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1 **The Permafrost Young Researchers Network (PYRN) is getting**
2 **older – the past, present, and future of our evolving community**

3 George Tanski^{1,2,3,*}, Helena Bergstedt⁴, Alexandre Bevington⁵, Philip Bonnaventure⁶, Frédéric
4 Bouchard⁷, Caroline Coch^{1,3}, Simon Dumais⁸, Alevtina Evgrafova^{9,10}, Oliver W. Frauenfeld¹¹,
5 Jennifer Frederick¹², Michael Fritz¹, Denis Frolov¹³, Silvie Harder¹⁴, Ingo Hartmeyer¹⁵, Joanne
6 Heslop^{16,17}, Elin Högström^{18,19}, Margareta Johansson²⁰, Gleb Kraev²¹, Elena Kuznetsova²²,
7 Josefine Lenz^{1,23}, Alexey Lupachev²¹, Florence Magnin²⁴, Jannik Martens^{25,26}, Alexey
8 Maslakov¹³, Anne Morgenstern¹, Alexandre Nieuwendam²⁷, Marc Oliva²⁸, Boris
9 Radosavljevic²⁹, Justine Ramage^{1,3}, Andrea Schneider³⁰, Julia Stanilovskaya³¹, Jens Strauss¹,
10 Erin Trochim³², Daniel Vecellio³³, Samuel Weber³⁴, Hugues Lantuit^{1,3}

11 *Corresponding author: George Tanski (George.Tanski@awi.de)

12 ¹ Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Periglacial
13 Research Unit, Telegrafenberg A43, Potsdam, Germany.

14 ² GFZ German Research Centre for Geosciences, Helmholtz Centre Potsdam, Section 1.4:
15 Remote Sensing, Telegrafenberg, Potsdam, Germany.

16 ³ Potsdam University, Institute of Earth and Environmental Sciences, Karl-Liebknecht-Str. 24/25,
17 14476 Potsdam, Germany.

18 ⁴ University Salzburg, Interfaculty Department of Geoinformatics - Z_GIS, Schillerstr. 30, 5020
19 Salzburg, Austria.

20 ⁵ Ministry of Forests, Lands, Natural Resource Operations and Rural Development, Government
21 of British Columbia, 499 George Street, Prince George, British Columbia V2L 1R5, Canada.

22 ⁶ Geography Department, University of Lethbridge, 4401 University Drive, Lethbridge, Alberta
23 T1K 3M4, Canada.

24 ⁷ Centre Eau Terre Environnement, Institut national de la recherche scientifique (INRS-ETE),
25 490 rue de la Couronne, Québec G1K 9A9, Canada.

26 ⁸ Université Laval, Department of civil and water engineering, 1065 av. de la Médecine, G1V
27 0A6 Québec, Canada.

28 ⁹ Geography Institution, University of Bern, Hallerstrasse 12, 3012 Bern, Switzerland.

29 ¹⁰ Geography Department, University of Koblenz-Landau, Universitätsstr. 1, 56070 Koblenz,
30 Germany.

31 ¹¹ Texas A&M University, Department of Geography, MS 3147 College Station, TX 77843,
32 USA.

33 ¹² Sandia National Laboratories, Applied Systems Analysis and Research, 1515 Eubank Blvd SE,
34 Albuquerque, NM 87123, USA.

35 ¹³ Lomonosov Moscow State University, Department of Geography, GSP-1 Leninskie gory,
36 119991 Moscow, Russia.

37 ¹⁴ Department of Geography, McGill University, 805 Sherbrooke Street West, Montréal, Québec
38 H3A 0B9, Canada.

39 ¹⁵ GEORESEARCH, Hölzlstraße 5, 5071 Wals, Austria.

40 ¹⁶ Water and Environmental Research Center, University of Alaska, 760 Tanana Loop, 75 5860
41 Fairbanks, AK 99775-5860, USA.

42 ¹⁷ Department of Geography and Planning, Queen's University, 68 University Ave, Kingston,
43 Ontario K7L 3N9, Canada.

44 ¹⁸ Vienna University of Technology (TUW), Department of Geodesy and Geoinformation
45 (GEO), Gußhausstraße 27-29, 1040 Vienna, Austria

46 ¹⁹ Austrian Polar Research Institute (APRI) c/o Universität Wien, Universitätsstraße 7, 1010
47 Vienna, Austria.

48 ²⁰ Department of Physical Geography and Ecosystem Science, Lund University, 22100 Lund,
49 Sweden.

50 ²¹ Russian Academy of Sciences, Institute of Physico-Chemical and Biological Problems in Soil
51 Science, Institutskaya st. 2, 142290 Pushchino, Russia.

52 ²² Norwegian University of Science and Technology, Department of Civil and Environmental
53 Engineering, Høgskoleringen 7a, 7491 Trondheim, Norway.

54 ²³ Institute of Northern Engineering, University of Alaska Fairbanks, 1760 Tanana Loop,
55 Fairbanks 99775-5910, USA.

56 ²⁴ Department of Geosciences, University of Oslo, 1047 Blindern, 0316 Oslo, Norway.

57 ²⁵ Stockholm University, Department of Environmental Science and Analytical Chemistry
58 (ACES), Svante Arrhenius väg 8, 11418 Stockholm, Sweden

59 ²⁶ Bolin Centre for Climate Research, Svante Arrhenius väg 8, 11418 Stockholm, Sweden.

60 ²⁷ Centre of Geographical Studies – IGOT, Universidade de Lisboa, R. Branca Edmée Marques,
61 1600-276 Lisboa, Portugal.

62 ²⁸ University of Barcelona, Department of Geography, Montalegre 6-8, 08001- Barcelona,
63 Catalonia.

64 ²⁹ GFZ German Research Centre for Geosciences, Helmholtz Centre Potsdam, Library and
65 Information Services, Potsdam, Germany.

66 ³⁰ Centre for Arctic Gas Hydrate, Environment and Climate, UiT The Arctic University of
67 Norway, Dramsvegen 201, 9019 Tromsø, Norway.

68 ³¹ Sergeev Institute of Environmental Geoscience, Permafrost laboratory, Ulansky per. 13-2,
69 101000 Moscow, Russia.

70 ³² Alaska Climate Adaption Science Center, University of Alaska, 2160 Koyukuk Drive,
71 Fairbanks, AK 99775-7340, USA.

72 ³³ Climate Science Lab, Department of Geography, Texas A&M University, 810 Eller, 3147
73 TAMU College Station, TX 77843, USA.

74 ³⁴ Department of Geography, University of Zurich, Winterthurerstrasse 190, 8057 Zurich,
75 Switzerland.

76

77 **Abstract**

78 One of the lasting legacies of the International Polar Year (IPY) 2007-2008 was the formation of
79 the Permafrost Young Researchers Network (PYRN), initially an IPY outreach and education
80 activity by the International Permafrost Association (IPA). With the momentum of IPY, PYRN
81 developed into a thriving network that still connects young permafrost scientists, engineers, and
82 researchers from other disciplines. This research note summarizes (i) the development of PYRN
83 since 2005 and the role of IPY, (ii) the results of the first PYRN census and survey in 2015, and
84 (iii) PYRN's resulting future plans to improve international and interdisciplinary exchange
85 between young researchers. The review concludes that PYRN is an established network within
86 the polar research community that has continually expanded and developed since 2005. PYRN's
87 successful activities led by enthusiastic "early-career" scientists were largely fostered by IPY and
88 its outreach efforts. PYRN and its alumni today continue to bring together and promote the next
89 generation of young researchers. With more than 200 of the 1,200 registered members active and
90 engaged, PYRN is capitalizing on the availability of social media tools, and increasing
91 environmental challenges to maintain its role as self-organized, visible, and successful network
92 in the legacy of IPY.

93 **1. Introduction**

94 The imminence of the International Polar Year (IPY) prompted the need for visible
95 representation of the young permafrost community (Krupnik et al., 2011). From the onset, the
96 IPY emphasized the development of 'the next generation of polar scientists'. This translated into
97 a record involvement of young scientists in IPY projects. A rough estimation by IPY organizers
98 showed that the entire IPY endeavor involved a greater number of young researchers than

99 ‘senior’ ones (Baeseman et al., 2011). In anticipation of the IPY, the Permafrost Young
100 Researchers Network (PYRN) was established in November 2005 at the 2nd International
101 Conference on Arctic Research Planning as an IPY education and outreach activity of the
102 International Permafrost Association (IPA) and to represent permafrost young researchers within
103 the Youth Steering Committee of the IPY. At the time, the Youth Steering Committee was the
104 overarching program for youth and “early-career” activities in the IPY framework. PYRN was
105 focused on young permafrost researchers (i.e., scientists and engineers), but was integrated into
106 the overall IPY “early-career” networking effort from the beginning.

107 PYRN is an “early-career” network that fosters innovative collaboration and seeks to recruit,
108 retain, and promote future generations of permafrost researchers. From the beginning, PYRN
109 disseminated permafrost science and engineering information to the public and especially to
110 schools. Since PYRN’s initiation in 2005, its membership, visibility, and activities steadily
111 increased to 1,200 members at the time of its 10th anniversary in 2015. PYRN reports regularly
112 to the IPA, its members and interested researchers on a regular basis at geoscientific conferences,
113 through a news bulletin, website (<https://pyrn.arcticportal.org/>), and social media (e.g.,
114 Facebook, Instagram).

115 The strength of PYRN is based on its interdisciplinarity and its presence in virtually all regions
116 of the world. PYRN members are interested in the frozen ground regions of the Earth, including
117 alpine, submarine and polar latitudes. In the Northern Hemisphere alone, 23 million km² of the
118 landmass is characterized by permafrost occurrence (Romanovsky et al., 2010; Zhang et al.,
119 2008); a vast region with an area almost twice the size of Antarctica. This large area is impacted
120 by climate change, which fundamentally affects environmental and socio-economic systems
121 (Hope & Schaefer, 2016; IPCC, 2013). With its global presence, PYRN has the ability to

122 mobilize its members beyond borders and disciplines to tackle these issues in a progressive and
123 innovative manner.

124 PYRN represents permafrost science and engineering within broader international and regional
125 young researcher assemblies, such as the Association of Polar Early Career Scientists (APECS).
126 Both networks were developed during IPY and have a memorandum of understanding to
127 coordinate efforts. Further strong bonds exist with the Arctic Portal, which hosts PYRN's
128 website and database, the ArcticNet Student Association, the United States Permafrost
129 Association, Polar Educators International, Climate and Cryosphere, the Global Terrestrial
130 Network for Permafrost, the working group 'Permafrost' of the *Deutsche Gesellschaft für*
131 *Polarforschung*, the Bolin Centre for Climate Research, and various large research projects such
132 as the Horizon 2020 project Nunataryuk.

133 The main aim of this research note is to illustrate that the momentum of IPY has promoted and
134 sustained this young researcher network for a decade, which in turn facilitates intercultural and
135 interdisciplinary exchange, reflecting the original charge of IPY. More specifically, the
136 objectives are (i) to review the development of PYRN since IPY, (ii) to present the first
137 membership survey conducted since the IPY, and (iii) to set a vision for PYRN as crucial part of
138 the polar research community.

139 **2. The development of PYRN**

140 PYRN has continuously evolved since its establishment at the 2nd International Conference on
141 Arctic Research Planning 2005 and IPY 2007-2008. At its 1st anniversary in 2006, it already had
142 250 members from 20 countries (Lantuit, 2006). During IPY, registrations rapidly increased,
143 with 620 members by the end of IPY in 2008 (Lantuit, 2007). PYRN largely benefited from the

144 momentum of IPY with its members expanding to 1,200 at its 10th anniversary in 2015 (Tanski et
145 al., 2015). Since 2005 there have been seven executive committees with each coordinating
146 PYRN for two years, except of the initial committee that governed the network from 2005-2009.
147 In the following section, the evolution of PYRN and its main activities are summarized and its
148 milestones synthesized in Table 1. All major activities and events since 2005 are listed in the
149 Supporting material Table S1.

150 **2.1 PYRN activities from 2005 to 2010**

151 After the launch at the 2nd International Conference on Arctic Research Planning in 2005, PYRN
152 focused on developing the network. It organized its internal structure consisting of an executive
153 committee and national representatives. It also established an online presence, a monthly
154 newsletter, a thesis bibliography (Grosse & Lantuit, 2006), and an annual PYRN award for
155 permafrost conferences. During PYRN's kick-off meeting in Abisko, Sweden (February 2007),
156 the first PYRN mandate was drafted, progress of ongoing initiatives was reviewed, and future
157 activities were planned (Fig. S1). PYRN's first meeting during IPY was the 2nd national
158 representatives meeting at the Otto Schmidt Laboratory in St. Petersburg, Russia
159 (November/December 2007). The meeting set the stage for numerous 'IPA-IPY-PYRN'
160 activities that took place until 2009 (Lantuit, 2007), with one of the major initiatives being the
161 PYRN Thermal State of Permafrost project (Christiansen et al., 2007) and the establishment of
162 PYRN Thermal State of Permafrost boreholes in Scandinavia (Christiansen et al., 2010).
163 PYRN's IPY activities were endorsed and supported from the beginning by both IPY and IPA
164 (Baeseman et al., 2011), with PYRN officially representing the IPA during the IPY opening in
165 Paris, France (March 2007) (Lantuit, 2007). In addition to PYRN's IPY activities, new efforts

166 were initiated such as the creation of a list of senior scientist mentors (Bonnaventure et al.,
167 2009), as well as the organization of young researcher activities at the 9th International
168 Conference on Permafrost (NICOP 2008) in Fairbanks, Alaska (June/July 2008).

169 **2.2 PYRN activities from 2010 to 2012**

170 The period from 2010 to 2012 was characterized by a refocusing of the PYRN mission and
171 objectives and an internal restructuring process, following on the initial successful IPY years.
172 This meant adapting the network to create the conditions of sustainability and move on from the
173 “one-off” momentum provided by the IPY. Early in 2011, PYRN identified its major priorities,
174 which included an update of the PYRN bylaws, organizing a young researchers’ workshop at the
175 10th International Conference on Permafrost (TICOP 2010) in Salekhard, Russia (June 2012),
176 and strengthening its ties with IPA and APECS. A major event was the PYRN workshop at
177 TICOP 2010, which kicked-off the tradition of holding workshops before major biennial
178 gatherings of young permafrost scientists. It also acted as the new transition point for the
179 incoming executive committee to meet in person and identify their priorities for the coming two-
180 year term. Emphasis was placed on creating a more inclusive and team orientated approach to
181 governing the PYRN network and the new executive committee had triple the number of
182 members as the departing one. The large gathering of PYRN and polar researchers at TICOP was
183 leveraged to support the implementation of a memorandum of understanding between PYRN and
184 its official host IPA and APECS. The memorandum of understanding clearly established PYRN
185 as the primary organization for the coordination of permafrost young researchers for committees
186 and events surrounding IPA and APECS activities.

187 **2.3 PYRN activities from 2012 to 2014**

188 In 2012 PYRN's activities intensified. This invigoration was fostered by the new motivation and
189 energy gained from the activities at 10th International Conference on Permafrost (TICOP 2010),
190 executing the memorandum of understanding with APECS that fostered and multiplied
191 information exchange, and the forthcoming 4th European Conference on Permafrost (EUCOP4
192 2014) in Évora, Portugal (June 2014). The executive period 2012-2014 culminated in the
193 Permafrost Young Researchers Workshop at EUCOP4, co-organized with APECS, Changing
194 Permafrost in the Arctic and its Global Effects in the 21st Century, and Arctic Development and
195 Adaptation to Permafrost in Transition. Aside from bringing young researchers together, the
196 workshop aimed at determining future avenues of permafrost research from a young researcher's
197 perspective. This part of the workshop was mentored by the International Arctic Science
198 Committee, which was leading the implementation towards the 3rd International Conference on
199 Arctic Research Planning in 2015. A major outcome of the workshop was a strategy paper about
200 future avenues for permafrost science from the perspective of "early-career" researchers led by
201 PYRN members (Fritz et al., 2015). This strategy paper has been formulated in collaboration
202 with the IPA as a contribution to the 3rd International Conference on Arctic Research Planning
203 2015.

204 **2.4 PYRN activities from 2014 to 2016**

205 The 2014-2016 period was characterized by a professionalization of the network. A 4-year
206 agenda and long-term strategy were developed to enhance the network's visibility, transparency,
207 and cooperation with IPA. In turn, the IPA granted PYRN an annual and independent budget to
208 support its activities and achieve its long-term objectives. Various strategic initiatives were

209 achieved, including a major update of the member list because there had been no mechanisms to
210 ‘remove’ young researchers that became ‘senior’. This membership overhaul uncovered that east
211 Asian colleagues were strongly underrepresented within PYRN. To tackle this issue, outreach
212 activities were specifically designed to better engage permafrost research institutes in Korea,
213 Japan, and China, and the network advertised at the Arctic Science Summit Week in Toyama,
214 Japan (April 2015).

215 PYRN also improved its overall online outreach by better utilizing its website and social
216 networks, in particular its Facebook following, which rose from almost zero in June 2014 to
217 more than 600 in June 2016. Furthermore, PYRN expanded its partners by establishing an
218 information exchange program with the Global Terrestrial Network for Permafrost. The
219 executive term ended and a new executive committee was introduced (see Supporting material
220 Fig. S2) at the 11th International Conference on Permafrost (ICOP 2016) in Potsdam, Germany
221 (June 2016; Fig. S2). During ICOP 2016 PYRN organized a 2-day young researcher workshop as
222 well as a soccer tournament. ICOP 2016 has been the largest gathering of PYRN members so far
223 (see Supporting material Fig. S3).

224 **2.5 PYRN activities from 2016 to 2018**

225 Following the great success of the 11th International Conference on Permafrost and with the
226 increasing importance of young researchers within the research community, recent activities
227 have focused on strengthening the national representation of PYRN, establishing an improved
228 presence on social media as well as preparing the PYRN workshop at the 5th European
229 Conference on Permafrost (EUCOP5 2018) in Chamonix, France (June/July 2018). The
230 Facebook following further increased during this period to more than 800 people. Many

231 workshops, events, and meetings were convened thanks to the continuous efforts of the executive
232 committee and national representatives (see Supporting Table S1). To better promote the
233 participation of PYRN members on a national scale, a coordinator position of the national
234 representatives was created and national representatives are encouraged to apply for funding and
235 to organize local, national, and regional events. To strengthen the social media presence, the
236 PYRN Facebook page (facebook.com/PYRNofficial), Twitter (@pyrn_official) and Instagram
237 (@pyrn_official) were improved. A major improvement was the update and launch of the fully
238 redesigned PYRN website. The increased social media and web presence throughout 2016-2018
239 helped to strengthen PYRN's role as a key promoter of international collaboration in permafrost
240 research. In addition to these media improvements and to better engage our members and
241 society, a major outreach and educational effort was devised – the 'Frozen-Ground Cartoons'
242 project (see Bouchard et al., this special issue). This project was officially launched in early 2016
243 as an IPA-funded Action Group, and later received financial support from many organizations,
244 including PYRN. Most of the contributors to the project are indeed PYRN (and APECS)
245 members. This international and interdisciplinary scientific outreach initiative aims at making
246 permafrost science accessible and fun for children, youth, their parents, and teachers through the
247 creation of cartoons and illustrated products (Nääs et al., 2017).

248

249 **3. PYRN's structure and the first census in 2015**

250 **3.1 PYRN's international structure**

251 Since being founded in 2005, PYRN has undergone many changes in its executive structure to
252 become more dynamic and to more rapidly adapt to the evolving needs of its members. Whereas
253 the first executive committees (2005 until 2012) consisted of only two to three members that had
254 multifold tasks, the executive committees since 2012 consisted of 12 members that had more
255 specified tasks. Currently PYRN is led by an executive committee, supported by a Council and
256 several national representatives (Fig. 1). The executive committee directs PYRN's activities and
257 consists of 12 positions, including president, vice-president, secretary, newsletter-editor,
258 treasurer, web manager, representative for regional and international permafrost conferences, and
259 ordinary members. The Council is an advisory panel responsible for providing feedback from
260 PYRN members to the executive committee. National representatives are regular PYRN
261 members representing a specific country and are part of the Council. PYRN has implemented a
262 Constitution and Bylaws in 2012 to structure and organize itself, which have been first
263 formulated in 2007 and reviewed with every new executive period since the IPY. PYRN also
264 hosts independently operating national branches with the most active ones being PYRN Russia,
265 PYRN D-A-CH (Germany, Austria and Switzerland), and PYRN NA (North America, i.e., USA
266 and Canada).

267 **3.2 PYRN's regional branches**

268 PYRN Russia is the oldest branch within PYRN. PYRN Russia's goal is to improve the
269 qualifications of young permafrost researchers in Russia (Kraev et al., 2013). The network

270 maintains an independent web portal (http://vk.com/pyrn_russia) for Russian-speaking
271 researchers and engineers, raises funding, and provides solutions to overcome language-barrier
272 problems. PYRN D-A-CH is a conglomerate of German-speaking countries and is the successor
273 of PYRN Germany that existed until 2013. PYRN D-A-CH's main aim is to bring the polar and
274 the alpine permafrost community closer together. It has gathered annually since 2009, at the
275 meetings of the 'Permafrost' working group of the *Deutsche Gesellschaft für Polarforschung* –
276 German Polar Society. PYRN North America (PYRN NA) is the latest established branch and
277 was launched simultaneously in Canada (at Arctic Change 2017) and the USA (at AGU 2017).
278 Its main objective is to improve networking of young permafrost researchers based in Canada
279 and the US, which was lacking so far.

280 **3.3 PYRN census and member survey**

281 The PYRN constitution and bylaws state that *'a young researcher is defined as early in their*
282 *career and is any individual currently enrolled as a post-secondary student or having completed*
283 *their most recent post-secondary degree within the last six years'*
284 (<https://pyrn.arcticportal.org/about-us/constitution-bylaws>). Since the establishment of PYRN,
285 memberships cumulated without formerly young 'seniors' members bailing out. Thus, the first
286 membership survey (in English) since PYRN's establishment was carried out. The purpose of the
287 census was to review the PYRN membership and to improve the performance and networking
288 capabilities of PYRN. The objectives were to obtain a better sense of how many PYRN members
289 are currently active (i.e, receiving information and responding), where they are located, and what
290 research topics they study. The census identified areas where PYRN has been successful, and
291 likewise areas that need improvement. In addition to disseminating it to its registered members, it

292 was sent through to various media channels (e.g., Cryolist and Facebook) to promote the network
293 and gain new members. The survey was conducted with support from the United States
294 Permafrost Association, and survey questions were revised through several internal and external
295 reviews and feedback from APECS and IPA.

296 In total, 200 members completed the survey (via Google online Forms) between June and
297 November 2015, of which 79 were female and 121 male, representing 26 countries across the
298 world (see Supporting material Fig. S4 and S5). The majority of participants was young (mean =
299 30 years old; Fig. 2). Most of the members were from the academic sector and had a master's
300 degree, followed by PhDs and undergraduates (Fig. 2). Of the 1,200 officially registered
301 members, we assume that a large portion does not meet the requirement of 'young researcher'
302 anymore, and another large portion is inactive. However, the survey gives a representative
303 sample of the active and enthusiastic PYRN members on which the network relies, and this
304 number roughly matches the ~280 young researchers that gathered at the 11th International
305 Conference on Permafrost (see Supporting material Fig. S3). In the survey, several questions
306 were asked about potential improvements to the network, which have been considered and
307 implemented in PYRN's plans and strategies for the future (see following section). A summary
308 of all questions can be found in Table S2 in the Supporting material.

309 **4. Future plans and visions in the legacy of IPY**

310 PYRN continuously improved its visibility, outreach, and impact during the years by constantly
311 exchanging with its own members and partners. The use of social media and Facebook in
312 particular improved the visibility of the network with more than 800 followers in 2018. The
313 PYRN membership survey helped to consolidate its own members and thus made the network

314 also more visible for its own members. This survey was part of a long-term strategy supported by
315 the IPA with a first independent annual budget in PYRN's history. This money, in return, was
316 used to support further outreach activities such as PYRN marketing for new members in general
317 and East Asian members in particular. Apart from that PYRN activities started to have a direct
318 impact on scientific decision making. With joint efforts of APECS and PYRN, which both had
319 one of its members as liaison on the other ones executive committee, it was possible to establish
320 PYRN members as session co-chairs at conferences and to develop its own priorities for the
321 future of permafrost research, which fed directly into research planning exercises such as the 3rd
322 International Conference on Arctic Research Planning (ICARP III, 2015).

323 The outcomes of the membership survey served as a guideline for PYRN's future developments.
324 The survey revealed that to PYRN members, information on funding as well as workshops and
325 meetings is most important. Less important are activities from social media, access to literature,
326 pictures and videos, or education and outreach. In the future PYRN is planning to establish
327 further branches such as PYRN Europe or PYRN Northern Europe (Scandinavia and
328 Fennoscandia) to facilitate efforts and promote regional gatherings, which was one of the
329 recommendations of the survey. As improved interactions with Asian members are an ongoing
330 priority, PYRN also seeks to capitalize on the upcoming 12th International Conference on
331 Permafrost in Lanzhou, China to establish a PYRN Asia or East Asia branch for its Asian
332 members (i.e., China, Japan, and South Korea). Recent PYRN activities during the Arctic
333 Science Summit Week 2015 in Toyama and the 2nd Asian conference on permafrost 2017 in
334 Sapporo, Japan certainly reiterated the interest for an Asian regional branch.

335 One of the main legacies of PYRN is the creation of a community of practice, a strong
336 networked group of individuals committed to permafrost research who remain connected to
337 PYRN and its activities after their departure from the organization. This is visible through the
338 mentoring from former members taking place during workshops, through the informal
339 commenting and involvement in social media activities or through the involvement of many of
340 these individuals in large research projects. This community of practice has been very efficient at
341 articulating a strong vision for permafrost research (Fritz et al., 2015) and at proposing future
342 avenues for collaboration between early career and senior scientists. Ultimately, a PYRN Alumni
343 network would give a forum for PYRN members from all generations, many of whom connected
344 as ‘young’ researchers during the IPY 2007-2009. However, this project remains in its infancy.

345 In response to the survey results, PYRN will enhance its online media presence through various
346 channels (e.g., YouTube, Instagram, Facebook) that have been under development since 2014.
347 Although PYRN members indicated that social media is not necessarily a development priority
348 for PYRN and that the dissemination of information on funding and positions should be the
349 focus of the network, social media is nonetheless an effective mechanism to disseminate this
350 information, and offers opportunities to reach out beyond PYRN membership. It is clearly an
351 important tool for outreach to society and promotes permafrost as popular science. A good
352 example is the ‘Frozen-Ground Cartoons’ project (<https://frozengroundcartoon.com/home/>), led
353 by PYRN members.

354 **Conclusions**

355 This research note demonstrates that PYRN has successfully grown and evolved since its
356 establishment in 2005, and has become a strong and effective network within the polar research

357 community today. This development was catalyzed by the original IPY project, which helped its
358 membership grow and promoted exchange of PYRN and other polar research network members.
359 An important legacy of the IPY 2007-2009 is that it successfully united a young emerging
360 international community of researchers into PYRN, a network that promotes permafrost young
361 researchers in their “early-career” stages. PYRN today (data from 2015), as a self-governing
362 body supported by the IPA, relies on approximately 200 active members, which are mostly
363 responsible for the success of the network. Many of the first generation PYRN members that
364 became ‘senior’ researchers are still affiliated with PYRN and pass on the legacy of IPY to the
365 new young generation. In the future, PYRN will strive to maintain its role within the polar
366 research community. Regional PYRN branches will foster stronger and independent support of
367 young researchers ‘on site’. PYRN will promote the establishment of a PYRN Asia branch to
368 further thrive, and to complement its international diversity of members. Finally, new
369 technological developments and media tools will help PYRN improve its outreach and education
370 projects to promote the important role of permafrost that it deserves in the Earth system and for
371 society.

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448

449 **Tables**

450 **Table 1.** PYRN milestones since its establishment in 2005. PYRN assemblies mostly included
 451 workshops and awards (see Supporting material Table S1).

Milestone	Year
Establishment of PYRN at ICARP II in Copenhagen, Denmark	2005
1st anniversary with 250 registered members	2006
PYRN assembly at ACOP 2006 in Lanzhou, China	2006
PYRN officially represents the IPA at the IPY opening in Paris, France	2007
Kick-off meeting in Abisko, Sweden	2007
PYRN assembly at NICOP 2008 in Fairbanks, USA	2008
Establishment of PYRN TSP boreholes in Scandinavia	2009
5th anniversary with > 600 registered members	2010
PYRN assembly and workshop at TICOP 2012 in Salekhard, Russia	2012
MoU between PYRN, APECS, and the IPA	2012
PYRN assembly and workshop at EUCOP4 2014 in Évora, Portugal	2014
Permafrost research priorities from a young-researcher’s perspective report	2015
Long-term strategy submission and independent IPA budget	2015
10th anniversary with 1,200 registered members	2015
First PYRN census and membership survey	2015
PYRN assembly and workshop at ICOP 2016 in Potsdam, Germany	2016
Update and launch of new website	2016
PYRN assembly at ACOP 2017 in Sapporo, Japan	2017
PYRN assembly at EUCOP5 in Chamonix, France	2018

452

453 **Figure captions**

454 **Figure 1.** Organigram displaying the latest organizational structure of PYRN (2016 to 2018).

455 **Figure 2.** Bar-chart (A) showing the distribution of PYRN members by age and stacked bar-

456 chart (B) showing the distribution of PYRN members by work sector and highest degree

457 completed ($n = 200$). The charts only show PYRN members that participated in the online

458 survey.

459

PYRN Executive Committee

Simon Dumais President	Justine Ramage Anna Bobrik Vice-President	Joanne Heslop Secretary Alevtina Evgrafova NR-Coordinator	Caroline Coch Treasurer APECS	Denis Frolov Webmaster Helena Bergstedt Website	Florence Magnin EUCOP Alexey Maslakov Newsletter	Jannik Martens Mingyi Zhang Daniel Vecellio
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PYRN Council

Boris Radosavljević Chair Julia Stanilovskaya PEI	George Tanski Alexandre Bevington Elin Högström ExOfficios	Josefine Lenz Silvie Harder Andrea Schneider	Jens Strauss Elena Kuznetsova William Longo	Cayetana Recio Blitz Michel Paquette AECRA
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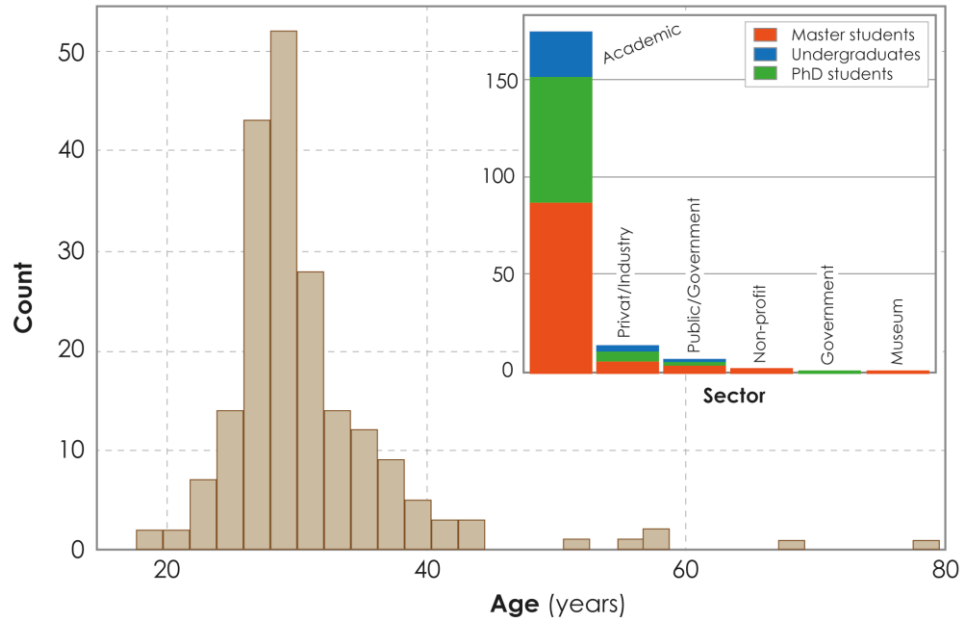


460

461

Figure 1

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463

464

Figure 2