
I SNEEZE EVEN INSIDE THE CLEAN ROOM, DOCTOR... I DON'T KNOW WHAT TO DO!
HMM...
ALLERGIES USUALLY OCCUR WHEN YOU'VE BEEN OVER-EXPOSED TO SOMETHING IRRITATING OR UPSETTING.
YOU MEAN-
JORGE CHAM © 2010
YOU'RE ALLERGIC TO YOUR THESIS.
I KNEW IT!
LET'S TRY IT: WHAT ARE THE MAJOR CONTRIBUTIONS OF YOUR WORK?
I-
ACHOO!
ACHOO!
ACHOO!
WWW.PHDCOMICS.COM
YES, THESIS ALLERGIES ARE VERY COMMON AMONG GRAD STUDENTS.
ESPECIALLY IN THE SPRING.
THE POLLEN MAKES IT WORSE?
EVERYONE ELSE GRADUATING MAKES IT WORSE.
JORGE CHAM © 2010
WE SEE ALL KINDS OF REACTIONS: HIVES, NAUSEA, VOMITING...
IT'S LIKE YOU'RE HYPERSENSITIVE TO THE MERE QUESTION OF FINISHING.
I'M ALMOST DONE, OK!!?
ACHOO!
ACHOO!
WWW.PHDCOMICS.COM
BUT I'VE NEVER BEEN ALLERGIC, DOCTOR. WHAT HAPPENED?
IT'S CALLED THE HYGIENE HYPOTHESIS.
YOU'VE BEEN INSIDE THE BUBBLE OF ACADEMIA FOR SO LONG, YOUR EGO'S IMMUNE SYSTEM HAS BECOME EXTREMELY SENSITIVE TO REALITY.
REALITY
MY WORK MATTERS!
"THE BUBBLE" (A.K.A. GRAD SCHOOL)
JORGE CHAM © 2010
ARE THERE ANY DRUGS FOR IT?
WELL, THERE'S DENIAL, BUT IT'S ADDICTIVE.
YOU MEAN I CAN'T STAY IN ACADEMIA FOREVER?
AS A REAL DOCTOR, I WOULDN'T RECOMMEND IT.
WWW.PHDCOMICS.COM

University of Alberta

Kallithea to Halos: the defensive network of the north Othrys mountains.

by

Christopher Myles Chykerda

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Arts
in

Humanities Computing

Department of History and Classics

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Dr. Jeremy Rossiter, History and Classics

Dedication

Recognition to all those who have encouraged and supported me throughout my education at the University of Alberta is required.

Although there are many to name, from friends to colleagues, each person has provided something precious to this stage of my life.

Standing above all others are my mother and father,
Marlene and Walter Chykerda,
who have always been there whenever needed.

To them I dedicate this work.

Abstract

This thesis presents an interdisciplinary examination of a series of towers existing between the sites of Kastro Kallithea and New Halos along the north ridge of Greece's Othrys Mountains. The overarching goal is to utilize digital archaeological techniques such as GIS to refine the methodologies used in determining the rate of efficient communication between towers in defense networks. Tools within the ArcGIS software package allow line of sight and viewsheds to be examined remotely with a series of criteria to be met, such as maximum allowable distance. In doing so, past studies of regional networks are critiqued in light of their inclusion or exclusion of considerations such as distance, atmospheric conditions, and time of day when determining over how far a distance fire signaling could be effective. A second critique explores the dangers of employing digital means from the perspectives of both the investigator and public.

Keywords: humanities computing, Kallithea, viewshed analysis

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I would like to acknowledge the ongoing support received for many years from my supervisors, Dr. Margriet Haagsma and Dr. Sean Gouglas. Both have continually stood by me and provided advice as I attempted to juggle the pressures of school with work, mortgage payments, volunteer commitments, and many other distractions. I apologize for all frustrations I may have caused them along the journey but am truly thankful they were there. I also would like to thank Dr. Jeremy Rossiter for sitting on my committee and bringing a unique perspective to the editing stage of this work.

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I am grateful to have worked with such a dedicated team at Kallithea where staff are not only co-workers but good friends. Each year I eagerly await catching up with Tracene Harvey, Crysta Leslie, Bryan Leslie, and Laura Surtees.

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Ioannis Georganas of Greece provided vital assistance in Athens when the Project worked towards purchasing the digital map data that formed the foundation of my analysis.

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Chapter 1: Introduction and Literature Review

1.1 Introduction

The fourth century BC was a period of great change for Greek warfare. Newly introduced technologies in the field of poliorcetics[1] ended years of stagnant hoplite tactics and presented for the first time a serious threat to the enceintes of major *poleis*. However, this was not the only major shift in tactics occurring in this period. The Greeks had also begun to reexamine their basic principles of city and regional defense. Whereas the *polis*[2] formerly was the central focus of any good defense strategy, by 300BC the entirety of a city's surrounding landscape[3] and *chora* was considered equal in importance to the city when defending one's territory against enemy incursion. Throughout Greece are numerous towers[4] and small forts that dot the landscape. Groupings of towers in a narrow geographic disbursement can be interpreted as components in a system constructed for defending the *chora*. As lookout posts, present theories suggest these towers acted as signaling posts that communicated any incoming threats to its home base through the use of fire signals. One such system is a series of towers located between the *poleis* of Kastro Kallithea and Halos along the edge of

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[1] Poliorcetics is defined as art of siege warfare and fortification.
[2] The Oxford Classical Dictionary defines a *polis* as "the Greek city-state [that is the] characteristic form of Greek urban life." Each *polis* controlled a territory, called the *chora*, "delimited geographically by mountains or sea, or by proximity to another *polis*."
[3] "Landscape" should be taken as a holistic term. As Tilley notes, "landscape...transcends the particular meanings of locales, signifying a set of conventional and normative understandings through which people construct and make sense of their cultural world. Locales stand, then, in relation to landscapes as parts to wholes." Christopher Tilley, "The powers of rocks: topography and monument construction on Bodmin moor," *World Archaeology* 28, no. 2 (1996): 161.
[4] The term 'tower' can refer to any building or structure, either standing alone or integrated into a city wall or other construction, which is of noticeable height. Usually when included along a city wall, the tower's height reaches above the tallest point of the wall itself.

the Othrys Mountains.[5] Likely constructed at the end of the fourth century, this system and its connection with Kallithea and Halos provide a rare opportunity to understand Hellenistic Thessaly, its defensive considerations and overall use of contemporary Greek tactical theory in an area usually viewed as marginal within the Greek world.

The overarching goal of this thesis is to utilize digital archaeological techniques such as GIS to refine the methodologies used in determining the rate of efficient communication between towers in a defense network. Studies[6] documenting groups of towers have unanimously glossed over the practicalities of fire signaling and assume that observers perceived any kind of signal over distances of 20km or more. However, line of sight cannot be the only consideration in the analysis of the distribution of towers. To do so assumes that seeing a geographical feature such as a hill in the distance equates discerning hand-held torches. Any theory must consider the distances that exist between sites and the limiting factors such separation can enact, even where an author addresses the matter of line there are often inadequate descriptions of how indicated viewscapes were determined. In the absence of explanations of how the

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[5] Ger Wieberdink, "A Hellenistic Fortification System in the 'Othrys Mountains (Achaia Phthiotis)," *Newsletter of the Netherlands Institute at Athens* 3 (1990): 47-76.

[6] S.C. Bakhuizen, *Salganeus and the Fortifications on its Mountains* (Groningen: Wolters-Noordhoff) 1970; John M. Fossey, *The Ancient Topography of Eastern Phokis* (Amsterdam: JC Gieben) 1986; John M. Fossey, *Topography and Population of Ancient Boiotia* (Chicago: Ares Publishers) 1988; John M. Fossey, *Papers in Boiotian Topography and History* (Amsterdam: JC Gieben) 1990; Nigel Spencer, "Multi-dimensional Group Definition in the Landscape of Rural Greece," In *Time, Tradition and Society in Greek Archaeology*, edited by Nigel Spencer, 28-42 (London: Routledge, 1995).

author determines visual connections, the reader must assume that the author has relegated the study to a map-based supposition. The tools currently available in GIS software, in conjunction with necessary support from field observations, allow for more advanced spatial analysis and presentation of the findings. In this thesis, a collection of analytical tools in the ArcGIS software package assesses lines of sight and viewsheds that exist at each tower and fort in the Othrys system.

The analysis, contained in Chapter 3, clearly demonstrates the power of utilizing GIS applications in an archaeological setting. Projected viewsheds[7] and the resultant visualizations emphasize the importance of two towers, known as the Myli towers, located on the plains of Almiros. Before the viewshed analysis, these towers seem to be nothing more than a pair placed curiously close to each other in a highly vulnerable setting. ArcGIS analysis shows that this location is actually a vital location for the entire Othrys defense system as the only location visible to all surrounding sites. Myli was the communication lynch pin of the entire group and the presence of two towers allowed discrete signals to be seen over distances far enough to encompass all known sites between Halos and Kallithea. Fourth century tactics in light of the Othrys system also proves that Myli did not require strong defenses itself as its location was far behind the forward lines of this defense network.

Consideration of fourth century tactics, undertaken in order to understand the strategic situation that necessitated these towers, also reveals several regional variants of tactics and construction style. Thessaly and its cities have long been

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[7] A viewshed is an area of land, water, or other environmental element that is visible to the human eye from a fixed vantage point.

considered less wealthy and behind the times in regards to the most 'recent' defense strategies in ancient times. Instead of being a backward area, this thesis demonstrates that the selection of certain construction techniques matched the defensive advantages allowed by the region's topography. A site such as Kallithea with its strong topography would not have required a defensive line capable of withstanding large siege engines as its terrain naturally defended against such threats. Nearby sites, such as Goritsa, present evidence that military architects would construct larger works where necessary.[8] Likewise, the style of masonry, trapezoidal, is not indicative of Thessaly being unable to adopt a construction style n vogue at that time. Instead, it suggests a regional variation to the overall timeline proposed by Scranton's[9] construction style chronology.

In order to collect all required data and provide a context for this study three major areas shall be examined. First, a survey of both primary and secondary literature will ascertain the theoretical frameworks that regional network examination and line of sight assignment has used.[10] Factors such as the size of each system, typical distances, and indications as to how authors arrived at their conclusions will be explored. As there is a lack of quantifiable characteristics detailing signaling distance in modern works, the research process necessitated a review of ancient sources in order to understand what mechanisms were used to relay messages.[11] Methods more advanced than a simple lighting of a beacon were required in order to communicate the detailed messages demanded

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[8] S.C. Bakhuizen, *A Greek City of the Fourth Century BC* (Rome: L'Erma di Bretschneider, 1992).
[9] Robert Lorentz Scranton, *Greek Walls* (Cambridge, MA: Harvard University Press, 1941).
[10] See section 1.3 for a comprehensive list of the sources considered.
[11] Authors commenting on fire signaling include Polybius, Aeneas, and Polyaenus.

by armed forces in the fourth century. Knowledge of the methods used by the Greek will then allow a hypothesis to be made in regards to the functional distance at which a target scout would be able to see the signal and be able to discern its meaning.

An examination of these systems is not possible without placing them in a proper historical context.[12] This will help to understand the reasoning behind their construction. The second phase of research introduces the region of Kastro Kallithea and the site itself. In order to assess the tactical situation at play in the closing years of the fourth century Kallithea's archaeological remains are used as a case study to determine to what degree emergent offensive and defensive techniques were used in Thessaly at this point. Despite its relative obscurity in the written historical record, Thessaly was a politically vibrant region that was not isolated from the changes to warfare brought about throughout the fourth century. In an attempt to increase their regional influence, Macedonian client kings inspired many Thessalian cities new fortifications built to design standards current at the particular time. As the eastern anchor of the Othrys defense system, Kallithea and its defenses are strong evidence that the builders of this site did not rely on outdated theories or methods but were aware of innovative strategies utilized by military architects across Greece. Investigation of defensive considerations here will also allow a broader understanding of Kallithea's setting within the landscape and relation to the Othrys system.

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[12] The two main sources used for this purpose are: A.W. Lawrence, *Greek Aims in Fortification* (Oxford: Clarendon Press, 1979); F.E. Winter, *Greek Fortifications* (Toronto: University of Toronto Press, 1971).

The final section of this thesis will present an overview of the digital archaeology methods and the data sets used in this stage of research. Numerous visual representations of both line of sight and viewsheds shall advance the understanding of the role of the various towers in the Othrys system while taking into account distances between each component of the system. Through a combination of distance buffers and viewsheds, it becomes possible to see if signal communication could indeed occur between each tower. One must always keep in mind that although digital archaeology and computer generated visualizations are powerful tools they do not come without certain limitations. The section will note dangers inherent in using technology, during both the data gathering stage and interpretation stages. Despite these risks, a properly formulated mode of inquiry can benefit immensely from the use of GIS systems and analysis. At Kallithea, the resultant visualizations allow for a new way of analyzing systems of towers and each location's individual role in an overall system.

1.2 Regional Survey Background

A general trend exists for regional surveys to reduce the consideration of site visibility to a yes or no question: a sort of 'I can see my house from here' syndrome. This does not mean to suggest that this oversight has been caused by deliberate ignorance of topographic realities. As Lock and Harris point out, many archaeologists prefer established modes of informal map-based spatial analysis with little regard for quantitative aspects.[13] A lack of attention to factors affecting visibility can in turn lead to a lack of detail when considering the cultural processes surrounding the design and construction of regional networks. A seemingly innocent oversight of matters such as distance, atmospheric conditions, or transmission complexity thus leads to a simplification of the methods used in Greek signal communication. Perhaps this state of affairs arose partly from the first generation of GIS viewshed analysis. Many of these studies were based upon a single line of sight calculation, a task which is a relatively trivial computing problem given the proper data is available.[14] In such cases, the main hypothesis deals with a simple 'can site *x* see site *y*' scenario and often concerns land usage and space conceptualization in pre-historic cultures,[15] where the greatest distance that exists between two sites is under several kilometers. One does not need to consider much beyond whether or not the point of observation has a valid line of sight to the intended target because of such close proximities.

Matters are not so straight-forward in the ancient Greek landscape. The Greeks established numerous regional networks via the construction of towers and

[13] Gary Lock and Trevor Harris, "Visualizing spatial data: the importance of Geographic Information Sytems," In *Archaeology and the Information Age*, eds. Paul Reilly and Sebastian Rahtz, 84 (New York: Routledge, 1992).
[14] D. Wheatley, "Cumulative viewshed analysis: a GIS-based method for investigating intervisibility, and its archaeological application," In *Archaeology and Geographical Information Systems: A European Perspective*, eds. Gary Lock and Zoran Stancic, (Bristol: Taylor & Francis, 1995): 171.
[15] Henry Chapman. *Landscape Archaeology and GIS*. (Stroud: Tempus, 2006); John Waldron and Elliot M. Abrams. "Adena burial mounds and inter-Hamlet visibility: A GIS approach." *Midcontinental Journal of Archaeology MCJA* 24, no. 1 (Spring 1999): 97-111; Wheatley; Benjamin R. Gearey and Henry P. Chapman, "Digital gardening: an approach to simulating elements of palaeovegetation and some implications for the interpretation of prehistoric sites and landscapes," In *Digital Archaeology Bridging Method and Theory*, eds. Thomas L. Evans and Patrick Daly, (New York: Routledge, 2006), 171-190; Marcos Llobera, "What you see is what you get? Visualscapes, visual genesis and hierarchy," In *Digital Archaeology Bridging Method and Theory*, eds. Thomas L. Evans and Patrick Daly, (New York: Routledge, 2006), 148-168.

forts throughout the landscape surrounding significant urban centres.[16] As Classical archaeologists have directed research questions toward landscape studies over the past several decades, an increasing corpus of evidence has demonstrated that the towers which dot the Greek landscape were not isolated rural guardians but were components of systems specifically designed to monitor the entirety of a city's *chora*. Many of these systems are composed of towers constructed in the fourth century BC, a period when the defensive interests of Greek states moved beyond the city walls and encompassed the *chora*.[17] During the Hellenistic period armed forces needed to transmit quickly a variety of detailed messages, suggesting that signaling systems would have required more complex means than a simple lighting of a beacon or torch. In order to arrive at an understanding of systems used by the ancient Greeks both the archaeological remains and historical sources must be examined.

The following section will provide a summary of several regional system investigations with which to ascertain what assumptions authors use when determining site intervisibility. In order to balance archaeological research with primary sources, this discourse shall consider the writings of contemporary Greek and Roman authors who touch on the matter of towers, defense networks, and fire signals, although the sources will be focused on at the chapter's end. The conclusion also includes a brief discussion of the matters of signaling: what sort of signaling systems the Greek would have been likely to use, how systems

[16] I refrain from using the term *polis* here as several fortified sites, such as Peuma and Goritsa, did not for certain have the status of a full *polis*.
[17] See the author's discussion on Athenian defensive mentality during the 5th and 4th century in Ch. V of Josiah Ober, *Fortress Attica: defense of the Athenian land frontier 404-322 BC* (Leiden: EJ Brill, 1985); Spencer, 36.

changed through time, and the visual requirements for such signals. These numerous facets of the present dialogue will be the foundation in composing a set of hypothetical operating guidelines. The final chapter of this thesis will propose a unique set of qualifications.

1.3 Previous Studies

Polygonal towers of Lesbos

Spencer's work is primarily a stylistic investigation of towers types found on the island of Lesbos, a Greek island unique in having five co-existing poleis throughout the Classical period.[18] Although towers built of isodometric and polygonal stones are on the island, the latter occur in much greater number and are Spencer's primary focus. Since regional defenses and the protection of the *chora* were not tactical foci of the archaic and classical periods, during which the Greeks used polyginal stonework, Spencer believes the towers to be imitative productions of the local elite who vied for social status through ostentatious construction projects.[19] However, he does allow interpretive room for a defense purpose by stating that they could have also played a role in inter-*poleis* relations. Although Spencer does not include an in-depth topographical analysis he does belive that the "relationship of the towers and enclosures to the entrances and

[18] The five *poleis* on Lesbos were Eresos, Antissa, Methymna, Pyrrha, and Mytilene.
[19] Spencer, 36.

exits of the plains which must have been the central production areas of the *poleis* is...obviously of note."[20]

Otherwise, Spencer provides no sense of intervisibility. Towers are situated at positions on high hilltops and mountains near or beyond the edges of the plains where the *poleis* are located. No tower is closer than 3km to a *polis* while most are 6-12km away with four located over 12km from the nearest city.[21] Spencer notes that although many of the polygonal towers are in commanding locations their positioning often makes each tower invisible from the others.[22] Therefore, with the assumption that the towers had some kind of military function, they could act only independently to guard the areas and passes they commanded and could not be part of a cohesive and reliable signaling network.

<u>Salganeus and surrounding mountains</u>

In the mid-1960s, Bakhuizen surveyed a defensive system in the mountains of Salganeus, located 4km southwest of the modern city of Chalkis.[23] Although archaeologists were aware of an ancient wall running through the mountains, known as the Aniforitis wall, Bakhuizen discovered the remains of four ancient forts associated with the Aniforitis. Together, the system of bases and wall defended the plains west of the Euripus straight against incursions from Attica to the south. The wall follows a path that runs below the mountains' ridge on its southern face so that the high ground remained under the control of the

[20] *Ibid.*, 38.
[21] *Ibid.*, 34.
[22] *Ibid.*, 36.
[23] Bakhuizen, (1970).

northern defenders, a basic Classical era tactic. More importantly, the wall served to block the Aniforitis Pass, which gives its name to the wall, the only passable route through the mountains. Along this 11km stretch of wall are five fortified bases, ranging in size from the larger fortresses of the Kastro[24] and Kleftoloutsa to the small Galatsidheza Fort.[25]

Bakhuizen's statements regarding viewsheds suggest that he bases his observations upon personal site visits. His writing forces this assumption as nowhere in the text does the author specifically detail how visibility was determined. Phrases such as "one can see,"[26] "commands a good view of the plain below,"[27] or "the view from here is grand"[28] are unfortunately as detailed as Bakhuizen gets when describing views. Despite their vague nature, such statements are not out of the ordinary given the short distances that exist between each site.[29] The furthest distances are between the western-most fortress, Kleftoloutsa, and the two eastern bastions: Euripus fortress at 6.5km and the Aulis fortress at 7km. Bakhuizen does not indicate whether these fortresses at opposition ends of the wall were visible to each other or would have directly communicated with each other. If not, the series of sites between the two terminal points could have easily relayed any visual messages along the defensive line.

Bakhuizen's description of the system is nevertheless important thanks to the presence of line of sight discussion. Kleftoloutsa's outer wall includes an

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[24] The Kastro was the only fort recorded prior to Bakhuizen's survey and guarded the main coastal transportation route together with the Aulis fortress located east of the road.
[25] See Bakhuizen (1970), 68 for an overall area map detailing the location of forts along the wall's course.
[26] Bakhuizen (1970), 70.
[27] *Ibid.*, 77.
[28] *Ibid.*, 72
[29] See Appendix B for a table of distances

extension to the southeast that grants a view overlooking the plain of Dhrosai, Euripus, Chalkis,[30] and nearby mountaintops. From this fortress' northwestern corner, one can see the continuation of the wall to its western termination 2km northwest. Once again, a specially designed viewing platform is present at the small fort of Galatsidheza, a site that Bakhuizen sees as a fortified observation post.[31] Including the view from an eastern-facing bastion, one can see all aspects of the wall system, the Dhrosain plains to the north, and the central plains of Boeotia to the south. Despite the lack of details as to signaling abilities there can be no doubt that this mid-point in the system was an important relay station. Bakhuizen believes this fort's single 'bastion' is a signaling platform that communicated directly with the Kastro 3.5km away, indicated by its eastern positioning.[32] In contrast, the enclosure on Mikro Vouno commands a good view of only the plains below and of the surrounding hills. Despite being useful to observe armies preparing to attack the wall or the Kastro, scouts would have had to send signals via nearby stations.[33]

At the eastern border of the system are several bastions built into a section of the Aniforitis wall that serves as an outwork of the acropolis at the Kastro. From the four south facing towers an observer could watch the nearby coastal road (0.5km) or relay signals to the Aulis fortress (1.5km). Bakhuizen suggests that bastion 13 was constructed for communicating with Aulis[34] although this hypothesis is far from certain. Given the southeast position of the Aulis fortress

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[30] All are within 10km, the distance to the sea.
[31] Bakhuizen (1970), 72.
[32] *Ibid.*, 74.
[33] Tsouka Madhari and the Kastro were both ~1km in distance.
[34] Bakhuizen (1970), 83.

there is no reason why bastion 14 could not have served this function. Tower 13 instead may have been a post constructed to monitor Cape Perama and the Steno straight, located slightly less than 1km to the northeast.

East Central Greece

In several regional studies,[35] John M. Fossey provides an overview of proposed defensive networks existing throughout eastern *Sterea Ellas*, a modern administrative zone that covers ancient Attike, Megaris, Boiotia, Opuntian Lokris, Phokis, Epiknemidian Lokris, Malis, Doris, Ozolian Lokris, Aitolia, and Akarnania. [36] Fossey's systems range in size from two towers guarding a pass south of Lake Kopais[37] to hypothetical large-scale regional networks present in both Opuntian Lokris[38] and Boiotia.[39] In terms of basic geography, site placement, and regional interaction the proposals are sound. The construction and planning of such complex systems in hotbed areas of Greek military activity is a logical expectation. In particular, the assortment of towers mapped in the *Skroponeri* area appears to be an exhaustive network through which outlying posts could inform Thebes of any northern incursions into its territory.

Fossey's argument lacks strength in reporting the details of visibility. Nowhere in the text of his article does he provide a strong consideration of

[35] Fossey (1986); Fossey (1990); John M. Fossey "The Development of some Defensive Networks in Eastern Central Greece during the Classical Period." In *Fortificationes Antiquae*, eds. Symphorien van de Maele and John M. Fossey, 109-132. (Amsterdam: J.C. Gieben, 1992).
[36] Fossey (1992), 109.
[37] *Ibid.*, 121. Lake Kopias no longer exists as it was drained in 1867-1887.
[38] *Ibid.*, 127.
[39] *Ibid.*, 115.

viewshed factors. What exactly does this mean for his proposals? For the small *Palaiothiva-Vigla* system[40] there is but little consequence. The two forts monitoring the area's passes are only 3.5km apart; a distance which is short enough to safely assume effective communication was possible. Yet as an isolated system, one could argue the validity of Fossey's proposal that these two towers were a large enough deterrent to force Kleombrotos and his Spartan army to take the southern route that led to disaster at Leuktra.[41] That these rubble forts could have convinced an army of 10,000 troops to change its course is highly unlikely.[42] While the ancient sources report several unsuccessful attempts at taking border forts,[43] barring a pass from an army as large as Kleombrotos' in the absence of a tight crevasse similar to Thermopylae is altogether a different matter. Xenophon's text suggests that the towers in conjunction with a nearby Theban army laying in wait were the true reasons for the change in course.[44] Although not significant enough to hold back an army, the towers could have been an effective means of signaling enemy movements to nearby allies.

Potential problems compound when Fossey presents the larger systems, particularly that of *Skroponeri*. Although he indicates arcs of vision for each defensive site on a regional map,[45] once again there is no methodological

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[40] *Ibid.*, 112-114.
[41] *Ibid.*, 112.
[42] At the very least, the defending forces would have needed to be supported by a great many troops in order to dissuade the path of such a large number of troops. Historical examples (*Hell* 6.5.24) demonstrate that lightly armed peltasts could pose a significant threat to hoplites in narrow passes. Thucydides' description (7.78.5-79.2) of Athens' losses on Syracuse in the Acrean pass describes a pass of narrow ravines in which Syracuse had many more troops than a typical country garisson.
[43] Thucydides 8.98 for example
[44] *Hellenica* VI.4.3-4
[45] Fossey (1992), 119.

explanation in his text of how such viewsheds were determined. Even if the author had personally visited each one of these isolated sites the exercise nevertheless seems relegated to a simple map-based spatial analysis with little consideration of quantitative questions. There is no indication of how Fossey determined that the six forts indicated as visually connected with Thebes provided effective communication links. At an average distance of 15km, discussion is required as to what sort of signals would have been manageable and visible between these towers. The final section in this chapter will demonstrate that the sometimes complicated beacons described by the ancient authors would have been impossible to distinguish at such a distance.

Fossey does point out the great distances that exist between several sites in the system of Eastern Phokis[46] but does not consider what they might mean for signaling capabilities. He is eager to ensure the entire system links together and thus proposes that a station must be present on one of the hills between Ambrossos and Steiris.[47] Yet the author visited only one of the numerous candidate hills and found no extant remains. He in turn suggests a nearby and higher hill as a better candidate for a minor fort or tower's location while the "whole question of military signaling in Greek antiquity" is reduced to a mention that "signaling was usually by fire."[48] Given the sheer amount of hills, plateaus, slopes, etc in Greece that could be a potential tower location, Fossey's attempt at finding a hypothetical location is nothing more than a far reach in order to ensure

[46] Fossey (1986), 135.
[47] *Ibid.*, 136-7.
[48] *Ibid.*, 136

all known sites link together visually (while refusing to quantify what is meant by 'visual' connection).

Finally, there is need to compare Fossey's treatment of the Aniforitis system with Bakhuizen's reporting of the same area.[49] It appears that he bases his arc of vision map directly on the observations made by Bakhuizen in his earlier survey of the site, although Fossey adds his own indications of line of sight to the map.[50] Chalkis and the Euripus Fortress are not considered, but the analysis still presents itself as a logical synthesis of Bakhuizen's descriptions. However, upon closer inspection several notable variations are present. Kleftoloutsa, the western most fort, is not indicated as having an arc of view encompassing the western continuation of the wall. In the east, a significant arc of vision and sightlines to all forts in the system have been added to Mikro Vouno, a site which Bakhuizen directly states has a limited field of vision and could only communicate with the Kastro and nearby sites. Indeed, Fossey interconnects all of the system's forts and only limits viewsheds from Bastion 13 and Aulis. Without a description of methodology or personal visits to the site providing evidence contrary to Bakhuizen's findings, one can only wonder as to how Fossey arrived at his conclusions for this particular system.

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[49] An interesting side point is that Fossey believes that the system was built in several stages as several of the bastions are not connected directly with the wall. Construction may have occurred in multiple phases, but there is little evidence to definitively prove the point in either case. Similar arguments could be levied against Fossey's belief that the *Skroponeri* system was a single phase due to the forts being of similar rubble construction. As shall be seen in Section III, rubble walls are notoriously difficult to date and place within an historical setting.

[50] Fossey (1992), 121.

<u>Attica</u>

Ober's *Fortress Attica*[51] is a *tour de force* of regional defensive system analysis. Within this book is an in-depth attempt to understand the overall factors which affected changes to Athens' defensive mentality during the fourth century and the possible societal shifts that led to these changes. Ober balances his discussion of political and social matters in Athens with archaeological reports detailing existing defenses surrounding Athens, their associated outworks, and all routes into Attica. He pays good attention to the finer details of all known defensive constructions in Attica thus providing a large body of evidence with admirable tactical considerations.[52] When assessing the various routes into Attica, Ober ensures that each description includes a discussion about the qualities of each route, visible remains of paving or retaining walls, as well as assessing which passes would have been a suitable size for an army with baggage train as opposed to raiding parties which could have infiltrated territories through more treacherous mountain passes. This extremely robust collection of data suggests that Ober's study would include a theoretically sound and well-rounded analysis of lines of sight. If Athens had truly shifted her entire defensive strategy to a system of regional posts, then long distance communication was of vital concern.

Ober uses the idea that each fort formed part of a visual network as evidence that the individual components were part of a single defensive system.[53] Such a line of thought is quite opposite previous examples that suggest a

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[51] Ober (1985).
[52] Ober's observations can be contrasted against those in the early 20th century by Lilian Chandler. "The North-West Frontier of Attica." *The Journal of Hellenic Studies* 46, no. 1(1926): 1-21.
[53] Ober (1985), 196.

defensive system in order to rationalize the existence of lines of sight or force a proposed visual network onto a topographical map. Whereas the previous examples paid little attention to the system overall, Ober does recognize a necessity for a hierarchy of signal transmission. He proposes three layers, or stages, of transmission in order to send a message from the borderlands to the central *polis*. First, an outer line comprised of watch posts, towers, and forts placed strategically throughout Attica's frontier monitored all routes approaching the *chora* and in most cases could have spotted the enemy 15-20km outbound.[54] From this line, a series of relay stations that were in direct contact with Athens would transmit all signals. A large number of posts fall into this intermediate category to address geographical obstacles that exist in the rural areas. Multiple 'routing'[55] options also provided redundant channels that could pass the message onto Athens. In this regard, Ober does hint at accounting for less than ideal weather conditions by stating the backup towers would transmit a message "even under inclement conditions."[56]

Despite these considerations, the reader is left in the dark as to what sort of signals were transmitted. The stations that are indicated as being closest to Athens are no less than 10km distant, a fact that is not granted any attention. Could a scout see a handheld torch at such a distance? Could torch movements required to transmit complex messages be distinguished? Ober cites an interesting passage from Thucydides as evidence for direct signaling across the

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[54] *Ibid.*, 196. No indication is given as to how a distance of 20km is selected but one should assume he refers to spotting large armies and the associated disturbance (ie. dust) they create in the landscape.
[55] See "Attica Visual Communication System" map. *Ibid.*, 110.
[56] *Ibid.*, 197.

20km between Boudoron, a fort at the northwest tip of Salamis overlooking the port of Megara, and Piraeus.[57] Thucydides' text is not clear as to how the signal was sent to the Athenians. Peloponnesian forces assailed the Boudoron fort and ravaged the surrounding area of Salamis.[58] Thucydides reports, "By this time fire-signals had carried the alarm to Athens."[59] This suggests one of two possibilities. In order for a signal to be directly visible over such a long distance, one would have to ignite a large beacon. An alternative is that smaller signals, likely handheld torches, relayed a message through a system of coastal forts until eventually reaching Piraeus.

In either case, history recounts that the means of transmission was less than perfect. Upon receipt of the signal, the Athenians became confused and, as Thucydides reports, believed that the enemy had taken Salamis and was on the move to Piraeus.[60] If confusion could arise in this segment of Attica's communication system then messages could break down anywhere. Ober attempts to provide a solution by linking Aeneas' recommendation that scouts be swift runners to the problem of signal misinterpretation. Following the initial signal which would bring the recipient to a heightened level of readiness, a scout would be dispatched and provide details on which the defender's forces could act. However, Aeneas clearly recommends swift scouts and the use of horses "where

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[57] *Ibid.*, 193.
[58] Thucydides 2.93-94
[59] A similar distance is involved with signals between Artemisium and Sciathus. Herodotus (VII.183) states that the Greeks "that had their station at Artemisium were informed...by beacons from Sciathus."
[60] Thucydides III.94; Ober (1985), 198.

signaling is impossible and information has to be conveyed by word of mouth."[61] Ober notes this section of Aeneas, but contradicts his previous statement:

> "In order to correct this problem [miscommunication to Piraeus] Aeneas (6.5) recommends that scouts be fast runners so that matters which cannot be signaled may be reported quickly."[62]

The tactician is not suggesting that scouts function alongside signals, but act only where fire was impossible to use due to terrain or distance. Ober's carefully thought out system is still at a loss to explain the finer details of how signaling alone occurred.

Ober does make one final attempt at suggesting how the Greeks would have used signals as a means of communication within the overall context of Attica's defenses. In the Histories, Polybius[63] dedicates a large section of Book X to existing signaling methods as well as providing his own suggestions on how further to refine procedures to allow the relaying of messages that are more complex. Ober logically cites Polybius' recounting of Aeneas' 'water jar' example as proof that the Greeks of the fourth century were in need of improved methods by which to transmit messages that included all details required for contemporary tactical considerations.[64] Although Ober does not include mention of Polybius' own work at further refining fire communication, the point nevertheless stands that commanders of the time required something more than

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[61] Aeneas 6.5

[62] Ober (1985), 198.

[63] Ober cites the system as an innovation of Aeneas, although the text of *Preparations* has since been lost. Only a brief reference in *How to Survive* (7.4) mentions Aeneas' work on signals. Polybius (X.43-47) discusses fire signals and does indicate that it was Aeneas' work. Nevertheless, it should be noted that this reference now only exists as a retelling of Polybius.

[64] Ober (1985), 198.

simple beacons indicating pre-determined messages. Yet this is as far as Ober goes in his analysis of visual communication used in Attica's fourth century defensive arrangement. While he proposes the use of certain methods of transmission, he does not provide a clear scenario of how practically to implement the methods described by ancient authors. The requirements of Aeneas' system are very different from that of a single large beacon. The latter would allow visibility over long distances while the former would have its visibility limited by the size of the torch but benefit from being handheld. An investigation of the mechanics of fire signals and examination of what the ancient authors said on the matter will now be undertaken in order to determine system criteria in the hopes of quantifiably analyzing signal transmission.

1.4 Mechanics of Fire Signals

As demonstrated above, existing studies of defense networks only marginally examine the means by which ancient Greeks utilized fire for transmitting messages between posts. Each author consistently looks at only one factor: visual connections between known sites with no intermediate topographical features blocking the lines of sight. No attention is paid to factors such as what a person would be able to see at certain distances, atmospheric conditions, weather trends, or any other quality that could affect the visual reception of discrete fire signals. Such factors are of primary concern in hoping to understand holistically how these systems functioned within the tactical landscape of fourth century Greece. Understanding the methods used by the ancients for fire communication over long distances is necessary before it is possible to suggest a series of criteria for analyzing system abilities. It should be noted that in many accounts and studies the differentiation between signals at night or day is not definitive. Despite this lack of attention, light signals sent at night must have been visible over a much further range when compared to similar conditions in the day.

Light and the simple presence or lack thereof has played a role in warfare since the earliest days of human conflict. Pre-classical cultures used torches made of rushes and bitumen to give signals.[65] Studies such as that of Forbes should be consulted for an exhaustive collection of ancient sources referencing the use of torches in cultures predating the Classical period.[66] In Greek literature one of the earliest mentions of fire transmitting a message describes how the news of Troy's fall was reported to Argos via capes and islands.[67] One can imagine a fantasy novel styled series of beacons being lit across the Aegean to signal Troy's defeat yet the matter of distance must nevertheless be examined even when considering the use of large beacons as simple transmitters. Diels argued that two steps in the recounted path would be 150km and 180km in distance, too far for the use of a fire signal.[68] Darmstaedter does mention that fires atop mountains in the Tyrol have been visible 80km distant and perhaps more in clear sky conditions.[69] He also calculates that a beacon lit on Mt. Ida would be visible at 240km distant[70]

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[65] R.J. Forbes. *Studies in Ancient Technology*. Volume VI. (Leiden: E.J. Brill, 1958), 169.
[66] *Ibid.*, 169-171
[67] Aeschylus, *Agamemnon* V.
[68] H. Diels, quoted in Forbes, *Antike Technik*, (Leipzig: Teubner, 1914), 71-90.
[69] E. Darmstaedter, quoted in Forbes. *Feuer-Telegraphie im Altertum*. Die Umschau. (1924), 28:505-507.
[70] *Ibid*.

while Appian mentions a fire being visible at a distance of 187km.[71] Nevertheless, in order to be visually perceivable as a deliberate signal, any long-distance beacon would have had to been of immense size and therefore limited in capability to either being lit or doused.

In the above situations, it is possible to transmit a simple signal by either handheld torch or large beacon fire. As the abilities of a beacon were limited to either being present or not present, in such cases the recipient must have been aware of current events (a major battle) and that a signal would represent a predetermined message (battle has been won). Lookouts stationed at the *polis* or a regional fort likely assumed that beacons appearing at guardian towers signaled the approach of enemy forces. All that was required in order to send a basic message was a way to create a beacon visible at the targeted lookout. Diodorus clearly states that "by means of *prearranged* fire signals" the Nabataeans were alerted to Demetrius' movements.[72] Persia's signal network was coupled with a messenger service which allowed a general warning to be sent quickly with the message details arriving by courier shortly behind.[73] Diodorus tells of Antigonus instituting a similar system throughout his Asian territories by establishing "a system of fire-signals and dispatch-carriers."[74]

Forbes[75] rightly brings attention to two accounts which at first glance suggest that complex relay system may have been in use prior to the tactical

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[71] Appian 12.67
[72] Dio. Sic. 19.97
[73] Forbes, 171. Diodorus (19.17.7) describes the Persian system as consisting of lookout posts stationed "by the distance at which a man's voice can be heard." Men stationed at each posts would have the "loudest voices" in order to shout the communiqué onward.
[74] Dio. Sic. 19.57.5
[75] Forbes, 171-172.

advancements of the fourth century. Herodotus recounts that following Xerxes' naval assault of Skiathos "the Greeks that had their station at Artemisium were informed of these matters by beacons from Skiathos."[76] Two questions that arise here concern the message itself and the distance of transmittion. Pre-arranged messages may not have been effective during the chaotic Persian assault yet may have been the only transmission possible given that the distance between Artemisium and Skiathos is approximately 20km. Herodotus could be interpreted as saying the fleet received the message while in a position closer to Skiathos, perhaps at the 10km point, but such a situation is unlikely. Any signaling bastion must have been designed with a certain destination in mind. Trying to reach a fleet at sea in what could have been extremely turbulent marine conditions was surely a desperate gamble at best. Forbes believes that a two-stage path with traditional, simple signaling could have alerted the forces at Artemision.[77]

Thucydides tells a similar story of a signal sent between the islands of Korkyra and Leukas.[78] He writes that the Korkyraeans, after enduring an assault from the Peloponnesian forces had, "at nightfall the approach of sixty Athenian vessels was signaled to them from Leukas." [79] In this text there appears to be little doubt that a beacon sent a signal from one island from the other, a distance of roughly 80km. Forbes believes that a single beacon transmitted over the entire

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[76] Herodotus VII.183
[77] Forbes, 171. He does not indicate what these two stages are. I envision an intermediate outlook at the northeast corner of Euboea that would be visible to both Artemisium and Sciathus.
[78] Leucas itself had a number of towers throughout the island. Sarah P. Morris, "The Towers of Ancient Leukas: Results of a Topographic Survey 1991-1992," *Hesperia* 70, no. 3(2001): 285-347.
[79] Thucydides 3.80

distance,[80] but there is also a possibility that a relay was used through the intervening islands of Paxos and Antipaxos which lie roughly 55km from Leukas. Such a hypothesis would require the testing of possible lines of sight to ensure a suitable relay point could be located but is no less likely than a single beacon used over the entire distance of 80km. In the absence of any experimental archaeological studies to confirm the visual abilities of large beacons, only the aforementioned sources suggest signal distances. These two small situational studies suggest that simple beacons could relay messages over a great distance. However, the difficulty did not lie in single beacons but methods used once the Greeks invented a variety of signals that did not rely upon pre-designated messages.

A signal beacon in its most basic form indicates only a pre-determined condition. While theoretically useful over large distances, the possible signals of a single binary system can only indicate limited information. If Ober's assumptions about the development of complex regional defense networks are true,[81] regional commanders would have required matching advancements in signaling. This assumes that Greek warfare advanced beyond traditional hoplite strategies beginning in the early 4th century. If Greek tactics had remained static, Ober's hypothesized advances in signaling and increasingly efficient tactical response times may not have been necessary. This was not the case, as detailed

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[80] Forbes, 172.

[81] Harding presents a rebuttal to many of the basic arguments of Ober. However, I find that his attack, which can be described nothing short of zealous, on Ober misunderstands many of Ober's underlying arguments. Ober addresses these concerns in his later rebuttal. P. Harding, "Athenian Defense Strategy in the Fourth Century," *Phoenix* 42, No. 1 (Spring 1998): 61-71; Josiah Ober, "Defense of the Athenian Land Frontier 404-322 BC: A reply," *Phoenix* 43, no. 4 (Winter 1989): 294-301.

by Ober's background discussion. An array of forces, such as lightly armed skirmishers, started to supplement the formerly singularly hoplite forces of the Classical era. Furthermore, as the following section shall demonstrate, the Greeks had to address the emergent field of poliorcetics. Descriptions of how tacticians developed fire signaling throughout the fourth century can be found in the writings of Greek authors who examine the issues of warfare and sieges, such as Aeneas, Polybius, and Polyaenus. Proper communication became a vital matter if the home base was to know how and in what force to render assistance during this turbulent and changing era.[82]

From simple signals the ancients moved to inventing a variety of ways to use fire in relaying complex messages. Forbes lays out two scenarios in the movement towards the so-called "pyrseutic method" propagated by Sextus Julius Africanus in the late 2nd century AD: one could hold up a torch and then move if up, down, and circularly or one could invent a code based upon the simultaneous lifting and showing of one or more torches.[83] Fortunately, both Polybius and Aeneas include detailed descriptions of signal methods in their tactical essays. Aeneas likely[84] wrote in the mid-fourth century BC, the same period when the Athenians and other Greek territories were establishing regional networks. He proposes a system where both the sender and receiver have large pots filled with water located at the signal station.[85] Once both parties have their torches aloft they lower them together while simultaneously allowing water to escape the jars

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[82] Forbes, 174.
[83] *Ibid.*, 172.
[84] See the introduction of Whitehead's translation of Aineias' *Siege* for a discussion of its dating.
[85] Aineias 7.4, Polybius X.44

through apertures in the jug. Marked segmentations on a rod attached to a cork indicated the desired message. Once the appropriate message lines up to the top of the vessel, the messenger raises his torch again to indicate the recipient should plug his vessel's water drain. The segment of the stick at the jar's mouth indicates one of a number of pre-determined messages.

Despite the system's ability to relay an actual message, is still had the major limiting factor of how many segments one could inscribe on the jar's rod.[86] Polybius felt that Aeneas' "device still fell far short...as can be seen from the description of it"[87] and proposed an alternate system that allows the direct transmission of any message. Only providing a brief summary is within the scope of this thesis as a result of the complexities of the signaling system, although Polybius X.43-47 includes a full explanation. He suggests that each party have five tables, each with a division of the alphabet written upon it. The signaler uses a number of torches (flashes) on his left side to signify which tablet should be consulted while flashes on his right side indicate which letter on the tablet should be written down. Polybius mentions the use of a 'telescope,' but this device was only a sighting device with two tubes that would separate the observer's field into two separate halves so as to distinguish the two torches.[88] Fire signals were still not without problems. Many men and many stations would have been required to

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[86] Aeneas suggests separations of three fingerbreadths. Smaller segments could result in accidental overlaps if the scout did not stop the flow of water quick enough.
[87] Polybius X.44.1
[88] Polybius X.46.1

transmit a message accurately over a reasonable distance because of visibility issues and avoiding any terrain blocked sightlines.[89]

As both the system of Aeneas and Polybius date to approximately the fourth century, the designers of Thessaly's regional defense systems likely constructed towers while keeping in mind the requirements of advanced signaling theory. A conclusion is that as *poleis* turned their defensive interests towards the entire *chora*, contemporary tacticians were concerned with ensuring relatively detailed and accurate messages could be signaled by means of fire throughout their networks. While implementing either Aeneas or Polybius' system, the defenders certainly found that the major limiting factor was viewing distance. Torches must be distinguishable to such a degree that they are effective discrete signals. The recipient would not only be required to see the motions of raising and lowering a torch but also, in the case of Polybius' proposal, distinguish between torches on either side of a signaler. It was not until the third century AD that Sextus Julius Africanus suggested the improvement of having "fields in the middle,"[90] referencing an increased distance between the torches. Forbes believes that increasing the distance to 10m would result in visibility at the range of 10km,[91] although Africanus' suggested separation did not come into effect for hundreds of years after Greek military dominance.

Despite bonfires being potentially large and bright enough for far distance signaling due to their size relative to a handheld torch, the historical texts suggest that the complex systems developed in the fourth century were not effective over

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[89] Forbes, 176.
[90] Africanus, *Kestoi* 77.
[91] Forbes, 176.

distances of ~20km. Distances of 10km or less are more likely to be manageable given the need to account for visual separating torches on either side of the signaling parties in the case of Polybius' outlined system. Soldiers with superior eyesight were an option, but Aeneas does not mention this quality in his description of the ideal scout. Instead, he says that the scouts should have "experience in war...to avoid any one scout's ignorantly supposing that something is important."[92] Thus while the scouts may see an approaching army,[93] fleet, or other instance at a great distance they were not necessarily able to relay the message over an equal distance. When accounting for fluctuating weather and the necessity to signal during the day[94] as well as at night there is little doubt that complex fire signaling must have occurred between distances of 5-10km.

This complex change in warfare was matched by the complexity of Thessaly's tactical situation throughout the 4th century, despite being somewhat isolated from the major centres of the Classical area. Local attempts to unite Thessaly followed by Macedon's march southward created a complicated political and tactical landscape. A proper contextual setting is required before the matter of visibility between towers of the Othrys system is considered. The following section shall investigate the political scene of fourth century Thessaly and consider the changing nature of warfare during the period.

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[92] Aeneas 6.1

[93] Caesar reports that when a Belgic army camped two Roman miles away, the fires and smoke showed the camp to be seven miles round. (Gallic War 2.7)

[94] As previously noted, sources contain significant lack of detail to the difference between signaling in the day as opposed to the night. Several accounts, such as those of Thucydides, do detail signals sent at night that suggest a further transmission distance was possible. However, one cannot assume that the same can be said of the daytime. Due to the lack of hard evidence as to how signals appear in the day, I am left to propose a lower range distance of 5km as a distance over which signals could still be seen during the day provided skilled scouts who were highly trained in their duties.

Chapter 2: Kastro Kallithea and its regional and strategic setting

It is impossible to study any aspect of the Greek defensive tactics without understanding the context surrounding the construction of the Othrys system. Through an examination of the region's history it is clear that Thessaly would not have been unaware of emerging theories and techniques in the realm of defensive architecture and regional strategies. As the western anchor of the Achaia Pthiotis' defense, Kastro Kallithea provides a glimpse into the minds of the region's planners and assists us in understanding their strategic decisions. While the walls and towers of the area may not be on the same grand scale as Syracuse, Athens, or other larger *polis* found to the south, what was constructed was done by conscious decisions and in no way represent a lack of will or resources. Summarized below are the objectives of this section:

1. Discussing the overall political situation of Thessaly during the fourth century. Kallithea, Halos, and numerous other *poleis* in the plains of Almiros are a product of complex political interplay during this period. Nearby sites also demonstrate similarities in construction style and defense theories which may suggest shared architects and/or funding patrons.
2. Determining whether or not Kallithea can be considered contemporary to the rest of the Othrys system, which includes the site of New Halos, using dating evidence from Kallithea. As many of the mountain forts have little

datable evidence the use of architectural style for the purpose of dating and the associated challenges in such methods shall also be considered.

3. Establishing the possible height of the walls and towers at Kallithea for use in the viewshed analysis section of the analysis. An increase of even a few meters above ground can greatly aid scouts at an observation tower and therefore a reasonable hypothesized height for Kallithea's posts is necessary.
4. Examining the development and dispersal of Greek catapult technology to address whether or not these new forms of siege weapons would have posed a serious threat to Kallithea. If they did, very specific choices made in the design of Kallithea's defense may be found that could effectively act as the eastern stronghold of the Othrys system.

2.1 Thessaly

Kastro Kallithea is located within Thessaly, a region of Greece with a climate and geographical setting markedly different from other districts of Greece. The interior has the highest concentration of plains in the country and lacks the sharp geographical delineations which so easily separated states which nonetheless lay close to each other elsewhere in Greece. Characteristics including unique terrain allowed Thessaly's post-Dark Age development to follow a path divergent from the typical Greek polis, a process which has recently been further investigated by scholars, detailed below.[95] Older models held that the federal

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[95] Basic elements of Thessalian political history are somewhat clear but the situation quickly breaks down when one attempts to detail exact processes. Aristotle's account of Thessaly's

Thessalian state had its origins in large 'baronies' of the Archaic and Classical periods.[96] Morgan rejects this concept as erroneously reinforcing the impression that war was the sole basis of national unity.[97] However, Archibald stresses that the relationship between power, territory, and urban centres is likely to have been a complex matter in Thessaly.[98] Morgan's study of big site development at Larisa and Pherai presented three different archaeological stories of regional growth, complicated even more so when the list of Thessalian cities in the *Catalogue of Ships* is considered.[99] Owing to such complexities, an indepth description of Thessaly's geography and history prior to the late 4th century is outside the scope of this paper, but to present some introductory background information is useful in order to provide a context for the present study. Detailed information on Thessalian city-states will be limited to those in Achaea Phthiotis which are of immediate concern in their potential relation to Kallithea.

Thessaly's primary units of geographical division during antiquity were its four main plains: Thessaliotis, Hesiaeotis, Pelasgiotis, and Phthiotis.[100] Known as tetrads, their confines were based upon the natural delineation of the plainland. All together, the total extent of these lands, which owe their unique flatness to

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Classical-era constitution is almost completely lost while other surviving sources are generally fragmented. See B. Helly, *L'état Thessalien: Aleuas le Roux Les Tétrades et les Tagoi* (Lyon: Maison de l'Orient Méditerranéen, 1995).

[96] H.D. Westlake, *Thessaly in the Fourth Century BC,* (Groningen: Bouma's Boekhuis NV, 1969), 21-23.

[97] Catherine Morgan, *Early Greek States Beyond the Polis*, (London: Routledge, 2003), 24

[98] Zosia Halina Archibald, "Space, Hierarchy, and Community in Archaic and Classical Macedonia, Thessaly, and Thrace," In *Alternatives to Athens: Varieties of Organization and Community in Ancient Greece*, eds. Roger Brock and Stephen Hodkinson, 212-233, (Oxford: Oxford University Press, 2000).

[99] Morgan, 102; Strabo 9.5

[100] Strabo, 9.5.3

being an ancient inland sea, amounts to ~6200km^2.[101] These tetrads were also political constituencies, referred to in this sense as tetrarchies, and from their foundation came a unified, although short lived, Thessalian state in the late 6th century.[102] Today, the plains are divided roughly into municipal districts. Pelasgiotis is known as the plain of Larisa while Hestiaeotis and Thessaliotis are now combined as the plain of Trikkala. Phthiotis does not have a true modern counterpoint while the plains of Volos and Almiros are roughly the territory of ancient Achaea Phthiotis.[103] Bordering Thessaly are several mountain ranges: the Othrys to the south, Pindus to the west, Mts. Pelion and Ossa in the east[104], and a number of chains including Mt. Olympus to the north. Of interest to Kallithea's setting are the Narthaki mountains which force east-west roads to pass either north through Pharsala or south past Kallithea.[105]

Tribal movement into Thessaly during the 12th and 11th centuries is associated with a period in the Dark Ages when foreign groups began to enter the peninsula. One theory relating to slave groups in Greek society, such as the helots, states that existing populations were overwhelmed by the immigrating

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[101] Westlake, 2.
[102] Plutarch, *Moralia*, 492; Aristotle, *Fragments*, 497-8.
[103] H. Reinder Reinders, *New Halos: A Hellenistic Town in Thessalia, Greece*, (Utrecht: HES Publishers, 1988), 17. Reinders and Westlake vary slightly in their geographical representation of the ancient tetrads and bordering lands. See Reinders 22 vs. Westlake's map of Thessaly. Reinders representation of the plains is mirrored in Wieberdink 1990 and Berndt Jan Haagsma, Zoï Malakassioti, Vasso Rondini, and Reinder Reinders, "Between Karatsadagli and Baklali." *Pharos* 1 (1993): 147-67.
[104] The Aegean Sea is to the east of Thessaly but separated from the plains by these steep coastal mountains. There are no sheltered harbours here as can be found along the Pagasitic Gulf. Reinders (1988), 17.
[105] Appendix H, Figs. 2 and 3.

populations.[106] The newcomers, being ethnically different, were able to treat the existing population as a lesser class because of the ethnic separation. Various authors report that whereas the Dorians themselves pressed south deep into the Greek peninsula, a group known as the *Thessali* settled in the northern plains and gave their name to the region.[107] Existing populations either migrated, as did the Boeotians, fled into the mountain districts where they became known as Perioeci,[108] or were subdued by the invaders into a serf-class called the Penestae.[109] Although the Penestae were never subjugated to the same degree as the Helots,[110] their presence nevertheless allowed the early aristocracy to develop into a wealthy aristocratic class, although room was left available for the small-holdings of free peasants.[111]

Before the emergence of dominant communities, the settled invaders organized into *έθνη* with the aristocratic estates falling into one of the four tetrad districts which existed as independent states at this time.[112] No major ethnic divisions separated the tetrads so it was almost natural that some form of union emerged with which to promote matters of cross-tetrad concern. Towards the end of the seventh century an ambitious project, spearheaded by Aleuas, was

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[106] Sarah B. Pomeroy, Stanley M. Burstein, Walter Donlan, and Jennifer Tolbert Roberts, eds., *Ancient Greece A Political, Social, and Cultural History* (Oxford: Oxford University Press, 1999), 98.
[107] Herodotus 7.176. Thucydides 1.12.2
[108] The Perioecic regions economically relied upon Thessaly but had political autonomy as implied by their separate representation in the Delphic amphictyony. Morgan, 23.
[109] Morgan, 191.
[110] Aristotle (*Politics* 2.6.2) presents the penestai as repeatedly arising against their masters while Plato (*Laws* 776c-d) and Pollux (3.83) rank the 'ethnos of the penestai' at the opposite end of a moral spectrum from the handling of the helots.
[111] Strabo, Geography 9.5, Pomeroy *et al*, 98.
[112] Westlake, 24.

undertaken to unite the whole country into a single state.[113] This was not to be a permanent union, but a means by which to organize a combined national army either against an invading force or for the purpose of a specific campaign outside of Thessaly. This military κοινόν was lead by an elected ταγός who was to hold the office only until the current crisis was over.[114] During times of peace tetrarchs were in charge of all local administrative matters, no doubt in conjunction with some kind of ruling council.[115] During the first half of the sixth century a unified Thessaly had possibly the strongest military in all Greece and was poised to control a significant percentage of central and northern Greece, including Boeotia.[116] Nevertheless, for whatever the cause centralized leadership wavered and the region fragmented back into its four major districts by the late 6th century.[117]

Although the tetrarchies remained a basic political unit in Thessaly, by the fifth and fourth centuries urban centres developed and assumed the responsibilities of local administration.[118] Three cities quickly emerged as dominant centres in Thessaly, perhaps since they were the home bases of major aristocratic families which vied for the office of the ταγός: Larisa, home of the Aleuadae; Pharsalus, home of the Echecratidae; and Krannon, home of the

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[113] Westlake, 25. Herodotus 7.6 calls the Aleudae "princes of Thessaly."
[114] Pomeroy *et al*, 126. In reality members of leading aristocratic families, who were the real holders of power, would to their best to find ways to remain in the tageia office as long as possible. Although irksome to rival families, outside of campaign seasons political maneuvering about this office had little effect on everyday citizenry (Westlake, 26).
[115] Westlake, 27.
[116] Xen. *Hell.*, VI.1.7-10, 4.20-37.
[117] See Westlake, 29-30 and Pomeroy *et al*, 126 for several theories as to why the centralized government wavered. Westlake's belief that the aristocratic class allowed their infighting to cause detriment to the overall state finds strong correlative support in example from medieval Europe where a similar governing system arose.
[118] Westlake, 8.

Scopadae.[119] Krannon and the Scopadae disappear from notice by the end of the 6th century while Larisa and Pharsalus remain strongly present in the historical sources.[120] Together with Pherae they became large *poleis* through attracting rural outsiders and begin to exert direct control over their surrounding territories, thus negating the role of the tetrarchies.[121] Thessaly's written history becomes a quiet affair until the end of the fifth century when Lycophron becomes tyrant of Pherae in 405 BC.

Thessaly's wide plains, lack of land-hunger, and strong tradition of aristocratic nobles who quickly adapted themselves to city aristocracies meant that the region had not succumbed to the typical pre-democratic condition of tyranny experienced by so many other Greek city-states.[122] Nevertheless, not only did a strong tyranny establish itself in Pherae but it also became a source of major political upheaval. Delving deeply into the details of Lycophron's ascension is not required beyond examining how he founded his rule upon the strong local economy. Pherae and its associated port of Pagasae[123] allowed Lycrophron to create a strong export industry, particularly through controlling Thessaly's grain industry following the tumultuous years of the Peloponnesian Wars.[124] Much of Greece was in the market for grain and Lycrophron was able to

[119] B. Helly, *L'état Thessalien: Aleuas le Roux Les Tétrades et les Tagoi* (Lyon: Maison de l'Orient Méditerranéen, 1995), Ch. 2.
[120] As Morgan points out, a 'big site' with a long settlement history could change role in relation to neighbouring settlements. There is no surprise that Krannon should become politically obscure in the written histories. Morgan, 164.
[121] Westlake, 35-37; Archibald, 212-13.
[122] Westlake, 47.
[123] Pagasae and Demetrius are essentially the same site. Friedrich Stählin, Ernst Meyer and Alfred Heidner, *Pagasai und Demetrias* (Berlin: Walter de Gruyter, 1934).
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[124] Westlake, 49.

supply it, thus enriching both himself and the commercial classes of Pherae all while cementing his tyranny by ensuring economic success. Although he openly declared his ambition to rule over all of Thessaly[125] and had the monetary resources to hire mercenary armies, his goal was never achieved despite entering into a treaty with Sparta and winning several key battles against Larisa and its Macedonian allies.[126] His death left his ambitions of a unified Thessaly to his successor, Jason.

Little is known about when and how Jason came to power, but no doubt he entered into a political realm where Thessaly was separated into numerous evenly matched cities and factions that, unable to revive the χοινόν on their own, relied upon foreign intervention in order to gain the upper hand.[127] The situation must have changed as when Jason does appear in the historical record he had already exerted his power over most of Thessaly's leading cities while also removing the threat of external politicking in the area's affairs.[128] As with his initial rise to power, details are lacking regarding how Jason was able to gain control of Thessaly, including Larisa which had been hitherto the main source of opposition to Pheraean tyranny. Westlake suggests that it was a combination of factors which afforded Jason his successes.[129] Pherae's wealth was a boon which allowed Jason to maintain a standing army of 6,000 men that, as trained mercenaries, was more than a match for opposing aristocracies' collection of

[125] Xen, *Hell*, II, 3,4.
[126] Foreign intervention became a hallmark of Thessalian politics in the 4th century with the exception of Jason's administration.
[127] In general Pherae had become aligned with Spartan while Larisa relied upon both Macedon and anti-Spartan allies at varying times. Westlake. Ch. III.
[128] Westlake, 71.
[129] Westlake, 71-72.

quickly raised hoplites and cavalry. Jason himself must have had a charismatic personality, under which he could rally the citizens of Pherae, and possessed a strong political guile.[130]

By 370 BC Jason was in a position to exert Thessalian influence over the rest of Greece. His foreign policies had allowed him to stay out of the conflicts which engulfed central and southern Greece while still managing to play a major role at Leuctra, mediating terms between the Spartans and opposing allies.[131] Weak alliances with the victors maintained neutrality while offering no future constraints on Thessaly's expansion. An informal friendship with Athens did not impede future naval aspirations in the way a formal alliance would have but still maintained good standing with Athens and her allies. Although he positioned himself well politically, rumours about his empirical aspirations began to circulate following the announcement that he intended to attend the Pythian Games in August and September of 370 BC.[132] Thessalian cities were ordered not only to prepare sacrifices but to mobilize the national army, leading to whispers that Jason was preparing to seize the Delphic treasures and begin conquering Greece.[133] Whatever his intents, they would not come about. When inspecting

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[130] Jason's strong political sense is demonstrated by the way which he took Pharsala from Spartan influence, as chronicled by Xenophon. Polydamus, a tyrant of sort installed by Sparta in Pharsala was summoned by Jason and issued a frank ultimatum. Polydamus was promised a partnership in Jason's Thessalian order if he submitted. Otherwise, Jason urged him to ask for a 'large army or none' from Sparta to defend the city against Jason's combined might. As Sparta was occupied against Athens in a naval battle and against Thebes on the land prior to the peace of 374 Polydamus was forced to submit. Xen. *Hell*. VI; Westlake Ch. IV.
[131] Westlake, 89, 93-95; Xen. *Hell*., VI.4.
[132] Xen. *Hell.*, VI.4.29-30. Jason's plan demonstrates that the boundaries of poleis borders were quite permeable, particularly when dealing with large forces. Xenophon reports here that Jason's plans included bringing no fewer than 1000 cattle and 10,000 other animals to the Pythian Games as sacrifices.
[133] Westlake, 97-98; Xen. *Hell.*, VI.4.30-31.

Pheraean cavalry in the early summer of 370 BC seven young men, pretending to be in an argument, fell upon Jason and ended the dreams of a unified Thessaly.[134]

Following the death of Jason, the fate of Thessaly was intertwined with that of Macedon. Philip II gained influence through various means, such as marrying Philinna of Larissa[135], culminating in his assumption of the Thessalian League's arconship following the battle of the Krokian Plain in 350 BC. Later, Alexander the Great, upon his own ascension to the Macedonian throne, assumed his father's Thessalian role. Philip had a great influence on the regional politics of Thessaly and may have played a pivotal role in the development of both Kallithea and the Othrys Mtn. forts through his campaigns in Achaia Pthiotis and siege of Old Halos in 346 BC.[136]

Within Thessaly a number of cities, many of which are previously mentioned, were centres of political and military action during this period. As a number of ancient sites surrounding Kastro Kallithea are of importance to the final analysis, a short catalogue of relevant cities is provided below. Specific attention will be paid to the following sites which existed in the landscape of 4th to 3rd century Thessaly when Kallithea was active: Pharsala, Halos, Phthiotic Eretria, Demetrias, and Goritsa.

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[134] Westlake, 100; Xen. *Hell.*, VI.1.9-10; *Hell.* VI.4.32-33.
[135] Matthew W Dickie, "The Identity of Philinna in the Philinna Papyrus," *Zeitschrift für Papyrologie und Epigraphik* 100 (1994): 119-122.
[136] Strabo (9.5.8) informs the reader that the territory of Halos was given to Pharsala.

2.2 Thessalian Poleis

Pharsala

Pharsala was very prominent in Thessalian history and both its built form and geographical setting are important factors therein. Pharsala's acropolis lies 16km to the northeast of Kallithea and has a number of architectural remains, especially when compared to the lower city where the modern town has covered much of the ancient habitation zone. Significant sections of the remaining fortifications are of a style similar to what is seen at nearby sites and conform to a Hellenistic date.[137] Commencing in the mid-4th century, Pharsala would have had an interest in the Krokian plains and territory of Kallithea upon its acquisition of Halos' lands, those of Kallithea lying immediately between the two. It is thus a serious tactical misfortune that the forces of Pharsala would have had a good view of neither Kallithea nor Halos due to the Narthaki Mountains and several other isolated hills blocking lines of sight from Pharsala's acropolis.

A solution was the establishment of a small fort on the eastern tip of the Narthaki Mts. immediately overlooking the modern village of Narthaki. Modern day remains are far from clear as most of the rubble walls have collapsed into unintelligible piles. Several sections of wall are somewhat visible in the rubble and the overall nature of the site is similar to the forts and walls of the Aniforitis system that lines a mountain ridge near Salganeus.[138] Even if the walls were preserved or clearly delineated, rubble walls are challenging to date without

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[137] Wall stones are cut in isodomic trapezoidal style and finished with *randschlag*. The other two construction phases visible are Classical and a much later Byzantine phase. The enceinte of the lower city is clearly associated with the Hellenistic building period. S. Katakouta, and G. Toufexis, "Τα τειχη της Φαρσαλου," In *Quinze Années*. (Athens), 189-200.

[138] Bakhuizen (1970).

collaborative evidence. What is clear is that from this point one can clearly see Kallithea, Pharsala, and much of the surrounding plains.

Phthiotic Eretria

Eretria is situated on a prominent hill 12km to the north east of Kallithea, located in Achaea Phthiotis between the Krokian plain and Enipus valley.[139] Despite their proximity, Kallithea and Eretria are not intervisible thanks to intervening terrain, although the hill of Xylades could have served as viewshed mid-point. Its acropolis lies along the southern face of the hill, presenting a formidable cliff face to the modern road. The hill slopes down to lower terrains along its north face where the remains of the ancient enceinte are found. In the 1980s, this site was surveyed by Blum, whose description includes several towers found along the northern wall or integrated into the city's gates.[140] Much of the north wall and towers were heavily covered in vegetation during summer 2008, although reaches of the wall along the east and west slopes were in remarkable condition and possessed two intact posterns. Most of the gates were distinguishable, although those along the north wall were difficult to recognize.

Current evidence suggests Eretria's urbanization dates from the early Hellenistic period.[141] Inscriptions and grave stelae are clear indicators of occupation in the mid-Hellenstic period while also demonstrating a level of

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[139] Appendix H, Fig. 5.
[140] I. Blum, "Die Stadt Eretria in Thessalien," In *Topographie Antique et Géographie Historique en Pays Grec*, ed. E. Blum, 157-235 (Paris: Centre National de la Recherche Archéologique, 1992).
[141] I. Blum, *Die Stadt Eretria in Thessalien: Survey, Bauaufnahme und historische Einordnung*, (Ludwig-Maximilians-Universität. November 1981), 118-122, 129.

economic subsidy which could afford luxury goods.[142] Construction style of the enceinte suggests a late 4th century date as the stones are in isodomic trapezoidal style and are very similar to the walls of Kallithea, Halos, and Pharsala. All sections of the wall, including the acropolis, are built in the same manner and suggest a single construction phase.

Eretria must have been of some significance despite its close proximity to Pharsala, Kallithea, and Demetrias. A high concentration of both gates and posterns in relation to the enceinte's interior space suggests that a great deal of in/out movement occurred between the protected portions of the hill and its outlying regions. Considering the lack of public buildings which one would expect to find in such a well fortified hill, it may be that Eretria's enceinte was built as an emergency defensive position for people living in the area during insecure Hellenistic periods. If the city was indeed a major player in the landscape and not simply providing a first level of defense, one would expect the wall to have a higher number of towers, particularly on the northern slope where enemy engines could easily have been brought into range.

Halos

Of present concern is the city now referred to as New Halos as opposed to the former Classical city of Old Halos. "Old" Halos was a *polis* destroyed by Philip's general Parmenion in 346 BC following the city's opposition to the

[142] M. Dannbauer, "Urbanization in Hellenistic Thessaly," (MA thesis, University of Alberta, 2006), 50, 104-5.

Macedonian faction during Philip's war against the Phokians.[143] Following the city's destruction, the *chora* of Halos was handed over to Pharsala, which had remained pro-Macedonian throughout the mid-4th century struggles. New Halos refers to the Hellenistic city, likely founded in 302 BC by Demetrios Poliorcetes, located at the eastern point of the Othrys between the mountains and the sea.[144] In this thesis "Halos" will refer to the Hellenistic City. The acropolis of Halos is 25 km to the east and slightly south of Kallithea, from which the acropolis is somewhat visible in good climate conditions.[145] Today a Byzantine fort sits atop the acropolis while the main Hellenistic enceinte is located at the eastern foot of the Othrys Mountains.[146] The city itself is in no way visible from Kallithea because of the positioning of the Othrys range. Reinders has conducted research at New Halos and the surrounding area since the mid-1980s.

Halos' location places it in complete command of the north/south pass that allowed entry into the plain of Almiros from the small plain of Sourpi to the south, which was in turn accessible from Lamia along the northern shore of the Malic Gulf.[147] The only other route that would have been easily passable by large invading forces, particularly if they were supporting a baggage train, is from the plain of Karditsa through the Enipus valley to Domokos and Lamia.[148] Its setting on level ground below a mountain is unusual in Greek city planning, particularly since attacking forces could easily have bombard the city from neighbouring

[143] *Ibid.*, 162, 42-43. The exact location of the original habitation site is still disputed but may have been atop the Magoula Plataniotiki. The destruction is attested by Demosthenes (19.39).
[144] *Ibid.*, 180.
[145] This observation is based upon my personal experiences in the field.
[146] Reinders (1988), 35.
[147] Wieberdink (1990), 47.
[148] *Ibid.*, 47. Kallithea's location allows it to control any roads near the Enipus' entry into Achaia Pthiotis.

heights.[149] The city's ability to completely control the narrow pass must have outweighed potential risks. Its founders took precautions by surrounding the spur of the mountain with two walls that emanated from the western corners of the city's enceinte and met at the peak of the acropolis. Although the Byzantine fort now covers the apex, it is likely a battery was originally at the point of convergence in a manner similar to that at Alea.[150]

As it was abandoned within 50 years of its foundation,[151] the site grants a valuable case study of Hellenistic city construction in the region of Achaia Pthiotis during the late 4th/early 3rd centuries. New Halos is a large site encompassing 41 hectares within a well built Hellenistic enceinte supported by 70 individual towers.[152] The construction technique is very similar to Kallithea's with the same masonry style and mud brick atop stone socle construction. Reinders has calculated that the population could have ranged between 7,200 and 11,500 inhabitants, which further supports that the new foundation was a full *polis*, as was its predecessor, and not just a fortified garrison.[153] Together with Kallithea and the forts of the Othrys mountains, Halos was a site vital in the defense of Thessaly's southern borders.

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[149] Reinders (1988), 57-58.
[150] *Ibid.*, 59.
[151] Halos was again destroyed in 265 BC. Evidence from the southeast gate suggests the abandonment was the result of a fire.
[152] Reinders (1988), 192-193.
[153] *Ibid.*, 193.

Demetrias

At the northern tip of the Pagasitic Gulf lie two sites located at the periphery of Kallithea's area of influence and that of Achaia Pthiotis overall. Despite their distance, both sites are useful to consider as they are very much contemporary to the construction activities carried out throughout the region during the second half of the fourth century. The first is Demetrias, a city founded by Demetrios Poliorcetes in 294 BC to serve as a new Macedonian capital closer in proximity to his territories in central and southern Greece than any base in Macedon could provide.[154] Its population was collected via a *synoecism* of citizens from Pagasai, beside which Demetrias was founded, and the inhabitants of neighbouring townships.[155] Demetrias' foundation demonstrates the power Macedonian rulers had to initiate projects that required concentrated resources.[156] At what could be seen as nothing more than a whim, Demetrios created a major city which significantly altered the political landscape of northern Achaia Pthiotis and the area encircling the Bay of Volos.

Although the walls encircle a total of 440 hectares,[157] only 90 hectares are developed.[158] The remainder of the walled territory was enclosed as to prevent enemy forces from gaining any of the high ground surrounding the port's primary area of inhabitation. Its walls are typical of constructions dated to the late fourth century, being trapezoidal isodemetric, and consisted of a mudbrick

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[154] Anthi Batziou-Efstathiou, *Demetrias,* (Athens: Ministry of Culture Archaeological Receipts Fund, 2002), 9.
[155] Plutarch, *Lives* Demetrius, LIII.
[156] Archibald, 229.
[157] Batziou-Efstathiou, 17.
[158] Reinders (1988, 193) proposes that the population of Demetrias could have varied between 16,000 and 20,000.

superstructure atop a stone socle,[159] a building style which may have been employed at Kallithea. As Demetrias was inhabited for a number of centuries, its fortifications serve as an example of how defensive thinking evolved over time until their destruction in 167 BC.[160] Several of the enceinte's towers are of particular interest in examining the development of using towers as both artillery platforms and signaling bastions.

Upon excavation, four separate expansion phases were uncovered around Tower 43's original core.[161] At the centre lies the first Hellenistic tower, still topped with remains of mud brick.[162] The remaining expansions suggest rushed constructions as many of the interior facing blocks are highly finished and resemble stone found on the faces of major public structures. Bases of grave stelai were also incorporated into the fill which suggests a hasty repair of the towers in 88 BC.[163] The incremental size expansions at Tower 43 suggest changing space requirements for the most modern siege weapons. Authors also attest Demetrias as a major receiving station for visual signals, such as Polybius' account of torches used to transmit information about enemy movements from Mount Tisaion to the city.[164]

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[159] Tower 43 still had the remains of semi-dissolved mud brick atop the stone foundations when it was initially excavated (Stählin, Meyer and Heidner, 36-37). Most of the wall remains are embedded in embankments of yellow soil, contrasting greatly with the natural grayish soil, which is further evidence of mud brick construction. Bakhuizen, (1992).
[160] Batziou-Efstathiou, 15.
[161] Also referred to as "Tower A" in sources.
[162] A personal visit to the site in summer 2009 showed that a substantial part of the superstructure is still present, although nowhere near the original excavated mass.
[163] Batziou-Efstathiou, 19.
[164] *Ibid*.; Polybius X.42.7-8

<u>Goritsa</u>

The second peripheral site if located west of Demestrias across the Bay of Volos. Lying on a spur of Mt. Pilion located at the eastern fringe of the modern city of Volos is a fortified site on the Goritsa hill. During the 19th century writers associated these remains with the city of Demetrias, a hypothesis which was since been rejected with the discovery of Demetrias' actual location on the opposite side of the Volos bay.[165] Alternate names of Iolkos, Neleia, Orminion, and Magnesia have all been suggested although no final conclusions have been made in the matter.[166] Bakhuizen and his team simply refer to it as the Goritsa settlement in a manner similar to the naming of 'Peuma' as Kastro Kallithea in the absence of irrefutable evidence.

Goritsa's interior contains a built up area of 17.5 hectares which could have accommodated between 2,000 and 3,500 inhabitants.[167] A mixture of regularly laid housing blocks, hypothetical public areas, and an assortment of domestic finds demonstrates that this site is a full city and not just a military camp.[168] Bakhuizen suggests its foundation to have been in the mid to late 4th century, perhaps in association with Philip's Magnesia building projects beginning in 352, but occurring certainly before the founding of nearby Demetrias.[169] Goritsa had a short habitation period, much like New Halos, as it was quickly abandoned following the establishment of Demetrius' new capital.

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[165] See Bakhuizen (1992) 33-35 for a summary of research carried out at Goritsa.
[166] *Ibid*., 315.
[167] Reinders (1988), 193
[168] Bakhuizen (1992), 313.
[169] *Ibid.*, 313.

As such it is another useful example of what construction methods and tactical matters would be considered in a new foundation during the late fourth century.

As Goritsa's location is at the periphery of the study region is will not be considered past the above. A final note is in regards to which region it is more closely associated with is in order. Goritsa may have been part of a proposed defense network in Magnesia. Wisse's overview of state formation in the ethnos of the Magnetes goes so far as to suggest that Goritsa was the primary site of the state formation of Magnesia and a key position in the organization of the region's defensive system.[170] Nevertheless, Phthiotis' proximity to the south certain influenced the site's location at the southern most part of Magnesia. With the establishment of Demetrias, the settlement of Gortisa quickly fell into disuse and its remains 'fossilized' from 294 BC onward.[171]

2.3 Kastro Kallithea

Modern archaeological work at Kastro Kallithea began in the spring of 2004 when a team from the University of Alberta[172] began foundational work for the following five years of survey and excavation work.[173] The Greek Ministry of Culture issued the project's permit and work at this site has been a 'synergasia,' a co-operative venture, between the 15th Ephorate of Prehistoric and Classical

[170] Ton Wisse, "Early State Formation in Ancient Greece: The Ethnos of the Magnetes in the Fifth and Fourth Centuries BC," *Newsletter of the Netherlands Institute at Athens* 3 (1990): 8.
[171] Bakhuizen (1992), 314.
[172] A list of participants can be found in Appendix A. I would like to particularly thank Laura Surtees and her teams over the years for their surveying and measuring numerous defensive structures. Special thanks go to Brendan Bruce, Adam Tupper, and Tristan Ellenberger for their ongoing support of my personal study of Kallithea's defensive structures.
[173] In accordance with permit laws of the Greek Ministry of Culture, the project had an original timeline of five years, making summer 2009 the last season of the permit given the 2008 hiatus. To allow completion of Building 10 excavation the project has been extended to 2010.

Antiquities in Larissa and the Department of History and Classics at the University of Alberta. Directors of the project are Athanasios Tziafalias of the 15th Ephorate of Prehistoric and Classical Antiquities and Margriet J. Haagsma of the University of Alberta with Sophia Karapanou (Larissa) and Sean Gouglas (Alberta) as principal collaborators.[174]

Kastro Kallithea is an ancient urban centre located on a hill which sits prominently in the landscape of the region known in antiquity as Achaia Phthiotis. Several 19th century travelers and authors make mention of the Kastro, although such mentions are more often than not brief log entries in a journal rather than a proper site survey.[175] Friedrich Stählin carried out the first true archaeological study of the site in the first quarter of the 20th century. He provides extremely useful information about the site and its topography in both a book, *Das Hellenische Thessalien*, and various articles.[176] The modern survey of the site has demonstrated that Stählin's mapping of the site is extraordinarily accurate given

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[174] Although many thanks have been provided in Haagsma *et al.*, it would be inconceivable for me to not briefly go over those whom the Project owe many thanks. The central archaeological council and Department of Foreign Schools of the Hellenic Ministry of Culture and the 15th Ephorate at Larissa have provided immense support throughout each field season which has resulted in many opportunities for stimulating collaboration and cooperative efforts. The project would have been nearly impossible without the boundless help and hospitality from the municipality, governing council, and inhabitants of Narthaki, the village which is home base for the team. The local Mayor, Dimitrios Kapetanios, and Kostas Kottas stand out as providing solutions to many practical issues that come about each year without fail. Over the past five years I have enjoyed getting to know the inhabitants of the village and always look forward to the warm greeting that awaits the team's return each summer. To the list of locals in Haagsma et al. I would like to thank Babis for consistently defeating us at foosball, the local young people for always being up for a game of football, and in particular Dimitri for being a friend, interpreter, and guide to the local culture.

[175] N. Georgadis, *Thessalia* (Volos, 1894), 216; W.M. Leake, *Travels in Northern Greece* (Amsterdam: Adolf M. Hakkert, 1835. Reprinted 1967), 331, 469; F.L. Ussing, *Griechische Reisen und Studien* (Kopenhagen: Verlag der Gyldendalschen Buchhandlung, 1857), 113-14.

[176] Stählin 1906, 1914, 1938, 1967

the technology of the time, especially when one considers he only spent several days at Kallithea over the course of his travels in Thessaly.

Stählin concluded that Kastro Kallithea was in fact the ancient city of Peuma through the interpretation of coins and several ancient inscriptions, the most prominent of which deal with arbitration over territorial disputes.[177] Although topographical clues in these inscriptions could be interpreted as referring to the site currently under consideration, there is to date no evidence coming directly from the site itself. As such, the designation of Peuma is not certain and the project's supervisors continue to refer to the site as Kastro Kallithea.[178] Regardless of identification, the location of the site is extremely prominent in the surrounding landscape and is at an ideal point to exert control over the plains. Reaching approximately 600m at its highest point, the saddle-shaped hill on which the city was founded dominates the western edge of the Crocian plain. It effectively controls a 7km wide east-west corridor found between the southern Othrys mountain range and northern Narthaki range that was a major route connecting inland cities (Pharsalos, Phyladion, Pereia, and Melitaia) with cities along the Pagasitic Guilf (Halos or Phthiotic Thebes).[179]

Whatever its ancient name, this site exerted a major force over the ancient Thessalian landscape due to its geographical setting. Members of the Project have all witnessed over the years that the site is clearly seen throughout the plains

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[177] A. Tziafalias, MJ Haagsma, S Karapanou, and S Gouglas, "Scratching the Surface: A Preliminary Report on the 2004 and 2005 Seasons from the Urban Survey Project at Kastro Kallithea ("Peuma"), Thessaly. Part 1: Introduction and Architecture," *Mouseion* 6, no. 2 (2006): 92.

[178] For a complete discussion on the matter of whether or not Kastro Kallithea may indeed be the ancient city of Peuma, see Tziafalias *et al*, 92-93..

[179] *Ibid*.

of Almiros lying to the east. In addition, it is within full view of the national highway running north-south near the coast. This imposing hill, located 500m north of the River Enipeus, is roughly elliptical at its base and oriented on a NW-SE axis.[180] The highest points of the site are found at separate east and west peaks[181], separated by an area referred to as the saddle[182] which is approximately 15m lower than either peak. The slopes to the north and south of the saddle exhibit a steeper grade than elsewhere, significantly narrowing the usable area of the site's central area. The overall effect is a contour map very much resembling a barbell at higher elevations.

Lying roughly two-thirds up the ascent of the hill is Kastro Kallithea's outer *enceinte*. As measured by the survey team, this first line of defence has an impressive circumference of over 2.4km.[183] It is well preserved throughout its course with the exception of a 250m section in the south central segment. Here the masonry has been most susceptible to disruptive events in the post-depositional process due to the extremely steep slope. The Project's efforts to trace the course of the wall were furthered frustrated by extremely thick vegetation. Not only was the team unable to consistently trace the wall in this section, but was also unable to locate towers 25 and 28,[184] despite numerous attempts during each year of the survey (the towers will be discussed further below). The slope and dense vegetation present along the entire southern slope

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[180] It has been convention on site to use the closest cardinal direction for ease of reference. For example, although the secondary peak is technically in the south-east of the site, it is simply referred to as the east peak.

[181] Although extremely close in elevation, the western peak is higher by only a few meters.

[182] The saddle houses most of the presumed public buildings, including a stoa and shrine.

[183] Tziafalias *et al.*, 102.

[184] The Project followed the tower numbering system as developed by Stahlin, who identified a total of 43 towers.

mean that one cannot even surmise what battlements may have been present via the observation of fallen stones. Ironically, the dense vegetation along the north-central section of the wall has held much of the wall masonry in place and the highest preserved sections are present amidst the dense *pournari*.

As the walls are not at their original height it is a simple matter to observe both the internal and external construction of the *enceinte*. The wall construction is a double scale with interior rubble and earth fill design over the whole of the wall's circumference.[185] It is a somewhat difficult matter to assign any sort of classification of wall construction to Kastro Kallithea's defences. Indeed, both Winter and Lawrence are quick to point out that a satisfactory system of masonry classification is difficult to attain and even then prone to subjective interpretation.[186]

The direct dating of city walls, towers, and associated works can be attempted in a number of ways. One method employed is the inspection of construction technique and style, particularly when artifacts are lacking. Robert L. Scranton was the first to create a sequence of masonry styles in defensive constructions. *Greek Walls* greatly refined the traditional succession of masonry styles – cyclopean, polygonal, ashlar – and many still accepted it as a firm base on which to determine the date of walls.[187] A great deal of attention is devoted to minute variations within the preexisting broad categories, resulting in numerous

[185] Although the interior ground soil is now level with the wall's existent height, enough interior facing blocks and top-down stone profiles are visible to deduce that the inner facing of the wall used the same construction methods and material as the outer facing.
[186] Lawrence, 83.
[187] McNicoll, 3.

possible descriptors.[188] However, Scranton's major shortfall is an oversimplification of stylistic considerations. A chronology of masonry development assumes that there was a linear progression of stylistic development, yet the choice of a certain style could be dependent on a number of factors including aesthetic ideals, site specific concerns, requirements of siege warfare, concern over cost, and available stone.[189] Regional inclinations could have heavily influenced the adoption of a specific style or technique.

If a stylistic classification is to be assigned from Scranton's system then this wall could be described as isodomic trapezoidal construction.[190] At the eastern side, just south of the east gate, the wall is preserved to a height of 2.5m along the exterior face. Several segments of the north wall also reach a height of 2-2.5m, although vegetation covers these sections . From a wall-walk and survey in the 2007 season it was concluded that there are enough fallen stones visible for at least another three courses to be part of the original construction.[191] Atop the stone socle presumably a mud brick superstructure was constructed.[192] As is

[188] See Scranton, 16-24 for his full classification system. McNicoll, 3 adds several modifications to Scranton's system in his analysis of Hellenistic sites in Asia Minor. As each of Kastro Kallithea's construction phases consist of uniform technique I shall not deviate from Scranton's original terminology. Kallithea's uniformity also allows us to avoid ambiguous modifiers frequently employed by Scranton such as 'tending to.'

[189] McNicoll, 3; Lawrence, 234-5. Lawrence also mentions a resurgence in the popularity of polygonal masonry in Hellenistic times, as demonstrated by examples such as Oeniadae's tower 1.

[190] Scranton, 18-19. Trapezoidal refers to the shaping of the stones while isodomic refers to the layering of stones in regular courses. It is difficult to classify the *enceinte* as true isodomic vs. or pseudo-isodomic (the latter being used by various authors to refer to either irregular variances in height or layered header-and-stretcher construction) due to variances throughout the wall. Lawrence (235) points out "in good masonry the courses may be interrupted by an occasional taller block." Places in the wall where a course is divided between two half-height stones was also noted. The amount of variation in regular masonry could be due to a conscious attempt to provide ample hooking blocks to bind the construction together. (Lawrence, 238).

[191] This would bring the socle height to six courses above current exterior ground level. These survey results will be discussed in detail later in this chapter.

[192] At present the walls' superstructure is extremely unclear. It is plausible that a significant amount of rubble lies on the slopes of the hill, covered by vegetation and fill. The use of a brick

typical of mud brick constructions, as opposed to baked brick which would not be dissolved by rainwater, no sign of the superstructure is present in the archaeological record.

Making judgements on the wealth and status of the city in question based upon typological and stylistic features of defensive walls can be troublesome. Observing the overall quality, care, and cost of the construction can be useful in deducing the broad category of importance and cost into which the defensive project fell. Several features demonstrate that the builders were concerned with creating a quality construction that, as Aristotle notes, answered aesthetic as well as military demands:[193]

1. Each stone's outer edges were carefully cut in order to create a tight fit with all the surrounding stones.[194] The backing of the stone, the part abutting the internal fill, was left rough in order to bond with the fill. The exterior facing is quarry[195] work, although several stones exhibit patterning which could be classified as broached. Most likely the visible striations on the stone are quarry marks and not purposeful facing.

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superstructure is just as likely and may be proven via test trench excavation along the wall. Nearby sites such as Goritsa and Demetrias had walls with brick superstructures, the latter being built as Demetrios Poliocretes' seat of power. The use of brick is therefore not a sign of inferior construction. Wood was used only where a roof was built to enclose the *parados*. Lawrence, 368-69; Winter, 140-41.

[193] Lawrence, 234; *Politics* vii. 11.1311a 12.

[194] Tight fitting stones do not equal ashlar masonry, a style defined by consistent and regularly shaped blocks. Kallithea's masonry, although tightly fit, consists of trapezoidal blocks that vary in shape and size.

[195] It could also be classified as hammered work, although Scranton pointed out the difference between these two "is difficult, and has not been pressed." Scranton, 21.

2. When present, although rare given the sheer quantity of stones in the construction, small gaps between large blocks were filled with small, flat, rectangular stones.[196] Lawrence notes that even a wealthy state tolerated such inclusions and they played little part in overall stability.[197] However, the careful filling of such spaces, opposed to leaving open gaps, demonstrates a level of quality and attention to detail.
3. Exterior 90 degree angles are consistently drafted. The interior wall of the East Gate was also drafted at a turn in the wall's path where a definite angle in the wall's path was created.[198] Such drafting at wall corners, outward tower corners, and bends in curtains had become customary by the mid 4th century.[199]
4. Individual stones predominantly laid as stretchers in the wall construction are interspersed with headers. Such a construction increases the cohesion of the wall and its ability to withstand shocks as well as securing it against lateral forces caused by shifting fill.[200] Although they do not occur at regular intervals as at sites such as Syracuse,[201] they are visible at irregular intervals, averaging 3m

[196] Tower 13's west face intersection with the main wall has one such example.
[197] Lawrence, 238.
[198] The drafting also lies opposite the terminal point of the exterior arm of the eastern gate.
[199] Lawrence, 242.
[200] Lawrence, 237.
[201] Winter, 135.

spacing.[202] Clearing and probing of a section of the wall may in future reveal a more regular construction than is currently visible.

Wall Height

In order to consider the visibility of a person standing atop the parados or the range of any defensive machinery, the height of the wall must be deduced. The archaeological evidence is naturally the first exhibit to consult. One could easily assume that the height of the wall was not much greater than what it is today, with the interior city ground level being much higher than the level outside the wall. Such a situation would not be unusual. Lawrence notes "wherever feasible, walls were sited to terrace a slope [and] at some places, the ground within stands only just below the level of the wall-walk, and almost invariably it gave…a strengthening effect,"[203] an observation mirrored by Winter.[204]

Similarly, the team initially believed that there was little sedimentation present on site owing to its positioning high on a hill and that the visible remains represented original foundation levels due to the effects of erosion.[205] The team based its hypothesis on initial evidence, but an expanding data collection has helped to determine where the ancient ground level is located among the various depositional segments. Using a hypothetical ground level as the basis for

[202] Tziafalias *et al*, 103. Confirmed by measuring stretchers in the north wall during the 2009 season which are ~3.5m apart.
[203] Lawrence, 233.
[204] Winter, 127.
[205] In the case of the *enceinte*, more courses have survived than at many buildings. Debris from fallen courses of the wall is easily seen lying just beyond the wall.

theorizing the depth of deposition, other hypothesis can lead to the refining of theories regarding the enceinte's original curtain height.

Several drains built into the wall are visible at the upper surface of the existent wall courses. As the internal construction of the wall is visible in such cases, it can be assumed that these drains went completely through the wall. Examples cited by Winter, such as at Selinus, suggest such drains occurred at or above the interior ground level.[206] Kastro Kallithea's *enceinte* has one intact drain near tower 1, located at the site's north-west corner, which is well below the interior surface level. This drain could be a section of missing rubble chinking as all the other drains that have been discovered are at modern surface level, although the regular shape and dimensions make such a hypothesis unlikely despite the construction which appears quite different from other drains that were located.[207] Drains are not necessarily passages through the wall but were often one-sided exit channels for water entering through the top of the wall.[208] Kallithea's wall is still intact two courses above the drain near Tower 1 so it is impossible to get a sense of the interior construction. It therefore could have been designed as a seepage release channel which would not penetrate through the wall, or it could be similar to site's other visible drains.

Two different styles of drain were possibly built into the *enceinte* at Kallithea: the channel extending entirely through the wall and a one-sided 'hole-in-the-wall' outlet. A dualistic setup of this nature does match two uses for water

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[206] Winter, 150.
[207] The Tower 1 drain appears to be a simple hole in the wall whereas other drains consist of a channel cut into a base stone with vertically placed stones forming the sides of the channel.
[208] Winter, 150-151.

channels described by Winter and Lawrence. Winter focuses primarily on the use of drains to collect moisture seeping into the fill of the wall from the level of the *parados*, a concept mirrored by Lawrence.[209] This certainly would have been of concern at Kallithea given the tight setting of the facing stones of the outer wall. The Tower 1 drain is thus a simple solution to the problem of moisture building up within the wall's fill. Lawrence also discusses the use of channels to direct surface water past the wall.[210] Drains visible at Kallithea with internal structures fit this category. The hill's slope, which is extreme in some areas, would require a good drainage system to be in place to prevent water backup behind the wall. Although gates and posterns would let water out, there are only six doorways in a wall 2.4km long with no major artificial channels visible.[211]

The evidence presented by existent drains is inconclusive as there is no evidence regarding the original system's implementation. One could surmise that the present ground level is close to the ancient ground level as channel drains located north of the east gate, between towers 11 and 12, and between tower 5 and 6 are all atop the existent wall and level with the interior ground. However, if the drain of Tower 1 had an identical purpose, than its location below the present interior ground level suggests that a large amount of sediment has been deposited.[212] One is left to hunt elsewhere for more conclusive evidence,

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[209] Lawrence (271) gives two examples which seem very similar to Kallithea's Tower 1 drain. Lawrence states tall revetments were drained through openings "made by cutting away the corner of a facing-block" or openings which issued "through a gap between the blocks," with examples from Selinus and New Pleuron.
[210] *Ibid.*, 270.
[211] Drainage channels large enough to allow men through them were present in cases where extreme drainage was necessary. *Ibid*.
[212] Examination of channel's interior may prove its design and intended purpose. I shot several photos of its interior during the 2004 field season. Although under low light, the interior has a

although targeted excavation along the enceinte's internal face may clarify drain usage.

The most telling evidence of the original ground level at the enceinte is a small gate, or postern, discovered near Tower 13A.[213] Unlike posterns I, II, and IV, this gateway's lintel stones are intact, thus giving clear indication as to the original height of the opening. Postern III is 1.17m wide and the visible exterior height, from current ground level to the existing lintel, is close to 1m in height, whereas the internal ground level almost reaches the lintel stone at the wall face. If the postern's original height was ~ 2m then the internal fill is also 2m and the wall's outer face has debris of 1m at its base. Notably the wall has two masonry courses visible on either side of the postern with each course falling within a site average of 0.5-0.6m.

A depth of 1-2m is consistent with excavation records collected at Building 10 during the 2007 and 2009 excavation seasons. Although the overall stratigraphy and floor depth is unclear in all trenches, one small test trench has provided a good gauge of how deep the deposition is. This trench was started in the 2006 season, along with several other test trenches spread throughout the site, and finished during the excavation of Building 10 in summer 2007, at which point the floor level was reached.[214] 0.8m of soil was removed to expose this layer

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clean construction entirely lined with stone. The opening of the opposite site was not visible due to debris in the channel.

[213] Both the postern and tower were not noted by Stahlin. The designation '13A' was given so as to keep the remainder of Stahlin's tower numbering system intact. The postern itself is Postern III by Kallithea's numbering system. Postern I is located between towers 7 and 8, Postern II between towers 9 and 10, and Postern IV directly beside tower 30.

[214] Floor level was indicated by two finds. Intact wall plaster lines the bottom 0.10m of each wall and appears to curve inwards at floor level. A collection of pottery atop an altar was also

while several other floor levels found in 2009 match the floor level discovered in the test trench. Given that Building 10 is positioned at a mid point between the eastern acropolis and the city wall, a greater amount of soil deposition at the enceinte is not unreasonable.

Although there is correlation between two pieces of evidence from the north-east quadrant of the site, the single sample of postern III cannot be taken and applied across the entire city as the hills slope varies great from one section of the hill to another. It may be possible that the depositional situation is similar at each of the three northern posterns, given the similar slope, vegetation cover, and height of lintel stones.[215] Yet the single existing postern on the south wall presents a different situation. Postern IV, located directly east of Tower 30, has a surrounding environment quite different than that of the northern wall of the enceinte. Vegetation cover is almost absent with present growth limited to small, knee-high shrubs. Exterior facing stones at postern IV are preserved to a height of 0.6m above surface level[216] with an entrance width of 2.04m, slightly larger than posterns at the north of the wall.[217]

With no lintel stones remaining and an area clear of heavy vegetation compared to the northern wall, it would be an easy assumption that deposition at

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discovered at this level. If this collection was a kind of foundational offering from the construction of the house then this layer may actually be slightly below ancient floor level.

[215] Stahlin reported that sometime between his 1912 and 1926 visits the large lintel stone of postern II fell out of situ. If the lintel was resting on courses still existent on the wall, then the height of the passage and distance to modern ground level is similar to that of postern III.

[216] The single course visible above the soil is the same course as the highest existent course at the SE corner of Tower 30.

[217] Postern III was measure by tape as 1.17m wide. Posterns I and II are 1.26m and 2.18m wide respectively, extrapolated from Total Station measurements. Postern II's greater width may be explained by the areas extreme overgrowth resulting in inaccurate measurements taken in the 2004 field season.

the southern postern is minimal. In this case, the only evidence without intensive excavation is the change in slope from the exterior of the gate to the exterior of Tower 30's projection. The vertical drop over this distance is one course of stone, or approximation 0.6-0.7m.[218] Despite the differences between the northern half of the site and this south-eastern example, the resultant estimations in deposition are very similar. It is a likely hypothesis that much of the enceinte has ~2m of deposition along the interior wall with ~1 m along the exterior face. Variations to this trend exist, as demonstrated by several remains of drains which now lie atop of the existent fortifications. Given the typical extent height of 1-1.5m of stone along the external face of the enceinte, it is likely that the existing original stone socle was as high as 3m along the entire course of the wall before fill, not including fallen courses.

Kastro Kallithea's main wall is but one part of its defensive structure. Attached to the exterior wall are almost forty towers, which will be the focus in the following section. As the towers and curtain wall were a single construction, one cannot be treated separately from the other.[219] Towers are a supplementary construction that increases the capabilities of a defensive network by allowing

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[218] A curiosity of Postern IV is a long stone found at the exterior side of the postern. Without clearing and excavation it is impossible to say exactly what its function is. If in situ, two extreme possibilities exist. It could either be a paving stone, perhaps forming the stop set of stairs leading through this postern, or be an extremely buried lintel stone. As the team found at the eastern acropolis gate, there are several sections of the fortification where the actual remains are much deeper than suspected.

[219] Towers and curtain are not necessarily the same construction. In Later Hellenic times, Philo warns against bonding towers and curtains together for fear of the collapse of either affecting the stability of each other. Additions to an enceinte, either new towers or enlargments, could also be undertaken at a later date, as demonstrated by the construction stages at Halieis. See Marian H. McAllister, *The Fortification and Adjacent Structures*, vol. 1 of *The Excavations at Ancient Halieis* (Indianapolis: Indiana University Press, 2005), 14-19. Methods of construction seen at Kallithea denote that curtain and towers were bonded to each other throughout the exterior enceinte. The *diateichisma* is integrated with the outer defenses at towers 39 and 44 but was not integrated into the presumably earlier acropolis wall.

semi-offensive strategies to be employed either through the use of stationary weapons, such as catapults, or the deployment of archers in the raised confines of tower chambers. Observations made during the 2007 season regarding the original height of the towers' socles shall serve as a further dataset to be used in the estimation of how many courses of masonry existed in the original construction of Kallithea's towers and walls vs. what is presently existent.

Towers

The height and size of Kastro Kallithea's towers are of vital concern to several of this thesis' main channels of inquiry. As the highest points on a city's enceinte and focal points of the defense system, towers are lookout stations from which the defending force could view the surrounding landscape and any nearby friendly structures. The site's acropolis, being 40m higher in elevation than the line of the enceinte, may have been used as a lookout, but it can be assumed that most of the defense force would be stationed at the city's walls. Such an arrangement is harmonious with Classical inclinations to secure the peak and outer edge of all surrounding terrain, even at the cost of greatly increasing the trace's overall length or including undeveloped land within the city walls. The original acropolis wall itself appears not to have had any towers[220] and it is unclear how tall it would have originally stood. Furthermore, if terrain height was the deciding factor then it would be likely that some sort of post would be located

[220] Tower 39 is not part of the original acropolis wall, but was built at the same time as the *diateichisma*. Tower 40, along with the west acropolis gate, is a possible retrofit which occurred synonymously with the outer enceinte's construction.

atop the site's eastern "acropolis."[221] Since no such remains have been found, it is safe to assume that the enceinte's 38[222] towers were the primary lookout and defensive stations for Kallithea, guaranteeing commanding views in all directions.[223]

Towers served as nerve centres along a city's defense. They were originally constructed to provide a platform for superior enfilading.[224] Prior to the tower, military architects had built jogs, referred to as the indented trace, into walls from which the defenders could launch flanking fire at any force approaching the wall. Builders quickly discovered that a free standing bastion could provide coverage of the wall face in both directions while not affecting the trace.[225] Thus the three primary modes of assault before siege warfare changed tactics; escalade, ram, and the probe, could all be effectively kept in check.[226] Kallithea's steep slope is a further aid to the site's defensive potential as any attacking force would have had to overcome it. By Hellenistic times, the tower had developed into a multi-storied strong point that housed not only soldiers and

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[221] I use the term acropolis here to refer to the site's second highest point and other hill crest. There have been no finds discovered to suggest this was ever a true Acropolis for the site.

[222] Stahlin's map counted 38 towers, although as previously mentioned a team discovered 13A which was not noted by Stahlin nor was Tower 44, a round tower located where the *diateichisma* meets the enceinte. They could find no trace of towers 25 and 28, both located on the site's steep southern face. Whether their disappearance was caused by human actions or natural processes cannot be said for sure. The south section is also heavily vegetated, which could obscure towers and wall sections that have are not as well preserved as examples seen along the northern wall.

[223] The number of towers alone, 44 along a wall 2.4km in length, suggests Kallithea was built to play a significant militaryistic role in regional defense. As a comparison, the site of Halieis has 20 towers along a trace 1.9km long (McAllister, 15) and Priene's 2.5km trace has 30 existing towers (A.W. McNicoll, *Hellenistic Fortifications from the Aegean to the Euphrates*, Oxford: Clarendon Press, 1997, 49) whereas the military sites of Goritsa and Halos have 34 (Baukhuizen 1992, 25) and 70 (Reinders 1988, 192) respectively.

[224] For a complete discussion on the historic development of towers, the reader is directed to Winter, Lawrence, McNicoll, or Ober.

[225] Winter, 152.

[226] McNicoll, 8.

archers but also defensive catapults. The Syracusean invention of the *gastrophetes* in 399 BC revolutionized Greek poliorcetics. Methods of defense were quickly altered to meet the new challenge in a manner that Ober calls "the ongoing conversation between offensive and defensive strategies."[227]

The overall layout and plan of a city's defenses[228] can be used to deduce a number of factors relating to this ongoing conversation. Although the tower spacing at Kallithea is irregular, ranging from 39m to 156m, certain sections exhibit regular positioning of towers, particularly along the west and northwest sections of the enceinte. The lesser slope present at these quadrants allows the easiest points of ascent and therefore would have been the most likely to face assault. Despite tower concentration along vulnerable sections, Kallithea's enceinte has an overall regular placing of bastions along the trace. Omni-directional coverage suggests that the construction project that strengthened the hill's defensive nature was intended to safeguard all sectors of the hill and ensure that visual connection was maintained with all of the surrounding landscape.

The built form of a site's tower is strong evidence for the defensive strategy guiding its architects. Although aesthetic embellishments were frequently added, the basic constituents of a Hellenistic tower are purely practical in nature. Height and size are vital considerations for the following reasons:

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[227] Josiah Ober, "Towards a typology of Greek Artillery Towers: the first and second generations," In *Fortificationes Antiquae*, eds. Symphorien van de Maele and John M. Fossey (Amsterdam: J.C. Gieben, 1992), 147.
[228] See Appendix H, fig. 4, for a map of Kallithea.

1. The height at which a tower's platform was built, either as a covered chamber or roof-top post, directly affects the station's lookout potential.
2. In a case where the tower housed defensive artillery, superior height would have increased the maximum range of the machinery. Even a few meters of maximum range gained ensured that the defenders range of fire would have covered any approaching force before the city's own defenses were threatened by opposing artillery.[229]
3. Each tower's size may be used to estimate what kind defensive equipment was placed in the tower. The available floor-space is the primary dictate of what kind and of how many machines could be placed in the chamber.[230]
4. A subset of overall tower dimensions is the thickness of a tower's wall, foundation, and structural details of any interior buttressing. These aspects of the design reflect the end built product. For instance, interior buttressing suggests a concern for stability and the possible need to support a significant superstructure.

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[229] The height of towers gave defending artillery an immense advantage, as demonstrated by Marsden, Diagram 6 (157). He also stresses the advantage of placing towers on a naturally high point. The builders of Kallithea's defenses therefore would not need to emphasis height in their towers. E.W. Marsden, *Greek and Roman Artillery Historical Development* (Oxford: At the Clarendon Press, 1969), 131.

[230] For instance, a 0.5m bolt launched from a torsion machine required a stock length of 1.5m and arm width of 0.7m, a 1.4m bolt extended these requirements to 4.6m and 2.1m respectively. A 1[st] generation non-torsion *gastraphete* with a 0.8m bolt had a stock length of 1.6m and bow width of 1.2m. Engine size will be reviewed in the concluding section of this chapter. Josiah Ober, "Early Artillery Towers: Messenia, Boiotia, Attica, Megarid," *American Journal of Archaeology* 91, no. 4 (Oct 1987): 600.

Many of the examples cited by Winter, Lawrence, and Ober are defensive works constructed entirely out of stone. Such selection is of no surprise given that the un-baked mudbricks that formed the superstructure of many Greek defenses have rarely been preserved.[231] Masonry construction provides many near-complete standing remains from various time periods throughout Greece. Such excellent preservation allows one to deduce vertical organization, the arrangement of defensive catapults,[232] or note exceptions to general rules[233]. Even a single course of stone forming the lower edge of a window can provide an idea of how large the openings were or indicate whether details such as bottom-hinged shutters were present.[234] Stone constructions simply stand up better to post depositional forces and therefore form a much larger sample of existent fortifications.

Kastro Kallithea's towers, although at first glance appearing to be significant stone constructions, were not masonry alone but had a brick superstructure resting upon a stone socle.[235] All that remain of the towers are their solid foundations, although nowhere do they stand to their original height. Along the entire trace of the outer enceinte are many tumbled blocks lying at the

[231] As only one example of baked brick has been located, the capping of Tower 43 at Demetrias, it may be assumed for practical purposes that Greek fortifications used mudbrick exclusively. Tower 43 is also an example of how quickly mudbrick can wear away. Upon excavation 3.5m of standing brick was uncovered, only to have washed away in the following sixy years of exposure. Lawrence, 208 and personal observations.

[232] Tower A of Aigosthena is an outstanding example. Ober (1987), 586.

[233] Isaura's towers have only archery loopholes present, even at the highest levels, which goes against the pattern of solid base, arrow loops in the lowest chamber, and windows for engines in the highest chamber. Winter, 190.

[234] Ober 1987, 584. Krischen believed that these holes held iron bars which would have been used to push open an exterior hanging shutter, allowing defenders to drop various items onto the besiegers. I shall agree with Ober and Marsden's (152) assumption that the shutter arrangement would have been so built to accommodate catapults over the simple dropping of objects.

[235] Lawrence, 212. Other brickwork/stone defenses mentioned by Lawrence include Gela, Hellenistic Sunion, Eleusis, and Old Paphos.

base of the wall and towers, and down the slope of the hill. It is difficult to estimate how much rubble is present beyond the tower bases because of heavy vegetation. During the 2007 and 2009 seasons extensive observations of each tower were made, noting the amount of rubble at each. Based upon the highest surviving sections of Kallithea's enceinte and the rubble present at each tower, the data suggests a total of six courses along the exterior face is a likely minimum for the original socle height. Three in place courses are typical with another three courses being made up from toppled masonry. With an average course height of 0.55-0.65m observed along the wall, a minimum tower base height of 3.5m can be assumed.[236]

It is possible that Kallithea's towers had a higher base, but available evidence cannot support this hypothesis at present. The aforementioned vegetation completely hides most of the hill's slopes, the steep grade of which would have allowed any tumbling stone to fall quite far, particularly without the hindrance of dense pournari. Estimating how much structural stone lies about the hill is therefore difficult or impossible.[237] Furthermore, test trenching along a tower base could locate the lowest foundation courses as well as reveal the ancient ground level in the stratigraphy. Until such excavations are conducted, only the visual examination of remains and estimations based thereupon are available. Fortunately such a trench would be relatively easy when examining the

[236] Marsden, 156. Assuming the wall parapet was at this level then Kallithea's wall height would be very similar to Messene's.

[237] This task is further complicated by the need to differentiate facing stones and internal fill. Material used for fill can be quite large. If a facing stone was lying with its finished faces and/or corners obscured, it could not be necessarily viewed any differently than the mass amounts of rubble fill. Such a problem is especially true at towers where internal buttressing stones were almost identical to facing stones.

exterior of the wall. A 1m x 2m trench set perpendicularly against the exterior of the wall should allow both the stratigraphy and foundation stones to be examined. The interior face of the wall is a different matter due to the depth of infill lying against the well, as demonstrated by Postern III.

During several days of the 2007 and 2009 dig seasons the existing height of each tower was measured.[238] The first data set, recorded June 3, 2007, measures the height of each tower's protruding corners, how many courses are present at each corner, and the average course height.[239] Towers 29 through 38 were measured in this manner. The second data set was recorded on June 30, 2007 but is a slightly truncated version of the components in the first set. Operating pressures surrounding the season's primary excavation of Building 10 did not present many opportunities for side research and the weather on June 30th threatened rain throughout the work day. In order to ensure all towers were at least partially recorded, I decided to limit my data collection to each tower's highest existing point, the courses present at that point, and the average course height.[240] In all cases the amount of rubble visible was noted in order to estimate if the proposed original height of six courses was likely throughout the site. During the 2009 season towers 1 through 28 were revisited in order to record a dataset matching the results of June 3, 2007.

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[238] I owe a great deal to Tristan Ellenberger who was my data recording companion during these wall-walk outings.
[239] The two outer corners were chosen as measurement points as it was from the corner that previous seasons' GIS teams had plotted
[240] In cases where the top course displayed a height deviating from the average range of 0.50-.70m a second nominal course was measured.

The level of preservation varies greatly depending on terrain and vegetation. The shortest remaining tower corner is the southwest corner of tower 33, located in the site's southwest quadrant, measuring only 0.53m above present ground level. The highest preserved section of tower is the northwest corner of tower 9, located in the central section of the city's northern wall, measuring 2.80m with five courses of stone preserved *in situ* along its western face. The location of these two extremes along the enceinte effectively demonstrates two differing preservation zones. Towers along the north wall, particularly Towers 11, 10, 9, 8, and 7[241], are well preserved. The lesser grade along with the heavy *pournari* vegetation preventing stones from falling down seem to be the primary reasons behind the preservation levels.[242] The rest of the towers are generally intact to between 1.00 and 1.25m, with two notable exceptions. Tower 21, located on steep terrain south of the East Gate, is preserved with two courses to a height of 2.06m. Along the steep southern section, 27 was covered in vegetation and partially destroyed while no trace of Tower 25 was found. The remains of both are likely at the base of the south hill face, perhaps due to earthquake disturbances.

Kallithea's towers have an average width of 6.70m and protrude an average of 2.25m from the *enceinte's* exterior face. With the wall's width taken into account, the average Kallithea tower is 6.70m wide by 4.85m deep. Exceptions to the norm are Tower 26 with a width of 9.14m and Towers 1 and 15,

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[241] Surviving heights are 2.10m, 2.70m, 2.80m, 2.74m, and 1.86m respectively.
[242] Several tense moments occurred in the 2004 season during wall clearing. Key branches and vegetation concentrations were left in place after episodes involving wall blocks almost falling down the hill and taking team members with them.

which are located at the site's northwest and northeast corners, respectably. Kallithea's average sizes are very similar to tower dimensions seen at nearby sites, such as Goritsa where tower widths are ~6m and project ~2.5m from the curtain wall.[243] Ober's examination of what he terms "first generation catapult towers" mentions two examples with dimensions similar to Kallithea's average: Phyle at 5.5m by 5.5m, Siphai 3 at 6.5m by 5.5m, and the freestanding Tower C measuring 5.5m by 5.5m.[244] Messene, which Marsden views as one of the first cities to adapt to the threat of siege weapons, has towers averaging 5.4m square.[245] A typical Halos tower is 6.75m by 6.30m[246] and Demetrias' average size is 10m by 10m.[247]

Dating

Dating an artifact, site, inscription, or any historical item is a primary task of archaeology. Temporal context is vital to understanding remains found within the archaeological record. For present purposes, the habitation period of Kastro Kallithea is extremely important for an investigation of the site's placement within the broader strategic landscape of late 4th and early 3rd century BC Thessaly. Defensive technique and offensive tactics are two time-specific factors that were the primary influences upon the city plan implemented by the Kastro's builders. However, this poses a potentially antithetical analysis: does one use Kallithea's defensive constructions to date the site and determine its positioning

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[243] Bakhuizen (1992), 99-118.
[244] Ober (1992), 598.
[245] Marsden, 156.
[246] Reinders (1988), 192.
[247] *Ibid.*

in the strategic landscape or are dates from other pieces of evidence used to build defensive scenarios based upon such evidence? Sole attention cannot be given to either side of the equation. Herein, I propose to examine the possible date of Kallithea by considering as many data sources as possible, akin to McNicoll's six points of examining sites.[248] Current evidence includes the fortifications themselves (style of construction, tactical elements, and strategic elements), epigraphic evidence, numismatic finds, and pottery.[249]

This topic warrants a brief overview of the state of warfare in the fourth century. The strategic situation in Greece, particularly in the Thessalian border region near Macedon, rapidly changes throughout the 4th century following the introduction of *gastraphetes*, the earliest form of Greek artillery, by the forces of Dionysius I of Syracuse in 399 BC[250] Armies became equipped with siege trains, thus ending centuries of tactically static infantry warfare. Within another fifty years siege techniques were further developed with the discovery of torsion principles by engineers of Philip II, such as Polyidus the Thessalian.[251] Philip's sieges of Perinthus and Byzantium in 340 BC are the first recorded practical deployment of this new generation of torsion siege machine.[252] Continual redevelopment of defensive measures occurred at a rapid pace following the exploits of Alexander and the universal attention paid to siege-warfare in the last

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[248] These are stratigraphical excavation, epigraphy, literary sources, masonry, strategic concepts, and tactical concepts. McNicoll, 2-14.

[249] Although excavation has been done at Building 10, no excavation has been done directly on the walls.

[250] Marsden, 55.

[251] Vitruvius. x. 19. s. 13

[252] Marsden, 58-60. Polyidus is noted in Athenaeus Mechanicus as being "particularly successful in this craft" whose two pupils joined Alexander on campaign.

quarter of the fourth century.[253] It is within this rapidly changing world of siege weaponry and defensive construction technique that Kastro Kallithea must be temporally placed within.

The Kastro Kallithea Project has had two full seasons of intensive excavation but has already provided several finds which can be used for relative dating.[254] Pottery samples were collected via surface surveying, which covered most of the Kastro's 34 hectares, during the 2004, 2005, and 2006 seasons. Although surface finds must be treated cautiously due to their lack of context, ground pottery finds were later supplemented by items pulled from several test trenches in 2006 as well as the excavation of building 10, located in the site's north-east quadrant. The earliest datable finds come from the early fourth century BC with no finds dating from the fifth century or beyond while the latest finds comes from the mid-first century BC Although not directly related to the current study's timeframe, the 2007 season surprisingly uncovered several pieces of Byzantine pottery dating from the 6th, 7th, and 13th centuries.[255] While later periods of habitation could not have influenced the construction of the city's defenses, they may have been responsible for several sections of the wall being mined for its ready-to-use stonework.[256]

Pottery provides occupation dates beginning in the early fourth century BC. Such a date is only a temporal beginning point in understanding Kallithea's

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[253] Lawrence, 385.
[254] At the time of writing, finds from the 2007 season have not been entirely catalogue and analyzed. I am very grateful to Tracene Harvey for compiling numismatic data.
[255] All pottery dates provided by Margriet Haagsma, email to author, March 2009.
[256] Excavation at building 10 demonstrated that large stones on the surface were not the foundation stones they were originally thought to be, but placed atop an underlying double-socle wall. One stone in particular had a groove and triangular notch carved into it which may suggest it was reused from part of the outer enceinte or perhaps the East Gate complex.

history. Coin finds are helpful by refining the dates to a somewhat more specific period. Just as with pottery, coins have come from both surface survey and excavations occurring in buildings 1, 4, and 10. The earliest datable coins are a silver Amyntas II coin dating to the late 5th century BC and three AE 18 bronze coins issued in Larissa with a Larissa Nymph on the obverse and horseman on the reverse which can either be attributed to 352-325 BC or 400-344 BC.[257] A silver AR Hemidrachm issued from either Elis or Olympia with the head of Zeus on the obverse and eagle with snake on the reverse was found on survey in 2005 and is datable to either 336 BC or the 270s-260s BC Three Thessalian league coins, all found in building 10 during the 2007 season, are dated 199-146 BC. Although coin evidence still leaves a wide range of possible dates, the range is nonetheless narrower than any provided by the pottery evidence.

Inscriptions can provide extremely specific dates depending on the information included in the inscription. In the case of Kastro Kallithea there are three known inscriptions dealing with the *polis* of Peuma. As discussed earlier, it is not certain that Kastro Kallithea is ancient Peuama but these three inscriptions are important pieces of evidence. A two part inscription supposedly dating to ca. 270-260 BC outlines a territorial arbitration involving borders between Pereia, Phylladon, and Peuma.[258] If the assumption that Kastro Kallithea can be associated with Peuma is made then it was certainly a *polis* of some significance by the mid-third century. In a later inscription from the second century BC, the

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[257] Located in buildings 1, 4, and 10. Tracene Harvey, email to author, 28 August 2009.
[258] S.L Ager, *Interstate Arbitrations in the Greek World, 337-90BC* (Berkley: University of California Press, 1996), 99-103, nos. 30 &31; IG IX 2 add. 205; as cited in Dannbauer, 149.

writer indentifies Peuma as a full *polis* when a citizen of the city was honoured as a Larissean.[259]

Assuming for a moment that Kastro Kallithea is Peuma, the numismatic and epigraphic evidence suggest that the city was a significant centre by the time it attempted to expand its borders between 270 and 260 BC. The city must have had its main *enceinte* and defensive system in place by this decade if the *polis* hoped to embark upon a successful territory grab. A lack of proper defenses would have left the community at an extreme disadvantage against nearby rivals.[260]

Lack of defenses by this point is also questionable due to Kastro Kallithea's earlier involvement in regional politics. Research suggests that Kallithea played a role in the rivalry between the *poleis* of Old Halos and Pharsalos.[261] Parmenion, a general of Philip II, destroyed Old Halos in 346 when Athens retracted its support following the Peace of Philocrates. Macedonia handed the now defunct *polis*' territory over to pro-Macedonian Pharsalos.[262] Kallithea's positioning and commanding view was a logical and convenient location for a base from which to exert Pharsalian control over the newly acquired territory.[263] Although economically challenging for a single *polis*, fortification and expansion of Kallithea for the purpose of defending the territory of Pharsalos

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[259] IG IX 2 519 1 Stahlin "Peuma" 1405; Dècourt inscriptions 145-157 no. 131; as cited in Dannbaurer, 149.

[260] Pherae presumably retained an amount of power in the years following Jason of Pherae's creation of a Thessalian hegemony (Westlake, 68). By 191 BC it was still able to mount resistance to the attack of Antiochus III (Livy xxxvi.9.12 as cited in Lawrence, p. 148).

[261] Tziafalias *et al*, 131-132.

[262] Demosthenes 11.1

[263] Philip II would have likely provided financial support for the construction of Kallithea's second building phase.

would have been achievable with Philip's backing. Given the location of Halos marks a major north/south access between Thessaly and Phokis, Philip could support his goals of southern expansion by such a move to indirectly control vital territory. Although the above situation is theoretically possible, evidence cannot provide a firm association between the construction of Kallithea's *enceinte* and the destruction of Old Halos.

A second possibility is that the walls and general city expansion were sponsored by Demetrios Poliorketes who in 302 BC had engaged in a military stand off with Cassandros in 302 at the nearby plain of Almiros.[264] Demetrios carried out a policy of 'liberating' *poleis* and could have done so to Kallithea, further acting as a benefactor through supporting the construction of the city's expansion and fortification.[265] The similarities in construction techniques seen at both Kallithea and New Halos suggest that their respective building projects were somehow connected.[266] Stylistic similarities cannot be the only evidence supporting this connection. The direct examination of the physical remains, style, tactical, and strategically elements of Kallithea's fortification are necessary additional evidence.

Exactly how new construction techniques and designs were disseminated throughout Greece is another important factor. Lawrence suggests individual engineer-designers were not bound to a single state and travelled throughout Greece in search of continued employment, thus widely diffusing their particular

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[264] Tziafalias *et al*, 132.
[265] *Ibid*.
[266] See Reinders (1988), 67-82 for a description of Halos' walls and towers. Although the construction of each city is separated by several years, the city walls of both Demetrias and Gortisa are also similar to the construction style seen at Kallithea and Halos.

style of design.[267] Theoretically, such an arrangement could support Scranton's view of a single procession of construction technique. Architects searching for work or specifically employed by a newly wealthy border town would be exposed to new trends and would no doubt include these into their own designs, allowing for the needs of the client. Nonetheless, McNicoll rejects the possibility of creating a universally valid sequence of masonry, instead favouring the concept of region-specific development trends.[268] Focused chronologies allow regional variances to be accounted for, such as extreme broaching commonly found north of the Gulf of Corinth.[269] Fortunately both Kallithea and the sites around it are part of Thessaly, which in of itself was a specific region during the 4th and 3rd centuries BC. Regional variation was not a factor affecting differing masonry styles of these cities.[270]

As previously referred to, Kastro Kallithea's city wall and several sections of the acropolis wall are built in the Isodomic Trapezoidal style.[271] All exterior faces are "quarry faced," meaning that they have received no substantial finishing beyond removal from the quarry and rough shaping.[272] Lateral faces are regularly

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[267] Lawrence, 234.
[268] McNicoll, 3.
[269] Lawrence, 234.
[270] Certain Thessalian remains may also be stylistically linked to the efforts of Demetrios.
[271] The acropolis wall itself is an earlier construction which had its west and east entrances rebuilt in a style matching the outer enceinte and major public buildings in the saddle area. Features that are most telling of this match are the size and style of the block cutting as well as drafting of corners (*randschlag*), a consistent feature across second phase constructions. Haagsma has dated the earlier sections of the acropolis wall to the Classical period based upon comparison to Phthiotic Thebes and Gonnos. Tziafalias *et al*, 114.
[272] Scranton, 21. Within Scranton's system of surface finishes, the only possibility for most of Kallithea's walls is the 'quarry faced' description. However, the matter is complicated by Lawrence's reference to three kinds of surface treatment favoured by Philo (Lawrence, 240), which is in turn referenced by Reinders' description of New Halos' walls as finished to a rough bossing serving to deflect the blow of either a projectile or ram (Reinders 1988, 68). Based upon photo comparison between Kallithea and my visit to Halos' Southeast gate in 2006 I believe that

cut at an angle while the odd stone also projects into the course above or below. Both features prevent vertical and horizontal slippage, as well as locking courses together.[273] Jointing is consistently tight throughout the *enceinte* and regular stretcher/header construction, ~3m intervals, is visible where degradation of the superstructure has exposed the internal arrangement. Notable examples of Isodomic Trapezoidal Quarry Faced cited by Scranton include Eretria, New Halos, Kislar/Kallithea, Oiniadai, Pharsalos, and Pherai, examples which he uses to ascribe this stylistic subset to the last quarter of the fifth century and first quarter of the fourth century.[274] Goritsa is another site which should be added to this stylistic list. Although much of the site's *enceinte* is poorly preserved, extant sections are isodomic trapezoidal with facing similar to what is found at the aforementioned sites.[275]

Several of these sites contradict Scranton's fifty-year window for quarry faced constructions. Bakhuizen's team considers the defenses of Goritsa, including the Grand Battery, as a single planned construction which must have postdated the spread of large stone-throwers (the Grand Battery being a platform for such large engines), thus dating the site to the last quarter of the 4th century.[276] Similarly, Reinders dates Halos' period of occupation between 302 and 265

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both can be considered quarry faced with slight differences attributed to the stone's fracturing characteristics. While Lawrence's Asine example for pointed face is quite clear, his referenced photos of Messene do not match his description of purposeful extreme bossing, nor does the outer face appear as rough as the inner face of a stone would be. Kallithea's stones do tend to bulge up to 0.15m between the drafted corners and centre of the forward face. Such a feature is more likely due to a careful finishing of all sides contacting other blocks and the drafting of corners versus a quick smoothing of the outer face. For the sake of clarity, I shall continue Scranton's usage of the term 'quarry faced.'

[273] Lawrence, 238.

[274] Scranton, 98, 170-1. Scranton includes dating for only Eretria.

[275] See Bakhuizen (1992), 94-166 for the full description of the site's defenses.

[276] *Ibid.,* 163.

BC,[277] while other referenced sites have contested dates.[278] Scranton's system therefore seems to be off by approximately fifty years in concern to numerous Thessalian sites. A possible cause may be due to an artificial separation of quarry faced treatment and broached face[279] treatment into two separate periods. Several photos taken of Kallithea's east gate clearly show angled grooves cut into block faces within the overlap section forming the gatehouse area which visually matches examples of Scranton's broached face style. However, even Scranton's dates for broached work are earlier than the dates under consideration as he states this style began in the second quarter of the fourth century and lasted until the end of the third quarter.[280]

In order to reach a satisfactory conclusion a separate Thessalian chronology must be considered. Numerous sites that have been dated via means other than defensive architecture suggest that the trapezoidal style was widely used from the last half of the fourth century to at least the first quarter of the third century BC Possible causes for this fifty year lag behind an overall construction chronology are numerous:

1. Regional delay in adoption of new construction techniques.

   Although Thessaly had a brief moment of political power in

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[277] H. Reinder Reinders and Wietske Prummel, *Housing in New Halos, A Hellenistic Town in Thessaly, Greece* (Lisse: AA Balkema, 2003), 1. 302 BC is the historic date of the city's rebuilding by Demetrios.
[278] For instance, Oiniadai is dated both to the fifth century and the late third (Bakhuizen 1992, 163). Scranton (171, 174) gives Oiniadai two construction dates for what he perceives as two construction phases.
[279] Broached face is where "the quarry face has been modified by cutting long grooves with the pointed chisel; usually they slant downward across the face of the block." Scranton, 21.
[280] *Ibid.,* 98.

fourth century,[281] the region was generally removed from the powerful centres of Attica and southern Greece.

2. Cities in Thessaly may have had less wealth than that provided by the income of major Greek *poleis*. Although Thessalian cities clearly could provide trade income suitable for the ambitions of Aleuas and Jason, they were not supported by a large number of colonies or Imperial desires. As such, they may not have been able to or even desired to employ the latest trends in defensive construction.

3. Macedonian influences may have preferred a certain construction style. Phillip of Macedon may have funded construction of new *enceintes* as a benefactor of Thessalian states which supported his initial foray into the region's political scene. Furthermore, if Kallithea was indeed fortified to secure Pharsalos' hold over the territory of Halos following 346 BC, it can be assumed that the polygonal style was chosen as a trusted and quick to erect style.

4. Similarly, foundations of Demetrios Poliorketes exhibit notable similarities in style and construction method. In the region of the Gulf of Pagasae, New Halos, Demetrias, Gortisa, and Kallithea are all wall constructions possibly connected to Demetrios' battles with Cassandros. The similarities of these city's walls may be due to their geographical and temporal

[281] See Westlake's account for Jason's unification of Thessaly.

> proximity, but only with a major benefactor could some of these relatively minor sites afforded such major works.

A sizable amount of evidence suggesting a construction date in the late 4th century or early 3rd century is thus present. Nevertheless this investigation must finally examine the tactical and strategic situation at Kallithea as even a quarter century gap is too large to pinpoint Kallithea's historical setting. McNicoll focuses upon the fourth and third century development of the 'great circuit,' or *Gelandemauer*, which defended an occupied area bordered by high ground, or *Landschaftsstadt*.[282] Once siege engines were brought into play, circuits would have been preferably built in a position where they lay beyond the 200m[283] effective range of enemy catapults. Walls would also be built to provide height advantages wherever possible, thus extending the defender's range of attack. Such strategic considerations support dating Kallithea to the latter half of the 4th century. The site's positioning on the hill allowed it to achieve the goal of a 'great circuit' without building a long *enceinte,* such as Demetrias' 8.2km of wall. Surrounding terrain provides a height advantage while ensuring the wall does not lie within range of potential siege fire. The most vulnerable face is the west wall, explaining this sector's high concentration of towers, the west gate's construction style, and the size of Tower 1.

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[282] McNicoll, 4.

[283] A maximum range of 200m is extrapolated from Philon's statement that a 1-talen stone-thrower is unable to strike walls 170m away. However, Schramm's modern reconstructions were able to launch a 2-cuibt arrow shot from a catapult 370m. I shall continue McNicoll's assumption that 200m is a maximum range for bolts still capable of causing damange to defenses, whereas anything beyond that is anti-personnel. *Ibid.*, 4-5.

Kallithea demonstrates two further strategic concerns: supply of defenders and monetary cost. Regarding supply of defenders, Kastro Kallithea's defenses do include *diateichisma*, two cross walls that section off the western third of the hill.[284] As the construction of the *diateichisma* bonds into the outer curtain at towers 44 and 49, one can assume they were built as two elements of a single design. The *diateichisma* provided a fallback point in the case a limited number of troops were unable to hold the western gate,[285] where the terrain meant the west gate was the most likely to face a strong offensive. Similarly, it is unlikely that the small, earlier settlement was able to afford a massive construction project, particularly when the hill's terrain provided many natural advantages. Both matters suggest a publically funded expansion which occurred rapidly and also provided a contingency plan (the *diateichisma*) for a limited number of troops.[286]

The last matter to consider is tactical concepts, meaning the individual features employed in a defensive system.[287] Philon of Byzantium remains the principal ancient source regarding theory of defensive system construction in the Hellenistic period and comments on several individual features which can be examined at Kallithea:

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[284] See Appendix H, fig. 4 for a map of Kastro Kallithea.

[285] The fallback point of the *diateichisma* may also represent the point where the site's densely populated area beings. While architectural remains do exist around the western slopes, the eastern half contains much more evidence for habitation, particularly in regards to housing blocks. Similar to the concept of the *landschaftsstadt*, the builders of Kallithea could not have considered leaving the western hill unfortified even if it wasn't habitated.

[286] Such a stratagem is also seen in the existing wall of Demetrias. Although the entire wall length reached 8.2km in order to control high terrain, a secondary wall of 5.5km allowed a compacted defense line to be manned by fewer men. It is highly unlikely that any Classical city with a 'great circuit' had the number of troops necessary to heavily defend all sectors.

[287] McNicoll, 6.

1. Bonding of towers and curtains: Philo A62-3 recommends that towers and curtains should never be bonded together for fear that collapse of one might result in the collapse of the other. At Kallithea the realities of the site's setting and need for stability on a steep grade overrode such tactical concerns. Steep terrain and bedrock foundations are a major hindrance to any attempt at a mine or sap. Preventing tower instability and slippage owing to the slope is a far more important concern. Thus, the presence of bonding is not reasonable cause for dating the site earlier in the fourth century.
2. Size of towers: Lawrence[288] and Ober's[289] commentary on tower development suggest a gradual increase of size and height throughout the early Hellenistic period. Once again it is likely that the terrain and realities of Kallithea's setting allow for deviation from broader generalizations about the period. Although the hill foundation provided resistance against ram, sap, and escalade, it also provided superior natural height. Any machinery in Kallithea's towers would have had a strong range advantage even at the height of the curtain.
3. Posterns: Although the posterns cannot be used directly for dating, their number at Kallithea suggests the tactical purpose of the City. Only two posterns, those near towers 13A and 30,

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[288] Lawrence, 233-234.
[289] See Ober 1987 and 1992.

> could have been used for active defense. Numerous ports should be expected if the defenders engaged in sallies, especially along vulnerable stretches of wall. Only five such openings in the wall were noted which, given their locations, are more likely to have been used for practical reasons, such as spring access.[290]

In conclusion, it seems that Kastro Kallithea dates safely to the last quarter of the fourth century BC What is not certain at present is whether Philip II or to Demetrios were connected to the defensive construction. However, the difference between these two possible periods will not affect the present analysis. As the following section will demonstrate, the siege engines employed were similar in both periods.

<u>Siege Weaponry</u>

Within this rough timeframe of Kallithea's outer enceinte construction one can consider what types of siege weapon that available to the defenders of Kastro Kallithea. The physical limitations imposed by the size of the site's towers are just one clue as to what sort of artillery could be placed in each tower. What siege technologies were available at a given time will supply the other half of the answer, particularly as the 4th century BC was a time of rapid siege development in the Greek world. As Greek siege artificers improved their craft, they first increased the power of an engine by building larger and larger machine

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290 Tziafalias *et al*, 25.

components.[291] Eventually a size cap was hit and engineers were left to experiment with new materials and methods in order to increase both missile size and projection force.[292] However, in the case of Kallithea there is a third matter to consider: terrain. The location of Kallithea granted the defenders a significant advantage over many Hellenistic city defenses.

The fourth century BC was a period during which the Greeks both invented[293] siege machinery, starting with the hand-held *gastraphetes* created by Syracusean engineers in 399 BC, [294] and quickly advanced the field's technology. The earliest Greek engines, of which the *gastraphetes* is one type, are all a construction type referred to as 'non-torsion,' meaning that they were powered by large composite bows. Over time more powerful non-torsion engines were produced via the development of larger composite bows. Extremely powerful machines were built, such as the stone thrower of Isidorus of Thessalonica which could likely project a forty pound shot to the 'normal' catapult operating distance

[291] Marsden estimates the bow size of a stone thrower built by Isidorus of Thessalonica to have been 15 feet wide and 1 foot thick. Marsden, 15.

[292] In the words of Heron, "They sought to make the arms of the bow more powerful, but they could not realize their intention by the use of composite bows" (Heron, Bel. W 86 as cited in Marsden, 16).

[293] The term invented here applies to the Greek realm. Seige weaponry may have existed outside the Greek sphere prior to 399 BC, although Marsden's examination of alternative accounts upholds the 399 BC date. Marsden, 54-56.

[294] Marsden (49-52) effectively refutes Schramm and Schneider belief that 399 was the date of invention for torsion catapults. Diodorus' definite statement that "artillery was discovered at that time in Syracuse" must refer to some kind of major breakthrough in poliorcetics. Marsden (49) believes that such a significant discover must be one of three inventions: the *gastraphetes*, torsion springs, and calibration formulae. While the reader is directed to Marsden for a full account, a summary at present is useful. No Greek author mentions any sort of artillery before 399 BC meaning it is unlikely that Diodorus could be referring to anything but *gastraphetes* (*ibid*). While artillery may have existed outside of the Greek sphere of influence, the sources suggest that nothing was known about these techniques within Greece. Even at a fervid pace of development, Marsden (56) believes a period of thirty years would have passed by before the maximum-size bow limited further non-torsion development. Between 353 and 341 BC torsion catapults were probably discovered by the engineers of Philip II, whereas the calibration formulae were not collected until the Ptolemaic dynasty, after years of practical experience (Marsden, 60).

of 400 yards. Increasing an engine's power came with an exponential increase in both the size of a machine's composite bow and overall dimension. Marsden estimates that within a period of thirty or forty years Greek bowyers had reached the physical limits of the composite bow.[295] Engineers were left to research alternative means of propulsion, eventually developing the torsion engine.

The term torsion refers to siege engines which varied from their earlier counterparts in the way a bolt was launched. Engineers discarded Composite bows and replaced them with Philip's torsion engines in the mid-fourth century.[296] Two wooden frames flanking the stock each contained tightly wrapped bundles of sinew-cord into which the builder would insert a tapering wooden arm. The two arms were fitted with a bowstring which acted in the same way as the string of a composite bow. Tension was finally applied by iron levers that were inserted between the sinew and cross-pieces of the frame. Although the earliest design, which Marsden refers to as the Mark I, suffered from an inability to impart high tension on its sinew springs, it nevertheless was an important step forward in siege technology.[297] Gradual improvements to the overall design were made, soon[298] resulting in the Mark IIIa and IIIb frames, the former being euthytone catapults for arrows and the latter being palintones designed for

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[295] Marsden, 56.
[296] Philip's engineers at this time were lead by the Thessalian Polyidus. *Ibid.,* 58, 60.
[297] *Ibid.*, 18.
[298] Given the evidence available in Heron and Philon, it appears that the development process was quite rapid. Mark I catapults were introduced c. 350 BC while Mark IIIB frames appeared in the late 330s. *Ibid.*, 43.

throwing stones.[299] Mark IV and V captapults were eventually developed but lie outside the temporal scope of the present analysis.[300]

Advanced non-torsion catapults were continually developed until 360 BC and saw the addition of the winch and base to the original form of the *gastraphetes*. Stone throwing *gastraphetes* were then introduced sometime before 353 BC.[301] The time of torsion catapults now begins which is marked by several key developments occurring in a relatively rapid pace.[302] Mark I torsion catapults appeared *c.* 350, defined by having a pair of simple spring frames. Mark II catapults introduced spring-frames with holes sometime before 340 BC while Mark III engines included washers to aid the tightening of springs sometime after 340 BC. The Mark IIIa, signified by their Euthytone frame, was introduced before 334 while the IIIb palintone stone-throwers were developed between 334-331 thus making the Mark IIIa and IIIb engines the current model at the turn of the century.[303]

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[299] Euthytone comes from a Greek term referring to the machine's spring tops and long single hole-carrier forming one straight line. A line drawn along the arms of a palintone machine and through the spring and hole-carriers resembled a palintone hand-bow. Briefly put, the modifications in the IIIb frames were to increase the angle through which each arm could recoil, thus providing the power needed to hurl stones. See Marsden 16-24 for details of structural changes made in the development of torsion engines.

[300] Mark IV catapults were built using fully developed calibration tables which allowed the artificer to know exactly how large each component should be to fire a shot or stone of a certain size, ca 270 BC. Mark V engines used improved washers, ca 60 BC. *Ibid.*, 24-33, 43.

[301] 353 BC being the year Onomarchus employed non-torsion stone throwers against Philip.

[302] The rapid pace of development in the second half of the 4th century BC can be attributed to the programs of Philip II and Alexander. Greek states during the opening half of the century had been exhausted by the strain of the Peloponnesian War and its aftermath. Jason of Pherai could have theoretically attempted programs on a scale equal or greater to those of Dionysius but his assassination prematurely ended the dream of a Thessalian hegemony (Westlake, 99-100). It therefore fell to Macedon's power, wealth, and breadth of vision to fully implement and develop Dionysius' creation (Winter, 318).

[303] Marsden, 43.

By the third century BC artillery had diffused throughout the ancient world, particularly following the death of Alexander in 323 BC and during the subsequent campaigns of Cassander and Demetrios Poliorcetes at the turn of the century. Although the most complicated and fully-implemented defensive works remained affordable to only major centres,[304] even minor cities came to have enceintes built for defensive engines out of sheer necessity. Philip's campaigns from 357 to 340 BC decisively demonstrated that in order to have any chance of withstanding the Macedonian siege train the defending city must have its own engines in place. Greek states did not wait long to begin defensive adaptations designed to face the threat of Philip's advances in poliorcetics. Indeed, adaptations allowing the inclusion of new catapults in a defensive manner began in earnest ten years prior to the start of Philip's Greek campaign.

Ober's categorization of early siege towers is a convenient grouping to use in a survey of construction development. "First generation" towers are those constructed roughly between 375 and 325 BC which did not need to address the threat of large-scale stone throwers.[305] The circuit of Messene has some of the earliest preserved towers belonging to the first generation category.[306] Work began in 369 BC and was completed within a single season's work, thus

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[304] The Euryalos fort and Epipolai Gate of Syracuse are notable examples. The Euryalos and Epipolai were both constructed over many years and should not be viewed as entirely works of Dionysius. For a detailed account of its chronological development see F.E. Winter, "The Chronology of the Euryalos Fortress at Syracuse," *American Journal of Archaeology* 67, no. 4 (Oct. 1963): 363-387.

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[305] Ober (1987), 571-72; Lawrence, 45. While the first recorded demolition of a wall by bombardment occurred in 332 BC it was only during Alexander's campaign that the 60-lb shot became a standard piece of equipment in Greek siege trains.

[306] Group I towers include Messene, Siphai, Gyphtokastro, and Phyle.

providing a tight chronological context for the circuit.[307] Tower N is a well preserved example of an early form which integrated several novel design elements. It stands 9m high with a single chamber surmounted by a fighting platform on a solid base 3.6m in height.[308] Its four windows, two in the front and one on each side, are pentagonal and resemble enlarged arrow slits in the sense that they splay in width from 0.37m at the exterior face to 0.74m at the interior.[309] With such an arrangement of windows, three non-torsion catapults with bows 1.8m wide and stocks 2.1m long, capable of shooting missiles 1.1m in length, could be accommodated in the chamber: two for each forward window and a single engine in the back of the tower which could be pivoted to shoot through either side window.[310] Overlapping fields of fire from each tower's side windows would compensate for the resulting narrow field of fire through the side windows.[311]

Tower L of Messene presents a differing form of construction which has led it to be described as both contemporaneous to the entire circuit and as a later addition reflecting changes in architectural standards.[312] The most striking

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[307] Diodorus Siculus 16.66.1, 67.1 as cited in Ober 1987, 572.
[308] Ober 1987 573.
[309] *Ibid.*, 574.
[310] The engine dimensions provided are what Ober lists as "Group I Standard" (Ober 1987, 599). Marsden suggests that four catapults the size of Zopyros' mountain shooter (2.2m wide and 2.9m long) could be accommodated "provided that their bases had slightly different heights" (Marsden, 129). Given the inherent complexities arising from worrying about different heights of mechanism I find that Ober's arrangement of three catapults is much more likely than four.
[311] See Figure 3 in Ober 1987 for engine placement as well as the unique splay of Tower N's side windows. Marsden figure 6 and diagram 1 (Marsden 142, 155) exhibit square tower fire coverage.
[312] An observer could easily guess that Tower N represents an earlier stage of construction while Tower L dates from a later rebuild or expansion of the defenses. Marsden states that the ashlar construction of Tower L demonstrates that "the fortification designers had now learned two most important lessons" relating to the need for full windows and superior height (Marsden, 129-130). Ober follows Lawrence's firm stance that the whole of Messene's defenses are contemporary (Lawrence, 47).

differences are its extra height (12.5m atop a solid base 6.6m high), gabled roof and lack of fighting platform, strict ashlar masonry, and two-storied construction. Ober attributes these differences to the greater threat associated with the relatively level terrain and proximity to Messene's Arkadian gate.[313] Here is also seen the employment of true windows, two occurring on each of the front and side faces, in the tower's top level instead of the pentagonal openings of Tower M. Within this 5.5 meter square space two catapults of "Group I standard" size could be fitted in each forward corner and take advantage of one forward facing window and one side window. Two more engines could be placed at each of the rear side windows to provide superior enfilading abilities. In order to fire out of both the front and side windows, the forward catapults were seated somewhat back from the windows, a position which restricted the lateral range of fire.[314] Such a placement of the engines required wide openings to compensate for the lost range thus leading to Tower L's experimentation with full sized windows.[315]

While at first observation the two tower types of Messene seem to represent separate stages in tower architecture, their similarities becomes very apparent once later towers are brought into consideration. Aigosthena is a prime example of Ober's Group II tower category which he separates based on notably taller construction with multiple firing chambers built atop lower stories

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[313] Ober (1987), 576.
[314] A normal setting would be to place the engine as close to the window opening as possible. Marsden, 140, Fig. 5.
[315] Tower L's experimental nature is demonstrated through two window features. The lower sill is formed by rabbetted blocks, perhaps in the hope for greater stability. Four holes around the window presumably held bolts for double-leaved, outward-opening,, side-winging shutters. If so, this is the only example of such a window arrangement in existent towers. Lawrence, 415.

exaggerated in height in order to raise the top-most artillery chamber.[316] Despite being a small Megarian town, Aigosthena's Tower A is one of the most impressive existent towers on mainland Greece, preserved to 18.4m at the top of its gable and containing four levels.[317] Although Lawrence links this tower to Demetrios Poliorcetes on the sole basis of its large size, Ober's dating of the site to 343 BC seems the most likely option, particularly given that the Aigosthena circuit was constructed with financial aid from the Athenians.[318] A date of 343 BC also fits the general period established for first-generation towers and although larger than earlier towers, Aigosthena A does not present any construction techniques addressing the threat of stone throwers. Its top level, measuring ~7.6m^2, has three windows on each face, allowing for a variety of proposed catapult arrangements. The simplest arrangement is a catapult in each corner commanding two windows and a catapult placed at each middle window for a total of eight machines in the chamber.[319] The bows could have been no wider than 1.8m with stocks 2.1m, measurements which are close to the typical size seen in both Group I and Group II towers.

The remainders of Ober's Group II examples are similar to that of Aigosthena with several noteworthy variations. A freestanding tower 5km east of Gyphtokastro, the Mazi tower, contains five chambers and possibly an open

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[316] Ober (1987), 596.
[317] *Ibid.*, 587. The 340s were still early for independent *poleis* to try and build such major defenses on their own.
[318] Lawrence, 389; Ober (1987), 586-7. As Ober points out, the dimensions of Demetrios' siege tower used at Rhodes in 305/4 (reported by Diodorus Siculus as 23m^2 at the base and 46m tall) dwarf Aigosthena A.
[319] Ober (1987), 588. Ober proposes several other arrangements which may have allowed bows up to 2.2m and stocks of 2.5m at the cost of field of fire.

roof.[320] The Mazi tower's state of preservation is far from ideal, with only the northwest corner still standing, but there are enough remains of two faces to suggest its form of construction. The top floor, which foundation stones suggest was around 8.8m^2, had two full windows on each face. Four catapults with stocks 2.1m long could be easily accommodated while if 2.8m bows and 3.2m stock with mobile stands were possible additions if a compact situation was acceptable.[321] Each of the three floors between the main floor entry and upper catapult tower had two arrow slits on each face meaning a total of 24 archers could have operated in support of the main catapults.[322] Three towers in the region of Vathychoria provide examples of free standing towers, one circular in shape, which possessed theoretically significant firepower despite not being attached to even a small-scale fort.

The similarity in size of the considered tower chambers suggest that defensive catapults did not vary greatly in dimension during the non-torsion period, a stark contrast to reported holdings of city armories in the third century[323]. These engines were apparently used as anti-personnel weapons since their small size could not handle the large bolts and shots necessary to damage enemy siege weapons. Philo's recommended 10 mina and 20 mina machines

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[320] *Ibid.*, 590.
[321] *Ibid.*, 591.
[322] The arrow slits at Mazi are similar to Aigosthena and Gyphtokastro slits in their height. Each of these towers have arrow slits only one course in height, clearly suggesting that they were intended for archers. Messene L is an exception in that its 'arrow' slits appear to have been designed specifically for catapults. Lawrence believes the double-course height of these slits, as well as their height from the chamber floor, indicate they were used for catapults (Lawrence, 47). The limitation of lateral range was a tradeoff for greater structural protection of the catapults which in this case may have been easier to maneuver if it had not been provided with any armour platting. (Lawrence, 48).
[323] Scipio Africanus found catapults of larger and lesser sort in New Carthage in 209 BC. Livy, xxvi. 47. 5-6 as cited in Marsden, 78. Athenian catalogues mention numerous sizes of catapults stored in the Erechtheium (Marsden, 70).

would have stock lengths of 6.4m and 8.4m respectively.[324] Despite structural changes intended to raise the main catapult chamber and the resulting increase in wall thickness, each tower has similar window dimensions and window height from floor, as well as a constant ratio of floor space to total number of windows.[325] However, architects did have to adapt tower design in several ways to face the proliferation of large stone throwers in both defensive and offensive usage.

What Ober terms as 'second generation' towers, those dating from the end of the 4th century and later, are distinguished by complex walls noticeably thicker than those of earlier towers and by windows enlarged for torsion engines. The upper chamber wall of the Mazi tower, the thickest of Ober's sample, is 0.70m and only one course thick whereas most towers built in the 3rd century BC have walls at least 1 meter in thickness.[326] At Herakleia-ad-Latmum, a site founded by Cassandros early in the 3rd century, tower masonry is consistently two-course thick ashlar and built with a header-and-stretcher system.[327] Perge's tower walls are ~2.2m thick.[328] Isaura and Assos are two further well preserved examples of elaborate Hellenistic tower construction.[329] While there are few examples of clear intervening towers dating from the late fourth century, it is clear that defensive sensibilities reacting to the diffusion of large torsion stone throwers dictated the construction of towers very different from those of the mid-fourth century.

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[324] Ober (1987), 599. Ober references the calibration tables outlined by Marsden.
[325] See Table 1 in Ober 1987 for a summary of tower dimensions.
[326] Ober (1987), 599.
[327] Ober (1992), 152.
[328] Winter, 176-77
[329] Winter , 136-7.

Chronological development and diffusion of siege weapons in the south of mainland Greece and Ionia is relatively secure given the available archaeological and epigraphic evidence. However, the situation of northern Greece is not necessarily the same. Thessaly was in a unique position for much of the 4th Century BC. Following Jason of Pherae's attempt to create a Thessalian Hegemony, which could have seen the north rule over Greece proper had it not been for Jason's assassination, the region quickly fell under the influence of Philip II.[330] Thessaly was potentially the first region in Greece to be exposed to full-scale deployment of siege weapons as its new patron, Philip, was a primary force in beginning the refinement of siege tactics. During the first two-thirds of the fourth century BC only Dionysius, the Phocians, and Philip II could have possibly afforded a military surplus of modern engines.[331] Philip's early affinity for catapults is also tied to a battle in 354 BC where Onomarchus the Phocian concealed stone-throwers along the heights of a pass into which Philip was lured.[332] The Macedonian troops were routed and Onomarchus claimed the day. The effectiveness of these small shots in the field, which were about 2.2kg (~5 mina), demonstrated that compact units could be effective anti-personnel emplacements in city defenses.

Archaeological remains that are well published in Thessaly are unfortunately lacking compared to that available in the Attica and Boeotia

[330] Westlake should be consulted for a detailed history of the rise and fall of Jason and the subsequent political maneuvering employed by Philip in his attempt to dominate Thessaly's politics.
[331] Marsden, 58.
[332] Marsden, 59.

regions. Tithorea[333] and Lilaia have excellent remains, but are both geographically and temporally removed from Kallithea.[334] Remains of three Thessalian cities can help determine what siege weapon arrangements were in use late in the 4th century BC: Goritsa, Demetrias, and New Halos. Goritsa's enceinte, consisting of 24 towers and two large artillery platforms, dates as a single construction to the late 4th century.[335] Oude Kotte reconstructs Goritsa's defenses as tall two storied towers with artillery chambers above a *parados* level chamber. Each 6x6m space could accommodate four 1-cubit engines or two 3-span catapults, firing bolts of 0.46 and 0.69m respectively.[336] The Grand Battery housed two 1-talent (60 minas) stone throwers, with a stock length of 11.6m and arm width of 4.6m.[337] Demetrias was founded slightly later than Goritsa in 294BC as the capital city of Demetrios Poliorcetes. Here the enceinte is 8.2km long with 90 towers, averaging 10x10m in size, although numerous towers were later expanded to accommodate the largest available catapults.[338] Without any

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[333] Laurence B. Tillard, "The Fortifications of Phokis," *The Annual of the British School at Athens* 17 (1910/11): 54-75.

[334] Both sites are located in Phocis and are dated to the mid 4th century BC. Dating of both sites is based upon Tillard's initial chronology and supported by Ober's tower classification. (Tillard, 1910-11; Ober (1992), 163-4). Maier and Lawrence (385, 423) question a mid-century date by suggesting both sites would have had their walls destroyed in the demilitarization program of Philip in 346 BC. F.G. Maier, *Griechische Mauerbauinschriften. Erster Teil: Texte und Kommentare*, Vol II, (Heidelberg: Quelle und Meyer, 1961), 98.

[335] Bakhuizen (1992), 313. Bakhuizen notes while Philip's fortification program was started as early as 352 BC, building activities were interrupted by the Thessalian League. The decision to fortify Goritsa therefore could date from ~350BC with actual work starting after political disruptions had ended.

[336] *Ibid.*, 143. Two one-mina torsion stone-throwers could alternatively be housed. Their stock length of 2.7m is only slightly longer than the 2.3m stock of a 3 span machine.

[337] *Ibid.*, 150. Meyer and Winter had previously dated this part of the enceinte to several different phases, an idea rejected by the Goritsa Team. Noticeable differences in the quality of stonework between the Grand Battery and acropolis tower are due to later rebuilding. Meyer, E., "Goritsa," *Mitteilungen des Deutschen Archäologischen Instituts, Athenische Abteilung* 71 (1956), 98-100.

[338] Reinders (1988), 192. Towers 25, 43, 52, 66, and 83 were all expanded in later periods to become large artillery platforms. Tower 43, which also functioned as a signal tower (Batziou-Efstathiou, 19), was expanded to 40x40m during a fourth construction phase (Stahlin 1934, 36).

preserved superstructure denoting window size and placement the catapult arrangement in Demetrias's towers is pure conjecture.[339]

New Halos is a site closely related to Kastro Kallithea. Parmenion destroyed the old city and its territory given to Pharsalos in 346 BC and the new Hellenistic city was founded ca. 302 BC.[340] Halos' square enceinte is 2.7km long and possesses 70 towers, placed an average of 40m apart from each other.[341] The average dimensions of the towers are 6.75m x 6.30m, slightly smaller than those at Demetrias but very similar to other all-stone towers at Messene, Tithorea, Lilaia, and Drymaia. Another important distinction is that while Demetrias' defenses were constructed of a mudbrick superstructure, Halos' towers were entirely of stone.[342] These similarities allow such comparisons to be useful in reconstructing a likely superstructure. Reinders suggests reconstructing Halos' towers as ~11m high first-generation style with an archer chamber at parados level topped by a catapult chamber.[343] Four two-cubit torsion bolt shooters placed at each window, with stock lengths of 3.1m and arms width of 1.4m, is a likely reconstruction. Although larger forward engines could be used, such a tactic would come at the cost of enfilading fire. The flat terrain surrounding the

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[339] Two 80 dactyl torsion bolt-shooters or a pair of 10 mina stone throwers are two examples of large catapult placement. Smaller bolt shooters could be placed to the side windows if the forward facing machines were also bolt throwers. As stone-throwers required larger stocks (6.4m vs 5.1m for the given examples) there would be little operating room in the chamber's rear.

[340] Reinders (1988), 163, 169-170. Reinders comments that while "we simply do not know when the town was founded," a date around 302 BC fits with Thessalian activities of both Demetrios and Cassander.

[341] *Ibid.*, 192.

[342] *Ibid.*, 72.

[343] *Ibid.*, 80. If Halos was indeed founded in 302 BC it may be expected that its towers would have been second generation style, constructed to address the pressures of large torsion engines. However, given the similarities to first generation towers I agree with Reinder's hypothesis. Ultimately if Halos did follow second generation tenants then adjustments would have necessitated in order to house fewer, but larger, engines. Ober (1992), 159-161.

city required superior enfilading ability in order to deal with any enemy troops approaching the main curtain.

Finally Kastro Kallithea's towers can be considered. An important matter at Kallithea is the steep terrain which must be overcome to approach the city's enceinte. Traditional siege methods, such as sapping, mining, and rams, would have been useless given the wall's sitting on steep bedrock. During the 3rd century BC even small siege towers[344] could never have scaled the hill. Whereas muddy ground could bring mobile towers to a halt, a steep slope was entirely un-navigable. Large enemy catapults also posed little threat to Kallithea's enceinte. Several of Marsden's calculations are useful demonstrations of how large stone throwers were unlikely to damage the wall.[345] An engine must be set at an angle of 45 degrees in order to achieve its maximum range of 365m. At this angle, a shot would reach its apogee of 80m at a point 182m away from the engine. An attacking force would therefore have to find a position to set up its catapults no more than 80m lower in elevation than the wall while ensuring the location is also ~182m in distance from the wall. Such positions, if they even exist, are very few around the base of the Kastro. Yet while the above scenario uses a theoretical maximum, Philo's suggestions for outerworks imply a stone thrower had to stand within 137m[346] of the target wall and set at a lower angle in order to impact the target with an effective amount of forward momentum.[347]

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[344] By this I refer to the large, mobile towers built by the offensive army, not to city towers.
[345] Marsden, 90.
[346] From Tower 1, no point at a distance of 137m reaches past the modern road which circumnavigates the hill at a point one-quarter up the hill's entire ascent.
[347] Marsden, 91. While this distance is technically Philo's recommended placement for an outer ditch, one can assume that it would be at a distance which would prevent siege weaponry from being easily placed within range of its target (the city walls).

Given Kallithea's late-fourth century timeframe, the towers are very similar to those of Halos and other late first-generation towers, although less deep by ca. 1m. If one relates Kallithea's enceinte expansion to events surrounding New Halos' foundation in 302 BC then the possibility of second generation tower construction must be entertained. However, it is highly improbably that the architect responsible for Kallithea's defenses would have abandoned earlier sensibilities in order to use the latest technology. Any threat from stone throwers, which second generation towers are specifically designed to address, is negated by the site's terrain. As Ober puts it: "Presumably a good military architect, working within a budget, would not build a given tower bigger than necessary to house the sort of artillery needed to counter the worst threat that the enemy could bring against the wall sector in which the tower was located."[348] Bulked up towers would have been a large waste of money, labour, and material at Kallithea. Furthermore, the site's remains do not give any indication of second generation styles such as double scale tower walls[349] or large floor area to window ratios. Several earlier towers do have large floor area, but were built to accommodate multiple catapults. Aigosthena's 68.89 m^2 upper chamber has three windows on each face suggesting up to nine catapults could be housed. While second generation towers are typically large, each face has only one or two windows[350]

[348] Ober (1992), 162.
[349] All examples of second generation towers in Ober 1992 are thick and built of double scale masonry, often in header and stretcher style. While several earlier towers are also double scale, they are less thick. Sipha's Sea Gate walls are only 0.6m thick vs. the typical thickness of 1-1.5m in second generation upper chambers.
[350] Many towers classified as second generation by Ober are not preserved to the height of the catapult chamber. Structures with intact upper chambers and windows include Latmian Herakleia 22, 18, 58, and 59. Moderately intact towers from which extrapolations can be made include Samos 27, 24 and Latmian Herakleia 20, 56, 60, 61, and 62. Examined collectively, this

suggesting that an equivalent amount of space was used for larger torsion engines necessary for defense at the close of the 4th century BC.[351]

Typical towers at Kallithea, assuming a wall thickness of 0.5m, are externally 5.8m wide and 4.85m deep with internal dimensions of 5.70m wide by 3.85m deep, or 21.95m^2.[352] Compared with the average size of Ober's first generation towers examples, the Kallithea typical is 10m^2 smaller. The reduced size is due to the notably shorter depth: almost 2m smaller than the width of most towers. Unlike Ober's examples, which are almost uniformly square in dimension, Kallithea's towers are significantly wider than their depth. In this regard they are more similar to those of Goritsa: Oude Kotte's example of a typical dimension is 4.80m wide by 3.6m deep.[353] He also provides two hypothetical catapult placements: either four 1-cubit engines each facing its own window (two forward and two side) or two 3-span engines which could be rotated to fire through either a forward or side window.[354]

A similar model can be applied for a typical tower at Kallithea. Here the towers abut against walls somewhat thicker than those at Goritsa (2.6m vs 2.45m) and therefore have shorter side faces (2.25m vs 2.36m). However, the difference in size is minimal and each face can still accommodate a window with

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assortment of towers supports a placement of only one or two windows on the forward face while in some cases the sides of towers were not given any windows at all. Small towers (< 30m^2) invariably have only one window while the larger examples (> 30m^2 but often < 40m^2) have two forward windows and one side window.

[351] Philon (iii.5-6) suggests 10-mina stone-throwers as idea for destroying enemy catapults. Herakleia 18 (66.4m^2) could accommodate two such weapons. None of Ober's example were large enough to accommodate 1 talent engines which Philon recommends against siege towers. Ober (1992), 162.

[352] Of the exterior 4.85m depth, only 2.25m extend beyond the outer face of the wall. Internal dimensions are arrived at by simply subtracting 1m from each dimension as each side of the wall was ~0.5m thick.

[353] Baukhuizen (1992), 143.

[354] *Ibid.*

a typical first-generation width so that enfilading catapult fire remains a possibility.[355] I agree with Oude Kotte's that 1-cubit machines are a small caliber weapon despite the advantage of having one machine at each window. I therefore suggest that a typical Kallithea tower accommodated two 3-span machines which were Mark IIIa euthytone frames.[356] Stone throwers may have been present in towers 2 and 14 at the site's NE and NW corners but it is unlikely that a typical tower could accommodate Mark IIIb palintone machines of a useful size. A 1-mina shot (436.6 grams) would require a stock length of 2.96m, leaving 0.89m between the rear of the machine and the back wall.[357]

It becomes very apparent that Kastro Kallithea was an imposing defensive post that would not have faced serious threats from newly developed siege weaponry, particularly with the inclusion of even small catapults in the city's towers. With a solid understanding of the tactical situation of fourth century Thessaly and the importance of Kallithea attention can now be turned to analyzing the Othrys system and it defensive capabilities.

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[355] Ober's examples have an average width of 0.8m. Ober (1987), 598.

[356] Although calibration tables had not yet been codified by the late 4th century, they are used by modern authors to calculate the area needed for a certain caliber machine and oppositely the largest caliber machine one could fit into a given space. The ancient artificer would have based all machine measurements around the single variable D which equals the diameter of the hole through which the main springs passed measured in dactyls. For overall dimensions and missile length, three equations are of interest: missile length = 9D, total stock/machine length = 30D, and total arm width = 17D (see Marsden 44-45 for complete table). In a space of 3.85m, the theoretical bolt maximum is 1.15m which is equivalent to a 5-span bolt. However, this would allow for no operation space behind the machine. A 2 cubit machine would be 3.09m in length, leaving only 0.76m of space in the rear of the tower, whereas a 2 span machine is 2.32m in length allowing a comfortable 1.53m of operation space.

[357] Calculating the dimensions of a IIIb palintone frame require equations more complex than those used for euthytones. Here the equations are: $D=1.1\sqrt[3]{100M}$ where D is again the diameter in dactyls and M is the mass of the shot in minas, stock length = 30D, and arm length = 15D.

Chapter 3: Project Analysis

3.1 Role of Digital Archaeology

The stereotype of an archaeologist toiling away in trenches with nothing more than a few hand tools is still very prevalent in popular culture. However, such imagery would be more accurate if it included computerized cataloguing centres, total station measurements in field, and tablet PCs lying next to the traditional trowel and brush. Archaeologists were early adopters of computer technology, particularly during the height of the processual school of thought, a theoretical framework which had a natural affinity with the statistical and analytical abilities enabled by the development of large mainframe computers.[358] Zubrow suggests that digital archaeology's research scope has mirrored the size of the equipment used: mainframe computing research remained focused on regional data sets and behaviour models while the adoption of desktop computing has shifted interest to site and sub-site specific data.[359] Contradictory to Zubrow's view that the theoretical underpinnings of post-processualism slowed archaeology's pickup of technology,[360] Kvamme pinpoints the early to mid 1980s as the period when GIS technology appears in literature.[361] Three early lines of research were site location models for use in cultural resource management applications, GIS procedure studies, and theoretical concerns related to the use of

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358 Ezra Zubrow, "Digital Archaeology: A historical context," In *Digital Archaeology Bridging Method and Theory*, eds. Thomas L. Evans and Patrick Daly (New York: Routledge, 2006), 16.
359 *Ibid.*
360 *Ibid.*, 17
361 K.L. Kvamme, "A view from across the water: the North American experiecne in archaeological GIS," In *Archaeology and Geographical Information Systems: A European Perspective*, eds. Gary Lock and Zoran Stancic (Bristol: Taylor & Francis, 1995), 2.

GIS for landscape archaeology.[362] GIS applications have since become increasingly common as hardware, software packages, and digital data become more affordable and accessible while at the same time allowing a greater range of analytical processes.

The development and adoption of GIS applications within archaeological contexts has a complex and highly regionalized history (*ie.* North American vs. European archaeology). Reilly, Green, Savage, Marble, and Zubrow provide an extensive historical overview of the field.[363] Whereas the term 'digital archaeology' could previously be applied only to a limited sub-set of archaeological research utilizing mainframe computing, 'digital' now refers to a large number of devices and procedures brought about by the modern proliferation of desktop computing. GIS and associated applications are merely one of many ways digital solutions are aiding archaeological research both in the lab and in the field. GIS-specific uses have themselves diffused into a wide array of research areas with current efforts categorized into four broad areas: resource management, excavation, landscape archaeology, and spatial modeling of human behaviour.[364]

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[362] Stephen H. Savage, "GIS in archaeological research," In *Interpreting Space: GIS and Archaeology*, eds. Kathleen M.S. Allen, Stanton W. Green, and Ezra B.W. Zubrow (Bristol: Taylor & Francis, 1990), 22.

[363] Savage, 1990; Zubrow, 2006; Stanton W. Green, "Approaching archaeological space: an introduction to the volume," In *Interpreting Space: GIS and Archaeology*, eds. Kathleen M.S. Allen, Stanton W. Green, and Ezra B.W. Zubrow, 3-8 (Bristol: Taylor & Francis, 1995); Duane F. Marble, "The potential methodological impact of geographic information systems on the social sciences," In *Interpreting Space: GIS and Archaeology*, eds. Kathleen M.S. Allen, Stanton W. Green, and Ezra B.W. Zubrow, 9-21 (Bristol: Taylor & Francis, 1990); Paul Reilly and Sebastian Rahtz, "Introducation: archaeology and the information age," In *Archaeology and the Information Age*, eds. Paul Reilly and Sebastian Rahtz, 1-28 (New York: Routledge, 1992).

[364] James Conolly and Mark Lake, *Geographical Information Systems in Archaeology* (Cambridge: Cambridge University Press, 2006), 33.

The thesis concerns the categories of excavation and landscape archaeology, the latter including several GIS-based studies specifically dealing with the landscape of ancient Greece.[365] Excavation at Kallithea has openly embraced digital methodologies. Conolly and Lake rightly emphasize a strong conceptual divide between data collection and data analysis, a separation which is all too apparent when comparing day-to-day data excavation operations against post-excavation activities.[366] Availability and accessibility of digital devices has rapidly increased the ease and rate of collecting data on site, a scenario which quickly results in a project literally drowning in data.[367] An example from Kallithea is that the total station's relative ease of use allowed the 2009 team to collect ~1000 measurement points consisting of findspots and depth measurements at Building 10. In total almost 10,000 data points have been recorded over the course of the project.

Onsite digital archaeology was an early consideration for the Kallithea project. Dr. Sean Gouglas of the Humanities Computing Program was recruited during the early stages of planning in order to develop and oversee the first few years of GIS operations. A considerable amount of forethought and planning is required when a project decides to utilize GIS software and equipment in order to

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[365] Kythera Island Project, http://www.ucl.ac.uk/kip/; N. Smith, "Towards a study of ancient Greek landscapes: the Perseus GIS," In *Archaeology and Geographical Information Systems: A European Perspective*, eds. Gary Lock and Zoran Stancic, 239-248 (Bristol: Taylor & Francis, 1995).
[366] Conolly and Lake, 36.
[367] *Ibid.*, 61; Paul Backhouse, "Drowning in data? Digital data in a British contracting unit," In *Digital Archaeology Bridging Method and Theory*, eds. Thomas L. Evans and Patrick Daly, 35-49 (New York: Routledge, 2006).

ensure clear research goals and a controlled budget.[368] Without clear research objectives a great deal of money and time can be expended in a futile attempt to use technology for technology's sake. Fortunately goals for GIS research at Kallithea were identified at an early stage. A total station was employed for the specific purposes of mapping terrain within the city's enceinte, plotting various architectural features, and creating a grid pattern for the land survey team. As an overarching goal of the project is to understand Kallithea's place within the broader region, this current study is a logical next step in the overall research progress.[369] Utilizing digital means to analyze the ancient landscape in light of the tactical realities in the 4th century BC is thus a natural progression out of the first steps taken during those early years of the dig when the primary focus was on the site itself.

Whether working on site or reviewing an article, all parties involved with projects using digital methods should be aware of the dangers inherent with the use of technology. Although equipment, software, and training can all be costly endeavours, one should never assume that expensive technology makes it infallible. End results can be vastly skewed if early errors are not caught. These minor data errors can find their way easily into any analytical dataset if the user is not on their best guard. Before visualization is even attempted, the user must account for any potential misrepresentation arising from incorrectly added data. For example, a misplaced target spot, due to either an incorrect map projection or data input, could significantly affect all results produced by a software package.

[368] Careful planning is required in the implementation of any technology whether it be GIS or a database used for cataloguing purposes. Conolly and Lake, 37.
[369] Tziafalias *et al.*, 97.

Generally speaking, using logic checks at each stage of analysis is a good first line defence that will prevent earlier errors from compounding along the research chain. If the data produces a result which seems absolutely incorrect, the data must be checked.

A more serious danger occurs in the presentation of data, particularly when one is considering GIS presentations for the purpose of visualization. Authors such as Miller and Richards argue that a large percentage of computer-based visualization is created to present data in a way accessible to the public as opposed to ways that advance research.[370] Research uses of visualization where present are good indications of how varying display settings can produce very different visualizations with the same dataset.[371] Unfortunately, the public is also an audience that has a tendency to accept anything digitally created as the truth: the better it looks the more likely it is to be accepted as correct.[372] In order to avoid any such misconceptions I have attempted to accurately detail the steps taken in the analysis section and take note of any manipulations applied to the raw data. I have also refrained from draping satellite imagery over analysis maps so that the emphasis remains on the digitized postulates that have been created.

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[370] P. Miller and J. Richards, "The good, the bad, and the downright misleading: archaeological adoption of computer visualisation," In *Computer applications and quantitative methods in archaeology 1994,* eds. J. Huggett and N. Ryan, 19-22 (Oxford: Bar International Series 600).
[371] Joseph D. Wood and Peter F. Fisher, "Assessing Interpolation Accuracy in Elevation Models," *IEEE Computer Graphics and Applications* 13, no. 2 (1993): 48-56.
[372] Chapman, 171. An example is a 3D model created from total station measurements. Although the resulting map represents only the top third of Kastro Kallithea anyone viewing the map could easily interpret is as showing the entire hill.

3.2 Analysis

Google Earth

Google Earth provides a powerful visualization tool useful for both amateur and professional archaeological uses. In its original release, the *Earth* platform had limited functionality due to low-resolution 2D imagery laid over a virtual globe that lacked elevation and terrain data. Google had provided an easily accessible virtual atlas, although it did not provide archaeologists any tools that went beyond pre-existing 2D map analysis. Despite its strengths in providing a great deal of searchable atlas data via the internet, *Earth* was for the general public and lacked any appealing topographical features. Later revisions of the software continually added new functions to the package as well as providing an ongoing improvement in image quality. As of *Earth* 5, the latest version, much of the globe is represented with medium to high-resolution satellite imagery. Equally important to landscape archaeology is *Earth*'s representation of topography in three dimensions and use of the World Geodetic System 1984 datum, the same reference system used by the Global Positioning System.[373] The software is no longer limited by its previous lack of detailed imagery and terrain data but has numerous potential uses. Google Earth can now be a beneficial addition to projects that may benefit from basic landscape analysis yet lack the access or financial resources to purchase higher-level GIS software packages and topographical datasets.

[373] WGS84 is also the reference system used by the Greek Hellenic Army Geographical Service to georeference digital evaluation maps.

In order to asses Google Earth's abilities as a preliminary analytical tool, I used Google's software package to undertake a visual analysis of Wieberdink's proposed sightlines between the forts lining the northern edge of the Othrys range.[374] Although no data acquisition was necessary, the locations of each tower and fort had to be pinpointed and marked within the virtual environment. This process was facilitated by descriptions of each site and their surrounding terrain as detailed in numerous reports outlining the forts and their surrounding topography.[375] Kallithea, Halos, and the Myli towers were quickly located as I have personally visited these sites. With the assistance of Dr. Margriet Haagsma the remaining sites were securely located with the exception of Neochoraki and Tsurnati Vrisi. A spur located 1km south of the village of Neochoraki appeared to have a topographical setting and architectural remains similar to Wieberdink's description.[376] However, from this point the Myli towers and most of the lower plain were not visible in Google Earth which contradicted Wieberdink's report. While this could be due to errors in Google's elevation data I nevertheless identified an alternate spur 0.65km to the south as another possible site location which provides visibility to the plains.[377] No remains were visible at the site of Tsurnati Vrisi although a ridge near the modern road appeared very similar to Wieberdink's topographic sketch and was used as the reference point. All points were laid out with numbered markers roughly following Wieberdink's system.[378]

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[374] Two years ago this sort of study would have been impossible as the region of Almiros was not represented in hi-res images and lacked topographical information.
[375] Wieberdink 1990; Haagsma *et al* 1993; Reinders 1988
[376] Wieberdink (1990), 49.
[377] Appendix C, Figures 17 and 18
[378] Appendix C

Several changes to the numbering were required as I included both sites near Karatsadali, as described by Haagsma *et al*.[379] Vrinena is indicated on the map but was not included in my analysis as Wieberdink did not indicate any sightlines to this southern fort.[380]

In order to examine visibility the camera was positioned at ground level within each post's external boundaries and then raised approximately six meters to simulate the height of a wall's parapet or average tower height.[381] Camera placement is not accurate to any specific point on each fort's wall but represents a rough central area of each bastion, all of which are described as at least 35m in diameter.[382] All markers within Google Earth required having their scale adjusted to a value of 100 so as to remain visible within the landscape with the camera positioned close to the ground. At each location the camera was panned as necessary in order to face each surrounding tower, resulting in the screenshots available in Appendix C. Karatsadali 2 was not considered in this part of the exercise as Wieberdink does not include it in his system analysis. Karatsadali 2 will be revisited during line of sight and viewshed analysis.

Results were similar to those reported by Wieberdink, whose in-field analysis forms a check and balance to the current study.[383] Two alternative observations were made regarding the line of sight from Halos to Karatsadali and Kallithea to Neochoraki. For the former, Wieberdink did not indicate a viable

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379 Haagsma *et al*.
380 As Wieberdink did not indicate any sightlines this is of little consequence. Vrinena is ~ 7km south of the defensive line deep in within the Othrys mountains. Its location is idea for guarding the river pass, but isolates it visually from any other tower.
381 Similar to how in most cases an additional value is added to the source cell's *z* value to account for the height of the human eye above surface. Wheatley, 171.
382 Wieberdink, 71.
383 Appendix B

sightline between Halos and Karatsadali while observations within Google Earth suggest that both sites are intervisible. For the latter, Kallithea was not visible from either of the spots I suggested as locations for the Neochoraki fort due to a tall ridge present to the west. Two further results were questionable but could not be interpreted as definitely contradicting Wieberdink's findings. He reports Halos and Karatsadali as not being intervisible while Tsurnati Vrisi and Neochoraki are intervisibile. Both observations could be neither confirmed nor denied in the *Earth* virtual environment due to the difficulty in seeing the point at which each marker's base intersected the terrain at ground level. While the user is able to zoom in and out of the entire scene via changes in altitude there is no option for a kind of 'telescope' with which to zoom in on a view while maintaining a constant viewing position. Ambiguous situations such as these highlight current limitations of Google Earth and the resulting necessity for accurate GIS enabled software packages in landscape archaeological analysis.

ArcGIS – Line of Sight

ArcGIS desktop is "full-featured geographic information system (GIS) software for visualizing, managing, creating, and analyzing geographic data."[384] Manufactured by ESRI, ArcGIS is currently the industry standard for digital geographic analysis and the logical choice for carrying out analysis of the Othrys mountain system. ArcMap was the main software environment that carried out

[384] http://www.esri.ca

analytical functions with 3-D views generated in ArcScene.[385] Both the spatial analyst (viewshed function) and 3D analyst (line of sight tool) program extensions were required. These two extensions are not included with the base license of ArcGIS and require separate software license purchasing, thus presenting a real life example of the matter of cost considerations mentioned previously. Projects investigating the potential use of ArcGIS must be diligent in planning research questions and consider what analytical tools will be required. If the necessary extensions had not been available on University terminals then this analysis would have required a significant software investment.

The Project purchased[386] necessary topographical data from the Hellenic Army Geographical services.[387] Two sets of 250m resolution digital elevation maps (DEMs)[388] covering the north Othrys between Kallithea and Halos as well as the terrain between Kallithea and Pharsalos was purchased at a price of 169 Euros. A third DEM in 30m resolution covering the hill of Kallithea and immediate surrounding territory was also purchased for 35 Euros. Given the highly variable terrain surrounding several of the mountain forts, 30m resolution maps may have been preferable for the entire study in order to avoid inaccuracies if not for their high cost. While 250m DEMs have unit price of 0.20 Euros, 30m

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[385] ArcScene, ArcMap, ArcGlobe, and ArcCatalogue are the core products included in the ArcGIS package as of version 9.3

[386] I am in great personal debt to Ioannis Georganas who provided invaluable assistance in negotiating the bureaucratic channels leading to the purchase of the dataset.

[387] Although alternative sources of map data are available, the Hellenic Army Geographical Service was used as their data is georeferenced and provided in a known map projection. The reference used by the Service is WGS 1984, the same system utilized by Google. Although ArcGIS can rectify data based on different projects there is always the possibility of errors in the manipulation. http://www.gys.gr

[388] DEMs were chosen over data extrapolated from contour data as transitions to TIN/DTM structures are more accurate over large areas when using grid data. Zhilin Li, "A comparative study of the accuracy of digital terrain models (DTMs) based on various data models," *ISPRS Journal of Photogrammetry and Remote Sensing* 49, no. 1(1994): 9.

resolution DEMs have a per-unit cost of 3 Euro. For the study area's 845 units, 30m maps would have cost a total of 2535 Euro.[389] Even though price was a major consideration for selecting a less accurate DEM, 250m is nevertheless a good resolution at which to carry out regional studies.[390]

Before analysis could begin several stages of data preparation were necessary. Certain analytical tools within ArcGIS required vector-based working files which required conversion of the each raster dataset, the DEMs, into a Triangular Irregular Network (TIN).[391] ArcGIS facilitates this process through tools contained in the 3D Analyst extension. For the conversion, a Z tolerance value of 0 was input in order to maintain maximum accuracy for the landscape analysis that would be utilizing the TIN structure.[392] With the virtual landscape data prepared, the final dataset required was point data expressing the location of each fort. Latitude and longitude values were obtained via Google Earth and converted to decimal degrees for input into ArcMap.[393] All points were first input and saved as a group in one shapefile with each individual location further saved as a separate shapefile for analysis where only a select group or single point would be needed.

Line of sight (LOS) was the first matter investigated, final images of which can be found in Appendix D, in order to address the question of whether

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[389] See Conolly and Lake 35 for a brief discussion of associated costs.
[390] Wheatley, 177; Conolly and Lake, 41. The Kythera Island Project achieved 10m resolution maps through manually scanning 1:5000 topographic maps, a lengthy and time consuming process.
[391] See Chapman, Chapter 3 for an overview of types of spatial data.
[392] The closer the tolerance is to 0, the more points will be added to the TIN structure resulting in higher accuracy. A higher tolerance could be set for something like generalized visualization of a 3D landscape where high accuracy is not required nor necessarily desired due to increased computing time.
[393] For example, 39° 4'49.19"N is expressed as 39.08033 in decimal degrees.

one tower was visible from another. ArcGIS' 3D analyst was used to create lines of sight between each fort/tower and the remainder of the system's outposts. The LOS tool allows the user to dictate an assume height above ground at both the observer and target's locations. Both values were set at 6m, simulating a likely tower or parapet height at both the observation and target points of the LOS. Users carry out this task in a simple manner: ArcGIS requires one to click at the point of origin and then click at the target. A line is then generated which indicates whether sections are visible or not from the origin by colouring the line green or red respectively. The target point is marked by a dot which is shaded either green or red, signifying visibility at that point with the input height taken into consideration. If the target dot is red, a blue dot appears along the line indicating the point at which the terrain blocks the LOS.

Findings were similar to the observations made with Google Earth with several variations as summarize below:[394]

1. Proposed LOS between Ayios Nikolas and Halos tested as negative.
2. Proposed LOS between Karatsadali and Halo tested as negative.
3. Proposed LOS between Neochoraki and Tsurnati Vrisi which was unclear in Google Earth tested as negative.
4. Proposed LOS between Neochoraki and Kallithea tested as negative, which confirms the observations made in Google Earth.
5. Proposed LOS between Tsurnati Vrisi and Kallithea tested as negative.

Five results contradict Wieberdink's initial hypothesis. In two of these cases observations made within the Google Earth environment support the

[394] A full table of results is presented in Appendix B

findings while the other three results, those dealing with Tsurnati Vrisi to Kallithea and both Ayios Nikolas and Karatsadali to Halos, test negative only with ArcGIS. Fortunately the LOS analysis provides indications as to where in the landscape visibility is blocked. At Tsurnati Vrisi, a small spur of the mountain to the north east blocks visibility. Google Earth also presents this spur in its visual model although within *Earth* an observation point at Tsurnati can see over the ridge and straight to the hill of Kallithea. However, the landscape seen in Google Earth may also present an explanation for this discrepancy. As the site itself was unable to be precisely pinpointed, I had located it on the edge of a cliff overlooking lower terrain and the plains below. Within a 250m radius, the resolution of the source DEM, there are extreme variations in topography. Tsurnati's modeled location could be atop a pixel of the DEM which has an average height lower than that of the neighbouring spur.

Similar reasoning can explain the discrepancy seen relating to the visibility between Halos and the nearby sites of Karatsadali and Ayios Nikolaos. Halos' acropolis lies relatively low on a narrow ridge that is approximately 800m across with steep slopes on both sides. The 250m resolution map is again likely the cause for a decrease in the height reported by the DEM. As visible in both Google Earth and the TIN model, a neighbouring spur to the west is similar in height to Halos' acropolis. Indeed, the view presented in Google Earth demonstrates that this hill does create a severe visual limitation for lower elevations on the spur of Halos. However, it does not block the view entirely.

Leaving the LOS matter aside and instead turning to a full viewshed analysis may present alternatives.

ArcGIS - Viewshed

Whereas line of sight only presents a true/false value representing visibility along a single line between the observer and target, a viewshed analysis calculates all areas visible from a specific point. As viewsheds are traditionally calculated using DEMs the 250m resolution map was used as base topography.[395] Although ArcGIS can also utilize a TIN as a topographic base, the first stage utilized the original DEM so as to work with the raw data.[396] Individual units of the TIN may be of higher resolution[397] but represent an extrapolation created from the actual raw data.[398] Utilizing a TIN presents a potential for the user to see extrapolated data as accurately reflecting the real world. Such a map would look impressive and could easily be presented in a 3D isodometric view, creating an authoritative look which is not necessarily true. Many viewers would no doubt accept such a digital map and not question what it represented without personal knowledge of the terrain. In order to avoid any potential confusion or artificially created data skewing the results the analysis used only the 250m resolution maps in this part of the exercise.

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[395] Chapman, 148-152; Wheatley, 171; Conolly and Lake 47

[396] Conolly and Lake, 61.

[397] Although each triangle varies in size, they had an average width of 69m in this transformation.

[398] With the available raster dataset a generated TIN or DTM can produce noticeable errors. Li has found that accuracy of a generated map can be greatly improved with the inclusion of feature-specific data where possible. However, the overall size of the sample is greater than any of the test areas used by Li. Refinement of available geographical dataset outside the precincts of Kastro Kallithea itself is not a possible goal for the project and thus is left to work with the available datasets.

Data acquisition followed the same procedure as outlined above with one exception: this exercise did not require the generation of a TIN. Discrete shape files, each representing a single site, were overlaid on the DEM of the area between Kallithea and Halos, including much of the Almiros plain. Unlike the point and click method of calculating LOS, viewshed calculation is instigated via a dialogue box which allows the user to select an input terrain layer and an observation point shapefile. To adjust the height of the observation point a unique table value must be assigned with the column name of “OffsetA” while “OffsetB” may be used to indicate height at the target, which would be the entire map in this case. Two viewshed maps were created for each tower position: one with an OffsetA value of 0m and the second with a value of 6m. In both cases no OffsetB value was indicated as target heights were investigated in the LOS study. For general viewshed the primary objective was to gain a sense of the terrain visible from each fortification.

Viewshed results support the findings from the LOS study while also providing a visualization with which to identify whole areas lacking in visibility from each tower. An observer at Halos, both at 0m and 6m above ground, cannot see any of the area surrounding Ayios Nikoloas and indeed most of the land along the north Othrys is due to the ridge previously discussed. A 6m point at Halos is therefore also unable to see any land within half a kilometer of Karatsadali. When the viewsheds of both Ayios Nikolaos and Karatsadali are examined they reveal that the marked location of Halos’ acropolis is within 250m, one pixel, of an area visible to both sites. Once again the topography of Halos’ spur appears to have been artificially lowered due to the resolution of the source DEM. Likewise both Neochoraki and Tsurnati Vrisi tested for viewsheds at 6m do not indicate any areas near Kallithea as being visible, supporting both line of sight and Google Earth findings. Furthermore, Neochoraki and Tsunati Vrisi tested as being intervisibile neither to each other nor any pixel close to the respective targets.

A curious result presented itself when a viewshed was created from the Kallithea point. The position used for this particular input is the latitude and longitude of Tower 15 at the city's northeast corner obtained via Google Earth. The view from this entire sector of the city is quite familiar to Kallithea project veterans as the entire plain to the east is visible. However, the viewshed analysis at both the 0 and 6m heights indicated a large cone shaped area of no visibility. The only nearby feature that could present such a dispersal is a small spur of Kallithea's hill projecting east at a low elevation. Naturally it was necessary to investigate the point's location in hopes of explaining this discrepancy. A measurement obtained during the 2009 field season with a handheld Garmin GPS unit provided a location with only several meters difference compared to the Google Earth coordinates, thus eliminating the possibility of error in Google's provided latitude and longitude.[399] An aerial image of the site was superimposed over an equivalent section of the ArcGIS map[400] and it became apparent that the shapefile point was positioned north of the tower and therefore significantly lower on the slope. Manual adjustment shifted the point ~100m south and initiated

[399] Google Earth: 39°12'5.50"N, 22°32'15.56"E. GPS: 39°12'05.2"N, 22°32'15.7"E
[400] Figure 1, Appendix F. The 30m resolution map was used for the sake of accuracy and clarity.

another viewshed analysis. The results, figures 2 and 3 in Appendix F, present a conclusion that is more logical than the initial results.

All together these viewsheds provide a unique way to visualize the purposes of each location as well as the overall abilities of the system. For example, Karatsadali 2's main objective must have been to guard the nearby river valley against any minor incursions from the south. The location of this fort visually isolates it from the rest of the systems, suggesting that communication between it and the nearby site of Karatsadali 1 must have occurred via land.[401] Karatsadali is not alone in having its purpose clarified by the examination of viewsheds. Anyone might have questioned the importance of the Myli towers with only a 2D map to use as a reference, but their importance becomes apparent with the data provided by a viewshed analysis. The two towers at this location are the only structures in visual contact with the entire Othrys system. In such a position the Myli towers must have been a vital central relay for the entire system.

The visualizations have not provided a sense of whether the sites are close enough to each other for discrete signaling. I believe that two distances, decided upon with the data presented in chapter 2, are useful in considering potential communication paths. 5km represents an ideal: a distance good for communicating if a fair distance did not separate torches or if poor weather was a frequent event. 10km is another likely distance given Forbes suggestion of 10m separation between towers which is possible on the walls of city but not always in towers which often had faces less than 10m in width. ArcGIS can examine both distances as the program allows the user to create 'buffers' around the shapefile

[401] Appendix E, figures 7 and 8

location points. The results of adding both 5 and 10km buffers are presented in figures 1 and 2, Appendix G. With a 5km buffer applied, no sites fall within either Kallithea or Halos' buffer zone. However, once a 10km buffer is overlaid atop the system map the importance of Myli again becomes apparent. The two towers of Myli are the only ones within a distance of 10km that had a direct visual connection to Kallithea. The remaining towers of the system are also within a distance of 10km to Myli with the notable exception of Halos. What, then, of the major polis anchoring the eastern side of the network? Although Ayios Nikolaos is within 10km distance of Halos, Halos cannot see Ayios according to ArcGIS analysis. With both the LOS and viewshed maps suggesting that no nearby sites were visible from Halos' acropolis it is possible that the DEM averaging lowered the height at the indicated observation point.[402] Adjusting the point for Halos in a manner similar to that done for Kallithea may bring nearby sites into view. The areas noted as visible from sites such as Aghios is notably higher up on the spur and some distance from the walls of Halos' ancient acropolis.

The towers of Myli may provide a novel solution to this problem while allowing the selected point for Halos to remain. These two towers, built some 100m from each other, are an odd feature taken on their own. There are neither defensive walls nor any indications that these towers were part of a more substantial fort. Deep ploughing in the neighbouring fields could have wiped out traces of a fort yet even in such a case there should be some remains of either other towers or curtain protrusions from extant courses. If indeed constructed in

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[402] Linear relationships between map accuracy and grid intervals was noted by F. Ackerman, *The accuracy of digital terrain models*. Proc., 37^{th} Photogrammetric Week, University of Stuttgart, 113-143: 1979.

such an isolated manner it is curious as to why two towers were on their own in a low lying area on the broad plains of Almiros. They hardly could have been an effective defense against a land army of any size but may have been purposefully separated in order to provide two signaling posts that could act together. At a distance of 100m torches in either tower could have been distinguished by observers at both Kallithea and Halos. Appendix G, figure 3 highlights that the towers were built on an axis perpendicular to a line drawn from Halos to Kallithea, thus presenting their broad face to both major forts. Myli's two towers thus appear to have been a vital part of the entire Othrys system and able to communicate clearly with both Kallithea and Halos. If one assumes that they acted in tandem then despite the distance between Myli and Halos (15km) the integrity of the entire communication network is validated.

Chapter 4: Conclusion and Future Work

Despite Thessaly's relative absence in written sources, there is no conclusive evidence supporting the idea that the region in any way was less advanced in development, both civil and military, when compared to the major *poleis* of southern Greece. Several short lived attempts to unite the region may have transformed Thessaly into a major force of the Aegean's political landscape, but these attempts would not succeeded and the dream of a united Thessaly remained unrealized. Thessaly instead was largely under the influence of foreign powers for much of the Classical and Hellenistic periods. The fourth century BC brought about monumental changes in Greek politics and warfare. Macedon quickly extended its influence south, followed by Alexander's Hellenic Empire and the kingdoms of the successors. Thessaly gained a new position of prominence once Demetrios Poliorcetes founded his new capital here and engaged in numerous campaigns in an attempt to bring all of Greece under his control.

Kastro Kallithea is a fortified site constructed in a manner matching tactical considerations dating to the late fourth century. A strong location, which provided an effective defense against the developing field of Greek siege warfare, allowed the defenders of this site to control an important entry point to the plains of southern Thessaly. Although available evidence cannot accurately pinpoint the site's date of foundation, there can be little doubt that the expansion and fortification of the Kallithea hill was connected to a stage of Macedon's growing influence in the Thessalian theatre. The position of this site became vital when Philip II destroyed Old Halos in 346 BC. As Pharsalos inherited the coastal territory, Kallithea became the only fortified site guarding the southern plains until Demetrios re-founded Halos in ~302 BC. With Halos rebuilt, these two sites became important positions for defending Thessaly against invasions from south of the Othrys mountains. However, two sites alone could not have guaranteed total control of the region due to the changing manner of warfare in the late 4th century. Adoption of troop types other than the traditional heavily armed Hoplites allowed enemy raiding parties to enter Thessaly through mountain passes and potentially avoid the region's main roads all together. Thessaly's response was the construction of a series of towers that guarded major passes and valleys that cut through the Othrys range.

Authors have attempted to describe numerous towers dotting the Greek landscape as individual components in systems designed for the purpose of regional defense. As demonstrated by Ober's investigation of the changing defense mentality in 4th century Athens, such regional networks arose due to defense strategies shifting away from the *polis* and focusing instead on the entire territory of a city-state, the *chora*. Each component of the network did not work alone in defending an area but also communicated to neighbouring strongholds through fire signaling. Several studies have attempted to describe these towers as parts of regional systems using a sort of connect-the-dot method based on traditional 2D map analysis. Although each author addresses general issues relating to line of sight they pay little consideration to the actual mechanics of fire signaling and the distances over which such messages could be effectively transmitted. If the series of towers between Kallithea and Halos was visually connected, as suggested by Wieberdink, what methods were used to communicate and to what distance these signals would remain visible and distinguishable as unique signal codes must be considered.

Digital archaeology can be a valuable tool for analyzing such regional systems and determining if a group of towers could in fact act as a visual communication network. GIS programs, such as ArcGIS, allow a user to input various data as separate layers and create any number of visualizations to compare against each other in a final analysis. In my own research, I found that a combination of line of sight and viewshed analysis not only validated the Othrys chain as a means of effective communication but also revealed that the towers of Myli were the single most important component of the system. Myli's two towers are the only location visible from all other fortifications that have been identified alone the north side of the Othrys.[403] However, visibility alone is not conclusive evidence. When the study of Forbes is weighed against reports from the ancient sources consideration of distance is a major issue. When buffers of both 5km and 10km are added to the site of Myli, the data reveals that this location is also within ideal distances to ensure effective communication to all components of the system.

One might wonder why such a vital component of a communication network lacked strong defenses. Two isolated towers lying in the lower plains of Thessaly could not have hoped to withstand attack by an army nor resist even the most basic of siege weapon. A solution is achieved by considering once again defensive strategies utilized by the Greeks in the 5th and 4th centuries. Its builders

[403] Karatsadali is an exception due to its location deep within a river valley.

direct the Othrys system against incursions from the south with Kallithea and Halos, effectively blocking any movement of large troops over the primary land passes at the east and west edges of the mountain range. Myli's towers are nestled well behind the front line of defense, some 2km from the base of the Othrys. From this location the defenders could easily respond to all alerts from the border forts and ensure support was on the way from either Kallithea or Halos well before Myli's location faced any real threat.

Archaeologists must be on the lookout for potential error and correct digital artifacts[404] wherever possible. When carrying out analysis in GIS programs a simple logic check at each stage is an excellent defense against cascading errors. The initial digitized location of Kallithea produced a viewshed map that immediately failed this test and therefore required further investigation before analysis could proceed. Following a check against both satellite imagery and GPS coordinates gathered in the field it was determined that the input data was correct but resulted in the shapefile positioning its point ~100m north of Tower 15. Manually adjusting the point to match Tower 15's location was crude compared to inputting exact coordinates but resulted in a viewshed that matched observations made in the field. Without such proper field observations, a critical data error may have drastically affected the results of this analysis. Digital archaeology is thus an important tool in the modern archaeologist's skill set but one that is not isolated in its use from other means of investigation and supportive evidence.

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[404] These are any undesired alterations in data introduced in a digital process by an involved technique and/or technology.

Such dangers should not be grounds for any project to avoid digital archaeology if technology can aid in specific research goals. The Kallithea Project's use of GIS has provided a valuable dataset and aided both academic and public audiences visualize the site. The present research as presented has demonstrated how landscape data can also be of great use in the analysis of a landscape surrounding a specific site. Archaeologists should never assume that digitally created maps or analysis based upon such data are any more authoritative than traditional means of investigation. Just because a map is computer-generated does not mean it should be subject to any less scrutiny. GIS systems have allowed for a unique examination of sites and their positioning in the landscape between Kallithea and Halos. Despite the work done along the Othrys range, the region between Kallithea and Pharsalos, the ancient *polis* that was granted Halos's territory, has been surveyed but not yet published. Topographic analysis in a following phase may either assist in locating potential relay sites or examine viewsheds from known fortified locations. Pharsalos would have required some way to keep in touch with its newly acquired coastal territory and Kallithea may have served as both an important guardian and signal relay station.

The Kastro Kallithea Archaeological Project has allowed a valuable opportunity for archaeologists to embrace digital archaeology and effectively used at a startup dig. Although many of the research goals to date have dealt with the examination of site-specific research questions, this fortified location does not exist isolated from neighbouring sites in the Thessalian landscape. Via the utilization of digital map information and ArcGIS, Kallithea and the adjoining

Othrys tower system prove that well planned systems of regional defense were not limited to the major centres of southern Greece but were also present in the region of Thessaly. Distances over which complex fire signaling could be effective were maintained throughout the system and where a long separation did exist, between Halos and Myli, the construction of two towers that may have worked in tandem allowed communication to be maintained.

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Appendix A: Participants

Site Administration

Athanasios Tziafalias – 15th Ephorate of Prehistoric and Classic Anitquities, Greece
Margriet J. Haagsma – University of Alberta, Canada

Sophia Karapanou – Greece
Sean Gouglas - Canada

Teaching Staff

2004 – Arwen Felming, Laura Surtees
2005 – Manuela Dannbauer, Arwen Fleming, David Laurie, Heather Simpson, Laura Surtees
2006 – Myles Chykerda, Tristan Ellenberger, Tracene Harvey Laura Surtees
2007 – Myles Chykerda, Tristan Ellenberger, Tracene Harvey, Adam Tupper, Laura Surtees
2009 – Myles Chykerda, Tristan Ellenberger, Tracene Harvey, Crysta Leslie, Laura Surtees

Volunteers

2005 – Brendan Bruce, Theodora Kopestonsky, Adam Tupper
2006 – Manuela Dannbauer, Ioannis Georganas, Lana Radloff
2007 – Diana Lefebvre, Jason Marceniuk, Lana Radloff
2009 – Alexandra Dosser, Prof. John Griffith, Brian Leslie, Jason Marceniuk, Prof. Gerald Schaus, Laura Termes

Students

2004 – Chris Adamson, Brendan Bruce, Samil Chagpar, Myles Chykerda, Manuela Dannbauer, Maricon Hidalgo, Melissa Schlachter, Natalie Szekely, Adam Tupper
2005 – Justin Bairnes, Emanuela Bocancea, Christina Bouthillier, Tristan Ellenberger, Kara Fauser, Marya Grupsmith, Carla Meyer, Jennifer Padilla, Lana Radloff, Michele Routhier, Monica Sawicka, Brandon Schreiber
2006 – Rebecca Deckert, Glenn Gardner, Alicia Hibbert, Crysta Rose Kaczmarek, Kirsten Klingle, Ryan Lee, Diana Lefebvre, Sherri Malcolm, Jason Marceniuk, Christine Martin, Lisa Omerzu, Amanda Plomp, Tonya Small, Victoria Smith, Janet Wiszowaty
2007 – Kristen Badley, Adriana Brook, Saliha Chattoo, Tahnis Cunningham, Matthew Harrison, Brian Leslie, Caroline Loewen, Stephen Lyons, Graham McIntosh, Michelle Philips, Jaime Rathor, Silvia Russell, Peter Stewart, Patrick Wisheu
2009 – Cady Berardi, Michael Bird, Stefan Bouchard, Beth Brothers, Gino Canlas, Megan Conrad, Jolène Davies, Kailey Edgelow, Shannon Fisher, Jen Gawne, Nizar Ghazal, Sarah Hewko, Robin McCorry, Haley MacEachern, Robert Metcalfe, Jainna Moysey, Julian Schultz, Rory Spickett, Alison Tang, Neil Thomson, Kassia Ward, Katrina Weyer

Appendix B: System Distances

Table 1. Distances between forts of the Othrys system

	1	3	4	6	7	8	9
1		7.6		16			25
3	7.6		3.47	8.6			17.6
4		3.47		6			
6	16	8.6	6		2.6	6.8	9
7				2.6		4.4	8.4
8				6.8	4.4		6.4
9	25	17.6		9	8.4	6.4	

Legend

1 Halos
3 Ayios Nikolaos
4 Karatsadali
6 Myli Towers
7 Neochoraki
8 Tsurnati Vrisi
9 Peuma

* No 2 as this denotes Vrinena
* No 5 as this denotes Karatsadali 2
* Shaded squares were not measure as Wieberdink did not indicate lines of sight

Table 2. Distances between forts of the Salganeus system

	1	2	3	4	5	6	7
1		2.5	4	4.75	5.5	7	6.5
2	2.5		1.75	2.75	3.5	4.75	5.5
3	4	1.75		1	2	3.25	4
4	4.75	2.75	1		0.75	2.5	3.5
5	5.5	3.5	2	0.75		1.75	3
6	7	4.75	3.25	2.5	1.75		4
7	6.5	5.5	4	3.5	3	4	

Legend

1 Kleftoloutsa
2 Galatsidheza
3 Tsouka Madhari
4 Mikro Vouno
5 Kastro
6 Aulis Forstress
7 Euripus Forstress

Table 3. Distances between forts of the Othrys system

	1	3	4	6	7	8	9
1	—	green	green	green	red	red ?	green
3	green	—	green	green	red	red	green
4	green	green	—	green	red	red	red
6	green	green	green	—	green	green	green
7	red	red	red	green	—	green ?	green X
8	red ?	red	red	green	green ?	—	green
9	green	green	red	green	green X	green	—

Legend

1 Halos

3 Ayios Nikolaos

4 Karatsadali

6 Myli Towers

7 Neochoraki

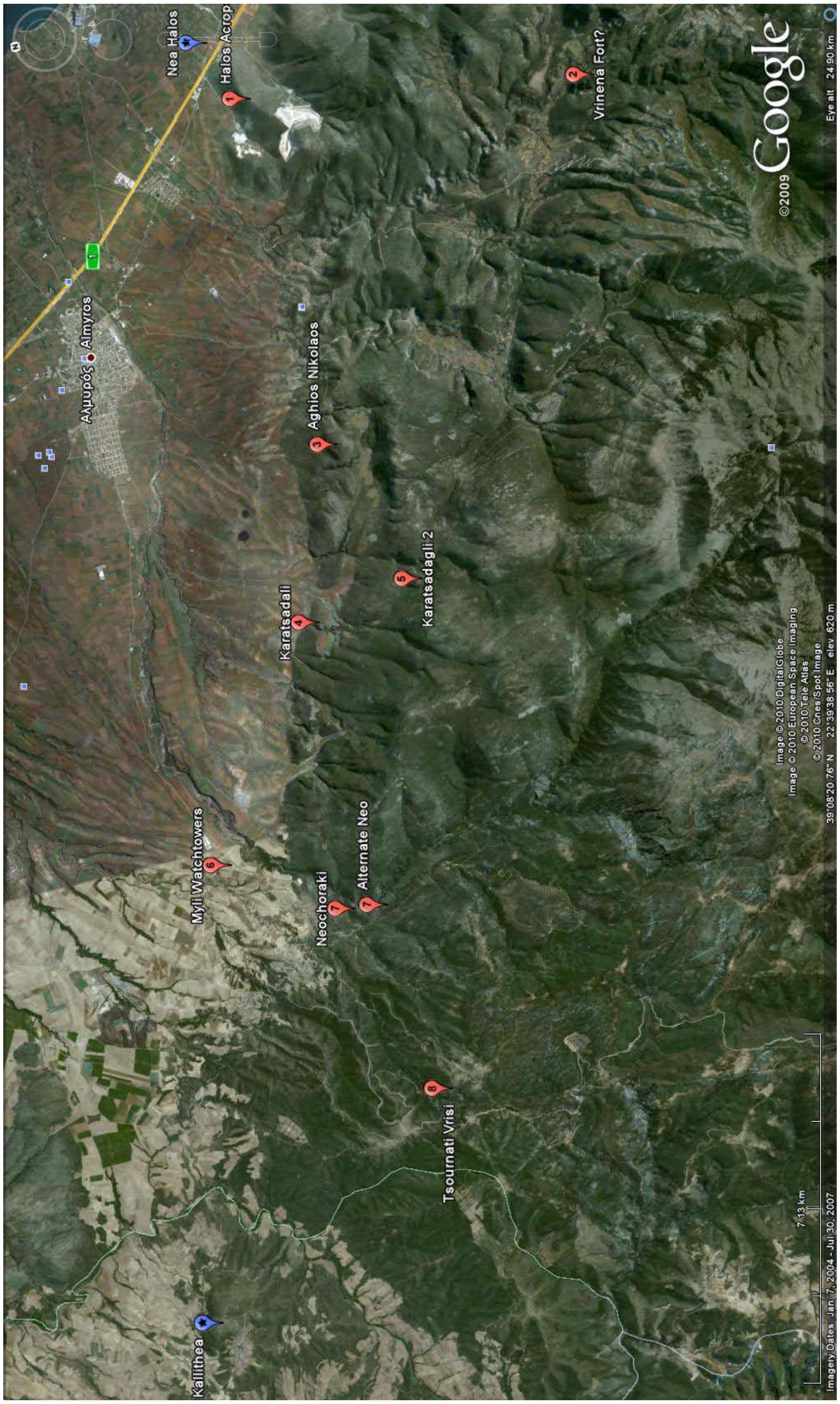
8 Tsurnati Vrisi

9 Peuma

red	no sightline in Wieberdink
green	sightline in Wieberdink
X	denotes opposite finding in Google Earth
?	denotes unclear status

* Lack of no. 2 as this denotes Vrinena
* Lack of No 5 as this denotes Karatsadali 2

Appendix C: Google Earth Imagery



Google Earth Enviornment
1: Halos, 2: Vrinena, 3: Ayios Nikolaos, 4: Karatsadali, 5: Karatsadali II
6: Myli, 7: Neochoraki, 8: Tsurnati Vrisi, 9: Kallithea

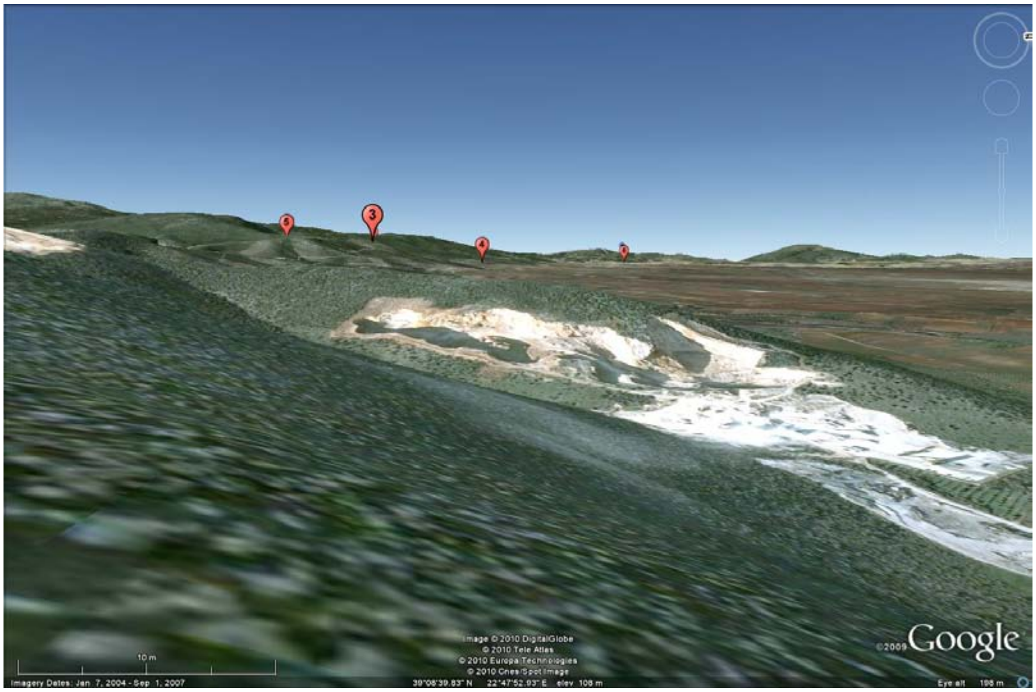


Fig 1 – Halos Facing West
193-198m

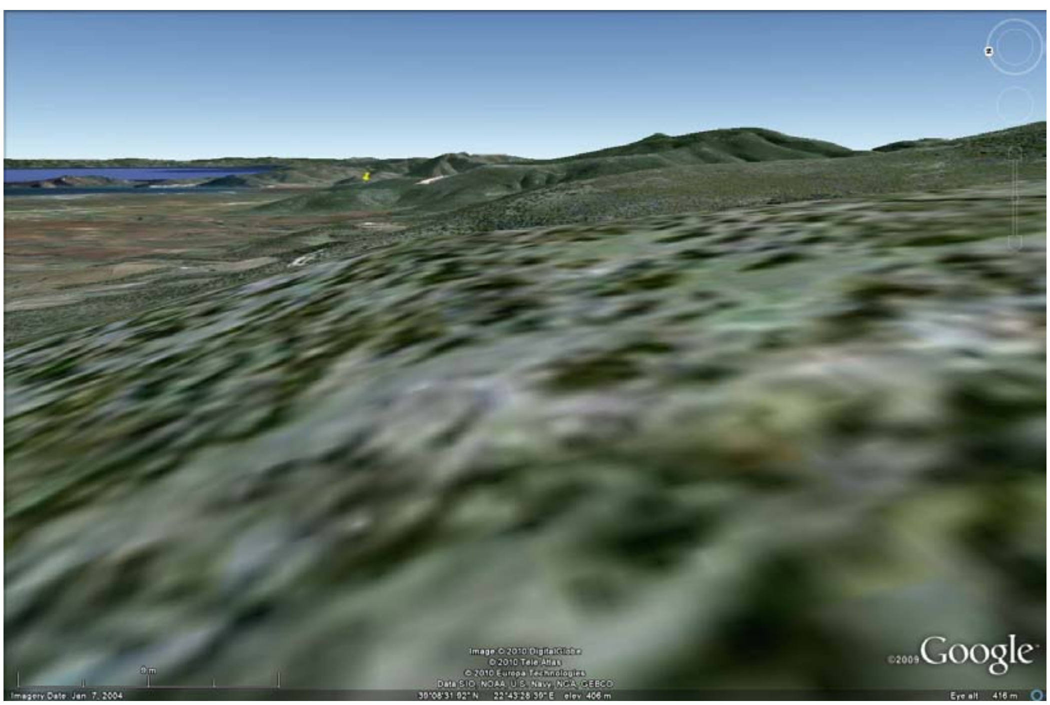


Fig 2 – Ayios Nikolaos facing east
411-417m

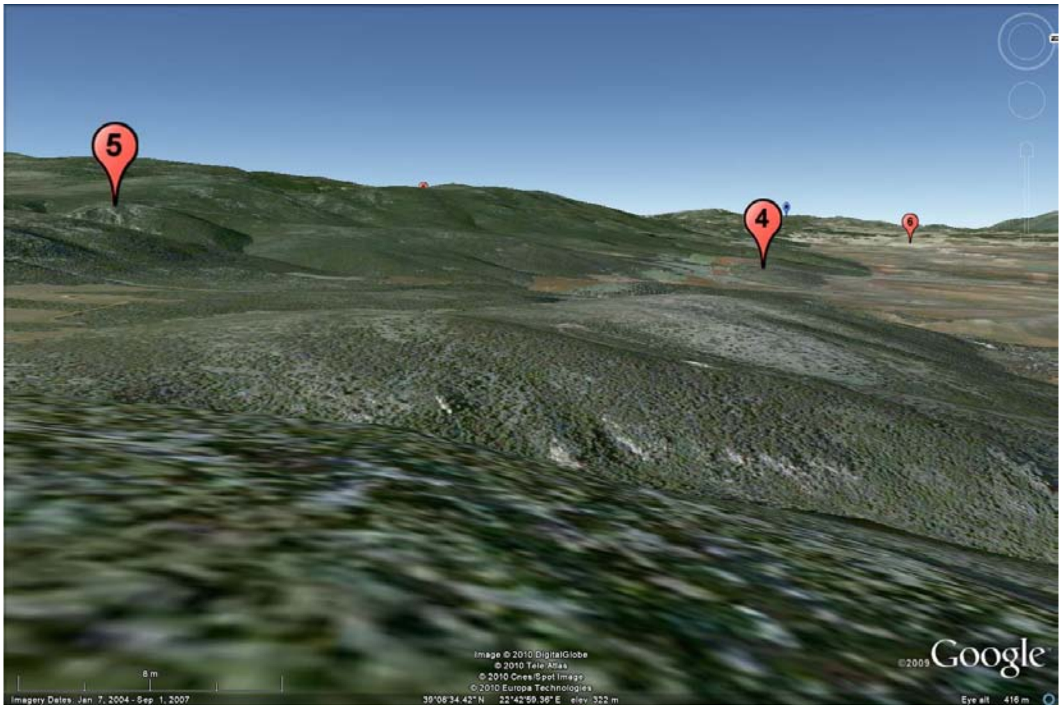


Fig 3 – Ayios Nikolas facing west

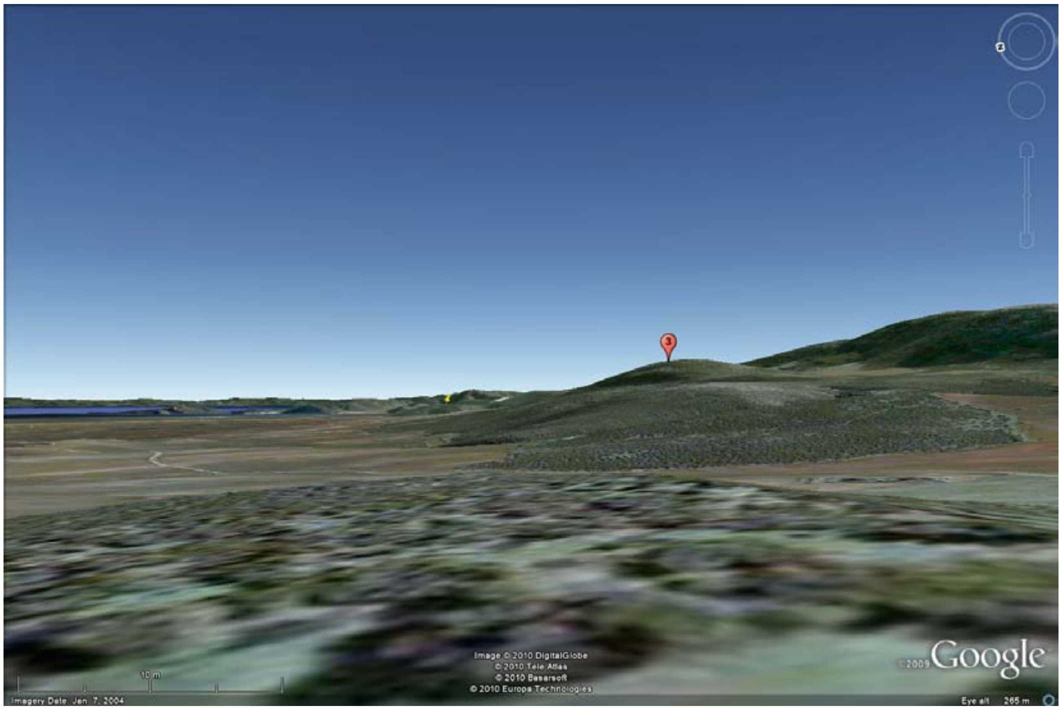


Fig 4 – Karatsadali 1 facing east
259-265m

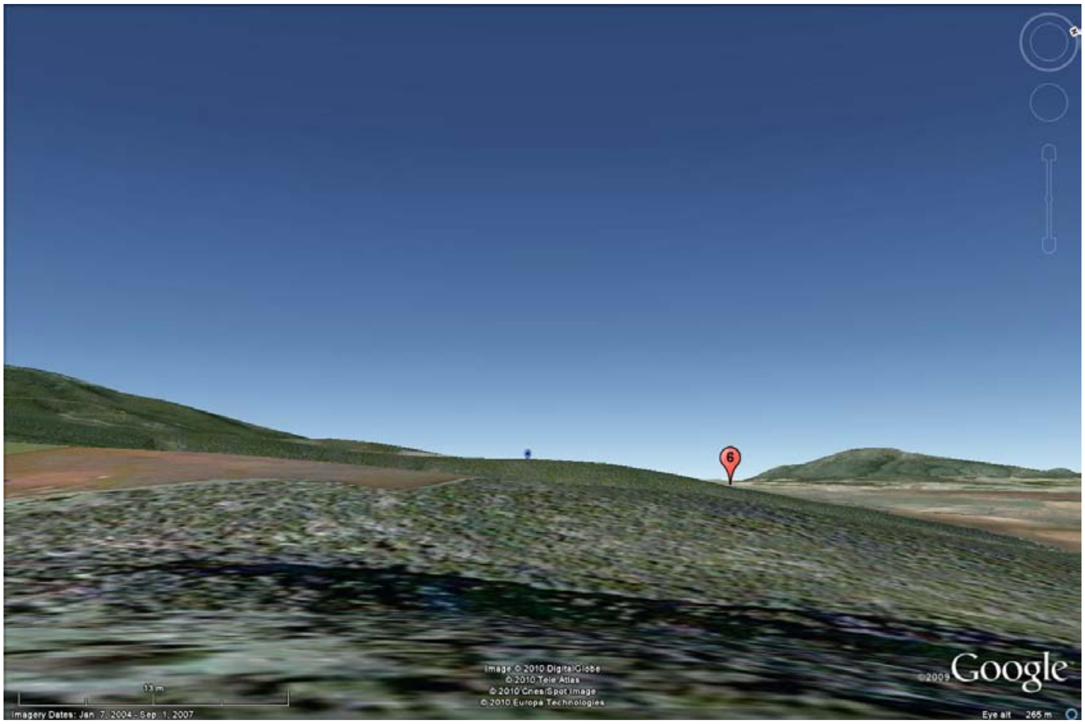


Fig 5 – Karatsadali 1 facing west

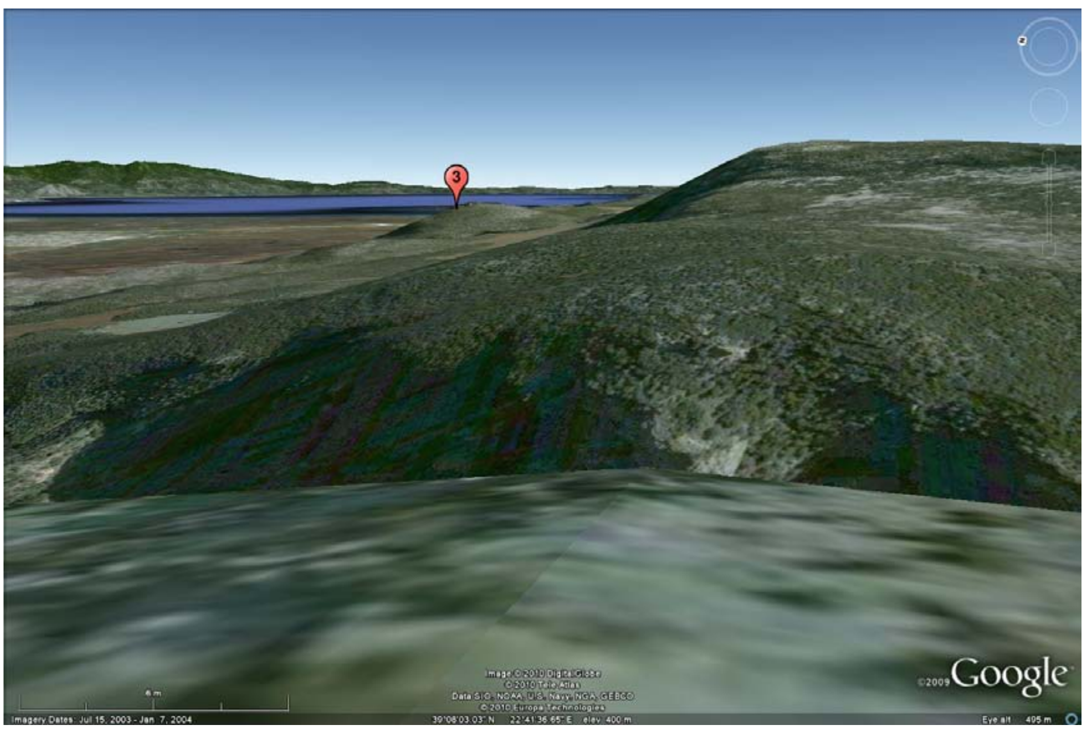


Fig 6 – Karatsadali 2 facing east

Fig 7 – Karatsadali 2 facing west

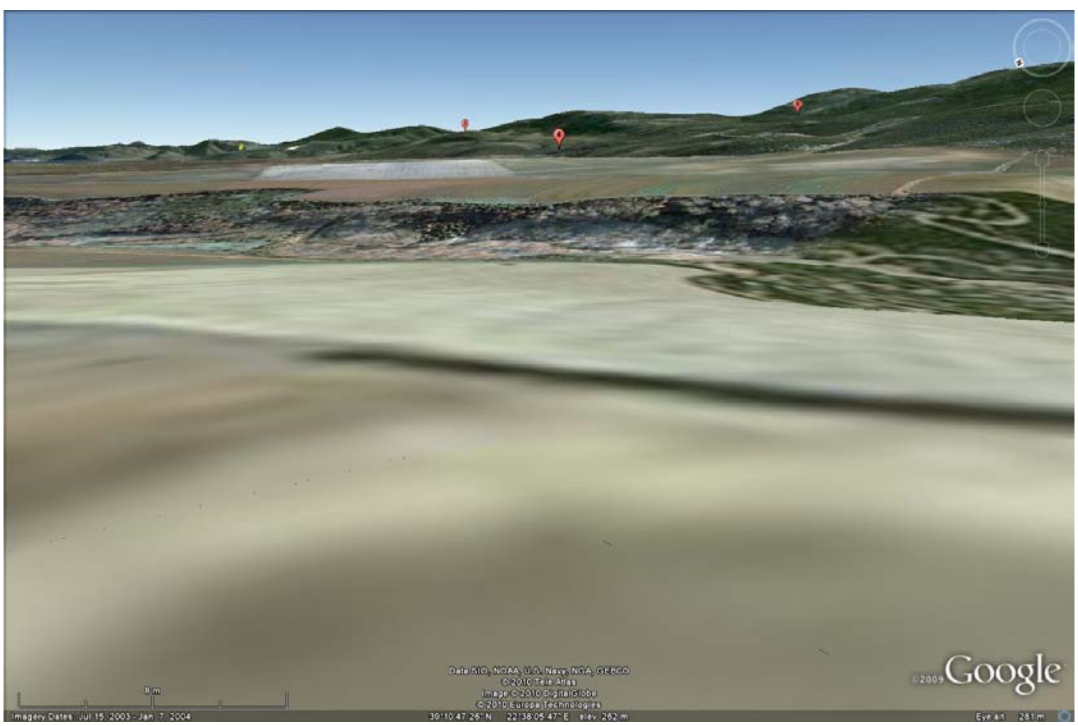


Fig 8 – Myli facing southeast
275-281

Fig 9 – Myli facing southwest

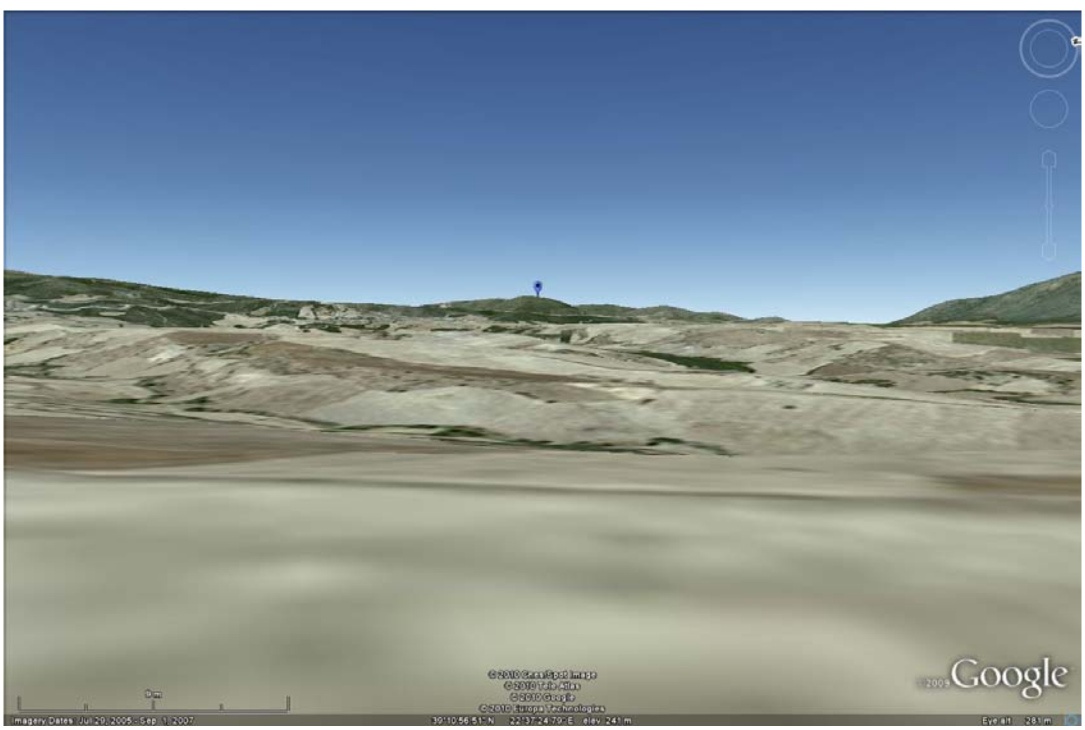


Fig 10 – Myli facing west

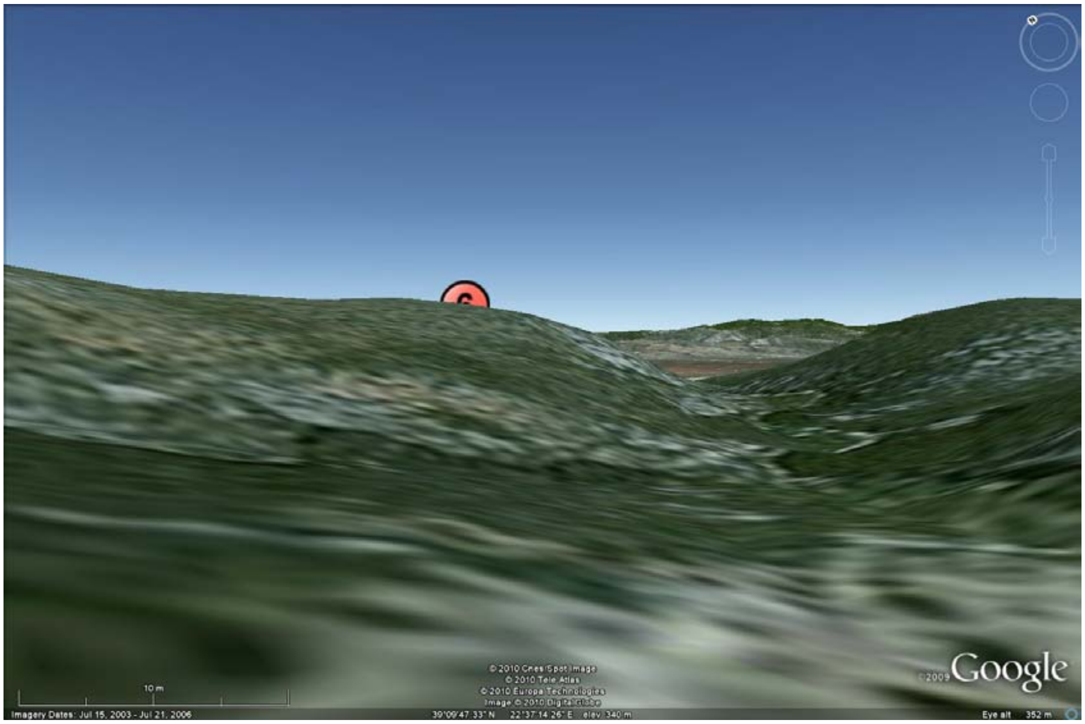


Fig 11 – Neochoraki possible facing south
346-352

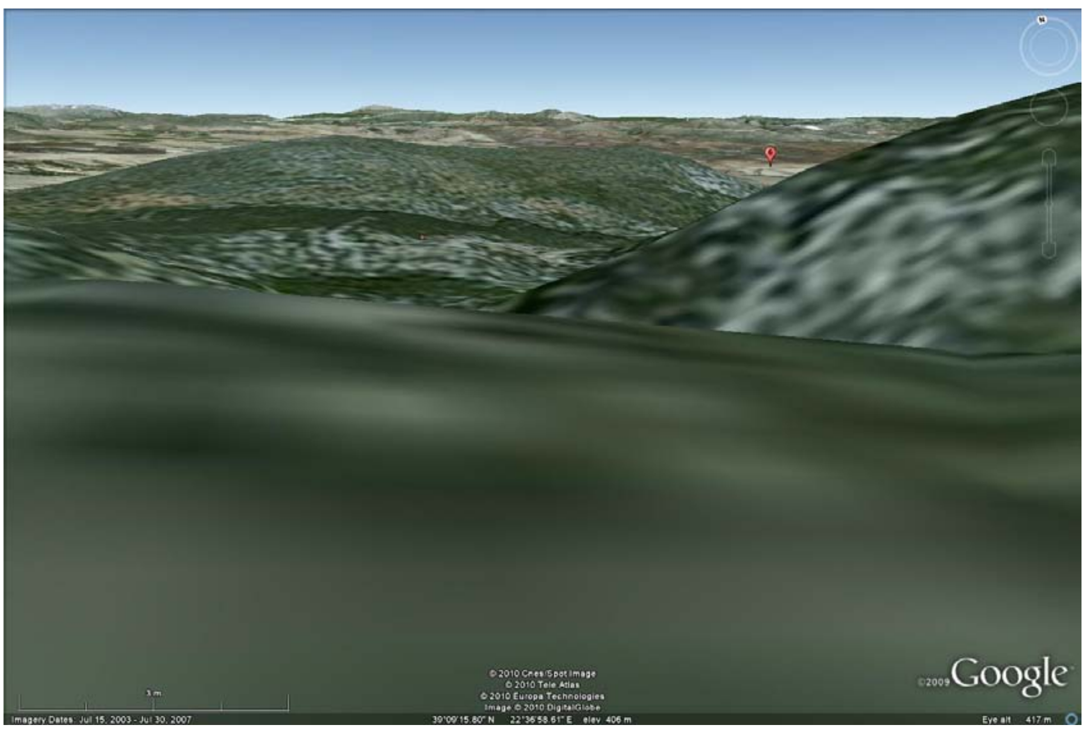


Fig 12 – Neochoraki Alternate facing south
411-417

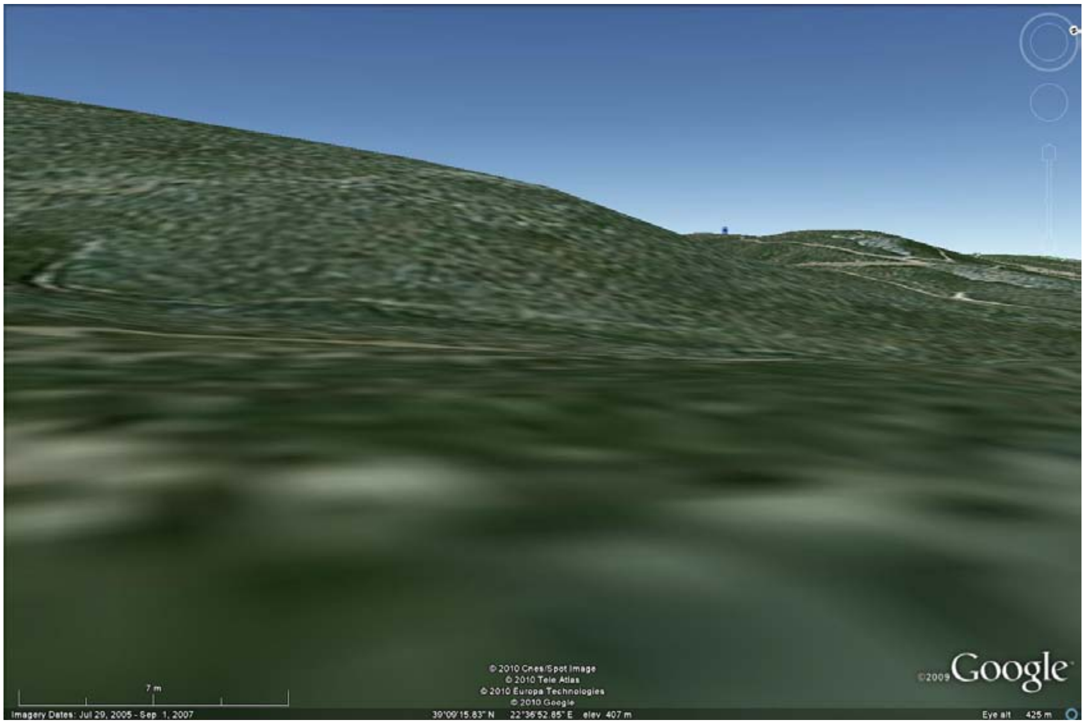


Fig 13 – Neochoraki Alternate facing west

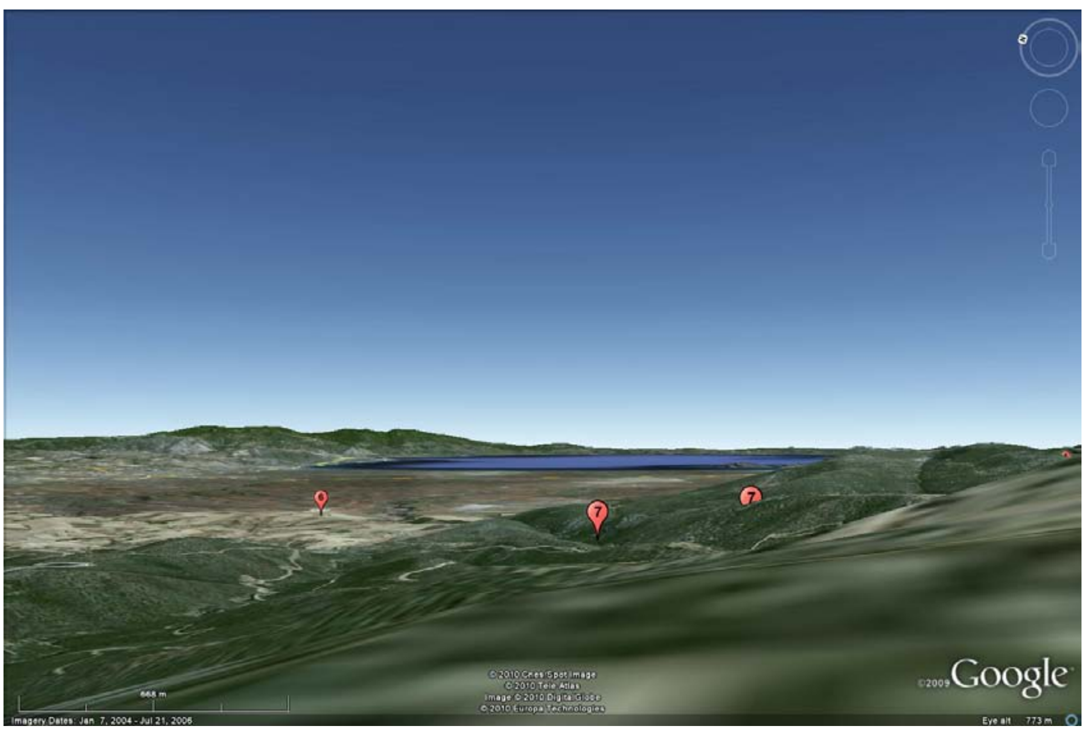


Fig 14 – Tsurnati Vrisi facing northeast
767-773

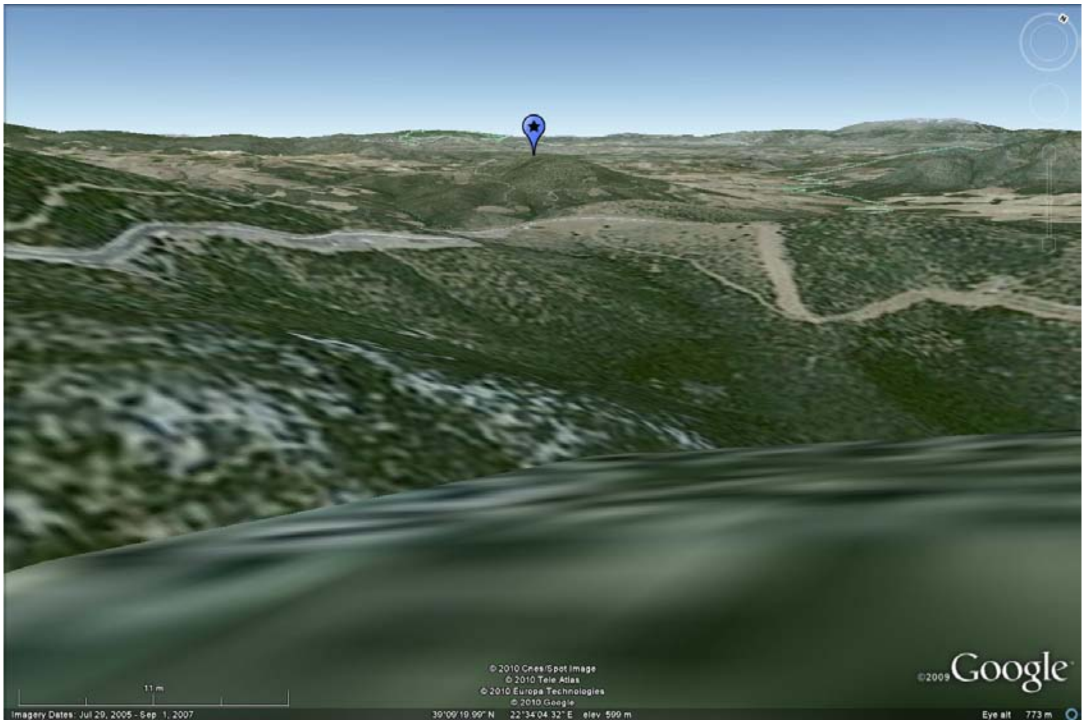


Fig 15 – Tsurnati Vrisi facing northwest

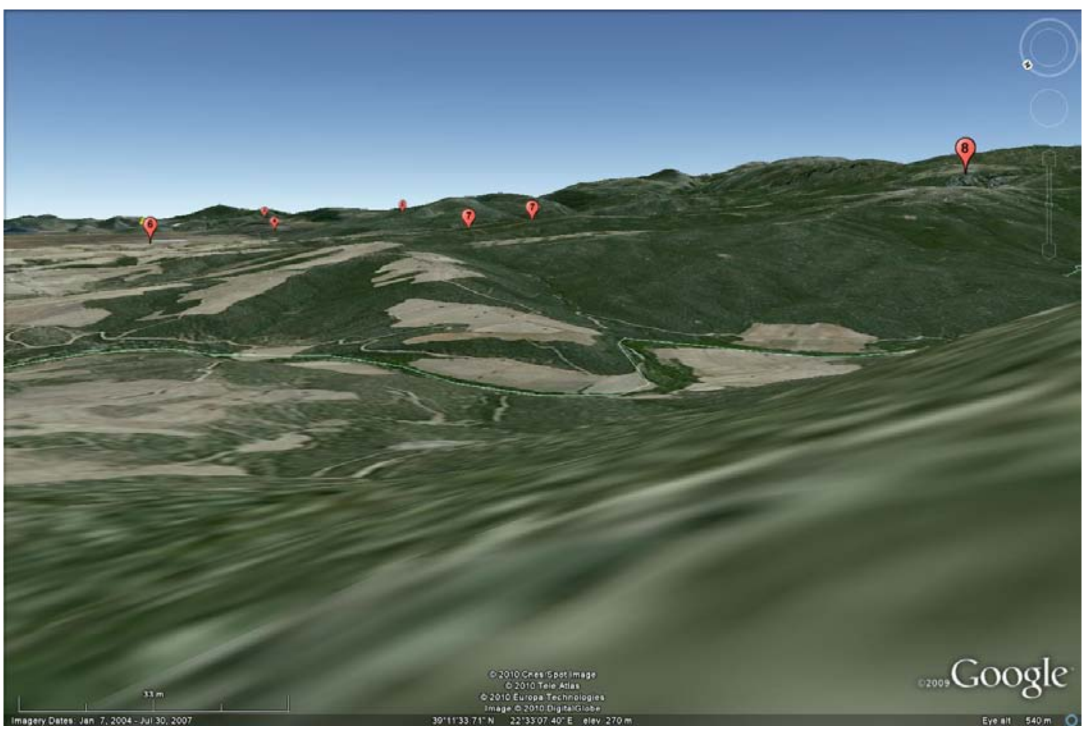


Fig 16 – Kallithea facing east
533-540

Fig 17 – Neochoraki and alternate, overhead

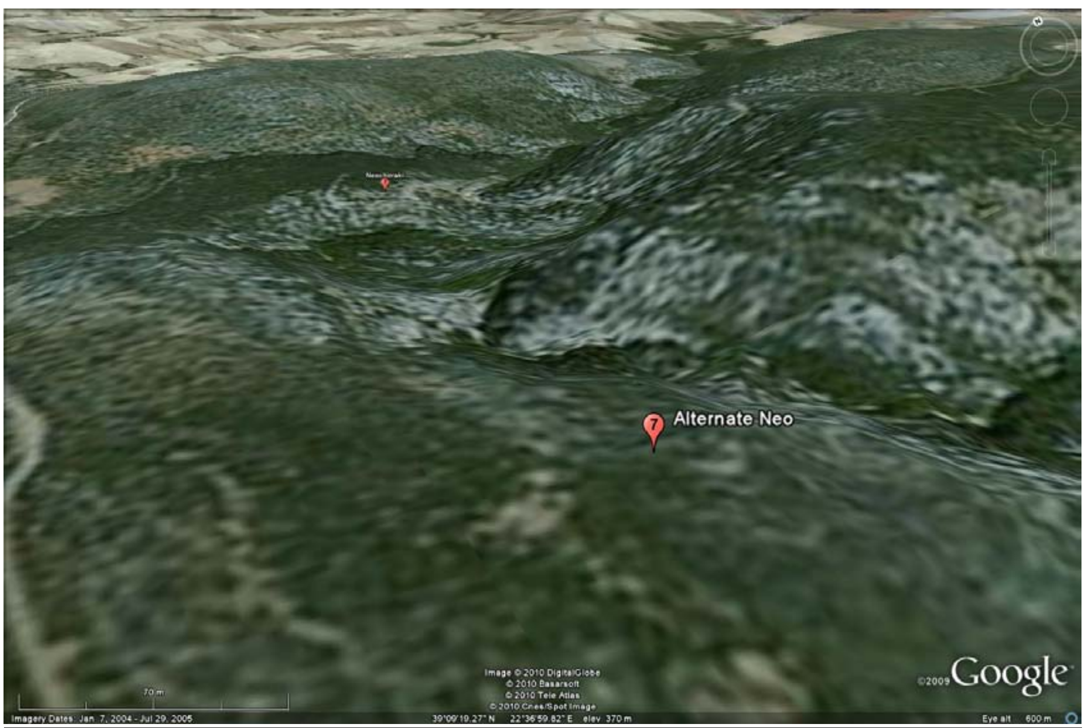


Fig 18 – Neochoraki and alternate, oblique

Appendix D: Line of Sight Images, 1:70,000

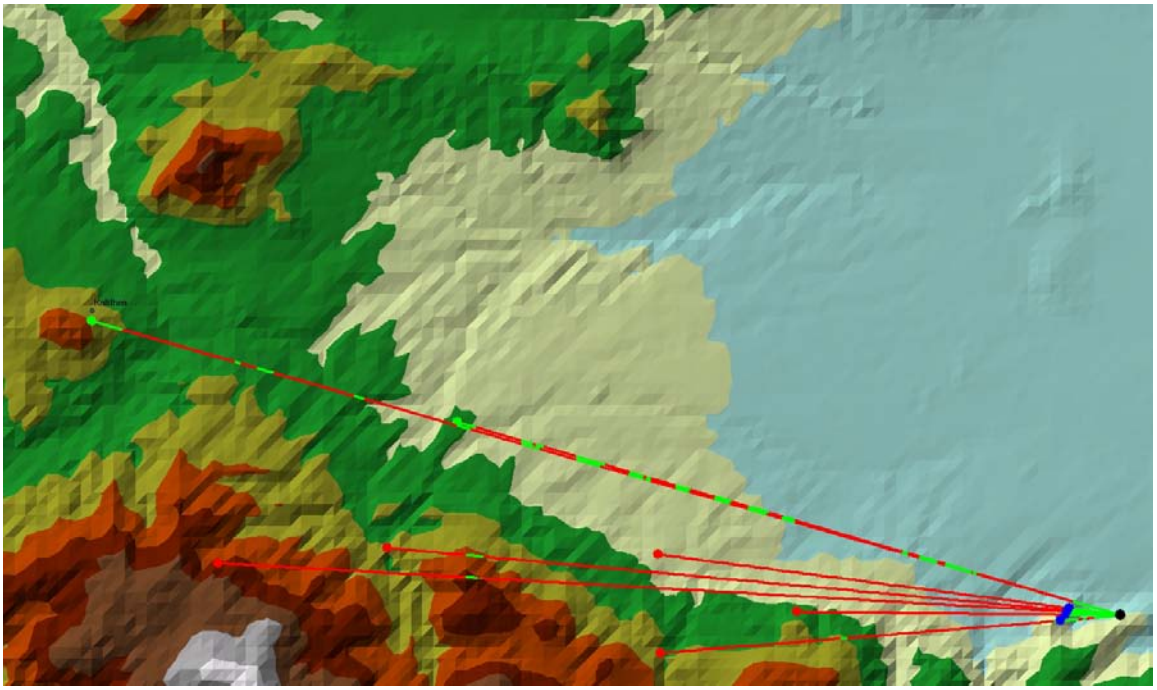


Fig 1: Halos

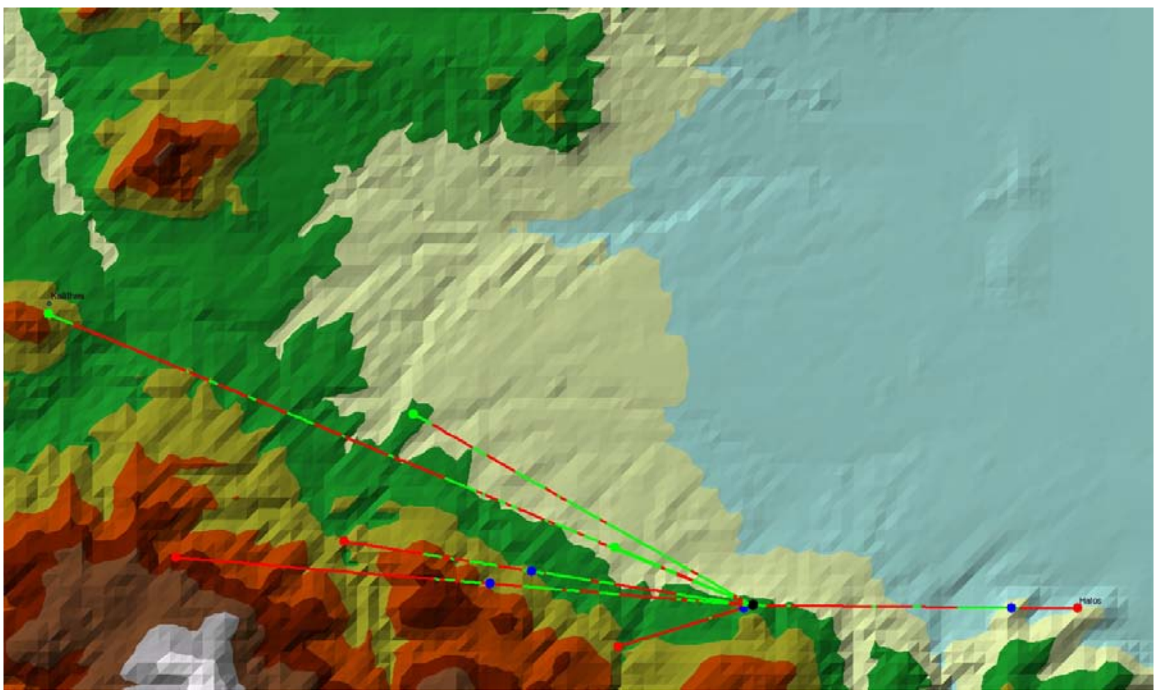


Fig 2: Aghios Nikolaos

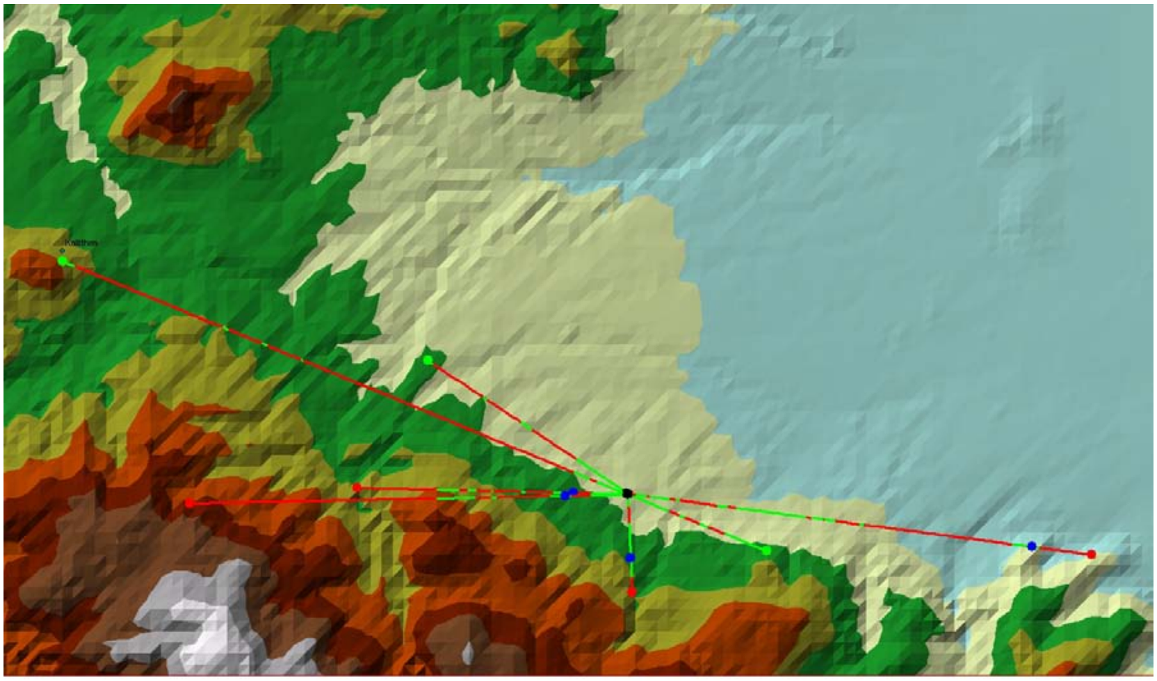


Fig 3: Karatsadali

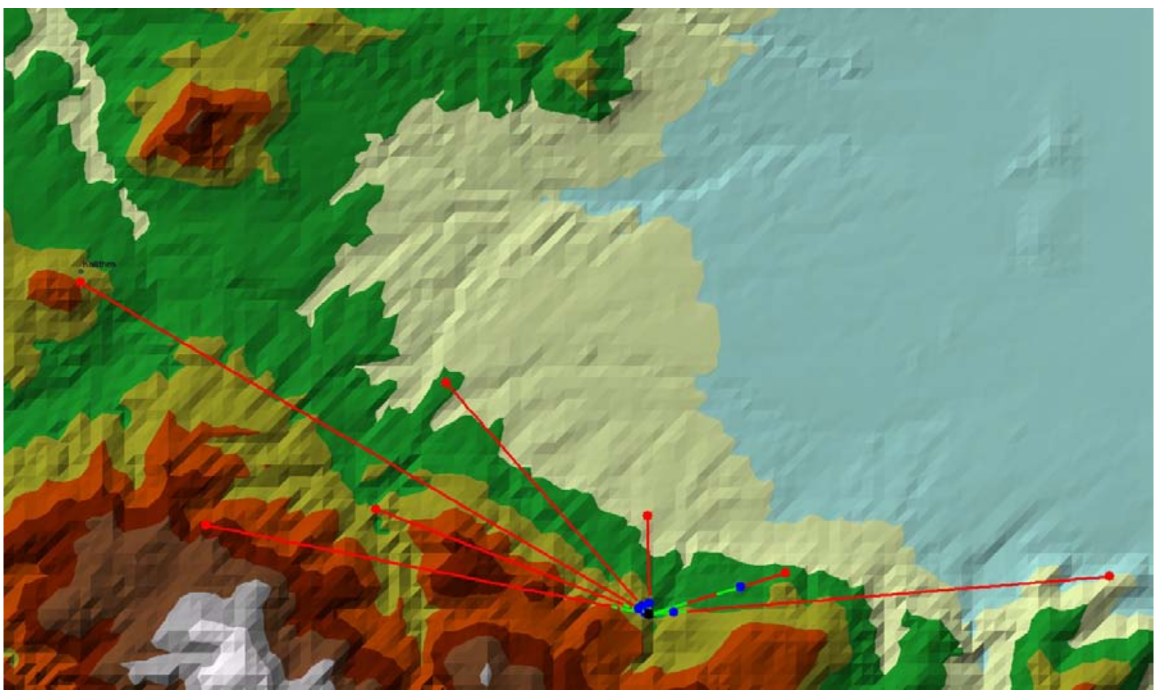


Fig 4: Karatsadali 2

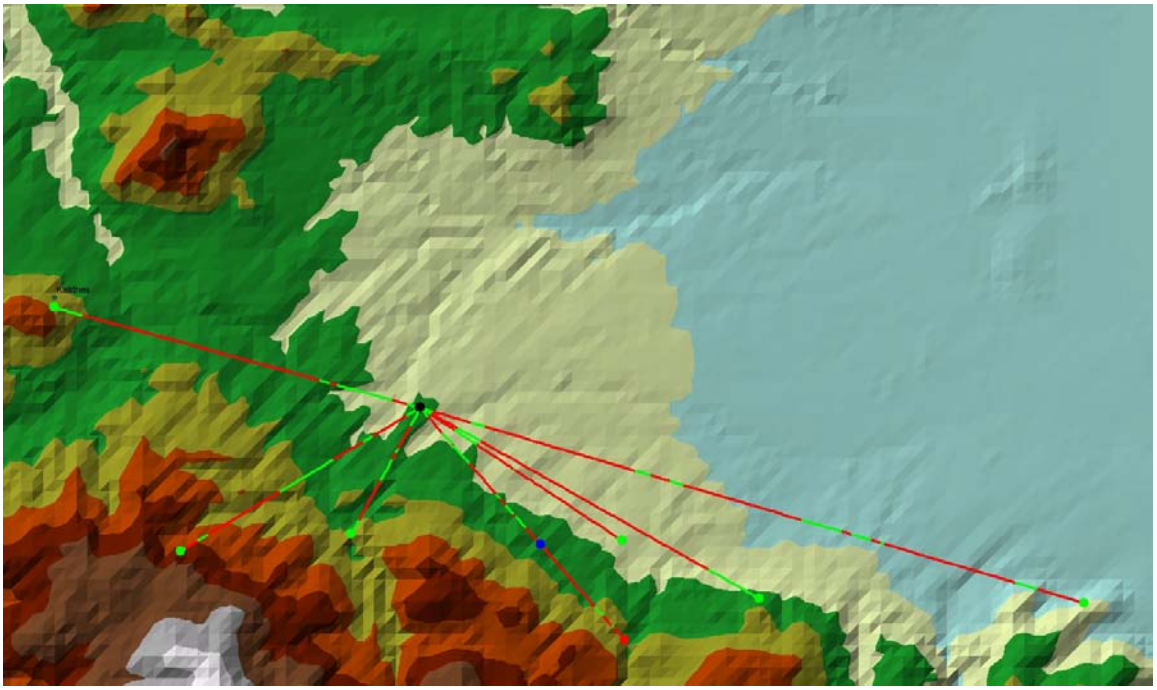


Fig 5: Myli

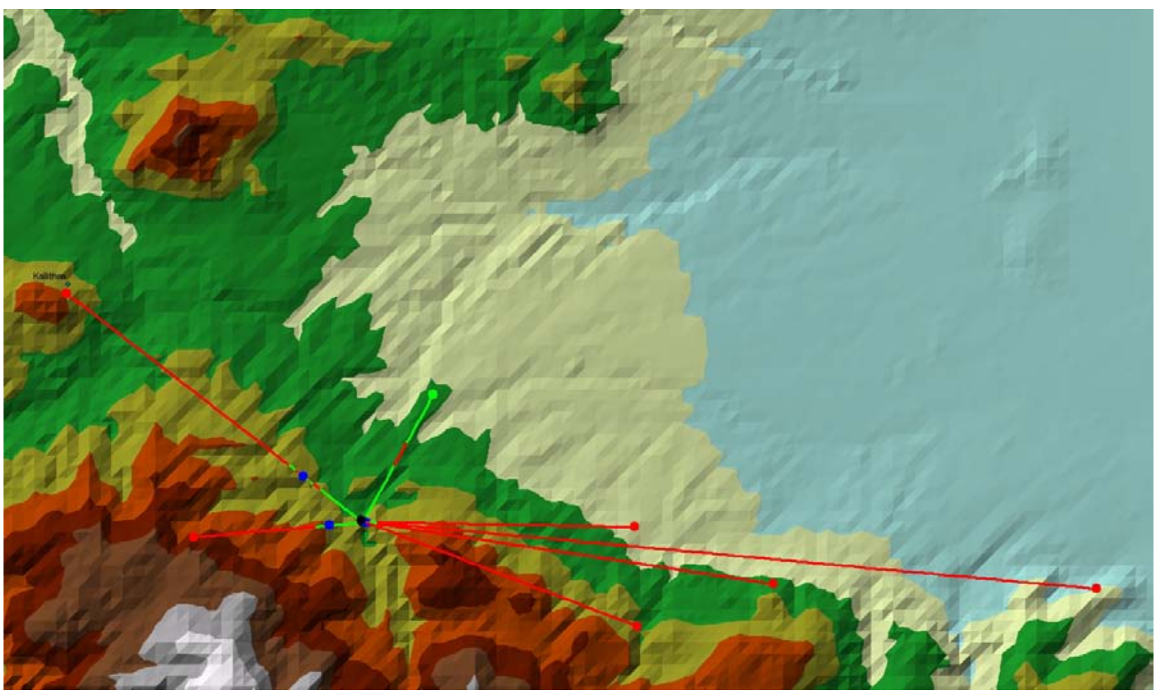


Fig 6: Neochoraki

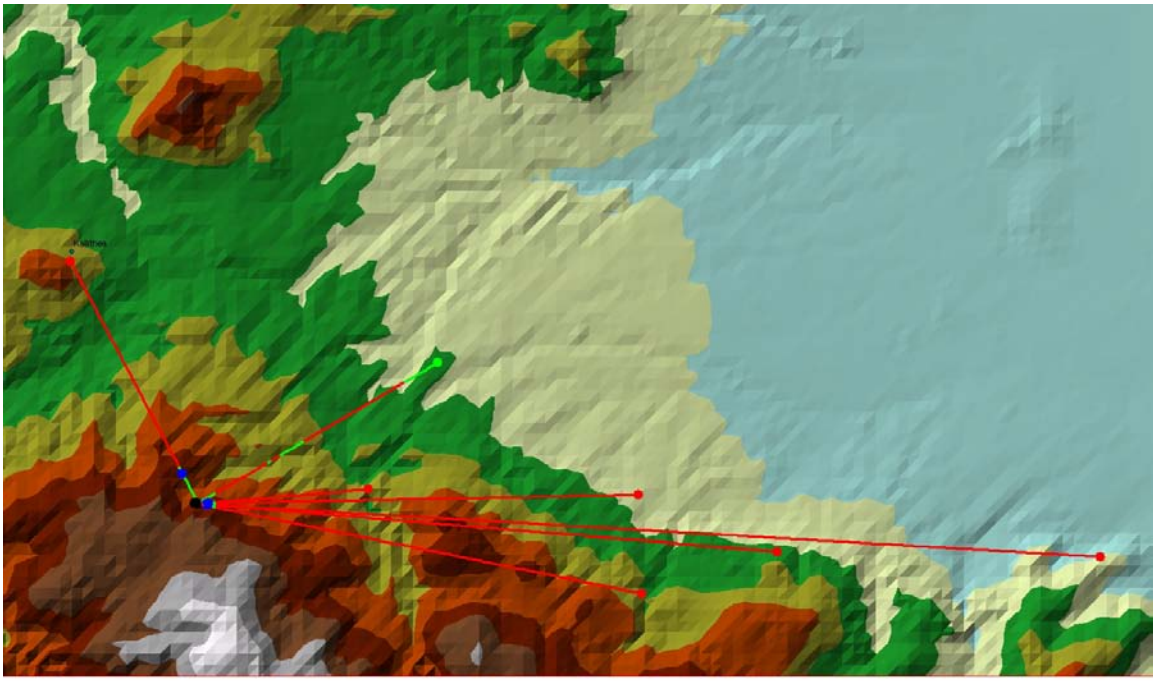


Fig 7: Tsurnati Vrisi

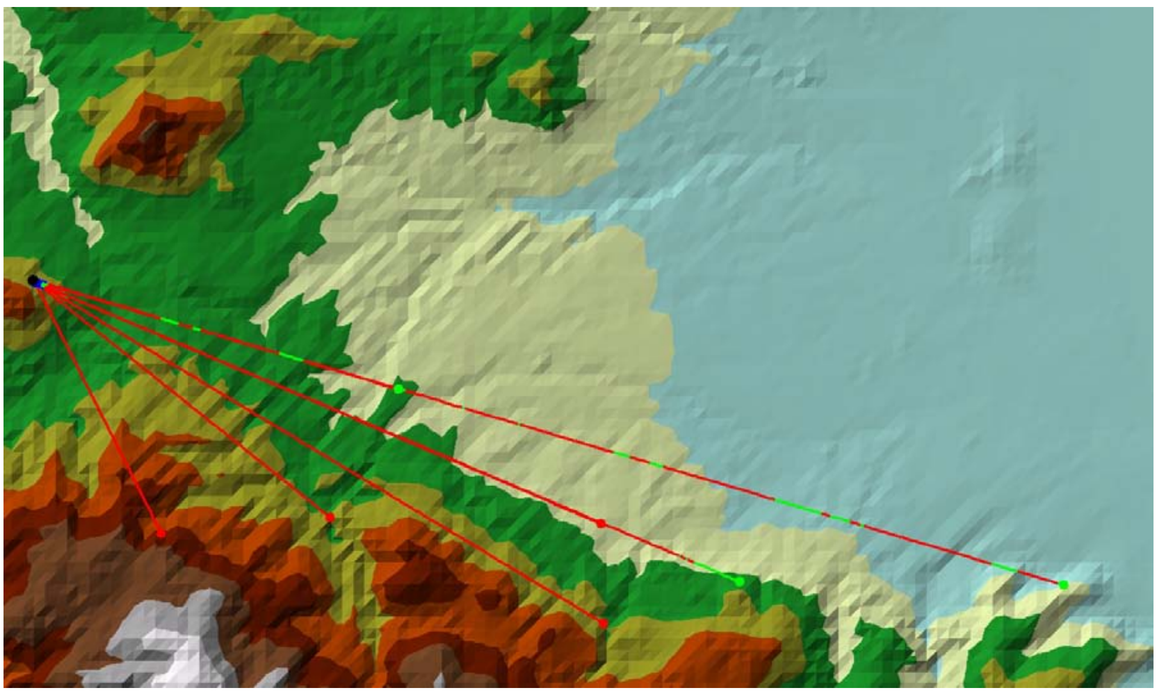


Fig 8: Kallithea 1

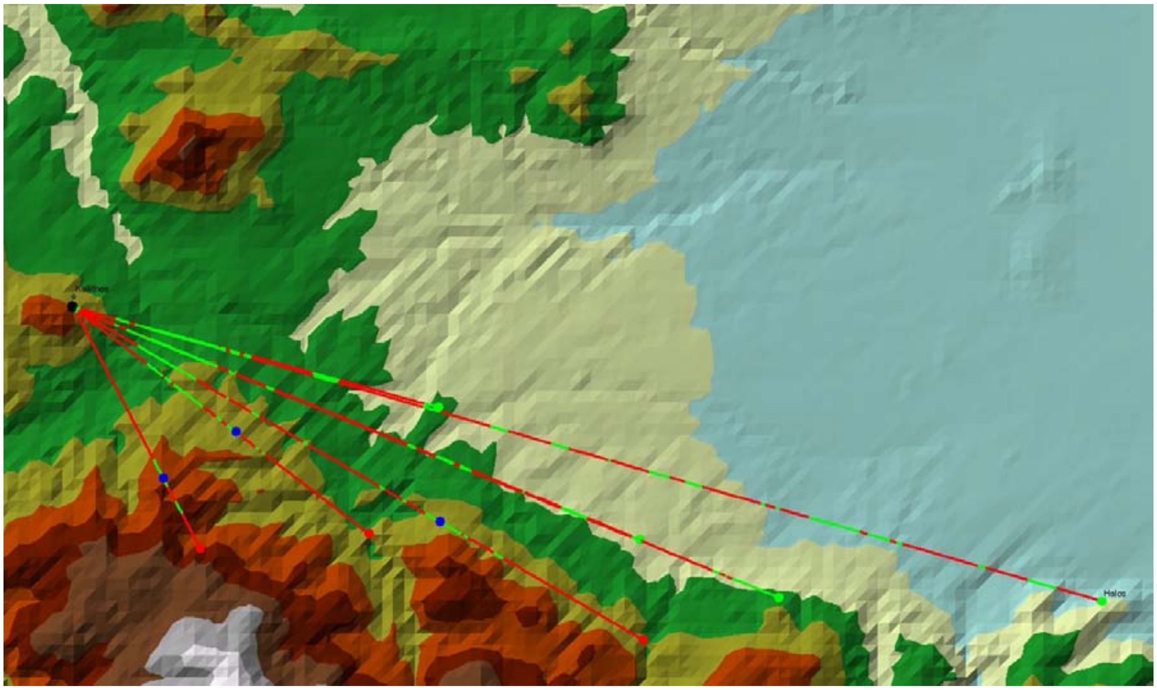


Fig 9: Kallithea 2

Appendix E: Viewsheds, 1:70,000

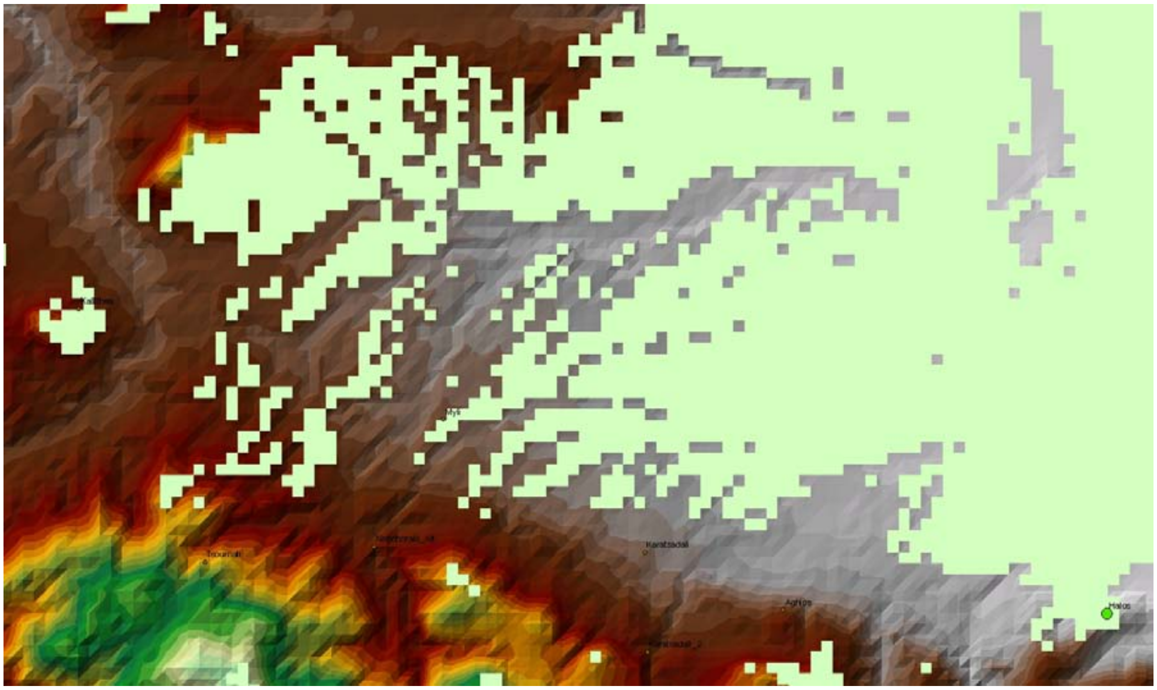


Fig 1: Halos, 0m

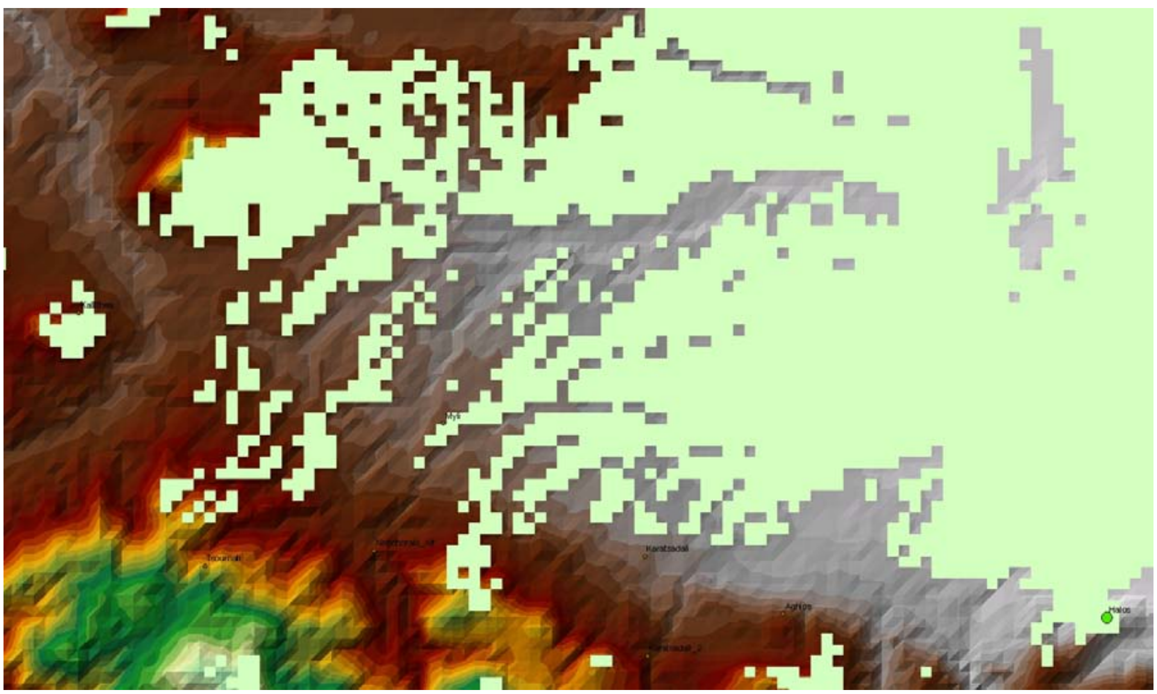


Fig 2: Halos, 6m

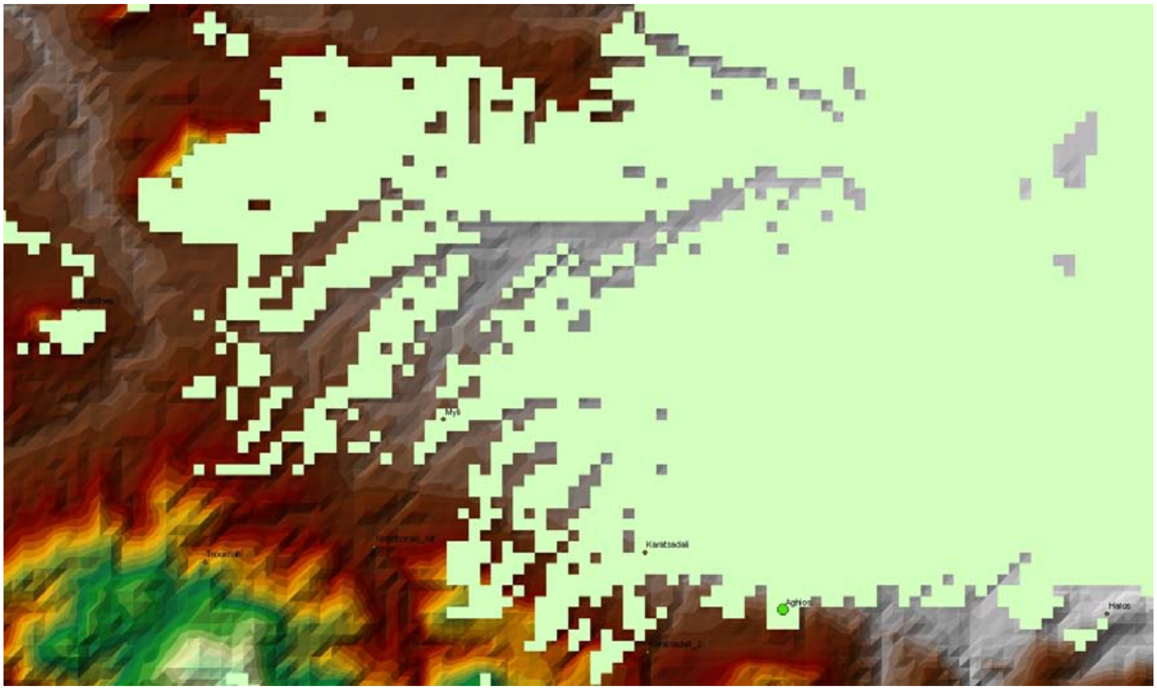


Fig 3: Ayios Nikolaos, 0m

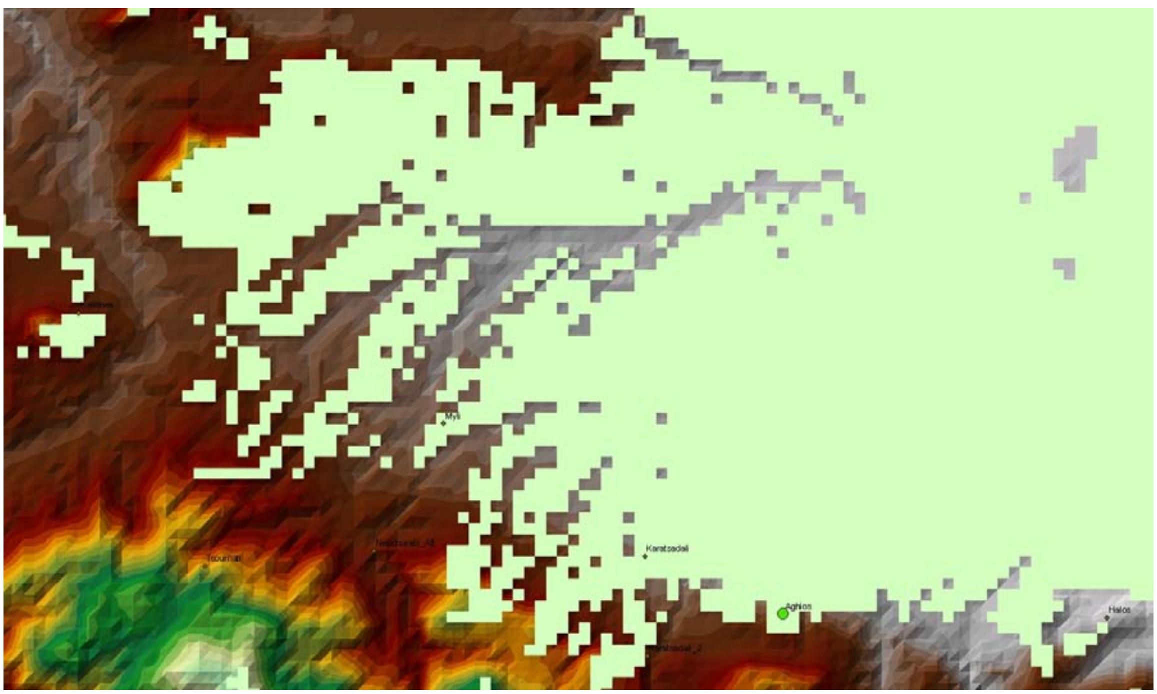


Fig 4: Ayios Nikolaos, 6m

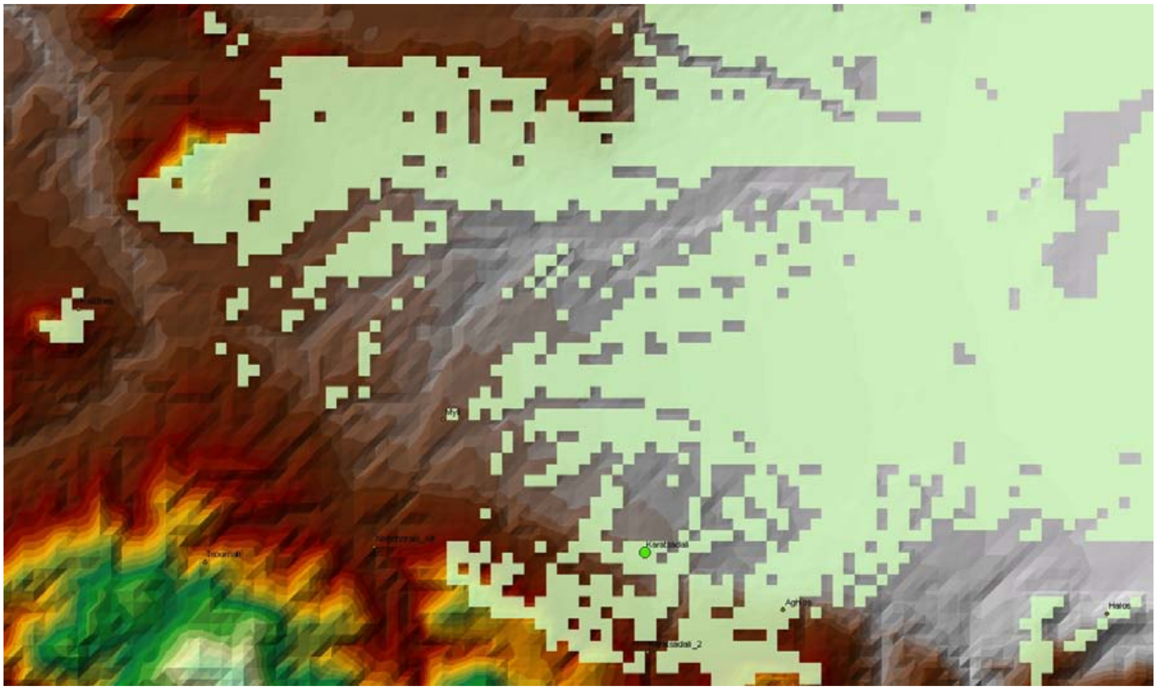


Fig 5: Karatsadali, 0m

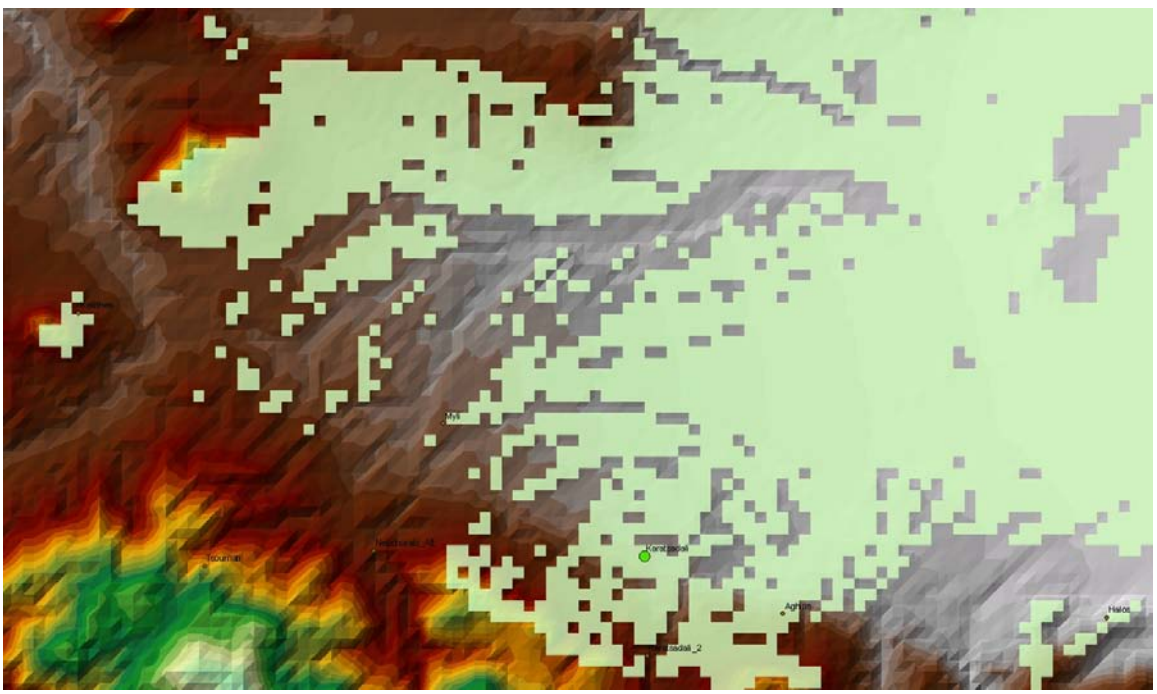


Fig 6: Karatsadali, 6m

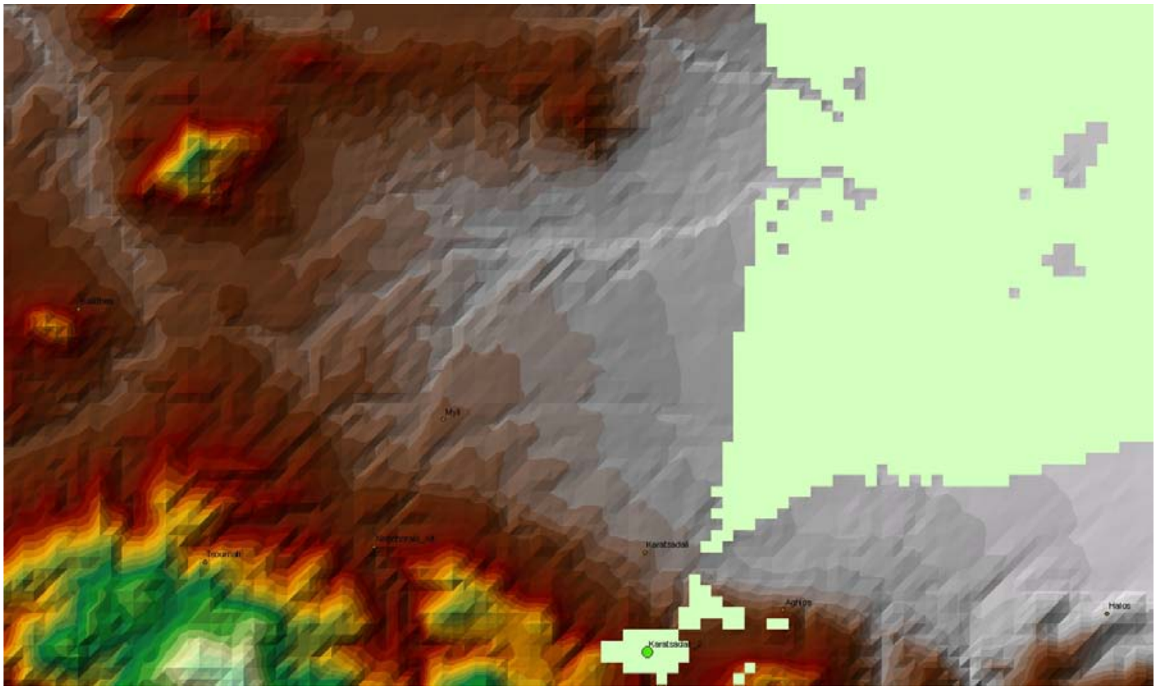


Fig 7: Karatsadali 2, 0m

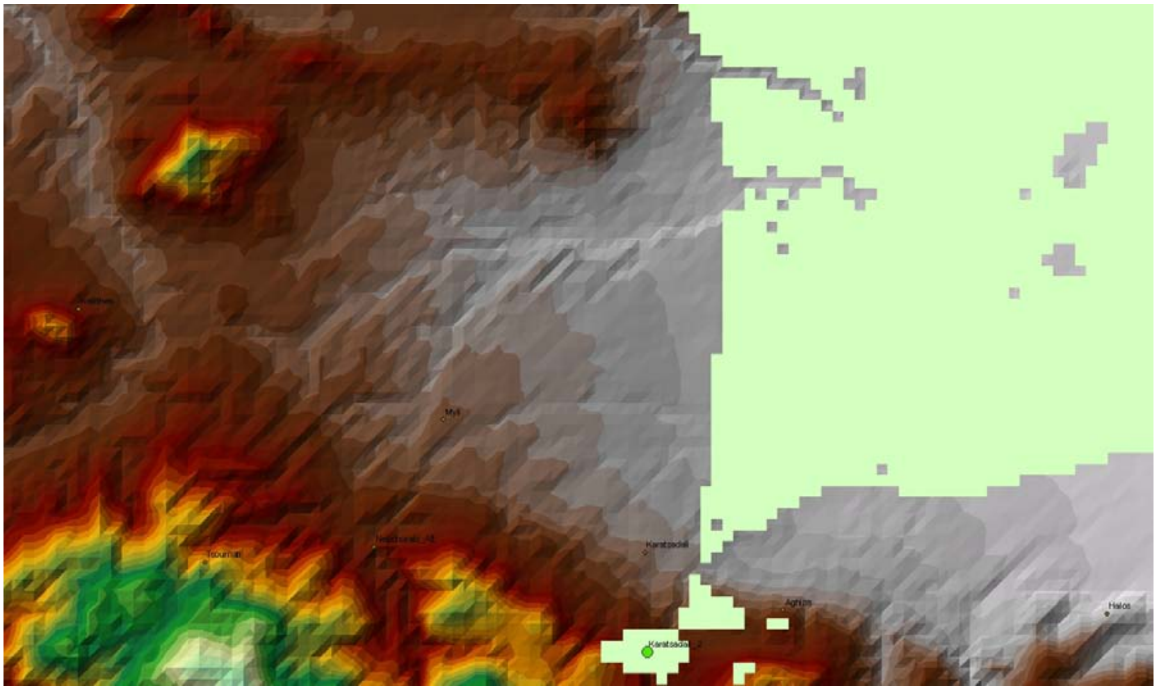


Fig 8: Karatsadali 2, 6m

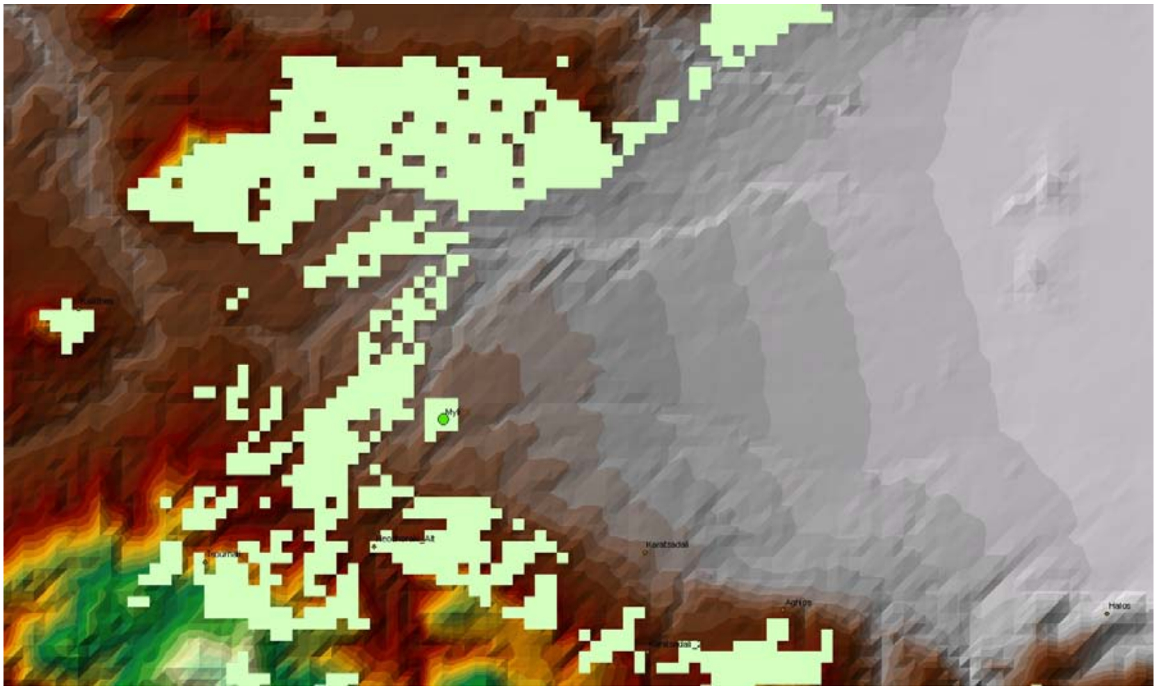


Fig 9: Myli, 0m

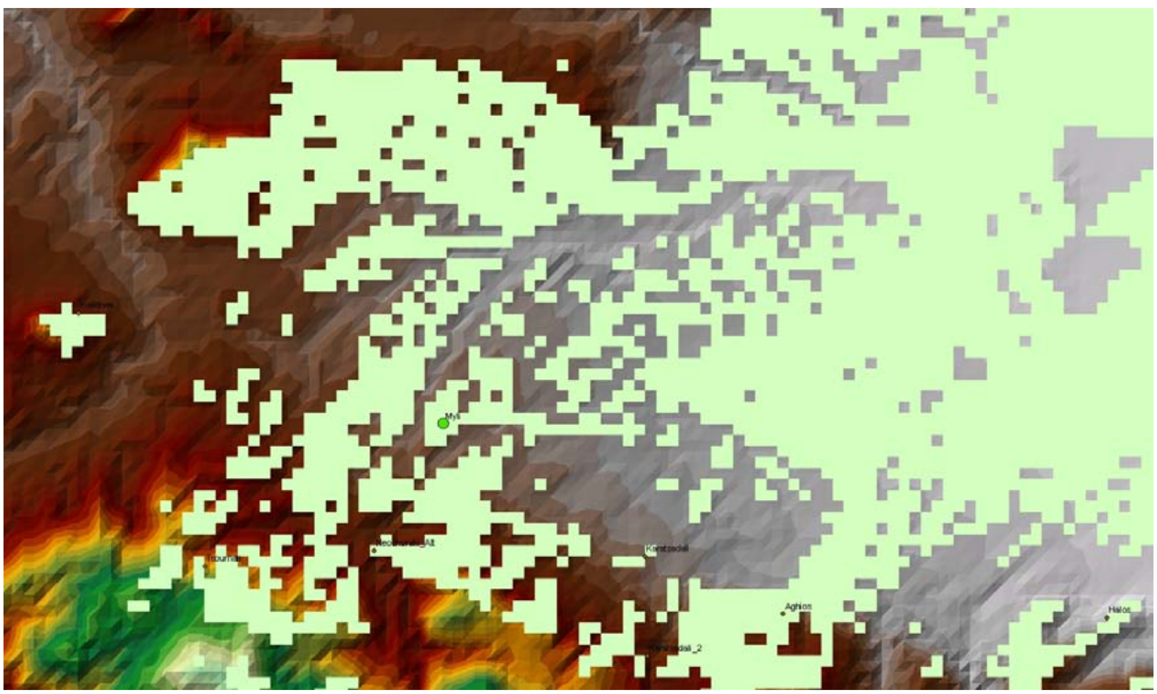


Fig 10: Myli, 6m

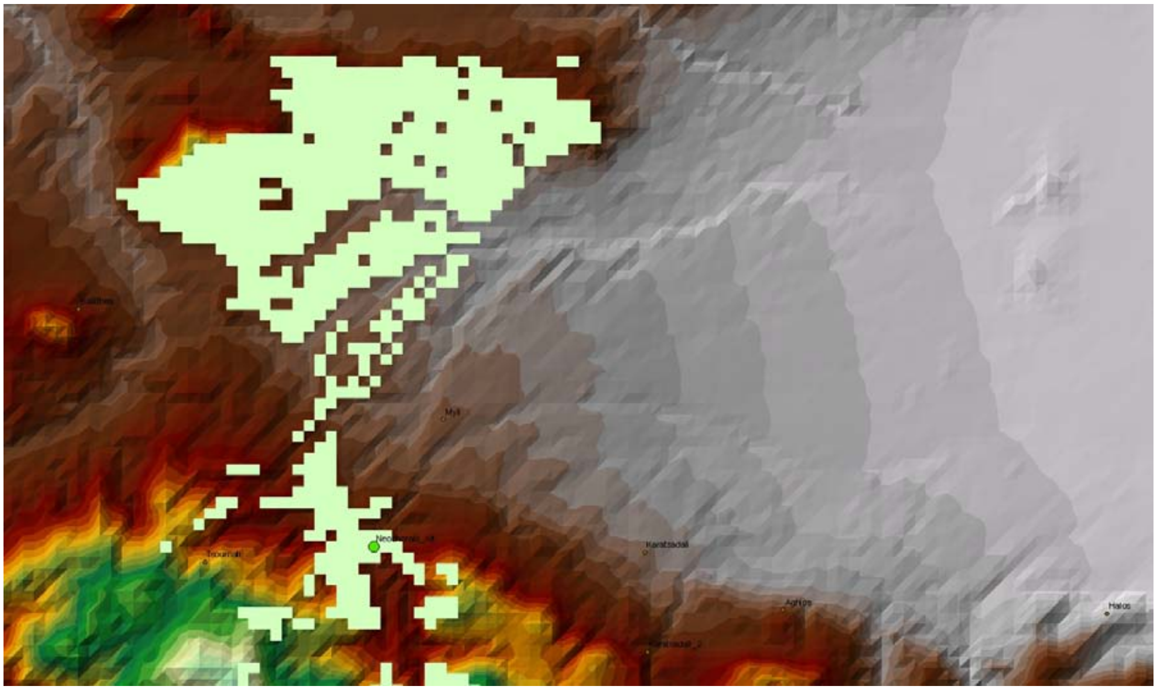


Fig 11: Neochoraki, 0m

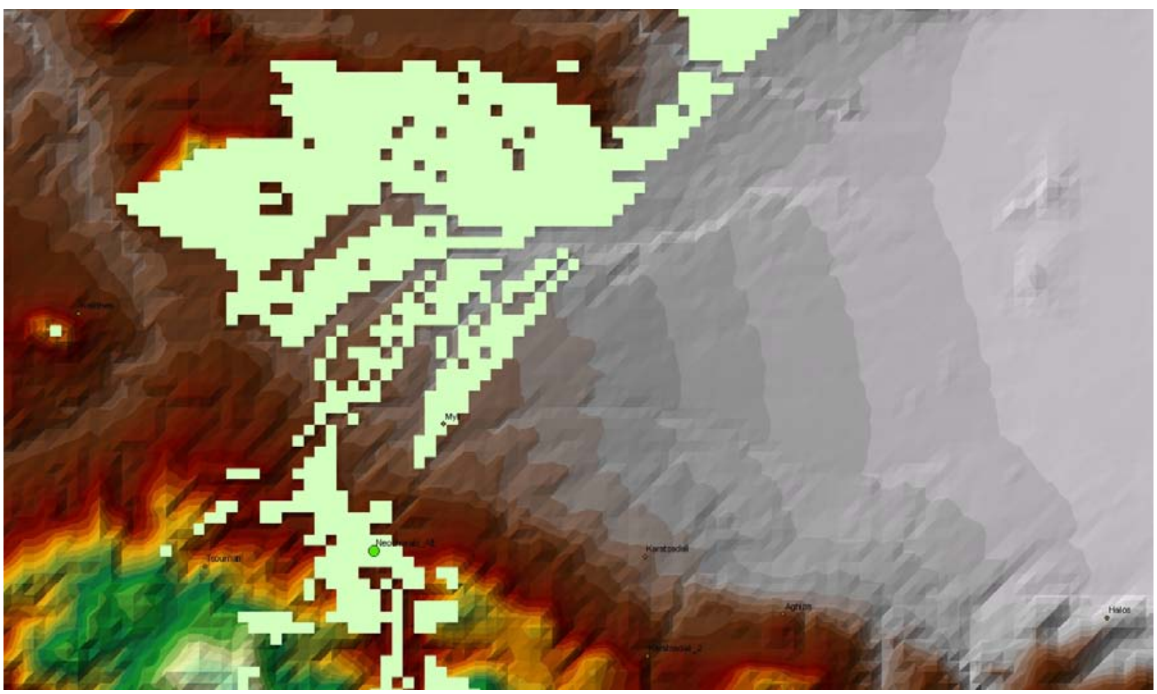


Fig 12: Neochoraki, 6m

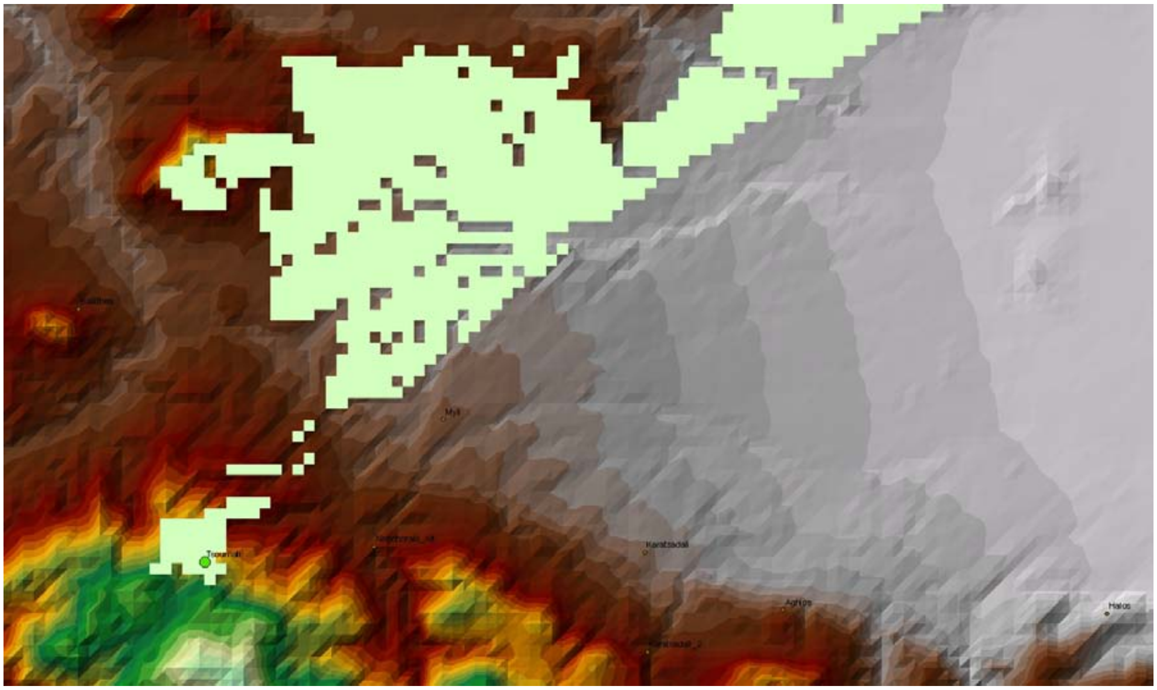


Fig 13: Tsurnati Vrisi, 0m

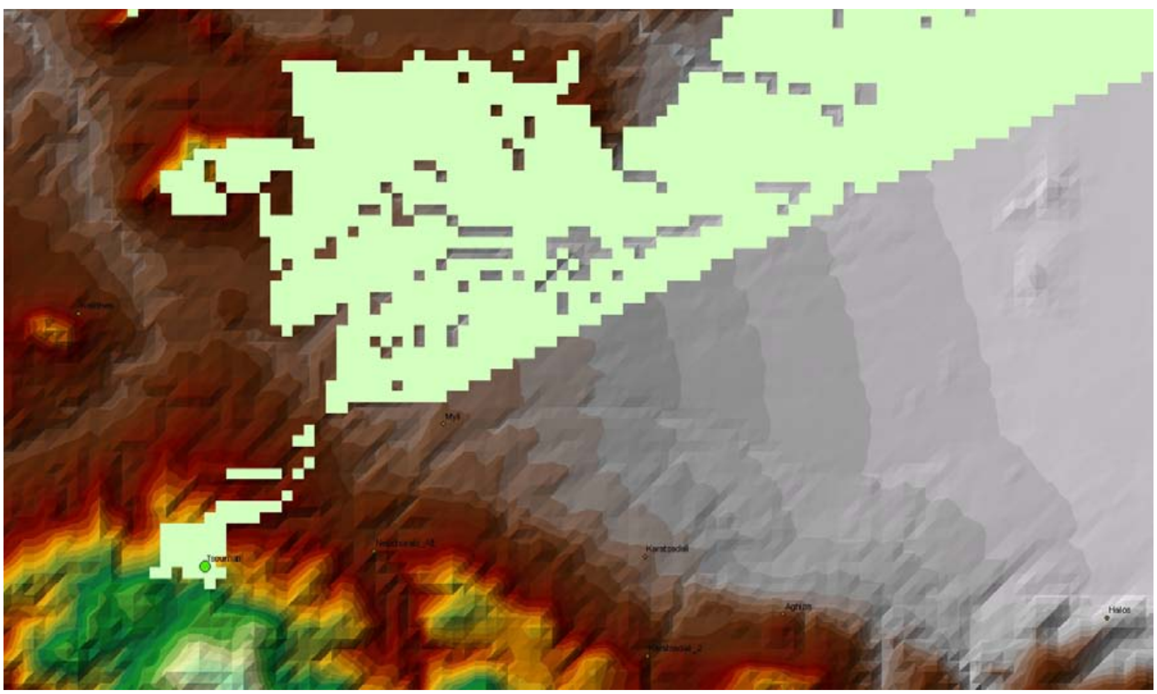


Fig 14, Tsurnati Vrisi, 6m

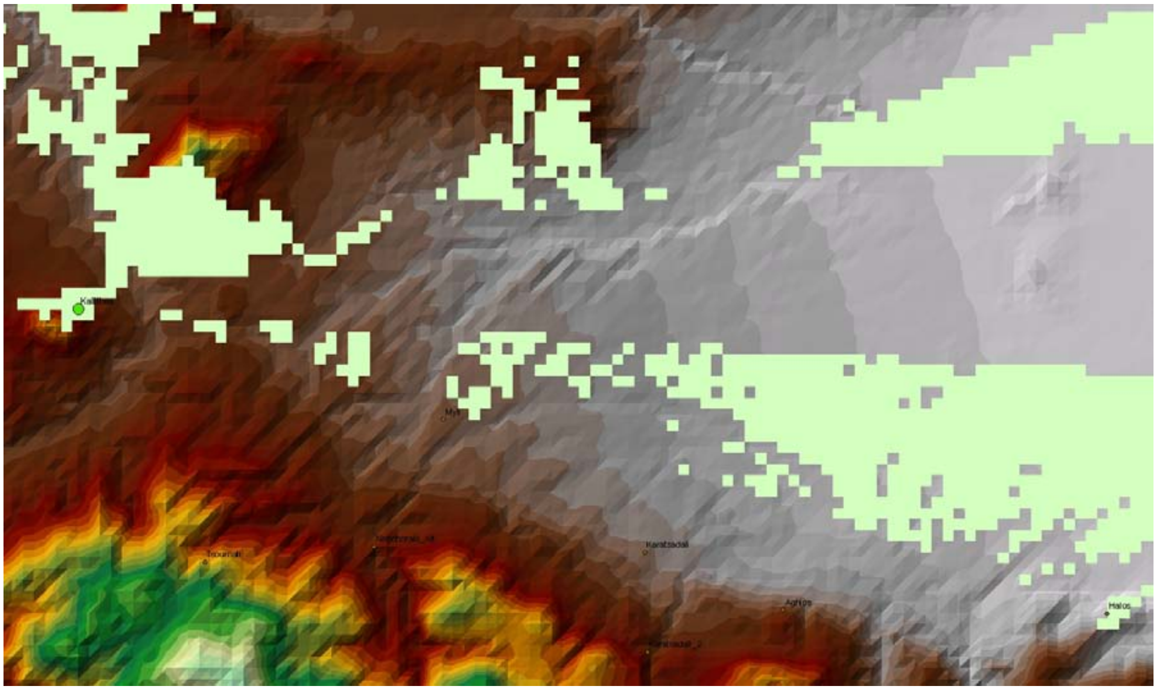


Fig 15: Kallithea 0m

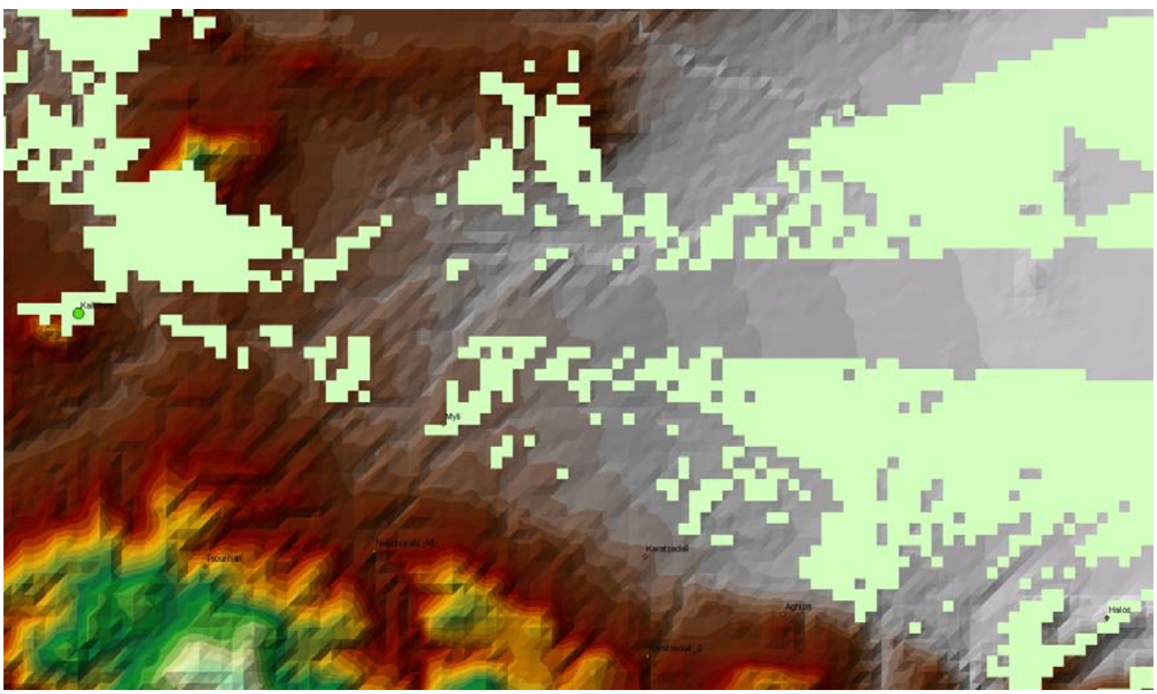


Fig 16: Kallithea 6m

Appendix F: Adjusted Viewsheds, 1:70,000

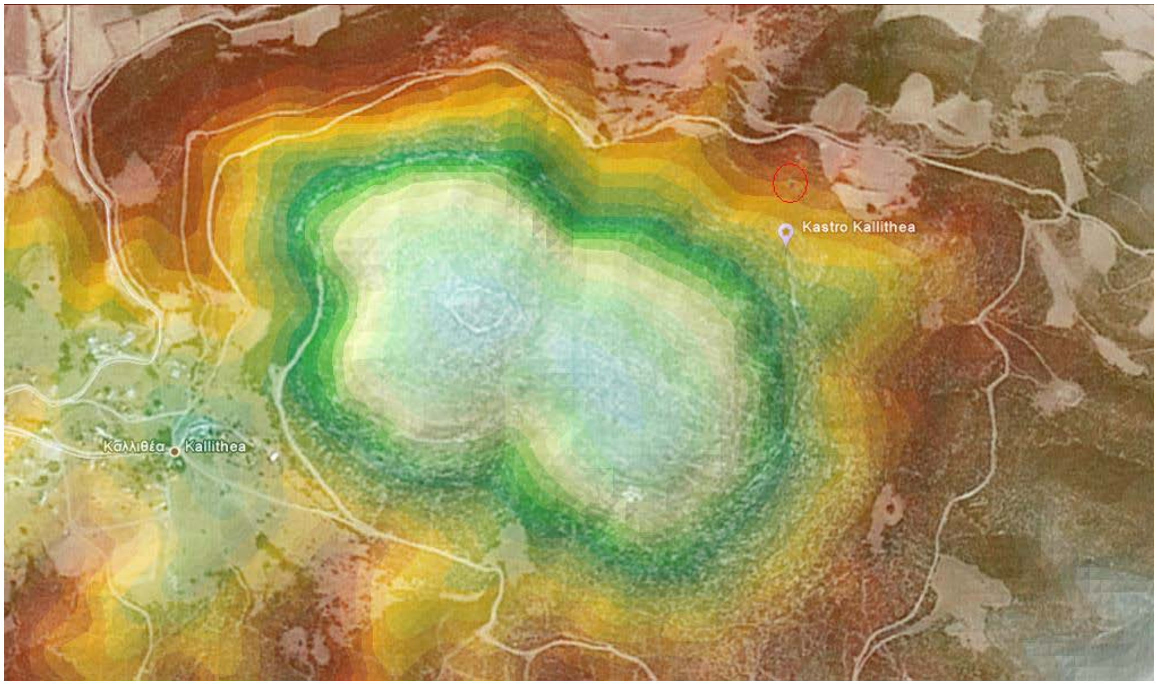


Fig 1: 30m DEM with superimposed satellite image
Note input points circled in red which lie ~100m north of Tower 15

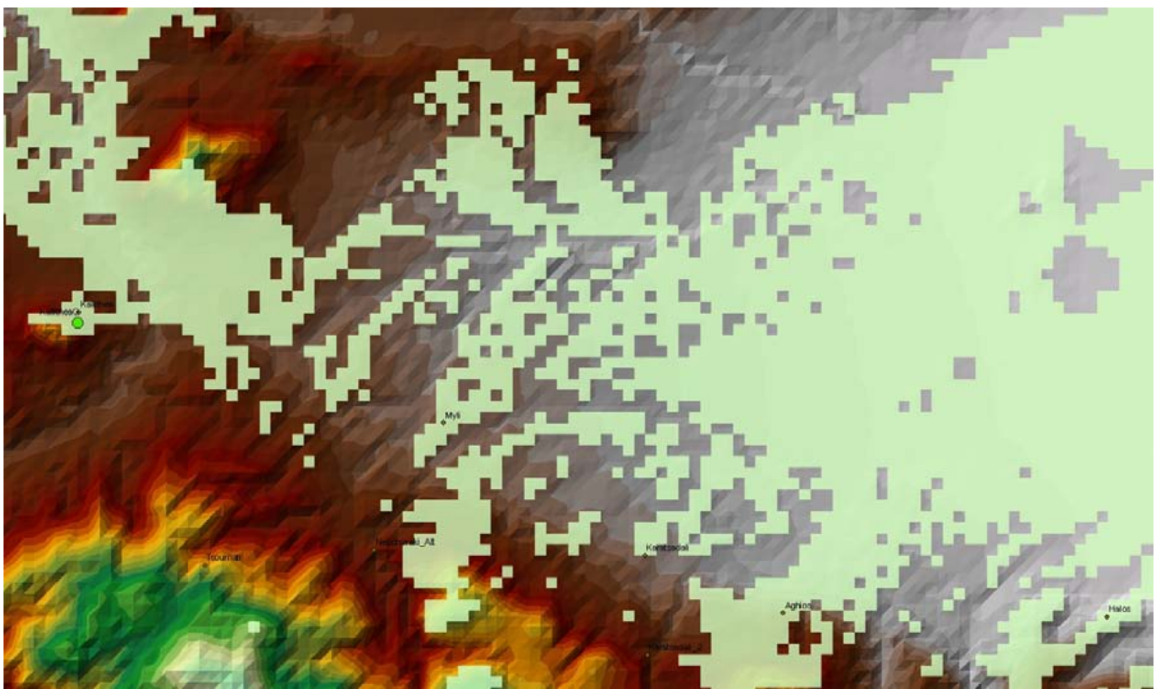


Fig 2: Adjusted Kallithea, 0m

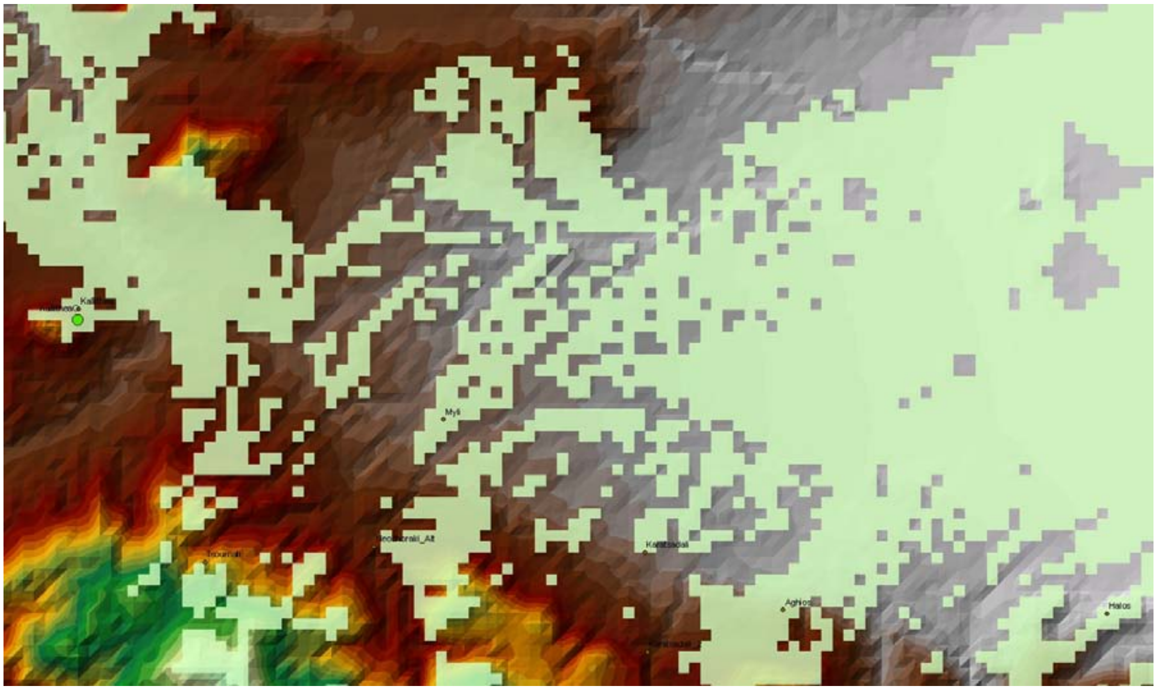


Fig 3: Adjusted Kallithea, 6m

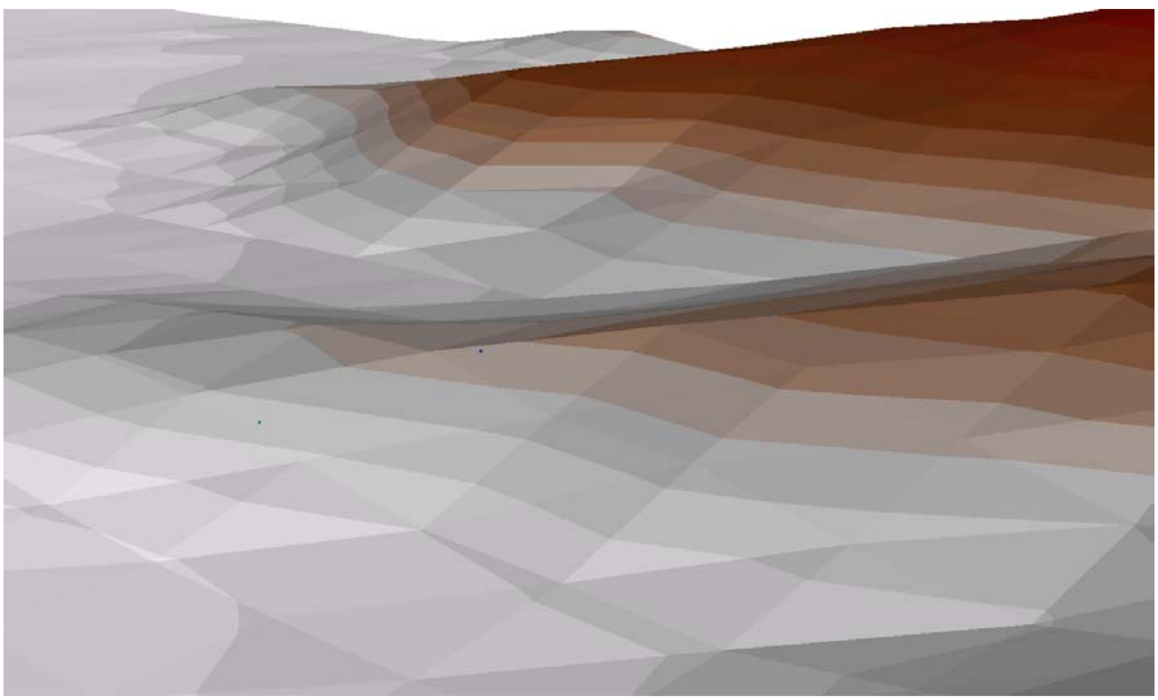


Fig 4: Adjusted Halos point

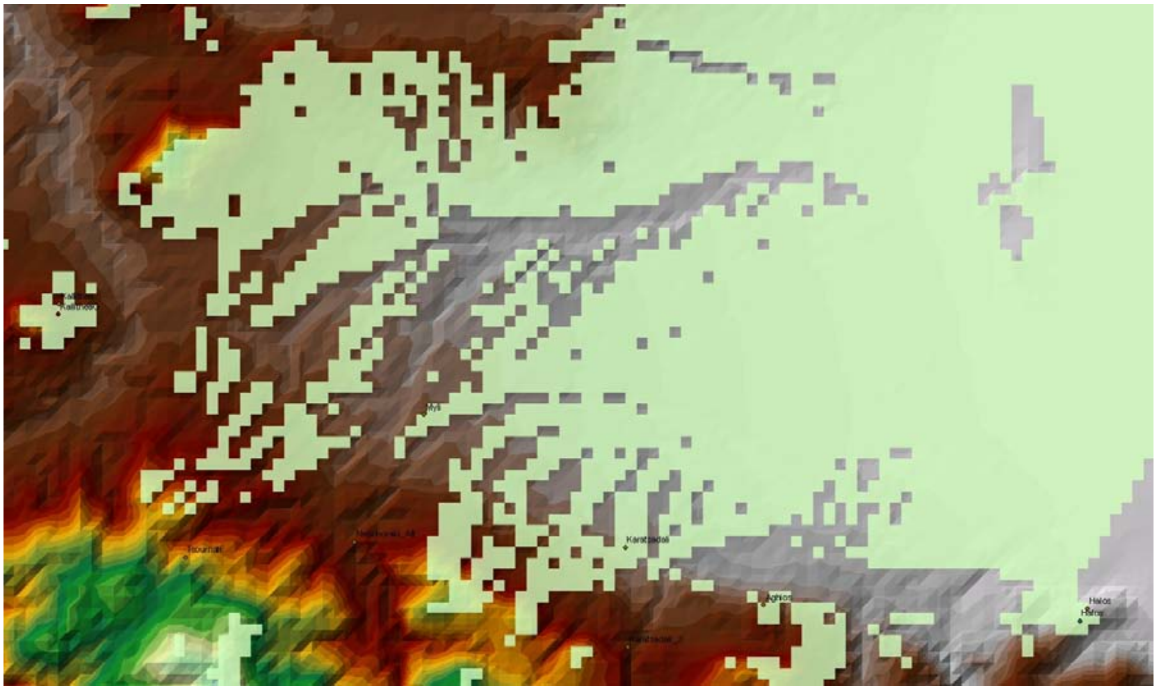


Fig 5: Adjusted Halos viewshed, 0m

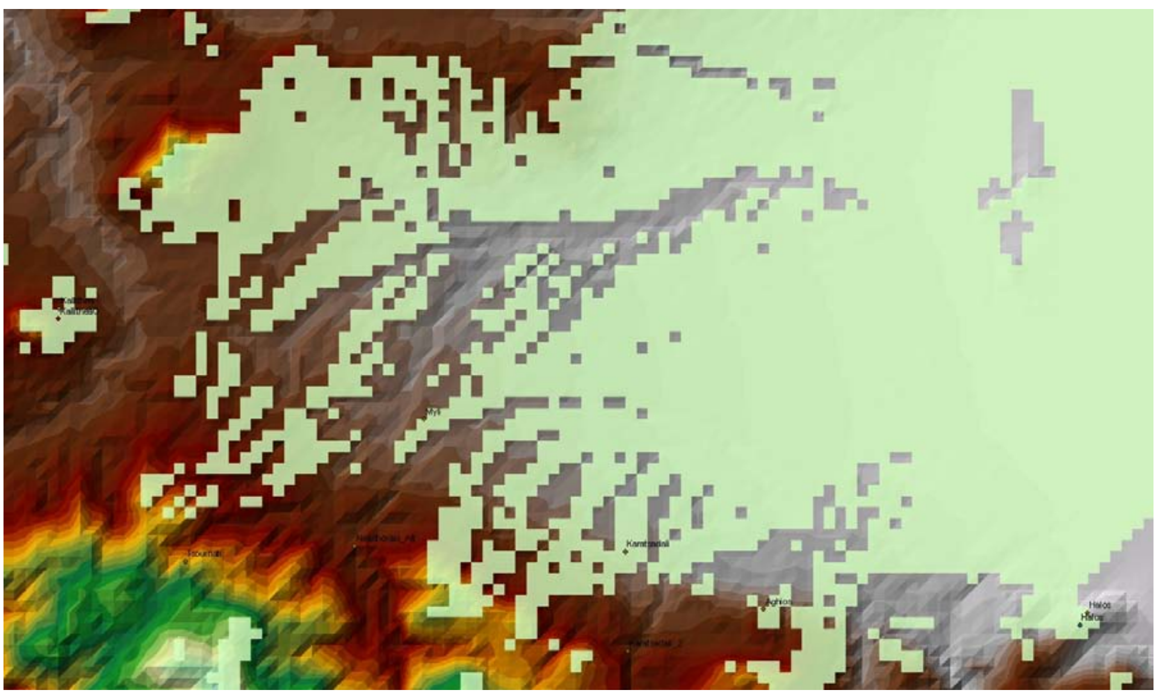


Fig 6: Adjusted Halos viewshed, 6m

Appendix G: 5/10 km Buffers, 1:70,000; Kallithea-Halos Axis

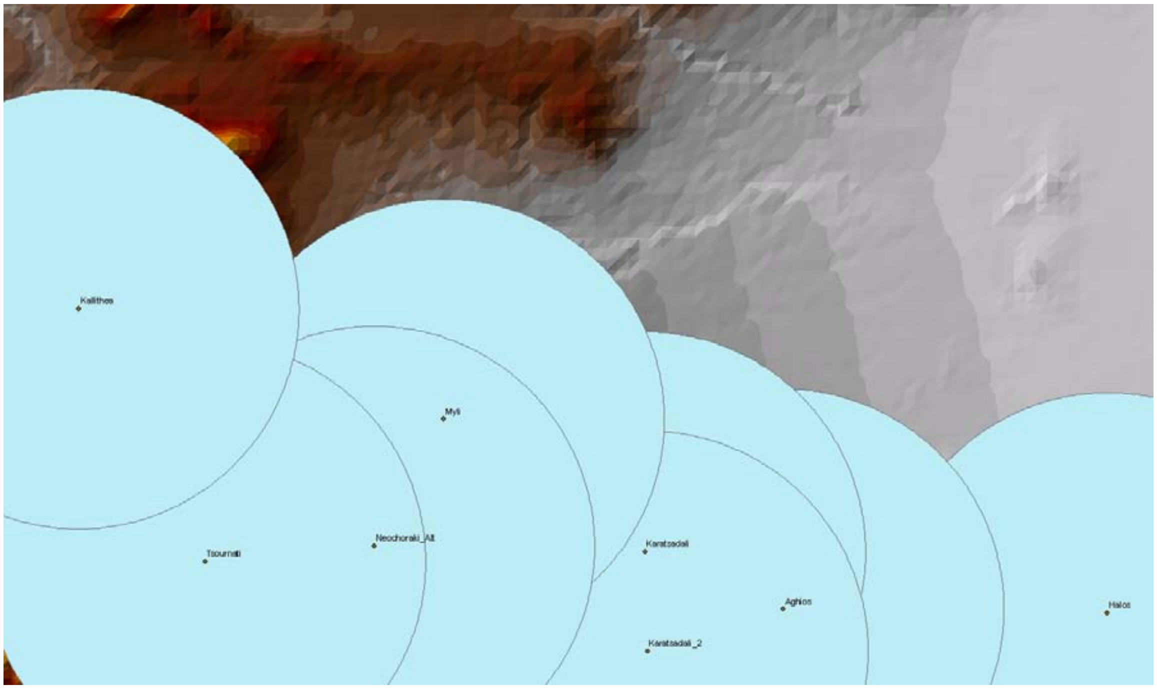


Fig 1: 5km buffer

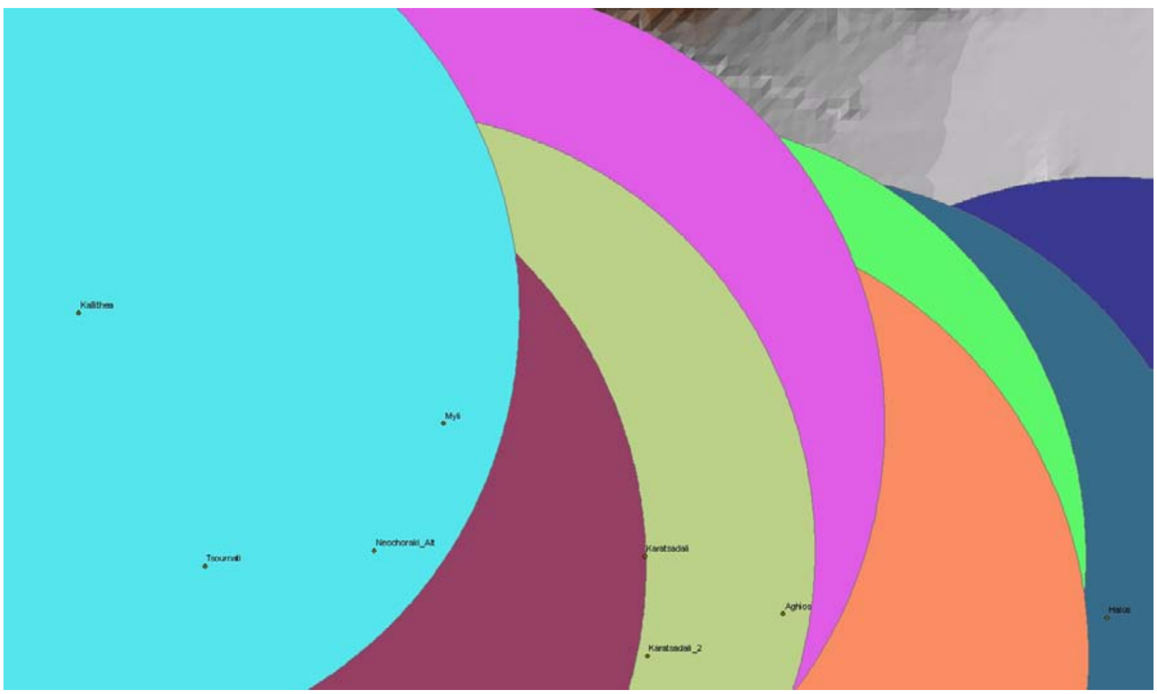


Fig 2: 10km buffer

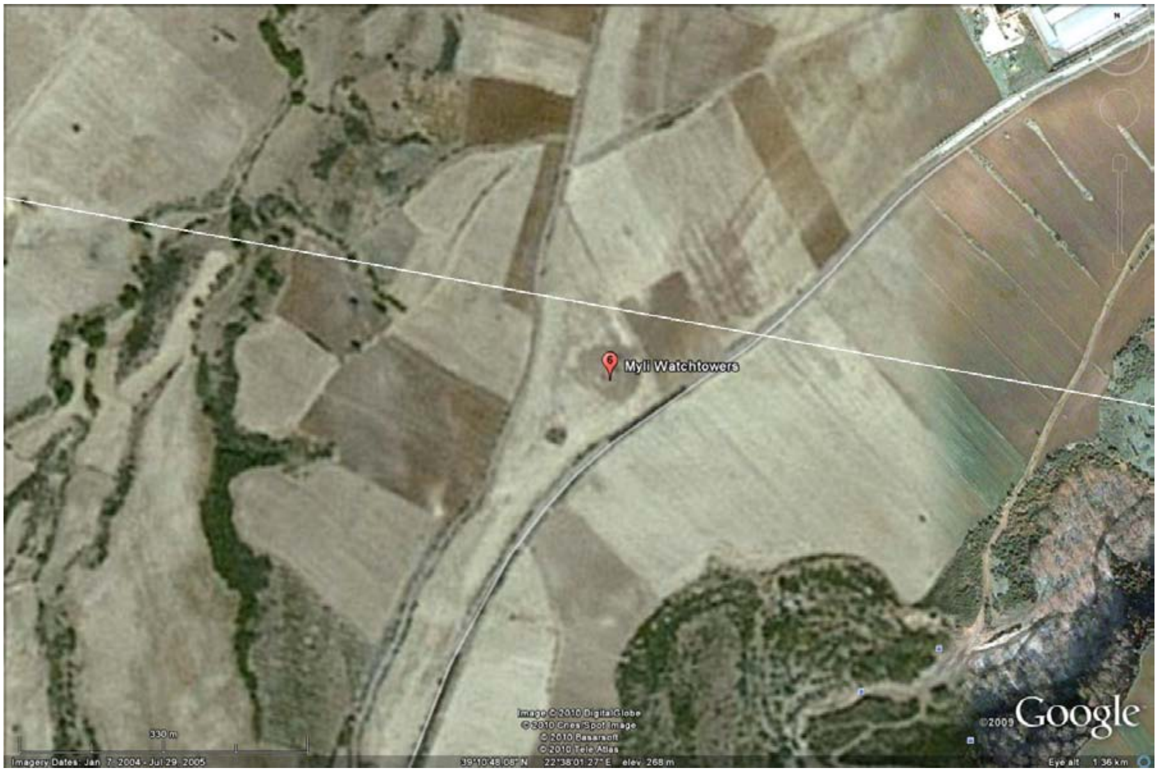


Fig 3: Myli Watchtowers with axis drawn between Halos and Kallithea

Appendix H: Maps

Fig 1: Greece with Thessaly highlighted

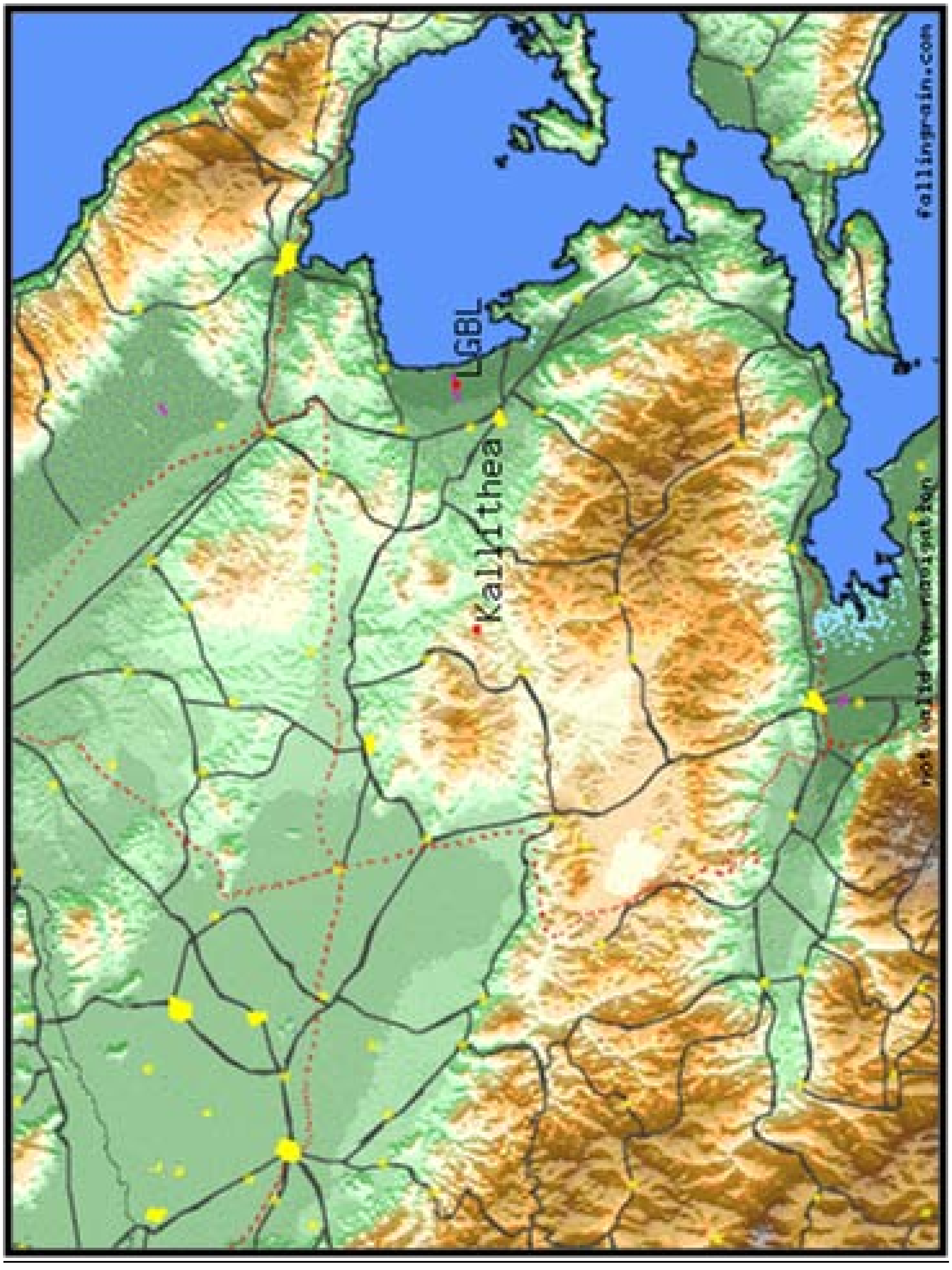


Fig 2: Achaia Phthiotis

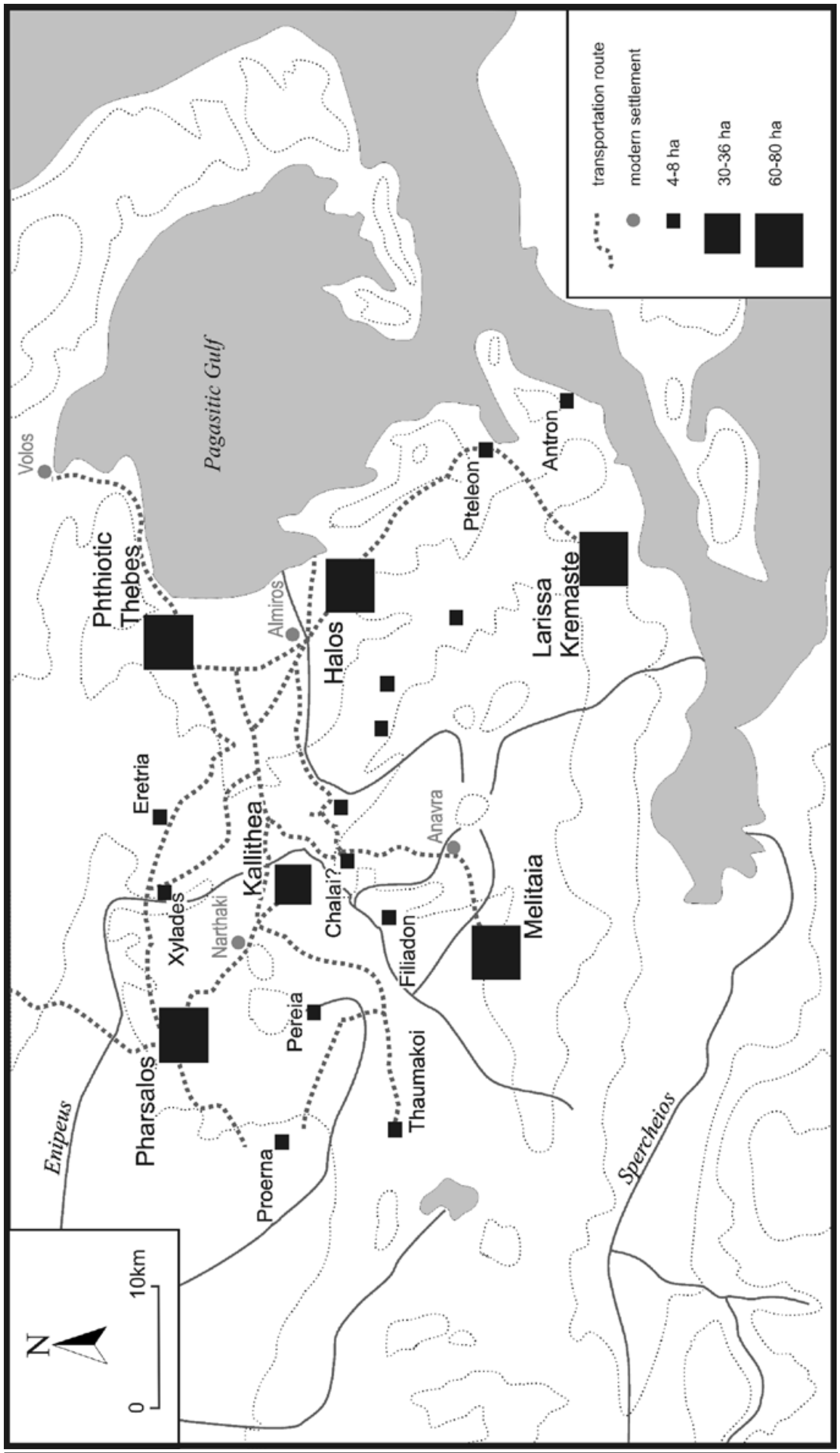


Fig 3: Kallithea and surrounding sites

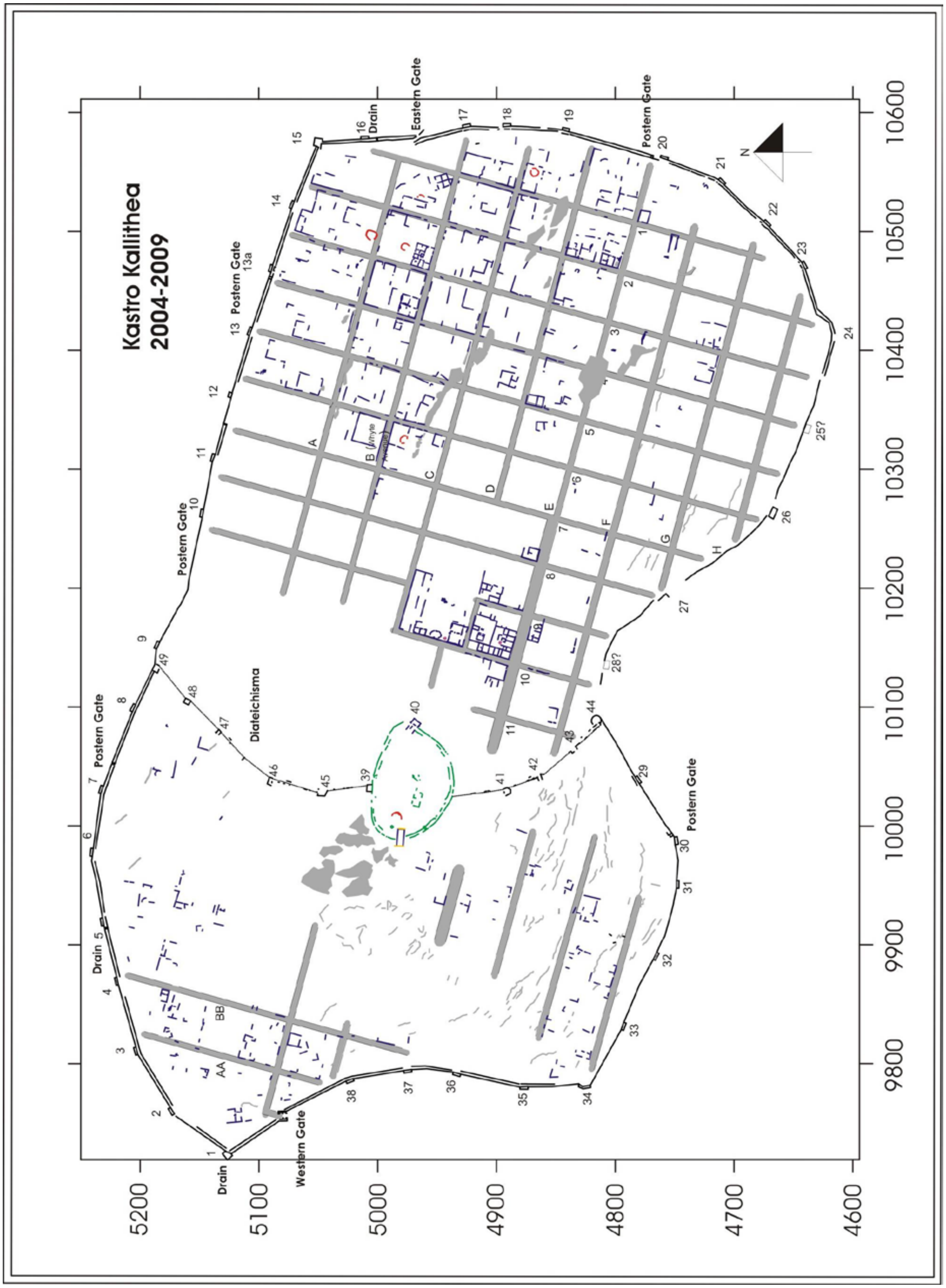


Fig 4: Kastro Kallithea

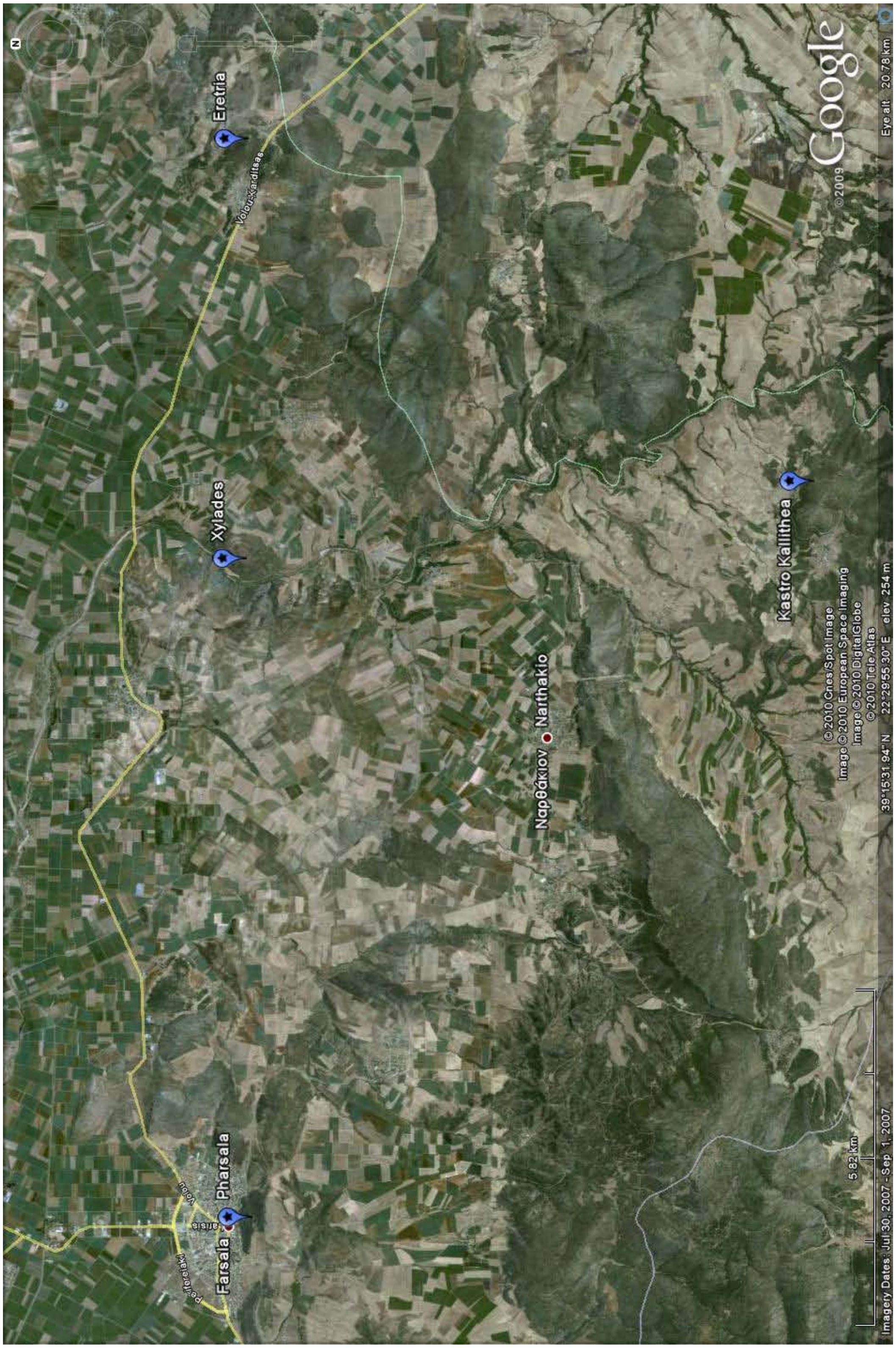


Fig 5: Kallithea, Pharsala, and Xylades