Assessing Avalanche Risk near Highland Peak, Colorado

Introduction

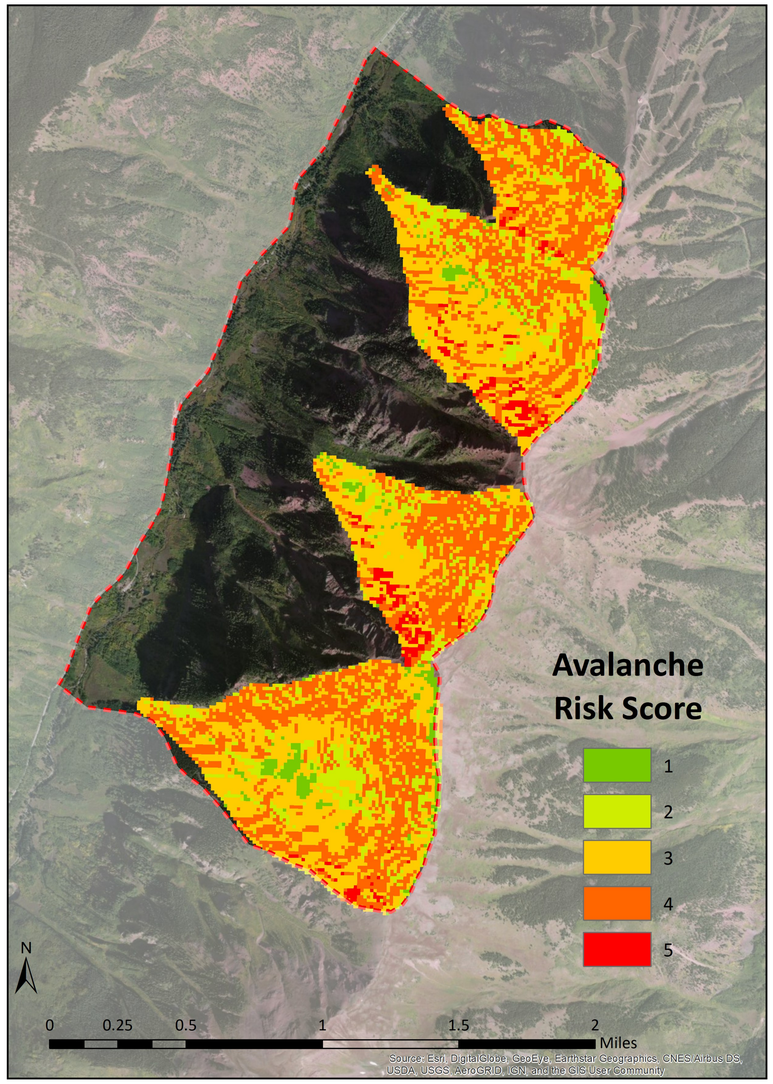
While winter in the Colorado Rockies brings thousands of thrill seekers into the backcountry; it also creates the conditions for a powerful and deadly natural force, avalanches. During the 2018 – 2019 winter season 25 people were killed by avalanches in the US, including 6 skiers in Colorado. The causes of avalanches are complex, and include climate, topography, and snow conditions. This spatial analysis attempts to identify avalanche risk in backcountry skiing locations west of Highland Peak, Colorado. These spots, which are adjacent to the popular Aspen Highlands Resort, sees many backcountry skiers who enjoy the area's relatively easy access from the resort and the Maroon Creek Road at the bottom of the valley. This popularity can have deadly consequences. In 2018 a skier was killed in one of the backcountry bowls near Highlands. While avalanches will always be a risk in the mountains, geospatial tools may be used to help identify the safest places to engage in dangerous winter activities.

Methodology

Avalanche risk is depended on snow conditions, which are very time dependent and consequently difficult to model in GIS. To simplify I assumed that the snow was already favorable for avalanches. Doing so, I can model risk as a function of slope, aspect, and the surface type. Also, to be considered in the calculation the area had to be located in a major drainage basin. While avalanches can occur anywhere with accumulated snow, the most dangerous ones happen over large areas. I limited my analysis to a 2-mile long area between Hunter Ridge on the east and Maroon Creek on the west. A Digital Elevation Model (DEM) was used to determine the slope, aspect, and major basin areas of the study boundary. This data, along with land surface data was used to in a weighted overlay to find the spots where avalanches are most likely be triggered on a scale of 0 (very unlikely) – 5 (very likely).

Limitations

Avalanches and their causes are complex. Many causes are difficult or even impossible to display geospatially. Factors like snowpack, crystal structure, and wind direction all play major roles. To simplify the analysis, it was assumed that the conditions required for avalanches, like a typical winter snowpack, were already present. Also the final risk raster only considers the risk of triggering an avalanche in that spot. The risk of being underneath a high-risk trigger zones is not considered.

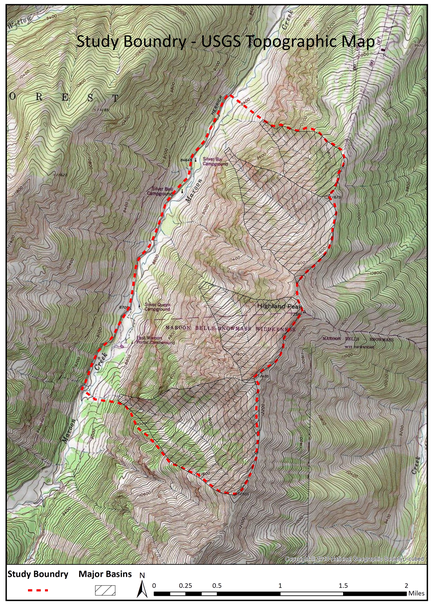


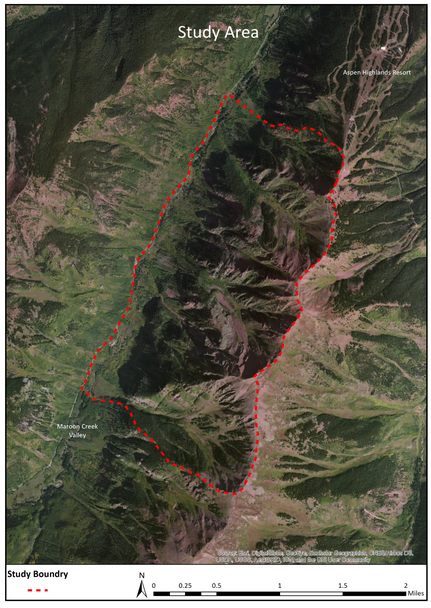
Results

The resulting raster shows that all 4 major basins include areas of high risk, typically near the top and south of the bowls where slope is the highest. It is important to note that the risk value corresponds to the risk of triggering an avalanche in that spot, so an area of low risk can still be prone to avalanches triggered in high-risk areas. The location where an avalanche was triggered by a skier in Maroon Creek Bowl, the second most northerly basin, was identified as a very high risk zone in the analysis.

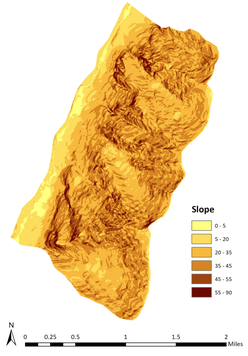
Conclusions

The results proved what was already known, areas like this have high avalanche risk. GIS will never eliminate the risk posed to backcountry adventurers who decide to go into hazardous terrain. However, it can provide valuable insight to engineers and planners who want to determine where to place avalanche barriers or build new development. These types of maps can be used by avalanche control teams to determine the best place to trigger controlled snow releases.

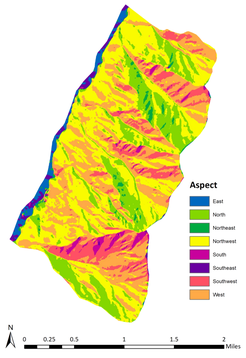




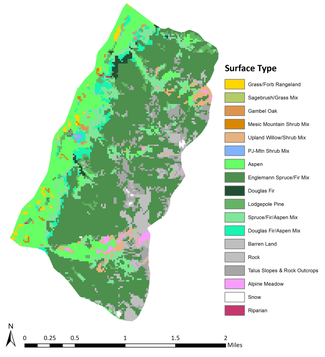
Slope



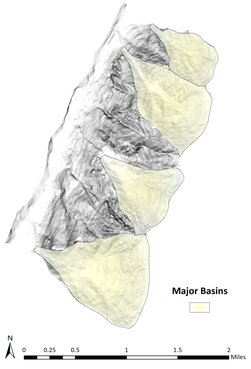
Aspect



Surface Type



Major Basins



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Sources: ESRI, USGS, CDOW, BLM