OCTOBER 2024 | ISSUE 6

TERMINATION DUST ON THE HORIZON YET?

COMMUNITY SNOW OBSERVATIONS NEWSLETTER

"Termination dust is the term used to describe the first dusting of snow on the Chugach Mountain range in Alaska, as seen from Anchorage. It's a sign that winter is coming and summer's endless daylight is over." According to National Weather Service climatologist Brian Brettschneider, to define a termination dust phenomenon, the snow dusting needs to fulfill the criteria: (1) It must occur after August 1, (2) It must occur at an elevation of 4,000 feet or lower, and (3) It must persist for at least half a day. *Photo: Tim Morton*

TRULY A TEAM EFFORT!

Welcome to our fall newsletter! As we're embarking on another winter season with Community Snow Observations, backed by our wonderful ambassadors and countless volunteers active in all corners of this country [and the world for that matter!], we want to highlight the team effort that CSO really has become. In this newsletter we want to focus on stories shared by some of our ambassadors (p. 5-10, 18-19) and partners (p. 3, 16-17). CSO keeps growing in numbers, and more and more educational institutes choose do adopt CSO into their curriculum. An additional growth factor has been our

COZY UP ON THE COUCH AND ENJOY THE READING:

partnership with Propagation Labs - isn't their Snow Scope app just plain awesome? Also if you haven't tried the snow profile tool in the app yet, please do so this winter. Learn about their new 'voice to video' feature and other news on p. (3).

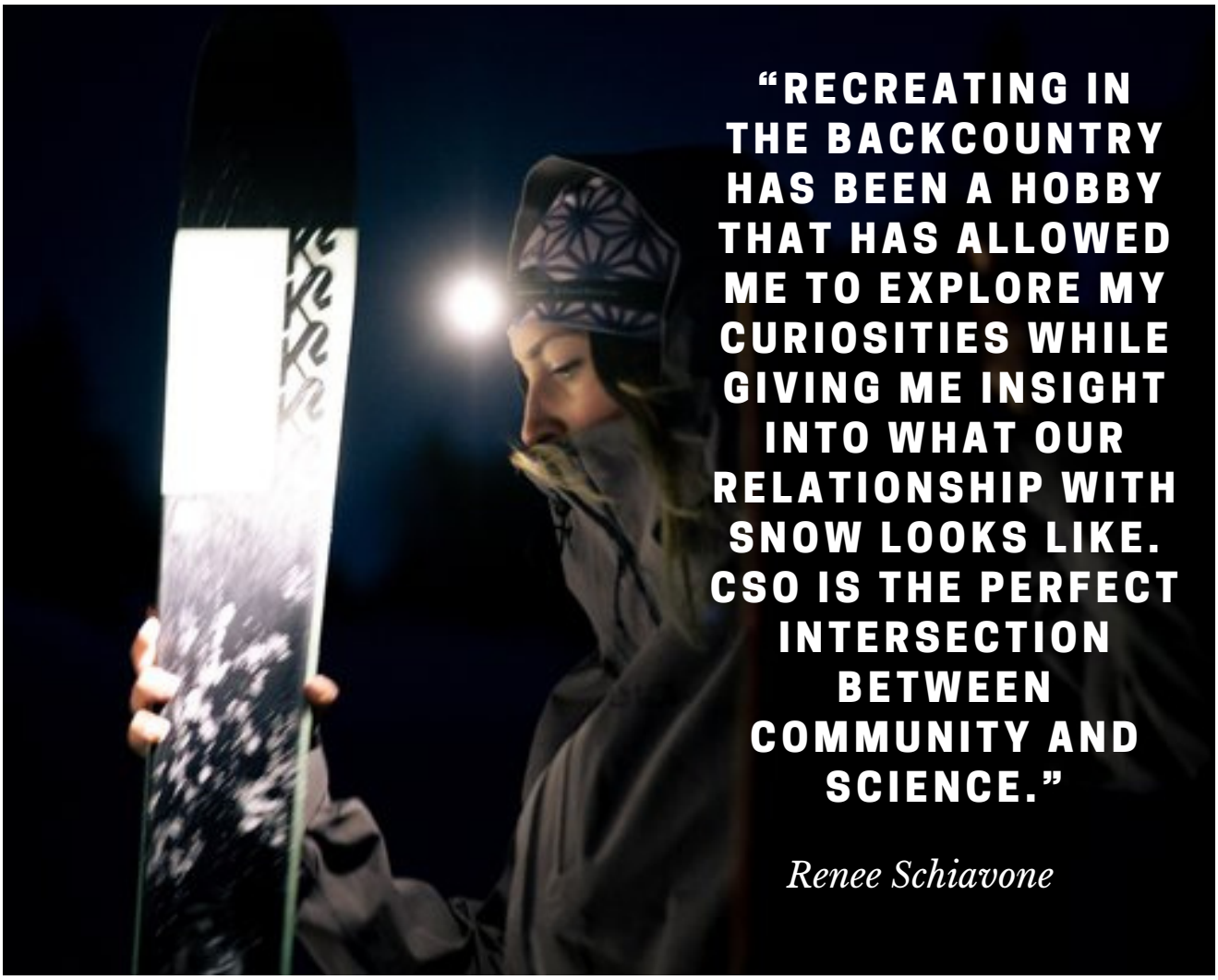
We hope you enjoy this newsletter! If you have any questions or comments, contact us at **communitysnowobs@gmail.com**.

Follow us on Instagram **@communitysnowobs** and on X **@communitysnowob**

Check out our Youtube-channel for snow modeling up-dates and fun videos!

NEW AMBASSADORS

Last fall we tried something new and sent out an inquiry via our Instagram account to see if there were any individuals out there interested in becoming CSO ambassadors. We received a huge response and ended up welcoming 23 (!) new ambassadors to our team! While we did introduce each and everyone in individual announcement posts on Instagram, we think it would make this newsletter a bit too lengthy to also include all the bios here. Each person brings a unique and interesting contribution to CSO, so instead we encourage you to get to know them all by accessing our 'About Us' page here.

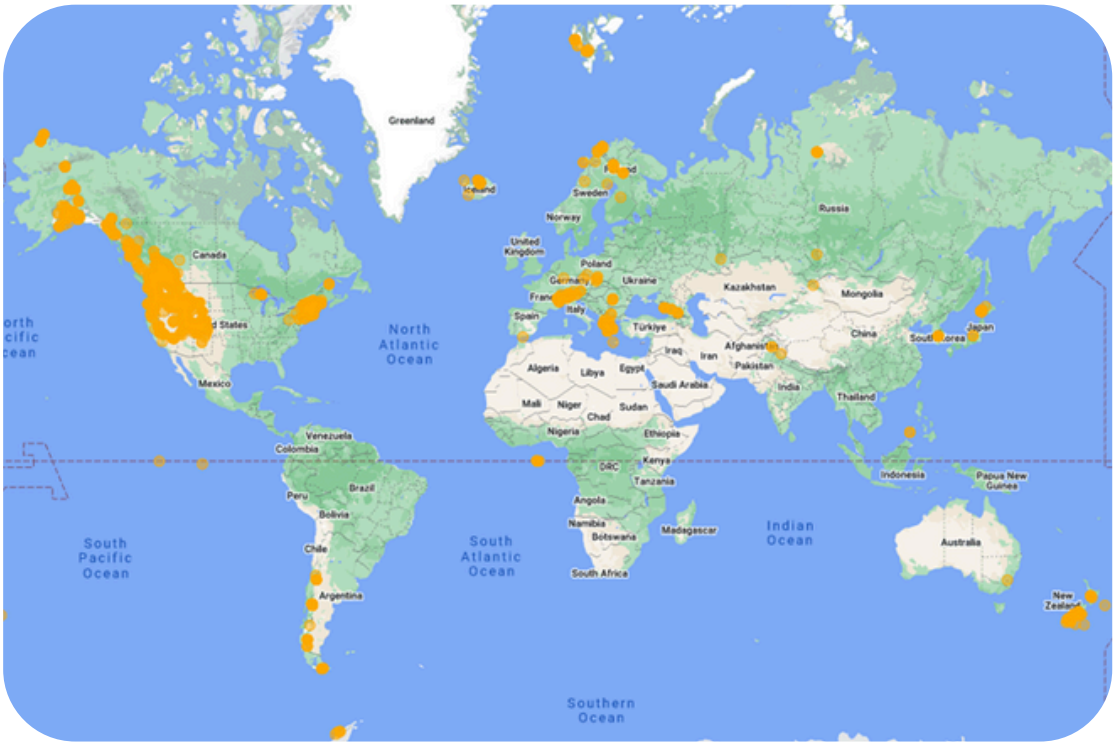


UPDATES FROM PROPAGATION LABS

Propagation Labs is a small (two guys!) and mostly volunteer-based tech company based out of Salt Lake City, Utah. Their snow data collection app Snow Scope has been praised by our users for its easy-to-use design and handy features. We asked the guys running Propagation Labs, Joe and Garrett, to give us some updates for this winter and it turns out they have a few exciting things to share!

At Propagation Labs, we are grateful for our partnership with CSO and very excited to see the continued growth of the CSO community on the Snow Scope App (over 3000 observations this past season!). Through working with CSO, we've come to see the power of the citizen snow science community, and the impact that making observations easier to measure and submit can have on the quantity and quality of data collected. Our view is that the more quality, geolocated, crowdsourced snowpack data of all types we collect, the better we'll all be able to understand snow and its impacts on hydrology, avalanche safety, ecology, and more.That's why we've continued to develop the Snow Scope App to improve the tools we already offer and introduce new observation types to enable even more snow data to be collected. For the upcoming season, we're excited to introduce several new observation features:

- **Voice to Pit:** Allows hands free recording of snow profile information, automatically taking an audio recording of your description of a snow profile and drawing a full snowpit from it. We're very psyched to launch this, and look forward to keeping our hands warmer and screens dryer in pits this season! Learn more here.

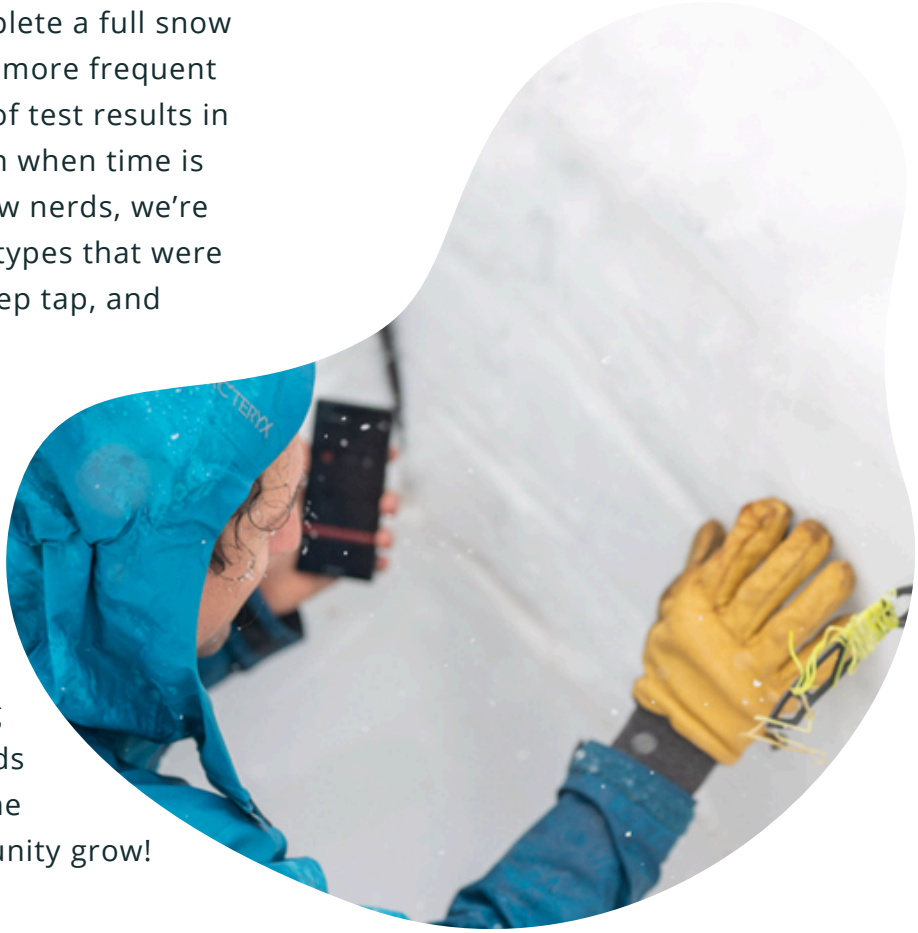


Locations of observations recorded on the Snow Scope App in the last year.

Scoping locations for measuring snow heights deep in the Wind River Range, Wyoming.

- **Cracking and Collapsing:** Enables extremely simple and quick documentation of snowpack cracking, collapsing (whumpfing) in the field, where it occurs. Having point based recording of this information is important for assessing spatial variability of snowpack stability, and will be used by scientists to improve snowpack modeling.

- **Quick Test Results:** You'll soon be able to quickly record the results of snowpack tests (CT, ECT, PST, etc.) without needing to complete a full snow profile. This encourages more frequent and accurate recording of test results in their true locations, even when time is limited. For the true snow nerds, we're also launching new test types that were missing (rutschblock, deep tap, and shovel shear).



Testing the new "Voice to Pit" feature in wet spring conditions at Alta, Utah.

We look forward to continuing our collaboration with CSO and are hoping for another snowy winter full of nerding out in pits, skiing with friends in new places, and seeing the citizen snow science community grow!

-Garrett & Joe

BEST DAY OF WINTER 23/24

Earlier this summer we asked our ambassadors to share a memorable day (along with a photo from that day) from this previous winter season. All the examples we received were wonderful in their own way as they highlighted that a day can become memorable for so many different reasons. Here they are!

Brooke Maushund

The 10th of February came to central Idaho bearing not one but two gifts. A duo of persistent weak layers lay sandwiched with slabs below a fresh input of soft snow that skiers and riders alike were jonesing to slide through. Rounding the corner while heading south on Galena Pass to ski in the Boulder Mountains, the NW Bowl of Galena Peak came into view. Multiple avalanches ran earlier that morning / the night prior, with the main D3.5 avalanche ripping across 1,500' of terrain and all three crowns spanning over 3,000' wide. While the snow was soft, the dragons had shown their faces. "Looking forward to keeping it low angle or skiing a bed surface today!" my partner and I mortally giggled to one another.

Renee Shapiro

I am in the midst of describing the way wind impacts snowpack to a group of wonderful women in an AIARE Level 1 class. The avalanche danger was high, the snow was coming down, but we still had an amazing course of low angle wiggles and learning.

Ben Roberts-Pierel

I had a lot of awesome days in the mountains this winter and many with better weather and snow than this classic PNW near whiteout day on Mt Hood. This day was particularly memorable though because after skiing her whole life, my mom who is 68, had her first touring day in the backcountry. Completing the party was myself and my wife who was also four months pregnant in this photo. It was a really cool experience to be able to share with them both, despite the sub-optimal weather and snow conditions.

James Molloy

Over spring break, I visited my old friends in the North to scratch an itch. Late March can present every snow condition from summit to valley, especially leaving the house as late as we did. We drove to 9400 ft to bypass the cream cheese, punch crust, and death cookies expected below. The climb ended at the wilderness boundary overlooking a meadow stream I'd visited many times in the summer months. Wildflowers are lovely, but the view is nice painted white.

Ben with his mom on her first day of backcountry skiing.

James after some great turns!

Mike Styllas

During a poor winter for Mediterranean mountains, with alternating cold and warm weather the snowpack was mostly unstable, but by the end of March we found the optimum conditions to dig several snowpits on Mount Olympus (Greece's highest mountain) and take samples of snow and Saharan Dust for isotopic and chemical analyses.

Tyler Miller

This image is of me standing just before one of the most interesting storm deposits I've witnessed. In the 3 mile approach to this couloir there was about a foot of new low density snow. Once we hit about 11,000 feet, we encountered a massive increase in new snow depth, about 6 feet. This snow did not appear to be slough or wind deposit as the snow grains were not rounded in any way throughout the entirety of the new snow's depth. We spent some time assessing this, mostly in awe, and turned back due to the storm snow instabilities. CT1, -78cm

Pete Gadomski

During a excellent hut trip in the Colorado Rockies, I had a chance to dig a pit for the group and talk through some snow science. Through questions and some narrative, we got to explore vapor transport, the effects of dust on snow, and much more! The turns on the way down weren't half bad, either!

SEASON STATS 2023/2024

BY DAVE HILL

Every year, at the end of the snow season, we like to look back on participation in the program to see how it's going! After this last season, we are amazed to report that, since the beginning of CSO, we have aggregated over 51 THOUSAND measurements of snow depth from participants, distributed around the globe as shown below (left).

The second figure (right) shows you the cumulative observations over time. The 'stair step' nature of the figure has to do with the fact that most of our observations (but not all!) come in during the winter season of the Northern Hemisphere, with the summer season being comparatively quiet. The smaller rise observed in 2020 is due to Covid restrictions which reduced winter recreation. Post-2020, you see consistent and strong participation, made possible, in part, by the great new Snow Scope app. This app has a more streamlined submission process than Mountain Hub did, and we are glad to see it paying off, in terms of strong participation. Let's see what happens in 2024-2025 and beyond!

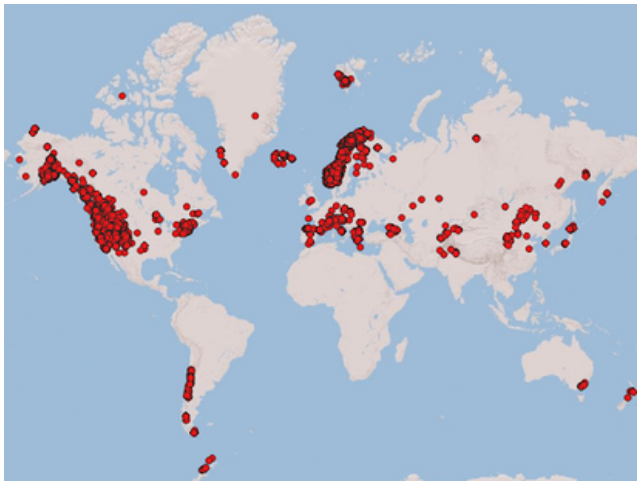


Fig 1.World-view of CSO observations.

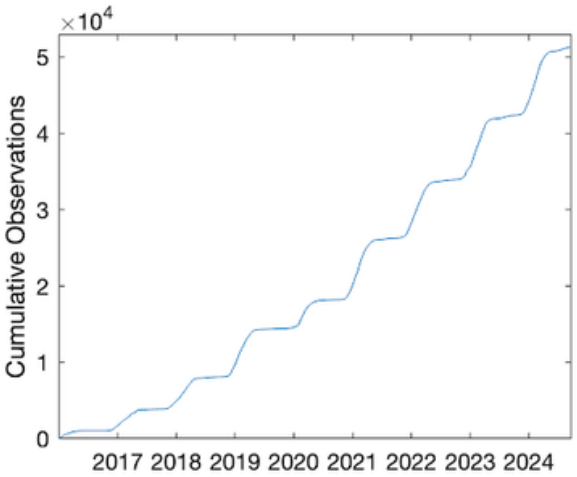


Fig 2. Cumulative observations over time.

SNOW & AVALANCHE WORKSHOPS

BY DAVE HILL

Regional Snow and Avalanche Workshops (SAWs) are held every autumn across the United States. They are a wonderful reminder that winter is on its way, and they are also wonderful gatherings of snow professionals, industry representatives, scientific researchers, and the general public. If you have never been, you can view the 2024 lineup here, and see if any of these events are near you! They are typically 1-2 day events and feature a broad mix of presenters…you will here about avalanche dynamics, new technology relative to avalanche monitoring, human factors issues related to decision making in avalanche terrain and more. The broad audience in attendance results in presentations that are very accessible, visual, and fun!

Since the beginning of the CSO project, CSO science team members have been fortunate enough to have been able to present at nearly every single SAW event across the country! These presentations have always been very well received and have been invaluable in helping to spread awareness of and interest in the CSO project. We are extremely grateful to the planning committees for these events and appreciate collaborating with them over the years.

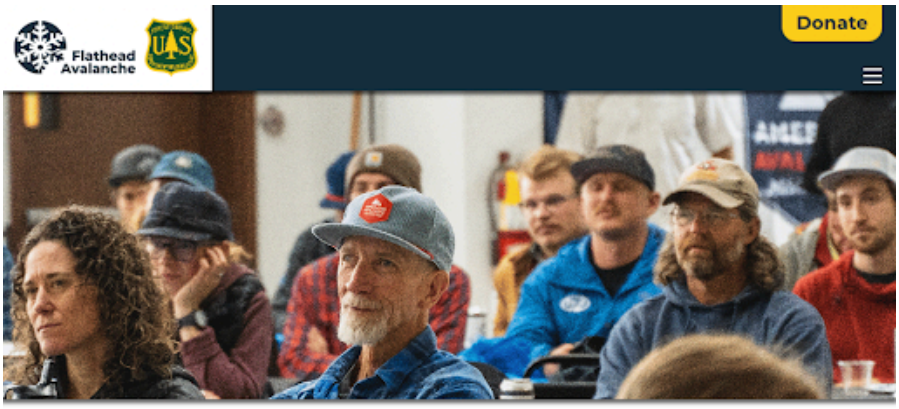
Silverton, Colorado

In 2023, David Hill got to travel to spectacular Silverton, CO to speak at the Four Corners SAW, hosted by the Silverton Avalanche School. The theme of the workshop was 'avalanche intelligence' and all of the speakers were encouraged to talk about how new and emerging technologies were improving our understanding of the snow and our ability to stay out of danger. There were great talks about new technologies such as SafeBack, monitoring systems such as GeoPrevent, and more. The most challenging part of the workshop was keeping your heartrate below aerobic threshold, given the more than 9300' elevation of the venue!

In 2024, CSO will be representing the project at two terrific SAWs. Nina Aragon will be showing Oregon what is new at the BendSAW event in Bend, Oregon, hosted by the Central Oregon Avalanche Center. She will be speaking about some of her research into Snow Water Storage (SWS) and how this concept helps give us a more nuanced look at how snowpacks are changing over time. She will also speak about long-term changes in snowfall distribution…are we getting more snow, less snow, and how is it arriving?

CENTRAL OREGON
AVALANCHE CENTER

Also in 2024, Dave Hill will travel to Whitefish, MT to present at the Northern Rockies SAW, hosted by the Flathead Avalanche Center, one of the few SAW events that CSO has not previously been to. We look forward to engaging with the public and with our snow professional colleagues at both of these wonderful events. There is no better way to get fired up for the 2024-2025 snow season. Break out the wax and iron and start doing some squats to wake up your quads!



NRSAW

Proudly presenting the

Northern Rockies Snow & Avalanche Workshop

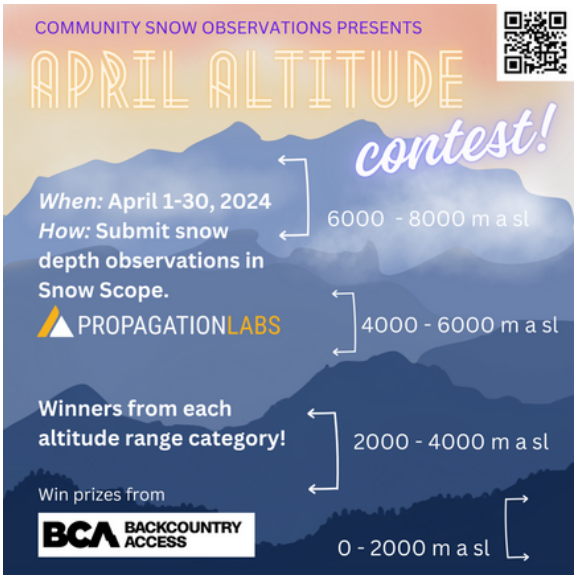
November 9th, 2024

CONTEST SEASON 2023/2024

We started off the winter season with a classic data collection contest that ran over the holidays. These simple data crowd-sourcing contests are great for us to gauge the interest among our participants for the upcoming season and it's a great way to incentivize new participants to try out CSO and get familiarized with the Snow Scope app! We sent off some sweet prizes from Backcountry Access to the top contributors.

We enjoy getting photos from our participants so for Valentine's Day this year we ran a photo contest where participants were asked to show their love for snow. We received some very cute submissions and once again congratulated the winners with a gift from BCA.

We often get the question whether we'd be interested in getting measurements from different elevation bands and -- absolutely, we are! So, during the month of April we ran a contest where we randomly drew winners from across the United States by picking snow observations that had been submitted at different elevation ranges. That's easy to do for the United States given that we have large concentrations of backcountry folks all the way from sea level up to over 10,000 ft a sl. Lucky winners received a gift from BCA!



SNOW WATER STORAGE - A NEW WAY OF QUANTIFYING HOW MUCH WATER IS HELD IN OUR SNOWPACKS

BY NINA ARAGON

The snowy peaks we admire in winter are doing more than providing a playground for skiing and snowboarding—they are crucial naturally-occurring water reservoirs! Snowpacks collect snowfall during the winter and gradually release it as water when it melts, providing essential water for agriculture, drinking supplies, and hydropower. This is particularly important in places like western North America, where snowmelt plays a big role in water availability.

Two members of the CSO science team, Christina (Nina) Aragon and David (Dave) Hill, recently published a paper introducing an exciting new tool to measure this vital resource: Snow Water Storage (SwS). SwS quantifies how much water is held in snowpacks and for how long. Unlike previous methods that only measure snow at a single point in time, SwS tracks the total water stored over a season, providing a more comprehensive view of snowpack behavior. Think of the total mileage on your car's odometer vs how far you drove today. This metric is especially important now, as climate change is altering snowpacks. SwS can be used to track how natural water storage changes year-to-year in the same area or can be used to compare natural water storage across different regions. Whether it's permanent snowpacks high in the mountains or temporary snow at lower elevations that comes and goes quickly, SwS captures it all. Even more, it can help identify snowpacks transitioning due to climate change from long-lasting to intermittent.

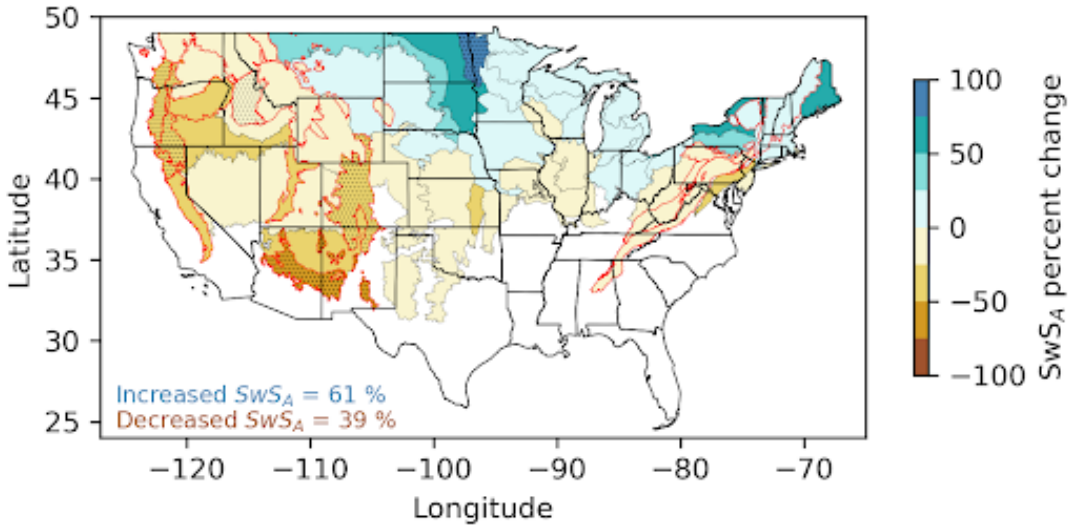


Figure 1. Percent change in SwS aggregated across ecoregions over water years 1982-2020. Mountainous ecoregions are outlined in red.

The research revealed that mountain snowpacks are doing heavy lifting when it comes to water storage: mountain regions contribute 72% of the U.S.'s total annual snow water storage, despite covering only 16% of the land. But there's bad news too—over the last four decades, annual mountain snow water storage has dropped by a significant 22% (Figure 1). Since the SwS metric can be applied to numerous types of snowpacks, it may become increasingly valuable for monitoring and predicting water resources amidst a future of increased climate variability. If you would like to see how SwS at stations near you compares to long term trends - check out the SwS app that Dave built!

A NOTE FROM OUR PARTNERS

CSO partners with several educational institutions in the United States. These schools have implemented snow data collection and submission to CSO as part of their science curriculum. These partnerships have proven to be very fruitful -- students love to see their efforts going to an actual *real* case and we love getting all that data!

TETON SCIENCE SCHOOLS

BY JULIA OLSON

Teton Science Schools Field Education has so enjoyed working with CSO! We host visiting school groups from all over the country to create outdoor science education experiences, and teach a lot of snow science in Grand Teton National Park. Uploading snow depth data to a larger data set--which students can view in nearly real time--has really helped put into context the importance of snow in the mountain west for our visiting groups. It makes students feel like they're part of something bigger, and that has been rewarding for all of us here at TSS!

Learn more about Teton Science Schools here.

Teton Science Schools

HIGH MOUNTAIN INSTITUTE

BY EMMA WOOD

The High Mountain Institute in Leadville Colorado is a semester school for students in high school that focuses on rigorous academics and outdoor experiences. This winter, after learning about snow science and the importance of snow-water equivalent in the West, all students embarked on a 10 day winter backcountry ski trip. While camping in snow caves and learning the lost art of telemark skiing students contributed to CSO by collecting snow height data throughout the course. This gave students a tangible way to interact with the unit's learnings and actively contribute to community science. It was a great success and we are looking forward to doing it again this winter!

Learn more about the High Mountain Institute here.

FROM WINTER SNOWPACK TO SUMMER SNOWFIELDS

BY ETHAN SHAW

For several years now, I've been surveying the distribution and persistence of summer snowfields in the mountain ranges of my corner of the U.S. Interior Northwest: the Wallowas and the Blues. Broadly speaking "rain shadow country," these uplifts actually exhibit a pretty fascinating climatic spectrum: from windward slopes in the lee of the Columbia River Gorge touched by maritime influence all these hundreds of miles inland, to semi-arid country on the doorstep of the Great Basin. And this, in turn, shakes out to quite a lot of regional ariation within our overall Intermountain-type snow climate.

My main field season for this Wallowa-Blue Mountain Snowfield Project goes down from early summer to mid-fall: tracking the ebbing of seasonal snow patches—those that normally dwindle away during the ablation season— then checking on perennial snowfields, i.e., those that tend to last year after year.

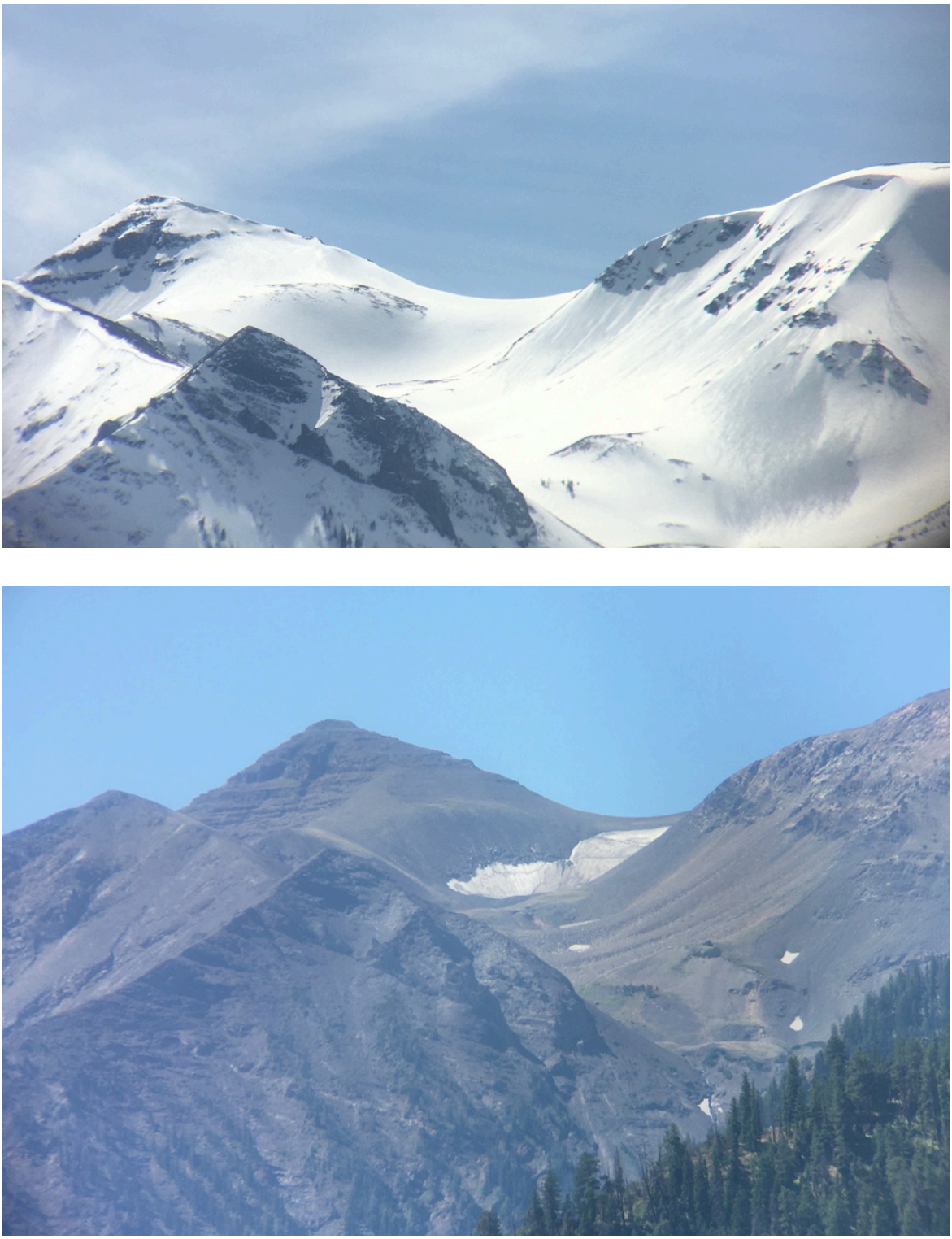
Confirming which mountain snowfields are truly perennial (these mainly in the Wallowa Mountains, host to alpine glaciers not all that long ago) is one of the fundamental goals of this effort. That requires multiple years of data: cross-referencing against historical satellite/aerial imagery, topographic maps, and photographs and ground-truthing across many summers to identify the most resilient patches of snow, typically hidden away in the shadows of steep headwalls, hollows, and couloirs.

Typical dwindling of a persistent seasonal snowfield from early to late summer

The project may be in highest gear during the ablation months, but it has me thinking about our region's snow dynamics year-round—not least in the depths of winter, when the snowmaker cyclones and fierce high-country winds build up the drifts that sustain summer snowfields; and in the spring, when the meltoff of the seasonal snowpack—besides all its ramifications for

fish, agriculture, river-running, etc.—sets the initial timetable for the snow patch landscape of early summer.

It's been awesome, therefore, to start collecting snowpack data for CSO, deepening my connection to the other end of the snowscape calendar. I also help out with a program called the Grande Ronde Community Science Project, which,



(Top) Late-winter vs. (bottom) late-summer "habitat" for a Wallowa Mountain perennial snowfield.

informed by Indigenous knowledge, tracks our regional watershed over time and involves local youths in hands-on water-quality monitoring and other fieldwork. We hope to potentially expand that program's focus to include some snow science and contribute to CSO.

From snow-probing it for CSO to sampling springtime streamflow and hunting out high-elevation firn-patches at the cusp of autumn, I'm enjoying delving deeper into the snow hydrology that knits together our landscape: from remote cirque and foothill pinewood to the farms, rangelands, and canyon bottoms down below.

-Ethan

OH CAPTAIN, MY CAPTAIN... NEW LEADER OF THE POW CREATIVE ALLIANCE

In August, Reno-based action photographer and CSO ambassador Emily Tidwell became the newest Protect Our Winters Creative Alliance Captain. "This is a huge honor, and I am excited for my future with POW and to build a strong Creative Alliance prepared to inspire the Outdoor State." Tidwell has been a member of Protect Our Winters since 2021. She has had the privilege of lobbying in D.C. for the Inflation Reduction Act with the organization, received the Gerhard Gross Protect Our Winters Member of the Year award in 2023, and recently completed her first film, Saving Silence, with Protect Our Winters as a leading sponsor. You can check out the trailer HERE.

Photo: Holly Shankland (POW)

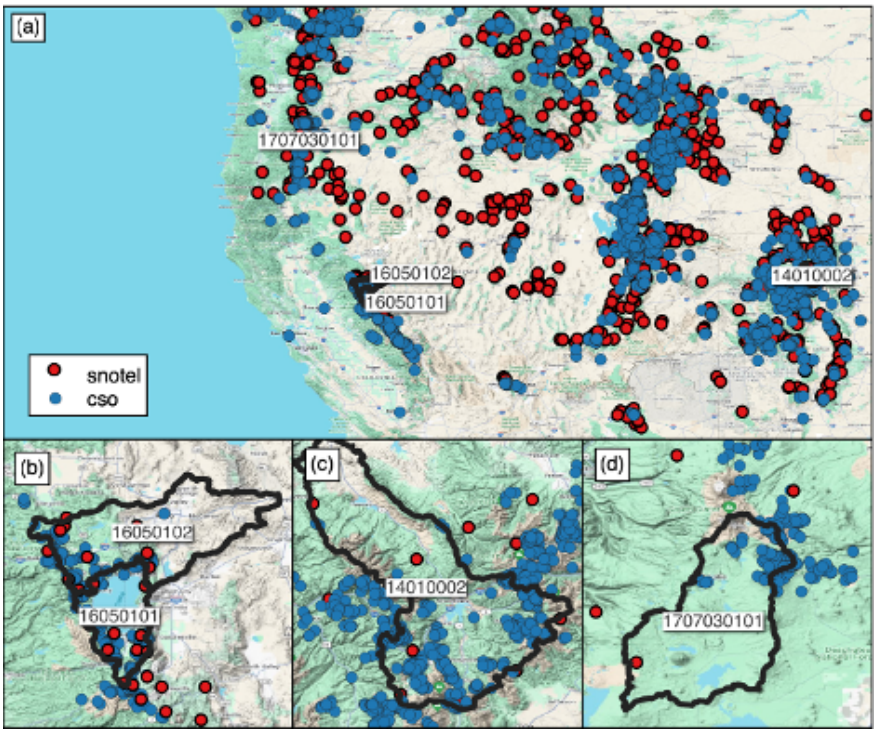
NEW FUNDING ON THE HORIZON...

BY DAVE HILL

The Community Snow Observations project was first funded by NASA back in 2017 for a one year demonstration period, and then in 2018 for a full three year implementation period. This funding provided the resources to develop the community engagement and the computing infrastructure to take snow depth measurements from participants and turn them into modeled products of snow distribution and evolution over many modeling domains across the United States. Funding for this work has also come from the National Geographic Society.

The science team of CSO is always on the lookout for grants that will provide an opportunity to both improve snow modeling and also continue to develop community participation in snowpack measurements. We are pleased to announce that we have been awarded for funding through the Snow Water Supply Forecasting Program, run by the US Bureau of Reclamation.

This program is unique in that it funds projects that create new snow monitoring technologies, improve existing technologies, deploy technologies to poorly sampled areas, or use snow monitoring data to improve water supply forecasts. And, most importantly, all funded projects must acquire new LiDAR (Light detection and ranging) surveys of snow distribution.



The work that the CSO science team will be involved with includes three components:

1. Acquisition of new LiDAR data in the Oregon Cascades (panel (d) of the figure above). Flights will take place once per season, along with a 'snow off' flight to allow for direct measurements of snow depth at a resolution of less than one meter.
2. Exploration of how blending LiDAR data and community measurements of snow properties can improve assimilative modeling of snow distribution. This is where CSO participants come in!
3. Exploration of how 'subsets' of LiDAR data can be used for data assimilation. Let's ace it…LiDAR is expensive. Lasers! Airplanes! If we can use a smaller LiDAR footprint and get equally good results, this will be a cost savings.
4. Items 2 and 3 above will take place in domains in Oregon, California, and Colorado. But, CSO activities will continue elsewhere as well. If you happen to live in OR / CA / CO and and want to learn more about how to help, please reach out to us any time. We'll be sure to share the official funding announcement when it happens.

See you at SAWs or on the skin track!

We thank our ambassador Tyler for sharing his global perspective on why snow matters (right). The more you can see how it all links together, the easier it is to stay motivated and dedicate a few minutes to CSO. Now with the Snow Scope app becoming such a handy tool for everything snowpack studies, it feels like even less of a chore to pull up the phone in the backcountry. And while you're at it -- take some sweet photos because maybe it'll be the best day of the season and a day to remember!

-Dave, Nina, Katreen & Gabe