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Towards continuous observations of ice microstructure by means of microstructure mapping and digital image processing.

Content

The physical properties of ice crystals are strongly related to the flow and deformation of ice. This has been established by detection of crystal size and crystal orientation on 10cm x 10cm thin sections of ice through many of the deep ice cores by microstructure mapping. This technique was first used to analyze firn cores (Arnaud et al., 1998) and further developed to investigate the microstructure of ice by means of digital imaging techniques (Kipfstuhl et al., 2006).

The method maps etch grooves on sublimated-polished surfaces at microscopic resolutions and allows to visualize air inclusions, grain and sub-grain boundaries in plain light illumination. The standard analysis consisted of a 4.5cm x 9cm mosaic of about 1500 images and a resolution of 3-4µm using a microscope, a CCD area scan camera, and a computer-controlled XY-stage. In 2007 it was replaced by a specially developed large area scan microscope (LASM) equipped with a line scan camera, improving the sampling to 10cm x 10cm with a resolution of 5µm. The LASM images were analyzed through the Ice Microstructure Analyzer, a digital image processing approach (Binder et al., 2014), and applied to image data from the ice coring projects of EPICA and NEEM.

The Ice Microstructure Analyzer (Binder et al., 2014) deploys complex and computationally expensive algorithms with the processing of an image requiring many hours. Here, we aim to develop a framework to acquire and analyze 55cm length high-resolution images obtained from a new experimental setup, xLASM. (see *xLASM: A new extra-Large Area Scanning Macroscope-microtome system to analyze the microstructure of firn and ice cores up to 55 cm in length*). Scanning full ice cores allow us a rapid sampling preparation and homogenize the image acquisition conditions such as sublimation and brightness. The xLASM calibration and the development of the new image processing techniques aim to produce continuous measurements over the whole length of the ice core.

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