

April 24, 2019

To:

Heather Woods (CP)

Andrea Lustenberger, Ross Cloutier and Rob Rohn (HeliCat Canada)

Joe Obad and Walter Bruns (Canadian Avalanche Association)

Mike Wiegele, Bob Sayer and Elias Ortner (Mike Wiegele Helicopter Skiing)

Gilles Valade and Kevin Seel (Avalanche Canada)

Gord Ritchie (Avalanche Canada Foundation)

RE: 2018/19 Supporter Update of SFU Avalanche Research Program

1 Purpose of document

The purpose of this document is to inform the supporters of the Simon Fraser University Avalanche Research Program (SARP) including the NSERC Industrial Research Chair in Avalanche Risk Management (IRC) about the activities accomplished by the research team between May 1, 2018 and April 30, 2019 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. Simon Horton (postdoctoral fellow)
- John Sykes (PhD student, since Jan. 2019)
- Florian Herla (PhD student, since Jan. 2019)

- Reto Sterchi (MRM student, graduated in Dec. 2018)
- Taylor Clark (MRM student, graduated in Jan. 2019)
- Brendan Wakefield (MRM student)
- Anne St Clair (MRM student)
- Henry Finn (MRM student)
- Moses Towell (MRM student)
- Katie Fisher (MRM student, since Sept. 2018)
- Stan Nowak (Master student in SFU's Visual Analytics graduate program)

In addition, SARP includes the following affiliate members:

- Grant Statham, Parks Canada (adjunct professor)
- Dr. James Floyer, Avalanche Canada (adjunct professor)
- Dr. Patrick Mair (research associate, statistics)
- Dr. Robin Gregory (research associate, risk communication)
- Eirik Sharp (external master student collaborating for his thesis project)
- Rosie Longford (undergraduate student)

3 2018/19 Highlights

3.1 Securing of additional research funding

Securing external research funding and getting industry contributions matched remains a primary objective for SARP. In the last 12 months, we have been able to secure an additional \$175,500 of new external funding for three different projects:

- **MITACS**
 - A Mental Model Approach to Avalanche Risk Communication: Examining Avalanche Bulletin Use and Comprehension (in partnership with Avalanche Canada):
\$30k for Anne St Clair + \$10k in expenses (MITACS contribution: \$22k)
- **SSHRC**
 - Canada Graduate Scholarship – Master's Program:
\$17.5k for Katie Fisher (Sept. 2019 to Aug. 2020)
- **Canadian Mountain Network** (<http://canadianmountainnetwork.ca/>)
 - 3 years of funding for a PhD student to examine avalanche safety challenges and develop solution approaches for remote communities in the Canadian Arctic:
\$75k for PhD student + \$28k in expenses
- **Swedish Environmental Protection Agency**
 - A 1-year project to develop a comprehensive framework for effectively conducting social science in support of public avalanche safety:
\$30k of project funding

We were also able to obtain \$12,000 of additional research funding from existing supporters for new research projects.

- **Avalanche Canada**

The AvID project of Avalanche Canada is providing SARP with an additional \$12,000 between January and August 2019 to support a masters student (Stan Nowak) working on a research project focusing on effective visualization of complex datasets.

Over the last 12 months, we have also applied to the following funding body for support for future research initiatives:

- **MITACS**

- Improving avalanche forecasts in data-sparse areas with physical snowpack modelling (Elevate Postdoctoral Fellowship in partnership with Avalanche Canada):
\$110k for Simon Horton + \$10k in expenses over two years
(MITACS contribution: \$60k)

3.2 Research projects

Over the last 12 months, the research efforts of SARP were focused on ten main projects that can be grouped into three overarching themes.

3.2.1 Decision-making and risk in mechanized skiing

- **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. Over the last 12 months, Reto has published a research article, which describes our approach for developing customized terrain classifications for mechanized skiing operations in Natural Hazard and Earth System Science (<https://www.nat-hazards-earth-syst-sci.net/19/269/2019/>). A second research article that explores the link between hazard assessments and run list codings has been submitted to Natural Hazard and Earth System Science and is currently under public review (<https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2019-57/>). The analyses described in these publications provide the foundation for the development of decision aids at the run list level. Visit http://www.avalancheresearch.ca/pubs/2018_mrm_sterchi/ for a copy of Reto's thesis.

- **Terrain perception among ski guides (Brendan Wakefield)**

An accurate perception of the skiing terrain is critical for making informed decisions about whether it is appropriate to ski a specific run. Existing research on avalanche terrain has primarily focused on simple terrain characteristics (e.g., incline, aspect, vegetation) that can be easily extracted from existing terrain datasets (e.g., DEM, TRIM). However, over their careers, guides develop a much more detailed understanding of the terrain that goes beyond these simple characteristics. Using a website for ski run characterization developed with the help of Roger Atkins and Clair Israelson, Brendan

has collected detailed ski run characterizations from the guiding teams at Northern Escape Heliskiing and Selkirk Tangiers Heliskiing for approximately 100 ski runs in total. He is currently in the final stages of analyzing this data and writing a research article for publication.

- **Small-scale terrain choices in mechanized backcountry skiing operations (John Sykes)**
John joined the SARP research team from Montana State University in January 2019 to pursue a PhD in Geography. This project will build on the research of Reto and Brendan and focus on extracting knowledge and meaningful decision aids from the GPS tracks that have been collected at collaborating operations over the last few winters. John's primary focus for 2019 is to develop a detailed proposal for his PhD research and pass his comprehensive exam.

3.2.2 Patterns in avalanche hazard and avalanche hazard modelling

- **Regional summaries and visualizations of modelled snowpack observations (Simon Horton, Stan Nowak)**
Snowpack models fed by numerical weather models have tremendous potential for offering insight into snow and avalanche hazard conditions in areas that are otherwise data sparse. However, the data volume of hundreds of simulated snow profiles is overwhelming and not useful for practitioners. To-date, Simon and Stan's research has focused on how to best summarize and visualize the modelled snowpack information to give practitioners meaningful and efficient insight about the key features expected in the snowpack and their variability. They are currently in the process of turning their research into research article for publication.
- **Snowpack modelling in support of operational decision-making (Florian Herla)**
Florian joined the SARP research group from Innsbruck, Austria, in January of 2019. His research will also contribute to the overall goal of making snowpack modelling more useful for operational decision-making. His initial explorations are focusing on how to assess the similarity of snow profiles (modelled and observed) and how to adjust simulations if they deviate substantially from observed profile. This is critical for maintaining meaningful simulations over an entire season. This research will provide the foundation for the development of meaningful snowpack modelling simulation over large spatial areas. Florian's focus for 2019 is to develop the proposal for his PhD research and to write a first research article with Simon on how to assess the similarity of snow profiles.
- **Linking avalanche problems to modelled weather and snowpack observations (Moses Towell)**
The objective of this project is to explore whether it is possible to use modelled weather and snowpack observations to predict the presence of avalanche problems. For this pilot study we modelled the evolution of the seasonal snowpack for several seasons at multiple locations in Glacier National Park, and we are currently in the process of examining the relationship with the avalanche problems published in the public

avalanche bulletins using a variety of statistical approaches. Our goal is to have a research article ready for publication by the end of the year.

- **Linking the avalanche danger scale to the conceptual model of avalanche hazard (Taylor Clark)**

While the conceptual model of avalanche hazard (Statham et al., 2018) offers a framework for avalanche hazard assessment, it does not provide public avalanche forecasters with explicit guidance for assigning avalanche danger ratings similar to the Bavarian Matrix used by the European avalanche warning services. Using hazard assessment data from Avalanche Canada and Parks Canada, this project explored the relationship between avalanche hazard assessment and danger ratings to identify the rules used by forecasters to assign danger ratings, to examine differences between forecast regions and to highlight conditions when danger ratings might not be assigned consistently. Visit http://www.avalancheresearch.ca/pubs/2019_mrm_clark/ for a copy of Taylor's thesis and a visualization of his analysis.

3.2.3 Public avalanche risk communication

- **Examining use, comprehension and application of information provided in Canadian avalanche bulletins (Anne St Clair and Henry Finn)**

This project is part of Avalanche Canada's AvID initiative that aims to develop a new data system for the production and publication of public avalanche bulletins in Canada. The objective of the research project is to better understand how recreationists use, understand and apply the information currently provided in Canadian avalanche bulletins and to provide recommendations for presentation alternatives. In the summer of 2018, the research team conducted 46 in-person, semi-structured interviews with recreationists at different levels of avalanche awareness expertise and activities to better understand how the present avalanche bulletin products are used. The insight gained from these interviews were then used to develop a comprehensive online survey to examine the patterns that emerged in the interviews in more detail. The online survey was launch at the end of March 2019 and as of April 24, we had collected more than 2,800 completed survey responses. The focus of the summer will be to complete the analysis of the collected information, inform Avalanche Canada about critical findings, and write at least two research articles for publication in peer-reviewed academic journals.

- **Evaluating an interactive approach to avalanche risk communication (Katie Fisher)**

The objective of this project is to build on the results of Anne and Henry's project and develop an interactive component to the avalanche bulletin to improve user comprehension and decision-making. The current plan is to develop an interactive bulletin component collaboratively with Avalanche Canada over the summer and then assess its effectiveness over the next winter.

- **Developing a framework for enhancing the benefit of social science research for public avalanche safety (Rosie Langford)**

This project aims to provide a framework for conducting social science research in support of public avalanche safety more effectively. In the first phase of this project, we put together a comprehensive literature review that describes and assesses methods for monitoring backcountry use in the winter.

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 2018/2019 winter season.

This winter we had 45 GPS units in the field and worked with six operations:

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

As of April 20, 2019, the complete dataset consists of 8,900 tracked guide days including slightly more than 59,000 ski runs under a wide variety of conditions. Collaborating operations can access their own tracks using an online viewer.

- **Idealized snow profiles**

To facilitate the snowpack modelling research objective in the IRC, SARP continued their collaboration with Mike Wiegele Helicopter Skiing to capture and archive their operational idealized snowpack profiles during the 2018/19 winter season. This information is critical for Simon and Stan's aggregation and visualization research.

- **Operational snowpack modelling**

The evolution of the seasonal snowpack was modelled daily at roughly 3,000 grid points in western Canada using the research computing resources accessible to us from Compute Canada. The modelled grid points were located in areas of upcoming research projects (e.g., Glacier National Park), areas of interest for industrial supporters (e.g., Mike Wiegele Heliskiing, Whistler Heliskiing) and operational needs of Avalanche Canada (e.g., North Rockies). Collaborating operations are able to access summaries of our model runs within their area on a password-protected page at <http://www.avalancheresearch.ca/>.

3.4 Outreach

3.4.1 Peer-reviewed publications

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

1. Haegeli, P., Rupf, R., and Karlen, B. (submitted). Do avalanche airbags lead to riskier choices in the backcountry? Submitted to *Journal of Outdoor Recreation and Tourism* on April 25, 2019.
2. Sterchi, R., Haegeli, P., and Mair, P. (under review). Exploring the relationship between avalanche hazard and large-scale terrain choices at a helicopter skiing operation – Insight from run list ratings. Submitted to *Natural Hazards and Earth System Science* on March 20, 2019.
3. Walcher, M., Haegeli, P., and Fuchs, S. (accepted). Risk of death and major injury from natural winter hazards in mechanized backcountry skiing in Canada. Accepted in *Wilderness and Environmental Medicine* on April 18, 2019.
4. Rupf, R., Haegeli, P., Karlen, B., and Wyttenbach, M. (accepted). Does crowding cause winter backcountry recreationists to displace? Accepted in *Journal of Mountain Research and Development* on April 10, 2019.
5. Sterchi, R., and Haegeli, P. (2019). Deriving customized terrain classes for avalanche risk management in mechanized skiing operations from operational terrain assessments. *Natural Hazards and Earth System Science*, 19, 269-285. doi: 10.5194/nhess-19-269-2019.

Several additional research articles are currently in preparation and close to submission.

I also contributed a short overview paper to the ‘2018 State of Mountains Report’ initiative of the Canadian Mountain Network.

6. Haegeli, P. (2018). Snow avalanches. In Hik, D., Parrot, L. and Robinson, Z. (Eds.), *2018 State of the Mountains Report*. Alpine Club of Canada and Canadian Geographical Society, 21-22.

3.4.2 Presentations at academic conferences

My research team and I gave a total of **nine presentations at academic conferences**. Eight at the 2018 International Snow Science Workshop in Innsbruck, Austria, and one at the 2018 Annual Meeting of the Society for Risk Analysis in New Orleans:

1. St Clair, A., Henry, F., and Haegeli, P. (2018). Constructing risk communication based on how users make decisions: an example from avalanche safety warnings. Poster presentation at the *2018 Annual Meeting of the Society for Risk Analysis* in New Orleans LA, December 2-6, 2018.

2. Horton, S., Novak, S., and Haegeli, P. (2018). Exploring regional snowpack patterns with gridded models (2018). Oral presentation at the *2018 International Snow Science Workshop* in Innsbruck, Austria, October 7-12, 2018. 1136-1140.
3. Sharp, E., and Haegeli, P. (2018). Patterns in the exposure of ski guides to avalanche terrain. Poster presentation at the *2018 International Snow Science Workshop* in Innsbruck, Austria, October 7-12, 2018. 1656-1656-1660.
4. Haegeli, P., Rupf, R., and Karlen, B. (2018). Do avalanche airbags lead to riskier choices in the backcountry? Oral presentation at the *2018 International Snow Science Workshop* in Innsbruck, Austria, October 7-12, 2018. 1293-1297.
5. Shandro, B., and Haegeli, P. (2018). Effects of large-scale atmosphere-ocean oscillations on the nature of avalanche hazard in Western Canada. Oral presentation at the *2018 International Snow Science Workshop* in Innsbruck, Austria, October 7-12, 2018. 1145-1149.
6. Clark, T., and Haegeli, P. (2018). Establishing the link between the conceptual model of avalanche hazard and the North American Avalanche danger scale: Initial explorations from Canada. Oral presentation at the *2018 International Snow Science Workshop* in Innsbruck, Austria, October 7-12, 2018. 1116-1120.
7. Sterchi, R., and Haegeli, P. (2018). What type of ski runs are acceptable for skiing under different avalanche hazard conditions? Extracting knowledge from ski guides? Poster presentation at the *2018 International Snow Science Workshop* in Innsbruck, Austria, October 7-12, 2018.
8. Wakefield, B. F., Haegeli, P., Sterchi, R., Atkins, R., and Israelson, C. (2018). A new, guide focused approach for characterizing skiing terrain to facilitate risk management decisions and research. Oral presentation at the *2018 International Snow Science Workshop* in Innsbruck, Austria, October 7-12, 2018. 1646-1650.
9. Walcher, M., Haegeli, P., and Fuchs, S. (2018). Risk of death and major injury from natural hazards in mechanized backcountry skiing in Canada. Oral presentation at the *2018 International Snow Science Workshop* in Innsbruck, Austria, October 7-12, 2018. 1289-1292.

3.4.3 Technology transfer

Over the last 12 months, core SARP members gave **18 presentations at association meetings and early season staff training sessions**. In total, an estimated 495 avalanche professionals were reached with these presentations (1445 if each presentation is counted individually).

1. Haegeli, P. (2019). Latest developments from the SFU Avalanche Research Program. Research week at *Mike Wiegele Helicopter Skiing* in Blue River, BC. April 4, 2019 (size of audience: approx. 25).

2. Horton, S. (2019). Decision support for deep persistent slab avalanches. Invited presentation at Northwest Avalanche Center Professional Development Workshop in Seattle, WA. March 12, 2019 (size of audience: approx. 80).
3. Horton, S. (2019). Visualizing regional snowpack patterns. Invited presentation at Northwest Avalanche Center Professional Development Workshop in Seattle, WA. March 12, 2019 (size of audience: approx. 80).
4. Haegeli, P. (2019). Latest developments from the SFU Avalanche Research Program. Guides' training of *Northern Escape Heliskiing* in Terrace, BC. January 7, 2019 (size of audience: approx. 15).
5. Haegeli, P. (2018). Latest developments from the SFU Avalanche Research Program. Guides' training of *Selkirk Wilderness Skiing* in Meadow Creek, BC. December 12, 2018 (size of audience: approx. 10).
6. Haegeli, P. (2018). Latest developments from the SFU Avalanche Research Program. Guides' training of *Bella Coola Helisports* in Bella Coola, BC. December 9 and 10, 2018 (size of audience: approx. 30).
7. Horton, S., Nowak, S., and Haegeli, P. (2018). Enhancing our ability to track the snowpack. Guides' training of *Whistler Heliskiing*, Whistler, BC. December 3, 2018. (size of audience: approx. 25).
8. Horton, S., Nowak, S., and Haegeli, P. (2018). Enhancing our ability to track the snowpack. Guides' training of *Mike Wiegele Helicopter Skiing* in Blue River, BC. November 27, 2018. (size of audience: approx. 40).
9. St Clair, A., Finn, H., Fisher, K., Gregory, R., and Haegeli P. Insights into avalanche bulletin use from 43 interviews with recreational backcountry users. Forecasters' training of *Avalanche Canada* in Revelstoke, BC. November 15, 2018. (size of audience: approx. 20).
10. Horton, S., Nowak, S., and Haegeli, P. (2018). Enhancing our ability to track the snowpack. Forecasters' training of *Avalanche Canada* in Revelstoke, BC. November 15, 2018. (size of audience: approx. 20).
11. Clark, T., and Haegeli, P. (2018). What's the danger rating for a storm slab avalanche problem with likely avalanches up to size 2? *Spring meeting of Canadian Avalanche Association* in Penticton, BC. May 4, 2018 (size of audience: approx. 150).
12. St Clair, A., Finn, H., and Haegeli, P. (2018). What would Jerry and Sally do? Exploring avalanche bulletin use and comprehension. *Spring meeting of Canadian Avalanche Association* in Penticton, BC. May 4, 2018 (size of audience: approx. 150).
13. Wakefield, B. F., and Haegeli, P. (2018). Capturing the essence of heliskiing terrain *Spring meeting of Canadian Avalanche Association* in Penticton, BC. May 4, 2018 (size of audience: approx. 150).

14. Sterchi, R., and Haegeli, P. (2018). Extracting unique terrain classes using the operational knowledge stored in run list data. *Spring meeting of Canadian Avalanche Association* in Penticton, BC. May 4, 2018 (size of audience: approx. 150).
15. Horton, S., and Haegeli, P. (2018). Will computers forecast avalanches? Steps towards automated hazard assessments. *Spring meeting of Canadian Avalanche Association* in Penticton, BC. May 4, 2018 (size of audience: approx. 150).
16. Haegeli, P., and Shandro, B. (2018). Exploring the Effect of El Nino and the Artic Oscillation on the nature of avalanche hazard in western Canada. *Spring meeting of Canadian Avalanche Association* in Penticton, BC. May 4, 2018 (size of audience: approx. 150).
17. Haegeli, P. (2018). Update on risk analysis and incident database. *Spring meeting of HeliCat Canada* in Penticton, BC. April 30, 2018 (size of audience: approx. 100).
18. Haegeli, P., and Wakefield, B. F. (2018). How to best characterize the essence of skiing terrain? *Spring meeting of HeliCat Canada* in Penticton, BC. April 30, 2018 (size of audience: approx. 100).

3.4.4 Public Outreach

Over the last 12 months, core SARP members **participated in four public avalanche awareness events** reaching an estimated 660 recreationists.

1. Horton, S. (2019). Avalanche safety panel discussion after screening of 'This Mountain Life' at MEC North Vancouver in North Vancouver, April 28, 2019 (size of audience: approx. 50).
2. Haegeli, P. (2019) Panel discussion on human factors in backcountry skiing during 5th Annual Winter Stoke Backcountry Festival at Arc'Teryx store in Whistler, January 24, 2019 (size of audience: approx. 50).
3. Haegeli, P., Rupf R, and Karlen, B. (2018). Do avalanche airbags lead to riskier choices in the backcountry? Invited presentation at Vancouver Island Avalanche Bulletin Fundraiser Evening in Victoria, BC. November 3, 2018 (size of audience: approx. 60).
4. Haegeli, P., Rupf R, and Karlen, B. (2018). Do avalanche airbags lead to riskier choices in the backcountry? Invited presentation at Northwest Snow and Avalanche Workshop in Seattle, WA, October 27, 2018 (size of audience: approx. 500).
5. Finn, H., St. Clair, A., and Haegeli, P. (2018). What type of bulletin user are you? Invited presentation at Northwest Snow and Avalanche Workshop in Seattle, WA, October 27, 2018 (size of audience: approx. 500)

During the last year, SARP has also been featured in several media stories in North America and Europe including:

- January 2019: Leaders in the field – 34 innovators and pioneers of mountain safety. Backcountry Magazine;

- January 22, 2019: Lawine – Naturgewalt vom Berg. Panel discussion on ‘Der Club’ on Swiss National Television SRF. SARP research mentioned by Jürg Schweizer (link: <https://www.srf.ch/play/tv/club/video/lawine---naturgewalt-vom-berg?id=fdfc3053-93d7-4af6-81b3-21fd07602fe3>);
- February 6, 2019: What snow scientists say about surviving avalanches. Allen Best in Jackson Hole News & Guide (link: https://www.jhnewsandguide.com/jackson_hole_daily/state_and_regional/writerrrs_on_range/article_0108df33-0687-570f-86f5-593341965571.html); and
- February 16, 2019: Das hilft beim Überleben in der Lawine. Frederik Jötten in NZZ am Sonntag (link: <https://nzzas.nzz.ch/wissen/das-hilft-beim-ueberleben-in-der-lawine-ld.1460203?reduced=true>).

3.5 Award and recognitions

In the last twelve months, my research team and I received the following recognitions:

- Katie Fisher: Awarded a SSHRC Canada Graduate Scholarship for her Masters research.
- Erik Sharp: Receives the GISCRG Dissertation Prize for his MSc thesis from the GIScience Research Group of the British Royal Geographical Society (<https://quantile.info/giscrg-dissertation-prize-winners/>).
- Taylor Clark: Recipient of Young Snow Science Professional Award at International Snow Science Workshop in Innsbruck, Austria (all conference expenses)
- Matthias Walcher: Nominee for Young Snow Science Professional Award at International Snow Science Workshop in Innsbruck, Austria.

3.6 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 spring 2020), 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 where we discuss current avalanche conditions (winter only) and research papers on special topics.

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

3.7 Other relevant activities

I finished my 3-year term as co-editor-in-chief of the **Journal of Outdoor Recreation and Tourism** (JORT) on December 31, 2018. My original objective to establish JORT as 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 only had limited success.

I am also the director of SFU's **Centre for Tourism Policy and Research (CTPR)**, 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 core faculty members whose research expertise was directly in tourism, we currently have an opportunity to realign the CTPR with current needs of the industry. To better use the remaining research capacity of the CTPR and further enhance it, a proposal for funding a part-time managing director for three years was developed and submitted to the BC Government in collaboration with the Adventure Tourism Coalition (ATC). Unfortunately, the submission was not successful.

3.8 Challenges

In my opinion, the biggest challenges for my program are:

- Maintaining a continuous and meaningful connection with supporting organizations and practitioners to ensure the research we work on is meaningful to the community;
- Providing my students with the training they need to allow them to start a promising career in the avalanche community.

Any guidance on these challenges would be welcome.

4 Outlook for next 12 months

4.1 Personnel

The following individuals will be joining the SARP team in the fall of 2019:

- Amelie Goulet-Boucher (Masters student; REM thesis stream)
- Heather Hordowick (Masters student; REM thesis stream)
- Abby Morgan (Masters student; REM project stream)

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:
 - Submit Bret's second paper on the effect of climate oscillations on the nature of avalanche hazard in western Canada;
 - Turn Taylor's thesis into a research article and submit it by the end of the summer;
 - Bring Brendan's project to completion and submit a research article for publication by the end of the summer;
 - Bring Anne and Henry's project to completion and submit a research article for publication by the end of the year;
 - Bring Moses' project to completion by the end of the year;
 - Submit several papers on summarizing and visualizing simulated snowpack information with Simon, Stan and Florian;
 - Develop PhD research proposals with John and Florian;

- Write position paper on how to conduct social science research in support of public avalanche safety more effectively.

4.2.2 Funding

- Continue to secure matching funds for unmatched contributions from partners (Avalanche Canada and Avalanche Canada Foundation) whenever possible.
- If meaningful and if there is sufficient capacity, submit NSERC Discovery grant application on examining the effect of climate change on avalanche hazard in western Canada.

4.2.3 Teaching

- Develop a new university course in avalanche risk management over the summer. The course will be taught for the first time in spring semester of 2020 (Jan. to Apr.)

4.2.4 Outreach

- Attend the 2019 Annual Meeting of the Society for Risk Analysis in Arlington, VA, with Anne and Henry (Dec. 8-12).
- Continue to build research network outside of traditional avalanche research fields within SFU (e.g., big data, visualization) and beyond (e.g., risk communication).
- Strengthen public outreach with social media, practical resources on website, presentations, and articles published in the Avalanche Journal and presentations.
- Strengthen connection with operators and avalanche professionals by visiting them and connecting them with students more frequently.

4.2.5 Student training

- Develop a better plan for giving students the opportunity to go into the field and connect with collaborating operations and avalanche professionals in a meaningful way.

4.2.6 Anticipated Challenges

- The program has grown tremendously since we started in the fall of 2015 and I am getting concerned about reaching the limit of my capacity. I am not planning to grow the research program any further.

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.