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2D inverse modeling of isochrone layer geometry in a steady state ice sheet

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Internal stratigraphy of polar ice sheets, which can be identified on radio-echo sounding measurments, provide unique insights of the velocity field in the ice. However, inverse modeling of the internal layers is difficult, because they integrate effects of the flow field both in space and time.

The general theoretical link between isochrones geometry and velocity field has been recently established in the case of a steady plane ice sheet. Based on these theoretical investigations, we propose an inversion algorithm to reconstruct the steady velocity field from the isochrones and from boundary conditions (velocity at the divide, at the surface and at the base). We study the numerical aspects of this algorithm, as well as its sensitivity to errors in the data and in the boundary conditions. We apply this algorithm to synthetical isochrone data coming from a velocity field either prescribed or produced by a forward finite elements full-stokes model.

Applications of this study to measured radar profiles from current ice sheets may concern particular cases, such as reconstruction of the velocity profiles upstream or downstream of subglacial lakes or at divides where the so-called Raymond effect operates.