AVALANCHE TERRAIN ANALYSIS OF HATCH PEAK AT HATCHER PASS, ALASKA USING ATES AND GIS

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ABSTRACT: Parks Canada created the popular Avalanche Terrain Exposure Scale (ATES), identifying eleven factors that can increase the probability of an avalanche happening on a given slope. It creates an easy-to-use scale of exposure ratings for an area. Geographical Information Systems (GIS) has been used previously to produce a more technical analysis of avalanche terrain factors. Using ATES and GIS models, two maps were created of Hatch Peak at Hatcher Pass, Alaska. Hatch Peak was selected as a study area due to the large number of accidents. The first map, created using ArcGIS 10, shows potential release areas in regards to slope shape and angle analysis. The second map, created using Google Earth, shows the ATES analysis of the study site. When actual accident fatality data was overlaid on both maps, fatalities had occurred in areas identified by the model as high exposure and located below potential release areas.

KEYWORDS GIS, ATES, Terrain Analysis Hazard Mitigation

1. INTRODUCTION

Avalanche terrain analysis is one of the most important tools any backcountry traveler can use. The question of whether the terrain can produce an avalanche is the first one a traveler should answer. Many different variables within the terrain factor in the slope's ability to produce a slide. Models have been developed using different approaches to analysis terrain exposure. This study examines the terrain factor on Hatch Peak in Alaska using two different methods. Out of 15 documented avalanche accident at Hatcher Pass since 1990, nine occurred on Hatch Peak (CNFAIC 2008). This easy access mountain poses high terrain exposure for recreationalists.

2. BACKGROUND

2.1 Avalanche Terrain Exposure Scale

One of the most popular methods for analyzing avalanche terrain is the Avalanche Terrain Exposure Scale created by Parks Canada (Statham 2006). The scale accounts for 11 separate factors that can increase the likelihood of an avalanche occurring on a given slope. A technical model of the scale is used to develop a rating for the public (Statham 2006). There are three classifications within the scale: simple, challenging, and complex. During this study, ATES was applied to create a map of the entire mountain showing different exposure levels for three popular routes on the peak.

2.2 GIS Modeling

During a study by the Swiss Federal Institute for Snow and Avalanche research, different methods of GIS modeling were analyzed to find the most accurate method of Potential Release Areas (Maggioni 2003). Potential Release Areas (PRA) are locations where avalanches are more likely to release on a slope. A PRA is determined based on slope shape, angle, and aspect. Using Digital Elevation Models a PRA can be found through an analysis of slope angle, shape, and aspect. Maps produced using this method are helpful for forecasting and finding areas of high exposure.

3. STUDY AREA

The study site was Hatch Peak at Hatcher Pass, Alaska, a popular backcountry ski and

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snow machine area. It is easily accessible to recreationalists, attracting people of all skill levels and levels of avalanche education. Since 1990, there have been 15 documented avalanche accidents and countless unreported accidents and close calls (CNFAIC). The area lies in a continental snow pack. This study site was suggested by Hatcher Pass Avalanche Information Center with the intent to provide more detailed terrain information to the public.

4. DATA

Several datasets were used to produce the terrain hazard maps. The Digital Elevation Model, ASTER GDEM (15 min), was produced by METI and NASA in 2010. A USGS base map was overlaid to provide proper names on the final DEMs. Avalanche accident data was acquired from the Chugach National Forest Avalanche Information Center. Route information was derived from personal experience in the area and through other recreationalists.

5. METHODS

For this study, two separate maps were produced. The first one was made using the process created by Maggioni et. al.(2003) to show PRAs of the mountain. In ArcGis/ArcMap 10, spatial analysis tools were used to find slope angles and reclassify them according to the model (Maggioni, 2003). A plan curvature layer was created and reclassified based on the rule by the Maggioni et. al. (2003) study. After both the slope raster and curvature raster were produced, PRAs were defined and separated into independent start zones.

The second map was produced following the ATES guidelines from Parks Canada. Both Google Earth and ArcGIS were used for creating polygons representing the three categories of exposure ratings. Three popular ski tours ($1000 Run, Sunny Side, and False Summit) were selected for further analysis following ATES. These routes were mapped on Google Earth with narrative analysis.

6. RESULTS

This study produced two separate maps and an analysis of three routes on Hatch Peak.

6.1 Potential Release Area Map

The Potential Release Area Map shows PRAs on Hatch Peak (Figure 1). These areas are shown in red on the map. The map shows PRAs covering large portions of the peak. It is helpful for Identifying start zones on the peak and can be used for forecasting.

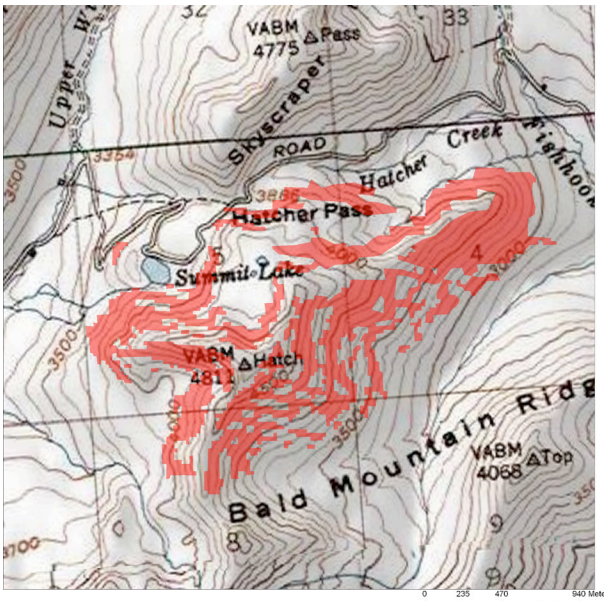
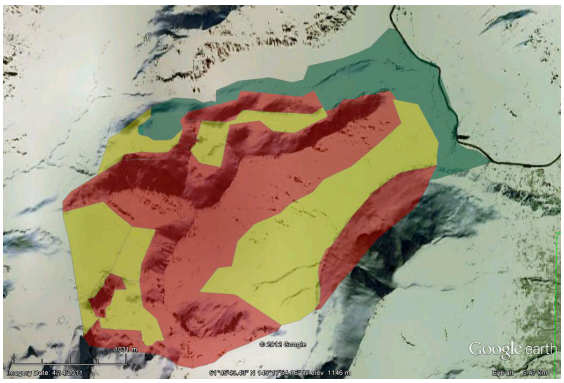


Figure 1. Potential Release Area Map for Hatch Peak.

6.2 ATES Map

The second map was produced in Google Earth following the ATES mapping Guidelines (ATES). The majority of the mountain was identified as challenging or complex due to slope angles. Most of Hatch Peak is above 30 degrees with large sections above 35 degrees. Convoluted slope shapes also add to the exposure. Terrain traps in the form of creek beds, gullies, and drainages funnel many of the avalanche paths into narrow runouts. The lower section of Hatch on the Northern and North-eastern aspects are the only simple exposure rating areas.



6.3 $1000 Run Via The Summer Road

This route is an easy tour that is relatively safe all season (Figure 2). The ATES rating is challenging for this tour. The access point is the start of the Summer Road at Hatcher Pass, just before the Independence Mine Parking Lot. The objective is to ski the run named $1000 that follows the bench on the north side of the peak. The tour ends at the summer road. The tour is 4.96 Km and has an elevation gain and loss of 412 meters. The whole tour lies above tree line in alpine vegetation. The main caution with this tour is the overhead avalanche paths while skiing down along the bench. It is important to be aware of what is going on above you. The main ATES variable with this classification is slope angle. Most of the route lies between 30 and 35 degrees, with small dispersed sections at higher angles. The approach is easy to manage and allows for quick travel.

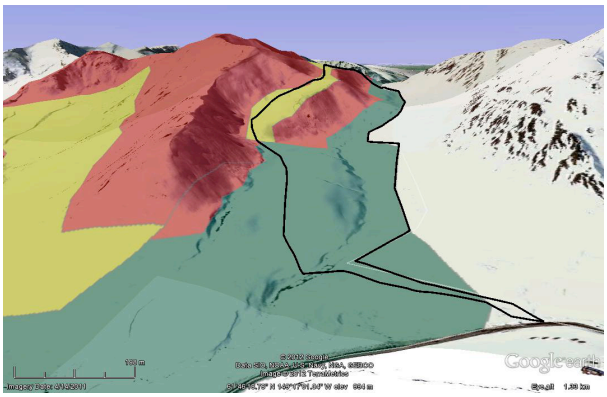


Figure 2. ATES map of $1000 Run

6.4 *Sunny Side*

This route is a challenging tour on Hatch Peak (Figure 3). The ATES rating is complex for this tour. The access point is from the Fishhook Parking Lot on Fishhook Willow Road. The objective is to ski the Sunny Side run on the south face of Hatch Peak. The common up track follows the east shoulder of Hatch to the ridge line. The tour ends at the same parking lot. The tour is 5.36 km and has an elevation gain and loss of 673 meters. The whole tour lies above tree line in alpine vegetation. The main caution with this tour is high slope angle and two gullies along the path. Avalanches are often funneled into the gullies causing deep burial depths. The main ATES variable with this classification is slope angle. Almost the entire route lies at angles above 35 degrees. It is important to practice safe travel techniques such as skiing one at a time and moving quickly. The approach follows the shoulder of the east ridge.

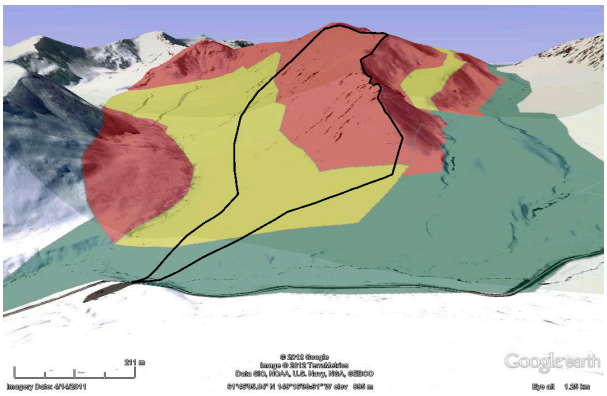


Figure 3. ATES Map of Sunny Side Run

6.5 *False Summit of Hatch Peak*

This route is a great tour with easy access (Figure 4). The ATES rating is complex for this tour. The access point is the start of the Summer Road at Hatcher Pass, just before the Independence Mine Parking Lot. The objective is to ski the run named False Summit of Hatch Peak that is on the north side of the peak. The tour ends at the summer road. The tour is 5.6 km and has an elevation gain and loss of 476 meters. The whole tour lies above tree line in alpine vegetation. The main caution with this tour is high slope angle and a wide avalanche path. It is important to practice safe travel techniques like skiing one at a time and checking snowpack conditions as you travel. The main ATES variable with this classification is slope angle. Most of the run is above 35 degrees. The approach is simple to manage and allows for quick travel. It is popular for early season skiing.

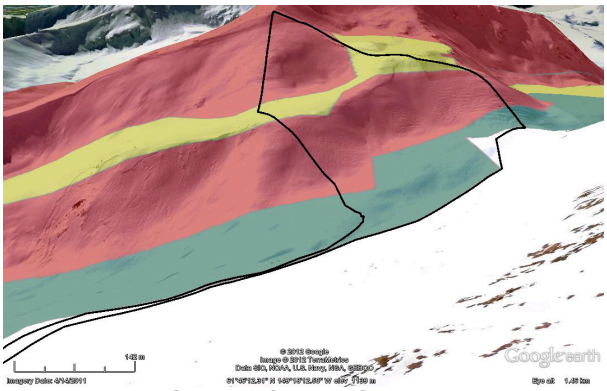


Figure 4. ATES Map of False Summit

7. DISCUSSION

These maps can be very valuable tools for recreationalists at Hatcher Pass. The data collected will be available through Hatcher Pass Avalanche Information Center. The maps can help travelers plan tours and be used with other tools to make safe decisions. It is the first time terrain analysis information has been developed for Hatcher Pass. The more information and tools available to recreationalists, the easier it will be for them to recreate more safely in the backcountry.

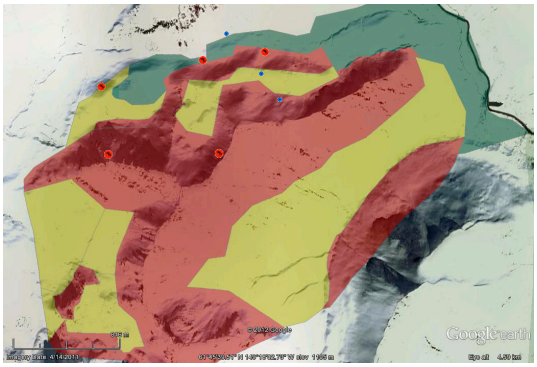


Figure 5. Accident sites on Hatch Peak since 1990

Figure 5 shows where reported accidents happened on Hatch Peak since 1990. All the accidents occurred in areas of Challenging or Complex exposure ratings.

The results of the analysis were limited by the availability of data in Alaska. Unlike many other places, DEMs of Alaska are not available in a wide variety of scales. A smaller scale map would allow for a better analysis of slope angle on the map. There are also limited data of accidents. Although there is record of quite a few incidents on Hatch Peak, there is not complete database for the accidents reports.

Future projects could create more ATES maps of the rest of the pass. Hatch Peak is only a small section of the skiable terrain at Hatcher Pass. It is best early season and other peaks see much higher traffic for most of the winter. An in depth analysis of the accidents and a user survey at the pass can also provide valuable insight into why there is a high concentration of fatal accidents here.

8. CONCLUSION

Avalanche Terrain Analysis is an important to tool for backcountry travelers. It allows them to make better judgments on where to ski on a given day. Using both ATES and GIS, a full analysis of the terrain at Hatch Peak was performed. The maps created will help provide information about avalanche paths on the peak and exposure ratings. As more information about terrain is made available to recreationists, people are going to be able to make sounder decisions and recreate more safely.

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10. REFERENCES

Avalanche terrain exposure scale (ATES) rating and mapping guidelines. ().Canadian Avalanche Center. . (ATES)

Maggioni, M., & Gruber, U. (2003). The influence of topographic parameters on avalanche release dimension and frequency. *Cold Regions Science & Technology, 37*(3), 407. doi:10.1016/S0165-232X(03)00080-6

Statham, G., & McMahon, B. (2004). *Avalanche terrain exposure scale.* Retrieved 10/15, 2011, from http://www.avalanche.ca/resources/cac/attachments/atesmodel