117th Annual Meeting - Archaeological Institute of America San Francisco, California. January 6-9, 2016. Session 4C: Friday, January 8, 8:00 - 10:30 am

New Perspectives on Neolithic Agricultural Villages in Eastern Thessaly (Greece) through Remote Sensing Applications

A. Sarris, T. Kalaycı, F.-X. Simon, J.C. Donati, I. Moffat, C. Cuenca-Garcia, M. Manataki, G. Cantoro, N. Nikas, N. Argyriou, S. Déderix, G. Karampatsou, E. Kalogiropoulou, C. Manzetti, K. Vouzaxakis, V. Rondiri, P. Arachoviti, K. Almatzi, D. Efstathiou & E. Stamelou

Laboratory of **GEO**physical – **SAT**ellite **RE**mote **SE**nsing and **ARCH**aeo-environment Institute for Mediterranean Studies Foundation for Research and Technology, Hellas (I.M.S.-F.O.R.T.H.) Rethymno, Crete, Greece

&

Archaeological Ephorate of Karditsa & Archaeological Ephorate of Magnesia, Greek Ministry of Culture.





Neolithic habitation in Europe Ground zero

Neolithic Thessaly in a Historical Research Context



1901-1903: Excavations at Sesklo and Dimini1908: Excavations at Zerelia



1960-1977: Trial Excavations at several neolithic sites by D.R. Theocharis and Vl. Milojcic1977-1979: Excavations at Dimini by G. Hourmouziades

ΘΕΣΣΑΛΙΚΟ ΙΜΕΡΟΛΟΓΙΟ	1984:	Halstead's catalogue of prehistoric sites in
		Thessaly, French's survey.
	1992:	Gallis' catalogue of sites in E. Thessaly.



1990-present: Field survey in Almiros plain 13th EPCA & the Netherland Institute at Athens
1990-2005: Rescue excavations (national road, Lake Karla)



2005-present: Extensive satellite R.S. & geophysical surveys by GeoSat ReSeArch Lab of IMS (FORTH). PENED (2005-2007), INSTAP (2006-2010), ARISTEIA (2013-2015)

Status of knowledge of the Neolithic Landscape in Thessaly

http://neolithicthessaly.ims.forth.gr/

a Direction (Aat

δινιώτικη Μαιούλα

υνριώτικη μανοι

Πέρδικα, Νταρυτία 75 ce

Kaparoavraya

Registration and mapping of Neolithic settlements, VHR/HS Space imagery & GIS spatial analyses

for

Regional site <u>distribution</u> <u>patterns</u> among ecological and topographic zones of Thessaly.



ເຈົ້າແ ມີເຫັດແພດໃດ

- GPS/Aerial documentation of 342 magoulas
- 181 sites (53% of the total) are established on alluvial deposits & 81 sites on fluvial deposit areas.
- These formations are of low altitude & are ideal for cultivation.

IGEAN (Innovative Geophysical Approaches for the Study of Early Agricultural Villages of Neolithic Thessaly) "ARISTEIA" Action (2013-2015).

A multi-year Remote sensing fieldwork campaign to study the <u>physical landscape dynamics</u> <u>of Neolithic settlements</u> within <u>the coastal hinterlands of E. Thessaly</u> (C. Greece).

AIMS: <u>explore multiple settlements</u>

<u>extract new archaeological</u> <u>data on an extensive scale</u>

<u>analyze the broader</u> <u>habitation configurations of</u> the Neolithic agricultural villages.



Successful documentation of the <u>diachronic</u> <u>development</u> of Neolithic sites

from core habitation mounds (≤ 1 hectare) to large, sprawling communities several hectares in size.

Methodologies – Multi-magnetometer Techniques





Sensorik & Systemtechnologie (SENSYS) MX Compact system

8 multi-channel measurement system FGM600 fluxgate gradiometers separated by 0.25-0.5m & connected to a DGPS navigation system

Ideal for large-scale scanning



Bartington single sensor unit also in use in thick vegetation areas

Methodologies – Ground Penetrating Radar (GPR) & EMI Techniques Penetration Depth ~2.5m



8 channels MALA MIRA GPR, 400 MHz antennas Sampling 10 x 2.5 cm





GEM2: HCP 2.5 m Conductivity / 1.7 m susceptibility



Sensors & Software Noggin Plus System with 250 MHz antennas Sampling 50 x 2.5 cm

CMD Mini explorer-GF Instruments





CMD: HCP 2 m Conductivity / 1 m susceptibility

Methodologies – Magnetic Susceptibility Measurements_ Soilscapes





Coring and soil analysis

Bartington MS2B

Low & High Frequency susceptibility & Phosphate analysis

Methodologies – Aerial Photography

Quadrocopter DroidWorx CX4

- ø DJI navigation, viewpoint and failsafe
- α Average altitude 100-200 m above surface
- α Autonomy ~13-15min with camera load







	SITE	PERIOD	COVERAGE	
			(in hectares)	
			Magnetics	UAV
1	Agios Demetrios	EN, MN	0.39	5.19
2	AgiosNikolaos	LN	N/A	N/A
3	Almiriotiki	EN-LBA	8.38	20.7
4	Almiros2	EN-MN	6.63	7.33
5	Bakalis	FN-beyond	0.46	8.84
6	Belitsi	EN, MN	3.02	11.73
7	Dexameni	N, EBA	0.07	3.20
8	Eleuterochori	undefined	N/A	N/A
9	Kamara	MN	1.55	N/A
10	Karatsangliou	LN	2.94	12.17
11	Karatsantagli	EN	2.65	12.38
12	Kastro Kokkinas	LN, FN & historical	1.01	7.02
13	Nikonanou	MN-EBA & Byzantine	2.95	4.1
14	Perdika1	EN, MN, MBA	5.27	3.12
15	Perdika2	MN	3.83	13.41
16	Perivlepto Kastraki2	EN, MN	5.09	20.46
17	Rizomilos2	N, EBA	10.52	6.81
18	Vaitsi Mylos	EN- MBA	3.16	10.37
19	Velestino(3) Mati	EN-MN & EBA &	3.19	2.50
		historical		
20	Velestino4 - Visviki	MN-LBA	5.36	2.56
21	Zerelia	EN-LBA & historical	4.87	30.16
	SUM		71.29	182.06

Selected Results





- **Deposition of collovial deposits**
- Core habitation zone: 15-20 rectilinear structures with high magnetic values (burnt daub made structures). Enclosed by wall fortifications. A few features outside the core habitation zone.
- 4 At least 2 circular ditches & multiple possible entrances

EM Susceptibility (HCP for 0-1.7 m depth)

Almiros 2

Magnetic susceptibility indicating different usage areas within the settlement?

EM Conductivity (HCP for 0-2.5 m depth)



High conductivity area to the south → possible evidence of flooding susceptibility ??

Nikonanou_EM_conductivity_Lines Nikonanou magnetic Lines

Legend

Nikonanou_magnetic_Polygones_enclosures



Nikonanou

(MN - EBA)

Close to Velestino 3 (Mati) and Velestino 4 (Visviki) magoules.

- 2-3 fragmented oval enclosures (<3 m ۲ wide) around the magoula.
- The outer enclosure defines the • boundary between the high and low conductivity zones, suggested from the EMI (GEM-2 and EM31) conductivity measurements.
- Entrances to the NW and SE.
- Built up area confined within the • magoula consisting of (burnt) daub based structures.



Magoula Rizomilos 2 (N – EBA)



□ Multiple concentric ditches with various breaks that represent entrances.

Enclosure walls at the center

□ Flooding marks

 Another smaller pre-existing settlement to the east
 with each having its own system of ditches & enclosure walls

Velestino 4 - Visviki: EN-MN-LN



"Satellite" Settlements and Megaron type Buildings?

The geophysical data support the existence of an early more dispersed occupation followed by a more compact habitation area (see the interrupted sequence of the SE enclosures).

This can be also compatible to the finds of the 1941 excavation trench A: the earlier settlement sequence of 2.8 m thickness dates from the end of the EN to the MN period.







Magoula Almiriotiki (EN-MN-LN-LBA) – Magnetics

Almiriotiki

High: 50
- Extensive settlement built around a core habitation zone on the highest topographic level marsh area
- Structures on the top have high magnetic values (burnt daub made structures)

100

50

200 m

Magoula Almiriotiki – GPR (depth 0.7-0.8 m)



Details of Structures

- Low magnetic value probably indicates that the structure(s) has stone foundations

- Rectilinear form 38 m x 10 m.

In GPR, the large "megaron" type structure appears to be formed from three separate structures built side by side.



200 n

Magoula Almiriotiki Early Neolithic – Late Bronze Age

About 30+ burnt daub structures within the magoula.

Outside the core zone: - 60+ rectilinear structures

- Structures with low magnetic values (stone built) have 2-3 rooms

- Extensive network of ditches (at times double) surround the settlement – multiphase construction.



Perdika 1 (Dautza) (EN-MN, MBA)

Extensive settlement (>200x100m) that greatly expands beyond a core habitation zone on the highest elevation.





Perdika 1 Early Neolithic – Middle Bronze Age

- 13 burnt daub structures within the core zone and "empty" area to the East.
- 50+ rectilinear stone-built structures

- The majority of structures have high magnetic values (burnt daub structures), but others have low magnetic values (stone) with 2-3 rooms (similar to Almyriotiki). 3 phases? Coexistence of habitation at various sections but not in the core of the magoula.

- Ditches and or walls preserved on the northern side of the settlement



Perdika 2

- Extensive network of enclosures built on a natural hilltop
 - A sequence of openings that gave access into the settlement
 - Little evidence for individual structures (some have high magnetic values)



Perdika 2 – Magnetics (left) and GPR 0.7-0.8 m depth (right)





- Large rectilinear structures with low magnetic value (stone foundations?) were identified with GPR

Concluding Remarks

Successful Employment of Geophysical and Satellite remote sensing techniques – Importance of using an arsenal of various approaches (manifold geophysics)







What can we get out of these results?



Extent & Internal Organization of Settlements

Almyriotiki

Perdika 1

Karatsantagli



- Conceptualize a landscape of variation: Similar and divergent characteristics of settlements in planning and structural materials)
- Dimension of settlements and structures
- Internal organization of the settlements, clusters of structures
- burnt and unburnt structures / mudbrick & stone structures
- open/unbuilt spaces, pits, a.o.

Neolithic Ditches

Rizomilos 2

Almyriotiki

Almyros 2



<u>Neolithic Ditches</u>

- Existence of enclosures: internal fortifications and external ditches
- Sustaining terracing walls at more abrupt slopes and hilly terrains
- Corridors and entrances

Flooding Simulation and flood vulnerability using ASTER DEM

Rizomilos 2

Karatsangliou

Velestino 4 - Visviki









- Existence of ditches in terms to the surrounding geomorphologic features (e.g. proximity to palaeochannels and to prone flood areas).
- Persistence of habitation even in flood prone areas and the existence of multiple enclosures and ditches around these settlements may suggest <u>counter measures against</u> <u>periodic flooding events</u>.
- Does it suggest flood based cultivation strategies?

A New Perspective in the Neolithic Settlement Organization







Implications regarding the chronological continuation of habitation, the persistency in occupation, the sustainability issues, the social organization and relations of the communities in intra site, local and regional level, etc. → still able to make some reconstruction of Neolithic landscape and organization of the settlements.

117th Annual Meeting - Archaeological Institute of America San Francisco, California. January 6-9, 2016.
Session 4C: Friday, January 8, 8:00 - 10:30 am



New Perspectives on Neolithic Agricultural Villages in Eastern Thessaly (Greece) through Remote Sensing Applications

A. Sarris, T. Kalaycı, F.-X. Simon, J.C. Donati, I. Moffat, C. Cuenca-Garcia, M. Manataki, G. Cantoro, N. Nikas, N. Argyriou, S. Déderix, G. Karampatsou, E. Kalogiropoulou, C. Manzetti, K. Vouzaxakis, V. Rondiri, P. Arachoviti, K. Almatzi, D. Efstathiou & E. Stamelou

Laboratory of **GEO**physical – **SAT**ellite **RE**mote **SE**nsing and **ARCH**aeo-environment Institute for Mediterranean Studies Foundation for Research and Technology, Hellas (I.M.S.-F.O.R.T.H.) Rethymno, Crete, Greece

&

Archaeological Ephorate of Karditsa & Archaeological Ephorate of Magnesia, Greek Ministry of Culture.





