the digital map are identified in the physical space of today's city as thematic transect and aim to link the emerging ruins together to reconstitute the original history that united those places in the ancient roman urban fabric.

The goal is so redrawing the connections of the ancient Roman city, made of physical connections and visual connections, to overcome the current fragmentation of the city which has encompassed them over the centuries. The knowledge thematic paths of visit in presence are assisted by Augmented and Virtual Reality in case of impossibility to physically access the ruins. Some interactive maps (in Google My maps) connect the widespread

archaeological sites to recreate a plot of functional connections of the Roman city. The presence of archaeological assets in the Park that are not fully visitable yet, due to structural or safety problems, addressed this research towards the identification of the most appropriate use of digital technologies in relation with a certain number of case studies: ICT's task is to assist and sometime to replace the physical experience on sites by means of new forms of virtual spatial fruition, characterized by interactive and/or immersive technologies in order to obtain an active users' involvement in the knowledge process.

Understanding of archaeological remains, in fact, is frequently difficult for the public: the loss of the main representative volumes, coatings, decorations and colours frequently compromises the general public's ability to appreciate the asset. On the other hand, archaeological ruins are a very rich database of historical evidence and information, because determined by a stratified process of human actions and transformations induced, in Phlegraean Fields, by geological phenomena: «the actions of human beings and nature bring buildings into a different state, transforming them into ruins, providing evidence of the history of humans' and nature's interventions on architectures, of the patterns according to which they have been used daily. From this point of view, ruins expose the history of the natural (and human, as integrated in nature) environment and of its daily life» (Iaconesi, Persico, 2017).
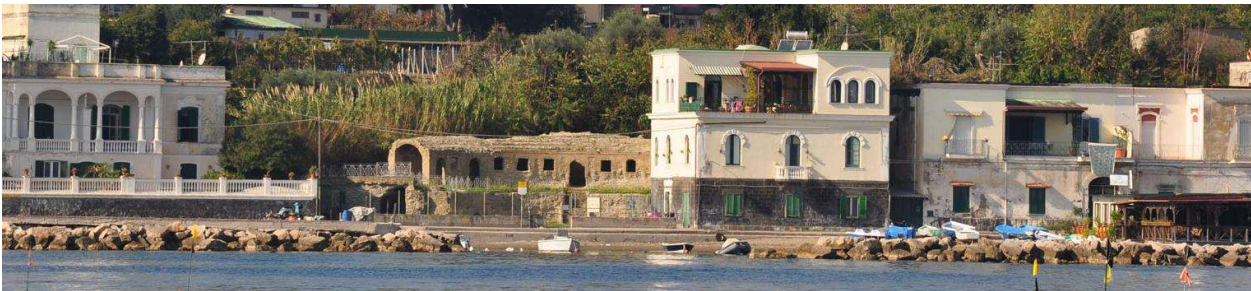

Figure 1: The "so called" Agrippina's tomb, poorly valorised because of the strong presence of modern buildings that surround it, Bacoli (Na)

Digital reconstructions of the original state and the relocation of the sculptural decoration, sometime removed for protection and conserved in the museum, can suggestively enrich the emotional impact in situ, both for citizen and tourists, thus ensuring a deeper knowledge and more conscious appreciation that could induce the local population to look at their own archaeological heritage as a driving force for new meaningful relationships between the contemporary city and the ancient archaeological diffuse assets inside of it. The aim of this research is, therefore, the re-signification of the archaeological heritage, thus overcoming, by using ICT, the current isolation of the minor sites, not accessible or partially accessible, to communicate their value even when closed, by showing their interior spaces both in their current state and in their original one. Through short clip videos, interactive 3D models and spherical photos, we propose a virtual access both to the monument architecture and to its knowledge. For each site, on the outside of the boundary fence, we're going to install, in cooperation with the Archaeological Park, an interactive descriptive panel in which the contextual use of augmented and virtual reality has been arranged, together with the more basic aid of Q-Codes for web links to multimedia contents, to design a new form of direct interaction in an integrated setting, partly physical and partly digital.

The case studies: the "so called"Agrippina's tomb, the Sacellum of the Augustals and the Hadrian sector in the Baiae thermal archaeological park

The presence of vast submerged and inaccessible portions of these monuments and the need to have high-definition textures to read, through the visual inspection of the traces in high defined digital materials (traces of collapsed portions or of any modifications that may have occurred over the centuries), led our research towards a digital photogrammetry survey, using the SfM technique, supplemented by direct surveys of the physically accessible parts.

The photogrammetric survey of the archaeological heritage was carried out using the software Photoscan and Metashape and it provided a reliable three-dimensional model, with high definition meshes, correctly proportioned and verified. On the texturized mesh surfaces it is possible to read not only the simple metric data but also the materials evidence of transformations over the centuries.

The research therefore deals with a critical use of the 3D model with respect to the concept of Digital Twin, an innovative digital alter ego, not a mere copy, of an archaeological heritage asset.

The digital twin is an active and dynamic entity, able to interact with the today's context, but also with the original one over the centuries. The reconstruction of heritage places and objects by means of digital models lends itself to a plurality of objectives, combining the need for scientific digital restoration with the urgent necessity for an emotional and effective communication addressed to the general public. We hypothesised a reliable transformations' chronology that the monument underwent over the centuries, being hardly affected by the descendent bradyseism that led to its sinking for many centuries.

Reliable shapes of the vaulted room roofs were reconstructed on the basis of the architectural coherence of the rooms and of the traces found in situ, such as the lower remaining parts of cross vaults.
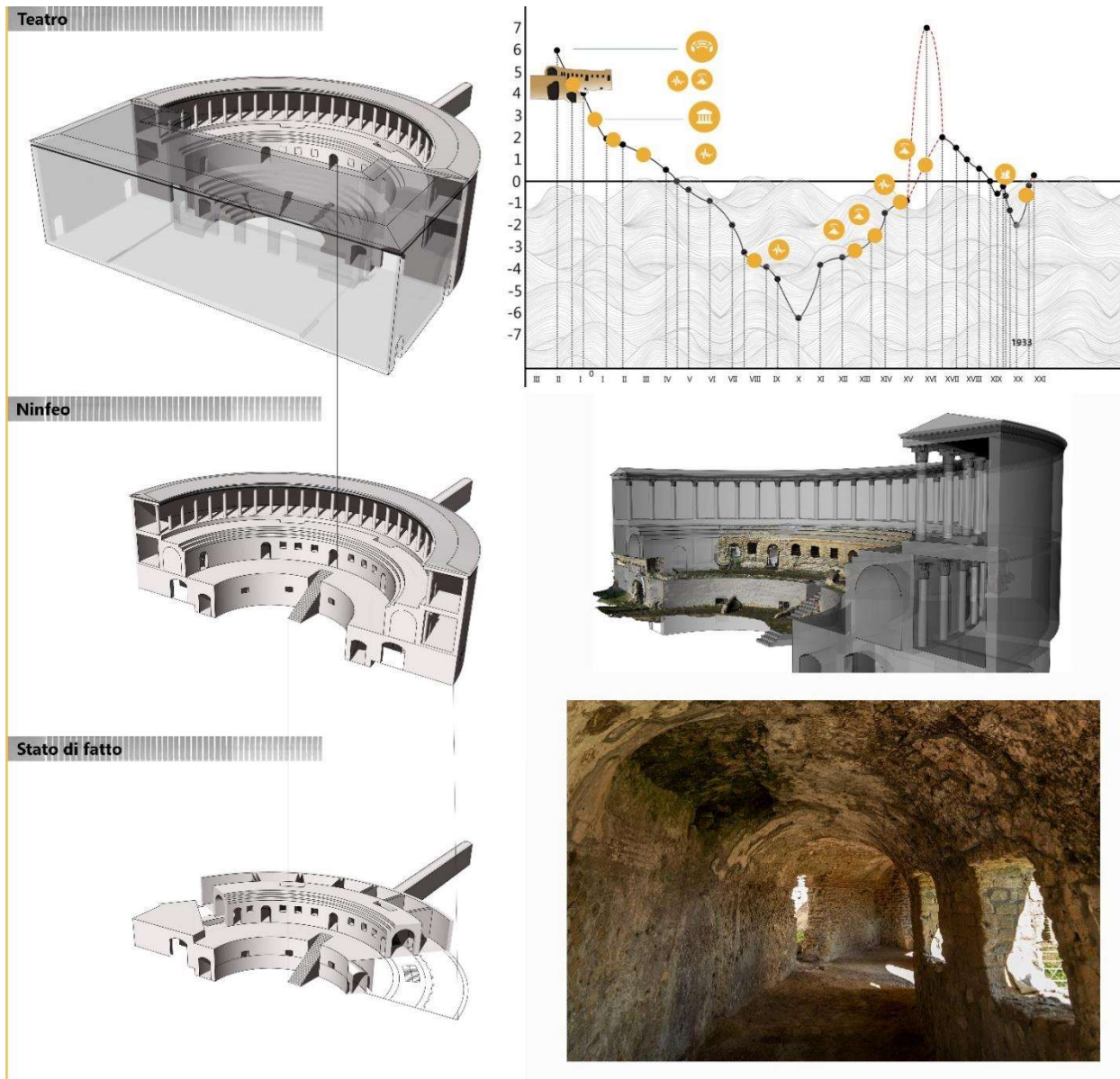
Figure 2: Reconstructive hypotheses and transformation phases (due to the bradisism) for the "so called" Agrippina's tomb, Misenum (Na)

The most probable reconstructive hypotheses of the original state and functions of the monument, heavily damaged by collapses and transformations, were made in relation to current literature.

In particular, in the case of the so-called Agrippina's tomb, we highlighted the monumental nature of the asset focusing on its original state (2nd century B.C.) of odeion into a rich maritime villa; its transformation into a nymphaeum (1st century B.C.) is due to the increase in descending bradyseismic phenomena (that led to the cavea's collapse) with its subsequent sinking and the re-emergence in 17th century A.D., in the meantime that the modern city was growing unaware of its presence, occupying surrounding spaces and boundaries. Outside the fence which surround the monument, not always open and only partially accessible, we set a descriptive panel addressed to bathers on a crowded public beach in front of the ruin; the board is interactive because the observer can access to extra digital contents simply framing with a personal smart device the highlighted images.

Downloading the free app Artivive, static images come to life and in their place are superimposed in augmented reality short videos and interactive 3D models. On the board is possible to experience a 360° video in VR too, which allow the observer to enter the upper gallery and explore the digital twin.

In the case study of the Sacellum of Augustales in Misenum, reduced to its current state of a "difficult to understand" ruin because of the loss of higher volumes, vaults and decorations, the research aimed to enrich the visitor's emotional impact in situ by reconstructing the original unity and the monumentality of the temple (today hardly recognizable) through the relocation of sculptural decorations, now preserved in the the Aragonese castle of Baia that houses the Archaeological Museum of the Phlegraean Fields, but not accessible. The reconstructive hypothesis, therefore, aimed to relocate the decorative elements, the statues, the columns and the pediment, properly surveyed by digital photogrammetry. The 3d model, based on the survey of the current state, reconstructs volumes and surfaces to show a probable configuration of the temple before the numerous collapses that have compromised the possibility for the general public to really appreciate its value. To bring back the ruin to the monumentality of its original state, an immersive impact of 360° films has been calibrated for virtual reality fruition using an oculus during the visit to the site.

As a third case study, the research analysed a small thermal sector within the large archaeological park of Baia. The archaeological thermal complex in Baia, sited between the sea and a scenic hill, offers one of the most spectacular views of the Gulf of Pozzuoli. The excavation and development of the archaeological park under the direction of Amedeo Maiuri were interrupted by the war in 1943 and resumed in 1950. Maiuri defined the structures as a real "thermal city", whose plan is due to the natural location of different thermo-mineral sources and different steam emanations. The archaeologists divided the area into different sectors according to the buildings' prevailing directions and alignment and according to the different period of construction.

The present case study focuses on the small Adrianean baths located in the lower portion of the sector of Venus. The location according to Maiuri was strictly dependent on the hot air springs that were conducted into the thermal rooms of the entire sector and on some underground cold spring water present there.

The 3D model derived from the reconstructive hypothesis of the original state let us to investigate the architectural configuration of the small baths, which are now severely compromised by the collapse of the main vaulted surfaces. Above all, it was possible to verify the spatial coherence of certain hypotheses that recently tend to affirm that the current unusually isolated position of the so-called Temple of Venus is actually an effect of an abrupt urban cut due to the opening of the modern via Lucullo and the construction of some residential buildings along to the street.

An interactive descriptive panel, in which some AR markers are inserted, will allow the visitor to access specific digital contents which, with short video clips, will narrate the assumed uses of the various rooms, the geometric form of the collapsed roofs and will show the genesis of the final reconstructive configuration presented. Was also tested, in this case study, the expressive potential of the augmented reality superimposition of digital reconstructive hypothesis over the existing ruins, framed by the smartphone thanks to the opensource app Artivive. Augmented Reality allows to replace the lost volumes in direct coincidence with the remains, which are thus completed although the current fragmentary condition that sometimes makes it difficult for the general non-specialist public to understand archaeological remains.

Figure 3: Photogrammetric survey and relocation of statues and sculptural decorations in the reconstructive hypotheses of the Sacellum of Augustales, Misenum (Na)

The observer, framing the archaeological remains directly from the indicated position, experiences a short subtitled video, whose first frames have been calculated to complete the existing parts and provide a coherent and reliable image of a reconstructive hypothesis, and then explain each architectural parts until the integration of these into a more general configuration, in relation also to the surrounding architecture, with which an attempt is made to reconstruct their original relationship.
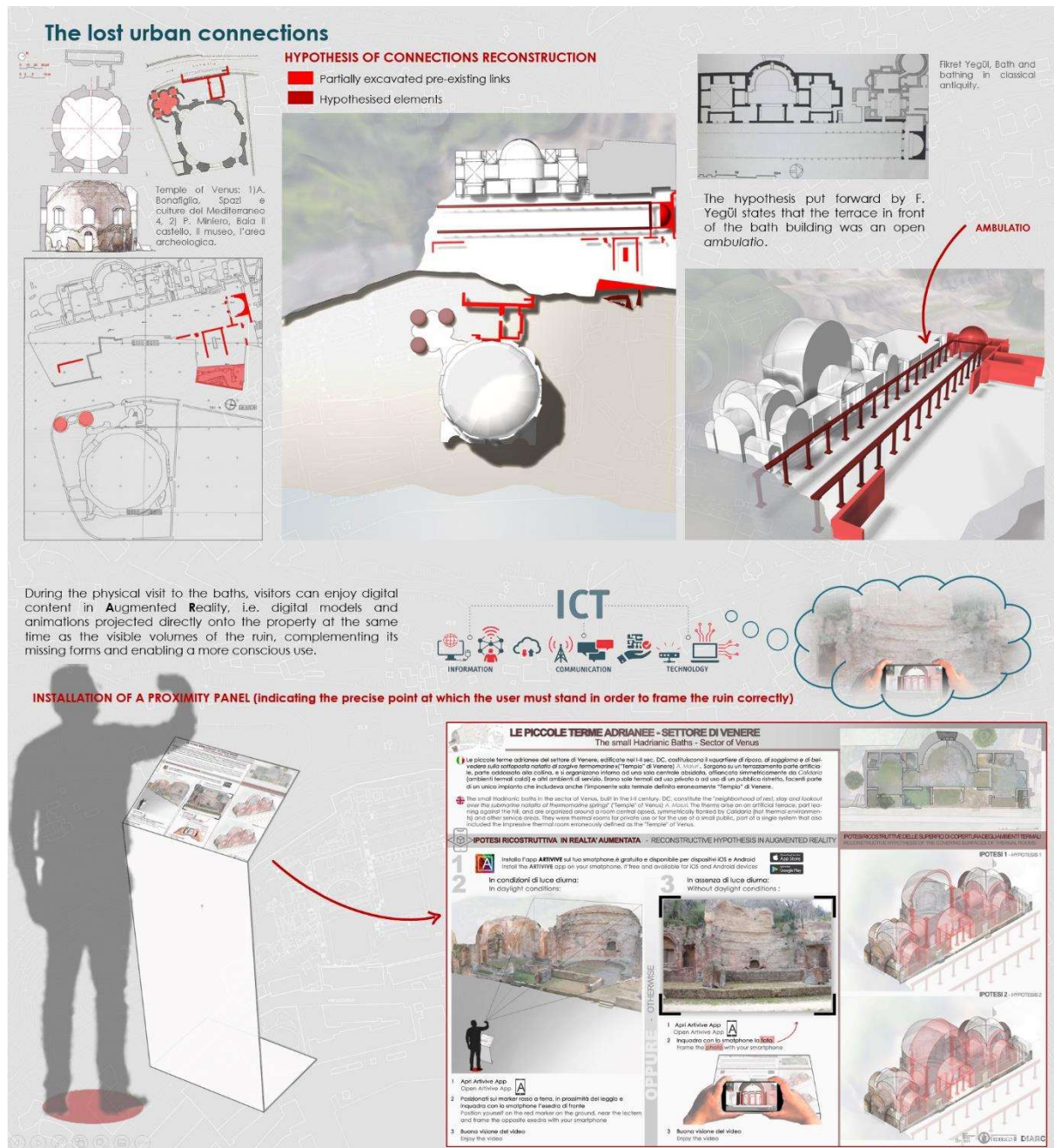
Figure 4: Interactive board for the small Adrianean baths provided with AR contents to be activated framing with *Artivive* app the picture highlighted by black corners.

CONCLUSION

This research originates from the need to protect the memory of a very fragile archaeological heritage, at risk of disappearing due to bradyseism, but it intended to use the digital models derived from the survey to deepen the knowledge of these ancient assets through some probable reconstructive hypotheses, verified thanks to the comparison with the spatiality of the current configuration.

The 3D models derived from the photogrammetric survey were in fact used as a rich database of dimensional and spatial information, as well as information on the transformations undergone by the artefact, the memory of which frequently remains in the material traces, which can be consulted in detail in the digital model thanks to the survey of high-definition textures.

The last step of the research has the most innovative approach since it proposes a project based on a user friendly fruition of archaeological asset that makes the Phlegraean heritage accessible to the general public. Accessibility has been conceived as a cultural overcoming of physical barriers through new technologies, and therefore it has been interpreted in terms of access to knowledge and therefore to the recognition of value.

Many archaeological sites of the Phlegraean Fields are in fact still partially or totally inaccessible due to security or management problems, causing a difficult appreciation of these assets; the creation of thematic digital maps connecting the immense and widespread heritage of the Phlegraean Fields Archaeological Park and the provision of interactive panels in AR and VR outsides the boundaries of partially or totally inaccessible sites, allow a simple and inexpensive operation of enhancement of these assets, hoping for future openings.

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