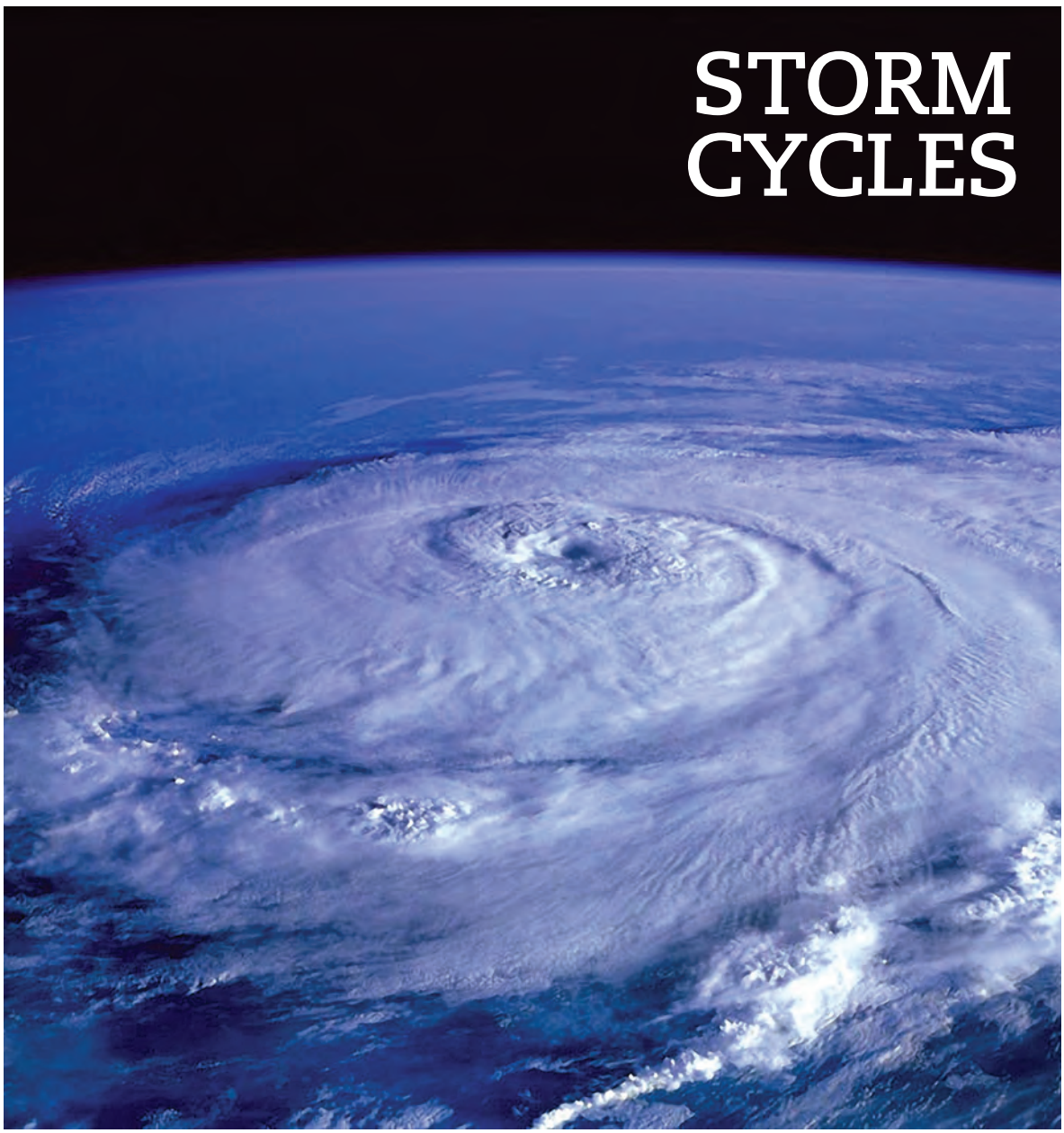
the avalanche journal

STORM CYCLES



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Wyssen Canada Inc.
Revelstoke BC
+ 1 778 252 05 17
canada@wyssen.com
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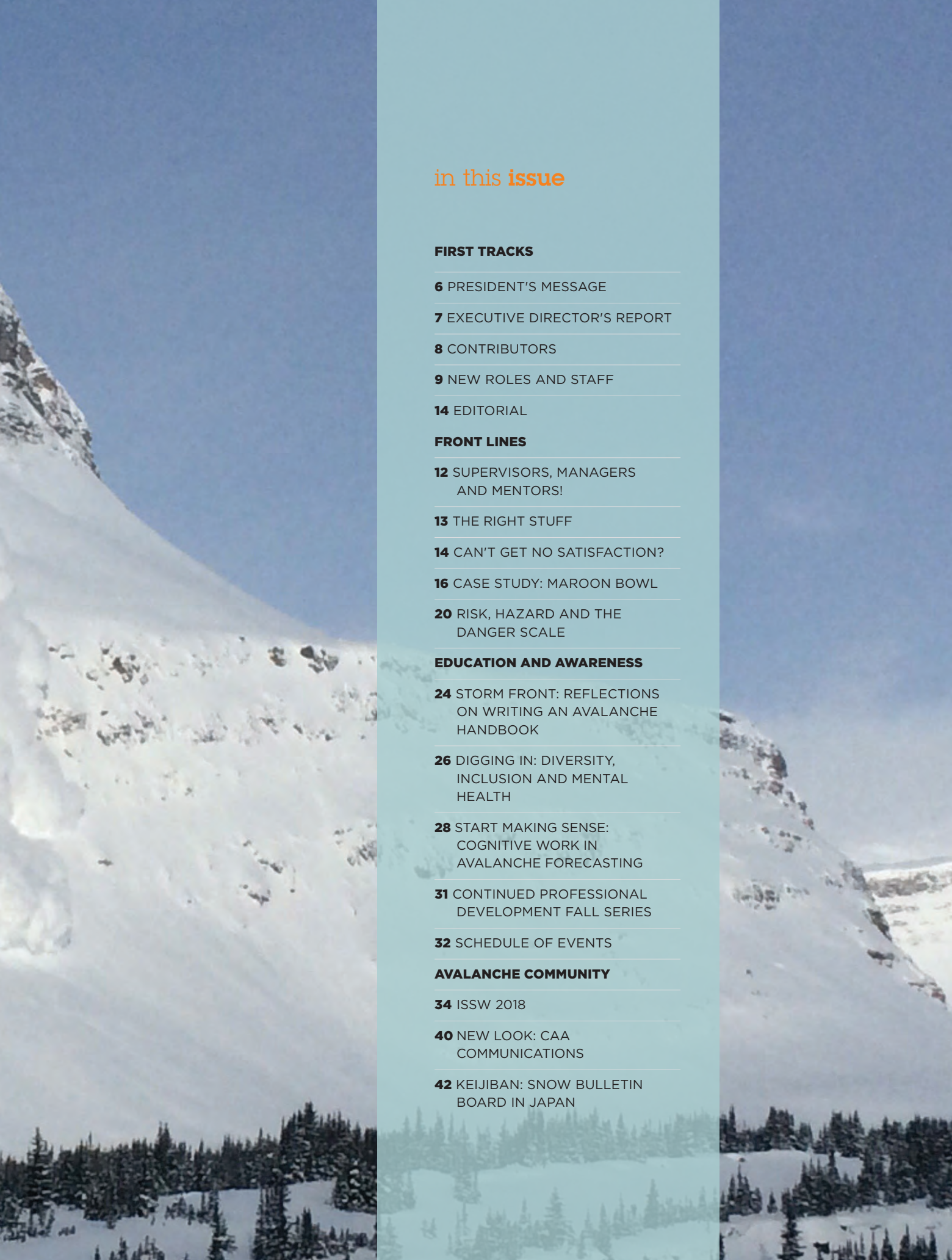

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Walter Bruns
CAA President

President's Message

WINTER IS HERE. The winter issue of the CAA *Avalanche Journal* is here. The theme is storm cycles. Those of you who work in the snow will have already dealt with the first cycles of the season. Those who (also) play in the snow will have eagerly anticipated successive cycles, as they refresh our immense winter playground.

Check out Jill Macdonald's excellent editor's message on page 10. Her wonderful metaphor for storm cycles describes the magic and the mayhem, the beauty and the beast, but also her frustration in chasing contributors to submit content (in my case, three notices and counting, of increasing frequency and decreasing cordiality, for this just-in-time introduction)!

And please read Joe Obad's Executive Director's report on following page. He paints a perfect picture of our association on the international stage, one that we can be very proud of. The ground-breaking achievements of so many members of our Canadian avalanche community continue to be accepted, adopted and celebrated; not just in this journal, or only here at home, but indeed around the world.

It is daunting to try to write anything upstream of such awesome literary talent. Seeking inspiration, if not direct assistance, I stopped in at the Revelstoke office to connect with the staff. What a pleasure! The CAA crew were in great spirits (or one should say, err, stoked) – it was full-on, pedal-to-the-metal!! Winter is definitely here.

At a weekly staff meeting, Kristin Anthony-Malone reported a strong financial position for our association. We are achieving or even exceeding targets. Emily Grady briefed everyone on the high demand for ITP courses, with last-minute additions. Luke Norman and Ben Clark were holding the IT fort, while Stuart Smith was in the USA selling international InfoEx subscriptions. Eiri Smith and Kristin were busy wrapping up the financial year-end.

You may recall that the federal government announced a substantial amount of funding for our sister organization Avalanche Canada. This was great news for the entire avalanche community. For far too long, the good folk at Avalanche Canada have been living hand-to-mouth, so to speak, trying to scrape together enough government and sponsor support for the critical services they provide.

There is still uncertainty around aspects of the funding, which Avalanche Canada Executive Director Gilles Valade summarizes as follows:

"Obviously, $25 million dollars will go a long way towards stabilizing our funding situation and helping us better serve the cause of public avalanche safety. That said, we currently have no information on what the funding will entail in terms of spending timelines and other conditions or obligations. With that in mind it would be best to assume that nothing will happen quickly and we will continue to operate according to our 2018/19 fiscal plan.

"Regardless of how the new funding reality unfolds, we will continue to exercise the same kind of disciplined financial decision-making that got us here in the first place. $25 million sounds like a lot of money but we will probably have to make it last for a long time so we need to continue to make prudent, long-term decisions. Additionally, this funding is meant to cover an expansion of services from NL to Vancouver Island to the Yukon and includes funds for Avalanche Quebec.

"None of that should take away from how amazing last week's announcement was or the fact that Avalanche Canada is worthy of such recognition and support. Now we need to get the provinces on board…"

Brent Strand, who splits his time between the CAA and Avalanche Canada, reported that quite a few people have congratulated the CAA for all the money headed our way! If only!! Evidently, there is still some confusion out on the street regarding the difference between our two entities. And let's not forget the Avalanche Canada Foundation (ACF), which solicits and allocates donations.

The CAA, AC and the ACF can be regarded as three legs of a stool which supports the Canadian avalanche community. Each organization has its distinct purpose, each organization relies on the others, and all are working in concert to enhance safety for anyone who works or plays in the snow. Here, and around the world.

May there be many good storms, and few nasty cycles, in your winter ahead.

Best wishes,

Walter Bruns, CAA President

Joe Obad
CAA Executive Director

Executive Director's Report

SEED, NURTURE, HARVEST - SEED AGAIN

LIKE THE REST of the many Canadians who attended the International Snow Science Workshop (ISSW) in Innsbruck this year, I was impressed and proud of the many Canadian accomplishments celebrated at the conference. It felt like a harvest of the many seeds planted and nurtured in the Canadian industry over the last few decades. Perhaps more importantly, the spirit that led to these developments is alive and well planting new seeds.

Take the Conceptual Model of Avalanche Hazard (CMAH) for instance. Many presentations referenced this Canadian model, which is now the basis of avalanche work conducted from Chile to Iceland, Nevada to New Zealand.

Much the same can be said for the Avalanche Terrain Exposure Scale (ATES). Developed by Parks Canada, ATES has now been adopted and adapted in Japan, New Zealand, Spain and Norway. Technical Aspects of Snow Avalanche Risk Management (TASARM) was central to Stian Langeland's presentation on two Norwegian industrial avalanche forecasting applications.

There was evidence of widespread adoption of the CAA's *Observation Guidelines and Recording Standards* (OGRS), and strong demand for Industry Training Program courses and InfoEx software. Likewise, *Planning Methods for Assessing and Mitigating Snow Avalanche Risk* edited by Bruce Jamieson and newly published by the CAA was in high demand in its international debut.

What is the point of noting all these Canadian advances on the international stage? Are Canadian ideas advancing upon the world like an unstoppable Zamboni? Hardly.

Successful ideas and concepts often seem inevitable in hindsight, but those who seeded them offer a more complex view, like Grant Statham, one of the driving forces behind CMAH. "During our first presentations, some folks stared blankly after I presented these new ideas around hazard, risk and the CMAH. Others assured the CAA's leaders not to worry because the CMAH was going nowhere. But Pascal Haegeli and I felt we were on to something valuable. We were determined to stick it out and see what CMAH could become. Little by little we developed the CMAH with others, gaining new defenders and proponents."

Success requires guarding fragile ideas and initiatives while they take root no matter the scale at which new initiatives are found. In your operation, folks are likely experimenting and tinkering to do things better. Such an example could be found at our Spring Conference, where Bill Mark gave a presentation on the rapid snow profile recordings done graphically at Wiegele Heli-Skiing. The technique gently challenged OGRS and got a lot of folks talking - including the Technical Committee. You can find Bill's talk on our website and in the last issue of *The Avalanche Journal* (vol 118).

In this issue, we offer an idea whose time may have come: a survey on gender in our industry, led by Rachel Reimer. Supported by both the CAA, ACMG and CSGA, Reimer will investigate gender, diversity, inclusion, and mental health in leadership. How is leadership affected by our sense of inclusion? How do we recognize different leadership qualities in decision-making and risk management processes in our workplaces? Reimer will attempt to establish a baseline understanding of how gender and other factors affect decision making. From this initial understanding we can decide what further steps may need to be taken in our workplaces.

This constructive spirit is alive and well amongst the CAA membership. Recently, the CAA asked for volunteers at the early stages of their professional careers to test the portfolio component of our future membership requirements. The response has been very positive, and we have lined up a great cohort of testers to help us build competency-based entrance to membership processes.

Our partners at home and abroad are also keen to nurture promising new seeds. Avalanche Canada, the ACMG, Helicat Canada and the Backcountry Lodges of British Columbia, and Parks Canada have worked with the CAA and a consortium of international partners to build open source snow profile software. The early rough work on this project can be found at Niviz.org.

I was reminded again and again in Innsbruck of this theme of planting seeds, nurturing and harvesting them. As we look forward to the Fernie rendition of ISSW 2020, the opportunity to share your thoughts and innovations with our international network is just around the corner. Perhaps the next big idea for avalanche practice is being tossed around in someone's head right now as she works her way up the skin track. Will that idea flourish or flounder? When you're approached to help nurture a bold new concept that might change the industry how will you respond?

The future depends on your answer.

Joe Obad, CAA Executive Director

Contributors

KEITH ROBINE MSc, MA
Keith started his avalanche career in Colorado in 1990 and moved to Rossland, BC in 1997. He has been a ski patroller, cat ski guide and avalanche educator. Keith also works with youth as a mental health clinician. His other passions include spending time with family, rock climbing, river rafting and off-road triathlons.
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YUKINORI (NORI) SAOTOME
After many years of involvement with the Japanese Avalanche Network (JAN), Nori took on the role of President in 2016. He is also a Japanese Mountain Guide Association ski guide, a JAN instructor, a rice farmer and, if that wasn't enough, he's soon to be father of two.
42 KEIJIBAN: SNOW BULLETIN BOARD IN JAPAN

BRIAN LAZAR
Brian is currently the Deputy Director of the Colorado Avalanche Information Center, and faculty and technical advisory for the Colorado Mountain College's Avalanche Science Program. Mountain guide, avalanche educator, curriculum developer, and former Executive Director with the American Institute for Avalanche Research and Education, he has also been a consultant to the ski industry, investigating potential changes to seasonal snowpacks as a result of climate change. When not thinking about avalanches, he chases his wife and kids around, and spends too much time frustrating himself with politics.
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LAURA MAGUIRE
Laura studies human performance in high risk/high consequence work. She has a Masters degree in Human Factors & Systems Safety and is currently completing her PhD in Cognitive Systems Engineering at Ohio State University. She is an active backcountry skier and alpine climber.
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JESSE PERCIVAL
Based on Vancouver Island, professional member Jesse has 20 years of experience in ski area operations, avalanche hazard assessment and control on remote power and forestry projects, and avalanche safety instruction. Currently he works at Mount Washington and as an independent consultant.
28 START MAKING SENSE: COGNITIVE WORK IN AVALANCHE FORECASTING

New Roles and Staff

Andrea Lustenberger
Membership Services

NEW ROLE FOR ANDREA LUSTENBERGER

Membership Services is back! We are thrilled to announce the return of a staff position dedicated solely to membership services and to bring Andrea Lustenberger into this role.

Siobhon Quinn, whom many of you may remember, was the last person to fill this position. When she left the CAA, her duties were split between existing staff. It has been a challenge to balance the workload. Happily, we are now able to recreate the Membership Services role and we welcome Andrea into the position.

Andrea is no stranger to this community. She has been working as the Administrative Assistant with the CAA for over a year. A long-term resident of Revelstoke, she grew up in Invermere, BC, embedded in the ski community. Previously a lodge manager for CMH, Andrea currently works for HeliCat Canada in addition to the CAA. Her organizational skills are extraordinary, and along with her shining personality, we are incredibly lucky to have her on board.

Jess Landing
Adminstative Assistant/
Bookkeeper

JESS LANDING

Administrative Assistant/Bookkeeper Jess Landing joins us from Vancouver, BC where she worked to bolster local food access through community programming. Additionally, she served as a venue manager for the Vancouver International Mountain Film Festival and was very active in the UBC Varsity Outdoors Club. Bringing outreach and engagement skills, as well as an avid interest for trail running, ice climbing, and getting into the backcountry, we are fortunate to have her join our staff. Please drop in to the Revelstoke office and say hello.

Storm Cycles

Jill Macdonald
Managing Editor

THE TUMBLE DRYER. Or perhaps better stated, the front loading washing machine. In either visual, images of turbulence come to mind. Somewhat orderly, in that the mechanical action is predictable, but equally unpredictable, given the constant possibility of mechanical failure and human error (what is making that clunking noise – is that a cell phone?).

Storm cycles excite the senses. Heavy snowfall accompanied by wind or sudden temperature shifts are expressions of energy, the power of natural forces in collision. These are dramatic times; or so we can tell ourselves.

Going into this issue, the concept of storm cycles as a topic generated its own momentum. It seemed a natural lead-in to case studies, research, and applicable to the broad range of daily avalanche practices. This volume of the Journal should practically write itself!

Spoiler alert: this did not prove to be the case. The first few flakes of content fell into place, sharp tingles on an expectant upturned face. A familiar sensation, the awakening that comes when anticipation is fulfilled. But then, the flow petered out. The washing machine stalled between the rinse and spin cycle, full of water, slight on content, no resolution in sight. Panic stirred. Waiting for the engine to kick in, but nothing, nada. Silence akin to whiteout conditions settled over the project.

Some common advice on business storm cycles tells us to a) put people in roles that suit them best; b) ensure clear and constant communication; and c) expect resistance to change. Business storms refer to companies during times of reorganization, but the strategy holds useful general wisdom. When things are chaotic, in good ways and not-so-good ways, we can easily lose sight of the constants. We become swept up in the moment, often forgetting to confirm what we think we know and failing to recognize the obvious. We focus on the new. Accumulations, wind events, mounting emotions as the turbulence continues.

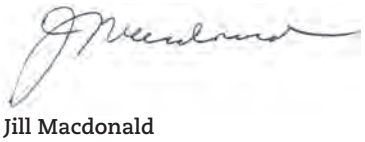
To counteract these tendencies, we can refer to the advice outlined above and adopt different strategies to remain rational. A) Identify our best evaluation tools and rely on them to reveal a relevant picture. B) Try changing up morning meetings. Shifts in presentation and perspective can spark fresh observations. C) Expect resistance within yourself. Weather patterns are changing. We need to question the nuances of memory and test familiarity.

Storm cycles excite the senses. Sometimes we yearn for the big kahuna and we subconsciously cheer it on, pumped up by the challenge, emboldened by adversity, conflict. It's human. In reference to the process of gathering articles on this topic, from the get-go it was foolish to assume that anything would develop as expected. To achieve a result, to find the way forward, patience was the only viable option and the means to push through the distress caused by a gap between expectation and result. There was never going to be a tidy basket full of fresh pressed whites and perfectly sorted laundry. Odd socks are best anyhow – each one tells a distinct story.

What we have in this volume is a tragic case study to learn by, one that involved seasoned professionals. Admissions of uncertainty in the conditions that most demand confidence. Unexpected tensions that arose during the writing of a book on avalanche safety and a large dose of international sharing from ISSW 2018, hosted in Innsbruck. Pegged to the clothesline, it's a good-looking bunch.

Winter has arrived and the snowpack is already forming its unique and temporary personality. Steady snowfall is not a storm, but a cycle that will eventually end. To quote the sage words of an article promised, but not yet delivered: "It's way too soon to panic."

Enjoy this issue of your journal.



Jill Macdonald

front lines

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CASE STUDY: MAROON BOWL

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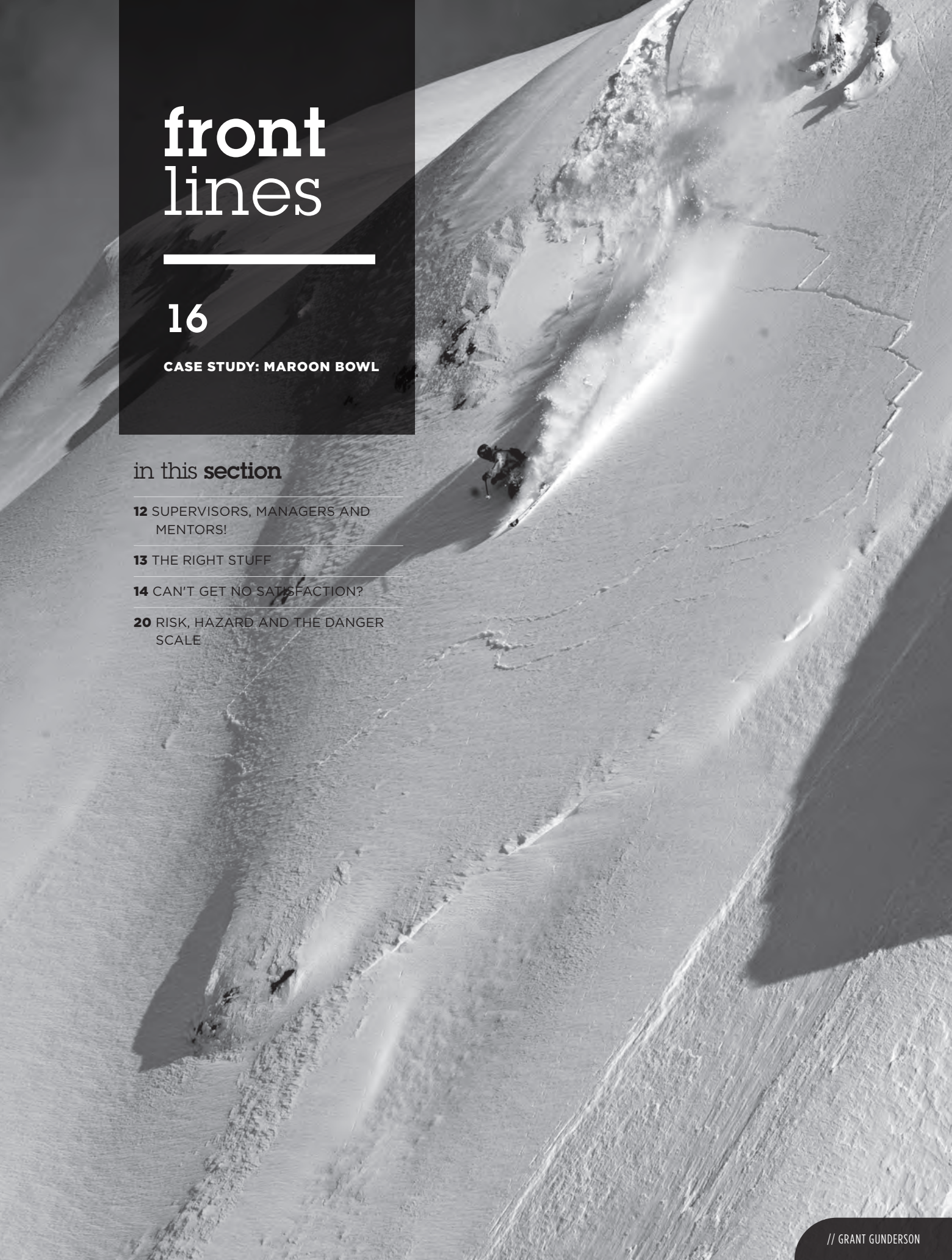
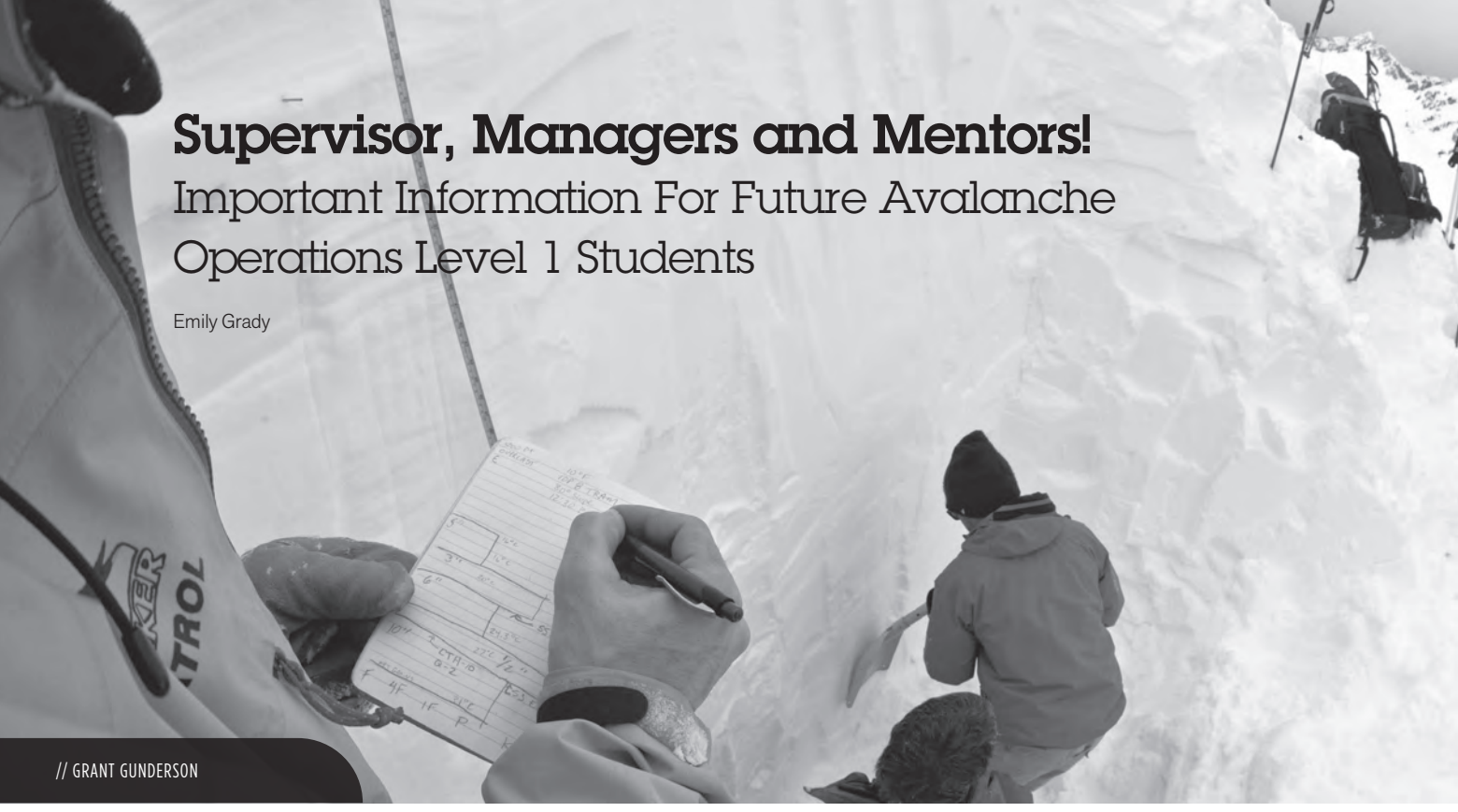


// GRANT GUNDERSON

Supervisor, Managers and Mentors!

Important Information For Future Avalanche Operations Level 1 Students

Emily Grady



// GRANT GUNDERSON

THE INDUSTRY TRAINING PROGRAM (ITP) continues to work towards alignment with the CAA's competency profiles through the Competency Aligned Avalanche Risk Management Training project, otherwise known as the CAARAT project. This 3-year project is thanks to the National Search & Rescue Secretariat's Search & Rescue – New Initiatives Fund (SAR-NIF) and one of the significant outcomes of the project is that the Avalanche Operations Level 1 course will now have an online component.

RESULT

As of summer 2019, the Avalanche Operations Level 1 has a new prerequisite – **Introduction to Avalanche Operations**. Delivered online, the course includes an introduction to:

- Important events that have impacted and affected the Canadian avalanche industry
- Avalanche risk management
- Avalanche terrain and the mountain snowpack
- How avalanches form and release
- Avalanche occurrence observations and recording
- Mountain weather
- Situational awareness and human behaviours
- Operational safety measures and mountain travel
- Professional avalanche rescue

THE COURSE IS SELF-DIRECTED

We estimate that students will take up to 25 hours to complete it successfully. Incentive to work through the material in a timely manner is built-in as students cannot register for Avalanche Operations Level 1 until the online portion is complete. Successful completion means attaining a certain standard on the learning checks. Mini-assessments within the units ensure that students are capturing the essentials.

RATIONALE

The online course allows us to:

- Enable students to learn the basic Level 1 concepts and theories prior to the field-based course
- Reduce time constraints through less review and more time in the field
- Increase the quality of training

IMPACT

In addition to current Level 1 prerequisites, prospective students will need to complete the online course *before* they can register for Avalanche Operations Level 1.

LOOKING FORWARD

Our initial foray into the online platform is quite basic. However, the intent is to build on this foundation by adding various media, interactive exercises, assessment tools, animations, and videos to further enhance the learning environment and engage learners. We anticipate using the online model for other ITP courses, whether it be pre-course content, supplementary modules, or complete course delivery.

Ultimately, we see a lot of potential to optimize time spent in person and in the field by ensuring that students arrive at courses with the same foundation of knowledge. This is an exciting time to be exploring educational tools for our industry. Thanks to the support of SAR-NIF for enabling this project.

The Right Stuff: How to Be a Real Referee

Katherine Dalman & Emily Grady

IF YOU ARE A CAA PROFESSIONAL MEMBER, you may be asked by a prospective student or member to provide a reference. At that time, you face the decision: to be or not to be, a reference. Before you commit, it's important to ask yourself if you are willing to take on this professional responsibility.

The CAA relies heavily on members to assess whether a person is ready for the next step in their career and learning. Referees provide valuable information and insights to help with this process. Consequently, candid and detailed responses are crucial when filling out the confidential reference form online. Here are three considerations to becoming a respected referee.

1. Is this candidate ready? Referees should verify that the candidate has the necessary requirements and prerequisites for their application. Evaluate their experience honestly. For example, when it comes to time in the field, are you comfortable vouching for their decision-making or do you think that they require additional days and/or mentorship before applying?
2. How much of the candidate's training or experience have you directly supervised? When the applicant is an employee or colleague this is straightforward. However, in instances where work/training has not been under your direct supervision, consider that person's duties and the reliability of their work.
3. Have a conversation with this person! Are you familiar with their current resume? Where else have they worked and what were their responsibilities? It's good to have an overall idea of this person's engagement in the industry and the direction of their career.

To sum up, the applicant should have the experience and training necessary to actively participate in and get the most out of the course or membership category identified in their application. Keep in mind that these folks will go on to be your colleagues and professionals in this small industry. What you put in your reference plays an important role in their successful candidacy.

// DANYELLE MAGNAN - PARKS CANADA

Can't Get No Satisfaction? Level 2 Application Updates

Emily Grady

SPOTS IN OUR Avalanche Operations Level 2 program have become hot commodities, as prized as tickets to a Rolling Stones concert. Fear not however, there is no need to turn to scalpers. We have revised the registration process and our new application requirements ensure equal opportunity for qualified entrants to advance their training.

PREREQUISITES: NEW

All Level 2 applicants must complete the following courses PRIOR to submitting their Level 2 application:

- Introduction to Weather
- Avalanche Search and Rescue Advanced Skills Theory
- Avalanche Search and Rescue Practical Skills Assessment

This change ensures that all applicants have the same base level of training in these topics when they begin the Level 2 Module 1.

SCHEDULE

Applications for the 2019-20 season will be accepted between September 1, 2018 to April 30, 2019. Applicants intending to apply for the 2019-20 winter season need to complete their prerequisite courses by **April 30, 2019.**

This deadline is critical because it enables scheduling of Level 2 courses based on the number of approved applicants, to ensure that as many new applicants as possible can be accommodated on Module 1 courses.

100 DAYS, OBSERVATIONS & WORK EXPERIENCE

In the past, the caliber of Level 2 applicants presented instructors with a wide range of skills, background, experience, and training. To tighten the skill set of applicants and to give everyone the best chance of success, we have defined what we are looking for with the 100 field days prerequisite.

100 days minimum of work experience over two operating seasons in weather, snowpack & avalanche occurrence observations & analysis. This includes participation as a team member, attending daily operations meetings and participation in operational activities that require avalanche risk management.

Likewise, based on instructor feedback, a minimum number of weather, snowpack, and avalanche occurrence observations has been established:

- 50 recorded weather observations (study plot, field, and/or telemetry);
- 30 recorded snow profiles (test and full profiles);
- 30 avalanche occurrence observations

Applicants must provide detailed information about their work experience (operation, # days per season and what year, specific avalanche-related job duties), plus the number of snowpack, weather, and avalanche occurrence observations they have completed to OGRS standard.

EXAMPLES OF WORK EXPERIENCE

OPERATION NAME SNOWMOBILE GUIDE

# DAYS	Winter	Duties
35 DAYS	2015/16	Daily duties: study plot/digital telemetry weather observations, AM/PM operational meetings, field weather and avalanche occurrence observations, assessing terrain and evaluating hazard while guiding (e.g. test slopes) Weekly duties: test profiles Monthly: full profile
46 DAYS	2016/17	
54 DAYS	2017/18	

CHALLENGES

Number of modules/season: Despite these changes, there will continue to be challenges for approved applicants to get into the modules of their choice. We cannot anticipate the timing of applicants' progress through the modules, therefore it is difficult to anticipate the number of module 2 and 3 course participants each season.

Freshies vs Veterans: Students who are already in the Level 2 program (ie completed modules in the previous winter) are granted a one-week early registration opportunity so they can complete the program over the coming season. Newly-approved applicants will then be able to register afterwards for the remaining spaces in modules 2 and 3, along with registering for their module 1.

BIG PICTURE

Our goal behind the new application requirements and revised application process is to ensure that all applicants meet the minimum prerequisites for the Avalanche Operations Level 2 program and can therefore get the most out of the Level 2 modules AND be successful in the assessment process.

Stay tuned! Just when we thought we had it all sorted, curriculum changes are in the works for winter 2020/21. Further Level 2 updates coming your way at the Annual General Meeting in May.

Case Study: Maroon Bowl

An Atmospheric River Event in the Colorado Rockies

Brian Lazar

THE ASPEN COMMUNITY was rocked April 8, 2018. A long-time and beloved member of the local search and rescue group was killed in an avalanche while skiing recreationally in backcountry terrain adjacent to Aspen Highlands ski area. The entire episode was witnessed by members of the Aspen Highlands Ski Patrol (AHSP) from the ridge and summit patrol shack. It was also captured by a ski area web cam.

The Colorado Avalanche Information Center (CAIC) issued a special product called an Avalanche Warning the morning of the accident. Both the victim and his partner were very experienced backcountry travelers. Both knew the terrain intimately. They witnessed and crossed fresh avalanche debris on adjacent slopes to reach their objective and the site of the accident. The compelling nature of the clues had the snow safety community asking: What happened?

After a summer to reflect on this accident, it's clear there were several contributing factors and some key take-home lessons that reinforce classic risk management advice in avalanche terrain. Yet it's hard to escape one critical factor: The two people decided to enter complex avalanche terrain at the tail end of an unusually warm and wet storm.

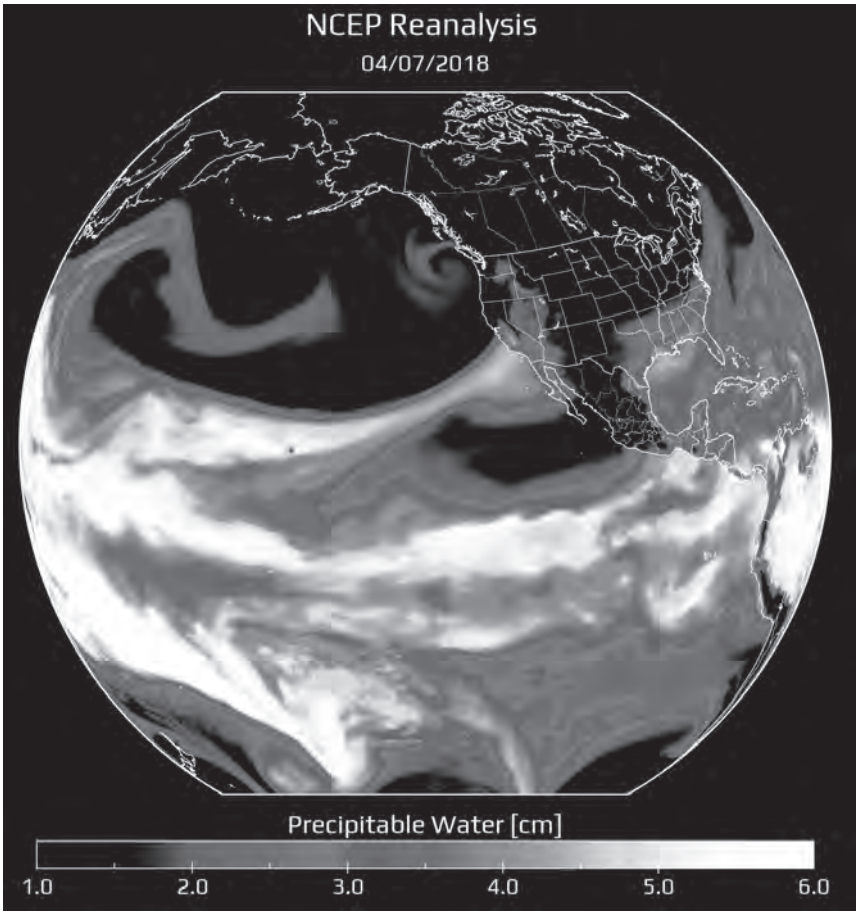


FIG. 1: NATIONAL CENTERS FOR ENVIRONMENT PREDICTION (NCEP) OF PRECIPITABLE WATER ON APRIL 7, THE DAY PRIOR TO ACCIDENT. THIS SHOWS THE ATMOSPHERIC RIVER OF DEEP PACIFIC MOISTURE HEADING TOWARDS COLORADO(IMAGE COURTESY OF NICK BARLOW)

THE STORM

From April 1 to April 5, conditions were typical of early spring weather in Colorado. There were several centimetres of new snow, and above freezing daytime temperatures with below freezing nighttime temperatures.

From April 6 to 8, an atmospheric river funneled deep Pacific moisture into the region (Figure 1). The sounding on April 8 from the National Weather Service in Grand Junction (approximately 150 km west of Aspen) showed the atmosphere had deep moisture to around 300 mb, and precipitable water was over 250% of average for the date. Some portions of the state picked up over 150mm HSTW in the 3-day period.

In the Aspen area, the storm began with above freezing temperatures to around 3600 m, and rain as high as 3400 m. Temperatures cooled as the storm progressed, and snow levels dropped. From April 6 to 7, AHSP measured less than 8cm of dense snow (HN24). On the morning of the accident, April 8, AHSP measured HN24 20cm (38mm). Another 3.8cm of snow fell later that same morning. HST totals were 31cm (43mm).

This was an unusual storm for Colorado, even for spring conditions. It was warmer and wetter than what most avalanche professionals in the area typically encounter. Rain at high elevations at the front end of a storm was rare, as was the high-density new snow that followed. The storm loaded a snowpack typical of the region: thin, cold, and with pronounced persistent weak layers.

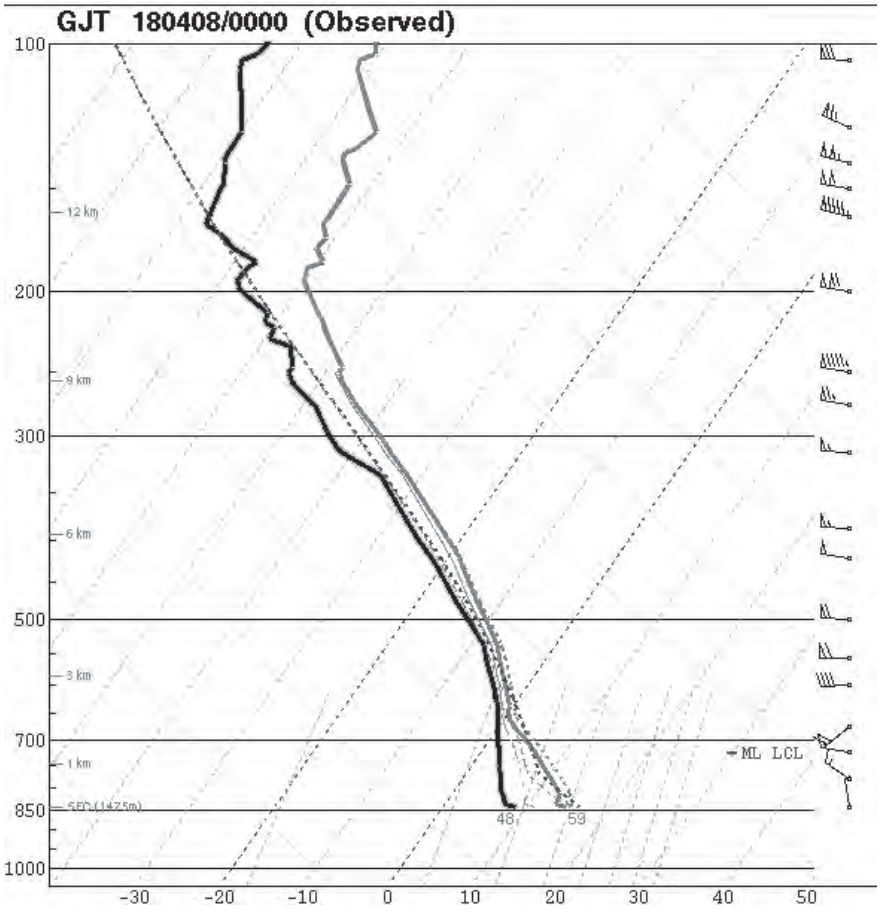


FIG. 2: SOUNDING IMAGE FROM THE NATIONAL WEATHER SERVICE GRAND JUNCTION OFFICE ON APRIL 8.

THE EVENT

The storm cycle had many avalanche professionals on edge. At the CAIC we engaged in discussions both inside and outside our group about the widespread uncertainty. How would the snowpack respond to the rain, storm snow density changes, and rapid HST settlement?

CAIC forecasters issued a High (Level 4) avalanche danger the morning of the accident (Figure 3) and an accompanying Avalanche Warning advising people to stay out of avalanche terrain.

Post-incident interviews revealed that the two skiers involved discussed the unusual storm. The survivor stated that he did not read the avalanche forecast that morning. We don't know if the victim knew that there was an avalanche warning in effect or if he was aware of the current backcountry avalanche forecast.

Clues indicating potentially unstable conditions were evident. The skiers observed fresh avalanches before entering the terrain and crossed avalanche debris to get to their intended route. They determined that the fresh avalanches on adjacent slopes were not pertinent, having seen similar avalanches many times on those same slopes in the past. They completed their initial descent without incident. As they skinned up towards their second descent objective, they made an impromptu decision to continue up a slope steeper than 35 degrees with a terrain trap (trees) below them. The survivor stated afterwards that as they climbed, they noted that conditions on that slope felt different than on the slopes travelled up to that point. (Figure 4).

As they climbed up for their next run, they triggered a size 2 avalanche. The crown face appeared to be about 40cm deep and 50m wide. The avalanche initiated on a steep, north-facing, near-treeline slope and ran up to 150 vertical metres. It swept both skiers down into sparse trees. The victim stopped at a large tree shortly below a rock outcrop. The survivor continued about 60m further, coming to a rest on the snow surface with both skis still attached to his boots.

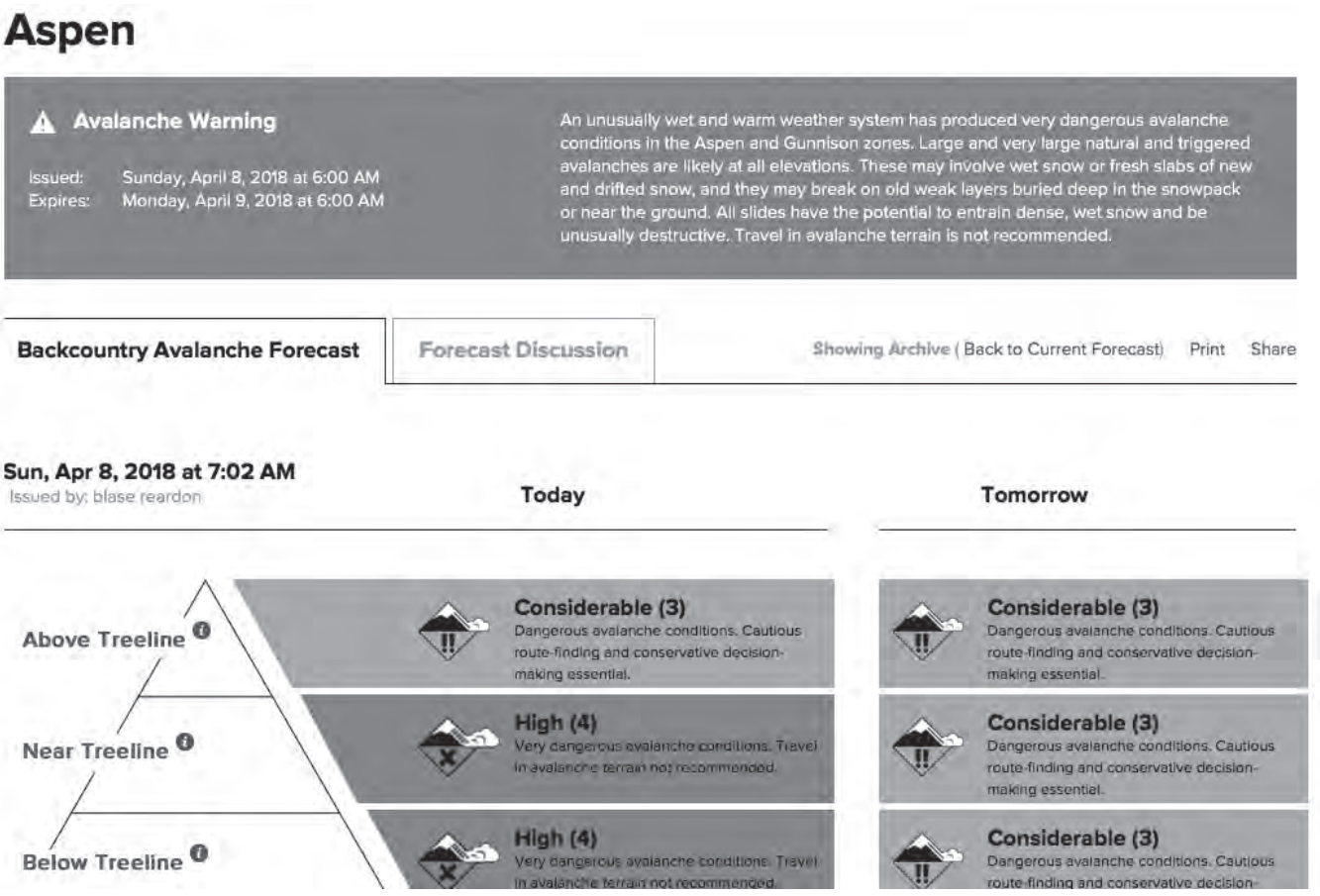


FIG. 3: THE ASHP SNOW SAFETY TEAM WAS ALSO CONCERNED ABOUT THEIR IN-BOUNDS TERRAIN. HIGHLAND BOWL, ON THE OPPOSITE SIDE OF THE RIDGE FROM THE ACCIDENT SITE, REMAINED CLOSED ON THE DAY OF THE ACCIDENT.

Despite witnessing the avalanche, professional ski patrollers and search and rescue members made the excruciating decision not to enter the accident site because of exposure and avalanche hazard. They were able to instruct the survivor via radio to self-evacuate down valley and out of harm's way. The local Sheriff's Office made the decision not to recover the victim that evening or the next day due to lingering avalanche danger.

THE LESSONS

Some of the lessons are too familiar in avalanche accidents, but they do reinforce the basic messaging we promote as avalanche safety professionals:

- The skiers did not discuss the forecast or the warning, and thus did not discuss the advice to stay out of avalanche terrain. How can we improve our outreach to reach all backcountry users?
- They observed fresh avalanche activity on slopes with the same aspect and elevation but did not find this compelling enough to avoid their objective since they had seen those slopes avalanche many times and intended to avoid those particular features.
- They changed their plan on the fly in the field by climbing higher than intended. They traveled safely until they made this change.

A couple lessons are particular to this storm event, and are cautionary for all of us who work and play in avalanche terrain:

- Terrain familiarity can make it difficult to recognize when conditions are different from those previously experienced. This group had used this route before in a variety of conditions.

FIG. 3: TRIGGERED SLIDES IN MAROON BOWL, 4-8-18. GREY ARROW MARKS A SMALL AVALANCHE TRIGGERED BY AHSP WITH AN EXPLOSIVE CHARGE ON THE MORNING OF APRIL 8. WHITE ARROWS MARK LARGER AVALANCHES TRIGGERED BY THIS SMALL ONE. THESE AVALANCHES WERE VISIBLE BEFORE THE TWO SKIERS DESCENDED THE TREES IN THE LEFT OF THE IMAGE. THE BLACK/WHITE ARROWS SHOW THE SKIERS' TRACKS ACROSS AND ALONG THE AVALANCHE DEBRIS. THE CIRCLE SHOWS THEIR TRANSITION POINT FROM DOWNHILL TO UPHILL MODE. THE BLACK ARROW MARKS AVALANCHES THAT WERE TRIGGERED BY SKIERS ASCENDING THE SLOPE THAT AFTERNOON, RESULTING IN A FATALITY. (IMAGE COURTESY OF ART BURROWS)

- Weather and climate are changing, and we need to be humble in accepting that our methods and evaluations need to be reconsidered. The tried and true approach to risk management can fail.
- Although we could not readily access the crown in our investigation due to lingering hazard, rain at the front end of the storm was likely a contributing factor. We all need to carefully consider rain on snow effects, even those of us who work in historically cold interior climates.

The intent in writing up this case study is not to cast judgment on those involved. Rather, the hope is that an honest reflection will challenge us all to consider what we can do better and to be on guard for storm systems that fall outside past experiences. The times, they are a changin'.

Risk, Hazard and the Danger Scale

Doug Latimer

Excerpt from an interactive avalanche ebook to be released later this year.

THE AVALANCHE DANGER SCALE is a powerful tool for determining safe travel options in avalanche terrain. When we talk about avalanches, risk and hazard quickly become the focus of discussion and our assessment is often expressed using this scale. While at first glance it appears to be a relatively simple tool, my interpretation of the avalanche danger scale and its significance has evolved over time.

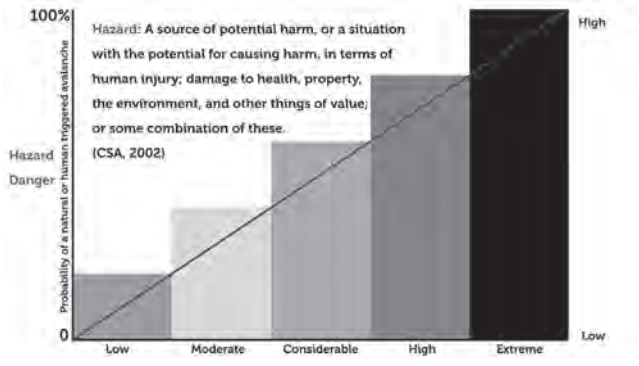


FIG. 1

THE DEFINITION OF HAZARD

According to the 2016 OGRS (Observation Guidelines and Recording Standards for Weather, Snowpack and Avalanches) defines hazard as: *A source of potential harm, or a situation with the potential for causing harm, in terms of human injury; damage to health, property, the environment, and other things of value; or some combination of these. (CSA, 2002)*. The Canadian Centre for Occupational Health and Safety defines hazard as: *A hazard is any source of potential damage, harm or adverse health effects on something or someone.*

These two definitions are similar; as the potential for harm and its consequences increases, so does the hazard. Initially, my perception of hazard on the avalanche danger scale was similar; it increased in a linear pattern. From absolute certainty the snowpack was stable (at the bottom end of low hazard), to absolute certainty of widespread avalanche activity (at the top end of extreme hazard).

THE DEFINITION OF RISK

Cited in 2016 OGRS, risk is: *The chance of injury or loss as defined as a measure of the probability and severity of an adverse effect to health, property, the environment, or other things of value. (CSA, 2002)*. Based on this definition, as the probability of loss increases so does the risk.

Going back to my original interpretation of the avalanche danger scale, risk elevates through the danger scale in the same linear pattern as hazard. This makes it very easy to misinterpret risk and hazard as being similar or even the same thing.

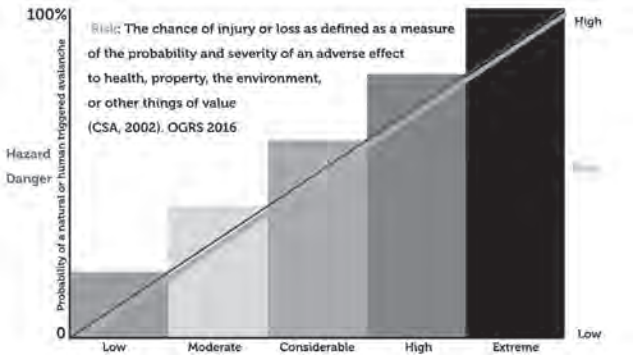


FIG. 2

The ISO (International Organization for Standardization) defines risk as the: *effect of uncertainty on objectives*. This is a very different definition.

For industrial and commercial avalanche programs, the OGRS definition of risk serves avalanche control and mitigation decisions very well. As the avalanche hazard or danger increases, the need to protect highways, buildings and commercial operations, also increases. Based on the OGRS definition you could call that risk.

For recreational travellers in avalanche terrain, mechanized ski operations and guided parties, the OGRS definition doesn't really provide any additional information or insight beyond the hazard rating on the avalanche danger scale. If risk and hazard are similar, then one should feel terrified in high or extreme hazard, but much more comfortable when the danger is considerable.

Based on personal experience, I find that the opposite is true. I feel more confident in my decision making when the hazard is high or extreme and very nervous/uncertain when the hazard is considerable or on the touchy side of moderate. As a skier, climber and guide, this creates a paradox. While determining avalanche hazard is relatively straightforward, managing uncertainty is a challenge.

RISK, DANGER SCALE AND UNCERTAINTY

If you take the ISO definition of risk and apply it to the danger scale, then an entirely different perception of risk appears. If risk is the *effect of uncertainty on objectives*, then the greatest risk on the avalanche danger scale is found at considerable hazard.

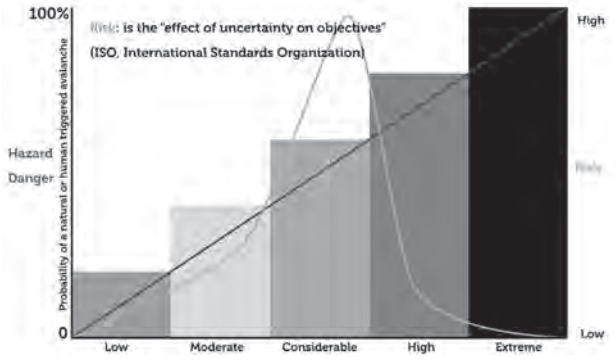


FIG. 3

RATIONALE

When the avalanche hazard is low, there is high certainty that the snowpack is generally stable. Only in very aggressive terrain or under highly unusual situations is a significant avalanche possible. At high or extreme hazard, there is high certainty that avalanche terrain is unstable and dangerous. By the ISO definition, decision making in low hazard is easy, with individuals having considerable latitude in selecting routes and comfortable margins for errors without any serious consequences. If the hazard is high or extreme, the decision-making process is also easy: Stay out of avalanche terrain and avoid exposure to it.

As a professional guide, these are high confidence scenarios with low risk events. To put it simply, in low hazard, we understand that things are generally good; and in high and extreme hazard we understand that conditions are very dangerous. Given the confidence or certainty of this information, it is relatively easy to make appropriate decisions.

My perpetual challenge remains with considerable hazard, where *natural avalanches are possible and human triggered avalanches likely*. This effectively says: Maybe. The description has a high degree of uncertainty in the outcome. The ISO definition indicates the highest level of risk is found at the greatest amount of uncertainty. By using this definition, considerable hazard and elevated moderate hazard represent the highest levels of risk when in avalanche terrain.

This interpretation of risk may help explain why most people are killed in avalanches when the hazard is considerable. It is not because the avalanche hazard is at its greatest, it is because of the difficulty in making appropriate decisions in a highly uncertain environment.

Highest uncertainty equals highest risk – which translates into my now rational fear of considerable hazard.

QUESTION:

Is considerable hazard really the most uncertain, variable, and least predictable danger rating?

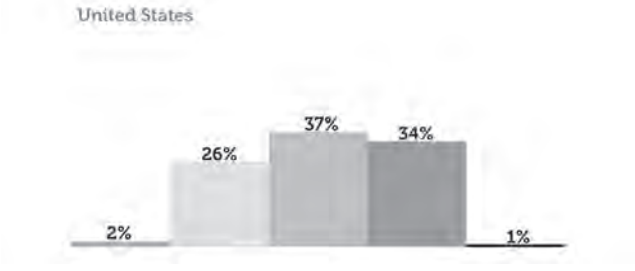


FIG. 4A

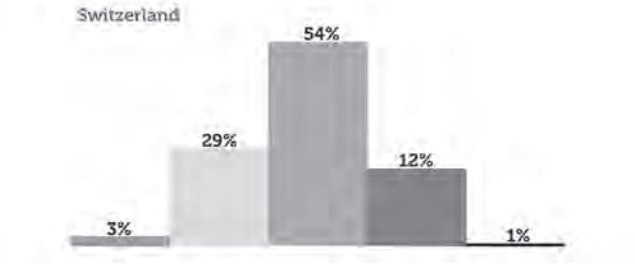


FIG. 4B

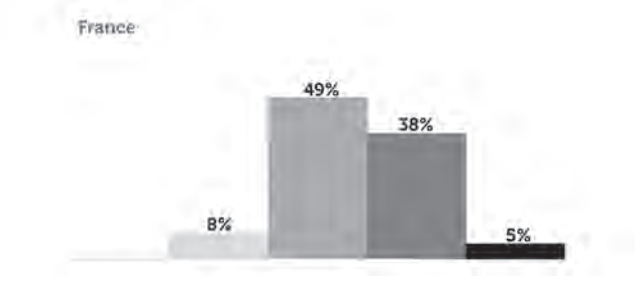


FIG. 4C

Probability is not represented on the danger scale. The scale uses words: *unlikely, possible, likely* and *very likely*. In numerical terms, does human triggered avalanches possible mean a likelihood of 1 in 10, 1 in 100 or 1 in 1,000?

Bruce Jamieson's 2009 paper, *Regional Danger Ratings and the Odds of Triggering a Potentially Fatal Avalanche* came up with some numbers. Multiple avalanche forecasters, guides and researchers with extensive experience working in avalanche terrain were presented with the scenario of an inexperienced

skier descending an avalanche slope with one trigger point. Based on their feedback, researchers calculated that on average the probability of a potentially fatal avalanche was:

- Low hazard 1:50,000
- Moderate hazard 1:6,000
- Considerable hazard 1:300
- High hazard 1:30
- Extreme hazard 1:3

These numbers represent an attempt to quantify risk. Now let's apply them to a hypothetical situation. Imagine four friends who ski together for 100 trips. On each trip, each person skis one run randomly down an avalanche slope with a single trigger point.

Probability of at least one person being in a potentially fatal avalanche:

- Low hazard: Less than 1%
- Moderate hazard: Less than 5 %
- Considerable hazard: Greater than 65% one person is involved
- High hazard: Greater than 90% everyone will be involved
- Extreme hazard: Highly unlikely anyone will survive 100 runs

(this assumes the entire group skis their runs within a single hazard rating)

The big jump in fatalities occurs at considerable hazard. Both low and moderate hazard represent a high probability for survival. High and extreme hazard have such low survival rates that any rational person would recognize the threat as non-survivable. But look at considerable. One hundred trips could represent four years of ski touring together and out of the four skiers there is slightly more than a 50% chance one person might be in a potentially fatal avalanche. The 1 in 300 chance of being in an avalanche means that there is a 99.3% chance everything will be fine. It's only when you multiply the risk by four people and 100 runs each, that the results stand out. Individually, each person would probably be fine every time he or she skied an avalanche slope in considerable hazard, but the cumulative toll would likely be deadly. Welcome to a high uncertainty, high risk scenario.

It is important to remember that this a thought experiment and should only be attempted at home. If the avalanche hazard is considerable or higher, there are likely to be many potential trigger points on a ski slope, not just one. These trigger points could also be large. Very large.

If you had told me in my early 20s that there was a 99.3% chance everything would be fine each time I was in avalanche terrain when the hazard was considerable, I may not have lived long enough to write this article. We need to look at the cumulative impacts of risk, not just the immediate consequences.

One truly unexpected consequence of exploring this issue was how it affected my perception of the avalanche danger scale. In considering the research, a thought began to germinate —the hazard level on the avalanche danger scale is not linear. Avalanche hazard increases in a pattern that is more consistent with exponential growth; a curve that starts low in the realm of considerable hazard and then shoots up into high hazard.

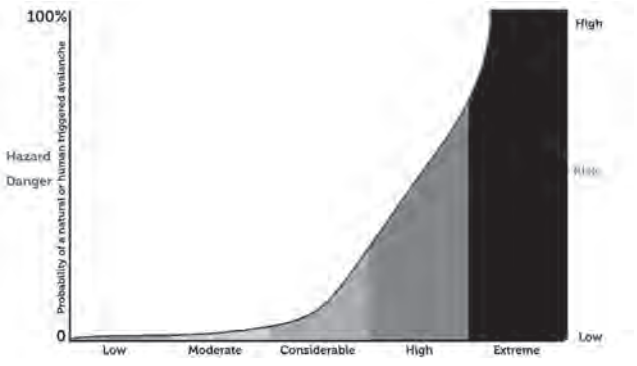


FIG. 5

Not only does considerable hazard represent the greatest uncertainty in the avalanche danger scale, the variation of the risk from the low end of considerable to the high end, is also a significant issue. At the low end, considerable hazard is only marginally more dangerous than moderate hazard. At the other end of considerable, the hazard is comparable to high hazard. We like to keep our decisions within the framework of the avalanche danger scale, but considerable hazard represents the greatest range of variability with regards to decision making. Perhaps the introduction of the Special Public Avalanche Warning (SPAW) was an intuitive process by professional forecasters to address this issue. To the best of my knowledge, all but one SPAW were released in considerable hazard. In terms of decision making, this is a lot for my little 1.5 kg. brain to navigate safely.

When I teach avalanche safety or work with practicum students, I stress that if the hazard is rated considerable, decisions are difficult. If we are not constantly questioning and second-guessing decisions, either the decision has been made to treat the hazard as if it is high and default to safe terrain, or the group has dangerously underestimated the risk.

Doug Latimer is a CAA professional member and ACMG ski guide. For more information about his book, visit www.shadowlightproductions.ca/avalanche

education & **awareness**

28

START MAKING SENSE: COGNITIVE WORK IN AVALANCHE FORECASTING

in this **section**

// GRANT GUNDERSON

Storm Front: **Reflections on Writing an Avalanche Handbook**

Keith Robine

// KELVIN SALDERN

James Floyer and Keith Robine teamed up with Avalanche Canada to write the Avalanche Skills Training Handbook, the new text for AST students as of winter 2018-19.

JAMES AND I ARE PROUD to share the news of this publication and some of its content with our colleagues in the avalanche patch. It was a rewarding, yet challenging, project that came with some personal lessons.

The previous text for recreational avalanche courses in Canada was *Backcountry Avalanche Awareness*, by Bruce Jamieson. There were eight editions, including a French translation and a version for snowmobilers. The last edition was published in 2011. The goal of this project was to write a new book that follows the AST curriculum, incorporating current best practices and decision tools used in the courses.

HUMAN ~~FACTORS~~ BEHAVIOURS?

That human factors often play a role in decisions leading to avalanche fatalities is widely recognized in our field. As an avalanche educator, it has been a challenge to teach human factors in a way that has real impact on students' decision-making. By nature, humans are susceptible to falling into the heuristic traps that can lead to accidents.

Working in the field of psychology, I have learned that helping people find their areas of strength is preferable to solely focusing on their areas of weakness. With that in mind, in the new AST Handbook we describe human factors that lead to accidents as well as positive human behaviours. Communication, leadership, patience and discipline: we highlight these qualities as important elements in making good terrain decisions.

IN THE FOOTSTEPS OF PROFESSIONALS: DAILY PROCESS

In the professional domain, we limit the impact of heuristic traps by following a structured approach to decision-making. For example, at a guides meeting, conditions and terrain are discussed by the group. By tapping into the expertise of the guide team in an environment where communication is relatively easy, the planning that takes place helps reduce the chance for errors caused by human factors in the field.

Decision aids such as the Avaluator have been developed to help the recreational public avoid similar heuristic traps. In the book, we wanted to highlight the Avaluator inside a larger decision-making process that mirrors the one used by professionals. We came up with a seven-step design that is called the Daily Process (Figure 1). Here is an excerpt:

"Surgeons, pilots and firefighters have one particular thing in common: they use structured and systematic approaches to their tasks to reduce the chance of human error. It turns out the higher the consequence of an error, the more important these well-defined processes are.

Travel in avalanche terrain is a high-consequence undertaking and as such, we benefit greatly from a structured approach to backcountry travel. In this course, you will learn a method similar to that used by avalanche professionals, who navigate avalanche terrain on a daily basis and are continually aiming to reduce the negative effects of human behaviours.

FIG. 1: THE DAILY PROCESS FOR TRAVEL IN AVALANCHE TERRAIN.

The daily process for backcountry travel in avalanche terrain (Figure 1) includes all the steps to go through to ensure you continue to enjoy your backcountry pursuits day after day, year after year."

GREAT MINDS (DON'T) THINK ALIKE

I came into this project knowing there would be some challenges in the process of collaboration. However, at times I was astonished by how difficult collaboration could be! It was a real challenge to work through the sometimes-opposing ways that James and I looked at avalanche education. Luckily there were two areas where we thought alike; we both have an eye for detail and we both brought a sense of humour to the project. We laughed at each other's jokes, (or at least pretended to!).

CONFLICT IS ~~BAD~~ GOOD

I don't like conflict. I try to avoid it. When James and I didn't agree about an idea for the book, I started to get a feeling in the pit of my stomach that I recognized as fear of conflict. Eventually we would find time to discuss the reasoning behind our different approaches. We always found a compromise without one person feeling he had to give up his beliefs. Instead, the compromise would create a new way of looking at the issue and forge a better way to write that aspect in the book. The fear of conflict never completely went away, but I learned to trust the process. I think we created a better book because we were able to face and resolve our conflicts.

It has been my great honour to write this book with James. I hope it will inspire students to enjoy the backcountry and make good decisions using strategies similar to what is practiced in our professional community.

Digging In: Diversity, Inclusion and Mental Health

Rachel Reimer

RISK MANAGEMENT AND DECISION-MAKING in avalanche terrain has focused on the study of snow, along with the study of 'human factors' (McClung, 2002), a catch-all concept referring to heuristics, biases, and human perception. In the last several years there have been recommendations for deeper inquiry into how "group formation"—the identity of members in the group–affect decision-making (Zweifel & Haegeli, 2014), including calls for an increase in behavioural sciences input into decision-making (Gale et al, 2016). This winter, the Canadian Avalanche Association has partnered with the Canadian Association of Mountain Guides and the Canadian Ski Guides Association to fund an inquiry into diversity, inclusion and mental health in the avalanche and guiding community in Canada. Specifically, how are diversity, inclusion, and mental health related and how might these affect decision-making and risk management processes in our workplaces?

Diversity is a concept most often equated with visible diversity: race, ethnicity, or gender. Diversity can also mean the behaviours, values, beliefs, and perspectives each person brings to a group, often rooted in learned cultural behaviours from family or cultures of origin. Within the avalanche and guiding community, gender is the most visible and easily measured aspect of diversity. However, gender means much more than whether one identifies as a woman, man, or other.

Gender is the behaviours and characteristics that we perform in relationship with others. The ability to express femininity or masculinity exists within us all. For example, using physical strength and stamina to start a snowmobile, or boot-pack up a slope during snow safety to perform stability tests, is an expression of masculinity. Coaching a struggling client through a challenging ski run accesses femininity. Gender is situation-dependent, meaning that we choose how we perform our gender at any given time. We all have the ability to express femininity or masculinity. Certain characteristics come more naturally than others, and the integration of a wide range of behaviours (feminine, masculine, and everything in between) within the ways we relate to ourselves, and to others, is inclusion.

Current statistics within the avalanche community regarding diversity and inclusion are not readily available. A cursory glance at the existing data reveals a male-dominated profession. The purpose of the study is to gather further data, to address how open the community is to accepting a wide range of behaviours and perspectives; in other words, does the high percentage of males affect inclusivity?

Related research in wildland fire has shown that professional cultural norms are gendered, meaning masculinity is more highly valued than femininity, a value system that has negative impacts for both male and female workers (Reimer, 2017; Reimer & Eriksen, in press). The practice of certain types of masculinity have been linked to decreased health and wellbeing (Courtenay, 2000), and leaders in male-dominated fields who use non-masculinity based leadership also have increased mental health risks (Gardiner & Tiggeman, 1999). In addition, in male-dominated industries there are links to workplace-induced Post-Traumatic Stress Disorder (PTSD), a condition that arises in response to overall workplace beliefs, rather than to singular critical incidents (AFE, 2016).The basic cultural belief that surfaces in male-dominated mountain-based professions like wildland fire is that 'femininity is weakness' (Reimer, 2017; Reimer & Eriksen, in press). Workers adapt various strategies to navigate this underlying, and often subtle, cultural belief. This includes self-censoring any attribute or perspective that may be interpreted as 'feminine', to avoid having their skills and capabilities questioned (AFE, 2016; Reimer, 2017: Reimer & Eriksen, in press). We become what we value.

Recent discussions about mental health, and stigma in the avalanche community have highlighted the need to reduce barriers to openly discussing mental health in the workplace (Jones, 2018). Death by suicide in the guiding and avalanche community has raised questions about the wellbeing of workers, and unofficial estimates cite the suicide rate in the profession at roughly six times the Canadian national average (Obad, 2017). Talking openly about mental health means confronting our hidden beliefs about what is strong, and what is weak. It means delving into diversity and inclusion, and the ways that we conform to what we value.

The inquiry into diversity, inclusion and mental health is timely and important. This winter, members of the CAA, ACMG and/or CGSA, will see an online, anonymous survey circulated via email, social media, and on each association's website from December 2018 to the end of February 2019. Data gathered from the responses is secure and private. Results will be shared widely in the spring of 2019.

As a member of the CAA and a practitioner in the field, my intention with this survey is to fill the gap in our collective knowledge and support the community as we move towards a diverse, inclusive, and resilient future. Please take the time to share your thoughts, experiences, and recommendations. Improving our workplace conditions benefits us all.

DISCUSSING ROUTE ON ILLECILLEWAET GLACIER // DANYELLE MAGNAN

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Start Making Sense: **Cognitive Work in Avalanche Forecasting**

Laura Maguire
M.Sc
Jesse Percival
CAA Professional Member

COGNITIVE SYSTEMS ENGINEERING (CSE) demonstrates how expert practitioners in high risk/high consequence domains make sense of risk in dynamic, ambiguous and changing conditions. Expert performance is identified as going beyond qualifications to include the ability to activate, organize and flexibly apply knowledge (Woods et al, 2010) in time pressured, goal conflicted and uncertain conditions. To do so involves cognitive work.

Using methods from CSE, this study assessed the operational aspects of snow safety then analyzed the artifacts (tools such as worksheets, websites, whiteboards, InfoEx, etc.) that shape cognition and collaboration. Semi-structured interviews were used to detail how tools are used to make and update forecasts over time. Finally, we elicited examples of surprise, near misses and actual incidents to calibrate findings.

Three prominent, interconnected themes emerged from the research:

1. Much of the cognitive work is not described in the explicit protocols.
   The formal representations of what constitutes good practice in forecasting is a small fraction of the strategies experts use.
2. The cognitive effort required to manage avalanche risk is a near continuous activity.
   Forecasting appears to require ongoing calibration. Disruptions to this calibration process have adverse effects on performance.
3. Forecasting is a distributed cognitive task across individuals, teams and the broader industry.
   Successful forecasting requires distributed practitioners of local team members as well as the resources and insights produced by others within the industry.

WITH UNCOMMON SNOWPACKS BECOMING INCREASINGLY COMMON, PRACTITIONERS IN A COASTAL SNOWPACK HAVE BEGUN DEPLOYING NEW STRATEGIES // JESSE PERCIVAL

PREPARATIONS FOR FORECASTING

Formally, the protocols for a forecaster on duty (FOD) suggests producing a control plan shortly after arriving onsite - but each forecaster interviewed detailed extensive preparations that were not captured by the formal description. A variety of work-related techniques were described. For example, time spent carpooling is used as an informal handoff from one FOD to another to discuss recent activity or control measures. This suggests that formulating the day's forecast begins well in advance so that a forecaster arrives for duty with a hypothesis of how recent changes in conditions affect their avalanche terrain management.

Shared, off the books activity is a common (and likely necessary) practice not explicitly noted in work procedures and demonstrates a need for ongoing calibration – an example that supports all three findings. It is well documented that forecasting takes place under time pressure. By seeking out data that can help them anticipate conditions in advance, the FOD relieves some of this pressure to lessen the cognitive demands required once they officially clock in.

DISRUPTION, ADAPTATION & SURPRISE

A second example: An unexpected in-bounds release. On this day, the forecasting plan had anticipated instabilities due to temperature changes. After control work, it was expected that normal monitoring would identify if a closure was necessary. However, a personal emergency meant the team was operating one person short. Concurrently, a first aid emergency tied up members who would otherwise be monitoring avalanche terrain. This left the FOD 'in the bump' for longer than the usual rotation and his normal practice was interrupted. As expected, the temperature fluctuated and a skier-triggered release occurred in one of the avalanche zones.

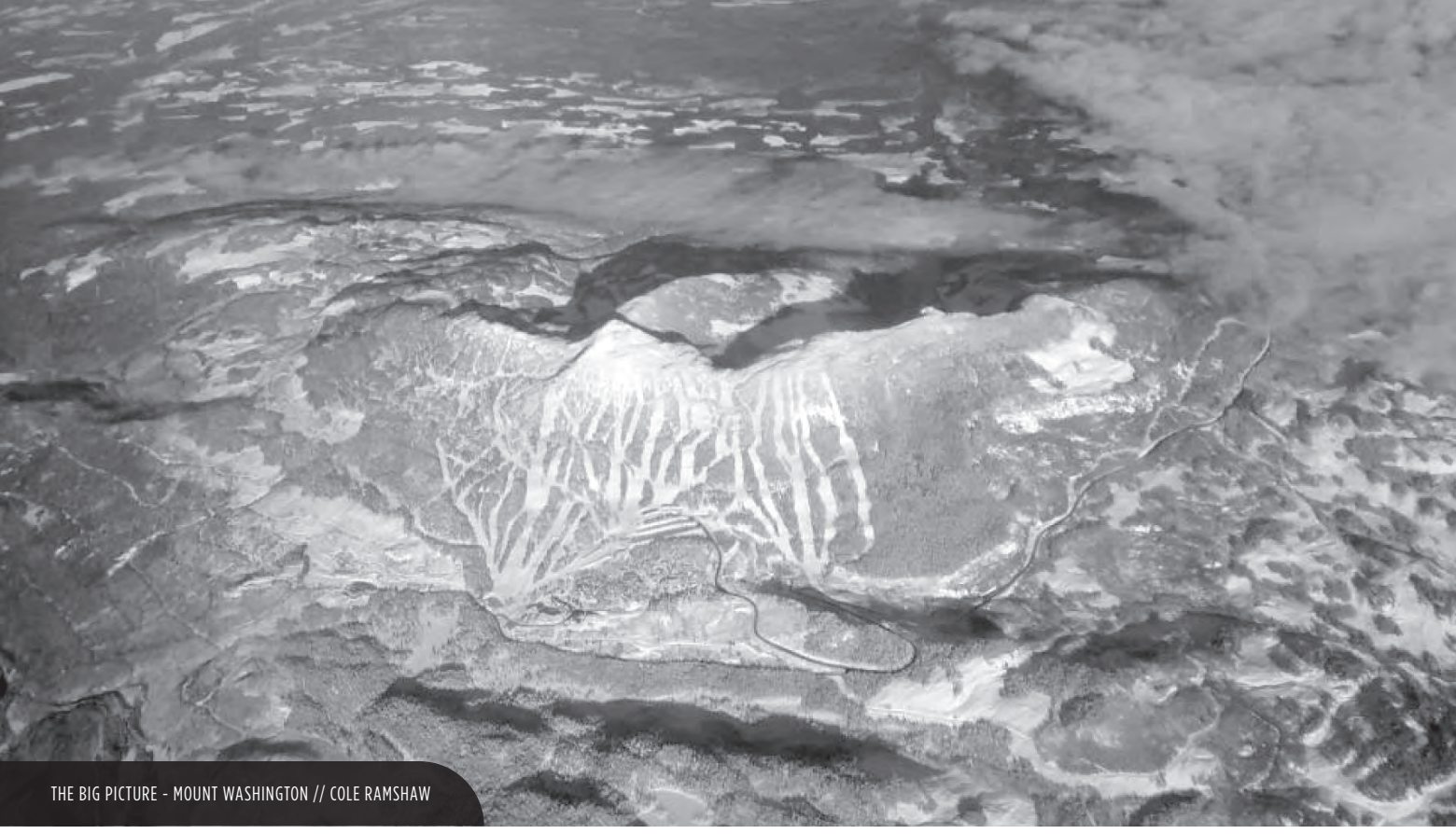
This example is informative in two ways. Firstly, it is reflective of what "normal work" is – constantly adjusting to workload demands or unavailability of resources and adapting practices to respond to conditions while balancing inevitable tradeoffs. Secondly, this example provides evidence that practitioners construct mental models (Adams, 2005) and continually update them.

MENTAL MODELS

The model is an internal representation of current hazards and an expectation of how this may change over time. Mental models are used to retrieve technical knowledge and to flexibly apply it to variable situations.

In constantly changing conditions, mental models become stale unless continually updated. Referring to the in-bounds avalanche example, the model became insufficient after only a few hours. In the previous example, the forecaster coming back from time off is aware their model is stale and seeks information to recalibrate. LaChapelle (1980) notes a "...prevalent and strong reluctance of working forecasters to experience an interruption in their winter routine..." (pg. 78). This finding emphasizes organizing work schedules to protect forecasters' daily and seasonal monitoring routine from interruptions or building in mechanisms to support rapid recalibration or redundancy by cross-checking across other team members.

MT. WASHINGTON FORECAST TEAM EXAMINING THE SNOWPACK AND MENTORING NEW MEMBER // JESSE PERCIVAL



THE BIG PICTURE - MOUNT WASHINGTON // COLE RAMSHAW

DISTRIBUTED COGNITIVE EFFORTS

Notable as well, is the role of a distributed network in constructing mental models. A diverse range of perspectives informed by different experiences, knowledge and mindsets is needed for accuracy. In the resort, the schedule for FOD's is designed to provide an overlap day to accommodate the need for distributed cognition. This is an explicit recognition of both ensuring currency of the mental model and the importance of interactions between practitioners. Updating provides an opportunity to draw attention to details and to generate shared insights.

Spatial and temporal constraints also require distributed cognitive efforts. Large terrain and limited daylight hours create time pressures. The FOD relies on technicians to gather and relay data efficiently and accurately. Without the team, the FOD's mental model can only partially represent actual conditions.

CONCLUSIONS

Errors by normally high performing experts are insights into how the cognitive demands may become temporarily overwhelming. Studies like this illustrate what aspects of practice should be protected from the pressures of 'faster, better, cheaper' common in many workplaces and allows for better engineering of the tools, technologies and protocols used.

Further research can provide an empirical basis for: designing decision support tools; developing training; orchestration & distribution of tasks; funding critical resources; and developing new forms of coordination across networks. Identifying cognitive work in different forecasting settings (mechanized skiing, transportation, industrial) is likely to be useful for accident prevention. In addition, CSE studies comparing expert vs recreational cognition is likely to help public safety efforts.

The authors gratefully acknowledge the Avalanche Canada Foundation for their travel support through the ISSW Fund and the Cora Shea Memorial Fund. For the complete proceedings paper or more information about this and other projects in cognitive work of avalanche forecasting contact Laura (maguire.81@osu.edu) or Jesse (jperceival@mountwashington.ca)

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THESE FOLKS ARE TAKING PART IN THE PERFECT SQUARE. A BLINDFOLDED CHALLENGE TO CREATE A PERFECT SQUARE WITH ROPES // KRISTIN ANTHONY-MALONE

Continuing Professional Development **Fall Series**

Krisitn Anthony-Malone

WE'RE WORKING FOR YOU! Our Fall CPD Series, hosted October 21-25 in Canmore, was a smash hit. Over 200 members from the CAA and ACMG attended, with many of the sessions booked to capacity well in advance. A significant number of our members are also members of the ACMG. Co-hosting these events allows us to exponentially increase the range of sessions available, in addition to reducing costs and pooling resources.

The CAA hosted 5 of the 13 sessions open to both membership types. Colin Zacharias presented his talk on decision points to a standing-room only crowd. We had small group, interactive sessions on digital tools and conscious leadership, as well as a case-based medical update on managing trauma of avalanche victims by Dr Don McPhalen. Luke Norman, our IT Manager, offered his insights on InfoEx for the independent guide.

CPD is your member benefit. Keep your professional skills sharp and up to date. Expand your range of knowledge. Many of the Canmore sessions will be on offer at our annual Spring Conference. Let us know what you need, and we will try to bring in subject matter experts to our Spring or Fall series.

COLIN ZACHARIAS DISCUSSES DECISION POINTS // KRISTIN ANTHONY-MALONE

Schedule of Upcoming **Events**

AVALANCHE AWARENESS DAYS

January 19-20, 2018
Various locations across Canada
AAD is a national celebration of Canada's avalanche sefety expertise and an invitation to enjoy the winter backcountry with education and training..
For more information:
www.avalanche.ca

87TH ANNUAL WESTERN SNOW CONFERENCE

April 15-18, 2019
Reno, NV
Warm Snow Environments.
For more information:
https://westernsnowconference.org/meeting/2019

ASSOCIATION OF CHARTERED ENGINEERS IN ICELAND INTERNATIONAL SYMPOSIUM

April 3-5, 2019
Siglufjörður, North Iceland
This year's theme Mitigation Measures against Snow Avalanches and Other Rapid Gravity Mass Flows.
For more information:
http://snow2019.is/

HELICAT SPRING MEETING

May 6, 2019
Penticton, BC
For more information:
www.helicat.org/

CANADIAN AVALANCHE ASSOCIATION SPRING CONFERENCE & AGM

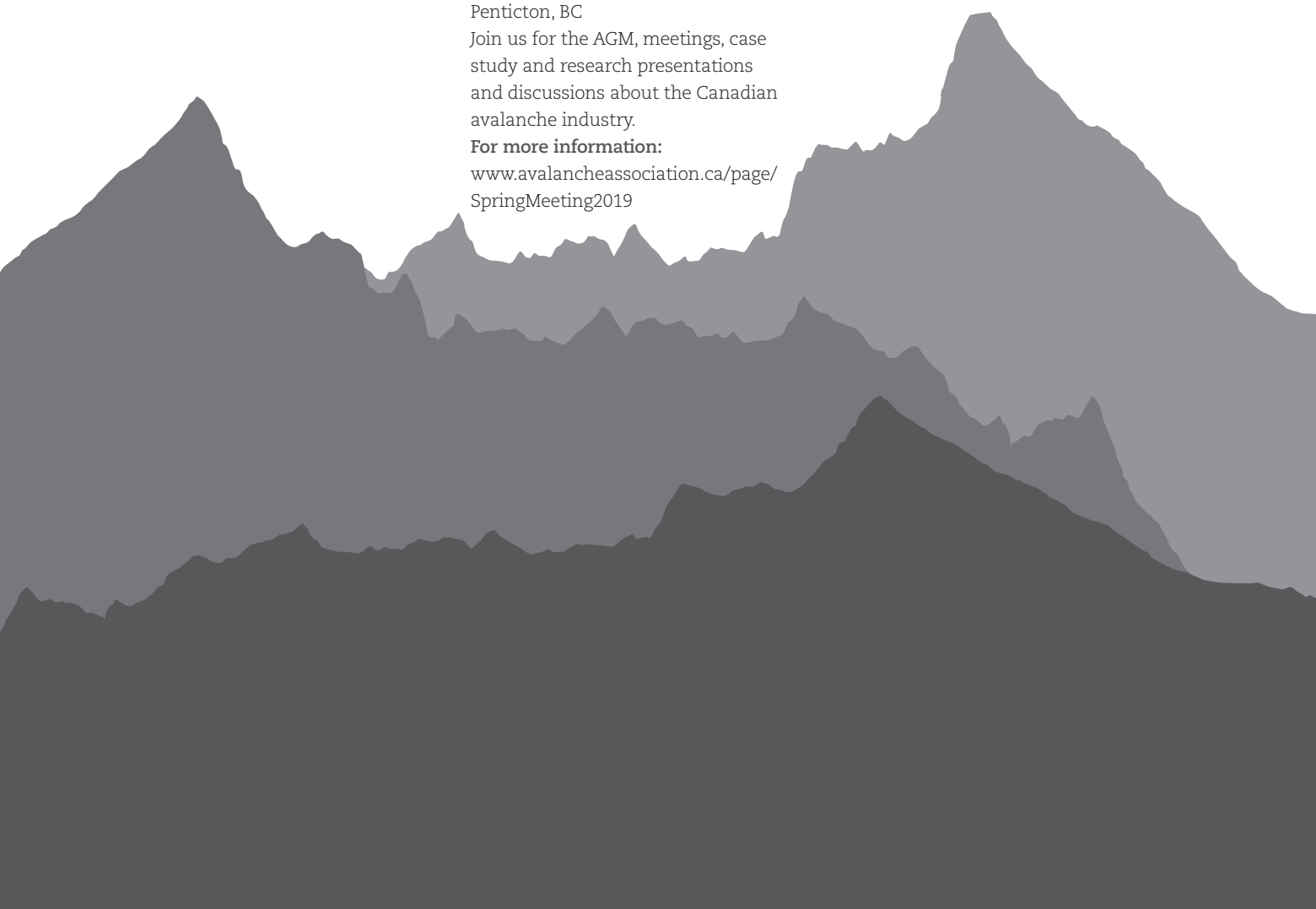
May 6-10, 2019
Penticton, BC
Join us for the AGM, meetings, case study and research presentations and discussions about the Canadian avalanche industry.
For more information:
www.avalancheassociation.ca/page/SpringMeeting2019

ICAR 2019 CONVENTION

October 9-12, 2019
Zakopane, Poland
For more information:
www.alpine-rescue.org

WILDERNESS RISK MANAGEMENT CONFERENCE

Oct 30-Nov 1, 2019
Albuquerque, NM
Facing Challenges Together
For more information:
https://www.nols.edu/en/about/risk-services/wilderness-risk-management-conference/



avalanche **community**

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KEIJIBAN: SNOW BULLETIN BOARD IN JAPAN

in this **section**

// GRANT GUNDERSON

ISSW 2018 October 8–12 Innsbruck, Austria

EMILY GRADY, MARY CLAYTON, AND ERICA ENGLE ON THE NORDKETTE KLETTERSTEIG (VIA FERRATA) // KARL KLASSEN

Merging theory and practice, the International Snow Science Workshop (ISSW) takes place every two years. Concentrating on the leading edge of research, new technologies and shared experiences from around the globe, this conference is the start zone of friendships, collaboration and careers. Presentation abstracts can be searched in the ISSW Archive at Montana State University. https://arc.lib.montana.edu/snow-science/. ISSW 2020 takes place in our hometown of Fernie, BC. We hope to see you there.

Now, as they say, what happens at the ISSW….makes its way into *The Avalanche Journal*. Reports from some of our over 50 members who attended and responded to Obad's Questionnaire: Attendee Responses. Thanks everyone.

KARL KLASSEN

Role(s) that brought you to ISSW: Public avalanche forecasting, representing Avalanche Canada.

Number of ISSWs you have attended: I honestly can't remember but lots.

What content really got you thinking about the future of avalanche practice or research and why?

Other than all the great Canadian presentations from the many different representatives, I was intrigued by the presentations that showed how various agencies are moving into the realm of modelling, AI, and machine learning to augment human forecasting. This approach is very much on the horizon for AvCan especially in data sparse regions where there's little or no professional activity in the avalanche patch but there's a recreational presence that would benefit from more avalanche information products and services. This includes both regions currently served by AvCan (e.g. North Rockies) as well as regions that have no services but would benefit from avalanche information of some kind.

Choose one ISSW experience you'd like to share with CAA members.

Running into people on the Nordkette Klettersteig (via ferrata) that I haven't seen in years! Including friends and colleagues from Norway, Canada, and the USA. Honestly the out of session interactions and opportunities to talk about common goals, objectives, and directions is as valuable to me as the presentations and posters.

MIKE CONLAN

Role(s) that brought you to ISSW: Planning Engineer for BGC Engineering

Number of ISSWs you have attended: 5

What content really got you thinking about the future of avalanche practice or research and why?

My favourite session was titled 'Snowpack: Stability and Variability'. As an avalanche professional, I think it is important to

FIELD DAY - AVALANCHE DEFENSE STRUCTURES // MIKE CONLAN

understand the fundamentals of failure and what we are trying to avoid (or initiate, in certain circumstances). We are still trying to learn the best way to understand snow failure and changes over time, and this session was a good summary of the current state of knowledge in the field.

Overall, the ISSW is about community. It was so great seeing fellow colleagues from Canada and around the world in one place, having a beer and discussing life. It is an experience that benefits everyone.

Choose one ISSW experience you'd like to share with CAA members.

I attended the Avalanche Defense Structures session led by Siegfried Sauermoser, an exceptionally knowledgeable professional who had helped design and maintain the structures around Innsbruck. What was even better was that many of my mentors and idols in the community were also on it, including Bruce Jamieson, Alan Jones, Peter Gauer, Jordy Hendrikx, and Chris Wilbur. The knowledge in the group was awe-inspiring and contagious.

MARY CLAYTON

Role(s) that brought you to ISSW: Communications Director, Avalanche Canada

Number of ISSWs you have attended: This was my fifth ISSW

What content really got you thinking about the future of avalanche practice or research and why?

Often for me, the conversations I have in the hallways, between presentations and over coffee/beer are the most memorable. One of those chats I will definitely be following up on was with a forecaster from New Zealand. He and I were speaking about the challenge of reaching the unaware. For us, it's the growing population of snowshoers venturing into avalanche terrain. In NZ, there's been a huge increase in tourism from the Lord of the Rings movies. The national tourism council even promotes Middle-earth itineraries, guiding eager fans to locations where iconic scenes were filmed. While most sites are fairly benign, some involve avalanche terrain—think where the beacons were lit between Gondor and Rohan, or where the heroes push their way through the Misty Mountains—that potentially expose hundreds of unaware movie buffs to significant hazard. We had a great discussion on communication strategies for these challenges and I took some really good ideas away from that meeting.

Choose one ISSW experience you'd like to share with CAA members.

I met this guy from Utah who had worked on both of Obama's campaigns and Hilary Clinton's. He was fascinating to talk to but what was really cool is that I introduced him to Steve Kujit, the organizer of the next ISSW in Fernie, who had been talking to me about the challenges of using a small town arena for a conference. This Utah dude knew all about how to set up arenas! It was great to hear his voice of authority on this and Steve, recognizing talent when he meets it, immediately asked him to be on the organizing committee. ISSW—merging theory and practice on all sorts of levels.

KIDS PLAYING ON AN AVALANCHE DIVERSION MOUND // CAM CAMPBELL

ALAN JONES

Role(s) that brought you to ISSW: Representing Dynamic Avalanche Consulting (owner). I was there as a presenter and co-authored 4 other papers, for a total of 6!

Number of ISSWs you have attended? 10. First one was in 1998 (Sunriver).

What content really got you thinking about the future of avalanche practice or research and why?

The presentation that stands out as the most hair-raising experience ever was presented at the ISSW 2008 in Whistler, by Matt McKee, now in charge of the Alaska Railroad avalanche program. Titled "Challenges in Forecasting, Chile 2005," Matt was in charge of a Chilean mine road avalanche forecasting and control program. This quote of his stands out: "This presentation is about my experiences trying to keep a struggling mining operation alive during a big winter, and in the end how it came down to getting out alive." He was honestly lucky to survive that winter! This has to be the best ISSW presentation ever, in my opinion.

Choose one ISSW experience you'd like to share with CAA members.

In 2001, I went to Innsbruck with Greg Johnson and Crane Johnson (we were all graduate students with Bruce Jamieson's UofC program). We spent that conference as bonafide dirtbags, camped out on the concrete in the underground parking lot at the Congress. We woke up each morning to cheerfully greet the conference attendees from our sleeping bags. ISSW 2010, Squaw Valley: We rented a condo and populated it with many of our usual Canadian friends. I recall one evening Steve Conger fighting off a bear from inside our condo; it was eating groceries/leftovers on the kitchen island. I was blissfully asleep in the next room, wondering what all that commotion could be, but probably a bit too intoxicated to care. Otherwise I would have come to Steve's aid no doubt. I believe that Steve was couch surfing in our condo, so was the first line of defense against intruders! In 2018, I had much better accommodations (an AirBNB condo) but reflected admiringly on my dirtbag past which I think is all part of the ISSW experience.

CAM CAMPBELL

Role(s) that brought you to ISSW: Planning Engineer for Alpine Solutions Avalanche Services

Number of ISSWs you have attended? 9

What content really got you thinking about the future of avalanche practice or research and why?

A poster presented by Håvard Larson on GIS-based ATES mapping in Norway. When I first started mapping terrain with the ATES almost 10 years ago, I felt it was only a matter of time before someone fully automated the process with GIS and mapped all the avalanche terrain in the world with a push of a button! We're not quite there yet, but the results from Havard et al's work certainly looks promising.

Choose one ISSW experience you'd like to share with CAA members.

The opportunity to catch up with our European colleagues and discuss the similarities and differences in how they do things. Especially in terms of land-use planning and remote avalanche control systems, they have significantly more experience than we do.

STEVE KUJIT

Role(s) that brought you to ISSW: Chairman ISSW 2020, Fernie, BC. Planning for 2020, attending specific ISSW sessions and of course the great beer and bratwurst in Innsbruck!

Number of ISSWs you have attended. 9

What content really got you thinking about the future of avalanche practice or research and why?

Backcountry snowmobile usage has grown up as a North American phenomenon and has had rapid growth, producing some incredible backcountry travel trends. Understanding those trends and the associated risk are a relatively new field and for many snow professionals in the EU it's hard to comprehend. I was happy to see several speakers addressing these topics and hearing the discussions around them.

Choose one ISSW experience you'd like to share with CAA members.

We had some great discussions around involving practitioners and the young snow professionals. Also of note was the continuing innovation of the big three large companies doing remote avalanche control and detection (Inauen-Schätti, TAS and Wyssen), most of which is based on past ISSW innovations and research but taken to another level with industry related products.

ANTON HORVATH

Role(s) that brought you to ISSW: Avalanche Forecaster/Snow Safety Supervisor/Whistler Blackcomb

Number of ISSWs you have attended. 7

What content really got you thinking about the future of avalanche practice or research and why?

Three presentations focusing on the snowmobile community really struck me:

First was the presentation titled, "Localized Dynamic Loading in Extreme Snowmobile Maneuvers", that demonstrated the varying effects these different maneuvers had on the snowpack with buried sensors. Second was "Backcountry Ascender", the new software developed by Christopher Mayer to help educate the uneducated sector of the snowmobile community. Lastly, our very own Jennifer Coulter's presentation, "Show Don't Tell", detailing the progress made by the south Rockies team in successfully reaching out to communicate with the sledder sector .

There is indeed hope! I'd like to add that I felt proud as a member of the avalanche patch in Canada to see how the made In Canada conceptual model of avalanche hazard has been embraced world-wide. We definitely got it right!

GRANT STATHAM

ROLE(S) THAT BROUGHT YOU TO ISSW: Visitor Safety Specialist for Banff, Yoho and Kootenay National Parks and Avalanche Risk Consultant

Number of ISSWs you have attended. Holy crap, 11!

What content really got you thinking about the future of avalanche practice or research and why?

My favorite presentation came from Chris Mayer, a software designer from Seattle who loves snowmobiling and used game theory to develop an online avalanche safety platform. He described the system he has developed to encourage the sledding community to get more involved in avalanche safety. It's an online training platform with various levels and incentives to gradually step people through more advanced training, and the last levels are outdoor AST courses. His reach is fantastic with people signing up like crazy. I saw really big potential here for an alternative way to teach avalanche safety on other people's terms. Really cool. Check out www.backcountryascender.com, or you can read his paper at https://arc.lib.montana.edu/snow-science/item.php?id=2780

Choose one ISSW experience you'd like to share with CAA members.

Canada night was fun, getting almost 50 Canadian's together for dinner and having Ruedi Krannabitter join us. Also riding over the high mountain pass at Khutai with a 35 km downhill was awesome too.

DON MCPHALEN MD. FRCSC.

Role(s) that brought you to ISSW: CARDA representative and presenter

Number of ISSWs you have attended. This was my first

What content really got you thinking about the future of avalanche practice or research and why?

The highlight of the program for me was the original research paper by Avalanche Canada's Jennifer Coulter and Grant Helgeson: "Show, Don't Tell: Modelling Behaviour on Social Media as a Strategy for Influencing Behaviour in Data Sparse Regions." This study described the development of a social media strategy designed to engage and connect with user groups in

AVALANCHE PROTECTION FENCING ON THE FIELD TRIP TO GALTUR // CHRIS ARGUE

data sparse regions such as the South Rockies and North Rockies regions. I discovered that the social media structures that the group developed to engage and direct users to the AvCan forecasts mirror well established and validated social science research models. These models are widely used in the study of the science and psychology of risk communication. Jennifer and Grant appear to have co-invented these research models from within the avalanche forecasting world! My sense is that this further opens the door for social scientists to collaborate within the avalanche world. Way to go team!!

Choose one ISSW experience you'd like to share with CAA members.

What really caught my attention was the level of engagement and the passion displayed by avalanche researchers and practitioners from all over the world. It's not surprising that mountain professionals and medical professionals (my world) have this in common! I really enjoyed putting on my "avalanche hat" and connecting with the avalanche community.

STEVE ROBERTSON

Role(s) that brought you to ISSW: Forecasting snow and ice accretion for the BC Ministry of Transportation and Infrastructure

Number of ISSWs you have attended. Two: Banff and Innsbruck

What content really got you thinking about the future of avalanche practice or research and why?

Speaking with Manuel Genswien and the MountainSafety.info launch team generated excitement around the formalization of a global avalanche language. The field trip to view transport infrastructure with Christian Rachoy & Christian Schekulin was an excellent example of a greater risk management strategy. For example, commercial traffic that is directed through gantries before avalanche or mountainous terrain. These gantries detect over height vehicles, preventing trucks hitting tunnels or snow sheds; they detect overheating of drive train, brakes and exhaust, preventing truck fires on hills; and directly lead to reduced exposure of vehicles being stopped or delays in avalanche terrain.

GALTUR MUSEUM ANNUAL MONTHLY SNOWFALL DEPICTED IN WOODEN RINGS // ANTON HORVATH

Choose one ISSW experience you'd like to share with CAA members.
Attending the ISSW Canada night was so much fun, thank you Susan! It was wonderful how it ended up being in part an impromptu birthday party for everyone who was celebrating that week in Innsbruck including my wife!! Cheers!

MARC PICHÉ

Role(s) that brought you to ISSW: ACMG Mountain Guide and Association of Canadian Mountain Guides Technical Director
Number of ISSWs you have attended. 6
What content really got you thinking about the future of avalanche practice or research and why?
It struck me that what has until has been a desperate grasping at straws of modelling snowpack on terrain may now be a reality within my career. I predict that before I'm done guiding skiing, I'll be using some level of computer-generated run list in my daily work.
Choose one ISSW experience you'd like to share with CAA members.
Andrea Mannsberg's presentation on "Keeping up With Jeremy Jones" shines a light on the traps of the competitive elements social media introduces to our industry.

PASCAL HAEGELI

Role(s) that brought you to ISSW: NSERC Industrial Research Chair in Avalanche Risk Management Simon Fraser University
Number of ISSWs you have attended. 9
What content really got you thinking about the future of avalanche practice or research and why?
Stephan Harvey and coauthors' presentation: "Avalanche terrain maps for backcountry skiing in Switzerland" (http://arc.lib.montana.edu/snow-science/item/2833). The author team derived two different avalanche terrain maps for all mountainous areas in Switzerland. The first map identifies start zones, runouts of size 3 avalanches, and possible areas for remote triggers. The second map highlights terrain in terms of avalanche release and the consequences. This is an interesting new approach for mapping terrain for recreationists.
Choose one ISSW experience you'd like to share with CAA members.
More important than the presentations are the social interactions at the ISSW. I had many interesting and inspiring conversations with researchers, practitioners and students.

NEW LOOK: CAA Communications

Jill Macdonald

WE HAVE BEEN WORKING on a new fleet of email communications, designed to sharpen our messaging and better serve your time and interests. You can look for these messages to begin appearing in your inbox in the coming months.

- **COLOUR** is the first indication to signal the content of the message
- Update **NAME** tells you what the email is about
- **TIMING** is everything: Scheduled messages you can rely on to keep you informed

MEMBER UPDATE

Regularly scheduled communications to members about things going on in our industry and community.

- Delivered the second Tuesday of each month, with exceptions: ie spring conference, CPD etc
- CAA news, course information, upcoming events, articles of note
- Contests, deadline reminders, announcements

IMPORTANT MEMBER UPDATE

Communications that need your attention. May include product recalls, industry announcements or anything that cannot wait for a Member Update to be delivered.

- Delivered as needed
- Urgent, time-sensitive material

PARTNER UPDATE

Content delivered to you from our supporting partners. All materials in the email are provided by the partner. This is an opportunity for them to reach you directly, as a benefit of their partnership with us.

- Delivered as per partner scheduling
- Product, event, contest or other informational or promotional materials
- Delivered via CAA: We do NOT share our email list

IN MEMORY

Notice of a member's passing. We are a small community. Offering our support and respect in difficult times to family and friends is important to us.

CRITICAL UPDATE
If you see this in your inbox, open it immediately. This communication is for rare instances where we feel you need to know the information as soon as possible, and that we wish to deliver it directly to our membership.

- Delivered as needed
- Critical, highly time-sensitive material

SPRING CONFERENCE
Content that pertains exclusively to our Spring Conference meeting. Watch for dates, CPD content, AGM details, booking accommodations, links to the full schedule and registration pages.

- Delivered weekly during March and April
- All information relevant to our Spring Conference and AGM

CONTINUED PROFESSIONAL DEVELOPMENT
Information pertinent to any continued professional development sessions that we are offering. Look to these updates for dates and registration links.

- Delivered prior to the event
- All information relevant to the sessions

INDUSTRY TRAINING PROGRAM UPDATE
Important information on changes to curriculum, new curriculum, application requirements, pre-requisites and assessment criteria.

- Delivered as needed

INFOEX UPDATE
Sent to subscribing InfoEx operation administrators when there is important InfoEx information to be shared.

- Delivered as needed
- Information on renewals/subscription rates; updates to InfoEx

Keijiban: **Snow Bulletin Board in Japan**

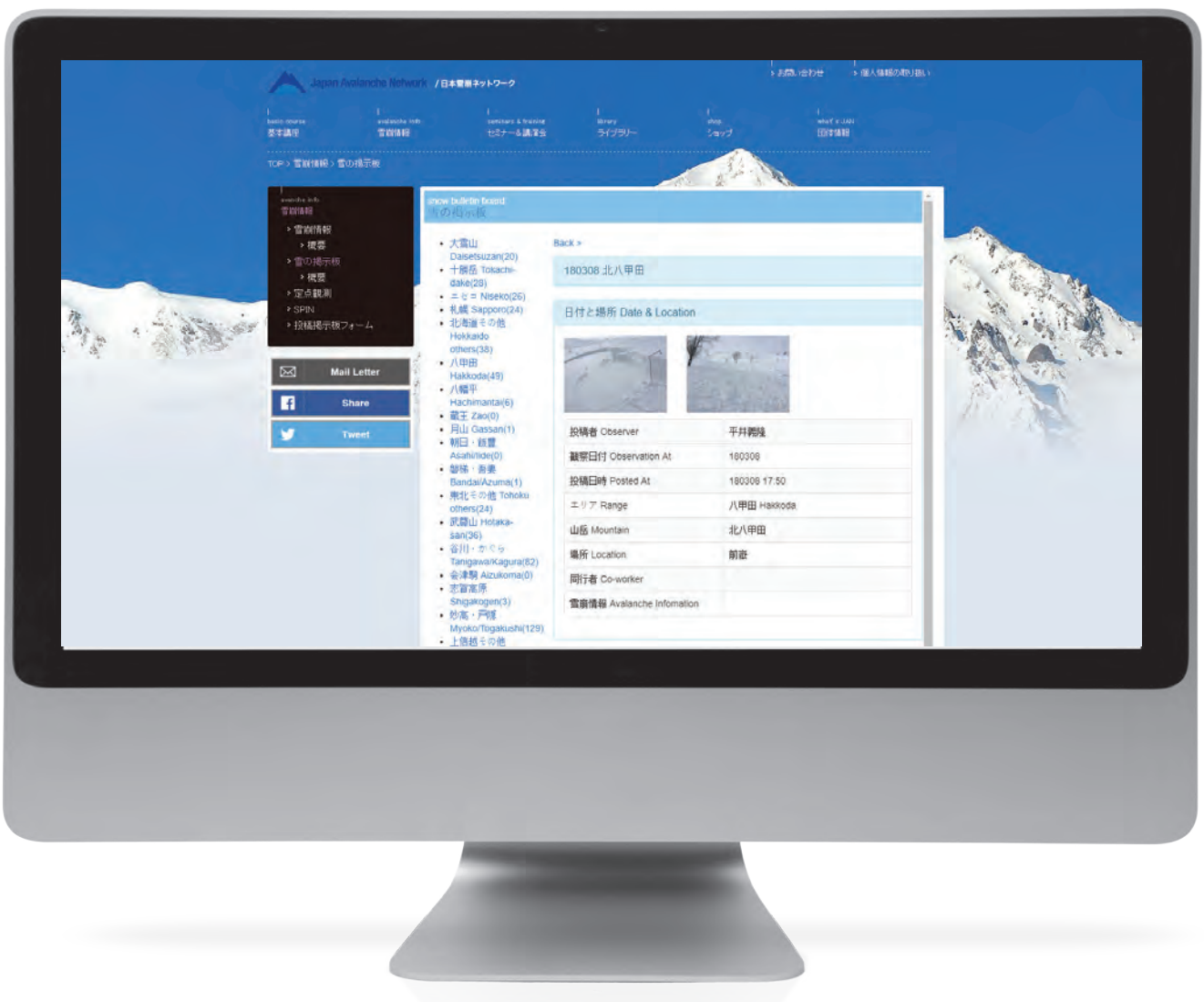
Yukinori Saotome

BACKCOUNTRY SKIING IN JAPAN has become increasingly popular with people from overseas during the last several years. Wouldn't it be nice to have an avalanche resource as a reference point? The Japan Avalanche Network (JAN) welcomes you to support and use our snow bulletin board as a platform for sharing avalanche information when you visit. We call it Keijiban.

JAN hosts avalanche forecasts and Keijiban on our website to support public avalanche safety in Japan. We feel that it would be better if we could get more information from wider areas and operate in both Japanese and English languages. As you can imagine, translating every time information is posted is quite a hassle.

Keijiban has two sections: one is open for the public and the other is private. You can choose to open or close your data when you post it. If you register as a contributor, you can view information that is both opened and closed. Contributors must have Avalanche Operation Level 1 or Level 2 certification.

Please email us: office@nadare.jp when you decide to come to Japan and are interested in sharing avalanche information. We will give you a posting page address, ID and password, then you can post it in English. Here is the JAN's snow bulletin page: https://www.nadare.jp/avalanche-info/bbs/



Flakes

ROB BUCHANAN

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Parks Canada - Banff - Bourgeau Gazex Avalanche Path Control

Images: Ian Jackson

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AvaTek Mountain Systems Inc.

250.344.2122 www.avateksystems.ca

Golden, BC, info@avateksystems.ca