



PermafrostNet
NSERC | CRSNG



International Day of Permafrost 2023

NSERC PermafrostNet Event Report

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www.permafrostnet.ca

Summary

On 1st March 2023 NSERC PermafrostNet invited the permafrost community to an online day of presentations and discussions highlighting the many organizations and projects around the world studying, monitoring, and addressing permafrost issues.

The meeting featured a series of presentations introducing organizations and groups working on permafrost such as PERMOS, INTERACT and Permafrost Carbon Network. There were presentations on transnational projects and some discursive sessions on issues facing the permafrost research community around the world, coordinating research and data efforts, such as data sharing and interoperability between countries.

Through discussion, participants found important research questions around better linking observations and models, establishing standards, and in considering ecology and food resources. Furthermore, data sharing was found to be improved by community building, standardization, and learning (“adopt and adapt”) from communities such as meteorological and oceanographic research. Participants stressed the importance of long-term partnerships. Having an organization to coordinate international research in Canada, provide linkages withing Canada, and make data available was suggested as a way forward. To increase awareness of permafrost and the importance of its changes, education of children and youth, as well as co-creation of projects with tangible benefits have been suggested. More details on the discussions can be found in the report and its appendices.

Objectives

The aims of the day were to (1) Provide the permafrost community with introductions to organizations working on permafrost, opportunities for them to ask questions of organizations and learn through participation in breakout session discussion; (2) Forge stronger engagement with international organizations and provide a forum for the organizations to introduce themselves to a wider audience; (3) Provide network members opportunities to share the outcomes of their international work; and (4) to help forge useful connections between organizations for future collaborative grant proposals or knowledge dissemination initiatives. This report summarizes the day’s results for items (1), (2) and (3), and records the key comments from the discussions.

Previous NSERC AGMs have highlighted our international partners. Our [2020 AGM](#) featured a smaller number of organizations in the session “Making new connections: International Partners”; INTERACT, IPA, Nunataryuk, PCN, Permafrost CCI+, GlobPermafrost, PERMOS and T-MOSAIc. This time we built upon that to feature 25 different permafrost related organizations, projects and working groups.

Organizations and Presenters

Organization	Speaker
Canadian Permafrost Association (CPA)	Kumari Karunaratne
NSERC PermafrostNet	Stephan Gruber
International Permafrost Association (IPA)	Isabelle Gärtner Roer
International Centre for Integrated Mountain Development (ICIMOD)	Miriam Jackson
T-Mosaic permafrost thaw Action Group	Julia Boike
International Network for Terrestrial Research and Monitoring in the Arctic (INTERACT)	Margareta Johansson
Swiss Permafrost Monitoring Network (PERMOS)	Cécile Pellet
Adventure of Science	Sabrina Muzafari
International Conference on Permafrost (ICOP)	Lukas Arenson
Permafrost Discovery Gateway	Guido Grosse
Canadian Consortium for Arctic Data Interoperability (CCADI)	Peter Pulsifer
Association of Polar Early Career Scientists (APECS)	Elise Devoie, Deniz Vural and Lina Madaj
Arctic-Boreal Vulnerability Experiment (ABoVE)	Scott Goetz
POLAR2E: College on Polar and Extreme Environments	Gonçalo Vieira
IPA Action Group: Towards an International Database of Geoelectrical Surveys on Permafrost (IDGSP)	Teddi Herring and Coline Mollaret
Northumbria University	Michael Lim
Tuktoyaktuk	Deva-Lynn Pokiak
Permafrost CCI+ and GlobPermafrost	Annett Bartsch
CryoSlideRisk	Tong Qiu
Prism-Arctyc	Antoine Séjourné
Permafrost Pathways	Sue Natali
Permafrost Carbon Network (PCN)	Ted Schurr

Participants

There were 219 attendees registered for the day, and 174 unique meeting participants. The attendees who were willing to share their details are listed in appendix 1.

Registered attendees were from 20 different time zones, across 28 countries. Canada was the most well represented country (115 registered attendees), with Germany (20), USA (18), Switzerland (12) and India (10) also having sizeable contingents. Similarly, most attendees (69) were in the Eastern Time zone (GMT -5), while 55 were in the Central European Time zone (GMT +1) (Figure 1.).

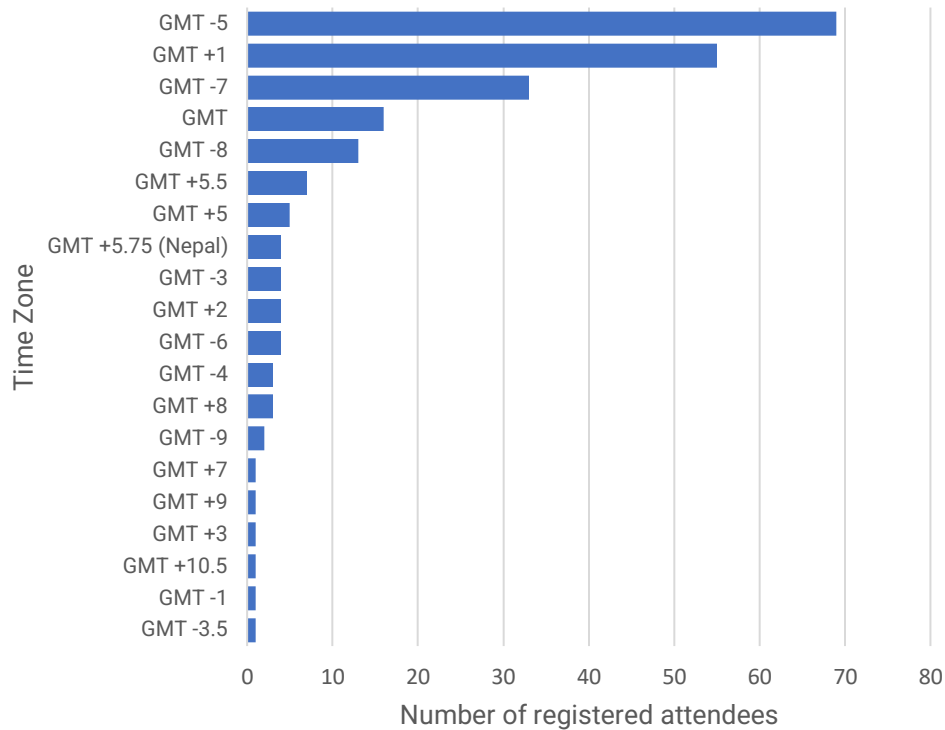


Figure 1: Time zone frequency of registered attendees.

Event Description

The event schedule and further details of the day were published on the NSERC PermafrostNet website. The day’s schedule is available in appendix 2.

The day consisted of four activities: expert presentations, group discussions, poster presentations, and networking. Each of the six presentation sessions began with invited speakers presenting on behalf of organizations involved in permafrost, followed by Q+A. Three breakout discussion sessions split up the presentations and allowed participants to share their views on six topics of interest. The presentations and breakout discussions took place on the meeting platform Zoom (Figure 2.). All the presentations, Q+As and plenary feedbacks were recorded and shared on the NSERC PermafrostNet website and YouTube.

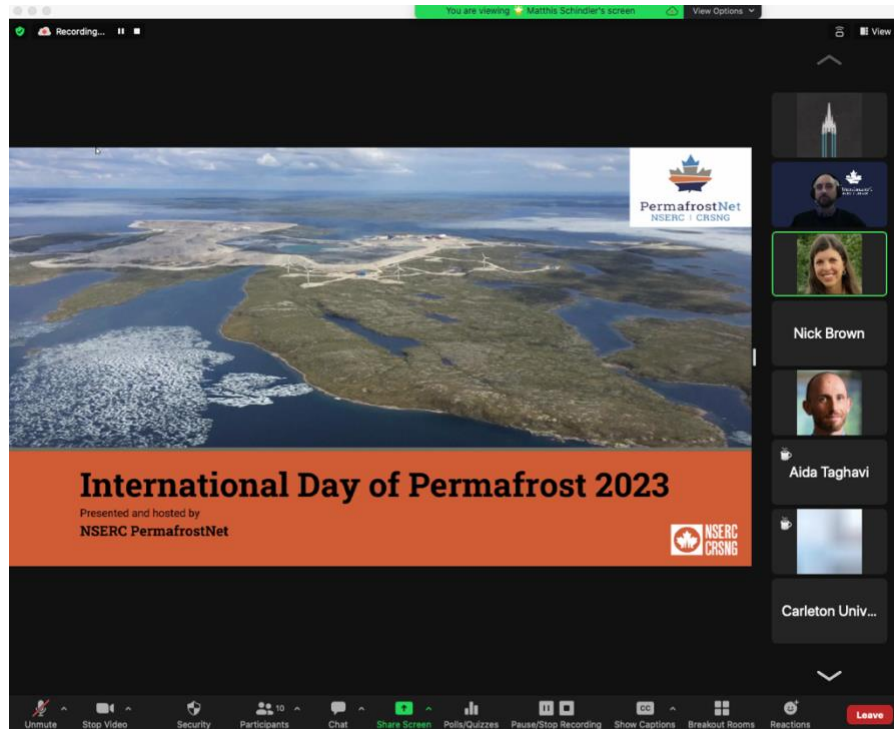


Figure 2: Zoom meeting presentations.

A proximity based online meeting space ([SpatialChat](#)) was used to facilitate the poster displays and networking activities (Figure 3.). The networking and poster presentation rooms in the space were open to attendees for 24 hours enabling people to see the content and connect before and after the scheduled presentations. Participants were also encouraged to visit the space and meet presenters during the lunch break in the middle of the day (Eastern Time).

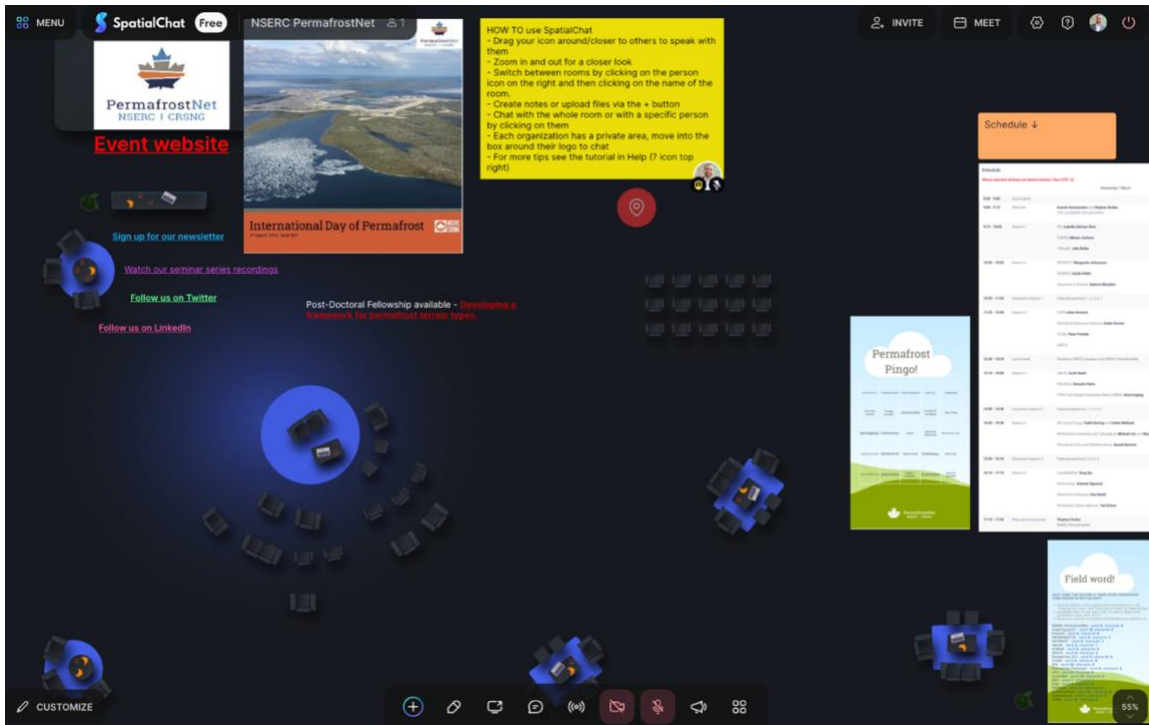


Figure 3: SpatialChat welcome room.

Discussions

The day featured three opportunities to discuss important issues for the permafrost community. Each discussion breakout session provided 30 minutes for discussion and 10 minutes for summaries in the plenary. There were six breakout rooms in each round of discussion and participants chose which discussion group to join. During the breakouts the discussions were chaired by presenters and participants, while notes were taken by members of NSERC PermafrostNet, with ideas and comments being recorded in the online whiteboard platform Mural (Figure 4.). Breakout group chairs then reported the key points from the discussions back in the plenary session.

The questions addressed in the discussion sessions:

1. What are the big research questions, and what are the challenges in addressing them at the international scale?
2. How can we improve data sharing and interoperability between countries?
3. What future shared infrastructure is required by the permafrost community?
4. What new long-term international partnerships do we need and how do we build them?
5. What is needed from Canada to make international research initiatives more successful and what are international researchers contributing to Canada?
6. How can we leverage the many initiatives around the world and raise awareness of permafrost issues?

The first topic was the most popular discussion group and featured the most participants in each of the three rounds.

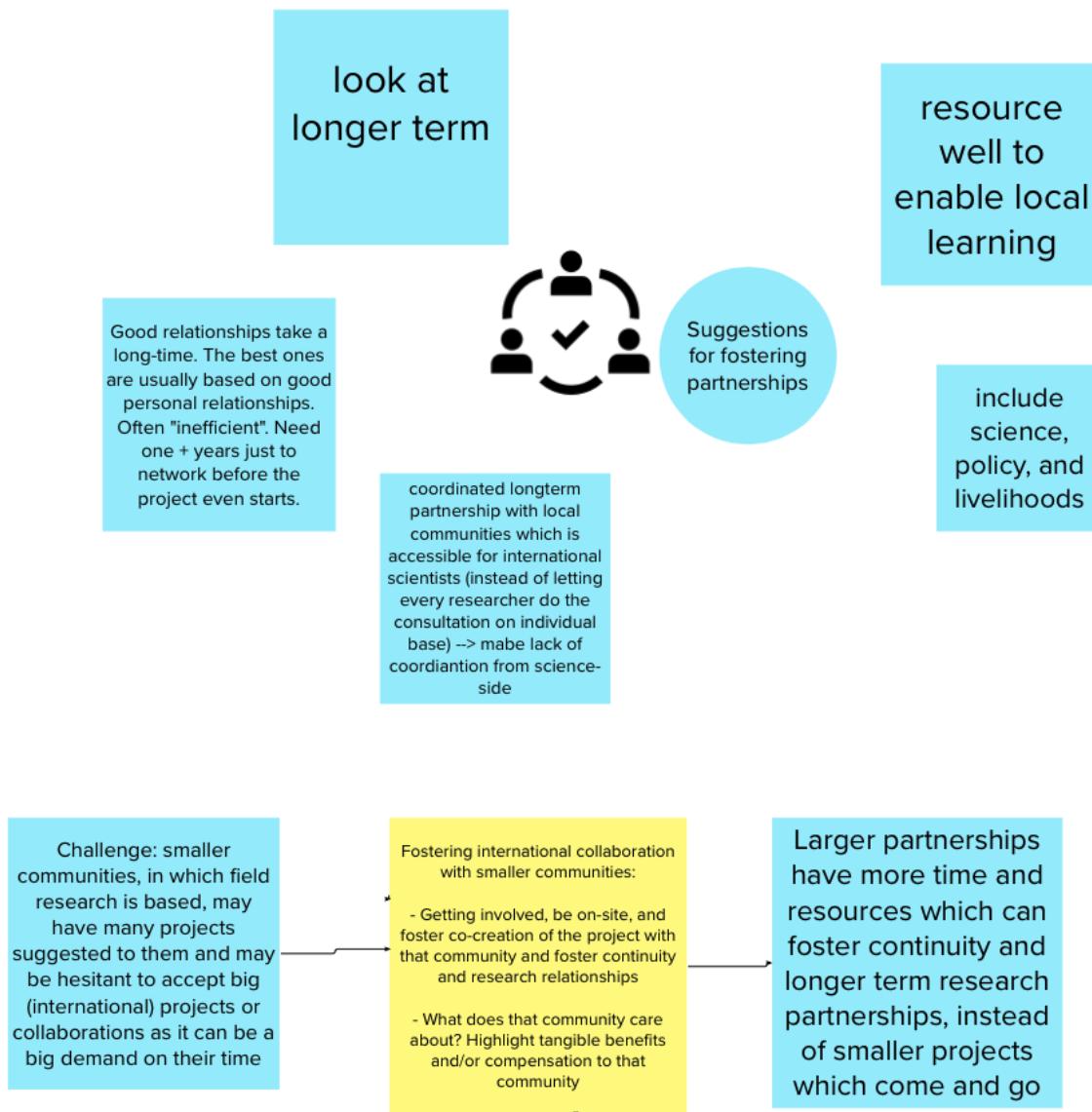


Figure 4: Section of Mural online whiteboard collaborative platform.

Summary of discussions

1. What are the big research questions, and what are the challenges in addressing them at the international scale?

The first topic discussed the big research questions and challenges in addressing them at an international scale. The big **scientific** questions included applied permafrost geomorphology carbon and methane release, monitoring changes, and the best ways to mitigate or adapt to permafrost thaw. It was felt more work should be directed to

carbon and methane release. A key challenge is linking fieldwork observations (*in situ* information) with models (carbon content, ground ice content), as well as the difficulty faced with numerical models. There is a need for better measurements, as an example of limitations of *in situ* information is the difficulty in determining the depth of permafrost without deep enough boreholes. There are also challenges in water security and availability, contaminants like mercury, and supporting local communities affected by permafrost thaw. The value and need to go into the field for carbon observations and having actual expertise from the to apply to actual research questions was pointed out, even though there are now good tools like remote sensing and modeling. This led on to discussions around the need for experts, a need to understand the processes linking remote tools and modelling to answering actual research questions and *in situ* research.

In terms of **engineering**, there is a need to establish national and international standards and develop different geotechnical approaches for construction. There are significant challenges with engineering infrastructure to cope with thawing permafrost and be climate change resilient. Participants also stressed it will be important to educate future engineers and provide them with field experience so they can succeed.

Socially, a bottom-up approach, public engagement, and consideration of ecological impacts are necessary. Understanding how permafrost thaw affects food resources due to the ecosystem disruption is important. The community of Tuktoyaktuk in Canada is an example of a community experiencing the social impact of permafrost thaw and highlights the importance of identifying how to support local communities affected by permafrost thaw. This led to discussion of how knowledge is then transferred to communities, so communities see the benefits. It was emphasised that this is easier with local knowledge, if you're working next to your community and you have a specific question related to that community, then it's much easier to communicate this to the community, and show the benefit; whereas those who work more on regional and global scale find it harder for their information to be transferred to communities, so that they see the benefits of what's been done.

2. How can we improve data sharing and interoperability between countries?

The second breakout group invited participants to identify ideas, challenges, and tools for permafrost data. The Mural feedback from the breakout group is shown in Appendix 5. Participants explored how to improve data sharing and interoperability between countries. Nick Brown led a productive discussion on improving data storing and interoperability between countries.

One highlight was the importance of building a community, for example through workshops and personal connections to facilitate data sharing and coordination. **Standardizing data** was highlighted, including through the creation of 'Data Cubes' was suggested and using publicly available tools for data cleaning were suggested. To avoid duplication of efforts and have a coordinated approach participants discussed how it is important for organizations to share their data workflows and the importance of sharing algorithms and workflows used for processing, cleaning, and analyzing data.

Challenges that participants discussed included finding funding and time to support data processing, verifying data, and liability issues. Challenges around the time it takes to collect, process, and clean data and the backlog of historic data that needs to be organized and shared were discussed. The idea of algorithm sharing and using the PolarTEP platform as a way to do that was put forward. Long-term investments are also needed for infrastructure in the North, and **tools** like the "Teaspoon" Python library ([Brown, 2022](#)) can be helpful for developing common data workflows.

Raising awareness of existing resources, was identified as an important step. Examples of these from Mural, the shared whiteboard, included the GTN-P database, Duane Froese's permafrost core library and other permafrost databases. The group also looked to other research communities for inspiration, concluding that ideas from the meteorological and oceanographic communities about data, sharing and interoperability could be applied to permafrost as well. The value and benefits of creating larger, international storage places of data and communicating their existence was discussed. ArcGIS storymaps for interactive result sharing with community partners was also put forward.

In the final session, the group discussed the importance of ensuring permafrost data is usable by the broadest audience. Central to this discussion were questions about legal liability for engineers using data produced by government and academia. . Exploring this issue, participants raised a number of probing questions to dig down into how it could be addressed: what metadata or data standards would be necessary for professional engineers to feel comfortable using this data? What in-house standards or metadata are used by engineering companies, and could these be adopted more broadly? If scientific data are used for engineering applications where does the legal responsibilities end up falling? Again, parallels were drawn to other scientific communities: how is it different using meteorological data from an organization like Environment Canada?

3. What future shared infrastructure is required by the permafrost community?

During the discussion, participants explored the infrastructure needed by the community and emphasized that physical infrastructure was not the only requirement. Better information to make informed decisions and identifying key science questions first and then deciding on the infrastructure needed to address those questions were stressed.

Examples of infrastructure needed for permafrost research include monitoring stations for ground temperature and thaw depth, drilling equipment for collecting ice cores and sediment samples, and remote sensing tools for mapping permafrost distribution and changes. Sites need to be identified for infrastructure like monitoring stations, remote sensing, and building, but the cost and environmental impact must be considered. The infrastructure should be in key regional transects, which are representative and useful for different groups and close to existing studies and weather stations. In terms of instrumentation, there is a need for sharing of drills and monitoring equipment.

Additionally, there is a need for better spatial visualizations of geotechnical products, which could help researchers plan where to install infrastructure. The easiest logistics should be considered when placing infrastructure, and there should be ways to organize expeditions and share instrumentation. Local communities should be involved in monitoring, and we should aim to automate as much as possible. However, there are challenges such as high costs and carbon and ecological footprint of physical infrastructure. Therefore, it is important to carefully select sites for infrastructure based on their representativeness and usefulness for multiple research needs. Examples of good practices in logistics sharing in Greenland and other Arctic regions were mentioned, along with initiatives in other fields such as the WMO. T-Mosaic was one example, as well as new sites organized by the European Polar Board, [Polardex](#) which includes research infrastructure data.

Standardized documents for measurements in permafrost and repositories for data and resources are needed. In addition to physical infrastructure, standardization of measurements and data collection protocols is also necessary to ensure data comparability and interoperability across different research groups and regions. A centralized repository for data and resources can also facilitate knowledge sharing and collaboration among researchers. A common website dedicated to permafrost research can bring together information on infrastructure needs. There is a need for a centralized repository that can provide guidance on fieldwork preparation, installation of temperature stations, instrumentation sharing, and other resources. A website site would serve as a compilation of available resources, rather than a permafrost database, and could help to organize expeditions and share information on infrastructure needs. To address these needs, initiatives such as an IPA action group would be good for bringing together information on needs and standardization efforts in a central location, and to promote collaboration and sharing of resources among the permafrost research community.

4. What new long-term international partnerships do we need and how do we build them?

It was recognised that partnerships may be small, like an exchange during a PhD project, as well as larger networks and initiatives. A variety of stakeholders need to be engaged, not just academics and common ground can be found of the similarities in the issues being faced or challenges being tackled, whether it's Canada or the Hindu Kush Himalaya region. The real benefits manifest themselves when partnerships are well-resourced and long-term. Later the group emphasized that partnerships take a long time to develop and that needs to be recognized. Partnerships that are built on friendship are more successful and can take a year before projects even start.

The discussion then revolved around the long-term international partnerships that are required to address the challenges associated with permafrost research. The importance of partnerships between countries, universities, and institutions is highlighted. Some partnerships, such as the ICIMOD-Carleton University collaboration, were discussed, while others are suggested, such as strengthened partnerships between the US and Canada, removing some of the administrative barriers between the

two countries for international funding, and developing collaborative funding and joint research programs.

To foster partnerships, it was suggested that coordinated long-term partnership with local communities which are accessible for international scientists be created. This would remove the requirement for individual researchers to restart community-researcher relationship building and undertake their own consultation. The challenge of coordinating long-term partnerships with smaller communities was also discussed, as they are often hesitant to accept large more long-term projects due to the demands involved, and their capacity. Whereas smaller projects come and go. It was also suggested that partnerships should include science, policy, and livelihoods to be effective. Applying research work to social aspects such as infrastructure, rehabilitation, urban planning, identifying and communicating the risks of hazards associated with permafrost and protecting permafrost under infrastructure is also emphasized. Furthermore, the need for capacity building and the importance of applying research results to engineering solutions and community decisions were discussed.

In the plenary, the demands on communities and researchers time for partnerships and engagement with projects as an ongoing challenge was brought up, with careful thought needed not to overwhelm the capacities of local communities. This theme was repeated in a few of the discussion groups.

5. What is needed from Canada to make international research initiatives more successful and what are international researchers contributing to Canada?

Groups discussing this topic talked about the contributions Canada can make to the international community, particularly in terms of practical knowledge on permafrost. Specific examples were provided such as an understanding of ice wedge permafrost landforms, thaw settlement, how deep permafrost is and how the composition of permafrost changes over time. The participants also discussed Canadian's long history of exposure to permafrost, and need to build infrastructure on permafrost, which has led to many practical or engineering solutions. The group discussed the challenges of international collaboration, such as managing time zones and engaging with small local communities. They highlighted the importance of developing better partnerships with local communities before looking at outside (international) partnerships. They emphasized that good partnerships take many years or decades to form, and it may be difficult to look at outside partnerships while this is taking place.

The group later discussed Canadian contributions and the importance of developing interconnectivity between Canadian and European permafrost research, especially the importance of long-term projects. They acknowledged the increasing pressure from permafrost and Arctic ecosystem researchers shifting away from Russian field sites to Canada. The participants emphasized the need for transdisciplinary research work to mitigate permafrost thaw and shared some examples of long-term partnerships with international research groups already in place. The Canadian National Adaptation

Strategy was provided as an example of forming connections between different disciplines, while the group mentioned the importance of gaining perspectives from other countries and not just relying on a single source. They emphasized the need for a system or ecosystem that enables international collaboration and better coordination, and the need for easier funding of such initiatives. They suggested building organizations dedicated to coordinating international research and making permafrost data available to other researchers from outside Canada. Some great international contributions to Canada mentioned were joint funded projects, including funding opportunities through programs like the bi-national program between the German Federal Ministry of Education and Research (BMBF) and NSERC. The IPA action groups were another example of good international collaboration.

In the final round, the focus was once again on the Canadian contributions, with the group recognizing that permafrost research is a relatively new discipline, compared to other disciplines like meteorology and that there are growing pains involved. The group acknowledged that local community liaison is a priority. The group discussed how a lot of the progress being made is with communities as opposed to international partnerships. Liaison with the local communities often takes precedence, and there's not a lot of bandwidth left to reach out to international partners. However, the group suggested looking at examples from international communities that have already gone through this phase. They concluded by suggesting that Canada can learn from international communities for examples of how to connect and form lasting partnerships with local communities. Overall, this discussion was Canada-focused and less on the international side.

6. How can we leverage the many initiatives around the world and raise awareness of permafrost issues?

The discussions on this topic started with educating youth, children, and how providing interactive and engaging materials like documentaries, podcasts, infographics are also helpful. During the first round there was focus on raising awareness about permafrost issues and the group agreed that children are an effective audience to target due to their natural curiosity and interest in diverse topics. However, they realized that it would take several years before these children become decision-makers, and we need solutions now. One suggestion was to educate children, who can then go back home and educate their parents, creating a generational continuity of knowledge. The group is also suggested to connect with media outlets, influencers, and celebrities to create public awareness. The discussion highlighted the important role of organizations in coordinating and planning activities such as an International Day of Permafrost each year.

The second group discussed including teaching science communication skills, understanding the audience and tailoring messaging, accordingly, using social media and interactive content, and engaging indigenous people through storytelling. Interactive and engaging forms of communication are important for reaching and teaching the younger generation, using formats like infographics, documentaries and

films. A key consideration the group raised is the need to know the audience and communicate effectively by listening to the indigenous community and sharing research results in their traditional ways of knowledge sharing. It is important to build good relationships between community people and researchers, helping youth community members to join research groups, and working out conflict with a positive approach. Collaborations with smaller communities are also encouraged by getting involved on-site, co-creating projects, and fostering research relationships. The focus should be on tangible benefits, compensation, and promoting community-driven data collection.

In the final round, they shared their experience working in science and emphasized the importance of involving community members in research, building trust, explaining the research's target and benefits, keeping the community updated, and finding researchers from within the community. They also encouraged others to expand proposals and work together to increase opportunities for proposal submissions.

Conclusion

The International Day of Permafrost identified a range of research questions and initiatives that would strengthen permafrost research around the world and help us address the problems thawing permafrost creates. Participants made a number of recommendations with shared infrastructure and coordinated initiatives featuring prominently. Suggestions ranged from transnational funding programs, to websites, coordinating centres for fieldwork and data and long-term partnership programs. The discussions also strongly advocated for the inclusion of communities at all stages of the research and application of permafrost knowledge, whether scientifically, in engineering or socially.

Follow-up and next steps

A few initiatives are underway to strengthen international collaboration, with some of them highlighted during the day's proceedings. However, there is a clear need for more funding and vision to capitalise and leverage on the existing work being undertaken in relation to permafrost. Some practical suggestions were made such as the forming of IPA action group around specific issues such as sharing infrastructure, and standardizing permafrost related data. Other suggestions were larger in scale and would likely require concerted and focused efforts to influence policy and research funding programs.

Author

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Acknowledgments

Presenters: Kumari Karunaratne, Stephan Gruber, Isabelle Gärtner-Roer, Miriam Jackson, Julia Boike, Margareta Johansson, Cécile Pellet, Sabrina Muzafari, Lukas Arenson, Guido Grosse, Peter Pulsifer, Elise Devoie, Lina Madaj, Deniz Vural, Scott Goetz, Gonçalo Vieira, Teddi Herring and Coline Mollaret, Michael Lim, Deva-Lynn Pokiak, Annett Bartsch, Tong Qiu, Antoine Séjourné, Sue Natali, Ted Schurr.

Co-ordinator: Matthias Schindler

Facilitators: Michelle Laurie, Michaela Slinger.

Discussion chairs: Radhakrishna Bangalore Lakshmi Prasad, Lukas Arenson, Annett Bartsch, Nick Brown, Gonçalo Vieira, Stephan Gruber, Ariane Castagner, Jennifer Humphries, Rose Lefebvre, Pat Jardine, Gabriel Karam, Sabrina Muzafari, Zakieh

Mohammadi and Mahya Roustaei.

We acknowledge the support of the Natural Sciences and Engineering Research Council of Canada (NSERC) and the other funders of NSERC PermafrostNet.

APPENDIX 1: Participants

The following lists all the participants who were willing to share their details.

Prefix	First Name	Last Name
Mr.	Matthis	Schindler
Dr.	Teddi	Herring
Prof.	Tong	Qiu
Prof.	Scott	goetz
Ms.	Sabrina	Muzafari
Dr.	Miriam	Jackson
Mr.	Antoine	SEJOURNE
Prof.	Julia	Boike
Ms.	Emma	Lathrop
Prof.	Guido	Grosse
Prof.	Gonçalo	Vieira
Dr.	Antoni	Lewkowicz
Dr.	Lingcao	Huang
Dr.	Jocelyn	Hayley
Mr.	Konstantin	Ozeritskiy
Prof.	Brian	Moorman
Mrs.	Ana	Silva
Dr.	Michel	Allard
Mr.	Pedro	Freitas
Prof.	Andreas	Hordt
Miss	Emma	Stockton
Mrs.	Allison	Plourde
Ms.	Lucile	Cosyn wexsteen
Mrs.	Adele	Joyeux
Dr.	Scott	Davidson
Mr.	Nana	Agyei
Dr.	Bala Raju	Nela
Miss	Vandana	L
Dr.	REMYA	S N
Dr.	Heather	Reese
Mrs.	Zakieh	Mohammadi
Mr.	Alexandre	Chiasson
Mr.	Adam	Kirkwood
Dr.	Jennifer	Spence
Mr.	Cas	Renette
Miss	Tabatha	Rahman
Mr.	Victor	Arias
Mr.	Carlos	Andrade
Mr.	Frederic	Brieger
Dr.	Kumari	Karunaratne
Dr.	Tristan	MacLean
Mr.	Daniel	Baptista






Prefix	First Name	Last Name
Mr.	Jurjen	van der Sluijs
Ms.	Emilie	Stewart-Jones
Mr.	Marc-André	Ducharme
Dr.	Martine	Lizotte
Mrs.	Eva	Thévenin
Miss	Diana	Martins
Ms.	Rachel	Pietersma
Ms.	Mariana	Verdonen
Dr.	Lukas	Arenson
Prof.	Frederic	Bouchard
Mrs.	Catherine	Deslauriers
Dr.	Mahya	Roustaei
Dr.	Mathia	Sabino
Dr.	Cécile	Pellet
Mr.	Jan	Lentschke
Dr.	Lina	Madaj
Dr.	Annett	Bartsch
Mr.	Gabriel	Karam
Miss	Lin	PENG
Dr.	Ivan	Sudakow
Dr.	Nikita	Kaplin
Ms.	Ipshita	Pradhan
Miss	Aesha	Sura
Dr.	Maria	Papale
Miss	Juliette	Ortet
Mr.	Dominik	Amschwand
Ms.	Lorelle	Juffs
Ms.	Naomi	Short
Mr.	Stephan	Gruber
Ms.	Marina	Taskovic
Dr.	David	Arthurs
Mr.	Victor	Caraballo
Mrs.	Saskia	Eppinger
Ms.	Michelle	Laurie
Ms.	Michaela	Slinger
Dr.	Alexandra	Veremeeva
Mr.	IgorEgorov	Egorov
Ms.	Dorra	Jlouli
Mr.	Deedar	Karim
Ms.	Kethra	Campbell-Heaton
Dr.	Sebastian	Vivero
Dr.	Paul	Overduin






APPENDIX 5: Program schedule





All times are listed in Eastern Time (UTC -5)





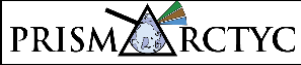
8:30 - 9:00	Zoom opens		
9:00 - 9:15	Welcome	CPA, Kumari Karunaratne NSERC PermafrostNet, Stephan Gruber	
9:15 - 10:05	Session 1	IPA, Isabelle Gärtner-Roer ICIMOD, Miriam Jackson T-Mosaic, Julia Boike	Presentations & Questions
10:05 - 10:55	Session 2	INTERACT, Margareta Johansson PERMOS, Cécile Pellet Adventure of Science, Sabrina Muzafari	Presentations & Questions
10:55 - 11:35	Discussion session 1	All Featured Discussion Questions	Break out groups, Mural
11:35 - 12:40	Session 3	ICOP, Lukas Arenson Permafrost Discovery Gateway, Guido Grosse CCADI, Peter Pulsifer APECS	Presentations & Questions
12:40 - 13:10	Lunch break	Hosted by APECS, Speakers and NSERC PermafrostNet	SpatialChat
13:10 - 14:00	Session 4	ABOVE, Scott Goetz POLAR2E, Gonçalo Vieira GTN-P and Global Cryosphere Watch (WMO), Anna Irrgang	Presentations & Questions
14:00 - 14:40	Discussion session 2	All Featured Discussion Questions	Break out groups, Mural
14:40 - 15:30	Session 5	IPA Action Group, Teddi Herring and Coline Mollaret Northumbria University and Tuktoyaktuk, Michael Lim and Deva-Lynn Pokiak Permafrost CCI+ and GlobPermafrost, Annett Bartsch	Presentations & Questions
15:30 - 16:10	Discussion session 3	All Featured Discussion Questions	Break out groups, Mural
16:10 - 17:15	Session 6	CryoSlideRisk, Tong Qiu Prism-Arctic, Antoine Séjourné Permafrost Pathways, Sue Natali Permafrost Carbon Network, Ted Schurr	Presentations & Questions
17:15 - 17:30	Wrap up/closing words	NSERC PermafrostNet, Stephan Gruber	






APPENDIX 4: Matrix of participating organizations

Organization	IPA (International Permafrost Association)	NSERC PermafrostNet	CPA (Canadian Permafrost Association)	ICOP (International Conference on Permafrost)	ICIMOD (International Centre for Integrated Mountain Development)
Website	https://www.permafrost.org	https://www.permafrostnet.ca/	https://canadianpermafrostassociation.ca/	https://icop2024.org https://www.permafrost.org/event/icop12/	https://www.icimod.org/
Logo					
Type of organization	Association	Research network	Association	Conference	Non-profit
Dates in operation	1983 – present	2019 – 2025	2018 – present	2024	1983 – present
Description	<p>The mission of the International Permafrost Association (IPA) is to promote research in permafrost and permafrost-related fields within the global scientific and engineering communities, to support the activities of researchers in these disciplines, and to disseminate findings concerning permafrost to the decision-makers, the general public and educators.</p> <p>The IPA is an Affiliated Organization of the International Union of Geological Sciences (IUGS) since 1989.</p>	<p>The NSERC Permafrost Partnership Network for Canada (NSERC PermafrostNet) unites researchers from 11 universities, with partners in government agencies, industry and Indigenous communities, who share the common goal of boosting Canada's ability to monitor, predict and adapt to large-scale permafrost thaw and its consequences. Network research focuses on understanding and predicting permafrost thaw and its consequences, to connect scales from field sites to national-scale prediction and to prototype knowledge products and practices with stakeholders. NSERC PermafrostNet supports the work of 15 professors and has 31 collaborators and more than 40 partnering organizations nationally and internationally. It is funded by partners and participating institutions along with Can\$5.5 million from the Natural Sciences and Engineering Research Council (NSERC) Strategic Partnership Grants for Networks.</p>	<p>The Canadian Permafrost Association (CPA) was founded in 2018 to bring together academics, practitioners, policy-makers, communities and indigenous organizations to help understand and address challenges. The CPA's objectives include e.g., Supporting the development of key synthesis products, such as maps and databases; Promoting permafrost education through specialized training seminars and workshops; Supporting early career researchers.</p>	<p>The IPA organizes regional and international conferences as part of its objective to bring together those interested in permafrost and permafrost-related subjects to share knowledge and exchange experiences. International conferences are held every four years and take place in cities all over the world. The 12th International Conference on Permafrost (ICOP 2024) is held from June 16-20, 2024 in Whitehorse, Yukon, Canada at Yukon University. The conference theme - Permafrost Thaw, Change and Adaptation: Integrating Perspectives. ICOP 2024 is held on the lands of the Kwanlin Dun First Nation and Ta'an Kwachan Council.</p>	<p>The International Centre for Integrated Mountain Development (ICIMOD) is an intergovernmental knowledge and learning centre working on behalf of the people of the Hindu Kush Himalaya (HKH). We are based in Kathmandu, Nepal and work in and for our eight regional member countries – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. We work to improve the lives and livelihoods of men, women, and children of the HKH and protect mountain environments and cultures. The knowledge we create, and share helps the people of the HKH become more resilient, make the most of new opportunities, and prepare for change. Our work strengthens regional cooperation for conservation and sustainable mountain development.</p>

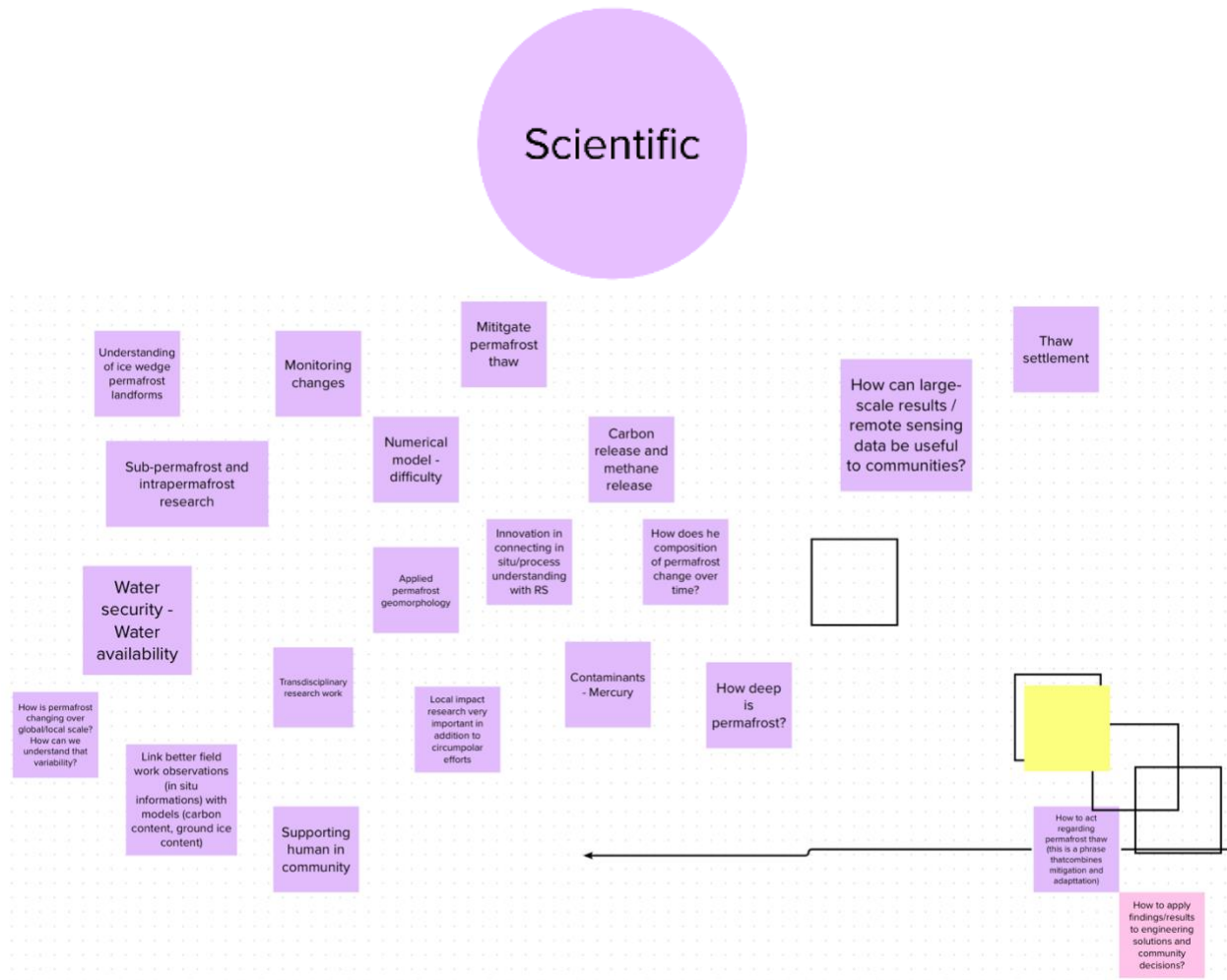
Organization	PERMOS (Swiss Permafrost Monitoring Network)	T-Mosaic (Terrestrial Multidisciplinary distributed Observatories for the Study of Arctic Connections)	POLAR2E (Polar and Extreme Environments)	INTERACT (International Network for Terrestrial Research and Monitoring in the Arctic)	Permafrost CCI+, GlobPermafrost
Website	https://www.permos.ch/	https://www.t-mosaic.com/permafrost-thaw.html	https://polar2e.ulisboa.pt	https://eu-interact.org	https://globpermafrost.info https://climate.esa.int/en/projects/permafrost/about/
Logo					
Type of organization	Research network	Research network	University-based	Research network	Intergovernmental organization
Dates in operation	2000 – present	2019 – 2020 – ongoing	2020 – present	2011 – ongoing	2016 – 2026
Description	The Swiss Permafrost Monitoring Network (PERMOS) documents the state and changes of mountain in the Swiss Alps in the framework of climate monitoring. We obtain long-term field measurements of basic permafrost variables. PERMOS obtains, manages and reports on field measurement of ground temperatures, changes in ground ice content and creep velocities of rock glaciers. Results and data are openly available to research, practice and the public.	The Permafrost Thaw Action Group contributed to the T-MOSAIC program by developing a standardized protocol for collecting field data to measure permafrost thaw. The protocol addresses the need for consistent data collection across the permafrost region and allows for better monitoring and understanding of permafrost thaw. The protocol is user-friendly and accessible through the myThaw mobile app, which enables a wide range of users to make high-quality, standardized measurements. The data collected through this protocol will be integrated within pan-Arctic geospatial datasets to establish a baseline for future measurements and support modeling analyses.	The College on Polar and Extreme Environments (POLAR2E) at the University of Lisbon creates synergies and links between research teams at the university in areas such as the cryosphere, climate modelling, ecology, remote sensing, constructing in extreme environments, astrobiology and aerospace engineering. POLAR2E has research teams working in the Canadian North on erosion in permafrost coasts (Beaufort Sea) and spatial variability and biogeochemistry of permafrost thaw ponds (Nunavik). Within this scope POLAR2E has a MoU with the Centre d'Études Nordiques and Institute Nordique du Quebec, as well as an ongoing collaboration with NRCAN (Dartmouth) and has several PhD and masters students conducting research in Canada. POLAR2E team members are involved in the international projects NUNATARYUK and EO4PAC (ESA), and also lead the nationally-funded projects PERMAMERC and THAWPOND taking place in northern Canada.	INTERACT is an infrastructure project under the auspices of SCANNET, an arctic network of 68 terrestrial field bases (formerly 89, but collaboration with Russia is currently on hold) in northern Europe, US, Canada, Greenland, Iceland, the Faroe Islands and Scotland as well as stations in northern alpine areas. INTERACT specifically seeks to build capacity for research and monitoring all over the Arctic and is offering access to numerous research stations through the Transnational Access Program. INTERACT is multidisciplinary: together, the stations in INTERACT host thousands of scientists from around the world who work on projects within the fields of glaciology, permafrost, climate, ecology, biodiversity and biogeochemical cycling. The INTERACT stations also host and facilitate many international single-discipline networks and aid training by hosting summer schools.	The Global Climate Observing System (GCOS) was established to meet the needs for climate observations and developed the concept of the Essential Climate Variable (ECV). The European Space Agency (ESA) has undertaken the Climate Change Initiative (CCI) programme which comprises 23 parallel projects geared to ECV data production. The ultimate objective of Permafrost_CCI is to develop and deliver permafrost time series maps as ECV products primarily derived from satellite measurements. Permafrost_CCI will strongly rely on data products from recent, ongoing and future ESA projects, which offer consistency over several satellite generations. Validation and evaluation efforts comprise comparison to in-situ measurements of subsurface properties and surface properties, as well as rock glacier inventories, local permafrost maps and geophysical survey measurements.

Organization	BGC Engineering	PCN (Permafrost Carbon Network)	CCADI (Canadian Consortium for Arctic Data Interoperability)	Permafrost Discovery Gateway	CryoSlideRisk
Website	https://www.bgcengineering.ca/	http://www.permafrostcarbon.org	https://ccadi.ca/	https://arcticdata.io/catalog/portals/permafrost/About	https://ine.uaf.edu/cryosliderisk
Logo					
Type of organization	Private Company	Research network	University-based	Scientific project	University-based
Dates in operation	1990	2011 – present	2015 – present	2019 – 2023	2019 – 2023
Description	<p>BGC is a Canadian corporation and a specialist in applied earth sciences, with the mandate of pioneering responsible solutions to complex earth science challenges in a changing world. The company works together as one team, with coordination and integration of all offices and technical disciplines. BGC’s flexible structure allows room for innovation while providing high quality work and common-sense solutions. BGC’s pioneering spirit, unique culture and practical approach to problem solving are rooted in a firm belief in our core values. By adhering to our core values. Currently, the company has over 700 staff located in Vancouver, Victoria, Kelowna, Kamloops, Golden, Calgary, Edmonton, Toronto, Ottawa, Sudbury, Kingston, Halifax, Fredericton, Santo Domingo, Santiago de Chile and Brisbane.</p>	<p>The Permafrost Carbon Network produces new knowledge through research synthesis to quantify the role of permafrost carbon in driving future climate change. The Permafrost Carbon Network started in 2011 and our activities include a series of meetings and working groups designed to synthesize ongoing permafrost carbon research which will produce new knowledge to quantify the role of permafrost carbon in driving climate change in the 21st century and beyond.</p>	<p>The Canadian Consortium for Arctic Data Interoperability (CCADI) is an initiative to develop an integrated Canadian arctic data management system that will facilitate information discovery, establish sharing standards, enable interoperability among existing data infrastructures, and that will be co-designed with, and accessible to, a broad user base. Key to the CCADI vision are: standards and mechanisms for metadata, data and semantic interoperability; a distributed data exchange platform; streamlined data services with common entry, access, search, match, analysis, visualization and output tools; an intellectual property and sensitive data service; and data stewardship capacity. The CCADI is currently composed of a group of Canada’s foremost Arctic scholars and Arctic data managers at six universities and Inuit Tapiriit Kanatami, Inuvialuit Regional Corporation, Natural Resources Canada, Polar Knowledge Canada, Cybera Inc., Polar View, and Sensor-Up Inc. CCADI was funded by the Canadian Foundation for Innovation (CFI).</p>	<p>The Permafrost Discovery Gateway is part of “Navigating the New Arctic,” one of NSF’s 10 big ideas, a scientific project with multiple international partners (universities and research centres). The Permafrost Discovery Gateway aims to create an online platform for permafrost big data creation and discovery to support knowledge-generation. The new online scientific gateway will make information of changing permafrost conditions available throughout the Arctic by providing access to very high-resolution satellite data products and new visualization tools that will allow exploration and discovery for researchers, educators, and the public at large. The online resource will include visualization tools that expand on Google Earth and the Fluid Earth Viewer. These, in addition to graphing tools and the ability to create animations, will enable users to explore changes that have occurred in recent years and decades from the meter to the pan-Arctic scales. The Permafrost Discovery Gateway is hosted by the Arctic Data Center.</p>	<p>Mass-movement events across the cryosphere are expected to increase in frequency as air temperatures continue to warm, putting infrastructure at risk. The CryoSlideRisk project will bring together a convergent team of researchers, policy makers, and local community representatives through two workshops, planned to take place in the spring of 2022 and spring of 2023, to address infrastructure resilience and adaptation to increasing mass-movement risks across the cryosphere.</p>

Organization	Permafrost Pathways	ABOVE (Arctic-Boreal Vulnerability Experiment)	GTN-P	Global Cryosphere Watch (WMO)	Prism-Arctyc
Website	https://permafrost.woodwellclimate.org/	https://cce-datasharing.gsfc.nasa.gov/above/projects/stats/0/h/0/	https://gtnp.arcticportal.org/data	http://globalcryospherewatch.org/	https://prismarctyc.com
Logo					
Type of organization	Non-profit	Government-based	Research network	Intergovernmental organization	University-based
Dates in operation	2022 – present	2008 – present	1999 – present	2020 (operational) – present	2021 – present
Description	Permafrost Pathways was launched in 2022 with funding through the TED Audacious Project—a collaborative funding initiative catalyzing big, bold solutions to the world’s most urgent challenges. Through a joint effort between Woodwell Climate Research Center, the Arctic Initiative at Harvard Kennedy School, and the Alaska Institute for Justice, Permafrost Pathways brings together leading experts in climate science, policy action, and environmental justice to inform and develop adaptation and mitigation strategies to address permafrost thaw.	The Arctic-Boreal Vulnerability Experiment (ABOVE) is a NASA Terrestrial Ecology Program interdisciplinary field campaign being conducted in Alaska and Western Canada (see above.nasa.gov). ABOVE is a large-scale study of environmental change and its implications for social-ecological systems. ABOVE’s science objectives are broadly focused on (1) gaining a better understanding of the vulnerability and resilience of Arctic and boreal ecosystems to environmental change in western North America, and (2) providing the scientific basis for informed decision-making to guide societal responses at local to international levels. Research under ABOVE links field-based, process-level studies with geospatial data products derived from airborne and satellite sensors, providing a foundation for improving the analysis, and modeling capabilities needed to understand and predict ecosystem responses and societal implications.	The Global Terrestrial Network for Permafrost (GTN-P) is the primary international programme concerned with monitoring permafrost parameters. GTN-P was developed by the International Permafrost Association (IPA) under the Global Climate Observing System (GCOS) and the Global Terrestrial Observing Network (GTOS) in 1999, with the long-term goal of obtaining a comprehensive view of the spatial structure, trends, and variability of changes in the active layer thickness and permafrost temperature.	The World Meteorological Organization's Global Cryosphere Watch (GCW) is an international mechanism for supporting all key cryospheric in-situ and remote sensing observations. To meet the needs of WMO Members and partners in delivering services to users, the media, public, decision and policy makers, GCW provides authoritative, clear, and useable data, information, and analyses on the past, current and future state of the cryosphere. GCW includes observation, monitoring, assessment, product development, prediction, and research. It provides the framework for reliable, comprehensive, sustained observing of the cryosphere through a coordinated and integrated approach on national to global scales to deliver quality-assured global and regional products and services. GCW organizes analyses and assessments of the cryosphere to support science, decision-making and environmental policy.	PRISMARCTYC was selected as part of the Belmont Forum’s call “Towards Sustainability of Soils and Groundwater for Society (Soils 2020)”. The PRISMARCTYC consortium gathers together scientists of various scientific disciplines, expertise, gender and nationality. The strength is the multidisciplinary and complementary approach to study the impacts of permafrost degradation in the Arctic. The project aims to understand the hydrological, geochemical, geomorphological, microbiological, and socio-economic impacts of permafrost thaw to soils and surface/groundwaters in the Arctic and Subarctic, and their sustainability in the changing climate. The study will focus on the near-surface permafrost-hydro system continuum in small watersheds where localized and rapid thermokarst occurrences remain under studied.

Organization	Northumbria University	Hamlet of Tuktoyaktuk	PYRN (Permafrost Young Researchers Network)	APECS (Association of Polar Early Career Scientists)	ArcticNet
Website	https://www.northumbria.ac.uk/	https://www.tuktoyaktuk.ca/	https://pym.arcticportal.org/	https://www.apecs.is/	https://arcticnet.ulaval.ca
Logo					
Type of organization	University-based	Northern community	Association	Association	Research network
Dates in operation	1992 – present	since ancient times	2005 – present	2007 – present	2003 – present
Description	<p>Northumbria University's Department of Geography and Environmental Sciences and Department of Mechanical and Construction Engineering are involved in research on cold and paleo environments. Engineering research includes investigating the mechanisms that operate in coastal environments and how they interact to shape landforms, habitats and coastal communities in a wide range of environments, from Alpine slopes to the rocky coasts of Svalbard and permafrost thaw complexes in Canada. The Department of Geography and Environmental Sciences' Cold and Paleo Environment group carries out research and field-based projects around the globe. The team investigate both modern and ancient environments from the tropics to the polar regions, under the main research themes of ice and snow permafrost; and past climate and environment. Research involves field-based projects in cold regions across the globe, including Antarctica, a range of high Arctic, European and Canadian sites, New Zealand, the Alps, Alaska and Chile.</p>	<p>Tuktoyaktuk/Tuk-tu-yaq-tuuq or short version "Tuk" (Inuvialuktun: resembling a caribou), is an Inuvialuit Hamlet of about 965 people which is located on the shores of the Arctic Ocean at the tip of the Northwest Territories. Inuvialuit have lived here since ancient times, thousands were scattered along the coast from Herschel Island to Cape Bathurst. Formerly known as Port Brabant, the community was renamed in 1950 and was the first place in Canada to revert to the traditional Native name. Today Tuktoyaktuk is a major Inuvialuit community in the Inuvialuit claim area. Residents of Tuktoyaktuk still hunt for food, often traveling on the land to traditional hunting or fishing spots for harvesting purposes.</p>	<p>The Permafrost Young Researchers Network (PYRN) is an international organization established under the patronage of the IPA fostering innovative collaboration, seeking to recruit, retain and promote future generations of permafrost researchers. Initiated during the 4th International Polar Year, PYRN was officially founded in November 2005 at the International Conference on Arctic Planning (ICARPII) and has grown to reach 1196 permafrost researchers and educators. PYRN directs the multi-disciplinary talents of its membership toward global awareness, knowledge, and response to permafrost-related challenges in a changing climate. PYRN is now developing innovative activities based on the needs of its members and tries to open new paths. To do so, it has multiplied actions aimed at building up the community (workshops, meetings, etc.) and will now aim at improving the curricula vitae of its members by furthering transdisciplinary activities.</p>	<p>The Association of Polar Early Career Scientists (APECS) is an international and interdisciplinary organization for undergraduate and graduate students, postdoctoral researchers, early career faculty members, early career professionals, educators and others with interests in Polar and Alpine regions and the wider cryosphere. APECS grew out of the 4th International Polar Year (IPY-4) 2007-2008.</p>	<p>ArcticNet is a Network of Centres of Excellence of Canada that brings together more than 230 Arctic researchers, engineers and managers studying human health, natural and social sciences in the Arctic. With partners from Inuit organizations, northern communities, 35 Canadian universities, eight federal and 11 provincial government agencies, ArcticNet works collaboratively with international research teams to study the impacts of rapid climate, environmental and socio-economic change.</p>

APPENDIX 5: Mural discussion notes



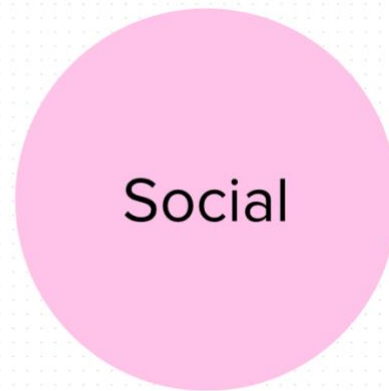
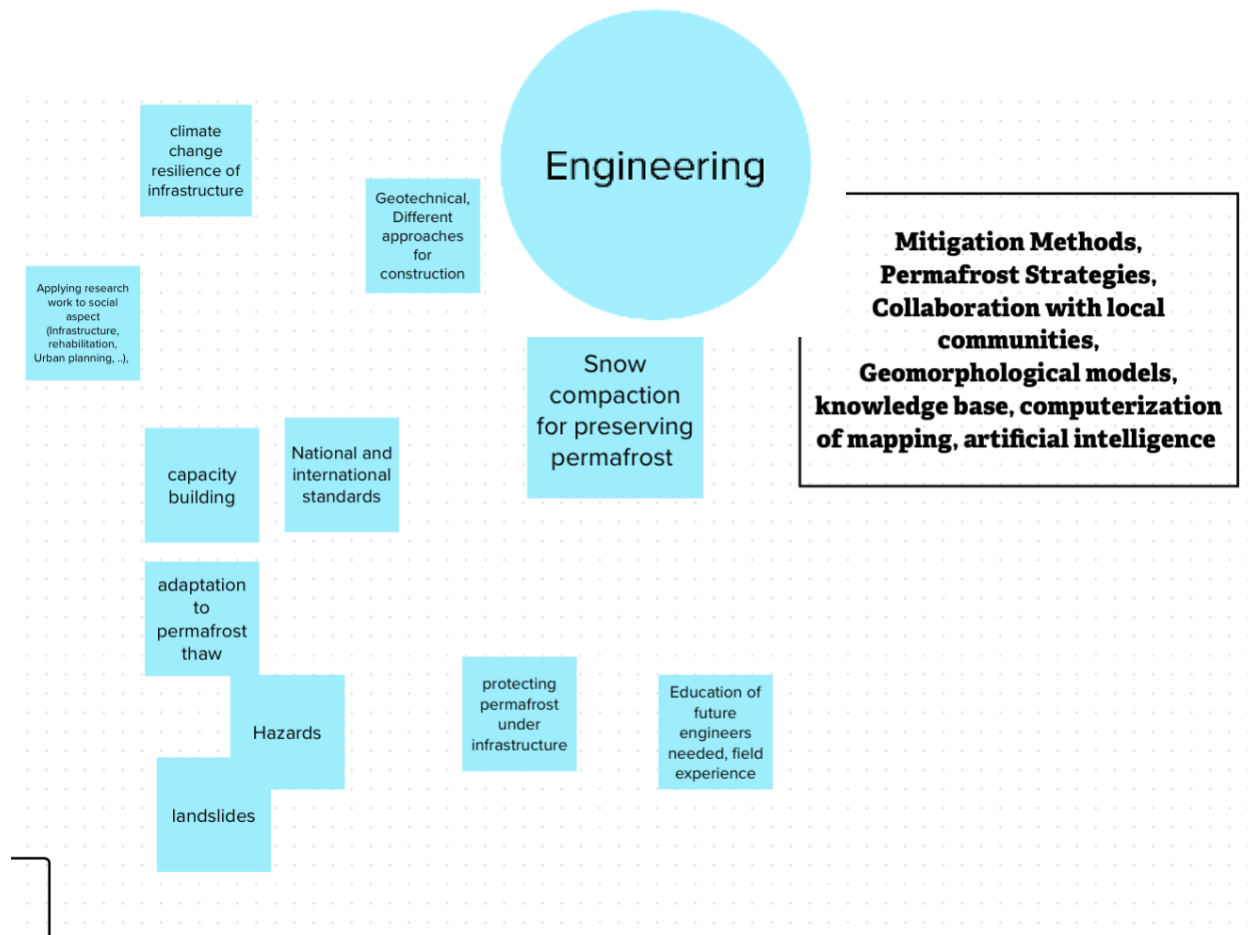


Figure 1: Mural feedback from breakout groups. Participants were asked to identify scientific, engineering and social research questions related to permafrost.



Ideas for standardizing data?

Standardized, publicly available tools for data cleaning

'Data Cubes' for standardizing data and allowing it to be easily partitioned.

Taking cues from the meteorological and oceanographic communities to create standards for data cleaning, gathering, and sharing

Build a community as a first step

Using the same classification systems or documented such that they can be connected

Permafrost sites are usually not representative of the entire landscape (e.g., we want to core in ice wedges rather than in bedrock)

Choose sites that are useful for different groups

Pick sites that are representative

Determine the metadata and standards necessary for as many people as possible.

Pick sites that are useful for many groups/people. E.g., close to existing studies and/or weather stations.



Useful tools for data sharing

Hopes for
datasharing to
evolve into
sharing of models,
algorithms, etc.

Data sharing works
best when members
from different groups
are all communicating.
Which is why days like
today are so
important!

Teaspoon: a python library for ground temperature data

contributions are welcome and encouraged
<https://permafrostnet.gitlab.io/teaspoon/source/about.html>
<https://gitlab.com/permafrostnet/teaspoon>
<https://doi.org/10.21105/joss.04704>

GEE

Creating larger,
international
storage places
of data and
communicating
their existence

ArcGIS
storymaps for
interactive result
sharing with
community
partners

Duane
Froese's
permafrost
core library

Must make
standards
easy to follow,
otherwise they
won't be used.



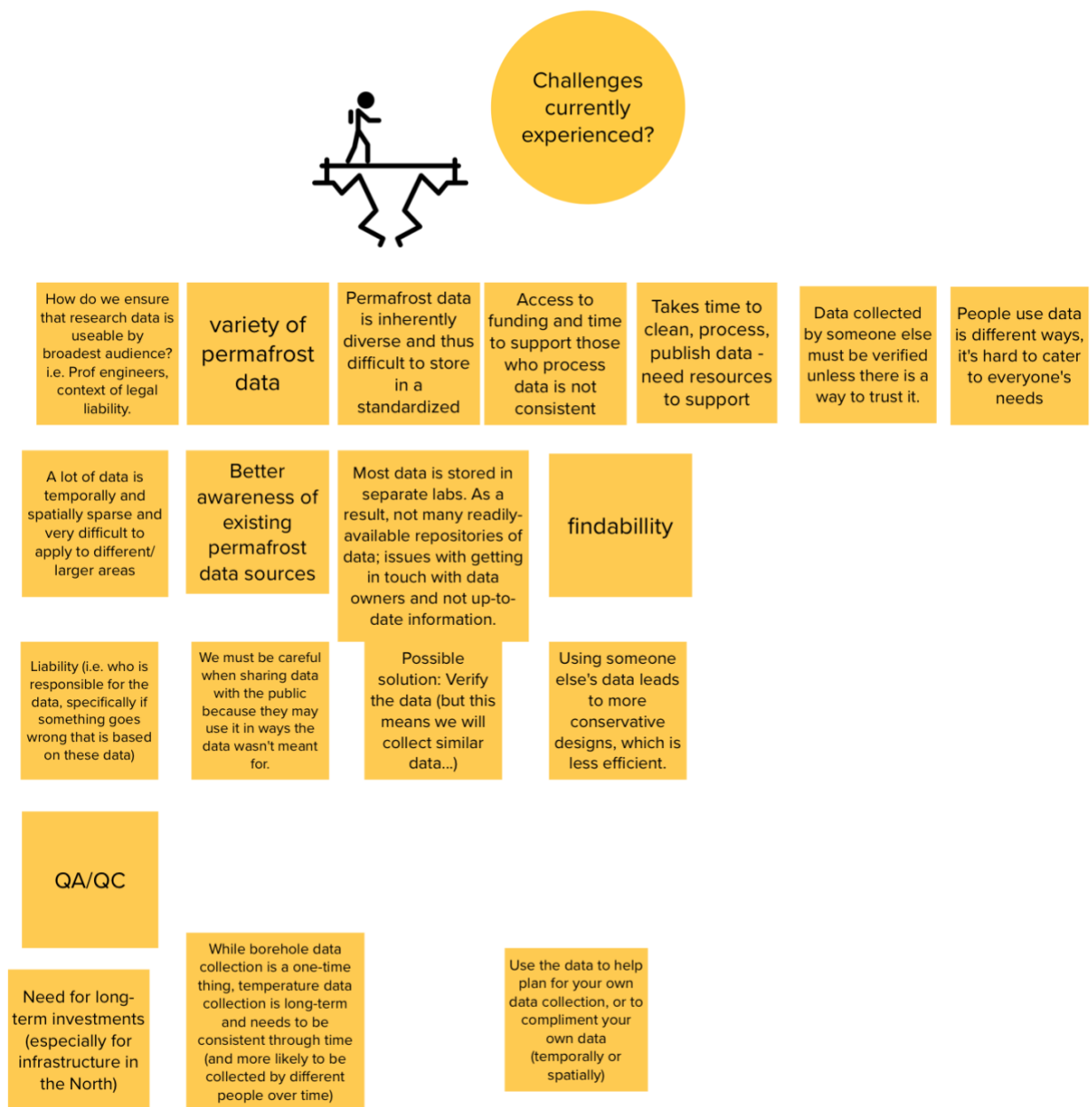


Figure 2: Challenges, solutions, and opportunities in permafrost data that were identified by workshop participants. Items have been grouped into three major themes.



Figure 3: Mural feedback from breakout groups. Participants were asked what future shared infrastructure is required by the permafrost community.

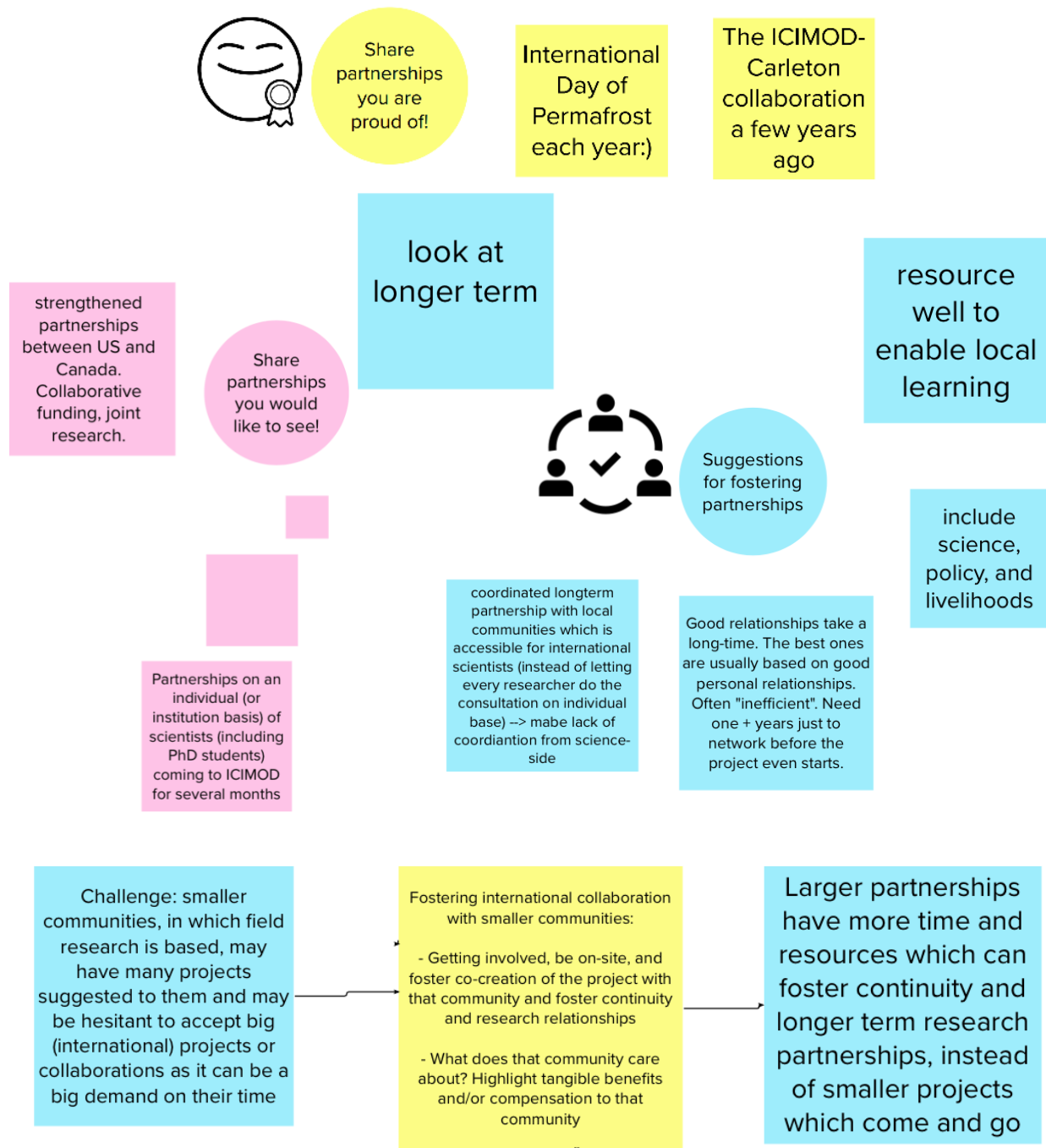


Figure 4: Mural feedback from breakout groups. Participants were asked What new long-term international partnerships do we need and how do we build them.

Canadian national adaption strategy connecting research from different fields

What is the international community gaining from Canadian research?

relationships with Indigenous people

long history of exposure to permafrost, need to build infrastructure on permafrost, lots of solutions

prioritize capacity building in the North first; learnings from international community?

communications with other people, even with different timezones

What more could Canada do/contribute?

Canadian researchers and institutes need to first develop better partnerships with local communities. Good partnerships take many years or decades to form and it may be difficult to look at outside (international) partnerships while this is taking place.

make permafrost data available to other researchers from outside Canada (ex. PermafrostNet)

Sharing and discussing research priorities

organizations dedicated to coordinating international research

Make it easier for researchers to come to Canada from abroad

Canada can look to international communities for examples of how to connect and form lasting partnerships with local communities.

collaboration should include broad, long term commitments, not just individual projects

Highlight the various permafrost related standards Canada has

International challenge: Maintaining coordination and access with Russian researchers

build easier contact points in Canada

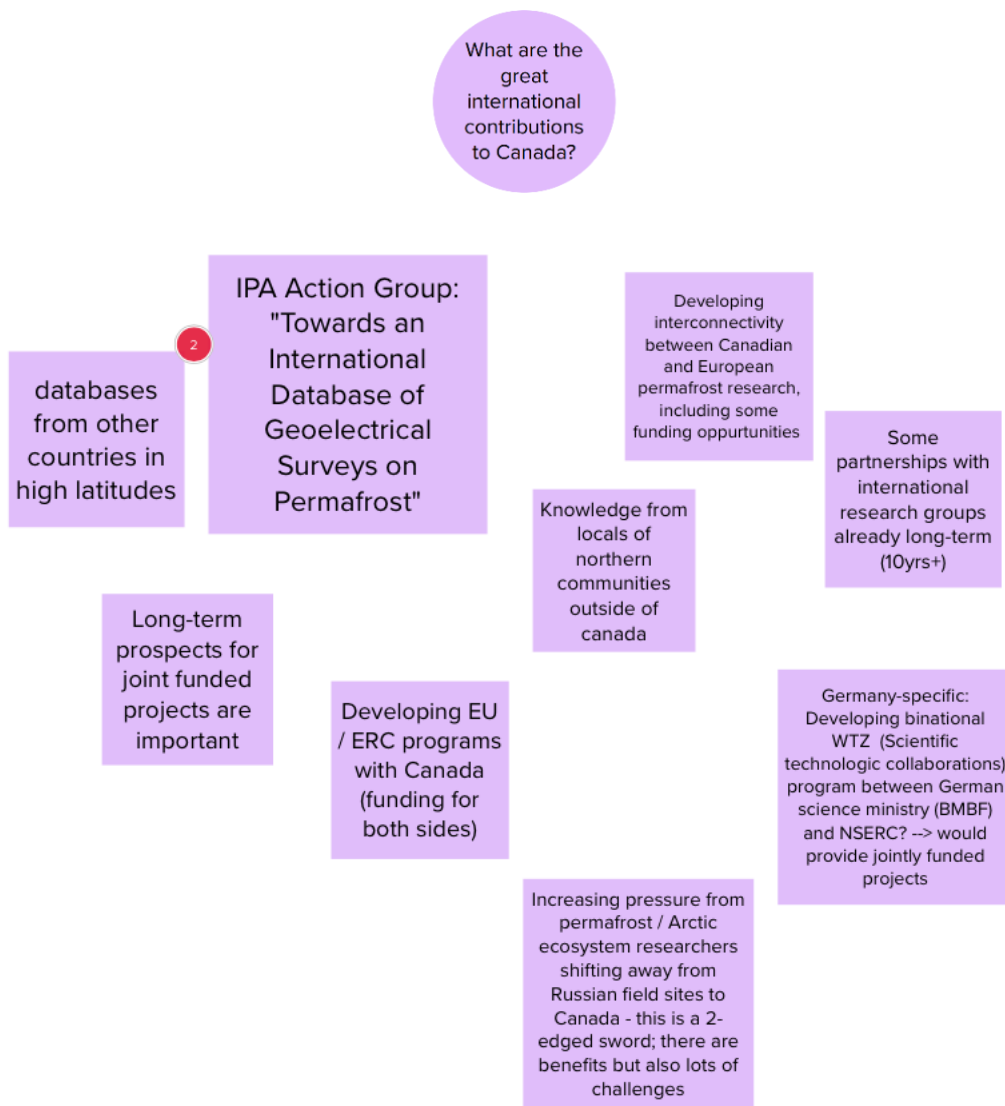


Figure 5: Mural feedback from breakout groups. Participants were asked What is needed from Canada to make international research initiatives more successful and what are international researchers contributing to Canada.



Ideas to communicate thawing permafrost and related issues

Giving the voice to the right people

Knowing the audience and knowing who we are communicating with (different audience, different voice, ways of communication)

Educating youth, kids

Educating youth, kids

Connect with media outlets, influencers, celebrities to create public awareness

work with young people
create awareness and inspire action

teach science communication skills to those interested in raising awareness

interactive and engaging materials like documentaries, podcasts, infographics

Social media targeting next generations (TikTok)

Information sessions with children

experiments

Communicating effectively with indigenous people and being aware that their interests can be different from our research objectives
Listening to indigenous communities/ communicating research results with them in their traditional way of knowledge sharing, like story telling

Organizations well-placed to coordinate

- Promote community driven data collection
- Build good relationships between community people & researchers
- Help youth community members to join research groups- Work out conflict with a positive approach

Figure 6: Mural feedback from breakout groups. Participants were asked How can we leverage the many initiatives around the world and raise awareness of permafrost issues.