



IPA Action Group Application

Date:

01 July 2020 to 30 June 2022 (24 months)

Action Group Contact:

Prof. Reynald Delaloye, Department of Geosciences, University of Fribourg, Switzerland, +41 26 300 90 21, reynald.delaloye@unifr.ch

Title of proposed Action Group:

Rock glacier inventories and kinematics (phase II)

Objectives and scope of the Action Group:

Background:

In mountainous terrain, frozen ground with sufficient ice content may be continuously in motion. Considerable volumes of fine- and coarse-grained debris are involved in building up rock glaciers as a typical morphological feature of the mountain periglacial zone. Even if there is still many discussions about the actual movement processes, rock glaciers appear to move at a rate, which is in particular depending on the temperature profile between the permafrost table and the main shear horizon at depth. Warmer permafrost conducts to higher motion rate, especially when the temperature is rising close to 0°C. Such warming may even lead to subsequent partial or complete destabilization of the rock glacier.

Rock glaciers inventories have been set up in many regions over the world for decades but without coordination. Whereas rock glaciers have to be primarily identified as geomorphological items of the mountain landscape, the development in remote sensing technologies and the greater availability of appropriate satellite imagery is permitting to include kinematic information within rock glacier inventories. New and sometimes overlapping initiatives for (re-)inventorying rock glaciers are rising in many regions with various methodologies. There is an obvious need for coordination and as far as possible for standardization.

Monitoring of rock glacier velocities provides clue information on the transfer rate of sediments along mountain slopes and on the impact of climate change on rock glacier stability. Observing or deriving a rock glacier kinematic variable on a global scale appears to be technically feasible using in particular satellite SAR interferometry, but also in combination with terrestrial geodetic surveys and photogrammetry analyses.

Doing so, rock glacier kinematics is promising to become a key parameter in the monitoring of the cryosphere in mountain regions and may also build up a unique validation dataset for climate models in mountain regions, where direct permafrost (thermal state) measurements are mostly lacking.

Objectives:

The Action Group intends to sustain the first steps toward the organization and the management of a network dedicated to rock glacier mapping (inventorying) and monitoring in all relevant mountain regions on Earth including definition of the necessary standards.

More specifically the Action Group aims to coordinate efforts to:

- (a) - define widely accepted standard guidelines for inventorying rock glaciers in mountain permafrost regions, including indication on the activity rate,
- (b) promote the use of satellite SAR interferometry, e.g. Sentinel data, for monitoring the rock glacier activity at a regional scale and define appropriate standards and guidelines,
- (c) integrate so far as possible local-scale based monitoring data based on aerial and terrestrial geodetic surveys
- (d) initiate the development a world-wide rock glaciers database, including kinematics,
- (e) set up standard guidelines for selecting an appropriate number of rock glaciers per region that can be then used to assess temporal trends with decadal to intra-decadal time steps,
- (f) build-up and manage a web platform for visualization and open data access.

The Action Group is expecting that in the long run rock glacier kinematics could be recognized by the permafrost community (e.g. GTN-P) and later by the WMO as a new associated parameter to the ECV Permafrost, characterizing the evolution of mountain permafrost on the global scale. Rock glacier kinematics could be integrated in the monitoring strategy of international programs in addition to the observation of permafrost thermal state and active layer trends.

Steps to meet the objectives:

The Action Group has launched its activities in June 2018 at EUCOP5. It is currently regrouping 100 subscribers, among them 40 participated to a first workshop in Evolène, Switzerland (sept. 2019) dedicated to the definition of the baseline concepts towards the set up of a global rock glacier inventory. The next workshop will be held in February 2020 in Fribourg (Switzerland) and will concentrate on initiating the development of ECV-oriented products related to the kinematic of rock glaciers.

The current application is aiming to get the support of IPA for the continuation of the action for two more years (Phase II, from mid-2020 to mid-2022). The Action Group will further be chaired by Reynald Delaloye, and the scientific aspects will be coordinated by a core group of rock glacier kinematics specialists, including young researchers, but also depending on the task, by other subscribers to the action.

The Action Group is basically communicating via its webpage (see URL below) and the associated mailing list. One or two workshops are foreseen during the phase II, depending on the advancement of the works and the necessity to meet. It is currently envisaged to organize at least one workshop in Mendoza (Argentina) in early 2022 as a conclusion of the action, including field trip to rock glaciers.

<https://www3.unifr.ch/geo/geomorphology/en/research/ipa-action-group-rock-glacier/>

The activities of the Action Group, in particular the development of ECV-oriented products, are also supported by the ESA (European Space Agency) through the “Mountain Permafrost” option of the CCI+ (Climat Change Initiative) project (09.2019-02.2021).

Benefits

We see three main benefits for the cryosphere and climate communities:

- Open access to the largest possible database on rock glacier occurrences, including kinematics information;
- Consensual guidelines for a standard implementation of the inventorying methodology in the many not yet systematically explored mountain regions;
- Development of regional rock glacier kinematics indices, which could be on the long run possibly integrated into Global Terrestrial Network on Permafrost (GTN-P)

Research communities involved in the assessment and monitoring of mass wasting processes in cold mountain environments is mainly targeted by this action. But more generally, providing tools and standards for monitoring rock glaciers will serve any instance involved with the management of cold mountain slopes and related hazards in particular. Regional to local monitoring programs (e.g. PERMOS Permafrost Monitoring in Switzerland, PERMAFRANCE Permafrost Monitoring in France) will also benefit from products that may result from this action. Countries where large efforts have already been made to inventory rock glaciers, like for instance Chile, Argentina or Austria who developed nation-wide inventories, will also be very interested in the initiative for improving their existing inventories with the kinematics variable.

Timeline:

The timeline spans 2 years (from mid-2020 to mid-2022).

The first year will be mainly devoted to :

- a) the edition of standardized *practical guidelines* for inventorying rock glaciers, including kinematics information (in the continuation of the 2019 Evolène workshop), and
- b) the development of the ECV-oriented products (*regional index for rock glacier kinematics*) (in the continuation of the 2020 Fribourg workshop).

The consolidation and further necessary development of both elements, as well as the designing of a global rock glacier database are planned for the second year.

Deliverables:

- *Practical guidelines* for inventorying rock glacier, including kinematics information
- Beta-version of web platform for open access to a global rock glacier inventory and related kinematic information
- Prototype of *regional indexes for rock glacier kinematics* (ECV-oriented product)
- Presentation during international conferences (mainly EGU, AGU, EUCOP, ICOP, ...)

Other Action Group Members:

- Dr Chloé Barboux, University of Fribourg, Department of Geosciences, Unit of Geography, Switzerland. Email: chloe.barboux@unifr.ch, tel : +41 26 300 90 26
- Dr Christophe Lambiel, Institute of earth surface dynamics, University of Lausanne. Mouline – Géopolis, CH-1015 Lausanne, Switzerland. Email: christophe.lambiel@unil.ch, tel: +41 21 692 30 64

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- Dr Xavier Bodin, Laboratoire EDYTEM, CNRS/Université Savoie Mont-Blanc, Pôle Montagne – campus scientifique de l'USMB, 73376 Le Bourget-du-lac, France. Email: xavier.bodin@univ-smb.fr, Tel : +33-4-79-75-94-43
 - Dr Andreas Kellerer-Pirklbauer, Department of Geography and Regional Science, Working Group Alpine Landscape Dynamics (ALADYN). University of Graz, Austria. Email: andreas.kellerer@uni-graz.at , Tel: +43 316 380 8844
 - Dr Lin Liu, Earth System Science Programme, Faculty of Science, The Chinese University of Hong Kong. 315 Mong Man Wai Building, Email : liulin@cuhk.edu.hk, Tel: (852)-3943-9862
 - Prof. Atsushi Ikeda, Faculty of Life and Environmental Sciences University of Tsukuba, Ibaraki 305-8572, Japan. Email: aikeda@geoenv.tsukuba.ac.jp, Tel: +81-29-853-4460
 - Prof. Alexander Brenning, Faculty of Chemistry and Earth Sciences, Department of Geography, Friedrich Schiller University Jena, Germany, E-mail : alexander.brenning@uni-jena.de Tel: +49-3641-948850
 - Dr. Dario Trombotto Liaudat, IANIGLA- CCT CONICET Mendoza, Argentina, E-mail: dtrombot@lab.cricyt.edu.ar, Tel: +54 – 261 – 524 4208
 - Prof. Viktor Kaufmann, Institute of Geodesy, Remote Sensing and Photogrammetry Working Group, Graz University of Technology, Austria, Email: viktor.kaufmann@tugraz.at, Phone: +43 316 873 6336
 - Dr Lea Hartl, IGF - Institut für Interdisziplinäre Gebirgsforschung, Österreichische Akademie der Wissenschaften, Innsbruck, Austria, E-Mail : Lea.Hartl@oeaw.ac.at , Tel: +43(0)512 507 41410

Young researchers

- Sebastian Vivero Andrade, Institute of earth surface dynamics, University of Lausanne. Moulins – Géopolis, CH-1015 Lausanne. Email: Sebastian.ViveroAndrade@unil.ch, Tel: +4121 692 43 39
- Brianna Rick, Colorado State University, Warner College of Natural Resources, USA. E-mail: Brianna.Rick@colostate.edu
- Hideyuki Takadama, Niigata University, Japan. Email : hide.takadama@gmail.com
- Marco Marcer, Laboratoire PACTE, Institut d'Urbanisme et de géographie alpine, University of Grenoble Alpes. Email: marco.marcer@univ-grenoble-alpes.fr
- Yan Hu, Earth System Science Programme, Faculty of Science, The Chinese University of Hong Kong, Hong Kong, China. Email: huyan@link.cuhk.edu.hk, Tel: +852 39439324

Requested funds will be primarily used to support travel costs for young researchers, to participate to the Action Group Workshop(s).

International dimension:

The scientific core group includes so far recognized experts from already six different countries that have large experience in rock glacier mapping and monitoring in many different mountain ranges. Most of them are already used to collaborate bilaterally or multilaterally for years in activities going for instance from research projects (e.g. the Alpine PERMANET project) to rock glacier dedicated papers (e.g. Delaloye et al. 2008, NICOP Proceedings; Kellerer-Pirklbauer et al, in progress). By their personal contacts, the members of the core group have also the connection to most of the scientists working currently on rock glacier issues, what is insuring for the Action the opportunity to be largely supported dedicated scientific community. The Action group intends also to actively collaborate with other Perma-

frost science communities. This will allow for improving the standardized rock glacier inventorying and monitoring strategy, as well as delivering our results to answer scientific questions.

Budget:

The requested budget (2 x 2500€) would be really appreciated to help the organization of the workshop(s) and in particular to sustain the participation of the young researchers.

Secretarial support:

Not specifically foreseen at the moment.