swisstopo

Bundesamt für Landestopographie
Office fédéral de topographie
Ufficio federale di topografia
Federal Office of Topography

Topography

Seftigenstrasse 264
CH-3084 Wabern
Telephone +41 31 963 21 11
Fax +41 31 963 24 59

www.swisstopo.ch

# Alpinists – and the future Swiss topographic landscape model

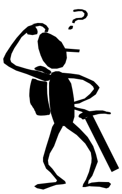
Martin Gurtner, swisstopo, Federal Office of Topography, CH-3084 Wabern
martin.gurtner@swisstopo.ch

*Summary*

*Compared to some animals, humans are rather poorly equipped for orientation. We rely mostly on our eyes for orientation. When visibility is poor, we need the assistance of a marked trail, a map or similar terrain depiction, and navigational instruments. What can a precise vector oriented topographic data base offer to the alpinist? There are many nice things possible (and thinkable), but in the end, someone will have to pay for all this. Generally speaking, the printed map combined with the instruments or a small computer furnishing the position on the background of a digital map are sufficient to cover an alpinists needs.*

Fig. 1: When the visibility is poor, orientation is difficult. Our senses are mainly based on visual impressions. Climbers in the mist, near Quito/Peru.

Once a single mountaineer (or a leader with a group) is on his way and visibility gets worse and worse, the three basic questions arise:



Where are we?

Where do we go?

How do we get there?

Depending on the experience, the instruments and – of course – the map used there may be a certain divergence in the results.

## Where are we?

The best way is to stay « tuned » all the time : to follow the track constantly on the map and to check the position every now and then with some prominent feature. This way, if all of a sudden clouds come in, no one gets surprised. When time counts, e.g. in an orienteering competition, or when someone has some difficulties to relocate himself on the map, it helps to hold the thumbnail on the current position on the map (which has been oriented to the north, which means that what lies ahead in reality is on an parallel line on the map). This way, one can always follow the course and there is no need to scan the entire map first to find the location before the next decision comes up.

Positions are usually indicated in the local map grid in X, Y, Z or in latitude and longitude. With a GPS receiver, we have these co-ordinates within seconds on the display. But what can we do with these numbers? They alone cannot help! We transfer them onto the map and can then judge if the surroundings in nature correspond to those shown on the topo sheet. The future generation of personal navigators will have a suitable display and enough storing capacity to show the map and the measured position on the screen.

As numbers can easily misread or misunderstood, co-ordinates have always to be followed by a further description of the location, e.g.

> *640 600/153 700, 200m E of the Rottalsattel at the Jungfrau, altitude 3780m*

With this information, a search and rescue team would know exactly where to head for. A few years ago, a helicopter crashed in central Switzerland, because they had been on the wrong side of a mountain, a co-ordinate had been wrongly transmitted by 1km!

For many people, a printed map is nearly a “holy” paper. Sure, they contain a lot of information. But they are also well suited for marking the proposed track, highlighting prominent features on the way or to note decision points and the criteria:

> *If the group is at the foot of the glacier leading up to the Fieschersattel before 10am and the weather is still fine, then we start the climb, otherwise we head straight down to the Konkordiaplatz.*

Once the trip is finished, we follow the track again on the map. We indicate the places where orientation was difficult and figure out how we can do better under similar conditions next time.

## Where do we go?

When we prepare a trip at home with the map and the guidebook, we know more or less precisely which way we want to go. We can mark the important positions and read the co-ordinates using the map grid. If we have a digital map, we can record the co-ordinates of the waypoints directly into the GPS receiver. Once we get stuck, we mark the next waypoint on the list – the bearing and the distance are instantly calculated. Think about to carry spare batteries along, a few hours continued use ware them down rapidly! The receiver needs the power to perform thousands of calculations.

No batteries are needed for a traditional compass. First of all, it helps to orient the map towards north, to make directions on the paper to coincide with their equivalents in nature. Compasses are most helpful in flat terrain and under poor visibility: at night, in the mist, in a snowfall or in the woods. If we know our current position and if the next waypoint is not too far away, we can transfer the bearing from the map using the 3-step-rule:

1. Place the compass on the map, with the long side parallel to the line we want to go and with the string towards the starting point and the arrow pointing in the direction of the next waypoint.
2. Turn the inner circle until the lines of the compass pointing north are parallel to those on the map. Now we can read the bearing if you want to, make sure you use the right division (° = 360 degrees, gon = 400 grads, rad = 6.2 .
3. Take the compass away from the map and turn yourself until the red part of needle is between the two marks. Now the arrow points toward the waypoint.

When we use the GPS receiver, it will automatically calculate the bearing and the distance to the next waypoint. As distances are most difficult to estimate, we look at our watch and make an estimate for the time we might need for the next lap.

If we do not have any instruments, the sun, the moon, the stars or a distant, prominent landscape feature will help to maintain the right direction.

## How do we get there?

By looking at the map, we can see if roads connect the two points, if there are any tracks or if we have to go cross-country. We get to know about the land use: is it a built-up area, will we have to go through forests or around lakes? Are there rocky areas on the way, or would we even have to cross glaciers? We can estimate if it is worthwhile to climb a hill or to go around it, we see where we can use a bridge to cross the river, and so on. To take such a decision, a quick calculation is necessary:

| | | |
|---|---|---|
| 1 km flat on flat terrain | ⇨ | _ hr |
| for each 100m climb | add | _ hr |

## Information sources

Beside the printed map, we can use birds-eye views of an area with special interest or orthophotos to get more information. Maybe we have access to a digital map, for remote areas a satellite image can be helpful. The hikers or climbers guide book gives us further information that cannot be depicted otherwise and we are sure to get up-to-date details from the rangers at the information center.

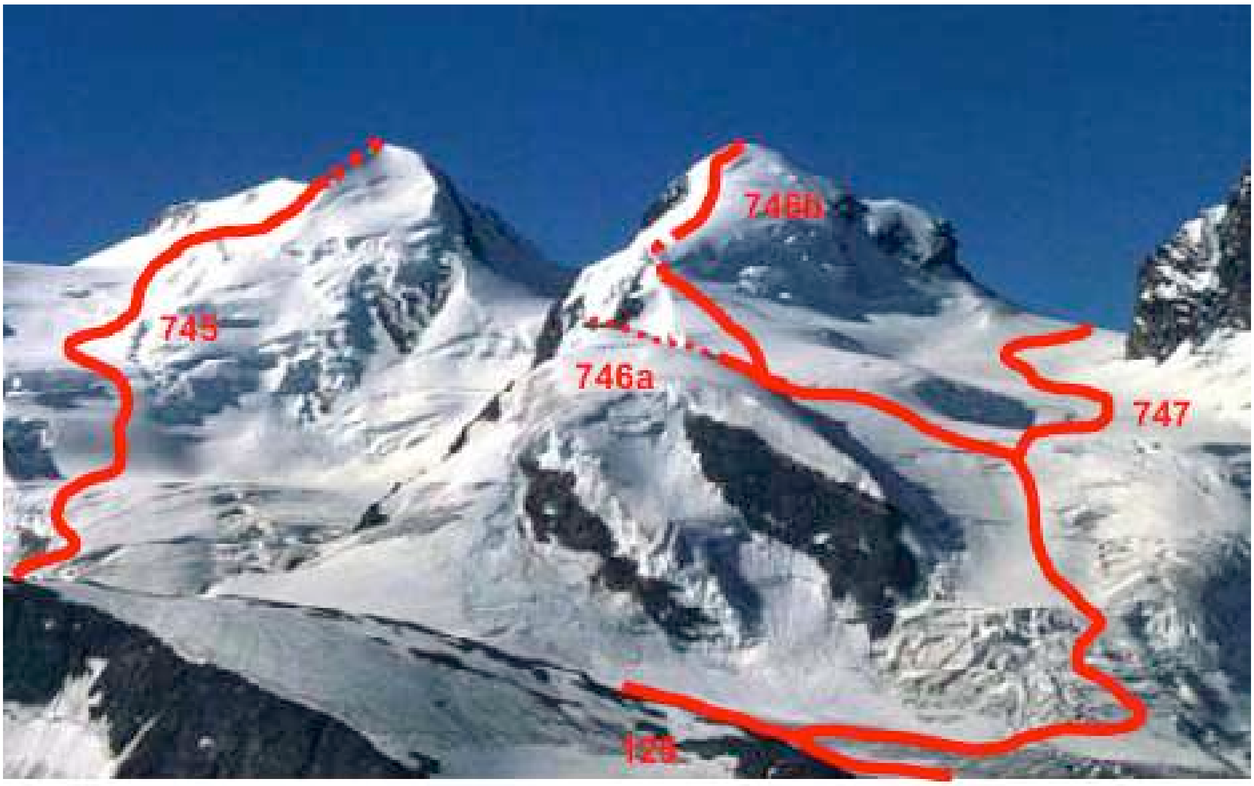



Fig. 2: From a climber’s guidebook, the peaks along the Swiss-Italian border near Zermatt.

## Information media

The get this the necessary information, we can ask directly or on the phone, we check the printed map or book, we listen to the forecast on the radio or watch on tv. The internet offers a wide variety of possibilities. Once we are on our way, the cell phone (or in special cases a radio transmitter) may be the only connection to the “outside” world.

## Tools and Instruments

Together with the (printed or digital) map, the GPS receiver is the most helpful instrument. The latest models have built-in altimeters and compasses. Of course the latter two traditional instruments are still of great importance – if we know how to use them and what accuracy we can expect.

## Involved organizations

Many different bodies are involved in the collection and distribution of data and information: National Mapping Agency, Local Government, Alpine Club, Hikers Association, Bikers Association, Tourist Boards, Park Board, Hotels, Huts, Local Business, Telecom, Instrument firms. This can make it rather difficult, when common actions are required.

## The future Swiss Topographic Landscape Model TLM

At swisstopo, a map based, vector oriented model is for sale, called VECTOR25. The preliminary works for a new and more accurate model have begun, aiming at the following specifications:

- 1m accuracy for important, selected features (roads, houses),
- road network with individual lanes,
- buildings 3D,
- highly accurate height information,
- frequent revision.

Fig. 3: Raster and vector maps, orthophotos and satellite imagery can be combined and draped on top a digital terrain model to produce spectacular views.

## TLM Production

To build up such a model is a huge task. Therefore, swisstopo is seeking the assistance of other organizations:

- roads should automatically be extracted from aerial photographs (research project called ATOMIR together with ETH Zurich);
- accurate height information (DTM terrain and DSM surface) is obtained by laser scanning carried out in the framework of an agricultural land use survey;
- buildings could be selected from aerial photography, using DSM and DTM (software developed in a common research project with TU Dresden);
- the hydrography (including glaciers) has already been treated by the Federal Office of Water and Geology.

## TLM compared to National Map Series 1:25‘000

| | TLM | Map |
|---|---|---|
| Data | fully digital | analogue and digital |
| Content | Layers and attributes | symbols |
| Access | fast | requires experience |
| Accuracy | 1m for selected Detail | generally sufficient |
| Hardware | heavy equipment | lightweight |
| | needs batteries! | |

## Conclusions

The improved accuracy serves mainly the specialists (although also an alpinist can make a profit out of it when he/she uses the car navigation system). The contour lines in forest areas were so far not always reliable (plane table surveys), improvements there could help.

The TLM gives supplementary information, e.g. if a road is tar sealed, or if there is a cycle track parallel to it. The closer we come to the mountains, the less important such detail is.

The fully digital approach offers new possibilities like a „3D“-view from a pre-selected site with combined overlays (aerial photography, vector and raster maps) on top of the DHM25 terrain model, or the network of marked trails and alpine routes. Such things are “nice to have”, but not really important for mountaineering.

## Final questions

1. What is possible and what makes sense? Could I download through wireless internet an extra portion of digital map data when I leave the chosen area? The technical side progresses rapidly and today’s dreams may become reality soon.
2. Who will pay for all this? Is it a government’s task or could the user be charged for the services he uses?
3. What shall be public domain? European NMAs have a different approach to this field than the US.
4. How much will a user be ready to pay? Of course he would like to have as many things for free as possible.
5. How much will the map sales be affected? Probably not that much, as a small screen never gives an overview of the area.
6. Who will coordinate these activities? A close(r) co-operation between NMAs and Alpine Clubs will be necessary. And this again will depend largely on the answers to questions 2 to 4.

## Literature


- Sayda F. +…: „Aufbau eines positions-bezogenen GI Service für Bergsteiger“, GIS/SIT Zürich, 2002
- Imhof, E.: „Gelände und Karte“, Erlenbach, 1968
- Voser, S.: TopoBank Voranalyse, Wabern, 2000 (not published)
- Gurtner, M.: „Karten lesen“, SAC-Verlag Chur, 1998