LESSONS LEARNED FROM AN UNPRECEDENTED SEASON IN SOUTHCENTRAL ALASKA.

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ABSTRACT: In the winter of 2024-25, the Chugach National Forest Avalanche Center (CNFAC) in southcentral Alaska experienced an exceedingly dangerous snowpack, with a layer of well-preserved surface hoar that was responsible for at least 46 human-triggered avalanches and 4 fatalities during a six-week period from mid-February through late March. At least three factors– geographic location, widespread distribution, and prolonged sensitivity to human triggering– contributed to these unusually dangerous conditions. This unprecedented snowpack setup required a critical shift in CNFAC operational mindset and public risk communication strategies. This drove the CNFAC's decision to keep the danger rating at Considerable or higher for 46 consecutive days, doubling the previous record of 23 days during the 2012-13 season. In this paper we discuss how the CNFAC identified and adapted to these conditions, and how the CNFAC mitigated cumulative stress and fatigue during this challenging season. We also discuss how one fatal accident during this avalanche cycle highlights a critical need in avalanche awareness and education in the growing demographic of very capable but less experienced young motorized users. We hope this paper serves to guide decisions made in the future, whether on a professional or recreational level, and that the lessons we learned can be useful when faced with any exceptionally dangerous conditions, regardless of the snowpack specifics.

KEYWORDS: buried surface hoar, risk communication, message fatigue

1. INTRODUCTION

The 2024-25 season in southcentral Alaska was characterized by a prolonged and uniquely dangerous snowpack from February 14 until after the Chugach National Forest Avalanche Center (CNFAC) forecast season ended in early May. The CNFAC responded by adapting its operational mindset, and expanded risk communication strategies to inform the public of these dangerous and unprecedented avalanche conditions. Mitigating cumulative stress after being involved in multiple accident responses and near misses was critical. Managing message fatigue became a challenge as the CNFAC forecasters attempted to inform as many backcountry users as possible.

Three factors contributed to unprecedented avalanche conditions: geographic location of a problematic layer of surface hoar, widespread distribution of that layer, and prolonged sensitivity to human triggering. The layer would ultimately contribute to at least 46 human-triggered avalanches within and immediately adjacent to the CNFAC forecast area. Two of these were fatal, resulting in 4 lives lost.

One of two fatal accidents of the season involved a 16-year-old, shining a grim light on a growing demographic that is highly skilled and confident, but still has a need for developing avalanche awareness and effective rescue skills.

Messaging to the public required a more aggressive approach to inform as many people as possible. We increased the severity of the tone in our messaging and introduced new methods to inform the public. While we feel these efforts were effective in decreasing the amount of avalanche accidents, we still had to manage stress as a team as human-triggered avalanches continued throughout the season.

2. METEOROLOGY AND SNOWPACK

The first half of the season was warm and wet, with consistent rain at popular trailheads limiting access to most areas until the season was well underway. As the season continued, we finally received a series of storms that brought snow down to sea level. This was followed by an extended cold, clear, and calm spell.

The weather responsible for the development of this unusually dangerous snowpack can be characterized by two separate and prolonged events. The first pattern would create the ideal environment for the growth of a well-developed and unusually continuous surface hoar layer. The second would bury the surface hoar layer intact and upright, under 60 to 90cm (2 to 3 ft) of snow, without ever adding enough load at one time to initiate a natural avalanche cycle.

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A persistent upper-level ridge centered just west of our forecast area from late January to early February (Figure 1) brought prolonged cold, clear, and calm weather.

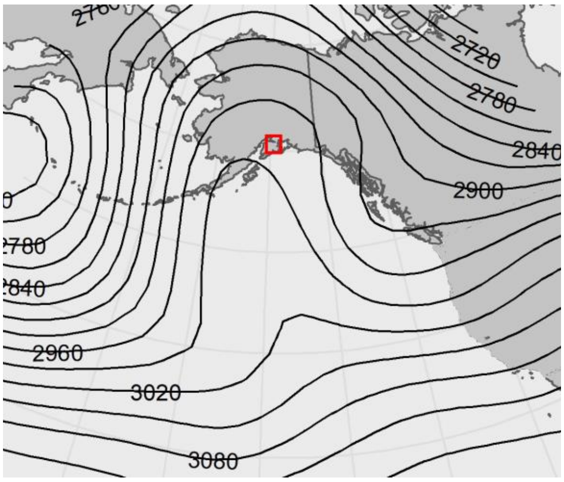

Figure 1: Composite of 700 mb geopotential heights from Jan. 28 through Feb. 13, 2025. The CNFAC forecast area (marked by a red box) was situated on the downstream end of a persistent ridge, which resulted in weak northwest flow for over two weeks. This is almost always accompanied by cold and clear conditions, but what was unusual in this case was that we also saw very calm winds. NCEP Reanalysis data provided by the NOAA/OAR/ESRL PSD, Boulder, Colorado, USA, from their Web site at https://www.esrl.noaa.gov/psd/.

Turnagain Pass did not receive any precipitation between January 29 and February 13. Ridgetop winds averaged 15 mph or less for all but 3 days of this period, and average ridgetop temperatures were in the mid-teens F. This was an ideal environment for widespread surface hoar development, with crystals growing to an average of 10-20 mm (Figure 2).

On February 14-15 a ‘storm’ finally brought 0.5 cm (0.2 in) SWE with moderate winds, burying this layer upright in most locations and giving it the name the Valentine’s Day surface hoar layer (Figure 2). During this initial ‘storm’, the Seattle Ridge ridgetop weather station (located on the motorized side of Turnagain Pass) recorded winds averaging 23 kph (14 mph) with gusts of 32- 40 kph (20-25 mph).

A series of weak storms gradually buried this layer 15 to 30 cm (6 to 12 in) deep by February 22. People started triggering avalanches on this layer once the SWE load above the weak layer exceeded 2.5 cm (1 in.). Incremental loading continued through mid-March, burying this layer 60 to 90 cm (2 to 3 ft) deep but never adding enough stress to create a natural avalanche cycle. These storms averaged 0.25 to 0.8 cm (0.1 to 0.3 in) SWE and never exceeded 1.8 cm (0.7 in) SWE in a 24-hour period. The layer was stubborn enough to stay intact, but fragile enough to produce very large human-triggered avalanches weeks after it was buried.

Time series plots of the complete season weather history and major avalanche events may be found in Appendix A.

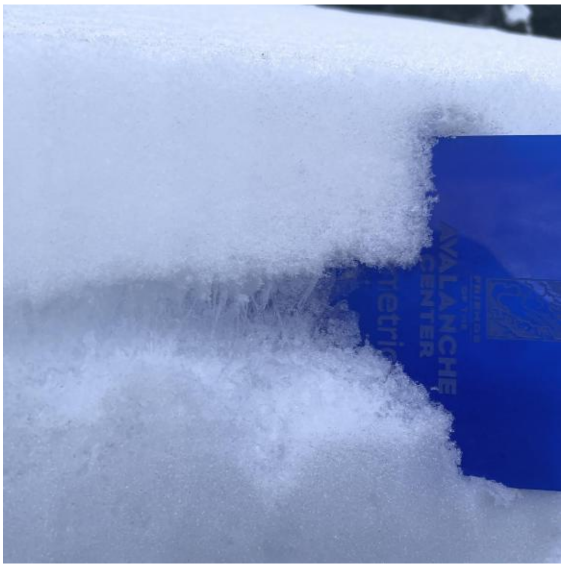

Figure 2: The Feb. 14 surface hoar layer shortly after it was buried. The layer would remain upright, intact, and reactive for months after it was buried. Photo: CNFAC, 02.25.2025.

3. ACCIDENTS AND NEAR MISSES

The first fatal accident occurred on March 4, when 3 heli skiers were caught and buried in an avalanche in the west fork of the Twentymile drainage outside of Girdwood. The skiers were buried an estimated 12-30 m (40 to 100 ft) deep and did not survive.

The second fatal accident occurred on March 22, when a snowmachiner riding on the lower portion of a large bowl on the west side of Seattle Ridge triggered a large avalanche. The avalanche released 60 to 90 cm (2 to 3 ft) deep and approximately 150 m (500 ft) wide, propagating roughly 60 m (200 ft) upslope of the rider. The rider tried to ride off the moving debris but was swept into a terrain trap and buried roughly 4 m (12 ft) deep. Riders from multiple groups responded immediately and were able to extricate the rider within roughly one hour of burial. Unfortunately, the rider had sustained severe traumatic injuries and did not survive. The rider was just 16 years old, and many of the responders were also in their late teens or early 20s.

There were 11 human-triggered avalanches in the Seattle Ridge area in the week leading up to this accident, including 6 that occurred the day prior. The most noteworthy near miss during this time occurred on March 17, when a snowboarder triggered an avalanche, was carried approximately 300 m (1000 ft), ended up on top of the debris and was able to ride away. At least 4 other slabs released sympathetically as the rider was carried. The slope had roughly 30 sets of tracks on it from that day and the day before. Some of those tracks were from CNFAC forecasters, who had been out doing fieldwork the day prior to the avalanche. They had dug two pits- one of which was roughly 15 m (50 ft) from what would be the crown of the avalanche, and the other was around 150 m (500 ft) from the flank. The weak layer of concern was not present in the upper pit, and did not produce unstable results in the lower pit (ECTN26, PST 65/100 end). However, in hindsight, conditions were clearly still very dangerous. This event really highlighted the unpredictability of the snowpack and made it clear that the practices we would normally consider safe were just not conservative enough for the problem at hand.

4. DANGEROUS VS. UNPRECEDENTED CONDITIONS

This season was defined by an escalation from ‘dangerous’ avalanche conditions (which we experience at some point during most winter seasons) to ‘unprecedented’ conditions. Although a similar weak layer has likely formed at some point in our region, there were several factors specific to the 2024-25 season that made it exceedingly dangerous.

4.1 Geographic Location

We consistently observed the most dangerous avalanche conditions in the region right in the middle of our Turnagain Pass forecast zone. We saw the worst setup on Seattle Ridge and Lynx Creek, which happen to be the areas of the Chugach National Forest that see the highest rates of motorized use. This was made more problematic by the fact that the beginning of the season was marked by a consistently high rain line that kept several other popular motorized trailheads closed, directing even more traffic than usual to these problematic zones. We recorded 25 of the 46 human-triggered avalanches failing on the Feb. 14 surface hoar layer in these two zones. Nineteen were triggered remotely or released sympathetically. Six of the avalanches involved people getting caught or carried.

4.2 Widespread Distribution

We are no strangers to buried surface hoar in southcentral Alaska. What was unusual was the number of avalanches triggered remotely, often pulling back into very low-angle slopes. Some of these avalanches released on slopes with angles as low as 18 degrees. The last observed remotely triggered avalanche occurred 35 days after the layer was buried, at which point it was 60 to 90 cm (2 to 3 ft) deep. This problematic layer was remarkably consistent across forecast regions, but remained exceedingly difficult to assess on the slope scale. While we continued to see human-triggered avalanches, we also observed a decrease in reactive stability tests. This unreliable feedback was challenging for professionals and recreationists alike and was a key factor in the near miss during CNFAC fieldwork.

4.3 Prolonged Sensitivity

There were documented human-triggered avalanches on the Valentine’s Day surface hoar layer as late as March 22, 36 days after the layer was buried. Conditions likely remained dangerous well after this date. However, a significant drop in backcountry traffic following the flurry of near misses and fatal accidents likely helped us avoid seeing accidents later into the spring season. It wasn’t until our springtime shed cycle that we saw a natural avalanche cycle fail on this layer. This began in early May, after the avalanche center finished issuing avalanche forecasts, and over three months after the layer was buried.

5. RISK COMMUNICATION

Making the distinction between ‘dangerous’ and ‘unprecedented’ was absolutely critical, both for operational backcountry travel and for public messaging. We were very intentional in communicating travel advice to the public that reflected the way we were managing terrain within our operation. This would ultimately guide our decision to keep the danger rating at Considerable or higher for 46 consecutive days. That streak doubled our previous record of 23 days, which occurred during the 2012-13 season when we were dealing with a deep slab problem. This streak contributed to a significant deviation from the distribution of danger ratings in our historical record (Figure 3). Between 2009 and 2024, roughly 40% of the daily danger ratings were at or above Considerable. For the 2024-25 season, this number jumped up to 63%.

Beyond the danger rating, we implemented several other strategies to convey our concern. We published 4 Special Avalanche Bulletins and 2 Avalanche Warnings in March and early April. We posted avalanche danger flyers at popular backcountry trailheads. We used media interviews to reach a wider demographic than would normally see our messaging through daily forecasts and social media posts.

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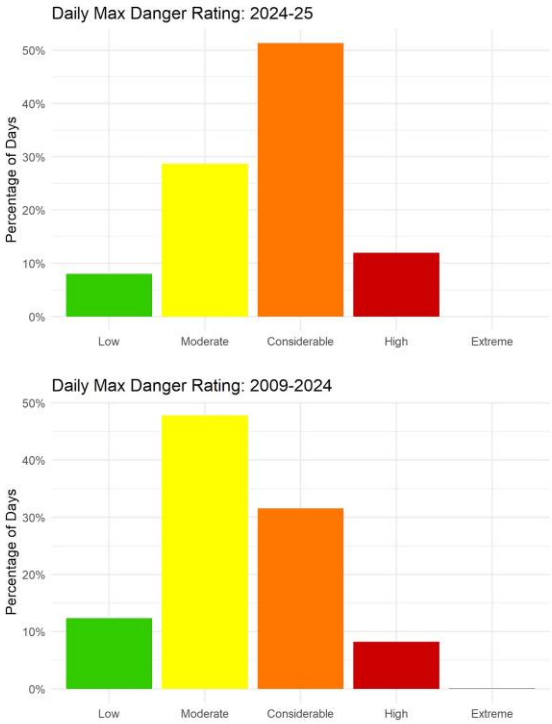

Figure 3: Percentage of days where each danger rating was assigned for the 2024/25 season (top), compared to the CNFAC historical record, which goes back to the 2009/10 season. For each day, these charts assess the highest danger rating assigned out of all three elevation bands (Alpine, Treeline, Below Treeline). The 2024-25 season saw a distinct shift to more days assigned Considerable and High compared to the historical norms.

We discussed the dangerous season in our outreach events and began collaborating with local snowmachine freeride teams to help inform the community. On March 29, just seven days after the March 22 snowmachine fatality, several members of the motorized community organized an avalanche outreach event on the Kenai Peninsula. This was part of an effort to improve avalanche awareness, especially for young people. Forecasters from the CNFAC and the Alaska Avalanche School introduced a curriculum that was similar to “Know Before You Go”. The turnout was the largest of any outreach on the Kenai Peninsula and consisted mostly of a younger snowmachine crowd. Overall we were able to meet a large group of riders who lacked adequate avalanche education but are eager to pursue educational opportunities. It is critical to continue investing in educating this group. We have another avalanche awareness event scheduled for the winter of 2026 utilizing the same partners as well as future ideas and goals to outreach specifically to the snowmachine crowd.

Less measurable, but possibly the most effective change we made was an intentional shift in our general tone to reflect the severity of the situation. This included the way we wrote about the conditions in our observations and forecasts, the way we talked about conditions in our field videos, and the way we communicated with the public while we were out in the field or at outreach events.

6. STRESS AND RESILIENCE

It is important to consider the psychological toll a season like this can take on the community and on any avalanche operation. While this is most acute during and immediately following a fatal accident or near miss, the effects are cumulative throughout the season. We have been proactive in addressing this issue as a team through our resilience program, which includes regular check-ins. We remain flexible with scheduling and sharing workload, especially in the wake of major events, and we have made a focused effort to identify those stressful periods. For any team that is headed down a similar path in the future, we cannot stress enough how helpful it can be to debrief critical incidents and to identify and address stress injuries early on.

7. CONCLUSION

Recognizing the transition from ‘dangerous’ to ‘unprecedented’ conditions was a critical shift, which necessitated a very different approach to backcountry travel. We communicated that change in mindset to the public using all of the tools we had available. Although we still saw fatal accidents this season, we believe that this approach was effective in guiding the decision-making process of the recreating public and avoiding more fatalities. We noticed this in the way people were using terrain, as well as the noticeable drop in traffic during what would traditionally be the busiest time of the season at Turnagain Pass. We may have avoided at least one more near-miss if we had made that distinction between ‘dangerous’ and ‘unprecedented’ earlier, and that is one lesson that we will carry into the future.

Ultimately, there were several questions that were left unanswered. Were we effectively communicating the severity of the situation to the public? Did people think we were forecasting too conservatively? Why were people still getting caught in avalanches? These questions will probably seem familiar to anyone sitting in the hot seat during a dangerous season, and we still don’t have any good answers.

The point of this case study is to be a resource to use when working with an anomalously dangerous snowpack in the future. Unfortunately, it does not capture the full gravity of this season. It is impossible to fully describe the cumulative stress of waiting for the phone to ring with news of another accident or the overwhelming loss and crushing defeat you feel when you respond to one of those accidents and the rescue effort was unsuccessful. Or the sinking pit in your stomach seeing a photo of a massive avalanche wiping out your tracks from the day before. These experiences can be viewed as “part of the job” but they do carry lessons to learn as a practitioner. We hope this case study preserves this season, offering practitioners a perspective that may help them through a challenging season in the future.

ACKNOWLEDGEMENTS

A shorter version of this article was previously published in The Avalanche Review 44.2.

APPENDIX A: Weather History

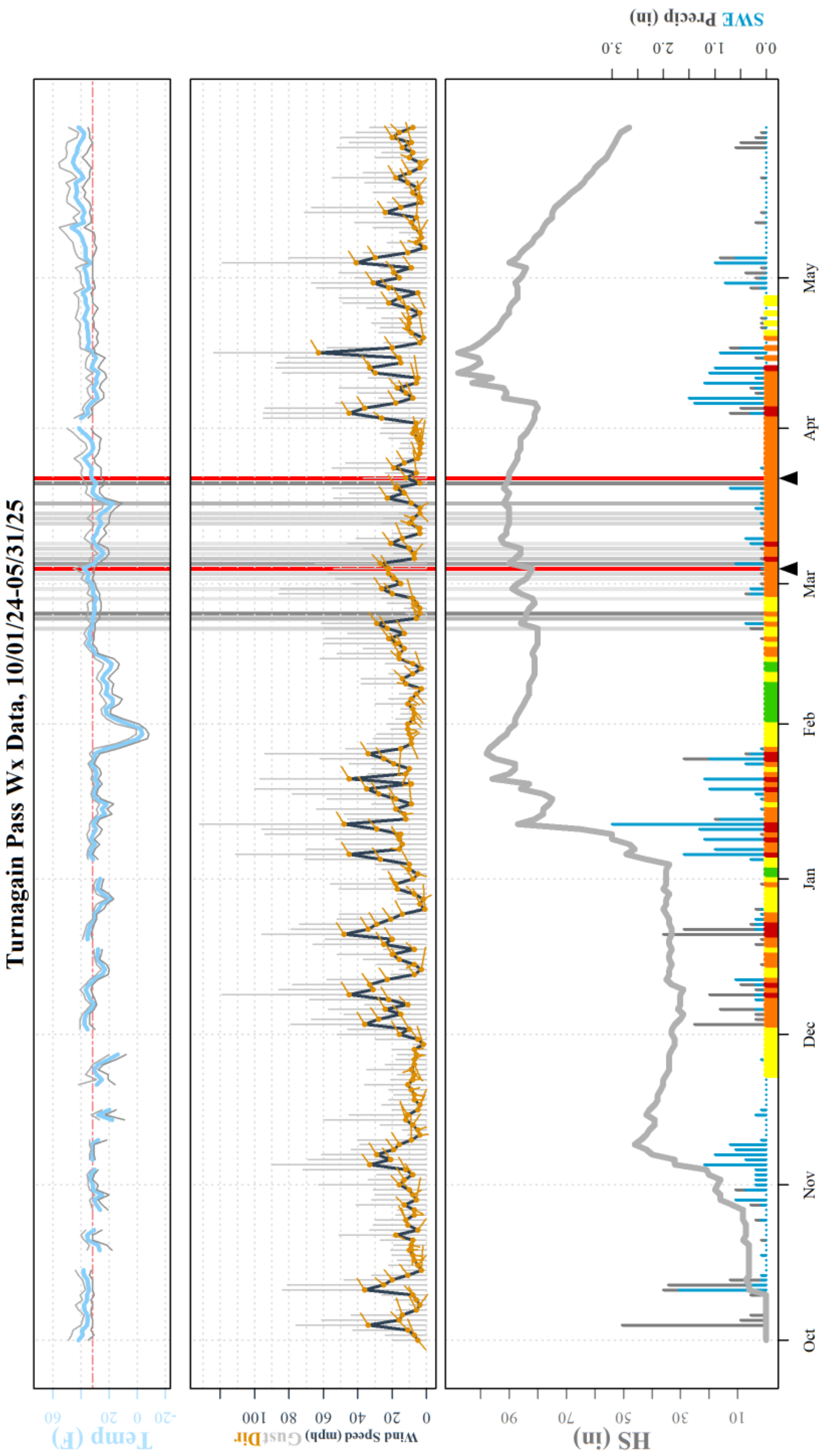

Figure 1: Season history for the 2024/25 winter. The top chart shows daily max/min (thin gray lines) and average (thick blue line) temperature. Middle chart shows daily average wind speed (navy blue line), direction (orange barbs), and max gust (gray vertical bars). Bottom chart shows accumulated height of snow (gray line), daily SWE (blue bars), daily liquid precipitation (gray bars), and danger rating (colored stripes along the bottom). Vertical bars represent avalanche activity on the Feb. 14 surface hoar layer. Darker gray bars indicate a larger number of avalanches, and red bars indicate fatal accidents (also marked with black triangles at bottom of plot). Note the cold temperatures, calm winds, and lack of snowfall during early February, followed by elevated avalanche danger, active weather, and increased avalanche activity beginning late February.