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Reconstruction of 2D and steady-state velocity field of polar ice sheet by inverse modeling of isochrones

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Radar detectable englacial layers of polar ice sheets, called isochrones, provide unique insights of the velocity fields within the ice. However, inverse modeling of these isochrones is difficult, as their geometry reflects spatio-temporal variations of the velocity field. 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 this work, we have developped an inversion algorithm to reconstruct the velocity field from the isochrones and the boundary conditions (velocity at the divide, surface and base of the ice sheet). We study numerical aspects of this algorithm and its sensitivity to errors in the input data and boundary conditions. We apply this algorithm to synthetical isochrones data coming from prescribed velocity fields, in cases where boundary conditions are known: up- and downstream of subglacial lakes, or at divides where the so-called Raymond effect operates. Further developments of this study, applied measured radar profiles of current ice sheets, may improve understanding of ice sheet dynamics and ice core datation.