Avalanche problems; an important part of the Norwegian forecast, and a useful tool for the users

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ABSTRACT: The Norwegian Avalanche Warning Service uses avalanche problems in their bulletins to provide a compact, yet exact, description for the end user of the current conditions. The Norwegian avalanche problems consist of the following elements: The type of expected avalanche, the cause of the avalanche, the likelihood, expected size, amount of extra load that is necessary for triggering and finally where in the snowpack we expect the avalanche to be released. Observers submitting observations and forecasters have the opportunity to make different combinations of all the available elements. Forecasters can choose up to three avalanche problems when composing the bulletin. A standard sentence and set of icons is automatically generated depending on the chosen elements. Given the large forecasting regions, few weather stations and field observations, our avalanche problems are an attempt to make the avalanche bulletin more useful to the end user. Feedback on the use of avalanche problems show that they provide a useful and good starting point for pre- trip planning and that they are also useful for evaluation during the trip. Avalanche problems have also been useful for educational purposes, both at the website varsom.no and for people teaching avalanche courses.

KEYWORDS: Avalanche problems, Avalanche patterns, Avalanche forecasting, avalanche bulletin, Norway

1 INTRODUCTION

Several avalanche warning services have started to integrate so called avalanche patterns or avalanche problems in their bulletins. SLF in Switzerland uses four patterns (Harvey et al., 2012), Tyrol in Austria uses 10 different patterns (Mair and Nairz, 2011), and Canada and the USA use different avalanche problems. Each warning service has chosen to implement different elements in their pattern or problem. Also the role of the pattern or problem in the forecast varies. An international unification of the patterns and problems seems to be unrealistic at the moment, but the EAWS is discussing the newest developments and steps for the future.

Returning combinations of factors that lead to similar avalanche situations is what we call avalanche patterns or avalanche problems (Mair and Nairz, 2011). The human ability for so called pattern recognition is very effective, and can be used in evaluating avalanche risk (Harvey, Rhyner and Schweizer, 2012). The use of patterns and problems within different forecasting services is an attempt to use the ability of pattern recognition and thereby helping end-users making better decisions. The idea is that it supports the recognition of situations at an early stage, for example pre-trip planning. It is also an opportunity to point out which factors are most important given the current conditions, and to communicate the answer to the question: “What and where is the main problem?”

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2 THE USE OF AVALANCHE PROBLEMS BY THE NORWEGIAN AVALANCHE CENTER

Looking at what warning services in other countries were doing, the Norwegian Avalanche Centre decided to implement avalanche problems in their bulletins during its first operational season (Engeset et al. 2013).

Inviting the Norwegian avalanche community into the process, the Norwegian Red Cross, Norwegian People´s Aid, Norwegian Mountain Guides Association, Norwegian Geotechnical Institute (NGI), and the Norwegian Alpine Club (DNT), the idea was to agree on a list of what we called “most prominent avalanche problems”. This resulted in a list of nine different avalanche problems. Evaluation showed the need for reevaluation. A fixed set of patterns, as Tyrol successfully applied (Mair and Nairz, 2011) seemed not applicable given the large variations in climate across Norway. We chose a flexible system allowing for various combinations, similar to the way avalanche problems are presented in the Canadian bulletin (avalanche.ca/bulletins/). We also wanted a system that helped the observers to structure their information when reporting field observations and a similar system to support the forecasters in writing the bulletin and communicating with the public.

To meet these needs, we made a chart combining the different elements we wanted to be integrated in our avalanche problems. These elements are: the type of expected avalanche, the cause of the avalanche, the likelihood, the

expected size, the amount of extra load that is necessary for triggering, and finally where in the snowpack we expect the avalanche to be released.

2.1 Avalanche problems as part of the bulletin

Our avalanche problems were then implemented in the software used for registration of field observations as well as in the software for writing the avalanche bulletin (Ekker.2013) (Figure 1).

Figure 1: Showing the drop down menu for avalanche problems in the publishing tool used by the Norwegian avalanche service during the first operative season 2012/2013.

The avalanche problem got a central position in the bulletin (Figure 2). In forecasting regions with a spatial extent of up to 8500 km^2, snow pack and weather conditions can vary substantially. The avalanche problems were supposed to help the user to identify exposed areas, while the danger level accounts for how widespread a certain problem might be.

The drop down menu used in the publishing tool generated a standard sentence and an icon. Writing the bulletin the forecaster could select up to three different avalanche problems when dealing with a complex situation.

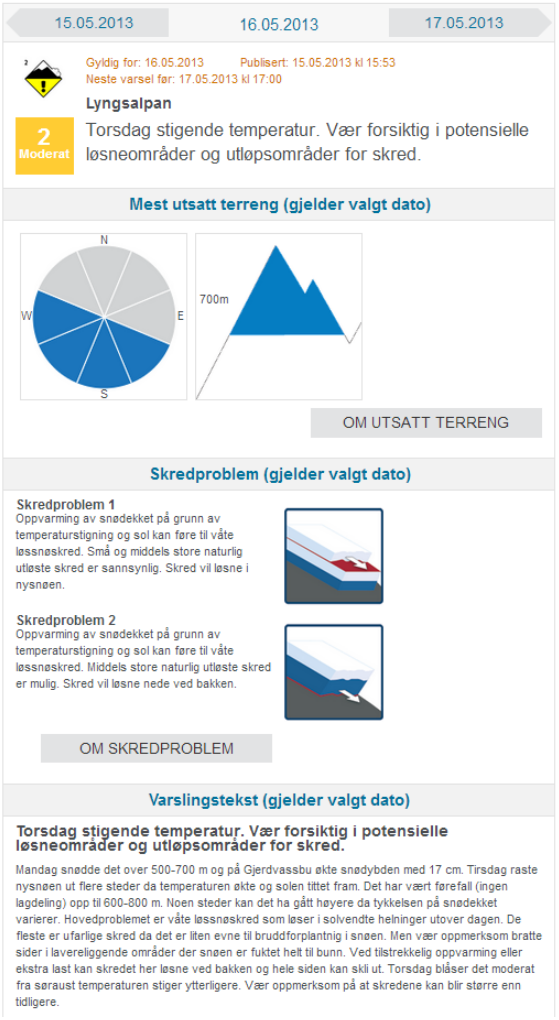

Figure 2: Showing a forecast from the Lyngen region with two avalanche problems in mid May, 2013. The icons indicate where in the snowpack the layer of concern is supposed to be found.

2.2 Supporting material

In addition to the avalanche problems in the bulletin, the avalanche service started using videos explaining the problems and giving advice on how to handle them (Figure 3). Videos where also used to explain avalanche situations of special interest to the public such as the big avalanche cycle in the Tromsø region during Easter (Müller et al., 2013). The videos were published both, on our homepage and our Facebook. These where very well received by the public. Many of the videos were based on pictures sent to the avalanche service by users. The videos were made using simple editing tools such as Snagit and coach´s eye.

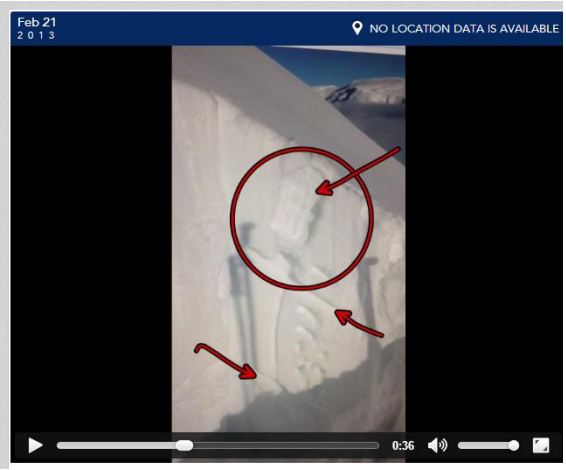

Figure 3: Showing a screenshot of a video explaining a situation with one layer of facets and one layer of surface hoar covered by 40 cm or fresh powder. The video is made with the app coach´s eye.

3 FURTHER DEVELOPMENT

Evaluation during, and at the end of the season 2012/2013 showed the need for further improvement concerning our avalanche problems. Both, the observers and forecasters, to some extent felt limited by the system and expressed the need to describe certain problems more precisely. Also some end-users felt that the way the problems were presented made it hard to understand.

In order to meet these requests we decided to apply some changes on the structure of field observations submitted, the working process of the forecasters and finally the format in how the avalanche problems are presented to the user. In the upcoming season we will implement the "systematic snow cover diagnosis" developed by the Bavarian avalanche service (Kronthaler and Zenke, 2006) and (Kronthaler et al. 2013). Shortly, this is an approach where you try to localize weak layers in the snowpack. The discovered weak layers are then described by their properties. Using so called "process thinking", where knowledge about the formation of the weak layer is essential, evaluation of what kind of avalanches is possible, the likelihood of triggering and how widespread this certain problem might be is the next step. This approach leaves us with 12 different kinds of weak layers, wet and dry slab- and loose-snow-avalanches, and four categories of triggering likelihood.

The use of the systematic snow cover diagnosis will have some influence on the elements of the avalanche problems, but there will only be minor changes, and the structure will stay the same. Instead of long and rather complicated standard sentences, we will use tags, shorter sentences and more icons. The extensive use of icons is due to its performance in presenting critical information to the public (Burkeljca. 2013). We also hope that this will improve the value of the bulletin to users who do not understand Norwegian, given the fact that at the moment only the headline and avalanche problems are translated into English.

4 CONCLUSION

The use of avalanche problems in the Norwegian avalanche forecast has been very well received. Feedback from end-users, mountain guides, rescue units, and professionals working in the field of avalanche forecasting state this. Changes might still come, but due to cost reprogramming software and available time, possibilities are more limited for now.

An international unification of the patterns and problems seems to be unrealistic at the moment, but the EAWS is discussing the newest developments and steps for the future.

The use of videos explaining avalanche problems and giving advice on how to handle them will continue and be developed further.

The upcoming season (2013/2014) we will see how the systematic snow cover diagnosis and process thinking works as a supporting structure for our observers and forecasters.

6 ACKNOWLEDGEMENTS

Since the Norwegian avalanche service is so young, we have had the opportunity to pick ideas and solutions from avalanche services with far more experience than we have. This has, among other things, resulted in a Norwegian version of the avalanche problems.

We would like to thank the EAWS for letting us take part in the European avalanche warning community, thus providing a forum for discussing avalanche problems and patterns.

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