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Frozen Ground

THE NEWS BULLETIN OF THE INTERNATIONAL PERMAFROST ASSOCIATION
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Words from the President

BY HANNE H. CHRISTIANSEN, THE UNIVERSITY CENTRE IN SVALBARD

2017 has been a very active year in the IPA, where we have again seen increasing regional permafrost activities reflecting that more scientists from natural, social, economic and health sciences and engineers are involved in permafrost research, education and outreach. Therefore, it is a natural development to see more IPA activity at the regional level, with conferences such as the Second Asian Conference on Permafrost (ACOP) held in 2017, which your Japanese colleagues report on in this issue. It was a true pleasure to experience the large efforts that the local organizers made with ACOP in Sapporo and with the field trips. The IPA will continue to encourage regional conferences so that we potentially will have such activity every year between the International Conferences on Permafrost.

The IPA is encouraging and supporting collaboration on various



It was a pleasure to join the Japanese – Norwegian CryoJaNo group that visited the volcano Mt. Meakan in Hokkaido during a pre-ACOP excursion led by Tatsuya Watanabe, Kitami Institute of Technology.

permafrost topics. In this issue you can read about five completed and near-completed Action Groups. Activities are continuing as the IPA is supporting three new Action Groups in 2018: ‘Rock glacier inven-

tories and kinematics’, ‘Towards a Permafrost Thaw Subsidence Product within the GTN-P database’ and ‘Permafrost Engineering in a Warming Climate – Current State and Future Strategy’.

The GTN-P released an updated 'Strategy and Implementation Plan 2016-2020' in November 2017, and the IPA supported the activities of the GTN-P extensively in 2017 to ensure the continuation of this permafrost thermal database (p. 14).

Permafrost mapping is becoming increasingly important. The IPA focuses on revising the existing Northern Hemisphere permafrost map and developing a first Southern Hemisphere permafrost map. This work goes on in close collaboration with the European Space Agency initiative DUE 'GlobPermafrost', which released new permafrost mapping products in 2017 (p.16).

I hope that all students interested in permafrost will join the Permafrost Young Researchers Network (PYRN), which, as you can read in this issue, is very active with several regional meetings and short courses. Well done, we certainly need the next generation of permafrost researchers to take leadership as well.

Reflecting the growing importance of permafrost and the need for collaboration on performing research that will provide guidance for society on how to live with and on permafrost, several new international permafrost projects have been launched. The H2020 project 'Nunataryuk' (p. 15) is the largest transdisciplinary project on permafrost ever funded by the EU, with a

clear interdisciplinary focus on permafrost thaw along changing Arctic coasts with a strong emphasis on socio-economic impacts of thaw.

In 2018, a highlight will of course be the 5th European Conference on Permafrost (EUCOP 2018) in the French Alps in Chamonix in late June. Remember to consider the excellent local and regional field excursion opportunities in the French, Italian and Swiss Alps, with our permafrost colleagues as guides. And of course, the IPA Council will also meet at EUCOP 2018.

In December 2019, our New Zealand permafrost colleagues, together with ANTPAS and other international researchers, will be offering the First Southern Hemisphere Conference on Permafrost (SouthCOP). This will be planned as a field-based conference, with more details to be provided at EUCOP.

Hanne H. Christiansen

Finishing Action Groups:

- Permafrost and Culture, pp. 4-6
- InterFrost, p. 6
- Frozen-Ground Cartoon, p. 7
- Arctic Permafrost Transects, p. 8
- Yedoma, p. 9

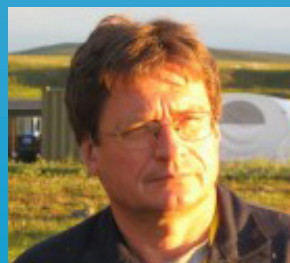
Newly funded Action Groups:

- Rock glacier inventories and kinematics
- Towards a Permafrost Thaw Subsidence Product within the GTN-P database
- Permafrost Engineering in a Warming Climate - Current State and Future Strategy

IPA Executive Committee, 2016-2018



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ACOP 2017: The 2nd Asian Conference on Permafrost

BY LOCAL ORGANIZING COMMITTEE CHAIR, MAMORU ISHIKAWA, HOKKAIDO UNIVERSITY



From needle ice to deep permafrost

The second Asian Conference on Permafrost (ACOP 2017) was convened at Hokkaido University, Sapporo, Japan, July 2-6. The conference organizers and co-sponsors were the Arctic Research Center, Hokkaido University, Japanese Society of Snow and Ice, Tokyo Geographical Society, Sapporo Convention Center, Kajima Co., Shimizu Co., Meiwafoasis Co., LI-COR, Chemical Grouting Co., Seiken Co., Cubic-I Co., Campbell Scientific, Climate and Cryosphere (CliC), Arctic Challenge for Sustainability (ArCS), and the IPA. A total of 178 participants from 17 countries including accompanying persons attended: Austria (1), Canada (7), China (62), Denmark (1), France (4), Germany (5), Hong Kong (2), Indonesia (1), Japan (55), Mongolia (6), Norway (18), Republic of Korea (2), Russia (23), Slovenia (1), Switzerland (2), and the USA (6). The ACOP 2017 LOC provided travel grants to 20 persons including young researchers and keynote speakers.

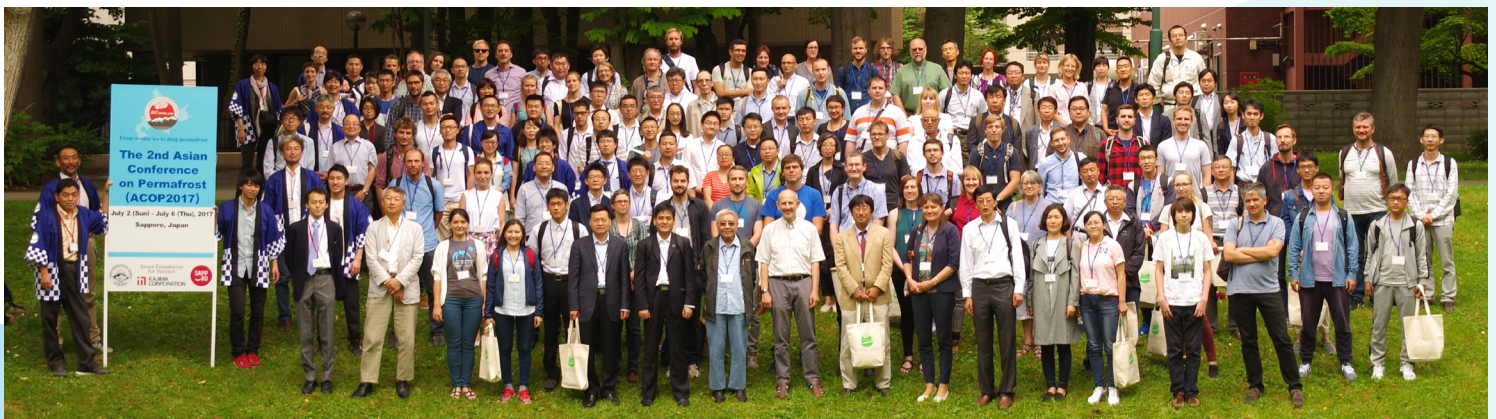
The sessions covered all aspects of frozen ground research, from needle ice to deep permafrost, from

frozen ground engineering in cities to permafrost on volcanoes, and from links between frozen ground and ancient cultures to present-day outreach. The daily sessions started with plenary talks from senior and young keynote speakers: Tazio Strozzi (Switzerland), Norikazu Matsuoka (Japan), Kabir Rasouli (Canada), Arne Instanes (Norway), Hisao Izuta (Japan), Sonia Tomaskovicova (Denmark), Anna Liljedahl (USA), and Jens Strauss (Germany). A total of 86 oral and 55 poster submis-

sions were presented in a series of two concurrent sessions. In the first day of the conference, a joint workshop between the IPA's Mapping Initiative and GlobPermafrost took place to discuss current conditions and future collaboration on permafrost mapping and remote sensing. On the same day, Arctic adventurer Yasunaga Ogita and Professor Emeritus at Hokkaido University, Masami Fukuda, kindly provided general lectures to the public at the museum of Hokkaido University.



Some of the pre-conference field trips visited the highest peaks of Hokkaido, the Daisetsu Mountains, to learn about permafrost in this area. Photo: Sarah Strand



ACOP 2017 participants at the Hokkaido University Campus. Photo: Tetsuo Sueyoshi

The two PYRN-IPA award winners for “Best Oral Presentation” were Matthias B. Siewert for “High-resolution mapping and spatial variability of soil organic carbon in permafrost environments” and Yury A. Dvornikov for “Gas-emission craters on Yamal and Gydan Peninsulas -- future lakes”.

ACOP 2017 included several options for pre- and post-conference field trips. Two pre-conference field trips hiked up to the summit area of the Daisetsu Mountains, the largest mountain permafrost area in Japan (led by Toshio Sone) and Lake Shikaribetsu and its surroundings, with extra-zonal permafrost sites (Yuki Sawada). Also several persons visited Fukushima-Daiichi nuclear

power plant, where artificial frozen soil walls are operating to isolate the power plant from the surrounding ground water environment (Satoshi Akagawa). The post-conference field trip went to the top of the most symbolic mountain in Japan, Mt. Fuji, with the focus on permafrost developed in an active volcano (Atsushi Ikeda).

ACTION GROUP REPORT

Permafrost and Culture (PaC): Integrating environmental, geo-, and social sciences to assess permafrost dynamics and indigenous land use

BY ACTION GROUP LEADERS, JOACHIM OTTO HABECK, UNIVERSITY OF HAMBURG, AND MATHIAS ULRICH, LEIPZIG UNIVERSITY

Against the background of ongoing permafrost degradation induced by global climate warming, research on land use in northern tundra and taiga regions is in the spotlight of scientific and public interest. Specifically, responses of northern indigenous communities towards environmental changes are highly relevant. Besides predicting the impacts of climate-related landscape changes on people’s livelihoods on permafrost, investigations of past and present local human impacts on permafrost dynamics are essential for understanding the complex interaction of the permafrost landscape system.

In this way, the PaC Action Group started its activity in 2014 with a specific focus on the unique alas ecosystems in Central Yakutia (Republic of Sakha, Russia). Since then, this Action Group made significant progress and has achieved two major milestones: (1) A successful workshop in July 2015 in the city of Yakutsk with a field visit to several alas sites and rural communities. It served as a forum for interdisciplinary debate and a starting point for intensive cooperation among social



Syriaga serves as a corral and storage facility for reindeer herders. The area north and east of Vorkuta is frequented by different groups of herders, leading to an increased grazing pressure. Photo: M. Ulrich, 25 September 2017

and natural scientists about land use in the Central Yakutian thermokarst landscapes. (2) A review and perspective article entitled “Permafrost livelihoods: A transdisciplinary review and analysis of thermokarst-based systems of indigenous land use” was published by Crate et al., 2017 in *Anthropocene*, 18, pp. 89-104. The article provides an integrated review and analysis of environmental and socio-econom-

ic trends in a particular subarctic region. It focuses on Sakha (Yakut) animal husbandry as an example of indigenous land use and combines local and scientific knowledge with information about permafrost landscape evolution.

In 2016-17, the PaC Action Group shifted their focus to the tundra lowlands on the western side of the Northern Urals. This region is characterized by a zonal and also longi-

tudinal gradient from continuous to sporadic permafrost. The surface of the area consists of loamy areas with low elevations, peat plateaus and multiple thermokarst landforms. Local land users comprise Nenets and Komi reindeer herders, hunters and fishermen. In addition, mineral resource extraction is planned or ongoing. There have been earlier studies on the impact of permafrost degradation on infrastructure and land use. The Action Group complements this line of research with a focus on the more extensive forms of renewable resource use, notably mobile pastoralism.

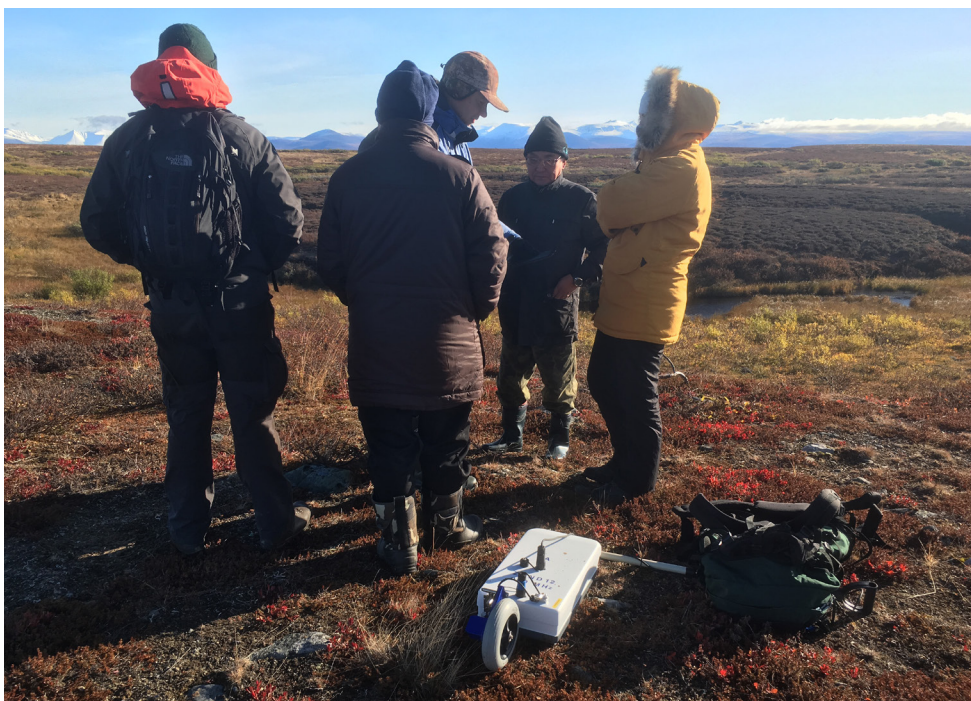
Old and new members of the PaC Action Group organized a second workshop to discuss the interplay between permafrost dynamics and indigenous land use in the tundra lowlands on the western side of the Northern Urals and to obtain first-hand experience and examples of landscape features conditioned by permafrost, the ways in which local land users (particularly reindeer herders) interact with the natural environment, and the problems which they are confronted with. This workshop was held from 24-27 September 2017 in the city of Vorkuta, and two days were spent at a base camp of one of the local reindeer-herding enterprises. The organizers, representing the Institute for Biology and the Institute for Language, Literature and History of the Komi Science Centre as well as the Universities of Hamburg and Leipzig, invited colleagues from a range of social sciences, geosciences and humanities. Support was provided by the IPA, the International Arctic Science Committee (IASC) and the Culture Department of the municipal administration of Vorkuta.

Kirill Istomin and J. Otto Habeck presented key points from their 2016 article on permafrost and rein-

deer husbandry as an entry point. There was discussion on soil and substrate, notably on whether tabey (“living earth”, tixotropically caused sludge that occasionally may lead to reindeer getting injured or killed) is locally conditioned by permafrost. Participants shared observations about desiccation of shallow lakes (khasyrey) and land slumps, such as those observed on the Yamal Peninsula. The linkage between different practices of reindeer husbandry, vegetation dynamics, and permafrost was also discussed. A high degree of conflict between different reindeer-herding enterprises in the region, along with discrepancies in pasture use, was identified. Migration routes have become shorter in recent decades, winter pastures in the forest zone are no longer frequented for socio-economic reasons, and shrubby areas may provide sufficient forage during the winter. Changes in the vegetation cover are not simply caused by climate change, but importantly also by reindeer grazing; changes in the vegetation cover, in turn, have local and regional effects on snow accumulation and snow persistence,

albedo, temperature insulation of the ground, and protection of the soil surface layer. Methodological differences and the possibility of juxtaposing data sets generated by different methods was considered.

There was an excursion to Syriaga, a reindeer herders’ base camp approx. 60 km northeast of Vorkuta. The site was chosen because of its closeness to the area of continuous permafrost, the existence of lakes, palsas and other landscape features that indicate permafrost-related processes, and also due to the potential presence of reindeer herders. Participants paid an extended visit to the local corral, constituting the main stable facility of reindeer husbandry in this region, and followed the report of an expert on reindeer husbandry working for the Ministry of Agriculture of the Komi Republic. Participants also jointly discussed vegetation changes and palsa developments at various spots between the Syriaga base camp and the upper River Usa. The weather allowed for a detailed exploration of palsas, active-layer and permafrost features at several spots in the proximity of the base camp.



Workshop participants checking the depth of the permafrost table near the base camp of Syriaga. Photo: O. Habeck, 26 September 2017

At the end of the workshop, participants planned a transdisciplinary paper to capture the current state of research on permafrost dynamics and indigenous land use in the Northern Urals.

Beyond Central Yakutia and the Northern Urals, the Action Group

ACTION GROUP REPORT

InterFrost

BY ACTION GROUP LEADER, CHRISTOPHE GRENIER, LABORATOIRE DES SCIENCES DU CLIMAT ET DE L'ENVIRONNEMENT (LSCE)

The InterFrost Action Group is concerned with the evaluation and improvement of coupled Thermo-Hydrological (TH) codes to match the challenges of realistic hydro(geo)logical systems encountered in cold regions.

In 2017, a manuscript "Groundwater flow and heat transport for systems undergoing freeze-thaw: Intercomparison of numerical simulators for 2D test cases", by Grenier et al., associated with the inter-comparison phase, was submitted. Over 20 participants from Europe and America took part in this inter-comparison with 13 coupled TH codes applied to well-defined academic test cases. For modelers that are interested to use these benchmark results, the datasheets and results are available on the InterFrost website (wiki.lsce.ipsl.fr/interfrost).

The second major effort within the InterFrost Action Group in 2017 was to develop one of the initial test cases into a reference laboratory experiment. The initial frozen inclusion case (TH2) was implemented in the cold room of GEOPS Laboratory in Orsay (Univ. Paris-Saclay), France. Though very challenging, this experiment has been continuously developed until presentation at the third InterFrost workshop organized 22-

seeks to explore further examples of land use in permafrost regions. Ultimately, the comparison of such case studies helps bridge an evident gap in current research. While it is often assumed that indigenous livelihoods in the Far North will inevitably suffer from permafrost degradation in a warming climate, the actual linkages between permafrost deg-

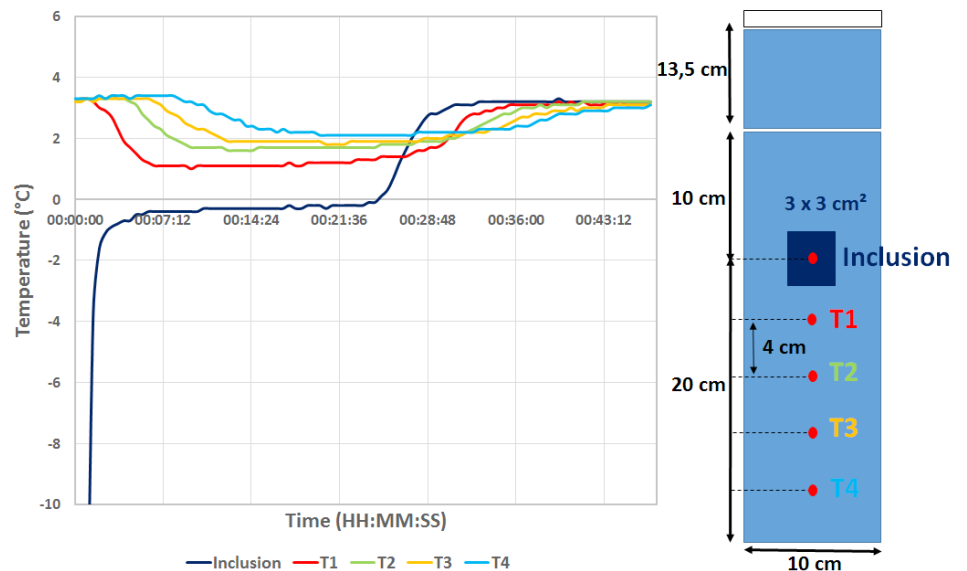
radation and renewable resource use are still unclear. Considering the potential of mobile pastoralism to modify the natural environment, it is necessary to examine the interplay of land use, vegetation, climate, hydrological and cryological processes in detail, taking into account the diversity of regional and local conditions.



23 November in Paris. Presentation of the experimental setup and results raised the interest of the InterFrost participants, who decided to run their models on two reference experiments, one including flow and the other considering no-flow conditions. Complementary tracer experiments help in providing constraints for the parameters that can't be directly measured. Interaction between modelers and experi-

menters within the next months will help improve the design of this validation phase. Preliminary results will be presented at EUCOP 2018 (Session 8: Coupled heat transfer and fluid flow processes in permafrost Regions).

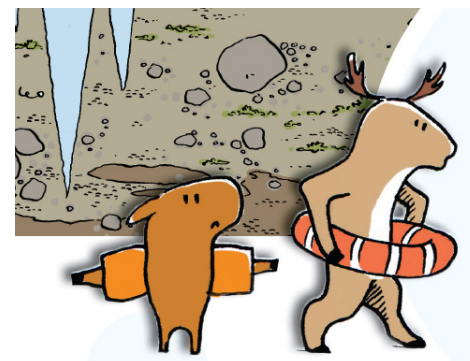
Another outcome of the third InterFrost Action Group workshop was revisiting future applications dealing with the coupled evolution of thermo-hydrogeological processes. Future tasks will include real field data, providing access to full, real-world complexity. Datasets from field monitoring surveys in North Québec, Greenland and Siberia were presented and discussed, and will potentially be implemented by InterFrost participants next year.



Experimental conditions and results (performed 10.11.2017): Saturated sand is initially frozen at the location of the inclusion (dark blue). Water is transferred through the experimental setup from top to bottom with imposed water level conditions in the upper box (13.5 cm). The temperature of the initial inclusion (dark blue line) increases due to conduction and advection of water around the frozen zone, and melting occurs. In the meantime, colder temperatures arising from the initial frozen inclusion are registered at the thermal probes T1, T2, T3, and T4. Eventually, the whole porous medium reaches 3.4°C.

A Frozen-Ground Cartoon: Explaining international permafrost research using comic strips

BY ACTION GROUP LEADER, FRÉDÉRIC BOUCHARD, UNIVERSITÉ LAVAL



The main goal of this scientific outreach project is to present field-based permafrost research using thematic comic strips. The project is led by a team of artists and permafrost young researchers from Canada, Germany, Portugal, Sweden, and Finland.

This year, the final strips were grouped, edited and printed as a 28-page full-colour booklet. Free copies were distributed at Arctic Change 2017 (<http://www.arcticnetmeetings.ca/ac2017/>) and at the AGU Fall Meeting (<https://fallmeeting.agu.org/2017/>). A one-minute 'frostbyte' video was also produced to publicize the project: <https://vimeo.com/234984536>. We also had the opportunity to present a Swedish version of the cartoons to schoolchildren in May 2017, during the Climate festival in Stockholm, which had 1200 visitors.

The Action Group is now wrapping up activities, but there are future plans ahead. For example, the English version has just been released, but other versions are planned in French, German, Inuktitut, Japanese, Komi, Chinese, and Hindu. Moreover, the cartoons will have a second life through 'augmented reality' (AR) – related computer-generated sound, video or graphics – in collaboration with the new H2020 project Nunataryuk (p. 15).

We are grateful to our project partners, without whom none of this would have been possible. Besides the IPA, this project also received funding from these organizations and research groups: IASC, PYRN,

CliC, Arctic Development and Adaptation to Permafrost in Transition (ADAPT), Association of Polar Early Career Scientists (APECS), Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research

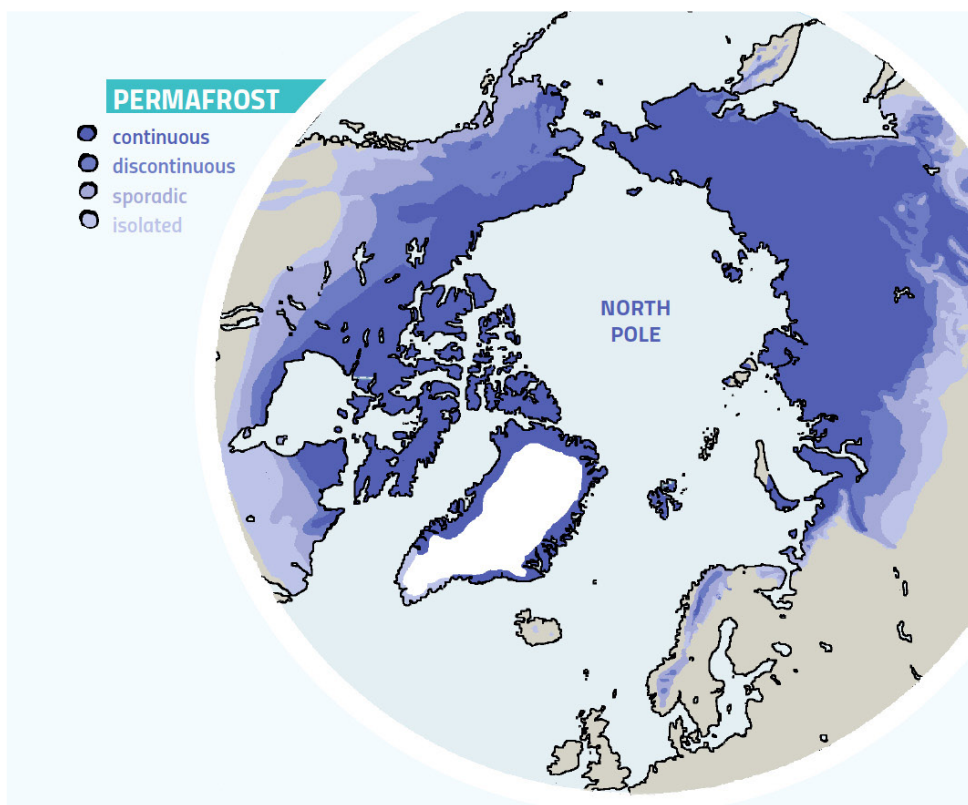
(AWI), Bolin Centre for Climate Research, and the IMPACT! Fund.

Visit online:

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Contact:

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Frozen-Ground
cartoons!

An international collaboration between artists and permafrost scientists resulting in 22 pages of cartoons about permafrost, climate change, research in the North and reindeer!

FROZENGROUND CARTOON.COM

Images taken from the front and back cover of the printed Frozen Ground Cartoon booklet. Illustrations by Heta Nääs and Noémie Ross

Arctic Permafrost Transects

BY ACTION GROUP LEADER, D.A. "SKIP" WALKER, UNIVERSITY OF ALASKA FAIRBANKS, AND CO-ORGANIZERS HOWARD EPSTEIN, UNIVERSITY OF VIRGINIA, MARINA LEIBMAN, EARTH CRYOSPHERE INSTITUTE - RUSSIAN ACADEMY OF SCIENCES, AND VLADIMIR ROMANOVSKY, UNIVERSITY OF ALASKA FAIRBANKS

Arctic permafrost environments extend along thousands of kilometers of latitude from the boreal forest, through forest-tundra transitions, to the extreme High Arctic. Examining the permafrost bio-geophysical and socio-economic properties and interactions along regional- to continental-scale climate gradients provides a first approximation of how these systems might change with respect to future climate dynamics. Given the need to visit numerous sites with challenging logistics, studies of the complete Arctic bioclimate gradient are rather rare from a field observational perspective, but there have been several recent research efforts that have developed transects for different geographic locations across the full Arctic bioclimatic gradient. Elevation transects, remote sensing and simulation modelling are other mechanisms for examining Arctic systems along bioclimate gradients.

Examples of permafrost-bioclimate transects in North America include: (1) IPA Thermal State of Permafrost transects along the Mackenzie River corridor and the Trans-Alaska Pipeline corridor; (2) The North America Arctic Transect, established to examine the complete Arctic bioclimate gradient in Alaska and northwestern Arctic Canada; and (3) the 1999 CAVM Canada Arctic Expedition.

Examples from Russia include the Taimyr bioclimate transect and the Eurasia Arctic Transect (EAT) which extends from the forest-tundra transition near Nadym to Hayes Island in the Franz Josef Land Archipelago. EAT was established to study the changes in zonal vegetation,

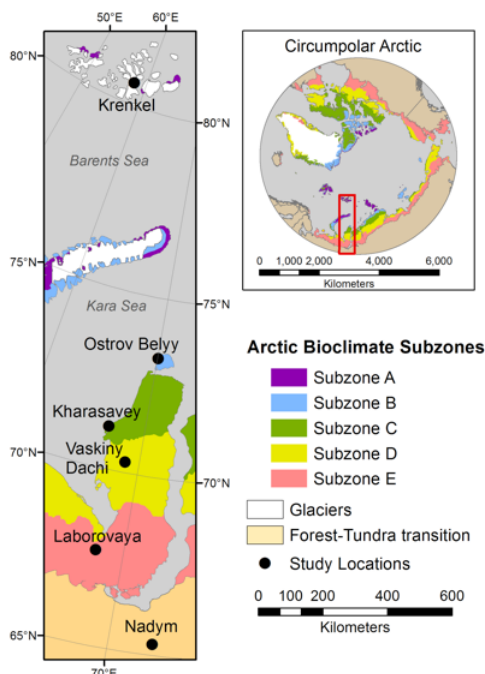


Figure 1. The northern Eurasia Transect has study sites in all five Arctic bioclimate subzones and the forest-tundra transitions. Interdisciplinary investigations at each location include permafrost cores, active layer measurements, vegetation, soils, and remote sensing studies.

permafrost, soils, and remote-sensing spectral properties.

Arctic-alpine climate transects have also been employed in southwestern Greenland and the Yukon Mountains of Canada, where latitudinal changes in permafrost conditions that occur over thousands of miles are compressed into elevation gradients of a few hundred meters.

Against the background of these existing transects, this Action Group focuses on the construct of Arctic and Arctic-alpine bioclimate gradients (e.g. temperature and precipitation) to examine heterogeneity in the structure and function of Arctic systems with respect to variables such as permafrost and active-layer, patterned-ground features, soils,

vegetation structure, biodiversity, remotely-sensed properties, and interactions with socio-economic factors.

ARCTIC TRANSECT SESSION, ARCTIC SCIENCE SUMMIT WEEK 2017, PRAGUE

The first activity of the Transects Action group was a session at Arctic Science Summit Week 2017 (Session 13.2 Transects). Twelve oral presentations and six posters were presented. Eight of these dealt with assessing environmental variables along the Eurasia Arctic Transect (Figure 1), including properties of vegetation and plant communities, cryogenic soils, permafrost, and geological processes, disturbances (landslides), in addition to ground thermal regimes and carbon dioxide fluxes. With regard to the North American Arctic Transect, Vladimir Romanovsky presented on the latitudinal patterns of permafrost dynamics. Another large group of papers (seven in total), focused on transects among islands of the North Atlantic region, such as Svalbard, Greenland, and Iceland; these papers focused essentially on patterns of flora and fauna, however, Hanne Christiansen presented on permafrost conditions between Svalbard and Greenland. We also heard about alpine gradients in the Czech Republic and vegetation dynamics on Victoria Island, Canada. Overall, these papers highlighted the utility of using geographical gradients in environmental properties to assess their controls on arctic ecosystem properties.

SESSION PRESENTERS

<i>Oral talks (12)</i>	<i>Posters (6)</i>
Bartsch	Borbrick
Bultmann	Buda
Christiansen	Bultmann
Epstein	Devetter
Goncharova	Jonsdottir
Jonsdottir	Zawierucha
Koncianova	<i>Other sessions (5)</i>
Kumpula	Konstantinov
Matyshak	Park
Orekhov	Udoenko
Romanovsky	Varentsov
Walker	Makhnykina

Deep ice-rich permafrost: Final report of the Yedoma Action Group

BY ACTION GROUP LEADER, JENS STRAUSS, AWI POTSDAM

Permafrost landscapes are threatened by climate warming and degrade in different ways. This includes near surface processes such as active layer deepening, as well as extensive processes like thermal erosion, and development of thermokarst features. In the Siberian and North American late Pleistocene ice-rich yedoma, permafrost thaw processes cause surface subsidence of several tens of metres due to loss of ground ice. With thawing, currently freeze-locked organic matter can be mobilized and contribute to the carbon-climate feedback, which is a process of global significance if formerly inactive, fossil carbon is re-introduced into the active carbon cycle.

But where is this deep and ice-rich permafrost? Focusing on the impressive yedoma sediments, the main objective of this Action Group was to get international experts together for compiling a map of the circum-Arctic distribution and thickness of yedoma deposits. This product is of importance for assessing infrastructure vulnerability, assessing permafrost carbon stocks, and to improve the modelling of future landscape change trajectories within this part of the (sub)Arctic.

The Yedoma Action Group started its activities in early 2015. With data on thickness extracted from drilling records and outcrop observations reported in the scientific literature, we aimed to derive the yedoma coverage based on the digitization of surface geological and Quaternary geological maps. A key milestone was reached by conducting a hands-on workshop organized prior to the 11th International Conference on Permafrost in Potsdam,

involving 24 scientists from 5 countries. The Action Group's progress and results were disseminated at numerous international conferences and meetings in Russia, Switzerland, Germany, and the United States. An appropriate finish was a plenary talk at the 2nd Asian Conference on Permafrost in Japan.

Deliverables and further products like a yedoma photo database and the first version of the yedoma map are published online and available on the Arctic Permafrost Geospatial Centre (APGC, <http://apgc.awi.de/tl/group/about/ipa-action-group-the-yedoma-region-a-synthesis-of-circum-arctic-distribution-and-thickness>) and the Pangaea database (<http://dx.doi.org/10.1594/PANGAEA.861733>). In addition, an open-access article "Deep Yedoma permafrost: A synthesis of depositional characteristics and carbon vulnerability" (Earth-Science Reviews, <http://dx.doi.org/10.1016/j.earsci-rev.2017.07.007>) was published. This Action Group effort identified that the yedoma domain, including drained thermokarst basins, contains ~398 gigatons thaw-susceptible organic carbon. This is more than 25% of the frozen carbon of the

permafrost area, while the Yedoma domain is covering only 7% of the permafrost region. Our results underline the need to account for the yedoma domain and its destabilization mechanisms in next generation Earth System Models for a more complete representation of the permafrost-carbon feedback.

ADDITIONAL REMARKS AND ACKNOWLEDGEMENTS

The core group of the yedoma Action Group included Jens Strauss, Guido Grosse, and Lutz Schirrmeister from the Alfred Wegener Institute (Potsdam, Germany), Daniel Fortier from Université de Montréal (Montréal, Canada), Duane Froese from the University of Alberta (Edmonton, Canada), Mikhail Kanevskiy from the University of Alaska Fairbanks (Fairbanks, USA), Viktor Kunitsky from the Melnikov Permafrost Institute (Yakutsk, Russia) and Aleksandra Veremeeva and Denis Shmelev from Institute of Physicochemical and Biological Problems in Soil Science (Pushchino, Russia).

We thank the affiliated partners G. Hugelius, M. Ulrich, E. Rivkina, Y. Shur, K. Walter Anthony, and Sergei Zimov. Moreover, we thank the IPA for funding. The Action Group was also supported by the ERC funded project PETA-CARB (Rapid Permafrost Thaw in a Warming Arctic and Impacts on the Soil Organic Carbon Pool, #338335). Thanks to all data contributors and to Sebastian Labour for database implementation and visualisations.



Degrading yedoma on Sobo Sise Island, Lena Delta, Siberia, with a person for scale. More geotagged pictures of the impressive yedoma cliffs are available at our picture database: <http://apgc.awi.de/tl/dataset/iryp/resource/660a0aa2-9763-4385-b054-b6bd6dd1d3dd>.



Education & Outreach

BY EDUCATION & OUTREACH COMMITTEE MEMBERS ANNA KLENE, UNIVERSITY OF MONTANA, YLVA SJÖBERG, STOCKHOLM UNIVERSITY, AND KENJI YOSHIKAWA, UNIVERSITY OF ALASKA FAIRBANKS

The IPA Education and Outreach Standing Committee continued efforts to promote permafrost education and outreach to all generations across the globe.

During ACOP in Japan, we held well-attended sessions on Living and Working on Permafrost which combined traditional education and outreach presentations with those focused on communities living with permafrost. We held a Committee Meeting in Fairbanks on 28 August 2017. After chairing our committee since its formation, Kenji Yoshikawa stepped down as Co-Chair, but remains a member. Ylva Sjöberg was elected as a new Co-Chair to serve with Anna Klene. We extend our sincerest thanks to Kenji for all his work chairing our committee and the amazing work he continues to do!

K-12 AUDIENCES

The Global Learning and Observations to Benefit the Environment (GLOBE) Program is an international science and education program. Over 110 countries participate in GLOBE and the website and activities are available in English, French, German, Spanish, and Russian, among other languages. The Frost Tube

Protocol Investigation was launched in October 2017, which means that teachers (in all frost tube countries) can now enter their frost tube data to the GLOBE database. Teachers, students, or anybody interested can access soils, weather, hydrology, phenology, and other biosphere archived data and visualize data on the GLOBE website.

UNDERGRADUATE AND GRADUATE STUDENTS

A new course, South American Geocryology, Permafrost in the Andes, and Paleo-Permafrost in Patagonia, was held in November 2017 at the National University of San Juan, Argentina. In addition, the University of the Arctic's Thematic Network on Permafrost (TNP) summer field school was held at the University of Alaska Fairbanks in July/August. Once again both Lomonosov Moscow State University in Russia and the University Centre in Svalbard offered their field courses to international students. Also, Lomonosov Moscow State in cooperation with the George Washington University held a permafrost field school in the Polar Urals and Siberia in July. The school was attended by

20 students from Russia, the US and the EU. Many of the field courses are available at low cost, with the exact fees varying course to course.

PERMAFROST COMMUNITIES, INDIGENOUS PEOPLES, AND THE GENERAL PUBLIC

In October 2017, the popular-press book "Permafrost in Our Time", was released in a Russian version: "Мерзлота в наше время". This was not simply a translation of the English-language version, but includes primarily examples from Siberian villages, many in indigenous communities.

In addition, in November 2017, the museum exhibition "Under the Arctic" opened in Portland, Oregon, USA. Some of the 3D models used can be made for teachers, and the exhibition can be bought by other museums.

The Education and Outreach Standing Committee can be contacted via Co-Chairs Anna Klene (anna.klene@gmail.com) and Ylva Sjöberg (ylva.sjoberg@natgeo.su.se).

USEFUL EDUCATION AND OUTREACH WEBSITES

EO Committee Website: <http://ipa.arctic-portal.org/about-the-ipa/standing-committees/education-outreach>

IPA Outreach Website: <http://ipa.arcticportal.org/activities/outreach/outreach-activities>

Permafrost in Our Time (English version): <https://cryoperu.files.wordpress.com/2014/12/yoshikawa-2013-permafrost-in-our-time.pdf>

Мерзлота в наше время (Russian version): <https://issuu.com/permafrostbook/docs/95>
GLOBE website: <http://www.globe.gov/>

Koichiro Harada's Frost Tube website (in Japanese): http://www.myu.ac.jp/~haradak/frost_tube.html

For South American activities: www.geocriologia.com.ar

Under the Arctic Museum Exhibit: <https://omsu.edu/products/under-the-arctic-digging-into-permafrost>



The University of the Arctic Thematic Network on Permafrost field course in Fairbanks, August 2017.

Permafrost Young Researchers Network (PYRN)

BY PYRN EXECUTIVE COMMITTEE MEMBERS ALEXEY MASLAKOV, CAROLINE COCH, JOANNE HESLOP AND SIMON DUMAIS, AND PYRN COUNCIL MEMBER JOSEFINE LENZ. ALL PHOTOS COURTESY OF PYRN.

The Permafrost Young Researchers Network, PYRN, in which membership is free of charge, was created with the objectives of engaging future generations of permafrost researchers, promoting collaboration, and providing a common platform to support activities and improve communication related to permafrost science and engineering. PYRN also aims to share information on upcoming events and meetings, travel grant and scholarship programs, and studentship and job postings.

PYRN members were indeed productive this year and actively participated in various events such as short courses, conferences and topical meetings.

PYRN DACH MEETING AT 9TH AK PERMAFROST, EINSIEDELN, SWITZERLAND, 9-11 FEBRUARY 2017

The German-speaking PYRN community meets annually at the AK Permafrost Meeting. This year's meeting attracted about 60

participants, 30 of which were PYRN members. The discussion of current and future research activities was followed by the "Scientific Poster Presentation Skills" workshop lead by Dr. Janneke van Woerden, University of Zurich. The PYRN-DACH-APECS poster awards were given to George Tanski, AWI Potsdam, for "Dissolved organic carbon (DOC) stocks in Arctic ground ice and its contribution to OC carbon fluxes into the Arctic Ocean" and to Matthias Meyer, ETH Zurich, for "Interactive Visualization of Big (Matterhorn) Data".

PYRN SHORT COURSE AT EGU 2017, VIENNA, AUSTRIA, 23-28 APRIL 2017

The "The future of permafrost in a climate-changing world" short course had four invited speakers: Carsten W. Mueller, João Canário, Annett Bartsch and Michael Fritz. The short course was organized to revise recent research that concerns permafrost in a changing climate in order to:

- Share a multidisciplinary

understanding of the role of permafrost in the climate system with young researchers;

- Strengthen international collaboration of early career researchers;
- Enable the participants to put their research into a larger context.

PYRN AT "EARTH'S CRYOSPHERE: PAST, PRESENT AND FUTURE" CONFERENCE, PUSHCHINO, RUSSIA, 4-6 JUNE 2017

More than 90 permafrost young researchers from all over the world attended six various sessions on permafrost research foci such as "the state of the cryosphere", "infrastructure management", "life on permafrost", "physico-chemistry and hydrology of frozen ground", and "permafrost-affected soils". During the conference, the Vice-President of the IPA, Vladimir Romanovsky, held a lecture. A few other senior researchers joined the event and shared their experience with the students and early career scientists.



Clockwise from top left: PYRN members at the 9th AK Permafrost meeting, at the PYRN short course at EGU 2017, and at the "Earth's Cryosphere: Past, Present, and Future" conference.

PYRN AT XI INTERNATIONAL SYMPOSIUM ON PERMAFROST ENGINEERING, MAGADAN, RUSSIA, 6 SEPTEMBER 2017

This meeting was aimed to strengthen scientific and technical collaboration between Chinese and Russian engineering organizations. The early career researchers held one third of the total presentations. The five PYRN prizes for the best presentations were awarded to: Zhang A.A., Lomonosov MSU, “A ground-penetrating radar study for assessing the effectiveness of embankment insulation at the Amur-Yalutsk railway”; Zhang H., Northwest Institute of Eco-environment and Resources CAS, “Pore-water pressure variation in warm and ice-rich frozen soils under loads”; Bazhin K.I., Melnikov Permafrost Institute SB RAS, “Application of electrical resistivity tomography to assessing the condition of dams”; Naberezhnyi A.D., Ammosov North-Eastern Federal University, “Research on bearing capacity improvement of friction pile foundations”; and Yang Lu, Hohai University, “Surface fractal assessment of cracks in clayey soils subjected to cyclic freezing and thawing”.

PYRN AT XX NATIONAL ARGENTINE CONGRESS OF GEOLOGY, SAN MIGUEL DE TUCUMÁN, ARGENTINA, 7-11 AUGUST 2017

PYRN members from Argentina and Chile assisted to organize the meeting, which started with a short presentation about PYRN activities around the world and Argentinian researchers’ contribution to permafrost sciences. A round table led by Carla Tapia, IANIGLA, emphasized that permafrost research is currently experiencing a renewed interest in Argentina. The hot topics are related to determination of permafrost extension, especially along the Andes, new remote sensing techniques for permafrost mapping and monitoring, mountain permafrost degradation risks as well as water supply network in periglacial environments. Another discussion focus was on communication issues among scientists themselves and with policy makers as well as the necessity of knowledge sharing with local communities.

PYRN AT THE 2ND ASIAN CONFERENCE ON PERMAFROST (ACOP 2017), SAPPORO, JAPAN, 2-4 JULY 2017

In total, 141 presentations were prepared by PYRN members on a wide range of permafrost research

and engineering topics. Moreover, 20 young researchers received financial assistance to attend the conference. The two winners of the PYRN-IPA Award for Best Oral Presentation were Yury Dvornikov for “Gas emission craters on Yamal and Gydan Peninsulas future lakes” and Matthias Siewert for “High resolution mapping and spatial variability of soil organic carbon in permafrost environments”.

PYRN would like to thank all the candidates, sponsors, judges and volunteers that participated in the aforementioned events.

PYRN - NORTH AMERICA

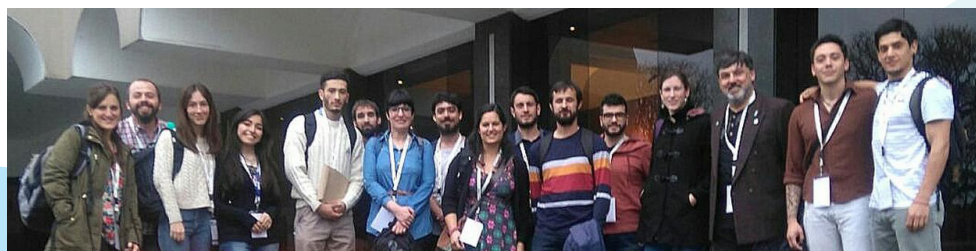
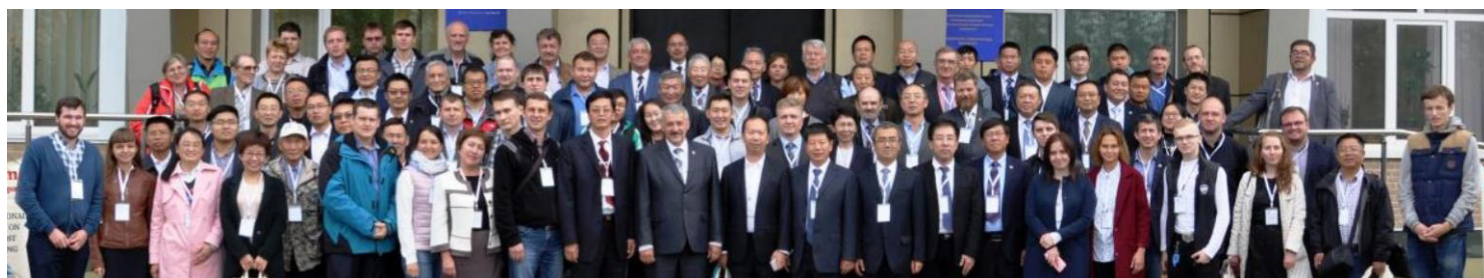
PYRN is thrilled to launch a North American regional branch: PYRN-NA! This group will be a space where PYRN members based in North America can share and discuss information and their research. Please visit our page and consider joining!

UPCOMING ACTIVITIES

PYRN is currently preparing the scientific program for the two-day PYRN Workshop which will be held 23-24 June, during EUCOP 2018.

Additional activities were held during the following two events:

- Arctic Change 2017, Québec, Canada, 11-15 December 2017; Student Day



Top: Participants at XI International Symposium on Permafrost Engineering. Left: PYRN at XX National Argentine Congress of Geology. Right: PYRN at ACOP 2017.

- American Geophysical Union (AGU) Fall Meeting 2017, New Orleans, USA, 11-15 December 2017; PYRN Meeting

Thank you to our PYRN National Representatives, who are doing a great job by staying active and keeping the Executive Committee updated on the activities in their countries. If you are also an active early career researcher, who would like to expand her/his network, you are more than welcome to become

a PYRN National Representative. Once again, congratulations to all PYRN Award holders, talented and promising early career researchers!

To be updated on a regular basis, please sign up for the PYRN newsletter and follow PYRN on Facebook, Twitter and Instagram. PYRN members are also more than encouraged to share photos or short videos on permafrost-related research and outreach activities, which can be submitted to contact@pyrn.org with “PYRN social media” as the subject line.



Website:

<https://pyrn.arcticportal.org/>

Email:

contact@pyrn.org

STANDING COMMITTEE REPORT

ANTPAS - Antarctic Permafrost, Periglacial Environments and Soils

BY ANTPAS STEERING COMMITTEE MEMBERS MAURO GUGLIELMIN, UNIVERSITY OF INSUBRIA, AND CHRISTEL HANSEN, UNIVERSITY OF PRETORIA

ANTPAS held an international workshop at the University of Insubria in Varese, Italy, 4-5 October 2017. The theme of the workshop was ‘From an Expert Group to a Research Program’ and was aimed at setting the foundation for the existing research group to move to become a Research Program within SCAR (Scientific Committee for Antarctic Research). The workshop started with a presentation on the Italian Antarctic research program (PNRA), given by the Director of Research at PNRA, Antonio Meloni, followed by an overview of Italian

research in the frame of ANTPAS by Co-Chair Mauro Guglielmin, and then a presentation by Jerónimo López-Martínez, the ex-president of SCAR, on the role of research programs within the SCAR strategy. Next, attendees presented their research papers. The three sessions of the day reflected the interdisciplinary nature of ANTPAS, with topics ranging from dating techniques, remote sensing applications, landform mapping, weathering processes, atmospheric drivers of ground thermal dynamics, microbial studies, biological

investigations, to permafrost modelling. The workshop included intense group discussions, as well as strategy meetings on how to develop ANTPAS. Posters were on display throughout the duration of workshop. For more on the workshop please visit the ANTPAS website at www.antpas.org.

During the workshop Gonçalo Vieira stepped down as Co-Chair, with a new Co-Chair to be elected within the next few months. The remainder of the Steering Committee remains the same.

ANTPAS would like to thank their sponsors, the University of Insubria, SCAR, and PNRA for their generous support. SCAR also made funds available to 10 students and emerging researchers from Canada, the Czech Republic, Italy, New Zealand, South Africa, and the USA to attend the workshop and their support is gratefully acknowledged.



Participants of the October 2017 ANTPAS workshop in Varese, Italy.

The Global Terrestrial Network for Permafrost (GTN-P)

BY STEERING COMMITTEE CHAIR, DMITRY STRELETSKIY, GEORGE WASHINGTON UNIVERSITY, AND DIRECTOR OF THE SECRETARIAT, BORIS K. BISKABORN, AWI POTSDAM

It was a challenging year for the GTN-P. The network had been completely revived and excelled to an unprecedented level, thanks to the significant funding and human capital under the EU PAGE21 project which ended in 2015. With new funding constraints, GTN-P faced a tough choice: to scale back its activities or to continue the same level of performance, but without any support for its vital components. We are happy to report that despite these challenges, the GTN-P was able not only to sustain its core activities, but also to enhance some of its functions.

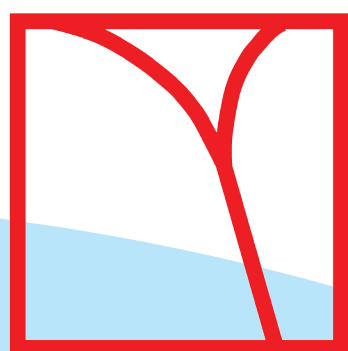
The GTN-P Strategy and Implementation Plan 2016-2020 was released in November 2017 (GTN-P SIP, 2017). The document re-states the core mission of the GTN-P as a sustained comprehensive long-term permafrost monitoring network, outlines network progress and challenges, and describes the governance, management structure, linkages to regional and global observing systems, management process and reporting strategies. It documents measurement methods and protocols for field data collection and the state of the art data management system designed and

implemented to process, analyze, and visualize permafrost data. The Data Management System (DMS) was designed by Arctic Portal (development and technical support) and Alfred Wegener Institute (data science and project management). The first GTN-P mirror was opened in Germany in May 2017 and represents additional efforts in data preservation in real time accessibility. Efforts of the Arctic Portal team advanced the GTN-P DMS to become a regular member the ICSU World Data System. GTN-P has also established closer collaboration with the Global Cryosphere Watch to advance best practices and protocols for permafrost.

GTN-P contributors presented at major international meetings including AGU (San Francisco, December 2016), ASSW 2017 (Prague, April 2017), Pushchino Cryosphere Conference (June 2017), and ACOP 2017 (Sapporo, July 2017). Also, GTN-P data were reported in international assessments such as State of the Climate, Arctic Report Card, and SWIPA 2017. Using the capabilities of the DMS, the most recent dataset of the thermal state of permafrost was compiled to evaluate permafrost temperature changes relative to the International Polar

Year (IPY, 2007–2008). This work is being summarized in a scientific paper soon to be submitted with publication anticipated in early 2018. Sessions on the GTN-P theme are being organized for POLAR 2018 (Davos, Switzerland 15 - 26 June 2018) and EUCOP 2018, where a workshop will be held June 24.

All these activities would not be possible without the dedication of national and young national correspondents and the leadership role of the Steering Committee in promoting the value of the network. Continued partnership of GTN-P and Arctic Portal allowed advanced technical support and development of the database. We sincerely thank the IPA and AWI for their continuous support. Please visit www.gtnp.org for more information about the network, data access and news updates.



GTN-P Global Terrestrial Network for Permafrost

International
Permafrost
Association



GTN-P
Global Terrestrial
Network for
Permafrost

STRATEGY AND IMPLEMENTATION PLAN
2016 - 2020

For the Global Terrestrial Network for Permafrost
(GTN-P)

The GTN-P Strategy and Implementation Plan 2016-2020 is available at <http://library.arcticportal.org/1938/>.

Nunataryuk

BY PROJECT LEADER, HUGUES LANTUIT,
AWI POTSDAM



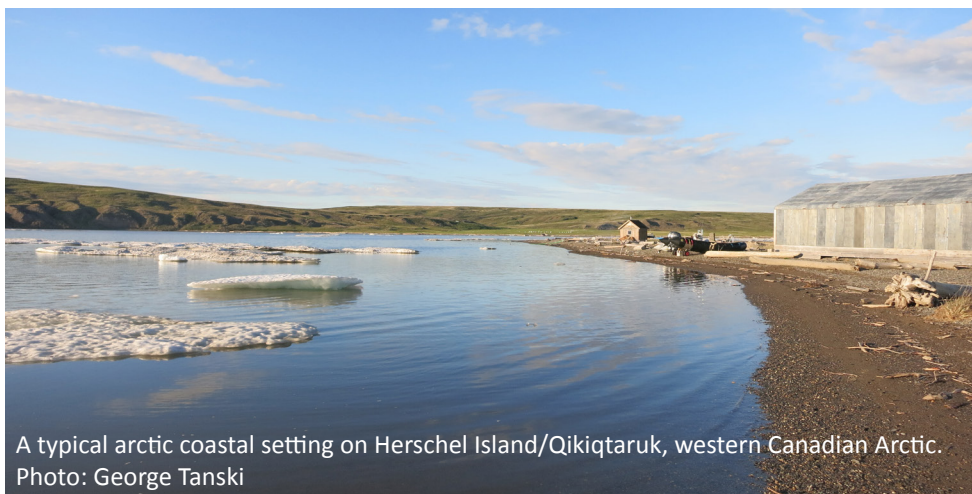
NUNATARYUK

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Nunataryuk is a new project funded by the European Union focusing on permafrost thaw and the changing Arctic coast with a strong emphasis on socio-economic impacts of thaw. The project includes 28 partners from 12 countries and is funded with 11.5 M€ for the 2017-2022 period.

Nunataryuk stands for “land-to-sea” in Inuvialuktun, the traditional language of the Inuvialuit in the western Canadian Arctic. Permafrost coasts in the whole Arctic embody this land-sea connection, making up 34% of the world’s coasts and representing a key interface for human-environmental interactions. These coasts provide essential ecosystem services, exhibit high biodiversity and productivity, and support indigenous lifestyles. At the same time, this coastal zone is a dynamic and vulnerable zone of expanding infrastructure investment and growing health concerns. Climate warming is affecting this fragile environment by triggering coastal landscape instability and increasing hazard exposure. Permafrost thaw in combination with increasing sea level and changing sea-ice cover expose the Arctic coastal and nearshore areas to rapid changes. The release of previously frozen organic carbon and its transformation into greenhouse gases may push the global climate warming above the 1.5 °C targeted in the COP21 Paris Agreement. Yet, the lateral transfer of organic matter from land to sea and subsea permafrost degradation are still not accounted for in global climate and Earth System Models.

A high proportion of Arctic



A typical arctic coastal setting on Herschel Island/Qikiqtaruk, western Canadian Arctic.
Photo: George Tanski

residents live near permafrost coasts and many derive their livelihood from marine resources. They will be directly impacted by rapidly changing conditions at the Arctic coast. Permafrost thaw will lead to destabilisation of infrastructure and natural resource extraction facilities, directly impacting the economy. Greater fluxes of sediment and organic matter from coastal erosion could impact the nearshore ecosystem, including aquatic resources. Permafrost thaw has also been shown to play a role in the health of Arctic coastal communities through changes in water quality and through the potential release of contaminants, frozen bacteria and anthrax. Yet, all of these issues have so far been considered in isolation because of the lack of data for Arctic coastal regions.

The pressing challenge is therefore to quantify and project organic matter, sediment and contaminant fluxes from thawing coastal and subsea permafrost and to accurately assess the implications of permafrost thaw for the indigenous populations, the local communities and the

local environment in Arctic coastal areas. The main goal of Nunataryuk is to determine the impacts of thawing land, coast and subsea permafrost on the global climate and on humans in the Arctic and to develop targeted and co-designed adaptation and mitigation strategies.

To achieve its mission, Nunataryuk will address nine specific objectives in three inter-related activities. These three activities (Physical Sciences, Social Sciences and Integration activities) were designed to facilitate transdisciplinary work within the project. Nunataryuk will conduct its activities in three focal areas located in North America (Beaufort Sea Area), Greenland and Svalbard (Nordic Area) and Russia (East Siberia Area).

Nunataryuk will undertake scenario-building and formulate conceptual socio-economic models under different future climate scenarios. This will inform the development and evaluation of adaptation and mitigation strategies for the Arctic coast.

For more information, see <http://nunataryuk.org>.

RELEVANT ACTIVITY

GlobPermafrost

BY PROJECT LEADER, ANNETT BARTSCH,
ZAMG

The first version of thematic products developed by the European Space Agency initiative DUE GlobPermafrost (2016-2019) were released in September 2017. They include InSAR-based land surface deformation maps, rock glacier velocity fields, spatially distributed permafrost model outputs, land surface properties and changes (trends from Landsat data 2000-2015), and ground-fast lake ice.

The WebGIS and data catalogue hosted by the Alfred Wegener Institute for Polar and Marine Research provide easy access. The GlobPermafrost information system is a core component of the Arctic Permafrost Geospatial Centre. Visit the WebGIS at <http://maps.awi.de/map/map>.

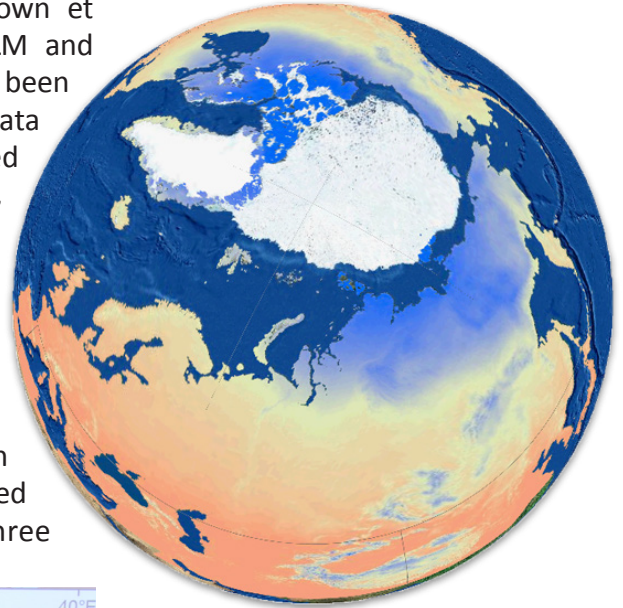


<http://maps.awi.de/map/map>
<http://apgc.awi.de/group/persys.html?cu=Globpermafrost>
Overview and the data catalogue at <http://apgc.awi.de/group/persys>.

Current views include the Arctic, Antarctic Peninsula, Central Asia, Andes and Alps. One can explore all datasets together with the permafrost map of Brown et al. (1997). The GTN-P, CALM and INTERACT site locations have been added for orientation. Data download will be facilitated through the catalogue, which will be linked with the WebGIS in the final project phase. All data sets will be published in PANGAEA by the end of the project (January 2019).

More than 30 research groups are currently associated with the project. Three

workshops have been carried out during 2017 at EGU, ACOP, and the Nunataryuk project kick-off to collect feedback on the developed services and coordinate validation activities. Service area extensions have been specifically requested by the community. The interaction with GTN-P and the IPA Permafrost Mapping Action Group is of high relevance to the project. A workshop dedicated to this exchange is planned during EUCOP 2018.



Above: A Northern Hemisphere potential permafrost distribution dataset based on an equilibrium model, including mean annual ground temperature as well as permafrost probability, has been developed by the University of Oslo.



Above: Team members present at the November workshop, from left to right: Guido Grosse, Sina Muster, Sebastian Laboor (AWI), Annett Bartsch (ZAMG), Birgit Heim, Antonie Haas, Ingmar Nitze (AWI), Jaros Obu (UiO), Alexandra Runge (AWI), Sebastian Westermann (UiO), and Tazio Strozzi (Gamma Remote Sensing). Further key team members include Frank Martin Seifert (ESA) and Claude Duguay (H2O Geomatics). External services are provided to the project by Goncalo Vieira (IGOT) and Achim Roth (DLR).



Upcoming events

2018

EGU General Assembly
8-13 April 2018
Vienna, Austria

POLAR2018
ASSW + SCAR + IASC meetings
15-27 June 2018
Davos, Switzerland

5th European Conference on
Permafrost (EUCOP 2018)
24 June-1 July 2018
Chamonix, France

Arctic Circle Assembly
19-21 October 2018
Reykjavík, Iceland

AGU Fall Meeting
10-14 December 2018
Washington, D.C., USA

2019

1st Southern Hemisphere Conference
on Permafrost (SouthCOP)
7-11 December 2019
Field excursions 4-6 & 12-14 December
Queenstown, New Zealand

2020

12th International Conference on
Permafrost (ICOP 2020)
22-26 June 2020
Lanzhou, China



The next regional conference of the IPA, the 5th European Conference on Permafrost, will take place 23 June to 1 July 2018 in Chamonix, France, at the foot of the Mont Blanc Massif. EUCOP 2018 is expected to attract more than 400 participants from all over the world to present and discuss their research within 26 topical sessions. These will cover relevant topics in permafrost research, like climate change impacts and adaptations, remote sensing, hazards assessment, geophysics, hydrology, monitoring techniques, geomorphology, engineering, and outreach and education.

The program includes three days of scientific sessions and two days of local excursions, which will give participants the opportunity to visit permafrost monitoring sites like the Aiguille du Midi mountain and the Dérochoir rock glacier. EUCOP 2018 will also host important side events such as IPA Council Meetings, PYRN activities, GTN-P meetings, a round-table on natural risks and a public conference in French for local people.

Social events include an ice-breaker, the Pétanque & Tartiflette night and a final banquet & concert. The conference will end with the oppor-

tunity to participate in one of three regional excursions: in Aosta Valley - from Mont Blanc to Matterhorn (Italy), in the Valais Alps - between Verbier and Zermatt (Switzerland) and in the French Alps - from Les 2 Alpes to Laurichard (France).

The Local Organizing Committee looks forward to warmly welcoming you in Chamonix and encourages the whole scientific permafrost community, especially young researchers and students, to attend the conference. For further information, visit <https://eucop2018.sciencesconf.org>.

THE INTERNATIONAL PERMAFROST ASSOCIATION

The mission of the International Permafrost Association 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 decision-makers, the general public, and educators.

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