

EFFICACY IN COMMUNICATION OF AVALANCHE WARNINGS

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ABSTRACT: In order to find out if the Norwegian avalanche warnings were communicated effectively on Varsom.no in 2017, we carried out an online user survey to find out (1) which risk factors are most difficult to assess and manage [results: snow cover, others in the group, terrain traps], (2) which parts of the warning are most important [results: avalanche assessment, avalanche problem, main message], (3) easily misunderstood or poorly communicated [results: core zone diagram, danger levels, local variation] and (4) what information is missing [data from automatic weather/snow stations, better terrain-/competence-specific advice, better visualization of weak layers]. Results are used to improve the communication of avalanche warnings in Norway. We also received suggestions for new features on the regObs app, which is to be further developed and more closely integrated with Varsom.

KEYWORDS: Avalanche warning, public forecast, risk communication, Varsom.

1. INTRODUCTION

A hazard (aka danger) warning becomes efficient if the user understands and successfully acts on the content and message in the warning. Most users of avalanche warnings are people at personal risk of avalanches or people who hold a mandate to warn and/or protect others from the hazard.

A number of Avalanche Warning Services (AWS) provide the public and preparedness authorities with public regional forecasts, which warn against future or ongoing avalanche hazards (ref. www.avalanches.org, www.avalanche.org). The Norwegian Avalanche Warning Service (NAWS) has issued the public forecasts using Varsom.no as communication channel since 2013 (Engeset, 2013, Johnsen, 2013). Varsom includes online education ("the avalanche school"), which is important for user communication and competence.

Risk communicators should pursue their intention to assess whether the message they disseminate is appropriate, understandable and useful (Charrière and Bogaard, 2016). This is of prime concern with the dramatic change in information technology and information consumption in society. Internet is rapidly becoming the main source of information, e.g. Brigo et al. (2016) concluded that internet campaigns with emotional content are important to effectively promote awareness programs on risk of avalanches and increase public knowledge related to these persisting and serious threats. In this paper, we ask: Does NAWS effectively communicate its intended message? To answer the question, we focus less on

campaigns and more on the avalanche warnings and forecasts published daily by AWS'.

2. APPROACH

We collected data by designing an online survey. Data was collected by an open invitation to users of the NAWS products on Varsom.no. The survey was implemented in Qualtrics to test how the avalanche forecasts were communicated on Varsom.no in 2017 (Fig. 1 shows an example of the avalanche warning). The survey was carried out in October/November 2017.

This study is part of a larger project on communication of flood, landslide, and avalanche danger. Here, we evaluated the efficiency of warnings by the NAWS on the website Varsom.no. Avalanche warnings are used in trip and preparedness planning, and influence the decisions people are taking in order to reduce risk (e.g., Furman et al., 2010; Marengo et al., 2017). Mountain guides, course providers, rescue services and avalanche observers report that people actively respond to avalanche warnings on Varsom.no, and to a large degree choose snow, terrain and day for travelling according to the danger level, avalanche problem and advice provided by the NAWS.

Warnings should therefore ideally be revealing and unambiguous. To assess whether the warnings published by NAWS fulfil these requirements, we asked the following questions:

- Which risk factors are considered as most difficult to assess and manage?
- Which elements in the warning are considered as most and least important?
- Which elements are easily misunderstood or considered poorly communicated?
- What kind of information and features are missing or ignored by users?

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We also tested if users interpreted the danger and behavioural implications differently depending on if the message was described by text, by symbols or by pictures – and we tested how well the warnings were understood, by testing four alternative ways of communicating two different danger scenarios. Engeset et al. (2018b) published the results of these tests, as well as more details on the survey reported here.

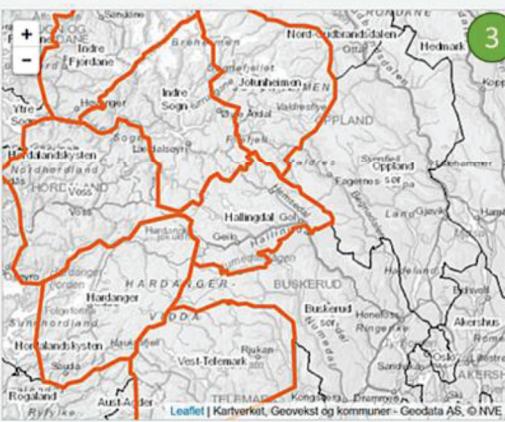
Snøskredvarslet for Hallingdal tirsdag 28.02.2017

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Skredfareurdering

Vær varsom der du finner fokksnø i snooverflaten. Nedbør og vind fra S – SØ vil føre til nysnøflak i N og NV. Den nylig innblåste snøen vil stedsvis legge seg over gammel fokksnø og lag av kantkornet sno. Hvor store skred dette kan gi, og hvor lett det er å påvirke laget er avhengig av tykkelsen og hardheten på overliggende flaksne. Kantkornet sno må forventes i alle himmelretninger. Unngå bratte heng som har samla sno i høyfjellet, da sannsynlighet er stor for at det er et ugunstig oppbygd snødekk med lag av kantkorn under fokksnøen. Det er knyttet usikkerhet til meldt nedbørmengde, men snøskredfare blir vurdert til faregrad 3-betydelig.



Skredproblem og ferdelsråd

Nysnøflak
Nedfylket svakt lag med nysnø



Skredtype:
Skredsterrelse:
Utløsningsårsak:
Utbredelse:
Sannsynlighet:

Unngå bratte heng og terregnfeller under og etter snøfallet til nysnøen har stabilisert seg. Skredproblemet finnes overalt hvor det ligger mye nysnø i bratt terregn. Se etter nysnø som binder seg sammen til myke flak og sprekk opp eller fester seg dårlig til den eldre snøen under. Sno som sprekker opp rundt skiene/brettet er et typisk tegn.

Fig. 1 continues

Vedvarende svakt lag

Kantkornet sno over skarelag



Skredtype:

Flaksred

Skredsterrelse: 3 - Middels

Stor tilleggsbelastning

Utløsningsårsak: Noen bratte heng

Mulig

Unngå ferdsl i skredterren og i utløpsområder. Det er sterst sjansen for å løse ut skred der snødekket er tynt, nær rygger og framstikkende steiner. Fjernutlosning er sannsynlig. Det krever mye kunnskap å gjennomgå svake lag i snødekket. Drønneylder og skytende sprekk er tydelige tegn, men fravær av slike tegn betyr ikke at det er trygt. Vær ekstra forsiktig etter snøfall eller vind og i perioder med temperaturstigning.

Snødekkehistorikk

Fokksnø med varierende tykkelse og fasthet over et vedvarende svakt lag. Kantkornet sno med stor utbredelse utgjør skredproblemet i regionen. Snødekket er noe mer jevnt fordelt, men fremdeles er det østvendte heng over skogsgrensen lengst vest i regionen, som har opp mot normale snømengder. Det er i disse områdene det er mest aktuelt å ferdes på ski, og her vil også skredproblemet være mest framtidende. Under det nevnte svake laget av kantkorn er snøen smelteomvandla og hard. Siste to dager har det kommet ca 15 cm snø i regionen. Mandag morgen er det lettskyet, -4 grader og 7 m/s fra S i Hemsedal skisenter, 1344 moh.

Fjellvær

Resten av mandag ventes SØ-S periodevis litt kuling i fjellet, om kvelden minkende til frisk bryg. Stort sett oppholdsvær. Om kvelden litt kaldere. Torsdag ventes SØ-S periodevis litt kuling i fjellet. Sno, mest i østlige områder. 10-25 mm nedbør. Litt kaldere om kvelden.

Observasjoner siste 3 døgn

28.02.2017 kl. 15.57

Rapportert av: Markus@NVE (****)

i kommune: GOL

Vær

Sno -1.0 grader

Figure 1 (left and right column): An example of an avalanche warning as issued on Varsom.no in 2017. The numbers refer to the elements analysed in this study. (1) Danger level and main message, (2) Avalanche danger assessment, (3) Region map, (4) Avalanche problems, (5) Snow cover history, (6) Mountain weather prognosis and (7) Observations (RegObs-feed). The figure shows the screen dump from a smartphone.

3. DATA

The online survey targeted recreational as well as other users of the NAWS. We recruited participants via social media, varsom.no and different user related web pages.

A total of 485 respondents answered the user survey. Not all respondents answered questions in all sections, leaving 361 respondents for analysis.

4. RESULTS

We asked "How well was the avalanche danger communicated on a scale from 0 to 10 points?". Most users stated that Varsom.no communicates the danger very well: 51 % gave 8 points or higher for a high danger warning, while 41 % gave 8 points or higher for a moderate danger warning.

4.1 What is difficult to assess and manage?

We asked "Which factors are most difficult to assess and manage in order to complete a safe trip?". The respondents could choose multiple factors. Fig. 2 shows available factors and results: the snow cover is the most difficult factor, followed by others in the group and terrain traps.

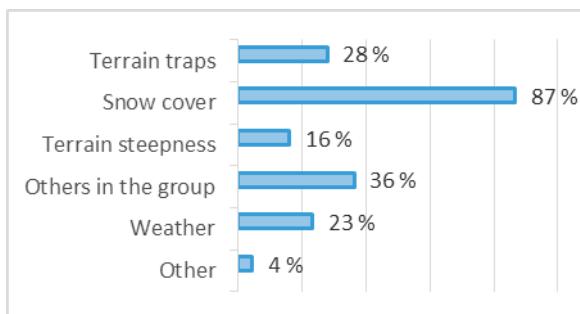


Figure 2: Factors considered most difficult to assess and manage.

4.2 What is most and least important in the avalanche warning?

Similarly, we asked "Which elements in the avalanche warning are most important?". Fig. 3 shows alternatives and results: Users rate several elements in the warning to be important, with the avalanche assessment, avalanche problem and main message at top. If confirmed by others, EAWS should look into revising its information pyramid at www.avalanches.org.

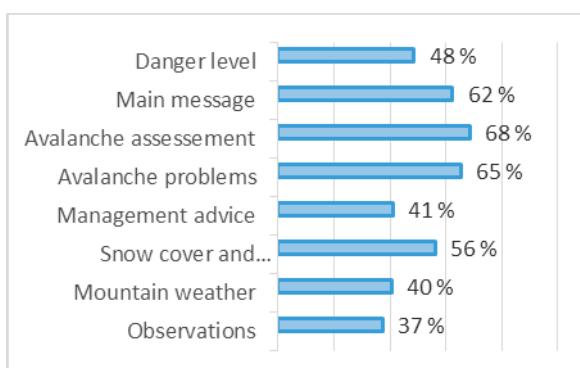


Figure 3: Important elements in the warning.

We also asked "Was anything of little use or importance? You may elaborate on the problem being format, content or other". Seven users found the mountain weather superfluous. Five reported

that the warning had too many and complex details. Six users considered the level of detail too low. Four users sometimes considered the snow observations to be too complicated.

4.3 What is easily misunderstood or poorly communicated?

Ninety five out of 361 users commented on what may be misunderstood or considered poorly communicated. These were the main findings:

- 11 users stated that it is difficult to know which of the sectors in the core zone diagram (dark or light) show dangerous zones.
- 11 users stated that the regional warning provide too little details in terms of spatial or temporal variability, and that the warning regions are too large.
- Eight users doubted the meaning and consequence of the danger rating for the user.
- Six users stated that the large amount of information made it difficult, especially for beginners, to decipher the key message.

4.4 Are you missing information or features?

Sixty seven out of 361 users missed information or features. Forty seven suggested improvements, here are some examples:

- Show observed weather and snow, and links to more detailed observations.
- Show terrain/trips rated by Avalanche Terrain Exposure Scale (Statham et al., 2006).
- Give advice according to user competence.
- Provide more detailed warnings/information and better visualisation of weak layers.

We also asked if users were missing information or features in RegObs (RegObs is the system for field data collection and sharing, see Ekker et al., 2013 and Engeset et al. 2018b). RegObs is used on mostly smartphones and was upgraded in March 2018 to provide easy and fast access high-quality maps and relevant observations in the system. Eighty one users responded (35 did not use it or were indifferent). Missing features and information mentioned included:

- Weather data.
- Possibility to enter and record snow profiles.
- Possibility to read the relevant warning (at least danger level and avalanche problems).
- Opportunity to track trips.
- More user-friendly interface.
- Access to avalanche paths.
- Access to elevation and avalanche problem.
- Easy access to the snow cover history and relevant recent snow profiles nearby.

5. CONCLUSIONS AND OUTLOOK

Our study confirmed that the communication of the avalanche warning on Varsom.no is perceived as effective by the users. We also make these conclusions and recommendations:

- *Redesign core zone and elevations graphics/text.* Problem: Participants found it difficult to understand if the avalanche problems were present or absent. Possible solution: add colour to the diagram, show danger rating/problem at different elevations, as is done by some other AWS'.
- *Less is more.* Problem: the amount of text and details in the warning reduced the motivation to read the warning and made it more difficult for the user to pick up the main message. Possible solution: Minimize repetitive information and reduce complexity.
- *Local information matters.* Problem: the avalanche warnings are produced for relatively large geographical areas with big spatial variations in the snow cover. Possible solution: use maps to show the parts most/least affected, present weather and/or snow observations from automatic stations, or present the snow history by visualising manual snow observations as time series.
- *We need to teach snow.* Problem: a very large share of the users find it difficult to assess and manage the snow cover. Possible solution: present the avalanche problem, snow cover analysis and the avalanche danger assessment in a more systematic and pedagogical manner in order to improve the competence of the users. Note that even experts considered the snow cover as the most difficult factor, suggesting that it is complex to manage for users at all levels.
- *We need to teach group dynamics and terrain traps.* Problem: One third finds it difficult to manage others in the group and identify terrain traps. Possible solution: Use the "avalanche school" to educate users about terrain traps and group dynamics to help users make better choices about whom they choose to recreate with in avalanche terrain.
- *We need to add functionality and forecasts in RegObs.* Problem: Information and functionality relevant for avalanche hazard assessment have been identified by users, but are not yet included in the field. Possible solution: Develop the RegObs system further.

An improved 2018-version of Varsom included redesign of core zone, reordering of elements and making the warning and its production leaner by (1) restructuring the elements in the warning and

- (2) motivating/sensitising forecasters to reduce redundancy.

Fig. 4 shows an example of the same avalanche warning as shown in Fig. 1, but accesses after Varsom.no was updated in 2018 and shown in English. Note that the Norwegian version also includes the avalanche danger assessment and the snowpack and avalanche history, these are not available in English. The English mountain weather is not shown in Fig. 4 as the example is from the 2017-season, and the new bilingual mountain weather was introduced at the start of the 2018-season.

Changes from 2017 are:

- Red colour shows avalanche prone sectors in core zone diagram
- Region map is moved to the lower part of the page
- Mountain weather is in English
- Avalanche problems are more compact, and the management advice are in a more prominent position
- Avalanche danger assessment (not shown in English) is moved down under the avalanche problems to avoid redundant reference to the avalanche problems and their properties in the danger assessment
- Sub-regions were named so that forecasters could more easily convey local information

It is worth noting that avalanche forecasts have limitations (e.g. resolution in time and space, uncertainty in current state, weather prognosis and process understanding), while users want higher resolution, smaller regions and slope specific advice. These conflicting factors are often hard to fully resolve.

In addition to improving the communication of the warnings on Varsom, NAWS are implementing several of the suggested RegObs improvements during 2018 (see Engeset et al., 2018b, for more details).

In conclusion, we believe that more studies on effective communication of hazards are needed.

ACKNOWLEDGEMENT

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Avalanche forecast for Hallingdal Tuesday
2017-02-28

[Norwegian avalanche, flood and landslide hazard warnings](#) > [Avalanche bulletins](#)
> Avalanche forecast for Hallingdal Tuesday 2017-02-28

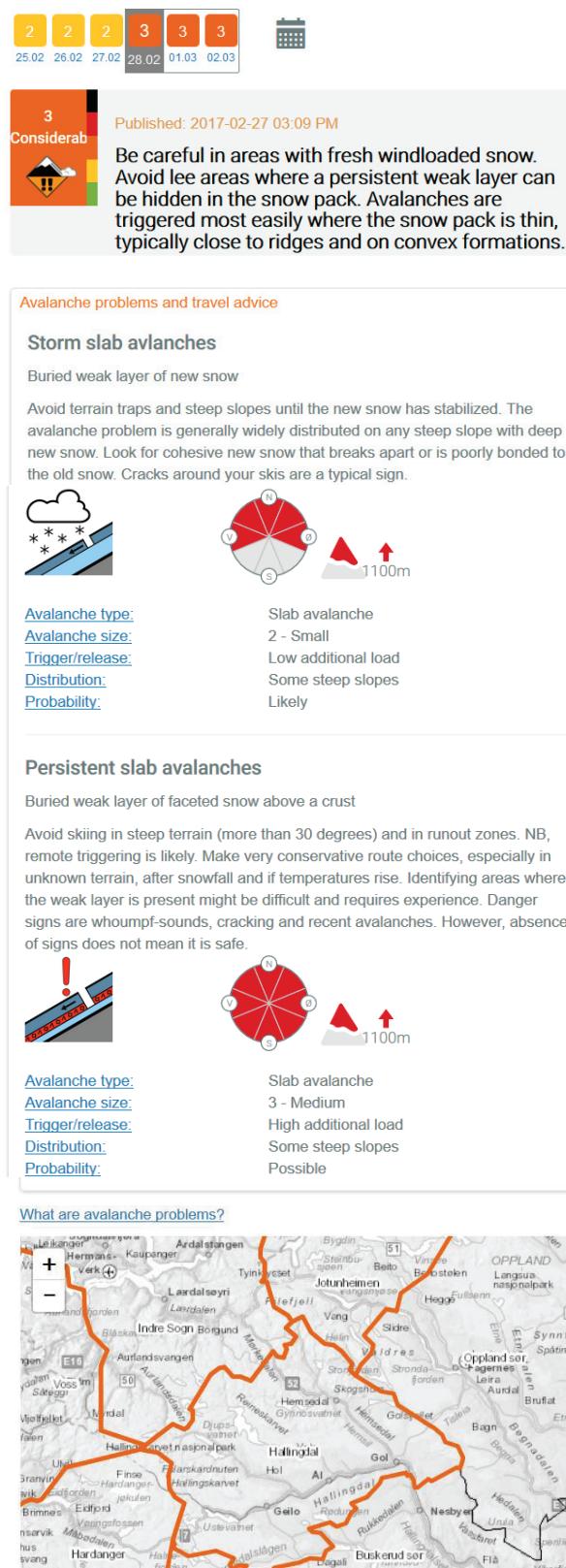


Fig. 4 continues

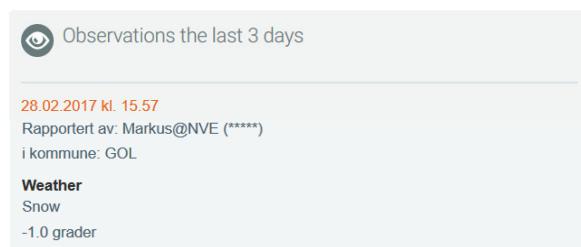


Figure 4 (left and right column): An improved English avalanche warning on as communicated on Varsom.no in 2018 (warning for the same day as in Fig. 1).

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