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A stratigraphy-based method for reconstructing ice core orientation

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Ever since the first deep ice cores were drilled, it has been a challenge to determine their original, in-situ orientation. In general, the orientation of an ice core is lost as the drill is free to rotate during transport to the surface. For shallow ice cores, it is usually possible to match the adjacent core breaks, which preserves the orientation of the ice column. However, this method fails for deep ice cores, such as the EastGRIP ice core in Northeast Greenland. We provide a method to reconstruct ice core orientation using visual stratigraphy and borehole geometry. As the EastGRIP ice core is drilled through the Northeast Greenland Ice Stream, we use information about the directional structures to perform a full geographical re-orientation. We compared the core orientation with logging data from core break matching and the pattern of the stereographic projections of the crystals'c-axis orientations. Both comparisons agree very well with the proposed orientation method. The method works well for 441 out of 451 samples from a depth of 1375–2120 m in the EastGRIP ice core. It can also be applied to other ice cores, providing a better foundation for interpreting physical properties and understanding the flow of ice.