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ANCIENT TEMPLES IN GREECE AND THE CONTRIBUTION OF GEOINFORMATICS TO THE DETERMINATION OF THEIR GENERAL SETTING CHARACTERISTICS

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ABSTRACT

The ancient Greek civilization is characterized by unique monuments of our world cultural heritage. Of these monuments, the ancient Greek temple is one of the most characteristic and majestic building of antiquity. Nowadays, numerous ancient temples can be found, which are scattered throughout mainland and island Greece. In this paper, the 271 ancient temples in Greece, dating from the Geometric period until the Roman era, were studied from the engineer's point of view, and some of their characteristics were recorded and digitized, many of which were obtained by utilizing geoinformatics tools. More specifically, the recording of the temples and their characteristics was carried out through extensive bibliographic research and then their location was determined with the help of a Geographic Information System (GIS) environment. Google Earth Pro® images were used to calculate their specific setting characteristics, especially their orientation and area. In addition, their altitude, their distance from the coastline, their distance from paved roads and their distance from paved or non-paved roads were calculated. Moreover, by correlating all the data, an attempt was made to draw conclusions. Finally, correlation of the names of the deities, to which the temples were dedicated, with the above characteristics led to further conclusions.

KEYWORDS: Ancient Greek temples, Geoinformatics, Geographic Information System, Google Earth Pro, Ancient temples general characteristics, Archaic, Classical, Hellenistic, Roman, orientation

1. INTRODUCTION

Nowadays, geoinformatics plays a crucial role for archaeology. In the past years, GIS have been used in archaeological studies since the 1980s, while studies for archaeology in computer applications (cartographic and statistical applications) that resembled GIS had been conducted since the 1970s (Scianna & Villa, 2012). The archaeological spatial data are stored in databases, drawings, or maps. Digital archaeological data now allow the connection or combination of different primary data to create new maps. In addition, databases can be connected to solve specific problems or answer specific questions (Neubauer, 2004).

Generally, there are several studies conducted for ancient structures and their characteristics all over the world. In particular, orientation of temples has been studied extensively. In one study, orientation of Luxor ancient Egyptian temples were determined using Quickbird satellite images and then the results were compared to previous studies. With the help of remote sensing techniques this study was made possible. No field survey took place. The research aims to establish a practical methodology for calculating the orientation of the main axis of ancient Egyptian temples based on very high-resolution QuickBird images as an alternative to traditional methods (Shaltout, 2014). Another study was made in Italy, where astronomical orientation of 41 archaic and classical Greek temples in Sicily was determined. Subsequently, the results were compared with temples in Greece. Using a binomial test, the study showed strong evidence that there is a preference for solar orientations. In this study, the research for orientations was done in a more classical way, using magnetic compass and clinometer. The aim was the determination of what extent 'Greek' culture differed in the two locations (Salt, 2009). In another study, seven ancient Hellenic temples chosen from a wide area in Greece and were measured. Measurements were carried out using a portable GPS and a magnetic compass with an attached clinometer. In conclusion, in this work it is considered that the orientation was intentional (Liritzis & Vassiliou, 2003). In another research, 200 ancient Greek temples were studied for the orientation of the diagonals. The aim of this study was to determine whether the north arrow on the plan was intended to indicate the true Astronomical North (AN) or the Magnetic North (MN). Another special effort was made to identify the exact shape of the rectangle since the direction of the diagonal directly depends on it. The main axis on the plan was calculated in Computer-Aided Drawing (CAD) (Ranieri, 2014).

In Greece, a study had been carried out about 57 ancient theatres and their main characteristics (area, orientation, distance from coastline, visibility, altitude, location, preservation state) with the help of geoinformatics. For a number of theatres an on-site study was conducted with the help of UAVs to determine their characteristics. As for the rest, Google Earth Pro® and satellite images (Ikonos-2) were used. Then, GIS were used to carry out the study. The software that had been used for aerial and satellite data were Erdas Imagine® and Agisoft Metashape® (Kaimaris, 2018).

In this paper, 271 ancient temples in Greece, dating from the Geometric period until the Roman era, and their general characteristics have been studied. The characteristics include location of the temples, construction era, preservation state, architectural order, distance from the coastline, altitude, surface area, orientation, and distance from paved or non-paved roads. Although the orientation of the temples has been studied several times in the past, methods and tools which were used are different, thus it should be included in the research. It is the first time such extensive research has been conducted on the ancient temples located in modern Greece and their characteristics with the help of Geoinformatics. A GIS environment was set up for the study and the software which was used included ArcGIS Pro® and Google Earth Pro®.

Regarding the history, for the worship of the Gods, the ancient Greeks created temples, which are considered as some of the supreme glories of their civilization. A unique architectural design was maintained for over eight hundred years. This includes an independent rectangle of columns rising on a stepped platform and framing an inner enclosed building, covered by a pitched roof and triangular gables. The temple is a completely autonomous and self-sufficient building. It is usually located within the sanctuary, which, in turn, is in the place dedicated to a god. Its size varies from smaller to larger, culminating in the Classical period. Simpler temples appear in Greek sanctuaries at the end of the 9th and 8th centuries BC and are the forerunners of colonnaded stone temples. The colonnaded, Hellenistic era, temple took shape around 600 BC and quickly established itself as the architectural foundation and flag of the Greek city-state. Very quickly its numbers multiplied, and the Athenians of the 5th century BC elevated their architectural design and execution to unsurpassed complex art. Colonnaded temples were protected by the Romans and survived the fall of successive Greek empires. With the rise of Christianity, some were destroyed, some were converted into churches and most fell into neglect and ended up as quarries. The

preferred location for the temples was next to the urban centre (the market), or an ancient theatre, in imposing wilderness or areas with a sea view, in plains, etc. In some cases, the choice of the location of a temple was not only linked to the cults attributed to the deity itself, but also to the sacredness of a particular site. Most Greek temples have their axis aligned in the east-west direction, with the main entrance facing east. This typical orientation may have served a practical purpose: to allow the first light of the Sun, at

dawn, to enter through the entrance and enlighten at the rear of the temple, in the sanctum, the sacred statue of the deity to whom the temple was dedicated. The main architectural styles, commonly known as orders, of the columns of the ancient Greek Temples are the “Doric” and “Ionic” and were established in the 6th century BC. An order known as “Corinthian” was later developed and added during the 4th century BC (Spawforth, 2006; Gruben, 2015).

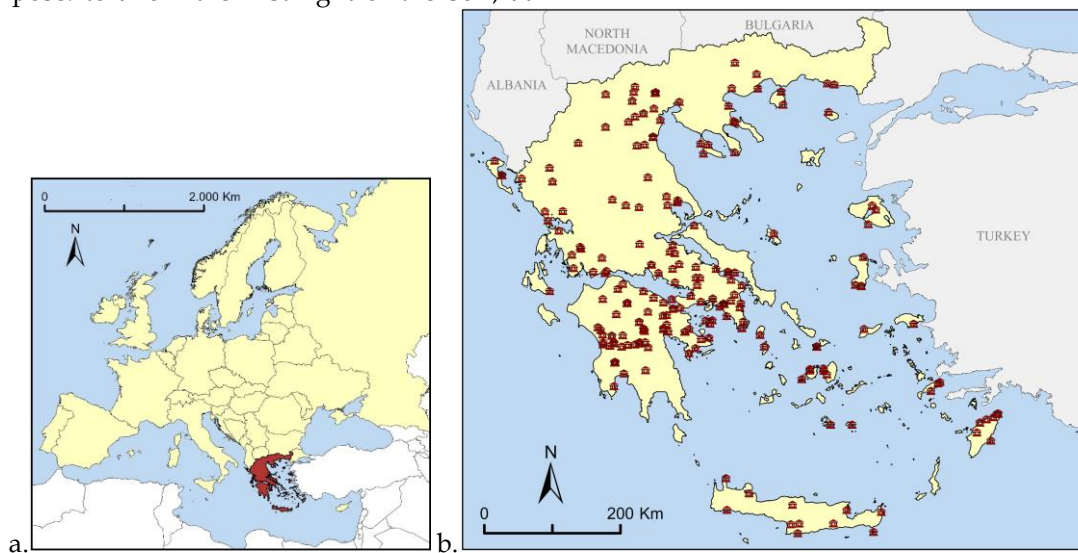


Figure 1. a. Greece in the European continent, b. Greece, its neighboring countries and the location of the ancient Greek temples presented in red/brown symbol.

According to the extensive research conducted for this paper, 271 temples were studied in Greece (Table 1, Fig. 1) and have been examined in detail (AMAC, 2015; AeginaIsland, 2022; Aksos, 2018; Antonopoulos, 2012; Archeology and Arts, 2020; Bellas, 2007; CAKV, 2020; Chatzidakis, 2012a; Chatzidakis, 2012b; Dakaris, 2012a; Dakaris, 2012b; Dakaris, 2012c; Dakaris, 2012d; DiscoveringKos, 2019; Drougou, et al., 2011; Ecotourism Greece, 2019; Efstathiou, 2012; EphAAetL, 2020a; EphAAetL, 2020b; EphAAetL, 2020c; EphAAetL, 2020d; EphAArg, 2020a; EphAArg, 2020b; EphAArg, 2020c; EphAArt, 2015; EphACeph, 2012; EphADod, 2022; EphAEAtt, 2020a; EphAEAtt, 2020b; EphAEub, 2020a; EphAEub, 2020b; EphAEub, 2022a; EphAEub, 2022b; EphAIL, 2022; EphAKard, 2022a; EphAKard, 2022b; EphAKav, 2020a; EphAKav, 2020b; EphALes, 2020; EphAMag, 2016a; EphAMag, 2016b; EphAMag, 2016c; EphAMes, 2021; EphAPhEv, 2022a; EphAPhEv, 2022b; EphAPhEv, 2022c; EphAWatt, 2022a; EphAWatt, 2022b; EphAWatt, 2022c; EphAWatt, 2022d; Exploring Greece, 2022; GTP, 2005; GTP, 2019; GoldenGreece, 2022; Google Maps, 2019; Google Maps, 2022; Gruben, 2015; Hatzi-Spiliopoulou, 2012; Hellenicaword, 2022; Kanellopoulos, 2019; Kanta-Kitsou, 2008;

Karantzali, 2012; Karapanagiotou, 2012a; Karapanagiotou, 2012b; Karapanagiotou, 2015; Korinthiaguide, 2022; Kourayos, 2012; Kourouni, 2012; Koursoumis, 2012; Kyriakou, 2012; Lambrinouidakis, 2019; Leventi & Mitsopoulou, 2005; LiFO Culture, 2021; Lolidis, 2015; Lykidou, 2008; MCS, 2012a; MCS, 2012b; MCS, 2012c; MCS, 2012d; MCS, 2012e; MCS, 2012f; MCS, 2012g; MCS, 2012h; MCS, 2012i; MCS, 2012j; MCS, 2012k; MCS, 2012l; MCS, 2012m; MCS, 2012n; MCS, 2012o; MCS, 2012p; MCS, 2012q; MCS, 2012r; MCS, 2012s; MCS, 2012t; MCS, 2012u; MCS, 2012v; MCS, 2012w; MCS, 2012x; MCS, 2012y; MCS, 2012z; MCS, 2012aa; MCS, 2012ab; MCS and EphAKard, 2012a; MCS and EphAKard, 2012b; Malleotus, 2022; Maniataki, 2018; Matsas, 2012; Mazarakis-Ainian, 2022; Melas, 1973; Mitsopoulou, 2012; Municipality of Agios Nikolaos, 2022; Municipality of Dodoni, 2018; Municipality of Kythnos, 2019; Municipality of Thira, 2022; Municipality of Troizinia-Methana, 2016; NCUA, 2008; Natsikopoulos, 2010; PCEM, 2012a; PCEM, 2012b; Panagou, 2012; Papadimitriou, 2012; Papaefthymiou & Christodoulou, 2012; Papatavrou, 2012; Papazoglou, 2009; Petratos, 2009; Rakatsanis, 1997; SMAS, 2013; Salvalaggio, et al., 2021; Sgouropoulou, 2012a; Sgouropoulou, 2012b; Sgouropoulou, 2012c; Sgourou, 2012; Spawforth,

2006; Stoupis, 2021; Thassos View, 2022; Themis, 2012a; Themis, 2012b; Tomlinson, 1976; Triantafyllidis, 2009; Tsaroucha, 2012; Tsatsopoulou, 2012; Tsiafis, 2017; Tsigarida, 2012; Tsoga, 2012; Tsonopoulou, 2013; Tsota, 2012; Tzanakaki, 2012; Venieri, 2012a; Venieri, 2012b; Venieri, 2012c; Venieri, 2012d; Vikatou, 2012a; Vikatou, 2012b; Vikatou, 2012c; Vikatou, 2012d; Vikatou, 2012e; Vikatou, 2012f; Vordos, 2012; WikiMapia, 2015; WikiMapia, 2017a;

WikiMapia, 2017b; Zarifis, 2007; Zeus Travel Guide, 2020). In their majority, only the foundations, ruins or remains have survived. Apart from these temples that have been recorded, there are many other temples that have not yet been discovered by archaeologists, but are mentioned in historical texts (e.g., Pausanias). Today few temples survive intact.

Table 1. Ancient temples that have been discovered in Greece.

A/A	Temple name	Temple's position (latitude N and longitude E in decimal degrees, Reference System: WGS84)	
		N	E
1	Temple of Artemis Iolkia, Volos	39,3389439	22,9322961
2	Temple of Zeus Thaulios, Ancient Feres, Volos	39,3892412	22,7424550
3	Archaic temple of Apollo, Metropolis, Karditsa	39,3336462	21,8193974
4	Temple of Apollo Daphniforos, Eretria, Euboea	38,3953708	23,7946572
5	Temple of Dionysus, Eretria, Euboea	38,3982438	23,7900394
6	Temple of Zeus, Ancient Aegira, Achaia	38,1289690	22,3778572
7	Temple of Artemis, Ano Mazaraki, Achaia	38,0146576	21,6993725
8	Temple of Artemis Imerasia, Lousoi, Arcadia	37,9718237	22,1120503
9	Archaic temple, Lousoi, Arcadia	37,9648347	22,1025651
10	Temple of Athena Makistos, Mazi, Ilia	37,6045909	21,6757001
11	Temple of Demeter, Lepreo, Ilia	37,4394223	21,7243804
12	Temple of Messini, Kalamata	37,1767340	21,9202872
13	Temple of Apollo Epicurius, Bassae, Arcadia	37,4296461	21,9001999
14	Temple of Athena of ancient Alifera, Ancient Arcadia, Ilia	37,5289098	21,8668378
15	Temple of ancient Gortyna (or Gortys), Arcadia	37,5398463	22,0452483
16	Temple of Pan, Arahamites, Arcadia	37,4217174	22,2503295
17	Temple of Athena Sotiros and Poseidon, Ancient Asea, Arcadia	37,4338480	22,3248273
18	Temple of Athena Alea, Ancient Tegea	37,4554832	22,4204059
19	Temple in Orchomenos, Arcadia	37,7182700	22,3150053
20	Temple of Poseidon, Ermioni, Argolis	37,3839348	23,2567701
21	Temple of Poseidon, Hermione, Poros	37,5225745	23,4797903
22	Temple of Hippolytus, Ancient Troizena, Argolis	37,5028467	23,3481885
23	Temple of Nemean Zeus, Nemea, Corinthia	37,8095308	22,7104570
24	Temple of Poseidon (Isthmia), Isthmus of Corinth	37,9157400	22,9929848
25	Temple of Apollo, Corinth	37,9060181	22,8791562
26	Temple E, Corinth	37,9048725	22,8779085
27	Temple of Apollo (or Artemis Limnia), Ancient Sikyon, Corinth	37,9839190	22,7136786
28	Heraion, Argos	37,6920008	22,7750219
29	Temple of Asclepius, Epidaurus	37,5986300	23,0744717
30	Temple of Artemis, Epidaurus	37,5983515	23,0748740
31	Temple of Hera (Heraion), Olympia	37,6388492	21,6298758
32	Temple of Zeus, Olympia	37,6379392	21,6302218
33	Temple of the Mother of Gods, Olympia	37,6388199	21,6308047
34	Temple of Hera, Plataea, Boeotia	38,2184781	23,2758691
35	Temple of Ismenius Apollo, Thebes	38,3164289	23,3223876
36	Temple of Apollo Ptoos, Perdicovrysi, Boeotia	38,4595020	23,2510345
37	Temple of Zeus Basileus, Livadia, Boeotia	38,4303370	22,8604279
38	Temple of Asclepius, Orchomenos, Boeotia	38,4939341	22,9702614
39	Temple of Athena Krania, Elateia, Phocis	38,6579588	22,8111629
40	Temple of Artemis Elaphebolos, Kalapodi, Phthiotis	38,6370410	22,8955229
41	Temple of Apollo Avon, Kalapodi, Phthiotis	38,6366094	22,8956433
42	Temple of Apollo, Delphi	38,4823004	22,5011617
43	Heraion of Perachora, Corinth	38,0281237	22,8524761
44	Temple of Athena Pronea, Delphi	38,4801354	22,5083734
45	Temple of Despoina, Lykosoura	37,3896048	22,0309543
46	Archaic temple of Trapeza, Aigio	38,2196837	22,0299619
47	Temple of Poseidon (or Velvina), Ancient Molykreion	38,3851813	21,7490091
48	Temple of Apollo Thermios, Aetolia-Acarnania	38,5597946	21,6680856
49	Temple of Artemis Lafria and Apollo, Ancient Kalydona	38,3720397	21,5298409
50	Temple of Zeus, Stratos, Aetolia-Acarnania	38,6712747	21,3111021
51	Temple of Artemis Gorgo, Corfu	39,6071230	19,9182031
52	Kardaki Temple, Corfu	39,6013633	19,9261224

53	Doric temple of Hera Akraia (Heraion), Corfu	39,6032236	19,9244833
54	Temple of Apollo Pythios Soter, Arta	39,1607502	20,9827576
55	Temple in Kassopi, Preveza	39,1481250	20,6802981
56	Temple of Zeus Areios, Kastri, Ioannina	39,7274238	20,7307470
57	Older Temple of Dione, Dodona	39,5474144	20,7898832
58	Newer Temple of Dione, Dodona	39,5473077	20,7898956
59	Temple of Hercules, Dodona	39,5473183	20,7902379
60	Temple of Aphrodite, Dodona	39,5468516	20,7894807
61	Temple of Zeus (Holy House), Dodona	39,5472419	20,7897063
62	Temple of Themis, Dodona	39,5470910	20,7896228
63	Temple of Apollo Pythios, Rhodes	36,4399607	28,2104417
64	Temple of Zeus Polias and Athena Polias, Rhodes	36,4439558	28,2112954
65	Temple of Athena Lindia, Rhodes	36,0911031	28,0882759
66	Temple of Asclepius (Asclepion), Kos	36,8752202	27,2567630
67	Corinthian temple, Kos	36,8756613	27,2572838
68	Temple of Olympian Zeus (or Olympeio), Athens	37,9693960	23,7330655
69	Temple of Delphinian Apollo, Athens	37,9685596	23,7329816
70	Temple of Kronos and Rhea, Athens	37,9682267	23,7334976
71	Temple of Mars, Athens	37,9755291	23,7227709
72	Temple of Hephaestus (or Hephaestion), Athens	37,9755943	23,7214095
73	Temple of Athena Polias, Athens	37,9719033	23,7263595
74	Parthenon (dedicated to Athena), Athens	37,9714986	23,7265976
75	Temple of Artemis, Gortsouli, Mantinea	37,6332310	22,3905261
76	Temple of Athena Nike, Athens	37,9715151	23,7248704
77	Erechtheion (Athena and Poseidon), Athens	37,9720858	23,7264545
78	Erechtheion (Athena & Poseidon), Athens	37,9716265	23,7273143
79	Temple of Athena Pallini, Ancient Pallini, Attica	38,0141516	23,8443242
80	Temple of Apollo Zoster, Aixonides Ales, Attica	37,8100378	23,7736730
81	Temple of Poseidon, Sounio	37,6501642	24,0245747
82	Temple of Athena, Sounio	37,6529428	24,0270269
83	Heroon of Frodi, Sounio	37,6530764	24,0271576
84	Temple of Demeter and Kore, Thoriko, Attica	37,7373826	24,0492877
85	Temple of Artemis Tauropolos, Attica	37,9797220	24,0088292
86	Temple of Nemeses, ancient Ramnouda, Attica	38,2175901	24,0268568
87	Temple of Apollo, Aegina	37,7503453	23,4236817
88	Temple of Athena Aphaia, Aegina	37,7543256	23,5332106
89	Temple (probably dedicated to Athena), Megara, Attica	37,9977102	23,3403287
90	Temple in Megara, Attica	37,9977778	23,3452774
91	Temple of Artemis Propylaia and Poseidon's Father, Eleusis	38,0422025	23,5391590
92	Temple of Athena, Kea	37,5610873	24,3303122
93	Temple of Diktyнна Goddess (Diktyнneo), Crete	35,6638964	23,7683289
94	Temple (probably dedicated to Athena), Toroni, Halkidiki	39,9773199	23,9006063
95	Temple in Stageira, Halkidiki	40,5924436	23,7955746
96	Temple of Muse Clio, Amphipolis	40,8269952	23,8511040
97	Temple of Ammon Zeus, Afitos, Halkidiki	40,0770690	23,4486626
98	Temple of Hercules, Thassos	40,7771894	24,7114061
99	Temple A (Aeolian sanctuary), Lesvos	39,2526235	26,2431406
100	Temple B (Aeolian sanctuary), Lesvos	39,2528152	26,2433717
101	Temple of Messon, Lesvos	39,1964803	26,3055458
102	Temple of Athena Emporios (Athena Poliada), Chios	38,1928772	26,0309073
103	Temple of Apollo and Artemis, port of Emporios, Chios	38,1876300	26,0276700
104	Temple of Asclepius or Dionysus or Apollo (Nagos santcuary), Chios	38,5748047	26,0742809
105	Temple of Zeus Sotiros, Ancient Mantinea	37,6179550	22,3926913
106	Temple of Fanaios Apollo, Chios	38,2072424	25,9307193
107	Temple in Kastri, Polyneri, Grevena	40,0693412	21,2081872
108	Temple of Zeus Eleftherios, Petres, Florina	40,7236299	21,6590379
109	temple of Ypsistos Zeus, Polymylos, Kozani	40,3665720	22,0655784
110	Temple of Hera (Heraion of Samos), Samos	37,6718984	26,8854216
111	Temple C (Heraion of Samos), Samos	37,6725261	26,8865014
112	Temple - North building (Heraion of Samos), Samos	37,6729118	26,8867074
113	Temple - South building (Heraion of Samos), Samos	37,6714114	26,8865052
114	Roman temple (Heraion of Samos), Samos	37,6720881	26,8866236
115	Temple of (propably) Demeter and Kore (or Apollo), Naxos	37,0291072	25,4312957
116	Temple of Apollo Delios, Portara, Naxos	37,1101395	25,3724502
117	Delion (Temple of Artemis and Apollo), Paros	37,1035023	25,1547797
118	Temple of Athena Poliouchos, Paros	37,0846523	25,1472247
119	Temple of Dionysus, Naxos	37,0776879	25,3807622
120	Temple of Apollo, Delos	37,4003871	25,2669682
121	Temple of Athena Itonia (Panthessalian Sanctuary), Sofades	39,2616498	22,0505706
122	Temple of Apollo Kerdoos, Larissa	39,6370872	22,4179115

123	Temple of Demeter, Kythnos	37,4063770	24,3969996
124	Temple of Demeter and Kore, Corinth	37,8988767	22,8763413
125	Temple of Demeter, Dion	40,1756504	22,4935345
126	Temple of Amphiaraos (Amphiareion), Oropos	38,2906329	23,8447107
127	Temple of Artemis, Vravrona	37,9259581	23,9935050
128	Temple of Artemis Orthia, Sparta	37,0828735	22,4351210
129	Temple of Isis, Delos	37,3973733	25,2708274
130	Temple of the Great Gods, Samothrace	40,5004835	25,5302103
131	Temple of Artemis and Apollo Kitharoidos (sector B), Kozani	40,2906826	21,6712530
132	Temple of Artemis Vaphyria, Dion	40,1696536	22,4967106
133	Temple of Artemis (sanctuary A), Philippi	41,0137582	24,2850881
134	Temple of Artemis (sanctuary B), Philippi	41,0136823	24,2861895
135	Temple of Artemis, Sani, Halkidiki	40,0911597	23,3143684
136	Asclepieion, Athens	37,9707569	23,7266628
137	Temple of Apollo, Ancient Zone, Thrace	40,8633182	25,6386694
138	Temple of Athena Polias, Megalopolis	37,4134261	22,1282036
139	Temple of Artemis Mesopolitis, Orchomenos, Arcadia	37,7231129	22,3151004
140	Temple of Apollo Deiradiotis, Argos	37,6417118	22,7205536
141	Temple of Apollo Maleata, Epidaurus	37,5994187	23,0854142
142	Temple of Pythian Apollo, Ikaria, Attica	38,0956690	23,9005044
143	Temple of Apollo (Building B), Logga, Messenia	36,8639726	21,9185433
144	Temple of Apollo (Building C), Logga, Messenia	36,8637338	21,9184529
145	Temple of Athena, Prasadaki, Ilia	37,4131145	21,7222358
146	Temple of Avlidia Artemis, Avlida	38,4333932	23,5924199
147	Temple of Poseidon, Poseidi	39,9587488	23,3656811
148	Temple of Artemis, Munichia, Piraeus	37,9355786	23,6589869
149	Temple of Athena Promachos, Antikyra, Phocis	38,3729657	22,6233354
150	Temple of Athena, Peline, Achaia	38,0438271	22,5474083
151	Temple of Athena Polias, Stymphalos	37,8585318	22,4573428
152	Temple on the hill of Magoula, Akarnania	38,8999241	20,9277373
153	Temple B, Palladion, Arcadia	37,4525936	22,3287406
154	Temple C, Palladion, Arcadia	37,4519438	22,3293741
155	Temple in Spathari, Lepenou	38,6951851	21,2943783
156	Temple of Demeter and Kore (Eleusinion), Athens	37,9734824	23,7248824
157	Temple of Apollo (underwater), Halieis	37,3159485	23,1491891
158	Temple of Artemis Knakeatis, Tegea	37,3887336	22,4715541
159	Geometric Temple, Tiryns	37,5988784	22,8002998
160	Temple of Artemis Limnatis, Mavromati	37,1787459	21,9301666
161	Temple of Eileithyia and Kouroi, Mavromati	37,1803122	21,9275648
162	Temple of Ithomata Zeus, Peloponnese	37,1855202	21,9263237
163	Temple of Isis Lochia, Dion	40,1761588	22,4950463
164	Temple of Aphrodite Hypolympidia, Dion	40,1762365	22,4950436
165	Temple in Dion	40,1760895	22,4950975
166	Temple of Isis Tychi, Dion	40,1760784	22,4952011
167	Temple of Olympian Zeus, Dion	40,1713746	22,4948794
168	Temple of Augustus Memorial (Apollo, Poseidon and Mars), Nikopolis	39,0278464	20,7356257
169	Temple (first building), Nea Roda	40,3769815	23,9118711
170	Temple of Apollo Helios (second building), Nea Roda	40,3767188	23,9120821
171	Temple of Asclepius, Alifira	37,5318885	21,8632117
172	Temple of Asclepius, Levina	34,9322828	24,9250170
173	Temple of Artemis Orthasia, Figalia	37,4405953	21,9019042
174	Temple of Aphrodite, Figalia	37,4414904	21,9015409
175	Temple of Hera, Ancient Mantinea	37,6180372	22,3927400
176	Temple of Isis (Iseon), Eretria	38,3929507	23,7987138
177	Temple of Hercules Pyre, Pauliani, Lamia	38,7533480	22,2987579
178	Temple in Skala, Kefalonia	38,0974562	20,8072334
179	Late Archaic temple of Aphrodite, Thessaloniki	40,6403215	22,9406591
180	Temple in Alepochori, Megara	38,0748111	23,1715937
181	Temple of Hermes and Aphrodite, Symi, Viannos	35,0559268	25,5000740
182	Temple of Artemis Proseioa, Pefki, Euboea	39,0097383	23,2169380
183	Temple of Dionysus Vrisaeus, Lesvos	39,0066977	26,1701485
184	Temple of Apollo, Amfanos, Volos	39,3112385	22,9284176
185	Temple of Poseidon, Akovitika, Kalamata	37,0346548	22,0772538
186	Temple of Asclepius, Phthiotis	38,7488863	22,8574785
187	Temple of Demeter Proernia, Proerna, Lamia	39,2391842	22,2756467
188	Thesmophorion (dedicated to Demeter), Pella	40,7635211	22,5272283
189	Temple of Graia & Aeolos (Sanct. of Mother of Gods and Aphrodite), Pella	40,7576369	22,5191807
190	Temple of Darron, Pella	40,7523563	22,5152296
191	Temple of Artemis Klaudia, Ancient Epidaurus	37,6364517	23,1503506

192	Temple of Artemis Orthia/Upisia, Ancient Messene	37,1759932	21,9201693
193	Artemisium, Ancient Messene	37,1758336	21,9201590
194	Temple of Artemis Limnatis, Lapithos	37,5436614	21,7105287
195	Temple of Artemis Iphigenia, Aegira	38,1288759	22,3778483
196	Temple of Artemis Aontia, Rakita, Achaia	38,1524990	21,9470478
197	Temple of Athena Oxyderkes, Argos	37,6419058	22,7208775
198	Temple of Athena Salpingos or Demeter Pelasgida, Argos	37,6300197	22,7219367
199	Temple in Kypseli	40,5479099	22,5021333
200	Temple of Zeus Hypsistos, Dion	40,1759273	22,4946348
201	Temple of Asclepius, Dion	40,1739638	22,4935480
202	Temple of Olympian Zeus, Mount Olympus	40,0678040	22,3511024
203	Temple of Eukleia (or Meilichios Zeus), Vergina	40,4799180	22,3213814
204	Temple of the Mother of Gods, Vergina	40,4814430	22,3242963
205	North Peristyle, Vergina	40,4802858	22,3211205
206	Temple of the Mother of Gods Autochthon, Lefkopetra, Imathia	40,4359234	22,1776346
207	Hellenistic era Temple (probably Zeus), Skydra	40,7613446	22,1452898
208	Two-room Temple of Dionysus's Mystes, Ancient Pella	40,8319131	22,1659064
209	Hellenistic era Temple (probably Eileithyia or Asclepius), Pydna	40,3977968	22,6170521
210	Temple of the Nymphs (Nymphaeum), Ancient Mieza	40,6434409	22,1221865
211	Temple of Mieza (Asclepion), Ancient Mieza	40,6450288	22,1230638
212	Temple of Zeus Soter, Megalopolis	37,4128998	22,1273580
213	Temple of the Kabeiroi gods, Thebes	38,3180062	23,2548899
214	Temple of Dionysus, Ancient Maroneia	40,8796319	25,5171828
215	Temple of Athena, Ancient Aisymi	40,8213173	24,3048505
216	Temple of Dionysus, Kali Vrysi, Drama	41,1647852	23,9064638
217	Temple of Aphrodite, Axos	35,3081656	24,8434257
218	Two-room temple, Ancient Aptera	35,4630273	24,1419612
219	Asclepion of Lissos, Lissos	35,2438006	23,7855472
220	Temple of the Great Mother or Rhea, Phaistos	35,0506640	24,8141260
221	Temple of Diktaeus Zeus, Paleokastro	35,1953008	26,2755867
222	Temple of Poseidon Hippios, Ancient Mantineaia	37,6025581	22,4080987
223	Temple of Apollo Pythios, Gortyn	35,0594166	24,9498539
224	Temple at Asklepieion, Ancient Messene	37,1755946	21,9204621
225	Temple in ancient Aegira	38,1284767	22,3781008
226	Temple C (probably dedicated to Apollo), Kos	36,8758176	27,2569010
227	Temple of Savina, Eleusis	38,0411936	23,5387533
228	Temple of Faustina, Eleusis	38,0413944	23,5384100
229	Temple of Pythian Apollo, Pythio	40,0542984	22,2183132
230	Temple of Poseidon Patron, Pythio	40,0544933	22,2185426
231	Athenian's Temple, Delos	37,4005363	25,2669009
232	Temple of Apollo Porinos, Delos	37,4006423	25,2668973
233	Letoon, Delos	37,4017341	25,2669500
234	Dodekatheon, Delos	37,4015447	25,2665484
235	Temple of Dionysus, Delos	37,4010231	25,2683462
236	Later Temple of Dionysus Elefthereus, Athens	37,9698601	23,7277767
237	Heraion, Delos	37,3970371	25,2708359
238	Temple of Zeus Cynthius and Athena Cynthia, Delos	37,3956906	25,2724470
239	Temple of Dionysos Eleuthereus, Athens	37,9699857	23,7277409
240	Temple of Zeus Agoraios, Thassos	40,7802448	24,7133108
241	Temple of Dioskouri, Thassos	40,6049070	24,7425932
242	Temple of Hera, Prodromos, Boeotia	38,2520095	22,9045734
243	Temple of Apollo, Despotiko	36,9704334	25,0140617
244	Temple in Koufonisi	34,9337352	26,1420779
245	Memorial temple in Akanthos	40,3897292	23,8865376
246	Temple in ancient Makynia	38,3561068	21,7249918
247	Temple in ancient Oeniades	38,4113607	21,1945185
248	Small temple of Themis, Ancient Gitana	39,5712975	20,2608947
249	Temple of Asclepius Phthiotides, Thebes	39,2731823	22,7622432
250	Temple of Apollo, Ancient Alasarna	36,7780498	27,1375597
251	Temple of Attalides, Kos	36,8910608	27,2897836
252	Temple of Attaviros Zeus, Rhodes	36,2070107	27,8647653
253	Temple (probably) of Pythian Apollo, Rhodes	36,3371439	27,9208456
254	Temple of Athena Kamirados, Rhodes	36,3349473	27,9210549
255	Temple of Athena Polias, Ancient Ialysus	36,3990184	28,1440907
256	Temple of Aphrodite, Rhodes	36,4459105	28,2273551
257	Temple of Apollo Erethimis, Rhodes	36,3749620	28,0305849
258	Temple of Pythian Apollo, Ancient Karthaia	37,5600651	24,3307169
259	Temple of Apollo Aigletis, Anafi	36,3580884	25,8297767
260	Temple Of Artemis Tavropolion, Nas, Ikaria	37,6219376	26,0597657
261	Temple of Apollo, Skyros	38,9014726	24,5679248

262	Temple of Apollo Roda, Corfu	39,7906860	19,7875758
263	Temple of Artemis Amarysia, Euboea	38,3872803	23,9083727
264	Temple of Mars and Aphrodite, Lenika, Crete	35,2301106	25,7191556
265	Temple in Ancient Koronta	38,5883166	21,1593282
266	Temple of Hercules, Ancient Kleones	37,8174075	22,7713652
267	Temple of Aphrodite Erykini, Peloponnese	37,8179337	21,9300111
268	Temple of Athena and Zeus Soter, Ancient Figaleia	37,3961787	21,8388970
269	Temple of Zeus Hellanios, Aegina	37,7076302	23,4975524
270	Temple of Apollo Karneios, Santorini	36,3622073	25,4806772
271	Temple of Dionysus, Ancient Thira, Santorini	36,3639464	25,4778748

In more detail, the above-mentioned ancient temples will be analyzed in terms of their main characteristics using GIS. More specifically, images from Google Earth Pro® will be used to locate them and calculate their surface areas and their orientations. Also, characteristics such as construction era, preservation state, and column orders will be collected. Finally, the altitudes of their location, distances from the coastline and road network will be calculated, and an attempt will be made to correlate all this data.

The aim of this paper was to locate as much temples as possible all over the country, create maps, study their characteristics and export, understand, and interpret various information. This information is important because it contributes to our understanding of ancient Greek culture and provides new insights into the construction of these remarkable structures. To be more specific, the usefulness of this study is to draw conclusions that could contribute to several scientific fields, such as archaeology, engineering, or geography. For instance, the data from this study could be helpful for a future archaeologist in having a more general idea of the characteristics of an ancient Greek temple when an excavation takes place. Finally, the data and conclusions of this study could be taken into account in a national-level spatial planning by an urban planner.

2. COLLECTION AND PROCESSING OF DATA

2.1. Locating and recording the temples

The recording of the temples was carried out through bibliographical references, websites of the

Ministry of Culture and Sports (MCS), the Ephorates of Antiquities (EphA), as well as the municipalities of the respective regions, and various other electronic sources. Along with the recording of the temples, all the information about their construction characteristics was collected. More specifically, a summary table was created (Tab. 2) containing the information on the name of each temple, its order, its construction date, its current preservation state, its surface area, its orientation and lastly its location. Then, with the help of Google Earth Pro® images, their coordinates were localized in ArcGIS Pro®. For the temples numbered 7, 89, 90, 90, 96, 103, 104, 107, 108, 109, 131, 132, 133, 134, 135, 138, 150, 154, 155, 157, 201, 208 and 218 (tab. 1), the exact location was not possible to determine, and as a result the point/position created for them is approximate, always in accordance with the location indicated by the references. After all the temples were located, the attribute table was merged with the summary table. In addition, the paved and non-paved roads (NAP, 2020), the coastline (CLMS, 2022), the borders (Eurostat, 2022), and the regions of Greece (HSA, 2022) were imported into the Geographic Information System (GIS). Then, the following research was carried out, both for the known characteristics of the temples, and for the characteristics calculated in the GIS.

Table 2. Extract from the summary table of temples.

a/a	Name	Rhythm	Construction era	Preservation state	Area (m ²)	Orientation	Location	Bibliographic reference	Page	URL
...
74	Parthenon (dedicated to Athena), Athens	Doric	5th century BC	Almost entire	69.53 X 72.31	East	Athens (Acropolis)	(Spawforth, 2006)	140	
75	Temple of Artemis, Gortsouli, Mantinea	-	7th century BC	Foundations	14.6 X 4.65	-	On the western slope of Gortsouli hill, in the area of ancient Mantinea	(Mitsopoulou, 2012)	-	http://odysseus.culture.gr/h/2/gh251.jsp?obj_id=6541
...

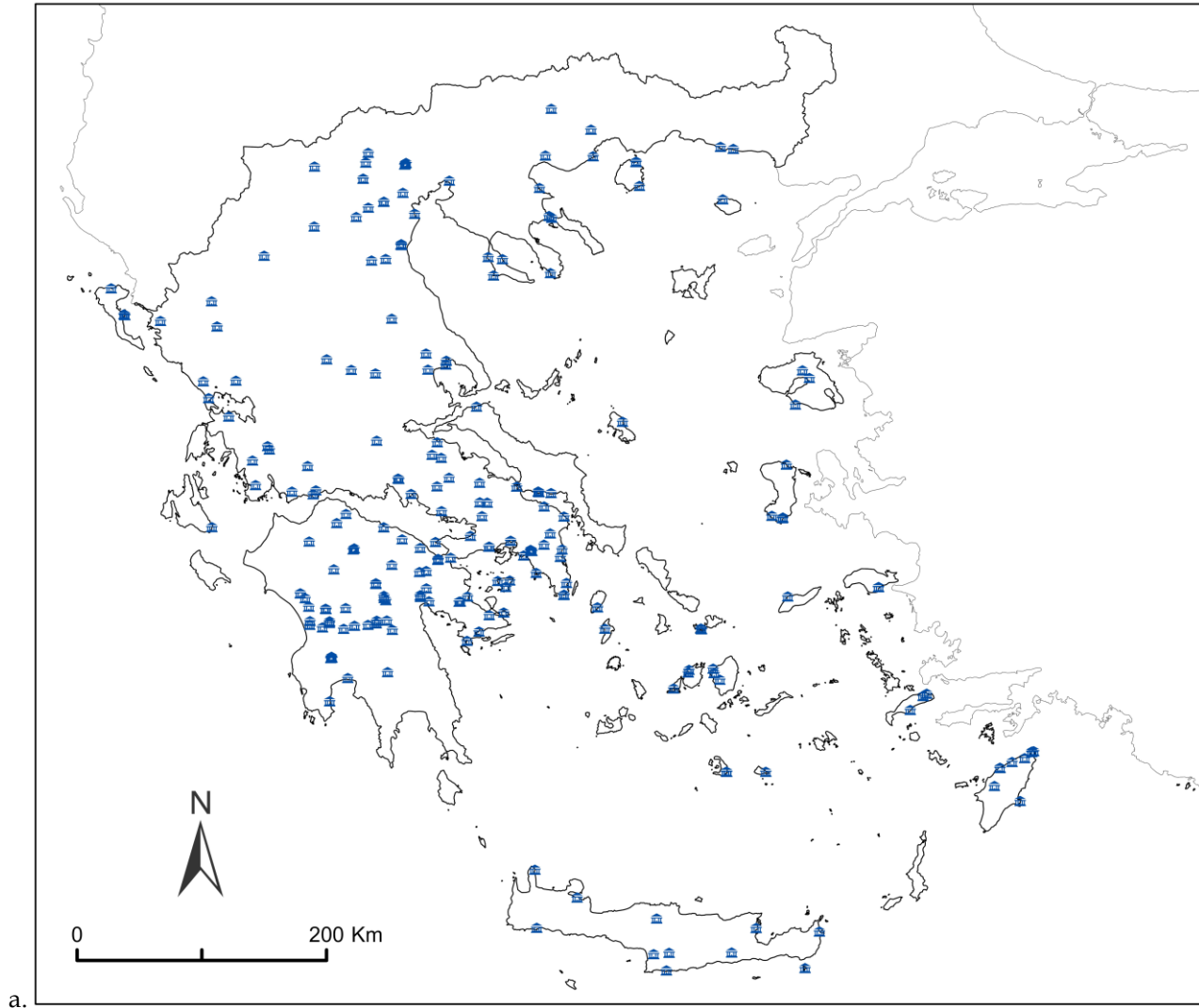
2.2. Google Earth Pro and Georeferencing

For the subsequent processing of the main characteristics of the temples (area, orientation, etc.) images from Google Earth Pro® were used. Images were taken of the temples whose foundations stood out. More specifically, with the command Save Image in Google Earth Pro® all images had been saved. After the images had been exported and saved, they were imported into ArcGIS Pro®. There, they were georeferenced by inserting at least 5 GCPs (Ground Control

Points), whose coordinates (X and Y) were collected from Maps of the National Cadastre (NCMA, 2022). No measurement was carried out in the field.

2.3. Location of the temples

In this section the temples are studied in terms of their location. More specifically, the temples are placed within the regions of Greece (Fig. 2).



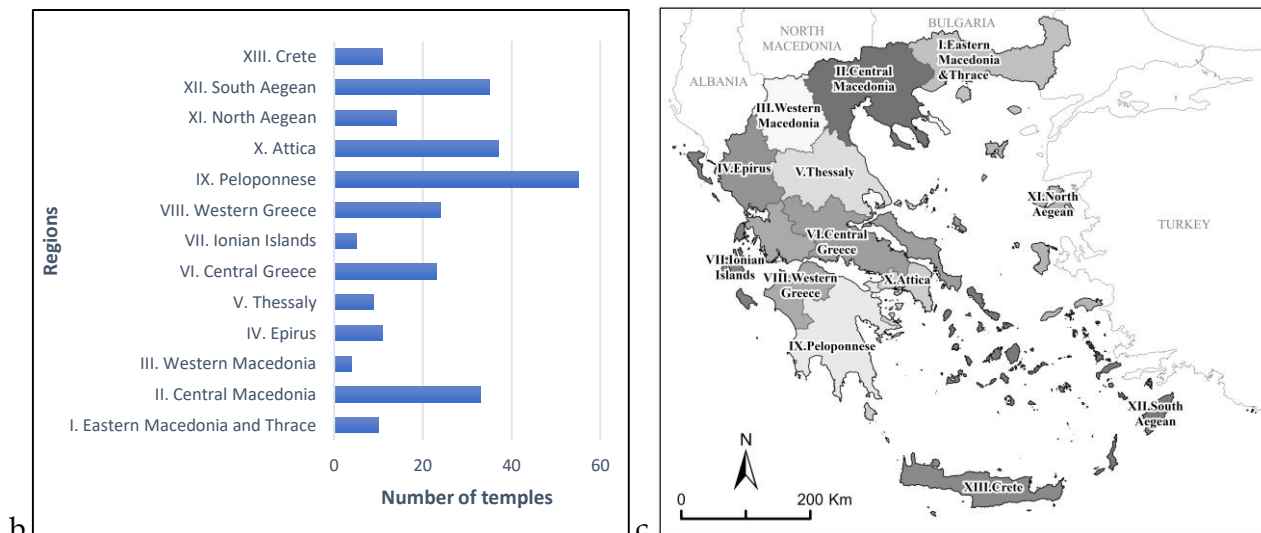


Figure 2. a. The location of the ancient temples, b. The diagram of the distribution of temples, c. The regions of Greece.

2.4. Construction era of the temples

The temples were divided into six categories according to the historical periods. These categories include the Geometric period, the Archaic period, the Classical period, the Hellenistic period, the Roman

period, and another category that was defined with the title "Unknown period", for the temples that have not been determined chronologically. Categorizing the chronology of the temples into centuries was not feasible, as many of the temples are vaguely dated to each historical period (Fig. 3).

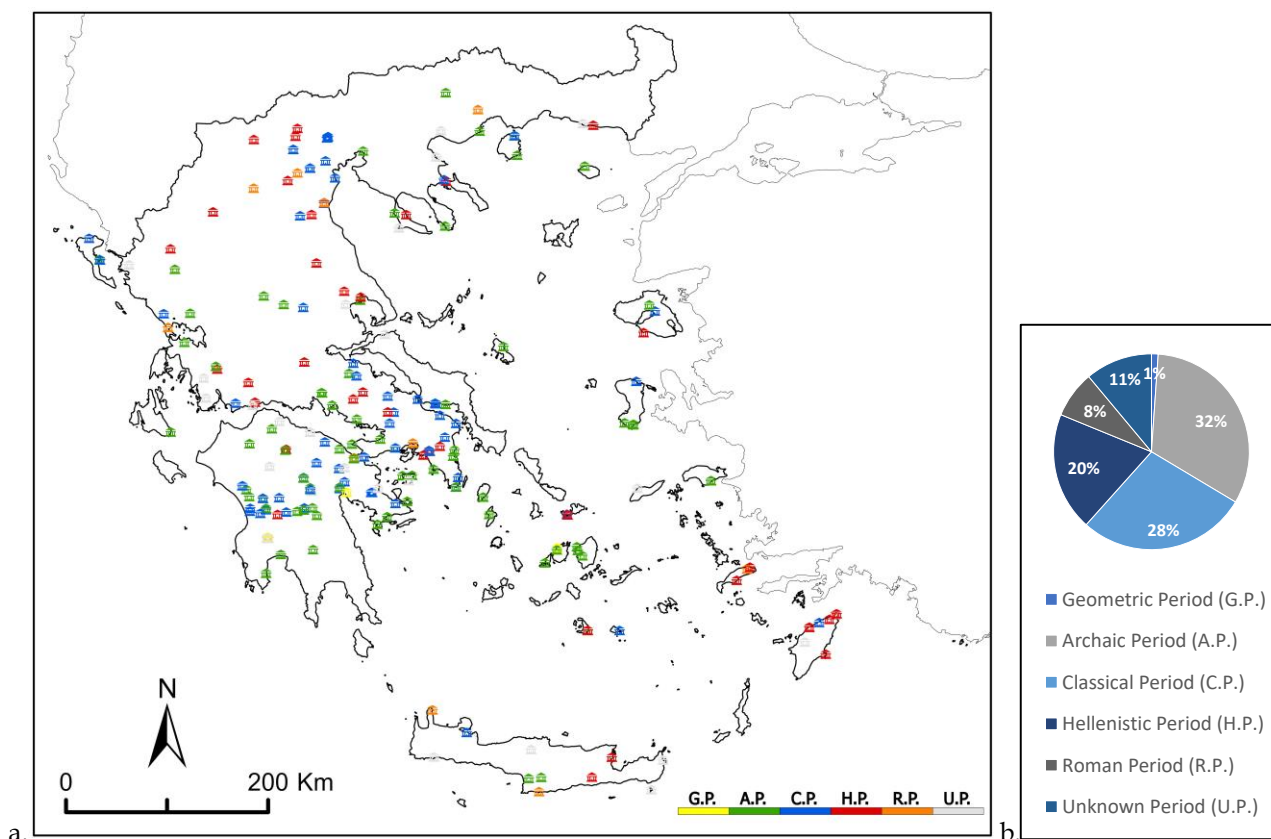


Figure 3. a. The construction era of the ancient temples, b. The diagram of the distribution of temples according to the construction era.

2.5. Preservation state of the temples

The temples were divided into 3 categories with the help of bibliography and according to the existing condition of the temples, as seen from Google Earth Pro® images. The first category is about the bad state of preservation, and it includes remains, ruins, remnants, fragments, and limited temple foundations.

The second category is about the moderate state of preservation, which includes temples that have whole and discrete foundations, have not been abandoned and their archaeological investigation/excavation is in a good state of progress. Finally, the third category is the good state of preservation and is about temples that have been found whole or are largely restored (Fig. 4).

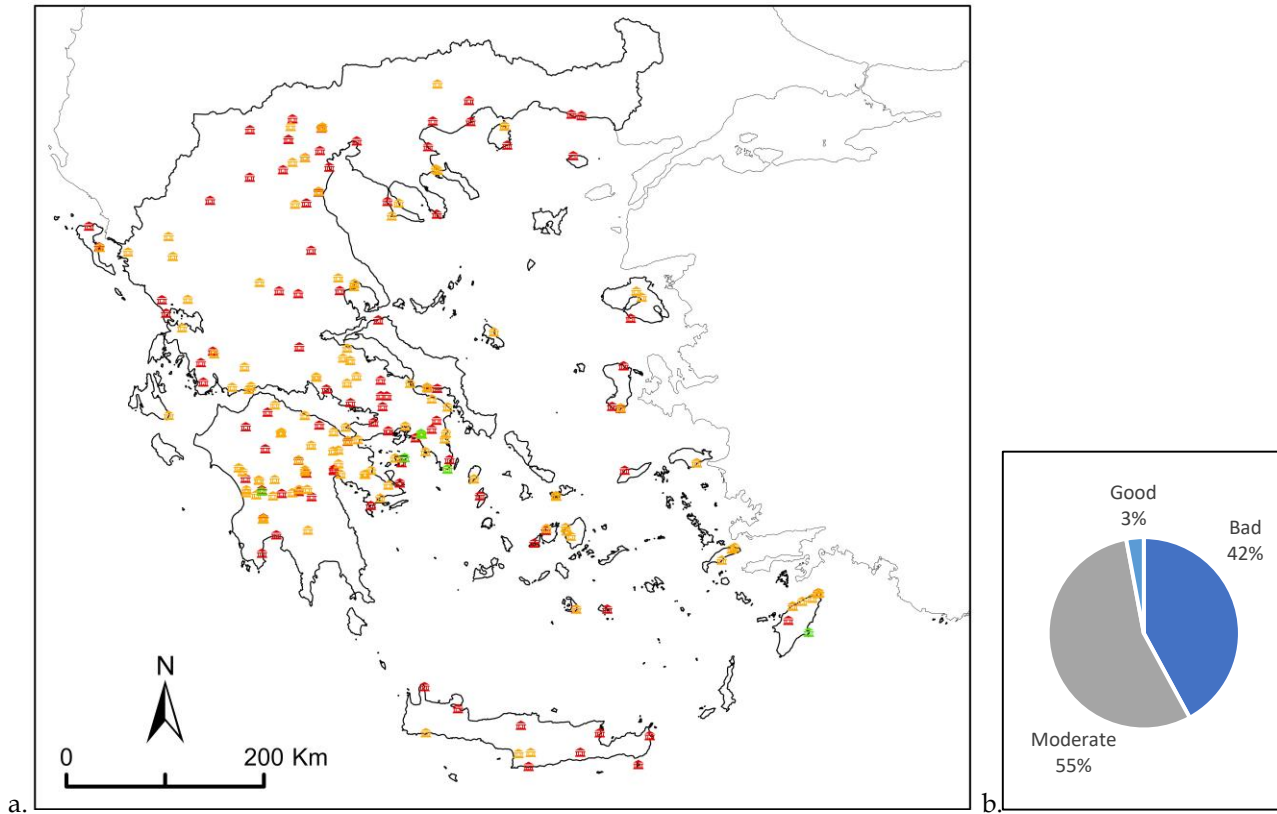


Figure 4. a. The preservation state of the ancient temples, green in good condition, orange in moderate condition and red in bad conservation status, b. The diagram of the distribution of the temples according to their state of preservation.

2.6. Order of the temples

The temples were divided into 4 categories with the help of bibliography: the Doric Order, the Ionic Order, the Corinthian Order, and the Unknown Order. The category "Unknown Order" includes temples whose order is not known from the bibliography or temples built before 600 BC (Fig. 5).

2.7. Distance of the temples from coastline

With the help of ArcGIS Pro®, the distances of the temples from the coastline were calculated. This was possible by executing the Near command. More specifically, the distance of a temple from the coastline was studied with meter accuracy (Fig. 6).

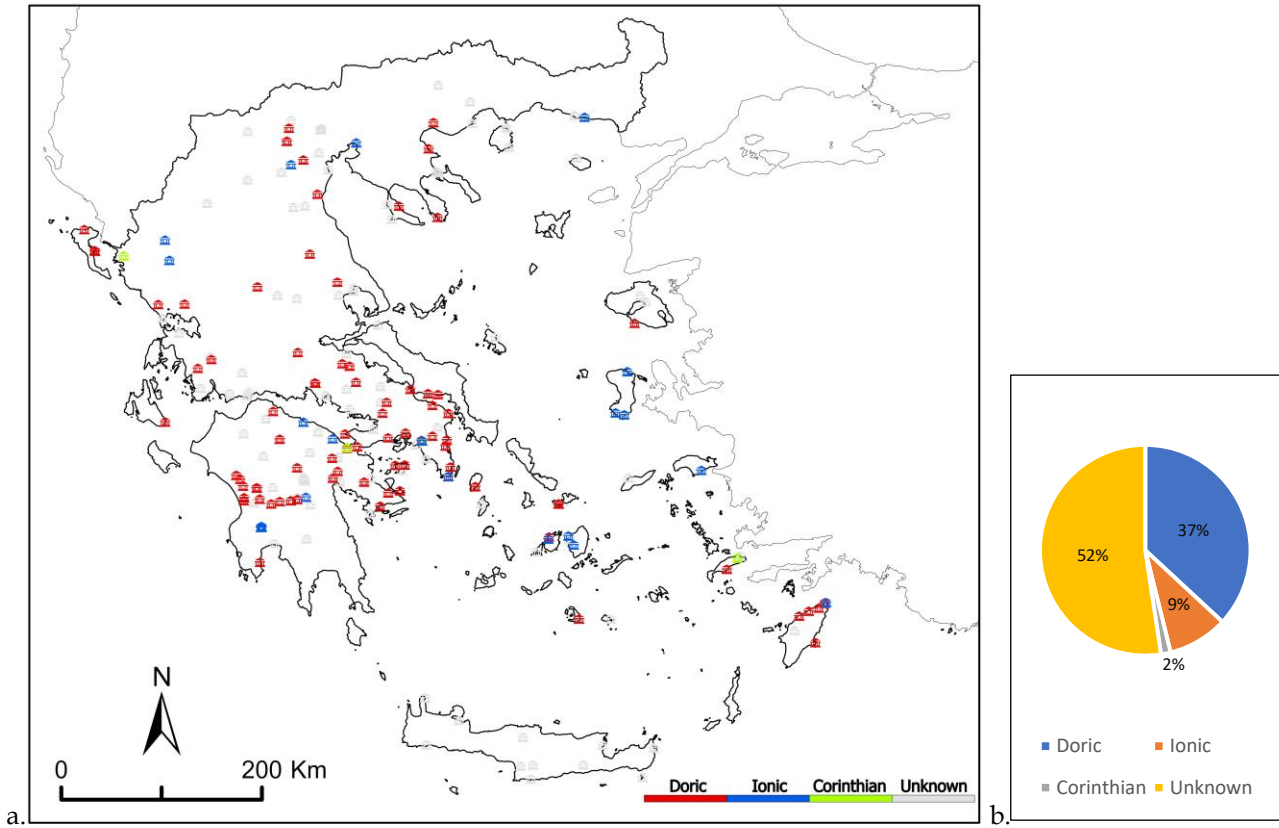


Figure 5. a. The order of the ancient temples, b. The diagram of the distribution of temples according to their order.

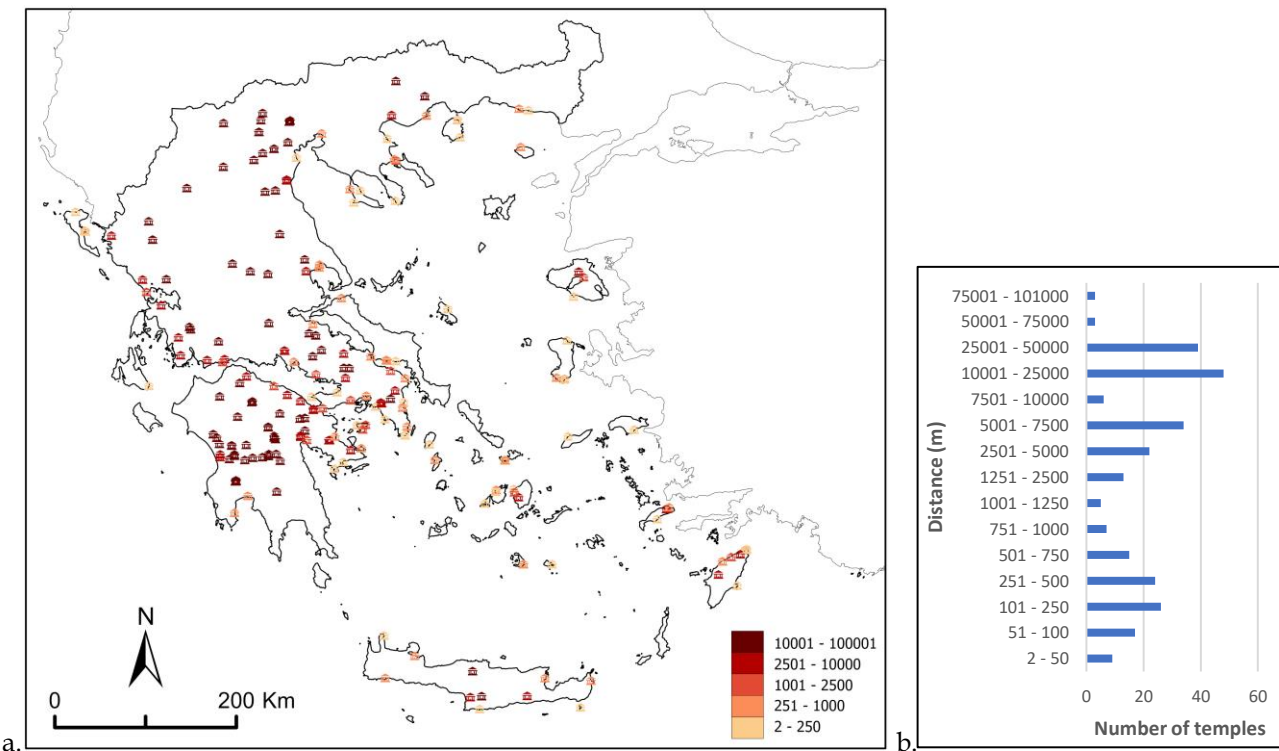


Figure 6. a. The distance (in meters) of the ancient temples from the coastline, b. The diagram of the distribution of temples according to their distance to the coastline.

2.8. Altitude of the temples

With the help of Google Earth Pro®, information was collected about the elevations (Absolute value) of the temples (Fig. 7). More specifically, by letting

the cursor in the desire location (in this case of a temple), elevation showed up in the bottom right corner in the “elev” field.

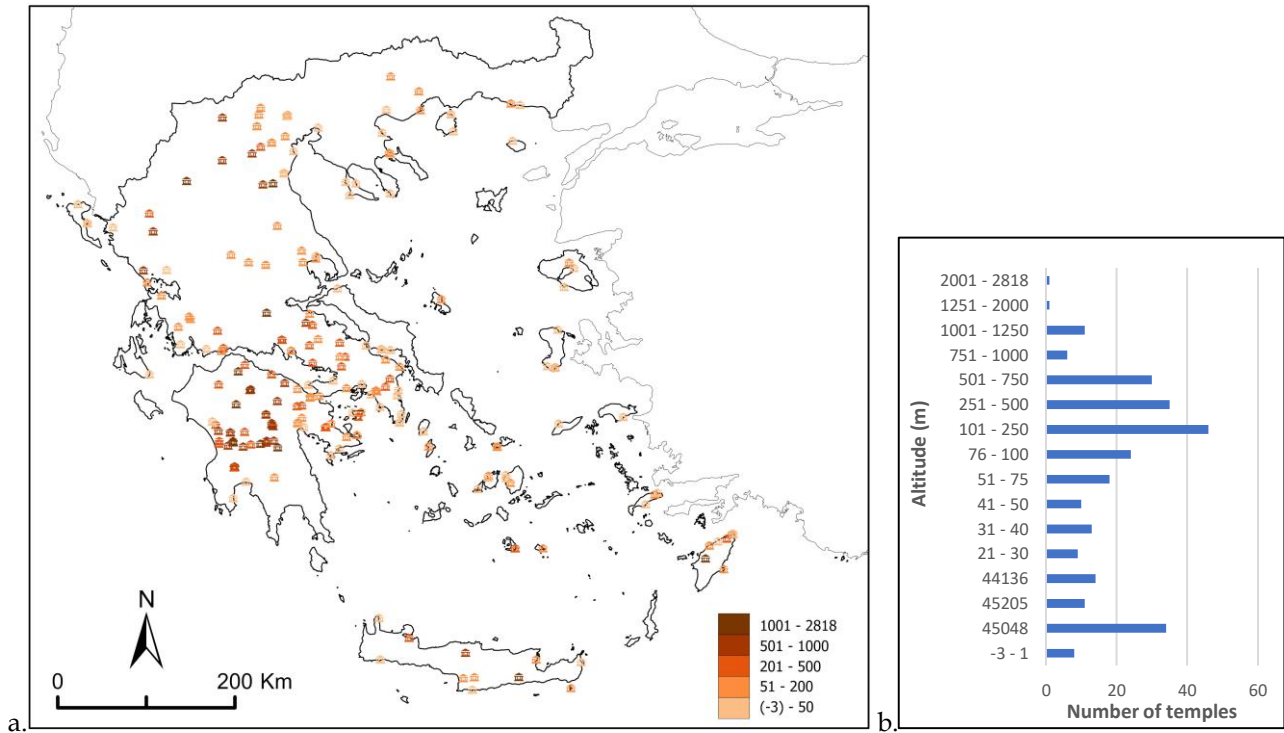


Figure 7. a. The altitude (in meters) of the ancient temples, b. The diagram of the distribution of temples according to their altitude.

2.9. Surface area of the temples

In order to find the surface areas of the temples, initially the perimeter was drawn for each temple according to the georeferenced images from Google Earth Pro® in ArcGIS Pro® and then, the surface area was calculated through the Calculator Geometry function using ArcGIS Pro® (Fig. 8). That was possible and applied to 134 temples out of a total of 271.

The foundations of those 134 temples were visible from the Google Earth Pro® images, while those of the rest they were not, either because the foundations were not visible (or were not present), or because the temples had a canopy installed. For the drawing of the polygon for each temple, the dimensions mentioned in the bibliographic references were also taken into consideration.

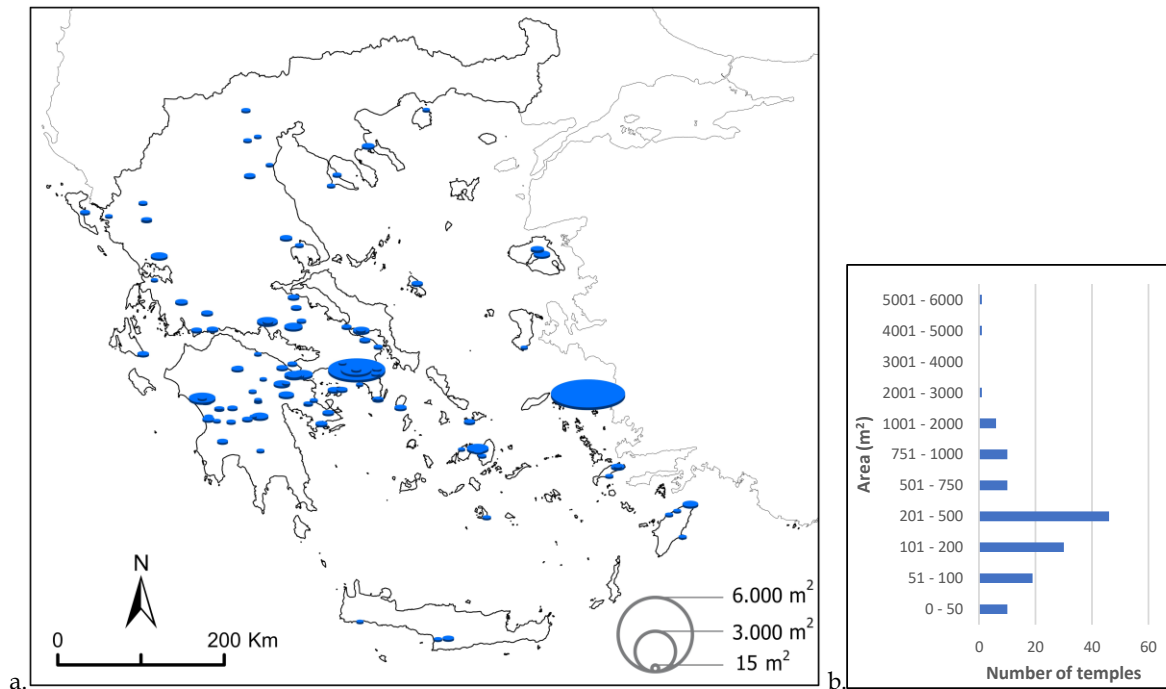


Figure 8. a. The surface area of the ancient temples, b. The diagram of the distribution of temples according to their surface area.

2.10. Orientation of the temples

For the orientation of the temples, the angle created by the geographical north (azimuth) and the

main axis of the temple passing through its entrance was calculated (Fig.9).

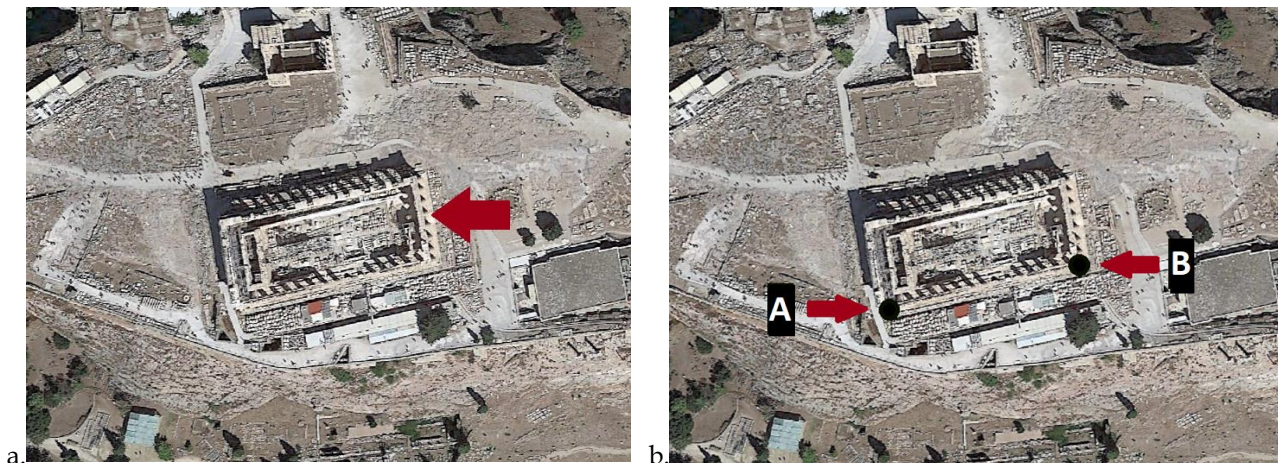


Figure 9. a. The Parthenon entrance to the east (red arrow), b. Input order of points of the orientation line (first point: A, second point: B). (Basemap: Google Earth images)

For this purpose, the direction of orientation of the temple entrances was drawn and then, the angle from azimuth was calculated through the Field Calculator with an expression using ArcGIS Pro[®]. That was applied to 155 temples out of a total of 271. For those 155 temples the orientation line drawing was feasible, as at least one large side of each temple was visible in the Google Earth Pro[®] images. At the same time, the orientations mentioned in the bibliographic references were considered (Fig. 10).

2.11. Distance of the temples from paved roads

To find the distance of the temples from paved roads, the country's paved roads, as they are today, were imported into ArcGIS Pro[®] (Fig. 11) and the distance of each temple from the nearest paved road was calculated by executing the Near command.

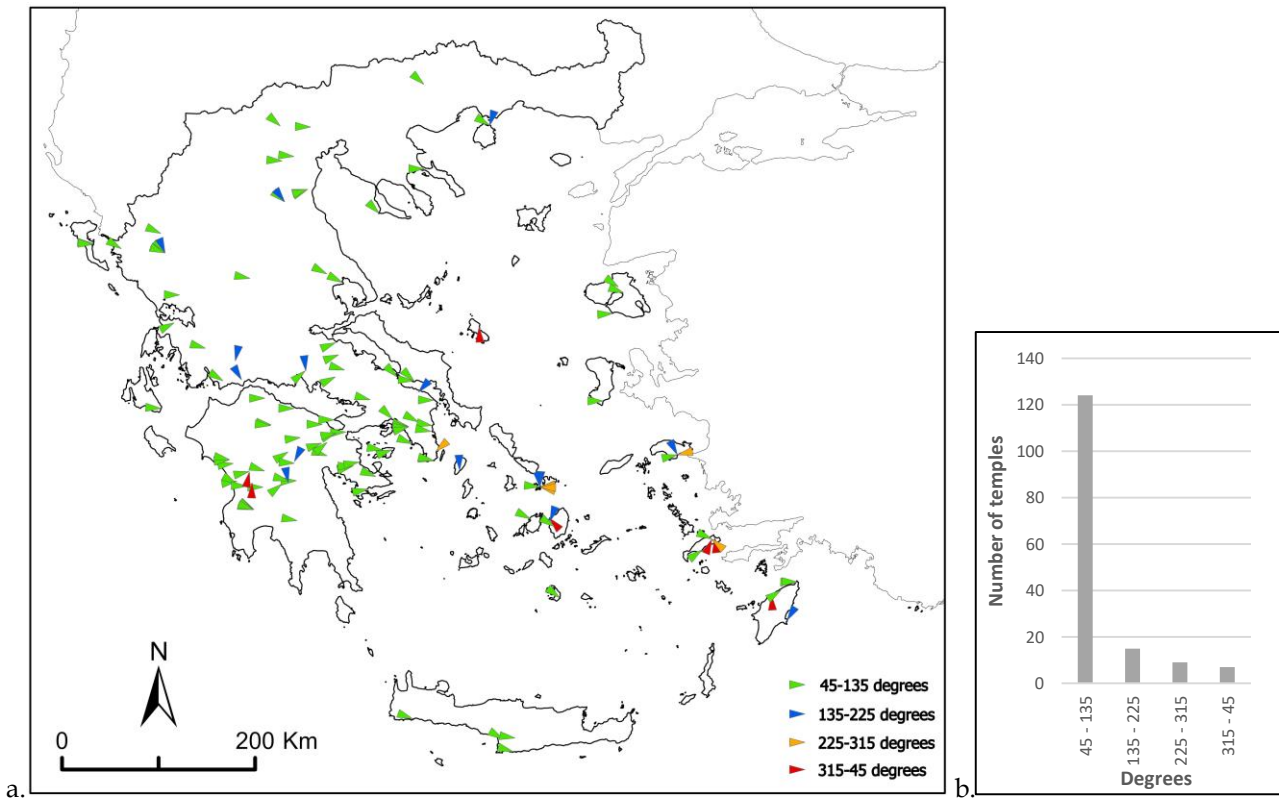


Figure 10. a. The orientation of ancient temples, b. The diagram of the distribution of temples according to their orientation.

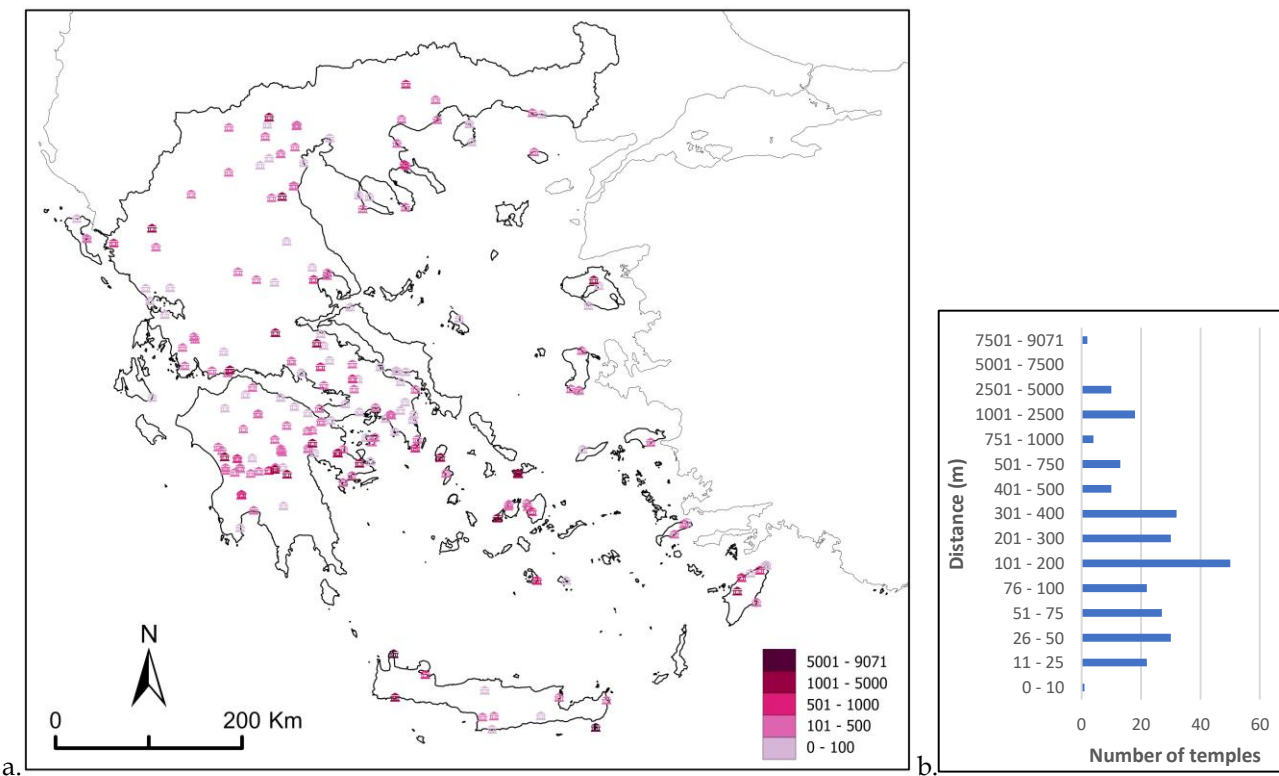


Figure 11. a. The distance (in meters) of the ancient temples from paved roads, b. The diagram of the distribution of temples according to their distance from paved roads.

2.12. Distance of the temples from paved or non-paved roads

By importing the country's paved and non-paved roads, as they are today, into ArcGIS Pro®, the distance from paved or non-paved roads was calculated

by executing the Near command. By non-paved means, the roads that include dirt roads, bike paths, pedestrian walkways, and footpaths (Fig. 12).

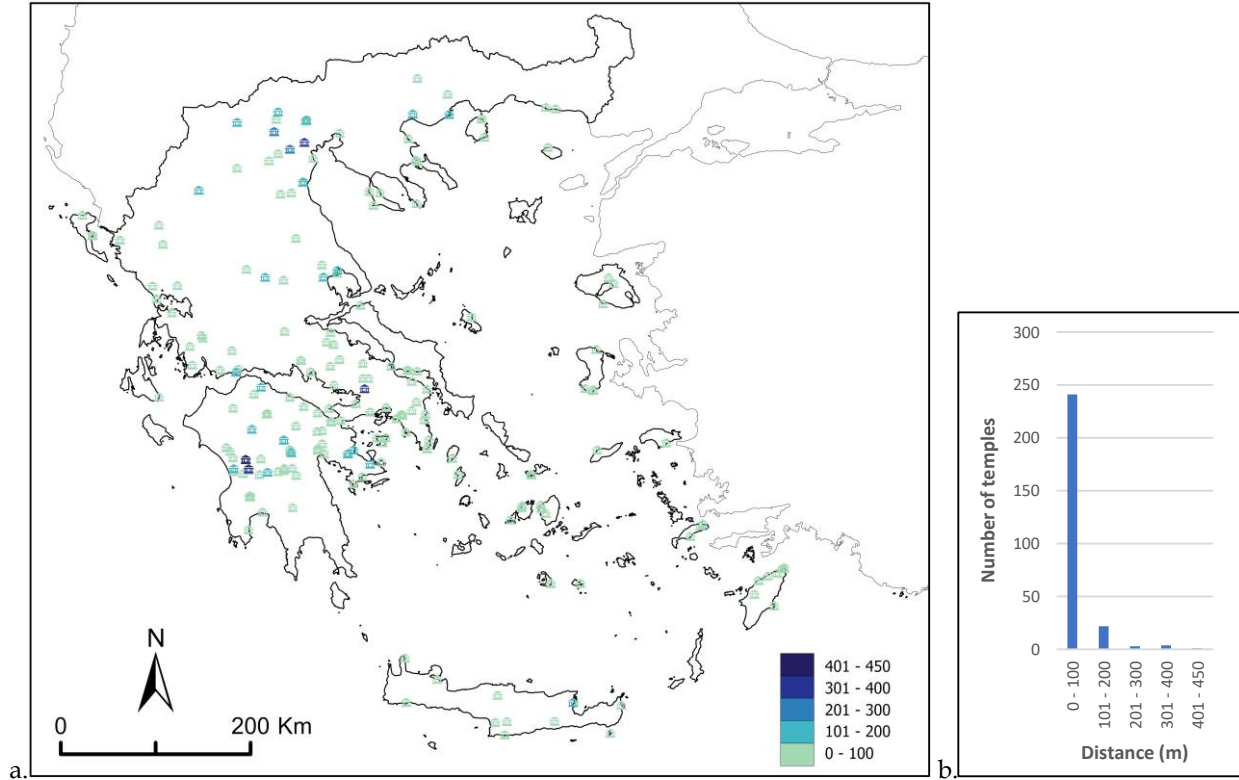


Figure 12. a. The distance (in meters) of the ancient temples from paved or non-paved roads, b. The diagram of the distribution of temples according to their distance from paved or non-paved roads.

3. CORRELATION OF DATA

By combining all the data extracted in the previous chapter, namely the order of the temples, their construction era, their state of preservation, their altitude, their area, their orientation, their distance from

the coastline and their distance from the paved and non-paved roads, an attempt was made to correlate them (Table 3).

Table 3. Correlation of data. Correlation was calculated in a spreadsheet, after all the data of temples' characteristics had been exported from ArcGIS Pro®. The correlation table is of high significance. If a correlation is high, a pattern can be highlighted about the characteristics of temples.

	Order	Construction era	Preservation state	Altitude	Area	Orientation	Distance from coastline	Distance from paved roads	Distance from paved or non-paved
Order	1	0,1744	-0,2382	0,0518	-0,1871	-0,0755	0,0492	0,1240	0,0873
Construction era	0,1744	1	-0,0531	0,0146	-0,1023	-0,0194	0,0168	0,1420	-0,0011
Preservation state	-0,2382	-0,0531	1	-0,0818	0,3333	0,5642	-0,0795	0,0071	-0,1728
Altitude	0,0518	0,0146	-0,0818	1	-0,0819	-0,1437	0,5130	0,0592	0,2231
Area	-0,1871	-0,1023	0,3333	-0,0819	1	0,1772	-0,0813	-0,0658	-0,0677
Orientation	-0,0755	-0,0194	0,5642	-0,1437	0,1772	1	-0,1100	0,1749	-0,2208
Distance from coastline	0,0492	0,0168	-0,0795	0,5130	-0,0813	-0,1100	1	-0,0993	0,2565

Distance from paved roads	0,1240	0,1420	0,0071	0,0592	-0,0658	0,1749	-0,0993	1	-0,0111
Distance from paved or non-paved roads	0,0873	-0,0011	-0,1728	0,2231	-0,0677	-0,2208	0,2565	-0,0111	1

4. DISCUSSION

By examining the maps and diagrams, initially a high density of ancient temples is observed in central Peloponnese (Fig. 2.b, Fig. 2.c). More specifically, in Macedonia, Thessaly and Central Greece, ancient temples are found further inland, while in the rest of the regions, the temples are mainly coastal ones. According to the diagram, (Fig. 2.a) the majority of the ancient temples are located in the Peloponnese while there are few temples in the Ionian Islands and in Western Macedonia.

Regarding the date of construction of the ancient temples (Fig.3.a), most of them (32%) were built in the Archaic Period (Fig. 3.b). The temples of the classical period (76 temples) found mainly in Attica and Peloponnese are second on the list, while the temples of the Hellenistic period (53 temples), with the majority of them found in Central and Western Macedonia, are third on the list. Only 21 temples (8%) were built in the Roman period, while 3 temples belong to the Geometric Period and are located in Peloponnese and Paros. We have no information about the date of construction of about 1/10 of the ancient temples.

As far as the current state of the ancient temples is concerned (Fig. 4.a), unfortunately it is not good. There are only 9 temples in good condition, with the majority of them being in Attica. More ancient temples are in moderate condition (149), and they are distributed mainly in Central Greece, Peloponnese, and Attica. Finally, 114 ancient temples, found all over Greece, are in bad condition (Fig. 4.b).

For the majority of ancient temples there is no information about their order (Fig. 5). However, the vast majority of temples of known order are Doric ones.

As for the distances of the ancient temples from the coastline, they range from 2 meters up to 100 km (Fig.6.b). The longest distances from the coastline can be found in Western Macedonia and Thessaly (Fig.6.a).

Regarding the altitudes where ancient temples are located, they range from -3 m. to 2818 m. (Fig.7.b). 7 temples being at high risk of soil erosion or flooding (due to upcoming sea level rise) are built at altitudes of up to 1 m. (temples numbered 80, 85, 103, 127, 147, 176, 185 in the summary Table 1), while 30% of the

ancient temples are located at a high altitude (100 to 500 m.). Ancient temples at high altitudes are found in the Peloponnese and Western Macedonia (Fig.7.a).

The surface area of the ancient temples ranges from 15 m² up to 5991 m² (Fig.8.b), while the vast majority of them do not exceed 1000 m². In southern Greece there are big ancient temples (Fig.8.a), in contrast to northern Greece, where their size is noticeably smaller.

Regarding the orientation of the ancient temples, most of them face east (Fig. 10.b). The 31 temples (temples numbered 13, 14, 17, 44, 47, 48, 59, 65, 66, 67, 75, 84, 92, 98, 111, 114, 116, 119, 120, 126, 129, 230, 231, 232, 233, 235, 237, 238, 251, 253, 261 in the summary Table 1) that do not face east, are mostly found in the Aegean islands, in the Peloponnese and in Central Greece (Fig. 10.a).

Regarding the distance of the ancient temples from paved roads, the shortest distances are found in the Attica region and the longest in the Aegean islands (Fig.11.a). More generally, 82% of the ancient temples are located close to the road network (up to 500 m.) (Fig.11.b). The distances of the ancient temples from paved or not paved roads do not exceed 428 m. (Fig. 12.b). The most disadvantaged temples in terms of accessibility, with a distance from the road network more than 200 m., are located in the Peloponnese (Fig.12.a).

By analysing all the data (Table 3), two correlations emerge with a satisfactory percentage. 1st: the altitude of ancient temples and their distance from the coastline, and 2nd: the state of preservation of ancient temples & their orientation. The 1st correlation is considered expected, while the 2nd is considered adventurous.

In addition to these correlations, for each group of temples dedicated to the same god, the following factors was studied: altitude, surface area, orientation, and order (Table 4). In particular, there are 5 columns in the table and each of them represents a temple characteristic. For each deity name, the remaining characteristics (altitude, area, orientation, architect. order) are presented in each row. In order to draw the safest conclusion possible, groups of at least 5 temples were studied. By combining this information, various conclusions were drawn for each group.

Table 4. Correlation table of 8 temple deities names with other characteristics.

DEITY NAME	ALTITUDES (Absolute, m)	AREAS (m ²)	ORIENTATION (% the number of temples) (North : N, South : S, East : E, West : W)		ARCHITECT. ORDER (% the number of temples) (Doric : D, Ionic : I, Corin- thian : C)
Zeus	445	865	E :	100	D : 72,73
			S :	0	I : 18,18
			W :	0	C : 9,09
			N :	0	
Hera	166	1372	E :	85,71	D : 83
			S :	14,29	I : 16
			W :	0	C : 0
			N :	0	
Athena	251	488	E :	73,33	D : 78,95
			S :	20	I : 21,05
			W :	0	C : 0
			N :	6,67	
Poseidon	234	527	E :	66,67	D : 100
			S :	33,33	I : 0
			W :	0	C : 0
			N :	0	
Artemis	343	161	E :	93,33	D : 76,92
			S :	6,67	I : 23,08
			W :	0	C : 0
			N :	0	
Apollo	154	487	E :	73,08	D : 85
			S :	3,85	I : 15
			W :	7,69	C : 0
			N :	15,38	
Asclepius	174	277	E :	88,89	D : 100
			S :	0,00	I : 0
			W :	0,00	C : 0
			N :	11,11	
Dionysus	85	266	E :	71,43	D : 100
			S :	14,29	I : 0
			W :	14,29	C : 0
			N :	0	

According to the above table (Table 4), as for the temples of Zeus we see that they are located at an average altitude of 445 m, their average surface area is 865 m², all of them face east (no other group of ancient temples dedicated to the same god is 100% east oriented), and their order is mostly Doric, sometimes Ionic and in a few cases Corinthian (no other group of ancient temples dedicated to the same god has such variety). In conclusion, the temples of Zeus were

built in semi-mountainous areas and their construction strictly imposed an eastern orientation. Moreover, the variety in the orders highlights the cultural diversity of ancient Greece and the timelessness of the worship of the deity. Last but not least, the large surface area shows the importance of Zeus for the ancient Greeks.

Regarding the temples of Hera, they are located at a fairly low altitude of 166 m (average), their average

surface area is 1372 m² (the largest of all the groups of temples dedicated to the same god), their orientation is mostly east and, in some cases, south, and its order is mostly Doric and to a lesser degree Ionic. In conclusion, the temples of Hera were built in lowlands, they mostly face east, their order is mostly Doric, and their very large surface area is mainly due to the largest -according to Herodotus- ancient temple in Greece, Heraion of Samos. (If this temple was not taken into account, the average surface area would be 448 m²).

Regarding the temples of Athena, they are generally found at a relatively low altitude (251 m average), their average surface area is 488 m², their orientation is mostly east and less south, and their order is mostly Doric, to a lesser degree Ionic and not at all Corinthian, a common pattern found in all the temples. In conclusion, the temples of Athena are located in semi-mountainous areas, their construction imposed an east orientation (although in some cases the orientation is south), their order follows again mainly the classical trend of Doric and to a lesser degree of Ionic order, and finally, their surface area shows the great importance the ancients gave to this deity.

Regarding the temples of Poseidon, they are located at an average altitude of 234 m, their average surface area is 527 m², their orientation is 2/3 east and 1/3 south, while their order is always Doric. In conclusion, the temples of Poseidon are located in semi-mountainous areas, although he is God of the sea, they have the smallest percentage of east orientation (only 2/3) compared to other temples (perhaps due to a deliberate choice of the ancient Greeks), while the fact that their order is always Doric may be due to the lack of timelessness of the worship of Poseidon. Finally, the large surface area is probably due to the great importance of Poseidon as God.

Regarding the temples of Artemis, they are built at an average altitude of 343 m, their average surface area is only 167 m² (they have the smallest surface area compared to the rest of the temples), their orientation is east (with a small exception of few temples that face south), and finally their order is mainly Doric and to a lesser degree Ionic (again, there are not any Corinthian temples of Artemis). In conclusion, the temples of Artemis were built in semi-mountainous areas, their construction imposed an east orientation (the percentage of ancient temples of Artemis with south orientation is negligible), the order follows the trend of the time (the majority of ancient temples are Doric ones with the Ionic ones being the minority), and finally the size of their surface area shows the trend for smaller temples in the time of their construction.

Regarding the temples of Apollo, they are located at an average altitude of 154 m, they have an average

surface area of 487 m², their orientation is mainly east, (there are some temples that face north and only a few that face west and south (no other group of ancient temples dedicated to a specific god has samples of all 4 orientations), and their order is Doric and to a lesser degree Ionic. In conclusion, the temples of Apollo were built in lowland areas, there were no strict rules regarding their orientation (a unique fact), they follow the classical trend of the Doric and Ionic order, and finally the relatively large size of their surface area also shows the great importance of the worship of Apollo.

Regarding the temples of Asclepius, they are at an average altitude of 174 m, their average surface area is 277 m², their orientation is mainly east and to a lesser degree north, and their order is always Doric. In conclusion, the temples of Asclepius are located in lowlands, they mostly face east and, their construction strictly imposed the Doric order. Finally, their relatively small surface area is perhaps due to the smaller "importance" of that god.

Finally, regarding the temples of Dionysus, they are located at very low altitudes, - average altitude just 85 m - (they are built at the lowest altitudes compared to the rest of the temples), their average surface area coverage is 266 m², their orientation is mainly east and to a lesser degree south and west, and finally their order is exclusively Doric. In conclusion, the temples of Dionysus were built in lowland areas, their orientation varies, their universally Doric order perhaps reflects their, not so long, "life span", while finally their relatively small average surface area probably shows the smaller "importance" of that god, always relative to the rest of the ancient gods.

5. CONCLUSIONS

Through the GIS, geospatial data of ancient temples can be stored, analyzed, processed, correlated, and finally utilized in combination with bibliographic research. Making full use of the correlation of data can be the tool for drawing various important conclusions. In this particular paper, the majority of ancient temples found are in the Peloponnese and Attica, while most ancient temples were built in the Archaic Period. Doric order temples dominate in Greece, while their altitude ranges from -3 to 2818 m with the majority not exceeding an altitude of 750 m. Their distance from the coastline varies from 2 m to 100 km, and most of them are located further inland (up to 50 km from the coastline). Regarding their surface area, it varies from 15 m² up to 5991 m², and in the majority of the cases the temples are not very big. Furthermore, most ancient temples have an east orientation (45 to 135 degrees).

In general, for the first time, an effort has been made to record and collect as many ancient temples

as possible in Greece on a large scale. This was done in order to study several characteristics and create maps and diagrams with the assistance of GIS. As a result, overall conclusions were drawn. For instance, conclusions were made about their surface area and the relation of this to their location. All of this data is of high value and could be used for achieving specific goals such as protecting temples from natural disasters or improving their accessibility. For example,

with proper planning, the temples could be protected from a possible flooding, thus, our cultural heritage is preserved. Additionally, by shortening the distance from paved roads, the temples could more accessible, especially for those with disabilities. To sum up with, all these factors will significantly contribute to not only the sciences but also the state in general to make more accurate decisions.

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