

INFOEX FOR PROFESSIONAL AVALANCHE EDUCATION: USING THE TOOL FOR COURSE RISK MANAGEMENT AND MEETING STUDENT LEARNING OUTCOMES

Sean Zimmerman-Wall^{1*}, Karin Pocock^{2*}, Chris Dyck^{3*}

1 American Avalanche Institute and AIARE, UT, USA

2 Silverton Avalanche School, CO, USA

3 Canadian Avalanche Association, British Columbia, CAN

ABSTRACT: For many avalanche education organizations, the documentation of daily avalanche forecasting and risk management has relied on internally developed paper forms and customized digital spreadsheets. The InfoEx, developed by the Canadian Avalanche Association and utilized by practitioners across the globe, is a daily exchange of technical snow, weather, avalanche and terrain information between subscribers. Its adoption in a wider variety of contexts and organizations has enabled comprehensive documentation of factors related to avalanche forecasting and operational decision-making. Several professional avalanche education entities now use the platform to document operational risk management. In addition, some are using the power of the tool to facilitate meeting student learning outcomes related to hazard assessment using the Conceptual Model of Avalanche Hazard (CMAH) and risk treatment plans.

The American Institute for Avalanche Research and Education (AIARE), the Silverton Avalanche School (SAS), and the Canadian Avalanche Association Industry Training Program (CAA ITP) all employ the tool in the delivery of their courses during the winter operating season. The purpose of this study is to define how operations are using the platform, explore the challenges they experience with its design and implementation, record insights related to operational decision-making, and identify emerging best practices in its usage. This information is gained through discussions with program managers tasked with InfoEx integration, review of InfoEx workflows, and synthesis of feedback from the different user groups of trainers and students.

Capturing a baseline of how professional avalanche education organizations are currently utilizing the InfoEx can guide future development and implementation of the tool in educational settings. This insight is useful to all avalanche educators who consider ways to improve documentation and data-sharing tasks in their work.

Keywords: Avalanche Education, Avalanche Forecasting, Decision-Making, Information Exchange, Terrain, Operations and Program Management

1. INTRODUCTION AND BACKGROUND

For many avalanche education organizations, the documentation of daily avalanche forecasting and risk management has relied on internally developed paper forms and customized digital spreadsheets. These forms contain current and forecast weather data, snowpack observations, avalanche occurrences, and a forecast with listed avalanche problems and a hazard rating. Depending on the scope of the educational courses offered, terrain selection may be in the form of a traditional run list or by indicating open and closed zones by Avalanche Terrain Exposure Scale (ATES) classes. A risk treatment plan or tour description is also captured, which links the hazard, terrain, and group. It is important to realize that not all avalanche courses enter avalanche terrain, and those that do, generally desire a limited exposure window given typically larger group sizes of five to six students and an instructor. A common challenge with paper forms is systematic and accessible filing, while being able to carry the document into the field for continued reference. Spreadsheets or customized word documents lend themselves to formatting constraints and open the door for loss of data integrity. While some operations invest in customized software packages to do the job, these often carry significant development costs, challenges in scaling across multiple computer terminals, and a steep learning curve to input, manage, and access data.

The development of the InfoEx platform in Canada during the 1990's, and its eventual proliferation across the globe in licensed international versions starting in the mid 2010's, allows avalanche practitioners to document and share observations with other subscribers at a larger scale than ever before (Haegeli et al., 2014). The digitization of the distinct form elements into "workflows" enables an operation to use standardized observation templates aligned with the Canadian Observational Guidelines and Recording Standards for Weather, Snowpack and Avalanches (OGRS) and the United States' Snow, Weather and Avalanches Observational Guidelines (SWAG). InfoEx also has a hazard forecast module adapted to the Conceptual Model of Avalanche Hazard (CMAH). Extensions for avalanche control results and structured run lists allow for even further detailed data capture and coding. Since 2015, InfoEx developers enabled customizable Free Forms, and in 2025 Structured Forms, that give program managers the ability to adapt their workflows in ways that fit the operational context and collect information relevant to their teams.

2. PLATFORM CAPABILITY AND CURRENT USAGE

InfoEx's use is concentrated in North America and is used regularly by agencies operating in South America, Asia, and Europe. There are three distinct versions that provide access to subscribers: Canadian, Swedish, and International (CAA, 2026a). The administration and development of the three versions is managed by the Canadian Avalanche Association, which provides software services through funding from subscriptions and grants. The continued adoption by agencies representing all sectors of the avalanche industry (ski areas, guide services, industrial and public forecasting, education, etc.) shows its prowess as an observation sharing platform, an internal risk documentation platform, and recently, as an educational platform for industry workers.

Information exchange across subscribers through sharing settings is a core benefit of the software and is managed differently across versions. By design, the Canadian InfoEx has more "always shared" data settings based on its lineage in the country. For the International InfoEx, there are more tailored sharing settings to suit the cultural differences of the populations it serves. In the US, the adoption of the tool was driven by the ability to limit the sharing of data from operation to operation. It is for this reason that a specialized Data Sharing page in the International version allows operations to select which operations they share data with, and which they don't. Info sharing can be one-way, or two-way. Within that context, operations can further select which portions of their workflows are shared versus private (S. Smith, personal communication, July 29, 2026).

* *Corresponding author address:*

Sean Zimmerman-Wall, American Avalanche Institute and AIARE.
Salt Lake City, UT 84094;
tel: +1 865-776-9516; email: seanzw@altocerrotrain-ing.org

The platform capability and usage are predicated on how each InfoEx version functions. There are three user levels, Operation Administrator, Submission Moderator, and User, each with varying levels of access and configuration ability. Importantly, as part of quality control measures for submissions in Canada, each InfoEx operation requires an at least one Operation Administrator or

Submission Moderator to be a CAA Professional Member. Users can be any level of avalanche worker, but the Professional Member is ultimately responsible for submitting to InfoEx. For International InfoEx subscribers, it is recommended that Operation Administrators and Submission Moderators are competent practitioners accustomed to using standards from OGRS and SWAG.

The rest of this paper focuses on how three North American professional avalanche schools currently use the platform and the workload associated with implementation. The authors aim to represent the current state of things to illustrate how InfoEx has been used over the last few seasons (2024/2025 and 2025/2026), with an eye towards next steps and work being performed in the 2026/2027 season.

2.1 *Canadian Avalanche Association Industry Training Program*

The CAA ITP instituted InfoEx usage for instructors on all its Operations 1 and 2 courses in 2024/2025, moving to more consistent risk documentation. Originally, the organization decided on using a single operation (CAA ITP) where all courses would input data. Within this operation, different workflows were created based on criteria such as when courses travel through non-avalanche (ATES 0) or mitigated resort terrain, when they traveled in unmitigated avalanche terrain (ATES 1+), and for Occupational Hazard Assessments to document a course's exposure to things like winter road conditions or cold weather travel. The entire instructor pool had access to this operation and were required to choose the appropriate workflows for a given situation. This created confusion and resulted in the wrong workflow being selected by a team, with the potential to then overwrite the data of another team when multiple courses were running simultaneously. Over the summer of 2026, this was changed to divide the operation into specific course locations; Whistler, Golden, Revelstoke, etc.

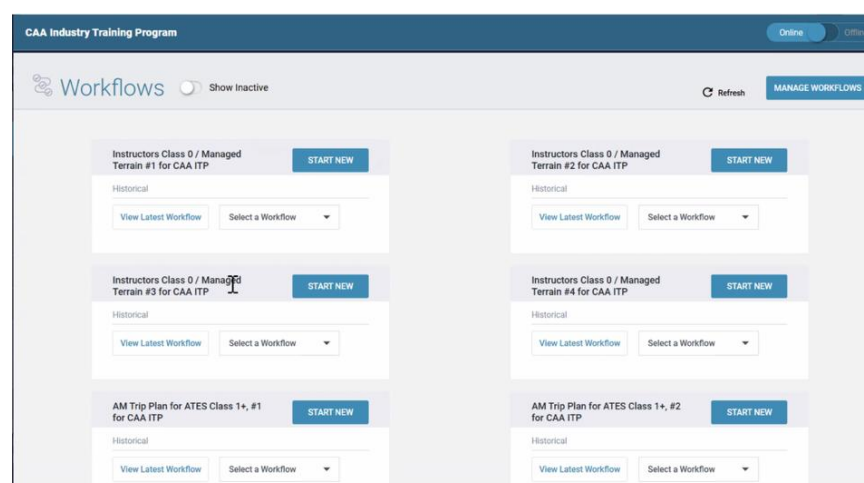


Figure 1. Initial CAA ITP workflow options during the 2024-2026 winter seasons.

On Operations Level 1 courses, instructors use InfoEx to model professional forecasting and operational planning practices. The goal is not to teach students how to use InfoEx, but to familiarize them with the role it plays in daily avalanche operations and demonstrate how information from InfoEx informs decision-making. Throughout the course, instructors explicitly relate the InfoEx workflows to the Conceptual Model so students recognize that operational forecasting follows the same evidence-based hazard evaluation process used in industry and taught throughout the ITP curriculum. Students do not create or edit the AM Workflow during the course. Instead, they use the morning meeting to begin documenting the day's forecast, operational plan, and key discussion points in the notes section of their field books. As the instructor works through the morning briefing, students record the information they consider relevant for the day's travel, decision-making and data collection. This allows instructors to coach students on effective field notetaking while reinforcing what information is operationally significant.

In Avalanche Operations Level 2 and Level 2 Assessment courses, students transition from observing the use of InfoEx to actively creating and using its workflows as part of the operational forecasting process. The goal is to allow students the opportunity to use the InfoEx platform to create morning and evening workflows. Throughout the course, instructors continue to explicitly relate the structure of InfoEx to the CMAH so students recognize how operational forecasting applies to the evidence-based hazard

evaluation process taught throughout the curriculum. Students progressively assume responsibility for creating the AM Workflow throughout the course. One method employed by course leaders is to use daily rotations, where two groups use paper forms to create the morning workflow but still use InfoEx to collect and analyze weather, snowpack and avalanche occurrence observations shared by other local operations. In this way, instructors and students co-create the InfoEx workflow in real time for the given course situation. The instructors evaluate the workflow and ultimately submit it to the network. A PDF is created and available to the teams as a digital reference, as well as emailed to the CAA home office in Revelstoke as part of their risk management plan.

2.2 AIARE

AIARE currently uses the International InfoEx as an internal operational risk management and observation sharing tool. The organization has multiple that it creates based on the geographic locations of the courses it runs. The AM and PM workflows have been standardized across locations so that instructors all use the same format, while also allowing for more consistent data analysis at the end of each season. Instructors are given access are not expected to monitor reports or make observations until a week before their course begins. Since 2024, the AM workflow has relied heavily on freeform modules that allow for increased customization and closely matches the paper form that is given to students on a course.

The workflow contains an InfoEx Hazard Assessment Module that is used to identify the primary avalanche problems and assign a hazard rating. The module's adherence to CMAH allows instructors to either follow the local avalanche bulletin and refine it to a smaller scale or create their own in the absence of a public forecast. Following the assessment, a risk treatment freeform captures the terrain selection and what areas will be avoided. This is tied to the operation's terrain catalog, which is housed in Cal Topo, with major landmarks mapped in the InfoEx Location Catalog. Additional freeform information such as other hazards, check in/out times, and Emergency Response Plan are captured. Upon submission of the workflow to the InfoEx network, a PDF is created and available to the teams as a digital reference. This is also emailed to the AIARE office as part of the organization's risk management plan.

While the tool has continuously been used as an instructor facing tool, it has gone through different stages of student use. Starting in 2019 it was only introduced as a concept on Pro 1 courses and mixed into the morning meeting and evening debrief on Pro 2 courses from 2019-2022. Student groups had the option of filling out an AM and PM workflow in small groups, saving the output to a PDF, but not submitting to the InfoEx network. Due to technological constraints with prior versions of the International InfoEx, and consistent instructor feedback, AIARE elected to stop using the InfoEx workflows as a student-facing option. While upgrades have been made to allow for a smoother procedural flow and "sharing to operation" versus "submitting" to the InfoEx network, AIARE has not reintroduced it as a student tool. This is primarily due to the extra workload to build a student-specific platform, train students, and the possibility of confusing the overall hazard assessment process with the digital technology. This can be revisited in the future as more of the instructors and students see InfoEx used at other operations and become more familiar with its nuances.

Conditions

Current Weather Observations (if not recorded elsewhere)

Location	Elev	Time	Ta	24hr Max Ta	24hr Min Ta	WS / Dir	HS	HN	Surface	Baro	Trends - Current or Past 24 hrs
Base	8050'	0500	17	34	17	-	27.7	7" / 24h	-	-	temp has decreased steadily in past 24h
Sinners	9480'	0500	11	29	11	-	82.8	-	-	-	same temp trend
Peak	11000'	0500	6	24	6	20-60/WNW G-44-85/WNW	-	-	-	-	Peak speed & gusts yesterday evening then tapered but still gusting to 45mph

Weather Observations Red Flags:

- Extreme wind gusts. Sustained wind with snow available for transport.

Weather Forecast & Source:

- NOAA Avalanche FX: Subsidence from a building ridge along the west coast allowed for showers to quickly taper off overnight, with cloud cover already quickly diminishing, leaving behind much colder conditions this morning. Lows in the single digits to mid-teens are expected this morning, with temperatures only climbing to near-freezing this afternoon. Gusty northwesterly ridgetop winds are expected to taper this morning, becoming light overnight. Light NNW winds with moderate gusts at 9,000' ridgelines, moderate to strong winds with strong gusts at 11,000' ridgelines.

Figure 2. AIARE InfoEx Freeform Table: Weather Conditions. Similar in format to student AM worksheet

2.3 Silverton Avalanche School

SAS's implementation of InfoEx as an operational risk management tool on courses began in 2018/2019 season. Through subsequent iterations it became mandatory for all its programming beyond just professional level avalanche training. A collection of regional workflows is provided for instructors and trip leaders based on geographic location. Single workflows will occur for that specific location each day and includes pro instructors, recreational instructors, guides working tactical programs, private days/Edu tours, and rescue instructors. A consistent structured meeting process establishes company-wide risk management for the operating area regardless of program type. It is used for other geographically distant locations. If SAS has multiple programs going on in a different operating area, then the same process will occur where all teams working in the area attending an in person AM meeting and creating a collective hazard and risk assessment in InfoEx. This helps prevent programs from becoming siloed in their hazard assessment and unifies terrain guardrails across the operating zone. Instructors create the umbrella for the courses' risk management independently of students.

Beginning in 2025/2026, SAS piloted a student-specific InfoEx operation for its professional courses. Pro 1 and Pro 2 students are given access to the tool and educated on its use. This required the Operations Administrator to build a "sandbox" for students that does not populate to the greater InfoEx network. Students work through AM/PM hazard & risk assessments in working groups, which allows hands-on practice with and learning of the CMAH. Since risk management accountability of the organization happens in a separate workflow, there is more freedom for students to play out their decisions in the field (if they are within the larger umbrella of risk management decided by the organization).

SAS uses the InfoEx to align the teaching of the CMAH across all its employees and programs. This consistency spans Pro 1 and 2 programs and can be seen in all workflows. The InfoEx also creates consistency in mockup forecasting assignments and serves as the platform for students to work with when tasked with these assignments, which are evaluated as part of the course outcomes. InfoEx is not just used to support the AM/PM process, but also to support scenario-based learning. Both staff and students' work is logged and saved, creating documents that can be accessed easily if needed in litigation stemming from an incident. A PDF is created and available to the teams as a digital reference, as well as emailed to the SAS home office as part of its risk management plan.

THEMES AND DISCUSSION

While a unified set of best practices is still emerging, it is possible to see that the use of InfoEx falls along a continuum based on the educational paradigm in each country and the operational structure and resources of each organization. Themes related to how the tool is most utilized by the schools are included below and provide a benchmark for how the operations train instructors and students.

3.1 Canadian Avalanche Education System

In Canada, where the tool enjoys a wide application, consistent usage by avalanche professionals, and some basic platform fluency, InfoEx integration has been relatively smooth. This is supported by the educational structure within Canada and the intentionally designed introduction of the tool throughout their course progression. For example, the CAA ITP linear flow starts with AvSAR Level 1 where documentation procedures are discussed (CAA, 2026,). This course is followed by an Introduction to Avalanche Operations online course, where different tools are introduced and the idea of documenting risk management and sharing observations among professionals is highlighted. When a student reaches the Operations Level 1 course, they are scaffolded well and have a smooth on ramp to a basic demonstration of InfoEx as part of a course's daily hazard briefing by the instructors. Before applying to the Operations Level 2, they are required to take another multi-day AvSAR Level 2, as well as create a portfolio of observations and show evidence of risk documentation used in their workplaces. When a student reaches this course, they will have had weeks of instructor-led course work, followed by on-the-job training where InfoEx is likely to be used for weather, snowpack and avalanche occurrence observation exchange, and in many cases, to complete a hazard forecasting workflow. Arriving for the Operations Level 2 Assessment, students are primed to operate within the digital space and have gained proficiency with the process of using the CMAH along the way. It should be mentioned that membership in the CAA at the practitioner and professional level is tied to the competencies related to each course offering. While membership may not be explicitly required by employers, this can serve as an opportunity that aligns the tool's usage with the workplaces of Canada.

3.2 United States Avalanche Education System

In contrast, an aspiring professional student in the United States may have minimal exposure to operational record keeping when reaching the Pro 1 (A3, 2026). They will have a foundation from their required recreational courses, generally in the form of a checklist or fieldbook that outlines a daily flow of elements that support safe travel in the backcountry. While the elements may be familiar, the unification of the content into a more formal output is likely to be quite varied across students. If students are coming from employment in the US avalanche industry, there are many different recording methods that they will have been exposed to. Students may or may not be introduced to InfoEx on the Pro 1, but they will go through a very detailed and rigorous hazard assessment lesson, followed by in-situ crafting of a full morning assessment starting early in the course. Student groups are expected to refine the local avalanche bulletin from a range scale down to a drainage scale in short order. This is a leap for many, and through careful coaching with the CMAH, they can do it by the end of the 5-day course. Students electing to take the Pro 2 will be required to submit a portfolio of observations and risk management documentation, along with meeting specific on-the-job requirements ahead of enrollment. A Pro 2 student is viewed as an emerging leader and will take responsibility for leading morning and evening hazard assessment meetings, further refining their knowledge and application of the CMAH. Membership in the A3 is not required for most jobs in the United States and Affiliate and Professional membership has not yet been directly mapped to the competencies of the Pro 1 and Pro 2. This is an area for future alignment between the two countries and could facilitate continued parity of the educational paradigms.

3.3 Conceptual Model of Avalanche Hazard Instructor Usage and Student Teaching

All three operations see the value of the integrated nature of the CMAH within InfoEx's Hazard Assessment Module. There is widespread agreement that instructors appreciate the ability to use the module to create their own forecast in an area without one or refine the local bulletin to a smaller geographic scale. It promotes consistency among instructor teams. Additionally, the digital record enables instructors from one course to review assessments from a previous course and neighboring operations assessments when robust data sharing is enabled. The ability to use this module with students as a framework for technically precise application of the CMAH also creates consistency due to the module's functions. There are embedded resources for various elements of the CMAH (Statham et al., 2018) such as drop downs for avalanche problem types and documented failure planes, definitions for sensitivity to triggering, distribution, avalanche size, and hazard ratings. The module also assists students in the assigning of likelihood based on sensitivity and description by automatically selecting the average size and likelihood on the accompanying hazard graph. Seeing the problems overlain in the hazard rating tab of the module also helps visualize the overlap of the avalanche problems across elevation bands. All this lines up to be a more intuitive step-by-step process contained in one place, rather than spread across multiple browser windows and printed workbooks.

The screenshot shows the 'Wind Slab' section of the InfoEx Hazard Assessment Module. It includes a 'Type of Problem' dropdown set to 'Wind Slab', a 'Location of Problem' circular diagram with a shaded sector, and buttons for 'Clear All', 'Fill All', and 'Reset'. To the right, there are dropdowns for 'Failure Plane(s)' (Non-persistent), 'Typical Depth' (Min 10 cm, Max 30 cm), 'Distribution' (Specific), 'Sensitivity' (Reactive), and 'Typical Size' (1). A 'Hazard Chart' is displayed with a green box indicating a 'Possible' hazard level. The chart's y-axis is 'LIKELIHOOD OF AVALANCHES' (Unlikely, Possible, Likely, Very Likely, Almost Certain) and the x-axis is 'DESTRUCTIVE SIZE' (1 to 5). A 'Reset' button is next to the chart. At the bottom, a 'Comments' section contains the text: 'We should see this problem on most leeward slopes today'.

Figure 3: InfoEx Hazard Assessment Module showing an example of a Wind Slab avalanche problem. The dropdown menus, hazard chart, and comments section give a clean visual overview to new and developing forecasters.

3.4 Blended Use of Analog and Digital Tools in Training and Implementation

InfoEx administrators and instructors at each school are aware of the cognitive load of simultaneously teaching a hazard assessment process and learning the nuances of a digital platform. There is a decreasing digital divide in the workplaces of the North American avalanche industry, and assumed competency with more tools is expected at many organizations. A good corollary is the use of mapping software such as Google Earth, Cal Topo, On X, and Gaia that have proliferated across operations and are in the hands of the average backcountry rider. These platforms invest heavily in the User Experience (UX) and have revolutionized how we visually interpret terrain. With the improvements made by the InfoEx developers, in conjunction with the InfoEx Advisory Committee and working groups, the UX has improved and now features mobile capability for observation submission. Using the tool offline without an internet connection is also possible.

These educational institutions find a way to balance the expectations of platform literacy with the reality of time constraints experienced on courses. Each school thoughtfully found a way to use InfoEx tool for staff and students. For AIARE, the use of the tool solely for instructors keeps the technology out of the classroom, but lends itself well to robust operational documentation, internal risk management, and observation sharing with other agencies in the region. Students focus on the hazard assessment process using paper forms and are not affected if the power goes out or a computer crashes. Analog works all the time.

SAS and the CAA ITP have fully digital and hybrid approaches respectively. SAS separates the instructor and student InfoEx Workflows by design, and each group is trained on its use prior to courses, with continuous coaching throughout a course. CAA ITP simply introduces the tool early in the education progression and then rotates groups through paper forms and InfoEx in later courses. In the Operations Level 2 course, instructors and students collaborate on the final submission for each day and it becomes the operational record for the course.

CONCLUSIONS & FUTURE WORK

The organizations profiled here have maintained a growth mindset throughout their adoption of InfoEx. Each entity sees potential to continuously refine the workflows and structure, as well as more intimately tie the tool's usage into the course for meeting learning outcomes. All three schools are still learning how to use the tool for report generation and data analysis and it will be interesting to see if they find ways to use these additional capabilities to reflect on the overall risk management of a given course within their operating season, and on their season as a whole. Karl Klaussen of Avalanche Canada published the main reference on using InfoEx data (Klassen, 2024), and he posited:

“One of the most important aspects of InfoEx is the ability to see anomalies; sometimes the outlier is more important than the average, in low probability-high consequence scenarios for example.”

Perhaps the real gold is in the data mining to be done later. In the meantime, each operation is working with its instructors and students to understand the efficacy of InfoEx for their operation. Researchers outside this group can explore how the tool can be integrated into the overall hazard assessment and documentation processes. This integration can help determine the skills within a student's zone of proximal development at any given level of the professional education paradigm. Further work may also illuminate if we are relying too much on digitization, thus endangering our ability to think critically, analyze thoughtfully, and make real time decisions more consistently without relying on technology.

AUTHORS' DISCLOSURE

The authors of this paper represent various avalanche education entities in the United States and Canada. The software being used by all three institutions profiled here is a subscription-based model designed, developed, and published by the Canadian Avalanche Association. None of the agencies or authors have a financial incentive to promote InfoEx as a platform and have not received any forms of direct compensation to produce this work.

ACKNOWLEDGEMENTS

We have profound gratitude for our team members at the Canadian Avalanche Association, American Institute for Avalanche Research and Education, and the Silverton Avalanche School for working with us to improve our understanding and usage of InfoEx. Stuart Smith, InfoEx Manager, provided direct and indirect support through his tireless efforts leading development and delivering consistent communications. Additional mentorship for the writing of this paper was provided by Eeva Latosuo. Without her guidance, patience, and encouragement this paper would have been very difficult to produce.

REFERENCES

- American Avalanche Association (A3). (2026). *Professional Avalanche Education*. <https://www.americanavalancheassociation.org/professional-avalanche-education>
- Canadian Avalanche Association (CAA). (2026a). *InfoEx Subscriber Information (International)* <https://www.avalancheassociation.ca/page/InfoEx>
- Canadian Avalanche Association (CAA). (2026b). *What Is The Industry Training Program?* https://www.avalancheassociation.ca/page/Training_Flowchart
- Haegeli, P., Obad, J., Harrison, B., Murray, B., Engblom, J., and Neufeld, J.: InfoEX 3.0 - Advancing the data analysis capabilities of Canada's diverse avalanche community, International Snow Science Workshop, 2014.
- Klassen, K. Making the Most of InfoEx Data. *The Avalanche Journal*. Winter 2024. Canadian Avalanche Association, 12-14
- Statham, G., Haegeli, P., Greene, E. *et al.* A conceptual model of avalanche hazard. *Nat Hazards* 90, 663–691 (2018). <https://link.springer.com/article/10.1007/s11069-017-3070-5>