



WGMS WORKSHOP ON MEASUREMENT AND UNCERTAINTY ASSESSMENT OF GLACIER MASS BALANCE

Tarfala, Sweden, 9–11 July 2012



The venue – Tarfala Research Station.

From 9–11 July 2012 the World Glacier Monitoring Service (WGMS), in collaboration with Stockholm University, organized a workshop on measurement and uncertainty assessment of glacier mass balance. The workshop built on the results and experience of earlier workshops in Tarfala in 1998 (Published in *Geogr. Ann. A*) and in Skeikampen, Norway, in 2008 (published in *Ann. Glaciol.*). It was held at the Stockholm University Tarfala Research Station in northern Sweden. The major aims of the workshop were to discuss methods and to identify and quantify related uncertainties of mass balance measurements from the ground, air and space, as well as to provide

best practices for the homogenization, validation and recalibration of (long-term) observational series. In view of the increasing number of long-term mass-balance series and the fact that there are several glaciers where the geodetic and glaciological results largely diverge, there is a strong need to address the questions raised. The meeting was attended by experts currently performing and (re-)analysing mass-balance measurements by means of glaciological and geodetic methods.

After a long day of travel (participants arrived from North America, Europe and Asia), the group reached Tarfala Research Station in the early evening and was warmly welcomed by the station staff. The station is located in a sub-Arctic alpine environment in the Tarfala valley at 1130 m a.s.l. in the Kebnekaise Mountains, Swedish Lapland. The valley is surrounded by peaks up to 2000 m a.s.l., including the highest Swedish mountain, Kebnekaise Sydtoppen. The station is fully modern with running water and electric power despite being 25 km from the nearest road. It can be reached by foot or by a scenic helicopter flight from the nearest village, Nikkaluokta, a small Sami village near Kiruna. In close vicinity to the station and in direct view from the station's terrace or comfortable living room, the surrounding glaciers can be admired. This includes renowned Storglaciären with its detailed and long mass-balance series, available since 1945/46.

The first day of the workshop included keynote presentations as input for the subsequent discussions on how to tackle the issues mentioned above. These covered uncertainties and problems



The workshop participants, with Isfallsglaciären in the background.



The audience was attentive.



Are Hallgeir and Chris pointing to the highest summit in Sweden (less high than Galdhøpiggen)?

related to the direct glaciological method, re-analysis of long-term mass-balance series and homogenization methods, and co-registration and bias correction of elevation data. Newly available techniques such as airborne laser scanning as well as statistical tools to assess the quality of mass-balance series were discussed, too.

The second day brought an excursion to Storglaciären with on-site discussions of issues discussed the day before. The group safely hiked to Storglaciären (about one hour from the research station) and entered the glacier for an easy walk. The Tarfala staff was mindful of the safety of each participant, and found a compromise on how to tie all members to the rope in the same way. All participants carry out mass-balance measurement on their respective glacier according to certain standards, but apparently everyone uses a unique knot system for the rope. Because there was plenty of snow from last winter, the rope was essential because the glacier was still nearly completely snow-covered, which is rather unusual. In fact, several members of the group unknowingly walked across a large moulin plugged with snow. During the walk, the group got valuable information on the current mass-balance programme and about glacier dynamics, as well as an interpretation of the impressive moraine formations in front of Storglaciären. At the end, an especially motivated sub-group decided to extend the excursion and climb Kebnekaise. Note that there is a north and a south summit, and they even climbed both of them. During the gathering at evening dinner, they reported not only the marvellous view from the top, but also the terrible smell between the two summits, stemming from huge amounts of kerosene that were released by the Norwegian C-130J-30 Hercules plane crash on 15 March 2012. The Tarfala staff is now monitoring the snow and water in the surrounding valleys to evaluate the extent of contamination of the water in the area.



An easy walk on Storglaciären.

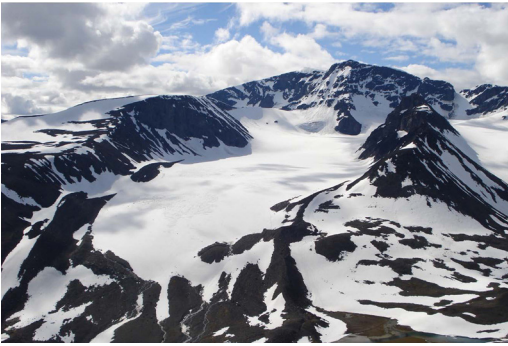


The interior of Storglaciären is equally well investigated.



Bernhard and Erich Heucke attended as guests – and undertook the servicing of the Heucke Ice Drill.

The third workshop day was fully dedicated to discussions in groups and in the plenum. As a final outcome of the workshop, a joint publication in a peer-reviewed journal is in preparation and will be made available as soon as ready. It will include a review based on the expertise of the workshop participants working with long-term monitoring mass-balance programmes, supplemented with best practices for assessing the uncertainty of glacier mass-balance series. In the evening, the group once again enjoyed culinary treats (Lappish



View of Storglaciären and Kebnekaise.



The local reindeer ignored the excursion group.



The station dog was glad to have friendly visitors who were clearly taking full advantage of the local hospitality.

food) prepared by the Tarfala staff. The hospitality of the staff and the setting of the venue greatly supported the spirit of intensive and constructive discussions during the workshop. This also included animated conversation in the evenings, stimulated by the diverse specialities that the participants brought along from their home. To calm down afterwards, there was the possibility of taking a hot sauna next to the river until midnight or later!

After a couple of days of excellent weather, Tarfala showed its characteristically glacier friendly weather of low temperature rain and fog in the morning of the departure day. Participants therefore had to hike out from the valley to the road at Nikkaluokta to catch ferry flights.

The workshop was supported by the Wenner-Green Foundation, the Marcus Wallenberg Foundation for International Cooperation in Science, the International Association of Cryospheric Sciences and the International Glaciological Society.

Samuel Nussbaumer, Peter Jansson and Michael Zemp

PS: A detailed workshop report is available from: http://www.wgms.ch/mbw_tarfala.html



Is everything ready for drinks?



The workshop participants and the station staff enjoyed a festive dinner together.

Ice

News Bulletin of the International Glaciological Society

Number 160

3rd Issue 2012

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Cover picture: A ~5 cm section of firn and melt from an ice core (photo by Peter Neff/US National Ice Core Laboratory)

Scanning electron micrograph of the ice crystal used in headings by kind permission of William P. Wergin, Agricultural Research Service, US Department of Agriculture

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