Using numerical modeling to appraise the performance of tomostatics

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ABSTRACT
First arrival tomography is enjoying increasing popularity as a tool for deriving near-surface weathering statics. Reports on the performance of tomostatics vary widely among users, with representative comments running the spectrum from "Tomostatics works better than conventional statics most of the time" to "Tomostatics doesn't work very well on my data". Variance in these evaluations notwithstanding, there are enough success stories to justify the inclusion of tomostatics in our processing toolbox, but the question remains as to where exactly in this toolbox tomostatics ought to be placed. Will tomostatics become a robust workhorse or rather a back-shelf tool that tends to be used mostly on special projects? It is correct to say that tomostatics works well when the near-surface is best described using a cell-based parameterization, whereas a conventional layer-based algorithm works well when the near-surface is best described by a series of layers. This can certainly help explain the differing opinions on the efficacy of tomostatics, but it would be helpful to quantify, or at least add some measure of precision to, this statement.

This paper attempts to perform a systematic evaluation of one particular implementation of tomostatics through the use of 2-D finite-difference acoustic modeling. Given realistic near-surface velocity models, this modeling algorithm is capable of simulating real-world first breaks with excellent fidelity, at least from a kinematic viewpoint. For a range of near-surface velocity models, synthetic first breaks will be generated and used as input to the tomostatics algorithm. The results (i.e., predicted velocity model and associated static corrections) will be compared to the (known) correct answer, and also to the results obtained using a conventional "GLI" layer-based algorithm. Questions regarding algorithm performance as well as optimal tomostatics parameter selection will be addressed.