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WINTER 2020

in this **issue**

Walter Bruns
CAA President

President's Message

SUPPORTING YOU

WELL, WE'RE IN IT FOR THE LONG HAUL. The pandemic will inform our reality to some degree for the foreseeable future. It has changed and claimed lives. Speaking for the entire board of directors, our thoughts go out to all members who are adversely impacted. Whether it is economic hardship, diminished quality of life, or compromised health; whether it affects you as an individual, family, or business; as our prime minister put it succinctly recently: "It really sucks."

We have been impacted at the CAA as well, but all things considered, your association has fared reasonably well, mostly as a consequence of the tremendous additional effort put in by staff. Joe highlights a number of program adaptations and initiatives in his report. The emergency wage subsidy helped keep folks at work and buffered impacts on our finances.

We are seeing a range of impacts on the snow and avalanche world. Many public and industrial avalanche programs are carrying on with little disruption, but the winter recreation sector is a very different story. Hardest hit are commercial operators who have historically depended on clients from beyond Canada's borders.

For many operations, business forecasting has become more like guesswork. Many have scaled back operations or shut down entirely. We are therefore anticipating impacts on InfoEx in terms of active subscribers and data input. Joe outlines InfoEx options that are available to accommodate these changing dynamics and help offset any reductions in submissions or coverage.

One potentially good news story is also emerging. Backcountry recreation equipment sales are booming. Demand for AST and ITP courses is strong. Smaller, more local groups, and individual recreationists may look to CAA members for services, offsetting some of the impacts of other lost work.

Membership dues are coming up in December. We recognize that times are far from normal, and impacted members need options. Joe provides details of a streamlined process for career recess.

To mutilate a well-worn quote: "The avalanche does not know that you are an expert." The snowpack this winter will not know that there is a pandemic. It may see slightly fewer clients or many more enthusiasts, along with all the other usual actors, but it will still just be a pile of snow. And that snow will do what it always does: fall, settle, change, bond (or not), slide (on occasion), and melt. The cycle repeats. I sincerely hope that you can make the very best of it,

Walter Bruns, CAA President

Joe Obad
CAA Executive Director

Executive Director's Report

TAKING AIM AT THE CURVEBALLS—PANDEMIC EDITION

WE ARE ENTERING A SEASON UNLIKE ANY OTHER. The scale of health, regulatory, and business uncertainty faced by members is truly daunting. For many, the effects of the pandemic have already set in. For others, those impacts are still evolving. At the CAA, we are trying to respond to serve members and stakeholders as best we can against the same shifting backdrop. Below, I offer a look ahead.

For many members, work options this year are diminishing. For some, it may mean a time away from practice. In the past, the career recess process required that the membership chair review all applications. We have recently streamlined this process to allow staff to process such applications directly. Members successfully taking up this option are listed in the member directory, with a notation that indicates career recess.

For members practicing this winter, many of you attended our fourth annual joint CPD sessions with the ACMG in November. In all, 383 members from both our organizations registered for over 1,050 sessions on a diverse range of topics, including fatigue, managing for COVID, ATES mapping, digital tools, inclusivity, and more. Whether you attended and need to refresh what you saw, or just want to know what you missed, you'll find links to recordings of the sessions in the CPD library. Found under the resources and benefits tab of the members-only section of the website, the CPD library now has several years of presentations to support your skill and professional development. These are your resources, waiting to be (re)discovered.

On the InfoEx front, we recognize operations are facing impacts from reduced business and fewer submissions to InfoEx as a result. The InfoEx Advisory Committee and CAA staff are working with the ACMG to try to facilitate subscriptions and observations from more independent guides, which may offset the loss of some data. Likewise, in early October we sent out payment and class options to offer flexibility to subscribers, which we hope will encourage InfoEx participation this coming season.

The Industry Training Program has been working diligently since the spring to ensure courses can be delivered safely and effectively. Under Andrea Lustenberger's leadership, ITP has delivered several courses already this fall. Students and instructors alike have adapted readily to respond to COVID-related restrictions. The same is true of our venue hosts. Like any operation, ITP may face regional or local restrictions that shut down courses. We are realists and have factored this into our planning. The season will throw us curveballs, but we stand ready to continue to deliver the best avalanche courses possible in a manner that respects the safety of students, instructors, venues, and our host communities. Find out more on page 11.

On the project front, this issue of *The Avalanche Journal* provides updates on the *Guidelines for Instruction in Avalanche Terrain* (GIAT) and work to bring the continuing professional development process into alignment with the CAA's competency-based membership objectives. In both cases, we envision offering draft versions of the supporting documentation for these initiatives for member review and comment in advance of the spring AGM. Until then, no new requirements will take effect.

These efforts and more are being delivered under a deficit budget for the 2020-21 fiscal year, which starts December 1. Prudent financial management in previous years allows us to make this choice now to provide full services to members and others in this challenging time.

As always, reach out to me or other staff for the help you need. We wish everyone the best for a safe winter season.

Joe Obad, CAA Executive Director

Alex Cooper
Managing Editor

I'D LIKE TO APOLOGIZE for this issue of *The Avalanche Journal* being a few weeks late. It's not my fault, nor was I waiting on a late contribution.

It comes down to Brent Strand being behind.

Now, before you toss this into the fire, hear me out. I've known Brent for about 10 years, since I first got my butt handed to me on one of his weekly Pedal n' Pint group mountain bike rides. (I didn't return for two years, but when I did, I became a regular for a while.) When he wasn't around to lead, the rides would be chaotic. When he was there, they would go smoothly and the whole group (often 30+ riders) would stay together, such were his leadership skills. I knew where he worked but didn't really know what he did, except that one week in May he would hand over the reins at Pedal n' Pint because he was away at the Spring Conference.

Then, 1.5 years ago, I got hired to work alongside him both at Avalanche Canada and here at the CAA. I realized the leadership he shows at Pedal n' Pint also emerges at work. He's organized and gets quality work done efficiently.

So, why is it his fault this issue is late?

When the pandemic struck Canada back in March, Brent was supposed to head on a month-long vacation to Vietnam. When that was cancelled, he spent what was supposed to be his holiday setting up the Virtual Spring Conference. That went as smoothly as possible, and on top of being a graphic designer, publications manager, and building manager for two organizations (and snowmobile outreach coordinator at AvCan), he became the webinar guy. He got roped into helping with the Virtual Snow Science Workshop, which also went off without a hitch, much to his credit. He produced the first few weekly webinars at AvCan, then switched gears and learned a new platform so the CAA and ACMG could host their joint CPD sessions online.

So, this issue is late, and it is Brent's fault. But he's got a pretty good excuse. It's because he's Mr. Everything, and it's guaranteed he'll do a good job when you ask him to do something.

In October, AvCan and the CAA had a little outdoor celebration for Brent to celebrate his 20 years at both organizations. Speaking from personal experience, I know that when it's time to get articles on the page, he turns this around quickly and helps ensure everything is in place. He makes sure articles that need colour get colour, and that nothing is left out. He's been laying out the *Journal* for 20 years, has seen it through several iterations, and is the reason this magazine always looks so good.

Three cheers for Brent!

I am extremely thankful for the people who have provided me with story leads for the *Journal*. Not all panned out for this issue, but they've lead to some great contacts that will hopefully turn into great content going forward.

Inevitably, a few articles deal with COVID-19 as it would be impossible to ignore the impacts it's having on our industry. But I hope this issue features a diverse range of articles that will give you something to think about going forward.

WHAT'S IN THIS ISSUE?

- Rachel Reimer has written a thoughtful article about dealing with mental health issues during the pandemic.
- Iain Stewart-Patterson looks at concepts you've learned during your professional training and applies it to the world of COVID-19.
- Uwe Gramann provides some friendly tips on pattern recognition in XT diagrams that will hopefully speed up your ability to spot weather trends.
- Mike Inniss presents AvSORT II, an updated avalanche rescue triage algorithm, for review.
- Markus Eckerstorfer, a senior researcher from NORCE Norwegian Research Centre, has contributed an article about their work using satellite imagery to detect recent avalanche activity.
- Mike Sadan from Whistler Heli-Skiing re-thinks the run list and provides some thoughts on how to make the process of deciding what to ski more efficient.
- Frank Techel from the Swiss avalanche warning service takes a look at the extended column test 10 years after it was introduced.

As always, I hope you enjoy this issue. If you have any feedback or ideas for the future, please email me at acooper@avalancheassociation.ca.

Alex Cooper

STUDENTS ARE WELL-SPACED AT AN INTRODUCTION TO WEATHER COURSE IN REVELSTOKE THIS FALL, DEMONSTRATING WHAT COURSES WILL LOOK LIKE THIS WINTER. // JAMES FLOYER

Adapting ITP to COVID-19

Andrea Lustenberger, ITP Manager

I AM WRITING THIS ARTICLE from the back of a classroom in Kamloops at the first Industry Training Program course of the year: *Introduction to Weather*. I'm here because I want to see for myself how the COVID-19 safety measures we put into place for the 2020-21 season are working in the real world.

The classroom is a new, larger venue for us; at 2,079 square feet it allows for students and instructors to comfortably physically distance. Forehead temperatures are taken each morning and students are required to complete a health declaration prior to arriving at the course, and reassess each morning of the course. Hand sanitizer and Lysol wipes are strategically placed throughout the room and everyone is wearing a mask. Group activities involve two-metre distancing, face masks, and personal bottles of hand sanitizer.

Like many operations, the Industry Training Program came to a halt on March 16, 2020, due to COVID-19. We cancelled eight courses, impacting 149 students and 21 instructors, and immediately refunded students their tuition.

After our initial response, the ITP team spent the spring and summer planning for the 2020-21 season by reviewing course delivery and COVID mitigation options. After extensive work by Emily Grady, CAA Curriculum Specialist, we opted to move forward with some modifications to our traditional course delivery. We are working under provincial health guidelines and ensuring our classrooms meet physical distancing requirements. We have cancelled the majority of our hut-based courses and switched to larger town-based venues. Masks are required in classrooms and outside when physical distancing is not possible or required under venue, resort, or municipality guidelines. Full details of our COVID response and safety plan can be found online at: avalancheassociation.ca/page/ITPCOVIDInformation.

We realize the decisions we made back in March—or were made for us—have a trickle-down effect that may last years. Course cancellations have a significant impact on students, so we implemented several procedures to support them to decrease the impact to their career progression, including preregistration for those whose courses were cancelled in the spring.

Looking forward, we are continuously monitoring provincial health guidelines and best practices for COVID management. We will continue to manage and adapt our safety plan and operating procedures as we learn more. This season isn't going to be normal or easy for any of us. It is going to take a lot of diligence, patience, and compassion, but we are hopeful that with our procedures in place, we can continue to deliver the level of instruction you have come to expect on CAA courses.

Towards **Competency-based CPD**

Kathy McKay, Brendan Martland and Joe Obad

Working group volunteers: David Stimson, Ben Jackman, Tony Sittlinger, Andrew Nelson, Kerry Macdonald, and Curtis Pawliuk.

VOLUNTEER MEMBERS HAVE BEEN WORKING hard with our project team to revise the CAA's continuing professional development (CPD) process. The team is close to offering a draft for the members to consider. Below, we look at how we got here and the steps to come.

Goal 1 of the CAA Strategic Plan states:

> *The CAA establishes a professional self-regulatory model that protects the public interest, while meeting the needs of CAA members, regulators and industry.*

In June, the CAA revised its membership criteria for Active and Professional members to a competency-based model. All incoming members are now assessed against the Active and Professional competency profiles, meeting one of the objectives under Goal 1.

Existing members also need a process to confirm they are competent and working within their scope: this is where CPD comes into play. The applicable strategic plan objective states:

1.4 Complete a robust Continuing Competency Program [i.e. CPD] that ensures excellence in practice and a culture of accountability for members. The public and stakeholders trust this process.

There is a lot packed into those words, so before getting started, the project team worked with the board of directors and several committees to clarify this goal. A set of tactical objectives for a revised competency-based CPD were established, allowing the team to begin work on the changes. (See sidebar for objectives.)

With these objectives in place, the team researched over 15 other professional organizations. Almost all used CPD models based on four components: self-assessment, a learning plan, an activity record, and reflection. We drew upon these themes to develop three draft processes that were then analyzed and refined by a volunteer working group. We tried to maintain the fundamental elements that are familiar to members: the existing CPD categories and points system. We also incorporated new key concepts such as the eight domains of the competency profiles and the associated proficiency scale.

The result, we hope, is a blend of visibly familiar concepts and new tools that provide members opportunities to define their individual scope of practice and career paths as much as they meet obligations for membership.

To gain member buy-in, we proposed the following rollout plan to the board in 2021:

- Early January: Draft process shared with membership for review.
- Early March: Membership feedback is due.
- March to early April: Member feedback analysis and revision.
- April: Send revised program, forms, and bylaw changes to membership for review ahead of a spring AGM vote.
- May AGM: Present feedback and edits for vote.
- Fall: Rollout revised CPD process to membership.

Look for the draft process for your review in January. The working group is excited about the potential options, and we hope you will be too.

Tactical Objectives for Competency-based CPD

To achieve Objective 1.4 of the strategic plan, the following objectives were set for the project team:

1. Establish methods by which members use the Continuing Competency Program to record and assess their proficiency in different competency domains to ensure they are offering their services competently and in the public interest.

1.1 Establish a means by which members can keep record of their continuing competency.

1.2 Establish a means by which the Continuing Competency Program requirements and process can be accessed on the CAA site by members, stakeholders, and the public (the process, not individual member's CPD records).

1.3 Establish recording and assessment methods that allow members to build off the CAA's competency-based application system in effect as of July 8, 2020.

1.4 Establish a rubric for evaluating the proficiency level of a member's competency domains.

1.5 Using this rubric, establish the minimum benchmarks that members must reach annually, subject to audit by the membership committee, including any mandatory competency areas to be addressed annually, such as emergency response.

2. Establish methods by which members use the results of their competency assessment to identify areas for additional professional development relative to their current and future avalanche practice needs (i.e. to identify weak areas or areas for growth and determine how to address them).

2.1 Establish methods to categorize continuing professional development resources by the competency domains.

2.2 Provide documentation on established/typical career development paths and career path changes available to members.

3. Establish methods by which a member's assessment results are used to declare the services they may offer within their individual scope of practice to ensure they are offering their services competently in the public interest.

3.1 Establish criteria by which the membership committee may audit a member's continuing competency and make recommendations.

3.2 Establish a means by which members engaged in advanced practice can demonstrate they have reached mastery to provide specialized services significantly beyond the abilities of the entrance to practice criteria for professional membership.

3.3 Establish guidance for members whose focused practice makes achieving minimum thresholds challenging. Guidance may include additional training requirements, declaration of specific areas for which the member offers service, and indicators that a member should change membership classes.

3.4 Establish guidance allowing members to judiciously expand practice contexts. E.g. ski control team member moving into resource management avalanche control; or broadly experienced member moving into consulting.

Guidelines for Instruction in Avalanche Terrain – Update of Forthcoming Draft

Kathy McKay, Brendan Martland, and Joe Obad

AS THE CAA HAS WORKED TOWARDS fulfilling the objectives under Goal 1 of its strategic plan (see opposite page) by transitioning to a competency-based membership, one of the challenges has been dealing with instruction. Avalanche course instruction is an area that does not easily fit under the competency model without additional guidance. At the same time, teaching avalanche courses is one of the most valuable services CAA members can offer.

To address this, the CAA has been working on developing guidance for members in this area to ensure they are working diligently within their capabilities. This development has run concurrent to the overall competency effort and has resulted in Guidelines for Instruction in Avalanche Terrain (GIAT). GIAT is intended to offer reasonable guardrails while supporting an essential aspect of practice.

Providing instruction in avalanche terrain is challenging to fit within the competency model. This is best illustrated by referring to the key working conditions for the Active and Professional member competency profiles:

New Active Member competency profile working conditions
At entry to practice, the Active Member functions within the following workplace conditions:

- A highly structured environment
- An established avalanche program
- Decision making subject to established protocols
- Consultation or supervisory review readily available and utilized

NEW PROFESSIONAL MEMBER COMPETENCY PROFILE WORKING CONDITIONS

At entry to practice, the Professional Member functions within the following workplace conditions:

- A moderately structured environment
- An established or developing avalanche program
- Decision making subject to established protocols
- General direction provided

While the profile conditions listed above are for new members, they highlight some key frameworks: workplace structure, established avalanche program, established protocols, and varying degrees of access to supervision. These elements are common in some large instructional programs like ITP or outdoor schools, but they are absent in many cases for solo instructors.

For members who offer avalanche instruction, GIAT provides guidance to avoid exceeding reasonable competency thresholds without additional training, while also providing tools to assist doing this. Draft versions of tools that have been developed for release with GIAT include an avalanche course instruction hazard form and checklist, an avalanche safety plan template, and an avalanche emergency response plan template.

It is important for Active and Professional members to avoid using CAA membership as though it is a guiding certification—it is not. GIAT is intended to provide clarity about what CAA membership enables and what it does not when taking students into the field for avalanche instruction. In this sense, GIAT seeks to guide CAA members while protecting the interests of the students to have access to responsible course delivery.

The draft GIAT document and tools will follow a similar rollout process as the revised CPD program. This will allow members to test-drive key practices this season, provide feedback, and allow for additional revisions before compliance is required in the 2021-22 season.

The proposed GIAT implementation schedule is as follows:

- November: Draft GIAT and associated documents posted to CAA members only site.
- December: Webinars to present GIAT, provide Q&A, and host open forum.
- Winter: Answer questions, solicit feedback, and assist instructors to implement GIAT.
- May: Summary of feedback and proposed revisions at AGM; final input/feedback.
- Fall: Provide GIAT Version 1 and enforce.

Contributors

KEVIN HJERTAAS
Just a ski bum, Kevin had a short, unremarkable career as a ski patroller and a stint as a middling professional skier. He was a passable ski coach for a time and a tolerable ski journalist some years ago. In a completely predictable move, he became a ski guide and started M-T-N Guiding. Kevin writes from Banff, Alberta, where he lives with his wife and daughter.
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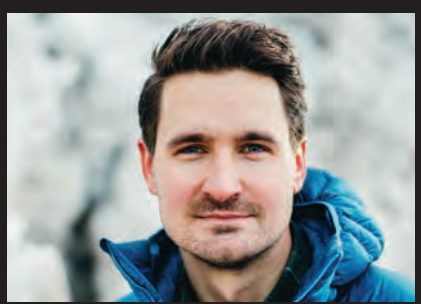

MARKUS ECKERSTORFER
Markus was born and raised in Austria and moved to Norway almost 12 years ago. He spent the first five years in Svalbard, studying for his PhD before moving to mainland Norway where he now lives with his family of four. He got interested in avalanches from his passion for backcountry skiing. He has worked on different aspects of avalanche science, always with a focus on trying to reduce uncertainty in avalanche forecasting.
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FRANK TECHEL
Frank has worked as an avalanche forecaster at the national avalanche warning service in Switzerland since 2011. Before this, he worked in various positions in ski area and highway snow safety programmes in Switzerland and New Zealand. Besides forecasting, Frank's current research interests include the question of whether avalanche forecasts are produced and communicated consistently, and on how to improve data analysis in public avalanche forecasting.
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MIKE SADAN
Mike has spent the last 12 years as general manager of Whistler Heli-Skiing, a company he has worked with for almost 30 years. He is currently the chair of the Standards Committee at HeliCat Canada and a graduate of the CAA's Avalanche Operations Level 3 (Applied Avalanche Risk Management) program.
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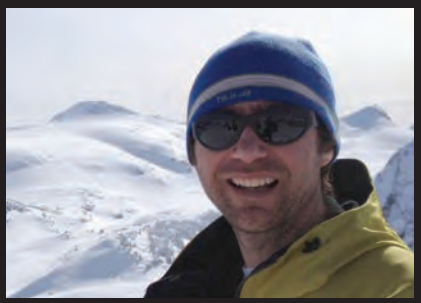

MIKE INNIS
Mike is a physician with a 30-year career in emergency, rural, and remote general practice. He is a CAA member and a team leader in avalanche response for Nelson Search and Rescue. He holds a diploma in mountain medicine from the International Commission for Alpine Rescue, and is part of the faculty of the Canadian Society for Mountain Medicine DiMM program. He is a physician/guide for Mike Wiegele Heli-skiing and the medical director for Retallack Catskiing.
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UWE GRAMANN
Uwe is a Canadian professional meteorologist and practice area lead for RWDI's climate data and weather forecasting teams. He has worked his entire professional life in the mountains of western Canada and is passionate about mountain weather, forensic studies, weather models, and, particularly, about communicating meteorological information for decision making—like meteograms.
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IT'S TIME TO HAVE AN 'FFT'

in this **section**

// JULIE LEBLANC

It's Time to Have an 'FFT'

Rachel Reimer

REMEMBER, YOU'RE NOT IN THIS ALONE. // RACHEL REIMER

IF THERE IS ONE QUALITY HELD by mountain people that I will never lose faith in, it's resilience.

We thrive in the most uncomfortable and difficult of circumstances. We persevere and we laugh at the challenges. Or we cry, step back, and redefine ourselves the second (or fifth) time around.

Yet here we are, the strong, self-sufficient, and typically resilient folks that we are, sharing a new and difficult experience together. I want to give us all permission to have what sociologist Brene Brown calls an "FFT"– an F–ing First Time.[1] It might be messy and difficult. In fact, it's bound to be. Let's give ourselves permission to not know what we're doing. To relax our expectations—of ourselves and each other.

The uncertainty that we all face at this very difficult moment in our industry can be a painful solo experience. It might cause us to secretly think we're the only ones having difficulty with our primary relationships, facing despair when we think about our financial goals, or seeing sides of ourselves come out we've never seen before as we interact with loved ones or colleagues. Yet the truth is, it is a shared collective experience within our profession. We are not alone.

Typically, when we've been faced with moments that demand our resilience, such as avalanche incidents, difficult mountain accidents, rattling near-misses, or personal losses like an important relationship, job, or family member, we have a pool of resources to draw from with those around us. If we cast a big enough circle, those who surround us socially are usually not all involved in the same difficulties that we are. Right now, this is a key difference.

Researching our industry culture, we've discovered we have a 'prove yourself' mentality, a culture that excludes people based on perceptions of performance.[2] These cultural norms can prevent us from letting ourselves acknowledge how tough a time we're actually having. These are typical of professions like ours and exist in most competitive, traditionally male-dominated workforces.[3]

I can recall working as a faller on a particularly difficult and steep wildfire, and deciding to 'pretend' I wasn't tired anymore just to make it through the day. It worked. I was training my brain to numb out discomfort rather than let myself witness how fatigued I was and do something more constructive to help myself. It was tantalizingly successful in the short term, but catastrophic in the long term. What if we felt safe to acknowledge the hardship?

Conrad Kain wrote of his more difficult early years, on a particularly bad day: "One who has never been in similar circumstances cannot imagine how a person so situated looks at life. It appears to be all chaos; the earth with its great beauty seems to lose its attraction. It seems worthless; yes worthless!"[4]

[1]Brown, B. (2020). Unlocking Us podcast, 'Brene on FFTs' https://brenebrown.com/podcast/brene-on-ffts/
[2]Reimer, R. (2019). Diversity, inclusion and mental health in the avalanche and guiding industry in Canada. Association of Canadian Mountain Guides https://acmg.ca/05pdf/2019DiversityInclusionandMentalHealthStudyFINALReport.pdf
[3]Glick, Glick, P., Berdahl, J.L., Alonso, N.M., 20180901. Development and Validation of the Masculinity Contest Culture Scale. *JOURNAL OF SOCIAL ISSUES* 74, 449–476. https://doi.org/10.1111/josi.12280
[4]Kain, C. (2009). *Where the clouds can go*. Rocky Mountain Books, Surrey BC.

This kind of frank self-observation is key in longer term challenges like the one we are facing now. Acknowledging the hardship of this moment in his life didn't devalue Kain's strength, achievement, or potential. Rather, it helped clarify his values and who he wanted to be in the world. It helped him face the reality he was in and work through it.

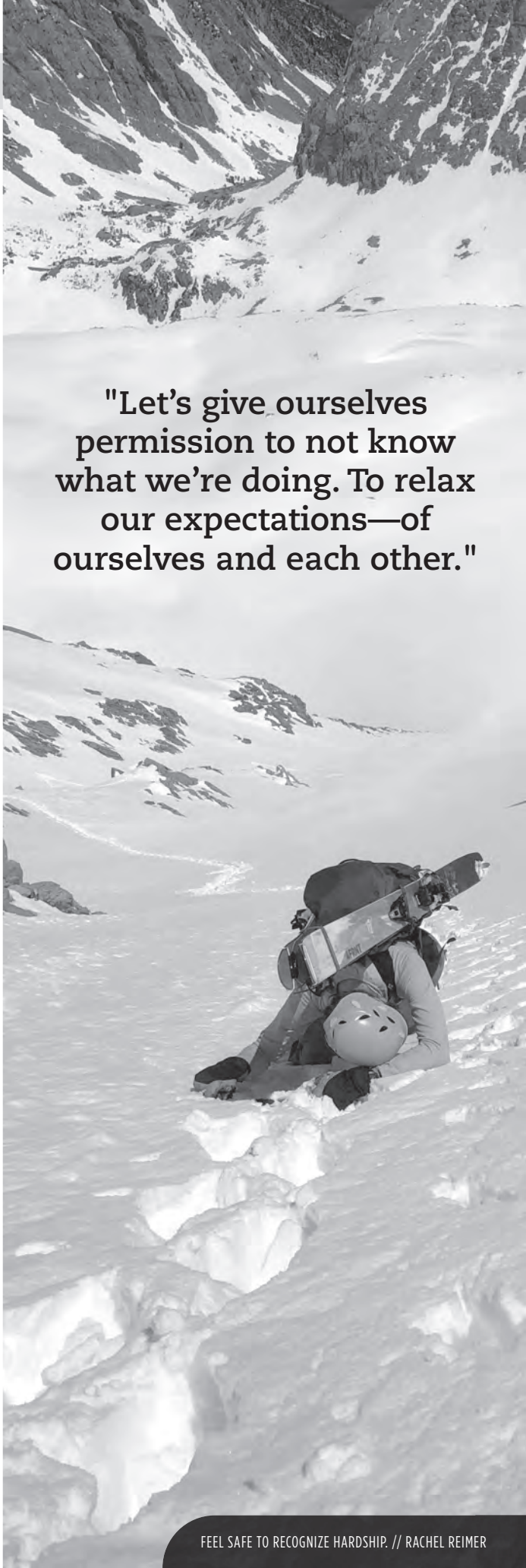
Here's the thing: if we choose to numb out the negative feelings, we also miss out on the beautiful feelings. We ultimately harm ourselves by using numbing strategies like food, alcohol, or withdrawal into compulsive exercise or mountain sports as an escape. Thich Nhat Hanh, a Zen Buddhist monk and Nobel Peace Prize winner, teaches us to mindfully embrace the painful feelings as Kain did. When we acknowledge the painful feelings there is pain, but there is also the bigger 'observer' piece of us that is the witness.[5] We are bigger than our pain. It is not all of us, but just a temporary part of life right now. Feeling pain does not make us weak—it makes us human.

The research on mental health and humanitarian events, like the global circumstances we're in now, present some challenging facts for us to consider. With society-wide economic downturns, rates of suicide, domestic violence, and child abuse rise.[6] In 2019, 57% of guides and avalanche workers reported mental health challenges and our industry had approximately six times the national suicide rate.[7] COVID will cause an increase in mental health challenges and suicide rates, as we've seen in Canadian society. We need to anchor into our deepest roots of self-compassion (seeing ourselves kindly, without judging) and compassion for others (extending a generous assumption that they are doing their best) so that we can make it through these times together.

Resources are available to support you.[8] None of us is alone in this challenging mess. Being courageous by letting yourself acknowledge it's hard is the first step. Reaching out to those around you is second. Finally, equip yourself with access to qualified mental health support.[9]

This period in our shared human history presents us with an opportunity to soften the stories we tell ourselves about needing to prove, about needing to be stoic and self-reliant. The way we get through this is by sharing the load.

Brene Brown writes: "Asking for help is a power move. It's a sign of strength." I share her opinion.



FEEL SAFE TO RECOGNIZE HARDSHIP. // RACHEL REIMER

[5]Hanh, T.N. (2013). Peace of mind: Becoming fully present. Paralax Press, Berkeley, CA.

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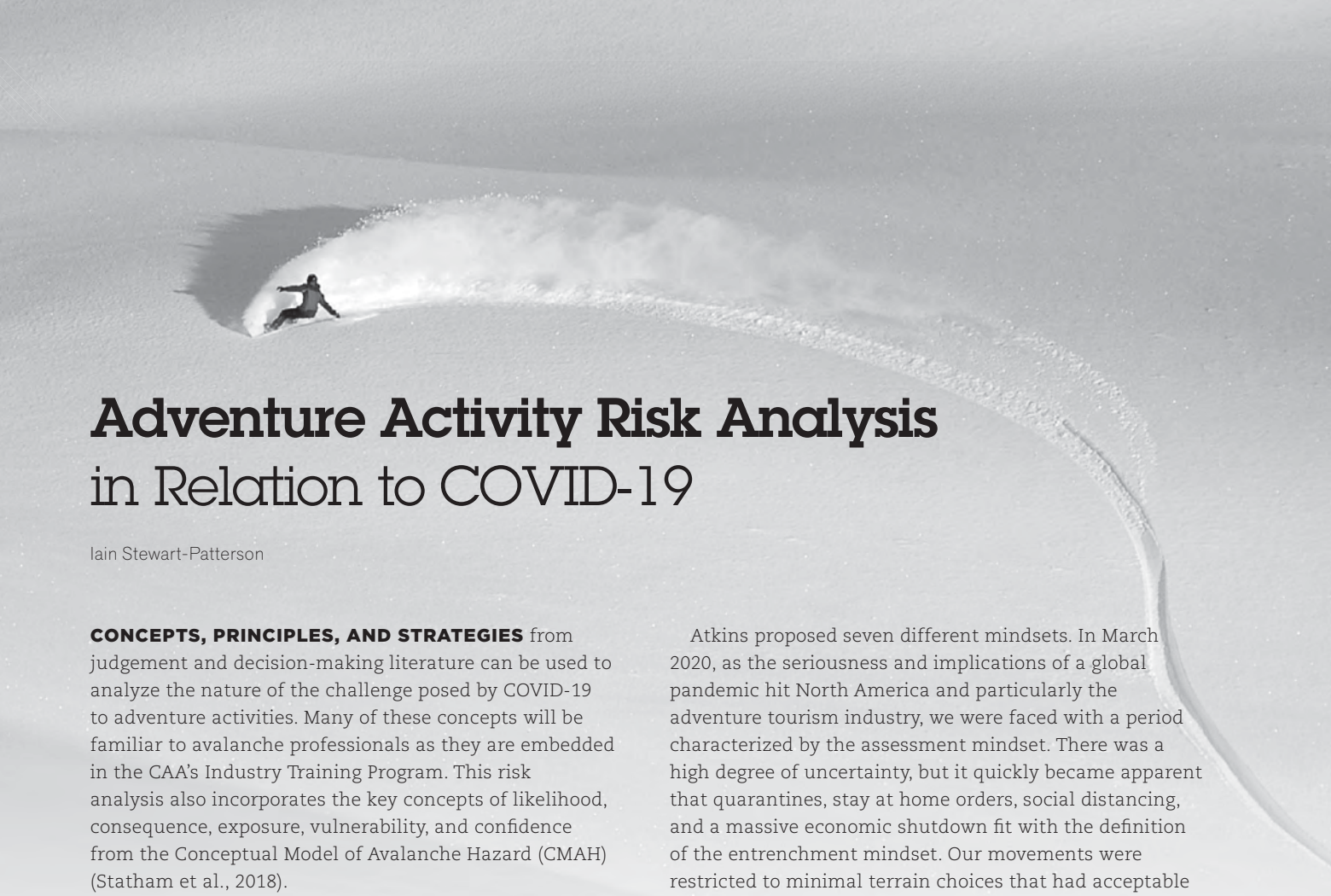

Adventure Activity Risk Analysis in Relation to COVID-19

Iain Stewart-Patterson

CONCEPTS, PRINCIPLES, AND STRATEGIES from judgement and decision-making literature can be used to analyze the nature of the challenge posed by COVID-19 to adventure activities. Many of these concepts will be familiar to avalanche professionals as they are embedded in the CAA's Industry Training Program. This risk analysis also incorporates the key concepts of likelihood, consequence, exposure, vulnerability, and confidence from the Conceptual Model of Avalanche Hazard (CMAH) (Statham et al., 2018).

The fact that COVID-19 is a novel virus makes decision making regarding participation in adventure activities difficult. It is a new game and we are still learning the rules. Medical researchers and practitioners have never seen this virus before; however, there may be lessons from previous pandemics.

As avalanche professionals, adventure educators, and guides, we are basing our decision making on the advice of medical researchers. Much of the information we need to make quality decisions is unknown, vague, or misleading. The research is rapidly evolving, and more is becoming known on a regular basis, so decisions have a short half-life. Decisions made today may become stale and outdated in a relatively short time. Hogarth (2010) described an important connection between feedback and consequence that applies here. Inefficient testing coupled with no cure and no vaccine produce a decision environment of inefficient feedback and massive consequence. Hogarth called this a 'wicked' environment.

THE STRATEGIC MINDSET

The strategic mindset proposed by Atkins (2014, p. 211) "consists of a collection of attitudes encompassing our perception of the avalanche hazard and the desires that we hope to satisfy." The Canadian avalanche industry has embraced the strategic mindset as a method to frame the day prior to getting out into the mountains; it is becoming integral to avalanche forecasting and terrain management.

Atkins proposed seven different mindsets. In March 2020, as the seriousness and implications of a global pandemic hit North America and particularly the adventure tourism industry, we were faced with a period characterized by the assessment mindset. There was a high degree of uncertainty, but it quickly became apparent that quarantines, stay at home orders, social distancing, and a massive economic shutdown fit with the definition of the entrenchment mindset. Our movements were restricted to minimal terrain choices that had acceptable risk (e.g. essential services such as grocery stores) until things got better. Compelling evidence was needed to open more terrain.

As the summer progressed and a new normal became established, we began to enter the next strategic mindset: cautiously stepping out. The challenge for the adventure industry with changing the mindset from entrenchment to stepping out was the pent-up demand to get the economy going again and to relieve the mental stress associated with absence from our adventure pastimes. It takes discipline to stay in the entrenchment mode, but perhaps even more discipline to slowly and cautiously step out rather than precipitate a stampede.

By September, there was a feeling of status quo. Our public health officials told us to go outside. People were out in the mountains. The crags were busy. Mountain rescue services were in high demand as many novices flocked to outdoor adventures. Camping gear and bicycles were out of stock at most stores. The last week of September brought sunny skies and warm temperatures, and the Skaha Bluffs parking lot was jammed with climbers who would normally be heading south.

In November, as the predicted second wave grows in intensity, we enter a stepping back phase. The hazard is increasing and the forecast looks grim.

There are two motivating forces that may play into future decision making: pandemic fatigue and pent up demand. We are tired of all the restrictions and just want

life to get back to normal. There is a desire and perhaps an expectation that we need to enter a stepping out phase. As the snow flies in the mountains, both our professional and personal desires rise to the surface. We want to get back to work. We want to get out and enjoy the snow. Atkins describes a critical distinction as we change our mindset. There is a big difference between adapting and changing objectives based on the existing and forecasted conditions compared to modifying our desires based on conditions.

ASYMPTOMATIC UNCERTAINTY

Uncertainty is integral to adventure decision making, but this is a novel virus. Patterns have emerged. We know that people with comorbidities or who are immunocompromised are more vulnerable. Generally, this is the elderly, but it also includes people with diabetes, asthma, and smokers. We also know extended care facilities were ground zero; when outbreaks occurr in a facility, the results have been deadly.

Meanwhile, closed systems such as cruise ships or backcountry lodges are completely safe unless a point of infection is introduced. Likelihood and exposure play into the decision-making process. A small closed system is more likely to be infection-free than a large open system. A group of six people on a multi-day backpacking trip in remote terrain are less likely to be exposed to a virus source than 3,500 people on a cruise ship.

Adventure tourism operations are under tremendous economic pressure to open prior to the availability of a vaccine and many have developed ways to do so. One of the challenges with this virus is that people can be asymptomatic and still be contagious. The key aspect of this problem for adventure tourism operations is not that this is a highly contagious and deadly virus, but that a large proportion of the target market is fit and active participants drawn from a global population. The greatest threat is likely the asymptomatic super-spreader.

REDUCING EXPOSURE

It is evident from the fatality statistics that vulnerability must be considered. In North America, the death toll in nursing homes and extended care facilities has been frighteningly high. Many within this elderly client group have comorbidities; they are already at risk from cardiopulmonary disease, diabetes, and asthma. However, smoking and vaping have been found to increase the comorbidity risk to younger populations.

Given the contagious nature of the virus, it is also important to consider co-vulnerability, or the circle of influence. If/when an extended care health practitioner becomes infected with only mild symptoms, the entire facility of vulnerable, elderly residents is at great risk. Reduced exposure is the primary tool that can help keep vulnerable populations safer.

There are several proposed strategies that may reduce exposure. COVID transmission is thought to be optimized when many people congregate within a cool, dry confined environment with reduced airflow, such as a classroom. A single person sitting alone on top of a mountain will not be exposed; however, the human need to engage with other people means that strategies aimed at reducing exposure should focus on limiting social networks while still allowing social interaction.

From an educational or guiding perspective, optimal grouping is based on exposure reduction. For example, one instructor with six participants for a seven-day course is preferable to three instructors rotating through 18 students for the same period. These experiences are ideally delivered regionally to a participant group that is local or has become local by proving themselves to be COVID-free.

CLASSROOM CONSIDERATIONS

A non-traditional format is needed to conduct classroom-based experiences. Project-based learning that is dependent on face-to-face group work should be reduced or eliminated. For courses that blend classroom learning with field learning, the delivery in the field of what is normally classroom content will reduce exposure. An outdoor classroom with several small groups or pods can be facilitated by a single instructor. It is also essential that participants self-isolate or reduce their social interactions prior to courses.

A COVID-free environment can be compared to a medieval castle under siege. If everyone inside the castle is healthy when the drawbridge is pulled up, then everyone inside is safe. However, if someone is an asymptomatic carrier when they enter, or if people sneak outside the castle to meet with others, the consequences can have a cascading effect. In an instructional context, if a participant or instructor presents with COVID symptoms (some of which are like a common cold or flu), the consequences begin with the loss of program time for that person.

Given a possible reluctance to admit to symptoms due to the subsequent loss of time, money, and experience, a participant or instructor may hide symptoms, resulting in a spread to the rest of the group. It is not too hard to envision this cascading into an outbreak within the larger group. This could result in either a temporary or permanent program shutdown. There are also monetary consequences. Prevention will require money and time. Evacuation from field locations, additional PPE, loss of participant program days, and loss of instructor/guide time will add up.

The concept of a pre-mortem might be applicable. If we envision an outbreak within an organization, how will it happen and how bad will it be? Consider the following scenarios:

Scenario 1: A participant (guest, student, guide, or instructor) begins a program and subsequently begins to exhibit symptoms.

Causation: The participant has a job that ended a few days prior to the start of the program. They were unable to self-isolate before the program started. They were exposed to the virus through an asymptomatic carrier and did not know that they were sick until symptoms showed up.

Scenario 2: A staff member begins to exhibit symptoms during the season.

Causation: The participant attended a social gathering during their time off and were exposed to the virus.

Best possible outcome: The person is isolated, and no further infection occurs.

Worst possible outcome: They hide their symptoms (or they are asymptomatic and contagious) and the entire group/organization is exposed.

Are these acceptable outcomes?

ANTICIPATING FAILURES

Reason's model of accident causation can be used to look for potential active and latent failures. Reason describes accidents as system failures with multiple contributing factors and rarely a single causation.

There are two types of system failures. Active failures occur at the operations level, while latent failures occur at the management level. Anticipation of these failures can lead to preventative measures. Accident prevention can be based on multiple layers of armour, with each organizational level responsible for one layer. The better each layer of armour is, the more accidents will be prevented.

As we look at the challenge posed by a global pandemic, it is impossible to anticipate all possible threats, so multiple layers of armour or protection are needed, recognizing that each layer of armour will have a weakness, or hole. There is also a limit as to how thick a layer of armour can be. For example, a complete societal shutdown would be a thick layer, but thicker layers reduce mobility and agility, making it harder to adapt to a changing environment. As with selecting clothing layers for outdoor activities, multiple thin layers are more effective, particularly as the weakness in each layer is less likely to line up with the weaknesses in other layers. Each additional layer reduces the probability of an accident.

LOOKING FORWARD: THE ILLUSION OF VALIDITY

How do we reconcile the fallibility of human judgment with a seemingly unshakable confidence in judgmental ability (Einhorn & Hogarth, 1978)? We know that this virus is new and we have minimal expertise on which to draw. We must look to external expertise and be willing to adapt as conditions change and new knowledge is generated. Probabilistic reasoning requires the use of assumptions (Nickerson, 1996). A lack of clear information can lead to an ambiguous understanding of the problem. Assumptions are needed to fill these information gaps however they must be clearly stated: "If we assume the following… then we can reasonably expect…"

However, we may be susceptible to two heuristic biases as we look for changing conditions: an anchoring bias and a confirmation bias (Cook & Smallman, 2008; McElroy & Dowd, 2007). Decisions can be seen as anchors due to the time and effort that was used to generate them, however, new information will necessitate the need to abandon decisions and adapt. Another trap is that decisions can be confirmed by only seeking information that affirms our desires, therefore disconfirming evidence is ignored.

Avoiding these heuristic traps requires diligence. Adjustment to an anchored decision point is based on the search for and acceptance of new information. The time, effort, and money that it takes to come to a decision within confusing circumstances must be labelled as a sunk cost. New information and an evolving landscape require adjustment. As new information comes in, the confirmation bias is avoided by looking for disconfirming evidence by fact checking.

ORGANIZATIONAL PREPAREDNESS

We are immersed in a changing environment in which a poor decision could be catastrophic. So, how well prepared is the organization to deal with a crisis? We are managing the unexpected (Weick & Sutcliffe, 2007). High reliability organizations have been defined as operations where failure will likely produce catastrophic results (Weick, Sutcliffe, & Obstfeld, 1999), the classic example being a nuclear power plant. Managing risk within the delivery of adventure programming demands high reliability. Doing so with the additional challenge of COVID-19 is even more so. Trial and error is unacceptable unless the errors that occur are kept small and each error generates learning.

There are several key characters of high reliability organizations. Preoccupation with failure is predominant and is based on the reporting and analysis of near-misses. Is there a common definition and understanding of a near-miss? Is there a culture of reporting near-misses? The next layer of defense is deference to expertise. How much power do front line staff have? To what extent is the leadership structure flat? The final layer is a commitment to resilience. Is there a willingness to make changes?

As avalanche professionals, our operations are threatened. We cannot ignore the problem with the hope that it will just disappear at some point. It is a persistent weak layer that is unlikely to heal this winter. Use the process of a strategic mindset to gauge whether stepping out is an option. However, be wary of information that contributes to a confirmation bias. We all want life to return to "normal."

"Safety is not bankable. It cannot be stored up and used on a rainy day. If the people on a carrier have been failure-free for 67 days, that does not mean that their system is safe. And it does not mean that their attention and effort can be relaxed. Instead, all it means is that the unexpected has not yet escaped containment." (Weick 2001)

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Layers of armour for adventure operations

1. Entry to a program:
- **a. Prove that you are healthy and not just asymptomatic**
  - **i. Self-isolate prior to arrival**
  - **ii. Get tested (if possible and reliable)**

2. Once a program starts:
- **a. Manage your proximity risk**
  - **i. Minimize your social network**
  - **ii. Small groups in the field**
  - **iii. Small groups in town**
  - **iv. Maintain the same groups**
- **b. Physical/social distancing**
- **c. Health monitoring (daily log)**
- **d. Contact tracing (daily log)**
- **e. Use PPE**

// FABRICE COFFRINI

Pattern Recognition in Meteograms

Uwe Gramann

METEOGRAMS, THE DISPLAY OF MULTIPLE weather parameters along a time series, have recently become a very useful decision-making tool for weather-related decisions in avalanche operations. Meteograms are traditionally evaluated based on absolute numbers, but these numbers alone are unable to unlock additional information that is contained in them, and that is the weather patterns within.

As general patterns repeat themselves much more frequently than numbers, the pattern recognition method is efficient and intuitive, especially for people who recognize visual changes. Counterintuitively, pattern recognition can also result in better decision making since patterns or changes in parameters are often predicted with higher accuracy than the underlying absolute numbers.

In order to recognize patterns, one has to have seen them first. This article provides a first look at the most common patterns together with an initial interpretation so that you can find them later in real-world applications.

BASIC SINGLE PARAMETER PATTERNS

In all meteograms time progresses from left to right. You can picture yourself 'riding' on any curve, experiencing the change in conditions as you go. As a result, a line, or curve that is slanted from the bottom left upwards to the top right indicates a parameter that is increasing over time. Conversely, when a curve progresses downwards from left to right, the parameter decreases. This may be obvious, but always pay attention to the intensity as well: it could be a gradual five degree temperature change over three days, or a sudden five degree change over three hours. In this context it also becomes important that you note the scale of the parameter on the y-axis, which changes between meteograms.

In general, it can be said the steeper the line is, the more intense the rate of change is and the more attention you may want to pay to that time period. A good example would be a drastic pressure increase behind a frontal passage, which is directly tied to wind intensity in the wake of the front.

Just as much as a slanted line indicates change, a flat line indicates persistent conditions. This may again be obvious, but it is often overlooked how important it can be to identify a period of persistent conditions. If the flat line starts at the current time, powerful statements can be made such as, "What you see is what you get for the next …" Additionally, if you can identify two different but persistent time periods with different values (Figure 1), chances are that you found a pattern change of sorts located between them (e.g. from a warmer subtropical pattern to a cooler polar pattern).

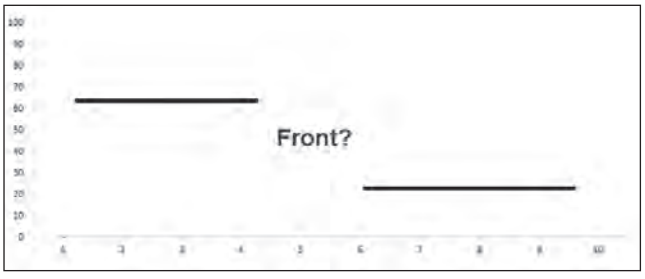


FIGURE 1

The third basic pattern, minima and maxima, also occurs at times when some change is taking place in the atmosphere that you need to pay attention to. It could be that a frontal system is moving through the region, allowing for clearing in its wake (a pressure dip), or that a ridge of high pressure is starting to break down, allowing clouds and wind to increase (a pressure peak). Just like before, be aware of the time frame within which changes happen and the associated intensity and scale.

A special kind of wave pattern that has a wavelength (peak-to-peak or dip-to-dip) of exactly 24 hours is the diurnal pattern that is caused by solar radiation, like temperature. The amplitude is dependent on the intensity of the solar radiation. A strong diurnal signal can be seen during clear days. A lack of a diurnal pattern in temperature (a flat line) hints at a lack of solar radiation, and thus, clouds.

Diurnal patterns also show up in sea level pressure when the solar radiation is still strong (during shoulder seasons and summer), particularly over continental regions away from the moderating influence of an ocean. It shows up more in the Rocky and Columbia Mountains than the Coast Mountains. Keep in mind that since diurnal patterns are created by solar radiation, they become weak during the darkest days of the year and vanish entirely over the far north.

COMPLEX PATTERNS AND TRANSITIONS

The patterns discussed above become more complex when nature changes or combines them into new patterns. The most common of these are:

a) Changes in intensity: In the left panel of Figure 2, isotherms are displayed in grey tones (pink-blue regularly) colours decreasing with time throughout much of Monday. However, a distinctly more intense temperature drop can be seen around 7 p.m. on Monday between 800 hPa and 500 hPa. Simultaneously, relative humidity decreases and winds veer from southwesterly to westerly. These are all hallmarks of a passing cold front.

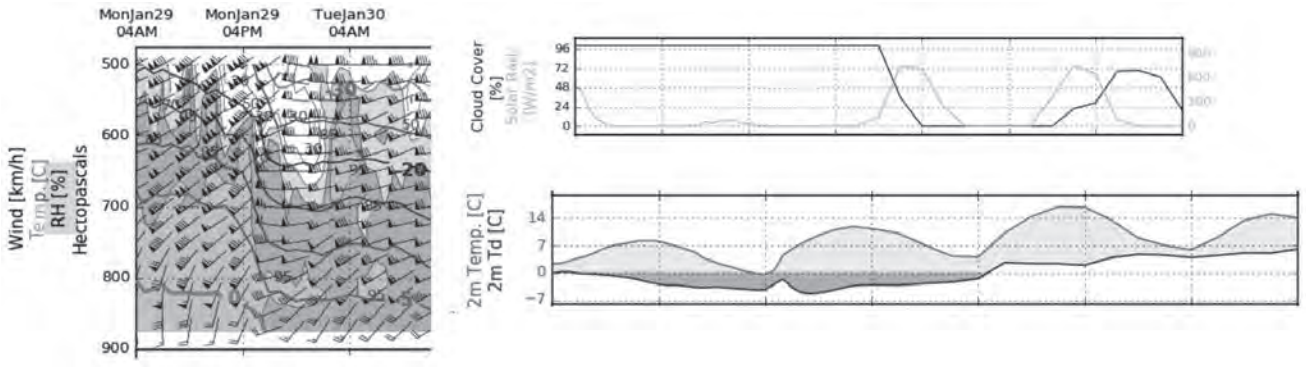


FIGURE 2

b) Transitions from one pattern into another: The top right panel in Figure 2 shows flat-lining cloud cover and solar radiation, indicating persistent conditions for the first half of the period. As cloud cover decreases, solar radiation begins to show a diurnal pattern with a decent amplitude of about 700 watts per meter squared (W/m2). An important next step is to understand what caused this change in cloud cover and what it means to your operation(s).

c) Two patterns appearing at the same time simultaneously: The bottom right panel of Figure 2 shows a diurnal temperature pattern overlain by a gradual temperature increase over the first three-quarters of the time period. Notice how both daytime highs as well as overnight lows increase over that time. This hints not just at clearing skies but also at a generally warming air mass.

The Pressure Dip

Sea level pressure is the most powerful single indicator of atmospheric changes. Almost all low-pressure systems and frontal passages are indicated by temporary low points in pressure, known as a pressure dip, followed by a pressure increase. The dip traditionally occurs together with changes in wind direction, precipitation, and cloud. The timing of the dip allows for surprisingly precise timing of surface frontal passages.

1. The deeper and more intense the pressure dip, the more intense the weather that may occur. The top diagram in Figure 3 is from a hurricane passage in Nova Scotia; this should be easy to pick out. Check the scale and how intense the pressure drop is.
2. If the pressure flatlines or decreases only slowly before suddenly increasing, chances are that a surface frontal passage lies right at the very beginning of the pressure increase. This is displayed in the middle diagram in Figure 3. Since this dip bottoms out near 1,015 hPa, weather associated with this feature is not expected to be intense. Note also how different the scale is compared to the hurricane case.
3. If pressure also shows a diurnal pattern, as in the bottom diagram of Figure 3, it becomes tricky to see the pressure dip, but examining conditions at the time of the lowest pressure dip is a very good first approach.

PUTTING PATTERN RECOGNITION TO WORK IN A METEOGRAM

The real power of any meteogram reveals itself when you take the above patterns and apply them across all available parameters and interpret their meaning together. Over time, you will learn to find fronts and ridges quite literally with one quick look. The meteogram in Figure 4 is a good practice example to start with.

The top panel shows an obvious white-green-white pattern that helps to divide the forecast time into three different weather periods: a dry (white) period lasting until 8 a.m. on Thursday, a moist (green) period lasting until about noon on Friday, and drier (white) conditions again.

The isotherms (pink-blue) in the first period show a mostly gradual increase (warming) that becomes much steeper (strong warming) when the moisture starts picking up below 700 hPa (about 3,000m), suggesting a warm front associated

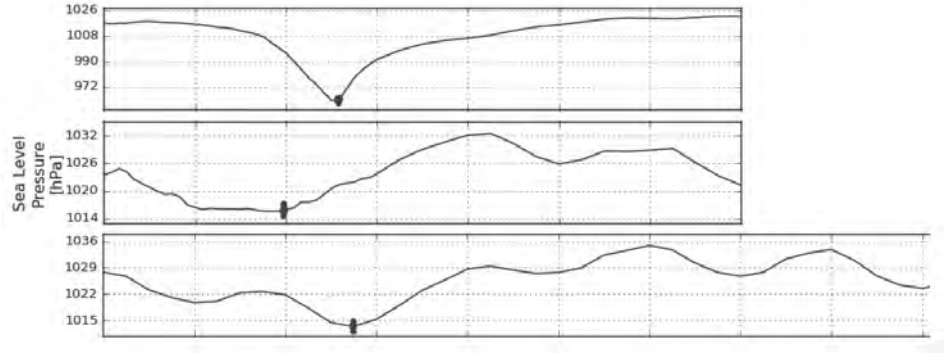


FIGURE 3

with the second period. Temperature then flatlines (stays persistent) in the third period but shows a definitive warmer environment than in the first period. A closer look at the outer envelope of the green shading in period two reveals it tilts slightly from top left to bottom right, therefore clouds can be expected to appear in the mid atmosphere several hours before they reach lower terrain.

Notice also how the sea level pressure shows a broad maximum in period one around 11 p.m. on Wednesday indicating a ridge or high pressure system moving into the area, peaking at 11 p.m. and then moving out again making room for the approaching front, increasing clouds, and backing surface winds from westerly to southerly.

In period two, you can see two precipitation periods associated with the cloud, the second of which is strongly correlated with a pressure dip near 5 a.m. on Friday. The pressure dip at the frontal passage is bottoming out around 1,007 hPa, which is not impressively low and reflected in the associated listless precipitation amount of four millimetres. It coincides with a shift in surface wind direction from southwesterly to northwesterly and thus strongly hints at a frontal passage that will trigger the clearing into period three. I would expect some improvement in sky conditions to start by 8 a.m.

Everything we have found so far is backed up by the 2m temperature that shows a distinct diurnal trend (clear skies) under the high-pressure ridge of period one. The diurnal trend becomes weaker (increasing cloud) and even disappears (overcast) into a gradual incline due to the warm front during period two, and is then followed by a warmer pattern with a diurnal trend reoccurring (cloud breaking up) in period three.

Meteograms are great tools to show exact forecast conditions at a location, but only by seeing beyond the numbers and recognizing the patterns will they reveal the story behind the numbers. With a little bit of practice and patience you will notice that these patterns occur again and again, allowing you to interpret the picture faster and with greater accuracy.

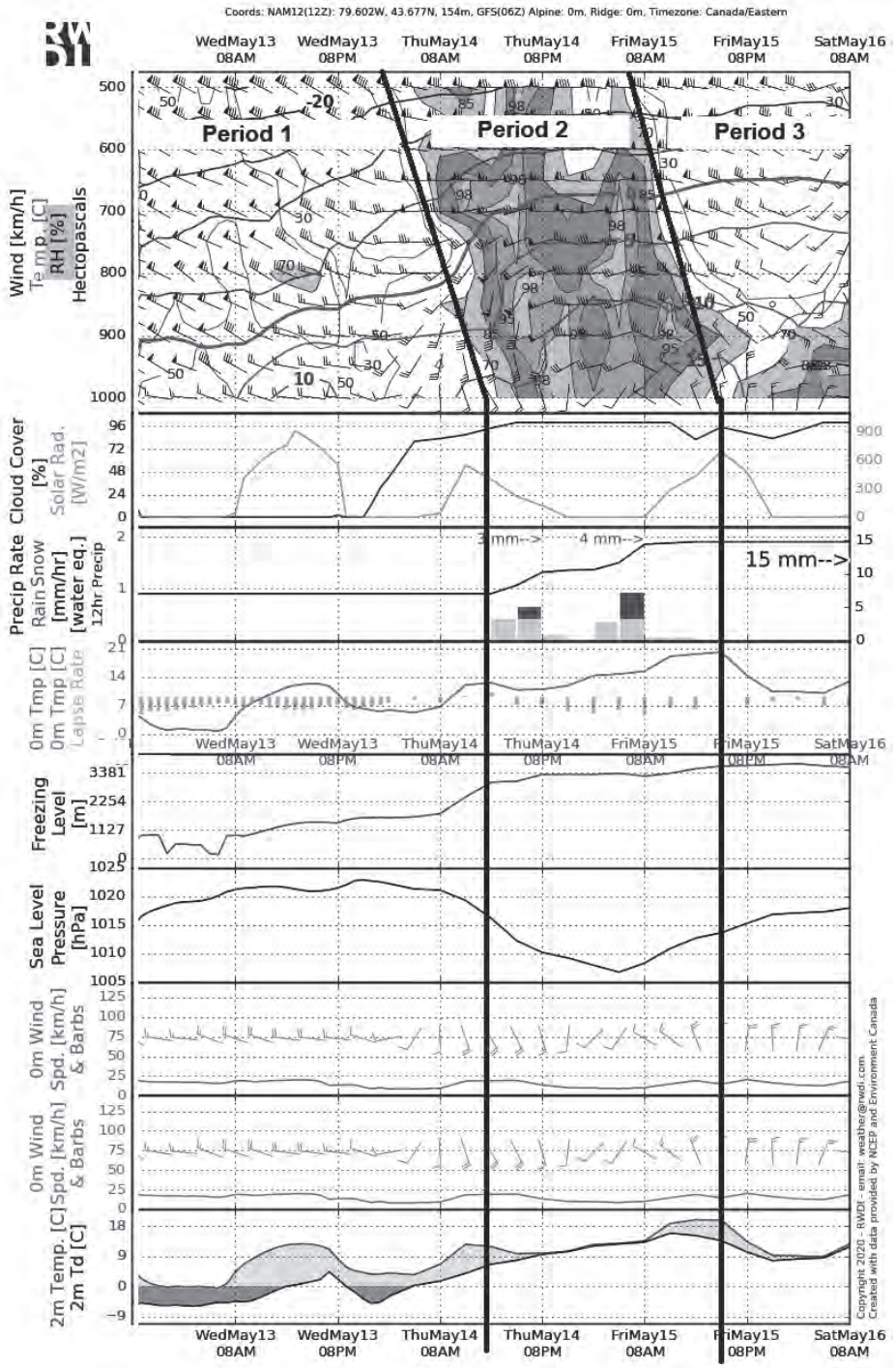


FIGURE 4

Adapting AST to COVID-19

Kevin Hjertaas, M-T-N Guiding

Many Avalanche Canada Training providers have looked at ways to offer the classroom portion of courses online this winter. Kevin Hjertaas of M-T-N Guiding realized there are bigger advantages to this than just social distancing.

WHEN COVID HIT, we started looking for a way to provide our Avalanche Skills Training course in a safe manner this winter. Over the summer, Scott Thumlert created an online avalanche curriculum that could act as the classroom day for our AST 1 courses.

We didn't realize the real advantages of creating a virtual classroom at first. But, as we started making our schedule, we realized having the old classroom learning done in advance meant students weren't committing one of their cherished weekend days to sitting indoors. Even better, we could run the field days on Saturdays and offer the one-day Managing Avalanche Terrain course on Sundays. One complaint you hear about AST is there isn't enough time to really travel in the mountains; this way, students who choose to take MAT get a whole extra day of valuable outdoor experience.

With this course layout, students start their online learning whenever they want, even weeks in advance. They complete sections with short quizzes at the end of each and the information is presented through videos, photos, text, and diagrams. Instructors follow students' progress, reply to their comments and questions, and then have a two-hour Zoom call to answer questions, drive home a few key points, and plan the field day. It seems like a more efficient use of people's time, and many people looking to get into the mountains aren't the type to happily sit inside for an entire Saturday.

Time will tell, but there may be some advantages for certain learner types as well. Students can do short bursts of learning, then quit when they stop retaining information. They can go back whenever they wish to make sure they understand what they've learned. You lose something not being in a classroom with students, but a motivated student should be able to learn and retain more this way.

Our field days look pretty much the same as ever. Social distancing is fairly easy in the mountains, and masks can be worn whenever it can't be maintained. Those who want, can do the Managing Avalanche Terrain course on Sunday.

We'll reassess at the end of the winter, but I could see staying with this format post-COVID. There are some negatives to losing the classroom day (mostly the time spent interacting with instructors), but the advantages may outweigh them.

Certainly, for this pandemic winter, we think it's a good solution.

THE OUTDOOR COMPONENT OF AN AST 1 COURSE WILL LOOK VERY FAMILIAR, BUT THE CLASSROOM SECTION IS BEING RECONSIDERED. // KEVIN HJERTAAS

THE MORNING GUIDE MEETING IS WHERE THE RUN LIST IS SORTED. // MIKE SADAN

The Run List Revisted

Mike Sadan

THE RUN LIST IS AN ICONIC PROCESS in heli- and cat-skiing. Every morning, a group of guides meets to choose which runs are opened and which get closed. The runs are colour-coded green for open, red for closed, and yellow as a hedge for objective criteria such as if a slope of concern has avalanched. The principles are that a group of guides will make better decisions than an individual lead guide, and that it reduces impulsive decisions biased by operational pressures in the field.

In companies with a long history of local terrain knowledge and intimate familiarity with specific runs, patterns develop as to what runs open first after a storm, and which runs open next as conditions improve. These undocumented but recognizable patterns make up a terrain hierarchy. Terrain severity ratings, which describe the exposure of terrain to potential avalanche hazard, are evolving; however, no professional scale has been standardized in mechanized skiing to date.

Overall, I believe run coding has prevented many accidents over the years; however, there are numerous challenges to this format, particularly in a day-skiing operation often interrupted by weather cancellations. They include the high number of runs to consider in a limited amount of time, a potential lack of local terrain knowledge by part-time and new guides, and the limited number of guides able to effectively participate given rarely used remote or new tenure. Consistency in run coding, a common mindset on the severity of runs, and matching chosen terrain to the hazard of the day also add to these challenges.

At Whistler Heli-Skiing we've experimented with variations to the status quo to try and address some of these problems. These are some of the solutions we've come up with:

Terrain classifications: We permanently assign a classification to each run in the InfoEx run list module using a scale with a resolution of nine categories: green-, green, green+, blue-, blue, blue+, black-, black, and black+. This can be a useful group exercise to create a common mindset for terrain. The classifications use a combination of terrain hierarchy validated by a set of in-house terrain severity definitions as a starting point. Subsets in classification tend to represent subsets of what runs are opened under what conditions.

Run coding: Only two colours are used: green (open) and lime (open but requiring further observations). Red, yellow, and all other colours are eliminated. Runs that are not coded are deemed not selected and not available

for the day. This makes meetings more efficient by reducing the number of runs that are coded, it simplifies the run list that shows up on tablets, and it improves prioritization of discussion with a greater focus on terrain that may potentially be used that day.

Lime runs are for terrain that deserves an opportunity pending further information. The standard operating procedure is it can't be an "opener" and that some observations need to be noted (or recorded) that reduce the epistemic or knowledge based yet resolvable uncertainty that was present at the morning meeting as a condition of it being skied.

To qualify, a coded run needs to be useful (proximity, elevation band, ski terrain) and safe enough (avalanche risk or uncertainty, crevasses, skier fall and slide hazard etc).

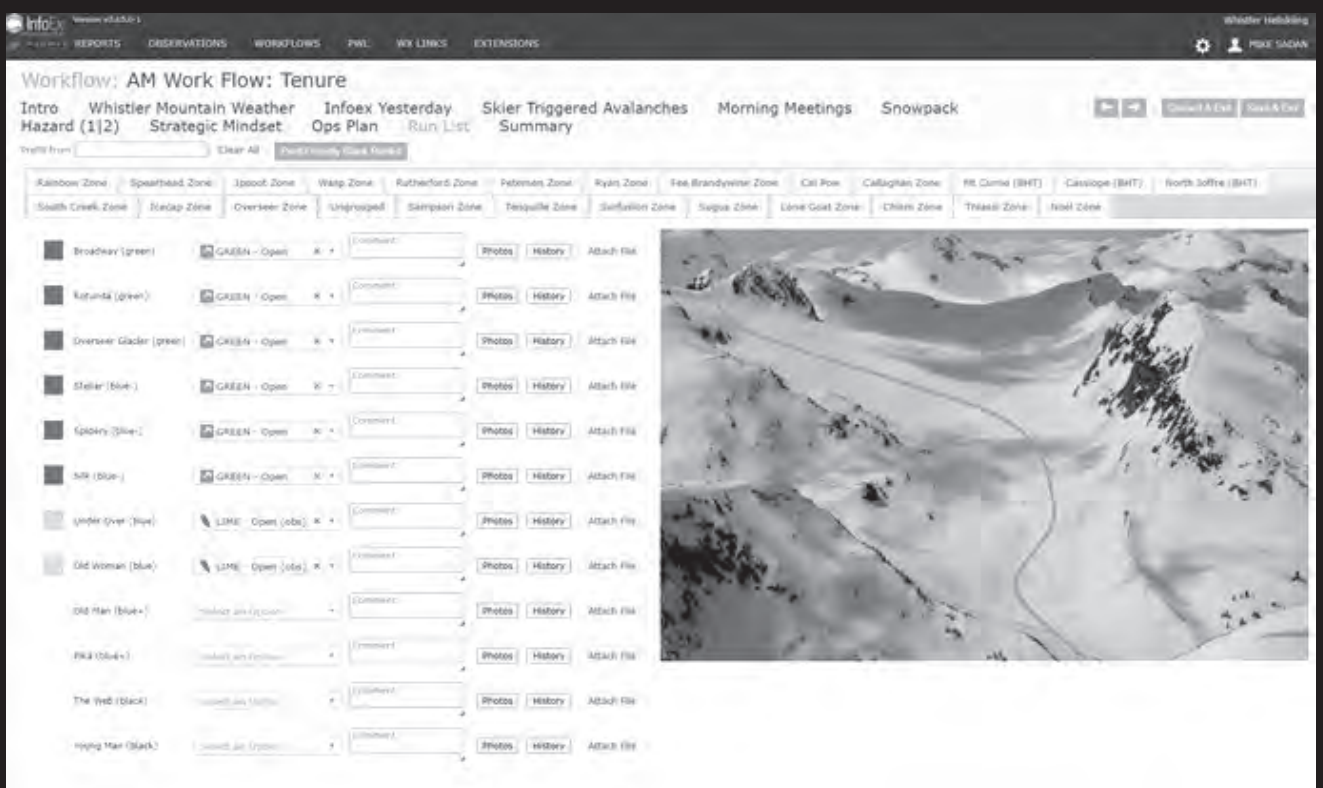
How it works: The run list is sorted by classifications—the green ones at the top and the black at the bottom. Invariably all the runs at the top will mostly be coded green or lime. Depending on hazard, eventually the coding will stop and the guides will move onto another zone before the entire list is considered. Runs not considered useful will also be skipped.

PERSONAL REFLECTIONS

This was our first winter using this format. My feeling was we got less bogged down debating and wasting valuable minutes on terrain that was on our list but had little chance of being skied that day. There were fewer instances where we were nearing the end of our meeting and rushing those last few run coding's to stay on schedule. In addition, it was easier for guides to follow along or form an impression on decision making for terrain they were not familiar with. The trade-off was a thinner documented track record for uncoded runs as a record keeping piece, but that did not impact day-to-day operations.

This format could also help with deciding what lines are chosen on an open run, another inherent challenge to the run coding process. In other words, it may not make sense to ski a black line on a green coded run if runs classified as black were not selected for the list.

Comments on this article are welcome. Please send them to msadan@vailresorts.com.



WHISTLER HELI-SKIING RUN LIST, CODED IN GREEN (DARK GREY) AND LIME (LIGHT GREY).

AvSORT II: Multi-casualty Avalanche Triage Algorithm

Michael Inniss, MD, DiMM

THE ORIGINAL AVSORT (Avalanche Survival Optimizing Rescue Triage) multi-casualty avalanche triage algorithm, first published by Jeff Boyd, Kyle McLaughlin and Lee Bogle in 2010, was introduced to help avalanche first responders address the challenges of multi-casualty avalanche rescue in the face of limited rescue resources. In the 10 years since its publication, several key rescue interventions have been introduced that have become standard practice in avalanche rescue. The AVSORT II project goal is to update the original AVSORT algorithm to current international standards and provide a practical triage tool to assist with avalanche incident response.

The AVSORT II project gained momentum and collaboration with the involvement of Boyd and McLaughlin following the presentation of a proposed update by myself during the Canadian Avalanche Association's 2020 Virtual Spring Conference. This input has resulted in further revisions and AvSORT II is now being presented for industry review and potential incorporation into avalanche rescue plans.

As with the original algorithm, subject assessment variables are found along the left-hand side from top to bottom as the rescuer would conceivably progress through a rescue response. Internationally recognized colour-coded (green, yellow, red, and black) medical triage designations, based on results of the progressive subject assessment process, are found along the right-hand side of the algorithm.

There are three tactical rescue triage assessments that are new to AvSORT II: terrain triage, burial depth triage, and extrication status triage. At the onset of the rescue, these assist the responder in tactically triaging a subject as a provisional black designation. This permits the rescuer(s) with limited resources to expediently move on to locate and extricate other full burials, or attend to critical, potentially life-saving interventions on other subjects in the hope of doing the most good for the most victims.

Experienced avalanche rescue teams recognize the importance and benefit of incorporating such tactical decisions into the early phases of the rescue in order to ideally prevent wasting resources on what are highly likely non-survivable circumstances. Drafting a medically-triaged green subject into the rescue team, perhaps as a shoveler, is another example of tactical rescue triage that responders may be familiar with. Recognizing that mountainside triage is a dynamic process, these decisions early on in the incident response often require revisiting as rescue resources allow and the rescue incident evolves.

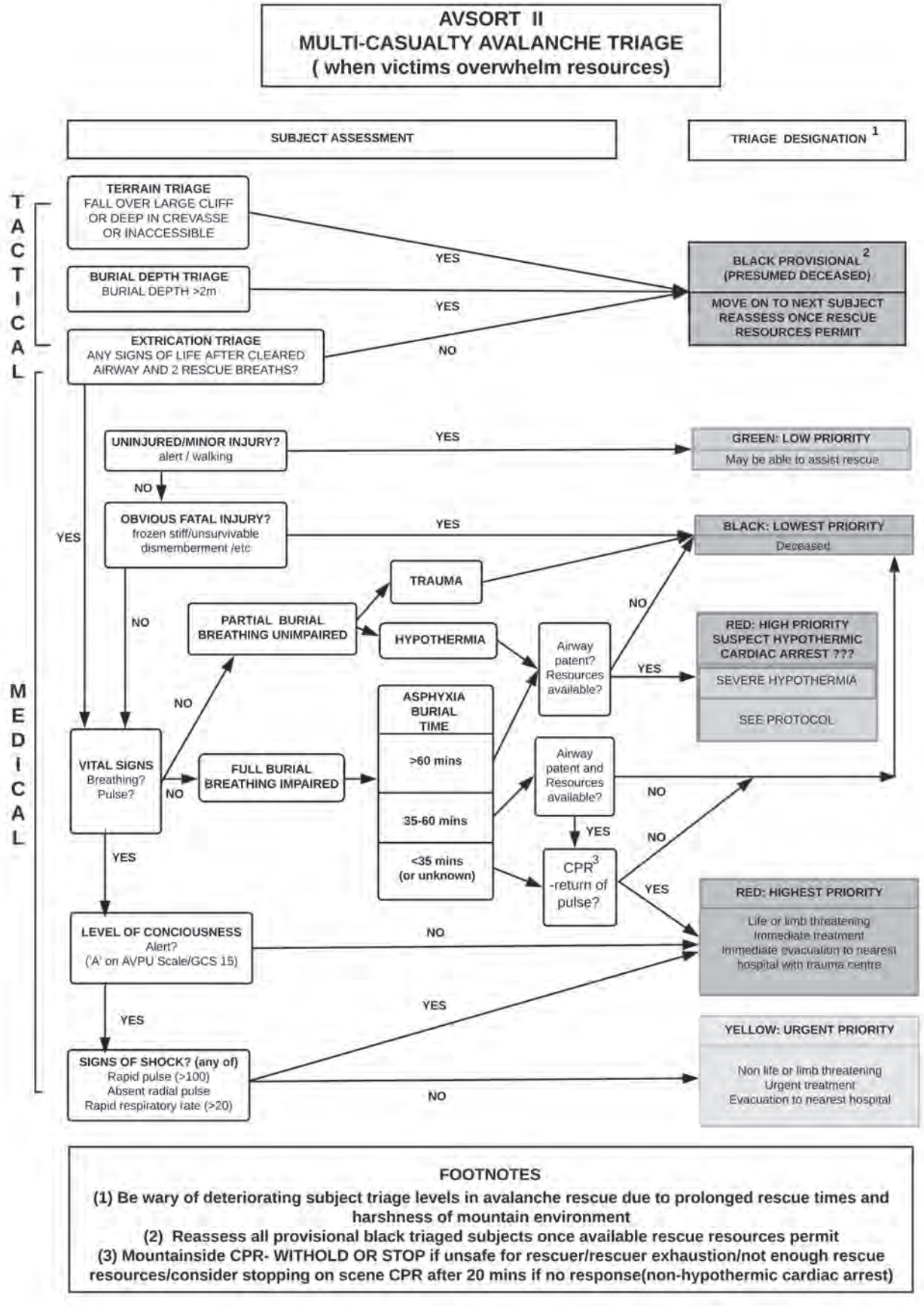
Advanced re-warming protocols have become standard internationally for avalanche subjects that appear to be suffering hypothermic (Swiss stage IV/vital signs absent) cardiac arrest after excavation from a prolonged burial of more than 60 minutes. This development in avalanche rescue has resulted in the addition of a novel red (severe) hypothermia triage designation with an accompanying resource-intensive pathway of care and subsequent transport ramifications.

A successful recovery from severe hypothermia after a prolonged full burial has yet to occur in Canada. Compared to Europe, our vast mountain geography, lack of expedient organized rescue resources, and relatively limited centres capable of providing such advanced vascular rewarming treatment have all to date, conspired against such a recovery.

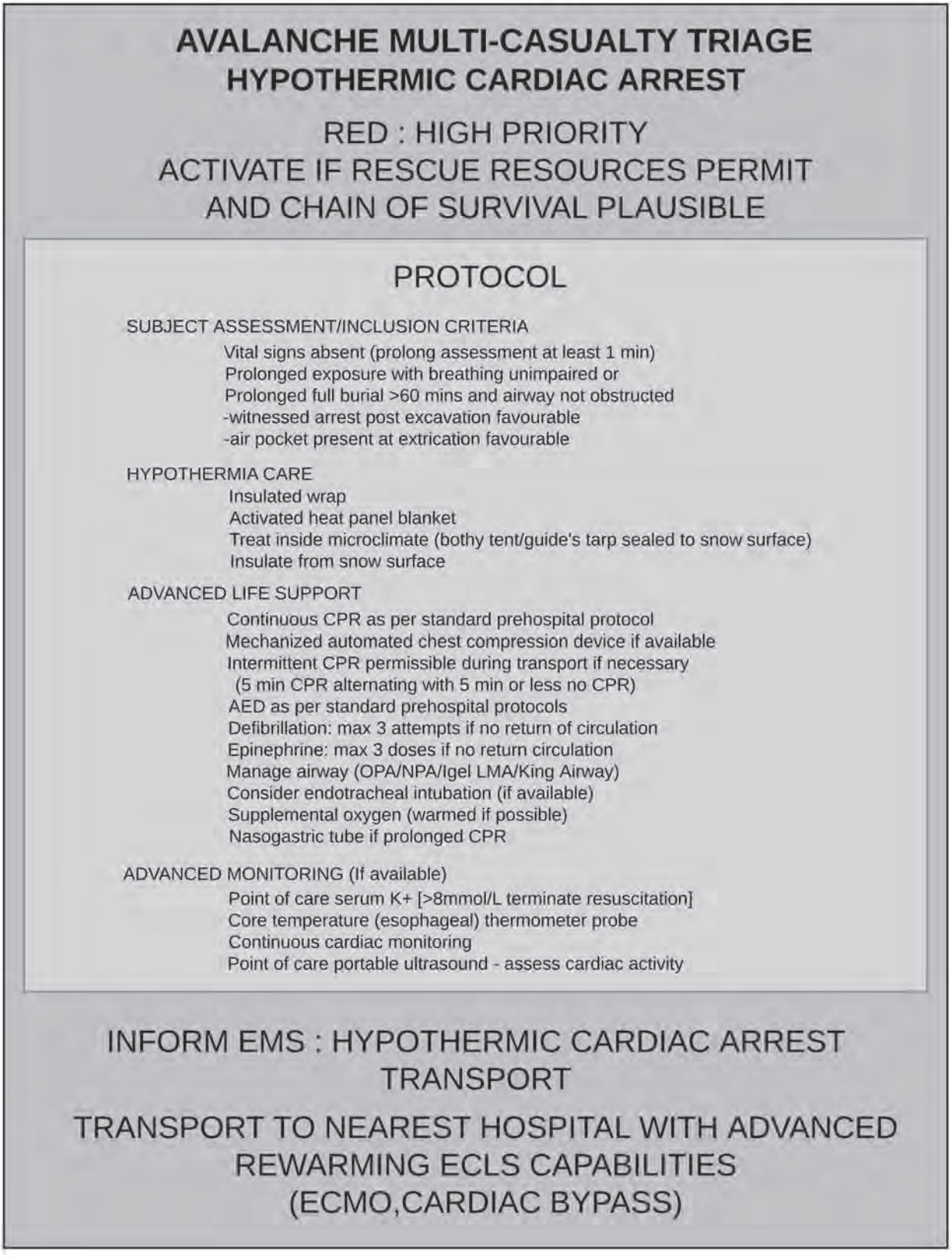
For reference, a detailed treatment protocol pathway is provided as an addendum to the main triage algorithm. It is for the prolonged full burial victim (>60 minutes) who is excavated with a non-obstructed airway, when the rescuer is considering severe hypothermia as the cause of cardiac arrest. Of note, the presence of an air pocket during subject excavation and witnessed cardiac arrest after extrication from a prolonged full burial are favourable prognostic factors for a potentially positive outcome.

Multi-casualty avalanche triage is a challenging exercise where rescuers may find themselves cognitively overloaded as a result of the urgency of the task at hand. It is hoped that reintroducing the AvSORT multi-casualty triage algorithm as an updated AVSORT II version will provide a useful tool in assisting rescue teams to optimize outcomes during multi-casualty avalanche rescue.

To provide feedback or ask questions, please contact Mike Inniss at minniss@telus.net.



AVSORT II USES INTERNATIONALLY-RECOGNIZED, COLOUR-CODED TRIAGE DESIGNATIONS.



A NEW ADDITION IS A TRIAGE PROCESS FOR PATIENTS EXPERIENCING HYPOTHERMIC CARDIAC ARREST.

What's Your **Biggest Challenge?**

WORKING IN THE AVALANCHE INDUSTRY means dealing with uncertainty. With COVID-19, a whole new layer of uncertainty lies over the industry. For some of you reading this, your winter will be determined by forces outside of your control. Will the border open? Will your employer stay open? Will there be enough clients to keep you employed? If you're tasked with keeping a highway open or a mine safe, it is likely you'll be working unless there is another major global shutdown. With this in mind, we asked a number of operations:

> What is the *biggest* challenge COVID-19 presents to your avalanche control operation going into this winter, and how are you addressing it?

Here is what we heard back:

The biggest challenge COVID-19 presents to our avalanche control operations is staffing when people present symptoms. Currently, rapid testing is not readily available by either purchasing test kits ourselves or by the BC provincial or federal governments. This means if staff present symptoms, they will be sidelined until lab tests come back many days later. Our worksites are remote and mobilizing "as and when" replacement staff is difficult, especially during storm periods. We've put together a long list of people to call, if required. Simply put, we will do our best.
Greg Johnson, 6 Point Engineering

I think the biggest challenge for our program will be staff infected or exposed to COVID-19 over the course of the winter. The Ministry of Transportation and Infrastructure (MoTI) has eight distinct avalanche programs across the province, each with its own unique operational considerations.

Local familiarity with snowpack characteristics, terrain, and local maintenance and MoTI operational staff is very critical and it can be challenging to move staff around the province to potentially backfill for a program, if required. It also leaves other programs potentially short-staffed if we do go into a province-wide avalanche cycle.

The MoTI has clear COVID-19 safe work procedures and training that does provide guidance and resources to minimize the risk of staff exposure to COVID-19. The MoTI avalanche program is also forming contingency plans if we do indeed need to move staff around the province to fill in where required.
Robb Andersen, Ministry of Transportation & Infrastructure, Kootenay Pass

Our main issues relate to cross-border travel field assessments, as we have a regular avalanche safety program in Washington State and I travel to the U.S. periodically for meetings and field reviews. The 14-day self-isolation has stopped that dead in its tracks, even though we are still able to go the U.S.

The other issue is with regards to some of our projects that are camp-based, or have workers at sites with many other workers (hundreds in some cases). We need to build redundancy into our work force to be able to address the chance that someone could be exposed to COVID, or have symptoms, in which case they won't be able to go to a work site. We're taxed for personnel in the main part of the winter in a normal year, so this year will be especially challenging.
Alan Jones, Dynamic Avalanche Consulting

I'd say the biggest challenge to our avalanche control operation is going to be the morning meeting. We are only permitting a limited number of patrollers in our locker room at one time. As a result, we will be bringing in our route leaders as one group and informing them of conditions and objectives of the day. We will assign them a route and a partner and then they will head up the mountain. The second group will have a slightly staggered start time and be provided the same conditions report and objectives. Teams will get together at the top of the gondola and discuss their plan for avalanche control, all while maintaining social distance and wearing masks. They'll grab their product and head up the chair. Once on route it will be easy to maintain distancing and should be operations as normal. We acknowledge this will be a dynamic situation that may require plans to change as the season progresses.
Al Roberts, Revelstoke Mountain Resort

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THE VIEW FROM SPACE: OPERATIONAL REMOTE SENSING OF AVALANCHE ACTIVITY USING SATELLITES

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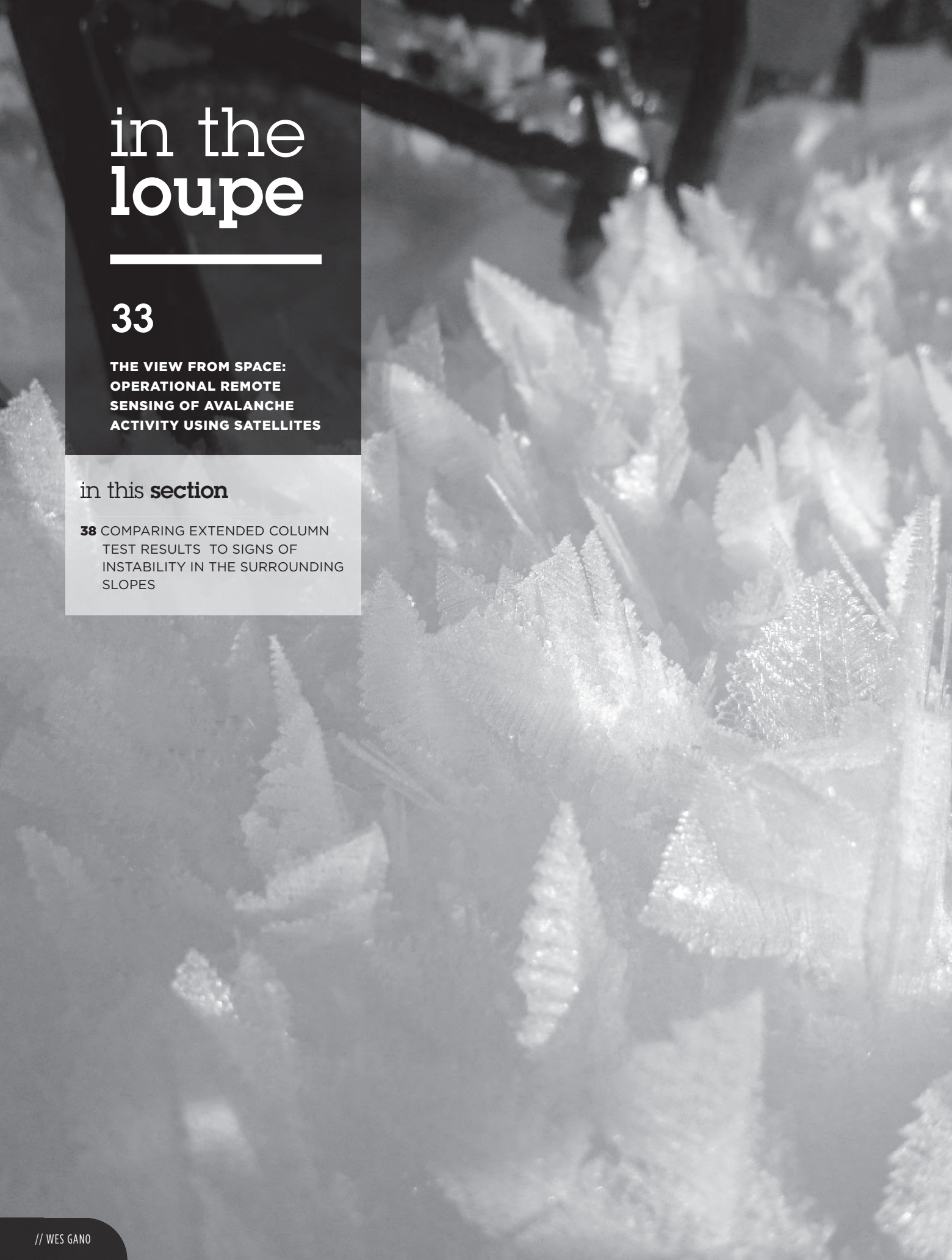

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The View from Space: Operational Remote Sensing of Avalanche Activity Using Satellites

Markus Eckerstorfer, NORCE - Norwegian Research Centre AS, Bergen, Norway

Detecting avalanche activity is critically important for avalanche forecasting. In Norway, they have begun using satellites to do this task.

THE PROBLEM: ***'How many avalanches, and of what size, have recently been released in our forecast domain?'***

This seemingly simple question is very difficult to answer for a typical forecasting region. Although avalanche activity information is critically important for generating reliable avalanche forecasts, such data are rarely available at the spatio-temporal scales relevant for an entire forecasting region [1]. Avalanche forecasters must therefore deal with spatio-temporal scaling issues, where data from short time frames across non-representative areas is all that is available. The forecast then relies on incomplete data from a convenient spatial sample—data that is easily observed within the forecast domain.

OVERVIEW OF SOLUTIONS

Over the past decade, innovative technologies have been introduced, tested, and operationalized to assist in solving the sampling and scale deficiencies in avalanche observations. A combination of different remote sensing platforms and sensors are used to monitor avalanche activity across a range of spatial domains spanning single slopes to entire forecasting regions, either through continuous monitoring or during monitoring campaigns.

We classify remote sensing platforms into ground-based, airborne, and spaceborne. Sensors on these platforms are classified into optical, radar, or acoustic. In general, there are tradeoffs between the temporal and spatial resolution of any remote sensing technique, thus the choice to employ a certain remote sensing technique ideally depends on best matching the system and sensor to the monitoring problem at hand [2].

Monitoring avalanche activity on a slope to valley scale has been successfully demonstrated using automatic time lapse cameras [3], lidar (light detection and ranging) scanners [4], infrasound [5] and terrestrial radars [6]. These remote sensing solutions are beneficial by allowing for continuous, real-time monitoring of small avalanches in a range of weather or light conditions (depending on the sensor, with the exception of time lapse cameras).

Some of these remote sensing techniques have been successfully operationalized and are employed for real-time avalanche monitoring in areas with critical infrastructure, such as the infrasound and long-range radar avalanche detection system in Rogers Pass.

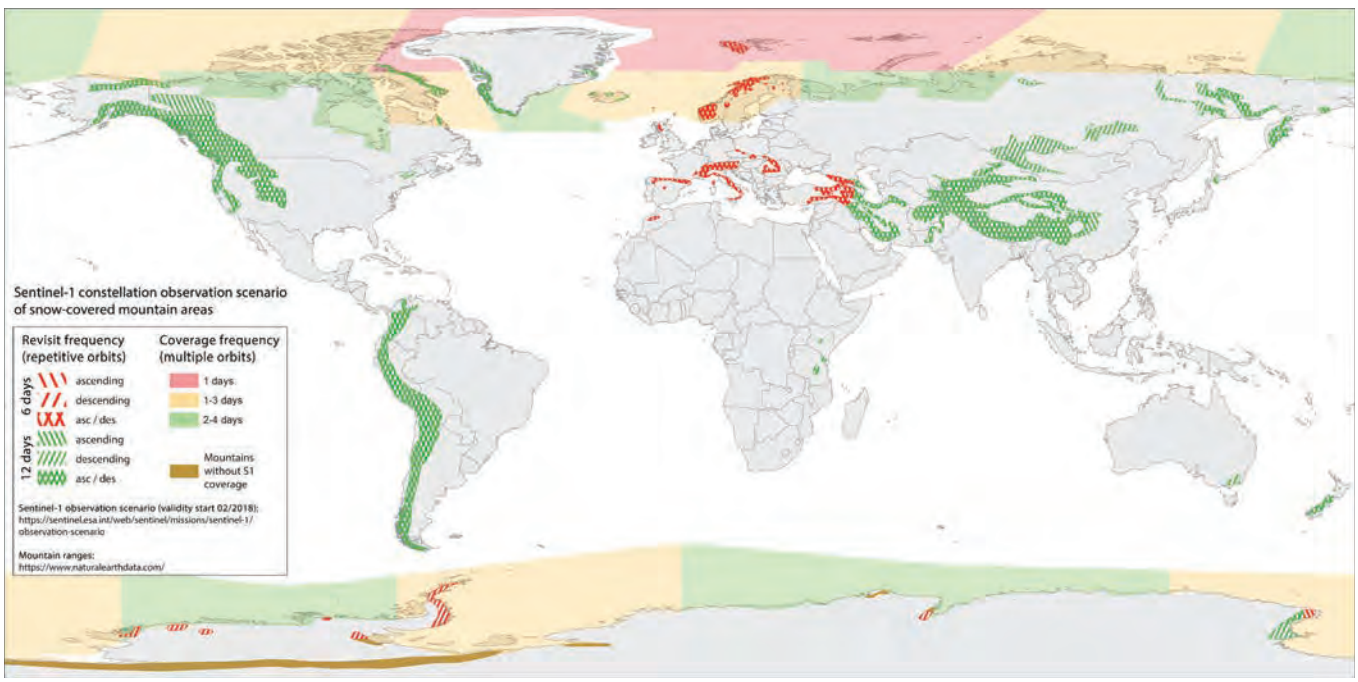

FIG. 1: SENTINEL-1 OBSERVATION SCENARIO OF SNOW-COVERED MOUNTAIN AREAS. FOR AVALANCHE DETECTION, BOTH ASCENDING AND DESCENDING IMAGES NEED TO BE AVAILABLE.

However, both equipment and operational costs are high for these, ground-based monitoring systems. These costs must be weighed, for example, against investing in permanent mitigation measures.

In recent years, the use of drones has increased our ability to monitor avalanche activity during dedicated field campaigns and we currently see different sensors being deployed on these airborne platforms [7].

The technology for monitoring broader spatial domains such as an entire forecasting region is still at a lower level of readiness. The main reasons include low data acquisition frequencies (often several days), high financial costs (several thousand dollars for very high resolution optical satellite imagery), limitations in detecting small avalanches due to poor sensor resolutions, and the complexity of automatically detecting avalanches in satellite imagery.

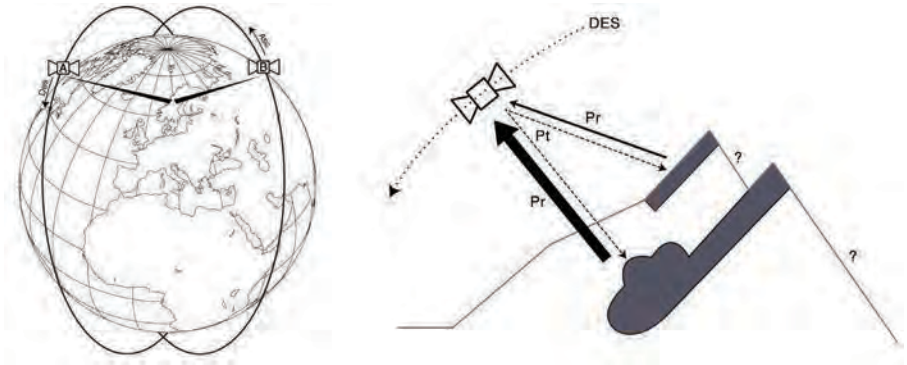

FIG. 2: LEFT PANEL: SENTINEL-1 A AND B SATELLITES IN THEIR DESCENDING (DES) AND ASCENDING (ASC) ORBITS RESPECTIVELY, WITH THE SIDE-LOOKING GEOMETRY INDICATED. RIGHT PANEL: A DRAWING SHOWING THE SENSOR ON BOARD OF SENTINEL-1 TRANSMITTING ENERGY (PT) AND RECEIVING BACKSCATTER (PR) FROM UNDISTURBED SNOW AND AVALANCHE DEBRIS. IN CASE OF AVALANCHE DEBRIS, MORE ENERGY IS REFLECTED BACK TO THE SENSOR, AS INDICATED BY THE THICKER ARROW. DUE TO THE SENSOR'S SIDE-LOOKING GEOMETRY, AWAY-FACING SLOPES (INDICATED BY QUESTIONS MARKS) HOLD NO INFORMATION.

AUTOMATIC AVALANCHE DETECTION IN SENTINEL-1 IMAGES

A handful of studies published in recent years have shown the two Sentinel-1 radar satellites to be the workhorses for regional to country-wide avalanche monitoring [8], [9]. The satellites are part of the European Commission's Copernicus environmental monitoring programme, which offers freely available, global earth observation data. They are equipped with synthetic

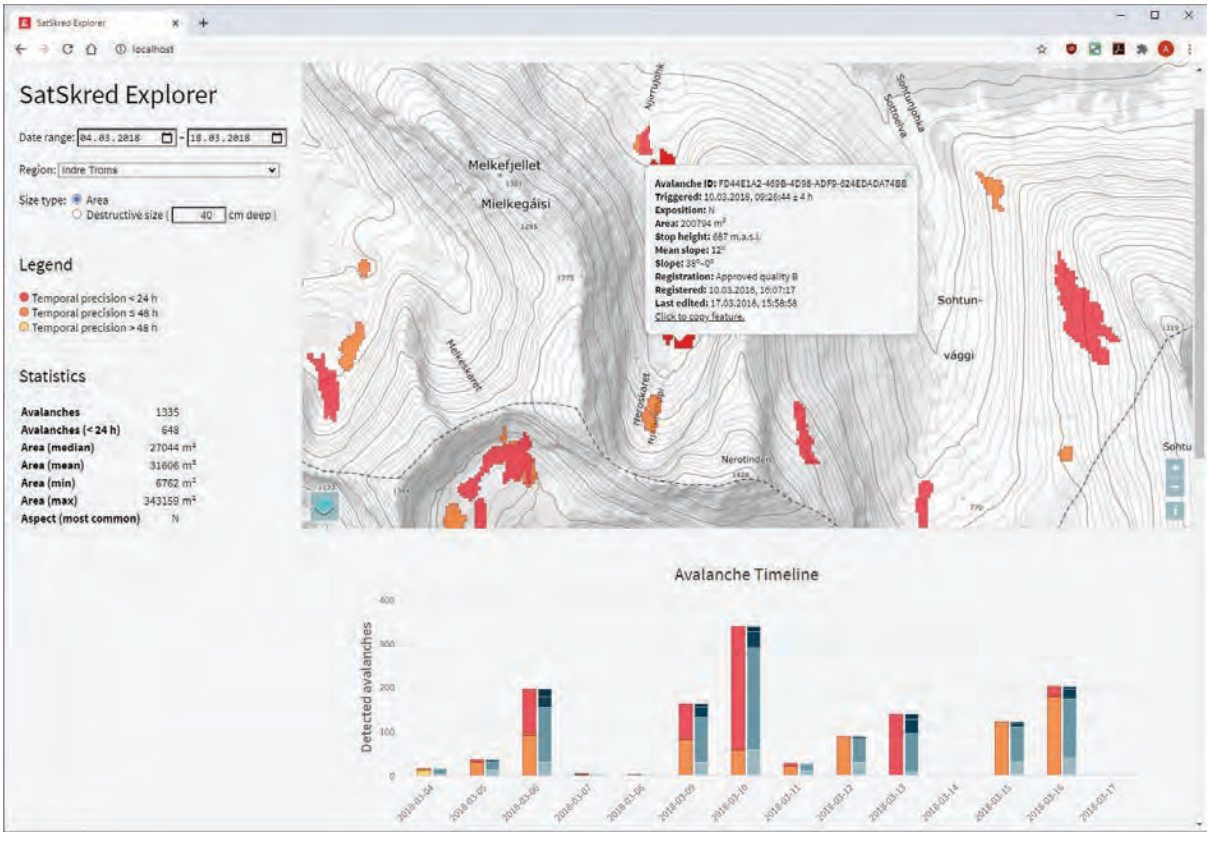

FIG. 3: A SCREENSHOT OF THE SATSKRED EXPLORER THAT VISUALLY PRESENTS THE OUTPUT OF THE AUTOMATIC AVALANCHE DETECTION SYSTEM TO THE NORWEGIAN AVALANCHE FORECASTERS. ENERGY IS REFLECTED BACK TO THE SENSOR, AS INDICATED BY THE THICKER ARROW. DUE TO THE SENSOR'S SIDE LOOKING GEOMETRY, AWAY-FACING SLOPES (INDICATED BY QUESTIONS MARKS) HOLD NO INFORMATION.

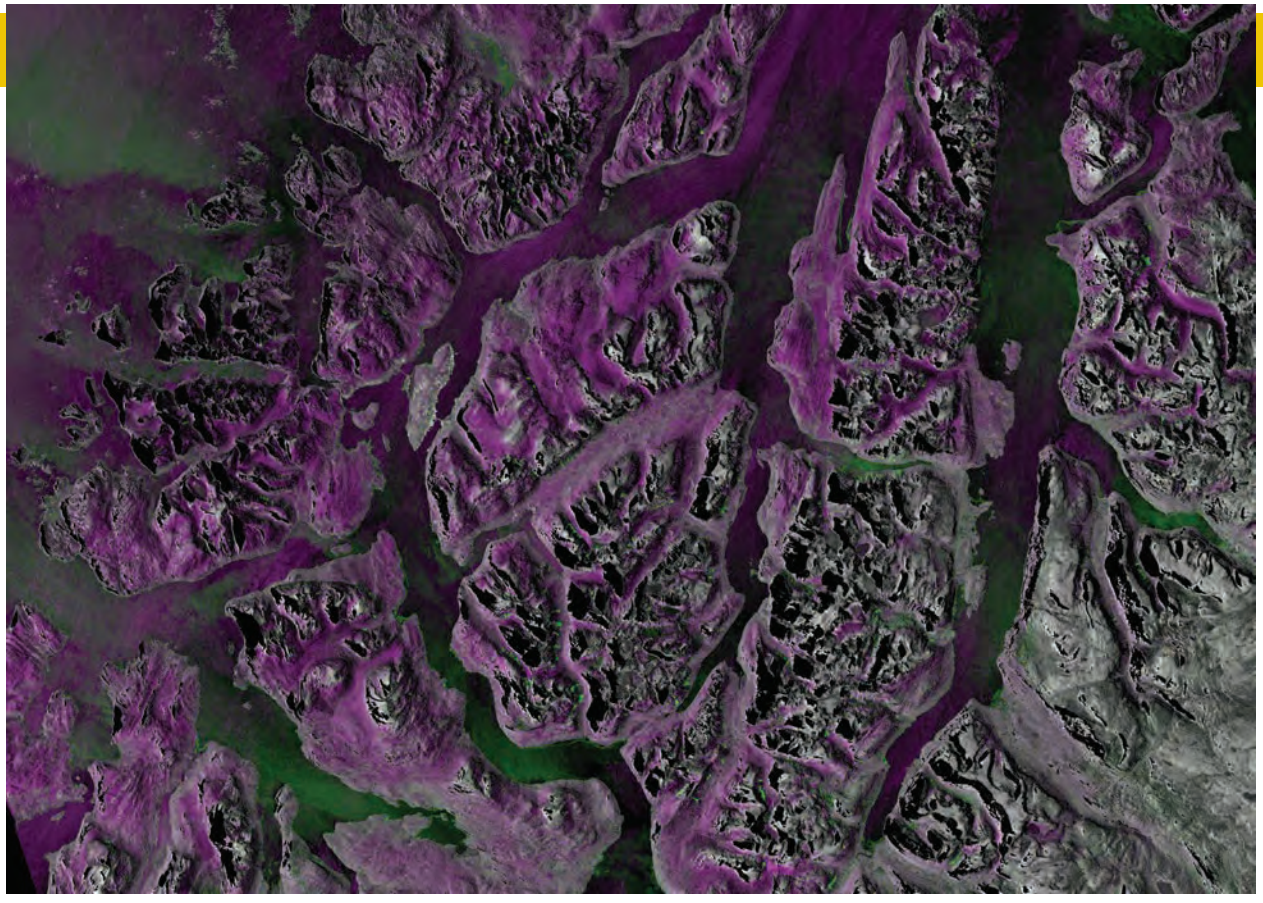

FIG. 4: AN RGB COMPOSITE THAT SHOWS RELATIVE CHANGE IN BACKSCATTER BETWEEN TWO SENTINEL-1 IMAGES THAT ARE SIX DAYS APART. PURPLE TONES INDICATE A RELATIVE BACKSCATTER DECREASE, LIKELY DUE TO SNOW TURNING FROM DRY TO WET, AND GREEN TONES INDICATE A RELATIVE BACKSCATTER INCREASE IN CASE OF AVALANCHES.

aperture radar (SAR) sensors that produce radar images with a pixel resolution of 20 metres. SAR sensors have all-weather, all-light monitoring capabilities; however, due to their side-looking geometry, radar shadow and layover effects occur on particular slope aspects.

The SAR sensors on board the Sentinel-1 emit electromagnetic radiation in C-band radar frequencies. C-band SAR is generally ineffective in detecting dry snow, however, it is reflected to a very large degree at the surface of wet snow. C-band SAR can thus successfully be used to distinguish dry from wet snow, and for determining snow water equivalent. The energy reflected back to the sensor is called backscatter.

NORWAY'S OPERATIONAL AVALANCHE MONITORING SYSTEM USING SENTINEL-1

Over the past five years, we have developed the most technologically mature automatic avalanche detection system for large scale monitoring using Sentinel-1. Norway is particularly suited for using Sentinel-1 data due to the country's high latitude, which ensures daily data coverage across the majority of the country. In addition, similar to Canada, avalanche forecasting regions are large and thus difficult to monitor consistently in space and time. In the Satskred ("skred" means avalanche in Norwegian) project, we worked with the Norwegian forecasting service (varsom.no) within the Norwegian Water and Energy Resource Directorate and the Norwegian Public Road Administration to develop the operational monitoring system.

A fully automatic processing system constantly downloads all available Sentinel-1 images over Norway and detects avalanches in these images by comparing them to images from the same location during the previous pass six days prior. If an avalanche occurred within these six days, our automatic detector identifies an increase in energy reflected back to the sensor from the debris field of the avalanche. As other natural phenomena can also exhibit temporal backscatter increase, we deploy our automatic detector only to predefined avalanche runout areas to increase the odds that the backscatter increase we are detecting is related to avalanche activity. The initial temporal uncertainty of six days is then iteratively minimized by detecting the same avalanche in subsequent Sentinel-1 images and tracking its age.

Wet snow avalanches exhibit a stronger backscatter increase and therefore also exhibit a stronger contrast to undisturbed snow. Our automatic detector performs significantly better for wet snow avalanches, with a probability of detection of around 75%, than for dry snow avalanches, where the probability of detection is around 20%, when we compare our detections to manual avalanche field observations. Moreover, the 20 metre spatial resolution of the SAR sensor sets the lower limit of detectable avalanches to destructive size two.

Overall, given the constraints in detectable avalanche size as well the problems with detecting dry snow avalanches, we assume we are under-detecting. To deal with the uncertainty that stems from the varying probabilities of detecting certain types of avalanches, the final output of the processing system is summarized to regional averages for each forecasting region. The avalanche forecasters receive daily updated information on the presence and location of avalanche detections and have the possibility to visually check detections presented as vector polygons on a web-based map solution.

For the upcoming winter, the Norwegian avalanche forecasting service will run the processing system on their servers, detecting avalanches in all 22 forecasting regions on a daily basis to assist in reducing uncertainty in their avalanche forecasts.

Global application of Norway's avalanche detection system

The Sentinel-1 satellites cover all snow-covered mountain regions worldwide, with the exception of the Transantarctic Mountains. Due to the generic nature of our avalanche detection system, it is feasible to establish consistent, automatic avalanche detection anywhere on Earth. As input data, a high resolution digital elevation model (20 m) and an avalanche runout area mask are required. The latter can now be automatically generated using a recently devised method to automatically derive Avalanche Terrain Exposure Scale Maps [10].

The largest limitation for applying our detection system anywhere on Earth is the availability of Sentinel-1 images and their revisit frequency. The standard revisit frequency for images with similar geometry and tracks is six days in Europe and over seismic hotspots, and 12 days elsewhere. However, since there are two

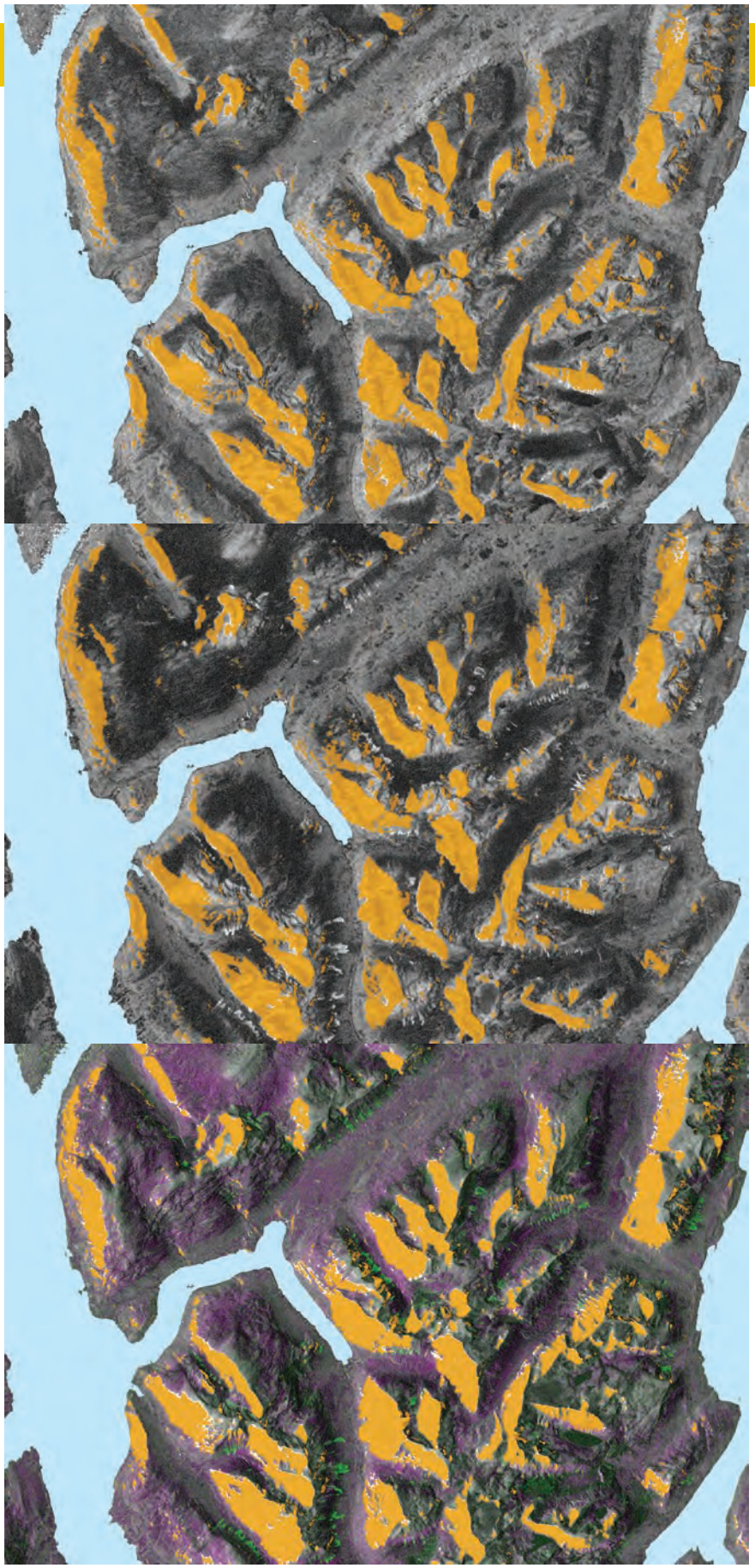

FIG. 5: THE THREE PANELS SHOW THE LOGIC BEHIND THE TEMPORAL CHANGE DETECTION USED TO DETECT AVALANCHES IN SENTINEL-1 IMAGES (THE ORANGE AREAS ARE IN THE RADAR SHADOW). IN THE IMAGE FROM DAY ONE (LEFT), NO AVALANCHE ACTIVITY IS VISIBLE, WHILE THE IMAGE FROM DAY SIX (MIDDLE) CONTAINS SEVERAL DOZENS OF AVALANCHES, VISIBLE AS ELONGATED, LIGHT GREY FEATURES EXTENDING FROM THE MOUNTAIN SLOPES. THE RGB CHANGE DETECTION IMAGE (RIGHT) SHOWS THE AVALANCHES IN GREEN FOR BETTER VISUAL INTERPRETATION.

Sentinel-1 satellites travelling 180 degrees apart in polar orbits, satellite tracks overlap, especially at high latitudes, effectively reducing revisit frequencies. For Rogers Pass, for example, during a 12-day repeat cycle, images are acquired on day one (ASC), day three (ASC), day four (DES), and day nine (DES). An equal number of ascending (from the North Pole, looking left) and descending geometry images (looking right) are thus required to detect avalanches on all slope aspects. However, the acquisition timing is inconsistent, with a five-day data gap between the images at day four and day nine, as well as a three-day data gap between day nine and the start of the subsequent 12-day cycle.

THE 'ORBIT' AHEAD

During next year's ISSW in Fernie, we hope to report from a successful first winter of Norway-wide avalanche detections using Sentinel-1 and share our experiences with the broader avalanche community. We are currently working on gaining a better understanding of the radar backscatter signal from avalanche debris—especially from dry snow avalanches—in order to improve detection performance. The latest development is to exchange our current automatic avalanche detection algorithm with a neural network, with initial tests showing a significant overall performance improvement [11]. Finally, we hope to engage more research communities in this important work, in order to progress this promising and exciting technology together.

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Comparing Extended Column Test Results to Signs of Instability in the Surrounding Slopes: Exploring a Large, International Data Set

Frank Techel, Karl Birkeland, Doug Chabot, Jim Earl, Ivan Moner, Ron Simenhois

SINCE ITS INTRODUCTION IN 2006, the extended column test (ECT) has become one of the most popular tests to assess point snow instability. In 2009, two studies explored how ECT results correlated to observed instabilities, laying the foundation for the test's interpretation we are using today. Based on data from the first winters, Ron Simenhois and Karl Birkeland from the United States showed that ECTPVs and ECTPs were typically observed when conditions indicated instability, while ECTNs and ECTXs were mostly observed on stable slopes. (For ECT scoring abbreviations, refer to *Observation Guidelines & Recording Standards for Weather, Snowpack & Avalanches* [CAA, 2016].) This continues to be the standard for interpreting ECTs in most countries. In Switzerland, Kurt Winkler and Jürg Schweizer noted that ECTP≤21 detected a large proportion of unstable slopes correctly while keeping the number of false alarms low. Again, ECTNs or ECTXs were more frequently associated with stable slopes in their study. In Switzerland, this is the operationally-used approach to classify ECT results.

Now, more than 10 years later, the ECT is a well-established test internationally. The time is right to revisit these stability interpretations, as recently done using Swiss data (Techel et al., 2020), by combining ECTs from North America (mostly from the U.S.), Spain, and Switzerland.

WHAT DATA DID WE USE?

We explored snow profile databases from snowpilot.org, Val d'Aran (Spain), and Switzerland. We only included backcountry snow pit profiles with ECT results and information about the presence or absence of clear signs of instability. In total, we had:

- 2,579 ECTs from snowpilot.org, with about 90% from U.S. (snowpilot.org is open to the public).
- 167 ECTs from Val d'Aran, Spain, with profiles mostly collected by forecasters and observers.
- 1,226 ECTs from Switzerland, with profiles collected by researchers and field observers.

These ECTs are just a small subset of the more than 30,000 combined ECTs in these databases.

HOW DID WE ANALYZE THE DATA?

For each ECT, if more than one failure was indicated, we used the following rules to decide which result was the most relevant for stability assessment:

1. If an ECTV or ECTP failure was recorded, we considered the lowest number of taps required for full propagation.
2. If full propagation was not observed, we considered the lowest number of taps associated with the ECTN or ECTX.

If there were several ECT results in the same snow pit, we randomly picked one. This provided us with a dataset of almost 4,000 ECT results.

We classified the stability of each ECT location by relying on observed signs of instability in its surroundings.

We considered ECT locations to be unstable when signs of instability such as cracking, collapsing, or recent avalanches were observed in surrounding slopes. If observers clearly stated that neither signs of instability nor recent avalanches were present, or if they indicated the slope in question was skied or snowmobiled (in the U.S.), we considered these locations to be stable. In our dataset, 32% of the ECT locations were classified as unstable and 68% as stable. These are our base rates, and we will compare the results of the tests to these base rates.

In short, for each combination of ECT results (whether or not it propagated and the number of taps), we calculated the proportion of tests associated with observations of instability. To smooth the scatter in our results, we calculated a running mean of the proportion of unstable observations for five consecutive numbers of taps. We then asked: is the proportion of unstable slopes of a specific ECT result (propagation and number of taps) significantly higher (or lower) than our base rate (0.32)? If the proportion unstable was higher than the base rate, the respective ECT result (propagation and number of taps) was clearly observed more often in unstable locations, confirming this result was more commonly associated with unstable conditions. If the proportion unstable was lower than the base rate (0.32) then those results correlated more often with stable conditions. Values that were not significantly different from the base rate were interpreted as neither truly unstable nor stable.

For a more scientific and detailed description, refer to Techel et al. (2020).

WHAT DID WE FIND?

Quite clearly, ECTVs and ECTPs are observed more often on unstable slopes (dark grey line in Fig. 1 located above the base rate, represented by the dashed black line). ECTNs and ECTXs are observed more commonly on stable slopes (light grey line in Fig. 1 located below the base rate). Further, ECTs with a higher number of taps tend to be more stable.

ECTPs with less than 14 taps were the most unstable, with about 60% of those tests being associated with avalanches or signs of instability. This is about double the number of locations associated with avalanches or signs of instability in our entire dataset (the base rate). While still clearly on the unstable side of the base rate, the proportion of unstable locations decreases with more taps, even with an ECTP result. When more than 22 taps are necessary to initiate a fracture in an ECTP, the proportion of unstable slopes was not significantly higher than the base rate, indicating that such results might be linked to something like "intermediate" stability. We note a similar result for ECTN≤8, while ECTN>8 was clearly linked to stability.

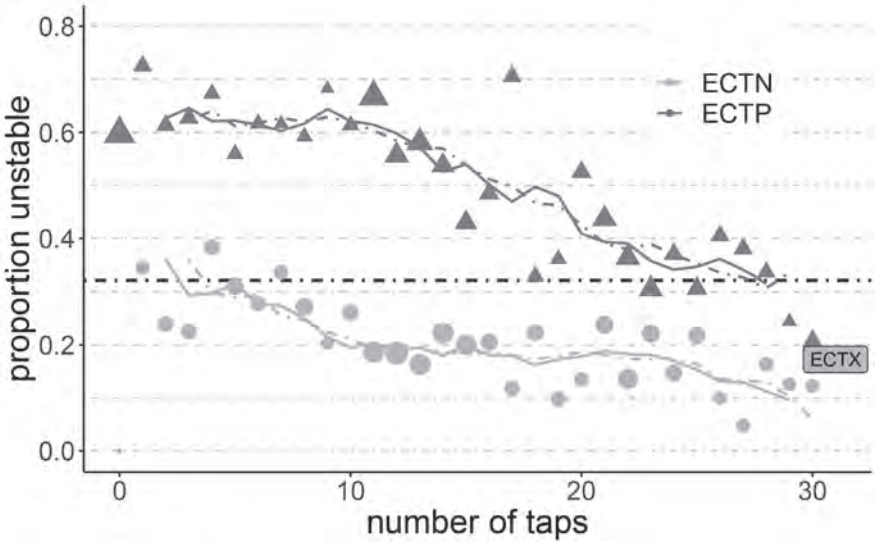

FIG. 1: PROPORTION OF UNSTABLE ECT LOCATIONS FOR EACH COMBINATION OF FRACTURE PROPAGATION AND NUMBER OF TAPS UNTIL FAILURE. THE LARGER THE SYMBOLS, THE MORE DATA POINTS. THE RESPECTIVE LINES REPRESENT A RUNNING AVERAGE, CALCULATED OVER FIVE CONSECUTIVE NUMBER OF TAPS. THE BLACK DASHED LINE REPRESENTS THE BASE RATE—THE PROPORTION OF UNSTABLE LOCATIONS IN THE DATA SET. ECTP (DARK GREY TRIANGLES) WERE OBSERVED MORE OFTEN IN UNSTABLE LOCATIONS (ABOVE THE BLACK DASHED LINE), AND ECTN (LIGHT GREY CIRCLES), AND ECTX IN STABLE LOCATIONS (BELOW THE BLACK LINE). THE PROPORTION OF UNSTABLE LOCATIONS FOR ECTP>22 AND ECTN≤8 NEITHER TRULY INDICATED UNSTABLE OR STABLE CONDITIONS.

INTERPRETING THE FINDINGS: A FEW REMARKS

In a perfect world, we would know absolutely whether a slope can be triggered or not. However, in reality, all studies exploring stability tests—including this one—must use other observations to infer slope stability. If the slope stability rating is wrong, which is inevitable for at least part of our data, then the test accuracy drops.

For example, in our study we likely had at least some cases where observers did not see any signs of instability but the snowpack was still unstable and avalanches could be triggered. Similarly, there are also likely cases where observers noted signs of instability on nearby slopes, but the slope being tested was in fact stable. These situations lead to a misclassification of the slope stability and have the potential to lower the correct classification by the stability test being evaluated. However, while these cases influence absolute values, it does not influence the observed patterns in Fig. 1.

We can see this when we compare our much smaller Spanish data set, which was thoroughly quality-checked by the forecasters in Val d'Aran, to our U.S. and Swiss data sets, which both relied on observations submitted together with snow profiles. In Spain, the proportion of unstable locations was about 80% for ECTP≤23, and 8% for ECTN and ECTX in a data set with 35% unstable slopes (Fig. 2b). In contrast, in the U.S. and Switzerland, absolute values and the shape of the curves were remarkably similar (Fig 2a and 2c). The only difference was that the proportion of unstable slopes for ECTP>22 was slightly above the base rate in the U.S. and slightly below in Switzerland.

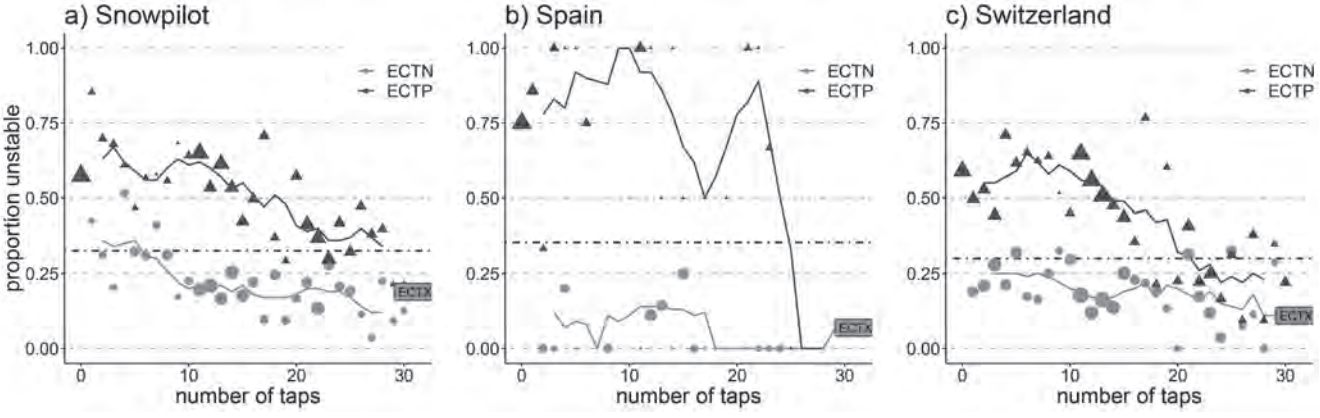

FIG. 2: PROPORTION OF UNSTABLE ECT LOCATIONS FOR EACH COMBINATION OF FRACTURE PROPAGATION AND NUMBER OF TAPS UNTIL FAILURE FOR THE THREE DATA SETS. THE U.S. (A) AND SWISS (C) RESULTS, WHICH ARE BASED ON A LARGE NUMBER OF ECT, LOOK RATHER SIMILAR. IN CONTRAST, THE ECT DATA FROM SPAIN DISCRIMINATES BETTER BETWEEN ECT RESULTS, INDICATING INSTABILITY AND STABILITY, BUT ALSO A MUCH MORE RANDOM BEHAVIOR DUE TO THE SMALL NUMBER OF ECTS.

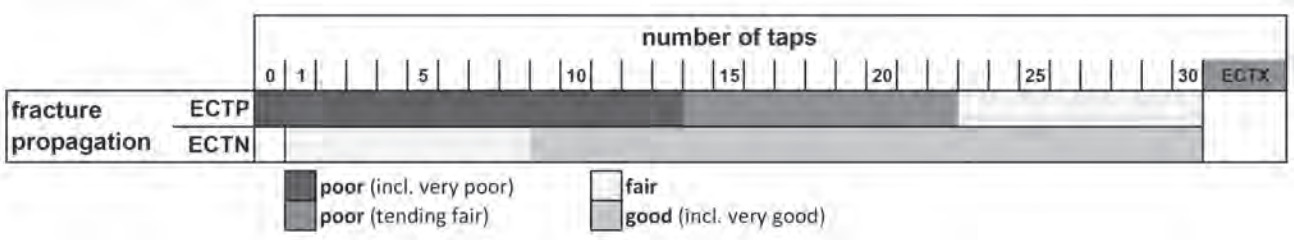

FIG. 3: RELATING ECT RESULTS TO OBSERVED SIGNS OF INSTABILITY IN THE SURROUNDINGS IN THIS DATA SET. THE STABILITY CLASS "POOR" IS SPLIT INTO TWO SUB-CLASSES, REFLECTING THE TREND SEEN IN FIG. 1 FOR AN INTERMEDIATE NUMBER OF TAPS.

TAKE-HOME POINTS

The correlation between signs of instability and ECT scores clearly shows that the ECT is a valuable test for assessing snow instability. Our data confirms the findings in the Swiss study that including the number of taps in addition to the propagation portion of the results can improve the overall accuracy of this test. In line with the work of Techel et al. (2020) on Swiss data, we suggest the following terms for ECT results (see also Fig. 3).

- Poor: ECTPs with easy—and to a lesser extent—moderate scores. In our data, these results are clearly correlated with instability.
- Fair: ECTPs with high scores and ECTNs with low scores. Our results suggest these values are more of a mixed bag in terms of their association with signs of instability.
- Good: ECTNs with moderate and high scores as well as all ECTXs. These results are most often associated with stable conditions.

Even though this classification may help us interpret ECT results, several challenges remain:

1. selecting the right location for the test;
2. determining how representative that location is for the slope(s) of interest; and
3. understanding the inherent spatial variability of test results.

Therefore, a single test with stable results should never be used as a sole indicator for stability but should always be used in combination with many other field observations and additional tests, preferably in different locations. On the other hand, a single test with unstable results is enough to warrant extra caution.

A SIDE NOTE: FURTHER RESULTS FROM A SWISS ECT STUDY (TECHEL ET AL., 2020)

Relying on the Swiss data set, which is included in our analysis, other relevant findings were noted:

- Performing a second ECT in the same snow pit was most useful when the first ECT indicated ECTP>14 or ECTN<10. Particularly in these cases, a second ECT could tip the balance towards indicating instability or stability.
- A direct comparison of ECT results with rutschblock tests performed in the same snow pit showed that RB test results correlated better with slope stability than ECT results. In other words, if an RB test result indicated instability, more slopes were classified as unstable, compared to an ECT indicating instability. For results indicating stability, the opposite was observed.

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snow globe

43

FAREWELL TO A GREAT LEADER AND FRIEND, SAM WYSSEN

in this **section**

// STEVE BRUSHEY

A Tribute to **Robert Claude "Pete" Peters**

David Sly

ON MAY 11, THE SNOW CONTROL industry lost a champion, ambassador, and advocate when Robert Claude "Pete" Peters passed away from complications of pneumonia. His impact came from the development of Avalauncher guns with Monty Atwater and Ralph McCracken.

Pete is survived by his partner Barbara Robertson, his brother James Peter, and his nephew Russell Peter.

Pete was born on Nov. 12, 1928, in Greenville, California. He was raised with his brother James on the 500-acre family ranch.

In January 1951, Pete joined the U.S. military and served in the Korean War. Although he did not speak much of the war with me, he did mention flying many reconnaissance flights over enemy lines, dropping propaganda intended to convince the enemy to surrender.

Following his discharge, Pete worked in appliance repair and had a laundromat business in Oakland. His life changed 50 years ago when he met two key people: Monty Atwater and Ralph McCracken. Not only was the chemistry among them obvious, but the genesis of their ideas began. Their experiences blended well, and they were the guiding minds behind the ideas, moulds, and systems for the Avalauncher.

The three created a reliable, effective, and properly fitting tail fin arming system. These corresponded with explosive booster parts, a recommended detonator geometry, base charge, and primary charge. The unique and well-thought-out designs culminated into the Avalauncher system still in use today.

Pete's time in the military and appliance repair know-how provided experience with the equipment, which had chatter valve and balance ports associated with the pistons in the motors. His knowledge fit well in developing an Avalauncher pressure vessel that could dump all the gases immediately without firing out of sequence.

He knew the value of a professionally installed balance port inside the valve chamber to help prevent piston chatter and premature firing.

Combine the above with Monty's studies of snowpack and Ralph's industrial experience with the Caterpillar Company, and the result was the onset of Avalanche Control Systems Inc, American Rocket Crafters. This company was originally a joint partnership between Pete and Monty.

The first tail fin engineered blueprint is dated 1973. I have all the original drawings of the guns, fins, and parts. (Perhaps you may find them in an avalanche control museum one day!)

PETE PETERS' LIFE PASSION WAS THE AVALAUNCHER. // PHOTO CONTRIBUTED

I met Pete about 20 years ago when CIL and Maple Leaf Powder were partnering to serve the avalanche industry with custom explosives and initiating systems, which also involved supporting the Avalauncher control niche. This meant working directly with Pete, whom I got to know very well, assisting him in making thousands of tail fins in his home.

Pete was very personable. He took time for you and tried his utmost to help. He would run around finding specialty parts for all of his customers, even those not directly related to his systems. His passion was being involved in snow control and promoting his Avalauncher systems.

He was quite the character and we shared many laughs and stories.

Avalauncher systems still maintain a special niche in the snow control market. They are relatively inexpensive, deployed from mobile or dedicated gun mounts, and can accurately deliver initiation signals and a decent sized payload up to two kilometres away fairly reliably.

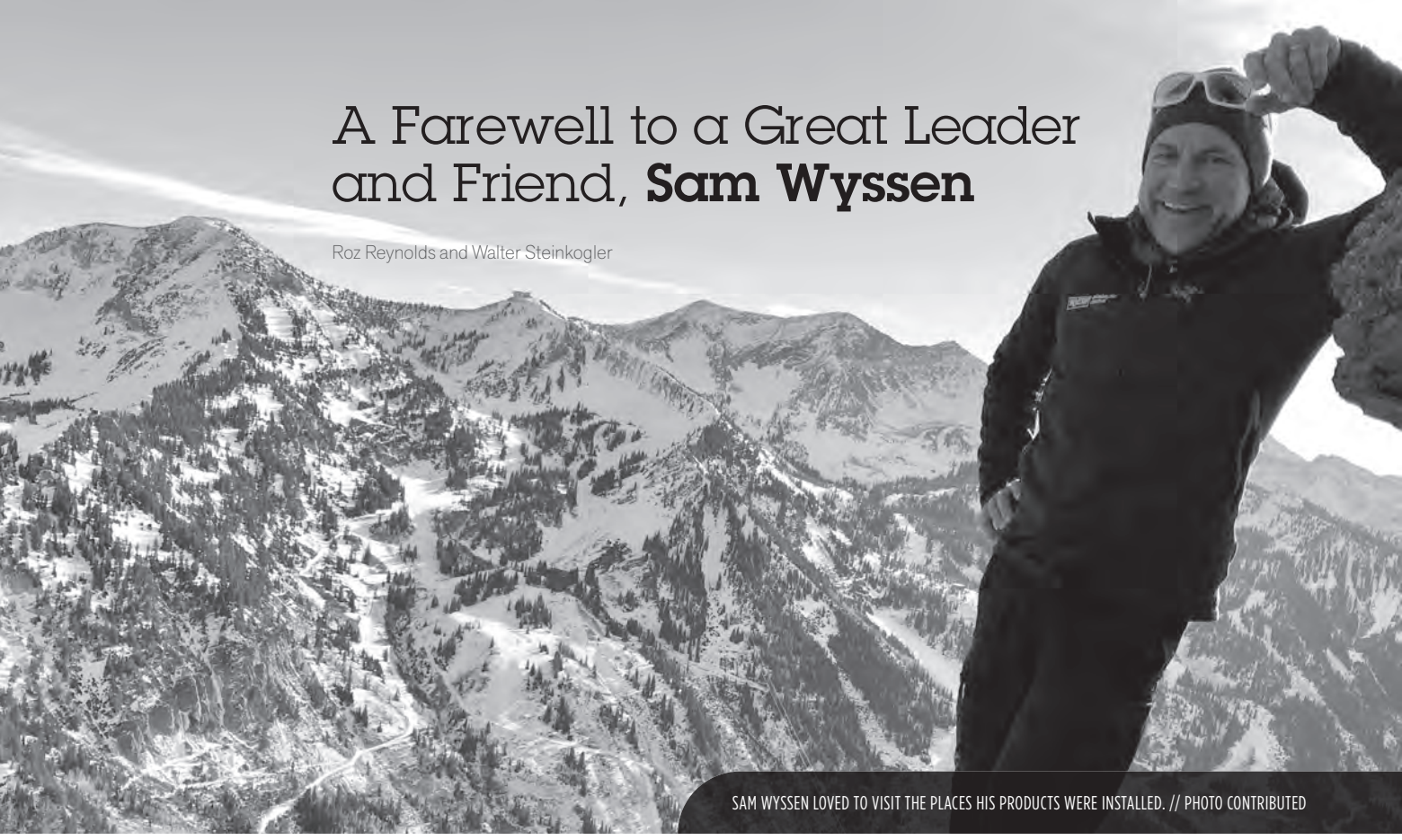
Dud rates over the past five years have hovered around 0.25 of one percent. "Quality control in the assembly process and a well-run, disciplined procedure at the gun tower are keys to a low dud rate," was Pete's veteran advice.

Pete made about 140 Avalauncher guns of various styles and models, many of which are still in use today. He assembled around 1,000,000 tail fin units that have been used all over South and North America.

Pete deserves wide recognition for his 50 years of dedicated service to the industry, his development of the Avalauncher guns and ammunitions, and his comradery to everyone he met. It was my honour and privilege to have worked and partnered with Pete during my career.

A Farewell to a Great Leader and Friend, **Sam Wyssen**

Roz Reynolds and Walter Steinkogler



SAM WYSSEN LOVED TO VISIT THE PLACES HIS PRODUCTS WERE INSTALLED. // PHOTO CONTRIBUTED

THE FIRST THING YOU WOULD NOTICE about Sam Wyssen was his frequent smile. He always took the time to share experiences with the people around him. No matter your position, Sam would lend you his ear and, likely, invite you to visit the Wyssen factory in Switzerland. He was a person who filled the world he lived in with his kind heart, good humour, and innovation. He truly cared about the people in his life and though he accomplished much, you would never hear it from him.

Tragically, on July 25, Sam and three others died when the small plane they were in went down while they were traveling to celebrate the retirement of a good friend.

Though Sam's presence is sincerely missed and deeply felt in the community, his innovations will continue to make avalanche control safer; his legacy will last for decades to come. His contributions to avalanche control live on in the world and in the spirit of the company he built. The story starts with Sam's grandfather, who started Wyssen Seilbahnen, a cable car company, almost 100 years ago. Wyssen Seilbahnen still operates today and was the foundation from which Wyssen Avalanche Control (WAC) was created. Both companies are still family-owned.

Through Seilbahnen, the first innovation in the avalanche realm was developed using cables to transport charges and preventatively release avalanches. Sam saw a need for a new design and an innovative solution for avalanche mitigation, which took the form of a new remote avalanche control system (RACS). The Wyssen Avalanche Tower was created.

Today there are over 450 of these systems installed worldwide. Sam personally traveled to each country where they were installed, and met with the avalanche teams who used them and the communities who would be affected by them. The projects took him around the world, including Canada, where Wyssen Canada Inc. started in 2016 with its first project at Three Valley Gap, B.C..

At home in Switzerland, as well as when Sam was on the road, he was sure to balance his work life with time with his wife and three kids. He would come home for lunch on weekdays to be with them and coached his son's ski team.

Sam routinely left his office to frequent the Wyssen factory, a picturesque place often surrounded by cows with Swiss bells. All Wyssen systems are still produced there today, and through the hard work put in by Sam and company along the way, Wyssen will continue to produce existing systems as well as innovate new ones into the future.

At his passing, his employees, whom he considered family, expressed how much they looked up to him, how they believed he was more than just a leader, but also a remarkable person with an amazing heart.

Many of us who had the pleasure of spending time with Sam learned so many life lessons from him. Sam led by example and truly embodied the ideal that connections in your life matter most. It is nice to reflect on time spent with him and apply his philosophy to our daily lives. To sit with dear friends, coworkers, and acquaintances and to enjoy the time we have together. To work hard but also realize the more connected you are with the people around you, the more effective your work will be. This is the legacy left behind by Sam Wyssen. In his words: "Let's stay for one more beer".

Dominic Boucher Honoured With Service Award

Alex Cooper

A SMILING DOMINIC BOUCHER RECEIVES HIS GORDON RITCHIE SERVICE AWARD THIS FALL. // JULIE LEBLANC

DOMINIC BOUCHER, THE LONG-TIME executive director of Avalanche Quebec, is the 2020 recipient of the Gordon Ritchie Service Award from Avalanche Canada.

The award goes to an individual or organization who has demonstrated exceptional dedication to public avalanche safety. Dominic was honoured for the leading role he has played in promoting avalanche safety in Quebec for over 20 years.

On Jan. 1, 1999, an avalanche struck a school in the remote community of Kangiqsualujjuaq, Quebec during a New Year's celebration, killing nine and injuring 25. An inquiry into the tragedy called for the establishment of a centre of avalanche safety in the province. Dominic was tapped to lead the new Centre d'avalanche de la Haute Gaspésie.

Over the years, he has overseen the organization as it has grown to become Avalanche Quebec and, this year, celebrating its 20th anniversary. Avalanche Quebec provides education and outreach in La Belle Province, and produces daily avalanche forecasts for the Chic Choc Mountains. Dominic oversees a staff of seven, including three avalanche technicians, three forecasters, and a communications specialist.

Dominic has also been instrumental in developing the next generation of avalanche professionals in Quebec. Since 2004, he has taught over 200 students in their first level of professional training, the CAA Avalanche Operations Level 1.

A native of the small community of Price, Quebec, Dominic could have pursued a career in western Canada. Instead, he dedicated himself to the Chic Mountains near his hometown.

He received the CAA Service Award in 2014.

Félicitations Dominic!

2020 CAA Blasting Scholarship Awarded

Jess Landing

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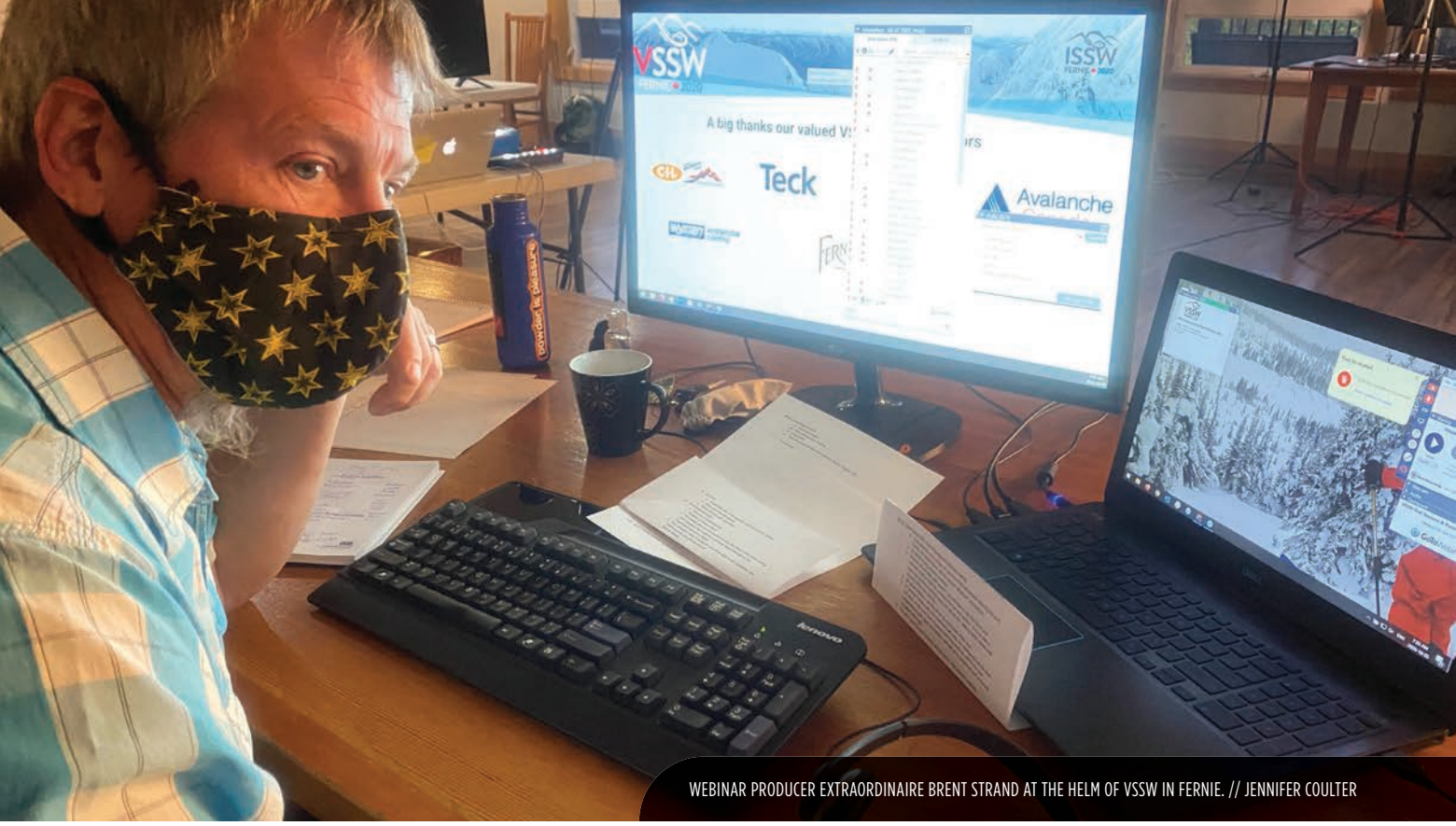
The CAA, CIL Explosives, and the Scholarship Committee would like to congratulate Active Member, Robert Currie, as the recipient of the 2020 CAA Blasting Scholarship. Thanks to sponsor, CIL Explosives, Robert received a scholarship to cover the course fees for this season's Avalanche Control Blasting course.



WEBINAR PRODUCER EXTRAORDINAIRE BRENT STRAND AT THE HELM OF VSSW IN FERNIE. // JENNIFER COULTER

How ISSW **Went Virtual**

Mary Clayton

WHEN THE COVID-19 PANDEMIC HIT us all hard in the spring, the organizing committee for ISSW 2020 was in full swing. Excitement was high in Fernie in anticipation of bringing a small-town BC vibe to this international conference. The decision to postpone plans was a tough one but, as history shows, it was definitely the correct choice.
It was the unmitigated success of the CAA's Virtual Spring Conference that rekindled the flame for ISSW. The CAA made it look easy! Maybe an online version of ISSW was a possibility? The idea for the Virtual Snow Science Workshop was born.

Once the commitment was made, work began in a flurry. There were just a few short months to pull it off. The decision was made to have 14 invited speakers and two panel sessions. The discussion on how to host the poster sessions took a while to figure out. How would we handle the interactive part? The solution, to get each poster presenter to host their own session, may look obvious in hindsight but that's how a lot of great ideas look in the rearview mirror.

Many members of the organizing committee deserve a lot of praise for how well this conference turned out. James Floyer did a great job as chair of the program, wrangling the lineup of speakers up to almost the last minute. Simon Horton ran the posters sessions, which were a terrific success with 50 presenters. Conference chair Steve Kuijt seemed to be everywhere all the time. (That guy deserves some time off!) And the CAA's own Brent Strand was the man behind the technology, bringing the show to computers around the world.

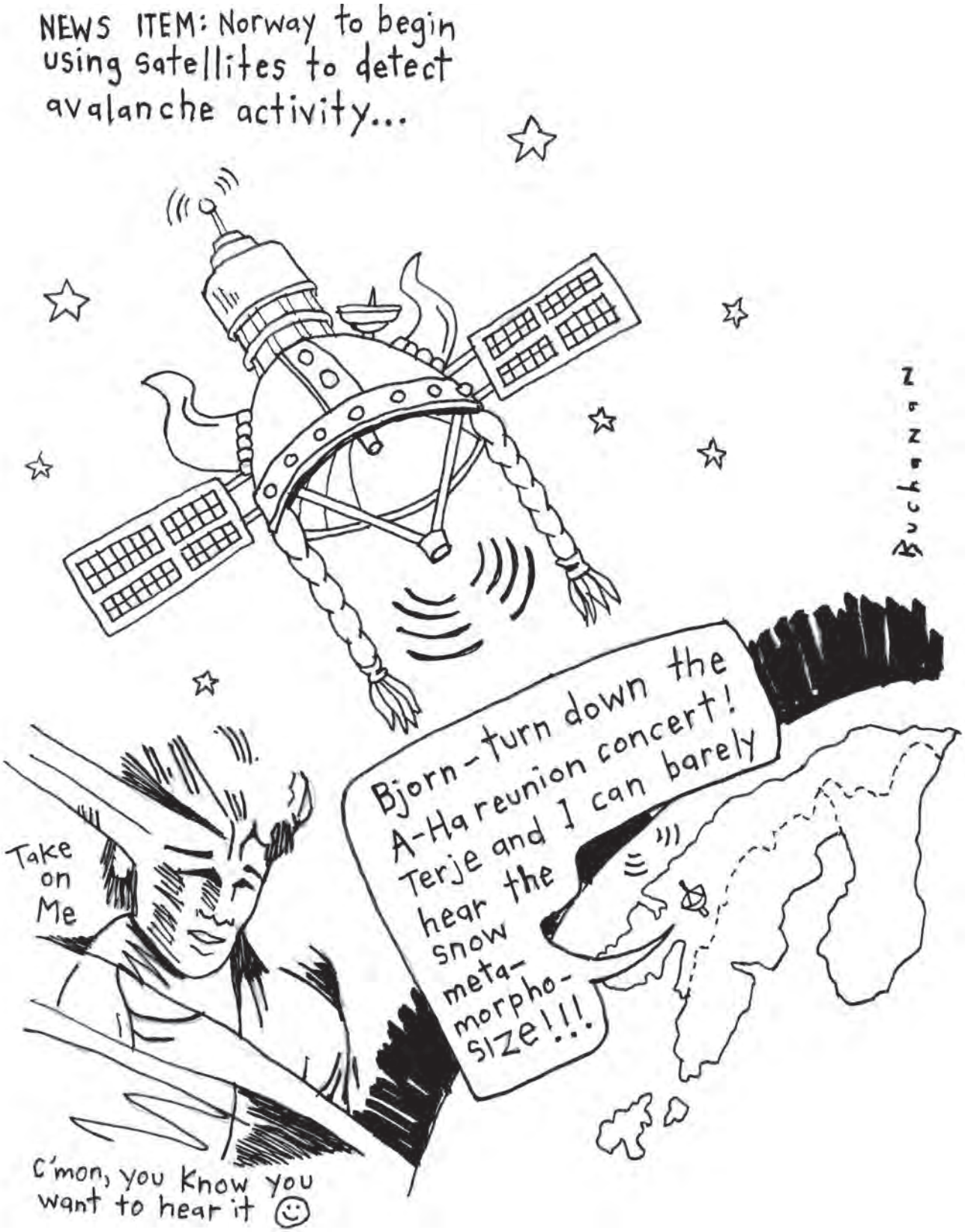
There are many others who pulled together to make the VSSW a tremendous success. In the end, there were 1,165 attendees from 30 countries. Looking ahead, the organizing committee remains cautiously optimistic that Fernie will host ISSW 2021 from October 3–8. Stay tuned!

Registrants were from:

CANADA, SPAIN, FRANCE, UK, CROATIA, JAPAN, NORWAY, NEW ZEALAND, RUSSIA, SWEDEN, USA, NETHERLANDS, GREECE, ARGENTINA, AUSTRIA, SWITZERLAND, HUNGARY, AUSTRALIA, CHILE, IRELAND, TAJIKISTAN, FINLAND, ICELAND, CZECH REPUBLIC, POLAND, SLOVAKIA, SLOVENIA, GERMANY, GREENLAND, AND GEORGIA.

Flakes

ROB BUCHANAN



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