Agios Demetrios

Archaeological Background

The Neolithic settlement near the modern village Agios Demetrios Aerinou, Greece was found recently and therefore; has not been archaeological studied in detail. According to surface material, the site can be dated to the Early and Middle Neolithic periods. Its geographic location at the top of a natural edge is significant in terms of its location, with views to the lower terraces that run from the east coastline to the west inner land.

The site of Agios Demetrios Aerinou is situated on top of an uncultivated hill, densely covered with scrub vegetation which is surrounded by flat agricultural land. The National Road runs slightly more than 1 km east of the site. A number of small villages are present, with the closest village of Agios Demetrios less than 1 km away to the west. Various streams and irrigation channels pocket the terrain, especially north of the uncultivated hill. Cultivation that is taking place is predominantly wheat and other low standing vegetation. Elevation in this area ranges from 190–200 mean average sea level (masl) on the hill to around 170–180 masl in the lower terrain. The 2003 aerial photograph shows that the landscape has not changed much over the last 10 years, except for a few modern field boundaries.

Satellite Remote Sensing and Historical Aerial Photography Survey

A WorldView-2 image from 22 July 2010 was used for satellite remote sensing at Agios Demetrios Aerinou (Figure 1). The satellite image has an off-nadir angle of 17.5°, a ground sampling distance (GSD) of 0.51 m (panchromatic) and 2.02 m (multispectral). In addition to the satellite imagery, an aerial photograph from 18 July 2003 with a scale of 1:30,000 was used for remote sensing (Figure 2).

No archaeological investigations (i.e. excavations) have been undertaken at this site therefore; the remote sensing data was analyzed first to locate potential archaeological features that may be present on the landscape. When examining the satellite and aerial datasets, there was no evidence of architectural remains and filtering of the remote sensing failed to detect anything directly associated with the Neolithic settlement (Figures 3–4). The hilly terrain and scrub vegetation are not particularly conductive for good results, and as a result made it difficult to detect architectural features. Only a cluster of surface anomalies just north of the site, e.g. anomaly #53, was identified. These are interpreted as former remnants of stream beds and are not associated with anthropogenic activity.

There are many surface anomalies in a 1 km radius around Agios Demetrios Aerinou and many of these are hydrological features from former stream beds and/or seasonal flooding (blue). However, a number of other features could be of archaeological interest. One feature is anomaly #69, located immediately south of the village of Kokkalaika (Figure 5). This feature has a distinctive globular shape, not quite a circle, but close to being one. It is located within a large field of low standing green vegetation. Some vegetation stress is noticeable in the red-green-blue (RGB) pansharp and 432 images, but the globular feature becomes more visible in the principle component analysis (PCA) and other spectral filters. The edges of anomaly #69 are fairly well-defined, except for the features eastern side which terminates beneath another field. The diameter measures approximately 150 m. A cluster of anomalies

west of Agios Demetrios Aerinou (anomalies #47, #49, #50-52) are likely remnants of hydrological activity and not potential magoulas.

Figure 1. Agios Demetrios Aerinou from a 22 July 2010 WorldView-2 image.

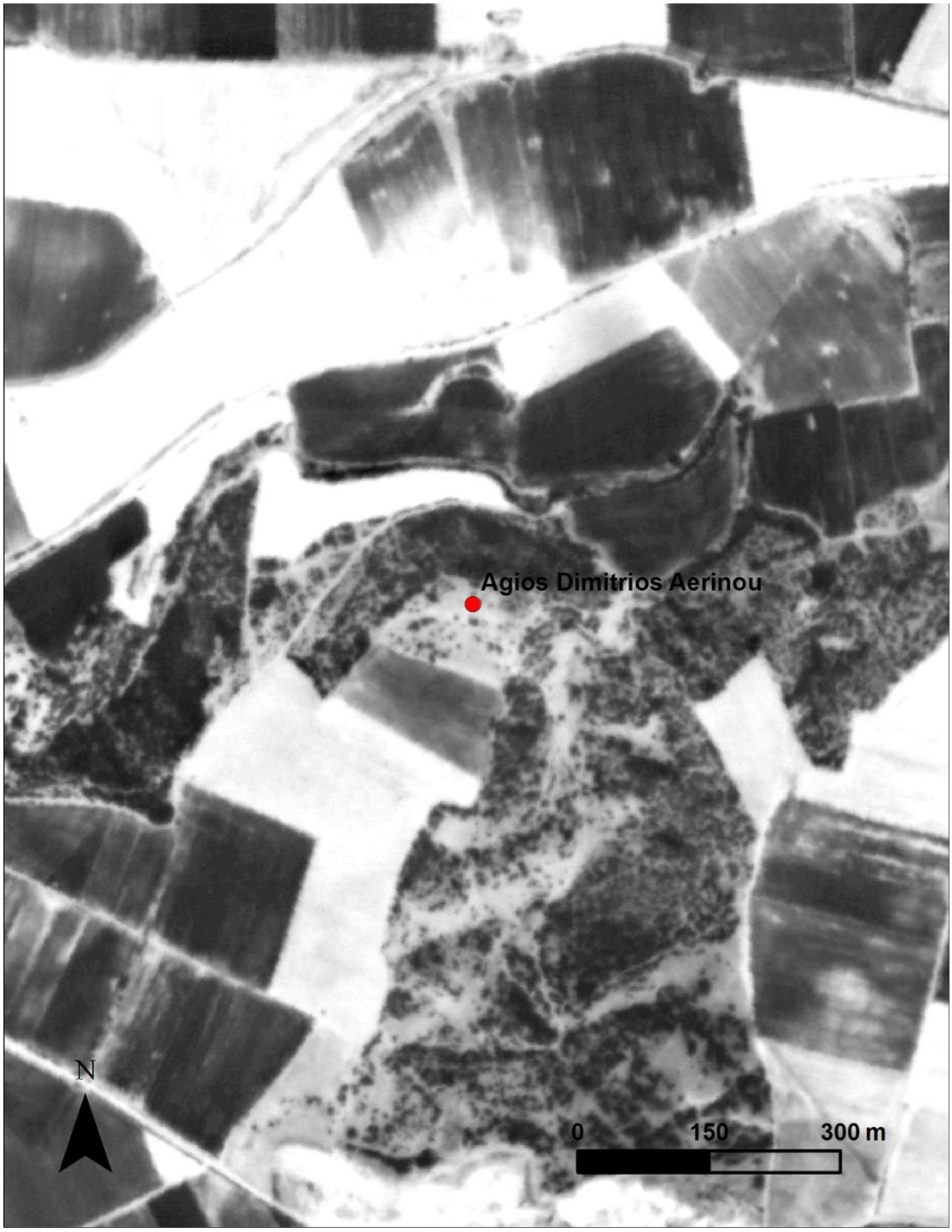


Figure 2. Aerial photograph of Agios Demetrios Aerinou from 18 July 2003.

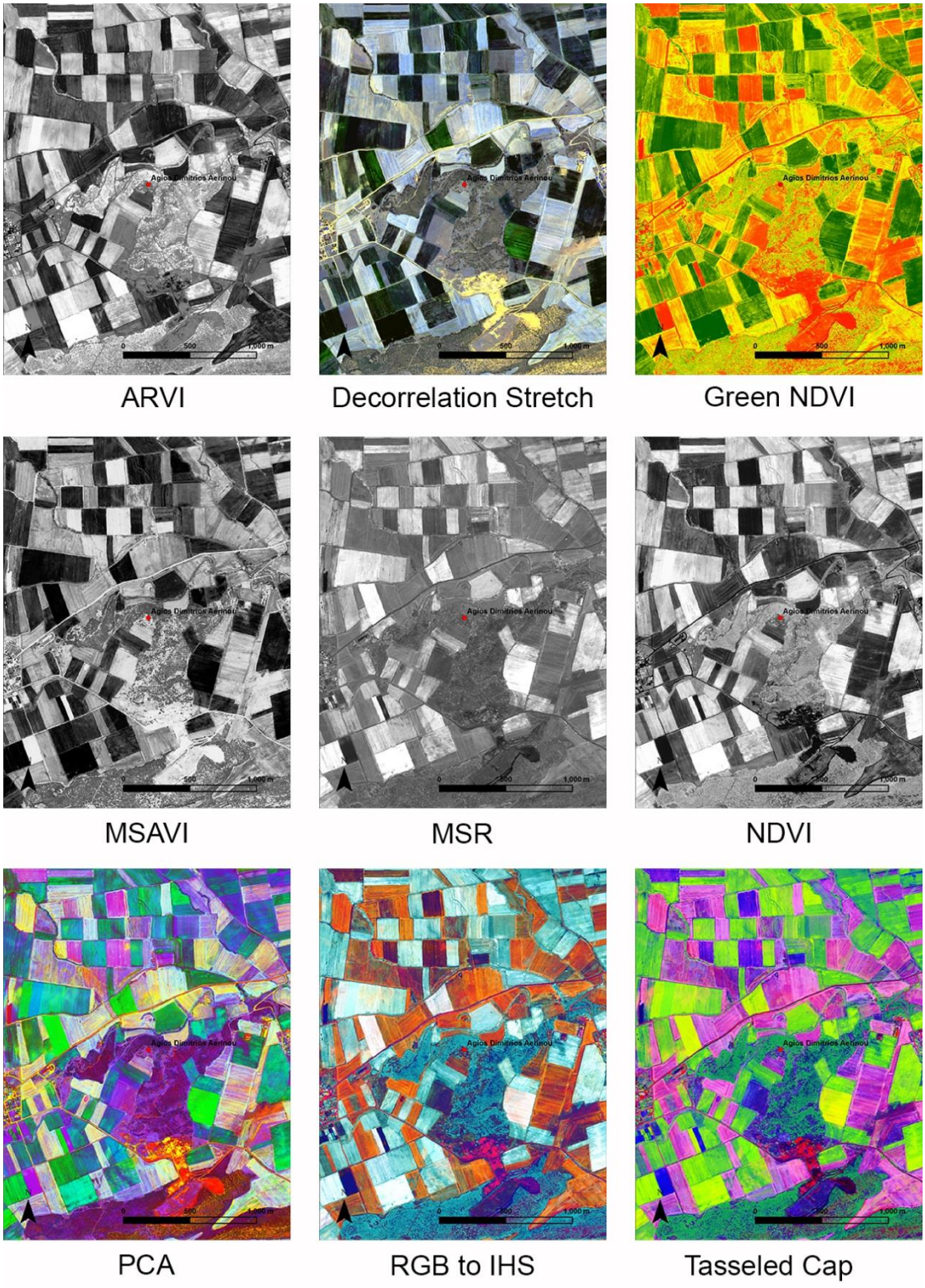


Figure 3. Spectral filters and vegetation indices applied to the 22 July 2010 WorldView-2 image around Agios Demetrios Aerinou.

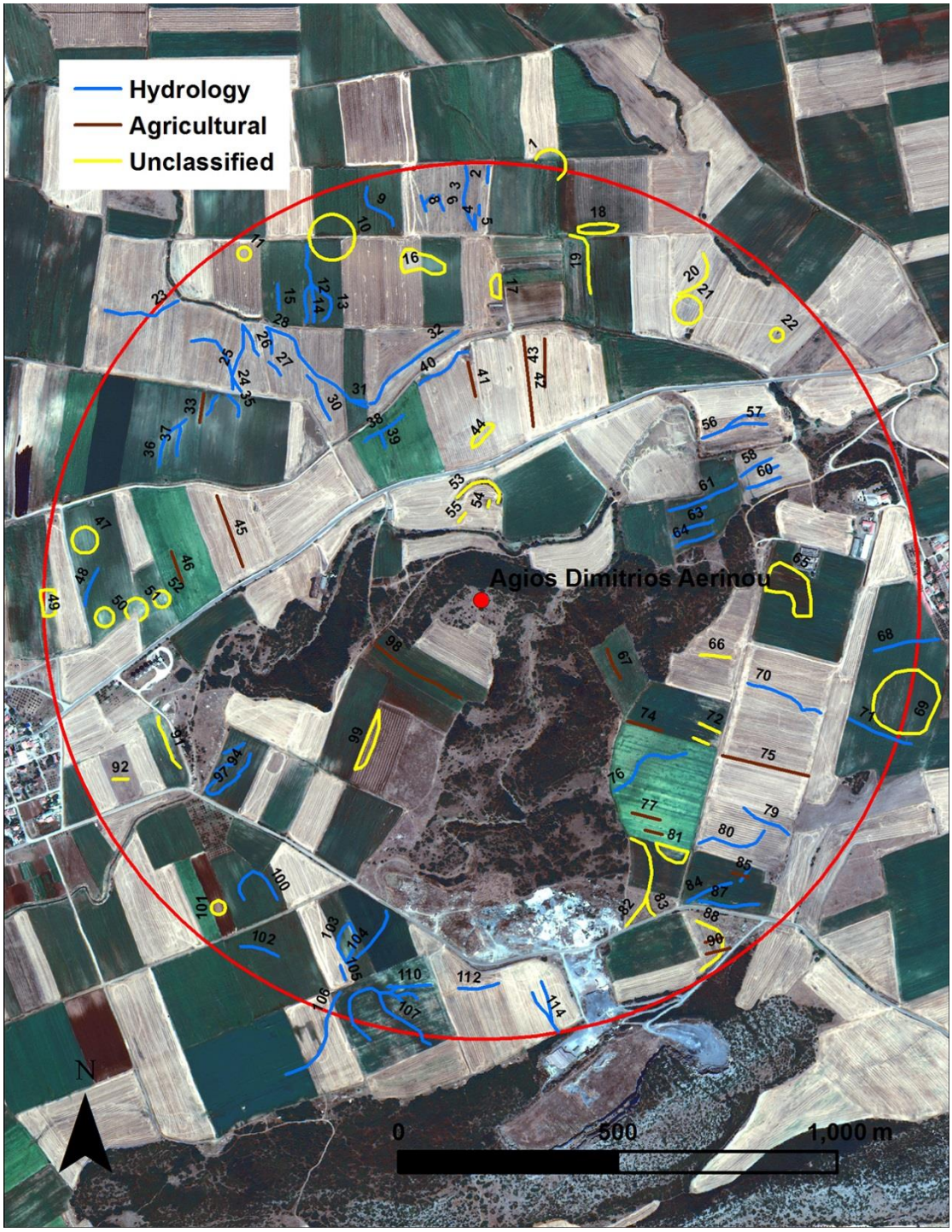


Figure 4. Surface anomalies from the 22 July 2010 WorldView-2 image within a 1 km radius around Agios Demetrios Aerinou.

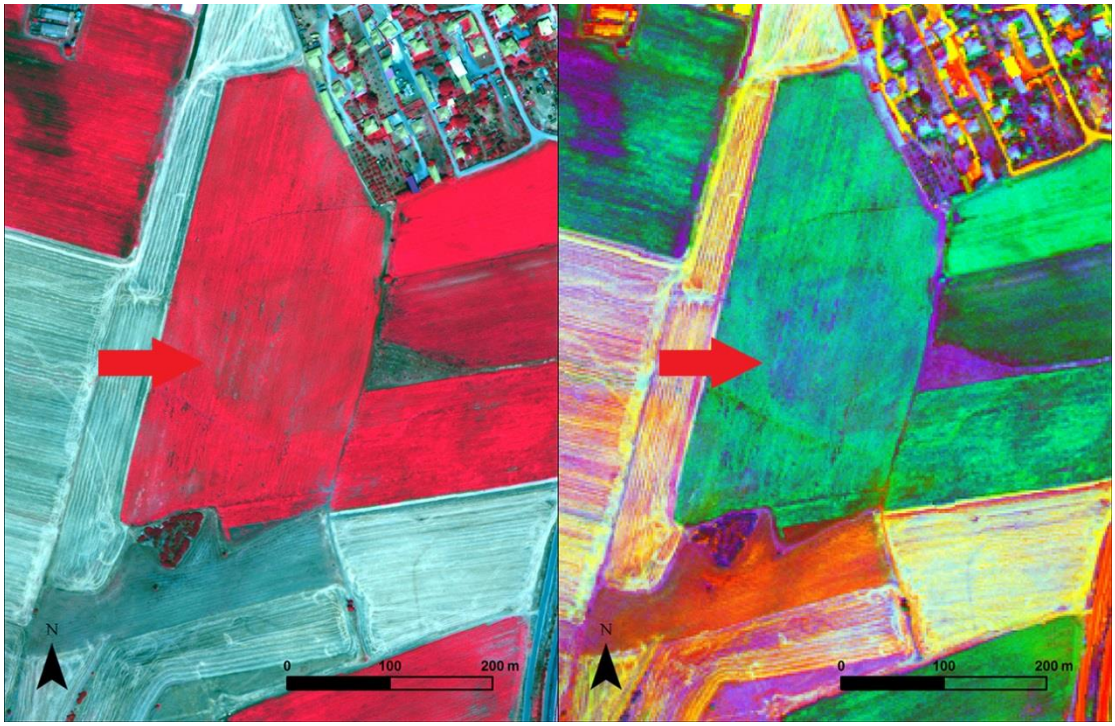


Figure 5. Anomaly #69 east of Agios Demetrios Aerinou indicated by the red arrow: (l) Bands 432; (r) PCA.

Remotely Piloted Aircraft Systems (RPAS) Survey

The site of Agios Demetrios has been covered with one single flight using a remotely piloted aircraft. A total of around 160 photographs for an area of around 5 hectares were covered. One orthophoto and one digital elevation model (DEM) have been created for the site (Figure 6).

The current vegetation conditions (dense and overgrown) made it difficult to detect any potential buried structures via photo-interpretation. Indeed no particular features or chromatic vegetation stresses could be identified, even after some color enhancement and level modifications were applied. Another factor to also consider in terms of interpretation is wind. Due to the height of the vegetation itself, even small wind breezes could produce high variation in the colors. As such, it was difficult to apply color balancing and sharpness to the images and which are noticeable in the lower part of the frame. Wind also made it almost impossible to accurate match the photogrammetric images (all the key-points identified by the algorithms are constantly moving and so tend to be ignored as unstable during matching).

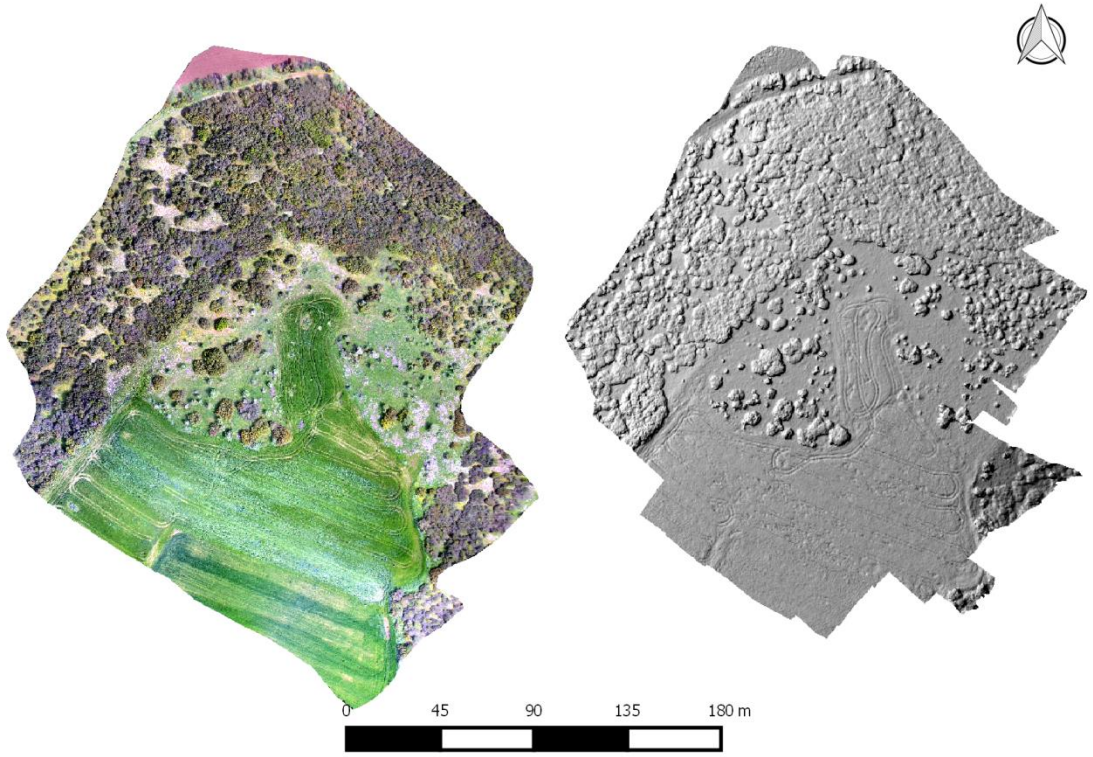


Figure 6. Orthophoto (left) and hill-shade view of the DEM of the site.

Geophysical Prospection

Geomagnetic Survey

The geomagnetic results from Agios Demetrios were largely inconclusive with respect to the distribution of anomalies detected on the site. This was due to patchy modern vegetation coverage as well as the topography in the area. Despite this, some anomalies were detected and are designated a-d (Figure 7).

Two short east-west positive magnetic anomalies (a) may be interpreted as the northernmost extent of the proposed settlement. Modern land cover in this area also suggests these anomalies provide the rough boundary between the open land and the woods area. The longer linear anomaly below this (b) ceases to continue to the southwest, and thus, may be considered as heavily disturbed. Its nature is unknown but could be related to architectural features. A series of linear anomalies (c) in the direction of anomaly (b) and the orthogonal running anomalies (d) can be regarded as remnants of anthropogenic activity. However, they are far from providing a clear spatial configuration.

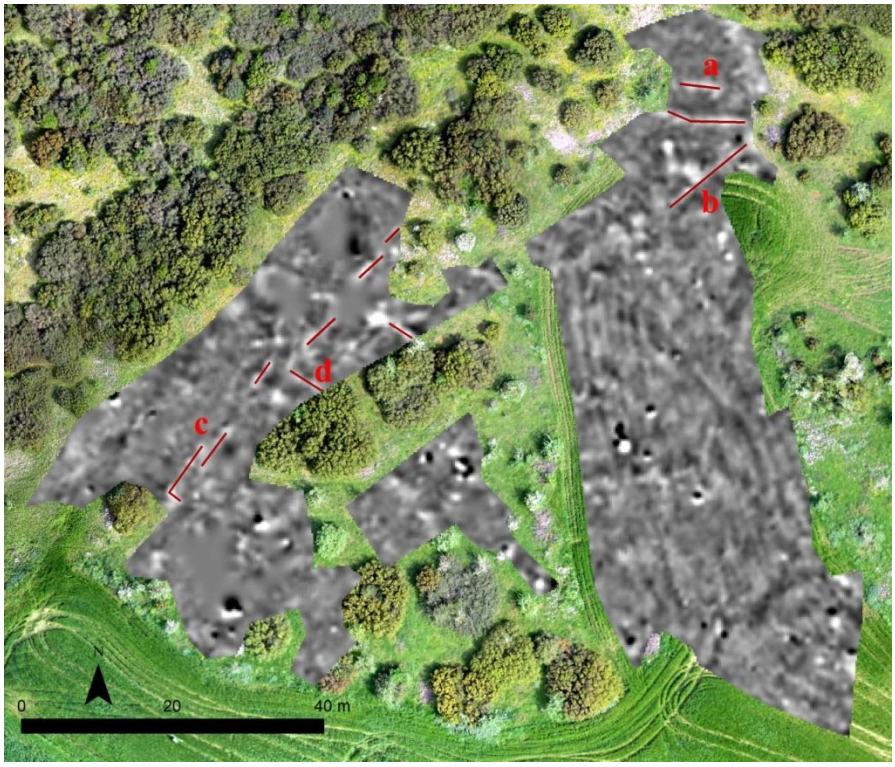


Figure 7. Results of the geomagnetic survey.

Electromagnetic Induction Survey

The electromagnetic induction (EMI) survey was performed using a Geophex GEM-2 instrument and a GF Instruments CMD-Mini Explorer collecting in-phase and quadrature data. The GEM-2 used five frequencies of 4950, 10230, 21030, 43350 and 89430 Hz while the CMD utilized three effective depth ranges from shallow to deep (0.5 m, 1.0 m and 1.8 m). Data were collected on approximately 1 m spaced lines at a rate of 2 samples per second for both instruments, with positions collected using a differential global position system (GPS).

No regular patterns exhibiting archaeological features are visible in the EMI datasets. Data from the GEM-2 and CMD instruments at Agios Demetrios show clusters of both low and elevated conductivity values compared to the background readings (Figure 8). Values throughout much of the survey area were fairly low. A cluster of smaller, semi-circular low conductivity values visible in the north-central section could represent archaeological material. Another area of interest for potential archaeological material is located directly west, in the northeast section of the grid marked by elevated conductivity values.

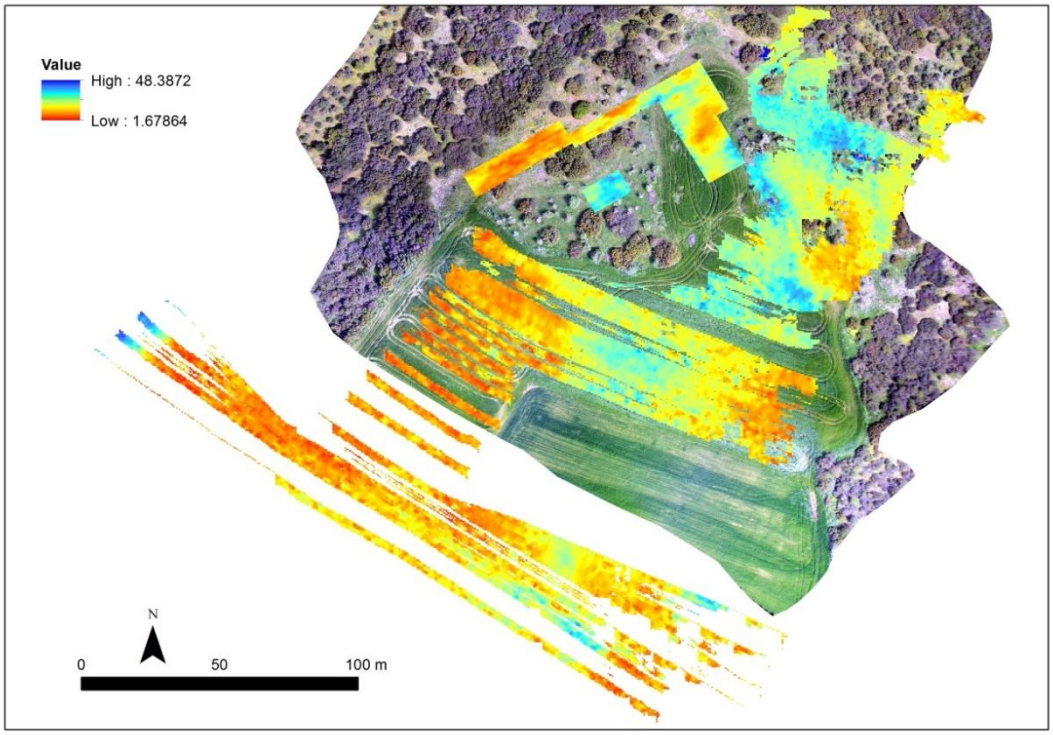


Figure 8. EMI map showing conductivity from both the GEM-2 and CMD instruments.

A large (<50 m) elevated magnetic susceptibility and magnetic viscosity anomaly are present in the central portion of the survey area (Figures 9 and 10), but these data do not display any obvious spatial pattern. Low magnetic viscosity values are also visible in those areas (northeast grid section) marked by elevated conductivity values.

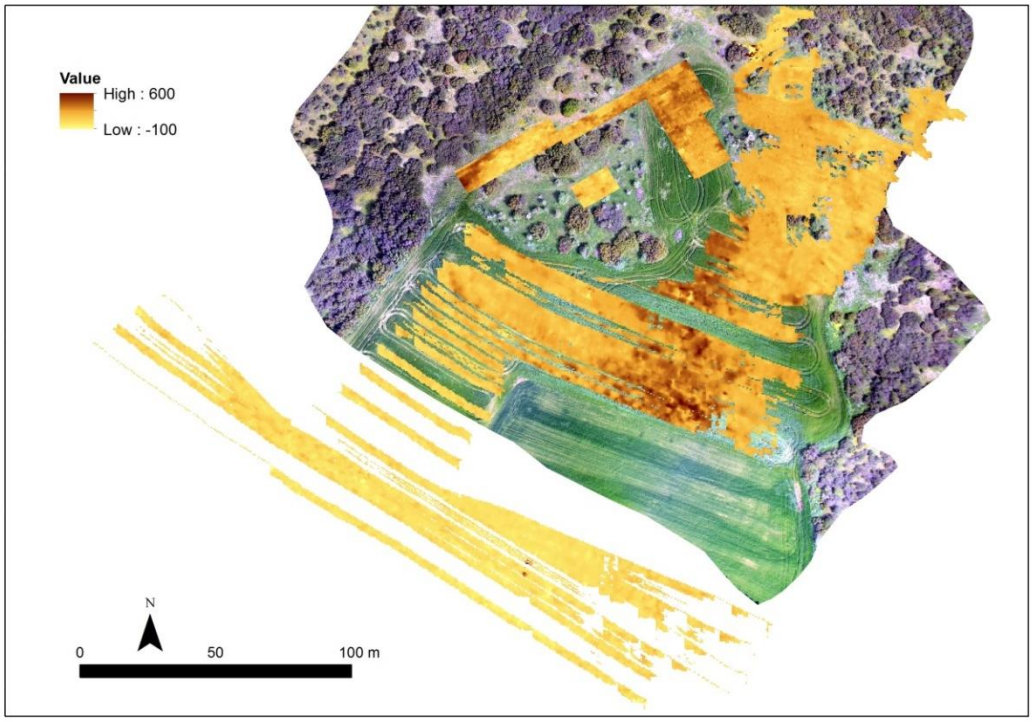


Figure 9. EMI map showing magnetic susceptibility (21030 Hz) from both the GEM-2 and CMD.

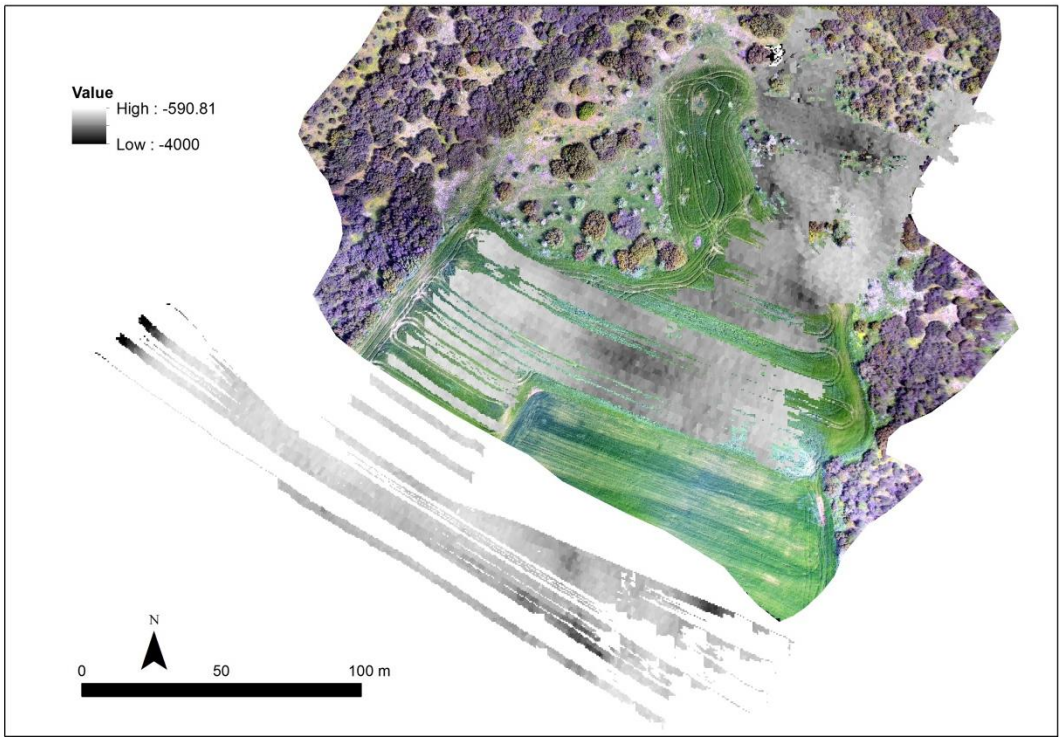
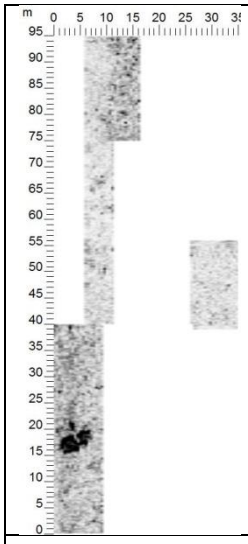
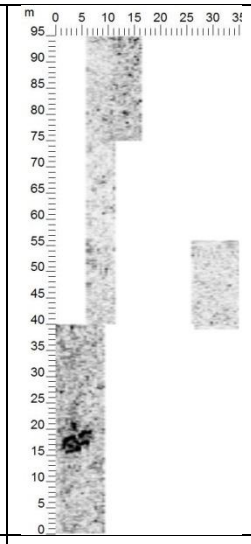
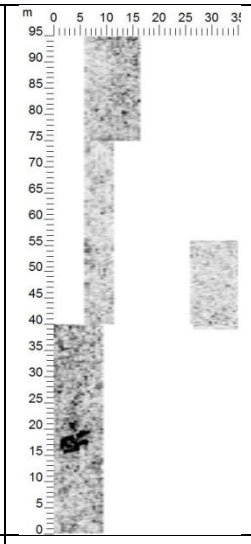
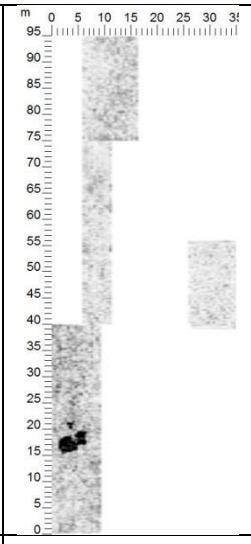
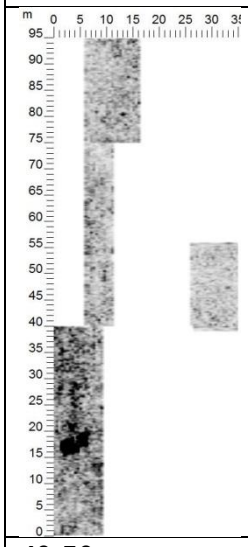
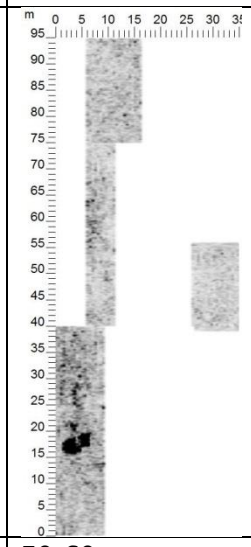
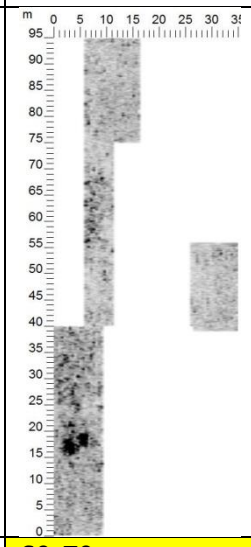
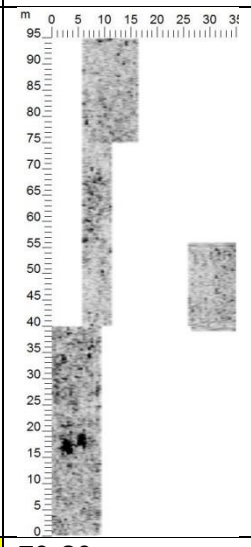
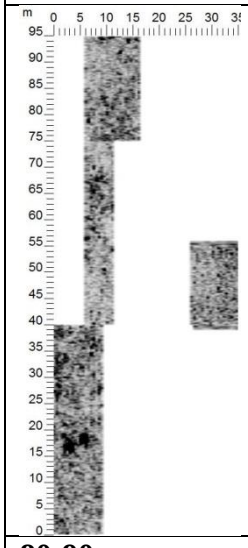
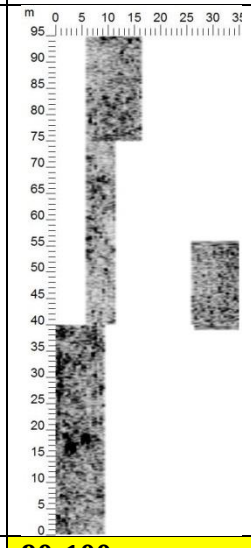
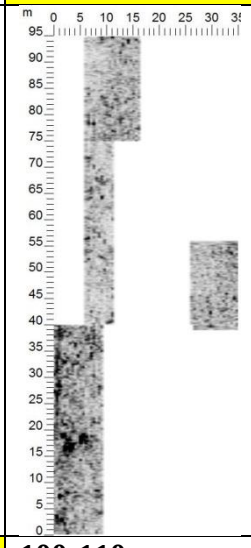
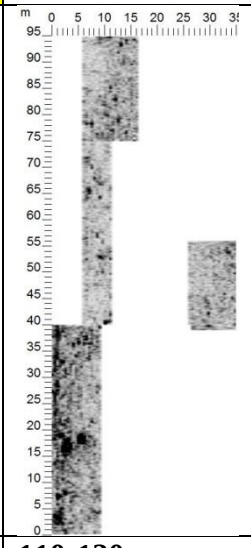


Figure 10. Magnetic viscosity (43350 Hz) from both the GEM-2 and CMD.

Ground-Penetrating Radar Survey

The resulting ground-penetrating radar (GPR) amplitude slices obtained by the single channel NOGGIN Plus Smart Cart are presented in Table 1, where darker colors indicate higher amplitude values. Depth slices or amplitude slice-maps were extracted using 10 cm thickness from the surface down to 2.0 m. The filters and corrections that applied were: Trace reposition, Repick first break (10%), Dewow, SEC2 (Atn=30db/m, StrtG=5, MaxG=700), Background average subtraction, Low-pass filter (f=50% Nyquist), High-pass filter (30% Nyquist).

The total area covered using GPR was 879 m^2 and consists of four survey grids which were set according to pottery distribution. Due to the rough terrain (i.e. rock, trees, bushes etc.) and the modern cultivated areas, the GPR survey covered less than the geomagnetic and EMI surveys. Additionally, the terrain and vegetation caused the data to be extremely noisy, and produced anomalies that change drastically with depth. Thus, the interpretation of the resulting data at this site was not an easy and extra caution should be taken.

			
0-10cm	**10-20cm**	**20-30cm**	**30-40cm**
			
40-50cm	**50-60cm**	**60-70cm**	**70-80cm**
			
80-90cm	**90-100cm**	**100-110cm**	**110-120cm**

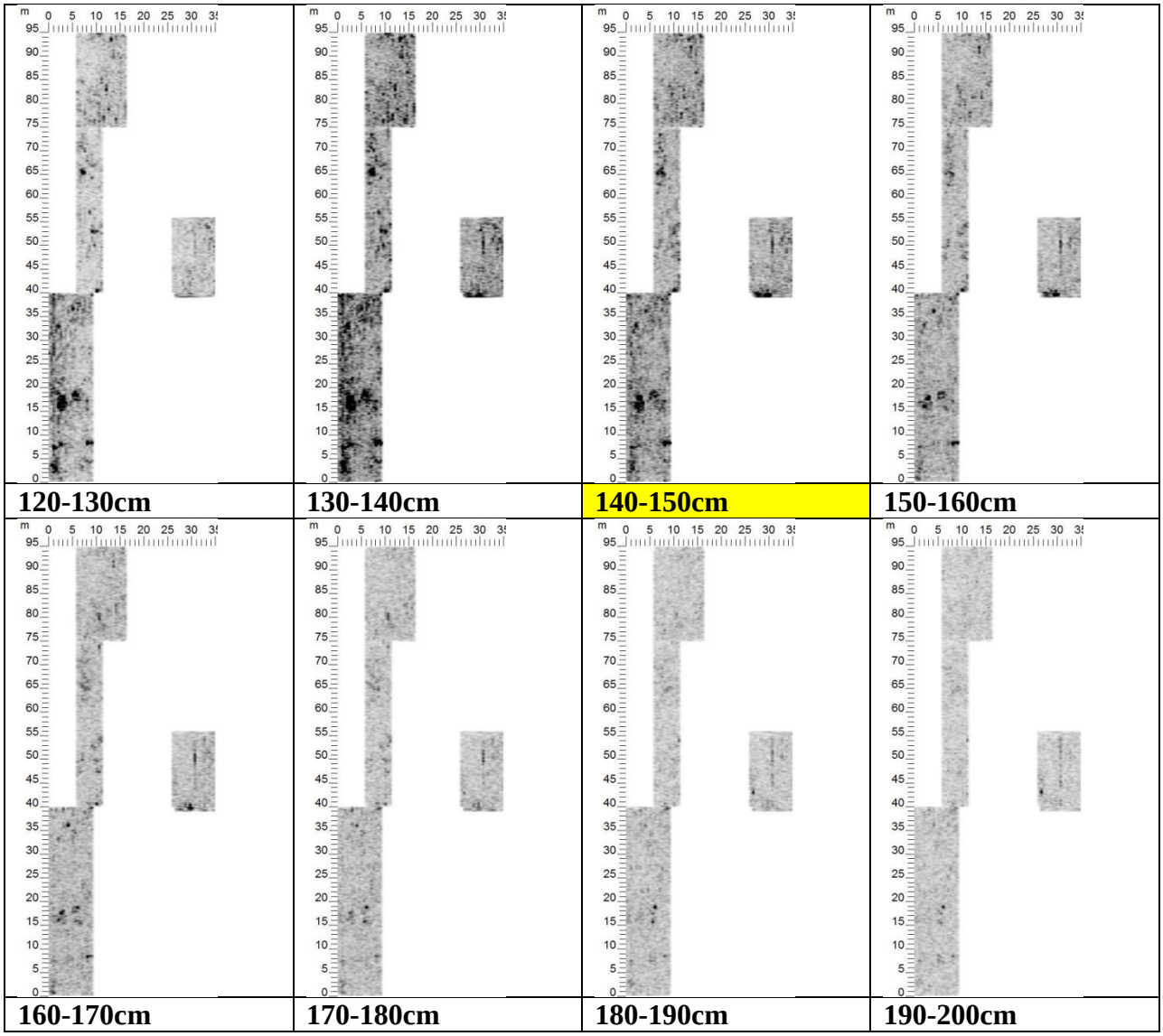


Table 1. GPR amplitude-slice maps for the grids AD1, AD2, AD3, AD4, AD5 and AD7 at Agios Dimitrios showing 10 cm depth thickness.

Figure 11 illustrates the depth slice at 0.6–0.7 m where the anomalies with the highest potential for archaeological material for have been outlined. GPR data do not exhibit any significant information between the range 0–50 cm besides the two strong circular anomalies designated A2. Those anomalies are likely caused by piles of rocks that were on the surface. Within the range of 50–100 cm, several linear anomalies are identified and described as A3, A4, and A5 (Figure 12). At deeper depths (below 100 cm) a few irregular shaped higher reflections are visible along with a few linear anomalies as indicated in Figure 10, by A1, A3, A4 and A6.

Figure 11. GPR depth slice from 0.6-0.7 m (Noggin GPR) where anomalies with the highest potential for archaeology are outlined.

The linear anomalies of A1, A6 and A3 with the exception of the one identified below 100 cm, exhibit a similar northeast to southwest orientation. Anomaly A4 exhibits slightly different orientation while in A5 the orientation is northwest to southeast.

Figure 12. Depth slice at 90–100 cm indicate anomalies with the highest potential for archaeological material within the range 50–100 cm.

Figure 13. Depth slice at 140–150 cm indicate anomalies below 100 cm.

Resistance Survey

The resistance survey reveals an enclosed space at the eastern edge of the survey area (a) (Figure 14). However, the survey boundary cuts this feature more in the east so the complete layout is not visible. A high resistance area to the north likely continues under this feature –or it was cut by the low resistance anomaly. Another enclosed space with low resistance is visible in the western portion of the survey area (b). It is aligned in a northeast-southwest direction and surrounded by high resistance areas where data is available to observe. Another low resistance lineament is visible running within this enclosed space and at the same direction.

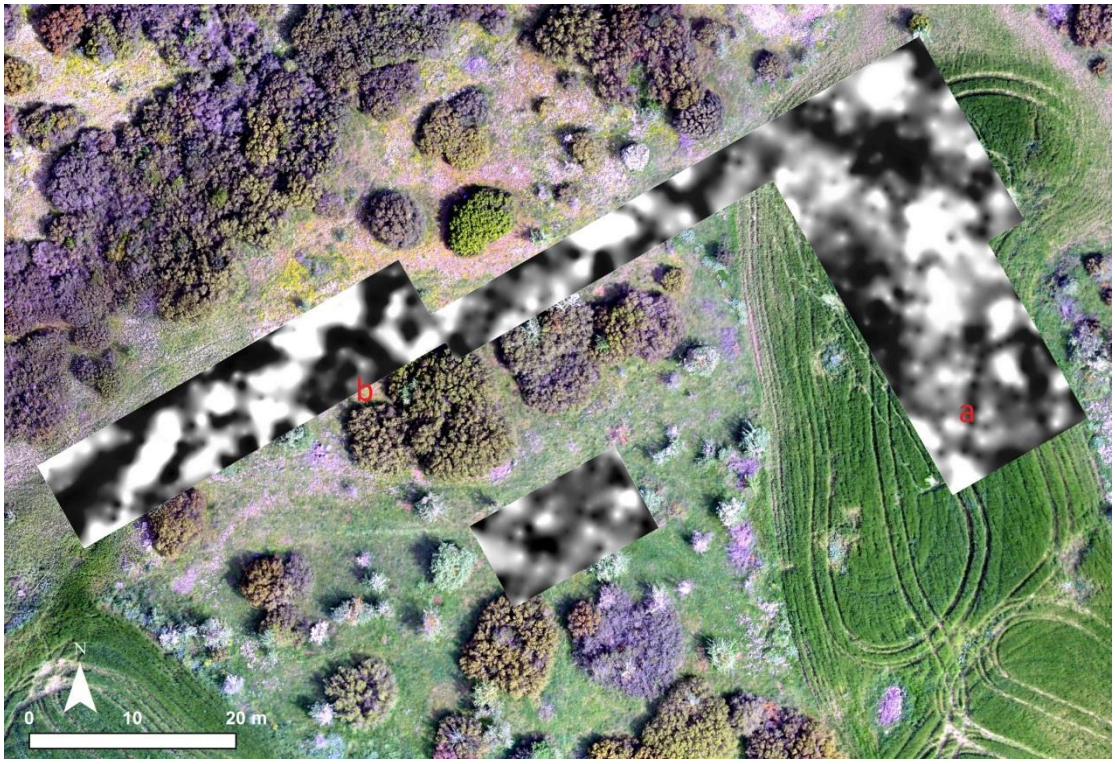


Figure 11. Results of the resistance survey.

Site Bibliography

Βουζαξάκης, Κ. 2008. *Γεωγραφικά πρότυπα και θεωρίες του διακοινοτικού χώρου στη Νεολιθική Θεσσαλία.* Διδακτορική Διατριβή. Τμήμα Ιστορίας και Αρχαιολογίας. Α.Π.Θ. http://invenio.lib.auth.gr/ record/114226?ln=el

Βουζαξάκης Κ., 2009. *Νεολιθικές θέσεις στη Μαγνησία. Ανασκόπηση – Ανασύνθεση δεδομένων,* στο Αρχαιολογικό Έργο Θεσσαλίας και Στερεάς Ελλάδας 2 (2006), τ. Ι, σελ. 61-74.