

Report for IACS from the "Intercomparison of Snow Grain Size Measurements Workshop", March 9-14, 2014, Davos, Switzerland

Reporting: Martin Schneebeli

The goal of this workshop was to compare all currently used direct and indirect methods of measuring snow grain size, including modern as well as traditional methods. A further objective was to develop protocols to establish future international standards. The measurements were conducted with standardized snow in the controlled conditions of the cold laboratories of the WSL Institute for Snow and Avalanche Research SLF and on a stratigraphically homogenous, undisturbed, tennis court in St. Moritz, Switzerland. The following instruments were used for the intercomparisons:

- micro-tomography (at SLF, and in preparation at Meteo-France CEN)
- BET adsorption methods (3 groups)
- Casting methods (2 groups)
- Spectroscopic methods (using 1030 nm absorption feature) (3 groups)
- Near-infrared and SWIR photography (3 groups)
- Direct optical reflectance methods at different wavelength (4 groups)
- High-resolution penetrometry (e.g. SnowMicroPen) (1 group)
- Traditional grain size (4 groups)

The raw data are stored in the database SwissExperiment and will be published after September 2014, after the evaluation workshop in Reading.

Scientific content of and discussions at the event

The final program consisted of two full days of cold laboratory measurements and two full days of field measurements. Due to an unusually warm and snow-poor winter in the Northern part of the Swiss Alps, the field site had to be relocated to St. Moritz. The high air temperature and intense solar radiation made it also necessary to work at night and in the early morning, such that effects of melting snow and heating of instruments could be minimized.

In the cold laboratory, 13 horizontally homogeneous blocks of ca. 35 x 35 x 35 cm³ were measured. Some blocks were taken from the outside, some blocks of the same dimension were sieved and stored at -5°C for 2 months (rounded grains). In addition, blocks of depth hoar and new snow are prepared. All lab measurements with 20 instruments were performed successively on the same block. The design resulted in very good spatial correlations between all measurements. The arrangement of measurements was carefully planned such that repeatability and comparison was as good as possible.

The sequence of measurements on a block was as follows:

- first 4 SMP measurements are performed to check the homogeneity of the snow and to delineate homogenous layers,
- walls were smoothed for the contact probe measurements,

- all measurements, which need sampling (or destroyed the surrounding snow), were performed,
- samples were directly measured using micro-CT and cast using Di-ethyl phthalate or Chloro-naphthalene.

During the first and second lab day, all instruments were working as expected. 6 blocks of snow were measured during the first day, 7 blocks in the second day.

Field measurements were done on a undisturbed tennis court in St Moritz (latitude 46.475694, longitude 9.822385). All 23 field instruments and measurements were performed in closely spaced snow pits to a depth of 140 cm (depending on the instrument, some measurements to 125 cm depth). Therefore complete well comparable sets under field conditions could be achieved. The traditional snow profile is shown in Fig. 2.

Data storage and availability: all raw data are stored on the swiss-exeriment database (<http://tinyurl.com/SGSW2014>). All data will be accessible under creative common license CC BY after evaluation of the data by the participants. The envisaged date is 1 September 2014.

Assessment of the results and impact of the event on the future directions of the field

The successful completion of the first step of the intercomparison, the measurements, was an important milestone. In the final session, the participants agreed to evaluate the raw data (level 0) to processed data until end of April 2014. Level 2 data (depending on the instrument, e.g. micro-CT), are due end of May 2014 (laboratory measurements) and end of June 2014 for field measurements.

To improve and simplify comparisons between different instruments, specific surface area (SSA) will be reported in units of $[m^2 kg^{-1}]$, the surface of the snowpack will be the reference (0 cm), the unit for snow depth is [cm], with a positive sign.

The workshop in Reading, 4th August 2014 – 5th August 2014 will be by invitation only, with priority to the participants of the Davos Workshop.

Final publication of the evaluated data and recommendations is planned in a special issue of "The Cryosphere". The publication process will start after the Reading workshop (for details on the workshop <http://store.rdg.ac/UoR-SnowGrainSizeIntercomparisonResultsWorkshop>).