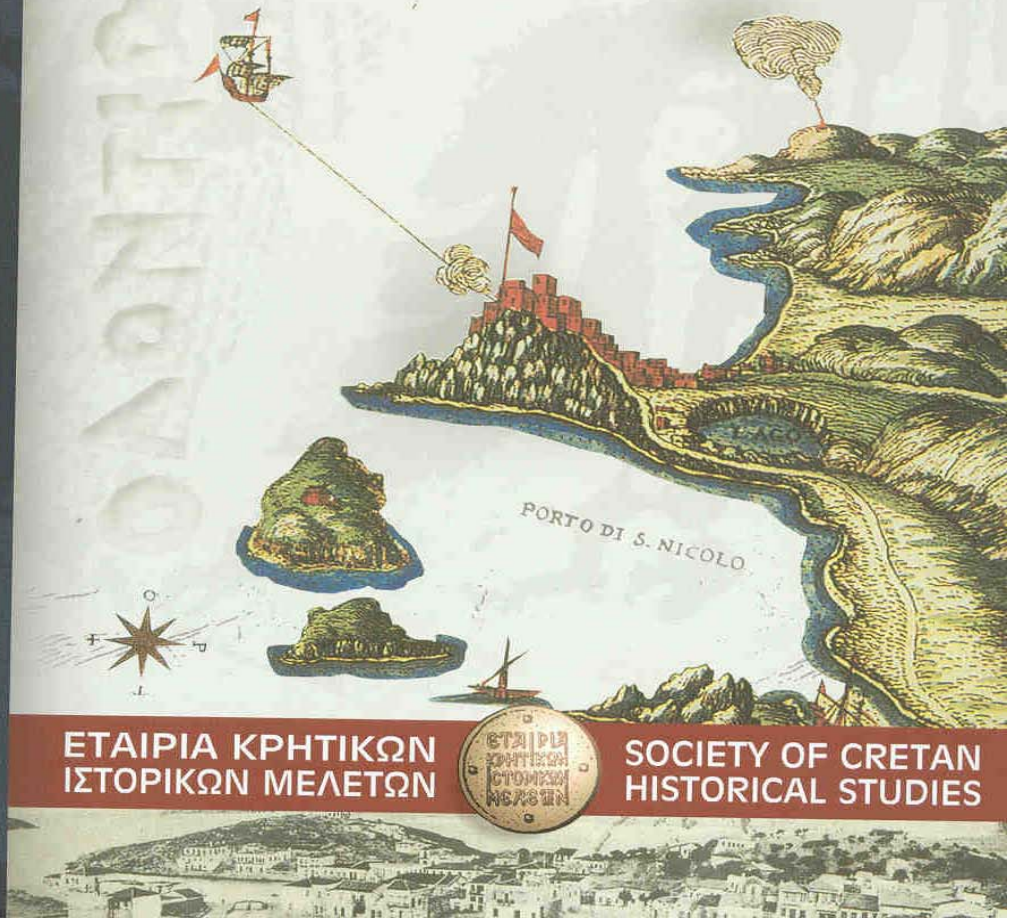
θ' Διεθνές Κρητολογικό Συνέδριο

9th International Congress of Cretan Studies

ΕΛΟΥΝΤΑ 1-6 ΟΚΤΩΒΡΙΟΥ 2001
ELOUNDA 1-6 OCTOBER 2001

ΥΠΟ ΤΗΝ ΑΙΓΙΔΑ ΤΟΥ ΥΠΟΥΡΓΕΙΟΥ ΠΟΛΙΤΙΣΜΟΥ ΚΑΙ ΤΟΥ ΔΗΜΟΥ ΑΓΙΟΥ ΝΙΚΟΛΑΟΥ



ΕΤΑΙΡΙΑ ΚΡΗΤΙΚΩΝ ΙΣΤΟΡΙΚΩΝ ΜΕΛΕΤΩΝ

SOCIETY OF CRETAN HISTORICAL STUDIES

PEAK SANCTUARIES IN THE MINOAN CULTURAL LANDSCAPE*

Steven Soetens[1, 2], Apostolos Sarris[1], Sofia Topouzi[1]

1. Laboratory of Geophysical-Satellite Remote Sensing & Archaeo-environment, Institute for Mediterranean Studies, Foundation of Research & Technology, Hellas (FORTH), Nik. Foka 130, P.O. Box 119, Rethymnon 74100, Crete, Greece, ssoetens@yahoo.com, asaris@ret.forthnet.gr, topouzi@students.phl.uoc.gr
2. Département d'Archéologie, Université Catholique de Louvain, Place B. Pascal 1, 1348-Louvain-la-Neuve, Belgium.

INTRODUCTION

Peak sanctuaries are distributed unevenly over the island of Crete. They date from the end of the Early Minoan period to the beginning of the Second Palace Period, and can be found on or close to mountain peaks. They were identified as sanctuaries because of the cult related finds that were found or excavated at their location.

"The sanctuary should be seen from the region it served" and *"it should 'see' that region"*. This is only one of the many topographical characteristics defined by Alan Peatfield in his 1983 study of Minoan peak sanctuaries[1]. Intervisibility in between the peak sanctuaries was understood as "*the expression of ritual unity that may have transcended political boundaries*[2]". Nowicki grouped the intervisible peak sanctuaries in three zones, connected to the physical geography of the island[3].

GIS is a new tool that can anchor the peak sanctuaries and their geographical data on a map, and it can be used to create a model that is capable of analyzing the location of these mountain sites, based on both environmental and cultural variables. It is therefore possible to better understand the choice of location, the use and the meaning of the peak sanctuaries in the broader Minoan cultural landscape.

PEAK SANCTUARIES, ENVIRONMENT AND CULTURAL LANDSCAPE

Most of the peak sanctuaries do not have any architectural remains, and identification as a peak sanctuary has been made on the evidence of finds and

* Acknowledgments: The authors would like to thank the Institute of Aegean Prehistory for financial support of the project "Building a cultural landscape model of Minoan peak sanctuaries through a GIS approach", part of the wider framework "A Topography of Power. Studies on the Political Structures of Minoan Crete and Etruria" (http://www.fltr.ucl.ac.be/FLTR/ARKE/Arka/accueil/fsr.html). Very much appreciated were the conversations with Dr. A. Peatfield and Dr. K. Nowicki on the subject, and the help of several friends during the GPS (Global Positioning System) fieldtrips, more specifically: Tim Cunningham, Spyros Dimanopoulos, Xenophon Frantzis, Anthi Giourou, Vangelis Kevgas, Despina Sgouraki, Eleftheria Tamiolaki, Achilleas Tripolitsiotis, Klio Tzanaki, Katerina Tzanetea. Many thanks to Freya Evenson for the final editing comments.

[1] Peatfield 1983, 274-276.

[2] Peatfield 1994, 25.

[3] Nowicki 1991, 143-145. He suggests tentatively at a West peak sanctuary state and an East Siteian "states".

topography. About 25 sites respond positively to the criteria set by Rutkowski, Peatfield and Nowicki[4]. These criteria are the site's closeness to peak, intervisibility between sites, proximity to contemporary settlements, and the presence of a specific artefact assemblage (figurines, pottery, pebbles from the river or sea).

Before these criteria were defined, more sites were identified as peak sanctuaries. They are either located near mountain peaks with unpublished, wrongly dated or not further specified archaeological evidence or have no relation with a mountain peak, but just produced many figurines[5].

For the purpose of this study, we consider only the sites located close to peaks, in order to isolate the peak sanctuary as a geographically determined site, deliberately located in a specific cultural and environmental landscape. The absence of archaeological evidence at these potential peak sanctuary sites does not mean it was never there; many sites have not been fully published (see footnote 4) and in addition a large number of these sites has suffered from bad weather and soil erosion, looting and destruction army, church, and antenna constructions. Even some of the 25 positively identified peak sanctuaries which were relocated during a recent field visits (1999-2001), were found to be lacking in the appropriate evidence.

So even if the archaeological evidence is weak, the topography and environment of a site can be a strong argument for the identification of a peak sanctuary: peak sanctuaries are sites located on or close to a mountain peak, with at least one gentle slope within an area of human exploitation and are visible from other peak sanctuaries[6].

These environmental characteristics, however, must be used in conjunction with the archaeological data[7]. Therefore, in the creation of a working model for the purposes of this project, an archaeological database was constructed which includes published material on the chronology, coordinates, archaeological finds, excavation data for each positively identified peak sanctuary and candidate sites. The database also incorporates other Minoan sites, including settlements, palaces, harbors, burial sites, guard posts, production centers, furnishing these sites with chronology and coordinates. It adds a cultural factor to the model and, when integrated in the GIS, can better explain the location and the function of the peak sanctuary in Minoan society.

GIS: MODELING AND ACCURACY

GIS is the most powerful tool now available for modeling complex archaeological phenomenona such as the peak sanctuaries. Thiessen polygons[8],

[4] Rutkowski 1986, 72-98; Rutkowski 1988, 74-77; Peatfield 1987, 90-92; Peatfield 1990, 117-119; Nowicki 1994, 33-35 (already noticed by Faure 1969, 176; 1972, 392); Peatfield 1994b: Only 14 peak sanctuaries have been excavated (mostly rescue excavations by Davaras), of which only three are extensively published; Petsofas (excavated by Myres in 1903, and Davaras in 1971): Rutkowski 1991, *passim*; Iuktas: (excavated in 1909 by A. Evans, by Karetsou from 1974 to 1985) Karetsou 1974, 1975, 1976, 1977, 1978, 1980, 1981a, 1981b, 1984a&b, 1985; Atsipadhes: Peatfield 1992, Morris & Peatfield 1995, Nowicki 1994, 41-42, Peatfield 1991, 1992b, 1993, 1994b&c, 1995, 1996.

[5] Faure 1967, 114-150; Faure 1969, 174-213; Faure 1972, 389-426. Lately some other candidates have been suggested by Watrous 1994, 393-403, corresponding more or less to the criteria mentioned above.

[6] Peatfield 1990, 120.

[7] Gaffney & Van Leusen 1995, 367-369.

[8] This method approximates the territory associated with a site by bisecting the distance between the site and a similar neighbouring site. The intersection of these lines forms a pattern of irregularly shaped "Thiessen Polygons".

Central Place Theory[9] and the X-tent model[10] have proved their value indicating the socio-political boundaries of territories and hierarchies, but should be updated to take into account the limits of human activity in the physical landscape. Natural boundaries (mountain ranges, rivers or the sea), environmental characteristics (presence of fertile soil or pastureland) and visibility are not considered by these models. The GIS can integrate this information together with topographical variables (elevation, aspect and slope) and the archaeological database.

In the construction of the GIS model for the Minoan peak sanctuaries, the first goal was to accurately position the peak sanctuaries and the other sites with xyz coordinates in a three-dimensional map of Crete. This map includes different layers, such as the geology, land use, land capability of the whole island, but also satellite imagery and aerial photographs of selected areas.

The accurate positioning of the peak sanctuaries and other archaeological sites was accomplished using the Differential Global Positioning System[11] (DGPS), satellite imagery, aerial photographs and digitizing techniques.

Environmental information was included by the digitization of geological, land use and land capability maps[12].

The Digital Elevation Model[13] (DEM) provides information on the elevation of the studied surface (the island of Crete) and further analysis of this DEM results in thematic maps related to the orientation of the slope (aspect), the degree of the slope (slope), and the visibility of an area from any given viewpoint (viewshed). The DEM can present the model in three dimensions and in a fly-through simulation mode.

Several limitations exist in the constructed model, mainly originating in the availability of the data.

The archaeological published data do not represent a complete spatial distribution of the Minoan settlement pattern, but rather the distribution of archaeological excavations and surveys. For a more complete image of the local distribution of sites and diachronic use of landscape, only an intensively surveyed area can be analyzed for optimal results. Secondly, due to the great size of the studied area, i.e. the whole of the island of Crete, the digitized maps and the DEM have a relatively low resolution (see footnotes 12 and 13), which leaves an error margin. Furthermore today's land use and land capability have changed from the past[14] and basically the proposed Minoan cultural landscape model is draped on a modern environmental background.

Nevertheless, the constructed model is sufficiently accurate to analyze the visibility from and to the peak sanctuaries and their wider topographical and environmental characteristics.

---

[9] This technique, developed by W. Christaller in the 30's argues that sites are evenly distributed over a region, spatially organized in hierarchy of importance.

[10] The area influenced by a site is proportional to the size of that site.

[11] Topouzi 2001, in press.

[12] Geology (ΙΓΜΕ), land use and land capability (Υπουργείο Γεωργίας – Δασολογική Υπηρεσία) were digitised from maps of scale 1:50000, resulting in a low resolution for the environmental layers (maps of 1:50000).

[13] Digital Elevation Model (DEM) is derived from stereoscopic SPOT images and has an accuracy of a pixel size of 50 x 50m.

[14] Kvamme 1997, 1; Rackham & Moody 1996, 39: *The change to a "Mediterranean" climate seems to have developed gradually during the Bronze Age*…Generally agreed upon: Crete is much greener now than it was in the Minoan period (pers. comm. D. Mylona). A much larger bibliography exists on this subject.

VISIBILITY

There are three different directions of view, which should be considered: the region visible from any given peak sanctuary, the peak sanctuaries visible from this region, and the intervisibility in between peak sanctuaries. Intervisibility was interpreted as the "ritual transcendence of political boundaries"[15]. From below we see "*…the most prominent mountain*" and therefore "*the best landmark for worshippers to travel to"*[16]. The amazing view from the peak sanctuaries themselves over the surrounding area has been interpreted as the need of the 'deity' to see the area from which the faithful came[17]. In addition to the religious character of these sites, their relationship with the palaces[18] points to a political meaning.

The area visible from each peak sanctuary or from an intervisible peak sanctuary group can be understood as a political unity and thus the uneven distribution of peak sanctuaries on Crete and the evolution of the distribution of visible settlements from the Proto- and Neopalatial periods can be closely related to the evolution of political control in these periods.

The most obvious initial observation which can be made based on the GIS model of the Cretan landscape is the density of peak sanctuaries and their viewshed in the eastern part of the island, and the absence of any major site or peak sanctuary to the west (Figure 1: cumulative viewsheds for Proto- and Neopalatial peak sanctuaries)[19].

Analyzed by period, the distribution of protopalatial peak sanctuaries can be characterized as unevenly balanced. The dense network of peak sanctuaries in the East Cretan mountains seems to lack any clear hierarchy, while the opposite is the case for the group of Central Cretan sites, where the peak sanctuary of Iuktas is clearly of a higher rank and dominates the surrounding peak sanctuaries of Kofinas, Pyrgos Filiorimos, Megalos Rozitis Lilianou and Karfi. In Western Crete, only three sites in the Rethymnon area (Vrysinas, Spili Vorizi and Atsipades Korakias) can be positively identified and are intervisible. This uneven distribution may in part be explained by a lack of research in certain areas, suggesting that not all peak sanctuaries in these areas have been found. It is also possible that the uneven distribution patterns are related to a similarly uneven settlement pattern.

Driessen has recently argued that in east Crete the settlement pattern of the protopalatial period developed much more towards nucleation, mainly around central settlements such as Petras, Palaikastro, and Kato Zakros, while the situation in central Crete seems to present a more dispersed pattern, with a large number of settlements both in the coastal agricultural and inland, dominated by the palatial centres of Knossos and Phaistos[20]. The distribution and intervisibility of contemporary peak sanctuaries can further add to this picture: The high intervisibility of early

[15] Peatfield 1994, 25.
[16] Peatfield 1983, 275.
[17] Peatfield 1983, 276.
[18] Peatfield 1987, 89-93.
[19] Viewshed analysis can verify visual links since it presents the visible terrain from a given point. For each of the positively identified peak sanctuaries, a viewshed was created with a 50km radius. A viewshed is a binary raster, which identifies the visibility of every pixel within the given radius from the viewpoint (visible =1, not visible = 0). The viewsheds from all protopalatial peak sanctuaries were overlaid, as well as the neopalatial ones in two additive viewsheds. The sum of these overlaid viewsheds results in cumulative viewsheds. These maps not only reveal which areas are visible from the peak sanctuaries, but also the number of peak sanctuaries from which a specific area is visible.
[20] Driessen 2001 (in press).

Protopalatial peak sanctuaries in east Crete may have served to unite the settlements in religious practice, as is evidenced in the finds from the peak sanctuaries, but at the same time their non-hierarchical distribution corresponds to a landscape of many polities with nucleated settlements.

Similarly, in central Crete, where society seems to have reached a higher level of hierarchy under the dominance of Phaistos and Knossos, the settlement pattern is mirrored by the distribution of the peak sanctuaries. Here, the main landmark is undoubtedly the peak sanctuary of Iuktas, which is intervisible with all of its satellite peak sanctuaries, but these subsidiary peak sanctuaries are not necessarily intervisible amongst each other.

The change in the distribution of the peak sanctuaries in the Early Neopalatial period seems to confirm this hypothesis, as the pattern follows closely the changing pattern of settlement distribution and hierarchy. Only eight out of the 22 Protopalatial peak sanctuaries remain in use. The high intervisibility in the Sitian district is mostly lost and the Petras – Agia Photia Survey[21] represented a more dispersed settlement landscape. Vrysinas in the west is left isolated, after the abandonment of the peak sanctuaries of Atsipades Korakias and Spili Vorizi. On the other hand, the stable intervisibility and continuous existence of most peak sanctuaries in central Crete is remarkable.

It is suggested that the centralization of state-controlled religion[22] and manipulation of peak sanctuaries by the central authority had already been established in the Protopalatial period in central Crete, but was only achieved in the early Neopalatial period in the rest of Crete.

The characterization of the peak sanctuary mountain as "*the best landmark for worshippers to travel to*" (see footnote 16) should also be redefined and expanded. As a landmark, the peak was not only useful to guide the 'worshipper' to the peak, but it also served as a point of reference for any traveler to mark the location or territory of an important close-by settlement.

The presence of possible ash-layers and of sea or river pebbles at several peak sanctuaries further suggests a relationship between the peak sanctuaries and the sea and/or rivers transportation routes[23].

Viewshed analysis from the islands of Kythera, Antikythera, Melos, Thera, Anafi, Kassos, Karpathos, and Gavdos was performed (Figure 2: Viewsheds from the sea). At least 16 out of 23 peak sanctuaries are potentially visible from the Cycladic islands of Melos, Thera and Anafi. Since from this distance Crete is not always visible[24] due to atmospheric conditions, the same process was repeated approximately 50 km from the Cretan coast. Main current and wind direction (both roughly from NW to SE) were taken into account to hypothesize a more realistic travel route[25], and once again a very high number of peak sanctuaries is visible. The visibility of the peak sanctuaries from the sea, and the further fact that many of the sanctuaries were found to have thick ash layers suggesting large bonfires, supports the idea that the sanctuaries were used as landmarks or even as beacons for travelers and especially for ships coming from the Cyclades.

[21] Tsipopoulou 1989, passim.
[22] Peatfield 1990, 126-130.
[23] Soetens et al. 2002 (in press).
[24] Nikolakopoulou 2001: "*At sunrise in winter with favourable atmospheric conditions Crete is visible from its East to West coast*".
[25] Lambrou-Phillipson 1991, 11-19.

TOPOGRAPHY

The broader relationship of the topography and geomorphology of Crete to the distribution of peak sanctuaries and their hinterland has only briefly been analyzed, as our aim here was to define the micro scale morphology of the peak sanctuaries themselves, based on the image processing and analysis of the DEM[26].

By analysis of the elevation, slope and aspect of the peak sanctuaries, several observations can be made (Chart 1: Aspect, slope and elevation).

First, we can see that the Protopalatial peak sanctuaries have a slope that varies between 3.8^{o} and 26^{o}[27]. Their slopes seem to avoid an orientation towards N or NW and half of them are located in altitudes between 700 and 900 m. The Neopalatial peak sanctuaries are located on a gentler slope, and show a preference to south orientation.

Combining aspect and slope on a X and Y axis, a broad cluster revealed a preference of peak sanctuaries on almost flat surfaces with a strong orientation to the south[28].

Fieldwork has shown that in many cases the steepest slope of the peak sanctuary is oriented towards the major settlement, which made the sanctuary highly visible and distinctively recognizable from the settlement. The correlation of the orientation of the peak sanctuary to the settlement with an aspect slope clustering should make this and other similar features more clear, while further analysis of the general topographical characteristics of the larger surrounding regions will clarify the relationship between settlements and peak sanctuaries in terms of relative elevation, aspect, and the relative steepness of the hinterland area compared to that of the peak sanctuary.

ENVIRONMENT

The relationship between settlements and peak sanctuaries can also be expressed in terms of its environmental characteristics.

The environmental characteristics of the peak sanctuaries were statistically analyzed by correlating the location of the peak sanctuaries to the geological, land use, and land capability maps. Based on 53 sites, including both positively identified and candidate sites, the results were to be expected but not very specific.

71% (or 33 sites) are located on geological formation of limestone and /or dolomite, while much smaller percentages of peak sanctuaries can be found on conglomerates, and phyllites.

58% (or 31 sites) are within phrygana zones.

90% (or 48 sites) are within the broadleaved evergreen land region.

81% or (43 sites) are in a region with none to moderate erosion.

These percentages indicate that we find ourselves in the typical Greek mountainous landscape, but they do not distinguish the peak sanctuary from any other

[26] After processing the elevation raster (accuracy pixel size: 50 x 50m), new rasters were created with pixel values on slope and aspect, based on the relative position of each pixel to its neighbour. Thus if the value of one pixel is higher than that of its northern neigbour, then there is a northern aspect between those two pixels. The difference between these values will determine the slope.

[27] At Spili Vorizi we encountered 40.9^{o}, but the actual sanctuary is not that steep (resolution error).

[28] This does not totally correspond to the field observations and is probably due to an accuracy bias (50 x 50m pixel DEM). We are refining these analyses, by including the nearby pixels, so that for each peak sanctuary an area of 250 x 250 m is examined, and a higher resolution DEM in under consideration.

mountain peak. The distinction between positive peak sanctuaries and candidate sites might emphasize certain environmental characteristics.

CONCLUDING REMARKS

The location of Minoan peak sanctuaries in the landscape is crucial to their function and meaning, much more so than any other type of site.

Viewsheds from the sanctuaries have shown that the decrease in number and visibility from protopalatial to neopalatial peak sanctuaries in the East reflects an evolution from rural and regional religious unity to a highly hierarchical system more like that of the central Cretan peak sanctuaries for both Proto- and Neopalatial period.

The distribution and visibility of peak sanctuaries suggest that they could have functioned as political control tools or even as military observation posts, while the evolution of the settlement patterns with the peak sanctuaries suggests a change of politics, a change of societal organization.

In addition, viewsheds from the sea showed a high degree of visibility from N-NE, suggesting that the peak sanctuaries could have functioned as landmarks or even as beacons for ships coming from the Cyclades.

It is too early to make final comments on aspect, slope, elevation and the environmental attributes of peak sanctuaries, but so far the peak sanctuaries can be found on rather gentle slopes; N-NW tilting slopes are avoided; and we are definitely in a typical Greek mountainous environment.

The further refinement of the GIS model will allow us to define even better choice of location, function and meaning of the Minoan peak sanctuaries.

BIBLIOGRAPHY

Driessen J., "History and Hierarchy. Preliminary Observations on the Settlement Pattern of Minoan Crete", in K. Branigan (ed.),*Urbanism in the Aegean. Sheffield Studies in Archaeology,* 2001 (in press).

Faure P., "Nouvelles recherches sur trois sortes de sanctuaires crétois",*BCH* 91, 1967,114-150.

Faure P., "Sur trois sortes de sanctuaires crétois", *BCH* 93, 1969,174-213.

Faure P., "Cultes populaires dans la Crète antique", *BCH* 96, 1972, 389-426.

Gaffney V. & Van Leusen M., "Postscript – GIS, environmental determinism and archaeology", in G. Lock & Z. Stančić (eds), *Archaeology and Geographical Information Systems, A European Perspective,*London – Bristol, Taylor & Francis, 1995, 367-382.

Karetsou A., *ΠΑΕ* 1974, 228-239; *ΠΑΕ* 1975, 330-342; *ΠΑΕ* 1976, 408-418; *ΠΑΕ* 1977, 419-420; *ΠΑΕ* 1978, 232-258; *ΠΑΕ* 1980, 337-363; *ΠΑΕ* 1981b, 405-408; *ΠΑΕ* 1984a, 600-614.

Karetsou A., *The Peak Sanctuary of Mt. Juktas*, in Hägg, R., and N. Marinatos (eds), *Sanctuaries and Cults in the Aegean Bronze Age. Proceedings of the First International Symposium at the Swedish Institute in Athens*, *12-13 May 1980,* 1981a,137-153.

Karetsou, A., *Έργον*, 1984b, 111-115.

Karetsou, A., *Έργον*, 1985, 83-87.

Kvamme K., "Ranters Corner: bringing the camps together: GIS AND ED", *Archaeological Computing Newsletter (ACN)*, 1997, 47, 1-5.

Lambrou-Phillipson C., "Seafaring in the Bronze Age Mediterranean: The Parameters Involved in Maritime Travel", in Laffineur, R. & Basch, L. (eds.)*, Thalassa, L'Egee prehistorique et la mer. Actes de la 3ieme rencontre egeenne*

internationale de L' Universite de Liege, Station de recherches sous-marines et oceanographiques (StaReSo), Calvi, Corse, 23-25 avril 1990. AEGAEUM 7, 1991, 11-19.

Morris Chr. & Peatfield A. A. D., "Pottery from the Peak Sanctuary of Atsipadhes Korakias, Ay Vasiliou, Rethymnon"*,* in *Proceedings of the 7th International Cretological Congress, Rethymnon, August 1990*, 1995, 643-646.

Nikolakopoulou I., "Μινωικοί πίθοι απο το Ακρωτήρι Θήρας", in *Proceedings of the 9th International Congress of Cretan Studies – Πεπραγμένα του Θ' Διεθνούς Κρητολογικού Συνεδρίου*, 1-6 October 2001, 2001 (oral presentation).

Nowicki K., "Some Remarks on the Distribution of Peak Sanctuaries in Middle Minoan Crete", *ArcheologiaWar (Warsaw)*, XLII, 1991, 143-145.

Nowicki K., "Some Remarks on the Pre- and Protopalatial Peak Sanctuaries in Crete", *Aegean Archaeology (AEA)*, 1, 1994, 31-48.

Peatfield A. A. D., "The Topography of Minoan Peak Sanctuaries", *BSA* 78, 1983, 273-279.

Peatfield A. A. D., "Palace and Peak: The Political and Religious Relationship between Palaces and Peak Sanctuaries", in R. Hägg and N. Marinatos (eds.)*, The Function of the Minoan Palaces. Proceedings of the Fourth International Symposium at the Swedish Institute in Athens, 10-16 June, 1984*, 1987, 89-93.

Peatfield A. A. D., "Minoan Peak Sanctuaries: History and Society", *OpAth*, 18, 1990, 117-132.

Peatfield A. A. D., "Crete Atsipadhes Archaeological report 1991", *AR* 1991, 26.

Peatfield A. A. D., "Rural Ritual in Bronze Age Crete: The Peak Sanctuary at Atsipadhes", *Cambridge Archaeological Journal* 2 (1), 1992, 59-87.

Peatfield A. A. D., "Crete Atsipadhes Archaeological report 1992", *AR* 1992b, 27.

Peatfield A. A. D., "Crete Atsipadhes Archaeological report 1993", AR 1993, 31-32.

Peatfield A. A. D., "After the 'Big Bang' – What? Or Minoan Symbols and Shrines beyond Palatial Collpase", in S. E. Alcock & R. Osborne (eds), *Placing the Gods, Sanctuaries and Sacred Space in Greece*, Oxford, 1994, 19-36

Peatfield A. A. D., "The Atsipadhes Korakias Peak Sanctuary Project", *Classics Ireland*, 1, 1994b (http://www.ucd.ie/~classics/94/Peatfield94.html).

Peatfield A. A. D., "Crete Atsipadhes Archaeological report 1994", *AR* 1994c, 23-35.

Peatfield A. A. D., "Crete Atsipadhes Archaeological report 1995", *AR* 1995, 25.

Peatfield A. A. D., "Crete Atsipadhes Archaeological report 1996", *AR* 1996, 26.

Rackham O. & Moody J., *The making of the Cretan landscape*, Manchester & NY, Manchester University Press 1996.

Renfrew C. & Level E.V., "Exploring dominance: predicting polities from centers", in Renfrew C. and Cooke K.L. (eds.), *Transformations, Mathematical Approaches to Culture Change*, New York, Academic Press 1979, 145-168.

Rutkowski, B., *The Cult Places of The Aegean*, New Haven & London, 1986, 72-98. (1st edition 1972, 152 ff.)

Rutkowski, B., "Minoan Peak Sanctuaries: The Topography and Architecture", in Laffineur, R., (ed.), *AEGAEUM* 2, 1988, 71-100.

Rutkowski B., *Petsofas. A Cretan Peak Sanctuary, Studies and Monographs in Mediterranean Archaeology and Civilization,* I. 1991, 1.

Soetens S., Driessen, A. Sarris, S. Topouzi, "The Minoan Peak Sanctuary Landscape through a GIS approach", *Archeologia e Calcolatori* 13, 2002 (in press).

Topouzi S., Tripolitsiotis A., Sarris A., Mertikas S., Soetens S., "Errors and Inaccuracies in Repositioning of Archaeological Sites", *Computer Applications in Archaeology 2001 BAR,* in press.

Tsipopoulou M., *Archaeological Survey at Aghia Photia, Sitia*. Partille 1989.

Watrous L. V., "Some observations on Minoan Peak Sanctuaries", in Laffineur, R. & W. -D. Niemeier, (eds.), *AEGAEUM 12: Politeia: Society and State in the Aegean Bronze Age. Proceedings of the 5th International Aegean Conference / 5e Rencontre égéenne internationale, University of Heidelberg, 10-13 April 1994*, Vol II. , 1994, 393-403.

Wheatley D., "Cumulative viewshed Analysis: a GIS based method for investigating intervisibility, and its archaeological application", in G. Lock & Z. Stančić (eds), *Archaeology and Geographical Information Systems, A European Perspective,*London – Bristol, Taylor & Francis, 1995, 171-186.

FIGURES AND CHARTS

Figure 1: Cumulative viewsheds for proto- and neopalatial peak sanctuaries

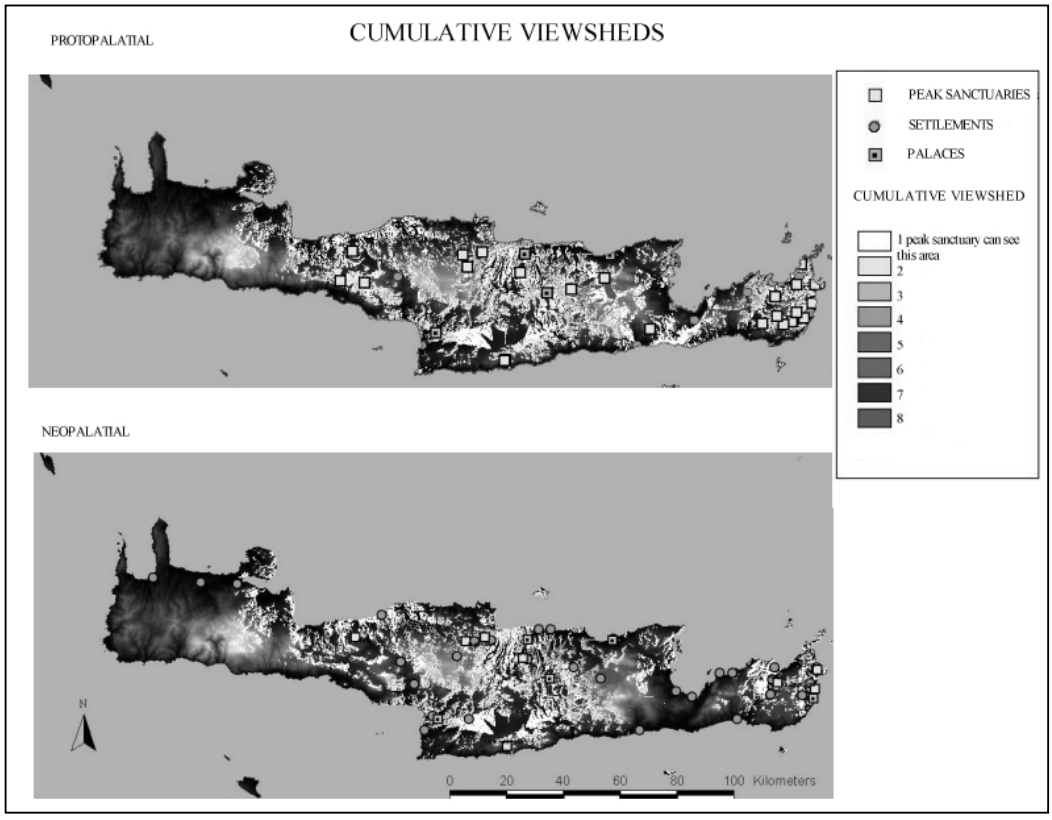


Figure 2: Viewsheds from the sea

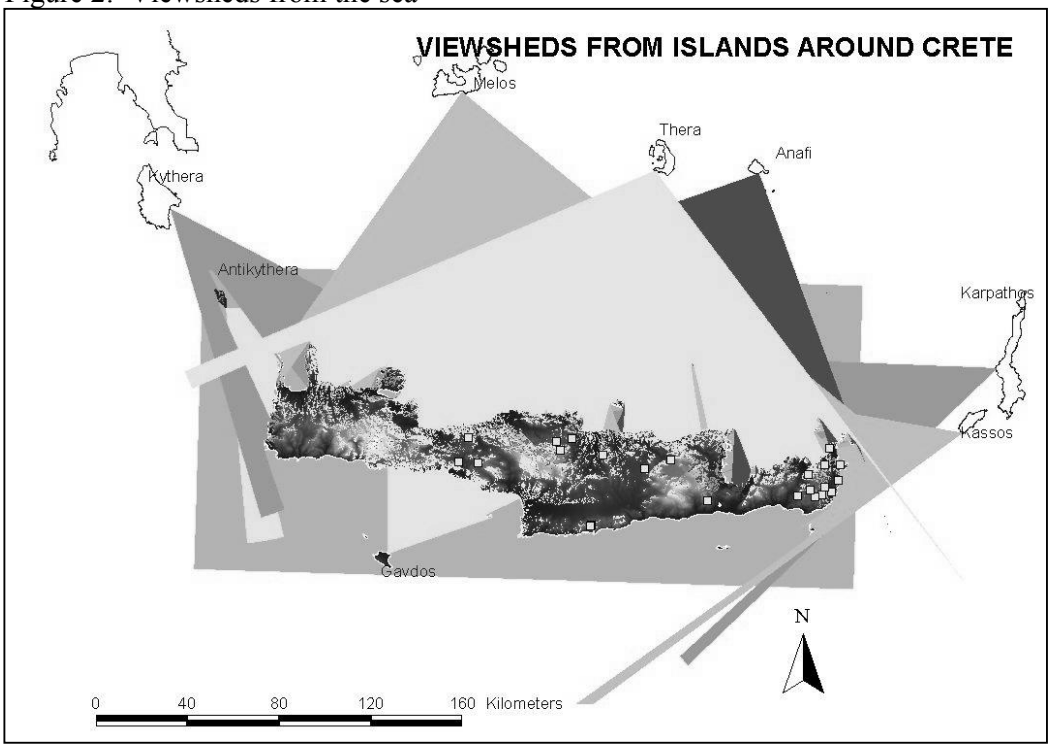


Chart 1: Aspect, slope and elevation (for the left column: peak sanctuaries are sorted from west to east)