Regional Assessments of Glacier Mass Change (RAGMAC), (2020 – 2023)

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Objectives and work packages

The overall goal of this working group (WG) is bringing together the research community that is assessing regional glacier mass changes from various observation technologies and to come up with a new consensus estimate of global glacier mass changes and related uncertainties. The WG is organized in three work packages (WPs), two related to different remote sensing technologies and a third that aims at regional comparisons of corresponding results. In 2022, the main focus was on the implementation and analysis of a glacier volume change intercomparison experiment, the submission and revision of a review paper on "Measuring Glacier Mass Changes from Space" (Berthier et al., 2023), and on the launch of the "Glacier Mass Balance Intercomparison Exercise (GlaMBIE; https://glambie.org)" funded by the European Space Agency.

Key achievements

After acceptance of the RAGMAC WG proposal by IACS in 2019, the co-chairs jointly started to bring the WG to life and action. The WG co-chairs started to tackle the proposed tasks (cf. proposal) and have been coordinating the work in about bi-monthly co-chair meetings.

The following list provides an overview on the main outcome that has been achieved so far:

- RAGMAC web page: https://cryosphericsciences.org/activities/wg-ragmac/
- RAGMAC proposal: https://cryosphericsciences.org/wp-content/uploads/2020/01/IACS_WG_RAGMAC_Proposal_2019.pdf
- RAGMAC kickoff presentation, including videos of kickoff meetings: https://prezi.com/view/hZHOtiJ6MGsBnCSr8hyO/
- RAGMAC webinars, posters, and papers: https://prezi.com/view/FiKMliBaGgS4blhoatf3/
- Research topic in Frontiers in Earth Sciences: https://frontiersin.org/research-topics/9957/observational-assessments-of-glacier-mass-changes-at-regional-and-global-level
- ESA's Glacier Mass Balance Intercomparison Exercise (GlaMBIE; https://glambie.org)

At present, RAGMAC counts 63 members (willing to actively contribute to WG) and 61 friends (interested in news and events).

In the following, we briefly summarize the main activities of the RAGMAC WG in 2022, followed by short statements on funding and outlook.

WP 1, Glacier mass changes based on glaciological and geodetic (DEM differencing) methods

The main goals of WP1 are to (i) develop best practices for geodetic estimates of glacier mass changes and related uncertainties and to (ii) improve the global coverage of geodetic glacier change assessments.

Main activities in the current year include:

- Refine working concept within co-leads meetings.
- Active call-for-data for glaciological and geodetic mass changes through the World Glacier Monitoring Service (WGMS; https://wgms.ch/).
- Coordination of geodetic data integration with groups working on major regional mass change assessments within the Copernicus Climate Change Service (C3S; https://climate.copernicus.eu/) run by the WGMS. Note: with the integration of the geodetic results by Hugonnet et al. (2021, Nature; https://doi.org/10.1038/s41586-021-03436-z), the WGMS database has reached almost global coverage.
- Implementation of the “Glacier volume change intercomparison experiment”, which was kicked off in October 2021. We received around 50 experiment runs from a dozen research groups. Analysis and paper preparation is in progress. Data and more information are available from: https://www.geo.uzh.ch/microsite/ragmac_experiment_data/

WP 2, Glacier mass changes based on altimetry and gravimetry

The main goal of WP2 is to develop best practices for the propagation of errors in glacier mass-change estimates derived from satellite altimetry and gravimetry.

Main activities in the current year include:

- Refine working concept within co-leads meetings.
- Co-lead workshop to define the concept and outline of a white paper on assessing glacier mass changes and related uncertainties from GRACE/GRACE-FO, ICESat, ICESat-2, and CryoSat-2. The results of this work served as input to a review paper of WP3.

WP 3, Regional comparisons of glacier mass changes from different methods

The main goals of WP3 are to (i) encourage regional assessments of glacier mass changes, (ii) foster open and free access to glacier data, (iii) define a common framework for regional-scale mass change estimates and identify best method(s) for each large-scale

glacier region, and to (iv) develop a consensus estimate of regional and global mass changes from glaciological, geodetic, altimetric, and gravimetric methods.

Main activities in the current year include:

- Refine working concept within co-leads meetings.
- Coordination with the IACS WG on the Randolph Glacier Inventory (RGI , https://cryosphericsciences.org/activities/working-groups/rgi-working-group/)
- Review paper by Berthier et al. (2023, Reports on Progress in Physics) on "Measuring Glacier Mass Changes from Space" with contributions by WP1 and WP2 co-chairs.
- Kickoff and first activities of ESA's "Glacier Mass Change Synthesis Exercise" (GlaMBIE; https://glambie.org/), with RAGMAC co-chairs as Scientific Advisory Committee.
- Initial work on paper about differences and comparability of regional glacier mass-change assessments within GlaMBIE.

Events

In 2022, RAGMAC reached out to the community with the following events:

- EGU General Assembly, May 2022, Vienna, AT, glacier monitoring session.
- ESA Living Planet Symposium, May 2022, Bonn, AT, RAGMAC & GlaMBIE presentations & community event.
- Cryosphere 2022, August 2022, Reykjavik, IS, RAGMAC & GlaMBIE presentations.
- AGU Fall Meeting, December 2022, Chicago, US, glacier monitoring session.

Funding

Up to 2022, the RAGMAC WG was run without funding. In 2023, we received IACS support for a RAGMAC face-to-face workshop held in Zurich 6-8 February 2023.

Outlook 2023

Besides the continuation of the planned work in the three WPs, we have submitted RAGMAC-related sessions and workshops for EGU General Assembly 2023, Vienna, AT, in April 2023 and the IUGG General Assembly Berlin, DE, in July 2023. A main focus will be to coordinate and consult the ESA GlaMBIE and to engage a wide community participation (in particular from the RAGMAC community) in this endeavor. The outcome of the glacier intercomparison experiment of WP1 has been summarized in a manuscript, which currently is in review with the participants of the experiment. In addition, we have started a discussion with members and friends of RAGMAC about potential follow-on working group(s).