IACS Working Group on Debris Covered Glaciers

Status report for the period June 2019 – November 2020

This is the second report of the WG, which was established in September 2018 aiming to advance our ability to map debris thickness, identify model complexity required to estimate sub-debris melt coordinate knowledge exchange on debris covered glaciers.

1) Melt model intercomparison:

Consistent data preparation, quality control and model simulations took longer than expected to gather, however, a final draft of a multi-author publication (led by Francesca Pellicciotti) comparing 14 sub-debris melt models over 9 locations is intended for submission before the end of 2020. Key findings and progress were discussed at a WG meeting at IUGG in Montreal and several successive focus meetings.

Title: DCG-MIP: The debris-covered glacier melt model intercomparison experiment

Abstract: *We present an intercomparison experiment aimed at advancing our understanding of the skill of models of different complexity to simulate ice melt under a debris layer. We compare 14 models at nine distinct sites in the European Alps, Chilean Andes, Nepalese Himalaya and Alps of New Zealand, over one melt season. We provide a definition of model complexity, and arrange the models along an axis from low to high complexity. We run the models with meteorological input measured at automatic weather stations, using estimated or measured debris properties, and compare model performance against validation datasets of surface lowering (for all models) and surface temperature (for the energy balance models). We then assess model performance at different sites, identify model strengths and limitations, and provide an understanding about the impact of a choice of model on modelled results. We also attempt to identify model deficiencies stemming from lack of data and identify data needs. Simple temperature index models perform very well when recalibrated, and, as expected, poorly when uncalibrated. Energy balance models show a range of performance and model skills. The EB models that perform best are those with the highest degree of complexity at the atmosphere-debris interface. However, addition of complexity within the debris and at debris-ice interface does not improve performance, because of lack of data to characterise the debris layer and within-the-debris processes. An important data gap emerged from our experiment: the poor performance of all models at the three sites of Djankuat, Lirung and Tasman was related to poor knowledge of debris properties, and thermal conductivity in particular. Debris properties are a major control on melt simulations and model performance, and we argue that there is a need for consistent data acquisition efforts to be combined with both existing models and new model developments. Indeed, there is still large potential for model improvement and developments and suggest a systematic effort of model development using a single model framework could be carried out in a subsequent WG activity.*

2) Conference sessions:

Well-attended conference sessions, stimulating good discussion and networking opportunities were proposed and (co-) chaired by WG members at:

- IUGG 2019: C09 - Debris covered Glaciers
- AGU 2019: C41E - Processes on, Within, and Around Debris-Covered Glaciers
- EGU 2020: CR4.1/GM7.8 -Evolution of glacial-periglacial-paraglacial landscapes and debris-covered glaciers

3) **Working group meetings:**

Working group general meetings were held alongside the three conference events listed above. In addition several focus group meetings were held to progress the melt model intercomparison activity (see point 1). The current membership stands at 66, coming from 18 nations, with 1/3 of the members being female.

4) **Special issue in Frontiers is online and underway:**

The Frontiers Journal Research Topic "Debris-Covered Glaciers: Formation, Governing Processes, Present Status and Future Directions", edited by WG members is now accepting submissions, and has over 40 registered intended submissions. We hope this will represent the state of the knowledge in 2020 (https://www.frontiersin.org/research-topics/15132/debris-covered-glaciers-formation-governing-processes-present-status-and-future-directions)

5) **Web outreach:**

We have taken over a previously established website www.rockyglaciers.org (started by Scott Watson with an updated international URL, and also established the @rockyglaciers.twitter handle with over 1000 followers. We hope to encouarage especially ECS WG members to contribute and take over these outlets for set periods of activity, which would help maintain activity and production of original content here.

6) **Data sharing platform and planned publication:**

The shared zenodo data space has 20 unique data entries currently stored there. A list of >100 further datasets that the community wishes to publish as freely available datasets with an accompanying **Earth System Science Data** (**ESSD**) publication was collected in the first half of 2020, and an outine of the content of this contribution is in preparation for discussion at the WG meeting planned for the period of AGU 2020.

7) **Debris thickness mapping**

This WG activity was not scheduled for this year, but several WG members have independently made some advances that will help define the relevant information gap to be addressed in the community effort to assess our ability in this in 2021.

8) **Funding aspects:**

We have spent GBP 98.88 for the hosting of rockyglaciers.org for 10 years. We have advised ECS and WG members lacking funding that we have some financial capacity to support them in participating in WG activities, but this has not been taken up.