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Deriving the internal ice layer architecture from Radio-Echo Sounding data of Rutford Ice Stream, Subglacial Lake Ellsworth and Fletcher Promontory

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Information of internal layers in ice sheets can be used to investigate the changes in ice flow, for flow modelling studies, calculate past accumulation rates, constrain ice core ages, verify modelled results etc. We use a method of automatically processing Radio-Echo Sounding (RES) data (Sime et al., Journal of Glaciology, in press) to calculate the dip angles of all small segments of coherent ice layers in the radar image. Compared with hand-picking internal layers, the advantages of this method of automatically calculating layer dip angles include that (1) it does not rely on internal layers being traceable over whole sections, (2) large areas can be processed relatively quickly and subsequently 3D models of ice architecture can be produced, (3) calculated layering structure can be used more flexibly in ice-flow models, and (4) information on past climates over large areas can be extracted from calculated englacial isochrones. We present verification of our results by comparing the calculated dip angles with hand-picked data of three well studied areas in West Antarctica: Rutford Ice Stream, Subglacial Lake Ellsworth and Fletcher Promontory. Internal layering within the top several hundred meters can be very accurately reproduced for all three cases. Depending on the quality of the raw RES data, calculated dip angles are typically in a range of $\pm$5-10° of the hand-picked angles. Where the radar returns from layers near the bed are strong, the estimation of dip angles can also successfully be used there. Three dimensional presentation of the internal ice structure including error bars and comparison of ice layers derived from hand-picking and from layer dip estimates demonstrate the method's fidelity.