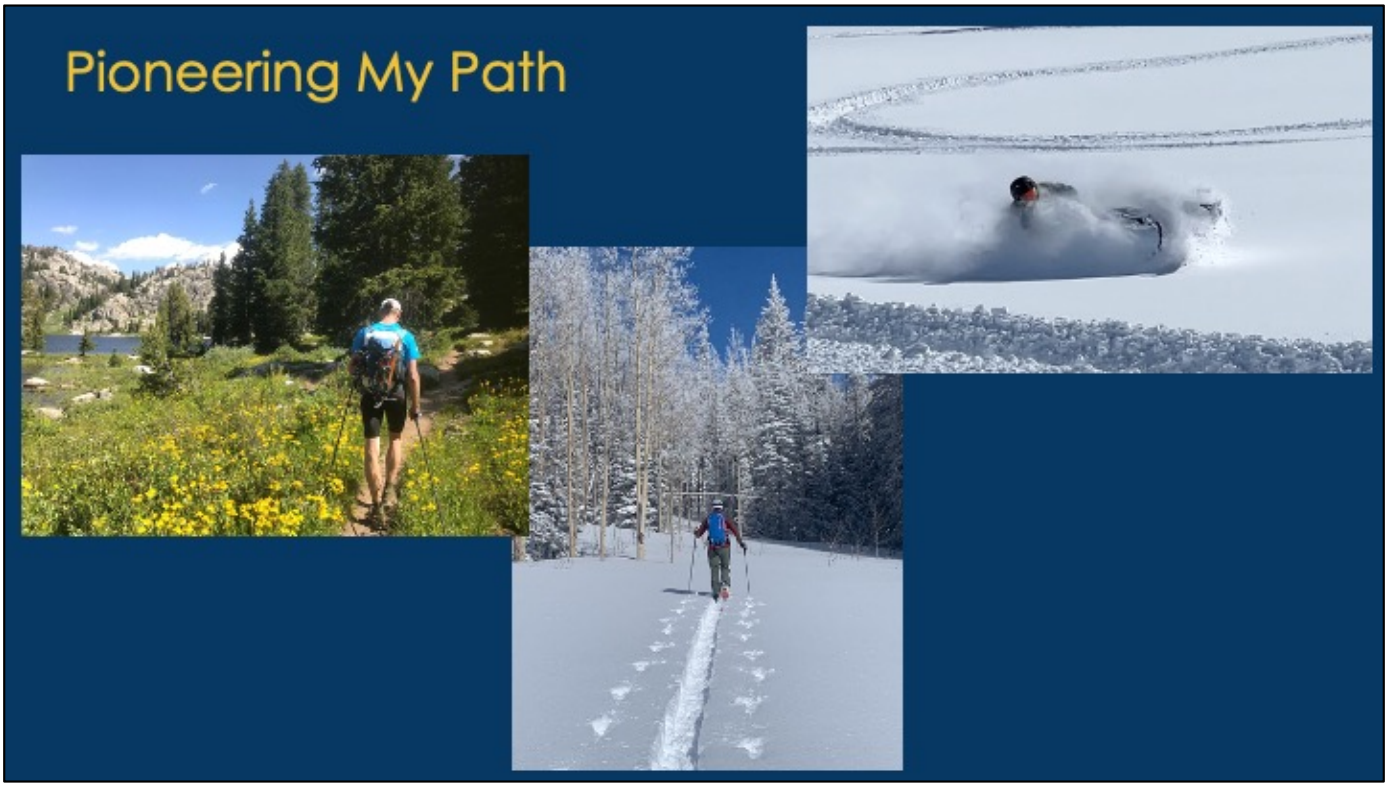
Last year was proof that we have The Greatest Snow on Earth. With machine learning we will help more people enjoy that snow, on more days, in more places, and more safely.

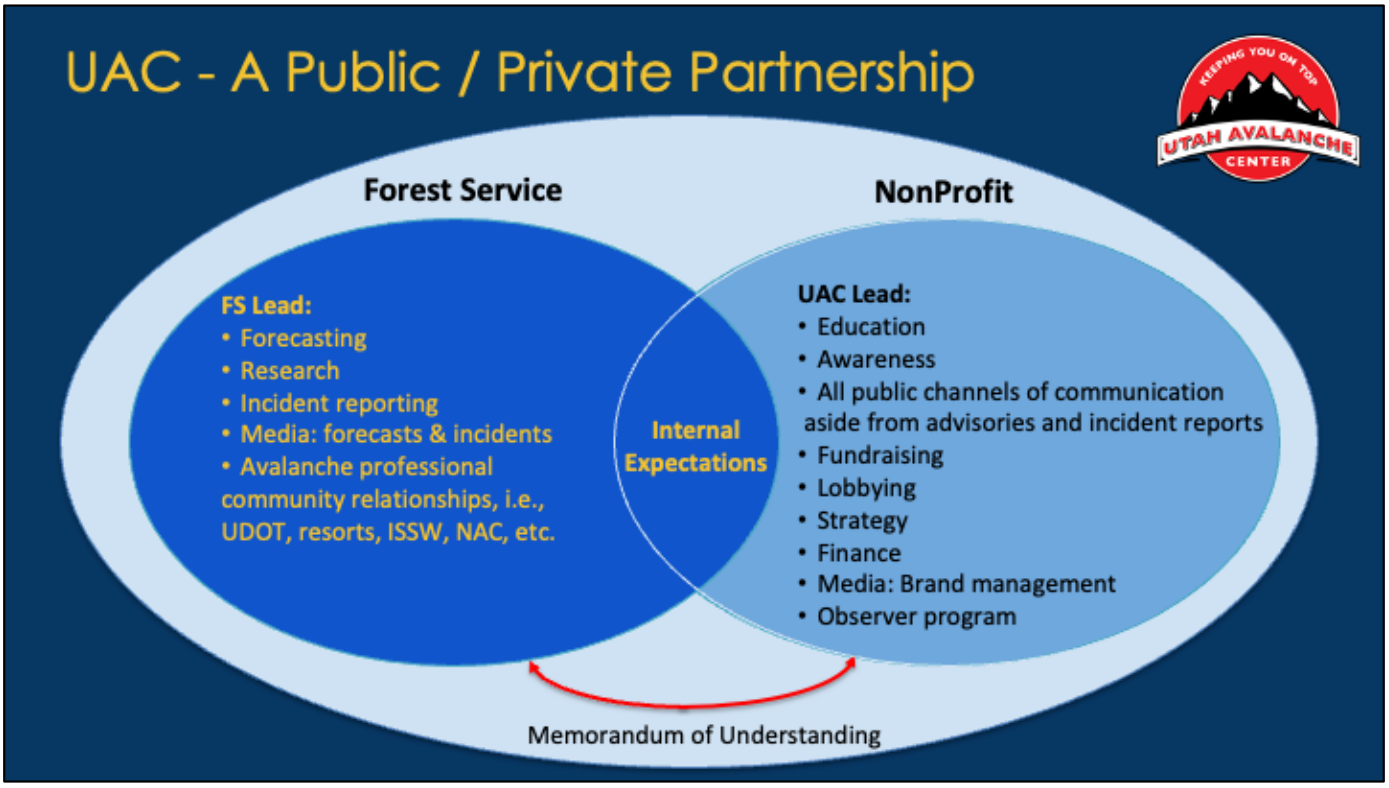


I love for traveling through the mountains. In the summer, that includes our amazing trails throughout the various Utah mountain ranges. Summer mountain travel generally restricts a person to the established trails. That is why I love traveling through the mountains on snow. Whether on my skis or snowmobile, winter travel opens up doors for exploration. You are no longer limited to trails, but instead, you to get pioneer your own trail through the forest and into the alpine. While getting powder turns is a great return, many days, just the act of blazing your own trail through the mountains is the return.

While infrastructure is often seen as things like trails, winter travel is unique as it does not require this traditional infrastructure, but rather it requires us the ability to provide people the information they need to create their own virtual trails.

As Utah's population grows, many of our areas are getting crowded. Backcountry users have to make a lot of decisions each day in the mountains.

By providing users with more information the UAC can help more people answer these questions and empower them to safely create their own virtual trails to seek the enjoyment and physical and mental benefits that the mountains bring us.



The UAC is a unique organization. We are partnership between the Forest Service and the nonprofit working in coordination to deliver avalanche forecasting, education and awareness across the entire state of Utah. We have offices in Moab, Spring City, Salt Lake, and Logan. Since 1980 we have been providing public safety resources for the residents and visitors in Utah.

The UAC has at the forefront of avalanche forecasting and education innovation for over 4 decades.

- From the first ever avalanche education video created in 1996 that revolutionized avalanche education and was used across all of North America
- To becoming the first avalanche center in the world to use iconography to communicate avalanche danger. Powder the Polar Bear was spurred by the 2002 Olympics. With thousand of people from around the world coming together in Utah, the UAC needed to find a way to clearly communicate avalanche information. This results in creation and use of icons to communicate the overall avalanche danger as well as what the danger was and where to find it. Since that time, every avalanche across the globe has implemented iconography to delivery avalanche information
- Continual innovation will be required to prepare for the next Olympics

When art meets science - How machine learning will help save lives?

Machine learning is at the forefront of all business innovation

- More data can be analyzed
- Increase forecast accuracy
- Provide more information to disperse use
- After storms, get people into the mountains sooner

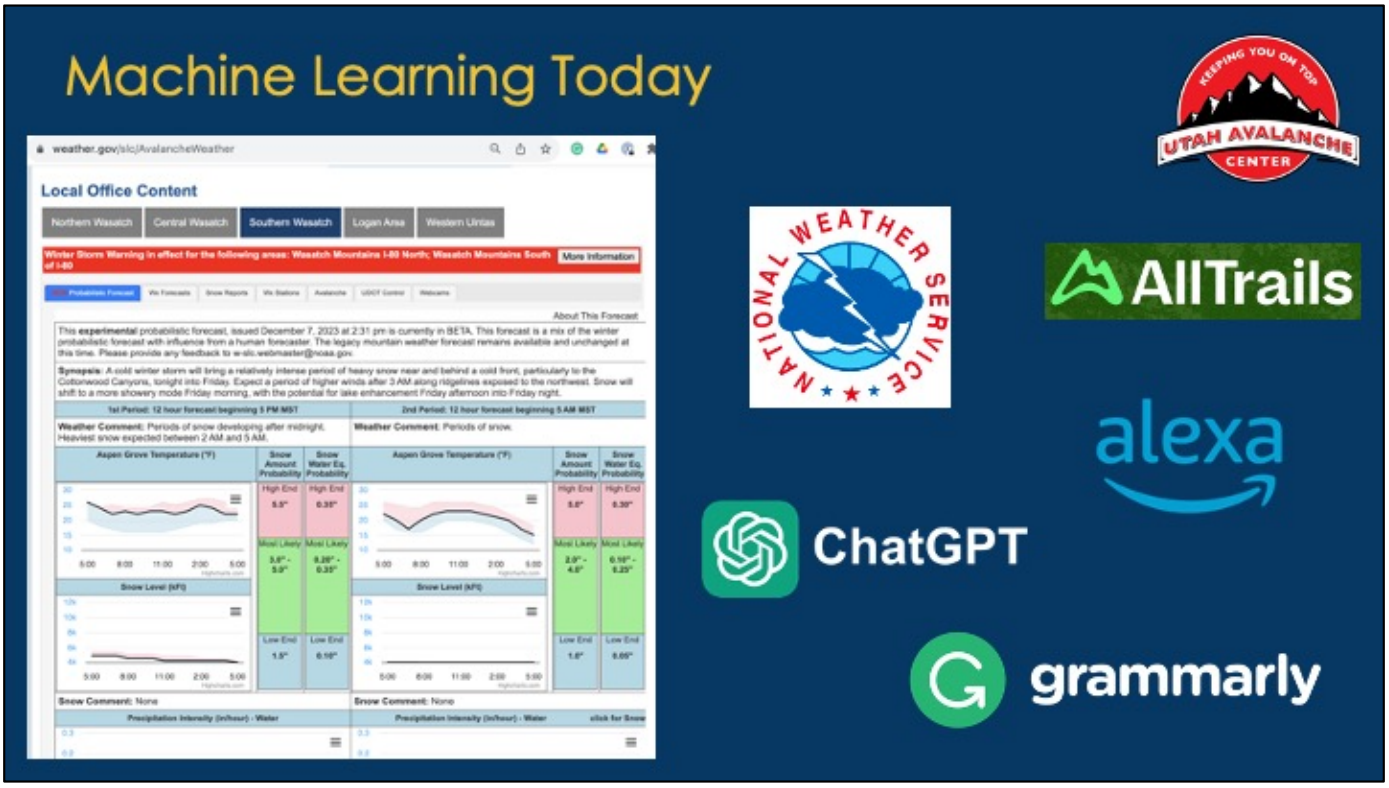
"AI won't replace people, but people who use AI will replace people who don't." - IBM

Currently avalanche forecasting is more art than science. For example, an avalanche forecaster, needs to know what weather stations to look at for data based on current and past weather. It takes a forecasters historical knowledge to know that a certain weather station will not provide accurate information if the wind blew from the east or that another weather station will be affected by wind drifted snow. An avalanche forecaster can spend up to 75% of the time it takes to publish a forecast just processing the data from weather stations and crowd sourced field reports, this data all needs to be processed manually.

With machine learning, this data can all be preprocessed and summarized for avalanche forecaster and point them just the most important information.

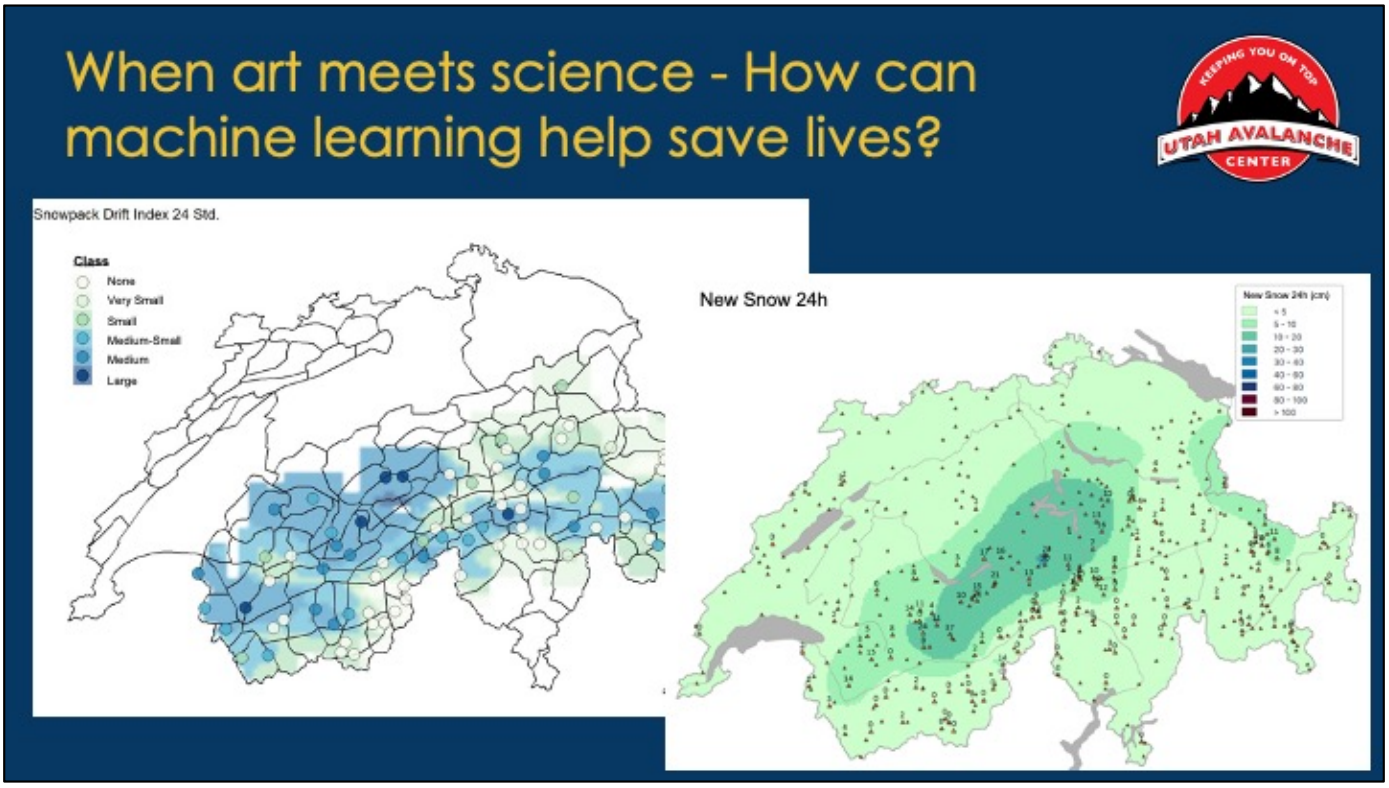
This creates efficiencies in for our staff allowing them to focus on communicating the current and predicted conditions for more mountain ranges enabling more people to pioneer their own path.

Machine learning, will also allow us to provide more publicly available information ranging from detailed danger ratings at a more granular scale to more precise information about where and when avalanches will occur.



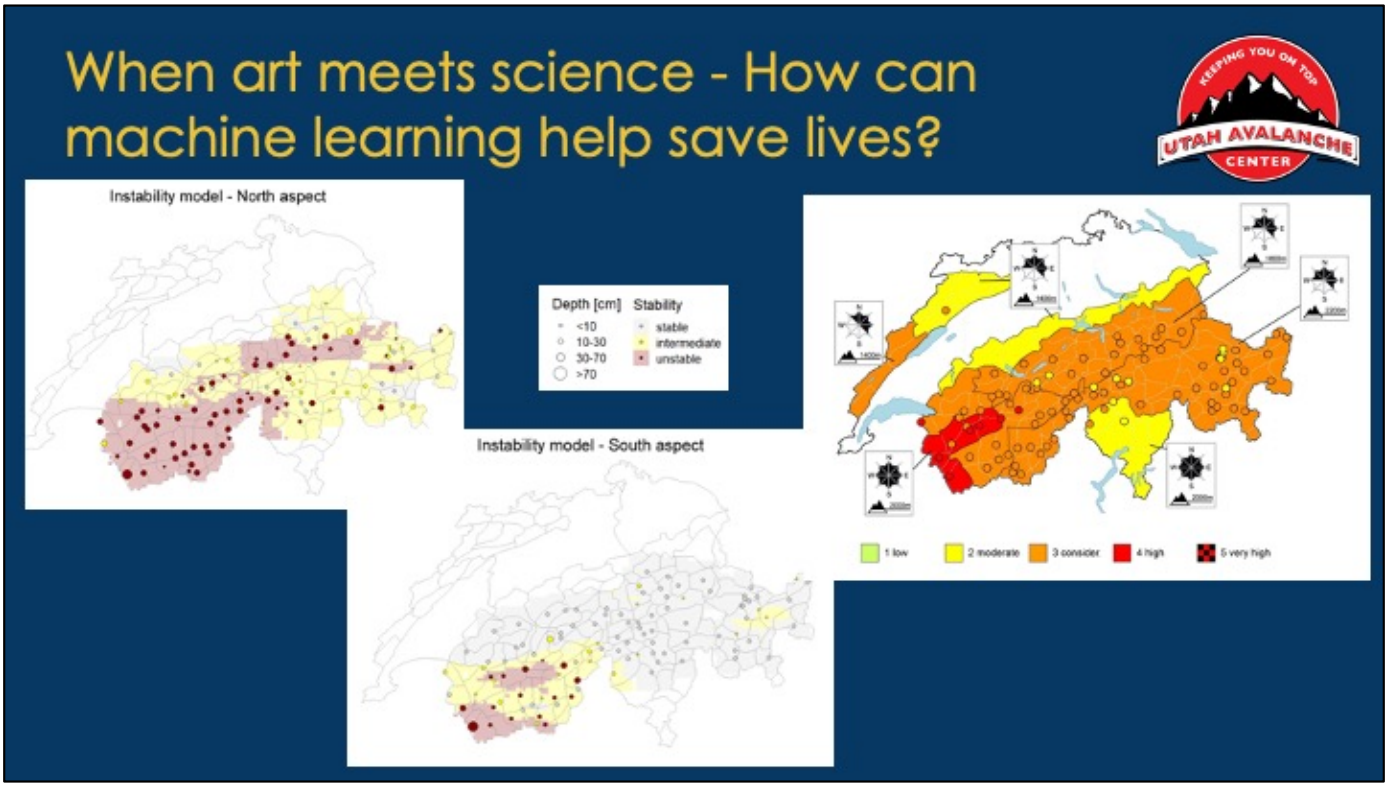
Machine learning continues to impact our lives in many ways. From apps on our mobile phones, to the online chat support we get, to the spelling and grammar check in our emails, to applications like All Trails that use AI to report trail conditions, to things that you might not guess are created by a machine like portions of the National Weather Service forecasts for snow and severe weather like hail, tornados

Machine learning is already being used by avalanche forecasters in both Canada and Switzerland.



With machine learning, we will be able to provide detailed information \

- Where did snow fall, and where did the wind blow the snow
    - This information is not only useful to keep backcountry users safe, but also crucial for organizations like UDOT to forecast road conditions to the ski resorts to help them open to the public more quickly, to SAR team who need to travel through the mountains for a rescue.



- Information about how stable or unstable the snow is by aspect. Understanding aspect specific conditions is crucial to safe decision making
- A detailed statewide avalanche forecast

Machine learning will not replace an avalanche forecaster, but they can spend more time helping people make sense of all the information. Additionally, this technology helps us provide helpful information in remote mountain ranges in rural parts of the state and possibly help from more urban areas to visit and recreate in these places helping to disperse use across the state.

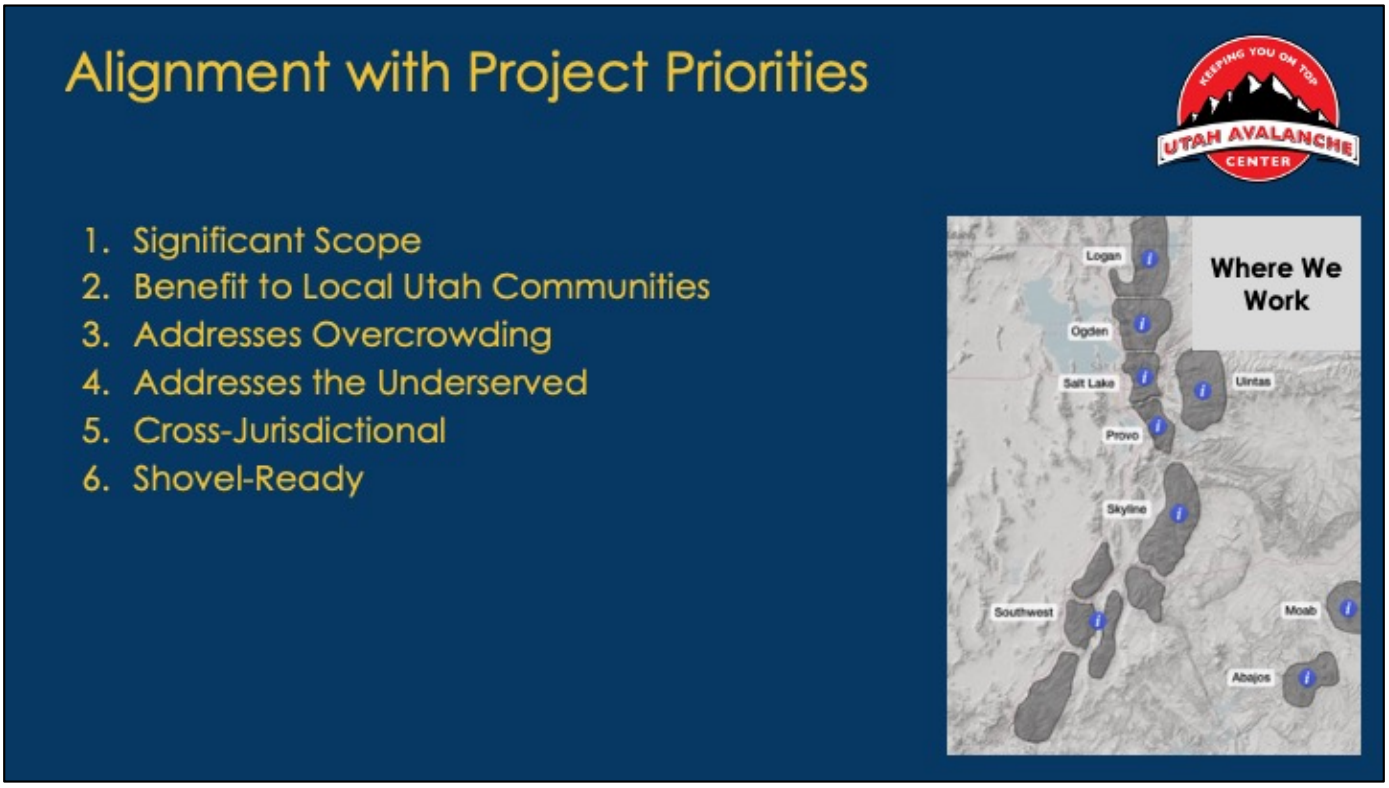
- Granular danger rating maps helping people make decisions of where to safely travel.

Budget

Phase and Component	Year 1	Year 2	Year 3	Total
Phase 1: Planning, Initiation, and Identification (see details below)	**$79,900**	**$86,700**	**$0**	**$166,600**
Project Planning	$7,600	$0	$0	$7,600
Identification	$64,600	$0	$0	$64,600
Data Updates, Modeling, and Initial Analysis	$7,700	$86,700	$0	$94,400
Phase 2: Field Data Collection	**$66,800**	**$245,388**	**$245,388**	**$557,575**
Installation of 2 New Weather Stations in Logan	$30,200	$0	$0	$30,200
Installation of Radiometer at Atwater Plot	$9,500	$0	$0	$9,500
Additional Weather Station Installation (3 per year)		$96,788	$96,788	$193,575
Updates to Existing Weather Stations (Radiometer, temp, data logger, battery, solar)		$121,500	$121,500	$243,000
Weather Station Data Collection and Validation	$4,100	$4,100	$4,100	$12,300
Avalanche Data Collection and Validation	$23,000	$23,000	$23,000	$69,000
Phase 3: Weather Data Analysis	**$41,000**	**$41,000**	**$66,000**	**$148,000**
Development of machine learning model, data analysis, and data presentation	$41,000	$41,000	$66,000	$148,000
Phase 4: Predictive Analysis	**$0**	**TBD**	**TBD**	**TBD**
Incorporate snowpack and avalanche data into machine learning model	$0	TBD	TBD	TBD
Combine with numerical snow cover models such as Crocus or SNOWPACK.	$0	TBD	TBD	TBD
Ongoing Support and Maintenance	**$28,400**	**$47,400**	**$47,400**	**$123,200**
Data Validation	$9,400	$9,400	$9,400	$28,200
Weather station maintenance	$19,000	$38,000	$38,000	$95,000
Phase 1-3 and Years 1-3 Support Total	**$216,100**	**$420,488**	**$358,788**	**$995,375**

This is a multi-year project. The complete budget is included in our submitted proposal. As you can see from the overview, we don't yet know the costs for Predictive Analysis. We have started phase 1 and will need to complete Phase 1 and parts of phase 2 in order to be able to fully estimate phase 4. As AI and machine learning technology is literally changing daily, this cost will drastically decrease over time.

The key is that we need high-quality data in order for this to be successful, so collecting and validating data is a crucial component.



As discussed already, this is a very large project and as the UAC covers the entire state of Utah this project provides benefits to numerous communities. Due to their pioneering spirit, backcountry users are eager to travel to new locations. By being able provide more information in our existing forecast regions as well as information for new regions like the Tushar or Oquirrh mountains more people will have the information they need to travel and recreate in those locations, dispersing users from currently crowded areas, and bringing an economic benefit to these rural communities.

Youth groups like Scout Troops and church groups currently struggle to understand the avalanche safety information available. This project will make information more readily accessible to these groups allowing them to safely access snow covered mountains. There are rural community across the state without avalanche forecasts. This project allows us to provide avalanche information to these communities so that their member can recreate safely in

the winter.

This project closely aligns with the adventure commission strategic plan.

This project includes collaboration with many local and international partners. From local partners like the University of Utah, UDOT, and National Weather Service, to avalanche centers like Avalanche Canada and SLF in Switzerland to technology partners. These groups coming together for this UAC project will be a huge collaborative effort benefiting not only winter recreationists across Utah, but also UDOT, the ski resorts, and Search and Rescue Team.

Increase the economic and health benefits generated by outdoor recreation

- Preventative Search and Rescue
- Decreases the need for search and rescue support for uneducated or ill-prepared recreationists

For many people, mountain travel in both the summer and winter provides not only physical health, but is a key component of mental health. Backcountry use since the year 2000 has increased by 20X. In 2020, we saw a huge spike in use due to COVID. This increase has added additional stress to the search and rescue teams across the state. Avalanche forecasts and education are form of preventative search and rescue. By providing more information and training to backcountry users, we can prevent accidents and help search and rescue teams who are already stretched thin.

Improve awareness and education about safe and responsible recreation

- Provides a wide variety of high-quality recreation opportunities, ranging from the highly-developed to the very primitive

Areas like Little and Big Cottonwood Canyons can easily be considered highly developed backcountry areas. There detailed avalanche forecasts, route maps, guide books, and wealth of information available about the conditions. Areas like the Eastern Uinta, Tushar and Oquirhh mountains are not as lucky. There is limited weather station information available, there are no daily avalanche forecasts, and there is limited crowd-sourced information. This project helps to address these challenges that users have in remote areas. By providing more information for these ranges, we increase the safety for existing users and open up opportunities for new users to pioneer their own paths.

And finally, we want to make sure that all mountain travelers have the information they need to safely create their own virtual while getting their physical and mental exercise.

Questions?

For any questions, feel free to reach out to Chad Brackelsberg

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