Comparison of fabric analysis of snow samples by Computer-Integrated Polarization Microscopy and Automatic Ice Texture Analyzer

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Accurate knowledge of fabric anisotropy is crucial to understand the mechanical behavior of snow and firn, but is also important for understanding metamorphism.

Computer-Integrated Polarization Microscopy (CIP) method used for the fabric analysis was developed by Heilbronner and Pauli in the early 1990ies and uses a slightly modified traditional polarization microscope for the fabric analysis. First developed for quartz, it can be applied to other uniaxial minerals. Up to now this method was mainly used in structural geology. However, it is also well suited for the fabric analysis of snow, firn and ice. The method is based on the analysis of first- order interference colors images by a slightly modified optical polarization microscope, a grayscale camera and a computer. The optical polarization microscope is featured with high quality objectives, a rotating table and two polarizers that can be introduced above and below the thin section, as well as a full wave plate. Additionally, two quarter-wave plates for circular polarization are needed. Otherwise it is also possible to create circular polarization from a set of crossed polarized images through image processing. A narrow band interference filter transmitting a wavelength between 660 and 700 nm is also required. Finally a monochrome digital camera is used to capture the input images.

The idea is to record the change of interference colors while the thin section is being rotated once through 180°. The azimuth and inclination of the c-axis are defined by the color change. Recording the color change through a red filter produces a signal with a well-defined amplitude and phase angle.

An advantage of this method lies in the simple conversion of an ordinary optical microscope to a fabric analyzer.

The Automatic Ice Texture Analyzer (AITA) as the first fully functional instrument to measure c-axis orientation was developed by Wilson and other (2003). Most recent fabric analysis of snow and firn samples was carried out by the AITA. This device makes a fast and precise measurement of the fabric of many small ice crystals. The high spatial resolution provided by the AITA makes it also practical for snow. The basic principle is actually the same as in CIP. But variations in the set up and differences in the data treatment process make a comparison of the two methods very valuable. However, the comparably large investment in the AITA can make the use of CIP attractive. Here, we compare identical snow and firn samples from both the AITA and CIP to find out differences in ease of operation and quality of the fabric analysis.

We prepared snow and firn thin sections and analyzed them by the CIP method as well as by the fully automated AITA device. It will be interesting to directly compare the two results of c-axis orientations. The comparison developed here allows choosing either method based on objective criteria.

References:

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