Map reading

Understanding and using national maps

free

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From reality to the map

Maps provide a simplified image of the earth's surface.

Reality

↓

Aerial photo

↓

Map

Reality
Our surroundings are marked by complex structures. People have always needed to apprehend them and depict reality in a simplified manner.
People are used to always seeing the terrain from a more or less horizontal viewpoint. The challenge is to show what is seen from an aerial perspective.

Aerial photos
Aerial photos are vertical aerial photographs of the earth's surface and are an essential source for the updating of national maps.
Map content invisible in aerial photographs, such as boundary lines or annotations, have to be ascertained.

Maps
Maps are scaled down and simplified representations of a section of the earth's surface. In a simple and legible form, they provide as much information as possible on settlements, paths, bodies of water, terrain, vegetation as well as individual objects. The degree of detail mainly depends on the scale – the reduction ratio. The meaningful reduction of the map's contents is called cartographic generalisation.

Landscape memory of Switzerland
Maps require frequent updating since reality in terms of structures or topography is subject to constant change. Keeping former maps enables us to create a history of the Swiss landscape.

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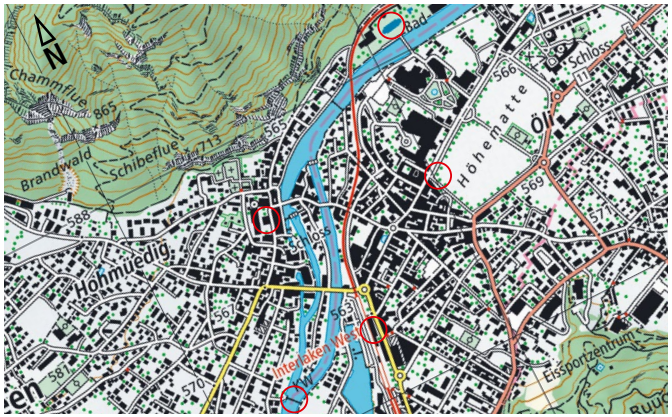
Reality

Aerial photo



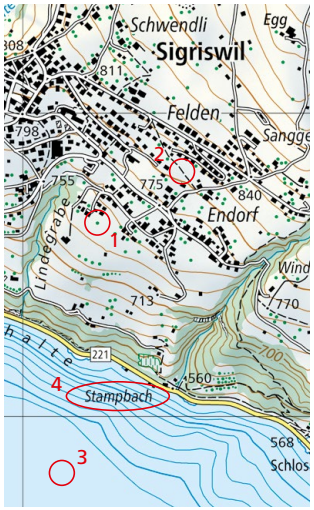
Map

Map symbols

Symbols are graphic characters that give information in maps. They are uniform, simple and as self-explanatory as possible.

Symbols can be compared to the letters of a language. They have to be quickly recognisable if we are to deduce from the map what the landscape looks like or quickly orient ourselves in the field.

Map symbols can be divided into the following groups:



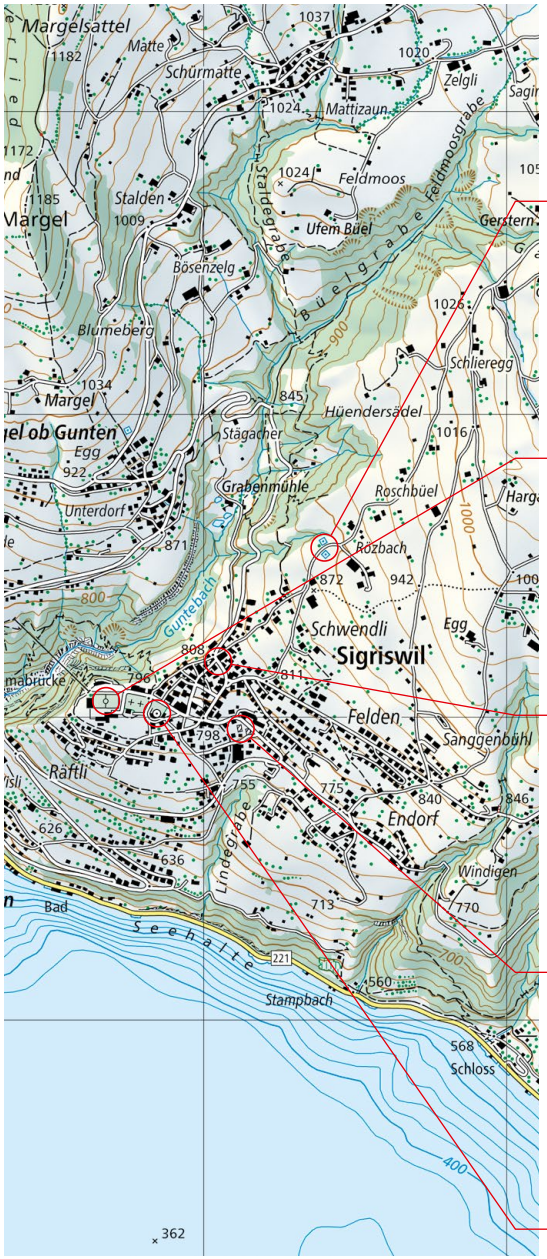
Point symbols [1]
Representation of local objects.
e.g. trees, towers, spot height, fountains

Line symbols [2]
Representation of objects that show a linear route.
e.g. rivers, streams, roads, tracks, boundaries

Area symbols [3]
Representation of surface areas.
e.g. forests, lakes, orchards, waste disposal sites

Annotations [4]
Annotations are additional elements that indicate and explain map contents more precisely.
e.g. place names, field names, mountain names

Conventional signs
Follow this link for an overview of Swiss national map symbols.
www.swisstopo.ch/mapreading



Cartography attempts to represent symbols as realistically as possible, both graphically and as to colour.

Map scale

Map scales indicate the relationship between distances on a map and the same distance in the field.

Map scale

1 km = 10 cm
1:10,000

1 km = 4 cm
1:25,000

1 km = 2 cm
1:50,000

1 km = 1 cm
1:100,000

Small scale

1 km = 0.5 cm
1:200,000

1 km = 0.2 cm
1:500,000

1 km = 0.1 cm
1:1 m

The map's scale is given as 1:scale figure, e. g. 1:25,000, which, in this case, signifies that 1 cm on the maps corresponds to 25,000 cm (250 m) in nature.

Conversion:

1:25,000 4 cm = 1 km
Map distance in cm divided by 4 = distance in the field in km

1:50,000 2 cm = 1 km
Map distance in cm divided by 2 = distance in the field in km

1:100,000 1 cm = 1 km
Map distance in cm = distance in the field in km

Large scale / small scale

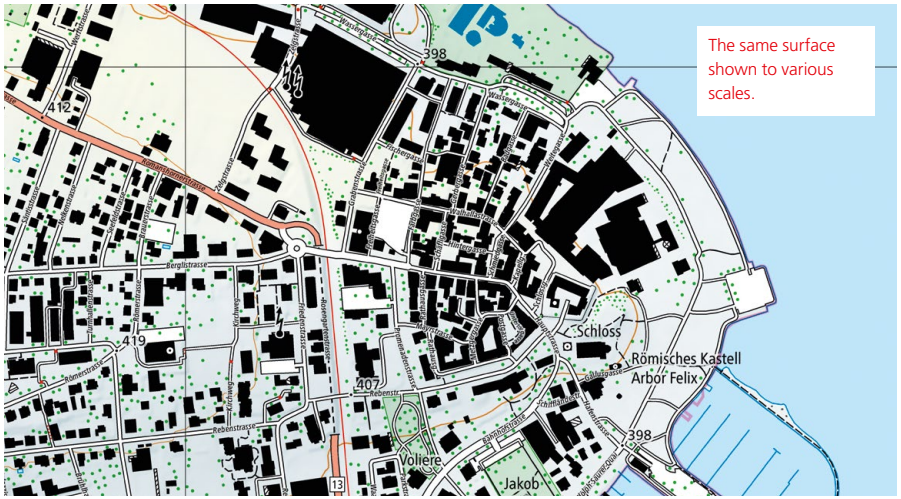
The precision of a map depends on its scale. Large-scale maps show a small area in detail, while smaller-scale maps show larger areas in less detail. The smaller the scale, the less space is available on the map and the less detail is shown.

What scale for which use:

1:10,000	Local orientation
1:25,000	Hiking, mountain climbing, mountain biking
1:50,000	Hiking, cycling
1:100,000	Overview for cycling, motorised traffic
1:200,000 to 1:1 m	Motorised traffic, overview

Generalisation

Cartographic generalisation simplifies maps graphically and as to content.



The same surface shown to various scales.

1:10,000

1:25,000

1:50,000

1:100,000

The smaller the scale, the less space is available on the map to depict the relevant contents. When producing maps, the contents are selected, simplified, summarised or emphasised according to their importance. The aim is to optimise the legibility and usability of a map, which is a process known as cartographic generalisation.

Example

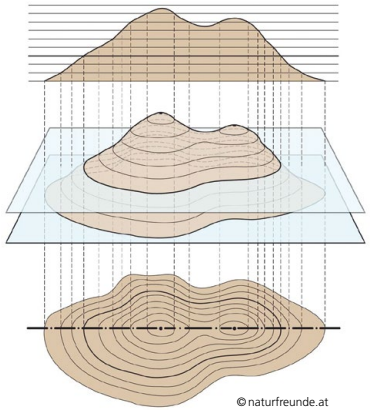
For the same surface area, there is one hundred times more space available at 1:100,000 scale than at 1:10,000.

Tip:

On the maps to 1:10,000, 1:25,000 and 1:50,000 scales, the distances between the lines of the coordinate grid always correspond to 1 km in the field.

Contour lines

Contour lines link points at the same altitude. They allow the representation of terrain such as hills and valleys.



Contour lines are lines on the map linking points at the same altitude. The altitude difference between two neighbouring contour lines is called equidistance.

The following equidistances apply to national maps:

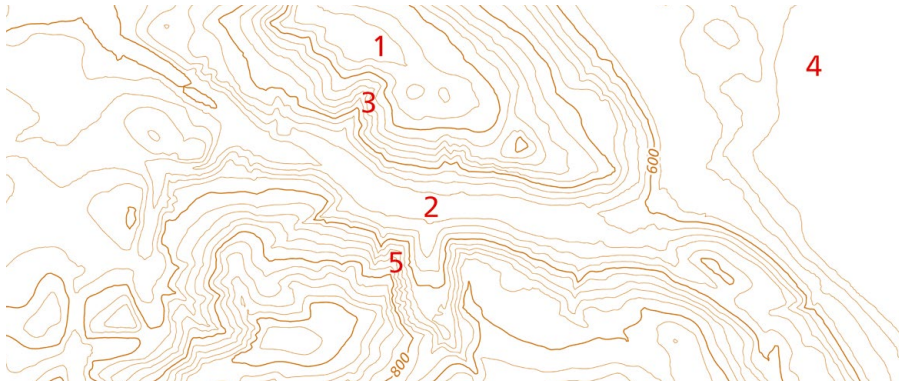
- 1:10,000 = 10 m
- 1:25,000 = Swiss Mittelland, Jura: 10 m / Alps: 20 m
- 1:50,000 = 20 m
- 1:100,000 = 50 m
- 1:200,000 = 100 m

Various important facts about the terrain can be gained from contour lines. Features of the terrain such as ridges [1], valleys [2] or troughs [3] can be identified from their course and distance.

The following principles apply:

The farther apart the contour lines are, the flatter the terrain. [4]

The closer the contour lines are, the steeper the terrain. [5]



Shaded relief and rock representation

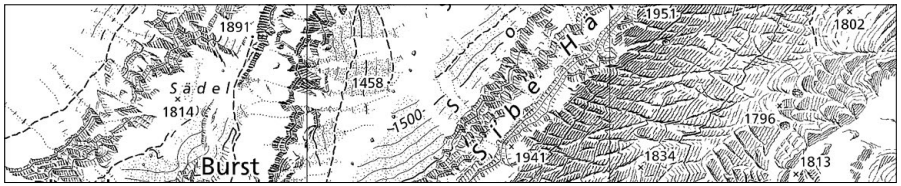
Shaded relief and rock representation help to depict the terrain and, along with the contour lines, assist the observer to interpret it.

A three-dimensional effect is achieved by emphasizing the shade tones. The use of shaded relief, a three-dimensional shadow effect, makes maps look more realistic and enhances the legibility of the terrain.
The depiction of rock helps users interpret mountainous areas and is essential in combination with the contour lines.

Shaded Relief

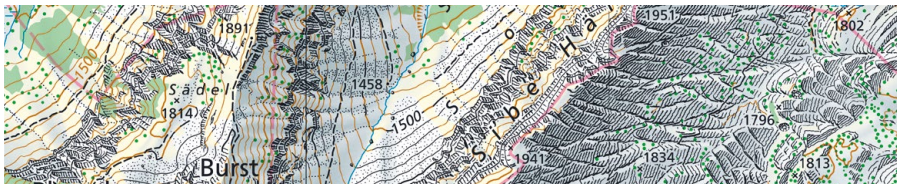
The light for the shaded relief comes from the upper left (north-western-illumination). This does not correspond to natural sunlight, but to mental habits. Our brains are used to light coming from above. The shading effect is enhanced by using a light yellow in the sides facing the light source.

Rock representation



National map rock representations show rock zones clearly and in great detail.

National map with relief and rock representation



The map looks three-dimensional thanks to relief and rock representations.

Annotation system

The lettering used in maps makes it fast and easy to find places and objects.

Certain typefaces and sizes are used according to the type and significance of the lettered object. Thus, for example, places with the same name as the political municipality are written in Roman type. All other place names, city districts and neighbourhoods are written in italics. The size of the place names is based on the number of inhabitants.

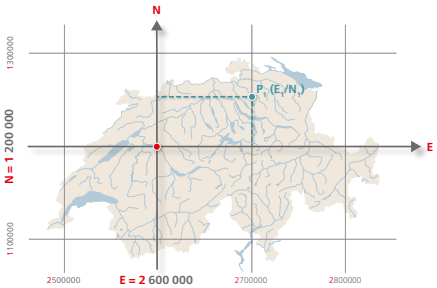
Swiss national maps use the concise, sans serif Frutiger typeface to increase the legibility of lettering that is sometimes very small for reasons of missing space.

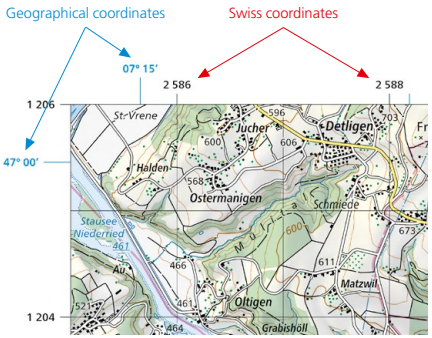
Examples of lettering

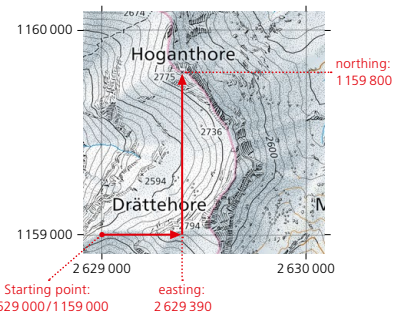
Municipalities Places Districts	**BASEL** **LUGANO** ***Oerlikon*** *Bethlehem*
Mountains	Piz Bernina Wildhorn Mont Tendre Belchenflue Cima Pescia
Passes	*Passo del San Gottardo* *Col de la Croix* *Hohtürli* *Oberlugge*
Area and topographical names	*Kiental* *Pfywald* *Allmend* *Grundwald* *Chlistalde*
Lakes and rivers	*Thunersee* *Lac de Joux* *Greifensee* *Lago Ritóm* *Lej dals Chöds*

Coordinates in Switzerland

Coordinates allow the exact indication of any point in Switzerland.







The Hoganthore has the coordinates: 2 629 390/1 159 800

Swiss national coordinates

Berne is the starting point for the Swiss coordinates system with coordinates 2 600 000/1 200 000. The first number is its location in a west-east direction, the second on the south-north direction. The 2 and 1 million digits were added with the new Swiss national survey (national survey of 1995).
The numbers indicate metres and can thus be used for measurement purposes.

Coordinate indications on the Swiss national map

On national maps, the Swiss national coordinates are added as an orthogonal coordinate grid. To 1:25,000 and 1:50,000 scales, this is a 1 km grid with a 4, respectively 2, cm grid.
There are also geographical coordinates in blue on the edges of the map. Longitudes and latitudes are indicated in degrees and minutes.

Determining a coordinate

The starting point is always the intersection of two coordinate lines at the bottom left. From there, you measure or estimate the number of metres towards the east and the north.

Tip: In order to avoid misunderstandings or mistakes, especially in emergencies, coordinates should always be supplemented by other place designations such as the name of the canton or municipality, the altitude, valley or name of a summit.

Products and applications

The right product for every occasion – either analogue or digital.

Paper maps

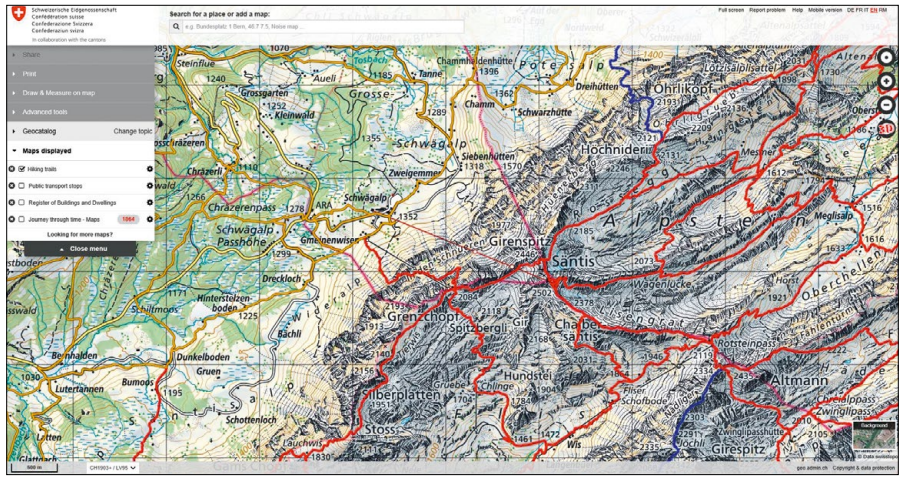
In addition to the national map series, paper maps also cover topics such as hiking, geology, history and aviation. With mySwissMap you can create your own personalised map.
Information and orders at www.swisstopo.ch/shop

Digital products

In digital form, maps, aerial photos and landscape models are available amongst other things. Digital standard products are free of charge and can be used freely.
More information at www.swisstopo.ch/geodata

Map viewer and app

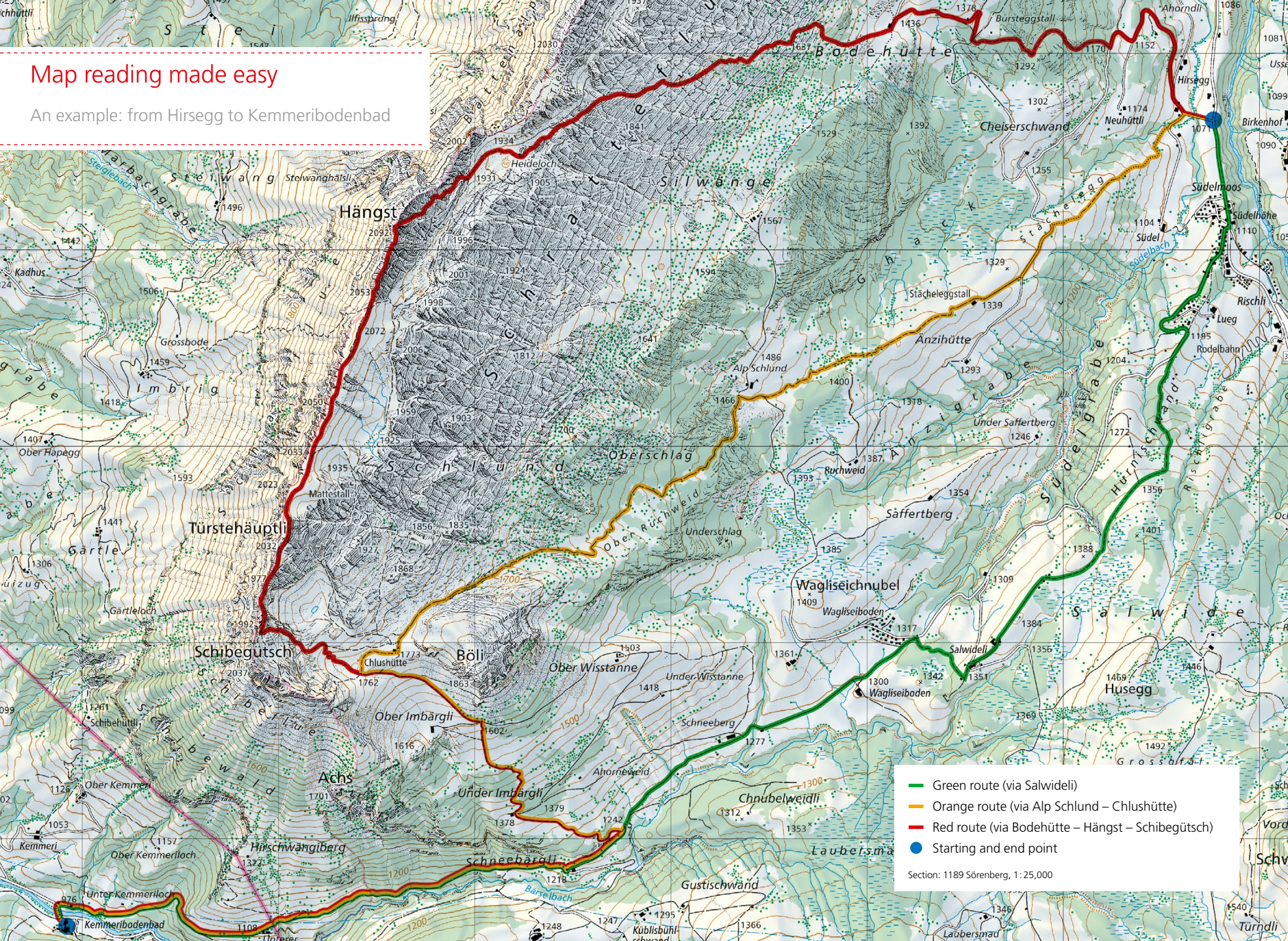
Maps and geodata can be easily discovered at map.geo.admin.ch. With the map viewer, geodata can be viewed and also printed out. The swisstopo app brings the national maps and many topics for leisure and work to your smartphone or tablet.
More information at www.swisstopo.ch/app



The Swiss federal map viewer – with integrated hiking paths and the 1:50,000-scale national map.

Map reading made easy

An example: from Hirsegg to Kemmeribodenbad



Preparation with maps

Maps allow a number of route selection factors to be interpreted.

The right map

The right map with the appropriate section and scale must be selected for the intended route. Planning with current maps avoids surprises en route. When hiking with digital maps, the required section should be downloaded onto a smartphone in advance, to be available even offline.

Physical requirements

Maps indicate distances, differences in altitudes or ascents and descents as well as the types of path. This information indicates the approximate hiking time and difficulty of a route and permits the creation of a realistic timetable. This is important to estimate if you are up to the challenge and are fit enough.

Itinerary

The type and surface of the path can be identified with the help of the map. If there are pathless sections, orientation challenges increase. Enough time should be included in your calculations if obstacles have to be crossed or if the route contains exposed paths.

Find significant waypoints

It is recommended to determine significant waypoints during planning. This will improve your orientation and break up the route into stages.

Other important influences to take into account during planning:

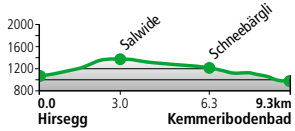
Season and weather: Is the weather good or can rainfall, thunderstorms or fog be expected? Is the ground dry or wet, are there fallen leaves? Is there snow at higher altitudes?

Bags and equipment: Am I carrying a large load? Do I have enough food and drink? Is my clothing appropriate for the season? Am I wearing sturdy shoes suitable for the route?

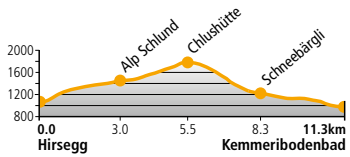
Route analysis and selection

Careful and thoughtful planning is a safety factor.

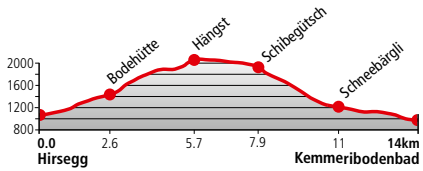
Green route



Orange route



Red route



It is imperative to take distances and elevations into account during preparations.

Tip: Mark the planned route on the map and decide on possible alternatives for difficult sections.

Distance

The distance is indicated by a map app on a PC, tablet or smartphone or with a distance calculator, or estimated summarily on the map sheet.

Green route:	9.3 km
Orange route:	11.3 km
Red route:	14 km

Elevation

Ascents and descents are indicated by counting the contour lines or are calculated automatically online by creating an elevation profile.

	Ascent	Descent
Green route:	330 m	420 m
Orange route:	720 m	810 m
Red route:	1020 m	1110 m

Route analysis

Green route: good paths and roads, no steep ascents or descents, no exposed sections, simple orientation requirements.

Orange route: sections on trails, paths and roads, medium-steep climbs, possibly exposed in the Chlushütte area, simple to medium orientation requirements.

Red route: sections on trails, paths and roads and some without paths. Very steep ascents and descents, the route through the gullies requires sure-footedness, exposed portions on the Hängst ridge as far as Schibegütsch, high orientation requirements with sections with no paths.

Route selection

Following the route analysis, the right route can be selected taking the influencing factors into account.

Walking time calculation for hikes

Calculating the walking time is an essential point when planning hiking trips.

Walking time calculation is important when there are no time indications.

Many route-planning apps calculate the walking time automatically.

This rule of thumb helps to calculate walking times for small groups:

	Approximate value:
One kilometre on a level path	15 min
Per 100 m ascent	+ 15 min
Per 200 m medium-steep descent	+ 15 min
Gentle descent	10 % deducted from time

Example

The red route from Hirsegg to Kemmeribodenbad gives the following basic times:

Distance: 14 km	14 x 15 min	=	210 min
Ascent: 1000 m	10 x 15 min	=	150 min
Descent: 300 m (steep)	1.5 x 15 min	=	22.5 min
Gentle descent: 5 km	–0.1 x (5 x 15 min)	=	–7.5 min
Estimated walking time (incl. short breaks):		=	375 min
		=	6 hours 15 min

Other factors

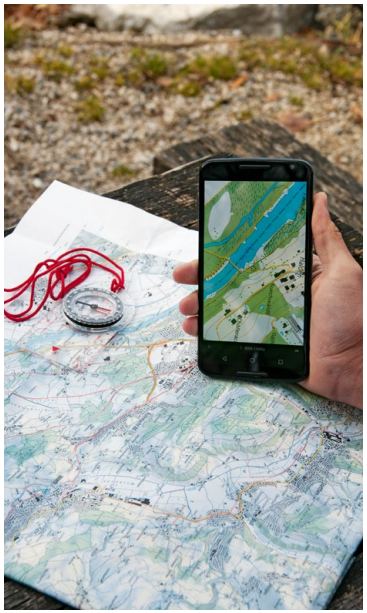
Quicker than usual:
Alone, without a load, in cooler temperatures, on good paths, with a gentle descent, in the morning when well rested

Slower than usual:
In groups, with a heavy load, in hot weather, in difficult terrain, after midday, as the hiking trip advances, in snow

Important: Calculate breaks separately from your walking time and plan stopping places in advance with the map.

Orientation in the field

Orientating the map and determining your location



Orientating the map using a compass or automatically on a smartphone.

In order to orientate a map towards the north and to determine where you are in the field, navigation devices or smartphones with map apps now provide good service. The devices are located by satellite, allowing your position to be determined. It is also important for hikers to be able to determine where they are without any technical devices.

All topographical maps are orientated north, i.e. the upper edge of the map is north. In order to orientate yourself with a map in the field, you first need to determine which way is north.

Orientating the map

The simplest way is to orientate the map towards the north with a compass. However, the map can also be orientated by means of easily recognisable lines in the field such as roads, water-courses or forest edges.

Determining where you are

If the map is orientated north, look for striking features close by (i.e. church towers, bridges crossroads) and align the map with these.

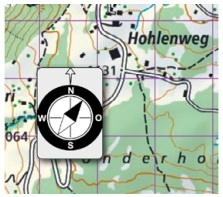
Tip: Paper maps can also be aligned using a smartphone. Use the compass function and position the smartphone along the coordinate grid on the paper map. Turn them until both of them point north.

Compasses as orientation tools

"Northing" and transferring the direction

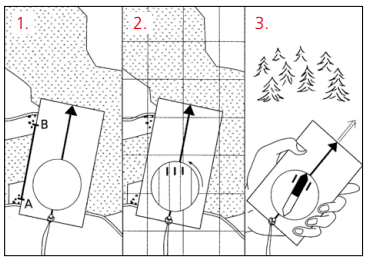
Northing with a compass

1. Compass needle pointing north.



2. Compass needle and map pointing north.

Transferring the direction



Three steps to transferring a direction from a map to the field.

Compasses

The natural orientation of a compass' magnetic needle towards the north aids in orientation in the field. This advantage is especially useful in fog or difficult terrain (i.e. a forest).
A compass' main task is to show the north and to transfer a direction from the map into the field.

Northing

The north can be surely and simply determined using a compass.

1. Lay the compass along the coordinates grid.
2. Turn both until the magnetic needle points to the north marking.

Transferring the direction

Transferring a direction from the map into the field is done using the 3-point rule:

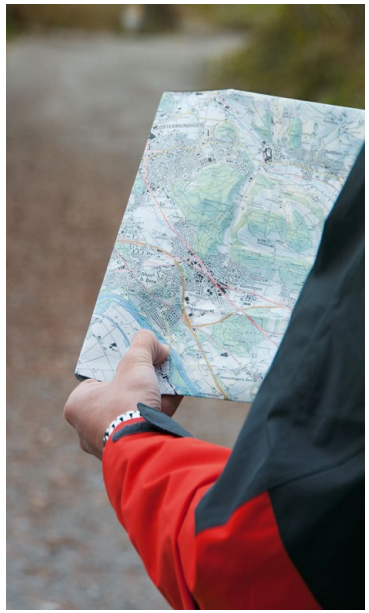
1. Lay the longitudinal edge of the compass on the map on the line linking location A with goal B.
2. Turn the bezel until the bezel's south-north line is parallel to the one on the map (north mark uppermost).
3. Turn the compass until the northern half of the magnetic needle is on the north marking of the bezel. The compass' longitudinal edge now shows the desired walking direction.

Please note:

- The magnetic needle can be severely disturbed in the vicinity of metallic objects, vehicles and high-tension power lines.
- Do not expect great precision from transferring directions and thus divide the route into short stretches.

Orientation on the go

The thumb grip helps avoid orientation errors.



With a thumb grip, you always know where you are on the map.

An up-to-date map is useful for orientation purposes. En route, the terrain should be regularly compared with the map to ensure that you are on the right route.

Thumb grip

The best thing to do is to fold the map into handy sections. The map should always be orientated towards the north so that the map image is comparable to the landscape. Keeping your thumbs on your location greatly helps in map reading.

Orientation errors

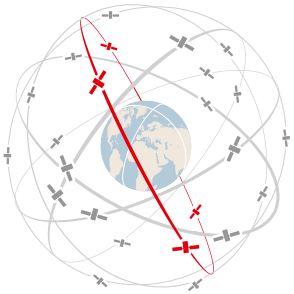
An orientation error is often the reason why the map information no longer corresponds to the terrain. It is easy to make a mistake when map reading, but you should first check if the map is up-to-date or if information is missing (new building, new path). Keep calm and proceed systematically if a map reading error has actually occurred.

Checklist in case of error

- Look for any distinctive locations on the map
- Think back on the route covered since the last certain position; can we find any features on the map? If not:
- Go back to the last certain position. If this is not possible:
- Look for a spot with a good view of the surroundings and get an overview (hills, crossroads, forest edges)

GNSS – Global Navigation Satellite System

Navigating without orientation features thanks to satellite technology



Satellite orbits around the Earth

Indication: The availability and accuracy of satellite systems can be limited due to signal masking (i.e. in narrow valleys, forests, densely built-up areas) or multipath propagation (i.e. reflections from buildings).

The systems

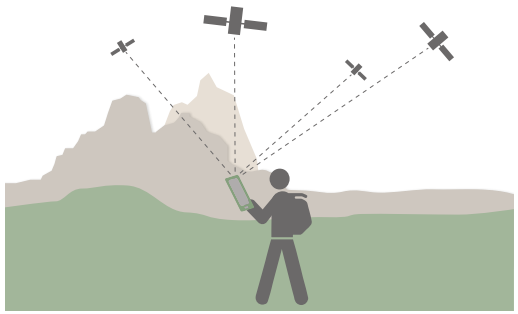
Global Navigation Satellite System or GNSS is the general term for all existing and emerging satellite navigation systems.
Some examples are:

- GPS (Global Positioning System) from the USA
- GLONASS (Global Navigation Satellite System) from Russia
- Galileo from the European Union
- Beidou from the People's Republic of China

All these systems are based on a constellation of 24–30 satellites that orbit the Earth twice a day at an altitude of approx. 20,000 km.

To determine a position you need at least four satellites

Global navigation satellite systems permit worldwide, 24/7, three-dimensional positioning as long as signals are received from at least 4 satellites. For this, you need a satellite receiver, such as those integrated in all smartphones today, or available on the market as various types of standalone devices. The precision of the position coordinates is about 5 to 10 metres. Altitudes are generally estimated to be two to three times less precise.



Satellite-aided navigation

Thanks to satellite technology, navigation devices and smartphones provide valuable services in field orientation.

Smartphones offer good orientation capabilities thanks to integrated satellite receivers and map apps.

Position

The devices primarily deliver coordinates and altitudes at the current position and can represent them on a digital map.

Navigation

A route can be followed by means of waypoints entered beforehand. The device constantly shows the distance and the direction to the next point.

Tracking

En route, positions are continuously determined and stored. After the hiking trip, the route can be evaluated on the device or a computer.

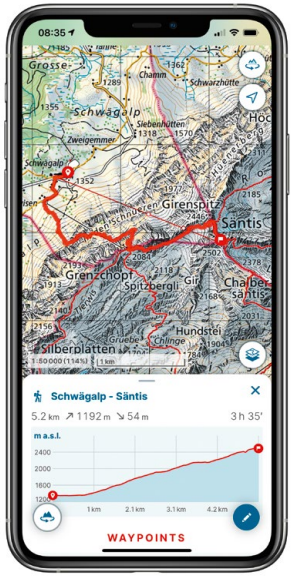
Tips

- Coordinate settings
  Set the device to the Swiss coordinate grid (Swiss Grid/CH-1903+).
- Precision
  To increase precision, change your location, stretch out your arm or measure again later.
- Batteries
  Only turn on the device briefly, take extra batteries or a power bank with you.

Warning: Navigation devices do not recognise hazards such as crevasses or slopes exposed to avalanches. Satellite-assisted navigation offers many possibilities and tools, but does not replace map-reading or mountain skills. Having a map in your bag as a fallback solution is never a mistake.

Maps on smartphones

Smartphones offer many functions – for navigation purposes, too.



Smartphones with map apps are a cheap and versatile alternative to navigation devices for orientation purposes. Smartphones combine many practical functions.
The planned route is simply entered and directs the hiker to his or her goal.
The integrated satellite receiver allows positions to be determined at almost any time, even without a mobile network.

Important facts:

- Most smartphones are not intended for outdoor use and are neither weatherproof nor sturdy.
- Satellite-aided navigation, displaying maps and a frequently activated backlight use a lot of energy.
- In remote areas, there is no mobile reception to download maps.
- Many smartphone displays are hard to read in sunlight.

→ Download map sections and routes in advance and navigate with offline maps.
→ Take along extra batteries or a power bank and deactivate unnecessary functions.
→ Take along paper maps as a fallback solution.

The swisstopo app

The app brings the National Maps of Switzerland, together with many other topics such as hiking, cycling, snow sports and aviation, to your smartphone.

www.swisstopo.ch/app
Download now for free

Download on the App Store

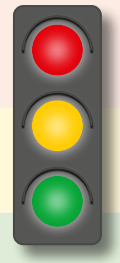
GET IT ON Google Play

Safety and emergencies

Minimising risks and reacting appropriately

People travelling with maps are often in mountains and impassable terrains. This can be hazardous. Appropriate preparations and defensive behaviour are important in avoiding accidents. In emergencies, keep calm, get an overview, think and act.

The traffic light diagram helps in reacting to an emergency.



Red = Look	Look at the situation • What has happened? • Who is involved? • Who is injured? • How many people are injured?
Yellow = Think	Recognise dangers • Danger for victims of an accident? • Danger for helpers? • Danger for other people?
Green = Act	Pay attention to safety Give first aid

Alert emergency services	112 International emergency number 144 Ambulance 1414 Rega helicopter assistance	• Who is calling? • What has happened? • When did it happen? • Where (precise indication of position with coordinates and place names)? • How many accident victims? • Other dangers?
	If alerting the helicopter also report:	• Power lines • Ropes • Weather at the scene of the accident

Tip: In rough and inaccessible terrain it is advisable to raise the alarm directly to the Rega.

On raising the alarm, Rega's free mobile app also transmits the caller's current position.

Signals for the emergency helicopter:

YES, help is needed
(do not wave arms)
Y as in yes

NO help is needed
(do not wave arms)
N as in no

www.swisstopo.ch/mapreading