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Beyond crossovers: Predicting ice thickness uncertainties in ice penetrating radar data from geometric controls

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Ice thickness is a key parameter for predictive ice sheet modeling, geological interpretation of the underlying bed rock, and site selection for deep ice sheet and bed rock sampling. However, the uncertainties typically reported are in terms of crossover statistics, and ice thickness uncertainties are generally not formally integrated into ice sheet models. Here we examine what crossover statistics reveal and conceal for the actual uncertainty in reported ice thickness, examine the impact of system and geometric parameters on uncertainties, and place these parameters in the context of the observed subglacial roughness. We provide a predictive model for uncertainties as a function of ice thickness, sensor height, and subglacial roughness parameters, evaluate it from the perspective of ground based, airborne and orbital sounding and make recommendations for parameters that should be reported in ice thickness data products.