Geophysical Research Abstracts
Vol. 17, EGU2015-10682, 2015
EGU General Assembly 2015

Is there an optimal deconvolution method for receiver function imaging?

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Deconvolution is an essential processing step in receiver function analysis. A variety of deconvolution approaches have been employed over the past few decades, including frequency-domain spectral division, multi-taper cross-correlation, time-domain least squares filtering, and iterative time-domain deconvolution. Every deconvolution approach has its advantages and disadvantages but no systematic comparison of these approaches has yet been done. Here, we carry out benchmark tests on synthetic and real data to assess how the various approaches perform for different input conditions including noise content and the complexity of the target structure. We present the results of this comparison and evaluate the various deconvolution approaches to provide a set of guidelines on how to use the different types of deconvolutions more efficently. Generally, our results show that the different approaches produce receiver functions that are equally robust provided that a suitable regularization parameter is found. For this purpose, we propose an efficient way of finding an optimal regularization parameter through the measure of spectral flatness of the receiver function. Our deconvolution intercomparison results also help us estimate the uncertainty of the receiver functions more accurately. In the process, we find that some deconvolution approaches may be better adapted than others to addressing specific imaging goals.