WSL Institute for Snow
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F. Techel, 2015, www.slf.ch

Regional patterns of avalanche accidents in Switzerland

A look at the map with the location of avalanche accidents in the Swiss Alps in the last 20 years (Fig. 1) shows a clear picture: a particularly large number of avalanche accidents occurred in Valais and Grisons. But what are the reasons for this regional clustering?

Is the clustering of accidents a consequence of a high touring frequency in these regions, or are there other reasons for a higher avalanche accident risk in these regions?

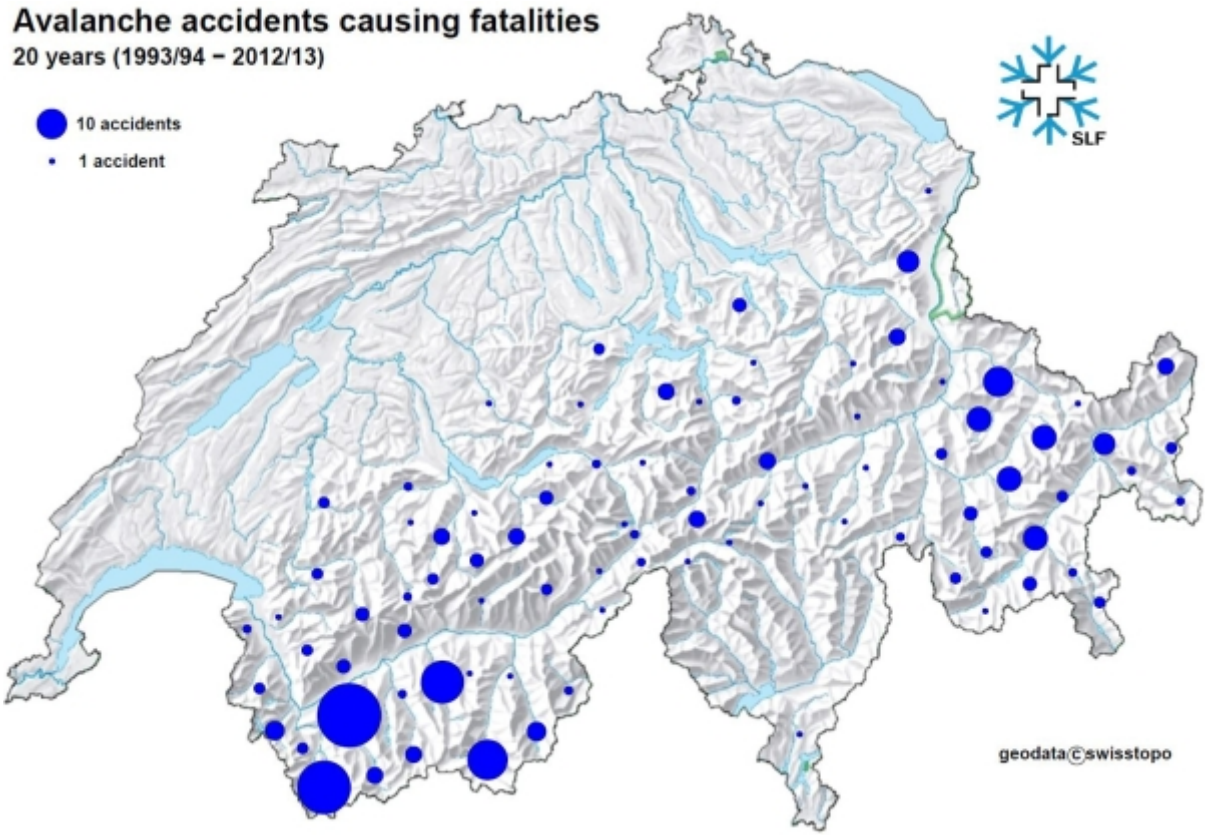

Fig. 1: Regional distribution of the fatal avalanche accidents in Switzerland (20 years, 1993/94-2012/13). For each of the more than 120 sub-regions as used for the avalanche bulletin, the number of fatal accidents was counted. The larger a symbol, the more accidents occurred in this region. geodata©swisstopo

To answer this question, we wanted to know the number of ski/snowboard-or snow-shoe tourers in the backcountry. As there is no data on who goes backcountry touring when and where, we investigated the condition reports posted on the two popular mountaineering networks www.bergportal.ch and www.camptocamp.org

We looked at the date and the location for which a report was posted. All up, there were 15’000 geo-referenced reports during the five winters 2009/10 to 2013/14 (see map below, Fig. 2). While this may seem like a large number, it is only a small proportion of the actual

backcountry users and may have an unknown bias leading to potentially misleading conclusions. Therefore, we compared the usage pattern with a survey concerning the Swiss avalanche bulletin (conducted in 2014). This comparison showed that the posted backcountry condition reports provide a plausible picture of regional backcountry usage. However, we would like to emphasize to be careful when interpreting this regional distribution.

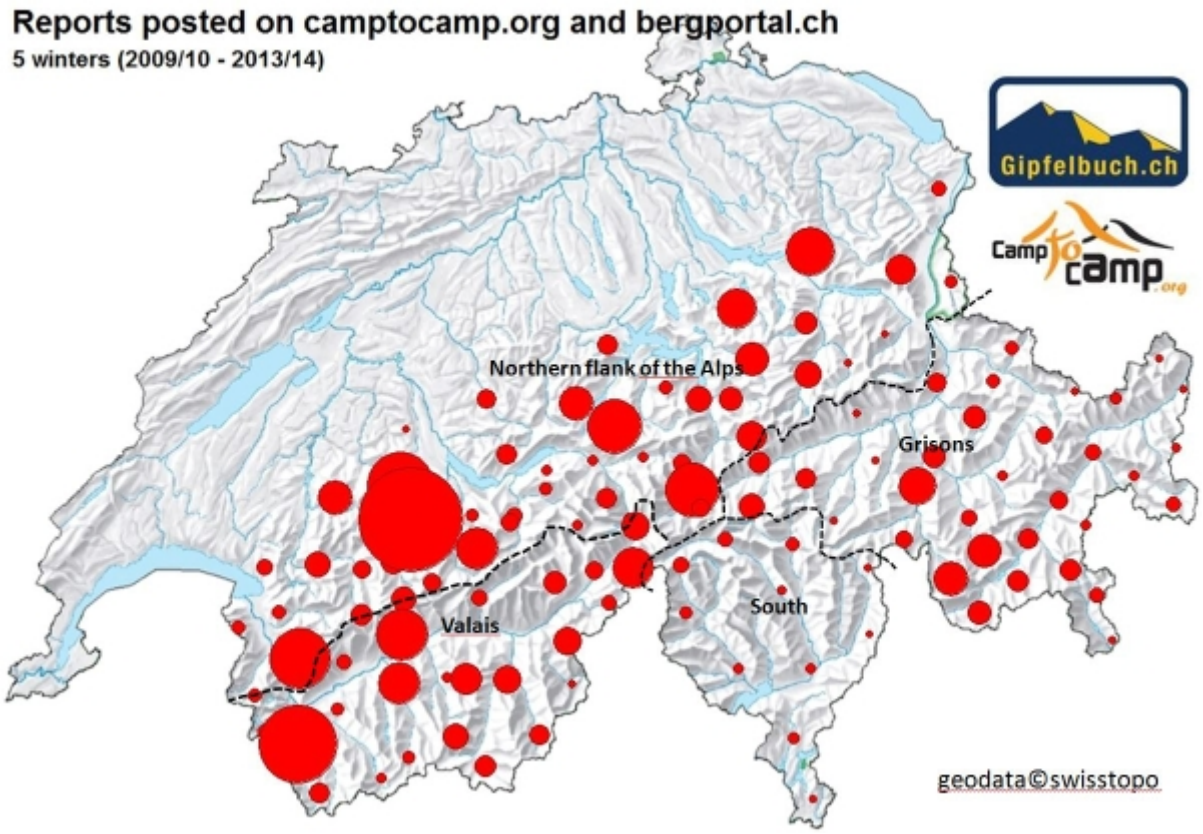

Fig. 2: Regional distribution of the location of www.bergportal.ch and www.camptocamp.org conditions reports (5 winters, 2009/10-2012/13). As in Fig. 1, for each of the more than 120 sub-regions the number reports was counted. The larger a symbol, the more reports were posted for this region. geodata©swisstopo

What did we find?

Even though there were large differences in posted backcountry touring activity on a relatively small scale, the reports indicate that the average backcountry usage (per surface area) was higher in the North and in Valais than in Grisons or the South.

During the same five winters (2009/10 to 2013/14), the number of severe avalanche accidents on backcountry tours was twice as high in Valais and Grisons (per surface area or per reported backcountry activity), as compared to the North (avalanche accidents considered as severe are those where at least one person was injured, fully buried or died).

Thus, we looked for other explanations. And one of the explications can be found in the snowpack structure: The more inner-alpine areas in Valais and Grisons are not only those with a frequently shallow snowpack, but as a result often have an unfavorable snowpack structure. An unfavorable snowpack structure means that the snowpack base is weak or that prominent weak snow layers are located within the snowpack (see map below, Fig. 3).

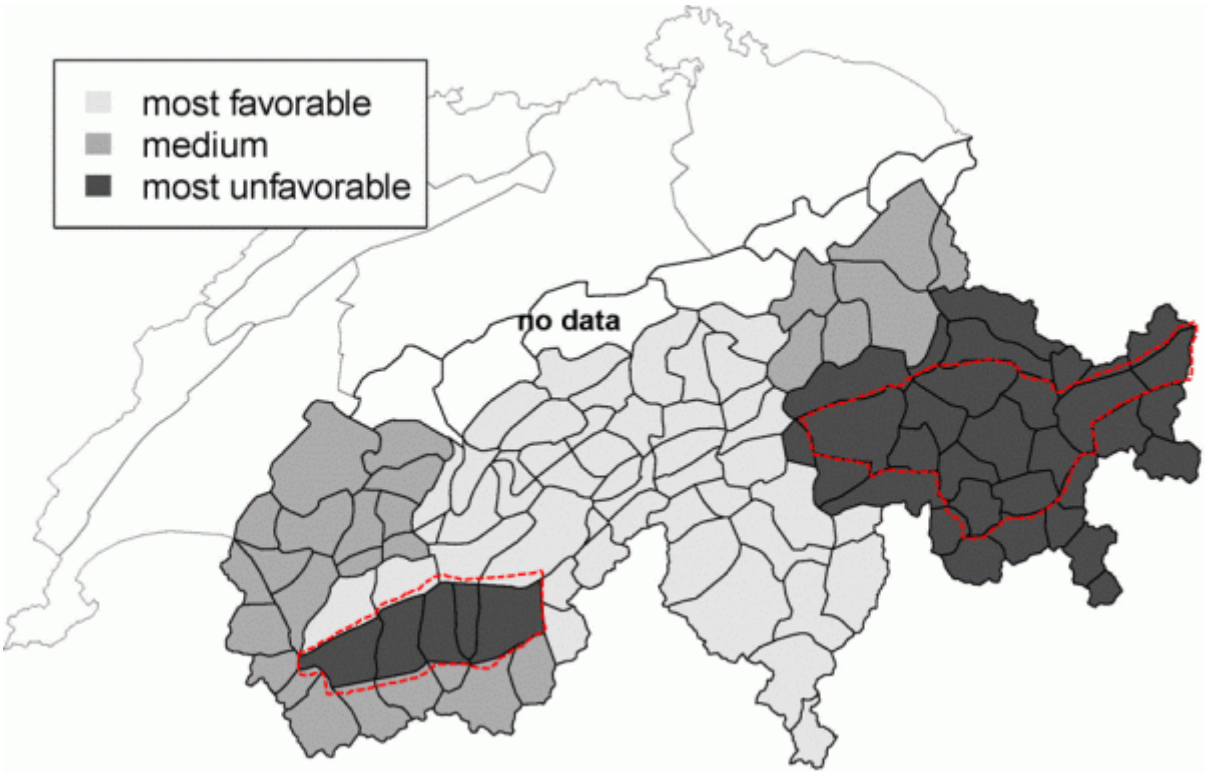

Fig. 3: This map shows regional patterns of snowpack structure ranging from the most unfavorable with an often more pronounced old snow problem (dark grey areas) to those with an often better snowpack structure (light grey areas). The regional ranking is based on feedback from mountain guides (old snow problem), snow-profiles and Rutschblock tests from our observer network for the five winters 2009/10 to 2013/14.

From avalanche accidents statistics it is known that such weak layers have been the failure plane of numerous fatal avalanche accidents (Fig. 4). These kind of persistent weak layers remain unstable for a longer time than, for instance, a new snow weakness. It is also more difficult to detect these dangerous slopes even for experienced people, as the weakness is buried deep in the snowpack and can sometimes only be found by digging a snow-profile.

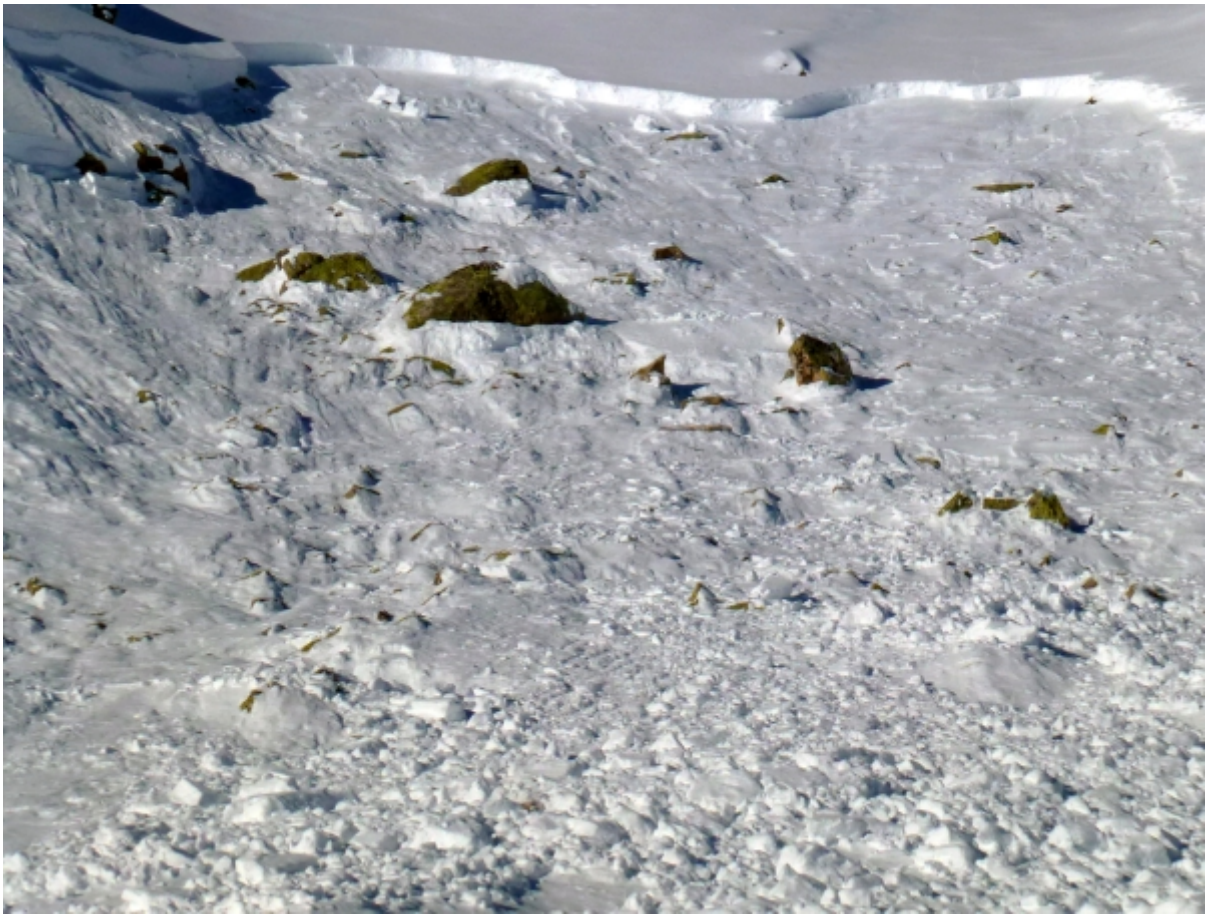

Fig. 4: Fracture line of a skier-triggered slab avalanche. The failure plane was a very weak layer - a so-called persistent weak layer - close to the snow-ground interface (photo: J. Seiwald).

Where can you find information about an old snow problem?

Besides digging a snow-profile yourself, sources of information may be the avalanche bulletin (danger description, snowpack and weather section) and the snow stability map, showing the most recent snow-profiles.

The avalanche bulletin not only informs about the danger level, the most dangerous slope aspects and elevations, but also about the most relevant avalanche pattern. For instance, if persistent weak layers within the snow are considered of concern, then an “old snow”-pattern is given. If considered important, even more details concerning the avalanche problem can be found in the danger description, as shown in the example of an avalanche bulletin from January 2014:

Old snow

Danger description

Distinct weak layers exist in the bottom section of the snowpack in particular on shady slopes. Avalanches can be released by a single winter sport participant. They can penetrate down to the ground and reach a dangerous size. Whumpfing sounds and the formation of shooting cracks when stepping on the snowpack can indicate the danger. The conditions are precarious for snow sport activities outside marked and open pistes. Defensive route selection is required.

Recommendations

Less touring activity, but more avalanche accidents means a higher risk of being involved in a severe avalanche accident in the inner-alpine regions, like in Valais or Grisons. As avalanches triggered in the old snow are usually dangerously large, a defensive behavior is appropriate. In addition, the damage potential in case of an avalanche can be limited by maintaining spacing between individuals and descending very steep slopes one person at a time.

More information concerning results from this dataset can be found in the scientitic publication “Avalanche fatalities in the European Alps: long-term trends and statistics. Geogr. Helv., 71(2), 147-159.”