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Airborne LiDAR application to karstic areas: the example of Trieste province (north-eastern Italy) from prehistoric sites to Roman forts

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Highlights

- Our manuscript reports the results of airborne LiDAR application to a karstic area (Trieste Karst, northeastern Italy).
- We have produced a Digital Terrain Model (DTM) of the studied area by the Free Open Source Software (FOSS) SAGA GIS starting from LiDAR data.
- LiDAR derived images have allowed identifying numerous unknown fortified structures ranging from prehistory to Roman time.
- We have discovered a Roman republican fort. This discovery is particularly significant since similar structures, almost unknown in Italy, find comparison only with younger examples of military forts from Roman provinces.
- We have applied computed micro-tomography (µCT) to study some artefacts from the archaeological structures.
Airborne LiDAR application to karstic areas: the example of Trieste province (north-eastern Italy) from prehistoric sites to Roman forts

F. Bernardini\textsuperscript{a}, A. Sgambati\textsuperscript{b}, M. Montagnari Kokelj\textsuperscript{c}, C. Zaccaria\textsuperscript{c}, R. Micheli\textsuperscript{d}, A. Fragiacomo\textsuperscript{e}, C. Tiussi\textsuperscript{f}, D. Dreossi\textsuperscript{f}, C. Tuniz\textsuperscript{a} and A. De Min\textsuperscript{g}

\textsuperscript{a}Multidisciplinary Laboratory, The “Abdus Salam” International Centre for Theoretical Physics, Trieste, Italy
\textsuperscript{b}Ispettorato agricoltura e foreste di Gorizia e Trieste, Trieste, Italy
\textsuperscript{c}Department of Humanistic Studies, University of Trieste, Trieste, Italy
\textsuperscript{d}Soprintendenza per i Beni Archeologici del Friuli Venezia Giulia del MiBAC, Trieste, Italy
\textsuperscript{e}Società per la Preistoria e Protostoria del Friuli Venezia Giulia, Trieste, Italy
\textsuperscript{f}Sincrotrone Trieste S.C.p.A., AREA Science Park, Basovizza (Trieste), Italy
\textsuperscript{g}Department of Mathematics and Geosciences, University of Trieste, Trieste, Italy

ABSTRACT

The Trieste Karst, at the north-easternmost shore of the Adriatic Sea, is rich in prehistoric caves and protohistoric hill forts. Most of these archaeological sites were already identified in the second half of the 19\textsuperscript{th} century when large parts of the area were almost without vegetation coverage for the effect of sheep breeding and exploitation of wood resources. Only a few open-air archaeological sites have been discovered in recent years due to the lack of systematic archaeological surveys and reforestation.

Airborne LiDAR (light detection and ranging) data, originally acquired for environmental monitoring over the Friuli Venezia Giulia region (north-eastern Italy), have been recently analysed by means of free open source softwares for archaeological prospection of the Trieste Karst area. The LiDAR derived images have allowed identifying numerous unknown fortified structures ranging from prehistory to Roman time within a complex archaeological landscape that includes possible funerary barrows, agricultural terraces and other structures. The discovery of a probable Roman republican fort is particularly significant since similar structures, almost unknown in Italy, find comparison only with younger examples of military forts from Roman provinces.

The discovery of prehistoric, protohistoric and Roman fortified sites reported in this paper shows that airborne LiDAR remote sensing represents a revolution in landscape archaeology and archaeological mapping of karstic areas. This technique can provide unexpected results even in relatively urbanized territories investigated for a long time.
KEY WORDS: airborne LiDAR, Free Open Source Software (FOSS) SAGA GIS, Trieste Karst, archaeological mapping, prehistoric fortified sites, republican Roman fort

1. Introduction

The karstic plateau near Trieste (north-eastern Italy), on the northernmost shore of the Adriatic Sea, (Fig. 1) is a carbonate succession ranging from the Aptian to the Lower Eocene, informally known as Trieste Karst Formation (Cucchi et al., 1989). Two parallel hilly chains with NW-SE orientation, separated by a relatively flat area in the middle, run through the Trieste Karst, one in front of the gulf of Trieste and one by the border between Italy and Slovenia. The height of the Karst increases from sea level in the north-west, near the Timavo mouths, towards the south-eastern area, where the maximum elevation is about 500 m (Fig. 1).

This area is rich in archaeological caves and rock shelters, mainly used from the Mesolithic to protohistoric times (Boschian and Montagnari Kokelj, 2000; Montagnari Kokelj, 1994; www.units.it/criga), and Bronze Age-Iron Age hill forts, locally called castellieri (Antonelli et al., 2004; Bandelli and Montagnari, 2005; Marchesetti, 1903), which entered under the direct Roman influence in the 2nd century BC (Bandelli 2004; Horvat, 1997, 1999, 2002, 2008, 2009). Prehistoric open-air sites are almost completely unknown, with few exceptions (Almerigogna, 1986; Bernardini, 2007; Bernardini and Betic, 2008; Dolzani, 1993).

The castellieri were recognized as protohistoric sites during the second half of the 19th century: the majority of them (24 sites) was identified and mapped by Marchesetti (1903), and only few other hill forts have been identified after his pioneering field research and studies (10 sites; Andreolotti and Stradi, 1965; Bernardini, 2005, 2012; Flego and Rupel, 1993; Schmid and Faraone, 1971) due to the Karst reforestation and the lack of archaeological systematic surveys (Fig. 1). Moreover, only some of these fortified structures have been partially excavated (for detailed references see Bandelli and Montagnari, 2005 and Flego and Rupel, 1993).

Several Roman archaeological sites are known in the area (Auiemma and Karinja, 2008) but traces of military fortified structures datable to the romanization of the region are unknown, perhaps with the exception of a possible Roman military fort on the top of San Rocco hill, between Trieste and Muggia (Flego and Župančič, 1991).

The light detection and ranging (hereafter LiDAR) remote sensing (Campbell, 2002; Jensen, 2000), presented in this paper, yields information that surpasses that obtained in many years of archaeological surveys in the Karst area, opening a new era for landscape archaeology and
archaeological mapping of karstic areas (Chase et al., 2011, 2012).

2. Materials and Methods

2.1 Open-air archaeological sites in temperate karstic landscapes
Despite temperate karstic areas represent a complex and dynamic system, the evolution of which mainly depends on climatic and geological conditions of the carbonatic outcrops, remains of even small archaeological structures can be preserved on the ground surface. This is possible due to the small sedimentation rates in comparison to other landscape systems, such as, for example, alluvial plains (Rommens et al., 2006).
Archaeological structures gradually become part of the landscape but are still detectable as relief variations. For this reason, LiDAR digital terrain models of karstic areas reveal, as in a palimpsest, a complex superposition of structures belonging to different periods.

2.2 Data Acquisition
The LiDAR over-flights of the Friuli Venezia Giulia region (Italy) were undertaken by Helica Company for the Protezione Civile della Regione Friuli Venezia Giulia during 2006. They used an Airborne Laser Terrain Mapper (ALTM) Optech 3033, which was mounted onto a helicopter AS350. This system allows the acquisition of data from a maximum height of 3000 m above ground level with a frequency of 33.000 kHz and a density of 4-5 laser shots per square meter.
The system includes a set of four main components: a laser (1064 nm - near IR), an inertial measurement system, a positioning and navigation system based on a Geographical Positioning System (GPS) and a central control unit mounted on board of the aircraft. The laser emits short pulses to an oscillating mirror which reflects them perpendicularly with respect to the advancement direction of the aircraft, thus effecting scanning of the underlying area. The Optech 3033 unit records up to 4 discreet returns per shot, recording their position and intensity. The obtained point cloud data in LAS format are then classified in non-ground (class 1) and ground points (class 2) through a filtering procedure (Wichmann et al., 2008).
It is therefore possible to obtain topographic maps of the ground with an absolute vertical accuracy higher than 15 cm, and a planimetric accuracy between 10 and 80 cm depending on the altitude acquisition.

2.3 Data elaboration
The original LAS format data from LiDAR survey were provided already classified in non-ground (class 1) and ground points (class 2). The ground data covering the entire Trieste province have been processed using the free open source software (FOSS) SAGA GIS (www.saga-gis.org). The LAS files have been imported into Saga as point clouds, from which the points belonging to the ground (class 2) have been extracted using the module "point cloud reclassifier, subset extractor". In order to merge different grids, a new grid system, covering the entire Trieste province, has been created using the module "grid tools create grid system", and the cell size has been set at 50 cm. Then, the data have been rasterized using the module "grid gridding, shapes to grid". The raster thus obtained shows numerous empty cells, corresponding to areas not detected by the laser pulses. These cells have been closed through an interpolation process using the module "grid tools, close gaps". This operation produces a continuous raster, which is called Digital Terrain Model (DTM). The DTM has been processed with the module "terrain analysis, analytical hill shading" to produce a shaded relief of the 212 sq km Trieste area, in order to reveal archaeological structures. The use of standard options of the module "analytical hill shading" (azimuth 315˚, declination 45˚ and exaggeration 4) already gives good results. However, in order to bring out the map of some structures, the azimuth angle has sometimes been modified (Devereux et al., 2008).

3. Results

The LiDAR data allow imaging of the complete Trieste Karst in 2-D, revealing topography and fortified archaeological structures of different ages. Their features have been brought out applying different light angles and shade conditions. A preliminary list of the archaeological fortified sites that have been identified by LiDAR is reported in Tab. 1. Among them, some examples of prehistoric, protohistoric and Roman sites, whose preliminary chronology has been defined on the basis of the artefacts found during archaeological surveys, are discussed below (Figs. 2, 5).

3.1 Open air prehistoric site

Most of the prehistoric sites of the Trieste Karst, ranging from the Early Palaeolithic to the Copper Age, have been identified in caves or rock-shelters, very common in this area. The only known open air-sites are relatively small concentrations of scattered flint artefacts found in a few areas not associated with any structure (Almerigogna, 1986; Bernardini, 2007, Bernardini and Betic, 2008; Dolzani, 1993). Moreover a few Copper Age artefacts have been reported from areas later occupied by protohistoric hill forts (Bernardini et al., 2009, 2010, 2011; Maselli Scotti, 1986, 1988; Montagnari Kokelj, 1988, 1989, 1997).
LiDAR images have revealed a long semicircular structure on a hilltop near Sgonico (Trieste) called Vrh Strele, where flint artefacts have been found (Area a of Fig. 1, Tab. 1). The geomorphologic features of the area, in the form of micro-relief variations, had already suggested to the authors a possible modification of the original morphology of the hill, but only LiDAR images seem to support this hypothesis (Fig. 2, I).

The top of the hill is surrounded by a semicircular structure that starts at the northern margin and runs along the eastern and southern mountain sides, where it changes direction forming a quite large terrace (Fig. 2, I). Only the terrace is quite easily recognizable from the ground.

The chipped stone artefacts have been mainly found in two areas, one on the hilltop inside the semicircular wall (hereinafter zone A; 16 artefacts) and the other one in the south western part of the site (hereinafter zone B; 25 artefacts; Fig. 2, I). Moreover a few flint flakes come from the terrace (2 artefacts). Among them some retouched implements have been recognized and in particular a lunate from zone A (Figs. 3-4, n. 6), an end scraper (Figs. 3-4, n. 2), a side scraper (Figs. 3-4, n. 3) and a fragmented tool with foliated retouch (a piercer or a fragmented harrow head) from zone B (Figs. 3-4, n. 1). Moreover some small bladelets and three corticated pieces have been also found in zones 1-2 (Figs. 3-4).

The surfaces of the artefacts are characterized by a white patina, which covers the original aspect of the raw material with the exception of a few fractured edges of the artefacts, where the original light grey colour is visible. The raw material shows a good quality due to the very fine-grained texture. The presence of a few pieces still preserving a calcareous cortex suggests exploitation from primary deposits while the good quality of the raw material excludes the low quality karstic flint deposits as possible source. The probable exploitation of primary deposits also indicates that the small flint pebbles, which can be found along the upper course of Reka/Timavo River and in the surroundings, were not used as raw material for the small Sgonico lithic assemblage (Turk, 2004). These features suggest a non-regional origin, perhaps from Lessini hills (Barfield, 2000; Della Casa, 2005; Ferrari and Mazzieri, 1998).

The typology of the artefact with a foliated retouch and the lunate tool (Figs. 3-4, n. 6) could suggest for part of the assemblage an attribution to Copper Age. In north-eastern Italy similar lunate tools, assigned to Copper Age, have been reported from several sites (Montagnari Kokelj, 1988, 1989; Moretti et al., 1978; Pessina, 1993).

However, the complete absence of pottery findings does not help in the interpretation of the small lithic assemblage and a different age of the flint artefacts cannot be ruled out. Lunate artefacts can be attributed to other periods too and the small bladelets recall Mesolithic artefacts from caves (Guerreschi, 1998) and open-air sites of the Karst (Bernardini, 2007).

In the case of a Copper Age attribution, the flint industry and the structures identified by LiDAR
could be aspects of the same occupation episode(s), although archaeological excavations should be scheduled in order to test this hypothesis.

3.2 Protohistoric hill forts

The protohistoric castellieri, which generally show irregular shapes, are today represented by big collapsed dry stonewalls which generally border the hilltops and support artificially levelled terraces where houses and/or other structures were built often in perishable materials.

As reported in the previous paragraphs, most of the protohistoric hill forts of the Trieste Karst were identified by Marchesetti (1903) (Fig. 1). Among the few sites discovered in the last decades, three of them have been recently identified after a time-consuming archaeological survey of all the hilltops of one sector of the Trieste Karst near the Rupinpiccolo village (Trieste; Bernardini, 2012). These structures are characterized by a bad state of preservation and are often recognizable only through micro-relief variations and, also for this reason, were not identified before. A few small fragments of protohistoric pottery have been found in two of the new sites (Bernardini, 2012; II and IV of Fig. 2).

These fortified structures are built on the top of contiguous hills next to the already known Rupinpiccolo hill fort (Area 1 of Fig. 1, Fig. 2, II, IV-V). Their interesting location confirms the existence of sites, which are close one to the other. The thick vegetation and abundance of ticks have made the schematic mapping of the three fortified structures very difficult.

Instead, the LiDAR DTM has revealed the shape of the defensive walls faster and more precisely than with traditional mapping systems, giving an accurate map of the protohistoric fortified structures (Fig. 2, II, IV-V) and revealing a complex anthropic landscape, including structures of different periods: agricultural terraces, dry stonewalls, causeways and war trenches. Moreover, an accurate observation of the LiDAR images close to the sites has also allowed identifying two circular structures of about 10 m diameter surrounded by probable agricultural terraces (Fig. 2, III). They could tentatively be interpreted as funerary barrows, which are quite spread in northeastern Italy (Càssola Guida and Calosi, 2012).

The other fortified structures identified in the area using LiDAR derived images (Tab. 1), ranging from very small to medium size fortifications, have considerably improved our knowledge about the castellieri settlement system in the studied area. The sites, generally organized in small clusters around a central hill fort, are concentrated along the inner hilly chain, often defending communication routes (Fig. 1). Such concentration of sites suggests a high strategic significance of this geographical border, which extends to southeast in present-day Slovenia.
Moreover the LiDAR derived images have shown that the localization of some archaeological sites was wrong and, sometimes, their maps incomplete. For example, the castelliere of Prečni vrh is located little further south than the position published by Flego and Rupel (1993).

3.3 The discovery of a Roman fort
C. Marchesetti (1903) reports a castelliere on mount Grociana piccola in the south-eastern part of the Trieste Karst, characterized by a double defensive wall. This elevation overlooks a large area with a strategic significance for the connections between the Trieste gulf, present-day Slovenia and the Quarnero bay (Croatia). The remains of dry stonewalls were already difficult to recognize when Marchesetti visited the site for the bad state of preservation and tree planting. The same author also mentions the existence on the hilltop of building remains and coeval pottery younger than the protohistoric structures, without specifying their chronology. Today the area is almost completely covered by thick vegetation and only small parts of the defensive walls are identifiable, while no traces of the buildings remains reported by Marchesetti are visible.

The LiDAR DTM clearly shows a large rectangular structure with a playing-card layout (c. 165 m x 134 m) oriented north to south, housing a smaller one (circa 100 m x 43 m) with a different orientation, (Figs. 5). From the ground, the remains of internal walls are larger than the external ones. Such a regular plan indicated from the very beginning that the age of the structures could not be protohistoric as previously supposed. The Roman origin of the site was shown by an accurate archaeological survey of the area, which has allowed discovering, inside the inner rectangular enclosure, two fragmented brims of transport republican amphorae (Fig. 6) as well as a few small fragments of other vessels. Protohistoric pottery has not been found.

3.4 Characterization and typology of the archaeological finds
An important element for the typological attribution of amphorae is represented by the brim section profile, which often shows a gradual evolution from one shape to another one. The section profile of Lamboglia 2 type develops from a clear triangular shape (derived from the previous Greek Italic models) in the second half of the 2nd century BC progressively becoming less triangular during the 1st century BC (Bruno, 1995; Casari, 2005; Horvat, 1997; Horvat and Bavdek, 2009; Nonnis, 2001). Since the only available artefacts from mount Grociana piccola which can give some preliminary chronological information are the two amphora brims (Fig. 6), they have been analysed through computed micro-tomography (µCT) in order to produce virtual sections, useful for the typological attribution and a preliminary micro-textural description (Figs. 7-8).
The analyses have been carried out at the Multidisciplinary Laboratory (MLAB) of the Abdus Salam International Centre of Theoretical Physics (ICTP). A cone beam µCT system has been recently built by ICTP in collaboration with Sincrotrone Trieste S.C.p.A. (Trieste, Italy) in the framework of the EXACT (Elemental X-ray Analysis and Computed Tomography) project, funded by the Regione Friuli - Venezia Giulia (Bernardini et al., 2012; Tuniz et al., 2012). The ICTP system is based on a microfocus X-ray source (minimum focal spot size 5 µm, voltage up to 150 kV) and a large area flat panel sensor. Exploiting the cone beam geometry a complete reconstruction of the objects with 42 µm isotropic voxel size has been obtained. The µCT scans were carried out with a source voltage of 145 kV, a current of 200 µA and recording 2400 projections of the sample over 360 degrees.

On the basis of the section profiles of the brims (Figs. 7-8), both the amphora fragments can be ascribed to Lamboglia 2 type. The sample still preserving part of the handle is probably older due to the triangular profile of the section (Fig. 7) and can be included among the hanging triangular brims of the variants A 6-8 according to the classification of Horvat and Bavdek (2009). This last brim shows a pinkish colour and a fine-grained homogenous texture without chamotte inclusions, while the other one has a pale yellow colour; its texture is characterized by quite abundant presence of reddish chamotte inclusions.

The chronology of Lamboglia 2 amphora type, ranges from the end of the 2\textsuperscript{nd} century BC to approximately the 3\textsuperscript{rd} decade BC (Bruno, 1995; Casari, 2005; Horvat, 1997; Horvat and Bavdek, 2009; Nonnis, 2001). Close to the investigated area, individual Lamboglia 2 amphorae were discovered at Cattinara protohistoric hill fort (Casari, 2005), Grad near Šmihel, Bandera and Laze on Planina plain (Horvat and Bavdek, 2009). Remains of republican amphorae have been also reported from the San Rocco hill, in front of the Muggia bay, where a large structure with orthogonal walls was identified by Flego and Župančič (1991). Abundant remains of the same amphora type were found in the Sermin settlement (Horvat, 1997) and in the Mandrga and Preval sites in the strategic Razdrto pass area (Horvat and Bavdek, 2009).

4. Discussion and conclusions

LiDAR derived images, produced using open source softwares, allow to easily discriminate between natural landscapes and those modified by man through times. Most of the Trieste Karst, mold since ancient times in order to get farmable grounds, is characterized by a complex superposition of structures belonging to different periods.

Thanks to LiDAR data and complementary archaeological surveys in the studied area, an open-air
prehistoric site probably associated with structures remains, preliminary datable to the Copper Age, has been identified on a hilltop close to the village of Sgonico. Numerous protohistoric fortified structures have been discovered and their plan has been detected with high accuracy after a quick processing of LiDAR data, significantly changing our knowledge about the settlement system of castellieri. The most surprising discovery is represented by the mount Grociana piccola republican Roman structures, probably to be interpreted as a military fort and previously believed to be a protohistoric site. The amphora brim of Lamboglia 2 type with a clear triangular shape suggests that the fort already existed in the end of the 2nd or in the beginning of the 1st century BC, but do not exclude an earlier construction of at least one part of the walls. The presence of two rectangular fortifications with different orientations and wall dimensions probably indicates at least two main building phases. Similar structures, almost completely unknown in the studied area and in Italy perhaps with the exception of the site identified on the close San Rocco hill (Flego and Župančič, 1991), find good comparison only with younger examples of military fortifications from Roman provinces (Bidwell, 2007; Brewer, 2000; Flynt, 2005; Guštin, 2002; Mason, 2006, 2008). The fortified structures of the mount Grociana piccola are likely to be related to one of the military episodes conducted by the Romans in this sector of Adriatic area between the third Istrian war (178-177 a.C.) and the complete romanization of the region (Bandelli, 2004; Horvat, 2009). According to literary sources, during the first phase of the third Istrian war, the Roman fleet moved from the Lacus Timavi to the first landing place in Istrian territory, while two consular legions camped at slightly less than five Roman miles (5 miles = 7.4 Km) from it (Liv. XLI, 1, 1-6). According to several authors, one of the most probable landing places of this episode would be inside the Muggia bay and the fort would have been built in the karstic plateau around Basovizza (Marchesetti, 1903). The mount Grociana piccola stands just in this area, about 7 km distant from the protohistoric and then Roman landing place of Stramare. This important site is located at the mouth of the Rio Ospo River inside the Muggia bay (Betic et al., 2008). Marchesetti (1903) also agrees with this localization of the landing place but suggests moving the position of the fort towards the sea between Cattinara and Montebello because in the Basovizza area no traces of entrenched camps were known at his time. On the basis of the position, planimetric map and preliminary chronology, a possible identification of the Roman fortified structures of mount Grociana piccola with the military fort reported by the literary sources (Liv. XLI, 1, 1-6) can be proposed. However, before drawing any firm conclusions about the role of the camp(s) in the roman history, archaeological investigations should clarify the function and chronology of the structures identified near Basovizza and their connection with those emerging on the top of San Rocco hill.
In conclusion, LiDAR images yield information that surpasses that obtained after years of archaeological surveys in the Karst revealing many previously unknown fortified structures belonging to different periods, identified in a complex archaeological landscape that includes funerary barrows, agricultural terraces and other structures. Although systematic survey and excavation programs are necessary to integrate the data obtained from the LiDAR acquisition, the case studies presented in this paper illustrate the exceptional informative value of this technique for the archaeological mapping of karstic areas.

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Captions

**Fig. 1.** The archaeological sites, ranging from prehistory to Roman period, identified by LiDAR in the Trieste Karst area (red symbols). The sites of *Area a* and *Area b* are discussed in the text. For the name of the new sites see Tab. 1. Red diamonds = fortified open-air prehistoric sites; red circles = fortified structures probably belonging to protohistoric time; red crosses = possible protohistoric funerary barrows; red squares = Roman fortified structures; black circles and crosses = protohistoric castellieri and funerary barrows identified by Marchesetti (1903); grey circles and squares = protohistoric castellieri and Roman fortified structures identified after the activity of Marchesetti (1903).

**Fig. 2.** LiDAR DTM of *Area 1* showing the identified archaeological sites: I = possible structures associated with flint chipped industry; II = protohistoric hill fort; III = possible protohistoric funerary barrows indicated by arrows; IV-V = protohistoric hill forts. Scale bars in boxes 1-5: 50 m.

**Fig. 3.** Photographs of selected artefacts from Sgonico.

**Fig. 4.** Selected artefacts from Sgonico (Trieste); drawings by A. Fragiacomo. Scale bar: 1 cm.

**Fig. 5.** LiDAR DTM of the mount Grociana piccola (*Area 2*) showing the Roman structures probably belonging to a military fort. Scale bar: 50 m.

**Fig. 6.** Brims of transportable republican amphorae from mount Grociana piccola; drawings by S. Privitera. Scale bar: 5 cm.

**Fig. 7.** µCT virtual reconstruction and sections of the amphora brim shown in Fig. 6 A, probably belonging to an archaic *Lamboglia 2* type, from the small rectangular enclosure of the Roman fort of the mount Grociana piccola. Scale bar of the virtual sections: 1 cm.

**Fig. 8.** µCT virtual reconstruction and sections of the amphora brim of Fig. 6 B, belonging to a *Lamboglia 2* type, from the small rectangular enclosure of the Roman fort of the mount Grociana piccola. Scale bar of the virtual sections: 1 cm.

Tables

**Tab. 1.** The fortified archaeological sites identified by LiDAR on the Trieste Karst. For the positions see Fig. 1.
<table>
<thead>
<tr>
<th>Number</th>
<th>Age</th>
<th>Name</th>
<th>Description</th>
<th>WGS84 Coordinates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Prehistory</td>
<td>Vrh Strele</td>
<td>Terraces on a hill top associated with chipped industry</td>
<td>E13.75536; N45.73436</td>
</tr>
<tr>
<td>2</td>
<td>Protohistory ?</td>
<td>Bitigonia</td>
<td>Fortified structure of castelliere type ?</td>
<td>E13.70044; N45.77421</td>
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<tr>
<td>3</td>
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<td>Pod Kalom</td>
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<td>E13.67688; N45.76114</td>
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<tr>
<td>4</td>
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<td>Vrsic</td>
<td>Fortified structure of castelliere type ?</td>
<td>E13.71096; N45.76250</td>
</tr>
<tr>
<td>5</td>
<td>Protohistory ?</td>
<td>Pod Kalom</td>
<td>Fortified structure of castelliere type ?</td>
<td>E13.67688; N45.76114</td>
</tr>
<tr>
<td>6</td>
<td>Protohistory</td>
<td>Rupinpiccolo II</td>
<td>Fortified structure of castelliere type</td>
<td>E13.76900; N45.72867</td>
</tr>
<tr>
<td>7</td>
<td>Protohistory</td>
<td>Rupinpiccolo III</td>
<td>Fortified structure of castelliere type</td>
<td>E13.77662; N45.72962</td>
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<tr>
<td>8</td>
<td>Protohistory</td>
<td>Rupinpiccolo IV</td>
<td>Fortified structure of castelliere type</td>
<td>E13.76782; N45.73550</td>
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<tr>
<td>9</td>
<td>Protohistory ?</td>
<td>Volnik</td>
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<td>11</td>
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<tr>
<td>12</td>
<td>Roman time</td>
<td>Grociana piccola</td>
<td>Roman fort</td>
<td>E13.88036; N45.63232</td>
</tr>
</tbody>
</table>

Table 1