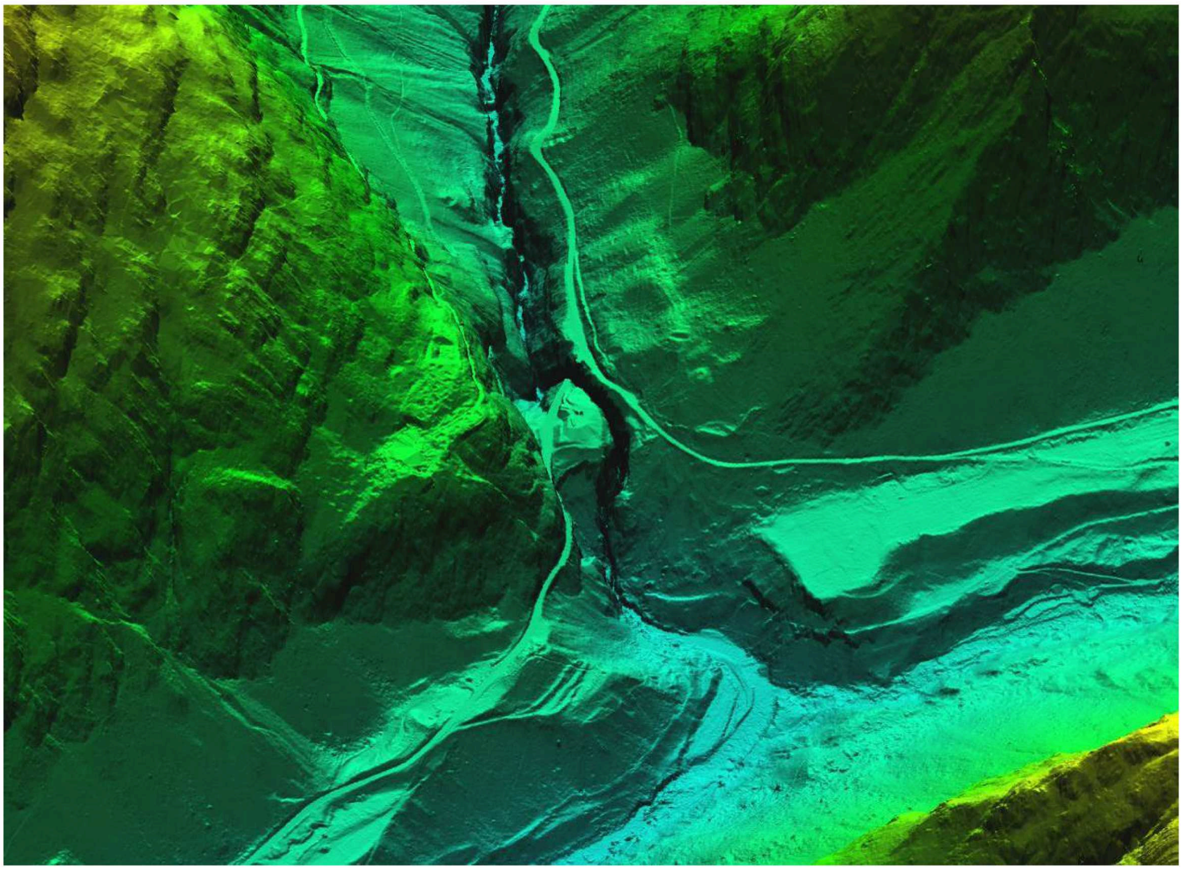
WP 6 Action 2

Identification of historic technologies for appropriate fortress conservation

Output 6.2.1 Identification of fortress relicts with modern technical procedures



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Zavod za varstvo kulturne dediščine Slovenije

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Introduction

In the recent years basic identification of archaeological relicts as well identification of fortress relicts from various periods has made a huge step forward. The architectural surveys are very informative; however they are mostly concentrated on individual locations of fortifications. They are supported by topographical surveys of the surrounding areas, which should place the fortification in a broader spatial envelope and reveal also the reasons for its erection. But almost up till now the surveys were above all bound to traditional topographical methods, which are limited in various ways, especially when we are dealing with areas with dense vegetation (e.g. woodland). The task of fully understanding a single fortress is also much harder, when we are dealing with places with multi-period occupation, which means that they their micro location, size, building material etc. has been changed and possibly reused for several times.

Documenting and interpreting areas covered by dense vegetation canopy, which were above that occupied in various periods up to modern times with intensive interventions in the landscape is therefore a real challenge for today's and future fortress research. It is not only the basic fortress and military specialist who have to combine their knowledge, but it is also archaeologists, geologist, architects and others who have to add their pieces into the puzzles of the researched areas for satisfactory results.

To touch the limits of modern identification of fortress relicts is also the main reason, why Bovec with its surroundings was chosen as a case study area (fig. 1–2).

Figure 1. Digital orthophoto of the broader study area.

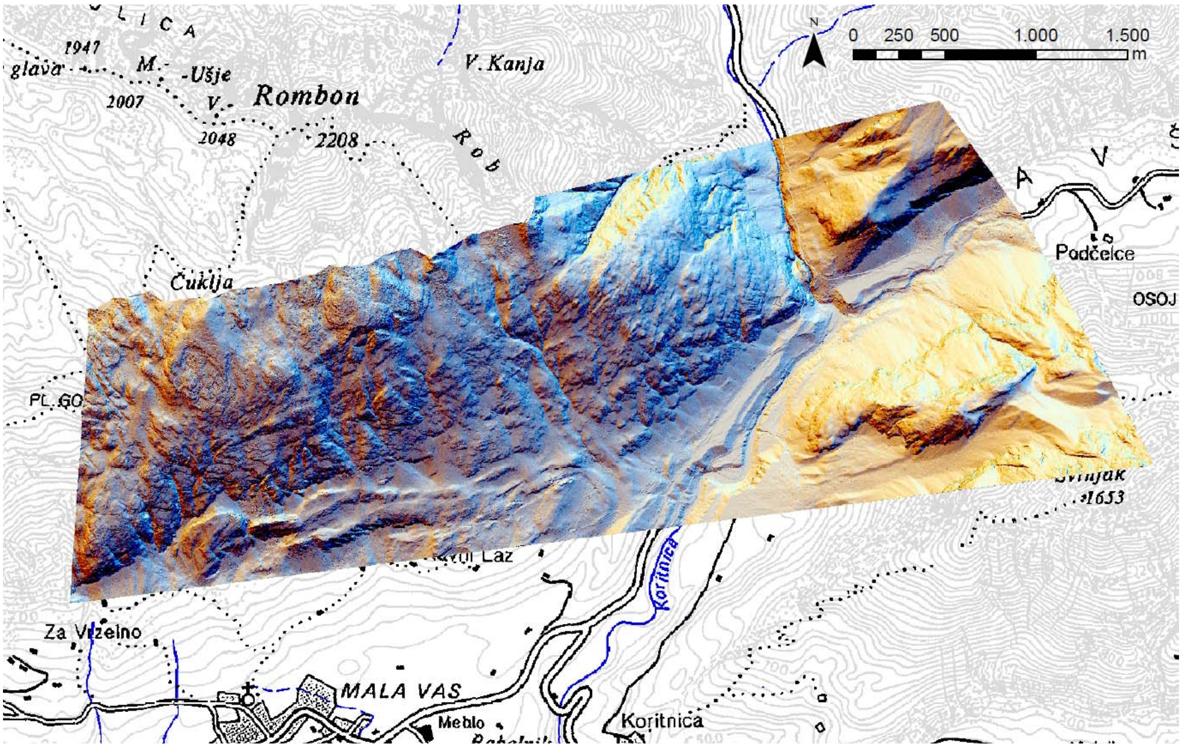

Figure 2. Lidar derived DTM of the study area.

Brief historical background

The broader area of Bovec was a transitional zone already in the prehistory and in the Roman times, which is evidenced by various interesting finds from different periods, found on significant locations in the landscape as the Predel Pass to the north of Bovec etc. However as the most important location proved itself the narrow gorge above the Koritnica River, which lies between the slopes of Rombon and Izgora, just above Bovec in the direction of Predel Pass.
Already in the second half of the 15th century a Venetian fortification was built above that deep gorge mainly as a defence against the oncoming Turks. After that, in 1509, it failed to fully perform its function in the first war between the Venetians and the Habsburgs. The last occupied it and the broader region. They had the fort built of stone and reinforced it on account of the Carinthian States. The first substantive major works on the fort were carried out towards the end of the 16th century.

Figure 3. Map of the Bovec fortress from the 17th century (*Steiermärkisches Landesarchiv*, Web 1)

From that time on and until 1751 it was the seat of the governor general of the independent Bovec province. One of the most important was Georg Phillipp von Gera, serving in the first half of the 17th century, who reinforced and improved the forts armament. He also discovered a spring nearby, which enabled the fortress to survive lengthy sieges. In this context illustrations from the 17th and 18th century are of special interest, as they reveal that the fort was not intended only for defensive purposes (Fig. 3).

The fortress again justified its strategic position in 1797, when an Austrian contingent of soldiers defended the fortress against the advancing French Army, which under the command of General Napoleon Bonaparte, defeated the Austrians in northern Italy. The defenders stood little chance against the overpowering adversary. Finally they had to surrender and the assailants took over the fortress, which was burned down and partly demolished. The fortress was partly rebuilt in 1804 and already the next year it faced a new battle between the Austrian and the French Armies.

Figure 4. Aerial photography of the current state of the Kluže complex (Photo: Boris Štupar, Web 2).

The present-day appearance of the Kluže fortress (Fig. 4) dates back to 1882, when also the new road was rock cut into the western bank above the Koritnica River. The central part of the fortress has the shape of a square with high and narrow embrasures in the walls. The complex of the fortress also includes the "upper" fortress called Fort Hermann, erected on a rocky ridge over the gorge, which was finalized in 1900. The path leading to it is hewn into the rock along its initial stretch and then runs partly also through a tunnel.

The nowadays state of both is connected to their different faiths, as Fort Hermann was demolished during an artillery barrage of the World War I (WWI), while the Italian battery could not damage the Kluže fortress by the road in the gorge (Fig. 5).

Figure 5. Fort Hermann from the south after heavy shelling in 1915 (*Kaiserjägermuseum Innsbruck*, Web 3).

The final military function had the Kluže fortress in the WWII, when its appearance was once again partly altered. As the road was being widened and the bridge reconstructed during the administration by the Allies, the defence rampart with its entrance portal, which was obstructing the road, was removed.

Besides the best known forts, which were recently described in a monograph (Simić 2005) also the adjacent mountain ridges played an important role in all the phases of the fortification of the broader area. Not enough is however up until today known about the exact locations of all the parts of defence lines, which were in the last phase, dated to the WWI, stretching all the way to the pick of Mt Rombon (2208 m a.s.l.).

As a witness of so many generations living in this region and their faiths regarding all the wars they have fought, the military legacy around Bovec is one of the best reminders for us and the future generations. That is also why the Kluže fortress has been continuously renovated since 1987. Inside it holds a small tourist office, a presentation of the history of the fortress and its surroundings, a local painting gallery and a wedding hall; it is hosting a variety of cultural events and re-enactments with soldiers in uniforms and the equipment from the WWI and is therewith promoting life and unification as diametric opposites to its former function.

Technical introduction

Laser scanning describes any technology which accurately and repeatedly measures distance using laser pulse, by precise measurement of time needed for the laser pulse to travel from the object and back, and transforms these measurements into a series of points, or a point cloud, from which information on the morphology of the object being scanned may be derived. Airborne LiDAR (Light Detection And Ranging), ALS or ALSM (Airborne Laser Scanning, Airborne Laser Swath Mapping) is an active remote sensing technique, which records the surface of the earth using laser scanning (Opitz 2012, 13). Lidar allows very precise three-dimensional (3D) mapping of the surface of the Earth, producing high resolution topographic data, even where surface is obscured by forest and vegetation. The level of detail on digital surface and terrain models produced from high resolution lidar topographic data helps us enormously in identification of past events which reworked and modified the surface of the earth.

Lidar technology

Airborne laser scanning systems are assemblages of technologies, including a laser scanner, positioning and georeferencing equipment (GPS and inertial measurement unit, IMU), data recording system located on an airborne platform, aircraft or helicopter that produce the trace of the surface of the Earth. Laser transmitter sends a pulse of laser light. Laser is coupled with the beam director which scans the laser pulses over a swath of terrain, usually centred on, and co-linear with, the flight path of the platform, the scan direction being orthogonal to the flight path.

When laser pulse reaches the ground has a finite diameter (10 cm and larger). It is possible that only a part of the diameter interacts an object, for example a tree. Part of pulse will interact with the tree canopy and then reflect back while the rest of the pulse keeps travelling through the gaps of the canopy till it encounters other objects (branches, leaves, ground) which result in reflection of other parts of the pulse.

The sampling of the received laser pulse can be carried out in different ways. Airborne lidar systems may be divided into discrete return and full waveform systems. Discrete return systems the detector triggers when the in-coming pulse amplitude (intensity or energy) reaches a set threshold, thus measuring the time-of-flight. Discrete return lidar usually records two to four returns per pulse. The round trip travel times of the laser pulses from the aircraft to the ground are measured with a precise interval timer and the time intervals are converted into range measurements knowing the velocity of light. The position of the aircraft at the time of each measurement is determined by a phase difference kinematic GPS. Rotational positions of the beam director are combined with aircraft roll, pitch, and heading values determined with an inertial measurement system, and with the range measurements, to obtain vectors from the aircraft to the ground points. When these vectors are added to the aircraft locations they yield accurate coordinates of points on the surface of the terrain.

Lidar raw data is thus a series of measurements of times and intensities of returned laser pulses. Adjacent strips of points are aligned to improve accuracy within the dataset and the final point cloud is adjusted to fit the coordinates of ground surveyed control points. These positions are typically stored as a point cloud, where each point contains attribute information such as GPS time, intensity, scan angle and flightstrip number along with its X, Y and Z coordinates. Due to their large volume, point clouds are usually manipulated and stored in the binary LAS format (Samberg 2007).

The essential and critical phase in post processing chain is classification. Points in the point cloud must be classified to returns from the ground and those from vegetation. The processing implies assumptions to be made about the properties of the ground, either explicitly by the analyst the data, or within the software systems applied. The assumptions have a major impact on the quality of derived data. Thus, the ground points are the measurements from bare-earth terrain that are usually the lowest surface features in a local area. Non-ground points are the measurements from the objects above the bare-earth terrain, such as trees, shrubs and buildings. In order to appropriately identify ground points, it is important to understand the physical characteristics of ground points that differentiate them from non-ground points. (Meng et al. 2010).

Classified point cloud allows interpolation of different digital elevation models. Digital terrain model (DTM) is a representation of bare-terrain surface, free of any object, such as trees, buildings, etc. Digital surface models (DSM) includes tops of the buildings, trees, power-lines and other "landscape clutter". For archaeology a combination between DTM with some landscape clutter is usually preferable.

Digital elevation models are then visualised using different methods. There are number of different visualisation methods (see Devereux et al. 2008; Kokalj et al. 2012)

Lidar survey of the the Bovec surroundings

Research area

The chosen research area surveyed using lidar had an extent of approximately 5km^2 (Fig. 2). The area covers the south-eastern slopes of the Rombon Mountain, the western slopes of the Krnica Mountain, a part of the Bavšica Valley and the northern slopes of the Svinjak ridge. The main goal of the survey was the recording of the fortifications that controlled the approach along Koritnica River through Kluže gorge and the traces of conflicts in its surroundings, e.g. the WWI battleground on the slopes of the Rombon Mountain.

The lidar survey was conducted from April to June 2013. The area proved to be extremely challenging due to the huge differences in altitude, steep slopes, dense vegetation and long duration of snow cover on high altitudes.

The area was surveyed with an average density of 15 points/m^2, all points were collected. During preliminary filtering process, 960803 points were classified as ground points. A high resolution (0.5 m) digital terrain model (DTM) was interpolated from the classified ground points and visualized using different techniques.

The adjacent basic processing of the gathered data was executed in June 2013, however due to the complex topography and dense vegetation (especially *Krummholz* on higher altitudes) processing of the point cloud is not finished yet. The first interpretation of features was followed by ground-truthing. Ground truthing allows lidar data to be related to the real features on the ground. The collection of ground-truth data enables calibration of remote-sensing data and aids in the interpretation and analysis of lidar dataset.

The processing workflow included preliminary filtering of ground points, interpolation of digital terrain model (DTM) and different visualizations of the DTM, including analytical hillshading, principal component analysis (PCA) of sequentially hillshaded images, skyview factor and slope map (.Fig. 6)


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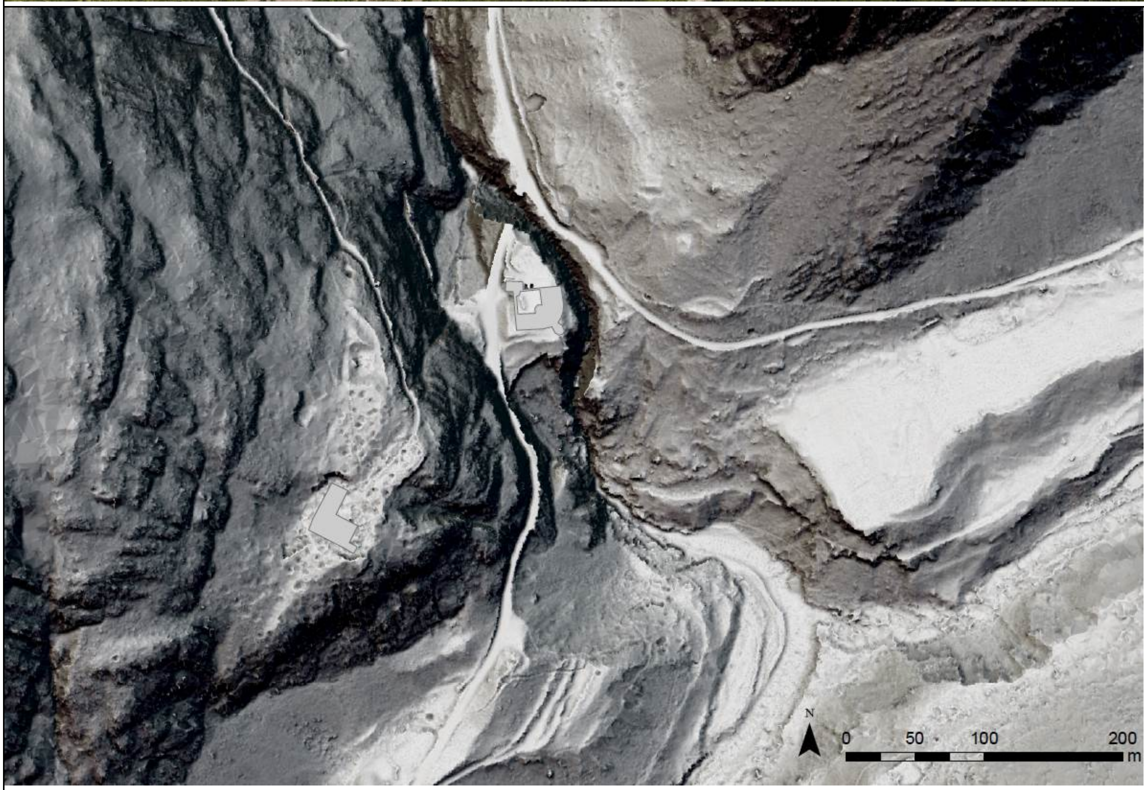
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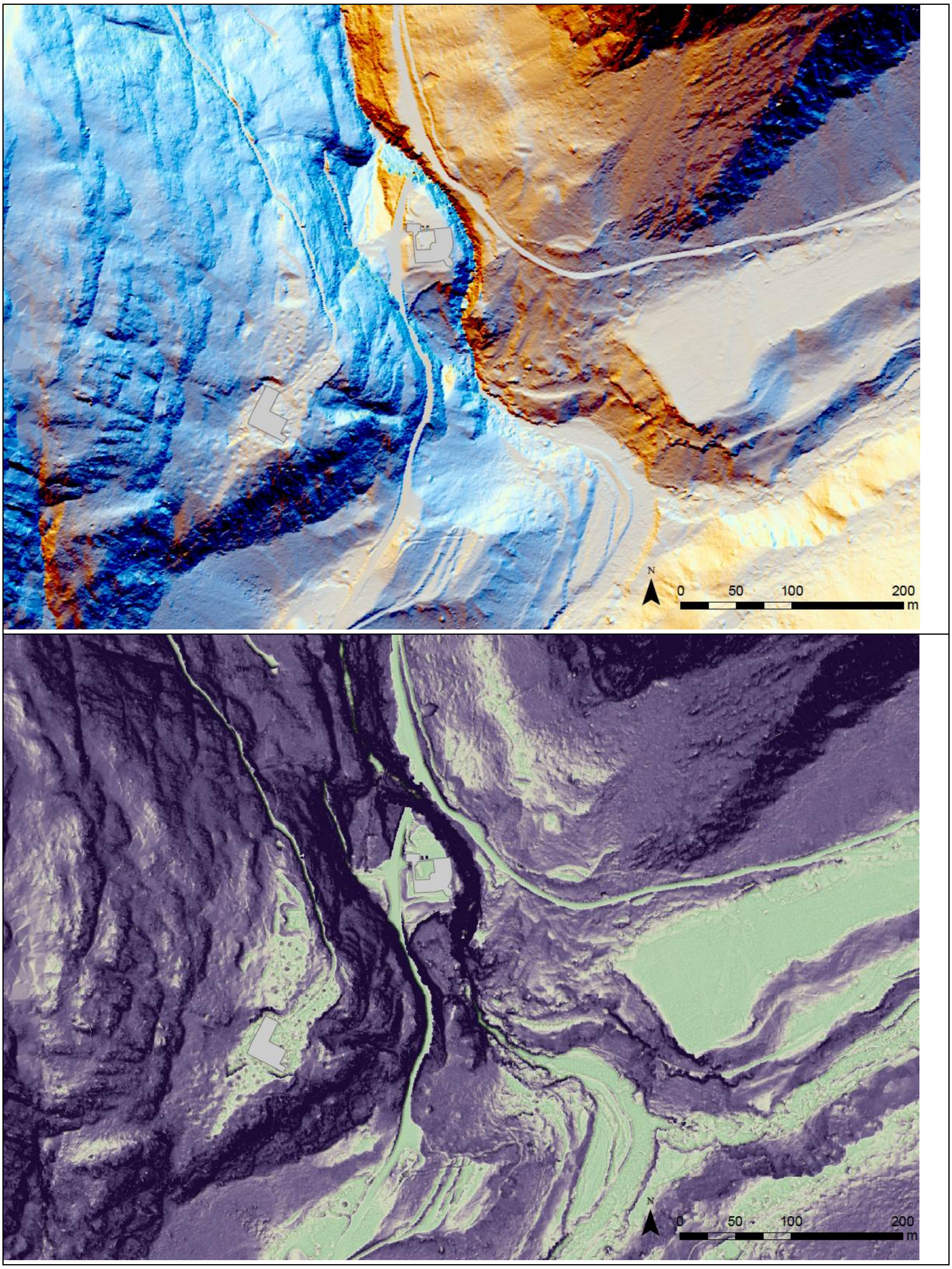

Figure 6. Digital orthophoto and lidar derived DTMs of the broader Kluže area with various visualizations.

Kluže gorge

If we exclude the basic features connected to the nowadays standing conserved and restored Kluže fortress on the eastern bank of the Koritnica River, we can observe several other features on the opposite bank, which today lie in dense woodland and which were up until today practically not researched.

The first features to be mentioned are the former roads (Fig. 7: purple colour[1]), which crossed the Koritnica River in the valley and approached the roadblock under the slopes of the Krnica Mountain. Its course can be observed also on historic maps, like the Austrian Army map from 1797, held by the *Kriegsarchiv* in Vienna, however the documentation of its remains is crucial for the interpretation of the whole area.

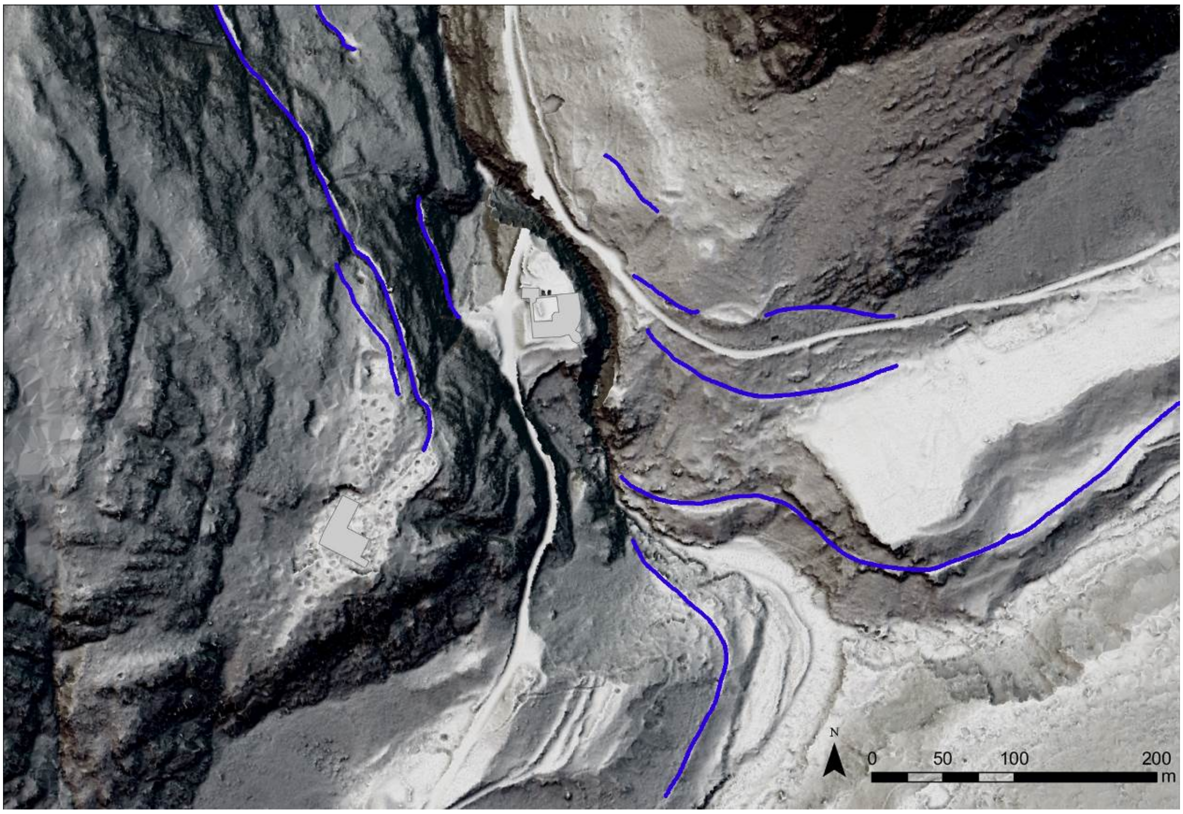

Figure 7. Lidar DTM with mapped some of the ground truthed ancient roads.

On the eastern bank of the Koritnice River, just opposite of the Kluže fortress (Fig. 8: Feature 1)

[1] The purple colour is in all figures used for roads, paths etc., whereas the black colour is used for mapping trenches.

we could probably document the remains of the roadblock (Fig. 9: Feature 1), as it can be observed already on maps from the 17th century, held by the *Steiermärkische Landesarchiv* in Graz and the *Arhiv Slovenije* in Ljubljana, or on later maps from the end of the 18th century, from the *Kriegsarchiv* in Vienna, which adjacently show structures rising up the slopes and ending in crags. The last can be probably seen in the embarked terraces just above the today's road (Fig. 8/9: Feature 1a), which have an adjacent stone rampart or remains of a stone wall rising up the ridge (Fig. 9: Feature 1b) and through which a path is leading nowadays. The map from the end of the 18th century also includes an entrenched battery, which can be probably observed on the ditched elevated circular plateau (Fig. 8/9: Feature 2) with terraces to the north-east right above it.

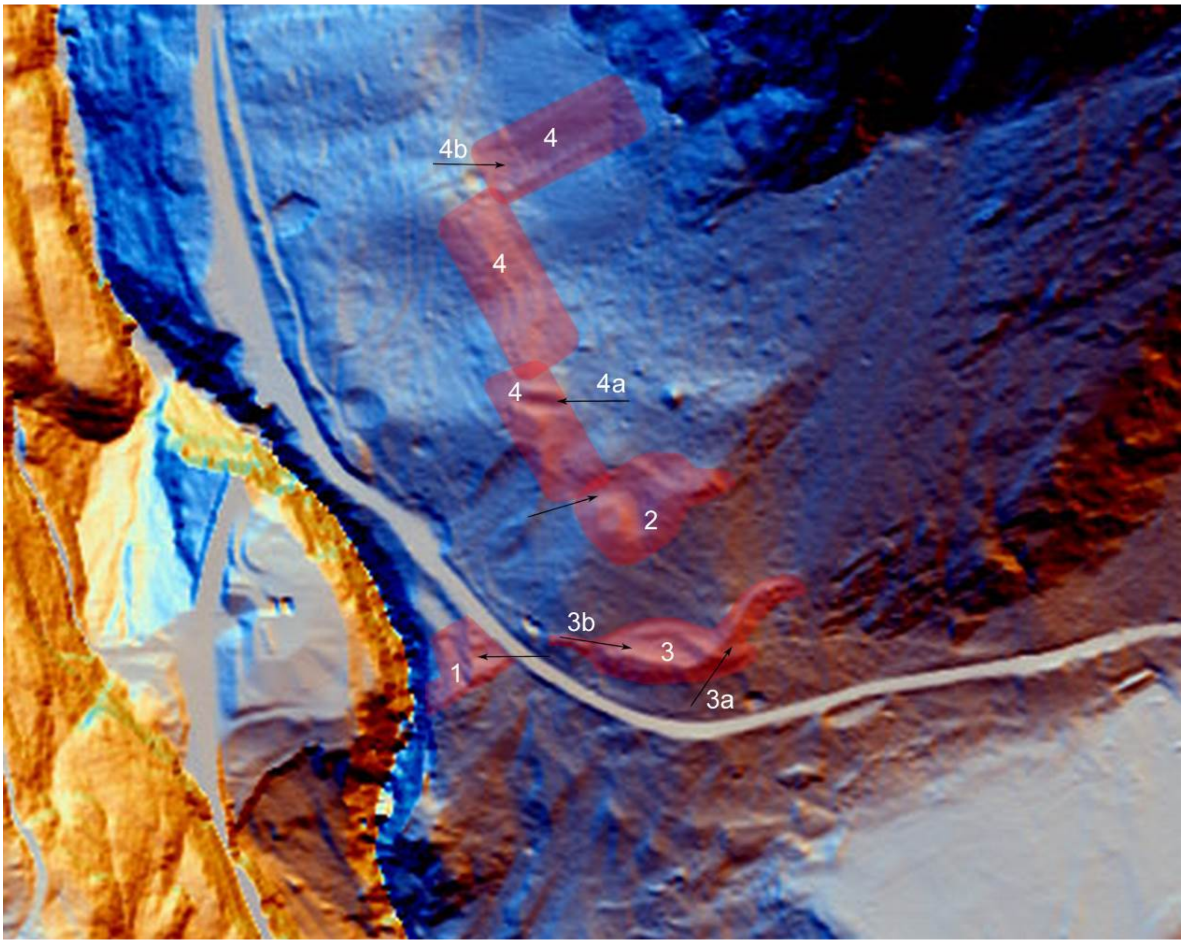

Figure 8. Lidar derived DTM with the location of main features on the eastern bank of the Koritnica River, with marked positions and orientations of belonging photographs (Fig. 9).

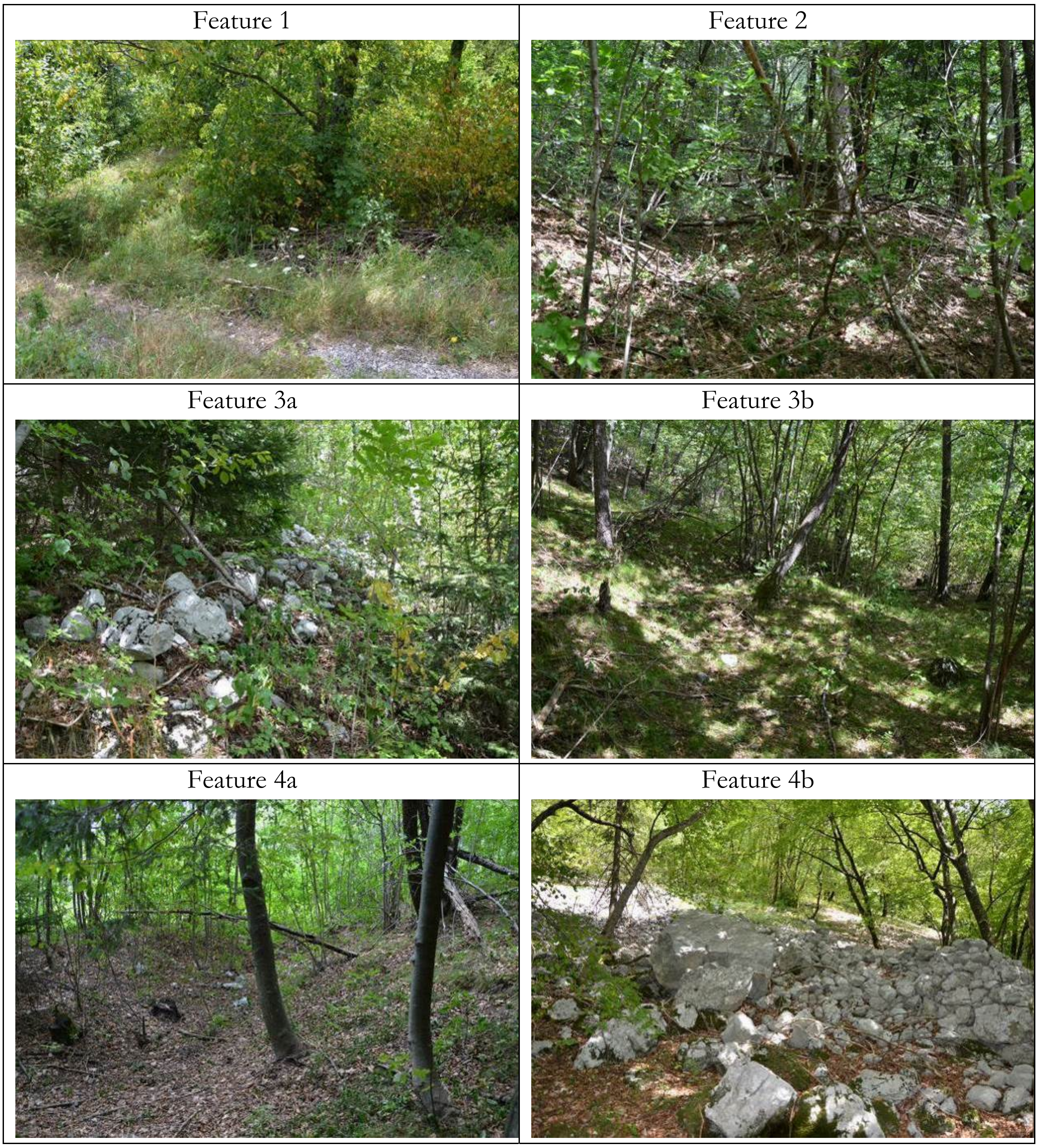

Figure 9. Photographs of chosen locations, marked on the lidar derived DTM of the eastern bank of the Koritnica River (Fig. 8).

Of much interest are also the three features formed by parallel running ramparts and remains of stone walls (Fig. 8: Feature 4). The walls, which are up to 2,5m wide, are on some parts preserved to a height of over 1m (Fig. 9: Features 4a, 4b). Up till now, we could not find their interpretation.

Several other features were detected on the high resolution topographic data, for instance several other cultural terraces and former paths or roads passing this important transitional area, however there have to be further investigated on field.

Moving to the western bank of the Koritnica River the area is besides the two fortresses Kluže and Fort Hermann characterized by numerous other features. Moving from the valley we can trace the rock carved road with a tunnel and caverns leading up the mountain (Fig. 10). Today its northernmost part is cut off by an after-war steep mountain stream, however remains of embankments on both still existing streams show that the builders of the road knew of the danger and tried to direct and limit the water masses. However after ground trothing it is also possible that the embankments are even predating the military building endeavours (Fig. 10: Feature 1, 11: Features 1a, 1b).

Observing the closest surrounding of Fort Hermann, we could identify almost numerous craters, as witnesses of the heavy shelling of the fort in the years 1915 and 1916, until its abandoning in May of that year (Fig. 10: Feature 2, 11: Feature 2b). The northern part of the fortress plateau is besides that occupied by a wider terrace with a surrounding wall, where we can probably see the location of the officer barracks (Fig. 11: Feature 2a).

North to the mention features and deeper in the Koritnica valley we can observe a path, leading in the direction of Log pod Mangartom. Following the road we come to an area right above the River, which is on one side marked by man-made terraces, but also remains of walls and even remains of partly still standing buildings (Fig. 10: Feature 3, 11: Features 3a, 3b). It is an abandoned farm, which still existed after the mid 20th century, however its history has not yet been thoroughly studied.

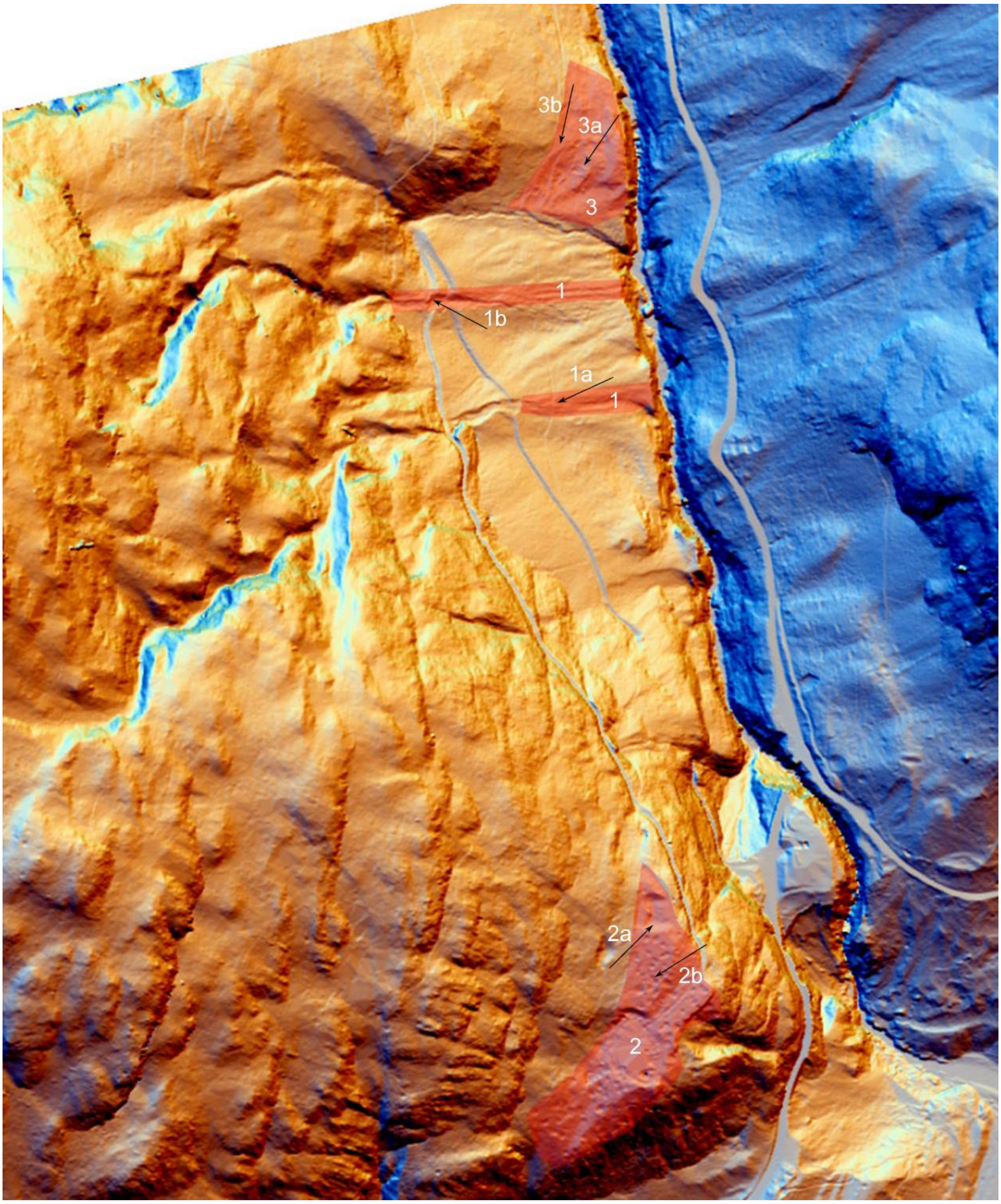

Figure 10. Lidar derived DTM with the location of main features on the western bank of the Koritnica River, with marked positions and orientations of belonging photographs (Fig. 11).

Figure 11. Photographs of chosen locations, marked on the lidar derived DTM of the western bank of the Koritnica River (Fig. 10).

As there are different parts of the battlefield rising up the Mt Rombon, we have divided the report in three sectors: Height 1313 (Fig. 12–13), Mrtvaška glava (Fig. 14–15) and Čuklja (Fig. 16–17), which will be studied separately.

Height 1313 (Fig. 12–13)

In autumn of 1913, the Austro-Hungarian army started building an artillery observation post on Veliki vrh (1306m). It was finished till October 1914 (Simić 2005, 188) and represented one of the observation points for the Bovec fortresses (*Sperre Flitsch*). During the WWI the location gained the name Height 1313 (*Kote dreizehn dreizehn*), which sticks to it until today (Simić 2005, 193). The central parts of the complex are the artillery observation post (*Beobachter*) (Fig. 12/13: Feature 1) and the range measurement post (*Distanzmesser*) (Fig. 12/13: Feature 2). The defence consists of fire trenches (Fig. 12: Feature 3) with individually fortified positions. Communication trenches (Fig. 12/13: Feature 4) run across the site and lead also to the shelters (Fig. 12: Feature 5) for the unit which was station there. The unit normally consisted of 38 men (Simić 2005, 193-194). In wartime, the complex was also a part of the last Austro-Hungarian front line, which would be used in the case of Italian capture of Mt Rombon.

In the vicinity of observation post some artillery positions were also located (Simić 2005, 194). We can recognise some of the building platforms northeast and west of the height 1313. There were wooden and stone barracks for soldiers, warehouses and even a bakery (Simić 2005, 194). To the north and northwest we can also trace numerous military roads that lead from the hinterland to the battlefield on Mt Rombon. During the war, a military cableway was also build from the Pustina, about 2 kilometres north of Kluže (Simić 1998, 105), across height 1313 to Mt Rombon.

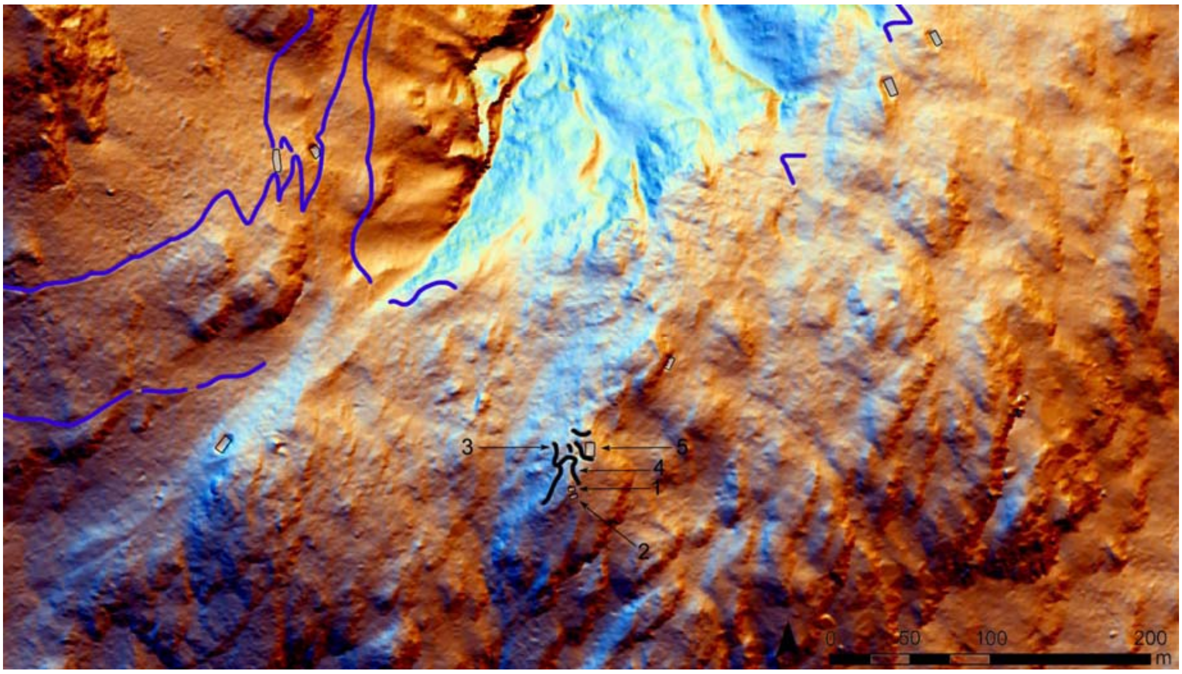

Figure 12. Lidar derived DTM of the Height 1313 area with marked locations of main features (Fig. 13).

Features 1 and 2	Feature 4
	

Figure 13. Photographs of chosen locations, marked on the lidar derived DTM of the Height 1313 area (Fig. 12).

Mrtvaška glava (Fig. 14–15)

During the war this little summit on the slopes of Mt Rombon was known as height 1583 or *Totenkuppe 1*. Today it is known as Mrtvaška glava (in translation: *death's head* or *skull*). Between 1915 and 1917 the Austro-Hungarian soldiers have built a network of trenches and fortified positions on the top and surroundings of Mrtvaška glava. Communication trenches (Fig. 14/15: Features 2, 4, 5, 7, 14) that can reach up to almost 3 metres in depth are very well preserved. On the summit a group of stone and concrete build trenches (Fig. 14/15: Feature 18), some machinegun posts in caverns and as well as in open are preserved. Fire trenches can also be recognized, which in some parts probably also had the role of communication trenches. Caverns, that are usually located behind small ridges, can also be seen (Fig. 14/15: Features 1, 6, 8, 9, 10, 11, 12, 13, 15, 17). Some of them were meant to accommodate soldiers; others were used to store ammunition or were used as machinegun posts. According to military maps the Austro-Hungarian army had a great number of machineguns and also mortars on Mrtvaška glava. We can identify some rectangular entrenchments, which can be interpreted as these machinegun or mortar position (Fig. 14/15: Feature 3).

Due to the steep slopes south of the summit, the positions were not joined together; segmentation of fortified positions was more common. We can trace the majority of these positions on lidar derived DTMs. A communication trench leads from Mrtvaška glava northeast to locations known as Kraljišče and Vršiči, where the Austro-Hungarian headcounters for Rombon battlefield were located. Many building platforms and trenches can be located in this area.

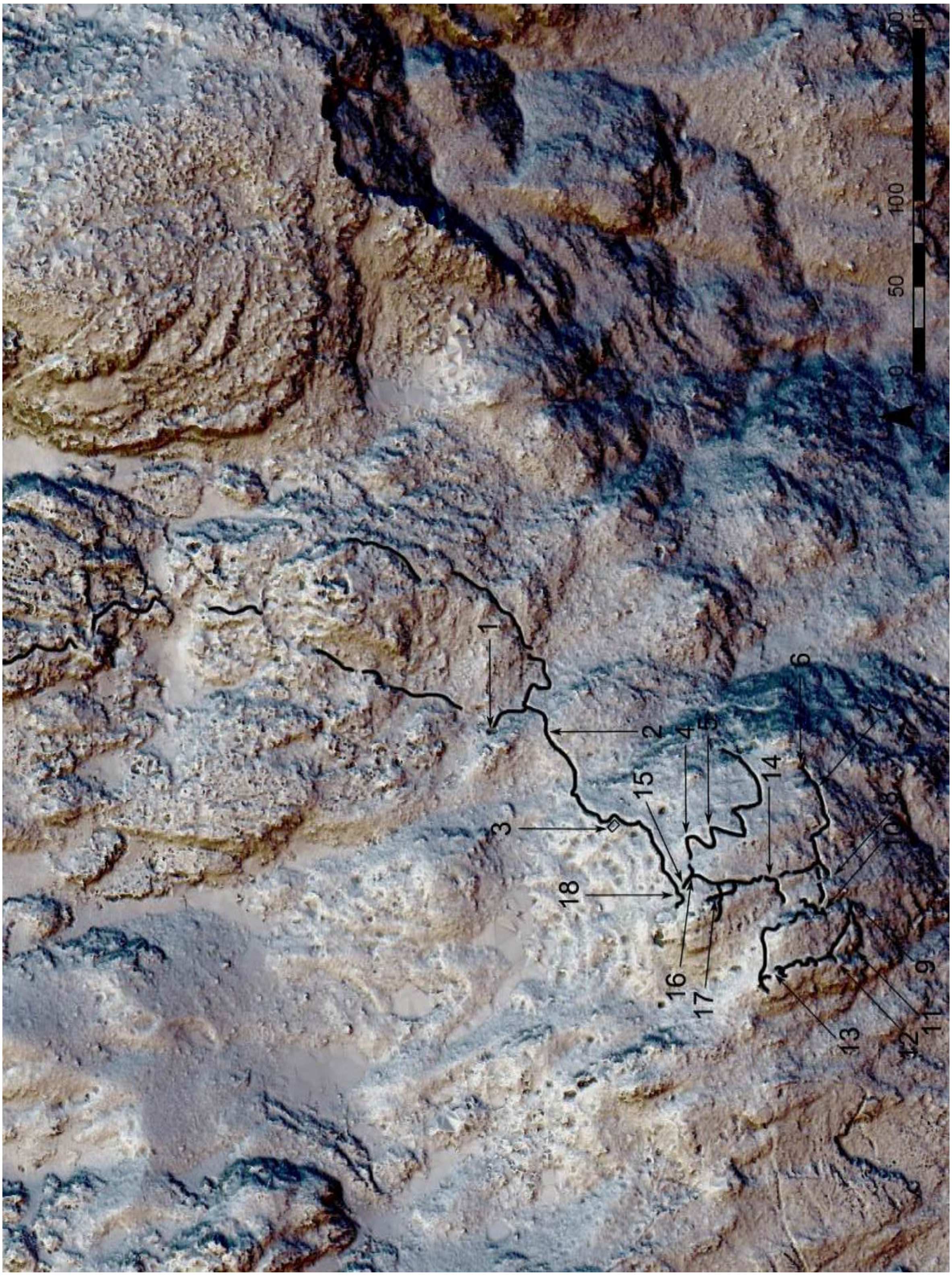

Figure 14. Lidar derived DTM of the Mrtvaška glava area with marked locations of main features (Fig. 15).

Feature 1 	Feature 2 
Feature 3 	Feature 4 
Feature 5 	Feature 6 

Feature 7 	Feature 8 
Feature 9 	Feature 10 
Feature 11 	Feature 12 

Feature 13 	Feature 14 
Feature 15 	Feature 16 
Feature 17 	Feature 18 

Figure 15. Photographs of chosen locations, marked on the lidar derived DTM of the Mrtvaška glava area (Fig. 14).

Čuklja (**Fig. 16–17**)

Čuklja is a 1767m high peak under Mt Rombon. It represented an important strategic point for Italian attacks towards Mt Rombon. From this very location the Italians had a great view and control over the Austro-Hungarian positions in the Bovec basin. The caverns (Fig. 16/17: Features 4, 5, 7, 8) and buildings platforms (Fig. 16/17: Feature 1) are not so common on the southern slope of Čuklja, due to the exposure to enemy fire. Great number of caverns and building platforms are however located under the cliffs of western Čuklja slope. There were also an Italian hospital (Fig. 16/17: Feature 9) and a medical station; in their vicinity small cemeteries were also located. Next to the hospital, large building platforms can be seen. The area southwest of the hospital is covered with shell craters, which show that Austro-Hungarian artillery tried to distract the military transports on the paths in that area. We can also recognise many building platforms west of the medical station. As elsewhere they were built under small cliffs so they were hidden away from the opponent. To the south we can see a distinctive line which represents a well build military road that leads to mortar positions under the Mrtvaška glava. On grassy Čuklja slopes many shell craters can be seen (Fig. 16/17: Feature 3). The majority of the remains are communication trenches which run from east to west across the slopes of Čuklja (Fig. 16/17: Feature 2a).

On the east side of the southern slope we can trace a fire trench (Fig. 16/17: Feature 6) that runs from northwest to southeast. This was the first firing line. On the military maps we can also see many machinegun positions in that area. The trenches are partially buried because of the erosion on the steep slopes. The exception is a long communication trench which was in some parts carved in solid rock (Fig. 16/17: Feature 2b). To the west of fighting positions many military roads and paths can be seen. There was also a cableway, which was used for the transport of the material.

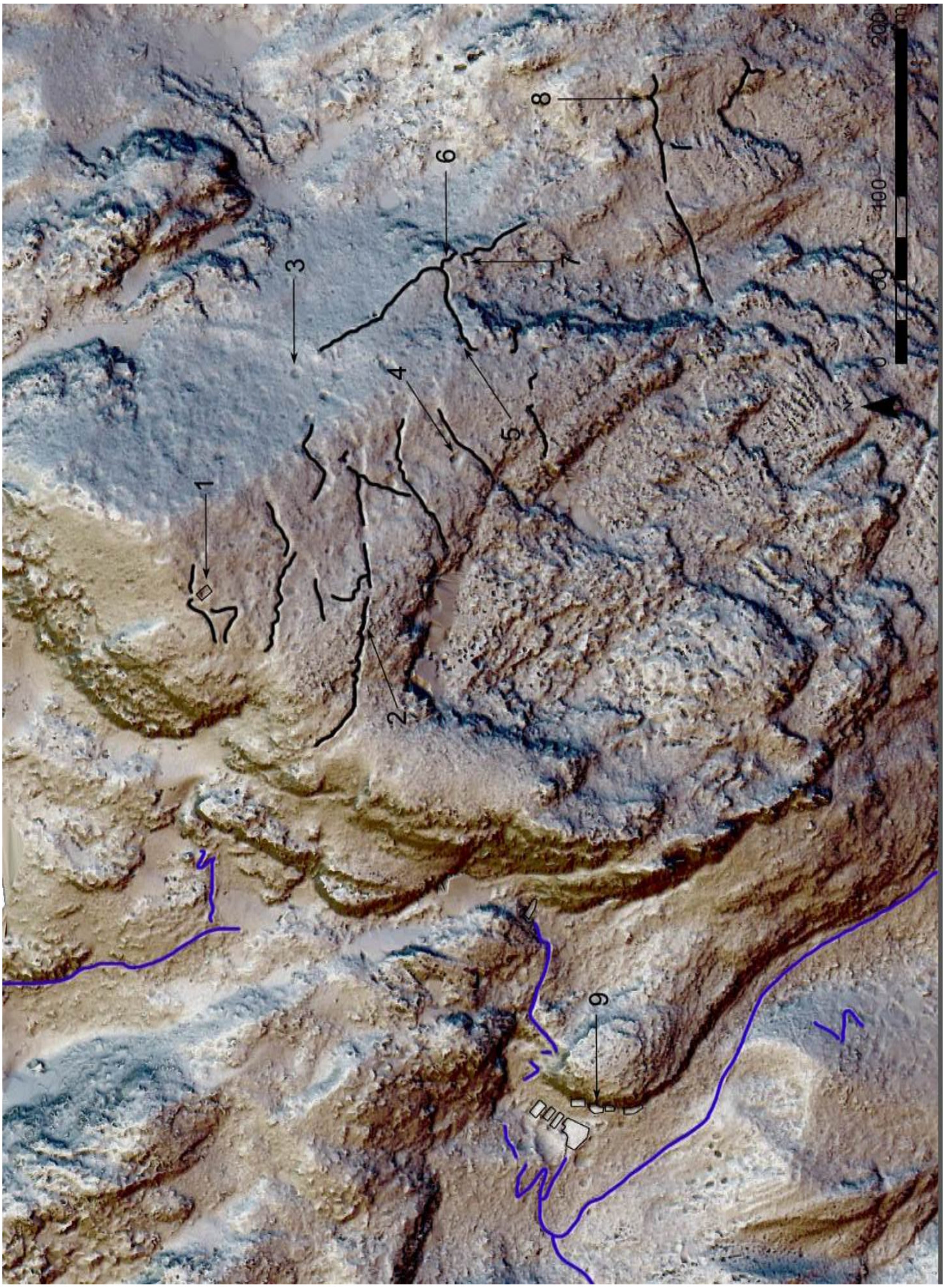

Figure 16. Lidar derived DTM of the Čuklja area with marked locations of main features (Fig. 17).

Feature 1 	Feature 2a 
Feature 2b 	Feature 3 
Feature 4 	Feature 5 

Feature 6 	Feature 7 
Feature 8 	Feature 9 

Figure 17. Photographs of chosen locations, marked on the lidar derived DTM of the Čuklja area (Fig. 16).

Conclusions

In the present study, lidar was successfully employed to study very complex Alpine landscape.
Lidar survey enabled to precisely located and map known features and revealed a host of new features that were inspected and confirmed through ground truthing. Lidar survey significantly expanded our understanding of the fortification of the Kluže gorge, revealed new features (defensive walls, buildings), that formed a part of the fortifications and revealed other features such as roads, tracks, terraces etc.
Lidar survey provided detailed and precise 3D map of the Rombon WWI battlefield, giving a synoptic view of this alpine landscape of conflict. In this way not only trenches and other defensive features were mapped, but the whole battlefield, including communication routes and shell craters. The 3D model of the battlefield enables to get an insight into the relations between defensive features and complex topography, providing deeper understanding of the conflict.
Lidar is related to a topographic survey, one of the oldest field techniques in the landscape archaeology's toolbox. Topographic survey means that location of surface traces, anomalies, "humps and bumps" are recorded. But the sheer quantity of data that can be quickly and relatively cheaply collected with lidar has transformed into new quality, new way of observing landscape. Lidar does not separate between sites and its environment, landscape, but treat them as the same.
It does not limit itself merely to "significant", isolated features of the landscape, which the topographer would immediately understand as such, and does not separate them from the landscape as separate "sites". All locations are fully incorporated into the surrounding area; their form, dimension, context and structure are the result of complex and lasting interactions with a changing landscape.
The study has opened a new horizon in the study of fortified landscapes. In this way fortifications, defensive structures and other traces of conflict can be understood as an integral part of a landscape. They are part of landscape in the making and play a role in the landscape history. Lidar enables us to observe relations between defensive structures and features of natural environment as well as man made features such as villages, roads, communications etc.
Lidar, with its lack of selectiveness, enables us to observe landscape as a whole, in this way obvious features such as monumental fortifications are not privileged, but recorded with same provision and resolution as often overlooked features such as bomb craters, paths, trenches etc.

As the method is new in the studies of fortified landscapes, the procedures will have to be adapted and field recognisance standardised, but the case study has shown great potential for this way of research.

It also means a step forward in terms of fortified heritage protection. Following this amount of new data, some major changes will have to be taken for the proper understanding, evaluation and protection of these fortified landscapes.

Nevertheless also the public will gain a great deal from our research. As some parts of the battlefields lie in high Alpine area they are inaccessible to many of the interested individuals. But the digital technology enables us to present this fortified landscapes, the reminders for us and the future generations, just by a simple mouse click.

References

Devereux, B.J., Amable, G.S. and Crow, P., 2008. Visualisation of LiDAR terrain models for archaeological feature detection. Antiquity 82(316), 470–9.

Kokalj. Ž, Zakšek K. and Oštir, K. 2012. Visualizations of lidar derived relief models. In: R. S. Opitz and D. C. Cowley (Eds.), Interpreting Archaeological Topography: Lasers, 3D Data, Observation, Visualisation and Applications . Oxford, Oxbow, 102–116.

Opitz, R. 2012. An overview of airborne and terrestrial laser scanning in archaeology. In: R. S. Opitz and D. C. Cowley (Eds.), Interpreting Archaeological Topography: Lasers, 3D Data, Observation, Visualisation and Applications. Oxford, Oxbow, 13–31.

Simić, M. 2005, Utrdbi pod Rombonom : predstraža soške fronte : razplet svetovnega spopada med utrdbami in topovi na Bovškem. – Ljubljana.

Sources

Web 1:
http://www.tol-muzej.si/eng/master.html?http://www.tol-muzej.si/eng/spomeniki_trdnjava_kluze.html

Web 2: http://www.gore-ljudje.net/novosti/46483/

Web 3: http://www.moesslang.net/1.WK_Alpen/Fort_Hermann_suedseite.JPG

Web 4:
http://www.europeana.eu/portal/record/92060/AA2AA74579C43007384CD85D911655E3F20B7DBA.html