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Estimation of ice thickness using a physical model and Bayesian inference

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Knowledge about ice thickness and volume is indispensable for studying ice dynamics, future sea-level rise due to glacier melt and mountain hydrology. Accurate measurements of glacier thickness require on-site work, usually employing radar techniques. However, these field measurements are time consuming, expensive and sometime even impossible.

The model of Farinotti et al. (2009) calculates ice thicknesses by using a mass conservation approach fed by estimates of the surface mass balance. The here presented model extends this by also incorporating assimilation of surface flow speed measurements, which are becoming available world-wide through remote sensing. This extension has the potential to improve the accuracy of the ice thickness predictions. The presented model is augmented with a Bayesian assimilation strategy allowing rigorous estimation of errors. We assess the model performance using glaciers of the Antarctic Peninsula with well known bed topography. The final goal of the project is to provide new ice thickness and volume estimates for all of the glaciers in the world.