2021 Crevasse Risk Management and Safety Workshop Review

Organizing Committee: Alison Banwell, Zoe Courville, Jessie Crain, Renee Crain, Kate Koons, Jennifer Mercer, Kate Ruck, John Stoddard, Martin Truffer, Lizz Ultee

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Introduction

The recent publication of the 6th Assessment Report from Working Group 1 of the United Nations Intergovernmental Panel on Climate Change (IPCC) detailed widespread and rapid changes in the atmosphere, ocean, cryosphere, and biosphere. Section A.4 highlighted that together, ice sheet and glacier mass loss were the dominant contributors to global mean sea level rise over the past 15 years. Continued research on polar land ice is imperative to further characterize the speed and magnitude of such unprecedented change. Rising temperatures also present unique challenges to researchers working in glaciated terrain. Atmospheric and oceanic warming of floating ice shelves enhance melting which decreases the stability of upstream glaciers. These processes, coupled with glaciological and hydrological forcings impacting the bed and surface results in rapidly developing crevasse damaged areas on the margins of once-stable ice sheets. This increased dynamism of important field sites presents an increased risk for funded projects focused on Arctic and Antarctic ice sheets.

Due to these rapidly evolving challenges, the U.S. National Science Foundation's Office of Polar Programs (NSF OPP) decided it was an appropriate time to meet with members of the glaciology community to discuss the topic of risk management and safety. This workshop would build on the success of a previous workshop focused on Arctic Field Safety Risk Management while also providing the opportunity for Arctic and Antarctic federal employees, researchers, and logistics contractors to share resources and to learn from each other. Soliciting feedback from polar glaciology researchers will help ensure that field teams have the support they need to successfully conduct research and will create a community of practice around the topics of safety and risk management while working in crevassed terrain.

To support the discussion of crevasse risk management and safety, NSF Arctic and Antarctic logistics program managers Jessie Crain, Renee Crain, and Jennifer Mercer tasked the organizing committee to create an agenda that would result in recommendations and resources to potentially implement in both logistics programs to enhance field team safety. The organizing committee consisted of Alison Banwell (Cooperative Institute for Research in Environmental Sciences at the University of Colorado Boulder), Zoe Courville (Cold Regions Research and Engineering Laboratory), Kate Koons (Antarctic Support Contract), Kate Ruck (QED Enterprises Inc.), John Stoddard (Polar Field Services), Martin Truffer (University of Alaska, Fairbanks), and Lizz Ultee (Middlebury College). This planning group was selected to represent the targeted audience - a mix of academics, federal funders, and contract field support staff from a broad cross-section of career stages who all contribute in different ways to the success and safety of NSF-awarded projects. An additional 53 participants (Appendix A) were selected to contribute their unique perspectives to the dialog. The agenda consisted of two days of focused breakout discussions grounded by introductory plenary presentations. The breakout sessions were pre-assigned to represent the many different professions that contribute to risk management and safety in the field while also balancing for career stage and any potential conflicts of interest. These pre-assigned groups were asked to engage in 20 minutes of guided discussion on the specific breakout session's theme and participate in a 15-minute plenary report out.

The following summary provides highlights from the Crevasse Risk Management and Safety Workshop and potential actions for improving the field safety of the NSF OPP glaciology community.

Presentation Highlights and Breakout Session Discussions

Day 1 was anchored by an invited presentation from **Zoe Courville** of Cold Regions Research and Engineering Laboratory and **Pat Smith** of Polar Field Services. Their presentation was entitled **"Technical Approach to Crevasse Travel"** and focused on lessons learned about crevasse safety during heavy logistical traverses over ice sheet margins.

The talk gave an overview of the substantial pre-planning and standardized, rigid, procedures used by field crews with a wide range of experience and expertise in the technical aspects of crevasse safety. Speakers also highlighted the importance that field teams understand the limitations of using GPR for crevasse detection and how it must be used in concert with other glaciology and mountaineering techniques.

The rest of **Day 1** was devoted to three breakout sessions:
Breakout Session 1: Standard Operating Procedures and Lessons Learned from Other programs
Breakout Session 2: Team Makeup/Diversity/Democratizing Power
Breakout Session 3: Staffing/Certification/Insurance/Liability

Day 2 was anchored by an invited presentation from **Steve Smith** of Experiential Consulting, LLC. His presentation was entitled **"Near-Misses are Telling You Something - Are You Listening?"** and included two pieces of media as pre-work to enculture the audience on the topic of near-misses. The first was a blog post written by Steve entitled "Focus on Near Misses to Cultivate a Culture of Risk Management" and the second was an episode from "The Sharp End" podcast called "Institutional Near Misses".
The presentation itself was a highly interactive exploration of the theory and research on near-misses and how they could be effectively integrated into the risk management of a field research program.

The rest of **Day 2** was devoted to two breakout sessions:
Breakout Session 4: Culture of Safety in Polar Programs
Breakout Session 5: Improving Risk Management in OPP

Desired Outcomes

Through the two days of presentations and discussion, the group identified four areas where additional guidance would benefit the Field community: hiring field guides and mountaineers, safety culture in the field, improving risk management when working in crevassed and risky glaciated terrain, and team makeup/diversity/democratization of power.

Field guides and mountaineers in the field

Field guides and mountaineers are essential personnel in the field, acting as objective safety experts to keep research teams safe. Academics feel that OPP and the logistics contractors are better qualified to evaluate and hire field guides and mountaineers. Contractor guides can help deconflict safety priorities in the field by allowing for an objective and autonomous resource for questions about safety. Contractor hiring could also ease proposal budget limitations and

alleviate issues with short-term hires with proper insurance coverage through universities. However, different hiring strategies may affect pay negotiations.

Recognizing that both logistics contractors and universities will continue to hire field guides, OPP and the academic community can create and publicize resources and guidance in several areas. These resources include:

- A list of required or recommended certifications, experience, and specific techniques for mountaineers/field guides, such as first aid or emergency medical training (Wilderness First Responder, EMT or Paramedic certifications) and AMGA/IFMGA certification. Some of these certifications are valuable, but potentially unnecessary and cost-prohibitive.
- A list of organizations like the International Polar Guide Association as a place to search for potential hires
- A list of known field guides and mountaineers with contact information, past experience and salary estimates.
- Arctic and Antarctic processes for processes for hiring and assigning field guides.
- Documentation from NSF and contractors about how they review safety and logistics.

Additionally, field guides can be better integrated into the Antarctica and Arctic programs and into the field teams. Discussions during the meeting yielded many ideas for how to facilitate this integration.

- New field guides could be paired with veteran field guides for training.
- For guides hired by the contractor, NSF could fund team building opportunities for the mountaineer/field guide and the science group very early in the field planning effort.
- NSF could create a mentoring program for polar field work perhaps like the chief scientist training cruises funded by the ocean science program, for how to request field guides, create safe field environments, etc.
- NSF polar sciences programs can consider including logistics/safety experts on panels to review proposals in addition to scientific peer review.
- NSF should provide clear expectations for having insurance in the field.

Safety culture in the field

A key theme emerged about developing a strong safety culture in the field. Ways to develop this culture are to start teambuilding activities long before the fieldwork begins, to create clear team roles and communication, and to share information across NSF programs, international partners, and the academic community. Specific suggestions included:

- Principal Investigators (PI) need to be explicit in the clothing, equipment, and emergency items necessary for all field members during the planning phase of field work so that teams from different home institutions are on the same page about expectations.
- PIs should start regular team meetings months before deployment and integrate safety discussions early into field planning. Once in the field, daily gear checks or morning and evening debriefs ensure that communication about safety is vital.
- PIs should outline a clear leadership structure and reinforce that each team member is responsible for their own safety and are expected to be situationally aware of their environment.

    a. Descriptions of healthy team dynamics displayed a democratization of power but with clear leadership by a designated team member with explicit training and qualifications. Everyone should be comfortable enough to express concerns or suggestions regarding safety without fear of negative repercussions or retaliation.
- NSF should cross-train with other international polar programs to share resources and best practices.
- NSF should create a transparent, outward-facing near-miss and lessons-learned program between the U.S. Antarctic Program and Arctic program.
    a. NSF OPP needs to better educate the community on how to report near-misses, define how near-miss reporting is different than injury/incident reporting, and clarify how the near-miss data is being used.
    b. Very few participants personally used near-misses to inform future field work. The few that had highlighted that near-misses changed established SOPs to de-stigmatize the past mistake and add supporting justification for the SOP.
    c. There is emphasis on making the process as simple as possible while also clearly communicating that the reporting will not result in any punitive actions.
- NSF should facilitate discussion with the academic community on how to standardize safety practices in the field with less reliance on home institutions to avoid variable safety standards.

Improving risk management when working in crevassed and risky glaciated terrains
It is necessary to constantly evaluate and improve risk management in dangerous field locations. Key themes that emerged while discussing risk management included more evaluation beginning earlier in the proposal process and employing technology to better detect crevasses, both over multiple seasons and in real-time.

By starting the risk management process earlier, the entire field team will be better prepared to work in risky glaciated terrain. Ideas to mitigate risk before going into the field include:

- Field team discussions of risk management should happen as early as possible.
    - This will allow for evaluation of proposed sites and traverse routes, ensure that required training can be identified and accommodated well before deployment, and initiate safety discussions with field guide to establish roles and responsibilities.
- NSF could support more risk management analysis from its logistics contractors during the proposal and pre-proposal stage.
- NSF could facilitate discussions with the academic community about options for getting field teams into a better analog for the environment they will be working in before deployment.
    - The NSF strategy to deploy an experienced ground crew to assess options before science at the Thwaites grounding-line worked very well and may be a model for future work.
- NSF could facilitate discussion about requiring a risk management section in proposals to work in glaciated terrain, and who should review that portion of the proposal.

    - Risk Management has become its own field of expertise and there is potentially a mismatch between the formal training of the writer and evaluator. The risk management section of a proposal should be used to highlight where potential PIs need extra support rather than using it as an additional metric that decides between an award or decline.
    - There was concern that this would hinder early-career PIs and if implemented NSF should offer specific training or a database of risk management strategies to bridge potential experience gaps.
    - Most participants agreed that this section of the proposal should be reviewed independent of the already established peer-review process. Some suggested potential reviewers included polar logistics contractors, certified mountaineers, and wilderness risk management experts.
- NSF could create an online forum or database that would allow PIs to easily see where others have worked so first-hand knowledge can be shared between field groups.

Furthermore, using additional technology at risky field locations was suggested to improve risk management at crevasse-laden locations. Suggestions included:

- Drones could provide real-time imagery that can be analyzed from above while autonomous vehicles could be used to scout for safe routes ahead of a field team.
- NSF could increase the use of ground-based GPR, training for field parties, and use of previously collected radar data from airborne campaigns and satellite assets (i.e., high resolution spatial SAR radar data, Operation IceBridge archival data, and previous GPR collected for accumulation/science projects).
- The need for long-distance, nimble traverse equipment that can be maneuvered easily to navigate through crevasse fields, such as trucks equipped with GPR or the PB300 vehicles used in the British Antarctic Survey ISTAR traverse.

Team Makeup/Diversity/Democratizing Power

While this was not a focus of the workshop, the organizing committee felt that team makeup and discussing how to democratize power was an essential part of managing risk for any Field team. There was widespread agreement that there is a need to keep opening doors for researchers from all backgrounds and that there should be conscious thought into how teams are built. Mentoring was a theme that surfaced for most and how important it is in addition to training, educational and field experience. Most, if not all in the workshop agreed that a positive team dynamic is central to a successful Field season. Building a positive team dynamic stems from clear roles and responsibilities, breaking down traditional power structures and giving ensuing everyone has a voice within the group. Suggestions of action items for facilitating diverse and inclusive field teams include:

- Offering leadership and facilitation trainings for Field leads. Many Field leaders lack skills to manage conflict and help guide a conversation about team dynamics.
- Establishing a fund/pot of money that could be used to help foster these initiatives, training and preparing people for field work (some PI's noted that getting physically qualified for field work could be a barrier for some).

- Having all teams do a shakedown prior to going into the Field to "test" out skills, roles and responsibilities.

Future Steps

1) Future webinars and meetings on specialized topics above, such as:
    a. Adding a Risk Management section in proposals
    b. How to best find and hire field guides/mountaineers
    c. Veteran field guide mentoring program
    d. Suggestions and requirements for best safety practices in the field, and understanding insurance and liability
    e. Using technology in the field (e.g., drones/autonomous vehicles) to better assess safety conditions in crevassed areas
2) Creating resources for the community, such as:
    a. New portal or informational guide on reporting near-misses and sharing lessons learned
    b. Information on hiring/finding field guides/mountaineers
    c. List of required or recommended trainings for field guides/mountaineers

Appendix A: Participant List

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