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cm-scale variations of crystal orientation fabric in cold Alpine ice core from Colle Gnifetti

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Analysis of the microstructural parameters of ice has been an important part of ice core analyses so far mainly in polar cores in order to obtain information about physical processes (e.g. deformation, recrystallisation) on the micro- and macro-scale within an ice body.
More recently the influence of impurities and climatic conditions during snow accumulation on these processes has come into focus. A deeper understanding of how palaeoclimate proxies interact with physical properties of the ice matrix bears relevance for palaeoclimatic interpretations, improved geophysical measurement techniques and the furthering of ice dynamical modeling.
Variations in microstructural parameters e.g. crystal orientation fabric or grain size can be observed on a scale of hundreds and tens of metres but also on a centimetre scale. The underlying processes are not necessarily the same on all scales. Especially for the short-scale variations many questions remain unanswered.

We present results from a study that aims to investigate following hypotheses:
1. Variations in grain size and fabric, i.e. strong changes of the orientation of ice crystals with respect to the vertical, occur on a centimetre scale and can be observed in all depths of an ice core.
2. Palaeoclimate proxies like dust and impurities have an impact on the microstructural processes and thus are inducing the observed short-scale variations in grain size and fabric.
3. The interaction of proxies with the ice matrix leads to depth intervals that show correlating behaviour as well as ranges with anticorrelation between microstructural parameters and palaeoclimatic proxies. The respective processes need to be identified.

Fabric Analyser measurements were conducted on more than 80 samples (total of 8 m) from different depth ranges of a cold Alpine ice core (72 m length) drilled in 2013 at Colle Gnifetti, Switzerland/Italy. Results were obtained by automatic image processing, providing estimates for grain size distributions and crystal orientation fabric, and comparison with data from continuous flow analysis of chemical impurities. A microstructural characterisation of the analysed core is presented with emphasis on the observed variations in crystal orientation fabric. The relevance of these results for palaeoclimate reconstruction and geophysical applications in ice are discussed.