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138 // S 2025

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Return undeliverable Canadian addresses, change of address and subscription orders to: Canadian Avalanche Association PO Box 2759, Revelstoke BC V0E 2S0 Email: info@avalancheassociation.ca
Publications Mail Agreement No. 40830518 Indexed in the Canadian Periodical Index ISSN 1929-1043

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WINTER 2025

in this **issue**

Eirik Sharp
CAA President

CAA President's Message

THE CAA'S annual Spring Conference remains one of the most meaningful moments in our professional calendar. This year, as many of us gathered in Penticton, I was struck again by the strength and depth of our community. Over coffees, trail conversations, and side chats between sessions, I was reminded how essential these gatherings are—not just for exchanging ideas, but for nurturing the relationships that sustain our profession. In a field where the line between colleague and friend often blurs, these meetings offer a rare chance to re-engage with the broader fabric of our work. For members who weren't able to join us this year, I hope this message provides a window into the key accomplishments and transitions that shaped our past 12 months.

PARTING WORDS

A major priority this year was completing the integration of the Avalanche Educator membership class and ensuring our systems continue to deliver value to all members. One of our most significant milestones was the launch of a comprehensive governance review, focused on representation and voting rights. This work culminated in the adoption of a weighted voting model, approved by members at the AGM, which grants Avalanche Educator members voting rights and board representation. This is an important step towards ensuring our governance structure reflects the diversity and evolution of our membership.

We also adopted new contracting guidelines and progressed a formal conflict-of-interest policy, supported by external legal review. These foundational tools help strengthen transparency and accountability across the organization.

Another major initiative is the CAA Operational Platform Advancement (COPA)—a multi-phase digital infrastructure project designed to modernize how we deliver services and manage workflows. The board approved the initiative earlier this year and work is well underway. COPA is more than a technology upgrade—it's a long-term investment in scalable, responsive systems built around member needs.

On the technical front, we completed an update of the *Operational Guidelines and Record Standards*, initiated a revision of the *Land Managers Guide to Avalanche Hazards*, and advanced both the EAST Project and Helicopter Explosives Use Guidelines. These projects support professional consistency, public safety, and best practices across jurisdictions.

To support professional development, we approved $35,000 for the Instructor Development Fund, revised the Everett Clausen Bursary to broaden access, and introduced sponsorship pathways for Avalanche Educator membership. We also extended InfoEx access to qualified Advanced Avalanche Educators, updated its pricing model, and began streamlining CPD tracking, auditing, and rehabilitation processes.

These accomplishments reflect a collective effort—particularly from our outgoing board members. Steve Conger, Kate Snedeker, and Jesse Percival each brought unique and deeply valued perspectives to the board table. Steve's clarity and institutional knowledge anchored our technical discussions. Kate's governance insight helped drive forward inclusive reforms. Jesse's steady hand on financial oversight kept our operations strategic and sustainable. Their contributions will be felt well into the future, and I thank them sincerely.

This year also marks the departure of Brent Strand, who has stepped down after 25 years of service to take on a full-time role with Avalanche Canada. Brent has contributed to nearly every part of the CAA—standards development, training, project leadership—but his most enduring impact has been as a community builder. His leadership of the Spring Conference gave them not just structure, but meaning. He brought humour, humility, and warmth to his work, and his presence shaped the tone of the association in countless quiet ways. We'll miss him, and we wish him every success in his new role.

Across all these developments, what stands out most is the strength of our community. The CAA continues to grow and evolve, but our shared values—trust, professionalism, connection—remain at the core of everything we do. That community doesn't sustain itself. It's built and rebuilt every season by members who care deeply about the work and each other.

On a personal note, I want to share that I've made the decision to step down early from my role as President and resign from the Board. While I had intended to serve one more year to support the executive transition, personal circumstances have led me to conclude that now is the right time. Serving as President of the CAA has been one of the great honours of my career. I'm proud of what we've accomplished together, and I'm excited to see how this organization continues to grow.

Eirik Sharp, Former President

Joe Obad
CAA Executive Director

Executive Director's Report

SUMMER IS OFTEN a season of changes at the CAA, when projects are started or progressed before the fall rush. There is certainly plenty of them this year, but what occupies my thoughts is the transition of folks away from longstanding roles with the CAA. For each of them, we owe gratitude for their service—perhaps all the more because neither are seeking attention or praise. Well, they better brace themselves for the praise that follows!

First, I'll start with Brent Strand. Brent has been at the heart of CAA operations for over two decades, managing our publications and building, and playing a key role organizing the Spring Conference. For years, his office was one of the first members would encounter.

TRANSITIONS AND GRATITUDE

Through conversations at the front door, he would have his finger on the pulse of the membership, and was judicious in sharing their insights, needs, and anxieties. This unofficial role ran beside his official duties, where he cared for our building like it was his own home, while juggling a myriad of publications sent his way from ITP, Membership Services, and an ED who should have planned and communicated sooner. Suffice to say, they all came out great.

Brent would be forgiven if his energy flagged. Instead, he put in 14–16-hour days at the heart of the Spring Conference, greeting members joyfully, herding them from the lobby ("OK FOLKS GET IN THERE! WE'RE GETTING STARTED!"), and promptly remedying 100 background snafus before attendees knew anything was amiss.

I stand in awe considering Brent did all this while working half-time! His other employer, Avalanche Canada, recently offered him an opportunity too good to turn down. We say thank you Brent for your service to our members over 25 years and we wish you well, knowing you remain a strong part of the avalanche community.

Also worthy of recognition is outgoing President Eirik Sharp, who served a full six years on the board before recently stepping down.

The role of President comes with more grief than glamour. We are not so far removed from the days when a veteran member was cornered in the hours before the AGM to take on the hard work of President. I'm happy to say in recent years, members have stepped up more freely to join the board and take on the role of President.

Eirik exemplified much of the best of what we seek from our directors. He joined the board and built his understanding before serving as Vice-president. He soaked up lessons from President Walter Bruns before taking over the leadership chair. No President's time is easy, and Eirik's tenure meant leading the organization through the development of the Basic and Advanced Educator membership categories.

More than most initiatives, this work involved hands-on governance from the board to steer the changes amongst several stakeholders—CAA members, staff, committees, and consultants; other large training organizations, Avalanche Canada, the ACMG, and others. Eirik tended to these duties with energy, empathy, and wisdom, seeking to understand challenges and perspectives while moving the educator initiative ahead.

I am thankful for all of Eirik's efforts, but perhaps none more so than when we were grilled by the membership for 45 minutes ahead of the vote on the new membership categories at the 2023 AGM. While this was very challenging and stressful, it was a high point for Eirik, CAA members, and governance. What more can we ask for than informed members rightfully challenging board and staff about a new initiative, and a President deeply versed in the choices managing the dialogue civilly and dispassionately, and stewarding the membership through the discussion and vote to follow? It is difficult to convey the stress this puts on a volunteer leader, and I am thankful for everything Eirik brought during that moment and many others.

The gratitude we hold for Brent and Eirik should be shared and conveyed to them. Not far behind are reflections on the big shoes they leave to fill. In Brent's case, we have parsed out the aspects of his role looking to fill them. That is a technical assessment. Replacing his energy and passion for the CAA and its members is another matter. What I can say is his can-do spirit and joyful approach to work permeates the office and has rubbed off on a new generation of staff, who are primed to pick up the torch.

There will always be challenges on the road ahead, but Eirik has likelwise has shown us that with a grasp on the issues, empathy for members, and energy to drive the CAA forward, there's little we can't accomplish.

Joe Obad, CAA Executive Director

Brent Strand
Publications & Properties

Guest Editor

I BEGAN MY CAREER with the Canadian Avalanche Association on October 1, 2000. Before that, I spent a decade in Fort McMurray, having moved there to become an electrician. Unfortunately, I arrived a few weeks too late, and the job was filled. Instead, I found work at a commercial printing shop. That detour allowed me to earn my graphic design ticket and build a career I enjoy to this day.

While living up north, I longed for the mountains. I made regular trips back home to Revelstoke to ski and mountain bike. One day, while talking to my mom on the phone, she mentioned she was working as the bookkeeper at the CAA, and they were looking for someone to help with publication work. It sounded interesting but meant a substantial pay cut. Still, the pull of the mountains was strong and it felt worth it.

THE MEMORIES

I moved home and chatted with Evan Manners, the Operations Manager. We agreed I would come on for 10 hours at $10 per hour to help with ***Avalanche News*** and some ITP manuals. I was so stoked to be back in the mountains, working part-time, at such a cool place.

I was a keener. Anything anyone didn't want to do, I'd jump on it—wrapping manuals for shipping, making coffee, doing the mail run, cleaning toilets, and even taking InfoEx shifts. I figured the more I did, the more hours I'd get, and the better my position would become.

Those evening InfoEx shifts were epic. Compiling the 90-or-so operational reports coming in by email, fax, and the odd phone call, took four to eight hours. I didn't understand half the acronyms being used, so Evan suggested I take Avalanche Operations Level 1 to better grasp what I was working with.

In 2001, I took my Level 1 in Rogers Pass. I realized that growing up, I had climbed nearly every avalanche path in the Pass without knowing their names or histories. That course sparked a desire to learn more about the snowpack, terrain, and risk. Being part of a world-leading avalanche education and training organization only fueled that curiosity further.

A few years after starting, I became the full-time receptionist. Every morning, I'd come in early to get a good pot of coffee brewing before the team arrived. One day during the 2003 season, I showed up to find a huge crowd outside the office. Camera crews from CNN, NBC, CBC, and others were shouting questions about the Durrand Glacier incident. I pushed through, locked the door and called Clair Israelson, the Executive Director. "Something big happened!" I told him. We had no communications plan for such events. Soon after, Clair hired Mary Clayton to build the communications program, which was a major turning point for the CAA and the broader community.

I have developed many projects through my 25-years at the CAA. *The Avalanche Journal—Avalanche News* when I started—is the main one. I used to print 1,000 copies of *Avalanche News* on 11x17 pages in our office, then staple, fold, package, label, and post them all. It is incredible that I now create a full-colour magazine that is commercially printed and shipped directly to members from the printer. With some help from Kathryn Whiteside, I could always make it look good; I want to thank Mary Clayton, Karilyn Kempton, Jill MacDonald, and Alex Cooper for their amazing talents as editors helping to create such a fantastic product!

The Spring Conference became another memorable part of my journey. I was often in charge of ensuring rooms were set up, presenters had what they needed, and the events ran smoothly. My first conference was intimidating. The evening before it started, I went to the Ramada pub, which was packed with CAA members. I felt out of place until I heard, "There's an empty seat here." It was Gordon Burns inviting me over. After introducing myself, he said, "So you're the new guy at the office?" He welcomed me warmly, introduced me to folks, and gave me the lowdown on who was who. That moment set the tone for my entire career at the CAA—everyone has always been supportive, accepting, and willing to share their knowledge.

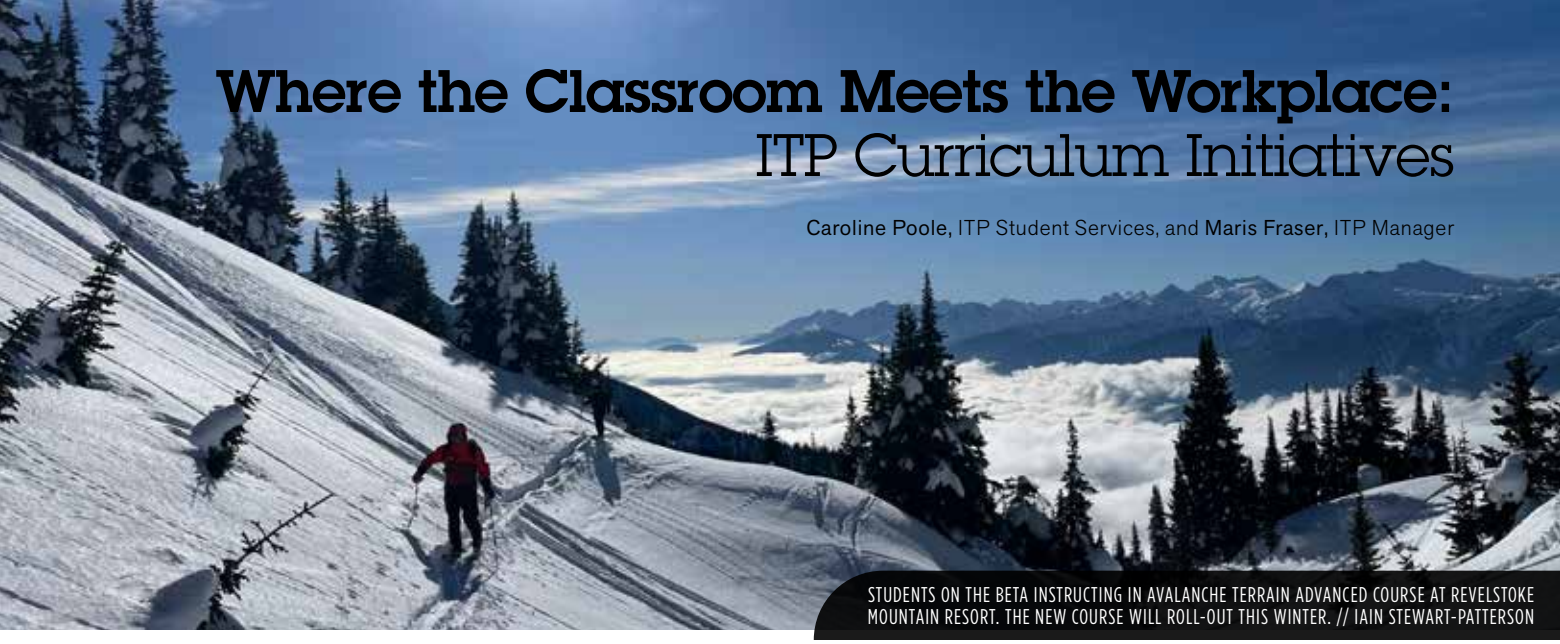
Over the years, I have had many opportunities linked to the CAA. I took all the training available to me, which led to eventually working with Peter Kimmel as an assistant avalanche technician, master blaster, and educator. I taught AST courses and ran avalanche safety for film shoots with the BBC and Disney.

Looking back, I feel incredibly grateful for the people I've met, the knowledge I've gained, and the opportunities I've had. It has been like working with a big extended family—a community deeply rooted in trust, respect, and shared passion for the mountains. After more than 23 years of balancing responsibilities between the Canadian Avalanche Association and Avalanche Canada, I've made the difficult decision to leave the CAA. I am taking on a new full-time role with Avalanche Canada that has grown out of UX design training I've taken in recent years. I may not be at the CAA anymore, but I am still working with the "avalanche people" organization!

Brent Strand, Publications & Properties Manager

Where the Classroom Meets the Workplace: ITP Curriculum Initiatives

Caroline Poole, ITP Student Services, and Maris Fraser, ITP Manager



STUDENTS ON THE BETA INSTRUCTING IN AVALANCHE TERRAIN ADVANCED COURSE AT REVELSTOKE MOUNTAIN RESORT. THE NEW COURSE WILL ROLL-OUT THIS WINTER. // IAIN STEWART-PATTERSON

THE INDUSTRY TRAINING PROGRAM curriculum is guided by a founding mission: aligning ITP courses with workplace needs and operational realities. With assistance from staff, instructors, subject matter experts, and partner organizations, ITP continually works to achieve this mission. These are a few recent highlights:

AVSAR SKILLS AT THE FOUNDATION OF ITP

The multi-year, publicly funded Effective AvSAR Skills Training project came to fruition in winter 2024-25 with the rollout of Avalanche Search and Rescue (AvSAR) Levels 1 and 2. To support this 21% increase in course-load compared to winter 2023-24, 24 new AvSAR instructors were trained.

Unlike previous seasons, AvSAR L1 now marks the starting point for professional training in the avalanche industry, and is a prerequisite for Avalanche Operations Level 1. This change grew out of a recognized need to emphasize fundamental AvSAR skills at the beginning of an avalanche professional's career. Starting as a team member, ITP trainees now begin their operational work with foundational rescue skills as a baseline. These skills are carried forward throughout their careers. Additionally, AvSAR L2 enhances field avalanche rescue skills and trains students to perform as team leaders. In the long term, this will help build an avalanche industry workforce with universally robust, adaptable rescue skills.

MEETING DEMANDS FOR RECREATIONAL AVALANCHE EDUCATION

Recreational avalanche education exploded in the immediate aftermath of the COVID pandemic. With this growth came a surge in demand for recreational Avalanche Safety Training courses *and* qualified instructors. To meet this challenge, the CAA and Avalanche Canada worked together to create two Avalanche Educator membership categories—Basic and Advanced—and three new ITP courses to pair.

Graduates of Instructing in Avalanche Terrain (IAT) Foundations, Basic, or Advanced can now seek more accessible pathways to CAA membership and AST teaching certification. This course-based membership pathway reduces previous barriers to entry for applicants for whom career-based or location-based experiences proved obstacles. During the winter 2025-26 season, IAT-Basic courses were among ITP's most popular offerings. Looking ahead, the 2025-26 season marks the first fully operational rollout of both IAT-Basic and IAT-Advanced courses.

MENTAL HEALTH IN THE INDUSTRY: THE RESPONDER STRESS CONTINUUM

Throughout the avalanche industry, more operations are embracing open conversations about mental health and trauma processing. Thanks to the continued partnership between the Responder Alliance and ITP, students are now introduced to the Stress Continuum at the beginning of their professional training. From AvSAR L1 onwards, this framework is carried forward throughout the entire ITP curriculum with reinforcement and practice on subsequent courses. ITP and Responder Alliance staff continue to support instructors as they integrate this tool into the classroom, complementing what many students have already encountered in their own operations. Thanks to growing dialogue surrounding stress response trends, more avalanche workers will be equipped with the language and mental frameworks necessary to seek support early on.

INFOEX & DIGITAL TOOLS IN THE CLASSROOM

Avalanche Operations Level 2 students now more thoughtfully engage with digital tools used throughout the avalanche industry. Students on both courses and assessments now participate in hands-on activities with InfoEx workflows, CalTopo mapping features, and several other tools. This hands-on integration ensures the Ops 2 program remains current and practically applicable in the growing technological world. Most importantly, these tools support Ops 2 graduates in developing the skills and proficiencies essential for operational roles. Ongoing updates to the Ops 2 curriculum will continue to strengthen this integration and complement evolving industry practices.

Letter: Climbing the CPD Mountain
Rethinking the CAA's Requirements for Avalanche Professionals

DEAR CAA,

As a self-regulating body, I fully recognize members of the CAA should maintain a high degree of continuing professional development. This ensures the association and its members foster public and government trust, stay updated in a changing world, and contribute to the expanding knowledge base.

I must admit that I had been lax about fully reviewing the CPD requirements for maintaining my membership as an Avalanche Professional. I work full-time as a guide in avalanche terrain, I attend CPD sessions and annual guide training, brush up on OGRS, and read CAA emails and *The Avalanche Journal*. I assumed I was probably fine, and I'd deal with an audit if one happened. But with the ACMG moving to mandatory reporting in 2026, I decided to dive deeper into the CAA's CPD point structure. To my surprise, I discovered I had been falling short.

This article serves to highlight the CAA's CPD requirements for others who might have taken them as casually as I did, and to shed light on the substantial number of points required to meet Avalanche Professional standards. I also ask: **Is the current CPD structure a reasonable one that sets members and the organization up for success?**

Let's consider the fictional case of Jenny Snowplow, a mother of a three-year-old daughter. Jenny and her partner work full-time, and she has been a lead ski guide and Avalanche Professional since 2016.

First, is the Avalanche Professional membership right for her? The CAA has two main membership streams: voting and non-voting. Let's assume Jenny wants to be a voting member. As a lead guide responsible for direct supervision and mentoring, the CAA's expectation is that Jenny should be an Avalanche Professional, not a Practitioner. Therefore, she must aim to average 80 CPD points annually to meet the required 240 over three years.

In 2020, before Jenny became pregnant, she was highly engaged with the CAA and accumulated the following CPD points. In 2020, she:

- worked four weeks as a lead guide with CMH;
- taught a Level 1 course;
- attended ISSW;
- wrote for *The Avalanche Journal*;
- presented at the Spring Conference and attended for two days;
- worked one week and attended one week of guide training for Raven Heli Skiing;
- attended the CAA AGM;
- participated in a CPD session; and
- took the CAA Advanced Weather and RTAM courses.

Her involvement was at an all-time high, earning her 116 points.

In 2021, when she was pregnant, she reduced her work schedule, but those points helped her meet the three-year average. From 2022 to 2023, she took parental leave with the CAA, which alleviated the CPD requirements. But now, in 2025, with leave behind her, she and her partner are juggling childcare while managing a busy work schedule to meet living expenses in a costly mountain town.

In 2025, Jenny:

- worked three weeks for CMH and attended their one-week training;
- worked two weeks with Raven Heliskiing and attended their one-week training; and
- took two CAA CPD courses.

Despite desires, Jenny isn't able to be involved with the CAA like in 2020, and there are limited new formal learning opportunities available to her.

What does this look like in terms of points? Jenny maxed out her informal learning points at 20, and she earned just 35 for professional practice, totaling 55 points. This falls short of even the Practitioner member requirements, despite having 140 hours of informal guide training, three hours of CPD course participation, and about 350 hours of professional practice.

To review my original question:
Are the current CPD requirements a reasonable expectation of the CAA that sets its membership and the organization up for success? I answer "no."

Jenny faces a significant challenge in meeting the requirements despite working nearly 500 hours away from home and balancing everyday life. Replace a young child with aging parents requiring care, work burnout, a year of leave, medical conditions, SAR, or other community involvement,

and many members face similar limitations. For some, 50 days of professional practice is a reasonable winter. Moreover, many members plateau in formal learning opportunities as their careers progress. A seasoned professional isn't likely to forget the knowledge they've accumulated in the span of three years, especially with continued practice and informal learning.

For comparison, the College of Applied Biologists (RPBio designation) requires 100 points over three years, with 60 potential points from professional practice, and 95 potential points from learning activities (including informal).

I commend those who can take the time to participate, present, and contribute to knowledge, and I believe these actions should be rewarded with CPD points. However, I believe the current CPD structure does a disservice to its members who are key to our industry, stay current, learn, and work hard to make a living in avalanche-related fields.

I suggest the CAA review its point system in the following areas:

- Professional practice: One point per day of practice and a 150-point maximum over three years both seem low. Points should also be based on hours of work, not days.
- Informal learning: review the maximum of 60 points towards the required 240.
- Comparison with other professions: Consider how the CAA's requirements align with those of other professional bodies (RPF/RFT, RPBio, ACMG, etc.).

To those who haven't probed into their CPD points, I encourage you to take a deeper look. We must ensure the CAA's membership remains relevant and meaningful and consider whether the expectations are reasonably attainable.

Sincerely,

Sam McKoy
CAA

Climbing the CPD Mountain: **A Response from the Membership Committee**

DEAR SAM AND CAA MEMBERS,

Sam, thank you for the letter you sent with your feedback about the CPD requirements. Engagement from members helps our committee and the CAA as a whole review its policies and practices. Your letter has generated much discussion amongst the Membership Committee. Our response is offered to clarify some opportunities to help members achieve CPD objectives and highlight the role staff can play in assisting them.

The current policy was modelled after reviewing frameworks from other professional bodies, and the system has been adapted to fit the unique structure of CAA membership. Still, CPD is not a static entity—it is continuously evolving in response to both member feedback and broader professional trends.

The Association recognizes the wide range of professional roles and life circumstances faced by our membership. Over the past year, we developed new policies to accommodate members facing injury, illness, and parental leave. Our aim has been to ensure a functional approach for members while maintaining industry-leading standards for professional growth. As a backstop, a remediation policy was also introduced, acknowledging that although sometimes people fall behind in CPD, the CAA wants to support members back to compliance.

Several other organizations have either based their CPD policies on the CAA's or are moving their policy more in line with it. The CAA is also working to harmonize its policies with those of partner organizations in order to improve systems for members of multiple associations. Our practice now is to defer audits of a CAA member who was audited in the last year by one of our partners. This reduces the administrative burden and stress members may face.

Based on member feedback, we revised our approach to some categories. Most significantly, the cap on participation points has been increased. Participation, which includes activities like mentorship, is calculated by the hour rather than by the day. This approach acknowledges the importance of mentorship in the industry. In practical terms, a member can either claim one day of professional practice or eight to 10 points in participation when providing mentorship at work (one point for each hour of mentoring that day).

CATEGORY	POINTS	ACTIVITY
Professional practice	30	30 days of guiding work (actually worked 35 days but some days are allocated to participation).
Participation	30	Provides mentorship to a junior employee at the guiding operations she works at.
Informal learning	20	Pre-season training and online CPD sessions.

Using Sam's example, if Jenny is still providing mentorship to junior guides, we recommend Jenny reallocate three to four days of professional practice to 30 points for participation for her work mentoring throughout the season. She would claim fewer professional practice points, but would receive more points overall. Sam provides a great example of where allocating points to maximum effect as above can make a big difference. With the information provided, Jenny may be able to meet CPD requirements if she is still mentoring within her guiding role (see above table).

While initially it may look like a member is significantly short on points, CAA staff are happy to support members to maximize available CPD points to meet requirements. The CAA is not here to penalize members who do not work full-time or punish those who don't seem to be meeting requirements. We seek to support members to meet CPD objectives. Where members struggle to do so, the committee is always keen to find solutions to help them maintain membership.

If members are not mentoring at work, opportunities such as Link Up & Learn and the Mentorship Forum are expanding opportunities for members to connect and grow through peer-to-peer learning. The Mentorship Forum allows for members in distant geographic regions to connect virtually, opening up mentorship opportunities outside of the workplace or a particular region.

Last summer, formal learning points were allocated to partner-organization courses. This summer, more courses will be assessed to make it easier for members to see how they can claim formal learning points after completing the traditional course pathways through the CAA and partner associations.

Sam raises a couple of good questions about calculating the number of days worked in a season and how that relates to professional practice. Five weeks, or 35 days, is around 30% of the season worked, which enables members to achieve 70% of the maximum professional practice points. In a 120-day season, how many days or hours does someone need to work to be considered full-time or maintain currency? The answer may be different between a relatively new Avalanche Professional who recently took a career recess compared to a seasoned professional for over 30 years. Some of the challenges lie with trying to create policy that meets such a wide range of circumstances without incorporating so much complexity that it is not digestible.

A dedicated working group has already conducted in-depth research on CPD practices across a variety of professional sectors, ensuring our system remains both rigorous and relevant. The committee and working group will review Sam's requests along with other member feedback this summer.

The CAA is committed to maintaining a CPD system that reflects both the realities of our industry and the aspirations of our members. While change can be challenging, it is also essential for keeping our standards current and inclusive. As we move forward, we welcome continued dialogue and feedback. Together, we are building a stronger, smarter professional community—one that grows through learning, collaboration, and respect.

If you would like to submit feedback on the current CPD policy, please email membership@avalancheassociation.ca.
Signed,

The CAA Membership Committee

LINK UP & LEARN IS AN OPPORTUNITY FOR MEMBERS TO EARN CPD POINTS BY MENTORING NEWER PRACTITIONERS. // ALEX COOPER

Fuse News

Tyler Carson, Rocket Miller, Chris Argue

WITH THE 2024-25 SEASON in the taillights, an update from the Explosives Advisory Committee (EAC) is in order. Over the last 12 months, a few issues have been resolved, some are coming to a head, while we are just becoming aware of others.

COMMITTEE TRANSITIONS

Kevin Marr left the committee following the 2024 spring meetings, handing over the reigns to Eric 'Chevy' Chevalier as the mechanized cat-skiing representative. Bernie Protcsh stepped down from the committee this spring; the EAC emphatically thanks him for his many years of service. Darren Saul has accepted the role of Vice-Chair and has already helped carry much of the load for the committee. Rocket Miller has taken on the role of secretary. Their collective contributions reflect the spirit of shared responsibility that supports the EAC's mandate.

SEPARATION DISTANCES FOR EXPLOSIVES POLICY UPDATE

Following extensive consultation with Natural Resources Canada's Explosives Regulatory Division (ERD), the long-standing Quantity Distance standards, formerly supported by the Bureau de Normalization du Quebec (BNQ), was replaced in January by the ERD's *Separation Distances for Explosives* policy. A key outcome of this change is the incorporation of ski resorts within the new policy, marking the end of ski resort operations under the G06-03 guideline. The ERD and CAA's common goal of balancing public safety while maintaining operational functionality was largely achieved. Moving forward, all operators can plan with more confidence in consistent application of policy.

Another policy coming from ERD is the new G06-08 document, *Storage of Explosives*, which defines magazine construction standards and will replace G06-01, *Storage Guidelines for Non-Industrial Explosives*, and G06-05, *Storage Guidelines for Compatibility of Explosives*. Key points from the new document are summarized here, with page numbers referring to the draft of G06-08:

- Type-6 magazines will not be permitted for Type E and Type I explosives after July 31, 2026. (page 14)
- Old construction of doors has a sunset date of July 31, 2026, or as indicated. (page 19-20)
- Old locking mechanisms have a sunset date of July 31, 2026. (page 20)
- Old walls built to be bullet-resistant may continue to be licensed. Magazines with walls with sand will not be licensed. (page 21)

Operators are encouraged to familiarize themselves with the updated policy, available at www.avalancheassociation.ca/resource/resmgr/files/CONSULTATION_on_G06-08_Stora.pdf

MAGAZINE DOOR LOCK COMPLIANCE

Operators are reminded magazine door lock upgrades must be completed by 2026. New lock designs may differ in function, including the ability to remove keys before full engagement. Field staff should be instructed to verify door security manually. Updating site-specific standard operating procedures to reflect this step is strongly advised.

HELICOPTER BOMBING GUIDELINES

The Board of Directors allocated funding to support the development of helicopter avalanche control guidelines, which aim to improve standardization in explosives handling and deployment. CAA staff are preparing a scope of work to hire a project manager and subject matter experts.

REMOTE AVALANCHE CONTROL SYSTEMS AND BLASTERS OF RECORD (BOR)

The EAC has corresponded with WorkSafeBC (WSBC) to clarify how a BOR is assigned to loading and arming versus firing of explosive-based RACS. These operations are unique because the loading and arming of the systems often occur weeks to months before the charges are fired, and usually different BORs are responsible for loading versus firing. WSBC confirmed once the charges are in the magazine/deployment box, the BOR who supervised the loading is no longer responsible. Another BOR must assume responsibility for firing.

SUMMER STORAGE AND WILDFIRE RISK

The risk of wildfire is an operational concern for explosives storage in summer. The EAC acknowledges complete removal of inventory during the off-season may not always be feasible. For sites maintaining summer storage, risk mitigation can include coordination with local wildfire and industrial fire responders, reference to ERG 112 protocols, and participation in seasonal response drills. Operators should ensure accurate inventories are readily available to emergency services.

RESEARCH SPOTLIGHT: DRONE DEPLOYMENT FOR AVALANCHE CONTROL

An emerging initiative led by the Canadian Emergency Responders Robotics Association (CERRA), with funding from Defence Research and Development Canada, is investigating drone-based avalanche control systems. This collaborative project involves stakeholders from the BC Ministry of Transportation and Transit, Transport Canada, and WSBC. Testing on effects of explosives on the drones and the use of remote initiation systems is planned at federal explosives facilities this summer/fall. The aim is to receive Transport Canada approval by next spring to do live testing in B.C.

As the avalanche industry evolves, so too must our approaches to regulation, technology, and best practices. The EAC remains committed to supporting practitioners through these transitions—whether by clarifying policy, advancing safety standards, or fostering innovation. We encourage continued engagement from the membership as we work together to ensure safe, effective, and forward-looking explosives use in avalanche control.

CAA Honorary Members
David McClung and Karl Klassen

Alex Cooper, using notes from Steve Conger and Eirik Sharp

DAVE MCCLUNG

When Dr. David McClung joined the CAA in 1981, he was member #1. Over a career spanning more than 50 years, he has helped advance snow science globally, first with the National Research Council of Canada, and then from his position as a researcher and engineer at the University of British Columbia.

Dave's ongoing research has focused on snow and avalanche mechanics, both theoretical and applied. He completed his PhD in 1974 and wrote his thesis on avalanche defense mechanics. Beginning in 1979, he conducted research on avalanche initiation that focused on material properties for shear fracture propagation. His work considered snow as a pressure-sensitive, dilatant, strain-softening material. In 2006, he co-authored a paper (along with Juerg Schweizer) on the significance of fracture energy as a crucial material property relevant to avalanche initiation. This concept remains instrumental in fracture models for avalanche initiation, including those that incorporate both shear and compression.

Dave's other contributions are almost too numerous to list and include work on statistical runout estimation, avalanche dynamics, the interaction of avalanches and forest cover, and human factors in avalanche forecasting. He also helped develop the Canadian avalanche size scale.

Dave worked alongside Peter Schaerer at the National Research Council until 1991, when their office was closed. He then went to UBC, where he was the NSERC's Industry Research Chair. There, he guided future leaders in the avalanche industry such as Pascal Haegeli, James Floyer, Steve Conger, and Chris Borstad. He co-authored the 2nd, 3rd, and 4th editions of *The Avalanche Handbook* with Peter Schaerer in 1994, 2006, and 2022, respectively.

Dave brought much of this research to the CAA. While known for his challenging academic presentations, he introduced many practical concepts to the membership including risk-based decision-making and concepts such as the operational risk band that have been invaluable for explaining to managers and those in government why operations should not strive for zero risk. He was also the founder of the CAA Technical Committee and has served on it for the past 35 years.

KARL KLASSEN

Karl Klassen's fingerprints are all over modern avalanche safety. Karl enjoyed a 40-year career as an ACMG Mountain Guide, avalanche forecaster, researcher, author, instructor, examiner, and even filmmaker. He was the long-time lead guide for Monashee Powder Snowcats and served as both the President and Executive Director of the Association of Canadian Mountain Guides.

Karl was one of the key players in shaping Avalanche Canada into the world-leading public avalanche safety agency it is today. As Warning Service Manager, he led Avalanche Canada's evolution into a one-stop shop for winter backcountry users of all kinds. He acted as a liaison with warning services around the world, and coordinated many avalanche safety initiatives with Canadian provincial and federal agencies. He was a mentor to dozens of avalanche forecasters, many of whom have become industry leaders. Finally, he supported Canadian research and led the development of the AvID forecasting platform.

For the CAA, Karl co-wrote the curriculum for the Avalanche Operations Level 3 course and served on the InfoEx Advisory Committee, where he shouldered critical tasks such as rewriting subscriber agreements, reconciling competing interests, and advising on InfoEx development.

"When the heavy lifting needed doing, one name always rose to the top—Karl Klassen," wrote one nomination.

DAVE MCCLUNG (LEFT) AND KARL KLASSEN, RECEIVED THEIR HONORARY MEMBERSHIPS AT THE 2025 SPRING CONFERENCE. // ALEX COOPER

2025 CAA **Service Award Winners**

Alex Cooper, based on the nominations submitted for each recipient

JOCK RICHARDSON

Jock was nominated for the CAA Service Award for his outstanding and long-time contribution as an ITP instructor, having taught over 90 courses throughout his career.

"The researcher Gary Klein tells us that in the type of work we do, one of the ways we gain expertise is through shared stories. Hearing stories helps us gain experiences that build the intuition so vital to applying our craft," wrote Garth Lemke in his nomination. "Jock shares stories and I can not think of an instance when I did not hear a story somewhere in a lesson or interaction. The countless individuals engaged in a course with Jock have advanced their experience and hopefully begun developing their intuition."

In addition to his CAA work, Jock has worked for decades as a ski patroller, avalanche forecaster, mountain risk specialist, and more. Outside the avalanche world, he has guided trips on some of the wildest rivers around the world.

GRANT STATHAM

Grant Statham's work has benefitted everyone who has worked in the avalanche industry. An ACMG Mountain Guide and Visitor Safety Specialist for Parks Canada, his impact has stretched far beyond those realms. He has led or contributed to many of the systems CAA members count on every day.

- He led the implementation of the Backcountry Avalanche Risk Review after the 2003 Rogers Pass tragedy, including the establishment of Avalanche Canada.
- He created the original Avalanche Terrain Exposure Scale and its successor, ATES 2.0, along with Cam Campbell.
- He led development of the North American Public Avalanche Danger Scale, Conceptual Model of Avalanche Hazard, and AvalX public forecasting system.
- He was an author of the CAA's TASARM Guidelines
- He helped create the Ice Climbing Avalanche Terrain Atlas with Sarah Hueniken.
- He is an Adjunct Professor with Simon Fraser University's Avalanche Research Program.

He is passionate about his own ideas, but also open to others that are brought his way. His accomplishments are a payload of riches that have benefitted the public and professional avalanche worlds.

PASCAL HAEGELI

Pascal Haegeli has been strongly contributing to the Canadian avalanche community for over 20 years. Following his PhD under Dr. David McClung at UBC, he went on to create the Avaluator and begin a series of contributions to professional and public avalanche domains, including development of InfoEx, the Conceptual Model of Avalanche Hazard, and more.

In 2015, he was appointed the Simon Fraser University Research Chair in Avalanche Risk Management from which he launched the Avalanche Research program (SARP). Through SARP, Pascal has led research into the public avalanche danger scale, snowpack modeling, avalanche terrain mapping, and more. He has produced a new generation of contributors to avalanche research and practice. He is a regular presenter at the CAA Spring Conference and the International Snow Science Workshop.

"What really makes him special and a valued member of our community is not what he does, but how he does it with a sense of kindness and deep service," said Scott Thumlert, who nominated Pascal for the honour.

GRANT STATHAM (LEFT) AND PASCAL HAEGELI HAVE COLLABORATED ON MANY PROJECTS TOGETHER AND RECEIVED THE SERVICE AWARD AT THE 2025 SPRING CONFERENCE. JOCK RICHARDSON WAS UNABLE TO ATTEND IN PERSON. // ALEX COOPER

In **Memoriam**

JASON REMPLE

Jason Remple, the owner and lead guide at Stella Heliskiing, died at the age of 53 in an avalanche while guiding in the Purcell Mountains on March 24.

Jason was born in the Kaslo area and grew up to be a stalwart of both his community and the larger mountain community in Canada.

"J" built his foundations as a CSGA Ski Guide at Selkirk Snowcat Skiing, where he worked for over two decades as lead guide and operations manager. In 2005, together with his wife and partner Kerry, he founded Stellar Heliskiing. In 2014, he left Selkirk Snowcat Skiing to work at Stellar full-time. He and Kerry built the operation from the initial tenure application into the mature operation it is today.

Along the way, Jason was active with HeliCat Canada, the CSGA, and the CAA. He contributed significantly to his industry and community, whether it was training and mentoring young guides at Selkirk and Stellar, buying and revitalizing the Kaslo Hotel, being active with the Kaslo Mountain Bike Club and Kaslo Search & Rescue, or saving Kaslo's main street from a fire.

Through everything, his greatest source of joy was his family—Kerry and their three children. He will be greatly missed by all who knew him.

"His caring, gentle leadership style brought out the best in everyone who worked with him, creating a family-like atmosphere among his staff and clients," said Stellar Heliskiing in tribute.

The avalanche also took the lives of Jeff Keenan and Alex Pashley, while Clay Mitchell was critically injured.

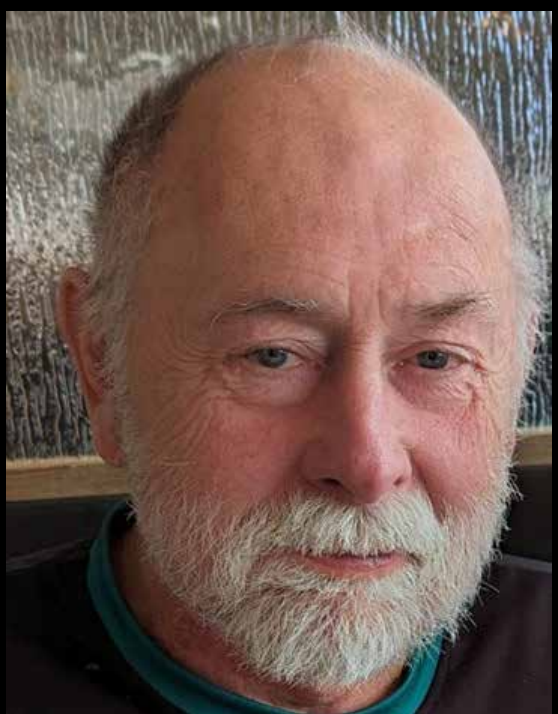
PETER KIMMEL (1950-1975)

Honorary Member Peter Kimmel passed away in Revelstoke on Jan. 3, 2025. Peter was involved in the avalanche industry for over 40 years and was a founding member of the CAA. Born in Vancouver, his love of the mountains began when he learned to ski at the age of five. He was an avid climber and the first paid employee for Mountain Equipment Co-op.

Peter started his career with Parks Canada's Snow Research Avalanche Warning Section, where he worked as an Assistant Observer and then Observer. During those years, he taught many avalanche courses and helped train new Assistant Observers.

Peter spent the last 33 years of his career with his own company, Incline Research, doing avalanche control for private industry and Crown corporations. He spent the last 15 years performing cutblock avalanche assessments, and his company also worked with the film industry, providing avalanche footage and conducting avalanche control for the BBC and Disney, among others.

Peter taught many CAA Avalanche Operations Level 1 courses, as well as numerous AST recreational courses around Revelstoke. He was a meaningful mentor to many.



Scenes from the **2025 Spring Conference**

Photos by Alex Cooper

Scan the QR code or visit avalanchejournal.ca to see a full gallery of photos from the Spring Conference.

THE SPRING CONFERENCE WAS ATTENDED BY 368 PEOPLE IN-PERSON AND 111 MORE ONLINE. AND WHILE THERE WAS A LOT OF SITTING AND LISTENING, ATTENDEES DID GET OUT OF THEIR SEATS FOR ONE PHOTO-OP, WITH (FROM LEFT) BILL MARK, EIRIK SHARP, GRANT HELGESON, AND SCOTT THUMLERT LEADING THE WAY IN THE FRONT ROW.

ANONA KAMPE, A MEMBER OF THE PENTICTON INDIAN BAND FROM THE OKANAGAN NATION SHARING A POIGNANT TRADITIONAL WELCOME GREETING AND SONG.

GORDON BURNS ATTENDS HIS LAST SPRING CONFERENCE AS THE REPRESENTATIVE FOR RECCO. GORD HAS BEEN A STALWART SUPPORTER OF THE INDUSTRY FOR DECADES AND HIS PRESENCE WILL BE MISSED.

THE THIRD ANNUAL LINK UP & LEARN WAS WELL ATTENDED, WITH A FEW DOZEN UP-AND-COMING PRACTITIONERS INTERACTING WITH 10 MENTORS.

BENJAMIN IMBACH, A PHD STUDENT FROM THE UNIVERSITY DU QUEBEC A RIMOUSKI, RESPONDS TO QUESTIONS ABOUT HIS PRESENTATION ON VALIDATING WEATHER DATA, WHILE BILL MARK (LEFT) LOOKS ON.

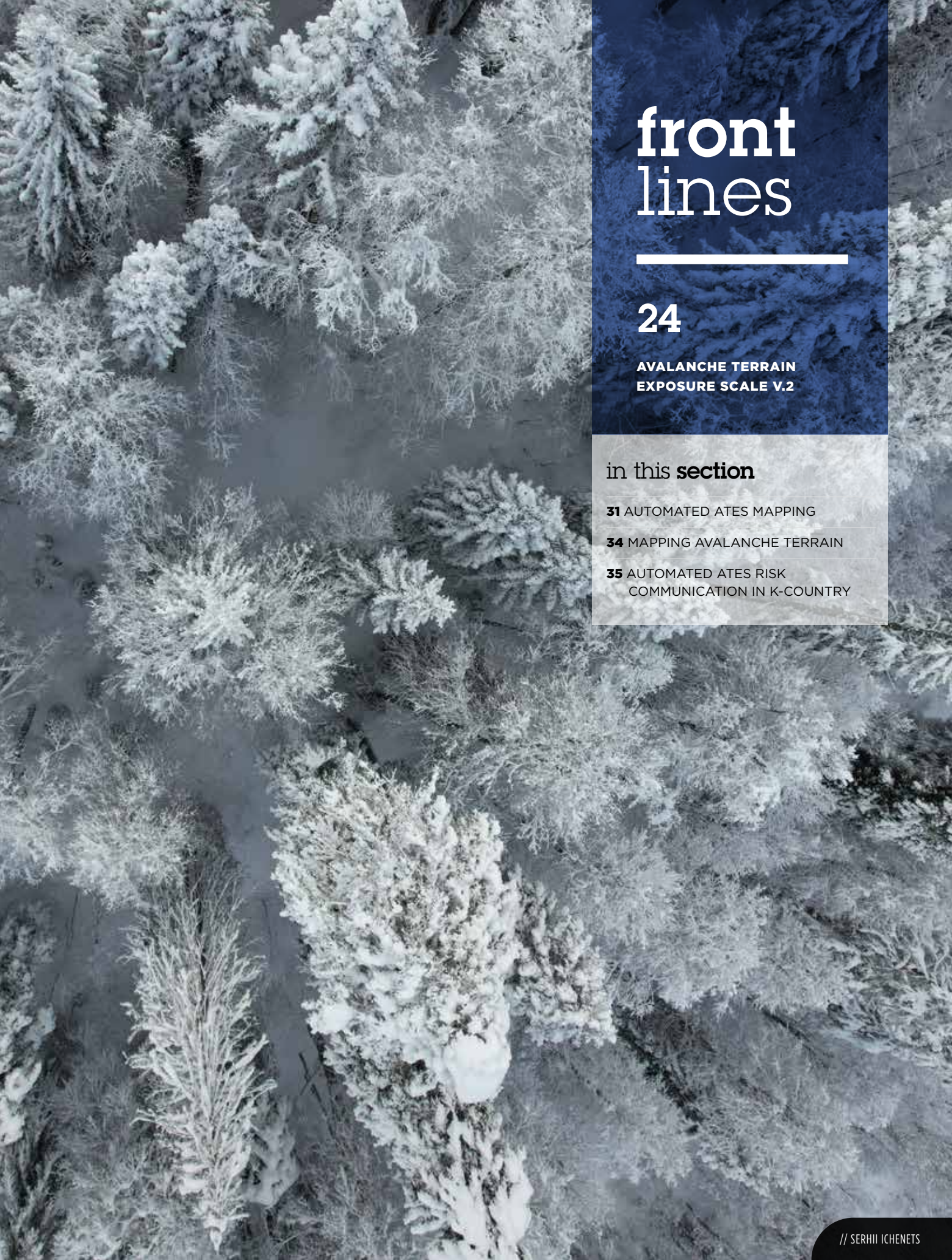
THE BURGER BAR AT THE MEMBER SOCIAL WAS A BIG HIT, AS USUAL.

Contributors

JOHN SYKES
John works as a forecaster for Chugach National Forest Avalanche Center in Alaska and as a postdoctoral researcher with the Simon Fraser University Avalanche Research Program. His current research focuses on automated avalanche terrain mapping and decision-making in avalanche terrain. He is interested in applying research tools to practical problems and developing tools to help people make informed decisions in avalanche terrain. He lives in Anchorage, AK, with his wife Amy and two sons Griffin and Tobin.
31 AUTOMATED ATES MAPPING

EEVA LATUSUO
Eeva is a PhD candidate at Simon Fraser University studying avalanche risk communication. Based in Anchorage, she teaches at Alaska Pacific University, leads advanced avalanche courses, and volunteers with SAR. She feels lucky to live, learn, and play in the mountains year-round.
39 CAUTION: AVALANCHE FORECAST MAY CONTAIN UNCERTAINTY

MIKE KOPPANG
Mike is a Mountain Rescue Specialist with Alberta Parks based in Canmore, Alberta. He has over 25 years of experience working in the Kananaskis Region and is a member of the CAA and ACMG. Mike actively supports using social media to enhance public avalanche awareness and safety.
35 AUTOMATED ATES RISK COMMUNICATION IN K-COUNTRY



front lines

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AVALANCHE TERRAIN EXPOSURE SCALE V.2

in this **section**

// SERHII ICHENETS

The Avalanche Terrain Exposure Scale V.2

Cam Campbell and Grant Statham

INTRODUCTION

The Avalanche Terrain Exposure Scale (ATES) is a system used to assess and communicate the severity of avalanche terrain and potential hazard exposure. Ratings are determined using both subjective and objective criteria that result in a measure of avalanche terrain exposure on an ordinal scale. It was introduced in 2004 in Canada as a guidebook-style terrain rating system for recreational backcountry trips and later expanded into a zoning model to accommodate spatial applications.

Since its introduction, ATES has been applied in many different jurisdictions and countries, has become a widely used risk management and avalanche education tool, and has been used by researchers to measure terrain use preferences. In Canada, use of ATES has grown beyond recreational applications into policy and regulatory frameworks. It is now widely used in workplace avalanche safety plans and Parks Canada uses it for custodial group management.

Over the past two decades, advances in technology and geospatial tools have facilitated a broader application of the ATES concept, including automated ATES ratings (Larsen et al., 2020), which greatly expand the potential scope of terrain classification. Simultaneously, the growth of backcountry recreation has furthered the need for improved avalanche terrain tools (Klassen, 2012) to meet the needs of both skilled backcountry users and those with no appetite for avalanche risk. Backcountry terrain-use patterns have changed, and ATES needed to change with them.

This article introduces ATES v.2 and contains excerpts from our recent peer-reviewed paper in *Natural Hazards and Earth System Sciences (NHESS)* (Statham & Campbell, 2025), which is freely available online (URL provided in the references). This version merges the two previous ATES models into a single method that:

1. expands the original version to five levels from three by including *Class 0 - Non-avalanche terrain and Class 4 - Extreme terrain;*

TABLE 1: ATES COMMUNICATION MODEL FOR BACKCOUNTRY TRAVEL.

Terrain rating	Class	Description for backcountry travel
Non-Avalanche	**0**	No known exposure to avalanches. Very low-angle or densely forested slopes located well away from avalanche paths, or designated trails/routes with no exposure to avalanches.
Simple	**1**	Exposure to low-angle or primarily forested terrain. Some forest openings may involve the runout zones of infrequent avalanches and terrain traps may exist. Many options to reduce or eliminate exposure.
Challenging	**2**	Exposure to well-defined avalanche paths, starting zones, terrain traps or overhead hazard. With careful route finding, options exist to reduce or eliminate exposure.
Complex	**3**	Exposure to multiple overlapping avalanche paths or large expanses of steep, open terrain. Frequent exposure to overhead hazard. Many avalanche starting zones and terrain traps with minimal options to reduce exposure.
Extreme	**4**	Exposure to very steep faces with cliffs, spines, couloirs, crevasses or sustained overhead hazard. No options to reduce exposure; even small avalanches can be fatal.

TABLE 2: ATES COMMUNICATION MODEL FOR WATERFALL ICE CLIMBING.

Terrain rating	Class	Description for waterfall ice climbing
Non-Avalanche	**0**	Routes with no exposure to avalanches except small sluffs and spindrift.
Simple	**1**	Routes with brief exposure to very low frequency avalanches starting from above or crossing occasional short slopes.
Challenging	**2**	Routes with long exposure to low frequency avalanches or brief exposure to high frequency avalanches starting from above or crossing a few short slopes. Options exist to reduce exposure.
Complex	**3**	Routes with long exposure to high frequency avalanches starting from above or crossing steep slopes with terrain traps below. Minimal options to reduce exposure.
Extreme	**4**	Routes with long and sustained exposure to very high frequency avalanches starting from above and crossing multiple steep slopes with terrain traps below. No options to reduce exposure.

TABLE 3: ATES TECHNICAL MODEL. THE BOLD ITALICIZED TEXT INDICATES DEFAULT VALUES THAT AUTOMATICALLY PLACE THE ATES RATING IN THAT CATEGORY OR HIGHER. THE USE OF CLASS 0 IS OPTIONAL DUE TO THE RELIABILITY NEEDED TO MAKE THIS ASSESSMENT; OTHERWISE, CLASS 1 INCLUDES CLASS 0 TERRAIN.

	Class 0 Non-Avalanche Terrain*	**Class 1 Simple Terrain**	**Class 2 Challenging Terrain**	**Class 3 Complex Terrain**	**Class 4 Extreme Terrain**
Exposure	No known exposure to avalanche paths	Minimal exposure crossing low-frequency runout zones or short slopes only	Intermittent exposure managing a single path or paths with separation	**Frequent exposure to starting zones, tracks or multiple overlapping paths**	Sustained exposure within or immediately below starting zones
Slope angle and Forest density	Very low angle (< 15°)open terrain unconnected to steeper slopes, or steeper areas in dense forest	Low angle (15°-25°) open terrain with isolated small (< Size 2) moderate-angle slopes and/or forest openings for runout zones	Moderate-angle (25°-35°) open terrain with isolated large (≤ Size 3) high angle slopes in glades or open areas	Large proportion of high-angle (35°-45°) open or gladed terrain, but mostly moderate-angle terrain	Large proportion of very-high angle (> 45°) terrain with few or no trees
Slope shape	Straightforward, flat or undulating terrain	Straightforward undulating terrain	Mostly undulating with isolated slopes of planar, convex or concave shape	Convoluted with multiple open slopes of intricate and varied terrain shapes	Intricate, often cliffy terrain with couloirs, spines and/or overhung by cornices
Terrain traps	No avalanche related terrain traps	Occasional creek beds, tree wells or drop-offs	Single slopes above gullies or risk of impact into trees or rocks	Multiple slopes above gullies and/or risk of impact into trees, rocks or crevasses	Steep faces with cliffs, cornices, crevasses and/or risk of impact into trees or rocks
Frequency-magnitude (avalanches:years)	**Never > Size 1**	**< 1:100 - 1:30 for ≥ Size 2**	1:1 for < Size 2 **1:30 - 1:3 for ≥ Size 2**	1:1 for Size 3 **1:1 for ≥ Size 3**	10:1 for ≤ Size 2 > 1:1 for > Size 2
Starting zone size and density	No known starting zones	Runout zones only except for isolated, small starting zones with Size 2 potential	Isolated starting zones with ≤ Size 3 potential or several start zones with ≤Size 2 potential	Multiple starting zones capable of producing avalanches of all sizes	Many very large starting zones capable of producing avalanches of all sizes
Runout zone characteristics	No known runout zones	Clear boundaries, gentle transitions, smooth runouts, no connection to starting zones above	Abrupt transitions, confined runouts, long connection to starting zones above	Multiple converging paths, confined runouts, connected to starting zones above	Steep fans, confined gullies, cliffs, crevasses, starting zones directly overhead
Route options	Designated trails or low-angle areas with many options	Numerous, terrain allows multiple choices; route often obvious	**A selection of choices of varying exposure; options exist to avoid avalanche paths**	Limited options to reduce exposure; avoidance not possible	No options to reduce exposure

2. removes glaciation as an input parameter; and
3. introduces a communication model for waterfall ice climbing.

This update also addresses shortcomings identified over the past 20 years of extensive ATES use. Note that ATES v.2 was originally presented at the 2023 International Snow Science Workshop in Bend, Oregon; however, it has seen a few revisions since then.

ATES V.2

ATES v.2 is a five-level terrain rating system that helps people gauge their exposure to avalanche-prone terrain. It follows the communication theory of *source–channel–receiver* (Wogalter et al., 1999), with dual objectives of assessment and communication, each with respective models. The *communication models* are simple by design to achieve ATES' primary objective of conveying terrain ratings to different receiver groups. The *technical model* is designed for the source (i.e., the terrain assessor) as a specialized reference for identifying, analysing, and classifying avalanche terrain exposure.

Communication models

The communication models describe terrain ratings in the language of the receiver. They are light on technical detail and prioritize comprehension. ATES v.2 contains two communication models, each for activities with distinct exposure characteristics: backcountry travel (Table 1) and waterfall ice climbing (Table 2). The models describe and rank avalanche terrain in a simple way, similar to how the danger scale describes and ranks avalanche danger. They represent the summary of a technical assessment intended for avalanche risk communication to less-experienced users.

ATES v.2 technical model

The technical model describes avalanche terrain exposure using eight parameters, each with thresholds for the five ATES classification levels. Of a total of 40 criteria, there are six ***bold defaults*** that, when met, automatically default the ATES rating into that category or higher. Otherwise, the overall rating is an evaluation based predominantly on expert judgement that involves analysing the terrain against each ATES parameter for the best fit, comparing this to levels above and below, and deciding what the best overall rating is. More guidance for evaluating each parameter to determine an overall rating can be found in our NHESS paper.

APPLICATION

Objectives and approach

Over the past two decades, ATES projects have used different approaches to meet different objectives or use emerging technology. Examples include the manual rating of backcountry touring routes, mixed GIS and manual mapping/rating of backcountry zones, and automated, algorithm-based mapping/rating.

Typically, a more objective approach leads to smaller-scale zoning around measurable terrain features, such as in Alberta Parks' AutoATES maps for Kananaskis (see article on page 35). This is different than a manual approach, where terrain is often grouped into zones that are logical for a recreational application (such as Avalanche Canada's Trip Planner), but this requires local expertise. Striking the right balance of objective measurements (e.g., slope angle), subjective estimates (e.g., frequency-magnitude), and local knowledge (e.g., route options) is a challenge for the assessment of any ATES rating. Ultimately, ATES is a communication tool and the resulting product must make sense and be easily interpreted by the receiver of the information.

The application of ATES starts by considering the objectives of the final product, which informs the approach to assessment and communication. The objective and approach depend on the target audience, their intended use of the terrain ratings, and the availability of terrain data. For example, the objective might be to facilitate recreational trip-planning, in which case a single rating for a specific area or route might be sufficient (or multiple ratings along that route for a more precise assessment). ATES zone-mapping might be more appropriate if you're creating an avalanche safety plan for roving field work that uses ATES ratings to dictate what

TABLE 4: ATES FEATURE TYPES AND THEIR SPATIAL REPRESENTATION (AFTER SHARP ET AL., 2023).

ATES Feature	Example Application	Spatial Representation
Area	Rating a commonly defined region with either a well-defined geographic boundary or an ambiguous one.	Point (Figure 1a) or polygon
Zone	Rating a specific slope or terrain feature within a well-defined geographic boundary where ATES parameters dictate the zone boundaries.	Polygon or raster (Figures 1d and 2)
Corridor	Rating a physical or conceptual path of travel between defined start and end points with navigational freedom within a well-defined geographic boundary or an ambiguous one.	Polygon (Figure 1c) or line (Figure 1b)
Route	Rating a physical or conceptual path of travel between defined start and end points with limited navigational freedom.	Line (Figure 1b)

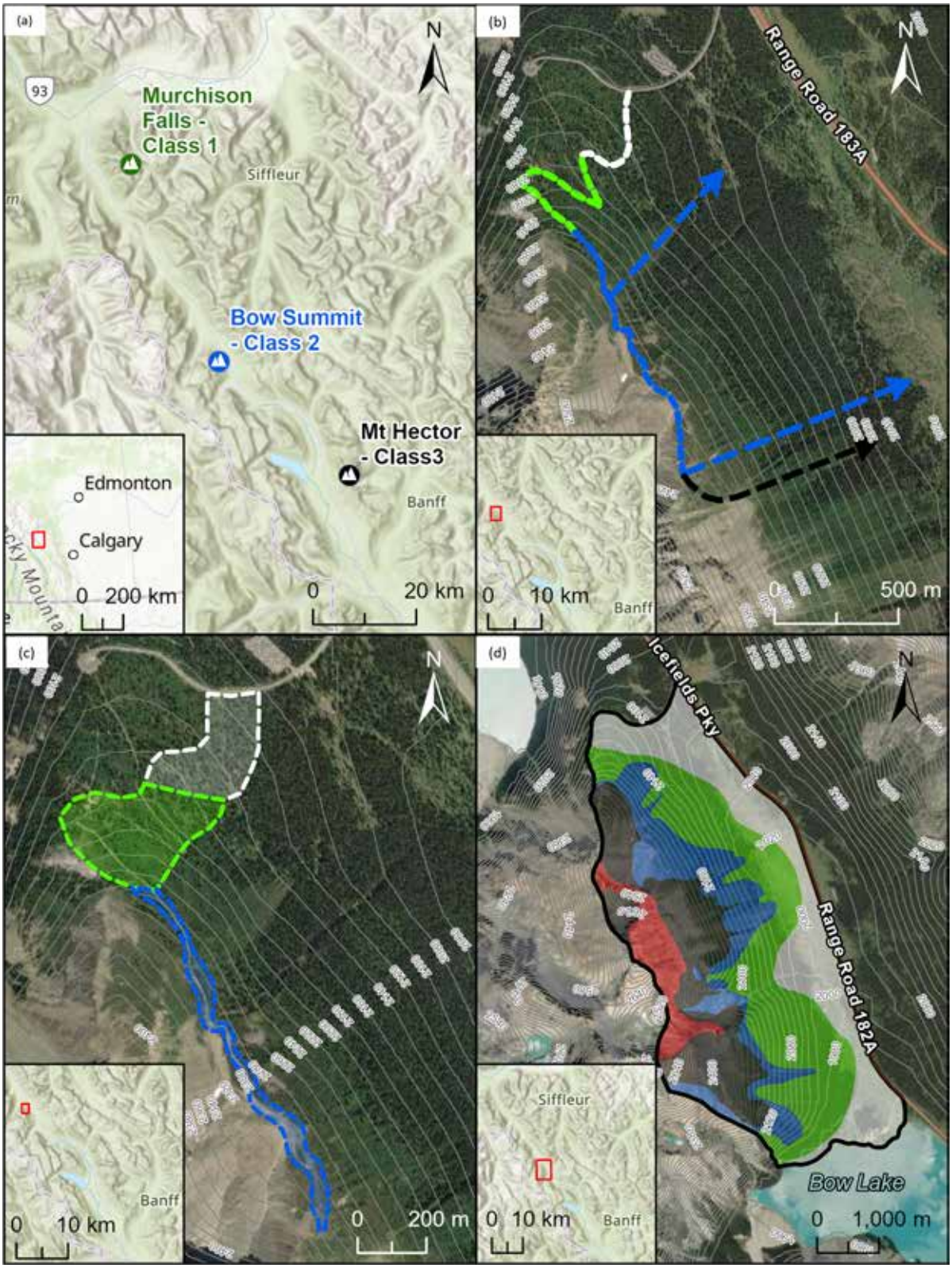

FIG. 1: SPATIAL REPRESENTATIONS OF DIFFERENT ATES FEATURE TYPES ILLUSTRATING AREAS REPRESENTED AS SINGLE-RATING POINTS (A), MULTI-RATING ROUTES REPRESENTED AS LINES (B), MULTI-RATING CORRIDORS REPRESENTED AS POLYGONS (C), AND ATES ZONES REPRESENTED AS POLYGONS (D).

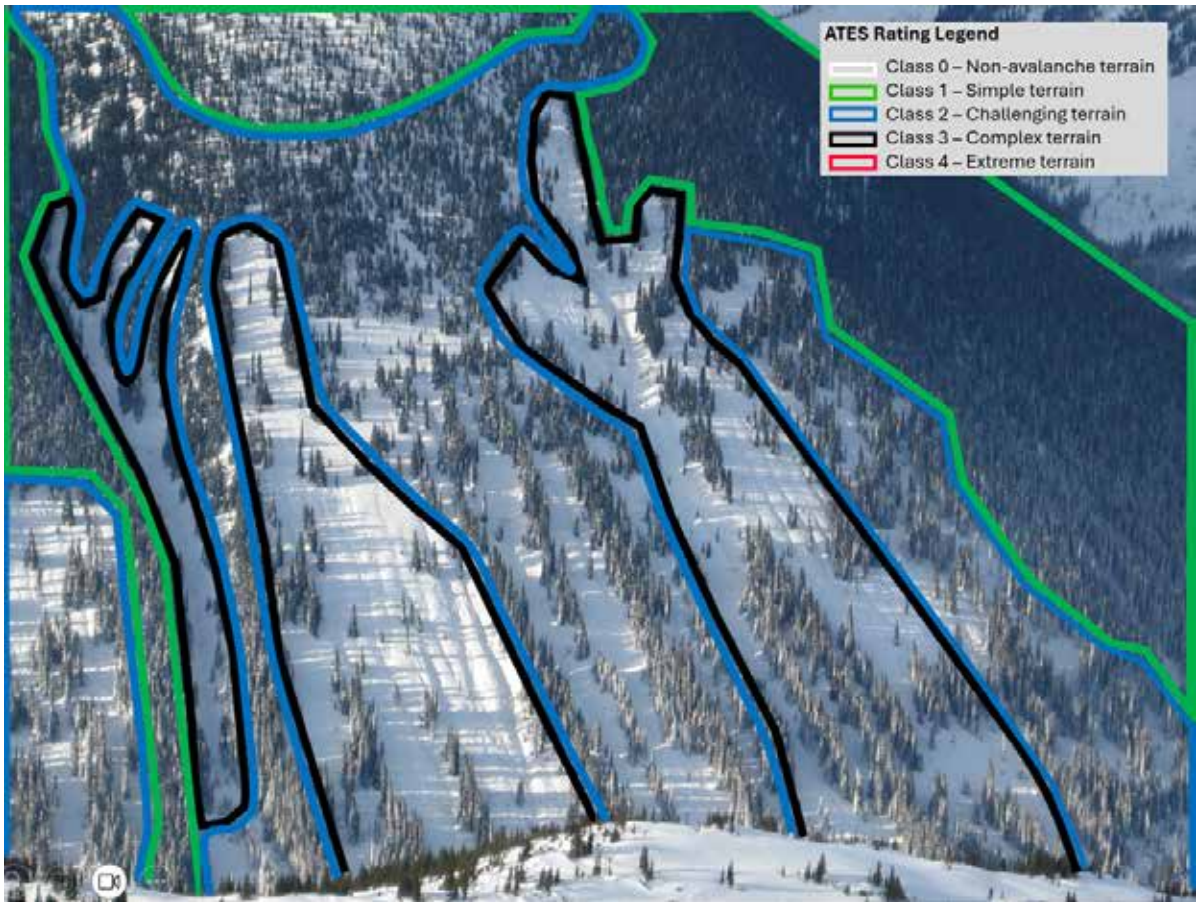

FIG. 2: EXAMPLE OF ATES ZONE-MAPPING ILLUSTRATED ON AN OBLIQUE PHOTO. THIS PARTICULAR SLOPE IS A RUN CALLED SWEET CAROLINE, WHICH IS PART OF THE CMH BOBBIE BURNS TENURE IN THE SELKIRKS.

kind of terrain can be accessed for a given avalanche danger. Over the past 20 years of use, four distinct approaches to ATES classification have emerged. These are listed in Table 2 and illustrated in Figures 1 and 2.

An area defines the boundaries of an overall assessment and can either be given a single rating (Figures 1a and 3) or be broken down into smaller-scale zones (Figures 1d and 3). A route defines a linear path of travel from start to finish and can be broken down into shorter segments using lines to represent precise routes (Figure 1b) and polygons to represent a corridor of travel where navigational freedom is possible (Figure 1c). A zone is a specific slope or grouping of terrain features with common ATES characteristics that is represented by a polygon, and is typically surrounded by adjacent polygons showing ATES zone ratings (Figure 1d).

Spatial scale

Spatial scale refers to the extent of a geographic area and the resolution at which ATES is applied. For example, when classifying a predetermined route, the scale of the entire area is already defined by the route. However, along that route there will be variations in avalanche exposure. These could be represented using smaller-scale ratings for improved accuracy, or they could be grouped together as part of the whole route and only a single rating issued. The smaller the scale, the higher the resolution and more precise the classifications will be, but this comes at the cost of greater effort and resources. It is important to determine at which scale the ratings are being applied and to recognize that not all the criteria shown in Table 1 can be applied at all scales.

Assessment methods

Evaluating avalanche terrain exposure using ATES requires qualified people skilled in avalanche terrain assessment and backcountry route-finding. ATES is intended to be used by both avalanche professionals and desktop GIS specialists, or ideally a team of both. Assessors ultimately develop their own techniques and work within the bounds of their scope of practice and organization's capacity, but the most accurate results are achieved through collaboration. Local terrain and route familiarity are a significant asset and necessary for analysing the interaction between people and avalanche terrain.

SIMPLE – CLASS 1

Banff National Park
Baker Creek
Baker Creek powerline
Bath Creek – 7 km from Hwy 1
Bow Riverside loop
Brewster Creek to Sundance Lodge
Bryant Creek
Cascade Fire Road
Cave and Basin trails
Fairview loop
Glacier Lake
Goat Creek
Great Divide Trail
Healy Creek – Sundance to SSV road
Johnston Creek to Inkpots
Lake Louise shoreline trail
Merlin Valley from Skoki
Minnewanka lakeshore
Moraine Lake road trackset
Mosquito Creek to MOS
Natural Bridge from Skoki
Pharoah Creek
Pipestone trails
Skoki via Boulder/Deception Passes
Skoki via Pipestone River
Spray River Trail
Sulphur Mountain backside trail
Sulphur Mountain trail under gondola
Sundance Pass
Telemark trail
Tower Lake
Tramline trail
Twin Lakes from Hwy 1
Upper Lake Louise nordic trails

Jasper National Park
Astoria River to Tonquin/WH hut
Athabasca Falls loops
Athabasca Falls/Meeting of the Waters
Bald Hills Lookout trail – to hitching rail
Cabin Lake fire road
Edith Cavell road – to hostel
Lorraine and Mona Lakes trail (to Evelyn Creek campground)
Marjorie and Caledonia Lake
Mina Lake loop
Moab Lake
Moose Lake trail
Palissades Lookout
Patricia Lake loop
Poboktan Creek
Pyramid-Bench loop
Shangri-La to Snowbowl only
Stutfield Creek (valley flats only)
Summit Lakes/Jacques Lake
Sunwapta Falls/Athabasca River
Valley of the Five Lakes/Wabasso Lakes
Whistlers campground loop

Kootenay National Park
Chickadee Valley (valley bottom only)
Dog Lake
Dolly Varden
East Kootenay
Hector Gorge
Simpson River (to KNP boundary)
West Kootenay

Yoho National Park
Chancellor Peak Campground
Emerald Lake designated nordic trails
Field to Emerald Lake nordic trail
Ice River fire road
Kicking Horse trail
Lake O'Hara circuit (avoid the north shorline)
Lake O'Hara road to EP hut
Morning Glory Lakes
Ross Lake circuit
Sherbrooke Lake (to lake only)
Wapta Falls
Yoho Valley road trackset

Glacier National Park
Beaver River
Rogers Pass ski hill (forest cuts behind hotel)
Wheeler Hut approach and vicinity

Mt. Revelstoke National Park
2km & 5km loop trails
Inspiration Woods
Lindmark trail to Parkway intersection
Meadows in the Sky Parkway
Summit Trail to 8 Mile Crossing

Waterton Lakes National Park
Akamina Pass
Akamina Pass to Forum Lake
Bear's Hump trail
Cameron Lake trail to lake only
Crandel Lake
Dipper
Wishbone

CHALLENGING – CLASS 2

Banff National Park
Boom Lake
Bow hut to Balfour hut via Nic/Olive col
Bow Summit area
Castlegard Mt.
Cirque Peak
Crowfoot Pass
Diablaret Glacier
Elk Lake Summit
Forty Mile Creek
Fossil Mountain loop
Gibbon Pass
Haiduk Lake via Shadow Lake
Healy Creek – SSV road to Healy Pass
Hidden Bowl region
Hilda Ridge
Katherine/Helen Lake circuit
Lake Louise resort backcountry accessed from ski area
Mt. Gordon (YNP)
Mt. Olive
Mt. Rhonda South
Mt. Thompson
Observation subpeaks
Paradise Valley
Parker Ridge
Peyto hut to Bow hut
Redearth Creek
Saskatchewan glacier
Skoki Mountain loop
Sunshine to Healy Creek
Sunshine Village backcountry accessed from ski area
West Nile

Jasper National Park
Amethyst Lakes/Moat Lake
Athabasca Glacier to first icefall
Bald Hills area
Fraser Glacier
Fryatt Creek
Little Shovel Pass
Maccarib Pass to Tonquin
Maligne Pass
Marmot Basin backcountry accessed from ski area
Shangri-La past Snowbowl
Skyline Trail
The Brazeau Icefield
Whistlers Creek
Wilcox Pass

Yoho National Park
Amiskwi Fire Road
Kiwetinok Pass
McArthur Pass
Odaray Plateau
Opabin Plateau
Ottertail Valley Fire Road
Glacier National Park
Avalanche Crest - to treeline
Cheops Glades
Flat Creek valley trail
Grizzly Shoulder
Hermit Meadows
McGill Shoulder
Sifton Col
The Hourglass

Mt. Revelstoke National Park
Balsam Lake to Eva & Miller Lakes
Balsam Lake to Mt Revelstoke Summit
Lindmark Trail above Parkway Intersection
Summit Trail above 8 Mile Crossing
Woolsey Creek Road

Waterton Lakes National Park
Akamina Pass to Wall Lake
Bertha Lake
Forum Ridge
Lakeshore
Summit Knob to Boundary Creek
Summit Knob to Cameron Lake
Summit Lake

COMPLEX – CLASS 3

Banff National Park
Balfour to Scott Duncan Huts
Ball Pass
Bath Glacier exit to Hwy 1
Bonnet Icefield
Bow Hut approach
Castle Mt. - to summit
Cirrus Mountain
Crowfoot Mt.
Dolomite Peak circuit
Drummond Icefield
Hector Lake Wapta access
Mike Wynn circuit
Mt. Baker
Mt. Balfour
Mt. Coleman
Mt. Fairview
Mt. Hector
Mt. Jimmy Junior
Mt. Jimmy Simpson
Mt. Mistaya
Mt. Niblock via Divide Creek
Mt. Patterson
Mt. Rhonda North
Mt. Wilson
Mystic Pass
Observation Peak (summit)
Oyster Lake
Packers Pass
Pat Sheehan Traverse
Peyto Glacier approach
Plain of Six Glaciers trail
Ptarmigan Peak
Pulpit Peak area
Pumpkin Traverse
Surprise Pass
White Pyramid

Jasper National Park
Athabasca Glacier past first icefall
Diadem Creek
Mt. Columbia
Mt. Kitchener
North Twin
Snow Dome
South Twin
Stutfield Peak

Kootenay National Park
Chickadee Valley - above valley bottom
Stanley Glacier Valley
Storm Mt.
Tokkum Creek

Yoho National Park
Emerald Pass
Emerald Peak/Slide Path
Isolated Col
Little Yoho Valley approach
Mt. Cathedral
Mt. Collie
Mt. Des Poilus
Mt. Field
Mt. McArthur
Opabin/ Wenkchemna circuit
Popes Peak
President Pass
Schaefer Basin
Scheisser/Lomas route
Sherbrook Lake Wapta access
Yoho Traverse

Glacier National Park
3 Pass Traverse
8812 Bowl
Asulkan Hut/Tree Triangle
Asulkan Pass
Asulkan Valley Practice Slopes
Avalanche Crest bowl/slidepath
Balu Pass
Bonney Glacier
Bruins Pass
Cougar Valley
Dome Glacier
Flat Creek slidepaths
Fortitude
Glacier Circle
Grizzly/Little Sifton Traverse
Illecillewaet Practice Slopes
Illecillewaet Neve access
Lily Glacier
Lizards Tail
Lookout Col
McGill Bowl - McGill Pass
Mt. Rogers
Mt. Swanzy
Mt. Tupper Traverse
NRC Gullies
Perley Rock
Sapphire Col
Smart Ridge
Steps of Paradise – Youngs Pk
Terminal Peak
The Cone
The Mouse Trap
The Ravens
Ursus Major
Ursus Trees
Vaux Moraines/Sir Donald/Uto Col
Vent Shaft slopes
Video Peak
Youngs Pk via Illecillewaet

Mt. Revelstoke National Park
Hamilton Creek Upper Meadows
Clachnacudain Creek
Clachnacudain Creek east fork
Saint Syr Creek
Coursier Creek
Woolsey Glacier- Coursier Peak
Clachnacudain Glacier-Inverness Peaks
Mount Klotz above treeline
West Woolsey Creek
Maunder Creek

Waterton Lakes National Park
Akamina Lake Chutes (The Fingers)
Alderson-Carthew
Lineham Lake
Rowe Bowl/Peak (CV 13)
Rowe Lake

FIG. 3: EXAMPLE OF SINGLE ATES RATINGS FOR AREAS LISTED IN A BROCHURE (PARKS CANADA, 2004).

AutoATES (Toft et al., 2024) is an emerging automated approach that enables efficient large-scale ATES mapping in a standardized manner. It uses GIS-based algorithms to identify potential avalanche release areas and calculate runout extent, then combines these results with forest cover data and slope angles derived from digital elevation data to determine ATES ratings for individual grid cells (i.e., pixels) in a raster surface. See John Sykes' article on page 31 for more on AutoATES.

Rating avalanche terrain using ATES can be straightforward for single routes with single ratings. For uncomplicated terrain with good data, such as a well-travelled trail with only a few avalanche paths or an alpine bowl with high-quality mapping and imagery, sufficient accuracy can often be achieved without field surveys or complex analyses. For more complicated projects such as large areas with extensive avalanche terrain, unfamiliar travel routes, significant overhead hazard, or a need for small-scale ATES zones, a more rigorous approach and level of effort are necessary. Typically, this uses some combination of GIS analysis, field investigations, aerial photographs, satellite image interpretation, climate analysis, and runout estimation. The level of effort put into ratings and review also depends on the objectives. For example, if the objective is a high-level trip-planning decision tool, then a desktop review for inconsistencies may be all that is necessary; however, if it will be used as a navigational aid, then thorough peer review and field-checking is probably warranted.

PARTING WORDS

Terrain rating systems play an essential risk management role in recreational outdoor activities such as climbing, hiking, kayaking, skiing, and biking. Industries where workers are exposed to avalanche risk also rely on terrain rating systems to enable occupational health and safety policies. Combined, these systems have helped millions of users plan and execute their activities by simplifying complex terrain attributes into easily understood categories that can be used to manage risk and improve their experience.

Backcountry avalanche risk is a complex interaction between snowpack, terrain, and people, where terrain is the only constant factor. It is often said: "When snow is the problem, terrain is the solution." For decades, professional guides have considered terrain assessment and route selection to be the principal mitigating factors in backcountry avalanche risk management—when nothing is exposed, nothing is at risk.

However, communicating to a lay person how to evaluate avalanche terrain and manage risk in the backcountry is challenging, as the subject is complex with many technical variables that are easily lost upon the target audience. The classic slope-angle-based terrain choice method (Landrø et

al., 2020), which has dominated avalanche decision-making strategies for decades, is limited in its scope. Its attraction is it is easy to understand, measurable, and accurate for human triggering inside avalanche starting zones. However, slope angle alone does not account for important factors such as propagation, overhead hazard, terrain traps, avalanche frequency, and the concept of exposure in general, which are the fundamentals of backcountry avalanche risk management. Including them in a simple, five-level terrain classification system that can be understood easily by the receiver is important in the same way that the danger scale helps people to categorize and understand the level of avalanche danger in a simple way.

Public avalanche bulletins warn about the current backcountry avalanche danger, but this is only part of the avalanche risk equation. Ultimately, people choose their own risk by making decisions about where, when, and how they travel. Even during periods of high danger, reducing exposure can lower or eliminate the risk. In small-scale terrain features, a few metres in either direction can be the difference between low- and high-risk situations. Thus, controlling terrain exposure is the most important avalanche risk management skill necessary for winter backcountry travel. The objective of ATES is to make that more explicit and easier to understand for backcountry users.

REFERENCES

Avalanche Canada, Trip Planner: https://avalanche.ca/planning/trip-planner, last access: 05 November 2024.

Delparte, D.: Avalanche Terrain Modeling in Glacier National Park, Canada. Ph. D. Thesis, University of Calgary, Calgary, AB, Canada. 195 pp, 2008.

Gavaldà, J., Moner, I., Bacardit, M.: Integrating the ATES into the avalanche information in Aran Valley (Central Pyrenees), in: Proceedings International Snow Science Workshop, Chamonix, France, 7-11 October 2013, 381-384, https://arc.lib.montana.edu/snow-science/item.php?id=1984 (last access: 21 April 2024), 2013.

Klassen, K.: Incorporating Terrain into Public Avalanche Information Products, in: Proceedings International Snow Science Workshop, Anchorage, AK, USA, September 16-21, 209-2013, https://arc.lib.montana.edu/snow-science/item.php?id=1582 (last access: 12 May 2024), 2012.

Landrø, M., Pfuhl, G., Engeset, R., Jackson, M., and Hetland, A.: Avalanche decision-making frameworks: Classification and description of underlying factors, Cold Reg. Sci. Technol., 169, 102903, https://doi.org/10.1016/j.coldregions.2019.102903, 2020.

Larsen, H. T., Hendrikx, J., Slåtten, M. S., Engeset, R. V.: Developing nationwide avalanche terrain maps for Norway. Natural Hazards (Dordrecht), 103(3), 2829–2847. https://doi.org/10.1007/s11069-020-04104-7, 2020.

Parks Canada: Avalanche Terrain Ratings for the Mountain National Parks. First edition. Parks Canada, Banff, Canada, ISBN 0-662-38737-6, 2004.

Parks Canada: Public information package for custodial groups planning winter backcountry travel, https://parks.canada.ca/pn-np/mtn/securiteenmontagne-mountainsafety/gardiens-custodial, last accessed 21 April 2024, 2005.

Scott, C and Klassen, M.: Alpine Ski Tours in the Canadian Rockies, 3rd ed. Rocky Mountain Books, Calgary, A.B., Canada, 344 pp, ISBN 978-1-926855-78-3, 2011.

Sharp, E., Campbell, C., Statham, G., Schroers, B.: A standardized multiscale, fuzzy GIS data model for ATES mapping. International Snow Science Workshop, Bend, USA, 2023.

Statham, G., and Campbell, C.: The Avalanche Terrain Exposure Scale (ATES) v.2, Nat. Hazards Earth Syst. Sci., 25, 1113–1137, https://doi.org/10.5194/nhess-25-1113-2025, 2025.

Toft, H. B., Sykes, J., Schauer, A., Hendrikx, J., and Hetland, A.: AutoATES v2.0: Automated Avalanche Terrain Exposure Scale mapping, Nat. Hazards Earth Syst. Sci., 24, 1779–1793, https://doi.org/10.5194/nhess-24-1779-2024, 2024.

Wogalter, M. S., DeJoy, D., and Laughery, K. R.: Organizing theoretical framework: a consolidated communication human information processing (C-HIP) model, in: Warnings and risk communication, CRC Press, 29–37, https://doi.org/10.1201/9780203983836, 1999.

Automated ATES Mapping
When Snowpack is the Question, Terrain is the Answer

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john_sykes@sfu.ca (research questions), ak.cryosphere@gmail.com (consulting questions)

AVALANCHE EDUCATION OFTEN presents terrain as a static factor that is used to manage safety margins during periods of unstable weather and snowpack conditions. While true, this characterization of terrain does not mean assessing avalanche terrain is a simple task. On the contrary, thoroughly assessing avalanche terrain goes way beyond slope incline—it requires evaluation of many contributing factors including slope shape, forest density, runout zones, and terrain traps.

The Avalanche Terrain Exposure Scale (ATES) was developed in the early 2000s to help simplify avalanche terrain assessment for a wide variety of recreational users. The original version was used to rate specific trails or routes and it gradually developed into a system used to create ATES zones that cover an entire basin or mountainside. Traditional ATES mapping is done by local experts who are familiar with the terrain and snowpack in an area. The process is time consuming and challenging to undertake even with a great deal of local familiarity.

Automated Avalanche Terrain Exposure Scale (AutoATES) mapping was initially developed in 2020 by Håvard Toft and colleagues to streamline the manual mapping process and make it possible to create nationwide ATES maps in Norway. Over the past five years, an international collaboration of researchers and practitioners have worked to improve the methods and test the performance of AutoATES against traditional manual ATES maps in Canada. The goal of AutoATES is to help simplify avalanche terrain assessment by providing an objective and consistent representation of avalanche terrain that can assist backcountry users in making informed avalanche risk management decisions.

The output of AutoATES includes three main map layers, which can serve as trip-planning resources for online and mobile mapping applications by illustrating potential start zones, runout zones, and ATES ratings. Each step in the AutoATES model can be tuned for local conditions by having local experts evaluate the output maps and tweaking model parameters. The goal of this article is to shed light on how automated ATES mapping works by answering the following questions:

1. What are the components of the AutoATES model and how do they work?
2. How does AutoATES compare to expert human ATES maps?
3. What are the common applications of AutoATES and what is required to apply it in new areas?

To answer all these questions in a short article I need to skip a lot of detailed information, but interested readers should check out Toft et al. (2024) and Sykes et at. (2024) for more detailed information.

INPUT DATA

Before I get into how AutoATES works, we need to briefly discuss the necessary input data to run AutoATES: a digital elevation model (DEM) and a forest density data set. Both these data sets need to be formatted as raster data, which means the area they cover is represented by pixels with a fixed size (typically 5–30 m^2), similar to the pixels of a digital photograph. In Canada, there are a variety of different DEM and forest data, which range in quality and spatial resolution. For context, the state-of-the-art avalanche terrain maps available in Switzerland (https://whiterisk.ch) are 5 m resolution. To get input data of this quality in Canada you

WHAT IS AUTOATES?

AutoATES mapping is an open-source (free) software tool that uses geographic information science (GIS) and remote-sensing methods to create avalanche terrain maps that can be produced at low cost and applied at the mountain range scale. To create AutoATES maps there are three basic steps:

1. Identify avalanche start zones.
2. Use the start zones to simulate avalanche runouts.
3. Classify the terrain into the ATES v2.0 system (0 - non-avalanche, 1 - simple, 2 - challenging, 3 - complex, 4 - extreme) based on the physical characteristics of the terrain.

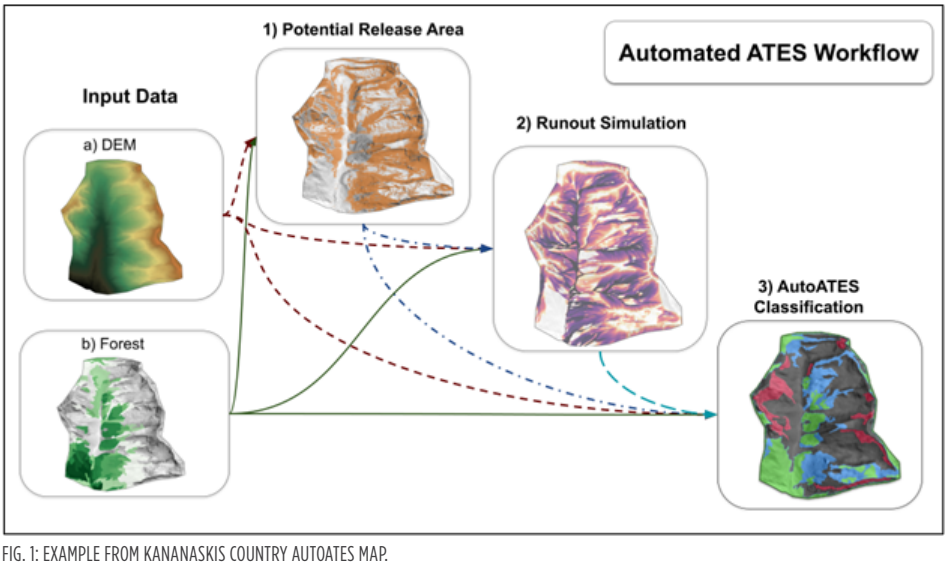

FIG. 1: EXAMPLE FROM KANANASKIS COUNTRY AUTOATES MAP.

typically need to buy it, which significantly increases the cost of creating AutoATES maps. However, 30 m resolution DEM and forest data is commonly available for free online. Despite the low resolution, I used this type of data to create AutoATES maps for Bow Summit in Banff National Park and Connaught Creek in Glacier National Park with good results (more details to follow).

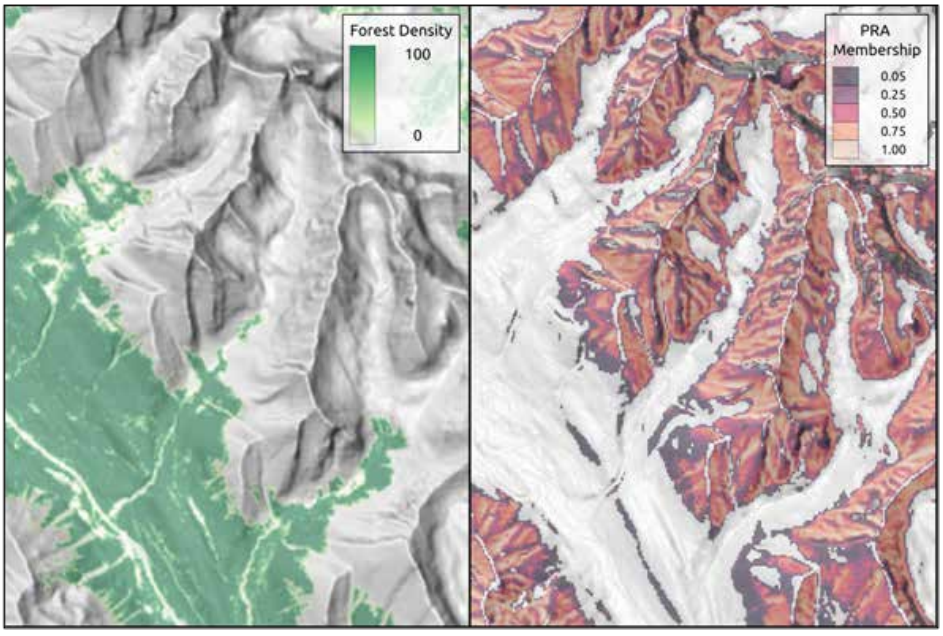

FIG. 2: EXAMPLES OF DEM AND FOREST INPUT DATA (LEFT) AND OUTPUT OF PRA MODEL (RIGHT) FROM KANANASKIS COUNTRY, AB.

STEP 1: PRA MODEL

The first step in the AutoATES model chain is to identify potential avalanche release areas (PRA) using DEM and forest data. The PRA model determines the likelihood of each pixel being a start zone (with a number ranging from 0 to 1) by considering the slope incline, terrain exposure to wind, and forest density. This is the first place where parameter tuning can help adapt AutoATES to local conditions. In areas with a more maritime snow climate, avalanches tend to start in steeper terrain because wetter snowfall and deeper snowpacks tend to stick to steeper slopes. Adjusting the slope angle parameter will shift the PRA model output to capture steeper or less steep start zones, depending on what is needed locally. Similarly, adjusting the forest density parameter will alter how much start zones are allowed to occur in forested areas depending on local forest characteristics. Working with local experts to validate the output of the PRA model is recommended before moving on to step two (runout simulation) because any errors in the PRA model will trickle down through the entire model chain.

STEP 2: RUNOUT MODEL

AutoATES uses a runout simulation tool called FlowPy (D'amboise et al., 2022) to capture the runout distance and potential size of avalanches. Defining the maximum alpha angle for the local area is required to run FlowPy, which determines how far avalanches will run relative to the location of their starting PRA pixel. For AutoATES, the default alpha angle value ranges from 18-25°, depending on whether or not the final AutoATES map will display the optional ATES Class 0 (non-avalanche terrain). Incorporating feedback from local avalanche experts is highly recommended for tuning the alpha angle parameter to capture historic runout patterns in the local area. The output of FlowPy provides layers that capture the alpha angle from the nearest start zone pixel as well as the potential size of avalanche that a start zone can produce. These runout simulations tend to be conservative (biased toward capturing low frequency avalanche paths) compared to other methods, but are intentionally tuned that way in order to avoid under-representing the overhead hazard potential in the final ATES map.

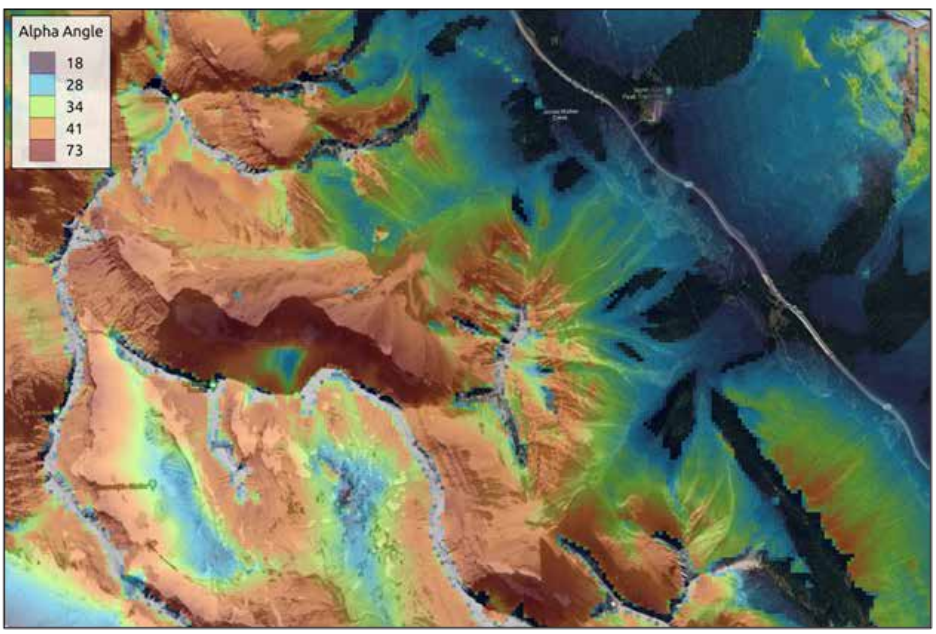

FIG. 3: EXAMPLE FLOWPY ALPHA ANGLE OUTPUT FROM KANANASKIS COUNTRY, AB.

STEP 3: ATES CLASSIFICATION

The final step in the AutoATES model chain is determining the ATES classification. Each pixel within the study area is classified using the ATES v2.0 scale (0—non-avalanche,

1—simple, 2—challenging, 3—complex, 4—extreme) based on the slope angle, forest density, runout alpha angle, runout potential avalanche size, and location of potential release areas. The ATES classification is determined by a set of input parameters that define the slope angle, alpha angle, overhead hazard, and forest density thresholds for each ATES class.

This is the final place where tuning parameters can be useful to customize AutoATES output for the local area. Consulting with local experts, or comparing AutoATES to existing manually generated ATES maps, if available, can be useful to fine-tune the output. To make the AutoATES output appear more similar to traditional manual ATES maps, there is also a parameter to remove small islands of pixels that do not match the surrounding ATES class. This is an optional feature that intentionally reduces the resolution and precision of AutoATES in the interest of a simpler and more streamlined final output.

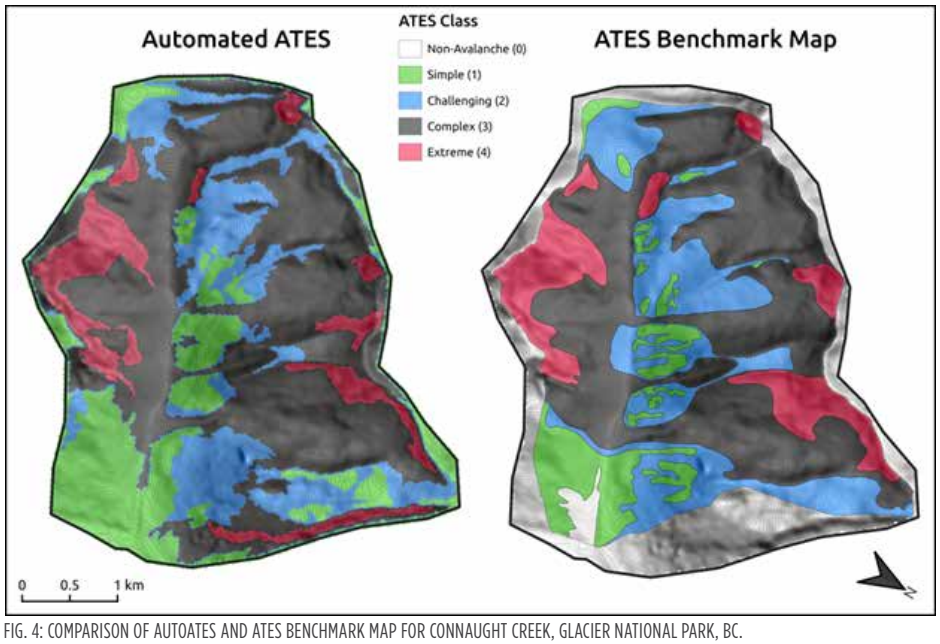

FIG. 4: COMPARISON OF AUTOATES AND ATES BENCHMARK MAP FOR CONNAUGHT CREEK, GLACIER NATIONAL PARK, BC.

HOW ACCURATE IS AUTOATES?

AutoATES works differently than traditional human-generated ATES maps, which makes true accuracy assessment difficult because comparing AutoATES to manual ATES is like comparing apples and oranges. The reason is that AutoATES classifies the terrain based on the physical characteristics of each pixel within the study area, which would be a highly inefficient method for human mappers to undertake due to the sheer number of calculations. Traditional ATES maps tend to group terrain features into polygons and then classify the entire polygon based on the general terrain characteristics. The manual approach leverages the strengths of avalanche experts by considering multiple spatial scales when drawing the polygons and creating their ratings, which would be difficult to replicate in an automated way. However, one disadvantage to the manual approach is that individual avalanche experts may draw polygons very differently from one another, leading to subjective differences in the final ATES map.

Despite the differences between automated and manual approaches, it is important to compare AutoATES to existing ATES maps to get a sense of the overall accuracy and help tune the parameters of the automated approach to best match existing maps. To achieve this, two sets of benchmark maps were created for Bow Summit and Connaught Creek by having three experts create independent maps and then collaborate to create a final consensus map. This approach limited individual subjectivity, which can have a strong influence on ATES mapping.

Compared to the ATES benchmark maps, AutoATES produced accurate ATES ratings in roughly 85% of the terrain in Bow Summit and 75 % of the terrain in Connaught Creek. Areas where AutoATES tended to not align well with the benchmark maps were:

- in forested runout zones, where runout distance is often overestimated by AutoATES;
- and in identifying the boundary between complex and challenging terrain in alpine areas, where AutoATES tends to rely heavily on slope incline and may underestimate the impacts of multiple overlapping avalanche paths.

Further improvements have been made to AutoATES since this comparison was carried out to try and address these limitations. Future research will aim to provide a larger comparison across multiple snow climates and mountain ranges.

HOW DO YOU APPLY AUTOATES TO A NEW AREA?

AutoATES is a free software that is available to anyone on GitHub (github.com/AutoATES/AutoATES-v2.0). However, applying AutoATES requires some technical expertise in GIS and basic skills in Python programming. Keen readers can try it out with the default parameters and see how the output looks for your local area. The quality of the output of any model is driven by the quality of the input, so I recommend spending some time looking for the best available DEM—especially forest data—for your study area before jumping in. Use the tips for working with local experts in the above sections to validate the AutoATES output and customize the model parameters for your local area.

Additional information on applying AutoATES is available in Toft et al. (2024) and Sykes et al. (2024). If your business is interested in trying AutoATES mapping but lacks the internal resources to create your own maps, reach out to ak.cryosphere@gmail.com for information about avalanche terrain modeling consulting services.

AUTOATES AS A TOOL FOR POST-WILDFIRE TERRAIN ASSESSMENT

One special application of AutoATES that could be particularly useful in Canada is the ability to rapidly assess wildfire impacts on avalanche terrain exposure (Miller et al., 2023). Forest characteristics play a large role in mitigating avalanche formation by anchoring the snowpack

and interrupting the radiation balance that can cause the formation of weak layers. AutoATES is capable of using satellite remote sensing data to characterize forest density pre- and post-wildfire to estimate the impacts on formation of new start zones and runout zones.

The satellite imagery used to create forest density data for AutoATES is captured globally every 5–10 days, which means a new forest density data set can be generated within weeks of a wildfire event depending on time of season and visibility conditions. This information can be useful for operations to rapidly evaluate the extent of changes to forest cover and avalanche terrain within their area.

CONCLUSION

AutoATES is an avalanche terrain evaluation tool that aims to produce accurate and consistent maps that can assist backcountry recreationists in making informed risk management decisions. Compared to manual ATES methods, AutoATES is capable of producing maps for much larger areas at a lower cost while also being customizable for regional snowpack and forest characteristics. As with any model, it will never be perfectly accurate, but the development team aims to continually improve AutoATES to better capture the nature of avalanche terrain and represent the ATES v2.0 scale as precisely as possible.

After receiving feedback from test sites in western North America, Austria, and Norway, AutoATES has demonstrated that it can produce valuable trip planning resources, especially when tuned in collaboration with local avalanche experts. Please reach out if you have questions or feedback on AutoATES or want to contribute to future developments of the open source model.

REFERENCES

D'amboise, C., Neuhauser, M., Teich, M., Huber, A., Kofler, A., Perzl, F., Fromm, R., Kleemayr, K., & Fischer, J.-T. (2022). Flow-Py v1.0: A customizable, open-source simulation tool to estimate runout and intensity of gravitational mass flows. Geosci. Model Dev, 15, 2423–2439. https://doi.org/10.5194/gmd-15-2423-2022

Miller, Z., Sykes, J., Guinn, M., VandenBos, B., Savage, S., & Peitzsch, E. (2023). Spatial extent of forested avalanche terrain impacted by wildfire across the Sawtooth National Forest. International Snow Science Workshop Proceedings 2023, Bend, Oregon, 272–279.

Statham, G. and Campbell, C.: The Avalanche Terrain Exposure Scale (ATES) v.2, Nat. Hazards Earth Syst. Sci., 25, 1113–1137, https://doi.org/10.5194/nhess-25-1113-2025, 2025

Sykes, J., Toft, H., Haegeli, P., and Statham, G.: Automated Avalanche Terrain Exposure Scale (ATES) mapping – local validation and optimization in western Canada, Nat. Hazards Earth Syst. Sci., 24, 947–971, https://doi.org/10.5194/nhess-24-947-2024, 2024

Toft, H. B., Sykes, J., Schauer, A., Hendrikx, J., and Hetland, A.: AutoATES v2.0: Automated Avalanche Terrain Exposure Scale mapping, Nat. Hazards Earth Syst. Sci., 24, 1779–1793, https://doi.org/10.5194/nhess-24-1779-2024, 2024

Mapping Avalanche Terrain: **A New Era for ATES**

Kristin Anthony-Malone, Project Manager, and Pascal Haegeli, Director, Simon Fraser University Avalanche Research Program

WE HAVE A NEW AND EXCITING project that aims to map large areas of mountainous terrain across Canada using the updated Avalanche Terrain Exposure Scale (ATES). The goal is to give backcountry users better tools to make informed decisions by providing broad, consistent terrain ratings.

To do this efficiently, we're building on AutoATES. Our first objective is to refine the algorithm and test it locally to make sure it works well across a wide range of Canadian mountain environments.

The project also tackles how this information is shared. We're building the infrastructure that Avalanche Canada needs to host and distribute ATES map layers. These maps will be made available to the public and shared with mapping platforms. Avalanche Canada's Avaluator trip planner will also be updated to incorporate the new terrain maps.

Another part of the project is understanding how backcountry users use and interpret this type of terrain information. We'll be running user studies to look at how Canadian users interact with ATES maps and similar tools from Switzerland. The findings will help us present the information in ways that are intuitive and useful for people with different levels of experience.

This project is a partnership between Simon Fraser University, led by Pascal Haegeli, and Avalanche Canada. Pascal is overseeing the research and development work, and Avalanche Canada will ensure the results are integrated into national avalanche safety tools and resources.

In the long run, this project will help establish Avalanche Canada as the go-to source for avalanche terrain information in Canada. It also supports the next generation of avalanche safety researchers and paves the way for future tools that combine terrain and hazard information in ways that work for real people in real terrain.

Automated ATES **Risk Communication in K-Country**

Mike Koppang

A GOAL OF THE FORECASTING PROGRAM in Kananaskis has been trying to find different ways to innovate our risk management communication to the public in terms of avalanche danger and terrain management. The avalanche forecast has always been the foundation of this communication piece, but we have also seen advances in how we forecast and communicate following the development of the Conceptual Model of Avalanche Hazard, iconography within the bulletin, and the use of social media and video content.

Of course, trying to summarize avalanche danger into a single webpage or two-minute video is a tricky problem. Not only are we talking about problems that have high levels of uncertainty and trying to condense these issues into a more understandable, shortened format, but we are also doing this for users who range from first-timers to seasoned professionals.

Kananaskis, like all areas these days, has a very diverse user group that comes out to experience the terrain in winter. Backcountry skiers are the largest users in the region, but ice climbers, snowshoers and hikers are also some of the many recreating in avalanche terrain. Skiing around during the past 20-or-so winters of working here, I have had the opportunity to interact with lots of people and have seen firsthand the different levels of avalanche awareness amongst the different groups. While avalanche awareness is increasing and people are better prepared than they were in the early 2000s, we still interact with many recreationists who are unaware they are in avalanche terrain.

ADOPTING ATES

The development of the Avalanche Terrain Exposure Scale following the challenging winter of 2003 was a great step forward in terms of how terrain (or, more importantly, the severity of terrain) could better relate to the avalanche bulletin. Common ski tours and popular ice climbs within our region were evaluated by forecasters and placed in one of the three terrain classifications: simple, challenging, or complex. This information was then compiled into a list and shared on our website along with the avalanche bulletin. The intention was that while planning a trip, you would consult the list to see if your trip was on there, evaluate the terrain classification you would be entering, read the bulletin, and then make an informed decision regarding the terrain and the avalanche danger.

While we knew this was an advancement in incorporating terrain into avalanche risk communication, there was a visual piece missing. I can think back to early emails between a few of us regarding potential mapping ideas and options to communicate this information in a topographical format in addition to the list. Fast forward several years to either an ISSW or a CAA Spring Conference, and I found myself fortunate enough to be discussing a presentation on automated ATES mapping that I had seen with Dr. Pascal Haegeli. We casually discussed the idea of a publicly available map to go alongside the avalanche bulletin and how interesting that would be to try.

One thing led to another and a few emails and introductions later, I found myself talking with John Sykes from Simon Fraser University about the idea of an automatically generated ATES map overlay of the Kananaskis region to be shared publicly. John had the technical knowledge and we had the regional knowledge, as well as the website development team and users. We came up with a plan to try to develop this tool over a few months/winters for use in Kananaskis.

CREATING THE MAP

Our plan started with a polygon of the forecast region and efforts to collect vegetation overlays, detailed topographical overlays, and other geographical references that would assist in the map's creation. John then inputted the data, applied his expertise and knowledge, and ran the model to produce an output for the region. Once the initial model or overlay was completed, we began to evaluate and examine the terrain on a more valley-to-valley scale.

One consistent error we noted was overestimation of runout zones around lakes or gravel flats. The model tended to include the entire lake or gravel bed as part of the runout due to a small interaction of avalanche terrain within a select area. Fortunately for us in our region, we were able to work closely with a GIS specialist who was able to edit some of these polygons to reflect the terrain more reliably. While this was a time-consuming part of the project that took several weeks, it enhanced the map's accuracy.

The other question was, how often do you update the map? Foreseeably after any large change such as a fire or logging, the map would have to be reevaluated to reflect changes to avalanche potential in the terrain. So far, there has been no significant changes in the region that would affect the overlay, but we are keeping it in mind in the event

of a major change caused by a wildfire, large avalanche cycle, or human-made influences from forestry practices or even fire smart efforts. Should any of these happen, the map would need to be updated to reflect these changes.

HOW IT WORKS

Following the review of accuracy, web layout was addressed. The website went through numerous development phases and beta testing until we came to a platform that we liked.

One of the biggest challenges we faced was educating users on map accuracy. While we were able to ground-truth and evaluate some popular areas, it was next-to-impossible to evaluate the entire region. Our approach was to educate people about potential inaccuracies based on the computer-generated nature of the map and outline the maps intended use for high-level trip-planning only. This has been done through a click-past disclaimer that all users must first agree to before accessing the map. Once into the page, a brief background of ATES is presented and then both the technical models and the public risk communication models are displayed as reference for map users.

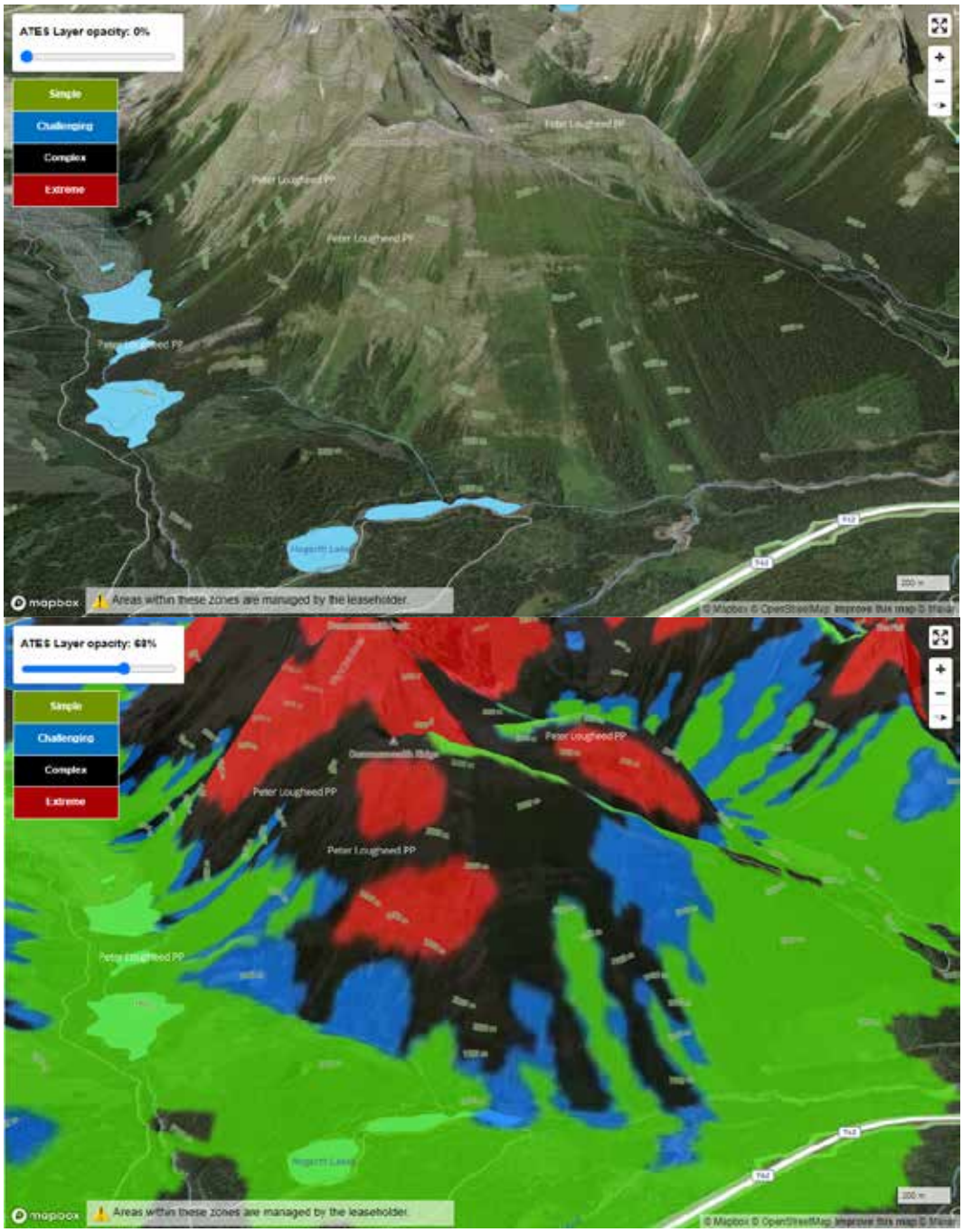

FIG. 1. SAME AREA SHOWN WITH DIFFERENT OPACITY SETTINGS.

The map base is a satellite image overlayed with topographical reference. This was the first time a 3D rendering of the Kananaskis region was presented on our website and as such, we needed to be able to provide the user a "how-to" for interacting with this feature. We also gave the user the ability to control the opacity of the ATES overlay so they could better interact with the 3D satellite imagery below. Contour lines were also added onto the satellite overlay to allow users to evaluate elevation with regards to trip-planning.

FIG. 2. ROBERTSON GLACIER/BURSTALL PASS REGIONS.

A critical part of making these changes was having staff who are tech-savvy with regards to website creation. Additional layers such as ice climbs, popular ski touring objectives, and common waypoints could be added in future iterations to better help users relate the terrain to their given objective.

USER SURVEY

Moving from a list of ski tours and climbs to an interactive map seemed like a significant step forward, but there were many questions about how best to present this new product to the public. In addition to deciding on the layout and user interface, we were also curious about who was using this map and how they were using it in terms of trip-planning. As such, a survey was developed to allow us to better understand the strengths and weaknesses of the map and how we could continue to improve it moving into the future. This survey was released in late-winter 2024 and as such, only some preliminary data was collected. We continued with the survey over the 2024-25 season to get more users contributing and have higher-quality data at the conclusion. Some of the important questions we are evaluating include:

- Who uses the map?
- Is the map in its current iteration easy to understand?
- What future changes are of interest?

We have learned a few things from users since the map has been released. One common piece of feedback is the use of the colour black for complex terrain. Complex terrain in this part of the world is usually rock faces that are already dark in colour and a black overlay on a grey rockface is potentially confusing. Varying the opacity slider helps make these areas more obvious but finding a default setting for the slider to be at when the end user arrives at the website is important to consider. Or, maybe black isn't the best colour to use in these applications? Another takeaway has been people must know the location of their trip on the map to be able to evaluate it. While trailheads and peak names are included, specific terrain features or ice climbs are not listed.

Anyone interested in participation in the survey can find it easily on the webpage at www.albertaparks.ca/ATES. We will begin to collect and evaluate this data in the fall of 2025 and hope to share the surveys contents either in Penticton or ISSW in 2026.

CONCLUSION

Overall, it feels like a significant advancement moving from a list that qualified Robertson Glacier as complex, with that being the only information regarding the trip, to an interactive map that shows the same trip to Robertson Glacier passes through simple, challenging, and complex terrain and is also affected by extreme areas (Fig. 2). The hope is that if people are planning to recreate in this terrain in the winter (especially users new to the area), they would open the map to get that big picture look at what type of terrain they would be in. Combining this information with the bulletin will hopefully enhance decision-making.

in the loupe

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CAUTION: AVALANCHE FORECAST MAY CONTAIN UNCERTAINTY

// MATT MACDONALD

Caution: Avalanche Forecast May Contain Uncertainty

A Study of Users' Awareness and Response to Uncertainty Information in Public Avalanche Forecasts

Eeva Latosuo & Pascal Haegeli

UNCERTAINTY IS AN INHERENT part of avalanche risk management. Can you remember a single day without experiencing any uncertainty when planning for or travelling in the backcountry? Without any uncertainty, there would be no risk to manage. In addition, every day is different. On some days, there are only a few unknowns, and on others, the whole day is stacked with more questions than answers.

Even though assessing avalanche conditions is a public avalanche forecaster's full-time job, they do not always know what is going on. They may not know what is happening in every part of their forecast region, or the exact timing of an incoming storm. However, there is no consistent way in which uncertainty is communicated in avalanche forecasts.

Some forecast centres do talk about uncertainty. For example, Avalanche Canada uses confidence statements at the end of their forecasts that give a general perspective to the unknowns of the day without providing the reader much tangible advice.

U.S. avalanche centres do not have a specific placeholder for discussing uncertainty, but forecasts sometimes talk about this conundrum. Last March, a forecaster wrote in the bottom line: "The new snow may be sensitive. On the other hand, it may be stable." This is a lot of words for simply saying, "Sorry, I don't know." It seems we want to communicate about uncertainty since it is a critical component of our assessments, but we do not know how to do it well. So, how can we do this more meaningfully in public forecasts?

To address this challenge, we have embarked on a multi-year research project that aims to develop and evaluate useful and feasible ways to communicate the extent and characteristics of uncertainty in public avalanche forecasts. This is a collaboration between the Colorado Avalanche Information Center, Avalanche Canada, the National Center for Atmospheric Research, and Simon Fraser University. We will combine three meaningful perspectives:

- We want to learn from best practices in related fields such as meteorology.
- We want to hear from forecasters about how they conceptualize uncertainty and what they think is feasible to communicate.
- We want to learn from users what they think is actually helpful for their decision-making process under uncertainty.

In this article we are sharing the initial results of what we learned from avalanche forecast users in an online survey.

UNCERTAINTY IN AVALANCHE FORECASTS

Let's first look at a general framework for uncertainty in avalanche forecasts. One source for unknowns is natural variability, or **inherent randomness** in the natural processes that lead to avalanches. The technical term for this is aleatoric uncertainty. A coin toss and the roll of a dice are good examples of this. Even though the process is quite simple, we cannot confidently predict the outcome due to factors that cannot be controlled. An important quality of this type of uncertainty is it is impossible to reduce it no matter how hard we try to understand what is going on.

Another source of uncertainty is **system complexity**. Complex systems have so many interactions and feedback loops at different scales that it is difficult to understand them in their entirety and hence make accurate predictions. This is called epistemic or knowledge uncertainty. A good example of this is weather, which is difficult to predict accurately even if the current models have reduced uncertainties through increased knowledge and innovative research.

The third type of uncertainty we consider is **ambiguity**, which is a property of the information we have about a system that allows for multiple interpretations. It often arises from vague definitions, incomplete observations, or conflicting evidence, where many interpretations seem reasonable given the available information.

We can apply these concepts to the production of avalanche forecasts (Fig. 1). We have an avalanche phenomenon that we are trying to capture with observations and models. This information is then interpreted by forecasters who describe their assessments in the forecast. Each step introduces new sources of uncertainty that ultimately affect the decision-makers who use the information to decide when and where to travel in the backcountry..

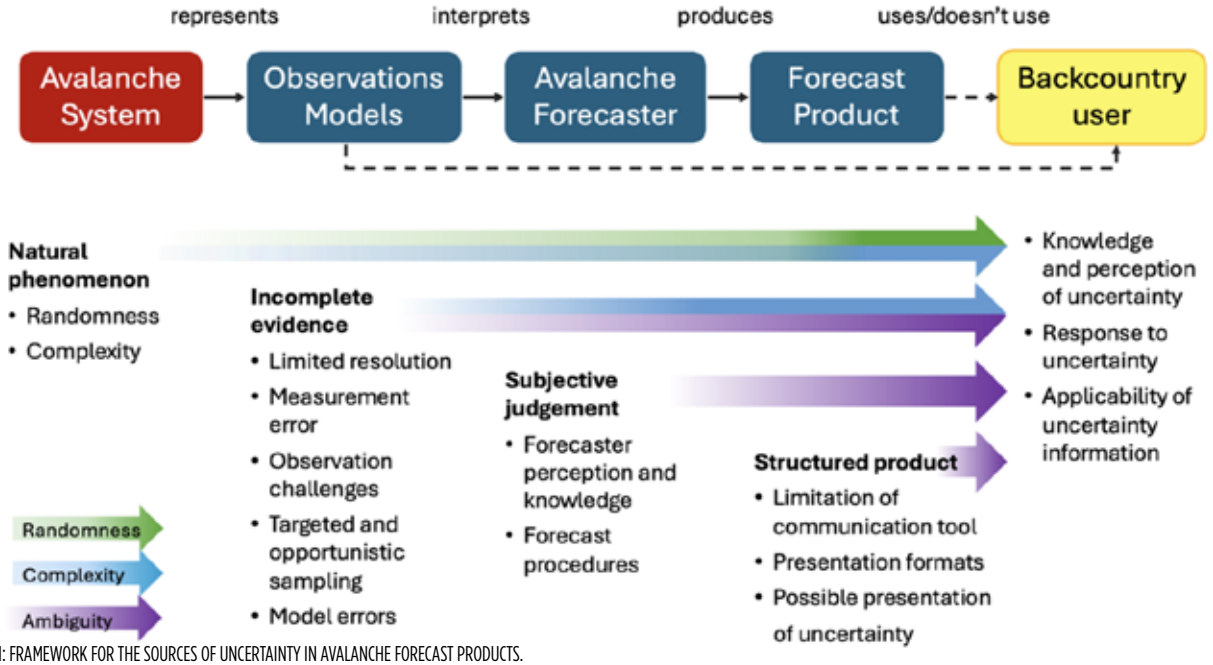

FIG. 1: FRAMEWORK FOR THE SOURCES OF UNCERTAINTY IN AVALANCHE FORECAST PRODUCTS.

The inherent randomness and complexity of the avalanche system results in spatial and temporal variability that makes predicting individual avalanches with certainty almost impossible. We gather observations and use computer models to try to capture what is going on, but they provide incomplete evidence and have their own challenges that introduce additional uncertainties. The interpretation of these data by forecasters are subjective judgments that are affected by their personal perceptions, knowledge, and biases, but also by forecast procedures such as the time a forecast must be published.

Finally, the structure and limitations of the forecasts themselves introduce additional uncertainty, including ambiguous or complex language. There are limits to what we can say with the text fields and graphics we currently have available.

In the end, the decision-maker must deal with these uncertainties and combine them with their own knowledge and perception of uncertainty to come up with informed decisions about when and where to travel in the backcountry. It is surprising that despite its prevalence, we do not talk about uncertainty more explicitly in the forecast itself, nor in avalanche safety courses.

SURVEY DESIGN

To gain first insights from forecast users, we conducted a detailed online survey in collaboration with the Colorado Avalanche Information Center in the winter of 2023-24. The goals were to learn more about how users perceive uncertainty in the forecast, how much they know about it, and how they would respond to explicit uncertainty information. Our survey included several components, but its core consisted of hypothetical (but realistic) avalanche forecast scenarios. Each participant was presented first with one baseline forecast without any explicit uncertainty information. To examine how they responded to uncertainty information, we modified these baseline forecasts by adding information about sources of uncertainty in the forecast discussion. The added information related to the timing of the hazard, the location of the avalanche problem in the terrain, and information about the quality of observations the forecast was based on. For example, we added sentences about high uncertainty around timing and location, and low uncertainty with respect to observations.

Forecasts could be modified by:

- adding more synthesized information about uncertainty to the bottom line;
- adding a statement about the overall magnitude of uncertainty based on the information that was provided in the discussion (e.g., "We have a very low amount of uncertainty (Level 1 of 5) in the forecast today."); and
- adding travel and terrain advice that explicitly talked about how to deal with the uncertainty (e.g., "Conditions will be more manageable if you start and end your day early.").

In total, we had 60 modified forecasts with different combinations of factors and levels of uncertainty. Each participant was presented with one baseline and three modified forecasts. For each, we asked:

- How much uncertainty do you think the forecaster faced when producing this forecast? (0-100 rating)
- Would you consider travelling in the backcountry under these conditions? (Yes/No)
- How useful was the presented avalanche forecast for your decision? (0-100 rating)
- How difficult did you find it to understand the forecast? (0-100 rating)

- How would uncertainty information like this impact your trust in the avalanche centre as a source of reliable avalanche safety information? (Seven-step Likert scale from "much decreased trust" to "much increased trust.")

The scenarios were designed to allow us to isolate the effect of each of the modifications on the answers of our participants.

In total, 1,313 participants completed all the relevant questions. Our sample was fairly experienced and committed to their winter backcountry activities. 75% were male, and the majority was 25–44-year-old. They were mostly university educated, and the majority had introductory level avalanche training.

USER RESPONSES TO UNCERTAINTY INFORMATION

Let's look at the main results. First, participants' estimate of uncertainty increased substantially between the baseline forecasts and the modified forecasts. This means simply talking about uncertainty made people more aware of this quality of the avalanche hazard environment. Participants' responses indicated they were most responsive to differences in the uncertainty related to observations. Their answers also showed they had some awareness that persistent avalanche problems have inherently more uncertainty than storm and wind slabs, but they were not aware wet slab avalanche problems are also very difficult to forecast. They also responded to uncertainty in location and timing, but only about half as much as the other factors.

In forecasts where we explicitly told them how uncertain the situation is using an explicit statement about the magnitude of the uncertainty; participants had a much better perception about the accumulation of overall uncertainty (Fig. 3). Without the magnitude statement, uncertainty estimates rose with the presence of zero to two uncertainty sources at level High, but levelled out with more sources (Fig. 3: blue box plots). However, they continued to increase linearly with cumulative number of sources when the statement was present (Fig. 3: red box plots).

We also learned participants' higher levels of perceived/estimated uncertainty are associated with more conservative choices about entering avalanche terrain. This shows including uncertainty information impacts their actions in the right direction. Their responses showed they have some awareness conditions with higher levels of uncertainty require a wider margin of safety.

However, increased estimated uncertainty was also associated with lower ratings of usefulness of the forecast for personal decision-making. While initially a disappointing finding, it makes sense. Increased uncertainty makes decision-making about where and when to go in the backcountry harder, and if one had the choice between a product with more or less uncertainty, we would all choose the more certain product. But we do not have this choice in avalanche forecasts. There is generally only one product, and sometimes there is just a lot of uncertainty. Hence, this result seems less related to the shortcoming of the forecast, and more related to the challenge of how we make decisions with more unknowns.

On the other hand, adding uncertainty information did not make the forecast text more difficult to understand; but participants did not think it was useful. Our interpretation of this juxtaposition is users will need support and guidance on how to meaningfully integrate uncertainty into their decision-making process. Avalanche warning services and avalanche education providers are in key positions to establish

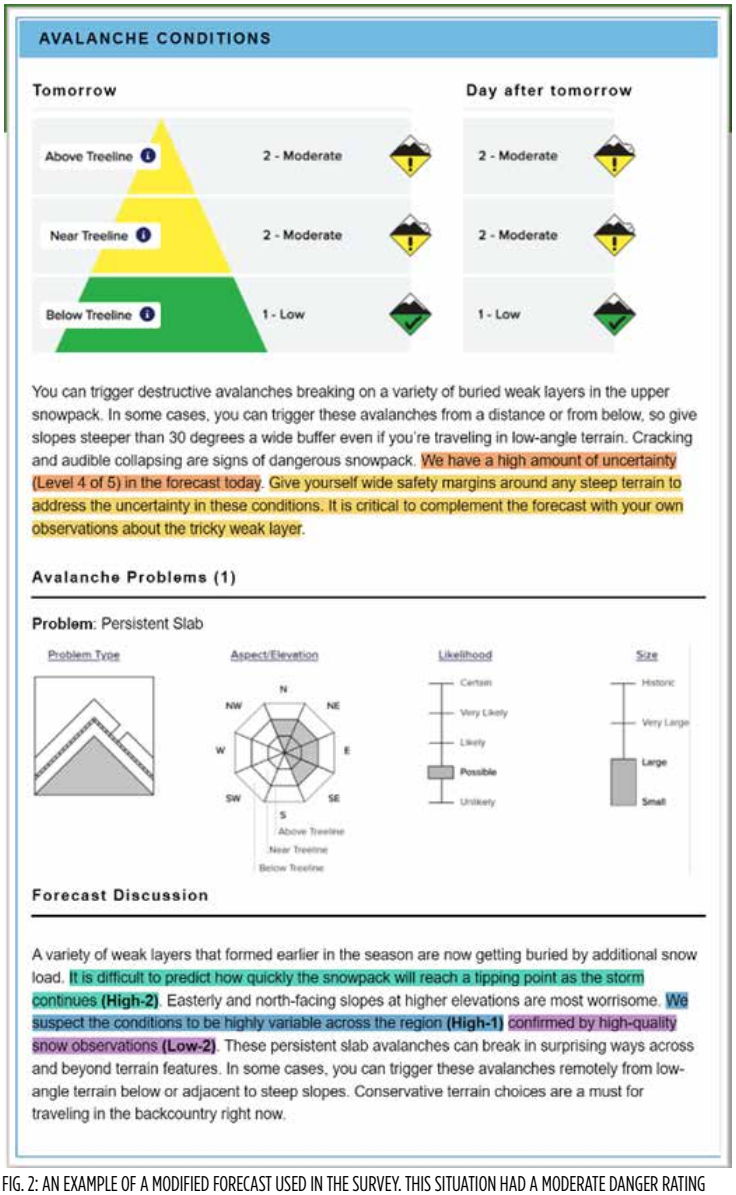

FIG. 2: AN EXAMPLE OF A MODIFIED FORECAST USED IN THE SURVEY. THIS SITUATION HAD A MODERATE DANGER RATING WITH PERSISTENT SLAB AVALANCHE PROBLEM. COLOURED TEXT SEGMENTS SHOW HOW WE EMBEDDED THE EXPLICIT UNCERTAINTY STATEMENTS. THIS EXAMPLE INCLUDED AN OVERALL MAGNITUDE STATEMENT (ORANGE), TRAVEL GUIDANCE (YELLOW), HIGH UNCERTAINTY ABOUT TIMING (GREEN), HIGH UNCERTAINTY ABOUT SPATIAL DISTRIBUTION (BLUE), AND LOW UNCERTAINTY ABOUT THE OBSERVATIONS (PURPLE). HIGHLIGHTS AND VALUE CODES ARE JUST SHOWN TO SPOTLIGHT ADDED STATEMENTS. THEY WERE NOT SHOWN TO PARTICIPANTS.

a common vocabulary for communicating uncertainty and to share practical suggestions for how to deal with it in the field. So far, we have not explicitly tested how to effectively teach forecast users about uncertainty, but possible opportunities for avalanche educators include:

- teaching consistent terminology and descriptors for uncertainty;
- discussing openly the inherent uncertainties due to data limitations and variability;
- teaching about the steps of the forecasting process that introduce uncertainty to the forecast;
- encouraging students to explore various outcomes based on changing forecasts or conditions through "what if" exercises; and
- addressing cognitive biases and their role in perception of uncertainties, and designing self-assessment exercises that increase the awareness of uncertainty.

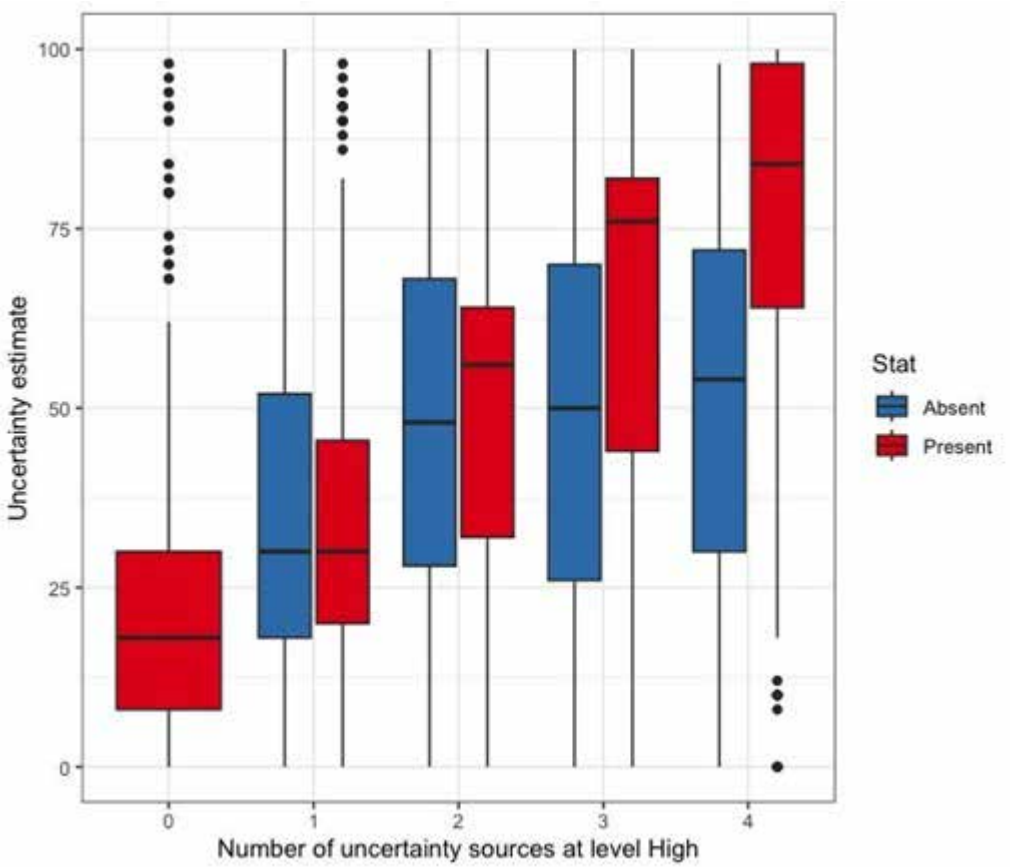

FIG. 3: PARTICIPANTS' UNCERTAINTY ESTIMATES AS A FUNCTION OF THE NUMBER OF UNCERTAINTY SOURCES AT HIGH AND THE UNCERTAINTY MAGNITUDE STATEMENT BEING ABSENT (BLUE) OR PRESENT (RED). HAVING THE UNCERTAINTY MAGNITUDE STATEMENT IMPROVED PARTICIPANTS' UNDERSTANDING THAT UNCERTAINTIES FROM DIFFERENT SOURCES ADD UP.

Finally, adding uncertainty information increased our participants' trust in the avalanche centre as a reliable source of information. 70% of participants would trust the warning service more if it included uncertainty information in their forecasts like the survey scenarios. Trust in the avalanche centre would decrease for only 5% of the participants. This was one of the strongest results we had in our survey.

CONCLUSION

In summary, there are two clear takeaways from our user research so far:

- Including uncertainty information in the public avalanche forecasts has clear benefits with no real downsides.
- Just adding uncertainty information is not enough—guidance on using that information effectively is crucial.

The perspective of users is just one piece of the puzzle. To take this further, we interviewed public avalanche forecasters at the Colorado Avalanche Information Center and Avalanche Canada last winter to better understand how they conceptualize uncertainty and how we could make the assessment of uncertainty more systematic and transparent. This is all setting a stage for next season, when we want to design prototype products to communicate uncertainty in avalanche forecasts more effectively. We will do this in collaboration with both forecasters and forecast users to ensure the approach is both feasible and useful. Our goal is to offer recommendations about how to communicate uncertainty to different types of users since a single product might not work for everybody in the diverse group of people using public avalanche forecasts.

Stay tuned for more insights. While uncertainty is unavoidable in avalanche forecasting, confusion about how to communicate about it doesn't have to be.

ACKNOWLEDGMENTS

We are grateful to the Coast Salish peoples on whose traditional and unceded territories Simon Fraser University and our research program resides. We thank the participants of the survey for their contributions to this research and Colorado Avalanche Information Center staff for the fundamental help with the outreach effort and the design of the forecast scenarios. Simon Trautman supported the outreach with the U.S. National Avalanche Center. Funding for the research was provided by the Colorado Avalanche Information Center.

snow globe

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A TRIBUTE TO BRENT STRAND

in this **section**

// AL SAFRATA

Interview: **Everett Clausen on the History of CIL and the CAA**

Alex Cooper

ON CHRISTMAS DAY 1996, a young ski patroller at Big Sky, Montana, lost her life following an explosives accident while conducting avalanche control. The tragedy had repercussions across the North American avalanche world when explosives companies refused to supply industry in the aftermath. In Canada, the situation was looking dire when CIL Explosives stepped in to fill the void.

Last year, Everett Clausen, the owner of CIL, sold the company to Austin Powder, marking the end of a nearly 30-year-long relationship with the avalanche industry. CIL Avalanche Control continues to serve the industry as a division of Austin Powder, led by Braden Schmidt, but Everett is now retired. We spoke to him a few weeks before the Spring Conference about his long relationship with the Canadian avalanche industry. This is an edited transcript of this interview. A video recording will be available on avalanchejournal.ca.

Alex Cooper: Maybe we can just start with a bit of background on your own history in explosives and CIL's background.

EVERETT CLAUSEN (LEFT) WITH HIS BUSINESS PARTNER ANDRE GAGNON. // PHOTO CONTRIBUTED

Everett Clausen: CIL is a company that's been around for 150 years. It was always in the general explosives business. I joined them after I graduated from university and worked in their ammunition and explosives division. Then, at some point, myself and Andre Gagnon purchased what I will call the pyrotechnics part of that division.

One of the first things that happened was that in the U.S., there was a very unfortunate and terrible accident where two avalanche practitioners made an error using a primed explosive and held on to it too long. One of them was killed and I think the other was seriously injured.

Following that accident, the manufacturers of the explosives, who at that time was Ensign-Bickford, paid out a $4 million court challenge and decided they would never again sell explosives to the avalanche business. That made it very difficult, particularly in Canada, where there was so much avalanche work being done in B.C. and Alberta in road clearing and wintertime travel.

The Canadian government, through the explosives division, contacted me to see if we would have any interest in supplying. We did a very in-depth survey of Canadian operations. We were satisfied the folks who were using the explosives were doing so in a safe manner, and also that B.C. had a very good training program, so we decided, yes, we would get involved. That's what led to years and years of very successful cooperation and client-supplier relationships.

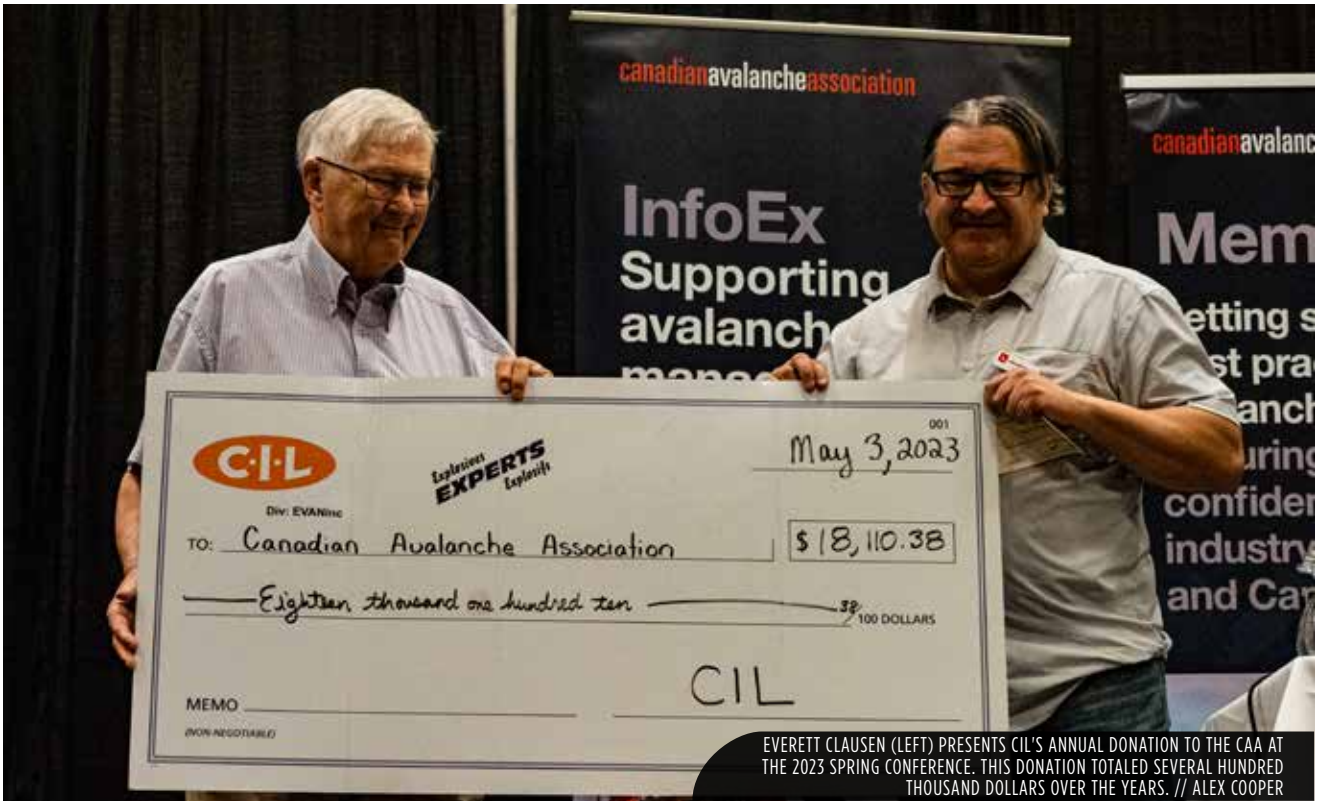
What were your products or specialties before getting involved in the avalanche industry?

Before that, we were primarily involved in pyrotechnic flares—that would be marine flares, the flares that you see carried on boats in case there's an emergency. These would be parachute flares, handheld flares, orange floating smoke, things of that nature.

We also did do quite a bit of supplying general contractors, such as beaver dam people who were using explosives to open up rivers. We supplied them with the detonating cord and some nitroglycerine-type explosives.

What did you know about the avalanche industry when you were approached to start supplying it?

Very little at that time. It was a steep learning curve for us as we looked into how well people were trained, the incidents that had been recorded. Talking to different potential users



EVERETT CLAUSEN (LEFT) PRESENTS CIL'S ANNUAL DONATION TO THE CAA AT THE 2023 SPRING CONFERENCE. THIS DONATION TOTALED SEVERAL HUNDRED THOUSAND DOLLARS OVER THE YEARS. // ALEX COOPER

and finding out that certainly in Canada, the people were well trained and well versed in the use of those explosives. It was a fairly easy decision for us to agree to develop the products needed and be the sole supplier.

What did you have to do as a company to begin supplying the explosives and fuses?
What we did do initially is deepen our relationship with a large explosives company in the U.S., that's Austin Powder, who had plants in central U.S, South America, and Europe. We developed with them the necessary explosives to be used in general avalanche use. At the same time, we deepened our relationship with a company called Omni out of Arkansas, who were assembling fuses. What we did then was to search out the best supply of fuses and the best supply of blasting caps that we could find. They came out of Bolivia.

Omni has an assembly plant in Crawfordsville, Arizona. They supplied us with the product we called Mildets, because the fuse actually was a military-type fuse, a green fuse—high quality—that passed all the military specifications that were set out and has proven to be a highly successful and a very reliable product.

So, you basically had to put these together and then create the explosives they would throw out of helicopters or chuck while on a ski patrol control route?
That's right.

What were some of the major challenges you faced in those early years?
Well, I wouldn't call it a challenge, but one of the things we had to do was to make sure all of our products had been tested and authorized by the Canadian government. Then, when we looked at people in the U.S. wanting to do it, we had to do the same thing down there. Go to the department of transport, make sure it had an EX number, make sure it had been all tested. Those things are not difficult, but they keep you busy. Once that was all approved, the customers really came to us. We had very little selling to do.

How long did you have to get all this going? I understand it must have been a fairly quick transition because of all the uncertainty.
Yes, it was probably no more than a couple of months.

Wow.
Which is really fast for developing that kind of business.

That seems like something like that should take a few years normally. Was there pressure or support from the government to get this going because of the importance of doing this work?

Oh yeah, no question. They were the ones that were really pushing it because you can imagine, winter comes and there's no way to clear the roads in B.C. and Alberta. That was a real worry for them, so they worked very hard with us to get everything done properly and quickly.

What was your relationship like with the CAA at this time?
At that time, we got involved because the people who had helped us a lot from the practitioners' point of view were members of the CAA, so they brought us in. We quickly developed that relationship with Clair Israelson and other folks, and became a big part of the CAA to the point where we supported them a lot, and supported training by virtue of setting up a plan where we would pay people 3% of our sales in order for them to be able to do training.

And how did that come about?
I have to say it was part of a marketing plan as well. If people are going to get 3% of their sales back in terms of a dollar value, that interests them, and it also interested us because it meant that they agreed to take that 3% and use it to train all of their practitioners. It was a win-win situation.

When did you start attending the Spring Conference?
Very shortly after we got into the business. It gave us an opportunity to expose people in the CAA to the operational side of the explosives part. I enjoyed that very much. Those were a lot of interesting years where we were able to do that and allowed to talk for an hour or so at a time to people at the CAA.

What are some of the big changes you've seen in avalanche control explosives over the last three decades? I found one article in our archives where you helped with the development of the first Avalanche Guard system near Revelstoke. I'm thinking of that, but I'm sure there's a lot more. I wonder if you could just talk a little bit about some of those developments over the years.
I think the use of remote ignition systems was a very important development because before that, when we first started, initiation was by just tossing 3" x 16" nitroglycerine sticks into the valley.

There were some remote ignitions, but these were mainly done by artillery guns. Very important developments came with these specialized Avalanche Guards, and with the Nitro Express systems that could be moved, aimed, and deliver explosives from kilometres away. To me, that certainly was the most important development I had seen in the years I'd been there.

What was CIL's role in in developing those?
We developed a gun, along with training people. That was that was a good part of the job that Braden Schmidt did for us for a number of years. He's now the President of CIL Austin Explosives, but he did all that development for us in the last eight or nine years. We were deeply involved in in that gun development.

Just to clarify, when you say "that gun," what gun are you referring to? I'm not an avalanche control guy myself, so I don't know all the ins and outs, but maybe you can just elaborate there?
It's called the Nitro Express and it's got a long barrel, 15–18 feet, and it projects a four-pound booster charge using nitrogen gas. It propels it by that gas being confined and driving the booster out and up to four kilometres. That's an interesting development, and it means you can aim and direct. If you look at our website, which you may do after, you'll see how that works. There's a video there that shows you.

So, we talked about the Spring Conference, but you've been a fixture there for a long time. I'm wondering, how your relationship with the avalanche industry compares to other sectors you work with?
I would say the avalanche business, CIL and myself personally, have a closeness I didn't have with the other parts of our business. You know, we sell highway flares to all of the police forces. It's good business and we work with them, but certainly not with the kind of closeness we have with the avalanche business. And I know that Braden is carrying that on.

What do you think you'll miss about this industry and this work?
It's an interesting business and the people who are in it are—I'm not going to say quite strange—but they're quite different. There's a wide range of people, all the practitioners you meet. There's a broad range of personalities and that's something I always enjoyed because you never knew quite what to expect and that's always nice when you're running a business.

Well, thank you so much, Everett. I appreciate your time. We appreciate the support over the last 30 years and congratulations on your retirement. It's well deserved.
Thank you so much. I've enjoyed every minute. Not retirement, but all the days working.

A Tribute to Brent Strand (2000 to 2025)

DON'T WORRY, BRENT'S NOT DEAD. BUT HE IS LEAVING THE CAA AFTER 25 YEARS TO WORK FULL-TIME FOR AVALANCHE CANADA. IN RECOGNITION OF HIS DEDICATION TO MEMBERS, WE ASKED A FEW OF HIS FORMER AND CURRENT BOSSES TO SHARE SOME WORDS ABOUT HIS IMPACT.

100 km Per Hour

Evan Manners, former Operations Manager

BRENT STRAND JOINED the CAA team in 2000, working at the original Canadian Avalanche Centre at a time of explosive growth. The Centre was barely treading water, with the new-fangled internet causing disruption and facilitating massive advances in communication services at the same time. InfoEx was still offered by fax or blisteringly fast 56K dialup (on three land lines simultaneously!) but was now also accepting member reports by FTP file transfer. The public avalanche bulletin had just been introduced as an online service (previously fax). We were struggling to hold the Training School marketing materials, *The Avalanche News*, and the analogue emergency phone directory at an appropriate level of professionalism. We needed someone skilled at this new technology, *FAST*. Someone who was interested in little old Revelstoke, B.C., as a home base, rather than Silicon Valley.

The existing staff were well aware of this need to rapidly (and affordably) transition from faxes, photocopiers, and modems to Canada's new normal in technology. Our comptroller Pat came to me and shared that her son was living in Fort McMurray and was involved in digital print and communications. He was looking to exit the big oil rat race and return home to Revelstoke. Brent and I spoke on the phone and I explained our needs, along with the fact we had very little to offer financially or in terms of job security. He agreed to help us out, although he reserved the right to make it a temporary arrangement if he decided to pursue other avenues. I found the money to make it work short-term and a deal was struck.

Not long afterward Brent pulled up to the office for his first day at his usual 100km/hr mountain bike speed. I soon learned that was his usual pace in life. We got him settled in and I showed him his new Pentium (!!) powerhouse computer. I asked him to help with a few communication products we had been struggling with, expecting some results by the end of the week. Later that day, he came to me with the finished products. ALL OF THEM!

I knew instantly the CAA had changed forever in capacity for the future. The rest is history…

BRENT AS THE FULL-TIME RECEPTIONIST IN THE OFFICE ON CAMPBELL AVE (LEFT). DRESSED UP AS RAOUL FOR HALLOWEEN 2005. // PHOTOS CONTRIBUTED

Coach Brent

Kristin Anthony-Malone, former Operations Manager

HOW DO YOU SUM UP Brent Strand in a few words? The truth is, you can't! Anyone who knows Brent knows he is impossible to encapsulate in a few paragraphs. He's a pillar of the Revelstoke and avalanche communities, the founder of Revelstoke's legendary Pedal and Pint mountain bike rides, the longest-serving employee at the CAA, and someone who gives his heart and soul to everything he does.

Brent has been many things to many people: bartender, therapist, designer, carpet ripper, logistics wizard, and conference ringleader. He was often the first face I saw walking into the office and the last one I'd see as I left. For a long time, Brent was the CAA—and the CAA was Brent.

When I first took the job as Ops Manager, I was terrified of being Brent's boss. Here was this loud, f-bomb-dropping, aggressively capable dude who seemed completely unmanageable. I was intimidated, not just by the volume, but by the respect he already commanded. I didn't think I'd ever be able to tell him what to do.

Of course, what I learned—what we all know—is Brent is one of the kindest, funniest, and most thoughtful people you could hope to work with. And once you get past the booming voice and fast opinions, you find someone who makes work not just productive, but fun.

Over the years, Brent and I developed a habit of making bets with each other, whether it was conference registration numbers or how long it would take Joe to unpack his office (spoiler: the boxes are still in the basement).

During pre-conference crunch time, when we were working long hours and the crankiness started to show, Brent would head to Malone's and come back with gummy candies for me—a quiet gesture of kindness that repeated itself whenever it was "necessary."

In addition to fun and candy and wagers, there is no task beneath him, and no request is too small. He jumps in wherever needed—whether it's graphic design or physical grunt work—with enthusiasm and humility. He never made me feel bad for asking for help, which meant, of course, that we all kept asking. We've been lucky to have him, and I've been lucky to work beside him. Thank you, Coach, for everything.

CLOCKWISE, FROM TOP LEFT: BRENT AND PASCAL HAEGELI AT THE 25TH ANNIVERSARY SPRING CONFERENCE IN 2007.; BRENT AT THE FOREFRONT OF A CAA/AVCAN STAFF CHRISTMAS PARTY IN 2013.; BRENT COMMANDS THE CROWD WITH HIS BOOMING VOICE AT THE MEMBER SOCIAL AT THE 2023 SPRING CONFERENCE.; BRENT AS THE MASTER BLASTER IN CHARGE OF AVALANCHE SAFETY FOR A BBC FILM PRODUCTION.; BRENT RUNNING THE 2021 VIRTUAL SNOW SCIENCE WORKSHOP IN FERNIE.; BRENT ENJOYING THE FESTIVITIES AT THE 2003 SPRING CONFERENCE. // PHOTOS CONTRIBUTED

Our Spirit Animal

Joe Obad, Executive Director

PINNING DOWN IN WORDS what Brent Strand means to the CAA is no easy task. By turns, he has been our spirit animal, the backstop that saves success from the jaws of disaster, the saviour of 1,000 CAA documents, the life of the party, and one of the driving forces ensuring there is a Spring Conference.

Brent's commitment has shined brightest at the Spring Conference. A few years ago, after Kristin Anthony-Malone departed the CAA, we had a challenging run up to Penticton. It was a new thing for the organizing committee (Rosie, Brent and myself) to proceed without KAM. There were many hiccups that year, but Brent, as ever, kept the trains on track at the presentations and the various socials. He started his day before sunrise and continued long after sundown. I thought to buy Brent a small gift to recognize these efforts, and the time he takes away from his wife, Tina. I settled on a bottle of wine.

I cornered Brent in his office and offered him the bottle with some simple words of appreciation. He accepted with grace and got choked up at how proud he was to work for the CAA, how much the members and their work meant to him, and how good it was to showcase the community's efforts. He expressed how thankful *HE WAS*.

My jaw dropped with a mix of surprised and recognition of the obvious. Working for us for over 20 years at that point, Brent's commitment to serving members and getting the job done had only grown stronger. I gave Brent a big hug and another thanks, and left his office with the same thoughts that fill me today—what a blessing and wonder it has been to have this guy's commitment to the CAA and its members all these years.

The Layout Magician

Mary Clayton, former Communications Director

BRENT WAS ONE OF THE FIRST PEOPLE I met when I joined the CAA in early-2004. As the newly minted Communications Director, I was put in charge of *Avalanche News*. Brent was the publication's designer and layout magician, so we worked closely right from the start. I quickly found him easy to work with and always open to new ideas.

Together, we changed *Avalanche News* from a stapled newsletter to a real magazine briefly called *avalanche.ca*, then renamed *The Avalanche Journal*. Brent had formerly worked in a print shop and his know-how took us far as he negotiated the improvements for the least amount of money possible. It was still in black and white, but we were mighty proud of that glossy cover. Moving to colour many years later was another exciting landmark.

My main memory is laughing a lot as we cooked up our big changes. Brent and I worked together for over 20 years. His design sense and all-around computer wizardry has made him an integral member of any creative project. Those skills, combined with his easy-going nature and willingness to try anything, has made him a colleague I'll never forget. He's been the beating heart of the CAA for a long time, and I know he'll be missed.

BRENT DURING A RARE MOMENT OF STILLNESS AT THE 2006 SPRING CONFERENCE. THE NAME TAG WAS MADE BY ONE OF HIS CO-WORKERS BECAUSE HE WAS ALWAYS RUNNING AROUND, MAKING SURE THE MEETINGS WERE RUNNING SMOOTHLY. // PHOTO CONTRIBUTED

Flakes

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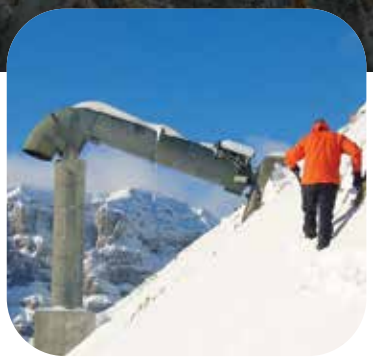
Upper photo: Duffey Lake. The location of the first Gazex installation in Canada in 1992. Phil Hein collection



Bottom photos: Parks Canada, Banff Bourgeau Gazex system installed in 2003. Bradford White Collection

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