December 2013
Proposal for an

IACS Working Group on the Randolph Glacier Inventory and infrastructure for glacier monitoring

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1. MOTIVATION

The Randolph Glacier Inventory (RGI; Arendt et al., 2013; Pfeffer et al., 2014) is a globally complete collection of digital outlines of glaciers, excluding the ice sheets. The RGI was created with limited resources by an ad-hoc group of scientists in a short period to meet the needs of the Fifth Assessment of the Intergovernmental Panel on Climate Change (IPCC) for estimates of recent and future glacier mass balance. Priority was given to complete coverage, if necessary at reduced quality, rather than to extensive attributes or documentary detail.

The RGI has proven highly valuable and has been used extensively since its first release in 2012. For example, the RGI has been used to compute regional and global glacier area (Gardner et al., 2013) and glacier volume (Huss and Farinotti, 2012; Marzeion et al., 2012; Grinsted, 2013; Radić et al., 2013) as well as thickness distributions (Huss and Farinotti, 2012) and area-altitude distributions (e.g. Radić et al., 2013). The completeness of the RGI has eliminated the need for upscaling (Radić and Hock, 2010) or simplifying assumptions, and has provided an indispensable basis for updated global-scale assessments and projections of glacier mass budgets (Marzeion et al., 2012; Gardner et al., 2013; Giesen and Oerlemans, 2013; Hirabayashi et al., 2013; Radić et al., 2013) that fed into the IPCC's Fifth Assessment Report.

Since 2000, glacier outlines have been archived at the U.S. National Snow and Ice Data Center (NSIDC) as part of the GLIMS (Global Land Ice Measurements from Space) initiative launched in

1995. Multi-temporal outlines are available, allowing glacier change detection. However, GLIMS outlines cover less than 75% of the world's glacier area, and completion of GLIMS is not foreseen in the near future. Also, data retrieval from GLIMS on global/regional scales is not straightforward. Hence, we anticipate that, at least for regional/global glacier mass-balance studies, the RGI will remain the main data source until the two datasets are merged (see below). Therefore, we propose a 4-year IACS Working Group (March 2014–February 2018) as an organizational framework to correspond to the exisitng framework within which GLIMS operates.The proposed work has the aim of further developing the RGI by increasing the accuracy of its outlines and the number of attributes attached to each outline. This will provide the glaciological community with the necessary base data for global-scale mass-balance studies, thus meeting the needs of upcoming assessments such as those of the IPCC in a timely way.

In the long term it does not make good sense for there to be two glacier databases with such similar content as the RGI and GLIMS. Thus one of the objectives of the Working Group is to oversee the gradual merger of these two databases. Their content is not identical, and the process of fusion requires consideration of how to retain the functionality and features of the RGI, expanded as outlined in the next section, as part of an expanded GLIMS. This is likely to require some time and may or may not be complete by the end of the Working Group's term.

2. OBJECTIVES

The proposed Working Group has the following general objectives:

A) To maintain and develop the Randolph Glacier Inventory as a resource for global/regional-scale mass-balance assessments and projections

Goals

1. Enlarge the set of attributes of the current RGI version 3.2, for example:
   - topographic (hypsometry, slope, aspect, min/max elevation, area, length, …)
   - glaciological (ice thickness, debris cover, climatic variables, glacier morphology (valley glacier vs ice cap), glacier type (lake/ocean-terminating, surge-type, …)
   - hydrographic (drainage basins)
   - political (national boundaries)
   - sources, dates
2. Improve the quality of glacier outlines where necessary
3. Periodically release updated versions of the inventory
4. Develop, document and make available tools for deriving inventory attributes

B) To work towards merging the RGI into GLIMS

Goals

1. Ensure that there is no duplication or omission during merging, and that the functionality and features of the RGI (such as region-wide downloads and RGI-like representation of nunataks) are retained in the future GLIMS
2. Advise GLIMS on enhancements of the GLIMS data model to facilitate global/regional-scale analysis
3. Discuss and plan the eventual fusion of the two databases

C) To develop a model for medium-term support of the RGI, for example for purposes of the next IPCC assessment

Goals

1. To explore prospects for increased funding to support the RGI
2. To liaise with relevant organizations (e.g. GTN-G: GLIMS, NSIDC, WGMS) to optimize data submission and data provision for glaciological users

3. DELIVERABLES AND MILESTONES

1.) **Updated versions of the RGI** with enhanced attribute set (target dates for new releases: June 2014, and annually thereafter)
2.) A **technical document** explaining in detail the derivation of the new attributes and their potential uses (released with each annually updated version)
3.) An **RGI-related session** at a suitable international conference, for example, IUGG 2015 in Prague; we expect also that numerous peer-reviewed publications will rely on updated versions of the RGI, building on results already published (see section 1) and extending into fields such as glacier hydrology and water resources in which the RGI has not yet been exploited fully

4. WORKING PROCEDURE

The Working Group will consist of both users and providers of inventory products, to ensure that the products are as accessible and useful as possible for the glaciological community. The Working Group will form subsets of members to accomplish each of the goals set out above, especially those in section 2A. In addition to regular communication by email/skype, we also plan two 1-day RGI workshops before or after other conferences. The first workshop, to be convened at the end of year 1, will focus on progress to date and ways of optimizing workflows for the remaining three years. The second workshop, at the end of year 3, will focus on the future of the RGI as a resource for long-term glacier monitoring in the context of societal responses to climatic change. We anticipate applications to IACS for support of these workshops.

If it is established, we will liaise closely with the working group on “ice thickness and volume evaluation” co-chaired by Dr. H.L. Li, and we will ensure that at least one person is a member of both groups.

5. CONCLUSION

In its present form the RGI is a globally complete dataset of glacier outlines with a limited set of attributes attached to each outline. We propose this IACS Working Group as a medium for ensuring both that the glacier outlines are updated as and when improved information becomes available, and that a richer set of attributes can be developed and added in a planned, orderly way.

Some of the goals described above can be realized quickly. For example the addition of hypsometric data for every RGI glacier is a problem that has already attracted much interest. It requires only technical decisions about formatting, and a moderate investment of effort, to be considered solved. It is an instructive example because a) it offers a huge payoff in convenience for students of glacier–climate and glacier–landscape interactions: a standardized hypsometric product (Paul et al. 2009) of acknowledged uniform quality would save much diffuse effort and would reduce uncertainty arising from the use of different topographic sources; and b) brief reflection makes it obvious that the best way to maintain the hypsometric part of a global glacier inventory is to do so at a central repository housing the necessary digital elevation models. Thus the topographic part of Goal A1 relates directly to Goal A4 (a standardized hypsometric tool would be very valuable) and to Goal C1 (it may not be possible to fund the labor required for maintenance from resources at current levels); moreover, centrally-calculated hypsometric data will be equally valuable for the RGI and for GLIMS, thus reinforcing Goal B2.

Other goals that are attainable over the 4-year lifespan of the Working Group are nevertheless more distant, because so far little concentrated thought has been devoted to them. For example digitized outlines of drainage basins, although widely used in hydrology, are less widely available in forms suitable for glaciological investigations; in the latter, positional accuracies of the order of 10 m or finer are needed in headwater catchments while coarser resolution is acceptable downstream. Similarly, although debris cover is widely acknowledged as an influence on glacier mass balance, until recently (e.g. Gardelle et al., 2012) it has been little studied as a factor complicating broadscale mass-balance estimates. The proposed Working Group will be a forum for discussions that will lead to practical and accurate solutions for these and other complicating factors.

6. REFERENCES

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