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Measurement of strain rate components in a glacier with embedded inclinometers

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We present measurements with inclinometer-magnetometer probes inserted in glacier ice and discuss the underlying mathematical theory to extract velocity gradient components from this data. Assumptions on the ice flow field must be made to reduce the number of unknowns and to close the system of equation obtained from the theory. With the incompressibility assumption and the first order plane strain approximation, the evolution equation for the tilt of the main sensor axis can be solved exactly and the obtained function can be fit to measured data to obtain optimal shear and normal strain components. Daily variations superposed on the tilt evolution reflect variations in sliding and perhaps partial elastic recovery of deformations.