INVESTIGATING AVALANCHE RELEASE IN RELATION TO LOADING EVENTS AND SNOW CLIMATE IN TURNAGAIN PASS, ALASKA, USA.

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ABSTRACT: Determining the likelihood for triggering a slab avalanche failing in a persistent weak layer, after many days of little to no contributing weather, is a common forecasting challenge for the Chugach National Forest Avalanche Center. This study looked for patterns, over a 7-year period in Turnagain Pass, Alaska, to see how much time passes after notable snowfall and wind loading before avalanche activity ceases to occur. We began by examining avalanche activity recorded from 2011 to 2018 and combined this with data collected at nearby weather stations to determine the respective 24-hour snowfall, 24-hour wind speeds, and snowfall accumulation. From this data we were able to determine avalanche release in relation to loading events and periods of no loading. Furthermore, variations in snow climate were also considered. Turnagain Pass can represent any of the three climate zones (Coastal, Intermountain, Continental) from one season to the next. To analyze snow climate, we calculated the average air temperature, December average temperature gradient, snow water equivalent and seasonal snowfall. These analyses complement previous research done in a primarily Continental snowpack. While our regional data set is small, further development shows promise. For example, during Intermountain and Coastal snow climates following 8 days of no snowfall, 100% of avalanches reported have already occurred.

1 Introduction

Turnagain Pass, Alaska is a popular backcountry destination for snowmachiners and backcountry skiers in the northern Kenai Mountains on the Chugach National Forest. Turnagain Pass is located 40 miles Southeast of Anchorage, the largest population center in Alaska. Alaska has the second highest avalanche fatality rate in the US since 1951, second to Colorado with only ~15% of the population. There have been 8 avalanche fatalities in Turnagain Pass out of 17 on the Chugach National Forest from 1999 until 2019. Although none occurred during the timeframe of this study, most of these avalanches have been a result of human triggered slab avalanches releasing on persistent weak layers. Persistent grains (facets and buried surface hoar) can linger in the snowpack for weeks or months making persistent slabs the most challenging avalanche problem to forecast. When there are periods of little to no loading and no recent avalanche activity, forecasters struggle to understand when a persistent weak layer becomes unlikely to trigger. During these periods of time lacking avalanche activity, stability tests can still show propagation propensity. This study looks for patterns over a 7-year period in Turnagain Pass to see how much time passes since notable snowfall and wind loading before avalanche activity stops occurring.

A previous study done by Konigsberg (2018) establishes a period following weather-related loading events when an avalanche becomes unlikely to occur on a persistent weak layer within a Continental snow climate of Colorado. The following research is closely based upon that paper (Konigsberg 2018) and the research methods used for that analysis. We examine a data set of avalanche event days and weather events within the Turnagain Pass forecast region.

Konigsberg's previous research focused on Colorado, a primarily Continental snowpack, with the main issue being dry snow persistent slab avalanches. Turnagain Pass has a Coastal location and proximity to the Gulf of Alaska. This Coastal location, in combination with significantly lower altitude mountains (1000-6000 ft), leads to issues like rain at sea level, and dry snow in the mid and upper elevation bands. This difference in elevation can allow the region to experience both wet avalanches and dry avalanches within the same storm cycle. For example Turnagain Pass can experience human triggered persistent slab problems in the alpine while lower elevations are going through a consistent melt-freeze cycle. Due to its far northern latitude and proximity to coastal storm patterns, Turnagain Pass is a dynamic and unpredictable snow climate and does not consistently align with one of the three snow climate categories (Coastal, Intermountain and Continental). (Mock and Birkeland, 2000). Turnagain Pass was also shown to vary between snow climates from season to season (Wagner, 2012).

This study does two things. It looks at avalanche patterns following loading events for Turnagain Pass as a whole. It also looks at Turnagain Pass as it represents different snow climates to see if patterns can be identified in relation to climate years.

2 Data and Methods

2.1 Study Location

This study was broken down into two sections, first examining the snow climate and then examining avalanches in reference to the weather. For both we only examined the weather and avalanche data in Turnagain Pass, Alaska for the years 2011-2018. Turnagain Pass is the core region of the forecast zone for the Chugach National Forest Avalanche Information Center (CNFAIC), making up a zone of 1036 km2 (400 square miles.) Due to the variations in weather across this zone, we only examined avalanches surrounding the nearest weather station in Turnagain Pass. We did not use avalanches that occurred in Girdwood, Portage or Placer Valley despite them being located within the forecast zone.

2.2 Snow Climate Data

For the snow climate, snow cover and atmospheric data were collected from the Turnagain Pass SNOTEL site. This site is located at 573m (1880 ft). Additional snowpack information was collected from the National Resource Conservation Service (NRCS) snow course, located near Bertha Creek in the Turnagain Pass area at 290m (950 ft).

To determine the snow climate, average air temperature, snow water equivalent, snow depth and December temperature gradient were calculated from the Turnagain Pass SNOTEL and input into a decision tree developed by Mock and Birkeland (2000). Only data between 1 December through 31 March were calculated, this is to be consistent with Mock and Birkeland's method. Five parameters are used in the decision tree (Figure 1):

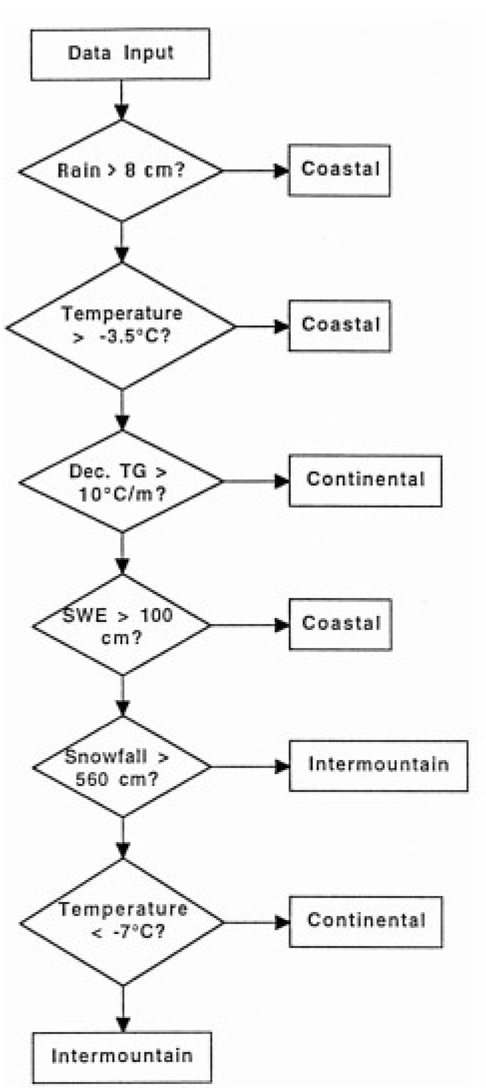

Figure 1:Flowchart illustrating the classification procedure for the seasonal snow avalanche classification (Mock and Birkeland 2000).

1. Seasonal Rain
2. Average Air temp
3. December average temperature gradient
4. Snow water equivalent
5. Snowfall

Seasonal rain and snowfall were not available from the SNOTEL data, nor any other source to the best knowledge of previous data, therefore have been omitted (Wagner, 2012).

2.3 Avalanche Data

The CNFAIC maintains a primarily manual avalanche database for avalanche occurrences within the forecast zone. Weather conditions, storm events and avalanche activity can have both a dry persistent issue in the upper elevations and a wet avalanche issue in the lower elevations. Due to the small forecast region and small data set for this research, we chose to select both wet and dry avalanche events within the Turnagain Pass forecast zone. For this same reason, we chose not to distinguish between slab and loose avalanches.

Rather than identifying specific avalanche events, we chose to evaluate avalanche event days. This represents any day that had a known avalanche. From the initial set, we removed avalanche event days that did not occur within the Turnagain Pass area and glide avalanches. We were left with 345 avalanche event days that fit the avalanches we wanted to examine; a dry-snow or wet-snow avalanche that was triggered by a natural-loading event or a person participating in winter recreation.

2.4 Weather data and loading events

For this study we identified three conditions including two types of loading events and a dry period:

1. Snowfall loading events
    a. a 24-hour period in which snowfall totaled four or more inches or snow water equivalent totaled 0.4”.
    b. Two or more consecutive days of snowfall totaling six or more inches or snow water equivalent totaling 0.6”.
2. Wind loading events
    a. a day with wind speed averages of 10mph & gusts of 20mph (or higher) and precipitation the day before equaling one of the two loading event criteria above.
3. Days without precipitation
    a. a day without any measurable snowfall or precipitation of any type.

For the snowfall loading events we used data from the National Resource Conservation Service (NRCS) automated Turnagain Pass SNOTEL site. This SNOTEL site is located at Center Ridge 573m (1880ft). SNOTEL sites like Turnagain Pass, and others in the area used by local forecasters provide a daily picture of snowfall loading. While it is recognized that higher elevations typically receive higher precipitation totals, since this SNOTEL location is protected from the wind and falls right around tree-line, it gives an accurate loading data set. This SNOTEL site measures snow height (HS) and snow water equivalent (SWE). The NRCS staff provides quality controlled daily readings to account for center errors (NRCS 2014).

Wind data was measured at an automated ridgetop weather site owned and operated by the Friends of the Chugach National Forest Avalanche Information Center (F-CNFAIC). This weather station is located within Turnagain Pass, on Sunburst Peak at an elevation of 1162m (3812 ft). Wind data was evaluated on a 24-hour period. Our criteria for a loading event based on wind loading was defined by an average wind speed of 10 mph with gusts 20 mph and above. This wind pattern also had to occur one day after one of the two snowfall loading events to have loose, unbounded snow available for transport. We chose to evaluate wind data at these parameters due to the conditions necessary to put loose, unbounded snow into saltation (5 to 10 m/s) (McClung, 2006).

For the days without precipitation events, we looked at the Turnagain Pass SNOTEL for any days without any measurable change in height of snow or SWE. That means even a height of new snow equaling zero, but an increase in snow water equivalent was included.

2.5 Comparing avalanche data and loading events

After identifying all of the loading event days for our region, we recorded how many days preceded each avalanche event day. The first data set is days since a snowfall loading event. This put days with avalanche event occurrences during the snowfall loading event as day zero. The second dataset follows the same pattern, identifying the snowfall and wind loading event as day zero. For example, if a snowfall or wind loading event occurred on Monday, Monday would be day zero.

The third dataset, we looked at days without measurable precipitation and avalanche activity during these times of no precipitation. The amount of days without any measurable precipitation were counted until an avalanche event occurred. The day the avalanche occurred was not included. For example, if the last snowfall recorded at the SNOTEL read 3 inches on Monday and an avalanche was triggered on Thursday, 2 days without measurable precipitation was recorded before the last avalanche event day occurred on Thursday.

2.6 Comparing event conditions and snow climate

After looking at the avalanche event days and event conditions, we then further investigated the patterns that went with each snow climate. Looking at the individual data set for Turnagain Pass, Alaska as a Continental, Intermountain, or Coastal snow climate.

3 Results

3.1 Snow climate

The snow climate approximation for Turnagain Pass from 2011-2018 can be seen in Table 1. It shows that over the last 7 years Turnagain Pass has almost equally represented an Intermountain and Coastal snow climate, and one year representing Continental. Since 1984 Turnagain Pass has had 4 seasons as Continental, 14 seasons as Intermountain, and 18 seasons as Coastal (Wagner 2012). Showing that the last 7 years have followed a consistent pattern to the 30 years prior.

Table 1: Snow Climate Turnagain Pass

Turnagain Pass SNOTEL (573 m - 1880ft)					
Winter Season	Temperature > -3.5 c	December TG > 10C/m	SWE > 100cm	Temperature < -7c	Climate
2011/2012	NO	NO	YES	YES	Coastal
2012/2013	NO	NO	NO	NO	Intermountain
2013/2014	NO	NO	NO	NO	Intermountain
2014/2015	YES	NO	NO	NO	Coastal
2015/2016	YES	NO	YES	NO	Coastal
2016/2017	NO	NO	NO	YES	Continental
2017/2018	YES	NO	NO	NO	Coastal

3.2 Avalanche Release following a precipitation loading event

Looking at Turnagain Pass during all years from 2011-2018, with loading events resulting from only snowfall we found that 75% of avalanche event days (both dry and wet) occurred within three days of a snowfall loading event. Within seven days of a snowfall loading event, 87% of avalanche event days occurred (Figure 2). That means 300 avalanche event days out of the 345 avalanche event days studied happened within seven days of a snowfall loading event.

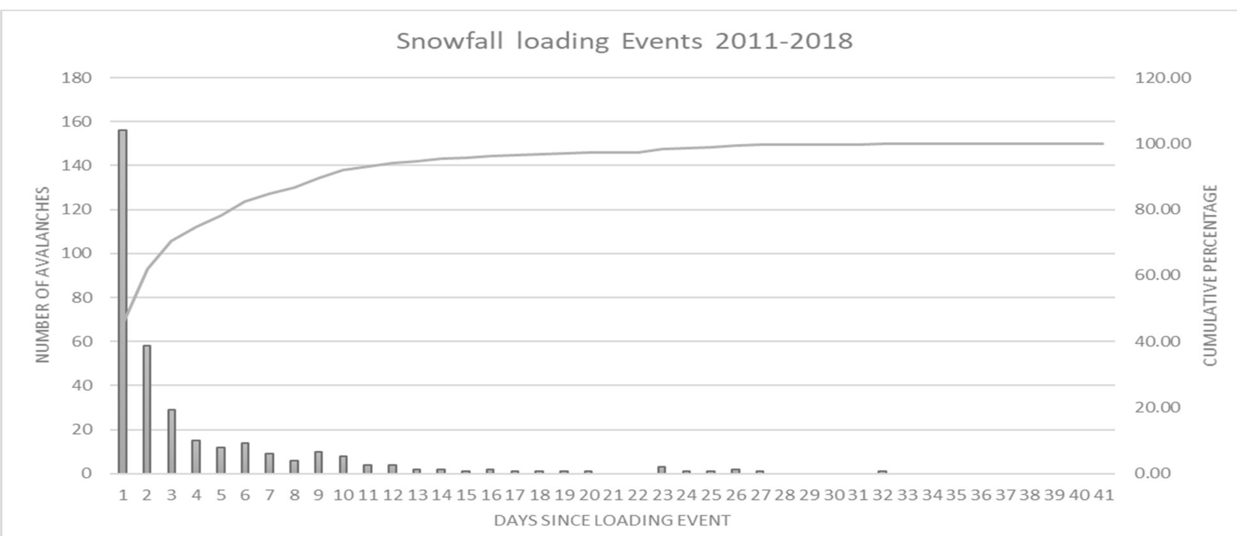

Figure 1: The bars plot avalanche event days for Turnagain Pass compared to days since a snowfall loading event. The curve shows the cumulative percentage of avalanche activity.

3.2.1 Avalanche Release following a precipitation loading event while representing an Intermountain Snow Climate

Looking at Turnagain Pass during the two years it represented an Intermountain snow climate from 2011-2018, with loading events resulting from only snowfall we found that 70% of avalanche event days (both dry and wet) occurred within three days of a snowfall loading event and 86% of avalanche event days happened within seven days of a snowfall loading event (Figure 3). That means 86 avalanche event days out of the 100 Intermountain avalanche event days studied occurred within seven days of a snowfall loading event.

3.2.2 Avalanche Release following a precipitation loading event while representing a Coastal Snow Climate

Looking at Turnagain Pass during the four years it represented a Coastal snow climate from 2011-2018, with loading events resulting from only snowfall we found that 78% of avalanche event days (both dry and wet) occurred within three days of a snowfall loading event and 90% of avalanche event days happened within seven days of a snowfall loading event (Figure 3). That means 176 avalanche event days out of the 195 Coastal avalanche event days studied occurred within seven days of a snowfall loading event

3.2.3 Avalanche Release following a precipitation loading event while representing a Continental Snow Climate

Looking at Turnagain Pass during the one year it represented a Continental snow climate from 2011-2018, with loading events resulting from only snowfall we found that 74% of avalanche event days (both dry and wet) occurred within three days of a snowfall loading event and 80% of avalanche event days happened within seven days of a snowfall loading event (Figure 3). That means 40 avalanche event days out of the 50 Continental avalanche event days studied occurred within seven days of a snowfall loading event.

3.3 Avalanche release following precipitation loading and wind loading events

Looking at Turnagain Pass during all years from 2011-2018, with loading events resulting from snowfall and wind loading events we found that 88% of avalanche event days (both dry and wet) occurred within three days of a snowfall loading event and 98% of avalanche event days happened within seven days of a snowfall loading event (Figure 4). That means 338 avalanche event days out of the 345 avalanche event days studied occurred within seven days of a snowfall loading event.

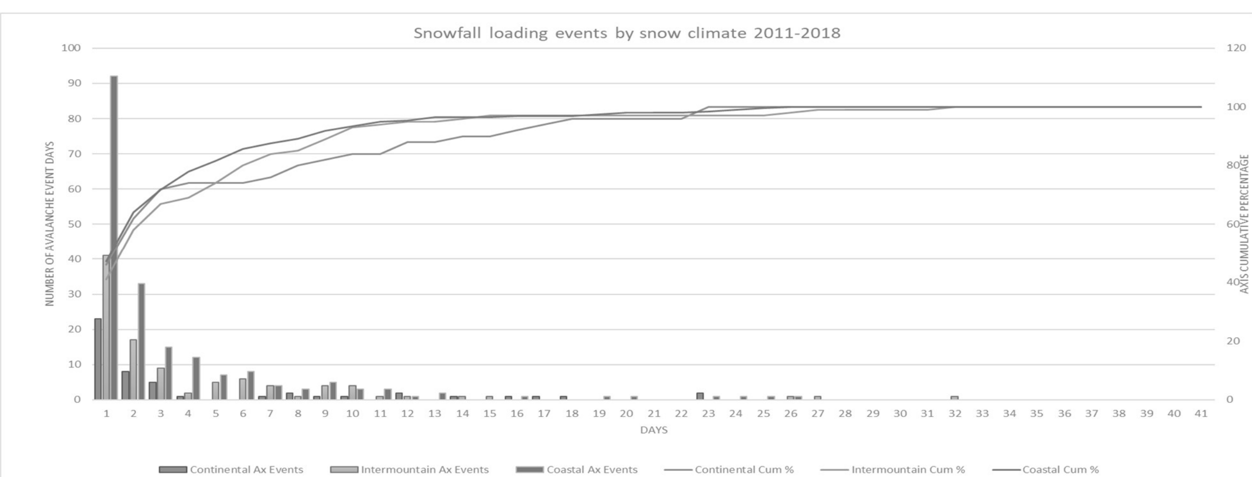

Figure 2. The bars plot avalanche event days for Turnagain Pass for each type of snow climate compared to days since a precipitation loading event. The curve shows the cumulative percentage of avalanche activity.

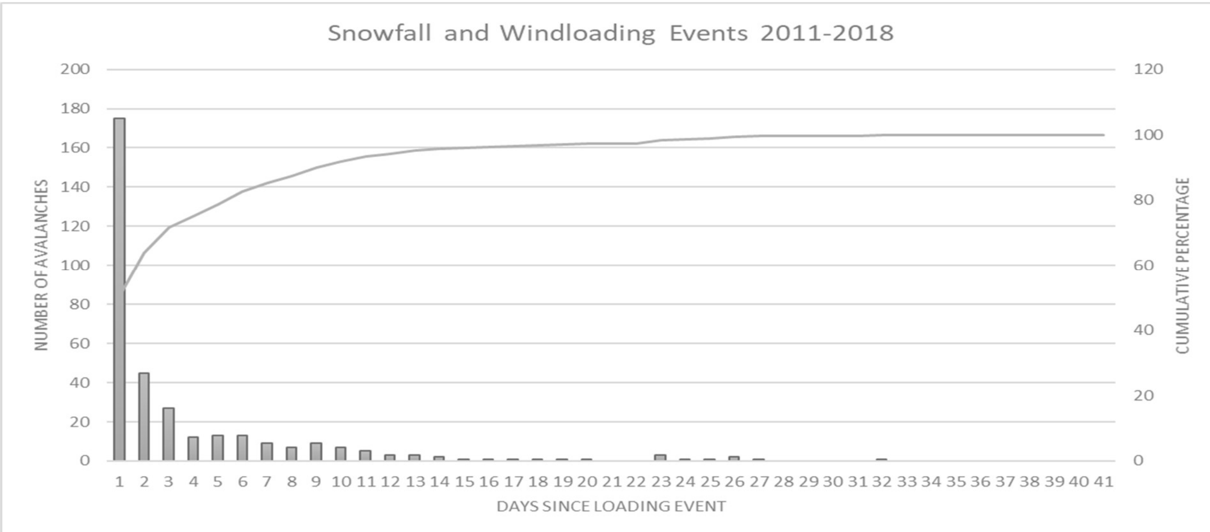

Figure 4:: The bars plot avalanche event days for Turnagain Pass compared to days since a precipitation and wind loading event. The curve shows the cumulative percentage of avalanche activity.

3.3.1 Avalanche release following precipitation loading and wind loading events while representing an Intermountain Snow Climate

Looking at Turnagain Pass during the years it represented an Intermountain snow climate from 2011-2018, with loading events resulting from snowfall and wind loading events we found that 94% of avalanche event days (both dry and wet) occurred within three days of a snowfall loading event and 100% of avalanche event days released within seven days of a snowfall loading event (Figure 5). That means 100 avalanche event days out of the 100 Intermountain avalanche event days studied occurred within seven days of a snowfall loading event.

3.3.2 Avalanche release following precipitation loading and wind loading events while representing a Coastal Snow Climate

Looking at Turnagain Pass during the years it represented a Coastal snow climate from 2011-2018, with loading events resulting from snowfall and wind loading events we found that 90% of avalanche event days (both dry and wet) occurred within three days of a snowfall loading event and 99% of avalanche event days released within seven days of a snowfall loading event (Figure 5). That means 193 avalanche event days out of the 195 Coastal avalanche event days studied occurred within seven days of a snowfall loading event.

3.3.3 Avalanche release following precipitation loading and wind loading events while representing a Continental Snow Climate.

Looking at Turnagain Pass during the year it represented a Continental snow climate from 2011-2018, with loading events resulting from snowfall and wind loading events we found that 70% of avalanche event days (both dry and wet) occurred within three days of a snowfall loading event and 87% of avalanche event days released within seven days of a snowfall loading event (Figure 5). That means 44 avalanche event days out of the 50 Continental avalanche event days studied occurred within seven days of a snowfall loading event.

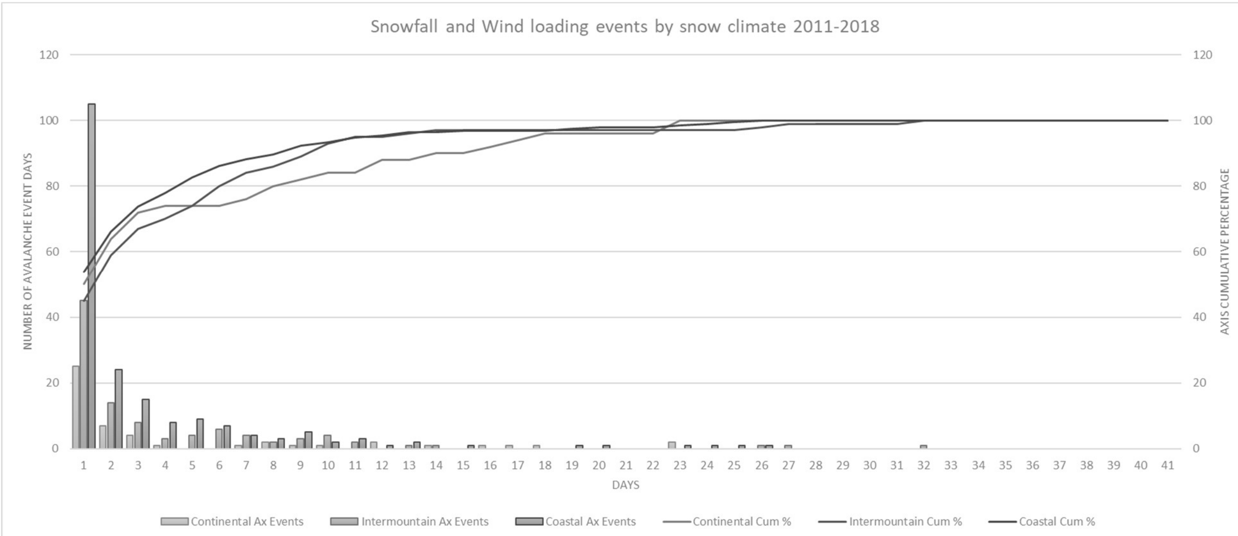

Figure 5: The bars plot avalanche event days for Turnagain Pass for each type of snow climate compared to days since last Snowfall and Wind loading event. The curve shows the cumulative percentage of avalanche activity.

3.4 Avalanche release and days without precipitation

With such a wide variety of snow climates in Turnagain Pass, long periods of dry spells followed by days of precipitation are often seen. To look at the frequency as well as the avalanche activity that occurs following these dry spells, we defined a dry period as a day or stretch of days with no measurable precipitation, this includes rain. Looking at Turnagain Pass during all years from 2011-2018, we found that after three days of zero precipitation, 92% of all avalanche event days (both wet and dry) that will occur, have occurred. After seven days of zero precipitation 98% of all avalanche event days (both wet and dry) that will occur, have occurred. Looking even deeper, after 10 days of zero precipitation 99% of all avalanche event days that will occur, have occurred. After 17 days of zero precipitation, within our data set, 100% of all avalanche days that will occur have occurred. (Figure 6)

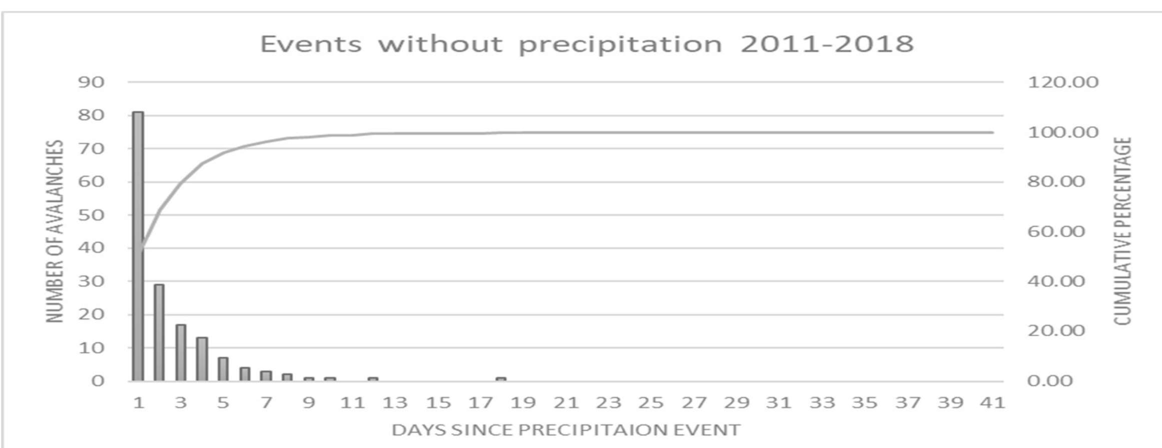

Figure 6: The bars plot avalanche event days for Turnagain Pass compared to days since a measurable precipitation. The curve shows the cumulative percentage of avalanche activity.

3.4.1 Avalanche release and days without precipitation while representing an Intermountain Snow Climate

Looking at Turnagain Pass during the years it represents an Intermountain snow climate from 2011-2018, we found that after three days of zero precipitation, 98% of all avalanche event days (both wet and dry) that will occur, have occurred. After eight days of zero precipitation 100% of all avalanche event days (both wet and dry) that will occur, have occurred.

3.4.2 Avalanche release and days without precipitation while representing a Coastal Snow Climate

Looking at Turnagain Pass during the years it represents a Coastal snow climate from 2011-2018, we found that after three days of zero precipitation, 94% of all avalanche event days (both wet and dry) that will occur, have occurred. After seven days of zero precipitation 99% of all avalanche event days (both wet and dry) that will occur, have occurred. Looking even deeper, after 10 days of zero precipitation 100% of all avalanche event days that will occur, have occurred. (Figure 7)

3.4.3 Avalanche release and days without precipitation while representing a Continental Snow Climate

Looking at Turnagain Pass during the years it represents a Continental snow climate from 2011-2018, we found that after three days of zero precipitation, 70% of all avalanche event days (both wet and dry) that will occur, have occurred. After seven days of zero precipitation 87% of all avalanche event days (both wet and dry) that will occur, have occurred. Looking even deeper, after 10 days of zero precipitation 99% of all avalanche event days that will occur, have occurred. (Figure 7)

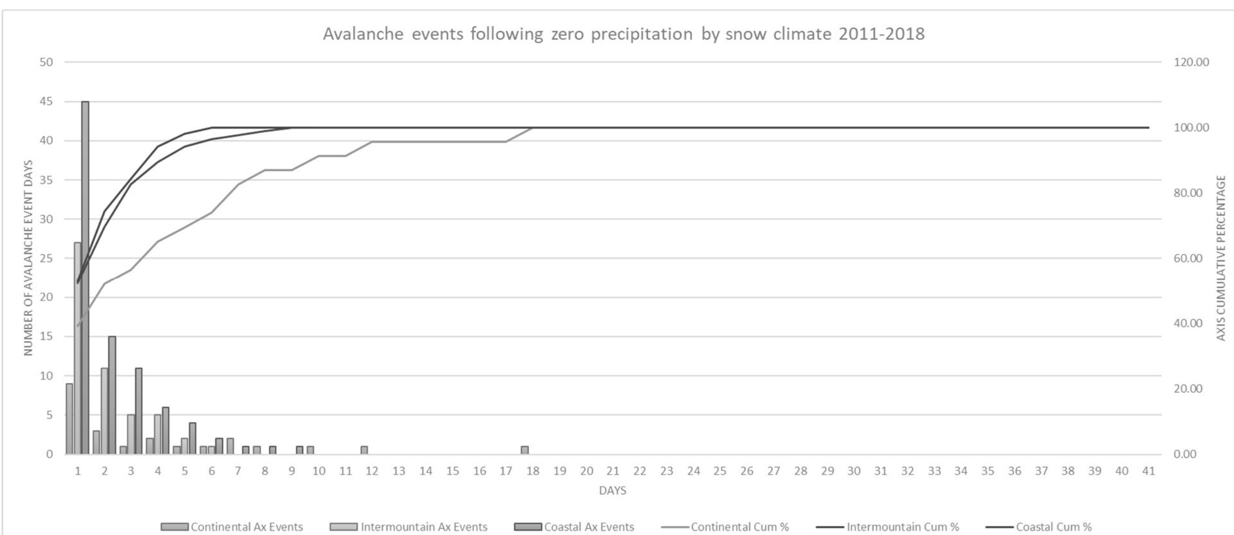

Figure 7: The bars plot avalanche event days for Turnagain Pass for each type of snow climate compared to days since a measurable precipitation. The curve shows the cumulative percentage of avalanche activity.

4 Discussion and Conclusions

This study is an attempt to grow on the research done in Colorado (Konigsberg 2018) about the decline of avalanche occurrences on weak layers following a loading event. Previously this had only been evaluated in a Continental snowpack on persistent weak layers looking only at dry avalanches. Due to

Turnagain Pass's unique weather patterns, Northern latitude, Coastal location and low altitude this research includes wet avalanches with the assumption that dry avalanches can also occur at the same time at higher elevations. This was also the first look at the decline of avalanche occurrences following a loading event in an area that experiences all three snow climates, Coastal, Intermountain and Continental. While Turnagain Pass's overall avalanche record and data set is small, it does allow for a brief insight into the patterns experienced while representing one or all three snow climates in the core of the Chugach National Forest Avalanche Information Center's forecast region.

The purpose of the study in Colorado was to look at how persistent slab avalanches become more unlikely after a period of minor loading events and very little precipitation. It was found that in Colorado less then 15% of their avalanches released 10 days after what was defined as a loading event and only 1% of their avalanches released after 10 days with no measurable snowfall (Konigsberg 2018). Looking at the initial dataset of all events for Turnagain Pass, over all years the research does align with these findings. Less than 10% of the avalanche event days occurred 10 days after what was defined as a loading event and less than 1% of the avalanche event days released after 10 days of no measurable precipitation.

In both types of loading events, Continental had a higher percentage of avalanche event days within the first three days compared to Intermountain and Coastal. However, Continental then slowly continued to have avalanche event days at a rate less than the other two. Within one week of a snow loading event, 86% of Intermountain and 90% of Coastal avalanche event days that will occur, have. Whereas within seven days of a loading event, a Continental snow climate is only at 80% of all avalanche event days. With a Continental snowpack it takes 11 days to get to 88% of all avalanche event days that will occur, to occur. This pattern change shows the differences within Turnagain Pass's snowpack when representing a Continental snow climate, and the uncertainty following minor loading event. (Table 2).

Table 2: Comparison of snow climates with days since snow and wind loading event

Days since Loading Event						
Day 0 = 1 day after event	Continental		Intermountain		Coastal	
	Total	Cumm %	Total	Cumm %	Total	Cumm %
0	25	50	45	45	105	53.85
1	7	64	14	59	24	66.15
2	4	72	8	67	15	73.85
3	1	74	3	70	8	77.95
4	0	74	4	74	9	82.56
5	0	74	6	80	7	86.15
6	1	76	4	84	4	88.21
7	2	80	2	86	3	89.74
8	1	82	3	89	5	92.31
9	1	84	4	93	2	93.33
10	0	84	2	95	3	94.87

An interesting finding was the differences in the amount of days an avalanche is triggered within each of the snow climates following no loading. Looking at the initial two loading events, some of the outlier avalanches could be caused by the continuous snowfall that could be occurring, but not accounted for as a loading event. For this reason, we also chose to evaluate true days without any type of precipitation, this includes both snow and rainfall. These results showed that after 3 days of zero precipitation, the chances of an avalanche event occurring drops below 10% for Turnagain Pass, Alaska. Yet, looking even closer at the snow climate of Turnagain Pass while it is representing an Intermountain and Coastal Snow climate, when we get over 8 days of zero measurable precipitation 100% of all avalanche event days that will occur, have. While this seems to be an important finding for seasons representing Intermountain and Coastal, it is understood that this is a small dataset.

Table 3: Comparison of snow climates and avalanche event occurrences after days of zero measurable precipitation.

Days without precipitation event						
Day 0 = 1 day after event	Continental		Intermountain		Coastal	
	Total Ax Days	Cumulative %	Total Ax Days	Cumulative %	Total Ax Days	Cumulative %
0	9	39	27	53	45	52
1	3	52	11	75	15	70
2	1	57	5	84	11	83
3	2	65	5	94	6	90
4	1	70	2	98	4	94
5	1	74	1	100	2	97
6	2	83	0	100	1	98
7	1	87	0	100	1	99
8	0	87	0	100	1	100
9	1	91	0	100	0	100
10	0	91	0	100	0	100

One of the key components that avalanche forecasters look at is the likelihood in which an avalanche could release naturally or by human trigger. With these complex problems involving persistent weak layers, it can be hard to know how many days can pass without avalanche activity until the layer of concern is nonreactive.

This data set shows that when Turnagain Pass is representing both an Intermountain or Coastal snow climate and has a week without any measurable snowfall or precipitation it would fall into the “unlikely” category. This suggests LOW (Level 1 of 5 danger) may be appropriate for communicating the likelihood of a human triggered avalanche within the layer of concern, even if stability tests are still showing propagation propensity. While, if the snowfall events occur but are not classified as a loading event, the likelihood of a human triggered avalanche may remain “possible” or MODERATE (Level 2 of 5) danger as small amounts of snowfall or wind loading continues. These results are focused on the Intermountain and Coastal snow climate results since Turnagain Pass has only represented a Continental snowpack once during this 7-year period, and the overall data follows those trends more closely.

This study was performed only on the data set given for Turnagain Pass and could be continued with the entire forecast region of Chugach National Forest Avalanche Information Center. This would further include the Girdwood region and Summit Lake. Currently we have a data set large enough for the Girdwood region, but avalanche and wind data for Summit Lake area is not complete and could be continued if the avalanche data was compiled and wind data was more reliable into the future.

Limitations with the data:

CNFAIC only has 7 years of avalanche data for Turnagain Pass – data before 2011 is incomplete. All avalanches were observed and reported by CNFAIC staff, other agency forecasters, local guide services or reported by the public. We realize that avalanches are triggered that go unreported and this data may not capture the full extent of all avalanches occurring following days of little to no loading.

The vast area and climate differences throughout the forecast region as well as the season could also be a limitation of the data. The snow climate identification process considers the temperature gradient of the December snowpack, which is used to identify a period in which basal facets would form (Mock and Birkeland 2000). On average December is the highest snowfall month for Turnagain Pass (NRCS) out of a 30-year climatic normal. Since 2004, when Turnagain Pass SNOTEL site began measuring height of snow, a temperature gradient $>10°C/m$ has never occurred. This is a limitation of the climatic study and doesn't necessarily reflect the presence or absence of basal facets within the snowpack at Turnagain Pass. In addition, the Summit Lake region located 12 miles South of Turnagain receives far less precipitation and can have a basal facet problem when Turnagain Pass does not. This has contributed to forecasting challenges on the far Southern end of Turnagain Pass where the snowpack often resembles the interior region of Summit Lake. It's important to acknowledge avalanche data from the Southern end of Turnagain was included in this study.

Another limitation with the data are the time periods without loading. Since we have a primarily Intermountain and Coastal snow climate, in general there is more consistent precipitation and less periods of no precipitation. This could cause the data set to look as though almost all avalanche event days occur within those initial days, while there could be fewer of these clear weather windows without loading. Since only one year in our data set represented Continental, we have a very small spread.

The final limitation was discovered while looking at some of the outlier events. In "days since loading events" for both wind loading and precipitation loading some of the outlier avalanches after 20+ days occurred as a result of radiation from the sun. Due to the far Northern location of Southcentral, Alaska wet avalanches as a result of radiation aren't common until mid-March or even April. Any future study should remove wet avalanches that occur as a result of radiation to keep the focus on the potential for triggering a persistent slab. In the "Days Without Precipitation" category none of the outliers were associated with radiation. However some of the outliers after 10 days were associated with wind loading, which was not accounted for in that analysis.

5 Acknowledgements

We would like to thank everyone at the Chugach National Forest Avalanche Information Center for providing us with the last 7 years of avalanche and weather data for Turnagain Pass. As well as assistance compiling the data, information, and thoughts into one place.

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