

Name of research institute or organization:

**Laboratory of Radiochemistry and Environmental Chemistry,
Paul Scherrer Institut**

Title of project:

Determining winter snow accumulation with shallow firn cores

Project leader and team:

Prof. Margit Schwikowski, project leader
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Dieter Stampfli, Felix Stampfli (FS INVENTOR)
Prof. Susan Kaspari, Central Washington University, Ellensburg, USA

Project description:

In the frame of a new SNF project „Helicopter-borne GPR for mapping snow accumulation distribution“, snow accumulation, its spatial distribution and its water equivalent are investigated. The development of the winter snow accumulation has a strong impact on the future management of water resources and tourism in the Alps, but also directly affects important cryospheric processes, such as snow avalanche hazards, glacier mass balance and permafrost degradation. In high-alpine terrain snow depth can vary by one order of magnitude over distances of a few meters. Measurements are laborious and only possible with direct surveys in the field. No easily applicable models for the spatial snow accumulation distribution are available to date. Therefore, tools to identify the spatial distribution of snow are an urgent need and would contribute to a much better understanding of the highly variable spatial distribution of snow.

In this collaborative effort, involving scientists from the Université de Fribourg and PSI, a new technology for monitoring and determining the spatial distribution of snow in high-alpine terrain by the application of innovative helicopter-borne GPR techniques is applied and further developed. This technology is used to accurately map the pattern of spatial variability in the snow cover in high-alpine terrain. The helicopter-borne GPR soundings are performed in combination with extensive ground based measurements (snow probing, snow/firn coring, ground-based GPR reference measurements, pits, etc.) to assess the uncertainties. The team from PSI is responsible for in-situ determination of snow accumulation from shallow snow/firn cores. With the firn cores snow/firn layer density and physical properties will be determined.

For collecting 10 m shallow firn cores an optimized version of the small Fast Electromechanical Lightweight Ice Coring System (FELICS small) was tested at the Jungfraufirn near the research station in April 2012. FELICS small is composed of a 90 cm long core barrel (60 mm inner diameter), chip barrel and drive unit attached to a 20 m long electric cable connected to a control box and the battery pack. No winch is used; the drill system is manually lifted out of the borehole by pulling on the electric cable. The optimized version uses aluminum extension rods with a simple coupling system instead of the electrical cable and a commercial cordless electric drill as drive unit (Fig. 1). The system worked well and allows a better guidance of the core barrel. After successful testing at the Jungfraujoch, the drill was employed to collect three 10 m firn cores on the Findelen glacier in May 2012 in the frame of the SNF project.

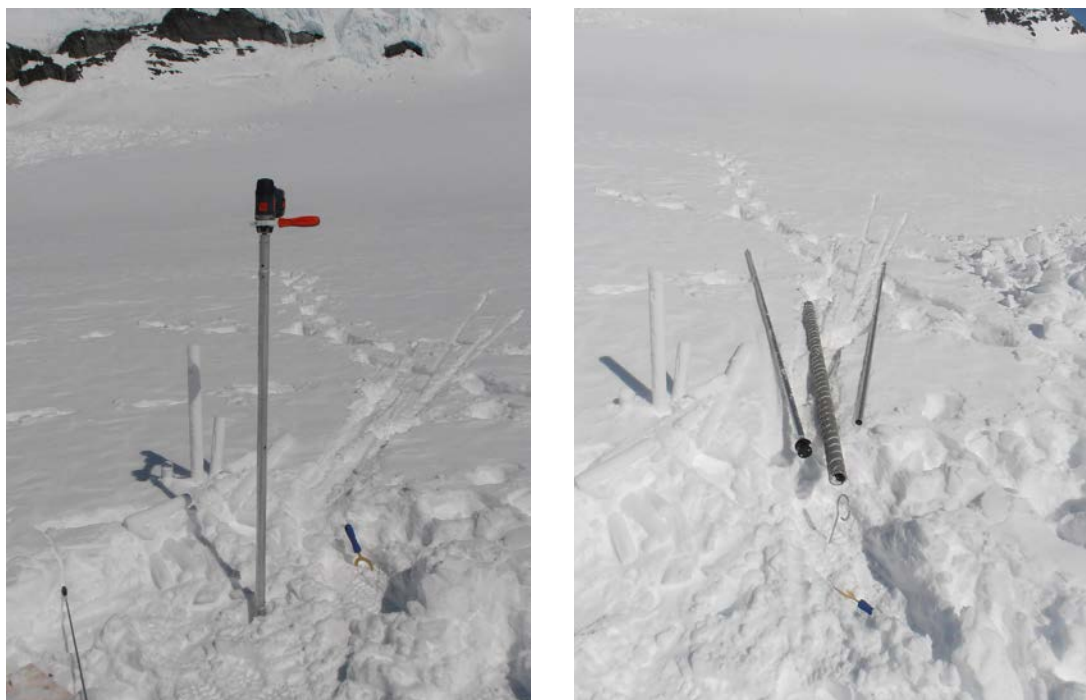


Fig. 1: Test of the shallow firn drill FELICS small at the Jungfraufirn. Left: Aluminum extension rod with commercial cordless electric drill. Right: Extension rod with coupling and core barrel.

Key words:

Winter snow accumulation, firn cores

Internet data bases:

<http://www.psi.ch/lch/analytical-chemistry>
<http://p3.snf.ch/Project-134768>

Collaborating partners/networks:

Prof. Martin Hölzle, Département des Géosciences Université de Fribourg
Dr. Matthias Huss, Département des Géosciences Université de Fribourg

Scientific publications and public outreach 2012:

Refereed journal articles and their internet access

Bukowiecki, N., P. Zieger, E. Weingartner, Z. Juranyi, M. Gysel, B. Neining, B. Schneider, C. Hueglin, A. Ulrich, A. Wichser, S. Henne, D. Brunner, R. Kaegi, M. Schwikowski, L. Tobler, F.G. Wienhold, I. Engel, B. Buchmann, T. Peter, U. Baltensperger, Ground-based and airborne in-situ measurements of the Eyjafjallajökull volcanic aerosol plume in Switzerland in spring 2010, *Atmos. Chem. Phys.*, **11**, 10011–10030, 2011.
<http://www.atmos-chem-phys.net/11/10011/2011/acp-11-10011-2011.pdf>.

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