CO-397

MAPS OF MILITARY TRAINING AREAS - SOME ASPECTS OF THE PRODUCTION OF A TOPOGRAPHIC MAP 1:25 000

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ABSTRACT

The topographic maps at the scale 1:50 000 used in the Austrian Armed Forces are produced by the Federal Office of Metrology and Surveying. For some special areas maps at a scale of 1:25 000 are necessary due to safety reasons. Topographic maps at this scale produced by the Federal Office of Metrology and Surveying are only graphically enlarged with no further information and less space for special military environment. For these reasons, the Institute for Military Geography decided to produce these maps for the military training areas on their own in 2008.

This article reports about the used data, a mixture of data from the topographic and the cartographic model provided by the Federal Office of Metrology and Surveying as well as computer generated hill shading, contour lines and GPS based field survey. Some aspects of cartographic design are discussed and the workflow of the map production is portrayed on the example of two maps. It also presents some solutions to solve occurring cartographic problems not only for maps of military training areas.

As an outlook, new technologies for gathering data and their possibilities for the production of these maps are evaluated.

1. MAPS FOR MILITARY TRAINING AREAS

Military training areas are special areas for exercising specific skills of soldiers, dependent on the character and the disposition of the training area, especially for firing. To assure the legal warranties and the safety of all people involved, detailed maps are necessary to find the areas of artillery positions and the shooting bases and to define safety areas and the necessary range guards, the primary direction of fire, the firing lane limits and target areas for the particular weapon systems. The topographic maps at the scale of 1 : 50 000 used in the Austrian Armed Forces, produced by the Federal Office of Metrology and Surveying, are not appropriate to meet the desired requirements.

For this reason the Institute for Military Geography decided to produce special maps for the smaller military training areas in Seetaler Alpe, Lizum/Walchen and Felixdorf (figure 1) based on orthophotographs at the scale of 1 : 10 000 in 2001. For the larger military training areas in Allentsteig and Bruckneudorf, a topographic map 1 : 25 000, only a graphic enlargement supplemented with military environment, is produced by the Federal Office of Metrology and Surveying. For the military training area Hochfilzen neither an orthophotomap nor a topographic map was planned and provided.

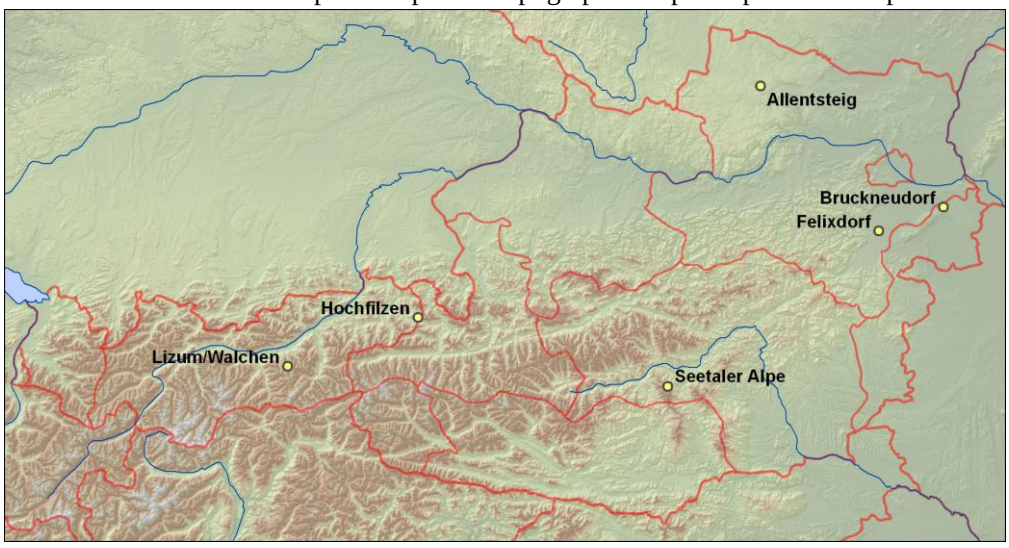

Figure 1: Military training areas in Austria

In the daily work, the orthophotomaps could not achieve the acceptance of the instructors and the staff at the military training areas. For that reason the Institute for Military Geography decided to produce a “real” topographic map 1 : 25 000 with the military environment and useful supplements in 2008. The following

article shows some selected aspects of the cartographic production using the example of the military maps Lizum/Walchen and Seetaler Alpe.

2. USED DATA

Most of the data used for the creation of these maps are provided by the Federal Office of Metrology and Surveying. The data are a mixture of data from the topographic model and selected features from the cartographic model 1 : 50 000. The features from the topographic model are mainly hydrological features, roads and paths as well as administrative boundaries. Rivers and lakes had to be generalised with a point density filter and a slight smoothing. The geometry of the rivers had to be connected, and the paths of the lakes had to be closed, respectively. Symbolised hydrological point features like springs or waterfalls had to be rotated.

The geometry of the roads and the paths could not be used because of incompleteness, nonexistent generalisation and insufficient quality of geometry due to high point density and no smoothing. The topographic model is mapped sheet by sheet in the system of the topographic map 1 : 50 000. For the map Lizum/Walchen, 4 sheets of the topographic base map were necessary but only road and path data of one sheet were available. Besides, the path data of that sheet were incomplete. For that reason, orthophotographs were used to digitize the geometry of roads and paths with a simultaneous generalisation and symbolisation, which was very demanding, especially in forested areas.

The features from the cartographic model 1 : 50 000 are wood and contour lines as vector data, and rock representation and hill shading as raster data. The geometry of wood could be used without any generalisation and only with slight adjustments to the further content. The pixels of rock representation were graphically reduced to weaken the clumsy impression of the enlargement.

Hill shading and contour lines of the cartographic model could not be used, because they did not match the hydrological features of the topographic model due to generalisation. For that reason a computer generated hill shading with the hydrologic features as breaking lines and contour lines had to be computed. The result of the hill shading with the rock representation, the contour lines and the hydrological features is shown in figure 2.

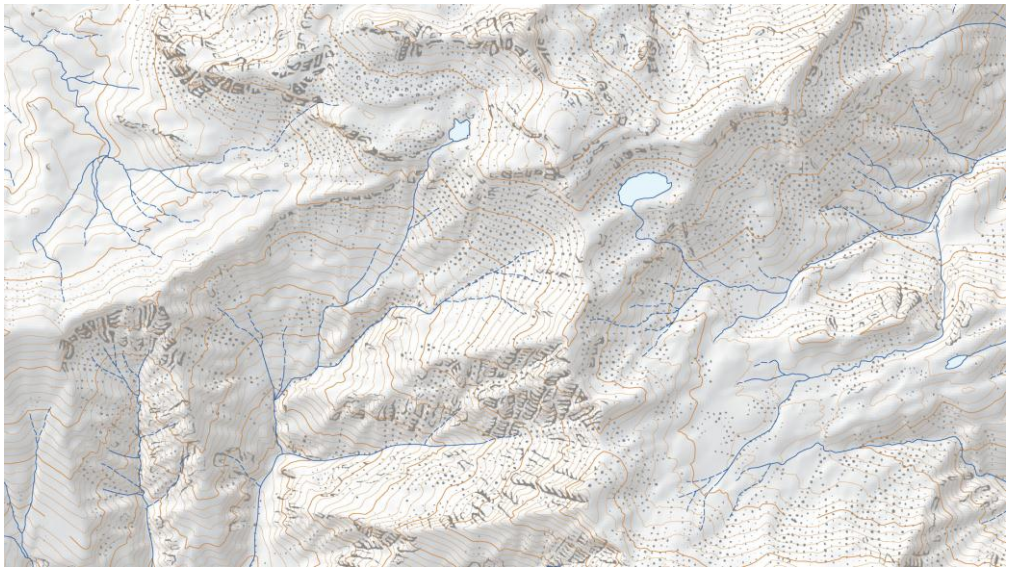

Figure 2: Coherent representation of the hill shading, the rock representation, the contour lines and the hydrological features

The boundaries of the military training areas and the restricted areas were provided by the topographical survey of the Austrian Armed Forces. The special military environment like military training area headquarters, warning barrels, range flags, helicopter landing pads, medical services and useful additional information like hiking trails excluded from the restricted areas and ski routes or cross-country and biathlon ski runs portrayed in the maps was gathered by field survey with GPS by the staff of the Institute for Military Geography. Lettering comes mainly from the topographic map 1 : 50 000, only toponyms especially used at these areas were defined and collected together with the staff of the military training areas. The boundaries of the springs protection areas, the protected forest of swiss pine, and the area of game animals feeding in the map Lizum/Walchen came from the Federal County Government of Tyrol and accordingly from the staff of the military training area.

Houses were also digitised from the orthophotographs, the approximate position and the completeness has been controlled and verified with the topographic map 1 : 50 000 and with data from the Digital Atlas of Styria, provided by the Federal County Government of Styria. Thereby, the same problems occurred similar to the roads and paths in forested areas.

3. CARTOGRAPHIC MAP PRODUCTION

3.1. Cartographic workflow

The cartographic workflow was similar to the workflow already described in Ditz (2007, 2009). The preparation and the projection of the data was done with ESRI ArcGIS (ESRI, 2011), the cartographic work was finished in ADOBE Illustrator (ADOBE, 2011) after importing the georeferenced data using AVENZA MAPublisher (AVENZA, 2011). Additionally, cartographic tools from the ETH Zurich (AI Plugins, 2011) for ADOBE Illustrator, especially described in Werner et al (2006) and Hurni et al (2008), were also used to create the maps. Finally, the final preparation of the printing files was done with ADOBE Photoshop.

3.2 Aspects of the map layout

The sheet size of the map is standardised with 60.5 by 74.4 cm and was calculated for folding the map. The extension of the portrayed area is 9' by 9' for Lizum/Walchen and 8' by 7' for Seetaler Alpe. The map is north orientated by the central meridian and has geographical sheet lines. Elements of the map are the map itself with the scale information, an overview map with the sheet line system, a legend, an example of a position report, information on the declination, the grid magnetic angle, the grid convergence and the annual magnetic change, information about the used data, and information about the military training area in terms of legal and safety instructions as shown in figure 3. The map is bilingual in German and English as commonly used for maps produced at the Institute for Military Geography.

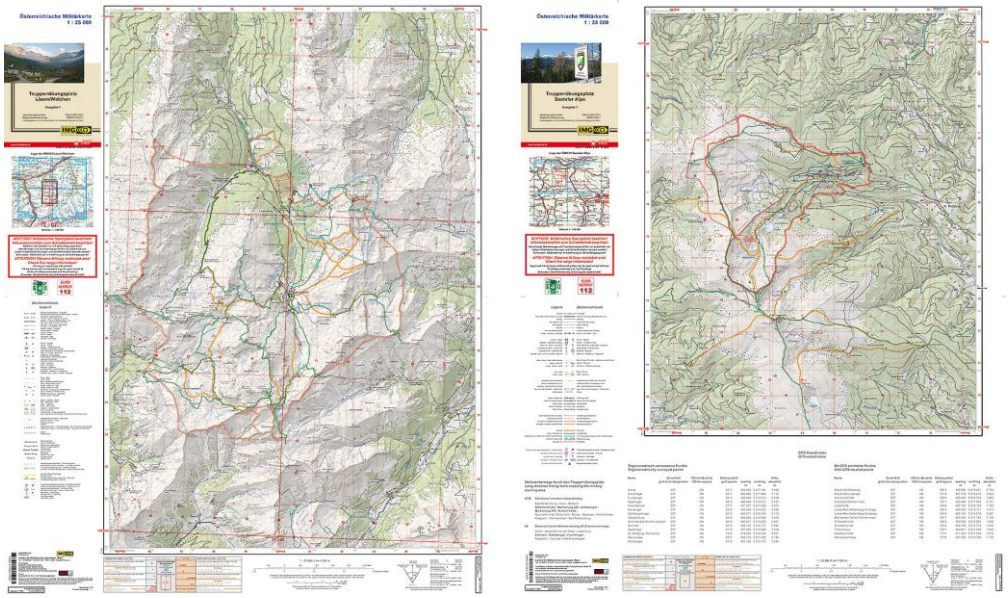

Figure 3: Layout of the maps Lizum/Walchen and Seetaler Alpe

A graticule as well as a UTM grid was computed for the topographic maps 1 : 25 000. A digit repetition on the UTM grid normally used for military maps, but increasingly important for civilian editions used by emergency services, is provided. The construction of this information was done manually.

At the rear side of the map additional information was printed with 40 percent black. Coordinates of trigonometrically surveyed points and points located with GPS, which can be used by artillery, are listed. Further on, coordinates of helicopter landing pads, information of how to prepare a helicopter landing, and how to take up contact with the helicopter crew when the helicopter approaches, are described.

A short description of hiking paths in the military training areas, of long distance hiking trails crossing the military training areas, as well as the European avalanche risk levels and alpine emergency information are given.

At the left and right side and at the border of the south and north side of the map at the front side, a raster of 2 millimetres depicting 50 meters in reality is shown which can be used as a coordinate ruler. The explanation of that is given at the rear side of the map, as shown in figure 4.

Figure 4: Coordinate ruler description with 2 millimetre lines at the rear side of the map

3.3 Aspects of the symbolisation

One of the prerequisites of the cartographic design was to create a map with a similar symbolisation like the topographic map 1 : 50 000 produced by the Federal Office of Metrology and Surveying, although other programs were used for the production. The symbols of the topographic map 1 : 50 000 could be obtained in an ADOBE Illustrator format. The size of the symbols was enlarged by the factor 1.5 for the map 1 : 25 000. The special military symbols were created to match the other symbols, as shown in figure 5.

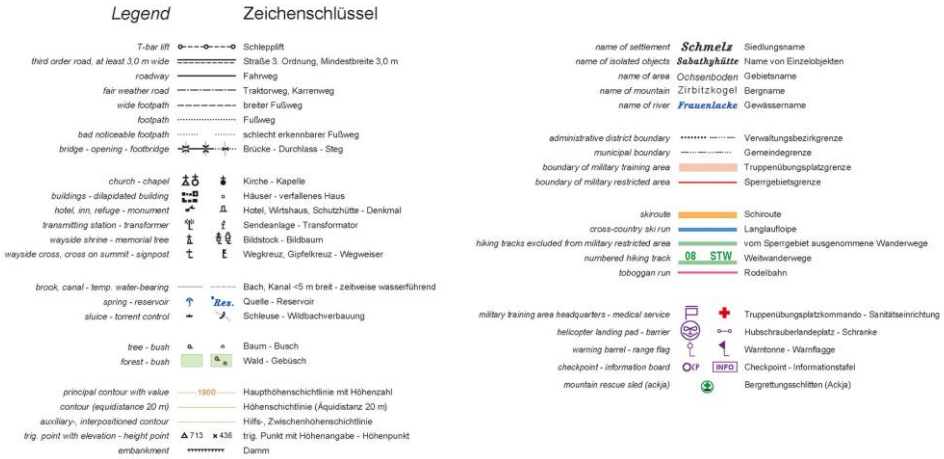

Figure 5: Legend of the topographic map 1 : 25 000

Special challenges to create and to handle are double lines in ADOBE Illustrator. The creation of simple double lines is easy, at the dialog of the appearance two different strokes can be defined, an outline and a centre line, with different stroke sizes and colours. Double lines with different lines like third order roads are difficult to realise, as described in figure 6. The first step is to select the path and to build an outline by offsetting the path where the distance between the two lines can be defined. The next step is to select the two end paths with the Direct Selection Tool, which could then be deleted. After that, the two lines can be symbolised with different line weights, line stiles and colours. The centre line, which is still available, can be used to define a line fill.

Figure 6: Creation of double lines with different styles

Rivers symbolised with double lines had to be corrected when connecting at a brook symbolised with a single line, as shown in figure 7. After creating the double line as described before, the ends of each line must be manually joined with the end point of the single line.

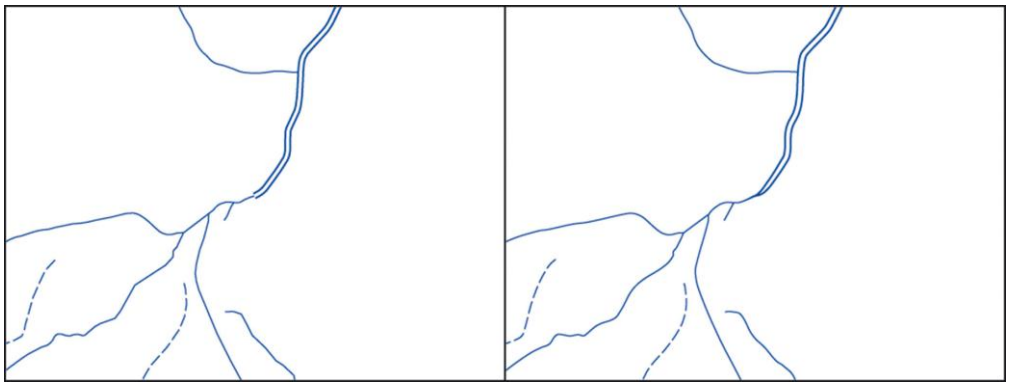

Figure 7: Corrected double lines

Another problem was the creation of lines with different symbols like the portrayed administrative district and municipal boundaries. For that purpose, Ernst Hutzler from the ETH Zurich accepted the proposal of the author to program such a function which is now available within the cartographic tools for ADOBE Illustrator (AI Plugins, 2011). That tool allows the placement of up to three different symbols along a path, where the distance between these symbols has to be defined. After the automatic placement of the symbols on a different layer, a manual adjustment of the position and the alignment respectively the rotation of the symbols can be done.

The knockouts for the symbols and the lettering were done almost manually. For that purpose, a copy of the element has been created that was enlarged by an outline with twice the weight of the distance the element should be spared. With that copy together with the line a new opacity mask with a knockout group is created. However, a precise inspection of the whole map is required urgently. A new function of MAPublisher 8.3 enables to spare a whole layer of text against a layer with lines. This function could be used to spare contour labels against contour lines at one time.

As a secondary product, the maps 1 : 25 000 were used to create detailed maps for the user regulations for military training areas. In these maps the base, firing line limits, and the primary direction of fire for particular firing ranges are portrayed. Additionally, warning barrels, range flags and range guards for the exclusion areas are displayed to obtain the required safety.

4. OUTLOOK

After printing the map Seetaler Alpe in January 2011, the request for the production of a map of the military training area Hochfilzen arrived at the Institute for Military Geography. The planning for the production is an already ongoing project.

The use of laserscanning data offers a new potential for deriving map features like rock representation as shown in Klauser (2009) or vegetation as described in Gartner et al (2009). The use of laserscanning data could also reduce drastically the time for processing, for instance the time for the field survey or the digitizing of roads and paths from orthophotographs by a simultaneous improvement of the quality especially for paths in forested areas.

Finally, it would be desirable to get more functions within ADOBE Illustrator to automate the cartographic production process, for instance the automatic placement of a UTM grid with the digit repetition.

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