Journal of Geography and Cartography 2024, 7(1), 4514.
https://doi.org/10.24294/jgc.v7i1.4514

Article

Cartographical digital products: Maps, 3D models, diagrams

Efthymios Spyridon Georgiou

Company Efthymios Georgiou, 11741 Athens, Greece; efthimios_georgiou@yahoo.gr

CITATION

Georgiou ES. Cartographical digital products: Maps, 3D models, diagrams. Journal of Geography and Cartography. 2024; 7(1): 4514. https://doi.org/10.24294/jgc.v7i1.4514

ARTICLE INFO

Received: 1 February 2024
Accepted: 25 March 2024
Available online: 24 April 2024

Abstract: The current paper aims at spatial presentation in Cinque Terre. The purpose is to reconstruct digital products (maps, statistics, diagrams, and 3D models) and the spatial analysis of the five villages. The goals are the presentation of the geomorphology, geography, population, density, and area. Also, the Strength-Weakness-Opportunities-Threats (SWOT) analysis creates the disadvantages and advantages of the five villages in the region. The methodology is based on the software (G.I.S. Pro, QGIS, Zephyr 3D, Microsoft Excel, Generic Mapping Tool) and the bibliography study. For instance, the construction 3D terrain model shows the buildings, roads, green areas, and land cover of the five villages. The digital products help better "read" the region and emphasize the measurements and location of the region's elements. The final results contain a message about new technologies and spatial planning. The new technologies have given spatial solutions in the last few years. The innovative, understanding, and attractive cartographical digital products present the geomorphology of the traditional villages in Cinque Terre.

Keywords: maps; SWOT; geography; 3D terrain; statistics

1. Introduction

The current paper aims to construct cartographical products. Each digital product is an index and way measurement of the spatial analysis. For instance, the full paper suggests recommendations about the usefulness of maps, diagrams, and 3D terrain in better understanding the region of Cinque Terre.

The digital urban solutions are summarized in the following points:

Recommendation 1: Understanding the methods and techniques to construct digital products. The digital era is a new reality. There are significant benefits to creating cartographical products (maps, diagrams, figures, tables, and 3D models). The products need to be created in an attractive and innovative way.

Recommendation 2: The Cinque Terre region analysis is a mosaic of political analysis and decisions, stakeholders, the law frame, geography, and strategic long-term planning. The final result is the SWOT analysis of Cinque Terre's strengths and weaknesses. This table helps make policies and configure urban and political planning for the future.

Recommendation 3: Understanding the usefulness and significance of digital products and eras in better urban planning. The digital era offers new opportunities for making political and regional decisions. For instance, the distance observation of the mountains, sea, and geomorphology is a crucial index. This index helps in measurements of distance, length, and polygonal area. Also, it answers the question of the most suitable place for opening tourist activities. The nice panoramic view, the slope of the ground, and the nearby activities are criteria for better urban and environmental decisions.

2. Region analysis

2.1. Cultural heritage and democracy

Cultural heritage management is crucial because strategic planning creates long-term benefits for the sites. When making decisions, one must prioritize priorities, advantages, and disadvantages. Also, the multi-participation of organizations, companies, institutions, government sectors, and universities is an optimistic direction for successful management. Democracy is for all. Protection, preservation, documentation, and promotion are the responsibilities of the governance and level of citizens.

Nowadays, culture is an ecumenical term. The exchange of ideas, opinions, recommendations, and practice experience provides the framework. Sometimes, the acceptance of democratic rules is an influential factor in success. For instance, cyclical and balanced economic development benefits all people. The level of satisfaction and sustainability is the highest. To summarize, the vision of a better planet goes together with cultural heritage protection.

2.2. Cultural heritage in Cinque Terre

Cinque Terre National Park is one of Italy's most valuable destinations for tourists worldwide. In addition, the park, inscribed on the World Heritage List as a cultural landscape, is an essential source of values that must be protected and exploited [1]. The site was added to the World Heritage List as a cultural landscape in 1997, and the Cinque Terre National Park was established in 1999 [2]. The management plan developed for this area needs to deal with different issues: abandonment of terraced cultivations and growth of secondary forests, hydrogeological risk, and high touristic pressure [3].

Recently, many Mediterranean cities have occasionally exceeded their carrying capacity, compromising their natural or urban environment, lifestyle, and cultural traditions [4]. Public participation is increasingly important in the decision-making process for incorporating the ideas and needs of the local communities, helping to find effective solutions for valorizing historic landscapes, and improving the quality of life [3].

2.3. Environmental heritage in Cinque Terre

The link between environmental strategy and firm performance may be affected by the managers' interpretation of the environment, that is, by their opinions about the opportunities and threats linked to the environment within the framework of the environmental strategy [4].

This management needs to be systematic, reflexive, and cyclic to use multiple views and methods for an environmental management problem [5]. The management needs to emphasize the planning and the results. His measurements are significant tools for successful management. His indexes lead to the best solutions and a better understanding of the situations.

3. Region analysis

3.1. Geography

Tables 1–3 present the area, perimeter, population, density, and coordinates in Riomaggiore, Manarola, Corniglia, and Vernazza. The five traditional villages are unique destinations. The natural beauty and the geography have great benefits.

Table 1. Geography units Riomaggiore and Manarola [6–8].

	Riomaggiore	**Manarola**
Population	1332	No available
Coordinates	44°06′N 09°45′E	44°06′23″N 9°43′41″E
Average elevation	250 m	161 m

Table 2. Geography units Corniglia, Corniglia, Vernazza [6,9,10].

	Corniglia	**Vernazza**
Population	No available	730
Coordinates	44°7′10″N 9°43′00″E	44°08′N 09°41′E
Average elevation	180 m	255 m

Table 3. Geography units Monterosso al Mare [6,11].

	Monterosso al Mare
Population	1340
Coordinates	44°08′45″N 09°39′15″E
Elevation	186 m

3.2. Scenario planning

The SWOT analysis examines four factors in Cinque Terre. Tourism, culture, environment, and geography. SWOT analysis in Cinque Terre sometimes offers a better "reading" and governance of the situation. Every politician, urban planner, cartographer, and governor in the sector needs to make decisions. The decisions are very significant for the future. The purpose of this chapter is to examine the use of the strategic management tool Strength-Weaknesses-Opportunities-Threats, or SWOT analysis [12]. The SWOT analysis guidelines are derived from contemporary strategic management theory, especially the resource-based view of the firm [13]. SWOT analysis may also have applications within appreciative inquiry, benchmarking, industry analysis, situation analysis, and scenario planning [14].

The protection of the planet has a crucial meaning nowadays. Society changes because technology moves forward. The economic environment makes up the cycle of life. The modern era needs "smart" and green solutions. For instance, cultural heritage includes buildings, routes, museums, and intangible and tangible cultural heritage. For example, the history of the places and the songs needs to be shared and preserved by the new generation.

In other words, Neoclassical buildings have the same goals: preservation, protection, and documentation because they offer income to their inhabitants. Also,

the historical places are part of the history of Italy. Making decisions is always significant for successful management. Social-technology conditions depend on age, gender, education level, and business environment. Also, the economic and environmental situation has significant meaning nowadays, such as the European green transformation. Preservation, protection, and alternative energy are the main pillars nowadays. **Table 4** depicts the Cinque Terre region's strengths, weaknesses, opportunities, and threats. Demography is sometimes presented as maps, graphs, tables, and data modeling. Visualizing demography is excellent because it constructs attractive and innovative digital products. This year's digital transformation is a reality. The new technologies build intelligent products.

Table 4. SWOT analysis [15–17].

SWOT				
	Strong	**Weakness**	**Opportunities**	**Threats**
Tourism	Tourism philosophy	Protect flora and fauna	Need management planning in person, local, governance level	Overpopulation sometimes
Culture	UNESCO world cultural heritage	Continuous care	Sharing the history	Preservation of Buildings
Environment	Protected areas	Need more business persons	New technologies	Fires, flows
Geography	Strategic location	Huge slope in villages	International cooperations	

4. Digital products

4.1. Generic mapping tools

The construction digital elevation model, or DEM, in Italy has requirements for the following things: Firstly, the author creates the color bar relative to the topography theme of the earth. For instance, the low elevation is green because it represents the alleys. The sea is blue, the high mountains are maroon, and the high mountain peaks are white. GMT, or Generic Mapping Tools, is a tool that creates modern, "smart," and innovative solutions. The commands can be searched on the website, generic-mapping-tools.org. [18]. It is free and open-source software. Since GMT classic mode has existed for 30 years, I participated in the InSar Processing and Theory with GMTSAR short course, which was organized by the Earth Scope Consortium [19]. The GMT toolbox includes various and varied core and supplemental program modules sharing a common set of command options, file structures, and documentation [20]. The Generic Mapping Tools progress based on three pillars:

- Generic Mapping Tools installation.
- Import GMT Color Bar.
- Import GMT Earth Relief (Coordinates Latitude, Longitude).

Figures 1–3 show the region of Cinque Terre. The coordinates are from 8′00″ to 11′00″ East and from 43′00″ to 45′00″ North. The location is near the sea and mountains. Also, there are a few alleys paralleling the coastline.

DEM Italy

```
gmt begin GMT_tut_16
 gmt set GMT_THEME cookbook
       gmt       fig.colorbar(frame=["a1000",
"x+lElevation", "y+lm"]
gmt       grdimage       @earth_relief_30s–
R5/20/32/45 –
I+a100+ne0.8 -JM6i -B -BWSnE
 gmt colorbar -DJTC -I0.4 -Bxa -By+lm
gmt end show
```

Figure 1. GTM Italy [18].

DEM Cinque Terre

```
gmt begin GMT_tut_16
       gmt set GMT_THEME cookbook
    gmt fig.colorbar(frame=["a1000",
"x+lElevation", "y+lm"]
       gmt grdimage @earth_relief_30s
–R8/11/43/45 –I+a100+ne0.8 -JM6i -B
    -BWSnE
          gmt colorbar -DJTC -I0.4 -Bxa -
By+lm
gmt end show
```

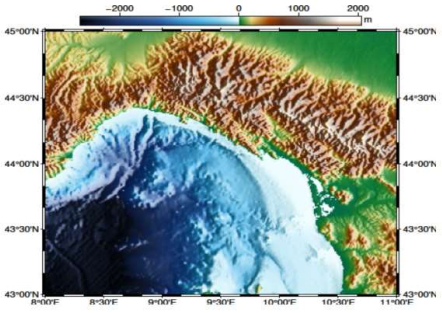

Figure 2. DEM Cinque Terre [18].

```
gmt begin GMT_tut_16
       gmt set GMT_THEME cookbook
    gmt fig.colorbar(frame=["a1000",
"x+lElevation", "y+lm"]
       gmt grdimage @earth_relief_30s
–R8/11/44/45 –I+a100+ne0.8 -JM6i -B
    -BWSnE
          gmt colorbar -DJTC -I0.4 -Bxa -
By+lm
gmt end show
```

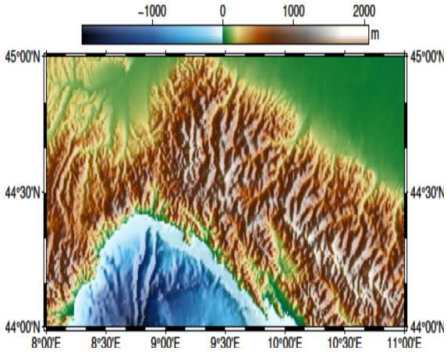

Figure 3. DEM Cinque [18].

The specialized flora of serpentine outcrops in Tuscany (Italy) is analyzed in terms of species richness and geographic variation to identify major centers of diversity and provide a basis for conservation programs [21]. Due to a centuries-old agricultural practice, the coastal landscape of the Cinque Terre (eastern Liguria, northwestern Italy) has been almost completely modified by terracing the slopes by reworking millions of cubic meters covered in rubble and the construction of thousands of kilometers of dry stone walls [22].

4.2. Maps

Figures 4 and **5** show the maps from Cinque Terre. In the region, there are five traditional villages with unique natural beauty. The map presents the location and the photos from Riomaggiore, Manarola, Corniglia, Vernazza, and Monterosso. Also, the map contains the scale bar and the symbol North. The map product is scaled at 1:50.000. The orange points show the location of each village. The coastline is the Ligurian Sea.

Figure 4. The location in Cinque Terre [23].

Figure 5. Location in Cinque Terre in Europe [23].

Cinque Terre—UNESCO world heritage site

Figure 5 shows the region of Cinque Terre in the orange cycle. The five most beautiful villages in Italy are in western and northern Italy. The map contains the symbol North, the scale bar, and the topographical basement. The coastline, the five villages, and the surrounding hillsides are all part of Cinque Terre National Park, a UNESCO World Heritage Site. Vernazza is a member of the I Borghi più belli d'Italia ("The most beautiful villages of Italy") association [24].

Figure 6. The train distance in Cinque Terre [25].

Figure 6 shows the train stations and the distance to each village. The total distance is 8.870 meters. The mean distance (total distance/four measurements) due to the shapefile (**Figure 6)** is ≈ 2217.5 m. There are five train stations in each village.

Figure 7 presents the elevation of every village. Vernazza (255 m) and Riomaggiore (250 m) have the highest elevations. Manarola has the lowest elevation of the five villages, at 161 m.

Figure 7. The elevation in Cinque Terre [25].

In the villages of Cinque Terre, the visitors meet the "green" and "blue." The train system between the villages is significant. Each village has something unique. The Monterosso al Mar has fantastic coastlines and mar, the Vernazza has romantic sunshine and quiet shops; the Corniglia is located at a high elevation; the Monterosso likes a cart postal; and Riomaggiore is a fish's village. The conditions in the villages of Cinque Terre are the environmental conditions, the fresh air, the sound of the waves, and the vision without cars. The name comes from the geography itself, because there are five traditional villages. **Figures 8–12** are screenshots from Google Earth [26]. It configures the angle, and the camera zooms in on every village. There are various and varied ways to export screenshots. Each photo presents the details of the area. Also, it is possible to configure each photo's contrast, brightness, and dpi.

Figure 8. The location from RioMaggiore [26].

Figure 9. The location from Manarola [26].

Figure 10. The location from Cornilia, from Manarola [26].

Figure 11. The location from Vernazza, from Manarola [26].

Figure 12. The location from Monterosso al Mar, from Manarola [26].

4.3. 3D Terrain

Figure 13 shows the steps of the project. It is significant to use Google Earth and Zephyr 3DF [27]. Google Earth has enough quality 3D aerial images. The author

takes 20–25 screenshots for each village. The photos cover the spherical villages. The process is part of a photogrammetric function because of the purpose of the 3D Terrain Cutch with the software 3DF Zephyr.

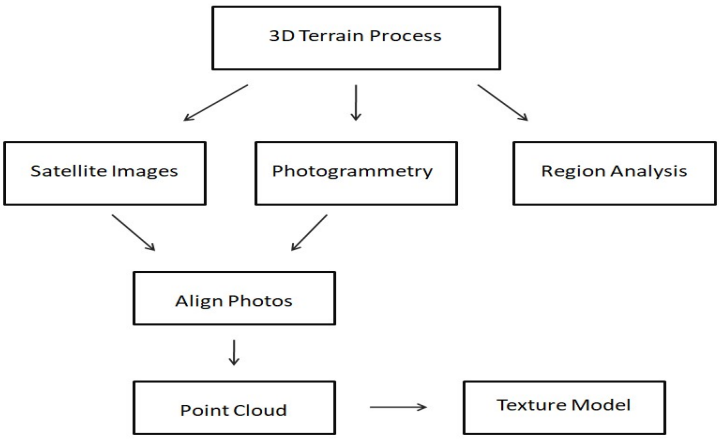

Figure 13. Data modeling the process.

The 3D aerial photos align with the 3DF Zephyr software. The steps are simple, understandable, and intelligent. There is an Italian tradition surrounding the design of products. Italian programmers and planners are famous because they have the philosophy to create new products. The final results (**Figure 14)** present the five beautiful villages. The texture model can rotate, cut areas, and zoom out/in. Also, the products are sometimes present on online platforms and stored in various formats.

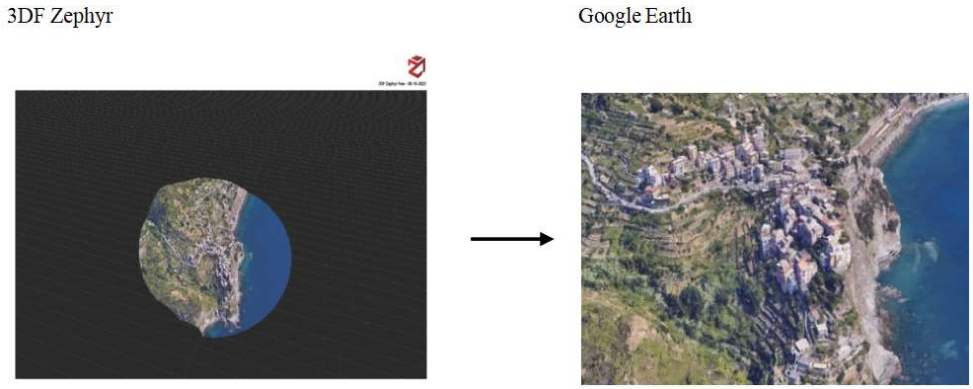

Figure 14. Photos and 3D model.

The 3D Model allows the terrain analysis and observations of the villages. Many times scientific results export with digital way, because the pedestrian observation in the field work hasn't effective. For instance, the slope of the ground is useful measurement, because it helps in the conditions of the walking roads and the buildings preservation. The following **Figures 15–19** show the view of the villages. The texture models present in the **Figures 15–19**. The platformplaycanvas [28]. The modern time needs modern solutions. Also, in the platform sketchfab.com [29] shows the 3D view of the five traditional villages in Cinque Terre.

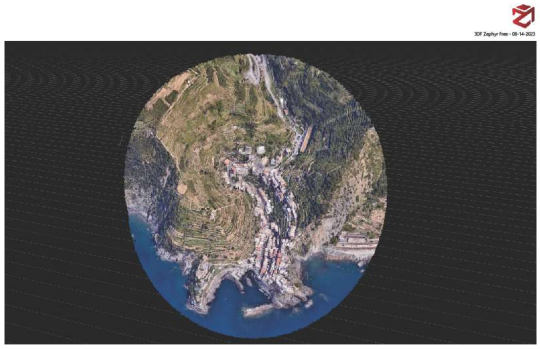

Figure 15. 3D Terrain from Manarola [30].

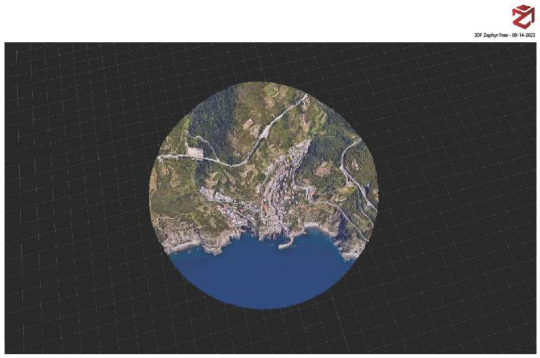

Figure 16. 3D Terrain from Riomaggiore [31].

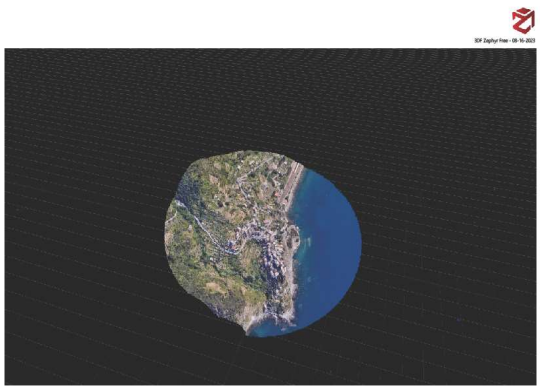

Figure 17. 3D Terrain from Corniglia [32].

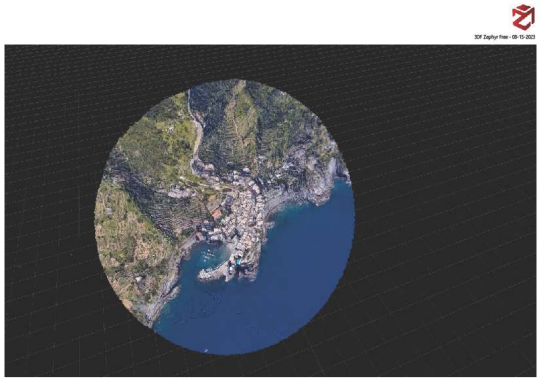

Figure 18. 3D Terrain from Vernazza [33].

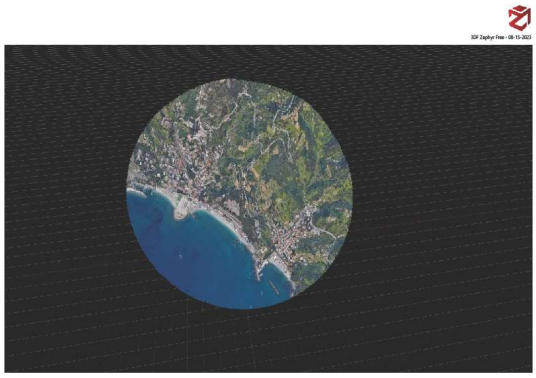

Figure 19. 3D Terrain from Monterosso al Mare [34].

5. Conclusion

The current paper is an individual effort. The work objectives are the visualization and spatial analysis of Cinque Terre. The manuscript describes the maps, statistics, graphs, DEM, and 3D Terrains. The new technologies offer modern solutions. In the final years, technological tools grow. This fact helps in a better study of the regions. For example, in the previous 20 years, visitors traveled to cities with analogical maps. Archeology works with maps and traditional measurements. Nowadays, digital products emphasize accuracy and authenticity in regions. Also, spatial, environmental, and cultural management are crucial for success.

Conflict of interest: The author declares no conflict of interest.

References

1. Bottazzi C, Bottero M, Mondini G, et al. Evaluation of the tourist demand in Management Plans for UNESCO sites: the case of the Cinque Terre Park (Italy). 2006 First International Symposium on Environment Identities and Mediterranean Area. doi: 10.1109/iseima.2006.345006
2. Acacia S, Casanova M, Macchioni E, et al. Terraced landscape preservation and tourism sustainability in Cinque Terre, Liguria. Ethical and Responsible Tourism. doi: 10.4324/9781003358688-11
3. Santoro A, Venturi M, Agnoletti M. Landscape Perception and Public Participation for the Conservation and Valorization of Cultural Landscapes: The Case of the Cinque Terre and Porto Venere UNESCO Site. Land. 2021; 10(2): 93. doi: 10.3390/land10020093
4. Candia S, Pirlone F, Spadaro I. Sustainable development and the plan for tourism in Mediterranean coastal areas: Case study of the region of Liguria, Italy. WIT Transactions on Ecology and the Environment. 2018; 217: 523-534.
5. Claver E, López MD, Molina JF, et al. Environmental management and firm performance: A case study. Journal of Environmental Management. 2007; 84(4): 606-619. doi: 10.1016/j.jenvman.2006.09.012
6. Official website Instat. Available online: http://dati.istat.it/Index.aspx?QueryId=18541&lang=en (accessed on 4 January 2024).
7. Official website Topographic Map. Available online: https://en-gb.topographic-map.com/map8dr49m/Riomaggiore/?center=44.10924%2C9.73742&zoom=12 (accessed on 4 January 2024).
8. Official website Topographic Map. Available online: https://en-gb.topographic-map.com/map-zq71h/Manarola/?center=44.10611%2C9.72744 (accessed on 4 January 2024).
9. Official website Topographic Map. Available online: https://en-gb.topographic-map.com/map-vmc4s/Corniglia/?center=43.62355%2C9.73007&zoom=8 (accessed on 4 January 2024).
10. Official website Topographic Map. Available online: https://en-gb.topographic-map.com/map-pvhmgt/Vernazza/ (accessed on 4 January 2024).

11. Official website Topographic Map. Available online: https://en-gb.topographic-map.com/map-wf2rnx/Monterosso-al-Mare/?center=44.23131%2C9.66158&zoom=11 (accessed on 4 January 2024).
12. Helms MM, Nixon J. Exploring SWOT analysis—where are we now? Journal of Strategy and Management. 2010; 3(3): 215-251. doi: 10.1108/17554251011064837
13. Valentin EK. Swot Analysis from a Resource-Based View. Journal of Marketing Theory and Practice. 2001; 9(2): 54-69. doi: 10.1080/10696679.2001.11501891
14. Leigh D. SWOT Analysis. Handbook of Improving Performance in the Workplace: Volumes 1–3. 2009. pp. 115-140. doi: 10.1002/9780470592663.ch24
15. Official Website. Available online: https://www.parconazionale5terre.it/Eindex.php (accessed on 2 January 2024).
16. Official Website. Available online: https://whc.unesco.org/en/list/826 (accessed on 2 January 2024).
17. Official Website, Available online: https://storymaps.com/el/stories/4c7a142f1fb2413687ea725473e29cc8 (accessed on 2 January 2024).
18. Wessel P, Luis JF, Uieda L, et al. The Generic Mapping Tools Version 6. Geochemistry, Geophysics, Geosystems. 2019; 20(11): 5556-5564. doi: 10.1029/2019gc008515
19. Certification of Completion this certifies that Efthymios Spyridon Georgiou has successfully participated in this InSar Processing and Theory with GMTSAR short Course organized EarthScope Consortium.
20. Wessel P, Smith WHF, Scharroo R, et al. Generic Mapping Tools: Improved Version Released. Eos, Transactions American Geophysical Union. 2013; 94(45): 409-410. doi: 10.1002/2013eo450001
21. Selvi F. Diversity, geographic variation and conservation of the serpentine flora of Tuscany (Italy). Biodiversity and Conservation. 2006; 16(5): 1423-1439. doi: 10.1007/s10531-006-6931-x
22. Brandolini P. The outstanding terraced landscape of the Cinque Terre coastal slopes (eastern Liguria). Landscapes and landforms of Italy. 2017; 235-244.
23. Official web site ESRI. Available online: https://pro.arcgis.com/en/pro-app/index-geonet-allcontent.html (accessed on 1 February 2024).
24. Liguria (Italian). Available online: https://borghipiubelliditalia.it/liguria/ (accessed on 9 December 2023).
25. Official website ESRI. Available online: https://pro.arcgis.com/en/pro-app/index-geonet-allcontent.html (accessed on 2January 2024).
26. Official website Google Earth. Available online: https://www.google.com/earth/about/versions/ (accessed on 7 January 2024).
27. Official website 3DF Zephyr Free. Available online: https://www.3dflow.net/3df-zephyr-free/ (accessed on 6 January 2024).
28. Official website playcanvas. Available online: playcanvas.com/viewer (accessed on 5 January 2024).
29. Official website sketchfab. Available online: https://sketchfab.com/ (accessed on 1 February 2024).
30. Official website sketchfab. Available online: https://sketchfab.com/3d-models/manarola-cinque-terre-57e4b1d2724a4f468926f695c97177fd (accessed on 18 February 2024).
31. Official website sketchfab. Available online: https://sketchfab.com/3d-models/rio-maggiore-cinque-terre-deb05d67f0ee4b609eb15d3b4c9841a8 (accessed on 18 February 2024).
32. Official website sketchfab. Available online: https://sketchfab.com/3d-models/cornilia-cinque-terre-6f3aaf4d768249b991f5df473b1bdcee (accessed on 18 February 2024).
33. Official website sketchfab. Available online: https://sketchfab.com/3d-models/vernazza-cinque-terre-0b52ce54769f4457b287e8ab4b4ba116 (accessed on 18 February 2024).
34. Official website sketchfab. Available online: https://sketchfab.com/3d-models/monterosso-cinque-terre-2bb616a737af49b38ba567d6a1ee1424 (accessed on 18 February 2024).