

April 22, 2017

To:

Neil Higgins and Heather Woods (CP)
Ian Tomm and Rob Rohn (HeliCat Canada)
Joe Obad and Walter Bruns (Canadian Avalanche Association)
Mike Wiegele and Bob Sayer (Mike Wiegele Helicopter Skiing)
Gilles Valade and Kevin Seel (Avalanche Canada)
Gord Ritchie and Bruce Jamieson (Avalanche Canada Foundation)

RE: 2016/17 Supporter Update of SFU Avalanche Research Program (SARP)

1 Purpose of document

The purpose of the document is to inform the supporters of the Simon Fraser University Research Chair in Avalanche Risk Management about the activities accomplished between May 1, 2016 and April 30, 2017 and to provide a brief outlook on the planned activities for the next twelve months.

2 Team

Over the last year, the core SARP team consists of the following personnel:

- Dr. Pascal Haegeli (team leader)
- Dr. Scott Thumlert (postdoctoral fellow funded by Mike Wiegele Helicopter Skiing through the MITACS Elevate Program until Nov. 2016).
- Reto Sterchi (PhD student)
- Bret Shandro (MRM student)
- Taylor Clark (MRM student; since September 2016)
- Brendan Wakefield (MRM student; since September 2016)

- Matthias Walcher (visiting Masters student from Austria, Dec. 1, 2016-May 15, 2017)

In addition, SARP includes the following affiliate members:

- Grant Statham, Parks Canada (adjunct professor)
- Dr. James Floyer, Avalanche Canada (adjunct professor)
- David Kallai (undergraduate student, GIS technician)
- Rosie Longford (undergraduate student)

3 2016/17 Highlights

3.1 Securing of external research funding

Securing external research funding was one of the primary SARP objectives for 2016/2017. In total, we have been able to secure \$547,500 of new external funding in the last 12 months.

- **NSERC Industrial Research Chair in Avalanche Risk Management (2017-2022)**
We were successful with our NSERC application for a NSERC Industrial Research Chair in Avalanche Risk Management in collaboration with CP Rail, HeliCat Canada, Canadian Avalanche Association, Mike Wiegele Helicopter Skiing and SFU. The overall budget of the chair is \$1,270,000, which includes a \$510k contribution from NSERC.
- **MITACS**
We were able to secure MITACS support for three projects:
 - Decision-making in avalanche terrain (in partnership with HeliCat Canada): \$20k for Reto Sterchi + \$10k in expenses (MITACS contribution: \$15k)
 - Risk within mechanized skiing industry (in partnership with HeliCat Canada): \$10k for Matthias Walcher + \$5k in expenses (MITACS contribution: \$7.5k)
 - Avalanche hazard climatology (in partnership with Avalanche Canada): \$20k for Bret Shandro + 10k in expenses (MITACS contribution: \$15k)

3.2 Research projects

Over the last 12 months, the research efforts of SARP were focused on four main projects:

- **Spatial terrain classification based on revealed preferences of professional mountain guides (Dr. Scott Thumlert)**
The objective of this project was to provide a proof of concept for the development of an algorithm to programmatically classify avalanche terrain into avalanche terrain exposure scale (ATES) type classes using GPS tracks of professional mountain guides under a wide variety of conditions. Scott's tenure with SARP finished on Nov. 30, 2016.
- **Professional terrain preferences for managing the physical risk from avalanche in mechanized backcountry skiing operations (Reto Sterchi)**
This project uses run list codings and run usage information to better understand how professional guides use terrain to manage the physical risk from avalanches and develop tangible tools for collaboration operations. Reto's work over the last 12 months focused

on conducting preliminary analyses, developing a detailed research proposal and passing his comprehensive exam, which he did on April 3, 2017.

- **Examination of seasonal avalanche hazard conditions in Western Canada using the conceptual model of avalanche hazard (Bret Shandro)**

The objective of this project is to explore the avalanche bulletin data of Avalanche Canada and Parks Canada and examine variations in assessments and the character of the seasonal avalanche hazard character among forecast regions and winter seasons.

- **HeliCat Canada sector risk project (Matthias Walcher)**

In December 2016, HeliCat Canada (HCC) and SARP initiated the 'HCC Sector Risk' project to improve our understanding of the risks involved in mechanized skiing. While we have detailed information on avalanche accidents, information on accidents involving other hazards (e.g., tree wells, crevasses, fall from height, flying, vehicles, etc.) resulting in injury or death have so far not been systematically collected. The objective of this project is to develop a new database that supports information for all types of incidents and collects as much historic incident information as possible.

3.3 Data collection and infrastructure

The collection of research data and the development of the necessary infrastructure continued over the last 12 months. The most important efforts included:

- **Collection of GPS tracks of professional terrain choices**

Our GPS track data collection efforts continued during the 2016/2017 winter season.

This winter we had 25 GPS units in the field and worked with six operations:

- CMH Galena
- CMH Revelstoke
- Monashee Powder Snowcats
- Northern Escape Heliskiing
- Selkirk Tangiers Helicopter Skiing
- Whistler Heliskiing

As of May 1, 2017, the complete dataset consists of 3,984 tracked guide days including slightly more than 28,000 ski runs under a wide variety of conditions. Collaborating operations can access their own tracks in an online viewer.

To continue with this type of research in the future, SARP has purchased 100 new GPS units in collaboration with Dr. Reto Rupf at the Zurich University for Applied Science, Wädenswil, Switzerland.

- **Non-avalanche related incidents in mechanized skiing**

Considerable time has been spent to develop a new incident database for the HeliCat Canada sponsored sector risk project and populate it with historic incident information.

- **Idealized snow profiles**

In anticipation of the snowpack modelling research objective in the NSERC IRC in Avalanche Risk Management, SARP teamed up with Mike Wiegele Helicopter Skiing to

capture and archive their operational idealized snowpack profiles during the 2016/17 winter season.

3.4 Outreach

3.4.1 Peer-reviewed publications

Four academic peer-reviewed publications were either submitted, revised or published over the last 12 months:

1. Haegeli, P., and Strong-Cvetich, L. (submitted). Using discrete choice experiments to examine the stepwise nature of avalanche risk management decisions—An example from mountain snowmobiling. Submitted to *Journal of Outdoor Recreation and Tourism* on March 21, 2017.
2. Thumlert, S., and Haegeli, P. (under revision). Describing avalanche terrain numerically from terrain choices of professional guides. Reviewer comments received from *Natural Hazards* on March 18, 2017.
3. Statham, G., Haegeli, P., Greene, E., Birkeland, K., Israelson, C., Tremper, B., Stethem, Ch., McMahon, B., White, B., and Kelly, J. (revisions submitted). A Conceptual Model of Avalanche Hazard. Revisions submitted to *Natural Hazards* on January 7, 2017.
4. Van Tilburg, Ch., Grissom, C., Zafren, K., McIntosh, S., Radwin, M.I., Paal, P., Haegeli, P., Smith, W.R., Wheeler, A.R., Weber, D., Tremper, B., and Brugger, H. (2017). Wilderness Medical Society Practice Guidelines for Prevention and Management of Avalanche and Non-Avalanche Snow Burial Accidents. *Wilderness and Environmental Medicine*, 28, 23-42.

3.4.2 Presentations at conferences

Core SARP team members gave **six presentations at the 2016 International Snow Science Workshop** in Breckenridge (2 oral and 4 poster presentations):

1. Haegeli, P. and Atkins, R. (2016). Managing the physical risk from avalanches in a helicopter skiing operation—merging and contrasting GPS tracking data with the operational guiding perspective. Oral presentation at International Snow Science Workshop in Breckenridge, CO, October 3-7, 2016. 104-111.
2. Thumlert, S., and Haegeli, P. (2016). Can we derive an avalanche terrain severity rating from observed terrain selection of professional guides? A proof-of-concept study. Oral presentation at International Snow Science Workshop in Breckenridge, CO, October 3-7, 2016. 112-120.
3. Sterchi, R., Haegeli, P., and Israelson, C. (2016). Exploring large-scale terrain preferences for managing avalanche risk in a commercial backcountry skiing operation. Poster presentation at International Snow Science Workshop in Breckenridge, CO, October 3-7, 2016. 838-845
4. Shandro, B., Haegeli, P., Statham, G., and Floyer, J. (2016). Spatial and temporal distribution of avalanche problems in Western Canada: An analysis of the winters 2010-

2016. Poster presentation at International Snow Science Workshop in Breckenridge, CO, October 3-7, 2016. 1307-1314.

5. Campbell, C., Conger, S., Gould, B., Haegeli, P., Jamieson, B., and Statham, G. (2016). In the pursuit of standards - the next step in Canada's avalanche risk management guidelines. Poster presentation at International Snow Science Workshop in Breckenridge, CO, October 3-7, 2016. 816-824.
6. Floyer, J., Klassen, K., Horton, S., and Haegeli, P. (2016). Looking into the '20s: Computer assisted avalanche forecasting in Canada. Poster presentation at International Snow Science Workshop in Breckenridge, CO, October 3-7, 2016. 1245-1249.

3.4.3 Technology transfer

Over the last 12 months, core SAPR members gave **12 presentations at association meetings and early season staff training sessions**. In total, an estimated 750 avalanche professionals were reached with these presentations.

1. Sterchi, R., and Haegeli, P. (2017). Exploring avalanche risk management expertise. Guides' training of Northern Escape Heliskiing in Terrace, BC. January 3, 2017. (size of audience: approx. 10)
2. Haegeli, P., and Sterchi, R. (2016). Exploring avalanche risk management expertise. Guides' training of Selkirk Tangiers Helicopter Skiing in Revelstoke, BC. December 7, 2016. (size of audience: approx. 30)
3. Haegeli, P., and Sterchi, R. (2016). Exploring avalanche risk management expertise. Guides' training of Whistler Heliskiing in Whistler, BC. December 4, 2016. (size of audience: approx. 20)
4. Sterchi, R., and Haegeli, P. (2016). Exploring avalanche risk management expertise. Guides' training of Monashee Powder Snowcats, BC. December 2, 2016. (size of audience: approx. 10)
5. Haegeli, P., Sterchi, R., and Atkins, R. (2016). Exploring avalanche risk management expertise. Guides' training of Canadian Mountain Holidays in Mica Creek, BC. November 25 & 26, 2016. (size of audience: approx. 120)
6. Shandro, B., and Haegeli, P. (2016). Spatial and temporal distribution of avalanche problems in Western Canada: An analysis of the winters 2010-2016. Forecasters' training of Avalanche Canada in Revelstoke, BC. November 15, 2016. (size of audience: approx. 20)
7. Sterchi, R., and Haegeli, P. (2016). Exploring the risk management practices of professional guides through terrain preferences. Spring meeting of Canadian Avalanche Association. Penticton, BC. May 6, 2016. (size of audience: approx. 150)
8. Shandro, B., and Haegeli, P. (2016). Spatial and temporal distribution of avalanche problems in western Canada: preliminary results from the winters 2010-2015. Spring

meeting of Canadian Avalanche Association. Penticton, BC. May 6, 2016. (size of audience: approx. 150)

9. Thumlert, S., and Haegeli, P. (2016). Capturing terrain selection of professional guides. Spring meeting of Canadian Avalanche Association. Penticton, BC. May 6, 2016. (size of audience: approx. 150)
10. Haegeli, P. (2016). The SFU Avalanche Research Program – an update after 7 months. Spring meeting of Canadian Avalanche Association. Penticton, BC. May 5, 2016. (size of audience: approx. 150)
11. Garner, J., and Haegeli P. (2016). The effect of heads-up-display (HUD) goggles on skiing and snowboarding speeds. Spring meeting of Canada West Ski Area Association in Whistler, BC. May 4, 2016. (size of audience: approx. 50)
12. Haegeli, P. (2016). The SFU Avalanche Research Program – an update after 7 months. Spring meeting of HeliCat Canada. Penticton, BC. May 2, 2016. (size of audience: approx. 80)

I also shadowed the **Public Safety Team of Banff National Park** for a week in March to discuss research projects and strengthen the connection between SARP and avalanche practitioners. This visit offered broad insight on public avalanche forecasting, highway avalanche control and rescue efforts during a week when avalanche conditions were particularly challenging.

3.4.4 Public Outreach

Over the last 12 months, core SARP members **participated in one public avalanche awareness event** reaching an estimated 60 recreationists. A second engagement scheduled in Jasper had to be cancelled due to road closures.

1. Haegeli, P. (2016). The effectiveness of avalanche airbags. Vancouver Island Avalanche Centre Speaker Series. Victoria, BC. November 13, 2016. (size of audience: approx. 60)

3.5 Student training

Since my research program does not have a field program and I am currently not teaching an avalanche risk management course at SFU (scheduled for fall 2019), I am using the following approaches to train my students in addition to the supervision of their personal research projects:

- Organizing visits to collaborating operations
- Weekly group meetings
 - Starting this winter, I organized personal InfoEx accounts for my entire team. Students use their personal accounts to keep up-to-date on current conditions and prepare presentations summarizing conditions at our weekly group meetings.
 - Discussion of research papers on special topics. During the winter, Bret Shandro moderated a series of discussions on avalanche release.

Suggestions on how to better train students for industry needs are welcome.

3.6 Other relevant activities

I continued to serve as co-editor-in-chief of the **Journal of Outdoor Recreation and Tourism (JORT)**, a transdisciplinary, academic peer-reviewed journal focusing on any aspect of theory, method, or concept of outdoor recreation research, planning or management. My objective with JORT is to establish a home for publishing interdisciplinary avalanche safety research that does not fit into the traditional outlets for avalanche research (e.g., Cold Regions Science and Technology) and to establish new connections with researchers working in other recreational fields.

I have also been elected as the new director of SFU's **Centre for Tourism Policy and Research (CTPR)** (starting July, 2, 2017), a research centre that was established in the late 1980s to support BC's tourism industry with policy relevant research. Due to recent retirements of CTPR faculty, I am currently the only faculty member left whose research focus is related to tourism. I have agreed to take on the directorship to reenergize the CTPR after the loss of three core faculty members and realign its strategic direction with the increasingly important adventure tourism sector of British Columbia. My objective with this role is to create the foundation for a new, tourism-focused faculty position at REM that offers synergies with my research program and thereby improves the research and training environment for my team.

4 Outlook for next 12 months

4.1 Personnel

The following individuals will be joining the SARP team in the fall of 2017:

- Dr. Simon Horton (Post-Doctoral Fellow)
- Anne St. Claire (Master Student; social science focus)
- Moses Towell (Master Student; natural science focus)

Matthias will be returning to Austria mid-May and I expect Bret Shandro to graduate in the upcoming fall.

4.2 Priorities

SARP has the following priorities for the next 12 months:

4.2.1 Research

- Continue to work on research projects with students
 - Bring Bret's and Matthias' projects to completion
 - Start Taylor's project on the conceptual model of avalanche hazard
 - Start Brendan's project on best practices for promoting a safe work environment in avalanche safety operations
- Advance GPS tracking research projects and submit paper on GPS track processing
- Start with NSERC IRC research program (Sept. 2017)
 - Install snowpack modelling infrastructure

4.2.2 Funding

- Establish long-term research plan with non-industry supporters (Avalanche Canada, Avalanche Canada Foundation)
- Secure additional external funding:
 - MITACS submissions for Taylor (Avalanche Canada) and Brendan (HeliCat Canada)
 - Submit NSERC Discovery grant application on examining the effect of climate change on avalanche hazard in western Canada.

4.2.3 Outreach

- Attend the conference on Human Judgement and Decision Making in Vancouver on Nov. 10-13, 2017.
- Strengthen public outreach with an improved website, social media, an article published in the Avalanche Journal and presentations.

5 Questions

If you have any question about SARP's research activities, please contact me anytime either by email (pascal_haegeli@sfu.ca) or phone (778-782-3579 or 604-773-0854).

6 Thank You

On behalf of my entire research team and SFU, I would like to thank all the supporters and collaborating operations for their support of the SARP research program. Our research would not be possible without your financial support and expert input to guide our program. We are grateful for this support and we are looking forward to a productive and long-term relationship between SARP and the Canadian avalanche community.