IPA Action Group Application

Title of proposed Action Group:
Development of a pan-Arctic drained lake basin product

Action Group Contact(s):

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Objectives and scope of the Action Group:

Background:
Drained lake basins (DLB) are ubiquitous in permafrost regions. The long-term dynamics of lake formation and drainage is evident in the abundance of DLBs covering >60% of arctic lowlands in parts of arctic Alaska, Russia, and Canada (Grosse et al. 2013; Olefeldt et al., 2016). Following partial or complete drainage, DLBs evolve through time. As the basins age and ice-enrichment occurs, the ground heaves and vegetation communities evolve, exhibiting imagery and texture differences indicative of these changing edaphic conditions. This mosaic of vegetative and geomorphic succession can be discerned and used to make a landscape-scale classification employing various spectral indices derived from Landsat (Frohn et al. 2005, Jones et al. 2012), that when combined with field sampling and peat initiation timing can be used to scale across spatial and temporal domains. Localized research has demonstrated the importance of DLBs on carbon storage, GHG and nutrient fluxes, hydrology, geomorphology, and habitat availability (Hinkel et al. 2003, Bockheim et al. 2004, Jones et al. 2012, Lantz, 2016, Roy-Léveillée and Burn, 2017). A coordinated pan-Arctic scale effort is needed to better understand the importance of DLBs in permafrost-regions across the pan-Arctic.

Objectives:
Our objectives align well with those of the IPA in that we propose to foster the dissemination of permafrost-region knowledge and to develop scientific information relevant for applications in a diversity of permafrost-region fields. We are proposing a two-year IPA Action Group to create a pan-Arctic DLB product, to synthesize field information on DLB ages and carbon stocks, and to assess the importance of DLBs in the Arctic System. The pan-Arctic DLB product will be based on multi-dimensional remote sensing datasets and machine learning to develop the first ever pan-Arctic product. This objective will combine imagery and skillsets from our diverse action team group members. The synthesis of DLB ages and carbon stocks will include field observations and datasets that span from the 1950s to Present and include

sites in Alaska, Canada, and Russia. The DLB age and carbon stock database will allow us to further classify the DLB product to estimate the broad impact of DLBs in permafrost-regions as well as to estimate their vulnerability to climate change.

Action Group Significance:
Local and regional assessments indicate that DLBs are the most dominant landscape feature in lowland permafrost regions around the pan-Arctic. In spite of this recognition, a pan-Arctic assessment of DLB distribution and their carbon stores has never been attempted. Our proposed Action Group will fill a fundamental knowledge gap in permafrost-region landscapes with implications for global-scale climate feedbacks.

DLB Task Force:
We will bring together three generations of researchers from around the pan-Arctic with diverse skills in linking spatial and temporal data across broad regions. The DLB Action Group will include several early career researchers with multi-disciplinary skills in field studies, carbon science, permafrost science, and remote sensing - Helena Bergstedt, Ingmar Nitze, Alexandra Veremeeva, Juliane Wolter, Louise Farquharson, Matthias Fuchs, Benjamin Gaglioti. Benjamin Jones will co-lead the DLB remote sensing effort with Helena Bergstedt, Ingmar Nitze, and Alexandra Veremeeva. Guido Grosse will co-lead the basin age and carbon stock database development with several of the other early career researchers. Additional leadership of the Task Force will be provided by Mikhail Kanevskiy, Amy Breen, Anna Liljedahl, Annett Bartsch, Pascale Roy-Leveillee, Trevor Lantz, Frédéric Bouchard, and Gustaf Hugelius. Dr. Kenneth Hinkel will provide overall guidance based on his many years of research on DLBs in northern Alaska. The Action Group will also provide an opportunity for graduate students and other early career researchers to get involved.

During the course of the two-year Action Group activity we will participate in quarterly web-based component reviews with the IPA secretariat to ensure adequate steps are being taken to meet our objectives. An annual report will be submitted by December 2020. Datasets will be published, a journal paper submitted, and the final report submitted by December 2021.

Information Exchange:
The resulting data product will be made available online for the permafrost community to access and utilize in their own work. A comprehensive pan-Arctic DLB data set is of great interest to our scientific community and will benefit researchers working on projects of many different disciplines (e.g. hydrological modelling, engineering, carbon cycling). During the life of this Action Group we plan to conduct several workshops at different international conferences to present our results to the scientific community and receive input and feedback from scientists outside the Action Group to assure the products will meet the needs of the broader scientific community.

Timeline:
We propose 2 years for the duration of this Action Group (2020 to 2021). During these two years, the following deadlines will be met:

Milestone 1: June 2020
- *Inventory of available ages and data from DLB cores from around the Arctic*
- *Publication of DLB ages and carbon data*
- *Action Group meeting at ICOP organized by Dr. Bergstedt*

Milestone 2: September 2020
- *Inventory of remote sensing datasets and development of pan-Arctic mosaics complete that will be used in machine learning classification algorithms*
- *Development of training datasets for DLB-based remote sensing analysis*
- *Action Group meeting at 16th International Circumpolar Remote Sensing Symposium organized by Dr. Bergstedt*

Milestone 3: December 2020
- *First version of pan-Arctic DLB product complete*
- *Presentation at AGU 2020 in San Francisco*

Milestone 4: April 2021
- *Accuracy assessed pan-Arctic DLB product complete*
- *Sub-Group workshop at EGU in Vienna*
- *Virtual three day writing session for developing Nature Geoscience publication*

Milestone 5: October 2021
- *Submit paper to Nature Geoscience*

Milestone 6: December 2021
- *Session on DLBs at AGU in New Orleans*
- *Project complete*
- *Action Group celebration at local watering hole*

Deliverables:

The deliverables of this Action Group will encompass the pan-Arctic DLB data product suite which will be made available to the permafrost community and consist of:

- *Vector and raster-based DLB map products for the pan-Arctic*
- *Database on DLB ages and carbon stocks*
- *Publication submitted to Nature Geoscience*
- *Numerous conference abstracts*
- *Numerous conference workshops*

Other Action Group Members:

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International dimension:
This Action Group is a collaboration of scientists from multiple international institutions located in 6 IPA-member countries. The pan-Arctic nature of the planned work calls for a synthesis of data collected by different research teams across the Arctic. The lead institution for the DLB Action Group will be the University of Alaska – Fairbanks. Primary collaborating institutions include the Alfred Wegener Institute in Potsdam, Germany, Laurentian University and University of Victoria in Canada, University of Stockholm in Sweden, Université Paris Saclay in France, b.geos in Austria, and the Institute of Physicochemical and Biological Problems in Soil Science in Russia. Researchers and collaborators from other institutes working in different areas of the Arctic will be part of the project, contributing their expertise to the remote sensing analysis and contributing their field data to the synthesis of DLB ages for the pan-Arctic data product. These researchers are listed in the section above as other Action Group members. Members of the PYRN early career researcher community will be strongly involved in all stages of this Action Group. We are planning to hold several workshops at different

international conferences to reach a diverse scientific audience (including PYRN members) to showcase our progress and receive input from the international permafrost community. We anticipate the Action Group network will grow over the course of the project.

Budget:
For a successful execution of this Action Group we believe that a budget of 2500€ per year (5000€ in total) will allow us to hold the planned workshops that are crucial for coordinating and presenting our work as well as for receiving the necessary feedback and input from the permafrost community. The requested funds will also be used to cover journal publication page charges and outreach activities. The Action Group is planned to cover the time span of two years.

The DLB Action Group will leverage resources being provided by the US National Science Foundation for a grant focused on lakes and lake drainage in northern Alaska that is funded until 2021. Here is a link to the award page –
https://www.nsf.gov/awardsearch/showAward?AWD_ID=1806213&HistoricalAwards=false
Other project funding and product development will be leveraged from colleagues at AWI and b.geos.

Secretarial support:
We are planning several workshops for the DLB Action Group and our planned data products. The workshops which would happen during international and regional permafrost conferences would benefit from some support from the IPA secretariat in form of establishing a connection with the local organizing committees. We would also benefit from the Secretariat participating in our quarterly progress reviews.

Please submit a PDF with these fields completed to the IPA Secretariat email at contact@ipa-permafrost.org. Applications must be submitted on or before November 1, 2019.