The MLK event at Crystal Mountain

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ABSTRACT: The winter of 2010/2011 created a surprisingly widespread weak layer across the northwestern United States. In Washington state it became to be known as the MLK Layer, and produced uncommonly destructive avalanches within Crystal Mountain’s ski area. Although the weak layer was well formed and identified, the relatively small weather changes in weather that initiated its release deserve further examination. Although the precise mechanics behind such events are difficult to understand, a pertinent weather history is presented and methods to better prepare for future events is discussed.

1. INTRODUCTION

For most of the western US, the La Nina winter of 2010/2011 possessed a dual character between its warm start, and record breaking snowfall finish. The major shift in temperature trend came in early February when snow began falling on the crust formed from the latest bout of warm weather in late January. At Crystal Mountain in Washington, settled snowfall on Feb 1st was only 68" at 6300’. Over the next two months we received the equivalent of our yearly average of snowfall, some 372" worth. The interface between the warm 1st half of the season and the abnormally cold and snowy second half of the season was delineated by a crust formed over the Martin Luther King Holiday. This MLK crust and the weak snow above it would be the culprit for one of the largest avalanche cycles Crystal Mountain has seen to date.

Fig 1. Seasonal Temperature and Precipitation trend for Crystal Mountain, Washington

2. MLK LAYER FORMATION

The MLK crust formed during a 2 day period from January 16-17th when 3.5” of rain fell at high freezing levels. Over the next 20 days, dry weather with periods of high freezing levels strengthened this layer into a melt-freeze crust. This was followed by six inches of snow on the night of February 7th. Avalanche Control that morning produced few results within the new snow, and the bond to the MLK crust was generally good. The next 4 days saw freezing levels mostly below the base area, but a slight warming trend on the 10th and 11th put down a weak crust on top of the Feb 8th snow. The end result of these weather events was a few inches of low density snow sandwiched between two melt-freeze layers, a structure known to quickly weaken under impending cold temperatures, (Jamieson 2006).

Fig 2. Temperature and Precipitation during the MLK crust formation

After the brief warming-up, temperatures again began to cool with incoming precipitation. The cooling trend created a relatively good bond to the weak trap crust on top of the Feb 8th snowfall. However, strong winds from the South did create some wind slabs on Northerly aspects. These would soon prove to be reactive on the facets beginning to form underneath the thin trap crust from the 10th and 11th.

3. APRIL 17th SNOWBOARDER RELEASE

A break in the weather allowed decent visibility for touring on the 17th. At approximately 2pm that day a snowboarder jumped off a cornice into Little Richards (a large avalanche path dropping 3500’) and initiated a 1.5-2’ deep release (SS-AR-R2-D2-O on a NW aspect at 6600’). The boarder was able to self-arrest on the bed surface.
The path had been cross-loaded from the strong South winds over the past several days and failed on the facets that had formed from the Feb 8th snowfall.

Finally, during the last day of March and the first day of April, Crystal Mountain saw freezing levels reach 7000’ with just over an inch of rain at the summit. Although not an extreme weather event by any measure, it would prove to be enough to create some of the most destructive avalanches originating from within ski area boundaries that the Northwest has seen.

On April 1st a natural avalanche occurred in the permanently closed Rockface area at Crystal Mountain. Debris reached open terrain and a search was conducted with no results. After removing search personnel from the area, the rest of the Rockface area was shot; the results impressive, each releasing on the MLK layer. The largest avalanche tore out 50+ trees, many 2’ plus in diameter. It was the largest slide seen in that area since modern control work efforts, but ended up being par for the course over the next two days.
trees, and almost reach the employee housing area along the access road (AH-SS-R5-D4-O on an ENE exposure at 6200'). A second shot in the hangfire had a similar effect, and after a few more tests in strategic locations the decision was made to leave the majority of terrain closed until the snowpack had time to adjust to the warm-up.

On April 8th, after 5 days of cooling, a final helicopter mission was launched with minimal results; the only exception being an 8-15’ deep release on steep North facing slope (3-Way Peak). All other tests produced no result. After a few more days of cold weather, the remainder of closed terrain was re-opened at Crystal with no activity.

3. ANALYSIS

The MLK event at Crystal was notable for a number of reasons. Firstly, it produced avalanches of size not commonly seen at our ski area. It also occurred much later in the season than most of our in-area avalanche cycles. Most interestingly, however, is the weather record leading up to and during the event. This was not a well-forecasted extreme hazard type scenario. In a location that regularly will see 3"+ of rain in a 24hr period at 9000’ freezing levels (Corral Pass 2012), a brief warm-up to 7000’ with relatively light precipitation is not the usual recipe for large scale destructive avalanching. In this case, however, with 50 days of abnormally cold temperatures, a weak substructure, and almost 200” of snow, all of the ingredients came together to create a deceptively unstable snowpack.

It is important to track these weather trends in a graphical format over long periods of time to enable the use of pattern recognition in daily forecasting routines over these long term cycles. Most avalanche forecasting organizations currently track weather on an hourly time scale, (Ferguson 1990). Just looking at wind speed, temperature, and precipitation from one station, 3600 pieces of data would have to be assimilated over the 50 day period of the MLK event. This is far too many to look at as individual data points, and even when broken down by day, 150 numbers would still have to be analyzed congruently. Even a rudimentary plotting solution greatly simplifies this data assimilation.

Lastly, it is important to realize that those working within the ski area boundaries for many years may have detached themselves from the true possible runouts of many of their paths. While skier compaction and consistent control work usually yield results that run along well understood distances, during times of deep...
instability the original and longer rounout distances may be realized. A careful look at the tree cover in starting zones will many times reveal seemingly unexplained differences in tree age (Carrara 1980). The large avalanche we observed during our helicopter blasting was not unparalleled in terms of its overall size; other ski areas have experienced similarly sized results. It was however extraordinary in the path it took through a seemingly mature forest. Almost none of the path was without tree cover. Yet, upon closer inspection of previous aerial photographs, effects of a similar event in lost history are present.

The MLK cycle was a difficult to forecast event, and we hope to improve not only our program, but the general understanding of deeper stability releases through the study of its evolution. Geographically, it was a very widespread weak layer, and we are eager to hear what other programs learned from the event.

4. REFERENCES

Corral Pass (418) - Site Information and Reports http://www.wcc.nrcs.usda.gov/nwcc/site?sitenum=418&state=wa 2012
