INCORPORATING TERRAIN INTO PUBLIC AVALANCHE INFORMATION PRODUCTS

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ABSTRACT: Public avalanche information has traditionally focussed on avalanche forecasts that provide avalanche danger ratings and contain information about weather, snowpack, and avalanche conditions. Recent developments in Canada include the adoption of a standardized conceptual approach for avalanche hazard analysis; better integration of the information pyramid in public avalanche forecasts; and development of advanced software (AvalX) that fully integrates the hazard analysis process with avalanche forecast production. Improvements in traditional public avalanche forecasting have reached the point of diminishing returns and future efforts to improve public avalanche information and decision-making aids need to focus elsewhere.

Making informed and educated choices about when and where to travel in mountainous areas requires linking avalanche hazard with terrain. To date, terrain components in public avalanche information products are limited. Tools that combine hazard and terrain have been developed but only rudimentary efforts have been made to utilize the power of computer, the internet, and mobile applications. This paper presents ideas for a better integration of terrain with hazard using online and mobile applications. The proposed approach will provide users with educational opportunities to help understand risk and practical tools to determine the potential risk of a given trip on a given day. This will result in more efficient trip planning and better informed terrain and route choices in the field.

1. INTRODUCTION

Between 2009 and 2012, the number of backcountry users in select areas in Canada and among certain user groups rose by up to 124% while enrolment in Avalanche Skills Training courses in the last two years has been relatively flat (Canadian Avalanche Centre, 2012). Recent intercept surveys on backcountry user groups in Canada showed that 59% of out-of bounds skiers (Gunn, 2010) and 60% of snowmobile riders (Haegeli, 2012; pers. comm.) do not have formal avalanche training. These observations indicate that the number of people accessing the backcountry in Canada with little or no formal avalanche training is increasing considerably and that many (perhaps the majority) of backcountry users in certain user groups likely have only a marginal awareness of the avalanche phenomenon and have little understanding of the weather, snowpack, avalanche activity, or terrain factors linked to avalanche hazard. As a consequence, these users have almost no ability to use traditional avalanche forecasts.

Meanwhile, public avalanche information products and services focus largely on avalanche problems, snowpack descriptions, weather data and forecasts, and avalanche danger ratings. Information about terrain is often minimal and there are few terrain visualization tools beyond simple icons to illustrate elevation and aspect.

Recent efforts to improve public avalanche information have focussed on increasingly sophisticated tools to help forecasters better analyze and predict avalanche hazard and on improved public communication of traditional data (see Figure 1 and 2).

State-of-the-art forecasting tools and public communications systems such as the AvalX software now in use in Canada (Statham, 2012) are necessary fundamentals for providing risk management advice to the public. However, we have reached the point where putting additional resources and money into traditional forecasting systems, processes, and products will yield increasingly less return in terms of improved public safety. The next phase of development in public avalanche safety products should focus on other pieces of the puzzle.

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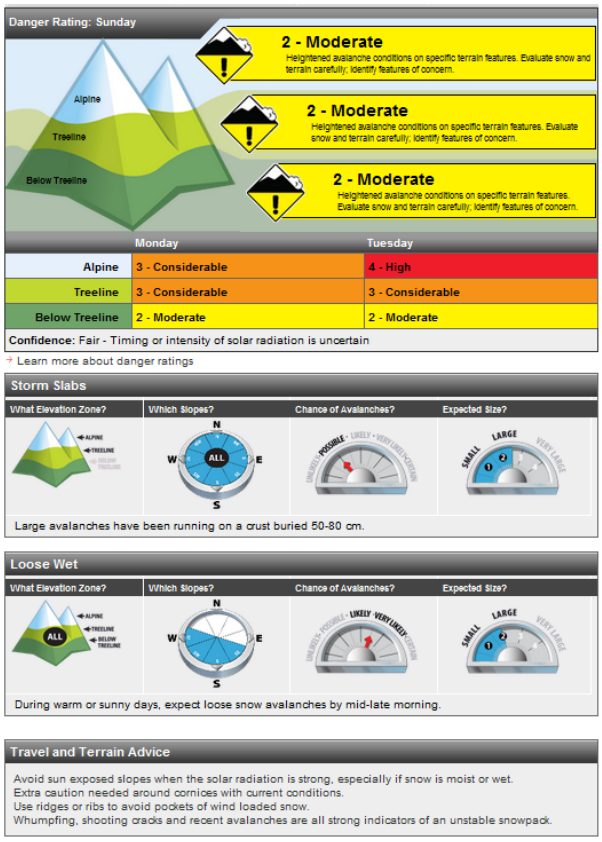

Figure 1: CAC Public Avalanche Forecast

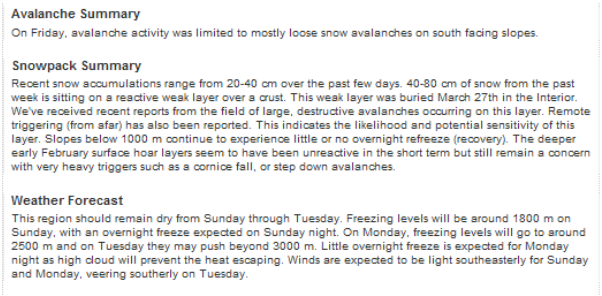

Figure 2: CAC Public Avalanche Forecast Details

2. THE MISSING LINK?

Choosing the right terrain allows backcountry travellers to significantly reduce or completely eliminate their personal risk regardless of the existing snowpack conditions or avalanche hazard. The key skill for this approach is the ability to combine the avalanche hazard of the day with terrain to determine the level of risk on a variety of possible trip or route options. This type of assessment provides the foundation for informed decision making in avalanche terrain based on acceptable risk. Linking hazard to terrain is something traditional avalanche forecasts don't do very well, if at all.

The next wave of development, resources, and funding should be directed at creating tools, products, and services that more effectively combine avalanche hazard with terrain to more clearly illustrate risk and provide better advice about choosing appropriate terrain.

The Avaluator Trip Planner and Slope Evaluation card (Haegeli, 2010), and the *Making Decisions in Avalanche Terrain* field book (Haegeli, Atkins and Klassen, 2010) have created the foundation for what could be a completely new era in public avalanche safety products, an age in which avalanche hazard and terrain are combined to illustrate risk and information products help people make informed decisions about which trip, route, and terrain is appropriate for them.

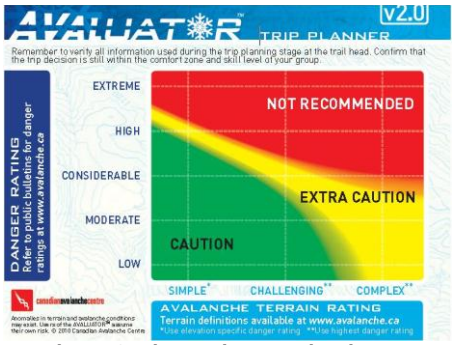

Figure 3: The Avaluator Trip Planner

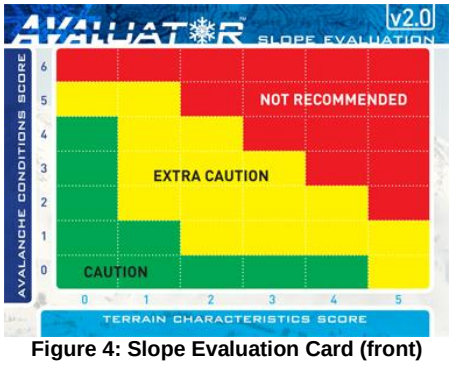

Figure 4: Slope Evaluation Card (front)

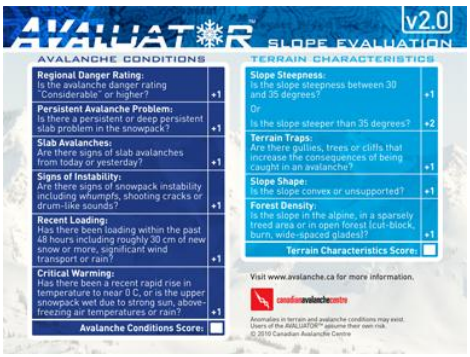

Figure 5: Slope Evaluation Card (back)

3. TERRAIN MAPPING: THE KEY COMPONENT

In 2004, Parks Canada produced the Avalanche Terrain Exposure Scale (ATES; Statham et al, 2006). Soon after, the Canadian Avalanche Centre (CAC) began rating backcountry trips using ATES and funding from the Province of British Columbia continues to allow the CAC to produce ATES ratings for various trips in British Columbia.

While the ATES system was originally intended for relatively large scale terrain ratings, the CAC has refined the process to allow assessment of smaller scale features (Campbell and Marshall, 2010 and Campbell et al, 2012). The CAC's ATES rating method has now reached the point where it can provide the foundation required for the next phase in the development of public avalanche information—the creation of tools in which terrain takes its rightful place as a major factor in helping users make informed decisions in the backcountry.

4. THE CAC ONLINE TRIP PLANNER

The CAC's first attempt at a trip planning and terrain selection tool that integrates terrain with avalanche hazard was the Online Trip Planner (OTP). The OTP consists of a database that contains a variety of trip information including ATES ratings. When a user selects a trip the OTP application combines the terrain rating with the avalanche danger rating, then rates the trip on an electronic version of the Avaluator Trip Planner (figure 6). In addition, the terrain can be visualized (figure 7) and a variety of other data is available that provides a wealth of information about the trip(figures 8 and 9).

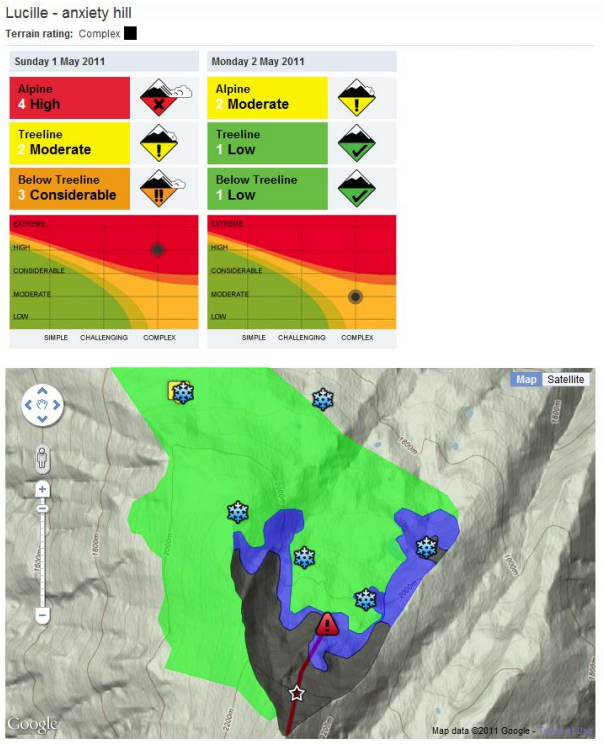

Figure 6: CAC Online Trip Planner: Danger Ratings, Risk Chart, and Topo View.

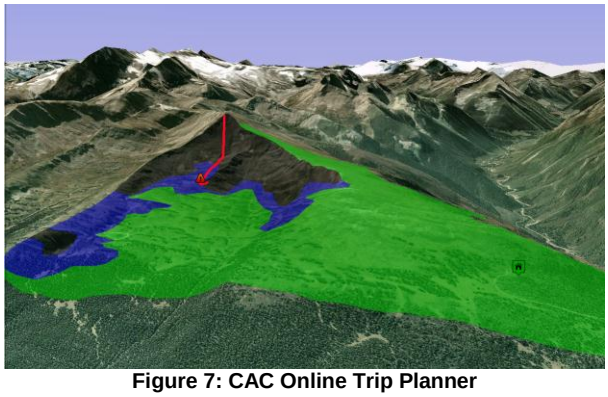

Figure 7: CAC Online Trip Planner Google Earth View

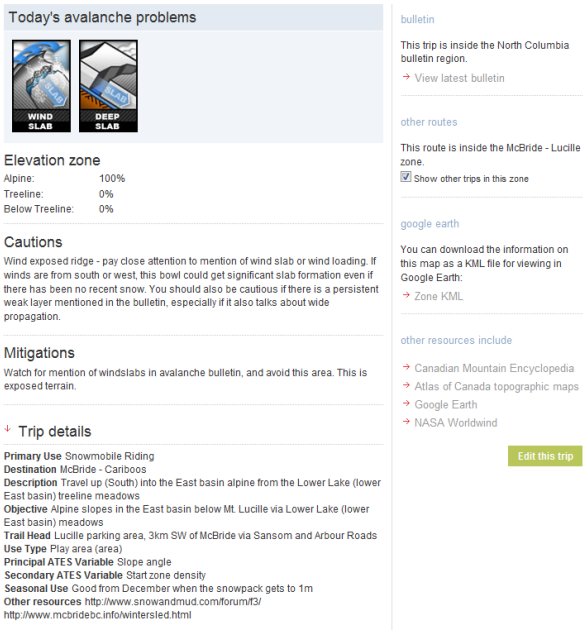

Figure 8: CAC Online Trip Planner Trip Information Page

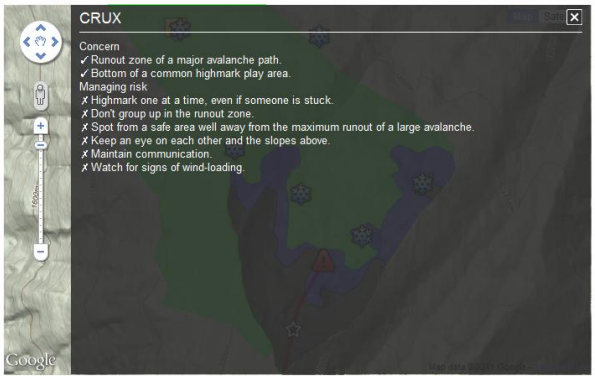

Figure 9: CAC Online Trip Planner Crux Information Overlay

While a significant development and an important first step, the CAC Online Trip Planner, even after a round of revisions and upgrades that improved on the first version, remains underutilized and is less than ideal in terms of user interface and functionality.

5. OTP v2.0: TRIP PLANNER ENHANCEMENTS

The following upgrades and improvements are being considered for the next version of the online planner:

- In addition to presenting the risk of a trip on a chart based on the avalanche hazard and ATES rating of the trip chosen by users, users should also be allowed to choose a risk level they are comfortable with and have the planner display trips that lie within their acceptable risk band.
- Add winter imagery (e.g. oblique photos) to the database to enhance user's ability to visualize and relate trip descriptions and terrain imagery with the actual terrain in the field.
- Add functionality for real-time commenting or blogging so users can engage in dialogue, exchange observations, and share photos related to current conditions, the trip and the terrain.
- Provide means by which forecasters can effectively access user dialogue, observations, and photos.
- Develop an advanced navigation system to allow both new and experienced users to efficiently find trips.
- Integrate the graphical presentation of risk into terrain imagery. Instead of having a star on a risk chart, have the terrain change colour as the cursor moves over it to more graphically represent which pieces of terrain present greater and lesser risk.
- Add a "scenario builder" function that allows users to create "what if" scenarios that show the results of different input parameters. For example, a conditions input screen where users can enter different combinations of snowpack, weather, or avalanche factors to see what the effect might be on the risk rating.
- Expand the links between danger ratings and terrain so an alpine trip is combined with the alpine danger rating for the area, treeline trips are linked to treeline danger ratings, and below treeline trips are linked to below treeline ratings.

6. AREAS WITH NO AVALANCHE FORECAST OR NO ATES RATINGS

In addition to the above, ways should be explored that allow users to utilize the trip planner in areas where avalanche forecasts are not available and/or the terrain has not been rated:

- Create an image bank with sorting/selection/ matching functionality that allows users to compare photos, topographical data, satellite imagery, etc. of unrated terrain with rated terrain so they can self-rate trips.

- Incorporate terrain checklists (e.g., the checklist included in Avaluator Slope Evaluation Card) to further assist users in self-determining terrain ratings.
- Provide guidance and tools for making a self-determination of local conditions and hazard. Possible examples include the concepts and factors presented in the Avaluator Slope Evaluation Card and the *Decision Making in Avalanche Terrain* fieldbook.
- Offer a means for users to insert their self-determined terrain and/or hazard ratings into the trip planner to determine likely risk levels.
- Create the functionality to allow users to save their self-determined ratings and share them with others.

7. MOBILE APPLICATIONS

Making it possible to take the OTP into the field on a mobile device would allow users to take their trip plan into the field and update it with actual real-time data using the "scenario builder." This would assist in determining if conditions, danger or risk are likely to be as expected or worse/better than expected.

Incorporating the ability to send data and images directly to the trip planner and to CAC forecasters would allow users to feed back into the system from the field or as soon as they attain connectivity.

8. SUMMARY

With recent developments in terrain rating systems, support for terrain rating projects, and utilizing modern computer and smartphone technology, the CAC is poised to take the first step into a new realm of public avalanche information products.

In the new era, terrain will play a much greater role. Eventually, tools like the OTP and mobile applications of the OTP might well eclipse the traditional avalanche forecast as the CAC's primary public avalanche safety product, especially for new users and those with little or no avalanche training and experience.

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